CGMS-46 CGMS-WP-27
June, 2018

Prepared by WGIII
Agenda Item: 7.1
Discussed in WGIII

CGMS Baseline

In response to CGMS action/recommendation A45.01
HLPP reference: 1.1.8

In CGMS-45, Working Group III agreed to hold a review of the CGMS Baseline to be synchronized with the development of the WMO Vision for WIGOS in 2040. Working Group III coordinated a new draft of the following CGMS-45 and discussed updates in the Working Group III intersessional meetings. WMO held a CGMS Baseline and Contingency Plan Workshop to discuss the documents with representatives from the CGMS Secretariat, CMA, EUMETSAT, KMA, JMA, JAXA, NOAA, and the WMO.

The appendix to this working paper serves as the CGMS Baseline as agreed to following resolution of comments out of the workshop.

Action/Recommendation proposed:

ACTION: CGMS to adopt the Appendix of CGMS-46-CGMS-WP-27 as the new baseline for the contributions of CGMS Members.

ACTION: WMO to take into account the new baseline in forthcoming updates of the Manual on the Global Observing System and related materials.

CGMS Baseline

1 INTRODUCTION

In CGMS-45, Working Group III agreed to hold a review of the CGMS Baseline to be synchronized with the development of the WMO Vision for WIGOS in 2040. Working Group III held intersessional meetings with the Space Weather Task Team and as a working group to discuss the CGMS Baseline. The Working Group III Co-Chair developed a draft to be shared with all members of Working Group III. Following these initial drafts, WMO hosted a CGMS Baseline and Contingency Plan Meeting with representatives from the CGMS Secretariat, CMA, EUMETSAT, KMA, JMA, JAXA, NOAA, and the WMO. Significant progress was made at the workshop that resulted in this working paper.

Working Group III is presenting this paper to the CGMS Plenary for endorsement at CGMS-46 to ensure that this updated CGMS Baseline will be included in the Manual on WIGOS scheduled to be published in 2019.

2 CGMS BASELINE

The CGMS Baseline enumerates the observations, measurements, and services that form the CGMS contribution to the space-based Global Observing System and is responding to end-user requirements expressed in WMO's Rolling Review of Requirements (RRR). The CGMS Baseline will strive to support the WMO Integrated Global Observing System (WIGOS) 2040 vison and serves as CGMS's response to the WIGOS 2040 Vision to document what missions are currently being, or planned on being flown.

The CGMS Baseline included missions that are comprised of the following key principles:

- Commitment: The CGMS Members are providing, or have firm plans to provide, the observations, measurements, and services enumerated in the Baseline.
- Sustained: The observations, measurements, and services are provided on a sustained basis.
- Available: The observations, measurements, and services are available on a free and unrestricted basis.
- Operational: The data and products can be utilized in operational applications.

The observations and measurements that constitute the CGMS Baseline are enumerated in a table that describes the Sensor Type, the Orbit, the Observation/Measurement (or geophysical parameter), and any specific orbital attributes. The table was designed to facilitate the linkage with the OSCAR/Space Database, future risk assessments, and gap analyses.

The CGMS Baseline discusses the importance of services and steps CGMS will take to ensure the quality and continuity of data and products.

3 CONCLUSIONS

The CGMS Baseline, as contained in the appendix, represents a major enhancement in comparison to the previous baseline. CGMS Members are invited to adopt the proposed revision of the baseline as contained in the Appendix. Once agreed by CGMS, WMO will take this revised baseline into account for forthcoming updates of the Manual on the WMO Integrated Global Observing System (WIGOS) and related materials.

Baseline Contribution to the World Meteorological Organization (WMO) Global Observing System (GOS)

Coordinating Group on Meteorological Satellites
June 5, 2018

1. Introduction

The Coordination Group for Meteorological Satellites (CGMS) provides a forum for the exchange of technical information on meteorological and environmental satellite systems as well as research and development missions in support of the World Meteorological Organization's (WMO) Rolling Review of Requirements (RRR). The primary goal of the coordination activities is to support operational weather monitoring and forecasting as well as climate monitoring. CGMS coordinates satellite systems of its members in an end-to-end perspective including, but not limited to protection of on-orbit assets, support to users, and facilitation of shared access to satellite data and products.

1.1 Document Purpose

The Baseline constitutes the commitments and plans of CGMS Members to provide particular observations, measurements, and services. CGMS Members plan to maintain the capabilities and services described below to support the WMO Global Observing System (GOS). This document will remain consistent with the principles of the WMO Integrated Global Observing System (WIGOS) 2040 Vision and the WIGOS vision serves as important input in the development of CGMS Members' Plans.

