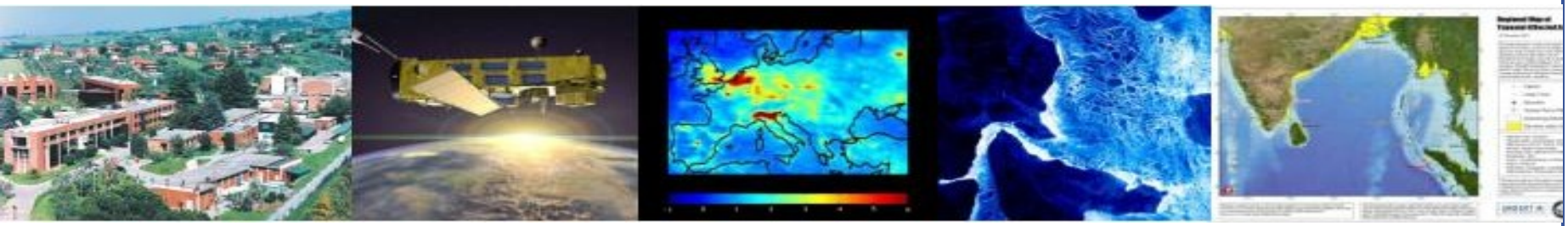
INTRODUCTION TO THE ESA EARTH OBSERVATION PROGRAMME. PROJECTS AND TOOLS FOR EDUCATION



Ana B. Ruescas

ESA/ESRIN

European Space Agency
Agence spatiale européenne

the Living Planet

Presentation Overview

- The European Space Agency (ESA)
- Science from Space
- ESA and Earth Observation Programmes
- Earth Observation Applications
- ESA EO Education: available tools for schools
  - The Website EDUSPACE
  - The ESA School Atla
  - Charter for schools

European Space Agency

ESA Member States

- **Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Norway, the Netherlands, Portugal, Spain, Sweden, Switzerland and the United Kingdom**

- **Canada takes part in EO projects under a cooperation agreement.**

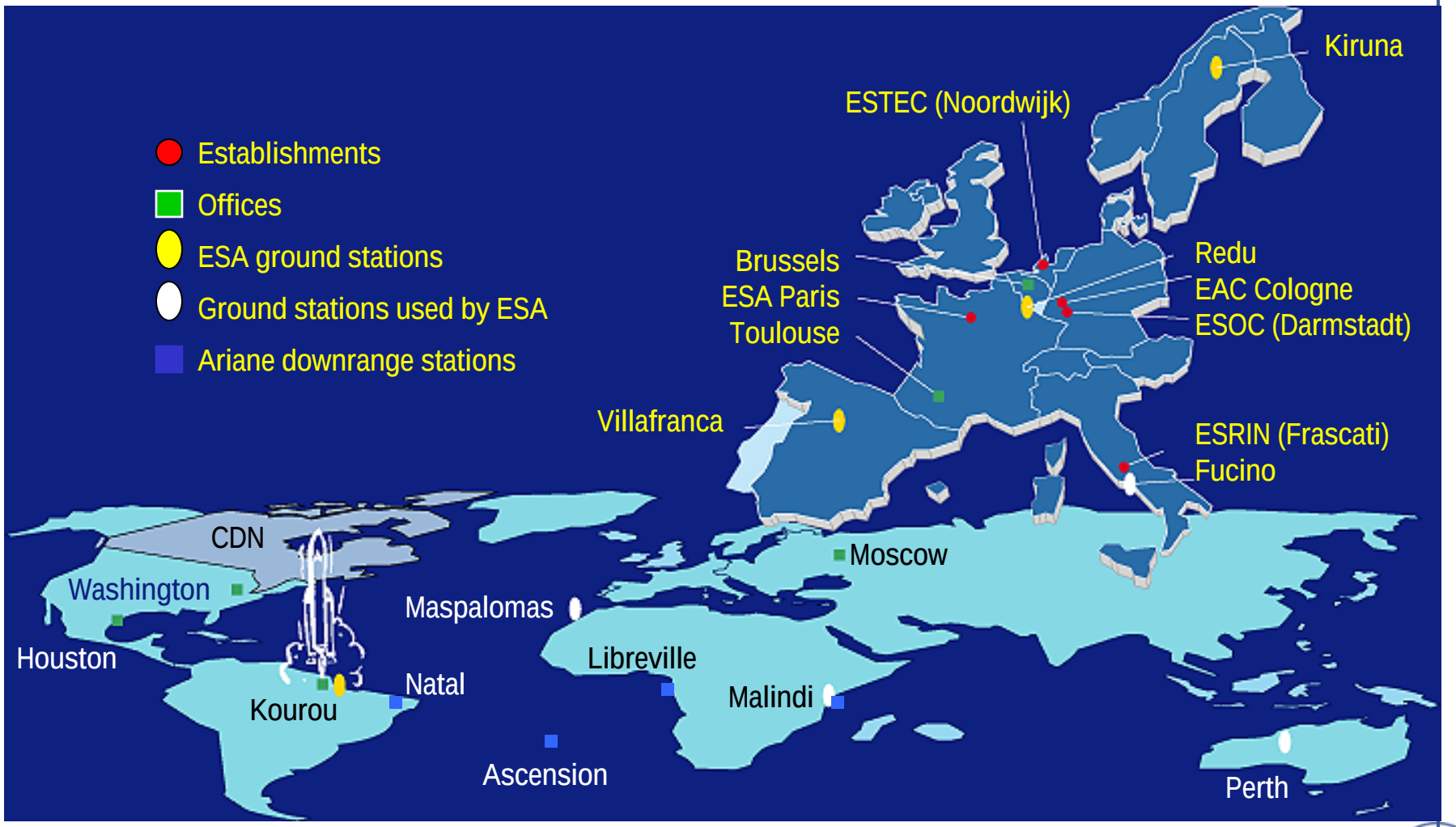
ESA, the European Space Agency, is an international organisation responsible for:

- **Space science, research & technology,**
- **Space applications**

ESA is running:

- space **activities** and programmes
- a long term **space policy**
- a specific **industrial policy**
- **coordination** with national space programmes

ESA locations worldwide

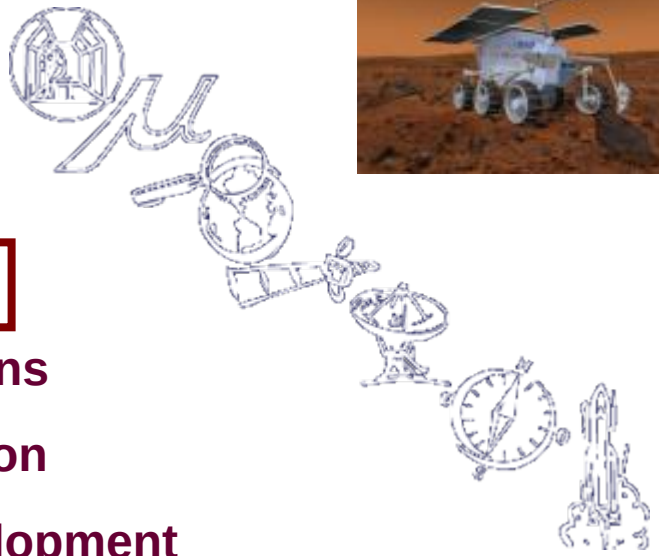


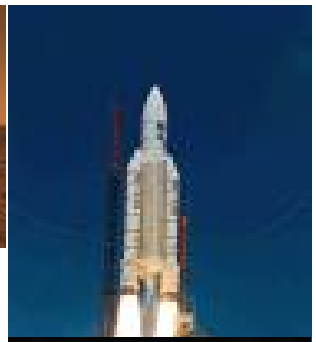
The ESA Programmes

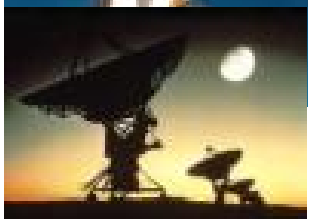
All Member States participate in activities and a common set of programmes related to Space Science **(mandatory programmes)**.

In addition, members chose the level of participation in so called **optional programmes**:

- **Human space flight**
- **Microgravity research**
- **Earth observation**
- **Telecommunications**
- **Satellite navigation**
- **Launcher development**







Science from Space

The International Space Station

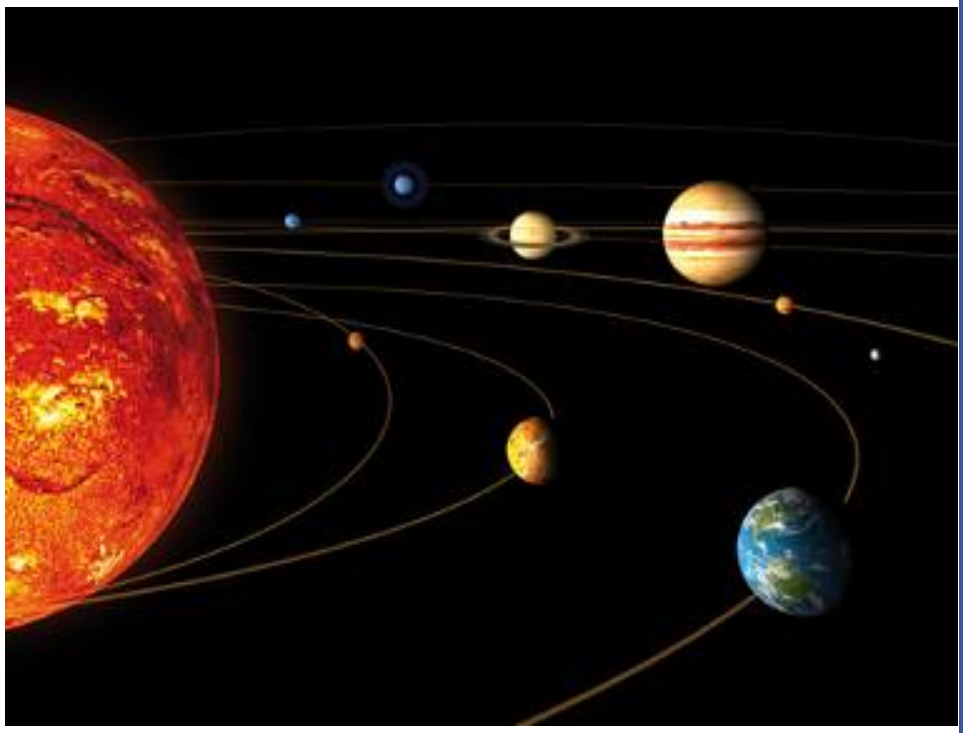
COLUMBUS LABOR

ISS visibility:
http://spaceflight.nasa.gov/realdata/sightings/index.html

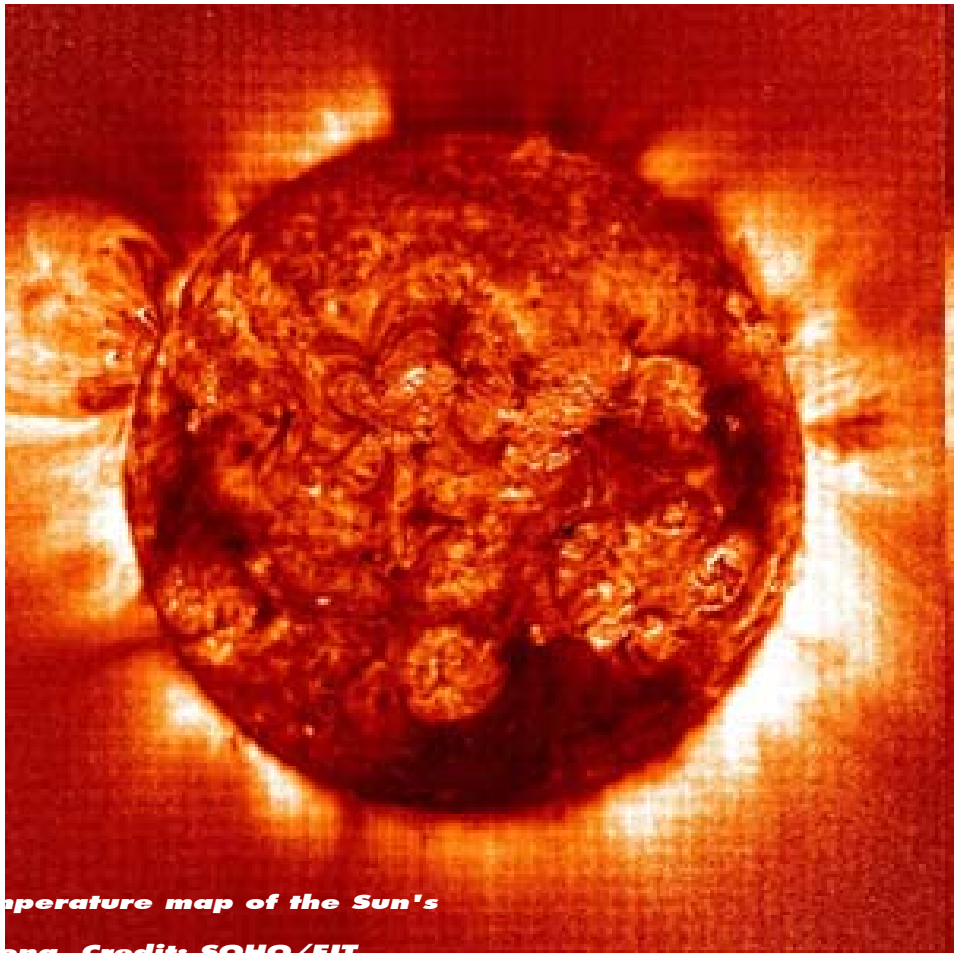
Space Science

For over 30 years ESA's space science projects have shown the scientific benefits of multi-nation cooperation.

1. Space environment of the Earth
2. Solar-terrestrial interaction
3. Interplanetary medium
4. Moon, planets and other objects
5. Stars and the universe
6. Fundamental Physics



Solar terrestrial interaction



Soho

SOHO is in a Halo-Orbit with a radius of 600.000 km Radius around Lagrange-Point L1 (distance 1,5 Millions Km from Earth)

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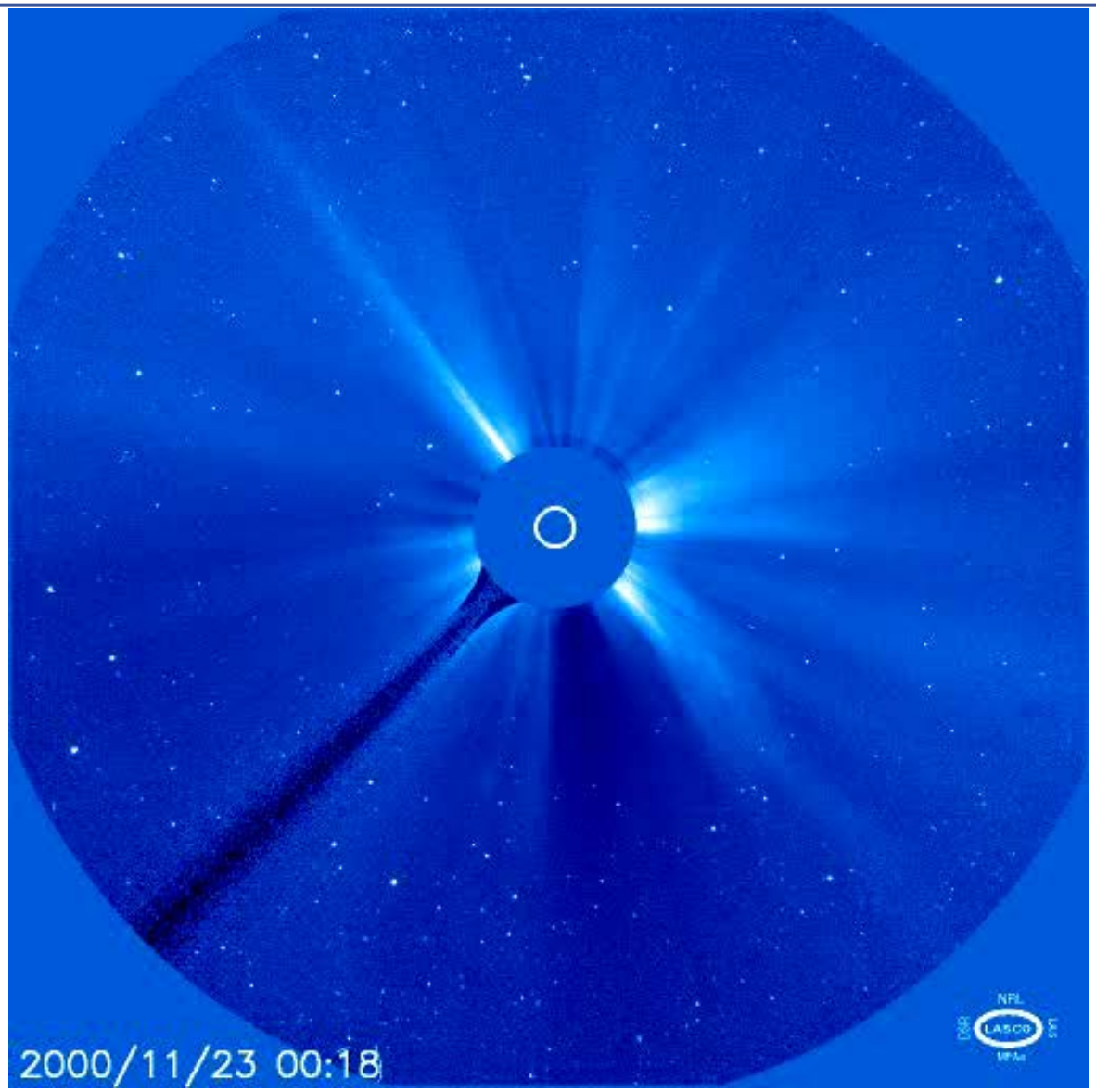
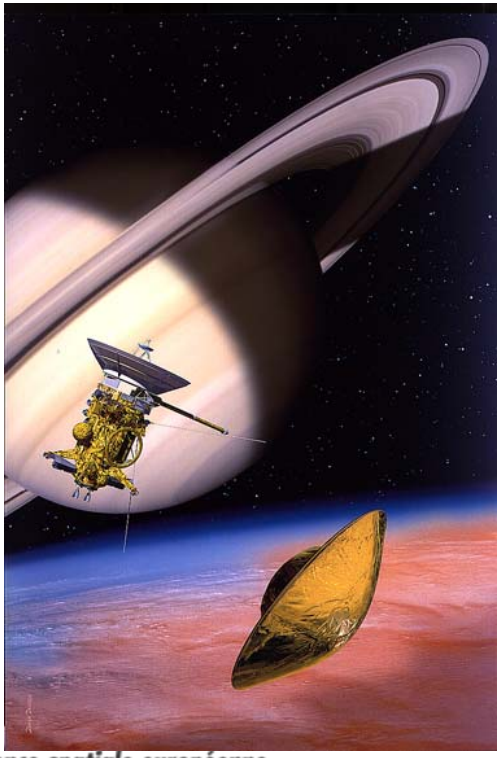
the Living Planet

SOHO observes the Corona and the “Sunwind”



Cassini and Hugyens observes Titan, a moon of Saturn

14 January 2005
after its seven-year journey through the Solar System on board the Cassini spacecraft, ESA's Huygens probe has successfully descended through the atmosphere of Titan, Saturn's largest moon and safely landed on its surface



Agence spatiale européenne

esa cassini-huygens European Space Agency

ESA | ESA Science | Cassini-Huygens

08-Mar-2010

Unique insights into a ringed world...
About Cassini-Huygens...
About Saturn...
About Titan...
Meet the team...

