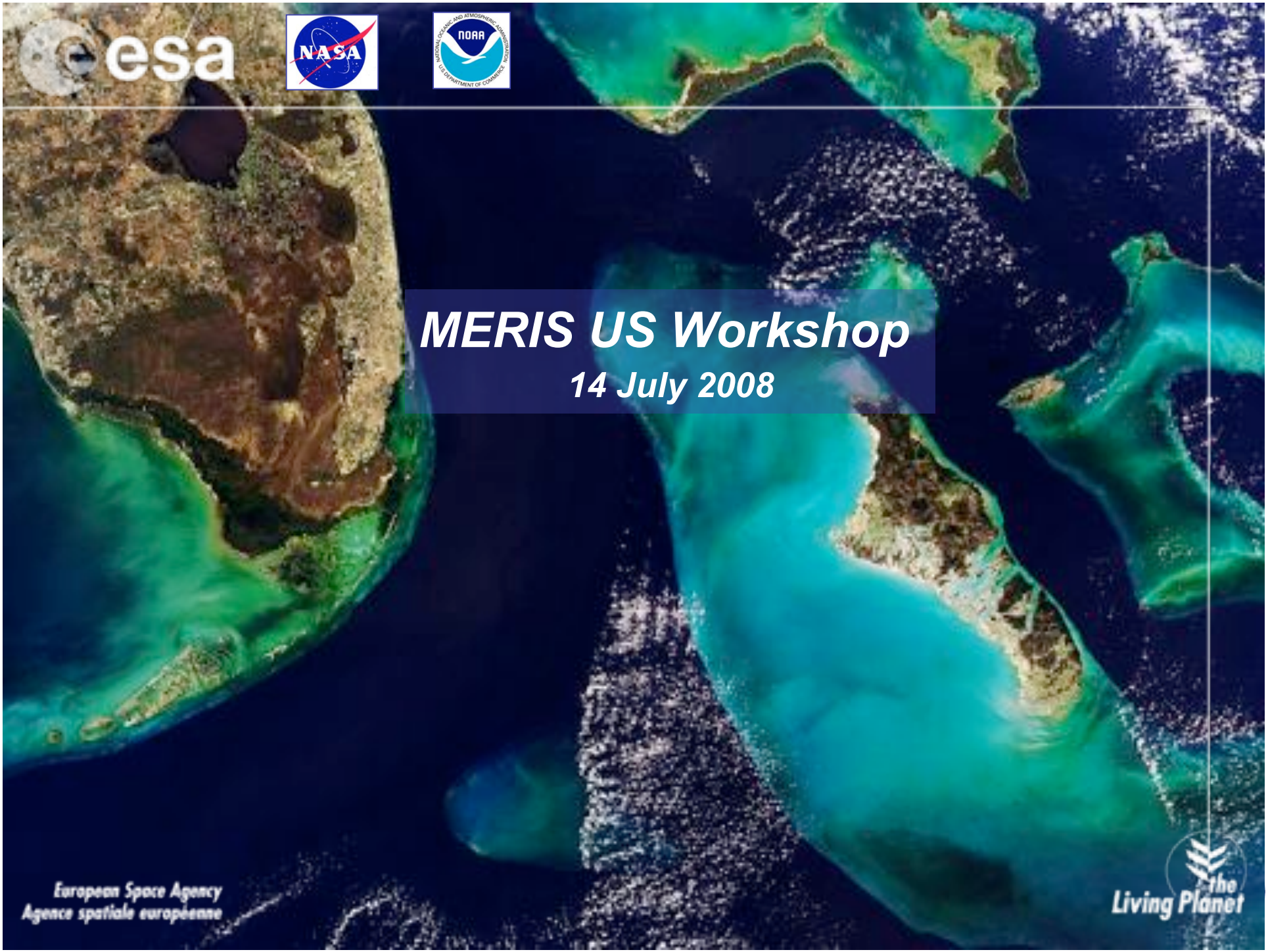
esa
NASA
NOAA
MERIS US Workshop
14 July 2008
European Space Agency
Agence spatiale européenne
the Living Planet

Agenda a.m.

08:10-08:55	H. Laur (ESA)	ENVISAT/MERIS mission status, access to MERIS data and distribution policy
08:55-09:10		Discussion
09:10-09:40	P. Regner (ESA)	Examples of the use of MERIS data in marine & land applications
09:40-10:00	B. Arnone (NRL)	Examples of MERIS data use for U.S. applications
10:00-10:20	S. Delwart (ESA)	MERIS instrument overview
10:20-10:40	S. Delwart	Instrument characterization overview
10:40-10:55		Discussion
10:55-11:10		*Coffee break*
11:10-11:30	S. Delwart	Instrument calibration methods and results
11:30-11:50		Discussion
11:50-13:20		*Lunch break*

Agenda p.m.

13:20-13:50	L. Bourg (ACRI)	Level 1 processing
13:50-14:10		Discussion
14:10-14:30	S. Delwart	Vicarious calibration methods and results
14:30-14:50		Discussion
14:50-15:10	L. Bourg	Overview Level 2 products
15:10-15:25		*Coffee break*
15:25-16:25	L. Bourg	Level 2 processing
16:25-17:10		Discussion
17:10-17:25	P. Regner	BEAM Toolbox
17:25-17:40	H. Laur	Plans and status of the OLCI onboard GMES Sentinel-3
17:40-18:00		Discussion

MERIS US Workshop, July 14th, 2008, Washington (USA)

ENVISAT / MERIS mission status, access to MERIS data and distribution policy

Henri LAUR
Envisat Mission Manager
& Head of EO Missions Management Office

European Space Agency
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ESA: the European Space Agency

The purpose of ESA:
An inter-governmental organisation with a mission to provide and promote - for exclusively peaceful purposes - the exploitation of:
- *Space science, research & technology*
- *Space applications*

HEADQUARTERS - Paris, France
Director General's office and general administration

EAC - Cologne, Germany
European Astronaut Centre

ESTEC - Noordwijk, the Netherlands
Satellite development centre

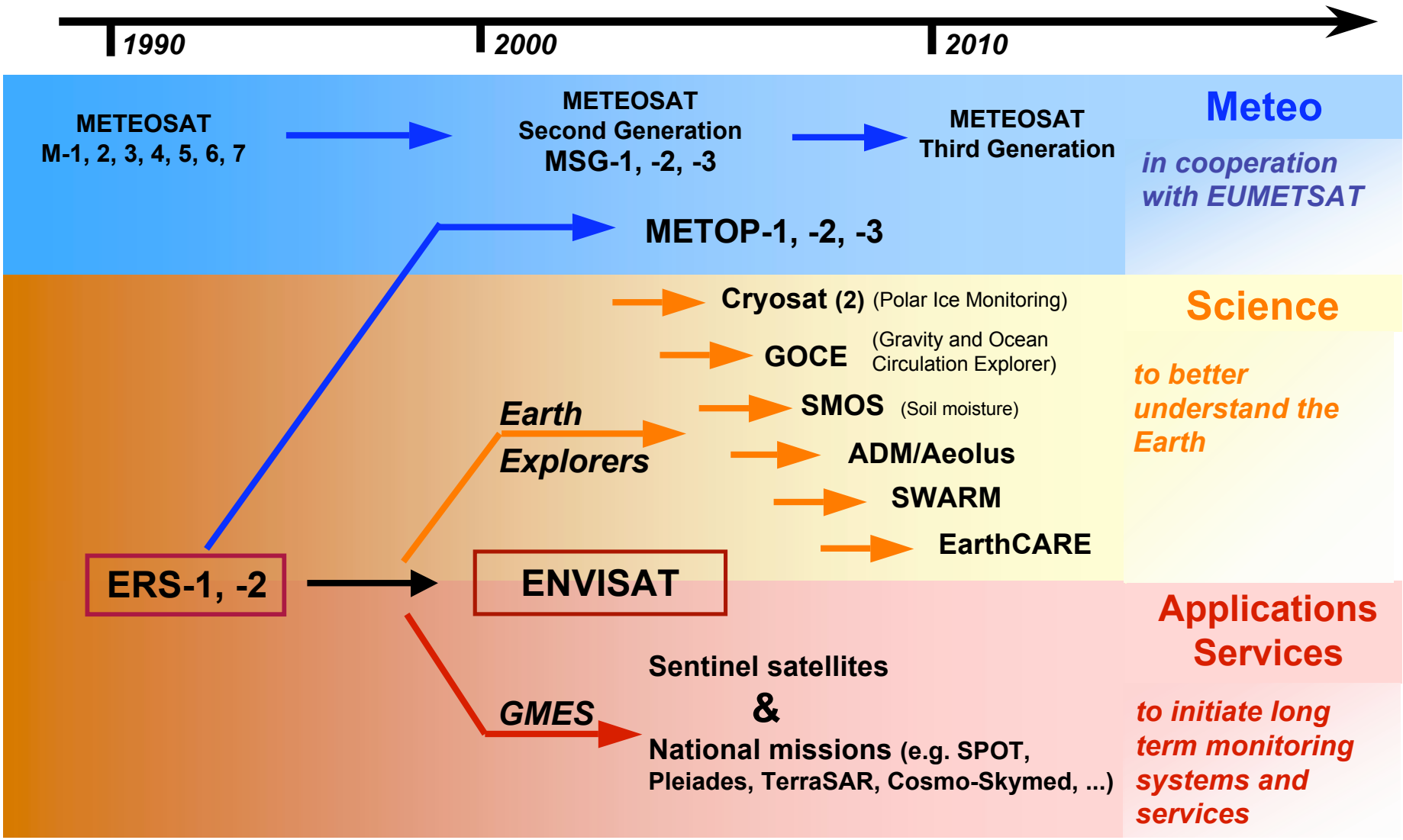
ESRIN - Frascati, Italy
Earth Observation centre

ESOC - Darmstadt, Germany
European Space Operations Centre

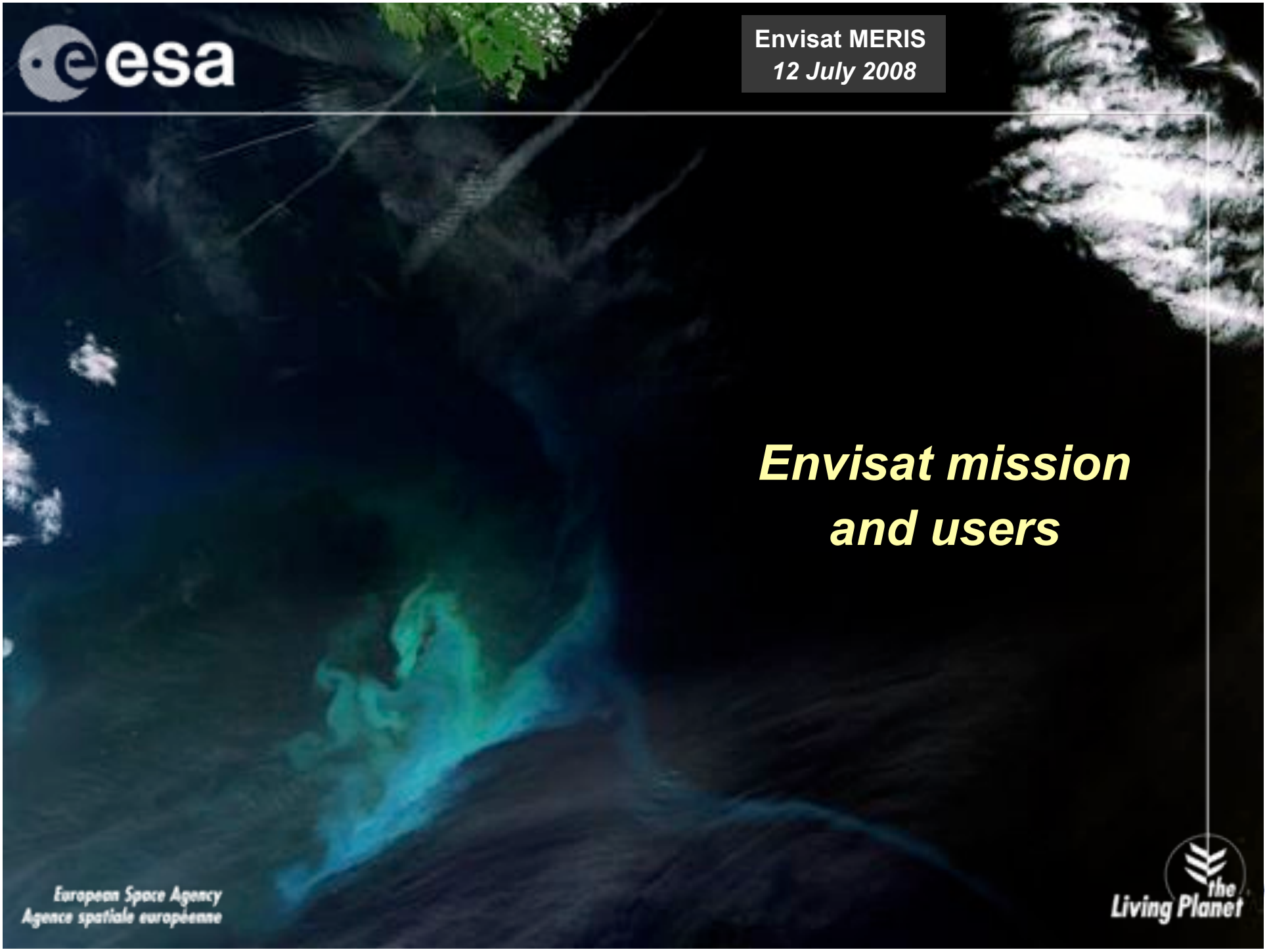
ESAC - Villafranca, Spain
European Space Astronomy Centre

Staff in post : ~ 2000

EO missions handled by ESA



and Third-Party Missions: *European access to non-ESA missions*
ALOS, SPOT-4, Landsat, Kompsat-2, SeaWIFS, MODIS ...


esa
Envisat MERIS
12 July 2008
Envisat mission
and users
European Space Agency
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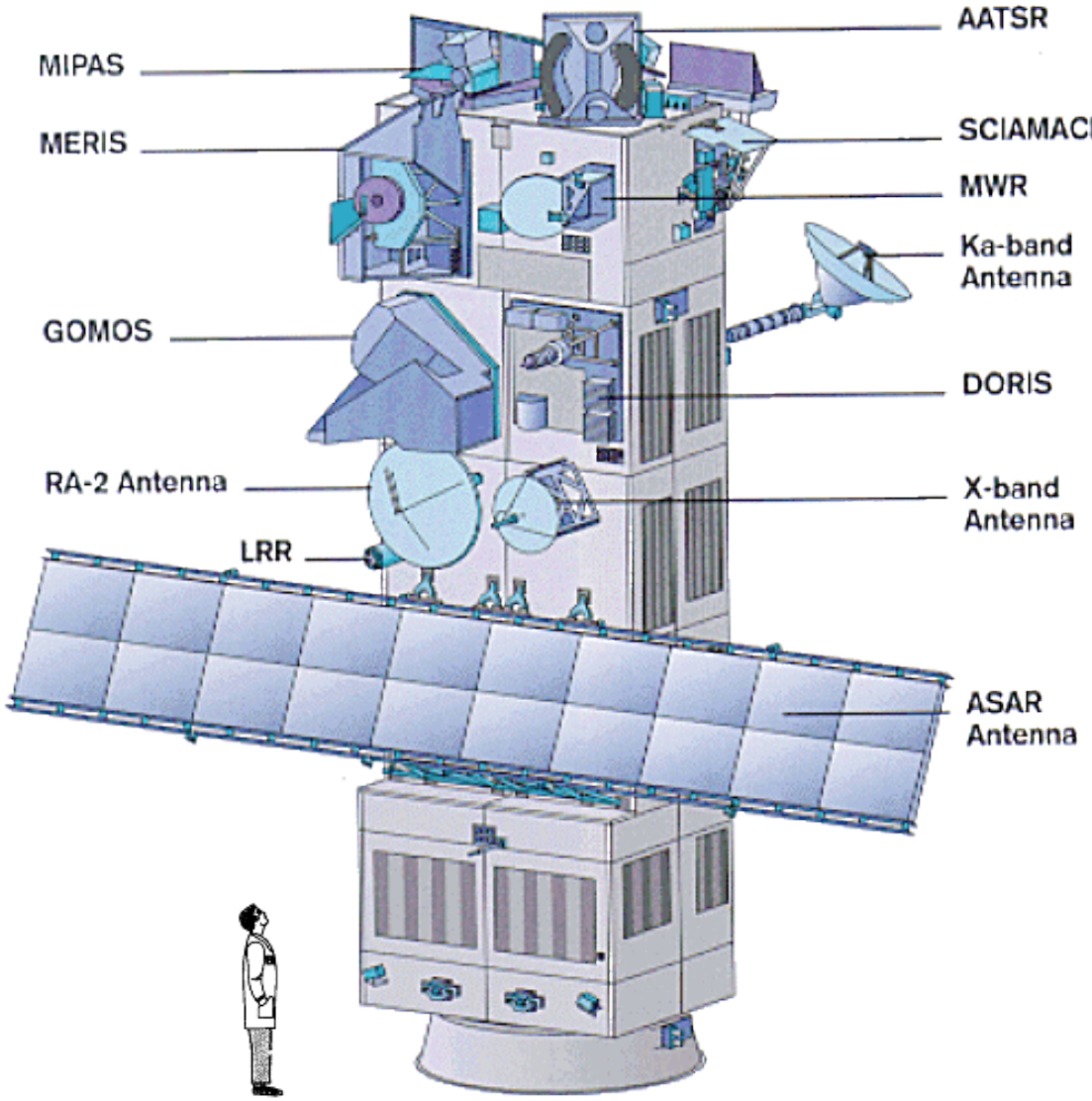
ENVISAT
❑ Launch by ESA ARIANE 5
on March 1st, 2002
❑ Injection on
perfect orbit