1.2 Scope of the Baseline

The baseline enumerates the observations, measurements, and their supporting missions that provide meteorological and environmental data required to support the WMO application areas. Support of this goal requires coordination and cooperation among all CGMS Members. In order to ensure efficient allocation of resources and timely cooperation, the capabilities contained herein are considered the aggregate baseline capabilities of all CGMS Members.

In the development of the scope of the baseline, the following principles determined which missions were included:

- Commitment by CGMS Members to provide a capability
- Long-term sustained provision of the capability by CGMS Members
- Data from missions are available on a free and unrestricted basis
- Data can be utilized in operational applications

This document takes a holistic approach and therefore includes: space-based observations and measurements; services, including data collection and direct broadcast; as well as data sharing and distribution.

1.3 Evolution of the Baseline

This document will be maintained by CGMS Working Group III and approved by the Plenary. The CGMS Secretariat is the repository for this document. The Baseline will be updated every four years to take into account the evolving WMO gap analysis and evolving plans of CGMS members.

The year following approval of the CGMS Baseline, WMO will include the CGMS Baseline in the new Manual on WIGOS. WMO will conduct a WMO Gap analysis of the CGMS Baseline against the WIGOS 2040 Vision every four years. Then, the process will begin again with CGMS updating the Baseline to include in the Manual on WIGOS. This process is outlined in Appendix A.

The baseline constitutes a comprehensive response to the WIGOS vision, but CGMS recognizes that due to budgetary constraints and specific national priorities, full implementation of the WIGOS vision may not be possible in the near term.

2. Observations, Measurements, and Orbits

2.1 Observations and Measurements

The following primary observations, measurements, sensor types, and orbits [e.g., Low-Earth Orbit (LEO); Geostationary (GEO); and Lagrange Point 1 (L1)] from which they are collected are considered part of the CGMS baseline. The LEO orbits comprise three orbital planes: i) early morning (nominally 05:30 descending; 17:30 ascending Equatorial Crossing Time, ECT); ii) mid-morning (nominally 09:30 descending; 21:30 ascending ECT); and iii) afternoon (nominally 13:30 ascending ECT). The term Sun-Earth line should be understood as covering observations that may be obtained from either Geostationary orbit (GEO) or Lagrange Point 1 (L1) when monitoring or observing the sun. The observations and measurements are a combination of active and passive remotely-sensed observations, and in-situ measurements.

Sensor Type	Orbit	Observation / Measurement	Attributes
Microwave Sounder	LEO	Atmospheric temperature, humidity, and precipitation	3 sun-synchronous orbits, nominally early morning, mid-morning, and afternoon
Infrared Sounder	LEO, GEO	Atmospheric temperature, and humidity	LEO - Hyperspectral on 3 sun-synchronous orbits, nominally early morning, mid-morning, and afternoon GEO - Hyperspectral at orbital positions 0° and 105° East.
Radio Occultation	LEO	Atmospheric temperature and humidity, Ionspheric Electron Density	3 sun-synchronous orbits, early morning, mid-morning, and afternoon as well as other designated orbits such as equatorial – A minimum of 6,000 globally distributed occultations

Sensor Type	Orbit	Observation / Measurement	Attributes
Multi-purpose meteorological imagers (multispectral, visible, and IR)	LEO, GEO	Sea Surface Temperature, Aerosols, Land surface temperature, Cloud properties, Feature tracking winds (AMV), Flood mapping, Fires, Cryosphere applications (sea ice, snow cover, etc.)	LEO - 3 sun-synchronous orbits, nominally early morning, mid-morning, and afternoon GEO - Global coverage, nominally 6 evenly spaced satellites
Narrow Band Visible and Near Infrared Imager	LEO, GEO	Ocean color	LEO - 2 orbits GEO - 1 slot located 128.2°E
High Resolution Visible Infrared Imager	LEO	Land use, Vegetation type and status	LEO - 1 orbit
Microwave Imager	LEO	Sea surface temperature, Ocean surface winds, Precipitatable water, Soil moisture, Snow and ice properties, Sea ice properties	LEO - 3 sun-synchronous orbits, nominally early morning, mid-morning, and afternoon
Radar Altimetry	LEO	Ocean surface topography	LEO - 2 sun-synchronous orbits, early morning and mid-morning orbits as well as reference mission on a high-precision, inclined orbit
Scatterometer	LEO	Ocean surface winds	LEO - 2 sun-synchronous orbits, early morning and mid-morning orbits [oceansat-3]

