CGMS

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Prepared by EUMETSAT
Agenda Item: E.1
For information to Plenary

STATUS OF EUMETSAT CURRENT AND FUTURE SATELLITE PROGRAMMES - REPORT TO CGMS-43

This document summarises the status of EUMETSAT current and future LEO and GEO satellite systems. The reporting period for current satellite operations is 1 April 2014 to 31 March 2015. For future satellites, progress to date at the time of writing is included.

Current satellite programmes cover status of the spacecraft, ground segment, data transmission, projects and services, user statistics.

Future satellite programmes cover the mission objectives (spacecraft, payload, instruments, products) and programme status (space, system and ground segments).

CGMS is invited to take note.

Status of EUMETSAT current and future satellite programmes - report to CGMS-43

1 INTRODUCTION

This paper reports on the status of EUMETSAT current and future satellite systems. The reporting period for current satellite operations is 1 April 2014 to 31 March 2015. For future satellites, progress to date at the time of writing is included.

2 CURRENT SATELLITE SYSTEMS

EUMETSAT Current GEO satellites

Sector	Satellites in orbit P=pre-operational Op=operational B=back-up L=limited availability	Location	Launch date	Details on near real time access to L0/L1 data (links)	Environmental payload and status
East Atlantic (36°W-36°E)	Meteosat-9 (Op)	9.5°E	21/12/2005	Service Status Data access Level 1 data info	Rapid Scanning Service, Prime GERB Service
	Meteosat-10 (Op)	0°W	05/07/2012		12-channel SEVIRI imager, DCS, GERB not operational Data disseminated via EUMETCAST and LRIT
	Meteosat-8 (backup)	3.5°E	28/08/2002		Back-up of Meteosat-9 and Meteosat-10. GERB and DCS not operational
Indian Ocean (36°E-108°E)	Meteosat-7 (Op)	57.5°E	02/09/1997		3-channel imager. Dissemination via EUMETCast Indian Ocean Data Coverage (IODC), currently approved until end of 2016

EUMETSAT Current LEO satellites

Orbit type ECT=Equator Crossing Time (for sun-synchronous orbits)	Satellites in orbit P=pre-operational Op=operational B=back-up, secondary L=limited availability	Equator Crossing Time (ECT) Ascending Node	Mean Altitude	Launch date	Details on near real time access to L0/L1 data (links)	Instrument payload and status
Sun-synchronous "Morning" orbit ECT between 19:00-24:00 and between 07:00-12:00	Metop-A (B)	21:30	837 km	19/10/2006	Data access L1 data info	AVHRR/3, HIRS/4, AMSU-A, MHS, IASI, GRAS, ASCAT, GOME-2, SEM, A-DCS (prime ARGOS-3 service) , SARSAT, (HRPT partly functional) Dissemination via EUMETCast
Sun-synchronous "Morning" orbit ECT between 19:00-24:00 and between 07:00-12:00	Metop-B (Op)	21:30	837 km	17/09/2012	Data access L1 data info	AVHRR/3, HIRS/4, AMSU-A, MHS, IASI, GRAS, ASCAT, GOME-2, SEM, DCS (ARGOS-2 service only), SARSAT, (HRPT fully functional). Dissemination via EUMETCast

2.1 Status of current GEO satellite systems

2.1.1 Mission objectives, payload/instruments, products

The Meteosat system is designed to support nowcasting, short-range forecasting, numerical weather forecasting and climate applications. The system currently comprises two operational satellites of the Meteosat Second Generation (MSG) (Meteosat 10 and 9) providing the core services over Europe and Africa and one satellite of the first generation (Meteosat 7) which is providing Indian Ocean Data Collection services. The Meteosat-10 satellite was launched in July 2012 and is currently providing the core service from 0-deg while Meteosat-8 was relocated to 3.5-deg East to provide backup function to Meteosat-10 and Meteosat-9.

Meteosat Second Generation (MSG) consists of a series of four geostationary meteorological satellites, along with ground-based infrastructure, that will operate consecutively beyond 2020. The core mission of the MSG satellites is provided by the Spinning Enhanced Visible and InfraRed Imager (SEVIRI), which has the capacity to observe the Earth in 12 spectral channels and provide impressive high quality image data which is at the heart of the operational forecasting needs, and the Geostationary Earth Radiation Budget (GERB) instrument supporting long term climate studies.

Each Meteosat satellite is designed to remain in orbit, in an operable condition for at least seven years, but the actual performance of the satellites in orbit has exceeded this limit. The current policy is to keep two operable satellites in orbit and to launch a new satellite based upon a service availability analysis. In the case of MSG-4, the last satellite of the series, in view of the on-ground storage limitation being reached, an approach was selected to store the satellite in-obit, following launch and an initial commissioning phase, as long as the in orbit status will allow. Towards the end of the MSG lifetime, there will be a follow-on series in geostationary orbit - Meteosat Third Generation.

2.1.2 Status of spacecraft

During the period from 1 April 2014 to 31 March 2015, the Meteosat Transition Programme (MTP) and Meteosat Second Generation (MSG) space segments have performed well.

The MSG system has been stable.

Meteosat-8

Meteosat-8, launched on 28 August 2002, has been on station at 3.5°E since 11 February 2013. The satellite is available for use as a hot backup for the Meteosat-10 prime service and for the Meteosat-9 RSS service.

Meteosat-8 is nominally configured in Full Earth Scan (FES) imaging mode with the images being archived, not disseminated, GERB is in safe mode, Search and

Rescue is switched-off and the Data Collection Platform (DCP) transponder is switched-off.

Meteosat-8 was used to provide the Full Earth Scan service during the decontamination of the SEVIRI instrument on Meteosat-10 (02-08 December 2014).

Meteosat-8 SEVIRI was used for an HRV upper window test from 6-June-2014 to 1-July-2014, again on 8-August-2014. This was in support of the 0-degree service assessment of the merits of modify the HRV upper window positioning to better match the day time sun illumination.

The number of life cycles for Meteosat-8 SEVIRI to conduct RSS are limited and hence the one month of Meteosat-9 SEVIRI RSS outage was not covered by Meteosat-8 (as a Meteosat-8 SEVIRI RSS lifesaving measure).

Meteosat-9

Meteosat-9, launched on 21 December 2005, is on station at 9.5°E since 5 February 2013 and supports the Rapid Scanning Service (RSS) since 9 April 2013.

The spacecraft is in RSS imaging mode, GERB is operated as prime GERB instrument since April 2013, (due to the GERB-3 anomaly on Meteosat-10), the Search and Rescue transponder switched-on (as requested by COSPAS-SARSAT) and the DCP transponder is switched-off.

Meteosat-10

Meteosat-10, launched on 5 July 2012, following January 2013 relocations, has been the prime Meteosat satellite for the 0° service since 21 January 2013.

The spacecraft is currently in imaging mode, fully configured including DCP and Search and Rescue transponders.

Meteosat-10 SEVIRI HRV Upper Window positioning was modified commencing on 4-November-2014 with a trial until 12-December-2015, with the window shift from the East to the West at 17:00 UTC every day, and then back to the East at midnight. This was to optimise the window positioning per sunlight illumination of the earth. After the successful trial completion, the 0-degree service went operational with this HRV image positioning commencing on 12-December-2014.

The GERB instrument was successfully recovered on 11-February-2015, after being non-operational since an Auto-Safe mode on 27 April 2013.

MSG-4

The progress of the MSG-4 satellite and related elements of the system has progressed well towards the readiness for launch, The satellite arrived in Kourou on 28 April and the launch campaign has started for a launch on 2 July 2015

Following launch and LEOP, the MSG-4 Commissioning is planned to last nominally until end December 2015 when the satellite will start the initial in orbit storage phase. Similar to the MSG-3 commissioning, it will include towards its end 2.5 months of SEVIRI data dissemination to National Meteorological Services (NMS) and ECMWF, allowing an expert feedback on the MSG-4 products. It is planned to store MSG-4 in orbit for about 2.5 years once the commissioning is successfully completed.

2.1.3 Impact on spacecraft due to space weather

Space weather related spacecraft anomalies (Items in bold are required)

Source: Recommendations for Contents of Anomaly Database for Correlation with Space Weather Phenomena, P. O'Brien, J.E. Mazur, T. Guild, November 2011, AEROSPACE Report No.TOR-2011(3903)-5.

