The EUMETSAT Network of Satellite Application Facilities (SAF)

Lothar Schüller

Programme Preparation &
SAF Network Division

EUMETSAT

Monitoring weather and climate from space
Surveiller le temps et le climat depuis l'espace

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Outline

- The concept of the SAF Network
- Objectives
- Benefits
- SAF Network Deployment and Status
- Short Introduction to the individual SAFs
- Development and Service Model
- Interaction with the SAF users
- Outlook
- Summary

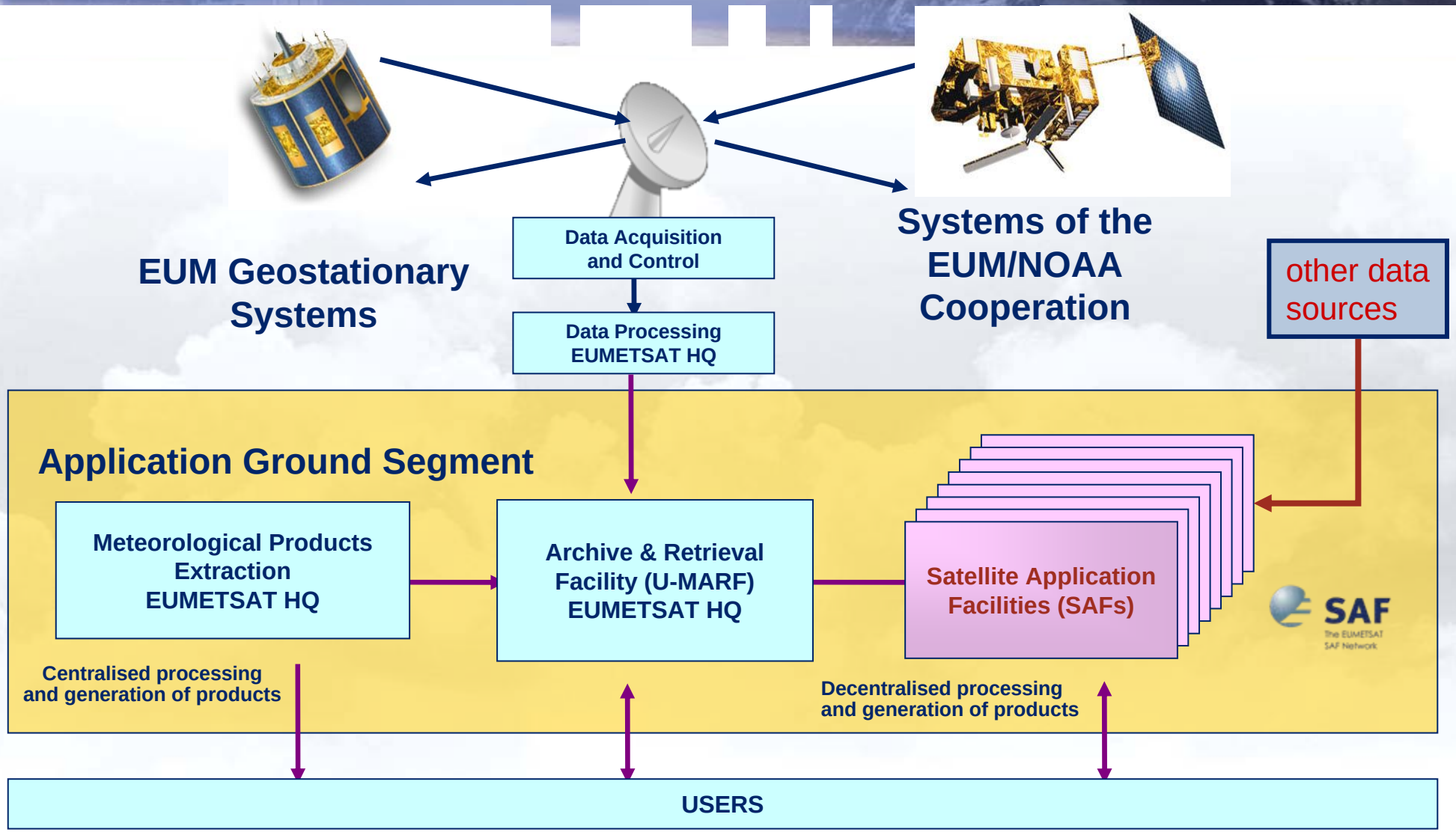
The SAF Concept

In 1992 EUMETSAT adopted the concept of a Distributed Application Ground Segment including:

- ***the EUMETSAT Central Facilities in Darmstadt***
- ***and a network of elements known as Satellite Application Facilities (SAF), as specialised development and processing centres.***

- SAFs utilise the **specific expertise** available in EUMETSAT's Member and Cooperating States.
- The SAF network **complements** the production of standard meteorological products derived from satellite data at the central facilities in Darmstadt and also distributes user software packages.
- SAFs are developed by **consortia** of organisations from the EUMETSAT Member States and Cooperating States, and are located at the National Meteorological Services in Member States.

The EUMETSAT Application Ground Segment



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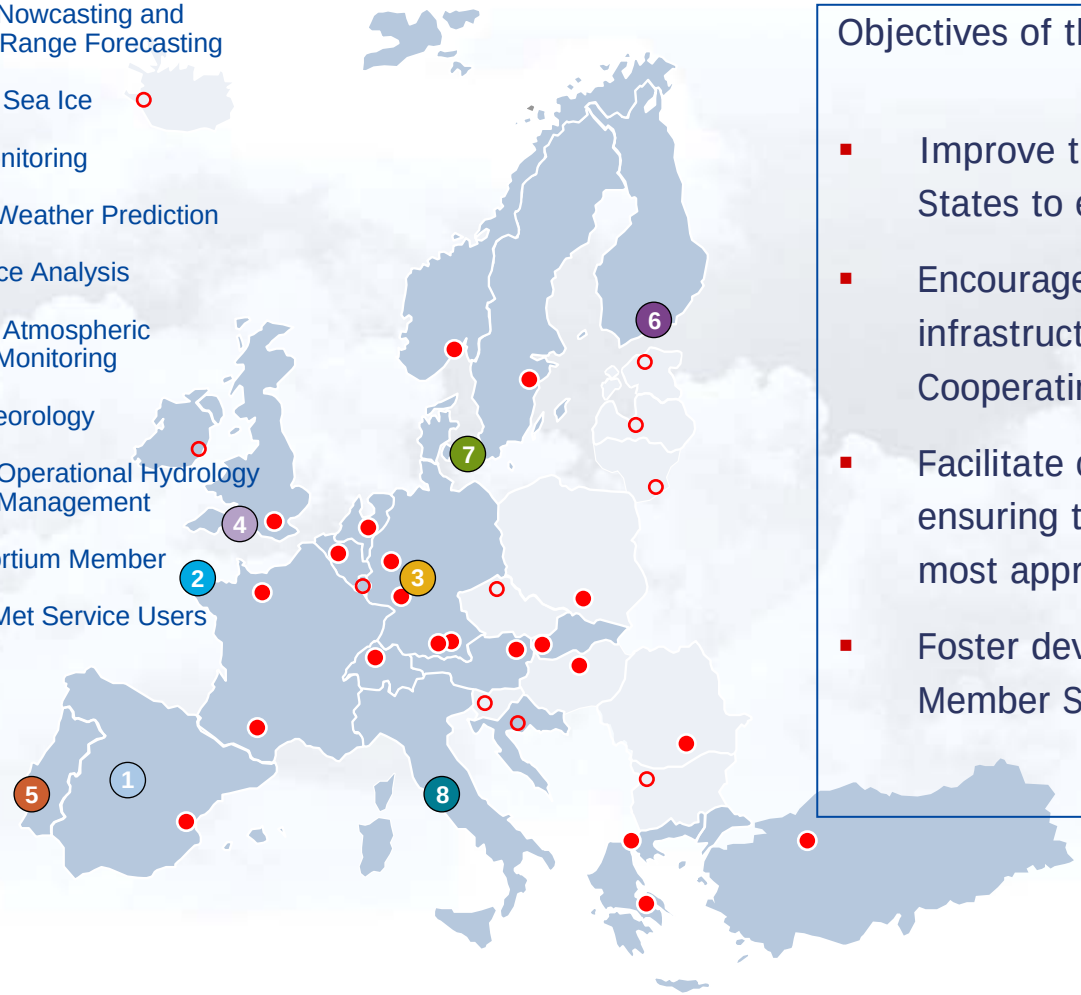
Objectives

