



An overview of Earth Observation (EO) programme of the European Space Agency (ESA) for applications in disaster monitoring

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www.esa.int

European Space Agency

1. Introduction to ESA and EO programmes
2. Examples of applications to Disaster Monitoring
3. International Charter “Space and Major Disasters”
4. Preparing for the future: Global Monitoring for Environment and Security (GMES)

ABOUT THE EUROPEAN SPACE AGENCY (ESA)



PURPOSE OF ESA

“To provide for and promote, for exclusively peaceful purposes, cooperation among European states in **space research** and **technology** and their **space applications**.”

Article 2 of ESA Convention



19 MEMBER STATES AND GROWING



ESA has 19 Member States: 17 states of the EU (AT, BE, CZ, DE, DK, ES, FI, FR, IT, GR, IE, LU, NL, PT, RO, SE, UK) plus Norway and Switzerland.

Eight other EU states have Cooperation Agreements with ESA: Estonia, Slovenia, Poland, Hungary, Cyprus, Latvia, Lithuania and the Slovak Republic. Bulgaria and Malta are negotiating Cooperation Agreements.

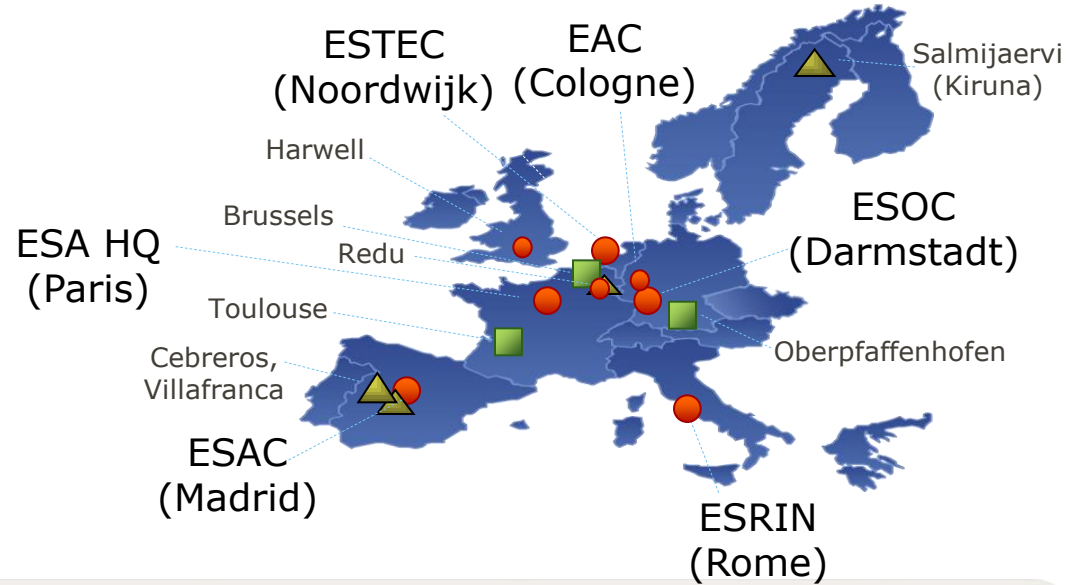
Canada takes part in some programmes under a Cooperation Agreement.



ESA'S LOCATIONS



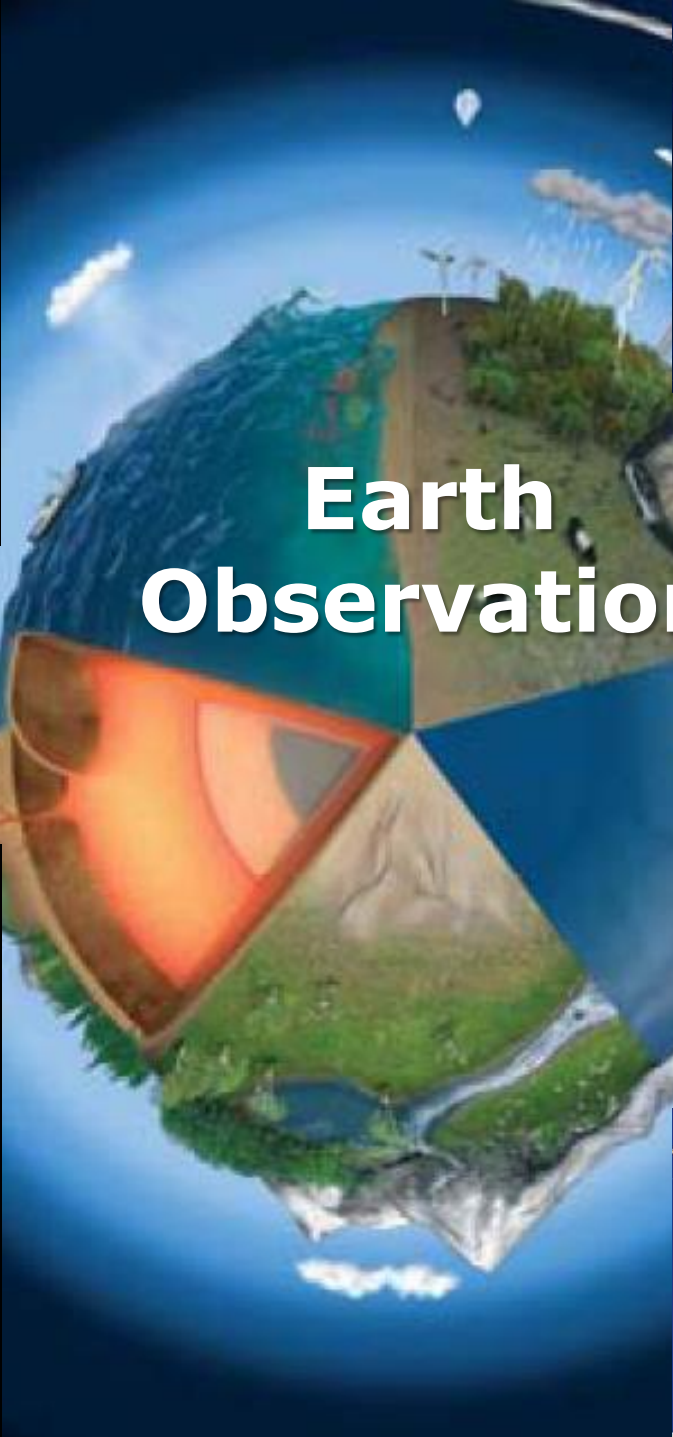
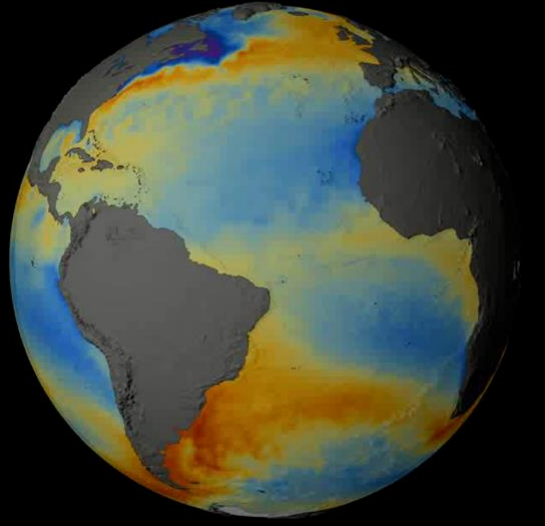
- ESA sites/facilities
- Offices
- ▲ ESA ground stations



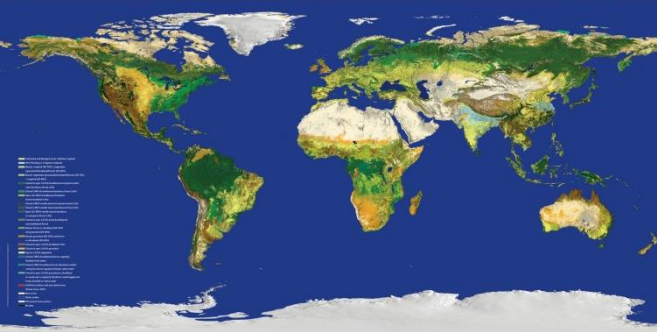
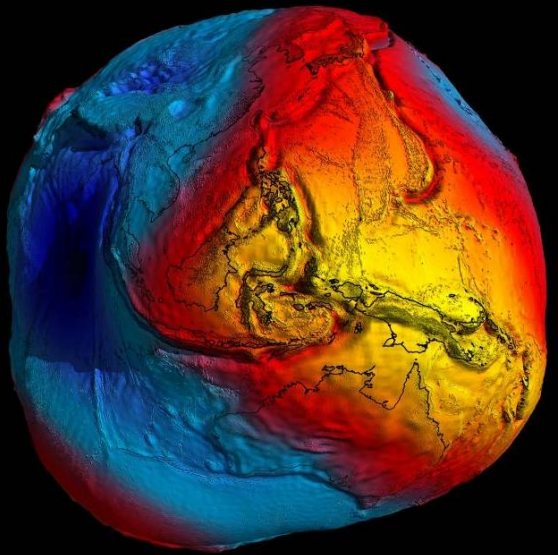
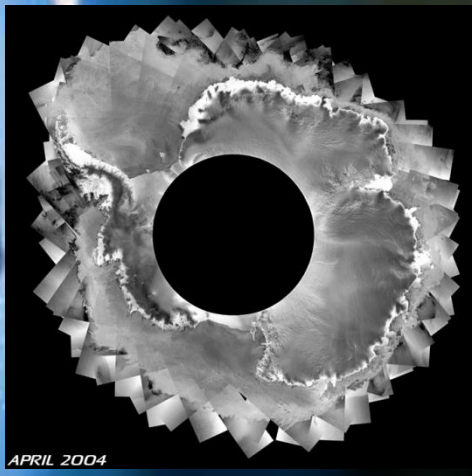
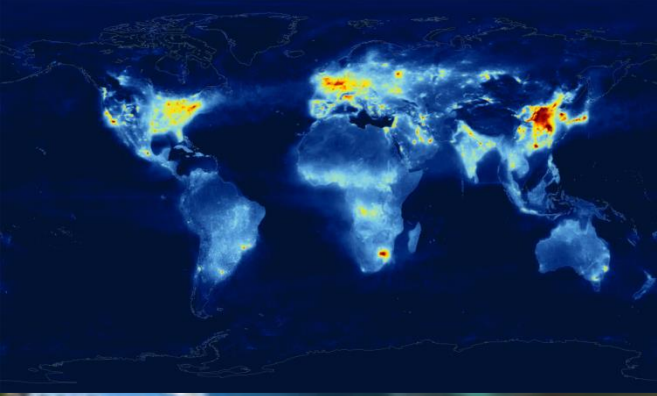
ESA is one of the few space agencies in the world to combine responsibility in nearly all areas of space activity.

- 1. Space science**
 - 2. Human spaceflight**
 - 3. Exploration**
 - 4. Earth observation**
 - 5. Launchers**
- Navigation**
 - Telecommunications**
 - Technology**
 - Operations**





Earth Observation

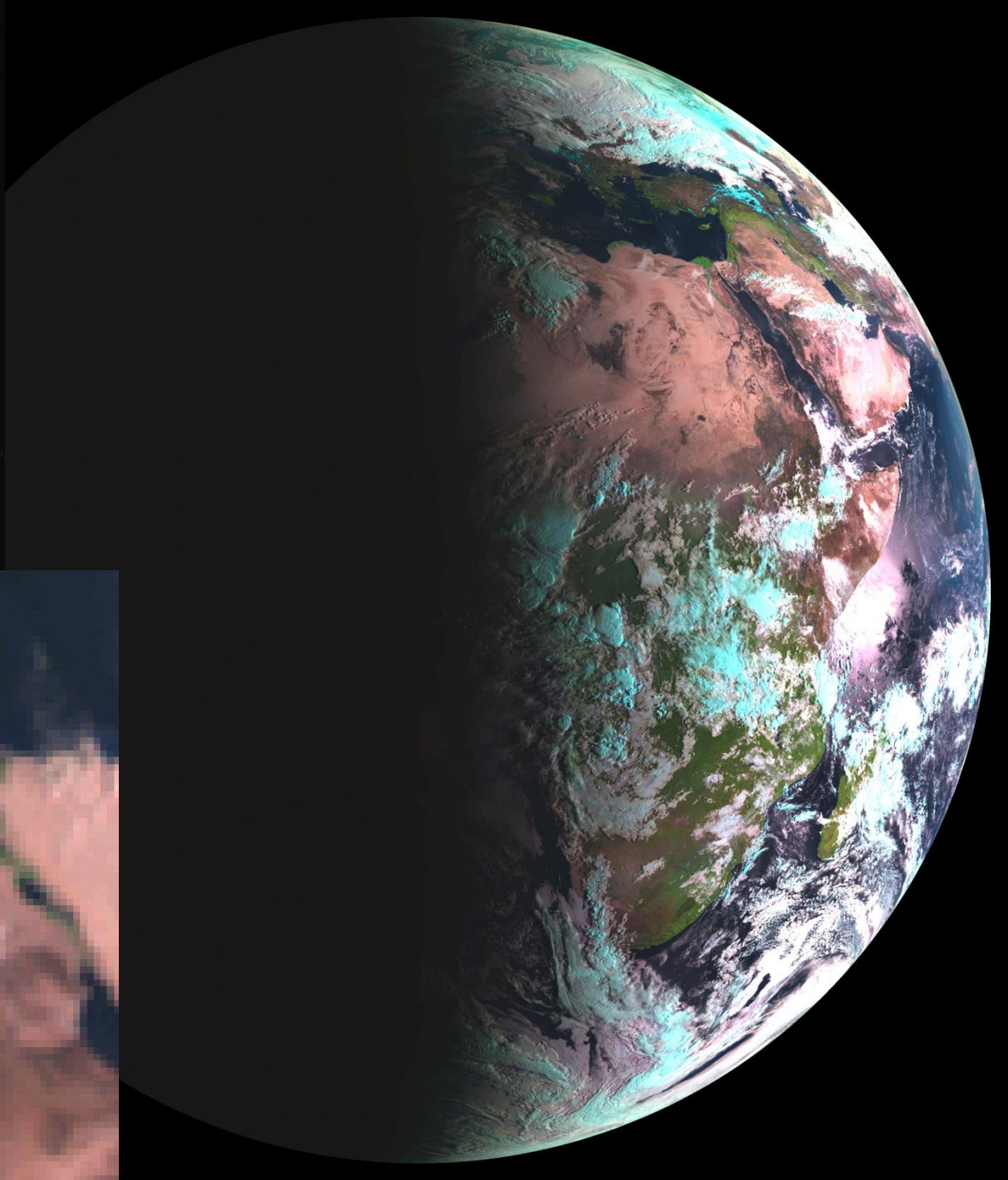
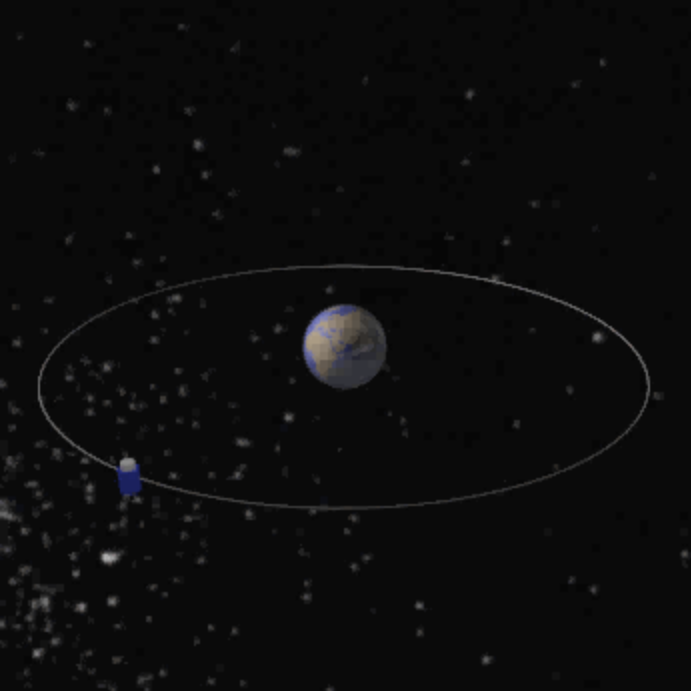


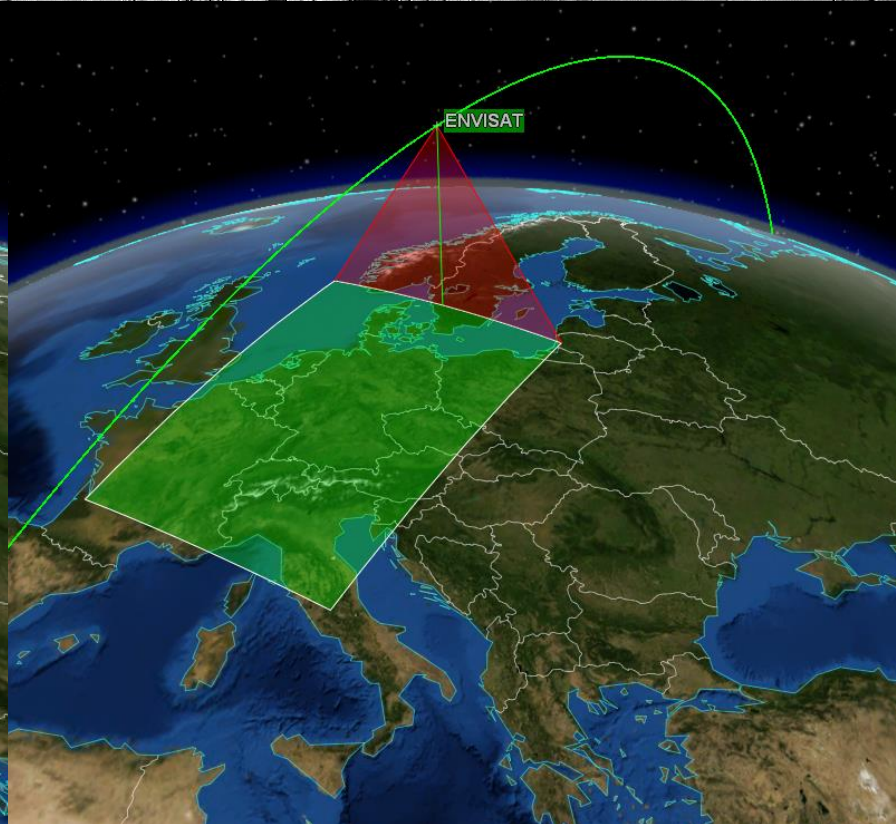
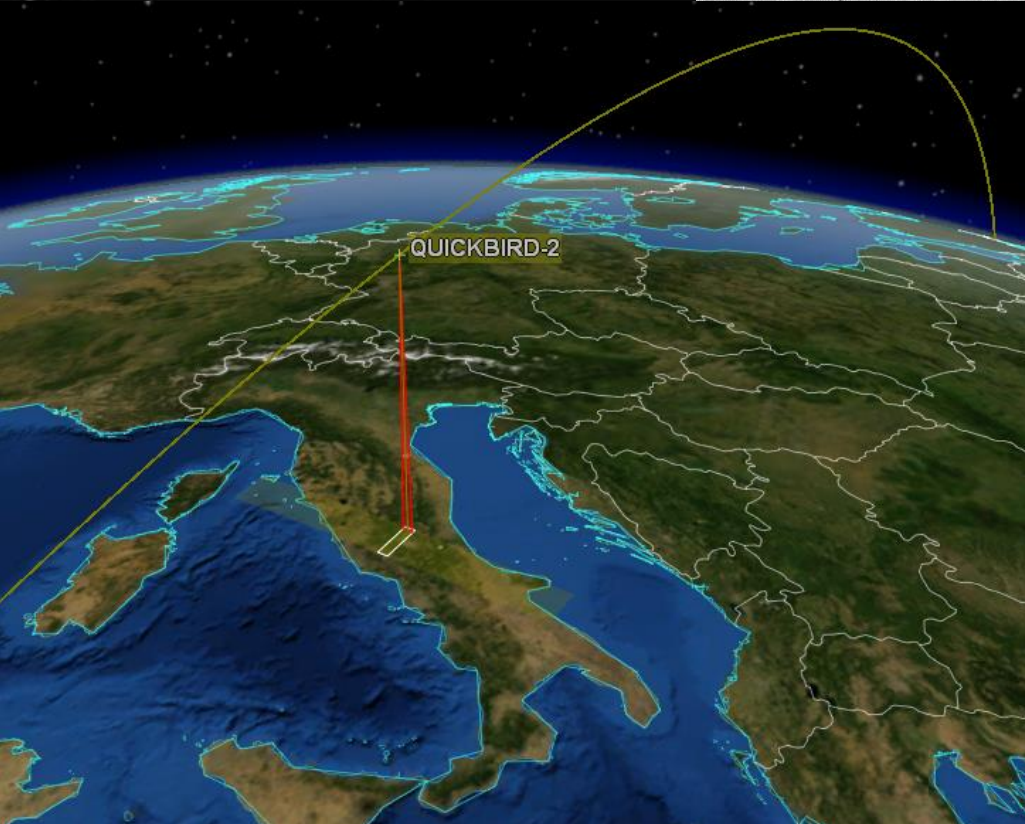
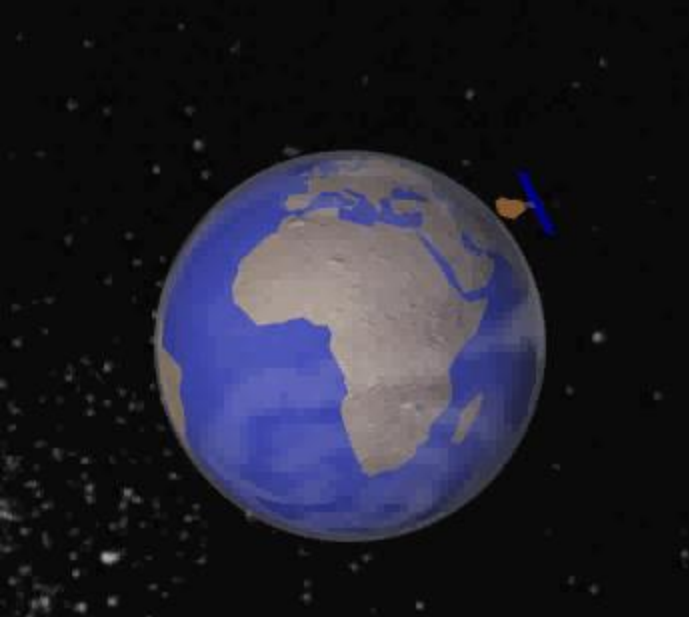
What is Earth Observation? ...**Observing** the **Earth** **remotely**.

Observing = acquiring data and information using instruments (e.g. cameras, radiometers, spectrometers, radars)

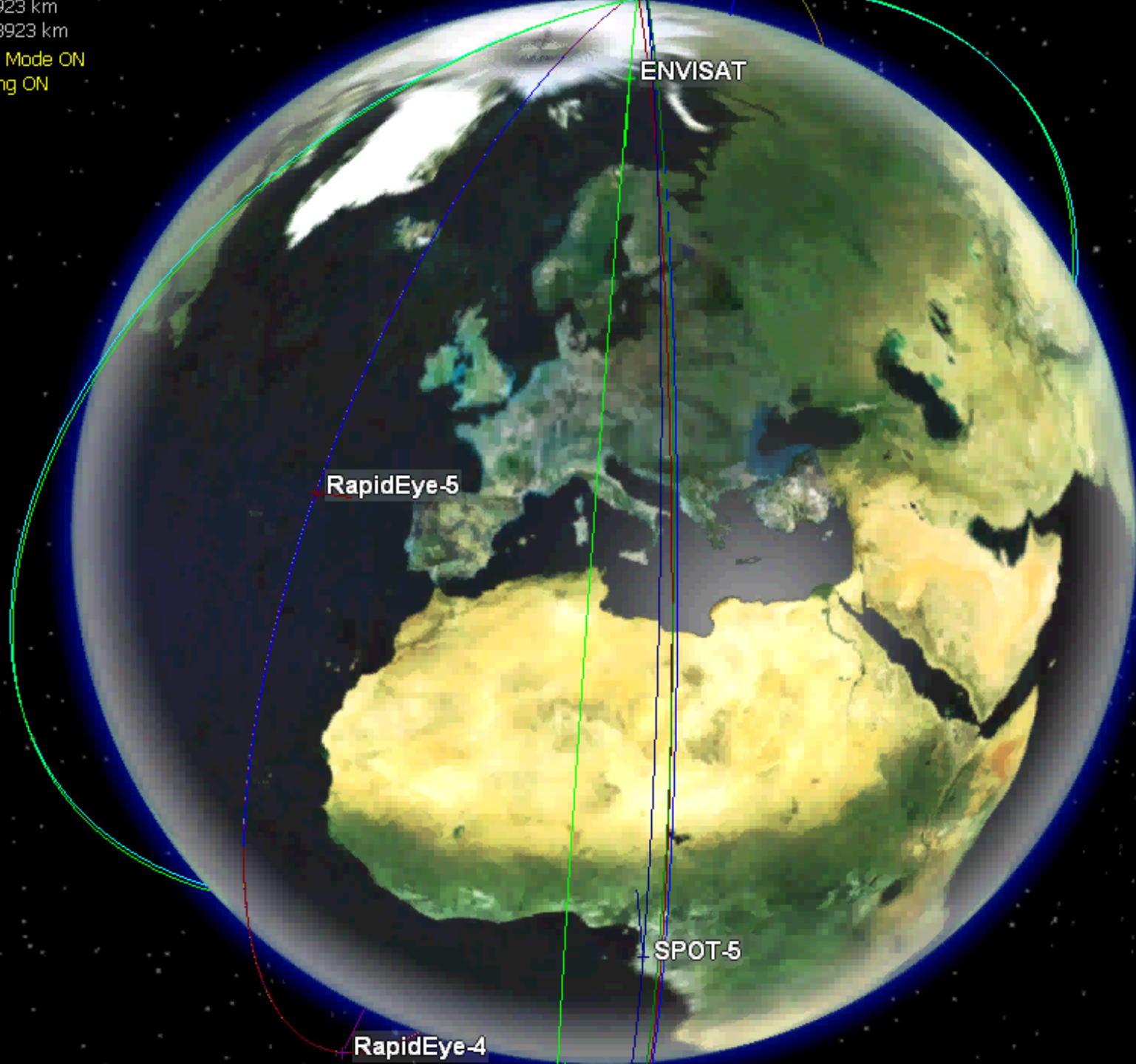
The **Earth** = includes the Earth's surface (water, land), the Earth's core (gravity sphere – geoid), the Earth's atmosphere.

Remotely = without being in physical contact with the Earth.





