Altimetry impact studies on global ocean analysis and forecasts at Mercator Océan

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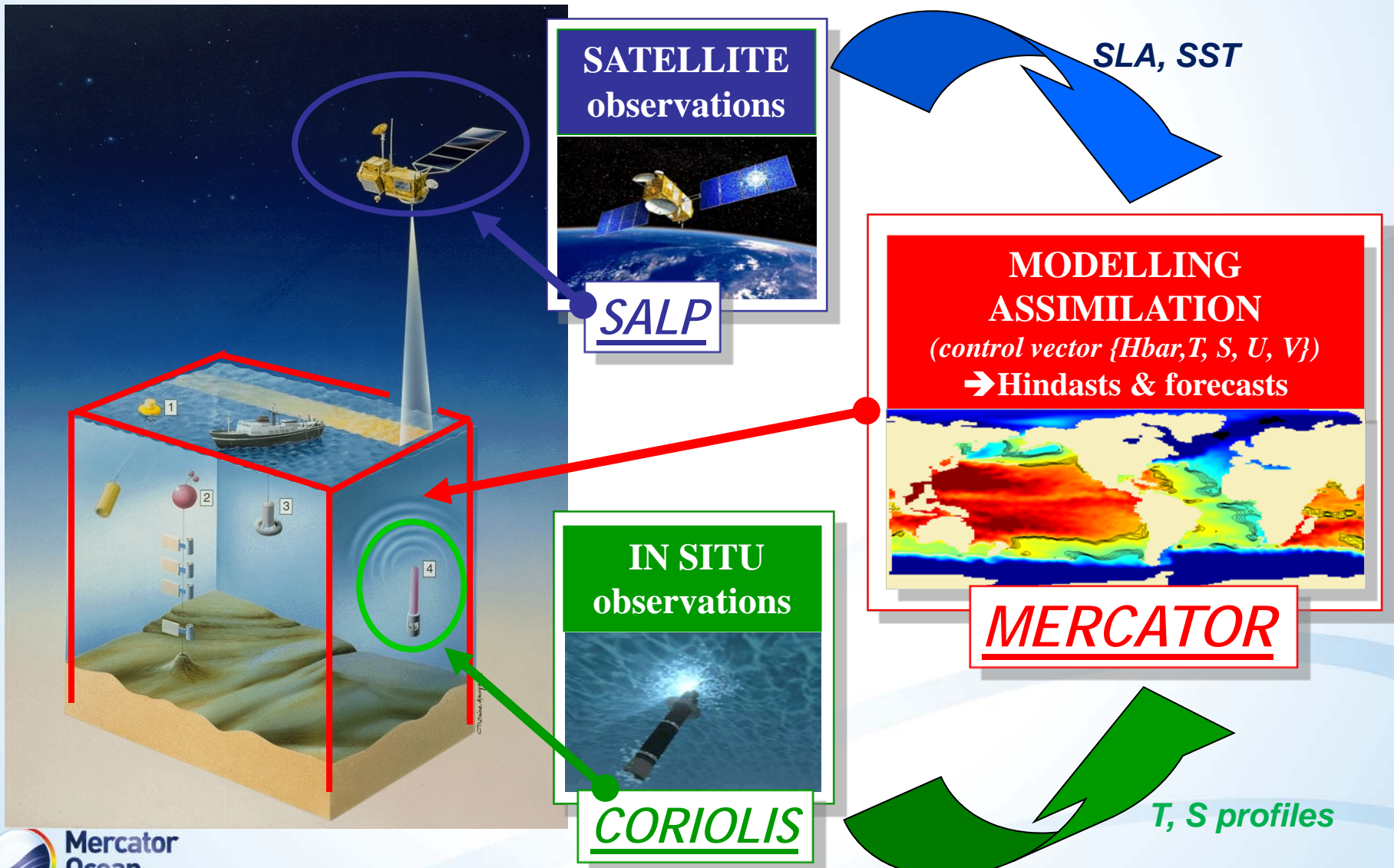
1 – Mercator Océan

