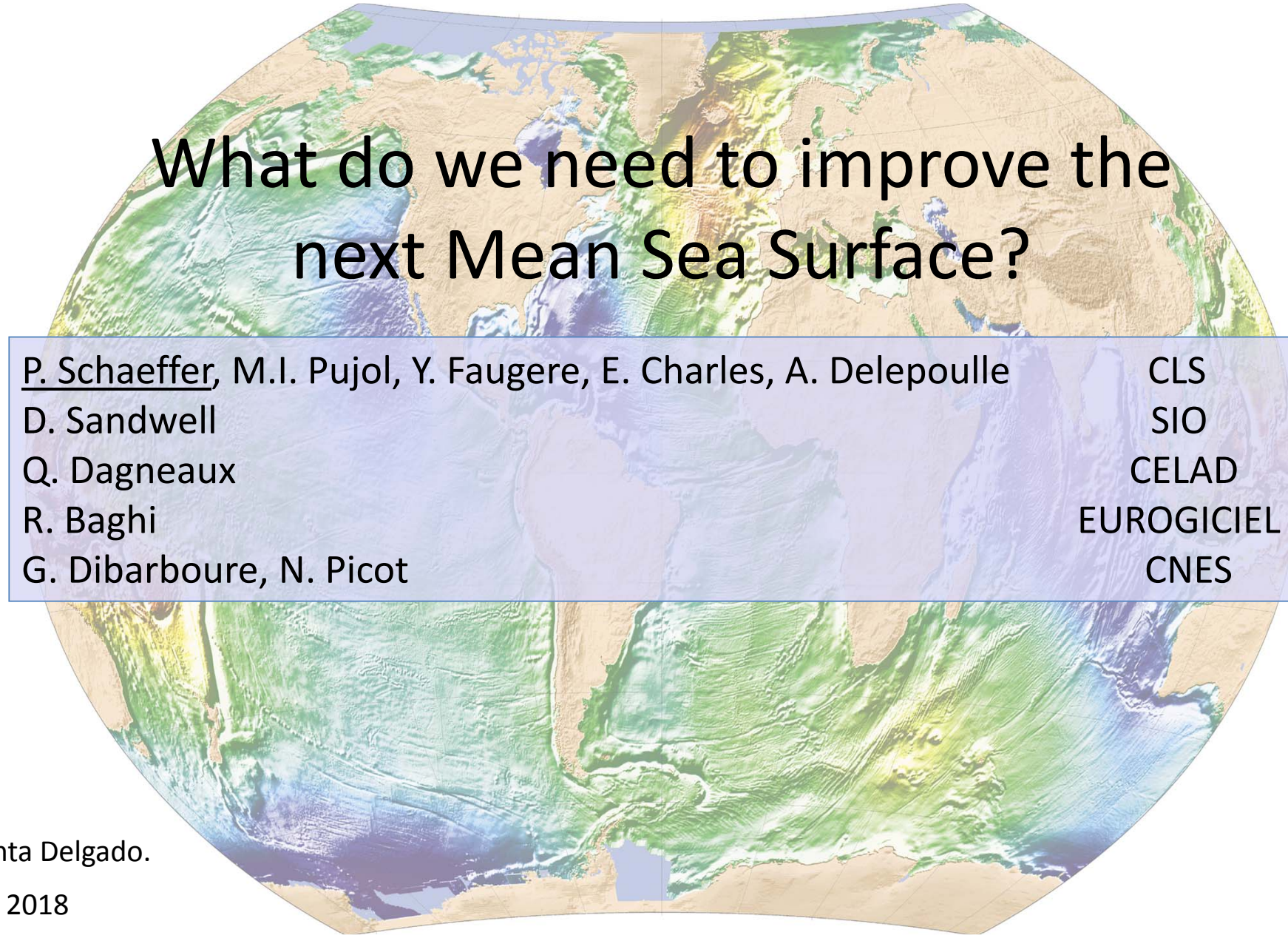


What do we need to improve the next Mean Sea Surface?

P. Schaeffer, M.I. Pujol, Y. Faugere, E. Charles, A. Delepoulle	CLS
D. Sandwell	SIO
Q. Dagneaux	CELAD
R. Baghi	EUROGICIEL
G. Dibarboure, N. Picot	CNES

OST-ST, Ponta Delgado.