Multimedia
- VideoTalk
- Cassini-Huygens images
- Cassini-Huygens videos
- Titan virtual tour
- Hygens probe descent - multilingual CD-rom
- Download wallpapers
- Download screensavers
- 3D Flash 'model'
- SOI animation
- Waiting for Titan - the human side of Huygens

Watch the event...

Services
- Comments

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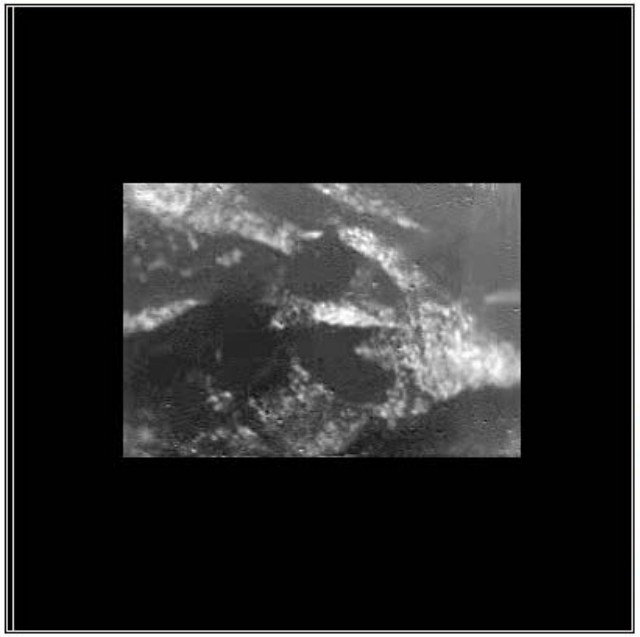
All
Space Science
GO



Fifth anniversary of the landing on Titan

14 January 2010 Five years ago today ESA's Huygens probe reached the upper layer of Titan's atmosphere and landed on the surface after a parachute descent of 2 hours and 28 minutes. As part of the joint NASA/ESA/ASI mission to Saturn and its moons, the Huygens probe was sent from the Cassini spacecraft to explore Titan, Saturn's largest moon.

Celebrating the fifth anniversary of Huygens' Titan touchdown

14 January 2010 Five years ago today, ESA's Huygens probe descended to the surface of Titan, Saturn's largest moon. Today planetary scientists from around the world have gathered in Barcelona to discuss the legacy of Huygens

Sounds of Titan

Huygens raw images

Titan first images

Where is Cassini now?
- Current positions

For the media
- Media Press Kit

In depth
- Huygens in-depth

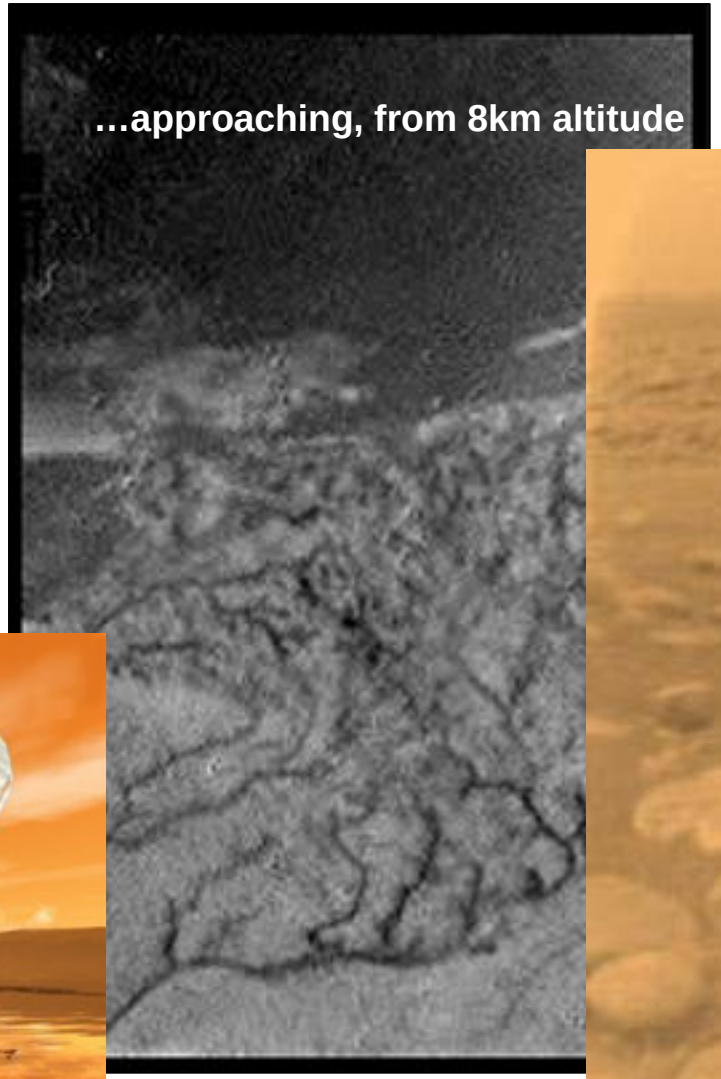
For kids

Related links
- ESA Spacecraft Operations
- Web-Spezial in deutscher Sprache
- NASA JPL Cassini-Huygens site
- Italian Space Agency (ASI)
- Music2Titan.com

The Huygens Sounder has landed on Titan

Image of the Sounder…

…and an artist's view



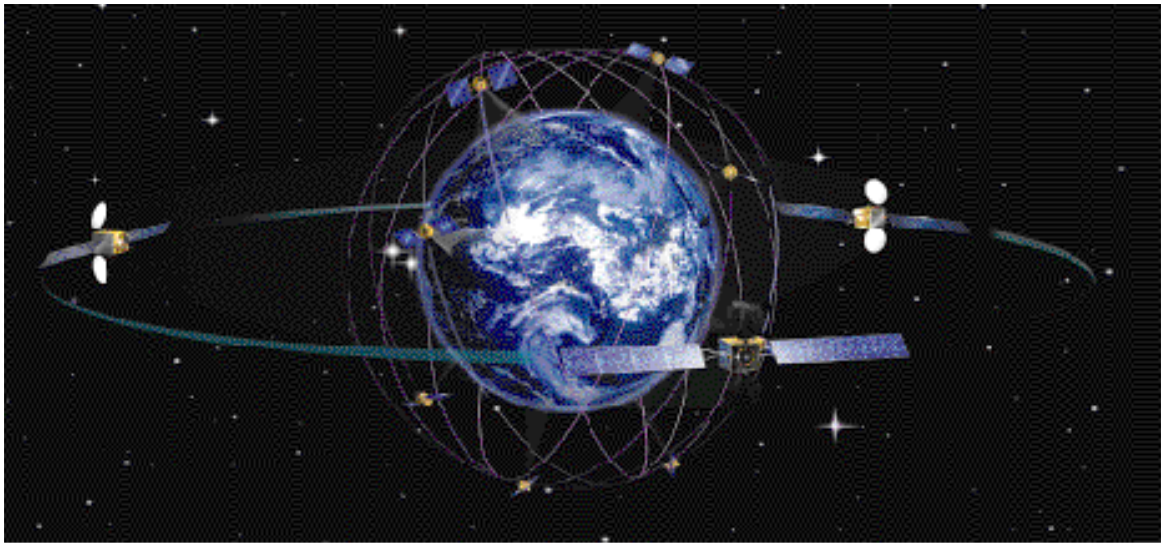
ESA NEWS:
5. September 2008 - Rosetta observes the Asteroid named „(2867) Steins“

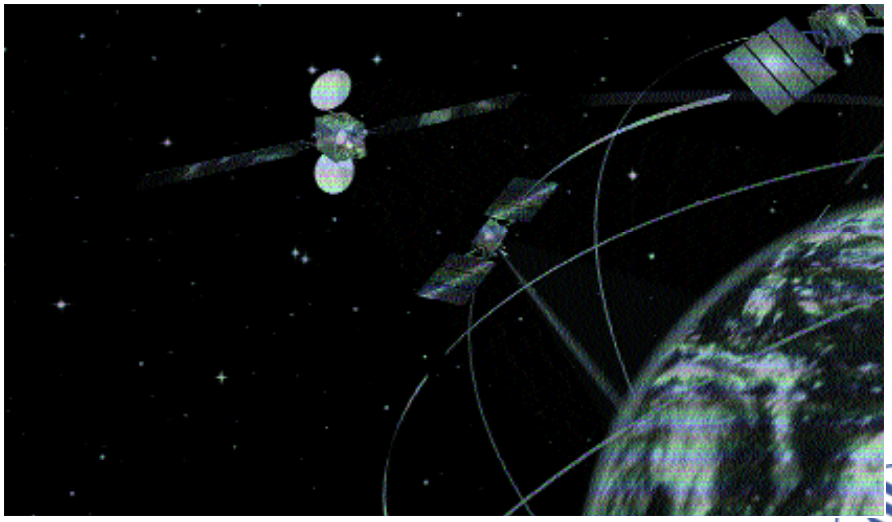
Artist‘s view

Rosetta is travelling since 2003 to the Cometen Churyumov-Gerasimenko, 11 years away

Rosetta acquired this image during a „swing-by“ near the Earth, 23 Nov. 2007

Satellite Navigation: EGNOS and Galileo



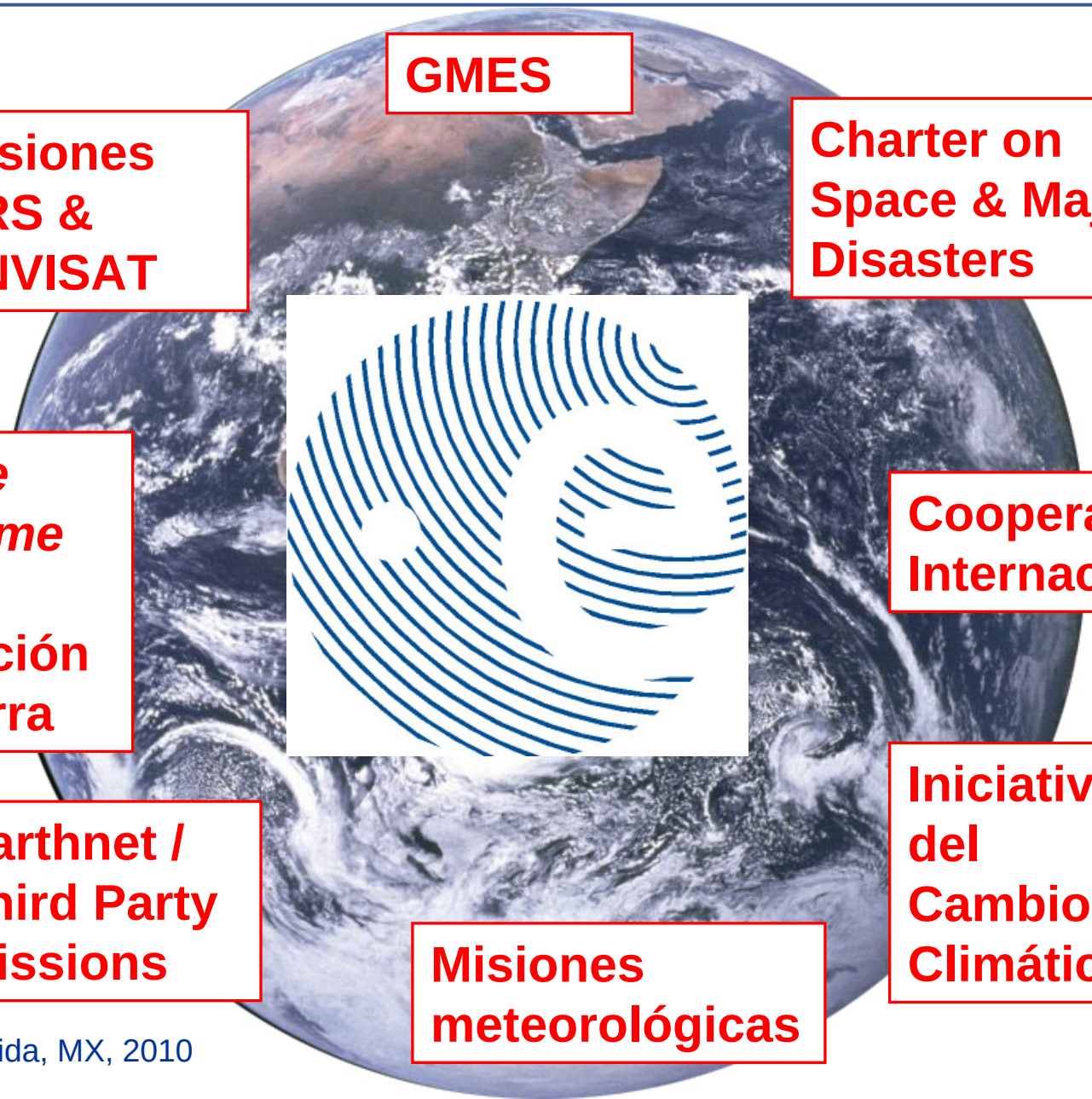


The EU/ESA Project

30 Communications- (EGNOS) and Navigation satellites (Galileo) to be launched

ESA and the EO programmes

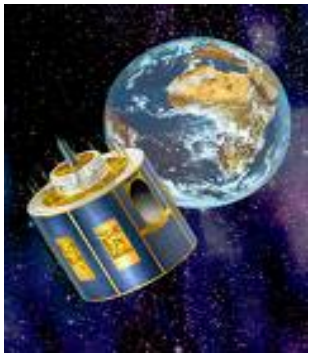
Actividades de la ESA en OT



- GMES
- Misiones ERS & ENVISAT
- Charter on Space & Major Disasters
- *Envelope Programme* en Observación de la Tierra
- Cooperación Internacional
- Earthnet / Third Party Missions
- Iniciativa del Cambio Climático
- Misiones meteorológicas

the Living Planet

Capacidad en expansión de la OT Europea



Since 1978 — **Meteosat**

1991 — **ERS 1**

1995 — **ERS 2**

2002 — **ENVISAT**

Earth Explorers

Sentinels / GMES

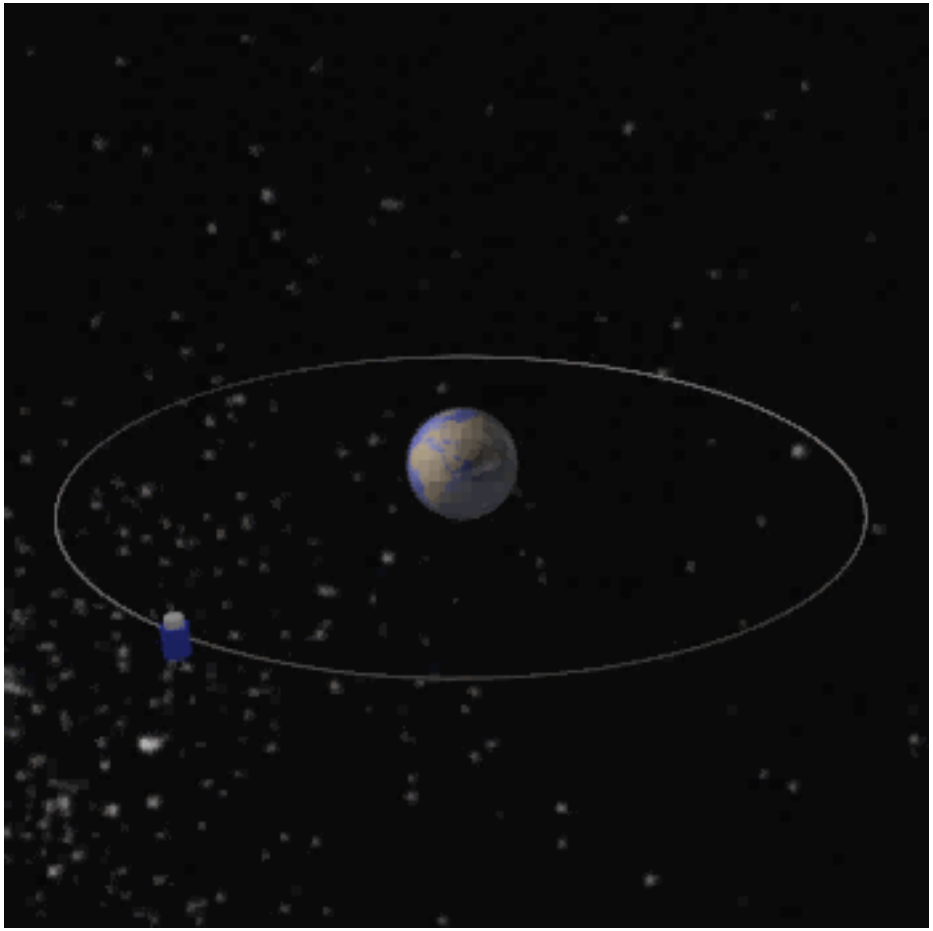
Misiones meteorológicas geoestacionarias

