Met Office
Hadley Centre

CMUG

CMUG Assessment of SST and Ocean Colour Precursors

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Assessment of CDRs

Confront

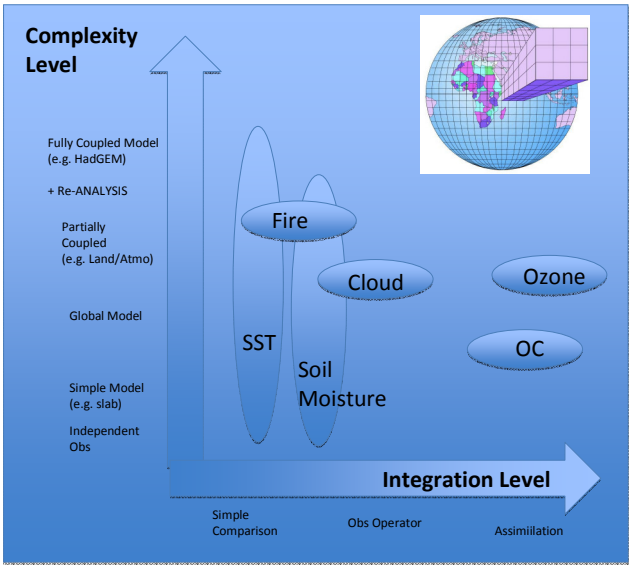
- **Consistency of Satellite Data Products in time (e.g. stability, uncertainty)**
- **Consistency with independent observations (e.g. limb view, in-situ, ground-based remote sensing)**
- **Consistency with precursor datasets to assess if the CCI datasets are better representations of the atmospheric/surface state**
- **Consistency compared to reanalysis fields**
- **Consistency across ECVs**
- **Ability to capture climate variability and trends for use in Climate Monitoring and Attribution.**

Assimilate and boundary condition

- **Impact in Model and Data Assimilation Systems (for a few ECVs)**

Assessing CCI Datasets

Data used for assessment of CDR	Advantages	Drawbacks
Climate Model (single, ensemble)	Spatially and temporally complete	Model has uncertainties Not all variables available
Re-analyses	Spatially and temporally complete	Analysis has uncertainties Not all variables available
Precursors	Comparing like with like	Precursors may have large uncertainties
Independent satellite or in situ measurements	Different 'view' of atmosphere/surface	May have much larger uncertainty than CDR, need to include representativity errors
Related observations (surface and TOA fluxes, temperature, water vapour)	Assures consistency with other model variables	May not be spatially or temporally complete



Contribution to International Efforts & Assessment

CMUG ECV assessment in Doc 3.1

Methodology used for assessment of ECVs	Assessment of ECVs in this report
Climate Model (single, ensemble)	Clouds, Ozone, Land Cover, Fire
Re-analyses	SST, SSH, Ozone
Precursor datasets	N/A
Independent satellite or in situ measurements	SST, Clouds, Ozone
Related observations (surface and TOA fluxes, temperature, water vapour)	Clouds
Assimilation	Ocean colour, SSH, Ozone

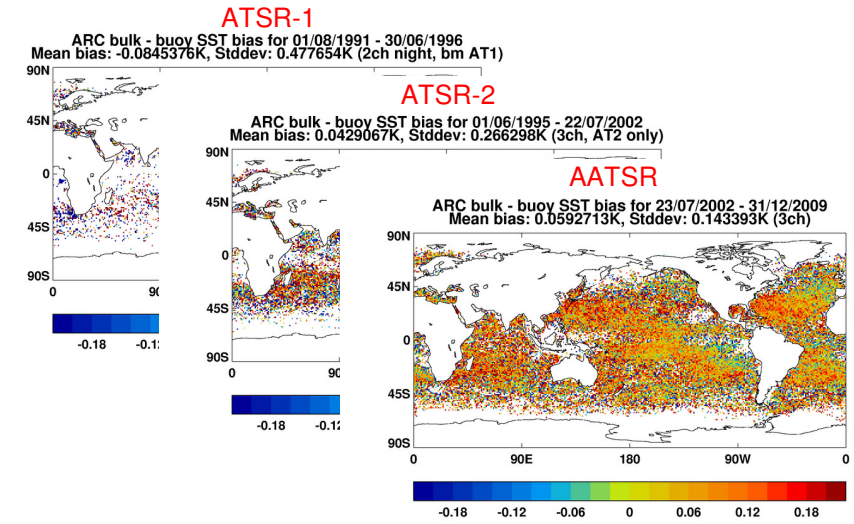
ARC SST Pre-cursor

- ARC = (A)ATSR Reprocessing for Climate
- All ATSR, ATSR-2 and AATSR SST retrievals reprocessed to provide a complete seamless SST dataset
- It covers 1991-2010
- It includes uncertainty estimates
- Several realisations (SADIST, Bayes, 2/3ch)
- Special Issue of RSE on ARC science out

