CHRIS HYPERSPECTRAL MISSION FIVE YEARS SINCE LAUNCH

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Dr Mike Cutter

SURREY
SATELLITE TECHNOLOGY LTD

Fordate Island, Indonesia

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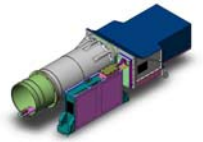
- Instrument Overview
- Observation Programme
- Applications Snapshots
- Future Plans

Dubai
23rd Sept 2006

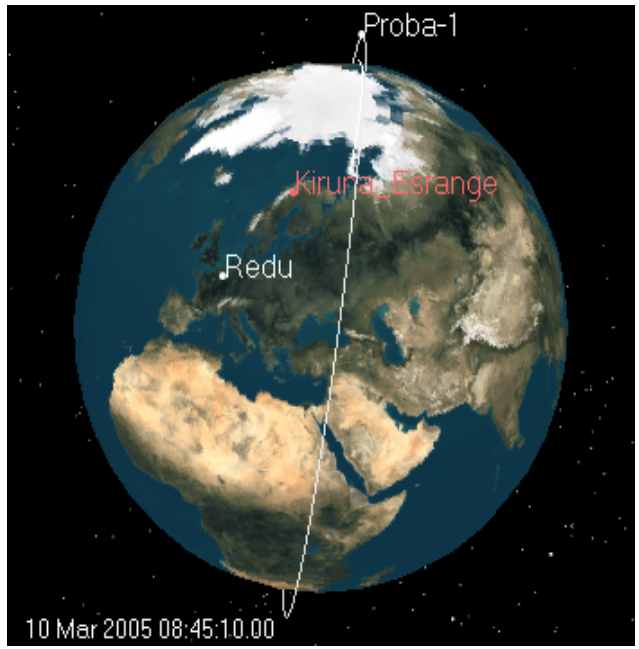
San Salvador, West Indies
22nd Sept 2005

Mission Overview



- CHRIS Mission
  - Proba-1: ESA smallsat technology platform (98 kg)
  - Principal payload: CHRIS hyper-spectral imager
- Mission Objectives
  - To assess Earth observation science from a small platform.
  - To perform a range of science investigations.
- Special Features
  - Highly agile small platform (roll, pitch & yaw)
  - Multi-view angle observations of each target
  - Use of forward motion compensation (x5)
- Utilisation
  - Active User group
  - 4th CHRIS Workshop held in Frascati, Italy

Mission Overview - Launch



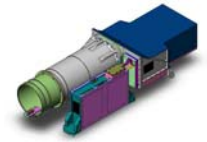
Launch: 22 October 2001 PSLV Indian Launcher from Sriharikota island, India.

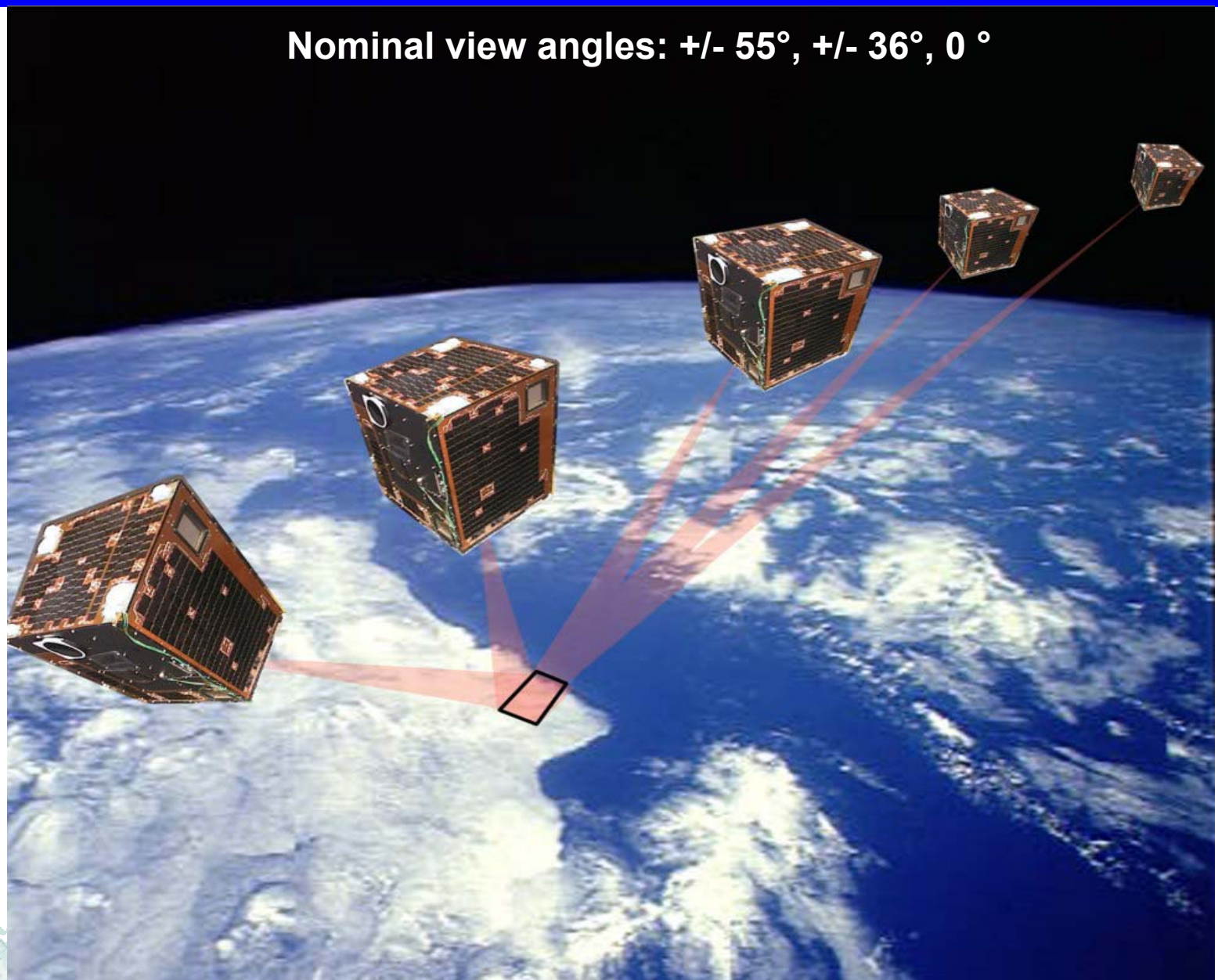
Orbit: SSO 10:30am

Altitude: 550 and 670 km.

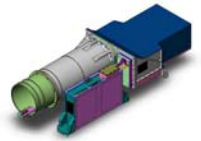
Inclination: 97.9 deg.

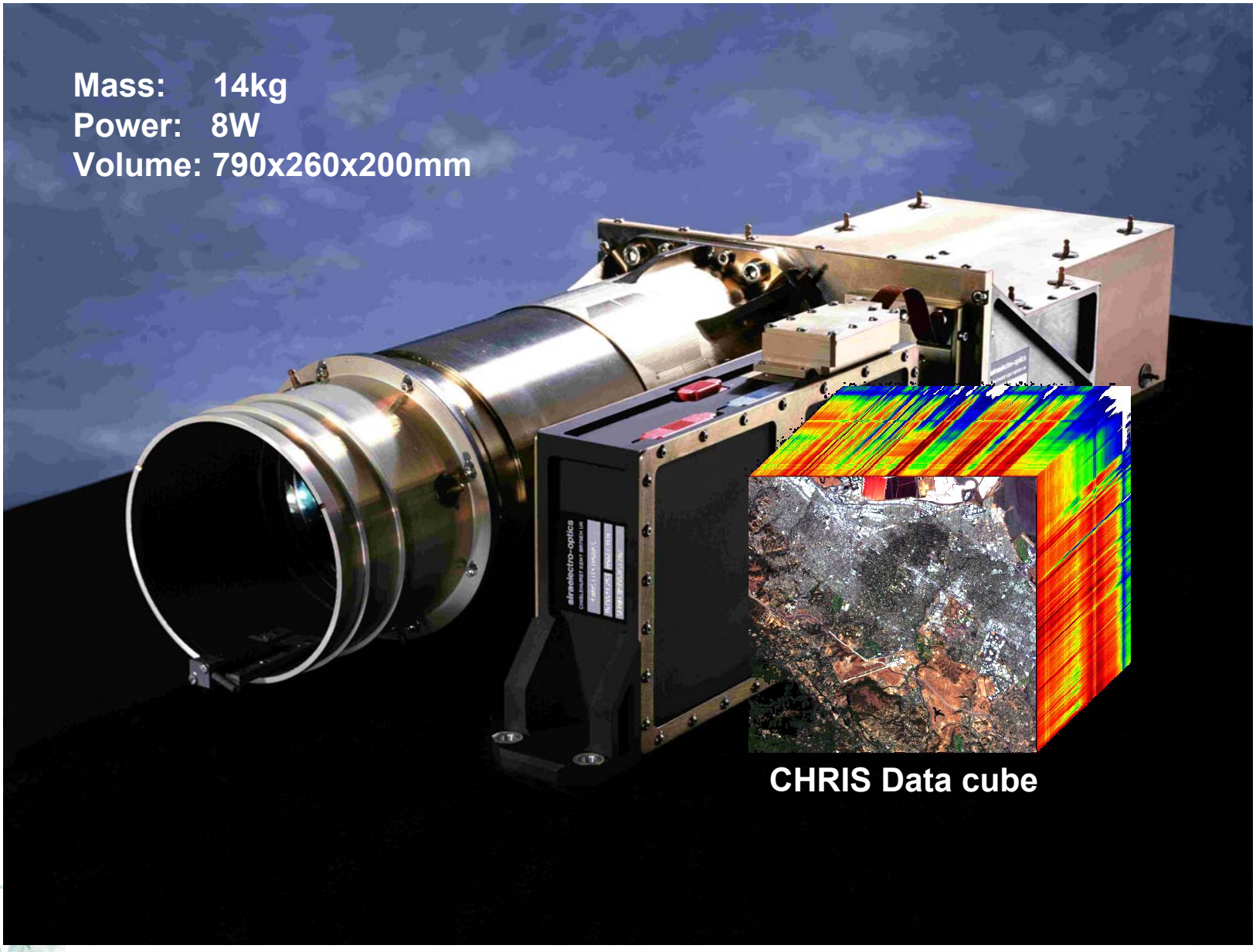
Mission Overview – multiple angles



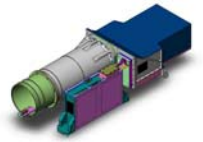


CHRIS Instrument



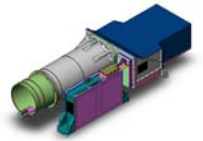


Basic System Parameters



- Image area 13 km square @ perigee
- Spatial sampling interval 17 m @ perigee
- Spectral range (nominal) 400nm to 1050nm
- Spectral resolution ≤11nm
- Gain stage 4 levels (albedo 0.5,1,2,4 levels)
- Digitisation 12 bits
- Signal-to-noise ratio 200 (@ 0.2 albedo, 17m, 10nm)
- Programmable spectral & spatial dimensions

