THE EUMETSAT NETWORK OF SATELLITE APPLICATION FACILITIES

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ABSTRACT

Thanks to the technological and scientific development during the last decades together with new capabilities arising from the advanced programmes (Meteosat Second Generation MSG and the EUMETSAT Polar System EPS), new possibilities appear for various fields. With the highly sophisticated instrumentation of MSG and EPS much more applications and services become feasible than EUMETSAT’s core activities on supporting weather forecast. This led to concept of a distributed Application Ground Segment, which includes the Central Facility in Darmstadt, Germany, and a network of elements, known as Satellite Application Facilities (SAF), as specialised development and processing centres. Utilising the specific expertise available in EUMETSAT’s Member States and Cooperating States, the SAF network complements the production of standard meteorological products derived from satellite data at EUMETSAT’s Central Facility in Darmstadt and also distributes software packages related to products generation.

The overall objective of a SAF is the provision of operational services, ensuring a cost-effective and synergetic balance between the central and distributed services. The SAF services are an integral part of the overall EUMETSAT operational services.

In this context, the objective of a SAF is to undertake, on a distributed basis, the necessary research, development and operational services and products aimed at enhancing the value and use of data for applications, which are a common need of EUMETSAT Member States and Cooperating States.

There are a number of specific benefits arising from the SAFs, including the improvements of short-range forecasts of severe weather, better data for aviation, agriculture, sea transport and fishing, better understanding of causes and effects of pollution, depletion of ozone and also high quality data for climate monitoring.

Seven SAFs are currently in Development or already in Initial Operations, covering seven “themes” agreed to by the EUMETSAT Council. Each theme addresses operational meteorological, observation of climate relevant parameters and other disciplines.

1. INTRODUCTION

When the European Organisation for the Exploitation of Meteorological Satellites EUMETSAT was established in 1986, its main objective was to establish, maintain and exploit European systems of operational meteorological satellites, supporting the weather forecast activities of the National Weather Services of its member state. The role of EUMETSAT has been expanded since then: The modified Convention from November 2000 addresses also the operational monitoring of the Earth’s climate as a further objective, helping to detect climate change. Thanks to the technological and scientific development during the last decades together with new capabilities arising from the advanced programmes (Meteosat Second Generation MSG and the EUMETSAT Polar System EPS), new possibilities appear for various fields. With the highly sophisticated instrumentation of MSG and EPS much more applications and services become feasible than EUMETSAT’s core activities on supporting weather forecast. This led to concept of a distributed Application Ground Segment, including the Central Facility in Darmstadt, Germany, and a network of elements, known as Satellite Application Facilities (SAF), as specialised development and processing centres. Utilising the specific expertise available in EUMETSAT’s Member States and
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2. THE SATELLITE APPLICATION FACILITIES NETWORK

Objectives and benefits

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The SAF themes

Seven SAFs are currently in Development or are already in Initial Operations, covering seven “themes” agreed to by the EUMETSAT Council. Each theme addresses operational meteorological, observation of climate relevant parameters and other disciplines. The following list describes briefly the currently established SAFs, their goals and their current status:

1) The SAF on “Support to Nowcasting and Very Short Range Forecasting” (NWC SAF) was established to utilise the new data from MSG and the future EUMETSAT Polar System (EPS) for enhanced Nowcasting. Software packages are being developed for the operational extraction of products relevant for Nowcasting and are distributed for local installation. The NWC SAF has been in its Initial Operations Phase (IOP) since March 2002 and the first official software versions have been released in October 2004.

2) The SAF on “Ocean and Sea Ice” (OSI SAF) routinely produces and disseminates products characterising the ocean surface and the energy fluxes across the sea surface. The OSI SAF is in its Initial Operations Phase since July 2002 and is currently distributing near real-time products based on MSG and NOAA data.

3) The SAF on “Ozone Monitoring” (O3M SAF) is being developed for the processing of data on ozone, other trace gases, aerosols, and ultraviolet radiation estimated from satellite observations. Emphasis is given on the preparation for the Global Ozone Monitoring Experiment (GOME-2) on EPS. The O3M SAF is scheduled to be operational in spring 2007.

4) The SAF on “Climate Monitoring” (CM SAF) generates and archives high-quality dataset for specific climate application areas. Currently it concentrates on cloud parameters, radiation budget parameters and atmospheric humidity. The CM SAF completed its development phase and entered the IOP in January 2004. Cloud parameters as derived from NOAA-AVHRR data are produced pre-operationally since November 2004.

5) The SAF on “Numerical Weather Prediction” (NWP SAF) aims at increasing the benefits to the various European meteorological services from Numerical Weather Prediction (NWP) by developing advanced techniques for the effective use of satellite data. The NWP SAF is in its Initial Operations Phase since March 2004.

6) The SAF on “GRAS Meteorology” (GRM SAF) is dedicated to radio occultation measurements from the EPS Metop satellite. It focuses on the Global Positioning System (GPS) Receiver for Atmospheric Sounding (GRAS) instrument to be flown on EPS. The SAF will provide near-real time and offline sounding data (temperature, pressure, and humidity) and corresponding validation products as well as software for the assimilation of GRAS data in NWP models. The GRAS SAF will enter its IOP in spring 2007.

