

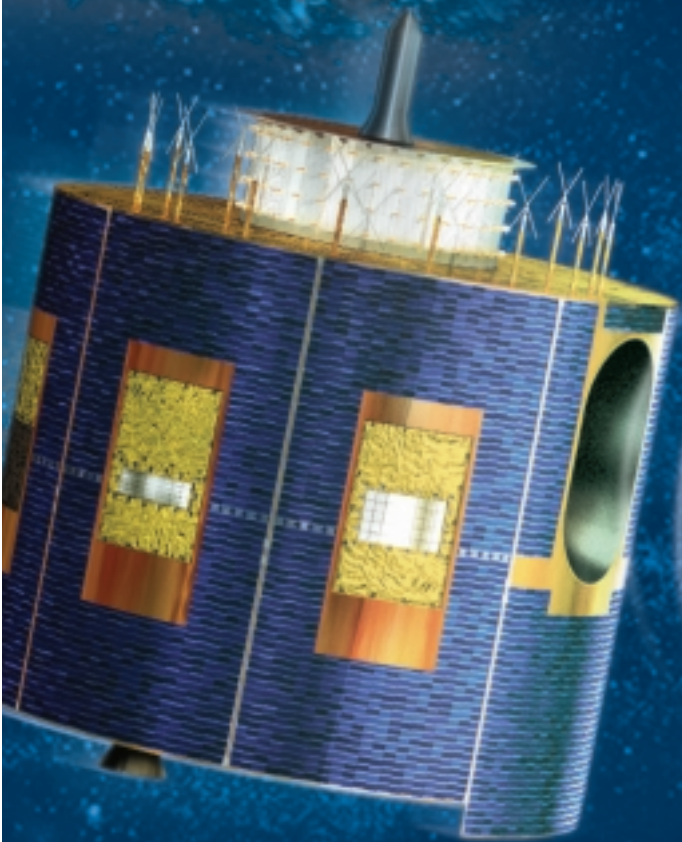
## METEOSAT SECOND GENERATION



### Contacts:

<b>EUMETSAT</b>	Am Kavalleriesand 31 D - 64295 Darmstadt Tel. +49 6151 807-377 Fax +49 6151 807-379
<b>ESA Head Office</b>	8-10 rue Mario Nikis F - 75738 Paris Cedex 15 Tel. +33 1 53 69 71 55 Fax +33 1 53 69 76 90
<b>ESA/ESTEC</b>	Keplerlaan 1 NL - 2200 AG Noordwijk Tel. +31 71 565 3006 Fax +31 71 565 7400
<b>ESA/ESOC</b>	Robert-Bosch-Str. 5 D - 64293 Darmstadt Tel. +49 6151 90 2696 Fax +49 6151 90 2961
<b>ESA/ESRIN</b>	Via Galileo Galilei I - 00044 Frascati (Rome) Tel. +39 06 94 18 09 51 Fax +39 06 94 18 09 52
<b>EUMETSAT website:</b>	<a href="http://www.eumetsat.de">www.eumetsat.de</a>
<b>ESA website:</b>	<a href="http://www.esa.int">www.esa.int</a>

# Meteosat Second Generation: New horizons for weather and climate

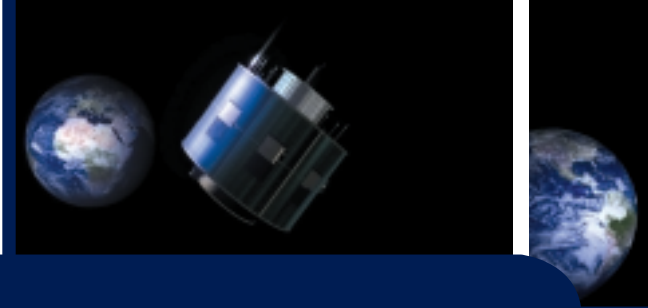


METEOSAT SECOND GENERATION





# Meteosat Second Generation: New horizons for weather and climate



## A generation change



Since the Meteosat satellite system was developed in the early Seventies it has achieved much more than ever imagined. Primarily supporting operational weather forecasting, it has also become vital for the study of climate.

