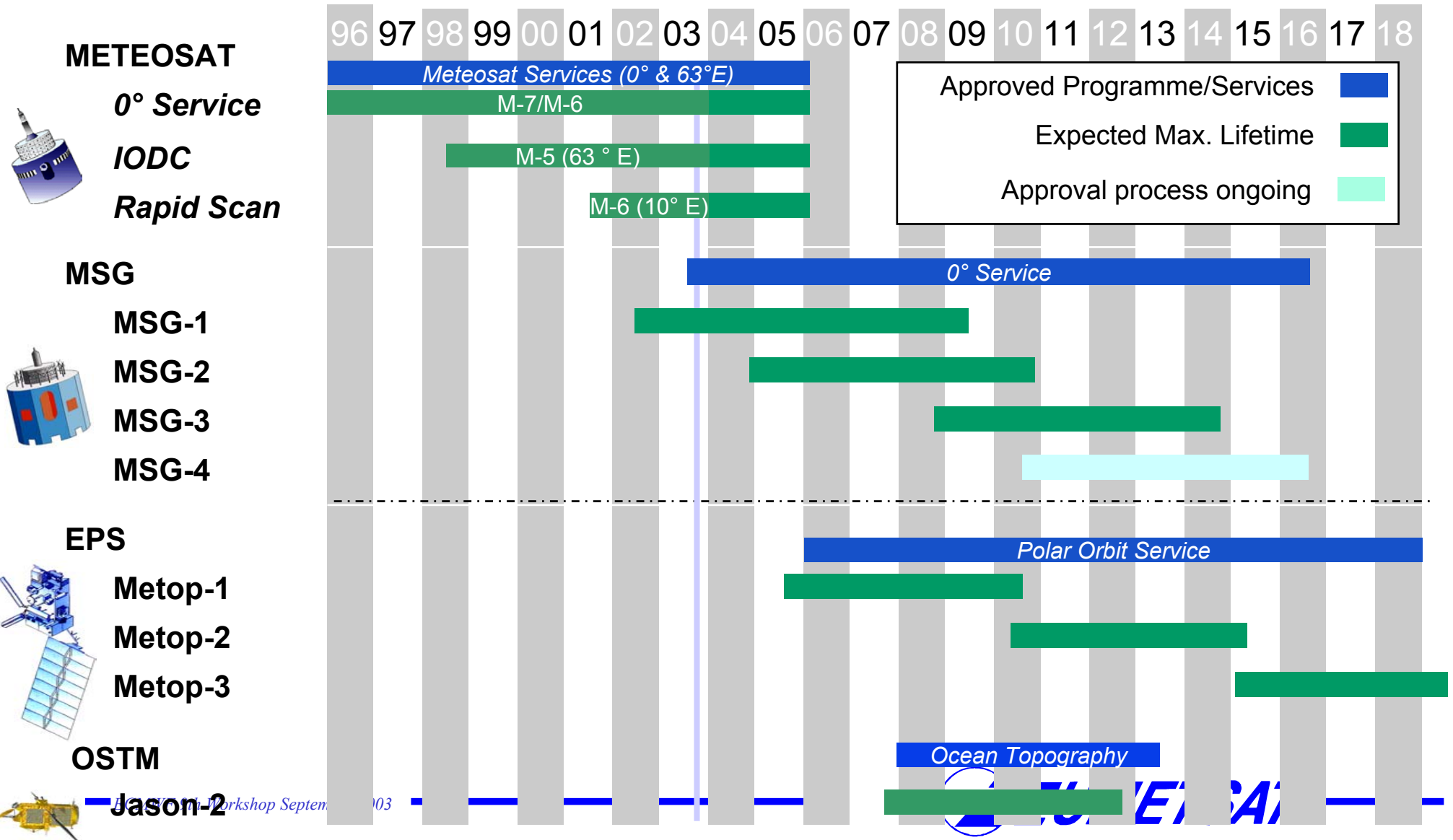


EUMETSAT current and future plans on product generation and dissemination

Ken Holmlund

holmlund@eumetsat.de

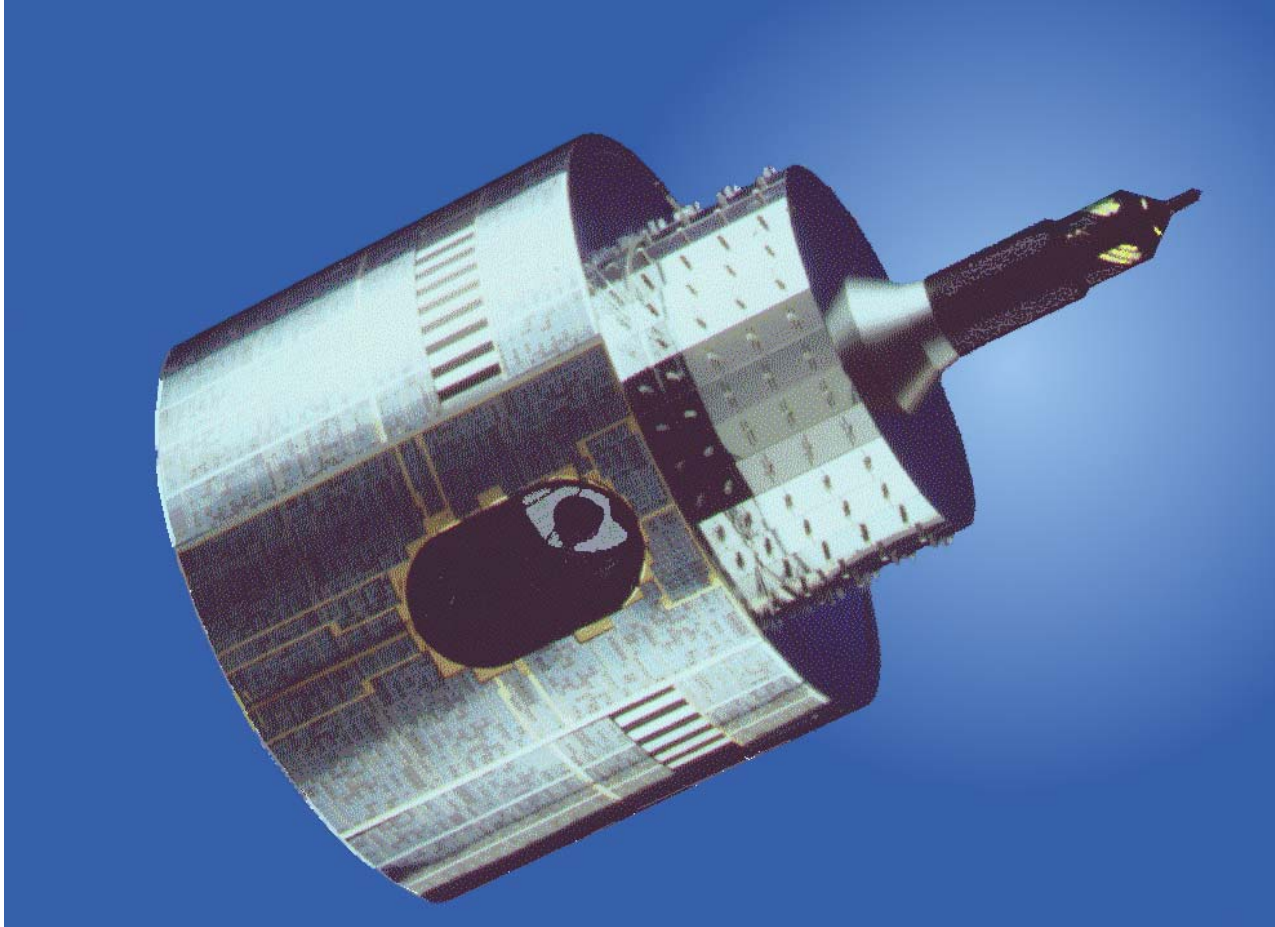
EUMETSAT SATELLITE PROGRAMMES



Workshop September 2003



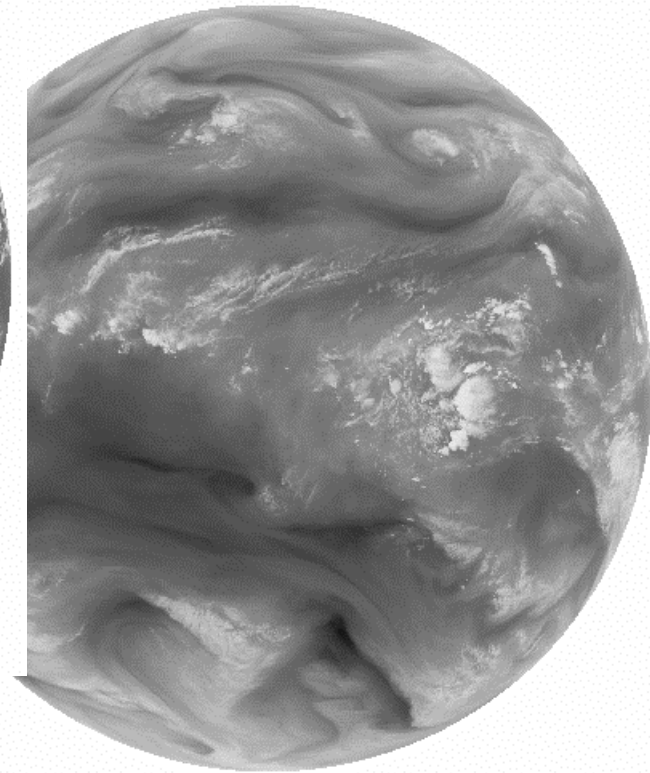
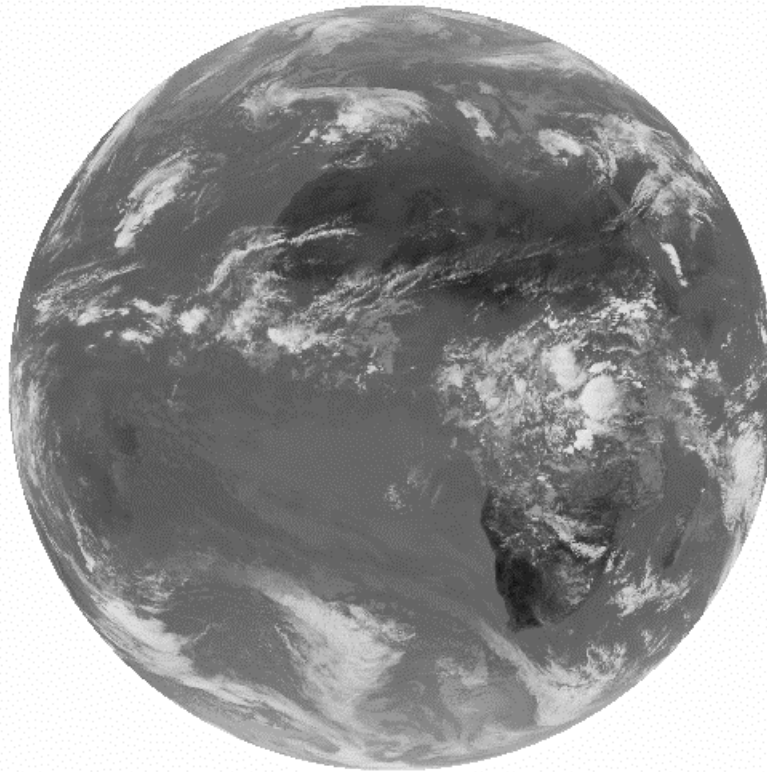
The Meteosat Satellite



Visible

Infrared

Water Vapour



Meteosat Meteorological Products

Operational products available in near real-time

- **Clear Sky Radiances**
- **Clear Sky Water Vapour Winds**
- **Climate Data Set**
- **Cloud Analysis**
- **Cloud Motion Winds**
- **Cloud Top Height**
- **High Resolution Visible Winds**
- **Sea Surface Temperatures**
- **Upper Tropospheric Humidity**

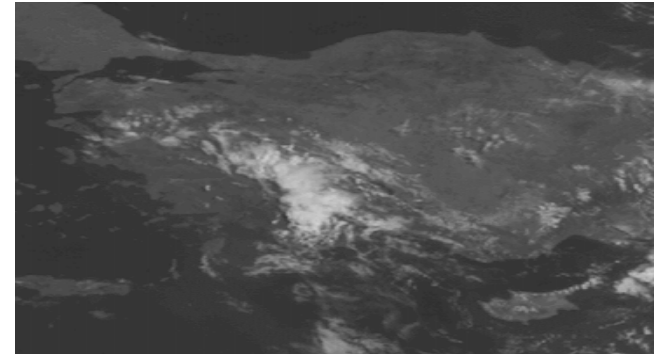
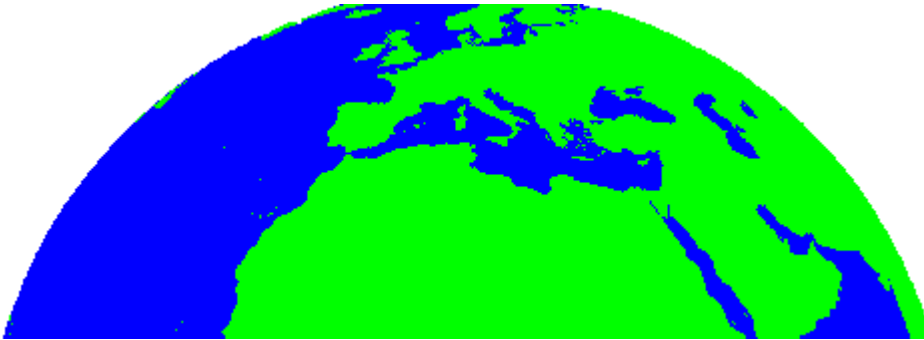
All of the above products are generated between 1 and 48 times each day on an operational basis. The Climate Data Set is stored for research use. The other products are distributed to users immediately after processing.

EUMETSAT Indian Ocean Data Coverage (IODC)



- From end of May 1998 Meteosat-5 has been located at 63°E where it supported INDOEX until the end of 1999 and will continue as IODC until at least the end of 2005

Rapid Scanning Service (RSS)



- Resulting from a request to support the Mesoscale Alpine Project (MAP) in September 1999 the backup spacecraft Meteosat-6 was configured to conduct a series of rapid scan operations
- Initially the rapid scan area covered the Alpine region at 5 minute intervals
 - ⇒ In 2000 the scanned area was increased significantly and the repeat cycle fixed to 10 minute intervals. From mid 2001 the Rapid Scanning Service became operational

Reprocessing of historical Meteosat Image Data

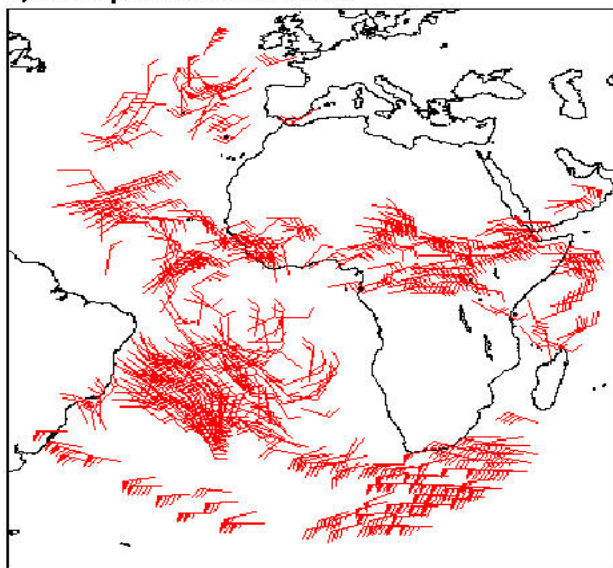
Improved product generation

e.g. AMV, CSR

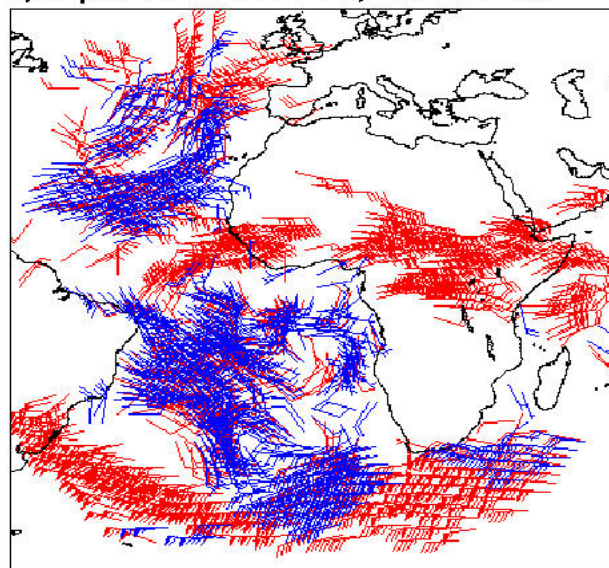
Better calibration

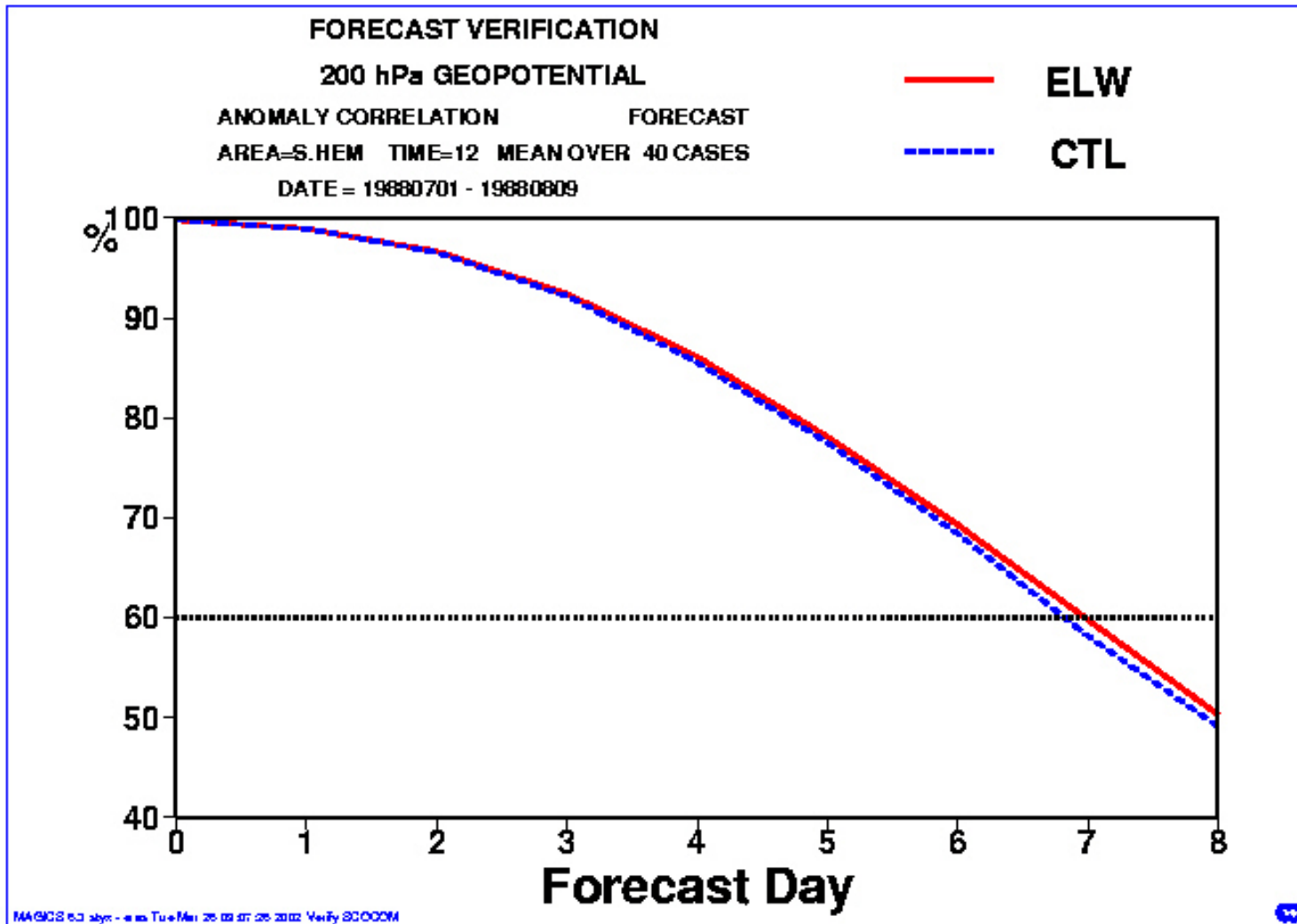
Typical AMV coverage after ECMWF blacklisting (12z +/- 3h)