September 2018

Reminder

MSS recommendations of last OST-ST (2016-2017) and also SWOT meeting (2017)

1. Continue efforts concerning the correction of the oceanic variability, especially for geodetic missions !

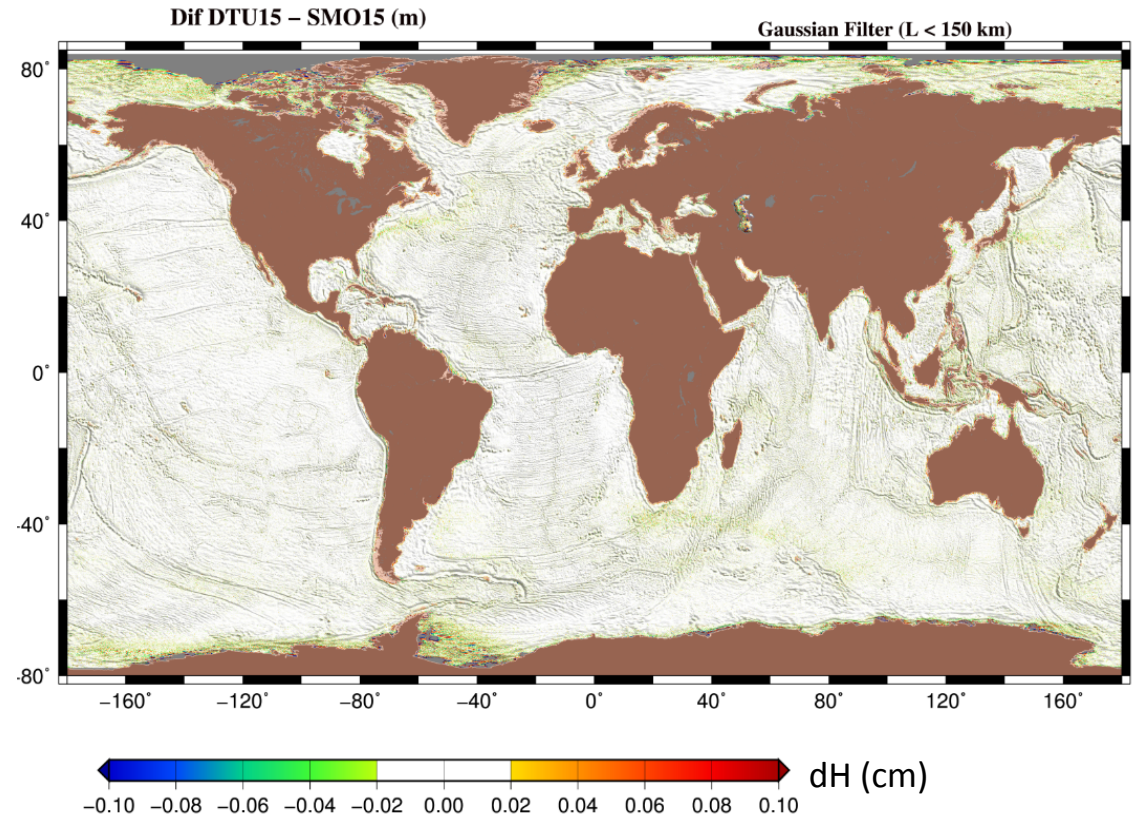
2. Spatial resolution of finest topographic structures (λ<30km) need to be improved !