ENVISAT: the largest civilian EO satellite



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

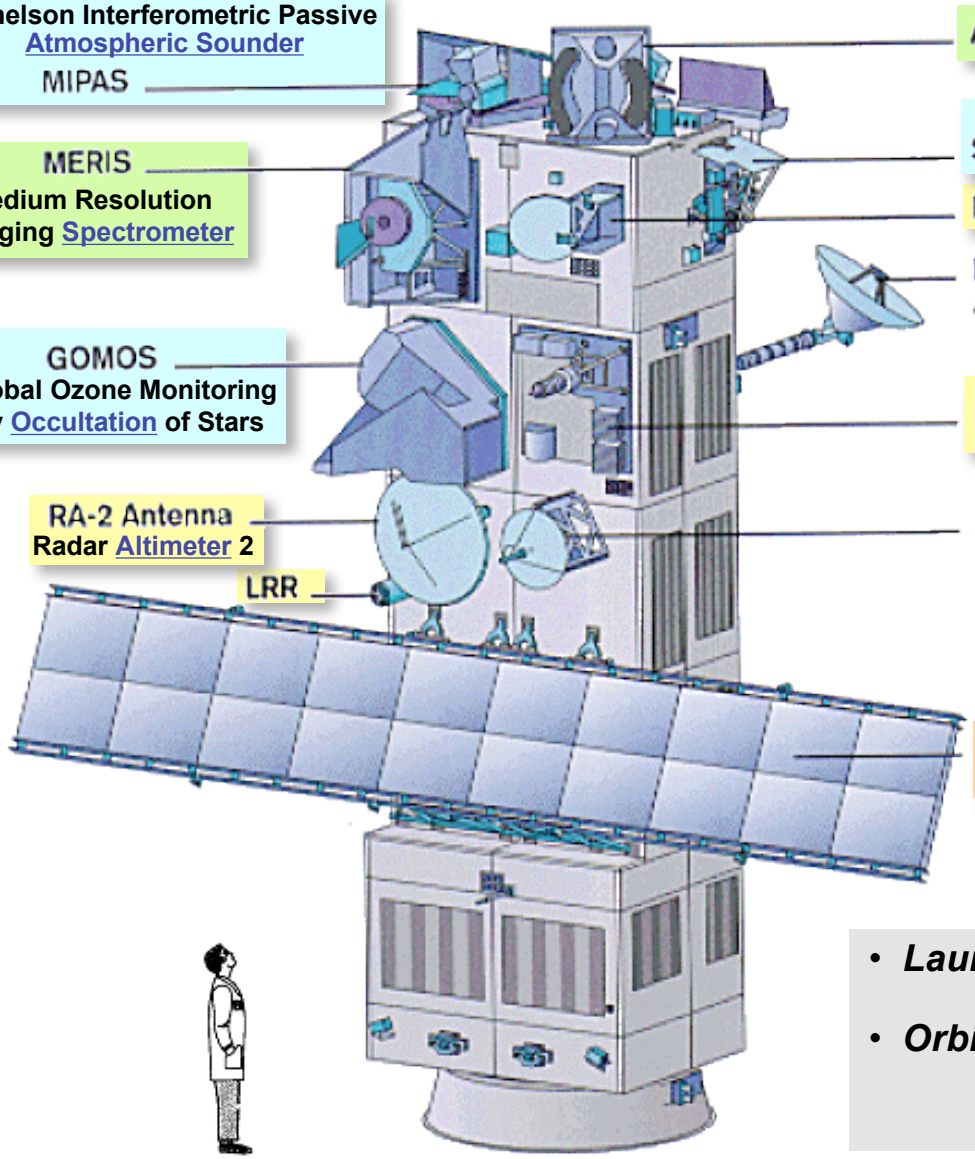
- ***Mass***
  Total satellite **8140 Kg**
  Payload 2050 Kg

- ***Power***
  Solar array power*:*
  6.5 kW (EOL)
  Average power demand*:*

	Sun (watts)	Eclipse (watts)
Payload	1700	1750
Satellite	3275	2870

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

ENVISAT: 10 ways to monitor the Earth



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 → *to Data Relay Satellite Artemis*

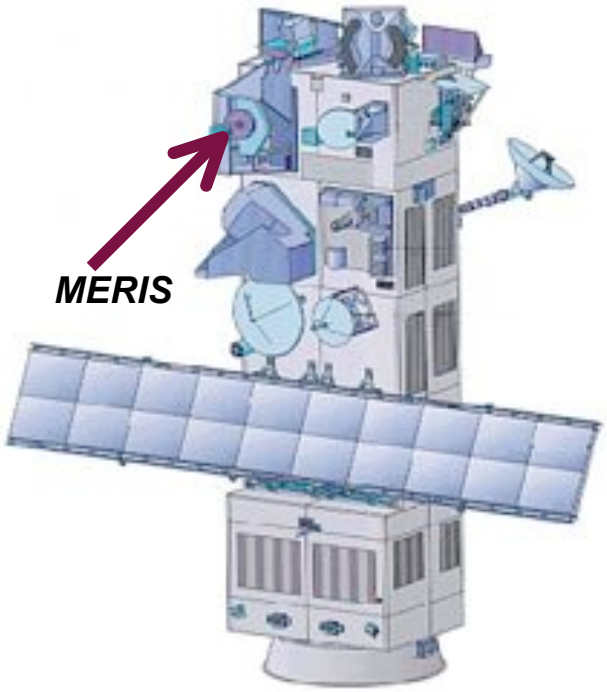
DORIS Doppler Orbitography and Radio-positioning Integrated by Satellite

X-band Antenna → *to Ground Stations*

ASAR Antenna Advanced Synthetic Aperture Radar

- ***Launch***
  1st March 2002
- ***Orbit***
  800 km, sun synchronous
  10:00 am, i.e. 30 minutes before ERS-2

MERIS instrument status



Status:

- **Very stable and excellent performance since launch.**
- **Full redundancy available.**
- **Calibration diffuser degrading as expected.**

Risks and evolution:

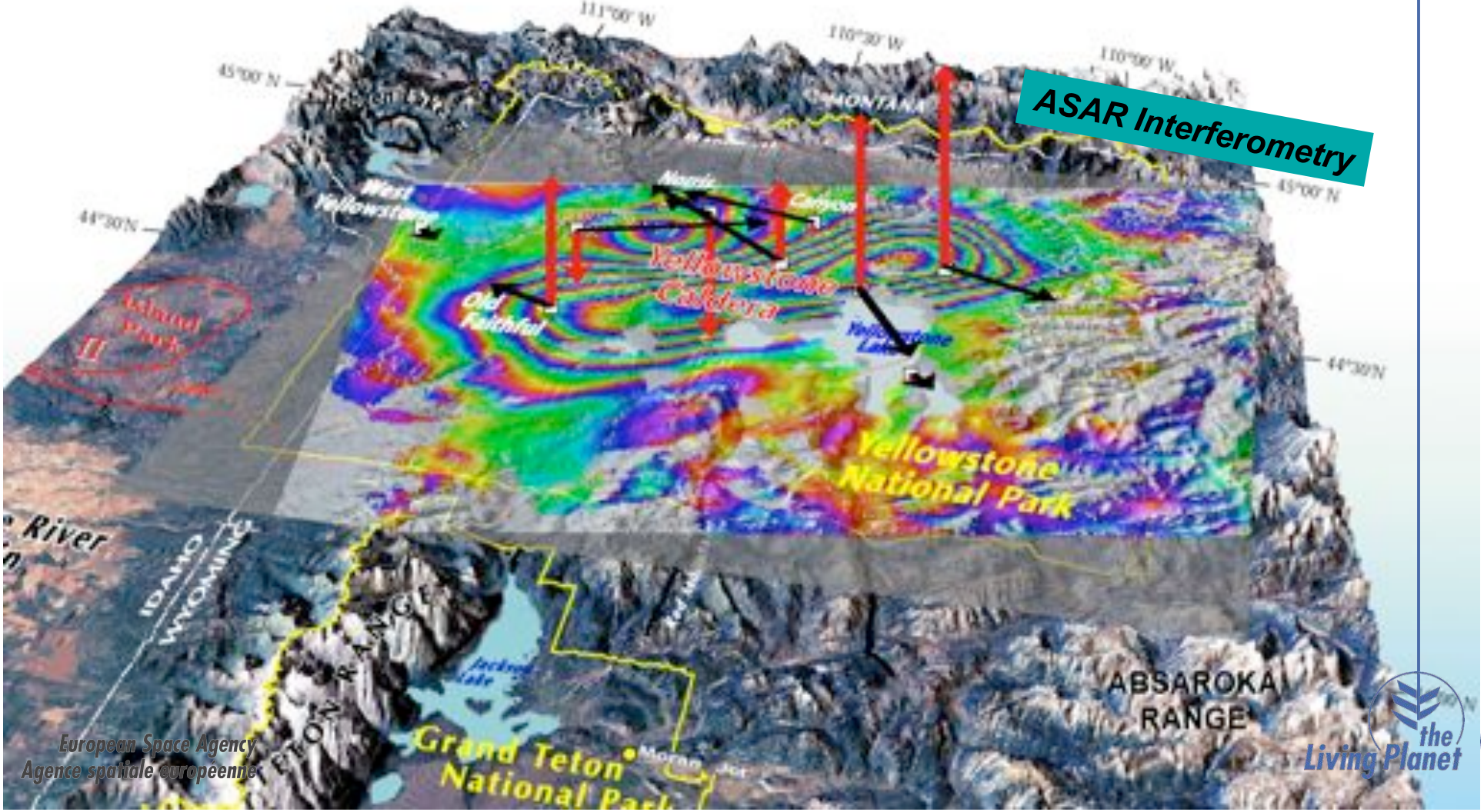
- **Very smooth ageing**
- **With the current ageing rate the required radiometric accuracy of the on-board diffusers can be maintained until 2013**

Current performances: *Excellent*
Expected evolution: *Excellent*

Some Envisat results

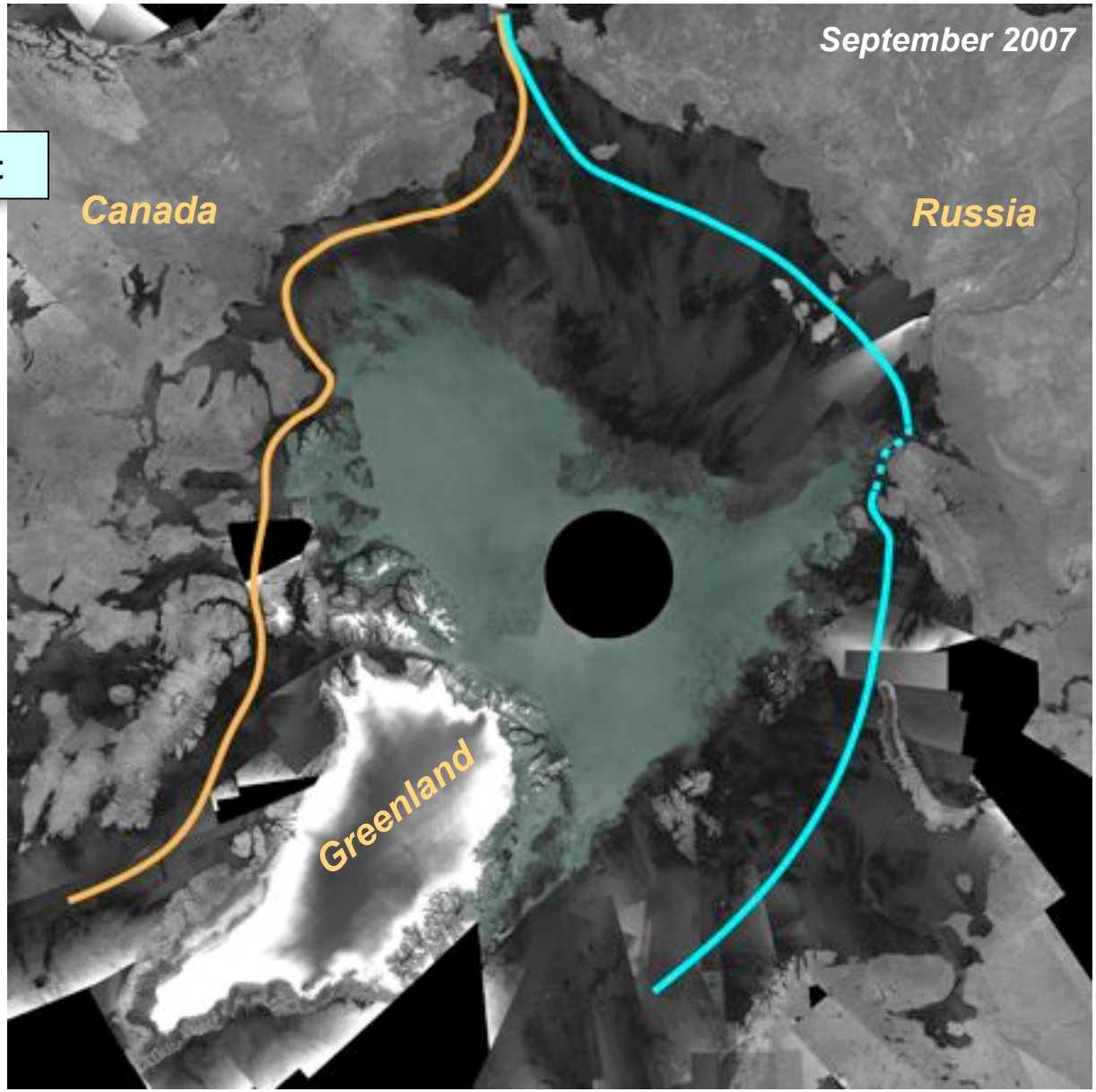
Yellowstone caldera accelerated uplift: up to 7 cm / year

Science, 9 Nov. 2007: " Accelerated Uplift and Magmatic Intrusion of the Yellowstone Caldera, 2004 to 2006", Wu-Lung Chang, et al., Univ. of Utah (ESA Cat-1 project #2765)



Some Envisat results

Arctic sea ice extent



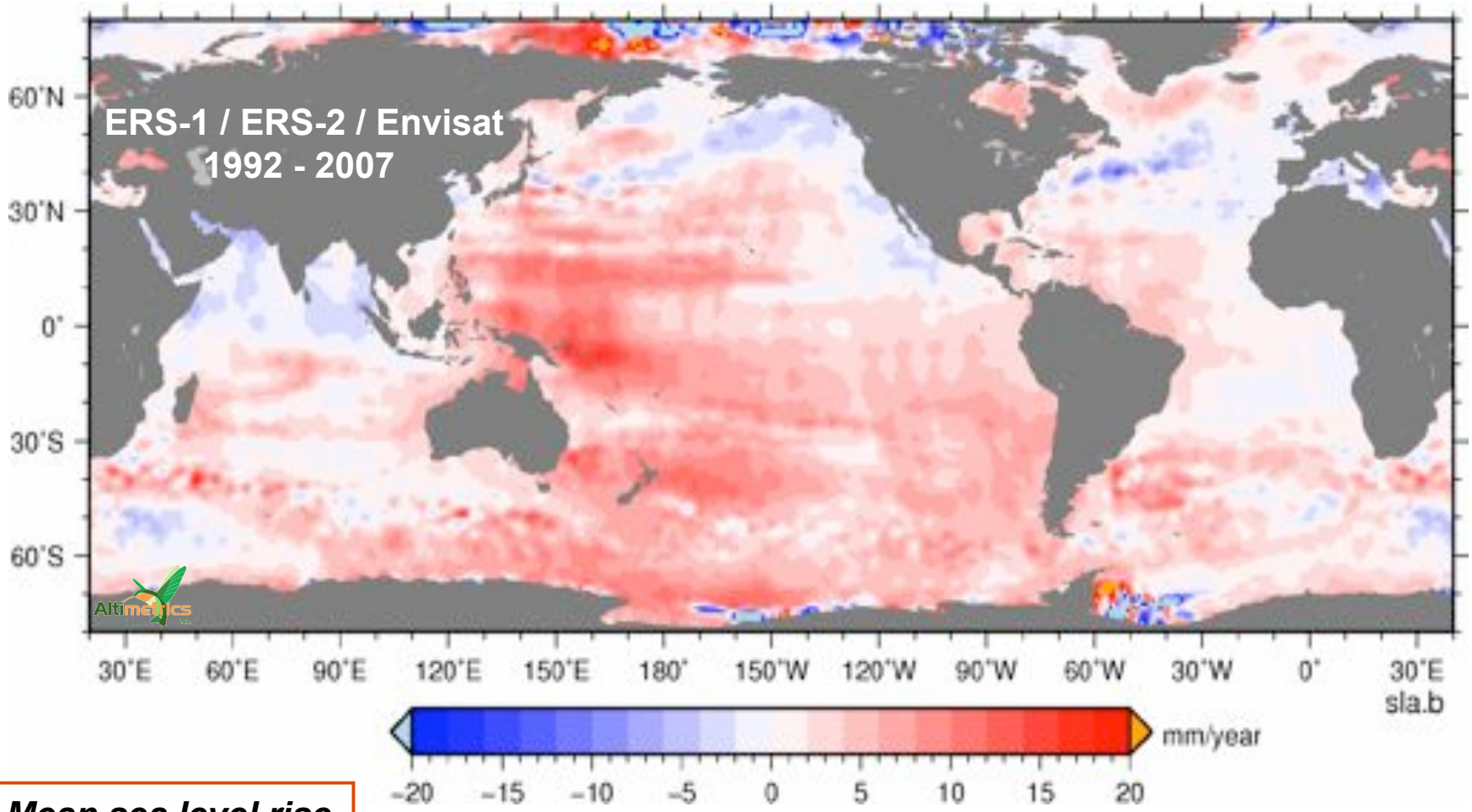
Arctic Sea:

Fast decrease of sea ice extent

Mosaic of ASAR images (10-days)

Some Envisat results

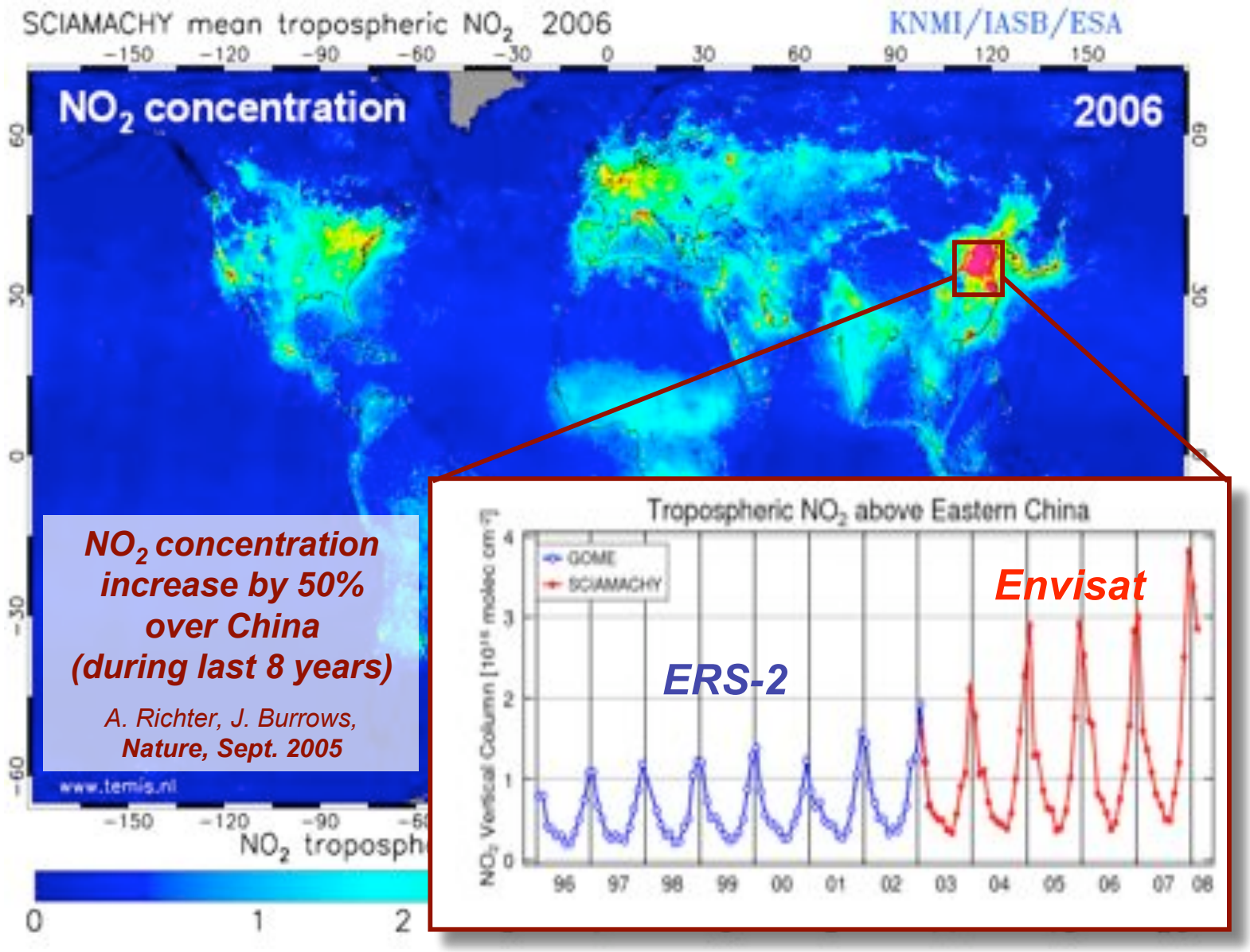
15 years of radar altimetry



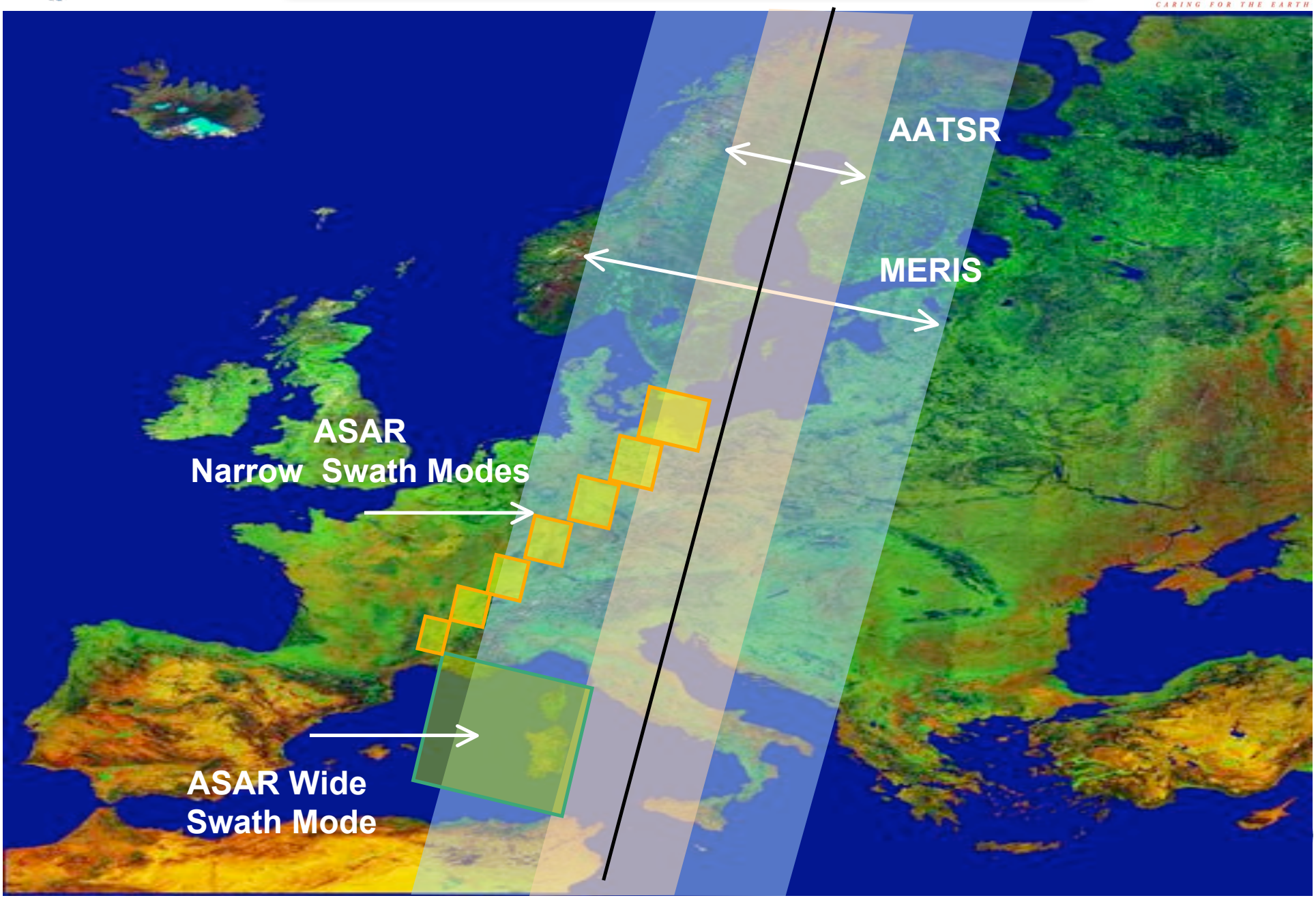
Mean sea level rise

This is one of the Essential Climate Variables (ECV)

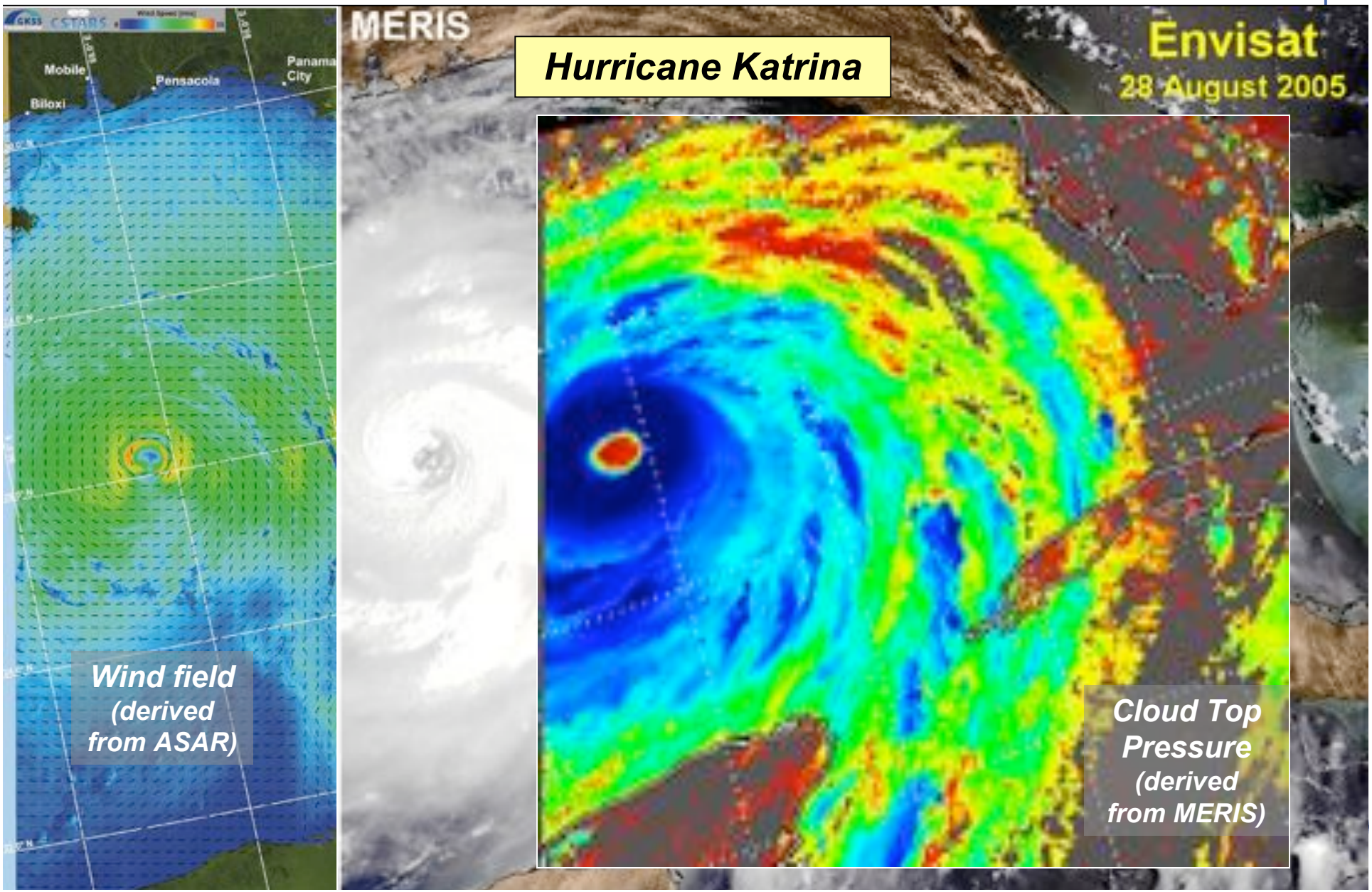
Some Envisat results



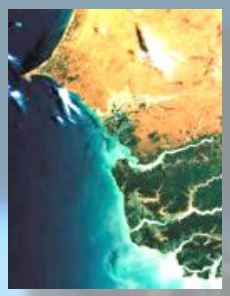
Synergy between ENVISAT imaging instruments

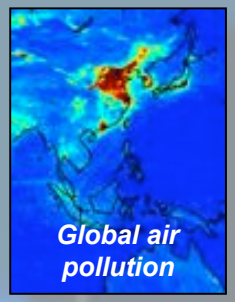


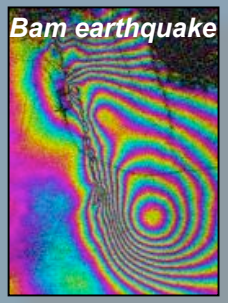
Synergy between ENVISAT imaging instruments

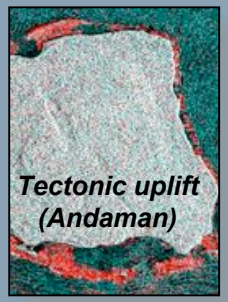


ENVISAT mission: 6 years !


First images

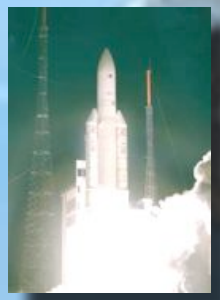


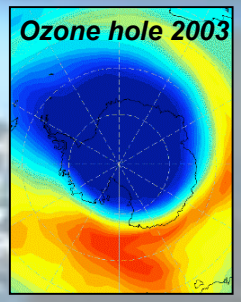

Bam earthquake

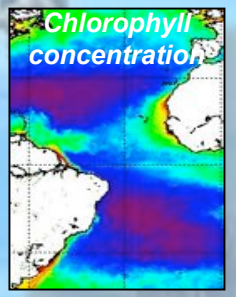


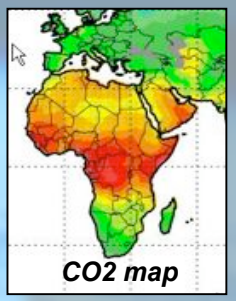
~2100 scientific projects

+ 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

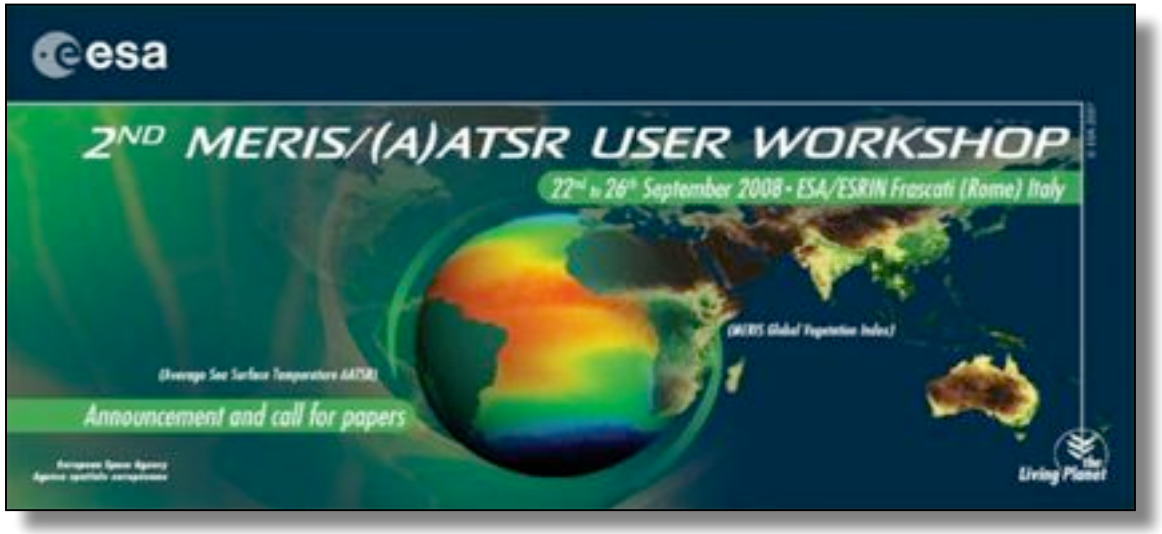
Altimetry Conference — Mar 06

Atmospheric Science Conference — May 06

Envisat Symposium Montreux (CH) — Apr 07

InSAR Workshop — Dec 07

Next MERIS workshop: *Sept. 08, Frascati*



Objectives:

