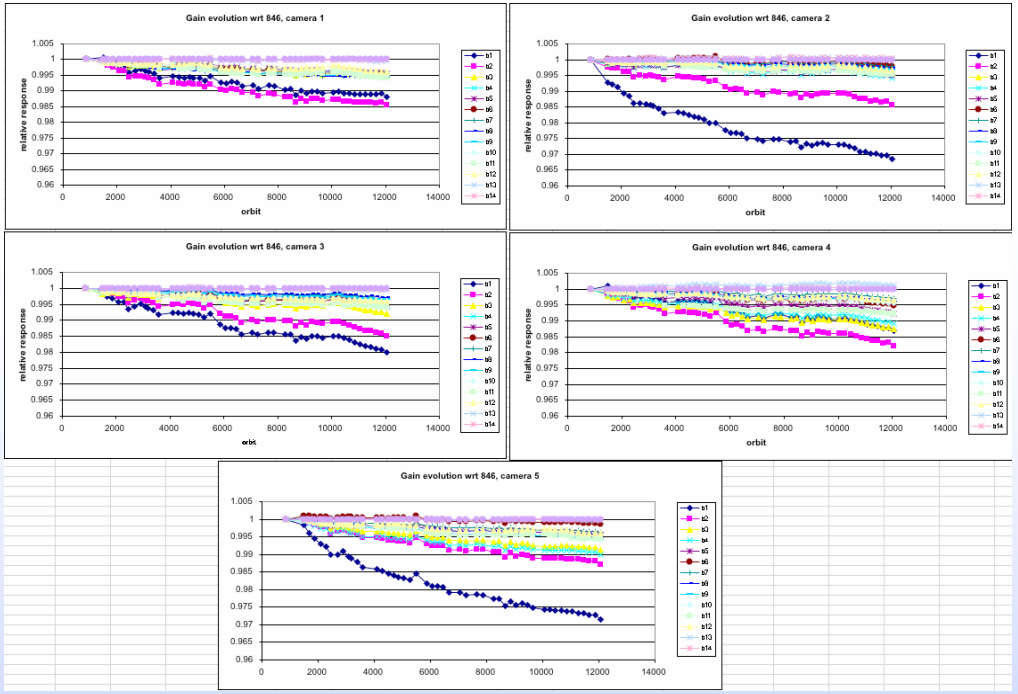
The status of the ESA MERIS mission on Envisat and the GMES Sentinels

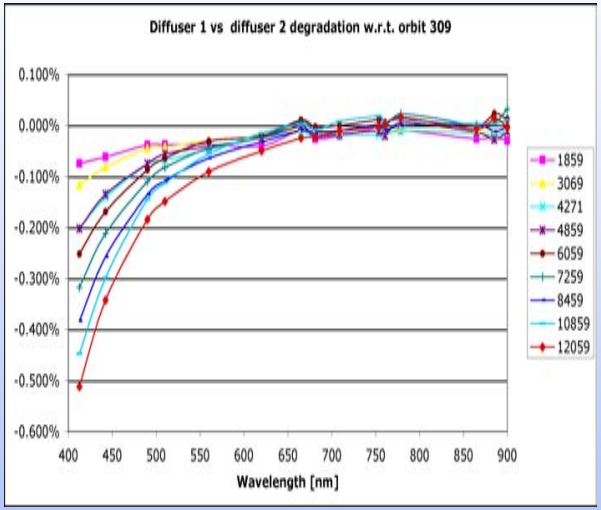
10th IOCCG Committee Meeting

Isla de Margarita, Venezuela, 19-21 January 2005

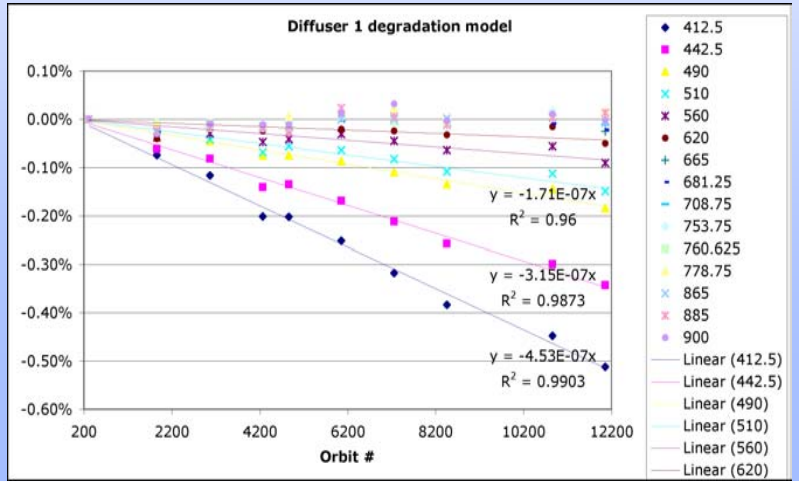
MERIS Aging

Degradation is < 3% after more than 2 years in space





Diffuser Degradation is <0.5 % after 100 min of Solar exposition



Diffuser Degradation process appears linear

The MERS Quality Working Group

To evaluate data quality and agree on the changes for reprocessing

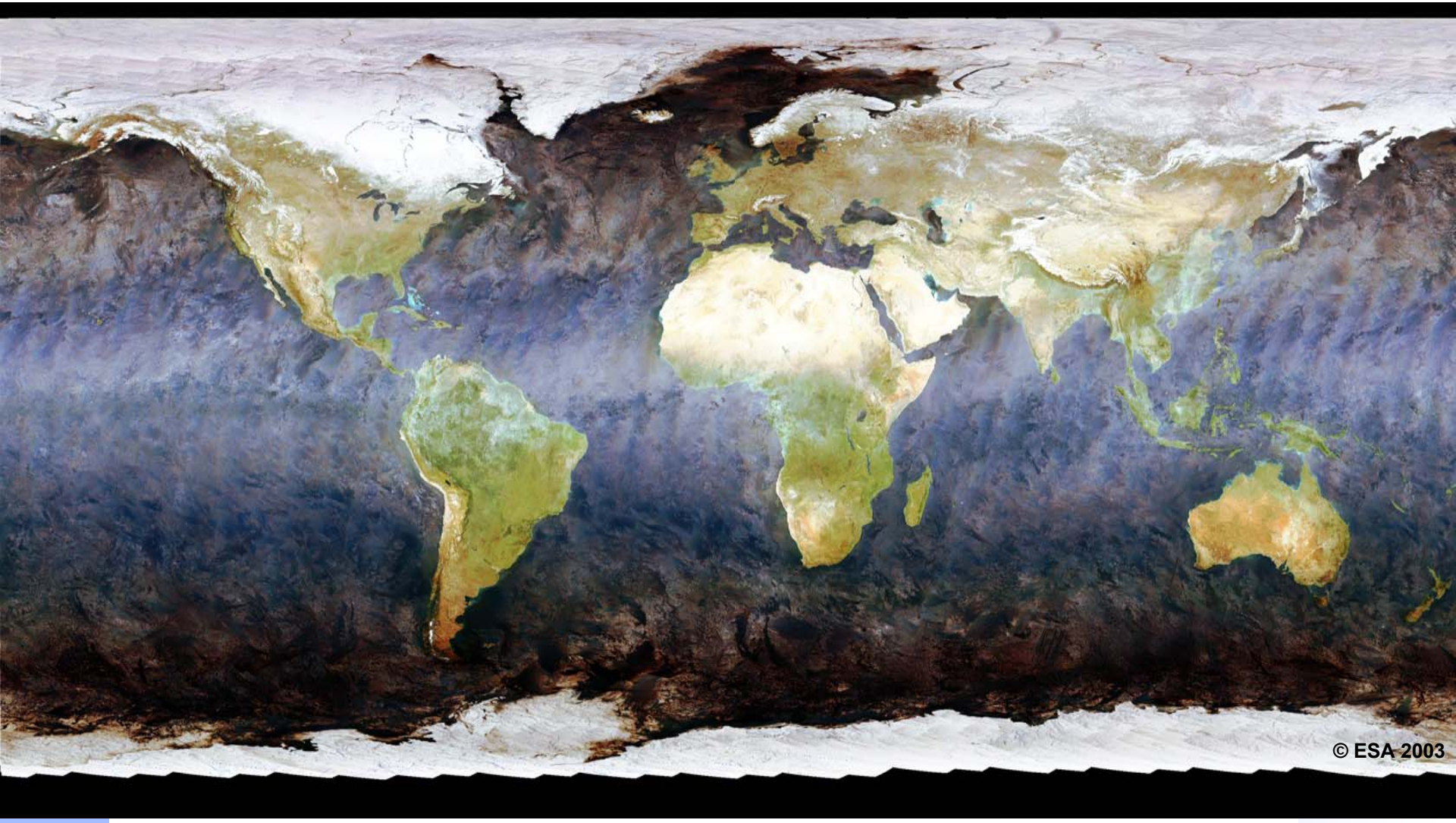
Level 2 :

- **Overall quality of all Level 2 products including WV over all surfaces looks very good.**
- **The atmospheric correction over case II waters has significantly improved. The flags seem to be correctly used in most cases.**
- **Foreseen evolution is the implementation of a "white Water" (Coccolithophore) flag for which the results are promising.**
- **The Sun Glint correction is still an issue for the next reprocessing.**

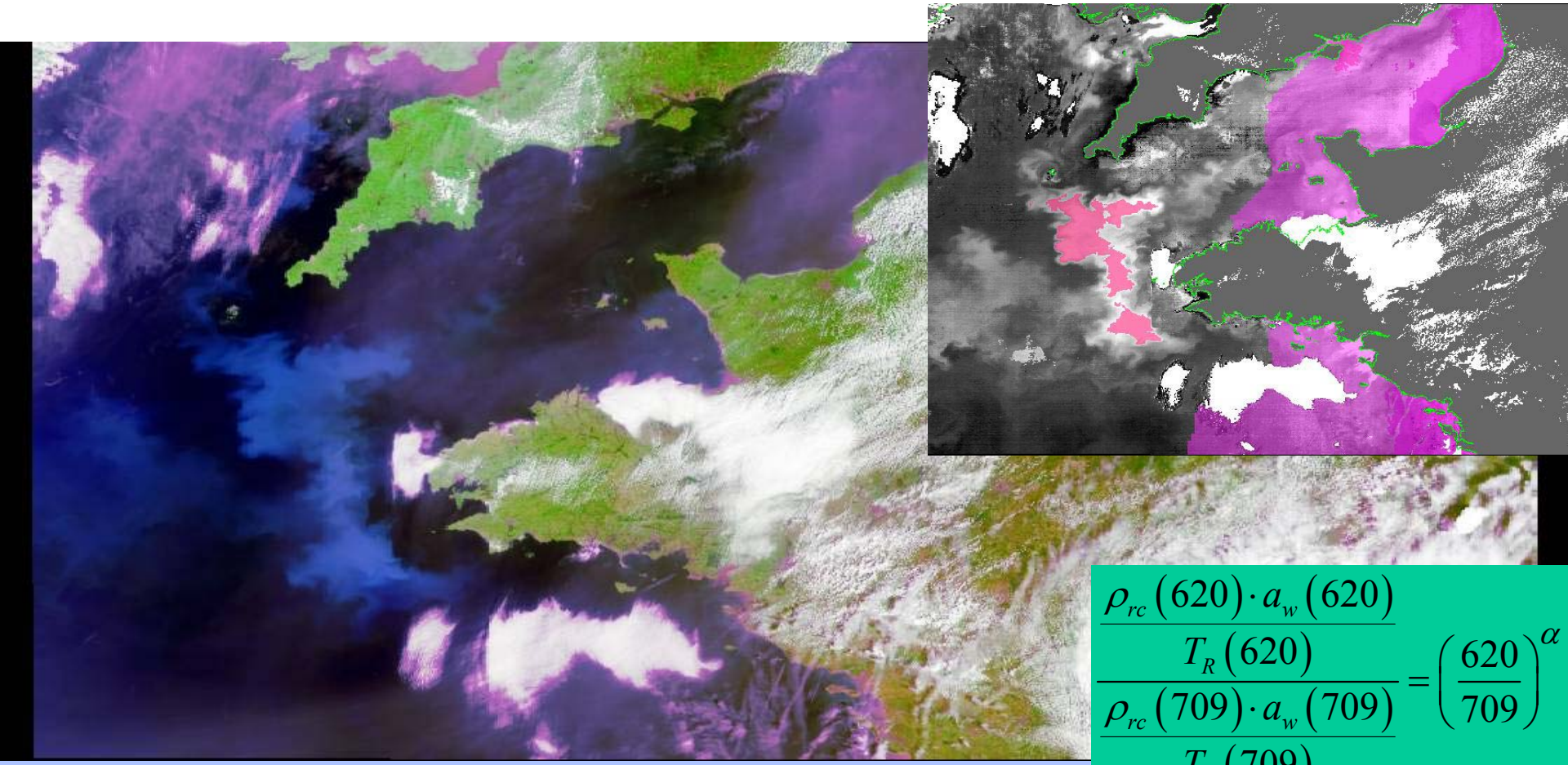
Level 1:

- **The spectral characterization of spring 2004 will be used for the reprocessing**
- **A validation report should be initiated in 2005**
- **A paper on MERIS calibration is under preparation**
- **The new and hopefully final processor could be ready by Mid-February.**

MERIS



New, the MERIS white-scatterer (Coccolithophores) flag



$$\frac{\frac{\rho_{rc}(620)\cdot a_w(620)}{T_R(620)}}{\frac{\rho_{rc}(709)\cdot a_w(709)}{T_R(709)}} = \left(\frac{620}{709}\right)^{\alpha}$$

Based on Rayleigh corrected reflectance using α to detect (white) scatterers within water. First test: bloom off Brittany, 15/06/2003.

