7.3 METEOSAT SECOND GENERATION (MSG): STATUS AFTER LAUNCH

Johannes Schmetz*, Marianne König, Paolo Pili, Sergio Rota, Alain Ratier and Stephen Tjemkes
EUMETSAT, Darmstadt, Germany

1. INTRODUCTION

The first satellite of a new series of European geostationary meteorological satellites, Meteosat Second Generation (MSG-1) (see Figure 1), has been launch from on 28 August 2002 with an Ariane-5 launcher from the Kourou launch site. MSG is spin-stabilised, as the current Meteosat series, however with greatly enhanced capabilities: The twelve-channel imager, called SEVIRI (Spinning Enhanced Visible and Infrared Imager) observes the full disk of the Earth with an unprecedented repeat cycle of 15 minutes. SEVIRI has eight channels in the thermal infrared (IR) at 3.9, 6.2, 7.3, 8.7, 9.7, 10.8, 12.0 and 13.4 µm, three channels in the solar spectrum at 0.6, 0.8, 1.6 µm and a broad-band high resolution visible (see Table 1). The high resolution visible channel has a spatial resolution of 1.67 km at nadir; pixels are oversampled with a factor of 1.67 corresponding to a sampling distance of 1 km at nadir. The corresponding values for the eight thermal IR and the other three solar channels are 4.8 km spatial resolution at nadir and an oversampling factor of 1.6, which corresponds to a sampling distance of 3 km at nadir.

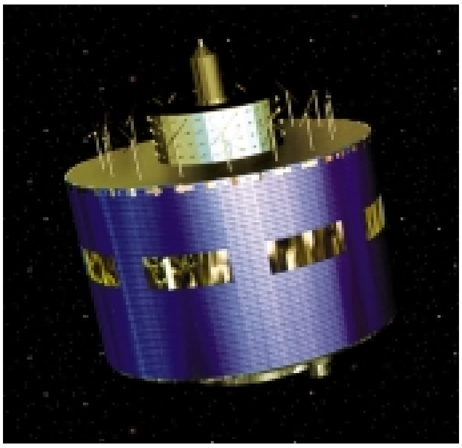

Fig. 1: MSG spacecraft; as with the current Meteosat series, MSG satellites are spin stabilized.

Radiometric performance of all channels is better than specifications (see Table 2). Thermal IR channels have an onboard calibration with an accuracy better than 1 K. Solar channels are calibrated with an operational vicarious procedure aiming at an accuracy of 5%. Meteorological products are derived in so-called Satellite Application Facilities (SAF) and in the central Meteorological Product Extraction Facility (MPEF) at EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites) in Darmstadt. The products support Nowcasting, Numerical Weather Prediction (NWP) and climatological applications. The most important product for NWP, the Atmospheric Motion Vectors, is derived from different channels to improve data coverage and quality. Novel products are, amongst others, Indices describing the instability of the clear atmosphere and Total Column Ozone. As additional scientific payload MSG carries a Geostationary Earth Radiation Budget (GERB) instrument observing the broadband thermal infrared and solar radiances exiting the Earth-atmosphere system. The MSG programme covers a series of three identical satellites, MSG-1, -2, and –3, which are expected to provide observations and services over at least 12 years. Each satellite has an expected lifetime of 7 years. MSG is planned as a two-satellite operational service, like the current Meteosat system, where one satellite is available in orbit as spare.
The capabilities, products and applications of MSG have been described in detail by in a recent paper by Schmetz et al. (2002) and the interested reader is referred to this paper for more detail. This extended abstract only recalls the salient features of MSG and its main payload SEVIRI (Spinning Enhanced Visible and Infrared Imager) and provides an update on the near-future plans until the start of the operational phase of MSG-1 in fall 2003.

