# Report of the 43rd Meeting

## of the Coordination Group for Meteorological Satellites

18-22 May 2015, Boulder, Colorado, USA

CGMS

# REPORT OF THE 43rd MEETING OF THE COORDINATION GROUP FOR METEOROLOGICAL SATELLITES

CGMS-43
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18-22 May 2015
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**CGMS MR 43**

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# PLENARY SESSION

## A OPENING SESSION

Dr. Stephen Volz, NOAA Assistant Administrator for Satellite and Information Services, welcomed the participants of the 43rd meeting of CGMS to Boulder, Colorado and thanked the CGMS Secretariat staff at EUMETSAT and the NOAA staff for the excellent arrangements for this year's meeting.

The full statement of Dr. Volz is provided in ANNEX I.

## B APPROVAL OF AGENDA, ACTION REVIEW

### B.1 Approval of the Agenda

The CGMS Secretariat presented the objectives of the meeting and the agenda was approved by all participants.

### B.2 Review of actions from CGMS-42

CGMS Secretariat provided an overview of the status of the list of actions and recommendations resulting from CGMS-42:

| CGMS-42 | Status | Open |
|---|---|---|
| WG I | All actions closed | None |
| WG II | All actions but 3 closed | 3 actions open with revised deadlines |
| WG III | All actions but 2 closed | 2 actions open with revised deadlines |
| WG IV | All actions but 8 closed | 8 actions open with revised deadlines |
| Space weather | (from WGIII) | 2 actions open with revised deadlines |
| Plenary | Several actions closed | 1 action open with deadline of CGMS-44 (CEOS-CGMS Joint Working Group Climate)<br>1 action open with revised deadline<br>2 actions expected to be closed following CGMS-43 plenary discussions |

One CGMS-42 plenary actions was given a new deadline following WGIII discussions:

| CGMS-42 PLENARY actions with revised deadlines: | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| WMO | Plen IV.4 | 40.06 | WMO to coordinate impact studies, through the CBS, in order to update and refine its requirements for GNSS radio-occultation (e.g. number of occultations/day, distribution in space) | EUM plans to launch a study in 2014 with results available for the IROWG meeting in Apr 2015 to which CEOS agencies will be invited. Action deferred to CGMS-43. It also contributes to Action 40.23 "CGMS to convene through the IROWG an ad-hoc meeting on the global GNSS-RO constellation, inviting all interested CEOS agencies".<br>(see also actions WGII 40.23, WGIII 41.35 and WGIII 41.37)<br>EUM will present at Working Paper on the outcome of its study *CGMS-43 EUM-WP-12*<br><br>Matter discussed at the IPET-OSDE-1, April 2014, and CBS-Ext(2014). CBS recommended conducting Observing System Simulation Experiments (OSSEs) in support of satellite system design criteria such as orbit optimization for GPS-RO satellites, or configurations for hypersperspectral IR sounders on geostationary orbit.<br><br>*Following WGIII discussions, the action will be kept open until CGMS-44. WMO and NOAA to report on their activities at CGMS-44.* | (CGMS-41, -42, -43)<br>**New deadline CGMS-44** | OPEN | HLPP #1.1.4 |

One CGMS-42 plenary action is maintained (the initial deadlines were for both CGMS-43 and CGMS-44):

| CGMS-42 PLENARY actions still open | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CEOS/CGMS joint climate WG | Plen H.3.2 | A42.11 | Regarding the Pilot FCDR Inventory:<br><br>• Conduct an initial analysis of available FCDRs past and current available for or planned for use in the current set of SCOPE-CM projects using CEOS, CGMS, and WMO satellite data bases;<br><br>• Identify SCOPE-CM ECV projects that are or may be able to use the above FCDRs;<br><br>• Assess availability of the above FCDRs for the future;<br><br>• Following the first ECV gap analysis, consider FCDRs that may be useful in assessing ECV opportunities in the future ECV gap analysis. | Nov '14: ONGOING. Discussions were held at the Climate Symposium regarding the Pilot FCDR inventory and work has begun on the specific identification of SCOPE-CM ECV projects and use of higher temporal and spatial resolution data from the next generation of geostationary satellites. The project will leverage the ECV assessment reference process being developed by WGClimate. CMA and KMA have been invited to participate in these efforts.<br><br>*Status reports were provided tor WGII and plenary at CGMS-43. The next reports will be provided at CGMS-44.* | CGMS-43, CGMS-44 | **OPEN** | HLPP # 5 |

The following two CGMS-42 plenary actions were left open pending CGMS-43 plenary discussions:

| PLENARY actions open at the start of CGMS-43 pending closure | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| WMO | Plen C.3 | A42.02 | WMO to establish a dialogue among CGMS satellite operators and the WMO Disaster Risk Reduction (DRR) programme to identify regional pilot actions for enhancing the use of satellites in support of DRR. | Dialogue initiated, will be reported at CGMS-43.under plenary item D. WMO to host a workshop in autumn 2015 to which space agencies will be invited<br>*Closed following CGMS-43 plenary actions with a new action raised (CGMS-43 A43.01)* | CGMS-43 | **OPEN** | HLPP # 2.4 |
| WGI and WGIV | Plen E.1.3 (for WGI and WGIV) | A42.07 | Following the revised scope of WGI and WGIV, the WGs to update the "Terms of Reference" of both WGs for endorsement by CGMS | This will be concluded by WGI and WGIV and be presented to CGMS-43 plenary for endorsement. (CGMS-43 EUM-WP-02).<br>NOAA will provide feedback in CGMS-43 WGI and WGIV<br>*ToRs agreed by WGI and WGIV at CGMS-43. Closure expected following plenary endorsement agenda items F.1.2 and F.3.1* | CGMS-43 | **OPEN** | - |

The final status of CGMS-42 plenary actions and recommendations resulting from CGMS-43 discussions is available here.

The status of CGMS-43 plenary actions and recommendations are provided in section L of the report.

The CGMS-43 actions will be maintained on the CGMS website under MEETINGS and CGMS-43.

## C CGMS MEMBERSHIP

### C.1 ISRO CGMS Membership

ISRO is eligible for CGMS membership since its satellite systems have shown the potential to contribute to WMO and supported programmes, fulfilling the Charter of the CGMS. More specifically, the application is based on ISRO's existing and planned contributions in a number of areas relevant to the objectives of CGMS:

- Indian Meteorological Satellite Missions
- International Collaboration/Joint Missions
- Satellite Data Archival and Dissemination
- Support to Operational Agencies
- CALVAL, GSICS, CEOS
- Disaster Management Support
- Training/Capacity building
- Instrument Development and Support
- Climate Research

Some expected benefits to ISRO from the membership are:

- Participation in the global meteorologist's platform as an official member for preparation of global observation strategy
- Provide information on the Indian missions to the global community starting from the conception stage itself
- Planning of ISRO's satellite missions to complement and supplement the global data requirements
- Use of the CGMS platform for developing collaborative missions with other space-faring agencies
- Working out joint calibration strategies

The Director-General of EUMETSAT was very pleased that ISRO has requested to be a member of CGMS. NOAA supported and agreed on the contribution of ISRO to CGMS activities. WMO also expressed support for ISRO joining CGMS.

### C.2 CGMS Charter amendment

Working Paper **CGMS-43-CGMS-WP-21,** proposed on behalf of the CGMS Secretariat, the required amendments to the CGMS Charter to enable ISRO to become a CGMS member. The document was circulated among the CMGS Members for consideration one month prior to the 43rd plenary session of CGMS, in accordance with the relevant provision of the CGMS Charter.

CGMS members were invited to consider the proposed amendments of the Charter as proposed in **CGMS-43 EUM-WP-21**.

The CGMS plenary expressed its strong support for ISRO's membership and looked forward with anticipation to the future contributions of ISRO to the CGMS activities. The plenary agreed on the revised charter and welcomed ISRO as a CGMS member by consensus and with acclamation.

## D USER REQUIREMENTS

### D.1 WMO Space Programme role as a bridge between satellite operators and users

**CGMS-43-WMO-WP-01** described the objectives of the WMO Space programme and its organisational context in WMO.

The 16th WMO Congress in 2011 defined the high-level goals of the Space programme, which are to:

- promote wide availability and utilization of satellite data & products for weather, water, climate and related applications of WMO Members
- provide a framework for dialogue, develop a shared vision, foster interoperability, share best practices & resources. Through this joint undertaking, satellite operators contribute to the global picture in a cost-effective way and best meet their goals to serve users, and users are assisted to consolidate their requirements, and informed and trained to take advantage of satellite systems.
- The WMO Space programme has four main components:
    - Develop an integrated observing system
    - Enhance data & product accessibility, interoperability and quality
    - Ensure user information and training
    - Coordinate space weather operations.
    - The progress of the Programme relies on partnerships with space agencies, including CGMS and CEOS, with International science groups, and with other relevant international bodies.

At CGMS-43 a large number of discussions triggered through WMO working papers contribute significantly towards the objectives of the Space Programme:

- Observing systems
    - WP-02: Vision of WIGOS/Space in 2040
    - WP-04: Satellite data user needs in the Indian Ocean region

- WP-05: Observation requirements of the GAW
- WP-06: GSICS in the architecture for climate monitoring
- WP-07: GCOS
- WP-14: Gap Analysis
- WP-16: GSICS Report
- WP-17: OSCAR/Space new functionality

- Access to data and products
  - WP-08: Draft WMO Resolution on Exchange of Data & Products
  - WP-09: Satellite Data Dissemination Strategy
  - WP-13: Direct Broadcast Network (DBNet)
  - WP-15: Operational data requirements from RA III/RA IV

- User Information and training
  - WP-03: User preparation (SATURN)
  - WP-12: VLab

- Cross-cutting Areas:
  - WP-10:Socioeconomic benefits;
  - WP-11:Space weather

EUMETSAT thanked WMO for the presentation and the reminder as to how WMO activities fits within CGMS activities.

NOAA also thanked WMO for the global framework that it offers for addressing meteorological matters.

It was noted that the WMO strategic priority of Disaster Risk Reduction was not addressed explicitly at CGMS-43, and the following action was agreed in this regard.

| **CGMS-43 actions – PLENARY** | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO | D.1 | A43.01 | WMO to report at CGMS-44 on engagement with satellite agencies via the planned "Joint RA-II/V Workshop on WIGOS for Disaster Risk Reduction" to be held in Indonesia in October 2015. | CGMS-44 | OPEN | HLPP # 2.4 |

The CGMS-42 action A42.02 was closed as a consequence.

### D.2 Development of a vision for the WIGOS Space based component in 2040

The WMO Space Programme – through the Commission for Basic Systems (CBS) Expert Team on Satellite Systems (ET-SAT) - has initiated the development of a "Vision for the Space Based Component of WIGOS in 2040" in response to the request from CBS in September 2014. In **CGMS-43-WMO-WP-02** WMO reported on the development.

The development of a Vision is approached from three different angles:

- First of all, the new vision should aim to respond to the anticipated societal needs of 2040, in the context of WIGOS and of the Global Framework for Climate Services (GFCS). A starting point is to address the unfulfilled requirements expressed in the Statements of Guidance of WMO application areas in the Rolling Review of Requirements. Looking ahead, the vision should consider the increasing maturity of some space applications and the emerging requirements of new application areas which are not fully addressed by current plans.
- The vision should consider the opportunities opened or anticipated from advances in satellite and instrument technology, including the lessons learnt from demonstration missions that, by 2040, will be mature for transition from R&D or a demonstration stage, to an operational stage (e.g. GPM, Doppler lidar), and possible new concepts. Rapid progress in technological capabilities will allow improved performances in terms of spectral and temporal resolution, which also has a bearing on the amount of data to be exchanged.
- Finally, attention should be paid to emerging changes in the provider community considering the increased number of space-faring nations, the range of possible approaches between large and very small satellite programmes, and the balance to be found between an increasing capability of the private sector to contribute to the system and the specific responsibilities of governmental entities.

Opportunities and risks should be carefully analysed considering the possible technological evolution, as well as the key strategies for optimal integration of space-based and surface-based observation capabilities.

A WIGOS Space 2040 Workshop is planned on 18-20 November in Geneva to support the dialogue between space agencies and major user communities. WMO stressed the importance of the participation of space agencies in the workshop.

The new draft vision will be presented to CBS in 2016.

IOC noted that support to seasonal prediction is a particular priority area and was pleased to see importance of ocean observations in the update of WIGOS.

NOAA noted that space agencies have 10-year or longer development plans and that adaptation is necessary to ensure that these plans, as far as is possible, fit together with the timeframe of the WIGOS vision.

The following action on CGMS members was agreed:

| CGMS-43 recommendations – PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | D.2 | A43.02 | CGMS members to consider the preliminary considerations on the Vision of WIGOS space-based components in 2040 and provide feedback to WMO through their representative in ET-SAT (or directly to jlafeuille@wmo.int if they are not represented in ET-SAT). Ref. CGMS-43, WMO-WP-02 | 30 Sept 15 | OPEN | HLPP # 1.1 |

### D.3 User preparation for new generation satellites including SATURN, Vlab and critical transition issues

In **CGMS-43-WP-03**, WMO reported on user preparation for the new generation of satellites.

The online portal SATURN (SATellite User Readiness Navigator) was launched for public access in June 2014 and now provides up-to-date information supporting user readiness activities, primarily for Himawari-8 and GOES-R. Preliminary content is available for MTG, Electro-L and FY-4. Continued support from the task team of CGMS focal points to develop and maintain the SATURN content remains vital to ensure its currency.

The initial scope of SATURN has been the new generation of GEO satellites, but it is planned in 2015 to extend the scope of the portal to the core meteorological satellites in low-earth orbit: NPP/JPSS from NOAA, Metop from EUMETSAT, FY-3 from CMA and (if feasible) Meteor-M from Roshydromet.

To support and guide satellite operators and users in their respective preparation activities, a Reference User Readiness Project has been developed, and is presented in detail. The Project provides a typical breakdown of user readiness activities and a timeline of deliverables that are needed from satellite development programmes to support user readiness activities.

In collaboration with the VLab and the COMET/MetEd programme, online training material on aspects of Himawari-8 and GOES-R has been made available through SATURN in English and Spanish (where available). The VLab strategy 2015-2019 places high emphasis on building capacity in understanding and exploiting data from the new generation satellites (see WMO WP-12 under item I.1).

The WMO Space Programme is continuing to develop SATURN and the Reference User Readiness Project, supported by experts from the WMO Expert Team IPET-SUP and by the CGMS focal points.

NOAA noted that the reference satellite system development approach is the result of many years of experience, and that direct involvement of users in the development process may result in increased risk.

EUMETSAT thanked WMO for the effort to share experience from GOES-R and Himawari-8. SATURN is a valuable tool for EUMETSAT and we will continue to support this activity. At the EUMETSAT Users Conference in September 2015, there will be a special session on user preparedness, offering an opportunity to discuss this effort further.

WMO strongly encouraged CGMS members operating new-generation GEO satellites to continue and strengthen their support to the SATURN portal.

The following actions were agreed:

| CGMS-43 actions – PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | D.3 | A43.03 | CGMS members to provide review comments on the Reference User Readiness Project, noting that the Project will be presented to CGMS-44 for endorsement as CGMS best practice (Ref. CGMS-43, WMO-WP-03) | 30 Sept 2015 | OPEN | HLPP # 5.3 |
| CMA, EUM, NOAA, ROSH | D.3 | A43.04 | CMA, EUM, NOAA, ROSH to appoint/reconfirm points of contact for including LEO satellites in the SATURN | 15 June 2015 | OPEN | HLPP # 5.3 |

### D.4 Satellite data User needs in the Indian Ocean

To inform the discussion on satellite data coverage services over the Indian Ocean region, WMO carried out in February/March 2015 a survey among key users of satellite data. **CGMS-43-WMO-WP-04** presents the preliminary results of this survey. Responses from eleven countries were received, regarding baseline requirements for satellite data (L1 and L2) needed for routine operations, and additional requirements in case of an emergency or a severe event.

Key conclusions from the survey are that

- requirements are dominated by the need to monitor and forecast tropical cyclones and monsoon-related phenomena;
- requirements are not limited to the need for observing the Indian Ocean but also address land applications, such as fire detection;
- some redundancy in satellite coverage of the region is needed;
- according to the majority of responses, the required baseline repeat cycle for GEO imagery over the region is 30 minutes;
- GEO has higher importance in case of emergencies or severe events due to its higher repeat cycle; most users require additional GEO imagery in such cases, with the majority requiring rapid-scan imagery every 10 minutes or less;
- several users expressed a requirement for GEO lightning products (both as a baseline and as an additional requirement).

The requirements identified in the survey have not yet been validated by the broader user community in the Indian Ocean region, nor matched against existing or planned capabilities. Further refinement and consolidation of the requirements need to be discussed.

In response to the presentation, IOC reminded the plenary that CGMS-43 occurs in the 50th anniversary year of the conclusion of the 1962-1965 observing phase of the International Indian Ocean Expedition (IIOE). IIOE was instrumental in generating extensive new knowledge about a highly under sampled region of the global integrated Earth system, fostered new long-standing international partnerships, and supported the development of advanced infrastructure, including India's establishment of the National Institute of Oceanography in Goa. IOC, in partnership with the Scientific Committee on Oceanic Research (SCOR), the U.S. National Academy of Sciences, and other agencies, contributed leadership for the outstanding success of IIOE. IOC is a leading sponsor of the Second IIOE (IIOE-2) to be launched at the International Symposium on the Indian Ocean on 30 November – 4 December 2015 in Goa, India. The IOC, in its statement announcing the launch of the IIOE-2 initiative, called the ambitious five-year effort "truly collaborative and socially relevant" and one that will "provide an exciting platform for knowledge transfer and capacity building," raising global awareness about the importance of the Indian Ocean.

In this regard, IOC encouraged CGMS Members to enhance satellite data acquisition capabilities over the Indian Ocean during the IIOE-2 Observing Phase from January 2016 to December 2020, make available satellite measurements in accordance with the Group on Earth Observations (GEO) Data Sharing Principles, and preserve satellite observations in accordance with GEO Data Management Principles.

IOC would be pleased to describe the status of IIOE-2 at CGMS-44.

CMA noted that the Indian Ocean coverage is very important for China as precipitation and the monsoons originate from this region. After the launch of FY-2G, CMA agreed to follow the CGMS recommendation to relocate FY-2E to the current position of FY-2D (86.5°E) providing much better observations on that part of the IO, in particular providing better calibration and products.

WMO thanked the satellite operators for their support over the Indian Ocean region.

The following actions were agreed:

| **CGMS-43 actions - PLENARY** | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | D.4 | A43.05 | CGMS members to take into account the user requirements identified in the WMO survey when discussing continuous satellite coverage over the Indian Ocean region and report results to CGMS-44. | CGMS-44 | OPEN | HLPP # 1.1.6 |

| CGMS-43 actions - PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO | D.4 | A43.06 | WMO to validate and consolidate the preliminary user requirements for satellite data in the Indian Ocean region with major user groups and stakeholders in the region, and to report on results to CGMS-44. | CGMS-44 | OPEN | HLPP # 1.1.6 |

### D.5 Requirements of the global atmospheric watch (GAW)

WMO in collaboration with the atmospheric composition community and satellite experts has initiated an update of the WMO observation requirements for atmospheric composition parameters, in support of the WMO Rolling Review of Requirements (RRR) process. The last update in the RRR framework in 2004 was based on the IGACO report, and identified only one "Atmospheric Chemistry" application area. Formulating internationally-agreed, technology-free observation requirements that relate to chemistry and composition of the atmosphere is important information for CGMS agency mission planning, to inform the Vision for WIGOS surface/space components in 2040, and for a subsequent update of the CGMS baseline.

A WMO Global Atmosphere Watch (GAW) Task Team on Observational Requirements and Satellite Measurements as regards Atmospheric Composition and Related Physical Parameters was established and held its first meeting on 10-13 November 2014.

Three main application areas for observations of atmospheric composition were identified:

- Forecasting atmospheric composition
- Monitoring atmospheric composition
- Providing atmospheric composition information to support services in urban and populated areas

For each of the three applications, detailed and quantitative observation requirements for the necessary parameters will be established by autumn 2015, and entered into the WMO RRR database (which is part of OSCAR) by the end of 2015. The Task Team collaborates with the GAW Scientific Advisory Groups and other experts from CGMS, CEOS and WMO CBS on this task. A set of priority variables that cut across several application areas of atmospheric composition observations will also be identified. This process will inform the Vision for WIGOS component systems in 2040, and subsequent updates of the CGMS baseline.

**CGMS-43-WMO-WP-05** contains the report of the Task Team report in November 2014, and related URLs.

The following action was agreed:

| CGMS-43 actions - PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO | D.5 | A43.07 | WMO to provide an update on the international observation requirements for atmospheric composition developed by the GAW Task Team, drawing on existing requirements and considering region-specific needs | CGMS-44 | OPEN | HLPP # 1.1 |

### D.6 WMO four-year plan for space weather

In **CGMS-43-WMO-WP-11** WMO reported on its space weather activities. The WMO Inter-Programme Coordination Team for Space Weather (ICTSW) involves now experts from 26 WMO Members and 7 international organizations. Over its five years of existence, ICTSW has performed a review of observation requirements, engaged pilot actions for space weather data exchange on the WIS, selected space weather products made available on a portal, and provided considerable support to the ICAO-WMO discussions on the definition of future space weather services to aviation. These activities have demonstrated the value that can be added by WMO in facilitating the international coordination of space weather activities and their evolution to full operational status.

A four-year plan has been developed in order to provide a clear framework for these activities, to increase their visibility within and outside WMO, to mobilize more WMO Members, to formalize the interactions with the relevant Technical Commissions, to strengthen the overall efforts and maximize the benefits. The plan which addresses the 2016-2019 timeframe will be submitted to the 17th Congress before consideration by the relevant Technical Commissions (CBS and CAeM). It is available as document 4.2.4(2) of the 17th Congress:

https://docs.google.com/a/wmo.int/file/d/0B8DhC1GSWSmxVU80M3JZY2lwZ1U/edit?usp=drivesdk

The plan defines first and second priority tasks at three levels:

- at the system level, including observations, data exchange and modelling;
- at the services level, to evaluate the end-user requirements and develop best practices to respond to these needs, in particular for aviation, emergency management, impacts on space and ground infrastructure;
- at the strategic level, to maintain close coordination with other international entities involved in space weather covering various aspects (research, policy, operational warning, training, regional organizations, etc.).

CGMS members provide a significant contribution to space weather observations by flying space environment monitors or other sensors (e.g. solar imagers) on-board meteorological satellites. Assuming that the plan is approved by Cg-17, and noting that Space Weather is mentioned in the CGMS HLPP, WMO looks forward to the participation of CGMS in this new framework of activities.

CGMS satellite operators were invited to consider the four-year plan for the space weather coordination activities of WMO and to consider flying space weather payload to fill gaps in space weather observations.

### D.7 Aquarius and SMOS sea surface salinity measurements: a review of initial results

In **CGMS-43-IOC-WP-01**, IOC provided an analysis of first results from sea surface salinity measurements from SMOS and Aquarius.

The global water balance and the relative magnitudes of its global and regional components are of fundamental importance to society and are largely unmeasured over the ocean. The advent of satellite sea surface salinity (SSS) measurements by the Soil Moisture and Ocean Salinity (SMOS) mission launched in November 2009 and the Aquarius on the fourth Argentine Satélite de Aplicaciones Cientificas (SAC-D) satellite mission launched in June 2011, opened a new era in ocean sciences. This paper outlines the new measurement systems, including a preliminary assessment of the technological challenges, and provides an overview of results, including the salt budget in the North Atlantic, tropical instability waves, Rossby waves, mesoscale motions, freshening of surface coastal waters from riverine outflow and impact on hurricane forecasting in northwest Atlantic, and SSS response to La Niña. As the SSS time series lengthen with continued mission operations, SSS data will receive additional attention in numerous studies, including the El Niño/La Niña phenomenon, Gulf Stream meanders, and global salt budget of the water balance.

For the planning of future missions, IOC encouraged:

- CGMS to support sustained high spatial and high frequency SSS measurements for improved weather and climate applications.
- CGMS to support the assimilation of measurements of satellite SSS, sea surface temperature, and ocean surface topography, together with in-situ measurement, into ocean general circulation models to improve estimates of vertical profiles of ocean currents and ocean heat transport.

It was agreed that relevant themes for an IOC contribution to CGMS-44 would be sensing of Sea Ice from space as well as a report from the Second International Indian Ocean Expedition (IIOE-2), and the following actions were agreed in this regard:

| CGMS-43 actions - PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| IOC-UNESCO | D.7 | A43.08 | IOC-UNESCO to provide a paper on guidance to CGMS members on sea ice observations | CGMS-44 | OPEN | HLPP # 1.1 |
| IOC-UNESCO | D.7 | A43.09 | IOC-UNESCO to provide status of the Second International Indian Ocean Expedition (IIOE-2) | CGMS-44 | OPEN | HLPP # 1.1 |

## E REPORTS FROM THE SPACE AGENCIES

### E.1 Report on the status of current and future satellite systems by Members (Operational Agencies)

In **CGMS-43-CMA-WP-02**, CMA reported on the status of current and future satellite systems.

In **CGMS-43-EUMETSAT-WP-22**, EUMETSAT reported on the status of its current and future satellite systems.

Regarding current satellites:

The geostationary Meteosat-7 satellite will continue to support the Indian Ocean Data Coverage mission at 57.5 °E until March/April 2017 and will be de-orbited in April/May of that year.

The three Meteosat Second Generation (MSG) satellites are continuing to support the prime 0° service (Meteosat-10) and the 9.5 °E Rapid Scanning service (Meteosat-9), with Meteosat-8 as a shared standby satellite.

The Low Earth Orbit satellites Metop-A and -B continued to perform well, with Metop-A being significantly beyond its nominal lifetime. The primary Metop-B data stream benefits from the best possible timeliness based on acquisition of dumps at both Svalbard and McMurdo, the latter through the Antarctic Data Acquisition Service (ADA) provided through NOAA.

The Jason-2 satellite has performed well, even though the satellite is significantly beyond its nominal lifetime. A one-day outage of the Advanced Microwave Radiometer, on 18-19 December, resulted in degraded sea surface height measurements due to missing humidity corrections. An extension of the Jason-2 mission until end of 2017 is expected to enter into force this summer.

Regarding future satellites:

The geostationary MSG-4 satellite is on track for a launch early July on Ariane 5 from Kourou. It is planned to store MSG-4 in orbit for about 2.5 years once the commissioning is successfully completed.

The preparation activities for the Low Earth Orbit Metop-C satellite have been realigned for a launch readiness target of 1 October 2018. The launch will be on a Soyuz from Kourou.

The Meteosat Third Generation (MTG) satellite system is in phase C/D of development. The planned launch date for the first satellite MTG-I1, carrying the FCI imager and the Lightning Imager is planned for 2019. The launch of the second MTG satellite MTG-S1 carrying the Infrared Sounder (IRS) and the UV and near-IR Sounder (UVN) is planned for mid-2021.

The Low Earth Orbit EPS-SG programme is in the final stages of full approval by the EUMETSAT Member States and the overall EPS-SG system is in phase B. The launches of the first satellites of the system are planned as follows: Metop-SG A1 in 2021 and Metop-SG B1 in 2022.

The shipment of the Jason-3 satellite to Vandenberg is planned for June 2015, to achieve readiness for a Falcon-9 launch in early August.

The EUMETSAT Jason-CS optional programme including two satellites that will ensure continuity of reference ocean altimetry after Jason-3 is under consideration by EUMETSAT Member States. The launch of the first Jason-CS satellite is planned for 2020.

The planned launch date for the first Copernicus ocean observation satellite Sentinel-3A is the end of October 2015. The handover of the Sentinel-3A satellite to EUMETSAT and the start of routine operations will take place following the commissioning phase currently foreseen for early 2016.

IOC recognised Alain Ratier and Jean-Louis Fellous for their contributions to Oceanography through the efforts to make Ocean Surface Topography missions operational since the launch of Topex-Poseidon, and commended EUMETSAT for its efforts to secure continuity of OST through Jason-CS. WMO commented positively on the plans to fly a UVN sounder on MTG.

In **CGMS-43-JMA-WP-02** JMA reported on the status of its current and future satellite systems.

MTSAT-2 (145°E) is currently undertaking operational imaging over the East Asia and Western Pacific regions with a backup from MTSAT-1R (140°E), which has continued to perform imagery dissemination and data collection services even after its imaging function was switched over to MTSAT-2 on 1 July 2010. Its DCS (Data Collection System) has functioned properly since the satellite began operations.

JMA successfully launched the next-generation Himawari-8 satellite on 7 October 2014, and plans to start its operation in July 2015 as a replacement for MTSAT-2.

Himawari-8 is the world's first next-generation geostationary meteorological satellite, and features a new imager with 16 bands (as opposed to the 5 bands of the current MTSAT series). Full-disk imagery will be obtained every 10 minutes, and rapid scanning at 2.5-minute intervals will be conducted over several regions. The unit's horizontal resolution will also be double that of the MTSAT series. These significant improvements will bring unprecedented levels of performance in the monitoring of tropical cyclones, rapidly developing cumulonimbus clouds and volcanic ash clouds.

WMO thanked JMA for the important contribution to the GOS and the support to RA-V, and also for the introduction of the HimawariCast/Cloud services. The Himawari-8 results will be presented at WMO Congress side-event on user preparedness.

CGMS congratulated JMA and expressed its deep appreciation for the successful launch and commissioning and early data availability for Himawari-8, stressing the importance of the Advanced Himawari Imager for the preparations of the global user community for the new generation of geostationary satellites, including GOES-R.

In **CGMS-43-KMA-WP-01**, KMA reported on the status of current and future satellites.

COMS (128.2ºE) MI is currently operational and data are distributed via landline and satellite over the Western Pacific region, and COMS GOCI over East Asian region.

The progress of the development of GEO-KOMPSAT-2A (meteorological mission) and -2B (ocean and environmental mission) scheduled to be launched in May 2018 and March 2019 respectively, was summarised.

IOC commended Korea for making the GEO ocean colour data from GOCI available to the ocean community, as this is a globally unique capability.

In **CGMS-43-NOAA-WP-01**, NOAA provided an overview of its current and future satellite systems describing its missions and priorities.

NOAA informed CGMS of the status of its geostationary satellite constellation, including plans for the placement and operation of its next generation satellite, GOES-R. NOAA's polar-orbiting constellation was described, as well as the latest plans for its next generation satellite, the JPSS series.

Additionally, an update on the DSCOVR space weather mission was provided. It is on its way to L1 after a successful launch earlier this year to replace NASA's ACE satellite. Jason-3, a joint US-European ocean altimetry mission was also described, which is scheduled for launch later in 2015.

NOAA discussed recent organizational changes, including a push for greater internal engineering expertise and a consolidation of the administrative functions of its data centres into a new National Center for Environmental Intelligence.

NOAA also spoke a bit about some of its early future planning, beyond their next generation JPSS and GOES-R satellites. NOAA will keep CGMS up to date as it begins exploring different constellations and approaches to collecting critical meteorological satellite data.

NOAA stated that the process for defining the long-term future satellite scenario has started in the US and that NOAA will contribute actively to the WIGOS 2040 process.

In **CGMS-43-ROSHYDROMET-WP-01** ROSCOSMOS and ROSHYDROMET jointly reported on status of current and future Russian satellite systems.

Meteor-M N2 polar-orbiting meteorological satellite was launched on 8 July, 2014 and Electro-L N1 geostationary meteorological satellite was launched on 20 January, 2011.

The future Russian geostationary meteorological constellation will consist of three Electro-L satellites. The location of Electro-L satellites in orbit will be 14,5W, 76E and 166E. The mission objectives, payload and ground segment matters are provided. An overview was provided of the future Meteor-3M polar-orbiting satellite system, which will include three meteorological and one oceanographic satellite, and also forthcoming series of Meteor-MP and Ocean satellites.

The Arctica-M constellation of highly elliptical orbit satellites is now under development. The system will include two spacecraft. These satellites will provide continuous observations over the Arctic region. The launch is scheduled for 2017–2019. An overview of the mission objectives, payload and ground segment was presented.

Considering ROSHYDROMET's geostationary and polar-orbiting missions, but also the strong potential of highly elliptical orbit satellites for cross-calibration with other satellites, EUMETSAT strongly encouraged ROSHYDROMET to actively participate in GSICS activities and the following action was agreed in this regard:

| CGMS-43 actions - PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| ROSH | E.1 | A43.10 | ROSHYDROMET to nominate a point of contact for GSICS related matters | CGMS-44 | OPEN | HLPP # 3.1 |

IOC also encouraged ROSHYDROMET participation in International Ocean Colour Coordination Group (IOCCG), in light of the capabilities of Meteor-2 Microwave Sounder for OC. ROSHYDROMET and ROSCOSMOS will consider this, and also consider participation in Ocean Surface Wind coordination.

### E.2 Report on the status of current and future satellite systems by Members (R&D Agencies)

In **CGMS-43-CNSA-WP-01**, CNSA presented the status of current and future satellite systems.

China National Space Administration (CNSA) currently operates FY operational satellite system and 4 R&D satellite systems, including HY, HJ, ZY, and GF series satellite. China will be launching several satellite systems in the near future.

CNSA continues to construct an Earth observing system (EOS) for the sustained and stable observation of the Earth from the space, including meteorological satellite series, ocean satellite series, resource satellite series, environment and disaster small constellation (HJ) satellite series, and high-resolution (GF) satellite series. CNSA is making great efforts to actively enhance the construction of space-earth integrating system, to boost the EOS serving capability, and improve the services of EOS data provision and sharing. In the current stage, the EOS datasets and products have been used in a diversity of applications, such as metrology, ocean monitoring, national land resource survey, ecosystem environment protection, disaster detection, city management, et al.

China EOS is now enhancing its operational service capability. A set of R&D satellites are transforming gradually to operational mode after in-orbit tests. Using this excellent platform of CGMS, CNSA is very glad to communicate and share our experiences with other members , explore new EOS technology and sensors, and to make more contributions for the optimization of the global EOS.

In **CGMS-43-ESA-WP-01**, ESA presented the status of current and future ESA EO missions and programmes.

The plenary was informed of the status of the current European Space Agency Earth Observation missions. Two of them, MSG and Metop are in co-operation with EUMETSAT.

The Gravity field and steady-state Ocean Circulation Explorer, GOCE, the first Explorer satellite launched on 17 March 2009, ended its mission in November 2013, exceeding its predicted lifetime. The SMOS satellite was launched on 2 November 2009. All reprocessed Level 1 and 2 data are available from the ESA Cal/Val portal since mid-March 2012. The CryoSat-2 satellite was launched on 8 April 2010. Release of systematic CryoSat products (Level 1b and 2) to scientific community is on-going on. The Proba-V small satellite was launched on 7 May 2013. Its coarse resolution imager continues the data acquisition of the Vegetation payload on-board SPOT-4 and 5. The Swarm satellites were launched on 22 November 2013.

About 4,000 data user projects worldwide use data from the ESA EO missions and this number is increasing. The total volume of ESA EO mission data exceeds 100 Terabytes per year, available to users free of charge.

The plenary was further informed of the status of the future European Space Agency Earth Observation missions. Two of them, MTG and Post EPS (now EPS SG) are in co-operation with EUMETSAT.

The Living Planet Programme has three lines of implementation: Earth Explorer satellites, Earth Watch satellites plus services and applications demonstration. Progress in the preparation of the forthcoming Explorer missions ADM-Aeolus, EarthCARE and BIOMASS was described.

Copernicus represents the major new initiative of European efforts in Earth Observation. The start of the Copernicus pre-operational services took place in 2008, with the provision of the relevant data. The first Copernicus dedicated satellite ("Sentinel-1A") was launched on 3 April 2014, other Sentinels will follow in 2015 onwards. Sentinel missions are developed in partnership with the European Union

The plenary was also informed of the status of the Earth Watch Programme Element, Global Monitoring of Essential Climate Variables (also known as the 'ESA Climate Change Initiative' or CCI). The CCI Programme has continued to progress well. The thirteen existing project teams have made significant progress on algorithm development and on specifying a future operational system. The Programme achieved its phase 1 objectives end-2013 and continues in Phase 2 starting since early 2014.

NOAA encouraged ESA to consider NRT real-time data dissemination early in the programmes. ESA responded that NRT dissemination will be considered by the satellite programmes where it is feasible and beneficial for the user community.

WMO urged efforts to ensure a data policy and data access provisions for Copernicus, which will allow the global meteorological community to benefit fully from the Copernicus data and products.

In **CGMS-43-ISRO-WP-02,** ISRO and IMD reported on the status of current and future satellites.

Presently, three geostationary meteorological satellites INSAT-3A, Kalpana and INSAT-3D are operational. INSAT-3D launched in July 2013, is now fully operational with products being generated regularly at the INSAT Meteorological Data Processing System (IMDPS) and available to the users from IMD and ISRO.

INSAT-3D derived AMVs are regularly monitored by NCMRWF and ECMWF and quality of the products are found to be good. These AMVs are operationally assimilated at NCMRWF and IMD. INSAT-3D products have been extensively used for various weather applications. The clear-sky radiance products from INSAT-3D Sounder are now being routinely generated and NCMRWF has started assimilating these products in operational models after examining the biases for three months. Based on RT model, the bias correction procedure was included in the Sounder processing using 6-month collocated RAOB and Sounder observations.

Polar orbiting satellites Oceansat-2, SARAL, RISAT and low-inclination satellite Megha-Tropiques (MT) are presently operational. The Oceansat-2 scatterometer was switched off in March 2014 and only OCM and ROSA are presently functioning. The MADRAS payload onboard MT worked only for 18 months after launch in 2011. SAPHIR and SCARAB data products are operational. SARAL-AltiKa data is being used operationally in ocean state forecast models for improved prediction. Prototype coastal products of sea level, wave height and wind speed are ready to be made available to researchers for scientific studies. A land hydrology product (inland water level) has been hosted on MOSDAC.

The future satellite INSAT-3DR, a repeat mission for INSAT-3D, is planned to be launched towards the end of 2015. GISAT, which will be launched in 2017, will enhance the nowcasting capability with the repeat cycle of 10 minutes over Indian landmass and the adjoining areas at spatial resolution of 1.5 km. The polar orbiting satellite SCATSAT-1 is planned in late 2016 as a replacement for Oceansat-2 Scatterometer. Oceansat-3 is scheduled for launch in 2018, and will provide continuity for Scatterometer besides proving sea surface temperature measurements. A joint NASA- ISRO mission NISAR having a dual frequency Synthetic Aperture Radar (SAR) will be launched around 2020. A dedicated satellite NEMO-AM aimed at measuring and monitoring atmospheric aerosol is planned to be launched in 2016.

IOC thanked ISRO for joining the International science ocean community.

NOAA noted that ROSA data from Oceansat-2 are currently not usable. ISRO recognized these problems and responded that the issues are being addressed.

In **CGMS-43-NASA-WP-01**, NASA presented the status of its current and future Earth Science satellite systems.

NASA currently supports the operations of 19 Earth Science missions. Over a 15- month period from February 2014 through April 2015, NASA's Earth Science Program successfully launched 5 new missions, and decommissioned 2. Although all missions were conceived as research missions, it has turned out that the efficiency of the communications and ground data handling systems has

supported operational and near-real-time applications. All missions are currently producing data, but several also show signs of aging, and 2 are currently scheduled for decommissioning in the next 12 months.

NASA's Earth Science Program is implementing a balanced and robust plan to accomplish a broad set of critical Earth observation measurements from space. The program advances knowledge of the integrated Earth system, the global atmosphere, oceans (including sea ice), land surfaces, ecosystems, and interactions between all elements, including the impacts of humans. A balance of satellite measurements, science research, technology development and applications are needed to address a complex global Earth system. NASA's plans include the launch of 11 missions and 4 instruments (on host missions) in the future.

WMO urged NASA to plan for NRT access to future research satellite mission data. NASA responded that this is being addressed internally and with users.

In **CGMS-43-JAXA-WP-01**, JAXA reported on the status of current and future satellite systems.

JAXA currently is operating ALOS-2 (Daichi-2), DPR on GPM Core, GCOM-W (Shizuku) and GOSAT (Ibuki), and is preparing GCOM-C, GOSAT-2, and the CPR instrument on EarthCARE.

ALOS-2 was successfully launched from Tanegashima on May 24, 2014. The first image from the ALOS-2 was successfully received on 19th June, and data provision though a commercial provider has started from 25th November 2014. ALOS-2 will contribute to climate change monitoring though the observation of land cover changes.

GPM Core Observatory was successfully launched from Tanegashima Space Center on Feb. 28. The first image of the DPR received on 10th March provides a 3D image of the precipitation in a growing low pressure system. GPM Core/DPR successfully replaces the TRMM/PR whose operation has been terminated after its 17-year long service.

Distribution of the DPR products started on 2 September 2014. Users are able to access the data from the G-Portal.

The AMSR-2 (on GCOM-W1) products are available at the GCOM-W1 Data Providing Service website. NOAA has started direct data reception of AMSR-2 and uses the data regularly for weather forecasting.

The GOSAT data products are distributed through the GOSAT User Interface Gateway (GUIG), a website for GOSAT data distribution. GOSAT operation will continue in order to provide a bridge with the follow-on GOSAT-2 mission scheduled to launch in 2017.

The developments of EarthCARE/CPR and GCOM-C are under way. EarthCARE and GCOM-C will be launched in JFY2016.

# F WORKING GROUPS REPORTS

## F.1 Satellite data and products (WGII)

### F.1.1 Working group II report

The Working Group held its session as part of the CGMS-43 meeting on Monday, 18 May 2015 from 09:00-18:00 and Tuesday, 19 May 2015 from 09:00-16:00. The Group discussed 65 Working Papers and had 40 participants. Stephan Bojinski (WMO) and Toshiyuki Kurino (JMA) served as group co-chairs served. The list of participants is provided in Annex III.
Toshiyuki Kurino (JMA) expressed his thanks to NOAA NESDIS and special thanks to UCAR for providing the facility, and highlighted the necessity for CGMS cooperation in introducing the new generation of satellites, and to facilitate user uptake.

Stephan Bojinski (WMO) stressed the role of the WG for identifying actions by CGMS operators related to satellite data and products, and for the exchange of information.

The full report from WGII is provided in the chapter Parallel Working Group Sessions.

### F.1.2 Summary of highlights and request for guidance from GSICS Executive Panel

**CGMS-43-WMO-WP-16** reported the outcome of the GSICS Executive Panel meeting in Boulder, Colorado, 15-16 May 2015.

CGMS members are collaborating in the framework of GSICS to develop and apply “best practices” for state-of-the-art and homogeneous calibration.

Upon its 10th anniversary the GSICS community is gradually encompassing all CGMS members. GSICS proves to be a great capacity building and collaboration opportunity. Its products are increasing in maturity. The practical value of GSICS was demonstrated in the role played to facilitate the commissioning operations of several satellite programmes in the most recent years. GSICS benefits on the one hand to satellite operators, through sharing of resources and best practices, and on the other hand to satellite data users, through improved calibration, assessments, and traceability to common references.

Several challenges were identified and led to specific recommendations to CGMS Members:

- All satellite operators should participate in GSICS Working Groups, including GDWG (as a target, it is recommended that every GRWG or GDWG member plans a yearly contribution at the level of at least one man-month).
- All satellite operators to evaluate their requirements for GSICS resources, products and services to serve the needs of their users
- Procedures, best practices and calibration resources required to ensure the consistency of data records through accurate and homogeneous calibration should be defined by GSICS and CEOS WGCV as an input to the Architecture for Climate Monitoring from Space.
- Give increased attention to ground calibration sites

- Consider enhancing ground-based Moon observatories in order to reduce the absolute uncertainty of satellite instrument calibration by lunar observation.

On the occasion of the 10th anniversary of GSICS, the CGMS plenary expressed its appreciation of the achievements of GSICS and in particular the contributions of Dr. Mitch Goldberg, NOAA, who has been a driving force in the project.

ROSCOSMOS noted that work is ongoing regarding LEO-GEO cross-calibration between Meteor and Meteosat and announced that it will join GSICS on an observer basis.

### F.1.3 Summary of highlights and request for guidance from IWWG-12

**CGMS-43-IWWG-WP-07** summarizes the outcomes of the 12th International Winds Workshop (IWW12). The workshop was hosted by the University of Copenhagen and took place in Copenhagen, Denmark from 16-20 June 2014. There was a good cross-spectrum of attendance (65 participants) from a wide range of satellite producers, NWP centres, and research centres.

The paper:

- recalls recommendations from CGMS-42 to IWW12
- highlights the outcomes and recommendations from IWW12

CGMS expressed its appreciation of the excellent contributions of Dr. Johannes Schmetz, who is stepping down from his role as rapporteur for IWWG. Dr. Schmetz has been a driving force behind the efforts to develop harmonized methodologies for AMV derivation since the first International Winds Workshop in 1991.

### F.1.3 Summary of highlights and request for guidance from IPWG7

The IPWG-7 was held at the Tsukuba International Congress Center and hosted by the Japanese Aerospace Exploration Agency (JAXA) Earth Observation Research Center (EORC), Tsukuba, Japan during 17-21 November 2014, attended by 125 participants from over 20 countries. It included a special session dedicated to Dr. Arthur Hou, NASA Global Precipitation Measurement (GPM) Project Scientist, who passed away in late 2013. In parallel, a satellite training course was given with 28 participants.

Two new co-chairs were selected; Remy Roca (CNRS, France) and Tufa Dinku (IRI, USA). IPWG-8 will be held in the fall of 2016, with an African venue being targeted.

IPWG encouraged CGMS to continue to provide financial support for the activities related to IPWG, including workshop support and associated travel for new participants (including those at any associated training activity), travel support for CGMS member participation, and support for IPWG co-chairs (or designated representatives) to participate at other relevant meetings (e.g., WMO, CEOS, etc.).

### F.1.5 Future radio occultation constellation

#### F.1.5.1 Summary of highlights and request for guidance from IROWG-4

**CGMS-43-IROWG-WP-13** summarizes the outcome of the IROWG Workshop No. 4 (IROWG-4) of the International Radio Occultation (RO) Working Group. The workshop was organized by the Bureau of Meteorology (http://www.bom.gov.au/) and the Centre for Australian Weather and Climate Research (http://www.cawcr.gov.au/) in Melbourne, Victoria, Australia; the meeting was held at the Bureau of Meteorology from the 16th to 22nd of April 2015.

The main recommendations of the fourth IROWG meeting were presented by Lidia Cucurull, NOAA and IROWG Co-chair- only a short and concise working paper could be provided to CGMS-43 since IROWG-4 and CGMS-43 occurred only a few weeks apart. The full set of recommendations, relevant at CGMS, at satellite operator, and at IROWG level will be made available at http://www.irowg.org.

The Plenary endorsed the following four main IROWG-4 recommendations, for consideration by CGMS members in their future plans for Radio Occultation measurements:

| CGMS-43 recommendations – PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS (space agencies) | F.1.5.1 | R.43.01 | IROWG requests that both, equatorial and polar components of COSMIC-2 are fully funded and launched; this is required for Numerical Weather Prediction, Climate, and Space Weather | Long-term | OPEN | HLPP # 1.1.4 |
| CGMS members (space agencies) | F.1.5.1 | R.43.02 | IROWG recommends targeting at least 20,000 occultations/day to be made available to the operational and research communities of Numerical Weather Prediction, Climate, and Space Weather | Long-term | OPEN | HLPP # 1.1.4 |
| CGMS members (space agencies) | F.1.5.1 | R.43.03 | IROWG recommends that the RO receiver design includes sufficient software/firmware flexibility to allow changes in the signal processing including processing of new GNSS signals/constellations as they become available; all receiver measurements should cover the ionosphere as well | Long-term | OPEN | HLPP # 1.1.4 |
| CGMS members (space agencies) | F.1.5.1 | R.43.04 | International space/research agencies (e.g. NASA, ESA, CMA, CSA, NSF, NOAA, EUMETSAT and others) to hold an interagency workshop to define cooperation options for implementing the next steps towards a LEO-LEO research and demonstration mission | Long-term | OPEN | HLPP # 1.1.4 |

All presentations, as well as minutes, from IROWG-4 will be made available at http://www.irowg.org

#### F.1.5.2 EUMETSAT radio occultation study outcome

In **CGMS-43-EUMETSAT-WP-12** the first results of a study currently running at ECMWF were presented. The study looks at saturation effects when assimilating RO observations, where RO observation positions are simulated using realistic LEO and GNSS orbits. This study is thus a refinement of an earlier study that assumed RO occultations to be randomly distributed in space and time.

An Ensemble of Data Assimilation (EDA) approach, using 10 (+1) members in a 4D-Var modern NWP system, was used. Within this study, the following 3 main issues are addressed:

- Refine the earlier, random occultation position, study with realistic future satellite orbits;
- Assess which observation constellation is best suited to achieve the best distribution in space and time;
- Provide guidance on RO instrument deployments on future LEO satellites.

Regarding Point 1, it has been found that although realistic orbits affect occultation positions significantly, a modern NWP system can still effectively use any observations, thus the impact of realistic orbits is small. Regarding Point 2, the more observations are available, the lower forecasting spreads are found; constellations that provide most observations at low latitudes are particularly useful, since here, per area the least occultations are available from polar orbiting RO instruments and the model errors are the largest. Regarding Point 3, it again can be concluded that the more observations, the lower the forecast spread, even if additional instruments are provided in orbits that are already populated with RO instruments.

The study itself is formally finishing by August 2015, with a final presentation at EUMETSAT about 1 month earlier. Underlying EDA runs are already completed, they have been run over the last year. Shown results and discussions, conclusions are thus also entering the final report. The study results have also been presented and discussed at IROWG-4 in April 2015.

#### F.1.5.3 CMA future prospects for radio occultation

**CGMS-43-CMA-WP-05** provides an overview of status and future plans for radio occultation measurements of CMA.

The GNOS instrument was launched for the first time on FY-3C in 2013. Summary of the instrument capabilities:

- Daily profiles can be up to ~500 for GNOS/GPS
- FY-3C/GNOS shows good data quality between 5-30 km altitude.
- F-3C/GNOS/ data have a neutral or positive impact on GRAPES forecast skill.

The next GNOS instrument on FY-3D and follow-on will be improved with respect to antenna gain, number of channels and B1 open loop tracking ability.

Future Work:

- More elaborated experiments on the assimilation of GNOS
- Promote operation of the occultation data from Bei Dou System (BDS)
- International Cooperation

IROWG encouraged CMA to provide GNOS data in near real-time on the GTS. The following action was agreed:

| CGMS-43 actions - PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| CMA | F.1.5.3 | A43.11 | CMA to consider providing GNOS data in near real-time on the GTS. | CGMS-44 | OPEN | HLPP # 1.1.4 |

### F.1.6 Applications using VIIRS Day-Night band and RGB composites

**CGMS-43-NOAA-WP-13** provided to the CGMS community a sampling of the emerging capabilities in nocturnal characterization enabled by the Day/Night Band (DNB) sensor on Suomi NPP, part of the Visible/Infrared Imaging Radiometer Suite (VIIRS). A growing collection of research papers is giving evidence to the DNB's far-reaching utility, well beyond the originally envisioned scope of 'imagery.' Quantitative applications are becoming possible with the conversion of DNB radiances to reflectance and combining with other VIIRS spectral bands. Unexpected sensitivity to nightglow is revealing tantalizing new scientific potential for the study of upper atmospheric dynamics.

CGMS was encouraged to explore the new and complementary information content of the DNB for night-time applications, and where appropriate, advocate for the inclusion of such measurements as baseline requirement of future low-earth orbiting and geostationary environmental satellites.

### F.1.7 First results and products from Himawari-8

In **CGMS-43-JMA-WP-09**, JMA presented first results and products from HImawari-8. The next-generation geostationary meteorological satellite of the Japan Meteorological Agency (JMA), Himawari-8, was successfully launched on 7 October 2014 and will start operation in July 2015. Himawari-8 features the new 16-band Advanced Himawari Imager (AHI), whose spatial resolution and observation frequency are improved over those of its predecessor MTSAT-series satellites. These improvements will bring unprecedented levels of performance in nowcasting services and short-range weather forecasting systems. In view of the essential nature of navigation and radiometric calibration in fully leveraging the imager's potential, the working paper reports on the current status of navigation and calibration for the AHI and outlines related products.

WMO noted the fact that the Himawari-8 imager employs detector arrays and requested JMA to provide more information on the imaging technology and characterisation of the multi-detector channels.

## F.2 Global issues on satellite systems and telecommunications coordination (WGI)

### F.2.1 Endorsement of WGI Terms of Reference

**CGMS-43-EUMETSAT-WP-02** presented the proposed revision of the Terms of Reference for WG I and WG IV.

CGMS Working Group I on "Global issues on satellite systems and telecommunication coordination" was set up in 1989.

CGMS Working Group IV on "Global Data Dissemination" was created in 2001.

During the existence of the working groups a considerable evolution in telecommunication systems and associated services took place, leading to an expansion of the scope in each working group.

With the implementation of ATOVS Retransmission Services (RARS) and wider use of DVB dissemination services it became necessary to redefine the scope of WGI and WGIV to avoid unnecessary overlap in both groups.

CGMS-43 plenary agreed to the revised Terms of Reference for WGI and WGIV and CGMS-42, Plen E.1.3, A42.07 was closed as a consequence.

### F.2.2 Report from Working Group I

Working Group I (WGI) on Global issues on satellite systems and telecommunications coordination convened on Monday 18 May 2015 at 08:30.

The Working Group held its session on Tuesday 19 May from 08.30-15:30. Vanessa Griffin from NOAA and Lars-Peter Riishojgaard from WMO served as co-chairs and Joaquin Gonzalez from EUMETSAT as rapporteur. Representatives of the following organisations attended the session: CMA, EUMETSAT, JMA, KMA, NOAA, ROSCOSMOS, and WMO as Members, and GEO and KARI as Observers (the list of participants is included in the Annex).

The full report from the meeting of WGI is provided in the chapter Parallel Working Group Sessions.

The Plenary discussed the detrimental effect of radio frequency interference on SMAP and SMOS measurements. There was a general agreement that a letter should be sent from CGMS to ITU, supported by WMO in its Observer capacity at ITU, reiterating the protected status of these frequencies. In addition Agencies shall also use their national Points of Contact to address RFI issues.

In this regard, the following action was agreed:

| CGMS-43 actions - PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| WGI co-chairs | F.2.2 | A43.12 | WGI Co-chairs, with the support of IOC-UNESCO, ESA and GEO to draft a CGMS letter to ITU, reminding the societal benefits and importance of all MetSats, EESS and Science Satellite Services , and need for enhancing the protection of the corresponding radio frequency bands | 30 Jun 2015 | OPEN | HLPP # 1.3.4 |

### F.2.3 Transition from GVAR-R GRB – service continuity

**CGMS-43-NOAA-WP-02** presented the planning for the transition from GOES Variable (GVAR) to the GOES-ReBroadcast (GRB).

GRB allows real time distribution of all Level-1b GOES-R data products for direct read-out users. Direct Readout users need to upgrade their equipment for GOES-R. GRB provides significant increase in data rate and a new data format

GRB downlink specifications and data format specifications have been published and updates will be posted on the GOES-R web site: http://www.goes-r.gov/.

## F.3 Global data dissemination (WGIV)

### F.3.1 Endorsement of WGIV Terms of Reference

The revised Terms of Reference for WGIV were endorsed by CGMS-43 plenary (see also section F.2.1).

### F.3.2 Report from Working Group IV

Working Group IV (WGIV) on Global Data Dissemination convened on Monday 18 May 2015 at 08:30.

The Working Group held its session on Monday 18 May from 08.30-14:30. Jae-Dong Jang from KMA served as chair and Klaus-Peter Renner from EUMETSAT as rapporteur. Representatives of the following organisations attended the session: CMA, EUMETSAT, ISRO, JMA, KMA, NOAA, WMO as Members, and KARI as Observer (the list of participants is included in the Annex).

The full report from the meeting of WGIV is provided in the chapter Parallel Working Group Sessions.

The following action was agreed during the discussion of the report from WGIV.

| CGMS-43 actions - PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMSSEC | F.3.2 | A43.13 | CGMS Secretariat to send a letter to JCOMM requesting that the JCOMM Cross-Cutting Task Team on Satellite Data Requirements reports on the definition of satellite data for the ocean community to CGMS-44 (ref. CGMS-43 WGIV/6.2 discussions) | 30 June 2015, CGMS-44 | OPEN | HLPP # 2.5 |

### F.3.3 GOES-R global data exchange

In **CGMS-43-NOAA-WP-37**, NOAA reported how GOES-R data will be obtained without a GRB receiving station:

Near-Real Time (NRT):

- PDA: New NOAA enterprise system for Product Distribution and Acquisition. GOES-R data will be available on PDA 1 minute after real-time
- GEONETCast: NOAA will work with its technical personnel and the user community to replace GOES-13 imagery on GEONETCast Americas with roughly equivalent amounts GOES-R imagery when it becomes the operational East satellite
- HRIT/EMWIN: The GOES-R HRIT/EMWIN service combines LRIT and EMWIN with GOES-DCS on a single ~ 1 meter Antenna

Non Near-Real Time:

- GOES-R level 1b and level 2+ data will be available on CLASS 3-4 hours after real-time NetCDF4 files
- All 16 ABI channels
- Registration process will be the same as today: https://www.nsof.class.noaa.gov/saa/products/user_profile.

WMO thanked NOAA for the commitment to work with the user community to explore the effective transition to GOES-R, including efforts to make Lightning Mapper data available on GEONETCast-Americas.

### F.3.4 PDA Product distribution and acquisition

In **CGMS-43-NOAA-WP-03** NOAA provided an overview of its new primary system for distribution of near-real-time data to users, PDA. In the working paper NOAA provides contact information in case CGMS Members require additional information.

WMO inquired about the process for gaining access to PDA NRT data, and in particular about the needed justification for NRT access. NOAA responded that applications are judged on a case-by-case

basis, looking at the justification for NRT data via PDA, but that operational users including Weather Services would in any case be granted access.

### F.3.5 WMO Satellite Data Dissemination Strategy

In **CGMS-43-WMO-WP-09** WMO presented the WMO Satellite Data Dissemination Strategy.

Ensuring the operational access to, and use of, satellite data and products for a growing number of WMO Members in the coming decade is a major objective for both WMO and CGMS. In achieving this, we are faced with major technical challenges including the exponential growth of data rates for new satellites, the requirement for improved latency (e.g. for NWP) and the threat to radio frequency allocations for meteorological satellites. There are also strategic and organisational challenges including the digital divide between most and least advanced users, and the need to ensure interoperability and standardisation of evolving systems, and their integration into WIS. At the same time, a number of opportunities are opened by the constant progress in information and communication technology (e.g. the Cloud).

Following earlier discussions at CGMS-42 and CBS-Ext.(2014), a medium-term Satellite Data Dissemination Strategy is proposed. This Strategy calls for active support of CGMS members in particular in the following areas:

- Enhancing data availability
  - Global Coverage of LEO Direct Broadcast Acquisition, Processing and Distribution Systems
  - Bilateral Exchange of Data and Products
  - Routine Availability of Data and Products from R&D Satellites
- Description and Registration of Satellite Data and Products
  - Making Satellite Data and Products Discoverable on the WIS
  - Standardized Data Formats
- Dissemination and user access
  - Standardized Direct Broadcast
  - Global Access to Data and Products on the Core WIS Network
  - Full Integration and Operation of DVB Broadcast Services
  - On-demand Access to Satellite Data and Products

EUMETSAT thanked WMO for the efforts going into the strategy. The new strategy needs to be assimilated. It is important to take time to review this in detail and to distinguish between what is the strategy and what is the implementation.

GEO stressed the importance of cloud technologies, including private clouds. WMO responded that the emerging cloud technologies and their application in the WIS context are being considered by appropriate expert teams like ET-CTS.

The Chair stressed that the strategy should not drill down too much into implementation details.

CGMS members were invited to the following action:

| CGMS-43 recommendations – PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | F.3.5 | R43.05 | CGMS members to<br>- comment on the WMO medium-term strategy for satellite data dissemination<br>- support the implementation of the strategy in contributing to the identified strategic targets and actions, as appropriate, and in taking the proposed strategic targets into account in their own dissemination plans | CGMS-44 | OPEN | HLPP# 2 |

## F.4 Operational continuity and contingency planning (WGIII)

### F.4.1 Report from Working Group III

Working Group III (WGIII) on Operational Continuity and Contingency Planning convened on Tuesday 19 May 2015 10:00-16:00.

Dr. Zhang Peng from CMA and Suzanne Hilding from NOAA served as co-chairs and Derek Hanson from NOAA as rapporteur. Representatives of the following organisations attended the session: CMA, EUMETSAT, ISRO, JMA, KMA, NASA, NOAA, ROSCOSMOS and WMO (the list of participants is included in Annex III). The Co-Chairs were pleased to note the large number of participants in this year's WGIII meeting.

The full report from the meeting of WGIII is provided in the chapter Parallel Working Group Sessions.