- Member State
- Cooperating State
- 1 Support to Nowcasting and Very Short Range Forecasting
- 2 Ocean and Sea Ice
- 3 Climate Monitoring
- 4 Numerical Weather Prediction
- 5 Land Surface Analysis
- 6 Ozone and Atmospheric Chemistry Monitoring
- 7 GRAS Meteorology
- 8 Support to Operational Hydrology and Water Management
- SAF Consortium Member
- Additional Met Service Users



Objectives of the SAF Network

- Improve the ability of EUMETSAT's Member States to exploit satellite data;
- Encourage the utilisation of existing skills and infrastructure in Member States and Cooperating States;
- Facilitate cost-effective exploitation by ensuring that services are distributed in the most appropriate way;
- Foster development of cooperation with non-Member States and other organisations.

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Benefits

- Improved information for land use, ecology, disaster monitoring and agricultural forecasting
- Benefits for sea transport, fishing and offshore industries
- Improved data for input to Numerical Weather Prediction
- Availability of user software packages for operational applications
- Improvements to short range forecasting of severe weather hazards
- Benefits to aviation, agriculture, construction, gas, water and electricity industries
- Better understanding of causes and effects of pollution of the upper atmosphere and the depletion of ozone
- Early warning of hazards (precise details for evacuation and alerting of emergency authorities)
- Enhanced data for climate monitoring

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The SAF Network Deployment

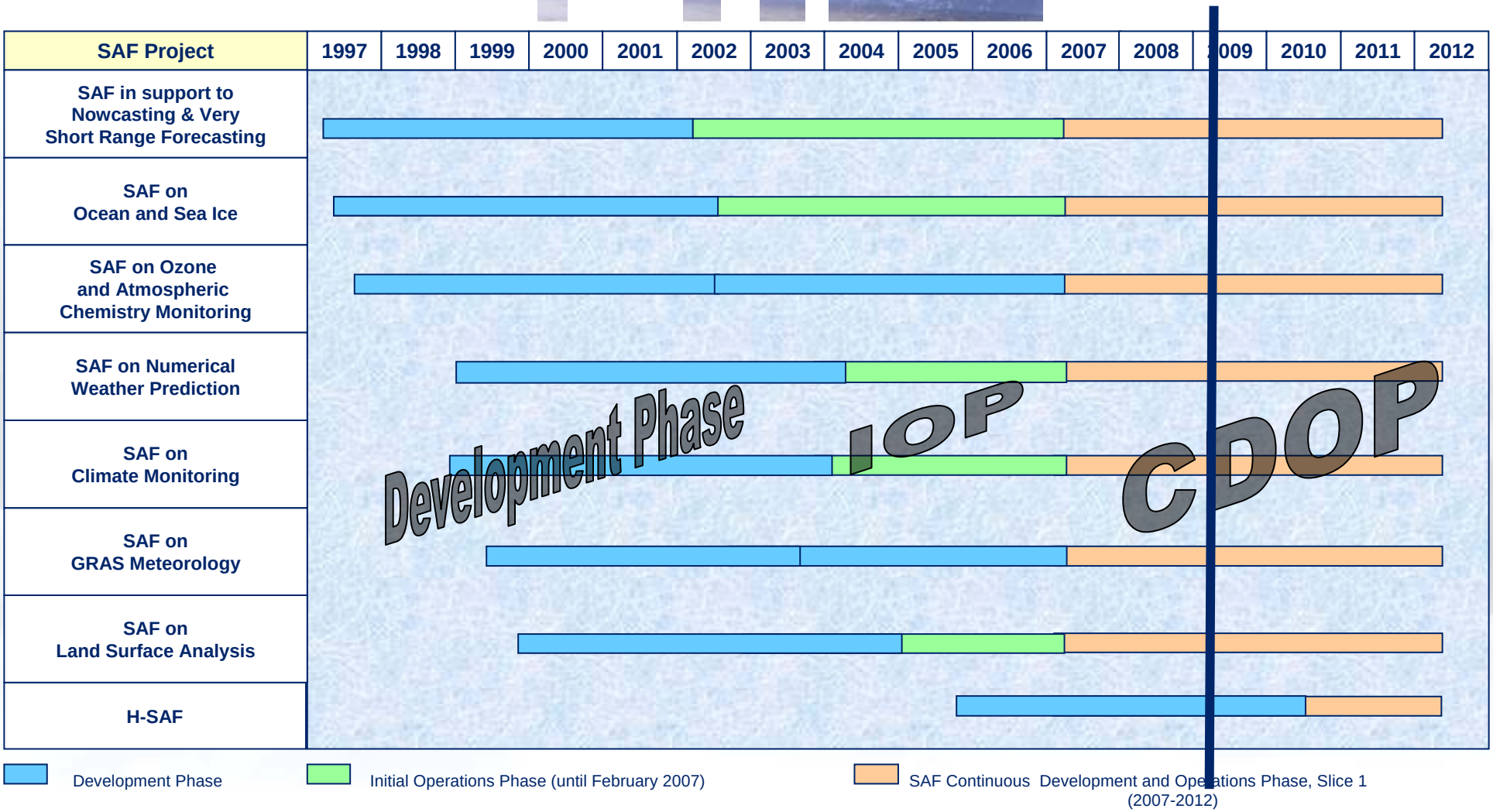
Seven SAF projects were approved, related Cooperation Agreements established, and development activities initiated in the period 1997-1999.

The first 7 SAFs incrementally initiated operational activities, using first MSG data and then Metop (EPS) Data.

An 8th SAF theme on support to Operational Hydrology and Water Management (H-SAF) was approved by the EUMETSAT Council in November 2002, thus creating a new SAF opportunity.

An H-SAF Project started in September 2005, following approval by EUMETSAT Council of the proposal prepared under coordination of the Italian Meteorological Service.