Range : 13923 km
Altitude : 13923 km
Intersection Mode ON
Auto Steering ON



ENVISAT

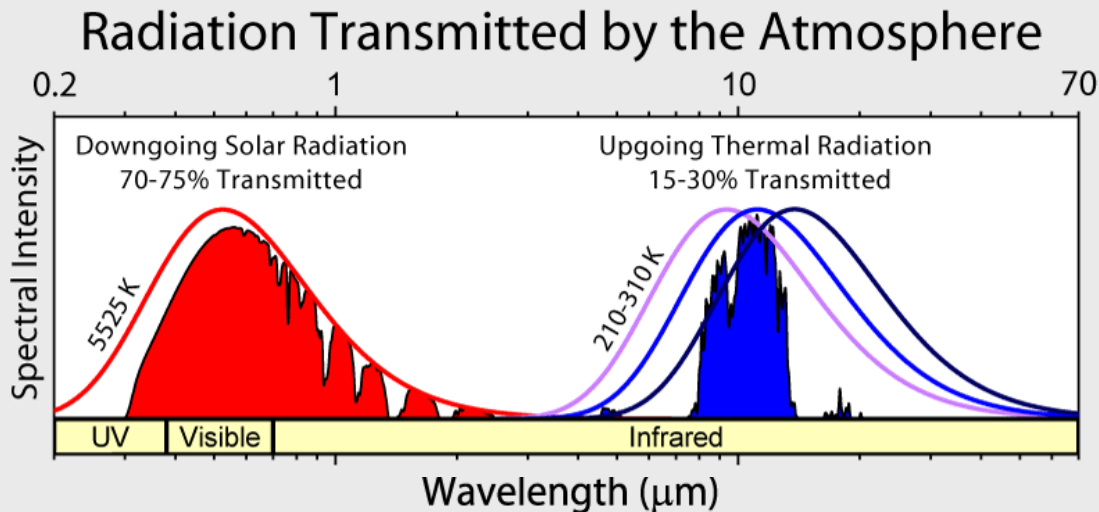
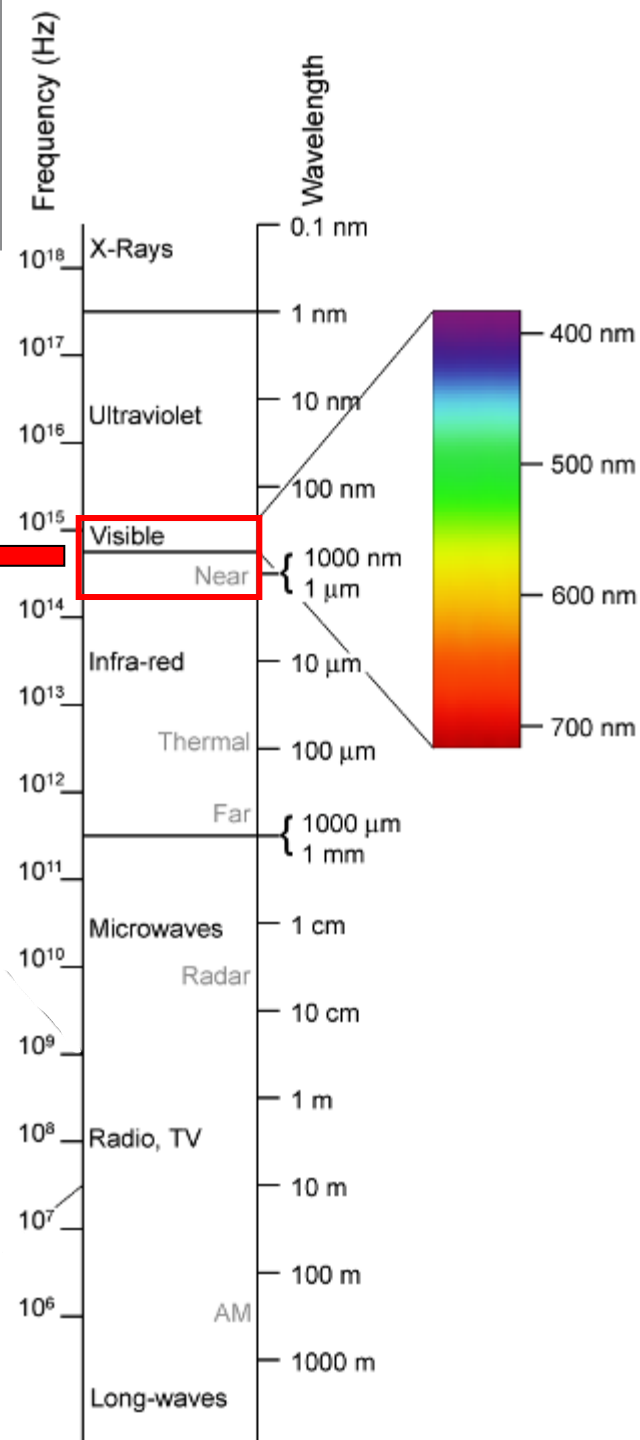
RapidEye-5

SPOT-5

RapidEye-4

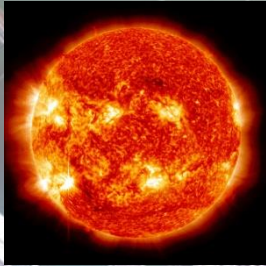
The electromagnetic spectrum

Visible (VIS) + Near Infrared (NIR) = Optical ←

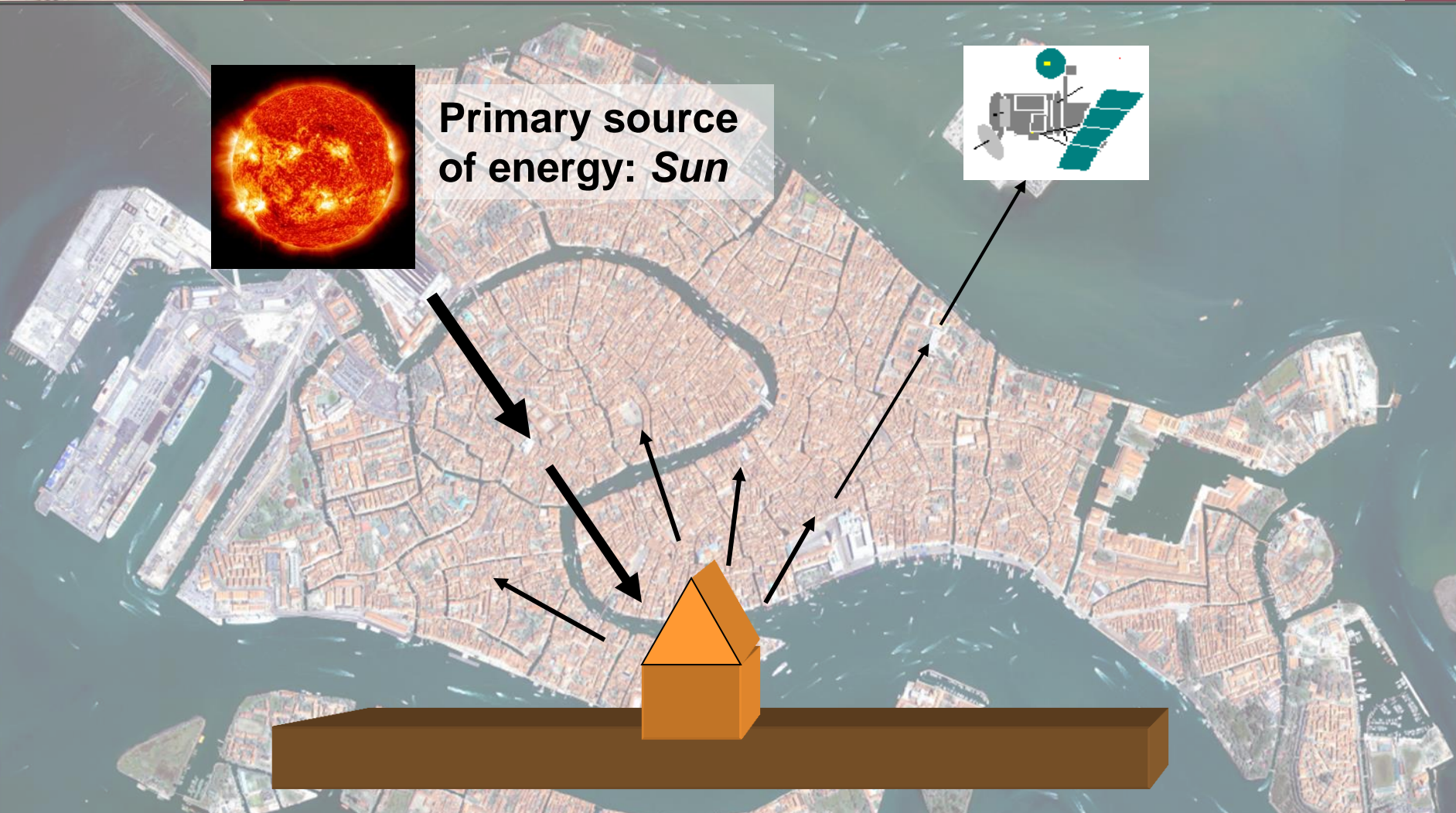


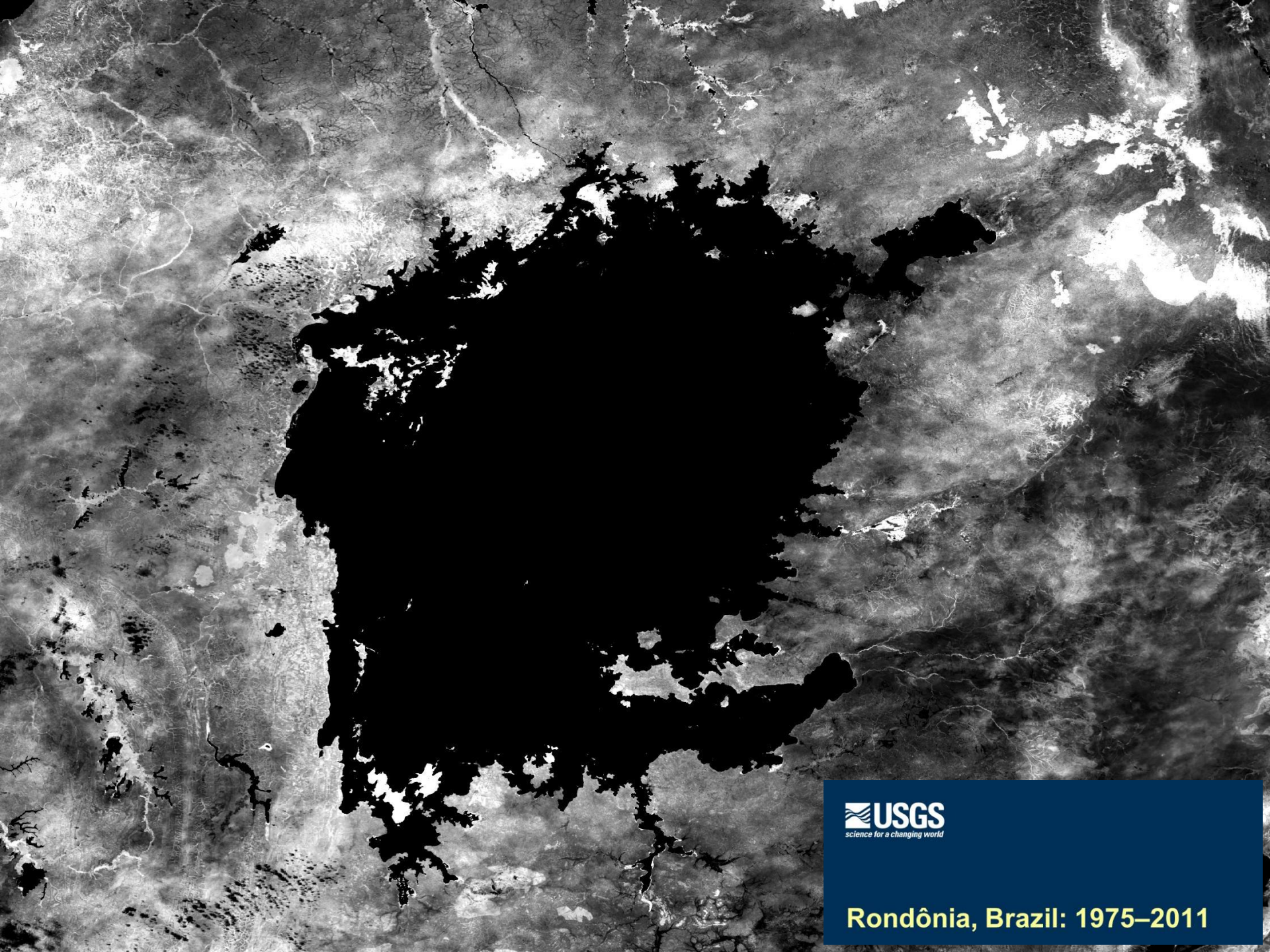


Passive Sensors



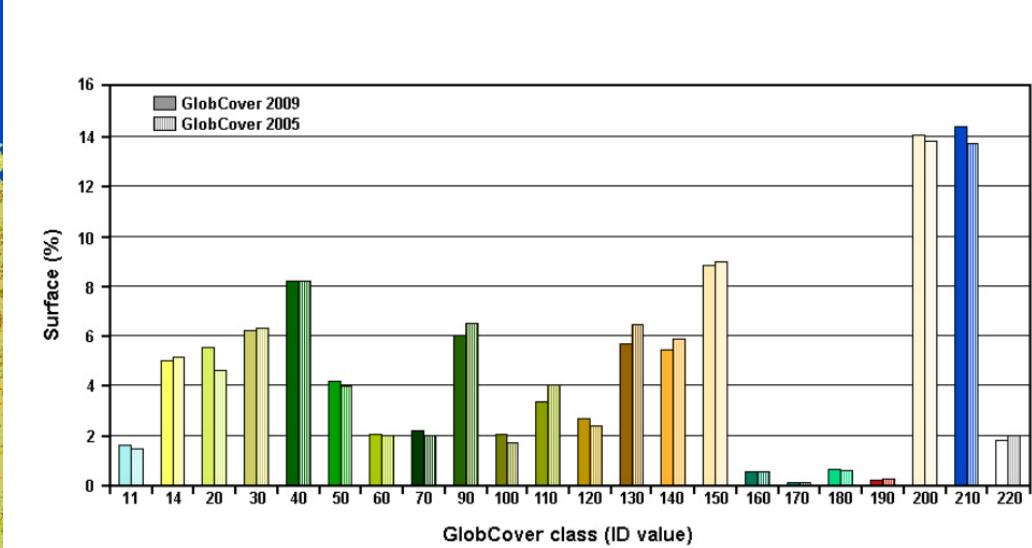
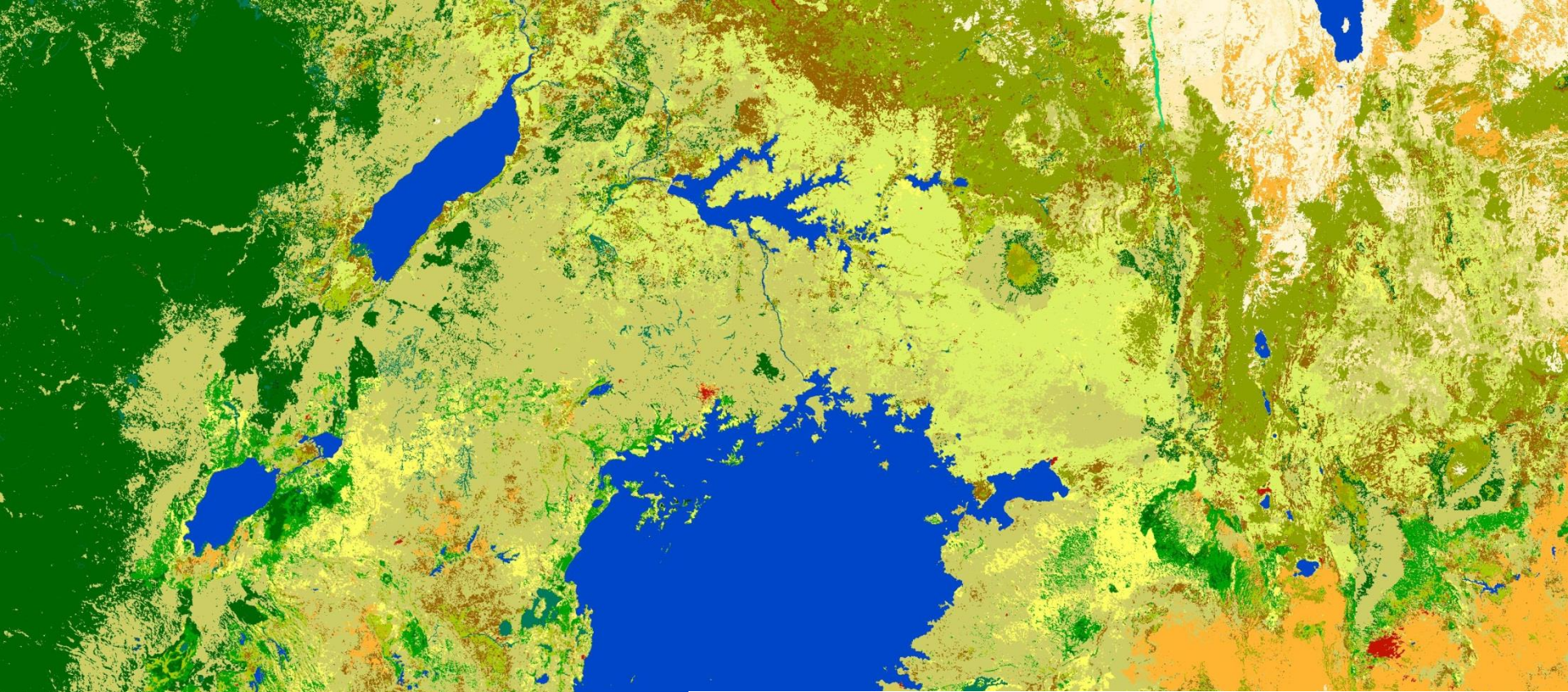
Primary source
of energy: *Sun*