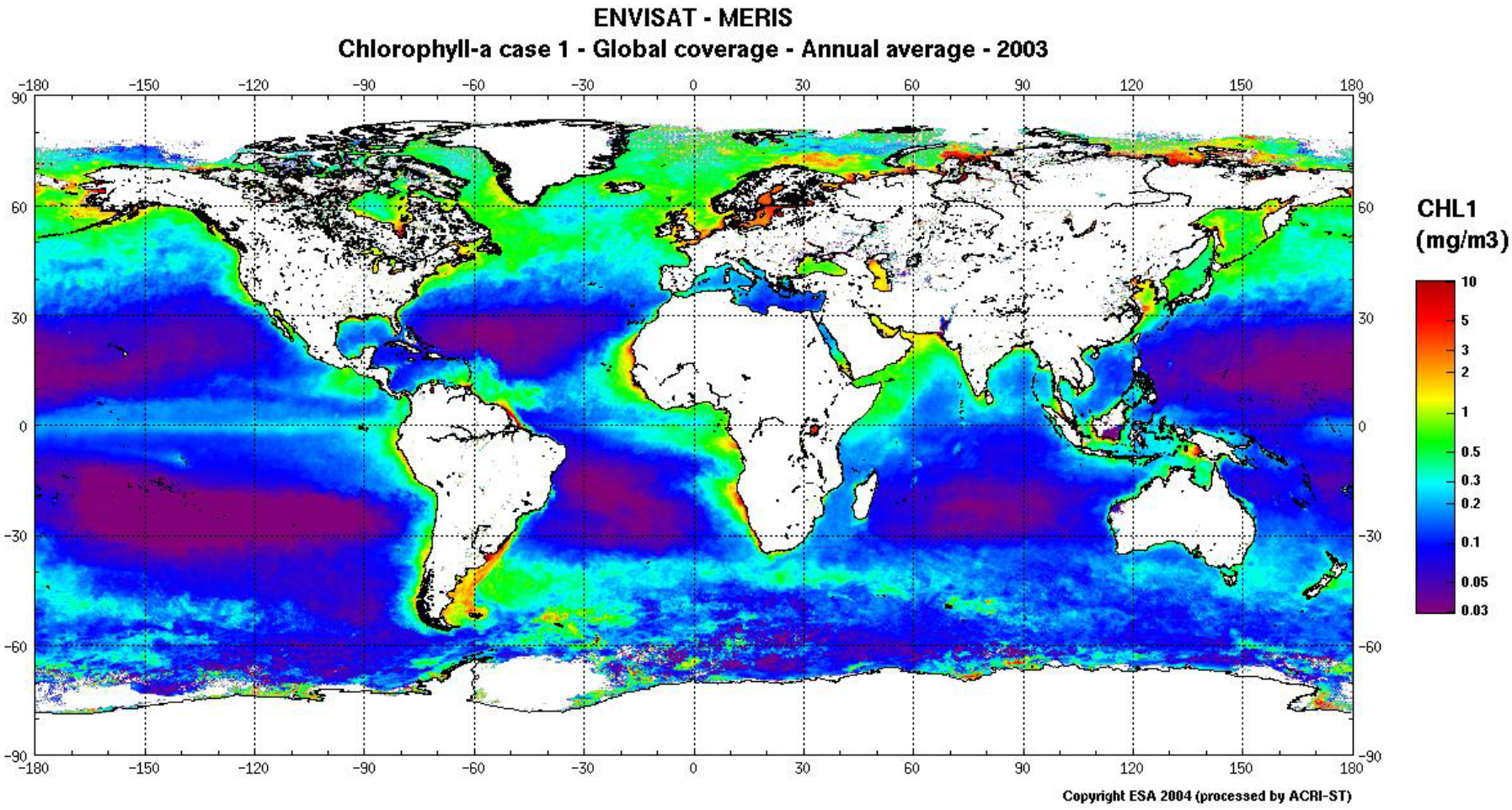
MERIS Re-processing and distribution status

The MERIS Prototype Processor is being upgraded and currently undergoes verification. The operational chain will be aligned with this Prototype Processor and should be operational by the end of the summer 2005. The start of the re-processing of MERIS data from all three years would be carried out before the 2nd quarter of 2005, leading to a consistent archive.

3 systems have been created to enhance data distribution:

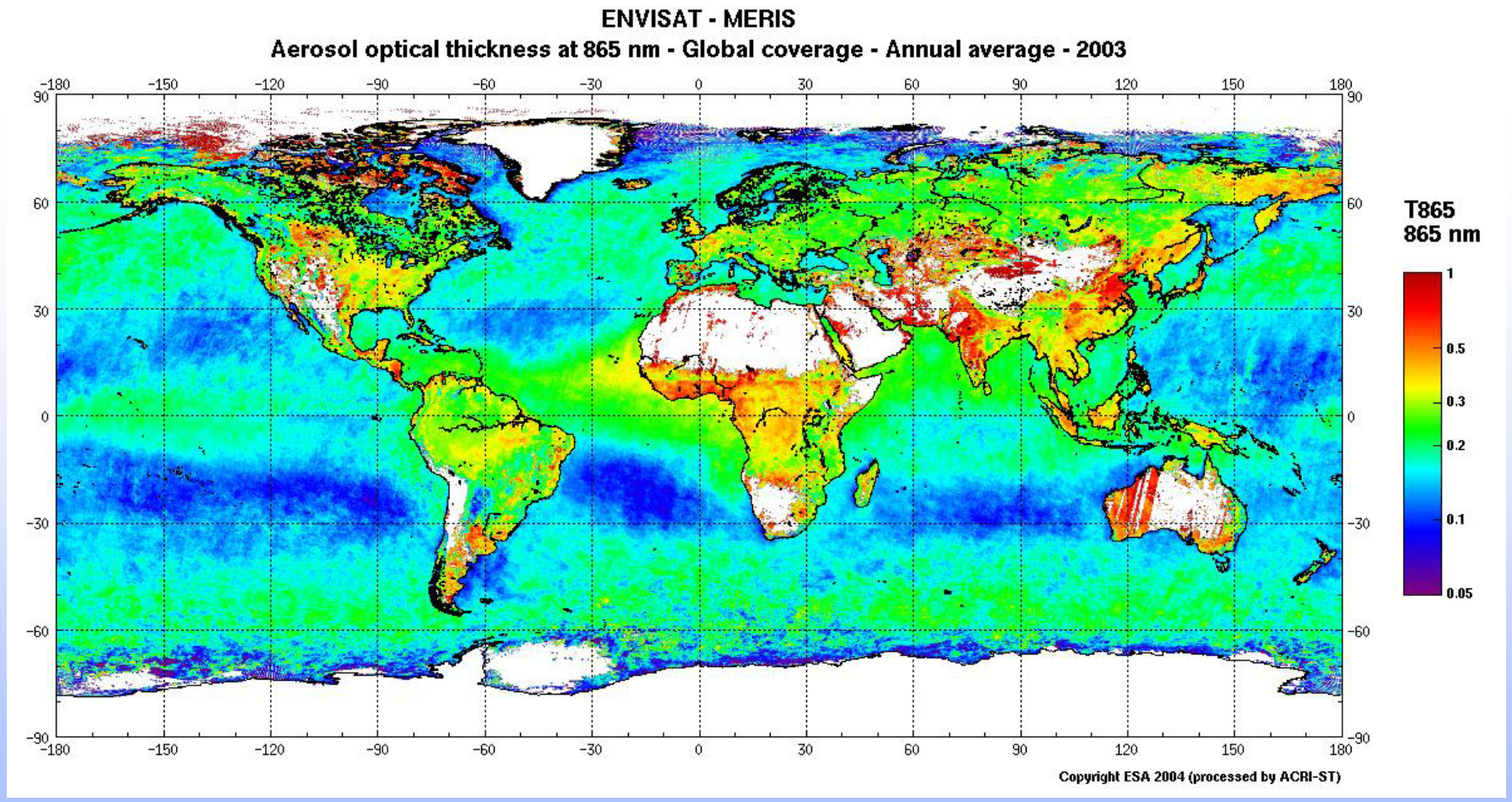
- Two NRT rolling archives (over one week of data) of L1b RR and L2 RR data one at Kiruna (downlinked data) and one at ESRIN (via ARTEMIS). The data would be available as standard PDS products for dedicated users.
- An other internet system, the web file selector enabled child extraction on the rolling archive.
- Broadcast over Europe in NRT of the data could now be done via DDS (Data Dissemination System) at low cost. All users could have MERIS data broadcasted directly at their facility for a limited cost.

MERIS status L3 products



Monthly and annual maps of Chla, AOT, Angstrom exponent, WV and MGVI available at :
http://www.enviport.org/meris/

MERIS status L3 products ctd.



Monthly and annual maps of Chla, AOT, Angstrom exponent, WV and MGVI available at http://www.enviport.org/meris/

The MERIS Workshop

MERIS/(A)ATSR User Workshop
ESA ESRIN 26th to 30th September 2005

First announcement and call for papers

Following the 1st MERIS user workshop in November 2003, ESA is organising a joint MERIS / (A)ATSR workshop, for up-to-date results from on-going research activities including discussions on scientific applications, data quality, development of new algorithms, data products, and user issues.

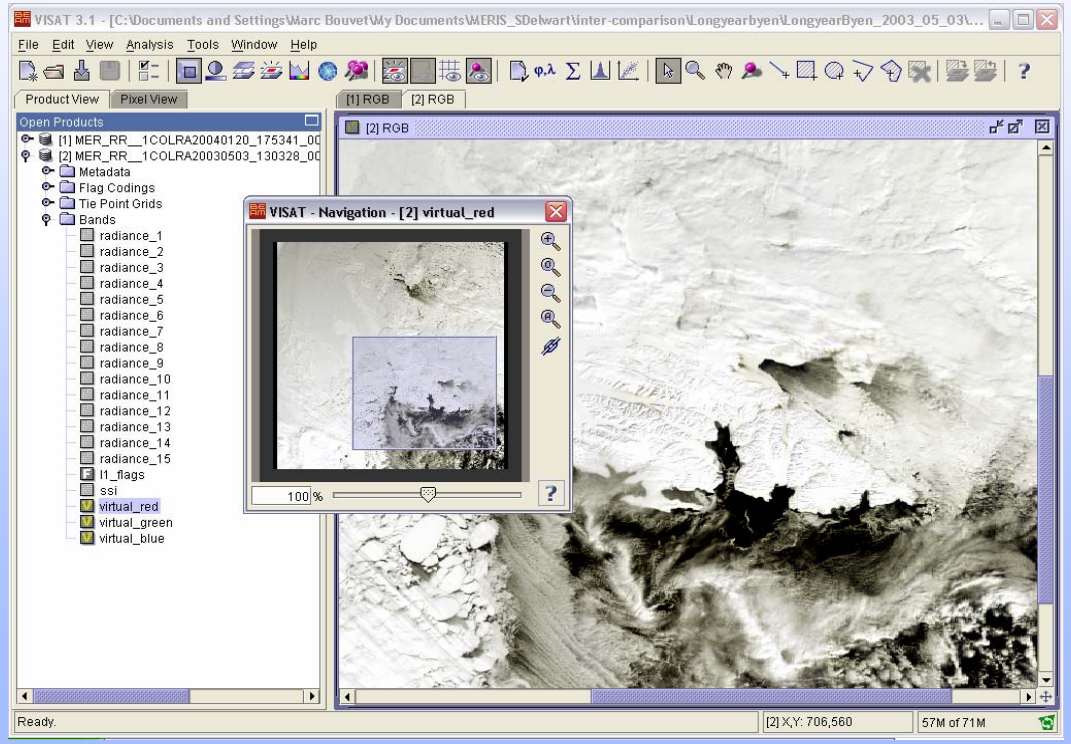
Of specific interest will be the synergistic use of the data from MERIS and AATSR for operational applications, primarily in the marine environment and the coastal zones, but also for applications over land and the atmosphere.

The workshop will be held at ESRIN, Frascati, Italy from 26-30 September 2005.

