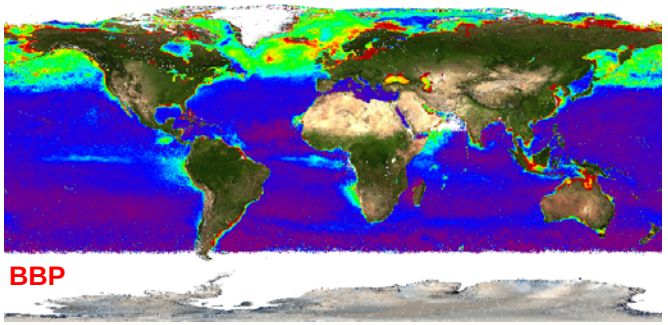
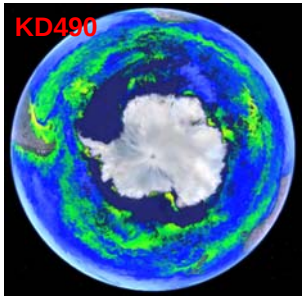
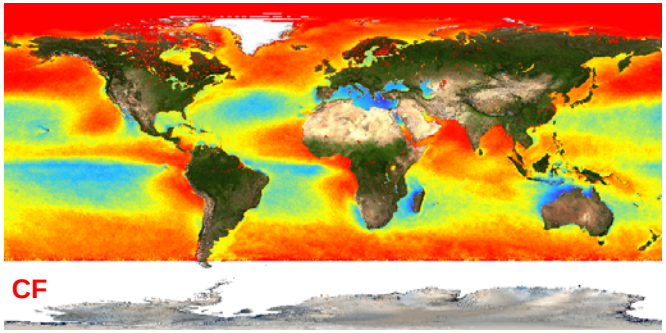
GlobColour : Progress and achievements

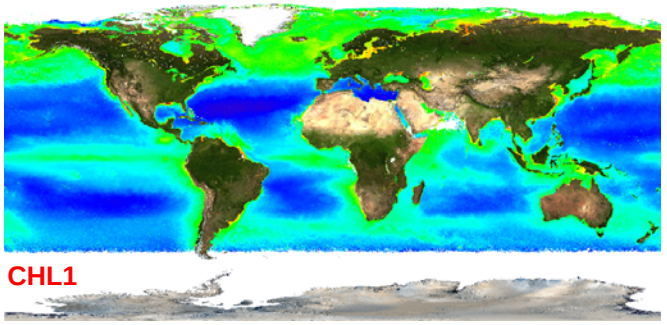
Odile Fanton d'Andon
ACRI-ST





July climatologies - 10 year GlobColour Time series





The GlobColour Concept

ESA's goal in creating GlobColour

•To satisfy emerging demand for validated merged ocean colour derived products expressed by global ocean colour user community (IOCCG, IOCCP)

•To satisfy operational oceanography requirements (for data assimilation)

•To support development of a European satellite based ocean colour data service having the capacity to continue production of such time series (both archive and NRT) in the future and to prepare for full exploitation of Sentinel 3

- Specific objectives of the GlobColour Service
  - Develop the software systems to support the Service (1)
  - Operate the service by delivering specific validated products :
    - 10 year global archive of merged MERIS-MODIS-SeaWiFS ocean colour products at 4.6 km resolution (2)
    - Produce GlobColour diagnostic data set (DDS) (3)
    - NRT global service at 4.6 km resolution (4)
  - Develop a user base for GlobColour products (5)

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

- First objective : Develop the software systems to support the Service
  - Achieved in one year, validated at the first UCM in Villefranche, December 2006
    - Initial merging candidates and products selection according to users requirements
    - Characterisation
    - System
      - Globcolour processor
      - Globcolour tools
      - Web

GlobColour – Data merging

Algorithm inter-comparison and trade-off analysis against in situ data

Merging recommendations:

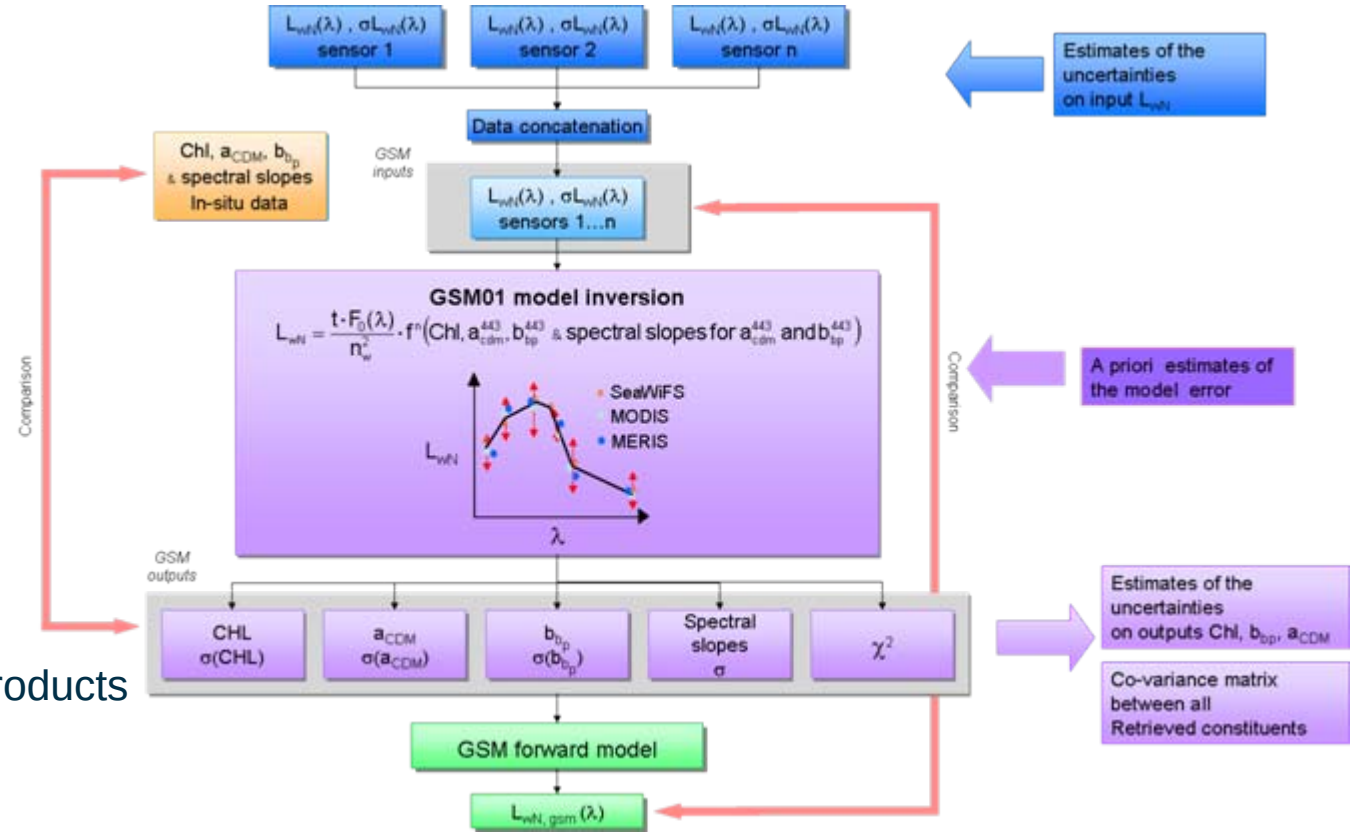
Weighted averaging of bio-optical properties (chl-a)

GSM01 model (Maritorena et al., 2002)

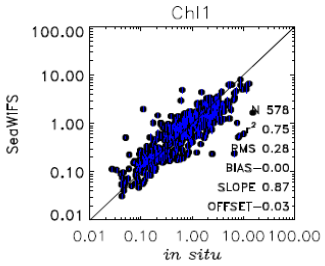
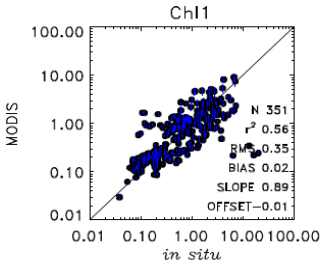
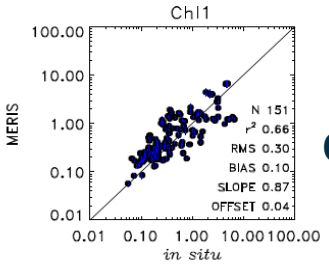
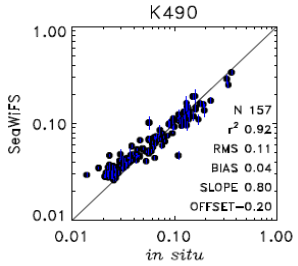
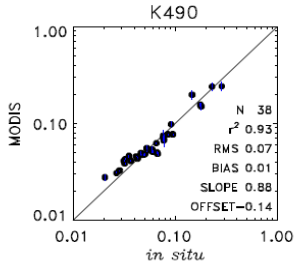
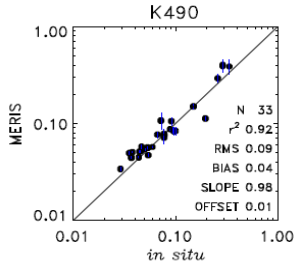
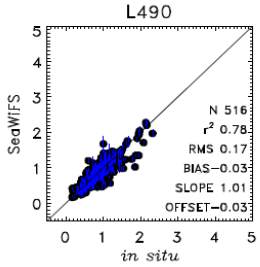
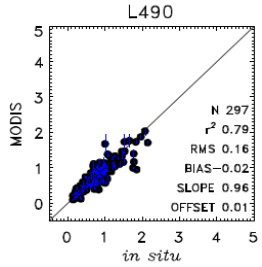
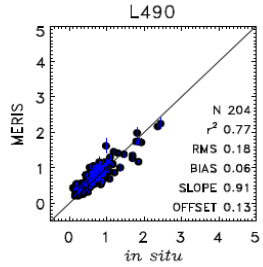
- **Input**
  Lw_n (l) from all available sensors
  + sensor specific error estimates