1. Date and Universal Time of the anomaly	**2. Fully specified location of the anomaly** (spacecraft location)	**3. Velocity or orbital elements at time of the anomaly**	4. Eclipse state of the vehicle (full, penumbra, partial, none)	5. Vector to Sun in spacecraft coordinates	6. Velocity vector of spacecraft in spacecraft coordinates	7. Initial guess at type of anomaly (See taxonomy below)	8. Estimated confidence of that guess	9. Anomaly category (e.g., affected system or kind of disruption)	10. Vehicle identity	11. Notes (e.g. unusual operational states or recent changes to operations (recent commands, attitude scheme, etc.)
25 Apr 2014	Geo (3.5 deg East)	Geo	No eclipse			Galactic Cosmic Rays	High	Satellite Safe Mode	Meteosat-8	
21 Jul 2014	Geo (9.5 deg East)	Geo	No eclipse			Galactic Cosmic Rays	To be confirmed	CACE mode change	Meteosat-9	

Taxonomy of Satellite Anomalies Caused by In Situ Charged Particle Environment (to be used for column 7):

1. Electrostatic discharge (charging)
    - 1.1 Surface charging
        - 1.1.1 Plasma sheet (subauroral)
        - 1.1.2 Auroral
    - 1.2 Internal charging
        - 1.2.1 Subsurface charging (e.g., beneath blanket)
        - 1.2.2 Deep charging (e.g., inside a box)
2. Single-Event Effects
    - 2.1 Protons
        - 2.1.1 Solar proton event
        - 2.1.2 Geomagnetically trapped protons
    - 2.2 Heavy ions
        - 2.2.1 Galactic Cosmic Rays
        - 2.2.2 Solar energetic particles
        - 2.2.3 Geomagnetically trapped heavy ions
3. Total Dose
    - 3.1 Long-term dose accumulation (multiple causes combined)
    - 3.2 Short-term (days or less) dose accumulation
        - 3.2.1 Solar protons
        - 3.2.2 Geomagnetically trapped protons
        - 3.2.3 Geomagnetically trapped electrons

2.1.4 Ground segment matters

The availability of the Meteosat (first and second generation) ground segments was nominal in the reporting period.

A significant activity on the MSG ground segment is the migration of whole MSG Ground Segment to the Technical Infrastructure Building (TIB) which is part of the MSG Ground Segment Computer Infrastructure Upgrade Project (MCIUP). During the reporting period, the mission data chain (IMPF, MPEF and DADF) were migrated. Work has now started on the migration of the CF.

2.1.5 Data transmission

GEO satellite product dissemination is made via EUMETCast.EUMETCast is EUMETSAT's primary dissemination mechanism for the near real-time delivery of satellite data and products generated by the EUMETSAT Application Ground Segment. Third party data and products from partner organisations are also delivered by the system, which is based on Digital Video Broadcast (DVB) technology. A new DVB-S2 based Ku-band service was started in August 2014, replacing the DVB-S service in December 2014. EUMETCast comprises three services:

- Ku-band Europe service (DVB-S2)
- C-band Africa service (DVB-S)
- C-band Americas service (DVB-S)

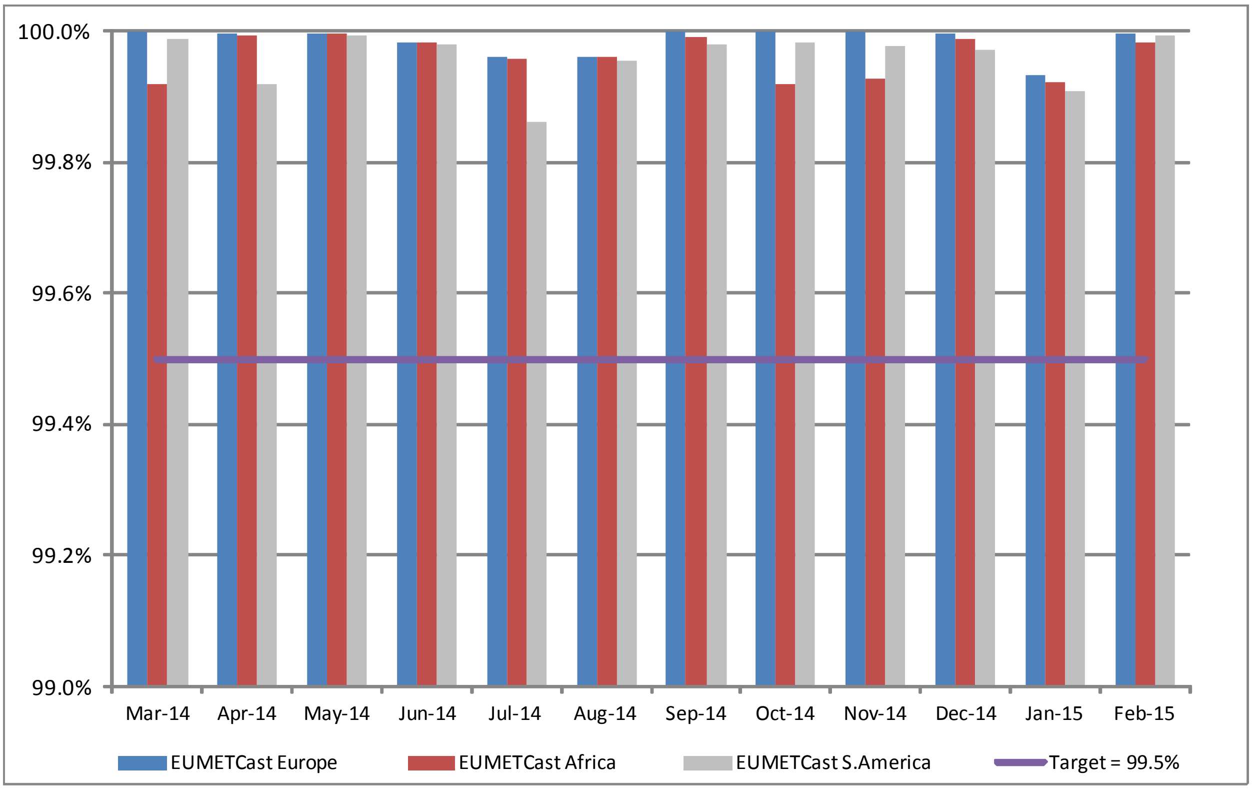

Figure 1: EUMETCast Availability

As can be seen in Figure 1, all services provided very good availability over the reporting period.

2.1.6 Projects, services

GOES and MTSAT Data Dissemination Service
EUMETSAT receives hourly image data from NOAA (GOES-11, GOES-15 and GOES-13) and from JMA (MTSAT-2) through Météo-France (Lannion) for retransmission via EUMETCast to end users.

FY-2D&E Data Dissemination Service
EUMETSAT receives image data and meteorological products from FY-2D (86.5° E) and FY-2E (105° E) for retransmission via EUMETCast to end users. The dissemination to EUMETCast Americas has been stopped due to lack of users in that area.

DWDSAT and RETIM
The DWDSAT and RETIM services on EUMETCast were nominal throughout the period.

BMD and MDD service
The Basic Meteorological Data (BMD) and Meteorological Data Dissemination (MDD) services on EUMETCast were nominal throughout the period.

MDD is currently part of the MSG Direct Dissemination Service and available on EUMETCast and BMD is implemented as a GTS-like data stream on a dedicated EUMETCast channel.

The BMD/MDD harmonisation activity started in July 2011. It has the goal of implementing GTS-like data streams for both services using WMO file naming on dedicated EUMETCast channels. This will also allow better data discovery using the EO-Portal and Product Navigator.

EU FP7 Projects
The dissemination performance of the Seventh Framework Programme (FP7) data streams reflects the general EUMETCast performance.

In addition to new products, the Agricab and GIO-GL projects provide continuity of the EAMNET and former Geoland2 projects in Africa and Americas.

Other EU FP-7 Projects have not yet reached the dissemination operations phase.

GEONETCast Data Exchange
The data exchange between NOAA, CMA and EUMETSAT is continuing with exchanged data being disseminated on GEONETCast Americas, CMACast and EUMETCast.

Other Projects

In the GEONETCast context the dissemination of products from NOAA NESDIS, US-EPA, SERVIR and RANET is ongoing with nominal status.

Vegetation data for Africa, provided by VITO, and Rainfall Estimates, provided by Tamsat / University of Reading, were nominal throughout the reporting period.

2.1.7 User statistics

EUMETCast

The status of EUMETCast registrations up to 31 December 2014 is provided in Figure 2. Note that Total number of registered Users on 31 March 2015 was 3321 (users may have more than one station).

