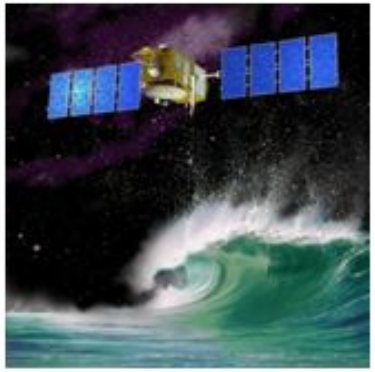
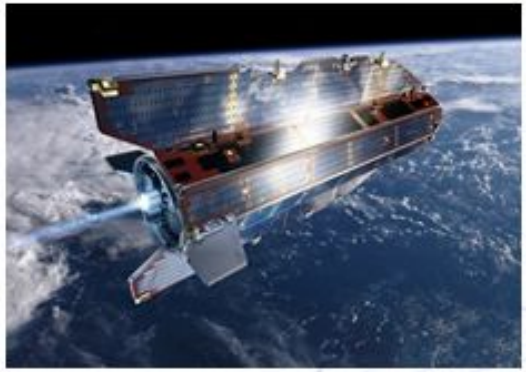
Validation of the preliminary GOCE Level-2 products

M.H. Rio, S. Mulet, P. Schaeffer, E. Greiner, G. Larnicol
CLS, Space Oceanography Division

Absolute Dynamic Topography from Altimetry: Status and prospects in the upcoming GOCE era

M.-H. Rio



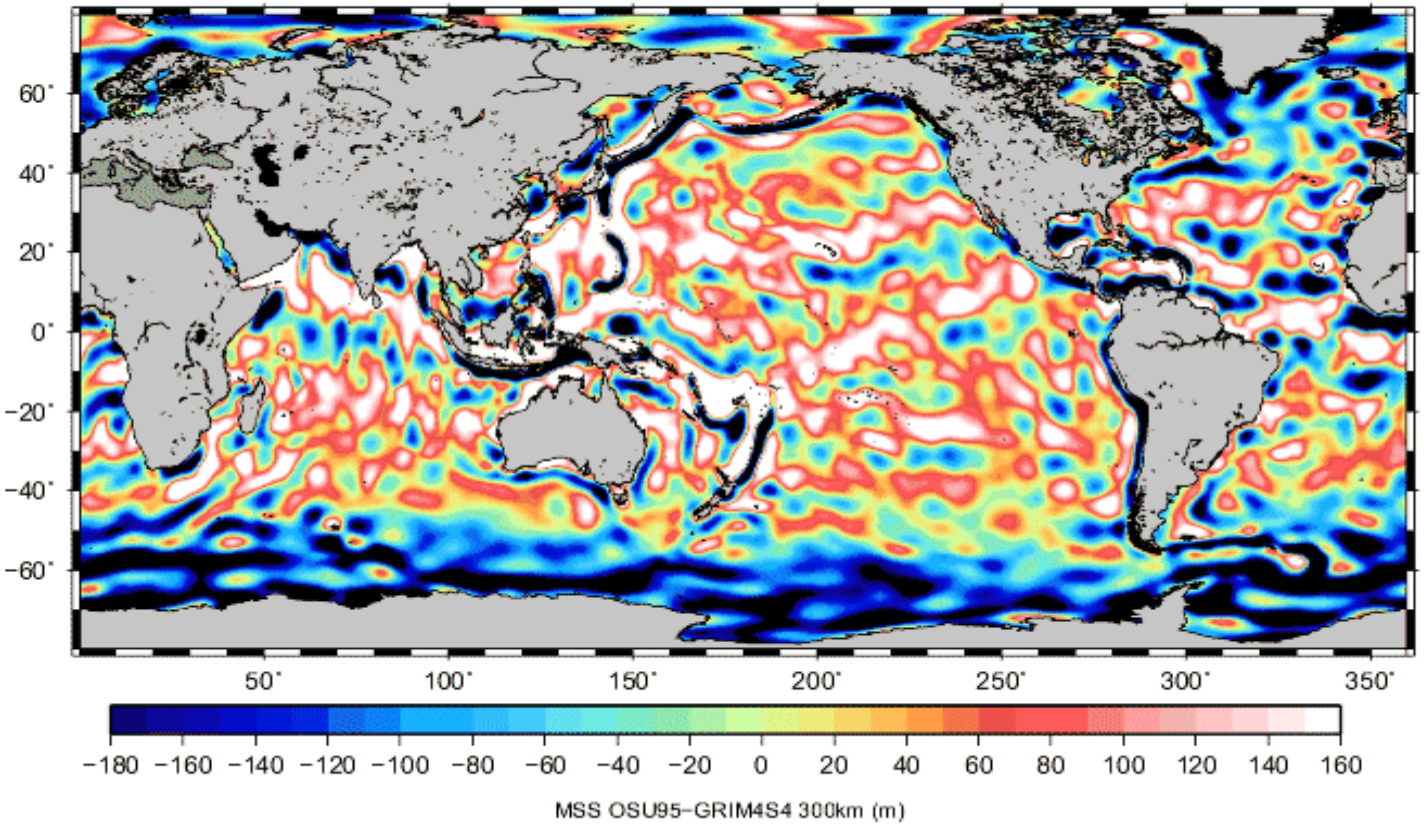


With material from: Nikolaï Maximenko, Peter Niiler, Chris Hughes, Martin Saraceno, Lee Fu, A. Hunegnaw, Femke Vossepoel, P. Schaeffer, N. Pavlis, Per Knudsen, Ole Andersen, E. Jeansou, P. De Mey, P. Legrand.