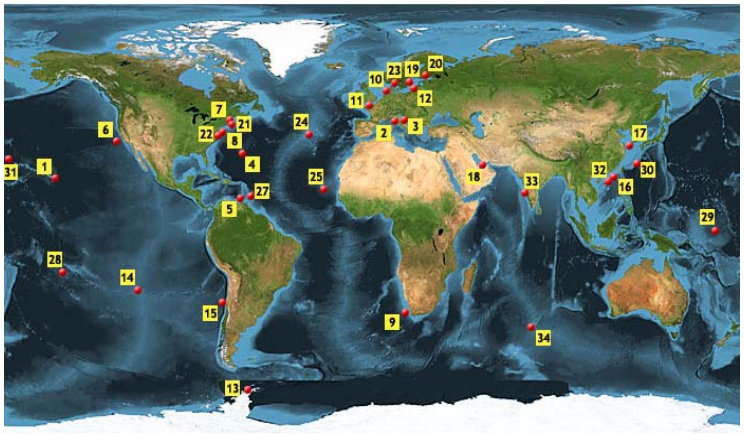
- **Model**
  Inversion procedure of a bio-optical merging model

- **Output**
  Several bio-geochemical products
  + error estimates per pixel



Sensor characterisation

SeaWiFS	MODIS	MERIS	
			**CHL**
			**K490**
			**L490**



In-situ Diagnostic Data Set for characterisation and validation

Achievement
Statistical uncertainties have been derived and are used for the data merging

see Samantha Lavender's presentation

GlobColour processor

Main modules

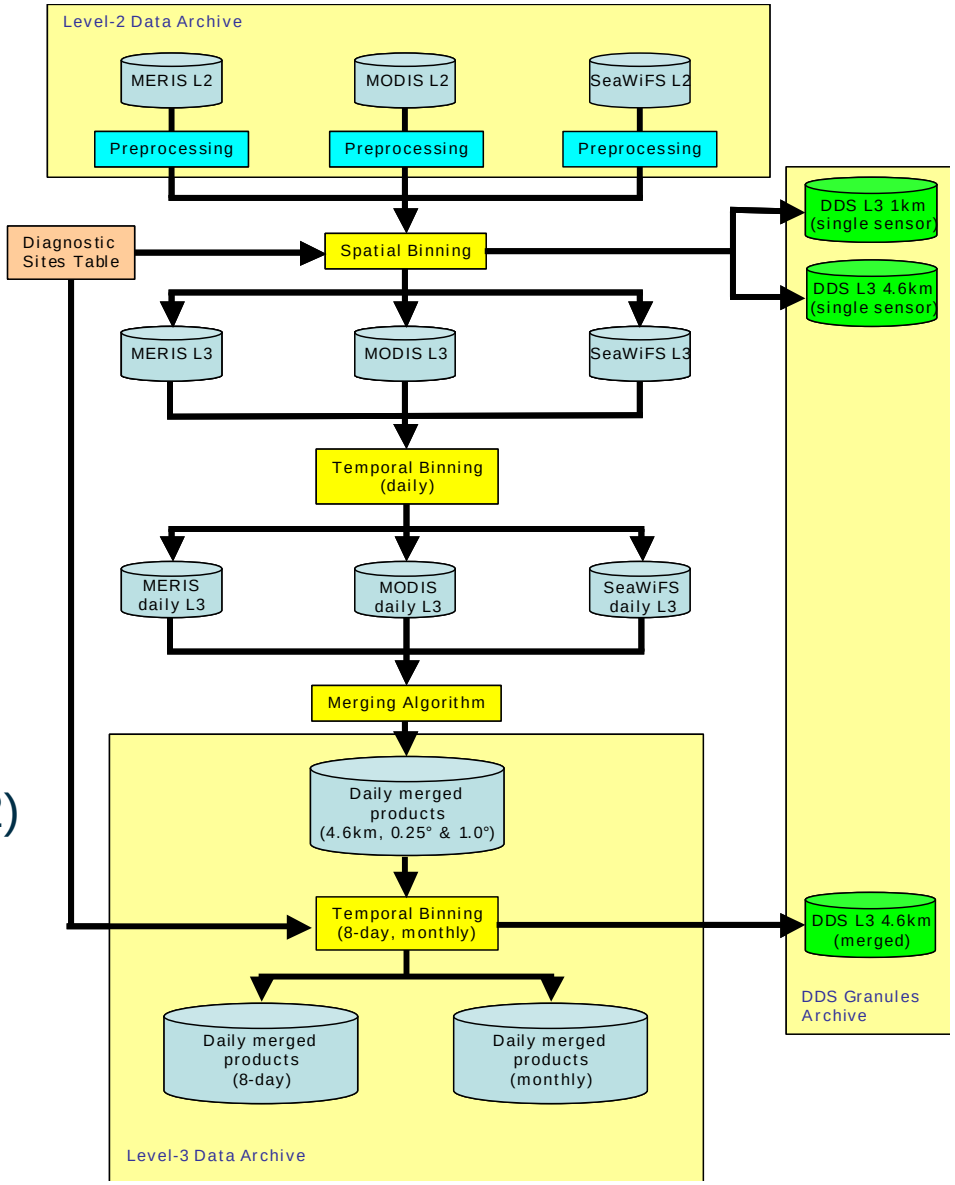
- Data acquisition
- Pre-processing
- Spatial binning
- Temporal binning
- Merging
- Formatting (netCDF, JPG/PNG)

Data Volumes

- More than 25 Tb of input data (level 2)
- 14 Tb of intermediate products
- 4.5 Tb of distributed data

Off-line and NRT production

see Gilbert Barrot's presentation

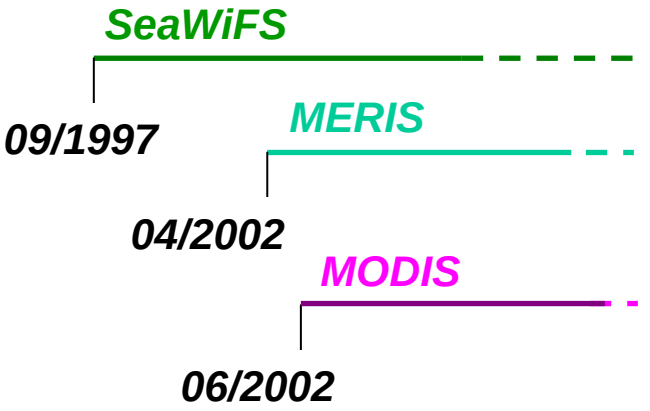


GlobColour products

Daily, 8-days, monthly products (4.6 km)

- Normalised water-leaving radiance @ 412, 443, 490, 510, 531, 555, 620 nm
- Water-leaving radiance @ 670, 681, 709 nm
- Particle backscattering coefficient (bbp443)
- CDM absorption (aCDM443)
- Chlorophyll concentration (Chla)
- Total Suspended Matter
- Diffuse attenuation coefficient @ 490nm (K_d490)
- Aerosol Optical Thickness (T865)
- Data quality flags
- Cloud fraction
- Excess of radiance at ~ 555 nm (turbidity index) (EL555)
- GSM01 error estimates per pixel for each layer

MODIS-only, MERIS-only



+ new demonstration products PAR, Secchi disk depth, heated layer in 2008

see André Morel's presentation

GlobColour
DUE project – 3 years – 3 phases

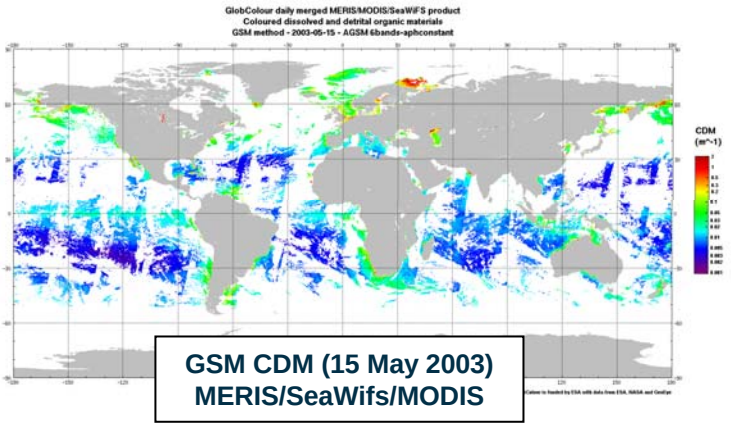
Phase 1 (2006) : Demonstration of feasibility

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

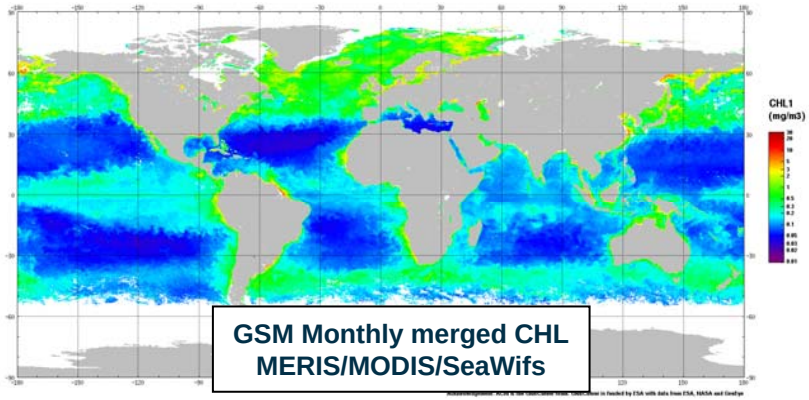
Phase 3 (2008) : Daily delivery of global merged ocean colour products