Status



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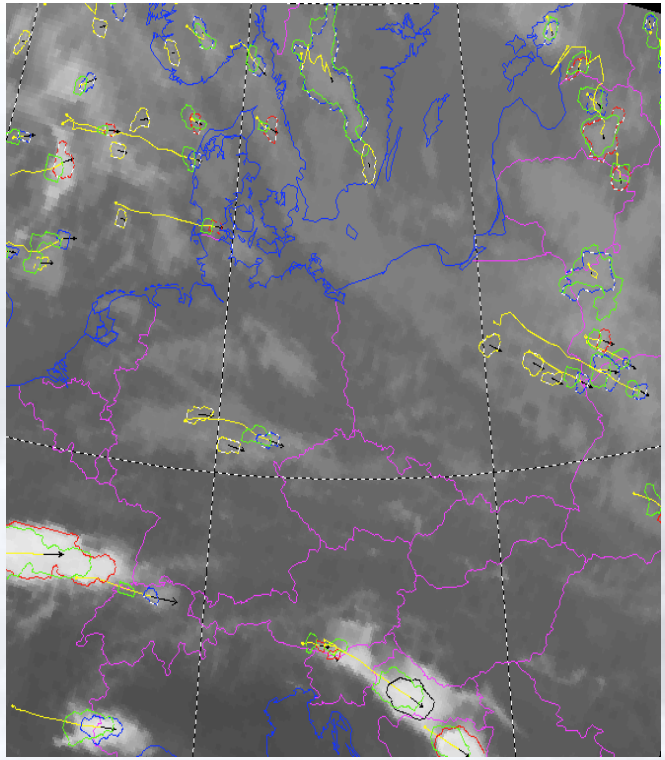
Nowcasting SAF

"Support to Nowcasting and Very Short Range Forecasting" (NWC SAF)

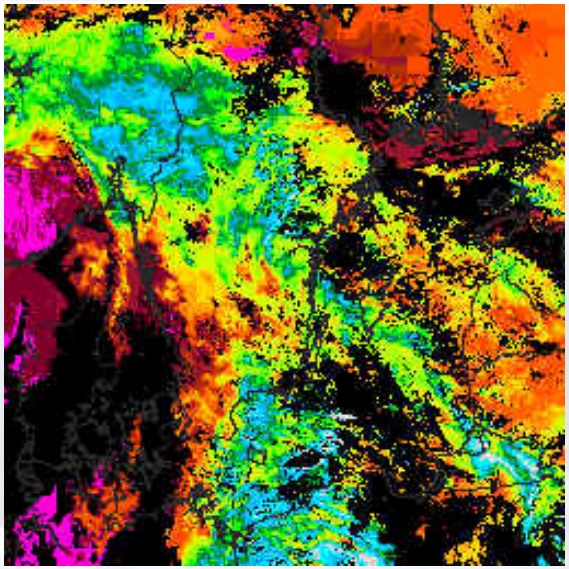
- established to utilise the new data from MSG and the polar platforms (Metop and NOAA) for enhancing Nowcasting
- Development of Software packages for the operational extraction of products relevant to Nowcasting and for local installation
- Leading Entity is the Spanish Meteorological Agency AEMET in Madrid
- NWC SAF is in its Continuous Development and Operations Phase (CDOP) since March 2007
- First official software versions released in October 2004

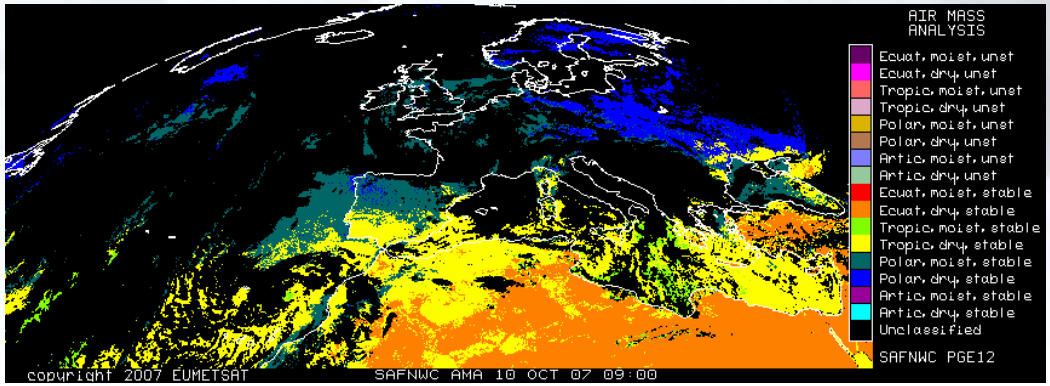


Rapidly developing Thunderstorm Product

NWC SAF Products

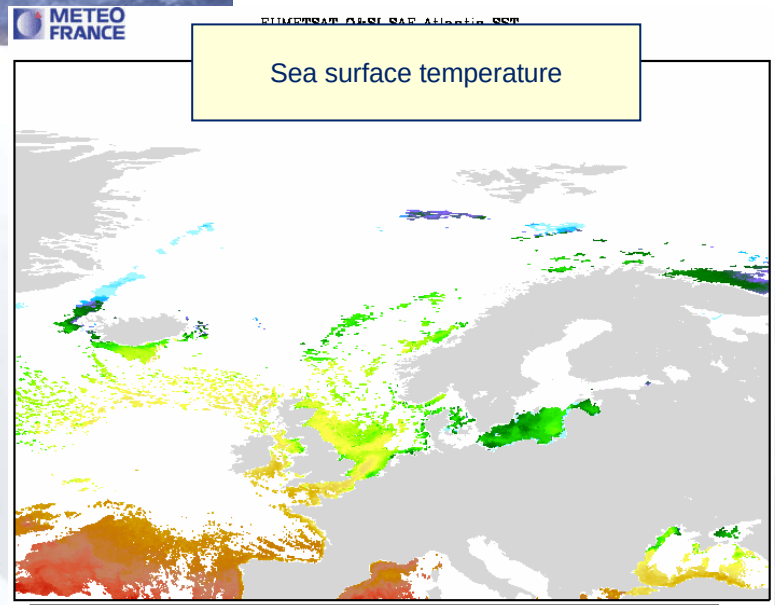
Software products	Cloud mask
	cloud type
	cloud top temperature and height mask
	Precipitating clouds
	Convective Rainfall Rate
	Total Precipitable Water
	Layer Precipitable Water
	Stability Analysis Imagery
	High Resolution Wind Vectors on HRV
	Automated Satellite Image Interpretation
	Rapid Development Thunderstorm
	Airmass Analysis

