CGMS

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WG III

REVISION OF THE CGMS BASELINE FOR CONTRIBUTING TO THE GLOBAL OBSERVING SYSTEM

In response to Actions A38.39, A38.41and Recommendations R38.19, R38.20

CGMS-38 agreed to proceed with an update of the CGMS baseline for GEO, LEO and HEO satellites within the space-based Global Observing System (GOS), as a proposed target-configuration for 2015. The Expert Team on Satellite Systems (ET-SAT) reviewed the issue in detail and proposed an updated baseline as contained in the Appendix to this WMO-WP-02, while clarifying the following:

- The baseline focuses on the missions to be performed on an operational or sustained basis, which implies that long-term continuity is planned.
- As advised by CGMS-38, the baseline describes the missions committed as a whole by CGMS members, without explicit mention of which member is taking responsibility for which mission(s).
- The details of the individual contributions of agencies are described in an annex, in order to ensure traceability between the baseline and the actual agency plans, and give confidence that the baseline can be implemented.
- The baseline and its annex take into account the missions *available* or *firmly planned* (with approved funding) at the time of adoption by CGMS.
- For describing the baseline, it is agreed to categorize space-based missions first by orbit types (GEO, LEO sun-synchronous, other LEO, and ultimately HEO).
- The baseline should, however, not be limited to listing space-based missions, but should also encompass a commitment for data availability and dissemination, as well as inter-calibration and contingency planning.

The proposed new CGMS baseline represents a major enhancement in comparison to the previous baseline, and represents already significant progress towards the full implementation of the Vision of the GOS in 2025. It reflects not only advances in technology to support meteorological missions but also the expanding scope of missions assumed by CGMS members in particular in support of climate and environmental monitoring.

Action/Recommendation proposed:

1. CGMS is invited to adopt the Appendix of CGMS-39-WMO-WP-02 as the new baseline for the contributions of CGMS Members to the WMO Global Observing System.
2. CGMS satellite operators are invited to commit their best efforts to contribute to the implementation of the new baseline.
3. WMO is invited to take into account the new baseline in forthcoming updates of the Manual on the Global Observing system and related regulatory material.

REVISION OF THE CGMS BASELINE FOR CONTRIBUTING TO THE GLOBAL OBSERVING SYSTEM

1. BACKGROUND

At the 38th session of the Coordination Group for Meteorological Satellites (CGMS-38) in November 2010, CGMS agreed to proceed with an update of the CGMS baseline for GEO, LEO and HEO satellites within the space-based Global Observing System (GOS), as a proposed target-configuration for 2015. CGMS gave an action (Action 38.39) to WMO to prepare an update of the baseline along the lines of the conclusions of CGMS-38, and asked that the revised baseline be circulated in advance of CGMS-39. The intent is that CGMS members be in a position to adopt the new baseline at CGMS-39 (Action 38.41), and that subsequently WMO will submit it for approval to its Commission for Basic Systems (CBS) in 2012 in order to update the definition of the GOS accordingly (Action 38.42).

This issue was addressed as a priority matter by the sixth session of the CBS Expert Team on Satellite Systems (ET-SAT-6), held in Geneva in April 2011. ET-SAT clarified the scope of the update and performed a careful review with the objective to ensure that the new baseline reflects the best contribution to the GOS that CGMS Members could commit to, along the lines of the Vision of the GOS in 2025.

Subsequently, the tenth session of the Executive Panel of the Global Space-based Inter-Calibration System (GSICS) brought a minor clarification to the “calibration” section.

The outcome of these expert discussions was submitted to all CGMS principals in July 2011 (Letter B.J. Ryan, Ref. 8014-11/OBS/SAT/CGMS-39, dated 12/07/2011) for review. Replies were received from CNES, EUMETSAT and NOAA indicating support subject to minor clarifications. As a result of these comments minor updates have been brought to the annex to the baseline.