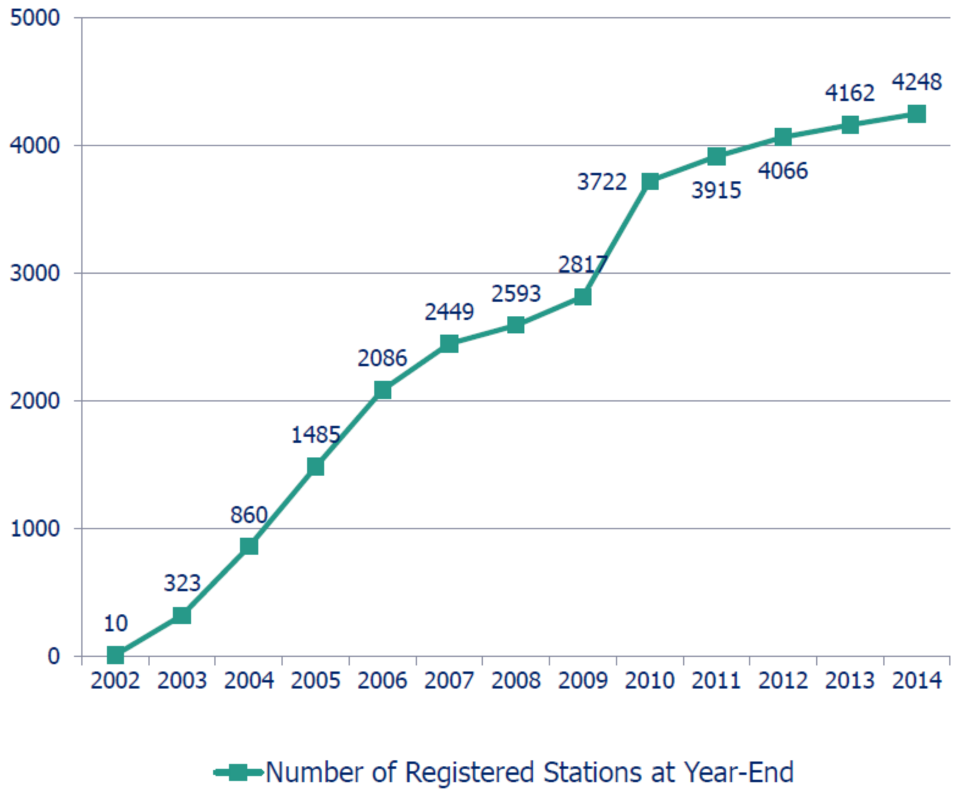

Figure 2: EUMETCast Registrations

The availability of the EUMETCast dissemination system has already been provided in Section 2.1.5.

The EUMETSAT Data Centre

EUMETSAT's Data Centre archives all payload data acquired from EUMETSAT's operational satellites and most of the products derived from that data. The Data Centre allows registered users to request data and products from the archive by use of its online 'self-service' ordering mechanism and supplies the requested items via physical media and the Internet. It also allows 'bulk orders' for long time-periods of data and 'standing orders' for repeated delivery of data / products over specified time periods to be requested for special needs.

The development of orders and deliveries is provided in Fig. 3 below. The chart shows volumes of data retrieved from the Archive in response to user ordering on a monthly basis, from Jan 2013 up to and including March 2015. Also presented is the resulting delivery to the users on a volume basis as well as in number of items. The dip in November 2014 is caused by a reduced ordering capability of the Archive following a planned maintenance.

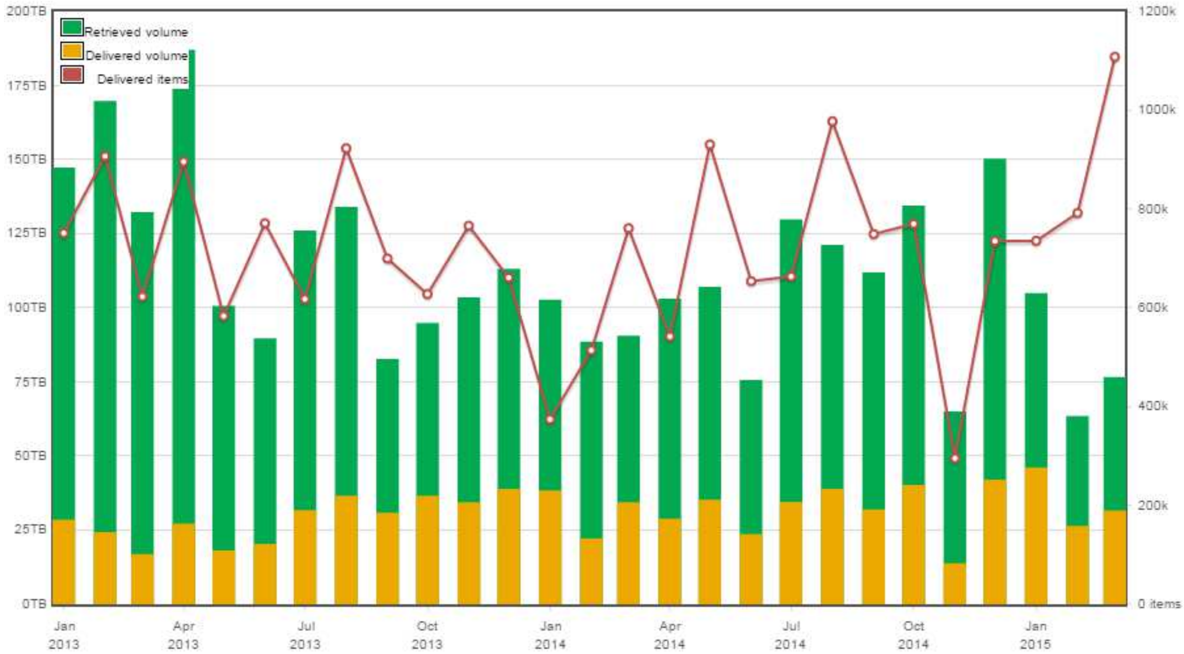

Figure 3: Data Centre Retrieval and Delivery of User Ordering

The release of the new lightweight, intuitive online ordering client which includes ordering features needed for the Sentinel-3 mission, has been delayed and is expected to be available at the end of Q2 2015. Since November 2014, High Rate SEVIRI Level 1.5 Image Data (MSG15) and HRI Level 1.5 Image Data (MTP15) are available for Archive ordering in the user friendly netCDF format. Further, LTO-5 tapes with a storage capacity of 1.5 Terabytes native can now be selected by users as a delivery media for large orders.

2.2 Status of current LEO satellite systems

2.2.1 Mission objectives, payload/instruments, products

The prime objective of the EUMETSAT Polar System (EPS) Metop mission series is to provide continuous, long-term datasets, in support of operational meteorological and environmental forecasting and global climate monitoring.

The EPS programme baseline consists of a series of three polar orbiting Metop satellites, to be flown successively for more than 14 years, from 2006, supported by the relevant ground facilities. However, with the continuing good health of Metop-A and following the successful entry into operations of Metop-B, it has been decided to continue a dual-Metop operational service as long as this provides added user value and is compatible with the Metop-A end-of-life constraints due to the space debris mitigation guidelines.

Metop-A was launched on 19 October 2006 and Metop-B was launched on 17 September 2012.

Metop carries a set of 'heritage' instruments provided by the United States and a new generation of European instruments that offer improved remote sensing capabilities to both meteorologists and climatologists. The new instruments augment the accuracy of temperature humidity measurements, readings of wind speed and direction, and atmospheric ozone profiles.

Taking advantage of the presence of Metop-B and the continuation in-orbit of Metop-A, a reduced-swath GOME-2 tandem product was introduced in July 2014 in order to improve resolution. This configuration uses a half swath/ double resolution on Metop-A, but a nominal swath on Metop-B, in order to combine the benefits of better resolution with global swath coverage. Furthermore, an AVHRR Global Wind product has been introduced made possible by the overlap of the two satellite ground tracks.

Under the Initial Joint Polar System (IJPS) and Joint Transition Activities (JTA) agreement, EUMETSAT and NOAA have agreed to provide instruments for each other's satellites; exchange all data in real time, and assist each other with backup services. NOAA, with the support of NASA and the US National Science Foundation also provide an Antarctica Data Acquisition (ADA) service providing global data acquisition and real-time transmission to the EUMETSAT processing facilities in order to reduce data dissemination latency. This service is currently providing Metop-B data from most orbits.

Full details of the satellite, its instruments and access to the related data and products can be found on www.eumetsat.int .

2.2.2 Status of spacecraft

The Metop-B satellite took over from Metop-A as the primary operational Metop satellite on 24 April 2013. Metop-A continues full service provision in parallel, as the secondary Metop satellite.

The Metop-A satellite continued to perform well over the reporting period.;

2.2.3 Impact on spacecraft due to space weather

Space weather related spacecraft anomalies (Items in bold are required)

Source: Recommendations for Contents of Anomaly Database for Correlation with Space Weather Phenomena, P. O'Brien, J.E. Mazur, T. Guild, November 2011, AEROSPACE Report No.TOR-2011(3903)-5.