2. OBSERVATIONS WITH SEVIRI

The primary mission of MSG is the continuous observation of the Earth's full disk. A repeat cycle of 15 minutes for full-disk imaging provides unprecedented multi-spectral observations of rapidly changing phenomena (e.g. deep convection) and provides better and more numerous wind

* *Corresponding author address*: Dr. Johannes Schmetz, EUMETSAT, Am Kavalleriesand 31, 64295 Darmstadt, Germany, e-mail:schmetz@eumetsat.de

observations from the tracking of rapidly changing cloud features. The imaging is performed, by combining satellite spin and rotation (stepping) of the scan mirror. The images are taken from South to North and East to West. The E-W scan is achieved through the rotation of the satellite with a nominal spin rate of 100 revolutions per minute. The spin axis is nominally parallel to the North-South axis of the Earth. The scan from South to North is achieved through a scan mirror covering the Earth's disk with about 1250 scan lines; this provides 3750 image lines for channels 1 through 11 (Table 1) since 3 detectors for each channel are used for the imaging. For the HRV (channel 12) 9 detectors sweep the Earth for one line scan. A complete image, i.e. the full disk of the Earth, consists of nominally 3712 x 3712 pixels for channels 1 through 11. The HRV channel covers only half the full disk in E-W direction and therefore a complete image consists of 11136 x 5568 pixels. A nominal repeat cycle is a full disk imaging of about 12 minutes, followed by the calibration of thermal IR channels with an on-board blackbody which is inserted into the optical path of the instrument. Then the scan mirror returns to its initial scanning position. It should be noted that the number of line scans is programmable such that shorter repeat cycles (rapid scans) can be performed. The operational utilisation of this 'rapid scan' capability will be defined with the operational user community once relevant experience has been gained with MSG-1.

Channel No.		Characteristics of Spectral Band (µm)			Main gaseous absorber/ window
		λ_{cen}	λ_{min}	λ_{max}	
1	VIS0.6	0.635	0.56	0.71	window
2	VIS0.8	0.81	0.74	0.88	window
3	NIR1.6	1.64	1.50	1.78	window
4	IR3.9	3.90	3.48	4.36	window
5	WV6.2	6.25	5.35	7.15	water vapor
6	WV7.3	7.35	6.85	7.85	water vapor
7	IR8.7	8.70	8.30	9.1	window
8	IR9.7	9.66	9.38	9.94	ozone
9	IR10.8	10.80	9.80	11.80	window
10	IR12.0	12.00	11.00	13.00	window
11	IR13.4	13.40	12.40	14.40	Carbon dioxide
12	HRV	Broadband (about 0.4 – 1.1 µm)			window/water vapor

Table 1: Spectral channel characteristics of SEVIRI providing central, minimum and maximum wavelength of the channels and whether the channel is an absorption or a window channel.

Channel	Short term radiometric error Performances	Short term radiometric error requirements	In-flight performance of Meteosat-7
HRV	0.63 at 1.3 W/ (m^2 sr µm)	1.07 at 1.3 W/ (m^2 sr µm)	
VIS0.6	0.27 at 5.3 W/ (m^2 sr µm)	0.53 at 5.3 W/ (m^2 sr µm)	
VIS0.8	0.21 at 3.6 W/ (m^2 sr µm)	0.49 at 3.6 W/(m^2 sr µm)	
NIR1.6	0.07 at 0.75W/ (m^2 sr µm)	0.25 at 0.75 W/ (m^2 sr µm)	
IR3.9	0.17K at 300K	0.35K at 300K	
WV6.2	0.21K at 250K	0.75K at 250K	0.25K at 250K
WV7.3	0.12K at 250K	0.75K at 250K	
IR8.7	0.10K at 300K	0.28K at 300K	
IR9.7	0.29K at 255K	1.5K at 255K	
IR10.8	0.11K at 300K	0.25K at 300K	0.3K at 300K
IR12.0	0.15K at 300K	0.37K at 300K	
IR13.4	0.37K at 270K	1.80K at 270K	

Table 2: Noise equivalent radiances and temperatures for the he solar channels and thermal infrared channels, respectively, of the SEVIRI instrument on MSG-1. The values in the table refer to the 'end of life' of the satellite and compare actual performance with requirements. Performance values were obtained from tests at satellite level complemented by a prediction of in-flight performance at the end of life. Thermal IR channel noise refers to a focal plane temperature of 95 K. The last column provides the actual performance of comparable channels from Meteosat-7; note that the Meteosat-7 channels are spectrally broader and therefore receive more radiation energy.