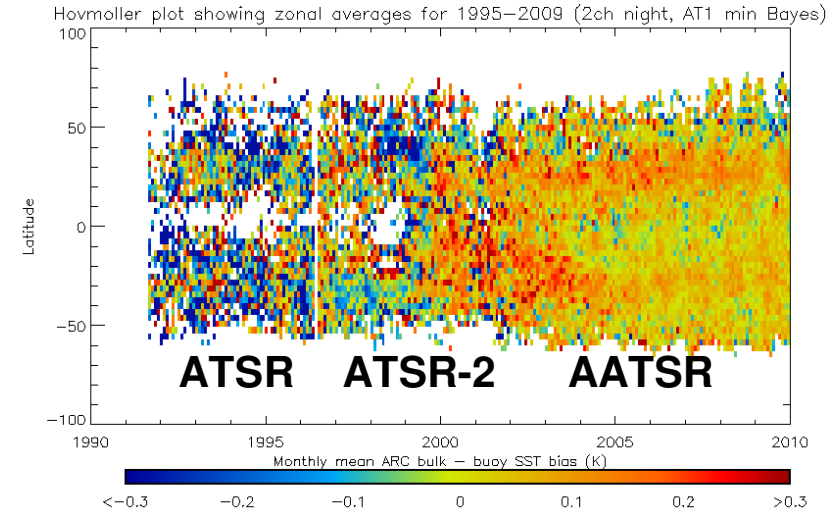
ARC SST Assessment in-situ data

- Using drifting buoys from version 2.5 of ICOADS for 1991-1996
  - Location given to 1 decimal place (0.1°) precision
- Using GTS drifting buoys from 1997
  - Location given to 3 decimal place (0.001°) precision
  - Buoy data merged with assimilation output – provides quality control flag and NWP background SST for comparison
  - Allows comparison with NWP model predictions to screen for large variability or large biases in each buoy

Coverage of collocations

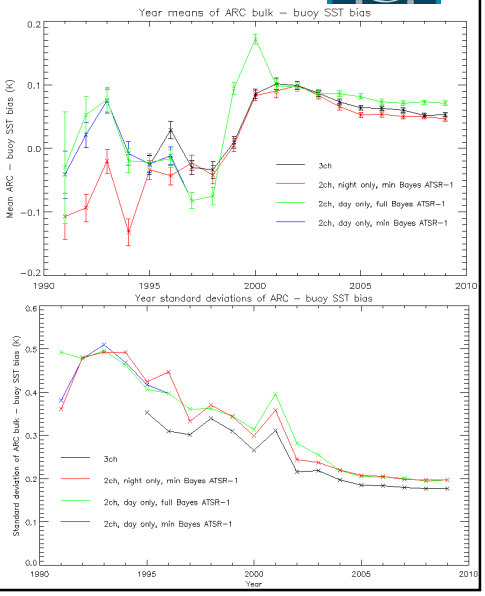


Hoevmuller plot for colocations

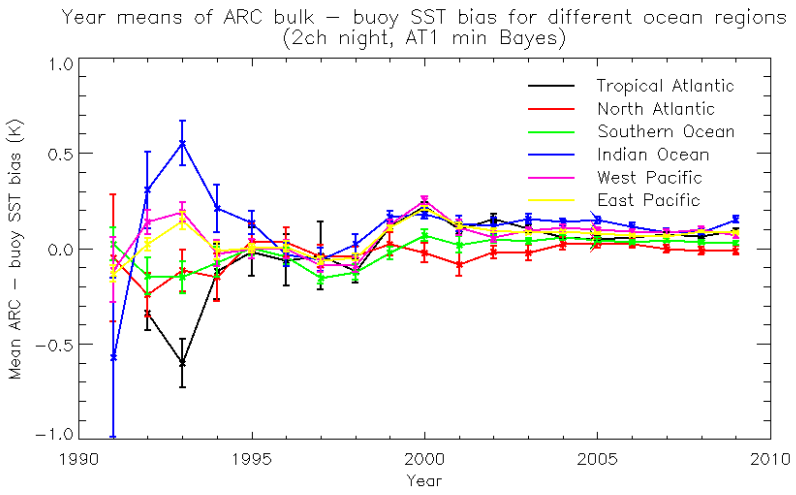


Global statistics

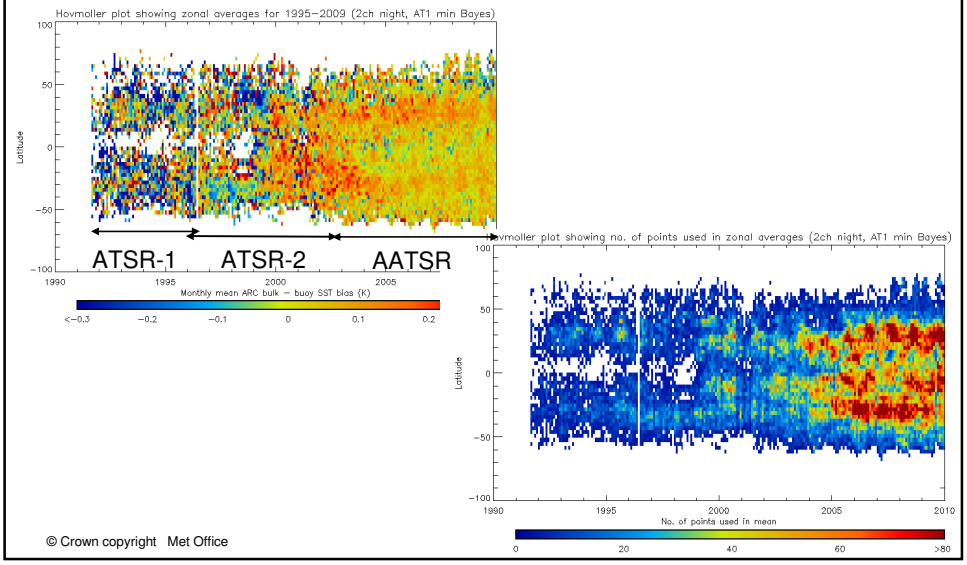
- Overall small, positive bias with respect to drifting buoys
  - 2 channel, night only: 0.044K
  - 3 channel, night only: 0.054K
  - 2 channel, day only: 0.064K
- Difference in stability of earlier and later years