For 25 years, Meteosat satellites have provided full Earth disc images every half-hour, day and night, in three spectral channels – around 1.5 million in all. In-orbit standby satellites have also provided data for experiments such as monitoring the Indian Ocean and rapid scanning of the Alpine region.

But now a new generation of more sophisticated weather satellites that will produce more precise data in a shorter time is poised to take over. Meteosat Second Generation (MSG) will bring big changes to the way we observe the weather. It will pinpoint extreme weather events so forecasters can predict, for example, hurricanes and severe storms with far greater certainty.

## ESA-EUMETSAT partnership for a new satellite



The advanced MSG satellite is part of a meteorological geostationary satellite programme designed to primarily serve the needs of operational meteorological and climate monitoring user communities.

A series of three MSG satellites will provide more comprehensive and frequent data to meteorologists and climate monitoring scientists for at least the next 12 years. A fourth MSG satellite is foreseen to extend the service even longer. MSG will bring about a step change in the outcome of weather forecasting systems with benefits for the people of Europe and further afield.

The satellites are being developed through the combined expertise of ESA (the European Space Agency) with its experience in project management and innovation of space systems - and EUMETSAT (the European Organisation for the Exploitation of Meteorological Satellites). With a thorough understanding of users' needs, EUMETSAT is making a major investment of 1.3 billion Euro in the total programme over 12 years, including development of the ground

segment, procurement of the launchers and follow-on satellites and operation of the MSG system from its Mission Control Centre in Darmstadt, Germany.

With 30 years of planning, project management and innovation in space systems and first-hand experience from the first generation of Meteosat, ESA was ideally placed to develop the MSG satellites. It is contributing 378 million Euro of the total initial investment to the first satellite in the range, the remaining one third coming from EUMETSAT. The satellites are built by Alcatel Space Industries, involving more than 50 subcontractors from 13 European countries.

## Satellites for the 21st century

Geostationary meteorological satellites deliver regular, frequent and high quality images of one quarter of the Earth's disc. In this orbit, a satellite circles the Earth at the same speed as the planet rotates, and therefore appears to "hover" in one place – in the case of MSG above the Gulf of Guinea at 0° Longitude off the west coast of Africa. From this orbital position it provides images of Europe, Africa, part of the Indian Ocean and the Atlantic Ocean.



The latter region is particularly important because it is the development area for most of the weather systems affecting Europe. The geostationary satellite continuously scans the same quarter of the globe, showing the development and progression of weather systems in moving sequences.

According to independent research from Bramhill Consulting (UK), the current Meteosat system contributed in the 1980s to dramatic improvements in weather forecasting with three-day forecasts becoming as accurate as one-day predictions of the previous decade. Building on the success of these earlier satellites and 25 years of valuable European experience, MSG will bring further improvements.

Planned for launch in Summer 2002, MSG will transmit more than 20 times the information of its predecessor. With a spatial resolution of 1 km in the visible spectrum (instead of 2.5 km currently), it will beam down sharper images of the changing weather over an area including Europe, all of Africa, and some parts of Asia every 15 minutes, rather than 30 minutes. It will help to monitor developing weather systems over areas of sparse information, such as oceans, before they cause havoc inland. With its 12 channels

(the current Meteosat has three) it will provide meteorologists with new insights into the atmosphere, land and ocean surfaces. The improved resolution and frequency of data will significantly contribute to the accuracy of both short-term and medium-range weather forecasts.



In order to ensure continuous service over the next 12 years, two more satellites will follow MSG-1, guaranteeing a full operational service with a back-up satellite in orbit at all times. MSG-2 will be launched about 18 months after the commissioning of the first satellite, while MSG-3 will be stored until MSG-1 nears the end of its life. From the time of the MSG-2 launch there will be two satellites in orbit, one operational at 0° Longitude and the other on standby. A fourth MSG satellite of exactly the same design as the three predecessors is foreseen to ensure complete continuity until the end of the next decade.