- Second and third objective : Operate the service by delivering specific validated products
  - 10 year global archive of merged MERIS-MODIS-SeaWiFS ocean colour products at 4.6 km resolution
  - Produce GlobColour diagnostic data set (DDS)
- Achieved in one year, validated at the second UCM in Oslo, November 2007
  - Service/production
  - Validation (validation protocol, match-up analysis)

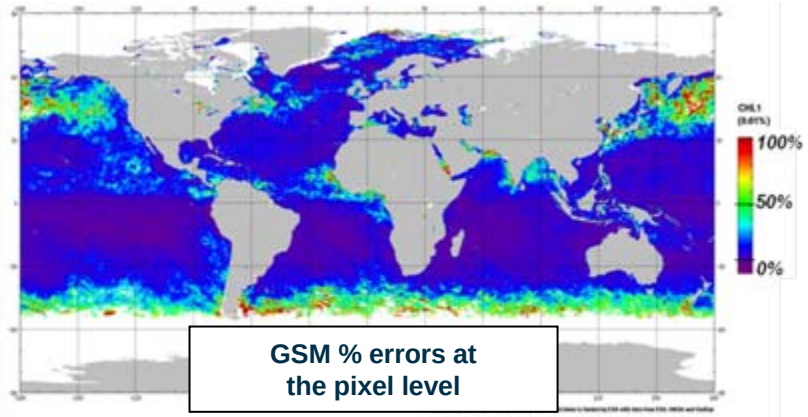
Product examples



GSM CDM (15 May 2003)
MERIS/SeaWifs/MODIS



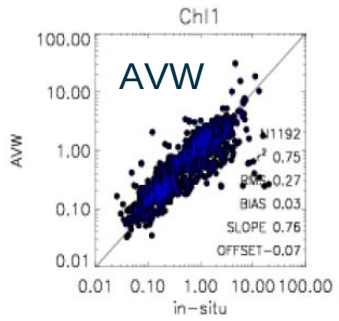
GSM Monthly merged CHL
MERIS/MODIS/SeaWifs

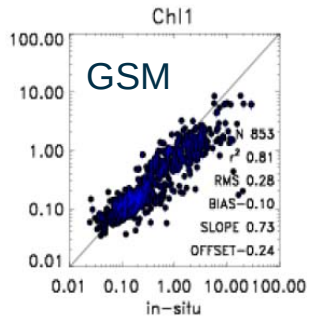


GSM % errors at
the pixel level

Match-up analyses (OBPG/NOMAD/BOUSSOLE) & product inter-comparison show:

- Error statistics of the merged data are in general better than data from the three individual sensors
- The normalized water-leaving radiance at 490 nm is the most homogeneous product among the 3 sensors
- GlobColour GSM01 merging algorithm shows to be quite robust over coastal waters



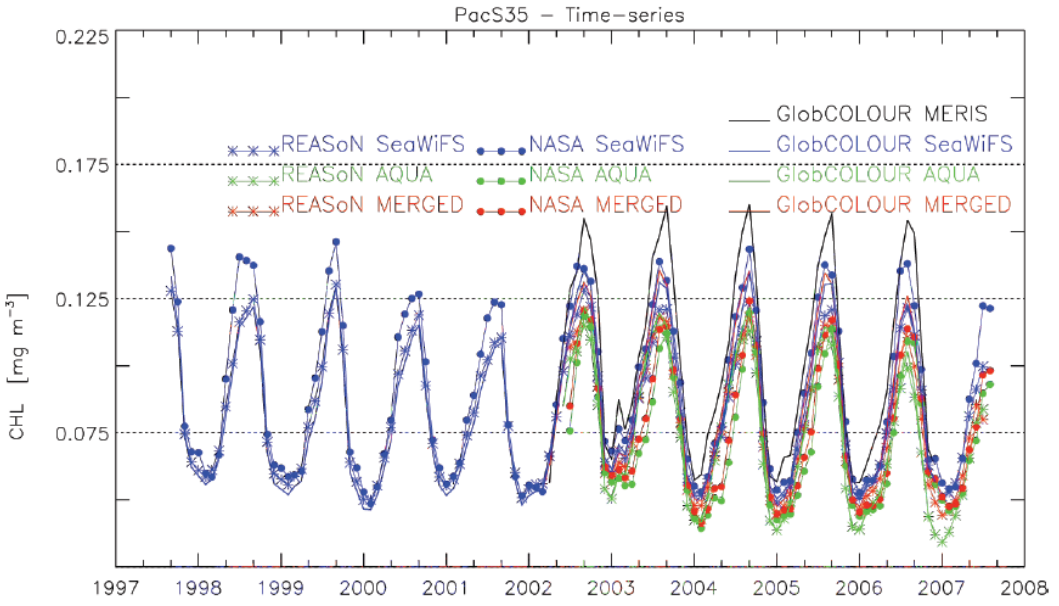


Inter-comparison with other initiatives

	REASoN	NASA OBPG	GlobColour
Input Data	•SeaWiFS •MODIS-AQUA	•SeaWiFS •MODIS-AQUA	•MERIS •SeaWiFS •MODIS-AQUA
Merging method	•GSM01 model (merges the Lwn(λ))	•Weighted average	•GSM01 model (with Lwn(λ) weighting) •Weighted average
Products	• CHL • CDM • BBP • (uncertainties for daily products)	• CHL	• 19 products (+ uncertainties for some)
Spatial, temporal resolution	9 km Daily, 4-Day, 8-Day, Monthly	9 km Daily, 8-Day, Monthly, Seasonally, Yearly	4.5 km, 1/4°, 1° Daily, 8-Day, Monthly

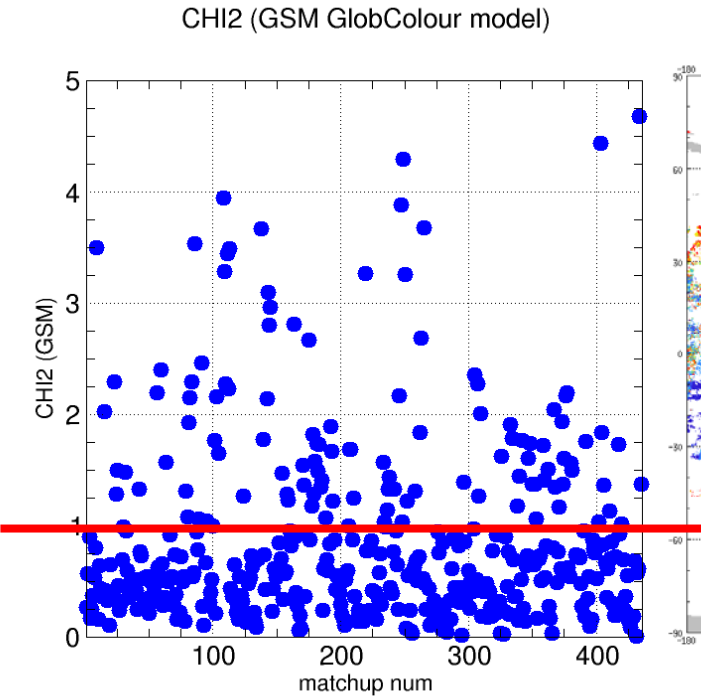
- **The CHL products, merged or from only the individual sensors are consistent and agree well**
- **MERIS alone tends to produce higher CHL values than SeaWiFS or AQUA**
- **AQUA alone tends to produce lower CHL values than SeaWiFS or MERIS**

Validation results presented at the 2nd user workshop in Oslo, Nov 2007
www.enviport.org/globcolour/validation/

