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School on "Exploring the Atmosphere by Remote Sensing Techniques"
18 October - 5 November 1999

1151-9

The Earth Observation Programme of the European Space Agency: *"The Current Programme"*

C. Readings
Head - Earth Sciences Division
ESTEC
Noordwijk
The Netherlands

Please note: These are preliminary notes intended for internal distribution only.

The Earth Observation Programme of the European Space Agency

The Current Programme

C.J. READINGS

Head, Earth Sciences Division
Estec, Noordwijk, The Netherlands

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22 October 1999, Trieste, Italy

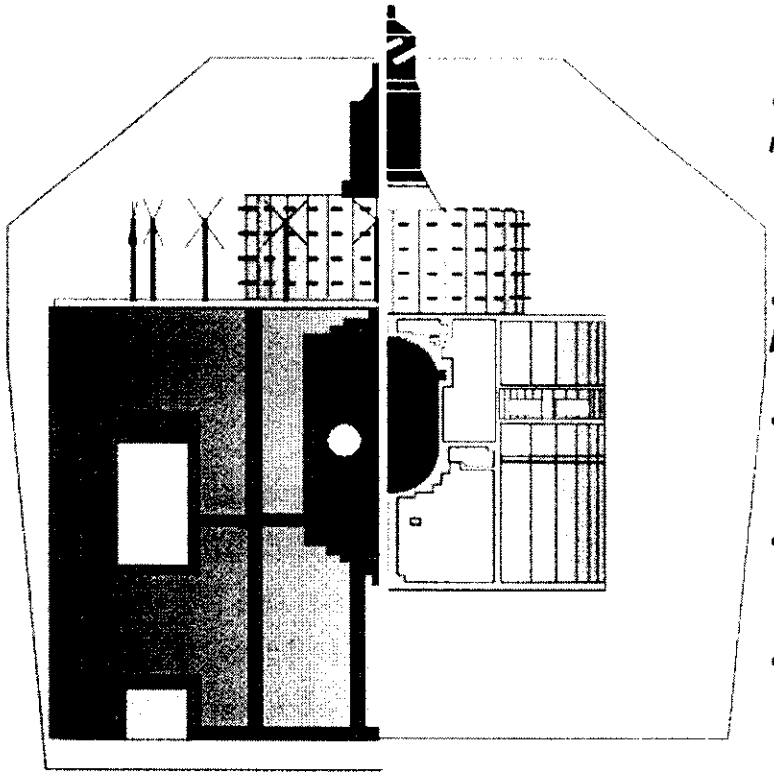
The Agency's Current Programme
The Current Elements

- METEOSAT and METEOSAT Second Generation (MSG) - with EUMETSAT
- ERS-1 and its follow-on ERS
- ENVISAT
- METOP - with EUMETSAT
- Earth Explorer and Earth Watch Missions

The Agency's Current Programme
Meteosat and Meteosat Second Generation

MSG

- *12 channels enhanced imaging and pseudo sounding radiometer.*
- *100 rpm spin stabilized body*
- *Bi-propellant unified propulsion system*
- *500W power demand*
- *2000kg in GTO*
- *Design compatibility with Ariane 4 (spelda 10) & Ariane 5*



MOP

- *3 channels imaging radiometer*
- *100 rpm spin stabilized body*
- *Solid apogee boost motor*
- *200W power demand*
- *720 kg in GTO*
- *Flight qualified with Delta 2914, Ariane 1-3-4*

The Agency's Current Programme
Meteosat Second Generation (1)

Changes compared with METEOSAT:

1. Enhanced Imager

   - Higher Spatial and Spectral Resolution Imaging (Visible & Infrared)
   - More Frequent Imaging: More Products
   - More Channels

2. Inclusion of the GERB Instrument (Geostationary Earth Radiation Budget):

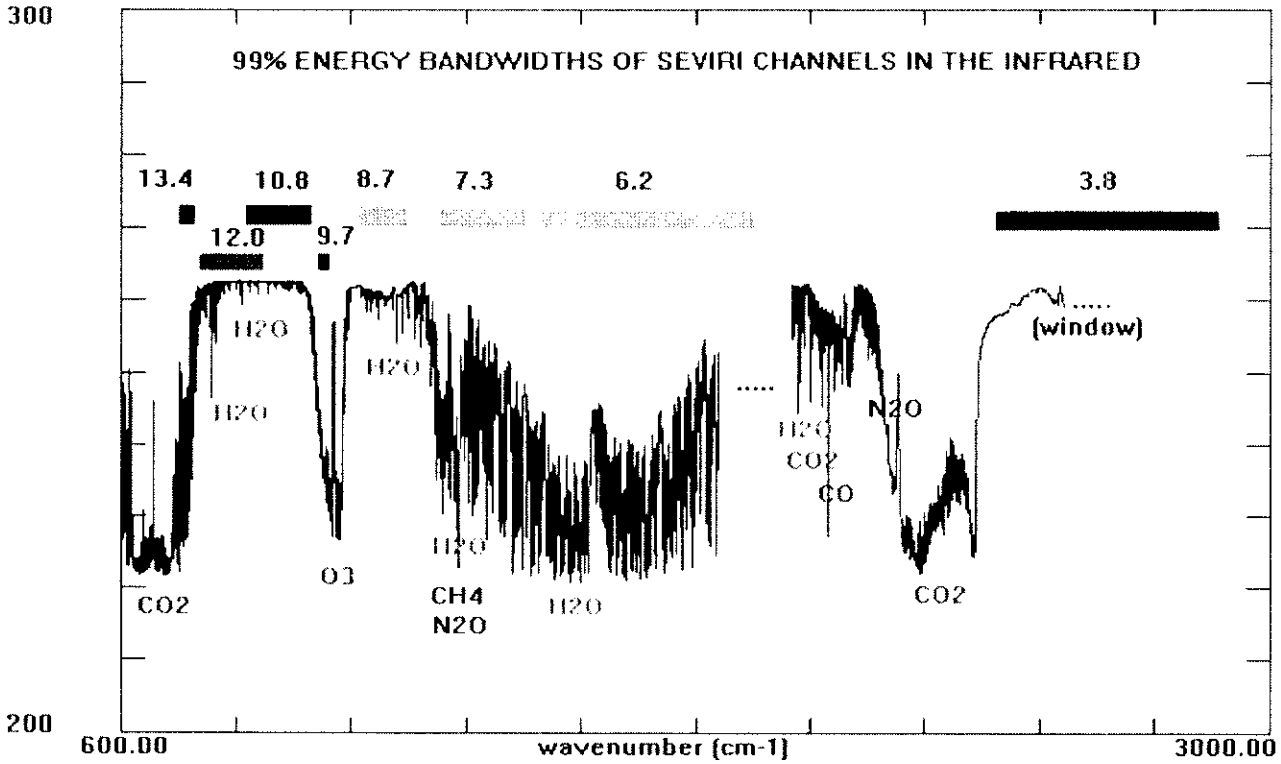
   - Broadband measurements of both shortwave (reflected: 0.2 to 4 μm) and long-wave (emitted: 4 to 50 μm) radiation
   - Required (absolute) accuracies: 1% for the SW and 0.5% for the LW
   - Observations of the Earth's visible disc from 0° longitude; 15 minutes repeat cycle: instantaneous field-of-view 48 km at sub-satellite point

3. Inclusion of Search and Rescue

The Agency's Current Programme
Meteosat Second Generation (2)

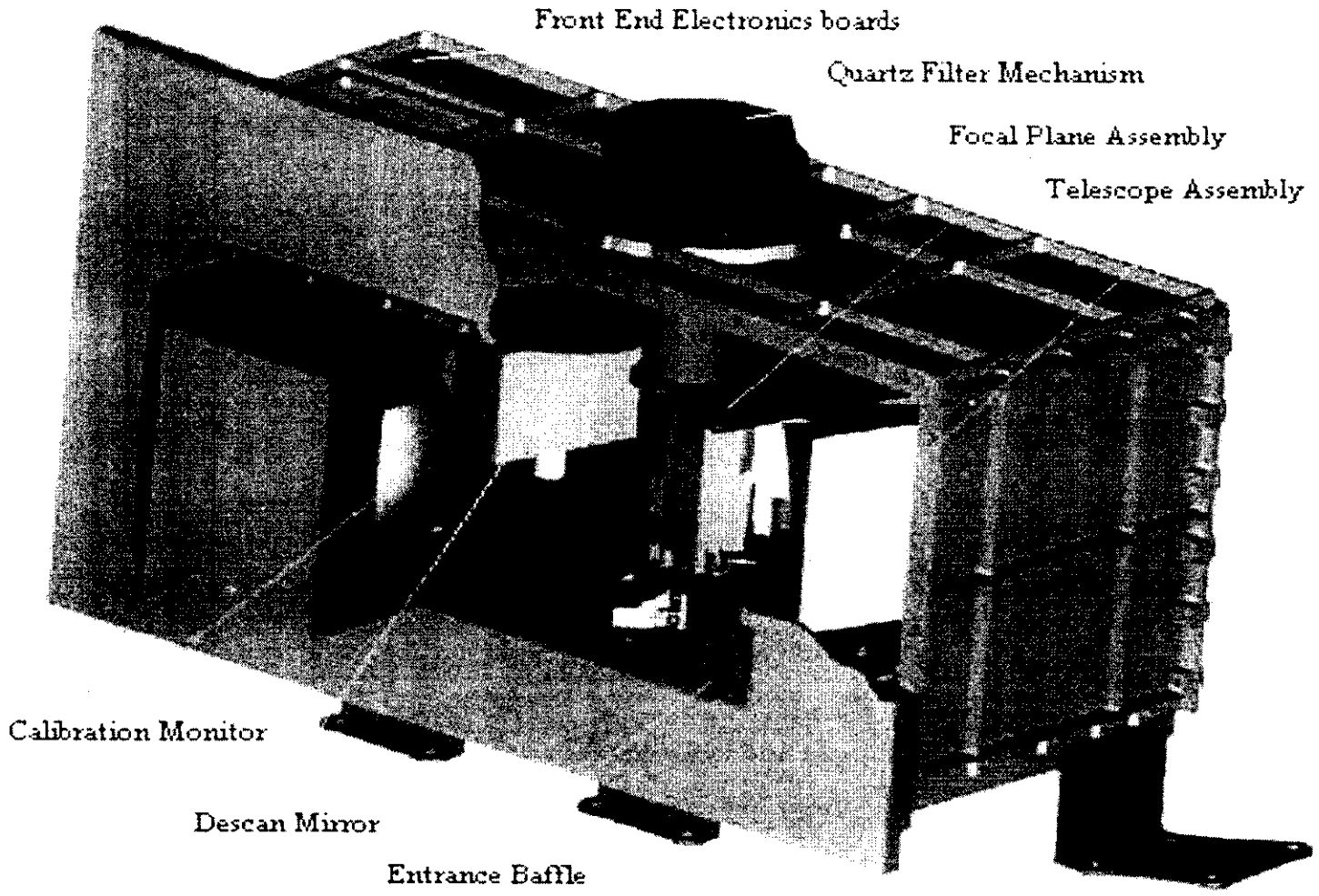
		MSG	Meteosat
SVIRI	Coverage	Full Earth	Full Earth
	Repeat	15 mins	30 mins
	Sample	3 km	2.5 km Visible 5 km Infrared
	Channels	3 Visible + 5 Infrared	Visible + WV + IR
HRVIS	Coverage	1/2 of 1/4 of Full Earth	Not Carried
	Repeat	5 mins	Not Carried
	Sample	0.5 km	Not Carried
Mass		982 kg (BOL)	320 kg (BOL)

