

# WMO Unified Data Policy and Core Satellite Data



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*ITSC-24, Tromsø, Norway,  
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**World Meteorological Organization**

**Organisation météorologique mondiale**

# WMO Space Programme News

- Kenneth Holmlund retired
- New head of Space System and Utilization (SSU) division will be Natalia Donoho (NOAA) from 3<sup>rd</sup> Apr 2023
- New staff Jesse Andries joining from 22<sup>nd</sup> May 2023
  - Space weather and radio frequency coordination
- Existing Staff
  - Heikki Pohjola
  - Zoya Andreeva
  - Chang Liu (Junior Professional Officer by CMA, temporary)



- SSU expert teams:
  - ET-SSU, Expert Team on Space Systems and Utilization
    - Cochairs Fiona Smith (BoM) and Jack Kaye (NASA)
  - ET-SWX, Expert Team on Space Weather
    - Cochairs Kirsti Kauristie (FMI) and Lee-Anne McKinnell (SAWS)
  - ET-RFC, Expert Team on Radio Frequency Coordination
    - Cochairs Eric Allaix (Meteo France) and David Franc (NASA)



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# WMO data policy for the international exchange of Earth system data



- New WMO Unified Data Policy (Res. 1) was approved by WMO members 2021 replacing the old Res 40 (weather), 25(hydrology) and 60 (climate)
- New data policy is single, overarching data policy resolution emphasis on the Earth System data: Observations, Monitoring, Prediction and Services
- As a fundamental principle, **WMO commits itself to broadening and enhancing the free and unrestricted international exchange of Earth system data**
- Two main categories of data:
  - **Core (*shall* be exchanged)**
  - **Recommended (*should* be exchanged)**
- The policy is addressed to national governments of WMO Members and cannot dictate private sector entities
  - Exchange of core data is considered mandatory, irrespective of data origin

# Satellite data in WMO Unified Data Policy



- Vital importance of satellite data now clearly recognized
- The concept of *Core* satellite data is framed primarily in terms of importance for global NWP
- However, no specific satellite datasets are listed as neither *Core* nor *Recommended* in new data policy, or in Manual on WIGOS



# Core observational data in WMO data policy

## 1. Weather-related data

This section lists observational and other data necessary to support weather monitoring and prediction efforts of the WMO Members. Such data are generally exchanged in real or near-real time, depending on the specific application.

### 1.1 Core observational data:

#### 1.1.1 Surface-based:

Observations provided by the Global Basic Observing Network (GBON) and other observational data, as specified in the [Manual on the WMO Integrated Global Observing System](#) (WMO-No. 1160).

#### 1.1.2 Space-based:

(a) Satellite data required in order to ensure the performance and quality of NWP output, as agreed with Members operating satellites or relevant satellite operators, and listed in the [Manual on the WMO Integrated Global Observing System](#) (WMO-No. 1160);

(b) Satellite data required to support nowcasting applications including the generation of warning and advisory products, as agreed with Members operating satellites or relevant satellite operators, and listed in the [Manual on the WMO Integrated Global Observing System](#) (WMO-No. 1160).

## 3. Hydrology

This section lists data, including (near) real time data, historical time series and aggregated data, that are fundamental to global knowledge of the hydrological cycle and essential to the application of such knowledge to support and protect life and health; ensure economic prosperity and well-being; and effectively manage resources through the undertaking of operational hydrology.

### 3.1 Core observational data:

(a) Observations from reference network stations, to be detailed in the *global hydrological observing network* and subsequently specified and adopted into the WMO [Technical Regulations, Volume III, Hydrology](#) (WMO-No. 49) and its annexes;

(b) All satellite data needed to ensure the performance and quality of hydrological forecast and outlook, as agreed with Members operating satellites or relevant satellite operators and specified in the [Manual on the WMO Integrated Global Observing System](#) (WMO-No. 1160).



# Catalogue of Core Data - WIGOS Manual

Initial list of Earth system data to be exchanged as core data

Reference to Annex 1	WMO-No.	Part/Section	Provision	Text of Provision	Data Type	Status	Note	Comment
1.1.2	1160	4	4.5.2.1	Satellite operators shall ensure near-real-time dissemination of the appropriate data sets, as per the requirements of Members, either by direct broadcast via an appropriately designed ground segment, or by rebroadcast via telecommunication satellites.	Not specified	C		
1.1.2	1160	4	4.5.3.4	Satellite operators shall maintain and provide unrestricted access to Level 1B satellite data archives including all relevant metadata pertaining to the location, orbit parameters and calibration procedures used.	Level 1B satellite data archives	N	Approved by EC-73	Effective 1 December 2022

The "Status" column includes the following three options, namely "C" (current), "N" (new, approved by EC-73) and "P" (submitted to Cg-Ext(2021) for its approval).