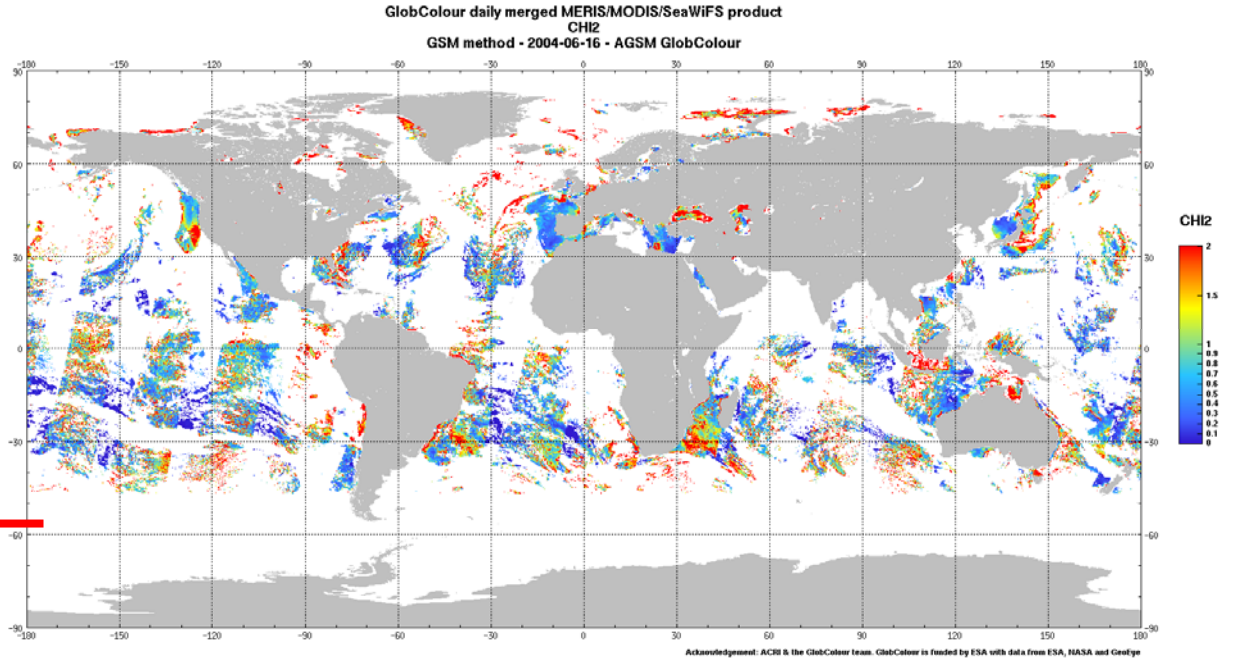


GlobColour uncertainties estimates
Qualification of retrieval – Chi-2 Indicator

NOMAD – V2.0

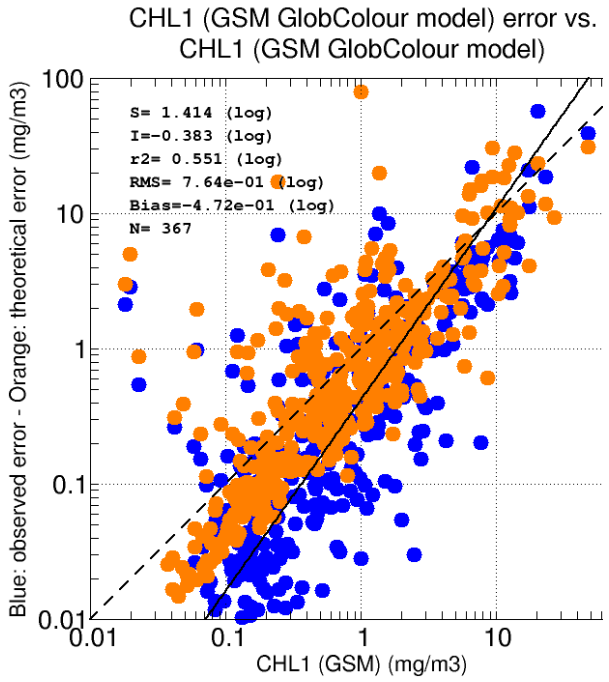


16 June 2004 - Global

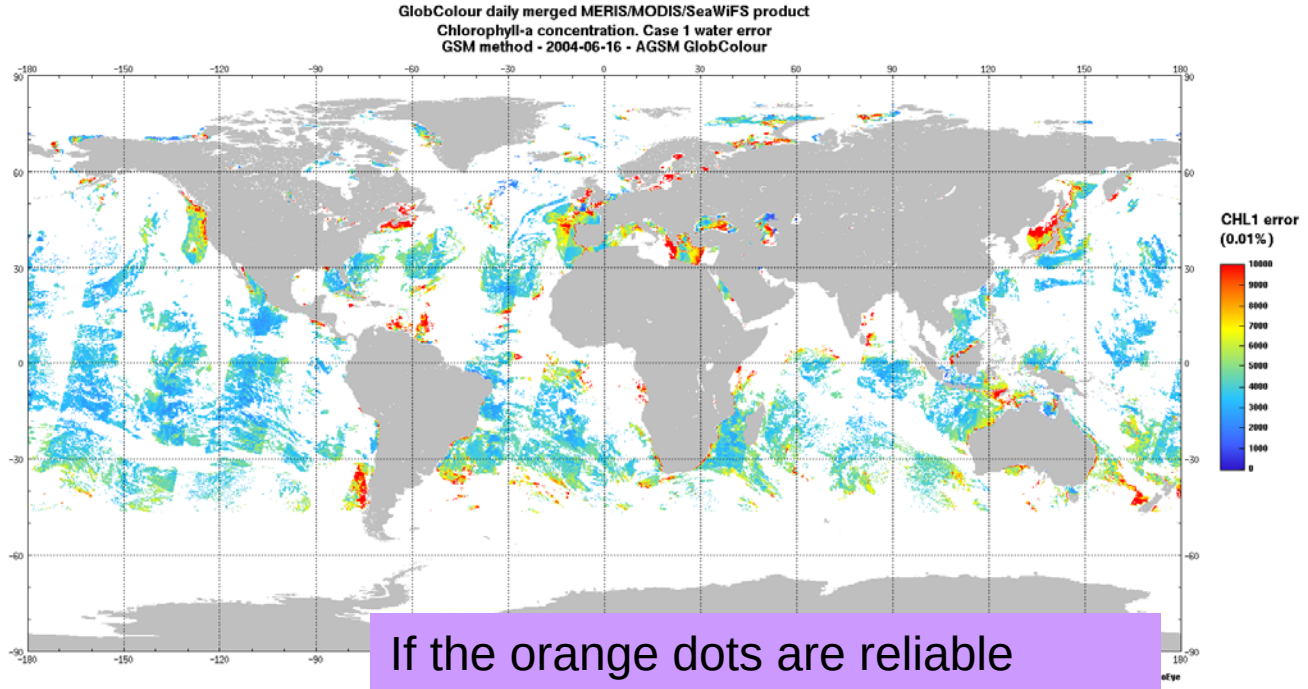


GlobColour uncertainties estimates
Qualification of retrieval – Chl-a error estimate

NOMAD – V2.0



16 June 2004 - Global



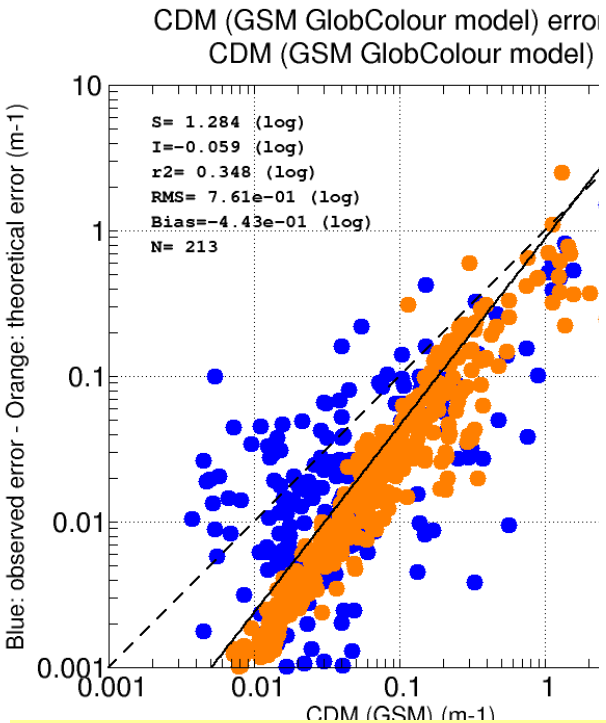
Uncertainties estimates (outputs of GSM)

Actual difference (absolute) between observed and retrieved

If the orange dots are reliable standard deviation – there should be, statistically, about 68% of blue points below the corresponding orange points (+/-1σ)

GlobColour uncertainties estimates
Qualification of retrieval – CDM error estimate

NOMAD – V2.0



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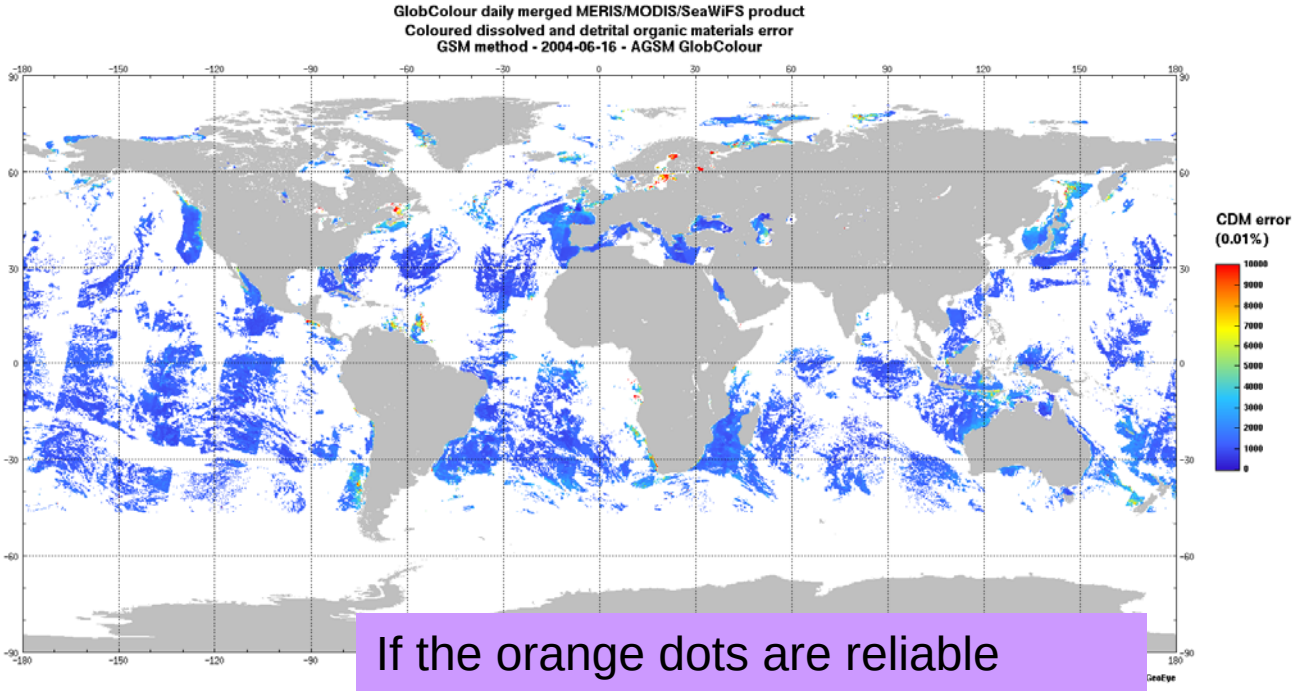