➢ This talk will focus on these 2 points

Removing the oceanic variability

Differences between DTU15 and CNES_CLS15 MSS

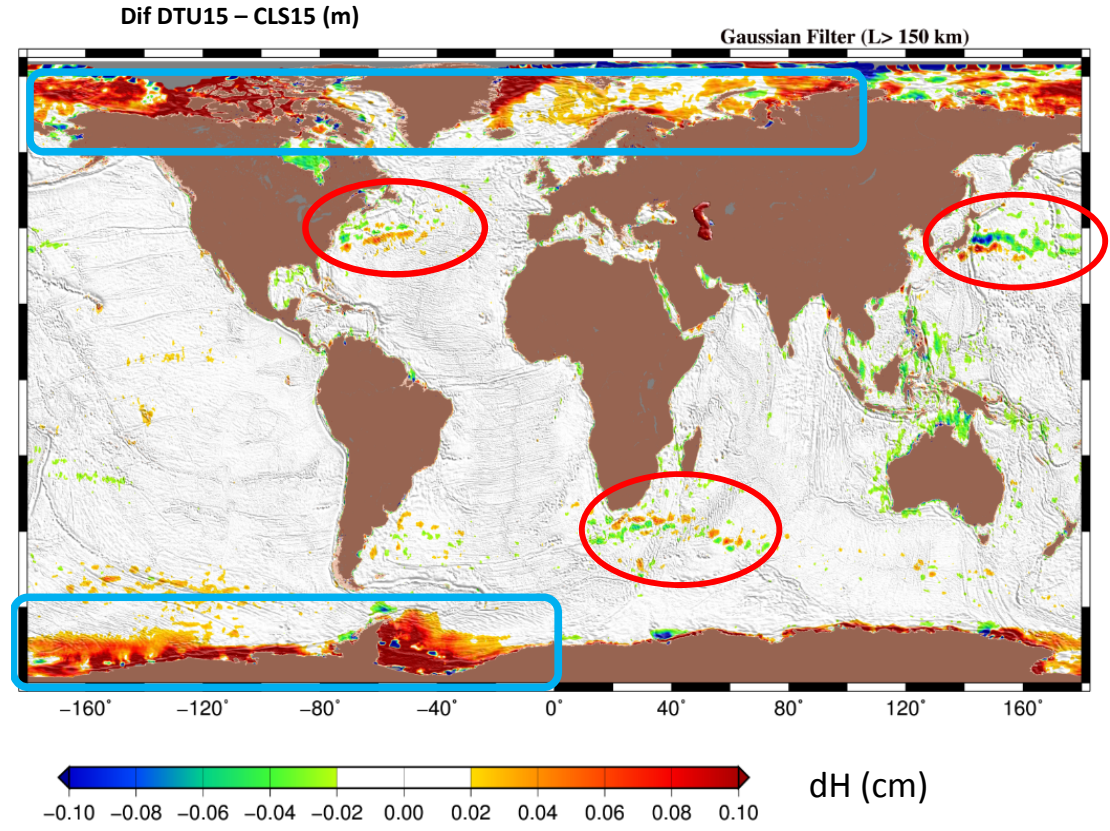
Short wavelengths λ < 150 km



- No significant differences at short wavelengths
- But these MSS are essentially based on 1 Hz data

➢ Need HR data (> 1 Hz) to improve finest structures

Long wavelengths λ > 150 km



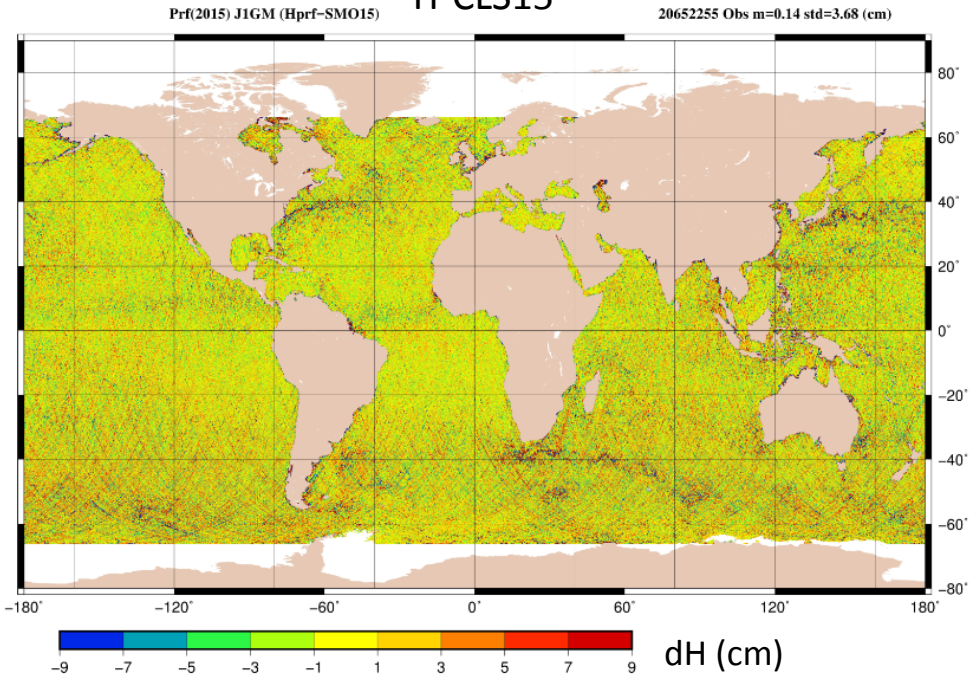
- *Data processing or time coverage differences for C2*
- Residual effect of oceanic variability

➢ "new" DUACS-MR + most accurate noise modeling (OI)

