



ESA-MOST DRAGON PROGRAMME ADVANCED TRAINING COURSE IN LAND REMOTE SENSING

## Optical-Thermal Day 1 Lecture 4

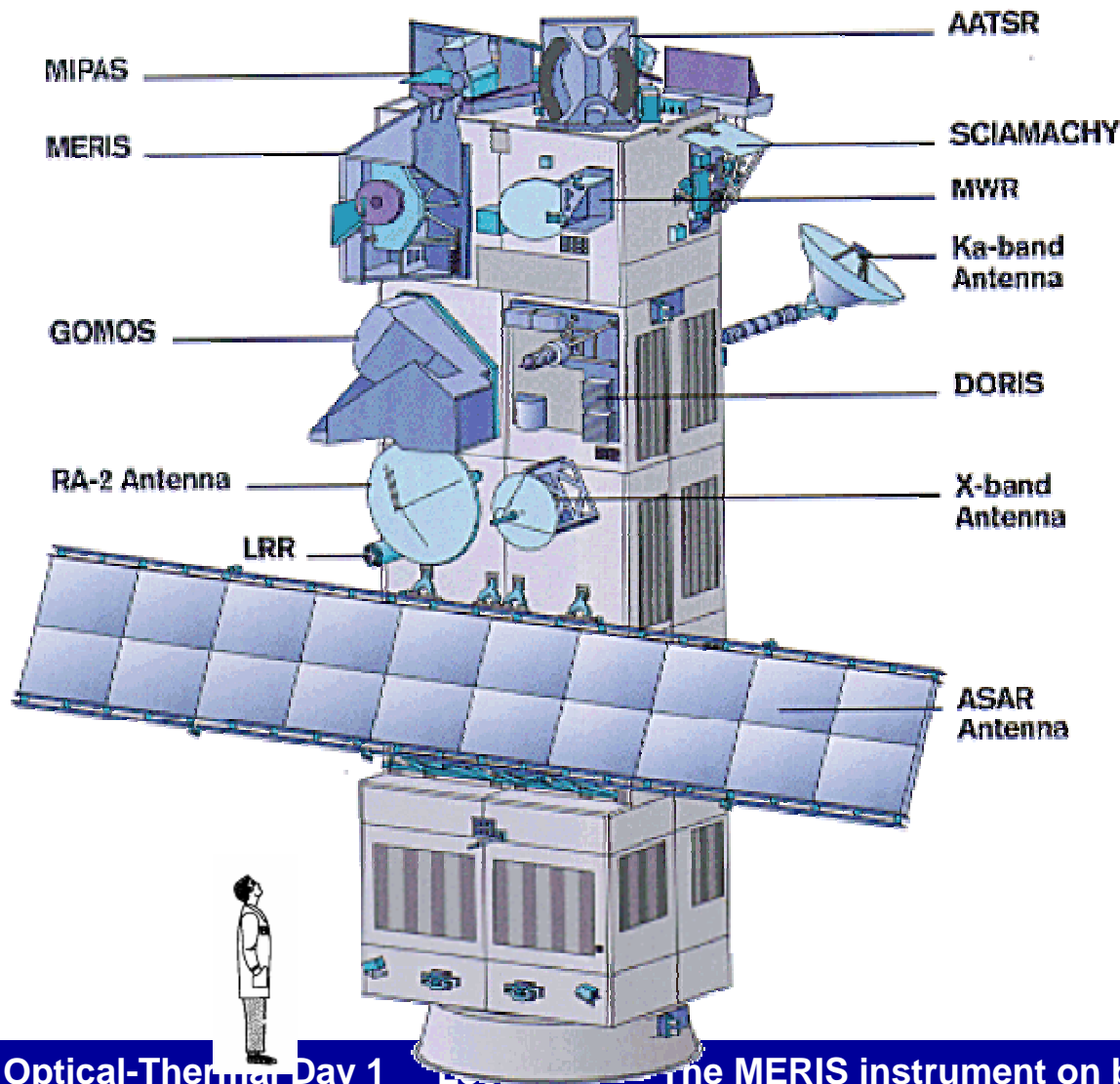
### The MERIS instrument on board Envisat

**Wout Verhoef**  
**National Aerospace Laboratory NLR**  
**The Netherlands**



**Envisat with MERIS sensor before launch at ESTEC, Noordwijk, The Netherlands**

**ENVISAT: the most powerful tool for monitoring the state of our planet**



• **Dimensions**

Launch configuration:  
 length 10.5 m  
 envelope diameter 4.6 m  
 In-Orbit configuration:  
**26m x 10m x 5m**

• **Mass**

Total satellite **8140 Kg**  
 Payload 2050 Kg

• **Power**

Solar array power:  
 6.5 kW (EOL)  
 Average power demand:

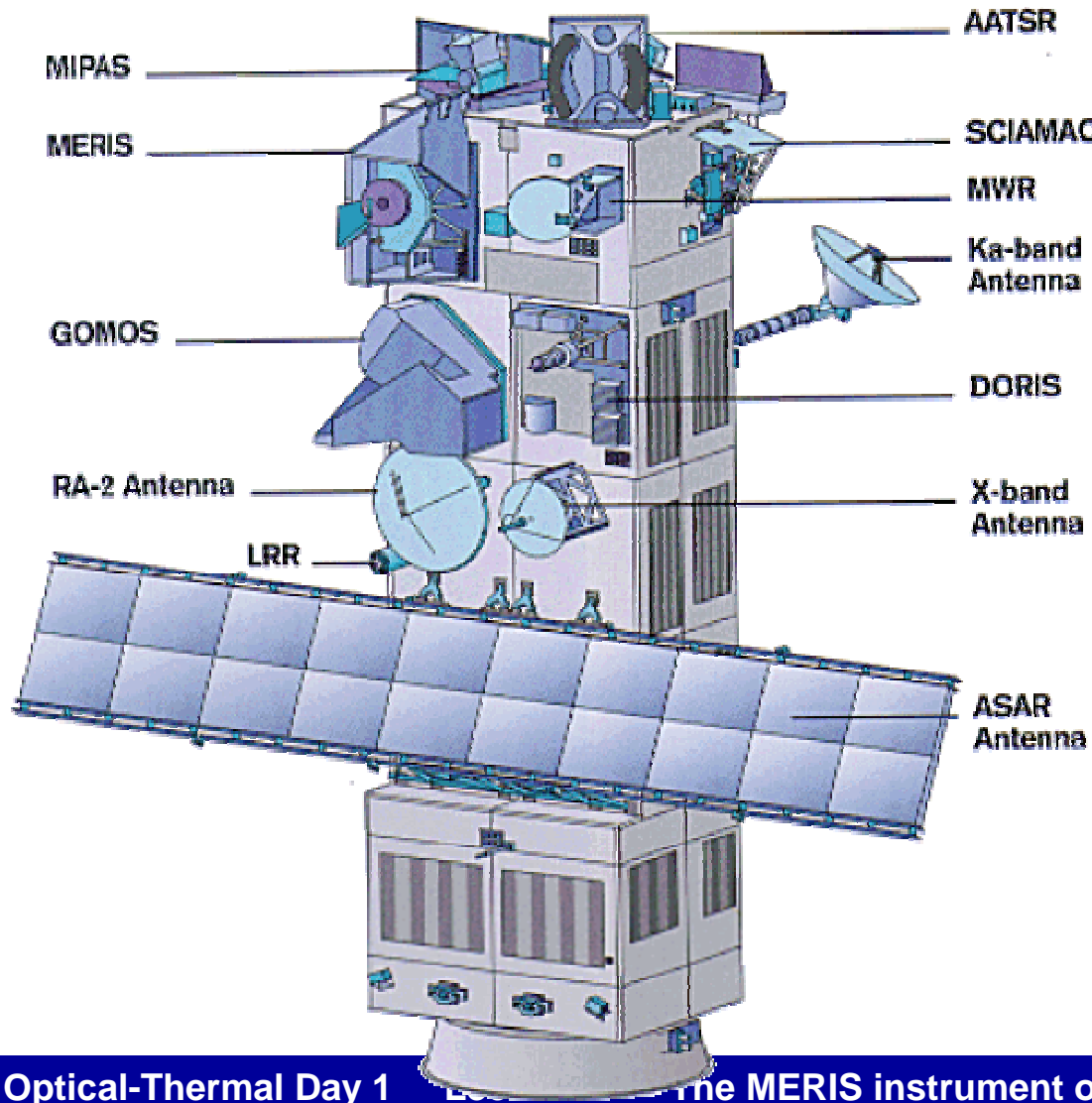
|           | Sun<br>(watts) | Eclipse<br>(watts) |
|-----------|----------------|--------------------|
| Payload   | 1700           | 1750               |
| Satellite | 3275           | 2870               |

