# An understanding biological variability in the open ocean (GlobCOLOUR project)


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ESA Observation Summer School (4-14 August 2008)

# GlobCOLOUR: objectives

§ Satisfy emerging demand for validated merged ocean colour derived information

§ Demonstrate the current state of the art in merging together data streams from different ocean-colour sensors: MERIS (ESA), MODIS-Aqua (NASA) and SeaWiFS (GeoEye/NASA)

§ Provide a long time-series (10 years) of ocean-colour information

§ Demonstrate a global NRT ocean-colour service based on merged satellite data

§ Put in place the capacity to continue production of such time series in the future and to prepare for full exploitation of Sentinel 3 (ESA)

# Consortium

| | |
|---|---|
| ACRI-ST (France) | Prime contractor / management<br>Processor / Production |
| University of Plymouth (UK) | User requirements follow up/<br>design justification / merging |
| ARGANS Ltd (UK) | New products / Evolution /merging |
| NIVA (Norway) | Validation (DDS) |
| Brockman Consult (Germany) | Tools development<br>Web server |
| ICESS (USA), DLR (Germany) & LOV (France) | Scientific support |

# GlobCOLOUR
# DUE project – 3 years - 3 phases

Phase 1 (2006) : Demonstration of feasibility

Phase 2 (2007) : Generation and validation of 10 year time series

Phase 3 (2008) : Daily delivery of global merged ocean colour products

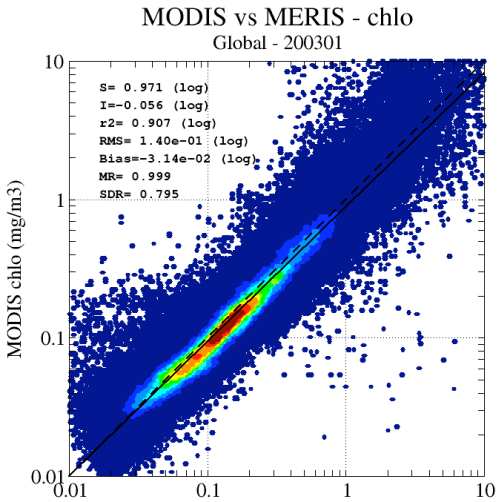
## Why merge?

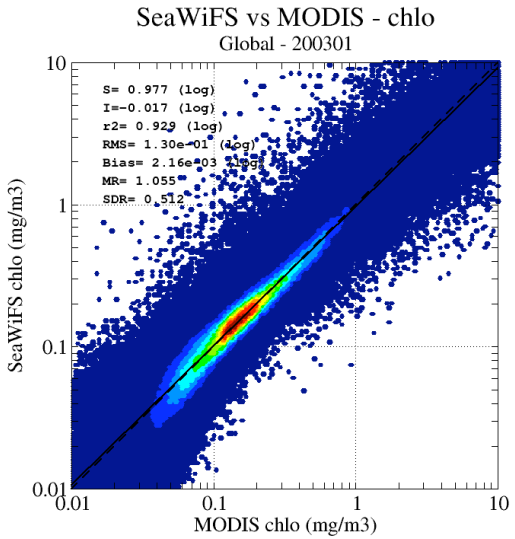
-The combination of two sensors increases the global ocean coverage to 20-25% per day, and to 30% per day with the combination of three sensors (IOCCG, 1999).

- Individual satellite sensors have a finite lifetime

# Difficulties

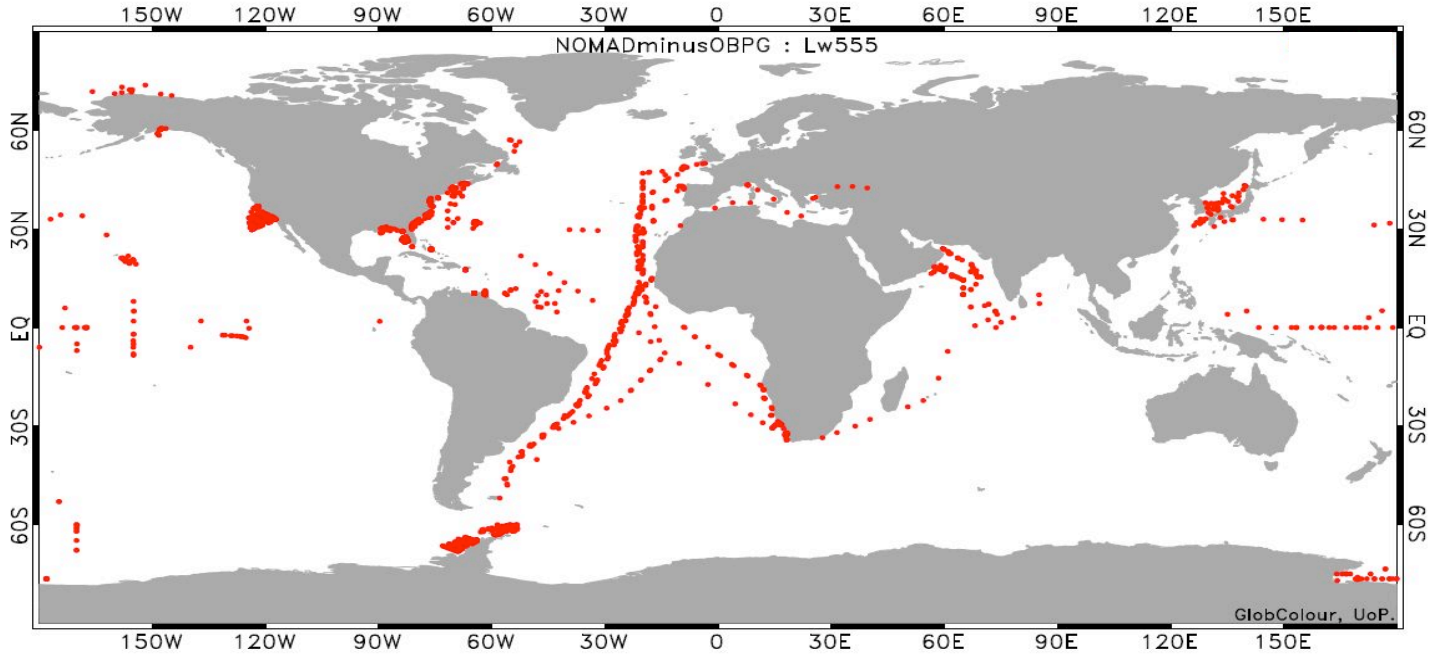
- Sensors are not created equal: different designs, calibrations, algorithms, accuracies….
- Large volumes of data to deal with: more than 25 Tb of level 2 input data, 14 Tb of intermediate and output products and 4.5 Tb of distributed data.
- Merging procedure should not create biases, discontinuities, artifacts…



# Phase 1 (2006): Demonstration of feasibility

§Sensor characterisation (continued in Phase 2)




For validation / characterisation: DDS (Diagnostic Data Set)

Data Courtesy

SeaPRISM [Giuseppe Zibordi, Brent Holben, Doug Vandemark]

