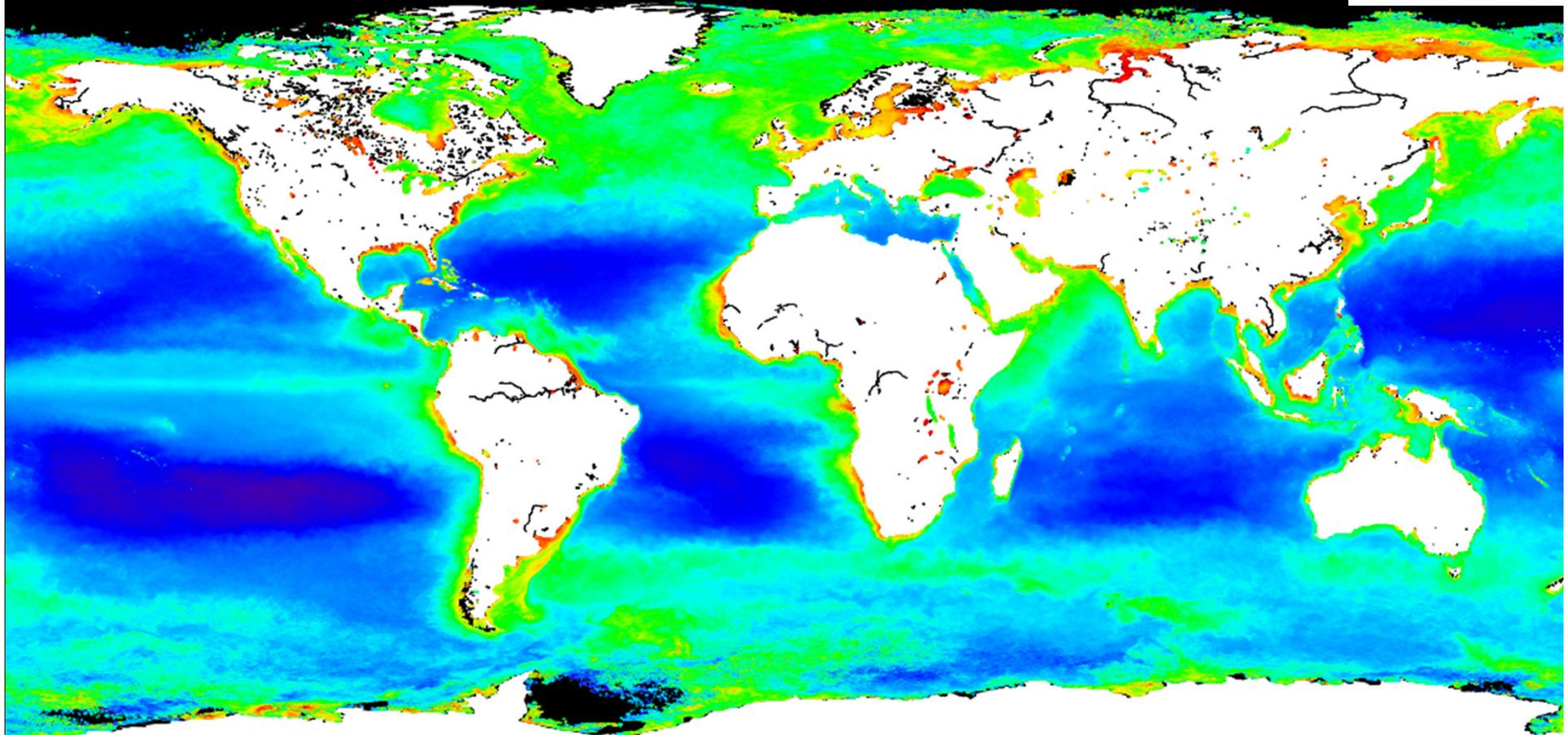


Products and Activities of the Ocean Colour Climate Change Initiative of ESA



OC-CI chlorophyll product

Shubha Sathyendranath, Stefano Ciavatta, Plymouth Marine Laboratory
and the OC-CI Team

Use of ocean colour products : process studies

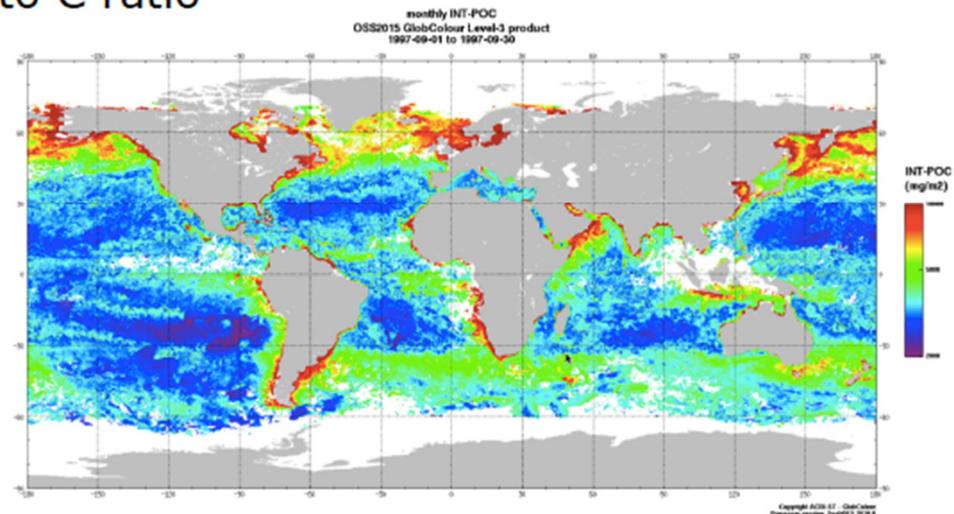
- detection of trends in response to climate change
- ecosystem dynamics : from NPP to export production
- 'diversity' of surface ocean ecosystem : PFTs

Requirements:

- continuous observational records
- further development and improvement of downstream products: e.g. algorithms for PFT identification
suspended particle and size spectra
chlorophyll to C ratio

Problems:

- undersampling of key regions (cloud cover)
- open ocean to shelf seas: changes in optical properties
- poorly constraint uncertainty

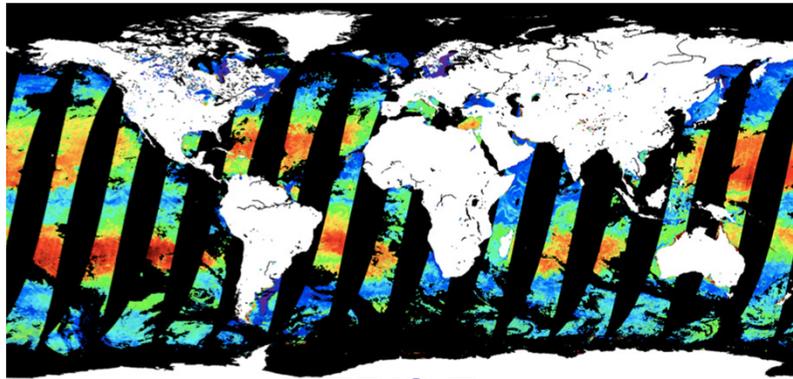


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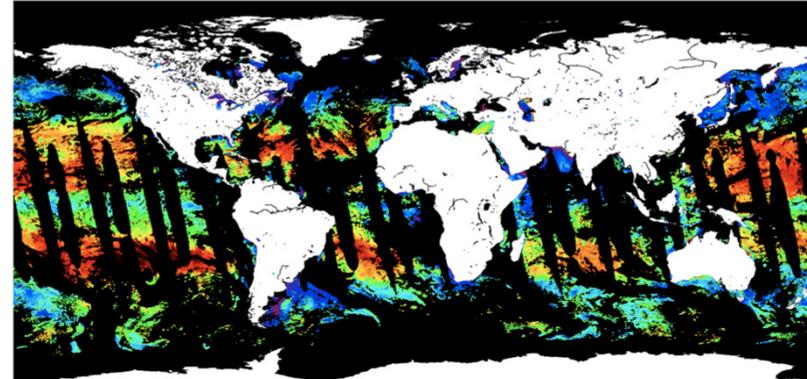