• **Orbit**

**800 km** as ERS, sun synchronous  
 10:00, i.e. 30 minutes before ERS-2

# ENVISAT: 10 ways to monitor the Earth

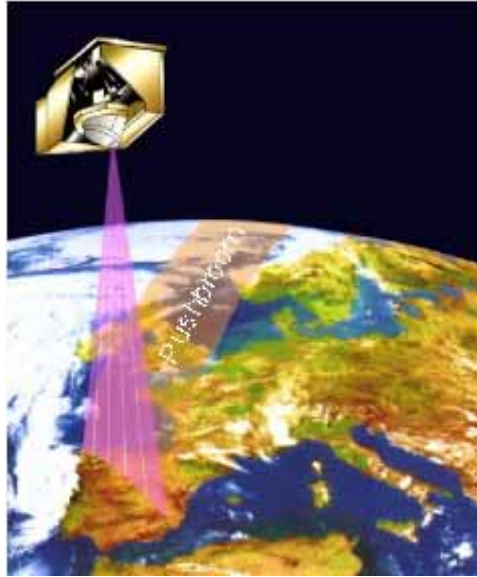
## ESA Developed Instruments



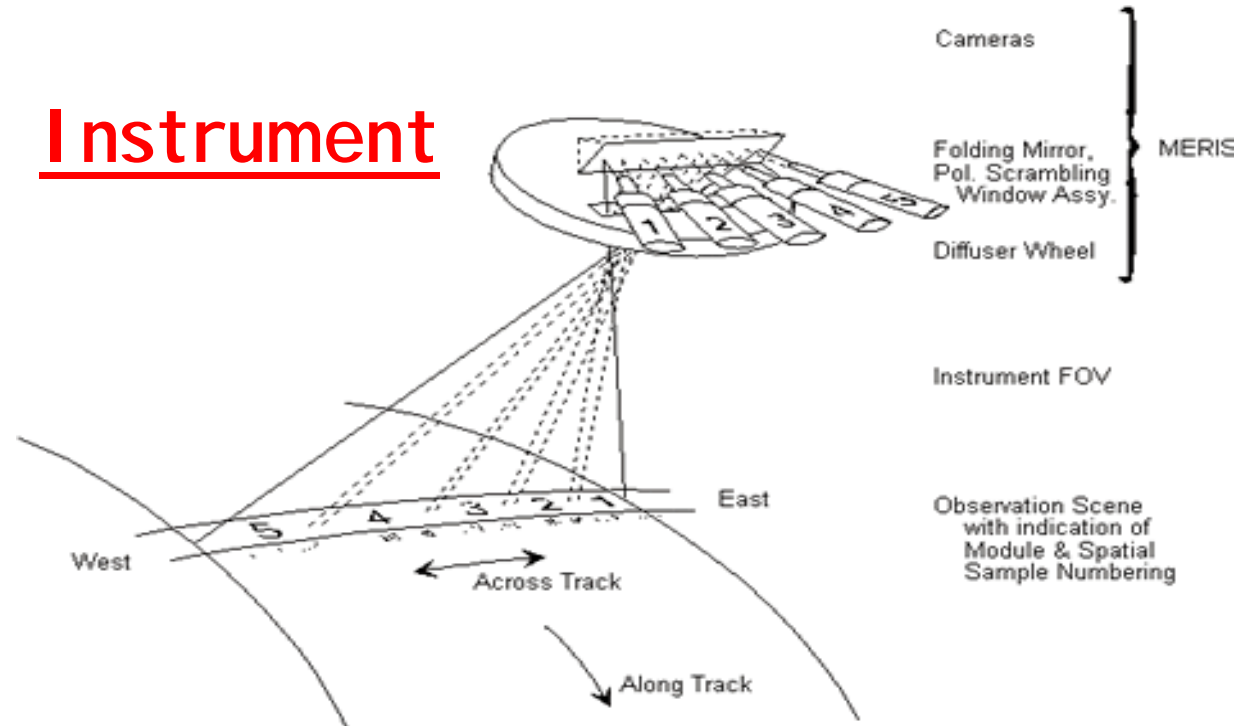
- ASAR**  
[Advanced Synthetic Aperture Radar]
- MERIS**  
[Medium Resolution Imaging Spectrometer]
- GOMOS**  
[Global Ozone Monitoring by Occultation of Stars]
- MIPAS**  
[Michelson Interferometric Passive Atmospheric Sounder]
- RA-2** [Radar Altimeter 2]
- MWR** [Microwave Radiometer]
- LRR** [Laser Retro Reflector]

## Announcement of Opportunity Instruments

- AATSR**  
[Advanced Along Track Scanning Radiometer]
- SCIAMACHY**  
[Scanning Imaging Absorption Spectrometer for Atmospheric Cartography]
- DORIS**  
[Doppler Orbitography and Radiopositioning Integrated by Satellite]

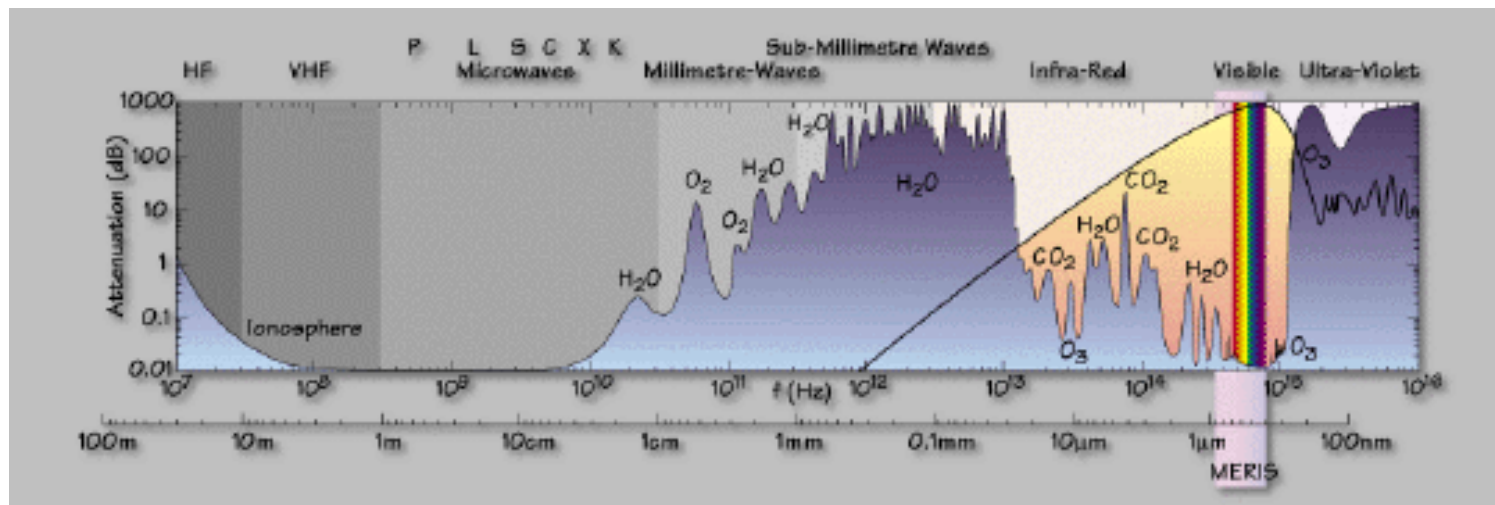


# Instrument



- MERIS is a push-broom instrument.
- The InFOV is  $68^\circ$ , which equates to a swath width of 1150 km.
- The 15 observed spectral bands are all programmable in position and width.
- Two spatial resolutions can be selected.
- The polarisation sensitivity of MERIS is very low.
- MERIS has a high radiometric (1 to 5%) and spectrometric (1 nm) performance.
- The InFOV is divided into 5 segments, each of which is imaged by one of the corresponding 5 cameras.