SEVIRI Infrared Channels

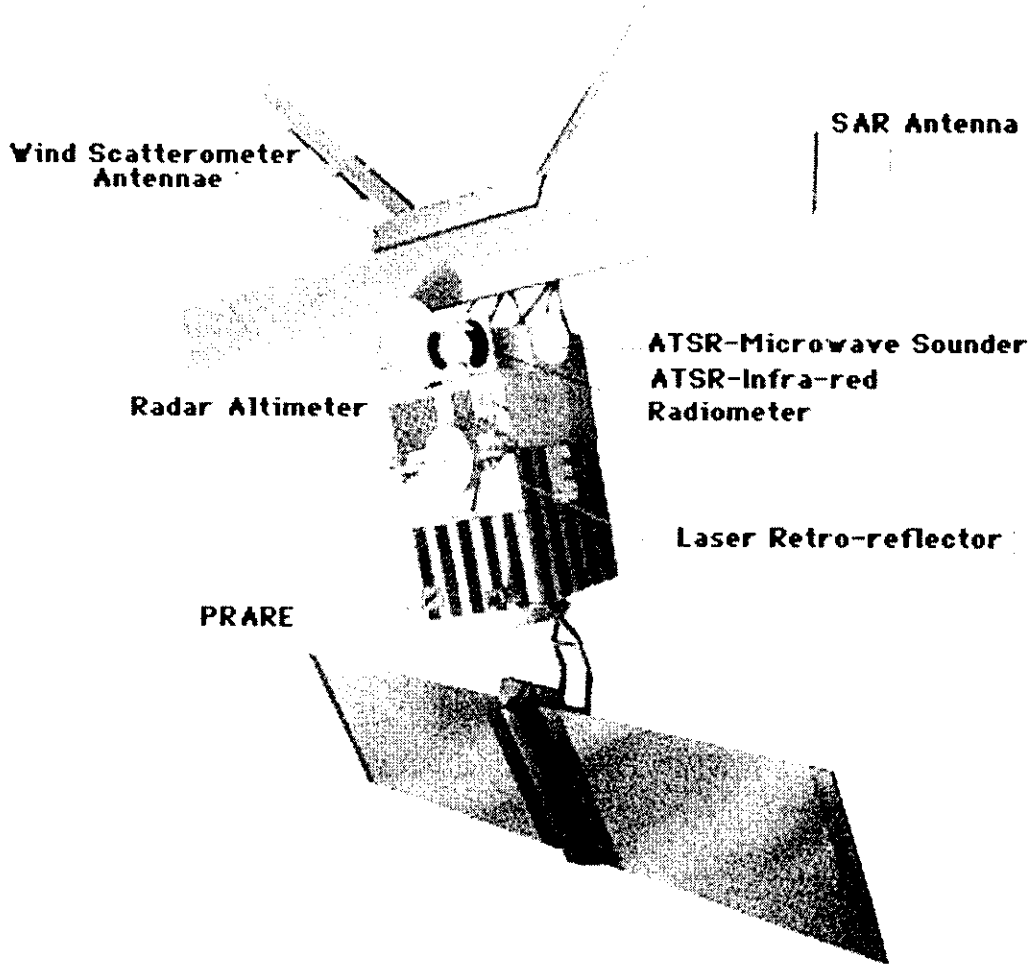


(Courtesy: Eumetsat)

The GERB Instrument



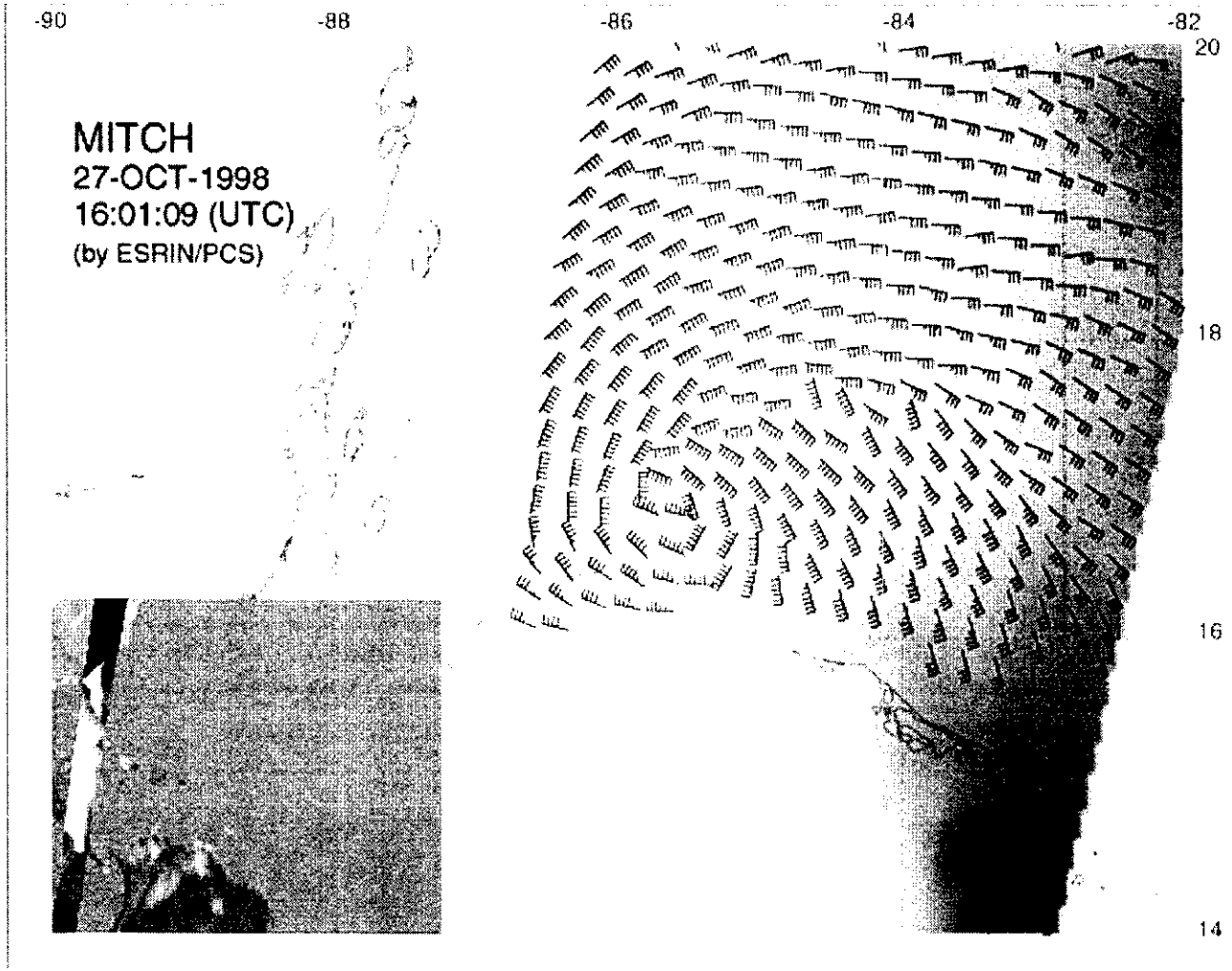
The Agency's Current Programme
ERS-1



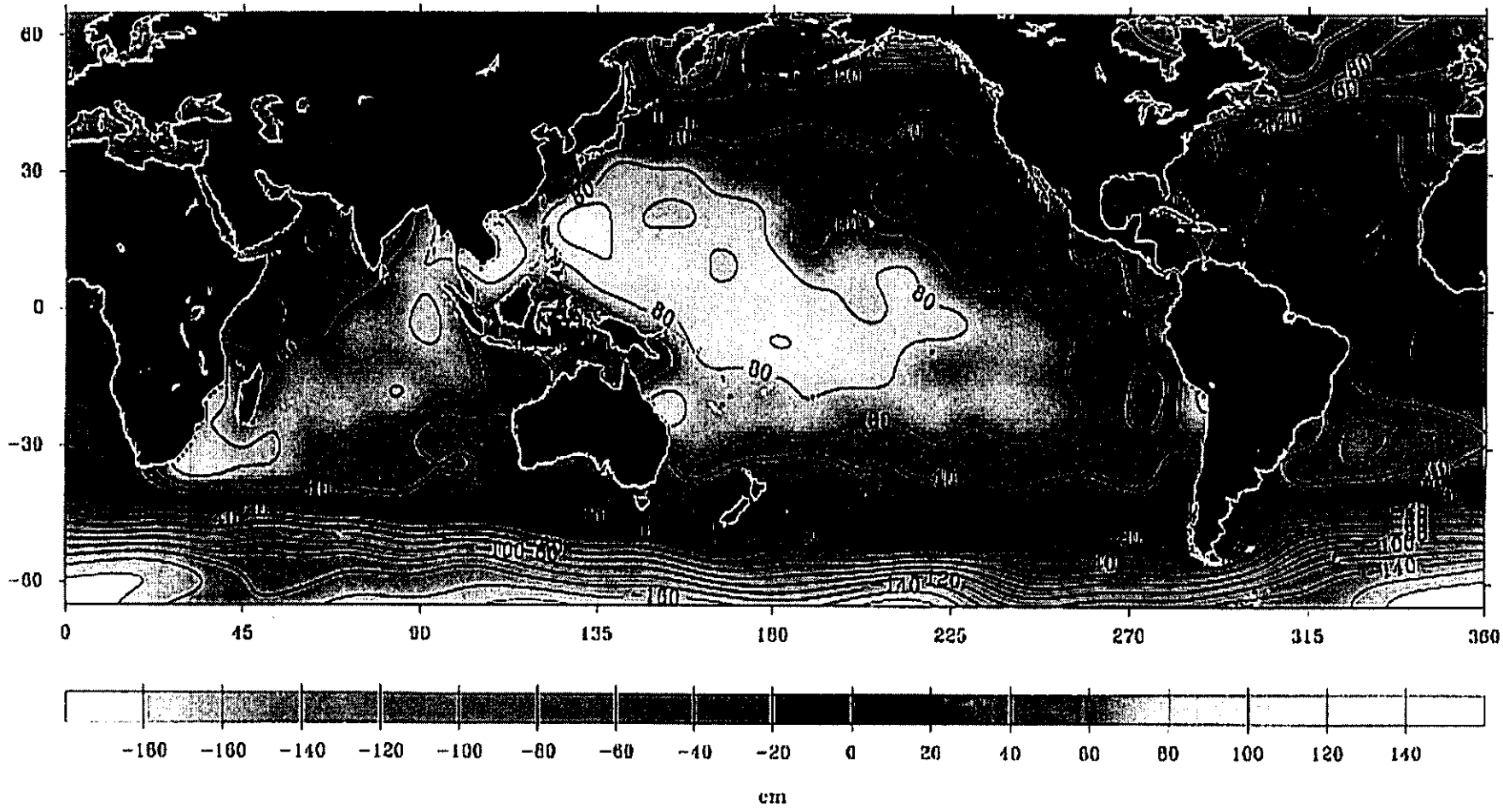
The Agency's Current Programme
The Performance of ERS-1

Geophysical Parameter	Range	Accuracy (bias /standard deviation)	Main Instrument
Wind Field			
- Velocity	0.5 – 30 m/sec	0.3/2.2 m/sec	AMI (wind mode) & radar altimeter
- direction	0 – 360°	0.8/22 degrees	AMI (wind mode)
Wave Field			
- significant wave height	1 – 20 m	0.05/0.5 m	AMI (wave mode) & radar altimeter
- wave spectrum			
direction	0/360°	15° (ang. resolution)	AMI (wave mode)
wavelength	50 – 100 m	20% (wave no. resolution)	AMI (wave mode)
Earth Surface Imaging (land, ice and coastal zones)	100 km (swath width)	0.14/0.2 dB (rad. accuracy) 25x22 m^2 (geom. resolution) 2 dB (rad. resolution)	AMI (imager mode)
Altitude (over ocean)	745 – 825 km	0.07/0.02 m (height)	Radar altimeter
Sea Surface Temperature	500 km (swath width)	±0.5 K	ATSR