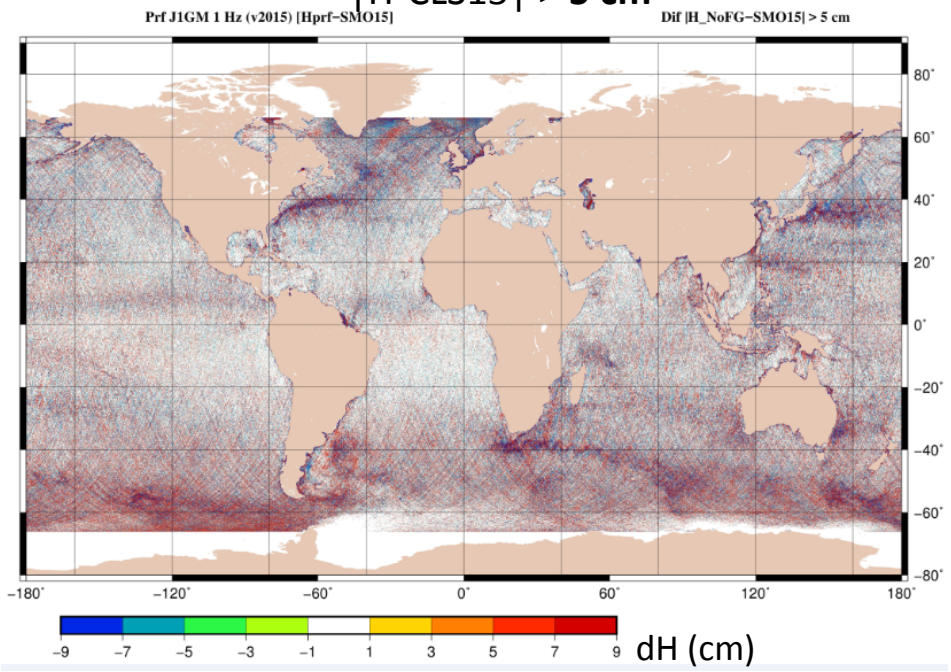
Removing the oceanic variability

J1-GM after removing MSLA DUACS (DT-2018 version)

H-CLS15



|H-CLS15| **> 5 cm**



- Despite the use of latest MSLA DUACS, residual effects persists (in particular for $50 < \lambda < 200$ km)

➢ **This point remains one of the major challenges for the next MSS**

Taburet G. et al, DUACS DT 2018: 25 years of reprocessed multi-mission altimeter data, in prep.,

Improve the spatial resolution

- Goal is to access to wavelengths < 30 km
- Use of « HR »generation of GM data (C2, J1-GM, AltiKa) sampled at 20/40 Hz provide us a good way.
  - **Collaborative analysis between CLS & Scripps are underway (DTU is joining us)**

HR MSS determination => 2 ways : Different dataset and different methods are used !

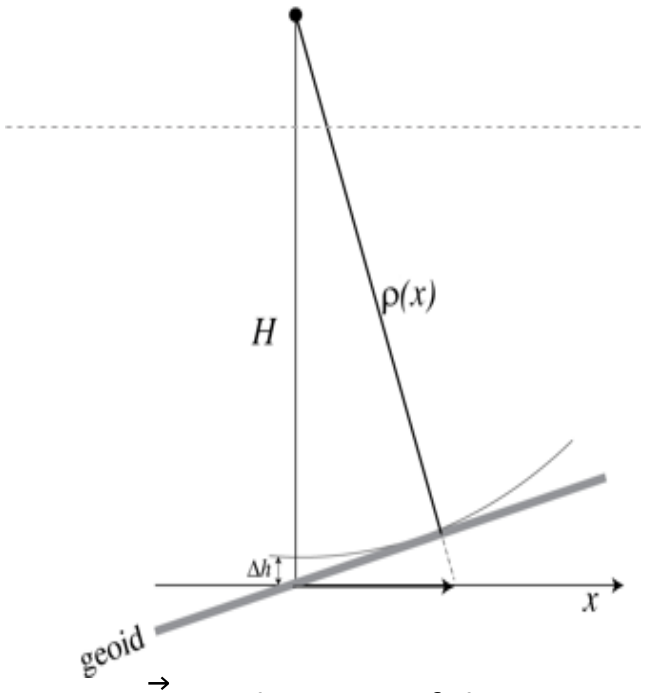
CLS	Scripps
2015 Mean Profiles +E1GM+J1GM (1 Hz) C2 SAR / 20 Hz (CPP RTK) SSH – MSLA DUACS Optimal interpolation + sum of different noises (white & correlated)	CNES_CLS15 MSS for λ > 30 Km C2 + J1GL + AltiKa : 2RTK + 5 Hz filtering + slope correction SLOPE combined with height Biharmonic splines in tension + appropriate uncertainties