## Position of MERIS bands in electromagnetic spectrum



**MERIS: 15 spectral bands**

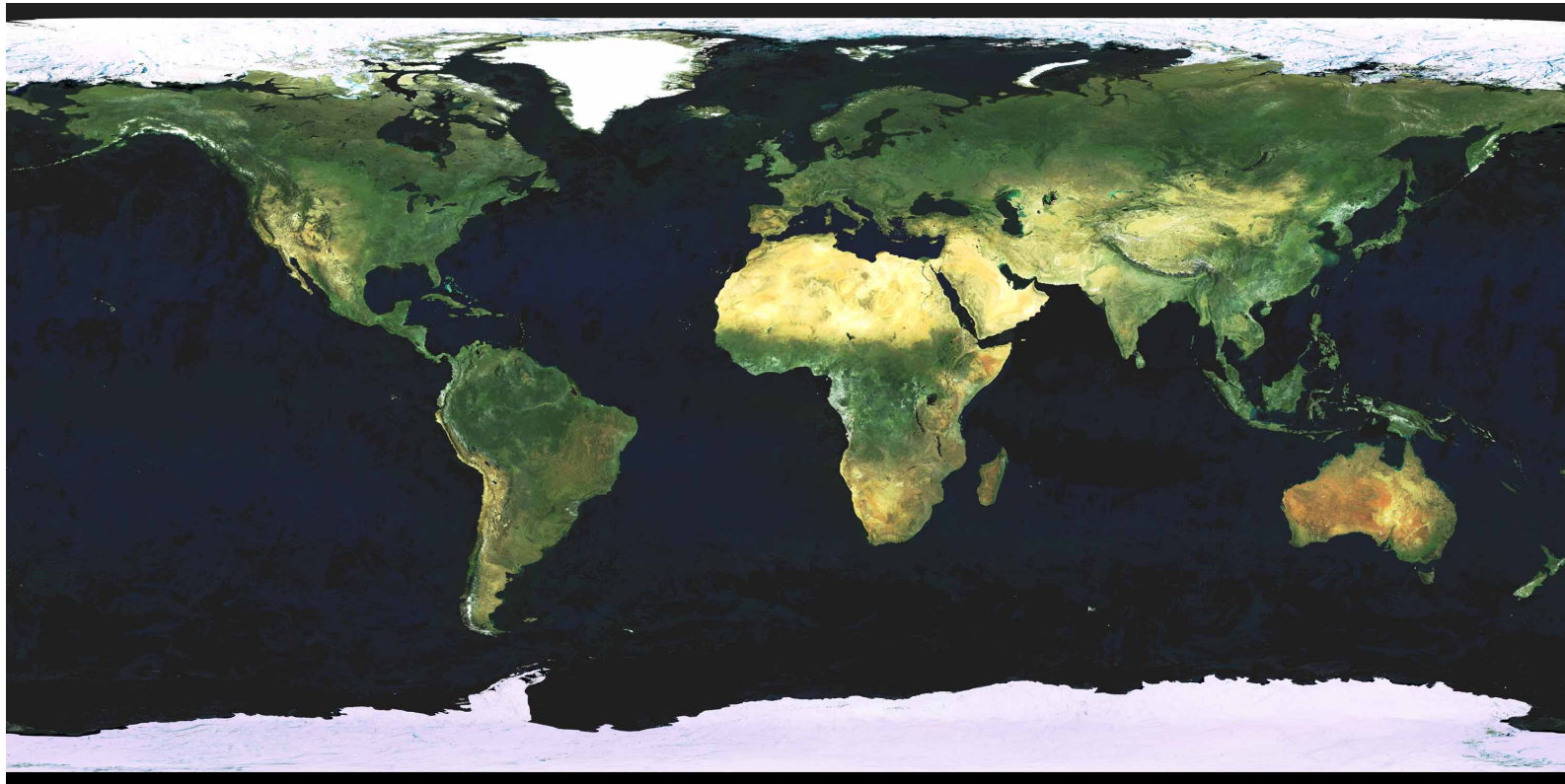


15 Bands

|  | Band | Band centre | Bandwidth (nm) | Primary Use                                |
|--|------|-------------|----------------|--|
| <b>V<br/>I<br/>S<br/>I<br/>B<br/>L<br/>E</b>       | 1    | 412.5       | 10             | Yellow substance and detrital pigments     |
|  | 2    | 442.5       | 10             | Chlorophyll absorption maximum             |
|  | 3    | 490         | 10             | Chlorophyll and other pigments             |
|  | 4    | 510         | 10             | Suspended sediment, red tides              |
|  | 5    | 560         | 10             | Chlorophyll absorption minimum             |
|  | 6    | 620         | 10             | Suspended sediment                         |
|  | 7    | 665         | 10             | Chlorophyll absorption and fluo. reference |
|  | 8    | 681.25      | 7.5            | Chlorophyll fluorescence peak              |
|  | 9    | 708.75      | 10             | Fluo. Reference, atmospheric corrections   |
| <b>I<br/>N<br/>F<br/>R<br/>A<br/>R<br/>E<br/>D</b> | 10   | 753.75      | 7.5            | Vegetation, cloud                          |
|  | 11   | 760.625     | 3.75           | Oxygen absorption R-branch                 |
|  | 12   | 778.75      | 15             | Atmosphere corrections                     |
|  | 13   | 865         | 20             | Vegetation, water vapour reference         |
|  | 14   | 885         | 10             | Atmosphere corrections                     |
|  | 15   | 900         | 10             | Water vapour, land                         |