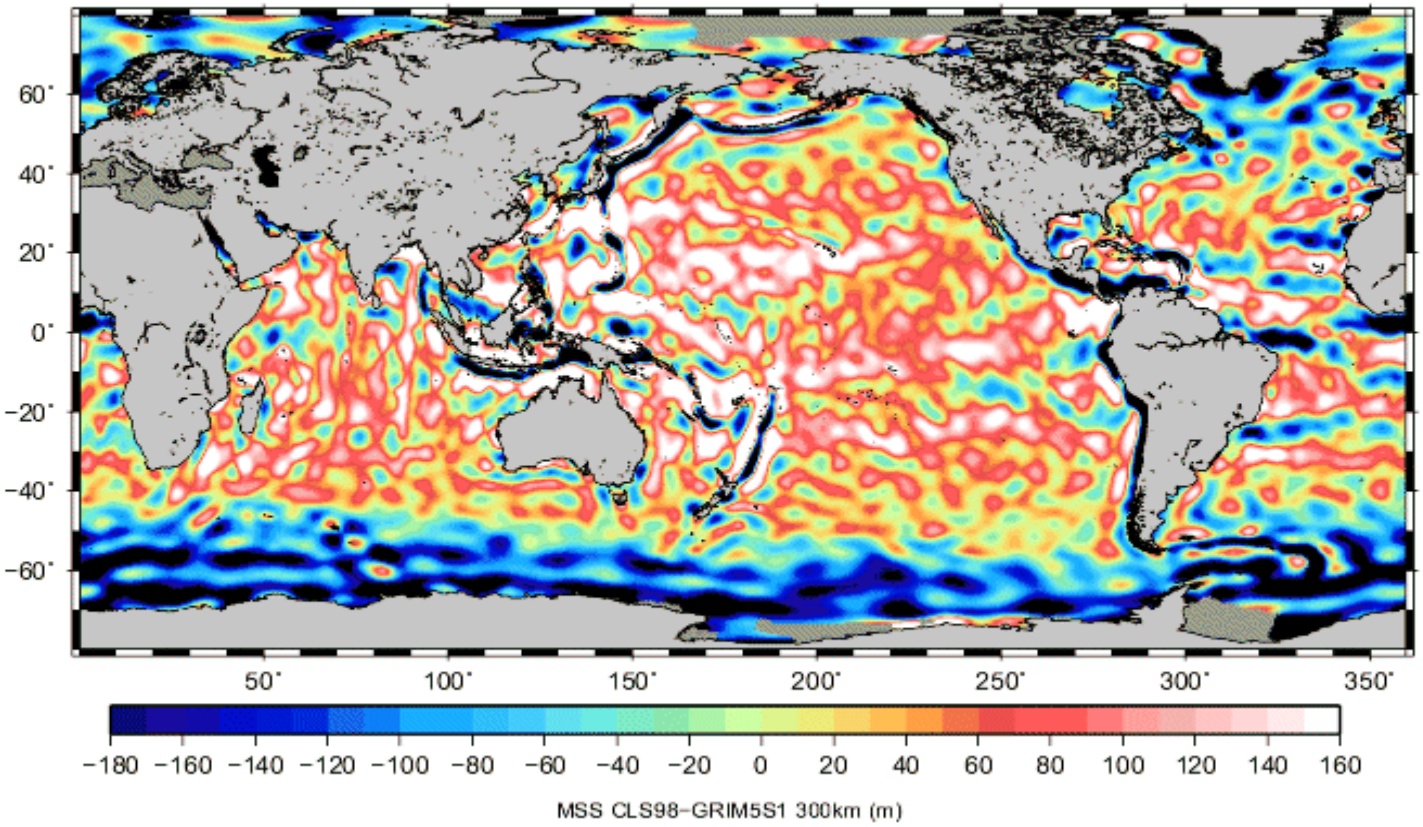
http://www.cls.fr

OSTST - Seattle - June 22-24, 2009

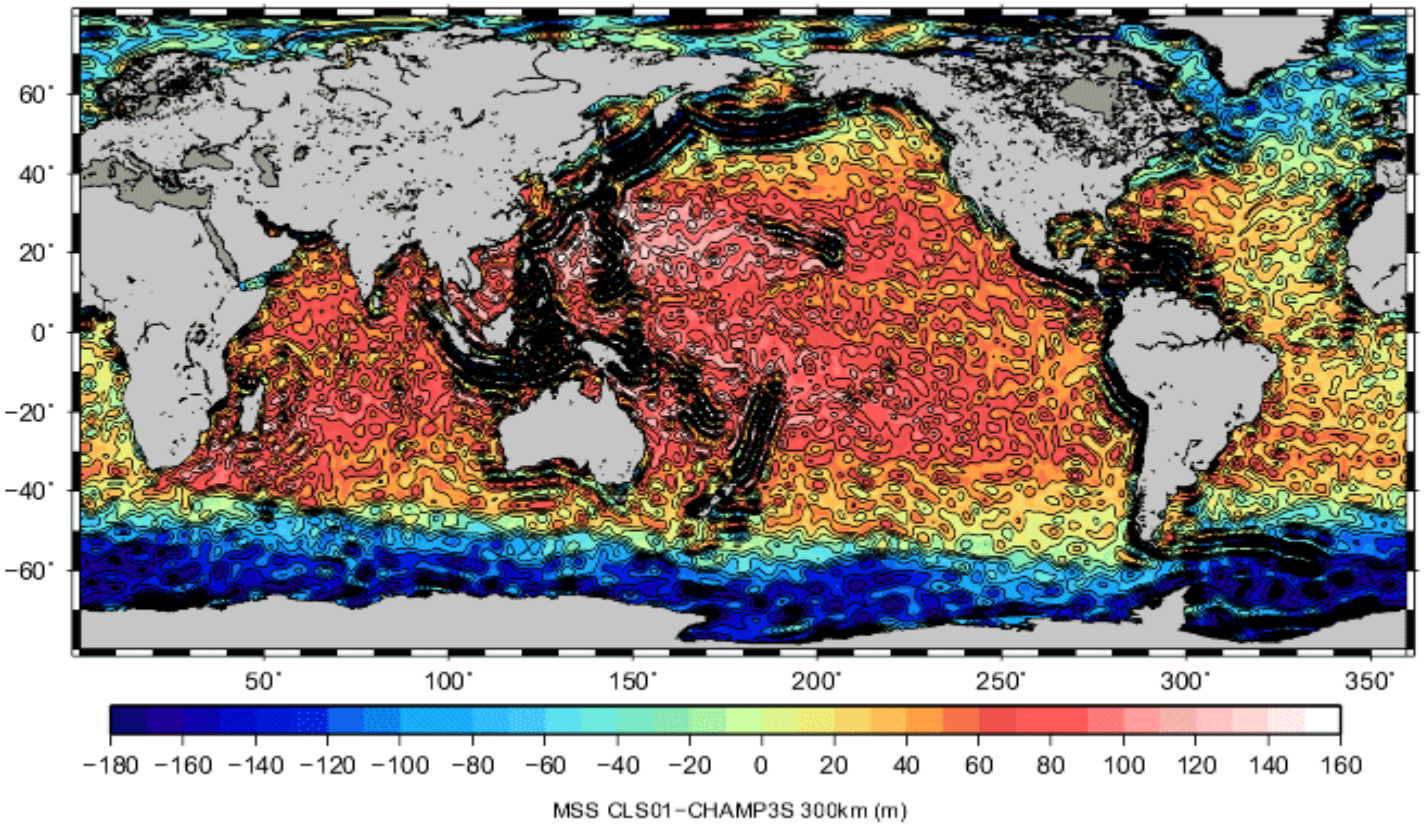
1995


60˚
40˚
20˚
0˚
−20˚
−40˚
−60˚
50˚
100˚
150˚
200˚
250˚
300˚
350˚
−180 −160 −140 −120 −100 −80 −60 −40 −20 0 20 40 60 80 100 120 140 160
MSS OSU95−GRIM4S4 300km (m)

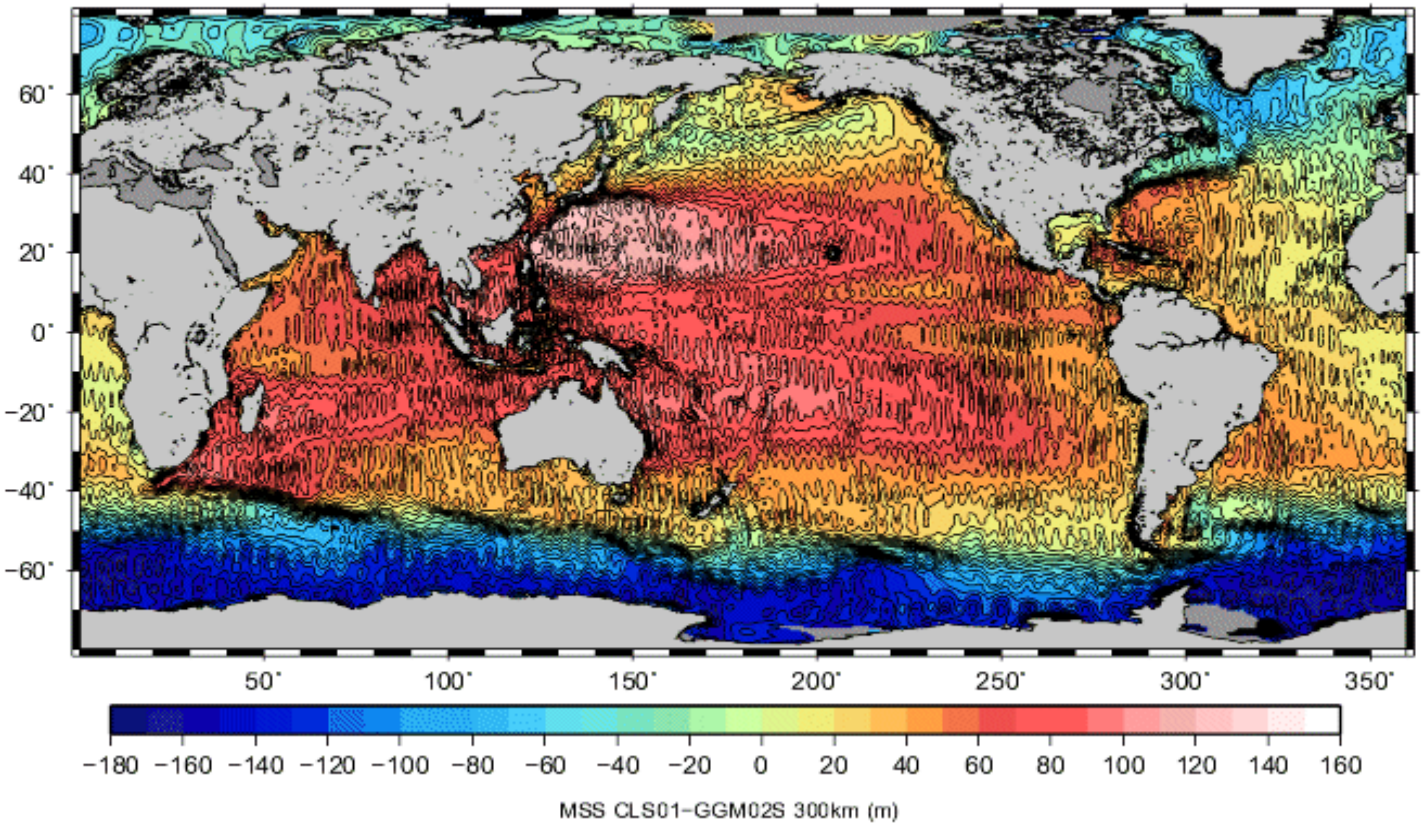
1999


60°
40°
20°
0°
−20°
−40°
−60°
50°
100°
150°
200°
250°
300°
350°
−180 −160 −140 −120 −100 −80 −60 −40 −20 0 20 40 60 80 100 120 140 160
MSS CLS98−GRIM5S1 300km (m)