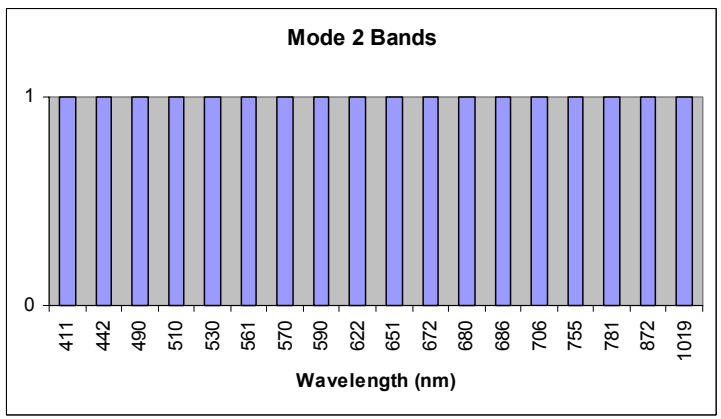
CHRIS Imaging Modes



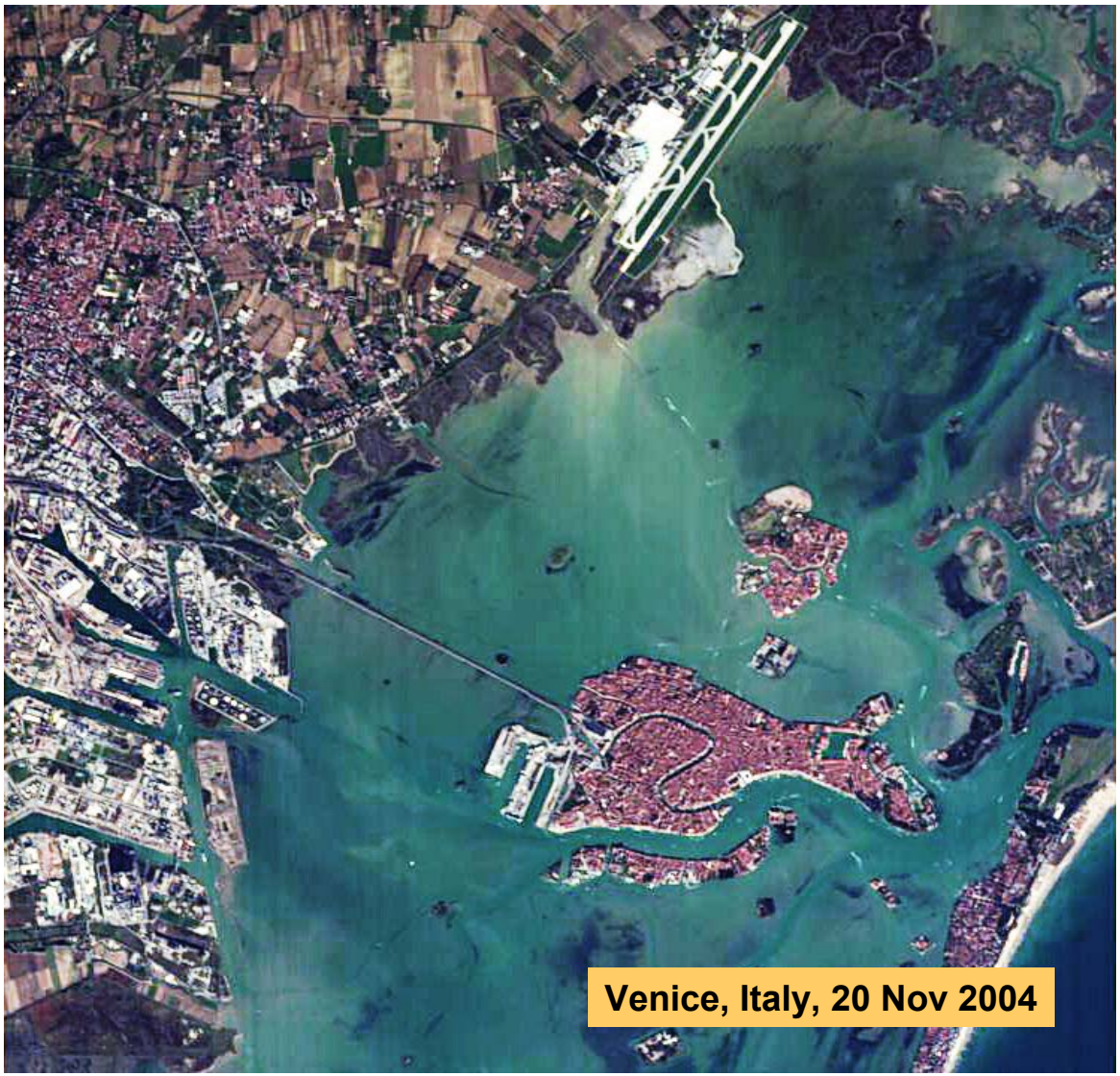
Programmed modes

Mode	No. of bands	GSD (m)	Swath Width	Applications
1	**62**	**34**	**Full**	**Aerosols**
2	**18**	**17**	**Full**	**Water**
3	**18**	**17**	**Full**	**Land**
4	**18**	**17**	**Full**	**Chlorophyll**
5	**37**	**17**	**Half**	**Land**

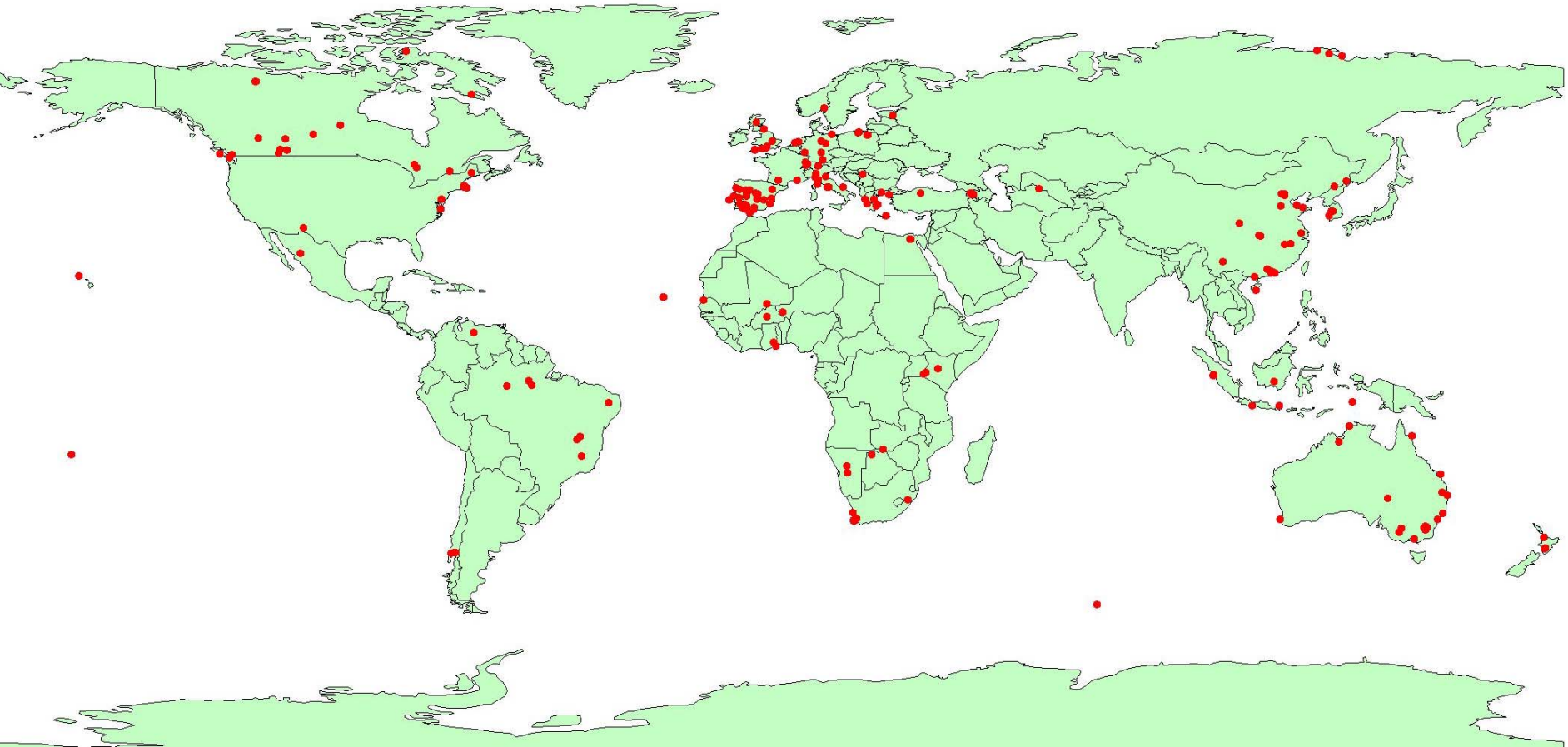
For example Mode 2 bands:



2007 Observational Programme



CHRIS Science Sites in 2007



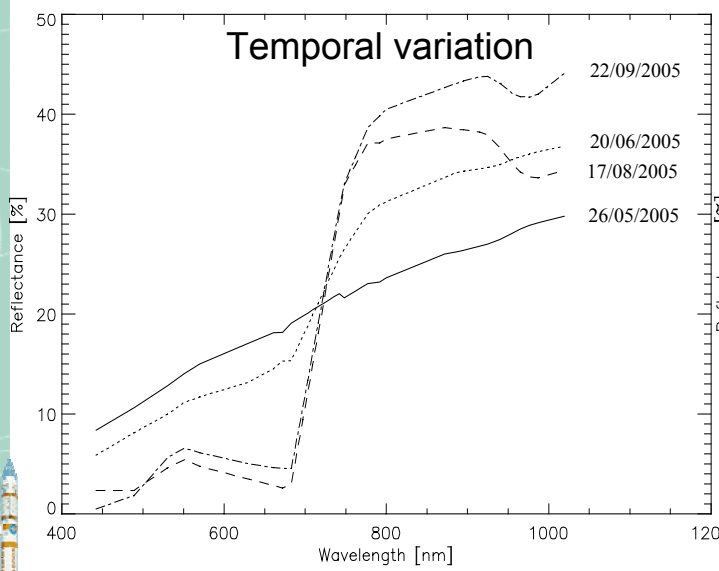
- **Science sites: 206 in 39 countries**
- **PIs: 87**
- **Total 3 sets of 5 images per day (≈ 400 images/month) – cloud prediction**
- **Total images: Science 8540, Public relations 2298, Disaster Charter: 510**