Version 3.1 available since with new features (improvements on map projection, geo-location, mosaic processor and user interface)

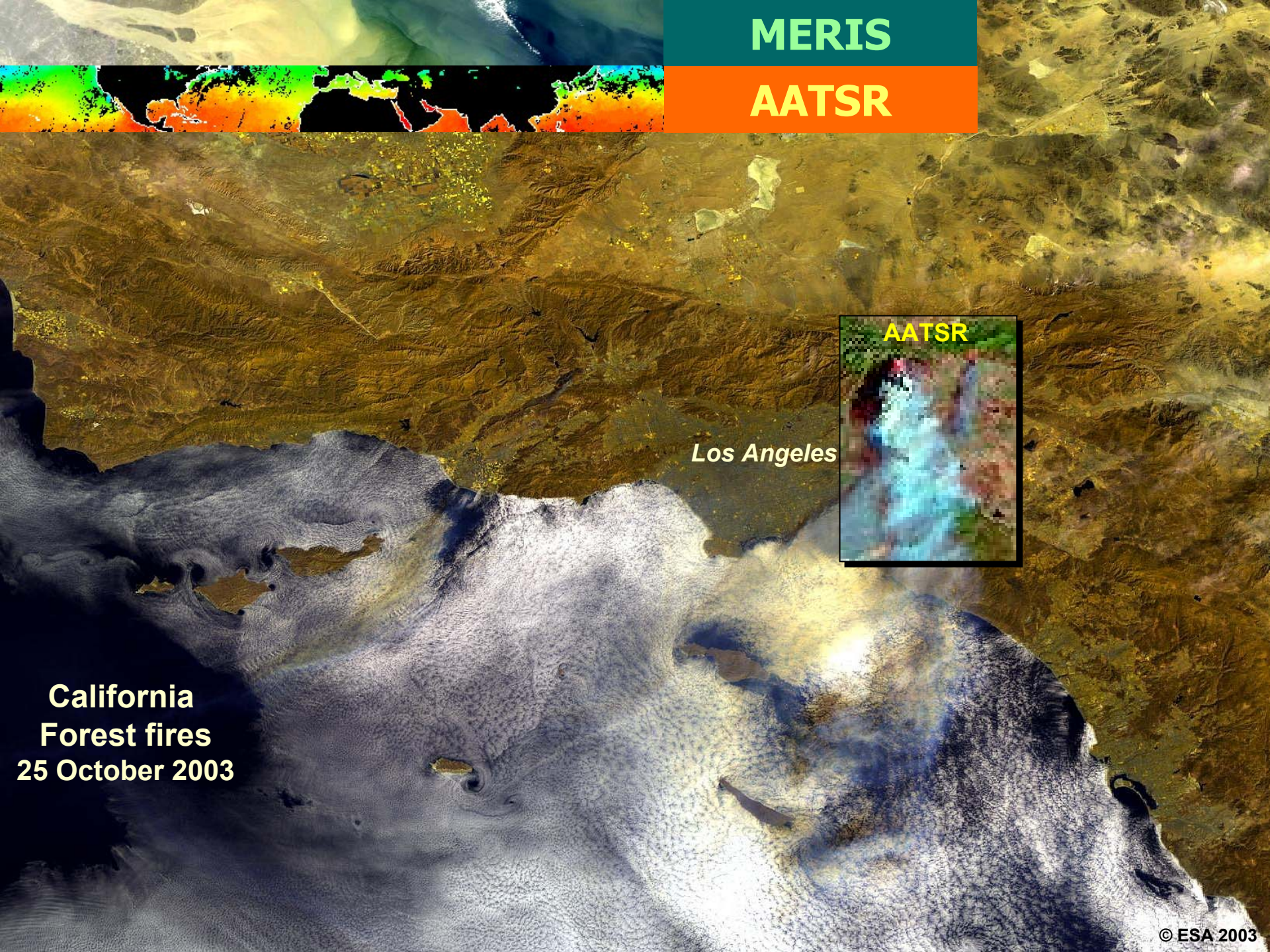
Next version will be available in February 2005

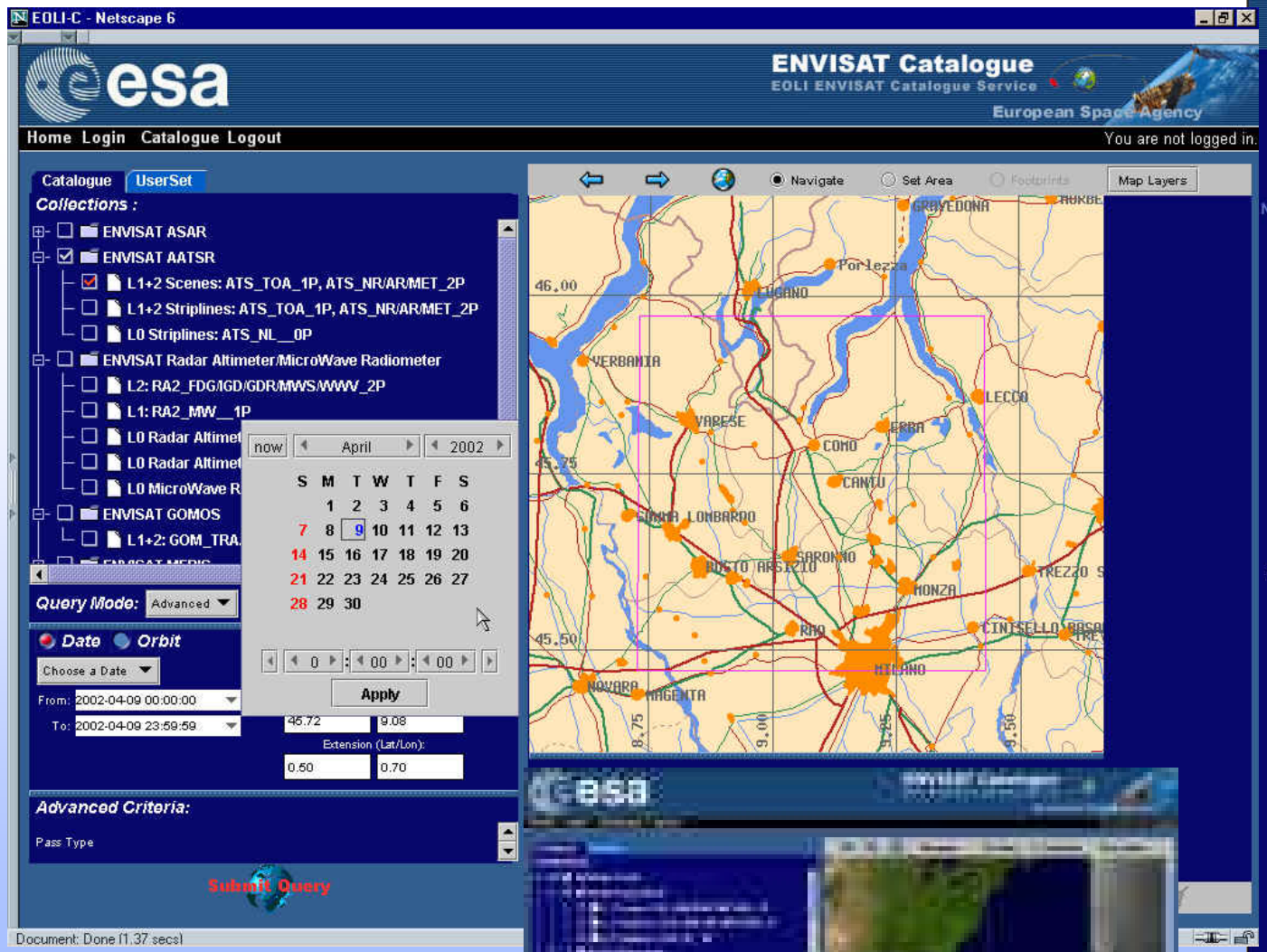
Link: www.envisat.esa.int



Envisat User Tools V2 Delivered in **Source code** for (A)SAR, MERIS, (A)ATSR, Atmospheric Instruments data

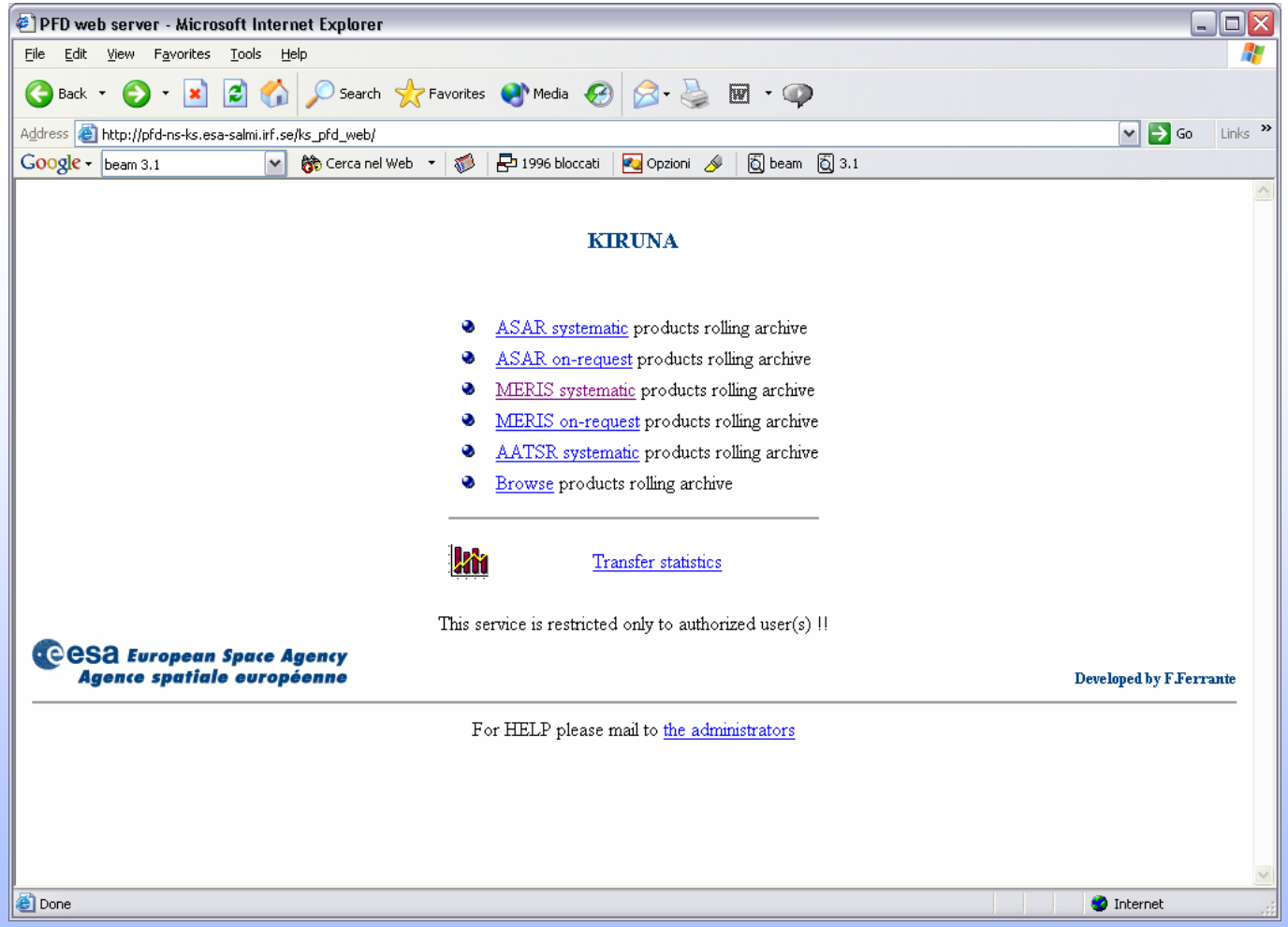
- **Adapters for importing** Envisat/ERS products into COTS
- Capabilities for **viewing, analysing, converting products**
- **Scientific modules** for generating new products
- **Portable** tools accessible from standard platforms
- **Fully documented** with clear interface specifications


MERIS
AATSR
AATSR
Los Angeles
California
Forest fires
25 October 2003
© ESA 2003



EOLI, Earthnet On Line multimission including Envisat

MERIS status Rolling archive



All MERIS L1b/L2 RR&FR within 7 days are now available for download from Kiruna and ESRIN. Access through: eohelp@esa.int

GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY

European Commission

European Space Agency

European and national user agencies

European and national space organisations

Industry

R&D institutions

and other partners

GMES

Global Monitoring for Environment and Security

An Intelligence System to provide timely and adequate information delivery

The Goal is to develop operational information services, relying on space infrastructure, in support of public policies, e.g.:

- **Environmental Governance (global and local)**
- **Civil Security**
- **Resources Management**
- **Food and Health Security**

It will rely on:

- **A space-based permanent global monitoring system**
- **Additional in-situ observations**
- **Operational modeling and forecasting centers**
- **A network of users/ customers**

GMES: Satellite Oceanography

- **Satellite Ocean Monitoring forms one of the key elements of Global Monitoring for Environment and Security (GMES)**
  - **Satellite systems are a unique, globally available data source and facilitate local, regional and global applications and related services.**
  - **GMES will establish operational capabilities providing information to the user community as specified in the EC Action Plan[1] (2004-2008).**

- **The economic and environmental importance of the oceans dictate that ocean and marine GMES applications are initially focused on:**
  - **fisheries and vessel monitoring**
  - **maritime traffic and security**
  - **coastal zones and open ocean environment monitoring**
  - **sea ice/oil spill monitoring.**

- **The general objective of the GMES programme is to realise the benefits of EO data for markets and society.**

[1] COM(2004)65 final GMES: Outline EC GMES Action Plan (dated 3 Feb'04)

