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# STATUS OF THE SPACE-BASED COMPONENTS OF THE GOS

*(Submitted by the Secretariat)*

## SUMMARY AND PURPOSE OF DOCUMENT

This document reports on the status of the space-based component of the Global Observing System (GOS) including: Operational geostationary satellites, Operational low-Earth orbit satellites, Research and Development satellites, and the Global Space-based Intercalibration System (GSICS).

## ACTION PROPOSED

The Meeting is invited to note the information contained in this document when discussing how it organises its work and formulates its recommendations.

# DISCUSSION

## 1. Introduction

A summary of the status and plans of operational and Earth Observation Research and Development satellites is maintained by the WMO Space Programme and available at: http://www.wmo.int/pages/prog/sat/satellitestatus.php . This page also provides links to the OSCAR/Space database (www.wmo.int/oscar/space) for more details on satellites and instruments. Some highlights are given in the sections below.

## 2. Operational geostationary satellites

2.1 Thirteen geostationary satellites are currently performing an operational mission, two satellites are supporting an operational satellite (Meteosat-8 supporting Meteosat-10 for rapid-scan imagery, MTSAT-1R supporting MTSAT-2 for telecommunications) and three other are in stand-by for back-up purposes.

2.2 It is striking to note the distribution of these satellite locations around the globe. Figure 1 displays the longitude interval covered by each operational satellite: 5 satellites only (MTSAT, GOES-W, GOES-E, Meteosat, Meteosat/IODC) are covering 80 % of the geostationary ring, while the other 8 are concentrated in the remaining 20 % between 65°E and 136°E.

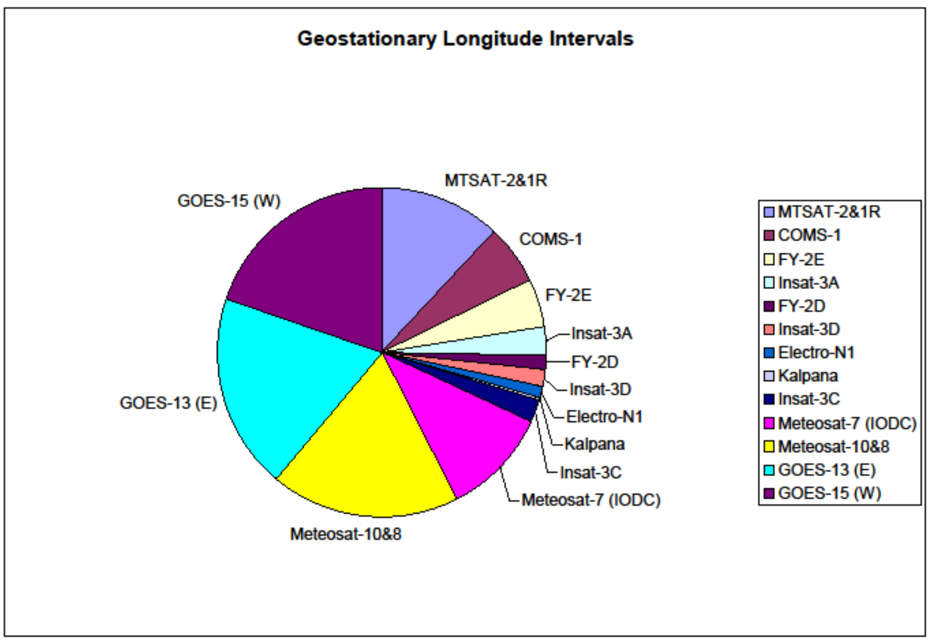


*Figure 1. Distribution of the longitude intervals covered by each of the operational geostationary satellites. For the purposes of this chart, the sector limits of two satellites are at assumed to be at the middle between these satellites. As a result, each satellite is covering a longitude interval which is one half of the longitude interval between its two adjacent satellites. For example, GOES-E being located at 75°W and Meteosat/IODC at 57°E, the interval associated to Meteosat-10&8 is (57+75)/2=66°*

2.3 Following the termination of the GOES-12 operation over South America in August 2013, due to satellite aging, the frequency of coverage of the South American continent has been a matter of concern, since only 3-hourly full disc imagery is normally provided by the GOES system when a severe meteorological situation is requiring rapid scan over the continental United States. In response to a request from WMO, and in consultation with the RA III /RA IV Coordination Group on Satellite Requirements, NOAA have studied an optimization of the scanning pattern of GOES-East which, in such situation, will secure at least hourly provision of two windows covering most of the South American continent. This mitigation scenario is being tested and will be implemented very soon by NOAA, thus responding to the users requirements in an exemplary way.

2.4 The INSAT-3D spacecraft, launched by India in July 2013 and declared operational in January 2014, provides for the first time a geostationary sounding capability over the Indian Ocean, significantly enhancing the capability of Insat-3A and Kalpana-1. Imagery and products are on line: http://www.imd.gov.in/section/satmet/dynamic/insat.htm. The near-real time availability of full resolution data is still to be confirmed.