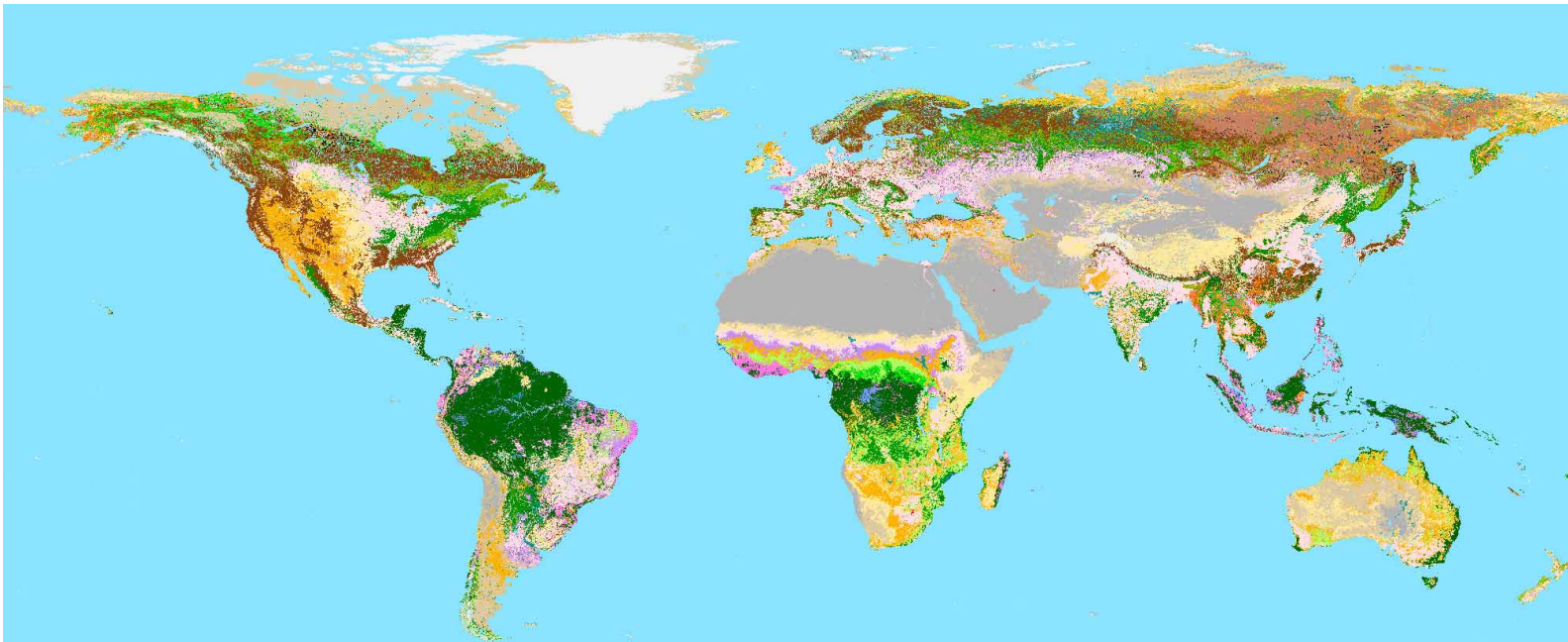


**Global mosaic a total of 1561 orbits taking place over the period May, July, October and November 2004**

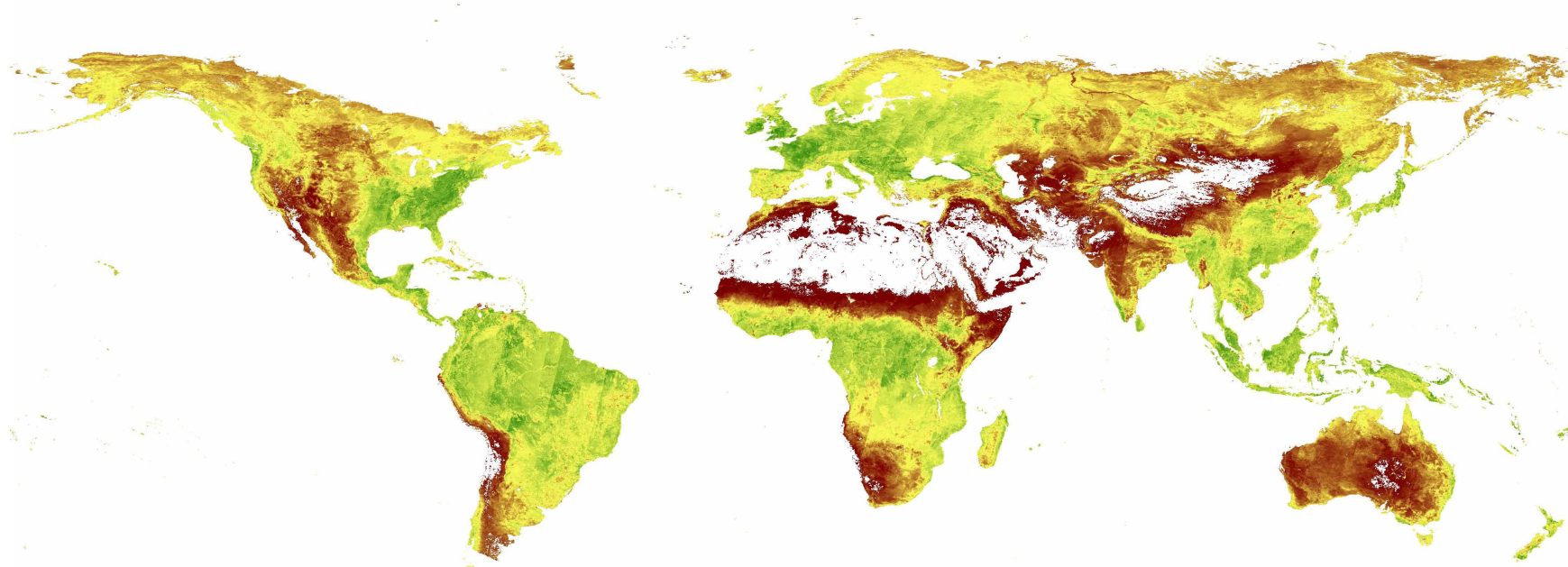




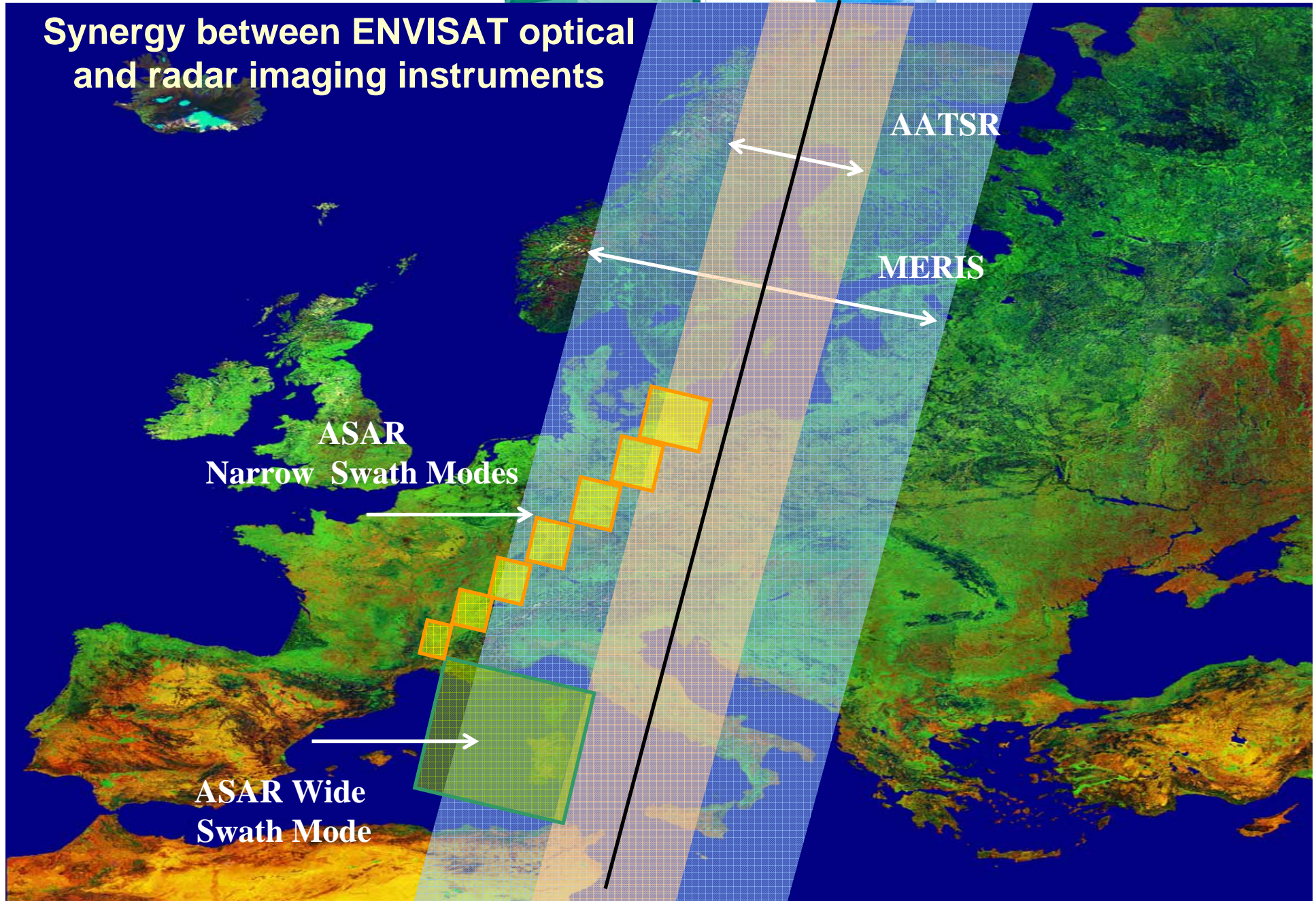
**GLC2000 land use product of JRC will be updated and refined with MERIS data**