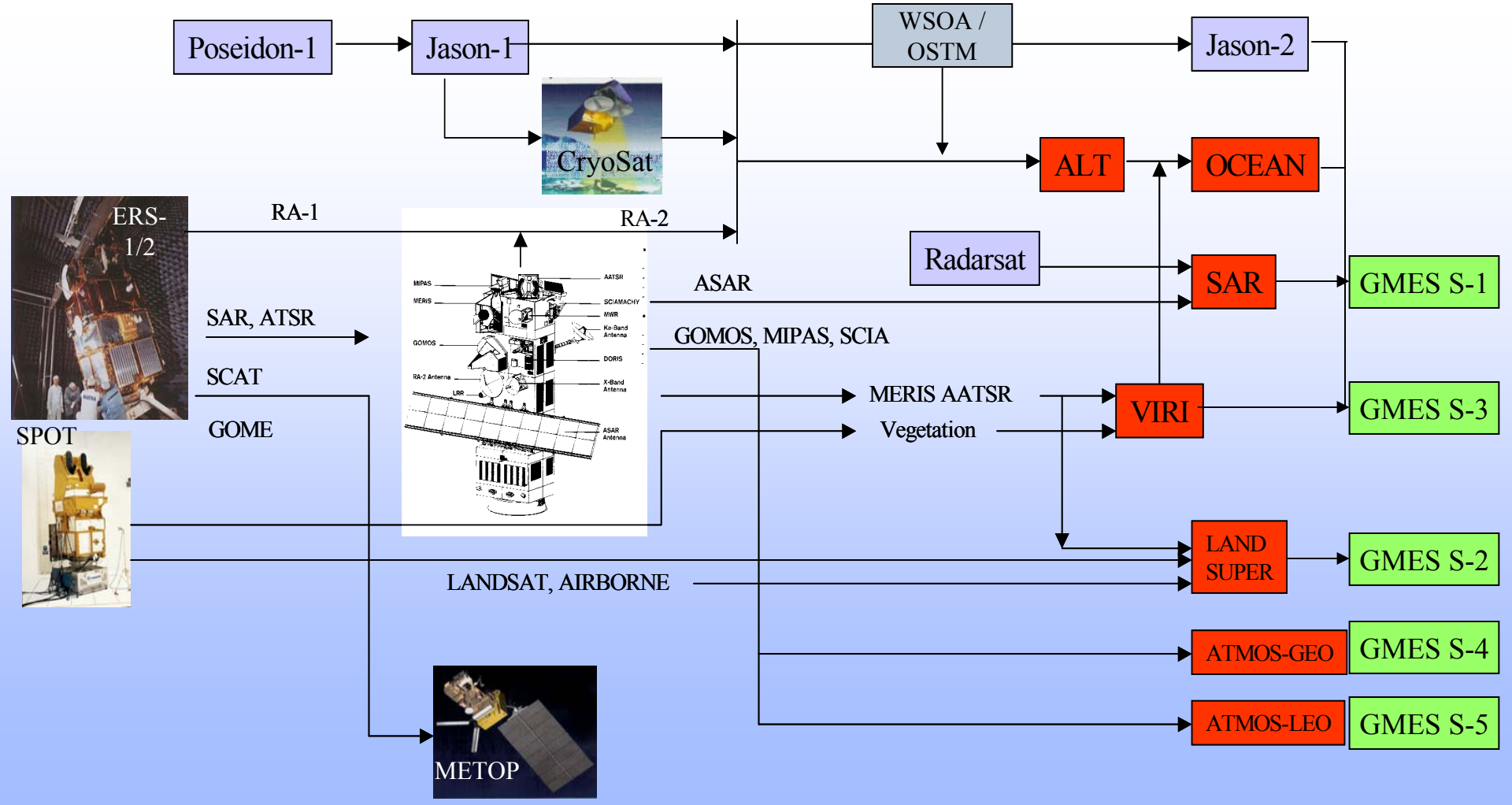
Establishing GMES Services

- The primary actors in GMES ocean-related projects need to have existing access to the “tools” needed to establish operational services.

- Since these tools must (in most cases) include operational ocean forecasting capability, these groups are logically also participants in MERSEA and the Global Ocean Data Assimilation Experiment (GODAE). Four key ocean modelling efforts are: FOAM, MERCATOR, MFS, and TOPAZ.

- There is an important overlap, in terms of capacity building, between GMES and GODAE, and thus ESA recognises the need to serve the primary data needs of these established users (both operational and scientific).

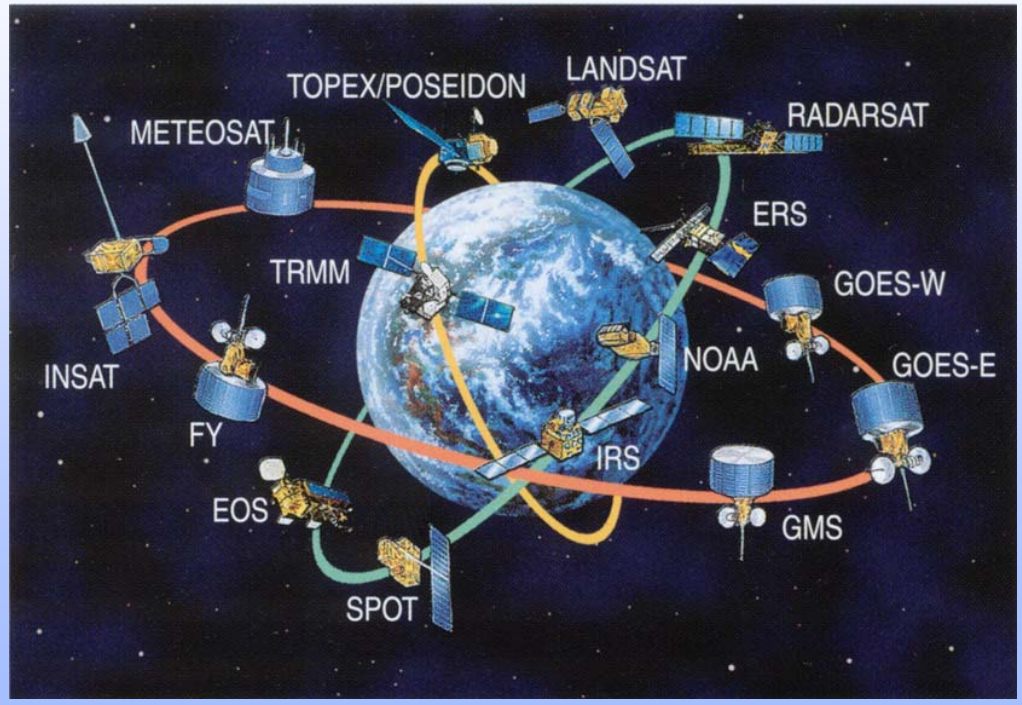
European EO Heritage



Background

Series of **OPERATIONAL** and **R&D** satellite sensors for oceanography has been and will be **functioning more than ten years** till the end of GODAE demonstration phase

- **Altimeter**
- **Scatterometer**
- **SST sensor**
- **Ice sensor**
- **Ocean Color sensor**



Courtesy IGOS-P

Requirements Definition - Steps

URD

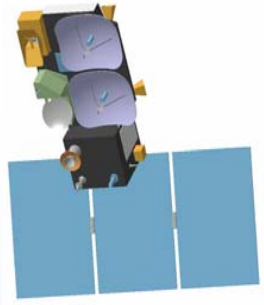
1. User Service Needs
   - User Requirements Documents for GSE studies
   - Must agree on the relevant needs of NWP, FP5/6, and others
2. Operational Product/Parameter Needs
   - e.g. Chla to n% accuracy, SST accurate to 0.3K abs. & 0.1K/decade
3. Observational Requirements
   - Measurement Requirements
     - parameters/timeliness/frequency/etc..
     - bands, swath width, resolution sampling requirements/orbits etc.)
   - Basic sensor requirements
     - e.g. Alt, MERIS follow-on, AATSR follow-on

MRD

4. Ground Segment Requirements
   - timeliness/data latency
   - NRT (<3 h) data flow to the product service providers
5. System Requirements
   - instrument specifications (e.g. PRF/accuracy/sensitivity)
   - Mass/Power launch constraints; Downlink rates etc

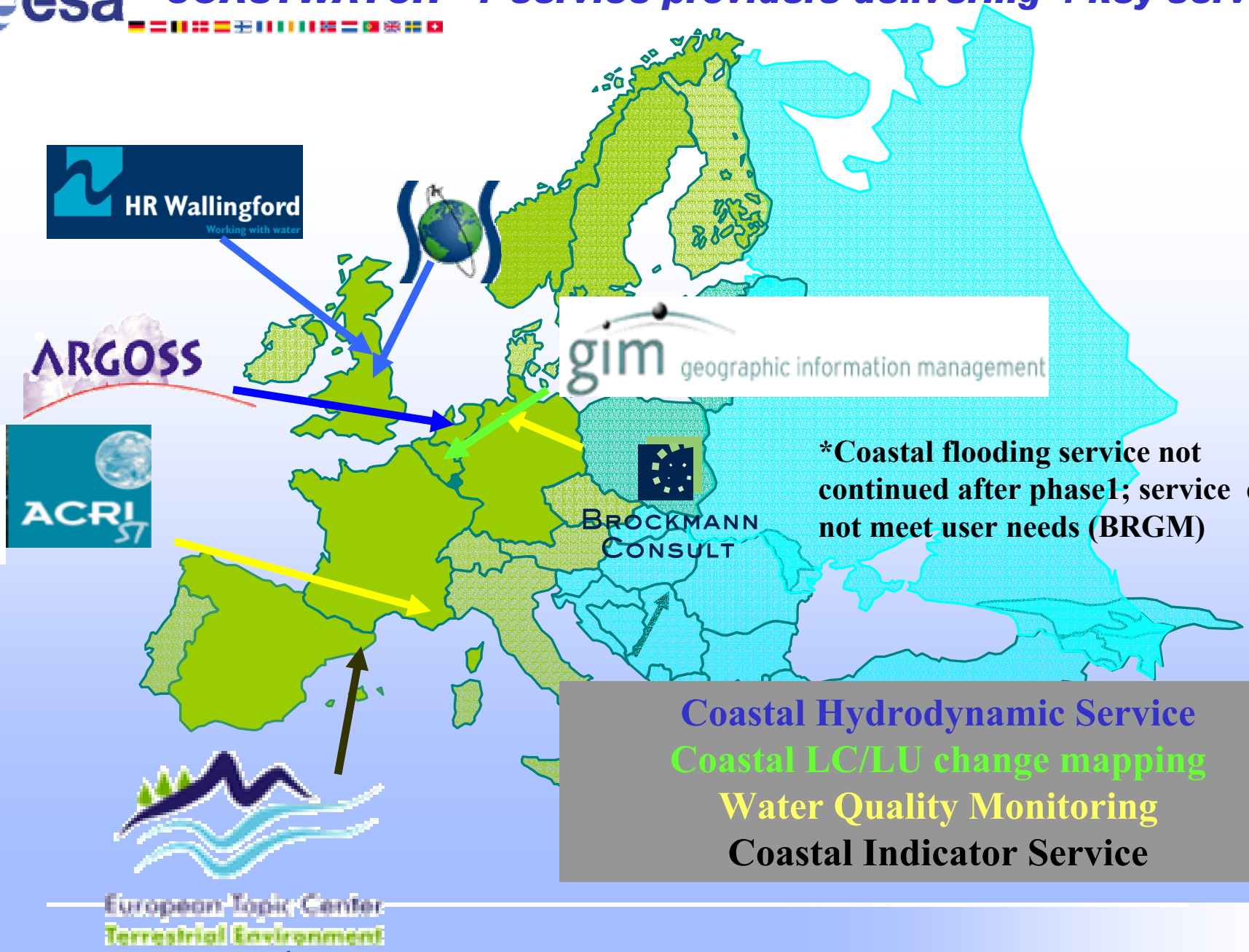
SRD

Mission Requirements



- **Broad requirements exist for ocean (blue water and coastal), ice and coastal waters observation. Considering expectations from existing/planned missions, the needs & potential implementation options include:**
  - **An Altimeter (ALT), with supporting instruments, (e.g. Microwave Radiometer, DORIS, and/or GNSS receiver – as needed).**
  - **Wide-swath coarse resolution (0.25 – 1km) sensor (VIRI) operating in the visible to infrared, to continue the (A)ATSR – MERIS – VGT missions. This component shall also be suitable for global land / vegetation monitoring.**
- **Implementation plan requires results of studies identifying robust operational instrument concepts, platform compatibility issues, etc.**