Image courtesy of: MeteoSwiss

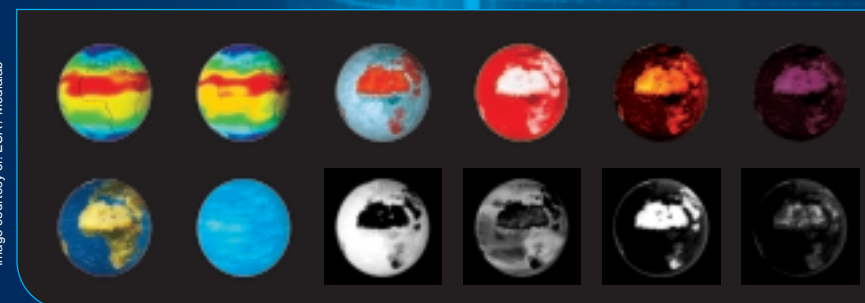
1 Satellite images are used for daily TV weather forecasting



Image courtesy of: ESA - J.L. Atteilyn

2 MSG satellite undergoing testing

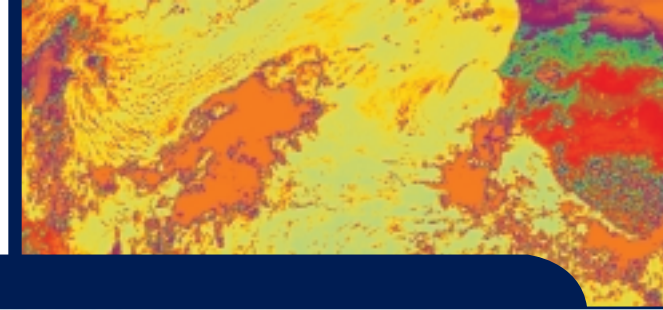
Image courtesy of: ESA / Medialab




3 MSG delivers images of the Earth in 12 spectral channels



# Meteosat Second Generation: New horizons for weather and climate



## Satellite control and data management

 To provide an uninterrupted service ensuring that data from MSG satellites in geostationary orbit reach the user communities, including national meteorological services, environment experts, commercial users and rescue organisations, EUMETSAT is developing a new ground processing and satellite control system. This will include networked elements distributed throughout Europe. The satellites will be managed from the EUMETSAT control centre in Darmstadt, Germany. This centre will process the raw data and retransmit it to the users via the communication system on board the MSG satellites. Meteorological information such as atmospheric winds, sea surface temperatures and atmospheric humidity will be deduced from the data and transmitted to users in addition to cloud imagery.

A network of processing centres known as Satellite Application Facilities, distributed throughout Europe, will provide specialised data products to the user communities. There are currently seven such centres under development for the provision of information on:


- > Support to nowcasting<sup>1</sup> and very short-range weather forecasting
- > Ocean and sea ice
- > Ozone monitoring
- > Numerical weather prediction
- > Climate monitoring
- > GRAS<sup>2</sup> meteorology
- > Land surface analysis

<sup>1</sup> *Nowcasting – the prediction of weather conditions over the next three hours on a horizontal scale of tens to hundreds of kilometres.*

<sup>2</sup> *Global Navigation Satellite System Receiver for Atmospheric Sounding – the GRAS centre will use polar orbiting satellite data.*

## Immediate advantages of MSG

### • Impact for all European residents

A sudden drenching, or a delayed journey in fog, are common. Weather forecasters are unable to prevent these sudden changes, but they can warn us about them. MSG  data will greatly enhance the accuracy of their predictions. It will help forecasters predict rapidly-changing phenomena such as thunderstorms and other types of severe weather.

There will be other, perhaps even life-saving or economic, improvements resulting from better

forecasts. Airports can look forward and plan for impending fog, snowfall or hazardous winds. Better tracking of atmospheric dust clouds from erupting volcanoes will improve air safety. Local authorities will know with greater precision when to grit roads before a cold snap. Farmers, construction companies and others can plan ahead more accurately and hikers will be able to make "go/no-go" decisions with increased confidence.