From the presentation of Marion Gehlen and Katja Fennel to IOCCG 2015

The Merged Product

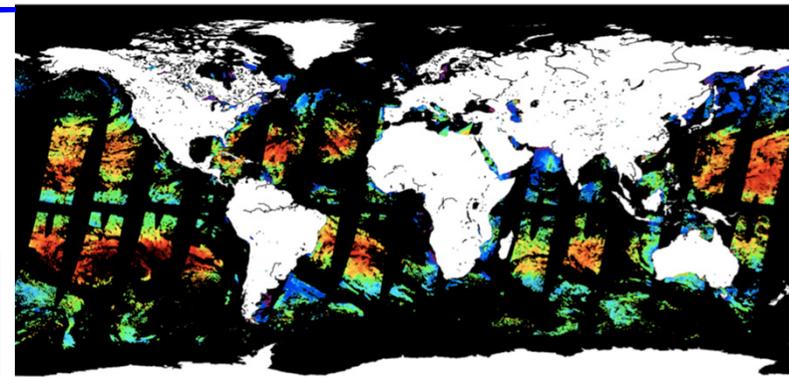
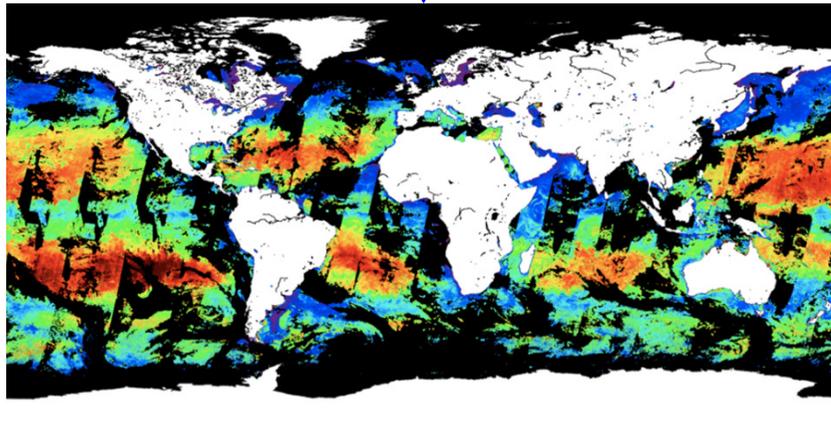


MERIS Rrs



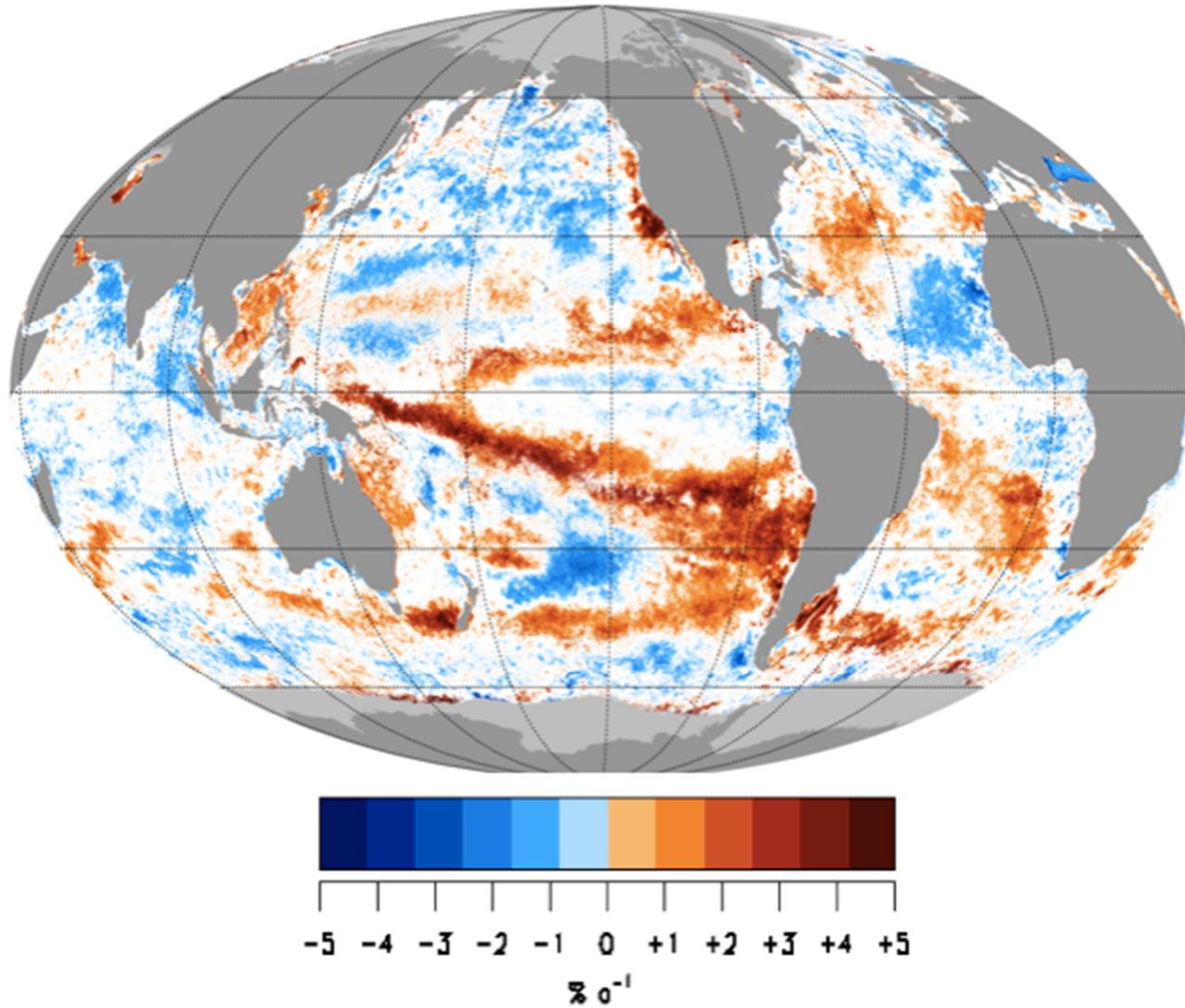
MODIS-A Rrs

Band-shifting, bias correction,
Merged product

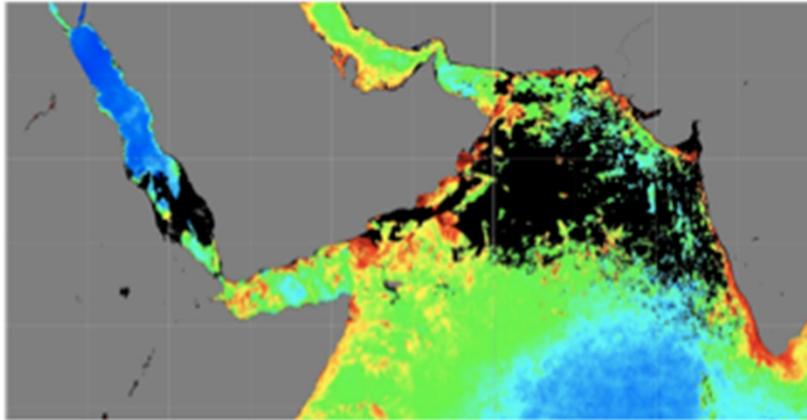


All Rrs data for MERIS and MODIS are corrected for inter-sensor bias with respect to SeaWiFS prior to merging. Common in-water algorithms (selected after algorithm comparison) applied to merged data.

