CGMS HIGH LEVEL PRIORITY PLAN (HLPP) 2020 - 2024

Prepared by the CGMS Secretariat
following CGMS-48 plenary session

CGMS Secretariat c/o EUMETSAT
EUMETSAT Allee 1, 64295 Darmstadt, Germany
cgmssec@eumetsat.int

INTRODUCTION

The main goals of the coordination activities of the Coordination Group for Meteorological Satellites are to support operational weather monitoring and forecasting as well as climate monitoring, in response to requirements formulated by WMO, its programmes and other programmes jointly supported by WMO and other international agencies.

It is the policy of CGMS to coordinate satellite systems of its members in an end-to-end perspective, including protection of in orbit assets and support to users - e.g. through appropriate training - as required to facilitate and develop shared access to and use of satellite data and products in various applications. This policy reflects in the structure of this 4-year High Level Priority Plan, which covers:

1. Operational Continuity and Contingency Planning
2. Coordination of Satellite Systems and Operations
3. Coordination of Data Access and End User Support
4. Enhancement of the quality of satellite-derived data and Products
5. Monitoring of Climate including Greenhouse Gases
6. Space Weather Monitoring
7. Outreach and training activities

CGMS reviews the HLPP on an annual basis, considering in particular new requirements and perspectives arising from interactions with the user and scientific communities, the development of applications, e.g. NWP, and relevant research activities. It ensures proper interaction with other space agencies and their relevant constituencies (e.g. CEOS including its working groups and virtual constellations).

HIGH LEVEL PRIORITY TASKS

The high level priority tasks are presented according to the logic of the CGMS end-to-end systems.

1 ENSURE OPERATIONAL CONTINUITY AND PERFORM CONTINGENCY PLANNING

1.1 Mitigate the impact of identified degradation or loss of capabilities of the CGMS baseline and ensure appropriate contingency measures are in place

The 2020 CGMS risk assessment concluded that the overall CGMS constellation is very robust, but that for a few observation areas, risks have been identified to the provision of operational services in the next decade. Based on this analysis, CGMS will take actions to:

1.1.1 Ensure continuity of passive microwave imager measurements;
1.1.2 Ensure continuity of the Early Morning orbit, in particular for IR/MW sounding;
1.1.3 Ensure continuity of Precipitation Radar measurements;
1.1.4 Ensure continuity of Scatterometer measurements;
1.1.5 Ensure continuity of Radio Occultation Measurements with required quantity, geographical coverage and temporal sampling for numerical weather prediction and for ionospheric monitoring;
1.1.6 Ensure continuity of Coronagraph and Plasma Analyser observations through exploitation of scientific space weather missions for operational gap filling.

1.2 Advance the response to the Vision for WIGOS in 2040 for space, by the implementation of new capabilities beyond the CGMS baseline

The 2020 review of the CGMS baseline concluded that the baseline is still a comprehensive response to the WIGOS vision, addressing the key application areas. However, in the coming years CGMS members will be launching several satellites with new capabilities expanding the response to the vision and CGMS therefore agreed to revise the CGMS baseline, and will:

1.2.1 Work towards establishing optimum constellations for new observations introduced in the CGMS baseline:

- Short Wave IR Spectrometers for monitoring of Greenhouse Gases (CO_2 and CH_4);
- Multi-viewing, multi-channel, multi- polarisation imaging for aerosols;
- UV limb sounding spectrometry for profiles of Ozone and trace gases;

In addition, a number of new satellite programmes are under consideration by CGMS members that offer the potential to expand the response to the WIGOS vision either through application of new technologies or through extending the coverage of existing capabilities. In this respect, CGMS will strive to:

1.2.2 Advance the new generation of GEO satellites, including advanced imaging, lightning mapping and IR sounding for the whole geostationary ring;