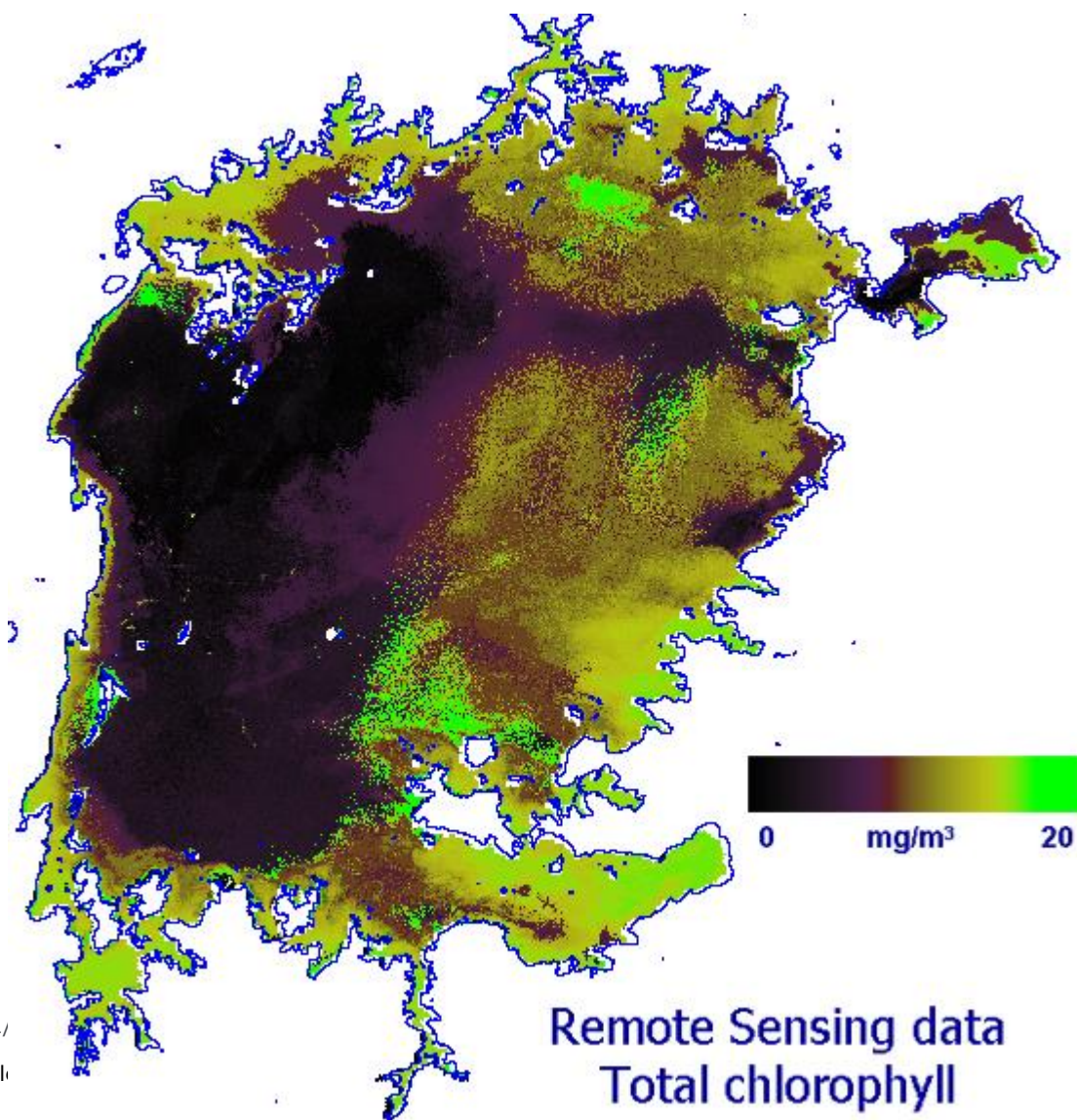


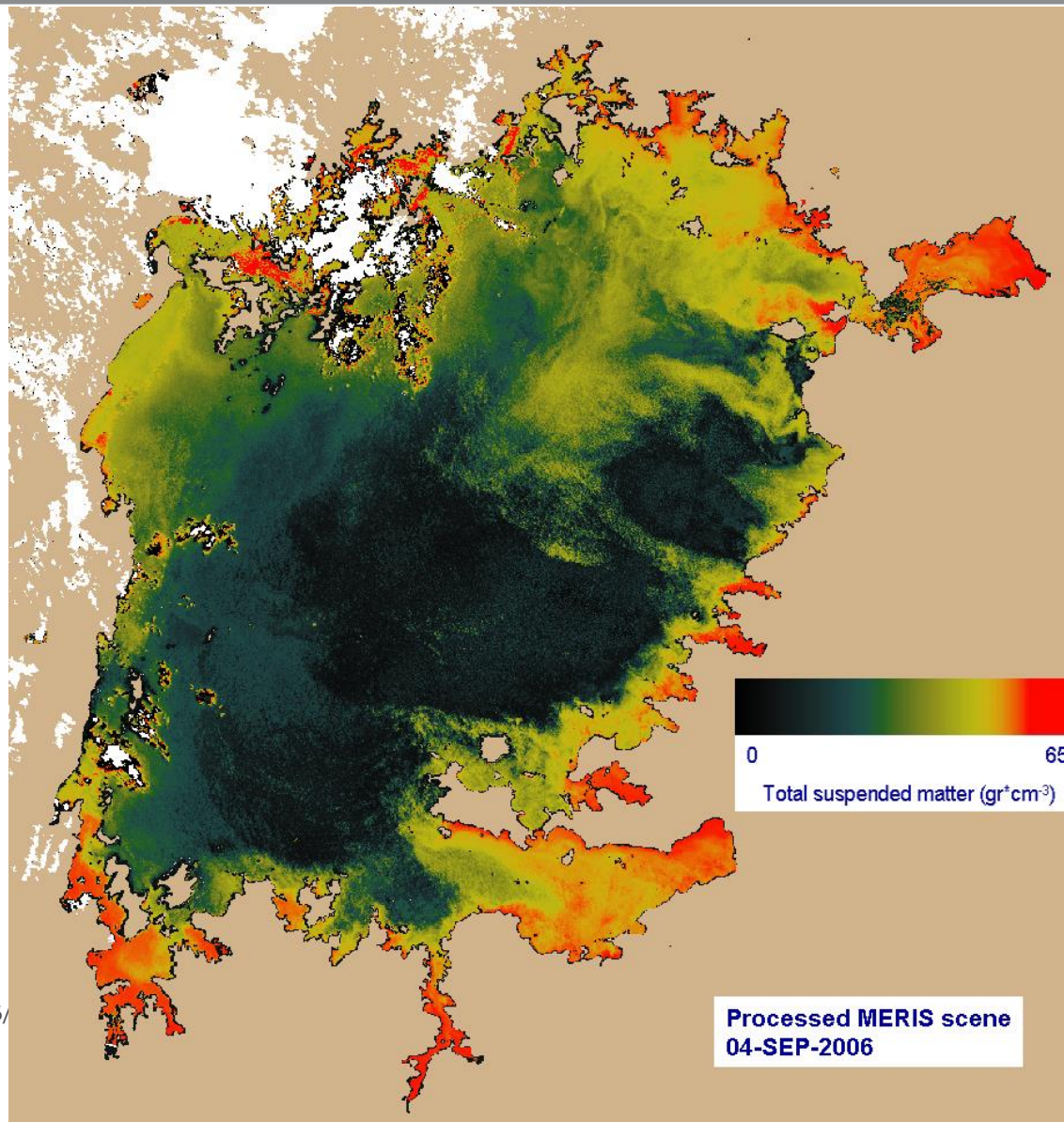


 **USGS**
science for a changing world

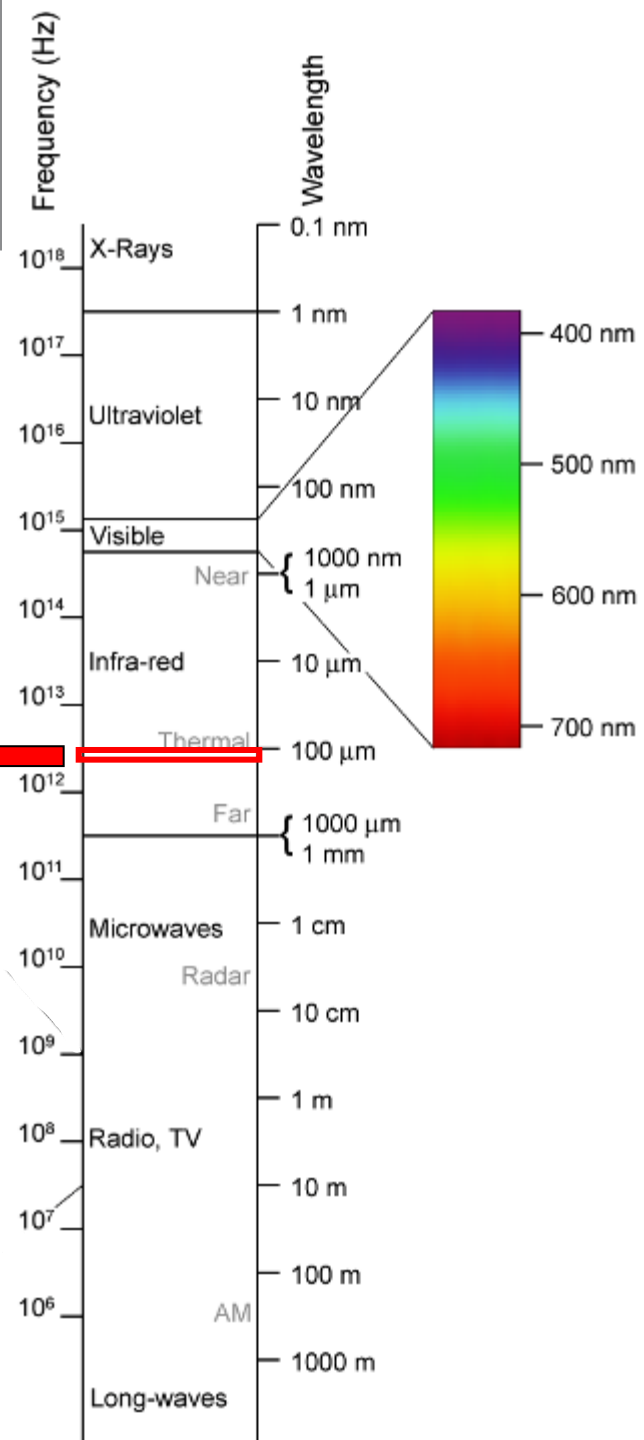
Rondônia, Brazil: 1975–2011



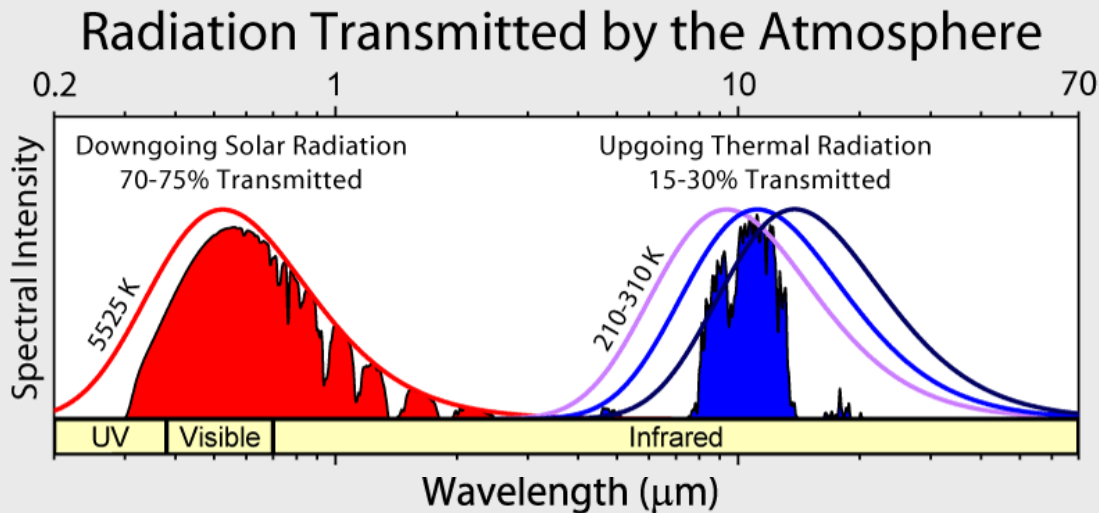




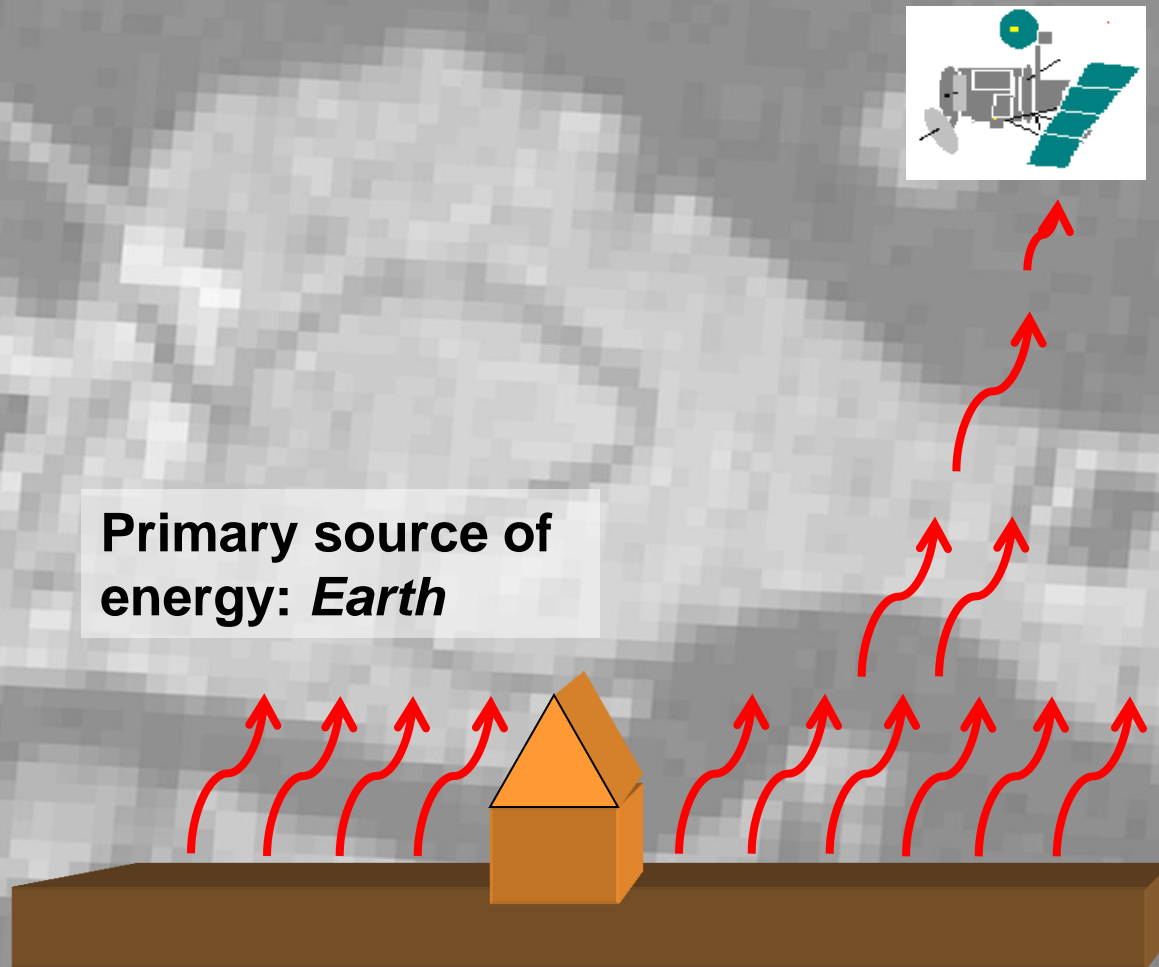
The electromagnetic spectrum



Thermal Infra-red (TIR) ←

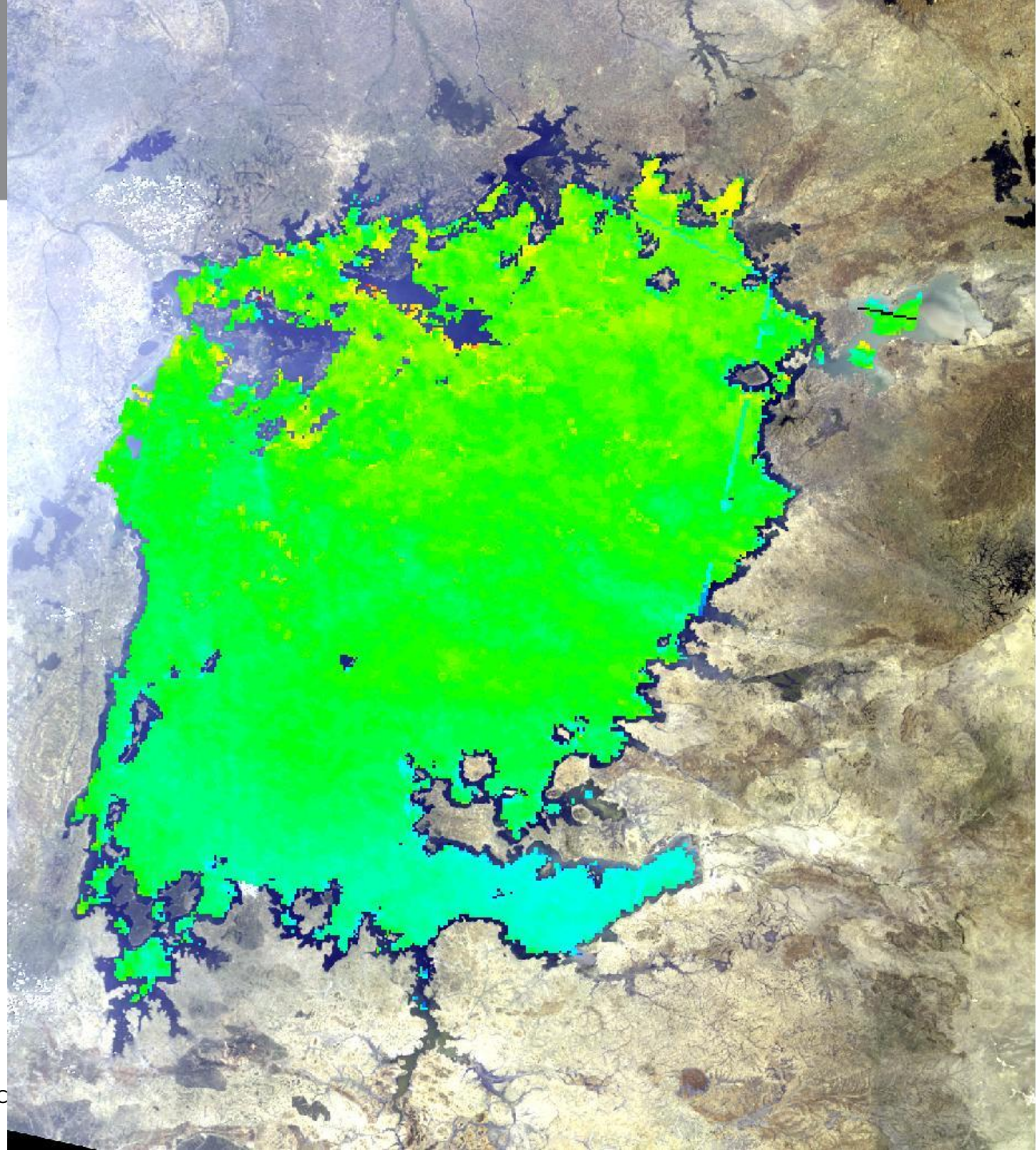


Passive Sensors



Derived from 3
AATSR scenes:

16-AUG-2006
19-AUG-2006
24-AUG-2006



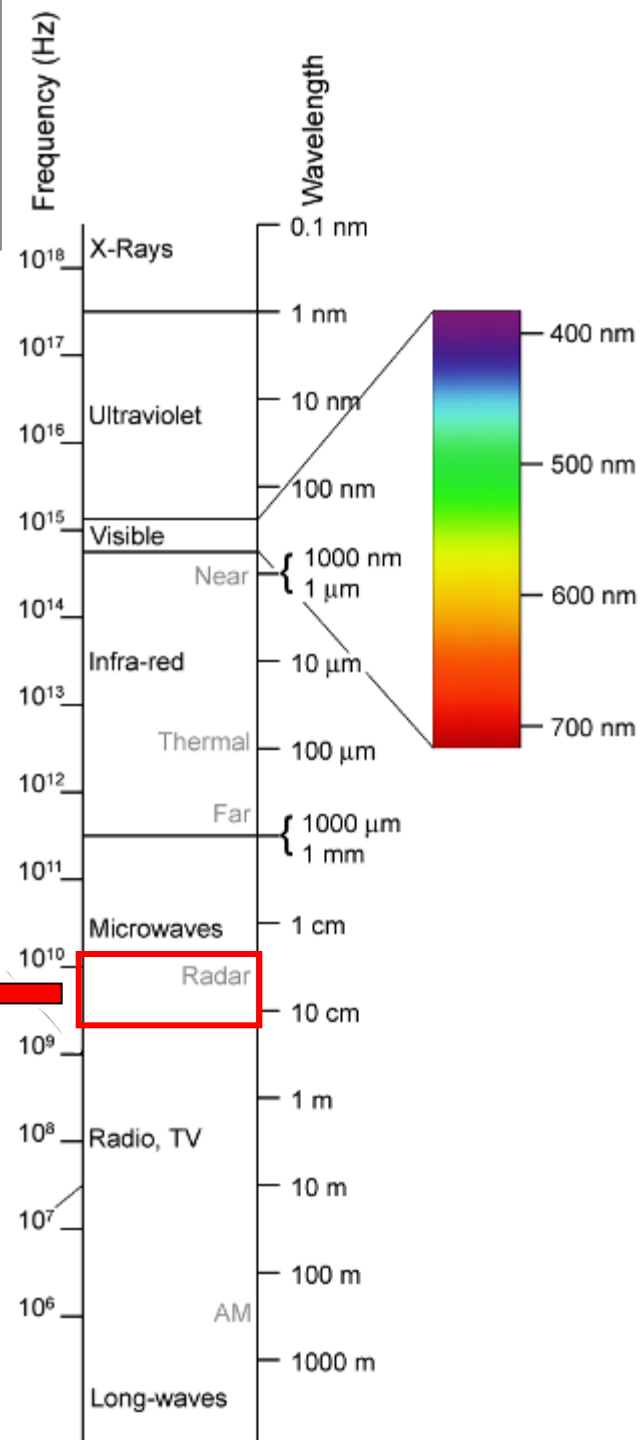
Legend

Temperature (°C)

-  18.5 ≤ T < 19.0
-  19.0 ≤ T < 19.5
-  19.5 ≤ T < 20.0
-  20.0 ≤ T < 20.5
-  20.5 ≤ T < 21.0
-  21.0 ≤ T < 21.5
-  21.5 ≤ T < 22.0
-  22.0 ≤ T < 22.5
-  22.5 ≤ T < 23.0
-  23.0 ≤ T < 23.5
-  23.5 ≤ T < 24.0
-  24.0 ≤ T < 24.5
-  24.5 ≤ T < 25.0
-  25.0 ≤ T < 25.5
-  25.5 ≤ T < 26.0
-  26.0 ≤ T < 26.5
-  26.5 ≤ T < 27.0
-  27.0 ≤ T < 27.5
-  27.5 ≤ T < 28.0
-  28.0 ≤ T < 28.5

The electromagnetic spectrum

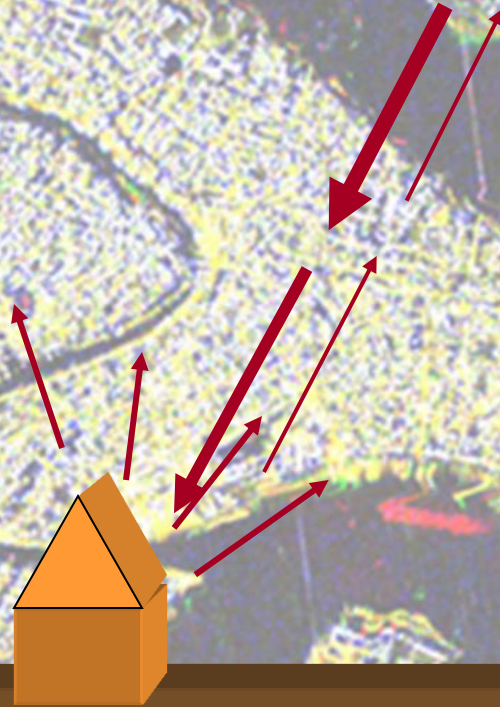
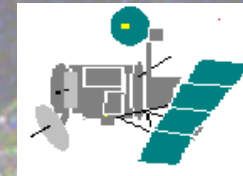
Synthetic Aperture Radar (SAR) ←





Active Sensors

Source of energy:
Satellite

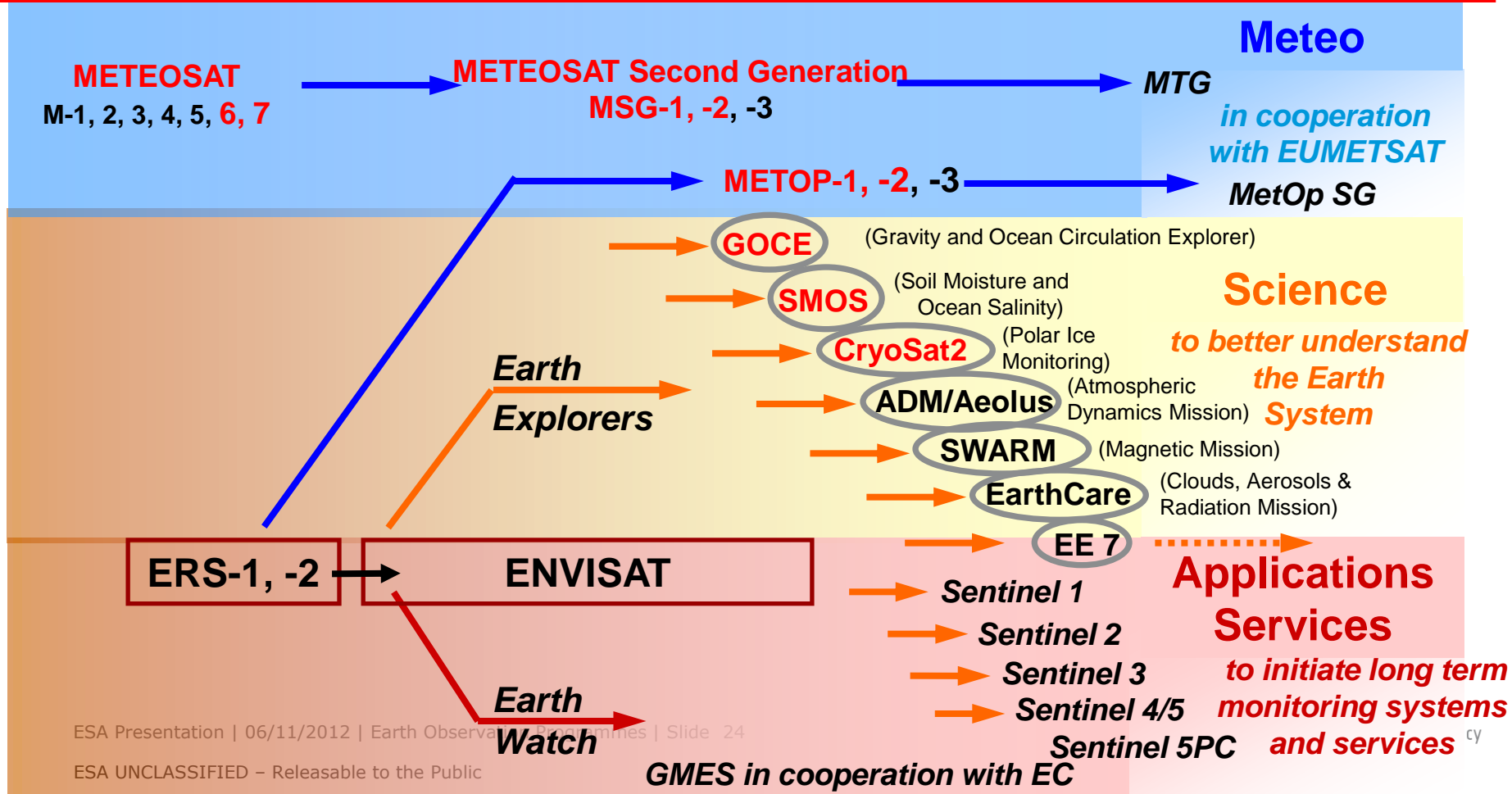




The development of Earth observation in Europe



Earthnet. Access for European users to non-European missions:
Landsat, SeaWifs, NOAA, JERS, MODIS, ALOS, Proba, Bird, Scisat...



Michelson Interferometric Passive Atmospheric Sounder
MIPAS

MERIS
Medium Resolution Imaging Spectrometer

GOMOS
Global Ozone Monitoring by Occultation of Stars

RA-2 Antenna
Radar Altimeter 2

LRR

AATSR Advanced Along Track Scanning Radiometer

SCIAMACHY
Scanning Imaging Absorption Spectrometer for Atmospheric Cartography

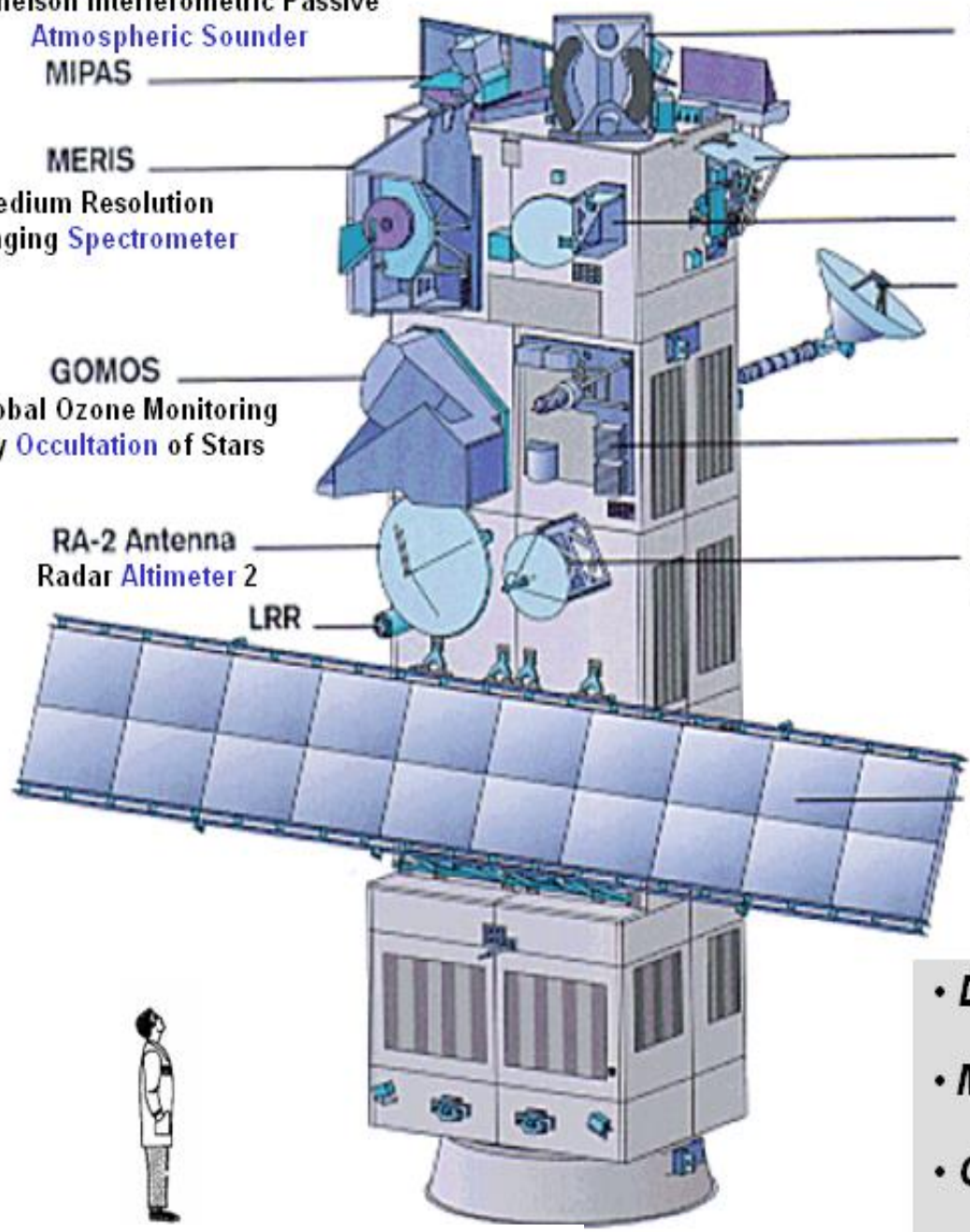
MWR Microwave Radiometer

Ka-band Antenna

DORIS
Doppler Orbitography and Radio-positioning Integrated by Satellite

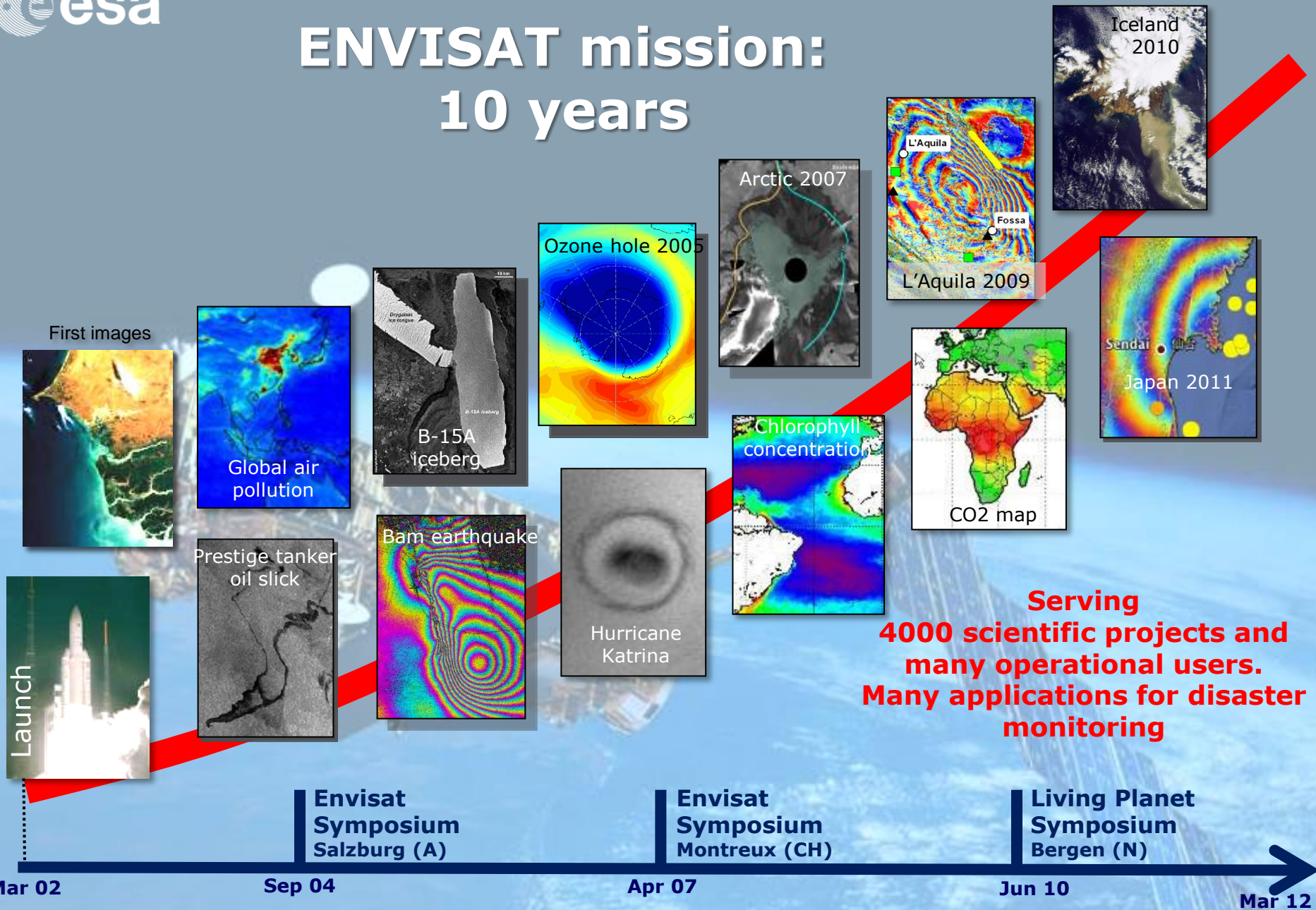
X-band Antenna

ASAR Advanced Synthetic Aperture Radar Antenna



- **Dimensions (in orbit)**
26m x 10m x 5m
- **Mass**
8140 Kg
- **Orbit**
800 km as ERS, sun synchronous
10:00, i.e. 30 minutes before ERS-2

ENVISAT mission: 10 years



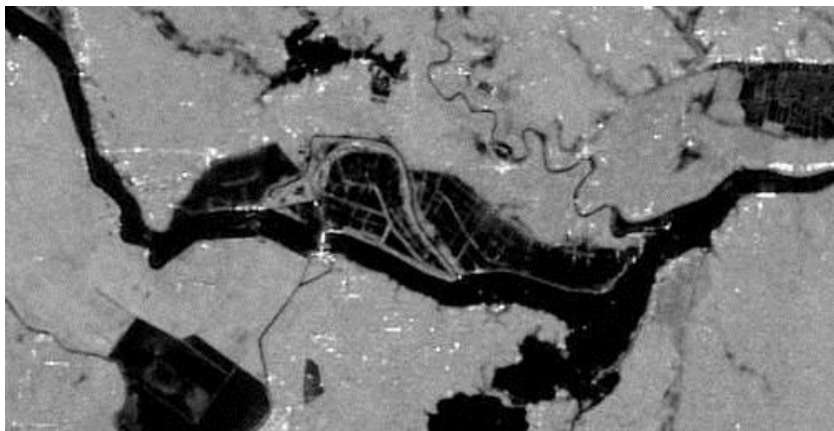
**Serving
4000 scientific projects and
many operational users.
Many applications for disaster
monitoring**

**Envisat
Symposium
Salzburg (A)**

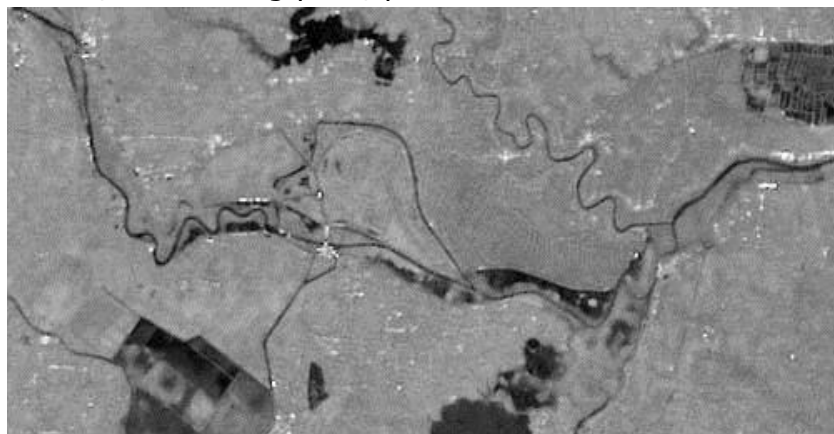
**Envisat
Symposium
Montreux (CH)**

**Living Planet
Symposium
Bergen (N)**

and many workshops dedicated to specific Envisat user communities



ASAR WSM 150m spatial resolution acquired 15th July 2007, descending pass, polarisation HH.