Regional statistics

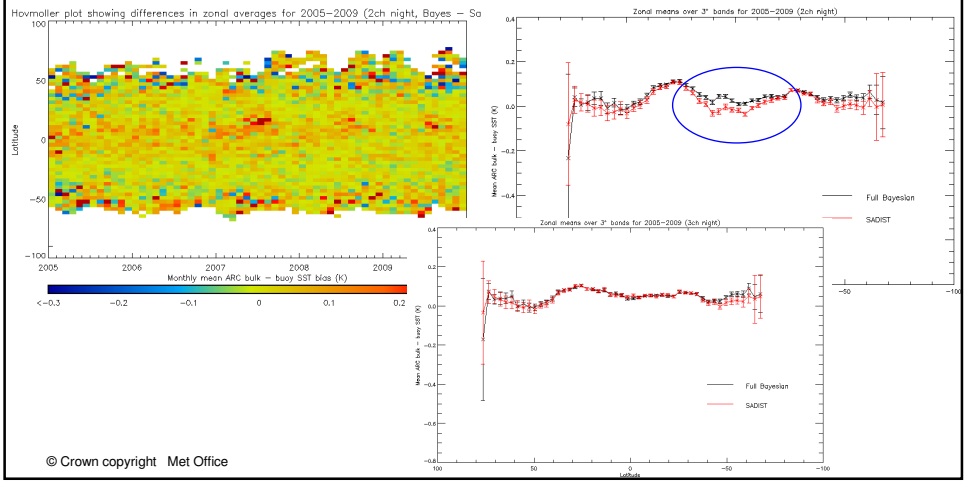


Summary of 2 channel night-time SSTs



Cloud mask differences

- Comparison of SADIST and full Bayesian cloud mask for 2005-2009



Estimating Uncertainties

3-way error analysis

Allows calculation of the standard deviation of error on each observation type

- Error variance calculated by:

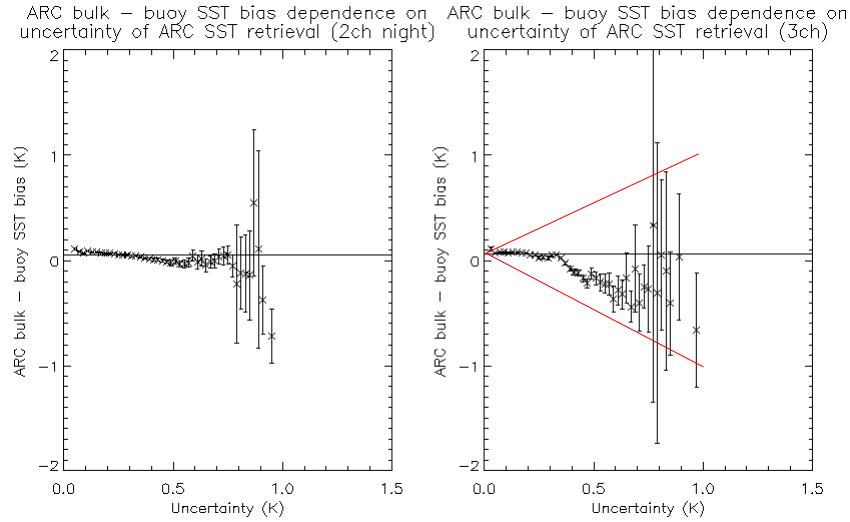
$$\sigma_x^2 = 0.5 * (V_{xy} + V_{zx} - V_{yz})$$

- σ_x : standard deviation of the error in observation type x
- V_{xy} : variance between two observation types x and y
- Note: no spatial or temporal scales defined
- Further details in paper by O'Carroll *et. al.* 2008
- For this analysis x=AATSR, y=AMSR-E, z=Buoys

Uncertainties from 3-way matchups

Sensor	ST. Dev of error for each year (K)						
	2003	2004	2005	2006	2007	2008	2009
ARC bulk SST	0.137	0.129	0.139	0.137	0.138	0.136	0.134
AMSR-E SST	0.468	0.462	0.462	0.466	0.482	0.489	0.500
Buoy SST	0.189	0.174	0.155	0.152	0.149	0.149	0.153