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12:10:07 20 June 2014	Lat 9 S Lon 41W (South Pole)	a[km] = 7204.047 e[-] = 0.00110 i[deg] = 98.615 RAAN[deg] = 231.332 PSO[deg] = 189.208 PSO[rad] = 3.30231 LON[deg] = 41.040W LAT[deg] = 9.106S	none		VY [km/s] = -7.424 VZ [km/s] = 0.504	Galactic Cosmic Ray	medium/ high	IASI	Metop-B	
00:48:17 10 July 2014	Lat 22S Lon 45.7W (SAA)	a[km] = 7201.908 e[-] = 0.00099 i[deg] = 98.603 RAAN[deg] = 250.546 PSO[deg] = 337.727 PSO[rad] = 5.89446 LON[deg] = 45.674W LAT[deg] = 22.147S	full		VY [km/s] = -7.421 VZ [km/s] = -0.472	Geo-magnet-ically trapped proton	high	MHS	Metop-B	
16:34:24 8 Aug 2014	Lat 48.2N Lon 98.2W (North Pole)	a[km] = 7187.113 e[-] = 0.00057 i[deg] = 98.604 RAAN[deg] = 279.710 PSO[deg] = 459.026 PSO[rad] = 8.01152	none		VY [km/s] = -7.444 VZ [km/s] = 0.080	Galactic Cosmic Ray	medium/ high	ASCAT	Metop-B	

1. Date and Universal Time of the anomaly	**2. Fully specified location of the anomaly** (spacecraft location)	**3. Velocity or orbital elements at time of the anomaly**	4. Eclipse state of the vehicle (full, penumbra, partial, none)	5. Vector to Sun in S/C coordinates	6. Velocity vector of spacecraft in spacecraft coordinate	7. Initial guess at type of anomaly (See taxonomy below)	8. Estimated confidence of that guess	9. Anomaly category (e.g., affected system or kind of disruption)	10. Vehicle identity	11. Notes (e.g. unusual operational states or recent changes to operations (recent commands, attitude scheme, etc.)
		LON[deg] = 62.309W LAT[deg] = 77.559N								
15:26:00 15 Jan 2015	Lat 78.9N Lon 40.1E (North Pole)	a[km] = 7187.024 e[-] = 0.00064 i[deg] = 98.784 RAAN[deg] = 77.233 PSO[deg] = 443.019 PSO[rad] = 7.73214 LON[deg] = 40.089E LAT[deg] = 78.935N	none		VY [km/s] = -7.443 VZ [km/s] = -0.062	Galactic Cosmic Ray	medium/ high	ADCS	Metop-A	
13:48:30 1 Feb 2015	Lat 75.3S Lon 151.1E (South Pole)	a[km] = 7187.446 e[-] = 0.00266 i[deg] = 98.784 RAAN[deg] = 93.921 PSO[deg] = 281.968 PSO[rad] = 4.92127 LON[deg] = 151.070E LAT[deg] = 75.331S	none		VY [km/s] = -7.426 VZ [km/s] = -0.106	Galactic Cosmic Ray	medium/ high	ADCS	Metop-A	
03:42:00 6 Feb 2015	Lat 58.9S Lon 78.2W (SAA)	a[km] = 7191.211 e[-] = 0.00215 i[deg] = 98.778 RAAN[deg] = 98.435 PSO[deg] = 300.018 PSO[rad] = 5.23631 LON[deg] = 78.166W LAT[deg] = 59.026S	full		VY [km/s] = -7.425 VZ [km/s] = -0.255	Geo-magnet-ically trapped proton	high	SARP	Metop-A	
00:16:22 14 Feb 2015	Lat 24.2S Lon 37.2W (South Pole)	a[km] = 7201.391 e[-] = 0.00083 i[deg] = 98.793 RAAN[deg] = 106.458 PSO[deg] = 335.346 PSO[rad] = 5.85289 LON[deg] = 37.169W	full		VY [km/s] = -7.421 VZ [km/s] = -0.464	Galactic Cosmic Ray	medium/ high	MHS	Metop-B	

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		LAT[deg] = 24.506S								
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00:16:22 14 Feb 2015	Lat 24.2S Lon 37.2W (South Pole)	a[km] = 7201.391 e[-] = 0.00083 i[deg] = 98.793 RAAN[deg] = 106.458 PSO[deg] = 335.346 PSO[rad] = 5.85289 LON[deg] = 37.169W LAT[deg] = 24.506S	full		VY [km/s] = -7.421 VZ [km/s] = -0.464	Galactic Cosmic Ray	medium/ high	MHS	Metop-B	
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1. Date and Universal Time of the anomaly	**2. Fully specified location of the anomaly** (spacecraft location)	**3. Velocity or orbital elements at time of the anomaly**	4. Eclipse state of the vehicle (full, penumbra, partial, none)	5. Vector to Sun in S/C coordinates	6. Velocity vector of spacecraft in spacecraft coordinate	7. Initial guess at type of anomaly (See taxonomy below)	8. Estimated confidence of that guess	9. Anomaly category (e.g., affected system or kind of disruption)	10. Vehicle identity	11. Notes (e.g. unusual operational states or recent changes to operations (recent commands, attitude scheme, etc.)
00:48:17 10 July 2014	Lat 22S Lon 45.7W (SAA)	a[km] = 7201.908 e[-] = 0.00099 i[deg] = 98.603 RAAN[deg] = 250.546 PSO[deg] = 337.727 PSO[rad] = 5.89446 LON[deg] = 45.674W LAT[deg] = 22.147S	full		VY [km/s] = -7.421 VZ [km/s] = -0.472	Geo-magnet-ically trapped proton	high	MHS	Metop-B	
16:34:24 8 Aug 2014	Lat 48.2N Lon 98.2W (North Pole)	a[km] = 7187.113 e[-] = 0.00057 i[deg] = 98.604 RAAN[deg] = 279.710 PSO[deg] = 459.026 PSO[rad] = 8.01152 LON[deg] = 62.309W LAT[deg] = 77.559N	none		VY [km/s] = -7.444 VZ [km/s] = 0.080	Galactic Cosmic Ray	medium/ high	ASCAT	Metop-B	

Taxonomy of Satellite Anomalies Caused by In Situ Charged Particle Environment (to be used for column 7):

1. Electrostatic discharge (charging)
    - 1.1 Surface charging
        - 1.1.1 Plasma sheet (subauroral)
        - 1.1.2 Auroral
    - 1.2 Internal charging
        - 1.2.1 Subsurface charging (e.g., beneath blanket)
        - 1.2.2 Deep charging (e.g., inside a box)
2. Single-Event Effects
    - 2.1 Protons
        - 2.1.1 Solar proton event
        - 2.1.2 Geomagnetically trapped protons
    - 2.2 Heavy ions
        - 2.2.1 Galactic Cosmic Rays
        - 2.2.2 Solar energetic particles
        - 2.2.3 Geomagnetically trapped heavy ions
3. Total Dose
    - 3.1 Long-term dose accumulation (multiple causes combined)
    - 3.2 Short-term (days or less) dose accumulation
        - 3.2.1 Solar protons
        - 3.2.2 Geomagnetically trapped protons
        - 3.2.3 Geomagnetically trapped electrons

2.2.4 Impact on spacecraft due to space weather

Space weather related spacecraft anomalies (Items in bold are required)

Source: Recommendations for Contents of Anomaly Database for Correlation with Space Weather Phenomena, P. O'Brien, J.E. Mazur, T. Guild, November 2011, AEROSPACE Report No.TOR-2011(3903)-5.

1. Date and Universal Time of the anomaly	**2. Fully specified location of the anomaly** (spacecraft location)	**3. Velocity or orbital elements at time of the anomaly**	4. Eclipse state of the vehicle (full, penumbra, partial, none)	5. Vector to Sun in S/C coordinates	6. Velocity vector of spacecraft in spacecraft coordinate	7. Initial guess at type of anomaly (See taxonomy below)	8. Estimated confidence of that guess	9. Anomaly category (e.g., affected system or kind of disruption)	10. Vehicle identity	11. Notes (e.g. unusual operational states or recent changes to operations (recent commands, attitude scheme, etc.)
12:10:07 20 June 2014	Lat 9 S Lon 41W (South Pole)	a[km] = 7204.047 e[-] = 0.00110 i[deg] = 98.615 RAAN[deg] = 231.332 PSO[deg] = 189.208 PSO[rad] = 3.30231 LON[deg] = 41.040W LAT[deg] = 9.106S	none		VY [km/s] = -7.424 VZ [km/s] = 0.504	Galactic Cosmic Ray	medium/ high	IASI	Metop-B	
00:48:17 10 July 2014	Lat 22S Lon 45.7W (SAA)	a[km] = 7201.908 e[-] = 0.00099 i[deg] = 98.603 RAAN[deg] = 250.546 PSO[deg] = 337.727 PSO[rad] = 5.89446 LON[deg] = 45.674W LAT[deg] = 22.147S	full		VY [km/s] = -7.421 VZ [km/s] = -0.472	Geo-magnet-ically trapped proton	high	MHS	Metop-B	
16:34:24 8 Aug 2014	Lat 48.2N Lon 98.2W (North Pole)	a[km] = 7187.113 e[-] = 0.00057 i[deg] = 98.604 RAAN[deg] = 279.710 PSO[deg] = 459.026 PSO[rad] = 8.01152 LON[deg] = 62.309W	none		VY [km/s] = -7.444 VZ [km/s] = 0.080	Galactic Cosmic Ray	medium/ high	ASCAT	Metop-B	

