

EUMETSAT Plans

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Abstract

In this paper EUMETSAT programmes, both mandatory and optional, are summarised. EUMETSAT is currently operating the Meteosat-6/7 and two satellites of the Second Generation of Meteosat (Meteosat Second Generation (MSG-1 and MSG-2)), now named Meteosat-8 and Meteosat-9. The MSG-3/4 satellites are under storage or production respectively (Tentative launch dates are January 2011 and January 2013 respectively.). The MSG Programme has been developed in co-operation between EUMETSAT and ESA. In parallel, EUMETSAT has developed jointly with ESA, NOAA and CNES EUMETSAT Polar System (EPS). After the successful launch of Metop-A, the first of a series of three satellites, on 19th October 2006, Metop-A provides operational services from the mid-morning polar orbit in the frame of the Initial Joint Polar System (IJPS) with the US. Tentative launch dates for Metop-B is April 2011. The EUMETSAT Advanced Retransmission Service (EARS) continued its operational services and provides observations from partner HRPT (High Resolution Picture Transmission) stations. Jason-2 is EUMETSAT's first optional programme, which will provide operational Ocean Surface Topography information services. It is a joint programme with CNES, NOAA and NASA. The launch of Jason-2 is planned on 19th June 2008. Preparations for Meteosat Third Generation (MTG) and Post EPS are under way. A MTG preparatory programme was approved by the EUMETSAT Council in 2007.

Introduction

EUMETSAT, the European Organisation for the Exploitation of Meteorological Satellites contributes to the WMO Space Programme with a number of operational meteorological satellites. The related satellite programmes include the European geostationary meteorological satellite system (Meteosat first generation under the Meteosat Transition Programme (MTP), and the Meteosat Second Generation (MSG)). The EUMETSAT Polar System (EPS) is EUMETSAT's contribution to the low

Earth orbiting, sun synchronous weather satellites system (Initial Joint Polar System (IJPS) with the Unites States). Together with these systems User and Data Services are provided.

Programmatic Aspects

EUMETSAT Polar System (EPS)

The EUMETSAT Polar System (Klaes et al., 2008) complements the US provided system and provides services in the mid-morning orbit. Together with the US it continues the NOAA polar orbiting satellite system in the frame of the Initial Joint Polar System (IJPS). The EUMETSAT satellites of EPS are the Metop (METeorological OPERational) satellites, jointly developed with ESA (Edwards et al., 2006). They provide hyperspectral sounding and high-resolution imagery in global coverage. The EPS programme activities have started in September 1998, while full approval to the programme was given in June 1999. The Metop satellites are flown in a Sun synchronous orbit with 9:30 a.m. equator crossing (descending node). After the successful launch of Metop-A on 19th October 2006 EPS provides data and products. Metop-B and Metop-C respectively, will follow Metop-A. They are recurrent copies. Metop satellites have a nominal lifetime of 5 years.



Figure 1: EPS Space Segment (Metop launch 19 October 2006 from Baikonur).

No HIRS/4 will be flown on Metop-C, as IASI will have proven its value. The EPS programme will cover at least 14 years of operation. For mission objectives and expected capabilities see Klaes et al. (2007).

Geostationary Systems

Meteosat-7 provided since 1997 the European meteorological geostationary satellite data coverage under the Meteosat Transition Programme (MTP). Meteosat-7 has the same capabilities as its predecessors. Together with the first MSG satellite Meteosat-8, Meteosat-7 was operated as part of a redundant two-satellite system until June 2006. The first spacecraft of the MSG Programme was successfully launched in August 2002 and started its operational service in January 2004. It has significant improvements in the observation capability and a nominal lifetime of seven years. In addition to the main observation mission it embarks a climatology experimental mission (the Geostationary Earth Radiation Budget (GERB) Instrument), a Search and Rescue mission and a mission communication payload. The second satellite of this series, MSG-2, was launched on 21st December 2005. It is currently providing the the operational satellite service at 0° W as Meteosat-9. Meteosat-8 was relocated to 9.5 ° E in March 2008 and is currently providing rapid scan services over Europe. MSG-3 and MSG-4 are foreseen to be launched in 2011 and 2013.