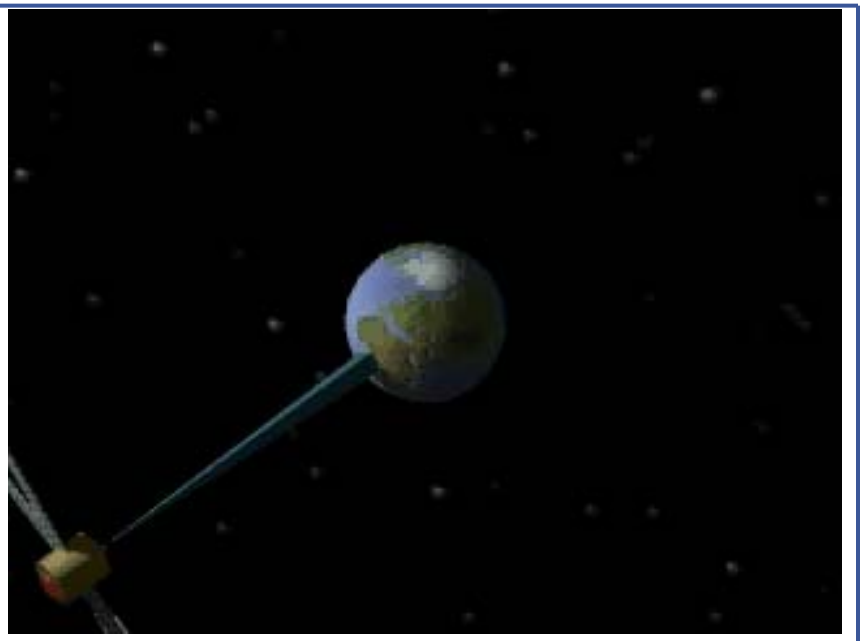
Océanos
Criosfera
Superficie terrestre
Climatología

+ Ozono global
+ Superficie terrestre

+ Color océano
+ Constituyentes atmosféricos

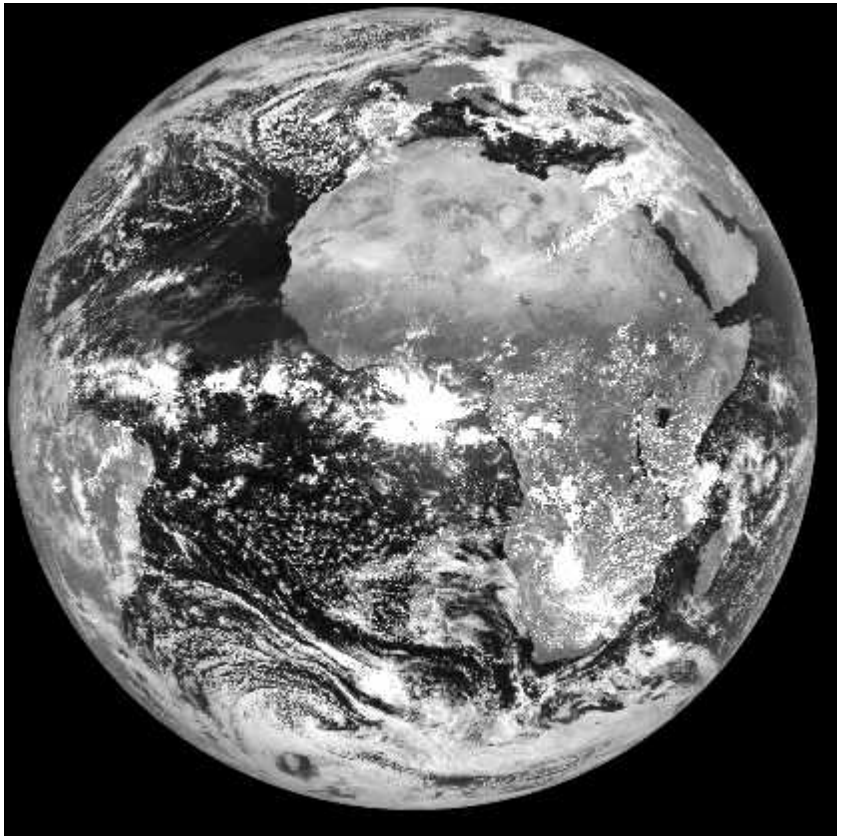
Geostationary Orbit





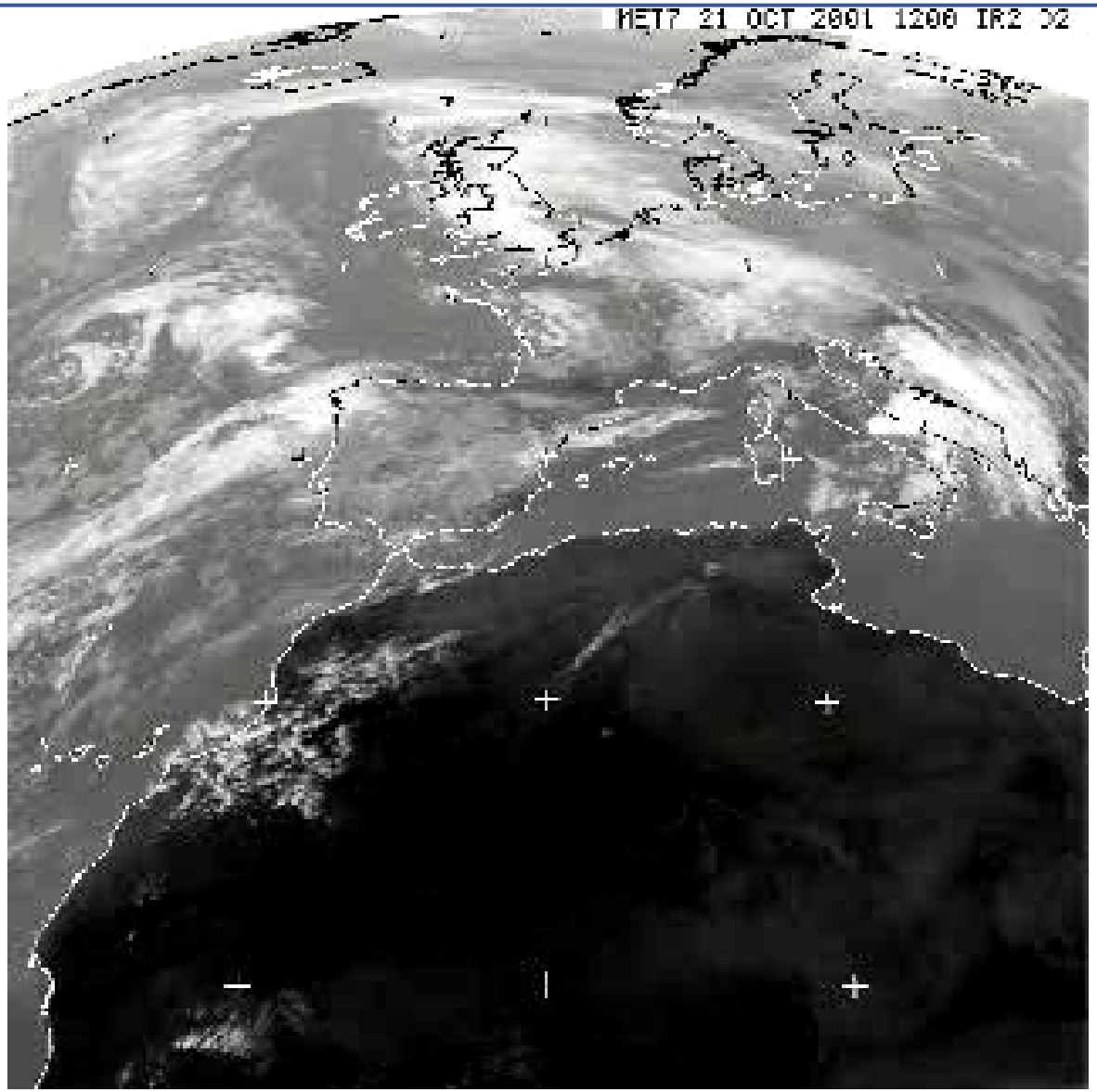
The geostationary orbit is quasi circular at 36000km altitude. One period lasts 24h, hence the satellite moves at the same angular speed as the Earth. The satellite seems fixed with respect to an observer on ground.

METEOSAT



ESA has developed the Meteosat and MSG series of weather satellites, METOP, the environmental and climate research and monitoring satellites ERS-1 & 2 and Envisat, and recently launched its first Earth Explorer, respectively for:

- Meteorology
- Environmental & climate monitoring
- Earth resource management & other applications
- Better understand the earth


MET7 21 OCT 2001 1200 IR2 02

Meteosat Third Generation

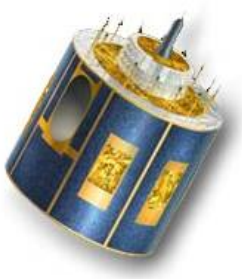
Development of the meteorological programmes:

1977 → 2002

MOP

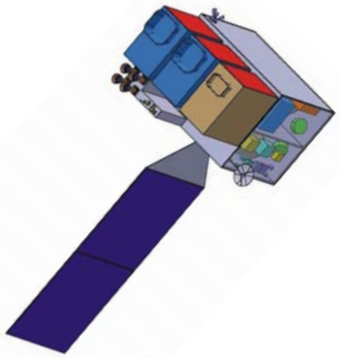
1 observation mission:
-MVIRI: 3 channels
-**Spinning** satellite

MSG



2 observation missions:
- SEVIRI: 12 channels
- GERB
- **Spinning** satellite

MTG

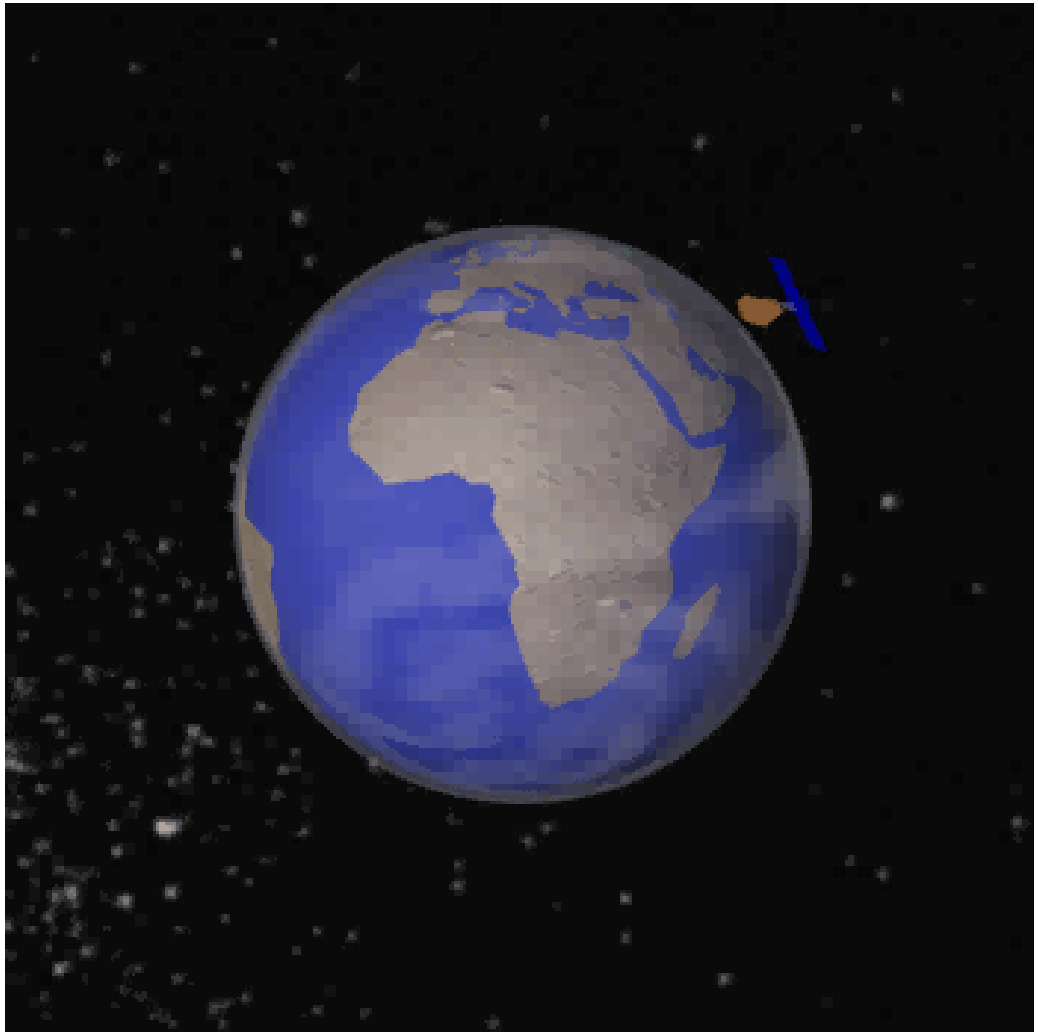


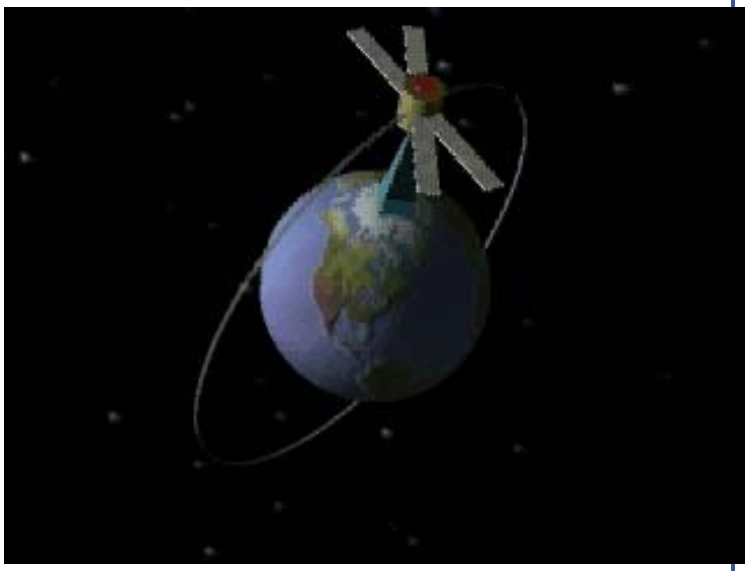
El MeteoSat Third Generation baseline es un sistema de dos plataformas (6 satélites)

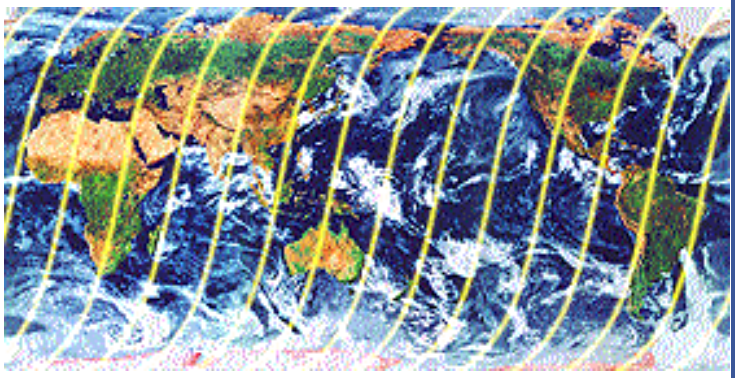
5 observation missions:
- **HRFI: 5 channels**
- **FDHSI: 22 channels**
- **Lightning Imager**
- **Infra-Red Sounder**

3-axis stabilised satellite

Polar orbits

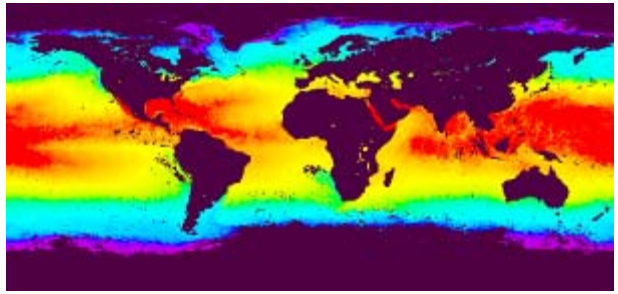






LEO SATELLITES

- Envisat 8 años operativo, ERS-2 14 años en el espacio
- Alrededor de 2600 usuarios/proyectos utilizan datos Envisat y ERS-2 30
- *Third Party Missions* para el beneficio de los usuarios europeos



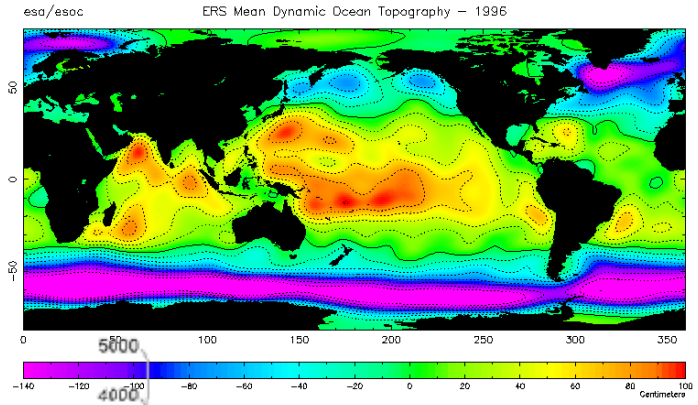
ERS 1 & 2 Heritage

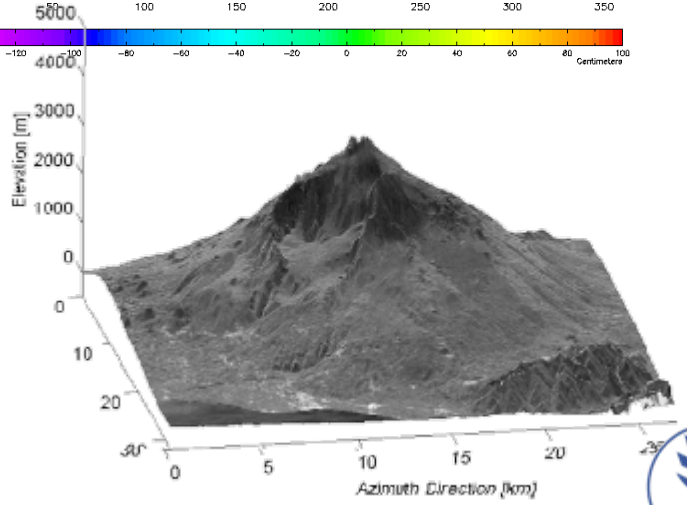
ERS 1 (1991 – 2000):
Oceans, sea ice, cryosphere, land surface & climatology

ERS 2 (1995 – still operational):
***(…) plus* global ozone & terrestrial biosphere monitoring**

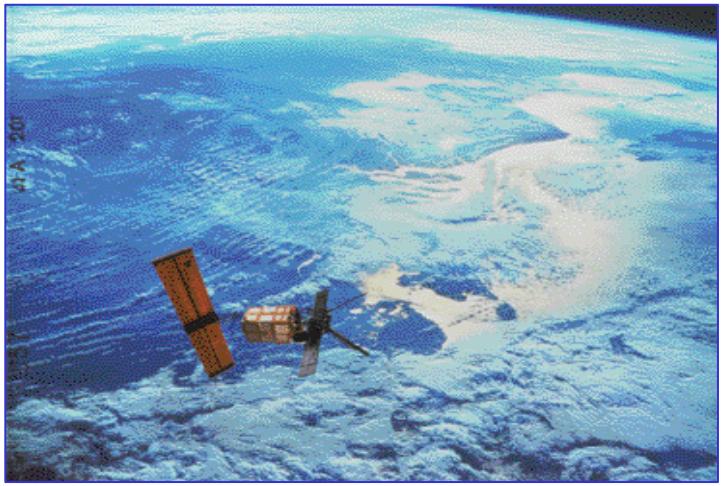
Results of 16 years ERS missions:

- **wealth of science and application results**
- **consolidation of a large EO community**
- **basis for long-term environmental monitoring**





Etna DEM



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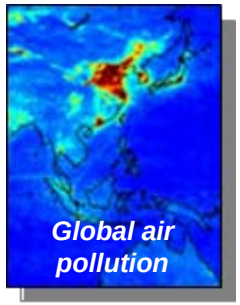
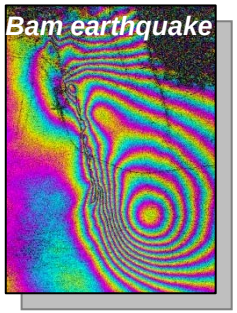
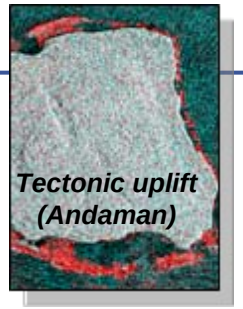
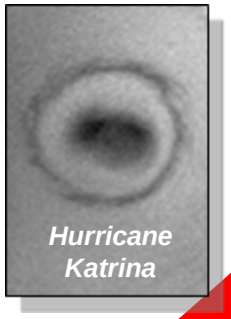
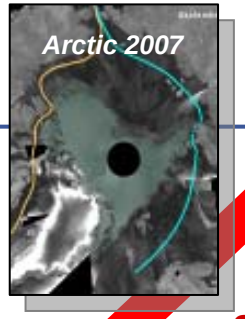
ENVISAT mission: 7 years !