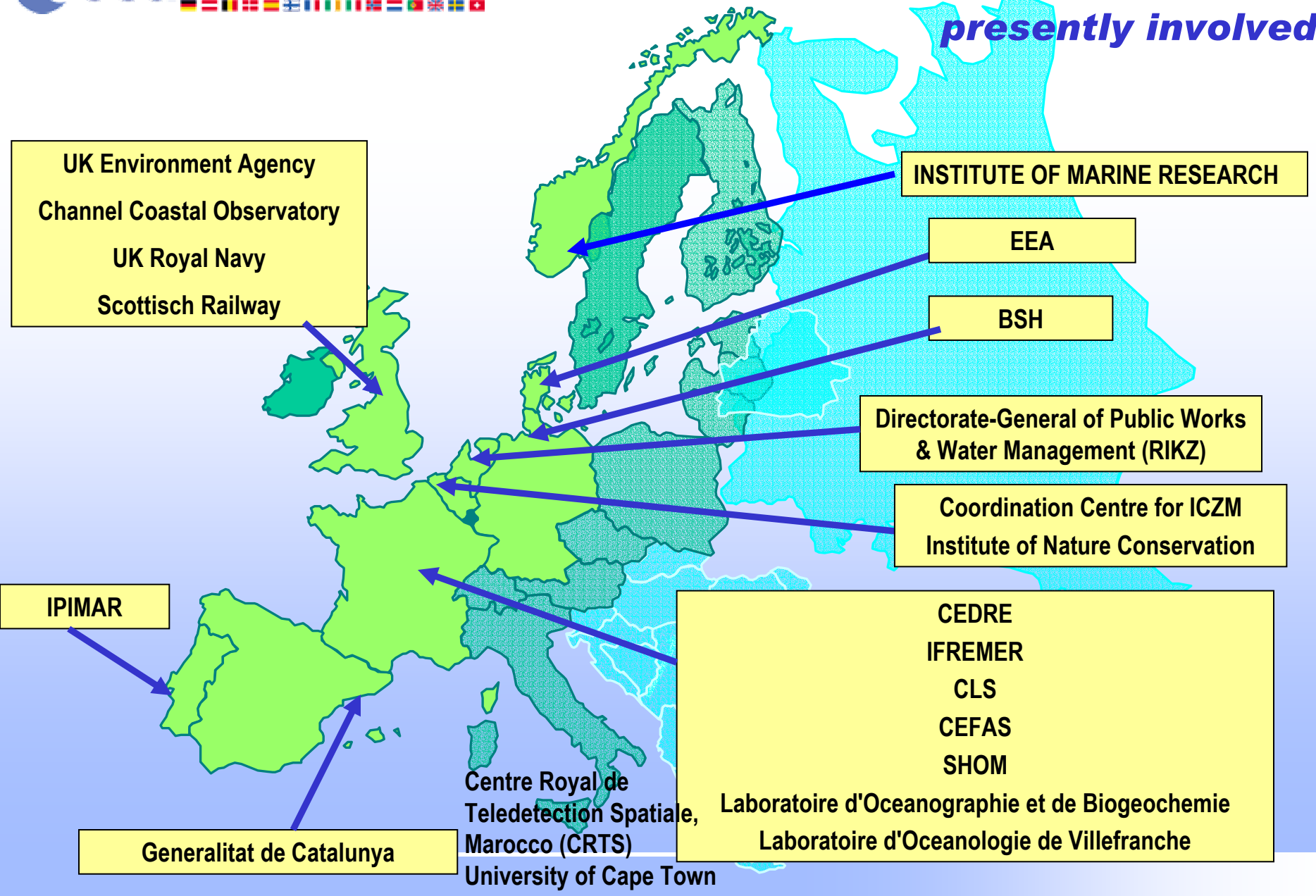
COASTWATCH - 7 service providers delivering 4 key services



*Coastal flooding service not continued after phase1; service does not meet user needs (BRGM)

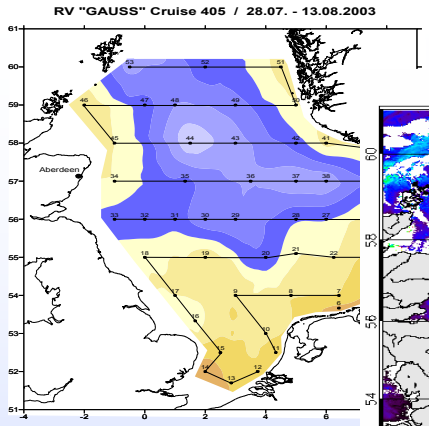
Coastal Hydrodynamic Service
Coastal LC/LU change mapping
Water Quality Monitoring
Coastal Indicator Service

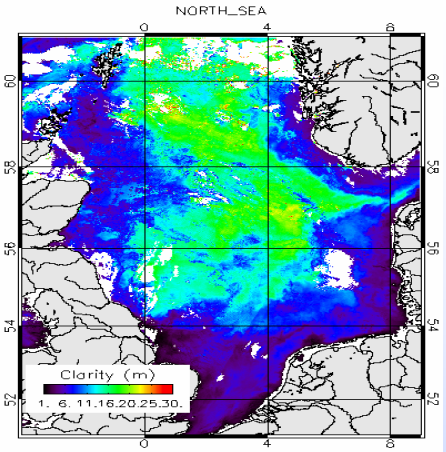
21 marine & coastal users presently involved



Service examples (1)

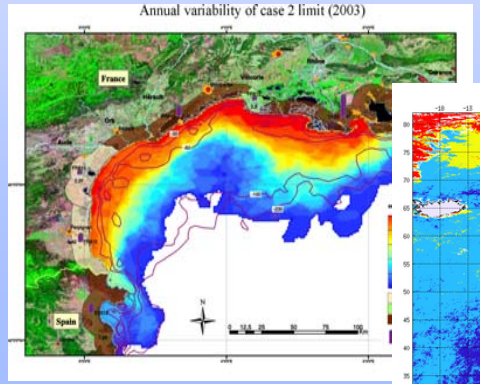
Water quality monitoring
Service Provider: ACRI

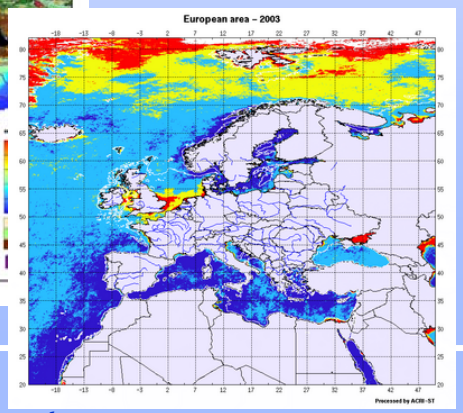




Transparency maps

User: BSH : Ship time reduced by 40%

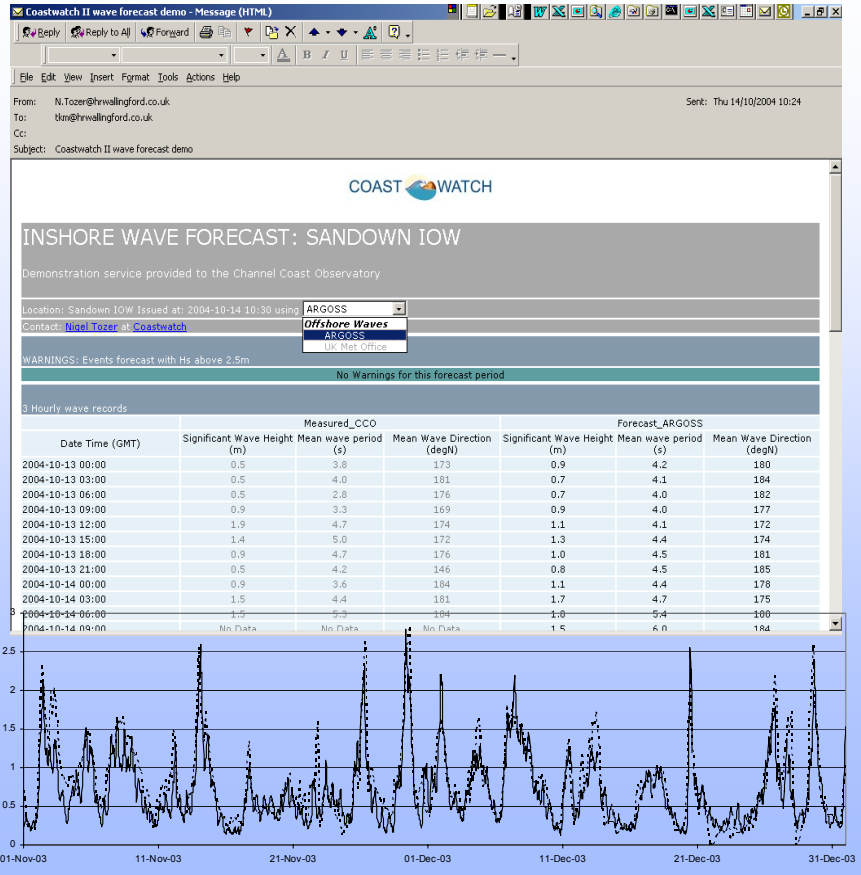




Turbid water index

User: EEA: European state and outlook report 2005

Hydrodynamic Service
Service Providers:ARGOSS/HRW
Users:UK Channel Coastal Observatory, Delft Hydraulics; ScotRail



Wind, wave, sea level real time, forecast, statistics

Service examples (2)

ICZM Indicator Service

Service Provider: ETC/TE

Users: EEA; Generalitat de Catalonia

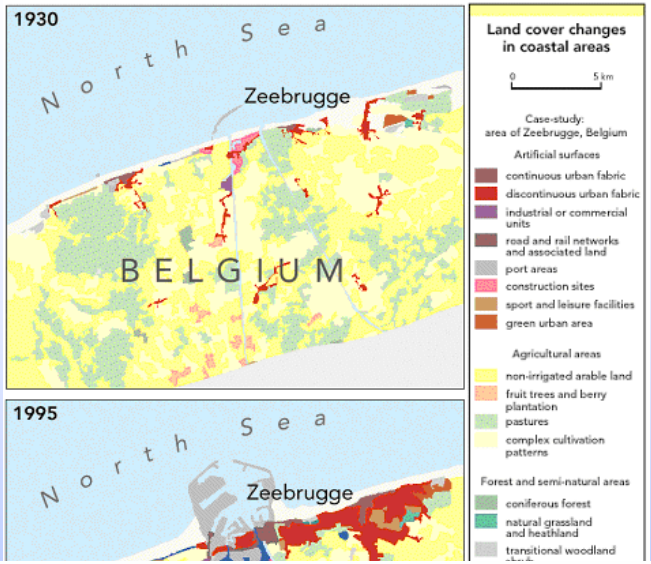
Coastal Indicators:

- Land take by built-up
- Built-up in distance to the coast
- Dominant landscape type
- Compact and diffuse sprawl
- Rate of development
- Percentage of coast protected by NATURA
- Potential conflict urban development/ Natura protection
- Erosion patterns
- Loss of natural & semi-natural areas

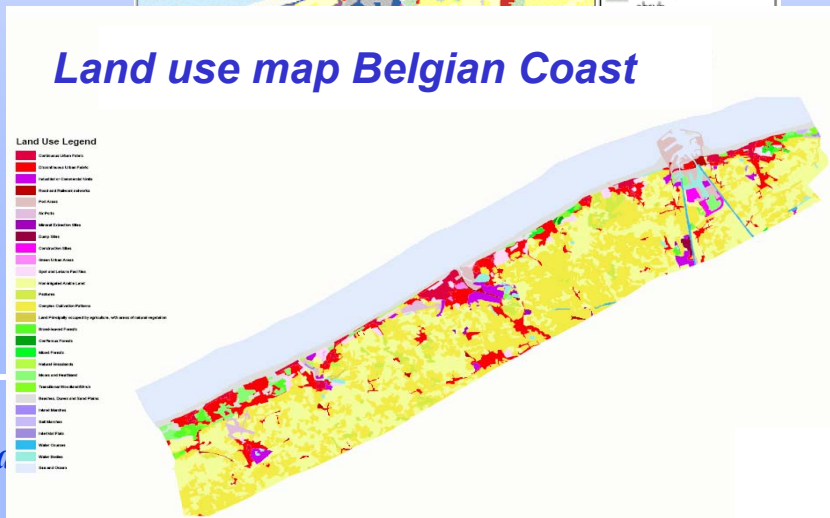
Coastal land mapping service

Service Provider: GIM (B)

User: EEA, Coordination Center for ICZM, Institute for Nature Conservation



Land use map Belgian Coast

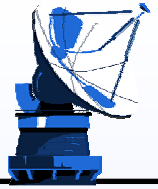


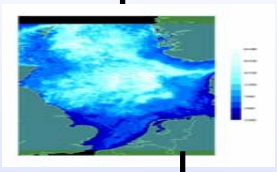
Supply chain structure

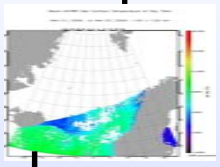
Water Quality Service

Hydrodynamic Service

Ocean Colour / SST data
MERIS
MODIS
SeaWifs
AVHRR
(A)ATSR





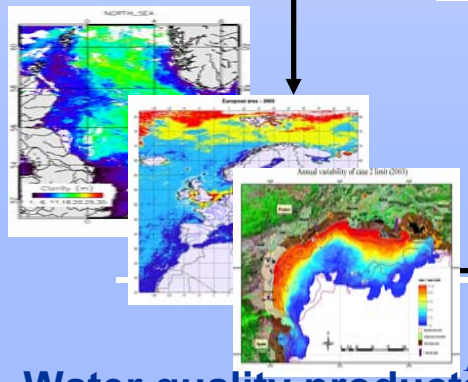


Off-line processing

NRT processing

Validation Bureau
Product & Service qualification

In-situ data



BSH
IFREMER
SHOM
RIKZ
EEA
IMR
et al.