2 - CLS

Mercator Ocean
Ocean Forecasters

Mercator Ocean integrated systems

SATELLITE observations

SALP

SLA, SST

MODELLING ASSIMILATION
(control vector {Hbar,T, S, U, V})
➜ **Hindasts & forecasts**

MERCATOR

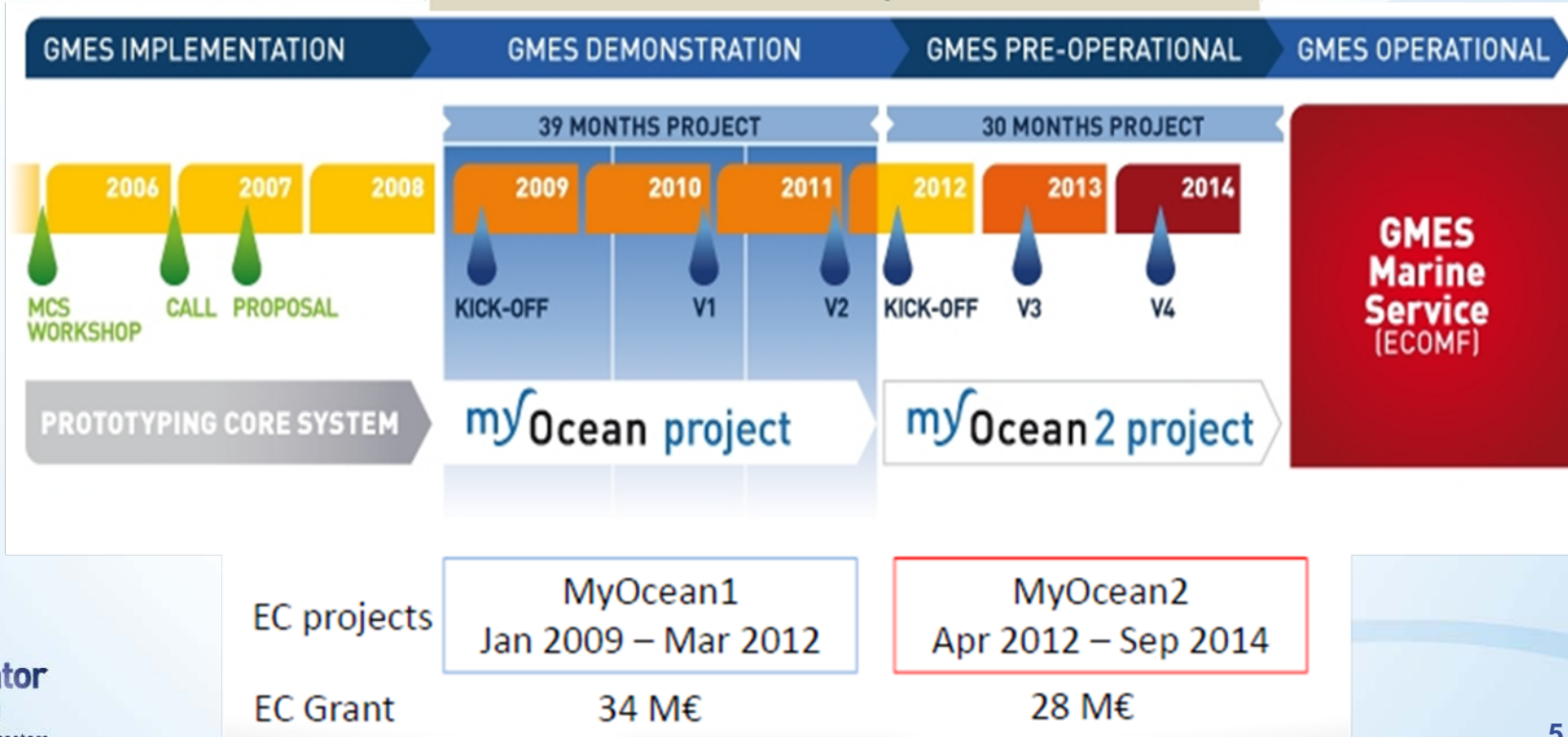**IN SITU observations**

CORIOLIS

T, S profiles

Mercator Ocean analysis and forecast systems

- Global 2° to 1/12° to regional model configuration
- Weekly analysis
- Assimilated observations :
  - AVHRR-AMSR 1/4° SST;
  - Along track SLA from SALP/DUACS (Verified/Filtered/Subsampled/Corrected, IGDR/OGDR);
  - In situ Temperature and salinity profiles from Coriolis;
  - hybrid MDT: MDT CLS/CNES 2011 corrected using model misfits.