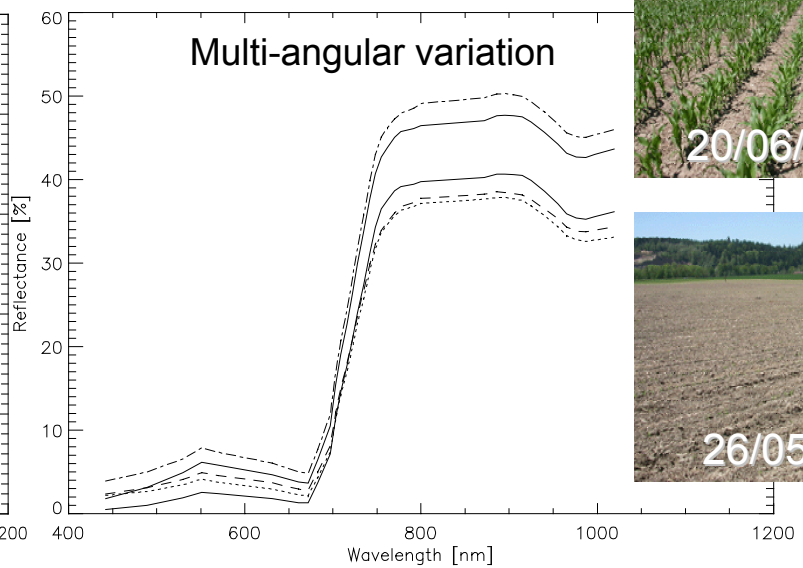
Applications Snapshots

Temporal & Angular Canopy Reflectance

CHRIS reflectances from maize

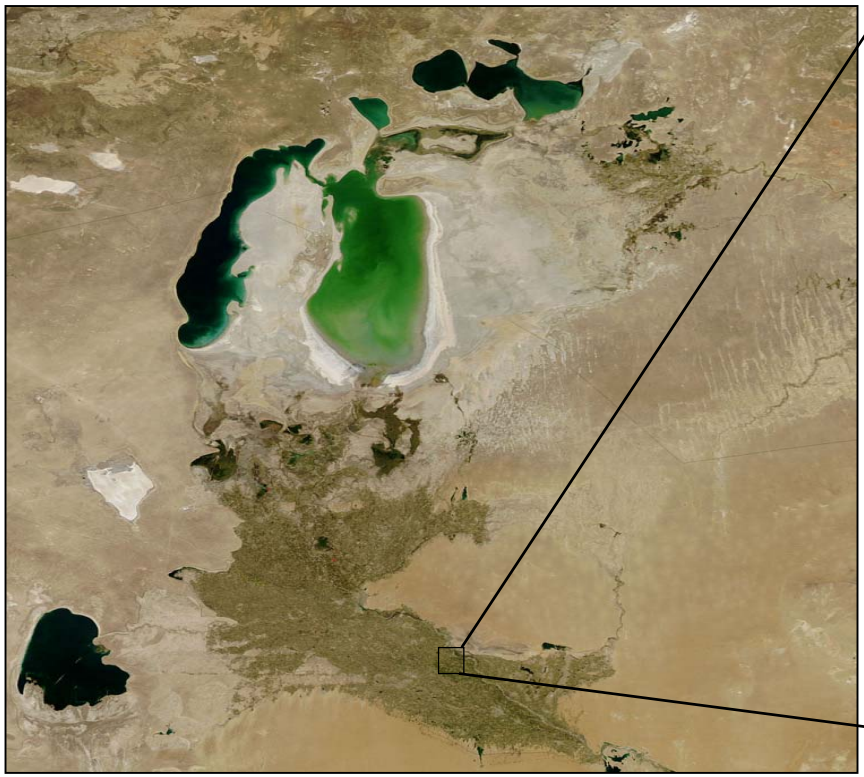
Swiss Midlands

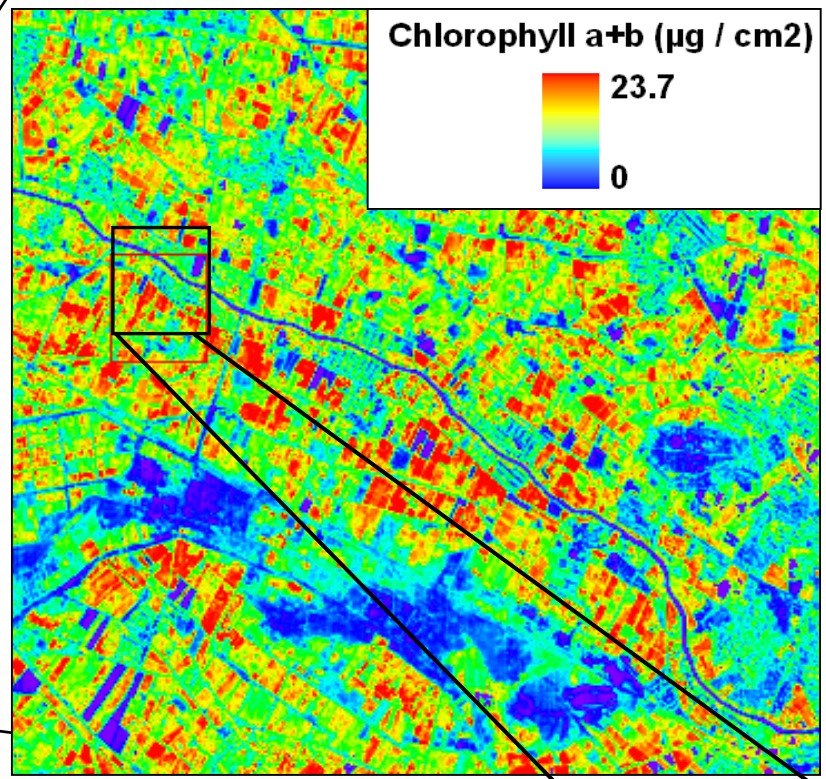




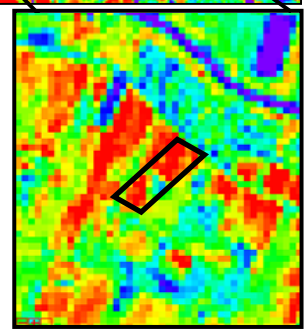
Source: Mathias Kneubühler et al, RSL, Univ. Zürich, Switzerland

Chlorophyll (Nitrogen) Detection in Uzbekistan



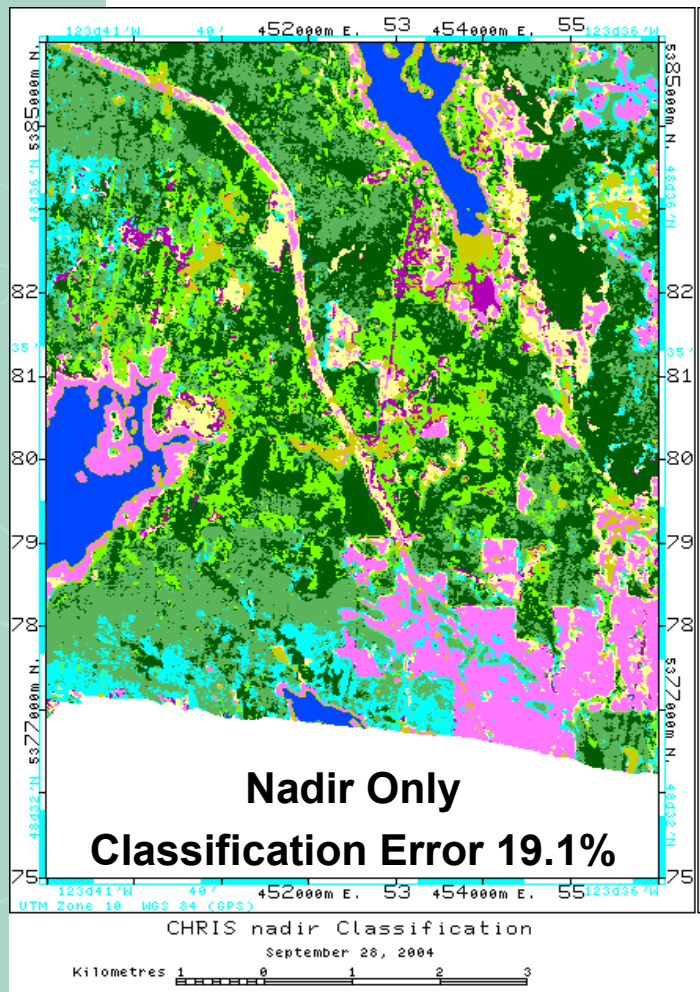


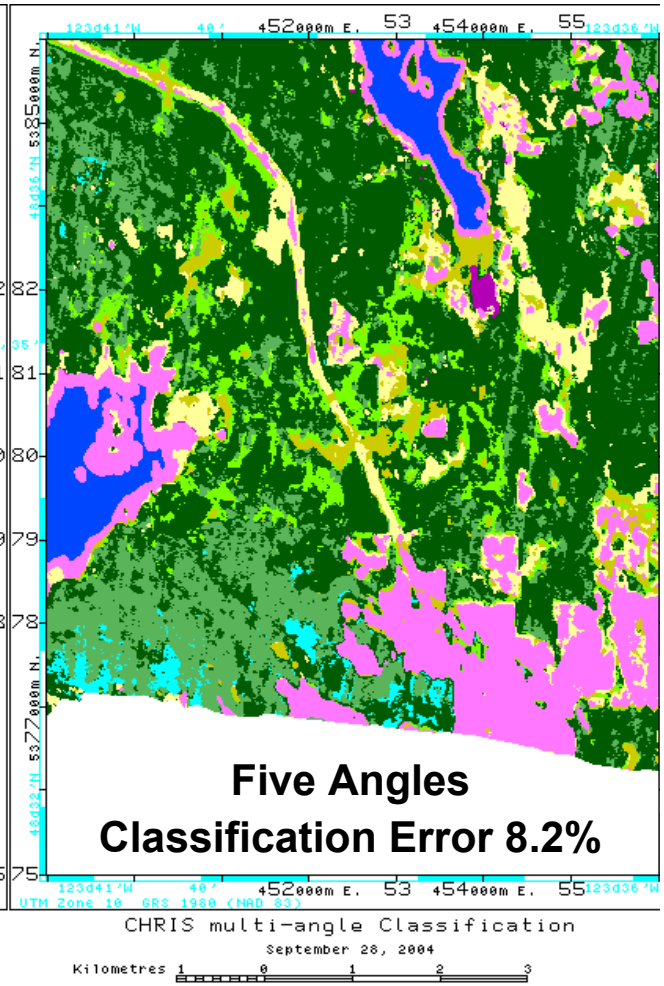
Cotton



Courtesy of G. Ruecker, German Aerospace Center (DLR), gerd.ruecker@dlr.de

Classification results in Canada





- Exposed Land
- Water Body
- Shrub Low
- Herb graminoids
- Swamp area
- Red alder dominant
- Hemlock dominant
- Lodgepole pine dominant
- Western redcedar
- Douglas-fir dominant
- Unclassified