a) Old operational IR data

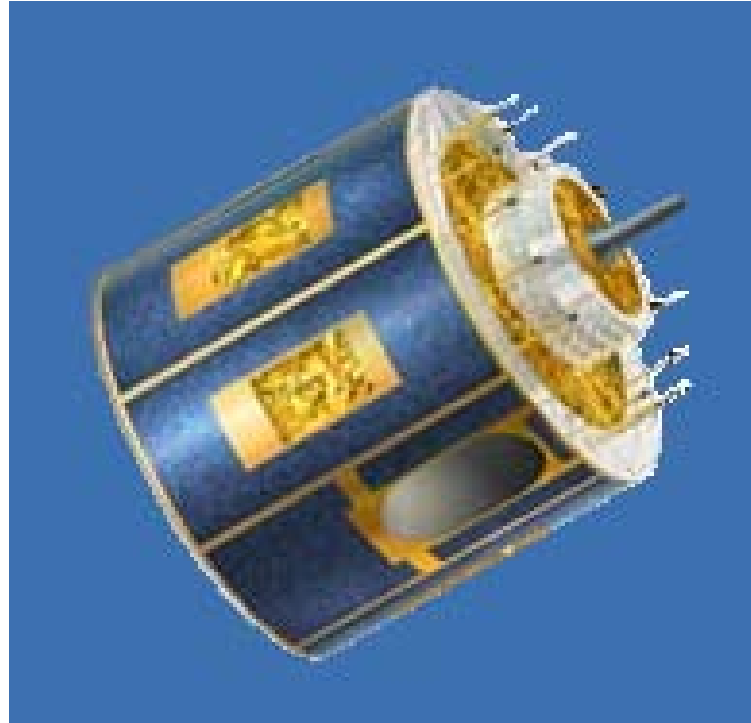


b) Reprocessed ELW data, IR and VIS





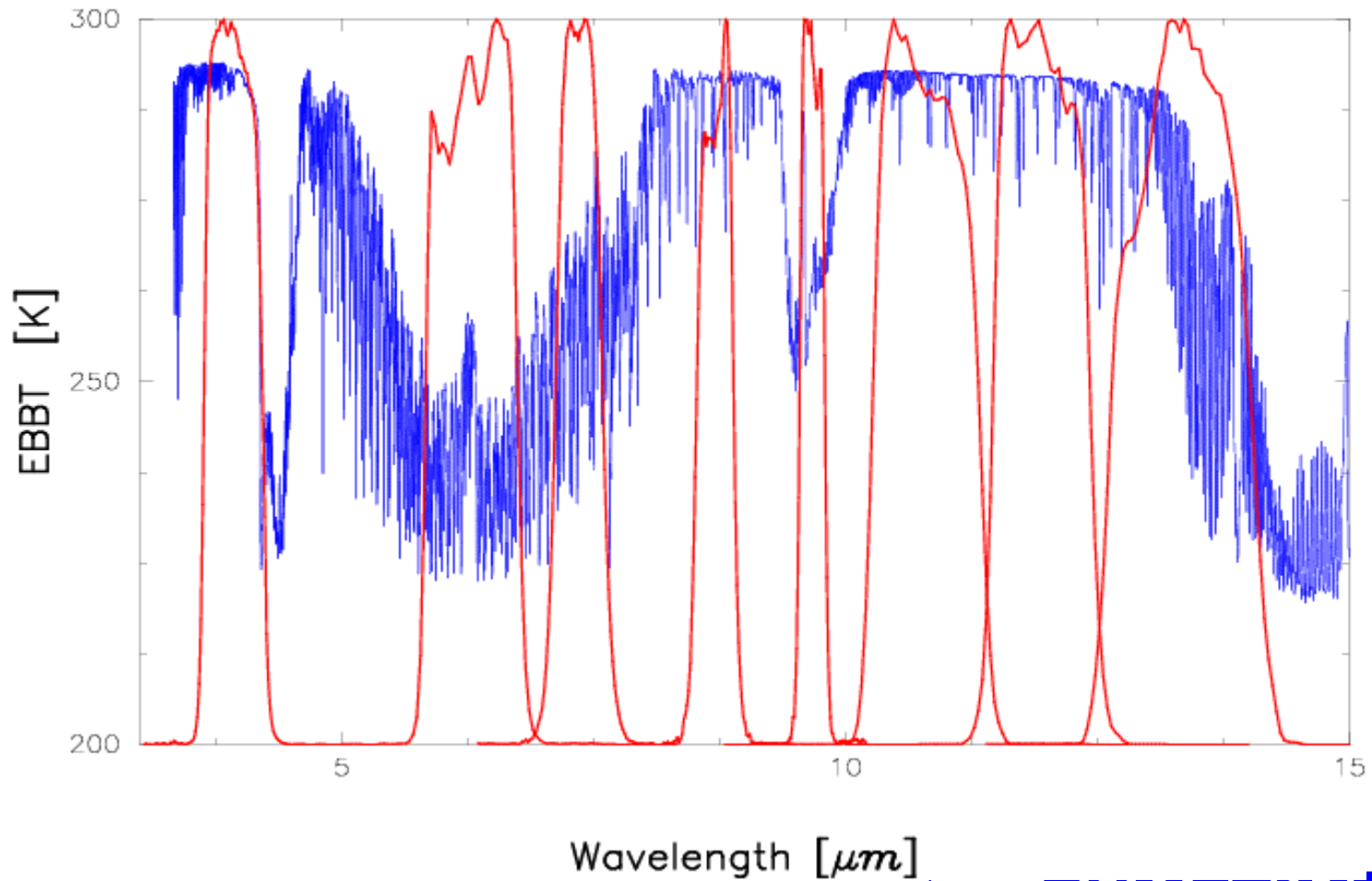
Meteosat Second Generation



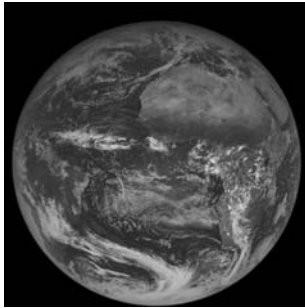
- Launched in August 2002
- Currently under commissioning
- Operations planned from January 2004

SEVIRI IR Channels

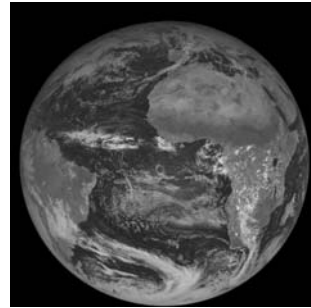
Standard Mid-Latitude Summer Nadir



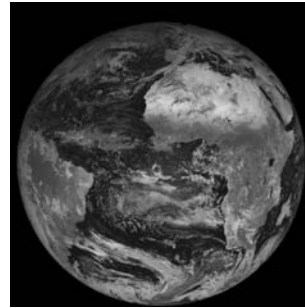
MSG channel



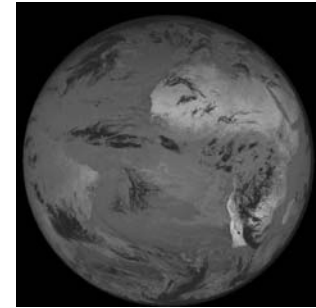
VIS 0.6 μm



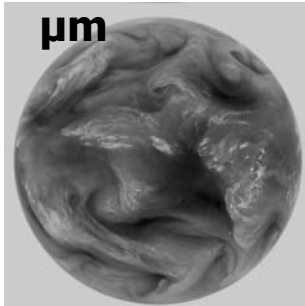
VIS 0.8 μm



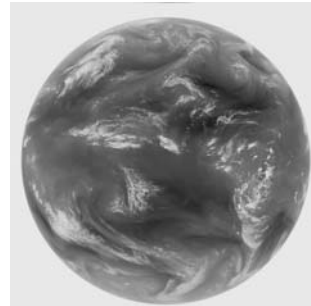
NIR 1.6 μm



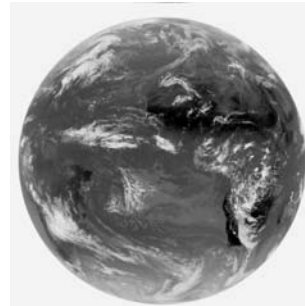
NIR 3.9 μm



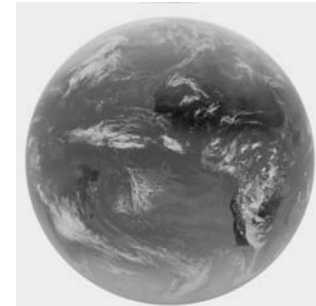
WV 6.2 μm



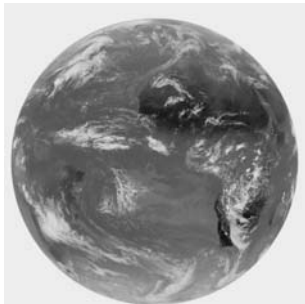
WV 7.3 μm



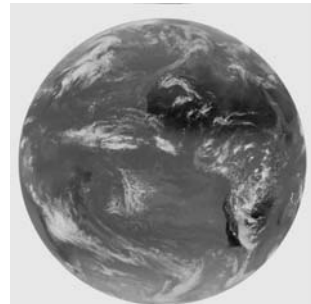
IR 8.7 μm



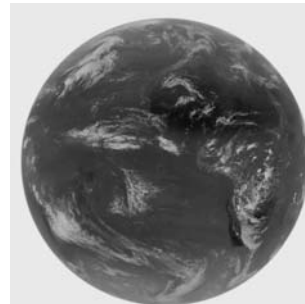
IR 9.7 μm



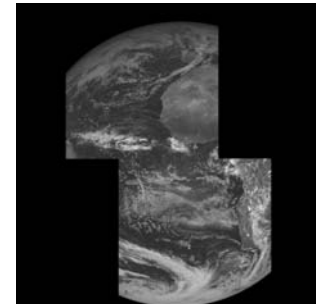
IR 10.8 μm



IR 12.0 μm



IR 13.4 μm



HRVIS

MPEF Products

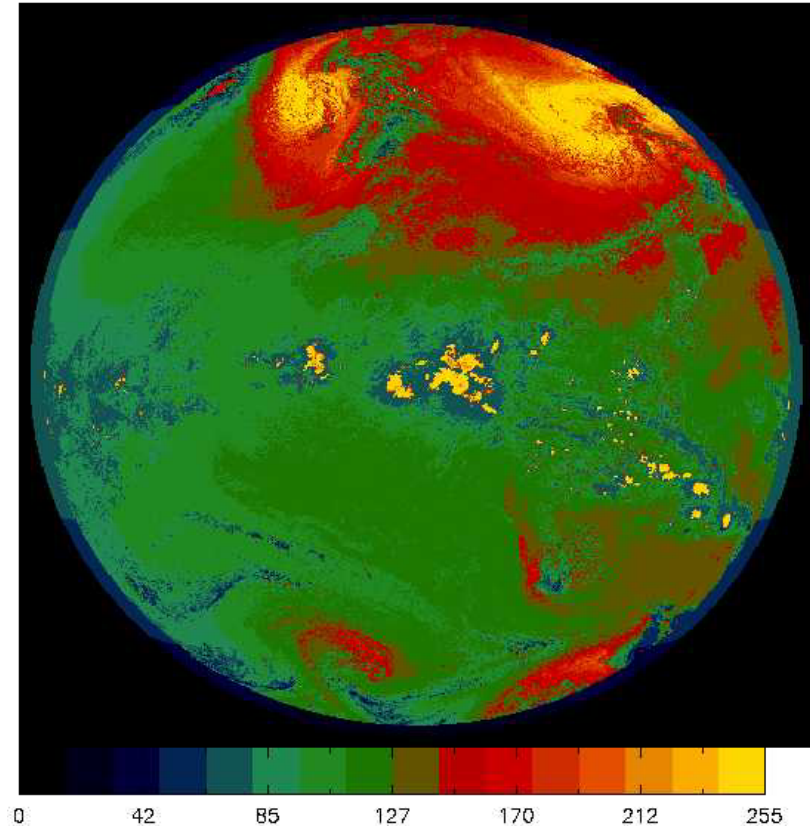
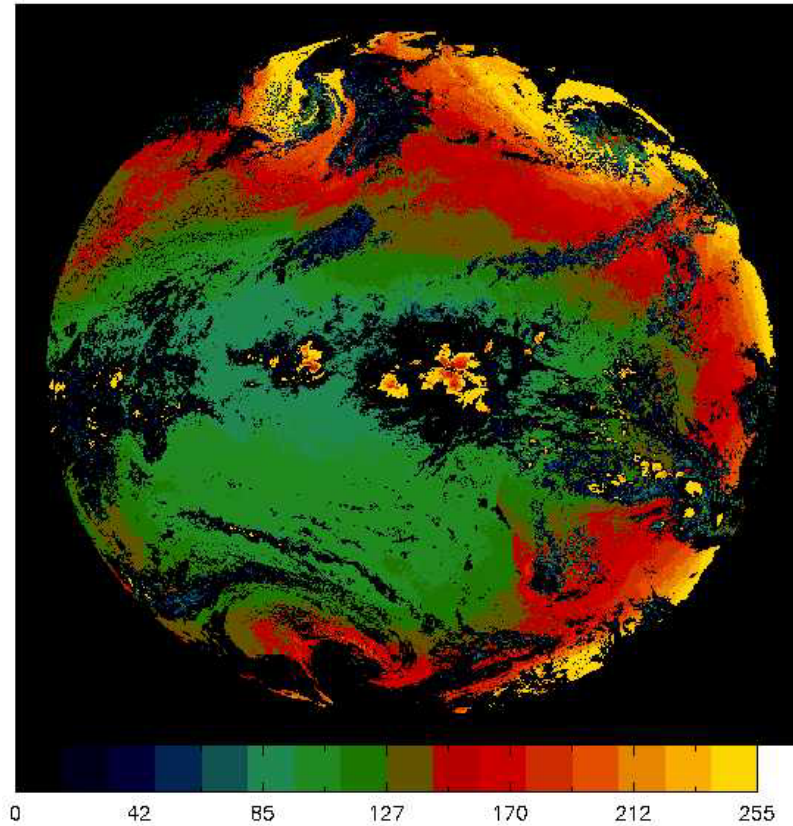
- Atmospheric Motion Vectors (AMV)
- Calibration Monitoring (CAL-MON)
- Clear Sky Radiance (CSR)
- Climate Data Set (CDS)
- Cloud Analysis (CLA)
- Cloud Top Height (CTH)
- Global Instability (GI)
- ISCCP Data Set (IDS)
- GPCP Precipitation Index (PI)
- Total Ozone (TOZ)
- Tropospheric Humidity (TH)

Product Validation Status

Products	Acronym	UMARF archive	GTS	EUMETCast (LRIT) (5)	Validated at RORR	Validated at IPVR close out
Atmospheric Motion Vectors	AMV	Yes	Yes	Yes	Partial (1)	Partial (1)
Cloud Analysis	CLA	Yes	Yes	Yes	Yes	Yes
Cloud Analysis Image	CLAI	Yes	No	Yes	No	Yes
Cloud Mask	CLM	Yes (4)	No	Yes	No	Yes
Cloud Top Height	CTH	Yes	No	Yes	No	Yes
Clear Sky Radiance	CSR	Yes	Yes	No	Yes	Yes
Climate Data Set	CDS	Yes (3)	No	No	Yes	Yes
High Resolution Precipitation Index	HPI	Yes (3)	No	No	No	Yes
ISCCP Data Set AC, B1 & B2	IDS	Yes (3)	No	No	No	Yes
Tropospheric Humidity	TH	Yes	Yes	Yes	Partial (1)	Partial (1)
Total Ozone	TOZ	Yes	Yes	Yes	No	Yes
Sea Surface Temperature (2)	SST	No	No	No	Yes	Yes
Scenes Analysis (2)	SCE	No	No	No	Yes	Yes
Radiative Transfer Model (2)	RTM	No	No	No	Yes	Yes
Calibration Support	CAL	Yes (3)	No	No	Yes	Yes
Global Instability	GII	Yes (4)	No	Yes	No	Yes

- (1) Seasonal
- (2) These products are for internal MPEF usage only.
- (3) Only available via U-MARF
- (4) Implementation in-progress
- (5) For information, the following OSI SAF products will also be added to the EUMETCAST (LRIT) distribution when ready: Sea Ice Products (High latitudes) with 3 sub-products edge, type and cover and the Atlantic Sea Surface Temperature.