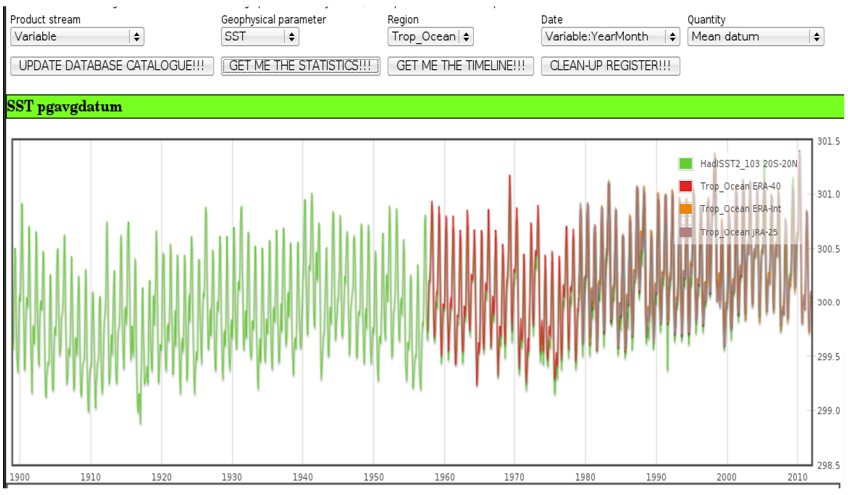
Assessing ARC uncertainty



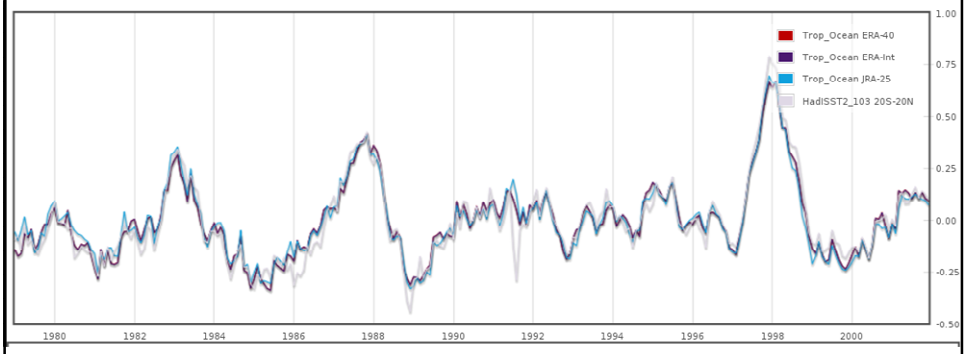
p-HadISST2 SST assessment

- p-HadISST2 is a new beta version of an historical SST analysis from 1850-2010
- It includes in-situ and satellite ((A)ATSR & AVHRR) data
- It has 10 realisations of SST for all months throughout the period giving spread of uncertainty
- It will be used in ERA-Clim, HadGEM climate model runs and many other applications

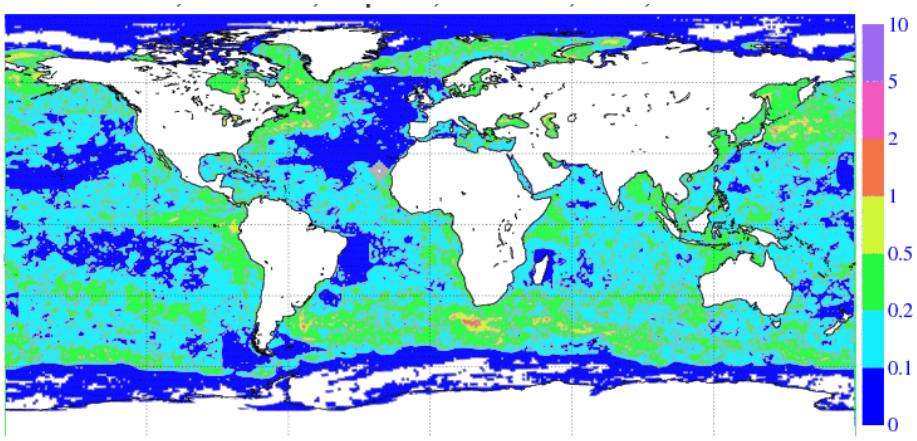
Assessment of p-HadISST2



Reanalysis and p-HadiSST2 SST anomalies 20S – 20N



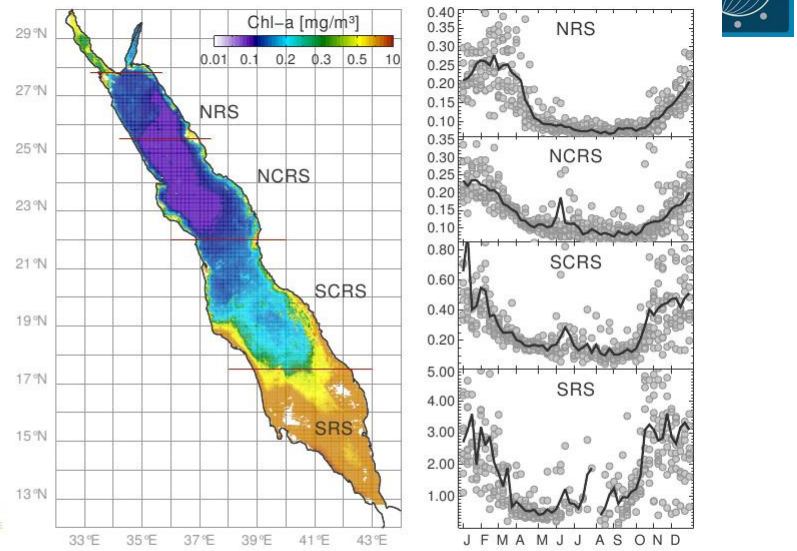
Ensemble spread of SST p-HadISST2 15 Oct 2010