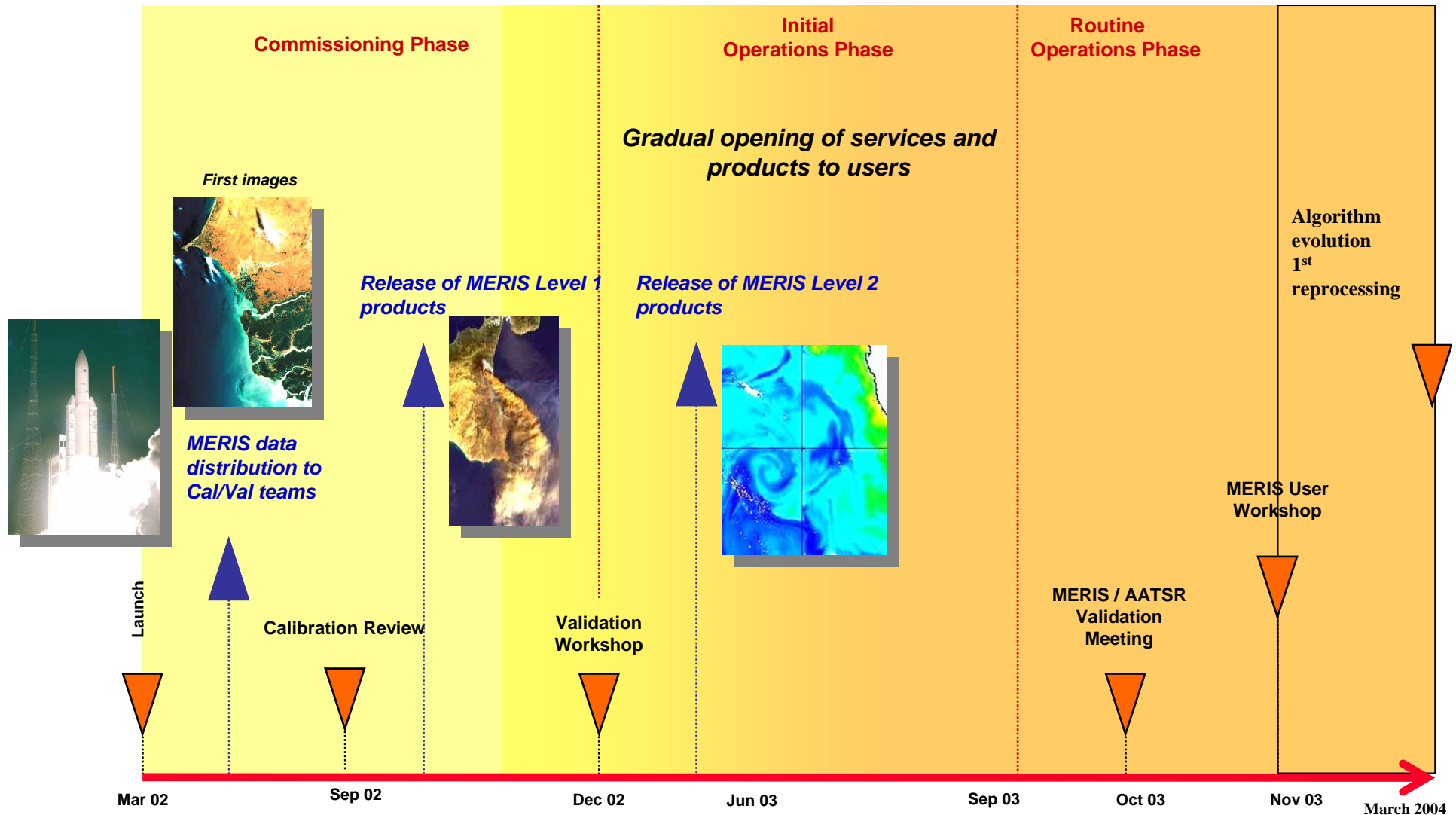
## MGVI



# Synergy between ENVISAT optical and radar imaging instruments



# ENVISAT mission phases and MERIS data distribution schedule





Envisat web site (<http://envisat.esa.int>)

The screenshot shows the Envisat website homepage. At the top, there is a blue header with the ESA logo and the text 'ENVISAT CARING FOR THE EARTH'. Below the header is a navigation bar with links for 'Mission and System', 'Instruments', 'Product Handbook', and 'User Services'. The date '13 Oct 2003' is displayed in the top right corner. On the left side, there is a sidebar with several sections: 'Multimedia links' (3D Model, Envisat Tour, Where is Envisat?), 'Envisat Quick links' (News, Image Showcase, Documentation, Tools, Sample Products, Catalogues, Applications, Workshops, EO PI Portal), and a search area with 'Advanced Search', 'Glossary', 'Sitemap', 'FAQ', 'Contact us', and a 'Help on...' dropdown. The main content area features several news items, each with a small image and a text block. The items include: a satellite manoeuvre announcement, an announcement for the ENVISAT/ERS Symposium, a notice about global land and sea level data, a report on the resurgent ozone hole, and a notice about radar altimetry tracking river levels. At the bottom, there is a section for 'Product Availability'.

recent mission News

direct access to Tools (Enview, Toolboxes)

Data Catalogues

Product Handbooks

Image Gallery

access to PI results

Optical-T

More on Envisat from the ESA Web Portal:

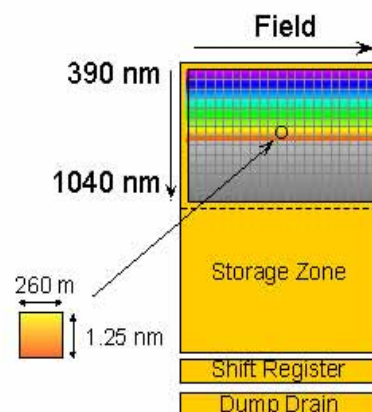
# CCD

## CCD Architecture

Architecture : Frame transfer  
 Size : 780 (H) x [576 x 2] (V)  
 Pixel size : 22.5  $\mu\text{m}$  x 22.5  $\mu\text{m}$

**Technology** : - Thinned CCD  
 (thickness = 17  $\mu\text{m}$ )  
 - Back side illuminated

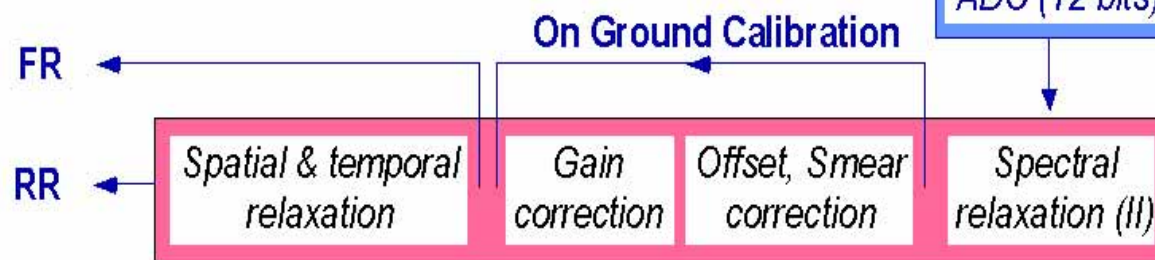
**Operating Temperature**  
 -22.5  $^{\circ}\text{C}$  via Peltier cooling



## Spectral Bands Programming

- Spectral lines are integrated in shift register to form spectral bands; e.g. 5 nm = 4 spectral lines
- Spectral lines outside programmed spectral bands are dumped

**Analogue Processing**  
 gain amplific.  
 ADC (12 bits)





## MERIS : 2 spatial resolutions

### ➤ Full Resolution (FR)

300 m.

Acquisition and processing on request. Maximum of 20 minutes per orbit.

Scene concept 575 km × 575 km or 296 km × 296 km (soon 1150 × 1150 km)

### ➤ Reduced Resolution (RR)

1200 m.

Continuous acquisition, processing systematic.

Orbit or child (i.e, temporal extraction)