The Meteosat-8, and -9 satellites represent the current operational geostationary satellites. The Indian Ocean Coverage with Meteosat-5 ended and Meteosat-7 (after successful commissioning of MSG-2/Meteosat-9) took over this service at 57.5° E. The direct dissemination service of Meteosat-7 ended 14/06/2006. Meteosat-6 provides coverage for the Data Collection Platform and back up to imagery mission over the Indian Ocean at 67.5 °E .

Optional Programmes: Jason-2

The Jason-2 programme EUMETSAT's first optional programme. EUMETSAT will contribute to the operations of the overall system and to the generation of the data stream, using a European Earth Terminal and a real time processing chain.

Within this programme EUMETSAT contributes to a joint undertaking with four agencies: EUMETSAT, the French Centre National d'Etudes Spatiales (CNES), the US National Oceanic and Atmospheric Administration (NOAA) and the US National Aeronautics and Space Administration (NASA). This forms the Ocean Surface Topography Mission (OSTM). OSTM is an important element in the overall altimetry data system and will bring high precision altimetry to a full operational status. The launch of Jason-2 is planned for the 15 June 2008 from Vandenberg AFB, Ca., U.S.A.

EUMETSAT and NOAA will process and disseminate the Near Real Time products, whereas CNES will process and deliver off-line high precision products.

SPACECRAFT AND INSTRUMENTS

EUMETSAT Polar System (EPS/Metop)

The Metop satellites of EPS are launched into a Sun synchronous, near polar orbit with an equator crossing time of 09:30 AM (descending node), i.e. the so called (mid-)morning orbit. To achieve the mission objectives in operational meteorology and climate monitoring an appropriate payload is embarked on Metop, with a number of sounding instruments. Novel technology and hyperspectral infrared sounding capability is provided by the IASI (Infrared Atmospheric Sounding Interferometer) instrument, improving soundings both in unprecedented accuracy and also vertical and horizontal resolution. The HIRS/4 (High Resolution Infrared Radiation Sounder) instrument, the AMSU-A (Advanced Microwave Sounding Unit - A) and the MHS

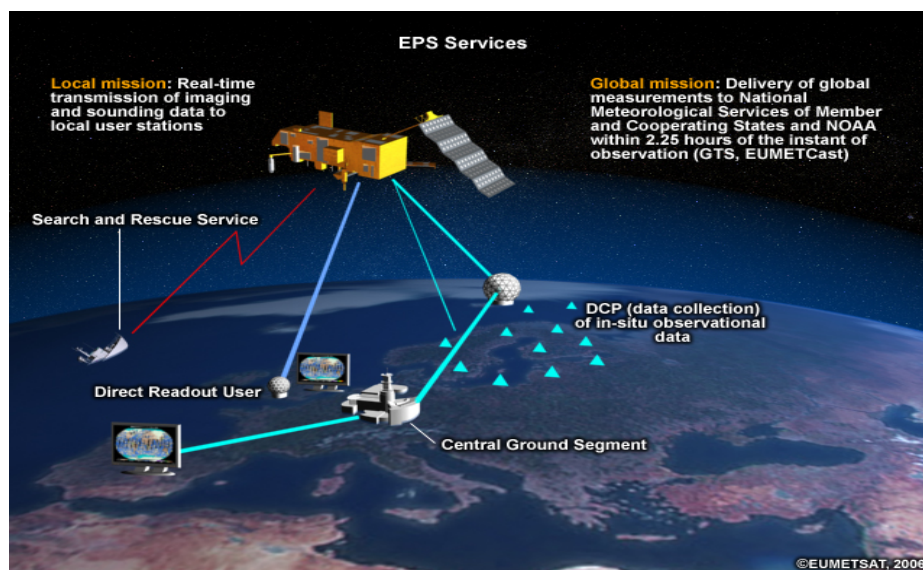


Figure 2. EPS services.