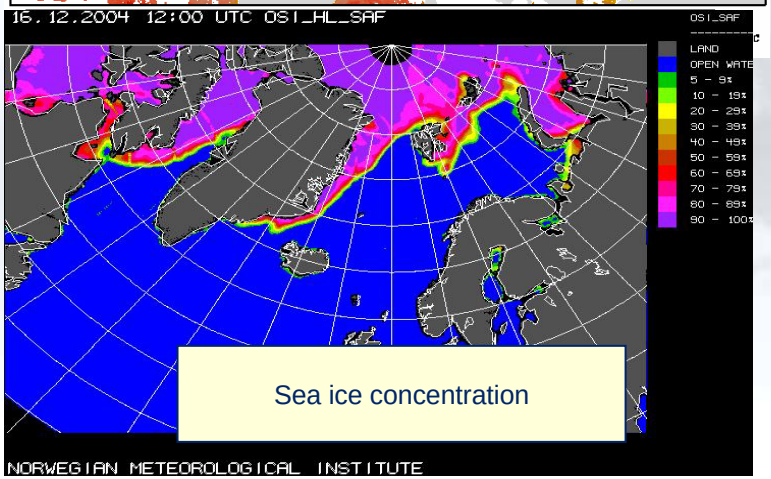




Ocean and Sea Ice SAF

- Ocean and Sea Ice (OSI) SAF routinely produces and disseminates products characterising the ocean surface and the energy fluxes across the sea surface
- Operationally produces information on the sea ice characteristics (extend, concentration, ...)
- Leading Entity is Météo-France in Lannion
- OSI SAF distributes near real-time products based on NOAA, MSG, Metop, SeaWinds, DMSP and GOES data
- OSI SAF is in its Continuous Development and Operations Phase (CDOP) since March 2007





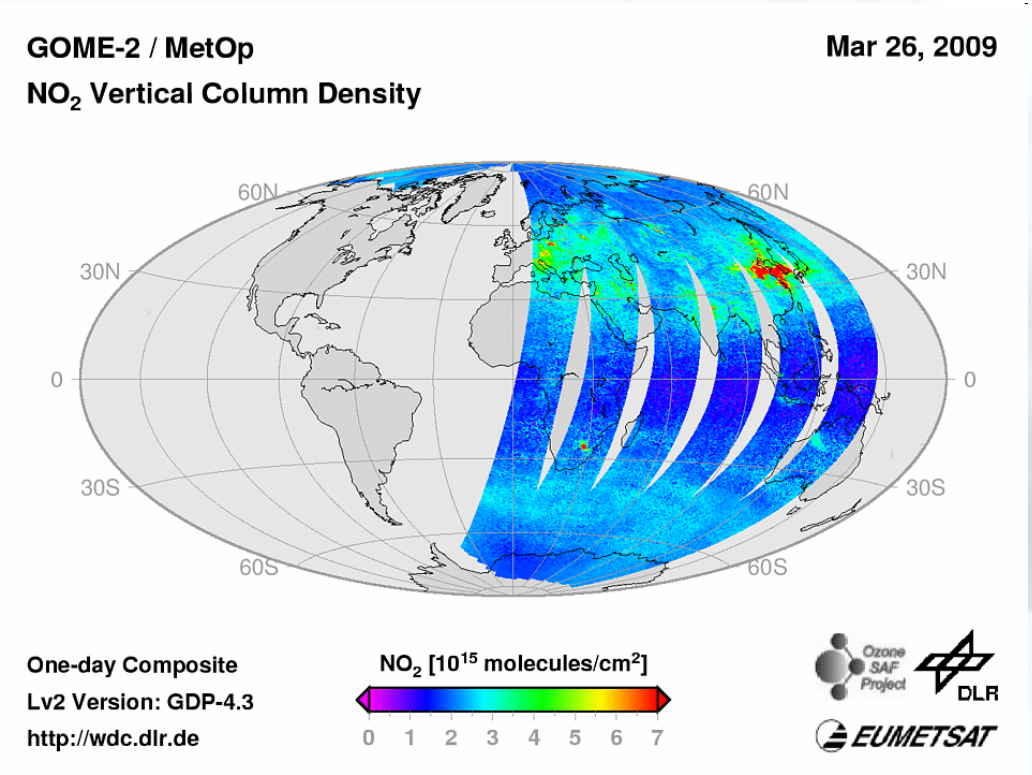
OSI SAF products

Near Real Time products	Sea surface temperature
	Surface short wave irradiance
	Downward long wave irradiance
	Sea ice concentration
	Sea ice edge
	Sea ice type
	Sea ice emissivity
	Sea ice drift
	Sea ice regional edge
	Surface winds

Offline products	Sea surface temperature
	Surface short wave irradiance
	Downward long wave irradiance
	Sea ice concentration
	Sea ice edge
	Sea ice type
	Sea ice emissivity
	Sea ice drift
	Sea ice regional edge
	Surface winds

Ozone SAF

- SAF on Ozone and Atmospheric Chemistry Monitoring (O3M SAF)
- developed for the processing of data on ozone, other trace gases, aerosols and ultraviolet radiation
- Emphasis on the Global Ozone Monitoring Experiment (GOME-2) on EPS (Metop)
- Leading Entity is the Finnish Meteorological Institute FMI, Helsinki
- The O3M SAF is in its Continuous Development and Operations Phase (CDOP) since March 2007
- First release of products in Summer 2007



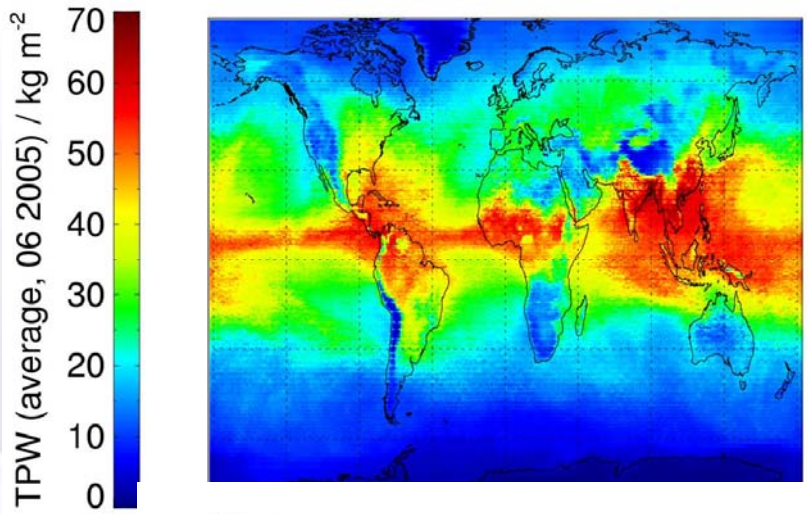
O3M SAF products

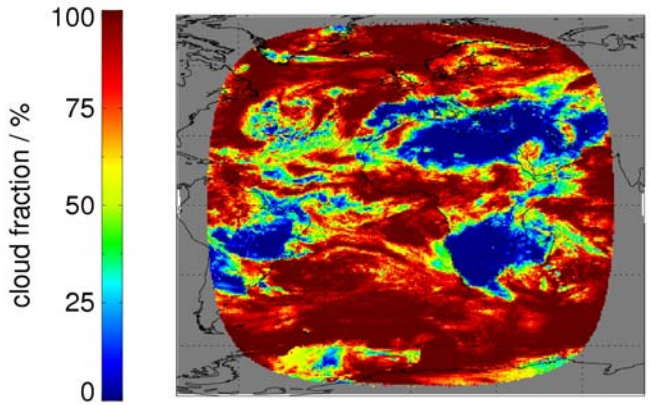
Near Real Time products	GOME-2 NRT total ozone
	GOME-2 NRT ozone profile
	NRT Clear-sky UV fields
	Assimilated total ozone
	GOME-2 total column water vapor
	NRTUV with cloud correction

Offline products	GOME-2 offline total ozone and trace gases
	GOME-2 offline ozone profile
	Offline UV fields
	HIRS total ozone
	Aerosol Product
	Assimilated total ozone GOME-2 total column water vapour
	Photolysis rates j(O3), j(NO2)
	Aerosol parameters from GOME-2/PMD
	IASI-GOME2 ozone profile

Climate Monitoring SAF

- SAF on Climate Monitoring
- generates and archives high-quality data-set for specific climate application areas
- Currently concentrates on:
  - **cloud parameters**
  - **radiation budget parameters**
  - **atmospheric humidity**
- Leading Entity is the German Weather Service DWD, Offenbach
- In Continuous Development and Operations Phase (CDOP) since March 2007
- NOAA-AVHRR based data operationally produced since November 2004, MSG based data from October 2005, Metop data used since 2009.