7) The broad scope of the SAF on “Land Surface Analysis” (LSA SAF) is to increase the benefit from MSG and EPS data related to land, land-atmosphere interaction, and biospheric applications by
developing techniques that will allow a more effective use of satellite data. The start of Initial Operations Phase of the LSA SAF was January 2005.

The EUMETSAT council approved an 8th SAF Theme on support to Operational Hydrology and Water Management in November 2002, thus creating a new SAF opportunity. Currently, the SAF project is under preparation.

**SAF Network Organisation**

Each SAF is led by the National Meteorological Service of a EUMETSAT Member State, working with a consortium of cooperating entities, such as other Meteorological Services, government bodies and research institutes of Member and Cooperating States.

The SAFs undergo a development phase, typically lasting 5 years, followed by an incremental transfer to operations of developed products. During the development phase, the leading Service assumes the role of host institute of the SAF. During the operational phase, the operations coordination is assumed by a SAF operational leading entity.

The progress of the development and operations of a SAF is monitored and directed by a Steering Group chaired by the SAF Host Institute (or Leading Entity), and involving representatives of the consortium, the EUMETSAT Secretariat, and appropriate EUMETSAT delegate bodies.

The EUMETSAT Council is responsible for deciding matters of SAF strategy, policy and funding. The EUMETSAT Secretariat is responsible for the supervision and monitoring of the overall SAF Network and its evolution, giving advice on management, development, engineering and planning processes to all entities responsible for the development. To this aim, the Secretariat establishes and implements SAF Network level coordination mechanisms to share information and maintain technical and scientific coherence across the SAF Network.

**Satellite Data Sources and product distribution**

During development, the SAFs may use data available from any suitable satellite systems, including research missions. In the operational phases, the primary focus is on the exploitation of data provided by operational satellites, and in particular by the EUMETSAT Geostationary and Polar systems.

**Products Distributions**

Near Real Time SAF products are distributed by satellite (e.g. EUMETCast) via the World Meteorological Organisation’s (WMO) Global Telecommunication System (GTS)/Regional Meteorological Data Communications Network (RMDCN) or by other means as appropriate. The SAFs are already users of the EUMETCast dissemination capability of EUMETSAT.

**Funding**

The SAF Development costs are shared between the EUMETSAT and the SAF Consortia. EUMETSAT provides dedicate funding for Visiting Scientists activities.

During operational phases EUMETSAT contribution covers up to 75% of the total operational costs, including relevant Research and Development activities. The EUMETSAT Council approved in June 2004 funding for SAF Development and Operations until 2012.

### 3. SAF PRODUCTS AS PART OF A GLOBAL CLIMATE OBSERVATION SYSTEM

Climate observations for the monitoring of the climate, the assessment of its natural variability and the detection of trends, requires high quality measurements of relevant climate parameters on a global scale. Such inputs are extremely essential for any precise prediction of climate change and its impact and are also necessary to attribute the causes that might have led to the changes. The parties of the United Nations Framework Convention on Climate Change (UNFCCC) have expressed the demand on systematic climate
observations and the International Programme on Global Climate Observation System (GCOS) is coordinating such activities.

Space borne observations systems are obviously an essential element of an global climate monitoring system, because of their ability to continuously observe large part of the Earth’s surface and atmosphere. Operational satellite systems, such as the current and future METEOSAT generations and the Metop satellites of the EPS programme play a particular role, since they can provide rather long observation records in contrast to research and experimental space missions.

Within the framework of GCOS, parameters of high relevance for global climate change has been identified (Essential Climate Variables ECV). GCOS also formulated principles for global climate monitoring as well as detailed requirements on the measurements of ECV in terms of accuracy and temporal and spatial resolution.

Many SAF products address Essential Climate Variables, e.g. the large suite of cloud parameters and radiative fluxes but also important quantities like Ocean and Land Surface Temperature and Sea Ice properties, and the processing of most of them is / will be in line with the GCOS requirements. Currently, the SAF products including the ones of the Climate Monitoring SAF are focused the regional scale, but dedicated development and SAF evolution will lead to global coverage of more and more parameters. For example: In spring 2005, the Ocean and Sea Ice SAF starts the operation of the global ice parameter product. This will be the first operational global SAF product. When the two SAFs that are especially related to measurements with instruments on the polar orbiting Metop-EPS satellites (Ozone Monitoring and GRAS meteorology) enter into operation in 2007, their product will have global coverage from the beginning.

Further development towards global climate products will be continuously conducted during the next phases in all relevant SAFs. Regular meetings and consultations within the SAF Network and/or with GCOS and the World Meteorological Organisation WMO ensure the consideration of GCOS requirements and during the evolution of the SAF Network along the climate monitoring principles.

4. MORE INFORMATION

Further information on the EUMETSAT SAF Network, more detailed description on the SAF activities, products and product characteristics accessible at: www.eumetsat.de/saf.