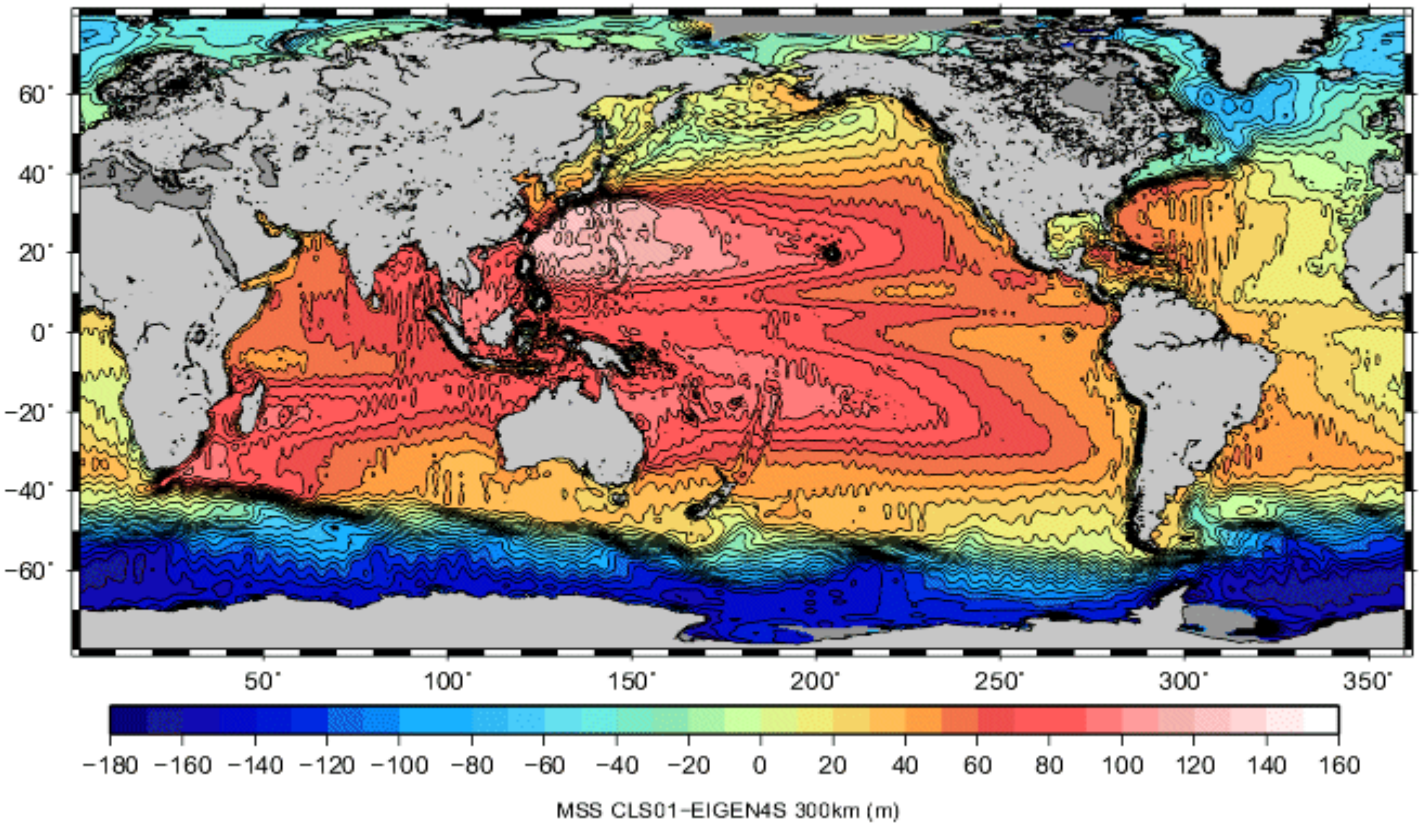
2003


60˚
40˚
20˚
0˚
−20˚
−40˚
−60˚
50˚
100˚
150˚
200˚
250˚
300˚
350˚
−180 −160 −140 −120 −100 −80 −60 −40 −20 0 20 40 60 80 100 120 140 160
MSS CLS01−CHAMP3S 300km (m)

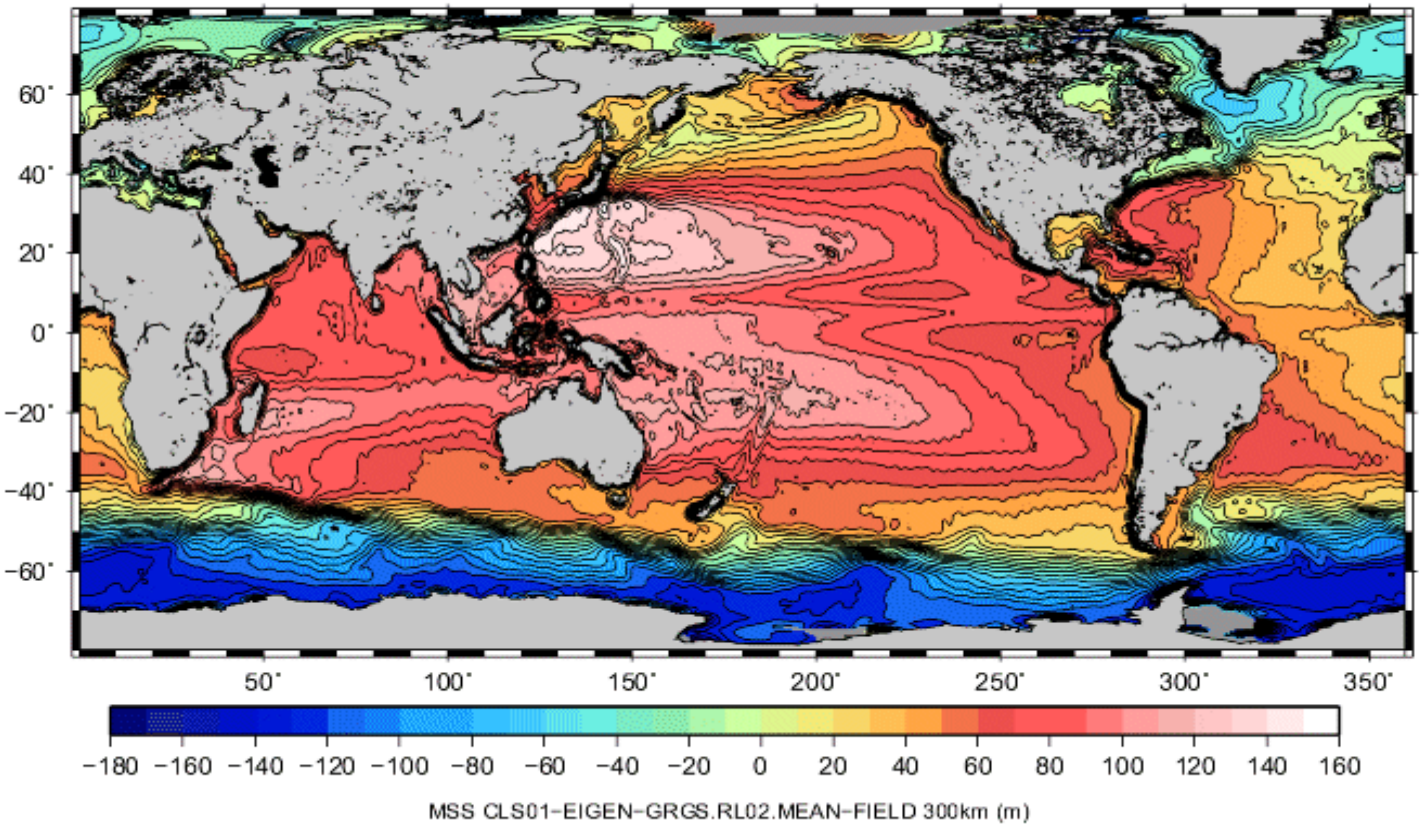
2005


60˚
40˚
20˚
0˚
−20˚
−40˚
−60˚
50˚
100˚
150˚
200˚
250˚
300˚
350˚
−180 −160 −140 −120 −100 −80 −60 −40 −20 0 20 40 60 80 100 120 140 160
MSS CLS01−GGM02S 300km (m)