3. GROUND SEGMENT

The EUMETSAT multi-mission Ground Segment is composed of a set of i) central facilities, located at EUMETSAT headquarters, in Darmstadt, Germany, ii) a primary and a back-up ground station for satellite control and data acquisition and iii) a geographically distributed network of so-called Satellite Application Facilities (SAFs). The central facilities control the EUMETSAT satellites through the relevant Ground Stations, pre-process all data acquired from these satellites up to level 1.5. In the case of MSG, pre-processing is performed by the Image Processing Facility (IMPF), where level 1.5 image data are produced from the level 1 data. The essential processing steps comprise: i) correction for differences in detector response (3 detectors for all channels, except the High Resolution Visible with 9 detectors), ii) compensation for non-linearity in manner similar to the one performed for GOES (Menzel and Purdom, 1994), iii) geometrical correction into a standard reference projection which also includes the registration between channels. The resulting level 1.5 data have a 10 bit digitisation and provide the basis for all further processing and for the derivation of meteorological products. Relevant calibration information is part of the level 1.5 image data stream that is broadcast via the satellite.
The Satellite Application Facilities (SAFs) are a distributed element of the EUMETSAT Applications Ground Segment. The novel idea behind the network of SAFs is that more products from MSG (and the future EUMETSAT Polar System) can be derived capitalising on specialised scientific expertise at National Meteorological Services and other National entities across the member states in Europe. Each SAF is expected to provide operational services to end-users, i.e. real-time and/or off- line product services, distribution of user software packages and data management (for more details see Schmetz et al, 2002).

4. GERB

The Geostationary Earth Radiation Budget Experiment (GERB) is a visible-infrared radiometer for Earth radiation budget studies (Harries, 2000). It makes accurate measurements of the shortwave (SW) and longwave (LW) components of the radiation budget at the top of the atmosphere. It is the first ERB experiment from geostationary orbit. It measures the solar waveband from 0.32 – 4 µm and the total from 0.32 – 30 µm. The LW from 4 – 30 µm is obtained through subtraction. With a nominal pixel size of about 45 by 40 km (NS x EW) at nadir view it obtains an absolute accuracy better than 2.4 Wm-2ster-1 (< 1%) in the SW and better 0.4 Wm-2ster-1 for the SW. The cycle time for full disk is 5 minutes for both channels (15 minutes for full radiometric performance). The derivation of products, i.e. radiation budget components at the top of the atmosphere, from GERB is described by Dewitte et al. (2000).

5. CURENT STATUS AND PLANS

MSG-1 was launched on 28 August 2002 at 22.45 UTC with an Ariane 5 launcher (see Figure 2) into a geostationary transfer orbit with excellent accuracy which will benefit the expected lifetime.

Fig. 2: Launch of MSG-1 with co-passenger Atlantic Bird with an Ariane-5 launcher from Kourou.

The European Space Operations Centre (ESOC) of the European Space Agency (ESA) took over control of the satellite after separation from the launcher. ESOC successfully performed the manoeuvres to place the satellite into a quasi-geostationary orbit with the satellite drifting towards to the commissioning longitude at 10.5°W. This longitude was reached on 18 September 2002 and on 25 September the hand-over of MSG-1 to EUMETSAT took place.

All platform units aboard the satellite work nominally. First SEVIRI images are expected in the last half of October 2002. A first and limited trial dissemination of image data with calibration and products will start in January 2003. The test flow of data from the GERB instrument will start around November/December 2002. It is interesting to note that MSG-1 will be renamed to Meteosat-8. The renaming takes place with the beginning of dissemination.

Following the first dissemination trial, a second trial period for image, calibration and product validation tests will start in summer 2003. The final Routine Operations Readiness Review is foreseen for November 2003, then MSG-1 (Meteosat-8) will be relocated to the nominal operational position at 0° longitude. Until then Meteosat-7 will remain at the nominal 0°longitude position to provide operational services. A continued parallel operation of both satellites is foreseen until end of 2005.

Additional information on MSG is available on the EUMETSAT webpage under www.eumetsat.de (go to Meteosat Second Generation) and www.eumetsat.de/saf/.

6. REFERENCES

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