1.2.3 Work towards operational hourly daytime UV/VIS mapping of air quality from geostationary orbit;

1.2.4 Work towards ensuring optimised High Spectral resolution IR measurements from LEO and GEO orbits to improve time sampling, spatial and spectral resolution and timeliness of observations, including the deployment of HSIR instruments across the GEO ring as per WIGOS vision 2040;

1.2.5 Work towards optimising the distribution of planned scatterometer missions across different polar and inclined non synchronous orbits to achieve the 6-hour sampling requirement of the WIGOS and resolve diurnal variations;

1.2.6 Work towards ensuring low frequency microwave imagery for all-weather SST and ice monitoring from at least 2 sun-synchronous orbits;

1.2.7 Increase geographical altimetry coverage, for example through wide-swath altimetry;

1.2.8 Advance the atmospheric Radio Occultation constellation, with the long-term goal of providing 20000 occultations per day on a sustained basis;

1.2.9 Move towards an operational space weather monitoring capability from the Lagrangian Point L-5;

1.2.10 Establish the operational framework for the provision of magnetometer data from LEO orbit;

1.2.11 Investigate continuous space weather observations from lunar orbit for terrestrial and future lunar space weather services as well as for heliophysics research, complementing the geostationary and L1 measurements.

1.3 Ensure long-term continuity of OSCAR/Space as a primary tool to support the CGMS Risk assessment and the WMO Rolling Review of Requirements including gap analysis against observing system requirements for satellite data and make OSCAR/Space the primary repository for WIGOS satellite metadata records generated by CGMS operators

1.4 Support satellite impact studies, including in particular impact of data latency and the impact of the Early Morning orbit

1.5 Identify partnership opportunities on space and ground segments and establish CGMS coordinated mechanisms

2 COORDINATION OF SATELLITE SYSTEMS AND OPERATIONS

2.1 Coordination/Optimisation of data collection systems

2.1.1 Assess Data Collection Service (DCS) status and evolutions including International channels, taking into account requirements of tsunami alert systems and in-situ ocean observations (e.g. buoys), and assess the utilisation of International DCS channels;

2.1.2 Establish International DCP design standards taking into account requirements of tsunami alert systems and in-situ ocean observations (e.g. buoys) and lessons learned from the development of High Rate DCPs.

2.2 Radio Frequency (RF) Protection

2.2.1 Facilitate an effective preparation of national positions for the World Radio-communication Conference (WRC) 2023 that will reflect CGMS priorities.

2.3 Direct Broadcast Systems and Data Processing

2.3.1 To ensure the ease of use of data products, provide for dissemination of satellite-derived data and products in one of the four established formats (HRIT, BUFR/GRIB, NetCDF 4 and HDF 5). When a unique data format is used, use an open standard if possible or provide full documentation of the format to users along with the software to convert the data to one of the established formats;

2.3.2 Facilitate the transition to new LEO direct broadcast systems (JPSS, FY-3, Meteor-M, EPS-SG);

2.3.3 Advance the implementation of the CGMS Agency Best Practices in support to Local and Regional Processing of LEO Direct Broadcast data for operational satellites with DB capability;

2.3.4 Support the evolution of the DBNet services to include new satellites and the extension to advanced sounders for at least half of the globe;

2.3.5 Prepare for future increased direct broadcast data rates from polar orbiting satellites, through development of new CGMS standards and best practices, while maintaining the affordability and the multi-mission capability of the direct broadcast reception systems.

2.4 Operational issues related to Space Weather

2.4.1 Evaluate existing operational space weather products and services in support of CGMS members' spacecraft operations and recommend additional services as appropriate.

3 COORDINATION OF DATA ACCESS AND END-USER SUPPORT

3.1 Support the user-provider dialogue on regional/continental scales through regional coordination groups maintaining requirements for dissemination of satellite data and products through the various broadcast services

3.1.1 Consider the full range of user capabilities (from advanced Short range NWP to more conventional nowcasting) when planning data utilisation, products generation and dissemination strategies, in particular for the new geostationary satellites;

3.1.2 Establish a sustained interaction with the operational nowcasting communities with a view to fully utilise the commonality of the future geostationary imagers and sounders.