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Mercator ocean in the MyOcean European integrated system

Mercator ocean in the MyOcean European integrated system

Mercator ocean in the MyOcean European integrated system

1 Global
2 Arctic
3 Baltic
4 NWS
5 IBI
6 Med Sea
7 Black Sea

Currents

Temperature & Salinity

Surface Wind

Sea Level

Biogeochemistry

Sea Ice

myOcean CATALOGUE OF PRODUCTS V2.0

THE OCEAN IN ONE CLICK

January 2012

REANALYSES
10 to 45 years

REAL-TIME
Daily hourly

FORECAST
2 to 10 days

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Observation data assimilation into MyOcean systems

MFC	MONITORING (Analysis and Forecast)		MULTI YEAR (Non Assimilative Hindcast or Reanalysis)		
	PHYS	BIO	PHYS		BIO
GLOBAL	XXX	O	XXXX XXXX XXX		O
ARCTIC	XXXX	O	XXXX		X
BALTIC	O	O	X X XX		X
NWS	XX	O	XX X	O	O
IBI	O *	N/A	XXX		O
MED	XXX	X	XXX		X
BS	XXX	X	XXX		X

O	No Data Assimilation (DA) (*indirect DA through OBC)
X X X X X	With Data Assimilation/nudging SST Sealevel Insitu Sealce Chlorophyll
	Not done yet but will be done before the end of Myo2 project

Mercator Ocean — Ocean Forecasters

myOcean

Real time production monitoring
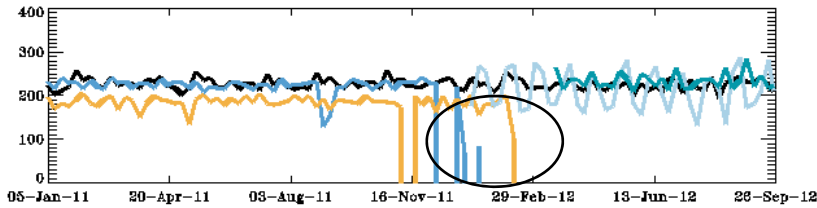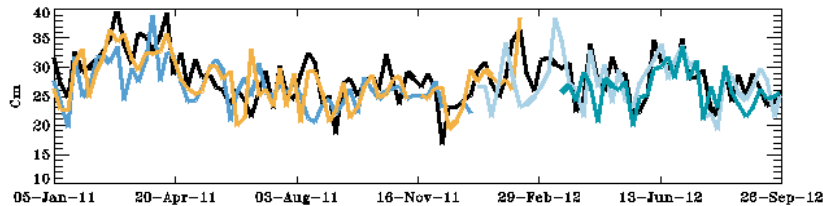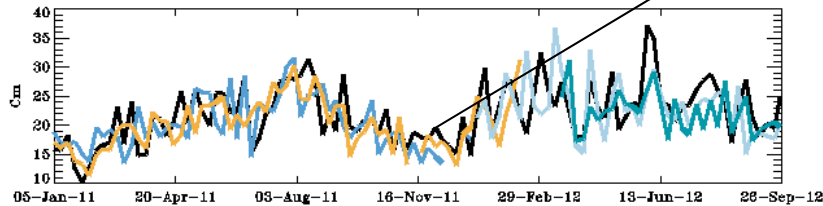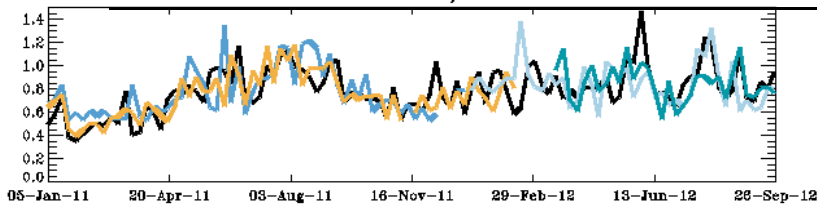
Monitoring of the global ocean ¼°system performance:

Evolution of the observation model misfit (forecast) in the Gulf Stream region in 2011 and 2012 when many constellation changes occurs.

Higher level in 2012. With a transition period on the 1st semester.

Dedicated impact studies

Observing system evaluations (OSE)

- Identify sensitivity to an existing data set,
- Test assimilation parametrization:
  - Observation error specification,
  - Correlation length scale,
- Setup assimilation of new data (SSS, L3S SST…).

Observing system simulation experiments (OSSE)

- test of the assimilation scheme in « ideal » conditions
- First step toward the assimilation of future data (Deep ARGO, SWOT SLA,…)

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OSSE with the global ¼° system

Ongoing work on altimetry constellation impact:
- Number of satellites,
- Type of satellite (geodetic, reduced error (SAR), large swath…)

Experiments will be extended to high resolution and regional systems.
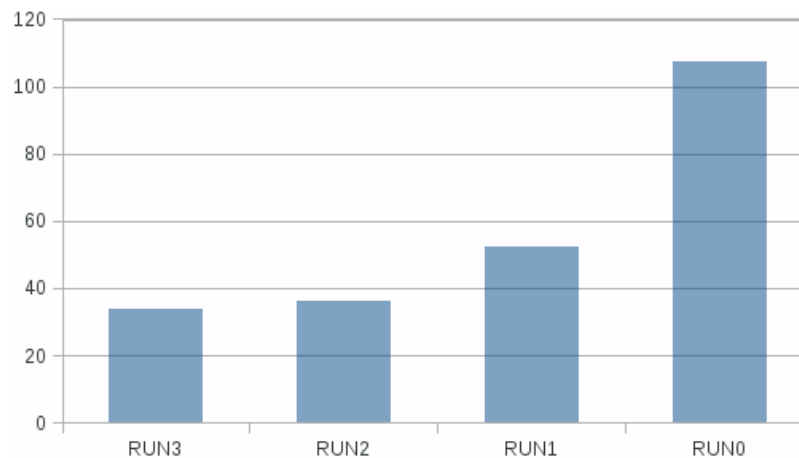
SSH error variance (% of signal variance) in the Gulf Stream region
as a function of the number of altimeters (0, 1, 2, 3)
¼° global model
(S.Verrier)

OSSE with the global ¼° system

RUNref — Sea Surface Height

RUN2 — Sea Surface Height (m)

RUN3 — Sea Surface Height (m)