Stratospheric Ozone and Dynamics

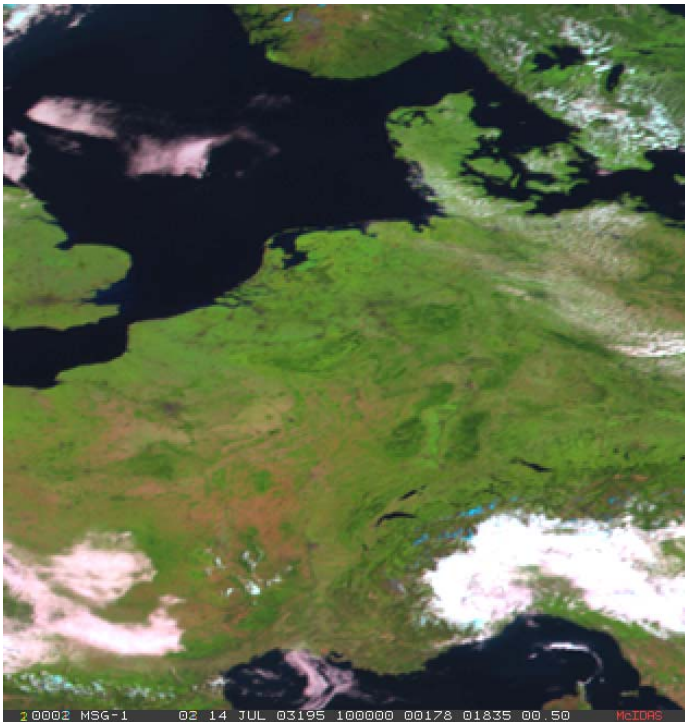


MSG-1 **total ozone product** for 24 Feb 2003, 12 UTC

Left: operational MPEF algorithm (Ozone SAF)

Right: alternative algorithm (OE method)

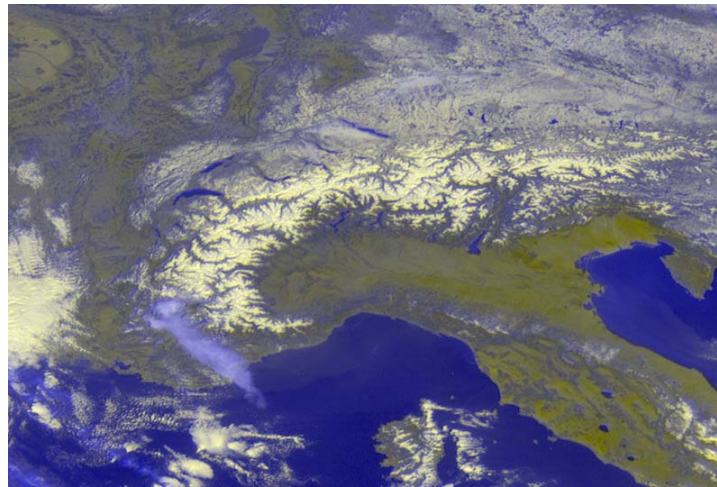
Note: values are not in DU!



MSG-1
14 July 2003
10:00 UTC

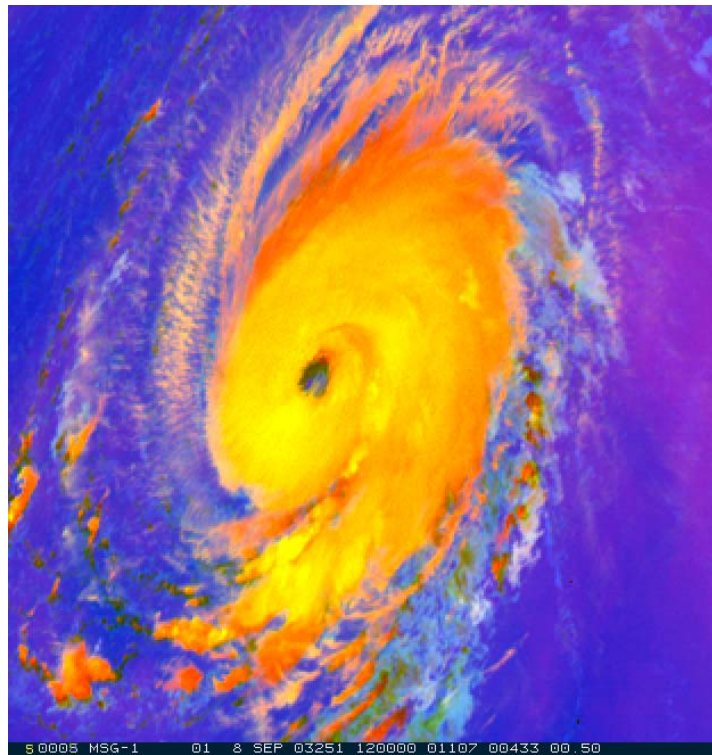
Details of vegetation in Europe – grassland shows up as bright green areas, the forests are dark green. Also noteworthy is the dense fog over the Po area and the poor snow cover over the Central Alps (small cyan-colored areas).

Composite image using NIR 1.6, VIS 0.8 and VIS 0.6



MSG-1, 14 July 2003, 10:00 UTC

Snow over the Alps, displaying the Alpine valleys in beautiful clarity. Composite image using the high resolution visible channel (HRVIS) and IR 10.8

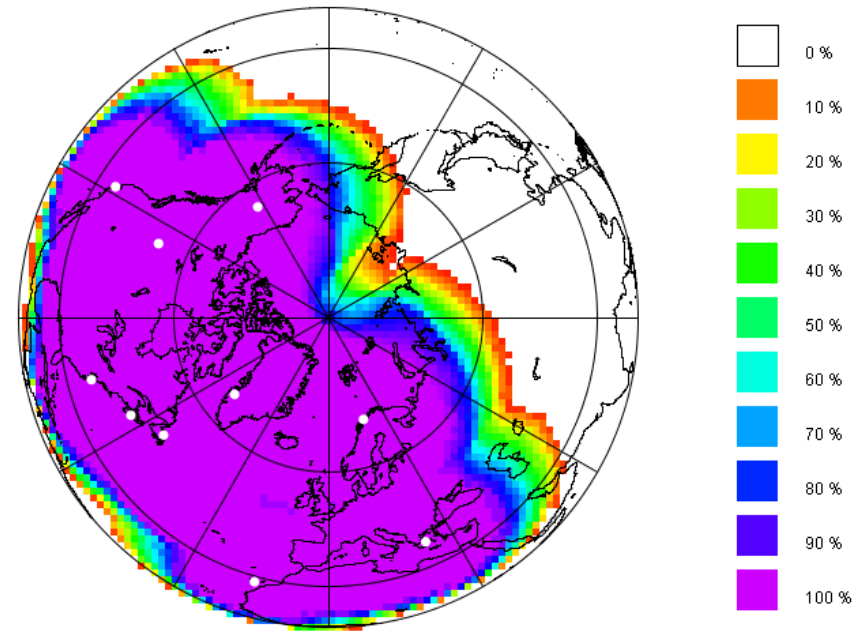
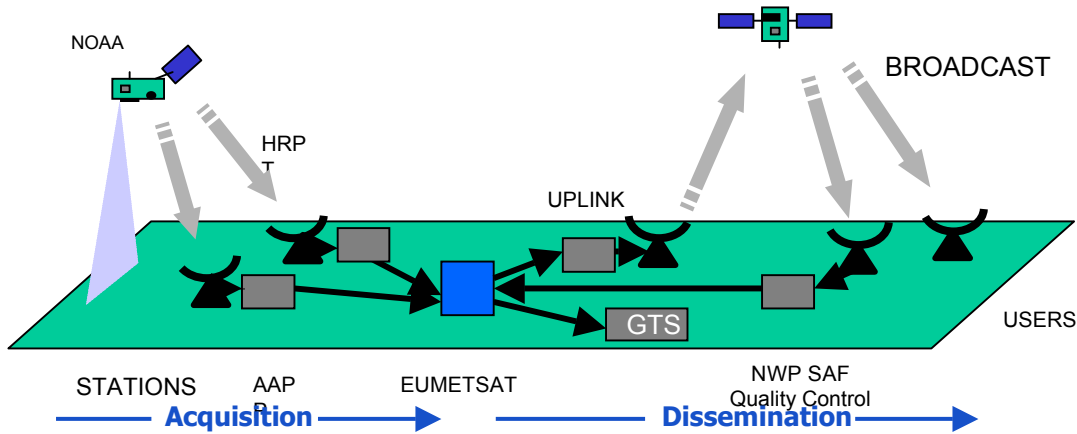


MSG-1
8 September 2003
12:00 UTC

Hurricane "Isabel" over the Atlantic.

Composite image produced from channels VIS0.6, NIR1.6, IR3.9, WV6.2, WV7.3 and IR10.8

EUMETSAT ATOVS Retransmission Service (EARS)



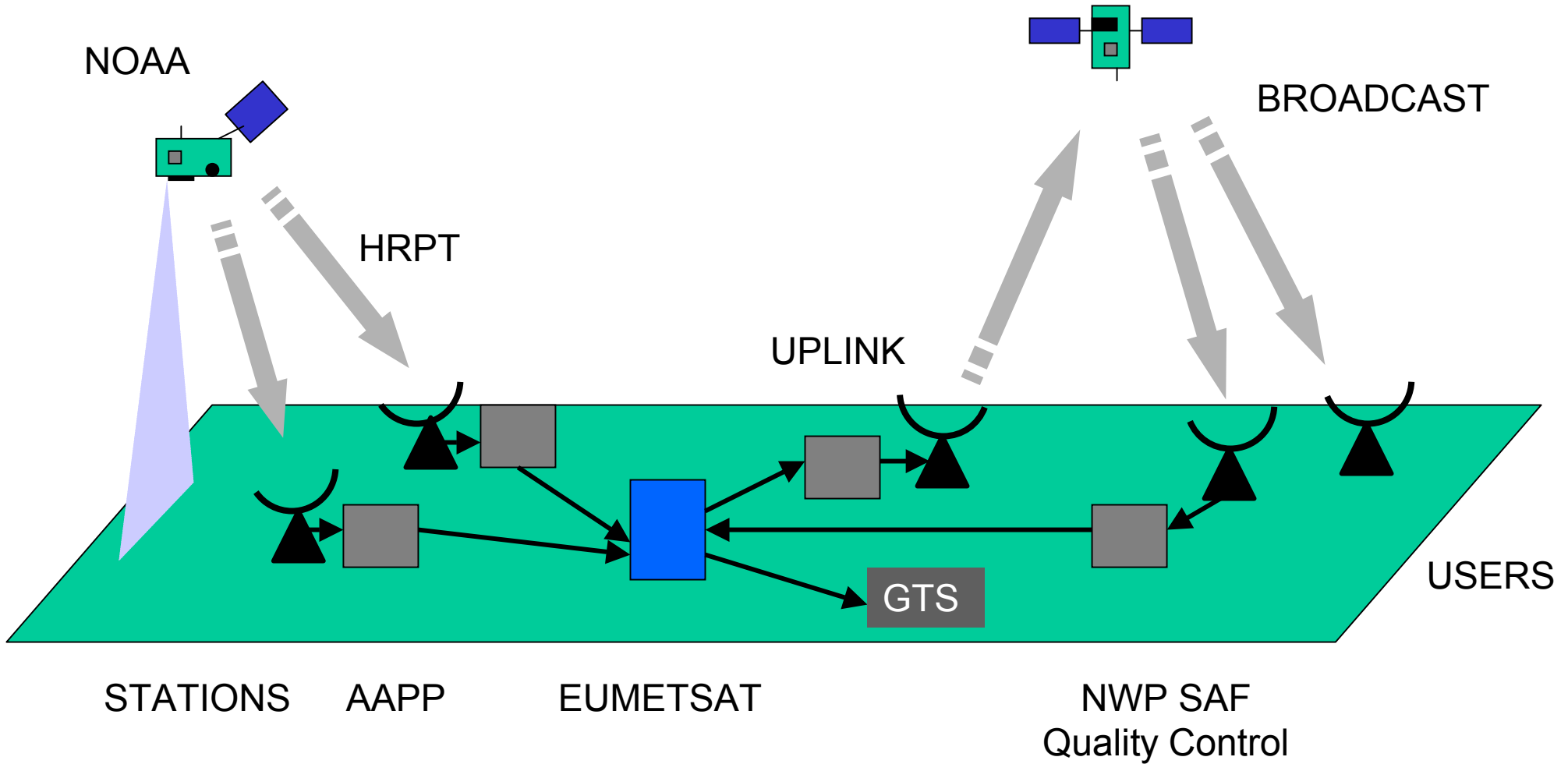
Local processing “global” dissemination
 30 min timeliness