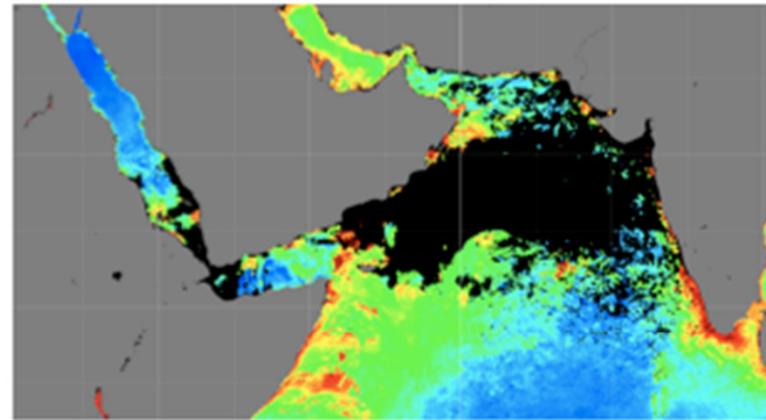
**Trend from OC-CCI Data
October 1997 – September 2012**



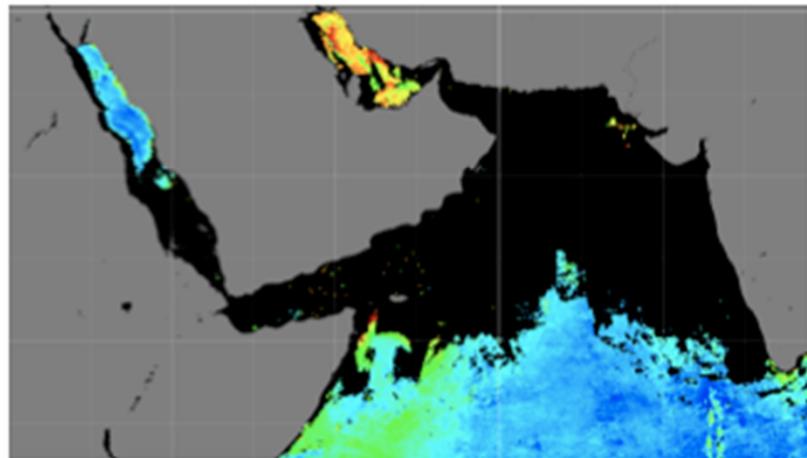
OC-CCI: Improved coverage in many under-sampled regions



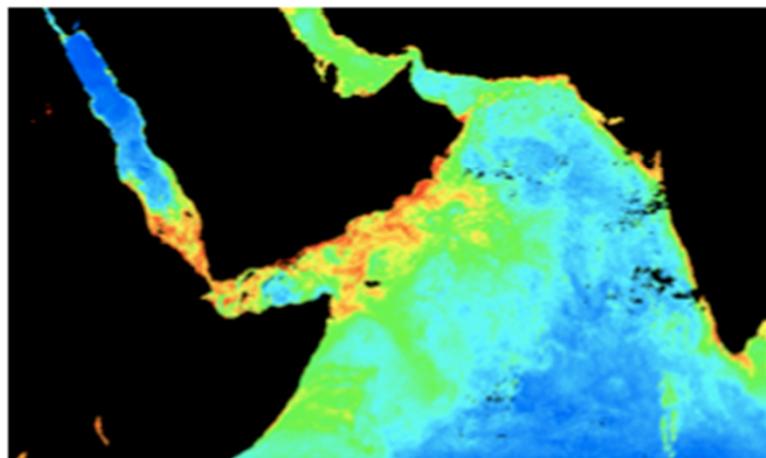
MODIS July Climatology from NASA



SeaWiFS July Climatology from NASA



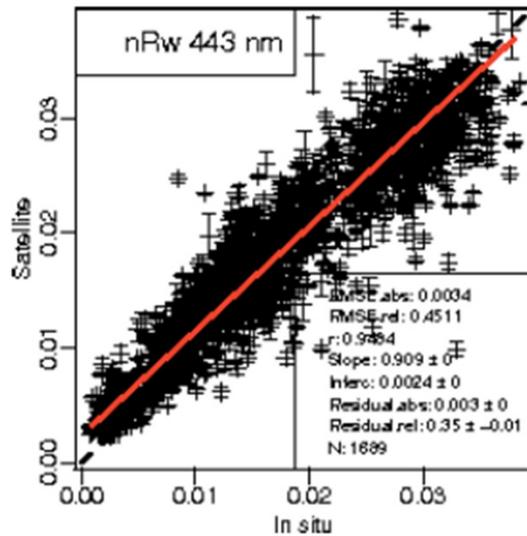
CZCS July Climatology from NASA



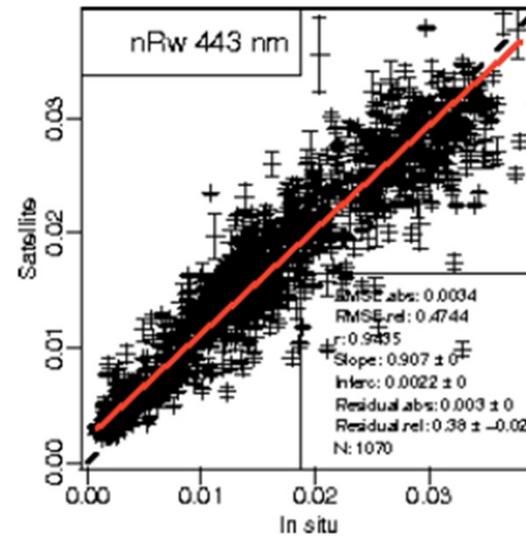
OC-CCI July 2003

Improved coverage for MERIS data due to use of POLYMER algorithm which performs better under sun glint and even thin clouds

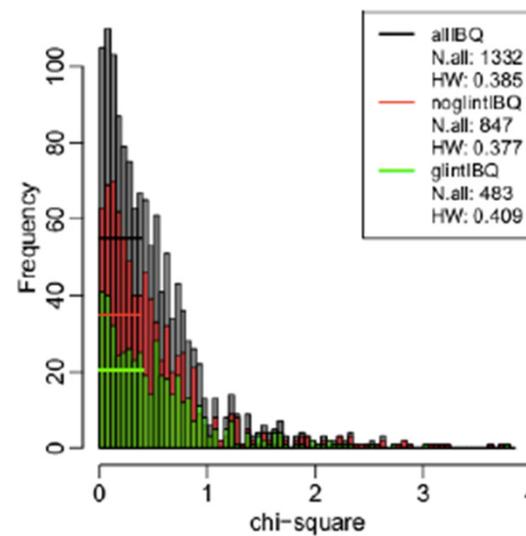
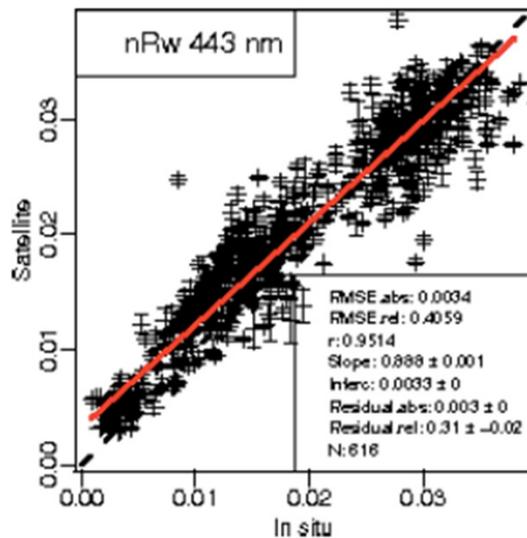
Influence of sun on water-leaving reflectances at 443 nm or on spectral shape derived with the POLYMER algorithm.