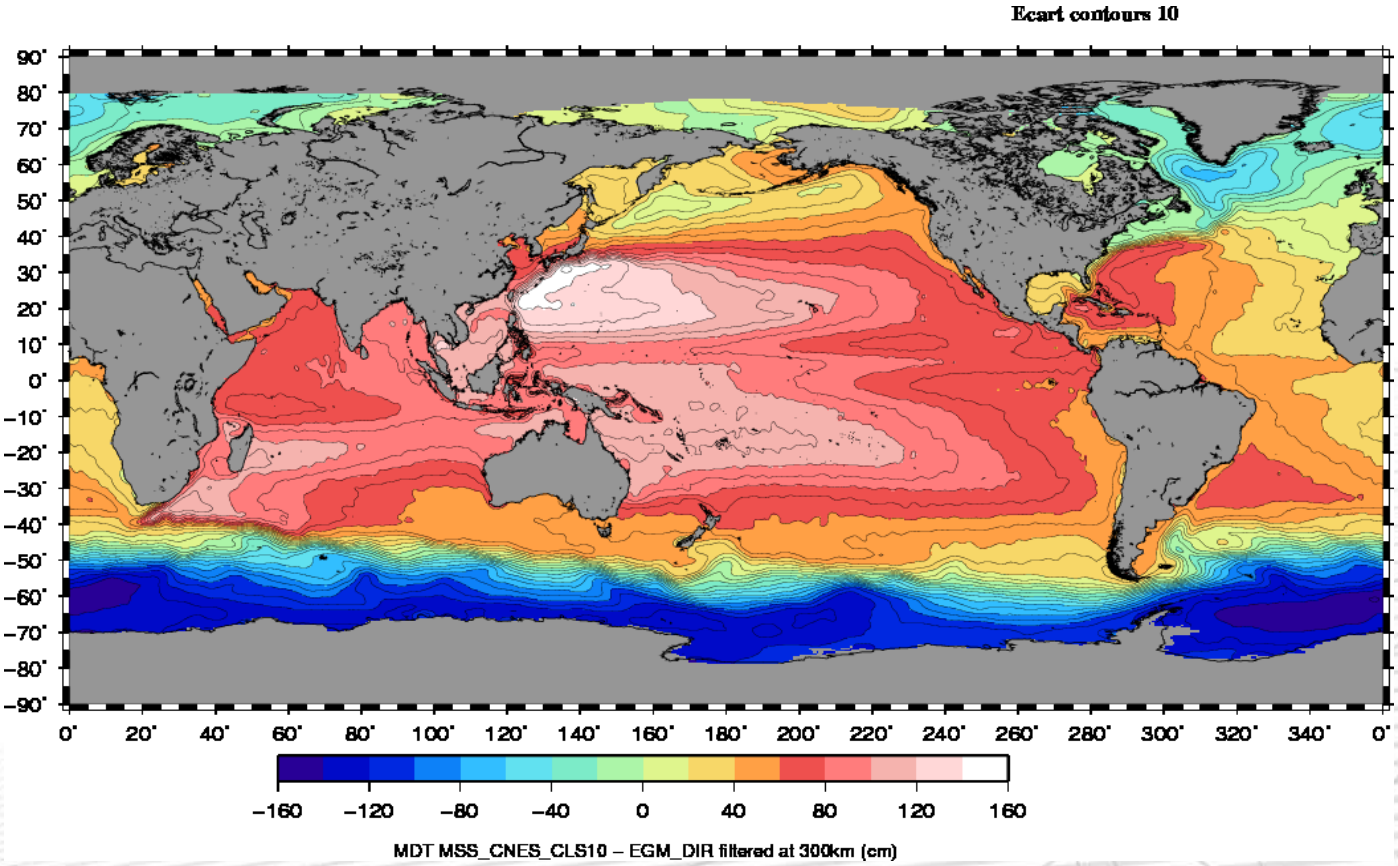
2006


60°
40°
20°
0°
−20°
−40°
−60°
50°
100°
150°
200°
250°
300°
350°
−180 −160 −140 −120 −100 −80 −60 −40 −20 0 20 40 60 80 100 120 140 160
MSS CLS01-EIGEN4S 300km (m)

2009

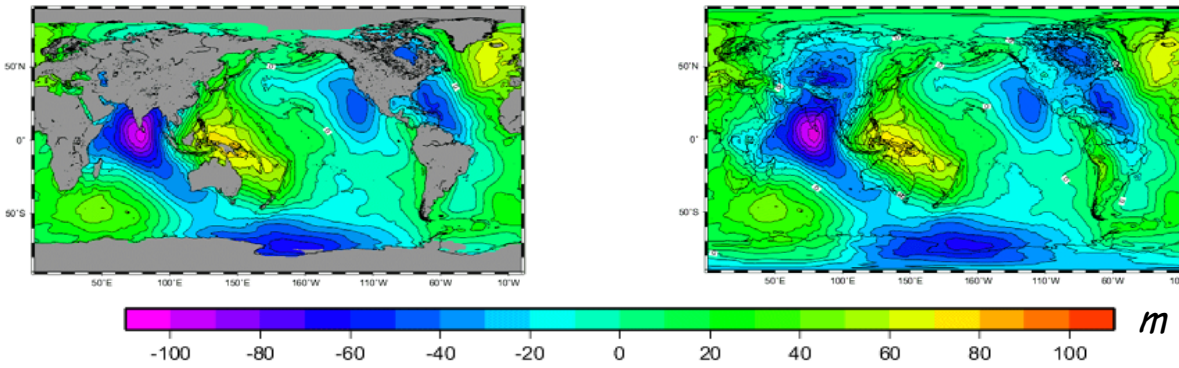

60˚
40˚
20˚
0˚
−20˚
−40˚
−60˚
50˚
100˚
150˚
200˚
250˚
300˚
350˚
−180 −160 −140 −120 −100 −80 −60 −40 −20 0 20 40 60 80 100 120 140 160
MSS CLS01-EIGEN-GRGS.RL02.MEAN-FIELD 300km (m)

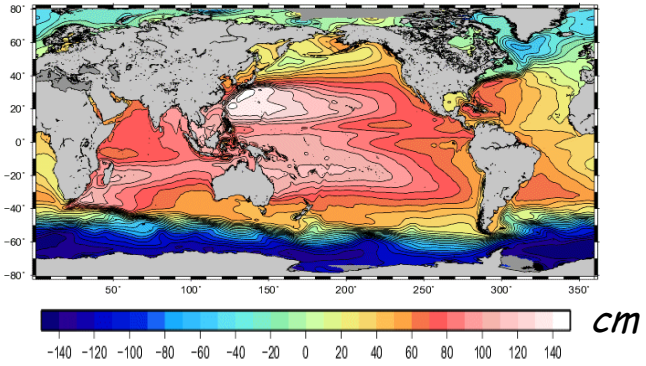
Here we are with the preliminary GOCE geoid !