MERIS: two levels of spatial resolution

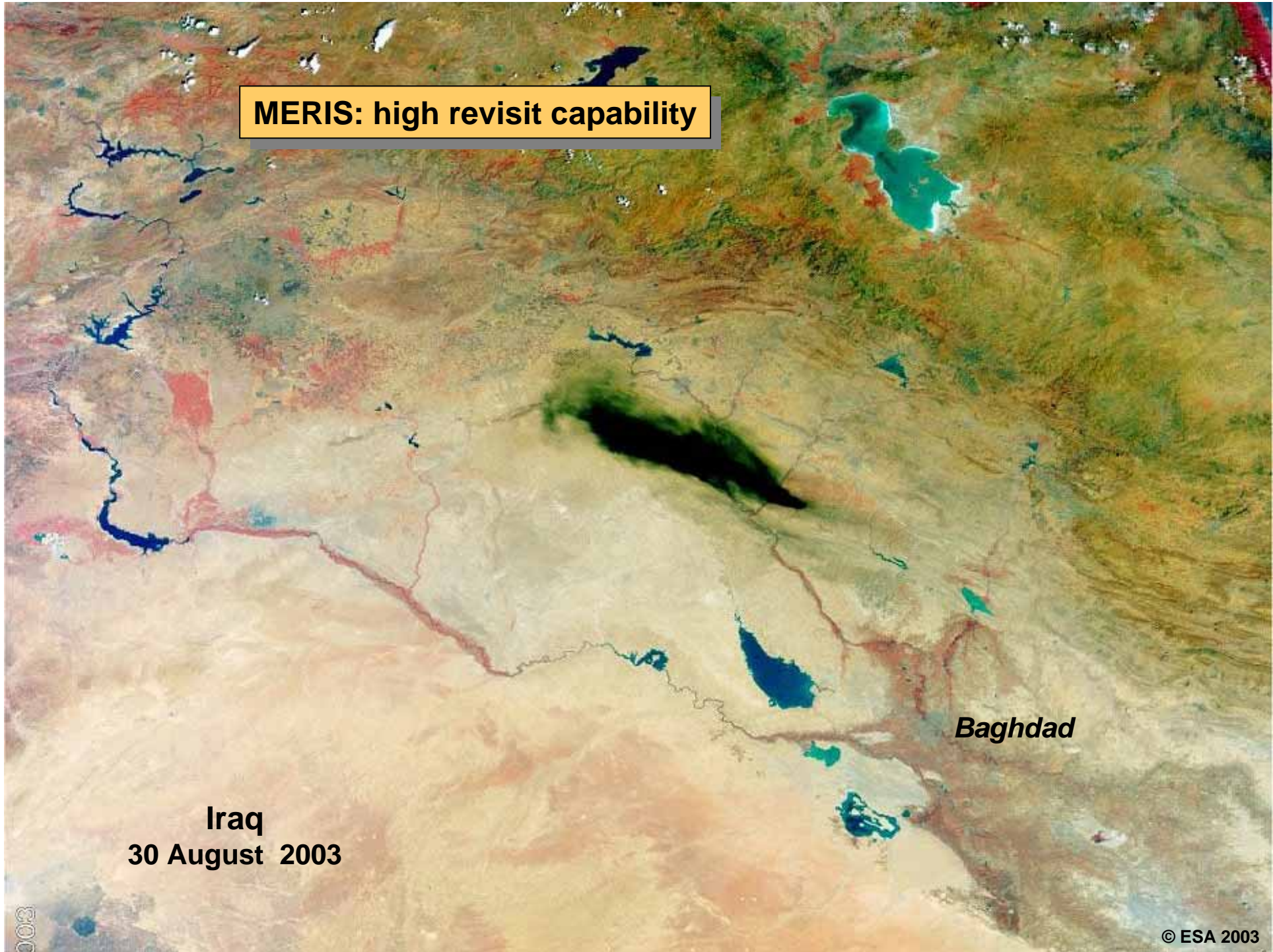
Reduced Resolution  
1200 m

Full Resolution  
300 m





**MERIS: high revisit capability**

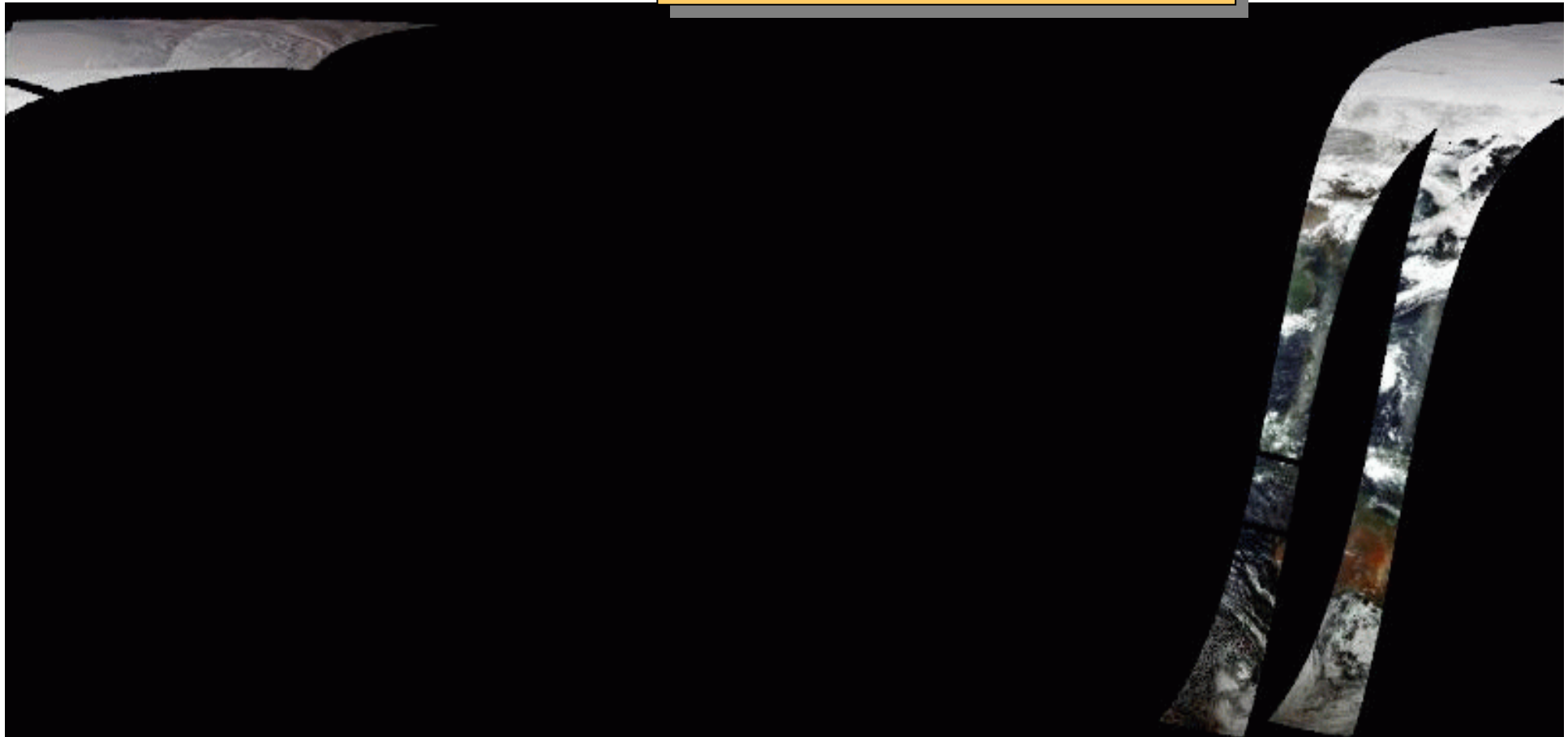


*Baghdad*

**Iraq**  
**30 August 2003**



**MERIS: high revisit capability**

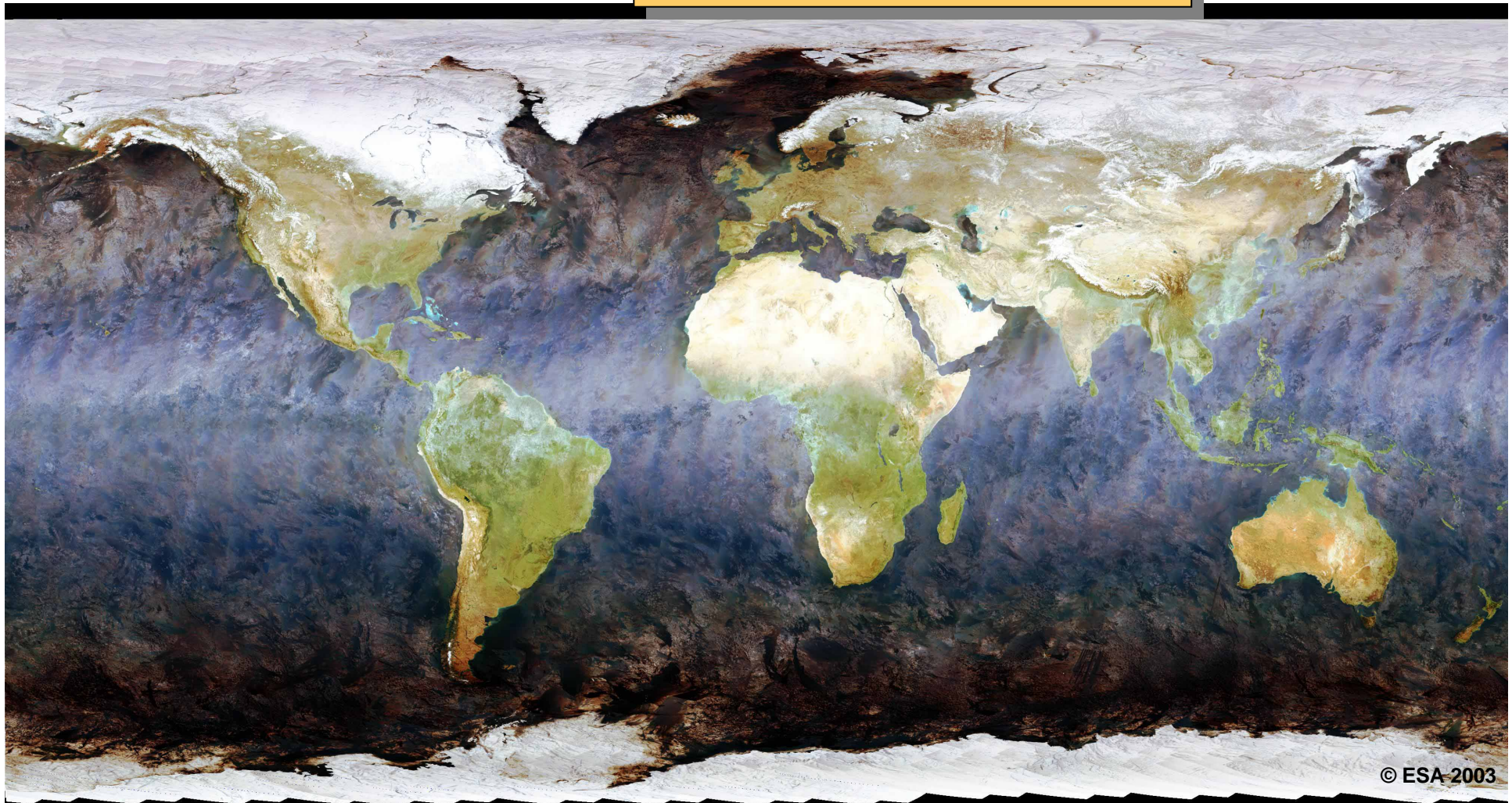


**MERIS imaging the world**  
15 to 30 April 2003