Ocean Colour precursor GlobCOLOUR

- ESA DUE project to reprocess MERIS ocean colour dataset
- SeaWIFS data from 1998-2007, and MODIS and MERIS data from 2002-2007.
- Chlorophyll concentration in $mg.m^{-3}$
- Includes estimates of uncertainty

Red Sea Study

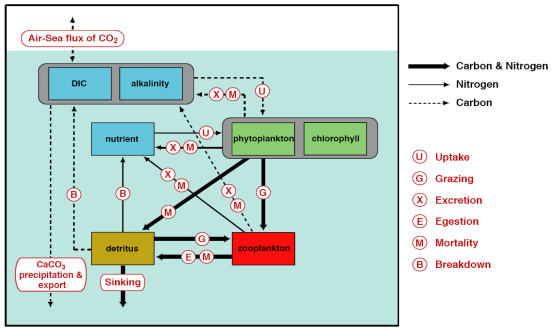


Ocean Colour Data Assimilation

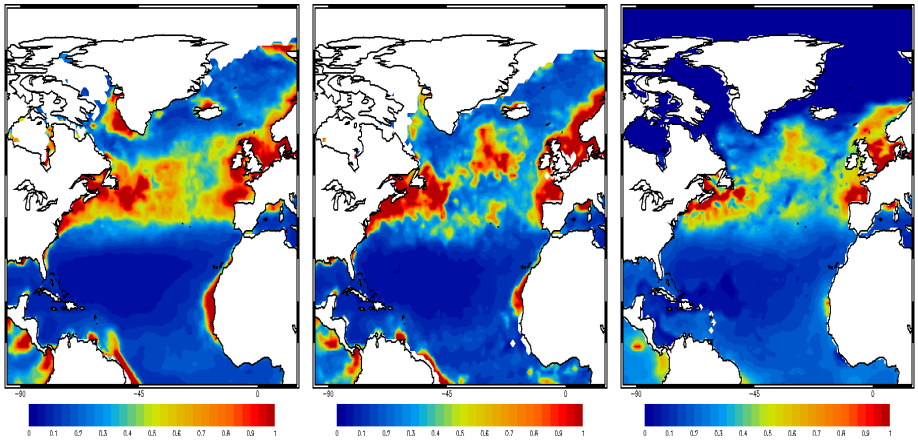
- Aims:
  1. Assimilate GlobColour data into FOAM-HadOCC ocean model
  2. Assess impact on the carbon cycle model
- The carbon cycle model is HadOCC (**Had**ley Centre **O**cean **C**arbon **C**ycle model)

- This model is used for operational short-range prediction as well as climate studies

- It is the biological component of the Met Office's HadGEM2-ES model and contributes to IPCC AR5

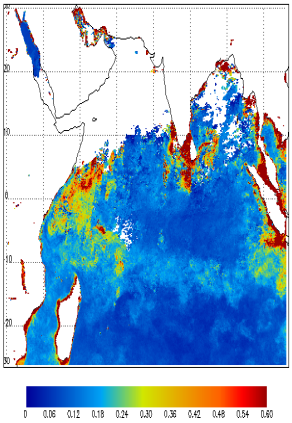


Chlorophyll coverage – North Atlantic April 2008

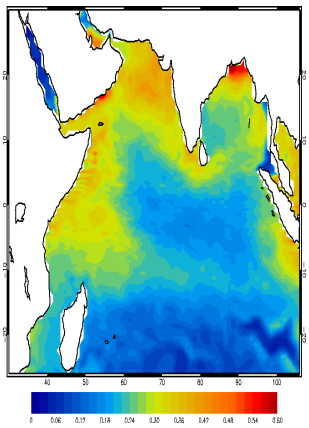


Climatology (April 1998-2007) | Observations (April 2008) | FOAM-HadOCC (April 2008)

Chlorophyll coverage – Indian Ocean July 2008 (during monsoon season)

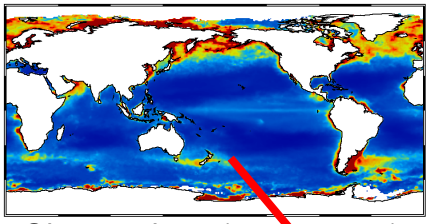


GlobColour
(July 2008)

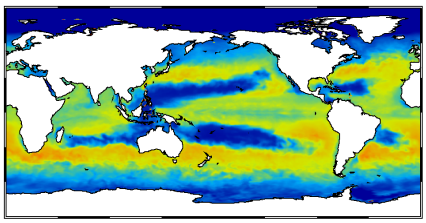


FOAM-HadOCC
(July 2008)