1. Date and Universal Time of the anomaly	**2. Fully specified location of the anomaly** (spacecraft location)	**3. Velocity or orbital elements at time of the anomaly**	4. Eclipse state of the vehicle (full, penumbra, partial, none)	5. Vector to Sun in S/C coordinates	6. Velocity vector of spacecraft in spacecraft coordinate	7. Initial guess at type of anomaly (See taxonomy below)	8. Estimated confidence of that guess	9. Anomaly category (e.g., affected system or kind of disruption)	10. Vehicle identity	11. Notes (e.g. unusual operational states or recent changes to operations (recent commands, attitude scheme, etc.)
		LAT[deg] = 77.559N								
15:26:00 15 Jan 2015	Lat 78.9N Lon 40.1E (North Pole)	a[km] = 7187.024 e[-] = 0.00064 i[deg] = 98.784 RAAN[deg] = 77.233 PSO[deg] = 443.019 PSO[rad] = 7.73214 LON[deg] = 40.089E LAT[deg] = 78.935N	none		VY [km/s] = -7.443 VZ [km/s] = -0.062	Galactic Cosmic Ray	medium/ high	ADCS	Metop-A	
13:48:30 1 Feb 2015	Lat 75.3S Lon 151.1E (South Pole)	a[km] = 7187.446 e[-] = 0.00266 i[deg] = 98.784 RAAN[deg] = 93.921 PSO[deg] = 281.968 PSO[rad] = 4.92127 LON[deg] = 151.070E LAT[deg] = 75.331S	none		VY [km/s] = -7.426 VZ [km/s] = -0.106	Galactic Cosmic Ray	medium/ high	ADCS	Metop-A	
03:42:00 6 Feb 2015	Lat 58.9S Lon 78.2W (SAA)	a[km] = 7191.211 e[-] = 0.00215 i[deg] = 98.778 RAAN[deg] = 98.435 PSO[deg] = 300.018 PSO[rad] = 5.23631 LON[deg] = 78.166W LAT[deg] = 59.026S	full		VY [km/s] = -7.425 VZ [km/s] = -0.255	Geo-magnet-ically trapped proton	high	SARP	Metop-A	
00:16:22 14 Feb 2015	Lat 24.2S Lon 37.2W (South Pole)	a[km] = 7201.391 e[-] = 0.00083 i[deg] = 98.793 RAAN[deg] = 106.458 PSO[deg] = 335.346 PSO[rad] = 5.85289 LON[deg] = 37.169W LAT[deg] = 24.506S	full		VY [km/s] = -7.421 VZ [km/s] = -0.464	Galactic Cosmic Ray	medium/ high	MHS	Metop-B	

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12:10:07 20 June 2014	Lat 9 S Lon 41W (South Pole)	a[km] = 7204.047 e[-] = 0.00110 i[deg] = 98.615 RAAN[deg] = 231.332 PSO[deg] = 189.208 PSO[rad] = 3.30231 LON[deg] = 41.040W LAT[deg] = 9.106S	none		VY [km/s] = -7.424 VZ [km/s] = 0.504	Galactic Cosmic Ray	medium/ high	IASI	Metop-B	
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16:34:24 8 Aug 2014	Lat 48.2N Lon 98.2W (North Pole)	a[km] = 7187.113 e[-] = 0.00057 i[deg] = 98.604 RAAN[deg] = 279.710 PSO[deg] = 459.026 PSO[rad] = 8.01152 LON[deg] = 62.309W LAT[deg] = 77.559N	none		VY [km/s] = -7.444 VZ [km/s] = 0.080	Galactic Cosmic Ray	medium/ high	ASCAT	Metop-B	
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        - 2.1.1 Solar proton event
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        - 2.2.1 Galactic Cosmic Rays
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3. Total Dose
    - 3.1 Long-term dose accumulation (multiple causes combined)
    - 3.2 Short-term (days or less) dose accumulation
        - 3.2.1 Solar protons
        - 3.2.2 Geomagnetically trapped protons
        - 3.2.3 Geomagnetically trapped electrons

2.2.5 Impact of Space Debris

Space debris related spacecraft events

1. Date and Time of the event	2. Location of the event (spacecraft position)	3. Orbital velocity at time of the event	4. Identity and size of offending object	5. Miss distance at closest conjunction	6. Angle and velocity of conjunction in S/C frame	7. Predicted collision probability	8. Executed Manoeuvre (size, time)	9. Mission Impact	10. Space asset identity	11. Notes
26 May 2014 12:02	On-orbit: 97.4 deg long 12.4 deg lat 78.7 deg	7.4 km/s	UNKNOWN #80390 < 0.1 m2	Total: 223.1 Radial: -21.2m	-129.9 deg 9.5 km/s	1/1600	In-plane: -0.0145 m/s; 12.5 orbits before TCA	Marginal fuel loss	Metop-B	Side conjunction: debris not in the public catalogue. Maneuver used to avoid exit from dead-band before ASCAT calibration campaign.

2.2.6 Ground segment matters

The EPS Ground Segment has generally performed very well, supporting both EPS (dual-Metop) and NOAA operations.

EUMETSAT is providing global data from Suomi NPP to its user community via EUMETCast and the GTS/RMDCN for routine operational use since 31 July 2012.

The EUMETSAT Advanced Retransmission Service (EARS) acquires regional data at a network of European ground stations and retransmits the data for processing and dissemination from the EUMETSAT Central Site, thereby providing regional data timeliness in the order of 30 minutes from sensing. All the services (EARS-ATOVS, EARS-AVHRR, EARS-ASCAT,EARS-IASI and EARS-NWC) performed well over the reporting period. For these services, the Metop-B data were added on 20 August 2013.

2.2.7 Data transmission

LEO satellite product dissemination is made via EUMETCast. This applies to the global data and the regional data acquired by EARS stations. Please refer to Section 2.1.5 for a report on EUMETCast availability.

Metop satellites also provide a direct broadcast service through the Advanced High Resolution Picture Transmission (A-HRPT) subsystem. Following the failure of the prime A-HRPT on Metop-A in 2007 due to heavy-ion impact, the redundant A-HRPT unit operation is providing a restricted, zone-based operations service, avoiding regions of high cosmic ray and proton activity such as the polar regions and the South Atlantic Anomaly. The extent of the operational zones can be found on:

http://www.eumetsat.int/Home/Main/DataAccess/DirectDissemination/index.htm?l=en

Since the A-HRPT on Metop-B was re-engineered as a result of the lessons learned from the Metop-A A-HRPT failure, users around the globe are receiving operational instrument raw data, without restriction.

2.2.8 Projects, Services

Suomi NPP Global and Regional Service Projects

The Suomi NPP (S-NPP) satellite was successfully launched on 28 October 2011 and is now operated under NOAA responsibility. It is the first of the next generation of polar spacecraft and ensures continuity of Afternoon Orbit operational data services within the IJPS. S-NPP has taken over the role as the primary operational satellite in this orbit from 1 May. NOAA-19 will continue as the NOAA Prime Services Mission for the afternoon orbits.

Global Data

EUMETSAT is providing global data from Suomi NPP to its user community via EUMETCast and the GTS/RMDCN for routine operational use since 31 July 2012.

EUMETSAT's Suomi NPP related activities encompass:

- The acquisition of global data from the CrIS, ATMS and VIIRS instruments from NOAA;
- The tailoring of these data according to the requirements of the user community;
- The dissemination of the tailored products to the user community.

It is recalled that EUMETSAT has no direct support to operations of Suomi-NPP operations. EUMETSAT is however supporting global and regional Suomi-NPP data services within the scope of IJPS and in the framework of Copernicus (SNPP4C).

Regional Data

The core European EARS stations are being upgraded to support Suomi NPP and to establish operational regional services for ATMS, CrIS and VIIRS instrument data.

All core EARS stations now have the new X/L-band reception systems operational and are receiving Suomi NPP data on a routine basis. The product processing for the ATMS, CrIS and VIIRS instrument data is based on the CSPP processing package provided by University of Wisconsin-Madison.

The EARS-ATMS and EARS-CrIS services were declared operational on 15 May 2013 from the first core stations to be ready (Svalbard, Lannion, Maspalomas and Athens). Data acquired in Kangerlussuaq was added in January 2014.

The EARS-VIIRS service became operational on the 29 October 2014, first with data acquired from Lannion, Kangerlussuaq, Svalbard and Athens. Data from the Maspalomas station was added to the service in November 2014.

<u>Jason-2 Data Processing and Dissemination Service</u>

This service delivers the 'Operation Geophysical Data Record' (OGDR) products, derived from the altimetry data acquired from the Jason-2 satellite. Jason-2 is operated in cooperation between EUMETSAT, NOAA, CNES and NASA in the frame of the Ocean Surface Topography Mission (OSTM). EUMETSAT and NOAA process the data from the Jason-2 satellite in near real-time and archive and disseminate the products.