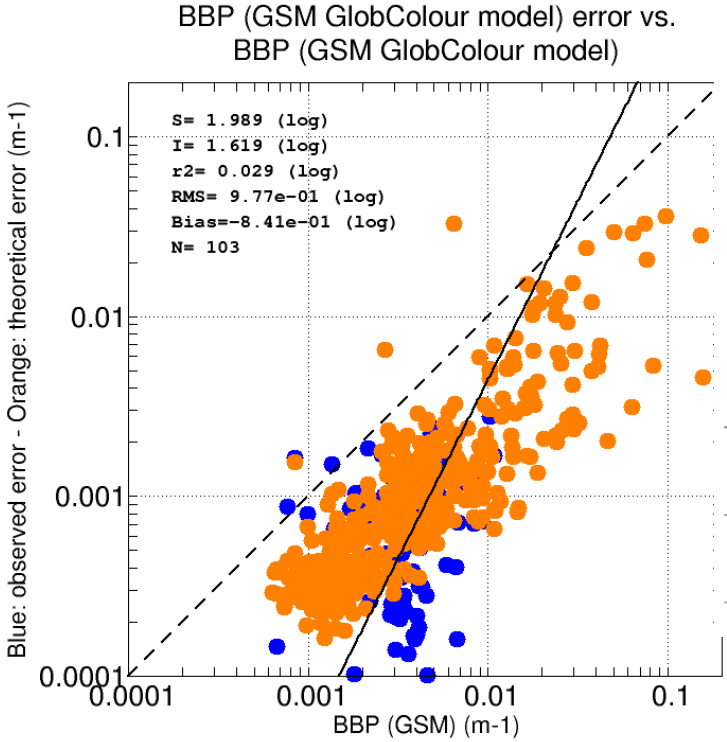
Uncertainties estimates (outputs of GSM)

Actual difference (absolute) between observed and retrieved

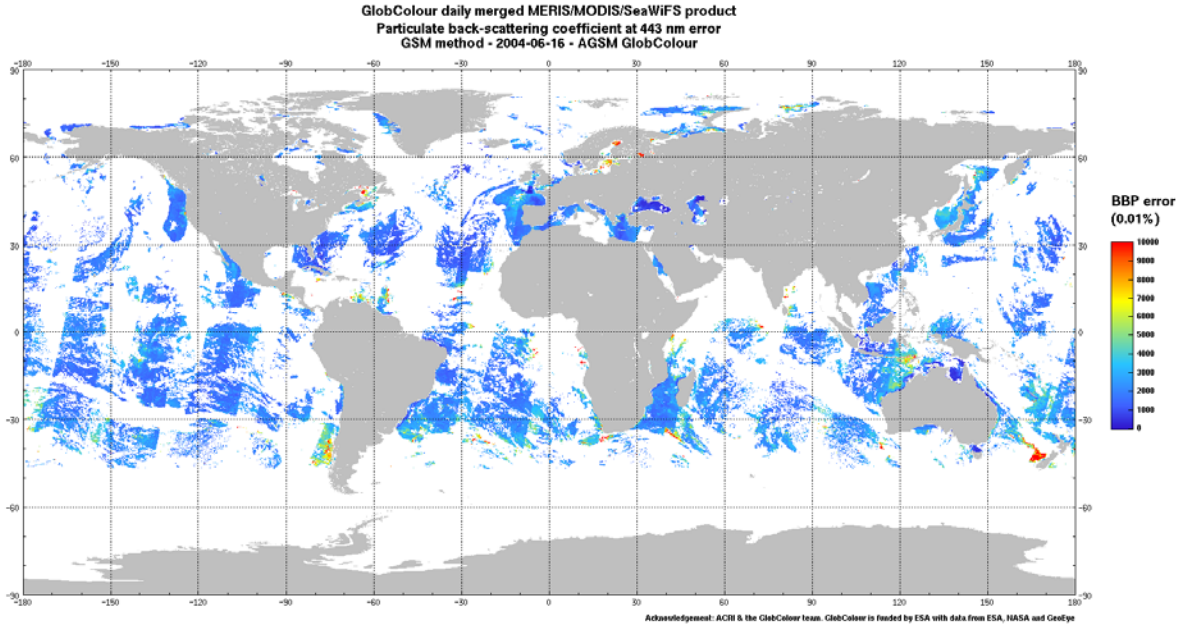
If the orange dots are reliable standard deviation – there should be, statistically, about 68% of blue points below the corresponding orange points (+/-1σ)

GlobColour uncertainties estimates
Qualification of retrieval – bbp error estimate

NOMAD – V2.0



16 June 2004 - Global



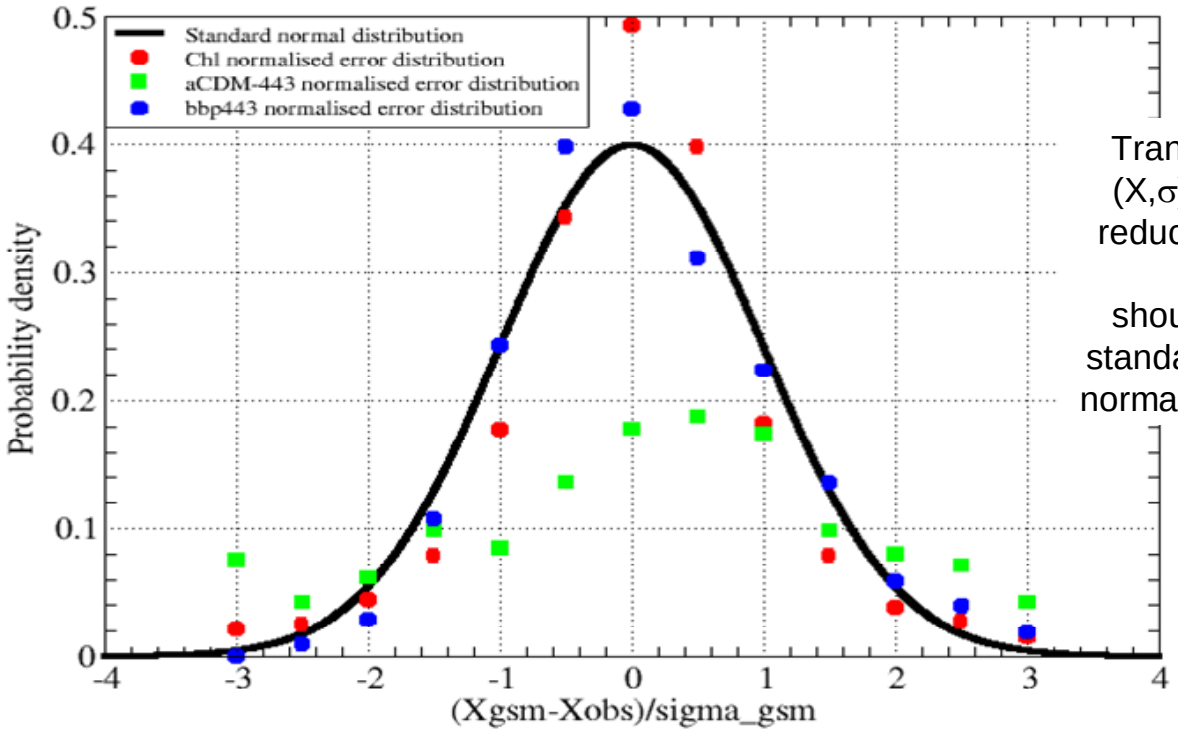
Uncertainties estimates (outputs of GSM)

Actual difference (absolute) between observed and retrieved

If the orange dots are reliable standard deviation – there should be, statistically, about 68% of blue points below the corresponding orange points (+/-1σ)

GlobColour uncertainties estimates
Qualification of retrieval – Error estimates

NOMAD – V2.0
Match-ups



Transition from (X,σ) couple to reduced variable X/σ should follow a standard centered normal distribution.

