|  |  |  |
| --- | --- | --- |
| WEATHER CLIMATE WATER | **World Meteorological Organization**  **COMMISSION FOR OBSERVATION, INFRASTRUCTURE AND INFORMATION SYSTEMS**  **Second Session** 24 to 28 October 2022, Geneva | **INFCOM-2/INF. 6.1(2)** |
| Submitted by: Chair, SC-ON  30.IX.2022 |

**Data exchange requirements of core satellite data**

### Introduction

Related to the WMO Unified Policy for the International Exchange of Earth System Data [Resolution 1 (Cg-Ext 2021)](https://library.wmo.int/doc_num.php?explnum_id=5204/#page=13) vital importance of the satellite data is clearly recognized. However, no specific satellite datasets are listed as neither core nor recommended in the referred regulatory material. This document provides an update of the WMO activities to establish core satellite data as per the WMO Unified Policy for the International Exchange of Earth System Data, the process for establishing the core satellite data and the currently identified data types.

The tables provided give an overview of the Earth Observation capabilities per longitude for the geostationary satellites and per equatorial crossing time for the low Earth orbit satellites. This will be used as the basis for the bilateral discussions with space agencies for the establishment of “core satellite data” to be documented in the Manual on WIGOS. WMO has invited space agencies for the bilateral discussion and some of the bilateral discussions already took place during the Coordination Group for Meteorological Satellites, CGMS-50. The goal is to complete the bilateral discussions as soon as possible to be able to update that in the regulatory material.

An analysis of the current and near future measurement capabilities of the CGMS members meteorological satellite programmes for Earth Observations and Space Weather has been carried out using the WMO OSCAR/Space database as a reference. Tables have been compiled of each partners’ capabilities which are used as the basis for this analysis. Numerical Weather Prediction (NWP) and nowcasting are the primary user requirements for this study although climate monitoring, model process studies, atmospheric chemistry, air quality and ocean modelling are also considered.

The status in 2022 and planned capability in 2025 is documented in this analysis as the near-term plans should be well defined. The analysis assumes that Level 1 and Level 2 data from all the measurements identified in the tables will be freely available as Core data domain to users and for NWP/Nowcasting disseminated within the required time to be of use. Although Climate is only mentioned for some variables as an application all the measurements in principle can be used for climate monitoring and model process studies.

**CURRENT CGMS MEMBERS CAPABILITIES TO DELIVER THE VISION FOR WIGOS 2040**

1. **WMO Core satellite data for Earth observations**

### Geostationary and Molniya orbits Core satellite data for Earth observations

**Table 1. Analysis of Geostationary and Molniya orbits Core satellite data for Earth observations**

**Analysis of Geostationary Core Data 2022**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Longitude** | **0E** | **41E** | **76E** | **82E** | **105E** | **123E** | **128E** | **141E** | **137W** | **100W** | **75W** |
| **Agency** | **EUMETSAT** | **EUMETSAT** | **Roshydromet Roscosmos** | **IMD ISRO** | **CMA** | **CMA** | **KMA KIOST** | **JMA** | **NOAA** | **NASA** | **NOAA** |
| VIS/IR Imagery channels | 12 | 12 | 10 | 6 | 15 | 15 | 16 | 16 | 16 | N | 16 |
| Rapid scan (<5 mins) | 12 | N | N | 6 | 15 | 15 | 16 | 16 | 16 | N | 16 |
| Sounder channels | N | N | N | 19 | 1680 | 1680 | N | N | N | N | N |
| Lightning detection | N | N | N | N | Y | Y | N | N | Y | N | Y |
| Radiation Budget | Y | Y | N | N | N | N | N | N | N | N | N |
| Ocean Colour\* | N | N | N | N | N | N | Y | N | N | N | N |
| UV/VIS Sounder | N | N | N | N | N | N | N | N | N | N | N |