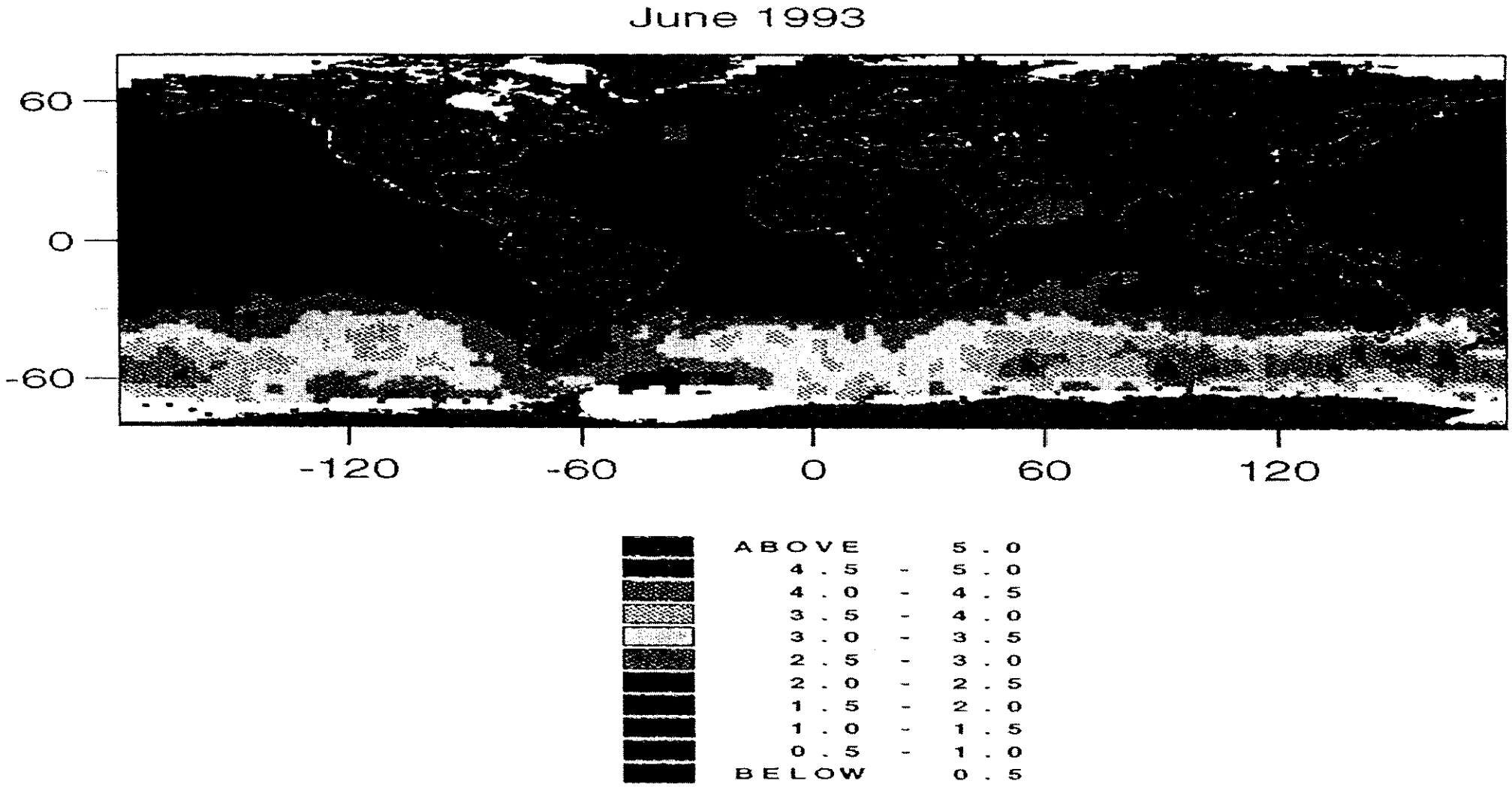
The Agency's Current Programme
ERS - Sea surface winds (scatterometer)



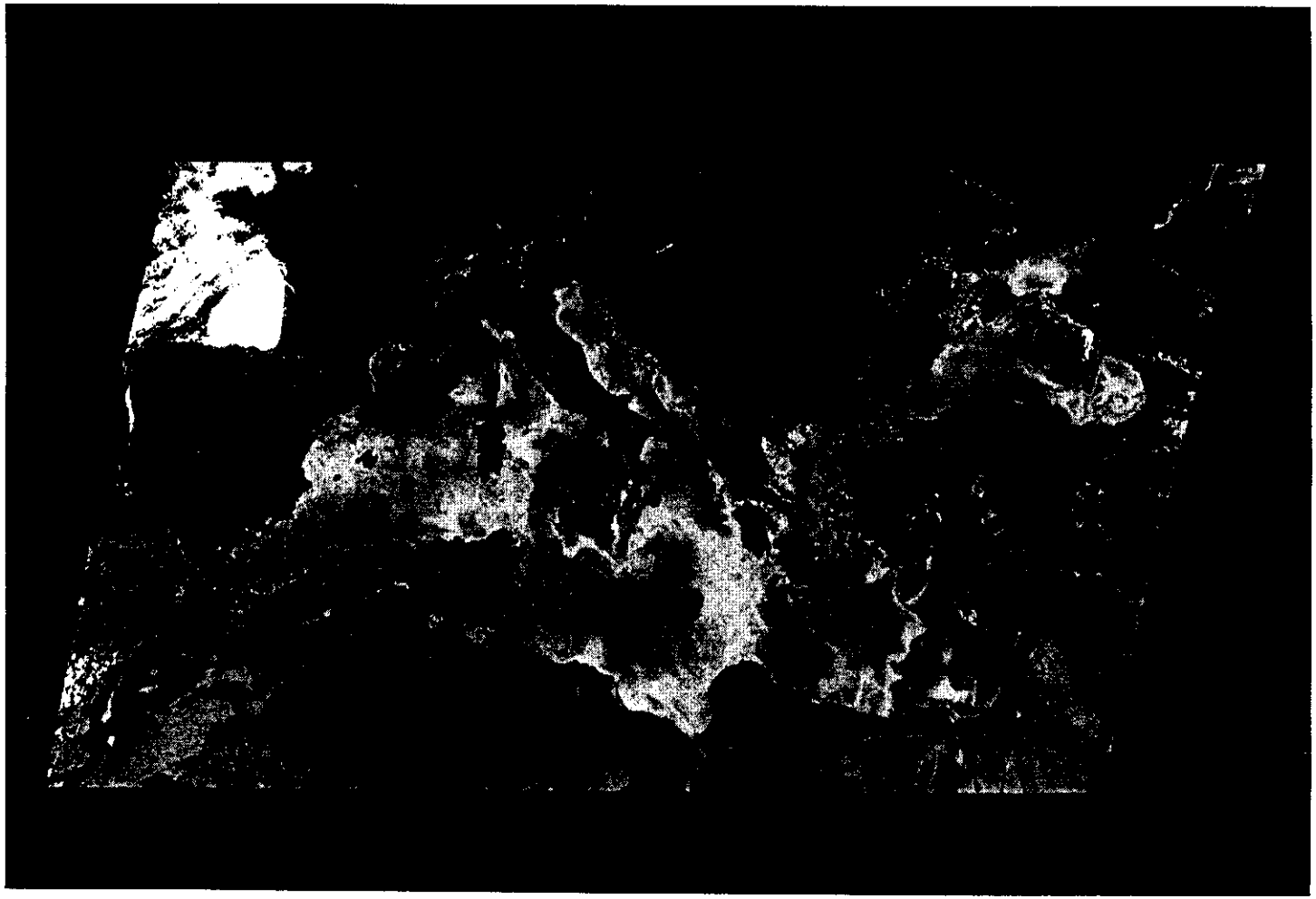
The Agency's Current Programme
ERS - Ocean topography (radar altimeter)



The Agency's Current Programme
ERS - Wave height observations (radar altimeter)



The Agency's Current Programme
ERS - Sea surface temperatures (ATSR)