2. MAIN ASSUMPTIONS

Taking into account the clarifications brought y ET-SAT, the following assumptions should be recalled:

- The baseline focuses on the missions to be performed on an operational or sustained basis, which implies that long-term continuity is planned.
- As advised by CGMS-38, the baseline describes the missions committed as a whole by CGMS members, without explicit mention of which member is taking responsibility for which mission(s).
- The details of the individual contributions of agencies are however described in an annex, ensuring traceability between the baseline and the actual agency plans, in order to give confidence that the baseline can be implemented.
- The baseline and its annex take into account the missions *available* or *firmly planned* (with approved funding) at the time of adoption by CGMS.

In formulating the baseline, ET-SAT agreed that space-based missions could be categorized at the first level by orbit types (GEO, LEO sun-synchronous, other LEO, and ultimately HEO).
The baseline should however not be limited to listing space-based missions, but should also encompass a commitment for data availability and dissemination, as well as inter-calibration and contingency planning.

3. CONCLUSION

The previous baseline, which is described in the WMO Manual on the Global Observing System, Chapter IV, and is recalled in the CGMS Global Contingency Plan is to a large extent superseded by the evolution of users' needs and agencies' plans.

As contained in the Appendix, the proposed new CGMS baseline represents a major enhancement in comparison to the previous baseline, and represents already a significant progress towards the full implementation of the Vision of the GOS in 2025. It reflects not only advances in technology to support meteorological missions but also the expanding scope of missions assumed by CGMS members in particular in support of climate and environment monitoring.

CGMS Members are invited to adopt the proposed revision of the baseline as contained in the Appendix, and to commit their best efforts to contribute to its implementation.

Once agreed by CGMS, WMO will be pleased to take this revised baseline into account for forthcoming updates of the Manual on the Global Observing system and related regulatory material.

PROPOSED UPDATE TO THE CGMS BASELINE

Satellite missions to be performed on operational/sustained basis

Introduction

In support of the programmes coordinated or co-sponsored by WMO for weather and climate, CGMS Members plan to maintain the capabilities and services described below, that constitute the "CGMS baseline contribution to the GOS".

The baseline takes into account the current satellite missions and the firmly planned satellite programmes as of 2011.

This baseline comprises a constellation of geostationary satellites, core meteorological missions and other missions in sun-synchronous orbits, missions in non-sun synchronous Low Earth Orbit, contingency planning, as well as provisions fo r satellite instrument inter-calibration, data dissemination and stewardship.

I. Constellation in geostationary orbit

At least six geostationary satellites shall be operated at evenly distributed locations with in orbit redundancy, and perform the following missions:

(a) Advanced visible and infrared imagery (at least 16 spectral channels, 2km resolution) over the full disc at least every 15 minutes
(b) Infrared sounding (hyperspectral on some positions)
(c) Lightning detection
(d) Data collection
(e) Space environment monitoring

On selected positions, the following missions shall be performed:

(f) Earth Radiation Budget monitoring
(g) High spectral resolution UV sounding
(h) Solar activity monitoring

II. LEO sun-synchronous missions

Operational sun-synchronous satellites shall be operated around three orbital planes in mid-morning ("am", nominally 09:30 descending, 21:30 ascending ECT), afternoon ("pm", nominally 13:30 ascending ECT) and early morning (nominally 05:30 descending, 17:30 ascending ECT) and, as a constellation, shall perform the following missions:

<u>1) Core meteorological missions nominally on 3 orbital planes</u>

(i) Multispectral visible and infrared imagery
(j) Infrared hyperspectral sounding (at least am and pm)
(k) Microwave sounding
(l) Microwave imagery

<u>2) Other missions on sun-synchronous orbits</u>
(m) Wind scatterometry over sea surfaces (at least two orbital planes)