The Jason-2 Service for Near Real Time (NRT) products became operational on 15 December 2008. Overall, for the reporting period, the Jason-2 System provided a satisfactory operational service with availability around 98%, and 90% of data meeting the 3 hours timeliness target.

MODIS Data Dissemination Service
EUMETSAT receives the following MODIS data from NASA for redistribution via EUMETCast:

- Level 1 calibrated radiances (MOD02, MYD02);
- Fire product (MOD14, MYD14);
- MODIS chlorophyll Alpha.

EUMETSAT also receives MODIS direct broadcast polar winds from the Cooperative Institute for Meteorological Satellite Studies (CIMSS) for redistribution via EUMETCast.

The level 1 calibrated radiances and geo-location data are processed at EUMETSAT in order to retain only those data over the geographical region north of 25° North between 60° West and 45° East, and north of 65° North elsewhere. Furthermore, the level 1 radiance data are further reduced by retaining only measurements from 18 spectral channels (1, 2, 5, 6, 8, 9, 10, 12, 15, 20, 23, 26, 27, 28, 29, 31, 32 and 33).

Agreed MODIS products are disseminated unchanged on EUMETCast. Level 1 Calibrated Radiances products (MOD02) are processed before dissemination, comprising a spatially thinned sub-set of channels. MODIS precipitable water products (MOD05 and MYD05) are processed by EUMETSAT in order to retain only near infrared measurements over land during daytime. The worst-case dissemination delay generally stays below 30 min.

FY-3A&B Data Dissemination Service
Level 1 products from FY-3A, FY-3B and FY-3C are provided by CMA, and are made available to EUMETSAT Member States via EUMETCast. MWRI from FY-3B are also redistributed via EUMETCast.

Due to instrument failures, all sounding data from FY-3A and MWTS from FY-3B are no longer available. The FY-3B MWRI and MWHS services remain available.

On 10 September, the full dissemination of Level 1 data from the IRAS instrument onboard FY-3B started. The full dissemination of FY-3C Level 1 data in original HDF format from Micro-Wave Temperature Sounder-2 (MWTS-2), Micro-Wave Humidity Sounder-2 (MWHS-2), Micro-Wave Radiation Imager (MWRI), InfraRed Atmospheric Sounder (IRAS) started on the 18 September. On 25 November, the full dissemination of BUFR products for FY-3B MWHS and IRAS data, and FY-3C MWTS-2, MWHS-2 and IRAS started.

SSMIS Data Dissemination Service
ENV, IMA, LAS and UAS products are disseminated on EUMETCast in BUFR format.

SARAL Data Processing and Dissemination Service

SARAL (Satellite with ARgos and ALtika) is a joint CNES/ISRO programme. The role of EUMETSAT is analogous to the support provided for Jason-2:

- NRT processing of AltiKa payload instrument data;
- Encoding the SARAL products in BUFR;
- NRT dissemination of the SARAL products via EUMETCast and GTS/RMDCN;
- Archiving of the SARAL products in the Data Centre; and
- Coordination with CNES for the set-up, validation and operations of the SARAL ground segment at EUMETSAT.

The SARAL NRT altimetry products are distributed via EUMETCast since 16 September 2013 and via the GTS since 10 October 2013.
There has been a Satellite Safe Hold Mode from 6 October until 10 October 2014, resulting in a loss of service of 3.5 days in total.

Oceansat-2 Data Dissemination Service

This service has been established to deliver data from the OSCAT instrument onboard of the ISRO satellite Oceansat-2 in near-real time to EUMETCast users and to NOAA.

The service was declared operational on 25th October 2012, its availability and timeliness usually reached the requirements of 85% of data within 180 minutes.

Unfortunately, since 2 April 2014 the service has been discontinued, due to an instrument failure.

Megha-Tropiques Data Dissemination Service

Based on the requirements for Level 1A2 data from the SAPHIR, MADRAS, ScaRaB and ROSA instruments and the tripartite cooperation agreement between ISRO, EUMETSAT, and CNES, a data transfer mechanism was agreed which uses a procured data line directly from ISRO to EUMETSAT.
The initial service started on 27 May 2014 with data from the SAPHIR instrument reformatted to BUFR. The availability of ROSA data remains to be clarified, and the MADRAS instrument has failed and so no products from MADRAS will be available for forwarding.

SMOS Data Dissemination Service

A BUFR version of the SMOS Level 1c near real time light product received from ESA via the Met Office (UK), is being distributed by EUMETSAT since February 2013.

GCOM-W1

GCOM-W1 AMSR2 data is redistributed to EUMETSAT Member State NMHSs and ECMWF via EUMETCast. The BUFR encoding sequence for the AMSR2 brightness temperature data has been defined. The trial distribution of these data via EUMETCast began on 27 February 2014, with a correction to the reformatting implemented on 15 July 2014.

NOAA 15, 16 and 18
Operational dissemination of NRT data from the ATOVS instruments onboard the non-IJPS NOAA satellites (since the loss of NOAA-16, now limited to NOAA-15 and NOAA-18) began on 25 November 2014. More precisely, L1B data from HIRS, AMSU-A, AMSU-B and MHS, received from NOAA DDS, are processed to L1C and reformatted to BUFR using the AAPP software.

2.2.9 User statistics

Overall user statistics are provided in Section 2.1.7.

3 FUTURE SATELLITE SYSTEMS

EUMETSAT Future GEO Satellites

Sector	Satellites in orbit P=pre-operational Op=operational B=back-up L=limited availability	Location	Launch date	Details on near real time access to L0/L1 data (Links)	Environmental payload and status
East Atlantic (36°W -36°E)	Meteosat-11 (MSG-4)	0°	07/2015		12-channel SEVIRI imager, GERB, DCS
	MTG I1[1]	9.5°E	01/2019 – 072019/		Meteosat Third Generation/ Imaging (FCI, LI)
	MTG S1	0°	Mid 2021		Meteosat Third Generation/ Sounding (IRS, UVN)
	MTG I2	9.5°E	Mid 2023		Meteosat Third Generation/ Imaging (FCI, LI)
	MTG I3	9.5°E	End 2026		Meteosat Third Generation/ Imaging (FCI, LI)
	MTG S2	0°	Mid 2029		Meteosat Third Generation/ Sounding (IRS, UVN)
	MTG I4	9.5°E	Mid 2031		Meteosat Third Generation/ Imaging (FCI, LI)

[1] Operational Scenario for the MTG Imaging Mission will be provided by one satellite at 0 deg and one satellite at 9,5 deg East, providing the Full Disc (FD) imaging service and the Rapid Scan Service (RSS)

EUMETSAT Future LEO Satellites

Orbit type ECT=Equator Crossing Time (for sun-synchronous orbits)	Satellites in orbit P=pre-operational Op=operational B=back-up, secondary L=limited availability	Equator Crossing Time (ECT) Ascending Node	Mean Altitude	Launch date	Details on near real time access to L0/L1 data (links)	Instrument payload and status
Sun-synchronous "Morning" orbit ECT between 19:00-24:00 and between 07:00-12:00	Metop-C (Metop-3)	21:30	837 km	October 2018		AVHRR, MHS,AMSU-A, IASI, ASCAT,GRAS GOME, SEM, A-DCS

3.1 Status of future GEO satellite systems

3.1.1 MTG

3.1.1.1 Mission objectives, spacecraft, payload/instruments, products

The MTG mission encompasses the following observation missions:

- Flexible Combined Imager (FCI) mission, allows scanning of either the full disc in 16 channels every 10 minutes with a spatial sampling distance in the range 1-2km (Full Disc High Spectral resolution Imagery (FDHSI) in support of the Full Disc Scanning Service (FCI-FDSS)) or a quarter of the earth in 4 channels every 2.5 minutes with a improvement in resolution by a factor of two High spatial Resolution Fast Imagery (HRFI) in support of the Rapid Scanning Service (FCI-RSS)).

- InfraRed Sounding (IRS) mission, covering the full disc in 60 minutes, providing hyperspectral sounding information in two bands, a Long Wave InfraRed (LWIR: 700 - 1210 cm-1) and Mid Wave InfraRed (MWIR: 1600 - 2175 cm-1) band with a spatial sampling distance around 4km.

- Lightning Imagery (LI) mission, detecting continuously over almost the full disc, the lightning discharges taking place in clouds or between cloud and ground with a spatial sampling distance around 10km.

- Ultraviolet, Visible & Near-infrared (UVN) sounding mission, covering Europe every hour taking measurements in three spectral bands (UV: 290 - 400 nm; VIS: 400 - 500 nm, NIR: 755 - 775 nm) with a spatial sampling distance better than 10km. This mission will be implemented with the Copernicus (formerly GMES) Sentinel-4 instrument which will be accommodated on two of the MTG Satellites, the so called MTG -S satellites.