EUMETSAT

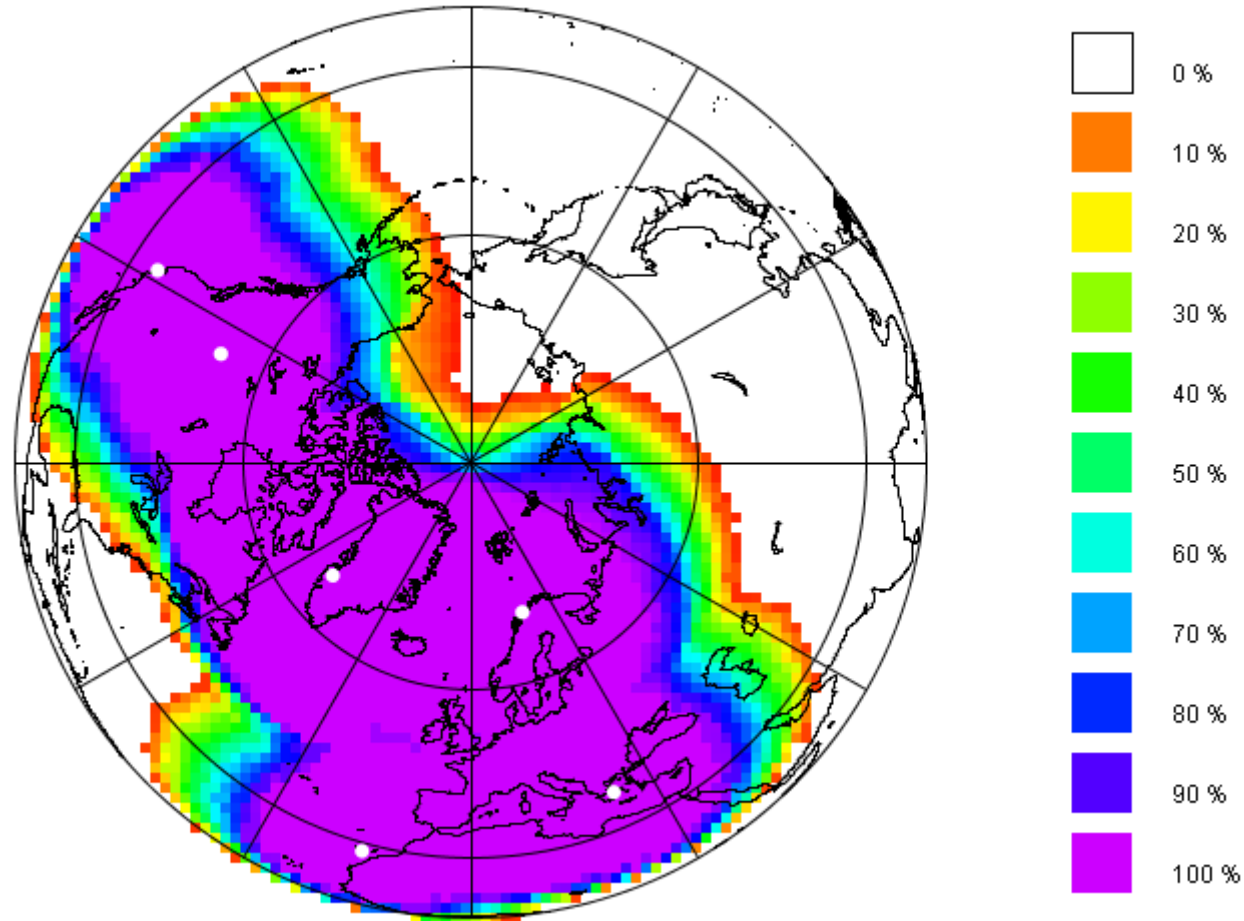
ATOVS Retransmission Service

EARS

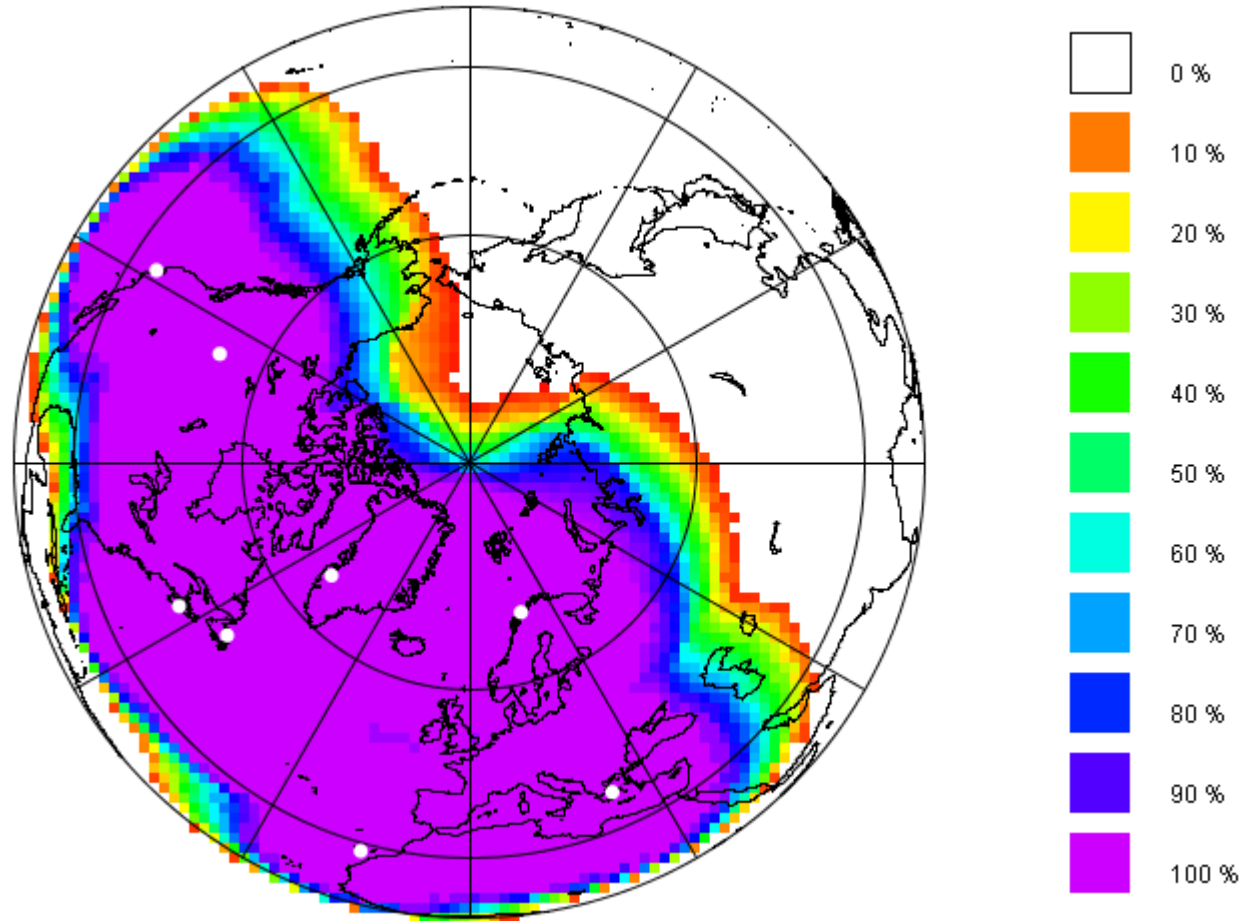
System Overview



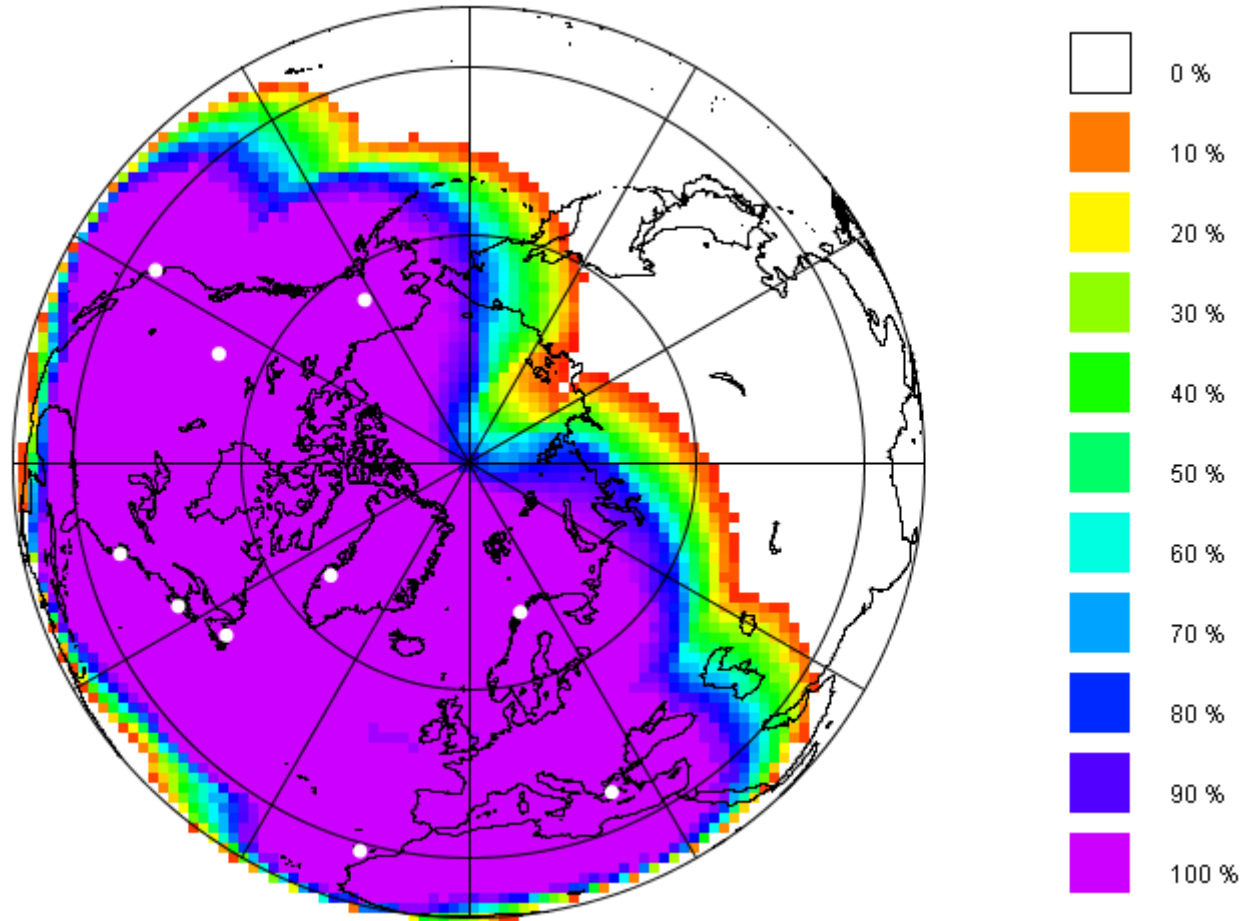
Coverage as of August 2003 adding: Edmonton, Monterey and Athens



Adding: Gander and Bedford



Adding: Wallops, Gilmore Creek



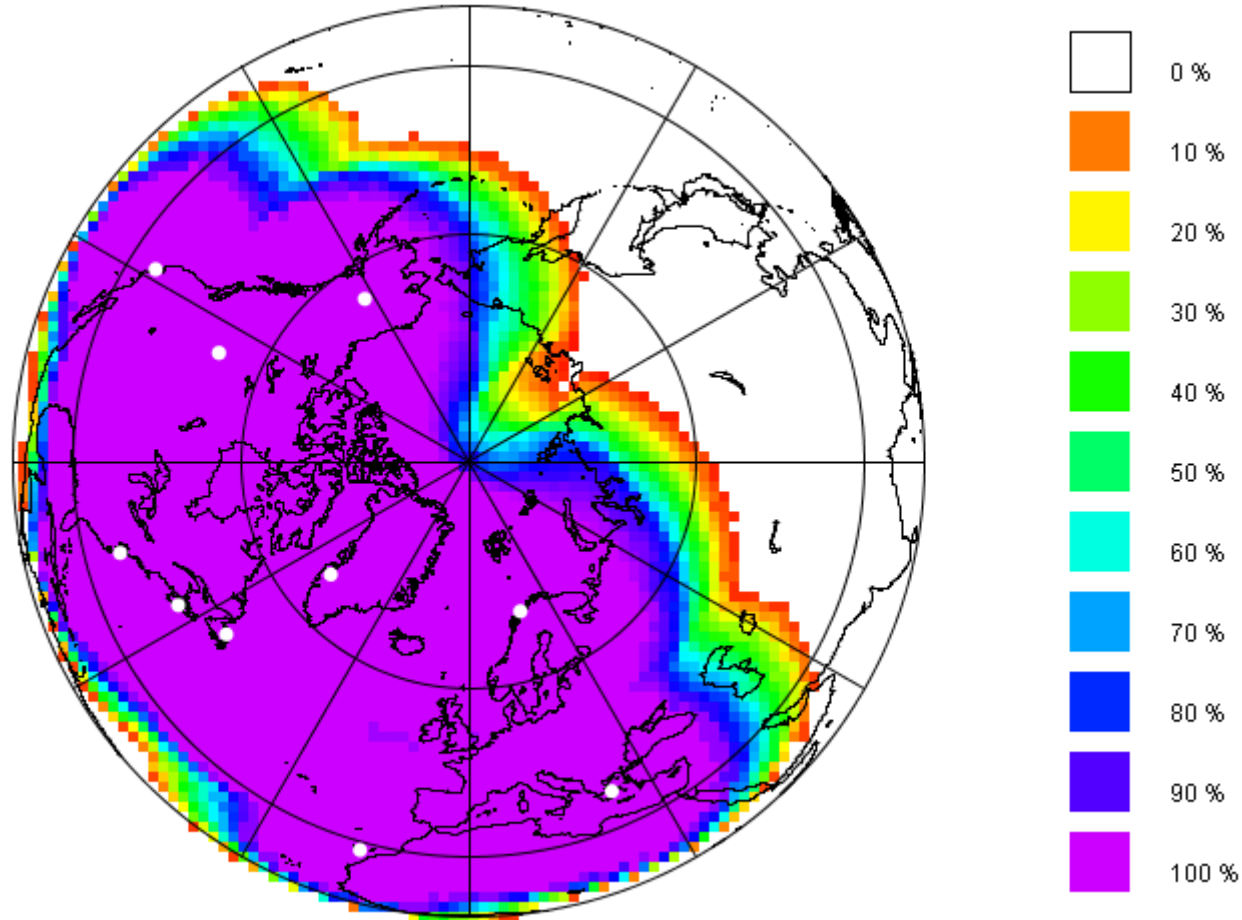
Users

- 77 Users now registered to receive EARS via EUMETCast
- Several NMS have set up their reception and processing systems and are performing off-line runs of the new data in their Numerical Weather Prediction (NWP) systems
- DMI has started assimilating EARS data operationally in their NWP system (HIRLAM)
- EARS workshop took place at the 2003 EUMETSAT Meteorological Satellite Conference at Weimar in October
- Some problems with bias correction when only local data used

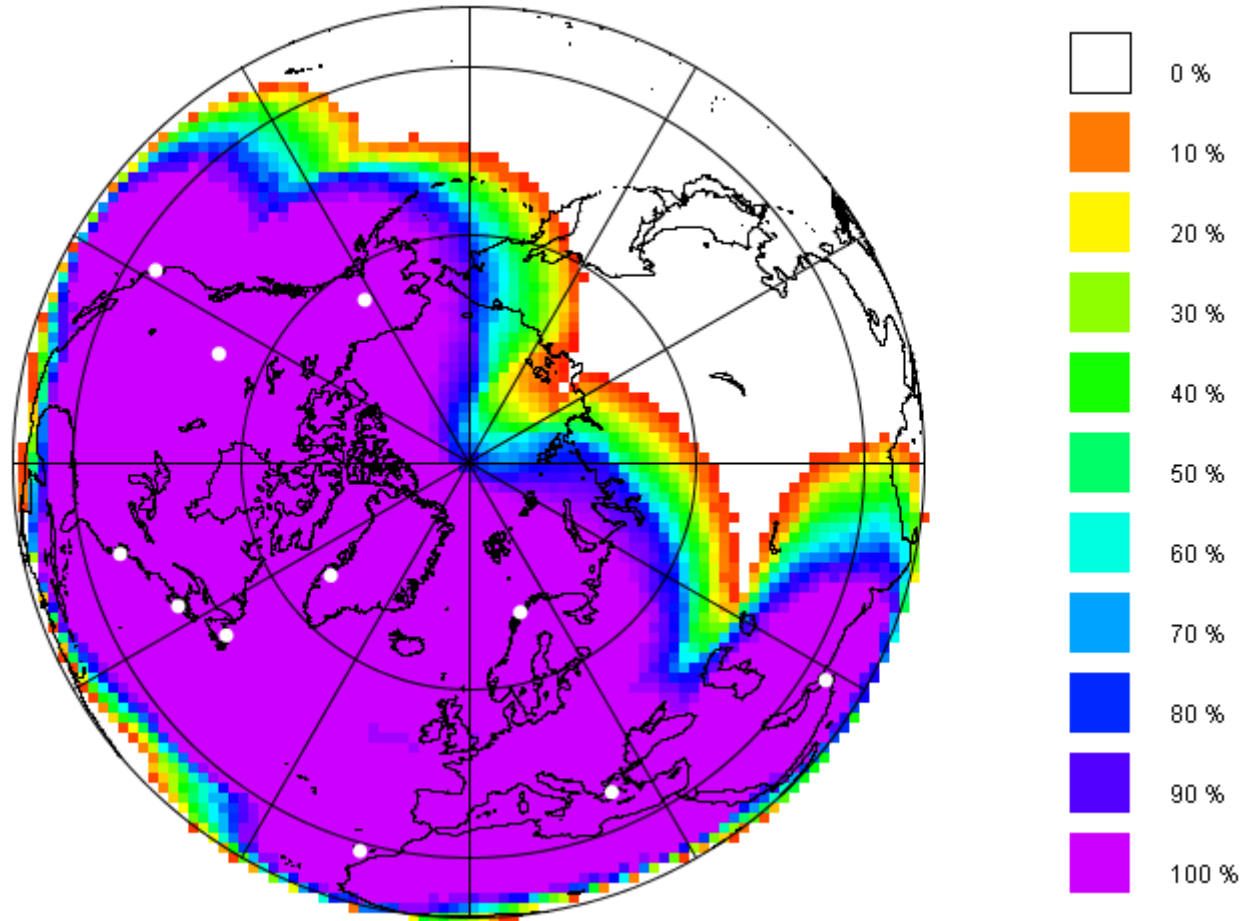
Planning

- Completion of the Quality Control function in the framework of the NWP SAF
- Feasibility investigation of AVHRR retransmission as requested by Climate SAF
- Potential expansion in NH (Russia, China and Oman)
- Preparation of a proposal for extending EARS beyond the Pilot Phase
 - Service enhancements
 - EPS support (Sounders, ASCAT, ...)
- Proposal to be ready for the Spring 2004 delegate meetings
- EARS is considered as a model for improving timeliness for MODIS winds

Adding: Oman



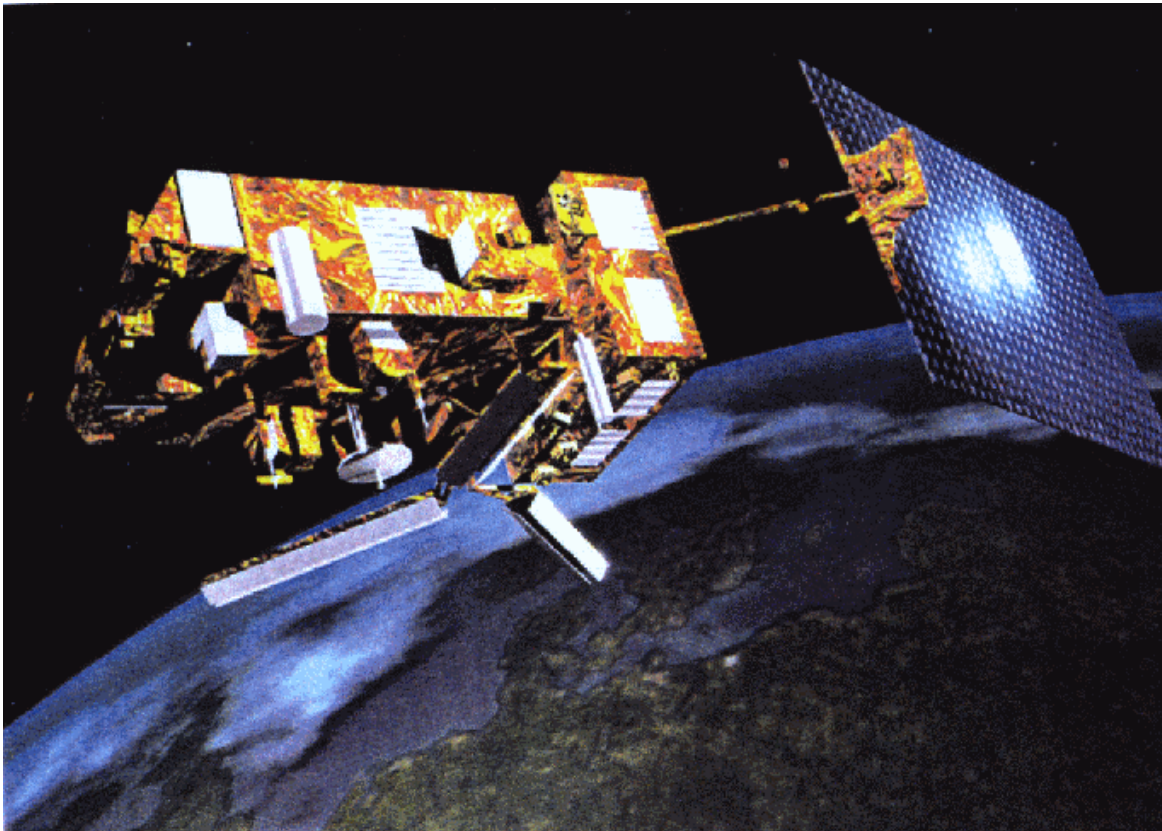
Adding: Oman



Instrument Data Rates

	Polar Satellite Generation			Instrument Data Rate
	NOAA KLM	NOAA N-N'	METOP	
HRPT Data rate	665.4 Kbps	665.4 Kbps	3.5 Mbps	
Launch Years	1998, 2000, 2002	2004, 2008	2005, 2010, 2015	
Imaging Radiometer	AVHRR/3	AVHRR/3	AVHRR/3	622 kb/s
Sounders Instruments	HIRS/3	HIRS/4	HIRS/4	2,9 kb/s
	AMSU-A	AMSU-A	AMSU-A	3,2 kb/s
	AMSU-B	MHS	MHS	3,9 kb/s
			IASI	1500 kb/s
Other Instruments			ASCAT	60 kb/s
			GRAS	60 kb/s
			GOME	400 kb/s

EUMETSAT POLAR SYSTEM



EUMETSAT POLAR SYSTEM

- Scheduled launch Oct 2005
- 14 years of operation
- All level 1b data within 2h 15min to NRT
- Level 2 data within 3h to NRT
- Level 3 data variable

EPS level 1b products

- **Level 1b all instruments:**
 - Brightness temperatures for IR and microwave channels
 - Reflectances for visible channels
 - Bending angles for GRAS
 - Calibrated brightness radiances/solar irradiances for GOME-2
 - Backscatter coefficient for ASCAT
- **Including:**
 - basic identification: date, time, spacecraft, orbit no, orbit elements;
 - pixel geo-location information, allowing the derivation for each pixel: observation time, latitude, longitude, Sun and satellite zenith angles, azimuth difference; viewing angle;
 - land/sea mask, elevation;
 - calibration coefficients;
 - algorithm, version information;
 - quality information
 - other.