### F.4.2 Indian Ocean Data Coverage (IODC) – CGMS roadmap

In **CGMS-43-EUMETSAT-WP-14**, EUMETSAT proposed a way forward for the provision of Indian Ocean Data Coverage (Services) after re-orbiting of Meteosat-7 in 2017, based on the analysis of the current status of CGMS partner satellite systems (CMA, EUM, ISRO and ROSHYDROMET) in the region.

The combination of satellites and services should lead to an overall resilient multi-partner IODC service, for which a requirements baseline has been agreed at CGMS-42.

The paper proposed a scenario and roadmap for approval by the CGMS partners contributing to future IODC services.

IOC was pleased to see the continuous response of the CGMS community to the aftermath of the Tsunami of 2004 with the DCPs, and commended the support to the Tsunami Warning System.

IPWG was highly supportive of the plan proposed, as observation gaps over the Indian Ocean are a major concern to the precipitation community.

WMO asked if an additional iteration with user community was needed in this area. EUMETSAT responded that surveys are important but we have a critical timeline and we need to make do with what we have. Thanks to the coordination we have a robust system with 4 partners, which is a solid basis for some years to come. It is particularly important that the contributors confirm their support to the roadmap, as CGMS needs to give a signal to WMO Congress.

The Chairperson noted that the proposal represents a robust and resilient approach providing a better long-term solution that what has been available in the past and asked the partners to state their commitment to the proposal

EUMETSAT informed Plenary that it was not yet in a position to fully approve the relocation of Meteosat-8, as the MSG-4 launch in July and the commissioning needs to be completed successfully by the end of 2015. Pending EUMETSAT Council approval in mid-2016, EUMETSAT is confident that if all things go well it will be able to move Meteosat-8 in 2016. EUMETSAT noted that the new IODC roadmap will provide an excellent system, which will be much more robust than what was possible in the past.

ISRO informed plenary that INSAT-3D has been launched and ISRO is making all data available through the ISRO Website, as well as contributing to GSICS. ISRO is committed to launch INSAT-3DR (end of 2015/2016) and INSAT-3DS in 2022, and is also looking at the GISAT satellite (2017) that will support nowcasting.

ROSCOSMOS/ROSHYDROMET will support the roadmap proposed by EUMETSAT. Electro LN1 has limitations and we are planning to launch LN2 in the same orbital position to cover IODC. Electro LN2 data will be made available after commissioning. DCS are available from LN1 and LN2.

CMA informed that FY-2G has been launched successfully and commissioned and was moved to Operational Status in April. In response to CGMS roadmap, CMA plans to move FY-2E to replace FY-2D with better radiance calibration and S/N for observations. The replacement is planned to be completed by the end of June.

WMO stated that this is a wonderful step forward and a historical achievement for CGMS. CGMS however now needs to look at the implementation details and in particular at actions to be taken for the dissemination of the data.

WMO drew a parallel with another historical achievement announced at this CGMS plenary session, which was CMA's decision on the deployment of FY-3E in the Early Morning orbit, and emphasised that these two achievements alone would justify the existence of CGMS.

The Chair stated he was impressed by the level of coordination achieved by CGMS on these matters.

The partners agreed to report to the next plenary session of CGMS:

| CGMS-43 actions - PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| CMA, EUM, ISRO, ROSH | F.4.2 | A43.14 | The partners of the IODC roadmap to report on the implementation and progress at CGMS-44 | CGMS-44 | OPEN | HLPP # 1.1.6 |

### F.4.3 CGMS and socio economic benefits issues

#### F.4.3.1 Outcome of WMO CM-12 discussion on socio-economic benefits

**CGMS-43-WMO-WP-10** reported on the discussion at the 12th session of WMO Consultative Meetings on High-level Policy on Satellite Matters (CM) on socio-economic benefits of space programmes. The CM serves as a forum for satellite operators and WMO management to discuss the strategic direction that WMO takes in relation to space. The session received briefings by the chair of the CGMS Socio-Economic Benefits Tiger Team (SETT), EUMETSAT, CMA, NOAA, and JMA. Participants recognized the importance of socio-economic benefit studies for satellite programmes, to justify investments and to meet communication demands, and provided perspectives on the conduct of such studies and related challenges.

The CM session recommended that the WMO workshops on assessing the impact of various observing systems on NWP be extended or emulated to other application areas, such as climate.

#### F.4.3.2 Socio-economic benefits of weather information

Jeff Lazo from UCAR Societal Impacts Programme provided the keynote speech on Socio-Economic Benefits of Weather Information.

**CGMS-43-UCAR-WP-02** provided a brief overview of socio-economic approaches to weather information including discussing why economics is needed and what detail of economic analysis is required. An exercise based on the benchmarking approach used by the World Bank was provided to illustrate a very basic approach to valuing weather information. This was followed by an illustration of the weather information value chain for improved irradiance forecasting for use by utility scale solar power generation indicating the complexity of more advanced valuation efforts. The weather information value chain concept was then discussed as a tool for understanding the value creation process and economic methods. An overview of some key economic concepts and a taxonomy of benefits assessment methods were presented.

Information was also provided on some available resources on economic analysis for hydro-met services including the new USAID/WMO/World Bank book on socio-economic benefits assessment. Some thoughts on the CGMS SETT were provided from the viewpoint of an economist, and recommendations were made for future socio-economic benefits work including showing results from a study on the value of improved hurricane forecasts and an illustration of the potential importance of a study of values to the general public of improved weather information.

The importance of social science in communicating the information from Weather forecasts was emphasised.

Jeff Lazo commented that the UCAR programme provides training to National Hydrometeorological Services, noting that there is a large amount of economic analysis going on in the private sector (i.e. aviation sector), but for obvious strategic reasons with no links to other efforts.

#### F.4.3.3 Report from Socio-Economic Tiger Team (SETT)

In **CGMS-43-NOAA-WP-04** NOAA as chair of the CGMS Socioeconomic Benefits Tiger Team (SETT) provided a status report from SETT and its plans for the next year. The report discussed the outcome of Workshop #2, including the work being done on the case study on "Understanding and Assessing the Value of Improved Satellite Data for the Users of Operational Sea Ice Products and Information". CGMS SETT is also developing a guidance document for use by CGMS Members considering their own socioeconomic benefit studies.

### F.4.4 Report from the ad hoc Group on Space Weather

The ad-hoc Group on Space Weather convened on Tuesday 19 May 2015 16:00-18:30.

Suzanne Hilding from NOAA chaired the session and Jerome Lafeuille from WMO acted as rapporteur. Representatives of the following organisations attended the session: CMA, ESA, EUMETSAT, JMA, KMA, NASA, NICT, NOAA, ROSCOSMOS and WMO (the list of participants is included in Annex III).

The full report from the meeting of the ad-hoc Group on Space Weather is provided in the chapter Parallel Working Group Sessions.

The CGMS Plenary endorsed the recommendation from the ad-hoc Group to create a dedicated CGMS Space Weather Task Team (SWTT), chaired by Suzanne Hilding from NOAA, and noted that an inter-sessional meeting of SWTT will be convened to translate the Terms of Reference (ToR) into specific objectives for the HLPP and to define next steps for action until CGMS-44. The initial membership of SWTT is based on the list server CGMSspaceweather@wmo.int.

| CGMS-43 actions - PLENARY | | | | | | |
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| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| SWTT | F.4.4 | A43.15 | The Space Weather Task Team (SWTT) to report on progress at CGMS-44 | CGMS-44 | OPEN | HLPP # 5.2 |

## G CLIMATE

### G.1 Status report by the CEOS-CGMS Joint Working Group on Climate

In **CGMS-43-JWGCLIM-WP-01** the COES-CGMS Joint Working Group on Climate presented an update on activities.

The Fifth meeting of the CEOS-CGMS Working Group on Climate took place 25-27 March in Geneva, Switzerland. Main foci of the meeting were: 1) progress and plans for the Essential Climate Variable (ECV) inventory assessment and gap analysis, 2) update of activities to support climate applications and decision making and the related WMO report on these activities, and 3) plans and reporting to the Global Climate Observing System (GCOS) and the UN Framework Convention on Climate Change (UNFCCC) Committee of the Parties Subsidiary Body on Scientific and Technological Advice (COP/SBSTA). The ECV inventory and gap analysis will move forward on selected records and feedback will be provided on input by Agencies to all records. The WMO report, 'Establishing an Architecture for Climate Monitoring from Space through Climate Service Case Studies' is expected to be published and presented at the WMO Congress in June 2015. The report to GCOS is being finalized and the content of the COP/SBSTA report was established.

IOC Representative noted the importance of the in situ community in the implementation of the architecture for climate monitoring from space. It was noted that some of the tools and processes developed will be made available to the in situ community.

Although the Working Group has made progress, most of the work has been accomplished by a limited number of Agencies. Thus, the Working Group encourages CGMS Agencies to renew their commitment to success of the Working Group by ensuring their agency participation. WGClimate also requested CGMS Plenary to approve Jörg Schulz of EUMETSTAT as incoming Vice-Chair. Pascal Lecomte of ESA is the incoming Chair.

On a question from IPWG, the JWGClimate chair noted that Interim Climate Data Records are captured in the Inventory.

CMA asked if NRT data were considered part of the Climate architecture. JWGClimate confirmed that this is not the case.

The CGMS plenary endorsed the appointment of Jörg Schulz of EUMETSAT as the incoming Vice-Chair of JWGClimate.

### G.2 Further CGMS Contributions to the climate architecture from the GSICS Executive Panel

In **CGMS-43-WMO-WP-06**, Dr. Holmlund from the GSICS Executive Panel presented considerations on calibration and the role of GSICS in the Architecture for Climate Monitoring from Space.

Calibration contributes significantly to the end-to-end Architecture for climate monitoring from space:

- The sensing level (Pillar 1) drives the *potential* to generate ECVs
- The climate record creation (Pillar 2) is the *actual* use of this potential
- The ECV inventory addresses Pillar 2 => helps maximize the use of data
- Calibration activities must be addressed in both Pillars 1 and 2 :
  - Space segment (pre-launch and on-board calibration, space/ground references)
  - Applying inter-calibration corrections, re-calibration of archived data

Calibration should be considered in the architecture by:

- Calibration infrastructure to be implemented and shared
  - In-orbit references for traceability
  - Ground-based calibration sites
  - Databases and software tools

- Calibration processes to be addressed by operators
  - Best practices for pre-launch calibration
  - Procedures for in-orbit calibration with uncertainty estimation
  - Procedures for in-orbit comparison and inter-calibration
  - Procedures for vicarious calibration with ground targets
  - Algorithms/tools for re-calibration of archived data
  - Communication and capacity building (incl. QA4EO)

- These activities are conducted by GSICS together with CEOS/WG on Calibration and Validation

GSICS will continue the work with CEOS/WGCV:

| CGMS-43 actions - PLENARY | | | | | | |
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| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| GSICS | G.2 | A43.16 | GSICS to work with CEOS/WGCV to:<br>– Describe the processes to be followed to ensure consistent calibration meeting climate requirements,<br>– Describe the required infrastructure (space-based and surface-based) supporting these processes,<br>– Review the analysis of calibration-related tasks in the logical analysis of the Architecture,<br>(with a view to provide a joint input to the Architecture for Climate Monitoring from Space) and report to CGMS-44 | CGMS-44 | OPEN | HLPP # 5.1 |

### G.3 Briefing on the GCOS status report and progress including the new GCOS implementation plan

The GCOS includes surface-based, air-borne, and space-based components and constitutes, in aggregate, the climate observing component of the Global Earth Observation System of Systems (GEOSS). The next GCOS Status Report on the global observing systems for climate will be available to the public in November 2015. The GCOS Secretariat has initiated the process of drafting a new GCOS implementation Plan, which will be highly relevant to space agencies, WMO programmes and related IOC and UNEP programmes and climate science activities, especially in the light of the

evolving Global Framework for Climate Services (GFCS). The new Implementation Plan will be launched at the GCOS Science Conference 2 – 4 March 2016, and published at the end of 2016.

CGMS members have the opportunity to contribute to the public review of the Status Report and to the process of drafting and launching the new Implementation Plan. Regarding the new GCOS IP content, CGMS members expressed satisfaction for the inclusion of supporting observations such as gravity, DEMs and orbit restitution.

### G.4 Key outcomes of the Symposium on Climate Research and Earth Observation from Space

**CGMS-43-EUMETSAT-WP-28** provided a report from the Symposium on Climate Research and Earth Observation from Space, held 13-17 Oct 2014 in Darmstadt, Germany.

The Symposium was organised by EUMETSAT and WCRP, on 13-17 October 2014, in Darmstadt, Germany, with support of EU, ESA and other CEOS/CGMS agencies. Around 500 participants from 50 countries, representing over 200 organisations, attended with another 500 following remotely via live-streaming.

The findings and recommendations are organized according to the following themes: i) Research and Process Understanding; ii) Observations; and iii) Coordination and Integration of Observations. Mr. Ratier summarized the key conclusions of the Symposium on needs and contributions of space-based observations and on coordination and integration of observations.

The consolidated set of outcomes of the Symposium will be published in the AMS bulletin. The full proceedings, including streaming and presentations, can be found at:
http://www.theclimatesymposium2014.com

CGMS members expressed congratulations to Symposium organizers for support for next generation scientists. This was noted as a unique benefit of the Symposium.

### G.5 WMO draft resolution on exchange of data and products to support the implementation of the global framework for climate services (GFCS)

**CGMS-43-WMO-WP-08** presented the Draft Resolution on International Exchange of Climate Data and Products to Support the Implementation of the Global Framework for Climate Services (GFCS), which was discussed at the 66th session of the WMO Executive Council and which is submitted in a revised version to the 17th World Meteorological Congress for adoption (Cg-17/Doc. 8.1(2), REV. 1).

From the perspective of the architecture for climate monitoring from space, the WMO informed space agencies of CGMS and CEOS of this draft resolution to solicit feedback. The draft resolution was presented at the 12th Consultative Meetings on High-level Policy on Satellite Matters (CM-12) and at the 9th session of the Expert Team on Satellite Systems (ET-SAT-9). The draft resolution, after recalling essential principles of the GFCS, would decide in particular to adopt the policies and practices of Resolution 40 (Cg-XII) and Resolution 25 (Cg-XIII) for the exchange of climate relevant data and products, and "that Members shall provide, on a free and unrestricted basis, the climate relevant data and products described in Annex I to this resolution to enable society to manage better the risks and opportunities arising from climate variability and change for all nations,

especially for those who are most vulnerable to climate-related hazards". The data listed in Annex 1 include in particular "All available climate relevant satellite data and products".

CGMS Satellite Operators are invited to communicate their support to this draft resolution to their relevant delegation at the seventeenth session of the World Meteorological Congress, which will open on Monday 25 May 2015.

CGMS members questioned the definition of climate data as: "meteorological observations that are older than 24 hours." Note this definition is footnoted in Annex 1 and appears to apply to "historical climate time series from the RBCN and GCOS Surface Network. Members cautioned that this could be used to limit or constrain access. WMO explained that consistent with the history and rationale behind Resolution 40 on meteorological data, the intention was not to restrict access to climate data but to expand or improve it. WMO informed members that any change to this draft resolution would have to be proposed by national delegations at the WMO Congress when the resolution is addressed.

IOC urged that climate data should be available for ships doing oceanographic surveys and asked whether this Resolution could hamper the download of data that are less than 24 hours. WMO responded that this is not the case. Access to recent data is addressed by WMO Resolution 40.

| CGMS-43 recommendations – PLENARY | | | | | | |
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| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMSSEC | G.5 | R43.06 | CGMS Secretariat to express the common position of CGMS members on the WMO draft resolution on data and products (CGMS-43 plen R43.03) at the WMO Cg-17 | 27 May 2015 | OPEN | HLPP # 5.1 |

## H GEO

### H.1 Status of GEO work plan, the next 10 year strategic plan and potential CGMS contributions (provided by the GEO Secretariat)

On behalf of the GEO Implementation Plan Working Group, Osamu Ochiai from the GEO Secretariat introduced the GEO Work Plan, Structure, and Implementation Mechanisms for the period 2016-2025.

As GEO approaches the end of its first 10-year 2005-2015 mandate, the Ministers from GEO Member governments and leaders from GEO Participating Organizations gathered at the Geneva Ministerial Summit on 17 January 2014, and decided to extend their political commitment to the GEO vision through 2025.

The Geneva Summit Declaration witnesses this renewed commitment and confirms the willingness to further leverage GEO's substantial accomplishments to improve Earth observations, as well as to increase the availability of Earth observations, data, and information to leaders in government, science, industry, civic society, and the public at large.

The declaration also requests that "…a new Implementation Plan through 2025 be prepared for endorsement at the next GEO Ministerial Summit …". To respond to the Ministers' request, an Implementation Plan Working Group (IPWG) has been set up to draft a new 10-year Implementation Plan (2016-2025) for initial review at the GEO-XI Plenary in November 2014, for acceptance at the GEO-XII Plenary, and subsequent endorsement at the associated Ministerial Summit, at the end of 2015.

The Group is composed by 25 Members, 15 Experts and 10 Writing Team Members, representing the five GEO caucuses (Africa, Americas, Asia-Oceania, Europe and Commonwealth of Independent States), with three Experts and two Writing Team Members per caucus. Nominations to the IPWG were forwarded by each caucus; the GEO Co-Chairs reviewed these nominations and proposed the composition of the Group that was then endorsed by the GEO Executive Committee.

The GEO Executive Committee and GEO Co-Chairs received the mandate from the GEO-X Plenary to oversee and steer the process of developing the new 10-year Implementation Plan. They agreed to a two-phase approach to guide the IPWG work; an initial reflective phase, followed by a longer 'synthesis and formulation' phase.

The initial phase – or 'fresh perspectives' exercise - lasts from the 1st IPWG meeting in April 2014 until the middle of June 2014, when a summary report will be submitted to the GEO Executive Committee. The second 'synthesis and formulation' phase begins immediately following the 8-9 July meeting of Executive Committee and lasts until the end of the exercise with the acceptance of the Implementation Plan including 2016 transitional Work Program by the GEO-XII Plenary and endorsement at the 2015 Ministerial Summit.

In terms of potential CGMS contributions to these efforts, Mr. Ochiai outlined three specific opportunities:

- Feedback to the GEO Strategic Plan 2016-2025 : GEOSS Implementation (including 2016 transitional Work Program)
- Coordination to best restructure the Foundation Tasks (e.g., GEONETCast, Radio Frequency Protection)
- New activity ideas (June 10$^{th}$ and onward) on the GEO 2016 transitional work program (e.g., new technologies direct readout, broadcast)

An action was placed accordingly:

| CGMS-43 actions - PLENARY | | | | | | |
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| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | H.1 | A43.17 | CGMS members are invited to provide feedback to the GEO Strategic Plan 2016-2025: GEOSS Implementation (including 2016 transitional Work Program) after issued the next version in the end of June 2015 to cgmssec@eumetsat.int. Proposals are welcomed, in particular to GEONETCast and Radio Frequency Protection as candidate Foundational Tasks, as well as new activities with regard to the activities on new technology, weather and beyond. | 10 July 2015 | OPEN | - |

With respect to GEONETCast (GNC), Charles Wooldridge of NOAA informed CGMS members of a meeting hosted by EUMETSAT on May 4th to discuss positioning GNC in the 2016-2016 GEO Work Plan. The regional GNC operators developed a set of principles that will be incorporated into a statement reconfirming their commitment as the operators of the GNC system. This statement will be given on behalf of the group at the November 2015 GEO Ministerial Meeting.

## I EDUCATION AND TRAINING

### I.1 The VLab Global Infrastructure for Education and Training: New 2015-2019 strategy and update on activities

In **CGMS-43-WMO-WP-12**, an update on activity for the VLab was provided by the VLab co-chair Kathy-Ann Ceasar, as well as a proposed update to the VLab 4-year strategy.

Since January 2014, VLab Training Centres of Excellence has offered a total of 66 courses and 41 Regional Focus Group sessions.

Furthermore, important developments have taken place since CGMS-42, including the change in VLab co-chairmanship, the Seventh Virtual Laboratory Management Group meeting (VLMG-7) in July 2014 in Saint Petersburg, Russian Federation, and the elaboration of the new Five-year Strategy document for VLab activities 2015-2019.

The focus of the new VLab strategy is on preparing users to the new generation of meteorological satellites, and on training on the use of satellite data and products on a broadening range of weather, climate and related environmental applications. Also Regional Focus Groups and the creation of a repository of sessions is being considered. The VLab is a solution to address key challenges in satellite-related training, capacity building, satellite applications development and operational services.

The VLab as an experienced, versatile and cost-effective global infrastructure will strive to deliver training in line with WMO and GFCS strategic priorities and GEO societal benefit areas, while also strongly engaging in the areas of climate monitoring; marine, ocean and coastal monitoring; dust, ash and smoke monitoring; and space weather.

An update on the WMO VLab Trust Fund shows that although contributions to the WMO VLab Trust Fund are matching expenses through 2015, the Fund's reserves are low and little progress has been made in the level and spread of funding by CGMS Members following the call for contributions sent by CGMS and WMO Secretariats in September 2014 (Action 42.08). Kathy-Ann Ceasar stressed the importance of the Technical Support Officer, due to the overall relatively low number of personnel dedicated to training.

IOC commended the VLab for including training modules on ocean applications, and offered potential collaboration of IOC, as IOC has been strongly involved in delivering training. The VLab was strongly encouraged to collaborate with IOC-UNESCO on the generation and delivery of training related to ocean applications.

GEO commended VLab for its intention to interact with GEO in addressing capacity building needs in its frameworks (e.g. AfriGEOSS). GEO could provide leverage and looks forward to collaborating with the VLab.

The CGMS plenary expressed its appreciation of the progress of the VLab and of the continued efforts of the VLab team and in particular of the co-chairs Kathy Ann Ceasar (Caribbean Institute for Meteorology and Hydrology) and Prof. Grigory Chichasov (Director of the WMO Regional Training Centre in the Russian Federation).

CGMS endorsed the new VLab strategy for the timeframe 2015-2019.

The following actions and recommendation were agreed following the discussions:

| **CGMS-43 actions - PLENARY** | | | | | | |
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| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO, CGMSSEC | I.1 | A43.18 | WMO and CGMSSEC to write a letter to all satellite operators in VLab (once receiving the revised expectations documents in August 2015) to:<br>- Recall the urgency for more training giving increasing service reliance on satellites, and the upcoming generation of new satellite technology,<br>- Recall expectations from operators,<br>- Mention results of a VLab internal evaluation indicating that some expectations are better met than others and that there are urgent needs for ramping up support,<br>- Suggesting that effective technical | 15 Sept 2015 | OPEN | HLPP # 4.2.3 |

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| | | | focal point be nominated / confirmed that will help CoEs address issues,<br>- Recall the need for sustained financial support to the VLab Trust Fund. | | | |
| CGMS members | I.1 | A43.19 | CGMS members to respond to the WMO/CGMSSEC letter on VLab (reference CGMS-43 action I.1, A43.18) | 15 Dec 2015 | OPEN | HLPP # 4.2.3 |

| CGMS-43 recommendations – PLENARY | | | | | | |
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| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | I.1 | R43.07 | CGMS members that are sponsors of VLab Centres of Excellence to review and where possible augment their support to these Centres, as per the "Procedure for establishing Virtual Laboratory Centres of Excellence for Training in Satellite Meteorology" (section 2.2, http://www.wmo-sat.info/vlab/wp-content/uploads/2012/02/Procedures-for-New-CoEs_LV2012.pdf) | CGMS-44 | OPEN | HLPP # 4.2.3 |

### I.2 Development of online educational resources for satellite applications

In **CGMS-43-UCAR-WP-01** UCAR provided an overview of COMET's Online Satellite Meteorology Educational Resources

The COMET® Program (www.comet.ucar.edu), a part of the UCAR Community Programs (UCP), receives funding from NOAA NESDIS, EUMETSAT, and the Meteorological Service of Canada to support education and training in satellite meteorology. These partnerships enable COMET to create educational materials of global interest on geostationary and polar-orbiting remote sensing platforms. Over the last several years, COMET's satellite education programs have focused on the capabilities and applications of current and next-generation operational environmental satellites and their relevance to operational forecasters and other user communities.

By partnering with experts from EUMETSAT, NOAA-NESDIS and its Cooperative Institutes, Meteorological Service of Canada, and other user communities, COMET stimulates greater use of current and future satellite data observations and products. The impact is evident in the large number of users from international meteorological services and universities. The translation of lessons into a number of languages further broadens the accessibility of COMET's learning materials.

This presentation provides an overview of COMET's self-paced satellite training and education lessons. It will focus on how to access the materials and on some of the latest offerings that are helping users prepare for using SNPP, the arrival of data and products from the next-generation GOES-R+ series, and the recently launched Himawari-8 satellite.

Over 100 satellite-focused, self-paced, online sets of material are freely available on the MetEd Web site via the "Education & Training", "Satellite" topic area http://meted.ucar.edu/topics/satellite in English, Spanish and French. Over 20 000 satellite lesson user sessions are held per year in English.

Recent modules added to the site include "How Satellite Observations Impact NWP", "GOES-R ABI: Next Generation Satellite Imaging", "Suomi-NPP: A New Generation of Environmental Monitoring Satellites", and "GOES-R Geostationary Lightning Mapper". In collaboration with MSC, a course on Water Vapour Interpretation for Forecasters was created.

Courses sponsored by EUMETSAT include the ASMET modules which have been very successful for building capacity with users in Africa. COMET/MetEd has more than 300 000 users around the world.

EUMETSAT commended UCAR/COMET for the great utility of these modules. These are very important in preparing users for the new generation of satellites.

### I.3 Information papers on training matters

In **CGMS-43-EUMETSAT-WP-25** EUMETSAT presented the EUMETSAT benefits from, and contributions to, the CGMS-WMO Virtual Training Laboratory on Satellite Meteorology.

WMO-CGMS VLab is a major conduit to enhance the use of EUMETSAT data and products outside its 31 Member and Cooperating States, including preparedness for the next generation satellites. The natural logic is that:

- The application of the satellite data contributes to the official duty mandates of the National Meteorological and Hydrological Services, i.e. greater protection of life and property;
- User training activities are required in order to fully exploit the investment in the satellite observing system;
- The training is most effectively and efficiently delivered through regional actors, who have the skill, mandate, and logistical capacity.

The principle benefits for EUMETSAT from the VLab work are:

- Working in partnership with Regional Centres of Excellence leads to training that is more relevant and efficient;
- Working with the Centres also provides a structure for channelling user feedback and innovation;
- Knowledge and experience is shared across the partnership;
- Distance learning techniques are effective in reaching out to large audiences.

The Technical Support Officer (TSO) role is crucial, particularly in the online and distance learning elements.

At this time, the principal contributions to the VLab are:

- Sharing knowledge and experiences, particularly in online and distance teaching – which enables greater accessibility to training;
- Active support to the Centres of Excellence in Africa and the Middle East;
- Financial support to the TSO Trust Fund.

EUMETSAT commended VLab on its new strategy, noting the potential challenges in addressing the broadening of scope, requiring the support of the entire VLab network in this effort. EUMETSAT emphasized the Technical Support Officer (TSO) role, funded through a WMO Trust Fund, which is crucial particularly for organizing and maintaining the online and distance learning elements. EUMETSAT encouraged further CGMS operators to contribute to the WMO Trust Fund for supporting the VLab Technical Support Officer.

KMA supported the VLab and the TSO recognizing the importance of training in satellite meteorology. KMA expects that more users and countries can use the VLab since it is very important for supporting NMHSs and to train the next generation of meteorologists.

**CGMS-43-KMA-WP-02**, presented jointly with JMA, provided a progress report on the RA II WIGOS project to develop support for NHMSs in satellite data, products and training. The Project serves as a bridge between the six satellite operators in RA II and users through a coordination group, representing a number of RA II member countries.

The paper outlined the background and mission of the WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training, and detailed recent accomplishments as well as future plans:

- Newsletters to RA II Members: Quarterly newsletters have been issued to share recent satellite-related information on topics such as imagery data, products and training;
- 5$^{th}$ Asia/Oceania Meteorological Satellite Users' Conference and VLab training event: The conference was preceded by a two day training event at CMA training facilities and brought together participants from Region II and V;
- Support activities to prepare satellite data users for the new generation of geostationary meteorological satellites: The RA II WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training will support preparations by NMHSs in RA II, especially in LDCs and other developing nations, for the new satellites;
- 6$^{th}$ Asia/Oceania Meteorological Satellite Users' Conference and training event: JMA will host the sixth AOMSUC in Japan in 9-13 November 2015 (http://www.jma-net.go.jp/msc/en/aomsuc6/). A two-day training event is also planned to coincide with the the meeting. It is suggested to continue such a cooperative training event in conjunction with future AOMSUC sessions;
- The third meeting of the Coordinating Group of the RA II WIGOS Project will be held in 2015 in Japan on the occasion of AOMSUC-6.

## J OUTREACH ACTIVITIES

### J.1 6th Asia/Oceania Meteorological Satellite Users Conference and 3rd meeting of the Coordination Group the RAII WIGOS Project

In **CGMS-43-JMA-WP-10**, JMA announced the 6th Asia/Oceania Meteorological Satellite Users' Conference from 9 to 13 November 2015 in Tokyo, Japan. Satellite users and operators in the Asia and Oceania regions were warmly invited to attend.

In conjunction with AOMSUC-6, JMA plans to hold a two-day training event for representatives from National Meteorological and Hydrological Services (NMHSs) in the Asia and Oceania regions. The 3rd Meeting of the Coordinating Group of the RA II WIGOS Project is also scheduled for the day after AOMSUC-6. The attendance of Coordinating Group members is requested.

The latest information and the initial announcement of the conference are provided on the following web pages:

http://www.jma-net.go.jp/msc/en/aomsuc6/
http://www.jma-net.go.jp/msc/en/aomsuc6/1stannounce.html

## K HLPP

### K.1 Proposed update to the CGMS High-Level Priority Plan for the period 2015-2019

As part of the agreed revision cycle for the CGMS High Level Priority Plan, this document presents a proposed HLPP covering the period 2015-2019. The update is based on the following inter-sessional activities:

- IWWG and IPWG meetings in 2014
- Other revisions identified by WG chairs and co-chairs

WGs I, II, III and IV considered the status of implementation of the HLPP (**CGMS-43-CGMS-WP-29,** Annex 1) and addressed whether priorities within their area of focus can be considered achieved and should be removed from the HLPP.

WGI proposed that the target 1.4.1 on the Direct Broadcast specifications should be considered achieved. New Direct Broadcast Global Specifications (GEO HRIT/LRIT and LEO Direct Readout (HRPT/AHRPT) have been published within 2013 and 2014 by CGMS on its web site. These Direct Broadcast specifications are applicable to existing and planned GEO and LEO systems. In this context it should be noted, that work continues led by WG I to assess the need for an update the GEO global specification in view of newly available and used standards on telecommunications and file formats. To reflect this, the HLPP target 2.6 is proposed to be moved from WG IV to WG I.

WGIII recommended that the HLPP target on the organisation of Space Weather matters in CGMS is considered achieved.

WGII further proposed a number of amendments to the HLPP based on inputs from and discussions with IPWG.

WGs I, II, III, IV confirmed that the proposed revised HLPP represent high level priorities to guide CGMS activities for a four-year period.

CGMS-43 plenary endorsed the overall proposal for an HLPP covering the period 2015-2019.

Following CGMS-43, a final version of the updated HLPP will be published on the CGMS website.

## L REVIEW OF CGMS-43 ACTIONS AND RECOMMENDATIONS

### L.1 Review of summary list actions and recommendations

**CGMS-42 actions and recommendations:**

The final status of all CGMS-42 actions and recommendations (plenary and working groups) following CGMS-43 discussions is available here (http://www.cgms-info.org/documents/CGMS-42_LoAandLoR_final.pdf).

**Plenary actions open following CGMS-43 deliberations:**

| PLENARY action to remain open following CGMS-43 discussions | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| WMO | Plen IV.4 | A40.06 | WMO to coordinate impact studies, through the CBS, in order to update and refine its requirements for GNSS radio-occultation (e.g. number of occultations/day, distribution in space) | EUM plans to launch a study in 2014 with results available for the IROWG meeting in Apr 2015 to which CEOS agencies will be invited. Action deferred to CGMS-43. It also contributes to Action 40.23 "CGMS to convene through the IROWG, an ad-hoc meeting on the global GNSS-RO constellation, inviting all interested CEOS agencies".<br>(see also actions WGII 40.23, WGIII 41.35 and WGIII 41.37)<br>EUM will present at Working Paper on the outcome of its study *CGMS-43 EUM-WP-12*<br><br>Matter discussed at the IPET-OSDE-1, April 2014, and CBS-Ext(2014). CBS recommended conducting Observing System Simulation Experiments (OSSEs) in support of satellite system design criteria such as orbit optimization for GPS-RO satellites, or configurations for hypersperspectral IR sounders on geostationary orbit.<br><br>*Following WGIII discussions, the action will be kept open until CGMS-44. WMO and NOAA to report on their activities at CGMS-44.* | (CGMS-41, -42, -43) **New deadline CGMS-44** | OPEN | HLPP #1.1.4 |

**Plenary actions open following CGMS-43 deliberations:**

| PLENARY action maintained following CGMS-43 discussions | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CEOS/CGMS joint climate WG | Plen H.3.2 | A42.11 | Regarding the Pilot FCDR Inventory:<br><br>• Conduct an initial analysis of available FCDRs past and current available for or planned for use in the current set of SCOPE-CM projects using CEOS, CGMS, and WMO satellite data bases;<br><br>• Identify SCOPE-CM ECV projects that are or may be able to use the above FCDRs;<br><br>• Assess availability of the above FCDRs for the future;<br><br>• Following the first ECV gap analysis, consider FCDRs that may be useful in assessing ECV opportunities in the future ECV gap analysis. | Nov '14: ONGOING. Discussions were held at the Climate Symposium regarding the Pilot FCDR inventory and work has begun on the specific identification of SCOPE-CM ECV projects and use of higher temporal and spatial resolution data from the next generation of geostationary satellites. The project will leverage the ECV assessment reference process being developed by WGClimate. CMA and KMA have been invited to participate in these efforts.<br><br>*Reports were made to CGMS-43 WGII and plenary, and will also be made to CGMS-44.* | CGMS-43, CGMS-44 | **OPEN** | HLPP # 5.1 |

**Plenary actions open following CGMS-43 deliberations:**

| CGMS-43 actions - PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO | D.1 | A43.01 | WMO to report at CGMS-44 on engagement with satellite agencies via the planned "Joint RA-II/V Workshop on WIGOS for Disaster Risk Reduction" to be held in Indonesia in October 2015. | CGMS-44 | OPEN | HLPP # 2.4 |
| CGMS members | D.2 | A43.02 | CGMS members to consider the preliminary considerations on the Vision of WIGOS space-based components in 2040 and provide feedback to WMO through their representative in ET-SAT (or directly to jlafeuille@wmo.int if they are not represented in ET-SAT). Ref. CGMS-43, WMO-WP-02 | 30 Sept 15 | OPEN | HLPP # 1.1 |
| CGMS members | D.3 | A43.03 | CGMS members to provide review comments on the Reference User Readiness Project, noting that the Project will be presented to CGMS-44 for endorsement as CGMS best practice (Ref. CGMS-43, WMO-WP-03) | 30 Sept 2015 | OPEN | HLPP # 5.3 |
| CMA, EUM, NOAA, ROSH | D.3 | A43.04 | CMA, EUM, NOAA, ROSH to appoint/reconfirm points of contact for including LEO satellites in the SATURN (CMA and NOAA provided their pocs at the meeting: tangshihao@nsmc.cma.gov.cn and Mitch.goldberg@noaa.gov) | 15 June 2015 | OPEN | HLPP # 5.3 |
| CGMS space agencies | D.4 | A43.05 | CGMS members to take into account the user requirements identified in the WMO survey when discussing continuous satellite coverage over the Indian Ocean region and report results to CGMS-44. | CGMS-44 | OPEN | HLPP # 1.1.6 |
| WMO | D.4 | A43.06 | WMO to validate and consolidate the preliminary user requirements for satellite data in the Indian Ocean region with major user groups and stakeholders in the region, and to report on results to CGMS-44. | CGMS-44 | OPEN | HLPP # 1.1.6 |
| WMO | D.5 | A43.07 | WMO to provide an update on the international observation requirements for atmospheric composition developed by the GAW Task Team, drawing on existing requirements and considering region-specific needs | CGMS-44 | OPEN | HLPP # 1.1 |
| IOC-UNESCO | D.7 | A43.08 | IOC-UNESCO to provide a paper on guidance to CGMS members on sea ice observations | CGMS-44 | OPEN | HLPP # 1.1 |

**Plenary actions open following CGMS-43 deliberations:**

| CGMS-43 actions - PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| IOC-UNESCO | D.7 | A43.09 | IOC-UNESCO to provide status of the Second International Indian Ocean Expedition (IIOE-2) for enhanced data acquisition and management | CGMS-44 | OPEN | HLPP # 1.1 |
| ROSH | E.1 | A43.10 | ROSHYDROMET to nominate a point of contact for GSICS related matters | CGMS-44 | OPEN | HLPP # 3.1 |
| CMA | F.1.5.3 | A43.11 | CMA to consider providing GNOS data in near real-time on the GTS. | CGMS-44 | OPEN | HLPP # 1.1.4 |
| WGI co-chairs | F.2.2 | A43.12 | WGI Co-chairs, with the support of IOC-UNESCO, ESA and GEO to draft a CGMS letter to ITU, reminding the societal benefits and importance of all MetSats, EESS and Science Satellite Services , and need for enhancing the protection of the corresponding radio frequency bands | 30 Jun 2015 | OPEN | HLPP # 1.3.4 |
| CGMSSEC | F.3.1 | A43.13 | CGMS Secretariat to send a letter to JCOMM requesting that the JCOMM Cross-Cutting Task Team on Satellite Data Requirements reports on the definition of satellite data for the ocean community to CGMS-44 (ref. CGMS-43 WGIV/6.2 discussions) | 30 June 2015, CGMS-44 | OPEN | HLPP # 2.5 |
| CMA, EUM, ISRO, ROSH | F.4.2 | A43.14 | The partners of the IODC roadmap to report on the implementation and progress at CGMS-44 | CGMS-44 | OPEN | HLPP # 1.1.6 |
| SWTT | F.4.4 | A43.15 | The Space Weather Task Team (SWTT) to report on progress at CGMS-44 | CGMS-44 | OPEN | HLPP # 5.2 |
| GSICS | G.2 | A43.16 | GSICS to work with CEOS/WGCV to:<br>– Describe the processes to be followed to ensure consistent<br>calibration meeting climate requirements<br>– Describe the required infrastructure (space-based and<br>surface-based) supporting these processes<br>– Review the analysis of calibration-related tasks in the logical analysis of the Architecture (with a view to provide a joint input to the Architecture for Climate Monitoring from Space) and report to CGMS-44 | CGMS-44 | OPEN | HLPP # 5.1 |

**Plenary actions open following CGMS-43 deliberations:**

| CGMS-43 actions - PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| **Actionee** | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | H.1 | A43.17 | CGMS members are invited to provide feedback to the GEO Strategic Plan 2016-2025: GEOSS Implementation (including 2016 transitional Work Program) after issued the next version in the end of June 2015 to cgmssec@eumetsat.int. Proposals are welcomed, in particular to GEONETCast and Radio Frequency Protection as candidate Foundational Tasks, as well as new activities with regard to the activities on new technology, weather and beyond. | 10 July 2015 | OPEN | - |
| WMO, CGMSSEC | I.1 | A43.18 | WMO and CGMSSEC to write a letter to all satellite operators in VLab (once receiving the revised expectations documents in August 2015) to:<br><br>- Recall the urgency for more training giving increasing service reliance on satellites, and the upcoming generation of new satellite technology,<br>- Recall expectations from operators,<br>- Mention results of a VLab internal evaluation indicating that some expectations are better met than others and that there are urgent needs for ramping up support,<br>- Suggesting that effective technical focal point be nominated / confirmed that will help CoEs address issues,<br>- Recall the need for sustained financial support to the VLab Trust Fund. | 15 Sept 2015 | OPEN | HLPP # 4.2.3 |
| CGMS members | I.1 | A43.19 | CGMS members to respond to the WMO/CGMSSEC letter on VLab (reference CGMS-43 action I.1, A43.18) | 15 Dec 2015 | OPEN | HLPP # 4.2.3 |

**Plenary recommendations open following CGMS-43 deliberations:**

| CGMS-43 recommendations – PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS (space agencies) | F.1.5.1 | R43.01 | IROWG requests that both, equatorial and polar components of COSMIC-2 are fully funded and launched; this is required for Numerical Weather Prediction, Climate, and Space Weather | Long-term | OPEN | HLPP # 1.1.4 |
| CGMS members (space agencies) | F.1.5.1 | R43.02 | IROWG recommends targeting at least 20,000 occultations/day to be made available to the operational and research communities of Numerical Weather Prediction, Climate, and Space Weather | Long-term | OPEN | HLPP # 1.1.4 |
| CGMS members (space agencies) | F.1.5.1 | R43.03 | IROWG recommends that the RO receiver design includes sufficient software/firmware flexibility to allow changes in the signal processing including processing of new GNSS signals/constellations as they become available; all receiver measurements should cover the ionosphere as well | Long-term | OPEN | HLPP # 1.1.4 |
| CGMS members (space agencies) | F.1.5.1 | R43.04 | International space/research agencies (e.g. NASA, ESA, CMA, CSA, NSF, NOAA, EUMETSAT and others) to hold an interagency workshop to define cooperation options for implementing the next steps towards a LEO-LEO research and demonstration mission | Long-term | OPEN | HLPP # 1.1.4 |
| CGMS members | F.3.5 | R43.05 | CGMS members to<br>- comment on the WMO medium-term strategy for satellite data dissemination<br>- support the implementation of the strategy in contributing to the identified strategic targets and actions, as appropriate, and in taking the proposed strategic targets into account in their own dissemination plans | CGMS-44 | OPEN | HLPP # 2 |
| CGMSSEC | G.5 | R43.06 | CGMS Secretariat to express the common position of CGMS members on the WMO draft resolution on data and products (CGMS-43 plen R43.03) at the WMO Cg-17 (25 May – 12 June 2015) | 27 May 2015 | OPEN | HLPP # 5.1 |

**Plenary recommendations open following CGMS-43 deliberations:**

| CGMS-43 recommendations – PLENARY | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | I.1 | R43.07 | CGMS members that are sponsors of VLab Centres of Excellence to review and where possible augment their support to these Centres, as per the "Procedure for establishing Virtual Laboratory Centres of Excellence for Training in Satellite Meteorology" (section 2.2, http://www.wmo-sat.info/vlab/wp-content/uploads/2012/02/Procedures-for-New-CoEs_LV2012.pdf) | CGMS-44 | OPEN | HLPP # 4.2.3 |

The actions and recommendations resulting from the working groups I to IV and the ad hoc space weather group deliberations are provided in the relevant section/report of each working group.

(The status of CGMS-43 actions and recommendations will be maintained on the CGMS website under MEETINGS and CGMS-43).

## M CLOSING SESSION

### M.1 CGMS nominations and representatives at meetings

In **CGMS-43-CGMS-WP-31** the CGMS secretariat proposed nominations for chairs and rapporteurs for CGMS working groups as well as CGMS representatives for different international meetings. The proposals were discussed and agreed as follows:

**CGMS Working Groups – WGI, WGII, WGIII and WGIV**

- Working Group I: Global issues on satellite systems and telecommunication coordination
  Co-chairs: Vanessa Griffin, NOAA/Sergey Uspensky, SRC-PLANETA-ROSHYDROMET
  Rapporteur: Joaquin Gonzalez, EUMETSAT

- Working Group II: Satellite data and products
  Co-chairs: Stephan Bojinski, WMO/Toshiyuki Kurino, JMA
  Rapporteurs: Mitch Goldberg, NOAA/Kenneth Holmlund, EUMETSAT

- Working Group III: Operational continuity and contingency planning
  Co-chairs: Suzanne Hilding, NOAA/Peng Zhang, CMA
  Rapporteur: Lars Peter Riishojgaard, WMO

- Working Group IV: Global data dissemination
  Co-chairs: Vasily Asmus, SRC PLANETA-ROSHYDROMET/Jae-Dong Jang, KMA
  Rapporteur: Klaus-Peter Renner, EUMETSAT

- CGMS Space Weather Task Team
  Chair: Suzanne Hilding, NOAA
  Rapporteur: Elsayed Talaat, NASA

**CGMS International Science Working Groups (ISWGs)**

- ICWG – International Cloud Working Group
  Co-chairs: Rob Roebling, EUMETSAT/Bryan Baum, SSEC, Wisconsin
  Rapporteur: Dong Wu, NASA

- IPWG – International Precipitation Working Group
  Co-chairs: Remy Roca, OMP/LEGOS/Tufa Dinku, IRI
  Rapporteur: Ralph Ferraro, NOAA

- IROWG – International Radio Occultation Working Group
  Current co-chairs; David Ector, UCAR/vacant
  Rapporteur: Anthony Manucci, NOAA

- ITWG – International TOVS Working Group
  Co-chairs: Mitch Goldberg, NOAA/Niels Bormann, ECMWF
  Rapporteur: Mitch Goldberg, NOAA
- IWWG – International Winds Working Group
  Co-chairs: Jaime Daniels, NOAA/Mary Forsythe/Met Office UK
  Rapporteur: Kenneth Holmlund, EUMETSAT

- From mid 2016 (following IWWS13):
  Incoming Co-chairs: Regis Borde, EUMETSAT/Steven Wanzong (University of Wisconsin/CIMSS)

**Other Working Groups**

CGMS plenary confirmed the following Groups:

- CEOS/CGMS Joint Working Group on Climate
  Current Chair: John Bates, NOAA
  Current Vice-chair: Pascal Lecomte, ESA
  From November 2015:
  Incoming Chair: Pascal Lecomte, ESA
  Incoming Vice-chair: Joerg Schulz, EUMETSAT
  (to be reconfirmed by CEOS plenary in November 2015).

- CGMS SFCG interface
  CGMS Secretariat (through Markus Dreis, EUMETSAT)
  (Reference is also made to CGMS-39 and WGI action 39.22 and the corresponding report).

- CGMS Representative at SATCOM Forum
  Sean Burns (EUMETSAT)

**Other international meetings**

| Meeting | CGMS Representative |
|---|---|
| WMO Executive Council, Congress | CGMS Secretariat (EUMETSAT) |
| WMO Commission for Basic Systems | CGMS Secretariat (EUMETSAT) |
| Inter-Commission Coordination Group on WIGOS (ICG-WIGOS) | Suzanne Hilding, NOAA |
| CEOS | CGMS Secretariat (EUMETSAT) |
| GEO | CGMS Secretariat (EUMETSAT) |

### M.2 Any other business

There was no other business discussed.

### M.3 Closing

#### M.3.1 Schedule of future CGMS plenary sessions

CGMS-44 is being hosted by EUMETSAT and will be held on 13-17 June 2016 in Reading, United Kingdom. The venue selected is conveniently located close to London's Heathrow Airport allowing for easy travel connections. Meeting venue and recommended hotel(s) are on the same site.

The *tentative* plan for CGMS plenary sessions in the 2017-2026 period is:

| CGMS plenary # | Year | Location |
|---|---|---|
| CGMS-45 | 2017 | South Korea (confirmed) |
| CGMS-46 | 2018 | India |
| CGMS-47 | 2019 | Russian Federation |
| CGMS-48 | 2020 | WMO |
| CGMS-49 | 2021 | Japan |
| CGMS-50 | 2022 | China |
| CGMS-51 | 2023 | North America |
| CGMS-52 | 2024 | Europe |
| CGMS-53 | 2025 | South Korea |
| CGMS-54 | 2026 | India |

#### M.3.2 Handover of CGMS flag

NOAA handed over the CGMS flag to EUMETSAT who will host the 44th CGMS plenary session.

### M.3.3 Closing words

Concluding the meeting, Dr Steven Volz, NOAA, declared that CGMS-43 had been a successful and fruitful meeting. As a newcomer to the community, he thanked the representatives of all members and observers for their dedication, which ensured that the meeting had been a success.

Over the two days of the plenary, all agenda items had been handled with encouraging results, and the discussions on the proposal and updates of the High Level Priority Plan (HLPP) will guide CGMS on the way forward over the next five years.

The Chairman thanked all those who contributed to organising the meeting so successfully with their outstanding work before and during the meeting, namely the Working Group Chairs and rapporteurs, the CGMS Secretariat, and the local organising committee.

Finally, he hoped to see everyone at the 44th CGMS plenary session in Reading, UK, in 2016.

The 43rd plenary session of CGMS was closed at 16:00 on Friday 22 May 2015.

# PARALLEL WORKING GROUP SESSIONS

## WG I REPORT

### I/0 Introduction

During the plenary session of CGMS-42, Dr. Lars Peter Riishojgaard, Mr Marlin O. Perkins (NOAA) and Mr. Joaquin Gonzalez (EUMETSAT) were appointed as Co-Chairs) and Rapporteur of Working Group I, respectively. Due to the fact that Mr. Perkins could not attend CGMS 43, WGI followed the advice of the Secretariat and appointed Mrs. Vanessa Griffin (NOAA) as co-chair of WGI.

WG I included representatives of the satellite operators from CMA, CNSA, EUMETSAT, ISRO, JMA, KARI, KMA, NOAA, ROSCOSMOS, ROSHYDROMET (absent this time) and WMO (see Annex III for full list of participants).

WGI reviewed and adopted the draft agenda proposed by the CGMS Secretariat.

### I/1 Review of actions from the Previous Meeting

Actions from previous meetings were discussed at the beginning of the working group meeting, and their status is summarized below.

Actions and Recommendations from previous CGMS WGI meetings:

| WGI status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS members | WGI/3.1 | A42.17 | CGMS members to nominate representatives in the Task Team to work on RARS related aspects (before 1st IS meeting (WGI.IS-2.1 mid October 2013) | To be discussed between EUM and NOAA during the CGMSSEC#2 on 12 Feb 2014.<br><br>CGMS-42: WGI/5: The list of representatives for the RARS Task Team (as agreed in CGMS-41) is incomplete:<br>CMA: LIU Jian liujian@cma.gov.cn<br>EUM: anders.soerensen@eumetsat.int, joaquin.gonzalez@eumetsat.int<br>JMA: Hidehiko Murata, satellite@ml.kishou.go.jp<br>NASA: jack.kaye@nasa.gov<br>NOAA: Vanessa.Griffin@noaa.gov<br>CGMS-42-ROSH-WP-01: Sergey Uspensky (uspenskys@planet.iitp.ru)<br>CGMS-42-WMO-WP-19<br><br>13 May 2015: NOAA nominates AK Sharma, Awdhesh.sharma@noaa.gov, Mitch Goldberg, mitch.goldberg@noaa.gov, Liam Gumley, Liam.Gumley@ssec.wisc.edu | (31 Aug 2013), **New deadline 15 Jun 2014** | **CLOSED** | HLPP# 1.4.5 |
| CGMS members | WGI/2 | A42.01 | CGMS members to provide feedback to WMO (David Thomas, Dthomas@wmo.int) on the preliminary WMO position on frequency protection for WRC-2015. | Discussed in plenary, draft letter endorsed by CGMS-42. (CGMSSEC sent the letter to WMO following CGMS-42). | 30 Jun 2014 | **CLOSED** | HLPP# 1.3.3 |

| WGI status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| EUM | WGI/2 | A42.02 | CGMS Liaison officer to SFCG to report to CGMS WGI on the discussions and disposition of SFCG on all topics of interest to the different CGMS members. For achieving that a dedicated CGMS Secretariat WGI working paper will be prepared by EUMETSAT Frequency Manager (in the role of liaison officer from CGMS to SFCG) and will be released to the participants of WGI before end of Q1 of the corresponding year. Based on the contents, CGMS members will decide the level of information they will include in their specific reports to CGMS for the corresponding WGI meeting. | CGMS-43-EUM-WP-03 | 30 Mar 2015 | **CLOSED** | HLPP# 1.3 |
| CGMS members | WGI/ 3.2.1 | A42.03 | CGMS members to regularly report to WGI their plans on the user preparation for their future systems (in areas aspects relevant to the WGI). | NOAA will address this verbally in WGI | CGMS-43 | **CLOSED** | HLPP# 1.4.2 |
| CGMS members | WGI/ 3.2.1 | A42.04 | CGMS members to gather responses from manufacturers of receiving stations about experiences and lessons learnt for both LEO and GEO systems. Due date: September 2014 and provided answers to be assessed in dedicated Inter-Sessional meeting in November 2014 | Discussed at WGI webex #1 (20 Jan 2015)<br><br>NOAA response pending, per further discussions in WGI.<br><br>Discussed at CGMS-43 and closed as a consequence. | 15 Sep 2014,<br><br>15 Nov 2014 | **CLOSED** | HLPP# 1.4.3 |

| WGI status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS members | WGI/ 3.2.1 | A42.05 | CGMS members to nominate focal points to support, via inter-sessional meetings, the analysis of the LRIT/HRIT Global Specification for its usefulness for next generation GEO satellite data dissemination, and propose an update taking into account the availability of new file format standards and dissemination means. Initial coordination to be done by EUMETSAT (as book captain of the document). | EUM: Simon.elliott@eumetsat.int<br>CGMS-43 EUM-WP-05<br>JMA: Akiyoshi Andou, satellite@ml.kishou.go.jp<br>CGMS-43-JMA-WP-08 (Section 2)<br>NOAA: Paul.seymour@noaa.gov<br>ROSH: Mr. Yuri Chetyrin, leading programmer, SRC "PLANETA", Far Eastern Center<br>E-mail: niokr@dvrcpod.ru<br>Action agreed to be closed by WGI at CGMS-43. A new action will be opened to use the identified team to work on the future updates of the HRIT Global spec | 30 Jun 2014 | **CLOSED** | HLPP# 2. |
| EUM | WGI/4 | A42.06 | EUMETSAT to provide template to report DCP system characteristics by the different DCP operators of CGMS | Circulated by EUMETSAT Jan/Feb 2015 | 30 Jun 2014 | **CLOSED** | HLPP# 1.2 |
| CGMS members | WGI/4 | A42.07 | CGMS DCP operators to provide DCP system characteristics (in the template form provided by EUMETSAT in action WGI/4 A42.06) in support of the preparation activities for the Satcom Forum in 2015. | CGMS-43 EUM-WP-06<br>NOAA has provided input to EUMETSAT.<br><br>Closed following WGI discussions at CGMS-43. | 30 Sep 2014 | **CLOSED** | HLPP# 1.2.1 |
| WGI and WGIV | Plen E.1.3 (wrt WGI and WGIV) | Plen A42.07 | Following the revised scope of WGI and WGIV, the WGs to update the Terms of Reference of both WGs for endorsement by CGMS | Note: This is a plenary action that needs to be treated in WGs I and IV.<br>Not started yet (status Jan 2015).EUM/KPR book captain.<br>CGMS-43 EUM-WP-02 (WGIV paper)<br>NOAA will provide feedback in WGI and WGIV<br>Closed following WGI discussions - for plenary to approve. | CGMS-43 | **CLOSED** | - |

| WGI status of recommendations on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS space agencies | WGI/2 | R42.01 | CGMS satellite operators are invited to communicate and take into account the WMO position on frequency protection when addressing WRC-2015 preparation at the national level. | Communication with national representatives implemented, on regular basis, at the level of the different CGMS members (e.g. NOAA, EUMETSAT,..) | (CGMS-43) | **CLOSED** | HLPP# 1.3.3 |
| CGMS members | WGI/2 | R42.02 | CGMS WGI, understanding the complexity of the issues to be covered in the area of frequency management and coordination (including interference assessments) for the existing and future space systems under the responsibility of the different CGMS members, and also recognising the efforts, already in place by most of the CGMS members, to concentrate these discussion in the frame of SFCG, recommends CGMS members to continue bringing all frequency management and coordination issues under the expert forum of SFCG and actions the liaison officer (from CGMS to SFCG) to report to CGMS WGI all aspects of SFCG discussions considered of relevance to CGMS. | EUM/CGMSSEC: markus.dreis@eumetsat.int acts as liaison officer | (CGMS-43) | **CLOSED** | HLPP# 1.3 |

| WGI status of recommendations on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS space agencies (with LEO space-craft) | WGI/5 | R42.03 | All agencies operating polar orbiting satellites to provide, whenever relevant for operational meteorology, a package based on the core software from the global processing for use in local and regional product processing, in particular level-1 processing | CMA has stated that they will do this, NOAA has IPOPP from NASA and CSPP (Nesdis) both available online. EUM has AAPP. For future systems is TBD<br><br>ROSH Apr 2015: Processing package for MTVZA-GY/Meteor-M N2 instrument data is being developing. Release date TBD | (CGMS-43) | **CLOSED** | HLPP# 1.4.4 |
| CGMS members | WGI/5 | R42.04 | Each agency providing product processing packages to implement a user support function supporting the software release process, the software installation and anomaly resolution | User support is online for NOAA [URL?]<br>JPSS software: http://cimss.ssec.wisc.edu/cspp/. GOES and GOES-R software: http://cimss.ssec.wisc.edu/csppgeo/software.html. Additional support at www.ospo.noaa.gov<br><br>TBD for EUMETSAT (USC?) and CMA? | (CGMS-43) | **CLOSED** | HLPP# 1.4.4 |
| CGMS members | WGI/5 | R42.05 | CGMS to consider further actions to evaluate and document commonalities and best practices in organisation and architecture of Regional Services. | See WGI IS-01 meeting, Dec '14. To cover global specification and RARS. (Global specs<br>Rational for Polarisation aspects for Direct Broadcast (e.g. FY-3C) Standardisation of User Terminals (HRPT), for example in terms of G/T. HRIT/LRIT Global specs for the instruments on board GOES-R and MTG.<br>RARS: Status of progress of Regional RARS implementation (or plans for it) Definition of regions. Models for securing HRPT (L/X Band) "infrastructure" in a region Ideas for data gathering within regions and for inter-regions data transfer | (CGMS-43) | **CLOSED** | HLPP# 1.4.5 |

| WGI status of recommendations on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS members | WGI/5 | R42.06 | Agencies to provide a complete and comprehensive Space to Ground Interface Control Document for each satellite family, defining the radio frequency encoding and data layout of the direct broadcast downlink | NOAA: http://noaasis.noaa.gov/NOAASIS/pubs/HRD-LRD_Transition.pdf<br><br>EUM: Metop on EUMETSAT web page [URL?] | (CGMS-43) | **CLOSED** | HLPP# 1.4.2 |
| CGMS members | WGI/5 | R42.07 | CGMS to promote standardisation of the data interface between the direct broadcast reception station and the product processing software | | (CGMS-43) | **CLOSED** | HLPP# 1.4.5 |
| CGMS members | WGI/5 | R42.08 | CGMS to promote standardisation of the pass scheduling interface between the Regional Service and the direct broadcast reception station. | | (CGMS-43) | **CLOSED** | HLPP# 1.4.5 |
| CGMS space agencies (with LEO space-craft) | WGI/5 | R42.09 | All agencies operating polar orbiting satellites to provide product processing auxiliary data via the Internet | Refer to CCSDS 902.1 (http://public.ccsds.org/sites/cwe/rids/Lists/CCSDS%209021R1/CCSDSAgency.aspx) | (CGMS-43) | **CLOSED** | HLPP# 1.4.5 |
| CGMS members | WGI/5 | R42.10 | CGMS to consider further actions on standardising the interregional interfaces for exchange of products, pass scheduling, monitoring and other information. | Closed following CGMS-43 discussions | (CGMS-43 | **CLOSED** | HLPP# 1.4.5 |

| WGI status of recommendations on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS space agencies | WGI/5 | R42.11 | CGMS Satellite operators to support the definition and implementation of community agreed operational procedures for LEO satellite data direct read-out, acquisition, and relay in the context of the DRARS Implementation Group. | | (CGMS-43) | **CLOSED** | HLPP# 1.4.5 |

Note that recommendations are closed at the relevant plenary session irrespective of whether they have been fulfilled or not. New (and sometimes the same) recommendations are then raised as necessary.

## I/2 Revised Terms of Reference of WGI

**EUMETSAT-WP-02** provided, in response to CGMS-42 action 42.07 (raised at plenary), revised draft Terms of Reference for WGI (as follows):

### 1.1 Scope of WGI

CGMS WGI will provide a regular forum for CGMS agencies to address topics of interest in areas related to global coordination of satellite systems and telecommunication. The working group will address these issues for existing operational systems and also for future ones and will aim at supporting CGMS in preparing for the future generation of meteorological satellite systems and to contribute on the consolidation and updates of interoperability and standardisation that the evolution of technology imposes.

### 1.2 Objectives

WGI will have the following objectives:

1) Provide a technical forum for CGMS agencies to address global issues and technical aspects of their satellite systems;

2) Address areas of mutual interest and advice agencies on topics related to frequency coordination and management;

3) Act as CGMS point of contact, at expert level, between CGMS and other groups and organisations in areas of frequency management (e.g. SFCG, ITU and preparation status and topics for WRCs);

4) Address technical and operational aspects of direct broadcast services (present and future) of mutual or global interest for the CGMS agencies;

5) Promote standards and interoperability and operational procedures to the CGMS agencies for the benefit of the user community of their direct broadcast services and the associated regional retransmission services;

6) Address technical and operational aspects of the Data Collection Systems at international level;

7) Promote standards and interoperability and operational procedures to the CGMS agencies for the benefit of the user community of the DCS Regional (and international) systems;

8) Optimisation/harmonisation and update of CGMS global specifications.