Not reconstructed with 2 sat
Well reconstructed with 3 sat
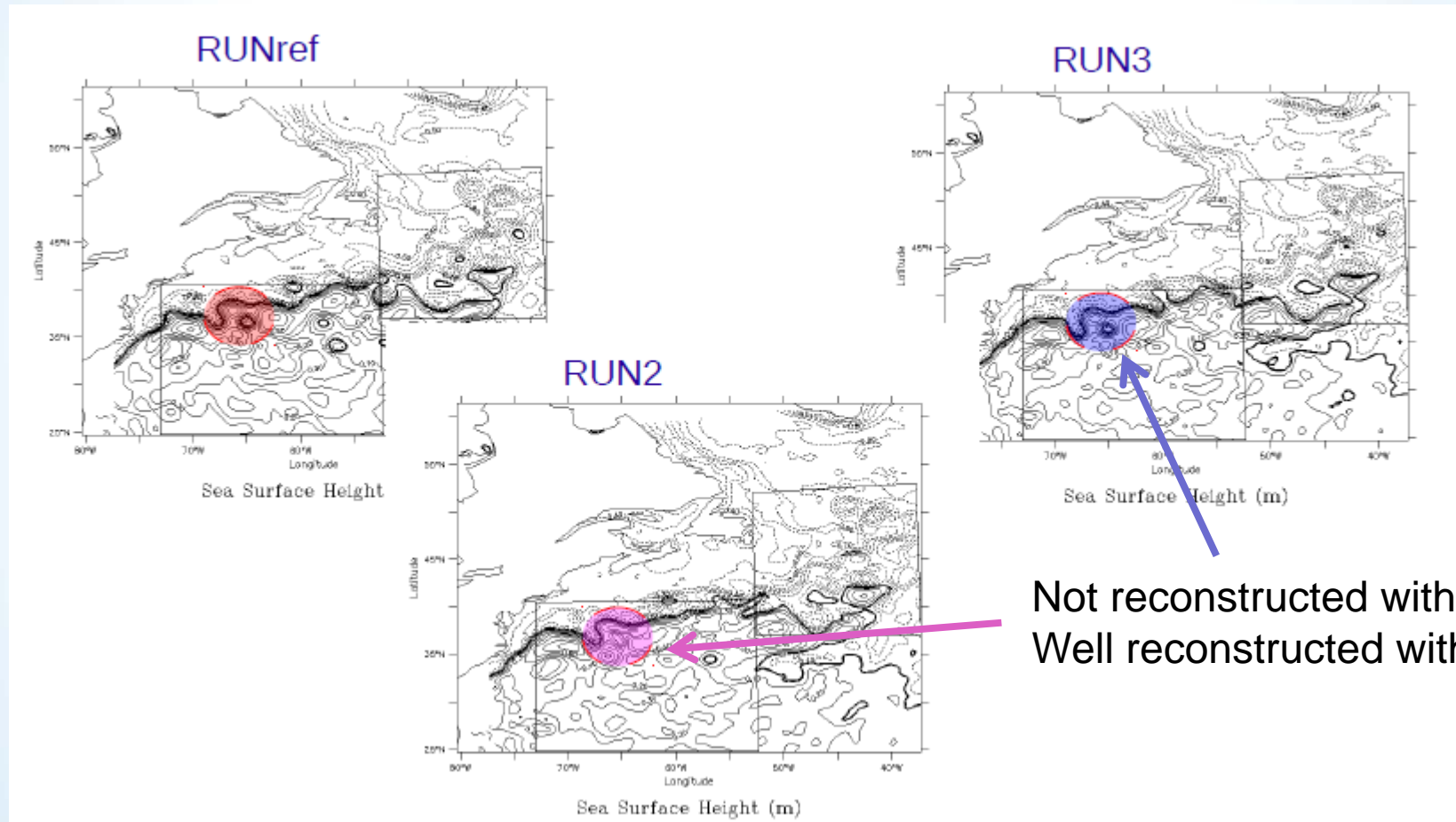
OSE with Atlantic Mediterranean system at 1/12°

RMS misfit, full domain.