David Goodenough & Andrew Dyk, Natural Resources Canada, Canada

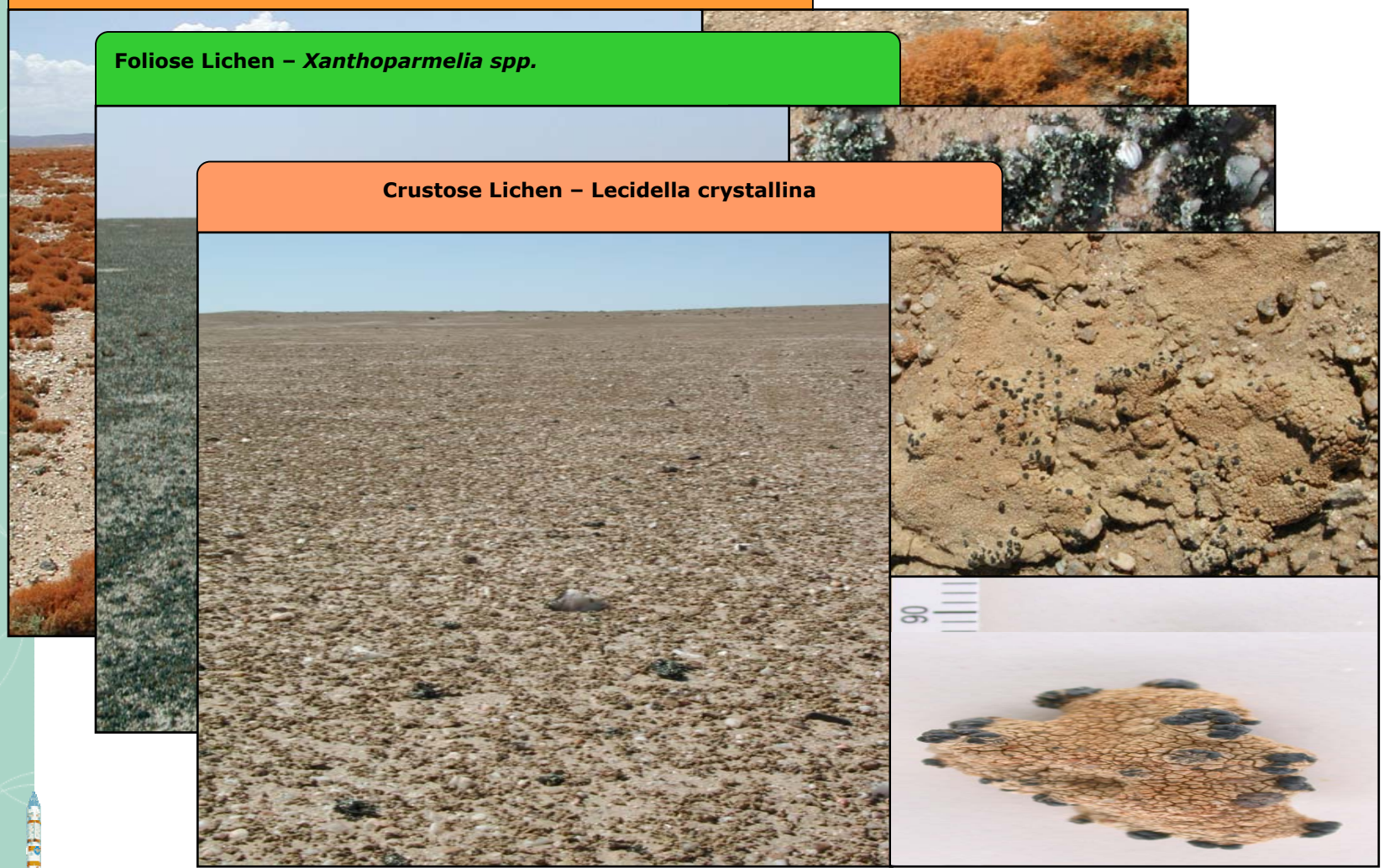
Lichen Cover in Central Namib Desert

Important to ecology of region

Fruticose Lichen – *Teloschistes capensis*

Foliose Lichen – *Xanthoparmelia spp.*

Crustose Lichen – Lecidella crystallina



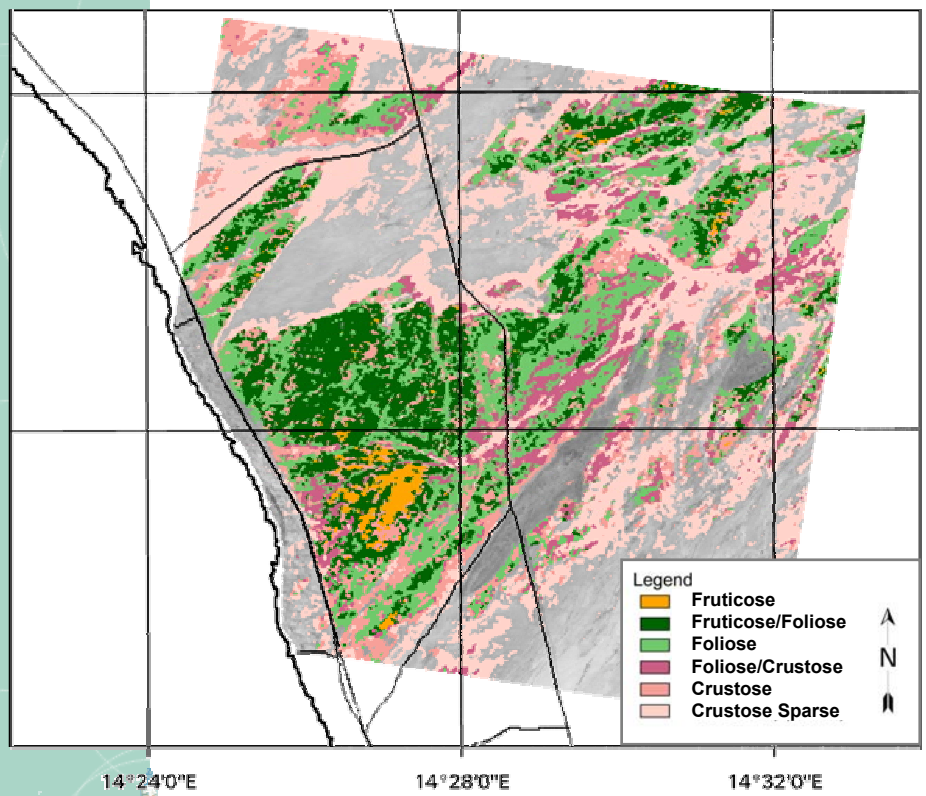
Courtesy of Bettina Weber, University of Kaiserlautern Germany

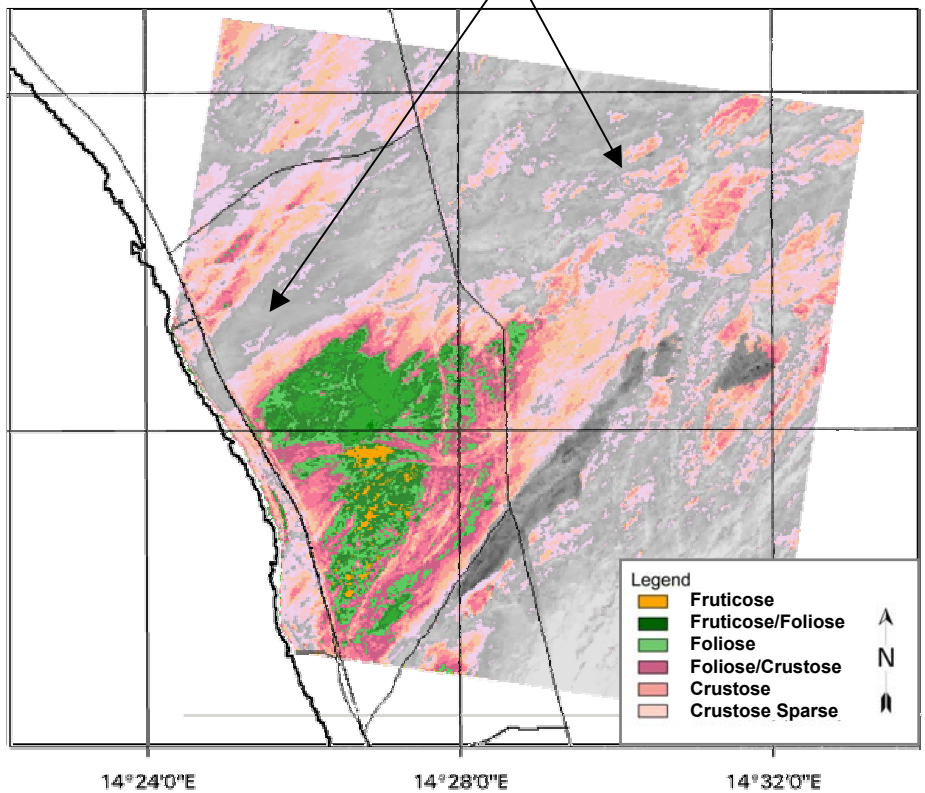
Cover & biomass estimates of biological soil crusts