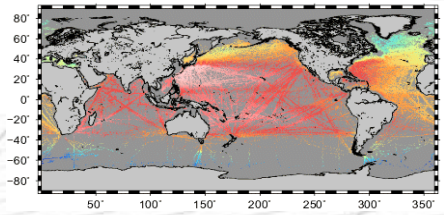
Reminder…

MSS - Geoid = **Direct MDTs**

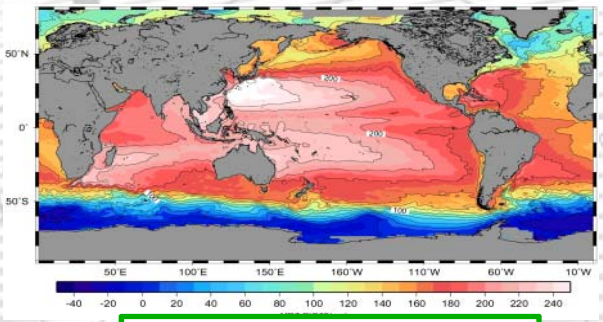




+



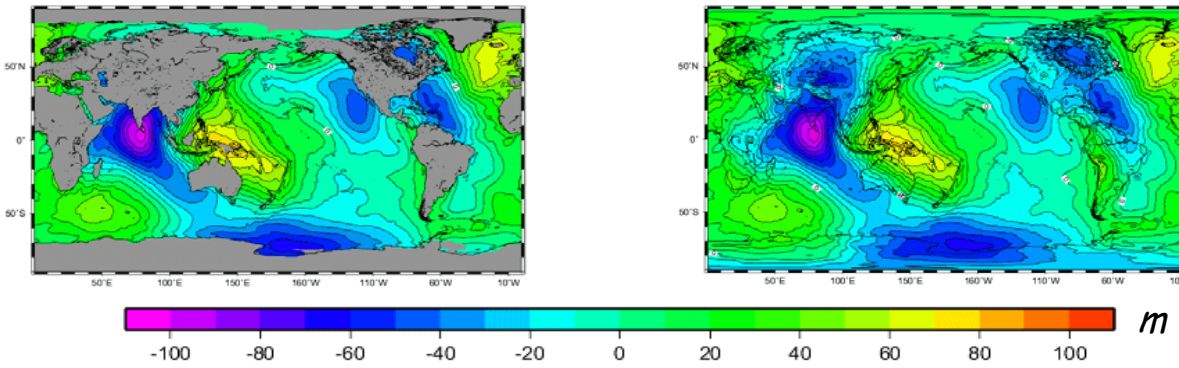
=

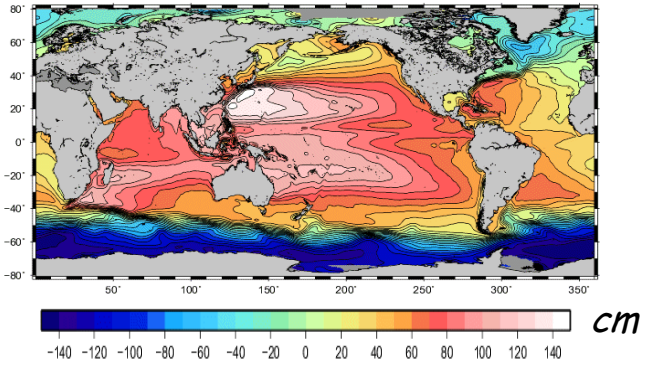


Combined MDTs

Reminder…

MSS - Geoid = **Direct MDTs**

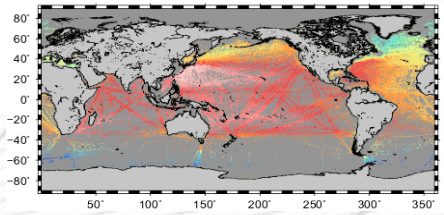




+

MSS_CNES_CLS10

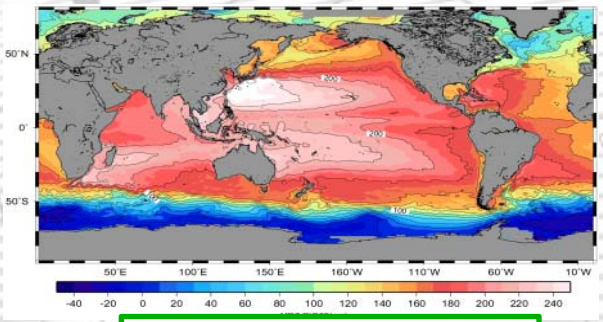
GOCE geoid:
EGM_DIR
EGM_TIM
EGM_SPW



=

Delivered in June
71 days of data

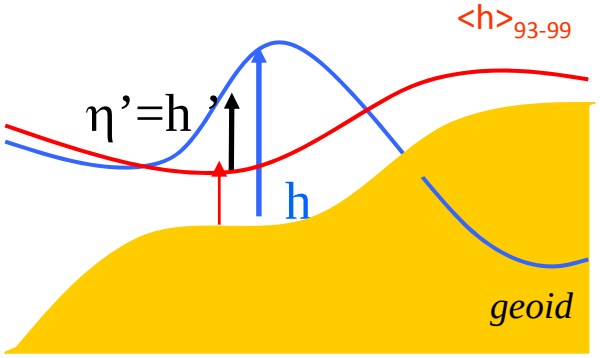
CNES-CLS09
DNSC08
Maximenko
GLORYS

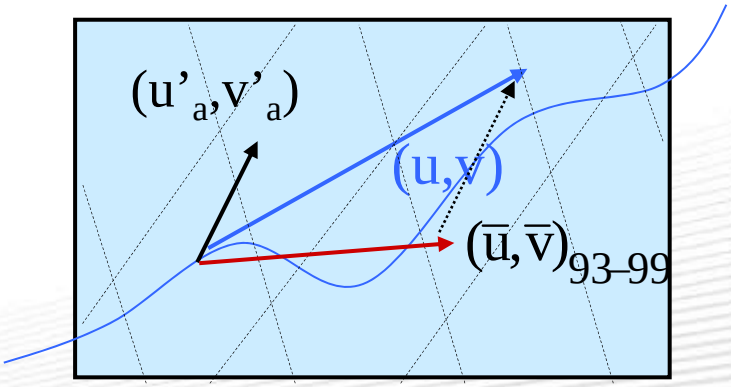


Combined MDTs

Method

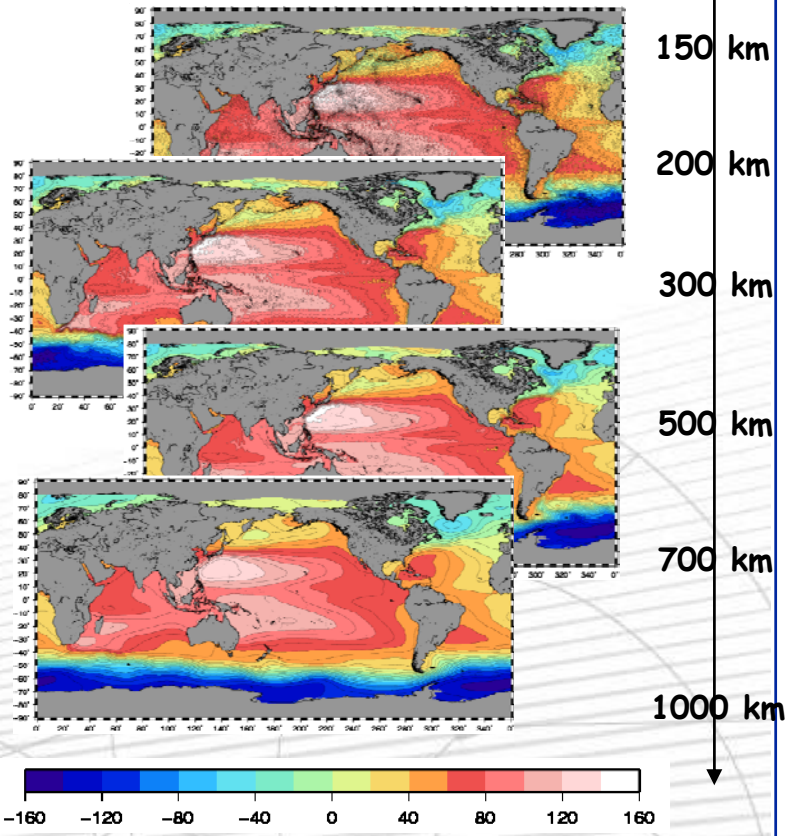
Use of in-situ oceanographic measurements and altimetry to compute **synthetic estimates of the MDT (and mean velocities)**





Computation of the ocean Mean Dynamic Topography from filtered altimetric MSS – Geoid

MSS – EGM_DIR



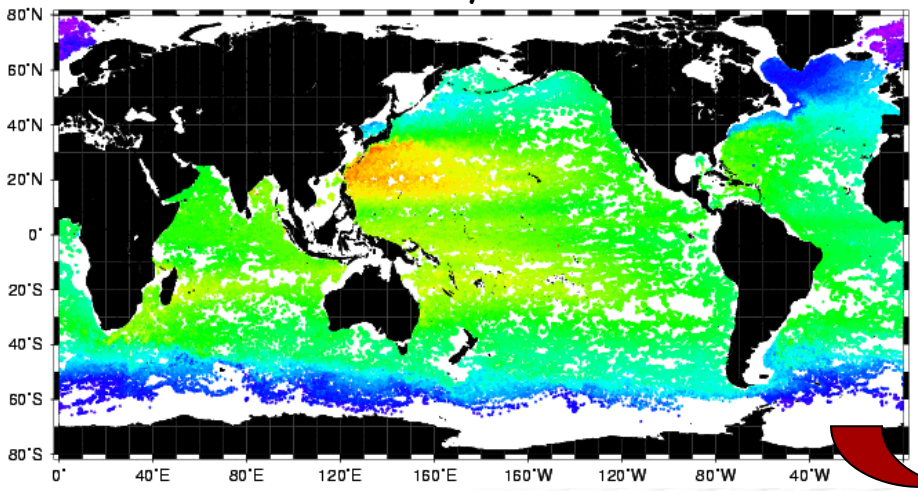
+ geostrophic mean surface currents

Data used

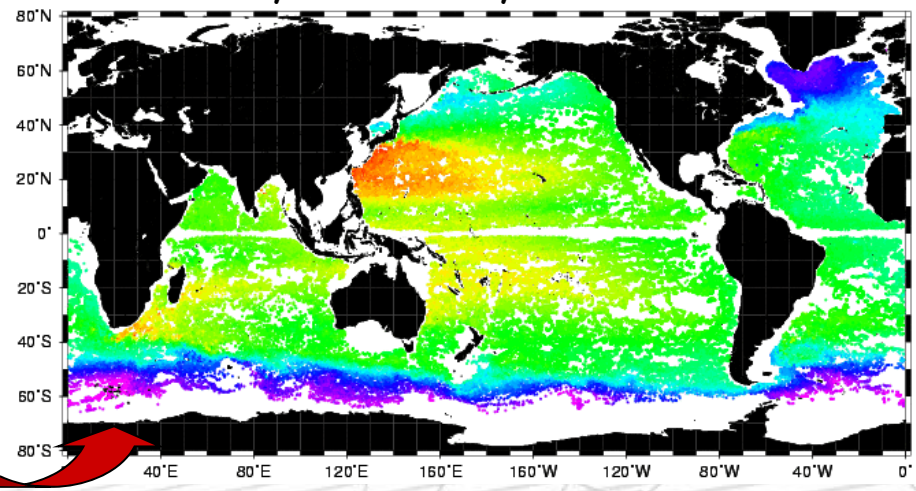
In-Situ oceanographic data

- T/S profiles distributed via Coriolis for the 1993-2009 period used to compute dynamic heights relative to 1000m

