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NETWORK OF EUMETSAT SATELLITE APPLICATION FACILITIES

The Network of approved Satellite Application Facilities (SAF) is under development, with Pilot SAFs on "Nowcasting and Very Short Range Forecasting" and "Ocean and Sea Ice" expected to start the Initial Operations Phase in 2002. This paper describes the status of the seven active projects and provides the updated list of planned products.

NETWORK OF EUMETSAT SATELLITE APPLICATION FACILITIES

1 INTRODUCTION

Since CGMS-XXVII, SAF activities have further evolved. The purpose of this paper is to report on the status of the approved network of SAF projects and to present a full list of the SAF products.

2 THE SAF NETWORK DEVELOPMENT CONTEXT

In November 1992 EUMETSAT adopted the concept of a distributed Applications Ground Segment, including the central Meteorological Products Extraction Facilities (MPEF) and the Unified Meteorological Archive and Retrieval Facility (U-MARF), both located in Darmstadt, Germany, and a network of elements known as Satellite Applications Facilities (SAF). The MPEF produces an agreed set of basic meteorological products, while the Satellite Applications Facilities (SAF) are more specialised development and processing centres, which, based on specific expertise in Member States, will deliver additional meteorological and geophysical products and related services, which form an integral part of the overall EUMETSAT service.

The SAFs are developed by consortia of organisations from the Member States, based in National Meteorological Services or other agreed entities, responsible for research, development and operational activities. EUMETSAT contributes up to 50% of the development cost of each SAF, and the EUMETSAT Secretariat coordinates and manages the SAF Network level activities and all activities necessary to integrate the SAFs and the central services into coherent end-to-end systems providing the operational services expected by the end users. It provides also managerial, technical and scientific support to the SAFs, including the organisation of reviews, interface and planning meetings. A SAF Network Management Scheme has been established and agreed for this purpose.

Seven SAFs are currently under development. They address the following topics:

- Support to Nowcasting and Very Short Range Forecasting
- Ocean and Sea Ice
- Ozone Monitoring
- Climate Monitoring
- Numerical Weather Prediction
- GRAS Meteorology
- Land Surface Analysis.

SAFs will use data from Meteosat, MSG and EPS and, in some cases, data from non-EUMETSAT missions. Until such data become available, information from current satellites will be used for development.

The partnership of each SAF project is presented in the following table.

SAF on	Date of kick-off	Hosting Institute	Consortium members
Support to Nowcasting & VSRF	February 1997	INM (Spain)	NMSs of France, Austria and Sweden.
Ocean & Sea Ice	April 1997	Météo France (France)	NMSs of The Netherlands, Denmark, Norway and Sweden; Institute Français de Recherche pour l'Exploitation de la Mer (France).
Ozone Monitoring	October 1997	FMI (Finland)	NMSs of The Netherlands, Belgium, Denmark, Greece, Germany and France; Deutsches Zentrum für Luft- und Raumfahrt (Germany), University of Thessaloniki (Greece).
Climate Monitoring	Dec. 1998	DWD (Germany)	NMSs of The Netherlands, Belgium, Finland and Sweden; Bundesamt für Seeschiffahrt und Hydrographie (Germany).
Numerical Weather Prediction	Feb. 1999	UKMO (UK)	NMSs of The Netherlands and France; ECMWF.
GRAS Meteorology	April 1999	DMI (Denmark)	NMS of United Kingdom; Institut d'Estudis Espacials de Catalunya (Spain).
Land Surface Analysis	Sep. 1999	IM (Portugal)	NMSs of Belgium, France and Sweden; Inst. Of Meteorology & Climate Research (Germany), University of Bonn (Germany), Federal Inst. Of Hydrology (Germany), University of the Aegean (Greece), Inst. of Agrometeorology & Environmental Analysis Applied in Agriculture (Italy), Applied Meteorology Foundation (Italy), Inst. For Applied Science & Technology (Portugal), University of Evora (Portugal), University of Valencia (Spain).

Table 1 – SAF Projects Partnership

The overall status of the SAF Projects development is presented in the following diagram, where the major achieved milestones, ongoing and planned reviews in 2000 are highlighted.