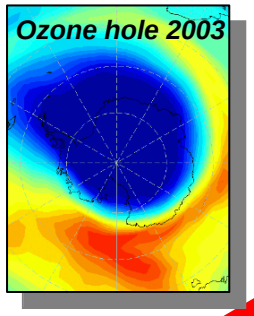


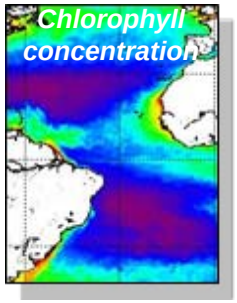


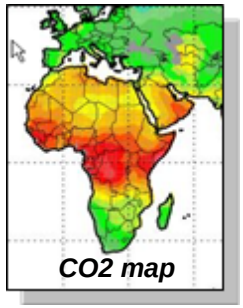


~2000 scientific projects

+ several GMES pre-operational projects







Launch
Mar 02

Calibration Review
Sep 02

Validation Workshop
Dec 02

MERIS Workshop
Nov 03

InSAR Workshop
Dec 03

Envisat Symposium
Salzburg (A)
Sep 04

MERIS (A)ATSR Workshop
Sep 05

InSAR Workshop
Dec 05

Altimetry Conference
Mar 06

Atmospheric Science Conference
May 06

Envisat Symposium
Montreux (CH)
Apr 07

InSAR Workshop
Dec 07

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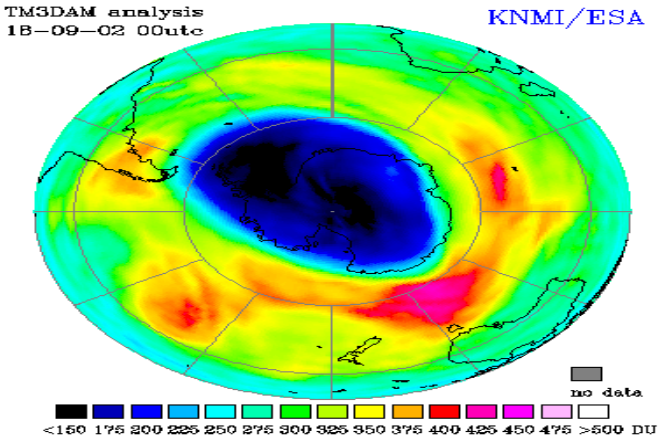
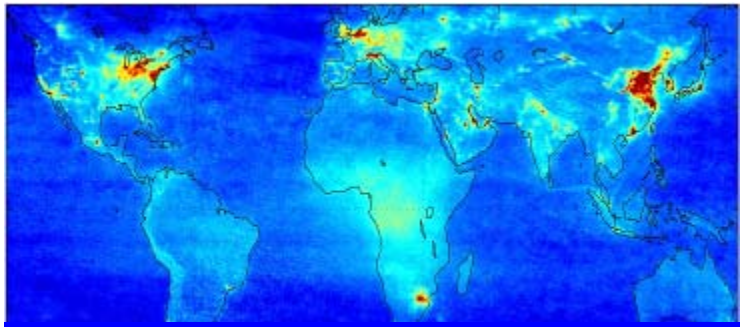
Major scientific results of ENVISAT and ERS

- **Climate change:** Global sea level rise of ~3mm/year and sea surface temperature increase of ~0.1 deg. C since 1992 (Envisat + ERS).
- **Atmosphere:** Worldwide monitoring of air pollution, with evidence of fast growing air pollution in China since 1995 (Envisat + ERS-2).
- **Polar areas:** Daily monitoring of sea ice motion and observation of Antarctica ice-shelves collapse.
- **Oceanography:** Quantification of global chlorophyll concentration, an index of the oceanic phytoplankton biomass.
- **Tectonics:** Identification of the blind tectonic fault at the origin of the Bam earthquake in December 2003.



Ozone hole



NO_2 / SCIAMACHY (Jan. 2003 - June 2004)

MetOp

- El EPS es el primer sistena de satélites meteorológicos de órbita polar europeo.
- Vuelan a una altitud mucho más baja que los satélites meteorológicos (~800 km) Meteosats y proporcionan detalles más precisos de la temperatura atmosférica y los perfiles de humedad.
- Desarrollado con la colaboración de ESA y EUMETSAT.

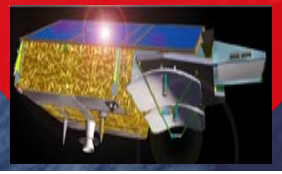
Launch of MetOp-A in 2006

ESA Earth Explorers

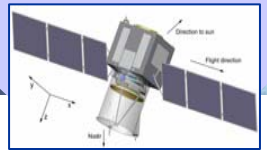
GOCE
17 March 2009

SMOS
November 2009

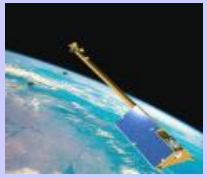
Cryosat
Feb. 2010



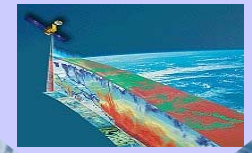
ADM AEOLUS



SWARM



EARTH CARE



7th EE

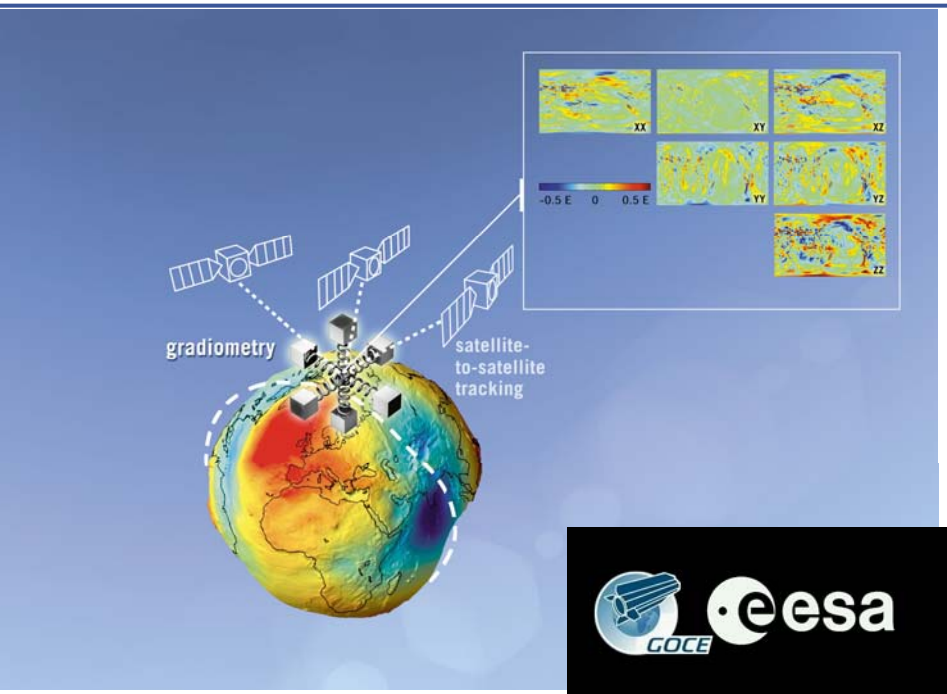
Living Planet

The Earth Explorer Missions

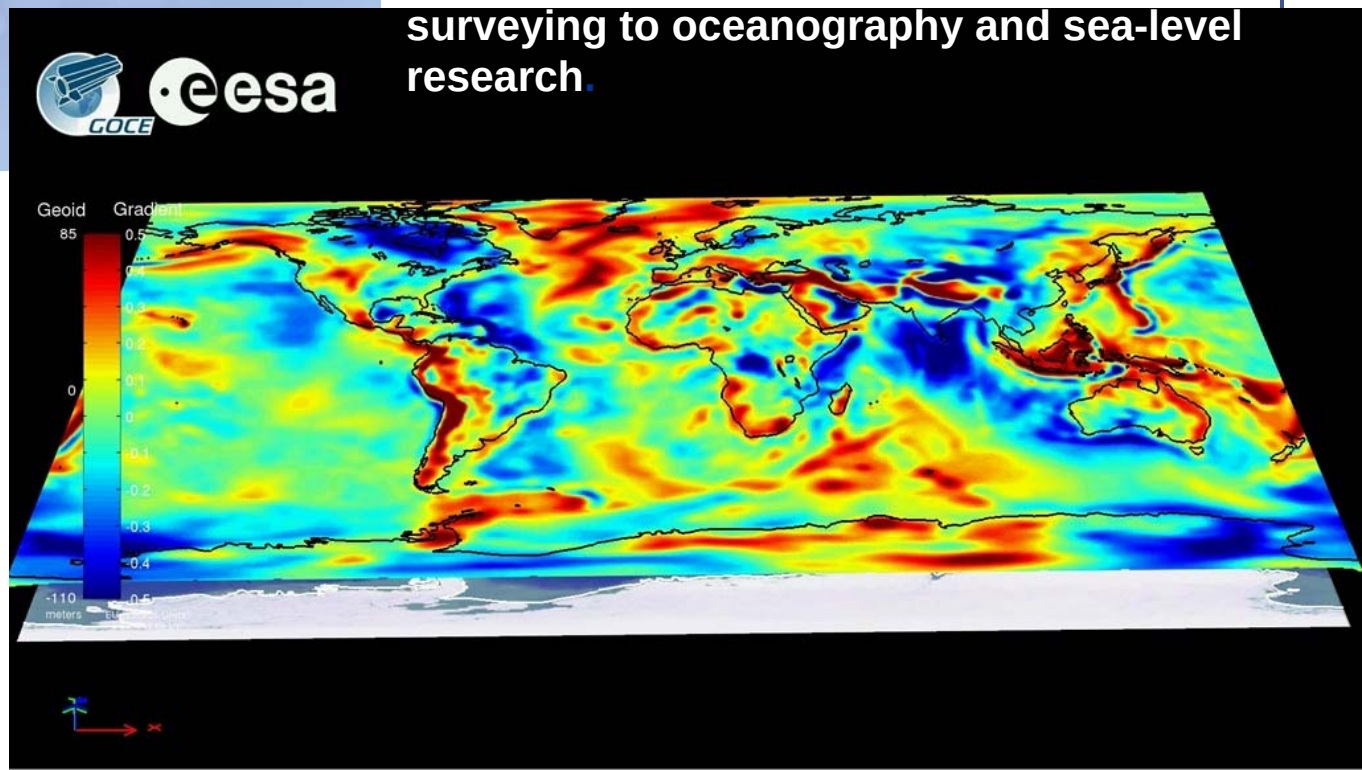
GOCE: Gravity field and steady-state Ocean Circulation Explorer

GOCE_liftoff_36s.wmv

La misión gravitatoria de la ESA

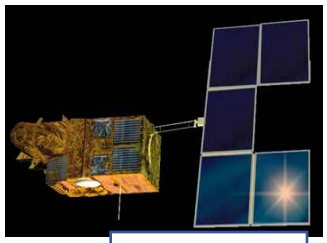


GOCE is now gathering data such as shown here to map Earth's gravity with unprecedented accuracy and spatial resolution. The final gravity map and model of the geoid will provide users worldwide with well-defined data products that will be instrumental in advancing science and applications in a broad range of disciplines. These will range from geodesy, geophysics and surveying to oceanography and sea-level research.



National, Eumetsat and Third Party Missions for GMES


Radarsat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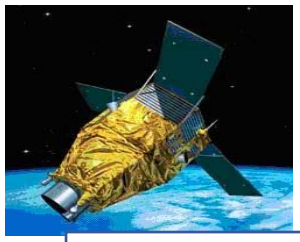
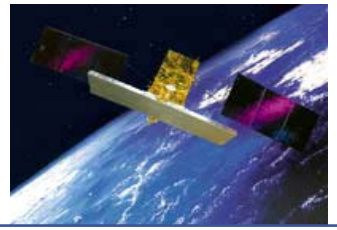
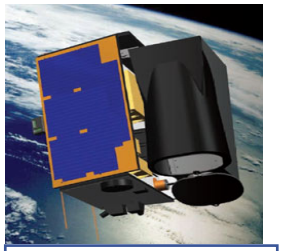
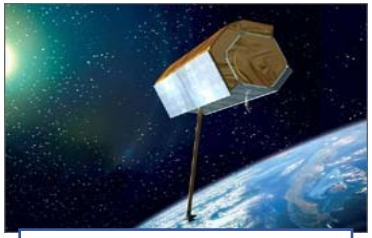