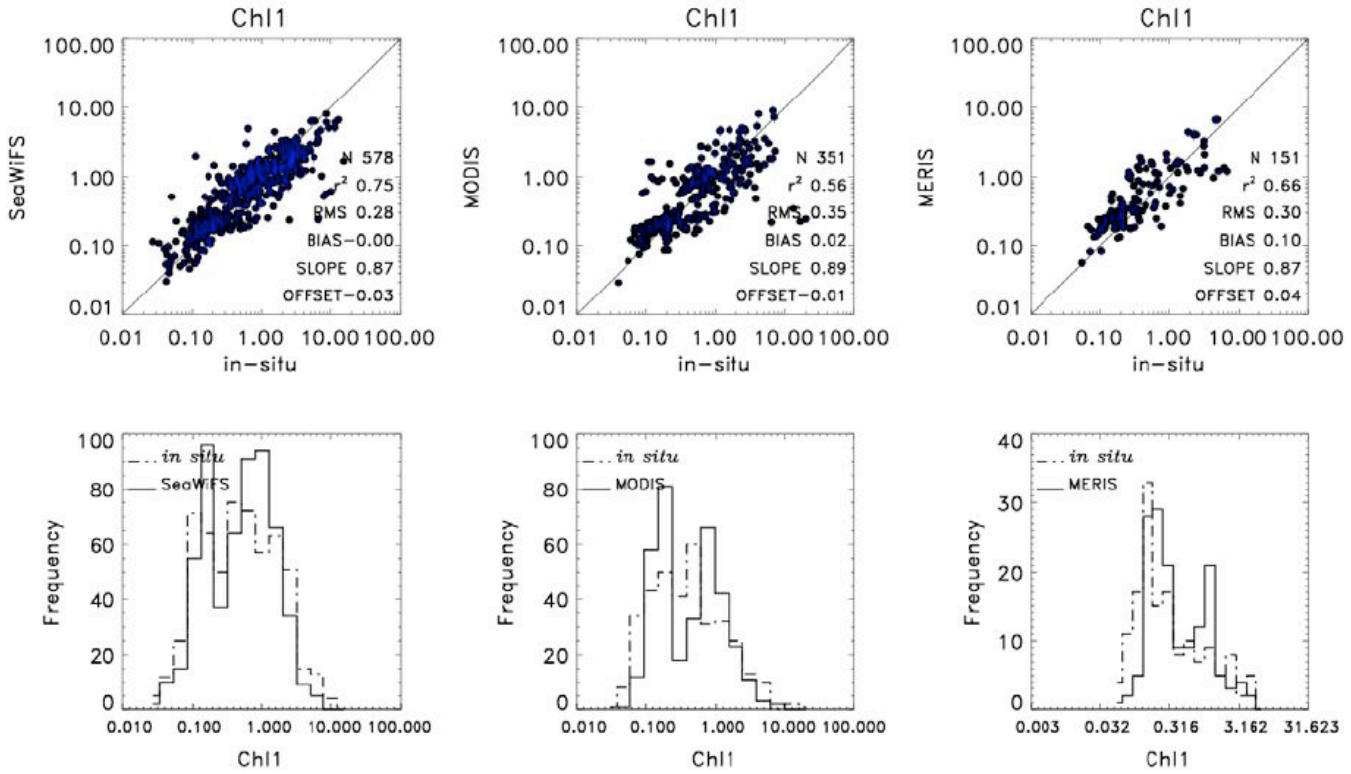
# Validation of satellite imagery using research cruises: AMT13

# Not so nice a day….

# Types of instruments/measurements….

# Phase 1 (2006): Demonstration of feasibility

## §Sensor characterisation (continued in Phase 2)




Achievement: Statistical uncertainties have been derived and are used within the merging process

# Phase 1 (2006): Demonstration of feasibility

## Developing the system

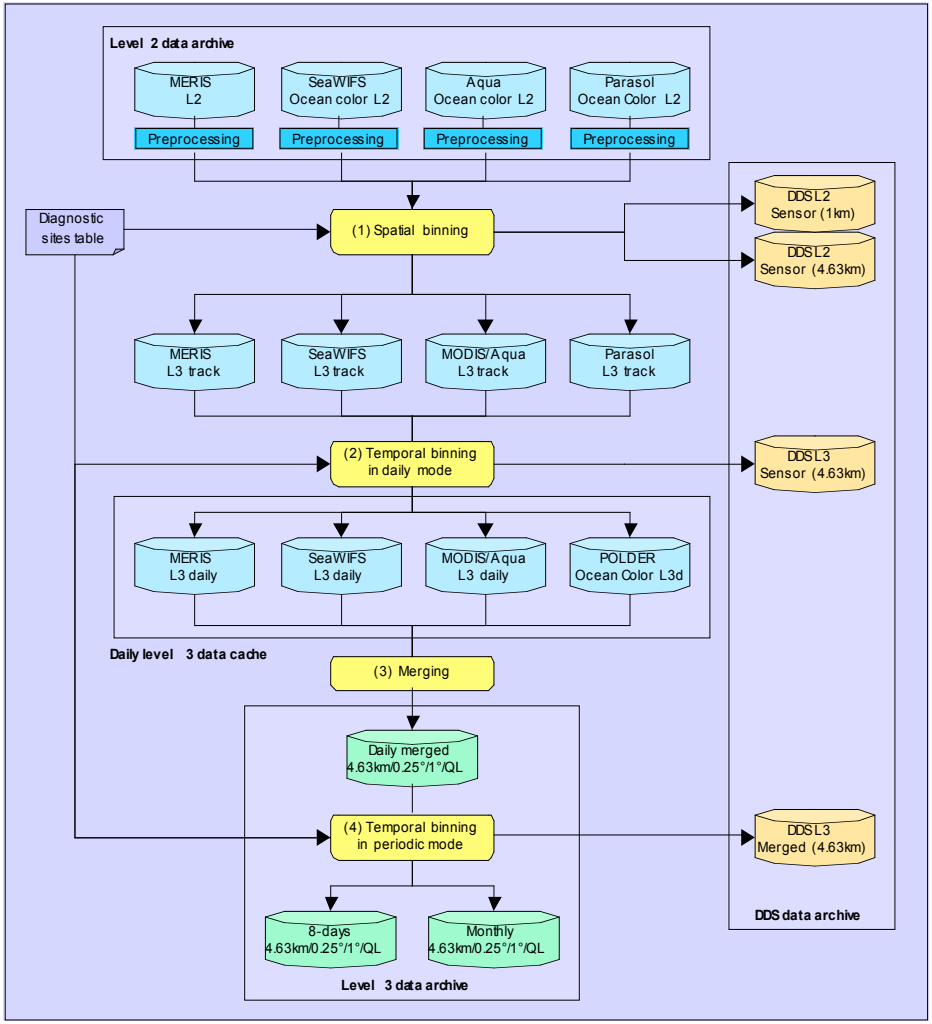
§ Globcolour processor

Main modules:

- Ø Data acquisition
- Ø Pre-processing
- Ø Spatial binning
- Ø Temporal binning
- Ø Merging
- Ø QC

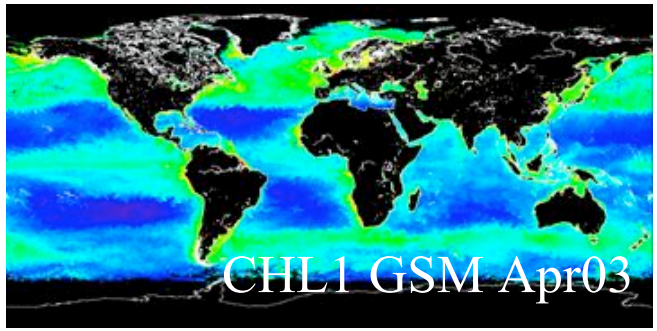
End 2006: System is ready for systematic production

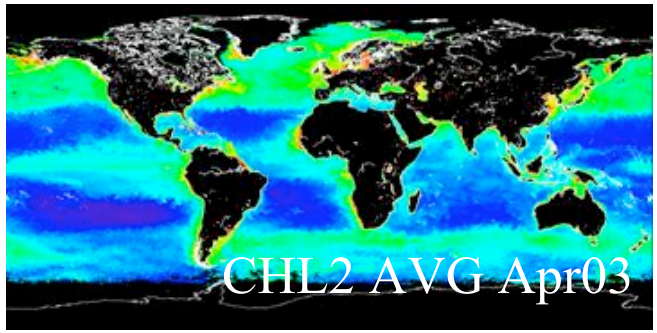
2007/8: Move into post-processing and then real-time processing