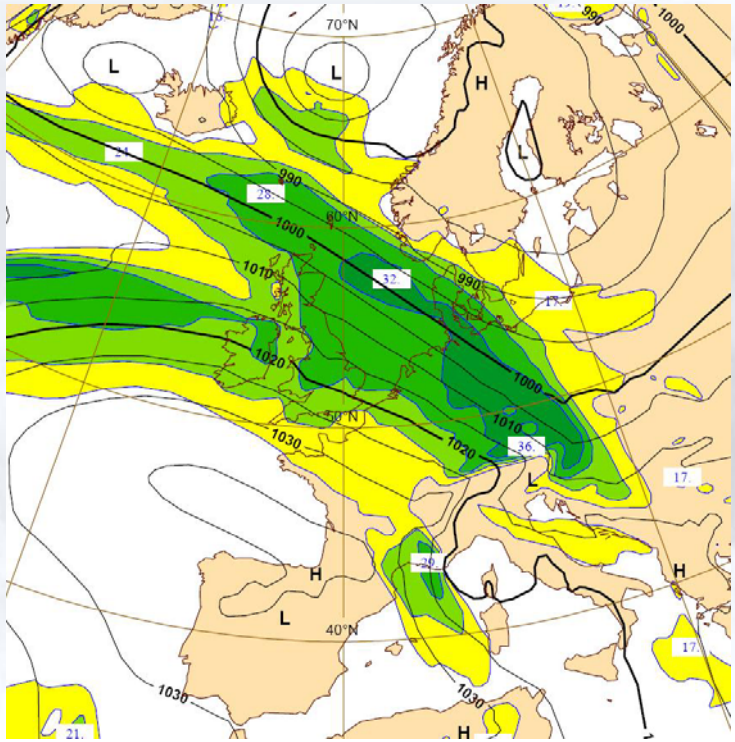
CM SAF products

Offline products	Fractional cloud cover
	Cloud type
	Cloud top temperature and height
	Cloud optical thickness
	Cloud phase
	Cloud water path
	Ice water path
	Surface incoming short-wave radiation
	Surface albedo
	Surface net short-wave radiation
	Surface outgoing long-wave radiation
	Surface downward long-wave radiation
	Cloud forcing

Offline products	Surface net long-wave radiation
	Surface radiation budget
	Direct irradiance at surface
	Spectrally resolved irradiance
	Daylight
	Incoming solar radiative flux (TOA)
	Reflected solar radiative flux (TOA)
	Emitted thermal radiative flux (TOA)
	Aerosol optical depth
	Aerosol forcing
	Vertical Integrated water vapour
	Layered water vapour and temperature
	Specific humidity and temperature
	Free tropospheric humidity
	Sea-surface specific saturation humidity
	Near-surface specific humidity
	Near surface wind speed
	Turbulent heat fluxes
	Precipitation rate
	Evaporation
	E-P

NWP SAF

- SAF on Numerical Weather Prediction (NWP SAF)
- aims at increasing the benefits to Met.-Services from Numerical Weather Prediction (NWP)
- develops advanced techniques for the effective use of satellite data
- Leading Entity is the UK MetOffice, Exeter
- The NWP SAF is in its Continuous Development and Operations Phase since March 2007



NWP SAF products

Software products	AAPP
	Advanced Infrared Sounder Processing
	RTTOV
	ASCAT Wind Data Processor AWDP
	1D Var analysis package
	Monitoring Services

Advanced ATOVS Processing Package

Radiative Transfer Model

GRAS SAF

- SAF on GRAS Meteorology
- GRAS: Global Positioning System (GPS) Receiver for Atmospheric Sounding flown on EPS/Metop satellites
- near real-time and offline:
  - **sounding data (temperature, pressure, humidity)**
  - **corresponding validation products, and**
  - **assimilation software**
- The Leading Entity is the Danish Meteorological Institute DMI, Copenhagen
- The GRAS SAF is in its Continuous Development and Operations Phase (CDOP) since March 2007
- Software packages released since 2007, first NRT product dissemination in October 2008

GRAS SAF products

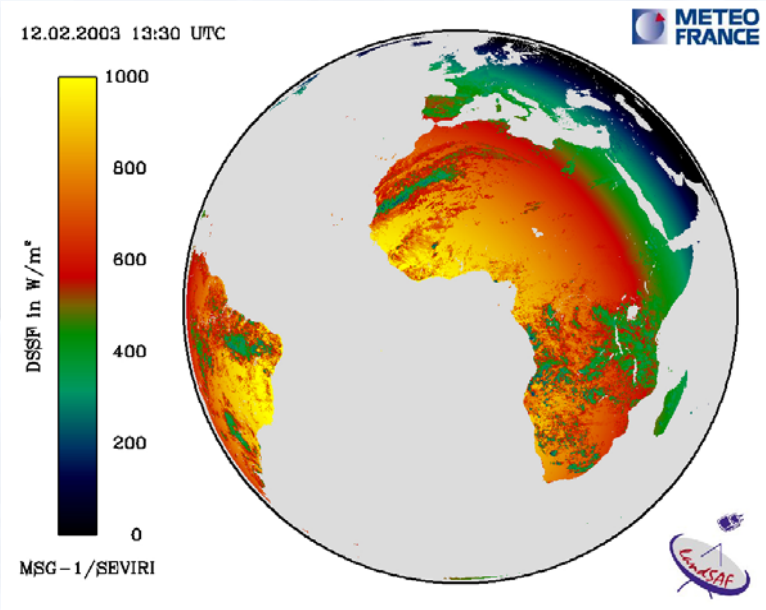
Near Real Time products	Refractivity profile
	Temperature profile
	Pressure profile
	Specific humidity profile
	Surface pressure
	validation products
	Error covariance matrix

	Monitoring Services

Offline products	Bending angle profile
	Refractivity profile
	Temperature profile
	Pressure profile
	Specific humidity profile
	validation products
	Error covariance matrix

Land Surface Analysis SAF

- SAF on Land Surface Analysis (LSA SAF)
- established to increase the benefit from MSG and EPS data related to land, land-atmosphere interaction and biospheric applications
- Generates operationally data services related to Surface Radiation, Vegetation and Soil Moisture
- Leading entity is the Portuguese Institute for Meteorology IM, Lisbon
- The Continuous Development and Operations Phase (CDOP) started in March 2007