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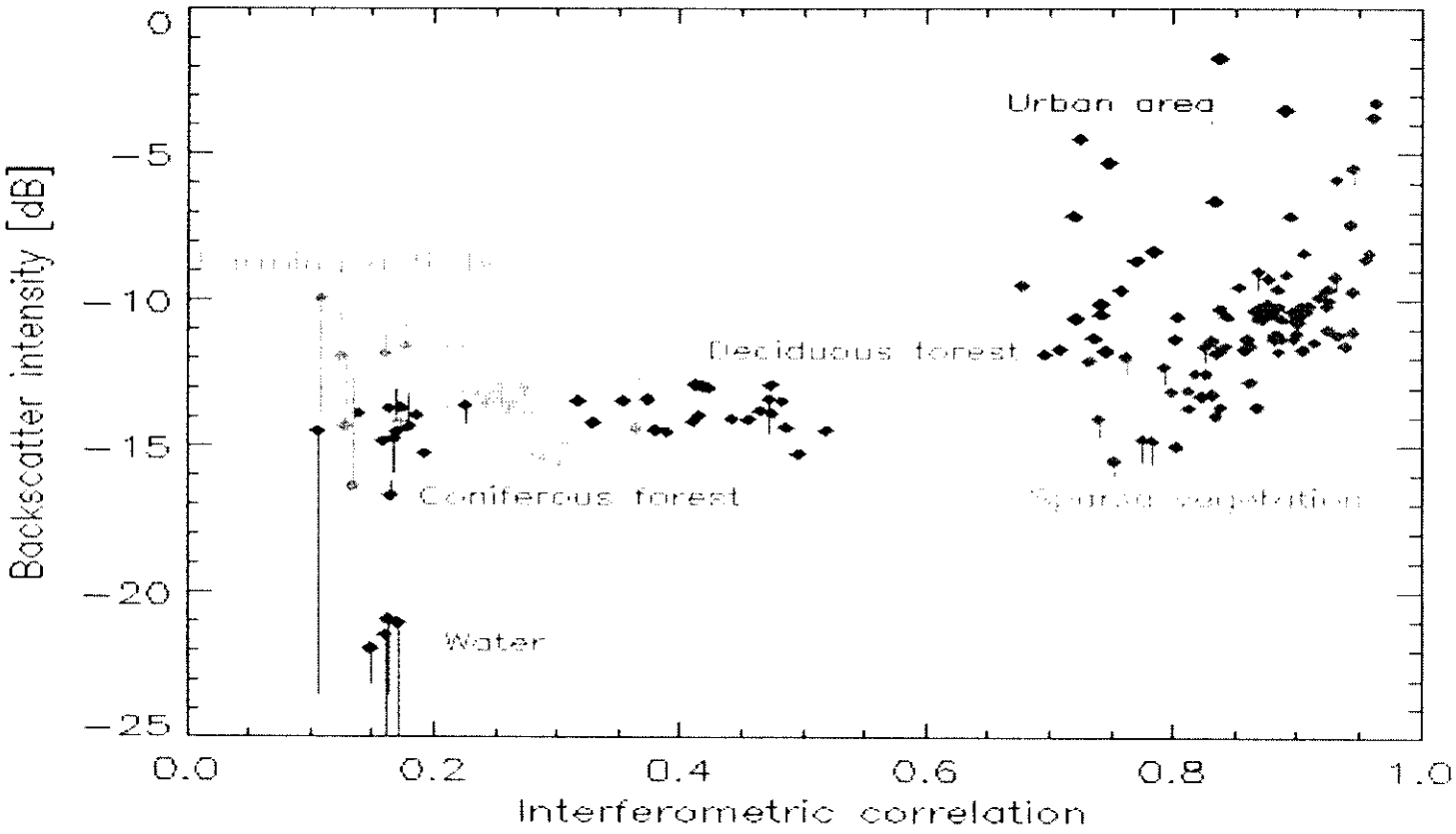
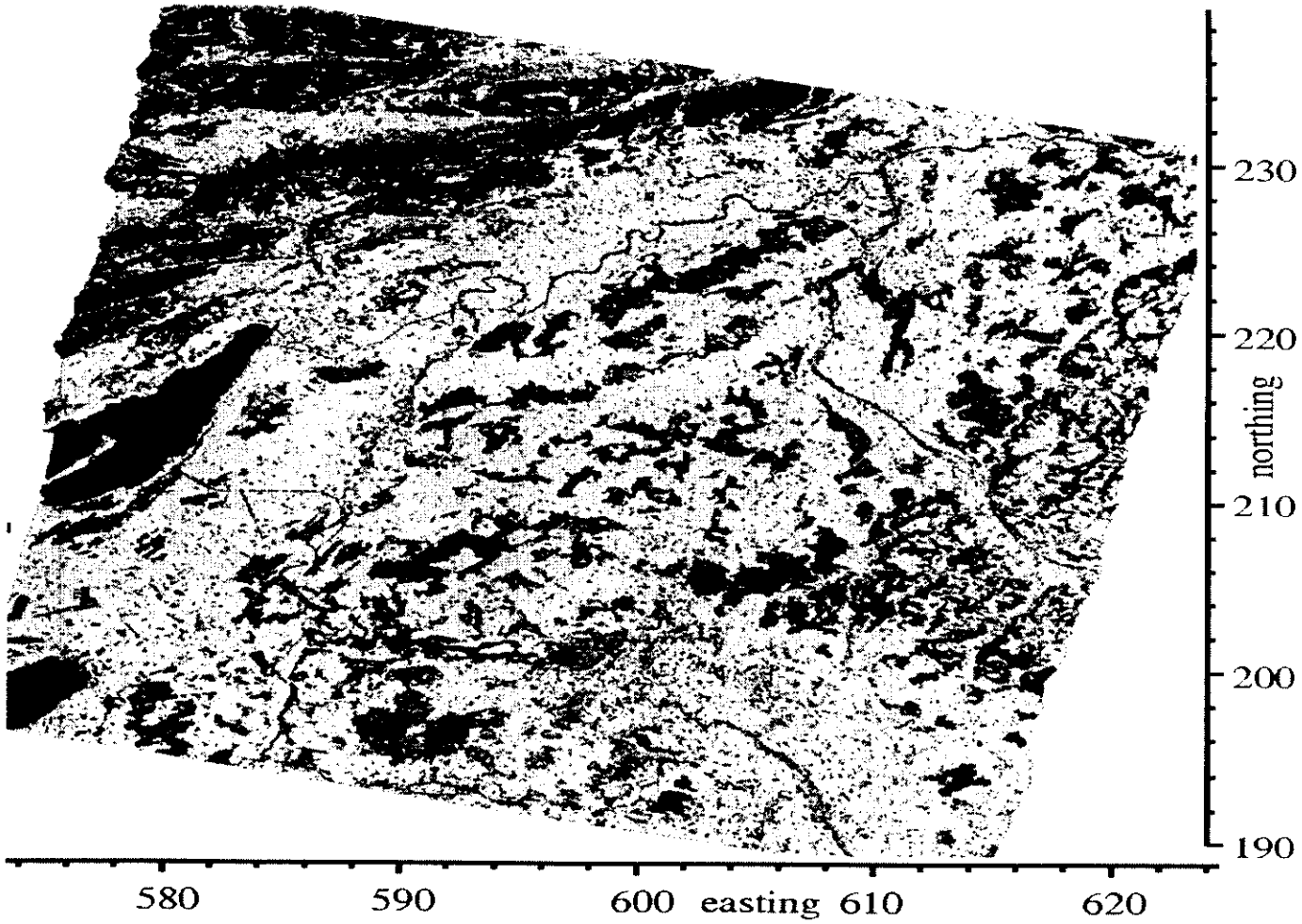
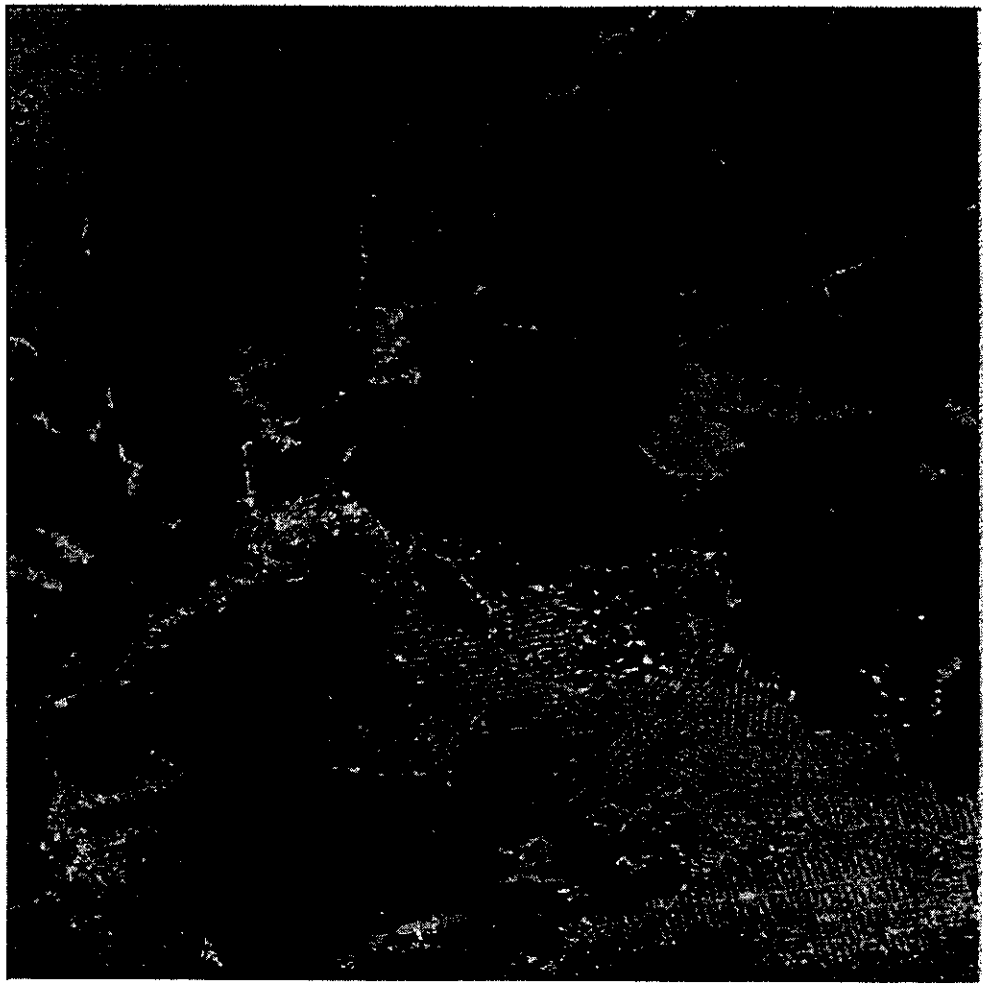
The Agency's Current Programme
ERS - Plot of backscatter verses coherence (SAR)



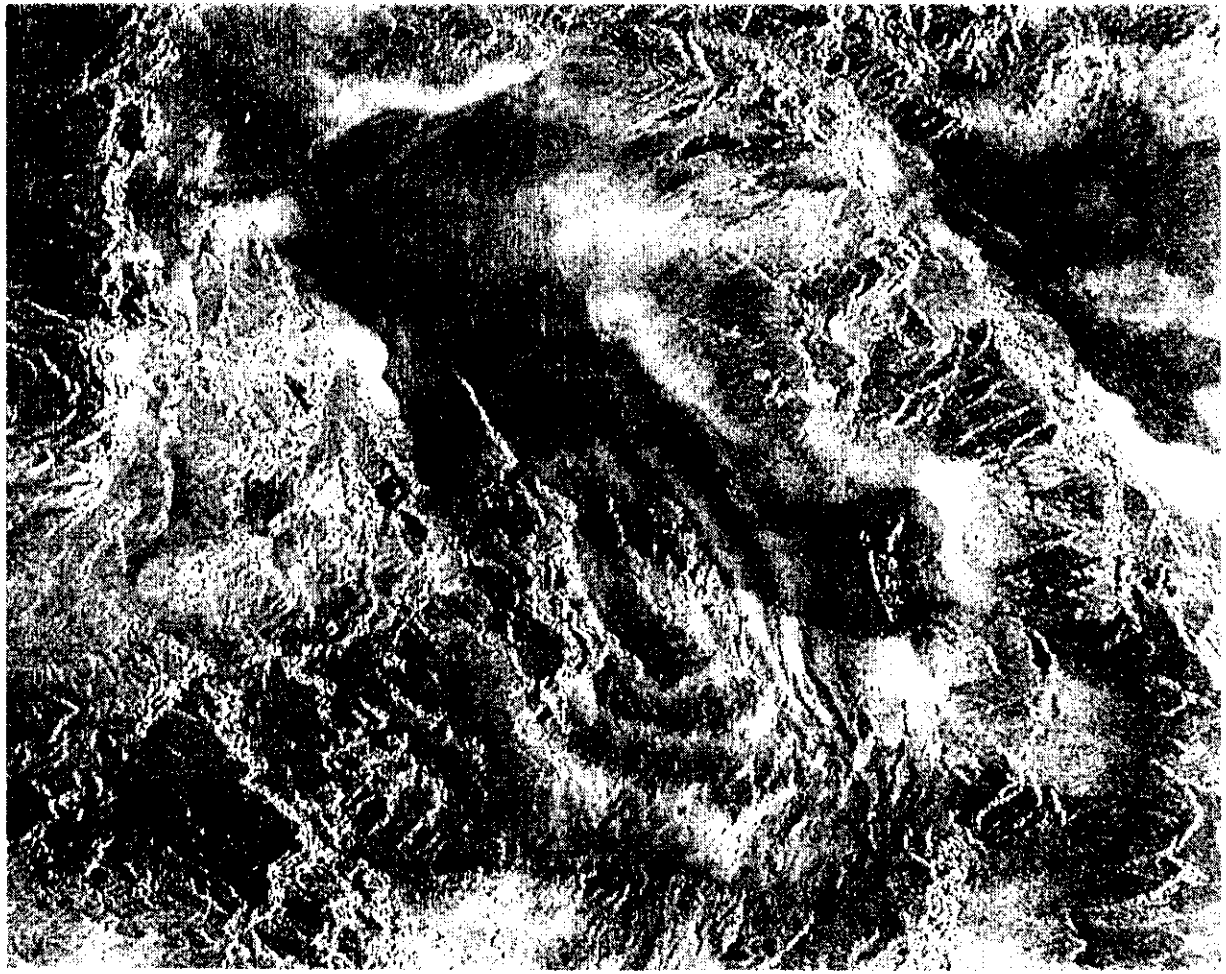
The Agency's Current Programme
ERS - Land Cover Classification (SAR)



The Agency's Current Programme
ERS - Deforestation in Brazil (ATSR)



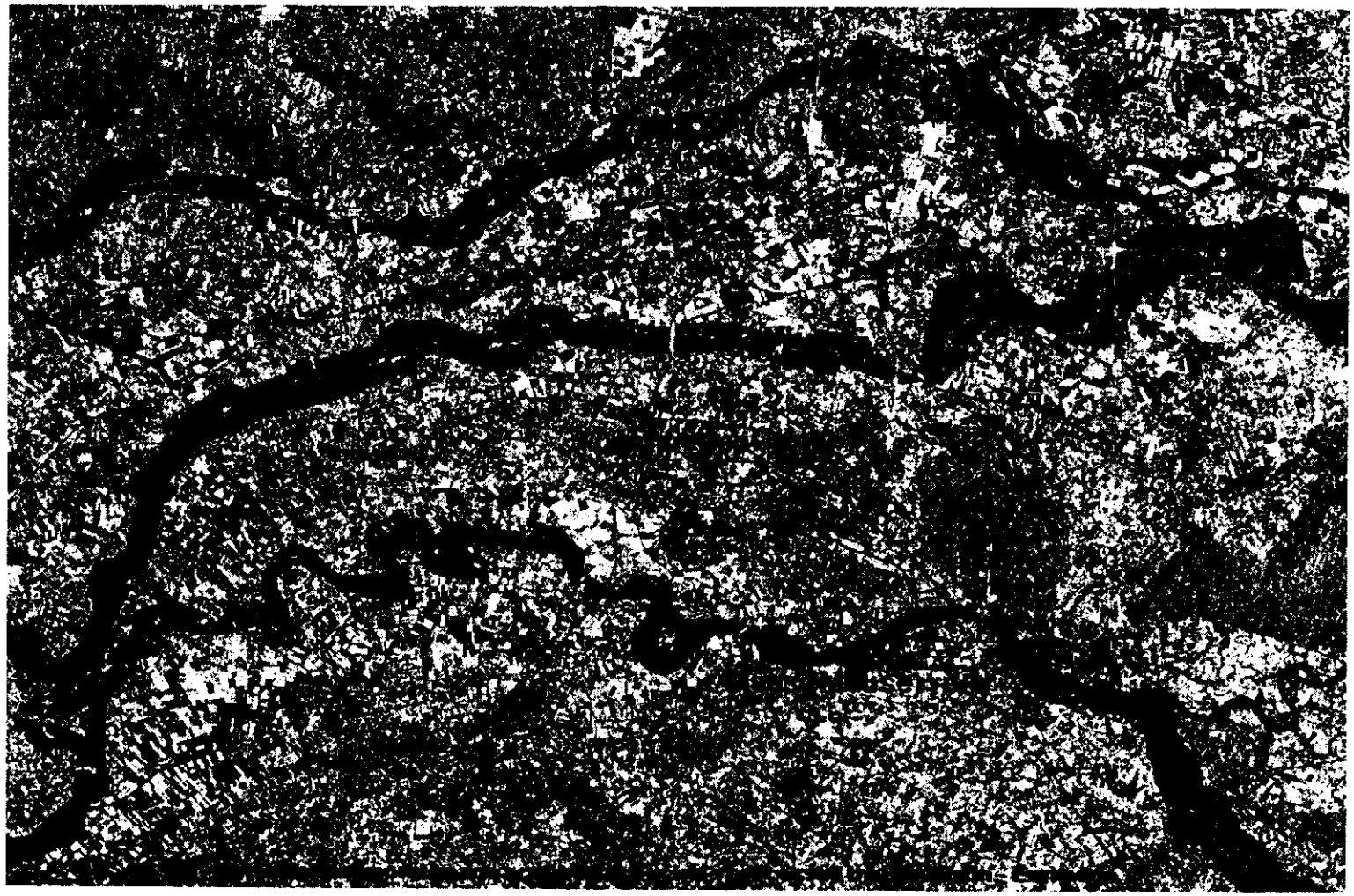
The Agency's Current Programme
ERS - Earthquake in California (SAR)



esa

The Agency's Current Programme

ERS - Flooding in southern Netherlands (SAR plus Landsat)