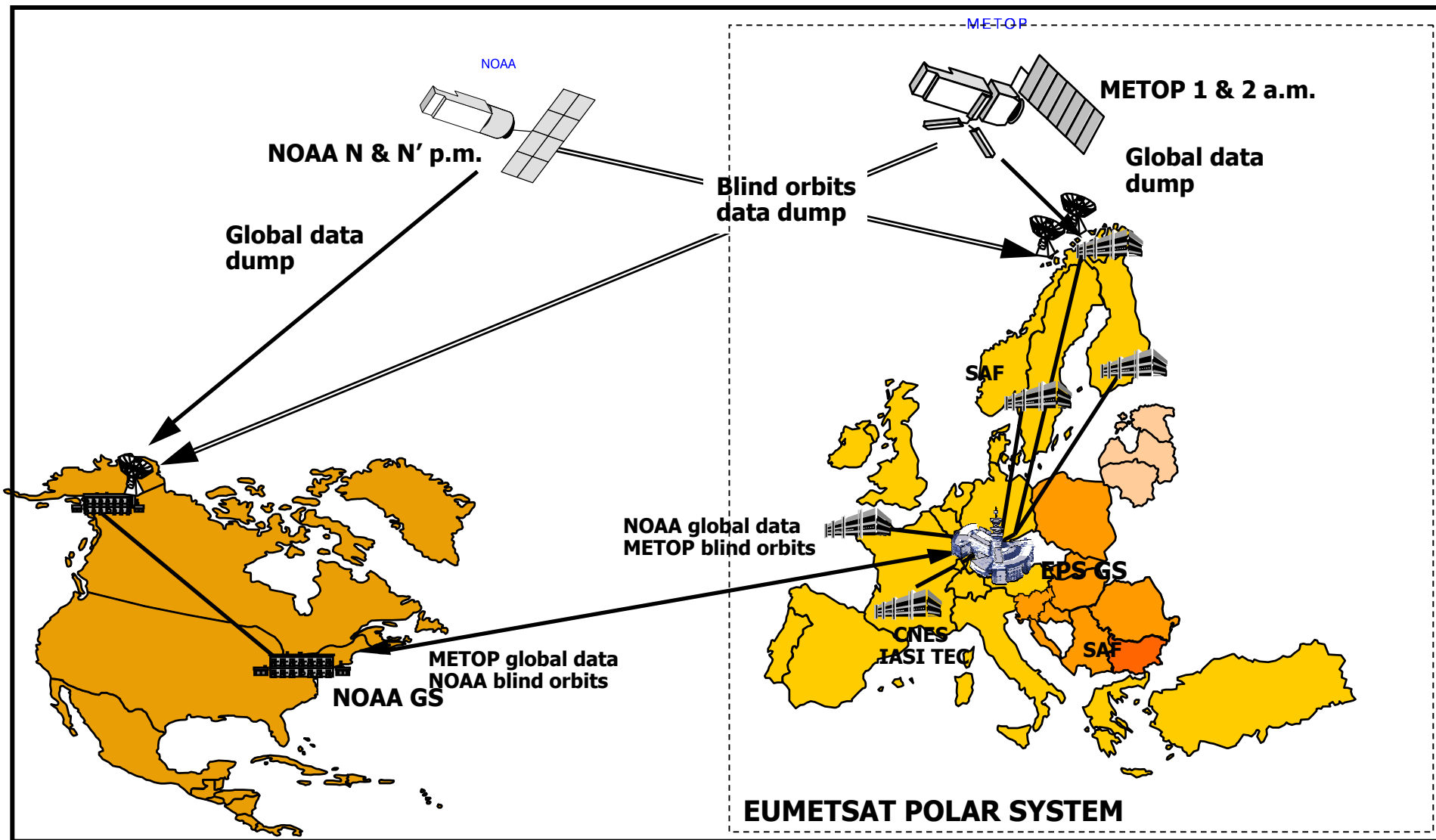
Extended EPS level 1b products

- Clear Sky Radiances for all microwave and IR channels of core payload
 - AVHRR/3, AMSU-A, MHS. HIRS/4, IASI

EPS level 2 products

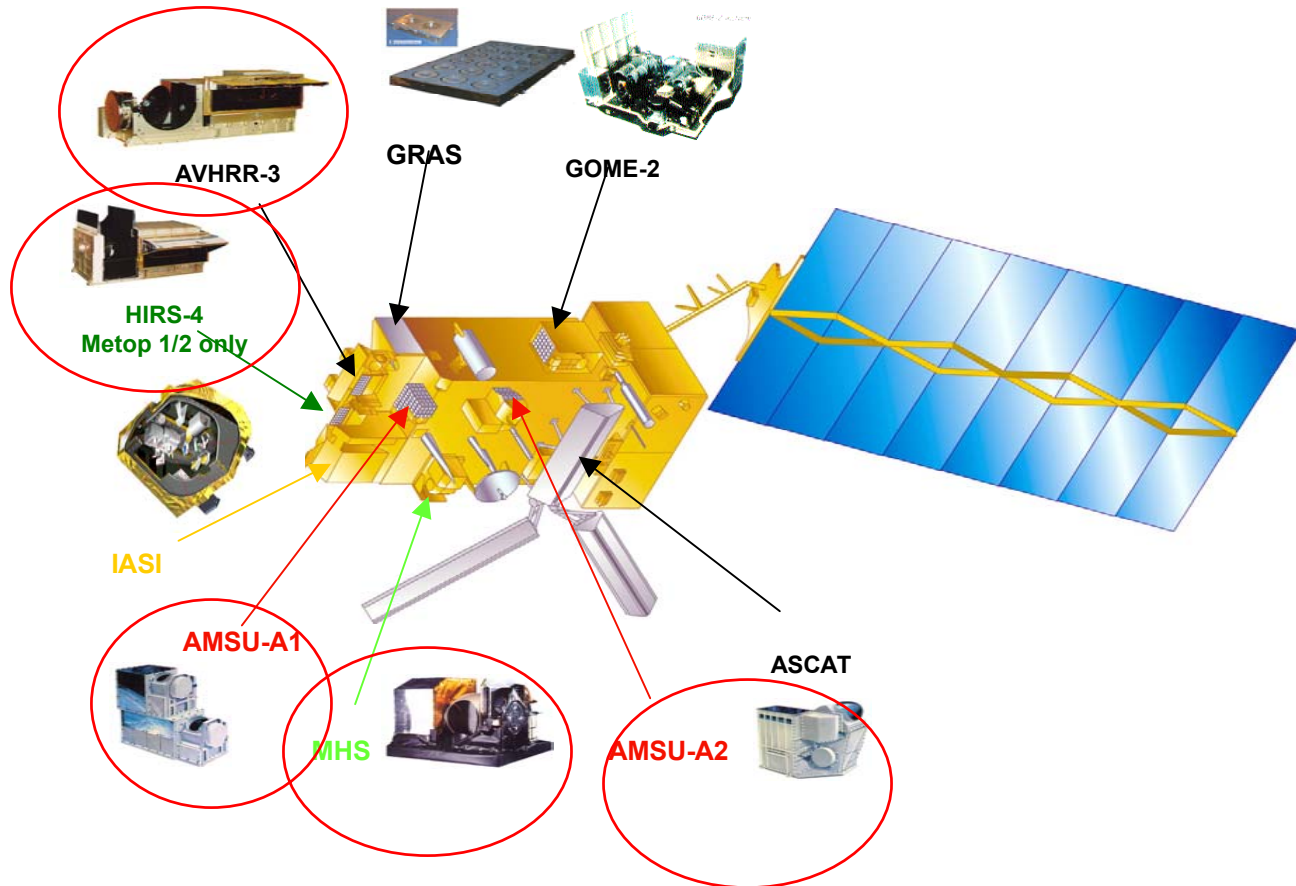
	AVHRR/3	HIRS/4	AMSU-A	MHS	IASI	GRAS	ASCAT	GOME-2
Temperature sounding		X	X		X	X		
Humidity sounding		X	X	X	X	X		
Cloud liquid water path			X	X	X			
Cloud cover	X	X			X			
Cloud Top Temperature	X	X			X			
Cloud Top Height	X	X			X			
Cloud Phase	X	X		X	X			
SST (skin)	X				X			
Sea ice concentration	X		X	X			X	
Ocean surface winds							X	
NDVI	X				X			
Soil moisture	X		X	X			X	
Snow/ice liquid water content				X			X	
LST (skin)	X				X			
Total Ozone		X			X			X
Ozone profile					X			X
Trace gases*					X			X
Aerosols	X				X			X

EPS in the IJPS



ATOVS and AVHRR

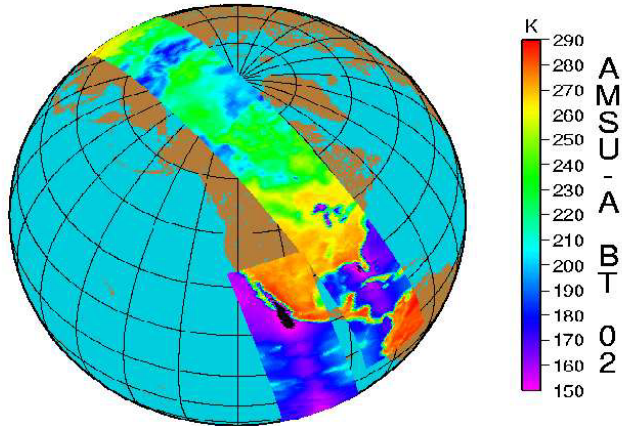
Provide continuity to current system



EPS provides GLOBAL products

AAPP V1.3 (08.1999)

NOAA15 1999 89 0:37:31 - 2:31:33



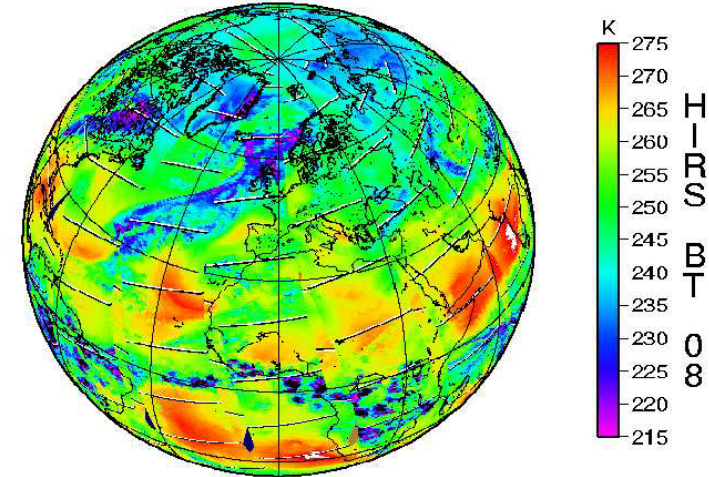
GMT Feb 27 18:30:51 2000 © KDK 01.2000

Global Products are dump-based

EPS provides local AHRPT/LRPT service

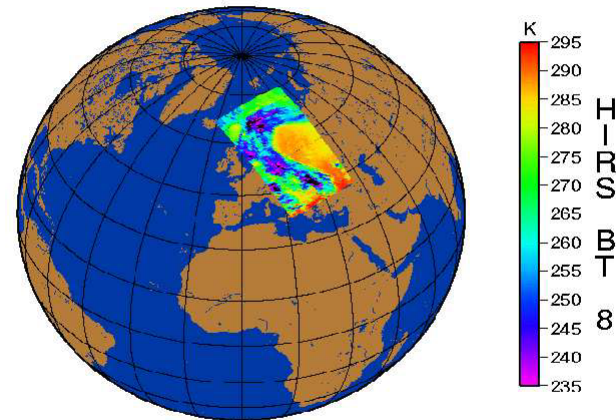
Composite of 14 level products of one day from HIRS

NOAA15 26/02/2000



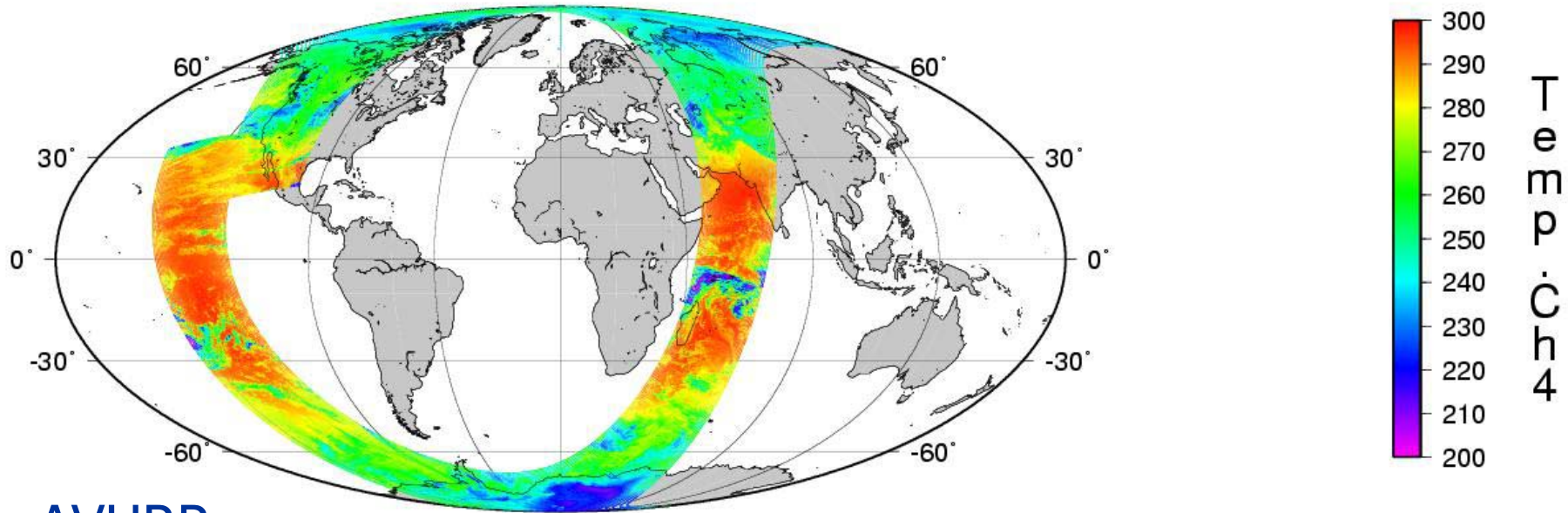
AAP GMT Aug 27 19:08:18 2000 © KDK 02.2000

NOAA15 199825617: 6: 3 - 17:15:26

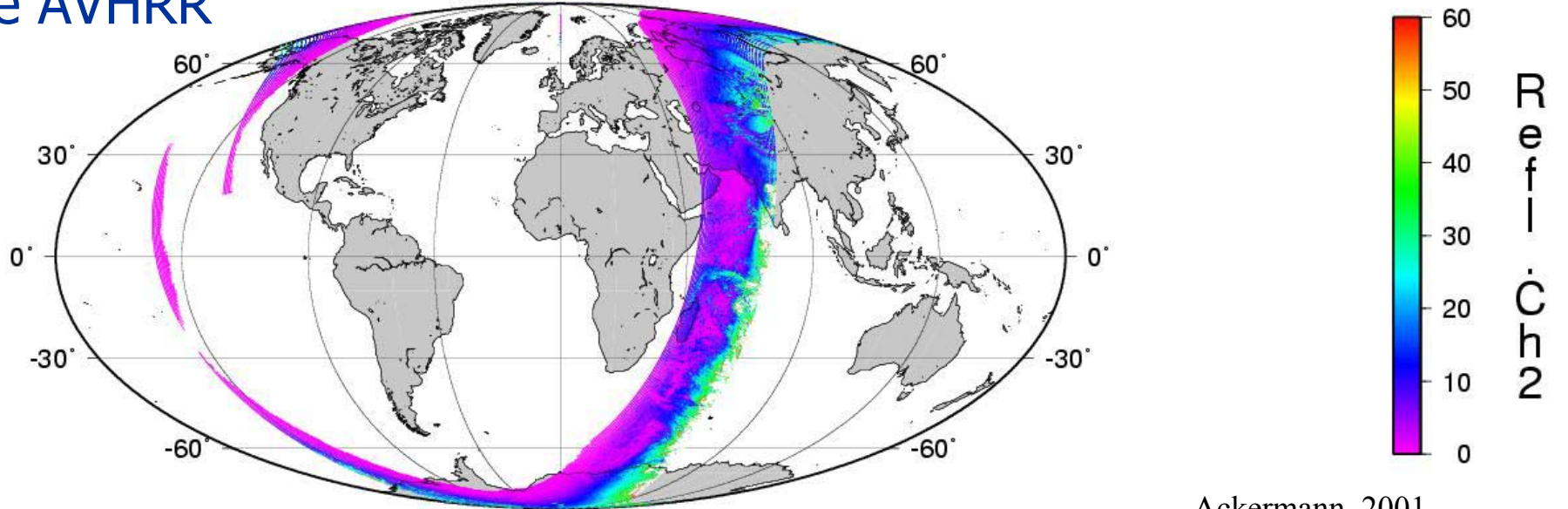


GMT Feb 27 13:12:04 2000 © KDK 02.2000

EPS provides continuity to the current polar system:

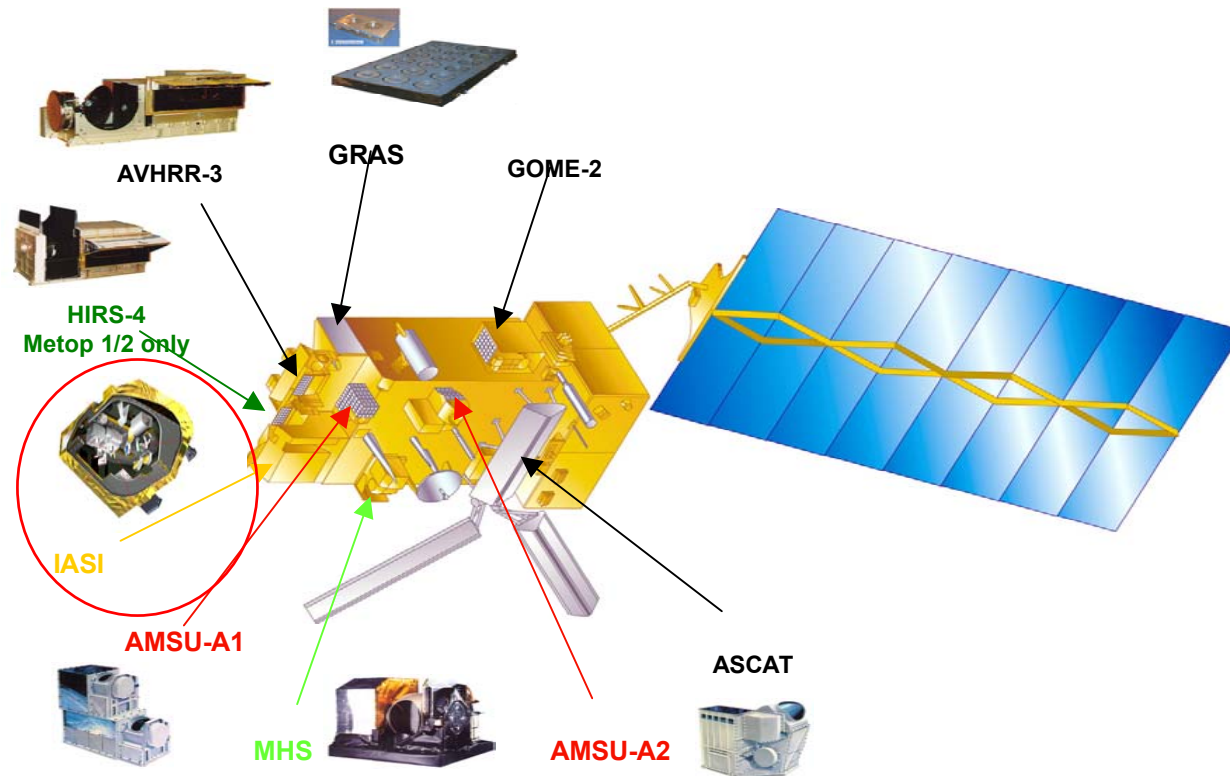


Example AVHRR



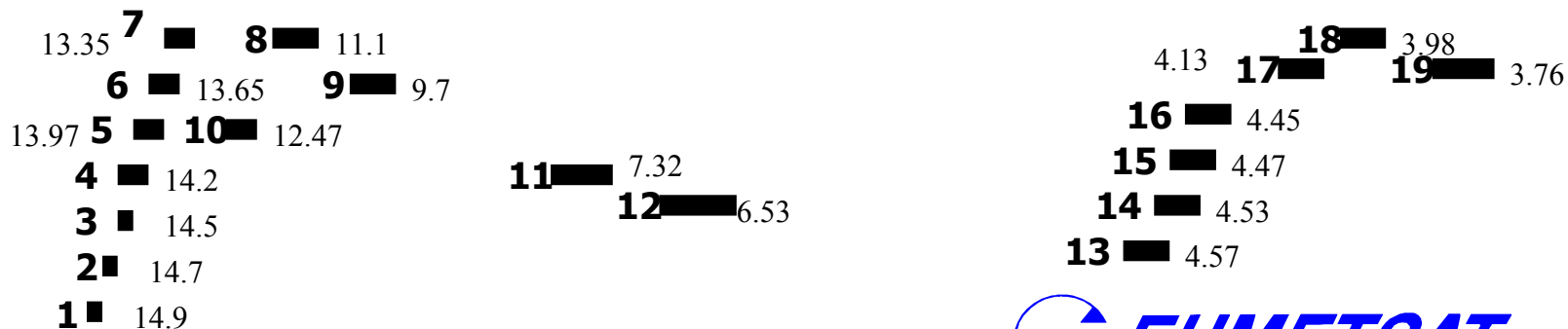
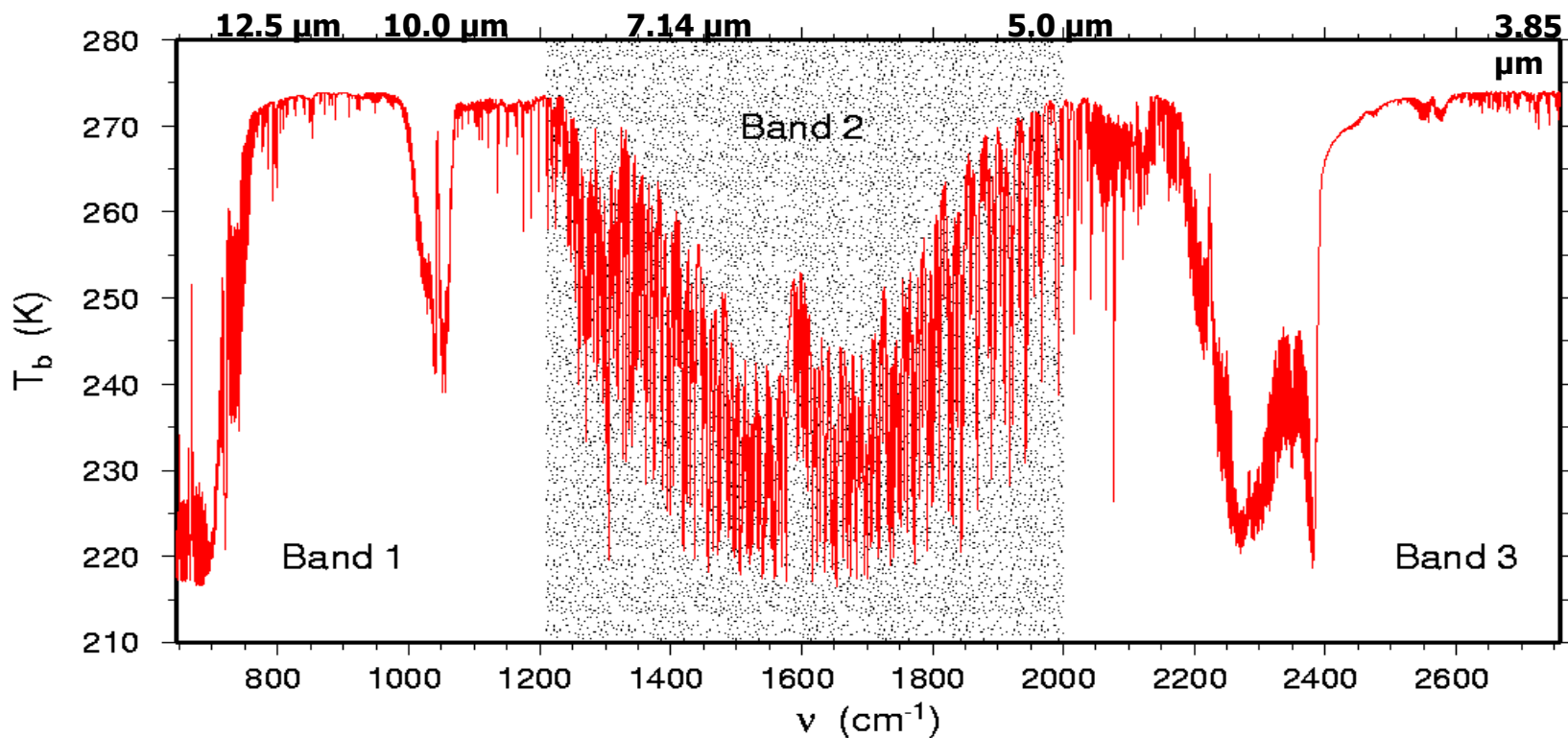
IASI

New Technology provides enhanced capabilities for
Infrared Sounding



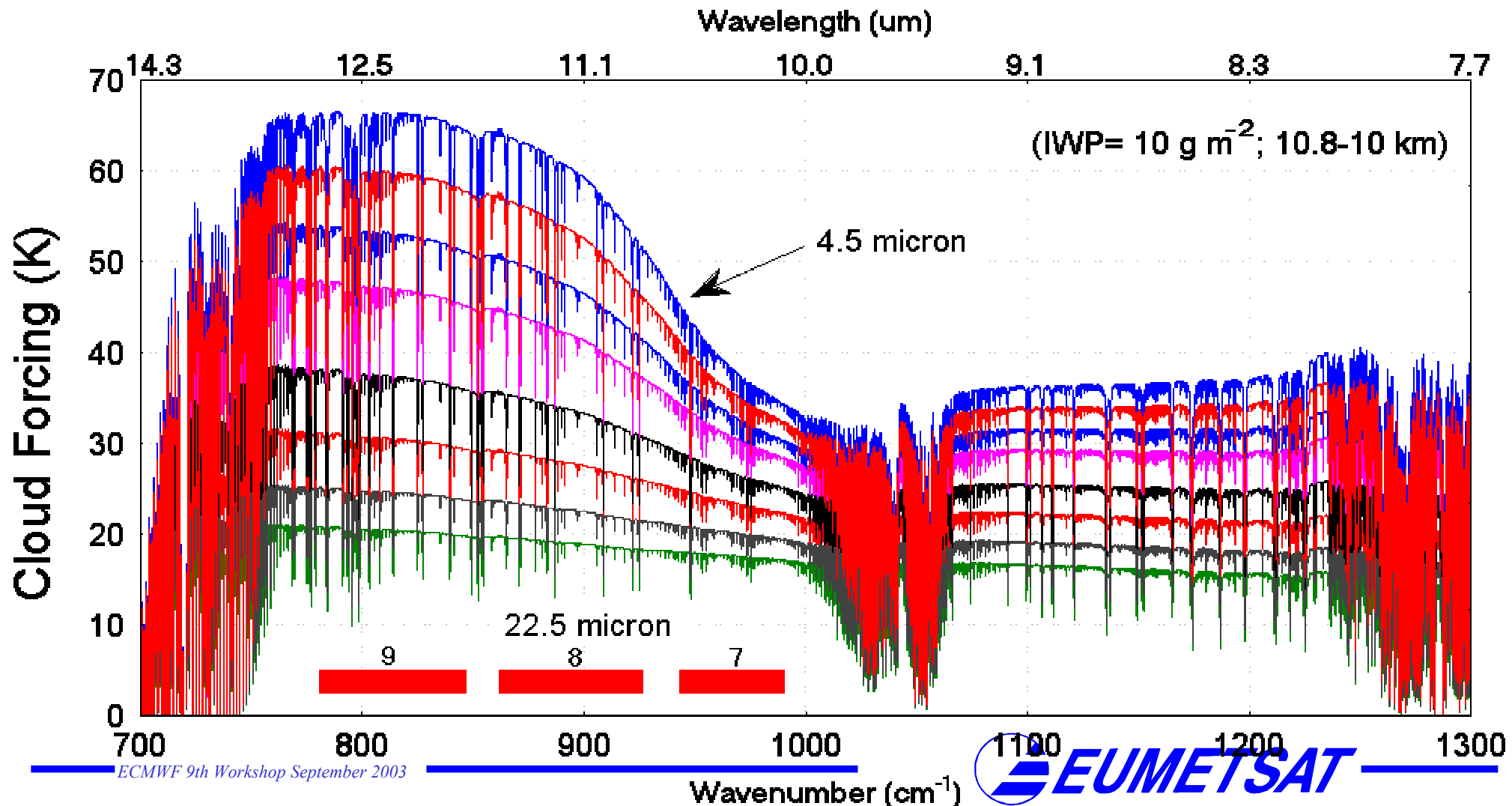
HIRS/4 IR Channels

IASI Bands

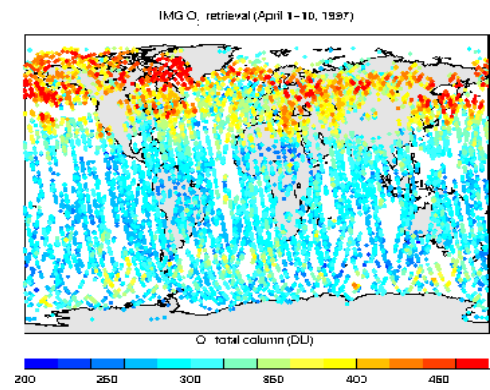
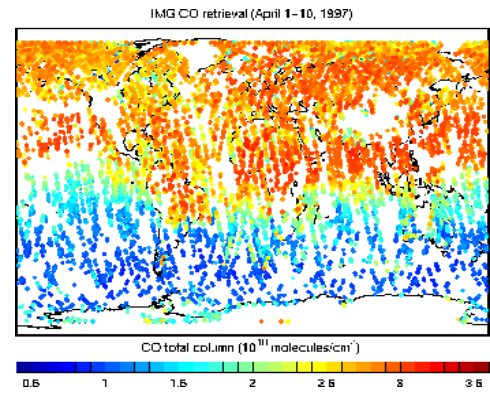
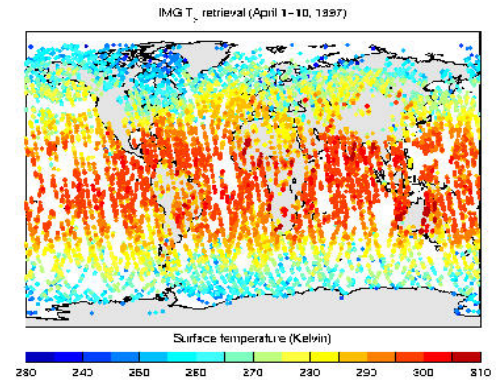
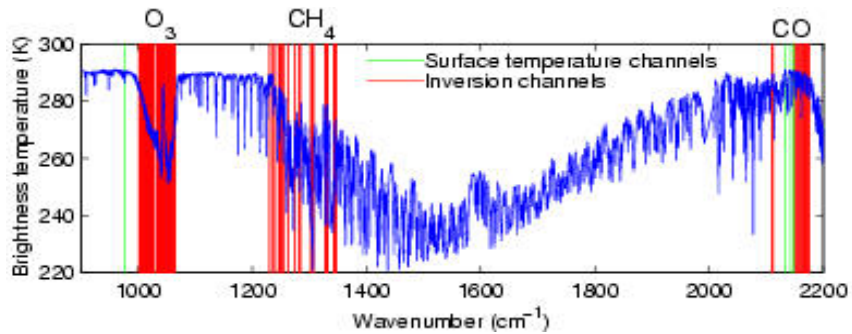


Example for enhanced capabilities: Cloud particle size can be derived with high spectral data

Variation with Particle Size (r_{eff})