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# Defining Core and Recommended satellite data as per WMO Unified Data Policy

- Analysis of space-based observation capabilities of CGMS members was carried out with WMO Expert Teams
  - ET-SSU, ET-SWX and CGMS SWCG
- Based on WMO OSCAR/Space, Vision 2040 for WIGOS, NWP Position Paper and other material as a reference aiming to capture user perspective
- Document for current and near future measurement capabilities was prepared
  - GEO measurement capabilities
  - LEO measurement capabilities
  - Space weather

ESA core measurements												
Orbit	Satellite	Sensors	Measurements	Frequency	Coverage	Spatial resolution km at esp	Spectral Ranges	Spectral resolution	No. of channels	Timeliness	Application	Notes
Polar	Sentinel-3	OLCI	Top of atmosphere radiances	24 hrs	Global in 2 days	0.3 km	0.4-1.02 um	2.5-40 nm	21	< 3 hr	NWP, Ocean models, Land	Backup
	Sentinel-3	SSTR	Dual view top of atmosphere radiances	12 hrs	Global	0.5-1 km	0.55-12 um		11	< 24 hr	Ocean models	Backup
	Sentinel-3	SRG	Ocean and topography	12 hrs	Global in month	< 20 km					Ocean models	
	Sentinel-5P	TROPOMI	Top of atmosphere radiances	24 hrs	Global	7 km	0.27-2.38 um	0.25-0.55 nm	2600	< 24 hrs	Atmospheric Chemistry	13 30Z LT
	SMOS	MIRAS	Soil moisture, salinity	24 hrs	Global in 3 days	50 km	1.413 GHz		1	< 24 hrs	Land and Ocean models	05 00Z LT
	AWS	MWR/AWS	Top of atmosphere radiances	< 6hrs	Global in 24 hrs	< 40km	50-325 GHz	150-2000 MHz	19		NWP	
	EarthCARE	ATLID	Atmospheric Lidar	12 hrs	Global in 16 days	30 m	355 nm				NWP, Climate	14 00Z LT
		BSR	Top of atmosphere fluxes	12 hrs	Global in 16 days	10 km			2		NWP, Climate	
		MSI	Multi-Spectral Imager	12 hrs	Global in 80R/16V/IS	0.5 km	0.67- 12 um	0.02-0.9 um	7		NWP, Climate	
Drift	Aeolus	ALADIN	Backscattered lidar pulse	12 hrs	Global in a week	87 km	355 nm			< 2 hr	NWP	

NASA core measurements											
	Satellite	Sensors	Measurements	Frequency	Coverage	Spatial resolution km at esp	Spectral Ranges	Spectral resolution	No. of channels	Timeliness	Application
Geostationary	TEMPO	TEMPO	Top of atmosphere radiances	10-360 mins	CONUS	2 km	0.3 - 0.8 um				Air quality
Polar	TERRA	MODIS	Top of atmosphere radiances	12 hrs	Global in 12 hrs	0.25 - 1 km	0.645-14.2 um	0.01-0.3 um	36	< 3 hr	NWP, Nowcasting, Ocean, Land
		CERES	Top of atmosphere fluxes	12 hrs	Global in 24 hrs	20 km	0.3 - 100 um				Climate
	AQUA	MODIS	Top of atmosphere radiances	12 hrs	Global in 12 hrs	0.25 - 1 km	0.645-14.2 um	0.01-0.3 um	36	< 3 hr	NWP, Nowcasting, Ocean, Land
		AIRS	Top of atmosphere radiances	12 hrs	Global in 12 hrs	13.5 km	3.74-15.4 um	0.5-2 cm-1	2378	< 2 hr	NWP
		CERES	Top of atmosphere fluxes	12 hrs	Global in 24 hrs	20 km	0.3 - 100 um				Climate
	AURA	MLS	Limb view microwave radiances	12 hrs	Global in 3 days	300 km	118-2500 GHz		5 bands		Atmospheric chemistry
		OMI	Ozone profile	24 hrs	Global in 24 hrs	13x24 km	0.42-0.63 nm		1560		Atmospheric chemistry
	OCO-2	OCO	Carbon dioxide profile	24 hrs	Global in 1 month	100 km	0.76-2.08 um	0.04-0.1 nm	3072		Atmospheric chemistry
	SMAP	SMAP	Soil moisture	12 hrs	Global in 1.5 days	40 km	1.41 & 1.26 GHz		2		Land surface models, Ocean winds?
Drifting	GPM-Core	GMI	Top of atmosphere radiances	3-12 km	Below 70 Lat in 2 days		10.65-183 GHz	100-2000 MHz	12	< 1 hr	NWP
		DPR	Backscattered radar	5 km	Below 70 Lat in 5 days		13.6 & 35 GHz		2		NWP

Analysis of Geostationary Core Measurements Jan 2022												
Longitude	0E	41E	76E	82E	105E	123E	128E	141E	137W	100W	75W	Application
Agency	EUMETSAT	EUMETSAT	Roshydromet	ISRO	CMA	CMA	KIOST	JMA	NOAA	NASA	NOAA	
VIS/IR Imagery channels	12	12	10	5	15	15	16	16	16	N	16	Nowcasting
Rapid scan (<5 mins)	12	N	N	5	15	15	16	16	16	N	16	Nowcasting
Sounder channels	N	N	N	19	1680	1680	N	N	N	N	N	Nowcasting
Lightning Flashes	N	N	N	N	Y	Y	N	N	Y	N	Y	Nowcasting
Radiation Budget	Y	Y	N	N	N	N	N	N	N	N	N	Climate
Ocean Colour	Y	Y	N	N	N	N	Y	N	N	N	N	Ocean monit
UV/VIS Sounder	N	N	N	N	N	N	N	N	N	N	N	Atmospheric