(a) All match-up points (IBQ).

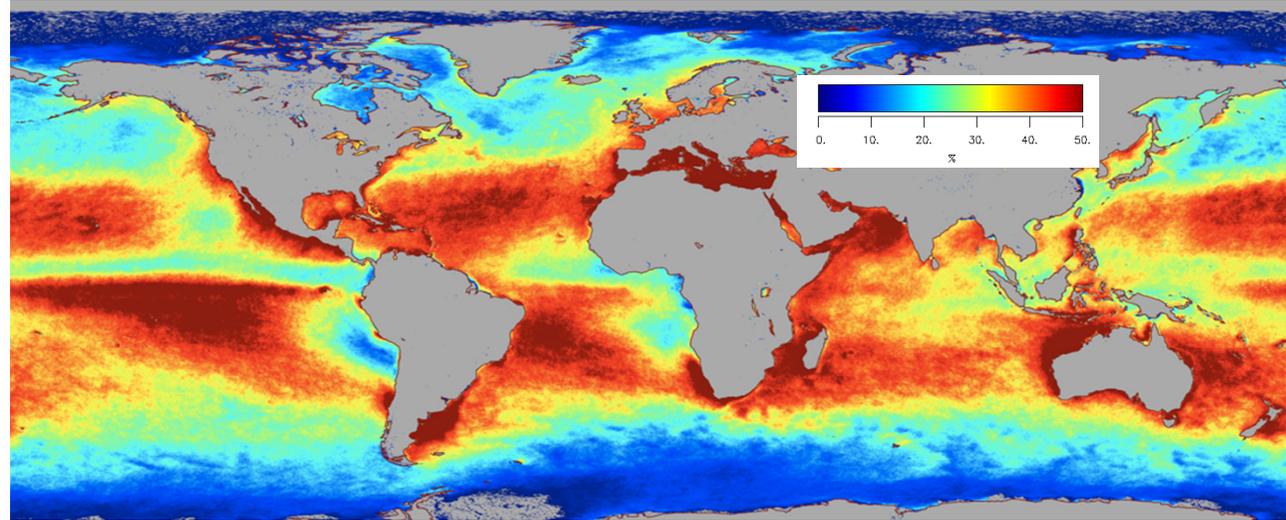


(b) Match-up points without high glint conditions.

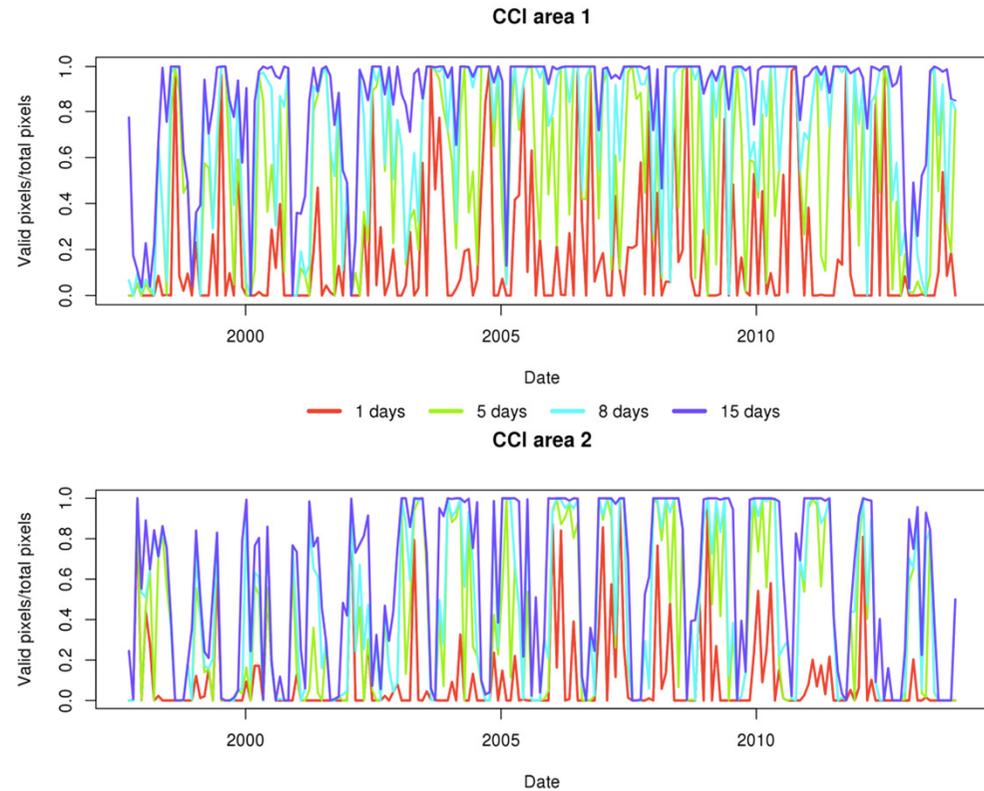
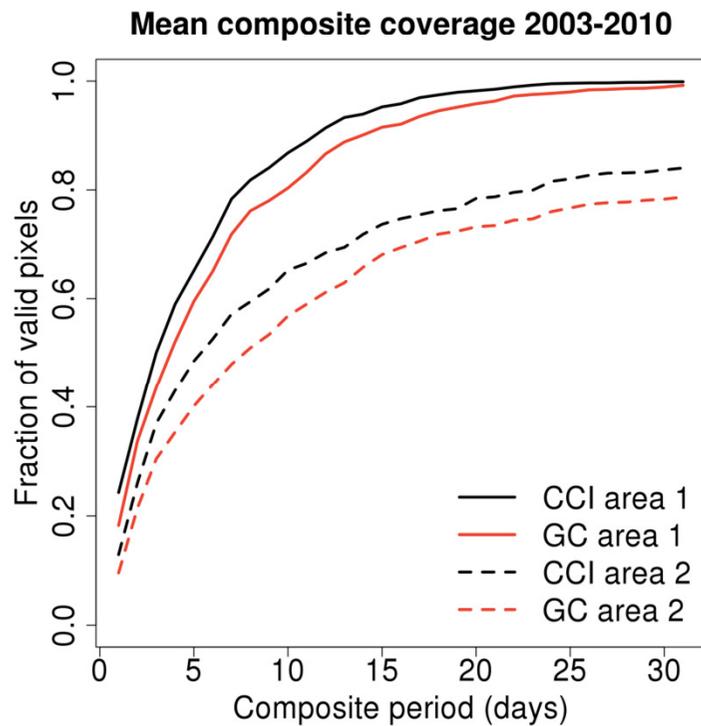