Green line: No altimetry,
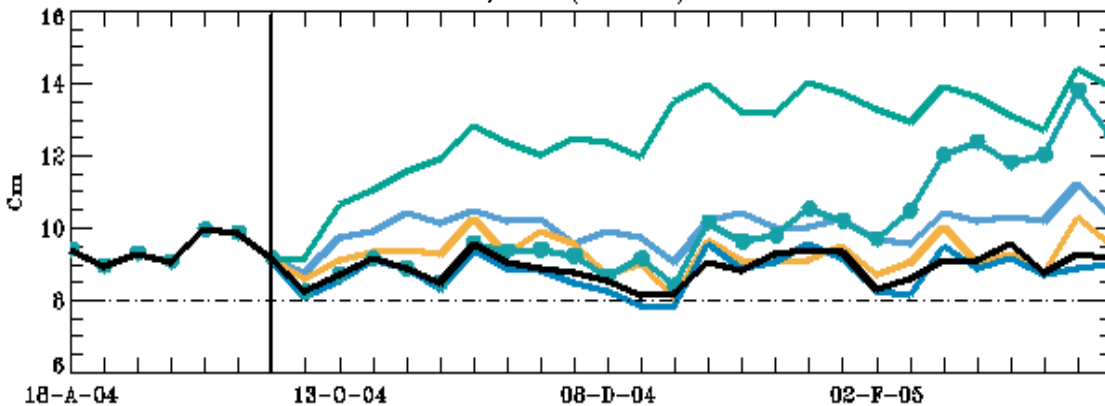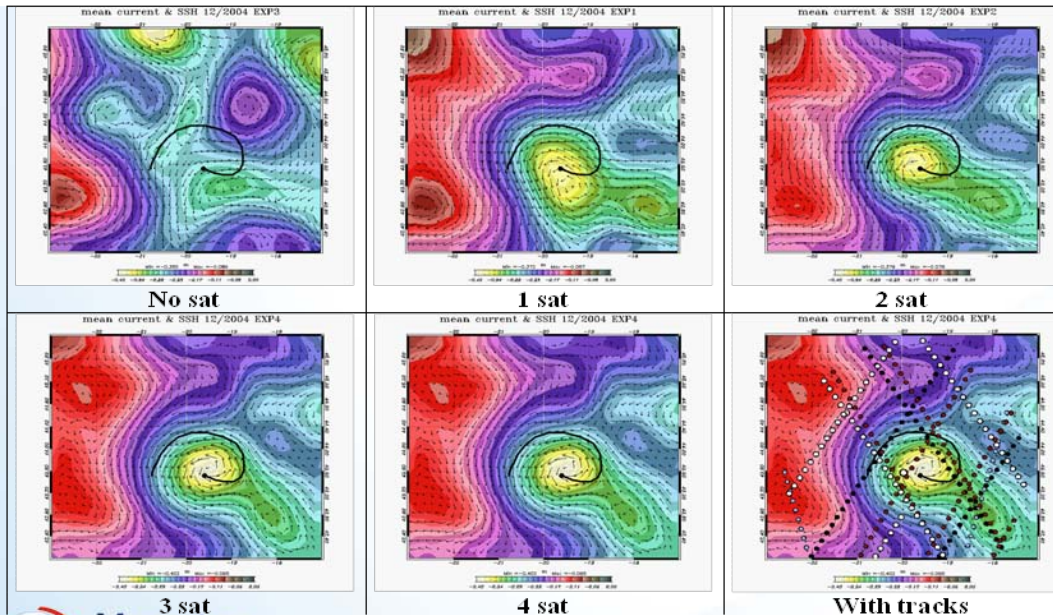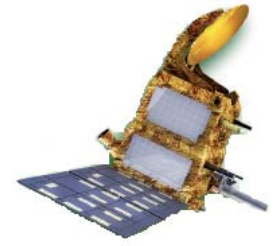Light blue line: Jason 1,
Orange line: Jason 1 + Envisat,
Black line: Jason 1 + Envisat + GFO,
Blue line: Jason 1 + Envisat + GFO + T/P,
Green dotted line: Progressive loss.