Potential for Trace Gas Retrieval

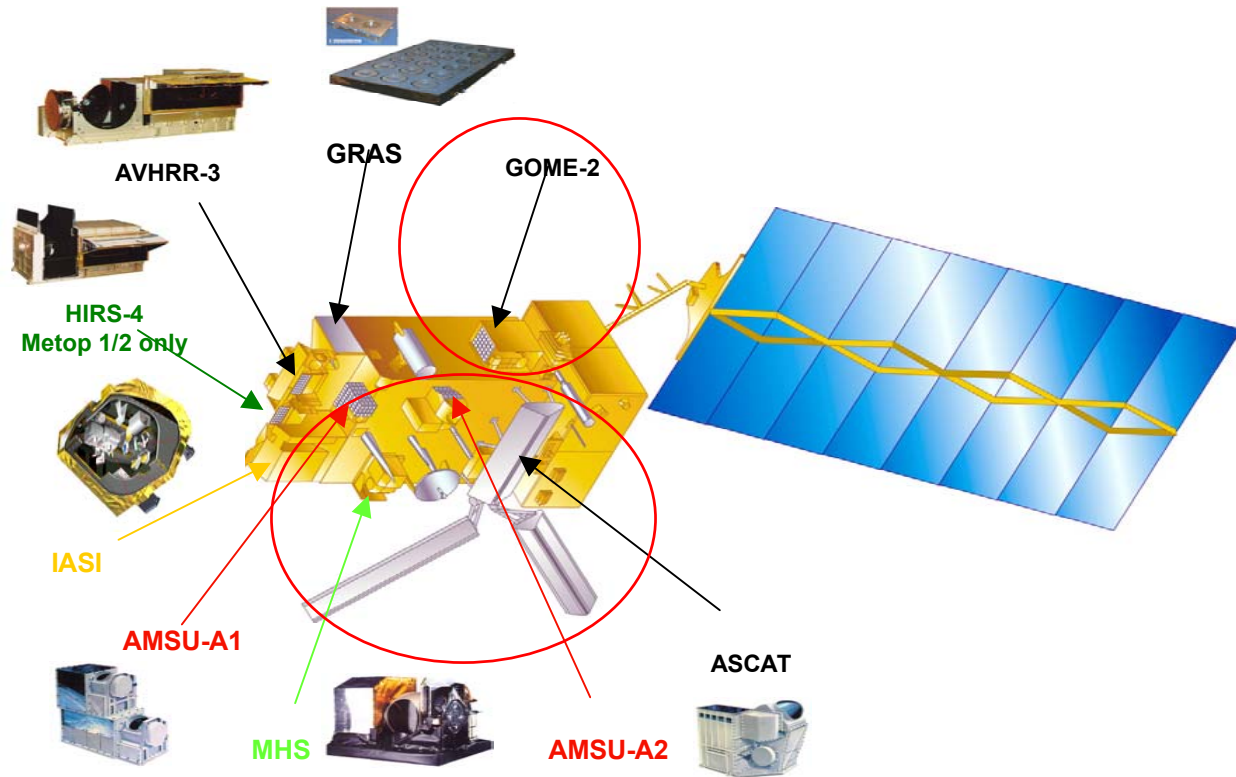


Clerbaux et al., 2003

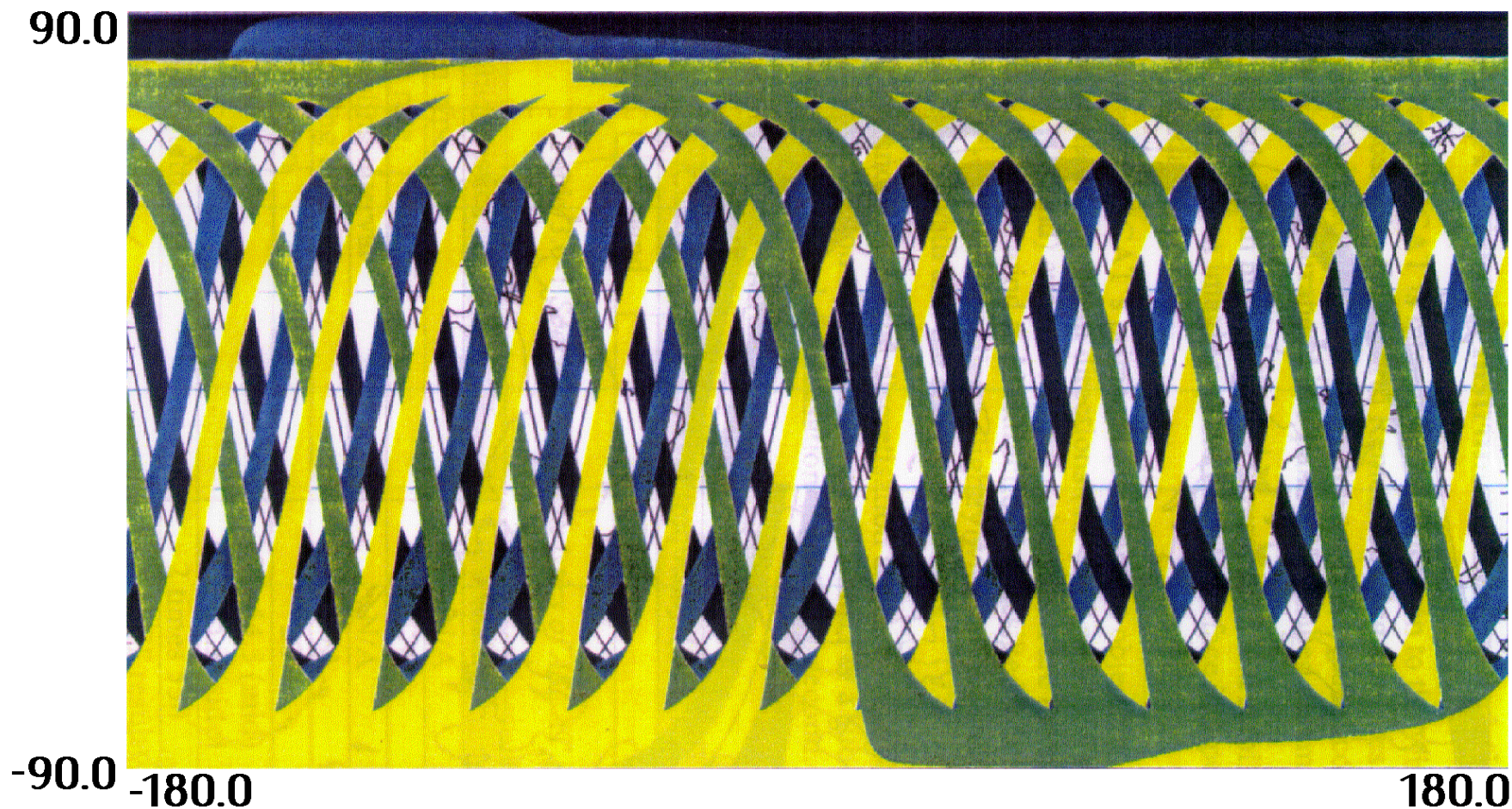


ASCAT and GOME

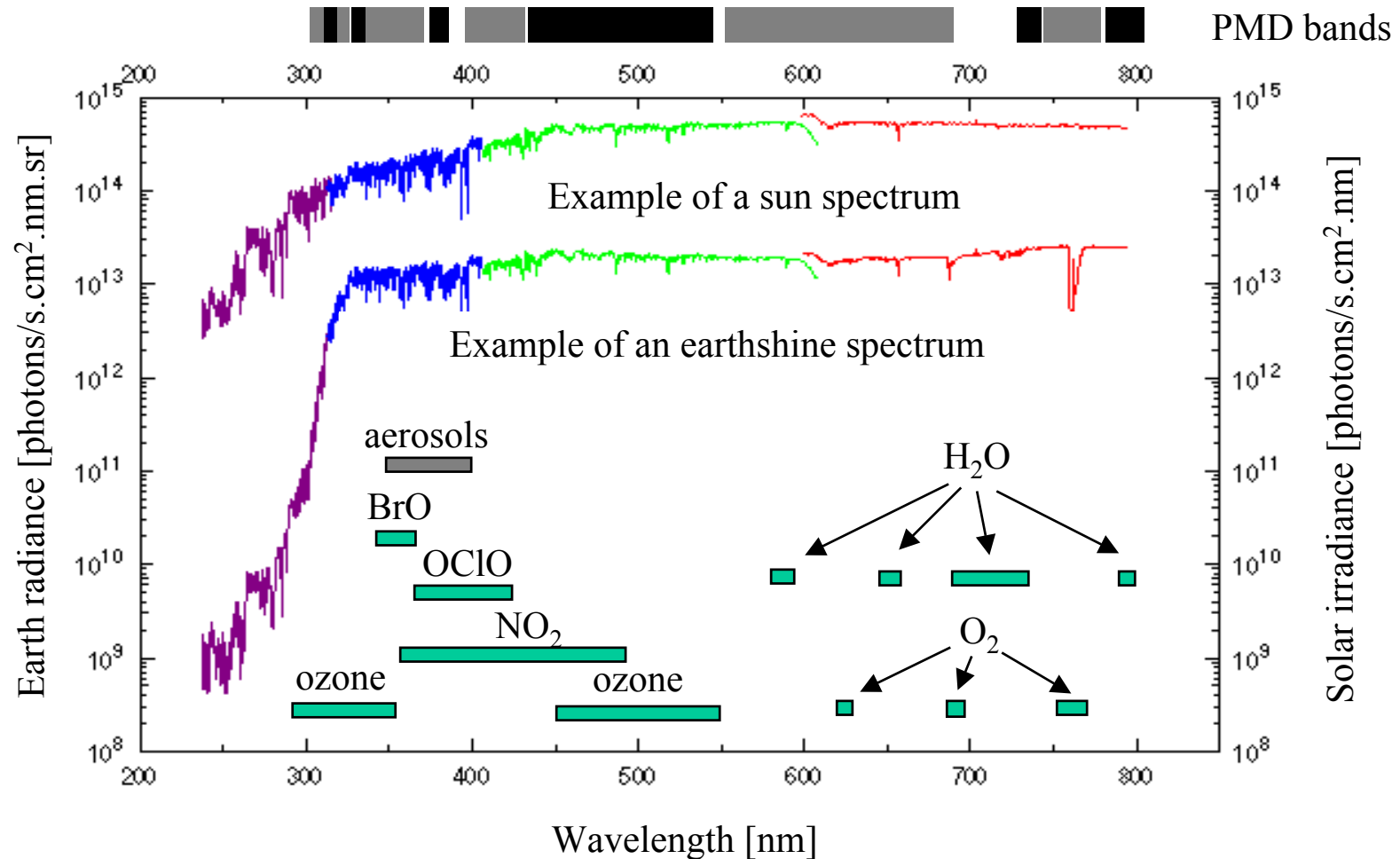
Proven Research Instruments become operational



Improved Earth Coverage with ASCAT during one day



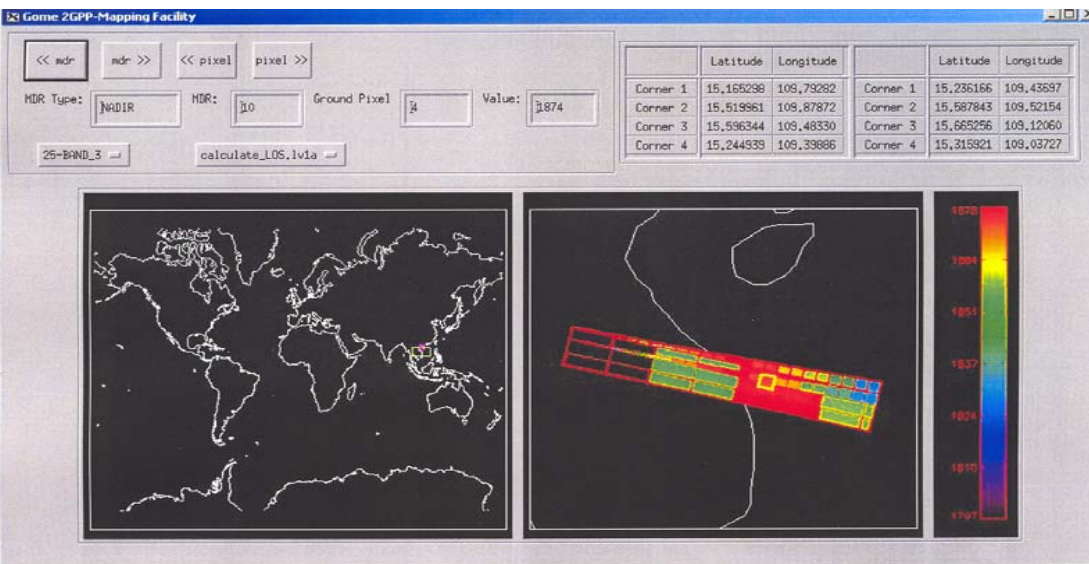
GOME-2 channels and potential for retrieval of species



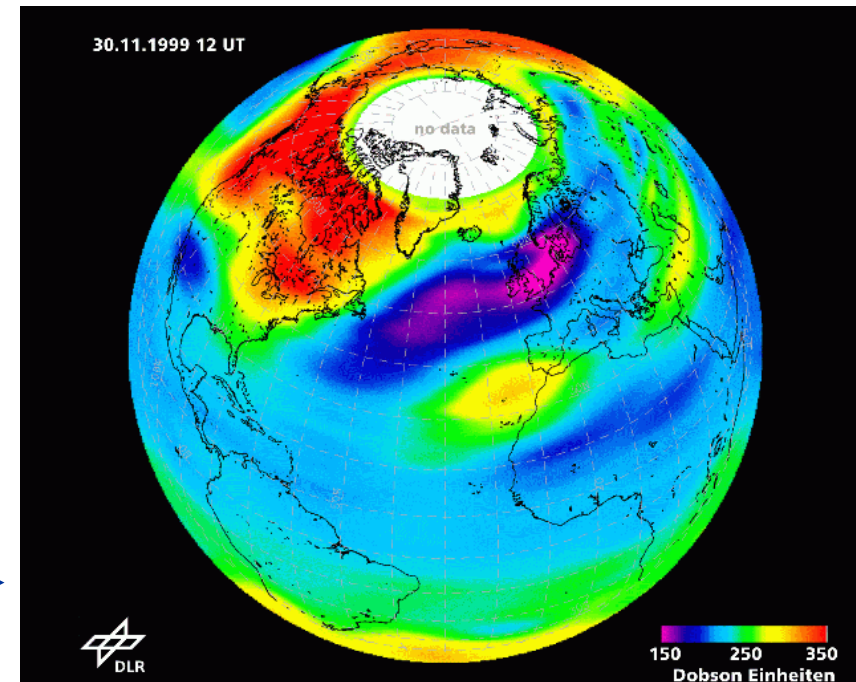
Source: ESA, Callies et al. 2000

GOME-2 Level 1 Ground Processor Prototype Output

Example for CGS product (1granule)

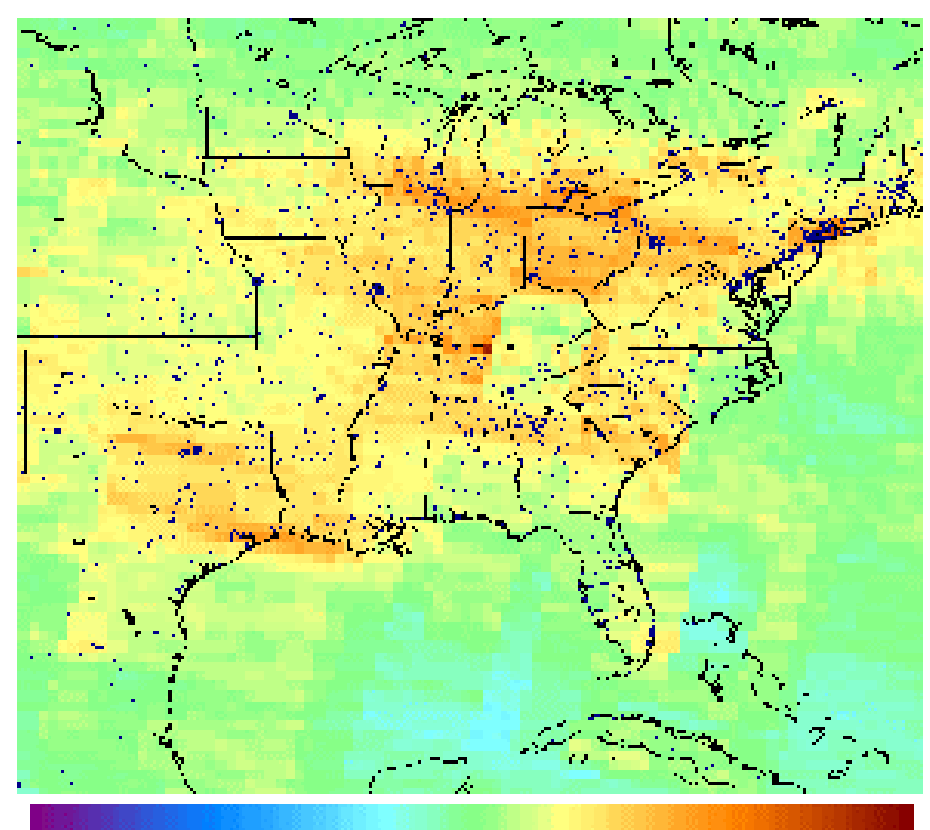
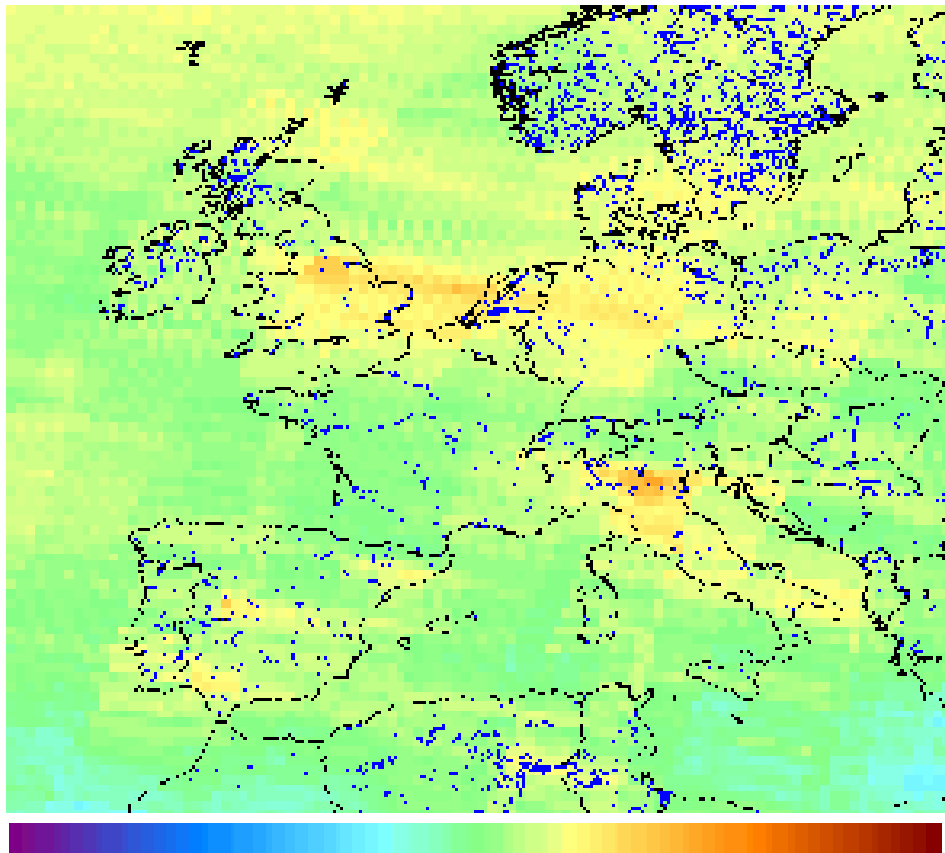


Level 2 and higher products will be generated in the SAF



Munro, 2003

GOME/ERS-2 30 November 1999
 Global ozone total column concentration. Low concentration of ozone over north Atlantic and north Europe due to dynamically induced ozone loss in the lower and middle stratosphere. Source: DLR

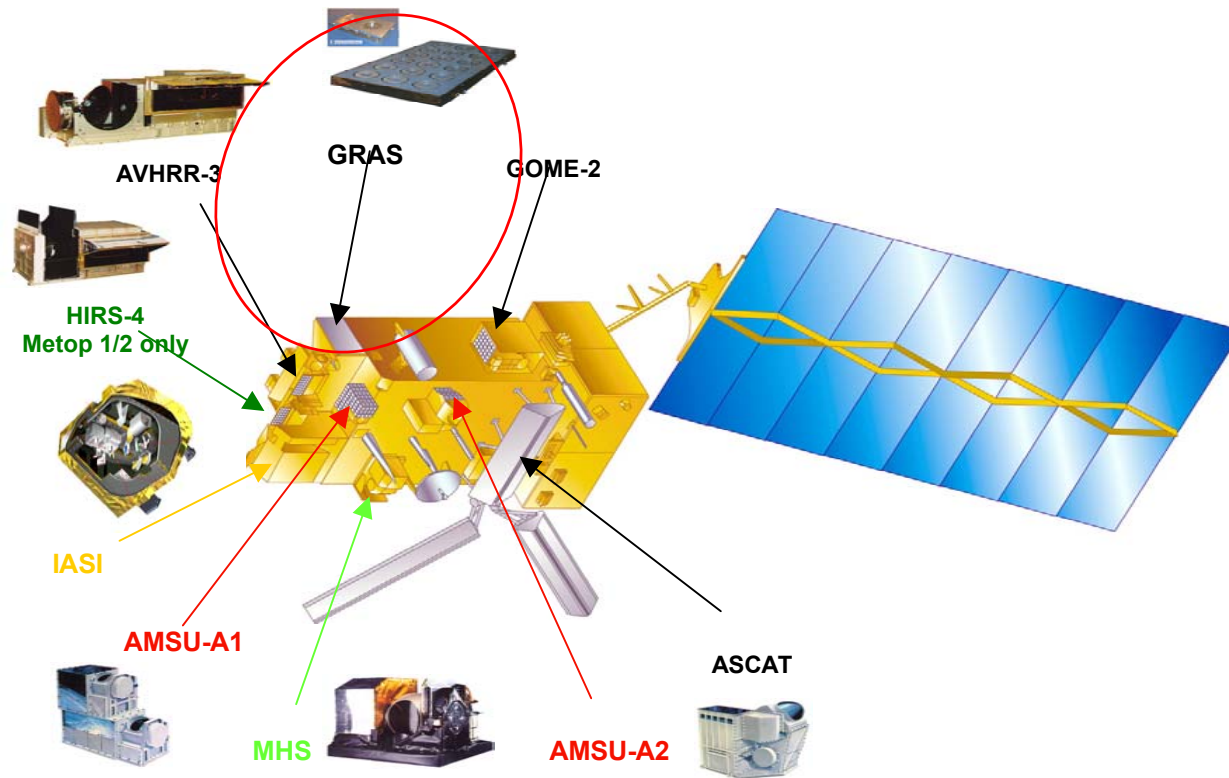


Source: DLR

GOME/ERS-2 15-16-17 July 1998: NO₂ total column concentration over Europe (left) and the USA (right): High concentration (orange) over areas with dense population (Po valley, The Netherlands, England, US East coast)