Water quality products: chla, SST, transparency

SAR data
RA data

Radar altimeter significant wave height & wind speed

Scatterometer wind data

SAR/model wave spectra

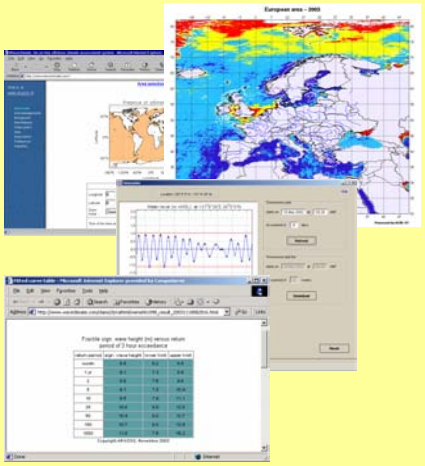
Buoy wave spectra and wind

- **Hindcast wave spectra & wind**
- **Wave climate statistics**
- **Forecast erosion damage**

Channel Coast Observatory
ScotRail
Consultants

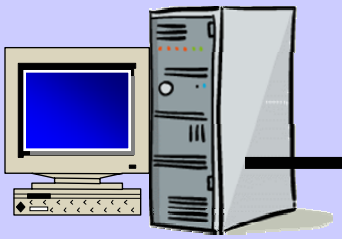
Supply chain structure (cont.)

EO Data
- Landsat
- Spot 4-5
- ASTER
- Ikonos
- QuickBird



Non-EO Data
- GISCO (Eurostat)
- NATURA2000 ETC
- Eurosion (DG-ENV)
- CLC (ETC)
- Lacoast (JRC)

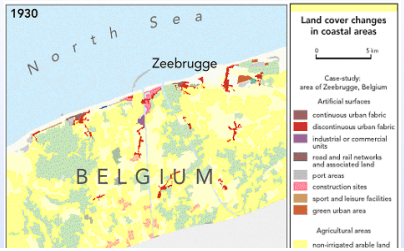
Processing



ArcInfo
ArcView
TERRIS

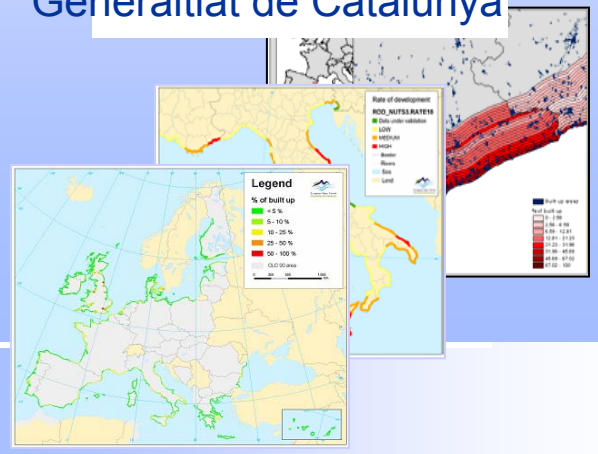
Coastal land mapping service

Users:
- EEA;
- Institute for Nature Conservation;
- Coordination Center for ICZM



ICZM Indicator Service

Users:
- EEA;
- Generaltiat de Catalunya



Core Users Executive Summary

Water quality service

- ***Positive aspects***
  - ***Uniformity and standardization of the products***
  - ***European scale coverage***
  - ***NRT availability of the geophysical parameters***
- ***Negative aspects***
  - ***In some areas accuracy of Case2 water products not yet adequate***
  - ***Regionally tuned algorithms not yet available; need to be developed***
  - ***Geophysical parameters not linked to hydrodynamic models***
  - ***Operational availability of MERIS full resolution data not yet adequate***

ICZM Indicator service

- ***Positive aspects***
  - ***Indicators available for the whole European coastline***
  - ***Harmonised data sets enabling similar analysis and comparison between different locations***
  - ***Important input for the future DG ENV reports regarding coastal areas***
- ***Negative aspects:***
  - ***Validation of the indicators is essential; more rigorous quality checks required***
  - ***Indicators for regional aspects to coarse in spatial resolution; regional scale products need to be developed with same methodology but higher resolution***
  - ***Better integration of socio-economic, biological and environmental data needed***

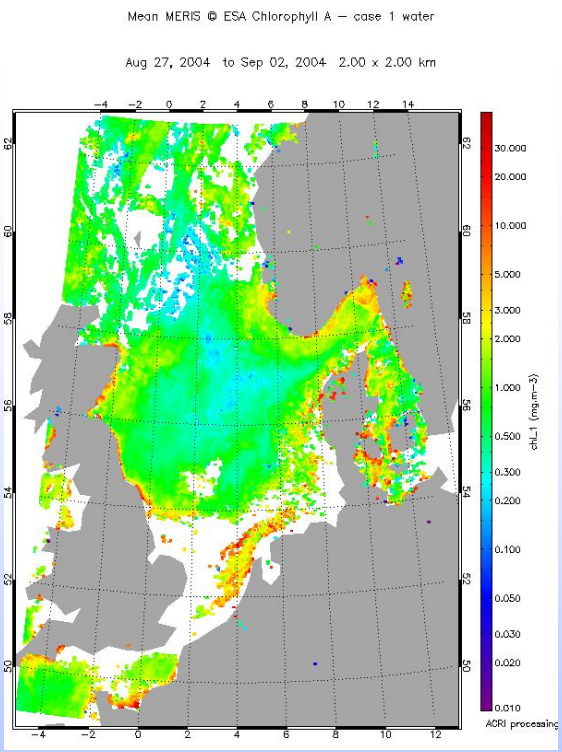
Benefits

- **Cost savings: more information at lower cost**
  - **Reduce survey and monitoring cost or water quality:**
    from "purely ship observation" to "EO data & ship observation"
  - **Increase frequency of observations (through EO) and focus on sensitive areas**
  - **Optimize cruise campaigns and in situ measurement networks:**
    less ship time, less personnel, less buys, less maintenance, less laboratory analysis
  - **Avoid costs of damages and reduce extreme event losses:**
    erosion - storm – flooding - land slides - pollution - algae blooms
  - **Cost efficient monitoring of environmental issues through indicators (harmonized):**
    better land planning, identification of environmental hot spots & high risk areas
- **Environmental benefits**
  - **Reduced coastal degradation through appropriate coastal protection measures**
  - **Preserve high economic value of coastal zones (aquaculture, tourism):**
    Lower cost for beach cleaning and nourishment operations
  - **Coastal habitat preservation**
- **Policy benefits**
  - **More efficient decision tools for policy regulation and assessment in the EU25 countries committed to the WFD and ICZM implementation**
  - **Support the implementation of these policies at European, national &regional levels**

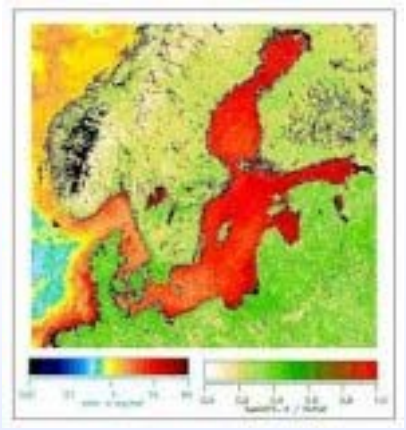
ESA GMES sevice elements: COASTWATCH & ROSES

- **Coastwatch WFD services:**
  - **Sea surface temperature,**
  - **Suspended particulate matters, Water transparency,**
  - **Chlorophyll-a concentration, Primary production, Photo-synthetically available radiation**
- **Wave exposure monitoring service:**
  - **near real-time sea state information, mainly significant wave height and wind speed.**
  - **climatologic statistics of waves: significant wave height, mean period and zero-crossing period and mean direction**
- **Coastal Indicators for**
  - **Landscape fragmentation**
  - **Pressure on biodiversity, Habitat destruction**
  - **Urbanisation and land use conflicts**
- **Oil spill monitoring**
- **Algal Bloom monitoring**

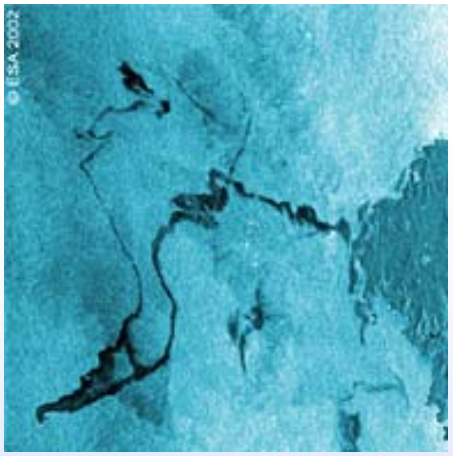
Coastwatch & ROSES Products



Chlorophyll map North Sea

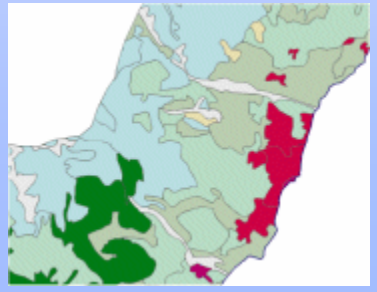


Transparency

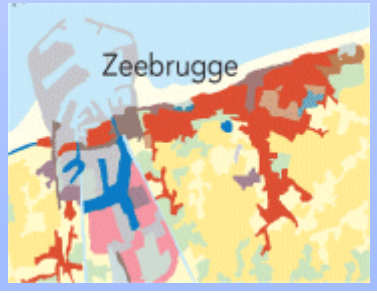


Oil spill monitoring

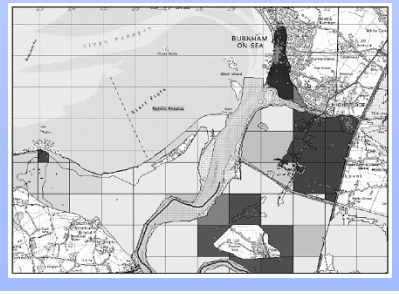
waves



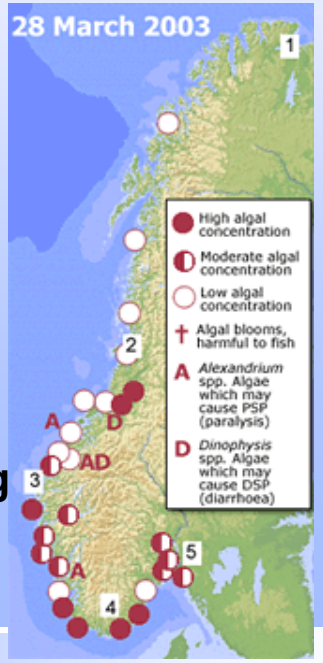
Coastal habitat



Land use change



Flooding risk



Algal bloom monitoring

Requirements: the GOOS perspective

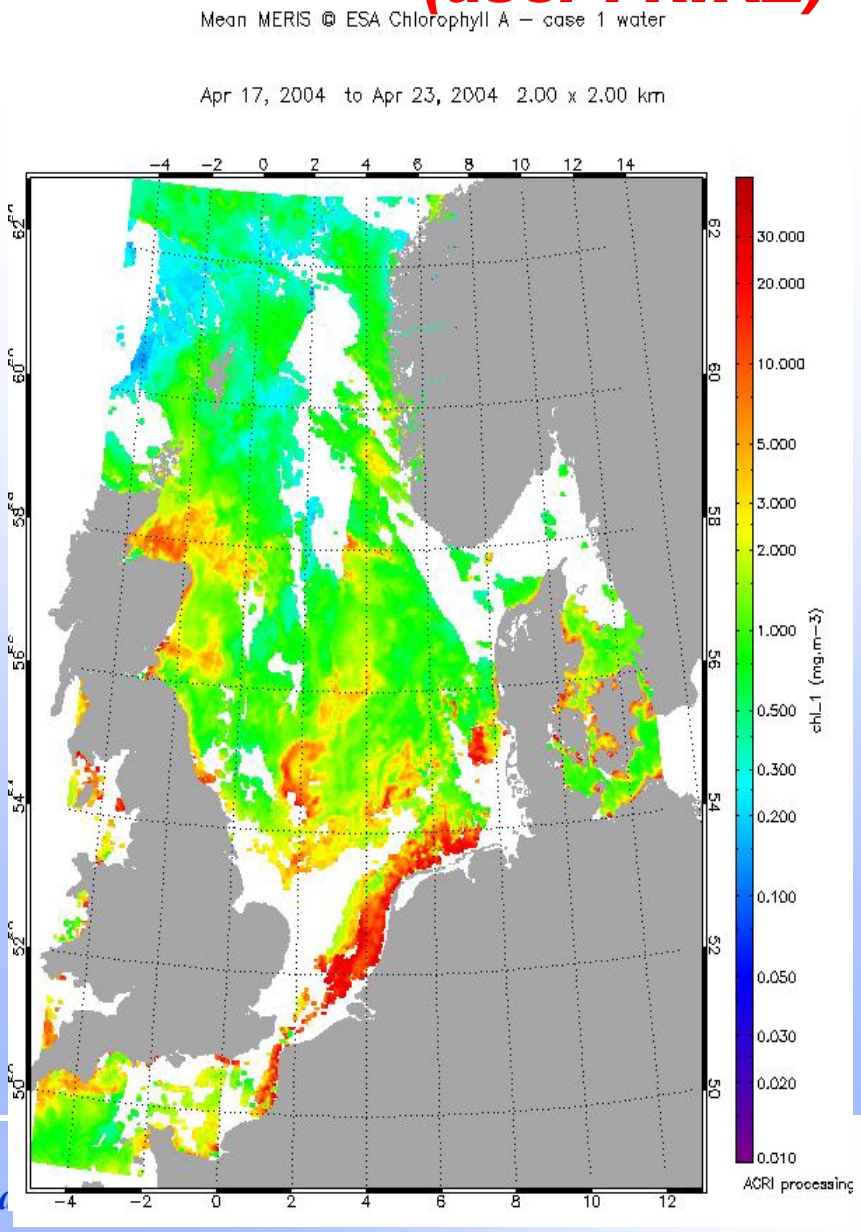
- Safety and efficiency of marine operations
- Control and mitigate the effects of natural hazards
- Detect and predict the effects of climate change
- Reduce public health risks
- Protect and restore healthy ecosystems
- Restore and sustain living marine resources