The Review Logic includes the following milestones for the initial phases of the development life cycle:

- **RADR**, Requirements and Architectural Design Review;
- **RAPR**, Requirements and Planning Review (for NWP only, in place of RADR);
- **MTR**, Mid Term Review, as a critical design milestone for all SAFs;
- **IRR**, Integration Readiness Review;
- **IVVRR**, Integration, Verification and Validation Results Review (IVVRR);
- **ORR**, Operational Readiness Review (ORR), formally closing the development life cycles activities.

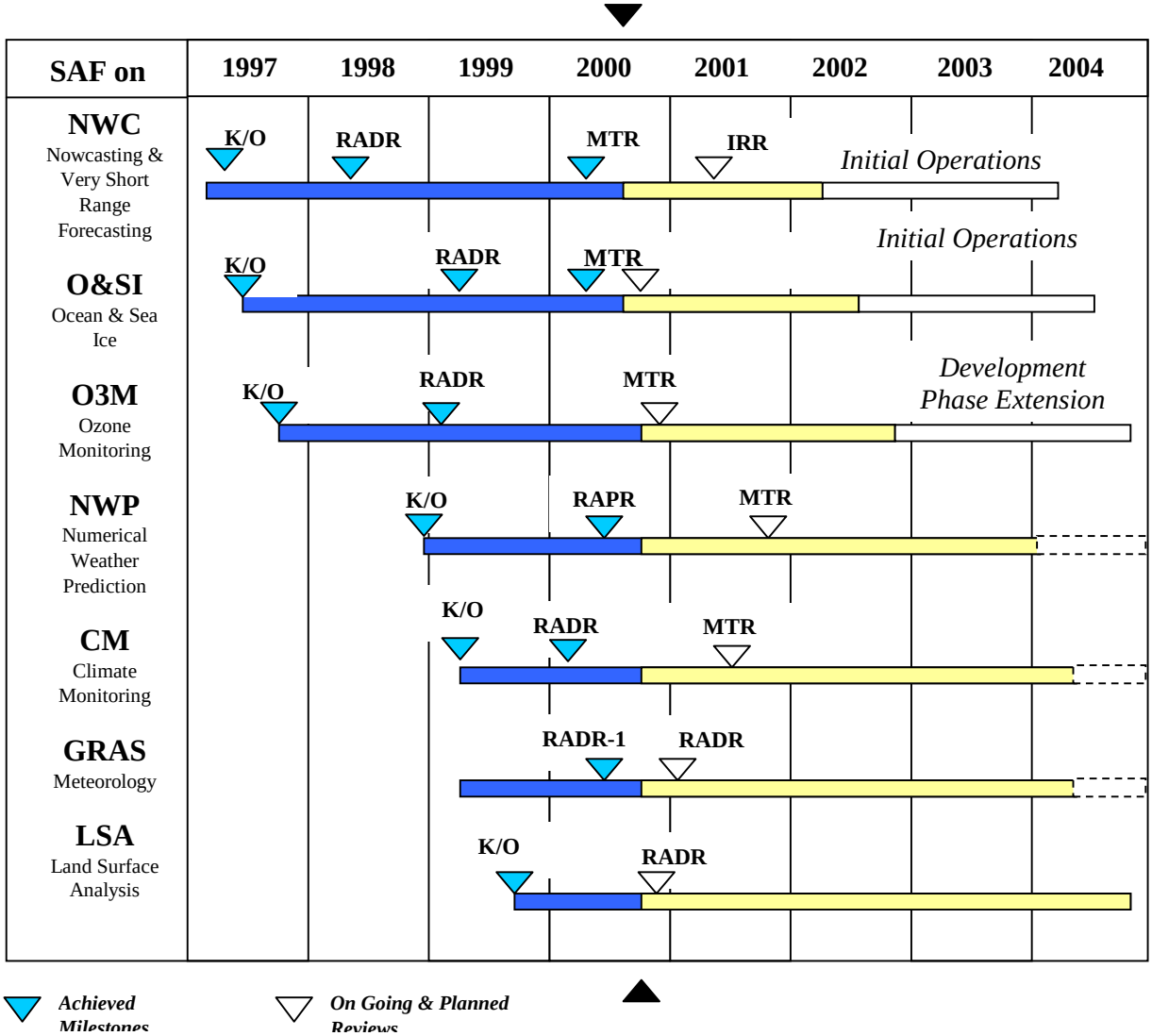

Figure 1 - SAF Projects Overall Schedule, Achieved Milestones and ongoing Reviews (August 2000 Status)

In consideration of the phasing needs with the MSG and EPS commissioning, the **NWC and OSI SAFs** will enter an **Initial Operational Phase** (IOP), which will be concluded after the EPS commissioning. During the IOP, the development for the EPS related products would be finalised, while MSG products will be put into operations after their validation using the real data provided by the MSG instruments. Continuous research and development will take place during IOP to sustain the needs for product improvements and innovation.