**Analysis of Geostationary Core Data 2025**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Longitude** | **0E** | **41E** | **76E** | **82E** | **105E** | **123E** | **128E** | **141E** | **137W** | **100W** | **75W** |
| **Agency** | **EUMETSAT** | **EUMETSAT** | **Roshydromet Roscosmos** | **IMD ISRO** | **CMA** | **CMA** | **KMA KIOST** | **JMA** | **NOAA** | **NASA** | **NOAA** |
| VIS/IR Imagery channels | 16 | 12 | 20 | 6 | 15 | 15 | 16 | 16 | 16 | N | 16 |
| Rapid scan (<5 mins) | 16 | N | 20 | 6 | 7 | 7 | 16 | 16 | 16 | N | 16 |
| Sounder channels | 1700 | N | 2528 | 19 | 1680 | 1680 | N | N | N | N | N |
| Lightning detection | Y | N | Y | N | Y | Y | N | N | Y | N | Y |
| Radiation Budget | N | N | Y | N | N | N | N | N | N | N | N |
| Ocean Colour\* | N | N | N | N | N | N | Y | N | N | N | N |
| UV/VIS Sounder | Y | N | N | N | N | N | N | N | N | Y | N |

\*Dedicated instruments for ocean colour monitoring

**Molniya Orbit Jan 2022**

|  |  |
| --- | --- |
| **Agency** | Roshydromet |
| VIS/IR Imagery channels | 10 |

### Low Earth and Drifting orbits Core satellite data for Earth observations

**Table 2. Analysis of Low Earth Orbit Core satellite data for Earth observations**

**Analysis of LEO Core data 2022**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Local Overpass Time** | **05:30** | **06:00** | **07:00** | **08:20** | **09:30** |  | **10:30** | **12:00** | **13:30** | **14:00** | **15:00** |
| **Agency** | **CMA** | **NOAA DOD ESA NSOAS** | **CNES CNSA** | **CMA** | **EUMETSAT ESA** |  | **CNES JAXA NSOAS** | **IMD ISRO** | **NOAA NASA CMA ESA JAXA** | **JAXA/ESA** | **Roshydromet Roscosmos** |
| VIS/IR Imagery channels | 6+D/N | N | N | 10 | 6 |  | Y | 15 | 21+D/N / 25 | N | 6 |
| IR Sounder channels | 1370 | N | N | 26 | 8461 |  | N | N | 2211/2378 1370 | N | 2670 |
| MW Sounder channels | 32 | N | N | 28 | 20 |  | N | N | 22/28 | N | N |
| MW Imagers | N | 24 | N | 10 | N |  | N | N | 10/16 | N | 29 |
| Radar backscatter | Y | Y | Y | N | Y |  | N | Y | N | N | N |
| GNSS Bending Angle | Y | N | N | Y | Y |  | N | Y | Y | N | N |
| UV/VIS Sounder | N | N | N | Y | Y |  | N | N | Y | N | N |
| Radiation Budget | Solar Irrad | N | N | SW/TOT | N |  | N | N | ERB | N | SW only |
| Doppler Winds | N | Y | N | N | N |  | N | N | N | N | N |
| Cloud Radar | N | N | N | N | N |  | N | N | N | N | N |
| Rain Radar | N | N | N | N | N |  | N | N | N | N | N |
| Ocean Colour | N | N | N | N | Y |  | Y | N | Y | N | N |
| SST (Dual View) | N | N | N | N | Y |  | N | N | N | N | N |
| Radar Altimeter | N | Y | N | N | Y |  | N | N | N | N | N |
| GHG monitoring | N | N | N | N | N |  | N | N | Y | N | N |

**Analysis of LEO Core data 2025**

| **Local Overpass Time** | **05:30** | **06:00** | **07:00** | **09:30** | **10:00** |  | **10:30** | **12:00** | **13:30** | **14:00** | **15:00** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agency** | **CMA** | **NOAA DOD ESA NSOAS** | **CNES CNSA** | **EUMETSAT ESA** | **CMA** |  | **CNES JAXA NSOAS** | **IMD ISRO** | **NOAA NASA CMA ESA JAXA** | **JAXA/ESA** | **Roshydromet Roscosmos** |
| VIS/IR Imagery channels | 6+D/N | N | N | 20 | 25 |  | Y | 15 | 21+D/N / 25 | Y | 6 |
| IR Sounder channels | 1370 | N | N | 16921 | 1370 |  | N | N | 2211/2378 1370 | N | 2670 |
| MW Sounder channels | 32 | N | N | 20 | 32 |  | N | N | 22/28 | N | N |
| MW Imagers | N | N | N | Y | 10 |  | N | N | 10/16 | N | 29 |
| Radar backscatter | Y | Y | Y | Y | N |  | N | Y | N | N | N |
| GNSS Bending Angle | Y | N | N | Y | Y |  | N | Y | Y | N | N |
| UV/VIS Sounder | N | N | N | Y | NADIR/LIMB |  | N | N | Y | N | N |
| Radiation Budget | Solar Irrad | N | N | N | N |  | N | N | ERB | BBR | SW only |
| Doppler Winds | N | N | N | N | N |  | N | N | N | N | N |
| Cloud Radar | N | N | N | N | N |  | N | N | N | CPR | N |
| Rain Radar | N | N | N | N | N |  | N | N | N | N | N |
| Ocean Colour | N | N | N | Y | N |  | Y | N | Y | N | N |
| SST (Dual View) | N | N | N | Y | N |  | N | N | N | N | N |
| Radar Altimeter | N | Y | N | Y | N |  | N | N | N | N | N |
| GHG monitoring | N | N | N | N | N |  | Y | N | Y | N | N |