Pleiades

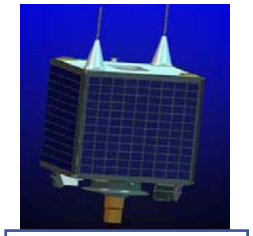

Jason-2


CosmoSkymed


TopSat

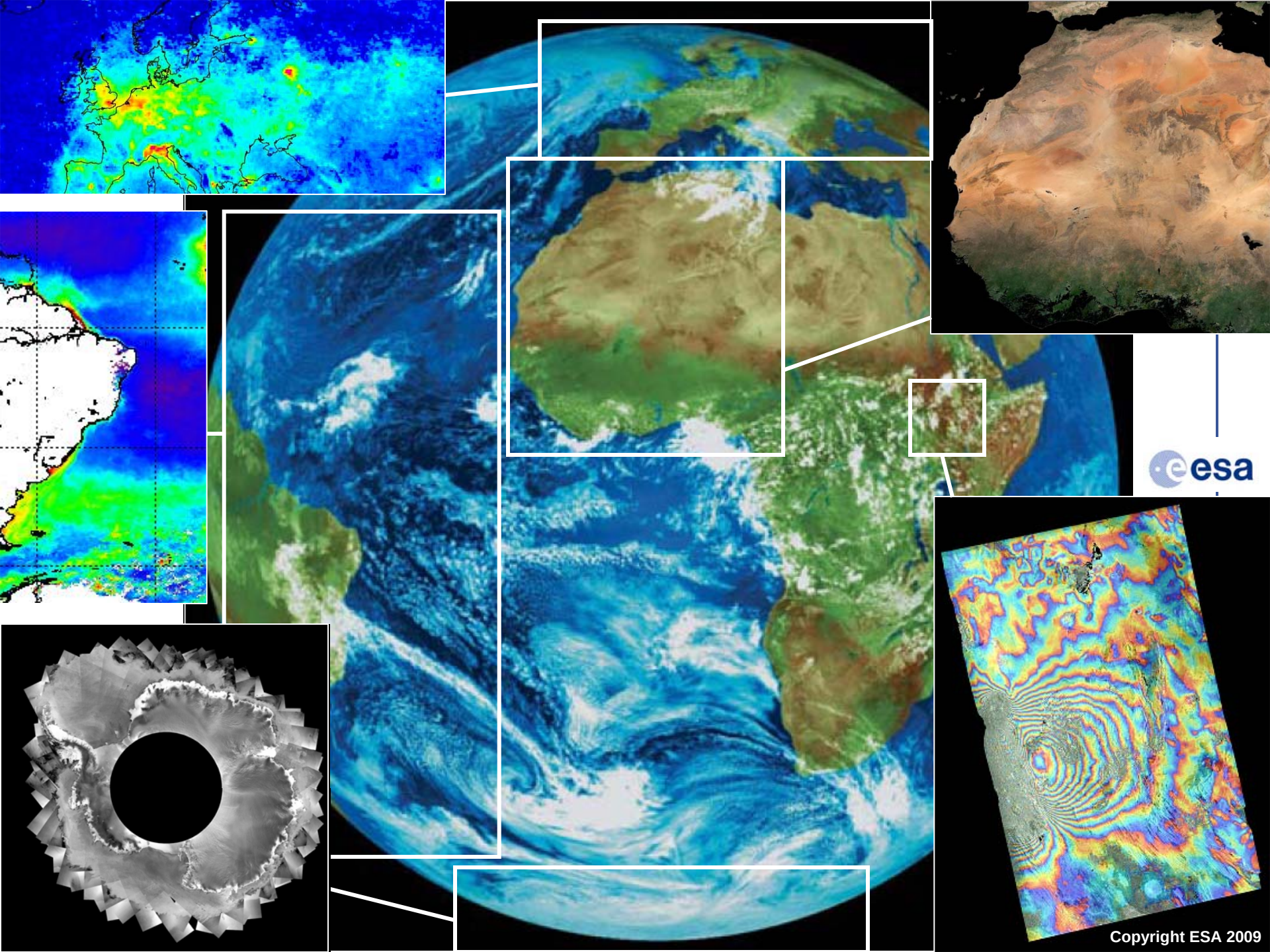

Terrasar-X


Rapideye


UK-DMC


METOP

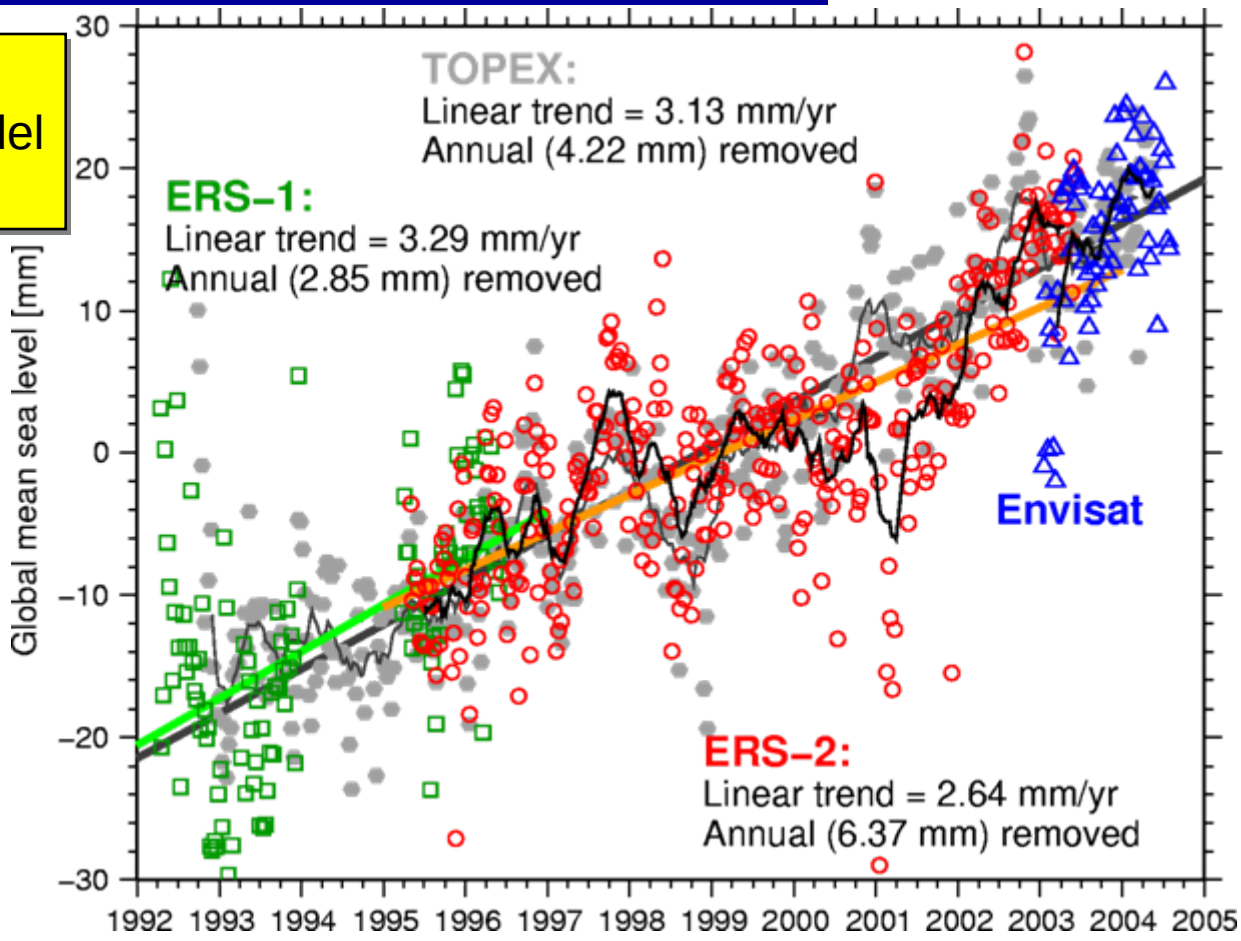
EO Applications


esa
Copyright ESA 2009

Elevación del nivel del mar

El altímetro de ENVISAT proporciona continuidad en las medidas iniciadas eal principio de los años 90

Tendencia de elevación del nivel del mar: +3 mm/año

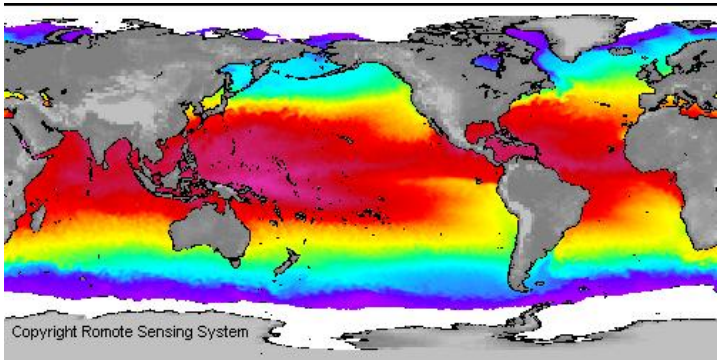


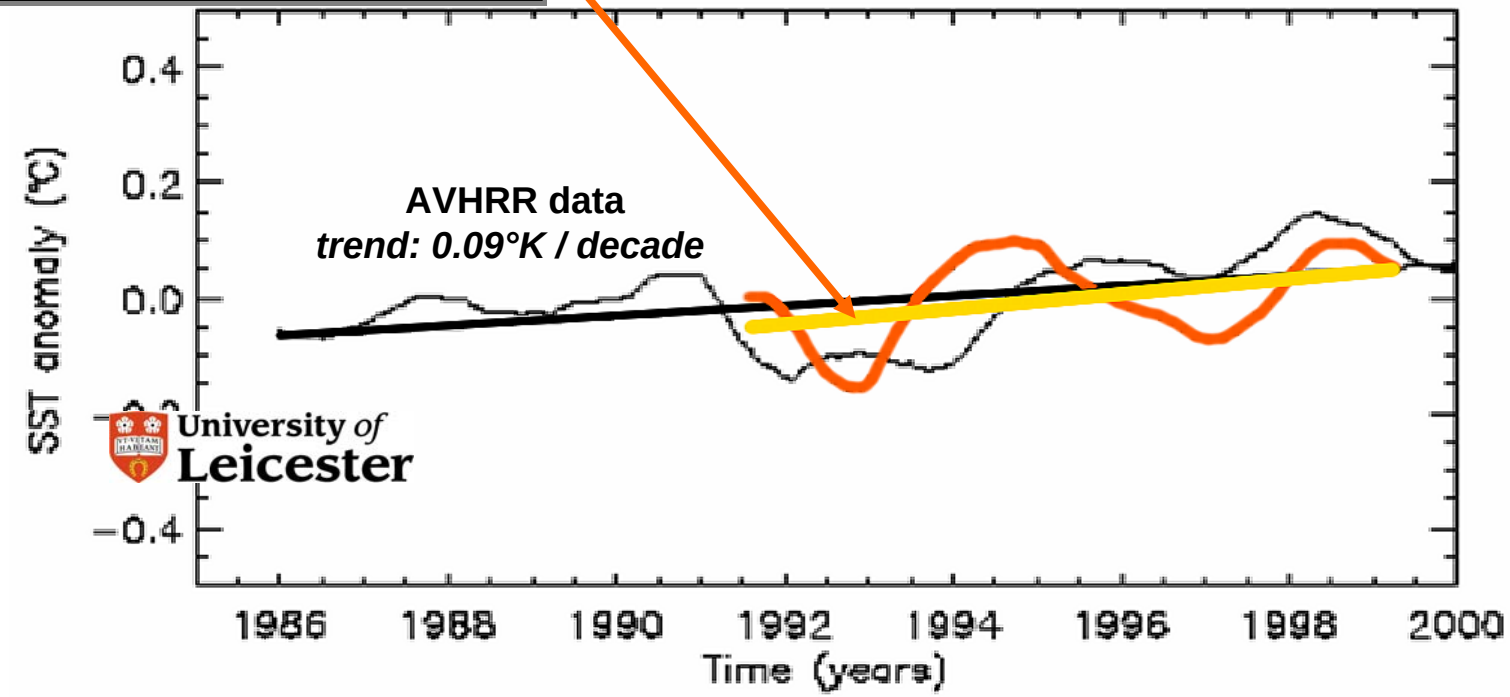
Courtesy of Remko Scharroo, NOAA,US

Temperatura superficial del mar

Medidas de la tendencia residual en la temperatura global de la superficie del mar

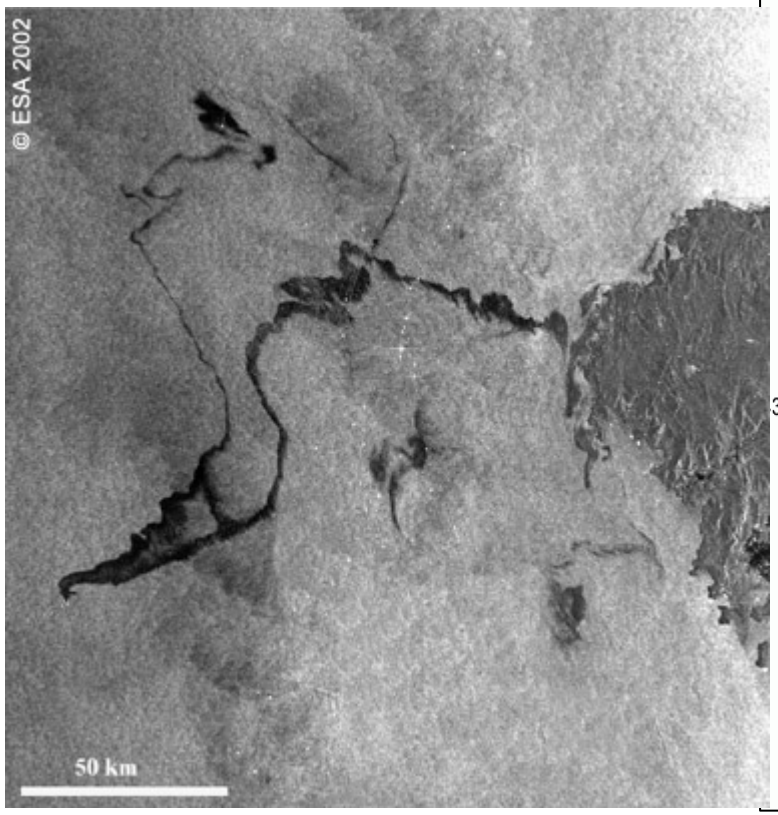
ERS / Envisat
Tendencia: +0.13°K / decada