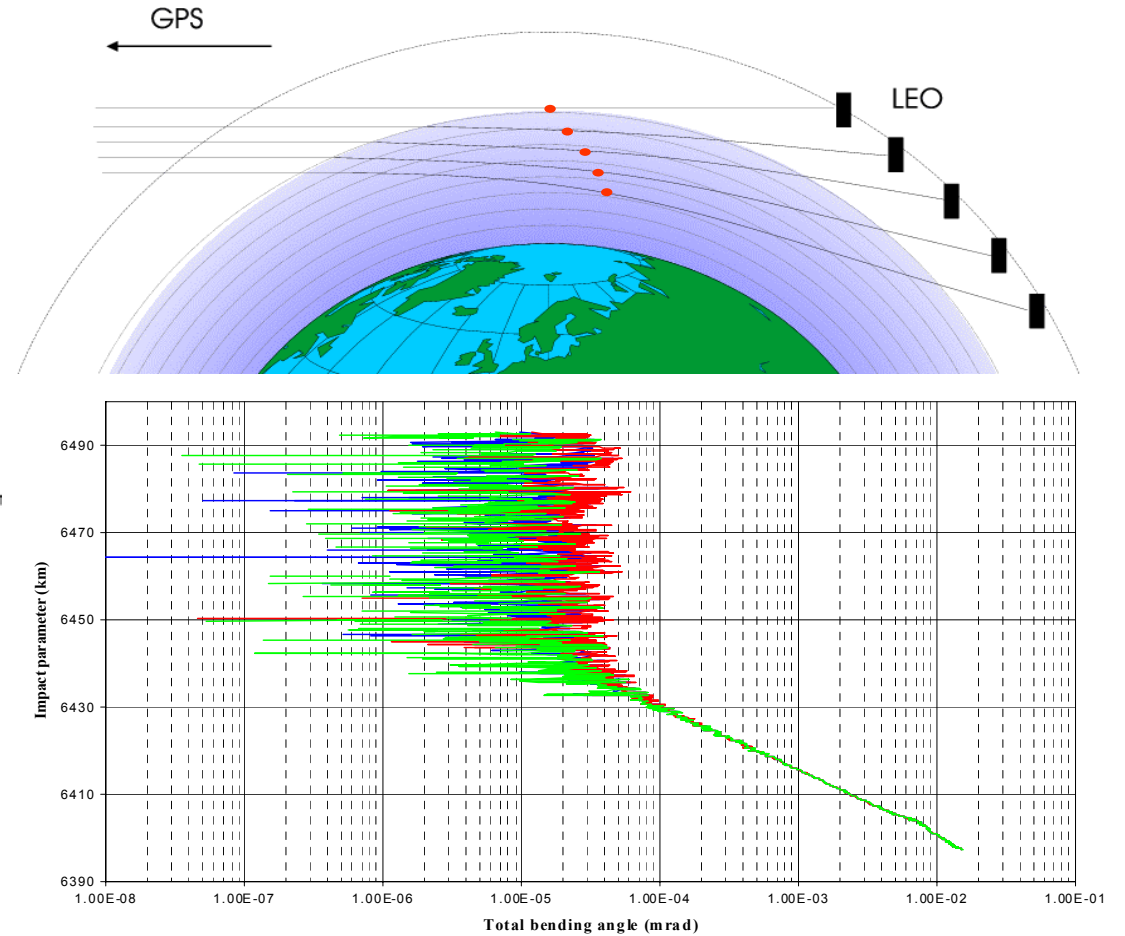
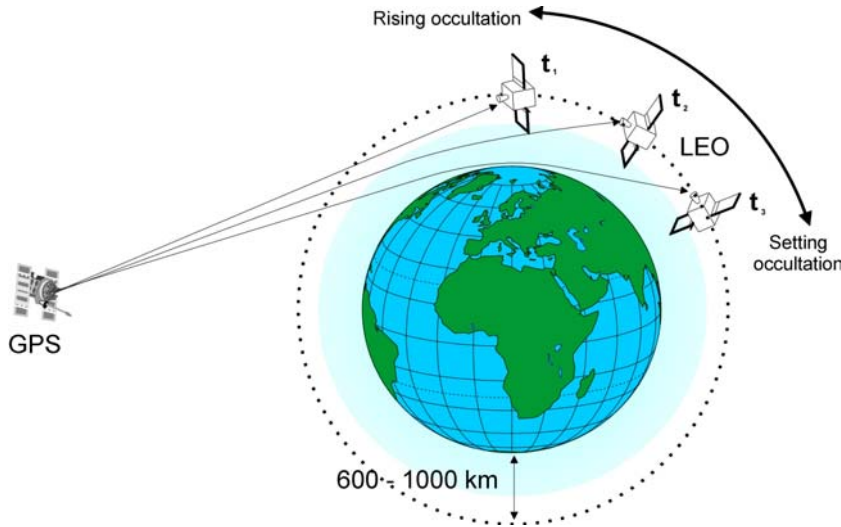
GRAS

First use of Radio Occultation technique in operations requires development of a whole system



GRAS:

limb sounding by occultation of GPS signals

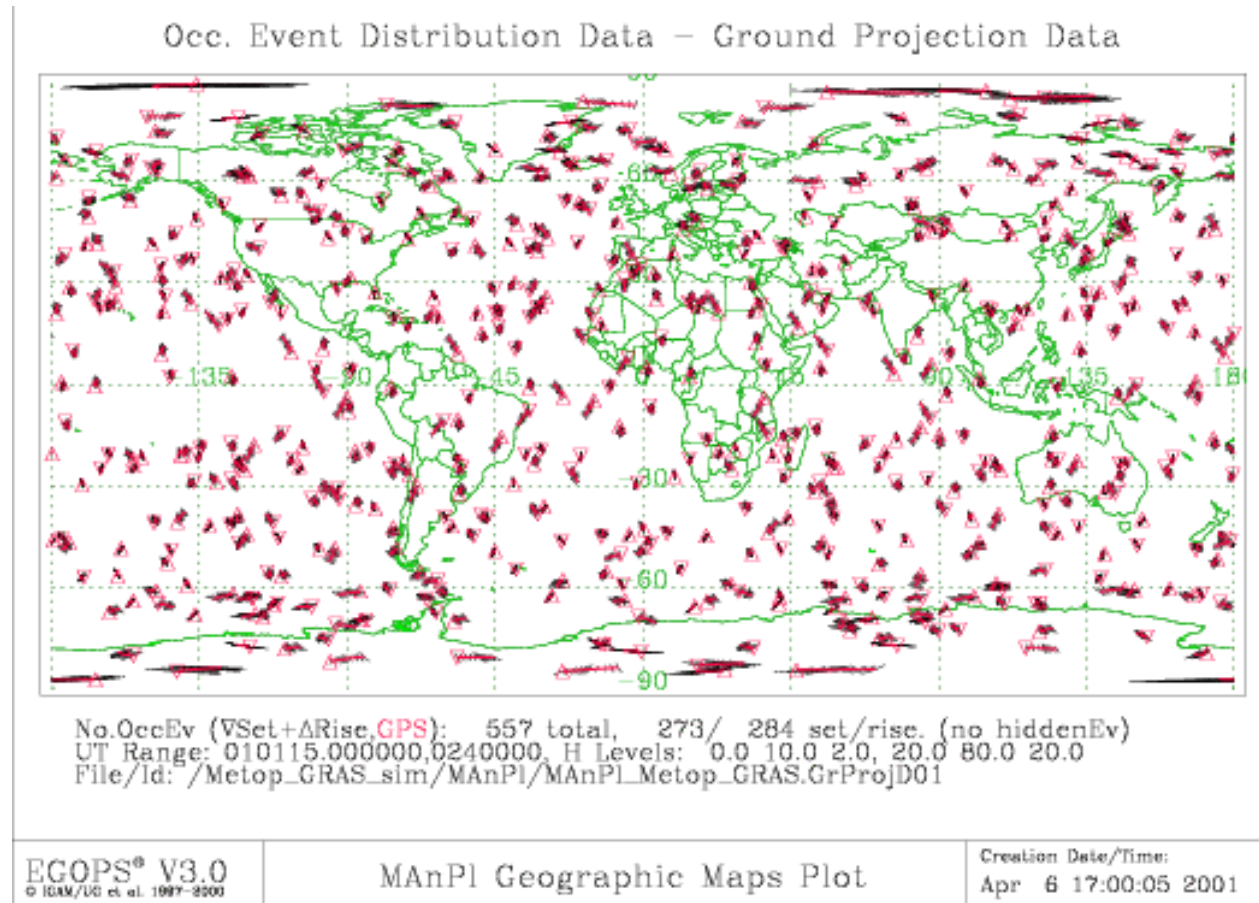


— from L2
— from L1
— ionospheric correction applied

From Luntama (2000)



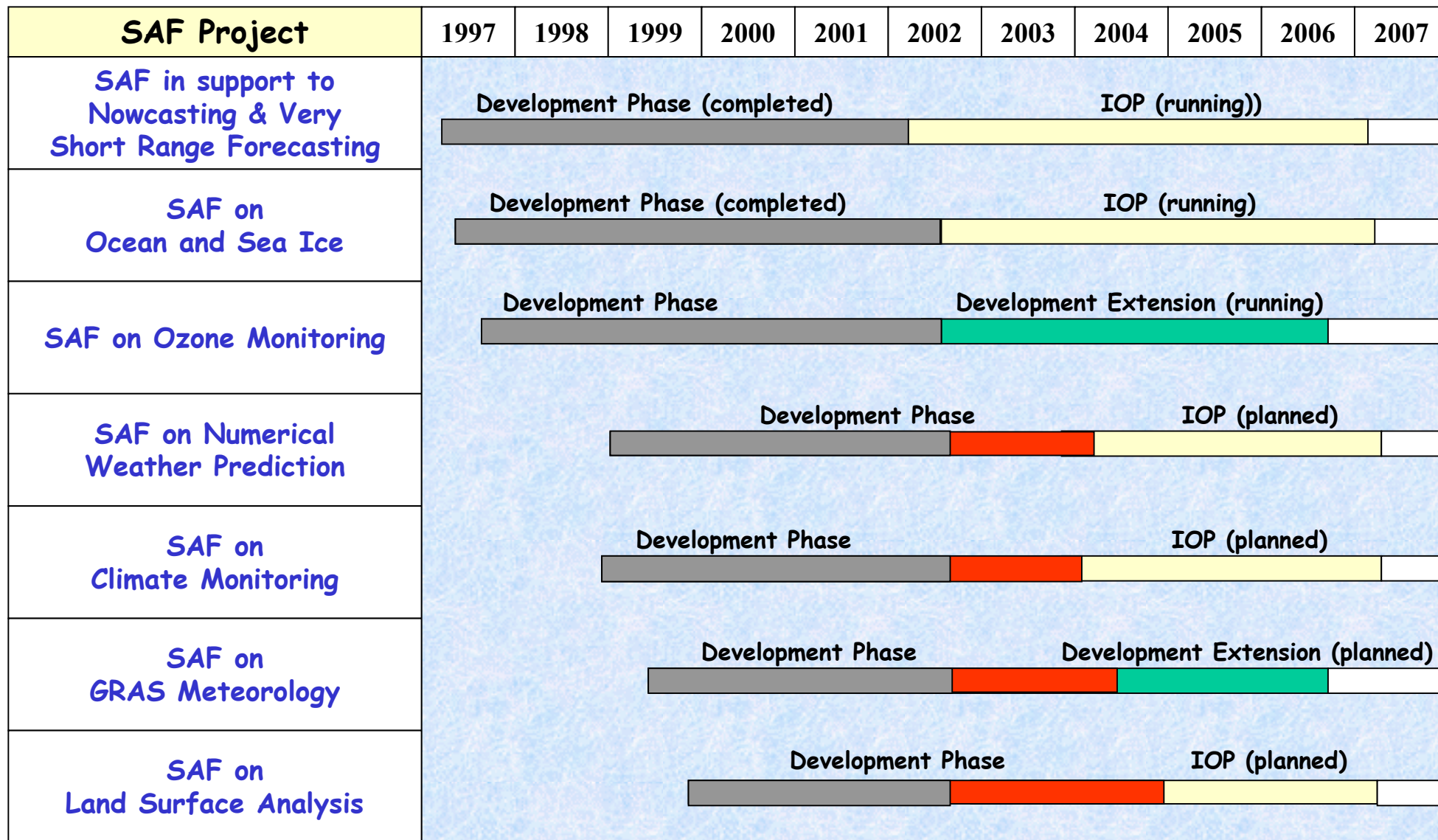
Global distribution of simulated EPS GRAS Observations over 24 h



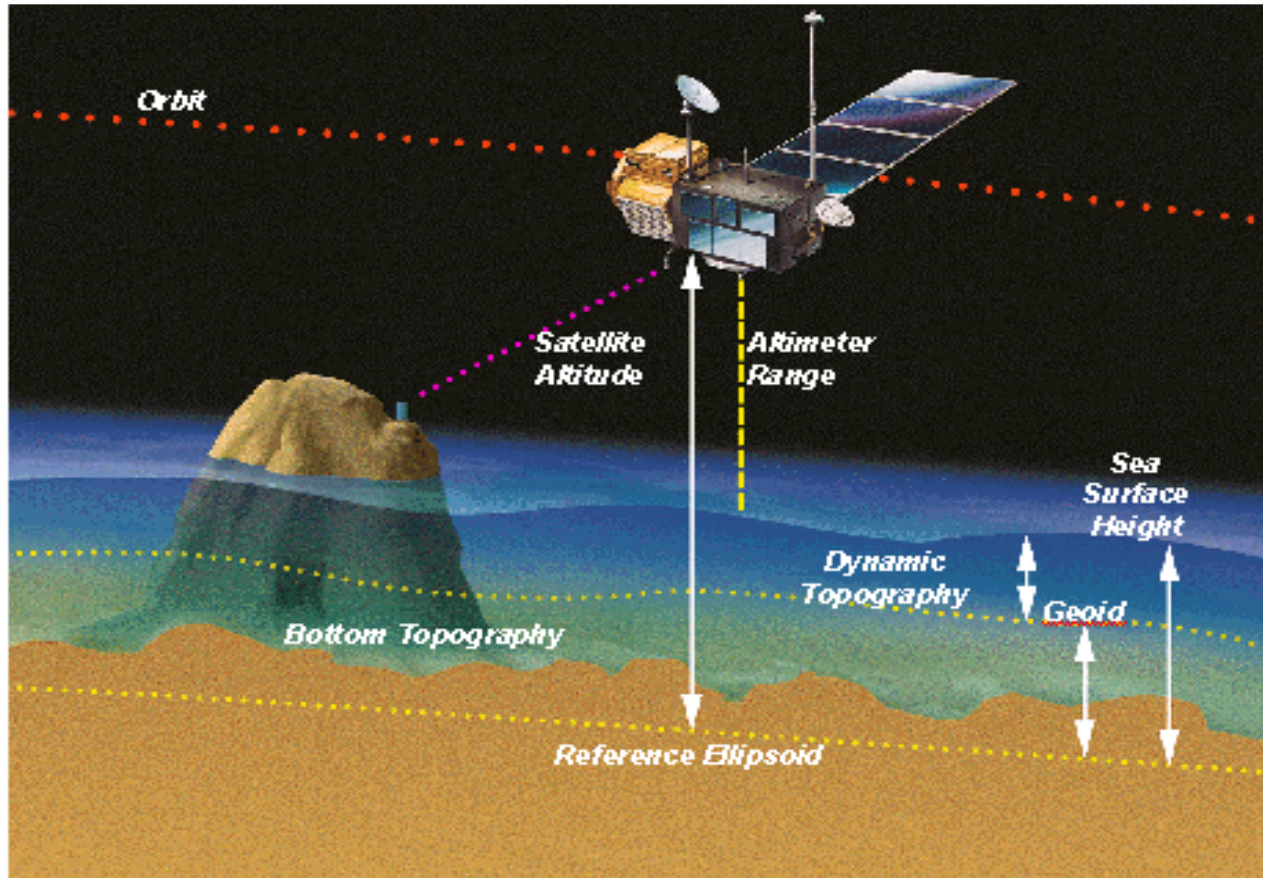
Satellite Application Facilities (SAF)

Integrated part of the distributed
EUMETSAT Ground Segment

SAF Network Overall Planning



Optional Programme Jason-2



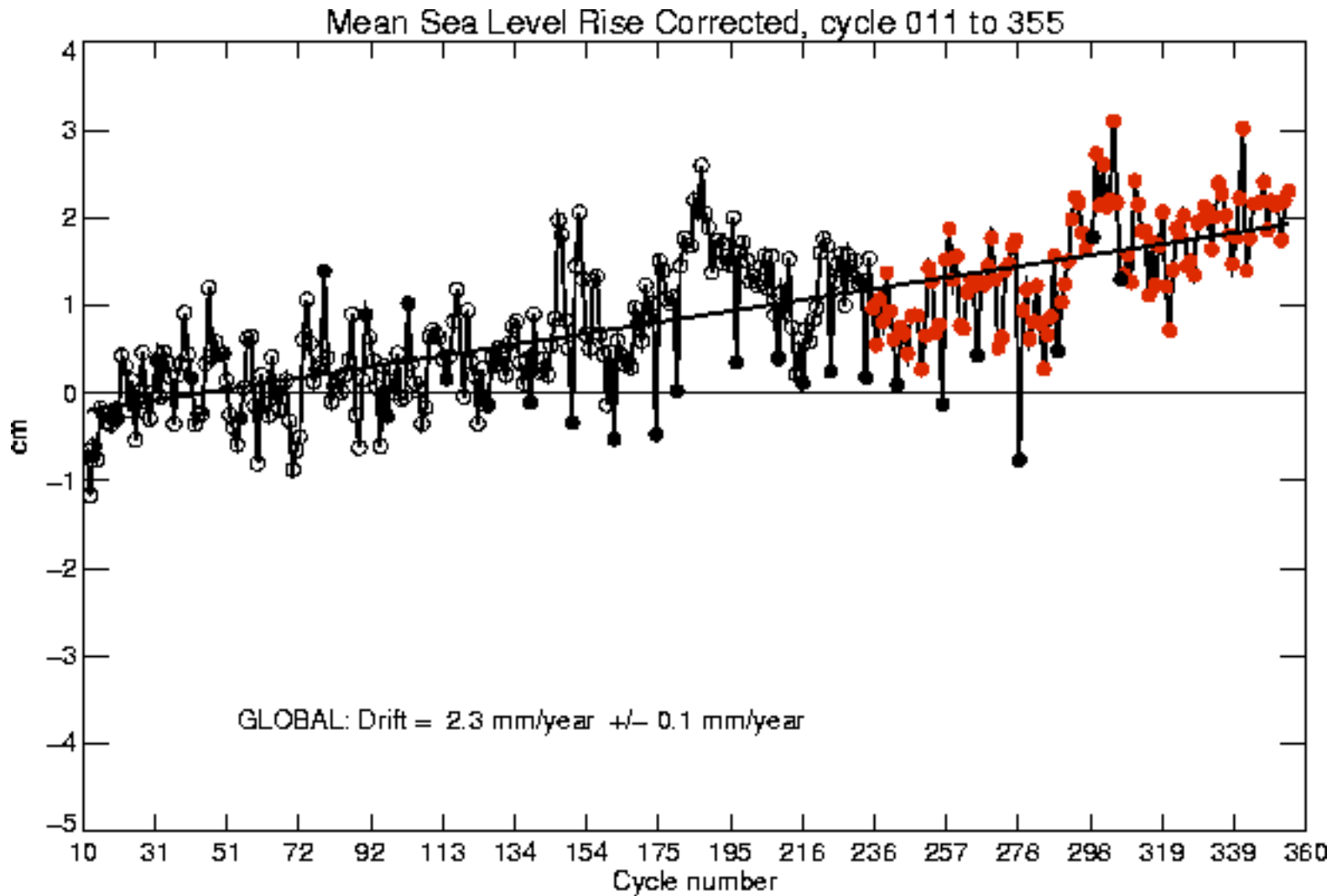
EUMETSAT responsibilities:

Earth terminal, ground network

Operational product processing and distribution

User interface

Mean sea level rise: 1992-2002 (global ocean)



Meteosat Third Generation

- MTG need date => 2015
- Currently Pre-phase A studies
 - High level requirements and priorities
 - Observation techniques and sensor concept
- Potential MTG imagery missions
 - High Resolution Fast Imagery (HRFI) mission
 - Full Disk High Spectral Resolution Imagery (FDHSI) mission
- Potential Sounding Missions
 - IR Sounding Mission
 - Ozone UV sounding mission
- Data Collection Platform mission
- Lightning imagery mission

CONCLUSIONS

- Meteosat services will continue
- Meteosat-8 (MSG-1) operational in January 2004
- EPS launch IV 2005
- JASON-2 launch in 2006
- MTG activities have started
- Post EPS ? => Has to be done!!