**Table 3. Analysis of Drifting orbit Core satellite data for Earth observations**

**Analysis of Drifter Core data 2022**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agency** | **CMA** | **NSOAS** | **ISRO** | **NOAA** | **ESA** | **CNES** | **EUMETSAT** | **NASA** | **JAXA** |
| MW Imagers | N | N | Y | N | N | N | N | Y | Y |
| Radar backscatter | N | Y | N | N | N | N | N | Y | N |
| GNSS Bending Angle | N | N | N | Y | Y | N | N | Y | Y |
| UV/VIS Sounder | N | N | N | N | N | N | N | N | N |
| Doppler Winds | N | N | N | N | Y | N | N | N | N |
| Cloud Radar | N | N | N | N | N | N | N | N | N |
| Rain Radar | N | N | N | N | N | N | N | Y | N |
| Radar Altimeter | N | Y | N | Y | Y | Y | Y | Y | N |
| GHG monitoring | N | N | N | N | N | N | N | Y | N |

**Analysis of Drifter Core data 2025**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agency** | **CMA** | **NSOAS** | **ISRO** | **NOAA** | **ESA** | **CNES** | **EUMETSAT** | **NASA** | **JAXA** |
| MW Imagers | Y | N | N | N | Y | N | Y | Y | Y |
| Radar backscatter | N | Y | N | N | N | N | N | N | N |
| GNSS Bending Angle | N | N | N | Y | Y | N | N | N | Y |
| UV/VIS Sounder | N | N | N | N | N | N | N | N | N |
| Doppler Winds | N | N | N | N | N | N | N | N | N |
| Cloud Radar | N | N | N | N | N | N | N | N | N |
| Rain Radar | Y | N | N | N | N | N | N | Y | N |
| Radar Altimeter | N | Y | N | N | Y | Y | N | Y | N |
| GHG monitoring | N | N | N | N | N | N | N | N | N |

1. **WMO Core satellite data for space weather**

### Geostationary orbits Core satellite data for Space Weather

**Table 4. Analysis of Geostationary orbit Core satellite data for space weather**

**Analysis of Geostationary Core data of in-situ particles/fields 2022**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Longitude** | **0E** | **76E** | **82E** | **105E** | **123E** | **128E** | **141E** | **166E** | **137W** | **102W** | **75W** | **14.5W** |
| **Agency** | EUMETSAT | Roshydromet | IMD/  ISRO | CMA | CMA | KMA | JMA | Roshydromet | NOAA | NASA | NOAA | Roshydromet |
| Electrons | N | Y | N | Y | Y | Y | Y | **N** | Y | **N** | Y | Y |
| Protons | N | Y | N | Y | Y | Y | Y | **N** | Y | **N** | Y | Y |
| Alpha+Heavy ions etc | N | N | N | Y | **N** | **N** | **N** | **N** | Y | **N** | Y | **N** |
| Plasma properties | N | Y | N | **N** | **N** | **N** | **N** | **N** | **N** | Y | **N** | Y |
| Magnetic field | N | N | N | Y | Y | Y | **N** | **N** | Y | Y | Y | **N** |
| X-Ray | N | Y | N | **N** | **N** | **N** | **N** | **N** | Y | **N** | Y | Y |