9) Address topics from the CGMS High Level Priority Plan within the scope of WGI.

| LIST OF CGMS AGENCIES REPRESENTATIVES IN WORKING GROUP I | | | | |
|---|---|---|---|---|
| Organisation (CGMS members) | Firs name | Last name | Role | Email |
| CMA | Luo | Dongfeng | | luodf@cma.gov.cn |
| CNES | Jean | Pla | | Jean.pla@cnes.fr |
| CNSA | Jun | Gao | | gaojun8858@sina.com |
| ESA | Ivan | Petiteville | | Ivan.Petiteville@esa.int |
| EUMETSAT | Joaquin | Gonzalez Picazo | Rapporteur | joaquin.gonzalez@eumetsat.int |
| IMD | n/a* | | | |
| IOC/UNESCO | n/a* | | | |
| ISRO | n/a* | | | |
| JAXA | Fujimoto | Nobuyoshi | | fujimoto.nobuyoshi@jaxa.jp |
| JMA | Yasushi | Izumikawa | | satellite@ml.kishou.go.jp |
| KMA | Hye-Sook | Lee | | hslee05@kma.go.kr |
| NASA | Betsy | Edwards | | betsy.edwards@nasa.gov |
| NOAA | Vanessa | Griffin | Co-Chair | vanessa.l.griffin@noaa.gov |
| ROSCOSMOS | n/a* | | | |
| ROSHYDROMET | Sergey | Uspensky | Co-Chair | uspenskys@planet.iitp.ru |
| WMO | Jerome | Lafeuille | | jlafeuille@wmo.int |

**CGMS members to confirm their key point of contact for WGI activities.*

The document identifies the scope and objectives of the working group and identifies the list of representatives (to be appointed by the different CGMS agencies). During the presentation of the working paper it was suggested that the proposed Terms of Reference (ToR), once approved by CGMS, would be included on the CGMS web page dedicated to WGI, and that the list of (permanent) representatives to the Group would be maintained by CGMS Secretariat, based on the updates to be provided by the respective agencies.

WGI reacted positively to the proposed ToR and thanked the CGMS Secretariat for the draft proposal. The draft was endorsed with a minor modification of objective 3), as follows:

3) Act as CGMS point of contact, at expert level, between CGMS and other groups and organisations in areas of frequency management (e.g. SFCG, ITU, ITU regional groups, and preparation status and topics for WRCs);

### I/3 Frequency management matters: SFCG, ITU and WRC activities

**EUMETSAT-WP-03** on frequency management topics provides a report from the CGMS/SFCG Liaison Officer on the discussions and dispositions of SFCG from its 34th meeting (3 – 11 June 2014) on all frequency management issues of mutual interest and concern, in order to support CGMS members in their decision on what level of information they will include in their specific reports to CGMS for the corresponding WGI meeting.

SFCG at its 34th meeting noted the issues reported by CGMS in SF34-62/I and took the information into account in its considerations on related subjects. Furthermore, SFCG agreed to the CGMS

approach for mutual reporting and entitled the CGMS Liaison Officer to report back to CGMS-43 on issues discussed at SFCG-34 that could be of interest to CGMS, namely:

- The updated SFCG Recommendation 11-1R4 on the use MetSat in the band 1670 – 1710 MHz,
- The updated SFCG Resolution 19-7R4 on the use MetSat in the band 7750 – 7900 MHz,
- SFCG objectives for WRC-15 agenda items of mutual interest.

In particular, SFCG noted with appreciation that the position and objectives of CGMS and SFCG members on WRC-15 issues of mutual interest are in-line and supports the letter from CGMS to WMO highlighting the importance of the various types of instruments using the band 5350 - 5470 MHz and the need to preserve this very important spectrum against potential interference from RLAN.

**MetSat use at 1695 – 1710 MHz**

At SFCG-34, NOAA provided an updated status (June 2014) of the situation in the United States regarding the repurposing of the band 1695 – 1710 MHz.

Legislation in the United States has authorized an auction intended for spectrum sharing in the band 1695 – 1710 MHz between U.S. Federal stations in the Meteorological Satellite Service (S-E) with mobile users for broadband wireless communications. According to this, the auctioning of the band 1695 – 1710 MHz was scheduled for November 2014 with expected implementation of all necessary mitigation measures, i.e. coordination zones, coordination portal, monitoring capability, GOES-R frequency shift down by 3.5 MHz and relocation of radiosondes within 3 years from the time when winner is certified.

For the protection of the most important sites at which MetSat Earth stations of federal users are located in the US, 27 coordination zones were identified with typical coordination zone sizes of 40 km for POES, respectively 10 km for GOES reception. Earth stations of non-federal users located outside of these zones will not be protected. In order to ensure that broadband mobile users will respect those coordination zones the mobile base stations will authorize the user terminals to operate in the band 1695 – 1710 MHz.

Furthermore, the status of the situation with regard to the company LightSquared requesting to combine 5 MHz of spectrum between 1670 - 1675 MHz, which they already occupy, with the adjacent 1675 - 1680 MHz band was reported. Studies to determine if LightSquared could operate without harmful interference to GOES and GOES-R operations in the band 1675 - 1695 MHz band are completed, but were still under review and therefore not publically available at the time of the SFCG-34 meeting. The studies with regard to radiosondes conclude that moving of their use from the band 1675 – 1680 MHz to 400.15 – 406 MHz is feasible.

In view of this situation in the United States for sharing of the band 1695 – 1710 MHz and changes in the use of the 1670-1710 band for various Meteorological Satellite Services, such as expanded data

dissemination by GOES and the use of the emergency weather information distribution systems, illustrates the need to review Recommendation SFCG 11-1R3 which was last reviewed in 2005.

The updated **Recommendation SFCG 11-1R4** takes into account the evolutions since this last revision in 2005 of the MetSat services in the different sub-bands in the range 1670 – 1710 MHz. The most significant change to this recommendation is the addition of "recommends 4" which elaborates on the situation and conditions when a MetSat operator intends to extend the use of non-geostationary MetSat systems below 1698 MHz. Recommend 4 stipulates "*that when extending the operation of future non-geostationary satellites from 1698 – 1710 MHz into 1695 – 1710 MHz, protection of the reception of transmissions from geostationary meteorological satellite systems operating below 1698 MHz should be facilitated through inter-operator coordination, as appropriate."*

**MetSat use at 7750 – 7900 MHz**

In order to ensure the continued efficient use of the recently enlarged band from 7750 – 7850 MHz to 7750 – 7900 MHz at WRC-12, it was considered necessary to review SFCG Resolution 19-7R3 with the view to assist in the most optimum use of this meteorological satellite service band 7750 – 7900 MHz, providing a guideline to the MetSat operators, which are currently in the phase of planning and developing next generation polar-orbiting systems using this band.

The updated **SFCG Resolution 19-7R4** now takes into account the extension of the MetSat allocation from 7750 – 7850 MHz to 7750 – 7900 MHz, but does not contain any significant changes to this Resolution on the way and conditions as to how MetSat systems shall utilize this spectrum.

**SFCG objectives for WRC-15 (Resolution SFCG 32-1R2)**

SFCG defines its objective in the framework of an SFCG Resolution which is updated at every SFCG meeting until WRC-15. In the following sections only those SFCG objectives for WRC-15 agenda items are highlighted and discussed that are of mutual interest to SFCG and CGMS.

**WRC-15 Agenda Item 1.1**

This agenda item deals with consideration of additional spectrum allocations to the mobile service and identification of additional frequency bands for International Mobile Telecommunications (IMT) and to facilitate the development of terrestrial mobile broadband applications, likely to concentrate on bands below 6 GHz.

The frequency bands of mutual concern are:

- the 1695 – 1710 MHz band used for meteorological satellite applications;
- the bands 2025 – 2110 MHz and 2200 – 2290 MHz used for earth exploration satellite and space operation (TM/TC and ranging) services;
- the band 3400 - 4200 MHz used for Galileo Data Distribution Network and the dissemination of meteorological data by systems like EUMETCast, CMACast and GEONETCast;

- the active remote sensing band 5350-5470 MHz used for SARs, scatterometers and altimeters.

**1695 – 1710 MHz**

The 1695 – 1710 MHz band is used by all meteorological-satellite systems with Earth stations operated by almost all National Meteorological and Hydrological Services (NMHS) and many other users. This band is essential for providing operational and time-critical meteorological information to the users around the world. For this reason SFCG is opposed to an allocation/identification of the frequency band 1695 – 1710 MHz for terrestrial mobile broadband applications including IMT except if such allocation/identification ensures the protection of MetSat Earth station operations in that band.

So far there are no indications from any of the six ITU regional groups or individual countries to propose this band for the introduction of mobile broadband, except potentially the US (to be confirmed).

**2025 – 2110 MHz and 2200 – 2290 MHz**

Although these bands no longer seem to play a major role in the global identification of additional spectrum for broadband mobile systems (thanks to the negative results of the sharing studies in the framework of the responsible fora within the ITU-R WRC-15 preparatory process namely JTG 4-5-6-7), there are still some proponents for these bands (or parts of) in the mobile industry and by some individual countries.

SFCG objects to any IMT identification in these bands under agenda item 1.1 and opposes any revisiting of the conditions set in RR No. 5.391 pertaining to the bands 2025 – 2110 MHz and 2200 – 2290 MHz used for space research, earth exploration-satellite and space operation services.

**3400 - 4200 MHz**

This frequency range is one of the prime targets of the mobile industry to cover their broadband spectrum requirements. Some parties even go as far as to propose the entire C-Band (3400 – 4200 MHz) for a mobile broadband identification. However, there is also very strong opposition by all commercial satellite operators and a number of countries around the world against identifying further spectrum in this frequency range.

Note: Already at WRC-12 the band 3400-3600 MHz was allocated to the mobile service and identified for International Mobile Telecommunications (IMT) in a number of countries by footnotes RR No. 5.430A, 5.431A, 5.432A, 5.432B and 5.433A to the Radio Regulations. Thus, an identification of the entire C-Band for mobile broadband systems is very unlikely, given the strong opposition from various sides. However, given the strong pressure on administrations, a possible scenario could be that parts of the band 3400 – 4200 MHz (to a maximum 3400 – 3800 MHz) would be globally (or at least regionally) identified for mobile broadband systems implementation. Thus, the remaining spectrum available for FSS systems could continue to be used for the dissemination of meteorological data.

**5350 – 5470 MHz**

Under this agenda item also the extension of the current RLAN (WiFi) spectrum (5150 - 5350 MHz and 5470 - 5725 MHz) by also allocating the gap in between (5350 - 5470 MHz) for RLANs is under discussion.

Such additional allocation of the band 5350 - 5470 MHz would affect most severely SARs such as CSAR on Sentinel-1 or RadarSat. Less sensitive to RLAN interference, but also affected in the long term by such an RLAN introduction in the band 5350 – 5470 MHz, could be scatterometers and altimeters. Thus, SFCG opposes an allocation to the Mobile Service in this band for use by terrestrial mobile broadband applications.

All studies performed in ITU-R JTG 4-5-6-7 agreed that, with the current RLAN parameters, compatibility cannot be achieved, even if the RLAN systems are limited to indoor use only. Thus, additional mitigation techniques to the ones identified so far would be required to achieve compatibility. The same situation applies to the compatibility with terrestrial and aeronautical radars operating in the band 5350 – 5470 MHz. So far the RLAN industry has failed to identify such mitigation techniques which could ensure compatibility. As a result the ITU regional groups CITEL (Americas) and CEPT (Europe) will not propose the implementation of RLANs in the band 5350 – 5470 MHz at WRC-15, but this issue will continue to be studied and could result in an agenda item for WRC-19.

**WRC-15 Agenda Item 1.6**

This agenda item deals under 1.6.1 with consideration of possible additional primary allocations to the fixed-satellite service (Earth-to-space and space-to-Earth) of 250 MHz in the range between 10 GHz and 17 GHz in Region 1.

Agenda item 1.6.2 deals with consideration of possible additional primary allocations to the fixed-satellite service (Earth-to-space) of 250 MHz in Region 2 and 300 MHz in Region 3 within the range 13-17 GHz.

One of the targeted frequency bands for a possible allocation of FSS (Earth-to-space) is 13.25 – 13.75 GHz, which raises particular concerns with regard to the allocation of this band to EESS (active). This band is used for active remote sensing (altimeters and scatterometers) by missions such as Cryosat, Jason-2, -3, Jason-CS (Sentinel-6), Sentinel-3, and HY-2.

Thus, SFCG supports the protection of existing space science service allocations. No additional allocation of spectrum to support FSS (Earth-to-space and space-to-Earth) should be made in space science service bands unless acceptable sharing conditions are agreed. There is particular concern with the possible allocation of FSS (Earth-to-space) in the 13.25-13.75 GHz band allocated to EESS (active). This band is used for active remote sensing (altimeters and scatterometers) by missions such as Cryosat, Jason-2, -3, Jason-CS, Sentinel-3, and HY-2. ITU-R studies concluded that sharing between EESS (active) and FSS (Earth-to-space) is not feasible. Therefore, SFCG supports no new allocation to FSS (Earth-to-space) in the band 13.25-13.75 GHz.

Sharing studies between EESS (active) and FSS (space-to-Earth) performed so far are showing compatibility between both services.

As the need for additional primary allocations of 250 MHz to the GSO FSS in frequency bands between 10 and 17 GHz is recognized and supported and the corresponding ITU-R studies show compatibility with the EESS (active), there might be a need to accept an allocation to the FSS (space-to-Earth) the band 13.4 – 13.65 GHz subject to the implementation of relevant mitigation techniques (e.g. PFD mask, limitation of transmit antenna size, etc.).

**WRC-15 Agenda Item 1.9.2**

This Agenda Item deals with the possibility of allocating the bands 7375 - 7750 MHz and 8025 - 8400 MHz to the maritime-mobile satellite service (MMSS) and additional regulatory measures, depending on the results of appropriate studies.

The potentially-affected space science service bands under this agenda item are 7450 - 7550 MHz MetSat (space-to-Earth, GSO) and 8025 - 8400 MHz EESS (space-to-Earth). Thus, according to the SFCG position, no new allocations to the MMSS should be made in these frequency bands unless acceptable sharing criteria with the science services are developed.

Of particular concern is the potential interference to EESS (space-to-Earth) operations in the band 8025 - 8400 MHz at high latitudes from ships operating in closer proximity. Large exclusion zones may be needed to avoid interference to EESS earth stations. Many EESS earth stations are located near coastal areas (e.g., Svalbard, McMurdo, Maspalomas, Lannion, Wallops) and could be seriously affected by emissions from vessels navigating in the area.

All compatibility analyses on the two different sharing aspects (MMSS vs. EESS and MMSS vs. the space research service (SRS)) came to similar conclusions regarding the sharing difficulties with EESS and the required separation distances to protect the SRS Earth stations.

Furthermore, the issue of the large number of exclusion zones and the regulatory mechanisms for implementing and keeping up-to-date the necessary exclusions zones makes such an allocation to the MMSS impracticable.

Consequently, CEPT, as the initial proponent of this agenda item, does not support an allocation to the MMSS in the band 8025 - 8400 MHz.

**WRC-15 Agenda Item 1.10**

This agenda item deals with the consideration of spectrum requirements and possible additional spectrum allocations for the mobile-satellite service (MSS) in the Earth-to-space and space-to-Earth directions, including the satellite component for broadband applications, within the frequency range from 22 GHz to 26 GHz.

The main frequency bands commonly at risk for SFCG and CGMS member agencies could be:

- The EESS (passive) band 23.6 - 24 GHz (purely passive, but to be protected against unwanted emissions taking into account interference apportionment and the levels contained in ITU-R Resolution 750 (rev. WRC-12);
- The first 500 MHz of the EESS/SRS space-to-Earth band 25.5 – 27.0 GHz.

The frequency band 25.5 – 27 GHz is allocated to the EESS (space-to-Earth) and is used for data links for EESS payloads. Relevant sharing criteria for this service are given in Recommendation ITU-R SA.1027. Studies have been performed with SRS receiving Earth stations tracking non-GSO SRS satellites. These studies, using protection criteria given in Recommendation ITU-R SA.609 show no compatibility between MSS downlink and SRS. Since the sharing criteria in Recommendation ITU-R SA.1027 are globally more stringent than the protection criteria in Recommendation ITU-R SA.609, it is expected that similar conclusions would apply to the EESS (space to-Earth). With regard to MSS uplinks, it has been shown that separation distances larger than 330 km would be required for SRS. These distances would even be larger when considering EESS. So far, the frequency bands targeted by the proponents of such new allocations to the MSS are still not clear, if there are any at all. Thus, the developments in preparation for this WRC-15 agenda item needs to be further carefully monitored.

**WRC-15 Agenda Item 1.11**

This agenda item deals with the consideration for a new primary allocation for the Earth exploration-satellite service (Earth-to-space) in the 7-8 GHz range. Initially proposed by ESA through CEPT this agenda item calls for the identification of a suitable frequency band for an EESS (Earth-to-space) allocation in the 7-8 GHz range for telecommand operations to complement telemetry operations of EESS (space-to-Earth) in the 8025 - 8400 MHz band.

Although there are currently no MetSat systems envisaged that would make use of such a new allocation in the near future, such spectrum would enlarge the potential evolutions of future MetSat systems and deployment scenarios. Supported by the necessary spectrum requirement studies and positive conclusions of the necessary compatibility assessments with the other already allocated services, SFCG supports a primary allocation to EESS (Earth-to-space) in the band 7190 - 7250 MHz as provided for in Method A of the Draft CPM Report. This would satisfy the EESS spectrum requirements identified.

**WRC-15 Agenda Item 9.1.1**

This agenda item deals with Resolution 205 (REV.WRC 12) - Protection of the systems operating in the mobile-satellite service in the band 406 - 406.1 MHz. Cospas-Sarsat space segment providers have developed protection criteria for the Cospas-Sarsat search and rescue instruments and local user terminals in the 406.0 - 406.1 MHz band in order to protect them against broadband out-of-band emissions and against narrow-band spurious emissions. These protection criteria have been recognized at the ITU-R level through ITU-R M.1478-1. However, they do not provide protection against emissions in adjacent bands which could hinder the Cospas-Sarsat system’s ability to detect and/or relay signal from beacons. Several noise measurements have been conducted using all the

three space components. The measurements of the 406 - 406.1 MHz band must be carefully examined, as Cospas-Sarsat has a general concern on the reception and processing of weak distress signals, in certain areas, caused by an increase of noise in the Europe and Asia.

Current analysis of observations show that over certain years, this noise (measured in the 406 - 406.1 MHz band) has increased by 15 to 20 dB above the interference level in some areas. Measurements performed at 406 MHz have shown that the noise level is especially high over Europe and also confirms the concern in part of Asia. This noise issue in UHF band addresses the frequency range between 390 MHz and 420 MHz might be caused by the operation of terrestrial systems deployed in many countries. Thus, Cospas-Sarsat with the support of its space segment providers will need to develop the relevant protection criteria for submission to the relevant ITU-R groups and translation into an ITU-R recommendation.

In order to ensure adequate protection of MSS systems in the frequency band 406 - 406.1 MHz, the revision of Resolution 205 is also required introducing further mitigation measures. Those would also include design and implementation of improved filters at the LEOSAR, GEOSAR and MEOSAR systems space receivers, which are already planned for future generation of satellites.

SFCG supports a revision of Resolution 205 (Rev WRC-12) containing appropriate mitigation measures, such as establishment of a guard band above 406.1 MHz concerning new frequency assignments to mobile networks.

CEPT and CITEL will propose to WRC-15 a significant step forward to improve the protection of the band 406 - 406.1 MHz by means of implementation of guard bands from 405.9 MHz to 406 MHz and from 406.1 to 406.2 MHz applicable to new frequency assignments in the mobile and fixed services.

**WRC-15 Agenda Item 9.1.5**

This agenda item deals with the consideration of technical and regulatory actions in order to support existing and future operation of fixed satellite service (FSS) earth stations within the band 3400 - 4200 MHz, as an aid to the safe operation of aircraft and reliable distribution of meteorological information in some countries in Region 1 (Resolution 154 (WRC-12).

This agenda item which was initially targeted particularly to countries in Africa now receives special attention due its discussion on the question whether or not the use of the FSS for aviation applications are safety related or not and thus, could significantly impact on the discussions of the same band under Agenda Item 1.1 where the band 3400 – 3800 MHz is one of the prime targets of the mobile industry to introduce broadband mobile on a global basis.

The importance of the band for distribution of meteorological information is undisputed in the context of this agenda item and will be appropriately reflected in the modifications to Resolution 154. Studies on this issue indicate that Resolution 154 (WRC-12) could be modified, calling for relevant administrations in Region 1 to use special care in the coordination, assignment, and management of frequencies taking into consideration the potential impact on FSS earth stations used for satellite communications related to safe operation of aircraft and reliable distribution of meteorological information in the frequency band 3400-4200 MHz. In parallel to the modification of

Resolution 154 (WRC-12), consideration may be given to modifying RR No. 5.430A to include a reference to the modified Resolution.

**WRC-15 Agenda Item 9.1.8**

WRC-12 decided to put on the WRC-19 preliminary agenda the issue of nanosatellites and picosatellites. In preparation for that, WRC-15 agenda item 9.1.8 deals with regulatory aspects for nanosatellites and picosatellites under Resolution 757 (WRC-12), which invites ITU-R "to examine the procedures for notifying space networks and consider possible modifications to enable the deployment and operation of nanosatellites and picosatellites, taking into account the short development time, short mission time and unique orbital characteristics" and instructs the Director of the Radiocommunication Bureau "to report to WRC 15 on the results of these studies". Many universities, space agencies and companies show a fast growing interest in the development and exploitation of nanosatellites and picosatellites. The increasing miniaturisation of electronics has enabled these satellites to offer a means to perform a variety of missions in space, from educational, research and experimentation to Earth observation and telecommunication missions.

The following difficulties in application of the Radio Regulations on nanosatellites and picosatellites have been identified and require careful consideration:

- The typically short development time of nanosatellites and picosatellites is not in line with the usual timeline of the regulatory coordination and notification process.
- Late knowledge of detailed orbital parameters as a result of the opportunistic launch arrangements. Furthermore, since many of these satellites are not equipped with a propulsion system their orbit will decay over mission time;
- Limited experience with the applicable regulatory procedures by some of the administrations involved as well as some of the developers of nanosatellites and picosatellites, leading to:
  - Inadequate ITU filing data provided in turn leads to unnecessary administrative burden to the ITU-R Radiocommunication Bureau (BR) and administrations involved,
  - Nanosatellites and picosatellites which are not always operating in the appropriate frequency band or radiocommunication service,
  - Late initiation of the ITU filing due to late knowledge of the orbital parameters;
- Issues related to the growth in numbers of small satellites launched and under development;
- Nanosatellite and picosatellite spectrum requirements are expanding along with their evolving applications;
- The large growth in numbers of nanosatellites and picosatellites puts pressure on the available allocations and associated ITU filings create additional administrative burden on the BR as well as on administration.

SFCG favours the study of this issue, since it recognizes that a growing number of nanosatellite and picosatellite are under development in the world. At present many of these satellites operate in frequency bands allocated to the amateur-satellite service. Now there is an increasing demand for these satellites to operate in other satellite services and frequency bands. Many of these satellites

are launched for scientific, experimental or educational purposes, sometimes in the form of constellations and there is a growing interest for commercial non-scientific applications. SFCG supports that the frequency bands used should align with the applications being supported. An investigation on how this growing number of satellites can be supported is needed. Given the complexity in obtaining a common definition of which types of satellites should be classified under the category nanosatellites and picosatellites and because these definitions tend to relate to elements that are not relevant from a frequency management perspective (size, mass, cost), SFCG supports further consideration of modifications to the RR, if needed, to facilitate the development of nanosatellites and picosatellites, taking into account the comparatively short development time and the potential lack of advance knowledge of certain operational parameters.

Any changes to the ITU-R Radio Regulations in relation to this agenda item should be carefully developed to ensure protection of all satellite missions. SFCG is of the opinion that any satellite, including nanosatellites and picosatellites, will have to be registered with the ITU and must adhere to the ITU-R Radio Regulations.

**WRC-15 Agenda Item 10**

Agenda Item 10 of WRC-15 calls for proposals for possible agenda items for WRC-19.

CNES, DLR and EUMETSAT, supported by France and Germany, proposed to CEPT an agenda item for WRC-19 for upgrading the secondary allocations to the MetSat (space-to-Earth) and the EESS (space-to-Earth) in the band 460 – 470 MHz to primary in order to secure future use of the band for ARGOS-4 and ICARUS. The objective of such an agenda item for WRC-19 is to improve the regulatory status of the MetSat (space-to-Earth) and the EESS (space-to-Earth) services in the frequency band 460 - 470 MHz while putting relevant constraints on these services in order to protect the existing primary (mobile, fixed) services. This proposal is in the CEPT “shopping list” for WRC-19 agenda items for further consideration.

SFCG also supports a proposal for such an agenda item. Also a similar proposal is expected from the US. The proposals for WRC-19 agenda items are currently under definition within the different regional groups and gathered in shopping lists.

One proposal for a new agenda item seems to be common across many of these regional groups, namely the identification of frequency spectrum for mobile broadband above 6 GHz which would concern a number of frequency bands used by EESS and MetSat systems. Furthermore, it is possible that the issue of RLANs in the band 5350 – 5470 MHz will be subject for an agenda item for WRC-19.

WGI thanked EUMETSAT for the detailed report provided on the frequency related topics of interested to CGMS.

CGMS WGI also wanted to re-iterate to SFCG the appreciation of CGMS on the support provided in protecting and preserving the frequency bands assigned or related to the activities of CGMS.

During CGMS meetings WGI was reported (via WGII) that IROWG has identified a potential of interference by ground based transmitters to RO receivers using the new L5 GPS signal. However, no clear information was made available to WGI during its CGMS 43 meeting to allow an informed discussion. In view of the possible implications for the RO receivers, EUMETSAT was tasked by the WGI to contact IROWG chair(s) seeking clarification on the identified potential of interference.

| CGMS-43 action - WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| EUM | WG/I | A43.01 | EUMETSAT to contact IROWG Chair to confirm needs for dedicated frequency protection for GNSS (Clarified between EUMETSAT and IROWG during CGMS-43 and closed as a consequence). | CLOSED | OPEN | HLPP # 1.3 |

**CMA-WP-04** describes that the China Meteorological Administration (CMA) is planning to deploy a scatterometer — WindRadar on FY-3E meteorological satellite, and to deploy a precipitation measuring radar on Fengyun Rain Measurement (FY-RM) satellite. These two radars each have a channel operating in 13.25-13.75 GHz, which is an important band for the earth remote sensing of space-borne active sensors. In Annex_1 of CMA-WP-04, CMA presents the result of a compatibility study between fixed-satellite service (FSS) and PMR2, which concludes that the ITU-R's possible new primary allocations to the fixed-satellite service (FSS) within frequency range 13.25-13.75 GHz, which has been allocated to the EESS (active) on a primary basis, would cause harmful interference in PMR2, and PMR2 would also create harmful interference to FSS earth stations.

WGI thanked CMA for the detailed report and concurred with the conclusions of CMA as provided in WP-04 and recalled that there is a specific agenda topic for WRC-15 that covers this issue. It is to be stressed that the proposed new allocations to the FSS (Earth-to-space) in the 13.25-13.75 GHz band allocated to EESS (active) are not supported by SFCG agencies (and CGMS members). Regarding the sharing studies between EESS (active) and FSS (space-to-Earth) performed so far (which will be complemented by inputs from CNES to the forthcoming ITU-R WP 4A meeting in June 2015), they are showing compatibility between both services. As the need for additional primary allocations of 250 MHz to the GSO FSS in frequency bands between 10 and 17 GHz is recognized and supported and the corresponding ITU-R studies show compatibility with the EESS (active), there might be a need to accept an allocation to the FSS (space-to-Earth) the band 13.4 – 13.65 GHz subject to the implementation of relevant mitigation techniques (e.g. PFD mask, limitation of transmit antenna size, etc.) and include regulatory conditions to ensure the protection of the sensors operating under the EESS (active) allocation.

Consequently, WGI agrees that this topic is of relevance and importance to all CGMS agencies and therefore, CGMS satellite operators are invited to communicate and take into account these views when addressing WRC-2015 preparations at their respective national levels.

**NOAA-WP-06 r**eported that GOES-R will be the first in the series of the next generation of U.S. geostationary environmental satellites. NOAA would like to coordinate GOES-R frequencies with the CGMS MetSat operators for use at 75 W and 137 W. As required by International Telecommunication Union (ITU) regulations, the GOESR network was published on 14 October 2014 as GOES-EAST-4 (75 W) and GOESWEST-4 (137 W), found in the ITU's International Frequency Information Circular (IFIC) 2780, under special section numbers CR/C/3606 and CR/C/3607, respectively.

The ITU Radiocommunication Bureau requested a decision from administrations, found to be possibly affected by the GOES-R filing, no later than 14 February 2015. The U.S. received comments from a number of MetSat operator administrations and is currently corresponding with these administrations with a view to reaching an agreement on the coordination request.

The ITU identified 25 countries for coordination under RR9.7. To date the USA has not received a decision from 15 administrations and will be sending messages to each of the countries in early May to request their decision. The USA have received agreements from Australia and Malaysia. The remaining countries have provided their objections and we are beginning the process of trying to reach agreements.

**PREVIOUS COORDINATION EFFORTS VERSUS GOES-R FILINGS**

NOAA successfully coordinated several GOES satellite networks beginning in the 1970s with GOES-EAST and GOES-WEST, continuing with GOES-EAST-1 and GOES-WEST-1 (GOES I-M), GOES-EAST-2 and GOES-WEST-2 (GOES N-P). The frequencies filed for GOES-R under GOES-EAST-4 and GOES-WEST-4 continue the use of the same frequency bands coordinated for prior GOES satellite networks with additional frequencies in X-band, viz., 7216.6 MHz (uplink) and 8220 MHz (downlink).

**401-403 MHz**

The band 401-403 MHz is allocated, inter alia, to the meteorological-satellite service (Earth-to-space) and traditionally has been used for uplinks from data collection platforms (DCPs) to both polar-orbiting and geostationary MetSats. The greatly expanded use of this band made it necessary to partition the 2 MHz into segments that would lead to continued harmonious use by the many MetSat networks in orbit as well as those planned. NOAA's GOES-R series follows this agreement as captured in the ITU Radiocommunication Recommendation ITU-R SA.2045, entitled "Basic general partitioning and sharing conditions for the band 401-403 MHz for future long-term coordinated use of data collection systems on geostationary and non-geostationary METSAT and EESS systems". Specifically, for the GOES-R series, GOES-R will comply with recommendation 2, viz., "that the band 401.7-402.435 MHz remains available only for DCS on geostationary MetSat systems" by employing up to 933 channels using 750 Hz steps (a potential maximum total use of 0.699750 MHz of the 0.7 MHz found in 401.7 – 402.4 MHz). In following this ITU-R recommendation NOAA feels that successful coordination of its use of 401.7-402.4 and the specific frequencies at 401.7 MHz, 401.85 MHz, 402 MHz, and 402.4 MHz can be readily achieved with the other CGMS MetSat operators.

**460-470 MHz**

The band 460-470 MHz is allocated on a secondary basis, for the meteorological satellite (space-to-Earth), *inter alia*. In the past this band has seen limited use by NOAA's GOES satellites, but its use is expected to expand for the GOES-R series with the 468.775 MHz and 468.825 MHz downlinks employed to interrogate data collection platforms within the footprints of the GOES-R 75 W and 137 W longitudinal positions. In order to prevent interference with the primary terrestrial services allocated in this band, the GOES-R downlinks will employ a spread spectrum technique that limits the power flux density (pfd) at the Earth's surface to a level less than -152 dBW/m²/4 kHz. This low pfd and the geographic location of DCPs interrogated by these GOES-R downlinks should avoid any conflict with DCPs responding to commands from other CGMS MetSat operators. Based on these operating constraints NOAA feels that coordination should be possible with the CGMS members using this band.

**1675-1695 MHz**

This band is allocated on a primary basis for Meteorological satellite (space-to-Earth) and Meteorological aids.

Within this band, there are four services being continued or replacements of those from the current operational GOES satellites, viz. Data Collection Program Report (DCPR) (1679.9 MHz and 1680.2 MHz), GOES ReBroadcast (GRB) (1686.6 MHz), CDA telemetry (1693 MHz) and High Rate Information Transmission/Emergency Managers Weather Information Network (HRIT/EMWIN) (1694.1 MHz). The DCPR is being moved from 1694.5 MHz and 1694.8 MHz to 1679.9 MHz and 1680.2 MHz, but will continue to use the same amount of spectrum, viz. 400 kHz at each frequency.

The GRB replaces the existing GOES Variable (GVAR) service, requiring a larger bandwidth to accommodate the much increased data rates. The GVAR currently operates at 1685.7 MHz requiring 4.22 MHz bandwidth, while GRB will need either 9.7 or 10.9 MHz to transmit the processed data and will operate at 1686.6 MHz. GOES-R telemetry will be transmitted at 1693 MHz instead of the current 1694 MHz with increased spectrum needs of 80 kHz from the existing 16 kHz.

The original Low Rate Information Transmission (LRIT) and weather facsimile (WEFAX) downlink at 1691 MHz (586 kHz) will be combined with the EMWIN currently operating at 1692.7 MHz (27 kHz) in a single downlink known as HRIT/EMWIN, where the HRIT replaces LRIT. The new combined service will transmit at 1694.1 MHz, requiring 1.21 MHz of bandwidth. The existing sensor data downlink at 1676 MHz will be moved to X-band (8220 MHz) to accommodate the greatly expanded data rates from the advanced sensors on-board the GOES-R spacecraft.

All of these replacements or changes will continue transmission to ground stations in the United States, either to Wallops Island, Virginia or to the backup site at Fairmont, West Virginia as well to those locations within the telecommunication footprints of the two GOES-R satellite positions at 75 W and 135 W that have the proper receiving equipment – similar to the current GOES operational scenario. Overall, the L-band needs for the GOES-R series will be more contiguous (i.e. smaller breaks between frequencies) than those of the existing operational GOES satellites in the range from

1679.7 MHz to 1694.605 MHz. Due to the very similar expected operations of NOAA's GOES-R satellites to those currently in orbit, as well as the existing interference-free service now provided by NOAA's GOES satellites in L-band, no interference is expected to the CGMS members who operate geostationary MetSats using frequencies in the range cited above. Based on these operation conditions, NOAA asks for coordination of all the GOES-R L-band downlinks.

**7190-7235 MHz and 8025-8400 MHz**

Due to the much higher data rates from new and advanced sensors on-board the GOES-R satellites, the geostationary MetSat L-band allocation in 1675-1695 MHz is insufficient to accommodate the necessary 120 MHz of spectrum for the raw sensor downlink. Additionally, the processed data uplink must be moved to meet the 9.7 MHz or 10.9 MHz continuous data stream sent to the GOES-R satellite. These two new frequencies, the first for a NOAA GOES satellite, have not been coordinated previously with CGMS members. The uplink at 7216.6 MHz is allocated within the United States, via footnote, to NOAA GOES earth stations operating in the meteorological-satellite service (Earth-to-space) and will only transmit to GOES-R satellites at their authorized longitudinal positions. The 120 MHz downlink centred at 8220 MHz operates under the Earth exploration-satellite (space-to-Earth) primary allocation in 8025-8400 MHz. This signal will be transmitted for reception at only the two GOES-R ground stations.

Due to the narrowly focused use of these X-band frequencies planned by GOES-R satellites, NOAA seeks the coordination agreement from the CGMS members for use of this spectrum.

**ACTIONS AND/OR RECOMMENDATIONS FOR CONSIDERATION**

NOAA requests that CGMS examine GOES-R frequency bands and provide appropriate comments and actions for coordination. NOAA requests MetSat operators in the CGMS meeting, consider approval of this coordination for GOES-R. The launch of GOES-R is expected in March 2016 and coordination agreement is urgently required for 75 W and 137 W.

WGI noted the detailed report provided by NOAA on the status of coordination of GOES-R and did not identify any reservation by the different CGMS members attending WGI to the GOES-R frequency plan submitted by NOAA for international coordination. WGI wanted also to recall that ITU procedures for international coordination of frequencies and systems cannot be waived by CGMS agencies. WGI also reminded that SFCG is the natural forum to address coordination topics between space agencies prior, or in parallel, to submission for coordination within ITU. Consequently WGI confirmed the support to NOAA in the coordination process and expect that the use of the existing working practices within SFCG will help in expediting the overall coordination process.

WGI also re-iterated the need of CGMS members to closely and regularly liaise with their national frequency management/regulation authorities on the importance of the frequency bands assigned/associated to MetSats and EESS and the need to protect/preserve them. These regular activities shall ensure that adequate awareness is raised, and maintained, with the national authorities that will convey the national positions to the WRC, and reminded all CGMS members of

the fact that none of the CGMS members is a member of ITU with voting rights (by definition of the membership in ITU –which is done at national signatory level).

**EUM-WP-04** is provided in response to HLPP 2014-2018, item 1.3.2. The assessment shows the situation in the EESS band 8025 – 8400 MHz, from the regulatory, usage and frequency coordination and sharing perspective and highlights the mechanisms implemented within SFCG to foster an efficient use of the spectrum as well as to facilitate coordination between space agencies. In addition, a similar assessment is performed for the MetSat band 7750 – 7900 MHz.

**8025 – 8400 MHz**

**Frequency allocation in the ITU-R Radio Regulations (RR)**

The band 8025 – 8400 MHz is among other primary services allocated to the Earth Exploration-Satellite service (space-to-Earth) on a primary basis. This EESS service includes the use by MetSat which is defined as an Earth exploration-satellite service for meteorological purposes (RR Article 1.52).

| Allocation to services | | |
|---|---|---|
| **Region 1** | **Region 2** | **Region 3** |
| **8 025-8 175** | EARTH EXPLORATION-SATELLITE (space-to-Earth)<br>FIXED<br>FIXED-SATELLITE (Earth-to-space)<br>MOBILE 5.463<br>5.462A | |
| **8 175-8 215** | EARTH EXPLORATION-SATELLITE (space-to-Earth)<br>FIXED<br>FIXED-SATELLITE (Earth-to-space)<br>METEOROLOGICAL-SATELLITE (Earth-to-space)<br>MOBILE 5.463<br>5.462A | |
| **8 215-8 400** | EARTH EXPLORATION-SATELLITE (space-to-Earth)<br>FIXED<br>FIXED-SATELLITE (Earth-to-space)<br>MOBILE 5.463<br>5.462A | |

**5.462A** In Regions 1 and 3 (except for Japan), in the band 8 025-8 400 MHz, the Earth exploration-satellite service using geostationary satellites shall not produce a power flux-density in excess of the following provisional values for angles of arrival (θ), without the consent of the affected administration:

| | |
|---|---|
| −135 dB(W/m$^2$) in a 1 MHz band | for $0 \leq \theta < 5º$ |
| −135 + 0.5 (θ – 5) dB(W/m$^2$) in a 1 MHz band | for $5º \leq \theta < 25º$ |
| −125 dB(W/m$^2$) in a 1MHz band | for $25º \leq \theta \leq 90º$ |
| | (WRC-12) |

**Frequency usage in the band 8025 – 8400 MHz**

As the band is very heavily used by a large number of EESS missions, the SFCG has maintained a database dedicated solely for this frequency band 8025 – 8400 MHz for a number of years.

With this database an overview of the current and future planned usage is provided allowing space agencies to plan their frequency use in this band on the basis of this background information and thus introduce their system into this band in the optimal way in terms of selected frequencies and characteristics to avoid, to the maximum extent, mutual interference with the other systems in the database.

**Extract from the SFCG X-Band Database for the band 8025 – 8400 MHz**

The SFCG maintains a database populated with satellite systems using, or planning to use, the frequency band 8025 – 8400 MHz.

As a complement to the general SFCG database in which only missions of SFCG member agencies are contained, this dedicated database provides a quick overview of the satellite system population in this band including missions of non-SFCG members as well as missions of SFCG members not included yet in the general database. It contains a number of technical parameters which can be used for frequency selections, pre-coordination purposes and interference simulations.

The SFCG X-Band database constitutes an attempt, on a best efforts basis, to provide an overview on all earth exploration satellites operating in the band 8025 - 8400 MHz. It neither claims to be complete nor precise in every respect. Use of this database is free and open to everybody having a vested interest in this area. Data shall not be used for commercial purposes.

Currently the SFCG X-Band database contains more than 110 satellite systems with one or more satellites in a constellation or series of satellites. 70 of which are already deemed to be in operation.

Only two systems currently under development are planning to use this frequency band for GSO systems, namely GOES-R and FY-4.

Figure 1 below provides an overview of the bandwidth distribution of the 70 satellite systems deemed to be already in use, noting that the number of frequency assignments is around 100 (not counting the systems for which no clear bandwidth information is available). For simplification of the overview the assignments consisting of more than one channel have been combined and counted in the column of the overall bandwidth (e.g. 2 x 140 MHz is included in column 251- 300 MHz).

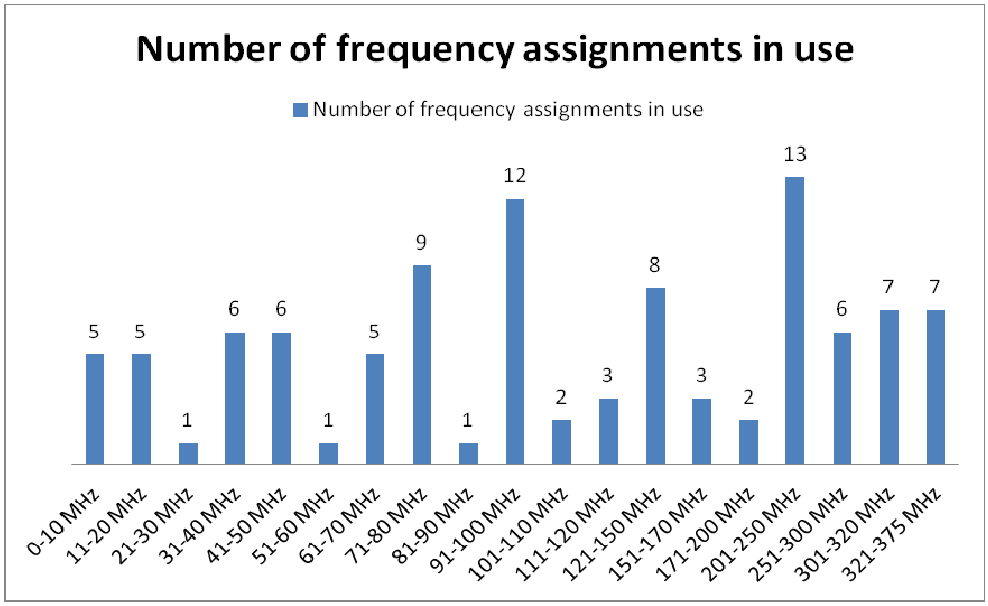



***Figure 1*** *Bandwidth distribution of operational satellite systems using the band 8025 – 8400 MHz (Source: SFCG X-Band database, Status: March 2015)*

In Figure 2 below also the bandwidth distribution of the around 45 satellite systems under development is added, showing that the trend for frequency assignments with larger bandwidth is continuing.

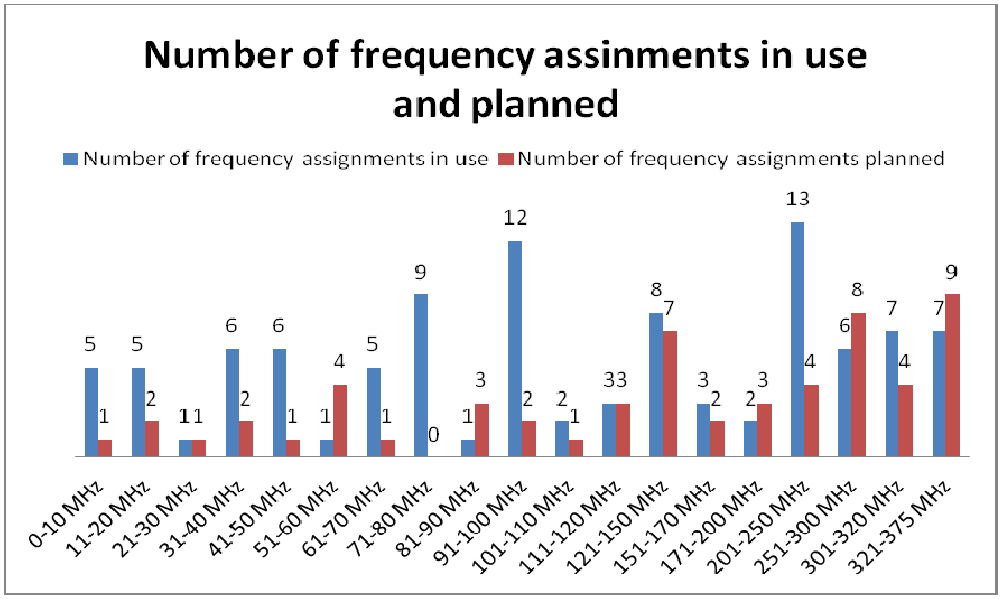



***Figure 2*** *Bandwidth distribution of operational and planned satellite systems using the band 8025 – 8400 MHz (Source: SFCG X-Band database, Status: March 2015)*

**Frequency coordination and sharing in the band 8025 – 8400 MHz**

Since the band is so densely used there is no means of avoiding frequency overlap with a number of other missions (see Figure 1 above). Depending on the bandwidth required there might be the possibility to avoid one or the other mission with high potential of mutual interference by means of frequency separation, but in most cases a frequency overlap will be unavoidable as the overall width of the band is only 375 MHz and the bandwidth requirements of the individual missions is ever increasing. Considering the very dense usage situation there is no possibility for introducing the concept of a frequency plan to group missions to minimise the interference potential and at the same time to maximize the usage potential of this spectrum resource. In order to mitigate the interference potential with other frequency overlapping missions other measures have been implemented. For this, the SFCG developed Recommendation SFCG 14-3R9 (Attachment 1) containing a number of mitigation measures that should be implemented to minimize the interference potential and, with this, improve the efficient use and counter congestion of this spectrum resource, such as:

- transmissions only when in view of the Earth stations;
- phasing of the orbital parameters for sun-synchronous satellites;
- low sidelobe, high gain satellite antennas;
- in case of low gain antennas use of isoflux instead of omnidirectional antennas;
- avoid broadcast mode operations, but if then in the lower part of the band;
- future missions to re-use characteristics of existing systems for homogeneity;
- power flux-density less than -123dB(W/m2 MHz);
- use of variable coding and modulation (VCM) techniques where practicable;
- polarisation discrimination, geographical separation of earth stations and large Earth station antennas with low sidelobes (Recommendation ITU-R S.465);
- prevent unwanted emissions exceeding the ITU-R deep space interference criterion (Rec. ITU R SA.1157) in the band 8400 – 8450 MHz;
- use of the band 25.5 – 27 GHz when possible;
- use of on-board power-controllable RF power amplifiers, where practicable.

In addition Recommendation SFCG 21-2R3 (Attachment 2) further provides mechanisms (selection of modulation scheme and spectral emissions masks) for the efficient spectrum utilisation for space science services on space-to-earth links.

Within the framework of these measures as outlined above, future missions planning to use this band are announced through the yearly presentation of information on current and future planned missions of the individual SFCG member agencies and are further coordinated through the application of Resolution SFCG A12-1R3 on the procedures for inter-agency frequency coordination.

**7750 – 7900 MHz**

**Frequency allocation in the ITU-R Radio Regulations (RR)**

The band 7750 – 7900 MHz is among other primary services allocated to the Meteorological-Satellite service (space-to-Earth) on a primary basis. The use of this band by MetSat systems is limited to non-geostationary satellite systems (RR Footnote 5.461B.

| Allocation to services | | |
|---|---|---|
| Region 1 | Region 2 | Region 3 |
| **7 750-7 900 MHz** | FIXED<br>METEOROLOGICAL-SATELLITE (space-to-Earth) 5.461B<br>MOBILE except aeronautical mobile | |

**5.461B** The use of the band 7 750-7 900 MHz by the meteorological-satellite service (space-to-Earth) is limited to non-geostationary satellite systems. (WRC-12)

**Frequency usage in the band 7750 – 7900 MHz**

Contrary to the band 8025 – 8400 MHz, this band is only used, or planned to be used, by a limited number of space agencies for their MetSat (see Figure 3 below), which is obvious as this band is dedicated specifically to MetSat system and there is only a limited number of space agencies operating such systems.

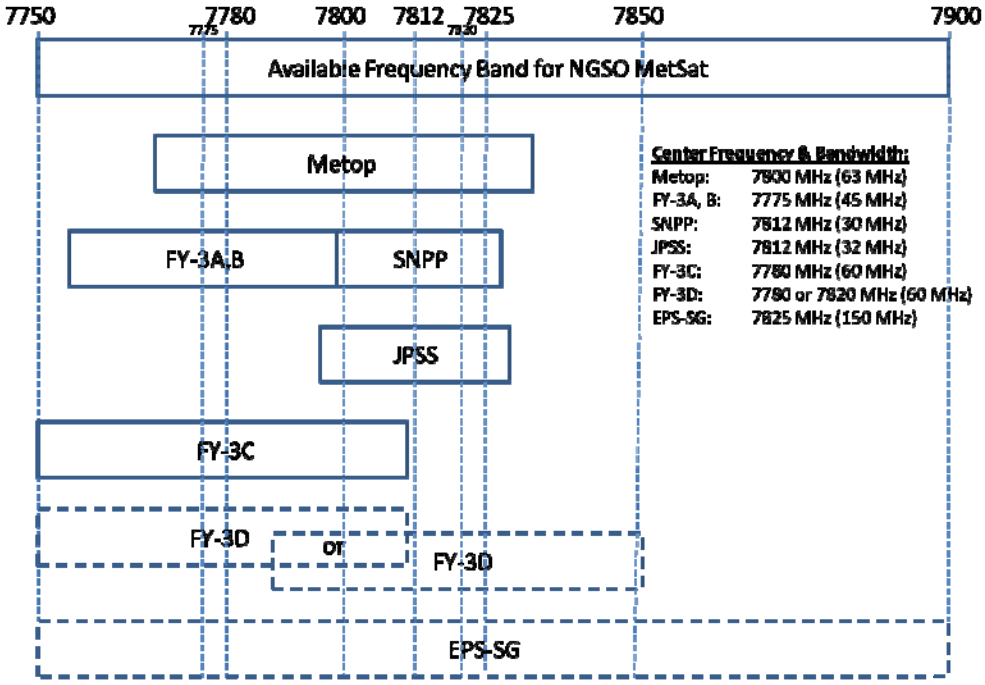



***Figure 3** Overview of the current and known planned use of the band 7750 – 7900 MHz*

**Compatibility among MetSat system in the band 7750 – 7900 MHz**

With document SF33-47/D the results of a compatibility assessment between the direct data broadcasts of EPS-SG and FY-3 in the band 7750 - 7900 MHz were provided and presented to the SFCG-33 meeting in 2013. Among the satellites outlined in Figure 1 above, the ones with the highest risk of mutual interference are EPS-SG DDB and the series of FY-3 satellites. The reason is that they fly on similar orbits (EPS-SG: 9:30 LTAN and FY-3A: 10:30 LTAN, FY-3C and FY-3D LTANs are still TBD). For the flying NPP satellite and the planned JPSS, both on afternoon orbits, the risk of interference with EPSS-SG or FY-3 is negligible as compared to the case of EPS-SG versus FY-3.

For assessing the compatibility of the data broadcasts of FY-3 and EPS-SG, simulations were conducted assuming:

- FY-3 earth stations in Svalbard and Beijing, with EPS-SG (in the two options for data rates/modulation/bandwidth) transmitting continuously in broadcast mode (DDB), and
- EPS-SG earth stations in Svalbard and Darmstadt, with FY-3 transmitting continuously in broadcast mode (MPT) with different data rates/bandwidth.

Considering the relevant ITU-R protection criteria as contained in ITU-R Recommendation SA.1027, the interference potential between EPS-SG and FY3 satellites both operating in broadcast mode, assuming full spectrum overlap, is very low (0.01% (3 - 6 minutes/year) or even less when considering an actual Eb/No criteria. Such already very small interference potential only exists for high latitude stations such as Svalbard. Large margins are available for victim earth stations of both systems at mid and low latitudes.

A comparison of the results with those of a theoretical FY-3 equator crossing time equal to the one of EPS-SG (9:30) shows that the actual shift of equator crossing times between FY-3 and EPS-SG constitutes a significant factor to mitigate the potential of interference between both systems.

It should be noted that for both systems the data rates, bandwidth requirements and centre frequencies likely to be required in the timeframe > 2020 were not finally determined by the time of conclusion of this assessment in 2013. However, given the fact that there was no significant difference in the overall time of potential interference when varying the data rates/bandwidth of either system, the overall interference potential between EPS-SG and FY-3 in the 7750 – 7900 MHz band can be considered very limited and relatively independent from the finally selected data rates, modulation scheme and bandwidth required.

The compatibility assessment and its results as presented at SFCG-33 were endorsed by CMA and NOAA.

**Frequency coordination and sharing in the band 7750 – 7900 MHz**

Due to the initially limited bandwidth available (until WRC-12: 7750 – 7850 MHz = 100 MHz) and the different usage concepts (main data dumps vs. direct readout) a separation of the different missions was not possible when starting to utilize this band. Thus, Resolution SFCG 19-7R4 was introduced to set force some principle for using this band and through this to ensure the coexistence of the different missions in this band.

With the next generation of NGSO MetSat systems this band will be more homogeneously used for direct readout services, once Metop will be no longer operational (>2030). However, as the bandwidth requirements for direct readout services also has and will continue to increase significantly, the introduction of a frequency plan to fully avoid frequency overlap will be difficult to implement, even with the recent enlargement of the frequency allocation to MetSat to 150 MHz (7750 – 7900 MHz).

Compatibility assessments as outlined in section 2.2.1 above however show that coordinated phasing of the equator crossing times between the different polar orbiting MetSat systems constitutes the most significant factor to mitigate the potential of interference between the systems and that, with this, the interference potential between the low number of MetSat systems using this band is very small.

Within the framework of these measures as outlined above, future missions planning to use this band are announced through the yearly presentation of information on current and future planned missions of the individual SFCG member agencies and are further coordinated applying Resolution SFCG A12-1R3 on the procedures for inter-agency frequency coordination.

CGMS WGI thanked EUMETSAT for the report and summary provided and concluded that the corresponding aspect of the HLPP (1.3.2) was properly addressed in EUM-WP-04. In addition, CGMS WGI wanted to re-iterate to SFCG the appreciation of CGMS on the support provided, as an expert forum, in coordinating and in protecting and preserving the frequency bands assigned or related to the activities of CGMS. CGMS WGI participants also confirmed the need to perform the necessary coordination and interference assessment studies whenever new systems are planned and to share within SFCG and WGI the results and information gathered for analysis and comment. Noting the importance of maintaining interference free systems, WGI concluded that this point should be maintained in the HLPP and that a specific bullet should be added to cover the interference assessment on regular basis for MetSats X-Band.