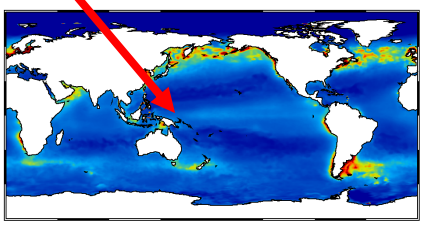
Impact of chlorophyll assimilation



Observations (2008 mean)

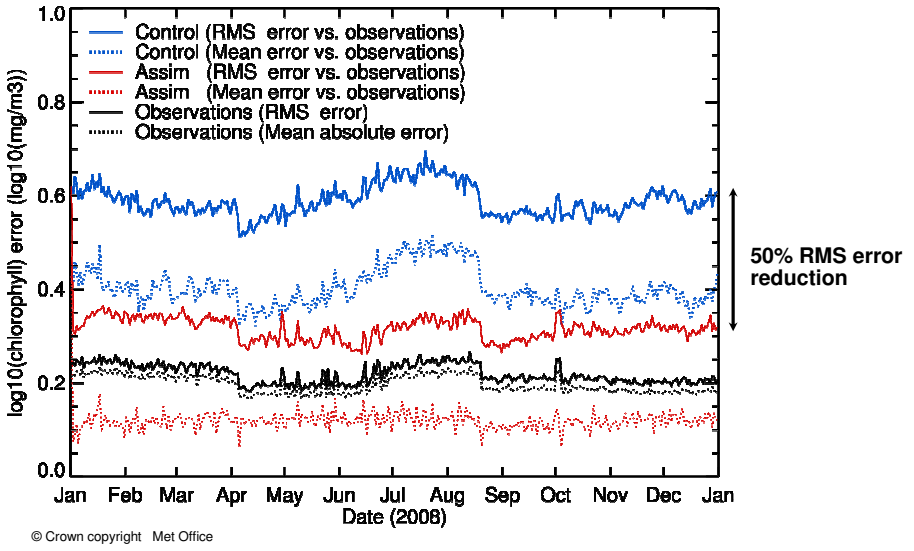


FOAM-HadOCC – no chl assim



FOAM-HadOCC – chl assim

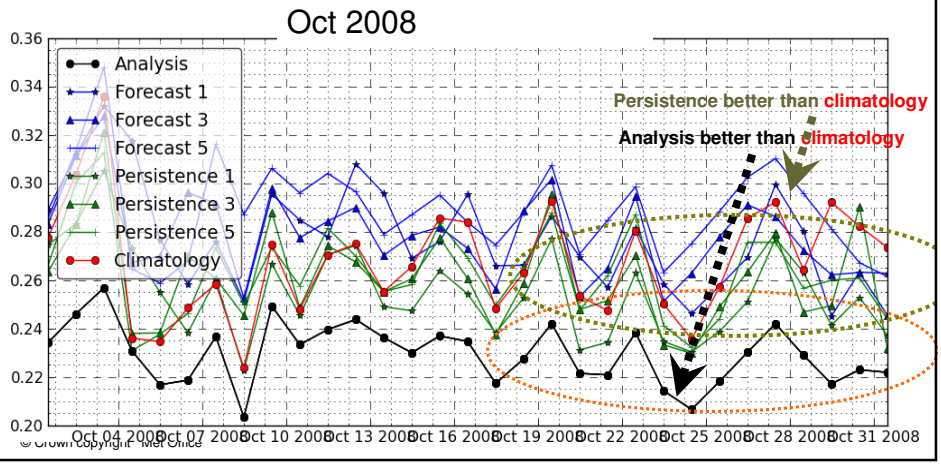
Impact of chlorophyll assimilation



Impact of assimilation on model analysis and forecasts

Time series of RMS error Indian Ocean

Biological data assimilation only



Summary

- Examples of assessing two pre-cursor CCI datasets shown
- Several different approaches from in-situ data validation to assimilation
- Assessment not only of parameter but also associated uncertainty
- CMUG documenting results in D3.1 document in preparation