**Analysis of Geostationary Core data of in-situ particles/fields 2025**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Longitude** | **0E** | **76E** | **82E** | **105E** | **123E** | **128E** | **141E** | **166E** | **137W** | **102W** | **75W** | **14.5W** |
| **Agency** | **EUMETSAT** | **Roshydromet** | **IMD/ISRO** | **CMA** | **CMA** | **KMA** | **JMA** | **Roshydromet** | **NOAA** | **NASA** | **NOAA** | **Roshydromet** |
| Electrons | Y | Y | N | N | Y | Y | Y | Y | Y | N | Y | Y |
| Protons | Y | Y | N | N | Y | Y | Y | Y | Y | N | Y | Y |
| Alpha+Heavy ions etc | Y | N | N | N | N | N | N | N | Y | N | Y | N |
| Plasma properties | N | Y | N | N | N | N | N | Y | N | N | N | Y |
| Magnetic field | N | Y | N | N | Y | Y | N | Y | Y | N | Y | Y |
| X-Ray | N | Y | N | N | N | N | N | Y | Y | N | Y | Y |

### LEO Earth orbit Core satellite data for space weather

**Table 5. Analysis of Low Earth orbit Core satellite data for space weather**

**Analysis of LEO Core data of in-situ particles/fields 2022**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Local Overpass Time** | **05:30** | **09:00** | **09:30** | **13:30** | **15:00** | **Drift** |
| **Agency** | **CMA** | **Roshydromet** | **EUMETSAT** | **NOAA/NASA/CMA** | **Roshydromet** | **NASA/EUM** |
| Electrons | Y | Y | Y | Y | Y | Y |
| Protons | Y | Y | Y | Y | Y | Y |
| Alpha+Heavy ions etc | Y | Y | N | Y | Y | Y |
| Plasma properties | Y | Y | Y | Y | Y | Y |
| Magnetic field | Y | N | N | Y | N | Y |
| X-Ray | Y | N | N | N | N | N |

**Analysis of LEO Core data of in-situ particles/fields 2025**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Local Overpass Time** | **05:30** | **09:00** | **09:30** | **13:30** | **15:00** | **Drift** |
| **Agency** | **CMA** | **Roshydromet** | **EUMETSAT** | **NOAA/NASA/CMA** | **Roshydromet** | **NASA/EUM** |
| Electrons | Y | Y | Y | N | Y | Y |
| Protons | Y | Y | Y | N | Y | Y |
| Alpha+Heavy ions etc. | Y | Y | Y | N | Y | Y |
| Plasma properties | Y | Y | N | N | Y | N |
| Magnetic field | Y | N | N | Y | N | N |
| X-Ray | Y | N | N | N | N | N |

### Core data of the Sun and its environment

**Table 6. Analysis of Core satellite data of the Sun and its environment**

**Analysis of Solar Core data 2022**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agency** | **EUMETSAT** | **Roshydromet Roscosmos** | **IMD/ISRO** | **CMA** | **JMA/JAXA** | **NOAA** | **ESA** | **NASA** |
| X-Ray Spectrometer/Imager |  | GEO |  | GEO/LEO | LEO | GEO | SOL |  |
| Extreme UV |  | GEO |  | LEO | LEO | GEO | L1/SOL |  |
| UV |  |  |  |  |  |  |  | DRIFT/LEO |
| VIS |  |  |  |  | LEO |  | L1 | DRIFT/SOL |
| Magnetic field |  |  |  |  | LEO |  | L1/SOL | DRIFT/SOL |
| Electric field |  |  |  |  | LEO |  | L1 | DRIFT/SOL |
| Velocity field |  |  |  |  | LEO |  | L1/SOL | DRIFT/SOL |
| Radio waves |  |  |  |  |  |  | L1 | DRIFT/SOL |
| Electrons |  |  |  |  |  |  | SOL | DRIFT/SOL |
| Protons |  |  |  |  |  |  | SOL | DRIFT/SOL |
| Alpha particles |  |  |  |  |  |  | SOL | DRIFT/SOL |
| Heavy ions |  |  |  |  |  |  | SOL | DRIFT/SOL |
| Solar Wind |  |  |  |  |  | L1 | SOL | DRIFT/SOL |
| Coronographic imager |  | LEO |  |  | LEO |  | SOL | L1/DRIFT |
| Heliospheric imager |  |  |  |  |  |  | DRIFT | L1/DRIFT |