For all SAFs, the full **Operational Phase** will aim to:

- Put into operations the accepted SAF Products and Services;
- Maintain these products;
- Improve the products, based on the results of the continuous research and

development effort as well as on the users feedback.

3 THE SAF PRODUCTS

The following SAFs will deliver MSG Products:

- SAF in support to Nowcasting and VSRF;
- SAF on Ocean and Sea Ice;
- SAF on Climate Monitoring;
- SAF on Land Surface Analysis;

as presented in the next Tables.

Nowcasting SAF	
Product Name	Product Characteristics
Cloud Mask and Cloud Amount	Information on the presence of clouds
Cloud Type (including fog)	Major cloud types, fractional clouds, semi-transparency, fog & stratus identification, snow or sea-ice occurrence
Cloud Top Temperature/Height	Vertical extension of clouds, cloud top temperature
Precipitating Clouds	Identification of clouds likely to produce precipitation within predefined precipitation intensity classes
Convective Rainfall Rate	Precipitation intensities for convective clouds
Total Precipitable Water	Total amounts of precipitable water in clear areas
Layer Precipitable Water	Distribution of liquid water and relative humidity per layer
Stability Analysis Imagery	Stability classes in clear air
High resolution Winds from HRVIS	Winds at high spatial resolution (25 km or better) from HRVIS
Aut. Satellite Image Interpretation	Cloud images with text and objective attributes overlays
Rapidly Developing Thunderstorms	Semi-quantitative image product showing features related to the evolution of convective systems
Air Mass Analysis	Combination of basic quantities that describe air masses into one integrated classification of the air mass. Detection of air mass boundaries

Table 2 – NWC SAF provided MSG Products

Ocean & Sea Ice SAF	
Product Name	Product Characteristics
Atlantic Low and Mid Latitude SST	Composite SST field (skin and bulk temperature averages over 3 hours) on a regular geographic grid from MSG SEVIRI and GOES Imager. Cloudy areas will be masked.
Merged Atlantic SST	Composite SST field (skin and bulk temperature averages over 12 hours) on a regular geographic grid from MSG SEVIRI, GOES Imager and NOAA/EPS AVHRR. Cloudy areas will be masked.
Atlantic Low and Mid Latitude Surface Radiative Fluxes	Downward shortwave surface flux (DSSF), net shortwave surface flux (NSSF) and downward longwave surface flux (DLSF) in W/m^2 on a regular geographic grid from MSG SEVIRI and GOES imager.
Merged Atlantic Surface Radiative Fluxes	Downward shortwave surface flux (DSSF), net shortwave surface flux (NSSF) and downward longwave surface flux (DLSF) in W/m^2 on a regular geographic grid from MSG SEVIRI, GOES imager and METOP/NOAA AVHRR.

Table 3 – OSI SAF provided MSG Products

Climate Monitoring SAF	
Product Name	Product Characteristics
Cloud Parameters	Cloud information for climatological applications from MSG SEVIRI, METOP/NOAA AVHRR and MHS. The products are fractional cloud covers, cloud classification, cloud top temperature, cloud top height, cloud phase, cloud optical thickness and cloud water path. Output includes daily and monthly values, mean diurnal cycles and frequency distributions.
Components of the Surface Radiation Budget (SRB)	Components of the SRB for climatological applications from MSG SEVIRI and METOP/NOAA AVHRR. The core product will be the solar irradiance. Output includes daily and monthly values, mean diurnal cycles for some components.
Components of the Radiation Budget at the Top Of the Atmosphere (TOA)	Homogeneous earth reflected and emitted radiation field at TOA for climate applications from MSG GERB and SEVIRI, CERES, ERBE and SCARAB. Albedo and solar absorbed flux will also be derived. Output will be daily and monthly values and mean diurnal cycle.