- Present latest results and status of research and development projects
- Update MERIS/AATSR users on instrument performance and product quality
- Formulate recommendations for improved data access and utilization, algorithms, user tools
- Foster collaboration between MERIS and AATSR research groups
- Inform users on the current status of the GMES Sentinel 3 mission
- **105 oral presentations, 75 Posters**

Registration at: http://earth.esa.int/meris_aatsr_2008

Next MERIS workshop: *Sept. 08, Frascati*

esa

22 – 26 September 2008

2nd MERIS - (A)ATSR WORKSHOP

‹ Envisat Home

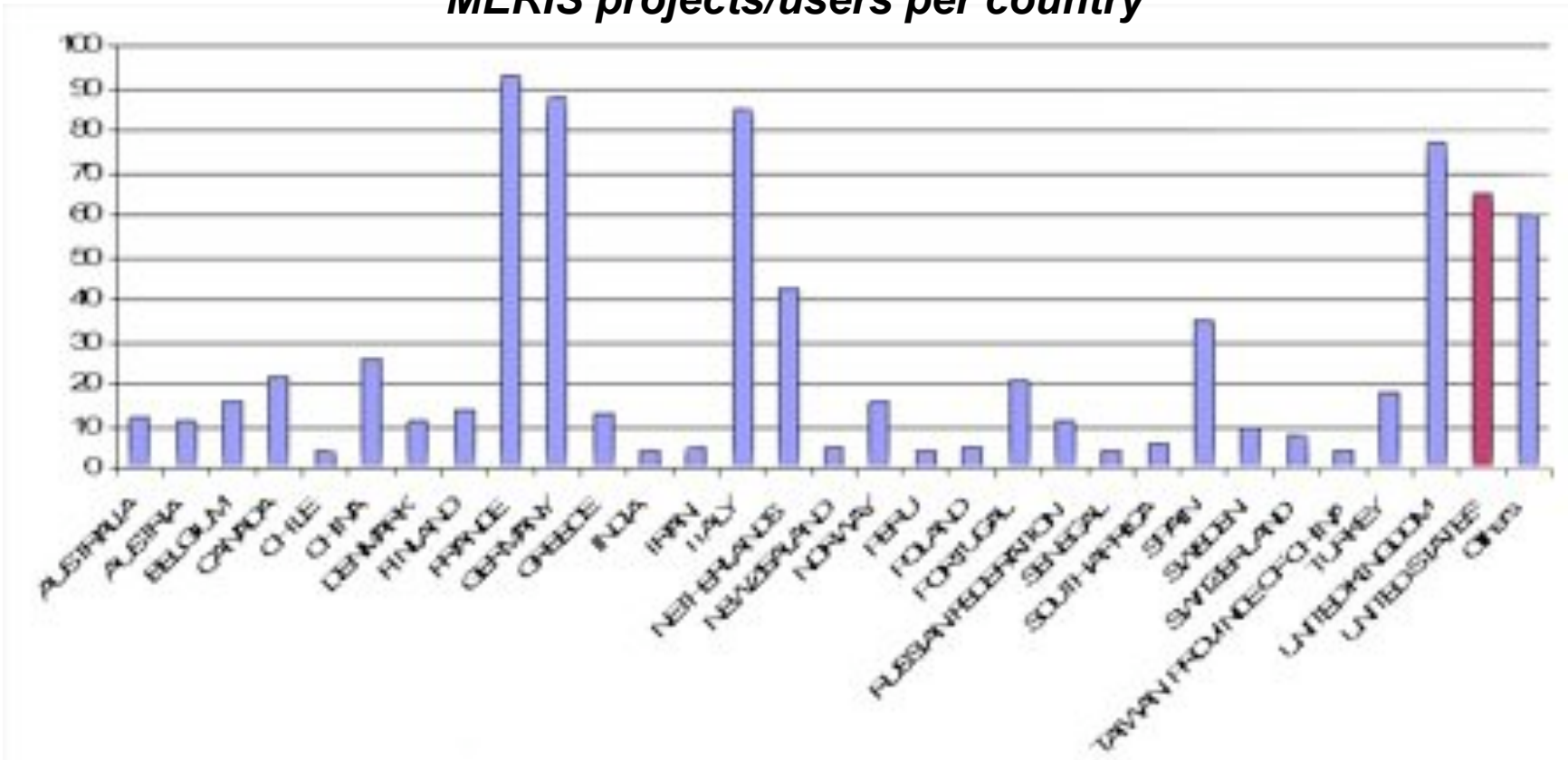
- Introduction
- Sessions
- Programme Overview
- Programme, Monday 22/09
- Programme, Tuesday 23/09, Building 14
- Programme, Tuesday 23/09, Magellan
- Programme, Wednesday, 24/09
- Programme, Poster Session, 24/09
- Programme, Thursday, 25/09
- Programme, Friday, 26/09
- Workshop registration, accomodation, and travel
- Workshop Flyer
- Abstract submission
- ESA Specific Links
- Author's Instructions

	Monday 22 Building 14	Tuesday 23 Building 14	Tuesday 23 Magellan	Wednesday 24 Building 14	Thursday 25 Building 14	Friday 26 Building 14
08:30-09:30	Registration	MERIS validation 2	AATSR applications 1	MERIS ocean & coastal zones 3	MERIS land	GlobSeries (starts 8:40)
	Opening Session	Discussion 20'	Discussion 20'	Discussion 20'		Discussion 20'
				Clouds		
11:00-11:30	Coffee break					
11:30-13:10	AATSR validation	MERIS ocean & coastal zones 1	AATSR applications 2	and atmosphere	MERIS land	Sentinel (to 12:10)
	Discussion 30'		Discussion 30'	Discussion 30'	Discussion 30'	Discussion 20'
13:10-13:40						Summary (starts 12:30)
13:40-14:40	Lunch break					Conclusion (ends 14:00)
14:40-16:00	MERIS validation 1	MERIS ocean & coastal zones 2	Tools & Services	Lakes	Synergy	
16:20-16:50	Coffee break					
	MERIS validation 1	MERIS ocean & coastal zones 2	Tools & Services	Lakes	Synergy	
		Discussion 20'	Discussion 20'	Discussion 20'		
18:10-18:40	Discussion 30'	Discussion 30'			Discussion 30'	
18:40-19:40	Welcome cocktail			17:50-19:50 Poster session & Cocktail	19:30-21:30 Dinner (non-hosted)	

http://earth.esa.int/meris_aatsr_2008

Current MERIS users

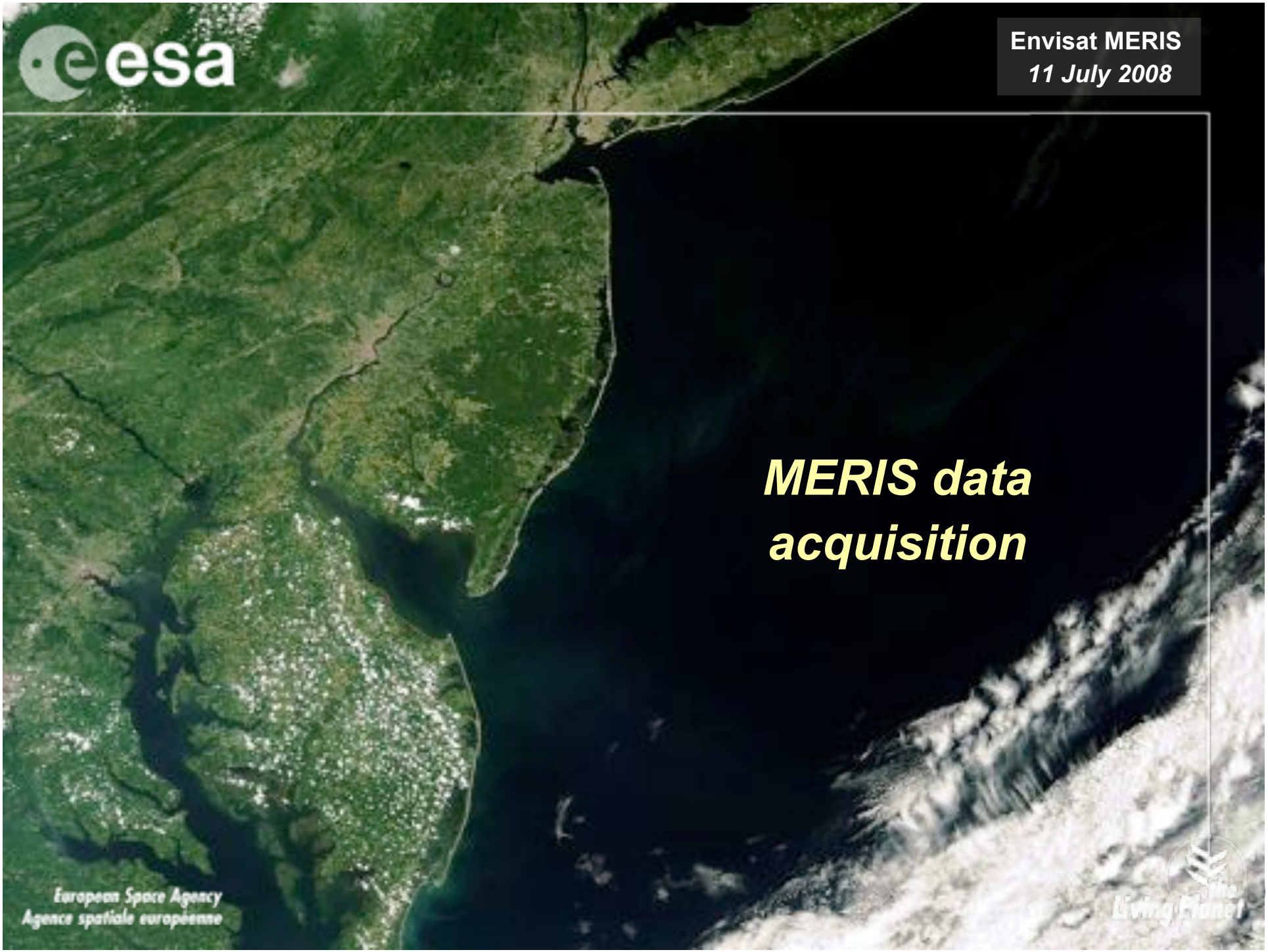
MERIS projects/users per country



358 Category 1 projects from the United States (all types of data)

→ 65 US projects requesting MERIS data (i.e. 18 % of total)

→ 33% asking Red. Res. data, 66% asking Full Res. data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Envisat MERIS
11 July 2008
MERIS data acquisition
European Space Agency
Agence spatiale européenne

MERIS data acquisition

MERIS has 2 operation modes:

Reduced Resolution (RR): 1040 m x 1200 m

→ acquired systematically (43 minutes per orbit)

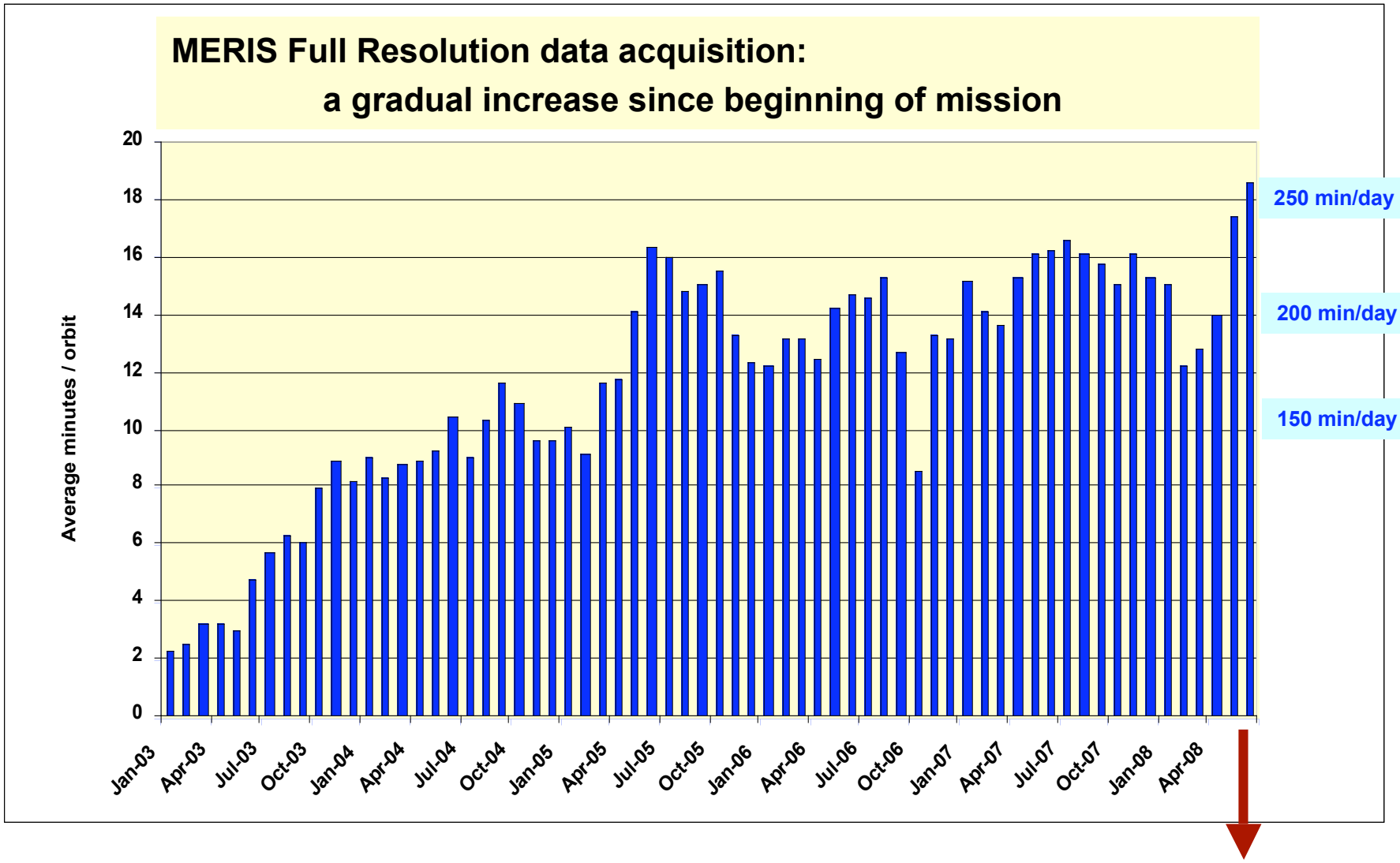
Full Resolution (FR): 260 m x 300 m

→ specific planning (currently ~18 min. per orbit)