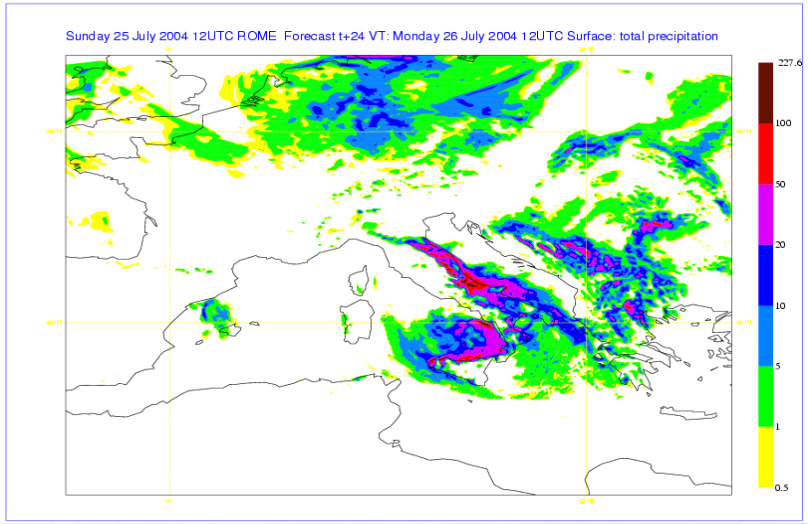
LSA SAF products

Near Real Time products	Surface Albedo
	Land Surface Temperature
	Downwelling Surface SW fluxes
	Downwelling Surface LW fluxes
	Snow Cover
	Fire Radiant Power

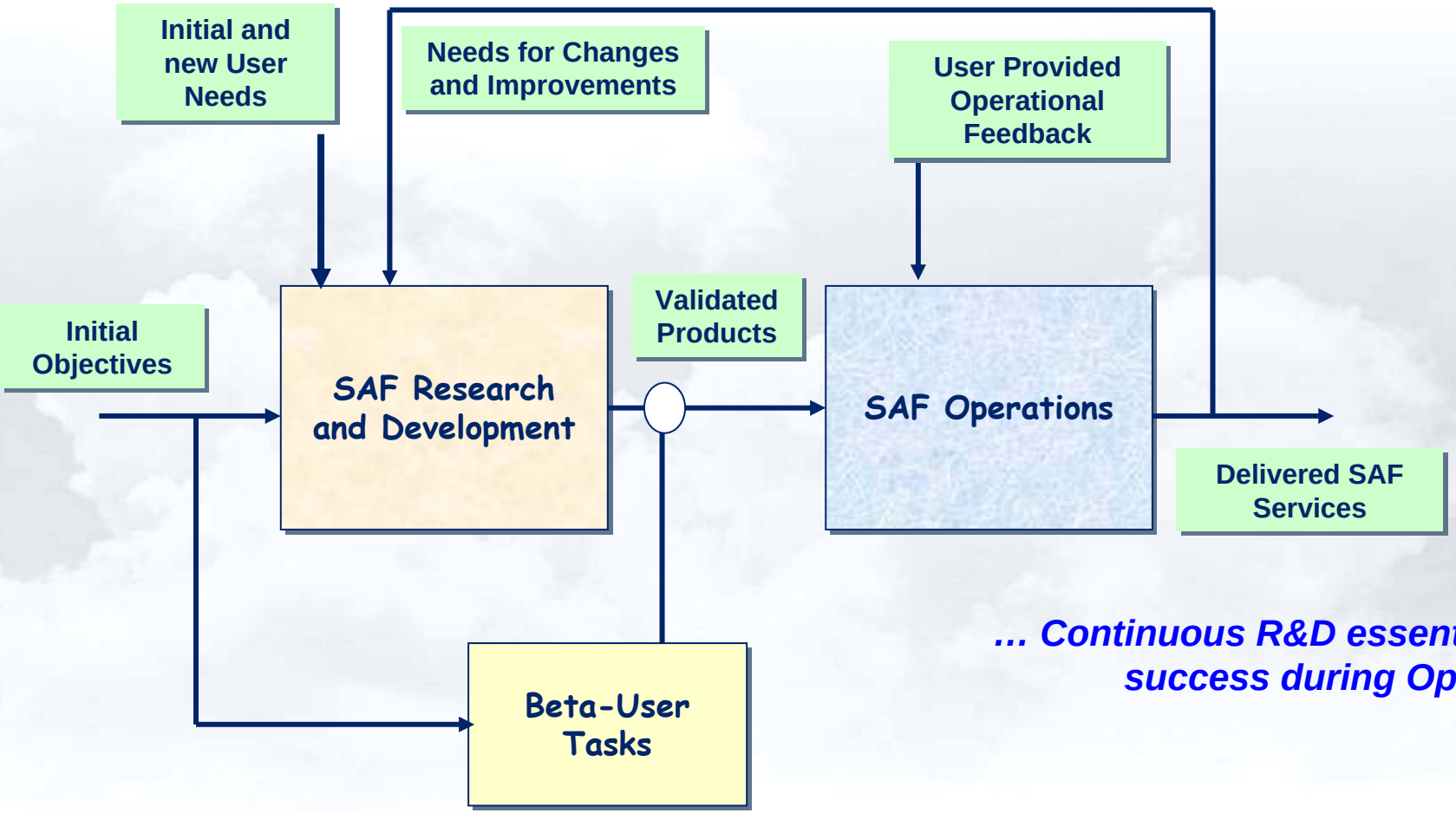
Offline products	Surface Albedo
	Land Surface Temperature
	Downwelling Surface SW fluxes
	Downwelling Surface LW fluxes
	Snow Cover
	Soil moisture and Evaportranspiration
	Fire detection and monitoring
	Risk of fire map
	Fraction of vegetation
	Fraction of absorbed photosynthetic active radiation
	Leaf area index

Hydrology SAF

- SAF on Support to Operational Hydrology and Water Management
- Host institute: Italian Meteorological Service (USAM), involving Member States and 4 Cooperating States
- SAF products focuses on
  - **precipitation**
  - **soil moisture**
  - **snow parameters**
  - **utilisation of these parameters in hydrological models and NWP**
- The H-SAF started Development Phase in September 2005