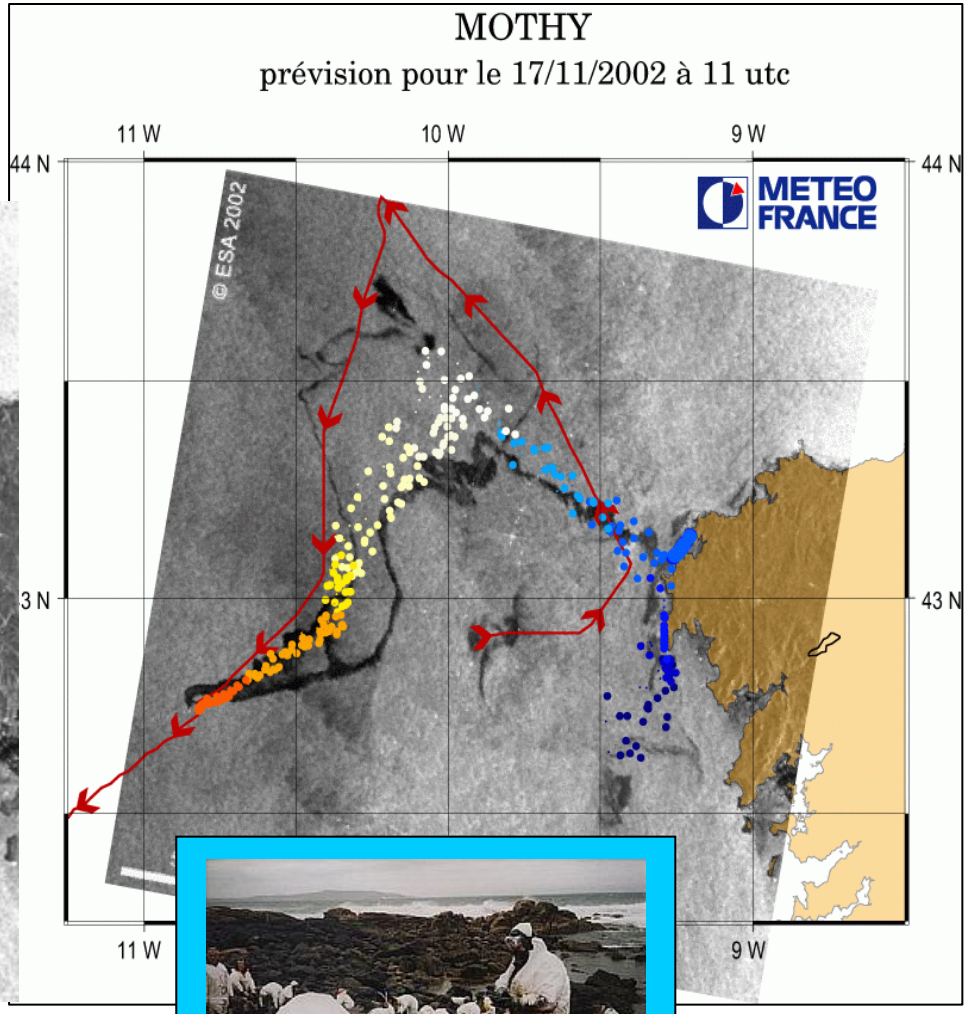




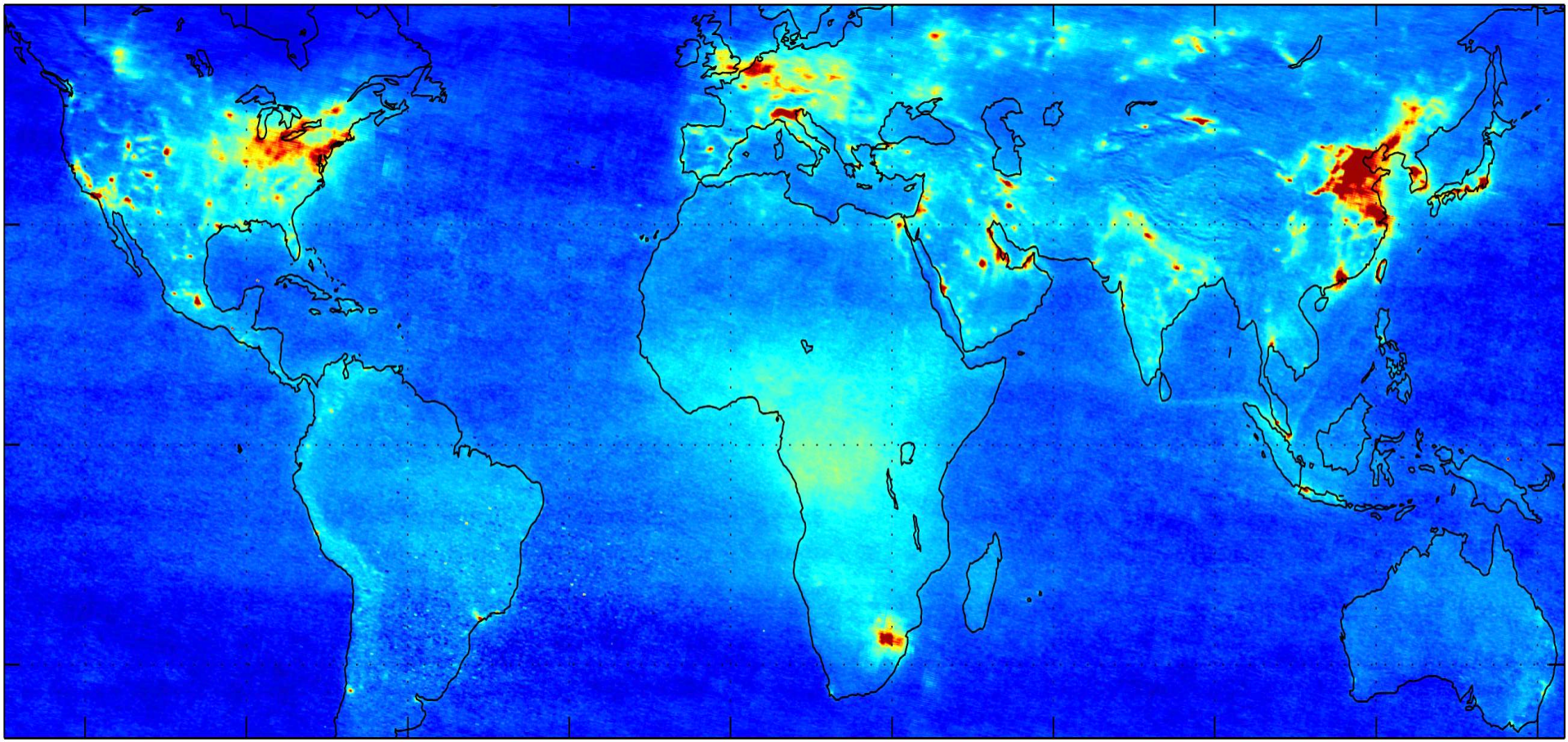
Seguimiento de derrames de petróleo

Derrame del petrolero “Prestige” visto por Envisat



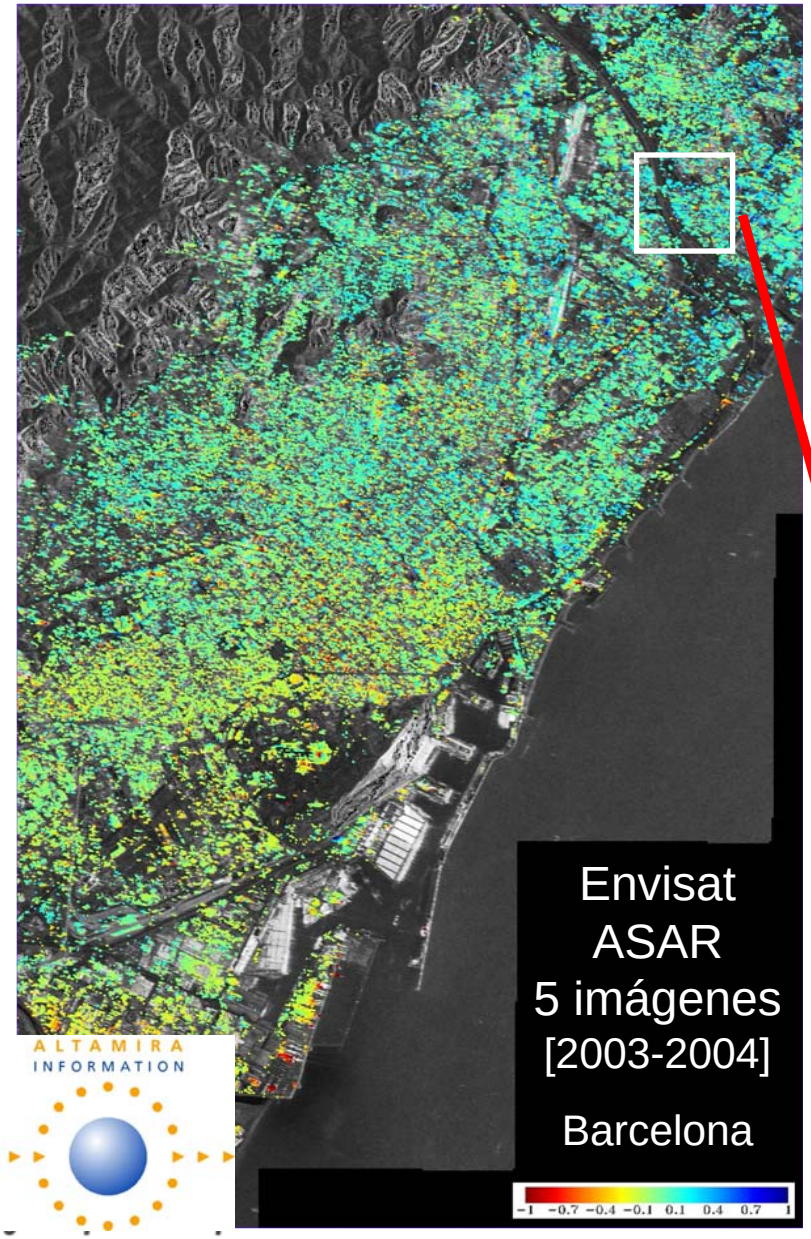


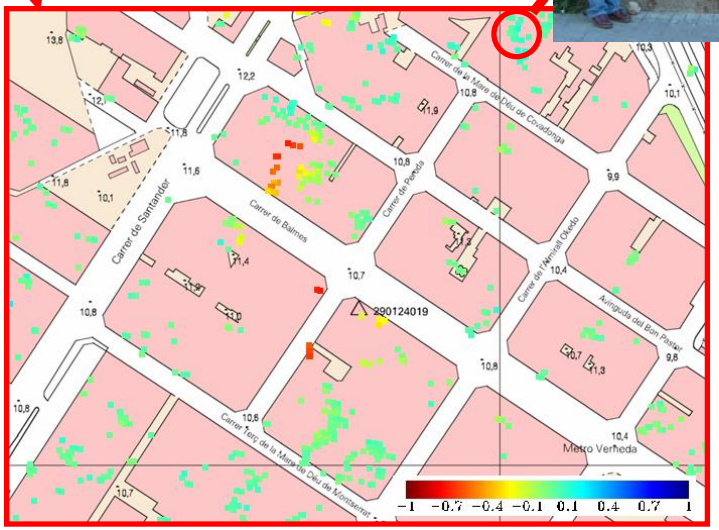
CONCENTRACIÓN DE NO2



Observación de subsidencias

Medidas interferométricas utilizando ERS SAR y Envisat ASAR





ALTAMIRA INFORMATION

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GlobCover: El nuevo retrato de la Tierra muestra la cubierta del suelo como nunca había sido vista antes

ESA EO Education: available tools for schools

CEOS: International cooperation

http://www.ceos.org/

The CEOS strategy for Earth observation education and training is the creation of an effective coordination and partnership mechanism among CEOS agencies and institutions offering education and training.

http://www.eohandbook.com/

CEOS, the Committee on Earth Observation Satellites, coordinates civil spaceborne observations of the Earth. Participating agencies strive to address critical scientific questions and to harmonise satellite mission planning to address gaps and overlaps.
www.ceos.org

ESA, the European Space Agency, is Europes gateway to space. It is an international organisation with 17 Member States. ESAs mission is to shape the development of Europes space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world.
www.esa.int

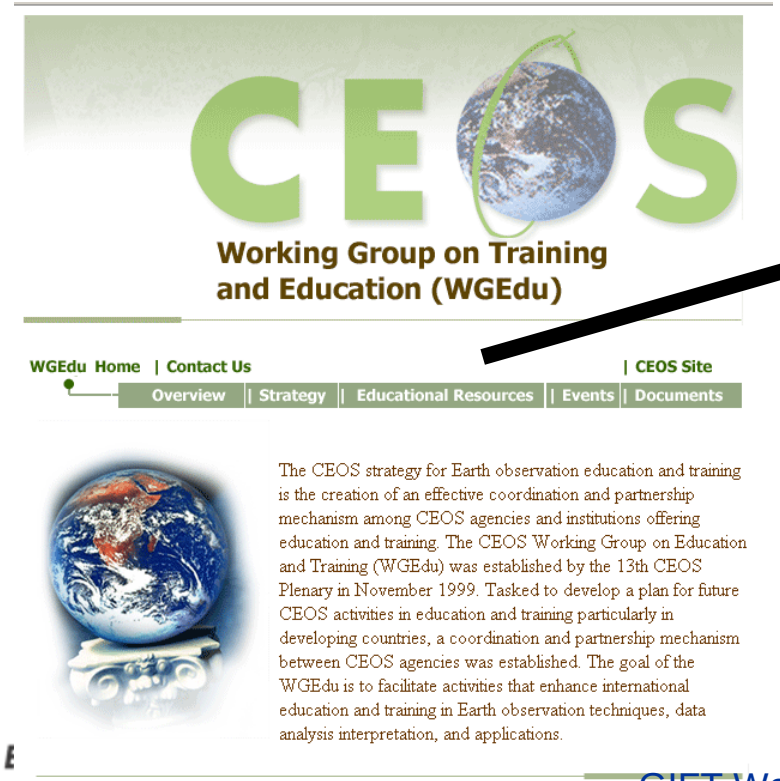
http://wgedu.ceos.org
reference to courses, case studies, satellite data, links to education sites

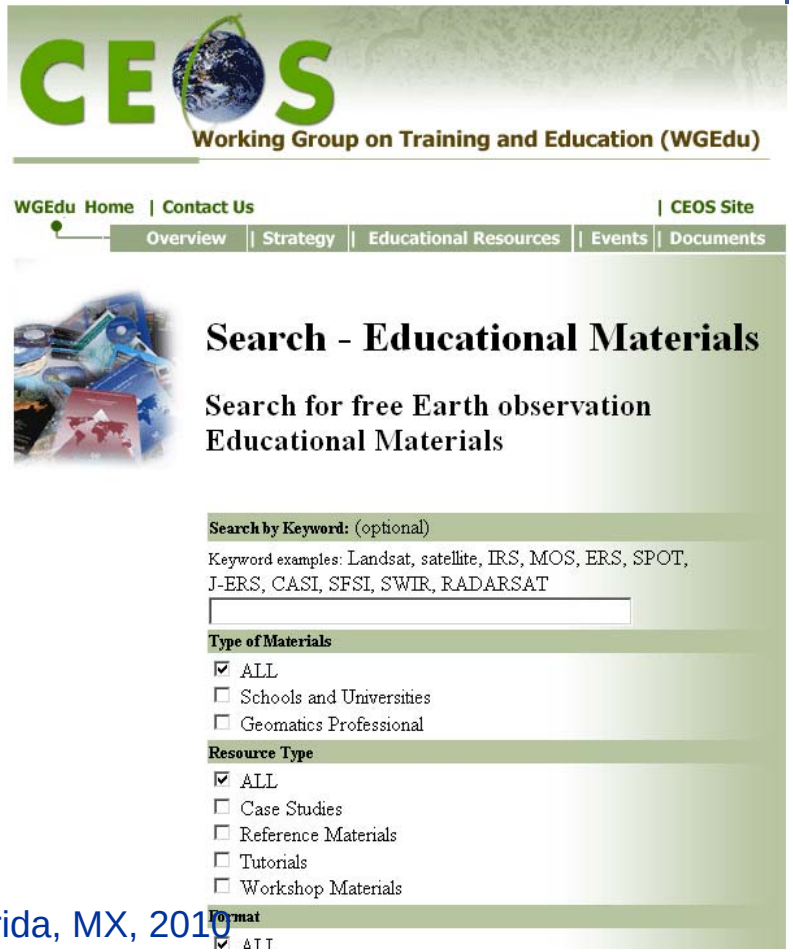
CEOS: International cooperation

The CEOS Working Group on Education and Training (WGEdu) links to a large database of free EO Educational material

http://www.acrors.ait.ac.th/ceos/home1_e.html

http://wgedu.ceos.org reference to courses, case studies, satellite data, links to education sites of various institutions through the internet.





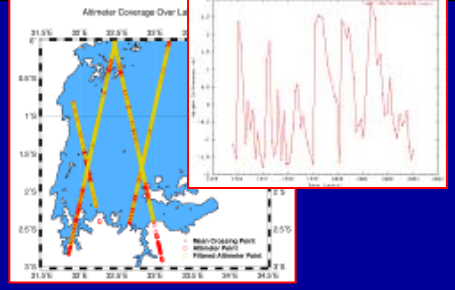
International Co-operation with Africa

TIGER Training Courses

Following the 2002 Johannesburg World Summit on Sustainable Development and focused on the use of space technology for water resource management in Africa. Series of training courses on a variety of applications and techniques.

http://www.tiger.esa.int/training_main.asp

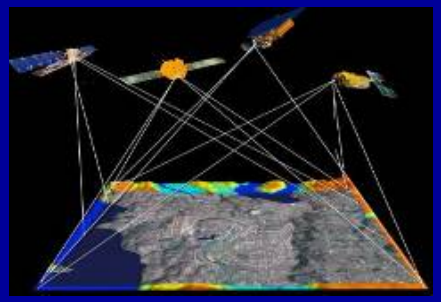
Wetlands Mapping



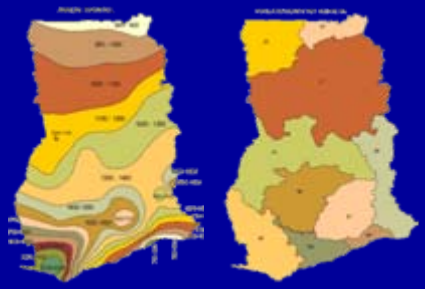
Rivers-Lakes-Water levels

Soil Moisture-SADC

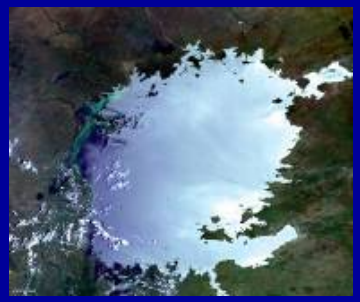
Nile Awareness Kit



Land and Topo. -Ghana.



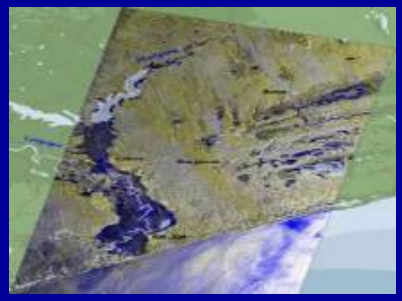
Hydrogeo. Model-Ghana



Lake Quality-Victoria

Lake Quality-Egypt

IS for IWRM-Morocco



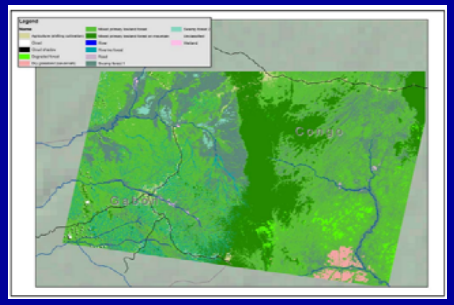
IS for IWRM- Mozambique

IS for IWRM-Zambia

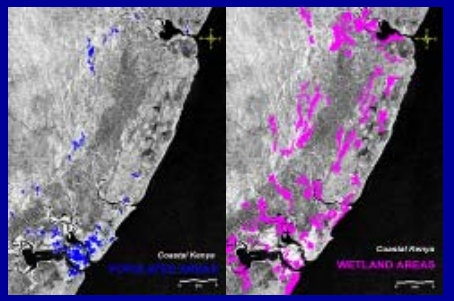
IS for WRM-Burkina Faso

AQUIFER

Water & Ground str.-Niger



EPIDEMIO



Malaria-mapping

International Co-operation with China:

DRAGON Training Courses

ESA Summer Schools

esa

Earth Observation Summer School

European Space Agency

ESA

Home

envschool@esa.int

2010 >

2008 >

2006 >

2004 >

2003 >

To join the EO summer school mailing list enter your email address and press submit.

Submit

5th ESA EARTH OBSERVATION SUMMER SCHOOL

ON EARTH SYSTEM MONITORING & MODELLING

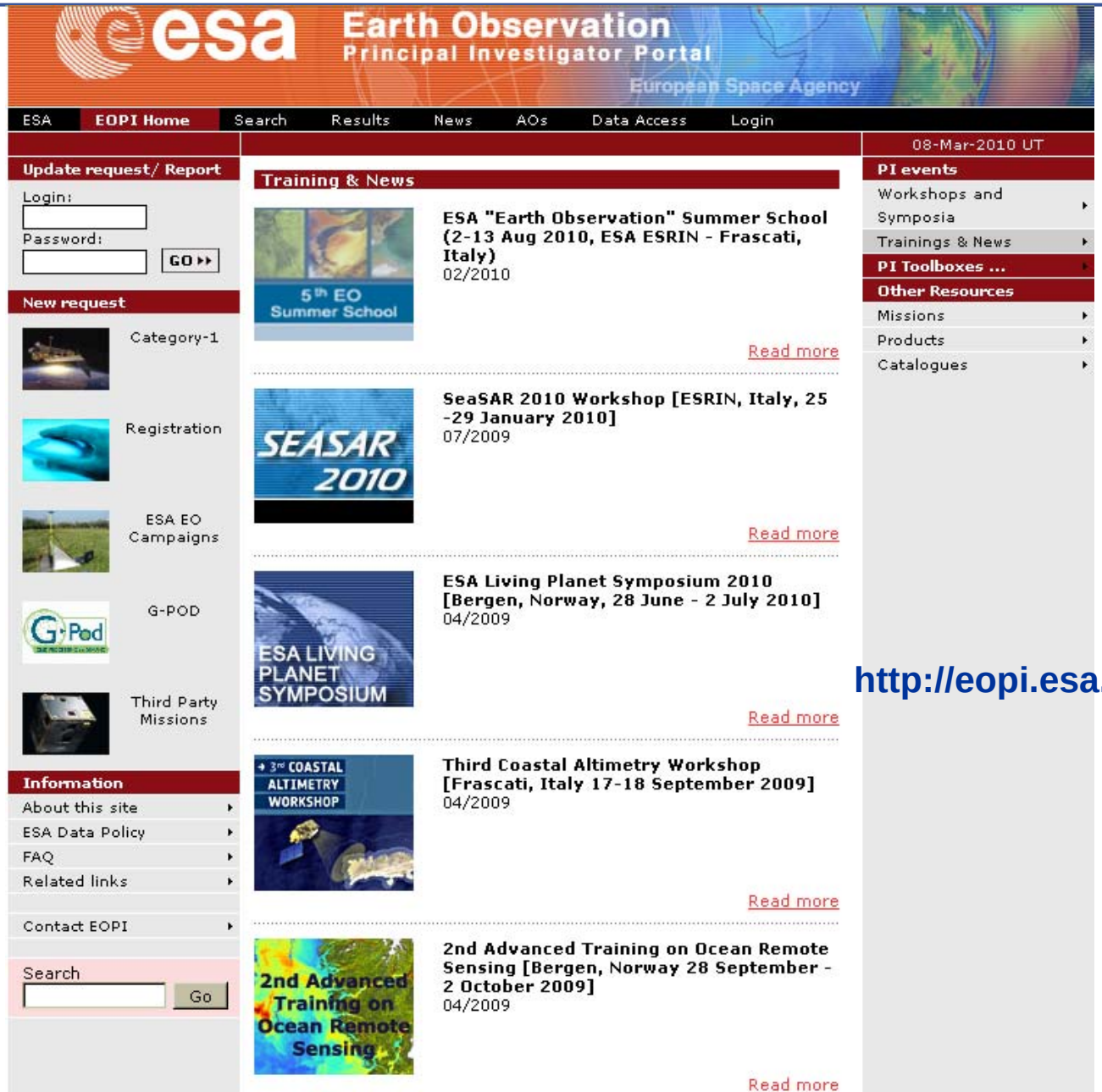
2-13 August 2010 | ESA-ESRIN | Frascati (Rome) Italy

Application is now open.
Please apply by completing the form no later than 15 March 2010.

Background and Objectives

The European Space Agency (ESA) organizes a series of summer schools on *Monitoring of the Earth System* to promote the exploitation of Earth Observation EO data across disciplines, with a specific focus on their assimilation into Earth System models.