### • Impact for weather forecasters

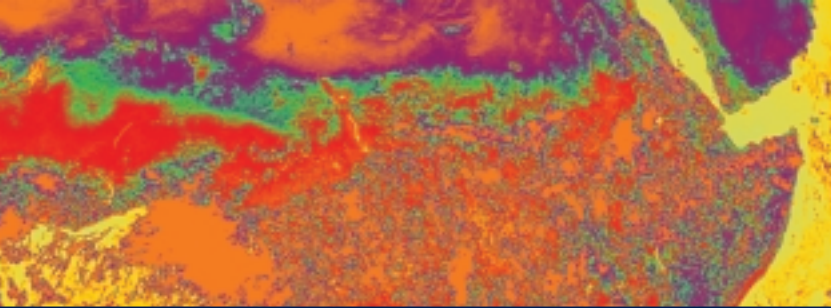
More precise and frequent data from MSG will help weather forecasters to produce even more reliable predictions. Firstly, the greater image frequency is vital because dangerous weather such as thunderstorms can develop extremely rapidly, so a snapshot at 15-minute intervals can build a more precise picture for the forecaster. The same applies to fog, snowfall and rapidly deepening depressions that bring hurricane-force winds. Secondly, improved optics and electronics will provide MSG with better resolution, leading to sharper images and more precision in the data. Currently, an object such as a cloud has to



cover at least 2.5 x 2.5 km to be seen in visible light, but MSG can see one square km. This is particularly important for providing more precise detail of cloud systems. And thirdly, the multi-spectral image data will lead to improved derived products such as winds at various levels in the atmosphere, important input to the complex mathematical super-computer models used by many forecasting centres.

### • Impact for scientists

Though pure research is not the primary aim, MSG provides some unique opportunities to support Earth Sciences research. The Geostationary Earth Radiation Budget (GERB) instrument initiated by ESA with funding from national agencies in the UK, Belgium and Italy and carried on MSG, can measure the Earth radiation balance as it views the top of the atmosphere. The Earth's radiation budget is the balance between the radiation coming from the Sun and the outgoing reflected and scattered solar radiation plus thermal infrared emissions to space. For instance, the greenhouse effect due to biomass burning and the release of CO<sub>2</sub> is believed to change the radiation budget of the Earth significantly, resulting in further global warming.

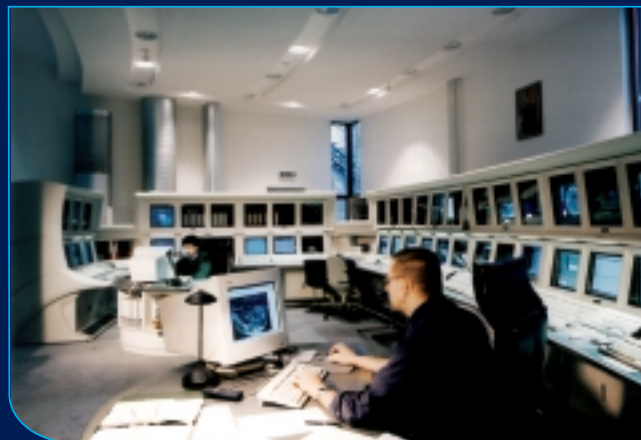


To ensure continuity of the observations, EUMETSAT is funding the provision of two further GERB instruments for MSG-2 and MSG-3.

### MSG helping to save lives

Severe and sudden changes in the weather can cause enormous damage and loss of life. As you read this, somewhere in the world a storm will be bringing disruption or even devastation, or a heatwave causing forest fires. In the recent past there have been many examples of severe weather that led to deaths and caused damage costing millions of Euro.

Such dangerous weather usually develops over a very short time. While MSG will not prevent such occurrences, the populations of Europe, Africa and neighbouring continents will be better advised by forecasters due to the improved data streams, and emergency authorities will be able to take action more quickly.