Gaps in Data:

Implications for
“representativeness”
of data in composite
images

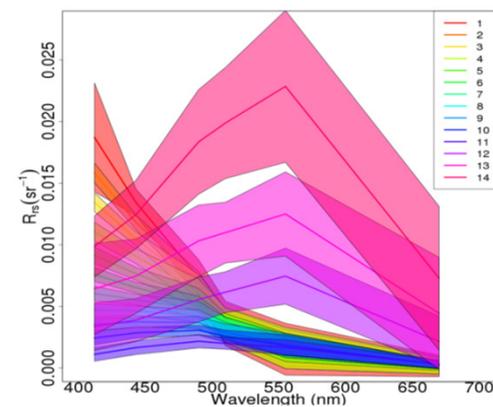
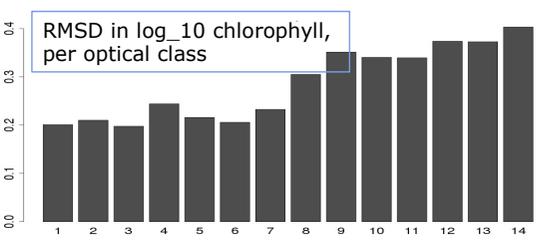
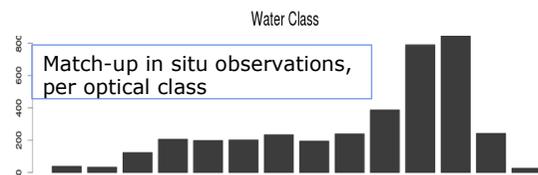
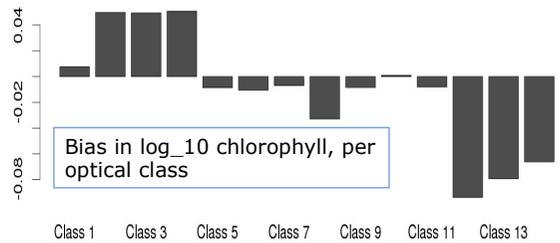


Daily coverage in % for merged OC-CCI product, test version for 2003

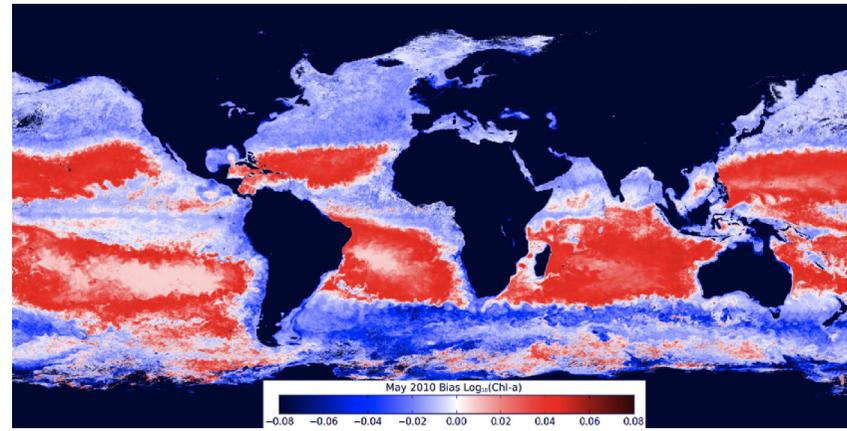


OC-CCI:

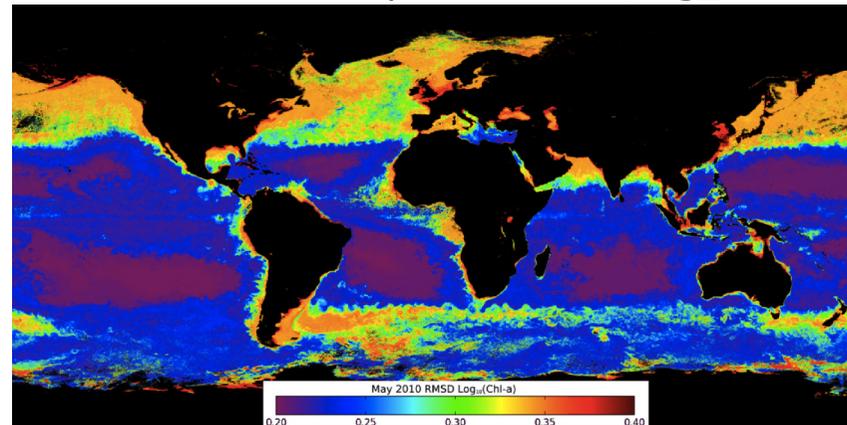
Validation of end products against in situ data; uncertainty characterisation on a per-pixel basis