ESA training courses in Europe



http://eopi.esa.int/esa/

European Space Agency
Agence spatiale européenne

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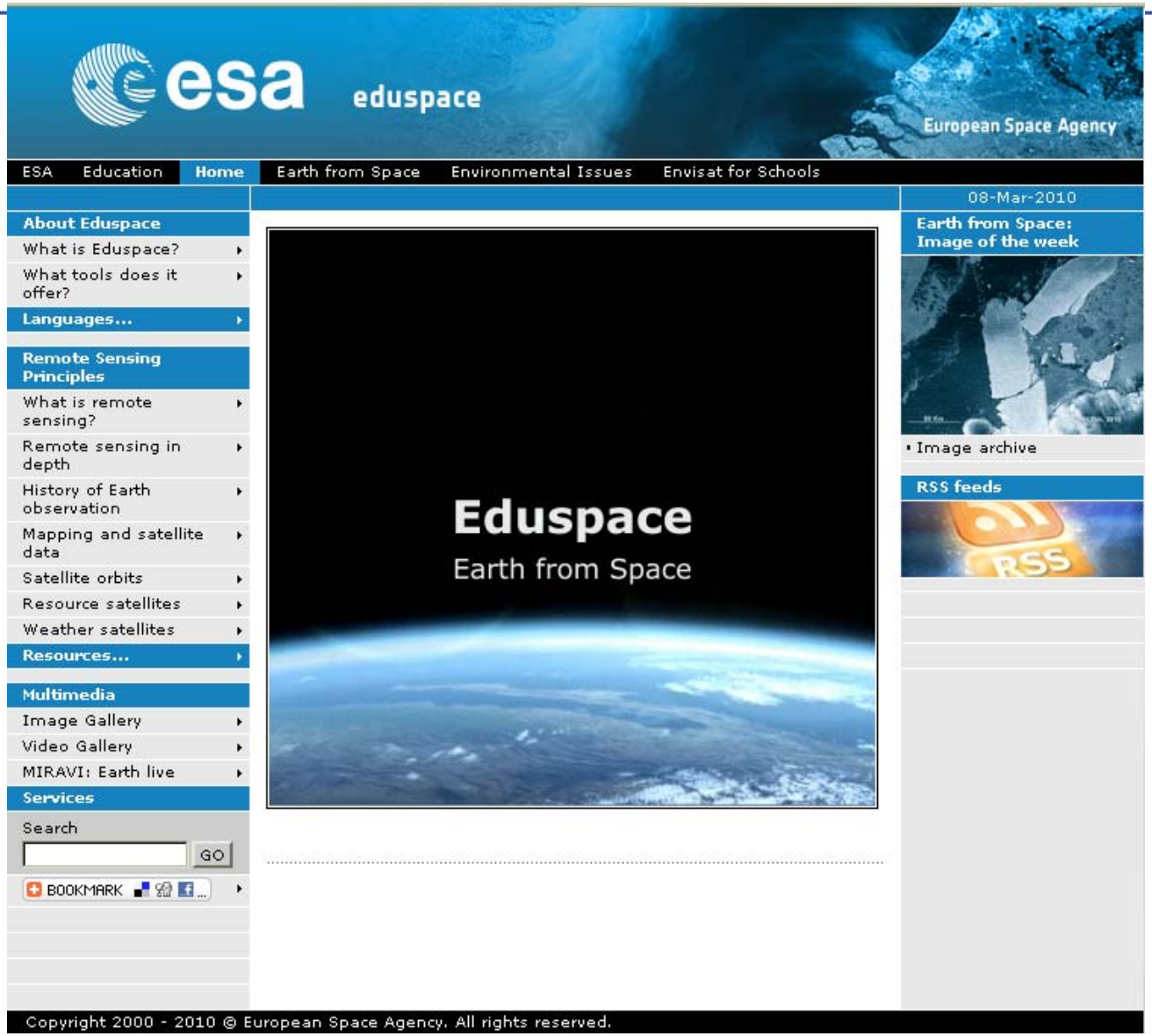
EDUSPACE



European Space Agency
Agence spatiale européenne

http://www.esa.int/SPECIALS/Eduspace_EN/

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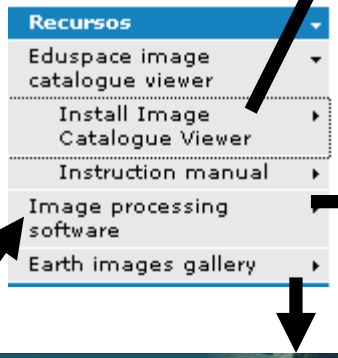
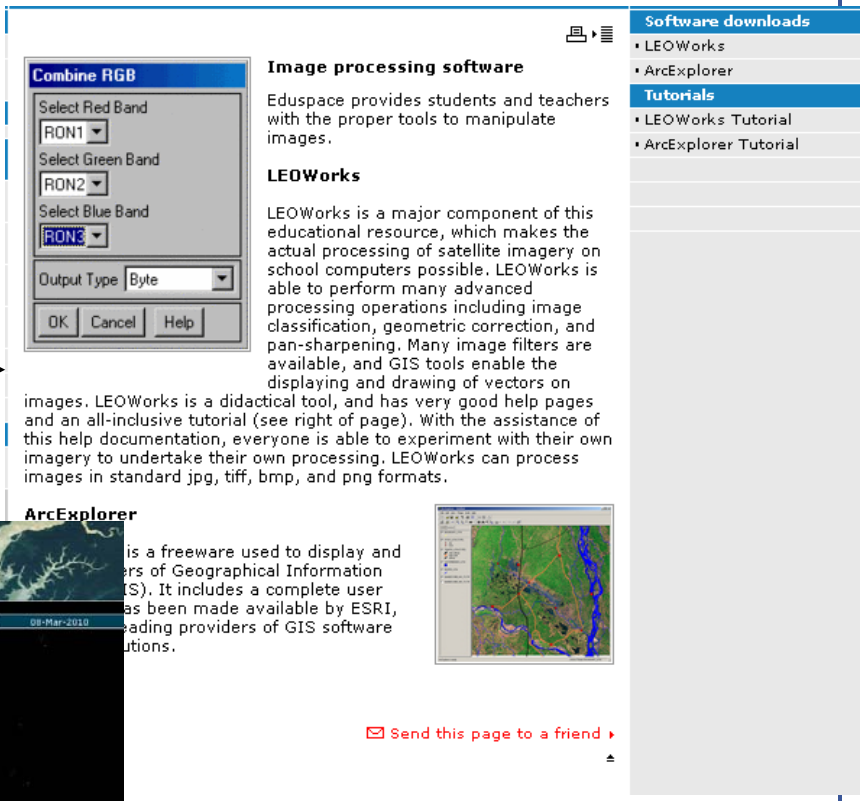
Target Groups

- Secondary school teachers who want to incorporate EO into their curricula
- Secondary school students to extend on what they have learned in class
- University students pursuing related academic studies
- Access to website www.esa.int/eduspace is free

EDUSPACE

http://imagedbk-srv.esrin.esa.int/Eduspace_Installer/install.htm



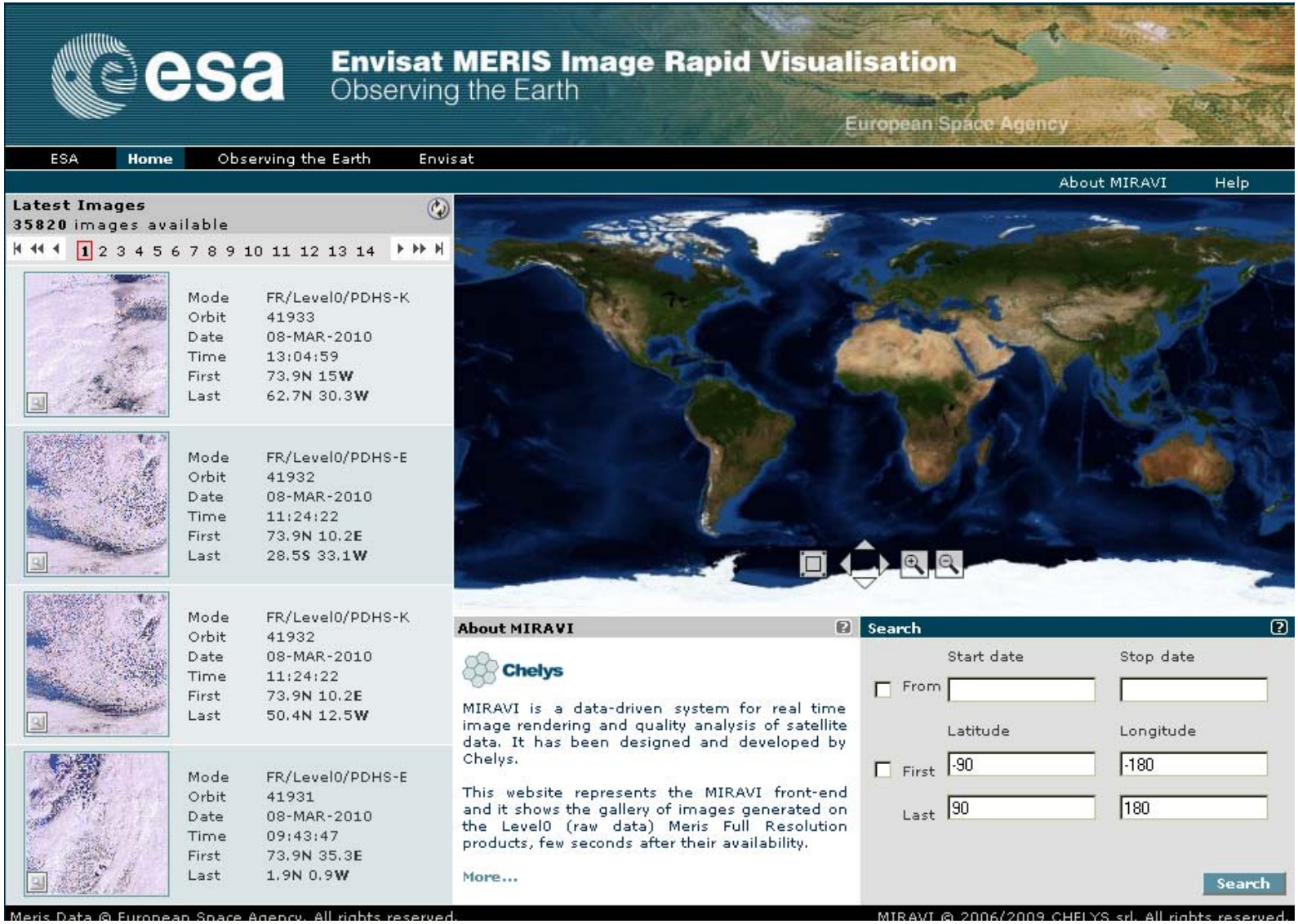


http://earth.eo.esa.int/satelliteimages/

Agence spatiale europeenne

the Living Planet

http://miravi.eo.esa.int/en/



OBJECTIVES

- To inspire teachers to incorporate Earth observation into their curricula
- To provide ready-made curricula projects
- To provide tools and Earth observation data for educational purposes
- To enable schools to take part in collaborative work in Earth observation through a network

E-learning

What is remote sensing?

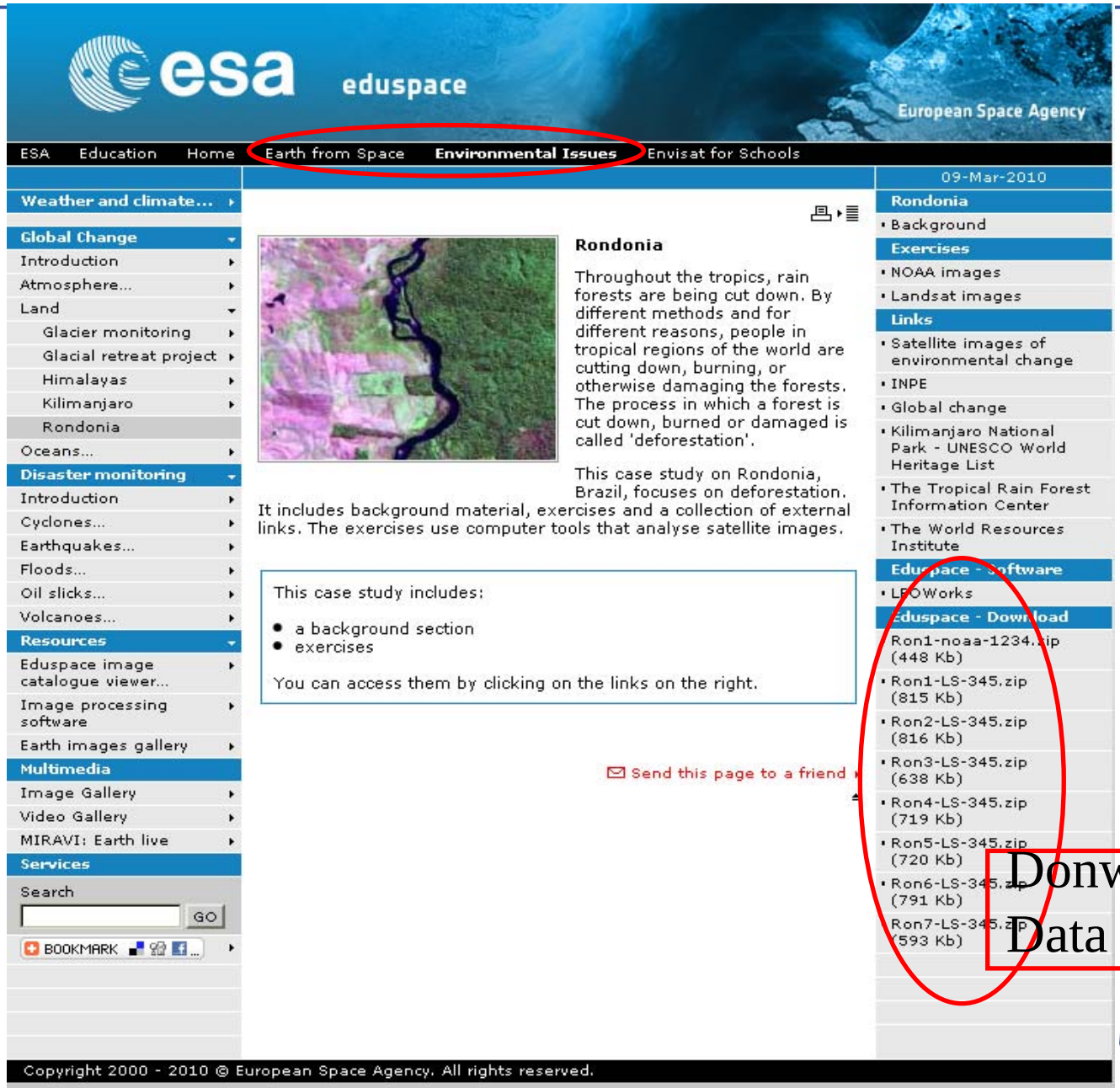
Remote sensing is a way of collecting and analysing data to get information about an object without the instrument used to collect the data being in direct contact with the object.

For example, if you take a photograph of your house, and on the picture you see that the house is composed of a roof, walls and windows, all of which appear as different colours, then this is remote sensing.

In remote sensing, three elements are essential. They are:

1 - a platform to hold the instrument
2 - a target object to be observed

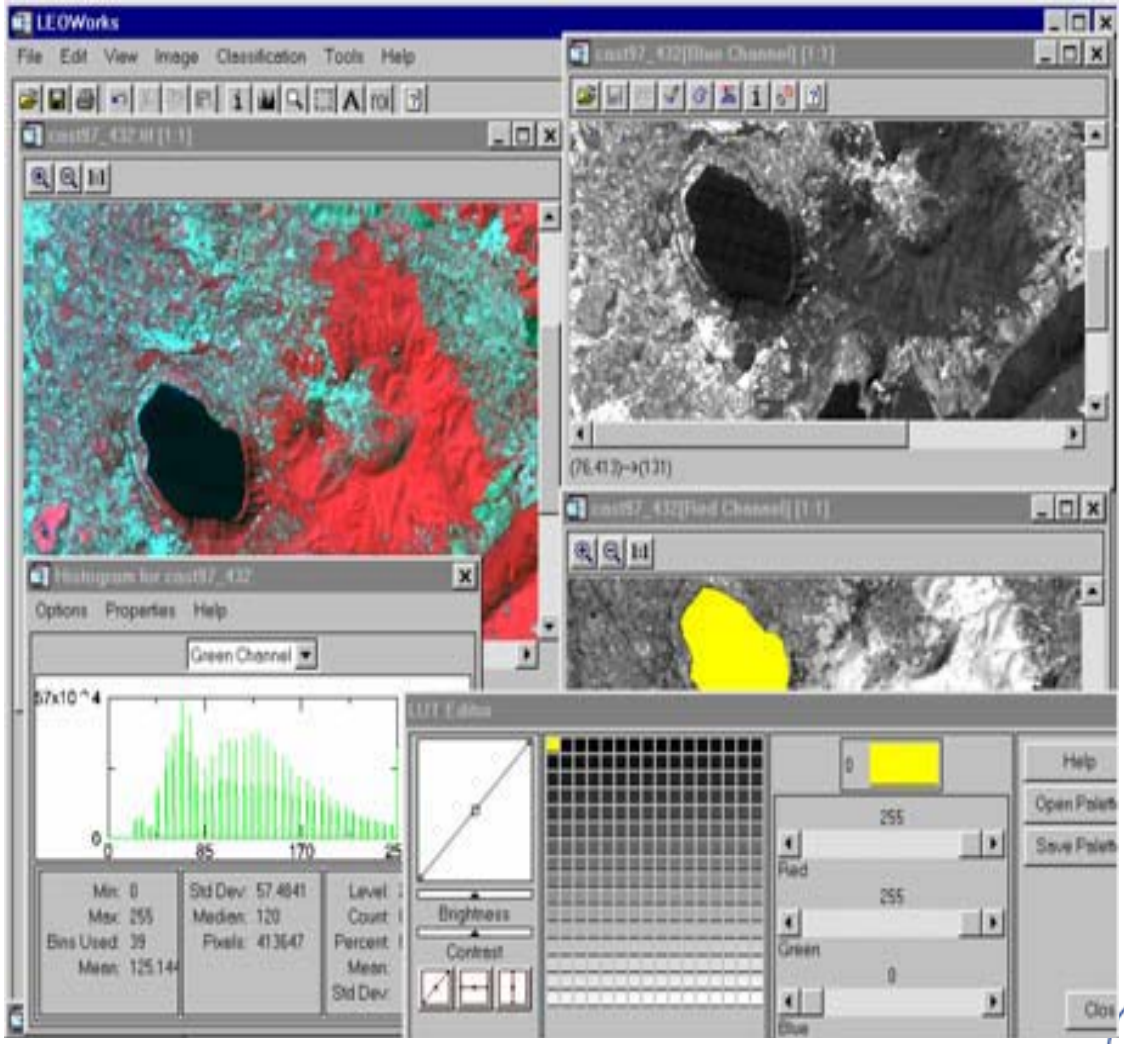
EDUSPACE: Case studies



LEOWorks 3.0

Image Processing Software (with GIS functionality)

- View images, histogram, pixel values, header info
- Crop, invert, stretch, layer stack, etc
- image arithmetic, filters
- Classification, PCA, geometric correction, pan sharpening
- GIS tools



eduspace

CHARTER for schools

INTERNATIONAL CHARTER
SPACE AND MAJOR DISASTERS

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  - Activating the Charter
  - Charter Members
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- Advanced Search
- Links

Search

The Charter for Schools

ESA in collaboration with the French publisher Nathan has produced a supplement on the Charter for "La Documentation par l'Image", a magazine distributed to schools and targeted at 8/12-year-olds and their teachers.