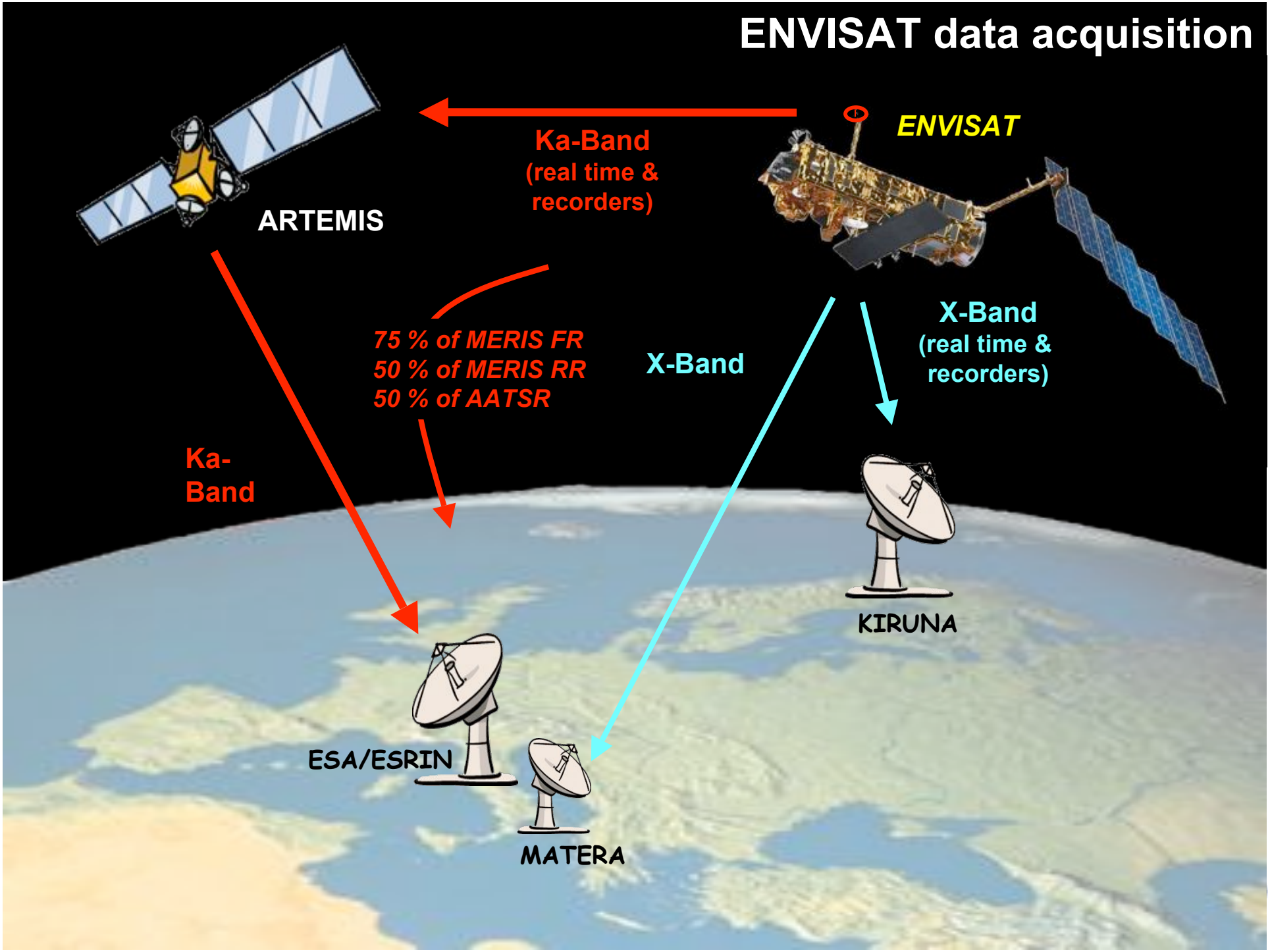
Swath width is 1150 km

global coverage is reached every 3 days

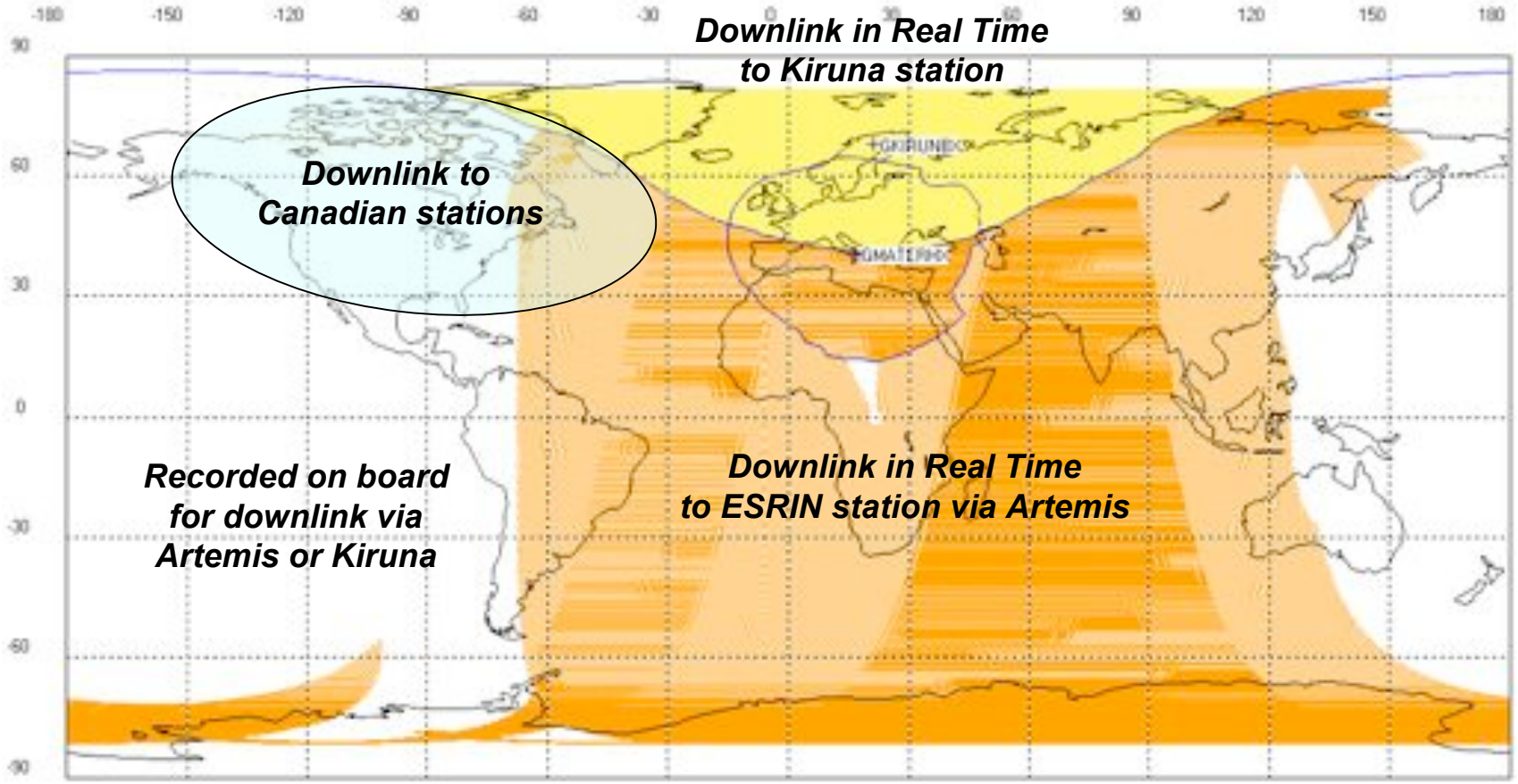
MERIS data acquisition



Recent increase thanks to new Canadian stations


ENVISAT data acquisition
ENVISAT
Ka-Band
(real time &
recorders)
ARTEMIS
75 % of MERIS FR
50 % of MERIS RR
50 % of AATSR
X-Band
X-Band
(real time &
recorders)
Ka-
Band
KIRUNA
ESA/ESRIN
MATERA

MERIS data acquisition



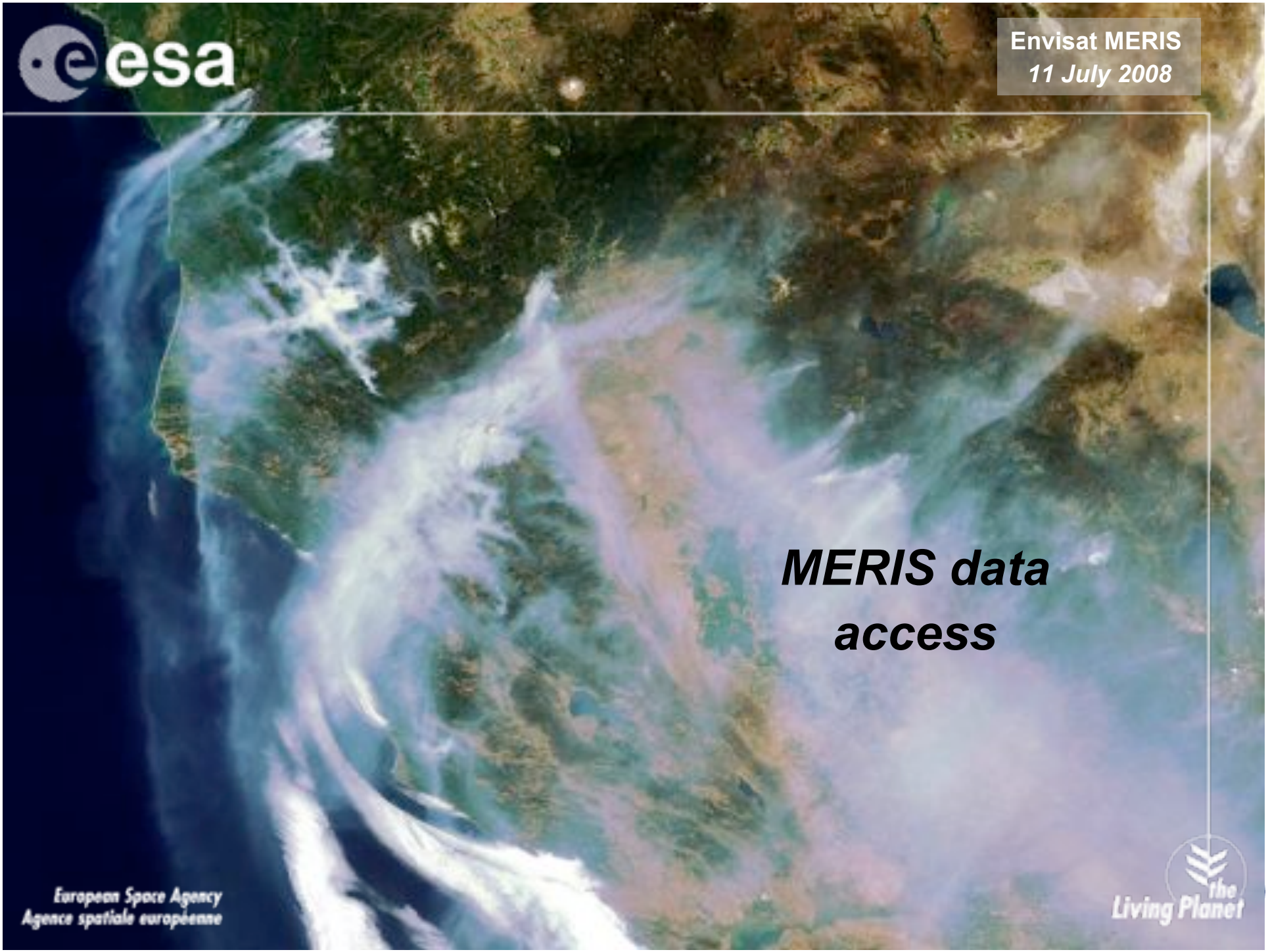
In yellow, data that are downlinked in Real Time to ESA Kiruna station.

In orange, data that are downlinked in Real Time to ESRIN station via Artemis.

In white, data that are recorded on-board, then downlinked to Kiruna or via Artemis.

In blue, data that are downlinked in Real Time to Canadian stations:

- Temporary set-up: raw data sent by Internet to Kiruna for processing
- Final set-up: processing in Canada (early 2009)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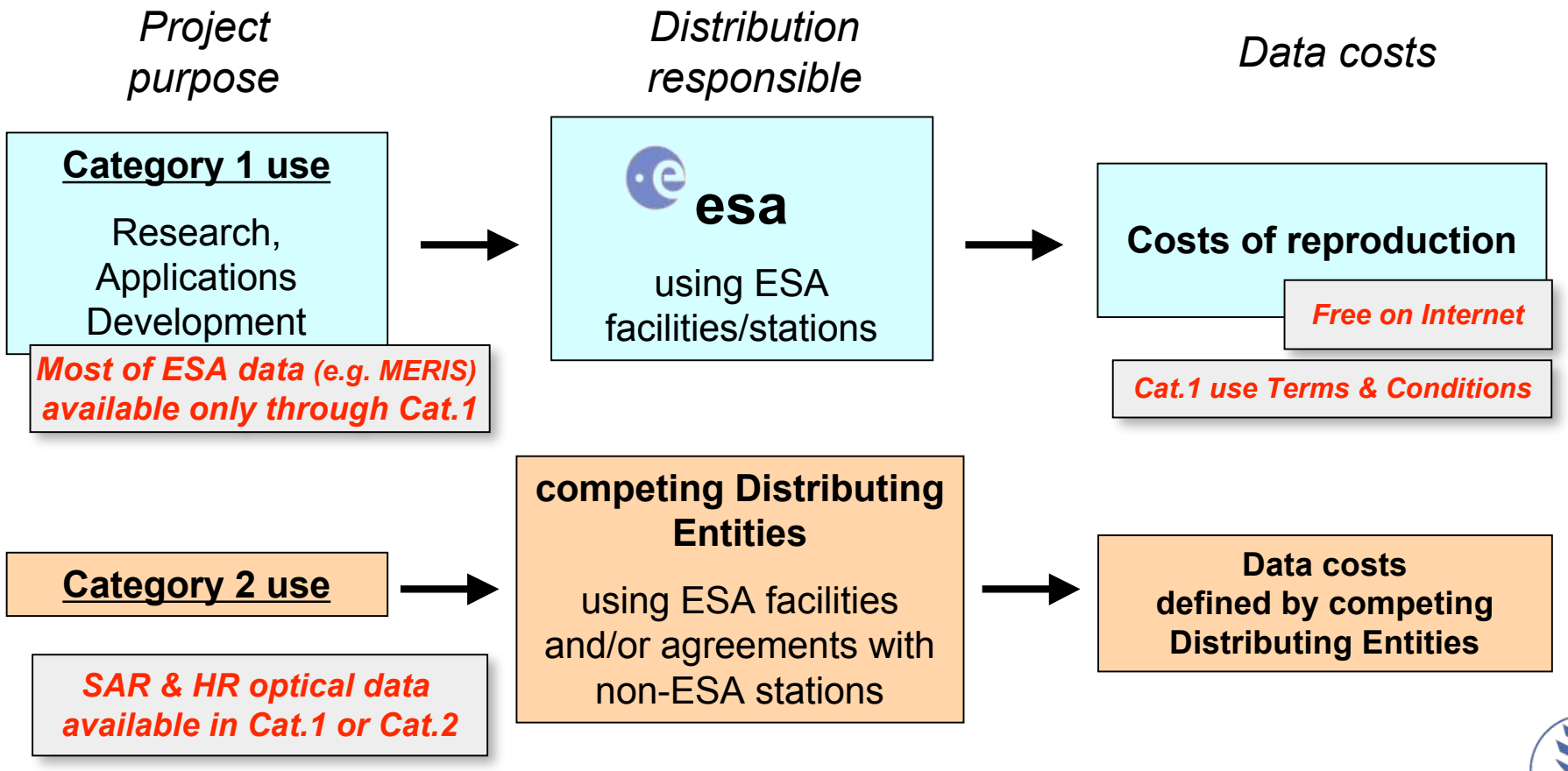
ESA Earth Observation Policy

Data policy defined by ESA Member States in 1997:

- **to stimulate a balanced development of Science, Public Utility and Commercial Applications, consistent with the mission objectives,**
- **to maximize the beneficial use of data from ESA EO satellites.**



Category 1 use Terms & Conditions

Main points:

• to use the data provided for Category 1 use only **within the project team** (i.e. PI and co-PIs)

→ i.e. no data redistribution outside the Cat.1 use project team

• to widely **publish** the project results in **scientific publications** or presentations,

→ with data citation:

"[mission or instrument] Data provided by European Space Agency"

(to facilitate ESA web searching of publications, and subsequent reporting on mission/instrument achievements)

Each PI shall sign the Category 1 use Terms & Conditions.

How to apply for MERIS data access ?

http://eopi.esa.int

Application for Category 1 use data access can be submitted to ESA at any time using the ESA Earth Observation Principal Investigator portal (http://eopi.esa.int)

Registration or full proposal ?

Products systematically available on Internet

→ ***Registration***

Free of charge products

Fast registration required, with no deadline for submission. ESA Terms and Conditions to be signed.