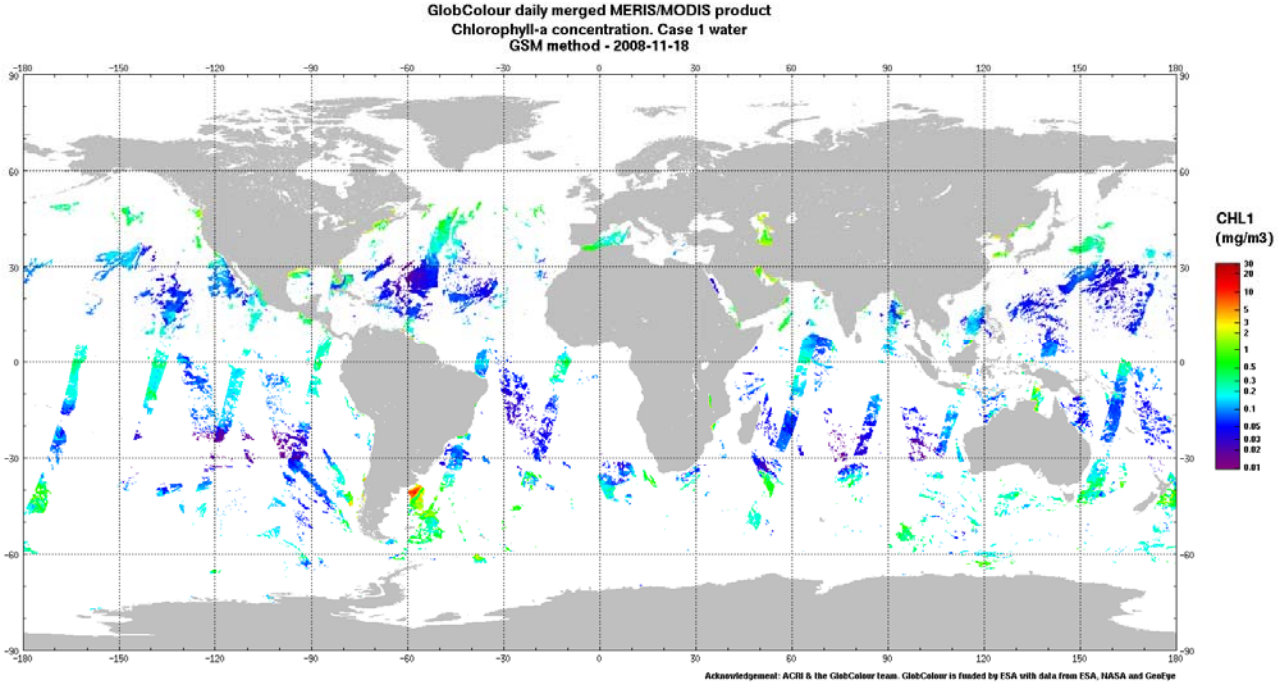
Chla and bbp error estimates are reliable
Error estimates on a_{CDM} are questionnable

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



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

– Fourth objective : NRT global service at 4.6 km
  - Achieved since July 2008

– Fifth objective : Develop a user base for GlobColour products
  - Started to grow in 2008

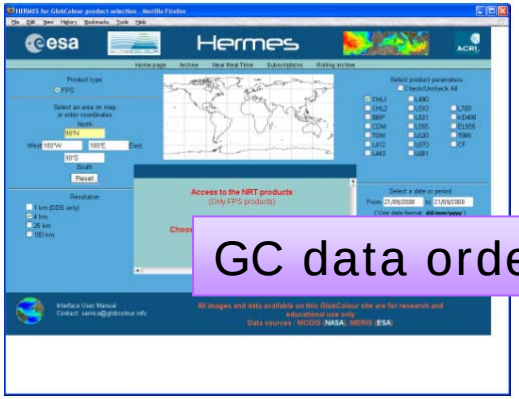
  - Data access
  - Communication
  - Validation (continuous)

see Gilbert Barrot's presentation

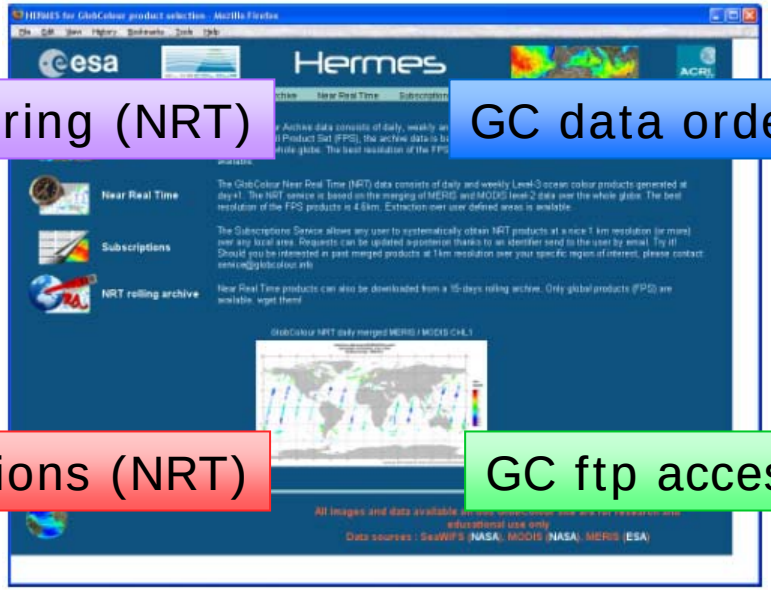
see Samantha Lavender's presentations

GlobColour

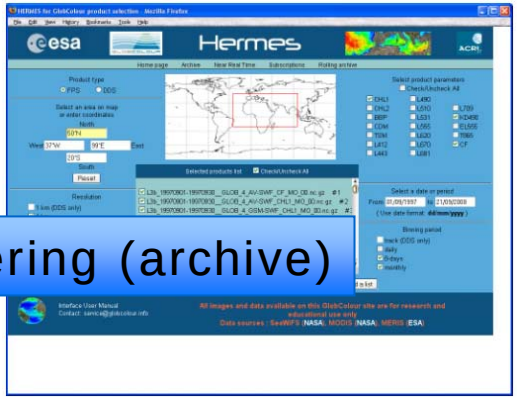
http://www.globcolour.info/
http://hermes.acri.fr/



GC data ordering (NRT)

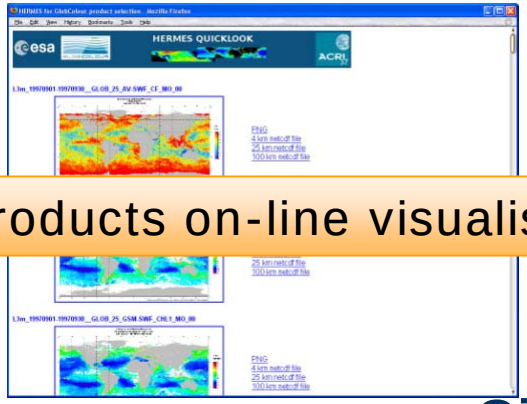


GC data ordering (archive)



GC subscriptions (NRT)

GC ftp access (archive, NRT)



GC products on-line visualisation

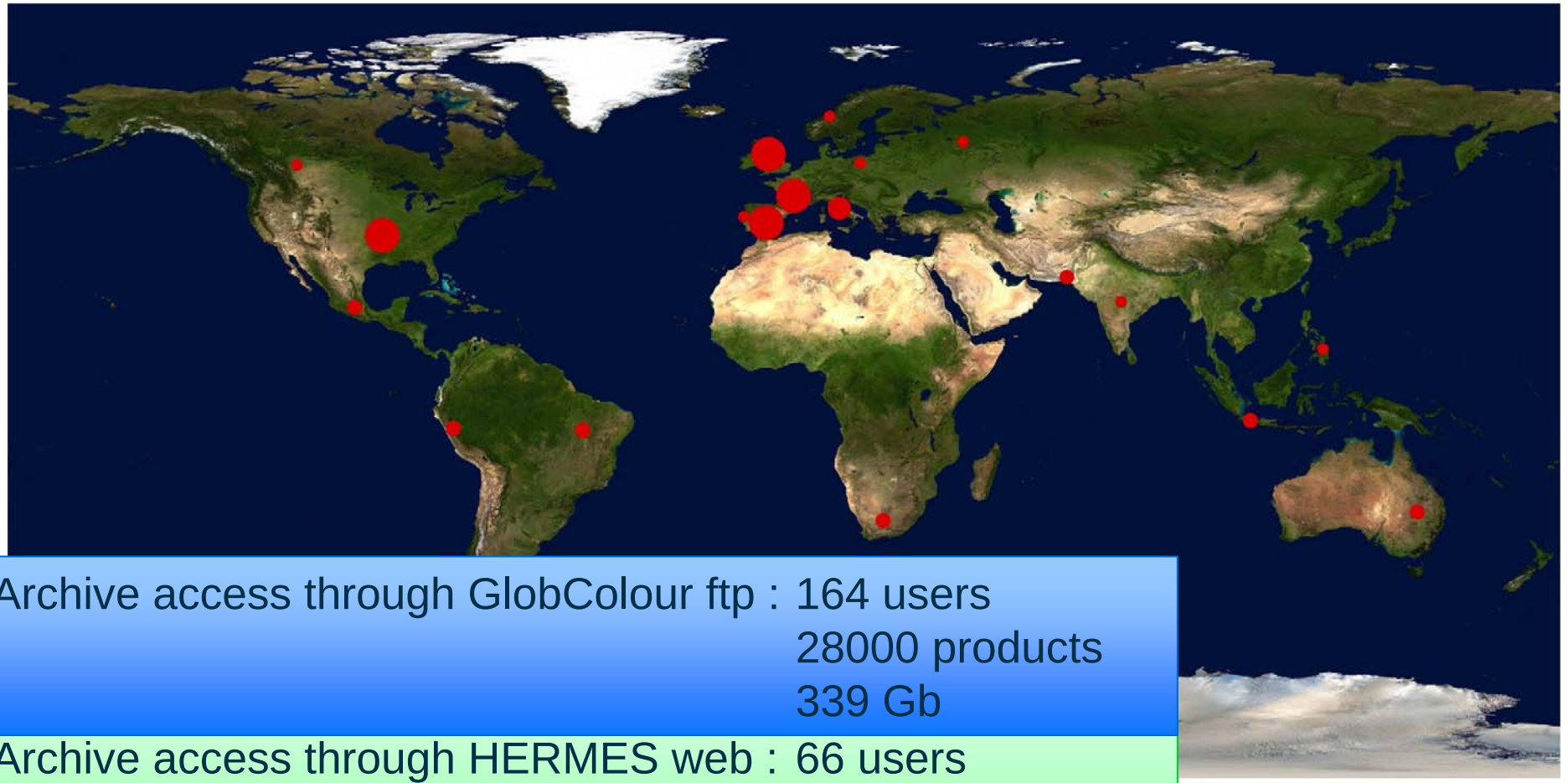
NRT global 4.6 km
and
NRT 1km
for user defined RoI
(subscriptions)