**WP-CMA-03** provides a description of current and future CMA Fengyun satellite systems as well as a list of radio frequencies used/to be used by these networks. CMA indicated that the provided WP contained an update on the information for FY-2G.

| Satellite | Period of Utilization | Position/ LST | Service/ Application | Dire-ction | Service freq. (MHz) | Emission | Band-width (kHz) | Polarization | Data Rate (kbps) |
|---|---|---|---|---|---|---|---|---|---|
| Current and future geostationary CMA satellite systems | | | | | | | | | |
| FY-2C | | 123.5E | DCP | E-S | 401.1-401.4 | | 300 | RHCP | 0.100 |
| | | | DCP | E-S | 402.0-402.1 | | 100 | RHCP | 0.100 |
| | | | Raw Data | S-E | 1671.6-1691.6 | 20M0G1D | 20000 | Linear | 14000 |
| | | | Ranging (station-2) | S-E | 1684-1685 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (station-1) | S-E | 1686-1687 | 1M00G2W | 1000 | Linear | 500 |

| Satellite | Period of Utilization | Position/ LST | Service/ Application | Dire-ction | Service freq. (MHz) | Emission | Band-width (kHz) | Polarization | Data Rate (kbps) |
|---|---|---|---|---|---|---|---|---|---|
| | Current and future geostationary CMA satellite systems | | | | | | | | |
| FY-2C | | | Ranging (primary-station) | S-E | 1690-1691 | 1M00G2W | 1000 | Linear | 500 |
| | | | S-VISSR | S-E | 1686.5-1688.5 | 2M00G1D | 2000 | Linear | 660 |
| | | | LRIT | S-E | 1690-1691 | 1M00G2W | 1000 | Linear | 150 |
| | | | WEFAX (not in use) | S-E | 1690.87-1691.13 | 260KFXD | 260 | | |
| | | | S-WEFAX (not in use | S-E | 1699.487-1699.513 | 26K0FXD | 26 | | |
| | | | Ranging (station 2) | E-S | 2044-2045 | 1M00G2W- | 1000 | Linear | 500 |
| | | | Ranging (station1) | E-S | 2046-2047 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (primary-station) | E-S | 2050-2051 | 1M00G2W | 1000 | Linear | 500 |
| | | | TT&C | E-S | 2056.5-2057.5 | 70K0FXD | 70 | | |
| | | | S-WEFAX (not in use | E-S | 2059.487-2059.513 | 26K0FXD | 26 | | |
| | | | LRIT | E-S | 2050.87-2051.13 | 260KFXD | 260 | Linear | 150 |
| | | | S-VISSR | E-S | 2046.5-2048.5 | 2M00G1D | 2000 | Linear | 660 |
| FY-2D | | 86.5E | DCP | E-S | 401.1-401.4 | | 300 | RHCP | 0.100 |
| | | | DCP | E-S | 402.0-402.1 | | 100 | RHCP | 0.100 |
| | | | Raw Data | S-E | 1671.6-1691.6 | 20M0G1D | 20000 | Linear | 14000 |
| | | | Ranging (station 2) | S-E | 1684-1685 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (station 1) | S-E | 1686-1687 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (primary-station) | S-E | 1690-1691 | 1M00G2W | 1000 | Linear | 500 |
| | | | S-VISSR | S-E | 1686.5-1688.5 | 2M00G1D | 2000 | Linear | 660 |
| | | | LRIT (not in use) | S-E | 1690-1691 | 1M00G2W | 1000 | Linear | 150 |
| | | | WEFAX (not in use) | S-E | 1690.87-1691.13 | 260KFXD | 260 | | |
| | | | S-WEFAX (not in use | S-E | 1699.487-1699.513 | 26K0FXD | 26 | | |
| | | | Ranging (station 2) | E-S | 2044-2045 | 1M00G2W- | 1000 | Linear | 500 |
| | | | Ranging (station 1) | E-S | 2046-2047 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (primary station) | E-S | 2050-2051 | 1M00G2W | 1000 | Linear | 500 |
| | | | TT&C | E-S | 2056.5-2057.5 | 70K0FXD | 70 | | |

| Satellite | Period of tilization | Position/ LST | Service/ Application | Dire-ction | Service freq. (MHz) | Emission | Band-width (kHz) | Polarization | Data Rate (kbps) |
|---|---|---|---|---|---|---|---|---|---|
| **Current and future geostationary CMA satellite systems** | | | | | | | | | |
| | | | S-WEFAX (not in use | E-S | 2059.487-2059.513 | 26K0FXD | 26 | | |
| | | | LRIT (not in use) | E-S | 2050.87-2051.13 | 260KFXD | 260 | Linear | 150 |
| | | | S-VISSR | E-S | 2046.5-2048.5 | 2M00G1D | 2000 | Linear | 660 |
| FY-2E | | 105E | DCP | E-S | 401.1-401.4 | | 300 | RHCP | 0.100 |
| | | | DCP | E-S | 402.0-402.1 | | 100 | RHCP | 0.100 |
| | | | Raw Data | S-E | 1671.6-1691.6 | 20M0G1D | 20000 | Linear | 14000 |
| | | | Ranging (station-2) | S-E | 1684-1685 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (station-1) | S-E | 1686-1687 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (primary-station) | S-E | 1690-1691 | 1M00G2W | 1000 | Linear | 500 |
| | | | S-VISSR | S-E | 1686.5-1688.5 | 2M00G1D | 2000 | Linear | 660 |
| | | | LRIT (not in use) | S-E | 1690-1691 | 1M00G2W | 1000 | Linear | 150 |
| | | | WEFAX (not in use) | S-E | 1690.87-1691.13 | 260KFXD | 260 | | |
| | | | S-WEFAX (not in use | S-E | 1699.487-1699.513 | 26K0FXD | 26 | | |
| | | | Ranging (station 2) | E-S | 2044-2045 | 1M00G2W- | 1000 | Linear | 500 |
| | | | Ranging (station1) | E-S | 2046-2047 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (prim-station) | E-S | 2050-2051 | 1M00G2W | 1000 | Linear | 500 |
| | | | TT&C | E-S | 2056.5-2057.5 | 70K0FXD | 70 | | |
| | | | S-WEFAX (not in use | E-S | 2059.487-2059.513 | 26K0FXD | 26 | | |
| | | | LRIT (not in use) | E-S | 2050.87-2051.13 | 260KFXD | 260 | Linear | 150 |
| | | | S-VISSR | E-S | 2046.5-2048.5 | 2M00G1D | 2000 | Linear | 660 |
| FY-2F | | 112E | DCP | E-S | 401.1-401.4 | | 300 | RHCP | 0.100 |
| | | | DCP | E-S | 402.0-402.1 | | 100 | RHCP | 0.100 |
| | | | Raw Data | S-E | 1671.6-1691.6 | 20M0G1D | 20000 | Linear | 14000 |
| | | | Ranging (station-2) | S-E | 1684-1685 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (station-1) | S-E | 1686-1687 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (primary-station) | S-E | 1690-1691 | 1M00G2W | 1000 | Linear | 500 |
| | | | S-VISSR | S-E | 1686.5-1688.5 | 2M00G1D | 2000 | Linear | 660 |
| | | | LRIT | S-E | 1690-1691 | 1M00G2W | 1000 | Linear | 150 |
| | | | WEFAX | S-E | 1690.87-1691.13 | 260KFXD | 260 | | |

| Satellite | Period of tilization | Position/ LST | Service/ Application | Dire-ction | Service freq. (MHz) | Emission | Band-width (kHz) | Polarization | Data Rate (kbps) |
|---|---|---|---|---|---|---|---|---|---|
| **Current and future geostationary CMA satellite systems** | | | | | | | | | |
| FY-2F | | | S-WEFAX (not in use | S-E | 1699.487-1699.513 | 26K0FXD | 26 | | |
| | | | Ranging (station 2) | E-S | 2044-2045 | 1M00G2W- | 1000 | Linear | 500 |
| | | | Ranging (station 1) | E-S | 2046-2047 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (primary- station) | E-S | 2050-2051 | 1M00G2W | 1000 | Linear | 500 |
| | | | TT&C | E-S | 2056.5-2057.5 | 70K0FXD | 70 | | |
| | | | S-WEFAX (not in use | E-S | 2059.487-2059.513 | 26K0FXD | 26 | | |
| | | | LRIT | E-S | 2050.87-2051.13 | 260KFXD | 260 | Linear | 150 |
| | | | S-VISSR | E-S | 2046.5-2048.5 | 2M00G1D | 2000 | Linear | 660 |
| FY-2G | | 99.5E | DCP | E-S | 401.1-401.4 | | 300 | RHCP | 0.100 |
| | | | DCP | E-S | 402.0-402.1 | | 100 | RHCP | 0.100 |
| | | | Raw Data | S-E | 1671.6-1691.6 | 20M0G1D | 20000 | Linear | 14000 |
| | | | Ranging (station -2) | S-E | 1684-1685 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (station-1) | S-E | 1686-1687 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (primary-station) | S-E | 1690-1691 | 1M00G2W | 1000 | Linear | 500 |
| | | | S-VISSR | S-E | 1686.5-1688.5 | 2M00G1D | 2000 | Linear | 660 |
| | | | LRIT | S-E | 1690-1691 | 1M00G2W | 1000 | Linear | 150 |
| | | | WEFAX | S-E | 1690.87-1691.13 | 260KFXD | 260 | | |
| | | | S-WEFAX (not in use) | S-E | 1699.487-1699.513 | 26K0FXD | 26 | | |
| | | | Ranging (station 2) | E-S | 2044-2045 | 1M00G2W- | 1000 | Linear | 500 |
| | | | Ranging (station 1) | E-S | 2046-2047 | 1M00G2W | 1000 | Linear | 500 |
| | | | Ranging (primary- station) | E-S | 2050-2051 | 1M00G2W | 1000 | Linear | 500 |
| | | | TT&C | E-S | 2056.5-2057.5 | 70K0FXD | 70 | | |
| | | | S-WEFAX (not in use) | E-S | 2059.487-2059.513 | 26K0FXD | 26 | | |
| | | | LRIT | E-S | 2050.87-2051.13 | 260KFXD | 260 | Linear | 150 |
| | | | S-VISSR | E-S | 2046.5-2048.5 | 2M00G1D | 2000 | Linear | 660 |
| | | | X and KA payloads for test | | | | | | |
| FY-4 | 2015 | TBD | DCPS | E-S | 401.1-401.4 | | | RHCP | |
| | | | DCPS | E-S | 402.0-402.1 | | | RHCP | |

| Satellite | Period of tilization | Position/ LST | Service/ Application | Dire-ction | Service freq. (MHz) | Emission | Band-width (kHz) | Polarization | Data Rate (kbps) |
|---|---|---|---|---|---|---|---|---|---|
| **Current and future geostationary CMA satellite systems** | | | | | | | | | |
| FY-4 | | | DCPS | S-E | 1686-1690 | | | Linear | |
| | | | Raw Data | S-E | 7450-7550 | | | RHCP | |
| | | | HRIT | E-S | 8175-8195 | | | RHCP | |
| | | | HRIT | E-S | 8195-8215 | | | RHCP | |
| | | | HRIT | S-E | 1675-1687 | | | Linear | |
| | | | LRIT and WAIB | E-S | 2056.5-2057.5 | | | RHCP | |
| | | | LRIT and WAIB | S-E | 1696-1698 | | | linear | |
| | | | TARS | E-S | 2042-2052 | | | RHCP | |
| | | | TARS | S-E | 1689-1697 | | | Linear | |
| | | | TARS | S-E | 2222-2232 | | | RHCP | |
| | | | TT&C | E-S | 2025-2110 | | | RHCP | |
| | | | TT&C | S-E | 2200-2290 | | | RHCP | |
| **Current and future polar-orbiting Fengyun satellite systems** | | | | | | | | | |
| FY-1D | 2004-2011 | 6.00 | Not in use | S-E | 1708.46 | 3M00G1D- | 3 | CL | 3 |
| | | | Not in use | S-E | 1700.4 | 5M00G1D | 5 | CR | 5 |
| FY-3A | 2008- | 10.30 | HRPT | S-E | 1704.5 | 6M80G1W | 6.8 | CR | 4 |
| | | | MPT | S-E | 7775 | 45M0G1W | 45 | CR | 18700 |
| | | | DPT | S-E | 8145.95 | 149MG1W | 149 | CR | 93000 |
| FY-3B | 2010- | 13.30 | HRPT | S-E | 1704.5 | 6M80G1W- | 6.8 | CR | 4 |
| | | | MPT | S-E | 7775 | 45M0G1W | 45 | CR | 18700 |
| | | | DPT | S-E | 8145.95 | 149MG1W | 149 | CR | 93000 |
| FY-3C | 2013 | 10:30 | HRPT | S-E | 1701.4 | 6M80G1W-- | 6.8 | CR | 4 |
| | | | MPT | S-E | 7780 | 60M0G1W-- | 60 | CL | 45000 |
| | | | DPT | S-E | 8175 | 300MG1W-- | 300 | CL | 225000 |
| FY-3D | | TBD | HRPT | S-E | N/A | N/A | N/A | N/A | T |
| | | | AHRPT | S-E | 7820 | N/A | N/A | RHCP | 60000 |
| | | | DPT | S-E | N/A | N/A | N/A | N/A | T |

CGMS WGI thanked CMA for the efforts in providing an update of the information.

**NOAA-WP-07** provides a description of current and future NOAA satellite networks as well as a list of radio frequencies used/to be used by these networks. The provided WP identifies the updates done to the CGMS-42 version of this paper and submitted to WGI for information. NOAA also informed CGMS WGI that official authorizations and frequency assignments are on file with the International Telecommunications Union (ITU) and the U.S. National Telecommunications and Information Administration (NTIA).

CGMS WGI thanked NOAA for the update of the information and used the opportunity to recall the ready availability of the WMO Observing System Capability Analysis and Review Tool (OSCAR -

(http://www.wmo-sat.info/oscar/satellitefrequencies), encouraging WGI members to provide and maintain updated WMO with the frequency information of their systems (present and future ones). WMO also took the opportunity to inform CGMS WGI on the plans to upgrade the OSCAR tool with additional features and capabilities (to be released before CGMS 44).

NOAA raised the point of accessibility to information by others than CGMS agencies to frequencies, instrument characteristics and applications based on them and requested clarification on the relation between OSCAR and the different ITU handbooks for MetSats and EESS. WGI considered with appreciation the question raised and noted that the current ITU practice is that any of these handbooks is subject to fees (either for hardcopies or for downloading it). Considering the relevance and importance of easiness and accessibility to information CGMS WGI agreed in a recommendation to foster the necessary capabilities in the next release of OSCAR to allow adequate reporting by applications, instrument types and set of frequencies. If necessary, hyperlinks in the CGMS web pages to the OSCAR based reports shall be ensured.

| CGMS-43 recommendations - WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO | WGI/3 | R43.01 | WMO to make the information on all (active, passive and comms) frequency use available and searchable in OSCAR/Space, such that pre-defined reports are easily accessible via external hyperlinks | CGMS-44 | OPEN | HLPP # 1.3 |

With all WPs on frequency topics presented and discussed, CGMS WGI recalled that CGMS nominated the Frequency Manager of EUMETSAT as liaison officer between CGMS and SFCG. CGMS WGI noted with appreciation the work done so far by the liaison officer. In discussing how to better use time and resources of both SFCG and CGMS WGI, it is proposed to continue using the identified liaison officer to also report back from SFCG on the topics of relevance to CGMS allowing the concentration of all frequency management and coordination issues between CGMS members (but also members of SFCG) to be addressed in an expert forum like the SFCG. To ensure that CGMS is informed of any issue needing dedicated attention within CGMS WGI, the following action was agreed to be captured in the best practices of CGMS.

| CGMS-43 recommendations - WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | WGI/3 | R43.02 | Recommends CGMS members to continue bringing all frequency management and coordination issues under the expert forum of SFCG and actions the liaison officer (from CGMS to SFCG) to report to CGMS WGI all aspects of SFCG discussions considered of relevance to CGMS. | CGMS-44 | OPEN | HLPP # 1.3 |

| CGMS-43 action - WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| EUM | WG/I | A43.02 | CGMS Liaison officer to SFCG to report to CGMS WGI on the discussions and disposition of SFCG on all topics of interest to the different CGMS members. For achieving that a dedicated CGMS Secretariat WGI working paper will be prepared by EUMETSAT Frequency Manager (in the role of liaison officer from CGMS to SFCG) and will be released to the participants of WGI before end of the corresponding year. Based on the contents, CGMS members will decide the level of information they will include in their specific reports to CGMS for the corresponding WGI meeting | 30 Dec 2015 | OPEN | HLPP # 1.3 |

**I/4 Optimisation/harmonization of direct readout dissemination (CGMS DB global spec)**

**I/4.1 Current systems**

No papers were presented during CGMS 43. But the need to maintain this agenda topic is discussed (and confirmed) under the revision of the HLPP (parts relevant to WGI.

**I/4.2 Transition to new direct readout systems (GOES-R, JPSS, FY-3, EPS-SG,..)**

**NOAA-WP-10** (ppt) presented the NOAA plans to transition to New Direct Readout Systems for GOES-R & JPSS. The GOES Re-Broadcast (GRB) service will replace the GVAR transmission on the current GOES spacecraft. NOAA's current direct broadcast services will change dramatically in data rate, data content, and frequency allocation, and drives changes to field terminal configurations. Direct readout data users must employ new field terminal receivers unique to each particular broadcast service. JPSS plans the carry and X-band service similar to the NASA EOS and NOAA S-NPP spacecraft. The HRD service will transmit a full complement of instrument data. GOES-R will make available an HRIT/EMWIN service which will be a combination of the LRIT and NWS' Emergency Managers Weather and Information Network (EMWIN) services.

GOES-R will be located at a check out position of 89.5 deg W for the first 12 months and will provide improved data products for hemispheric retransmission:

- "GOES Rebroadcast" (GRB)
- Faster full disk images with 5 minutes (Mode 4) and 15 minutes (Mode 3)
- Full set of Level 1b data with data from six GOES-R instruments including all ABI channels

GOES-R data reception requires new antenna, receiver hardware, and processing system to handle the new data volumes:

- Receiver frequency shift from 1685.7 MHz to 1686.6 MHz
- Dual circular polarized signals
- Going from 2.11 Mbps (GVAR) to 31 Mbps (GRB)

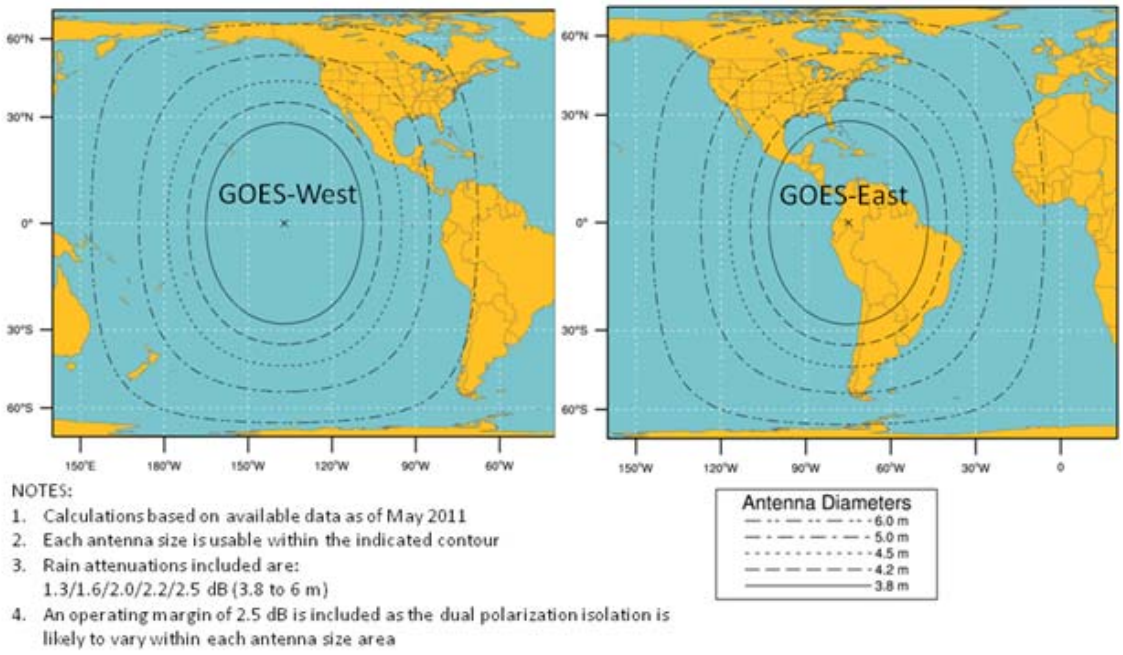



***Figure 4*** *GRB Ground Antenna Sizes*

GRB Downlink Specification Document for Users Provides GOES Rebroadcast radio frequency downlink characteristics, to enable the user community to develop GRB receivers

- http://www.goes-r.gov/resources/docs.html
- GOES-R Product Users Guide (PUG)
- Describes the format and content of GRB data
- http://www.goes-r.gov/resources/docs.html

Community Satellite Processing Package (CSPP) GRB Prototype 0.1 Release

- Prototype release of the CSPP Geo GRB software that will allow Direct Broadcast users to process GOES Rebroadcast (GRB) data received on their antennas from the GOES-R satellite, after it is launched in 2016.
- The main functionality included in this release is to ingest a simulated GRB data stream, recover Advanced Baseline Imager (ABI) Level 1 and Geostationary Lightning Mapper (GLM) Level 2 data payloads, reconstruct the datasets, and write output to mission-standard NetCDF files. Optionally, quicklook images can be generated from the ABI radiances.
- Later releases will add support for recovering data from the remaining GOES-R instruments: SUVI, EXIS, MAG and SEISS.
- This software is supported on 64-bit Centos6-compatible Linux platforms.

- Publicly available for download (and free to use) at: http://cimss.ssec.wisc.edu/csppgeo/grb_v0.1.html

**Transitioning HRIT/EMWIN from GOES NOP to GOES-R:**

- NOAA NWS Emergency Managers Weather Information Network (EMWIN) is a priority-driven weather data broadcast service broadcast
  - Alerts/Watches/Warnings
  - Forecasts, Graphic Format Products and Imagery
  - Low cost ground receive stations

- The NOAA NESDIS Low Rate Information Transmission (LRIT) is a collection of reduced resolution GOES and MTSAT imagery and products
  - GOES Visible, Infrared and Water Vapor Imagery at 4 Km Spatial Resolution
  - MTSAT Visible, Infrared and Water Vapor Imagery on LRIT-West
  - Tropical Storm Information
  - Copy of GOES Data Collection Service (GOES-DCS)

- HRIT/EMWIN data service will be provided in the existing Global Specification for HRIT/LRIT

- The GOES-R HRIT/EMWIN service combines LRIT and EMWIN with GOES-DCS on a single ~ 1 Meter Antenna

- Improved data products for hemispheric retransmission
  - Faster full disk images: between 15 and 30 minutes
  - Warnings, Watches, Tropical Storm Information
  - Copy of GOES Data Collection System (GOES DCS)
  - Requires new antenna and receiver hardware
  - Receiver frequency shift to 1694.1 MHz from:
    - EMWIN 1692.7 MHz and LRIT 1691.0
  - BPSK Polarization; EMWIN shift from Offset QPSK
  - Data Rate to a combined 400 Kilobits per Second from: EMWIN: 19.2 Kbps and LRIT : 128 Kbps (combined 147.2)

- Documents and updates to be posted on the GOES-R web site:
  - http://www.goes-r.gov/ -- http://www.goes-r.gov/users/hrit.html

**Getting Ready for JPSS**

- JPSS shall provide the DR community with software, documentation, and periodic updates to enable them to produce data products from JPSS, using their own hardware to receive the JPSS HRD broadcasts

- NOAA provides DR software packages under the JPSS Program Science. The software is called the Community Satellite Processing Package

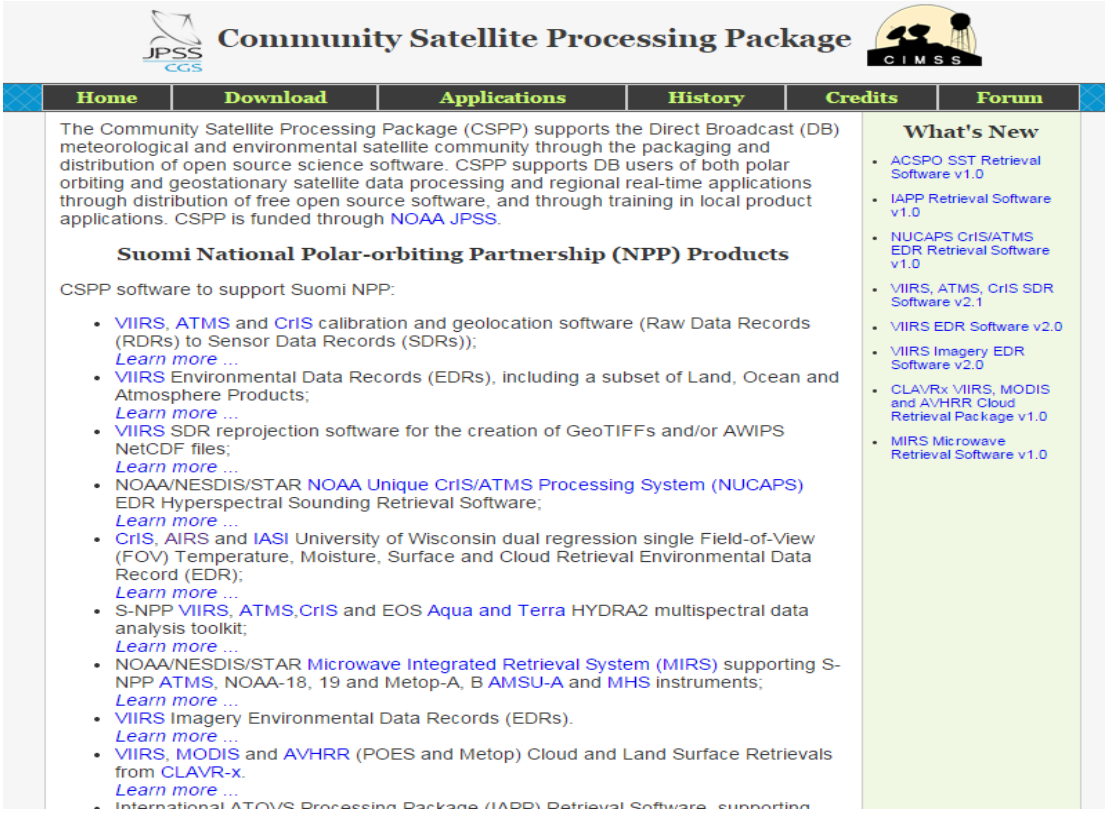



***Figure 5*** *Satellite Communication links*

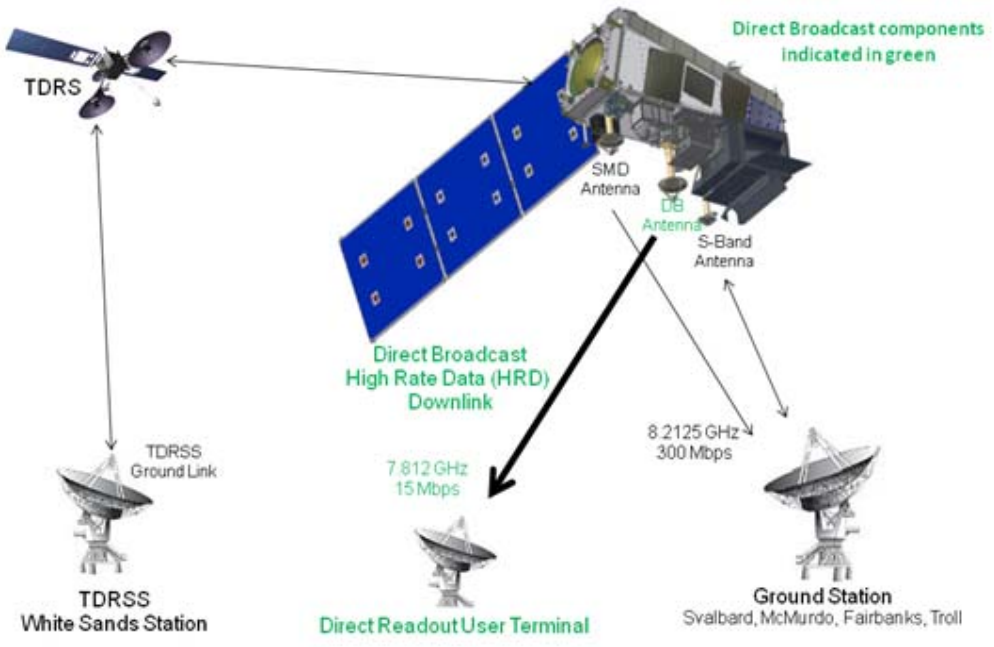



***Figure 6*** *Field Terminal System (FTS) Level 1 Requirements*

- JPSS Level 1 Requirements Document (JPSS L1RD) provides the fundamental requirements and scope of JPSS Field Terminal
  - JPSS-1 and JPSS-2 will provide High Rate Direct Readout (HRD) broadcast in X-band, ~15 Mbps downlink
  - JPSS shall provide the DR community with software, documentation, and periodic updates to enable them to produce data products from JPSS, using their own hardware to receive the JPSS HRD broadcasts
- The JPSS Program is not responsible for developing, testing, or deploying any JPSS capable field terminal
- JPSS will not perform encryption of the direct broadcast

**Key Functions of FTS**

- Hardware Specifications
  - Suggested field terminal configurations
- DFCB and RF-ICD
  - Containing specifics on direct broadcast data format
- Software to produce RDRs from packets
  - Provide and maintain RT-STPS
- Algorithms & Software
  - Used to create data products from direct broadcast
- Updated algorithms & software
  - Notification when updates are available
- Mission Support Data
  - Ancillary/auxiliary data
  - Maintain list of registered users
    - Condition for NTIA Frequency allocation approval
  - Mission status
    - Users are provided status of the JPSS direct broadcast
  - HRD Link status
    - Users are provided post-pass performance information
  - On-orbit checkout and special tests
    - Gather feedback from FTS community
  - User community prioritization of the HRD link
    - Provide feedback to the Program
  - Promote the use of the JPSS data products from HRD link
- The NOAA software interface to the direct readout community for software is the NOAA CIMSS Community Satellite Processing Package (CSPP)
- FTS will leverage existing annual workshops to provide a forum for the DB community to present, discuss, learn, and provide feedback to the JPSS Program

CGMS WGI thanked NOAA for the detailed presentation on the plans for transitioning to GOES-R and JPSS, and noted the approach proposed of annual workshops to gather feedback on the JPSS

program. In the discussions following the presentation of the WP, WGI agreed two actions. The first one relates to the possible inclusion of the GLM products in the HRIT stream. The second action relates to clarifying the need to register as user for Direct Broadcast.

WGI raised an action for the attention of WGIII for NOAA to consider including GLM products in the HRIT stream (see WGIII report)

| CGMS-43 actions - WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| NOAA | WGI/4 | A43.03 | NOAA to assess the need for user registration for Direct Broadcast | CGMS-44 | OPEN | HLPP # 1.4 |
| CGMS space agencies | WGI/4.2 | A43.04 | CGMS members to comment on the work done in the context of the EUMETSAT provided VIIRS Regional Service, and to provide feedback on the proposal to define a standardised compact product format, generalised to cover the advanced imagers of the current and planned polar orbiting satellites. | CGMS-44 | OPEN | HLPP # 2.6 |

**EUM-WP-05** presented a summary of the assessment done by EUMETSAT on the potential of the global specification for HRIT for future GEO systems. The CGMS LRIT/HRIT Global Specification defines the global aspects of an architectural specification for standardised data dissemination from geostationary satellites towards LRIT/HRIT user stations. The role of this global specification may benefit from being re-evaluated in the context of the adoption by data providers of widely established standards for data dissemination and formats. EUM-WP-05 proposes a number of areas of the CGMS LRIT/HRIT Global Specification which should be considered for update.

With this inputs provided, WGI debated the need to evolve the existing CGMS Global specification for GEO systems (Global Specification 03) to efficiently format and disseminate L1 and L2 products in the future (beyond the systems already in operations and planned to enter into operations in the next 3-5 years – as they have consolidated their design already). Therefore CGMS WGI agreed to include in the HLPP a dedicated entry to work on the evolution of the documents (as necessary to keep up with new formatting standards and adapt it to potential evolutions on the dissemination systems). Progress will be achieved by specific inter-sessional meetings (e-meetings) of the task team nominated following action CGMS-WGI-42.05

**I/5 Data collection systems**

EUM-WP-06 presents the work performed on behalf of CGMS in the SATCOM Forum in the context of Data Collection Systems. The paper contains information about the DCS and A-DCS systems of the CGMS partners, this will be used as an input to the first SATCOM Forum planned for the end of 2015/beginning 2016.

**BACKGROUND**

The International Forum of users of satellite data telecommunication systems (SATCOM Forum) is an entirely self-funded body jointly sponsored by the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO, of the United Nations with the view to address the requirements of these two Organizations for the timely collection of environment data from observing platforms.

The following is an extract from the Executive Summary from the Ad Hoc International Forum of users of satellite data telecommunication systems (SATCOM Forum) held on Paris, France, 3-4 October 2013.

*The ad hoc international Forum of users of satellite data telecommunication systems (Satcom Forum) was held at the headquarters of the Intergovernmental Oceanographic Commission (IOC) of UNESCO in Paris, France, from 3 to 4 October 2013, and was chaired by Mr David Meldrum (United Kingdom). 33 participants from 12 countries, and representatives of the satellite data telecommunication service providers, and the satellite equipment manufacturers also attended the meeting.*

*The objective was to build on the previous session (Toulouse, April 2012) to determine whether the Forum should become an established expert group, meeting on a regular basis. The future Forum is meant to provide an international mechanism, covering the wide user base that exists within the co-sponsoring Organizations, to address remote data communication requirements – including tariff negotiations as needed – for automatic environment observing systems using satellite data telecommunication systems (Satcom systems).*

*The meeting reviewed the World Meteorological Organization (WMO) and IOC user requirements for the collection of meteorological data from remote areas (including buoys, ship-based observing systems, seal level observing stations, Automatic Weather Stations, Polar Observations, profiling floats, and animal tracking). It reviewed the capabilities and the tariff schemes of the satellite data telecommunication systems that are mostly being used for the collection of environmental data from remote areas, and discussed the role that they could play in the future Forum. The meeting noted that the future Forum is meant to provide guidance to the WMO and IOC users on the use of Satcom systems, including guiding them on how to make the best arrangements for the purchase of airtime. The Forum will provide detailed information on satellite systems capabilities so that users will be able to make informed decisions on which system to use.*

*The meeting established an interim Executive Committee for the Satcom Forum to drive the work plan, which should lead to the formal establishment of the Forum by the sponsoring Organizations. The meeting reviewed the draft Terms of Reference of the Satcom Forum, proposed some changes to reflect the proposed reporting of the future Forum to the Executive Bodies of WMO and IOC through the Commission for Basic Systems (CBS) Management Group, and the GOOS Steering Committee respectively.*

**Satcom Forum Terms of Reference**

The Terms of Reference agreed by the interim Executive Committee are:

- Provide proper coordination amongst the users of satellite data telecommunication systems and represents their collective interests in working with the satellite telecommunication service providers and the industry in order to advance the awareness and understanding of the user requirements;
- Advance the awareness and understanding of available and planned capabilities;
- Facilitate adoption of interoperability and quality standards and principles as needed;
- Investigate and propose as appropriate cooperative and tariff negotiation mechanisms on the use of satellite data telecommunication systems;
- Provide guidance to best meet user needs of each considered application;
- Report to the executive bodies of WMO and IOC through the Commission for Basic Systems (CBS), the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), and the GOOS Steering Committee respectively.

Membership is open to all representatives of the co-sponsors stakeholders. The Satcom Forum Terms of Reference have now been approved at CBS-15th session, and will be formalised at the next WMO Congress in June.

**Satcom Forum and CGMS**

EUMETSAT (Sean Burns) is the CGMS representative to Satcom and is also a member of the interim Executive Committee.

Information about the Data Collection Systems of CGMS members has now been collected and is contained in Annex I and Annex II. This data will be reviewed during the WG I discussions and will be used as an input into the first Satcom Forum. The first SATCOM Forum is planned for late 2015/early 2016.

CGMS WGI thanked EUMETSAT for the dedicated report and update of information regarding the status of preparation for the first SATCOM Forum and agreed to review the data collected by the CGMS representative in the SATCOM Forum on the Data Collection Systems of the different CGMS members. Due to the shortage of time during the WGI meeting it was decided to perform this review offline and a dedicated action is agreed at WGI level for performing this review before the end of summer 2015.

| CGMS-43 actions – WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS member | WGI/5 | A43.05 | CGMS Members to assess, comment on the info package for the SATCOM Forum prepared by the appointed CGMS representative | 30 Oct 2015 | OPEN | HLPP # 1.2.1 |

CGMS WGI also agreed that, under the HLPP, the appointed CGMS representative in the SATCOM Forum will provide regular updates (annually) to CGMS WGI to confirm the status of preparation for SATCOM Forum, a WGI inter-sessional meeting (together with more general frequency coordination topics) is agreed to take place at the end of 2015.

**JMA-WP-06** reports on the present status of the Japan Meteorological Agency (JMA)'s Data Collection System (DCS) and related future plans, highlighting a recent increase in the number of Data Collection Platform (DCP) stations for which DCS regional channels are used for better tidal/tsunami monitoring.

**Introduction**

JMA has operated the Data Collection System (DCS) since its first Geostationary Meteorological Satellite (GMS) was launched in 1977. As follow-on satellites to the current MTSAT-1R and MTSAT-2 units, Himawari-8 and Himawari-9 are scheduled to become operational in July 2015 and 2017, respectively. These satellites will continue to provide services for the DCS, which plays an important role in collecting meteorological information as well as earthquake and tidal/tsunami data.

The name MTSAT-DCS will also be changed to Himawari-DCS with the operational satellite switchover in July 2015. DCP stations using MTSAT-DCS will be able to use Himawari-DCS with no change in DCP antenna direction or DCP settings and no reapplication to JMA.

**Current status of MTSAT-DCS**

Figure 7 shows the expansion of tidal/tsunami DCPs for which MTSAT-DCS regional channels are used. In addition to this increase, more frequent collection (from every 15 minutes to every 6 minutes) is being implemented for some tidal/tsunami DCP stations in consultation with the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) to support enhanced monitoring.

In 2014, nine DCPs began operation, and five DCPs have shortened the collection time from every 15 minutes to every 6 minutes. In 2015, Fiji DCP began operation.

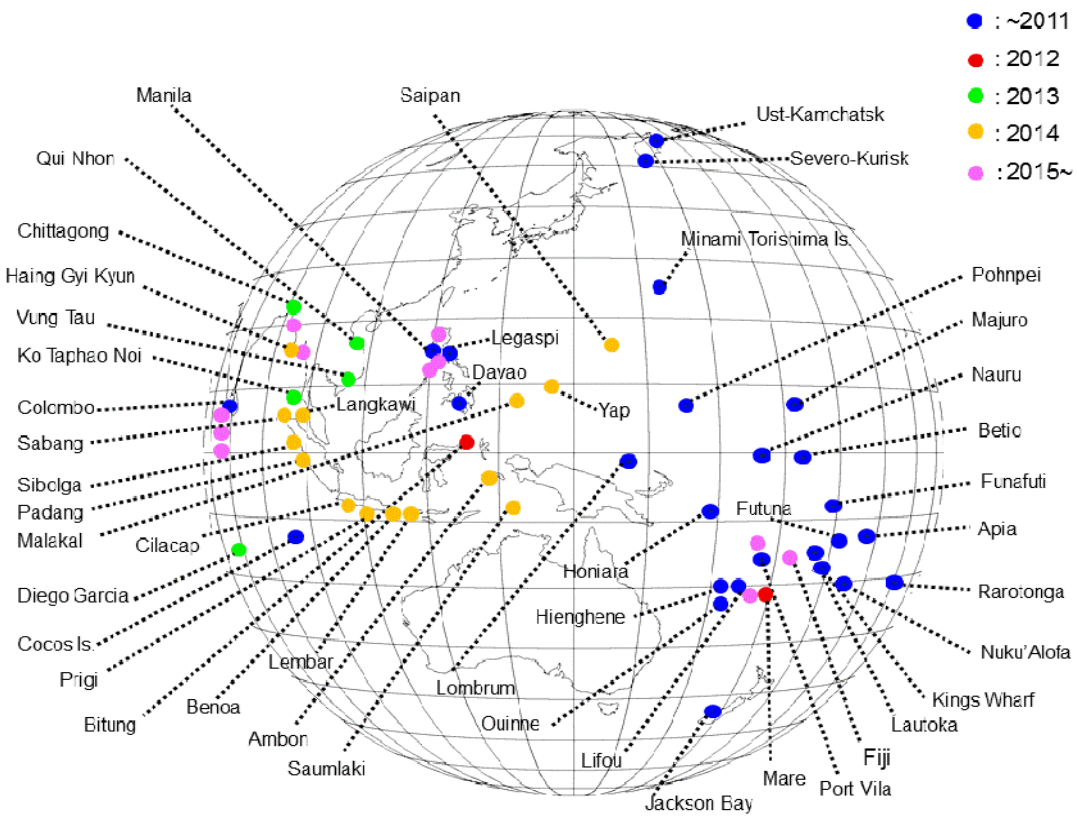



***Figure** 7 Expansion of tidal/tsunami DCPs for which MTSAT-DCS is used*

**Requests regarding the use of MTSAT-DCS and Himawari-DCS**

JMA is receiving more and more requests regarding the use of its MTSAT-DCS. Based on the importance of disaster reduction/mitigation activities in the relevant regions and the significant role of the DCS in such work, JMA has positively responded to such requests. Recent instances have been related to:

- Vietnam's plan to install more than 100 hydrometeorological DCP stations for disaster prevention along the Mekong River
- Vanuatu's request for two new tidal DCP stations
- A request from France's Service Hydrographique et Océanographique de la Marine (SHOM) for new tidal DCP stations in the Indian Ocean and the western Pacific
- Requests from the University of Hawaii Sea Level Center (UHSLC) for developments including transition of the use of DCS from Meteosat-7 to MTSAT and enhanced data collection periodicity

**Himawari-DCS data flow**

JMA's new satellite, Himawari-8, will assume MTSAT-1R's DCP data relay duties when it begins routine observation in July 2015. As Himawari-8 is located at 140.7°E, which is very close to MTSAT-1R's position at 140°E, DCP stations using MTSAT-DCS will be able to use Himawari-DCS with no change in DCP antenna direction or DCP settings and no reapplication to JMA. Himawari-8 and -9 will use the Ka band (up to 18 GHz) as the downlink frequency for relaying DCP data as opposed to the L band (up to 1.6 GHz) used on the current MTSAT-DCS. To cope with the effects of rain attenuation in the Ka band, JMA will introduce site diversity with two receiving stations in Tokyo and Hokkaido. As these stations are more than 800 km apart, they are unlikely to be affected by heavy rain at the same time. This is expected to guarantee 99.99% uptime in radio communication.

As shown in Figure 8, data transmitted from DCP stations to Himawari-8 are relayed to the Tokyo Station and the Hokkaido Station before being demodulated. The quality of data at both stations is compared, and the set with fewer errors is chosen for use. After format conversion, the data are distributed globally via GTS. Along with these distribution efforts, JMA provides online access to the data and an email transmission service as backup with the aim of creating redundancy in data distribution to users.

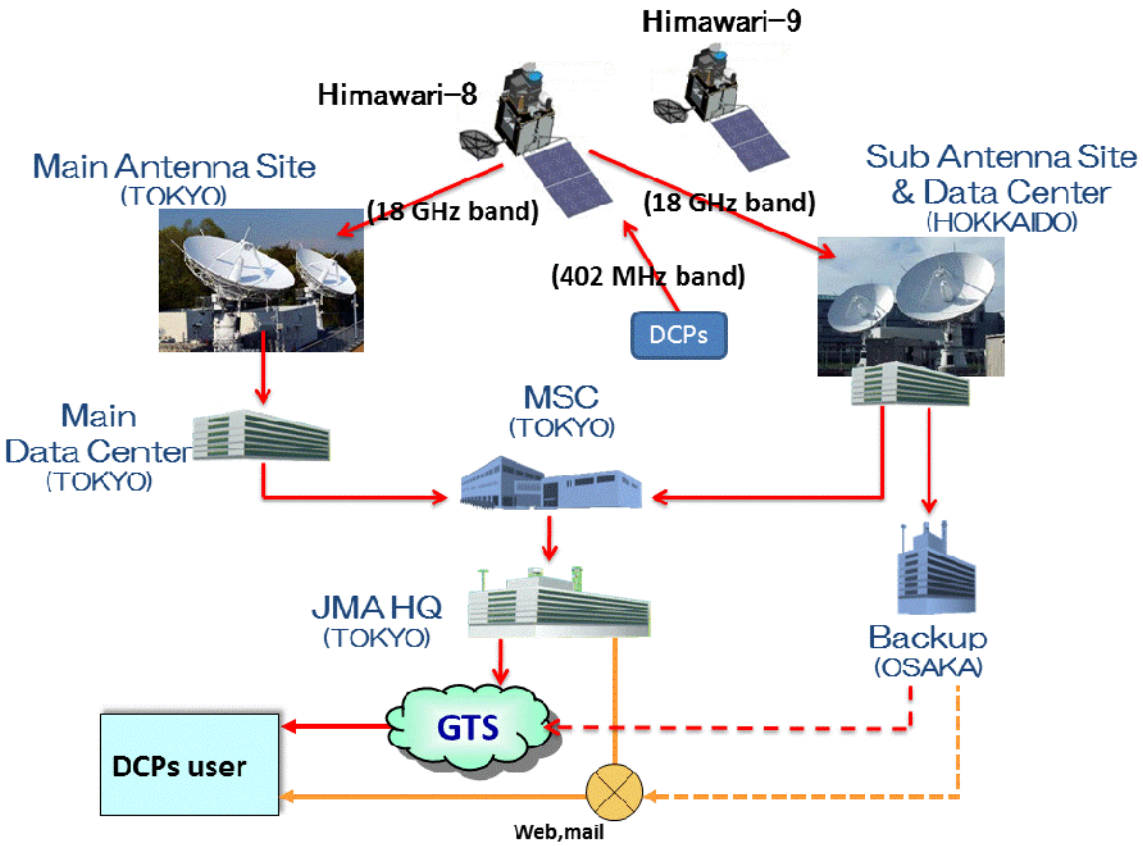



***Figure 8*** *Himawari-DCS data flow*

WGI expressed its appreciation for the dedicated report provided by JMA and asked JMA for confirmation on the plans to support HRDCPs in the evolved system using Himawari 8 and 9. JMA confirmed that currently there are no plans to introduce HRDCPs in the system.

**NOAA-WP-11** provides a status report on the performance of the International Data Collection System (IDCS) and NOAA's domestic DCS. NOAA's DCS Administration and Data Distribution System (DADDS, serving GOES DCS users) now has approximately 1500 individual users, with almost 800 organizations using the system.

NOAA has continued with populating user and platform tables, registering and training users, and has recently completed the task of upgrading browsers, including implementing a framework structure to simplify this task in the future. Soon NOAA will be rolling out an automated System Use Agreement processing system and online registration database for users of all NOAA satellite data, and will be developing a Machine to Machine Interface to simplify bulk updates for larger users.

NOAA has been using newer Version 2 transmitters (requiring half the bandwidth of existing transmitters) and already has integrated almost 5000 in the system. Implementation of 300 baud transmitters was fairly simple as they could be placed on existing 300 baud channels. However, the 1200 baud channels do not line up with existing channels, so NOAA has been clearing channels at the lower end of the spectrum to make room for new 1200 bps channels. NOAA continues to use a borrowed channel from EUMETSAT to ease this transition. The ultimate goal is to relocate the 1200 baud channels to the lower end of the spectrum, where channels have almost been vacated by 100 baud transmitters. The transition to high data rate (HDR) is officially complete, with approximately 50 of the 24,800 platforms that are active still reporting at 100 bits/sec. NOAA has communicated with owners of the still operating platforms to arrange termination. NOAA plans to continue to investigate the use of two way communications to better command and control platforms and has recently kicked off a study to capture the current state of technology before proceeding. Use of the international channels is minimal. NOAA is using the channels assigned to us for our domestic use by CGMS, and has already made assignments on all of them. A fully redundant backup system has been located in Suitland, Maryland since 2010, and is being fully utilized by users and by developers who continue to roll out enhancements to DADDS by testing them at the Suitland site first. In the near future we will add a more reliable feed to the LRIT (and eventually HRIT) systems, with the ultimate goal of phasing out our DOMSAT rebroadcast. Use of the GOES DCS continues to flourish in the U.S. The POES DCS (aka Argos) has 21,000 active platforms, supporting 2,000 programs/users in 100+ countries. The Argos space segment currently consists of NOAA-15/18/19, Metop-A/B, and SARAL. Future launches include Metop-C (~2018) and Metop-SG-B1 (~2022) by EUMETSAT, with additional launches by ISRO & NOAA also being planned (~2018-2019), and with exact details still being determined.

**DADDS Status**

NOAA's DCS Administration and Data Distribution System (DADDS) was placed into operation in October 2009. The system was brought on line with minimal capability, but has grown to be a highly functional system. Enhancements have continued, but the system is now considered almost complete, and NOAA is now moving into refresh mode. The tasks of capturing and maintaining user

and platform information and registering and training users to employ the system continue to be a major focus, but NOAA's priority for the past year has been to refresh operating systems and database tools, and make required enhancements to meet IT Security requirements.

The backup DADDS in Suitland, Maryland is operable, but is also the test-bed for system modifications. Both Wallops and Suitland have duplicate systems, so at least one system should be available for use at all times at each site. In an emergency the test system can be quickly reconfigured and available for use. The major change from DAPS to DADDS is the requirement for each user to have an individual login (instead of agencies sharing one among all their users). DADDS has now authorized more than 1500 individual users in the system. DADDS manages all platform and user information and automatically distributes data to most rebroadcast circuits. It can also be used by individual users to download message data, and improving that capability has been a focus this past year. NOAA has improved the download capability by reinstating the "network list" function from DAPS, which is a capability to store a list of id's of interest to each individual user (or agency). This will make selection of message data from specific platforms easier to manage. NOAA is also working to integrate our online System Use Agreement (SUA) processing system into DADDS. The SUA processing system was taken offline 3 years ago due to security issues, and has had a lower priority in the DADDS implementation than other tasks, but is moving up in the queue. These tasks were completed in 2014, but new IT security scanning reviews must be completed before the new capabilities are rolled out. In 2013 a task to update the html code to a standardized html5 was begun, but we quickly realized that the standard was still far from being universal. The task of keeping code up to date has been challenging due to the speed of advancement of Internet browsers. DADDS can be used with Internet Explorer 8, and with newer versions of Chrome, but most users find using Firefox to be more reliable at the moment. We have completed our next step to implement a "framework" tool, Bootstrap, to simplify management of code for use of multiple browsers. These improvements are also awaiting security scanning before rollout.

**Version 2 (v.2) Transmitter**

NOAA finalized new transmitter Certification Standards (designated as "Version 2" or v.2) in 2010, which allow transmitters to use smaller channels. This will double the capacity of the system when fully implemented. All existing high data rate vendors are now "Version 2" certified, and vendors are now prohibited from selling Version 1 transmitters. Changes to the digital demodulators have been implemented, allowing new transmitters and legacy transmitters to operate on the same channels at 300 baud. Changes to the filter from the legacy "Bessel" filter to the new "Square Root Raised Cosine" (SRRC) filter have been deployed onto both the NSOF and the Wallops DADDS. (A study several years ago identified the SRRC filter as the best choice for NOAA's system, but verified that the new transmitters could continue to operate using the Bessel filter in the receive system with minimal impact to data reception.) NOAA's ground system is now completely v.2 compatible. As new platforms are deployed and legacy transmitters are removed from the system, the channels will eventually become realigned. Once the existing channels are realigned, we will insert new channels between them. This approach to transition will minimize the impact on users of existing systems. Users will be given a 10-year timeframe to upgrade their existing transmitters to the new standard. Most transmitters may be upgradeable through a software change. Users have begun utilizing the new transmitters. The system is now populated with almost 5000 of the new models. The final step

in NOAA's transition, the development of tools to identify and track v.2 transmitter use in our ground system, has been completed. This tool will allow to monitor the transition, and to insert new channels as they become available. It is expected that the addition of new channels will be gradual, rather than instantaneous, so purchasing of additional demodulators will be an incremental process. In early 2014 NOAA implemented the first v.2 1200 baud channels, 1 in NOAA's existing bandwidth allocation, 1 in borrowed bandwidth from EUMETSAT after a user accidentally deployed v.2 transmitters into v.1 1200 baud allocations. The transmitters (which are used for tide monitoring) report too frequently for use in NOAA's multiuser allocation, and required a dedicated channel for management. We have now begun to clear new channels at the other end of the spectrum, and have begun implementing the new1200 bps channels. NOAA should be able to move the user out of EUMETSAT's allocation within the next year.

**High Data Rate Transition**

The transition to high data rate is almost at an end, with 24,800 platforms actively using NOAA's DCS at the time of this writing. Of that number only 50 are 100 bits per second (bps). NOAA has held discussions with the few remaining users of 100 bps transmitters who have not met the deadline of May 31, 2013 to have all 100 bps transmitters removed from the system. A few have requested a few more months to work with upgrading those systems. We are using the new channels allocated to NOAA by the CGMS and have some assignments on most of them. Several of these are allocated to international tsunami warning networks which have requirements for very frequent transmissions (in most cases transmitting every five minutes.) During the past year this requirement has continued to grow. This high demand has challenged NOAA to seek other ways to increase capacity, and we are hopeful that EUMETSAT's implementation of a high data rate capability will make it possible for the 2 systems to cooperate in supporting the Caribbean for the future.

**Rebroadcast of DCS Data**

Due to the critical nature of data sent through DCS in the U.S. NOAA provides many ways of rebroadcasting data to ensure reliability of delivery. Two such rebroadcasts are through a commercial satellite service called DOMSAT, and through the Low Rate Information Transfer (LRIT) system off of GOES. NOAA continues to investigate the possibility of dropping the commercial rebroadcast over a long period of time (6 years) by making the LRIT, and the follow on HRIT (High Rate Information Transfer) system more reliable and efficient.

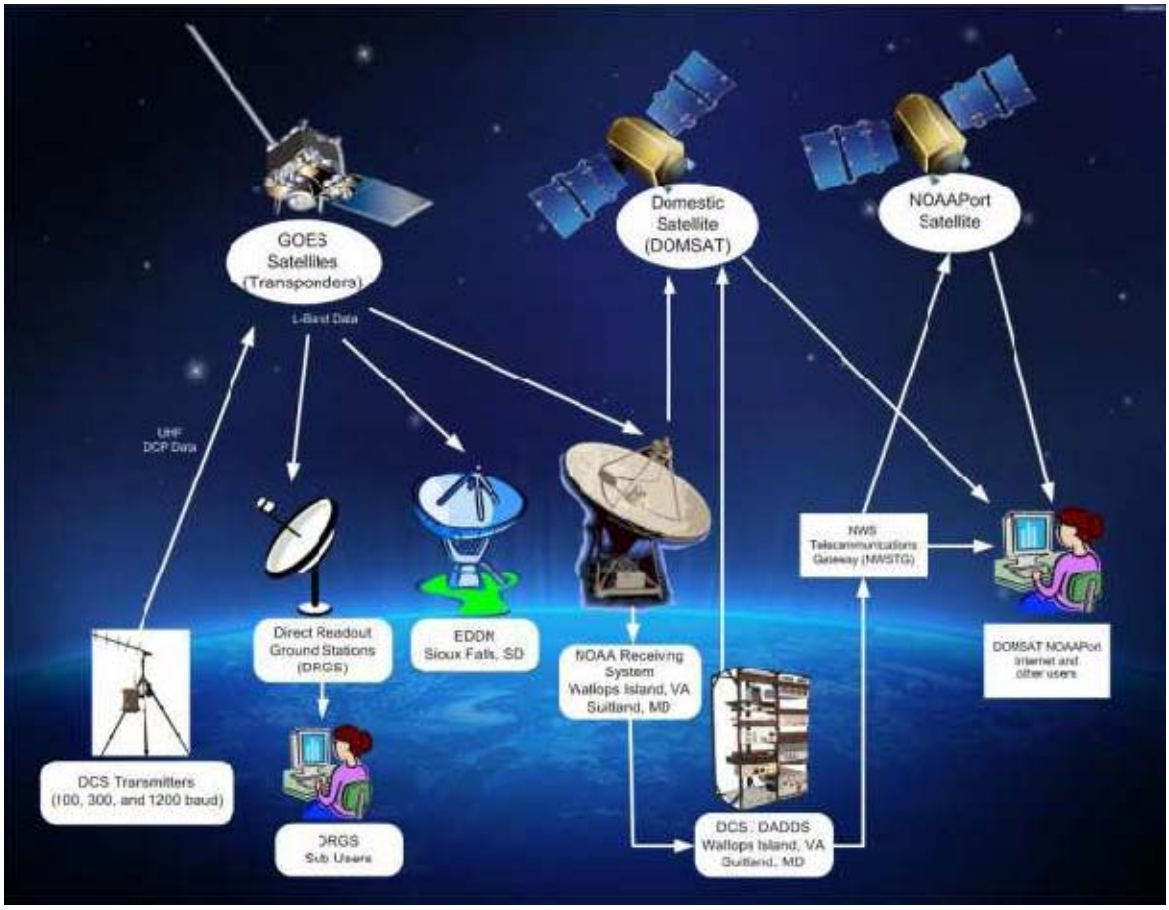



***Figure 9*** *Rebroadcast of DCS Data*

Commitment to funding the DOMSAT appears to be strong by both U.S. and neighbouring international agencies, so NOAA expects to continue this rebroadcast until we have fully tested and made required improvements to alternative methods. The administrative burden to perform this activity is high, so NOAA is continuing to look forward to replacing it with a less unwieldy process. U.S. users have continued to fund the DOMSAT rebroadcast through May 2016.

**Data Collection Platform Command (DCPC) development**

With progress in many NOAA priorities, including DADDS and Version 2 transmitters, NOAA is looking forward to continuing research into this area and to providing a successful implementation in the next few years. More resources will be devoted to the project once other development activities are completed. In 2015 NOAA kicked off a study task to define the state of technology and make recommendations in the best way to proceed with this task. A report will be made to the NOAA user groups and to NOAA management at the end of April. The report will document for NOAA management that a requirement for this activity continues from the NOAA user community. In the meantime, some vendors and users have begun to use Iridium as an alternate means of providing the platform control users require. NOAA is looking forward to seeing where this

cooperative venture might lead. Once NOAA reviews the study report, a best path forward will be determined.

**Frequency Concerns**

A broader push from the commercial sector and from other government agencies to look at using spectrum used by NOAA has surfaced over the past several years. A small band of frequencies used by NOAA polar orbiting satellites was just auctioned for approximately $2.4B U.S. With those sums of money available this problem is not likely to go away. The band used by GOES is under review. NOAA and other U.S. users are rallying to document the functions performed by NOAA satellites and to make known potential impacts. NOAA continues to monitor this activity closely, to minimize potential impact to operational systems. This topic will be addressed in other presentations. An additional concern to NOAA is the question of how to identify and manage unknown interference issues. Over the past several months interference has impacted NOAA systems significantly. Fortunately most events resolve themselves quickly, but a few have been long term in nature. One instance was determined to be interference from an entity interested in gaining access to NOAA's bandwidth. The FCC and other U.S. officials continue to press government agencies to find new technologies that will allow sharing of bandwidth.

**Interference from "Ionospheric Scintillation" from Solar Activity**

Near the end of 2011 NOAA began noticing interference to transmissions from a small number of platforms, primarily those near the North and South Poles (Canada and South America.) The data losses were not widespread, but instead seemed to be constrained to small areas, narrow time frames and specific platforms. After much investigation we concluded that the interference was coinciding with increased solar activity. This pattern seemed to be traced to a phenomenon called "Ioniospheric Scintillation", an ionization of a specific layer of the ionosphere that causes refraction and diffraction of radio waves. The pattern has also been tied to GPS interference.

The activity has appeared to decrease slightly in 2015, as the most active period dies down. While NOAA has continued to monitor this activity, and to understand it a little more, we have made little progress in finding ways to mitigate it. NOAA will continue to study this event, with the hope that we can be prepared to respond to the next cycle, expected in about 9 years.

**STATUS OF IDCS**

No new assignments have been made in the last year. Current allocations include:

| New International Channels | 224 | 226 | 228 | 230 | 232 | 234 | 236 | 238 | 240 | 242 | 244 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel # | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 |
| # of PLT(s) | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 4 | 0 | 0 |

A query of the DADDS message table showed no transmissions from any of these platforms.

**INTERFERENCE TO THE IDCS**

Due to the current limited use of the IDCS no monitoring is performed. If the usage expands NOAA's DADDS provides tools to make it easier to monitor interference.

**CONSOLIDATED LIST OF IDCS ALLOCATIONS**

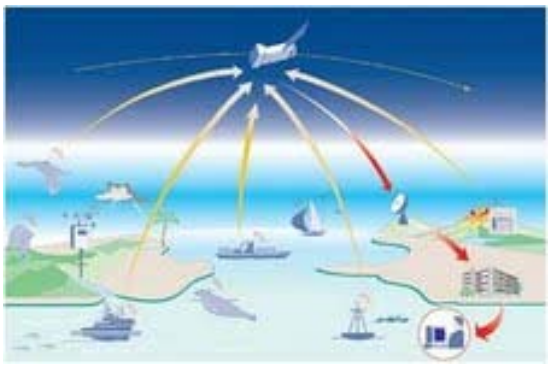
There have been no new allocations.

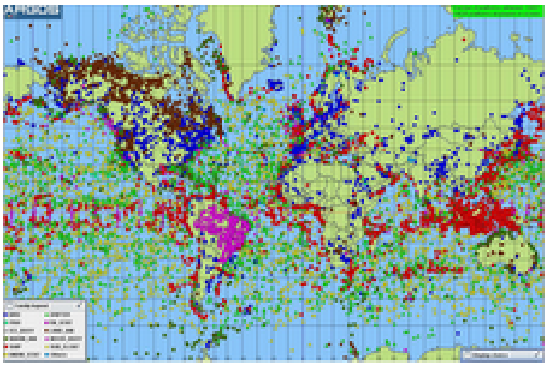
**STATUS OF THE ARGOS DCS**

The Argos Data Collection and location System (DCS) provides global coverage and platform location for government and non-profit agencies (which are reviewed and approved by CNES and NOAA), and for non government organizations with a vested government interest. The Argos program is administered under a joint agreement between the National Oceanic and Atmospheric Administration (NOAA) and the French Space Agency, Centre National d'Etudes Spatiales (CNES). Additional partners include EUMETSAT and the Indian Space Research Organisation (ISRO).

The system consists of in-situ data collection platforms equipped with sensors and transmitters and Argos instruments aboard NOAA, EUMETSAT, and ISRO polar-orbiting satellites. The global environmental data sets are collected at telemetry ground stations in Alaska, Virginia, Norway and Antarctica; and pre-processed by the National Environmental Satellite, Data, and Information Service (NESDIS) in Suitland, Maryland. Regional data sets are collected via a global network of HRPT stations. Two CNES subsidiary companies, Collecte Localisation Satellites (CLS) in France and CLS America in Maryland process the data and deliver it to users (and for met-ocean data, post it to the GTS).

Flying the Argos system aboard polar-orbiting satellites provides worldwide coverage. Additionally, incorporating the Argos instrument on a moving satellite allows a platform to be located using Doppler shift calculations. This positioning capability permits applications such as monitoring drifting ocean buoys, wildlife migrations, and commercial fishing vessels, among many others.





There are currently more than 21,000 active Argos Platforms being tracked by over 1,900 users in 118 countries. Argos use has steadily risen since its inception over 30 years ago, and especially in the last decade (subject to seasonal variation). The data latency requirement for the system is 60-

minutes, with 30-minutes strongly preferred. This is achieved by a robust spacecraft constellation and ground system.

Frequency uses include Platforms to Spacecraft – 401.65 MHz; Spacecraft to Platforms (for Metop-A and SARAL with operational Argos-3 instruments) – 465.9875 MHz; and Spacecraft to Ground Stations – 1695-1710 MHz. Future use of 399.9-400.05 MHz is anticipated for non-environmental applications, beginning with the next Argos launches by ISRO & NOAA (~2018-19), with the first Argos-4 instruments.

WGI thanked NOAA for the detailed and comprehensive report covering all aspects of the DCS and A-DCS under NOAA responsibility. It was also noted that any update of information regarding the status of these systems can be found at: http://www.noaasis.noaa.gov/DCS/ & ttp://www.noaasis.noaa.gov/ARGOS/.

**ROSHYDROMET-WP-02** addresses the current status and technical specifications of Russian data collection system, and related future plans. The DCS is established to provide collection and distribution of meteorological data from the remote areas and to support natural hazards warning systems.

Russian data collection system (DCS) has been established to provide satellite channels for meteorological data transmission from data collection platforms (DCPs) via meteorological satellites (backup option – via Luch communication satellites).

The DCS was developed according to the international requirements of WMO and CGMS and has to provide transmission of the messages every 3 hours (standard synoptic hours), and also storm warnings at any time. The development of the national DCS was started in SRC Planeta in 1990s. In the absence of national geostationary meteorological satellites (GMS) until 2011, the initial testing and experimental operation of DCS was based on Meteosat satellite (under the bilateral agreement between Roshydromet and EUMETSAT).

**Technical specifications**

DCP signals are transmitted via dedicated satellite channels at frequency ranges of 401.5-402.5 MHz (uplink) and 1696.5-1697.5 MHz (downlink) with transmission rate of 100 or 1200 bps. The message size is up to 15 000 bit. The transmission time is synchronized with GLONASS/GPS signals. System capacity allows data transmission from 300 DCPs simultaneously that provides throughput of 3000 DCPs in 10 minutes. The Russian DCS is developed for data transmission via the meteorological satellites: series of Electro-L GMS (constellation of three spacecraft to be located at 76E, 14.5W and 166E), series of Meteor polar-orbiting satellites (constellation of three spacecraft), series of Arctica highly elliptical orbit satellites (constellation of two spacecraft), and also series of Luch geostationary communication satellites.

The constellation of Electro-L GMS (with backup option via Luch communication satellites) provides coverage of the territory from about 75S to about 75N, the highly elliptical orbit satellites will give the coverage of high Arctic latitudes, polar-orbiting satellites will cover the regions outside the area mentioned above, but less frequently (see Figure 10).