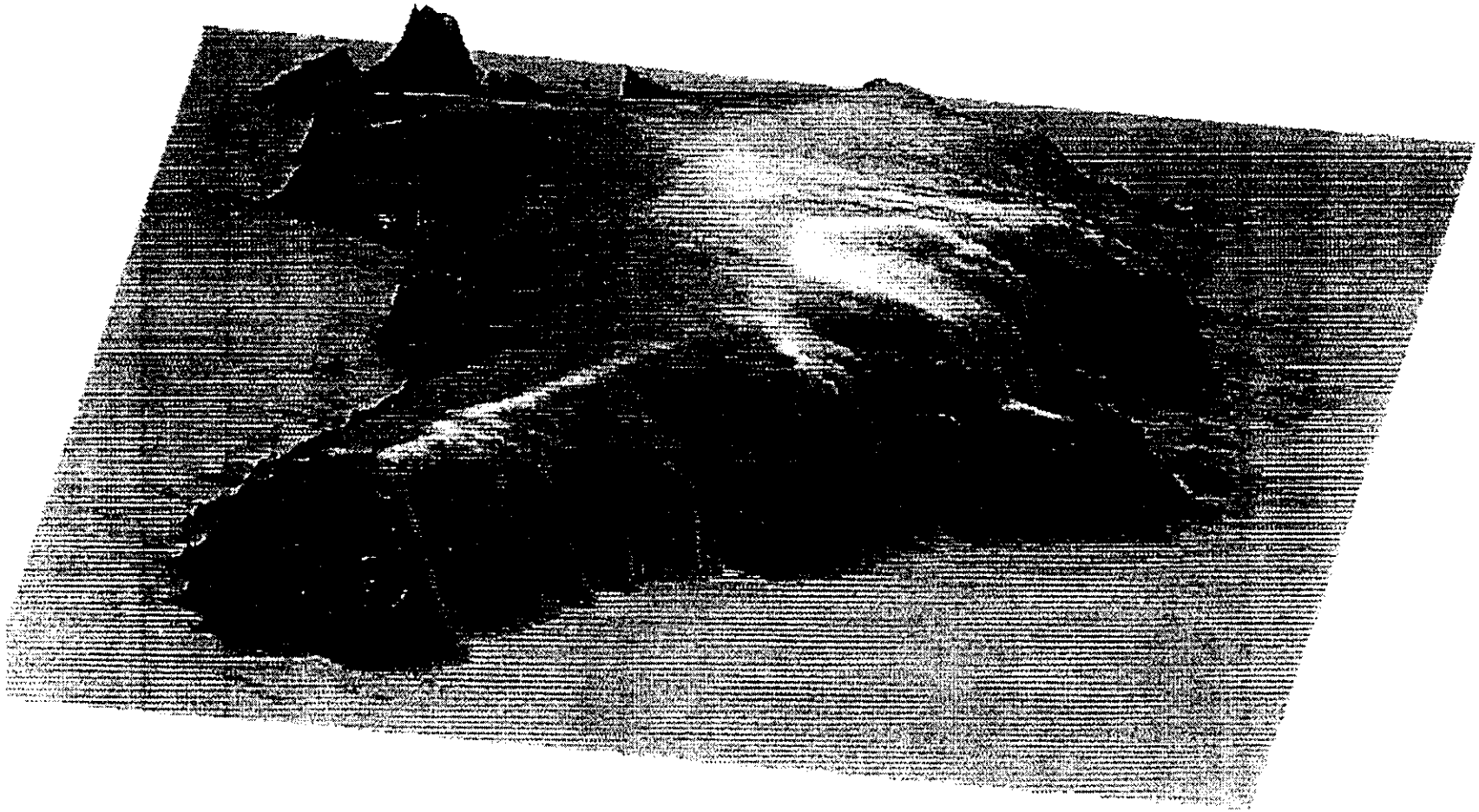


The Agency's Current Programme
ERS - Comparison of AVHRR and ERS-1 SAR

The Agency's Current Programme
ERS - Ice kinematics and snow cover (SAR)

Mean Ice Displ. 3.4 cm/s

The Agency's Current Programme
ERS - The Greenland ice sheet (radar altimeter)



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The Agency's Current Programme
ERS - Glacial topography (SAR)

The Agency's Current Programme
A Comparison of ERS-1 and ERS-2

1. ERS-2 now the operational satellite: ERS-1 now held in reserve.

2. ERS-2 identical to ERS-1 except for:

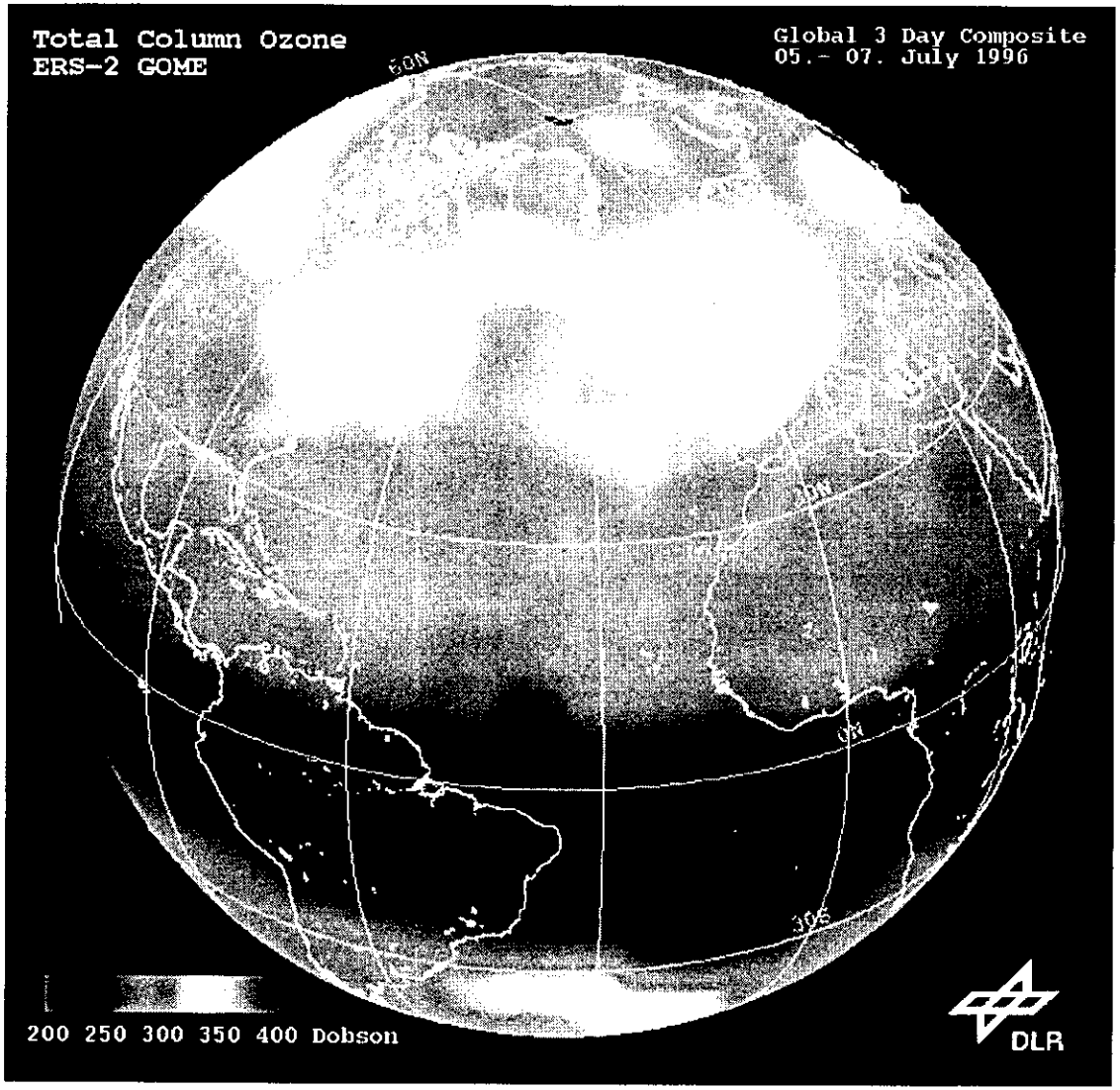
- Enhancement to ATSR (Along Track Scanning Radiometer) with addition of channels operating in the visible
- Addition of the GOME (Global Ozone Monitoring Experiment):

  - Spectrometer operating over the range 250-790 nm
  - Spectral resolution varies between 0.2 nm and 0.4 nm
  - Sun, moon and lamp calibration schemes
  - Good views of polar regions
  - Differential absorption plus backscatter technique