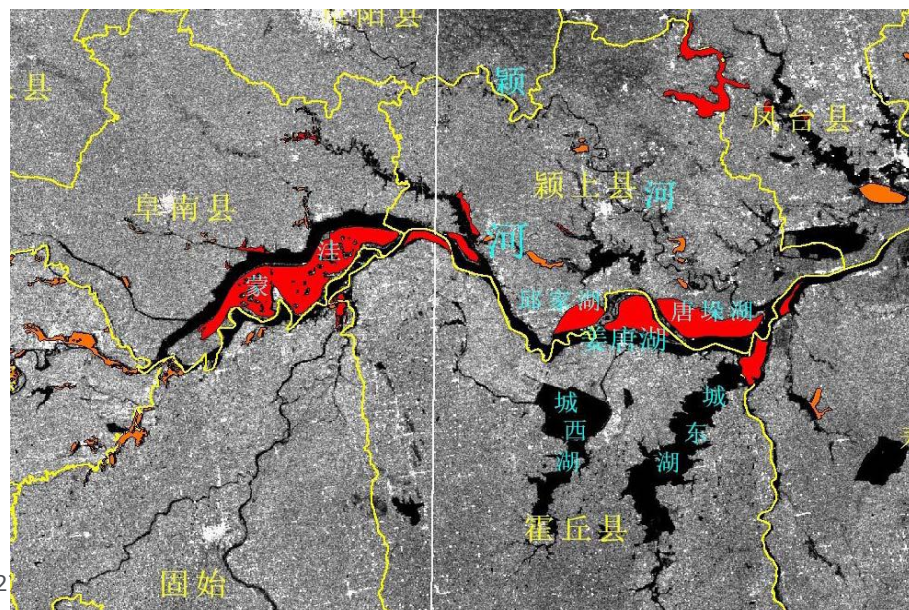


ASAR WSM 150m spatial resolution acquired 12th August 2006, descending pass, polarisation HH.

Inundated areas are clearly visible in this Envisat ASAR image acquired during floods in China in July 2007.

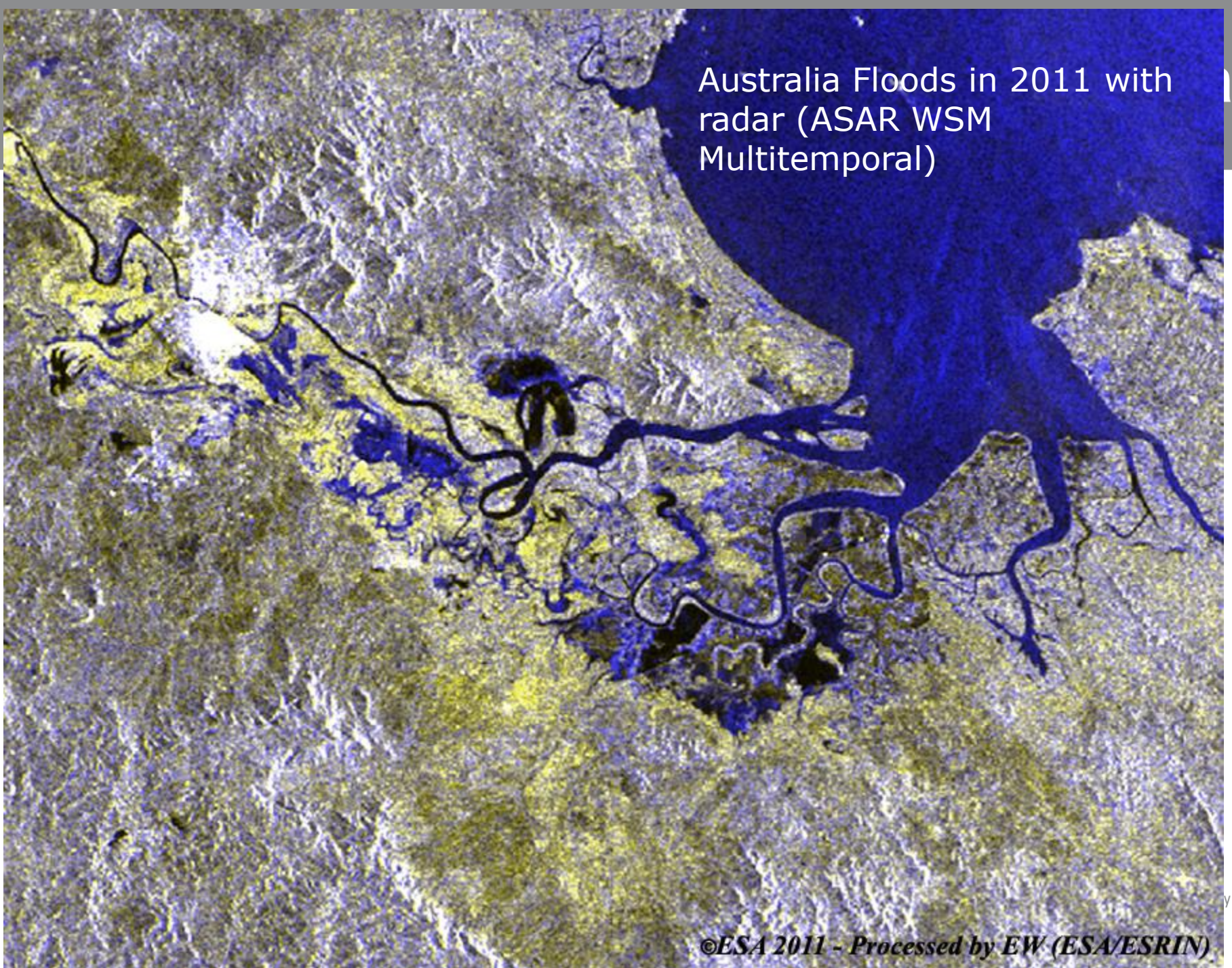
FLOODING IN CHINA JULY 2007

The two images were acquired during the same season but different years, one during the flooding, the other the year before. By comparing the two images, both with the same geometry (Wide Swath Mode, descending pass) and same polarisation (HH) it is possible to assess the extent of the flooding.

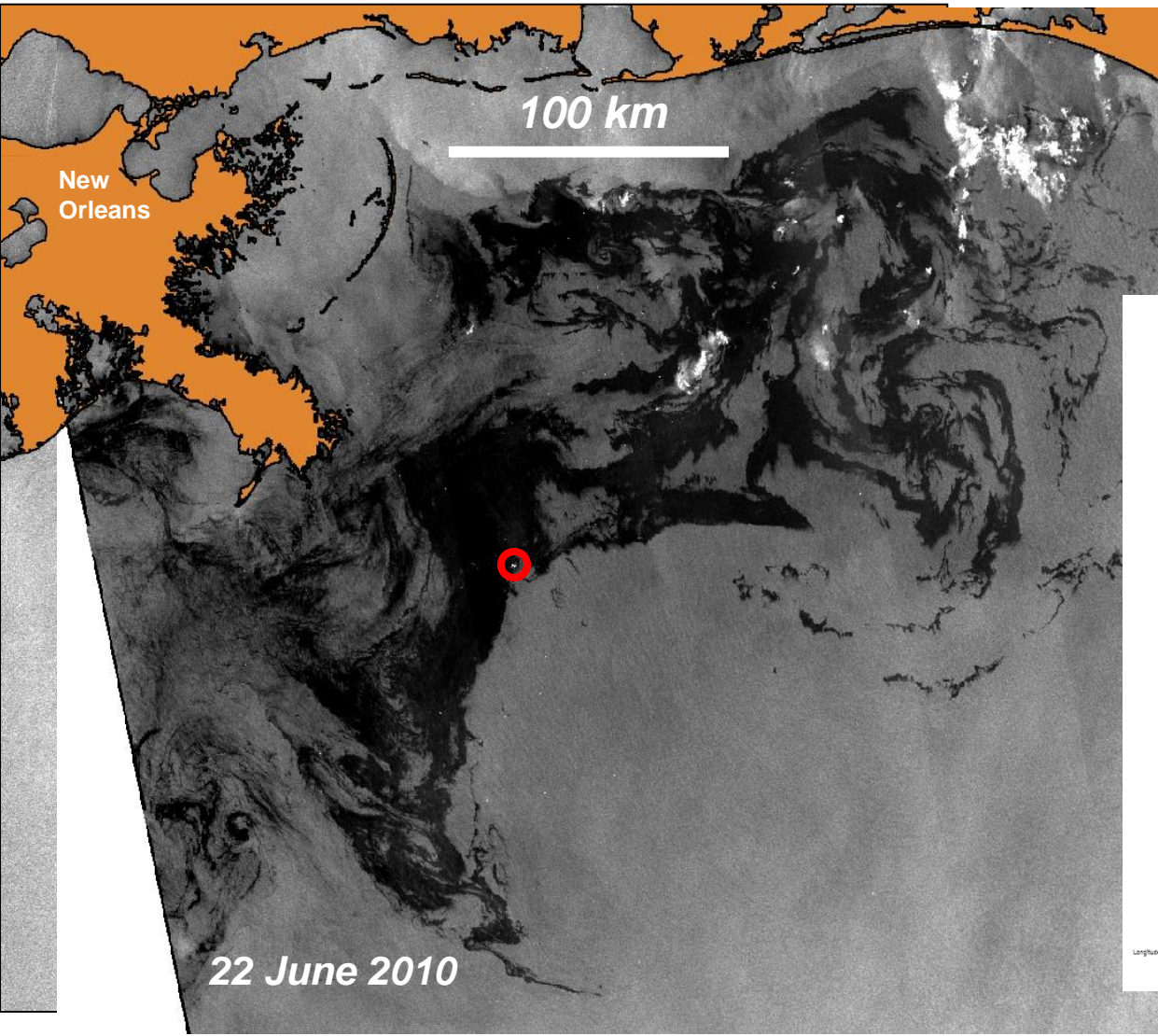


Courtesy of IWHR, Beijing

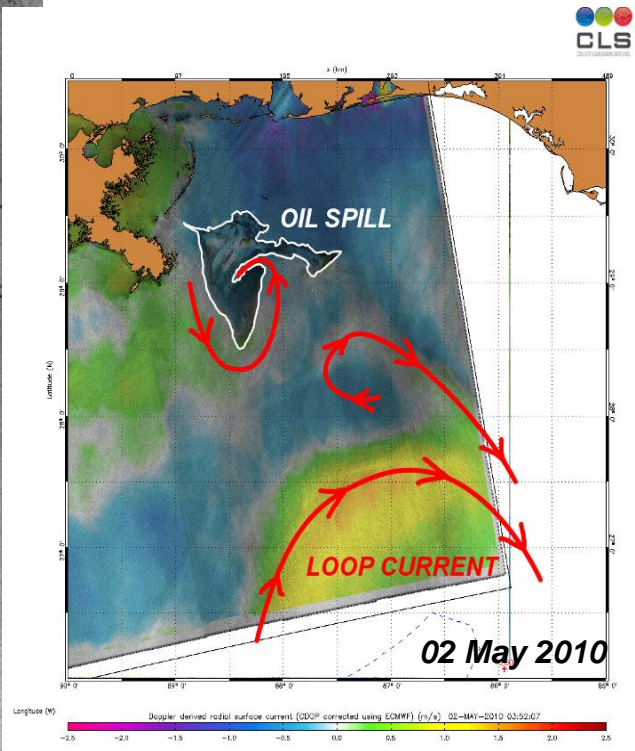
Australia Floods in 2011 with
radar (ASAR WSM
Multitemporal)



Oil spill monitoring using radar satellite



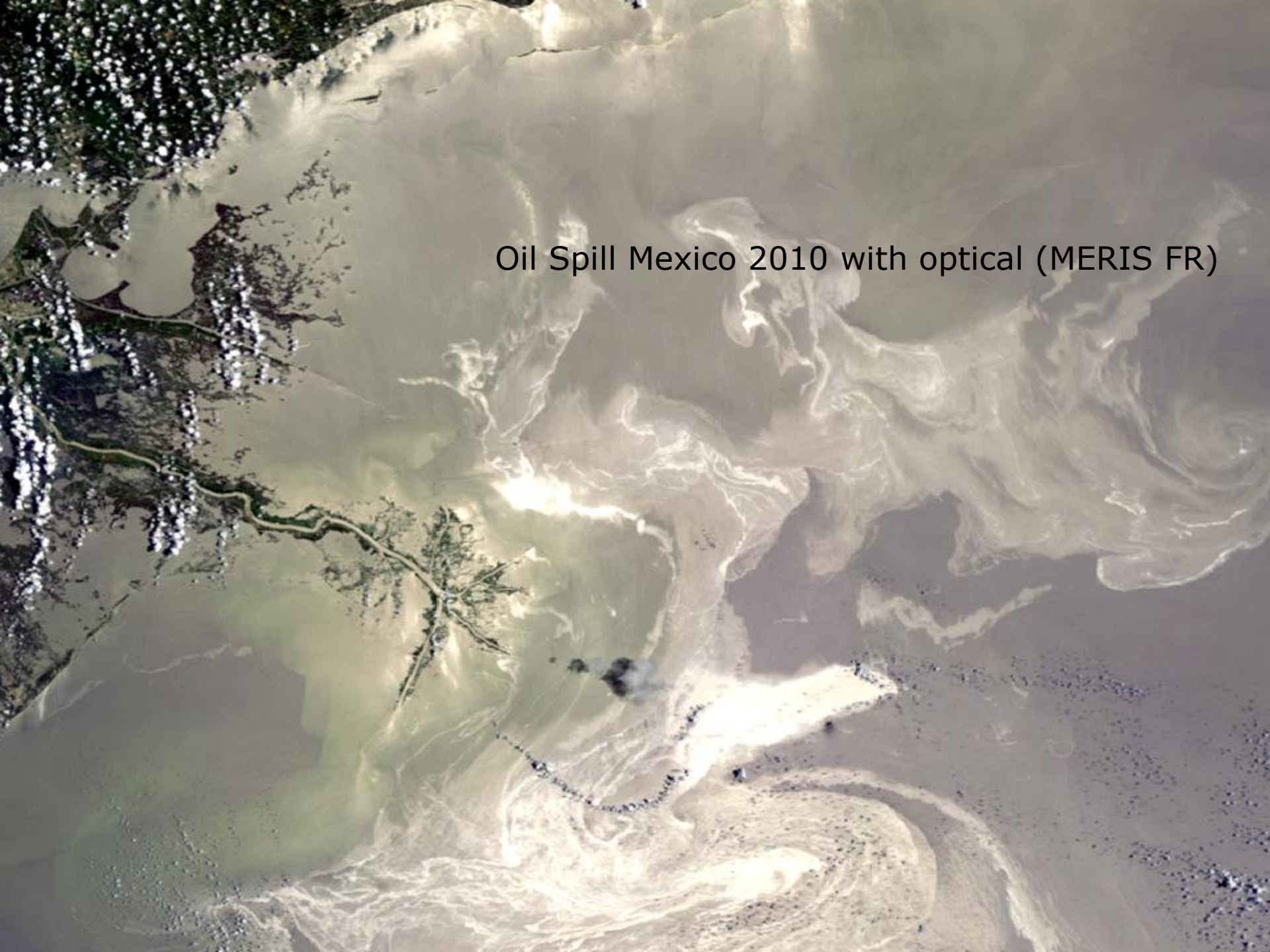
The Louisiana Oil Spill disaster from space (Envisat ASAR)





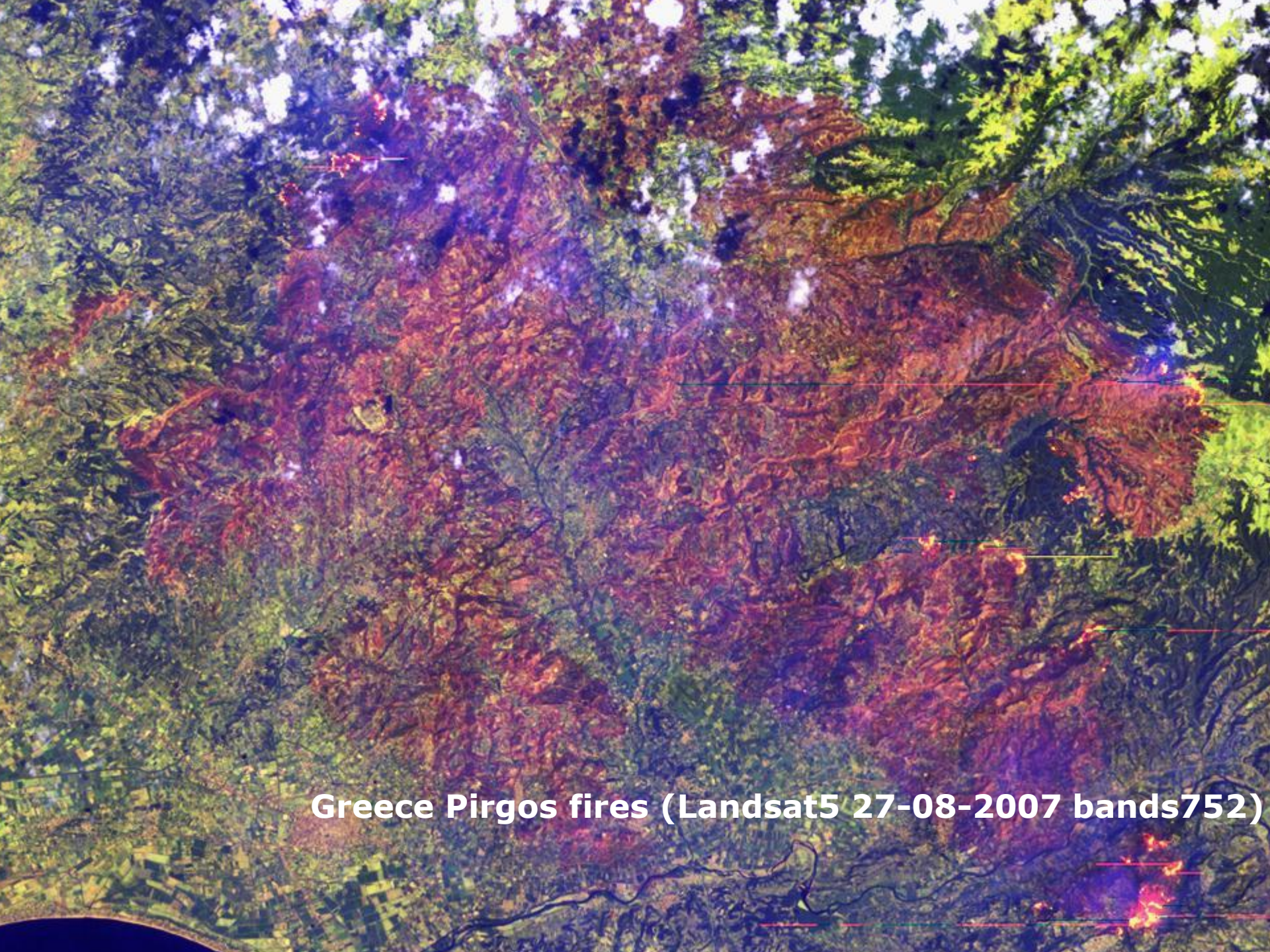
Oil Spill Mexico 2010 with radar (ASAR_WSM)

Oil Spill Mexico 2010 with optical (MERIS FR)

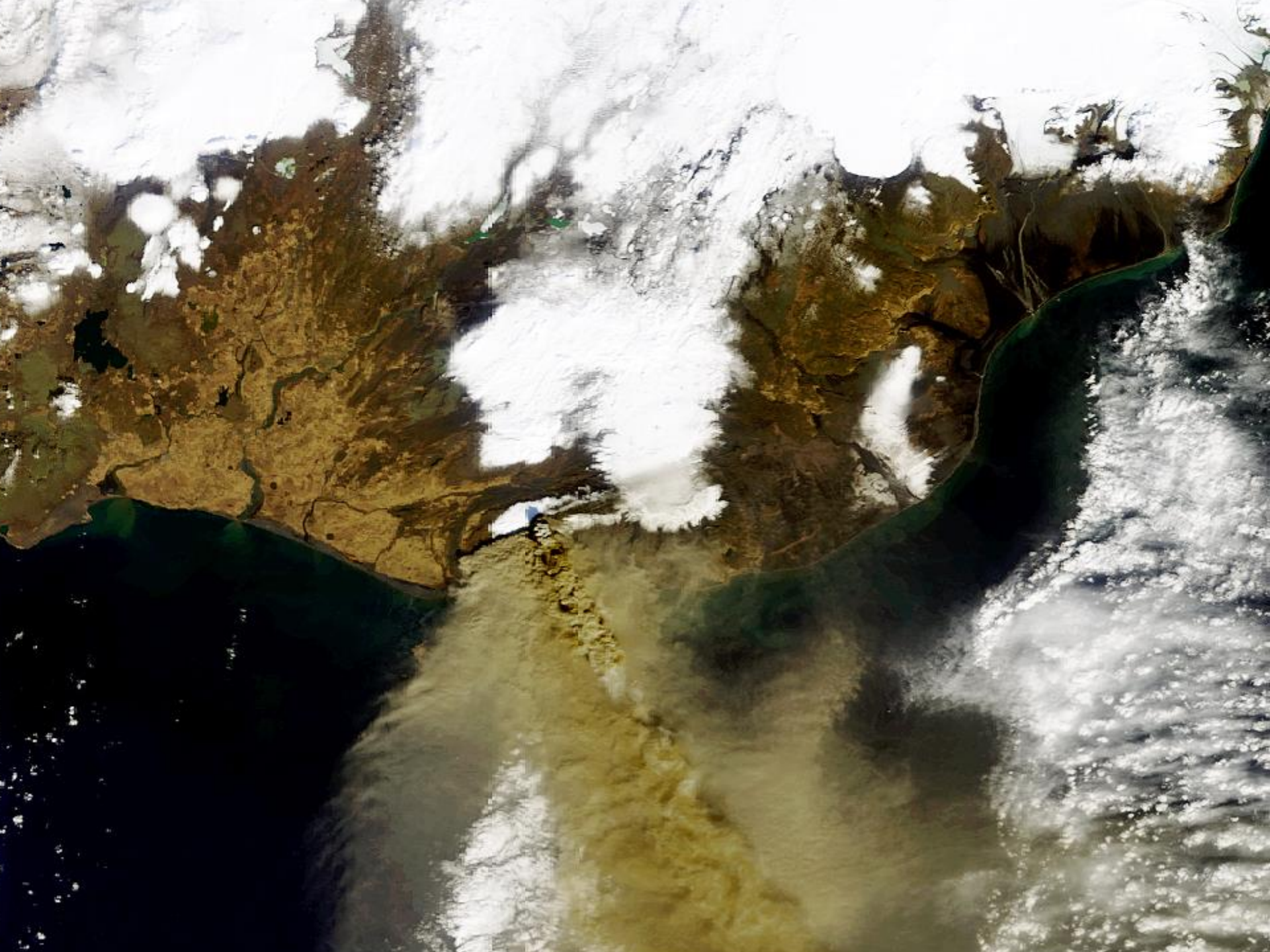


Moscow Fires (Meris FR 2011)