Drifter trajectory superimposed on mean SSH; bottom right: satellite tracks. (Benkiran et al.)
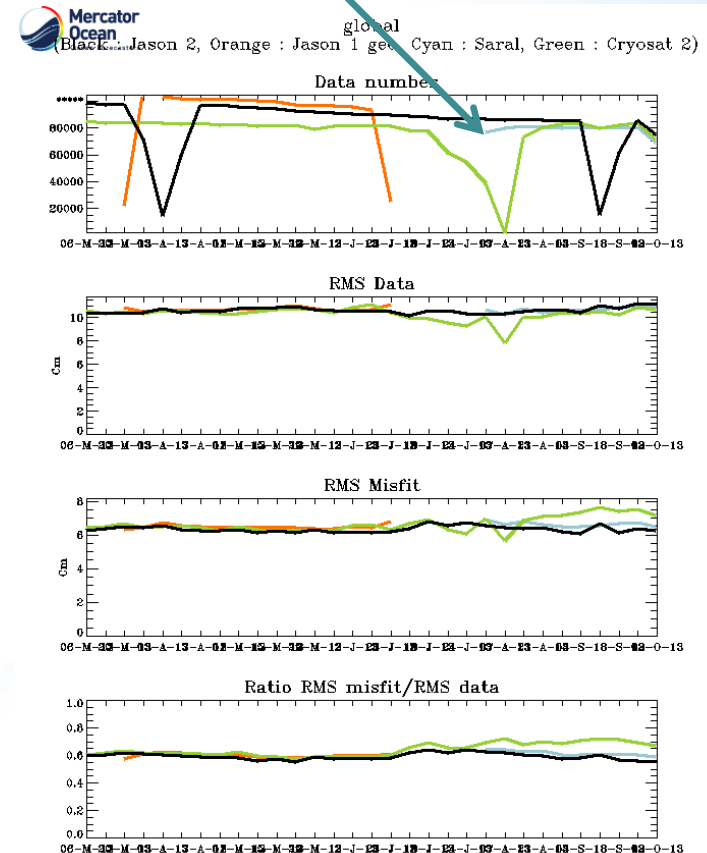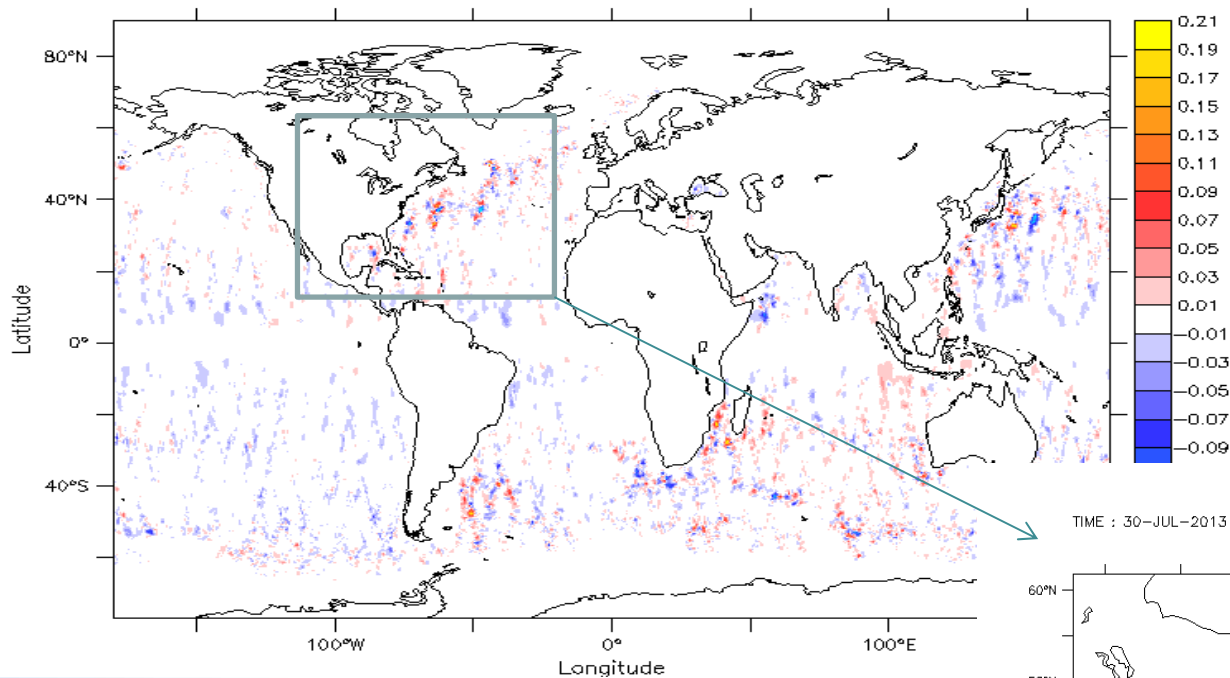
Assimilation of SARAL/AltiKa SLA

The along track SLA of SARAL/AltiKa provided by SALP/DUACS have been assimilated in the different operational systems since the 31th of July 2013.