1 EUMETSAT control centre in Darmstadt, Germany



4 Space-based weather data provide increased safety for hikers



2 The aftermath of the Lothar storm, Germany 1999



3 Accurate weather forecasts are essential for agriculture



5 Thunderstorms develop rapidly and MSG will be able to track them more effectively

Image courtesy of: Karlsruher Wolkenatlas

Image courtesy of: Karlsruher Wolkenatlas



# Meteosat Second Generation: New horizons for weather and climate

## • MSG helping at sea and in the air



Fishing remains one of Europe's most important industries, but it is also one of the most dangerous.

According to the International Labour Office around 24,000 workers in the fishing industry throughout the world are killed annually. In a third of these deaths, bad weather is a contributing factor. Improved forecasting of conditions at sea will obviously have a significant effect on safety.



In the air, MSG will help identify dangerous super-cooled water clouds which can cause ice build-up on aircraft. Similarly, the improved spectral channels will lead to better tracking and prediction of volcanic ash clouds that can damage jet engines.

In addition to the effect on improved weather forecasts, MSG satellites will carry a search and rescue transponder which will relay emergency beacon messages at 406 MHz from



ships and aircraft in peril to central reception stations in the UK and Spain from where they will be rapidly sent to the appropriate rescue organisations.

## A helping hand to the world

Over the past 15 years, Meteosat has provided increasing benefits to around 50 African countries due to its position over the Gulf of Guinea. Thanks to European Union funding, new integrated reception stations will be installed in Africa giving fast access to MSG data. The aim is to help many developing countries track tropical cyclones and predict severe weather events and droughts. EUMETSAT has assisted the European Union to establish a programme known as PUMA (Preparation for the use of MSG in Africa) to provide reception equipment and training on the use of MSG data for all African countries and the neighbouring Indian Ocean islands. It will considerably strengthen environmental monitoring throughout Africa with better and more timely information to help predict natural disasters, improve food security, and ensure more efficient water use and safer transport.

## Keeping a weather eye on the world

Monitoring our planet requires a comprehensive observation network with a global system of satellites making a significant contribution to the essential coverage. Like Meteosat, MSG will be part of the World

Weather Watch programme of the World Meteorological Organization. Also, the European initiative launched by the EU and ESA on Global Monitoring for Environment and Security (GMES) will allow the optimum use of all Earth Observation satellites, including weather satellites such as MSG. ESA's current and planned Earth Observation satellites and EUMETSAT's operational programmes and services will contribute to the GMES initiative.

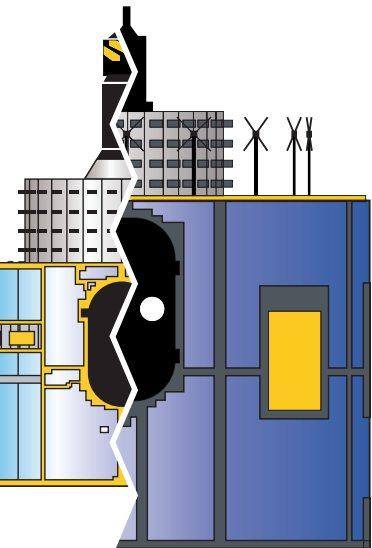
### Meteosat first generation (MOP/MTP)

- 3-channel imaging radiometer
- 100 rpm spin-stabilised body
- Solid apogee boost motor
- 5 years station-keeping
- 200 Watts power demand
- 720 kg in Geostationary Transfer Orbit (GTO)
- Flight qualified with Delta 2914, Ariane 1-3-4
- Height: 3.2 m
- Diameter: 2.1 m

Con



## Comparison of current Meteosat and MSG



### Meteosat Second Generation (MSG)

- 12-channel enhanced imaging radiometer
- 100 rpm spin-stabilised body
- Bi-propellant unified propulsion system
- 7 years station-keeping
- 600 Watts power demand
- 2000 kg in GTO orbit
- Design compatibility with Ariane 4 and 5
- Height: 3.7 m
- Diameter: 3.2 m

Image courtesy of Marine Nationale



- 1 Precise weather information is crucial for safety at sea

Image courtesy of Airbus Industries



- 3 Airline operations depend upon accurate weather forecasts



Image courtesy of Nasa / ESA

- 2 Tracking of volcanic ash clouds from space is vital for aviation safety