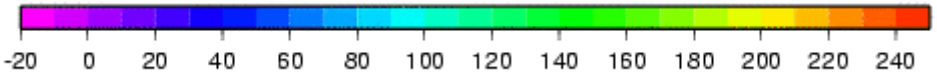
Hsynth



Hsynthtot=Hsynth+h1000

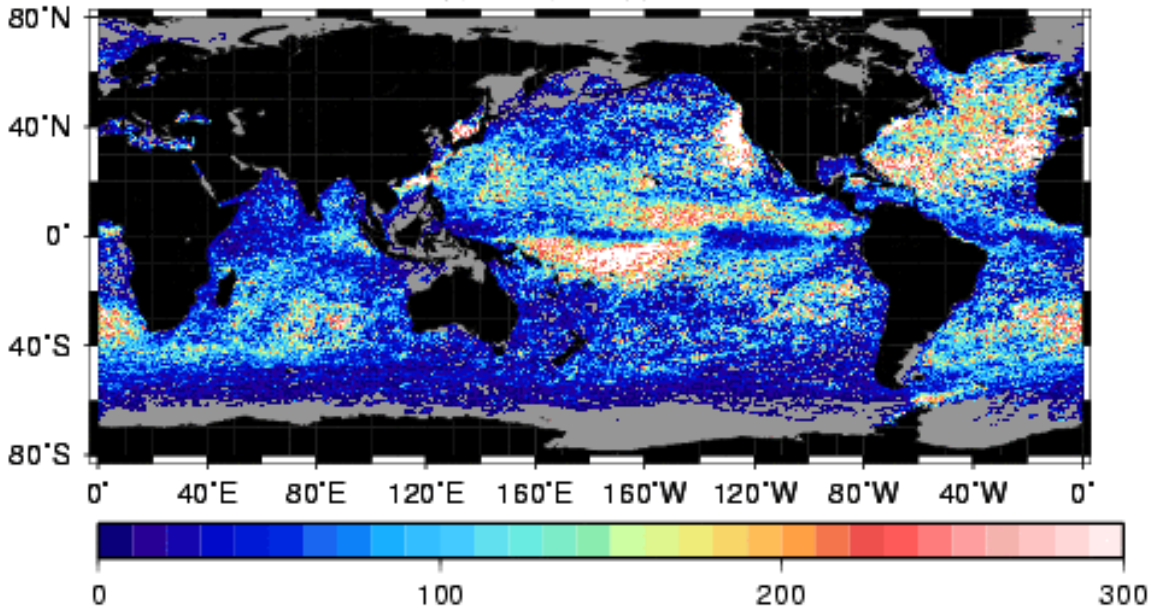


An estimate of the mean dynamic height at 1000m (Willis et al, 2006) is added to the dynamic heights relative to 1000m



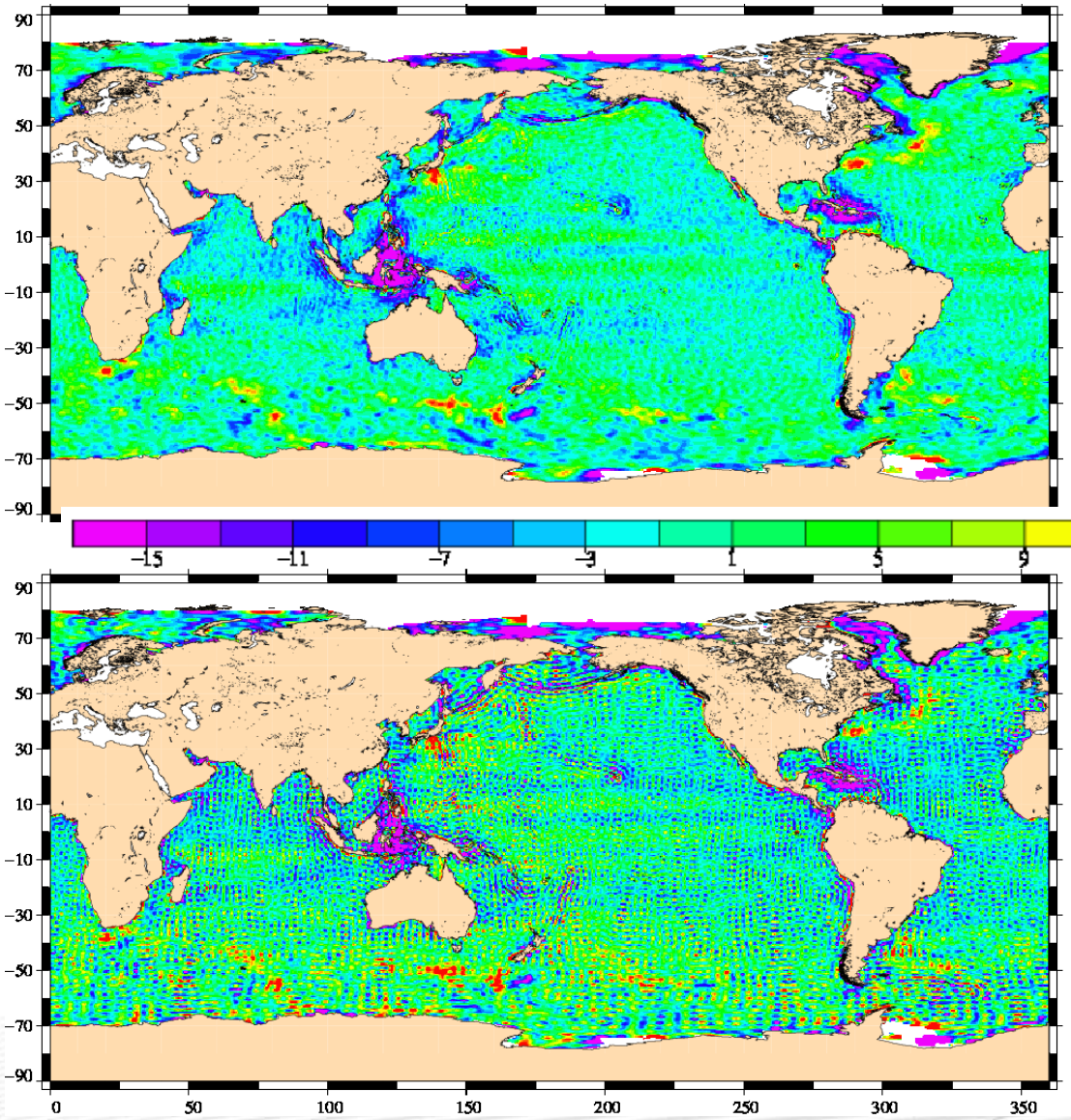
Data used

- Surface current velocities measured by SVP type drifting buoys and distributed by AOML over the 1993-2008 period



Drifter velocities are processed to extract the only-geostrophic component:
-Ekman currents are modeled (Rio et al, 2003) and subtracted
-A 3 days low pass filter is applied along the drifter trajectories

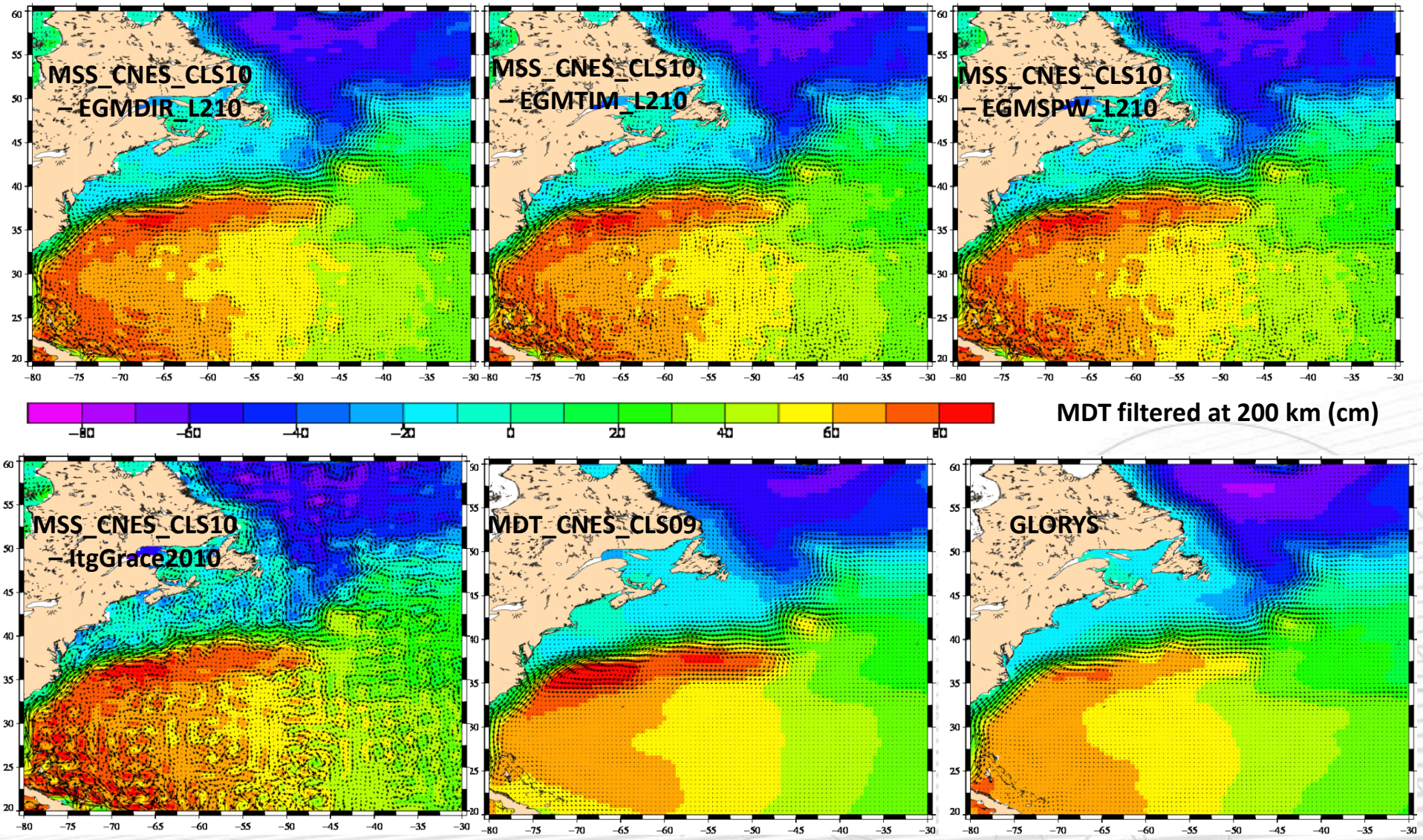
MDT comparison – Global difference at 200km