Analysis of Geostationary Core Measurements 2025												
Longitude	0E	41E	76E	82E	105E	123E	128E	141E	137W	100W	75W	Application
Agency	EUMETSAT	EUMETSAT	Roshydromet	ISRO	CMA	CMA	KMA	KIOST	JMA	NOAA	NASA	NOAA
VIS/IR Imagery channels	16	12	20	5	15	15	16	16	16	N	16	Nowcasting
Rapid scan (<5 mins)	16	N	20	5	7	7	16	16	16	N	16	Nowcasting
Sounder channels	1700	N	2525	19	1680	1680	N	N	N	N	N	Nowcasting
Lightning Flashes	Y	N	Y	N	Y	Y	N	N	Y	N	Y	Nowcasting
Radiation Budget	N	N	Y	N	N	N	N	N	N	N	N	Climate
Ocean Colour	Y	Y	N	N	N	N	Y	N	N	N	N	Ocean monit
UV/VIS Sounder	Y	N	N	N	N	N	N	N	N	Y	N	Atmospheric

Molniya Orbit Jan 2022			
Agency	0E	41E	76E
Roshydromet			
VIS/IR Imagery channels	10		
<b>SUMMARY</b>			
Year	2022	2025	Notes
VIS/IR Imagery channels			Imagers with more channels planned for 0E and 76E by 2025.
Rapid scan (<5 mins)			Status is yellow in 2022 as no RSS over Indian Ocean but will be green in 2025 assuming Electro-MI
IR sounder channels			2025 status is yellow as no firm plans for a hyperspectral sounder for GOES satellites or Himawari
Lightning Flashes			Status is yellow as no lightning coverage over Western Pacific planned
Radiation Budget			Only 0E longitude with Meteosat-11. No future plans.
Ocean Colour			No plans for Geo coverage for ocean colour except at 128E. Limited accuracy products from MTG-FY
UV/VIS Sounder			Only 0E and CONUS longitudes will have a UV/VIS sounder in Geo orbit.
<b>Legend</b>			
Coverage from all 6 GEOs			
Coverage from 3-5 GEOs			
Coverage from 1-2 GEOs			
No coverage from GEO			



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# Defining Core and Recommended satellite data as per WMO Unified Data Policy (cont'd)

- Letters with analysis of space-based observation capabilities were sent to Space Agencies (and WMO Members)
- Asking to nominate agency focal point and schedule bilateral discussion between WMO and Space Agency to define which data could be defined as Core or Recommended
- Most of the bilateral discussions already done
- Supportive outcome by space agencies to define most of their data as Core with free and unrestricted exchange



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Annexes: Current CGMS Members capabilities to deliver the Vision for WIGOS 2040

Dr Stephen Voltz  
Assistant Administrator  
National Oceanic and Atmospheric Administration (NOAA)  
1335 East-West Highway  
20910 Silver Spring, MD  
United States of America

10 May 2022

Subject: Invitation to bilateral discussions on Core Satellite Data and the International Exchange of Earth System Data

Dear Dr Voltz,

The 2021 Extraordinary Congress approved the [WMO Unified Policy for Exchange of Earth System Data](#), which defines Core and Recommended data. WMO Members shall exchange Core data on a free and unrestricted basis to the extent that they provide for the protection of life and property and for the well-being of society.

With the new WMO Unified Policy for the International Exchange of Earth System Data approved, WMO wants to define the Core satellite data related to satellite-based observations. In order to define the Core data commitments of NOAA, we kindly invite you to participate in discussions on the Core satellite data content provided by your agency.

To support the discussions, we have prepared the document in Annex 1. We request that data from all the measurements identified in the tables will be freely available to users and for NWP/Nowcasting disseminated within near real time. The relevant column the contributions expected from your Agency.

Please contact until the end of May 2022 WMO Director of Infrastructure and Information Systems ([area@wmo.int](mailto:area@wmo.int)) and Director of WIGOS Lars Peter Riishojgaard ([lriishoj@wmo.int](mailto:lriishoj@wmo.int)) and Head of Space Systems and Utilization Division Kenneth Holmlund ([kholmlund@wmo.int](mailto:kholmlund@wmo.int)), for establishing the way forward for the upcoming bilateral discussions.



# Way forward

- Complete remaining bilateral discussions
- Status update will be presented to Space Agencies in CGMS-51
- Seek endorsement from INFCOM 3 followed by Executive Council and finally WMO Congress for the decision by WMO members
- Consolidated commitments to be tabled in WMO regulatory material (WMO WIGOS Manual) and reflected elsewhere as suitable (OSCAR/Space database)



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Thank you  
Merci

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# SATELLITE DATA REQUIREMENTS FOR GLOBAL NUMERICAL WEATHER PREDICTION

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