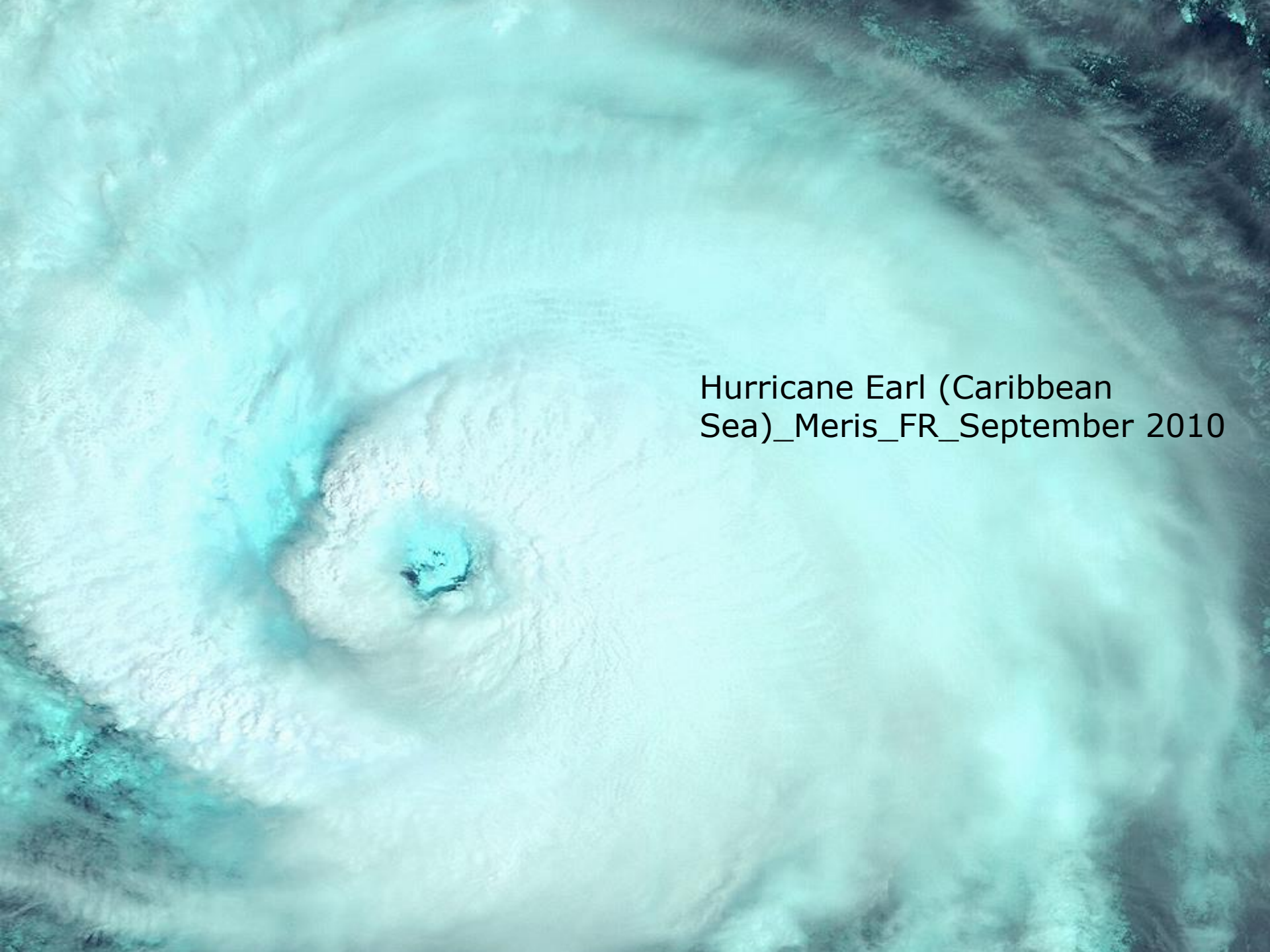
Greece Pirgos fires (Landsat5 27-08-2007 bands752)



Hurricane Earl



Hurricane Earl (Caribbean Sea)_ASAR_WSM_September 2010



Hurricane Earl (Caribbean
Sea)_Meris_FR_September 2010

Hurricane Gustav

30 August 2008, 15:40 UTC

28 August 2008, 15:00 UTC

25 August 2008, 15:00 UTC

Hurricane Gustav: wind and currents



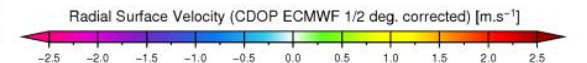
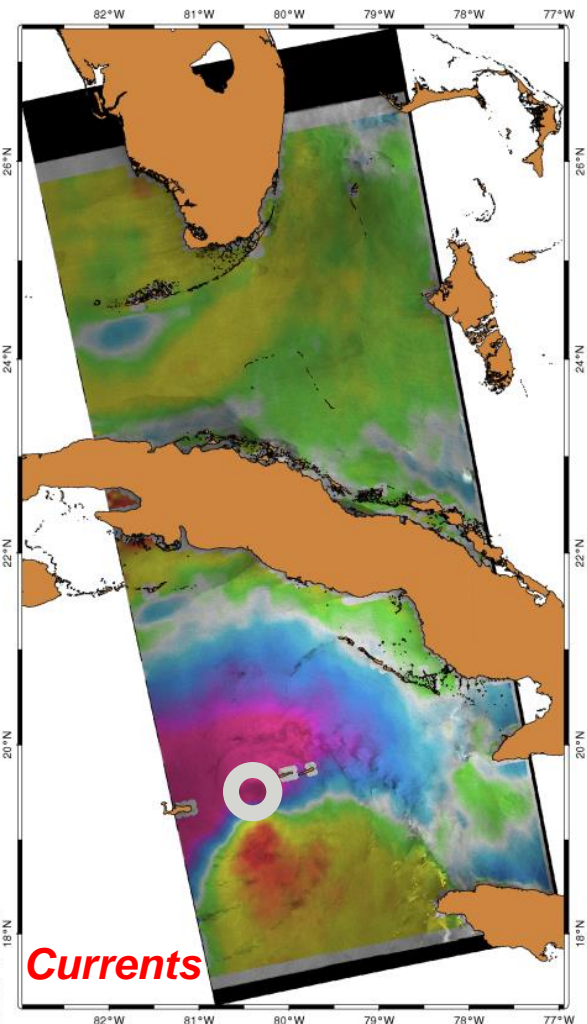
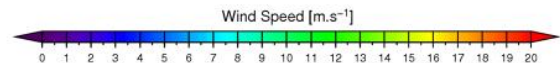
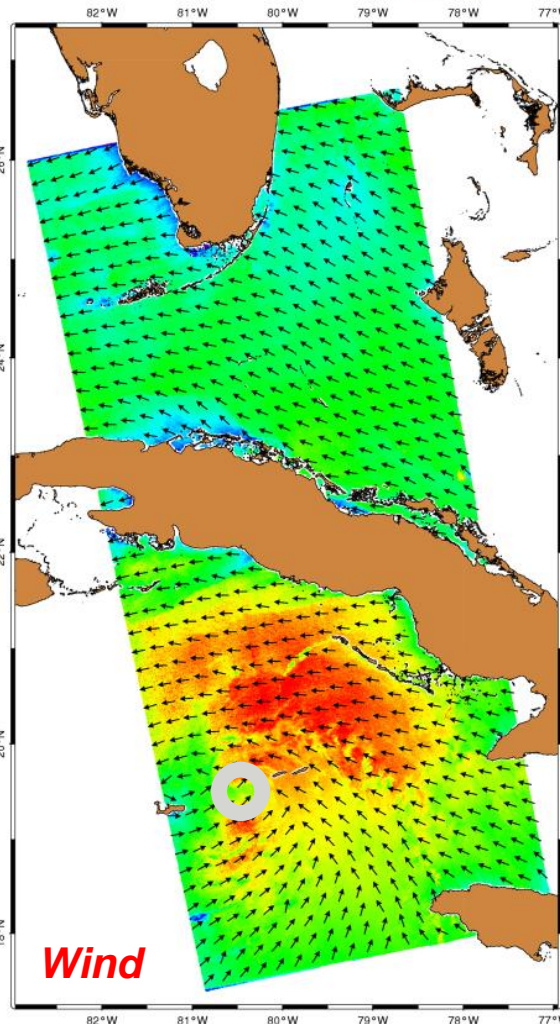
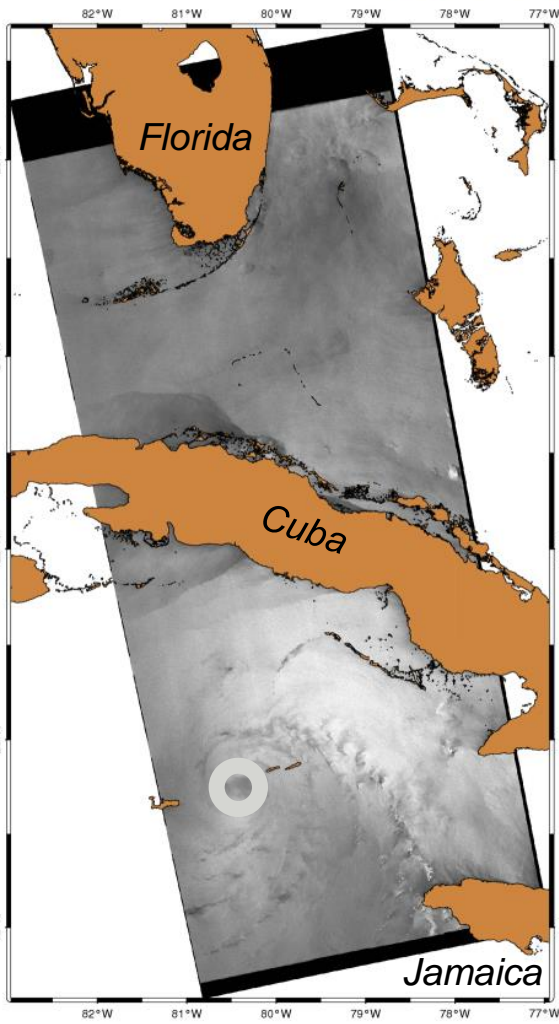
30-August-2008 03:21:37 (UTC)
ENVISAT WSM Product

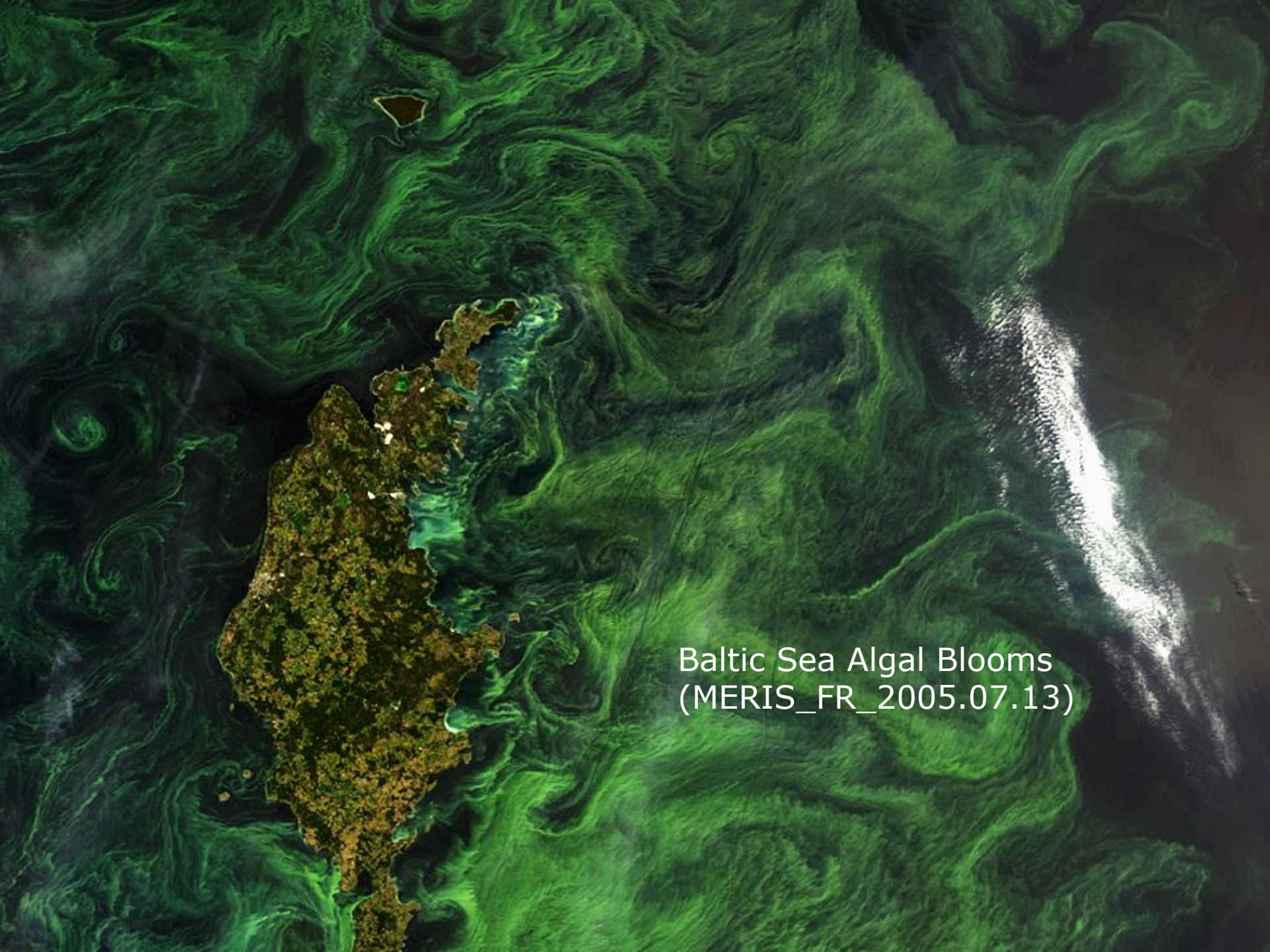


30-August-2008 03:21:37 (UTC)
ENVISAT WSM Product



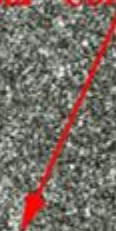
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ENVISAT WSM Product



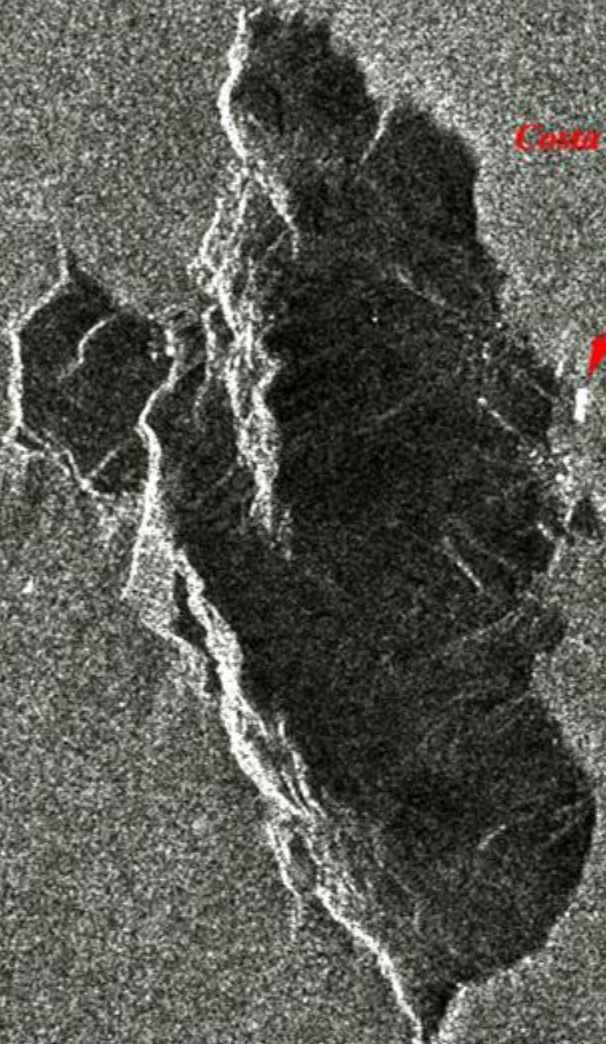


Baltic Sea Algal Blooms
(MERIS_FR_2005.07.13)

Costa "Concordia" Ship



Costa Concordia (ASAR IMP 10.Feb.2012)





ice tongue
piece

Drygalski
ice
tongue

B-15A
iceberg

Ross Sea

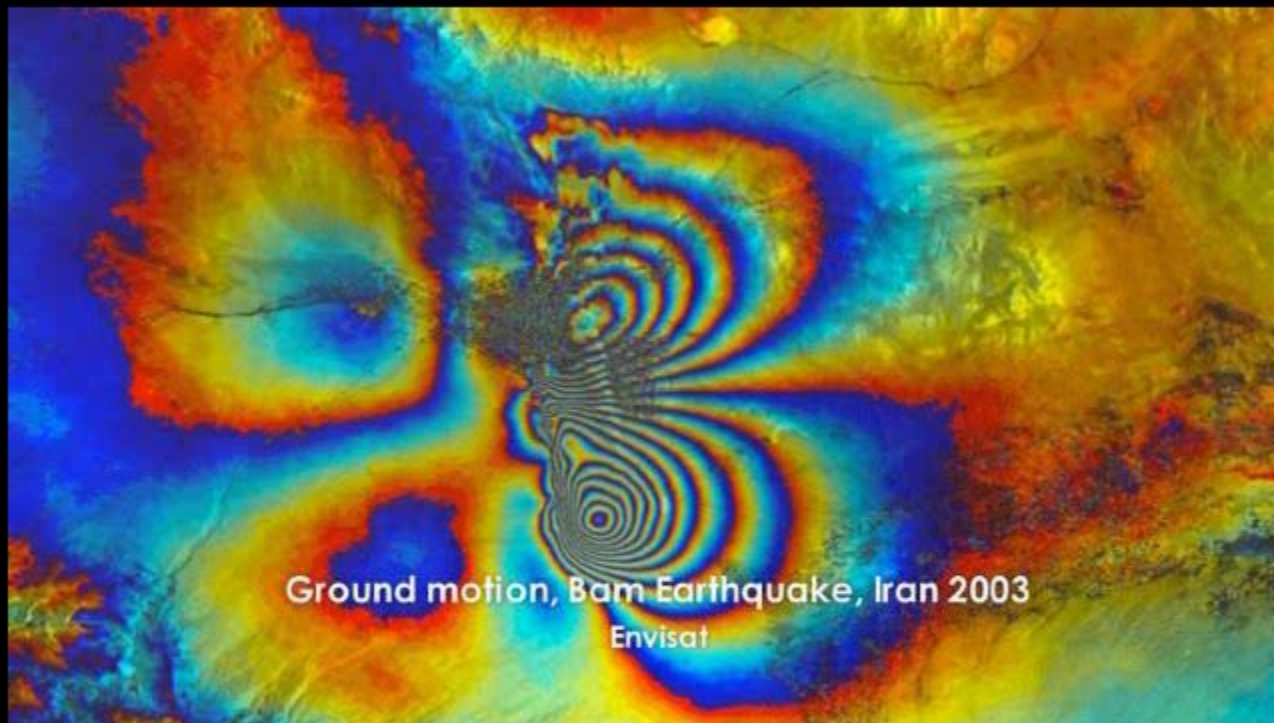
Iceberg B-15A
(ASAR_WSM_15Apr05)

a

ency

Iceberg B-15A Antarctic (ASAR_WSM 4 – 20 Apr 05)





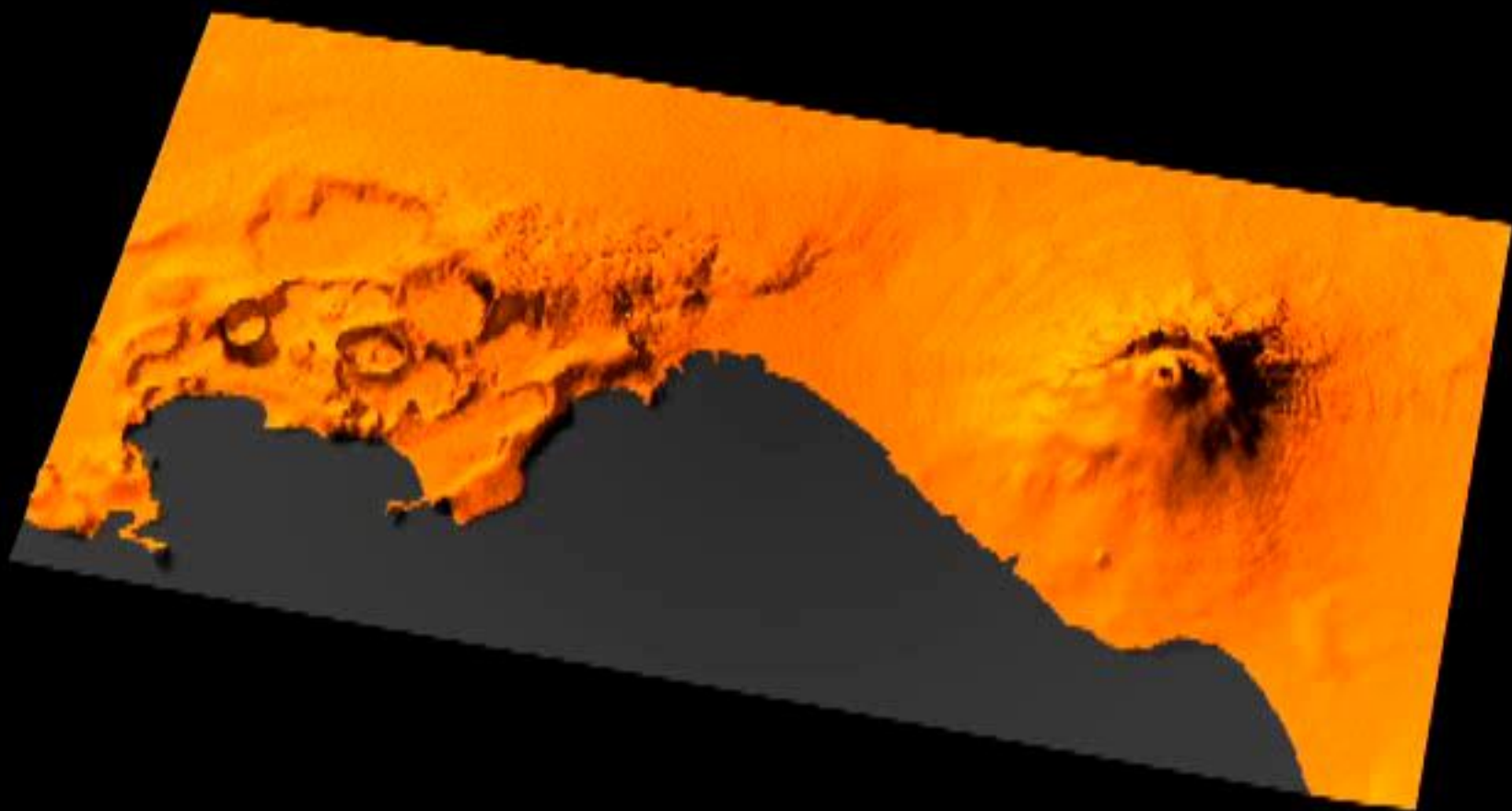
Ground motion, Bam Earthquake, Iran 2003

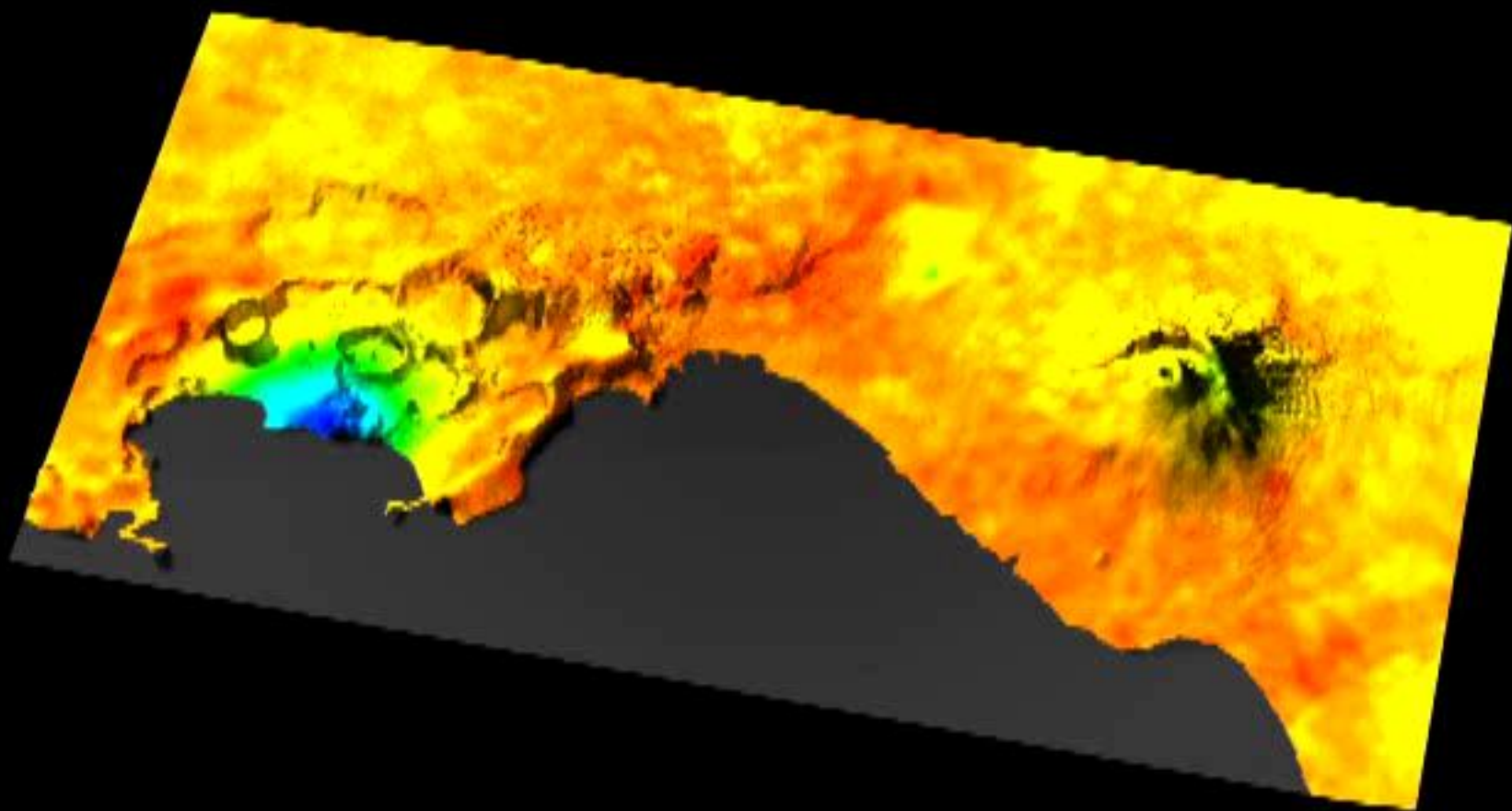
Envisat

ETNA monitoring from space

1992 - 2000

Radar Interferometry

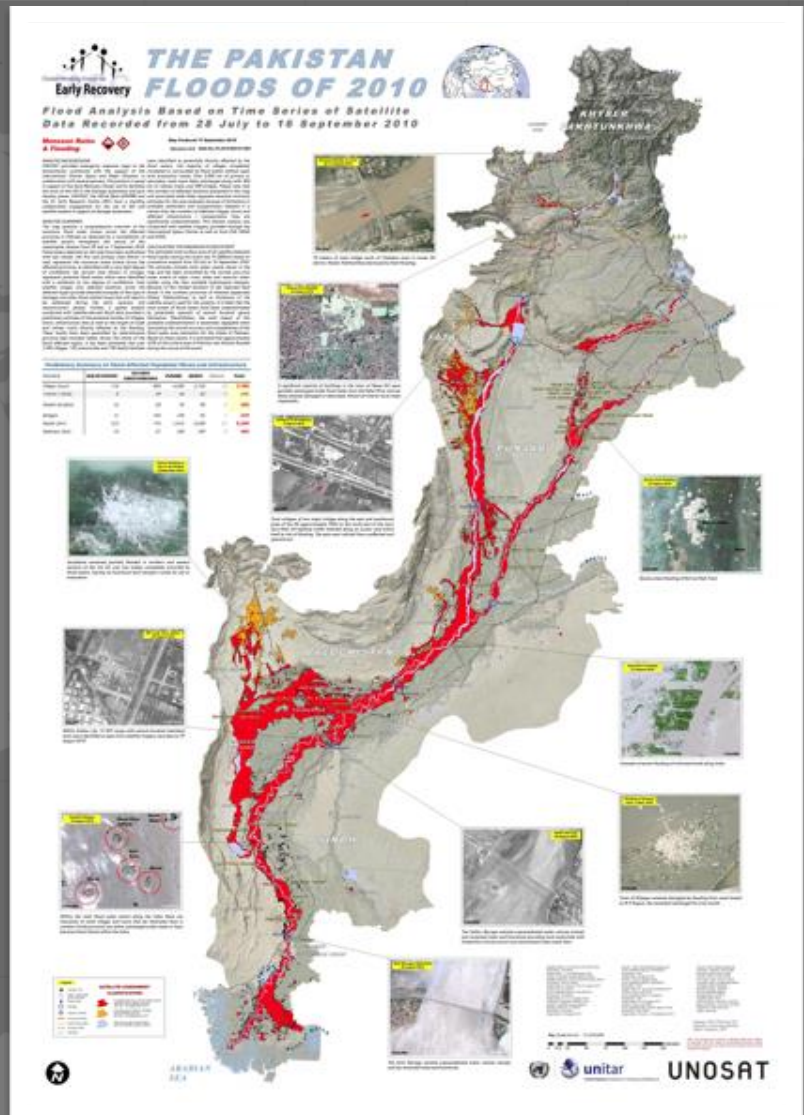




Many more examples available at:

<http://ew.eo.esa.int/web/guest/home>

International Charter Space & Major Disasters



**More than 350
activations in 110+
countries
since 2000 !**

**Universal Access
since Sept. 2012**

The example of the 2010 Pakistan Floods

International Charter Space & Major Disasters – purpose:



An International agreement among Space Agencies to support with space-based data and information relief efforts in the event of emergencies caused by major disasters

Disasters types supported



The International Charter makes priority tasking of different EO missions in a rapid fashion; it is designed to address sudden requests concerning major disasters caused by:

Natural events

- Earthquakes
- Fires
- Floods
- Ice jams
- Landslides
- Tsunamis
- Ocean storms
- Volcanic eruptions

Man-made events

- Oil spills
- Industrial accidents



Charter Activations (disaster types)



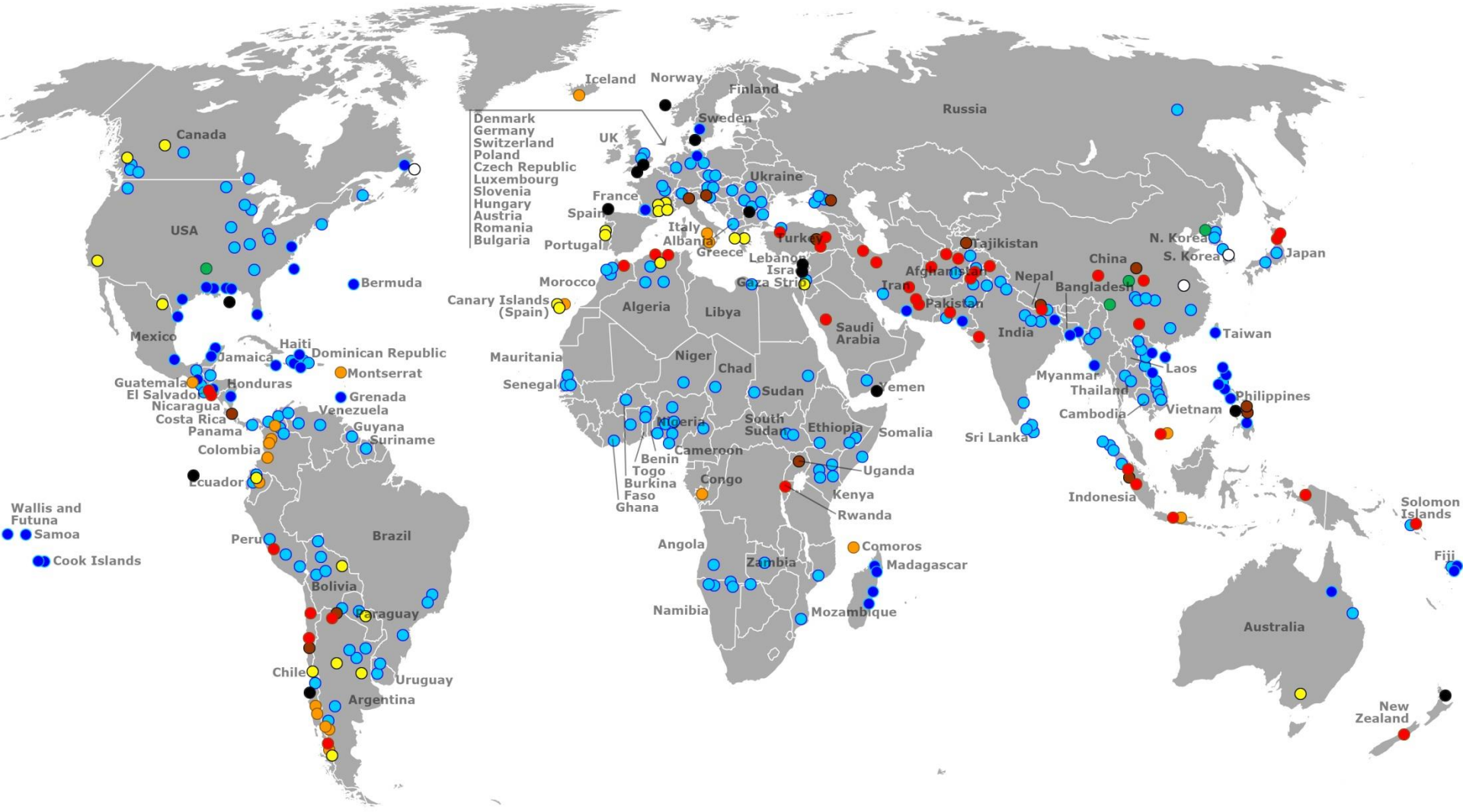
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Sub-totals	
Solid Earth	<i>Earthquake</i>		3	1	3	5	3	2	5	4	3	5	6	2	42	76
	<i>Landslide</i>	1	1	2	2			1			4	2	1		14	
	<i>Volcano</i>		1	1	2	2	1	1	2	3	3	2	1	1	20	
Weather / Atmospheric	<i>Storm/hurricane**</i>			1	2	3	6	1	8	8	8	11	3	2	53	260
	<i>Ice/snow hazard</i>								1			1	1		3	
	<i>Flood/ocean wave*</i>		3	8	4	9	13	16	22	23	18	25	16	23	180	
	<i>Fire</i>				5	1	2		4	2	4	1	3	2	24	
Technological	<i>Oil spill</i>		3	2				4	3			1	1		14	18
	<i>Others</i>					1						3			4	
Total / year		1	11	15	18	21	25	25	45	40	40	51	32	30		

Total: 354

*includes solid earth related phenomenon of a tsunami

**includes all wind type storms (hurricane, cyclone, typhoon and tornado)

Activation Distribution



Denmark
Germany
Switzerland
Poland
Czech Republic
Luxembourg
Slovenia
Hungary
Austria
Romania
Bulgaria

Wallis and Futuna
Samoa
Cook Islands

Legend: ● Earthquake ● Landslide ● Volcano ● Storm/hurricane ● Flood/ocean wave ○ Ice/snow hazard ● Fire ● Oil spill ● Other

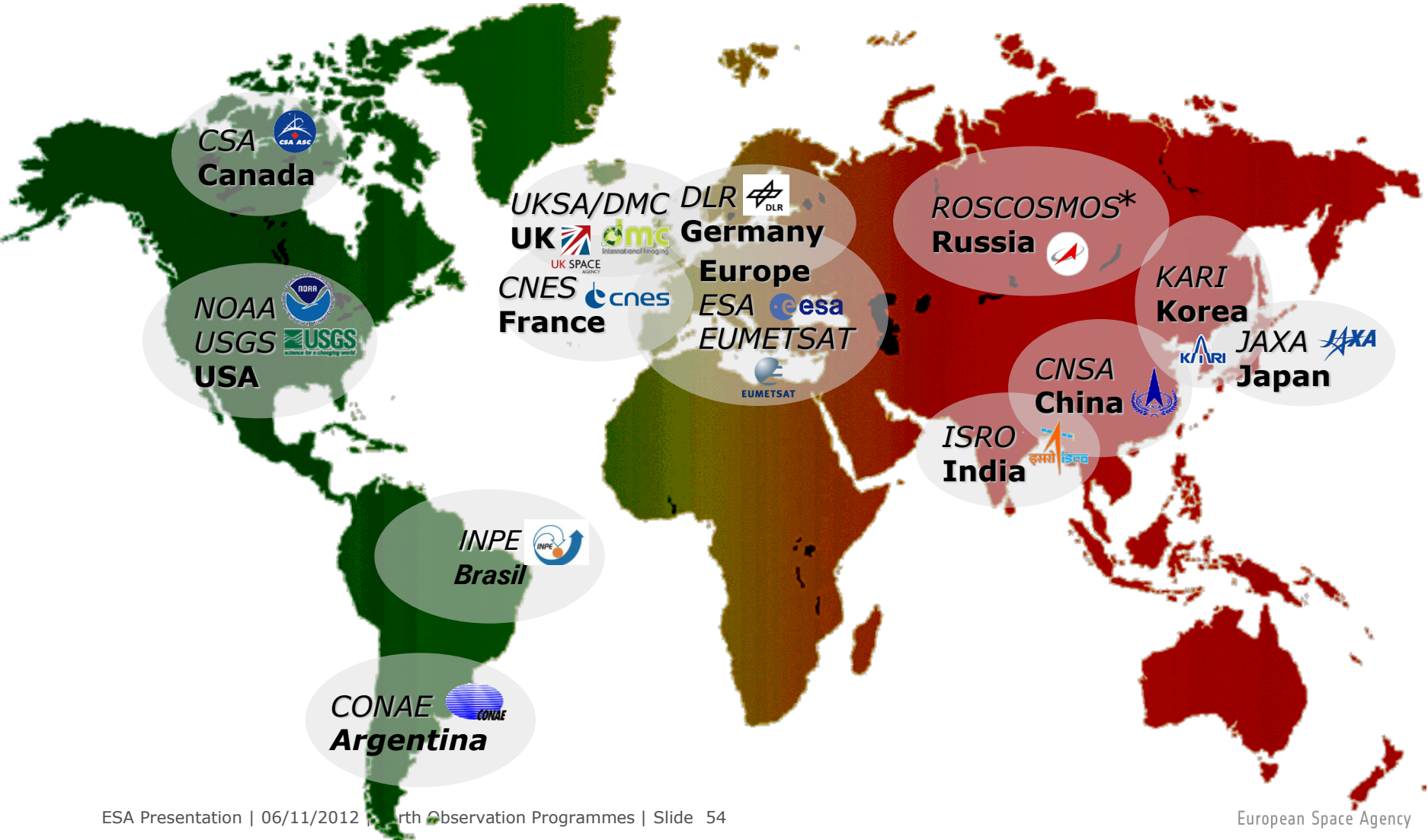
As of October 15, 2012

Charter History



- Following UNISPACE III in Vienna in July 1999, **ESA** (European Space Agency) and **CNES** (Centre national d'études spatiales) initiated the International Charter in July 1999.
- **CSA** (Canadian Space Agency) signed the Charter on October 20, 2000.
- Charter declared operational as of **November 1, 2000** after formal rehearsals and qualification tests.
- 350+ disasters covered to date in over **110+** countries worldwide.
- Now composed of **14 members**.

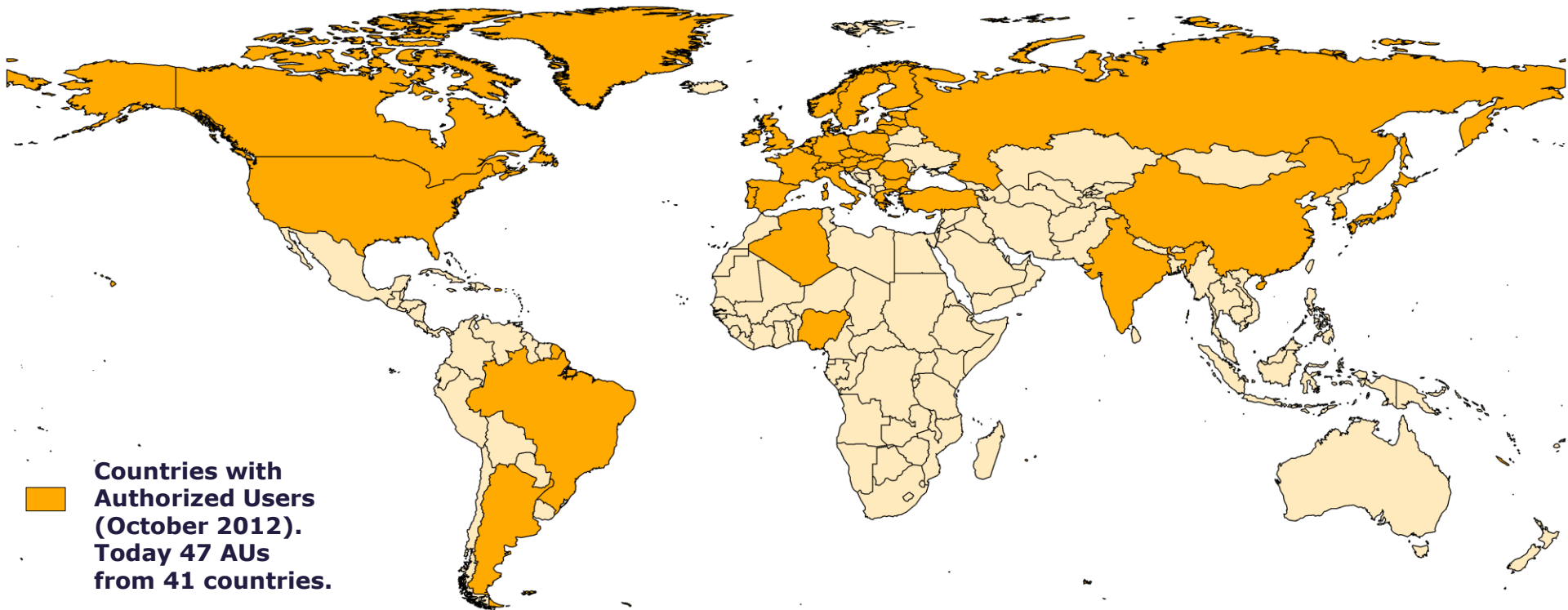
Charter Members



Activating the Charter: Authorized Users (AU)



The only bodies authorized to **directly** request the Charter to be activated are the **Authorized Users** - AUs (typically civil protection agencies, governmental relief organizations, or other authorities with a mandate related to disaster management).

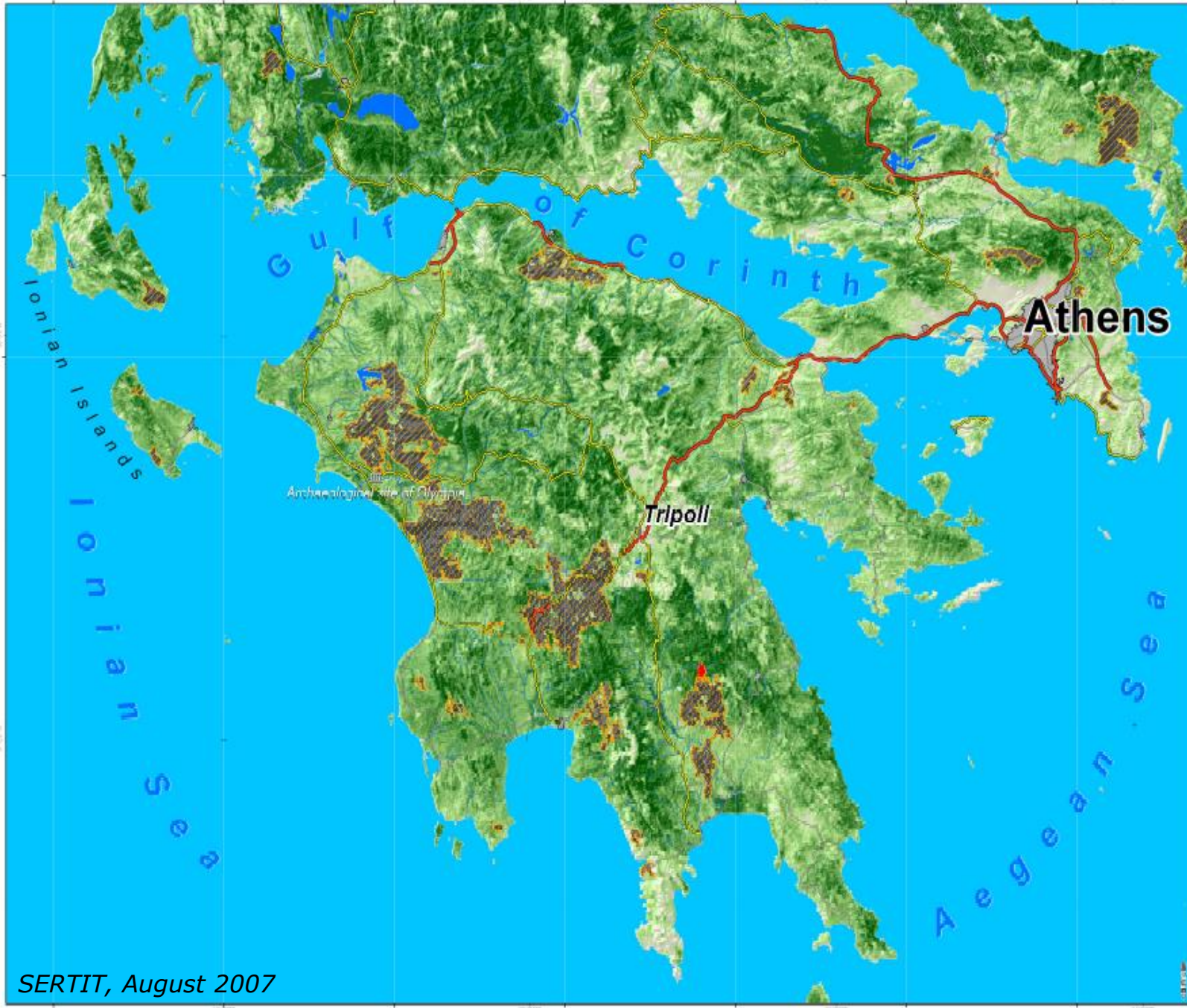


Since its inception, the Charter has demonstrated a strong commitment to expanding its number of users. Initiatives include collaboration with the UN and Sentinel Asia.

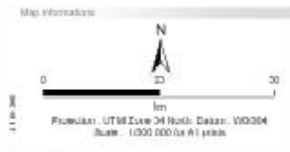
- **2007**: GEO requested direct access for its Member states.
- **2008**: the Charter Board adopted the principle of 'universal access' to support worldwide emergency response activities.
- **2011**: Charter Board adopted Universal Access resolution:
“Any national disaster management authority will be able to submit requests for emergency response support to the Charter. Proper procedures will have to be followed, but the affected country will not have to be a Charter member”.
- **September 2012**: launch of the Universal Access process.

Burnt area mapping using IR satellite data





- Legend**
- Active fire observed the 30th of August 2007
 - Burnt areas observed the 30th of August 2007
 - Vegetation index (low to high)
 - Mediterranean Sea
 - Island water
 - Urban areas
 - Major roads
 - Secondary roads
 - Other roads



Data sources

Vegetation index: Asterisk data
 (asterisk data: year of August 2007)

Legend

Active fire areas: from the analysis of the imagery acquired by the SPOT-4/5 on 29th of August 2007 (300m resolution). Processing SERTIT 2007

Vegetation index: from the MODIS FR 1° data acquired the 30th of August 2007 (500m resolution). Processing SERTIT 2007

Vector layers

- Mediterranean Sea: IGN
- © IGN
- Roads, island water, urban areas: IGN
- © IGN

Topography: IGN

© IGN

The products elaborated for this International Charter 'Space and Major Disasters' call are realized on a best effort basis in order mode within a very short time scale.

Map produced the 30th of August 2007
by SERTIT & IGN

www.cnes.fr
<http://www.esa.int>

cnes
CENTRE NATIONAL D'ETUDES SPATIALES

esa
EUROPEAN SPACE AGENCY

sertit

OVERVIEW OF CYCLONE NARGIS-AFFECTED AYEYARWADY DIVISION, MYANMAR

This map illustrates a basic overview of the cyclone affected areas of the Ayeeyarwady Delta region in Myanmar. The approximate cyclone track, estimated sustained wind speeds and areas of distribution have been provided by NOAA, University of Hawaii and the Tropical Storm Risk (TSR) sites and are estimates as of 4 May 2008. This data has not been validated in the field.



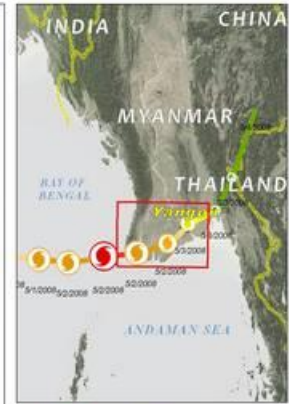
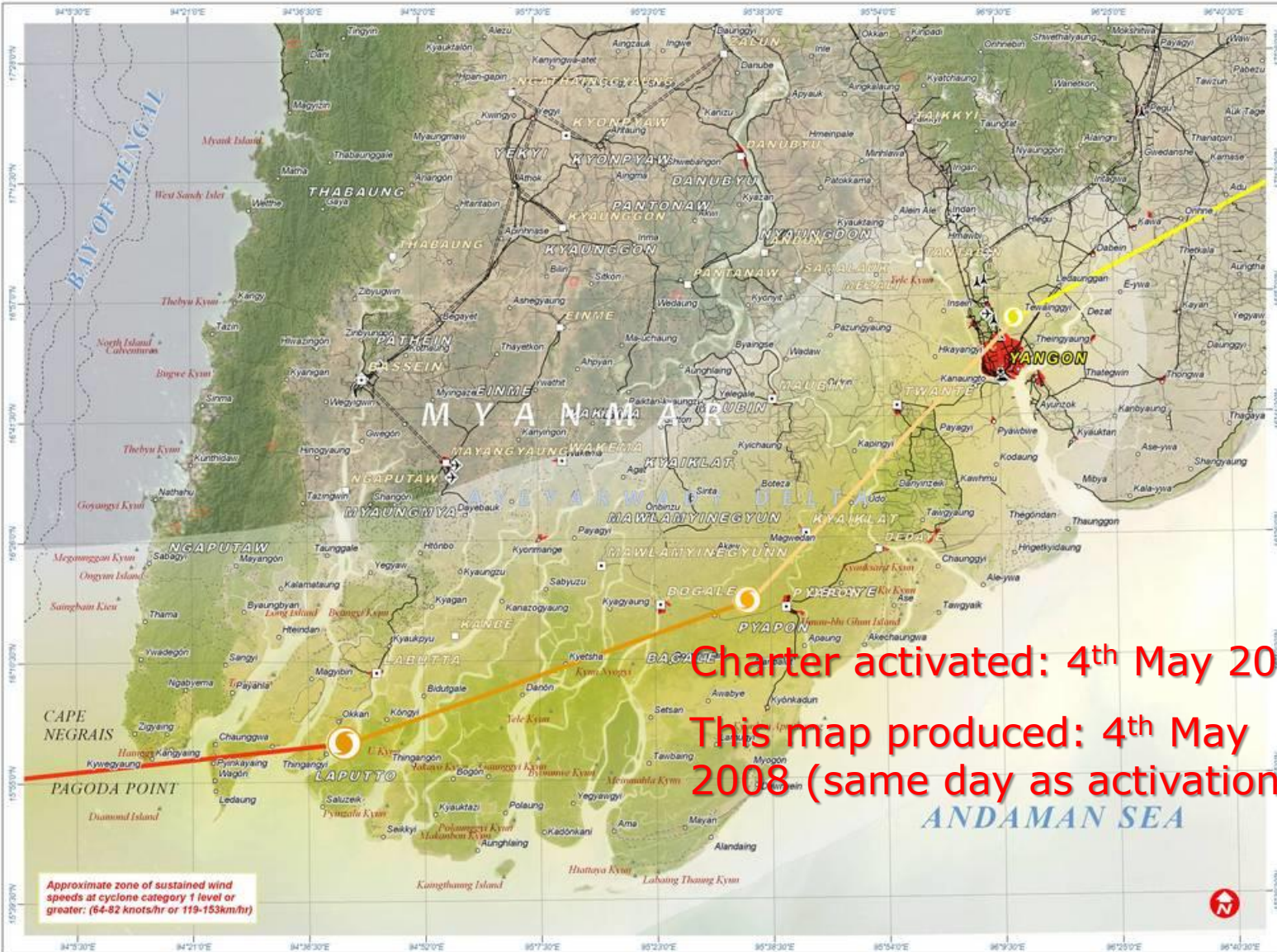
Cyclone Nargis

4 May 2008

Version 1.0



TC-2008-000057-MMR



Legend

- International Border
- Main Road
- Secondary Road
- Town
- Trunk / Trail
- Railroad
- Utility Line
- Port
- Urban / Built-up Area
- Capital
- City / Large Town
- Town
- Village
- Airfield
- Tower

EST. CYCLONE NARGIS TRACK & WIND SPEED:

CATEGORY	64-82 knots/hr	83-85 knots/hr	83-113kts/hr	116-153kts/hr
1	1	2	3	4

Approximate zone of sustained wind speeds at cyclone category 1 level:
 (64-82 knots/hr or 119-153km/hr)

Charter activated: 4th May 2008

This map produced: 4th May 2008 (same day as activation)

Map Scale for A3: 1:900,000

0 5 10 20 30 40 Kilometers

Cyclone Data: NOAA, Un of Hawaii's Tropical Storm Risk
 GIS Data: USGS, NGA, ESRI, NASA
 Satellite Data: MODIS-Aqua
 Imagery Date: 16 April 2008
 Resolution: 250m
 Map Production: UNOSAT (4 May 2008)
 Projection: UTM Zone 48 North
 Datum: WGS 1984

The depiction and use of boundaries, geographic names and related data shown here are not warranted to be error-free nor do they imply official endorsement or acceptance by the United Nations. This map was produced by the United Nations Institute for Training and Research (UNITAR) Operational Satellite Applications Program (UNOSAT). UNOSAT provides satellite imagery & related geographic information to UN humanitarian & development agencies & their implementing partners.

UNOSAT
 satellite solutions for all
 Contact Information: info@unosat.org
 24/7 Hotline: +41 78 487 4998
 www.unosat.org

Approximate zone of sustained wind speeds at cyclone category 1 level or greater: (64-82 knots/hr or 119-153km/hr)

Recent example: Super-storm Sandy, Haiti, October 2012

Disappeared or damaged buildings highlighted on Pleiades image acquired the 02/11/2012 following super-storm Sandy



Identification of damaged buildings highlighted on Pleiades image acquired the 19/07/2012 before super-storm Sandy



Charter Call 418
Glide N° TC-2012-000180-HTI
Product No. 05

Haiti - Port-au-Prince : Santo

Super-storm Sandy's impact along Grise River:
affected buildings and displaced riverbanks
Observation the 02/11/2012

Location Diagrams

Legend

Impact	Situation before event (19 July 2012)
Damaged building	Road
Affected road	Water body
Water body 02 November 2012	Old riverbank
New riverbank	
Riverbank displacement	

Interpretation

During the night of the 23-24 of October 2012, Hurricane Sandy hit Haiti with intense downpours and violent winds causing flooding and much damage. According to Civil Security, it left 51 dead and a number missing in its wake. Many dwellings, infrastructure and fields were destroyed. A country-wide state of emergency was declared on the evening of the 30th of October. This map highlights impacts along the Grise River within the Santo neighbourhood, to the NE of Port-au-Prince's airport. In many places, this flood provoked catastrophic riverbank changes sweeping away over 200 dwellings into the river waters.