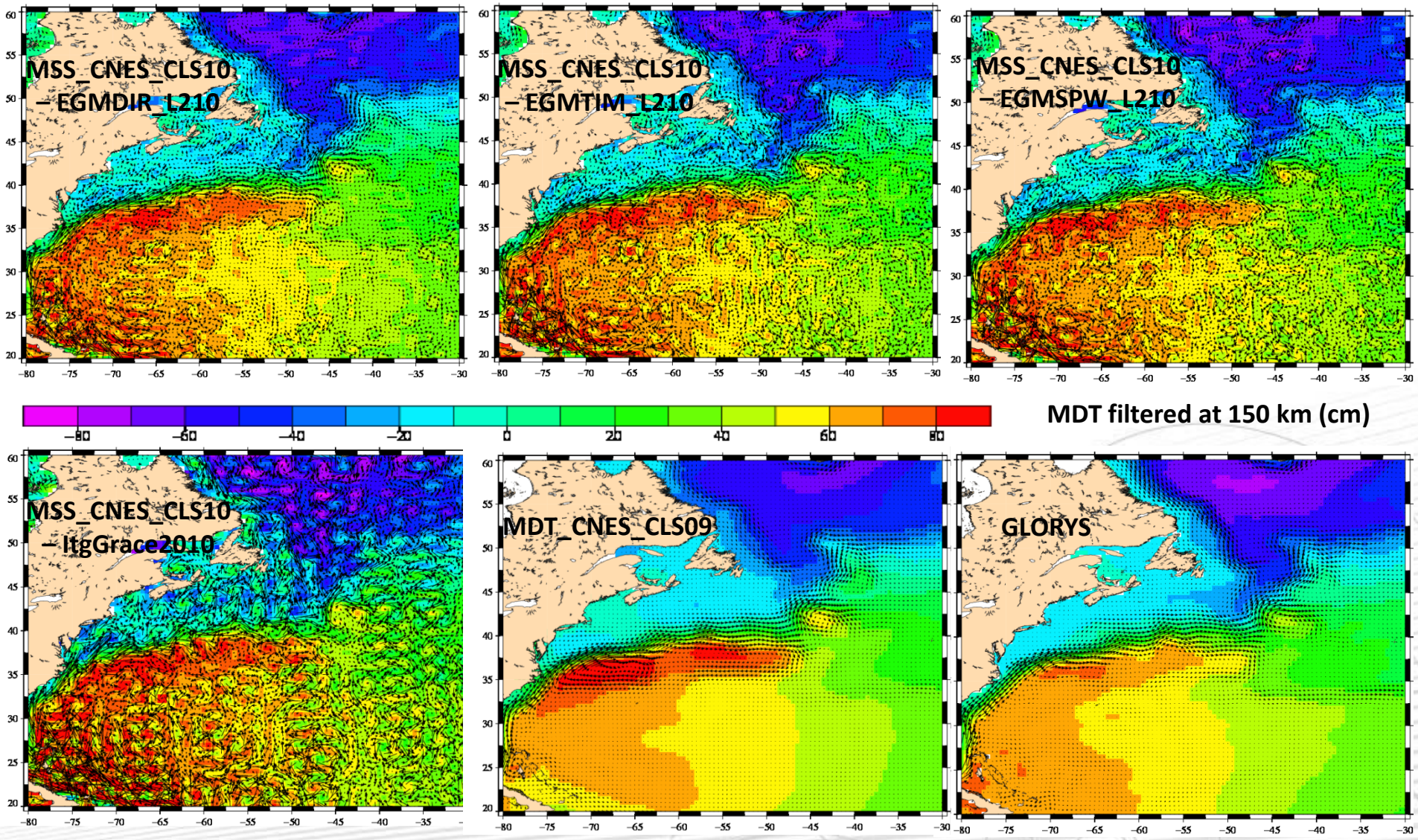
Difference of MDT_CNES_CLS09 – [MSS_CNES_CLS10-EGM_DIR] filtered at 200km