**MERIS: high revisit capability**



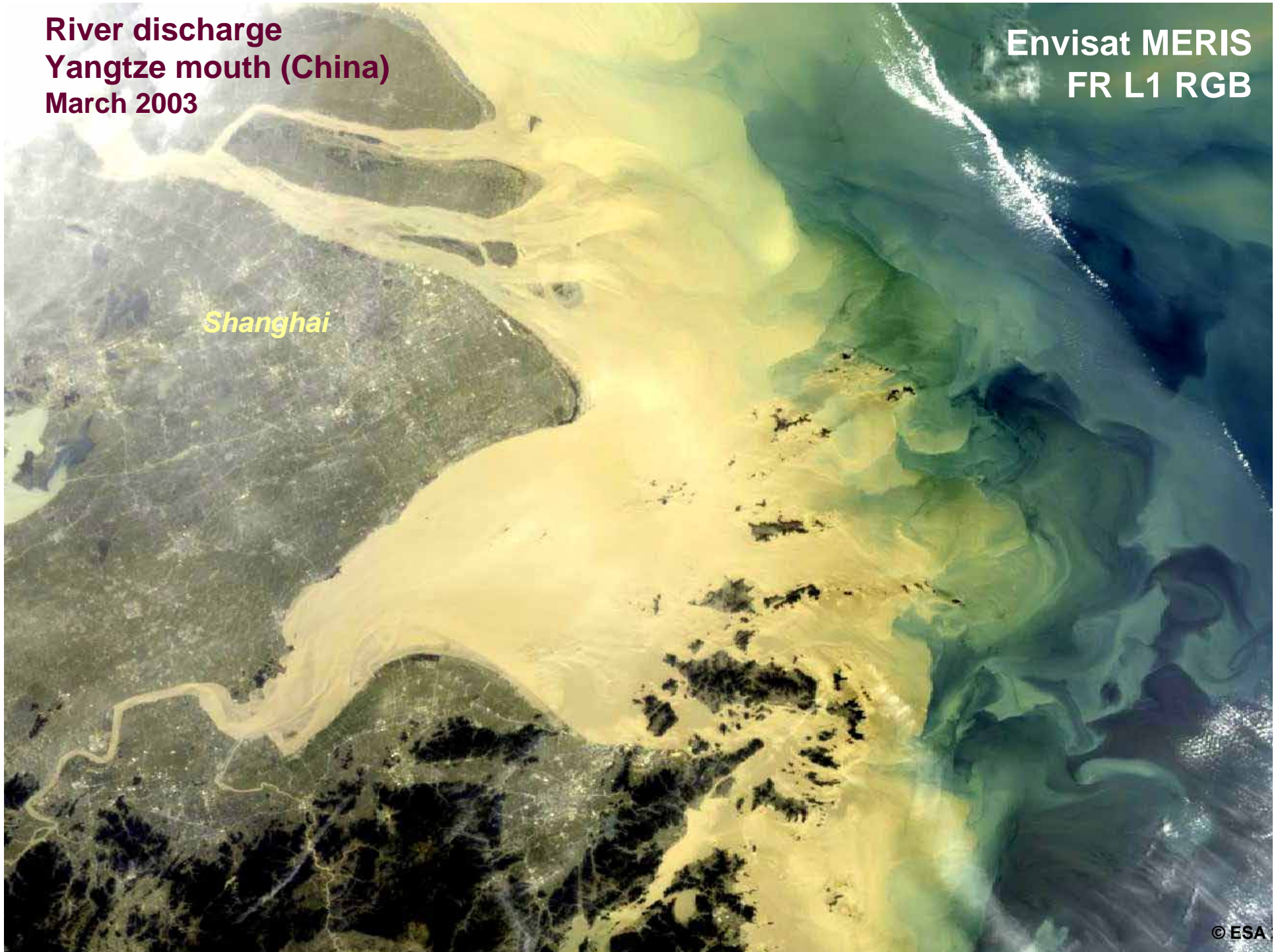
© ESA 2003

**MERIS image of the world  
March & April 2003**

**River discharge**  
**Yangtze mouth (China)**  
**March 2003**

**Envisat MERIS**  
**FR L1 RGB**

*Shanghai*





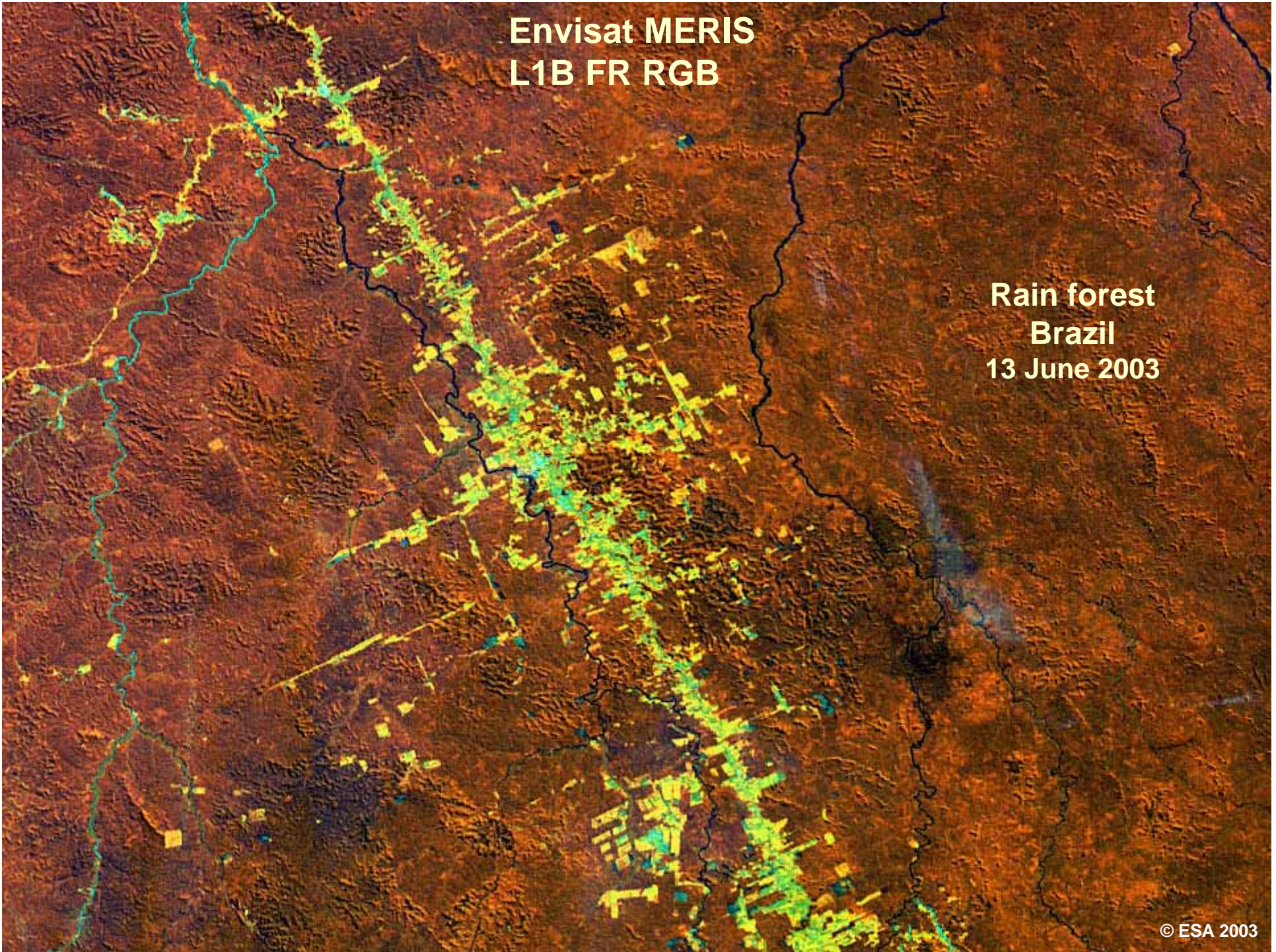
**Mouths of the Ganges**  
**India - Bangladesh**  
**Nov. 2003**