SSH
precursor assessment

CMUG Integration meeting
Toulouse, 14-16 May 2012

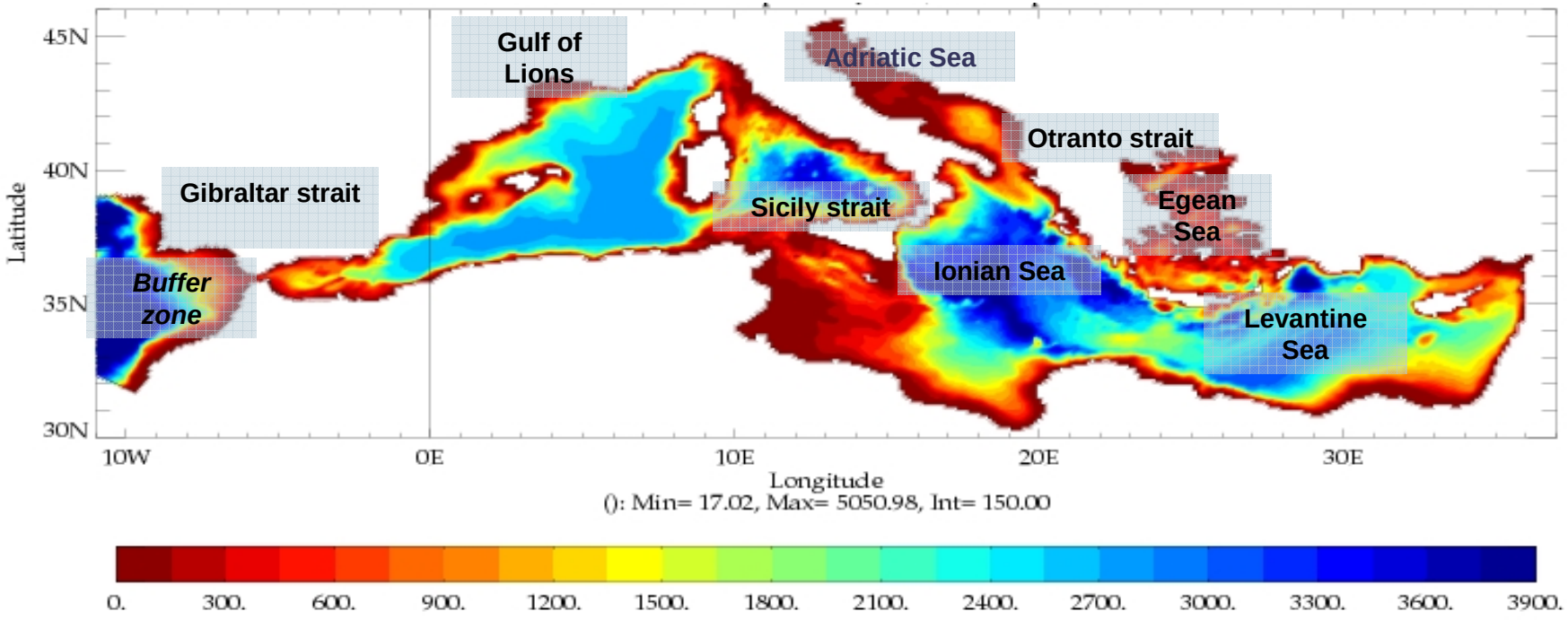
METEO FRANCE
Toujours un temps d'avance

Sea Surface Height

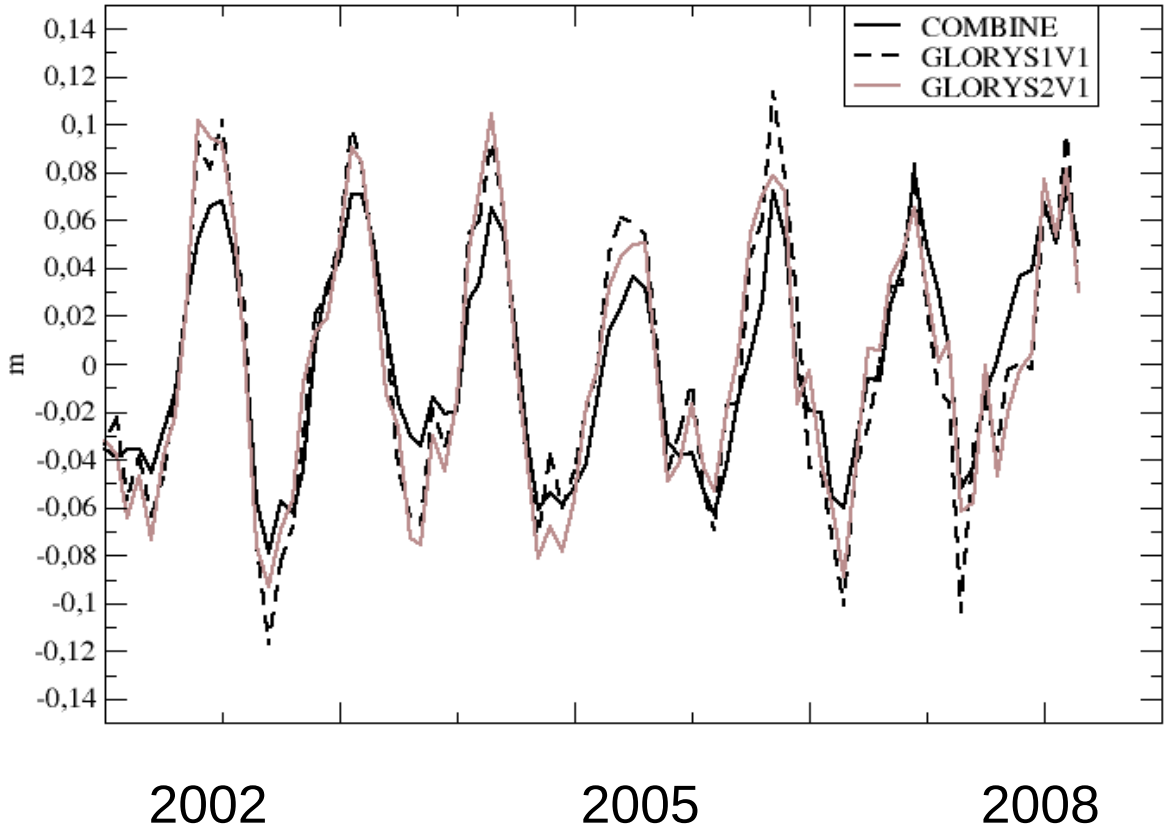
- The AVISO product (SSALT0/DUACS, Handbook 2009) is assimilated in the GLORYS reanalysis performed with the MERCATOR assimilation system.
- The Mediteranean sea model NEMOMED8 is used for regional climate variability and climate change simulations (here in uncoupled mode).
- The Mediterranean sea model is constrained over the near Atlantic through a nudging towards the GLORYS SSH or the so-called COMBINE SSH reanalysis assimilating only in-situ observations.
- The SSH freely simulated over the Mediterranean sea has been compared to the reanalysed SSH over the 2002-2008 period.