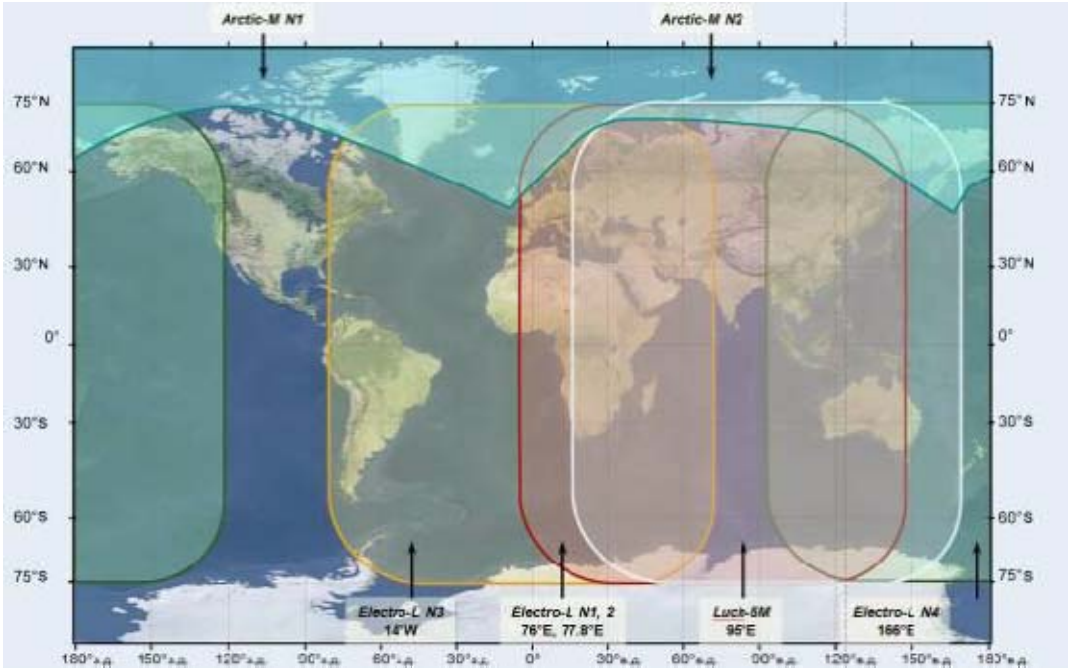



***Figure 10*** *The coverage of Russian geostationary and highly elliptical orbit satellites.*

**Current status**

At the present time national Data Collection System is in experimental operation based on Electro-L N1 GMS (with backup option via Luch-5B communication satellite) in SRC Planeta.

As shown in Figure 11, messages transmitted from DCPs to Electro-L N1 and Luch-5B are relayed to the European (Moscow region), Siberian (Novosibirsk) and Far Eastern (Khabarovsk) regional centres of SRC Planeta.

There are now about 530 DCPs allocated (April, 2015). DCPs are distributed all over the whole territory of Russia, including the remote areas and northern regions with extremely low elevation angles (about 3 degrees) (Figure 12). The national DCS currently has a reliability of 99.8 % based on the number of messages successfully received.

International DCS channels on Electro-L N1 satellite could be provided to WMO members for data transmission from DCPs.

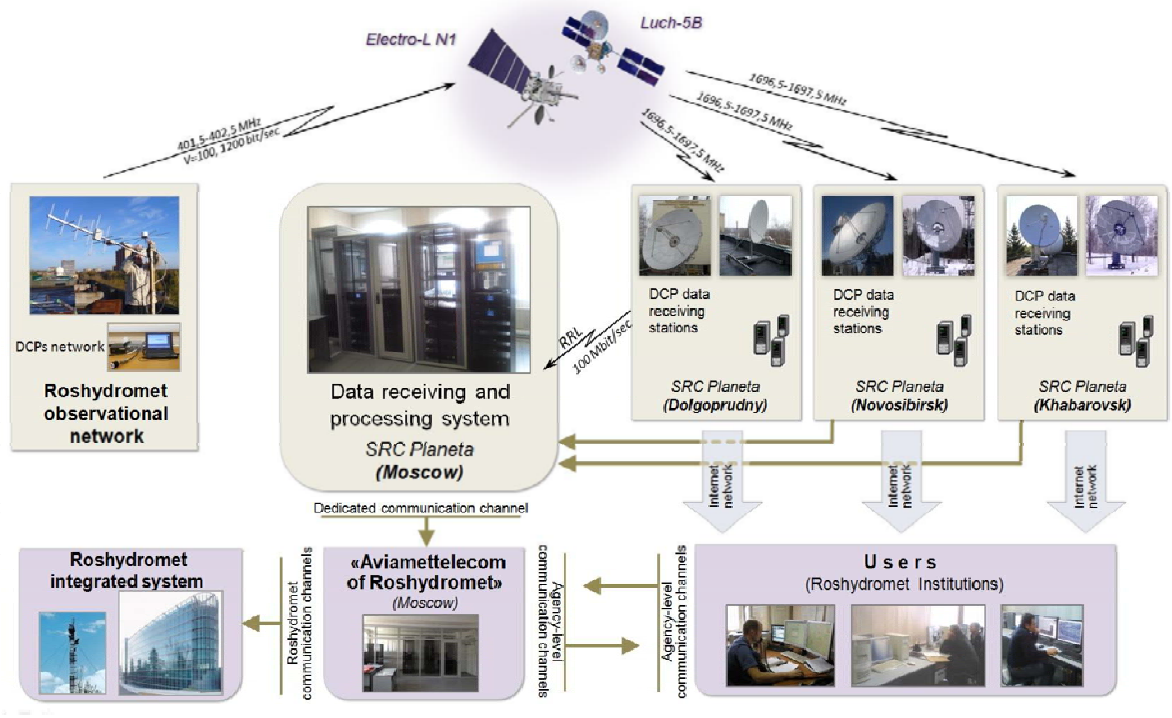



***Figure 11*** *Flowchart for current status of Russian DCS.*


***Figure 12*** *Geographical distribution of DCPs (532 DCPs, 21 April, 2015).*

WGI thanked Roscosmos/Roshydromet for the detailed report and suggested they keep CGMS informed of their continued success, confirming also the plans to make DCS related data available in the GTS.

### I/6 Regional Retransmission Services (RARS) incl. support for NPP and Metop

**WMO-WP-13** reports on the WMO work done in response to the requests from the satellite sounding community at the 19th International TOVS Scientific Conference (ITSC-19, Jeju, April 214) and to Recommendation 42.11 from CGMS-42, a coordination meeting was convened by WMO on 11-13 March 2015 with representatives of all RARS regional components, of the EUMETSAT EARS project, and of the NOAA Direct Broadcast Real Time Network (DBRTN) in order to investigate the steps to be taken to integrate the RARS, EARS and DBRTN initiatives.

At this meeting the participants agreed on the objective to build a global, integrated network of Direct Broadcast and near real-time relay services for advanced sounder and other LEO data which will be named "DBNet" and will unify the three initiatives above. In particular, NOAA and EUMETSAT will collaborate to ensure compatibility of the NOAA and EUMETSAT contributions to DBNet. The meeting reviewed an outline of a WMO Guide to DBNet which will document the agreed high-level service specifications of the system, and the best practices and standards to be complied with in order to ensure the required product quality and consistency. It is planned to present the draft version of the Guide to DBNet in October 2015 to the joint APSDEU-NAEDEX meeting and to ITSC-20 to seek feedback from these communities on the proposed specifications. It was furthermore proposed to replace the existing RARS Implementation Group by a DBNet Coordination Group with a wider membership. (See the final report of the meeting: http://www.wmo.int/pages/prog/sat/documents/DBNet-01_Final-Report.pdf.)

**BACKGROUND**

**RARS history**

In 2001, EUMETSAT initiated the EUMETSAT ATOVS Retransmission Service (EARS) project to improve timeliness/availability of ATOVS data in Europe. WMO convened Global workshops on Regional ATOVS Retransmission Services (RARS) in Dec 2004, Dec 2005, and Sept 2006. These workshops discussed the requirements for a global ATOVS retransmission service, planned and initiated a RARS in Asia-Pacific through APSDEU discussions, planned and initiated a RARS in South America through RA III discussion, and established a RARS Implementation Group.

A first RARS Implementation Group (IG) meeting was held in July 2007 to agree file naming convention, BUFR identifiers, data categories/subcategories for RARS. In May 2008 the IG discussed the implementation plan for global coverage, and software issues (AAPP). A third IG meeting in Feb 2009 provided guidance for filling gaps and monitoring. In Mar 2010 the IG discussed a plan for extension to advanced sounders, and actions on user outreach (RARS Poster at ITSC-17, Monterey). In May 2011 a 5th RARS IG meeting was convened as a side-meeting to the APSDEU-NAEDEX in Boulder, USA and discussed monitoring and operational coordination issues, as well as the extension to hyperspectral sounders and FY-3 sensors.

The need was expressed for more feedback from ITWG, which was considered as the most representative entity of RARS users. A RARS Technical Subgroup was thus convened during ITSC-18 (Toulouse, March 2012). This meeting showed that RARS/ATOVS products were used by an increasing number of NWP centres; it stressed that RARS products should be as close as possible to the global products; it encouraged the extension of RARS to advanced sounders of METOP, NPP and FY-3; and defined a roadmap for integrating METOP/IASI and NPP/CrIS.

In Oct 2012, the 6th RARS IG meeting was held at the Met Office in Exeter, UK collocated with APSDEU-NAEDEX. The meeting reviewed the roadmap for integrating IASI and CrIS, and addressed coding and data dissemination issues.

In 2013, CGMS-41 was informed of the NOAA Direct Broadcast Real Time Network initiative and agreed the following action:

- *Action 41.54: NOAA and WMO to discuss the relation of the Direct Broadcast Data Initiative (see NOAA-WP-13) to RARS, and how RARS can take advantage of this initiative.*

**ITSC-19 actions (April 2014)**

A technical subgroup meeting was jointly convened by NOAA and WMO during ITSC-19, which led in particular to the following actions:

- *SSEC (Univ. Wisconsin), NOAA, EUMETSAT, WMO should coordinate on data formats, software versions, and latency requirements and come up with a plan to provide the DBRTN products for inclusion in RARS*
- *The draft Guide on RARS which defines the RARS procedures, software, formats, data exchange convention, service requirements, etc. should be finalized, published, and shared widely with potential data providers*
- *There is a need for reactivating the RARS Implementation Group within WMO with a broader scope to include NOAA DBRTN*

**CGMS Recommendation R42.11 (May 2014)**

- *R42.11: CGMS Satellite operators to support the definition and implementation of community agreed operational procedures for LEO satellite data direct read-out, acquisition, and relay in the context of the DRARS Implementation Group.*

(Note: DRARS was the tentative name designating the new project beyond RARS)

**WMO Commission for Basic Systems (Asunción, September 2014)**

The Commission for Basic Systems (CBS-Ext(2014)) "*welcomed the steps taken to develop the Direct Readout Acquisition and Relay of Satellite Data (DRARS) which will follow and enhance the Regional ATOVS Retransmission Services (RARS) and recommended to complete a Guide to DRARS as part of the WIS reference documentation*."

**DRARS/DBNET COORDINATION MEETING**

A coordination meeting was convened by WMO in Geneva on 11-13 March 2015 with representatives of all RARS regional components, of the EUMETSAT EARS project, and of the NOAA Direct Broadcast Real Time Network (DBRTN) in order to address the requests from ITSC, CGMS and CBS. It was chaired by Anthony Rea (BOM, Asia-Pacific RARS Coordinator). The meeting reviewed the status of RARS and the new projects, investigated the steps to be taken to integrate the RARS, EARS and DBRTN initiatives, and discussed the outline of a future Guide to DRARS.

**RARS status**

The objective of RARS is to organize the global availability of near real-time ATOVS data received by a collection of Direct Broadcast stations distributed around the world. Global consistency should be ensured by using common software (AAPP), standardized coding and file naming, and by quality monitoring. Global availability should be ensured by the WMO GTS and possibly additional means (e.g. satellite rebroadcast). The initial goal is to achieve the distribution of ATOVS data level 1b from 90% of the globe in less than 30 minutes.

To-date the RARS network includes three components: EUMETSAT EARS, Asia-Pacific RARS, South America RARS, with a total of 39 stations representing a total coverage of about 80% of the globe. Most of the data are available on the GTS within 20 minutes from acquisition.

Three stations were added to the RARS network during the past year, all in the Asia-Pacific region:

- Papeete (French Polynesia) by Météo-France
- Delhi and Chennai (India) by IMD.

The RARS concept is excellent and should be pursued. This concept must however be: expanded to other sensors, broadened to accommodate the NOAA DBRTN initiative if agreement is reached on common high-level requirements and specifications; documented to be fully operational and sustainable; and integrated into the WMO Information System (WIS).

**Towards DBNet**

The participants agreed the objective to build a global, integrated network of Direct Broadcast and near real-time relay services for advanced sounder and other LEO data which will be unify the three initiatives above. In particular, NOAA and EUMETSAT will collaborate to ensure compatibility of the NOAA and EUMETSAT contributions. It was agreed to name the new system "**DBNet**" instead of DRARS.

The meeting reviewed an outline of a Guide to DBNet which will introduce the DBNet network components and services, document the agreed high-level service specifications of the system (including timeliness, availability, coverage, for each Service, to be defined in consultation with the user community), and the best practices and standards to be complied with in order to ensure the required quality and consistency of the products.

DBNet is composed of regional networks coordinated by regional or sub-regional nodes and a global DBNet Coordination Group. Global monitoring of product consistency is performed by the EUMETSAT NWPSAF (hosted by the Met Office, United Kingdom).

| Regional Network | Regional or Sub-regional Node |
|---|---|
| DBNet - Europe | EUMETSAT |
| DBNet - Asia-Pacific | JMA |
| | BoM |
| DBNet - South America | INPE |
| | SMN Argentina |
| DBNet - North America | NOAA |

Each DBNet regional network would contribute to one or more "Services". A DBNet Service consists of Direct Broadcast acquisition, processing and relay of a certain category of satellite data. The existing RARS (ATOVS) will remain, as one of the DBNet Services.

| Categories of services | Services/Instruments |
|---|---|
| IR/MW sounding | RARS (AMSU-A, MHS, HIRS)<br>ATMS, VASS (MWTS, MWHS, IRAS) |
| Hyperspectral IR sounding | CrIS, IASI, HIRAS |
| IR/VIS imaging | VIIRS, AVHRR, MERSI |

The best practices and standards will be related to the reception (priority scheduling), the acquisition and processing (L0/L1 software suite, orbital elements, product definition, quality control), the data coding and registration (data and metadata format, file naming, WIS registration), the distribution (in particular through WIS) as well as to the overall coordination, monitoring, and user information and support.

A number of technical points requiring further clarification or investigation were raised at the meeting, which showed the importance of developing such documentation.

Finally, it is proposed to replace the existing RARS Implementation Group by a DBNet Coordination Group with a wider membership. Draft Terms of Reference are provided in Annex to this paper.

The final report of this first DBNet coordination meeting is available at:

http://www.wmo.int/pages/prog/sat/documents/DBNet-01_Final-Report.pdf

**DIRECT BROADCAST X-BAND POLARIZATION ISSUE**

The CGMS-WG I requested feedback from the DRARS community about the possible use of LHCP instead of RHCP polarization for some X-Band Direct Broadcast services (e.g. FY-3). The matter was discussed by the DBNet meeting. RHCP was used initially by all meteorological satellites. There is however an increasing risk of interference in X-Band as the same frequency range is used by the meteorological satellites. In order to mitigate this risk, CMA is using LHCP polarization on FY-3C and announced the intention to use LHCP on every other spacecraft of the FY-3 series in the future.

The understanding of the group was that as of FY-3E, the spacecraft of the FY-3 series would be launched alternatively on an early morning and on an afternoon orbit. The early morning satellites would thus have LHCP while the afternoon satellites would have RHCP. If they used the same polarization, interference among these two series could only occur at high latitude (80°) in case of simultaneous overpass. With two different polarizations, this would not occur, however users worldwide may not be able to receive all satellites on the same antenna, unless the polarization is made configurable on their receiving system. This issue would become critical with FY-3E, which is planned to transmit all data in X-Band only, tentatively in LHCP.

In order to evaluate the impact of this potential measure on the user side, all station operators should be asked to indicate the type of receiving station they are operating and should investigate the feasibility of adapting their station to make the polarization configurable (LHCP/RHCP) to be able to acquire future FY-3 Direct Broadcast.

Feedback could be consolidated by WMO, for the DBNet Coordination Group. As a rule, satellite operators should provide details on DB services several years in advance of new systems, including for instance frequency, polarization, encoding, G/T requirements, and conformance with CCSDS standards.

**CONCLUSIONS**

RARS is a highly successful initiative, now operationally receiving, processing and distributing ATOVS data in near real-time from 80% of the Earth surface. Building on the RARS partnership, DBNet provides a framework for implementing services based on new sensors (IASI, CrIS, ATMS, VIIRS, MWTS, MWHS, IRAS, HIRAS, etc.) and fully integrating the NOAA DBRTN initiative. The DBNet coordination group will drive forward the DBNet implementation and further consolidate the existing ATOVS services. The *Guide to DBNet* will provide visibility by the user community and enable formal recognition by WMO/CBS. It is an excellent model of collaborative undertaking by satellite operators and user groups, fostered by CGMS and WMO.

CGMS has been instrumental for the convergence of RARS and DBRTN initiatives into DBNet. Satellite operators and their partners are playing a crucial role to provide and maintain processing software such as AAPP, CSPP, FY3PP, which are core building blocks of DBNet. Integration into WIS through data/metadata registration and common format implementation are other key elements for interoperability and wide user uptake.

The DBNet Coordination group recommended consulting the Direct Broadcast users on the feasibility to accommodate a configurable polarization. It should be noted that as the DBNet specifications will be developed, some future recommendations may be directed to satellite operators as regards the standardization of DB services.

**PROPOSED CGMS ACTIONS/RECOMMENDATIONS:**

WG I is invited to consider the DBNet implementation status and to formulate specific CGMS actions/recommendations as appropriate. WG I members (former RARS task team) are invited to actively contribute to finalizing the Guide to DBNet.

- (Updating R 42.11) CGMS satellite operators to support the definition and implementation of community agreed operational procedures for LEO satellite data direct broadcast, acquisition, and relay in the context of the DBNet Coordination Group.
- WMO to present the Guide to DBNet to CGMS-44 WG I for feedback in advance of the submission to CBS.
- Following the drafting of the DBNet guide, further actions/recommendations may be proposed at CGMS-44.

WGI thanked WMO for the detailed and comprehensive report covering the different aspects of the RARS and the proposed evolution. In the WP presented WMO proposes a number of actions. WGI fully supports the definition and implementation of agreed operational procedures for LEO satellites and supports WMO DBNet Coordination Group in such an initiative by means of the established CGMS RARS Task Team (fully part of the WMO RARS Implementation Group and of the new DBNet Coordination Group). Review of progress of the activities of these groups will be followed up by WGI via dedicated inter-sessional meetings, one in Oct 2015 and one in Jan/Feb 2016 to secure adequate preparation for CGMS 44.

WGI also debated how to better document some of the activities and their end results and it is proposed to use best practices (at CGMS level) instead of generating additional global specifications (where relevant). With the agreement of all WGI participants a number of recommendations are drafted in this report (see below) and the inter-sessional meetings of WGI will seek ways of progressing in this direction (and in coordination with the WMO DBNet Coordination Group).

Finally, at the proposal of WMO an action was raised by WGI for WG IV to the CGMS Task Team on Metadata to support the definition of discovery metadata for products produced by RARS/DBNet and delivered to the user community via the WIS.

| CGMS-43 recommendations - WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO | WGI/6 | R43.03 | WMO DBNET Coordination Group to report annually to CGMS WGI on status and progress | CGMS-44 | OPEN | HLPP # 1.4.5 |
| CGMS space agencies | WGI/6 | R43.04 | CGMS agencies to publish details on their SG-ICD with enough lead time to allow RARS/DBNET operators to plan their technical systems in advance (to be included in CGMS best practices) | CGMS-44 | OPEN | HLPP # 1.4.2 |
| CGMS space agencies | WGI/6 | R43.05 | CGMS agencies to make use of RH circular polarisation for future Direct Broadcast systems, if technically feasible. | CGMS-44 | OPEN | HLPP # 1.4.2 |

**EUM-WP-08** presents an update of the information regarding a Regional Advanced Retransmission Service (RARS) in Africa.

The document provides a brief summary of the overall RARS status and it discusses the rationale for developing a RARS network in Africa. The rational being based on:

- Need expressed by WMO RA-I community
- Willingness to develop NWP in Africa (e.g. SWFDP)
- In-line with the integrated African Strategy on Meteorology (Strategic pillar #2): *to invest in ground systems, training and analytical tools to make best use of existing satellite and model information available from international partners*

The technical approach selected is based on:

- 4 RARS stations (in Africa)
- Complementary to EARS coverage
- Operated by African entities and independent from EARS

In addition, the working paper provided a summary of the progress achieved since last CGMS meeting:

- June 2014: First workshop with African entities in June 2014. Outcomes:
    - ACMAD responsible for the RARS Africa implementation
    - 4 locations for the RARS stations pre-identified (Gabon, Niger, Kenya and South Africa)
    - ACMAD and other regional centres responsible for increasing NWP capabilities in Africa (regional and national level)
- July 2014: Fund identified for the project (intra-ACP programme on Disaster Resilience – through African Development Bank (AfDB)
- November 2014: Concept note for the project submitted by ACMAD to African Development Bank. Assessment started.
- November 2014: EUMETSAT Council approved EUMETSAT support for the programme (technical advice for RARS, based on EARS experience)
- April 2015: Workshop with ACMAD and potential hosting sites
  Main outcomes:
    - Confirmation of hosting site and list of site-survey activities to be implemented
    - Agreed procurement approach (single procurement for the four stations)
    - Satellites (NOAA, CMA and EUEMTSAT) and instruments (all sounders) to be acquired
        - High-level architecture design (processing of L1 data at each station, telecommunication architecture, including inter-regional communication)

The way forward is therefore defined as follows:

- Assessment of ACMAD proposal by the African Development Bank
- Obtain firm commitment of hosting sites for long term
- Signature of the contract between ACMAD and AfDB – before end of 2015

And with a tentative calendar that will:

- initialize design study (2015-2016)
- Start procurement (2016)

- Installation in 2017
- Operation in 2018

In summary, and to be considered by CGMS members, it can be concluded that:

- Funds and main partnerships are now identified and consolidated for RARS Africa. But key challenges remain to make RARS Africa a reality (e.g. deployment, assimilation of data in NWP, timeliness, sustainability),
- CGMS members operating polar orbiting meteorological satellite are invited:
  - to allow access to their sounding instruments to RARS Africa, and
  - to support the implementation in the RARS stations of the relevant data software for processing L0 and L1 RARS products (training, user support)

WGI noted with appreciation the report by EUMETSAT on the status of progress for the RARS Africa and confirmed the willingness and readiness to support access to instrument data over Africa (subject to the necessary data policy/access arrangements).

**JMA-WP-07** reports on the status of Asia-Pacific Regional ATOVS Retransmission Services (RARS) with a particular focus on JMA's involvement.

JMA provides ATOVS data from the two direct readout stations of Kiyose in Japan and Syowa Station in Antarctica. JMA also operates a RARS monitoring website that provides operational information on its direct readout stations and the status of Asia-Pacific RARS data regarding navigation, calibration and timeliness.

Within the Asia-Pacific RARS, ATOVS files are exchanged via the GTS network using WMO's FTP (put) protocol. BoM (RTH Melbourne) and JMA Tokyo (RTH Tokyo) act as sub-regional coordination centres. The benefit of RARS data is confirmed by the expansion of data coverage for NWP usage.

The Asia-Pacific RARS is coordinated by the Australian Bureau of Meteorology (BoM). Since June 2006, the Japan Meteorological Agency (JMA) has exchanged ATOVS data via the Global Telecommunication System (GTS) in its role as a sub-regional network coordinator. As of April 2015, ATOVS data from 15 stations are available at JMA.

JMA plans to continue these RARS activities and extend its data exchanges to Metop/IASI, Suomi-NPP/ATMS and CrIS under the DBNet project.

**CURRENT STATUS OF DIRECT READOUT STATIONS AND DATA PROCESSING AT JMA**

JMA provides ATOVS data from the two direct readout stations of Kiyose in Japan and Syowa Station in Antarctica (Table 1; highlighted on the RARS network map in Figure 13). The ATOVS data are processed using the ATOVS and AVHRR Processing Package (AAPP).

Metop/IASI data have also been processed using OPS-LRS since July 2013, and Suomi-NPP/ATMS and CrIS data have been processed using CSPP since June 2012 and January 2013, respectively.

Note that there are no data from Syowa Station for around a year from 28 December 2014 due to a hardware problem.

**Direct readout station information:**

| Station (identifier) | Kiyose (kiy) | Syowa Station (syo) |
|---|---|---|
| Operator | Japan Meteorological Agency (JMA) | National Institute of Polar Research (NIPR) |
| Location (latitude, longitude) | Kiyose, Tokyo (35.77°N, 139.53°E) | Syowa Station, Antarctica (69.00°S, 39.58°E) |
| Satellites | NOAA-18, 19<br>Metop-A, B<br>Suomi-NPP | NOAA-18, 19 |
| Average number of acquisitions per day | 20 (NOAA and Metop)<br>3.5 (Suomi-NPP) | 4.5 (NOAA) |

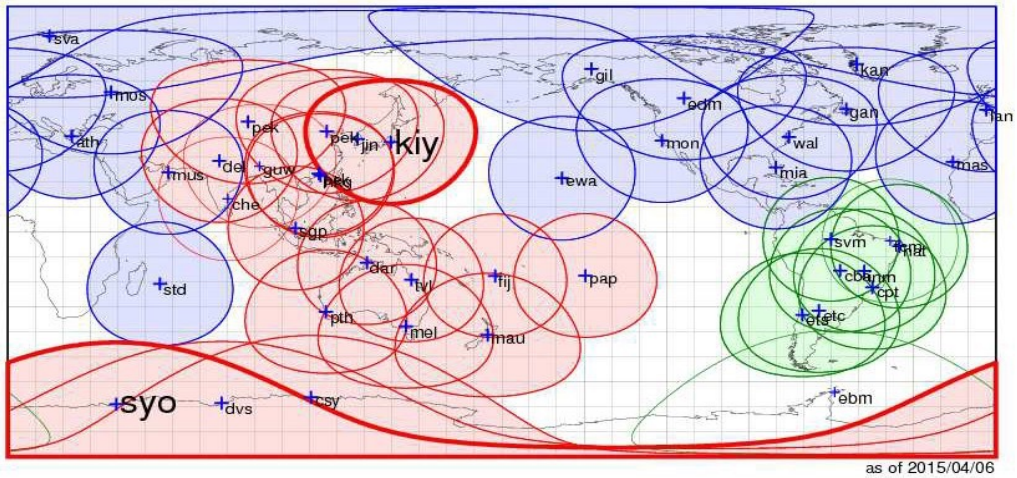



***Figure 13*** *The RARS network with Japan's Kiyose (kiy) and Syowa Station (syo) highlighted. Blue: EARS; red: Asia-Pacific RARS; green: South-American RARS. Filled circles indicate currently operational stations.*

**ASIA-PACIFIC RARS MONITORING WEBSITE**

JMA operates a RARS monitoring website that provides operational information on JMA's direct readout stations and the status of Asia-Pacific RARS data regarding navigation, calibration and timeliness. The site can be accessed at: http://ds.data.jma.go.jp/mscweb/data/rars/index.html

**Comparison with Global ATOVS Data**

On the website, comparisons of Asia-Pacific RARS data and global ATOVS data (from NOAA) are shown to enable checking of consistency in terms of navigation and calibration. Figure 14 shows a time-series representation of Metop-B/AMSU-A averaged geo-location differences as an example of the information provided. An anomaly at Tahiti (Papeete) caused by a problem with TLE data ingestion after a Metop-B manoeuvre was detected by the increase of geo-location difference.

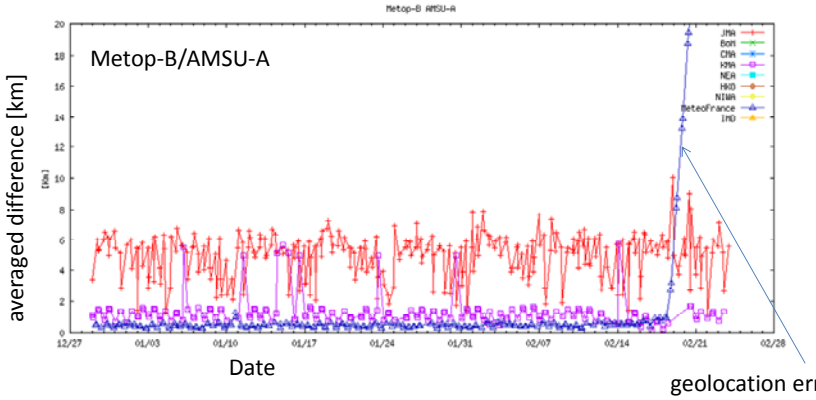



***Figure 14*** *Time-series representation of Metop-B/AMSU-A averaged geo-location difference*

**Timeliness of RARS Data in Tokyo**

Under the RARS project, efforts are made to deliver ATOVS data received at direct readout stations within 30 minutes. The timeliness of data arriving at RTH Tokyo is monitored on the website to enable checking of project target achievement. Figure 15 shows monthly statistics on timeliness (from data acquisition to delivery) for Kiyose station. The website also gives a breakdown of timeliness statistics to support identification of bottlenecks. The breakdown shows times from the start to the end of observation (i.e., the time taken for satellite passage), from the end of observation to the end of processing (i.e., the time taken for processing), and from the end of processing to the end of transfer (i.e. the time taken for transfer).

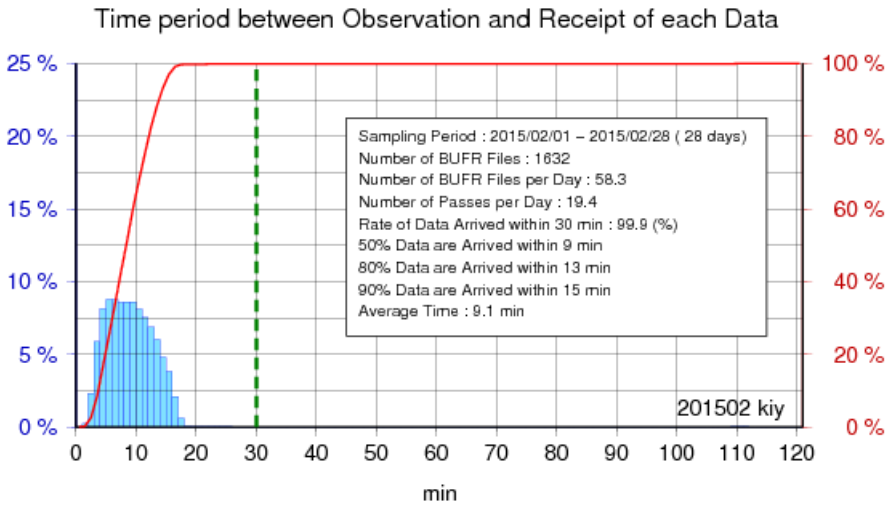



***Figure 15*** *Monthly statistics on timeliness for Kiyose station*

**ASIA-PACIFIC RARS CONNECTIVITY**

Figure 4 (1) shows a schematic view of the Asia-Pacific RARS network within which ATOVS files are exchanged via the GTS network using WMO's FTP (put) protocol. BoM (RTH Melbourne) and JMA (RTH Tokyo) act as sub-regional coordination centres for this network, collecting ATOVS data received at direct readout stations and relaying them to centres in the Asia-Pacific RARS. The data collected are also exchanged inter-regionally to Exeter and Washington. Figure 4 (2) shows the bandwidth (network speed) of the Asia-Pacific RARS. The speeds from Melbourne to RMDCN and Tokyo to RMDCN are 4 and 10 Mbit/sec respectively. Those from Exeter to RMDCN and from Washington to RMDCN are 20 and 50 Mbit/sec, respectively. The daily traffic volume from Melbourne to Tokyo and Tokyo to Melbourne is around 50 to 80 Mbyte/day.

In 2014, new stations Tahiti (Papeete) and New Delhi were added to the network on July 2nd and 19th, respectively.

**USE OF RARS DATA IN NWP**

The benefit of RARS data is confirmed by the expansion of data coverage for NWP usage. The maps in Figure 16 show the coverage area of NOAA-19/AMSU-A data as used in two JMA global data assimilation systems for global analysis at 18 UTC on 17th February 2015. The panel on the right shows a map of data coverage for delayed analysis with a sufficient cut-off time (7 h 50 m plus analysis time). All assimilated data were obtained from NOAA (global data) and covered the maximum area. The panel on the left shows a map of data coverage for early analysis with a shorter cut off time (2 h 20 m) for daily forecasting. The data with yellow dots are from NOAA. The data coverage area in the panel on the left is clearly much smaller than that on the right. However, data with dots in colours other than yellow were obtained via RARS in time and used in the early analysis.

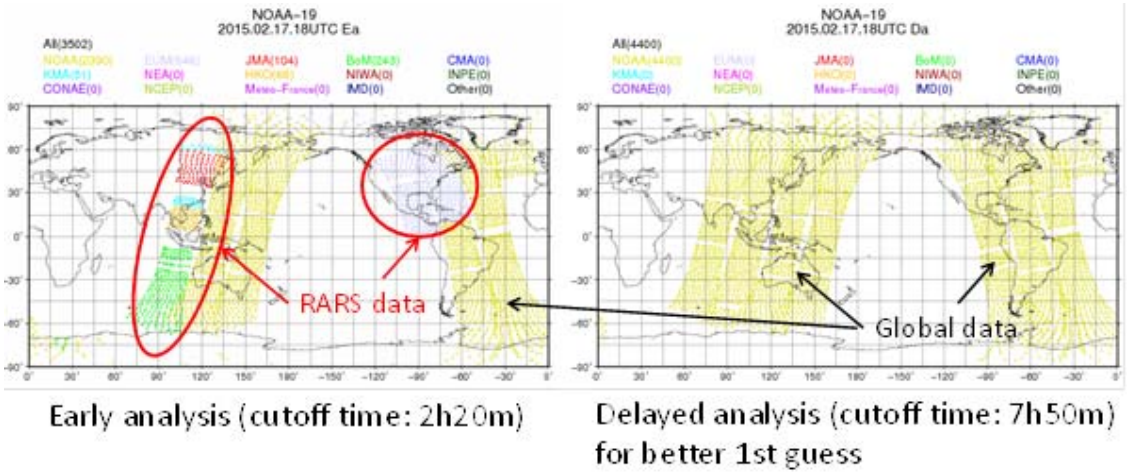



***Figure 16*** *Maps of NOAA-19/AMSU-A originating centers in NWP analysis (JMA/GSM 2015/02/17 18UTC). Left: early analysis; right: delayed analysis.*

JMA plans to continue the above RARS activities. In addition, JMA will extend its data exchanges to Metop/IASI, Suomi-NPP/ATMS and CrIS under the DBNet project.

WGI thanked JMA for the detailed report provided on the status of the Asia-Pacific RARS and noted with appreciation the JMA plans to continue the RARS activities and even further expand them for the new sounders like, for example, SNPP ATMS and CrIS.

**CGMS-43 NOAA-WP-12** reports on the NOAA plans and status of implementation for a SNPP Direct Broadcast Network (DBNet). The NOAA Direct Broadcast Real-Time Network is a demonstration of a method for providing low latency infrared and microwave sounder data to the NOAA National Weather Service. It started as a Sandy Supplement project to reduce risk of a SNPP/JPSS gap by providing all available sounder data with much lower latency than stored mission data. It is being sustained by JPSS Program Science until NOAA decides on operational commitment based on a formal value assessment by NWS to NESDIS. NWS will complete the evaluation by 2017 – efforts include developing CrIS and ATMS assimilation steps in the regional forecast model. The sounder data will be assimilated by the National Centers for Environmental Prediction (NCEP) and will increase the percentage of polar data used in NCEP NWP models, as well as provide backup in case of anomalies in polar global processing.

The project presents an opportunity to expand the coverage of the WMO Direct Broadcast Network, particularly for advanced sounders (CrIS, ATMS, IASI, AIRS).

| Station | Operator | Status | Satellites |
|---|---|---|---|
| Monterey | NOAA | Sustained Demo | SNPP, Metop, POES |
| Gilmore Creek | NOAA | April 2015 | SNPP, Metop, POES |
| Madison | NOAA/CIMSS | Sustained Demo | SNPP, Metop, POES |
| Honolulu | NOAA/CIMSS | Sustained Demo | SNPP, Metop, POES |
| Miami | NOAA/CIMSS | Sustained Demo | SNPP, Metop, POES |
| Mayaguez | NOAA/CIMSS | May 2015 | SNPP, Metop, POES |
| Corvallis | Oregon State University | Sustained Demo | SNPP |
| New York | City College | Sustained Demo | SNPP |
| Greenbelt | NASA | Sustained Demo | SNPP |

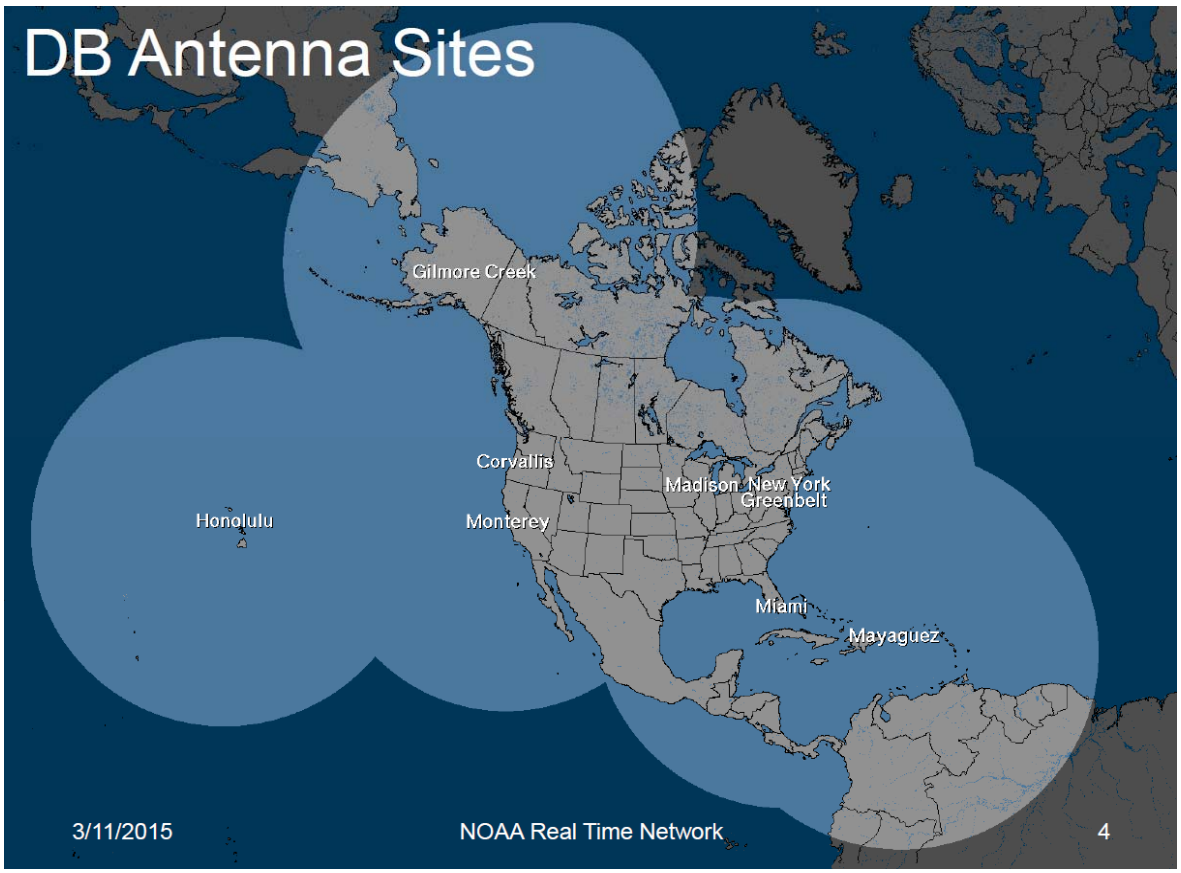



***Figure 17*** *WMO Direct Broadcast Network*

Future Guam station is under consideration, along with direct download of SNPP data from JMA to cover nearly all of the NH Pacific.

NOAA/CIMSS would be responsible for operating and monitoring:

- the network of DB reception stations
- the processing of ATMS, CrIS, ATOVS and IASI to level-1
- BUFR encoding of all Products
- FTP push over the Internet to NWS/NCEP & EUMETSAT of all BUFR products

As a EUMETSAT trial service (start TBD) for a duration of 1-2 years it is proposed that data are disseminated to EUMETSAT Member States and ECMWF via EUMETCast (services will not be operational on the CIMSS side); There is no product processing required at EUMETSAT, but simplified monitoring of the data flow. The NOAA Real-Time Network represents an opportunity to increase the coverage and availability of advanced sounder data (including CrIS, ATMS, IASI and ATOVS). NOAA/CIMSS have offered to EUMETSAT the possibility to collect this data from NOAA network and disseminate it through EUMETCast.

WGI thanked NOAA for the report on the plans and status of implementation of the SNPP Regional Retransmission Service and appreciates the efforts done to develop this new system. In the

discussions following the presentation by NOAA two points attracted the attention of WGI, firstly the need identified by NOAA to articulate the impact/improvement in the models through the use of the new RARS by NOAA. Secondly the need to make this data available to the full user community for which use of the WIS is the natural approach. For the first point an action was agreed, for the second point it is considered to be covered by the best practices of the CGMS agencies that WGI will be working on in the future

| CGMS-43 actions - WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO | WGI/6 | A43.06 | WMO to assess the impact of improved data latency from polar orbiters on NWP (WMO Impact Workshops) and other applications | CGMS-44 | OPEN | HLPP # 1.4.5 |

**I/6 Review and updating of the HLPP**

The WG considered the status of implementation of the High-Level Priority Plan (HLPP), and identified that 1.3.1 was considered to be achieved. The rest of the entries in the HLPP under the responsibility of WGI are in progress.

Following detailed discussions on the planned evolution of the future GEO systems, the WG proposed the following priority for inclusion in the new version of the HLPP:

"Evolution of GEO Global Spec for future systems (beyond 5 years from now) taking into account their planned characteristics, the products to be dissemination and the availability of new standards regarding product formats."

With this amendment, the WG recommended to the CGMS Plenary the proposal for an update in the High-Level Priority Plan.

**I/7 Any other business**

WGI discussed nominations for CGMS-44 and agreed in proposing to plenary the following:

***Co-chairs:***

- Vanessa Griffin (NOAA)
- Sergey Uspensky (Roshydromet)

***Rapporteur:***

- J. Gonzalez (EUMETSAT)

***CGMS-SFCG Liaison Officer:***

- M. Dreis (EUMETSAT)

***CGMS Representative at SATCOM Forum:***

- S. Burns (EUMETSAT)

### I/8 Planning of inter-sessional activities/meetings [CGMS-42 - CGMS-43]

Three groups of Inter-sessional meetings are agreed by WGI:

- WGI.IS-1.x: First group of Inter-sessional meetings will be dedicated to Global Specs for GEO direct broadcast (meeting quarterly starting mid-Nov 2015).
- WGI.IS-2.x. Second group of Inter-sessional meetings will be dedicated to RARS best practices, and it is agreed to have a quarterly frequency, starting mid-October 2015.
- WGI.IS-3.x: Third group of Inter-sessional meetings will be dedicated to preparation of the first SATCOM Forum (2015), including harmonisation of global Data Collection Systems and any Freq related issues, it is agreed to have one meeting in Dec 2015.

### I/9 Review of actions, conclusions, preparation of WG report for plenary

**CGMS-42 actions and recommendations:**

All actions and recommendations raised by Working Group I on the occasion of CGMS-42 were closed. The final status of all CGMS-42 actions and recommendations (plenary and working groups) following CGMS-43 discussions is available here (http://www.cgms-info.org/documents/CGMS-42_LoAandLoR_final.pdf).

**Actions open following CGMS-43 Working Group I deliberations:**

| CGMS-43 actions - WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| EUM | WG/I | A43.01 | EUMETSAT to contact IROWG Chair to confirm needs for dedicated frequency protection for GNSS (Closed during CGMS-43 following discussions between EUMETSAT and IROWG). | CLOSED | OPEN | HLPP # 1.3 |
| EUM | WG/I | A43.02 | CGMS Liaison officer to SFCG to report to CGMS WGI on the discussions and disposition of SFCG on all topics of interest to the different CGMS members. For achieving that a dedicated CGMS Secretariat WGI working paper will be prepared by EUMETSAT Frequency Manager (in the role of liaison officer from CGMS to SFCG) and will be released to the participants of WGI before end of the corresponding year. Based on the contents, CGMS members will decide the level of information they will include in their specific reports to CGMS for the corresponding WGI meeting | 30 Dec 2015 | OPEN | HLPP # 1.3 |

| CGMS-43 actions - WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | WGI/4.2 | A43.03 | CGMS members to comment on the work done in the context of the EUMETSAT provided VIIRS Regional Service, and to provide feedback on the proposal to define a standardised compact product format, generalised to cover the advanced imagers of the current and planned polar orbiting satellites. | CGMS-44 | OPEN | HLPP # 2.6 |
| NOAA | WGI/4 | A43.04 | NOAA to assess the need for user registration for Direct Broadcast | CGMS-44 | OPEN | HLPP # 1.4 |
| CGMS member | WGI/5 | A43.05 | CGMS Members to assess, comment on the info package for the SATCOM Forum prepared by the appointed CGMS representative | 30 Oct 2015 | OPEN | HLPP # 1.2.1 |
| WMO | WGI/6 | A43.06 | WMO to assess the impact of improved data latency from polar orbiters on NWP (WMO Impact Workshops) and other applications | CGMS-44 | OPEN | HLPP # 1.4.5 |

**Recommendations following CGMS-43 Working Group I deliberations:**

| CGMS-43 recommendations - WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO | WGI/3 | R43.01 | WMO to make the information on all (active, passive and comms) frequency use available and searchable in OSCAR/Space, such that pre-defined reports are easily accessible via external hyperlinks | CGMS-44 | OPEN | HLPP # 1.3 |
| CGMS members | WGI/3 | R43.02 | Recommends CGMS members to continue bringing all frequency management and coordination issues under the expert forum of SFCG and actions the liaison officer (from CGMS to SFCG) to report to CGMS WGI all aspects of SFCG discussions considered of relevance to CGMS. | CGMS-44 | OPEN | HLPP # 1.3 |
| WMO | WGI/6 | R43.03 | WMO DBNET Coordination Group to report annually to CGMS WGI on status and progress | CGMS-44 | OPEN | HLPP # 1.4.5 |
| CGMS space agencies | WGI/6 | R43.04 | CGMS agencies to publish details on their SG-ICD with enough lead time to allow RARS/DBNET operators to plan their technical systems in advance (to be included in CGMS best practices) | CGMS-44 | OPEN | HLPP # 1.4.2 |

| CGMS-43 recommendations - WGI | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | WGI/6 | R43.05 | CGMS agencies to make use of RH circular polarisation for future Direct Broadcast systems, if technically feasible. | CGMS-44 | OPEN | HLPP # 1.4.2 |

The status of CGMS-43 actions and recommendations will be maintained on the CGMS website under MEETINGS and CGMS-43.

Report of the 43rd Meeting of the
Coordinated Group for Meteorological Satellites

# Parallel Working Group Sessions: WGII Report

## WG II REPORT

The Working Group held its session as part of the CGMS-43 meeting on Monday, 18 May 2015 from 09:00-18:00 and Tuesday, 19 May 2015 from 09:00-16:00. The Group discussed 65 Working Papers and had 40 participants. Stephan Bojinski (WMO) and Toshiyuki Kurino (JMA) served as group co-chairs.

**WGII/0 Objectives**

Toshiyuki Kurino (JMA) expressed his thanks to NOAA NESDIS and special thanks to UCAR for providing the facility. Stephan Bojinski (WMO) stressed the role of the WG in identifying actions by CGMS operators related to satellite data and products, and for the exchange of information.

Participants identified themselves in a tour-de-table. The list of participants is provided in Annexes. Toshiyuki Kurino highlighted the necessity for CGMS cooperation in introducing the new generation of satellites, and to facilitate user uptake. Argelia Gonzalez (NOAA) assisted the session in operating the presentation laptop.

**WGII/1 Review of actions and recommendations from previous meetings**

| WG II actions from CGMS-41 and CGMS-42 to remain open following CGMS-43 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| JMA | WGII/8 | 41.26 | JMA to establish an environment to implement multiple algorithms to retrieve quantitative ash cloud parameters from operational satellites. This will serve as a test bed for the intercomparison of retrievals on an operational basis in the framework of SCOPE-Nowcasting. JMA is invited to perform an intercomparison based on historical data and report on this to CGMS-42. | JMA introduced software based on EUMETSAT approach to the testbed, and started validation activities in collaboration with Tokyo VAAC. The NOAA algorithm will also be included.<br><br>CGMS-42 JMA-WP-07/ppt: VA retrieval intercomparison activity started and workshop to be organised in the framework of WMO SCOPE-Nowcasting at SSEC, Madison, on 29 June-2 July 2015 (a preparatory meeting was held on 20-23 October 2014). The JMA testbed will be useful once results from VA retrieval algorithm intercomparison are available.<br><br>New deadline following discussions at CGMS-42.<br><br>CGMS-43-JMA-WP-05 (Section 2)<br><br>New deadline following CGMS-43 WGII discussions. WMO to report on VA Intercomparison at CGMS-44 | (CGMS-41/-42/-43) **New deadlineCGMS-44** | **OPEN** | HLPP #3.2.2 |

| WG II actions from CGMS-41 and CGMS-42 to remain open following CGMS-43 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CMA, EUM, JMA, NASA, NOAA, WMO | WGII/3 | A42.02 | The new task team on calibration events logging to identify a common set of parameters to be monitored as part of the calibration events logging and sensor performance monitoring. | 1st step: Template for calibration event landing pages presented at GDAWG in March 2015. New version of OSCAR/Space allows for identification of individual instruments and thus linking to calibration event test pages, test mode of new version of OSCAR/Space continuing until 1 month before CGMS-43;<br>2nd step: Draft a white paper to agree on common terminology to be used on landing pages, foreseen in 2015/2016 for presentation to CGMS-44.<br>CGMS-43 EUM-WP-10<br>CGMS-43-JMA-WP-03 (Section 2.4)<br><br>NOAA: Work ongoing as a part of the GSICS work plan. Next steps are gathering information and agreeing on common terminology.<br><br>New deadline following CGMS-43 WGII discussions. | (CGMS-43) **New deadlineCGMS-44** | **OPEN** | HLPP# 3.1 |
| KMA | WGII/4 | A42.03 | KMA is invited to present a paper of different sources of soil moisture retrieval on their NWP forecasts | CGMS-43-KMA-WP-04: Test use of Metop-B/ASCAT on their global NWP system<br><br>New deadline following CGMS-43 WGII discussions. | (CGMS-43) **New deadlineCGMS-44** | **OPEN** | - |

**WGII/1 Review of actions and recommendations from previous meetings**

| WG II actions from CGMS-41 and CGMS-42 to remain open following CGMS-43 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| JMA | WGII/8 | 41.26 | JMA to establish an environment to implement multiple algorithms to retrieve quantitative ash cloud parameters from operational satellites. This will serve as a test bed for the intercomparison of retrievals on an operational basis in the framework of SCOPE-Nowcasting. JMA is invited to perform an intercomparison based on historical data and report on this to CGMS-42. | JMA introduced software based on EUMETSAT approach to the testbed, and started validation activities in collaboration with Tokyo VAAC. The NOAA algorithm will also be included.<br><br>CGMS-42 JMA-WP-07/ppt: VA retrieval intercomparison activity started and workshop to be organised in the framework of WMO SCOPE-Nowcasting at SSEC, Madison, on 29 June-2 July 2015 (a preparatory meeting was held on 20-23 October 2014). The JMA testbed will be useful once results from VA retrieval algorithm intercomparison are available.<br><br>New deadline following discussions at CGMS-42.<br><br>CGMS-43-JMA-WP-05 (Section 2)<br><br>New deadline following CGMS-43 WGII discussions. WMO to report on VA Intercomparison at CGMS-44 | (CGMS-41/-42/-43) **New deadlineCGMS-44** | **OPEN** | HLPP #3.2.2 |

| WG II actions from CGMS-41 and CGMS-42 to remain open following CGMS-43 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CMA, EUM, JMA, NASA, NOAA, WMO | WGII/3 | A42.02 | The new task team on calibration events logging to identify a common set of parameters to be monitored as part of the calibration events logging and sensor performance monitoring. | 1st step: Template for calibration event landing pages presented at GDAWG in March 2015. New version of OSCAR/Space allows for identification of individual instruments and thus linking to calibration event test pages, test mode of new version of OSCAR/Space continuing until 1 month before CGMS-43;<br>2nd step: Draft a white paper to agree on common terminology to be used on landing pages, foreseen in 2015/2016 for presentation to CGMS-44.<br>CGMS-43 EUM-WP-10<br>CGMS-43-JMA-WP-03 (Section 2.4)<br><br>NOAA: Work ongoing as a part of the GSICS work plan. Next steps are gathering information and agreeing on common terminology.<br><br>New deadline following CGMS-43 WGII discussions. | (CGMS-43) **New deadline CGMS-44** | **OPEN** | HLPP# 3.1 |
| KMA | WGII/4 | A42.03 | KMA is invited to present a paper of different sources of soil moisture retrieval on their NWP forecasts | CGMS-43-KMA-WP-04: Test use of Metop-B/ASCAT on their global NWP system<br><br>New deadline following CGMS-43 WGII discussions. | (CGMS-43) **New deadline CGMS-44** | **OPEN** | - |

The final status of all CGMS-42 actions and recommendations (plenary and working groups) following CGMS-43 discussions is available here. (http://www.cgms-info.org/documents/CGMS-42_LoAandLoR_final.pdf).

**WGII/2 Image processing techniques and satellite imagery for nowcasting**

**CGMS-43-ISRO-WP-04**: Satellite image based nowcasting of severe rainfall events

Satellite based weather nowcasting is a growing field of research due to its immense application value and demand by the user community. Nowcasting models are extremely useful in predicting mesoscale and even shorter time scale weather events like thunderstorms which can cause threat to life and property. The applications of weather nowcasting range from satellite launches, aviation, transport, daily planning and disaster management. High-resolution observation networks such as Doppler Weather Radars, Automatic Weather Stations (AWS), Wind Profilers, Radiometers that monitor and provide accurate data at short spatial and temporal intervals, are the most essential component of a good nowcasting system. However presently in India there are many regions that are devoid of any ground-based observations and in such cases, satellite observations are the plausible alternatives. Data acquired from geostationary satellites are helpful in predicting the evolution of convective systems and its dynamics due to their high spatio-temporal resolution. At the Space Applications Centre, Indian Space Research organization (SAC, ISRO), the feasibility of nowcasting extreme rainfall events using satellite data has been explored and an algorithm has been developed for predicting intense convection and precipitation using half hourly INSAT-3D and Kalpana satellite data. Satellite observed thermal IR image sequence provides valuable insight into the vertical evolution of convective systems. Low Brightness Temperature (BT) values represent high clouds, and marked increases in the number of contiguous pixels having cold BT values indicate development of deep convection. The prediction of BT values thus has potential to provide nowcasting alerts for an impending disaster. Also the western Himalayan region is found to be most susceptible to extreme rainfall disasters causing loss to life and property every year. However it can be seen that Western Himalayan region is sparsely covered by ground observation stations. Thus a space-based model for Nowcasting of ExTreme orographic RAin events (NETRA) has been developed at SAC. The alerts from NETRA model are been provided for the hilly states of Uttarakhand and Himachal Pradesh and updated every half hourly though the Meteorology and Oceanography Data Archival Centre (MOSDAC) web portal.

The paper was warmly welcomed and a question was raised as to whether satellite data are also being used in short-range NWP, in addition to nowcasting. The ISRO plan is to make use of sounding data for SRNWP. It was specifically mentioned that the merging of nowcasting information with flood information (river catchment, area of flooding) is underway.

**CGMS-43-NOAA-WP-13_PPT**: NOAA Report on Image Processing Techniques: Applications using the VIIRS Day/Night Band

The presentation provided to the CGMS community a sampling of the emerging capabilities in nocturnal characterization enabled by the Day/Night Band (DNB) sensor on Suomi NPP, part of the Visible/Infrared Imaging Radiometer Suite (VIIRS). A growing collection of research papers are giving evidence to the DNB's utility well beyond the originally envisioned scope of 'imagery.' Quantitative applications are becoming possible with the conversion of DNB radiances to reflectance and combining with other VIIRS

spectral bands. The unexpected sensitivity to nightglow is revealing new scientific potential for the study of upper atmospheric dynamics.

The VIIRS Day/Night Band has shown capability of detecting visible light sources at night, from natural and anthropogenic sources, extraterrestrial, terrestrial, and atmospheric (e.g., fires, city lights, volcanic hotspots, fishing and industrial activity, nightglow, scattering from optically thin clouds). Progress is being made on a number of application fronts: quantitative, using calibrated radiances and converted lunar reflectance; multi-spectral imagery, leveraging the other bands on VIIRS; and other capabilities beyond the scope of those envisioned.

A DNB-like sensor is slated to fly on the 1330/0130 orbit (JPSS). The next-generation EUMETSAT program (EPS-SG) gave consideration to a Low-Light Imager initially, but is no longer considered due to low priority. Higher temporal refresh is of critical importance to operational users as well as research on the diurnal variability of essential climate data records.

The presentation encouraged CGMS to explore the new and complementary information content of the DNB for night time applications, and where appropriate, advocate for the inclusion of such measurements as a baseline requirement of future low-earth orbiting and geostationary environmental satellites.

**WGII/3 Satellite data calibration and validation including climate related aspects**

**CGMS-43-WMO-WP-16**: GSICS Report

Peng Zhang provided a summary and highlights of GSICS, which will also be presented to Plenary under item F.1.2. Examples of the benefits of GSICS are the correction of GOES IR bias through inter-calibration with Metop/IASI and SNPP/CrIS, the adjustment of SRF of COMS/MI, and support to commissioning of Himawari-8 and characterisation of INSAT-3D calibration. Some development highlights are: IR calibration with multiple reference spectrometers, lunar calibration and GEO visible imager inter-calibration based on DCC method (to become available in 2015). An overview of the GSICS procedure for product acceptance was provided, with ISRO, KMA, and CMA preparing their submissions, and describing changes to the leadership structure after ten years of successful coordination.

Roscosmos explained the reason for the non-participation of Roshydromet in the GSICS Executive Panel meeting held on 14-15 May 2015, but emphasised that Roshydromet is interested in collaborating with CGMS operators in GSICS.

Dong Wu noted the connection of ICWG and GSICS when using DCCs for vicarious calibration. GSICS should be aware of calibration requirements coming from the ISWGs. This ties in with areas of coordination among the ISWGs.

NASA provided information on a call for proposals on work related to calibration and inter-calibration of NASA research satellites.

For the inter-calibration of geostationary infrared imagers with reference hyperspectral resolution infrared instruments, it is important there are no spectral gaps in the high spectral infrared, which would prevent the monitoring and absolute calibration of the infrared imagery channels. Therefore it is recommended that CGMS operators consider removing spectral gaps in future generation hyperspectral sounders. For example, CrIS was designed before GSICS, and the GSICS has demonstrated the importance of tying geostationary infrared sensors to polar-orbiting high spectral resolution infrared sounders.

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | WGII/3 | R43.01 | CGMS members to consider removing spectral gaps from future hyperspectral sounders to support GSICS intercalibration of IR imagers. | | OPEN | HLPP # 3.1 |
| GSICS members | WGII/3 | R43.02 | Members to strengthen their engagement in GSICS and in particular in its GDWG. | | OPEN | HLPP # 3.1 |

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| GSICS | WGII/3 | A43.01 | GSICS to establish the requirements for absolute lunar calibration and prepare a white paper describing the tentative way to meet those requirements in case they go beyond those lunar calibration capabilities. | CGMS-44 | OPEN | HLPP # 3.1.2 |

**CGMS-43-EUMETSAT-WP-09**: Status report and highlights from SCOPE-CM

This document reported on the status of SCOPE-CM activities. The aim of the Sustained, Co-Ordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM) is to enable a network of facilities ensuring continuous and sustained provision of high-quality dataset for climate monitoring. The foundation of SCOPE-CM is the network of relevant space agencies and other organizations (including GSICS) with the aim to develop, extend and preserve the capabilities and skills of generating and regenerating Climate Data Records (CDR). The SCOPE-CM activity is a main contribution to the second pillar of the Architecture for Climate Monitoring from Space (climate record creation and preservation). SCOPE-CM has completed its phase-1 activity where the international collaborations network and the structure of the projects were set up. SCOPE-CM is entering the second year of its phase-2 activity. The main SCOPE-CM phase-2 objectives are to establish a systematic approach to increase the sustainability (maturity) of CDR generation capabilities and to establish the structures for sustainable generation of Fundamental and Thematic CDRs. Nine projects are active and generate both Fundamental and Thematic Climate Data Records. All projects show successes based on coordination that may result in real cost savings at the individual agency level. It is crucial for SCOPE-CM activities to be able to have

access to additional existing satellite data to close gaps in spatial coverage. The report covered the status of each project in Phase-2.