Allows geographical extraction of archived and NRT products

see Gilbert Barrot's presentation

GlobColour

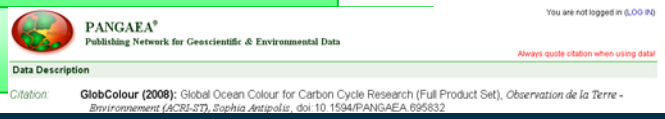
Hermes Archive - Nbr of users / country



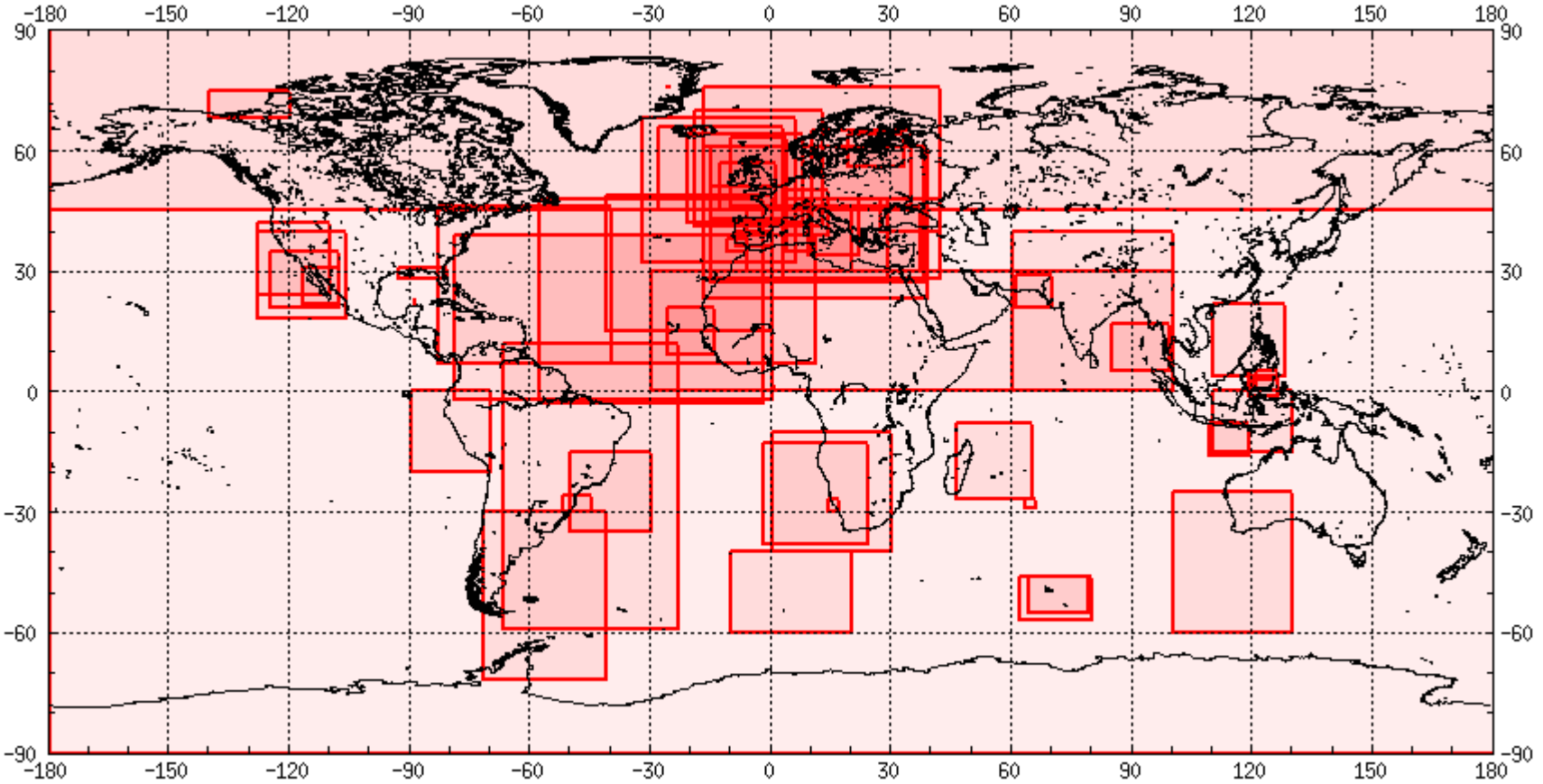
Archive access through GlobColour ftp : 164 users
28000 products
339 Gb

Archive access through HERMES web : 66 users
34000 products
710 Gb

Also : Archive access through WDC – MARE

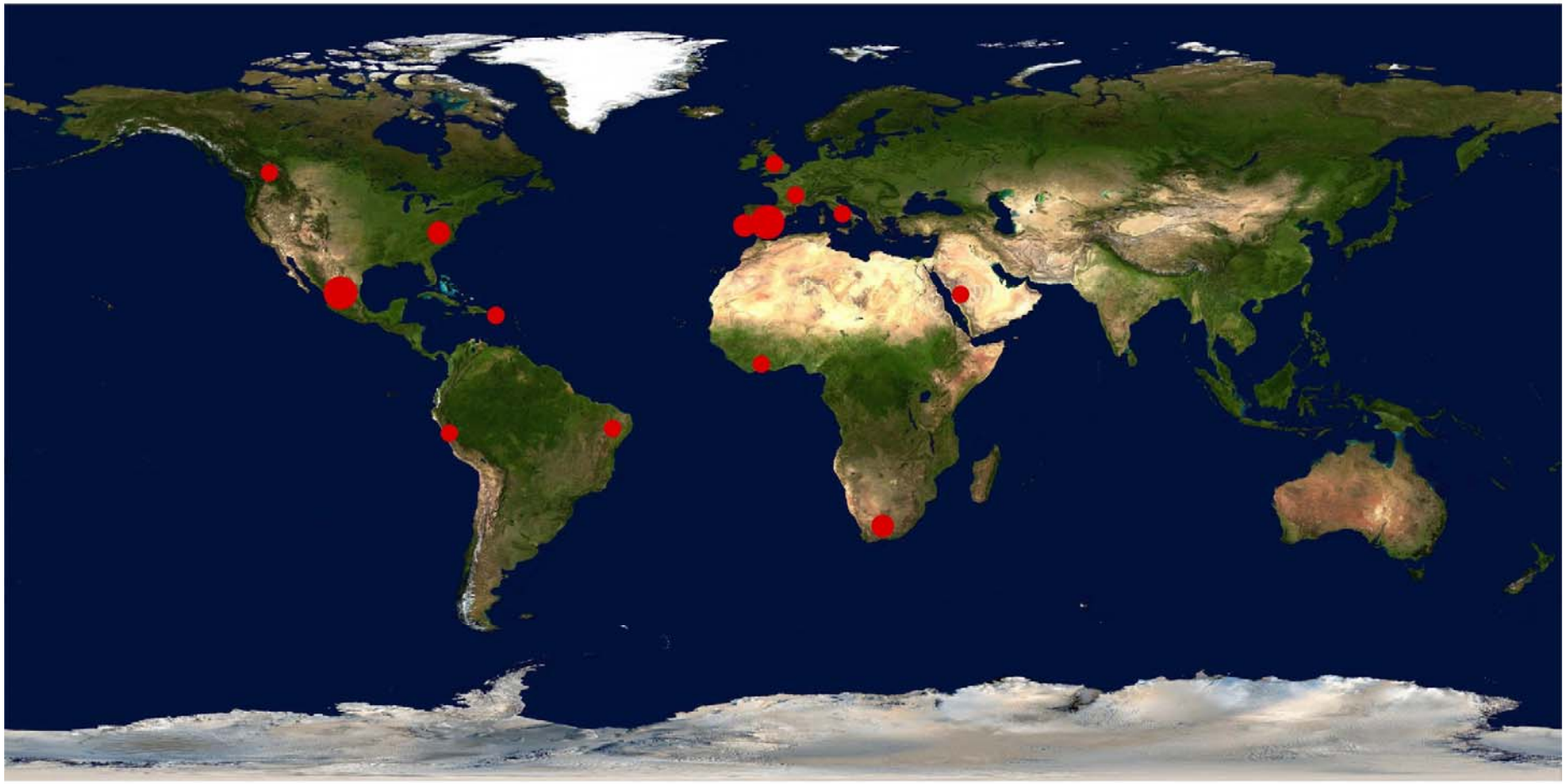


Archive specific requests : where ?