SAF Development and Service Model



… Continuous R&D essential for SAF success during Operations …

… Very large group of scientists involved in the support to SAF Projects …

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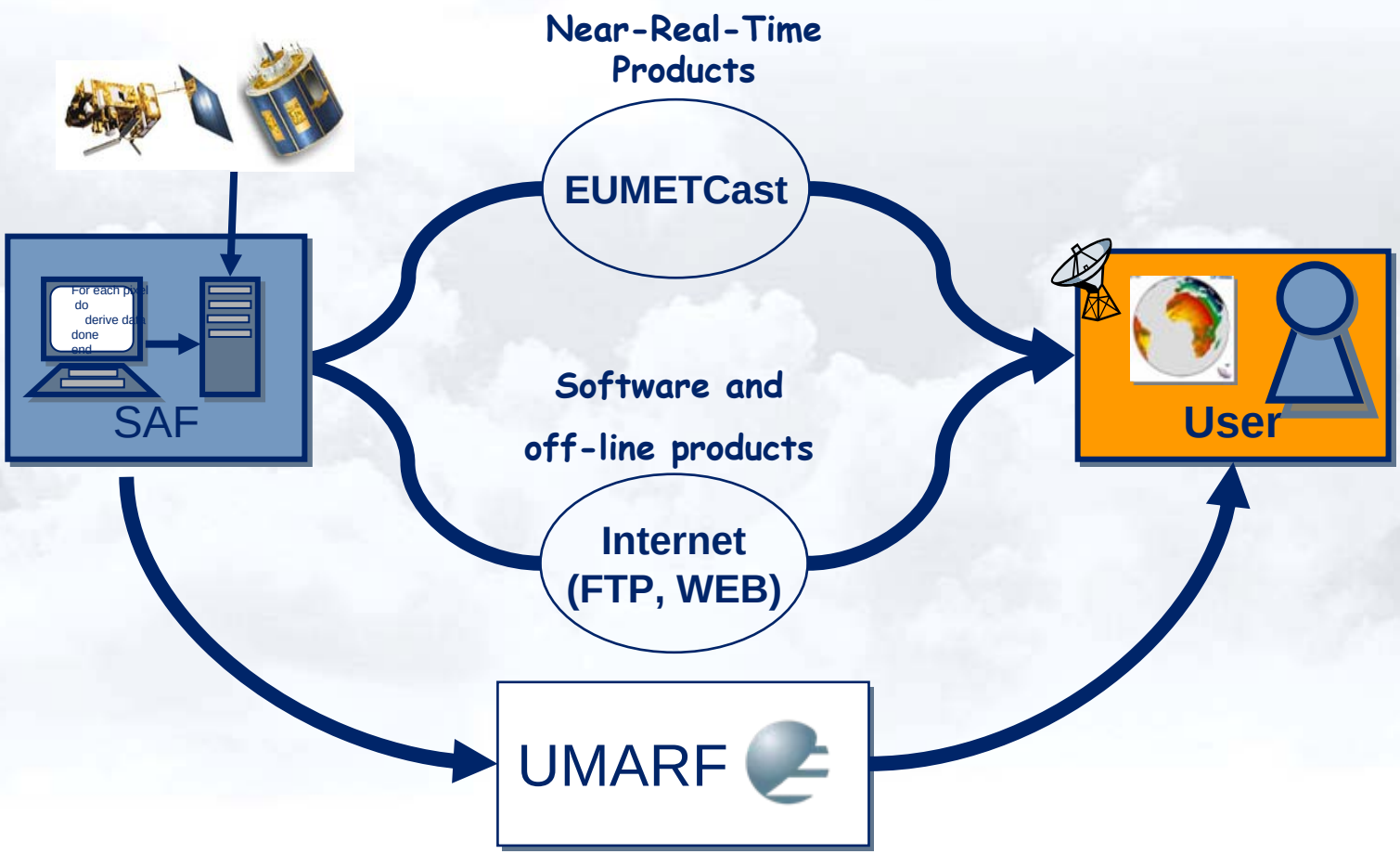
Interaction with Users: Services provided to users



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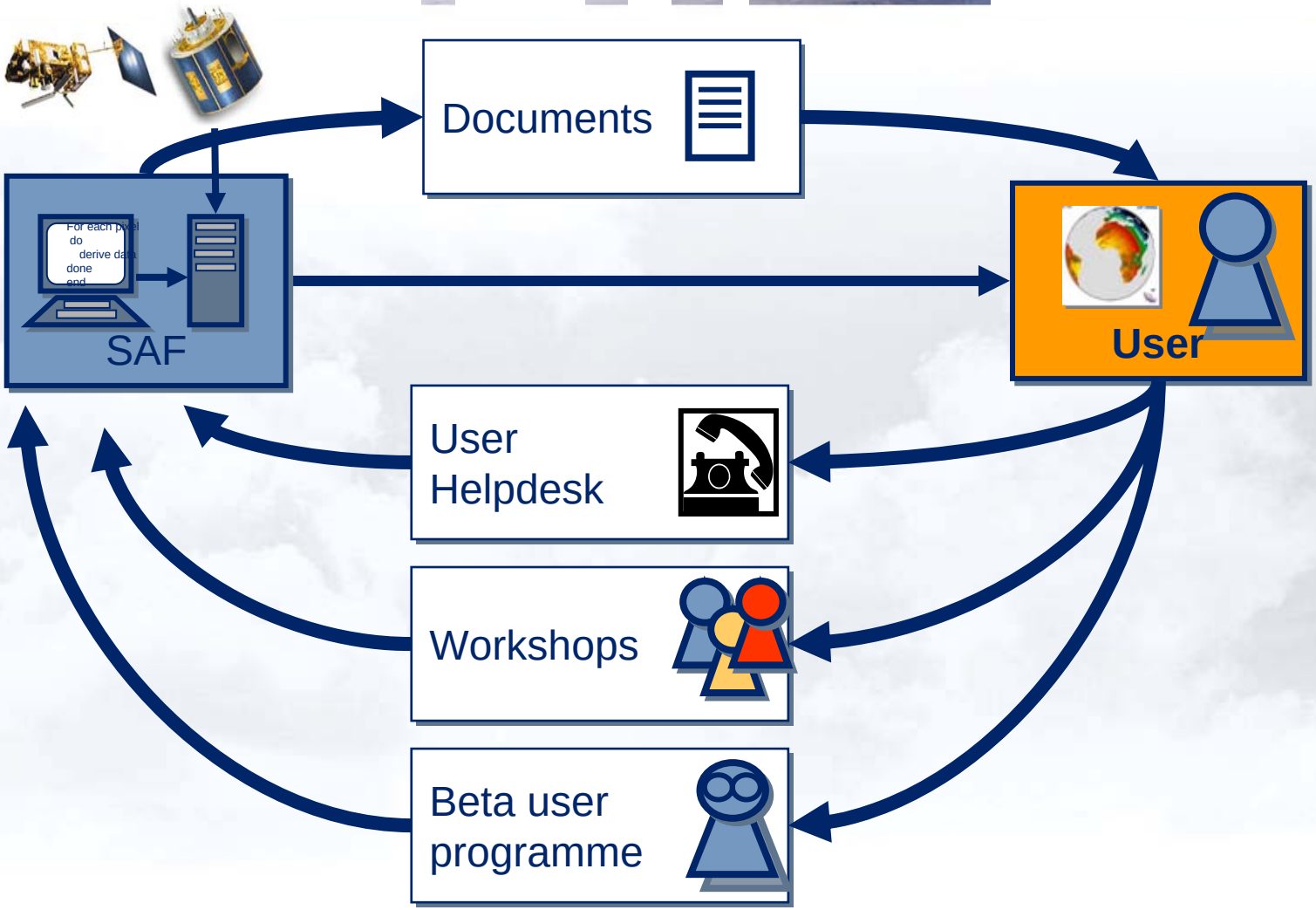
Interaction with Users: Feedback provided to SAFs