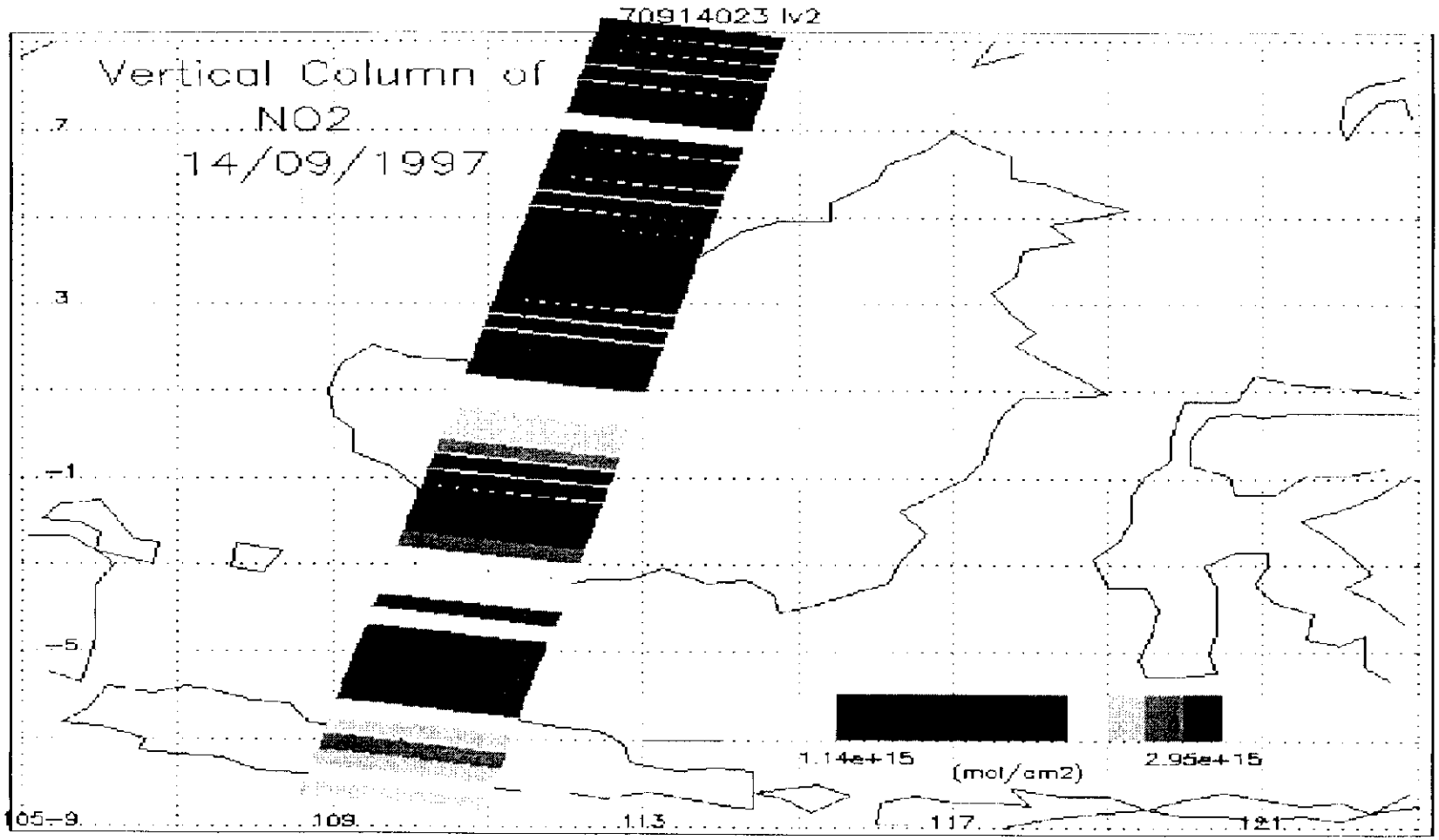
Near real time pictures on *http://www-iup.physik.uni-bremen.de*

3. *New Views of the Earth* set of three publications completed: *Scientific Achievements of ERS-1* ESA SP1176/I; *Applications Achievements of ERS-1* ESA SP1176/II; *Engineering Achievements of ERS-1* ESA SP1176/III; plus *Scientific Achievements of GOME-1 and Expectations for GOME-2* ESA SP-1212.

The Agency's Current Programme
ERS-2: The Gome Ozone Product



The Agency's Current Programme
ERS-2: Gome Observations of NO_2 over Indonesia



The Agency's Current Programme
Overall Mission Objectives - Envisat and Metop

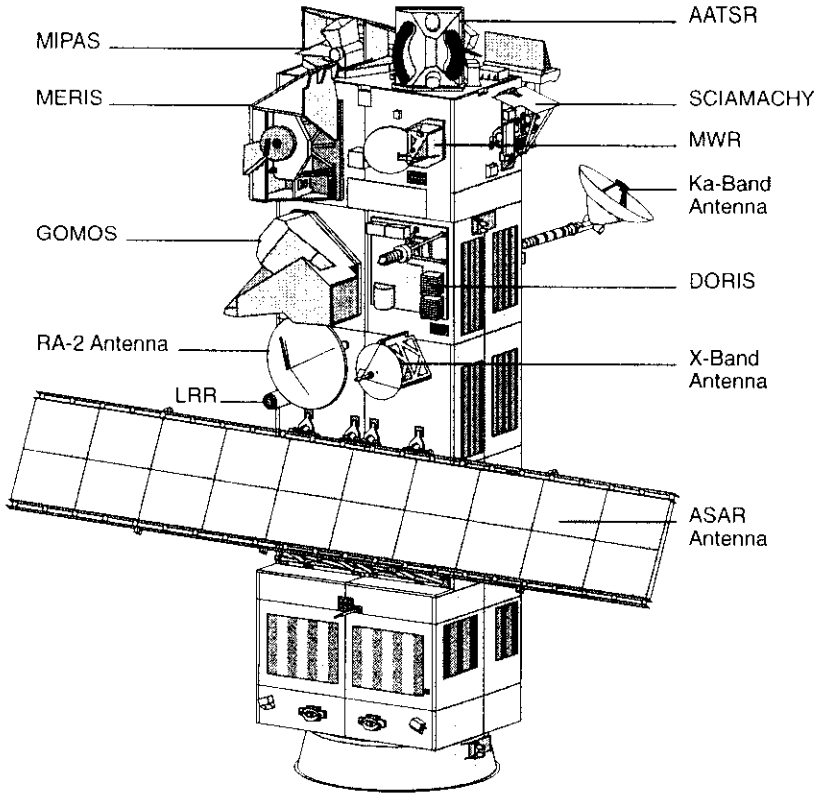
Envisat:

- **Continuity of ERS observations for the monitoring of coastal zones, open oceans, ice and land surface processes**
- **Improved oceanic mission with observation of biological components and colour of the oceans**
- **Major contributions to understanding, monitoring and modelling of atmospheric chemistry processes**

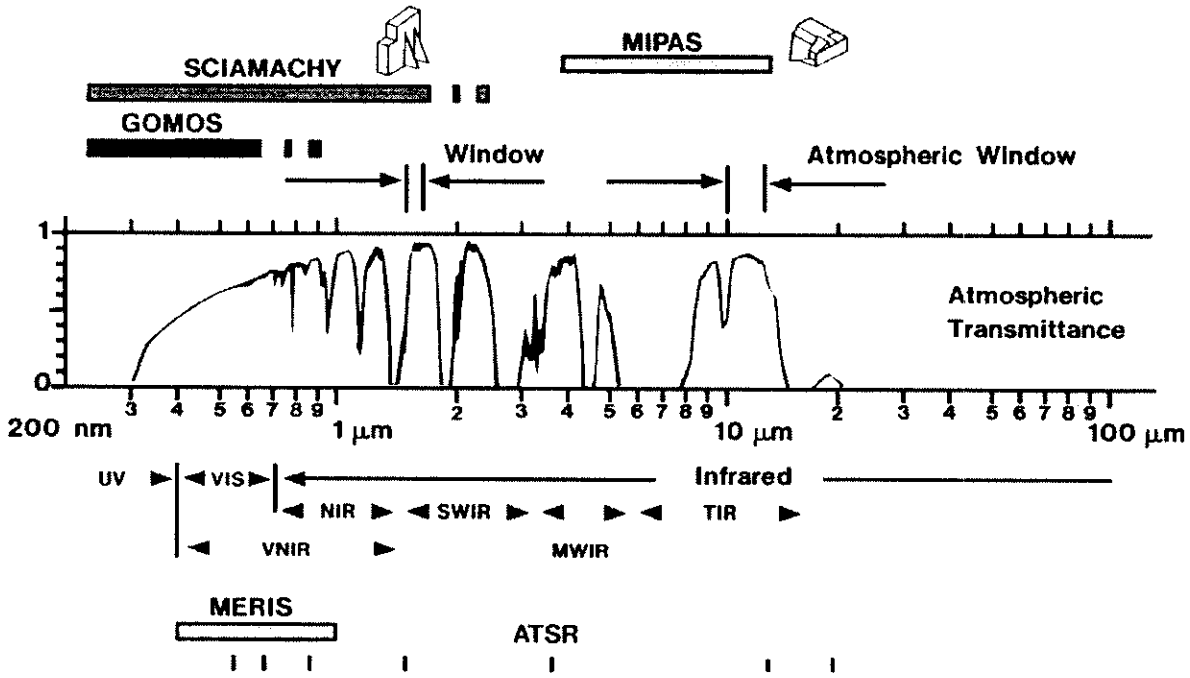
Metop:

- **Ensuring (and enhancing) the provision of observations from the "morning" polar orbit for operational meteorology**
- **Contributing to the Routine Long Term Observation of Key Climate variables e.g. Global Climate Observing System (GCOS)**

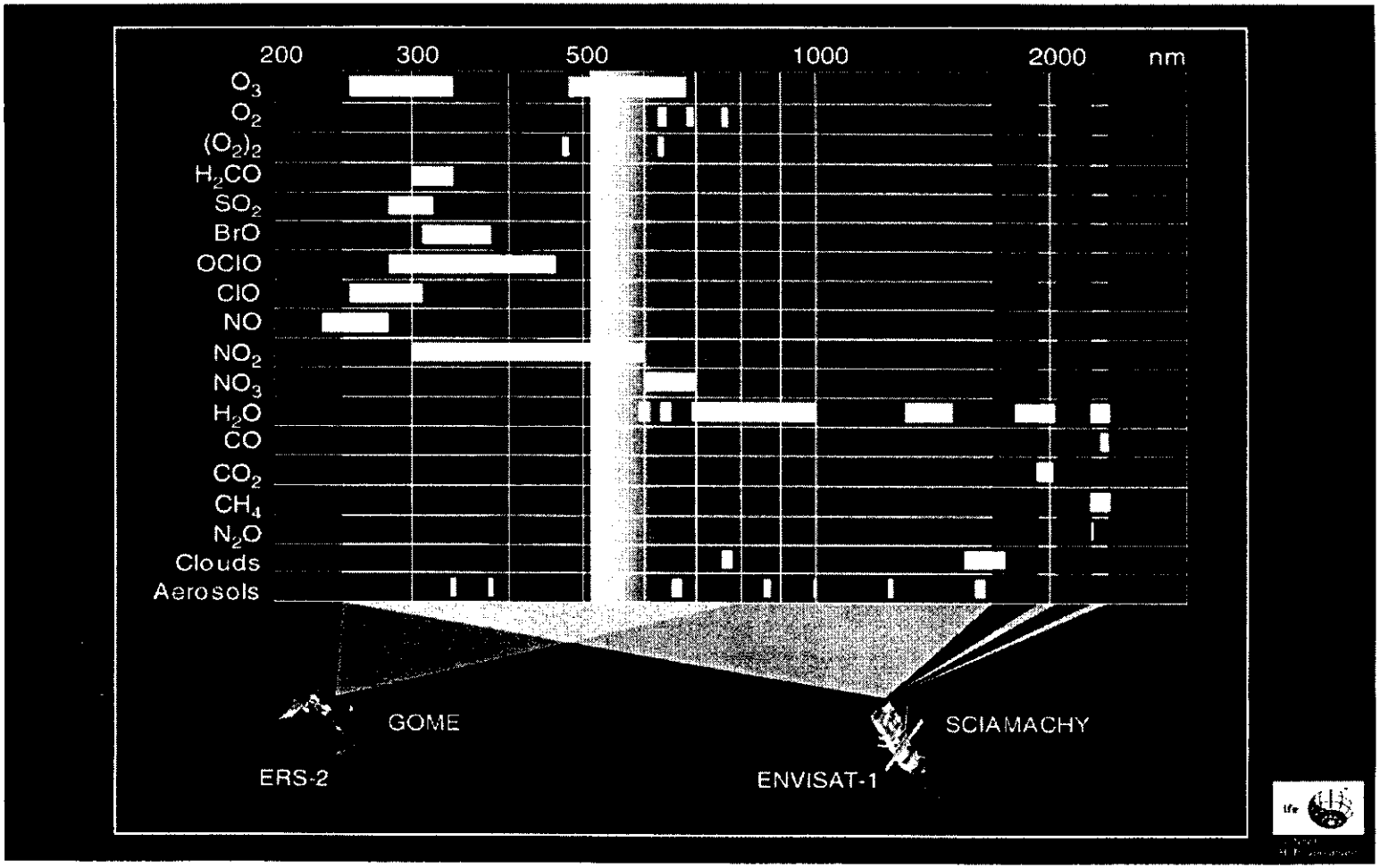
The Agency's Current Programme
Envisat - overview