Complementary to the direct observation missions summarised above and essential to satisfy key user needs, the following mission objectives also need to be fulfilled by MTG:

- Level 2 product extraction;
- Data Collection System (DCS), for collecting and transmitting observations and data from surface, buoy, ship, balloon or airborne Data Collection Platforms (DCP);
- Search And Rescue (SAR) relay service. Similarly to MSG, the MTG System will accommodate a Geostationary Search and Rescue (GEOSAR) transponder, enabling the operations of the mission under the aegis of the COSPAS-SARSAT System.

- Near Real Time Data Dissemination & Relay services to users, including Foreign Satellite Data (FSD) collection and distribution (data from other EUMETSAT and Third Party satellite systems for calibration and global applications):

  - EUMETCast & High Rate dissemination services (including relay of FSD);
  - Regional Meteorological Data Communication Network (RMDCN) dissemination service. (RMDCN provides a computer network infrastructure for the meteorological community in World Meteorological Organization (WMO) Region VI (Europe) and has expanded to sites in WMO Region II (Asia)). It is integrated with the Global Telecommunication System (GTS) established by the WMO.
  - Internet dissemination services;
  - Data stewardship and reprocessing support;
  - Off-line data delivery; on-line services to the Users; Data exploitation support, reach-out, training and help desk.

Archived dataset retrieval services will continue to be provided as part of the multi-mission EUMETSAT Data Centre services, and User support services will be enhanced to address the additional needs with MTG.

3.1.1.2 Programme status

3.1.1.2.1 Overall status, and space segment

The programme is now in full C/D mode. At satellite level, following the satellite and instrument level Preliminary Design Review, work continued with detailed design, analysis and development ongoing; manufacturing activities have started and first delivery of hardware for the Structural and Thermal Model (STM) and Engineering Model (EM) has occurred.

Readiness of the MTG-I Platform remains sub critical: in fact the integration of the primary structure for the Structure and Thermal Model (STM) has not started yet. The software development is the second element on the critical path of the platform development for the proto-flight model.

For the Lightning Imager (LI) important design modifications are being implemented particularly to reduce the induced effects of microvibrations propagating to the instrument. The Instrument and Mission Preliminary Design Review are onogoing to include the design changes with planned completion in mid 2015.

For MTG-S, the criticality of the Infrared Sounder (IRS) drives the critical path. Similarly to the FCI, is mainly associated with the instrument Structure/Thermal Control, the Scan Assembly and the Detector Chain Assembly. Schedule margins currently present in the overall MTG-S schedule make it possible to keep the MTG-S1 launch date mid 2021.

3.1.1.2.2 Ground Segment and scientific activities

At ground segment level, the Mission Operations Facility (MOF) Preliminary Design Review (PDR) was closed out in October 2014 as expected. The subsystem level PDRs have now also been performed and the facility development is well on track. The MTG-I Instrument Data Processing Facility (IDPF-I) development is also progressing well and the PDR concluded in November 2014 as expected. Subsystem level developments and reviews are now ongoing.

The two Ground Stations contracts for both the Telemetry Tracking and Control (TT&C) and Mission Data Acquisition (MDA) Ground Station Facilities were kicked off in November 2014 and September 2014 respectively.
Progress on the science activities pursued by the Secretariat focussed to the generation of proxy data representing measurements of the different MTG instruments and the assessment of the Level 2 (L2) processing algorithms. These activities, including the related software prototyping, have involved the external visiting scientists and have conducted under the guidance from Scientific Working Group of STG and dedicated Mission Advisory Groups..

3.2 Status of future LEO satellite systems

This section covers EPS-SG; Jason 3 and CS; and Sentinel 3.

3.2.1 EPS-SG

This section presents the status of the EPS Second Generation (EPS-SG) Preparatory Programme activities, which started in October 2012.

The scope and contents of the EPS-SG Programme were approved by EUMETSAT Delegations in July 2014 confirming that there will be a series of three spacecraft of Metop-SG A and B, with a 7.5-year design lifetime of each satellite covering at least 21 years of operations for each series of satellites. At the same time Council has adopted a resolution authorizing the Secretariat to proceed with the full programme implementation as soon as 95% of the financial envelope is covered by commitments of the Member States. It is expected that this level will be reached in June 2015.

Schedule

Phasing of the EPS-SG Programme is planned as follows:

Phase B	Preliminary Definition	Q4 2012 –mid 2015
Phase C,D	Detailed Definition, Production	2015 – 2021
Phase E	Utilisation	from 2021

The foreseen EPS-SG satellite deployment scenario is as follows:

- Nominal launch of Metop-SG A1:	2021
- Nominal launch of Metop-SG B1:	2022
- Nominal launch of Metop-SG A2:	2028
- Nominal launch of Metop-SG B2:	2030
- Nominal launch of Metop-SG A3:	2035
- Nominal launch of Metop-SG B3:	2036

EPS-SG Mission objectives, spacecraft, payload/instruments, products

The EPS-SG encompasses the following observation missions:

- The Infra-red Atmospheric Sounding mission (IAS), to provide temperature and humidity profiles, as well as observations of ozone and various trace gases, through a wide swath of hyper-spectral infra-red soundings in four bands from 3.62 to 15.5 µm, with radiometric and spectral resolutions improved by factor 2 vs. IASI and consistent spatial sampling of about 25 km.

- The Microwave Sounding mission (MWS), to provide all-weather atmospheric temperature and humidity profiles, as well as cloud liquid water columns, over a wide swath in the spectral region between 23.4 and 229 GHz, with footprints from 40 down to 17 km at the highest frequencies.

- The Scatterometry mission (SCA), to provide ocean surface wind vectors and land surface soil moisture by measurement of back-scattered signals at 5.3 GHz with spatial resolution of 25 km.

- The Visible/Infra-red Imaging mission (VII), for providing information on clouds, cloud cover, land surface properties, sea, ice and land surface temperatures, among other observations, by moderate-resolution optical imaging, in 20 spectral channels ranging from 0.443 to 13.345 µm, with a spatial sampling of 500 m (250 m in two channels).

- The Microwave Imaging mission (MWI), for precipitation and cloud imaging through measurements in the spectral range from 18.7 to 183 GHz with footprints from 10 to 50 km (for the highest to lowest frequency respectively).

- The Ice Cloud Imaging mission (ICI), to provide ice-cloud and water-vapour imaging in 11 channels (2 of which being dual-polarisation)by exploiting sub-millimetre-wave observations from 183 to 664 GHz with footprints of 15 km.

- The Radio Occultation mission (RO), for atmospheric all-weather soundings of temperature and humidity at high vertical resolution, and additionally ionospheric electron content in support of space weather, by tracking signals from global navigation satellites, GPS and Galileo at least.

- The Nadir-viewing Ultraviolet, Visible, Near-infra-red, Short-wave-infra-red Sounding mission (UVNS), to provide ozone profiles, monitor various trace gases, monitor air quality and support climate monitoring by means of hyper-spectral soundings with a spectral resolution from 0.05 to 1 nm in the wavelength range from 0.27 to 2.385 µm, at a spatial sampling of 7 km for channels above 0.3 µm.

- The Multi-viewing, Multi-channel, Multi-polarisation Imaging mission (3MI), for aerosol observations by moderate resolution optical imaging in 12 spectral channels from the ultra-violet (0.410 µm) to the short-wave infra-red (2.13 µm), at a spatial sampling of 4 km.

The IAS, MWS, SCA, VII, RO and UVNS missions provide continuity and improvements to missions currently provided with the Metop satellites. The MWI, ICI and 3MI are new missions with respect to Metop first generation, drawing from the experience with other experimental or operational missions.

In addition to the above observation missions, EPS-SG satellites will embark payload to provide the following service in the frame of a relevant cooperation and in continuity to EPS:

- ARGOS Advanced Data Collection Service (A-DCS), for the worldwide collection from in-situ platforms of oceanographic and meteorological data and their transmission to the user community.