2.5 The geostationary constellation is entering a phase of transition to new generation systems that will start with the launch of Himawari-8 in late 2014 by Japan, then GOES-R by the USA in 2016, FY-4A by China in 2017, GEO-KOMPSAT-2A in 2018, GOES-S and MTG-I1 in 2019. Each of these satellites will carry an advanced imaging payload of at least 16 channels, and other sensors for most of them. This new generation will provide considerably enhanced capabilities in support of nowcasting, severe weather forecasting, volcanic ash cloud monitoring, and wind observation for NWP. It will generate high data rates and require significant updates of the user infrastructure and operational chains. It is thus critical for the users to be prepared for this major change. An on line resource named SATURN (for Satellite User Readiness Navigator) is being implemented by WMO to provide a centralized entry point to technical information from satellite operators on these new systems.

## 3. Operational sun-synchronous low-Earth orbit satellites

2.6 Seventeen meteorological spacecraft are currently functional in sun-synchronous orbit. The primary ones for the provision of atmospheric sounding are:

- METOP-A and METOP-B, from EUMETSAT, operated in tandem on the mid-morning orbit (21:30 ECT), with a comprehensive payload including in particular an advanced sounding package (hyperspectral infrared sounder, microwave sounder, radio-occultation sensor) and a scatterometer;
- Suomi NPP, from the United States, which also includes an hyperspectral infrared sounder and a microwave sounder, and an advanced imager, is on the afternoon orbit (13:30 ECT).

2.7 The FY-3 programme from China is currently deployed on morning (FY-3A,-3C) and afternoon (FY-3B) orbits. The newly launched FY-3C spacecraft features an enhanced payload with improved performances and new sensors e.g. a radio-occultation sounder. Following discussions held within the Coordination Group for Meteorological Satellites, China has studied the possibility to place future satellites FY-3E and FY-3G on an early morning orbit (6:00 ECT) in order to best respond to WMO requirements. These plans are still subject to confirmation.

2.8 The United States have raised the attention to the risks linked to the transition schedule between Suomi NPP and its follow-on mission JPSS-1.

2.9 Details on data access and pre-processing tools for currently-flying low-Earth orbit satellites are collected on a WMO webpage that is under ET-SUP responsibility:
http://www.wmo.int/pages/prog/sat/accessandtools_en.php#LEO_Access_Tools

## 4. Operational drifting orbit satellites

Jason-2 is pursuing the high precision ocean surface topography mission, to be continued by Jason -3 in 2015.

## 5. Research and Development satellites

5.1 Several R&D satellites have been used operationally for an impressive number of years, e.g.: TRMM (17 years), Terra (15 years), Aqua (12 years), and Aura (10 years). This illustrates how R&D programmes are not only supporting research and technology development but bring a substantial contribution to sustained observation of weather, climate and the environment.

5.2 The COSMIC-1/Formosat-3 constellation has provided radio-occultation data that have been extensively used operationally in NWP assimilation over the past seven years. Once fully implemented (tentatively in 2018) the follow-up COSMIC-2/Formosat-7 programme will enhance this capability and appropriately supplement the operational radio-occultation sensors operated in sun-synchronous orbit by the METOP, FY-3 and Meteor-M/MP series.

5.3 GCOM-W1 launched in 2012 by Japan provides near-real time microwave imagery, which is available from a JAXA server and distributed onward by EUMETCast, through an agreement between JAXA and EUMETSAT. GPM-core, launched in February 2014, a cooperation mission between the USA and Japan, will enhance the global precipitation measurement mission successfully initiated with TRMM.

5.4 A number of other Earth Observation missions of interest for WMO are planned in the coming years. Though some of them have applications in several domains, they could be classified as follows:

- Ocean monitoring: Oceansat-3 (ISRO), HY-1C,D (NSOAS, CAST), HY-2B (NSOAS, CAST), Sentinel-3A (EC/ESA/EUMETSAT), Sentinel-3B (EC/ESA)
- Atmosphere monitoring: OCO-2 (NASA), SMAP (NASA), ADM-Aeolus (ESA), Sentinel-5P (ESA, NSO)
- Land monitoring: Sentinel-1A (EC/ESA), ALOS-2 (JAXA), Sentinel-2A (EC/ESA), ALOS-3 (JAXA), Sentinel-1B (EC/ESA);
- Polar Regions monitoring: Arctica-M N1 (Roshydromet, Roscosmos).

## 6. Global Space-based Intercalibration System (GSICS)

The new “Vision for GSICS in the 2020s” clarifies the scope and priorities of GSICS (http://www.wmo.int/pages/prog/sat/documents/GSICS_Vision-for-GSICS-in-2020s.pdf). GSICS. GSICS is a collaborative framework among satellite operators and science teams to develop, implement and share community-agreed best practices and standards, procedures and tools in order to monitor, improve and harmonize the calibration of environmental satellites within the Global Observing System. It focuses on in-orbit inter-calibration to generate *corrections* to be applied to the individual calibration of Level 1 satellite data. The status and description of available *correction products* (demonstration, preoperational or operational) are given in an on line catalogue on the GSICS portal (http://gsics.wmo.int).