Increase of the number of users after the announcement of the HERMES server on: ESA EO web site, IOCCG News and NASA OBPG News

GlobColour

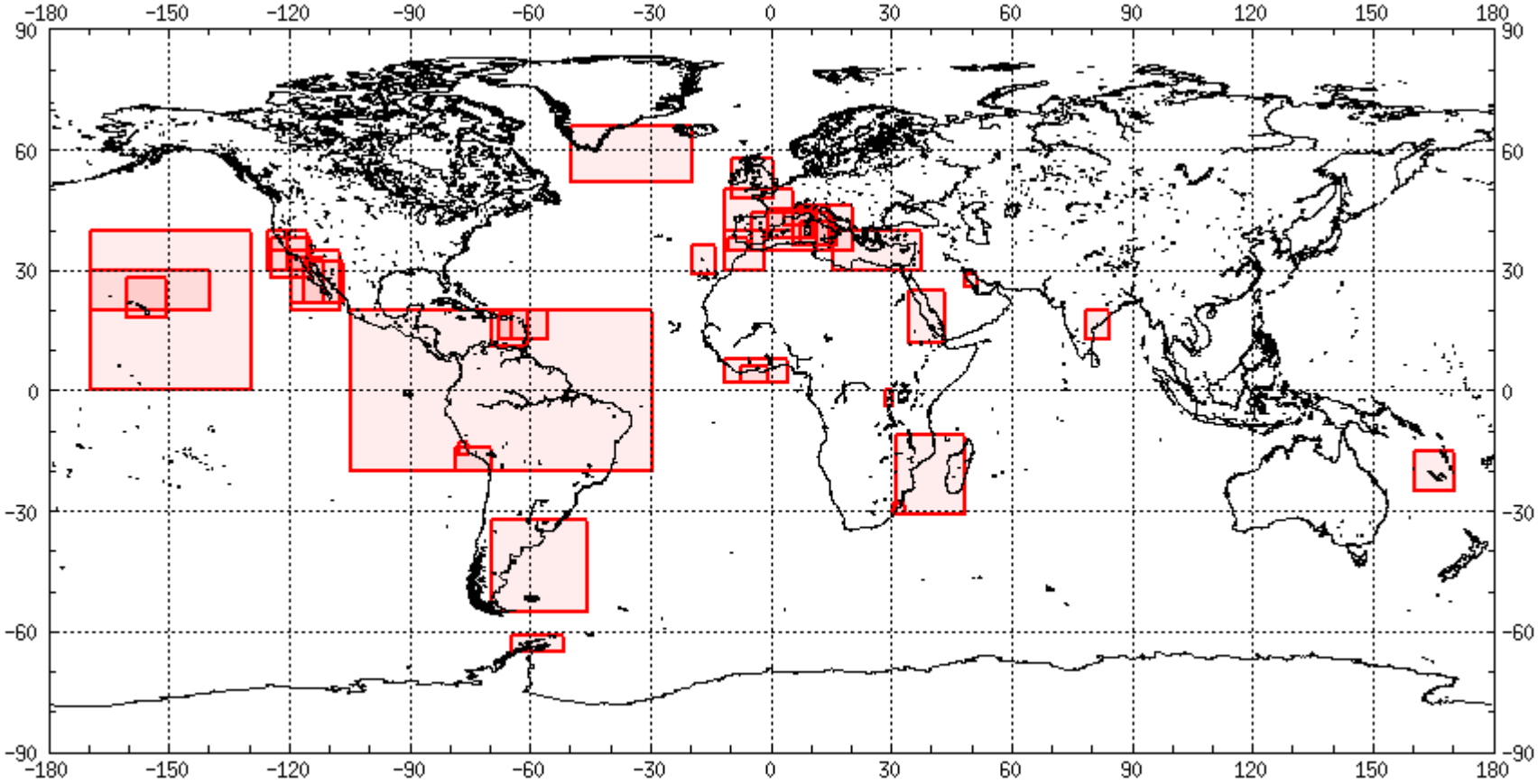


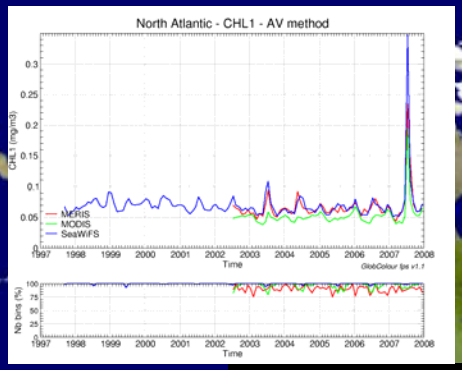
NRT subscriptions:

Double in two months

26 users
1673 products

NRT subscriptions : where




North Atlantic - CHL1 - AV method
CHL1 (mg/m3)
MERIS
MODIS
SeaWiFS
Time
GlobColour ljs v1.1
Nb bins (%)
Time

Conclusion

- The GlobColour service satisfying all the initial requirements is in place and ready to continue:
  - The GlobColour 10 year archive is fully available and easily accessible
  - The NRT Service is operational
  - The User Base is growing fast (256 users in November 2008)

- GlobColour products are at least as accurate as the individual sensor products. In most cases they are better. User feedback is very positive.

- Globcolour brings several benefits over existing products:
  - better sampling of the daily variability
  - inclusion of error estimates at pixel level, …

  (*Maritorena et al. 2008, Ocean Color merged data sets: benefits and challenges, under preparation)*

- GlobColour is a step towards meeting the requirements for an ocean colour Essential Climate Variable, but more work needs to be done !

  (*Siegel et al. 2008, Challenges Facing the Creation of Satellite Ocean Color Climate Data Records, under preparation)*

remember André Morel's talk yesterday

Perspectives

- The GlobColour archive will be soon obsolete : a reprocessing should be planned in 2009.
- International Collaboration ? GlobColour has already favoured international collaboration (NASA, ESA), as well as with the international scientific community.
- International forum ? In combination with MERIS, and OLCI dedicated forum ?
- Users want a coastal version of GlobColour => GlobColour 2 (?)
- GlobColour time-series production will continue as part of the EC Kopernikus (GMES) Marine Core Service from 2009 onwards with French national and regional support (REGICOLOUR, INFOCEAN-DESK)
- Real-time monitoring of GlobColour data quality and error estimates (Oceanographic Autonomous Observations that would feed MDB and DDS ala Medspiration)

Acknowledgement

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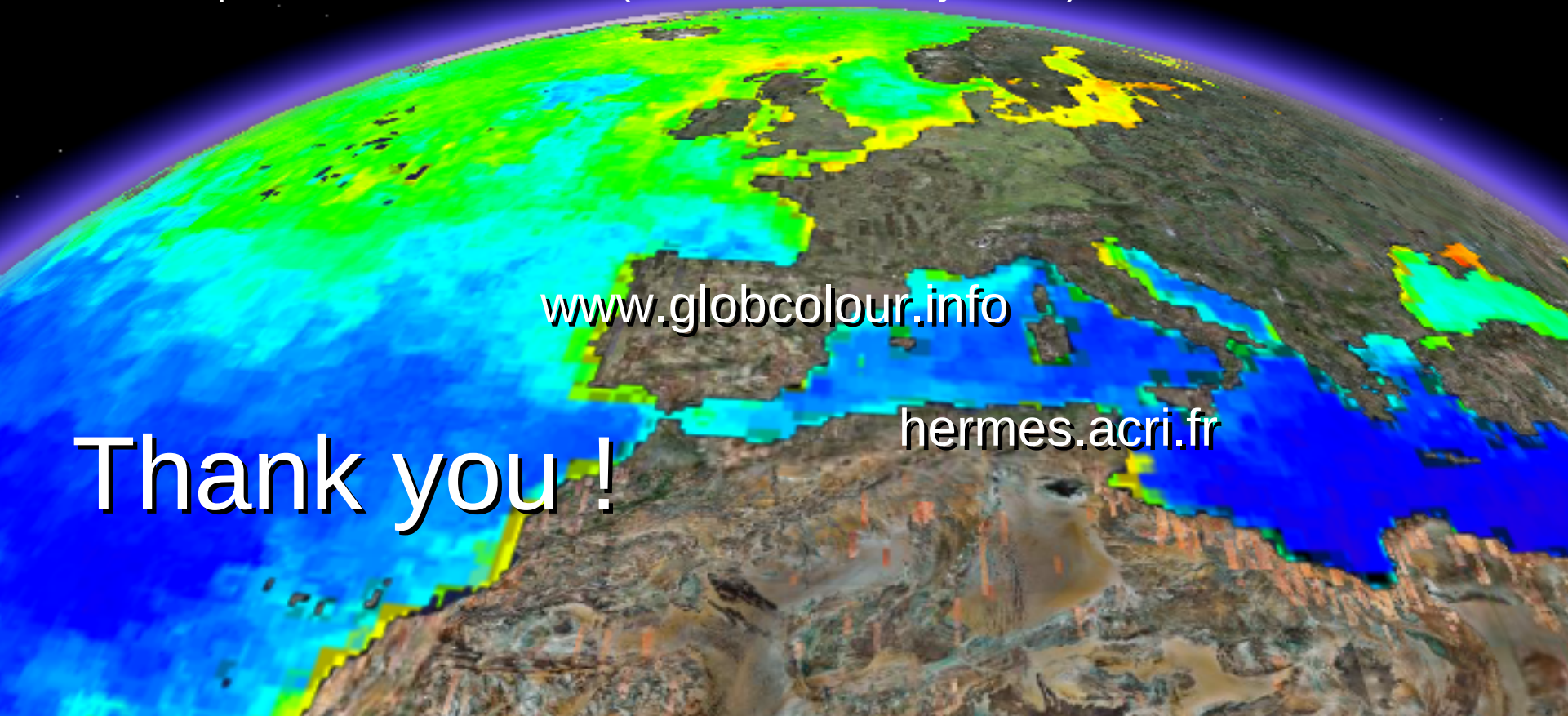
➢ GlobColour has largely benefited from NASA contributions, including the availability of the MODIS and SeaWiFS products; as well as the *in situ* data base of radiometric and phytoplankton pigment data, and other oceanographic and atmospheric data: SeaBASS (Werdell and Bailey, 2002).



www.globcolour.info

hermes.acri.fr

Thank you !

Where would we be without GlobColour ?

Thank you ESA !

Thank you Olivier !

Thank you Simon !