(n) Ocean surface topography by radar altimetry (at least on am and pm orbits, supplemented by a reference mission on a high-precision, inclined orbit)
(o) Radio-occultation sounding (at least am and pm, supplemented by a constellation in specific orbits)
(p) Broadband VIS/IR radiometer for Earth Radiation balance (at least am and pm)
(q) Total Solar Irradiance (at least one)
(r) Contribution to atmospheric composition observations (at least am and pm)
(s) Narrow-band Vis/NIR imagers (at least one sun-synchronous, am spacecraft) for ocean colour, vegetation and aerosol monitoring
(t) High-resolution multi-spectral Vis/IR imagers (constellation of sun-synchronous satellites, preferably in am)
(u) IR dual-angle view imagery for high-accuracy SST (at least one am spacecraft)
(v) Particle detection and / or electron density (at least am and pm)
(w) Magnetic field (at least am and pm)
(x) Solar activity (at least two)
(y) Data collection

III. Other LEO missions

The following missions shall be performed on an operational basis by Low Earth Orbit satellites on appropriate orbits:

(z) Ocean surface topography by radar altimetry (A reference mission on high-precision, inclined orbit, complementing two instruments on sun-synchronous am and pm orbit)
(aa) Radio-Occultation sounding (dedicated constellation of sensors on appropriate orbits)

IV. Contingency Planning

The CGMS baseline as well includes contingency plans for geostationary and polar-orbiting satellite systems, which are detailed in the CGMS Global Contingency Plan (http://www.wmo.int/pages/prog/sat/documents/CGMS_Global-Contingency-Plan_version2_070507.pdf)

V. Inter-calibration

Instruments should be inter-calibrated on a routine basis against reference instruments or calibration sites. The routine and operational intercalibration and corrections shall be performed in accordance with standards as agreed by the Global Space-based Inter-calibration System (GSICS).

VI. Data availability and dissemination

VI.1. Data open availability with suitable timeliness

All operational environmental observation satellite systems should be designed to ensure the provision of data with suitable timeliness, as appropriate for their intended applications. Data should be preserved for the long term and documented with metadata allowing their interpretation and utilization.The satellite operators should establish dissemination contents and schedules that take into account the data requirements of users. Re-broadcast via telecommunication satellites should complement and supplement direct broadcast services,

which allows cost-efficient access to integrated data streams including data from different satellites, non-satellite data and geophysical products.

VI.2. Direct broadcast for core meteorological missions in LEO

The core meteorological satellite systems in LEO orbits, and other operational observation satellite systems when relevant, should ensure near-real-time data dissemination of imagery, sounding, and other real-time data of interest to Members by direct broadcast. Direct broadcast frequencies, modulations, and formats for polar-orbiting satellites should allow a particular user to acquire data from either satellite by a single antenna and signal processing hardware.

VII. Note

The present update of the CGMS baseline is based on an assessment of currently (2011) operated or firmly planned satellite missions. The result of this assessment is summarized in Annex.

ANNEX TO THE PROPOSED UPDATE TO THE CGMS BASELINE

I. Constellation in geostationary orbit

Missions	*Qualifications*	135W	75W	0	76E	86.5	93.5E	105E	128E	140E
VIS IR imagery	*At least 6 positions*	NOAA	NOAA	EUMETSAT	ROSHYDROMET	China	IMD	CMA	KMA	JMA
Advanced VIS/IR imagery (2km resol or better, at least 16 channels, 15min or better)	*2 positions 2015* *3 positions 2016* *8 positions 2017*	NOAA (as of 2017)	NOAA (as of 2020)	EUMETSAT (as of 2017)	ROSHYDROMET (as of 2016)	CMA (as of 2017)		CMA (as of 2015)	KMA (as of 2017)	JMA (as of 2015)
IR Sounding	*3 positions until 2018*	NOAA (until 2018) mitigation	NOAA (until 2019) mitigation				IMD			
IR hyperspectral Sounding	*1 position 2015, 2 position 2017* *3 positions 2018*			EUMETSAT (as of 2019)		CMA (as of 2017)		CMA (as of 2015)		
Lightning detection	*2 pos. 2015* *3 pos. 2016* *6 pos. 2017*	NOAA (as of 2017)	NOAA (as of 2020)	EUMETSAT (as of 2017)	ROSHYDROMET (as of 2016)	CMA (as of 2017)		CMA (as of 2015)		
Data collection	*At least 6 positions*	NOAA	NOAA	EUMETSAT	ROSHYDROMET	CMA	IMD	CMA	KMA	JMA
Space Weather Monitoring	*3 pos. 2015* *4 pos. 2016* *6 pos. 2017*	NOAA	NOAA		ROSHYDROMET (as of 2016)	CMA (as of 2017)		CMA (as of 2015)	KMA (as of 2017)	JMA (as of 2015, housekeeping purpose)
Earth radiation budget	*1 position* *2 position 2016*			EUMETSAT (until 2020)	ROSHYDROMET (as of 2016)					
High spectral resolution UV sounding	*1 position 2018*			EUMETSAT (as of 2018)						
Solar activity	*1 position 2015* *2 positions 2016* *5 positions 2017*	NOAA	NOAA		ROSHYDROMET (as of 2016)			CMA (as of 2017)	KMA (as of 2017)	