BIOTA Southern Africa

05/2003 **09/2005**

Erosion





Courtesy of Bettina Weber, University of Kaiserlautern, Germany

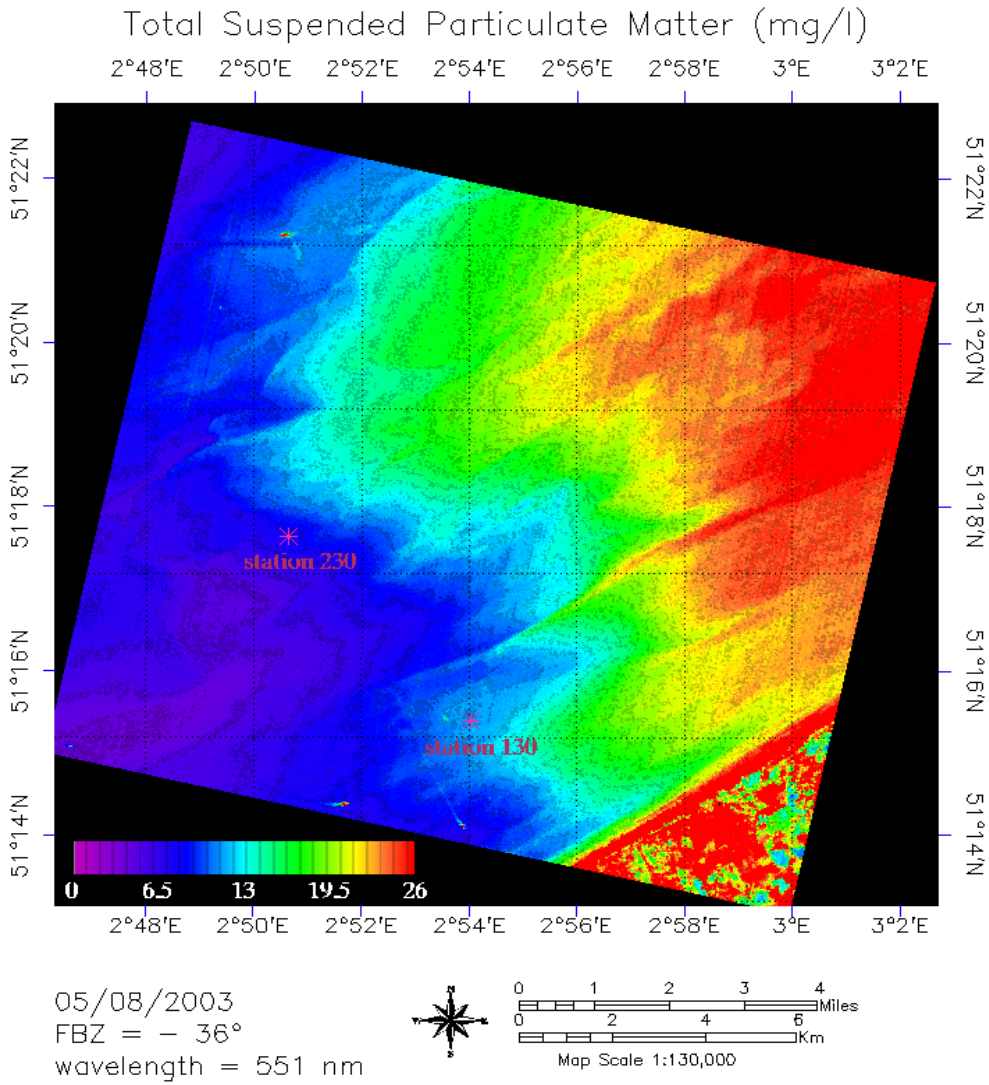
UNIVERSITÄT KAISERSLAUTERN

Coastal Investigation

Ostend, Belgium

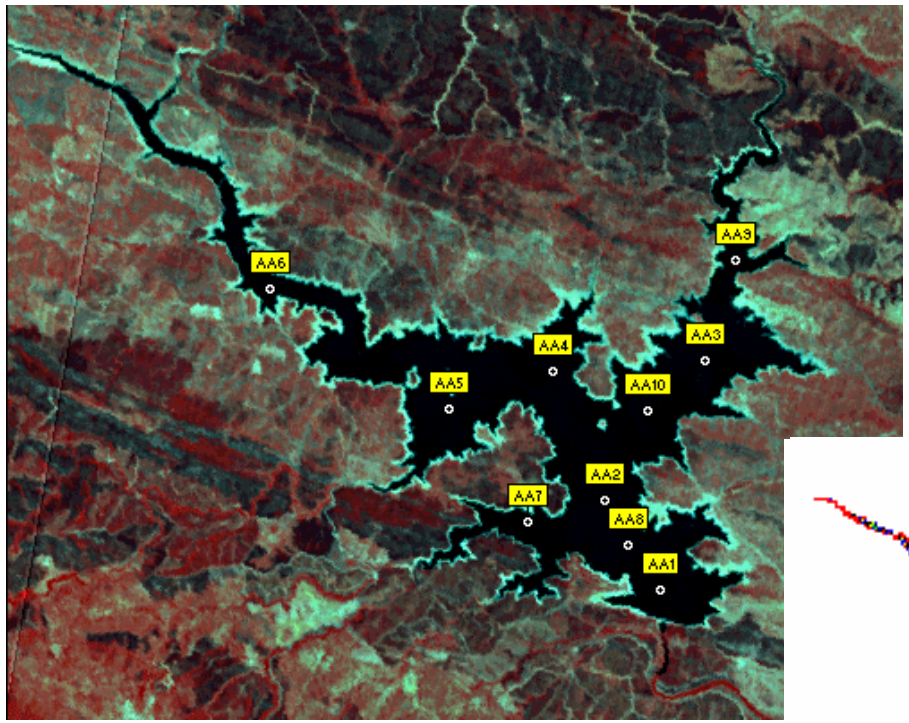
5 August 2003“

Retrieval of Chlorophyll and Suspended Particulate Matter

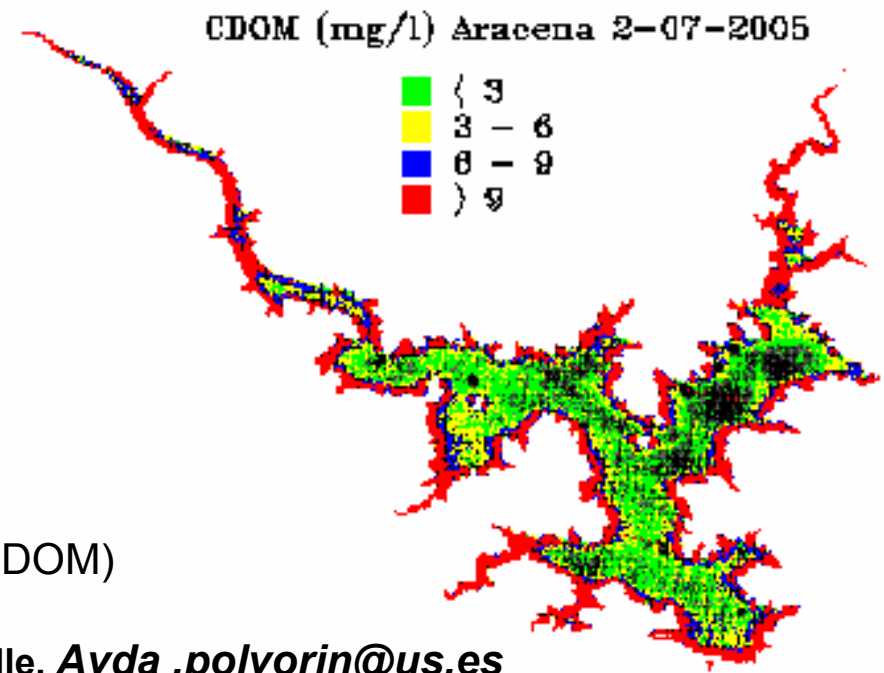


Courtesy of Kevin Ruddick et al, MUMM, Belgium (also University of Leuven, Belgium)

Inland Water Quality Assessment



Aracena Dam, Spain

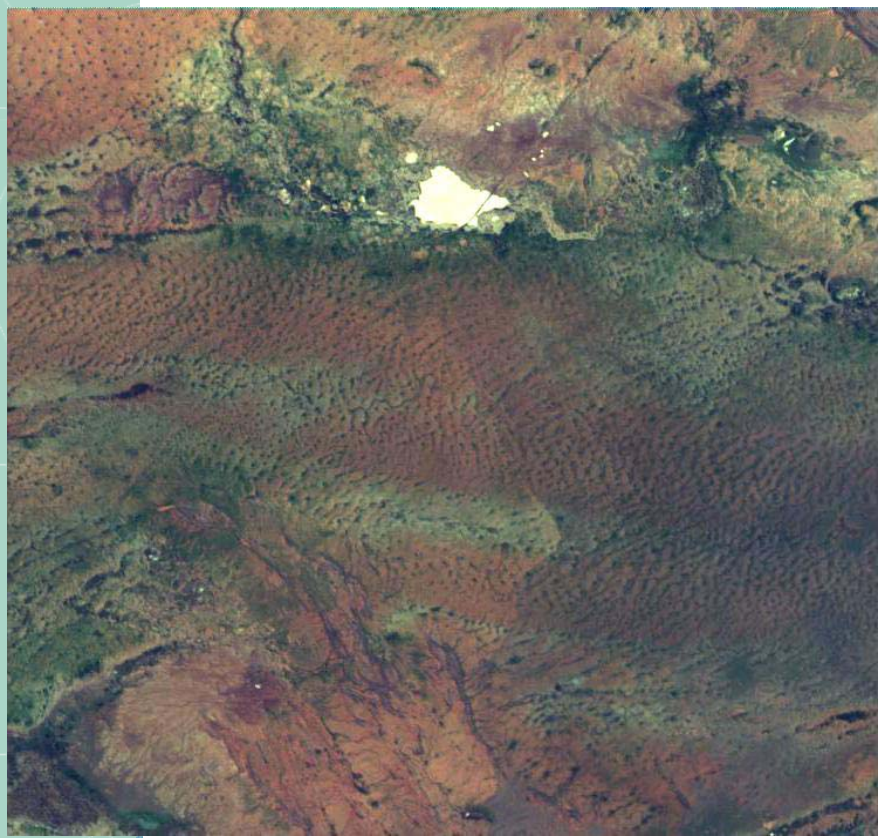


- Chlorophyll-a
- Total suspended solids (TSS)
- Turbidity
- Coloured dissolved organic matter (CDOM)