Common variables to be monitored, selected by GOOS

Variable	RS	indirect	remark
Sea level	+		
Water temperature	+		SST
Salinity	o		future
Currents	+		
Surface waves	+		
Oxygen		+	phytoplankton, turbidity, depth
Inorganic nutrients		o	phytoplankton
Attenuation solar radiation	+		
Bathymetry	o		Optical /radar
Shore line position	+		
Sediment size / organic content	o	o	SPM, eulithoral
Benthic biomass	o		Eulithoral, partly
Phytoplankton biomass	+		
Faecal indicators	-		

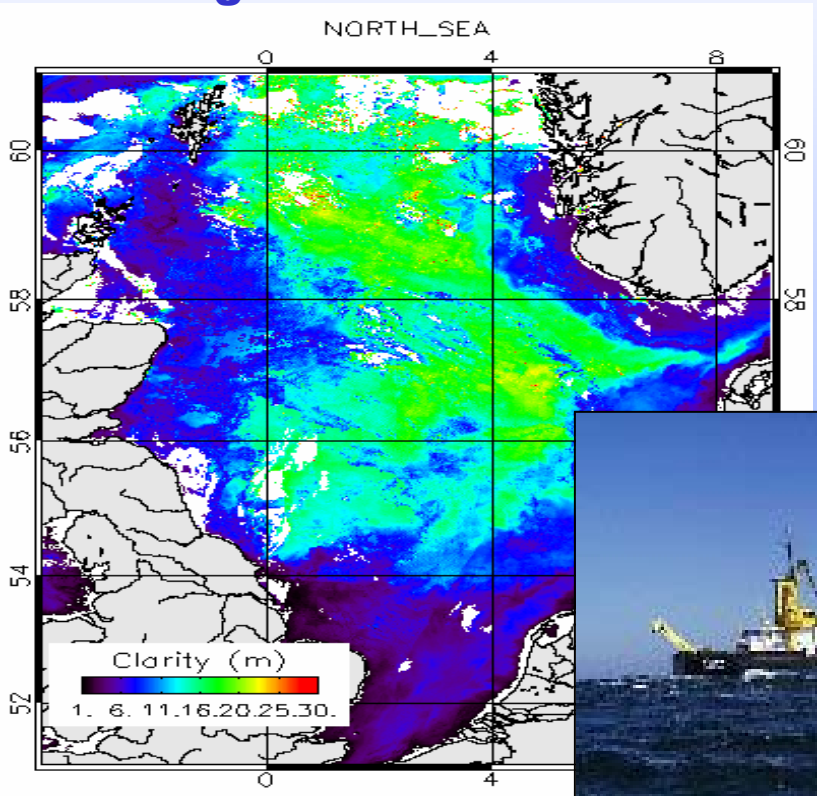
Success : Algae bloom monitoring (user : RIKZ)

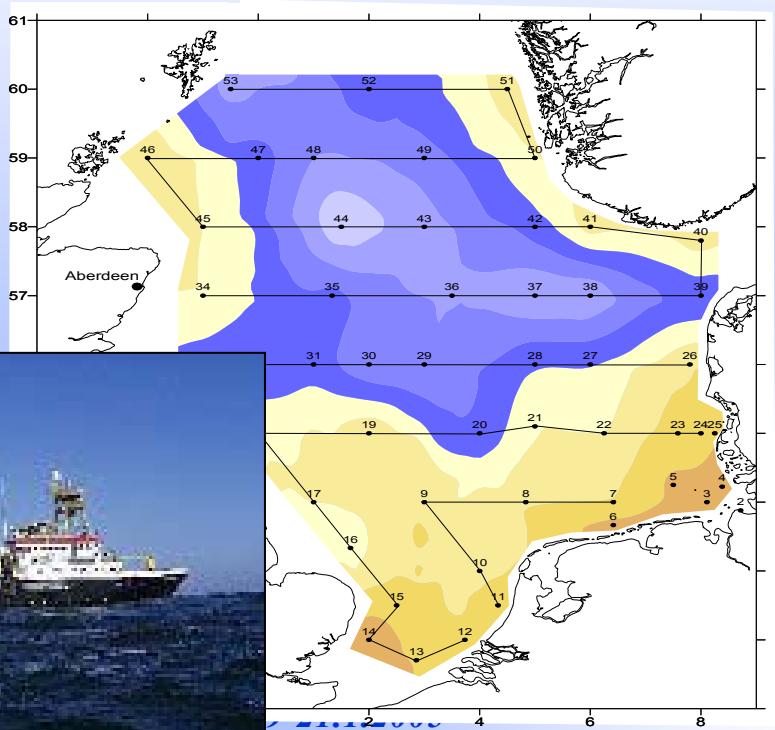
- **In 2002 about 200 M€ loss of mussel cultures in the River Scheldt area.**
- **Predicting of risk based on EO-Chlorophyll and wave data.**
- **Decision support for closing dams to keep Harmful algae blooms outside the estuary.**



Success : Water transparency monitoring (user : BSH)

- **Coastwatch supported the GAUSS campaign for surveillance monitoring for WFD compliance.**
- **Coastwatch transparency maps (from MERIS) compared well to insitu measurements and gave confidence in EO derived products.**
- **Ship time reduction of 40% through optimised cruise planning results in cost reduction in the order of 10% of the overall monitoring cost**

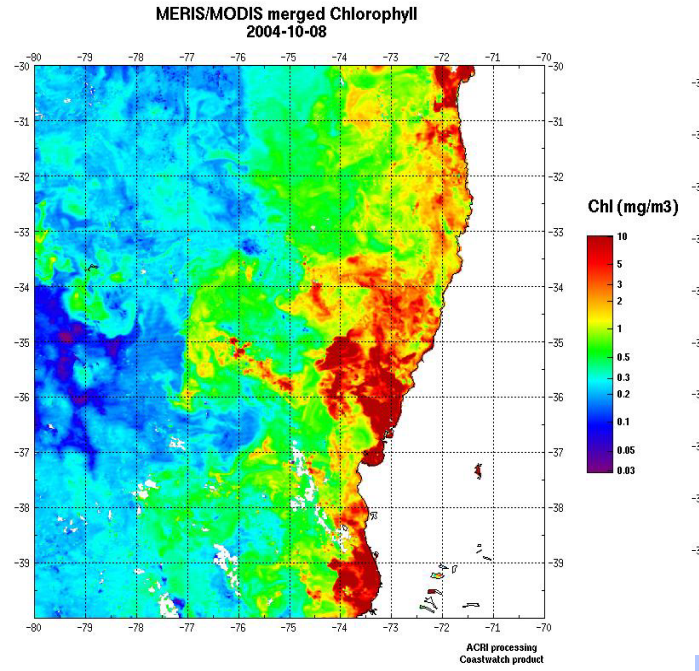


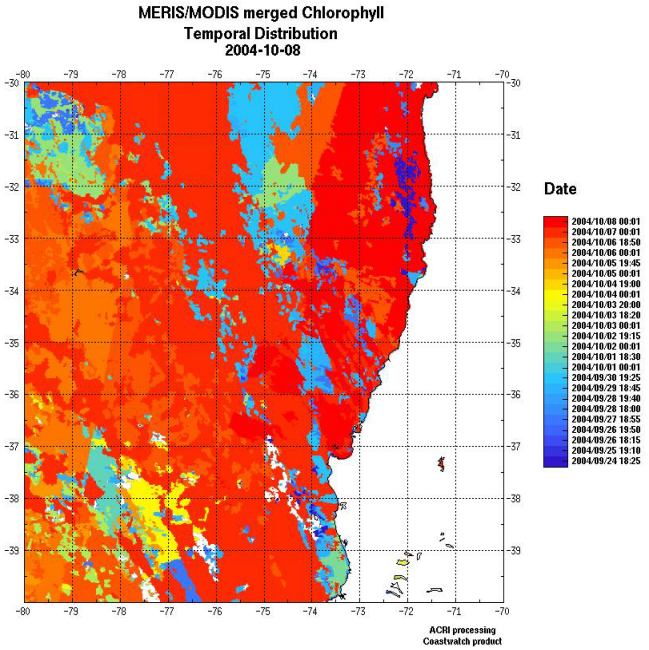


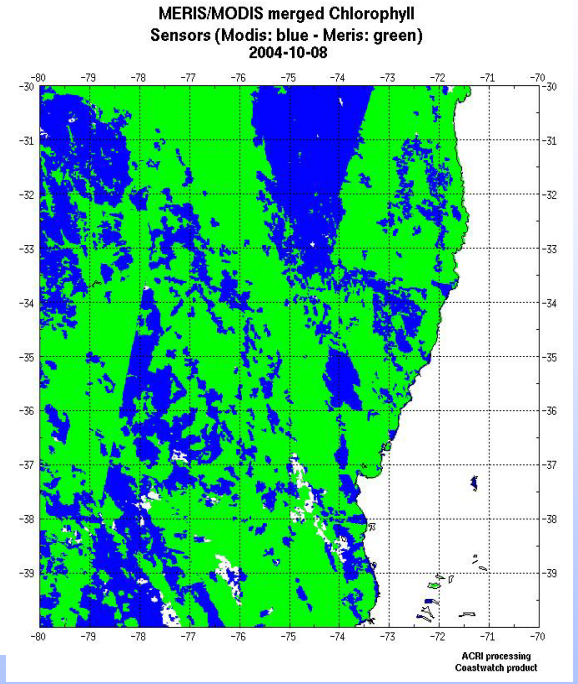
VIRI Requirements distillation

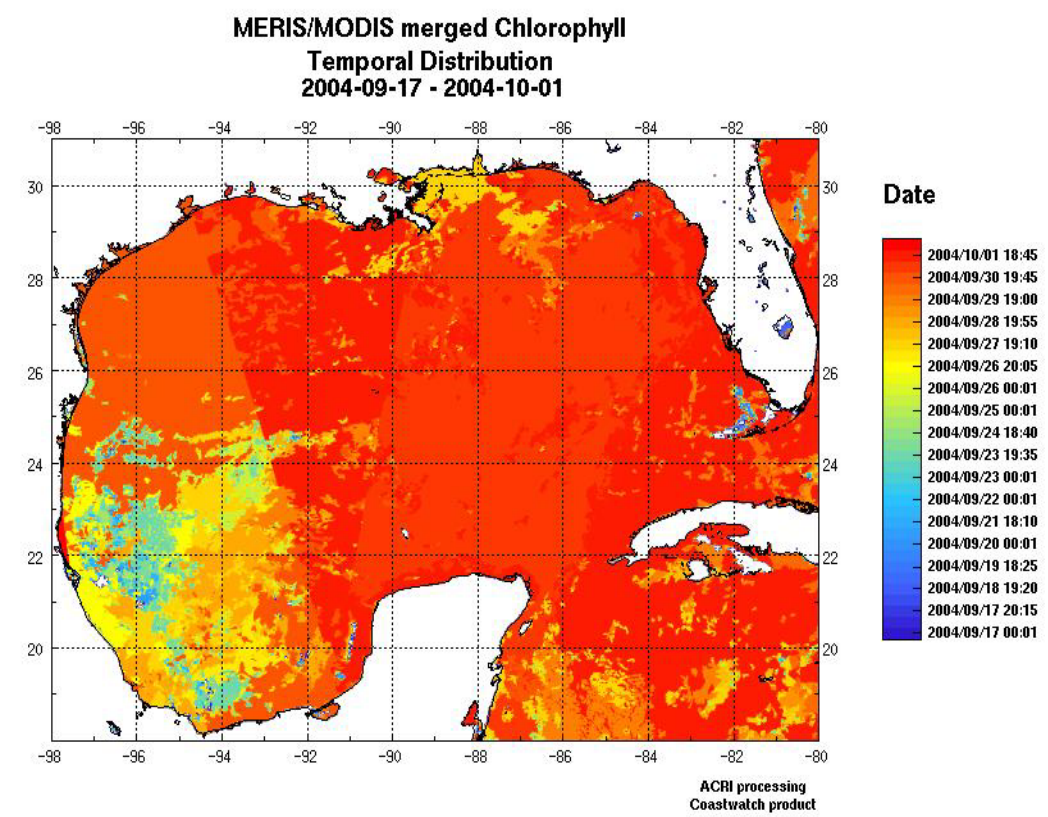
Eumetsat	Alcatel			Astrium			Earth Watch	GMES	Sentinel-3		
Priority	Priority	Centre wavelength (μm)	Band-width (nm)	Priority	Centre wavelength (μm)	Application	Centre wavelength (μm)	Band- width (nm)	MERIS AVHRR ATSR, VIIRS compatibility	IOCCG Report 1 /Report3	SPOT Vegetation band
		0.38	10			C2					
		0.412	10		0.412	Yellow matter	**0.4125**	**10**	M1/VII1	Max	
P5	Minimum	0.443	20	Minimum	0.440	C1, K and Vegetation Atmos correction	**0.4425**	**10**	M2/VII2	Max	0.43 – 0.47
	Minimum	0.49	10	Minimum	0.490	C1, C2, K	**0.490**	**10**	M3/VII3	Min	
	Minimum	0.510	10			C2, S2, Turbidity	**0.510**	**10**	M4		
	Minimum	0.560	10-20	Minimum	0.554	C1, S	**0.560**	**10**	M5/AV1/AT1/VII 4	Min	
		0.570				Turbidity					
					0.620	S2, C1 reference band, Y2	**0.620**	**10**	M6		
P1	Minimum	0.665	10-20	Minimum	0.670	C1, S, Y2 Vegetation	**0.665**	**10**	M7/AT2/VII5		0.61-0.68
		0.681				Chl Fluorescence peak , red edge	**0.68125**	**7.5**	M8		
		0.709		Ok	0.708	C2, Fluorescence baseline	**0.70875**	**10**	M9	Max	
	Metop	0.730				Vegetation					
P4	Metop	0.750	10	Minimum	0.750	O2 absorb ref./Atmos correct/Ocean	**0.75375**	**7.5**	M10/VII6	Min	
P4	Metop	0.763	0.5			O2 absorpt./Aerosols/ Ocean	**0.76063**	**3.75**	M11		
						Aerosols/Vegetation	**0.77875**	**15**	M12		
P1	Minimum	0.870	20	Open Sea	0.877	Atmos correction. Vegetation	**0.865**	**20**	M13/AV2/AT3/ VII7	Min	0.78-0.89
						Water vapour absorption ref.	**0.885**	**10**	M14		
							0.900	**10**	M15		
	Metop	1.03	20			Vegetation					
	Metop	1.245	50			Vegetation water			VII8		
P2			30	Ok	1.375	Cirrus over land, water vapour	**1.375**	**30**	VII9		
P1	Minimum	1.620	60	Min	1.610	Cloud phase, water content of canopy, snow/ice	**1.610**	**60**	AV3a/AT4/VII10		1.58-1.75
P6	Metop	2.200	80	Ok	2.250	Vegetation water content			VII11		
P1		3.7		Mln	3.700	Cloud temp. / particles/SST	**3.7**	**400**	AV3b/AT5/VII12		
P2				Ok	6.700	Water vapour					
P2		8.7		Ok	8.558	Night time cirrus detection			VII14		
P1		10.9		Mln	10.850	Temp/Night cloud mapping	**10.85**	**900**	AV4/AT6/VII15		
P1		12.0		Min	12.000	Temp	**12.0**	**1000**	AV5/AT7/VII16		
P2				Ok	13.400	Seviri band CO2 absorption					