(Microwave Humidity Sounder) instrument as successor of AMSU-B (MHS was developed by EUMETSAT), provide the continuity to the current polar sounding capabilities onboard the NOAA-15, NOAA-16 and NOAA-17 spacecraft and complement the payload of the first IJPS spacecraft, NOAA-18, in orbit since May 2005. The sounding payload is complemented by the proven AVHRR/3 (Advanced Very High-Resolution Radiometer) multi-spectral imager, which will provide visible and infrared imagery at high horizontal resolution. EPS products are processed centrally, level 1

products from all instruments and level 2 sounding products from ATOVS and IASI (from the EPS Core Ground Segment (CGS)) and in the distributed Satellite Application Facilities, which provide a large number of level 2 and higher level products (see Figure 2 for EPS services.). All products are operational.

Instruments, successfully flown as research missions, are now flown in longer term operational service. The Global Ozone Monitoring Experiment (GOME-2) for ozone profiling and trace gas retrieval continues the services of the GOME-1 instrument on ESA's ERS-2 and will provide product to support global change monitoring, climate monitoring and atmospheric chemistry. An Advanced Scatterometer (ASCAT) will provide improved retrieval capabilities to derive wind vectors at the ocean surface, continuing the successful SCAT instrument on ESA's ERS-1 and ERS-2 satellites.

GRAS (GNSS Radio-Occultation Atmospheric Sounder) will provide further sounding capabilities, which will make use of the information on the atmosphere and ionosphere contained in the GPS navigation satellite signals through the radio-occultation technique. It will be the first operational radio-occultation mission for meteorology and climate monitoring. A full system including a GRAS Ground Support Network (GSN) to support the clock error corrections required for the GPS and Metop clocks as well as a precise orbit determination service will be installed.

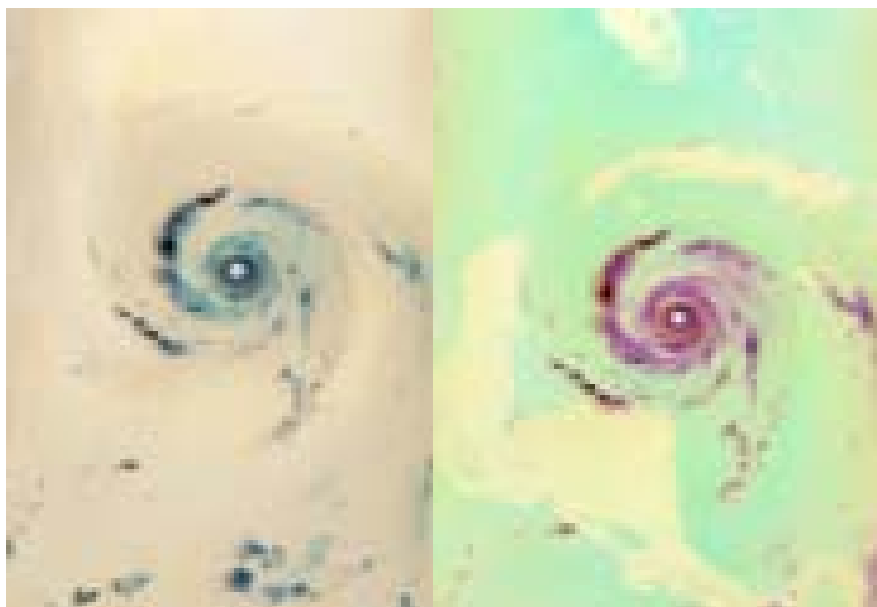


Figure 3: Hurricane "Dean", seen with MHS from Metop-A, RGB MHS Ch5Ch4CH3 (left), RGB MHS Ch1Ch2Ch3 (right), 20 August 20071457 UTC.

Metop-A was successfully launched in October 2006 and declared operational in March 2007. Data and products were made available for users the earliest as possible during the commissioning phase (Spoto et al., 2006) already. All products are now operational (see Figure 3 for an example) and have

already in 2007 demonstrated their positive impact on applications, namely Numerical Weather Prediction. Preparation for Metop-B has started.