Difference of MDT_CNES_CLS09 – [MSS_CNES_CLS10-ItgGrace2010] filtered at 200km

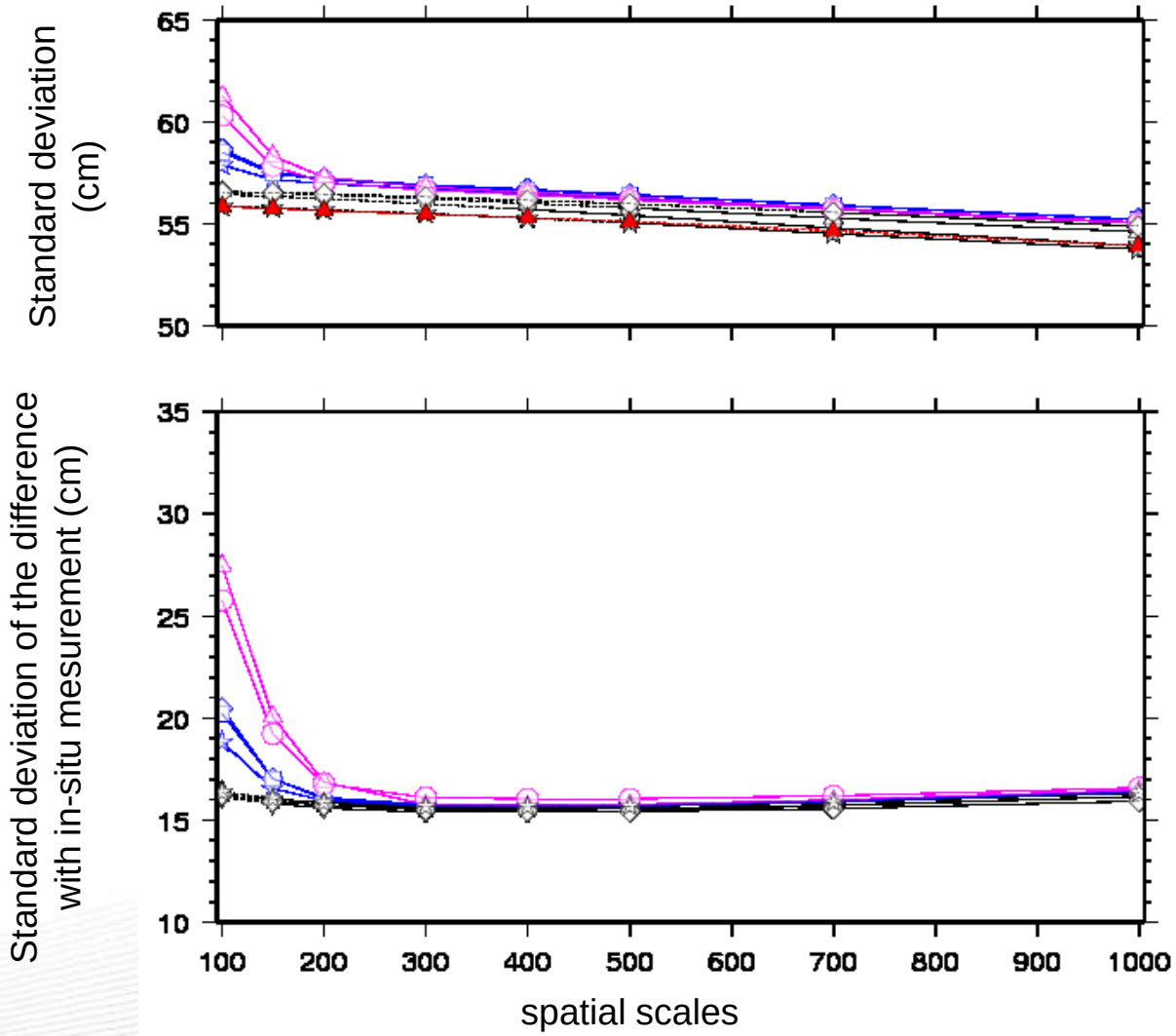
MDT comparison – Gulf Stream at 200km



MDT comparison – Gulf Stream at 150km

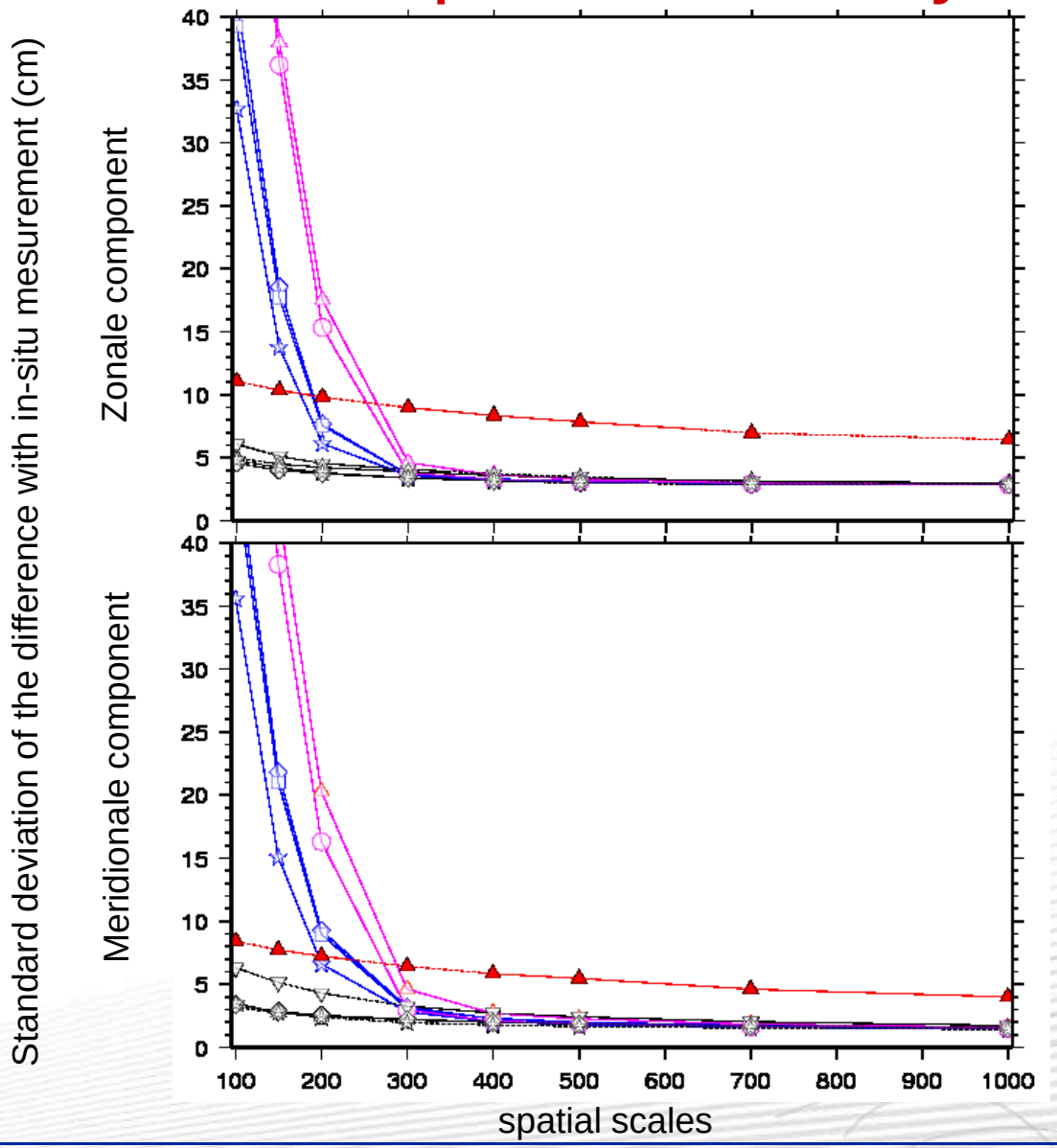


MDT comparison with synthetic mean height



- "Synthetic" MDT
- "Direct" MDTs
  - EIGEN-GRGS.RL02
  - ITG-GRACE_2010s
- "Direct" MDTs with GOCE
  - EGM_TIM
  - EGM_SPW
  - EGM_DIR
- "Combined/modelled" MDTs
  - GLORYS
  - Maximenko08
  - CNES_CLS09
  - DNSC08

MDT comparison with synthetic mean velocity



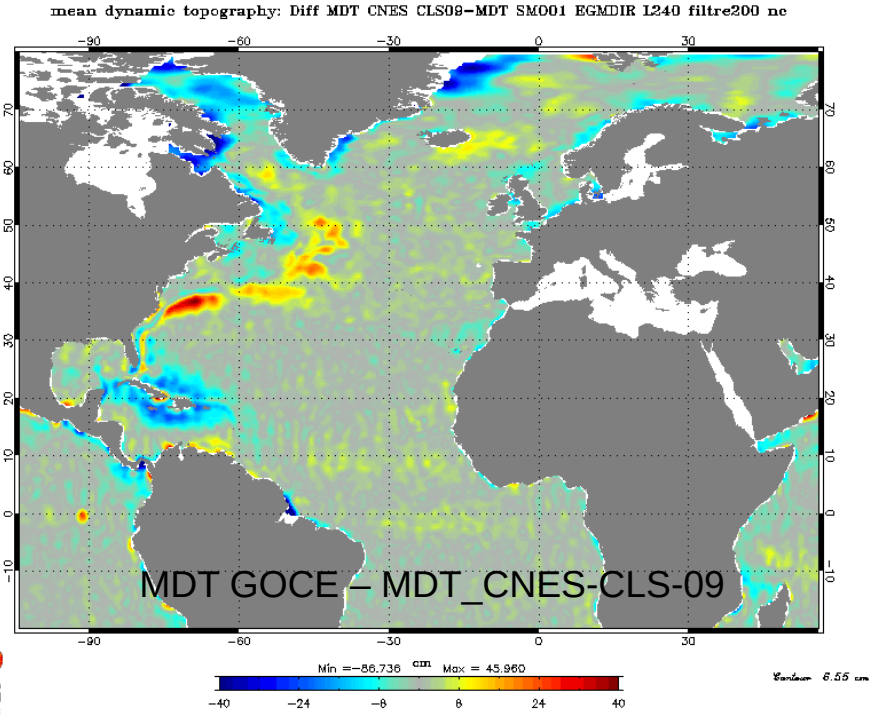
- "Synthetic " MDT
- "Direct" MDTs
  - EIGEN-GRGS.RL02
  - ITG-GRACE_2010s
- "Direct" MDTs with GOCE
  - EGM_TIM
  - EGM_SPW
  - EGM_DIR
- "Combined/modelled" MDTs
  - GLORYS
  - Maximenko08
  - CNES_CLS09
  - DNSC08

Collaboration with Mercator-Océan

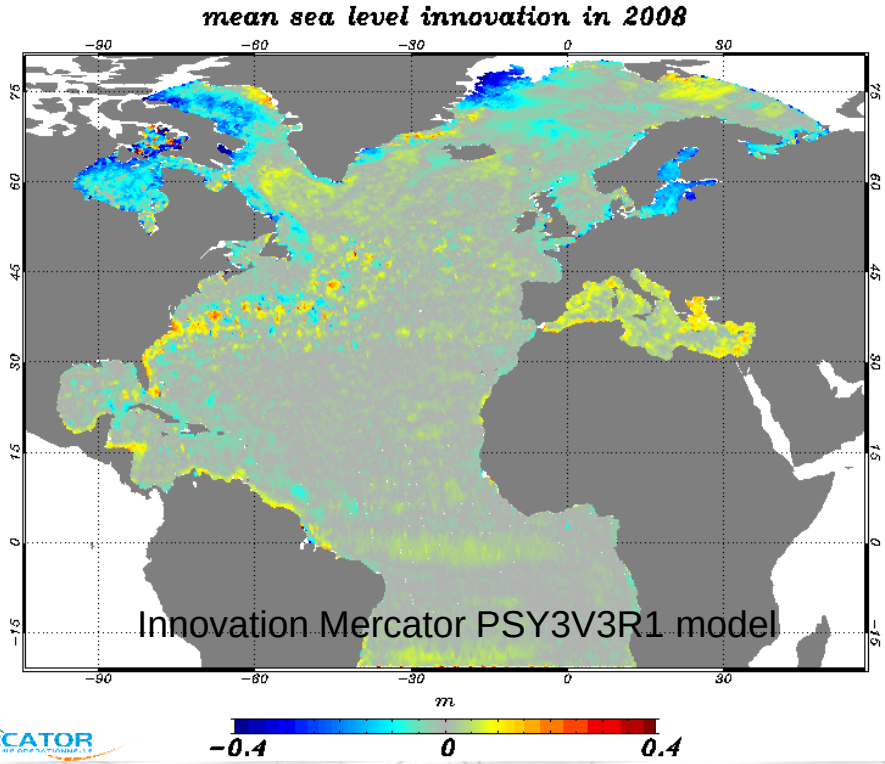
The differences observed in GOCE – CNES-CLS09 looks like to the innovations exibit by Mercator model

→Similarities and differencies really help us to better characterise the MDT error and their sources

do they come from the geoid model, the introduction of the in-situ observations, the lack of In-situ data, the limits of the models



MDT GOCE – MDT_CNES-CLS-09



Innovation Mercator PSY3V3R1 model

Conclusions

- The validation performed on the preliminary GOCE geoids is very promising

-1- GOCE geoid (with only 71 days of data) exhibits a better accuracy at smaller scale than GRACE derived geoid but do not reach the accuracy of the combined MDTs

-2- Significant improvement for scale comprised between 400 km to 200 km, progress should be done to obtain realistic circulation for smaller scale

-3- The method provided a quantative assessment of the direct MDT (i.e. geoid)

-4- The GOCE geoid obtained by the direct method (EGM DIR) seems to give the best results

- Future work

-1- We are waiting for the new release (by the end of the year) in order to assess the improvement between the two versions.

-2- Use optimal filtering rather than gaussian filtering to improve MDTs computed with GOCE geoid

-3-Look carefully at regions where we suspect some limitations in the CNES-CLS09 MDT (high latitudes…)