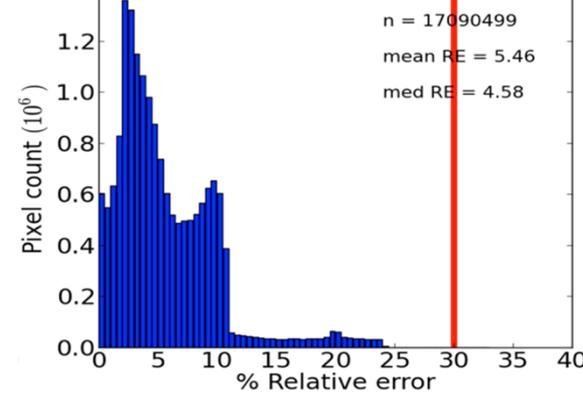
May 2010 bias, log₁₀ Chl



May 2010 RMSD, log₁₀ Chl



Relative error v2 Chl a, Jul 2003



Red vertical line:
GCOS requirement
for accuracy

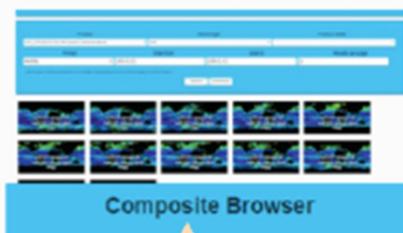
Data Dissemination

<http://oceancolour.org/>  **esa**

**Portfolio of access modes:
for discovery, subsetting,
download, analysis...**

OPeNDAP

**ftp
directory
structure**



**web browser
(composites)**

**Open
Geospatial
Consortium
web map &
functionalities**



Ocean-Colour Component of ESA's Climate Change Initiative

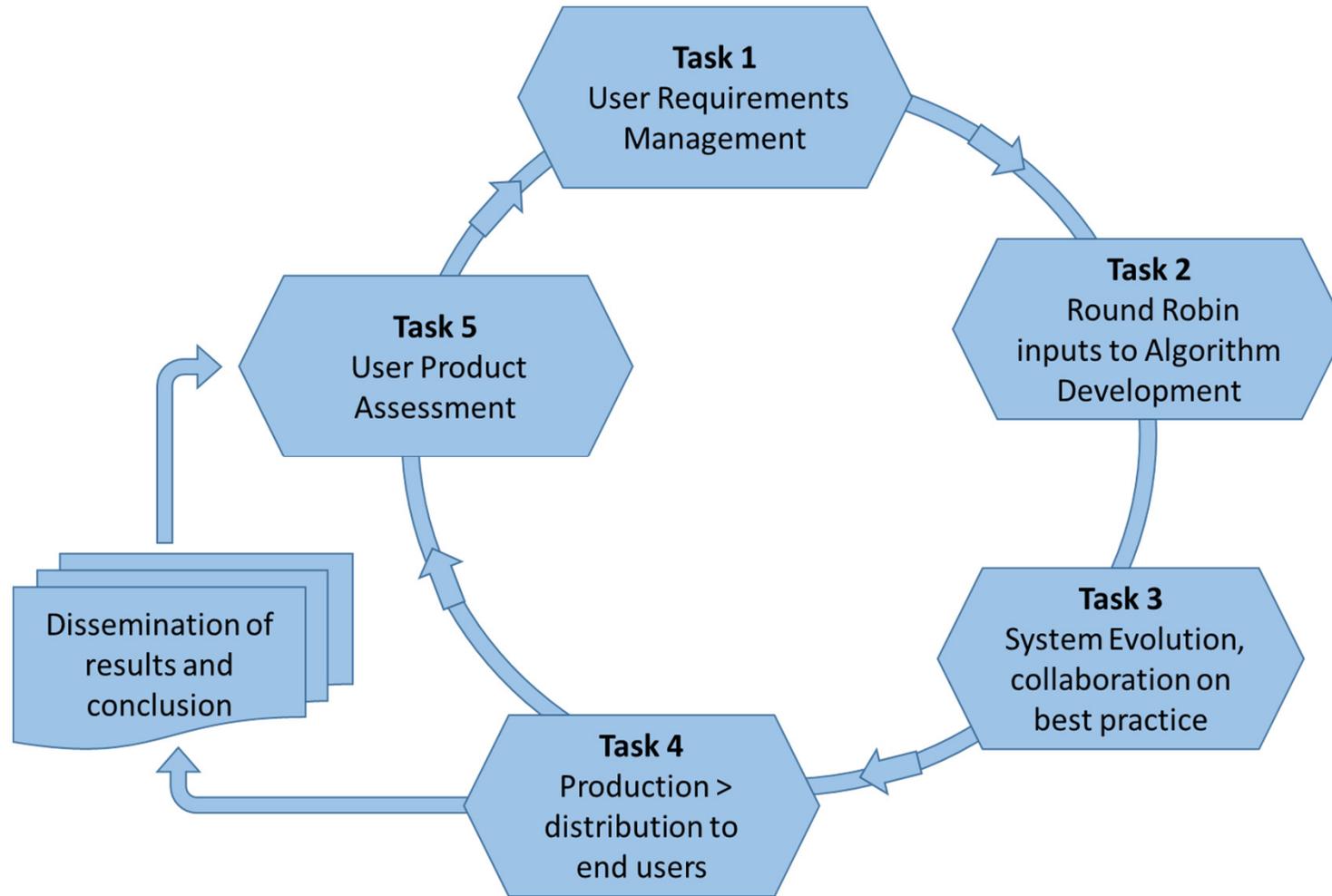
Objective: produce an uncertainty-characterised, inter-sensor bias-corrected, merged time series of ocean-colour products for climate research, user engagement

Released V2 of the merged time series (based on SeaWiFS, MERIS and MODIS-A) in March 2015. Specific aims of this version 2.0 release

- improves the in situ database used for uncertainty characterisation
- optimises the uncertainty generation for the CCI data. Specifically, the water classes are now based on the v2.0 data
- improves consistency in many areas, including unifying the binning/mapping processing (correcting some pixelisation issues noted in v1.0)
- incorporates an improved bias correction, able to respond to temporal variation (primarily seasonal)
- incorporates an improved cloud mask (Idepix 2.0) for MERIS
- benefits from a more automated quality assurance process
- extends the time series to the end of 2013
- refreshes the input datasets to the latest versions

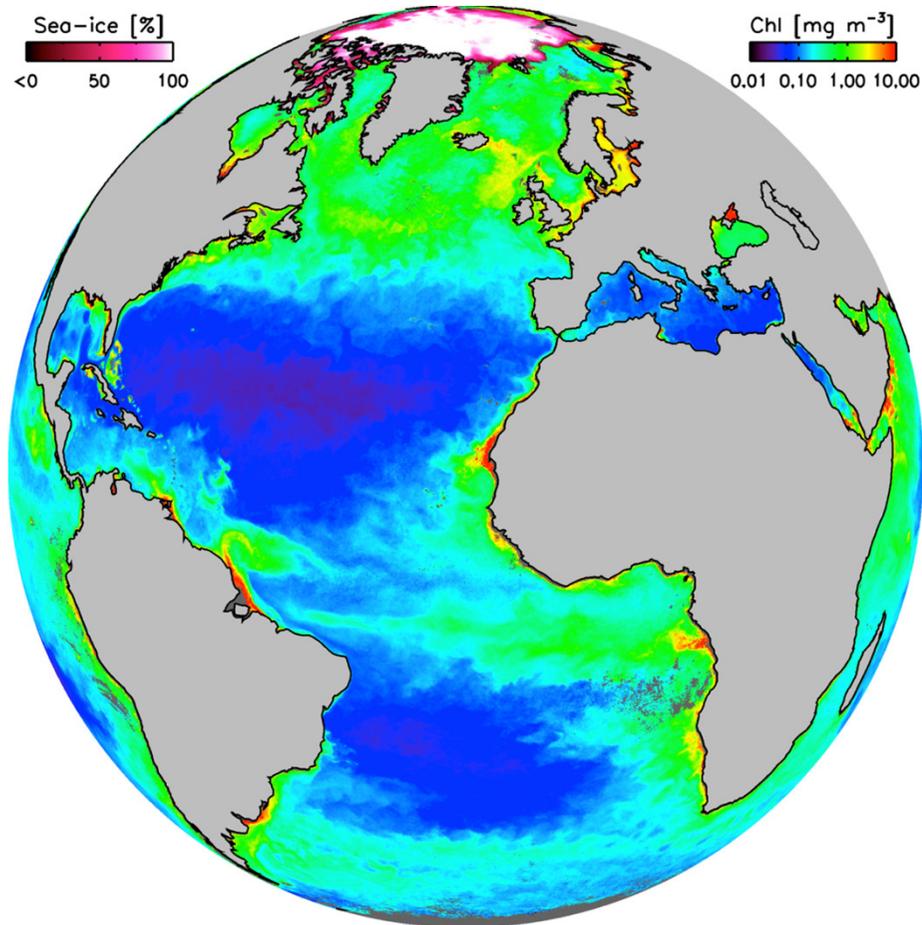


Cyclic Workflow



Future Plans

- Incorporate VIIRS into the time series
- Extend time series to 2015
- Prepare for Sentinel-3
- Improve Case-2 products



Acknowledgements

ESA and OC-CCI thank the many members of the ocean-colour community who helped in many ways: validation data, participation in user consultation; feedback on products. A special thanks to NASA for their continued help and support.

New products being developed under ESA projects

Include:

- Pools of Carbon in the Ocean (POCO Project)
- Photosynthetically Available Radiation (PAR Project)
- Marine Photosynthesis Parameters from Space (MAPPS Project)

One of the goals of these new projects is to engage new users, to facilitate use of ocean-colour data for broader applications.