- **Launched on 25 february 2013**
- **Released in SALP/DUACS NRT multi-mission products on 01 July 2013**
- **Assimilated into Mercator Operational system on 31 July 2013**
- **Going through all phases:**
  - Commissioning, verification, validation, and… early release of data

- no technical problem occurred
- no anomaly during the assimilation process (data rejection, bias, high model misfit…).

Assimilation of AltiKa SLA

Mercator Ocean
global
(Black : Jason 2, Orange : Jason 1 geo, Cyan : Saral, Green : Cryosat 2)

Data number

RMS Data

RMS Misfit

Ratio RMS misfit/RMS data

Global observation-model statistics
Misfit = Observed SLA – forecasted SLA
Mercator, Global, 1/12°

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Influence of the AltiKa SLA on the model SSH

On the last week of july, 2 analysis were done : *one with the SARAL/AltiKa SLA and one without*

Differences between the model SSH without SARAL/AltiKa SLA assimilated and not, at the end of the first week.

TIME : 30-JUL-2013 12:00   DATA SET: PSY4V2R2_1dAV_20130730_20130731_grid2D_R20130731
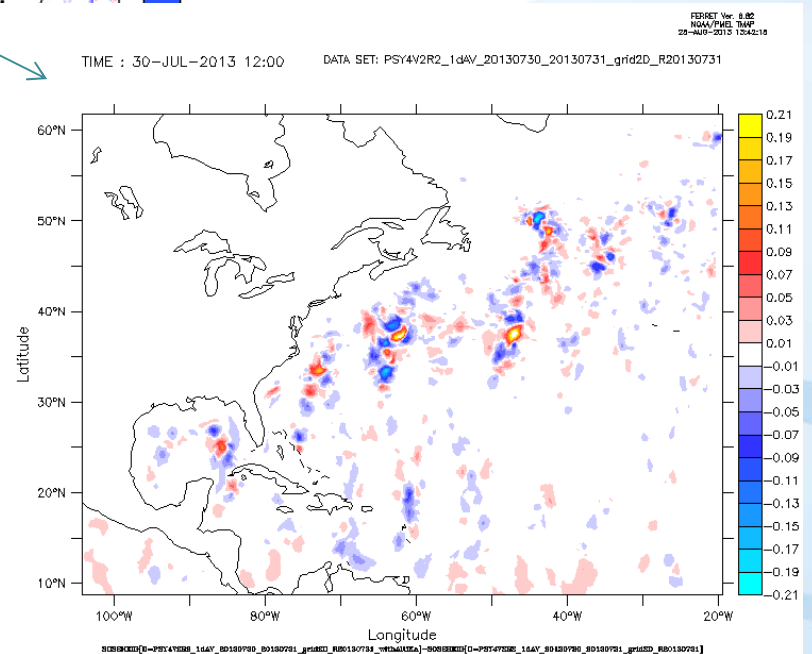
Conclusion

- Operational oceanography gives specific requirements for the observing systems:
    - NRT constraints: number of satellites (minimum of 3 to 4 altimeters), availability, timeliness
    - Complementarity of the satellite (and in-situ) constellation
- Ability to assimilate new datasets also depends on improvements of assimilation process and methods:
    - Selection of data
    - Computing power for large amounts of data, in a near real time context
- OSE/OSSE studies carried out at Mercator Ocean (also supported by CNES):
    - Assessment of new missions or observation data
    - Impact studies on operational analyses and forecast
    - Support to decision process (requirements to space agencies or data providers)
    - Requires specific diagnoses (not only ΔSSH variance…). Under development
- SARAL/AltiKa mission is an unprecedented success in the end-to-end validation and use of altimetry data: early availability of data, quick and efficient validation phase, inclusion in multi-mission and NRT SALP/DUACS, operational assimilation into Mercator global 1/12°
    - Demonstrates the operational oceanography concept
    - Does not preclude new performance studies (Ka band, High Resolution/low noise, etc…)

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