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| SCOPE-CM members | WGII/3 | R43.03 | SCOPE-CM to invite contributions to its next call for proposals, with particular regard to the sea ice, snow cover and land surface temperature communities, and others currently not represented. | End 2015 | OPEN | HLPP # 5.1 |

**CGMS-43-EUMETSAT-WP-10**: Calibration events logging status and way forward

This working paper summarized the response of EUMETSAT to CGMS action [CGMS-42: WGII/3 Action 42.01] "*EUM/NOAA/NASA/JMA/CMA/WMO and others to provide names for a task team on calibration events logging*" and CGMS action [CGMS-42: WGII/3 Action 42.02] "*The new task team on calibration events logging to identify a common set of parameters to be monitored as part of the calibration events logging and sensor performance monitoring*". The Task Team has been established after contacting the space agencies and WMO to nominate a representative [Actions 42.01]. The Task Team contributed to the GSICS action to organise their current instrument calibration information on a single landing page. The WMO modified their OSCAR web-interface, which now allows linking to one landing page per instrument per satellite. A high level design for logging calibration events and monitoring calibration information has been drafted. During the coming year the Task Team needs to draft a white paper outlining the set of parameters, the nomenclature, and the standards to be used for reporting on instrument calibration. Assessment of the nomenclature used for calibration events across space agencies revealed similarities in the types of events, but large differences in terminology. In the future, the white paper may serve as a protocol for reporting on instrument calibration across the CGMS space agencies. Once the CGMS space agencies reach consensus on a protocol they can start populating the database of calibration events for past, present and future instruments. This work should also be further discussed in the context of GSICS. Information should be included on Instrument specification (documents on instruments baseline physical basis), Calibration events (database or documents of calibration related events), Calibration monitoring (database or documents following state of the instrument) and Data outages.

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | WGII/3 | A43.02 | Calibration events logging task team to prepare a white paper outlining the set of parameters, the nomenclature, and the standards to be used for reporting on instrument calibration across space agencies. | CGMS-44 | OPEN | HLPP # 3.1 |

**CGMS-43-ISRO-WP-05**: ISRO's GSICS Activities

This paper presented the status of ISRO's efforts towards the GSICS. ISRO has established an automated procedure to generate the GSICS correction coefficients for INSAT-3D Imager and Sounder using MetOp-A IASI. The IASI data is acquired through EUMETCAST. In view of irregular data reception through EUMETCAST an alternative procedure has been setup to receive the near real time IASI data through EUMETSAT standing data order (THREDDS server). ISRO has submitted the ATBD, GPAF and the sample GSICS products to GCC for the approval as demo-products. VIS channel calibration initiated through DCC method.

**CGMS-43-JMA-WP-03**: JMA's GSICS and SCOPE-CM activities

This paper reported on the activities of the Japan Meteorological Agency (JMA) regarding the Global Space-based Inter-Calibration System (GSICS) and the Sustained, Coordinated Processing of Environmental satellite data for Climate Monitoring (SCOPE-CM).

JMA began its operation of the MTSAT-1R infrared (IR) inter-calibration system on GSICS in 2008. Re-Analysis Correction (RAC) and Near-Real-Time Correction (NRTC) for the MTSAT imager IR channels in Demonstration Phase are available online. Uncertainty evaluation for MTSAT-2 GSICS Correction with reference to IASI and AIRS is currently being performed to move related products into the Pre-operational Phase. A new GSICS inter-calibration product based on data from the visible channel of the MTSAT-2 Imager with Aqua MODIS observation using deep convective cloud observations is also under development, along with visible channel calibration using lunar observation data. Existing GSICS inter-calibration methods are being implemented for the Advanced Himawari Imager (AHI) on board Himawari-8 as described in JMA-WP-09.

JMA has launched a web page for satellite event logging activities led by EUMETSAT and NOAA. The page will be linked to from the WMO Observing Systems Capability Analysis and Review (OSCAR) tool. The Agency is also considering the development of an event logging database for its past, present and future satellites.

JMA has participated in SCOPE-CM since the initiative's establishment, carrying out initial activities in a Phase 1 pilot project related to historical Atmospheric Motion Vectors (AMVs) and Clear Sky Radiance (CSR) products to be provided for use in global and potentially regional Numerical Weather Prediction (NWP) model-based re-analysis. The Agency has continued to lead one of the projects in phase 2 since 2014, and also contributes to other projects such as land surface albedo product.

**CGMS-43-JMA-WP-09**: First results and products from Himawari-8

The next-generation geostationary meteorological satellite of the Japan Meteorological Agency (JMA), Himawari-8, was successfully launched on 7 October 2014 and will start operation in July 2015. Himawari-8 features the new 16-band Advanced Himawari Imager (AHI), whose spatial resolution and observation frequency are improved over those of its predecessor MTSAT-series satellites. These

improvements will bring unprecedented levels of performance in nowcasting services and short-range weather forecasting systems. In view of the essential nature of navigation and radiometric calibration in fully leveraging the imager's potential, this working paper reports on the current status of navigation and calibration for the AHI and outlines related products.

The presentation focussed on navigation and calibration issues of Himawari-8. Image navigation accuracy is less than 0.5 pixels in 2.0 km bands; the paper also showed co-registration errors for the various bands. GSICS has made a contribution on the approach to validate AHI calibration performance.

The session congratulated JMA for its achievements shown in the paper regarding Himawari-8, which are very promising.

**CGMS-43-KMA-WP-03**: KMA's GSICS and SCOPE-CM Activities

This document reports on KMA's GSICS and SCOPE-CM activities.

- COMS IR inter-calibration system with LEOs (IASI-A, IASI-B, and AIRS) from April 2011 to December 2014
- COMS VI calibration using Moon with ROLO model from GSICS (GIRO) from April 2011 to December 2014 with four Earth targets (Ocean, desert, water cloud and Deep Convective Cloud)
- COMS Water Vapour channel anomaly correction using Spectral Response Function Shift
- To contribute to SCOPE-CM activity by applying GSICS correction to Sea Surface Temperature (SST) and Clear Sky Radiance (CSR)

The discussion clarified that OLR is derived for the entire disk. The session thanked KMA for a useful paper showing the downstream benefits of GSICS to products.

**CGMS-43-NOAA-WP-14.PPT**: NOAA Report on Satellite Data Calibration and Validation: Satellite Anomalies

This paper reported on the NOAA Integrated Calibration Validation System (ICVS) system. ICVS monitors over 400 parameters for 28 instruments on-board NOAA/METOP/SNPP satellites, SNPP spacecraft parameters, instrument performance and anomaly events (with automatic alerts), sounder SDR data quality with respect to the numerical weather prediction model (NWP) simulations, and instrument noises for their real-time applications (e.g. error covariance in data assimilation). The paper showed the current status of monitored instruments and shed light on the background of some anomalies (e.g., SNPP ATMS scan driver main motor current anomaly).

NOAA implemented a new SI-traceable NEdT using the Allan deviation (Allan, IEEE 1987; used for characterizing random noise from a time series with a variable mean), which will be discussed in the GSICS Research Working Group.

A question was asked whether this approach was reasonable since it smoothes out spikes in NEdT, since these are "normalized" by spikes in the time series.

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | WGII/3 | R43.04 | CGMS operators to consider displaying instrument performance in a way similar to the ICVS. NOAA could share the software among CGMS operators. | CGMS-44 | OPEN | HLPP # 3.1 |
| NOAA | WGII/3 | R43.05 | NOAA to organize a workshop for CGMS operators on ICVS software design and development, and implementation. | CGMS-44 | OPEN | HLPP # 3.1 |

**CGMS-43-NOAA-WP-15 PPT**: NOAA Report on Satellite Data Calibration and Validation: GSICS at NOAA

The paper reported on the NOAA role as the lead for the GSICS Coordination Centre, guiding products through the GSICS Procedure for Product Acceptance, hosting the GSICS products and development websites, helping to organize the 2014 User's Workshop (as a session at the AOMSUC in Shanghai) and the 2015 User's Workshop (to be held with the EUMETSAT conference in Toulouse), and producing the GSICS Quarterlies.

Current and planned activities include development of new products using the S-NPP CrIS and VIIRS, and the new Microwave (MW) and Ultraviolet (UV) subgroups which have projects to expand the application of GSICS methods and processed to include MW and UV sensors. NOAA is participating with calibration and validation comparison studies for instruments including AMSU, MSU and ATMS for the MW; and SBUV/2, OMPS, EPIC and TEMPO for the UV. NOAA supports the on-going calibration events logging activity.

The paper called for CGMS agencies to ensure that personnel receive sufficient support to continue their collaborative GSICS activities, and that designated activities to maintain, operate and improve the GSICS Coordination Center, GSICS Data Working Group and GSICS Processing and Research Centers are supported.

GSICS has some resilience by relying on a range of reference sources (DCCs, lunar target, CrIS/IASI). The mission planning of the upcoming IR sounders introduces robustness through overlap and coordination. Sub-groups have been set up to address these points.

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| GSICS | WGII/3 | A43.03 | GSICS to document and implement its approach to manage changes in reference instruments. | CGMS-44 | OPEN | HLPP # 3.1 |

Dong Wu enquired about the role of ISCCP. Consistent calibration of sensors across agencies is a key mandate of GSICS, addressed through the GSICS Research Working Group. User requirements and feedback are essential to GSICS operations.

**CGMS-43-CNSA-WP-02**: The Calibration and Validation on HY-2 satellites

The HY-2A, launched in August 2011, is the first satellite for ocean dynamic environment measurement. The sea surface height calibration of HY-2A altimeter is performed using cross-calibration with the Jason-2 mission. Range absolute calibration activities are on-going based on the altimeter transponders. The main parameters in IGDR products are validated by in-situ NDBC buoys and Jason-2 measurements. The calibration of the HY-2A scatterometer is implemented using open sea measurements, Amazon rainforest measurements and transponders. Wind vector products are validated by NDBC buoy observations.

The key results are as follows: Crossover analysis with Jason-2 altimeter shows HY-2A altimeter total performance is close to the Jason-2. The calibration coefficients of sigma0 for scatterometer are -1.79dB for VV and -1.73dB for HH polarization using ocean calibration technique, the monitoring result of the scatterometer measurement stability by Amazon rainforest shows that the instrument system is stable, the RMS of wind speed and wind direction retrieved by scatterometer are about 1.051m/s and 16.122°.

**CGMS-43-CNSA-WP-05**: Geometry and radiation quality Evaluation of GF-1 and GF-2 satellite imagery

GF-1 and GF-2 are the first two satellites of China High-resolution Earth Observing System (CHEOS). Both satellites have been used in diverse application areas, such as land resource and surveying, disaster mitigation, environment protection, and so on. In this paper, the result of geometry and radiation quality evaluation of GF-1 and GF-2 satellite imagery is reported.

Generally, the geometry and radiation quality of GF-1&2 satellite imagery is fine. The geometric positioning accuracy of GF-1&2 satellite imagery can meet the requirement of high-precision image orientation. Due to no on-board calibration, the accuracy is dependent upon the in-situ measurements of field campaigns. The long-term cross calibration is necessary and on-going.

**CGMS-43-ESA-WP-02**: ESA Support to GCOS and Other Climate Monitoring Activities

This paper provided information on the status of the Earthwatch Programme Element, Global Monitoring of Essential Climate Variables (ECV), also known as the 'ESA Climate Change Initiative (CCI)'. The CCI program continues to proceed well and according to schedule. All thirteen ECV projects initiated in 2010 and in early 2012 have been completed. Phase 2 of this programme element was kicked-off in February 2014 and is now on-going for almost all projects. The report provides a short progress status for each individual ECV project and presents some outstanding results. The CCI is increasingly focussing on the use of ECV datasets for key applications, such as an integrated study of the sea level budget, and utilisation of CCI datasets by the community is on the rise. The CCI is also producing a Visualisation Tool as a communication aid, to showcase the ECV data products from the programme. Animations have been put together for the key variable from each project, where data is currently available, to illustrate key climate events for scientific and lay audiences.

In the discussion ESA was commended on the activities and the achievements obtained.

**CGMS-43-NOAA-WP-16 PPT**: NOAA Report on Satellite Data Calibration and Validation: SNPP/JPSS Cal/Val Update

The paper provides an update of the JPSS/SNPP cal/val activities and includes the overview of the 3-year performance of the SNPP instruments (ATMS, CrIS, VIIRS, OMPS), and their well characterized long-term performance. Algorithm Theoretical Basis Documents, validation plans, and validation results for a range of data records are all carefully documented and easily accessible. Definitions for JPSS product maturity (beta, provisional, validated), the product development process and the validation status are described. All SNPP instruments are performing within specifications.

CGMS-wide endorsement is recommended for a standard practice for the provision of deliverables needed to understand the science, the uncertainties and the maturity (independent validation and use) for operational and research products.

Recommended deliverables to document products were developed in the context of the WMO Product Access Guide (acceptance criteria) and QA4EO, and should be adopted by all CGMS operators.

**CGMS-43-ROSHYDROMET-WP-03**: Roshydromet CAL/VAL activity: progress report

The paper described the cal/val activities underway by Roshydromet to support the Meteor-M N2 polar orbiter series (Meteor-M N2 is currently in commissioning phase). Deployment of ground-based calibration/validation system for satellite L1 data and L2 products is underway. With respect to Meteor-M N2, post-launch calibration is on-going for all instruments (imaging radiometer MSU-MR, IR-sounder IKFS-2 and MW-imager/sounder MTVZA-GY), and validation of L2 products planned (e.g., vertical profiles of temperature and humidity, concentration of trace gases and aerosol, cloud cover analysis, etc). LEO-GEO intercalibration of the Meteor-M N2 imaging radiometer MSU-MR and the hyperspectral IR sounder IKFS-2 with SEVIRI is described in more detail. The inter-comparison of MSU-MR with SEVIRI reveals systematic biases of about –1.0, –1.2 K between MSU-MR channels 5, 6 and SEVIRI channels 9,10, while the std values are of 0.25 K. Validation of the hyperspectral IR sounder IKFS-2 was performed using line-by-line radiative transfer model simulations together with adequate atmospheric model (NWP data) for cloud-free scenes over sea. The IKFS-2 radiances spectra were integrated over response functions of SEVIRI channels 7-10, showing a mean difference in integrated brightness temperatures of about 0.3-0.7 K. Calibration of the temperature-humidity sounder MTVZA-GY is subject to further investigation. All instruments on board Meteor-M N2 are fully functional, except the Severjanin SAR which has a low SNR.

The session congratulated Roshydromet for the achieved results regarding Meteor-M N2 instruments. The advent of a new hyperspectral sounder IKFS-2 was welcomed. WGII asked Roshydromet to pursue the new opportunities and requested more information at the next CGMS meeting.

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| ROSH | WGII/3 | R43.06 | Roshydromet is invited to attend the next sessions of the ICWG, ITWG and the other International Science Working Groups. | CGMS-44 | OPEN | - |

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| ROSH | WGII/3 | A43.04 | Roshydromet to present an update on Meteor-M N2 data access, processing packages, and results of an intercomparison of the IKFS-2 with other hyperspectral sounders (IASI, AIRS, CrIS), to CGMS-44. | CGMS-44 | OPEN | HLPP # 1.4.2 |

In concluding the discussions on calibration and validation matters, the following action was raised:

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | WGII/3 | A43.05 | CGMS operators to provide a report on their approach on cal/val, including information on dedicated campaigns and permanent sites, and potential support to cal/val infrastructure, in order to maximize benefits of satellite missions. | CGMS-44 | OPEN | - |

**WGII/4 Infrared/Microwave sounding and ITWG matters**

**CGMS-43-CMA-WP-08**: CMA Report on Progress in Retrieving Thermal and Humidity Profiles from Infrared and Microwave Sounders

The working paper introduced recent progress of CMA in retrieving atmospheric thermal and humidity profiles from infrared and microwave sounders. The profiles are retrieved in the context of FengYun Satellite Algorithm Testbed for Sounder (FYSAT-S) that flexibly combines data from sounders on-board a platform. By default, the products from FengYun 3 serial satellite are those derived from measurements of infrared sounders, such as the InfraRed Atmosphere sounder (IRAS) or the Highspectral IRAS (HIRAS), and measurements of microwave sounders, like the Microwave Thermal Sounder (MWTS), and the Microwave Humidity Sounder (MWHS). For FengYun 4 satellite series, the products are from infrared sounder, the Geostationary Interferometric InfraRed Sounder (GIIRS) only. A set of statistical and physical algorithms are incorporated in FYSAT-S. By now, the FYSAT-S tuned for FY-3 has been implemented in the core ground segment at NSMC/CMA, and those for FY-4 will be implemented in the core ground segment later. Besides thermal and humidity profiles, ozone profile is derived when

information from high spectral infrared sounders are used. General performances of FYSAT-S for FY-3 and FY-4 (based on simulation) are illustrated; further improvements are also addressed at the end. For FY-3C, considering two comparisons of reference types, the results from about one year show that temperature soundings can be produced under partial cloud cover with RMS errors on the order of, or better than, 2.0 K in 1-km-thick layers from the surface to 700 mb, 1-km layers from 700–300 mb, 3-km layers from 300–30 mb, and 5-km layers from 30–1 mb; and moisture profiles can be obtained with an accuracy better than 30% absolute errors in 2-km layers from the surface to nearly 300 mb. For FY-4A GIIRS, the results based on simulated data shows that temperature soundings can be produced under clear sky condition with RMS errors on the order of, or better than, 1.3 K in 1-km-thick layers from the surface to 700 hPa, 0.8 K from 700–300 hPa, and 1.5 from 300–30 hPa, and moisture profiles can be obtained with an accuracy of better than 10% absolute errors in 2-km layers from the surface to nearly 200 hPa.

WG II commended CMA on their work on preparing the use of GIIRS, and pointed out the new opportunities collaboration.

**CGMS-43-ISRO-WP-06**: ISRO Report on INSAT-3D Sounder

The paper presented the status of the INSAT-3D 18-channel Sounder derived atmospheric temperature and humidity profiles. A radiative transfer model dependent bias correction procedure was established using collocated INSAT-3D/RAOB observations for the period of Jan-Jun 2014. The bias correction procedure has resulted in the improved quality of humidity profiles. A procedure was also established to generate the Clear-Sky Brightness Temperature (CSBT) from Sounder channels for use in the radiances assimilation in forecast operational model. The CSBT product is now operationally assimilated in the NCMRWF model.

GSICS procedure is used to monitor Sounder radiances, which are found to be stable. Clear-sky brightness temperature retrieval, now operationally assimilated in an Indian numerical forecast model, uses GOES cloud detection procedure.

**CGMS-43-KMA-WP-04**: Satellite Data Application in KMA's NWP Systems

This paper reported on the current status of the satellite data application in the numerical weather prediction at Korea Meteorological Administration (KMA). The KMA global data assimilation system is based on the hybrid system, which combines 4DVAR and ensemble forecast system. KMA is also operating a 4DVAR-based 12km regional model and 3DVAR-based 1.5km local model. Satellite data streams are currently assimilated in the global and regional model; in the local model, only scatterometer data are used. At the end of 2015, Ground-based GNSS data over Korean peninsula will be assimilated into local area model and KOMPSAT-5 RO (Radio Occultation) data into the global and local area model. It is planned that Metop-B/ASCAT soil moisture data will be assimilated operationally for the global model from 2015. Tests showed positive impact of Metop-B/ASCAT soil moisture data assimilation: forecast errors were generally decreased with the introduction of Metop-B/ASCAT soil moisture. In particular, the performance over the East Asia in the fall season was greatly improved.

The impact of IASI direct readout provided by KMA/NMSC will be evaluated for the global model, and put in operation from 2015 onwards.

**CGMS-43-NASA-WP-10**: Twelve Years of Observations from AIRS

The Atmospheric Infrared Sounder (AIRS) instrument on the NASA Aqua satellite platform has been operating without major disruptions since becoming operational in August 2003.

The basic AIRS observation contains a single infrared spectrum in 2378 channels obtained every 0.03 seconds (2,916,000 spectra per day) at wavelengths between 3.7-15.4 µm. A subset of these spectral observations is distributed in near real time, and has been operationally assimilated since late 2003 by forecast centres around the world. Additional channels are used to generate retrieved geophysical products (e.g., on atmospheric composition such as CO, CO2, O3, CH4), and these products have supported over 700 peer-reviewed publications. The AIRS instrument remains fully functional and without significant operational issues. The expected end of mission time of the AIRS instrument is that of the Aqua spacecraft: 2022 or later, conditional on the consumption rate of spacecraft fuel needed to maintain Aqua in the NASA A-Train satellite constellation and to deorbit Aqua safely.

**CGMS-43-NOAA-WP-17 PPT**: NOAA Report on Infrared/Microwave Sounding and ITWG Matters

This paper provided an overview of the SNPP/JPSS CrIS/ATMS Sounding Products (NUCAPS) and their applications and to provide awareness to the CGMS community on the availability of these products. Products are generated based on the AIRS science team algorithms (version 5). NUCAPS soundings are provided to the National Weather Service (NWS) for nowcasting applications. Soundings are available from the NOAA CLASS archive, and part of the NOAA Community Satellite Processing Package (CSPP) which enables the international community with direct readout capabilities to generate sounding products from CrIS and ATMS.

Retrievals are used to check consistency across platforms; detection of polar low anomaly. Comparisons of retrievals with radiosonde soundings at ARM sites showed differences of up to 30%. Question is discussed whether retrievals could improve forecasts. They provide support to dropsonde flight campaign for validation, using NRT retrievals through DB.

CrIS, IASI have climate monitoring performance (stability, calibration accuracy) that could allow discerning climate trend from variability (<30 years or less, cross-comparisons of IASI, CrIS and AIRS). Airborne validation campaigns are conducted to assess absolute calibration of CrIS.

CGMS should recognize the importance of (NIST traceable) validation campaigns to provide absolute calibration assessments for the user community - particularly the weather and climate communities.

Dong Wu pointed out that the difference between AIRS algorithm v5 and v6 is significant regarding cloud masking; this should be considered in NUCAPS.

**WGII/5 Precipitation and IPWG matters**

**CGMS-43-IPWG-WP-08**: Summary Report of the 7th Workshop of IPWG

Working paper IPWG-WP-01 was written by the two co-chairs of the International Precipitation Working Group (IPWG), Dr. Nai-Yu Wang and Dr. Kazumasa Aonashi. The report summarized the outcome of the IPWG-7 meeting. Furthermore, it highlighted the recent achievements of IPWG and provided an outlook for the planned activities over the next two years. The report also cited specific recommendations for CGMS members and IPWG comments on the current HLPP. The IPWG-7 was held at the Tsukuba International Congress Center and hosted by the Japan Aerospace Exploration Agency (JAXA) Earth Observation Research Center (EORC), Tsukuba, Japan during 17-21 November 2014. The meeting was attended by 125 participants from over 20 countries that included 49 oral and 57 poster presentations. It consisted of nearly three full days of plenary sessions (12 oral, 3 poster), one full day of working group discussions and a final group plenary, and then closed with a special session dedicated to Dr. Arthur Hou, NASA Global Precipitation Measurement (GPM) Project Scientist, who passed away in late 2013. Additionally, a satellite training course was given, which took place in parallel to the IPWG workshop; 28 participants attended the course.

Two new co-chairs were selected; Remy Roca (CNRS, France) and Tufa Dinku (IRI, USA). IPWG-8 will be held in the fall of 2016, with an African venue being targeted, however, former co-chair Vincenzo Levizzani has offered to host the meeting at his ISAC/CNR facility in Bologna, Italy as a secondary option.

IPWG highlighted the importance of the continuity of the geostationary coverage and data access over the Indian Ocean area.

For CMA and IMD – Provide institutional support to develop IPWG validation sites over China and India.

*The possibility of a WMO support letter to invite IPWG participation from these countries to access data, support sites should be discussed between WMO Secretariat and IPWG leadership.*

For all CGMS Members - Continue an operational constellation of conically-scanning microwave platforms to guarantee sustained support for the current level of capability. In particular, specific plans for the following missions are requested: JAXA for the GCOM-W/AMSR-2 follow-on; NOAA for the SSMIS F20 launch plan/DMSP follow on program; NASA/potential use of GMI#2; specific plans by EUMETSAT for EPS-SG/MWI.

*This is to be addressed in CGMS WG III.*

For ITWG, ICWG (and other ISWG's) – To foster more close collaboration on common topics, subgroups and parallel group reports should be shared at respective subgroup meetings, as well as potential specialty meetings (i.e., emissivity, snowfall, data assimilation) and other meetings of opportunity (e.g., AGU, EGU, etc).

*The session encouraged collaboration among the ISWGs.*

For all CGMS Members – IPWG encourages cross-agency coordination of satellite assets into "A-train-like convoys" of instruments with sensitivities to distinct aspects of precipitation processes. IPWG requests plans for such coordination from CGMS members, specifically, plans beyond CloudSat, EarthCare and GPM, etc.

*This is to be addressed in CGMS WG III.*

For all CGMS Members – Provide specific plans (e.g., sensors, timelines, etc.) regarding the reprocessing of all L1 radiance data, L2/L3 derived precipitation products, and their inter-calibration (i.e., SCOPE-CM, NOAA CDR, etc.).

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | WGII/5 | A43.06 | CGMS operators to report on their specific plans for reprocessing and associated user requirements (such information would be useful for the ISWGs). | CGMS-44 | OPEN | HLPP # 5.1 |

For all CGMS Members – Provide free and open access to satellite and ground validation data/products to IPWG members with minimal latency.

*Governed by WMO Resolution 40 and countries' data policies regarding precipitation data.*

For all CGMS Members - Coordinate crossing times of precipitation relevant satellites in an effort to improve the temporal sampling of the diurnal cycle, convective system lifecycles and severe storms. This might include aging satellites that serve in a backup mode.

*This is to be addressed in CGMS WG III.*

For all CGMS Members – There are emerging new technologies that can enhance precipitation retrievals by improved measurement of physical properties related to precipitation, in particular, cloud properties. IPWG requests that specific plans for any news sensors (e.g., Doppler radar, cloud radars, GEO MW sensors, etc.) be made available, including those relevant to ICWG

Additionally: CGMS-43 WGII confirmed Remy Roca (CNRS, France) and Tufa Dinku (IRI, USA) as the new IPWG co-chairs and to thank the outgoing co-chairs Nai-Yu Wang from the University of Maryland (USA) and Kazumasa Aonashi from the Japan Meteorological Agency and recommended this to the CGMS-43 plenary accordingly.

CGMS-43 is requested to provide information to the IPWG Rapporteur on areas for future consideration by the IPWG;

*Guidance was provided at CGMS session.*

CGMS members are requested to continue to provide financial support for the activities related to IPWG, including workshop support and associated travel for new participants (including those at any associated training activity), travel support for CGMS member participation, and support for IPWG co-chairs (or designated representatives) to participate at other relevant meetings (e.g., WMO, CEOS, etc.).

*Addressed at CGMS-42*

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| IPWG | WGII/5 | A43.07 | The session recommended a stronger application focus of IPWG (e.g. NWP, hydrology, agriculture), and asked IPWG to organize an IPWG-NWP workshop in 2015 or 2016. | CGMS-44 | OPEN | HLPP # 3.6 |

Regarding the planned development of snowfall validation best practices, reference was made to the WMO SPICE Solid Precipitation Intercomp Experiment (SPICE).

**CGMS-43-CMA-WP-09**: CMA Report on Precipitation Products

The paper introduced the work at CMA that uses Microwave Radiation Imager (MWRI) sensors of FY-3 to improve the FY-2 IR-derived precipitation products. The two types of satellites are combined dynamically to trace the variability of precipitation in different areas and for different seasons. The positive effect of adding microwave precipitation products of FY-3 into products of FY-2 is demonstrated. An improved estimate of hourly rain rate is investigated and compared with in-situ gauges and the CMORPH method. The study suggests the microwave precipitation is helpful for improving IR derived products. It is planned to add more microwave data into the operational products to raise the time-space sampling in near future.

In the discussion the group asked whether this work was discussed at IPWG-7, implying that this should be done.

**CGMS-43-ISRO-WP-07**: Precipitation over Orographic Regions

The paper presented the status of precipitation retrieval over orographic regions using INSAT-3D measurements in the Hydro-Estimator (H-E) Technique. The H-E method implemented in the ISRO Satellite Application Centre is found to have poor performance over high orographic regions (e.g. the Himalayas). A correction to the H-E module is attempted that provides improved performance over high orographic regions. The improved module is currently under implementation for operational rain estimation.

NCEP GFS underestimates rain rate in high-elevation areas. TPW and RH values as derived from GFS fields are enhanced to be more realistic, using histogram matching. Strength of convection is determined by comparison of the temperature of convective tops from IR adjustments with that of the

Equilibrium level (level of neutral buoyancy). Tuning is applied to account for orographic effects. Weekly averaged results of the modified H-E are compared for four Indian meteorological sub-divisions with surface rain gauge observations, and results from the TRMM 3B42V7.

**CGMS-43-ISRO-WP-08**: Precipitation from SAPHIR – Microwave Sounder

This paper presented the status of Precipitation Retrieval from the Megha-Tropiques SAPHIR passive Microwave Sounder. The retrieval of rain from SAPHIR is required as MADRAS, the primary instrument for rain retrieval on Megha-Tropiques satellite, is non-functional. SAPHIR rain rates (mm/h) are compared with TRMM 3B42V7, GSMap, and monthly averages with results from TRMM TMI, PR, and GPCC. SAPHIR is an adequate replacement for MADRAS to fulfil the mission objectives of Megha-Tropiques, and the value of the ScaRaB thermal IR instrument is subject to further investigation.

WG II made the suggestion to look at SAPHIR and INSAT-3D –derived rainfall rates in combination.

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| ISRO | WGII/5 | R43.07 | ISRO is encouraged to implementing a multi-sensor precipitation estimate based on SAPHIR and INSAT-3D | CGMS-45 | OPEN | HLPP # 3 |

**CGMS-43-NASA-WP-04**: Update of the NASA GPM and Precipitation Products and their Availability

2014 was a keystone year for NASA precipitation missions. The GPM core satellite was launched from the Tanegashima Space Center in Japan. The TRMM satellite ran out of fuel and began its descent and end of mission period. April 8, 2015 ended the TRMM science operations after 17.5 years.
GPM radiometer data became publicly available in July 2014 which was 3 months before the planned release. Dual-frequency radar data became available in September as scheduled. The GPM core mission carries a dual-frequency precipitation radar (DPR) and a passive microwave imager (GMI).

All data is available via ftp to all users. Distribution follows the NASA free and open data access policy. While users are required to register by email to obtain the data there are no additional requirements. Data is available either through a search and query interface or via ftp so that automated scripts can be used to routinely retrieve the data. The paper provides more detail on file formats and access routes.

An important part of the GPM mission is the inter-calibration of all the radiometers in the mission to a consistent mission standard. The “at launch” standard for the inter-calibration was a well-known calibration based on the TRMM TMI and PR. This inter-calibrated brightness temperature product carries the designation of 1C. These inter-calibrated 1C brightness-temperature products are used for producing the precipitation products.

NASA indicated that there are numerous precipitation products that NASA provides in NRT. NASA is continuously upgrading its retrieval algorithms to be able to improve the time latency. NRT data is provided on a best effort basis, however, there is no official requirement on NASA to do this.

Specifically for GPM, NASA provides GMI data both L1 and L2 in 1 hour or less after data collection, and combined within 3 hours of data collection. The key to merged products is routine and consistent provision of L1 data in NRT as well as ancillary data. In addition, a listing of available GPM data products, corresponding latency information and accessibility is available on NASA's Precipitation Measurements Missions website at: http://pmm.nasa.gov/data-access/downloads/gpm.

The Plenary noted the importance of the observations from the GPM core satellite.
CGMS thanked NASA for its long-standing support to the successful TRMM mission.

**CGMS-43-NOAA-WP-18 PPT**: NOAA Report on Precipitation and IPWG matters

NOAA contributes to CGMS Precipitation Activities in four primary ways:

- Operating LEO and GEO satellites that make observations in the visible, IR and microwave spectrums
- Generating operational precipitation and water vapour products
- Providing ground assets to validate and compliment the satellite observations
- Making all available data sets accessible to the CGMS community

The presentation summarized NOAA's satellite assets contributing to the measurement of Precipitation, provided an update on the status of operational precipitation products, noted any contributions to HLPP, and responded to actions from IPWG-7.

Key issues raised in the paper include (i) maintaining robustness of the satellite constellation specifically for precipitation, (ii) advancing science through synergy of LEO and GEO programs, (iii) greater commitment to "routine" reprocessing of L1 radiance and L2 products

**WGII/6 Atmospheric motion vectors and IWWG matters**

**CGMS-43-CMA-WP-06**: CMA Report on Progress of AMV Long-term Reprocessing

AMVs are one of the products of CMA derived from Fengyun-2 GEO satellite data and have been archived since Jan.1, 2006. CMA started a project to reprocess the historical AMVs data in 2013. The AMVs algorithm (CMA Version 2014) has been released. By using the new algorithm, AMVs density and quality are increased. After assessment, the algorithm was realized in Fengyun-2E AMVs' operational system in Dec. 2014.

The session expressed its appreciation to CMA for starting the reprocessing FY-2 data and its potential value for reanalysis. This work could be a contribution to the SCOPE-CM AMV project (10) where JMA, EUM, CIMSS coordinate AMV reprocessing.

CGMS-43-ISRO-WP-09: ISRO Report on INSAT-3D AMV

This working paper reports on the recent status of the Atmospheric Motion Vectors (AMVs) derived from INSAT-3D at India Meteorological Department (IMD) and Indian Space Research Organization

(ISRO). INSAT-3D AMVs produced based on TIR, WV, VIS and short-wave mid-IR channels, and disseminated via the GTS in BUFR format. RMS vector differences and biases are computed for TIR, VIS, WV, and MIR AMVs at different levels, evaluated against radiosonde observations. The INSAT-3D AMVs are regularly monitoring by NCMRWF, UK Met Office and the validation statistics are displayed in the respective websites. Upon successful monitoring for several months INSAT-3D AMVS are getting assimilated regularly in operational models of NCMRWF and IMD Delhi.

WGII welcomed the progress made with INSAT AMVs. In the discussion it was also suggested to enable, and start, a regular monitoring of the AMVs by all NWP centres.

**CGMS-43-IWWG-WP-01**: Atmospheric Motion Vectors and IWWG Matters: Report from the IWWG

The paper summarized the outcomes of the 12th International Winds Workshop (IWW12). The workshop was hosted by the University of Copenhagen and took place in Copenhagen, Denmark from 16-20 June 2014. There was a good cross-spectrum of attendance (65 participants) from a wide range of satellite producers, NWP centers, and research centers. This paper (i) recalled recommendations from CGMS-42 to IWW12, and (ii) highlighted the outcomes and recommendations from IWW12. Among others, the paper suggested that a Third AMV Intercomparison study, optimally to take place in the 2018-2020 time frame, primarily to investigate (i) the effect of using different QI processes and different target selection processes in the different AMV algorithms, (ii) the effect of using imagery from the newest satellite series (Himawari 8/9 or GOES-R), with higher spatial resolution, higher temporal resolution, and more spectral channels in the AMV calculations. Substantial discussion was held at IWW12 on the topic of using a “Common” algorithm in reprocessing activities. The idea is valid in concept, especially given the movement by CGMS satellite operators to acquire and use more consistent instrumentation. However, it was felt that greater consultation with scientists involved in reanalysis and climate was required before embarking on this complicated and expensive process. IWW felt that higher priority should go to ensuring we have as complete a record as possible of reprocessed AMV datasets using the current framework, particularly from the earlier satellites. Main concerns are that each instrument is different and that it would not be simple to construct a single algorithm that would accommodate these differences. Also, there is currently no stand-alone algorithm to process all data, and AMV require other concurrent meteorological products (e.g., cloud properties) that may or may not be available from each provider. Some steps toward a “common” algorithm were proposed, such as working toward the use of common algorithm components, facilitated by product inter-comparisons.

Collaboration with ICWG has proven very useful (cloud top height, microphysics), there was good representation of the scatterometer community (session on boundary layer winds), and MISR winds will soon be available on GTS.

Derivation and assimilation of high-resolution AMVs aim at resolving small scale dynamics of wind field, for nowcasting, short-range NWP, and capturing of high impact events. There are a number of difficulties and there is no single-best approach in deriving and assimilating such AMVs. The new-generation imagers with high repeat cycles and higher spatial pixel resolution are enablers to progress. For tracking, 5-10 pixels are typically used which leads to a larger amount of invalid retrieved vectors,

and requires use of other techniques (correlation surface, clustering) to constrain tracking. Assimilation needs to trade correlated errors of high-resolution imagery against context if this imagery is thinned too far.

Key recommendations for consideration at CGMS are:

IWW12.1. Producers and users to discuss and agree provision of further information characterising the AMV derivation for enhanced QC and error characterisation

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| ICWG, IWWG | WGII/6 and WGII/8 | R43.08 | ICWG and IWWG to liaise as appropriate on the provision of further information characterising the AMV derivation for enhanced QC and error characterisation. | CGMS-45 | OPEN | HLPP # 3.5.2 |

IWW12.2. Satellite operators to consider coordination of orbits for scatterometer instruments and to provide open and timely access to data in order to maximise independent coverage and benefits to nowcasting and NWP from assimilation of scatterometer wind data.

*WGII referred the recommendation IWW12.2 to WG III to be addressed there in due course.*

IWW12.3. All producers to consider, during design of future derivation systems for next generation satellites, the ability to handle existing and where possible earlier generations of satellites (with some expected code modularity to reflect the different channel availability, etc). This will remove the need to maintain more than one system, ensure improved approaches are applied to all operational satellites and will greatly simplify the approach to reprocessing.

Some items were *considered an internal IWWG matters which should be pursued there and reported to CGMS as required.*

IWW12.4. IWWG community to agree a new standard BUFR template, which when rolled out should be adopted by all producers.

IWW12.5. IWWG co-chairs to check current requirements for satellite-derived winds in the GOS [OSCAR/Requirements] and to raise with CGMS (i) how best to increase visibility of AMVs as a driver for the design and operations of future satellite systems, and (ii) how best to reflect the higher spatial and temporal resolution requirements of high resolution NWP and nowcasting.

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| IWWG, IPET-OSDE | WGII/6 | R43.09 | IWWG to liaise with the application focal points in the WMO RRR process (on IPET-OSDE) to provide feedback on the winds-related observation requirements in the RRR database. | CGMS-44 | OPEN | HLPP # 1.1 |

IWW12.6. Continue research into improved derivation and assimilation of high resolution winds for use in high-resolution data assimilation and nowcasting.
IWW12.7. IWWG to undertake a 3rd AMV Inter-comparison study in the 2018-2020 timeframe that will study the effect of using higher spatial, temporal, and spectral resolution imagery from the newest satellite series (Himawari 8/9 or GOES-R) on AMV derivation. The IWWG will coordinate with the ICWG in this study to gain an improved understanding of the cloud microphysics and its potential use for improving retrieved AMVs. Apply a NWP SAF analysis type approach to the results and dig deeper into differences observed by the various satellite operators in order to understand why some algorithms perform better in some situations than others.

*In view of the very useful and insightful outcome of the 2nd AMV inter-comparison WGII expressed encouragement to CGMS operators to participate in the next inter-comparison and to contribute to the definition of experiments to be conducted with their experts at the next IWWG13 to be held in 2016.*

IWW12.17 Encourage continued support and collaboration between AMV producers and feedback from users to help improve the quality of AMV datasets, particularly with a view to securing long-term AMV provision over the Indian Ocean region.

It was recommended to revisit wind-related requirements in OSCAR (high-res NWP, nowcasting); to confirm to what extent Wind is a driver for WIGOS (in Manual on WIGOS and otherwise).

As an important yet specific item, the session noted that revision of QC and QIs is required in view of AMV use in high-resolution NWP, since these have been defined for use in synoptic scales. This needs to be pursued as a matter of priority in view of the need of NWP for higher resolution AMV products.

Finally, WGII confirmed the proposal to change the Co-chairmanship to Regis Borde and Steve Wunzong as of IWW-13 in Monterey CA, USA, summer 2016 and recommended this to the CGMS-43 plenary accordingly. Warm thanks were expressed to the outgoing co-chairs Mary Forsythe and Jaime Daniels for the thorough and thoughtful work and leadership.

**CGMS-43-IWWG-WP-02**: Summary of the second AMV intercomparison study

The Second AMV Intercomparison study furthered a line of previously completed research regarding the similarities and differences between the operational Atmospheric Motion Vector (AMV) algorithms of seven satellite-derived wind producers (NOAA, CMA, JMA, KMA, EUMETSAT, NWCSAF, CPTEC from Brazil), using a common set of MSG/SEVIRI images and ancillary data.

The current study focused on including for the first time the CMA and NWCSAF AMV algorithms in the inter-comparison, in order to quantify its performance relative to other AMV algorithms, on updating the results of the previous AMV inter-comparison studies due to the changes that had occurred since 2009, and on performing follow up studies, identified in the previous intercomparison work, to analyze particular issues in pursuance of a more complete understanding of how the different AMV algorithms compare. Four experiments were carried out, using common input datasets (Meteosat-9 imagery, and ECMWF forecast grids for 17 Sep 2012). The inter-comparison looked at: target selection, height assignment, tracking, and quality indicators.

The study found a mix of both positive and negative results. The different AMV algorithms successfully determine the horizontal and vertical displacements of the moved features, but not all centres define a consistent AMV speed and direction with these displacements. Using the IR brightness temperature (TBT) for the height assignment, the distribution of AMV heights is highly variable due to the variability of how this representative TBT is defined. When additional height assignment techniques are used, all centres except JMA improve the AMV validation statistics. Nevertheless, the improvement is limited for some of the centres because of using the improved height assignment techniques in only a small part of the data. The two centres using CCC height assignment method (EUMETSAT and NWCSAF) are in general obtaining the best validation statistics. Considering the AMV coverage, important differences occur between centres even in the case in which a similar prescribed configuration is used.

The full AMV Intercomparison Technical Report (267 pages) can be found at:
www.nwcsaf.org/HD/files/vsadoc/CIMSS_AMV_Comparison_FinalReport_04July2014.pdf

A smaller Summary (8 pages) can also be found at:
www.nwcsaf.org/HD/files/vsadoc/AMV_Intercomp_Extended_Abstract_v3.pdf

More spectral channels and higher temporal resolution allow better understanding and more precise tracking of cloud features (e.g., a “wind” tracked in a convective cloud system).

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| IWWG | WGII/6 | A43.08 | IWWG to define the experiments for the next intercomparison at the next IWW workshop in 2016. | CGMS-44 | OPEN | HLPP # 3.2.1 |

**CGMS-43-JMA-WP-04**: JMA’s atmospheric motion vectors

This paper reports on the recent status of JMA's Atmospheric Motion Vectors (AMVs) from MTSAT-2 and MTSAT-1R, and gives an overview of Himawari-8 AMVs. Many improvements can be seen in using Himawari-8 for deriving AMVs. The paper showed radiosonde statistics for Himawari-8 and MTSAT AMVs for the period from January 24 2015 to February 23 2015. Quality is improved for upper and

middle levels over the Northern Hemisphere and tropical regions. However, increases in BIAS and RMSVD are seen for middle level over the Southern Hemisphere.

Himawari-8 gives the prospect of better depicting divergent flow in the tropics.

**CGMS-43-NASA-WP-05**: NASA Global Wind Measurements and Technology Development

Global wind measurements have become indispensable in numerical weather prediction (NWP), and NASA plays a vital role in improving satellite products for the atmospheric motion vector (AMV) from cloud and water vapour feature tracking and the 10-m height oceanic wind vectors from radar scatterometers. NASA continues to develop new technologies for global lidar wind profiles from space and for hurricane winds from GPS reflected signals.

The 17.6-km CMVs from NASA/JPL's MISR instrument are in good agreement with the collocated ERA-Interim winds except for a slightly slower zonal wind speed in the polar jets and a stronger tropical diverging flow in the upper-troposphere. As a MISR research product, the 4.4-km CMV provides valuable (daytime only) diagnostic to the classic Kármán vortex problem in the real atmosphere. NASA's RapidScat, newly installed on International Space Station (ISS) in September 2014, has begun to send quality scatterometer ocean wind data for operational numerical weather prediction. For decades NASA has been advancing Doppler lidar wind technologies for space-borne remote sensing, and is collaborating with ESA with airborne lidar wind validation/calibration to support the Atmospheric Dynamics Mission (ADM). NASA is currently developing an Earth Venture mission, Cyclone Global Navigation Satellite System (CYGNSS), to measure hurricane winds from reflected GPS signals with 8-satellite constellation that will be launch ready in October 2016.

Regarding cal/val plans for CYGNSS, NASA pointed out that GMAO assimilated RapidScat data, and a similar approach is envisaged for CYGNSS.

**CGMS-43-NOAA-WP-19 PPT**: NOAA Report on Atmospheric Motion Vectors and IWWG Matters

NOAA contributes to CGMS Satellite Wind Activities in a number of ways:

- Operating LEO and GEO satellites that make observations in the visible, IR and microwave spectrums
- Generates operational GEO and LEO Atmospheric Motion Vector (AMV) products
- Makes all available data sets accessible to the CGMS community

The paper responded to CGMS actions and recommendations CGMS-A41.28, CGMS-R41.08, and CGMS-R42.03. It provided an update to CGMS on the status of NOAA satellite wind products, and highlighted its contributions to the CGMS High Level Priority Plan (HLPP). Hourly GOES winds are now available (from 3-hourly previously), and low level wind height assignments in the presence of low level temperature inversions could be improved, with positive impacts in NWP data assimilation systems. Polar winds are now derived from the VIIRS M15 (10.76um) band.

As indicated during the calibration/validation discussions in WGII, polar region atmospheric winds using atmospheric motion vectors based on cloud and water vapour imagery have been demonstrated to be of critical importance to numerical weather prediction. The VIIRS instrument has no water vapour channel, mainly due to the development of VIIRS before water vapour polar winds were successfully demonstrated using MODIS. Without water vapour channels, the density of polar region winds are reduced by about 50% and forecasts are degraded. Therefore it is recommended that CGMS operators consider adding, if not already planned, a water vapour channel and a CO2 channel (for better cloud height estimation) for a future generation polar-orbiting imager. The addition of these channels would result in consistency with other next generation operational polar-orbiting imagers as well as next generation geostationary imagery, including the GOES-R ABI. At the same time we recognize the importance contribution of VIIRS with respect to consistent spatial resolution near the edge of scan and the Day Night Band capability.

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | WGII/6 | R43.10 | CGMS members to consider include a water vapour channel and a CO2 channel to polar-orbiting imagers, to maintain accuracy and coverage of polar winds and cloud height retrievals achieved by MODIS. | | OPEN | HLPP # 1.1.6 |

**WGII/7 Radio occultation and IROWG matters**

**CGMS-43-IROWG-WP-13**: Outcome and recommendations from the IROWG-4

Lidia Cucurull (NOAA) presented the paper on behalf of the IROWG co-chairs. The main recommendations of the fourth IROWG meeting are summarised below - only a short and concise working paper could be provided to CGMS-43 since IROWG-4 preceded CGMS-43 by about one month. The full set of recommendations, relevant at CGMS, at satellite operator, and at IROWG level will be made available at http://www.irowg.org.

For work in the immediate future CGMS-43 is invited to emphasise the following four main IROWG-4 recommendations:

- Ensure that both, **equatorial and polar components of COSMIC-2 are fully funded and launched**; this is required for Numerical Weather Prediction, Climate, and Space Weather;
- IROWG recommends **targeting at least 20,000 occultations/day to be made available to the operational and research communities** of Numerical Weather Prediction, Climate, and Space Weather;
- IROWG recommends that the **RO receiver design includes sufficient software/firmware flexibility to allow changes in the signal processing including processing of new GNSS**

**signals/constellations as they become available; all receiver measurements should cover the ionosphere** as well**;**

- International space/research agencies (e.g., NASA, ESA, CMA, CSA, NSF, NOAA, EUMETSAT and others) to hold an **interagency workshop to define cooperation options for implementing the next steps towards a LEO-LEO research and demonstration mission**.

All presentations, as well as minutes, from IROWG-4 are available at http://www.irowg.org.

An Ionospheric and Atmospheric Coordination Workshop was organized in Boulder CO, USA on 3 Oct 2014, to determine requirements for ionospheric products to be distributed over the WIS in NRT.

There is a common data format (based on BUFR) serving the NWP community. To serve the space weather community, further discussion is needed.

WGII asked a question about the nature of IROWG recommendations to CGMS and the science-related issues discussed at IROWG-4. WGII felt that recommendations presented were of a high-level nature and that specific science and technical matters to be addressed were missing. The presenter explained that the need to address scientific and technical objectives, which are the core remit of IROWG, will be forthcoming once the minutes from the workshop are finalized.

**CGMS-43-EUMETSAT-WP-12**: Status of EUMETSAT Study on Radio Occultation Saturation with Realistic Orbits

First results of a study currently running at ECMWF are presented. The study looks at saturation effects when assimilating RO observations, where RO observation positions are simulated using realistic LEO and GNSS orbits. This study is thus a refinement of an earlier study that assumed RO occultations to be randomly distributed in space and time. An Ensemble of Data Assimilation (EDA) approach, using 10 (+1) members in a 4D-Var modern NWP system, was used. Within this study, the following 3 main issues are addressed:

1. Refine the earlier, random occultation position, study with realistic future satellite orbits;
2. Assess which observation constellation is best suited to achieve the best distribution in space and time;
3. Provide guidance on RO instrument deployments on future LEO satellites.

Regarding Point 1, it has been found that although realistic orbits affect occultation positions significantly, a modern NWP system can still effectively use any observations, thus the impact of realistic orbits is small. Regarding Point 2, the more observations are available, the lower forecasting spreads are found; constellations that provide most observations at low latitudes are particularly useful, since here, per area the least occultations are available from polar orbiting RO instruments and the model errors are the largest. Regarding Point 3, it again can be concluded that the more observations, the lower the forecast spread, even if additional instruments are provided in orbits that are already populated with RO instruments.

The study itself is formally finishing by August 2015, with a final presentation at EUMETSAT about 1 month earlier. Underlying EDA runs have been run over the last year and are complete. Results, discussions and conclusions will this be included in the final report. The study results have also been presented and discussed at IROWG-4 in April 2015.

**CGMS-43-NOAA-WP-20 PPT**: NOAA Report on Radio Occultation and IROWG matters

The presentation provided a status report of the COSMIC-2 / FORMOSAT-7 constellation, which is a NOAA-NSPO-USAF-NASA/JPL partnership. It is a follow-on to the current COSMIC-1 satellite constellation, and its design concept meets L1RD requirements. The system will provide 10,000+ worldwide soundings per day, with all weather, uniform coverage over oceans and land with 30 min average latency. The constellation consists of 12 satellites, with 2 launches in different inclinations (6 satellites to 24 degree orbit – carrying USAF secondary payloads; and 6 satellites (+ 1 optional spare) to 72 degree orbit – carrying Taiwan secondary payloads (planned)). Details were provided on the instrument development status.

NOAA also described tracking methods that enable COSMIC-2 occultations to take measurements useful for space weather applications.

NOAA informed WGII that the full COSMIC-2 Programme (equatorial and polar) is included in the Presidential Budget for NOAA activities.

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS RO space agencies | WGII/7 | A43.09 | CGMS members that operate RO instruments to explore RO capabilities to support space weather applications and report on their support to space weather application to CGMS-44. | CGMS-44 | OPEN | HLPP # 5.2 |

**CGMS-43-CMA-WP-05**: CMA Report on Radio Occultation Processing

FY-3C, launched on September 23rd, 2013, carries a radio occultation sounder named GNOS (Global Navigation Satellite System Occultation Sounder). Compatible with GPS and BeiDou navigation satellite systems, GNOS makes daily measurement up to 800 times which are made available through web-based data services, CMACast, and the GTS. CMA-WP-05 presents the result of a study that compares the refractivity profiles with the co-located ECMWF analyses. Bias and standard deviation being calculated as the function of altitude, the result shows that the mean bias is about 0.2% from the near-ground surface to 35km; the average standard deviation is within 2%, but for the range 5-30km where best soundings are usually made, the magnitude is about 1%. In general speaking, GNOS meets the designed requirement; it gives FY-3 a new sounding capability and users a new data option.

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | WGII/7 | R43.11 | CGMS Members to approach Operators of GNSS systems to request them to provide a minimum level of information on the signal structure and interface control (ICD) in a timely manner to enable the use of these for future RO missions. | CGMS-44 | OPEN | HLPP # 1.1.4 |

**WGII/8 Cloud, ICWG and ash/dust related matters**

**CGMS-43-ICWG-WP-01**: Structure International Clouds Working Group (ICWG)

Cloud parameter retrievals are increasingly used for near-term (now-casting), short-term, (weather forecasting), medium-term (regional monitoring), and decadal (climate monitoring), as well as for potential improvements in the cloud and convection parameterizations adopted in weather and climate models. These developments have led to an increasing interest of space agencies to make cloud detection and cloud parameter retrievals part of their operational services. The space agencies from the Coordination Group for Meteorological Satellites (CGMS) ask for a mechanism that facilitates access to and sharing of knowledge, commonality of approaches, requirements, and training on cloud parameter retrievals.

At CGMS-42 WGII the nominated ICWG representatives of the Cloud Retrieval Evaluation Working Group (CRE-WG) presented the Terms of Reference (ToR) for establishing an International Clouds Working Group within CGMS. Thereafter, the CGMS−42 plenary endorsed the formation of an International Clouds Working Group (ICWG), making CRE-WG a formal entity.

This working paper presents the response to the action assigned to the co-chairs of the ICWG at the 42nd CGMS meeting [CGMS-42: WG II/8 Action 42.06], asking the ICWG co-chairs to develop the new ICWG into a structure which is common to the existing International Science Working Group under CGMS and provide a report to CGMS-43.

**CGMS-43-ICWG-WP-02**: Summary report of the International Cloud Working Group Activity

The ICWG was formally known as the group in Cloud Retrieval Evaluation Workshop-4 (CREW-4). The last workshop was held on 4-7 March 2014, Grainau, Germany, and aimed at enhancing cloud parameter retrievals, assessing their associated errors, improving their use in nowcasting and forecasting activities, and improving the characterization of long-term cloud property datasets. There were 69 participants who presented their work in four sessions and eight subtopics. The main recommendations of the CREW-4 were to:

- Improve cloud models used in retrievals to more accurately reflect reality, in particular ice crystal models, vertical in-homogeneity and multiple layers;

- Explore the potential of combining different types of observation in level-2 cloud retrieval methods;
- Explore the definition of a set of essential filtering rules in level-3 aggregation methods for different cloud parameters;
- Work towards the characterisation of uncertainties in level-2 and level-3 products;
- Explore production of multi-algorithm ensembles to assess uncertainty/sensitivity;
- Explore the production of long-term datasets aimed at stability and accurate assessment of product strengths and weaknesses;
- Use of common ancillary data and validation procedures for level-2 and level-3 data;
- Establish topical groups to make progress on a variety of outstanding issues, for example multi-layered clouds, severe weather applications, and aggregation methods.

The next ICWG meeting will be held during 17-20 May 2016, in Lille, France.

ICWG has formed topical groups to address key research questions, and actions agreed by the Group or coming from CGMS. A question was asked on the potential of ICWG to address ash and aerosol retrievals in the future, given the commonalities in microphysics. ICWG has not yet addressed this.

At its next meeting, ICWG should put focus on investigating data from the new-generations instruments on Himawari-8 and GOES-R for the retrieval of cloud parameters.

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| ICWG | WGII/8 | R43.12 | At its next meeting (May 2015), ICWG should put focus on investigating data from the new-generations instruments on Himawari-8 and if available GOES-R for the retrieval of cloud parameters. | 20 May 2016 | OPEN | HLPP # 3.2.4 |

**CGMS-43-NOAA-WP-21 PPT**: NOAA Report on Cloud, ICWG and Ash/Dust Related Matters: VIIRS Aerosols and Air Quality Applications

This presentation provided the status of the current cloud, and aerosols products from NOAA/NESDIS, current applications and future capabilities. The presentation included an overview of the volcanic ash satellite retrieval algorithm inter-comparison activity currently undertaken within WMO SCOPE-Nowcasting (workshop hosted by NOAA CIMSS on 29 Jun – 2 Jul 2015). Studies on merged VIIRS/CrIS cloud retrievals are underway, as well as cloud validation efforts using CALIPSO/CALIOP, and generation of cloud CDRs. The status of VIIRS aerosol products was presented (AOD, air quality parameters), and the value of synergistic use of several sensors (e.g., VIIRS, CrIS) to derive products highlighted.

The session noted that coordination between CGMS and the European Copernicus Atmospheric Monitoring Service (CAMS), GEIA (Global Emissions InitiAtive), and CEOS (Committee on Earth Observing

Satellites) Atmospheric Composition Constellation (ACC) is needed, on a geostationary constellation for atmospheric composition and air quality monitoring (consisting of TEMPO, Sentinel-4, and GEMS).

The session further noted:

- Coordination and commonality of processing code to generate VIIRS aerosol products (HLPP 1.4, HLPP 3.2)
- Work with users to obtain feedback on experimental VIIRS/OMPS synergy products (HLPP 2.3)
- Use SNPP VIIRS fire detection, FRP, burned area products to assess societal impacts of fires (HLPP 4.1.1)
- Develop training tutorials/webinars/modules through COMET on VIIRS aerosol products and air quality applications (HLPP 4.2.2)

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO | WGII/8 | A43.10 | WMO to provide a report on the volcanic ash intercomparison within SCOPE-Nowcasting at CGMS-44. | CGMS-44 | OPEN | HLPP # 3.2.2 |

**CGMS-43-JMA-WP-05**: JMA's SCOPE-Nowcasting activities

This paper reported on the status of activities engaged in by the Japan Meteorological Agency (JMA) for SCOPE-Nowcasting pilot projects 1 (RGB composite images) in support of the WMO Severe Weather Forecasting Demonstration Project (SWFDP), 2 (volcanic ash inter-comparison and test-bed) and 4 (sand and dust monitoring). Special imagery (RGBs, heavy rainfall potential) is being made available for the SWFDP regions in Asia and the SW Pacific. The volcanic ash algorithm test-bed will be useful for exploiting the results from the inter-comparison activity (the NOAA NESDIS and EUMETSAT algorithms have been installed in the test-bed). Products from Himawari-8 are expected to contribute to all projects.

RGB composites from Himawari-8 will be made available by JMA based on the WMO/EUMETSAT recipe. Asian dust products are also being made available through ftp or other means. Cooperation between KMA and JMA on this topic continues under SCOPE-Nowcasting Pilot Project 4.

Currently no limb correction is applied to RGBs from Himawari-8, and polar imagery has been corrected for viewing angle effects.

In addition an action was placed on NASA as follows:

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| NASA | WGII/8 | A43.11 | NASA to report on polar-based RGB composite viewing angle corrections to CGMS-44. | CGMS-44 | OPEN | - |

**CGMS-43-KMA-WP-05**: KMA improvement in cloud amount estimation and Asian dust detection

The paper introduced the improvement of cloud amount estimation using COMS observation data to support automatic observation of cloud amount instead of visual observation and very short range forecasting in KMA. Visual observation of cloud amount is used for comparison, to overcome cloud overestimation in winter-time when BT difference between IR and WV channel becomes very small, which leads to misclassification of cloud presence. The cloud detection algorithm was then modified accordingly.

**CGMS-43-KMA-WP-07**: KMA progress on COMS cloud detection

This report describes the current status of COMS cloud detection by an operational algorithm and to introduce a new method for improving the algorithm. The performance of the cloud detection affects the accuracy of all of COMS meteorological products because the cloud detection plays key role as a scene analysis for retrieving the products. The operational algorithm for deriving cloud mask in KMA/NMSC adopts the conventional static thresholds method, but it has a discontinuity in the day/night transition area. To remove the discontinuity, we introduce normalized reflectance and dynamic threshold of brightness temperature difference (11 - 3.7μm). According to the case studies the new algorithm shows better results for cloud detection during twilight time. And we are now developing a cloud detection algorithm for Geo-KOMPSAT-2A/AMI based on the COMS operational one including these methods.

WGII welcomed the papers and took the opportunity to iterate the importance of consistent, well-documented cloud masks (also in view of potential generation of climate data records), and thanked KMA for its reports. Furthermore KMA was encouraged to present this work to the ICWG at their next meeting.

**CGMS-43-CMA-WP-07**: CMA Report on Multi-channel Processing of Aerosol

This paper is prepared in response to CGMS Action item 42.05.