Use of ocean colour products : process studies

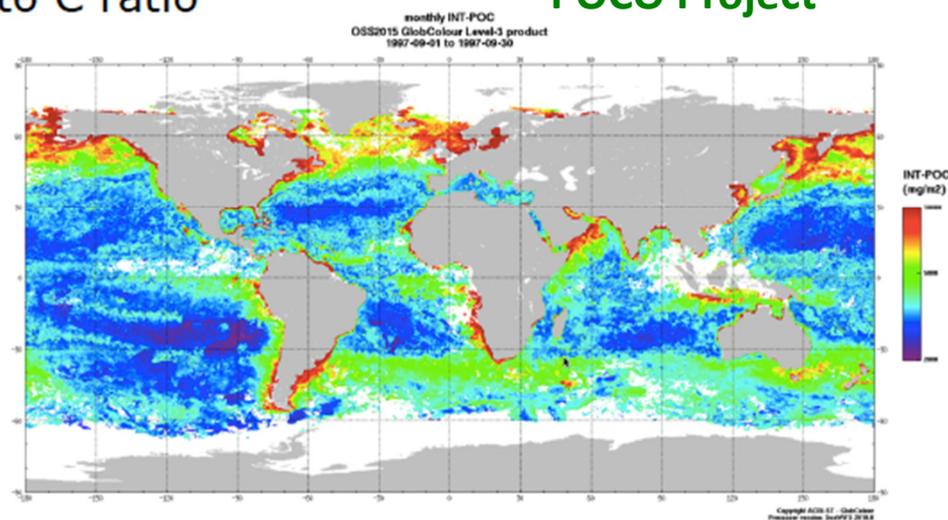
- ✓ • detection of trends in response to climate change
 - ecosystem dynamics : from NPP to export production
- ✓ • 'diversity' of surface ocean ecosystem : PFTs **PML Interest, PFT WG**

Requirements:

- ✓ • continuous observational records
- further development and improvement of downstream products: e.g.
 - ✓ algorithms for PFT identification **PML Interest**
 - ✓ suspended particle and size spectra **POCO Project**
 - ✓ chlorophyll to C ratio **POCO Project**

Problems:

- ✓ • undersampling of key regions (cloud cover)
- ✓ • open ocean to shelf seas: changes in optical properties
- ✓ • poorly constraint uncertainty

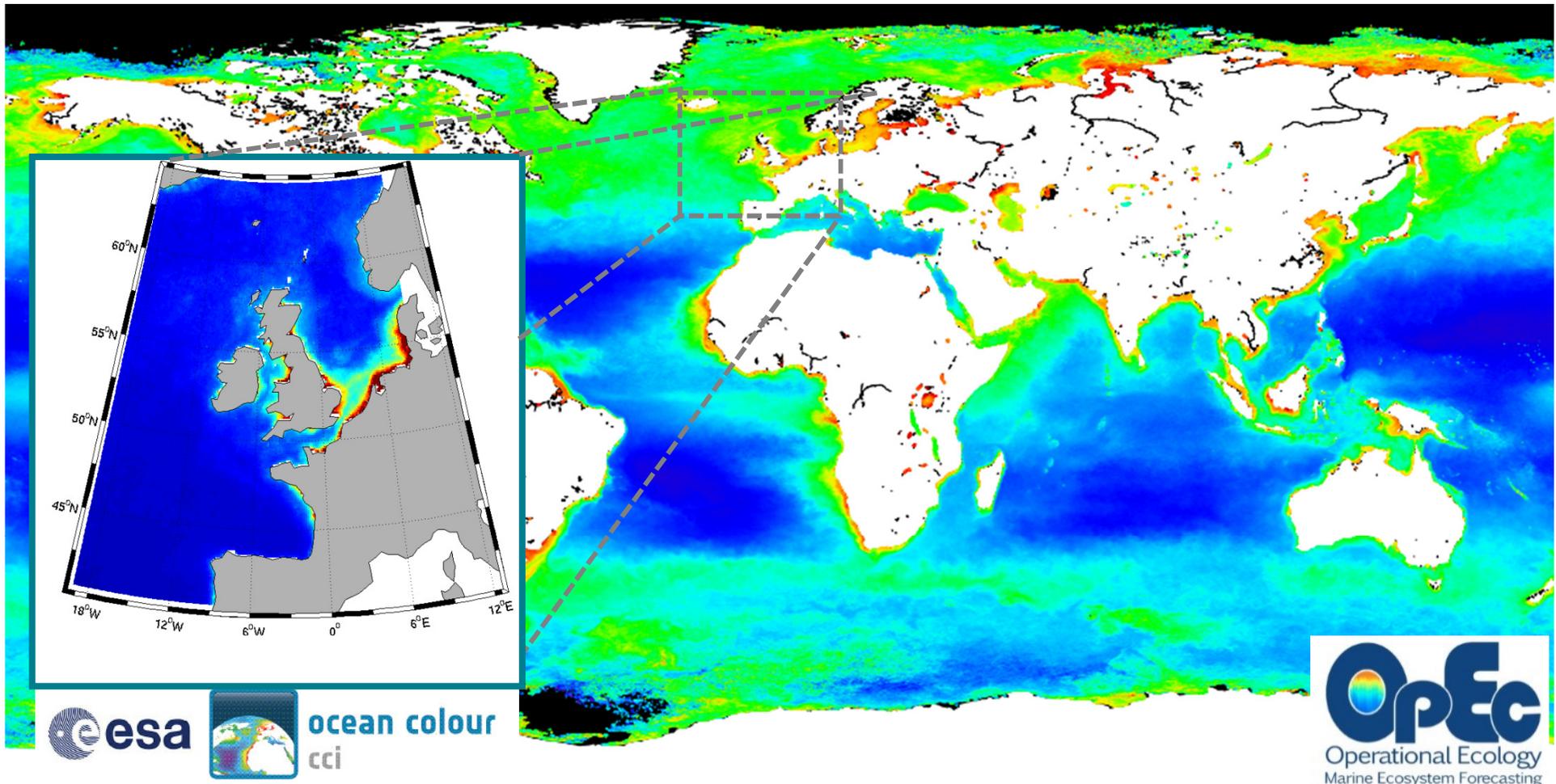


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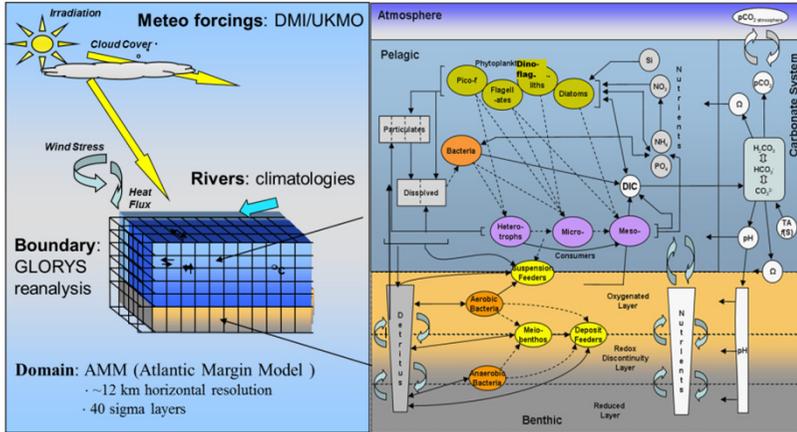


Overlapping interests

Decadal reanalysis (1998-2009)
of key ecosystem indicators and carbon fluxes
in the North East Atlantic, by using OC-CCI (V2)