Cartographic information

0 25 50 m

Local projection: UTM Zone 18 North, Datum: WGS 84
Geographic projection: Lat/Lon (DMS), Datum: WGS 84
Scale: 1:1 000 for A1 prints

Geometric references sourced from KAL-Haiti project:
Horizontal: Google Images, RMSe < 5m
Vertical: SPOT HRS, RMSe < 10m

Data sources

Disaster impact assessment (affected buildings and roads, water bodies and riverbanks) mapped from the Pleiades image acquired the 02 November 2012
© SERTIT 2012
Situation before event mapped from the Pleiades image acquired the 19 July 2012 (water bodies and riverbanks) and KAL-Haiti project (roads)

Background layers

Pleiades 1A (50 cm) images acquired the 19 July 2012 and the 02 November 2012, © CNES 2012, distribution Astrium Services / Spot Image S.A., all rights reserved

Framework

The products elaborated for this Rapid Mapping Activity are realised to the best of our ability, within a very short time frame, during a crisis/exercise, optimising the material available.
All geographic information has limitations due to the scale, resolution, date and interpretation of the original source materials. No liability concerning the content or the use thereof is assumed by the producer.
Map produced the 08 November 2012 by SERTIT
© SERTIT 2012
sertit@sertit.u-strasbg.fr
http://sertit.u-strasbg.fr

Nyragongo Volcano



Charter website



INTERNATIONAL CHARTER SPACE AND MAJOR DISASTERS

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[Charter Geographical Tool](#)

[Disaster Statistics](#)

[Movie of the Charter](#)

[Presentation of the Charter](#)

[Follow Disasters Charter on Twitter](#)

Activating the Charter

There are several [mechanisms to activate the Charter](#). It is based on a pre-defined list of appointed users, known as 'Authorized Users' (AUs). Until now AUs are typically disaster management authorities, from countries of Charter member agencies, able to request Charter support for emergencies in their own country, or in a country with which they cooperate for disaster relief.

Since its inception, the Charter has demonstrated a strong commitment to expanding its number of users. Initiatives include collaboration with UNITAR/UNOSAT and UN OOSA, active in many countries and who can submit requests to support in-country UN relief agencies, and Sentinel Asia, a regional network for Earth observation-based Emergency Response in 32 countries.

Universal Access

Building on a decade of success in making satellite data available for disaster response, the International Charter is now opening its doors even wider. The Charter Members have adopted the principle of Universal Access to further strengthen the Charter's contribution to disaster management worldwide. Any national disaster management authority will be able to submit requests to the Charter for emergency response. Proper procedures will have to be followed, but the affected country will not have to be a Charter member.

Universal Access benefits national disaster management authorities in countries beyond those of the Charter members, previously unable to make direct requests to the Charter.

A registration process is in place for national authorities interested in participating in the Charter as an "Authorized User". This process will validate the ability of national authorities to access and use Charter assets for disaster response, in accordance with Charter operational procedures. Steps and applicable conditions are explained in the Charter's [Universal Access Information Brochure](#) available together with its [Registration form](#).



país | 日本語 | 中文

It is based on a pre-defined list of appointed users, known as disaster management authorities, from countries of Charter member states, for use in emergencies in their own country, or in a country with which they

are making a commitment to expanding its number of users. Initiatives



- Tool
- > Disaster Statistics
- > Movie of the Charter
- > Presentation of the Charter
- > Follow Disasters Charter on Twitter

the affected country will not have to be a Charter member

Universal Access benefits national disaster management authorities previously unable to make direct requests to the Charter

A registration process is in place for national authorities to become a "User". This process will validate the ability of national authorities to respond, in accordance with Charter operational procedures. Charter's **Universal Access Information Brochure** available

Global Monitoring for Environment and Security

European **independence** in data sources for
environment and security monitoring

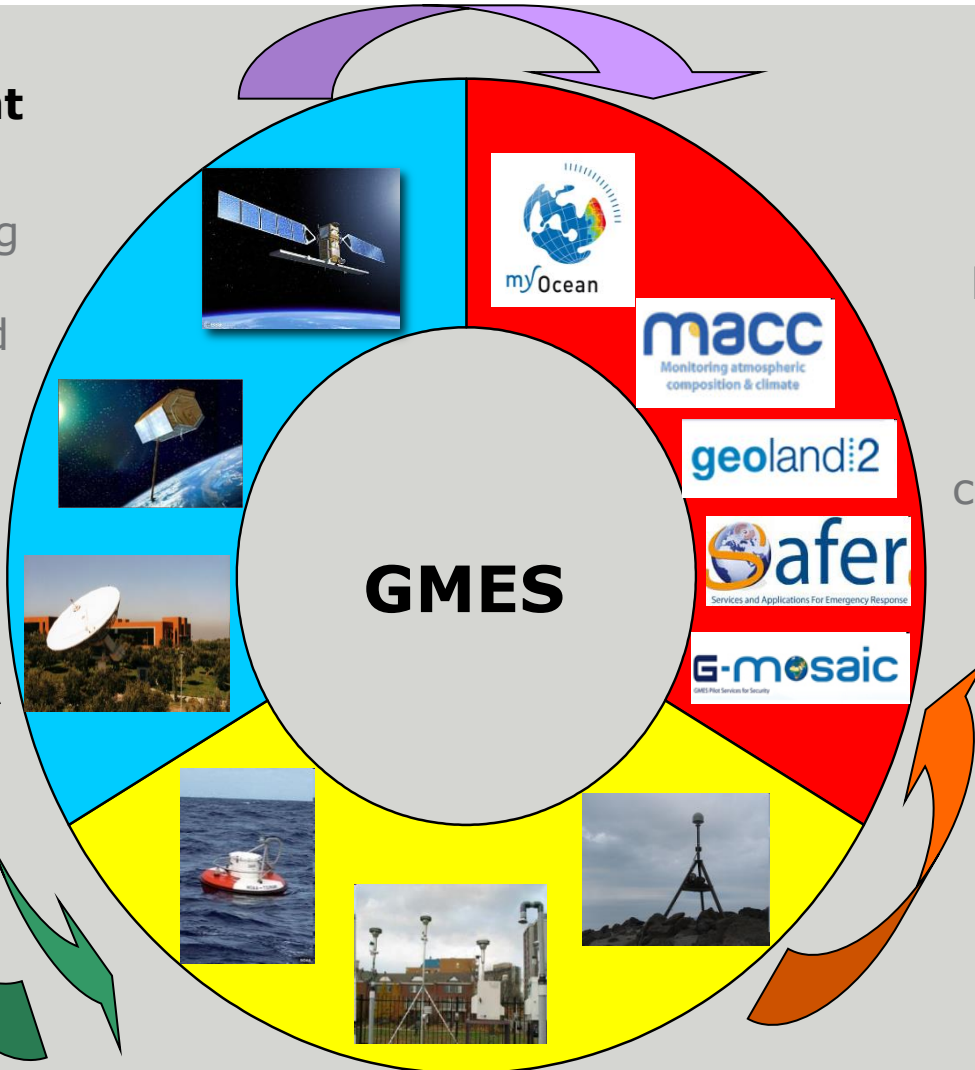
Global, timely and easily accessible
information in Land, Marine, Emergency
response, Atmosphere, Security and Climate
Change domains

GMES Components



Space Component

Sentinels,
Contributing
Missions
and related
Ground
Segment



Services Component

Information
services for
land, marine,
atmosphere,
emergency,
security and
climate change

In-situ Component Land, air and water monitoring sensors

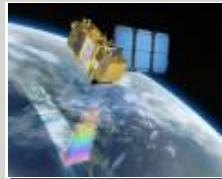
GMES dedicated missions: Sentinels



Sentinel-1 (A/B) – SAR imaging

All weather, day/night applications, interferometry

2013 /2015



Sentinel-2 (A/B) – Multi-spectral imaging

Land applications: urban, forest, agriculture,...
Continuity of Landsat, SPOT

2014 /2016



Sentinel-3 (A/B) – Ocean and global land monitoring

Wide-swath ocean color, vegetation, sea/land
surface temperature, altimetry

2014/2017



Sentinel-4 (A/B) – Geostationary atmospheric

Atmospheric composition monitoring, trans-
boundary pollution

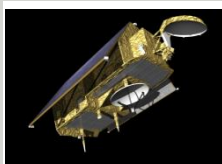
2019/2027



Sentinel-5 precursor/ Sentinel-5 (A/B) – Low-orbit atmospheric

Atmospheric composition monitoring

2015/2020/2027



Jason-CS (A/B) – Low inclination Altimetry

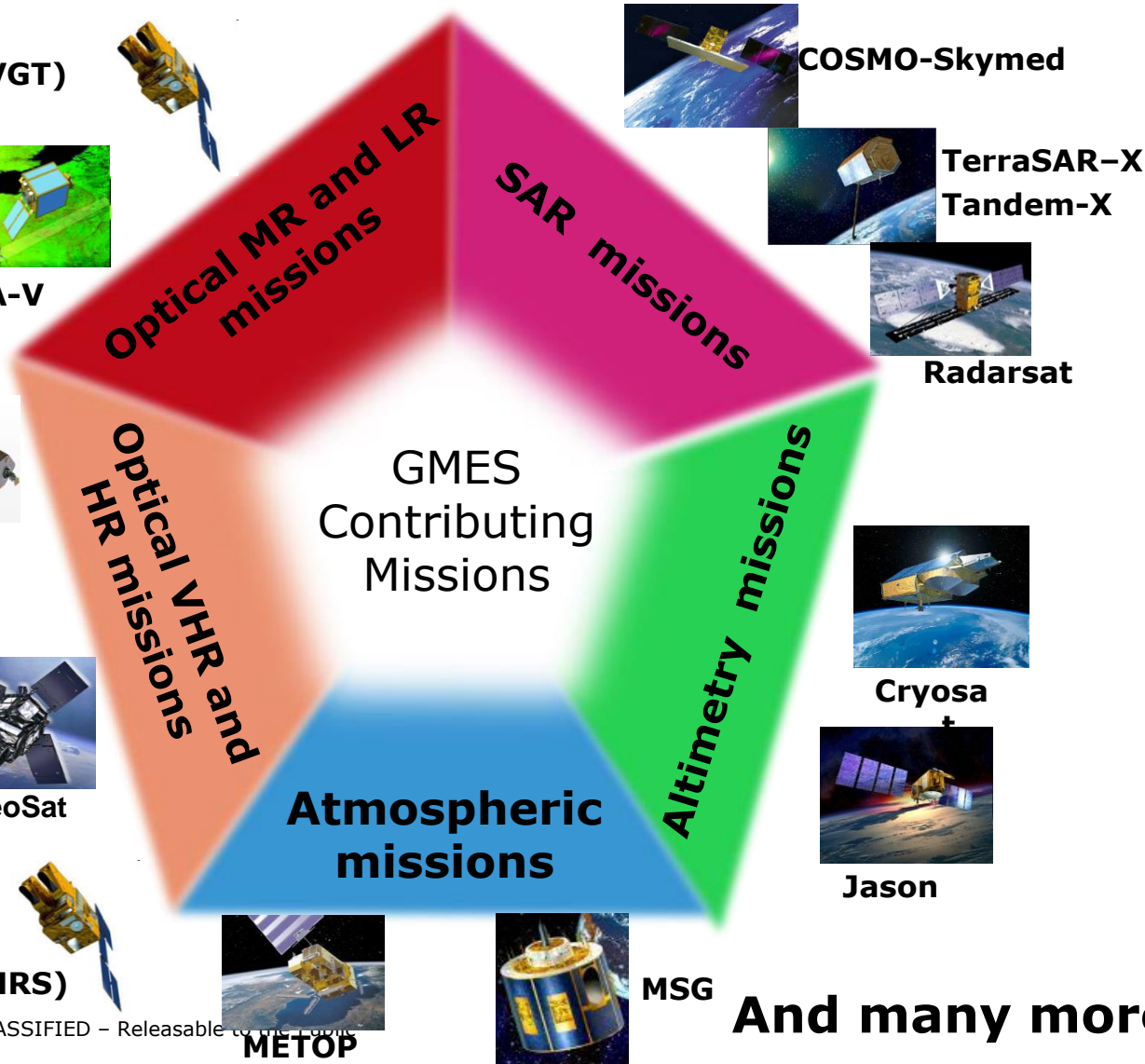
Sea-level, wave height and marine wind speed

2018/2023





Potential Contributing Missions to GMES – Some examples

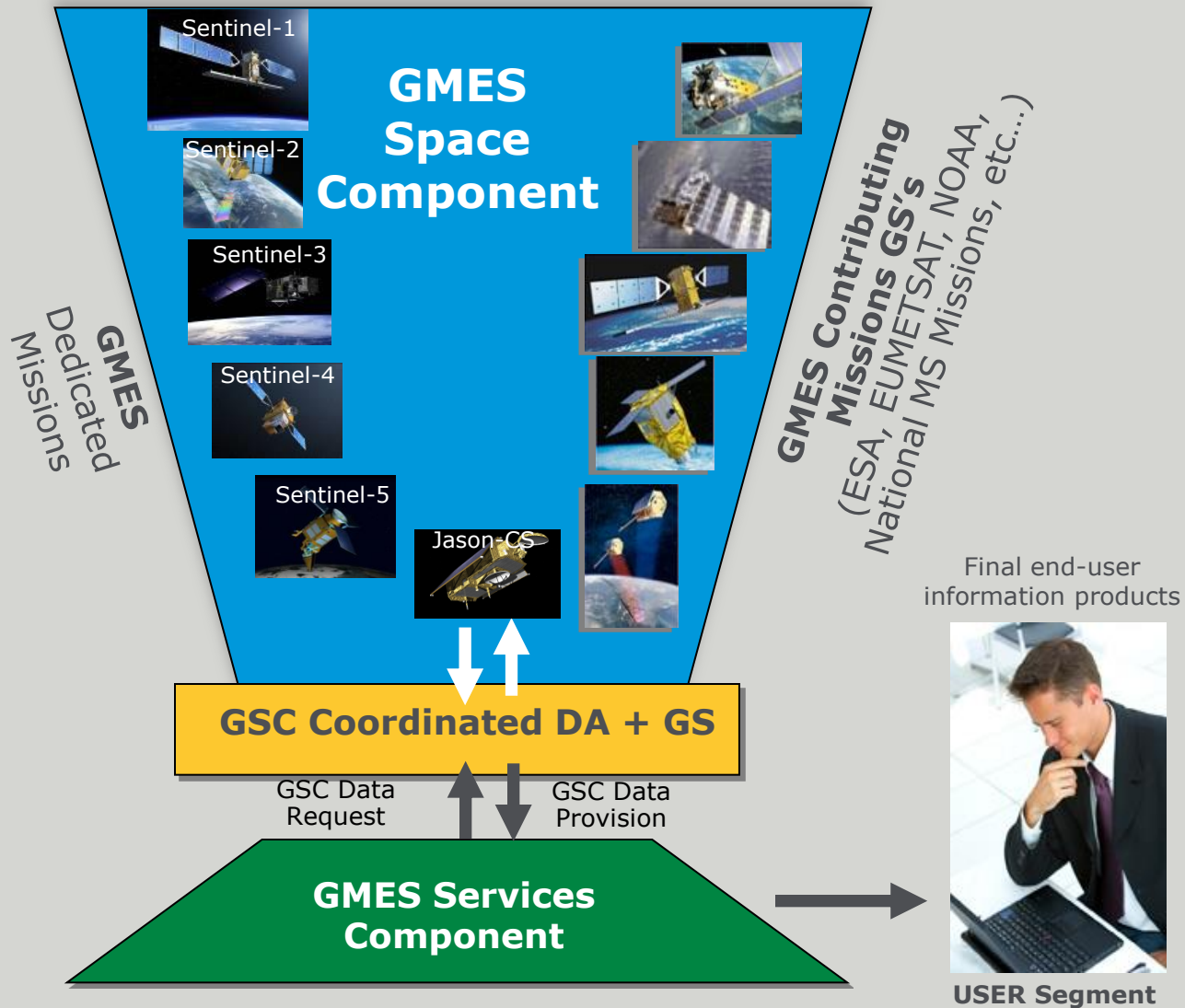


Available today or planned at European, national and international level

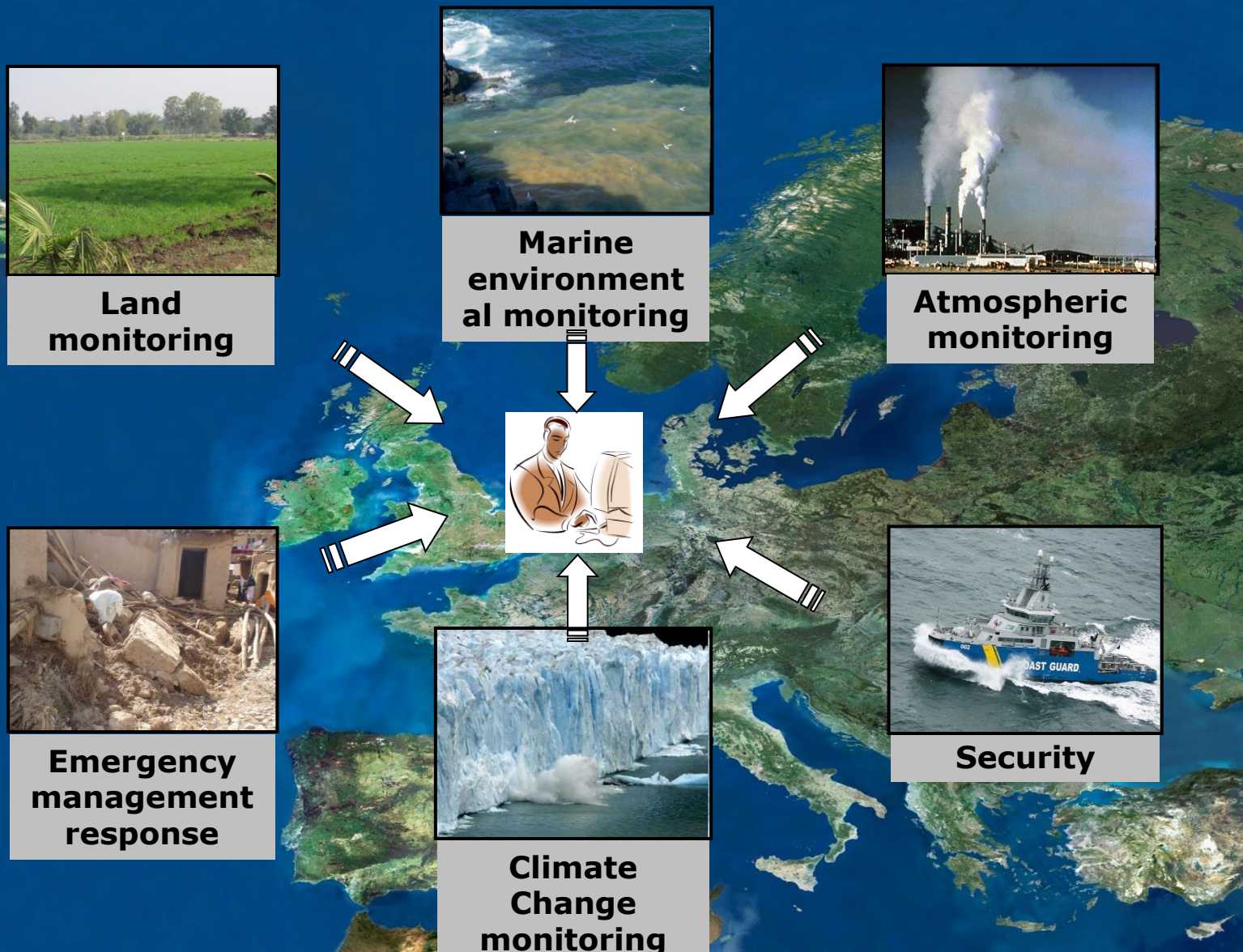
Developed for other purposes but making important data available for GMES

And many more ...

GMES Ground Segment and Data Access



GMES Services domains

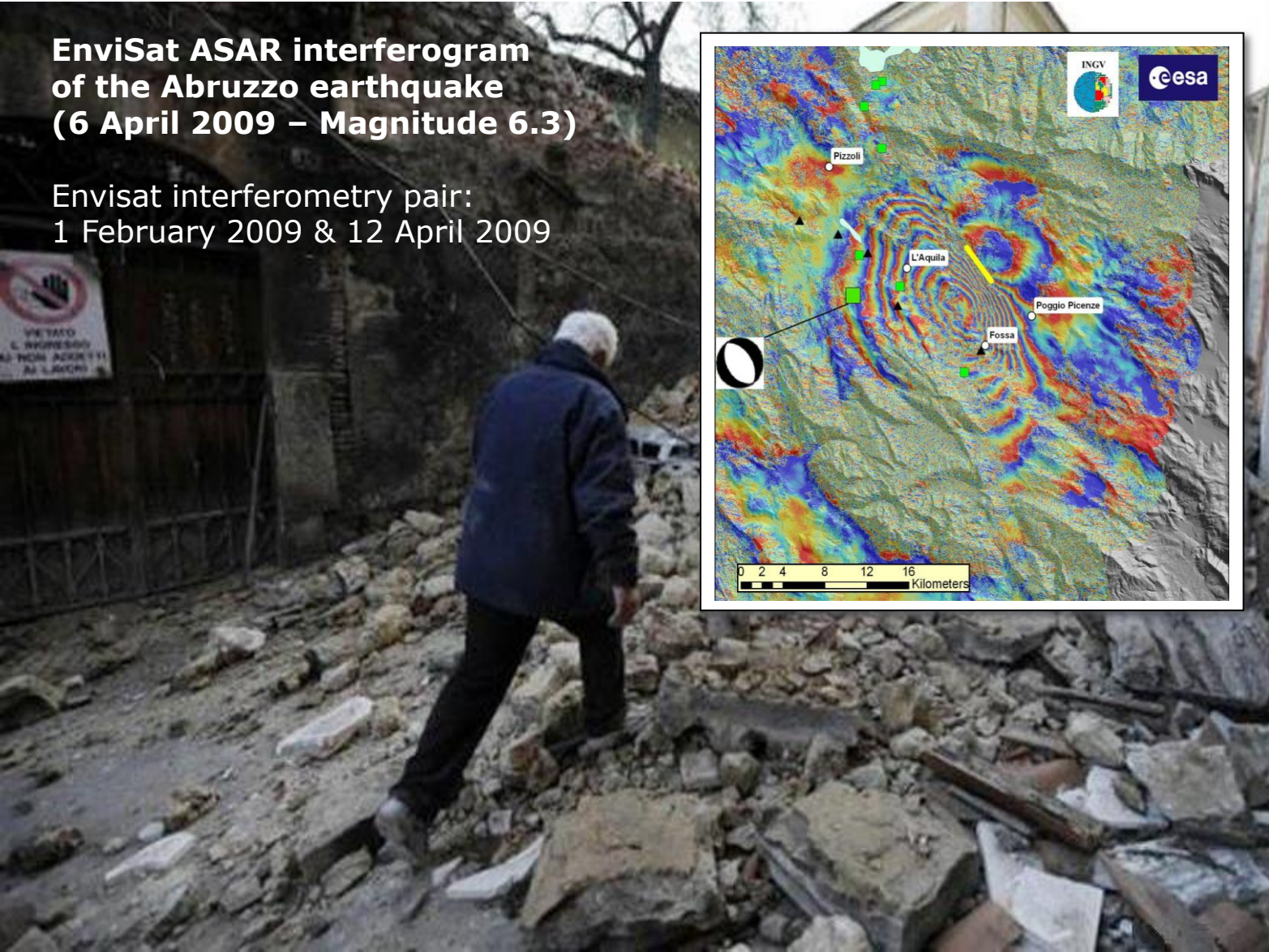
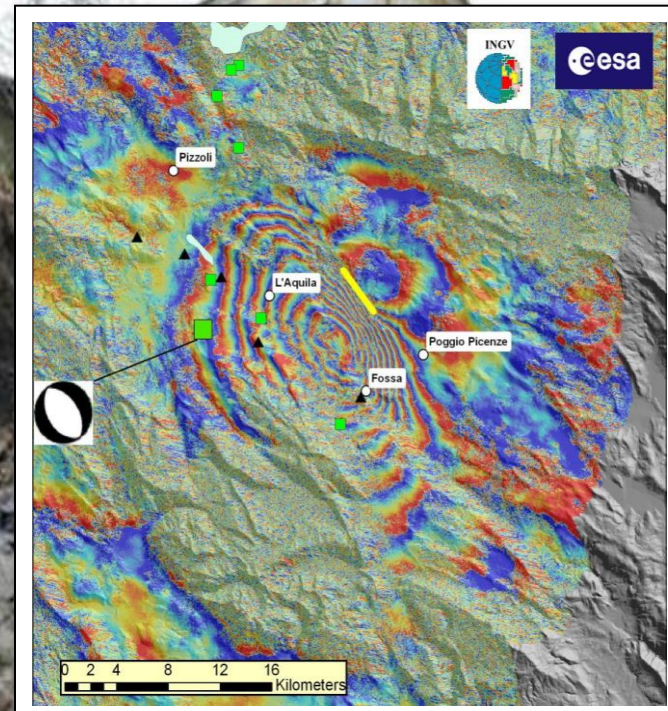


Several services can be linked to Natural Hazards

Example of Land monitoring service: Subsidence Monitoring

EnviSat ASAR interferogram
of the Abruzzo earthquake
(6 April 2009 – Magnitude 6.3)

Envisat interferometry pair:
1 February 2009 & 12 April 2009



Land subsidence - Venice, Italy

Venice has been subject to floodings for hundreds of years and the problem is increasing due to sea level rise and a constant subsidence of the city.

Radar data - like it will be delivered from the first GMES satellite - are providing t

Oil spill monitoring

Conditions at sea, human error and mechanical failure are some of the main causes of oil spills. For an effective clean-up operation to be organised, a knowledge of the extent of the spill and direction it is moving is essential.