The mapping between the EPS-SG missions and the corresponding instruments to be carried on the Metop-SG satellites is given below:

Metop-SG A Missions	Instrument (and Provider)	Predecessor on Metop
Infrared Atmospheric Sounding (IAS)	IASI-NG (CNES)	IASI (CNES)
Visible-Infrared Imaging (VII)	METimage (DLR)	AVHRR (NOAA)
Microwave Sounding (MWS)	MWS (ESA)	AMSU-A (NOAA) MHS (EUM)
Radio Occultation (RO)	RO (ESA)	GRAS (ESA)
Multi-viewing, -channel, -polarisation Imaging (3MI)	3MI (ESA)	-/-
UV/VIS/NIR/SWIR Sounding (UVNS)	Sentinel-5 (Copernicus/ ESA)	GOME-2 (ESA)

Table 1: EPS-SG missions and corresponding instruments on Metop-SG A

Metop-SG B Missions	Instrument (and Provider)	Predecessor on Metop
Scatterometry (SCA)	SCA (ESA)	ASCAT (ESA)
Microwave Imaging for Precipitation (MWI)	MWI (ESA)	-/-
Ice Cloud Imaging (ICI)	ICI (ESA)	-/-
Radio Occultation (RO)	RO (ESA)	GRAS (ESA)
Advanced Data Collection (ADCS)	A-DCS4 (CNES)	A-DCS3 (CNES)

Table 2: EPS-SG missions and corresponding instruments on Metop-SG B

For the delivery to the users of the mission data, services are defined which are similar and continue the services available with EPS, including:

- Near Real Time (NRT) Data Dissemination, for the distribution of Level-1 data (instrument measurements after radiometric and spectral calibration, and geo-referencing) with timeliness between:
  - 120 minutes (for 90% of the data, so called “Threshold” requirement); and

- 70 minutes (for 95% of the data, so called “Breakthrough” requirement) for global data; and down to
- 30 minutes at regional scale (data taken over Europe and the North Atlantic Ocean, for 95% of the data, “Breakthrough” requirement);

- as well as Level-2 data (geophysical variables) with timeliness increased by the relevant processing time (estimated in up to 10 minutes); the distribution will occur by various means such as EUMETCast, the internet, the GTS/RMDCN networks.

- Direct Data Broadcast, for the continuous and instantaneous transmission by the satellites of the instruments’ data being acquired;

- Non-NRT Dissemination, for the distribution of data whose delivery is not time-critical;

- Archiving and Retrieval, for the archiving of mission data in the multi-mission EUMETSAT Data Centre and their availability for off-line retrieval and reprocessing.

3.2.2 Jason-3 and follow-on

The Jason-3 mission is a joint effort among four organizations: NOAA (National Oceanic and Atmospheric Administration), EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites), CNES (Centre National d'Etudes Spatiales), and NASA (National Aeronautic and Space Administration), to measure sea surface height by using a radar altimeter mounted on a low-earth orbiting satellite. The collection of precise measurements of sea surface height is essential for ocean climatology and ocean weather applications. Ocean climatology includes global sea-level rise, a key indicator of climate change, decadal variability in the ocean, seasonal/inter-annual variability, and coastal variability and its impact on ecosystems. Ocean weather involves operational oceanography, surface wave forecasting and evaluation, and hurricane intensity forecasting.

The Jason-3 mission will ensure the continuity of the 20 plus year data record started with TOPEX/Poseidon in 1992 and continued with Jason-1 and 2. The launch of Jason-3 is planned in July 2015 with a 6-month overlap with Jason-2. The overlap period will be used to conduct initial cross-calibration and validation activities, complete on-orbit check-out operations, and maintain consistent observations of sea surface height between the successive altimeter missions.

From a satellite standpoint, after having performed all environmental and performance test, the satellite was stored on 11 December 2014 and the Flight Acceptance Review (FAR) was declared successful on 17 December.

3.2.3 Jason CS

In order to ensure continuity of ocean altimetry measurements over the next 15 years, Partners in Europe and in the US are now working in on a new programme named Jason CS (Continuity of Service). The programme is based on two satellites, the first one being launched in 2020 covering the time span before a new technology can eventually become operational.

The Jason-CS Programme Proposal, Draft Programme Definition and Draft Enabling Resolution were submitted to the 82nd Council in November 2014. The potential participating states unanimously adopted the draft Declaration and associated Programme Definition. The full Council adopted the Enabling Resolution.

At the time of Council, 15 Member States have indicated their interest in participating in the Optional EUMETSAT Jason-CS Programme. This has allowed the opening of the Programme for subscription with a nominal end of this subscription period on 30 June 2015.

The satellite baseline design is now frozen and major satellite budgets have been consolidated with only a few remaining open points for which the way forward has been discussed and agreed also with the partners at the kick off meeting. A number of best practices for selection of the satellite components are now on going.

At system level, most of the work is dedicated to the preparation of the System Requirement Review part 2 (SRR2), which will take place at EUMETSAT end of May.

Work has also progressed on the ground segment. A ground segment requirement document is in preparation as well as functional model. A first ground segment meeting has been organized with the partners to report on this activity and initiate discussions on interfaces, deliverables and schedule.

3.2.4 Sentinel-3

Background

Copernicus (formerly GMES) will cover several areas of applications, among which EUMETSAT will play a key role as satellite data provider for the oceanography and atmosphere user communities. In response to the need for data in near real-time, together with guaranteed service levels, EUMETSAT will serve the Marine User community both with routine, near real time (sensing + 3h) and off-line products (sensing + 48h, sensing + 1m).

Starting from the successful completion of the In-Orbit commissioning of the first Sentinel-3 spacecraft, the scope of EUMETSAT’s operational role will be:

- Monitoring and control of spacecraft and flight operations segment;

- Payload data acquisition, consistent with the overall COPERNICUS ground segment design under ESA's responsibility;
- Product generation and dissemination of all Sentinel-3 products routinely required by the Marine User Community and the related downstream services;
- Serving the offline requests of the Marine User Community for Sentinel-3 products.

Complementing the Marine part of the mission, ESA will serve the Land Services Community including:

- Product generation and dissemination of all Sentinel-3 Land products routinely required by the Land community and the related downstream services;
- Serving the offline requests of the Land User Community for Sentinel-3 products.

To fulfil this operational role, EUMETSAT has undertaken, under a co-operation agreement with ESA, the development of a ground segment to serve the needs of the Sentinel-3 mission as well as for the routine operations to be engineered, validated and rehearsed by a dedicated operations team.

The role of EUMETSAT for the provision of the Sentinel-3 Services over the mission lifetime takes benefit from, and builds upon, the significant infrastructure investments that have already been made, and will continue to be made, by EUMETSAT in the areas of:

- Multi-mission operations within a unified Operational centre (MTP, MSG, EPS and Jason);
- A common gateway to enable users to have straightforward access to all EUMETSAT's data and products (via the EUMETSAT unified archive and retrieval facility and its interface to the future ESA Heterogeneous Mission Accessibility (HMA);
- Ground segment infrastructure, which allows the addition of further missions/services.

The Copernicus Agreement with the European Union authorising EUMETSAT to conduct the relevant Copernicus Space Segment operations, including the S-3 operations and build up phase, was signed on 7 November 2014.

Sentinel-3 Mission objectives, spacecraft, payload/instruments, products

The EUMETSAT part of the Ground Segment is mainly composed of two distinct segments:

- The Flight Operations Segment (FOS) for routine operations responsible for the satellite monitoring and control activities during the routine operations following the In-Orbit Commissioning Review (IOCR).

- A Payload Data Ground Segment (PDGS) responsible for the instrument data acquisition and product generation, dissemination and archiving. The Marine

PDGS Centre which is subset of the PDGS dealing with the marine data products generation, dissemination and archiving is located at EUMETSAT HQ.

The ESA development plan foresees the execution of a Ground Segment Verification (GSV) testing phase. This phase is led by ESA with the support of EUMETSAT and will complete with the End-To-End Ground Segment Acceptance Review. The GSV has been subdivided in three main phases named Compatibility, Integration and Verification phases:

- The Compatibility Test (CT) phase, aims to ensure the format compatibility of the data exchanged between the Flight Operation System (FOS) and Payload Data Ground Segment (PDGS) and to verify all the File Format Specifications, and was successfully completed in 2014 noting however that some final PDGS compatibility tests, pending the availability of the PDGS V2L-patch (V2LP) version of the PDGS, will be re-run as part of the integration and verification test;

- The Integration Test (IT) phase, aims to verify the connectivity between EUMETSAT and ESOC FOS and between FOS and PDGS in terms of networking and data exchange protocols, this started in September 2014 and should complete in May 2015;

- The Verification Test (VT), aims to verify the end-to-end functional and performance requirements of the Ground Segment, and will start in May 2015 and should complete in June 2015, prior to the completion of GS Acceptance Review (AR).

Sentinel-3 Ground Segment matters

Sentinel-3 Flight Operations Segment Status

The development of the FOS facilities has almost completed and the team is now starting preparation for warranty phase. **Sentinel-3 Payload Data Ground Segment (PDGS) Status**

The development of the PDGS is progressing, but is on the critical path due to the late delivery of software by industry.

Sentinel-3 Multi-Mission Element (MME) Status

The S3 MME Verification Reviews (VRs)/Acceptance Reviews (ARs) for the different MME functional groups was kicked off 18 February and the Steering Committee (SC) meeting was held on 19 March. The SC decided that due to a few outstanding but important activities, for example, MME load testing, there is a need to organise a review closeout at the end of May. Although the acceptance of the MMEs could not be declared, convergence is expected in the next two months, in line with the S3 schedule needs. Nevertheless, it was agreed that the current MME versions are suitable to support the next phase, the S3 IVV campaigns.

4 CONCLUSIONS

This document summarises the status of EUMETSAT current and future satellite systems.

CGMS is invited to take note.