After successful investigation of the root cause of an anomaly with the HRPT service, which caused its switch off in July 2007, a re-switch on with periodical operations over areas, where the risk of heavy ion impact has low probability, is being planned.

Improvements of the product timeliness is planned through an Antarctic Data Acquisition (ADA) service being investigated in co-operation with NOAA.

Geostationary Satellites

Meteosat Transition Programme

The first generation Meteosat and the equivalent Meteosat Transition Programme Satellites (Meteosat-7) have as payload a three-channel imager with broad-band channels in the visible, infrared, and water-vapour regions of the spectrum. The spacecraft is spin stabilised with 100 rotations per minute. The imager yields a full disk image every 30 minutes. The sampling distance at the sub satellite point is 2.5 km for the visible, 5 km for the infrared and water vapour channels. There are 5000 x 5000 pixels of visible and 2500 x 2500 pixels of infrared and water vapour channel data per full disk image. The products include satellite-tracked winds, cloud products, upper level tropospheric humidity, and others. Meteosat-7 has been transferred towards a position at 57.5 ° over the Indian Ocean to provide the IODC, after Meteosat-9 became operational. The decision that Meteosat-9 is the primary operational spacecraft was taken after the Steering Committee of the Image Product Validation Review of MSG-2 on 05 March 2007.



Figure 4. IODC service with Meteosat-7, 26 February 2007.

Meteosat Second Generation

The Meteosat Second Generation spacecraft is also a spin-stabilised satellite. Its payload comprises

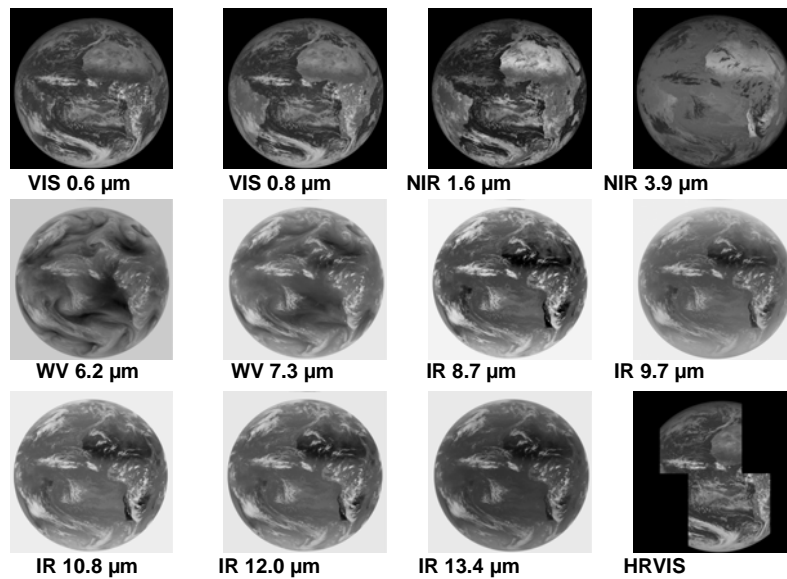


Figure 5: MSG capabilities: Example images from 12 SEVIRI Channels.

The Spinning Enhanced Visible and Infrared Imager - SEVIRI) with 12 different spectral channels

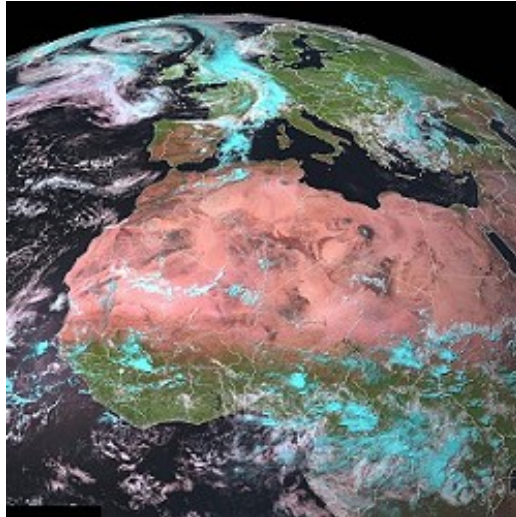


Figure 6: Meteosat-8 RGB, 04072005 1415 UTC.