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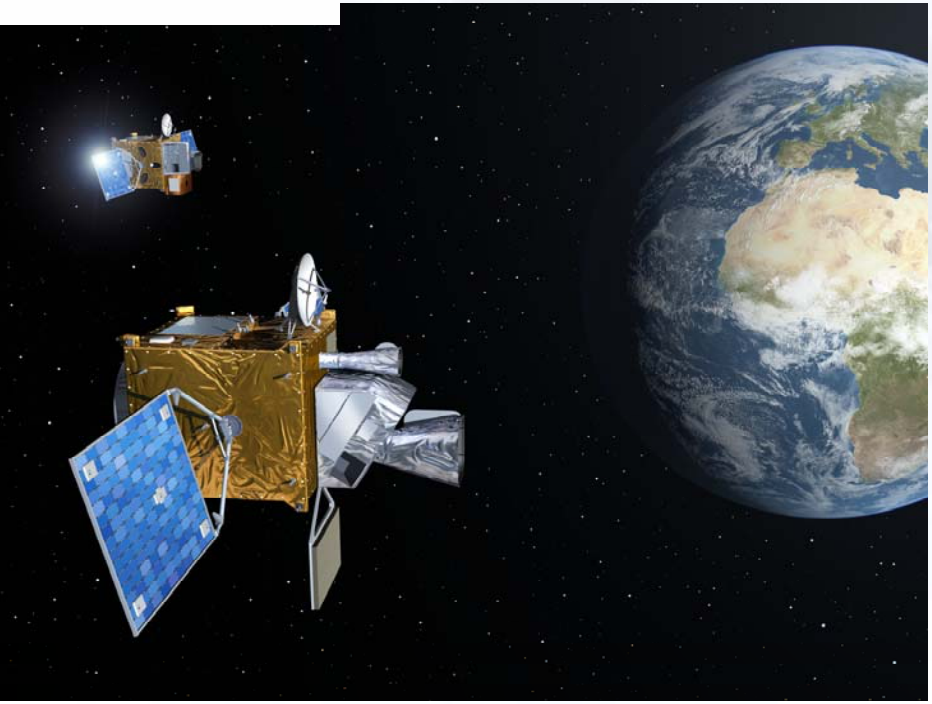
Outlook: CDOP-2

MTG



SAF Network after 2012:

- funding for 5 years of CDOP-2 foreseen within the MTG budget (subject to Council approval of the MTG programme)
- Currently, the strategic framework for CDOP is under definition
- SAFs started planning for activities and products for the 2012-2017 timeframe
- CDOP-2 will contain the development activities of Meteosat Third Generation (MTG) based products
- Integration and interfacing with other initiatives: GMES, WMO SCOPE-CM, EUMETCal, etc.

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Summary: SAF essentials

- SAF = Satellite Application Facility
- providing products and services to users on an operational basis with a long-term perspective
- specialised on topics and themes
- located at Weather Services in EUMETSAT Member and Co-operating States and developed and operated by consortium of partners
- part of the EUMETSAT application ground segment and complement production of standard meteorological products at EUMETSAT central facility
- SAF data and products are freely available for any user

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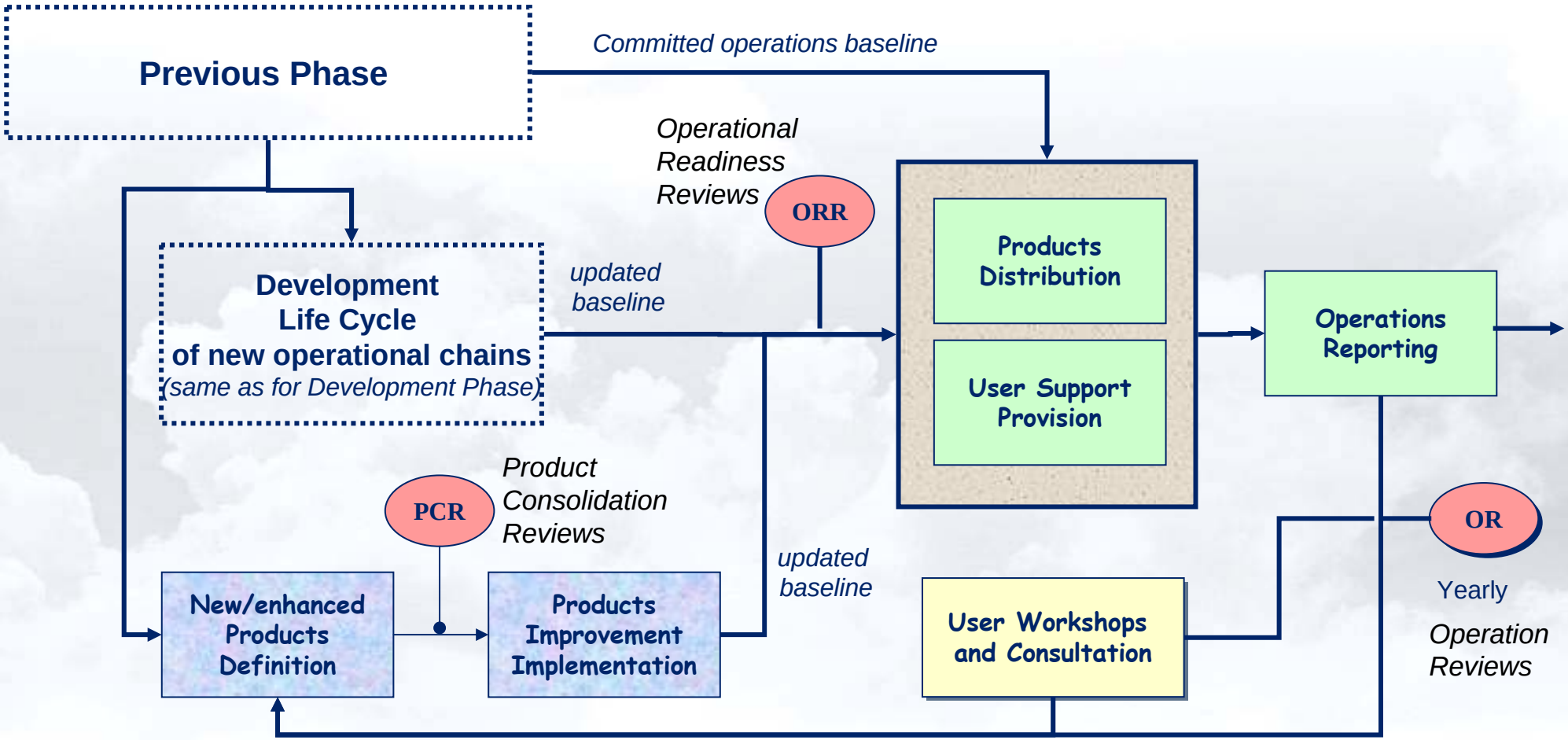
The CDOP



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Phase A MTG Configuration

- **Twin Satellite Concept, based on 3-axis platforms**
  - **Imaging Satellites** (MTG-I)
  - **Sounding Satellites** (MTG-S)
- **The payload complement of the MTG-I satellite consists of**
  - The Flexible Combined Imager (FCI)
  - The Lightning Imager (LI)
  - The Data Collection System (DCS) and Search and Rescue (GEOSAR)

Target for Imaging Missions is 20 years operational lifetime

- **The payload complement of the MTG-S satellite consists of**
  - The Infrared Sounder (IRS)
  - The Ultra-violet, Visible and Near Infrared Sounder (UVN).

    UVN is provided as GMES Sentinel 4 Instruments