Dust storm and air pollution is the most extreme aerosol event in China. NSMC/CMA use sensors aboard FY-series satellites to retrieve aerosol information. Typical sensors include VISNIR-TIR imagers, such as FY-3/MERSI/VIRR, UV mapper FY-3/TOU, and TIR observation from FY-2. Main derived products include Aerosol Optical Depth (AOD), Absorption Aerosol Index (AAI), Infrared Difference Dust Index (IDDI) using IR split-window, and dust storm quantitative parameters (dust optical depth, column dust density, and particle effective radii). The approach taken using MERSI is similar as for MODIS. These products support operational monitoring of dust storm, haze (air pollution), and volcanic ash cloud. NSMC/CMA is engaged in reprocessing the products to try to improve calibration, cloud mask method, and AOD multi-algorithms, realizing that consistency and quality of the aerosol products must be improved if they can be used for the study of climate.

**WGII/9 Ocean parameters**

**CGMS-43-CNSA-WP-03**: The Role of the HY-2 and CFOSAT satellite in the Frame of Globe Ocean Wind Vector Observation

The HY-2 satellite was successfully launched on August 16, 2011. The microwave conical scanning two-beam Ku-band scatterometer is an important payload of the HY-2 satellite. It can observe the global ocean wind vector. The CFOSAT scatterometer is a Ku-band dual-polarisation rotating fan-beam radar scatterometer for ocean surface wind vector, which will be launched in 2018. With the two scatterometers launched the temporal and spatial resolution will be better than with a single satellite. The two data source, HY-2 and CFOSAT scatterometer, will play an important role in the Frame of Global Ocean Wind Vector Observation.

**CGMS-43-ESA-WP-03**: Some results from the ESA Earth Explorer Missions GOCE, CryoSat-2, SMOS and SWARM

CGMS was informed about some outstanding results from the Earth Explorer (EE) missions GOCE, CryoSat-2, SMOS and Swarm. In orbit since March 2009, the Gravity field and steady-state Ocean Explorer (GOCE) has measured Earth's gravity field with unprecedented detail to advance our understanding of ocean circulation, sea-level change and Earth-interior processes. Launched on 2 November 2009, SMOS is the second Earth Explorer Opportunity mission to be developed as part of ESA's Living Planet Programme. The data acquired from the SMOS mission will lead to better weather and extreme-event forecasting, and contribute to seasonal-climate forecasting, as demonstrated in the results presented. ESA's Earth Explorer CryoSat-2 mission, launched on 8 April 2010, is dedicated to precise monitoring of the changes in the thickness of marine ice floating in the polar oceans and variations in the thickness of the vast ice sheets that overlie Greenland and Antarctica. The Swarm constellation comprising three satellites was launched on 22 November 2013. GOCE detected temporal changes in West-Antarctic ice sheet (together with GRACE); ocean circulation explorer. SMOS is performing well, the mission extended to 2017, RFI issues could be reduced; various product levels are provided including NRT (within 3h) and NRT "light", and distributed on the GTS; ocean salinity products from SMOS are critical to understand salt exchange in currents, traces of tropical instability waves, ocean acidification. CryoSat-2 data are now available within two days of acquisition, revealing unprecedented losses in both ice sheets (500 km3/year). The Swarm mission is looking at the magnetosphere.

BIOMASS has been selected as EE-8, a P-band radar mission to detect above-ground biomass and CarbonSat, FLEX selection slated for September 2015.

WGII asked whether direct broadcast was planned for any of the ESA and NASA future missions. It was explained that ESA data are partially distributed via EUMETCast and made available in NRT through ftp. However it was also recalled that direct broadcast is not necessarily part of the original planning of research missions.

**CGMS-43-ISRO-WP-10** – Satellite-based ocean and polar science data products

In the view of Earth Observations applications for ocean and polar science studies, a number of satellite-based products are being generated for operational as well as research studies. INSAT-3D retrieved half-hourly SST product is available routinely from MOSDAC. 10-years of daily Net shortwave radiation estimated from Meteosat satellite over the warm pool region of the Indian Ocean has been generated. Under polar research, one such product is climatological sea-ice occurrence probability data over Antarctic region using 34-years' daily 25-km sea-ice concentration data available from NSIDC site. This product is freely available to the global scientific community from ISRO's MOSDAC (www.mosdac.gov.in) site. Coastal products like, sea surface height and significant wave height for the Indian coast using SARAL/AltiKa satellite will be available soon from the same site.

WG II thanked ISRO for the presentation.

**CGMS-43-KMA-WP-08**: KMA progress on multi-sensor SST composition over East Asia region

This paper describes the accuracy of COMS SST in the East Asia region through robust quality control process of in-situ SST and cloud screening, and a composition technique of multi-sensor SST from COMS and LEO (AVHRR, GCOM-W1/AMSR-2, TRMM/TMI). KMA has a plan to use the satellite SST for NWP model as a surface condition.

In the discussion it was recommended that KMA seek feedback from GHRSST on the approach taken with OSTIA, to ensure that the merged SST product is consistent.

**CGMS-43-NASA-WP-02**: NASA Future Ocean Satellite Missions, 2014-2020

Prior to 1978, a ship was the critical platform from which to record oceanic conditions, which severely restricted perspectives of the global ocean. Oceanographers correctly wondered why the Gulf Stream or other major oceanographic features always followed the survey ship. Then, in 1978, NASA developed a series of major science and technology breakthroughs when it launched three missions that changed the way ocean sciences were conducted and presented, for the first time, global ocean quasi-synoptic views of the near-surface phytoplankton biomass, sea ice, ocean surface topography, sea surface temperature, and surface wind speed and direction. NASA embarked on a long-term strategy to improve measurement accuracies and horizontal and temporal resolutions with each succeeding mission for advancing the science of the global integrated Earth system, including introducing new measurement capabilities such as sea surface salinity in 2011.

The paper reviewed NASA's planned constellation of ocean missions, demonstrating NASA's commitment to pioneer new technology to advance ocean sciences as an essential component of global integrated Earth system science and how these missions will continue to extend the legacy initiated in 1978 (RapidScat, Jason-3 with main responsibility with NOAA and EUMETSAT, ICESat-2, SWOT, PACE).

WMO noted that ocean observations are critical for weather and climate services, and appreciated the NASA contribution. On the issue of continuity of proven research-based instrumentation, NASA referred

to the NRC Decadal Survey mechanism used for deciding on follow-on missions. Discussion in the U.S. is on-going on how NASA can support sustained missions for the oceans and climate.

**CGMS-43-NOAA-WP-22 PPT**: NOAA Report on Ocean Parameters: SST

The paper provided an update of the new SST that is now available from VIIRS onboard S-NPP (launched in 2011), and follow-on J1 (2017) and J2 (2022). VIIRS spatial resolution, radiometric performance, image quality, and wide swath are enabling new unprecedented SST remote sensing capabilities. The product highlighted is SST derived from VIIRS, and access to product, its accuracy, and application activities promoting its use are discussed.

**CGMS-43-NOAA-WP-23 PPT**: NOAA Report on Ocean Parameters: Ocean Color

The paper provided an overview of the ocean colour products that are now available from VIIRS, including a couple of new products. VIIRS spatial resolution and swath is enabling new ocean colour remote sensing capabilities. Products highlighted are the ocean colour suite (examples of global and regional) that is now available from NOAA/STAR (Wang et al., 2013; 2014). The presentation included a description of the STAR end-to-end ocean colour data processing capability (including in situ data for Cal/Val activities), data access/accuracy of these products, and application activities promoting the use of these products.

NOAA supports the Marine Optical Buoy (MOBY) programme, for validation purposes. A VIIRS cal/val cruise has been undertaken with international participation. Parameters of interest included nLw, chl-a, PAR. The NOAA processor can be used to ingest other sensor data, such as from Sentinel-3, GCOM-C. Reprocessing of the entire VIIRS record is planned.

EUMETSAT on behalf of the European Copernicus Marine service expressed appreciation for the NOAA ocean colour products. EUMETSAT is re-distributing these products in Europe through EUMETCast.

**CGMS-43-NOAA-WP-24 PPT**: NOAA Report on Ocean Parameters: Coral Reef Watch

The Coral Reef Watch mission is to utilize remote sensing and in situ tools for near-real time and long term monitoring, modelling and reporting of physical environmental conditions of coral reef ecosystems. Primarily, Coral Reef Watch uses satellite data to provide current reef environmental conditions to quickly identify areas at risk for coral bleaching around the world. The presentation provided an overview of the Coral Reef Watch program, which uses SST anomalies blended from VIIRS, AVHRR, and GOES. Value of blended data (at 5-km resolution) lies in better coverage, using polar data for global coverage, and geostationary imagery to fill gaps caused by clouds.

An unresolved issue is in-situ verification of near-shore SST data since in-situ SST data coverage is poor in developing nations, and reporting of coral bleaching is even more limited.

**CGMS-43-NOAA-WP-26 PPT**: NOAA Use of Scatterometry Products

This paper reported on the use of scatterometry products from EUMETSAT (ASCAT) and NASA (RapidScat, used now in AWIPS) by NOAA. Satellite scatterometer data provides critical information that supports short term weather analysis, forecasting and warning and longer-term monitoring and characterization of the environment. Proper temporal and spatial sampling require coordination among satellite agencies and a commitment of open and timely data access.

NOAA looks into possibility for reprocessed ocean colour and SST datasets.

IOC/UNESCO stressed the necessity of sustaining key missions in support of oceanography and marine meteorology. WMO clarified that the CGMS Baseline for the Operational Contribution to the WMO Global Observing System (GOS) includes satellite missions performed or to be performed on an operational/sustained basis.

**WGII/10 Other parameters and products**

**CGMS-43-EUMETSAT-WP-11**: Utilisation of Geostationary Satellite Data for Short-range NWP - A Questionnaire

This paper addressed the utilisation of new geostationary satellite data in Short-Range NWP (SRNWP) models. CGMS members are kindly requested to discuss the questions with their SRNWP experts as applicable and to provide responses to GCMS-44. With this paper EUMETSAT intends to establish a broader view among CGMS members on the needs and evolution of SRNWP for satellite observations. The responses will lay out pertinent research and development work on the part of satellite operators and SRNWP, respectively.

**CGMS-43 actions - WGII**

| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
|---|---|---|---|---|---|---|
| CGMS members | WGII/10 | A43.12 | CGMS members to provide responses to the questionnaire on use of satellite data for SRNWP from experts (in their organization) and provide a compilation of responses to CGMS-44. | CGMS-44 | OPEN | - |

A follow-on activity in 2016-2017 could be an expert workshop on this topic. The scope of satellite data is broad. E.g. it includes polar orbiters and is not limited to geostationary imagers. An important question is what scale a particular product represents.

**CGMS-43-CNSA-WP-04**: The Productions Distribution and Application about HY-2 satellite

HY-2 is an ocean dynamic environment satellite which was launched in August 2011 to obtain global marine dynamic environment parameters including sea surface height, significant wave height, ocean wind vectors, etc. Ocean observation data provided by HY-2 have been widely used by both domestic

and international users in extensive areas such as ocean disaster prevention and reduction, marine environment forecast, ocean resource development and management, ocean investigations and scientific research, etc.

The session acknowledged the contribution by CNSA in support of ocean applications through HY-2A.

**CGMS-43-IMD-WP-03 PPT**: Web based Satellite data Analysis tool "RAPID"

Real time Analysis of Products & Information Dissemination called RAPID is a web based quick visualization and analysis tool for satellite data on a real-time basis. This presentation introduced Next Generation Weather Data Access & Advanced Visualization Application ranging from weather events to atmospheric phenomenon to agricultural production. The fog presence over railway track and highways can be visualized, as well as the position of clouds, fog and visibility by a pilot along the entire route in real time and interactively.

The tool has a latency of 30 minutes. It allows visualization not only in NRT but also retrospectively. Quantitative information is provided per pixel.

In the discussion, ISRO agreed to enquire whether the software tool can be made available more broadly.

**CGMS-43-IMD-WP-04 PPT**: INSAT-3D New Products & their use in Operational Forecasting

The presentation provided an overview of the INSAT-3D payload (Imager, Sounder) derived products and their use. Full disk mode of the Imager takes 26 min, and rapid scan of specific sectors 6 min. Day/night-time microphysics RGB examples were shown, e.g., for dust detection. Surface insulation (irradiance) and land surface temperature products are also derived.

WGII asked whether the adopted visualisation of RGBs is based on the widely accepted standards developed by WMO/EUMETSAT. ISRO confirmed that this is the case.

**CGMS-43-NASA-WP-03**: Suomi National Polar-orbiting Partnership (SNPP): Continuing NASA Research and Applications

Following the 2011 launch of SNPP, spacecraft commissioning, and instrument activation, the NASA SNPP Science Team evaluated the operational RDRs, SDRs, and EDRs produced by the NOAA ADS and IDPS. A key part in that evaluation was the NASA Science Team's independent processing of operational RDRs and SDRs to EDRs using the latest NASA science algorithms. The NASA science evaluation was completed in the December 2012 to April 2014 timeframe with the release of a series of NASA Science Team Discipline Reports.

In summary, these reports indicated that the RDRs produced by the SNPP instruments were of sufficiently high quality to be used to create data products suitable for NASA Earth system science and applications.

However, the quality of the SDRs and EDRs were found to vary greatly when considering suitability for NASA science. The need for improvements in operational algorithms, adoption of different algorithmic approaches, greater monitoring of on-orbit instrument calibration, greater attention to data product validation, and data reprocessing were prominent findings in the reports. In response to these findings, NASA, in late 2013, directed the NASA SNPP Science Team to use SNPP instrument data to develop data products of sufficiently high quality to enable the continuation of EOS time series data records and to develop innovative, practical applications of SNPP data.

In 2014, NASA held the Second Suomi NPP Applications Workshop to brief application users on upcoming data products and to exchange information between application developers, the NASA Science Team, and the new Science Investigator-led Processing Systems (SIPS) community. The workshop provided updated information on instrument performance, data characteristics, and ways to access the data, a review of current SNPP applications in use by end users and opportunities for the user community to provide feedback to NASA and the science team, and the effort to identify current barriers to the integration of SNPP data into other existing and developing applications. Much of the interaction was conducted in breakout sessions aligned with the four focus areas of Public Health and Air Quality, Water Resources, Ecological Forecasting, and Disasters.

**CGMS-43-NASA-WP-06**: Use satellite observations in NASA reanalyses: MERRA-2 and future plans

Nearing completion, the MERRA-2 atmospheric reanalysis of the modern satellite era (1979-onward) is being produced at the Global Modeling and Assimilation Office at NASA Goddard Space Flight Center. The system is incorporating a number of advances in observation utilization, data assimilation methodology, and model development to produce a follow-on to the original MERRA project that both improves on the original and provides many value-added features. Many of these new features include the incorporation of a global aerosol modelling and analysis system, improved use of ozone and temperature observations in the stratosphere and lower mesosphere (notably during the NASA Aura period), and the incorporation of new satellite observations of temperature and water vapour in the most recent periods (2005-onward).

The paper aims to introduce MERRA-2 and to demonstrate the consistency of the analysis through the investigation of its observations. The system will serve as the basis for future reanalysis projects coupling the atmosphere, land, and ocean model and analysis components. Fundamental to the advancement of reanalysis is the further understanding and exploitation of both historical and future observations.

Observation feedback is important to link observation and analysis communities, and the use CORE-CLIMAX output is proposed. The session enquired as to what extent a facility for systematic collection of user feedback has been established within MERRA.

**CGMS-43-NASA-WP-07**: NASA's 7-km GEOS-5 Nature Run: A resource for satellite mission planning

The Global Modeling and Assimilation Office (GMAO) has produced a two-year 7-km resolution non-hydrostatic global mesoscale simulation with the Goddard Earth Observing System (GEOS-5)

atmospheric general circulation model. The simulation was produced as a Nature Run for conducting observing system simulation experiments (OSSEs). Generation of the GEOS-5 Nature Run (G5NR) was motivated in part by the desire of the OSSE community for an improved high-resolution sequel to an existing Nature Run produced by the European Centre for Medium-Range Weather Forecasts (ECMWF), which has served the community for several years. The intended use of the G5NR in this context is for generating simulated observations to test proposed observing system designs regarding new instruments and their deployments. Because NASA's interest in OSSEs extends beyond traditional weather forecasting applications, the G5NR includes, in addition to standard meteorological components, a suite of aerosol types and several trace gas concentrations, with emissions downscaled to 10 km using ancillary information such as power plant location, population density and night-light information.

To optimally support global modelling, CGMS operators should consider involving modellers early in the definition of future mission concepts.

**CGMS-43-NASA-WP-08**: Surface Pressure and other Meteorological Properties Measured by the NASA Orbiting Carbon Observatory-2 (OCO-2)

The Orbiting Carbon Observatory-2 (OCO-2) is the first NASA mission designed to measure atmospheric carbon dioxide (CO2) with the precision, accuracy, resolution, and coverage needed to quantify the processes emitting CO2 into the atmosphere and absorbing it at the surface on regional scales over the globe. OCO-2 was successfully launched from Vandenberg Air Force Base on 2 July 2014. After completing a series of spacecraft checkout activities and orbit raising manoeuvres, OCO-2 was inserted into lead position of the 705 km Afternoon Constellation (A-Train) on August 3, 2014. Its 3-channel, imaging grating spectrometer was then cooled to its operating temperatures and a series of calibration and validation activities was initiated. In early October, OCO-2 started routinely collecting almost one million soundings each day over the sunlit hemisphere. Preliminary results from the cloud screening algorithm indicate that around 25% of these soundings (250,000/day) are sufficiently cloud free to yield full column estimates of the column averaged CO2 dry air mole fraction, XCO2 with precisions of ~0.25% (one part per million (ppm) out of the ambient ~400 ppm background). While XCO2 is the primary product of the OCO-2 mission, its measurements also yield a number of other geophysical quantities that might be of use to the meteorological community, including the first space based estimates of surface pressure with precisions near 1 hecto-Pascal (hPa). Estimates of other meteorological variables, including near-surface wind speed over the ocean, aerosol optical depths, near-surface atmospheric temperature, and relative humidity profiles are also routinely retrieved, and are currently being validated against available standards. Once validated, the next step will be to assimilate these surface pressure measurements into a numerical weather prediction reanalysis model to assess their impact on weather forecasts.

The histogram of the differences between the retrieved surface pressure and the ECMWF prior model state, shows an overall positive bias of ~0.78 hPa and a standard deviation of 3.5 hPa. The bias may be associated with known uncertainties in the absorption cross sections of the O2 A-band or small errors in the instrument calibration.

While the nominal downlink and data processing strategy precludes meeting the NRT latency requirement (less than 3 hours), this strategy could be modified to meet this latency requirement. The agreement between GOSAT and OCO-2 is at the level of 2ppm, using the TCCON network as ground-based reference, and the aim is to achieve a level of 1ppm.

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| NASA | WGII/10 | A43.13 | NASA to report on progress in testing the use of surface pressure retrievals from OCO-2 by NWP centres, with a view to report on results at the WMO Impact workshop in May 2016 (and to CGMS-44). | May 2016 and CGMS-44 | OPEN | - |

**CGMS-43-NOAA-WP-25 PPT**: NOAA Use of Soil Moisture Products

The presentation described the NASA Soil Moisture Active/Passive (SMAP) mission launched on 31 Jan 2015. Benefits are expected to be realized in the NESDIS Soil Moisture Operational Product System (SMOPS), developed for timely (in near real-time) consistent processing of these data products for use in NOAA operations (NWP) and research. The System already uses soil moisture data products from ASCAT, SMOS, WindSat, and AMSR2.

CGMS should encourage collaboration between different research and operation groups for a globally consistent soil moisture data set.

Satellite continuity may need attention from operational agencies for development and application of consistent soil moisture data products.

NOAA has projects underway to demonstrate the impact of soil moisture retrievals on forecasting. Consistency in products with precipitation, vegetation, and snow cover require attention.

**CGMS-43-NOAA-WP-27 PPT**: NOAA Land Products

The purpose of this presentation was to provide an update on selected new land products that are now available from VIIRS. Products highlighted are green vegetation fraction, land surface temperature, and fire locations/fire radiative power. Product continuity of heritage sensors such as AVHRR is also covered. Some products are available through web mapping services, such as on active fire for early responders.

The presentation included access/accuracy of these products, and examples of application activities promoting the use of these products.

CGMS to consider:

- Consistent global multi-sensor products (LEO, LEO-GEO)
- Coordination of global land monitoring constellation (CEOS LSI dysfunctional)

NASA noted that work is underway to develop an all-sky land surface temperature product from AIRS.

Concerning the availability of datasets, the following recommendation was made:

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | WGII/10 | R43.13 | CGMS agencies to make available a non real-time cache of satellite level 1 data over the previous 2-3 months, similar to the NOAA CLASS system. | CGMS-44 | OPEN | HLPP # 2 |

**CGMS-43-ROSHYDROMET-WP-04**: Meteorological and environmental satellite data and products in Roshydromet – new development

The document presented an overview of operational and research activity in Roshydromet related to the derivation and application of remote sensing products from weather and environmental satellite data. It is focused mainly on the results of the Meteor-M N2 commissioning phase and further exploitation. The sample products are presented based on Meteor-M N2 and other satellite data. MSU-MR is used for deriving cloud images and analyses, precipitation intensity, SST; the KMSS instrument used for fire monitoring, flood mapping, sea ice cover). The X-band SAR sensor BRLK Severjanin can provide input to ice monitoring, but has low SNR and is therefore only used as a supplementary data source. Atmospheric sounding products are derived from the IR sounder IKFS-2 and the MW imager/sounder MTVZA-GY. During commissioning phase, all the main characteristics of IKFS-2 were confirmed, and a processing package for T,u retrievals is now being finalised. A comparison of MTVZA-GY that has been performed with similar AMSU/NOAA-, ATMS/SNPP- and SSMIS/DMSP-based products has shown good resemblance of both estimates. This can be treated as an indirect proof of reliability of the presented products.

WGII commended Roshydromet on their development and encouraged a wide access to the products by the CGMS user community.

In concluding the discussions, it was noted that the following action had been transferred from WGIV to WGII:

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | WGII/10 | A43.14 | (Action transferred from WGIV)<br>CGMS members that have not yet done so to nominate focal points that would work with the WMO Secretariat in populating the WMO Product Access Guide.<br>• ESA: Jean-Louis Fellous jfellous@noos.fr<br>• EUM: Sally Wannop, Sally.Wannop@eumetsat.int<br>• JMA: Daisaku Uesawa, satellite@ml.kishou.go.jp<br>• NOAA: Tony Mostek, anthony.mostek@noaa.gov<br>• ROSH: Dr. Sergey Uspensky, Head of Department, SRC "PLANETA" uspenskys@planet.iitp.ru<br>• CMA: Xu Zhe, xuzhe@cma.gov.cn<br>KMA: Nomination of a KMA focal point is pending. | 30 July 2015 | OPEN | - |

**WGII/11 Review and updating of the HLPP**

**CGMS-43-CGMS-WP-29**: Proposed CGMS High Level Priority Plan (HLPP) 2015-2019

As part of the agreed revision cycle for the CGMS High Level Priority Plan, this document presented a proposed HLPP covering the period 2015-2019. The update is based on the following inter-sessional activities:

- IWWG and IPWG meetings in 2014
- Other revisions identified by WG chairs and co-chairs

Annex 1 – Status of implementation of HLPP 2014-2018

Annex 2 – Proposed High-Level Priority Plan 2015-2019

WG II provided comments on the status of implementation of HLPP, and on the proposal for revision of HLPP 2015-2019 to the CGMS Secretariat in due course.

**WGII/12 Any other business**

WGII reconfirmed the WGII co-chairmanship of Toshiyuki Kurino and Stephan Bojinski, as well as Mitch Goldberg and Kenneth Holmlund as WGII rapporteurs to be presented to CGMS-43 plenary accordingly.

**WGII/13 Inter-sessional activities/meetings in 2015-2016 [CGMS-43 -> CGMS-44]**

Tentative dates agreed: 12 Nov 2015, 17 Feb 2016

**WGII/14 Review of actions, conclusions, preparation of WG report for plenary**

**CGMS-42 actions and recommendations:**

The final status of all CGMS-42 actions and recommendations (plenary and working groups) following CGMS-43 discussions is available here.

(http://www.cgms-info.org/documents/CGMS-42_LoAandLoR_final.pdf

The session reviewed and agreed on actions and recommendations from Working Group II.

**Summary list of WGII actions**

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| GSICS | WGII/3 | A43.01 | GSICS to establish the requirements for absolute lunar calibration and prepare a white paper describing the tentative way to meet those requirements in case they go beyond those lunar calibration capabilities. | CGMS-44 | OPEN | HLPP # 3.1.2 |
| CGMS space agencies | WGII/3 | A43.02 | Calibration events logging task team to prepare a white paper outlining the set of parameters, the nomenclature, and the standards to be used for reporting on instrument calibration across space agencies. | CGMS-44 | OPEN | HLPP # 3.1 |
| GSICS | WGII/3 | A43.03 | GSICS to document and implement its approach to manage changes in reference instruments. | CGMS-44 | OPEN | HLPP # 3.1 |
| ROSH | WGII/3 | A43.04 | Roshydromet to present an update on Meteor-M N2 data access, processing packages, and results of an intercomparison of the IKFS-2 with other hyperspectral sounders (IASI, AIRS, CrIS), to CGMS-44. | CGMS-44 | OPEN | HLPP # 1.4.2 |
| CGMS space agencies | WGII/3 | A43.05 | CGMS operators to provide a report on their approach on cal/val, including information on dedicated campaigns and permanent sites, and potential support to cal/val infrastructure, in order to maximize benefits of satellite missions. | CGMS-44 | OPEN | - |
| CGMS space agencies | WGII/5 | A43.06 | CGMS operators to report on their specific plans for reprocessing and associated user requirements (such information would be useful for the ISWGs). | CGMS-44 | OPEN | HLPP # 5.1 |
| IPWG | WGII/5 | A43.07 | The session recommended a stronger application focus of IPWG (e.g, NWP, hydrology, agriculture), and asked IPWG to organize a IPWG-NWP workshop in 2015 or 2016. | CGMS-44 | OPEN | HLPP #3.6 |
| IWWG | WGII/6 | A43.08 | IWWG to define the experiments for the next intercomparison at the next IWW workshop in 2016. | CGMS-44 | OPEN | HLPP # 3.2.1 |
| CGMS RO space agencies | WGII/7 | A43.09 | CGMS members that operate RO instruments to explore RO capabilities to support space weather applications and report on their support to space weather application to CGMS-44. | CGMS-44 | OPEN | HLPP # 5.2 |

| CGMS-43 actions - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO | WGII/8 | A43.10 | WMO to provide a report on the volcanic ash intercomparison within SCOPE-Nowcasting at CGMS-44. | CGMS-44 | OPEN | HLPP # 3.2.2 |
| NASA | WGII/8 | A43.11 | NASA to report on polar-based RGB composite viewing angle corrections to CGMS-44. | CGMS-44 | OPEN | - |
| CGMS members | WGII/10 | A43.12 | CGMS members to provide responses to the questionnaire on use of satellite data for SRNWP from experts (in their organization) and provide a compilation of responses to CGMS-44. | CGMS-44 | OPEN | - |
| NASA | WGII/10 | A43.13 | NASA to report on progress in testing the use of surface pressure retrievals from OCO-2 by NWP centres, with a view to report on results at the WMO Impact workshop in May 2016 (and to CGMS-44). | May 2016 and CGMS-44 | OPEN | - |
| CGMS members | WGII/10 | A43.14 | (Action transferred from WGIV)<br>CGMS members that have not yet done so to nominate focal points that would work with the WMO Secretariat in populating the WMO Product Access Guide.<br>• ESA: Jean-Louis Fellous jfellous@noos.fr<br>• EUM: Sally Wannop, Sally.Wannop@eumetsat.int<br>• JMA: Daisaku Uesawa, satellite@ml.kishou.go.jp<br>• NOAA: Tony Mostek, anthony.mostek@noaa.gov<br>• ROSH: Dr. Sergey Uspensky, Head of Department, SRC "PLANETA" uspenskys@planet.iitp.ru<br>• CMA: Xu Zhe, xuzhe@cma.gov.cn<br>KMA: Nomination of a KMA focal point is pending. | 30 July 2015 | OPEN | - |

**Summary list of WGII Recommendations**

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | WGII/3 | R43.01 | CGMS members to consider removing spectral gaps from future hyperspectral sounders to support GSICS intercalibration of IR imagers. | | OPEN | HLPP # 3.1 |
| GSICS members | WGII/3 | R43.02 | Members to strengthen their engagement in GSICS and in particular in its GDWG. | | OPEN | HLPP # 3.1 |
| SCOPE-CM members | WGII/3 | R43.03 | SCOPE-CM to invite contributions to its next call for proposals, with particular regard to the sea ice, snow cover and land surface temperature communities, and others currently not represented. | End 2015 | OPEN | HLPP # 5.1 |
| CGMS space agencies | WGII/3 | R43.04 | CGMS operators to consider displaying instrument performance in a way similar to the ICVS. NOAA could share the software among CGMS operators. | CGMS-44 | OPEN | HLPP # 3.1 |
| NOAA | WGII/3 | R43.05 | NOAA to organize a workshop for CGMS operators on ICVS software design and development, and implementation. | CGMS-44 | OPEN | HLPP # 3.1 |
| ROSH | WGII/4 and WGII/8 | R43.06 | Roshydromet is invited to attend the next sessions of the ICWG, ITWG and the other Int'l Science Working Groups. | CGMS-44 | OPEN | - |
| ISRO | WGII/5 | R43.07 | ISRO is encouraged to implementing a multi-sensor precipitation estimate based on SAPHIR and INSAT-3D | CGMS-45 | OPEN | - |
| ICWG, IWWG | WGII/6 and WGII/8 | R43.08 | ICWG and IWWG to liaise as appropriate on the provision of further information characterising the AMV derivation for enhanced QC and error characterisation. | CGMS-45 | OPEN | HLPP # 3.5.2 |
| IWWG, IPET-OSDE | WGII/6 | R43.09 | IWWG to liaise with the application focal points in the WMO RRR process (on IPET-OSDE) to provide feedback on the winds-related observation requirements in the RRR database. | CGMS-44 | OPEN | HLPP # 1.1 |
| CGMS members | WGII/6 | R43.10 | CGMS members to consider include a water vapour channel and a CO2 channel to polar-orbiting imagers, to maintain accuracy and coverage of polar winds and cloud height retrievals achieved by MODIS. | | OPEN | HLPP # 1.1.6 |

| CGMS-43 recommendations - WGII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | WGII/7 | R43.11 | CGMS Members to approach Operators of GNSS systems to request them to provide a minimum level of information on the signal structure and interface control (ICD) in a timely manner to enable the use of these for future RO missions. | CGMS-44 | OPEN | HLPP # 1.1.4 |
| ICWG | WGII/8 | R43.12 | At its next meeting (May 2015), ICWG should put focus on investigating data from the new-generations instruments on Himawari-8 and if available GOES-R for the retrieval of cloud parameters. | 20 May 2016 | OPEN | HLPP # 3.2.4 |
| CGMS space agencies | WGII/10 | R43.13 | CGMS agencies to make available a non real-time cache of satellite level 1 data over the previous 2-3 months, similar to the NOAA CLASS system. | CGMS-44 | OPEN | HLPP # 2 |

The status of CGMS-43 actions and recommendations will be maintained on the CGMS website under MEETINGS and CGMS-43.

Report of the 43rd Meeting of the
Coordinated Group for Meteorological Satellites

# Parallel Working Group Sessions: WGIII Report

## WG III REPORT

Co-Chairs: Suzanne Hilding (NOAA), Peng Zhang (CMA)
Rapporteur: Derek Hanson (NOAA)

### WGIII/0 Objectives

The Co-Chairs opened the meeting with a welcome and introductions. The Co-Chairs were pleased to note the large number of participants in this year's WGIII meeting.

### WGIII/1 Review of actions and recommendations from previous meetings

The meeting reviewed the status of actions from previous meetings.

| WGIII status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| WMO | WGIII | 38.40 | Action 38.40: WMO in collaboration with the atmospheric composition community and satellite experts to further refine the requirements for atmospheric composition requirements and the optimal way to address these in the revised baseline. | CGMS-41: Remains open. No progress; Ad-hoc task team to review the needs for GAW (atmospheric composition) regarding satellite measurements and the 2004 IGACO recommendations has not yet been formed.<br>Nov '14: Task is in progress with the establishment of a dedicated task team by the Global Atmospheric Watch programme.<br>The GAW JSC OPAG-EPAC took an action on 20 Mar 2013 to update the requirements contained in the 2004 IGACO Report, in consultation with the WMO Space Programme and relevant Expert Teams. A WMO Global Atmospheric Watch Task Team on Observational Requirements and Satellite Measurements as regards Atmospheric Composition and Related Physical Parameters was established and held its first meeting on 10-13 November 2014. The meeting was very effective. Actions are in progress to update the observation requirements in support of 3 applications: Atmospheric composition forecasting, atmospheric monitoring assessment for international conventions, air quality in megacities.<br>Working paper submitted to plenary - 43.<br>Closed following WGIII actions. A new WGIII action will be reformulated/ made. | (CGMS-38)<br>**New deadline CGMS-43** | **CLOSED** | HLPP #1.1.1 |

| WGIII status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| WMO | WGIII/4 | 41.42 | WG III (actionee TBD) to review the categorisation of missions in the CGMS baseline and refine it as appropriate in order to support a high-level mapping with FCDRs. | See also action Plen G.1.1; 41.12.<br>Interactions with ET-SAT is ongoing (Feb 2014)<br>CGMS WGIII rapporteur has presented a report to JWG on climate and WMO-WP-08 will be discussed at CGMS-42.<br><br>CGMS-42-WMO-WP-08: In progress with the contribution provided in the paper.<br><br>Action closed following WGIII discussions. If needed, WGIII will create a new action or place one on CEOS-CGMS JWG climate. | (15 Dec 2013) new deadline CGMS-43 | CLOSED | HLPP #5.1.2 |
| WGIII | WGIII (Plen E.3.1.3) | 41.48 | WGIII to investigate the long-term planning of space based observation for global precipitation measurements and liaise as appropriate with the CEOS Precipitation Constellation | Discussed at CGMS-42: Regarding the long term planning of active precipitation measurement, will be postponed to 2015 in order to best take into account the progress of GPM-Core and CMA's plans for FY-3RM.<br><br>CGMS-43: IPWG to provide an input to WGII, WGIII and to plenary on the current status, plans and recommendations to CGMS.<br>IPWG has raised comments on the HLPP (contingency planning, observational gaps) relevant to WGIII. | (CGMS-41) New deadline CGMS-43 | CLOSED | HLPP #1.1.3 |

| WGIII status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS space agencies | CGMS-41 Plen E.4.3/ CGMS-42 Ad hoc space weather mtg | 41.15 (from CGMS - 41 Plen) | CGMS Members to nominate points of contact to work with WMO/ICTSW in order to define jointly a procedure to improve the collection, availability, and use of satellite anomaly information (30 September 2013) | CMA: ZHANG Xiaoxin and Dr.GUO Jianguang xxzhang@cma.gov.cn; guojg@cma.gov.cn<br>EUM: mike.williams@eumetsat.int<br>JMA: Yasushi Izumikawa (Mr) satellite@ml.kishou.go.jp<br>KMA: Inchul SHIN icshin@korea.kr<br>NASA HQ:<br>Elsayed R. Talaat, Discipline Scientist, Heliophysics, NASA HQ, elsayed.r.talaat@nasa.gov<br>NOAA: vanessa.l.griffin@noaa.gov<br>WMO: jlafeuille@wmo.int<br><br>CGMS-42: Discussions. CGMS members to validate their poc and/or nominate new ones.<br><br>NOAA response pending, per further discussions in WGIII CGMS-43 | (30/09/2013) New deadline 30 Sep 2014 | CLOSED | HLPP #5.2.1 |
| WMO, CMA, EUM, ROSH, ISRO | WGIII/2.2 | A42.01 | WMO to initiate a dialogue with Indian Ocean satellite operators and clarify which data are essential in the sense of Resolution 40, in view of the meteorological requirements in the region. | CGMS-43-EUM-WP-14<br>A CGMS-43 plenary agenda item has also been foreseen. | CGMS-43 | CLOSED | HLPP# 1.1.6 |

| WGIII status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| EUM, ISRO | WGIII/2.2 | A42.02 | EUMETSAT and ISRO will address the technical issues to accommodate high-resolution half-hourly data from INSAT-3D on dissemination means. | To be implemented mid 2015. | CGMS-43 | CLOSED | HLPP# 1.1.6 |
| WMO | WGIII/2.2 | A42.03 | WMO to consider sending a request to CMA for moving an FY-2 spacecraft over the Indian Ocean after successful launch and commissioning of FY-2G. | (CGMSSEC Dec '14: Action slightly amended from "WMO to consider sending a request to CMA for moving FY-2D over the Indian Ocean after successful launch and commissioning of FY-2G."). This will be considered after launch of FY-2G.<br>FY-2G was succesfully launched on 31/12/2014. | CGMS-43 | CLOSED | HLPP# 1.1.6 |
| NOAA | WGIII/2.2 | A42.04 | NOAA to report at the first WGIIII Intersession meeting on its plans regarding the possibility of pre-operational dissemination of GOES-R data via e.g. GEONETCast-Americas both as a risk reduction measure and as a way to reap the earliest benefit of the new system. | Discussed at CGMS WGIII IS#1 of 17 March 2015. Closed as a consequence. | 30-Nov-14 | CLOSED | HLPP# 1.1.6 |

| WGIII status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| ISRO | WGIII/2.2 | A42.05 | ISRO to report at CGMS-43 on its progress on radio-occultation processing of ROSA on Oceansat-2 and Megha-Tropiques, and on the possibility of near-real time access to ROSA data acquired at a high latitude station such as Svalbard. | CGMS-43 ISRO-WP-03<br>partially closed.<br>NRT access to ROSA data remains open | (CGMS-43) new deadline CGMS-44 | OPEN | HLPP# 1.1.4 |
| EUM | WGIII/2.2 | A42.06 | EUMETSAT to review the schedule of its ECMWF radio-occultation study with the aim to deliver advanced results on the specific impact of the high-latitude COSMIC-2 constellation. | Nov '14: Study now at mid-term. First review Oct '14. The full set of scenarios, including the analysis, is expected early 2015, to be presented at the IROWG-4 meeting (Apr '15). The final report should become available in Q3 2015.<br>Action on EUMETSAT; has been partly address by providing early results at various workshops, meetings (e.g. A. Thorpe's talk at Eighth FORMOSAT-3/COSMIC Data Users' Workshop 2014), and by providing a Working Paper/Presentation for CGMS-43: CGMS-43-EUM-WP-12 | CGMS-43 | **CLOSED** | HLPP# 1.1.4 |

| WGIII status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CNSA, EUM | WGIII/2.2 | A42.07 | EUMETSAT and CNSA to report at CGMS-43 on the progress of EUMETSAT-SOA collaboration on the dissemination of HY-2 data in near real time. | | CGMS-43 | **CLOSED** | HLPP# 1.1.3 |
| EUM, ISRO | WGIII/2.2 | A42.08 | ISRO and EUMETSAT to report at CGMS-43 on their discussions on data dissemination collaboration for SCATSAT data. | Ongoing. New deadline following CGMS-43 WGIII discussions. | CGMS-43) **new deadline CGMS-44** | **OPEN** | HLPP# 1.1.3 |
| CMA, ROSH | WGIII/3 | A42.09 | CMA and ROSHYDROMET to provide points of contact for possible participation in GHRSST. | CMA: Mrs. WANG Sujuan wangsj@cma.gov.cn; Dr. LU Feng lufeng@cma.gov.cn<br>ROSH: Mr. Alexey Chudin, leading programmer, SRC "PLANETA", Far Eastern Center<br>E-mail: niokr@dvrcpod.ru, alexchudin@dvrcpod.ru | 31-Aug-14 | **CLOSED** | - |

| WGIII status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CEOS OCR-VC | WGIII/3 | A42.10 | OCR-VC Chair to provide feedback on the CGMS Baseline, and suggest more specific provisions addressing the needs of ocean colour monitoring, if relevant, for consideration by CGMS. | Input provided to WMO/J. Lafeuille by S. Bernhard, 17 Oct 2014 | CGMS-43 | **CLOSED** | HLPP# 1.1.6 |
| NOAA | WGIII/5 | A42.11 | NOAA to communicate to WG III the link to the information material collected by the SETT Tiger Team. | The link was circulated by e-mail. | 31-Aug-14 | **CLOSED** | HLPP# 4.1.1 |
| NOAA | WGIII/5 | A42.12 | NOAA to report at the first intersessional web meeting of WG III on the progress of the SETT. | Progress report provided at CGMS WGIII IS#1 of 17 March 2015. Closed as a consequence. | 30-Nov-14 | **CLOSED** | HLPP# 4.1.1 |
| NOAA | WGIII/5 | A42.13 | NOAA to circulate to WG III the 2-3 page report on socio-economic benefit to be produced by the SETT. | The report was circulated to the csr. | 30-Apr-15 | **CLOSED** | HLPP# 4.1.1 |

| WGIII status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS members | Plen H.1 for WGIII | A42.14 | CGMS Members to establish an implementation team tasked to define detailed objectives for the implementation of CGMS space weather activities as defined in the Terms of Reference | NOAA: suzanne.hilding@noaa.gov<br>cc kimberly.hurst@noaa.gov<br><br>Closed following CGMS-43 space weather discussions. To be addressed in the next inter-sessional webex meeting on 2 Sept 15 | (15 Oct 2014, CGMS-43) | **CLOSED** | HLPP# 5.2.2 |
| CGMS members | Plen H.1 for WGIII | A42.15 | The space weather implementation team to propose next steps until CGMS-43 and objectives to be included in the HLPP. This includes space weather observations into the WIS and implementation procedures to report on spacecraft anomalies | NOAA: To be discussed further in WGIII at CGMS-43.<br><br>Closed following CGMS-43 space weather discussions. To be addressed in the next inter-sessional webex meeting on 2 Sept 15 | (15 Mar 2015, CGMS-43) | **CLOSED** | HLPP# 5.2.2 |
| WMO | CGMS -42 Ad hoc space weather mtg | A42.16 | WMO to establish an e-mail listserver for CGMS Space Weather activities (including CGMS members and associated organisations) | Created 9 March 2015<br>CGMSspaceweather@wmo.int<br>(Please inform cgmssec@eumetsat.int if you would like to be added/removed from the list). | 30 Sep 2014 | **CLOSED** | HLPP #5.2.1 |

| WGIII status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS members | CGMS-42 Ad hoc space weather mtg | A42.17 | CGMS Members interested in space weather activities to indicate to the CGMS Secretariat their points of contact for inclusion into the e-mailing list. | ZHANG, Xiaoxin xxzhang@cma.gov.cn<br>GUO, Jianguang guojg@cma.gov.cn<br>mike.williams@eumetsat.int<br>Andrew.monham@eumetsat.int<br>Joachim.saalmueller@eumetsat.int<br>paul.counet@eumetsat.int<br>IZUMIKAWA, Yasushi<br>satellite@ml.kishou.go.jp<br>SHIN, Inchul icshin@korea.kr<br>LEE, Hyesook hslee05@kma.go.kr<br>suzanne.hilding@noaa.gov<br>terry.onsager@noaa.gov<br>kimberly.hurst@noaa.gov<br>Charles.wooldridge@noaa.gov<br>elsayed.r.talaat@nasa.gov<br>jlafeuille@wmo.int<br>cgmssec@eumetsat.int | 30 Sep 2014 | **CLOSED** | HLPP #5.2.1 |

| WGIII status of recommendations on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS satellite opera-tors | WGIII /2.1 (CGMS-41) WGIII /2.2 (CGMS-42) | R41.14 | CGMS Satellite Operators to address the anticipated or potential gaps identified by WG III, in particular:<br>• infrared and microwave sounding on the early morning orbit,<br>• geostationary coverage of Indian Ocean<br>• hyperspectral sounding missing in some geostationary sectors<br>• ocean surface wind by scatterometry<br>• long-term follow-on of radio-occultation constellation,<br>• global precipitation measurement precipitation radar follow-on mission,<br>• long-term Earth Radiation Budget monitoring<br>• limb sounding for high-vertical resolution observations in the stratosphere and mesosphere (of temperature, humidity, wind, aerosol, ozone and other trace gases). | Ref CGMS-41 WGIII R 40.36.<br>Ongoing.<br>Discussed in WGIII at CGMS-41 and -42.<br><br>CGMS-42-ROSH-WP-02: In order to fill the gaps in Hyperspectral sounding and Long-term Earth Radiation Budget monitoring over the Indian Ocean Roshydromet plans to install the appropriate instruments onboard future Electro-M geostationary satellites.<br><br>Recommendation amended following WGIII CGMS-42 discussions.<br><br>Closed following WGIII discussions. Terms of Reference for WGIII will be documented taking this recommendation into account. Furthermore the future agenda of WGIII will contain an item looking at any new potential risk areas. | (CGMS-43) | **CLOSED** | HLPP# 1.1 |

The WGIII attendees agreed to close some older actions, and to reformulate them if needed. The majority of the CGMS-42 WGIII actions were closed by WP presentations or through discussion during the WGIII meeting.

The WG also discussed the possibility of removing the final recommendation, for responding to potential gaps identified by WGIII, and incorporating that recommendation into a new Terms of Reference for WGIII.

**WGIII/2 Status of implementation of the CGMS baseline**

**WGIII/2.1 Mapping of planned missions against the baseline**

**WGIII/2.2 Continuity issues, risk analysis**

**CGMS-43-ISRO-WP-03 ROSA data processing at ISRO**

In this paper, ISRO responded to CGMS-42 WGIII A42.05 and provided an update on their ROSA data processing. ISRO discussed the latest update to the ROSA software, which shows considerable improvement in many respects and resulted in a 7% increase in the number of products delivered.

Additionally:

- Both bias and RMSD show significant improvement in refractivity between 8-25km.
- Corresponding improvement seen in temperature error.
- Higher errors persist above 25km causing large retrieval errors in geophysical parameters at these levels.
- Systematic errors in refractivity suggest improved algorithms are needed.
- Trade-off between more occultation events-penetration vis-a-vis quality of profiles, to be treated on merits, as data sparse regions and for critical applications, strict quality regimes might need to be relaxed. This may call for dual data processing regimes.

**CGMS-43-EUMETSAT-WP-12 Status of EUMETSAT study on radio occultation/saturation with realistic orbits**

EUMETSAT presented this WP in response to CGMS actions CGMS-41 WGIII A41.36 and CGMS-42 WGIII/2.2 A42.06. The information is also relevant with respect to Action Plen IV.4, 40.06 (WMO to coordinate impact studies) and Recommendation WGIII/2.1 (CGMS-41) WGIII/2.2 (CGMS-42) R41.14 (address the anticipated or potential gaps).

First results of a study currently running at ECMWF were presented. The study looks at saturation effects when assimilating RO observations, where RO observation positions are simulated using realistic LEO and GNSS orbits. This study is thus a refinement of an earlier study that assumed RO occultations to be randomly distributed in space and time.

An Ensemble of Data Assimilation (EDA) approach, using 10 (+1) members in a 4D-Var modern NWP system, was used. Within this study, the following 3 main issues are addressed:

- Refine the earlier, random occultation position, study with realistic future satellite orbits;
- Assess which observation constellation is best suited to achieve the best distribution in space and time;
- Provide guidance on RO instrument deployments on future LEO satellites.

Regarding Point 1, it has been found that although realistic orbits affect occultation positions significantly, a modern NWP system can still effectively use any observations, thus the impact of realistic orbits is small. Regarding Point 2, the more observations are available, the lower forecasting spreads are found; constellations that provide most observations at low latitudes are particularly useful, since here, per area the least occultations are available from polar orbiting RO instruments and the model errors are the largest. Regarding Point 3, it again can be concluded that the more observations, the lower the forecast spread, even if additional instruments are provided in orbits that are already populated with RO instruments.

The study itself is formally finishing by August 2015, with a final presentation at EUMETSAT about 1 month earlier. Underlying EDA runs have been run over the last year and are complete. Results, discussions and conclusions will be included in the final report. The study results have also been presented and discussed at IROWG-4 in April 2015.

EUMETSAT emphasized that the first results show that the full COSMIC-2 constellation (equatorial and polar) produces the largest improvements to accuracy. Jason-CS produces a relatively small impact, but is particularly important in the absence of COSMIC-2 polar. There was no saturation seen in any one orbit.

Statistically, improvements are determined mainly by observation numbers, rather than orbits. However, EUMETSAT pointed out that for specific events, certain orbits could be particularly important.

WMO reiterated the importance of COSMIC-2 to NWP and noted the importance of these measurements to long-term climate monitoring. WMO will also organize an Impacts Workshop in May 2016.

*Proposed recommendation:*

| CGMS-43 recommendations – WGIII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS Members | WGIII/2.2 | R43.01 | CGMS members are encouraged to consider including RO capabilities on all future polar-orbiting satellites. | Ongoing | OPEN | HLPP # 1.1.4 |

**CGMS-43-IPWG-WP-08 Summary of highlights and request for guidance from IPWG-7**

Working paper IPWG-WP-08 was written by the two co-chairs of the International Precipitation Working Group (IPWG), Dr. Nai-Yu Wang and Dr. Kazumasa Aonashi. The report summarizes the outcome of the IPWG-7 meeting. Furthermore, it highlights the recent achievements of IPWG and provides an outlook

for the planned activities over the next two years. The report also cites specific recommendations for CGMS members and IPWG comments on the current HLPP, including concern for continuity of Indian Ocean Data Coverage, support for conically-scanning microwave platforms, data reprocessing, and others (full list in WP).

The IPWG-7 was held at the Tsukuba International Congress Center and hosted by the Japanese Aerospace Exploration Agency (JAXA) Earth Observation Research Center (EORC), Tsukuba, Japan during 17-21 November 2014. The meeting was attended by 125 participants from over 20 countries that included 49 oral and 57 poster presentations. It consisted of nearly three full days of plenary sessions (12 oral, 3 poster), one full day of working group discussions and a final group plenary, and then closed with a special session dedicated to Dr. Arthur Hou, NASA Global Precipitation Measurement (GPM) Project Scientist, who passed away in late 2013. Additionally, a satellite training course was given, which took place in parallel to the IPWG workshop; 28 participants attended the course.

Two new co-chairs were selected; Remy Roca (CNRS, France) and Tufa Dinku (IRI, USA). IPWG-8 will be held in the fall of 2016, with an African venue being targeted, however, former co-chair Vincenzo Levizzani has offered to host the meeting at his ISAC/CNR facility in Bologna, Italy as a secondary option.

Following the presentation, there was discussion about continuity of microwave imagers and need for NWP centers to demonstrate their benefit.

*Proposed recommendation:*

| CGMS-43 recommendations – WGIII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| IPWG | WGIII/2.2 | R43.02 | IPWG should consider reporting impact of both passive microwave imaging and active dual-band radar to WMO Impact Workshop in May 2016. | 1 Nov 2015 | OPEN | - |

**CGMS-43-IROWG-WP-13 Outcome and recommendations from the IROWG-4**

This paper described the outcome and main recommendations of the fourth IROWG meeting. The full set of recommendations, relevant at CGMS, at satellite operator, and at IROWG level will be made available at http://www.irowg.org.

For work in the immediate future CGMS-43 is invited to emphasize the following four main IROWG-4 recommendations:

- Ensure that both, equatorial and polar components of COSMIC-2 are fully funded and launched; this is required for Numerical Weather Prediction, Climate, and Space Weather;
- IROWG recommends targeting at least 20,000 occultations/day to be made available in near-real-time to the operational and research communities of Numerical Weather Prediction, Climate, and Space Weather;

- IROWG recommends that the RO receiver design includes sufficient software/firmware flexibility to allow changes in the signal processing including processing of new GNSS signals/constellations as they become available; all receiver measurements should cover the ionosphere as well;
- International space/research agencies (e.g., NASA, ESA, CMA, CSA, NSF, NOAA, EUMETSAT and others) to hold an interagency workshop to define cooperation options for implementing the next steps towards a LEO-LEO research and demonstration mission.

All presentations, minutes, and the IROWG-4 CGMS working paper will be made available at http://www.irowg.org.

The IROWG representative emphasized the need to launch COSMIC-2 Polar and to develop an RO continuity plan after COSMIC-2. NOAA confirmed that it is looking at developing a continuity plan. The IROWG representative noted that NOAA is undertaking an extensive OSSE that is expected to be completed by the end of 2015. Finally, the IROWG representative encouraged CMA to make RO data available from their FY satellites and noted that there is significant interest in using this data.

*Proposed actions:*

| CGMS-43 actions - WGIII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| NOAA | WGIII/2.2 | A43.01 | NOAA to report on results of new OSSE on radio occultation. | CGMS-44 | OPEN | HLPP # 1.1.4 |
| WMO | WGIII/2.2 | A43.02 | WMO to report on the outcome of the WMO Impact Workshop in May 2016. | CGMS-44 | OPEN | HLPP # 1.1.4 |

### WGIII/2.3 Indian Ocean Data Coverage (IODC) – CGMS roadmap

**CGMS-43-EUMETSAT-WP-14 Indian Ocean Data Coverage (IODC) – CGMS roadmap**

In this paper, EUMETSAT proposed a way forward for the provision of Indian Ocean Data Coverage (Services) after the end of life and re-orbiting of Meteosat-7 in 2017, based on the analysis of the current status of CGMS partner satellite systems (CMA, EUMETSAT, ISRO and ROSHYDROMET) in the region.

The combination of satellites and services should lead to an overall resilient multi-partner IODC service, for which a requirements baseline has been agreed at CGMS-42. The paper proposes a detailed scenario and timeline for approval by the CGMS partners contributing to future IODC services.

EUMETSAT noted that currently:

- Data from ISRO's INSAT-3D is available and being received by EUMETSAT. EUMETSAT plans to disseminate images via EUMETCast later this year.

- Data from CMA's FY-2D and FY-2E is available. EUMETSAT plans to disseminate images via EUMETCast later this year, following CMA planned relocation of FY-2E to 86.5 degrees E.
- Data from ROSHYDROMET's Electro-LN1 was regularly available until a satellite anomaly in March 2014 - Electro-LN2 scheduled for launch this year.

EUMETSAT proposes to partner with CMA, ISRO, and ROSHYDROMET, and to move EUMETSAT's Meteosat-8 to 40 degrees E, following successful launch and commissioning of MSG-4 and assuming the continued health of the rest of the Meteosat constellation. The final decision could be made at the June 2016 EUMETSAT Council meeting. There would be significant coverage overlap between Meteosat-8 at this location and the satellites from identified partner agencies, allowing for coverage of the Indian Ocean region and for cross-calibration, etc. DCS would also be sufficiently covered.

WMO responded that they are pleased with the thorough plan presented by EUMETSAT. WMO asked about the plan for dissemination of data from these satellites through other means beyond EUMETCast and outside of that footprint.

WGIII endorsed the EUMETSAT proposal.

EUMETSAT noted the need to send clear signals at Plenary and at the upcoming WMO Congress that CGMS has a solid plan for Indian Ocean Data Coverage. EUMETSAT also noted that this proposal would be a major step forward over the current IODC, which relies on only one satellite, Meteosat-7, which is well beyond its design life. The new proposal would create a much more robust constellation, comprised of newer satellites from CGMS partners with long-term commitment to continued coverage in the region.

As a consequence an action was passed to WGIV:

EUMETSAT to coordinate with CGMS partners to develop a data dissemination plan from Indian Ocean Data Coverage partners identified in the CGMS-43-EUM-14 roadmap, to be reported and discussed at the first WGIV intersessional. (See WGIV report).

**CGMS-43-IMD-WP-02 Continuation of EUMETSAT satellite service over Indian Ocean**

ISRO presented the paper on behalf of IMD. ISRO noted that Meteosat-8 will provide a useful demonstration of additional capabilities that ISRO plans to use in their future satellites. ISRO confirmed that Indian Ocean Data Coverage is a big priority for India.

WMO thanked ISRO and IMD for their commitment to supporting Indian Ocean Data Coverage and encouraged ISRO to have the Indian delegation to WMO Congress to make clear that India is committed to continuing flying INSAT-3D satellites. WMO also emphasized the importance of availability of data in near-real-time.

**CGMS-43-WMO-WP-04 Satellite data user needs in the Indian Ocean region**

To inform the discussion on satellite data coverage services over the Indian Ocean region, WMO carried out a survey among key users of satellite data in February/March 2015. Responses from eleven countries were received, regarding baseline requirements for satellite data (L1 and L2) needed for routine operations, and additional requirements in case of an emergency or a severe event.

Key conclusions from the survey are that (i) requirements are dominated by the need to monitor and forecast tropical cyclones; (ii) requirements are not limited to the need for observing the Indian Ocean but also address land applications, such as fire detection; (iii) some redundancy in satellite coverage of the region is needed; (iv) according to the majority of responses, the required baseline repeat cycle for GEO imagery over the region is 30 minutes; (v) GEO has higher importance in case of emergencies or severe events due to its higher repeat cycle; most users require additional GEO imagery in such cases, with the majority requiring rapid-scan imagery every 10 minutes or less, (vi) several users expressed a requirement for GEO lightning products (both as baseline and as additional requirement).

The requirements identified in the survey have not yet been validated by the broad user community in the Indian Ocean region, nor matched against existing or planned capabilities. Further refinement and consolidation of the requirements needs to be discussed, and WMO plans to report on validated and consolidated user requirements at CGMS-44.

EUMETSAT noted that at CGMS-42, IODC user needs were identified. It appears as if those user needs closely match those identified in this WMO paper.

*Proposed recommendation:*

| CGMS-43 recommendations – WGIII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | WGIII/2.3 | R43.03 | CGMS members to take into account the user requirements identified in the WMO survey (CGMS-43-WMO-04) when discussing continuous satellite coverage over the Indian Ocean region and report results to CGMS-44. | CGMS-44 | OPEN | HLPP # 1.1.6 |

**CGMS-43-WMO-WP-14 Updated risk assessment and gap analysis**

In support of the discussion on global continuity and risk analysis by the Working Group on Operational Continuity and Contingency Planning (WG III), this paper recalled the status of critical missions identified in Recommendation 41.14 from CGMS-41 and CGMS-42.

Working Group III was invited to consider this document as a “Risk Register” to be updated in the light of the status and plans of their respective satellite programmes.

WGIII addressed the risk assessment and gap analysis in real time:

a) Indian Ocean Data Coverage: This issue was sufficiently addressed earlier in WGIII.

b) Transition to GOES-R in South America: NOAA has addressed this issue and the working paper reflects the current status.

c) Geostationary infrared sounding: The working paper reflects the current status.

d) Imagery and sounding on early morning orbit: CMA confirmed its plan to operate FY-3E in early morning orbit. WMO thanked CMA for this very important decision and looks forward to the announcement at the WMO Congress. WMO also encouraged CMA to continue to support the early morning mission beyond FY-3E.

e) Continuity of afternoon primary missions: NOAA confirmed that it is taking all possible steps to ensure Suomi NPP operates as long as possible and currently does not see any risks to the satellite's health. NOAA also confirmed that the JPSS-1 development is proceeding well, and have budget requests this year for JPSS-3 and -4. Additionally, considering high-risk gap mitigation, the EON satellite can be considered for the most important measurements. In short, WGIII will need to continue to monitor the situation, but have seen significant positive developments in the past year.

f) Radio occultation: NOAA noted that it has made significant progress in the past year, as the budget request includes funding for the COSMIC-2 polar constellation.

g) Altimetry: NOAA noted that Jason-3 is currently scheduled for launched on July 22, although we are awaiting resolution of a technical anomaly. EUMETSAT noted that it has started restricted dissemination of SOA HY-2 data, and the data looks good. There are discussions with SOA on improving the latency and increasing its distribution. WMO encouraged this EUMETSAT/SOA effort and the increased access to near-real-time data.

h) Active ocean surface wind measurement: EUMETSAT confirmed that quality of HY-2 scatterometry has been reviewed and is good. EUMETSAT noted that discussions are on-going with ISRO on SCATSAT. It was noted that Rapidscat on ISS is also currently providing useful data.

i) Earth Radiation Budget: Working paper reflects current status.

j) Limb sounding: Working paper reflects current status.

**WGIII/3 Space-based observing system review and optimisation**

**CGMS-43-WMO-WP-17 The new functionality of WMO OSCAR/Space**

The Observing System Capability Analysis and Review online tool (OSCAR) is a building block of the WIGOS. It has two main components: (i) OSCAR/Surface which is being developed by Meteo-Suisse on behalf of WMO; (ii) OSCAR/Space module (www.wmo.int/oscar/space) which is widely used in the satellite community with around 1000 visits per day. This working paper discusses the recently

completed development to allow the recording of the individual status of each instrument, including the start and end dates of operations, with link to "landing pages" maintained by satellite operators to provide calibration and other technical details as agreed by GSICS. It will enable more accurate availability charts for gap analysis.