3.2 Prepare operational users for new generation of meteorological satellites through user readiness programmes, with coordinated contributions from CGMS members

3.2.1 Advance the implementation of the Best Practices for Achieving User Readiness for New Meteorological Satellites, in as far as the apply to CGMS operators;

3.2.2 Provide up-to-date Information on these topics, to be synthesised and maintained by WMO in the SATURN portal, dynamically linked to resources of CGMS members, including the new generation of GEO satellites as well as new LEO satellites.

3.3 Support the coordination of the operational Digital Video Broadcast (DVB) satellite services for the Americas, Africa, Europe and the Asia Pacific regions

3.4 Increase access to, and use of, data from R&D and pre-operational missions, including space weather missions

3.5 Investigate the feasibility of utilising existing dissemination infrastructure for meteorological information in helping to mitigate disasters

3.6 Increase operational access to data and products in support to the ocean user community

3.7 Utilise operationally the WIS infrastructure for satellite data provision and discovery

3.8 Provide coordinated CGMS inputs to WMO on satellite and instrument identifiers for data representation and metadata within the WIS

3.9 Harmonise the metadata (e.g. quality descriptors) and format of products to be exchanged, in adherence to the Service and Discovery metadata standards formulated in the context of WIGOS/WIS

3.9.1 Support WIGOS in the definition of harmonised product metadata for satellite data and implement for CGMS missions;

3.9.2 Promote the product metadata standards within ocean communities, such as on SST, ocean colour, ocean vector surface wind and ocean surface topography, to facilitate common data representation and near-real time exchange. This must be done in dialogue with the relevant CEOS Virtual Constellations.

3.10 Document current data formats for space weather observations

3.11 Improve the near-real-time access to and global exchange of space weather data from instruments hosted on meteorological satellites

3.12 Improve acquisition, access to and exchange of near-real-time scatterometer data, share access to calibration and validation information across CGMS agencies, and make available results of NWP impact assessment studies

3.13 Improve the exchange of characterisation data for geostationary and low Earth orbit hyperspectral infrared instruments and make available results of NWP impact assessment studies and OSSEs to the user communities

3.14 Develop efficient standardised data handling for high-resolution imaging and hyperspectral instruments, employing novel methods like dissemination of hyperspectral infrared data based on Principal Component Analysis

3.15 Explore options for optimal data exchange of advanced data from new generation GEOs, in consultation with the global NWP centres through GODEX-NWP

3.16 Develop Best Practices for Global Data Exchange

4 ENHANCE THE QUALITY OF SATELLITE-DERIVED DATA AND PRODUCTS

4.1 Establish a fully consistent calibration of relevant satellite instruments across CGMS agencies, recognising the importance of collaboration between operational and research CGMS agencies

4.1.1 Maintain within GSICS a framework for inter-calibration of hyper-spectral sounders;

4.1.2 Establish within GSICS a consistent inter-calibration for solar channels using instruments with adequate in-orbit calibration and vicarious methods as reference. The implementation will be done successively by the individual satellite operators;

4.1.3 Establish within GSICS a consistent calibration for reflective solar spectrometers by using instruments with stable orbits, good ground-based pre-launch calibration, adequate on-board degradation and wavelength scale characterisation, and monitored records over PICS and ground-based atmospheric composition measurement sites with state of the art RT generation of radiance / irradiance ratios either absolute or relative constituent pattern differences;

4.1.4 Establish a common reference solar spectrum with appropriate spectral coverage and spectral resolution and develop common methods and tools for on-ground calibration and characterisation and inter-calibration of UV-Vis- NIR SWIR spectrometers;

4.1.5 Establish a methodology to characterise microwave instruments for O2 absorption channels through the SNO and RTM modelling. The implementation will be done successively by the individual satellite operators;

4.1.6 Establish mechanisms for the cross-calibrating scatterometers across the vector products across the constellation scatterometer.