Source: A. Polvorinos, University of Saville, *Avda .polvorin@us.es*

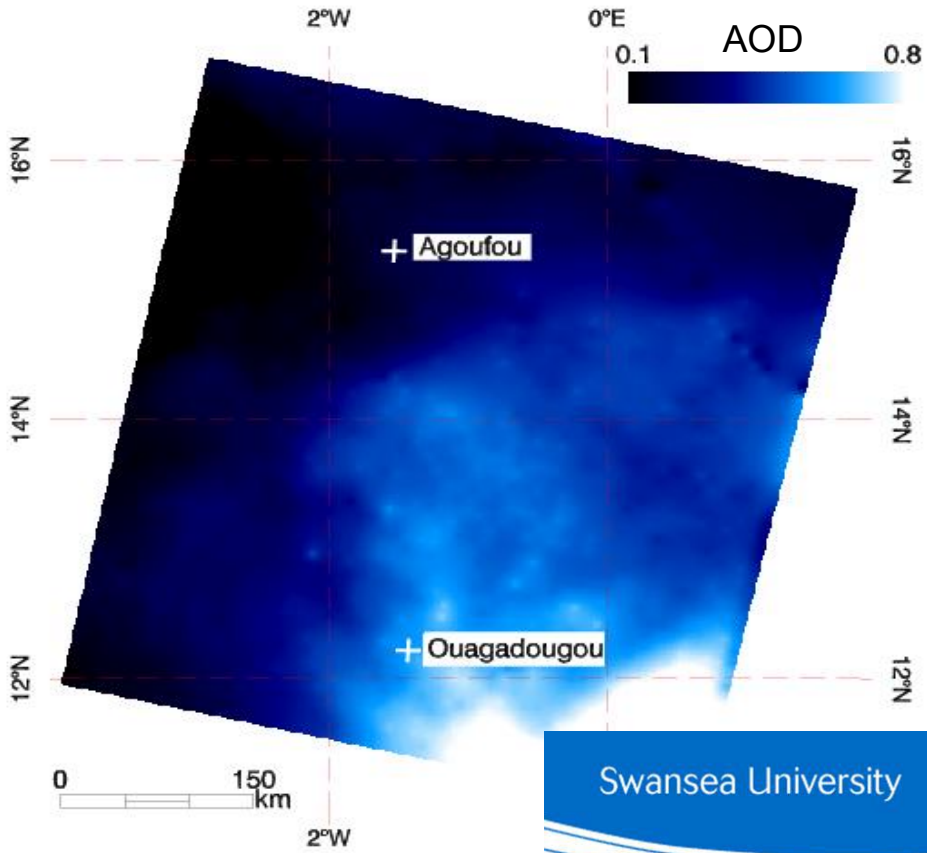
Aerosol Retrieval

CHRIS image of Agoufou, West Africa acquired on 26th July 2006



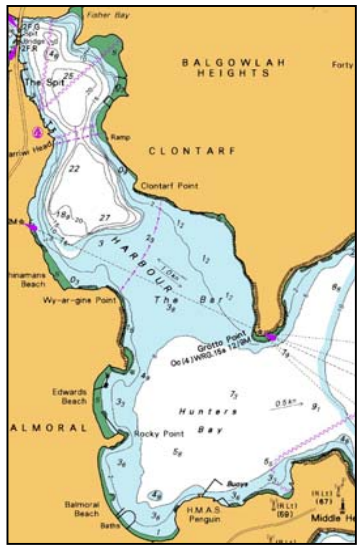
13 km

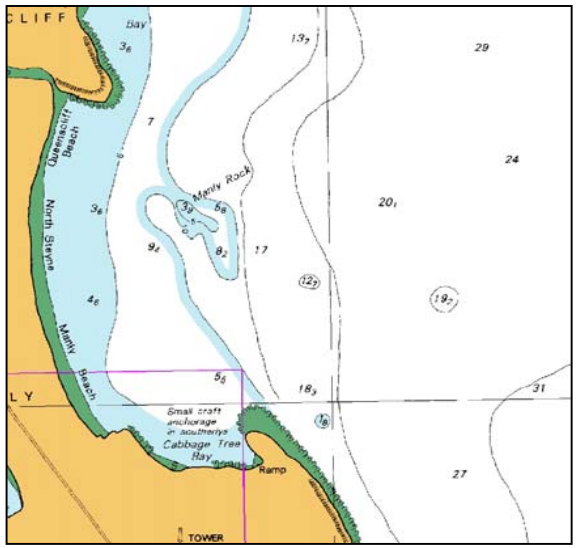
- Analysis of 5 pre-processed CHRIS images will be undertaken of data acquired over established AERONET sites
- Expect to get detailed information on aerosol properties (including size, and resulting optical properties)

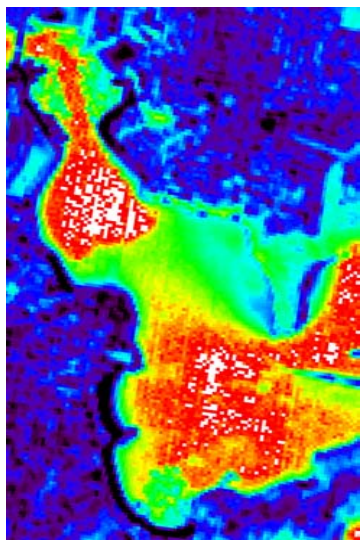


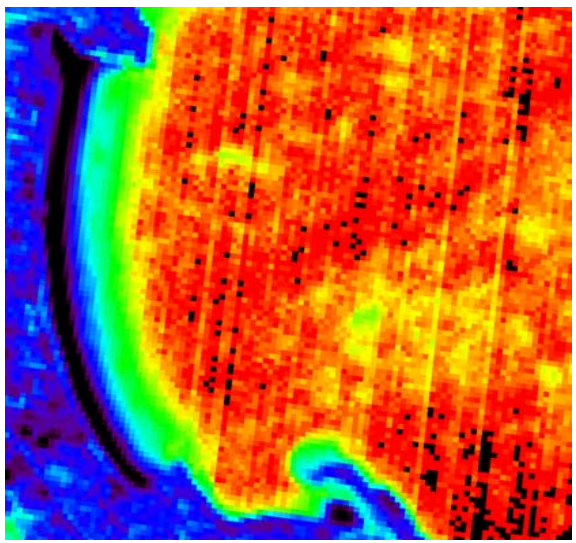
Courtesy of Will Gray, Swansea University, UK

Bathymetric Mapping



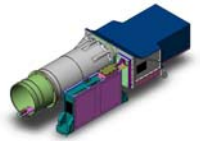


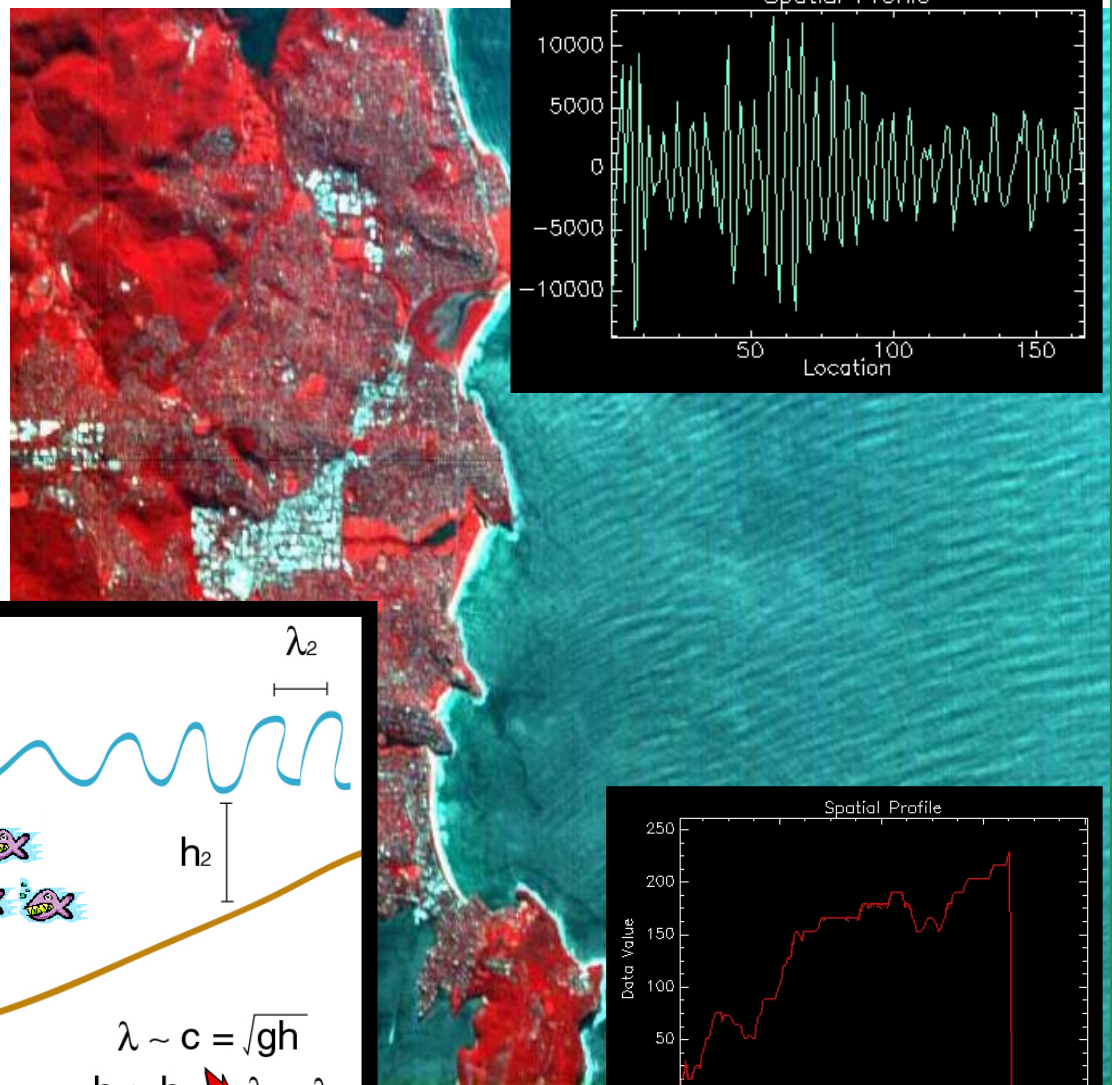


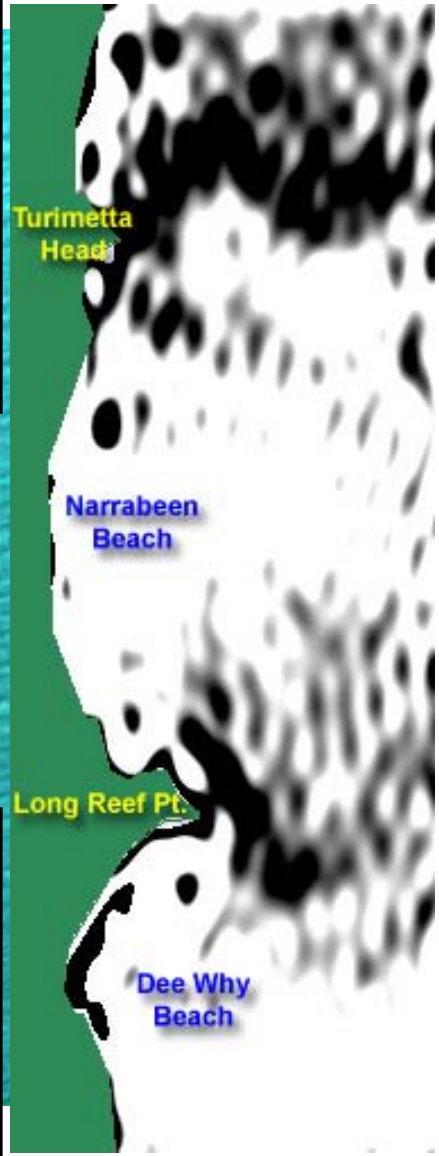


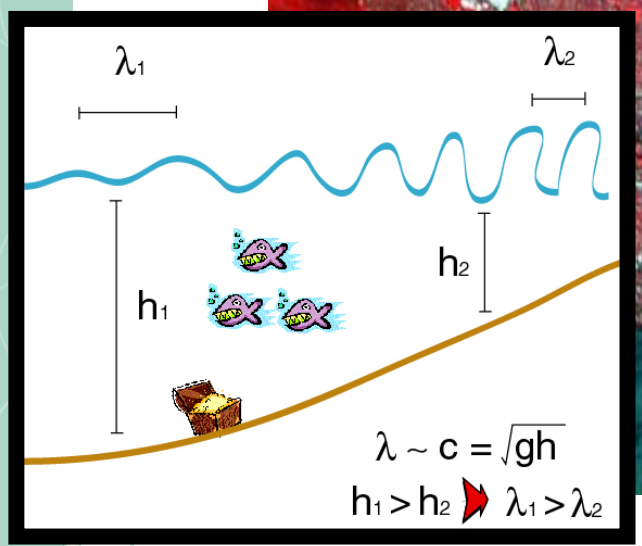
Courtesy of Ray Merton, University of New South Wales, Australia