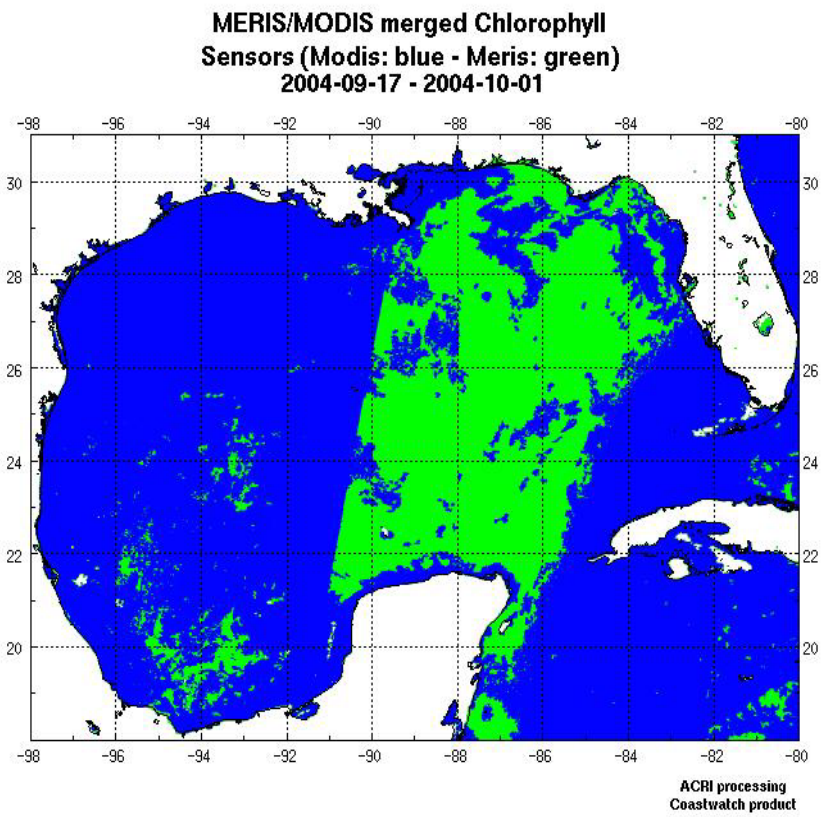
Baseline

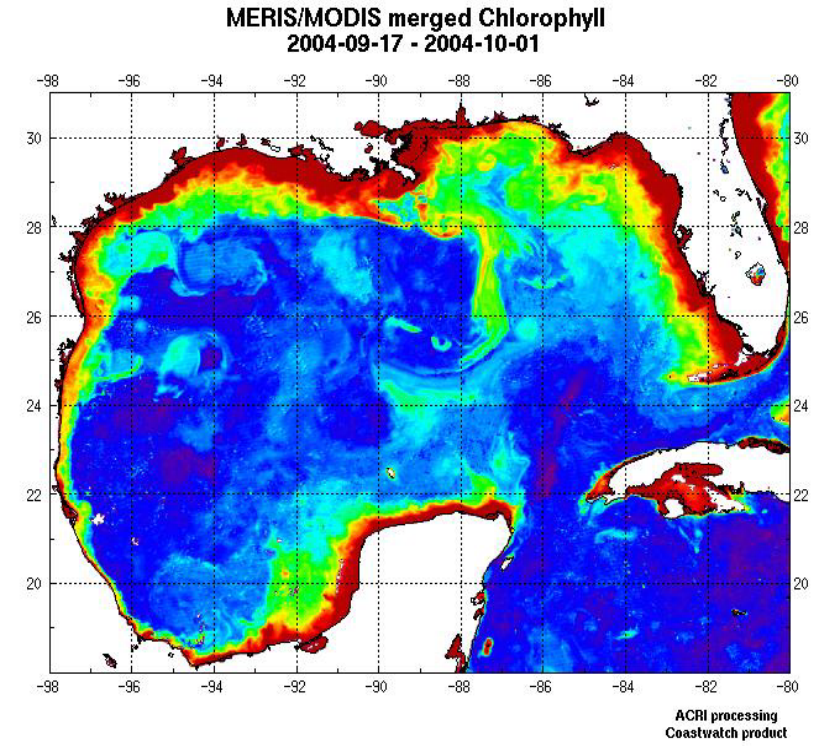

MERIS/MODIS merged Chlorophyll
2004-10-08
Chl (mg/m3)
10
5
3
2
1
0.5
0.3
0.2
0.1
0.05
0.03
ACRI processing
Coastwatch product

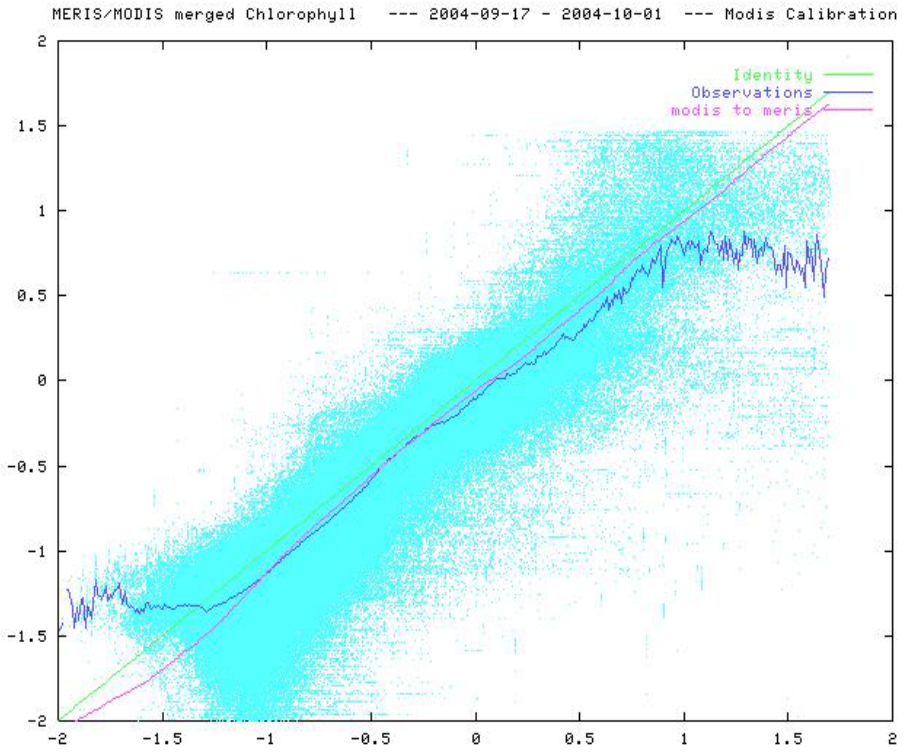

MERIS/MODIS merged Chlorophyll
Temporal Distribution
2004-10-08
Date
2004/10/08 00:01
2004/10/07 00:01
2004/10/06 18:50
2004/10/06 00:01
2004/10/05 19:45
2004/10/05 00:01
2004/10/04 19:00
2004/10/04 00:01
2004/10/03 20:00
2004/10/03 18:20
2004/10/03 00:01
2004/10/02 19:15
2004/10/02 00:01
2004/10/01 18:30
2004/10/01 00:01
2004/09/30 19:25
2004/09/29 18:45
2004/09/28 19:40
2004/09/28 18:00
2004/09/27 18:55
2004/09/26 19:50
2004/09/26 18:15
2004/09/25 19:10
2004/09/24 18:25
ACRI processing
Coastwatch product


MERIS/MODIS merged Chlorophyll
Sensors (Modis: blue - Meris: green)
2004-10-08
ACRI processing
Coastwatch product


MERIS/MODIS merged Chlorophyll
Temporal Distribution
2004-09-17 - 2004-10-01
Date
2004/10/01 18:45
2004/09/30 19:45
2004/09/29 19:00
2004/09/28 19:55
2004/09/27 19:10
2004/09/26 20:05
2004/09/26 00:01
2004/09/25 00:01
2004/09/24 18:40
2004/09/23 19:35
2004/09/23 00:01
2004/09/22 00:01
2004/09/21 18:10
2004/09/20 00:01
2004/09/19 18:25
2004/09/18 19:20
2004/09/17 20:15
2004/09/17 00:01
ACRI processing
Coastwatch product


MERIS/MODIS merged Chlorophyll
Sensors (Modis: blue - Meris: green)
2004-09-17 - 2004-10-01
ACRI processing
Coastwatch product


MERIS/MODIS merged Chlorophyll
2004-09-17 - 2004-10-01
-98 -96 -94 -92 -90 -88 -86 -84 -82 -80
30 28 26 24 22 20
Chl (mg/m3)
3 2 1 0.5 0.3 0.2 0.1 0.05 0.03
ACRI processing
Coastwatch product


MERIS/MODIS merged Chlorophyll --- 2004-09-17 - 2004-10-01 --- Modis Calibration
Identity
Observations
modis to meris
2 1.5 1 0.5 0 -0.5 -1 -1.5 -2
-2 -1.5 -1 -0.5 0 0.5 1 1.5 2

The DUE GlobCOLOUR Project

Technical Officer: Simon Pinnock, ESA/ESRIN, Frascati, Italy (simon.pinnock@esa.int)

Objectives

1. to provide a long time-series ocean-colour data set for research on the marine component of the global carbon cycle

2. to demonstrate the current state of the art in merging together data streams from different satellite based ocean-colour sensors

3. to put in place the capacity to continue production of this time series in the future

User: IOCCG – point of contact is Trevor Platt (letter of commitment signed 1 Dec 04)

Budget: M€ 1.0 - contract to be awarded through an open competitive invitation to tender

Schedule	URD delivery by IOCCG	Q1 2005
	ITT issue by ESA	Q2 2005
	Project kick-off	Q3 2005

Duration 24-36 months

Which other E.O.based OC activities should GlobCOLOUR be coordinated with

Helpful ESA Websites to remember

http://eoli.esa.int	Multi-Mission catalogue for ESA supported missions	•Access to ESA EO data catalogues
http://envisat.esa.int	Envisat web site	•General information about the Envisat mission •Products handbook / ATBD •Tools (BEAM) •Sample products •News
http://eopi.esa.int	Principal Investigator Web site	•Submit a Cat 1 Proposal •Latest results from PI projects
http://earth.esa.int/services/esa_doc	Documentation Library	•All documents relevant for ESA EO missions and Instruments
http://pfd-ns-es.esrin.esa.int	Rolling Archive	•Download Last 7 days of date for: ASAR, AATSR, MERIS
http://ewfs.esrin.esa.int	Web File Selector	•Download selected MERIS scenes from 7 days rolling archive
http://www.enviport.org/meris/	Level 3 products	•Download AATSR and MERIS L3 demonstration products

For any question you may have please contact eohelp@esa.int