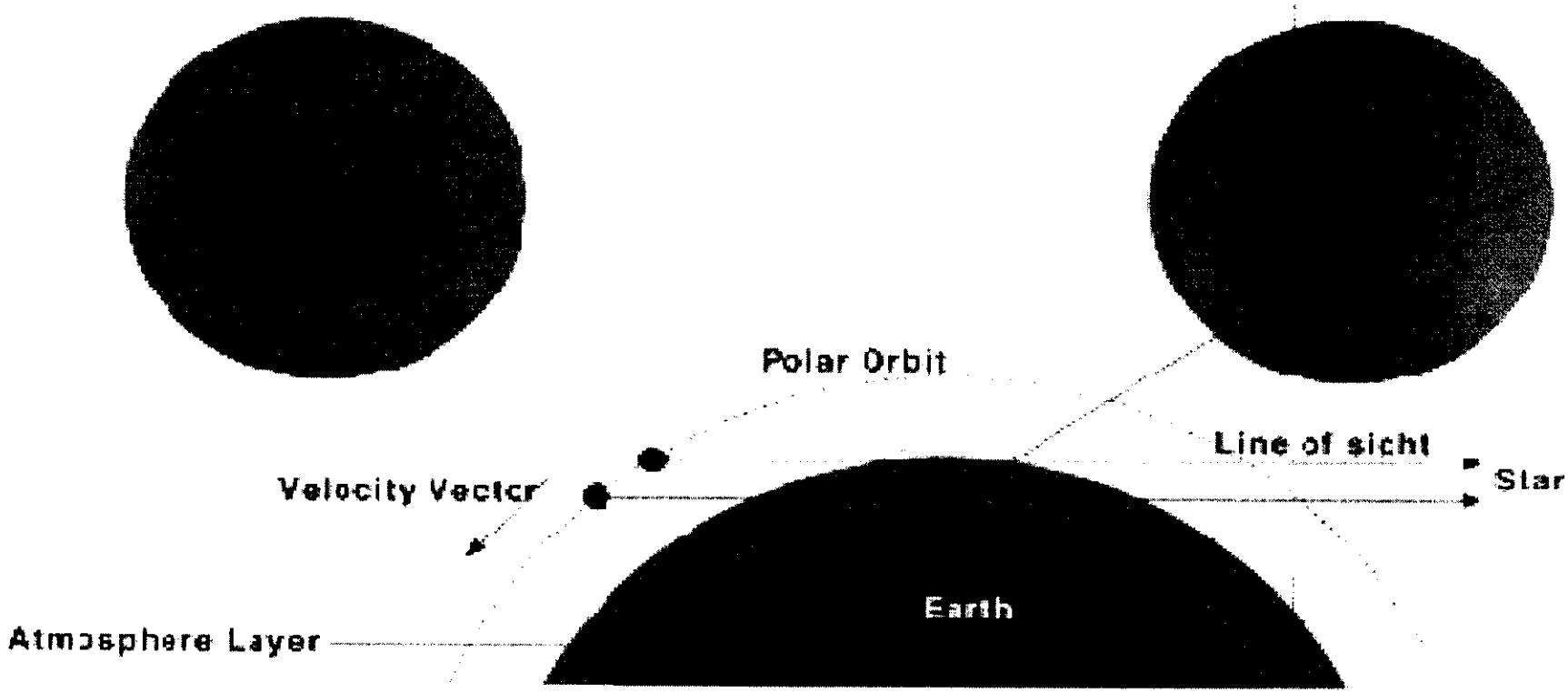
The Agency's Current Programme
Envisat - comparison of instruments

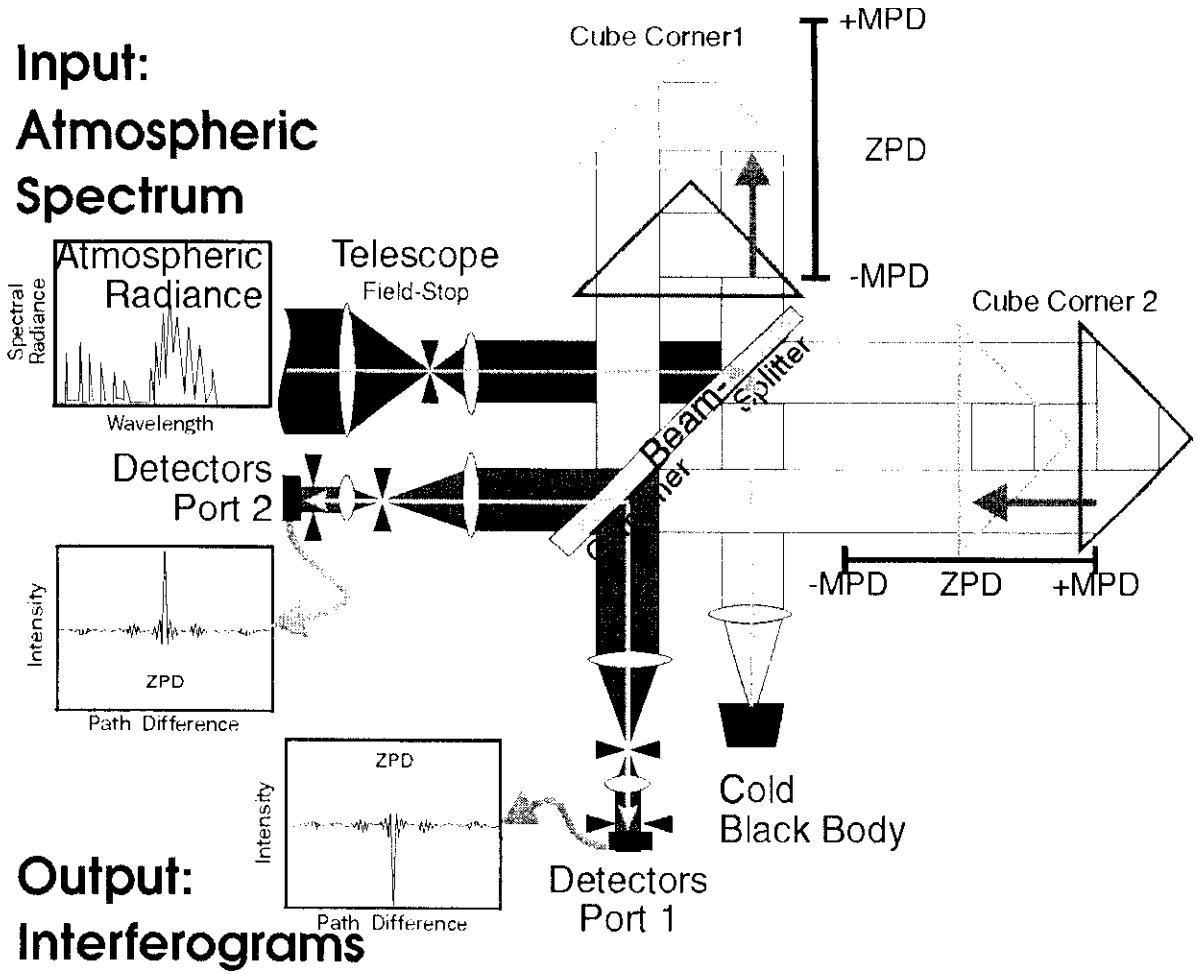


The Agency's Current Programme
Envisat - comparison of Gome and Sciamachy

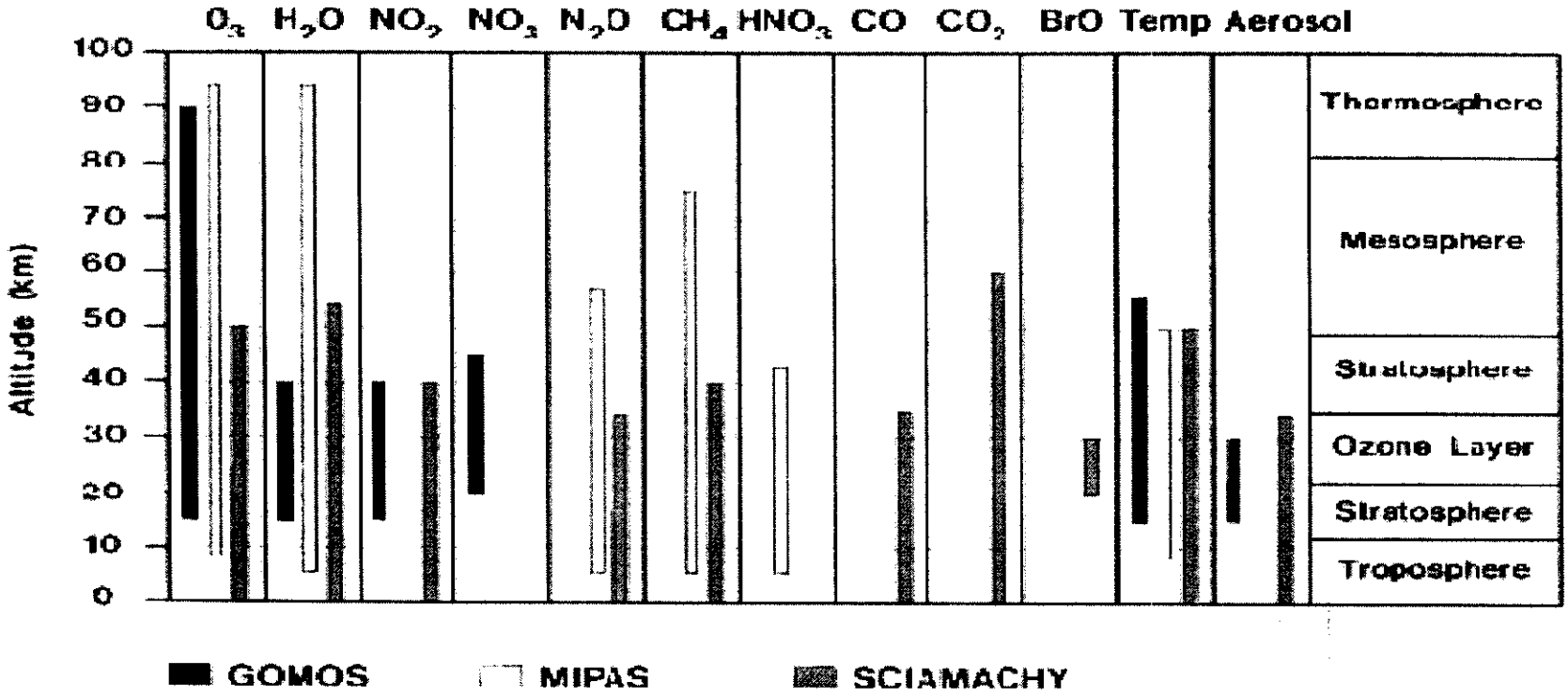


The Agency's Current Programme
Envisat - Gomos



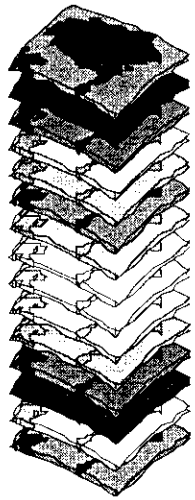

Input:
Atmospheric
Spectrum
Atmospheric
Radiance
Spectral
Radiance
Wavelength
Telescope
Field-Stop
Detectors
Port 2
Intensity
ZPD
Path Difference
Cube Corner1
+MPD
ZPD
-MPD
Cube Corner 2
Beam-
Splitter
-MPD
ZPD
+MPD
Cold
Black Body
Detectors
Port 1
ZPD
Intensity
Path Difference
Output:
Interferograms

The Agency's Current Programme
Envisat - constituents measured by chemistry instruments



The Agency's Current Programme
Envisat - Meris

MERIS measures the radiance backscattered by the Earth in the Visible - Near-Infrared part of the spectrum