# Phase 1 (2006): Demonstration of feasibility

## Merging recommendations:



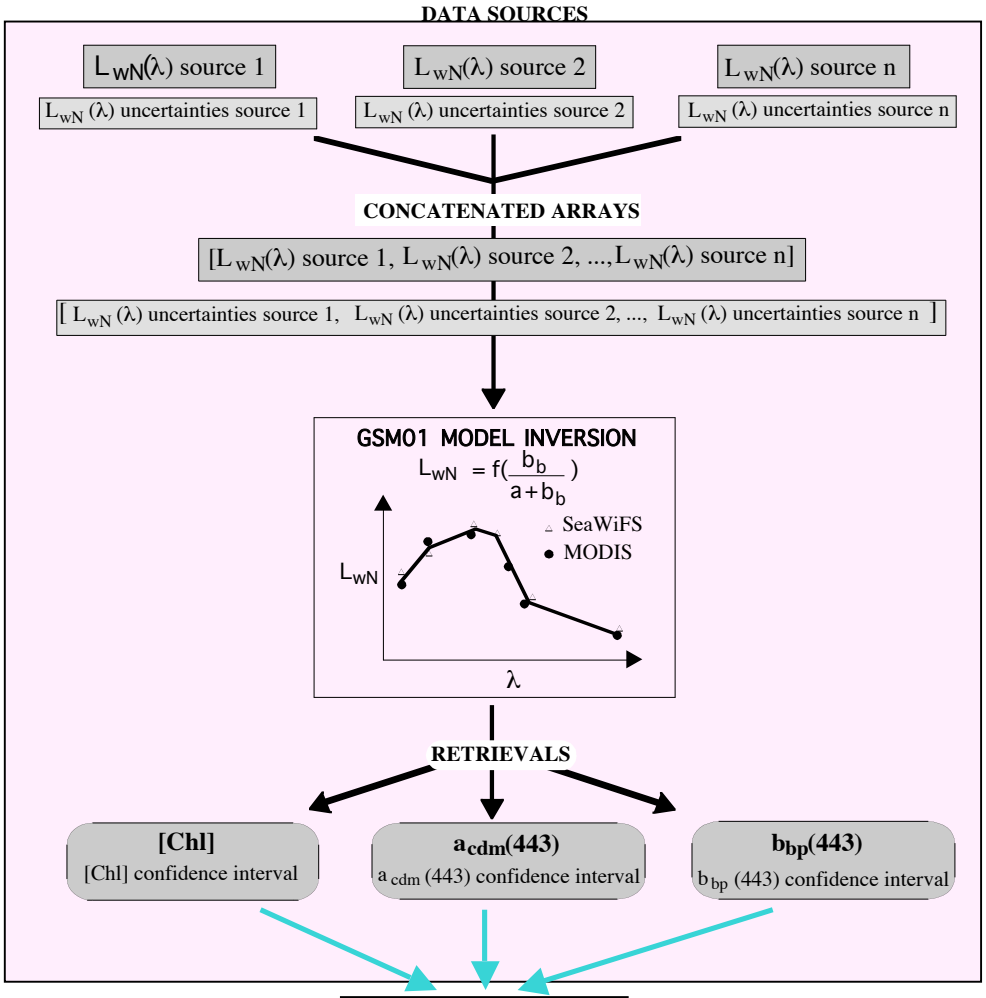




Normalized water-leaving radiances:
- Statistics are slightly better when using the weighted average than the simple average
- Use of the weighted average for the nLw's

Chlorophyll:
- GSM01 provides the best fit to *in situ* chlorophyll
- It has the advantage of providing other products
- Pixel-by-pixel error bars can be provided in the future

- Produce also weighted average Chlorophyll

# GSM Model (Maritorena & Siegel, 2005) with GlobCOLOUR forward component

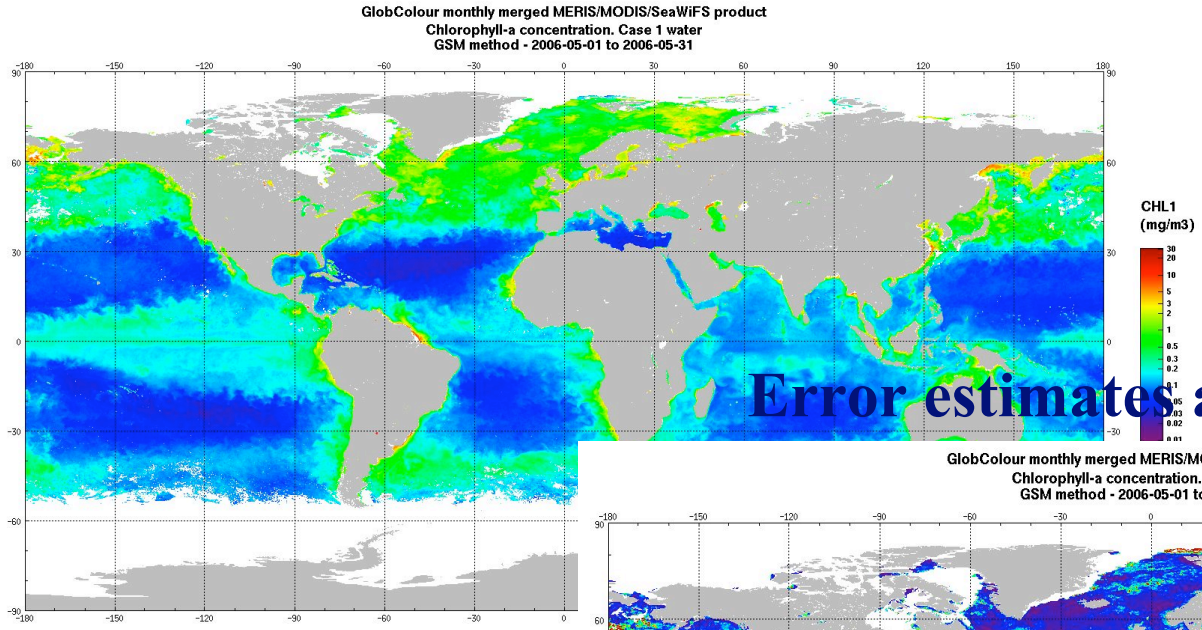



Quality Control

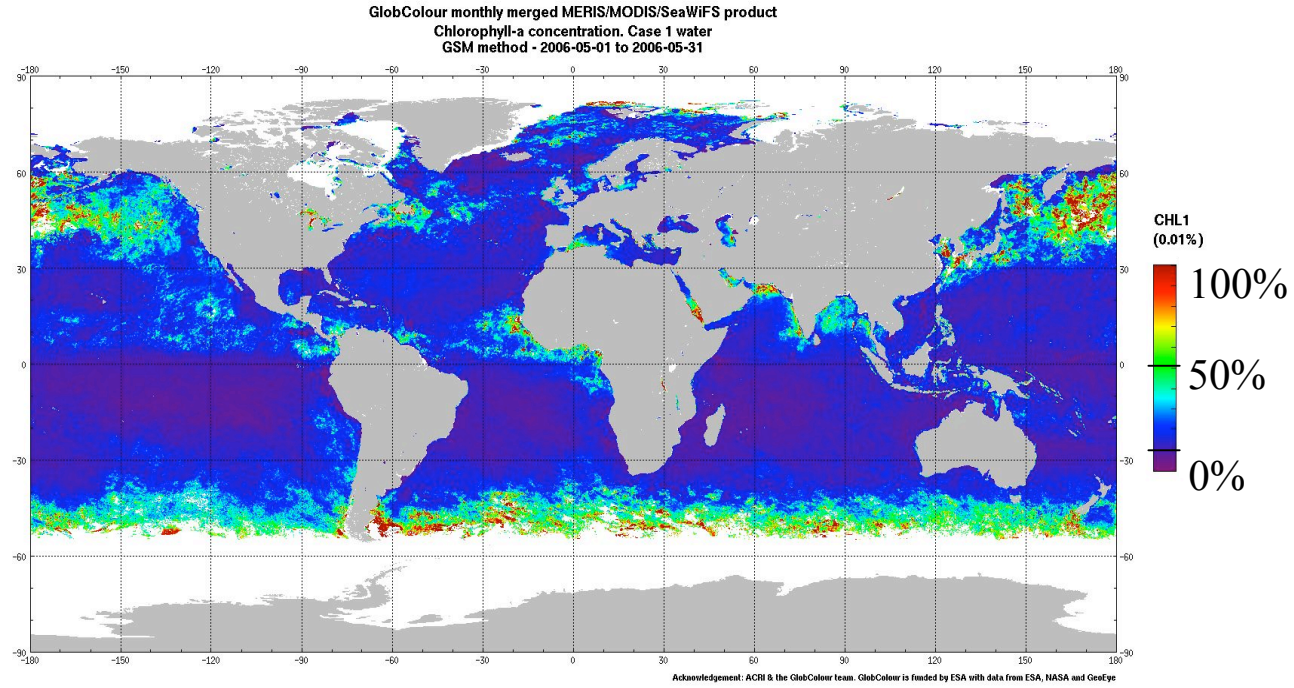
Global ocean colour data set at 4.6 km resolution covering 1997-2007 daily, weekly, monthly products:

- Diffuse attenuation coefficient @ 490nm ($K_d490$)
- Total Suspended Matter
- CDM absorption (aCDM443)
- Particle backscattering coefficient (bbp443)
- Aerosol Optical Thickness (T865)
- Chlorophyll concentration (Chla)
- Exact normalised water-leaving radiance @ 412, 443, 490, 510, 531, 555, 620nm MODIS-only, MERIS-only
- Water-leaving radiance @ 670, 681, 709nm
- Data quality flags
- Cloud fraction
- Excess of radiance at ~ 555 nm (turbidity index) (EL555)
- Error estimates per pixel for each layer

# Monthly chlorophyll composite: May 2006



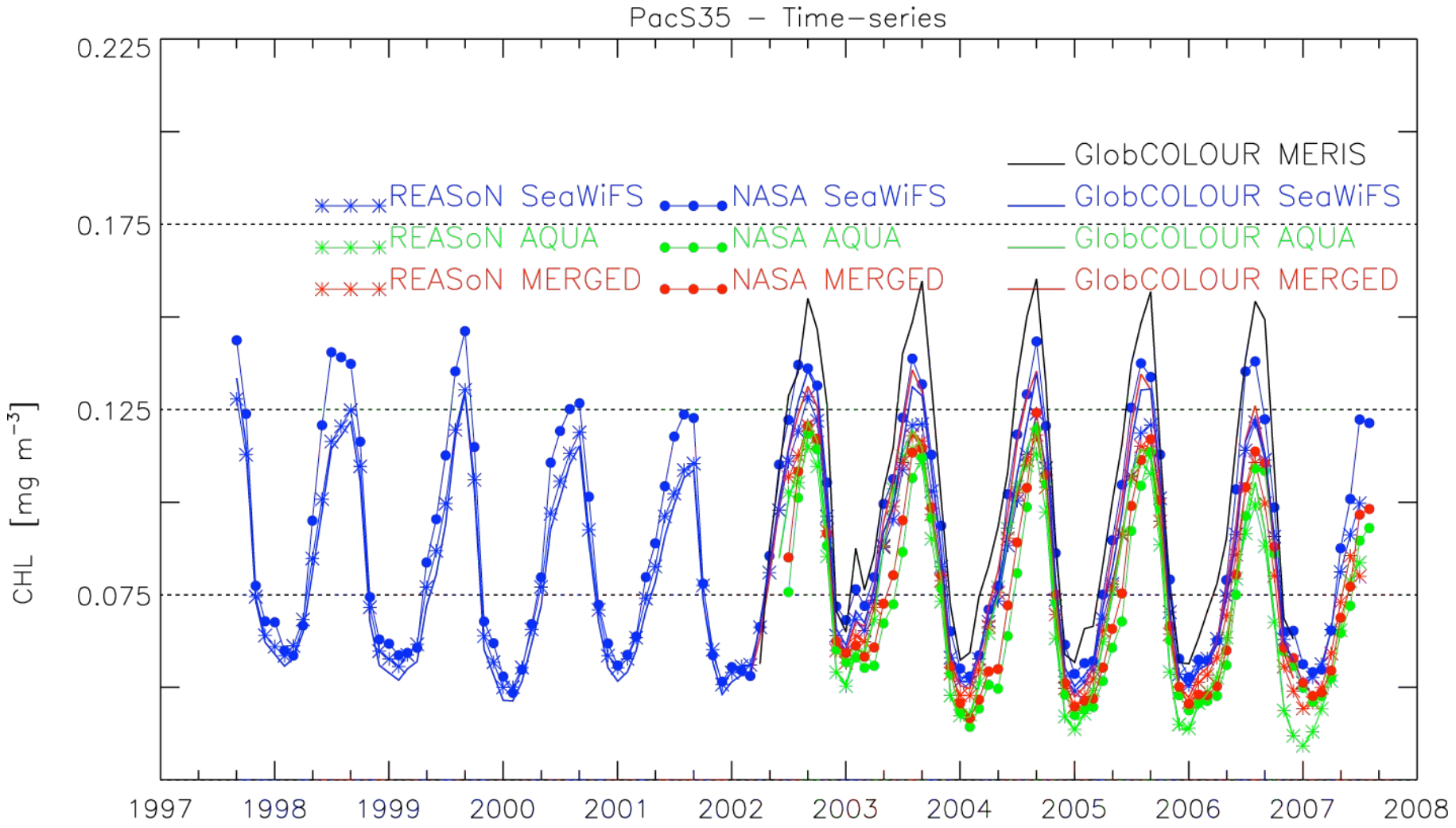

## Error estimates at pixel level (%)

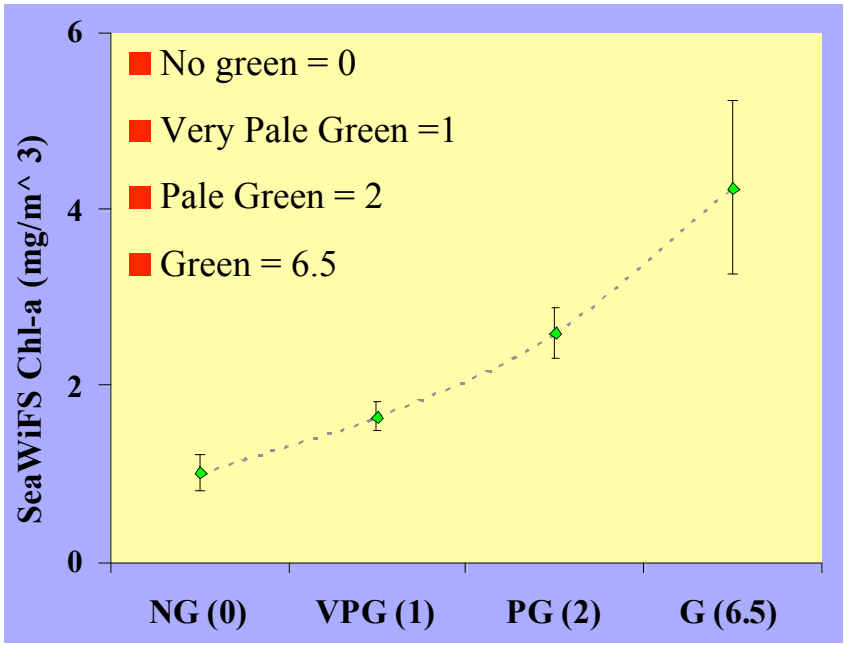



Data can be downloaded via www.globcolour.info

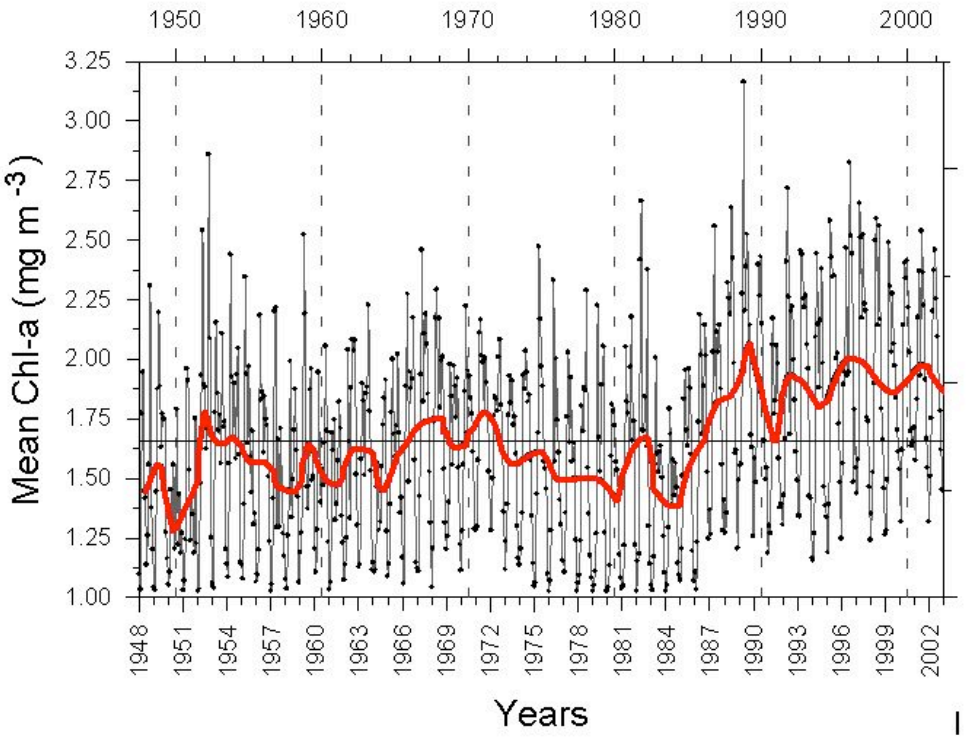
# Phase 2 (2007) Validation

## Inter-comparison with other similar initiatives (Stephane Maritorena)





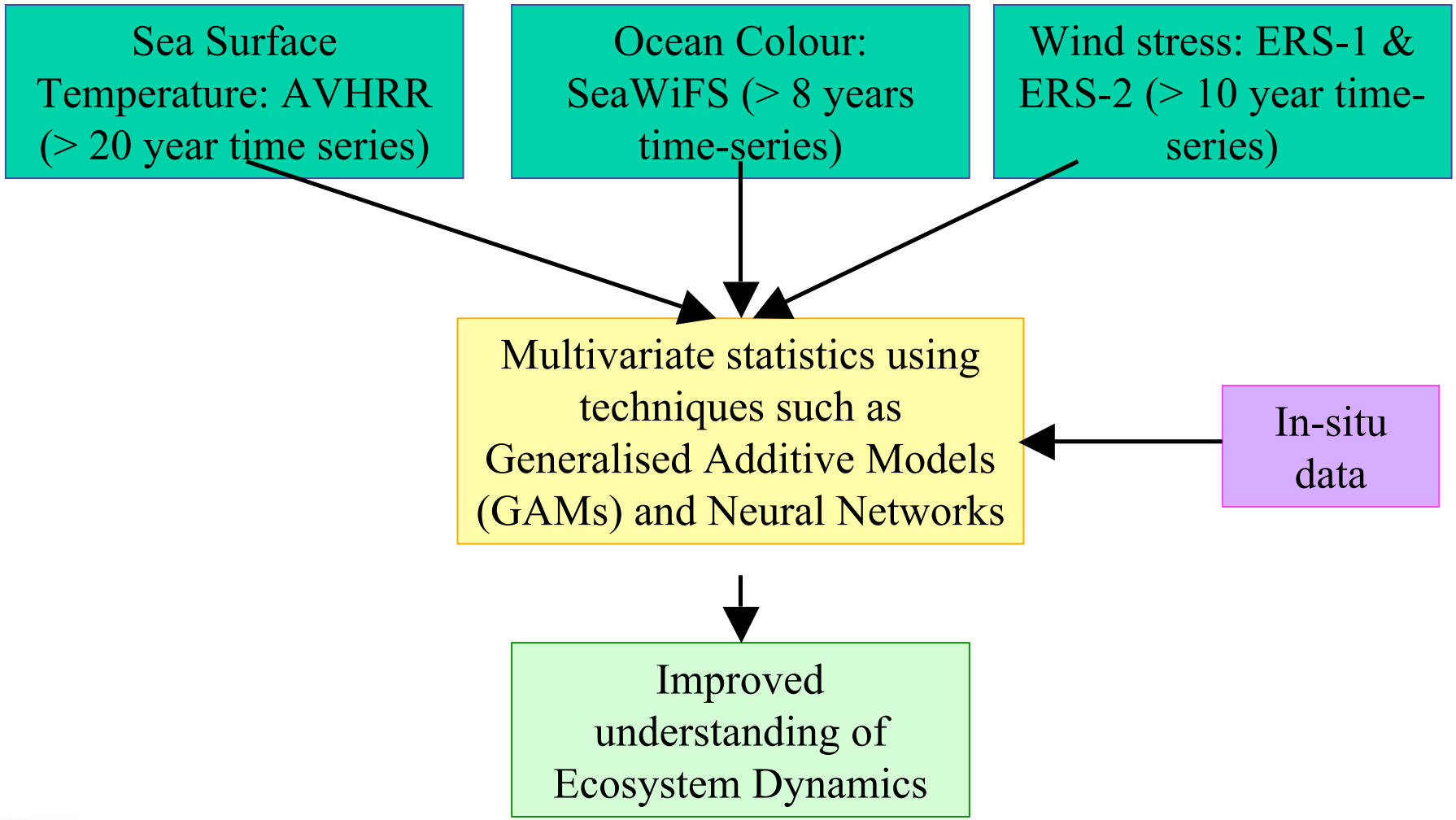

# Extending the SeaWiFS chlorophyll data set back 50 years in the northeast Atlantic



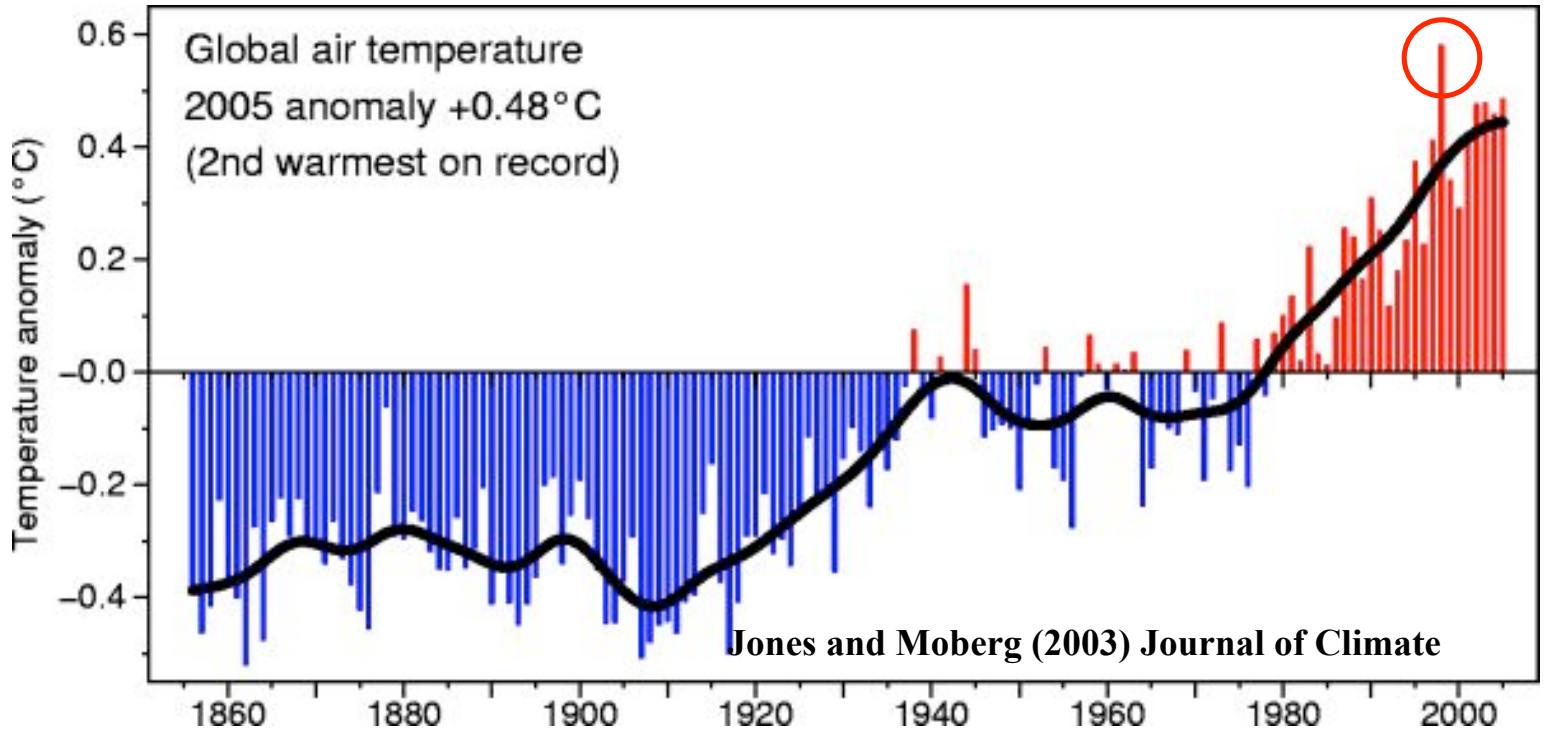