The objective is to explain how the mechanisms of the International Charter Space and Major Disasters work and to provide an introduction on the use of satellites and satellite images.

As a teaching guide, the supplement also includes three worksheets which can be used in the classroom to check how much children have learned and stimulate discussion.

The supplement is available in five languages: English, French, Italian, Spanish, and German.

The teaching guides and an introduction to the Charter for teachers are also available at the ESA education portal.

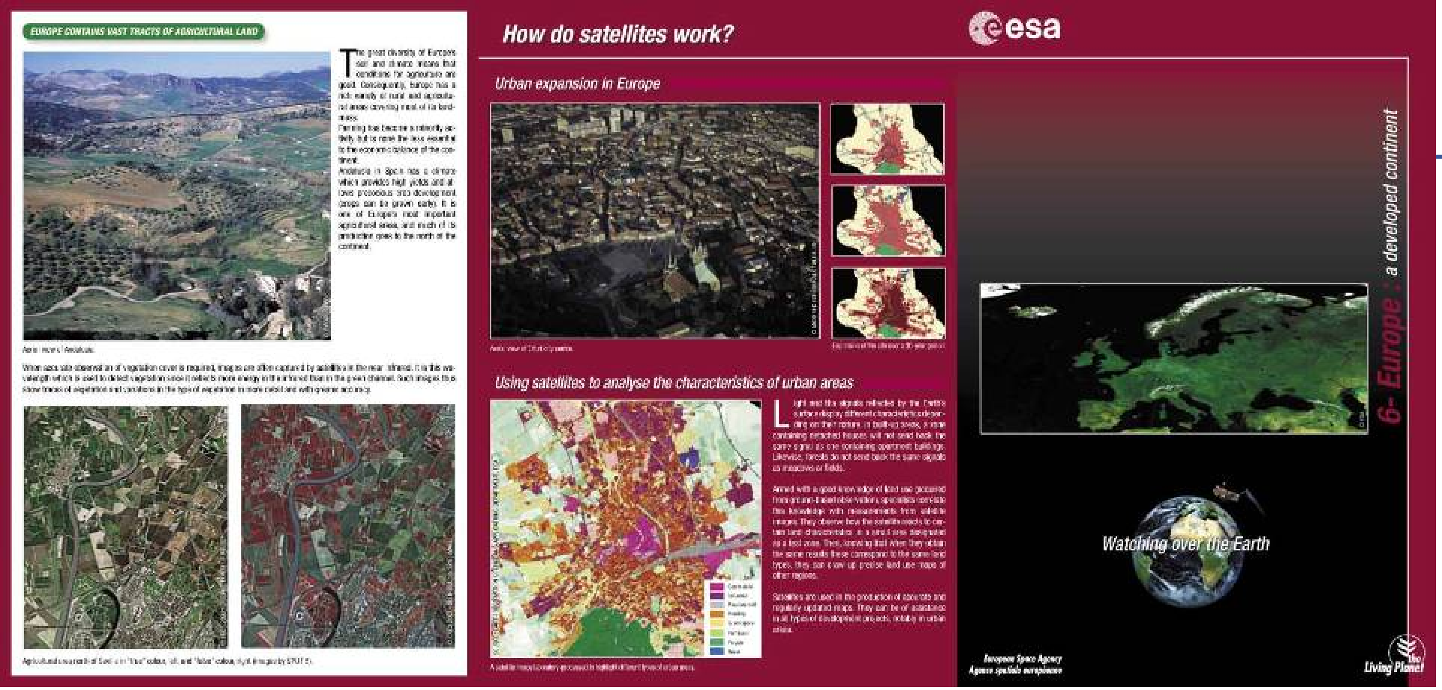
CHARTER for schools

- Target: primary/lower secondary level (8-12 years)
- Objective: make the role of space facilities to manage natural and technological disasters more visible to youngsters
- Product: a children supplement in 5 languages (En, Fr, It, Sp, Ger) downloadable in pdf from the Charter website http://www.disasterscharter.org/ecoles_e.html
- Includes 3 worksheets to be used in the classroom as exercises and to stimulate the discussion

SCHOOL KIT

(alias TEACHER's PACK)

- Target: lower secondary level (11-14 years)
- Objective: provide teachers with a working tool to introduce EO themes in schools.
- Available in 4 languages (En, Fr, Sp, Ned). German translation is ongoing
- Product: a folder containing 11 worksheets on EO themes related to teaching subjects such as geography, life and Earth sciences, physics. Each worksheet is composed of 3 colour pages recto-verso (triptych), plus an exercise sheet and a teacher information note



European Space Agency
Agence spatiale européenne

TOPICS

1. Earth observation satellites
2. The Earth viewed from space
3. Humans on Earth
4. Africa and environmental diversity
5. Asia and rice-growing
6. Europe: a developed continent
7. Living species and their environments
8. Water on Earth
9. Volcanoes: Mount Etna, a case study
10. Flood monitoring
11. Colours in satellite imagery

ESA School Atlas

ESA School Atlas – Funded by ESA, **produced by GEOSPACE**

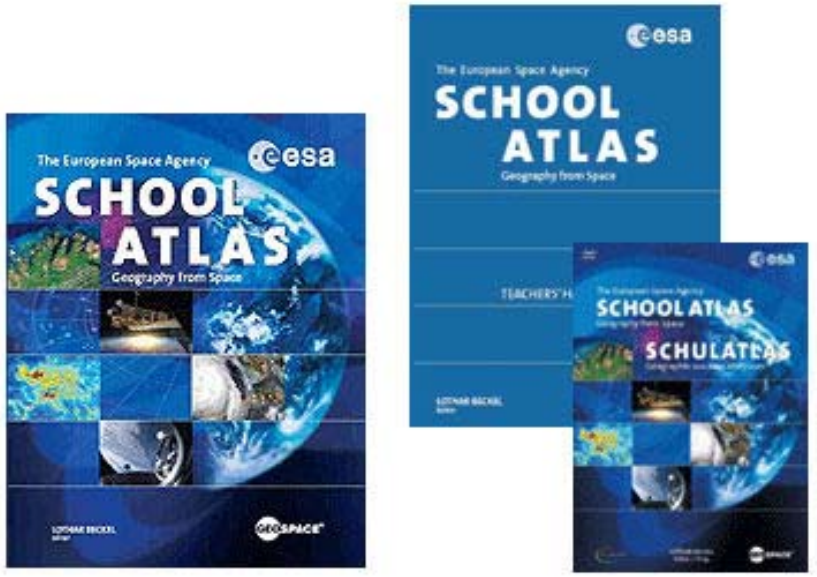
Targeting secondary schools and first university courses:

Realistic views of the Earth's surface, combined with thematic maps demonstrate the dynamic processes of our globe.

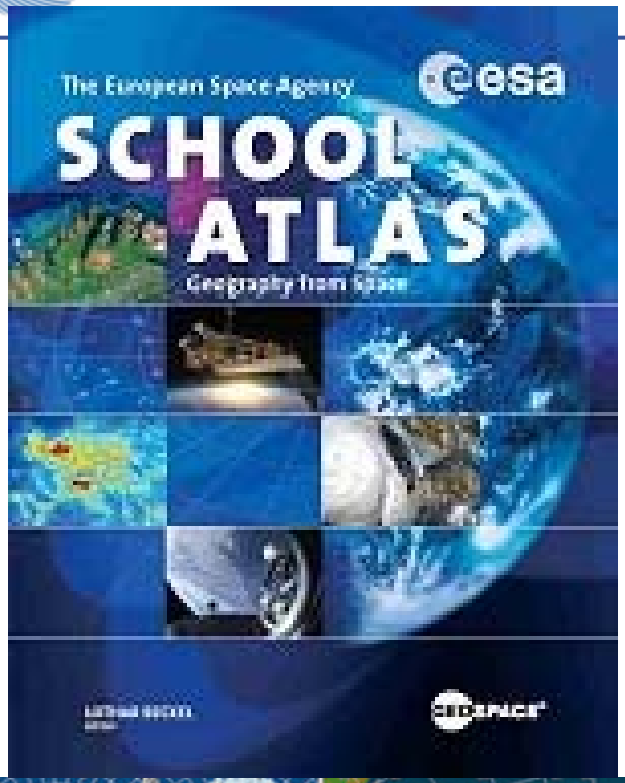
The atlas is accompanied by a Teachers' Handbook, a digital version on 2 DVD's and is also connected to Eduspace.

The Atlas is available in both English and German from the Geospace website at a special concessionary price for schools.

Order from: **www.geospace.co.at**



ESA School Atlas



1) Introduction to ESA (10 pages)

2) Earth Observation (8 pages)

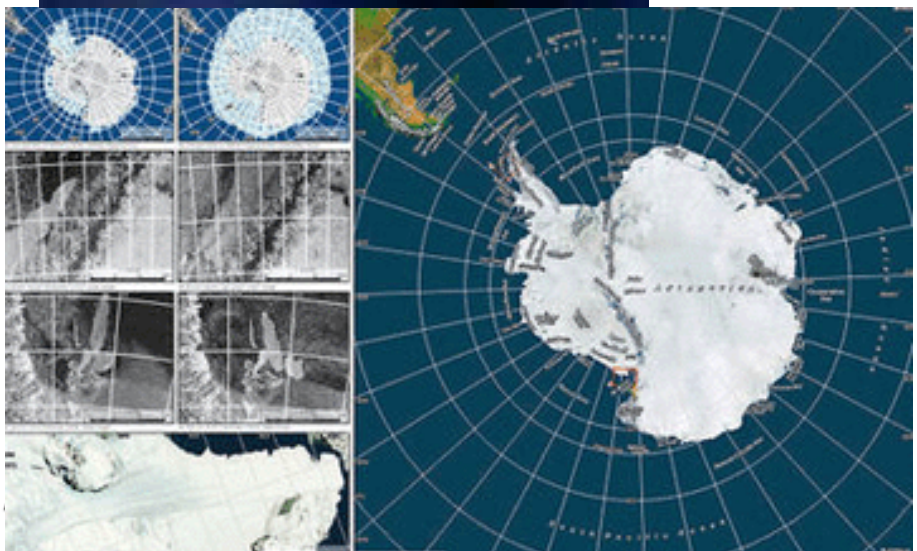
3) Global Overview (20 pages)

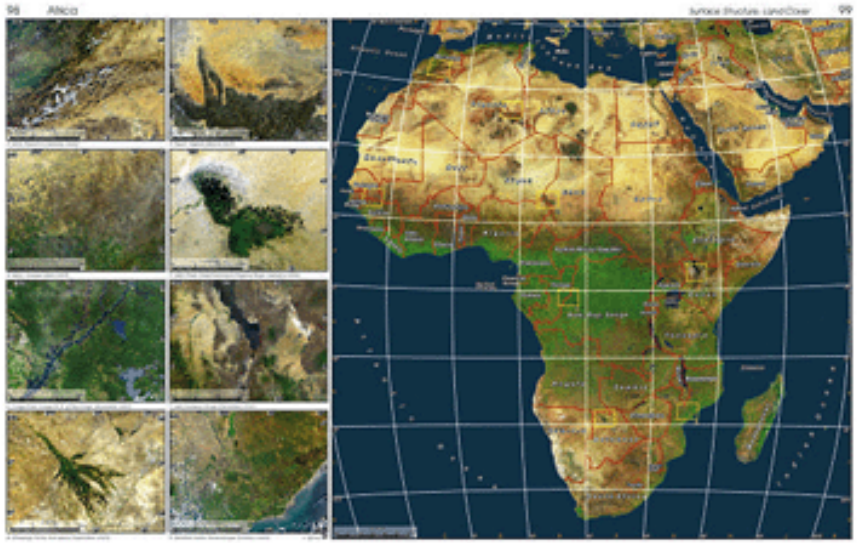
4) Continental Overview (82 pages)

5) The Natural Sphere (60 pages)

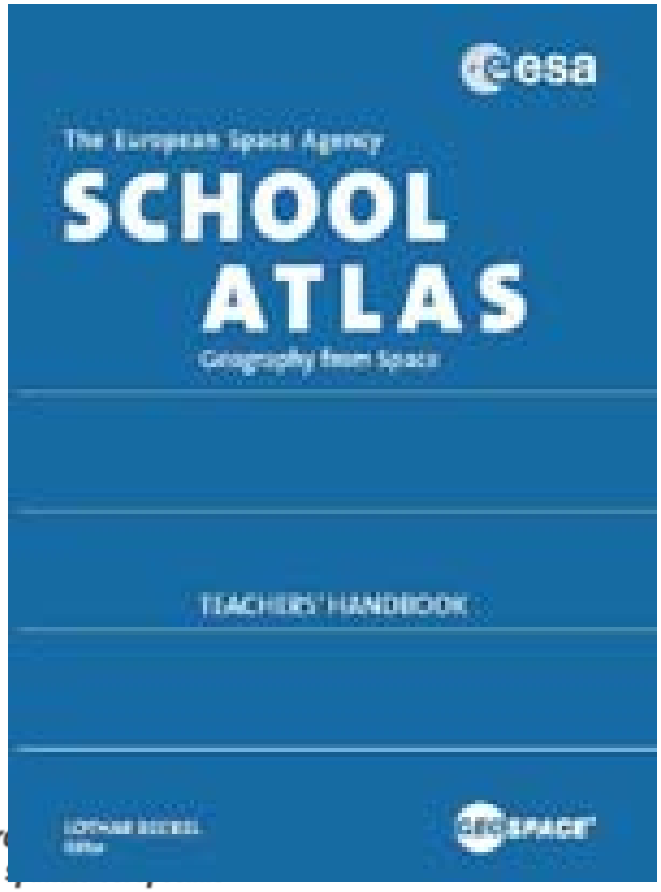
6) The Cultural Sphere (78 pages)

Index (18 pages)





Annex to the ESA School Atlas - Teachers' Handbook



Provides an introduction to Earth Observation and a general description of each double page of the Atlas. For every image or thematic map, technical information on the data, as well as descriptions and interpretation aids are included.

The purpose of the Teachers' Handbook is to support teachers in the use of the Atlas in the classroom. There are numerous suggestions of questions and exercises – for many of them the LEOWorks software may also be used.

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Annex to the ESA School Atlas - DVDs

The two DVD-ROMs contain the pages of the ESA School Atlas in reduced resolution (PDF format), **original bands of the satellite data, handbook content and exercises**. The images correspond with the maps in the atlas in the form of original data and thematic vector data. The software tools allow to process and evaluate the image data and thus to arrive at new maps.

Planet earth, heavens above!

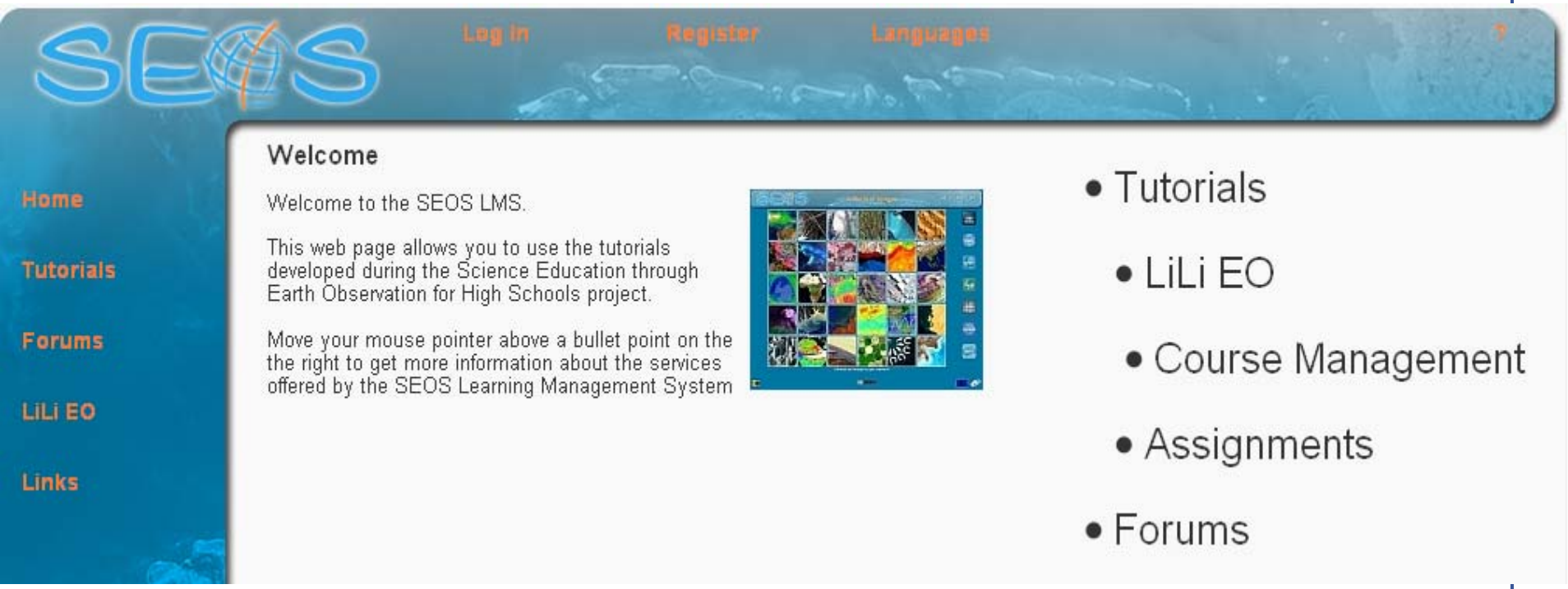
- Target: primary level (8-10 years)
- Objective: present EO themes (e.g. atmosphere, water, Earth's ice cover) to children trying to amuse and interest them (game approach)
- Product: CD-Rom in 7 languages (En, Fr, Du, De, It, Sp, Port)

Science Education via EO for High Schools (SEOS)

Projects with external partners :

6th Framework Programme of EC

http://lms.seos-project.eu/



Final Remarks

• EO education and capacity building is becoming increasingly more important in view of climate change, more frequent natural disasters (storms, flash floods, etc…), natural & cultural heritage degradation and need of preservation

• ESA and many other space agencies are taking this very seriously and aim to promote EO to an increasingly large, world wide audience

• All audiences including schools are targeted as decision makers and disaster managers of tomorrow are sitting in the classrooms today! EO and Space Education should be available for youngsters in schools, well before university level…..