Products available on specific request

(e.g. i.e. specific instrument tasking, products not generated systematically, products not available on Internet)

→ ***Category 1 Project Proposal***

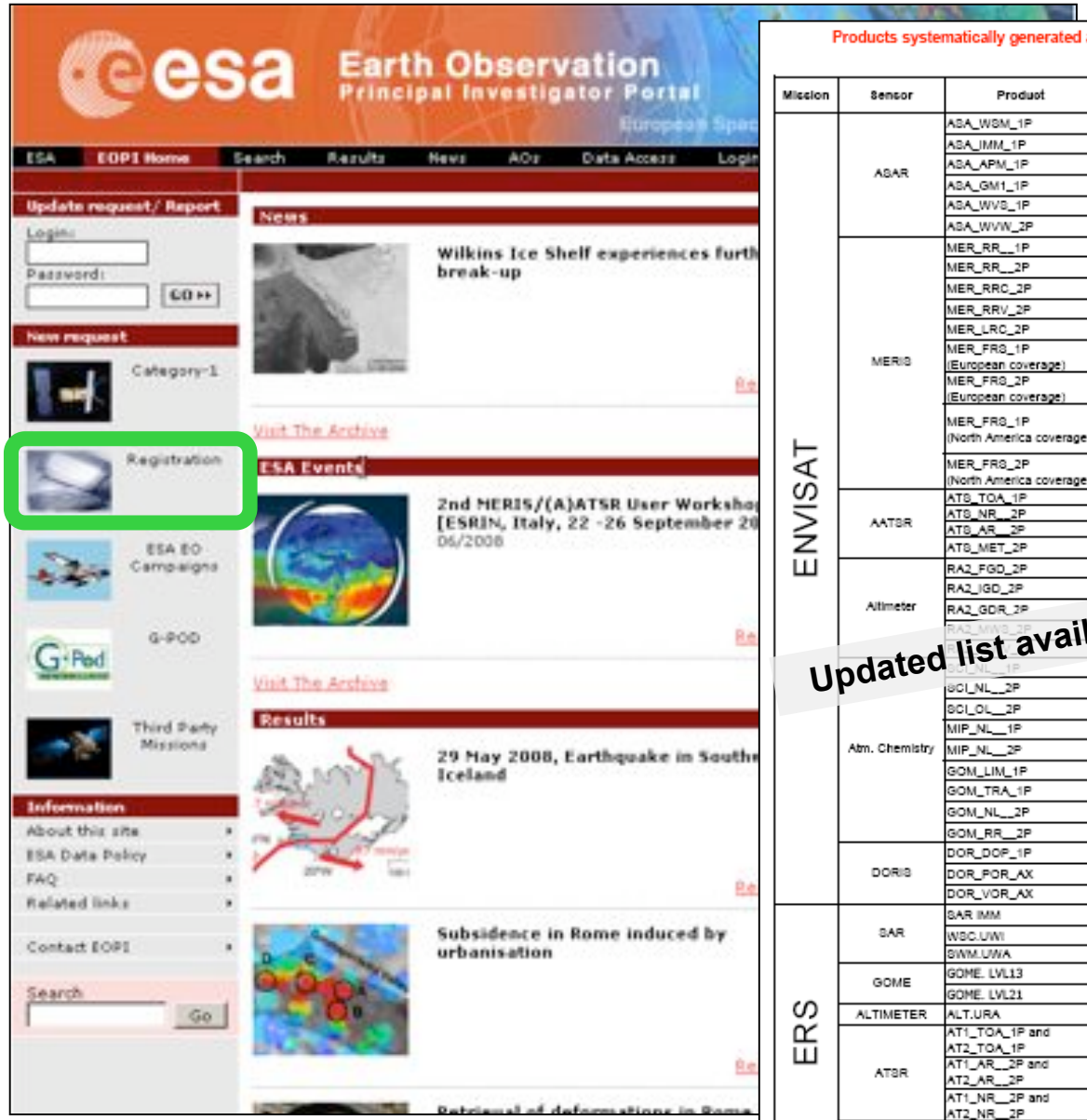
Available at cost of reproduction (ENVISAT, ERS and Third Party Missions)

Project proposal required, with no deadline for submission, to be evaluated by the Category-1 Scientific Advisory Group

Specific restrictions to the use of data may apply for Third Party Missions

If accepted by ESA, Terms and Conditions to be signed

Products systematically available on Internet → Registration



Products systematically generated and available via fast registration - release May 15th, 2008

Mission	Sensor	Product	Internet: Archived or Reprocessed	Internet: NRT and Recent	DDS Europe: NRT
ENVISAT	ASAR	ASA_WSM_1P		last 14 days	
		ASA_IMM_1P		last 14 days	
		ASA_APM_1P		last 14 days	
		ASA_GM1_1P		last 7 days	
		ASA_WVS_1P	Full mission	last 7 days	
		ASA_WVW_2P	Full mission	last 7 days	
	MERIS	MER_RR__1P	Full mission	last 7 days	NRT
		MER_RR__2P	Full mission	last 7 days	NRT
		MER_RRC_2P	included in MER_RR_2P	last 7 days	NRT
		MER_RRV_2P	included in MER_RR_2P	last 7 days	NRT
		MER_LRC_2P	included in MER_RR_2P	last 7 days	
		MER_FRS_1P (European coverage)		last 14 days	NRT
		MER_FRS_2P (European coverage)		last 14 days	
		MER_FRS_1P (North America coverage)		last 14 days	
		MER_FRS_2P (North America coverage)		last 14 days	
	AATSR	ATS_TOA_1P	Full mission reprocessing will be available in Fall 2008	last 7 days	NRT
		ATS_NR__2P		last 7 days	NRT
		ATS_AR__2P		last 7 days	
		ATS_MET_2P		last 7 days	
	Altimeter	RA2_FGD_2P			
		RA2_IGD_2P			
		RA2_GDR_2P			
				last 7 days	
	Atm. Chemistry	SCI_NL__1P	Full mission	last 7 days	NRT
		SCI_NL__2P	2002-2006		
		SCI_OL__2P	Full mission		
		MIP_NL__1P	Full mission	Last 7 days	NRT
		MIP_NL__2P	July 2002 to March 2004		
		GOM_LIM_1P		last 7 days	
		GOM_TRA_1P		last 7 days	
		GOM_NL__2P	Full mission	last 7 days	
		GOM_RR__2P		last 7 days	
	DORIS	DOR_DOP_1P	Full mission		
		DOR_POR_AX	Full mission	last 3 months	
		DOR_VOR_AX	Full mission	last 3 months	
ERS	SAR	SAR IMM		last 14 days	
		WSC.UWI	From 21/09/2003 onwards	NRT	
		SWM.UWA	From 16/11/2006 onwards	NRT	
	GOME	GOME. LVL13	Full mission		
		GOME. LVL21	Full mission		
	ALTIMETER	ALT.URA	From 16/11/2006 onwards	NRT	
	ATSR	AT1_TOA_1P and AT2_TOA_1P	Full mission reprocessing will be available in Fall 2008		
		AT1_AR__2P and AT2_AR__2P			
		AT1_NR__2P and AT2_NR__2P			
	Orbit	ORB.PRC	Full mission		
		ORB.PRL	Full mission		
	Chris, HRC (Proba)	PROBA.CHRIS.1A	All available data, including recent		
		PROBA.HRC.1A	All available data, including recent		

Updated list available at : http://eopi.esa.int

MERIS products available on Internet

NRT & recent data	availability	period	coverage
MERIS Red. Resolution (1200 m) **Level 1 & Level 2**	**Systematic** (i.e. processing of all data) Products available within 3 hrs from acquisition (95%)	Rolling archive of last 15 days	Worldwide coverage
MERIS Full Resolution (300 m) **L1 & L2 – Europe coverage**	**Systematic** (i.e. processing of all data) Products available within 3 hrs (L1) and within 12 hrs (L2) from acquisition (90%)	Rolling archive of last 20 days	Europe coverage Simple registration
MERIS Full Resolution (300 m) **L1 & L2 – North America**	**Systematic** (i.e. processing of all data) ***Temporary set-up:*** Products available within 9 hrs (L1) and within 24 hrs (L2) from acquisition (90%)	Rolling archive of last 20 days	North America coverage
MERIS Full Resolution (300 m) **Other geographical coverages**	Not systematic **On request** Limited quantities	Few hours after acquisition	According to instrument plan Full proposal

NRT data from other Envisat sensors (e.g. ASAR, AATSR) also available on Internet

Which data access systems for NRT and recent data ?

Same NRT and recent dataset for both systems

NRT and recent data

Rolling Archives

(ftp or http)

- Complete product (e.g. MERIS orbit)
- Each acquisition station has its own rolling archive

NRT and recent data

Web File Server

(http)

- Geographical selection (with product subset to decrease data volume for download)
- One single web site for all acquisition stations

Current download problems at Kiruna station !

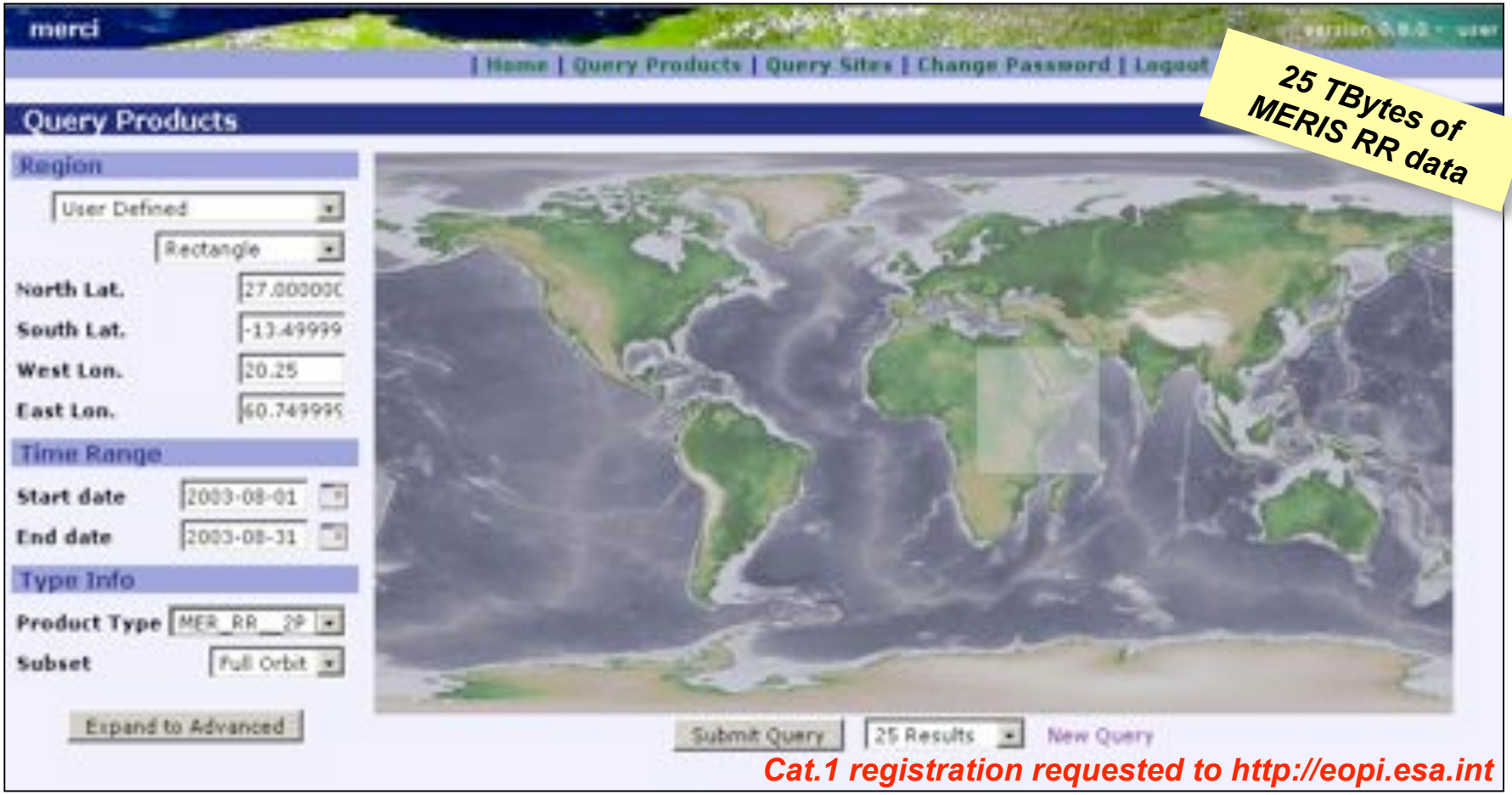
MERIS products available on Internet

Archived data

Archived	availability	period	coverage
MERIS Red. Resolution (1200 m) Level 1 & Level 2	**Systematic** (i.e. for each re-processing of the data) ***MERCI Web Interface***	Whole mission since mid-2002	Worldwide coverage **Simple registration**
MERIS Full Resolution (300 m)	Not systematic **On request** *Limited quantities on Internet* *Products usually provided on DVD-Rom*	Whole mission since mid-2002	Worldwide coverage **Full proposal**

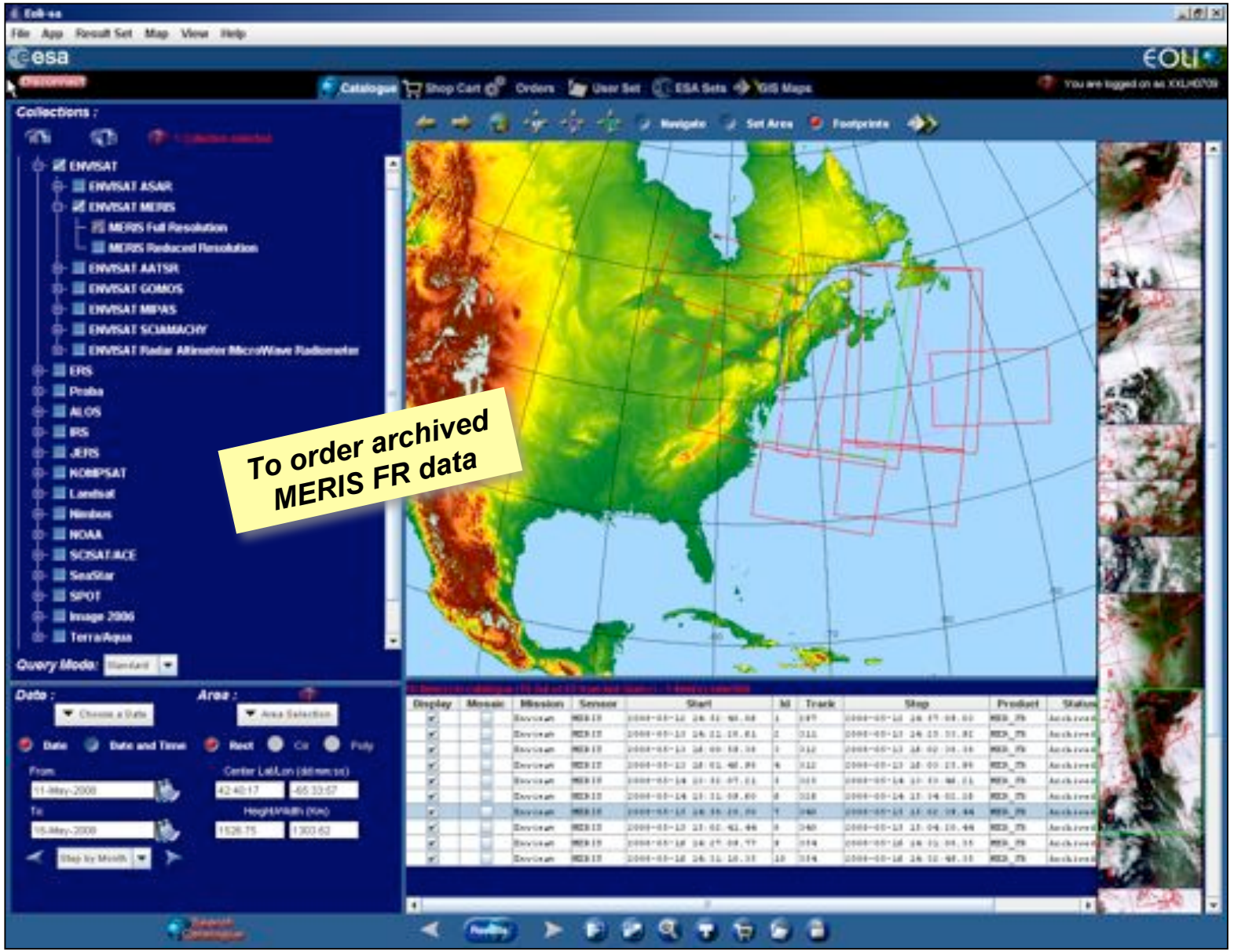
Which data access systems for archived data ?