Table 4 – Climate Monitoring SAF provided MSG Products

Land Surface Analysis SAF	
Product Name	Product Characteristics
Short-wave Radiation Parameters	Maps of Aerosols, Surface Albedo, Downwelling Surface Short-wave Fluxes (DSSF) and Scattered Radiance (BRDF) on a geographical grid from MSG SEVIRI and METOP/NOAA AVHRR.
Long-wave Radiation Parameters	Maps of Land Surface Temperature (LST) and Downward Surface Long-wave Fluxes (DSLF) on a geographical grid from MSG SEVIRI and METOP/NOAA AVHRR.
Soil Moisture Indices	Surface Soil Moisture (SSM) and Root-zone Soil Moisture (RSM) over more densely vegetated surfaces derived from the Land Surface Temperature and the Vegetation Parameters (NDVI) products.
Snow Cover	Information on the possible occurrence of snow and the related snow albedo from METOP/NOAA AVHRR and MSG SEVIRI.
Evapotranspiration	Evapotranspiration maps on a geographical grid derived from MSG SEVIRI and METOP/NOAA AVHRR and from the Vegetation Parameters.
Vegetation Parameters	Daily and decadel data sets of vegetation parameters derived from MSG SEVIRI, METOP/NOAA AVHRR, EOS MODIS, EOS MISR and SPOT Vegetation. The following vegetation parameters will be derived: the Normalised Differential Vegetation Index (NDVI), the Leaf Area Index (LAI), the fraction of Photosynthetic Active Radiation (fPAR) and the Fraction of Green Vegetation (FGV).

Table 5 – LSA SAF provided MSG Products

The following SAFs will deliver EPS Products as described in the following tables, where these products are identified in relation to the relevant EPS instruments.

	SAF in Support to Nowcasting & Very Short Range Forecasting	SAF on Ocean & Sea Ice	SAF on Ozone Monitoring
AVHRR	• Cloud Mask and Amount • Cloud Type • Cloud Top Temp. & Height • Precipitating Clouds	• Sea Surface Temperature • Surface Radiative Fluxes • Sea Ice Edge, Cover & Type	
HIRS			• Total Ozone • UV fields (clear sky) • UV fields with clouds
AMSU-A	• Precipitating Clouds		
ASCAT		• Ocean Surface Winds • Sea Ice Edge & Type	
GOME-2			• Total Ozone • Ozone Profiles • Trace Gases (BrO, OClO, NO_2, SO2, HCHO) • Aerosols • UV fields (clear sky) • UV fields with clouds

Table 6 – NWC, OSI and O3M SAF provided EPS Products

	SAF on Climate Monitoring	SAF on Numerical Weather Prediction	SAF on Land Surface Analysis	SAF on GRAS Meteorology
AVHRR	• Fractional Cloud Cover • Cloud Type • Cloud Top Temp. & Height • Cloud Phase • Cloud Optic. Thickness • Surface Radiative Fluxes •	ATOVS: • Improved RTMs • Observation Operators • Improved AAPP processing package • Monitoring of data quality	• Aerosols • Surface Albedo • Surface SW Fluxes • Scattered Radiance • Land Surf. Temp. • Surface Emissivity • Surface LW Fluxes • Vegetation Parameters • Evapotranspitation • Snow Cover	
MHS	• Cloud Water Path			
IASI		• Fast RTM • Observation Operators • IASI Processing Pack.		
ASCAT		• Observation Operators		
GOME-2/ OMI		• Observation Operators		
GRAS				• Refractivity profile • Temperature Profile • Humidity Profile • Pressure Profile • Integrated water vapor • Observation Operators

Table 7 – CLM, NWP, LSA, and GRAS SAF provided EPS Products

4 CONCLUSIONS

The SAF Network development proceeds in line with plans for all approved SAF Projects, with the two pilots SAF (NWC and OSI) planned to enter their Initial Operations Phase already in 2002. The IOP will give a major opportunity for users to initiate their activities based on SAF Products and Services. Lessons learnt would generate benefits for all other SAFs Projects Validation processes, using the real satellite data and would support optimisation of the Operational Phase concept and framework.