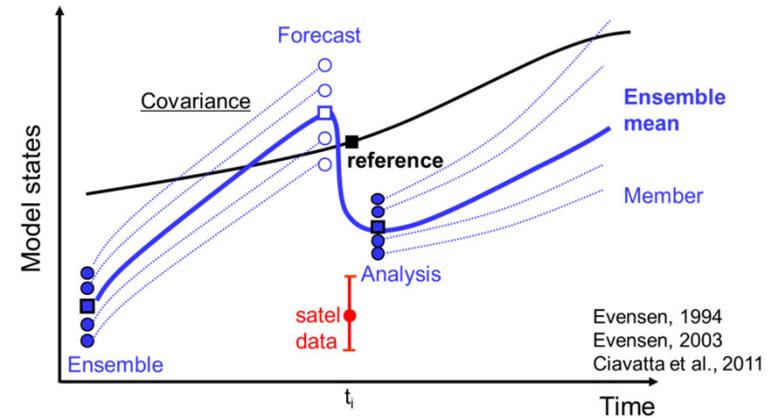


Model ERSEM



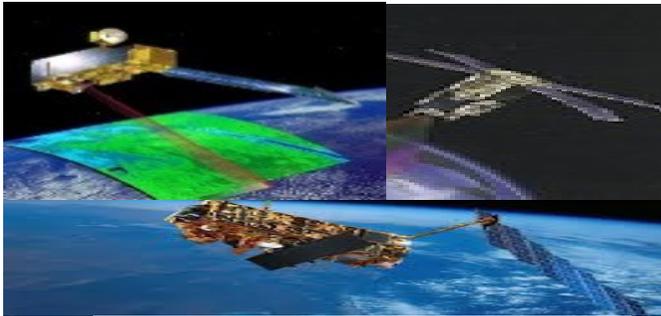
Assimilation scheme

Ensemble Kalman filter



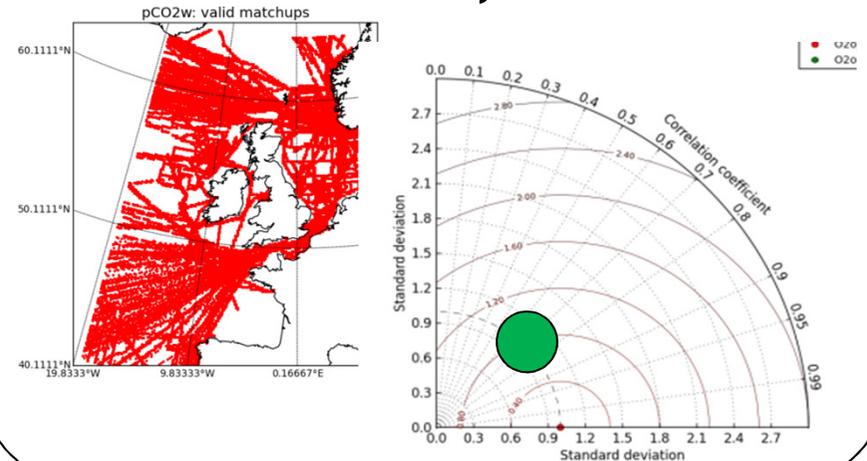
Assimilated data

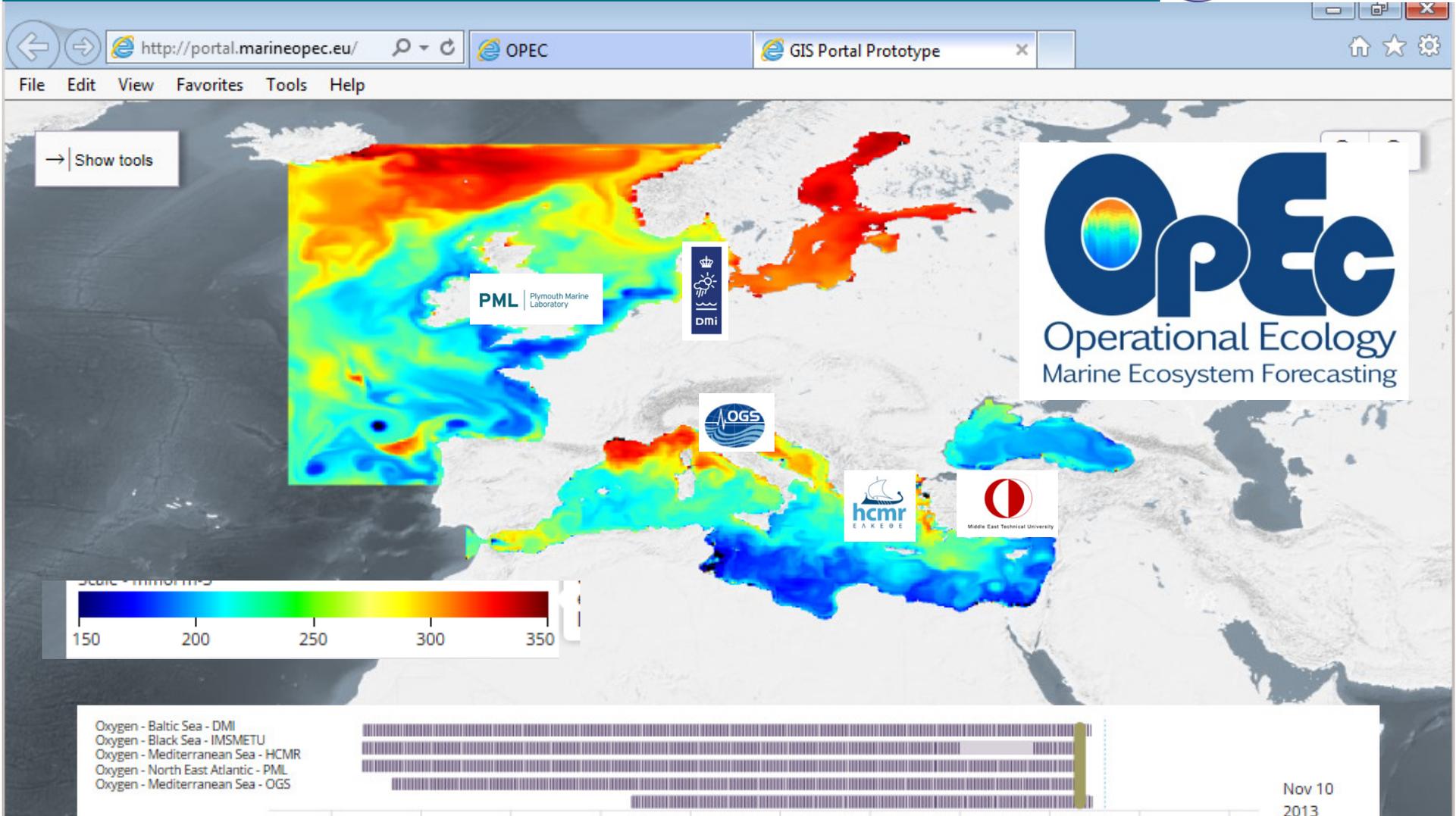
R. s. chlorophyll (& errors)



Skill data

in situ ICES, SOCAT





... an European pre-operational service for biogeochemical and ecological indicators of environmental status (for MSFD, CFP, ...)

<http://portal.marineopec.eu/>

- Assimilation of CCI can improve the simulation and understanding of ecosystem indicators and carbon fluxes in shelf-seas
- Error characterization (bias and RMSE) is a unique CCI asset that can support enormously data assimilation efforts
- Operational ecology to serve downstream applications is in the pipeline (e.g. OPEC)
- Assimilation of satellite biogeochemical data alternative to chlorophyll (e.g. light attenuation coefficient $K_d(\lambda)$, [Ciavatta et al., PiO, 2014](#))