MERCI web interface, giving access
to global MERIS Reduced Resolution data archived since mid-2002



MERCI web interface will be used also for Envisat/ERS (A)ATSR archived data (Oct. 2008)

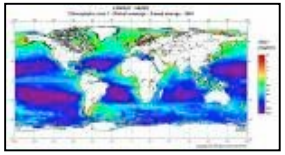
EOLI-SA: On-line multi-mission catalogue



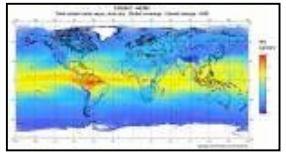
MERIS Level 3 demonstration products

code	Product	Data available
n412	Normalised water leaving radiance at 412 nm (n412)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
n443	Normalised water leaving radiance at 443 nm (n443)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
n490	Normalised water leaving radiance at 490 nm (n490)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
n510	Normalised water leaving radiance at 510 nm (n510)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
n560	Normalised water leaving radiance at 560 nm (n560)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
chl1	Chlorophyll-a, case-1 water (chl1) Description	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
t865	Aerosols optical thickness over water at 865 nm (t865)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
a865	Angstrom alpha coefficient over water at 865 nm (a865) Description	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
t443	Aerosols optical thickness over land at 443 nm (t443)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
a443	Angstrom alpha coefficient over land (a443)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
t550	Aerosols optical thickness over land and water at 550 nm (t550)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
a550	Angstrom alpha coefficient over land and water at 550 nm (a550)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
t865	Aerosols optical thickness over water at 865 nm (t865)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
wvcs	Total water vapor column, clear sky (wvcs) Description, Validation	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
absd	ABSOA_DUST flag statistics (absd)	Monthly: 2002 2003 2004 2005 2006 2007 2008 Daily: 2007 2008
mgvi	MERIS Global Vegetation Index Description, Validation	Monthly: 2002 2003 2004 2005 2006 2007 2008
mgvi-plc	MERIS Global Vegetation Index/Plate-Carree	Monthly: 2002 2003 2004 2005 2006 2007 2008

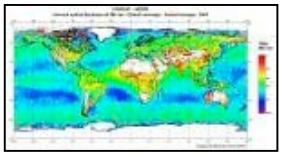
Chlorophyll-a Case 1



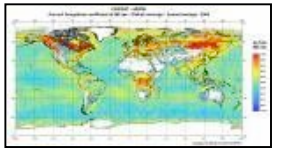
Total water vapour column



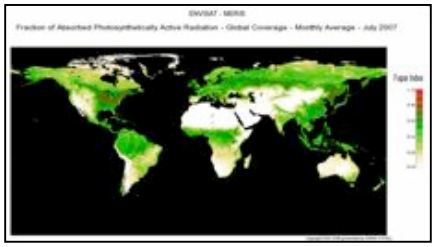
Aerosol optical thickness



Aerosol Angstrom coefficient



Global Vegetation Index



Available at: http://envisat.esa.int/level3

No registration required

MERIS data reprocessing

MERIS Reduced Resolution data reprocessing

➡ **First data reprocessing in 2004**

➡ **Second data reprocessing in 2006**

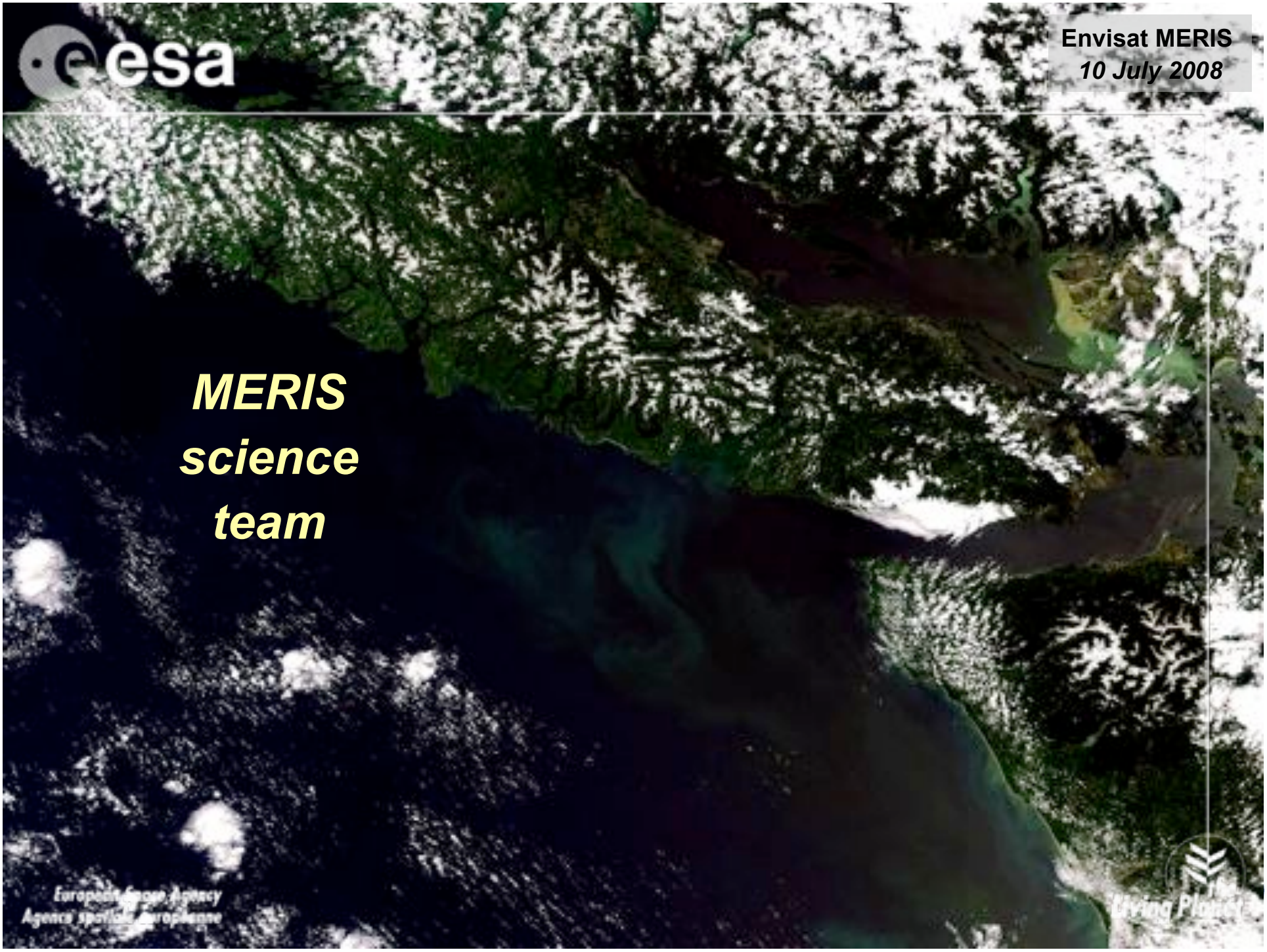
➡ **Third data reprocessing was planned for 2nd half 2008, but is postponed to 2009**

Main drivers:

✓ Observed **discrepancies in water leaving reflectances** with match-ups (Boussole between 13% (490nm) and 31% (412nm) errors).

✓ **Vicarious adjustment at Level 2:** same method as applied by NASA for SeaWIFS (Franz et al. 2007 [Applied Optics 46]; Bailey et al. 2007, submitted to JGR). It consists in computing average multiplicative gain factors to correct the TOA signal using a database of match-ups (Boussole, or Moby, or both).

✓ **New aerosol properties tables**.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team
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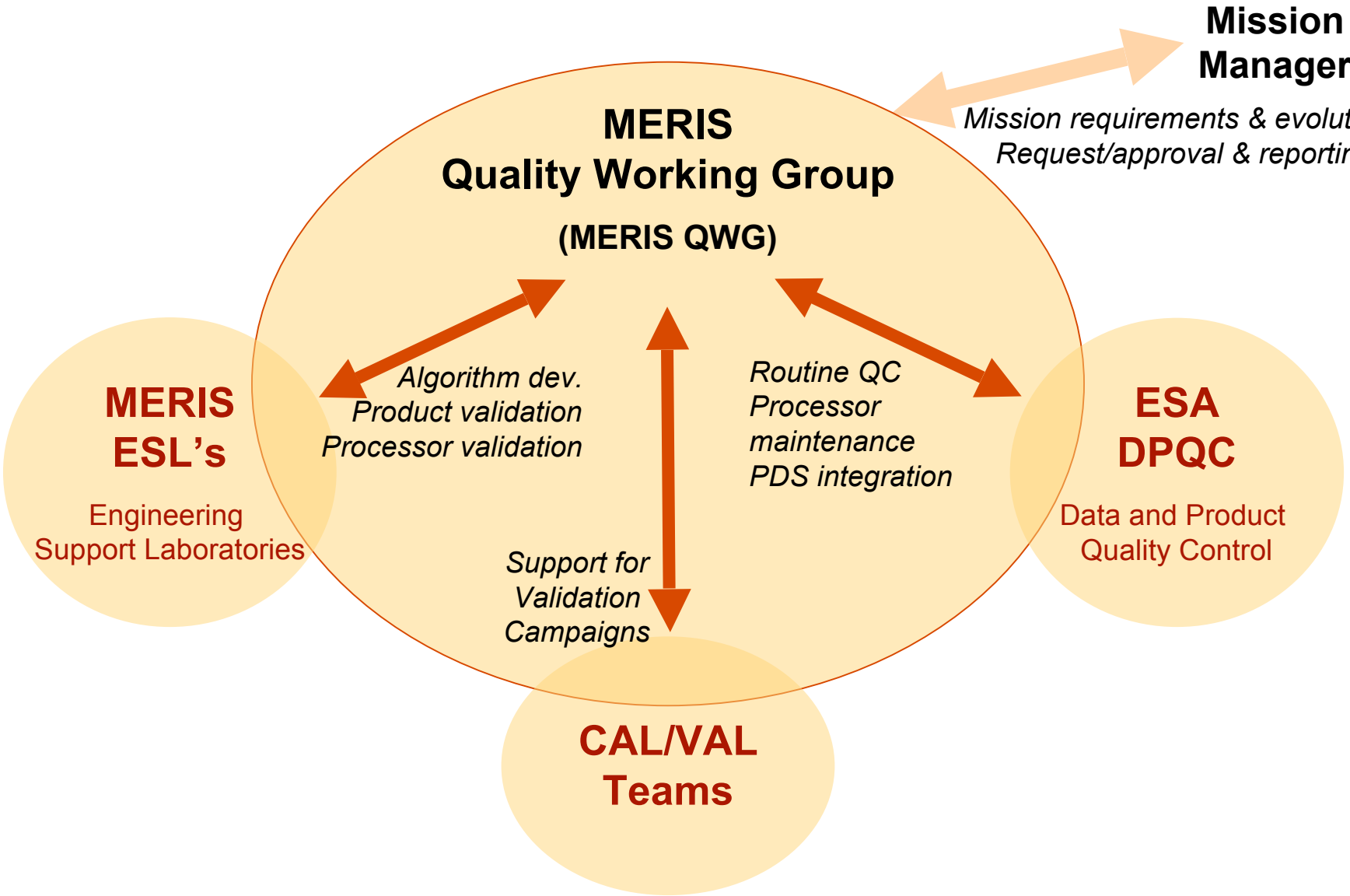
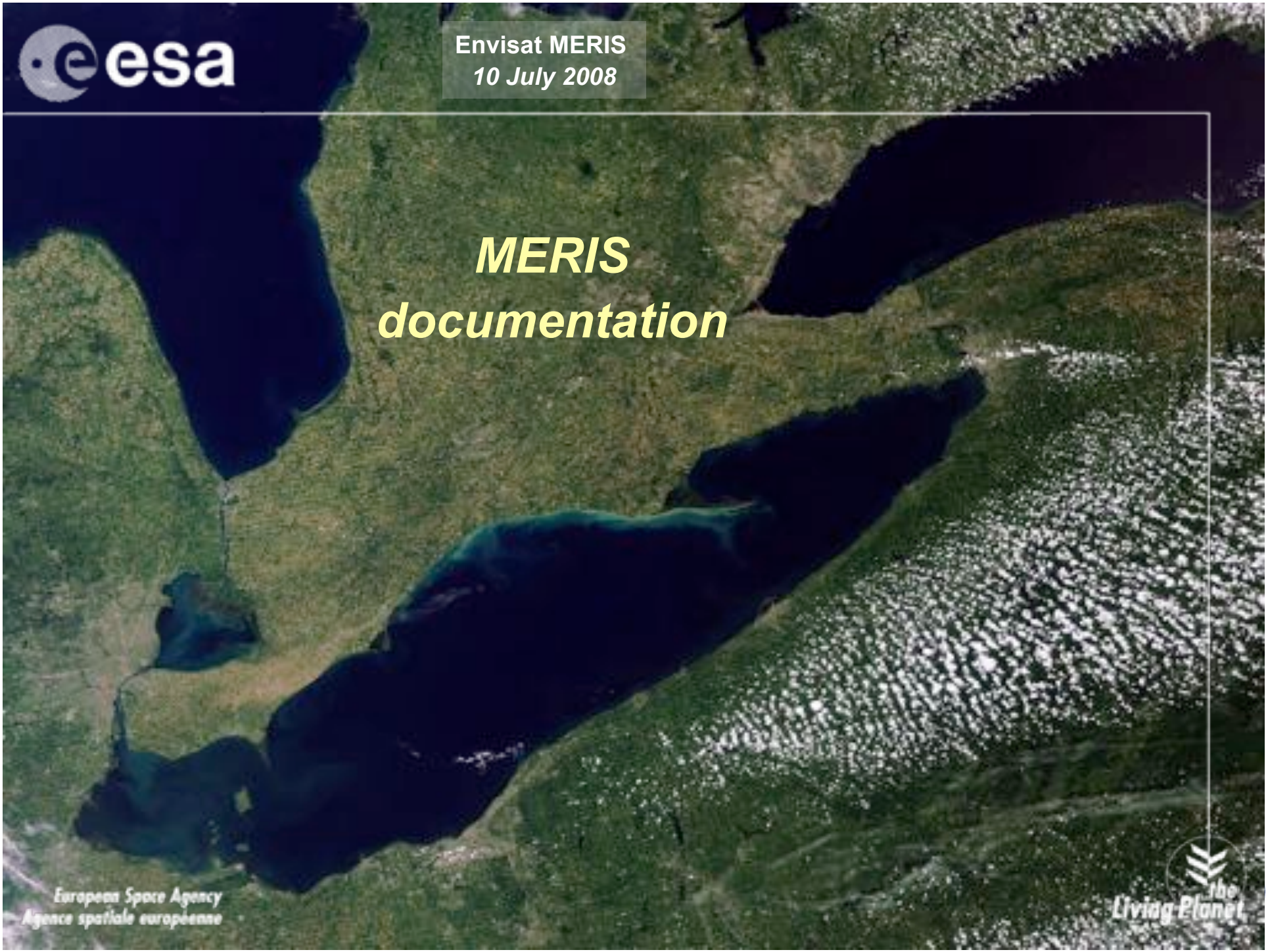
Agence spatiale européenne

MERIS data quality: organisation

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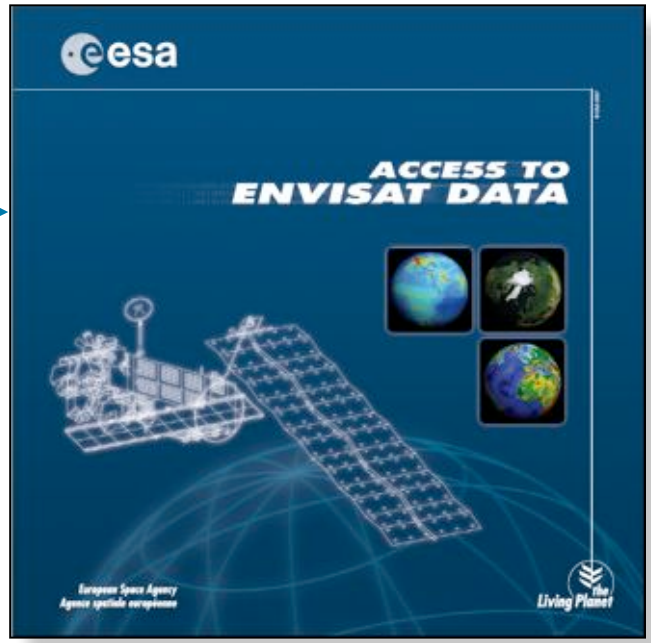
Documentation about MERIS data