- PUSHBROOM IMAGER,
- SWATH WIDTH: 1150 km,
- FULL RESOLUTION: 300m
- REDUCED RESOLUTION: 1200m

- VIS-NIR SPECTROMETER
- BANDS: 15, PROGRAMMABLE IN WIDTH AND POSITION

The Agency's Current Programme
Envisat - CZCS chlorophyll maps

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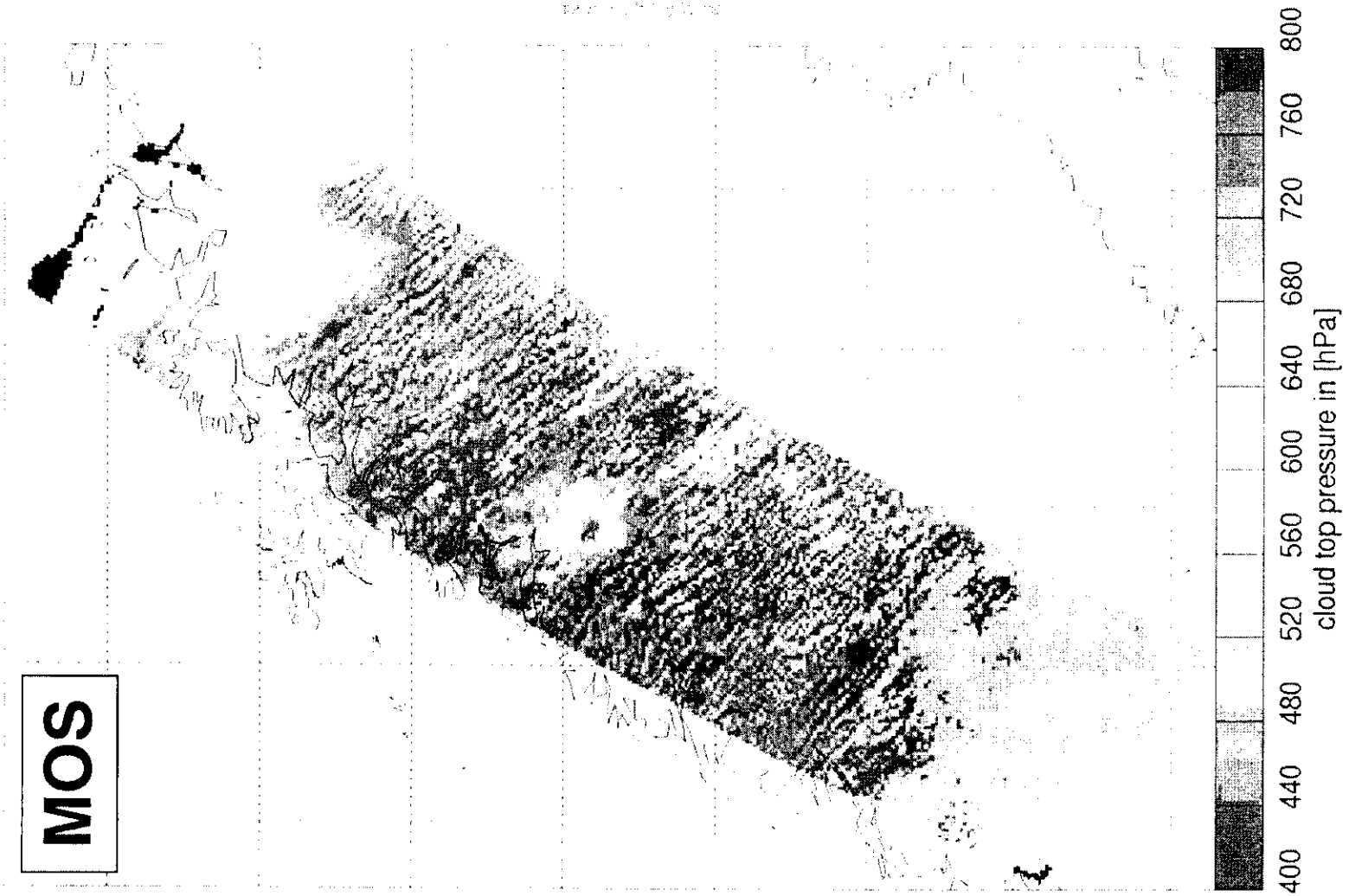
The Agency's Current Programme
Envisat - Atmospheric parameters (Meris)



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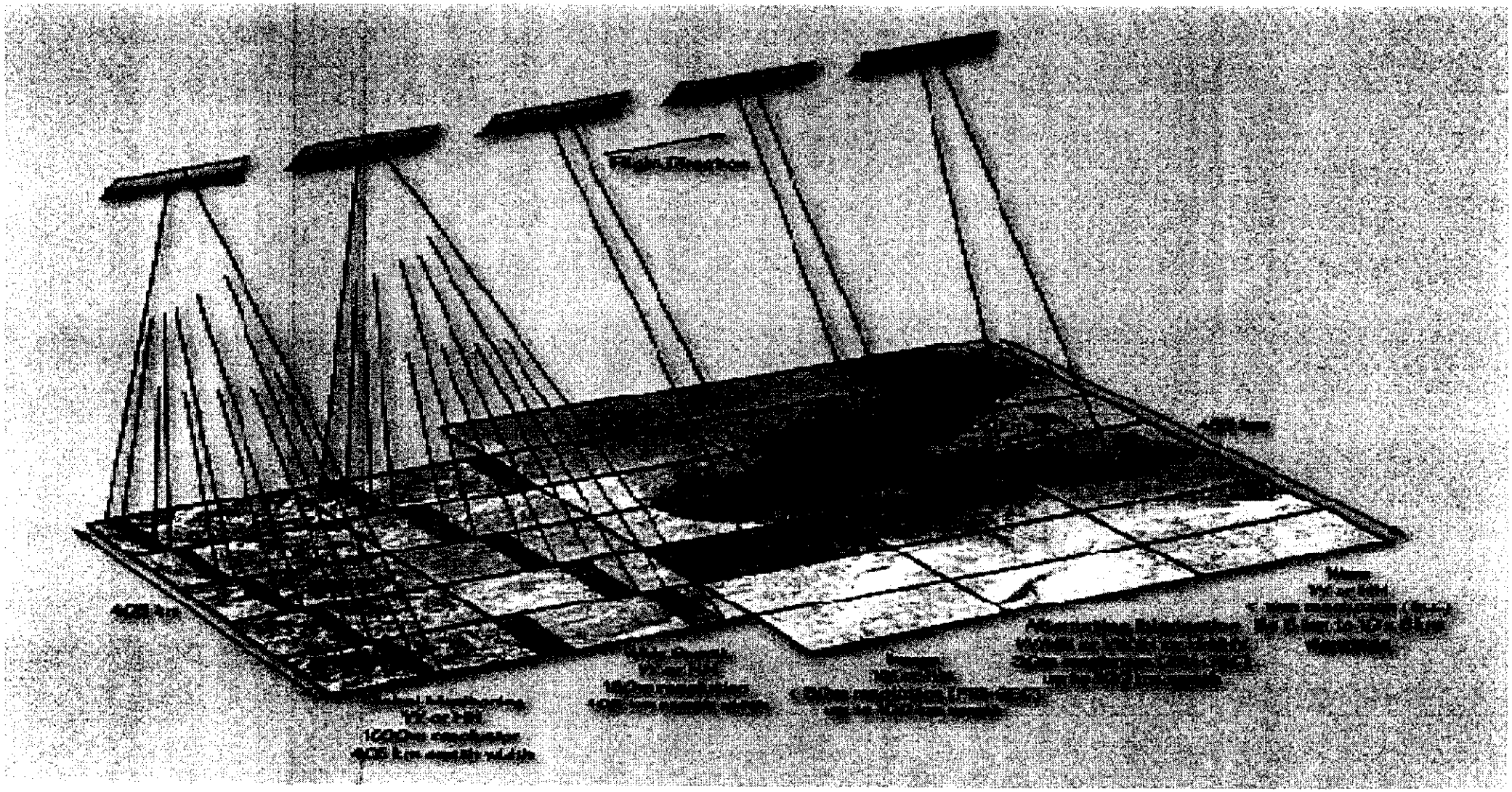
- C-Band 5.33 GHz
- Image Mode
  - Selectable Polarisation VV HH VH HV
  - Selectable Incidence Angles (15-45 deg.)
  - 30 m Geometrical Resolution (4 Looks)
  - 56 - 105 km Swath Width
- Alternating Polarisation Mode
  - Dual Selectable Polarisation VV HH VH HV
  - 30 m Geometrical Resolution (2 Looks)

The Agency's Current Programme
Envisat - the ASAR



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The Agency's Current Programme
Envisat - the ASAR

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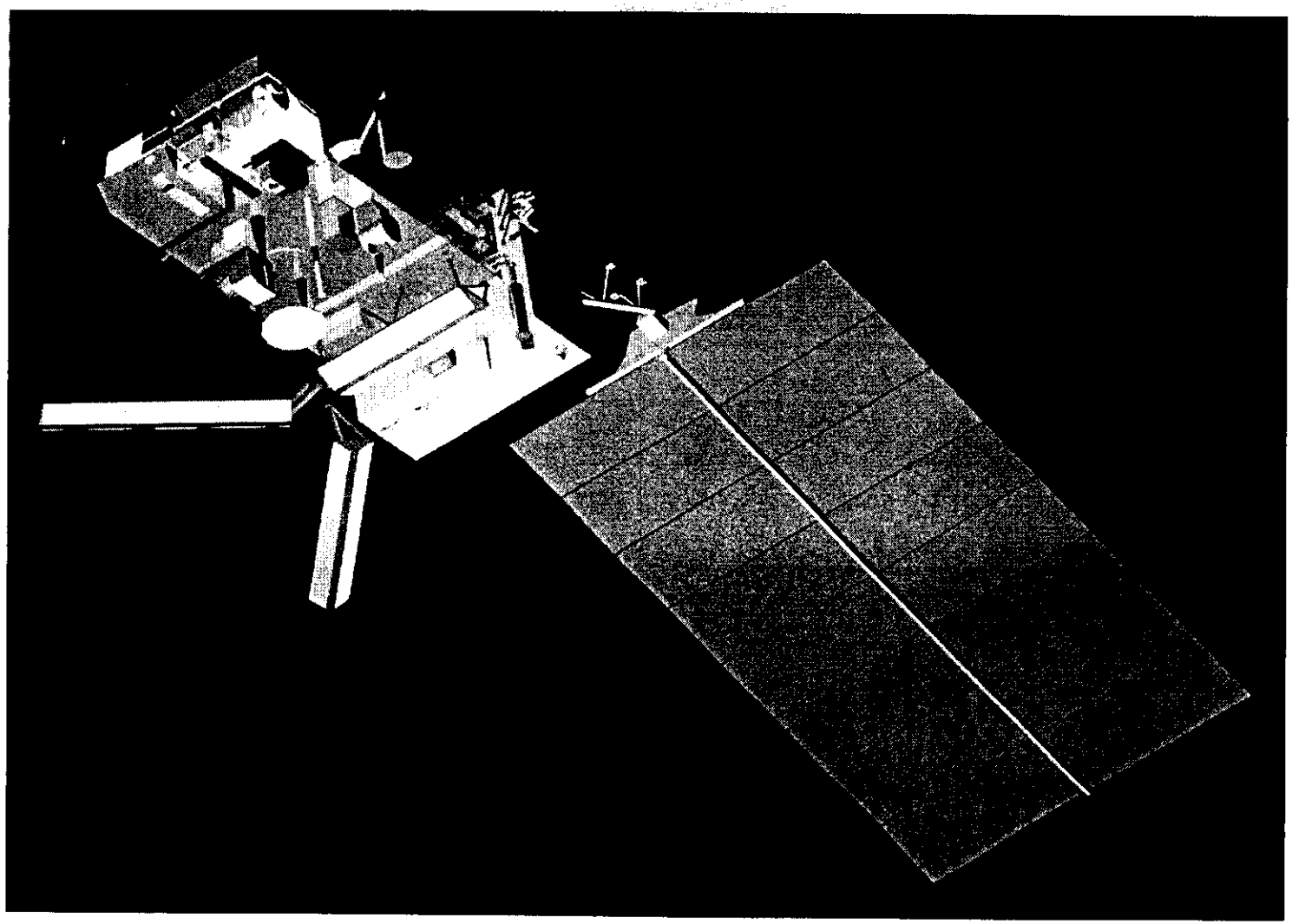
The Agency's Current Programme
Metop



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The Agency's Current Programme
The Envisat and Metop Missions

ENVISAT-1

ESA Developed Instruments

- A-SAR
- GOMOS
- LRR
- MERIS
- MIPAS
- RA-2
- MWR

A.O. Instruments

- AATSR
- DORIS
- SCIAMACHY

METOP-1

NOAA/EUMETSAT Provided

- METEO-Package

ESA Developed Instruments

- ASCATT
- GRAS
- GOME-2

A.O. Instruments

- IASI

The Agency's Current Programme

Overall Schedule