**Analysis of Solar Core data 2025**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agency** | **EUMETSAT** | **Roshydromet Roscosmos** | **IMD/ISRO** | **CMA** | **JMA/JAXA** | **NOAA** | **ESA** | **NASA** |
| X-Ray Spectrometer/Imager |  | GEO/LEO?? | L1 | GEO |  | GEO | SOL |  |
| Extreme UV |  | GEO |  | GEO |  | GEO | SOL |  |
| UV |  | LEO ?? | L1 |  |  |  |  |  |
| VIS |  | LEO ?? | L1 |  |  |  | SOL | SOL |
| Magnetic field |  |  | L1 |  |  |  | SOL |  |
| Electric field |  |  | L1 |  |  |  | SOL | SOL |
| Velocity field |  |  |  |  |  |  | SOL |  |
| Radio waves |  |  |  |  |  |  | SOL |  |
| Electrons |  |  |  |  |  |  | SOL | SOL |
| Protons |  |  |  |  |  |  | SOL | SOL |
| Alpha particles |  |  |  |  |  |  | SOL | SOL |
| Heavy ions |  |  |  |  |  |  | SOL | SOL |
| Solar Wind |  |  | L1 |  |  | L1 | SOL | SOL |
| Coronographic imager |  | LEO ?? |  |  |  | GEO/L1 | SOL |  |
| Heliospheric imager |  |  |  |  |  |  |  |  |

### Core satellite data of the Cross-Magnetosphere and Ionosphere

**Table 7. Analysis of core satellite data of the Cross-Magnetosphere and Ionospheric**

**Analysis of Core Cross-Magnetosphere and Ionospheric data 2022**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agency** | **EUMETSAT** | **Roshydromet/Roscosmos** | **IMD/ISRO** | **CMA** | **KMA/KARI** | **JMA/JAXA** | **NOAA** | **ESA** | **NASA** |
| Electrons |  | MOL |  |  |  | HEO |  | CLUSTER | CLUSTER |
| Protons |  | MOL |  |  |  | HEO |  | CLUSTER | CLUSTER |
| Alpha Particles |  |  |  |  |  | HEO |  |  | CLUSTER |
| Heavy ions |  |  |  |  |  | HEO |  |  | CLUSTER |
| Geomagnetic field (also LEO) |  |  |  | LEO |  |  | DRIFT | DRIFT | CLUSTER |
| Electric field (also LEO) |  |  |  |  |  |  | DRIFT | DRIFT | HEO/CLUSTER |
| Total electron content (also LEO) | LEO |  |  | LEO/DRIFT |  |  | DRIFT | LEO | CLUSTER |
| Electron density (also LEO) | LEO |  |  | LEO | LEO |  | DRIFT | DRIFT | CLUSTER |
| Ionospheric plasma |  |  |  |  |  |  | LEO | LEO | CLUSTER |
| Radio waves (also LEO) |  |  |  |  |  |  | DRIFT | LEO | CLUSTER |

**Analysis of Core Cross-Magnetosphere and Ionospheric data 2025**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agency** | **EUMETSAT** | **Roshydromet/Roscosmos** | **IMD/**  **ISRO** | **CMA** | **KMA/KARI** | **JMA/**  **JAXA** | **NOAA** | **ESA** | **NASA** |
| Electrons |  | MOL |  |  |  |  |  | CLUSTER | CLUSTER |
| Protons |  | MOL |  |  |  |  |  | CLUSTER | CLUSTER |
| Alpha Particles |  |  |  |  |  |  |  |  | CLUSTER |
| Heavy ions |  |  |  |  |  |  |  |  | CLUSTER |
| Geomagnetic field (also LEO) |  | MOL |  | LEO |  |  |  |  | CLUSTER |
| Electric field (also LEO) |  | HEO |  |  |  |  |  |  | HEO/CLUSTER |
| Total electron content (also LEO) | LEO | LEO |  | LEO/DRIFT |  |  |  | LEO | CLUSTER |
| Electron density (also LEO) | LEO | LEO |  | LEO |  |  |  | DRIFT | CLUSTER |
| Ionospheric plasma |  | LEO |  |  |  |  |  |  | CLUSTER |
| Radio waves (also LEO) |  | LEO |  |  |  |  |  |  | CLUSTER |

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