(see Figure 5) in the visible and infrared region of the spectrum (see example image in Figure 6) and the GERB (Geostationary Earth Radiation Budget) instrument intended to provide measurements of the Earth Radiation Budget from geostationary orbit. As new products stability parameters will be derived from pseudo-sounding (e.g. lifted index). Humidity fields are derived in the upper and mid-troposphere and total ozone fields are estimated. The sampling of the image data at the sub-satellite point are 3 km with exception of the High Resolution Visible channel (HRV), where the resolution is planned to be 1 km. The full disk image is composed of 3750 x 3750 pixels (except for HRV). One full disk image is provided every 15 minutes, but alternative repeat cycles up to 3 minutes are also possible. In HRV mode the scan area can be selected among predetermined rectangular blocks. Products are generated in the ground segment facilities at EUMETSAT's HQ and in the distributed part of the EUMETSAT application ground segment, the Satellite Application Facilities (SAF's). Meteosat-9 is providing the operational service over 0° W, whereas Meteosat-8 provides rapid scan service for Europe over 9.5 °E.

EUMETSAT ADVANCED RETRANSMISSION SERVICE

EUMETSAT provides a fast delivery service of Advanced TOVS data, based on HRPT stations for the North Atlantic and European Area. The service was installed based on an initiative of the members of the HIRLAM Group (Denmark, Finland, Ireland, The Netherlands, Norway, Spain, Sweden and Iceland) in November 2000. The service provides ATOVS level 1a and level 1c data with a timeliness of 30 minutes to cover the needs of EUMETSAT Member States regional and local numerical weather prediction requirements for sounder data. Today the data of ten HRPT stations are distributed The

operational phase will be continued and extended for use with NOAA-N and Metop. ASCAT level 1b dissemination and AVHRR will be part of the service. It is planned to add IASI as well. More details can be found on EUMETSAT's web site (see <http://www.eumetsat.int>, on the EARS (EUMETSAT Advanced Retransmission Service) home page.)

Outlook

EUMETSAT and ESA have in 2001 jointly started the process to define the follow on service for the geostationary satellite service, the Meteosat Third Generation (MTG), aimed at having the first satellite in orbit around 2015. Several user and expert workshops have been conducted, and baseline concepts are being explored. Missions investigated are a) Multispectral imaging (SEVIRI continuity, but enhanced capability), b) Infrared high spectral resolution sounding, c) Lightning imager, d) UV sounding. A preparatory programme has been approved at EUMETSAT level to cover the close out of phase A activities and the Phase B. ESA is in parallel running Phase A studies, entering phase B after their Council at ministerial level in November 2008. The final payload will be decided in autumn 2008. The detailed design and production of the Satellites and of the Ground Segment is planned to start after the approval by EUMETSAT Council of the programme proposal for the Development and Operations Phase in 2010.

The requirements analyses for the post-EPS era have also been started and a mission team has been formed. They aim for a need date in 2018 (core-mission) / 2020 (full mission) for an EPS follow-on service.

EUMETSAT is working with ESA to implement the operations of the Sentinel-3 satellite of the Global Monitoring for Environment and Security (GMES) initiative of the EU and ESA.

Conclusions

EUMETSAT's contribution to the global system of satellite observation within the WMO Space Programme comprise considerably improved sounding capabilities which provide a major contribution towards the improvement of operational meteorological services, in particular numerical weather prediction. Impact studies for various instruments on Metop have shown that the forecast skill does improve. The MSG satellites are currently the most advanced geostationary meteorological satellites. An important contribution to climate monitoring arises from EPS and the coming programmes and satellites. Further contributions from EUMETSAT include optional programmes like the Jason-2 data processing and distribution.

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