4.2 Establish commonality in the derivation of satellite products for global users where appropriate (e.g., through sharing of prototype algorithms)

4.2.1 Establish commonality in the derivation of AMV products for global users where appropriate (e.g., through sharing of prototype algorithms) and consider backwards compatibility when designing AMV algorithms for the 16-channel imagers, so that present state-of-the-art algorithms can be applied to old imagery;

4.2.2 Investigate the best configurations to be used by the AMV producers for use in global and regional NWP models respectively, and clearly define the appropriate requirements for each of them;

4.2.3 Assess the impact of Aeolus HLOS wind profiles on NWP, and investigate AMV height assignment issues using Aeolus data;

4.2.4 Establish a coherent development of volcanic ash products and applications with close user community coordination;

4.2.5 Develop best practices for evaluation and validation of cloud properties;

4.2.6 Establish together with the user community a commonly agreed approach for retrieval of Principal Component scores and associated parameters from hyperspectral infrared data, minimising information loss including the mutually acceptable update strategy for the principal component basis, and to implement such an approach in a coordinated manner.

4.3 Foster the continuous improvement of products through validation and inter-comparison through international working groups and SCOPE-type mechanisms

4.3.1 Apply the IPWG validation protocol (as defined on its web page) to precipitation combination datasets generated using multiple satellite and in-situ data sources, and expand the number of participating agencies to broaden the validation domain;

4.3.2 Provide a SCOPE-CM Implementation Plan following the agreed new concept by 2020;

4.3.3 Conduct an intercomparison study between the different methods to derive level 2 data from infrared hyperspectral sounders, recognising that there are several software packages available that utilise AIRS/IASI/CrIS data;

4.3.4 Explore the use of cloud products in Nowcasting applications through collaboration between the International Cloud Working Group, SCOPE-Nowcasting and other relevant initiatives.

4.4 Maintain, enhance and improve the methods to describe the error characteristics of satellite data and products

4.4.1 Establish a common vocabulary and methodology with appropriate error propagation to include the errors associated with validation data (e.g. radiosonde temperature, water vapour, precipitation and winds);

4.4.2 Agree on standardised procedures to derive NedT estimates for microwave sounders, and include such estimates in the disseminated BUFR data.

4.5 Strengthen interaction with users in selected thematic areas by establishing a close relation with them as beta-testers and foster optimum use of satellite data

4.5.1 Report on the progress within the Nowcasting community toward the use of hyperspectral sounders and work toward common products to serve the requirements of the global community;

4.5.2 Enhance the use of satellite precipitation datasets through an IPWG-led user workshop where training on visualisation and analysis tools will be one of the topics;

4.5.3 Foster the coordinated development of novel products and applications of the new generation of geostationary imagers, initially for the areas of fire, aerosols and flood mapping;

4.5.4 Provide support to users in the WMO Application Areas, including for agricultural, hydrology, marine/ocean and other applications and, where appropriate, identify and follow-up on opportunities by other entities (e.g. CEOS led activities).

4.6 Foster and support research regarding enhanced radiative transfer capabilities, recognising the paramount importance of radiative transfer developments for satellite products

4.6.1 Continue support for line-by-line (LBL) reference model development and enhanced characterisation of spectroscopy to ensure that product development teams and users of level 1 data have access to the latest updates in LBL forward modelling and the uncertainties involved;

4.6.2 Perform validation and intercomparison of LBL models/spectroscopy to assess the impact of spectroscopic uncertainties and the differences between line-by-line and fast radiative transfer models;

4.6.3 Through coordination between IPWG, ITWG and ICWG, continue to improve microwave radiative transfer models to include complex surfaces (e.g., snow, desert, etc.) and scattering atmospheres (e.g., frozen hydrometeors) to support improved algorithm development for current and future sensors.