In order to facilitate the future scientific maintenance of OSCAR/Space, a new concept has been developed for the mapping of instrument to variables and the evaluation of their potential performances. Using an expert system approach, it relies on a collection of expert rules, which apply to objective sensor features such as spectral, radiometric, and geometric characteristics. A proof of concept was performed to check the resulting performance assessment for all Earth Observation instruments, which was found similar to, or better than in the operational version. Developments are underway to implement this new scheme in OSCAR with the aim to deliver a beta-testing version OSCAR 2.0 before the end of the year 2015.

The rules being recorded in a declarative form, could be submitted to expert groups for review, for the variables or instruments corresponding to their fields of competence. Such a transparent, collaborative process, under the supervision of the Secretariat, would be a way to maintain and further improve the reliability of OSCAR gap analysis.

NOAA and CMA noted that this tool and these improvements are very important to CGMS and to considerations of future satellite development.

WMO noted that OSCAR only works when it receives updated information from the satellite operators, so it thanked CGMS members for their support.

*Proposed recommendation:*

| CGMS-43 recommendations – WGIII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS Members | WGIII/3 | R43.04 | CGMS satellite operators to keep WMO informed of satellite/instrument commissioning dates or termination dates and prepare individual instruments "landing pages" that could be pointed to by OSCAR. | Ongoing | OPEN | HLPP # 1.1 |

### WGIII/3.1 NOAA to present Requirement Analysis Tool

**CGMS-43-NOAA-WP-28 NOAA's Observing System Portfolio Management**

NOAA provided an overview of how it analyses NOAA observing systems and capabilities, collects NOAA's observing requirements, develops suites of analysis tools, and conducts portfolio analyses. There are plans to migrate these four tools into a US-government wide Earth Observing Requirements Evaluation System (EORES).

CMA thanked NOAA for the presentation and noted that it serves as a good example for other agencies.

**WGIII/4 Integration of R&D missions (research to operations transition)**

**CGMS-43-NOAA-WP-30 NOAA Activities Towards Transition Mature R&D Missions to an Operational Status**

NOAA noted that it uses 11 test-beds and proving grounds to facilitate the orderly transition of research capabilities to operational implementation through development testing, pre-deployment testing, and operational readiness/suitability evaluation (in operational proving grounds). U.S. Joint Center for Satellite Data Assimilation (JCSDA) is another important tool used by NOAA to effectively assimilate satellite observations, including from many non-NOAA satellites. The Satellite Product and Services Review Board (SPSRB) is the NOAA body responsible for transitioning products to operational use.

WMO inquired as to whether the operational use of research missions influences the status of those missions. NOAA responded that on a case-by-case basis, interactions among operational users and the operators of research missions have developed accommodations to benefit users (working to reduce latency, for example).

**WGIII/5 Update on the Socioeconomic Benefits Tiger Team activities**

**CGMS-43-NOAA-WP-29 Status Report of CGMS Socio-economic Benefits Tiger Team (SETT)**

NOAA chairs the CGMS Socioeconomic Benefits Tiger Team (SETT) and presented an update of its accomplishments and ongoing activities. Workshop #2 outlined a proposed CGMS SETT case study on "Understanding and Assessing the Value of Improved Satellite Data for the Users of Operational Sea Ice Products and Information." The case study is intended to demonstrate approaches and best practices for conducting socioeconomic benefit studies by CGMS members. During the coming year, the CGMS SETT will finalize the case study design and seek the resources needed to execute the study. CGMS SETT is also developing a guidance document for use by CGMS Members considering their own socioeconomic benefit studies.

NOAA invites further participation by additional CGMS Members, and plans to move forward with the case study design and complete the guidance document this year. The next CGMS SETT Workshop will be hosted by the Organisation for Economic Co-operation and Development (OECD) in October 2015 in Paris.

NASA suggested engaging with the SERVIR team in this effort.

WMO congratulated NOAA and emphasized the importance of this effort and encouraged the SETT to keep up its momentum. WMO also noted the importance of recognising the benefit of space-based observations in disaster response. Additionally, WMO encouraged SETT to consider a broader collaboration with GEO and WMO groups, and noted that one potential conference under consideration at the WMO Congress would address socioeconomic benefits

**WGIII/6 Review and updating of the HLPP**

**CGMS-43-CGMS-WP-29 Proposed CGMS High Level Priority Plan (HLPP) 2015-2019**

As part of the agreed revision cycle for the CGMS High Level Priority Plan, this document presents a proposed HLPP covering the period 2015-2019.

WGIII-specific topics included advancement of the implementation of the CGMS baseline missions, in particular the requirement for three LEO missions. Have made significant progress on identification of potential gaps and ensuring appropriate contingency measures. No HLPP targets have been fully achieved, but significant progress has been made on most.

WMO inquired as to the process for revising the CGMS/WMO baseline.

WGIII agreed to endorse the proposed CGMS HLPP 2015-2019.

*Proposed action:*

| CGMS-43 actions - WGIII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| WMO | WGIII/6 | A43.03 | WMO to report on the status of the Vision for the WIGOS space-based component in 2040 in WGIII meeting at CGMS-44. | CGMS-44 | OPEN | - |

**WGIII/7 Any other business**

**WGIII/8 Inter-sessional activities/meetings in 2015-2016 [CGMS-43 -> CGMS-44]**

Proposed dates for WGIII inter-sessional meetings are September 2, 2015, January 13, 2016, and May 4, 2016.

**WGIII/9 Review of actions, conclusions, preparation of WG report for plenary**

*Summary of Proposed WGIII Actions:*

| CGMS-43 actions - WGIII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| NOAA | WGIII/2.2 | A43.01 | NOAA to report on results of new OSSE on radio occultation. | CGMS-44 | OPEN | HLPP # 1.1.4 |
| WMO | WGIII/2.2 | A43.02 | WMO to report on the outcome of the WMO Impact Workshop in May 2016. | CGMS-44 | OPEN | HLPP # 1.1.4 |
| WMO | WGIII/6 | A43.03 | WMO to report on the status of the Vision for the WIGOS space-based component in 2040 in WGIII meeting at CGMS-44. | CGMS-44 | OPEN | - |

*Summary of proposed WGIII Recommendations:*

| CGMS-43 recommendations – WGIII | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS Members | WGIII/2.2 | R43.01 | CGMS members are encouraged to consider including RO capabilities on all future polar-orbiting satellites. | Ongoing | OPEN | HLPP # 1.1.4 |
| IPWG | WGIII/2.2 | R43.02 | IPWG should consider reporting impact of both passive microwave imaging and active dual-band radar to WMO Impact Workshop in May 2016. | 1 Nov 2015 | OPEN | - |
| CGMS members | WGIII/2.3 | R43.03 | CGMS members to take into account the user requirements identified in the WMO survey (CGMS-43-WMO-04) when discussing continuous satellite coverage over the Indian Ocean region and report results to CGMS-44. | CGMS-44 | OPEN | HLPP # 1.1.6 |
| CGMS Members | WGIII/3 | R43.04 | CGMS satellite operators to keep WMO informed of satellite/instrument commissioning dates or termination dates and prepare individual instruments "landing pages" that could be pointed to by OSCAR. | Ongoing | OPEN | HLPP # 1.1 |

The status of CGMS-43 actions and recommendations will be maintained on the CGMS website under MEETINGS and CGMS-43.

Report of the 43rd Meeting of the
Coordinated Group for Meteorological Satellites

# Parallel Working Group Sessions: WGIV Report

## WG IV REPORT

Working Group IV (WGIV) on Global Data Dissemination convened on Monday 18 May 2015 at 08:30.

The Working Group held its session on Monday 18 May from 08.30-14:30. Jae-Dong Jang from KMA served as chair and Klaus-Peter Renner from EUMETSAT as rapporteur. Representatives of the following organisations attended the session: CMA, EUMETSAT, ISRO, JMA, KMA, NOAA, and WMO as members, and KARI as Observer (the list of participants is included in the Annex).

The agenda proposed by the CGMS Secretariat was adopted with the following modifications:

The working paper "CGMS-43-IMD-WP-01" was moved to the beginning, to allow the presenter to attend the parallel working group session. However in this report the paper is located under the planned agenda item.

**WGIV/0 Objectives**

The objectives of the WGIV were postponed until Agenda item WGIV/2, where the updated **objectives were recalled.**

**WGIV/1 Review of actions and recommendations from previous meetings**

Actions:

After CGMS-42 a total of 13 Actions were open, 4 could be closed during the meeting, 9 actions remain open.

| WGIV status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS Members | WGIV | A39.51 | Action 39.51: All CGMS Members to propose using interoperability standards for providing and sharing of climate data records and report on their efforts at the next meeting of CGMS Deadline: CGMS-40 | EUMETSAT: No further developments since CGMS-39. EUMETSAT is prepared to revisit this following an input from other CGMS members. NOAA provided inputs which were circulated via the CGMS list server on 02/11/12. Other CGMS members to provide their input.<br>CGMS-41 WGIV commented that a more standardised solution is needed. Further discussion could take place at the EUMETSAT-WCRP Symposium on climate research and Earth observation from space planned for October 2014 if not completed earlier.<br>Feb '15: Outcome still pending.<br><br>*WGIV at CGMS-43 recommended to highlight this topic at plenary, in particular during the Climate session G.*<br>*after consultation with John Bates (CEOS) who provided a presentation about data access, it is recommended to address this at the first inter-sessional meeting* | (CGMS-40, -42) **New deadline CGMS-44** | **OPEN** | HLPP#5.1.3 |

| WGIV status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| (CGMS satellite opera-tors) **ROSH** | WGIV | A40.37 | CGMS satellite operators to report about the implementation of the World Geodetic System (WGS84) and Earth Geodetic Model (EGM-96) geographical reference systems. | EUMETSAT has updated the standard and reported that it will implement the new standard starting with the next generation of GEO satellites MTG.<br>JMA has recently made up a new document for the format of "Himawari standard data" and it adopts WGS84 for the reference of geodetic parameters. The document has been available on the JMA/MSC Web site since 30 October 2013. http://www.data.jma.go.jp/mscweb/en/himawari89/space_segment/hsd_sample/HS_D_users_guide_en_v11.pdf<br>IMD is using WGS84 for Insat 3D as documented in the product guide “INSAT/DP/SAC/ SIPA/DPSG/TN-02/Ver 1.3/Mar 10” (provided by IMD).<br>KMA: COMS HRIT and LRIT data is based on CGMS LRIT/HRIT Global Specification (Issue 2.6, not WGS84). KMA does not plan to adopt WGS84 for the COMS data. For GK-2A which is the COMS follow-on, KMA will adopt WGS84 for HRIT, LRIT and UHRIT (all 16 channels data) disseminated by GK-2A to users. Documentation will be available in the near future.<br>Other CGMS members (CMA) to report on the implementation.<br><br>CGMS-42-ROSH-WP-02: Open.<br>CGMS-43-JMA-WP-08 (Section 2) | (CGMS-41, 42, -43) **New deadline CGMS-44** | **OPEN** | HLPP #3.2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | NOAA May 2015: NOAA does not have plans to use WGS-84 for GOES-R, but will instead use GRS-80. See more information here:<br><br>NOAA does not have plans to use WGS-84 for GOES-R, but will instead use GRS-80. See more information here: http://www.goes-r.gov/users/docs/PUG-main-vol1-verC.pdf<br>&NOAA does not have plans to use WGS-84 for GOES-R, but will instead use GRS-80. See more information here: http://www.goes-r.gov/products/docs/PUG-Vol-5A-vC.1-Interim.pdf. Current POES are using WGS-72. Suomi NPP and JPSS will use WGS-84.<br><br>WGIV at CGMS-43: change actionee to Roshydromet. | | | |

| WGIV status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| ROSH | WGIV | A40.38 | ROSHYDROMET to report at CGMS-41 on the technical modalities for the near-real time provision of Meteor-M global data sets and associated ancillary information, as needed to fully contribute to the GOS. | This action was previously WGII 40.29. Following the CGMS-40 debriefing on 9 November 2012 it was decided to allocate it to WGIV. A new satellite of Meteor-M series is to be launched in 2013. After the commissioning phase ROSH will review the technical modalities for the near real time provision of Meteor-M data and associated ancillary information.<br>CGMS-42 ROSH-WP-02: A new Meteor-M satellite is to be launched in summer 2014. After the commissioning phase Roshydromet will review the technical modalities for the near-real time provision of Meteor-M data and associated ancillary information based on instrument operational functionality.<br>Apr 2015: Meteor-M N2 is now operational. There are still calibration issues to be resolved for major instruments. Microwave sounder MTVZA-GY data simulation is now being supported by the RTTOV v11 package. Provision of global datasets could be discussed.<br>ROSH were unable to attend CGMS-43 and the action was postponed to CGMS-44 | (CGMS-41, 42, -43) **New deadline CGMS-44** | **OPEN** | HLPP#2.8 |

| WGIV status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| EUMETSAT | WGIV/2 | A41.49 | EUMETSAT to present the MTG dissemination baseline for RA-I (Africa). | CGMS-42: Definition is in progress but too premature to report upon.<br>Jan 2015 IS#1 WGI/WGIV webex session: A study is under preparation bringing together the user community. Unlikely that results will be available for CGMS-43. Verbal status report to be provided. Output will serve as input to data dissemination baseline for Africa.<br>WGIV at CGMS-43: verbal status by EUMETSAT: Study is in progress and the results will be provided at CGMS-44. | (CGMS-42, -43) **new deadline CGMS-44** | **OPEN** | HLPP# 2.2, #5.3 |
| CGMS Members **- CMA** | WGIV/8 | A41.56 | Each CGMS member to review the GEO version of the Long Term Data Preservation Guidelines (GEO LTDP) and provide feedback on the applicability of each single guideline to its own organisation by creating a compatibility table for the organisation | CGMS-42-ROSH-WP-02: Still open<br>CGMS-42-NOAA-WP-01: In general, NOAA is compliant with the GEO Long Term Preservation Guidelines (GEO LTDP) since these guidelines are based upon the Reference Model for an Open Archival Information System (OAIS-ISO 14721) and Producer Archive Interface Methodology Abstract Standard (PIAMAS-ISO 20652). Please see WP for full feedback.<br>EUM: Michael Schick.<br>WGIV at CGMS-43: further feedback expected by CMA only, change actionee to CMA, deadline Dec 2015 | (CGMS-42, -43) **new deadline 31 Dec 2015** | **OPEN** | HLPP#5.1 |

| WGIV status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| WMO | WGIV/8 | A41.57 | WMO to provide feedback from CCl (Commission for Climatology) regarding the GEO LTDP. | Jan 2015: CCl to still provide feedback. WMO to remind them.<br><br>WGIV at CGMS-43: a last reminder to be sent, topic for intersessional meeting, deadline Dec 2015, then closure with or without feedback | (CGMS-42, -43) **new deadline 31 Dec 2015** | **OPEN** | HLPP#5.1 |
| CGMS Members | WGIV/9 | A41.58 | CGMS members to provide feedback on the improved concept of the WMO Product Access Guide (PAG), in particular on the feasibility with respect to their organization's product catalogues | EUM: Input provided to WMO Space Programme mid 2014, EUMETSAT's product navigator URLs provided to the PAG.<br>NOAA: CGMS-42-NOAA-WP-01<br>ROSH: CGMS-42-ROSH-WP-02: Still open<br><br>Other CGMS members to provide feedback.<br><br>Jan 2015: The Product Access Guide has been published.<br>EUM: No comments in view of action A42.04 (Feb '15)<br><br>WGIV at CGMS-43: action is obsolete after publication of PAG, can be closed | (CGMS-42) **new deadline CGMS-43** | **CLOSED** | HLPP#5.3 |

| WGIV status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS Members | WGIV/4.2 | A42.01 | CGMS members producing ocean colour products to comment on the 2 recommendations given in CGMS-42-CEOS-WP-29:<br><br>- to adopt netCDF4/CF for their ocean colour data;<br><br>- to support large volume, batch data access and download (e.g., through established means such as ftp/http), as well as more targeted access through protocols such as REDDS/OpenDAP | KMA (KIOST) : - GOCI data is currently in HDF-EOS5. netCDF4/CF will be considered as a candidate for GOCI-II data format.<br>- KIOST partially supports large volume data access and download through ftp. KIOST will consider positively to support more targeted access through protocols such as THREDDS/OpenDAP.<br><br>NOAA 13 May 2015: a. Yes, our SNPP-VIIRS ocean color products will adopt netCDF4 format. In addition, we would like recommend additional formats of png, Geotiff and HDF4.1. b. To support large volumes, batch data access and download, we have established means such as ftp/http. We are planning to build the Thredds distribution server which has the following functionality: more targeted access through protocols such as OpenDAP, HDF, GRIB, BUFR, and NEXRAD.<br><br>WGIV at CGMS-43: no further feedback expected, can be closed | CGMS-43 | **CLOSED** | HLPP# 2.5 |

| WGIV status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS Members | WGI V/6 | A42.02 | CGMS members to comment on the work done in the context of the EUMETSAT provided VIIRS Regional Service, and to provide feedback on the proposal to define a standardised compact product format, generalised to cover the advanced imagers of the current and planned polar orbiting satellites. | WGIV at CGMS-43: this is addressed in the RARS context and will be handled by WGI. Suggest to wait until a conclusion is reached in RARS before expanding to a wider context.<br>Action to be closed and a new action created in WGI. | CGMS-43 | **CLOSED** | HLPP# 2.7 |
| CGMS Members | WGI V/7 | A42.03 | CGMS members to comment on the IGDDS vision, and to provide feedback to WMO (jlafeuille@wmo.int) | Reminder and text for commenting circulated to csr on 26 Feb 2015 by CGMSSEC.<br>EUMETSAT feedback provided to WMO on 19 May 2015.<br><br>WGIV at CGMS-43: action is obsolete with CGMS-43-WMO-WP-09 on the "WMO Satellite Data Dissemination Strategy", can be closed | CGMS-43 | **CLOSED** | HLPP# 2.8 |

| WGIV status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS Members | WGI V/9 | A42.04 | CGMS members to nominate focal points that would work with the WMO Secretariat in populating the PAG, initially for one year; such nomination could take into account current membership of the WMO Expert Team on Satellite Utilization and Products (ET-SUP).<br>WMO: Stefan Bojinski sbojinski@wmo.int | ESA: Jean-Louis Fellous, jfellous@noos.fr<br>EUM: Sally.Wannop@eumetsat.int<br>JMA: Daisaku Uesawa,satellite@ml.kishou.go.jp<br>KMA: Chu-Yong CHUNG cychung@kma.go.kr<br>NOAA nominates Tony Mostek, anthony.mostek@noaa.gov<br>ROSH: Dr. Sergey Uspensky, Head of Department, SRC "PLANETA"<br>E-mail: uspenskys@planet.iitp.ru<br><br>WGIV at CGMS-43: this topic is a data content issue, rather than data access. Closed for WGIV. New action to be raised in WGII | 15-Jul-14 | **CLOSED** | HLPP# 5.3 |
| CGMS Members | WGI V/9 | A42.05 | CGMS Members to provide detailed comments on the Reference User Readiness Project to WMO (sbojinski@wmo.int) | EUM: Input on MTG provided through the WMO ET-SUP.<br>This is now referred to SATURN Satellite User Readiness Navigator, part of SATURN portal. https://www.wmo-sat.info/satellite-user-readiness/<br><br>WGIV at CGMS-43: extend deadline to CGMS-44 | (CGMS-43) **new deadline CGMS-44** | **OPEN** | HLPP# 5.3 |

| WGIV status of actions on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| WGI and WGIV | Plen E.1.3 (wrt WGI and WGI V) | Plen A42.07 | Following the revised scope of WGI and WGIV, the WGs to update the "Terms of Reference" of both WGs for endorsement by CGMS | *Note: This is a plenary action that needs to be treated in WGs I and IV.*<br><br>*ToRs agreed by WGIV at CGMS-43* | CGMS-43 | **CLOSED** | - |

| WGIV status of recommendations on the occasion of CGMS-42 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actionee | Action | # | Description | Action feedback/closing document | Deadline | Status | HLPP ref |
| CGMS space agencies | WGIV/7 | R42.01 | Satellite operators to provide WIS Discovery Metadata Records, compliant to WIS requirements and following the guidance to be provided by the CGMS-WMO Task Force on metadata implementation, in order to facilitate satellite information discovery and access | NOAA: Related to metadata, the best reference is NGDC metadata provided here the URL: http://www.ngdc.noaa.gov/metadata/<br><br>WGIV CGMS-43 discussions: Ongoing and routine activity. Recommendation maintained until CGMS-44 | (CGMS-43) | **OPEN** | HLPP# 2.9 |

The final status of all CGMS-42 actions and recommendations (plenary and working groups) following CGMS-43 discussions is available here (http://www.cgms-info.org/documents/CGMS-42_LoAandLoR_final.pdf).

**WGIV/2 Revised Terms of Reference of WGIV**

**CGMS-43-EUMETSAT-WP-02** EUMETSAT presented the updated Terms of Reference of WGIV from this paper which also contains the Terms of Reference for WGI.

CGMS Working Group IV on "Global Data Dissemination" was created in 2001. During the existence of the working group a considerable evolution in telecommunication systems and associated services took place, leading to an expansion of the scope in the working group. With the implementation of ATOVS Retransmission Services (RARS) and wider use of DVB dissemination services it became necessary to redefine the scope of WGIV with respect to WGI to avoid unnecessary overlaps in both groups.

The revised Terms of Reference were agreed by the group and recommended for endorsement by Plenary.

**WGIV/3 WMO Satellite Data Dissemination Strategy**

**CGMS-43-WMO-WP-09 -** WMO presented the WMO Satellite Dissemination Strategy.

Ensuring the operational access to, and use of, satellite data and products for a growing number of WMO Members in the coming decade is a major objective for both WMO and CGMS. In achieving this, we are faced with major technical challenges including the exponential growth of data rates for new satellites, the requirement for improved latency (e.g. for NWP) and the threat to radio frequency allocations for meteorological satellites. There are also strategic and organizational challenges including the digital divide between most and least advanced users, and the need to ensure interoperability and standardization of evolving systems, and their integration into WIS. At the same time, a number of opportunities are opened by the constant progress in information and communication technology (e.g. the Cloud).

Following earlier discussions at CGMS-42 and CBS-Ext.(2014), a medium-term Satellite Data Dissemination Strategy is proposed. This Strategy calls for active support of CGMS members in particular in the following areas:

- Enhancing data availability
  - Global Coverage of LEO Direct Broadcast Acquisition, Processing and Distribution Systems
  - Bilateral Exchange of Data and Products
  - Routine Availability of Data and Products from R&D Satellites
- Description and Registration of Satellite Data and Products
  - Making Satellite Data and Products Discoverable on the WIS
  - Standardized Data Formats
- Dissemination and user access
  - Standardized Direct Broadcast
  - Global Access to Data and Products on the Core WIS Network
  - Full Integration and Operation of DVB Broadcast Services
  - On-demand Access to Satellite Data and Products

In summary, IGDDS is now reformulated as a broad strategy, including

- A vision
- Strategic targets realizing the vision
- Strategic activity threads for the realization
- A concept for overseeing the strategy implementation

The working group took note of the presentation and emphasised the common elements of the WMO and CGMS strategy. Following the recommendation from the paper, an action was proposed by the working group:

| CGMS-43 actions – WGIV | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | WGIV/3 | A43.01 | CGMS members to comment on "WMO Satellite Data Dissemination Strategy" (CGMS-43-WMO-WP-09) | CGMS-44 | OPEN | HLPP # 2 |

**WGIV/4 Global DVB satellite services**

**CGMS-43-EUMETSAT-WP-15** EUMETSAT presented the EUMETCast Evolution consisting of the EUMETCast Satellite and EUMETCast Terrestrial elements.

A new EUMETCast Europe Service based on DVB-S2 became operational in August 2014. The old DVB-S service remained active until 31 December 2014, allowing the users to migrate in a seamless manner to the new system. On the new system a "Basic Service" provides continuity for the former DVB-S service, while the "High Volume Service" allows a factor 1.5 higher data rate for the same transponder resources, but requires larger reception antennas.

The data rates on EUMETCast Europe will significantly increase with Copernicus Sentinel 3A and 3B data, and later with MTG and EPS SG data, leading to a multi-transponder usage.

EUMETCast Africa and EUMETCast Americas are operated as a turn-around services, broadcasting a sub-sets of the data from EUMETCast Europe toward Africa and South America in C band using the DVB-S standard.

Significant data rate increases are expected for EUMETCast Africa in the context of Copernicus Sentinel 3 and MTG. This will eventually also fill up a full transponder and require an upgrade to the DVB-S2 standard. It is planned to extend EUMETCast Americas for one more year until end of 2016, and then terminate the service.

A pilot project has been established for distribution of a EUMETCast multicast stream over terrestrial research networks involving GÉANT and NRENs. A number of pilot users including EUMETSAT member states across Europe, NOAA and KMA participate in this project. The majority of the EUMETCast infrastructure (EUMETCast platform, registration, helpdesk, reception stations) can be shared or used in the EUMETCast Terrestrial system.

It is foreseen to start a Demonstration EUMETCast Terrestrial dissemination service in 2016, allowing subscription of eligible users via the standard EUMETCast user support management and the Earth Observation Portal

On request by WMO it was clarified that MTG does not have any Direct Broadcast capability, and EUMETCast will be used for data dissemination.

The working group took note.

**CGMS-43-IMD-WP-01** ISRO presented a paper on behalf of IMD concerning EUMETCast transmission over India.

EUMETCast transmission over India is limited to only the western part and data loss is reported from the reception station used by IMD. It is requested to analyse the possibility to extend the access to EUMETCast to the entire Indian region so that scientists and the operational agencies can make a better use of it in weather forecasting and research. IMD would be willing to provide Indian satellite data for this GEONETCast facility**.**

In response to the presentation EUMETSAT explained that an extension of the footprint to cover India is technically not possible, since a commercial telecommunication satellite provides the service. Instead, IMD was encouraged to consider using CMACast which covers the Indian region as a GEONETCast facility and it already provides a subset of EUMETCast data.

CMA confirmed that CMACast has good coverage over India.

The below action was made following the discussions.

| CGMS-43 actions – WGIV | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| EUM | (WGIII/2.) WGIV/4 | A43.02 | (Action transferred from WGIII) EUMETSAT to propose dissemination plan for data from Indian Ocean Data Coverage partners identified in CGMS-43-EUM-14 roadmap. | CGMS-44 | OPEN | HLPP # 1.1.6 |

**CGMS-43-NOAA-WP-35** NOAA presented a report on the Status and Future Plans for GEONETCast Americas.

GEONETCast Americas (GNC-A) is a regional contribution to the global GEONETCast system. GNC-A serves much of North America, the Caribbean Basin and all of Central and South America. GEONETCast Americas has links with “global” GEONETCast regional environmental data dissemination systems.

NOAA has made several enhancements to the broadcast in coordination with our partners, participated in capacity building projects in the Americas region and has worked to re-vitalize the GNC-A Coordination Group. NOAA is working closely with regional partners to support the nine

GEOSS Societal Benefit Areas and to address the requirements of the Coordination Group on Satellite Data requirements for RA III AND RA IV where appropriate. Brazil's INPE intends to contribute to GNC-A by increasing the bandwidth available.

GNC-A supports capacity building through assisting the efforts of countries to add receive stations and develop national networks like those in Brazil, El Salvador, Costa Rica, Colombia and Mexico; collaboration with the WMO Virtual Laboratory for Training and Education in Satellite Meteorology (VLab) and promoting participation in the GEONETCast Americas Coordination Group. NOAA assisted WMO VLab organizers to plan a Train the Trainer event on April 25th and 26th 2015 which focused on GNC-A. On 09 November 2014, a first Hands-On "GEONETClass" was provided by INPE focusing on GeoTIFF manipulation. Another training session in the region was held in Mexico on 11 September 2014 dedicated to the use of GeoTiFF images in GNC-A.

The GNC-A Coordination Group has been re-vitalized to serve as a forum for regional Partners, Providers and Users to provide advice and coordinated input on the GEONETCast Americas data flow, including the identification of data and products, data acquisition, priorities, data utilization, system operation, and opportunities for capacity building.

WMO thanked NOAA for the efforts in taking up the questions from the user community, for the conversion of user stations, and encouraged all satellite operators to make further improvements for the users.

In general there is strong development in areas less covered by powerful data access methods, e.g. Africa, Central and South America. This results in increasing requirements for full resolution data leading to a growing need for diverse dissemination systems, Direct, DVB, terrestrial, etc. It is important to answer how all WMO members can benefit from the full meteorological satellite capabilities.

On the question as to why GNC-A is not considered fully operational, NOAA clarified that the service is not operationally monitored on a 24/7 basis, rather on a working day basis. However the achieved performance is close to 100% due to the high reliability of the system.

EUMETSAT commented that frequent discussions, in the form of user coordination groups in the regions, are recommended to make best use the limited dissemination capacities, or in other words to deliver the best package to the users.

**WGIV/5 Incorporation and dissemination of R&D and pre-operational mission data**

**CGMS-43-EUMETSAT-WP-16** EUMETSAT presented an overview of the EUMETSAT Third-Party Data Services transmitted on EUMETCast. The document is structured in two parts – an assessment of the Third-Party Data Services under consideration, and a summary of the status of currently on-going Third-Party Data Services, implementation activities, excluding those implemented at the request of Copernicus. The Third-Party Data Services include data from R&D satellites (NASA, ESA, CNES, China, JAXA, ISRO) and operational agencies (CMA, KMA, ROSHYDROMET).

The working group took note of the presentation.

**WGIV/6 Coordinated dissemination services for:**

**WGIV/6.1 Disaster mitigation purposes**

There was no specific presentation under this topic. As part of **CGMS-43-NOAA-WP-35** NOAA mentioned that GEONETCast Americas is an alternative dissemination method for the Disaster Charter.

CMA noted that satellite-based dissemination can become the only working data access method during disasters when ground infrastructure is destroyed, as recently experienced in the Himalaya.

**WGIV/6.2 Ocean user community**

No papers were presented under this item. The working group started a discussion on how to better address coordination needs for the ocean community and proposed to address this at the plenary meeting.

**WGIV/7 Global data exchange from next generation GEO satellites**

**CGMS-43-JMA-WP-08** JMA presented the Himawari-8/9 data distribution/dissemination plan.

The Japan Meteorological Agency (JMA) will distribute multi-band high frequency data with high-resolution from Himawari-8 via the HimawariCast service and the HimawariCloud service.

Dissemination of current MTSAT-2 imagery captured with 5 bands at 30/60-minute intervals began via the HimawariCast service on 29 January 2015.

Once Himawari-8 becomes operational, imagery from the satellite will be disseminated via the service with 14 out of 16 bands and 10-minute intervals. JMA launched the HimawariCloud service on 8 April 2015 with distribution of Himawari-8 in-orbit-test imagery. NMHSs in the Himawari-8/9 coverage area can access HimawariCloud and retrieve data using an HTTP 1.1 client such as a Web browser or Wget.

In response to specific questions by EUMETSAT and KMA, JMA explained that the MTSAT-1R direct broadcast will be terminated and the satellite deorbited in December 2015. JMA will start an operational HimawariCast and HimawariCloud service in July 2015 for Himawar-8 data. On HimawariCast there are no plans to extend the number of disseminated bands (from 14 to 16), due to limitations in the bandwidth.

**CGMS-43-KMA-WP-09** KMA presented the KMA Data Service Plan for GK-2A which is scheduled to be launched in May 2018.

The baseline data broadcast policy for GeoKOMPSAT-2A is to disseminate all 16 channels data of meteorological observations in Ultra HRIT (tentatively named as UHRIT) in X band and to maintain H/LRIT broadcast corresponding to COMS five channels in L band. GeoKOMPSAT-2A data will also be provided to users via landline service such as website, FTP etc.

In response to comments from WMO, KMA clarified that the rationale for keeping the L band transmission was to provide continuity for users who have recently procured L band stations. KMA also confirmed that the timeliness for all data is 3 – 5 min.

**CGMS-43-ROSHYDROMET-WP-05** EUMETSAT presented this paper on behalf of ROSHYDROMET who was not able to attend the meeting.

The document presents an overview of satellite data exchange mechanisms in Roshydromet, including participation in EUMETSAT Advanced Retransmission Service (EARS). The launch of the next geostationary satellite Electro-L N2 for IODC is currently scheduled for July 2015. After the commissioning phase, it is planned to provide EUMETSAT with the data converted to HRIT format for redistribution to national meteorological services and all interested parties.

The working group took note.

| CGMS-43 actions – WGIV | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| NOAA | (WGI/4) WGIV/7 | A43.03 | (Action transferred from WGI) NOAA to consider including GLM products in the HRIT stream | CGMS-44 | OPEN | HLPP # 1.4.2 |

**WGIV/8 Development of coordinated approach for compression of data, incl. geographical location, from high-resolution imaging instruments**

No paper was presented under this item.

The working group recalled that the related open action A42.02 should be first addressed in WGI in the context of RARS.

**WGIV/9 Contribution to the WIS infrastructure incl. RMDCN**

EUMETSAT explained that the originally planned working paper **CGMS-43-EUMETSAT-WP-17** on "Analysis of satellite products exchanged on the GTS" was not yet in a state to be presented. More coordination is needed and the paper is now planned for CGMS-44.

**WGIV/10 Coordination of metadata for satellites and instruments**

**CGMS-43-EUMETSAT-WP-18** EUMETSAT presented the feedback on "GEO version of the Long Term Data Preservation Guidelines (GEO LTDP)" in this paper.

EUMETSAT as a member of the LTDP working group within the GSCB has previously reviewed and assessed the Long Term Data Preservation Guidelines. Common Guidelines for Earth Observation Space Data are essential for the future of collaborative ground segments and exchange of data, which is already actively taking place as part of climate initiatives. Common guidelines should be standardised and adopted to ensure a minimum level of adherence by the global players.

EUMETSAT fulfils the Level A guidelines and the majority of Level B ones. In general, inputs such as from CGMS members should be taken to adjust the adherence levels A, B and C and to find a decent common, minimum level of compliance that long term archives should be recommended to implement.

A certification for a given adherence level could potentially be interesting for EO long-term archives.

The working group took note.

**WGIV/10.1 Task force on metadata**

**CGMS-43-EUMETSAT-WP-19** EUMETSAT presented the Progress Report and Outcomes from the TF on Metadata Implementation.

The CGMS-WMO Task Force on Metadata implementation was created after CGMS 42 to provide a consolidated view regarding the WMO Information System (WIS) discovery metadata definition for satellite data products, accelerate the adoption of WIS by satellite data providers and represent the satellite data users' point of view within the WIS.

The Task Force has started to work on two aspects of its mandate: the generation of guidance documentation to generate WIS discovery WMO Core Profile 1.3 metadata for satellite data products and a “WIS portal usability report” representing the view of satellite data users when using the WIS portals.

This document presents the work performed by the Task Force during year one, the progress made in the direction of fulfilling its mandate and the planned schedule for finalising its work. It describes in particular the information model for satellite data products created by the Task Force as a necessary preliminary work for generating the WIS metadata for satellite products guidance documentation. It also summarizes the recommendations of the WIS Portal Usability Report to help move the WIS infrastructure towards a state where it completely fulfils the satellite data user’s community needs when using a meteorology product catalogue.

WMO thanked the task force for the job done and emphasized the importance of this task for WIS and also WIGOS. The job is not finished yet and formal feedback will be required.

WMO will support the work of TT-Metadata by ensuring the involvement and contribution of the related peer WMO Expert Teams including WIGOS.

The following actions and recommendation were raised:

| CGMS-43 actions – WGIV | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | WGIV/ 10.1 | A43.04 | CGMS members to provide comments on the Progress Report of Task Team on discovering Meta Data (CGMS-43-EUMETSAT-WP-19) | CGMS-44 | OPEN | HLPP #2.8 |

| CGMS-43 actions – WGIV | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| EUM | (WGI/6) WGIV/10/1 | A43.05 | (Action transferred from WGI) CGMS Task Team on metadata to define discovery metadata for DBNET | CGMS-44 | OPEN | HLPP # 1.4.5, 2.8 |

| CGMS-43 recommendations – WGIV | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | WGIV/10 | R43.01 | Satellite operators to provide WIS Discovery Metadata Records, compliant to WIS requirements and following the guidance to be provided by the CGMS-WMO Task Force on metadata implementation, in order to facilitate satellite information discovery and access. NOAA: Related to metadata, the best reference is NGDC metadata provided here the URL: http://www.ngdc.noaa.gov/metadata/ The recommendation will be kept following WGIV CGMS-43 discussions. | CGMS-44 | OPEN | HLPP # 2.7 |

**WGIV/11 Data access portals, harmonisation between different portals**

No papers were presented. The working group raised an action to get feedback on the need for coordination of this agenda item:

| WGIII IIIVCGMS-43 actions – WGIV | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | WGIV/ 11 | A43.06 | CGMS members to provide a listing of their data access portals. | CGMS-44 | OPEN | HLPP # 2.7 |

**WGIV/12 User dialogue and interface**

**WGIV/12.1 Response to region-based requirements for satellite data access and exchange**

**CGMS-43-NOAA-WP-36** NOAA presented the "NOAA Response to Satellite Data User Requirements in WMO RAs III/IV"

A "Preparatory Meeting of the Coordination Group on Satellite Data Requirements for RAIII and RAIV" was held on April 8, 2013 prior to the NOAA Satellite Conference. In the meeting report, it was noted that the "Satellite Data Requirements Task Team" was originally formed in June of 2009 under the auspices of the Secretary General of WMO. All member states in RA III and IV were invited to

nominate representatives to the Coordination Group on Satellite Data Requirements. The initial spread-sheet detailing the requirements was completed in 2011.

The terms of reference for the Requirements Coordination Group contains the following task:

"The Group maintains an updated list of satellite data and products available to the Region through existing dissemination services. Data and products shall be classified by categories of variables and derived products."

NOAA has been working with the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and the Instituto Nacional de Pesquisas Espaciais (INPE) to detail the products on the requirements table that are available from the satellite providers. By the end of 2014, there were 395 products listed that covered 49 out of the 58 categories of data and products. Work continues to fill in the remaining gaps. A very successful and well-attended meeting of the Coordination Group on Satellite Data Requirements for RA III and RA IV was held at the April 2015 NOAA Satellite Conference.

**CGMS-43-WMO-WP-15** WMO presented the "Operational data requirements of the WMO Coordination Group on Satellite Data Requirements for Region III and IV (Americas)".

The WMO Coordination Group on Satellite Data Requirements for RA III and IV has been formally recognized by the WMO Regional Associations III and IV and held its first formal session on 27-28 April 2015. The Group currently comprises 14 Members as well as NOAA and EUMETSAT in their capacity as satellite data providers.

The Satellite Data Requirements for Region III and IV currently comprises 396 entries spanning GEO and LEO-based level 1b/1.5 data and products such as winds, precipitation, lightning, and volcanic ash. The Group has prioritized its requirements and matched them with actual provisions from providers (NOAA, EUMETSAT, INPE).

The Group is concerned with the issues impeding coordinated and efficient, user-tailored satellite data distribution across the Region, particularly for near real-time services: diversity of satellite data distribution mechanisms over the Region (none of which meet all requirements), the diversity of technical and financial capacities among countries, issues with near real-time access, the need to prepare for using data from the next-generation GOES-R/S, and uncertainty with the timing of operational data availability from GOES-R/S.

The Group recognized the efforts by NOAA to assist the Region in the provision and distribution of satellite data, and appreciated the plans to replace the GOES East NOP imagery with an equivalent amount of GOES-R series imagery if GOES-R is placed at the GOES East position. The Group also appreciated the EUMETSAT-NOAA transition plan to reduce the risks of interruption of service for current EUMETCast-Americas users.

GEONETCast-Americas, although currently used by only a few NMSs, was identified as a potential data access option for many NMSs in the Region, either as a primary, cost-effective data access system, or as a back-up system to other techniques (see Action WG III 42.04).

The Group formed two task teams: (i) on assessing the status of data reception systems in the Region, and developing options for each member on the Group; and (ii) on identifying technical and application-specific training needs, with emphasis on transitioning to GOES-R.

The working group commented on both papers, which provided complementary information reports on the activities of the Coordination Group on Satellite Data Requirements in Region III (South America) and Region IV (North America, Central America and the Caribbean), in particular in view of the transition to GOES-R. Data access in the region is very diverse, no "one fits all" mechanism could be identified. Uncertainties in the GOES-R placement cause problems in terms of planning for data reception systems on the user side. An early availability of transition plans will help users in preparation for the transition to GOES-R. GNC-A could be used as risk reduction measure.

It was agreed to highlight these items at plenary.

**WGIV/11 Review and updating of the HLPP**

**CGMS-43-CGMS-WP-29** The CGMS Secretariat presented the status and an update proposal of the HLPP, relevant to WGIV.

After discussion the working group concluded that all of the HLPP items covered by WGIV are still considered relevant and important (none of them are obsolete or complete). No update with respect to WGIV was identified.

**WGIV/12 Any other business**

There were no items.

**WGIV/13 Planning of inter-sessional activities/meetings**

Three inter-sessional meetings are planned:

- 14 October 2015, 13:00 UTC
  WGIV intersessional meeting: topics are status of actions/recommendations and possible contribution to the WIGOS Space 2040 Workshop in November at WMO/Geneva
- 2 December 2015, 13:00 UTC
  WGIV intersessional meeting: topics are status of actions/recommendations and feedback from the WIGOS Space 2040 Workshop
- 24 February 2016, 13:00 UTC
  WGIV intersessional meeting: preparation for CGMS-44.

**WGIV/14 Review of actions/conclusions, preparation of WG report for plenary**

New actions and recommendations as included in the report were reviewed and accepted.

The co-chairs thanked the participants and the WGIV session was closed at 14:30 on Monday 18 May.

***Summary list of WGIV Actions:***

| CGMS-43 actions – WGIV | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | WGIV/3 | A43.01 | CGMS members to comment on "WMO Satellite Data Dissemination Strategy" (CGMS-43-WMO-WP-09) | CGMS-44 | OPEN | HLPP # 2 |
| EUM | (WGIII/2.) WGIV/4 | A43.02 | (Action transferred from WGIII) EUMETSAT to propose dissemination plan for data from Indian Ocean Data Coverage partners identified in CGMS-43-EUM-14 roadmap. | CGMS-44 | OPEN | HLPP # 1.1.6 |
| NOAA | (WGI/4) WGIV/7 | A43.03 | (Action transferred from WGI) NOAA to consider including GLM products in the HRIT stream | CGMS-44 | OPEN | HLPP # 1.4.2 |
| CGMS members | WGIV/ 10.1 | A43.04 | CGMS members to provide comments on the Progress Report of Task Team on discovering Meta Data (CGMS-43-EUMETSAT-WP-19) | CGMS-44 | OPEN | HLPP # 2.8 |
| EUM | (WGI/6) WGIV/10. 1 | A43.05 | (Action transferred from WGI) CGMS Task Team on metadata to define discovery metadata for DBNET | CGMS-44 | OPEN | HLPP # 1.4.5, 2.8 |
| CGMS members | WGIV/ 11 | A43.06 | CGMS members to provide a listing of their data access portals. | CGMS-44 | OPEN | HLPP # 2.7 |

***Summary list of WGIV recommendations:***

| CGMS-43 recommendations – WGIV | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| CGMS space agencies | WGIV/10 | R43.01 | Satellite operators to provide WIS Discovery Metadata Records, compliant to WIS requirements and following the guidance to be provided by the CGMS-WMO Task Force on metadata implementation, in order to facilitate satellite information discovery and access.<br>NOAA: Related to metadata, the best reference is NGDC metadata provided here the URL: http://www.ngdc.noaa.gov/metadata/<br>The recommendation will be kept following WGIV CGMS-43 discussions. | CGMS-44 | OPEN | HLPP # 2.7 |

The status of CGMS-43 actions and recommendations will be maintained on the CGMS website under MEETINGS and CGMS-43.

The final status of all CGMS-42 actions and recommendations (plenary and working groups) following CGMS-43 discussions is available here (http://www.cgms-info.org/documents/CGMS-42_LoAandLoR_final.pdf).

Report of the 43rd Meeting of the
Coordinated Group for Meteorological Satellites

# Parallel Working Group Sessions: Ad-hoc meeting on space weather report

## AD-HOC MEETING ON SPACE WEATHER REPORT

### 1. COSPAR Space Weather roadmap

Jean-Louis Fellous, Executive Director of the ICSU's Committee on Space Research (COSPAR), introduced the roadmap developed by the COSPAR Space Weather Panel "Understanding space weather to shield society: A global road map for 2015-2025 ", which is being published in Advances in Space Research. The meeting noted that this community effort provides a valuable reference with recommended priorities for observations and scientific developments required to progress in space weather science and applications.

### 2. WMO four-year plan for space weather coordination

Terrence Onsager (NOAA, Co-chair WMO/ICTSW) introduced the activities undertaken by WMO through the Inter-Programme Coordination Team on Space Weather (ICTSW) and the four-year plan submitted to the 17th WMO Congress (Cg-17) in this respect. It was noted that the presentation of this plan to CGMS was putting emphasis on space-based observations, while its presentation to WMO Members at Cg-17 would put more emphasis on the reasons why it is relevant to WMO, in particular for preparedness to space weather hazards and support to aviation. It will also be introduced in a Cg-17 side event on space weather.

### 3. Space weather observations related to recent launches

Tsutomu Nagatsuma (NICT, Japan) reported on observations on board Himawari-8, which rely on SEDA-P and SEDA-E. These observations from Himawari-8 are contributing to a 3-D geospace monitoring network of solar energetic particles and magnetospheric particles, with GOES-E, GOES-W and other spacecraft such as Van-Allen Probes. It was underlined that CGMS could play a role in facilitating coordination and inter-calibration of such a geospace network.

NOAA reported on the status of the DSCOVR launched on 11 Feb 2015, which will be placed in a Lissajous orbit at L1. Comparisons with ACE magnetometer and solar wind particles show excellent consistency. Products are being developed at the NOAA Space Weather Prediction Center (SPWC) and will be available on-line and archived at the NOAA Center for Environmental Information (NCEI). International cooperation is essential to ensure real-time reception of such deep space mission data through receiving facilities distributed around the globe.

### 4. Updates on space weather activities and plans

Dohyeong Kim (KMA) reported KMA space weather services, which were officially established in April 2012 for space weather forecasting and warning to the public. Three Space weather instruments will be flown on GEO-Kompsat-2 spacecraft (magnetometer, charged particle detector, and surface charging sensor). A radiation dose model is being developed.

Tom Berger (NOAA/SWPC) gave an overview of NOAA/SWPC activities, including the preparation for several space weather satellite missions including (GOES-R, DSCOVR, CCOR and COSMIC-2). A wealth of products is provided on the SWPC website. The geomagnetic storm on 17 March 2015 was severe and caused ionospheric disturbances to satellite communications but no failure to the power grid network.

Elsayed Talaat (NASA) presented the NASA activities in space weather. NASA operates 33 spacecraft for heliophysics observations and implements a research program that includes data analysis, theory and model, instrumentation technology development, suborbital flights, and the development of space weather empirical and first principles modelling.

William Denig (NOAA/NCEI) reported on the spacecraft anomaly database and the important applications of such information. He encouraged CGMS members to contribute to an initial spacecraft anomaly database, which could be hosted by a member organization or third party. He further recommended establishing a Working Group and soliciting participation of commercial satellite operators e.g. Space Data Association, and suggested a recommendation from CGMS to NOAA to pursue its enhanced spacecraft anomaly mitigation programme.

W. Zhang (WMO) welcomed the presentation and suggested widening the scope of the database to ground impacts. Jérôme Lafeuille (Rapporteur) recalled CGMS-42 discussions on this subject, which had shown the importance of a clear understanding of the requirements for recording spacecraft anomaly data, and of how the information will be used, e.g. to support real time warnings, or forecast verification, or spacecraft anomaly analysis, or as a climatology information to support satellite design.

William Murtagh (NOAA/SWPC) presented an overview of the new space weather strategy adopted by the USA to raise space weather awareness and address the protection of critical infrastructures in the framework of strategic national risk assessment. The strategy involves a coordinated effort among national agencies and identifies six high-level goals: (i) Establish space weather event benchmarks; (ii) Enhance space weather response and recovery capabilities; (iii) Improve protection and mitigation efforts; (iv) Improve assessment, modelling, and prediction of impacts in critical infrastructure; (v) Improve space weather services through advancing understanding and forecasting; (vi) Increase internal cooperation**.** The strategy is associated with an Action Plan. Goal #6 of the strategy (Increase international cooperation) is of particular relevance to WMO and CGMS. It includes the following objectives: to build international support at policy level; to promote a collaborative approach; to increase engagement in the international community; to enable data sharing, to strengthen international coordination, and to develop international communication strategies. Alexander Karelin (Roscosmos) underlined the need to address space weather at the global level to address the needs of all countries.

**5. High-level Priority Plan objectives of CGMS Space Weather activities**

Suzanne Hilding (Chair) recalled the two objectives currently included in the HLPP for space weather: to establish a coordinated approach to the monitoring of space weather and the reporting of space weather-related spacecraft anomalies; to assess how CGMS is organized to address space weather

matters. With respect to the second objective, she invited the participants to express their views about the most appropriate structure to address space weather matters in CGMS in the future. Two possible paths were considered: either establishing a dedicated CGMS working group for Space Weather, or sustain it as part of WGIII and possibly the other existing working groups. WMO noted that in view of the increased international attention to space weather, including the WMO four-year space weather plan, merging space weather issues within the agenda of existing CGMS working groups would facilitate a close integration with Earth Observation matters; on the other hand, it was noted that space weather activities did not have the same maturity yet as Earth Observation. NASA favoured a separate structure to keep a focused activity. NICT supported the view that a separate structure would help the participation of other agencies that are not CGMS Members. KMA expressed interest in fostering collaboration on inter-calibration activities if a separate WG was established. EUMETSAT would support the status quo, having no particular mandate to be active in the field of space weather and recognizing that space weather has not the same level of maturity as other CGMS activities. ROSCOMOS stressed the importance of space weather issues which deserved a working group. CMA supported the view that space weather is important and recalled that the NSMC includes a space weather centre and that CMA satellites are flying space environment payloads; it considered that space weather matters should ultimately be addressed by the existing structure through integration into the terms of reference and agenda of the existing groups, however on a provisional basis it might be more practical to address space weather separately. In conclusion it was recommended to address space weather in a dedicated task team for the time being, and to review the situation when space weather activities have reached a higher level of maturity within CGMS.

## 6. Review of outstanding actions from previous meetings

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|---|
| Plenary action 41.15: CGMS Members to nominate points of contact to work with WMO/ICTSW in order to define jointly a procedure to improve the collection, availability, and use of satellite anomaly information (30 September 2013) |

Points of contact for this satellite anomaly procedure have been nominated by the following CGMS members:

CMA (ZHANG Xiaoxin, xxzhang@cma.gov.cn and GUO Jianguang, guojg@cma.gov.cn),
EUMETSAT (Mike Williams, mike.williams@eumetsat.int),
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| CGMS-42 actions – PLENARY (for WG III) | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | Action item | # | Description | Deadline | Status | HLPP ref |
| CGMS members | WG III (from Plen H.1) | A42.14 | CGMS Members to establish an implementation team tasked to define detailed objectives for the implementation of CGMS space weather activities as defined in the Terms of Reference | 15 Oct 2014, CGMS-43 | CLOSED | HLPP# 5.2.2 |
| CGMS members | WG III (from Plen H.1) | A42.15 | The implementation team to propose next steps until CGMS-43 and objectives to be included in the HLPP. This includes space weather observations into the WIS and implementation procedures to report on spacecraft anomalies | 15 Mar 2015, CGMS-43 | CLOSED | HLPP# 5.2.2 |

It was agreed that Actions 42.14 and 42.15 would be addressed at an intersession web meeting to be held tentatively on 2 September 2015. The Terms of Reference for CGMS space weather activities, as approved at CGMS-42, will be translated into specific objectives for the HLPP.

| CGMS-42 actions – Ad hoc Space Weather for WG III | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | Action item | # | Description | Deadline | Status | HLPP ref |
| WMO | Ad hoc space weather for WG III | A42.16 | WMO to establish an e-mail list server for CGMS Space Weather activities (including CGMS members and associated organisations) | 30 Sep 2014 | CLOSED | HLPP# 5.2.1 |
| CGMS members | Ad hoc space weather for WG III | A42.17 | CGMS Members interested in space weather activities to indicate to the CGMS Secretariat their points of contact for inclusion into the e-mailing list. | 30 Sep 2014 | CLOSED | HLPP# 5.2.1 |

The list server CGMSspaceweather@wmo.int has been established by WMO as a Google Group, which includes the contact points provided by CGMS members.

Actions 41.15, 42.14, 42.15, 42.16 and 42.17 can thus be closed.

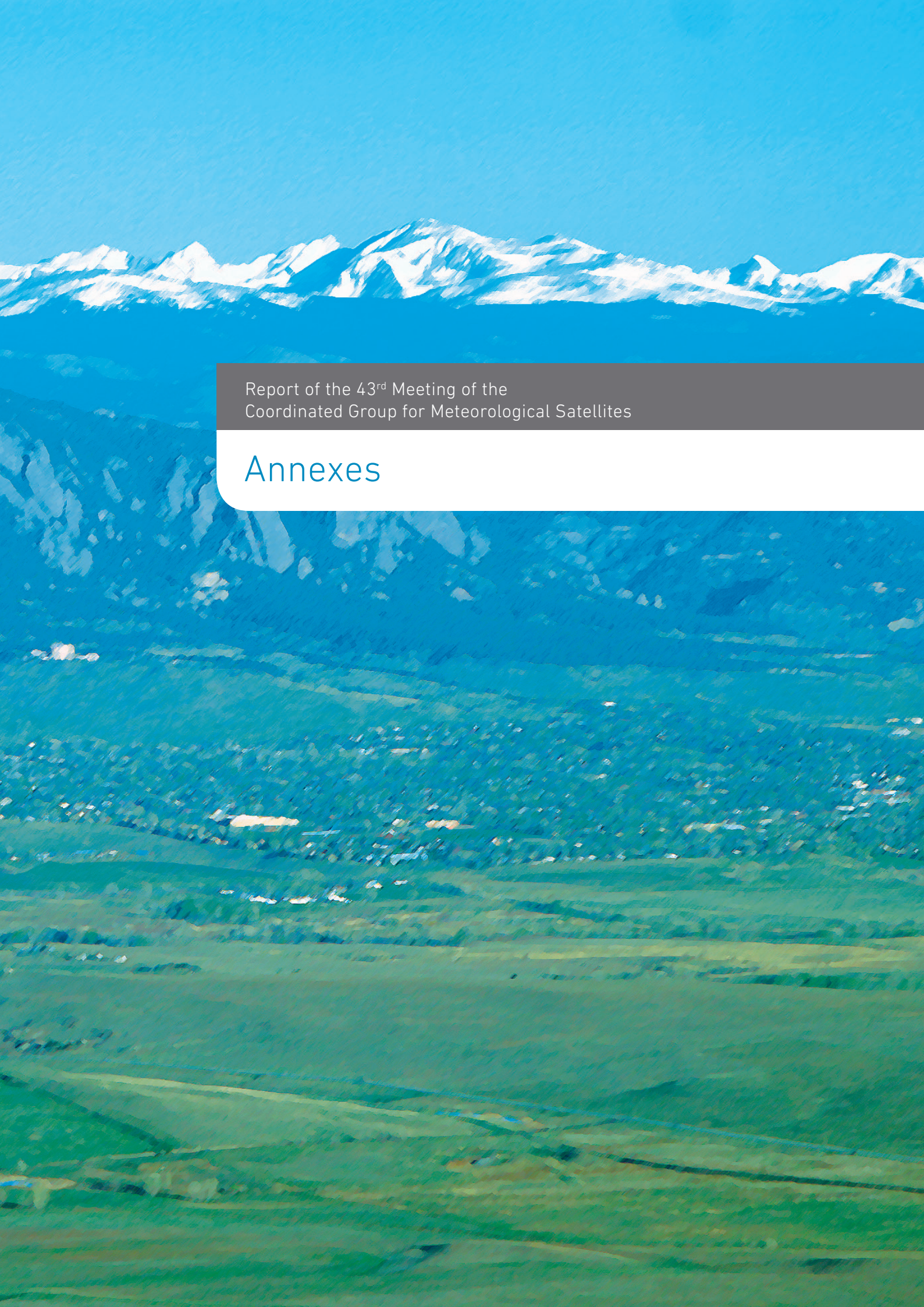
The following action and recommendation following CGMS-43 deliberations were opened:

| CGMS-43 actions – Space Weather TT | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| SWTT Chair | Ad hoc SW | A43.01 | SWTT Chair to convene an intersession meeting to translate the ToRs into specific objectives for the HLPP and to define next steps for action until CGMS-44 | 2 Sept 2015, CGMS-44 | OPEN | HLPP # |

| CGMS-43 recommendations – WGIV | | | | | | |
|---|---|---|---|---|---|---|
| Actionee | AGN item | # | Description | Deadline | Status | HLPP ref |
| SWTT | Ad hoc SW | R43.01 | Space weather matters to be addressed in a dedicated Space Weather Task Team (to be initially based on CGMSspaceweather@wmo.int) as discussed in CGMS-43 plenary. | CGMS-44 | OPEN | HLPP # 5.2 |

The final status of all CGMS-42 actions and recommendations (plenary and working groups) following CGMS-43 discussions is available here (http://www.cgms-info.org/documents/CGMS-42_LoAandLoR_final.pdf

The status of CGMS-43 actions and recommendations will be maintained on the CGMS website under MEETINGS and CGMS-43.



Report of the 43rd Meeting of the
Coordinated Group for Meteorological Satellites

# Annexes

## ANNEXES



The annotated agenda and Working Papers (WPs) can be found at http://cgms.eumetsat.int/views/agendaext.jsf

Information on points of contact and list servers can be requested from the CGMS Secretariat CGMSSec@eumetsat.int

Other information such as the CGMS Charter and the current list of Members and Observers are available at http://cgms-info.org

## STATEMENTS IN OPENING CEREMONY

### *Dr Stephen Volz, Assistant Administrator for Satellite and Information Services, NOAA*

Distinguished Representatives, Ladies and Gentlemen,

It my distinct honor to welcome you to the 43rd Meeting of the Coordination Group for Meteorological Satellites. Welcome to Boulder, Colorado. I am Stephen Volz, NOAA Assistant Administrator for Satellite and Information Services. I have only been in this new position for over six months. While this is my first CGMS meeting, I was aware of CGMS in my previous position and supported Jack Kaye who represents NASA. You can imagine my surprise when I learned that NOAA was hosting this year and I would therefore be the Plenary Chair. I am grateful for the assistance today from my good colleague Alain Ratier, Head of CGMS Secretariat.

First, let me say a few words about the Boulder, Colorado area. We are pleased to be able to host you here at the University Corporation for Atmospheric Research (UCAR) facilities. Boulder has become a science and technology hub, and NOAA plays a big part in Boulder's S&T industry. Boulder is home to NOAA, the National Institute of Standards and Technology (NIST), UCAR, and the University of Colorado, which hosts CIRES - the Cooperative Institute for Research in Environmental Sciences - NOAA's largest and oldest cooperative institute, and Ball Aerospace. IBM also has a large facility here. More than 1,000 NOAA researchers, scientists, and engineers staff NOAA's Earth System Research Lab, the Space Weather Prediction Center (SWPC), the Denver/Boulder Forecast Office, NOAA's Paeloclimatogy Branch, and the geophysical division of NOAA's National Center for Environmental Information. Boulder is an important hub for us. These NOAA scientists support a wide array of atmospheric and space science research, diverse data collection and dissemination programs, as well as operational weather forecasts for the Denver metropolitan area and for space weather. I know many of you visited SWPC yesterday.

I am excited to be a new member of the CGMS community. In my new position, I get to be part of one of the most interesting and important organizations in our field —National Oceanic and Atmospheric Administration. NESDIS is the backbone of NOAA’s environmental intelligence enterprise, operating satellites and develops the science that our partners in the Weather Service, across government, and around the world use to make critical forecasts and warnings.

As I learn about CGMS, I am impressed by the history of achievements. The ongoing technical coordination, planning, and optimization that take place at CGMS are of great benefit to us all. To name a few, these include establishment of a global back-up framework; optimization of the Global Observing System by rigorously looking at requirements, gaps, and strategies to mitigate gaps; standardization of data dissemination formats; coordination of protective measures for meteorological satellites radio-frequency allocations; and the great strides being made in calibration/validation and satellite inter-calibration critical to move us toward a more integrated global observing system.

I look forward to our discussions today and tomorrow as we carry forward a number of these very significant topics. As the host organization, we are also happy to be able to provide presentations on preparing users for our upcoming GOES-R mission planned for launch in 2016.

Finally, I want to thank the CGMS Secretariat staff at EUMETSAT and my own NOAA staff for the excellent arrangements for this year's meeting.

Thank you for your contributions to CGMS-43. There has already been significant work done with the many working group and side meetings earlier this week. I am also pleased that we welcome a new member to CGMS at this meeting.

I look forward to learning more at this meeting and I hope you find this meeting useful as well.

Have a pleasant stay in the Boulder area.

Thank you.

Stephen Volz

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