Time-series of the new Chl-a dataset (in-situ SAHFOS Continuous Plankton Recorder data converted to Chl-a based on SeaWiFS match-ups) for the period 1948 to 2002 in the Central Northeast Atlantic and North Sea.

Raitsos *et al*. 2005. Geophysical Research Letters

# Use of multi-sensor EO data to gain an improved understanding of ecosystem dynamics.

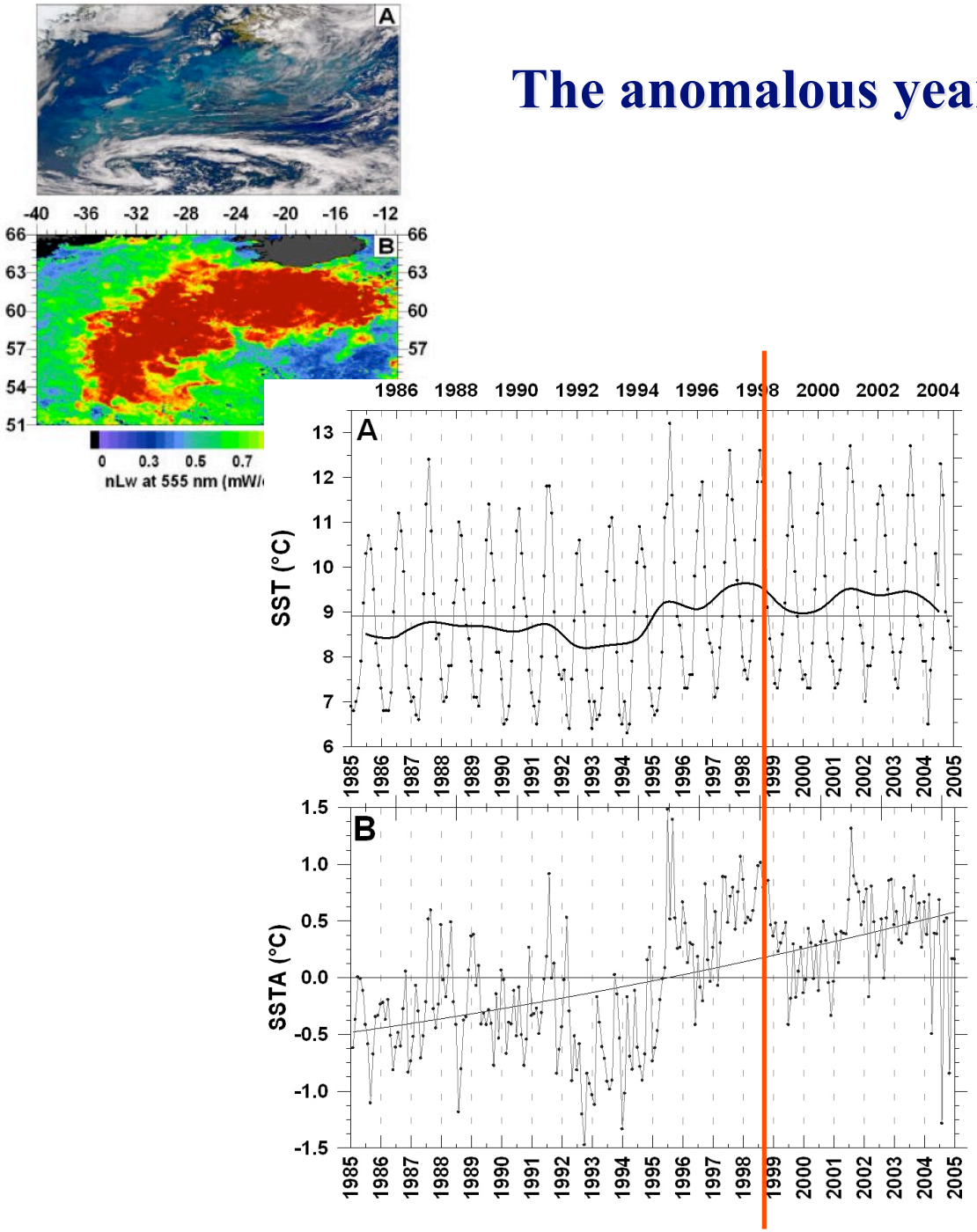


# The anomalous year of 1998….




Combined global land and marine surface temperature record from 1856 to 2005: 1998 was the warmest on record and 2005 was the second warmest.