4.7 Stimulate trade-off analyses for the development of future passive sounding instruments

4.7.1 Conduct studies to investigate the technical feasibility to reduce the field of view sizes for future microwave sounders to keep in line with the spatial resolution expected for future global NWP models.

5 ADVANCE THE ARCHITECTURE FOR SPACE-BASED MONITORING OF CLIMATE, INCLUDING GREENHOUSE GAS MONITORING (THROUGH THE JOINT CEOS-CGMS WORKING GROUP ON CLIMATE)

5.1.1 Update ECV Inventory of Climate Data Records, Gap Analysis and Coordinated Action Plan (CAP) of CEOS and CGMS and report on status of the implementation of the CAP (This target is cyclic and all three parts are covered every year including endorsement by CEOS and CGMS);

5.1.2 Report to and interact with the UNFCCC Subsidiary Body for Scientific and Technological Advice – Research and Systematic Observation (SBSTA-RSO) to foster usage of satellite data in the context of the Paris Agreement, in particular results from the operational GHG monitoring system. (This target is also part of the cyclic regular annual reporting);

5.1.3 Respond to the GCOS IP after new versions of it issued by GCOS (every 5 years). Provide support to GCOS for the GCOS status report (1 year ahead of the new GCOS IP);

5.1.4 WGClimate Task Team on GHG monitoring to coordinate the specific CGMS contributions to the operational GHG constellation, covering activities on mission coordination, inter-calibration, product prototyping, data distribution, exchange, formatting, and on training and outreach;

5.1.5 Foster the implementation of the architecture for climate monitoring from space by strengthening the analysis of use cases for climate data records to increase usage in climate services and science;

5.1.6 WGClimate to publish updated definitions for the Fundamental, Thematic, and Interim Climate Data Record.

6 ADVANCE OPERATIONAL SPACE WEATHER MONITORING FROM SPACE

6.1 Coordinate CGMS activities and align priorities with the space weather user community, in particular the ICAO Space Weather Centres, ISES, WMO IPT-SWeISS and the UNCOPUOS Expert Group on Space Weather;

6.2 Investigate feasibility of a consistent inter-calibration for energetic particle measurements using instruments with adequate in-orbit calibration and vicarious methods, using GSICS methodology as reference;

6.3 Advance the integration of Space Weather coordination activities into the relevant CGMS working groups;

6.4 In coordination with IROWG establish requirements for and recommend an implementation of an optimised system for radio occultation observations for ionosphere monitoring.

7 OUTREACH AND TRAINING

7.1 Impact and benefit of CGMS satellite missions

7.1.1 Develop capacity to assess and communicate socio-economic benefits of CGMS satellite missions;

7.1.2 Engage in communication and outreach activities to promote EO and Space Weather observations benefits;

7.2 Training

7.2.1 Continue to foster optimum use of satellite data for weather forecasting, climate applications, and environmental assessments including hazardous events such as volcanic ash and flooding;

7.2.2 Update and develop new training material where necessary, and in collaboration with partner organisations such as Collaboration among Education and Training Programmes (COMET), Committee on Space Research (COSPAR), the CEOS Working Group on Capacity Building and Data Democracy (WGCapD) and the CEOS-CGMS Joint Working Group on Climate; disseminating such material through the VLab;

7.2.3 Provide shared, regular support to funding the VLab Technical Support Officer function through the WMO VLab Trust Fund, and to the VLab Centres of Excellence as per agreed expectations.

7.3 User Conferences

Conduct regional satellite users' conferences to:

- i) share experience and foster the exchange of ideas;
- ii) promote better access, and improve the utilisation of, existing satellite data and products;
- iii) prepare the user community on new satellite systems' data products and services;
- iv) engage with the user community on the application of new Climate Data Records, supported by the CEOS-CGMS Joint Working Group on Climate;
- v) gain user feedback on data, product and system real-world application;
- vi) engage young people entering the field; and
- vii) other items as appropriate.