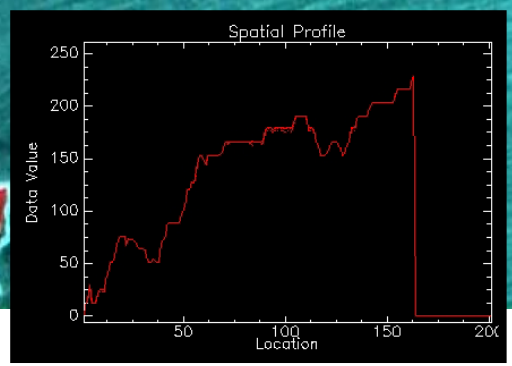
Bathymetric mapping in turbid waters





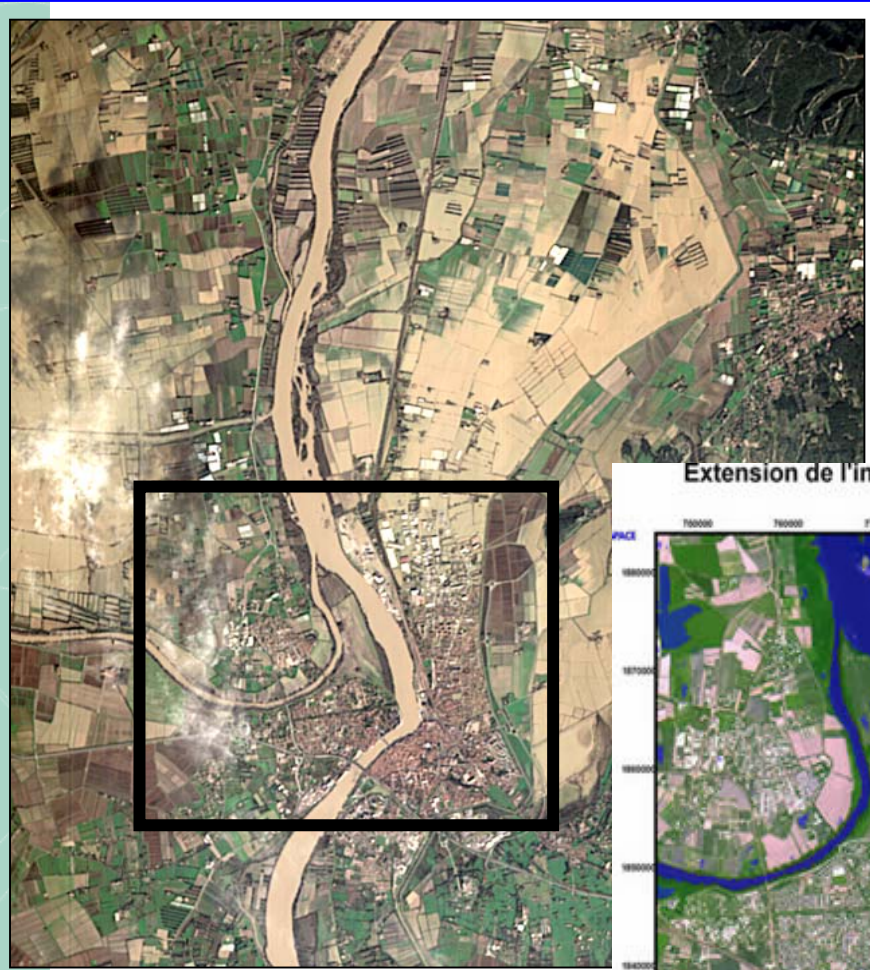






Courtesy of Ray Merton, University of New South Wales, Australia

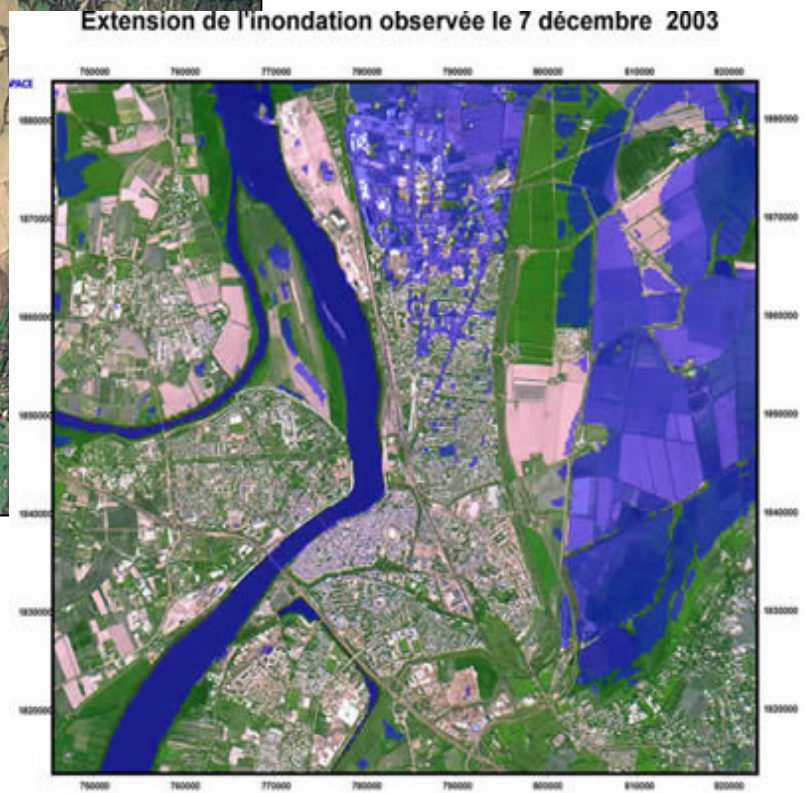
Disaster management - Floods



7 Dec. 2003
Arles (France) Floodings

Since end 2003: Image provider for International Charter

International Charter Space and Major Disasters



Data Access

esa

Satellite Imag
Observing the Earth

European Space Agency

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Access to Global Maps

16-Nov-2005

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By satellite

Proba

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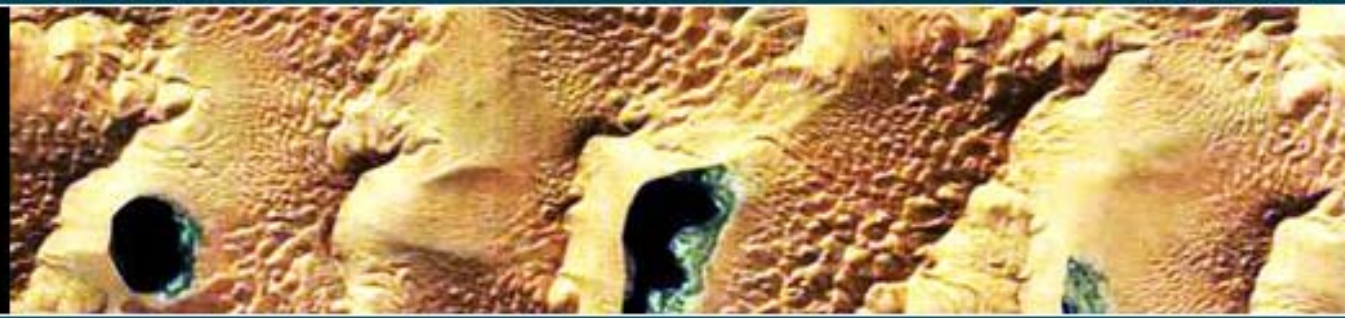
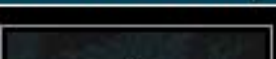
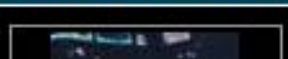


Lakes in the Gobi Desert, China

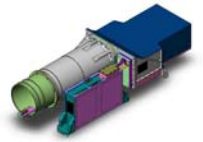
Satellite: Proba | Instrument: CHRIS | Acquisition: 29-Sep-2005