# The anomalous year of 1998….

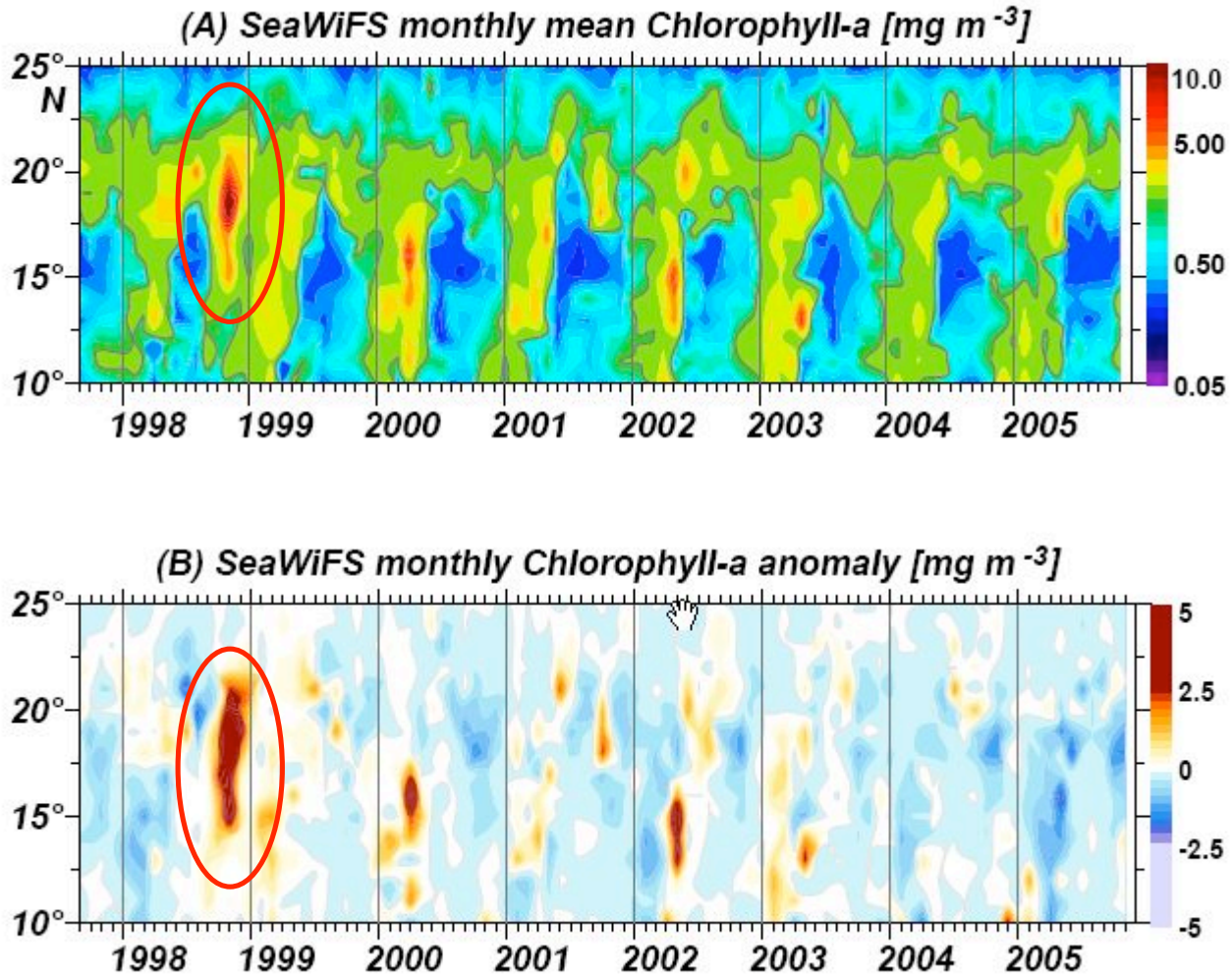



During June 1998 an extensive coccolithophore bloom occurred in the subarctic North Atlantic.

Research, based on a SeaWiFS 7-year dataset, showed that a combination of high light intensity, unusually high SST, together with a very shallow Mixed Layer Depth (11.6 m), may have caused strong stratification favouring the extensive growth of this species.

Raitsos *et al.* (In Press) L&O

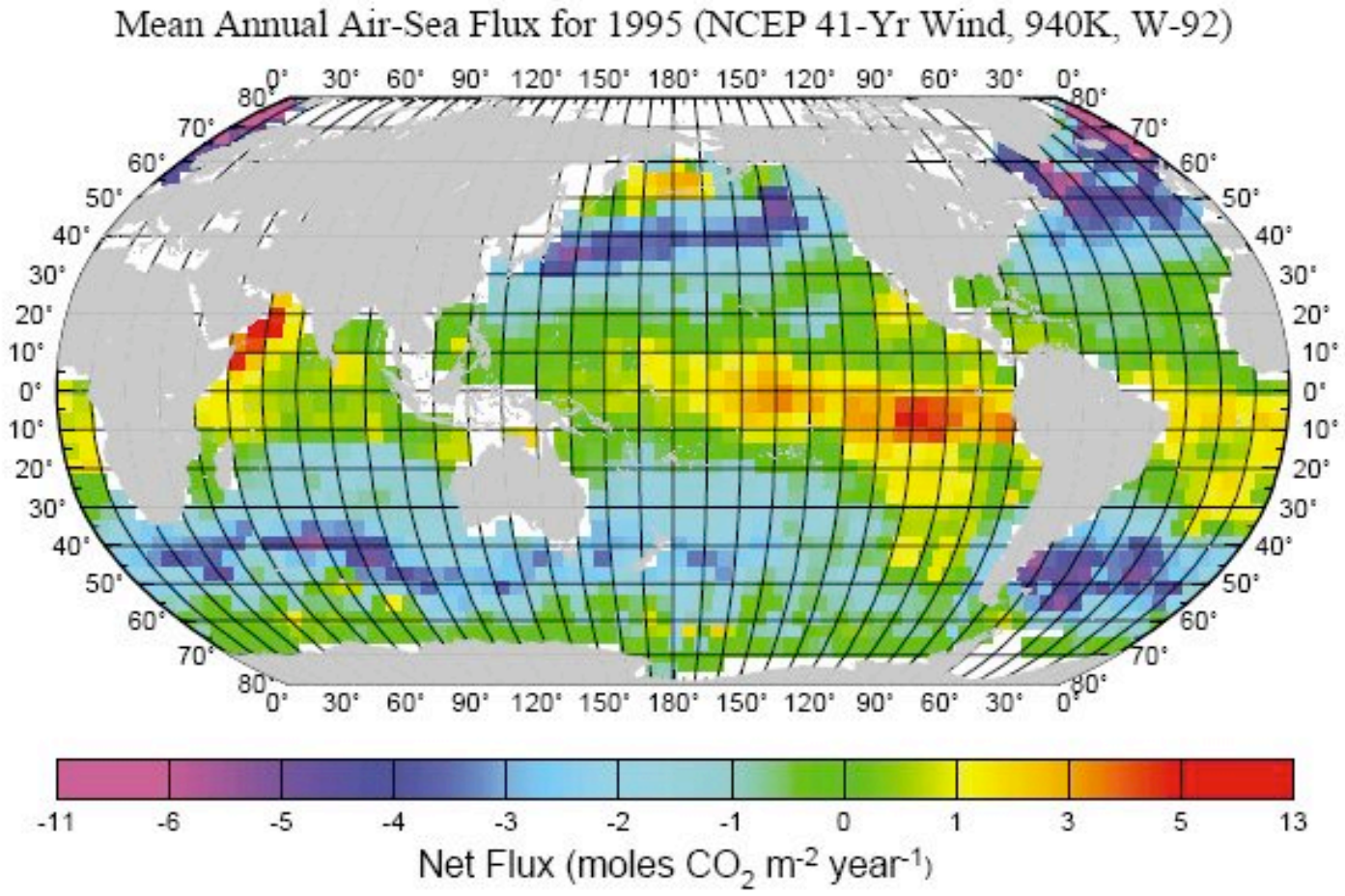
# The anomalous year of 1998….




A cold event, following an intense El Niño, in the Pacific during the summer of 1998 was found to mirror the intensity of wind forcing and phytoplankton concentration in the Mauritanian upwelling, a few months later.