Radar satellite

Example of Emergency management response service: 2010 Flood Crises in the Danube River basin



**3 July flood extent
Galati/Braila, Romania
produced within 24
hours**



**Flooding in Passau, Germany, 3
June**

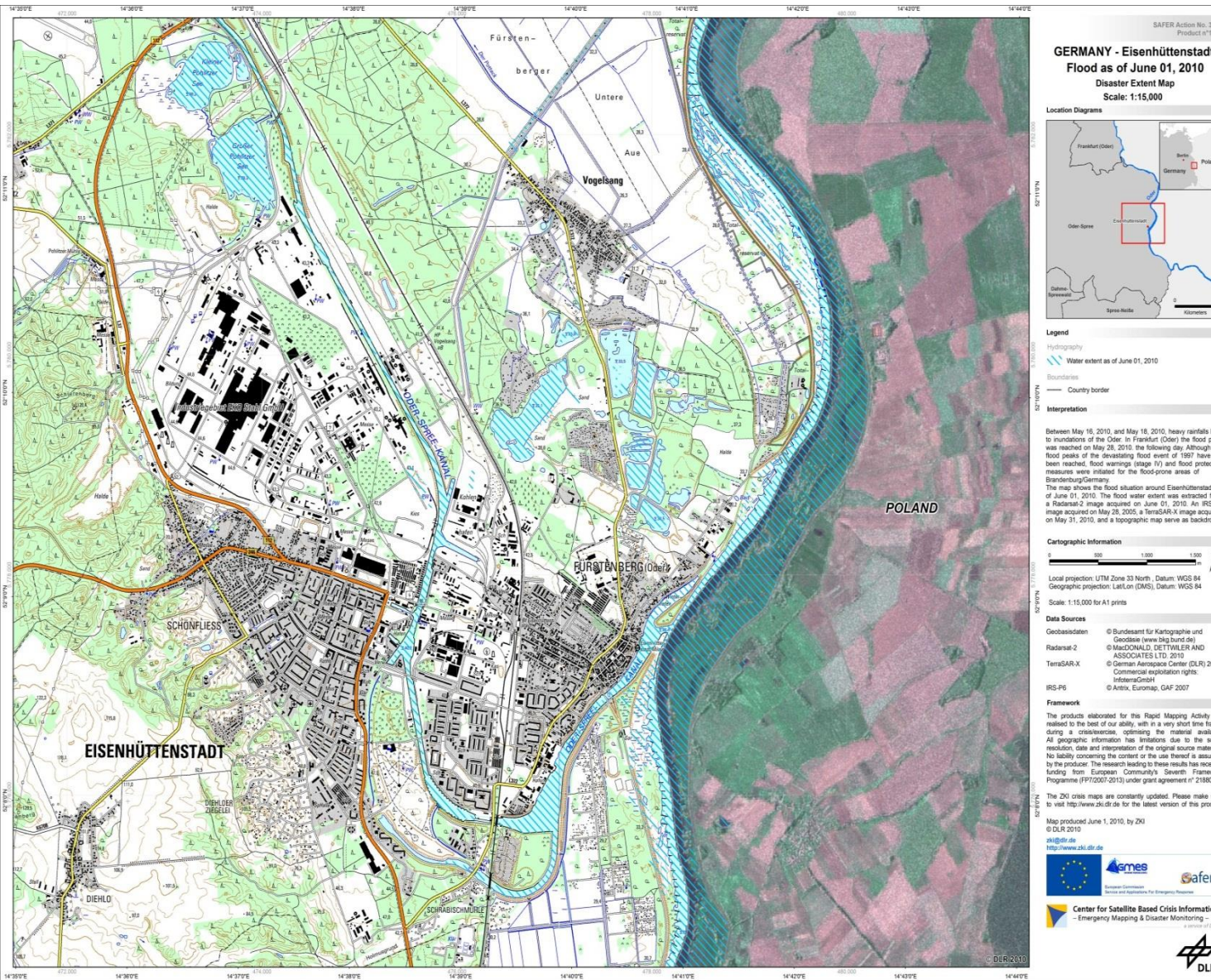


Slide 74

- Water extent as of July 03, 2010
- Water extent as of June 05, 2000

European Space Agency

Emergency service example: German floods



Floods in the German-Polish border (near Eisenhüttenstadt), May-Jun 2010

Data source: Radarsat-2/
TerraSAR-X:

Credits: DLR/SAFER

European Space Agency

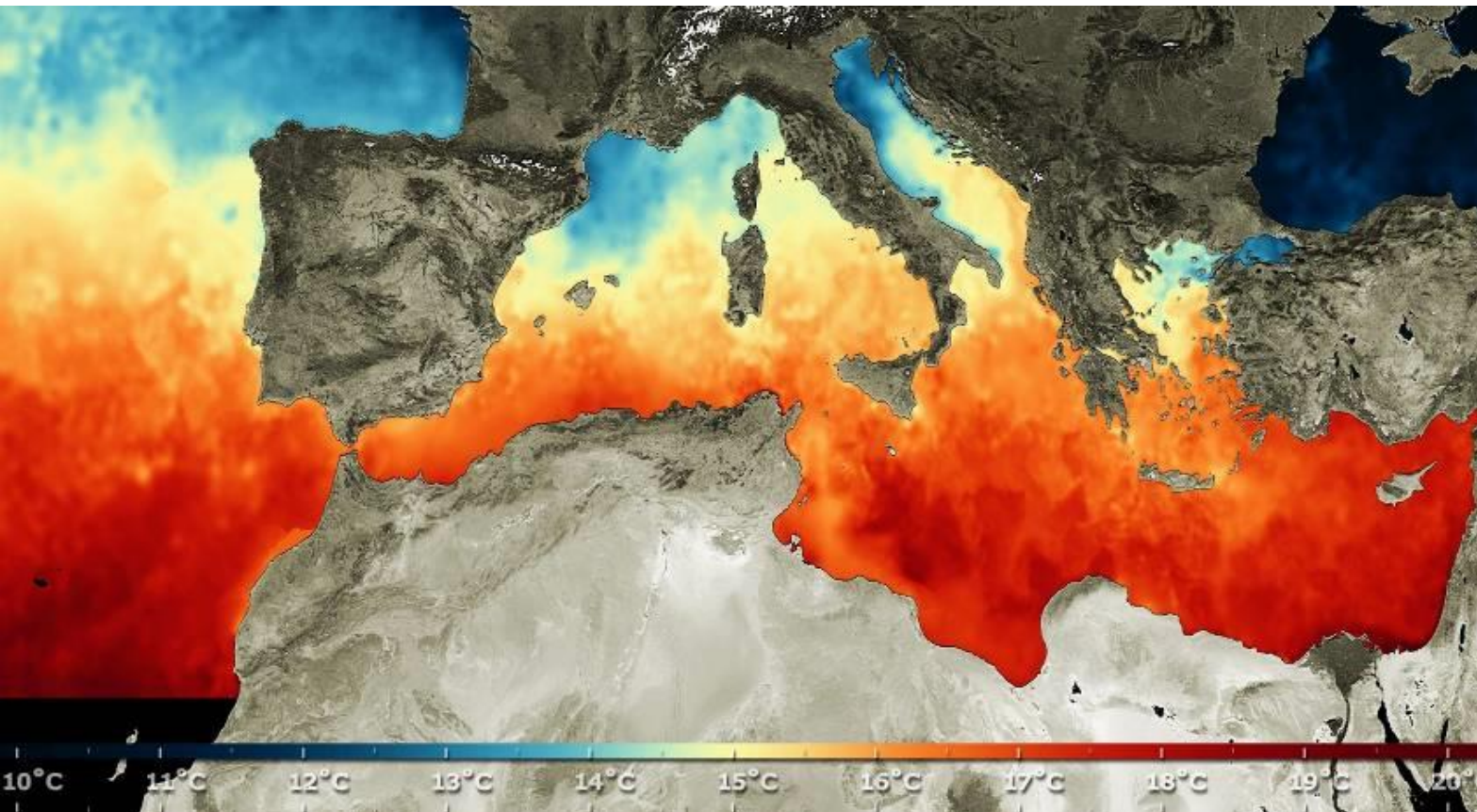
Disaster management from space

Floods are usually accompanied by cloudy skies making it difficult to monitor them from space.

Using radar technology, the new GMES Sentinel-1 satellite is able to 'see' through clouds and rainfall to map emergency-stricken regions.

Radar data not only provide high-resolution information for flood events, but also for other kinds of natural and manmade disa

Example of Marine environmental monitoring service: Marine Monitoring

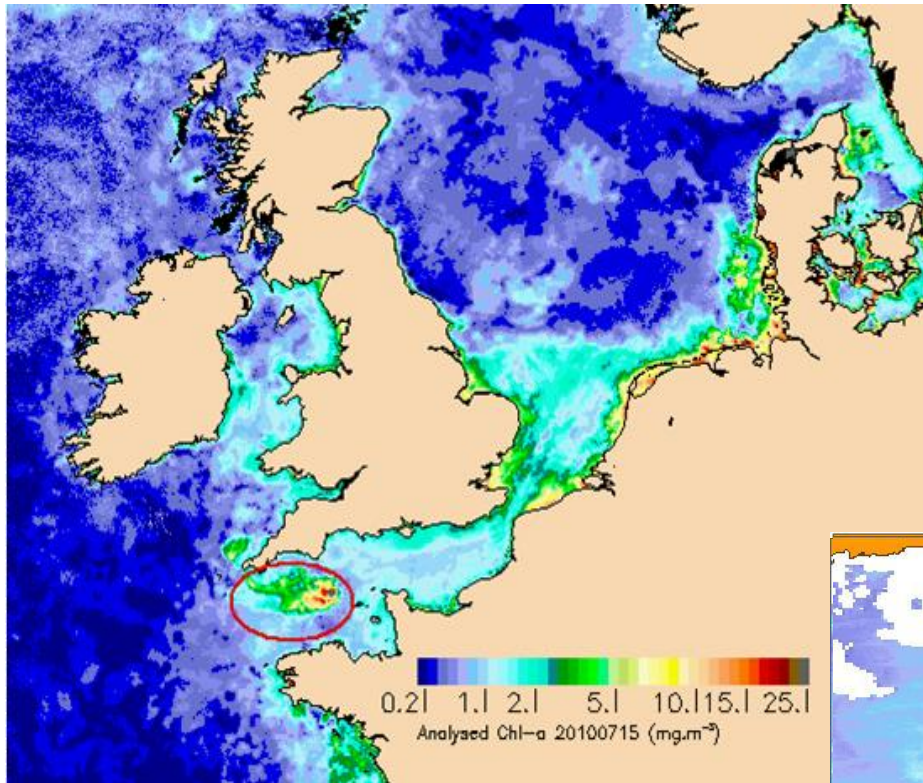


**2006 sea
Surface
Temperature
over the
Mediterranean**

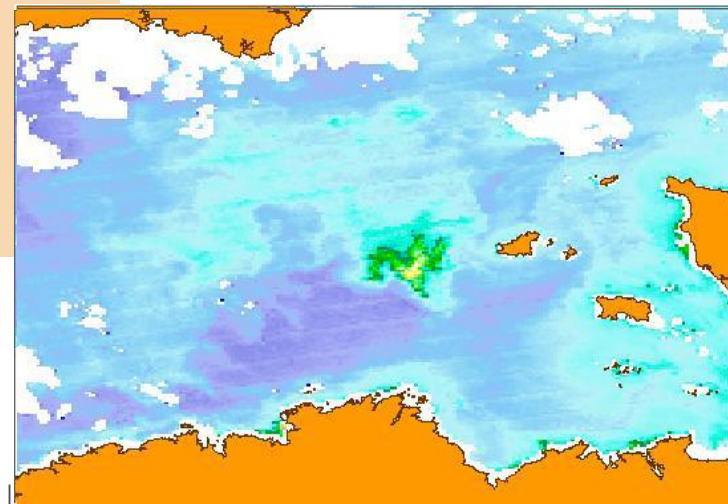
Credits:
Medspiration

European Space Agency

Example of Marine environmental monitoring service: Coastal water quality – Algal Blooms



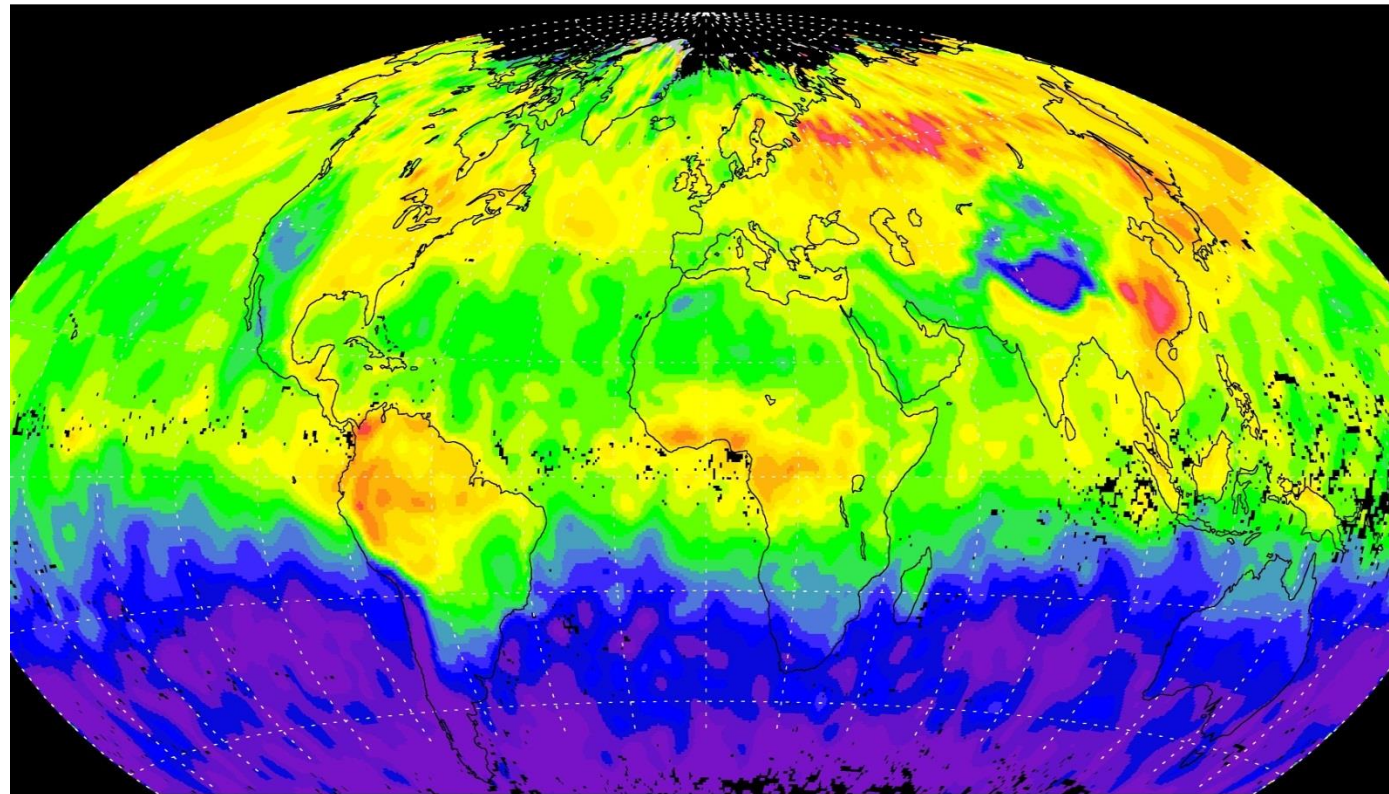
- Detection of a significant algal bloom using Earth Observation data lead to in situ sampling
- The bloom was classified to be a type particularly harmful for aquaculture (*K. Mikimotoi*)



26 July 2010



Example of Atmospheric monitoring service: CH₄ Concentration

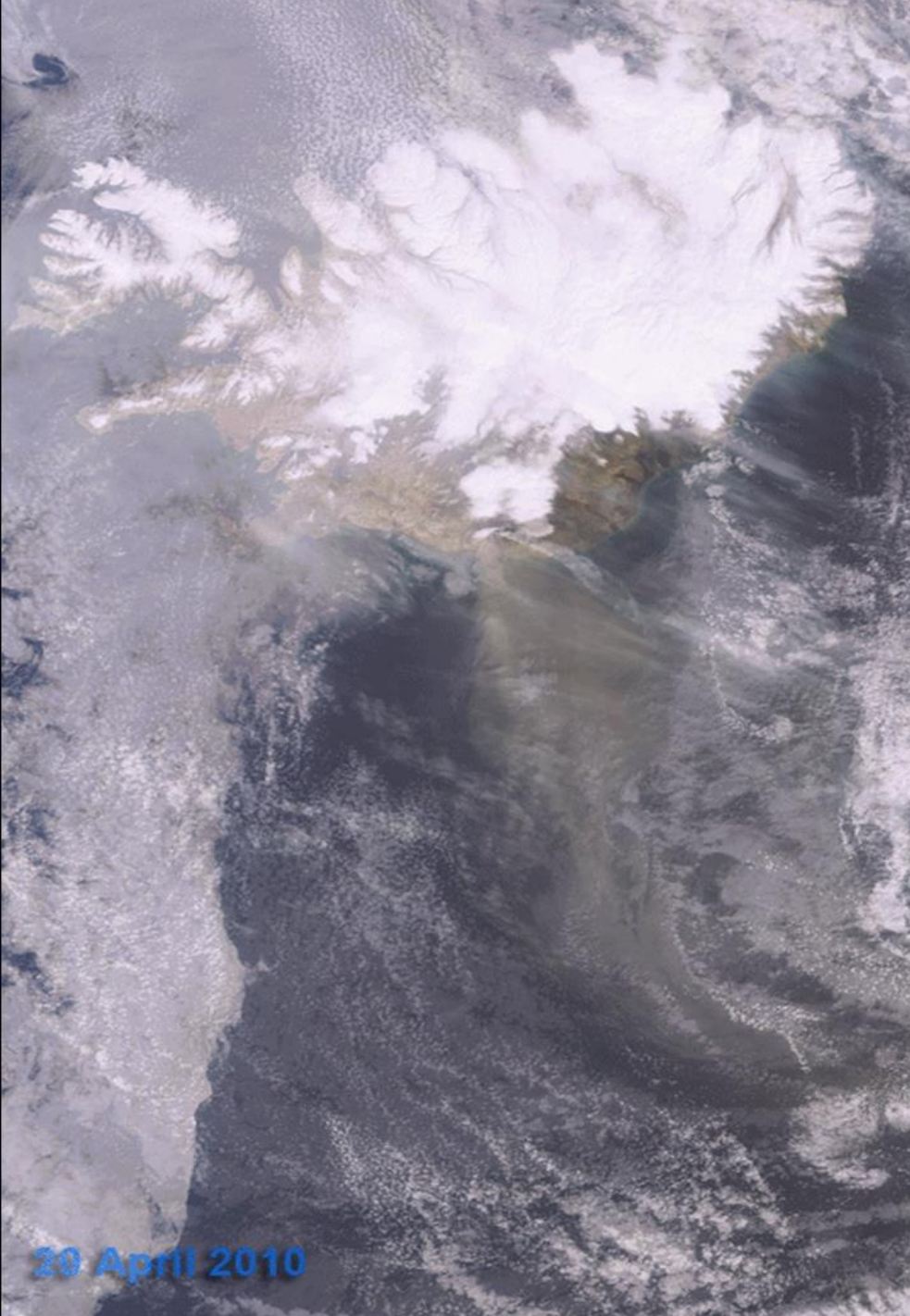


**2003-2005
ESA's
Envisat
global
atmospheric
methane
distribution
(air mole
fractions in
parts per
billion)**

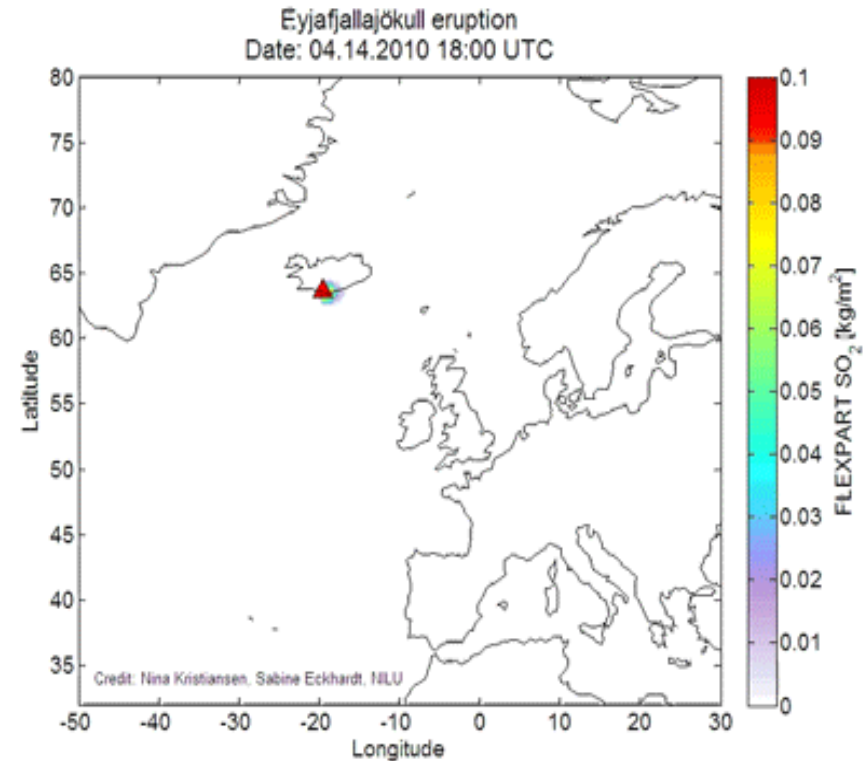
Credits: ESA
and
University of
Bremen



Example of atmospheric application



20 April 2010



Norwegian Institute for Air Research

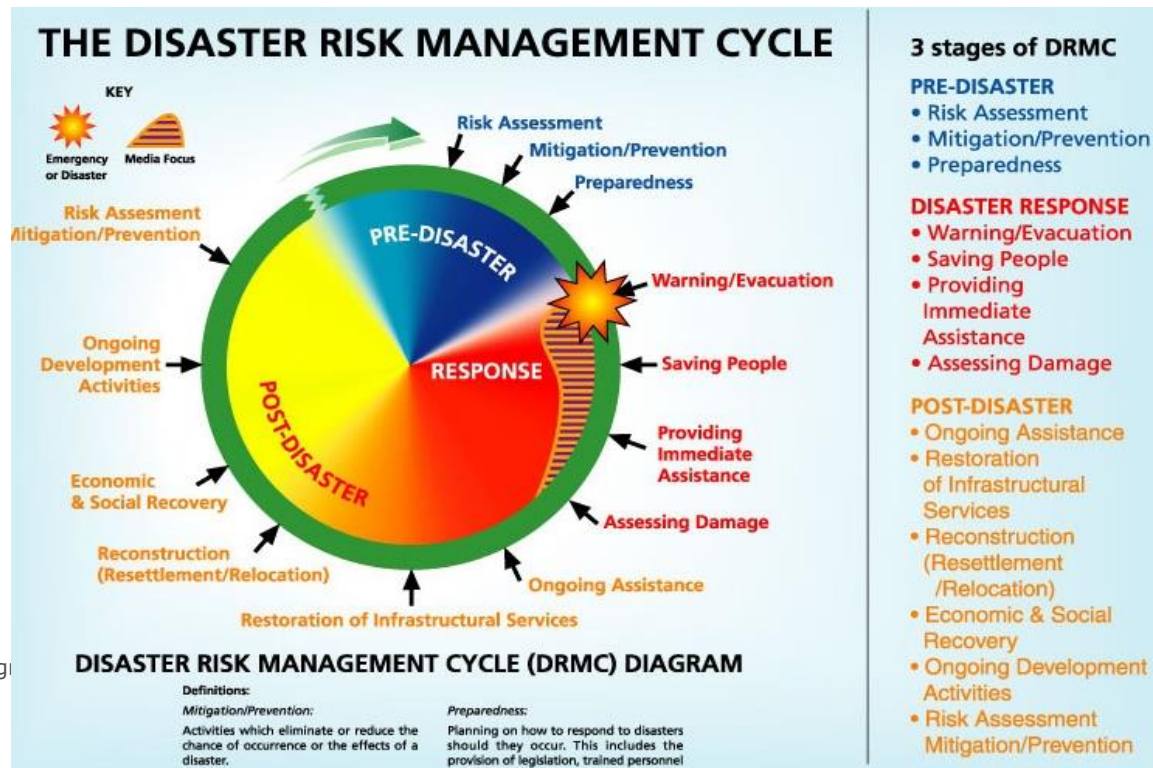
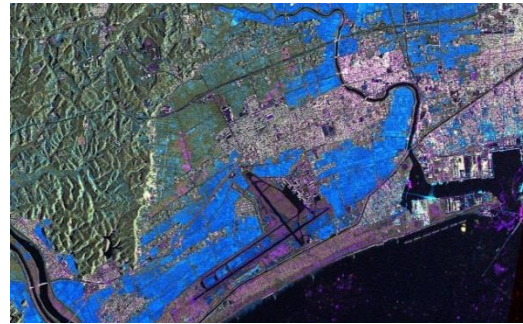
Ash cloud monitoring during volcanic eruption in Iceland April 2010

European Space Agency

Stakeholders in Disaster Risk Management



- National governments, Local authorities, Civil Protections Agencies (field teams and decision makers)
- The International Humanitarian community
- International Development Organisations
- GEO & CEOS
- Science community
- National agencies incl. Space agencies
- Mass media



Disaster Risk Management



Emergency Response

- rapid crisis mapping & damage assessment,
- situation mapping

Prevention, preparedness (disaster risk mitigation)

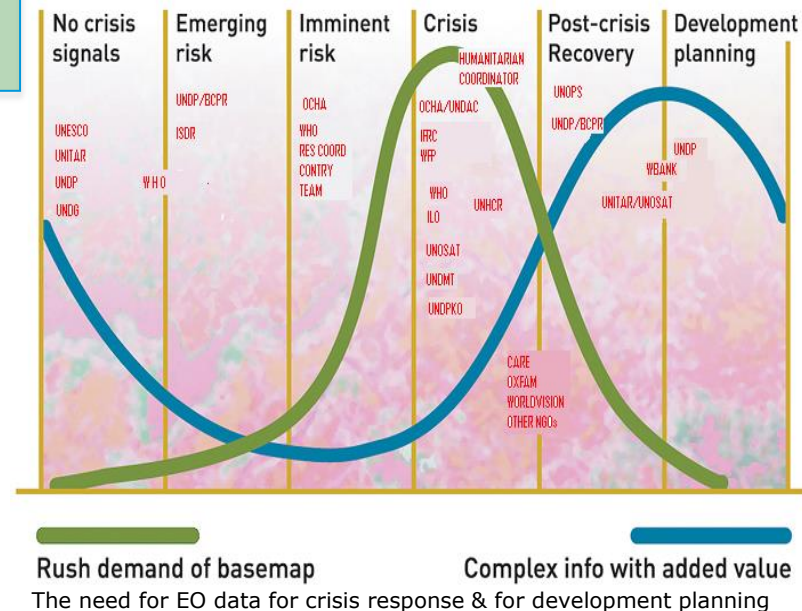
- detailed damage mapping,
- risks assessment (floods, fires, geo-hazards)

All phases

- reference mapping
- digital elevation and digital terrain models
- LU/LC cover mapping
- asset mapping

Available globally !
Pre-operational to operational

Requires appropriate archives, interpretation, value adding, integration in models



GMES in a video



Thanks for the attention!!!



Web sites of interest for teachers:

International Charter: www.disasterscharter.org

GMES: <http://copernicus.eu/>

ESA Earth Watching: <http://ew.eo.esa.int/web/guest/home>

ESA Education: <http://www.esa.int/Education>

ESA Earth Observation:

[http://www.esa.int/Our Activities/Observing the Earth](http://www.esa.int/Our_Activities/Observing_the_Earth)

ESA Earth Observation Education: <https://earth.esa.int/web/guest/eo-education-and-training>

Eduspace: [http://www.esa.int/SPECIALS/Eduspace EN/](http://www.esa.int/SPECIALS/Eduspace_EN/)

SEOS Project: <http://www.seos-project.eu/home.html>