**Calcutta**

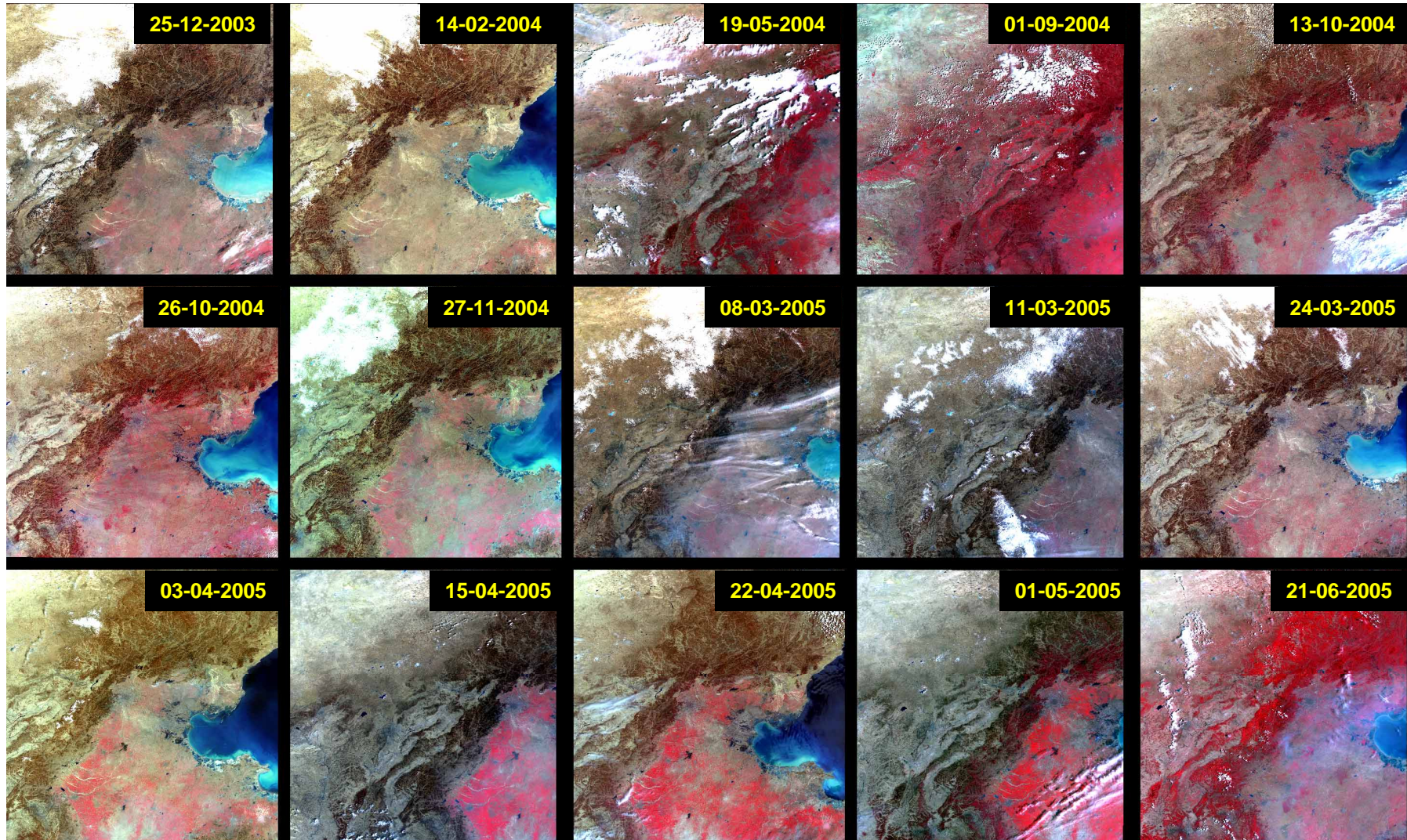


**Envisat MERIS  
L1B FR RGB**

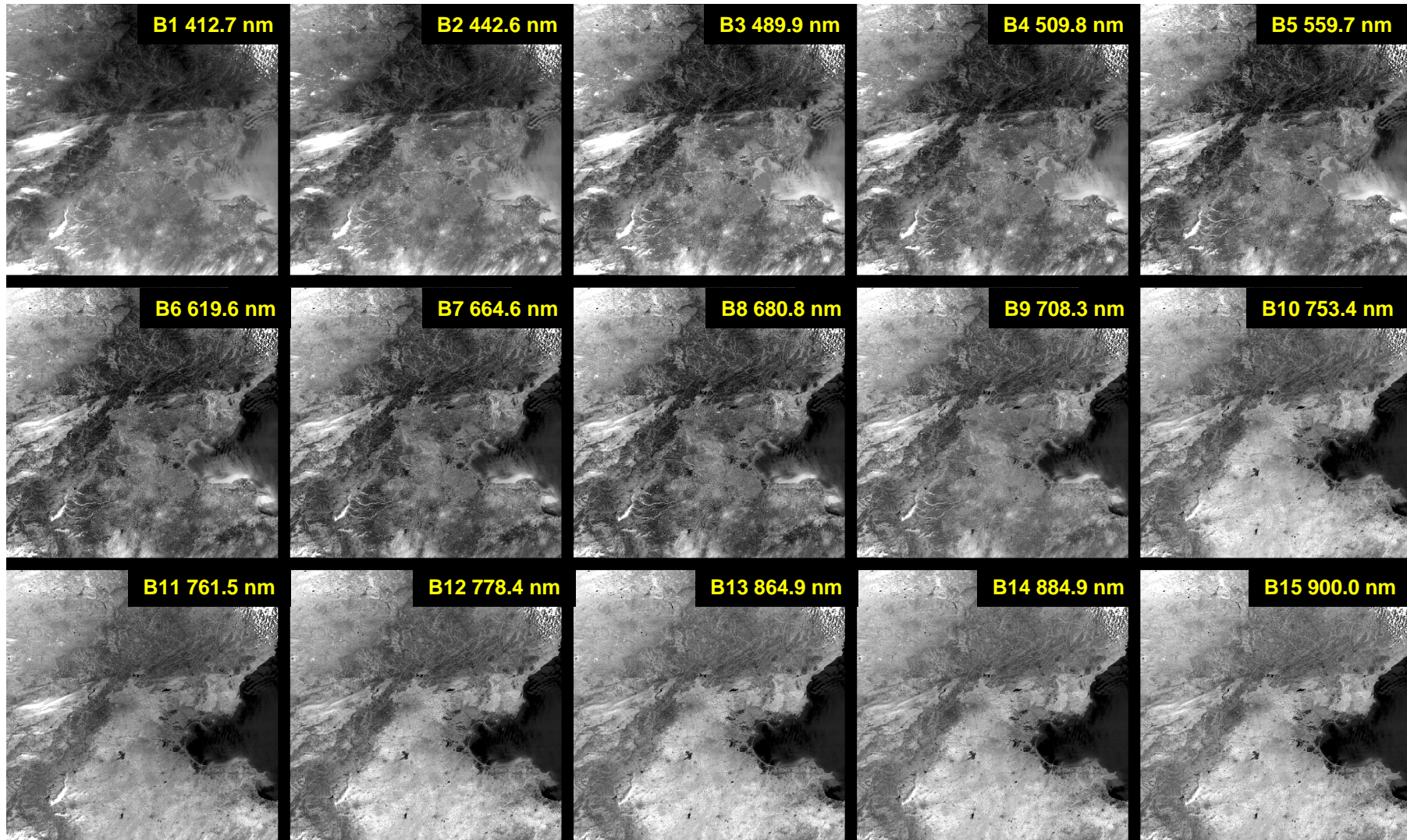
**Rain forest  
Brazil  
13 June 2003**



# Time series Beijing 2003-2005



# Bands of image 22-04-2005





The image features a detailed illustration of the ENVISAT satellite in orbit. The satellite is a complex, gold-colored structure with various instruments and a large solar panel array extending to the right. Below the satellite, a globe of the Earth is shown with a color-coded map of vegetation, where green indicates high vegetation density and yellow/orange indicates lower density. The background is a deep blue space filled with stars and a grid of white lines representing orbital paths. In the top right corner, the ENVISAT logo is displayed, consisting of a stylized satellite icon above the word "ENVISAT" in a bold, yellow, sans-serif font.

**ENVISAT**

eohelp @ esa.int

<http://envisat.esa.int>