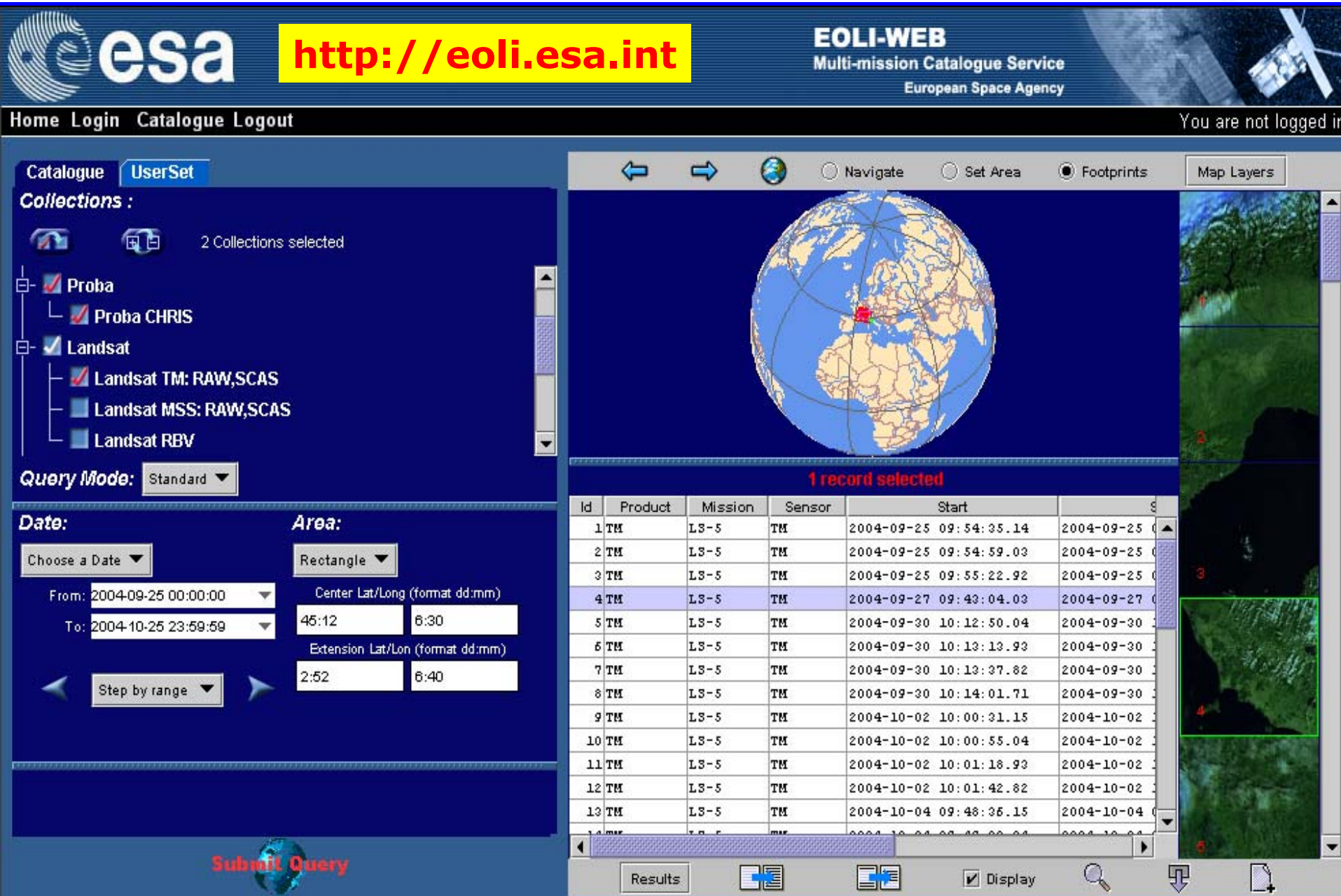
Full Image ▸





ESA EO Data: EOLI Web-catalogue





http://earth.esa.int/proba

esa

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Earth Observation

European Space Agency

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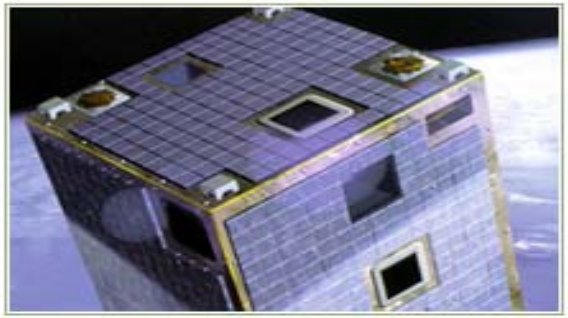


Proba

The Project for On-Board Autonomy (Proba) was originally a technology demonstration mission of the European Space Agency, started in mid-1998 and funded within the frame of ESA's General Support Technology Programme.

Intended as a one-year mission, Proba has provided data successfully ever since its launch on 22nd Oct 2001. Hosting two Earth Observation instruments CHRIS and HRC, Proba is since 2004 managed by ESA's Ground Segment Department within the Directorate of Earth Observation at ESA/ESRIN.

Latest news from the mission

+ **Small Satellite Systems and Services - The 4S Symposium**
25 - 29 September 2006- Chia Laguna, Sardinia - Italy

+ **4th CHRIS/HRC Proba Workshop**
19 - 21 September 2006- ESRIN, Frascati - Italy

+ **Updated CHRIS/Proba Reference Document**
This gives detailed information about the CHRIS acquisition procedure and image geometry

+ **3rd ESA CHRIS/Proba Workshop** - Proceedings

+ **3rd ESA CHRIS/Proba Workshop** - Presentations

+ **2nd ESA CHRIS/Proba Workshop**

+ Proba CHRIS data are now

Data

+ Category-1 access to data has been opened and more information can be obtained at **EOPI**

+ CHRIS acquisitions are generally prioritised according to the **Nominal Acquisition Plan**, based on the intial request of each project.

+ **CHRIS Data Format 4.2**
Contains information needed for mode 5 acquisitions

+ Following the Nominal Plan, the acquisition are scheduled according to **viewing opportunities** but also taking account of the cloud coverage

+ Successful acquisitions may be tracked from **Actual Acquisitions** and **Latest**

More on Proba

+ **Proba Achievements**

4 October 2005

An overview of the achievements of the Proba mission, as well as pointers to publications.

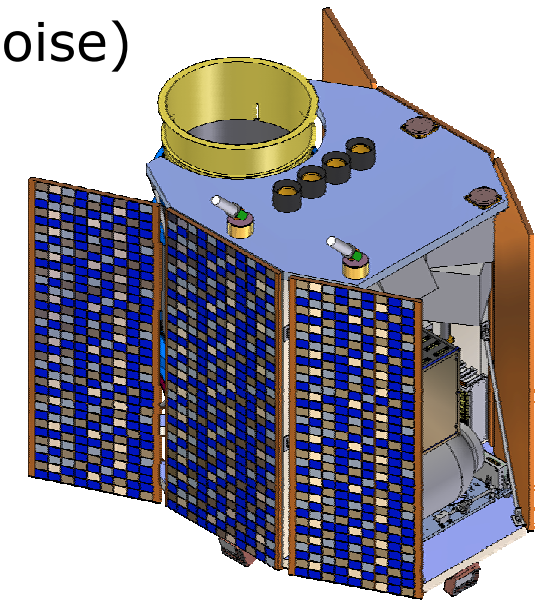
+ **Proba workshop: small satellite yielding beautiful results**

24 March 2005

Read more about how ESA's smallest Earth Observation satellite is making a big contribution to science. Proba applications range from studying land vegetation to water quality monitoring, assessing productivity of Italian vineyards, even helping hunt for meteorite impact craters.

Future Plans

- Continue CHRIS Programme through 2007
- Development of an image processing toolbox:
  - Noise reduction tool ("fixed" pattern noise)
  - Cloud masking tool
  - Geometric correction
  - Atmospheric correction
  - Aerosol optical depth
  - Land surface optical reflectance



- Designs for future missions exist within SSTL providing increased capability & the option of enhancing the operational aspects of the mission.

Thank you

For further information contact :

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Business Development Department
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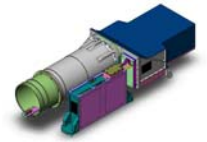
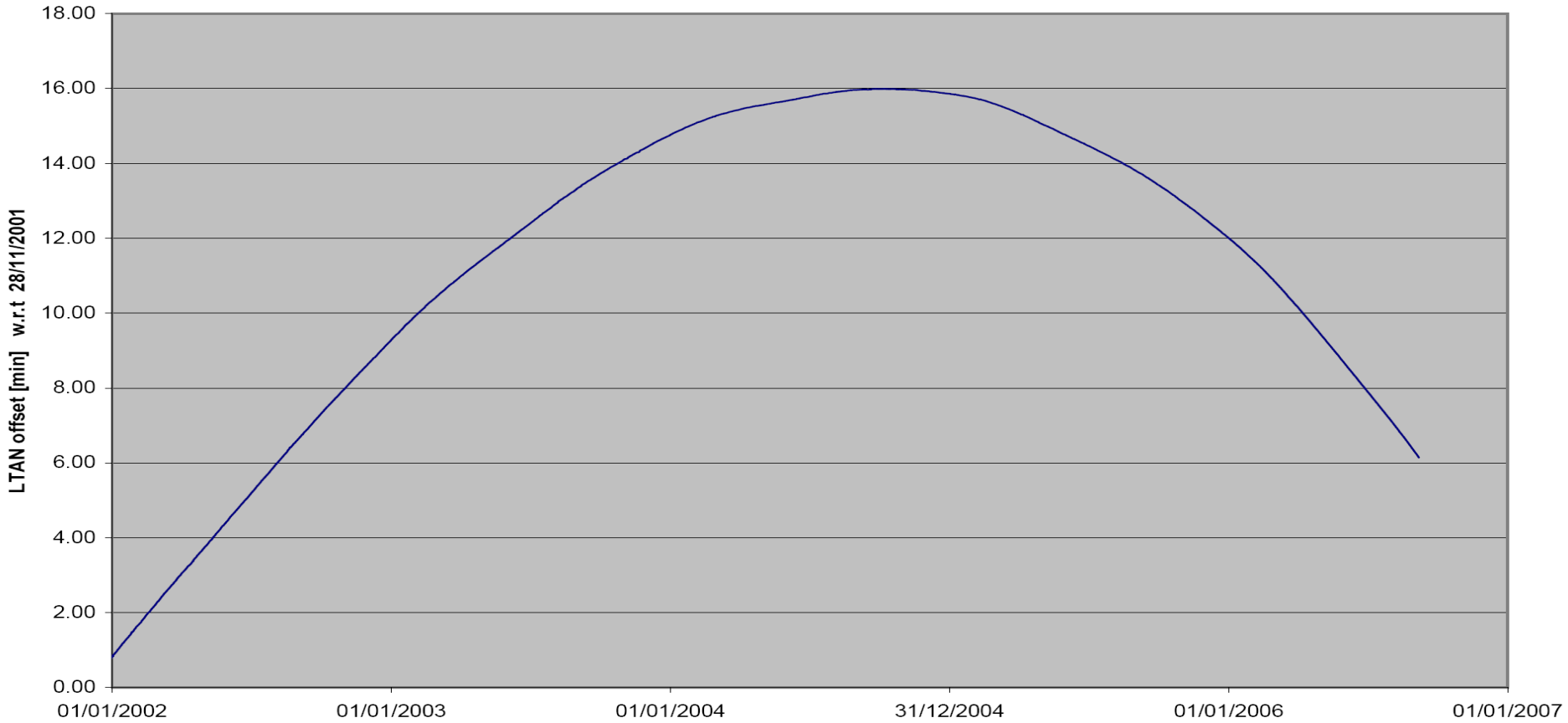
Tycho House, Surrey Research Park,
Guildford, Surrey, GU2 7YE, UK
Tel: +44 1483 803803, Fax: +44 1483 803804
Email: info@sstl.co.uk Web: www.sstl.co.uk

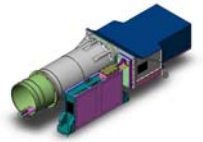
Mission Overview – orbit evolution



➢ ***RAAN drift decreasing after a maximum of +16 min.***



Mission Overview – orbit evolution



➢ ***Orbital natural decay is very slow (14 kms sma decay since launch).***