



Satellite data Requirements for Global NWP

Presented to CGMS-49 Plenary, agenda item 5
CGMS-49-WMO-WP-20

Executive summary of the WP

- WMO Expert team on Space Systems and Utilization has prepared a Position paper on Satellite data Requirements for Global NWP. The paper represent a user perspective on the needs for data to ensure that global NWP models are performing at the state-of-the-art level
- During the preparation views from other WMO Expert Teams as well as other international expert bodies and meetings have been collected, like the Joint Expert Team on Earth Observing System Design and Evolution, Global Data Exchange for NWP, 7th Workshop on the Impact of Various Observing Systems on NWP, CGMS WG II/III Risk assessment Workshop
- The Position paper is capturing a snapshot in time and will have to be reviewed and revised over time as user requirements change. It will therefore be presented to CGMS on a regular basis, nominally on a four-year cycle or when significant changes to the user requirements occur. This process is still under implementation
- The Commission for Observation, Infrastructure and Information Systems decided at its First Session (Third Part) in April 2021 to adopt the Satellite Data Requirements for global Numerical Weather Prediction (NWP) and, recognizing the need for future updates to the Satellite Data Requirements for Global Numerical Weather Prediction, to identify a mechanism to publish the Annex to this decision that supports future updates, and to submit to the next session for consideration
- The Position Paper was also presented to CGMS-49 WG III in April 2021 for consideration and possible implication on the CGMS baseline

The Approach

- The Position Paper reflects the user requirements for satellite data for global NWP
- It follows the terminology of the WIGOS Vision 2040
- The Position Paper is fully decoupled from the Data Policy discussion.
 - This is similar to the approach that was taken for GBON which was discussed at INFCOM-I(II).
- The Position Paper represents a WMO response to the CGMS Plenary Action 47.02
 - (“On global NWP: WMO to provide a report at next CGMS on baseline requirements for satellite products for global NWP, to trigger a CGMS discussion on status of delivery of such observations and possible improvements in the future and inclusion in the CGMS baseline document.”)
- The Position Paper developed by ET-SSU was presented to INFCOM Part-1(III) for decision, which adopted the following decision:

“The Commission for Observation, Infrastructure and Information Systems decides to adopt the Satellite Data Requirements for global Numerical Weather Prediction (NWP) and, recognizing the need for future updates to the Satellite Data Requirements for Global Numerical Weather Prediction, to identify a mechanism to publish the Annex to this decision that supports future updates, and to submit to the next session for consideration.”

- The paper will not be turned into technical regulations
- In addition WMO, will consider developing similar position papers for other WMO application areas with the support of ET-SSU, JET-EOSDE and other expert teams at WMO.

The Position Paper Main Elements

- Background/Purpose/Future Evolution
- 10 principles that by and large are captured in the current WIGOS Manual
 - Principle 10 (goes beyond WM4.1.5): Maintain space-based assets beyond the design lifetime as long as they provide value added observations on a safe and affordable basis as determined by the operating agency
 - Again these represent a user perspective and are not committing for the Space Agencies
- Recall the Space-based component of WIGOS 2040
- **Three tables capturing the requirements, which is the main substance**
 - **Backbone, Additional, Emerging**

Impact on CGMS

- CGMS to consider any possible improvements and inclusion in the CGMS baseline as indicated by Action 47.02.
 - The non-NWP aspects of the baseline would remain as they are.
- The CGMS baseline will remain for now, an integral part of the WIGOS Manual and 1-2-1 reflected in the Annex to the WIGOS Manual reflecting the Space Agencies commitment.
- WMO will regularly inform CGMS on changes in the user requirements for satellite data for global NWP, e.g. every 4 years.
- As already reflected in the WMO Res 40, and considered for the new Data Policy, WMO and the Space Agencies should agree on what data should be exchanged on free and unrestricted basis. This is a separate activity and the way forward has to be agreed.

Table 1: Backbone Satellite for global NWP

Geostationary core constellation with a minimum of five satellites providing complete Earth coverage		
Type of satellite sensors	WIGOS Subcomponent	Products
Multi-spectral VIS/IR imagery with rapid repeat cycles	1	Level 1: Radiance products Level 2: Atmospheric Motion Vectors (AMVs), Aerosol Optical Depth (AOD), Sea Surface Temperature (SST)
IR Hyperspectral I Sounders	1	Level 1: Radiance products Level 2: AMVs
Sun-synchronous core constellation satellites in three orbital planes (morning, afternoon, early morning)		
Type of satellite sensors	WIGOS Subcomponent	Products
VIS/IR imagery	1	Level 1: Radiance products Level 2: Aerosol Optical Depth (AOD), Atmospheric Motion Vectors (AMVs), Sea Surface Temperature (SST)
IR Hyperspectral Sounder	1	Level 1: Radiances
Microwave Sounder	1	Level 1: Radiances
Microwave Imagery	1	Level 1: Radiances Level 2: SST, total column water vapour, clouds, precipitation, sea ice
Scatterometer	1	Level 1: Backscattering cross-sections Level 2: Ocean surface vectors winds, soil moisture
Sun-synchronous satellites at three additional (any other than above) equatorial crossing times for improved robustness and improved time sampling		
Type of satellite sensors	WIGOS Subcomponent	Products
Microwave Sounder	2	Level 1: Radiances
Hyperspectral Infrared Sounder	Not currently reflected in WIGOS Vision 2040	Level 1: Radiances
Wide-swath radar altimeters and high altitude, inclined, high-precision orbit altimeters	1	Level 2: Sea surface height, wind and waves, ice freeboard
Global Navigation Satellite System (GNSS) radio-occultation (basic constellation)	1	Level 1: Bending angle Level 2: Refractivity
UV/VIS/NIR sounders, nadir and limb	1	Level 2: Ozone, aerosol properties
IR dual-angle view imagers	1	Level 2: SST



Table 2: Additional Satellite for global NWP

Data from Low-Earth orbiting satellites		
Type of satellite sensors	WIGOS Subcomponent	Products
Multiangle, multipolarization radiometers	2	Level 1: Radiance products Level 2: Aerosol Optical Depth (AOD)
Precipitation Radar	1	Level 1: Backscatter Level 2: Precipitation rate
Scatterometer	Not currently reflected in WIGOS2040	Level 1: Backscattering cross-sections Level 2: Ocean surface vector winds, soil moisture
Radio-occultation	3 and 4[3]	Level 1: Bending angle Level 2: Refractivity
SAR imagers	1	Level 2: Sea ice
Absolutely calibrated broadband radiometers and total solar irradiance and solar spectral irradiance radiometers	1	Level 1: Radiance

Table 3: Emerging Satellite for global NWP

Geostationary core constellation with a minimum of five satellites providing complete Earth coverage		
Type of satellite sensors	WIGOS Subcomponent	Products
Lightning mapper	1	Level 2: Strike density
Data from Low-Earth orbiting satellites		
Type of satellite sensors	WIGOS Subcomponent	Products
Wind lidar	Currently 2	Level 1: Backscatter, extinction Level 2: Line-of-sight winds
Cloud lidar	2	Level 1: Backscatter, extinction
Cloud radar	1	Level 1: Reflectivity
Sub-mm imagery	2	Level 1: Radiances Level 2: Clouds

To be considered by CGMS:

- CGMS is invited take note of the information provided in this working paper
- Possible implication on the CGMS baseline has been taken into account by WG III