The NEMOMED8 ocean regional model

- Regional version of NEMO-V2 (Madec, 2008) with filtered free surface
- Horizontal resolution 1/8°x1/8°cos(Φ), 43 vertical levels, 20 min time step
- An Atlantic buffer zone (3D T and S relaxation)
- Climatological rivers and black sea runoffs
- Forced with ERA-Interim reanalysis over 2002-2008



Comparison: GLORYS SSH and COMBINE SSH on average over the Mediterranean sea



Correlation:

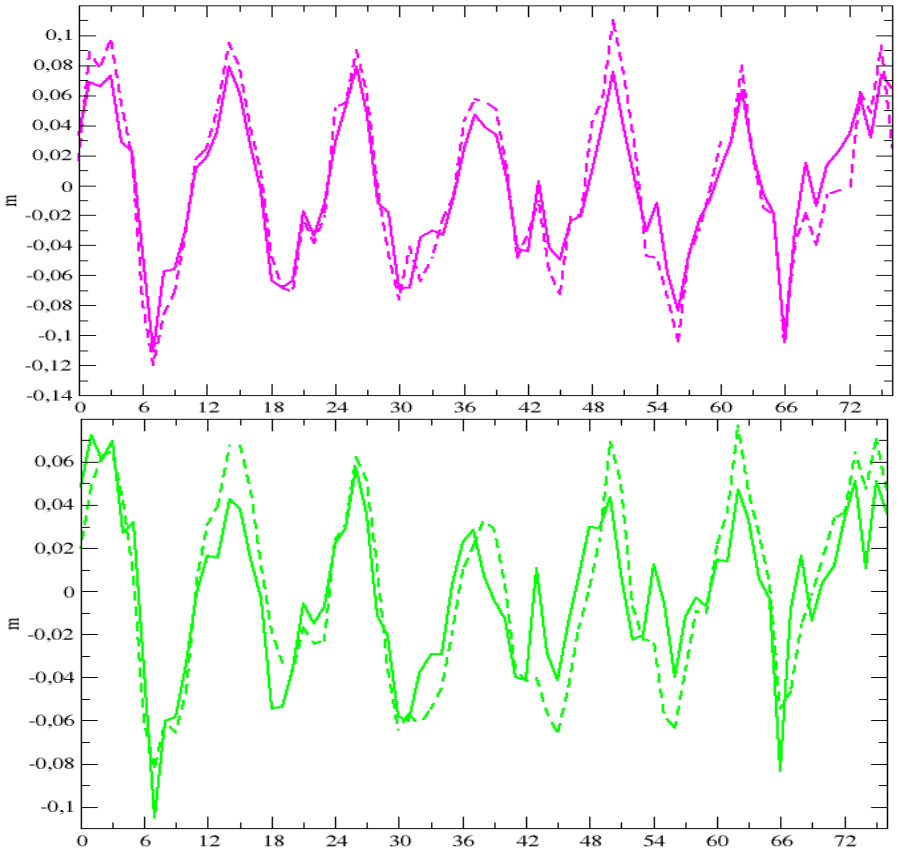
combine/glorys1v1 =0,92
combine/glorys2v1 =0,92
glorys1v1/glorys2v1=0,96

Amplitude of the seasonal cycle:

combine = 11,07 cm
glorys1v1 = 14,27 cm
glorys2v1 = 13,82 cm

Comparison: NEMOMED8 and the GLORYS and COMBINE SSHs on average over the Mediterranean Sea

NM8-GLORYS : SSH relaxation to GLORYS1V1
NM8-COMBINE : SSH relaxation to COMBINE



Solid lines: NM8
Dashed lines: reanalyses

Correlation:

NM8-glorys/glorys1v1 =0,95
NM8-combine/Combine=0,86

Sea Surface Height

- Evaluation of coupled or uncoupled regional climate models with CCI SSH could demonstrate the added value of the new product (improved resolution, better accuracy, …).

- Evaluation over the Mediterranean area is a good opportunity due to MedCORDEX international modelling exercise and the HyMEX field experiment starting this year.

- There is also the opportunity to evaluate consistency with other CCI products over the region (SST, aerosols, …) taking advantage of the development of regional climate system models.