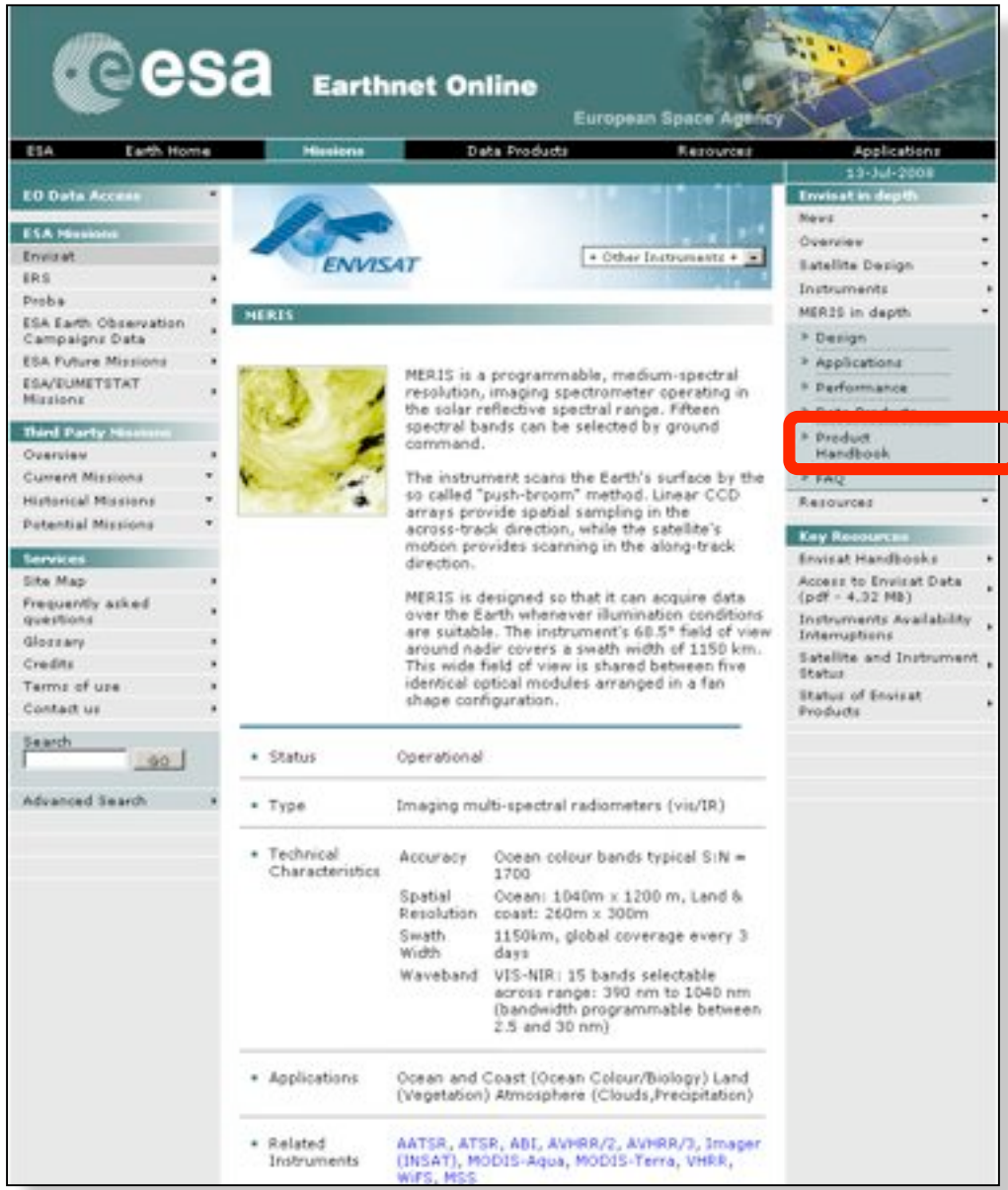
http://envisat.esa.int

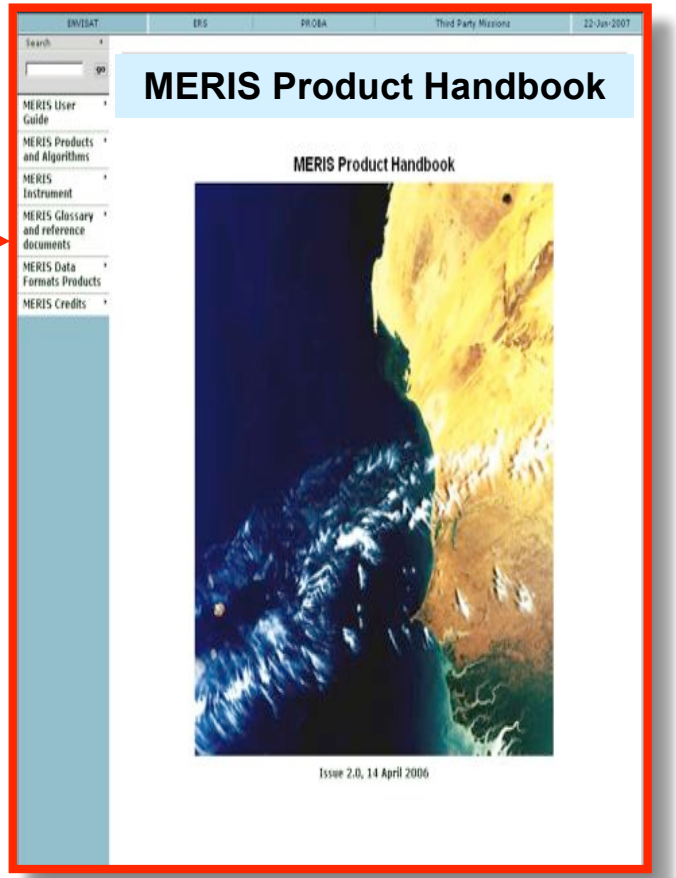


eohelp@esa.int

Documentation about MERIS data

http://envisat.esa.int/instruments/meris





Documentation about MERIS data

http://envisat.esa.int/handbooks/meris/

Extract of DPM2

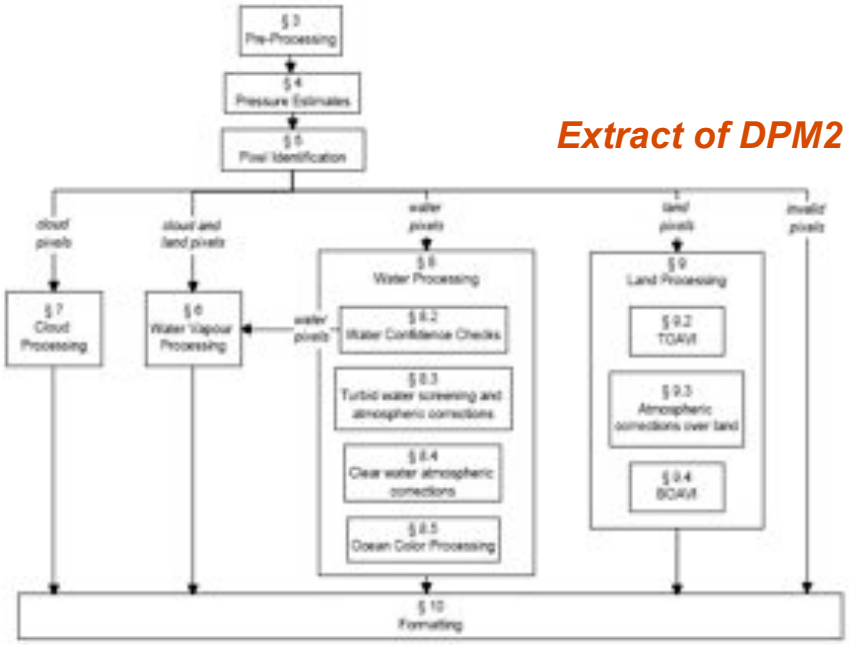
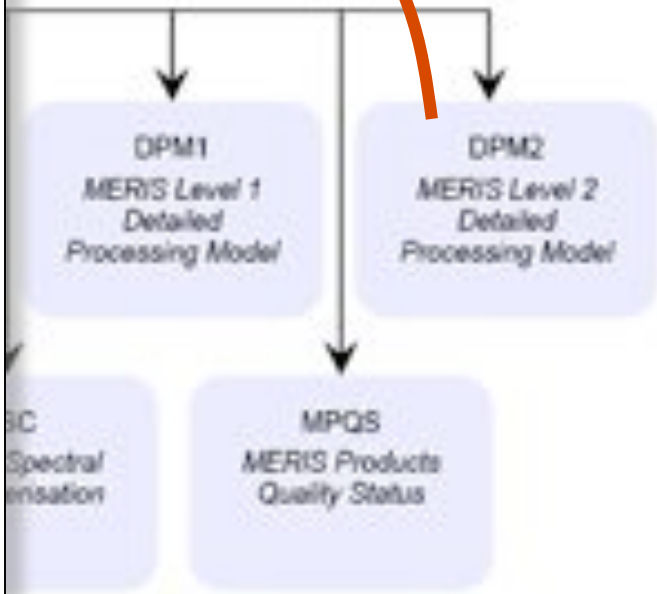


Figure 1.2-1 : Meris level 2 general control flow

1.3 - Guide to this document

This document is organised as follows:

- **Section 2** lists the applicable and reference documents, abbreviations, notations and conventions.
  Section 2.4, notations and conventions, is essential reading and reference for this specification.
- **Sections 3 to 10** provide the detailed specification of the MERIS level 2 processing. Level 2 processing is hierarchically broken down into algorithm steps. The top level breakdown



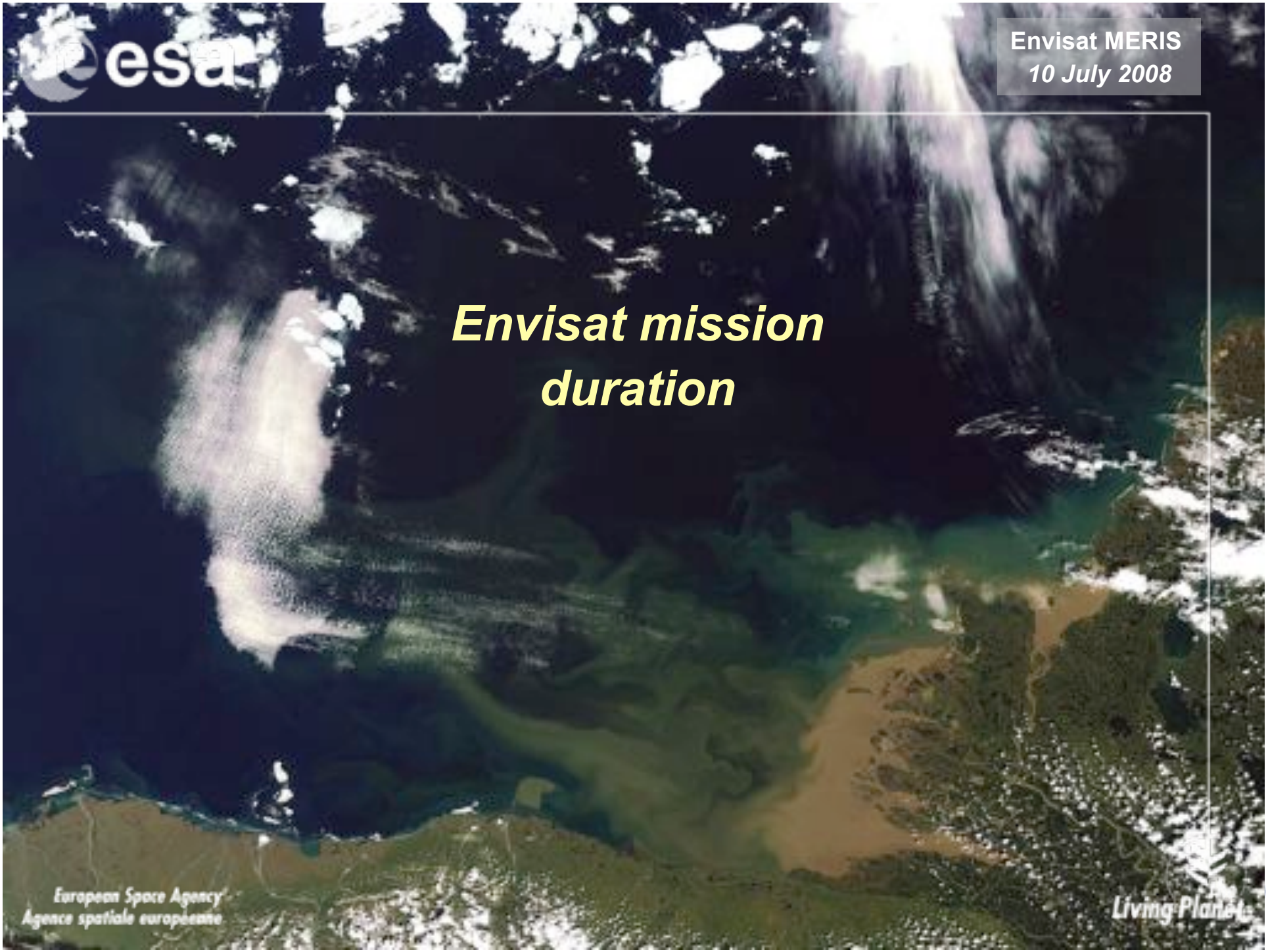
Documentation about MERIS data

Cyclic Report:

Detailed information of every 35 day period of:

- instrument performance
- modifications in the processing chain
- results of cal/val activities

http://earth.esa.int/pcs/envisat/meris/reports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Envisat satellite status and evolution

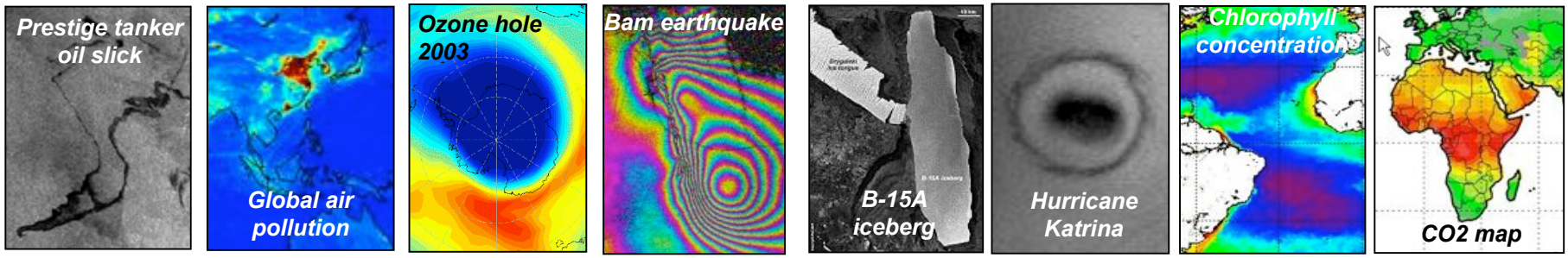
- **Envisat satellite is in good health and with an expected reasonable evolution.**
  → MERIS instrument is in excellent shape.

- **Efficient consumption of on-board hydrazine allow to operate nominally Envisat until 2010. But most of hydrazine will be consumed in 2010.**

  → ESA has elaborated a technical solution to further extend mission by 3 years, i.e. until 2013, based on a decrease of orbit altitude.

  → the solution allows to carry on with the current Envisat applications, including MERIS applications.

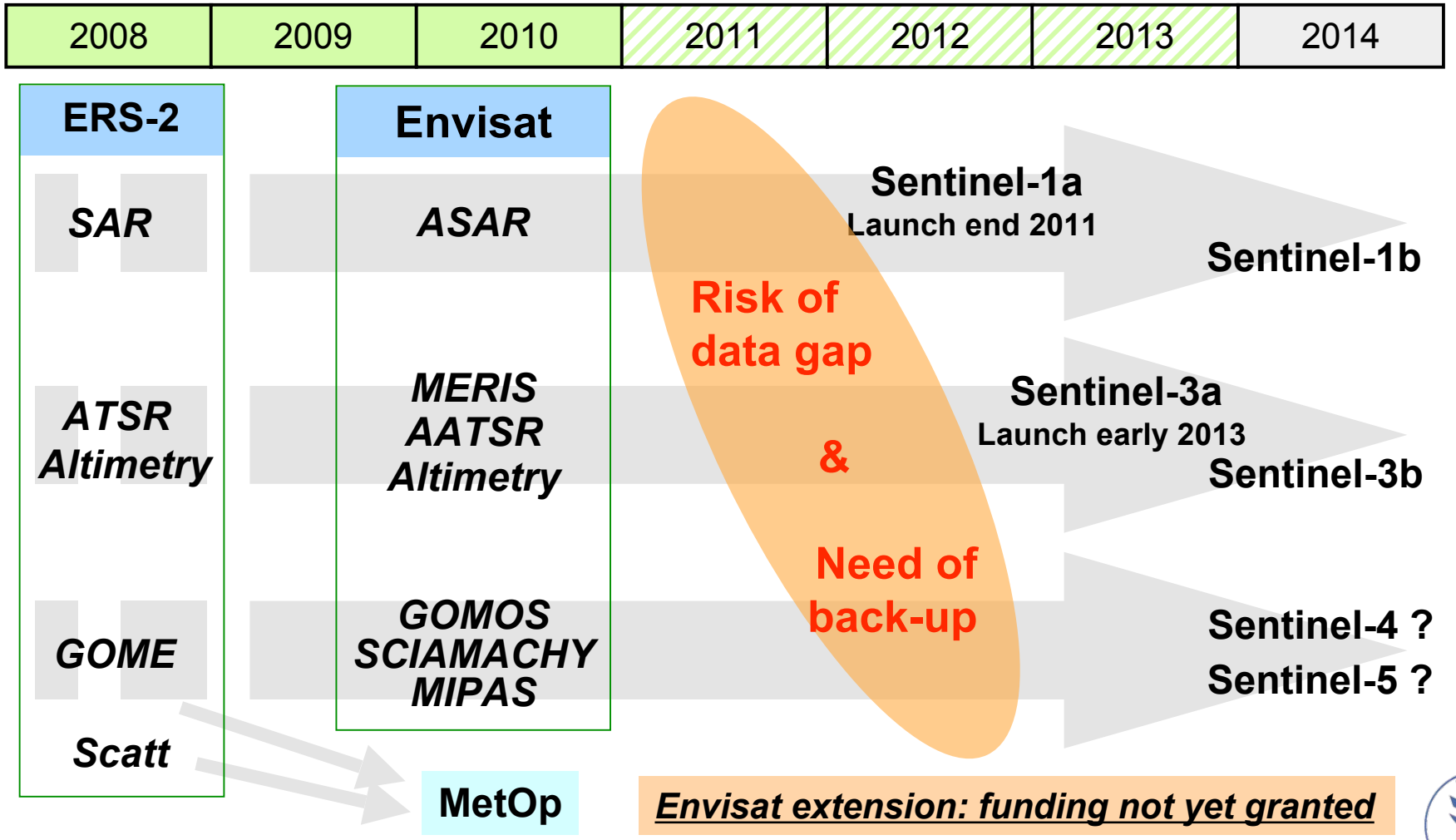
- **Funding for Envisat operations extension (2011-2013) is however not yet granted.**



Envisat mission extension

Envisat 3-years extension [2011-2013]:

- the need to prevent gaps for long-time series essential for Earth Science
- a growing demand for operational data for GMES

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