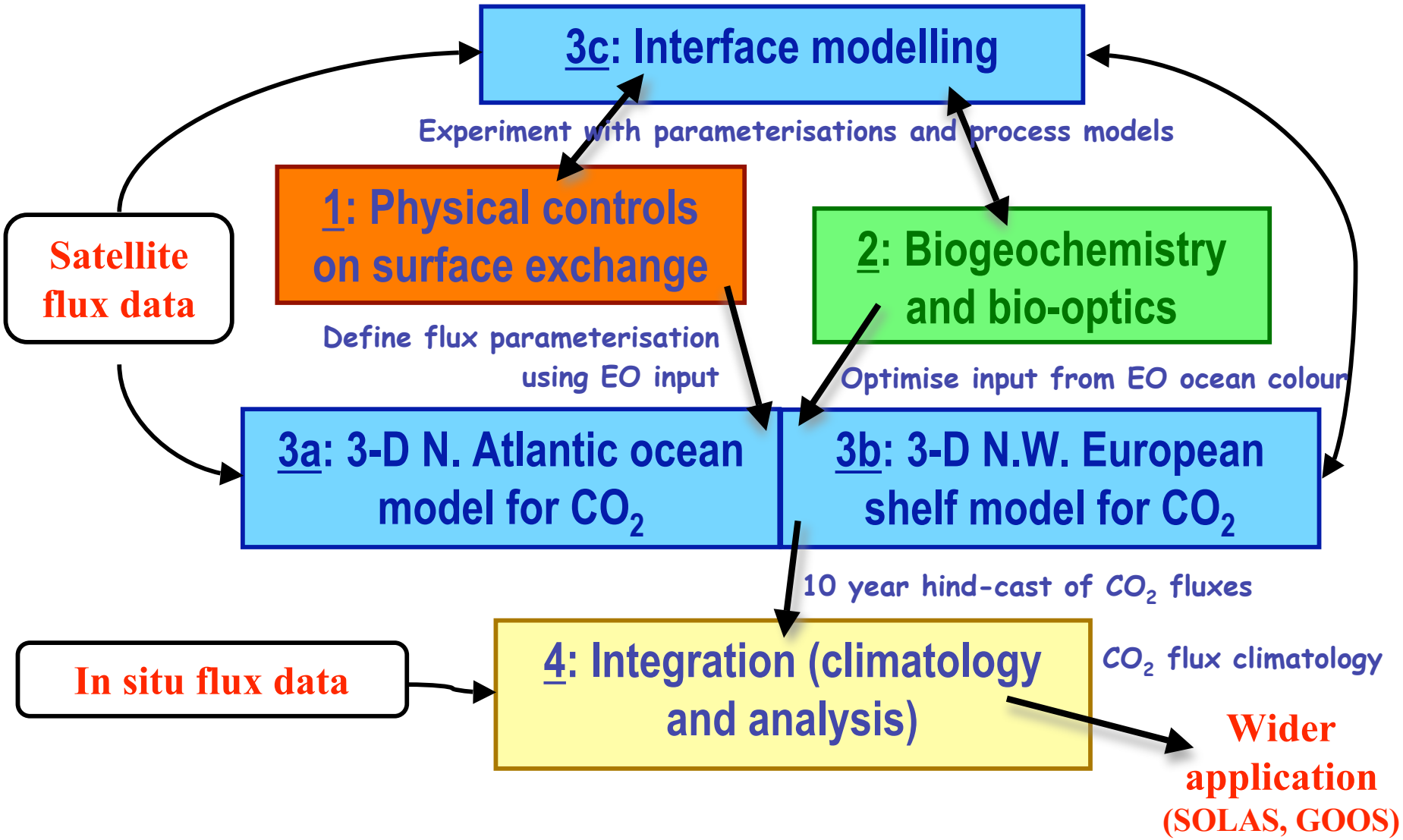
Pradhan *et al.* (2006) DSR II: AMT Special Issue

The exchange of $CO_2$ between the ocean and the atmosphere, which is regulated by the interplay of physical and biological processes, is not evenly distributed in space and time……



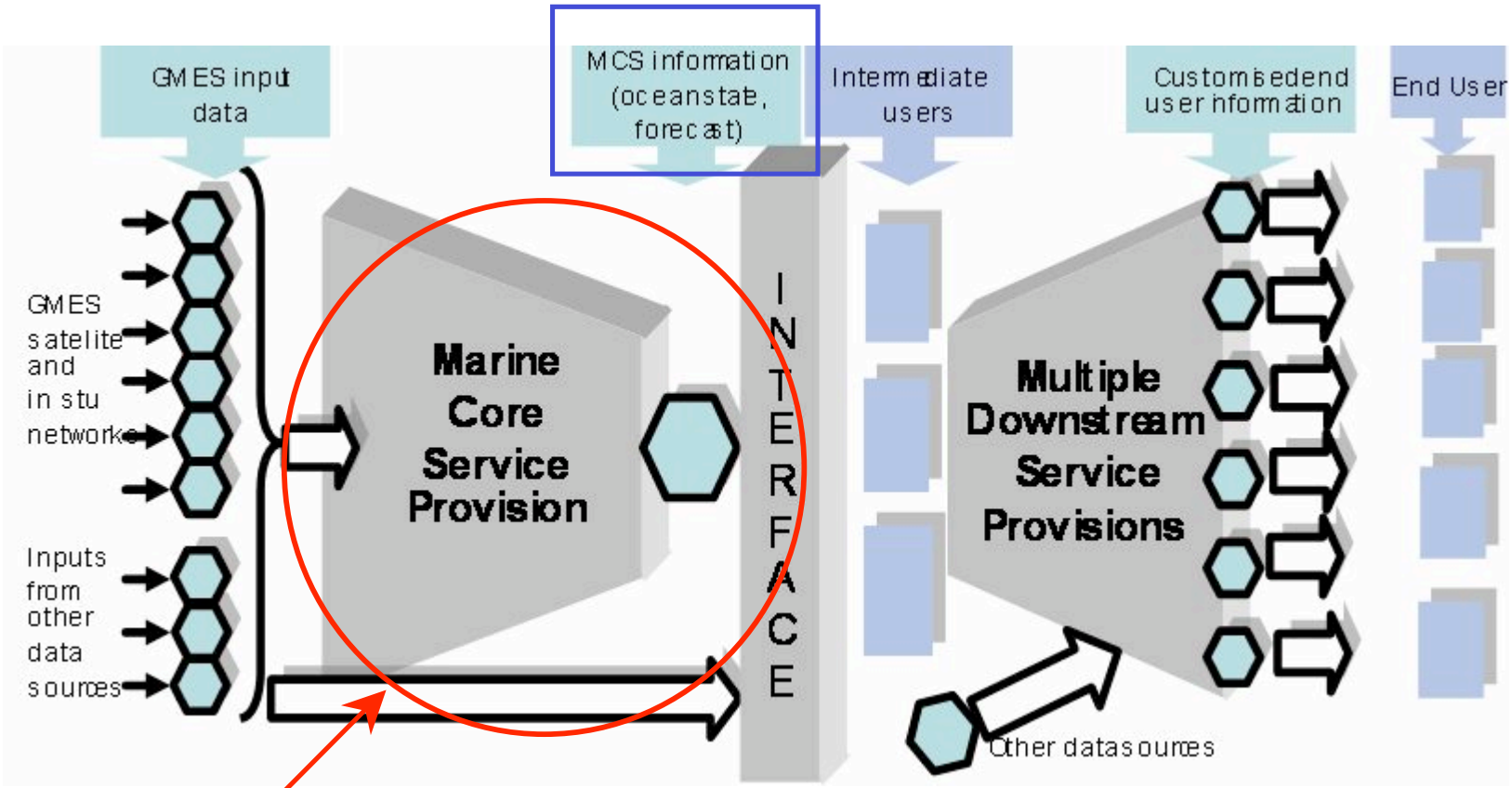

Takahashi *et. al.* (2002) Deep-Sea Research II.

# Centre of Observation of Air-Sea Interactions and Fluxes (CASIX)



# A European Marine "core" service

## clearly defined by the EC GMES Implementation Group




Strong involvement of numerical models and assimilation of EO data

*From GMES MCS Implementation Group report by P.Ryder & al*

Modified from slide belonging to MyOcean official presentation, 16 April 2007