II. LEO SUN-SYNCHRONOUS MISSIONS

II.1 Core meteorological missions required on 3 sun-synchronous orbital planes (AM, PM, EM), with direct broadcast

Missions	**Planned Orbital Configuration** as available or firmly planned by 2011 *(Missions marked with a star are operated in a "sustained" mode by R&D agencies)*		
	Mid-morning (AM)	**Afternoon (PM)**	**Early morning (EM)**
Multispectral VIS/IR imagery	EUMETSAT CMA ROSHYDROMET (as of 2015)	NOAA CMA	DOD
IR hyper-spectral sounders	EUMETSAT CMA (as of 2016) ROSHYDROMET (as of 2015)	NOAA CMA (2014)	
MW sounders	EUMETSAT CMA ROSHYDROMET (as of 2015)	NOAA CMA	DOD
MW imagers – some polarimetric	CMA ROSHYDROMET (as of 2015)	CMA JAXA (*) (no direct broadcast)	DOD

II.2 Other operational/sustained missions on various orbits

Missions	Planned Orbital Configuration as available or firmly planned by 2011 (Missions marked with a star are operated in a "sustained" mode by R&D agencies)			
	Sun-synchronous Morning	**Sun-synchronous Afternoon**	**Other sun-synchronous**	**Non sun-synchronous**
Scatterometers (At least 2 on well separated orbital planes)	EUMETSAT ROSHYDROMET (2015)		ISRO(*) *ECT=12:00*	
Altimeter constellation	EU/ESA/EUMETSAT (as of 2014)		ISRO(*) *ECT=12:00*	EUMETSAT/CNES/NOAA/NASA *(Precision, inclined orbit)*
Radio occultation (At least 8 receivers)	EUMETSAT CMA (2016) ROSHYDROMET (as of 2015)	CMA (as of 2014)	ISRO(*) *ECT=12:00*	NOAA
Broad-band Vis/IR radiometer	CMA	NOAA		
Total solar irradiance sensor	CMA			NOAA
Atmospheric composition (Contribution to)	CMA EUMETSAT ROSHYDROMET (as of 2015)	NOAA CMA		
Narrow-band Vis/NIR imagers (for ocean colour and vegetation)	EU/ESA/EUMETSAT (as of 2014) ROSHYDROMET (as of 2015)	NOAA		
High-resolution multi-spectral Vis/IR imagers (Land surface imaging constellation)	NASA/USGS INPE/ CNSA (*) EU/ESA (as of 2014) (*)			
IR dual-angle view imager (for high accuracy SST)	EU/ESA/EUMETSAT (as of 2014)			
Particle detection (Electrons, protons, neutrons, etc) and/or electron density	CMA EUMETSAT ROSHYDROMET (as of 2015)	CMA	DOD *(early morning)*	
Solar monitoring	CMA	CMA		
Magnetic field	CMA	CMA	DOD *(early morning)*	
Data Collection System	EUMETSAT	NOAA		