Sensor Type	Orbit	Observation / Measurement	Attributes
Lightning Mapper	GEO	Lightning mapper	GEO - In certain slots, 0°, 75.2°W, 137°W 86.5°E, and 105°E
Visible / IR Radiometer	LEO	Radiation balance	LEO - 2 sun-synchronous orbits, early morning and afternoon orbits
Visible/UV Spectrometer	LEO, GEO	Ozone	LEO - 2 sun-synchronous orbits mid-morning and afternoon GEO - 2 slots at 0° and 128.2°E
Coronagraph	Sun-Earth line	Coronagraphy	GEO - 1 slot L1
EUV Imager	Sun-Earth line	EUV imagery	GEO - 2 slots
X-Ray Spectrograph	Sun-Earth line	X-Ray flux	GEO - 2 slots
Ion/Electron/Proton Spectrometer	LEO, GEO, and L1	Energetic particles, solar wind	LEO - 2 sun-synchronous orbits, nominally early morning, mid-morning, and afternoon GEO - Global coverage, nominally 6 evenly spaced satellites L1 as in situ measure measurements

Sensor Type	Orbit	Observation / Measurement	Attributes
Magnetometer	LEO, GEO, L1	Magnetic field, Solar wind	LEO - 3 sun-synchronous orbits, nominally early morning, mid-morning, and afternoon GEO – 2 slots L1 - as in situ measurement
Plasma Analyzer	L1	Solar wind	L1 as in situ measure measurements
Precipitation Radar	LEO	Precipitation	LEO - equatorial orbit
Submillimeter Ice Cloud Imager	LEO	Cloud ice	LEO - sun synchronous mid-morning orbit
Synthetic Aperture Radar	LEO	Soil Moisture, Sea ice	LEO - 1 orbit

3. Services

3.1 Data Sharing Services

Meteorological applications in general are critically dependant on global exchange of observation data. The international exchange of satellite data obtained by the CGMS Baseline system is a vital element of the WMO Integrated Global Observing System, which underpins the operational weather, climate, hydrological and other environmental services of all 191 WMO Members. CGMS Members will establish and operate terrestrial and space-based dissemination services in order to exchange observations and measurement directly among Members, and to make them available to National Hydrological and Meteorological Services and to the broader international user community in a timely and cost-effective manner. This data exchange should also follow to CGMS Working Group I and IV best practices.

3.1.1. Direct Broadcast Services

The core meteorological satellite systems in LEO orbits, and other operational satellite systems where applicable, should ensure near-real-time data dissemination of imagery, sounding, and other real-time data of interest to Members by direct broadcast. CGMS Members should follow the best practices for direct broadcast services developed by Working Group I.

3.2 *In-situ* Data Relay

CGMS Members will provide for the relay of *in-situ* meteorological and environmental information from fixed and mobile platforms (e.g., ocean buoys, tide gauges, tsunami platforms, and river gauges). *In-situ* data relay services should be provided on both LEO and GEO satellites when relevant.

4. Ensuring Data and Services

To ensure quality and continuity of observations and measurements CGMS Members will take the following steps in the provision of their data and services.

4.1 Calibration and Validation

CGMS members are responsible for ensuring the quality and comparability of satellite measurements taken at different times and locations by different instruments by various satellite operators. CGMS Members will characterize instruments prior to launch, follow the common methodologies, and implement operational procedures outlined by Global Space-based Inter-Calibration System (GSICS). Instruments should be inter-calibrated on a routine basis against reference instruments or calibration sites.

CGMS will strive to achieve global compatibility of satellite products, by establishing commonality in the derivation of satellite products for global users where appropriate and by fostering product validation and inter-satellite comparison through International Science Working Groups and SCOPE-type mechanisms.

4.2 Contingency Planning to Ensure Continuity

CGMS Members will take steps to ensure continuity of this CGMS Baseline by following the guidelines outlined in the CGMS Contingency Plan.

4.3 Monitoring Implementation of the Baseline

CGMS will monitor Members' implementation of the CGMS Baseline through an annual risk assessment. CGMS Members will provide the information necessary to compare current observing capabilities against the CGMS Baseline. This assessment is outlined in the Global Contingency Plan.

4.4 Research to Operations and Employing Research Missions

The CGMS Baseline focuses on satellite missions that are provided on an operational and sustained basis; this does not preclude the use of other missions undertaken on a research or experimental basis (e.g. to demonstrate a specific capability). Research and experimental missions support the CGMS Baseline by:

- Supplementing the CGMS Baseline observations and measurements.
- Providing a pathway for new sensors, observations, and measurements to be added to the CGMS Baseline as future operational missions.
- Supporting contingency operations in the case of a gap in the CGMS Baseline.

4.5 System Compatibility and Interoperability

In order to help maintain a robust Global Observing System, CGMS Members shall work through Working Group I, II, & IV to establish and adopt best practices for interoperability and compatibility of systems and services.

APPENDIX A: CGMS Baseline Process