- Validations are performed using S3A: not include in these MSS

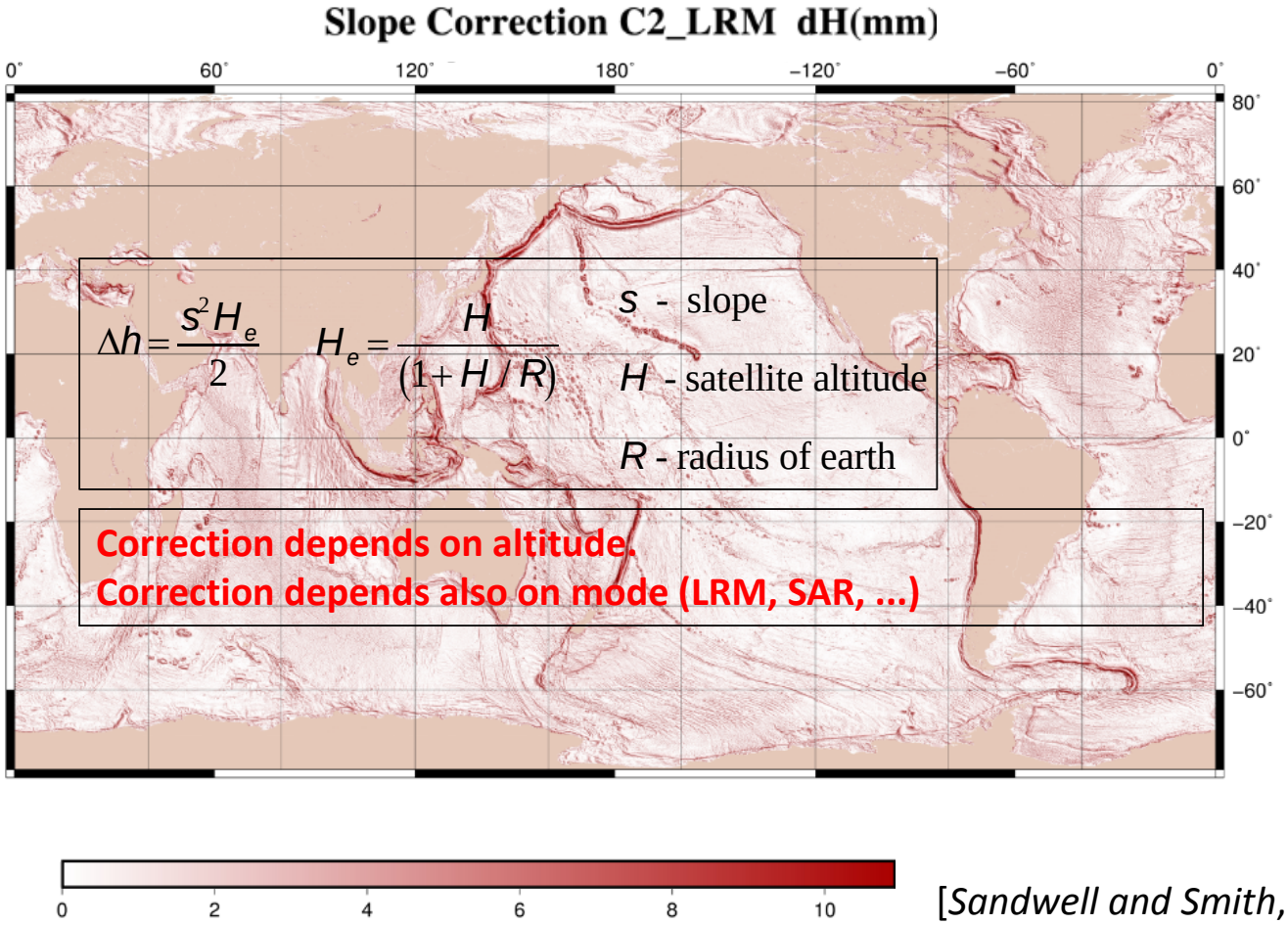
Improve the spatial resolution

- **Remark concerning SAR & LRM data**: new MSS will result from a combination of these 2 kinds of observations that are not affected in the same way by the slope of the sea surface.

➢ it is therefore necessary to correct these data from the slope effect.



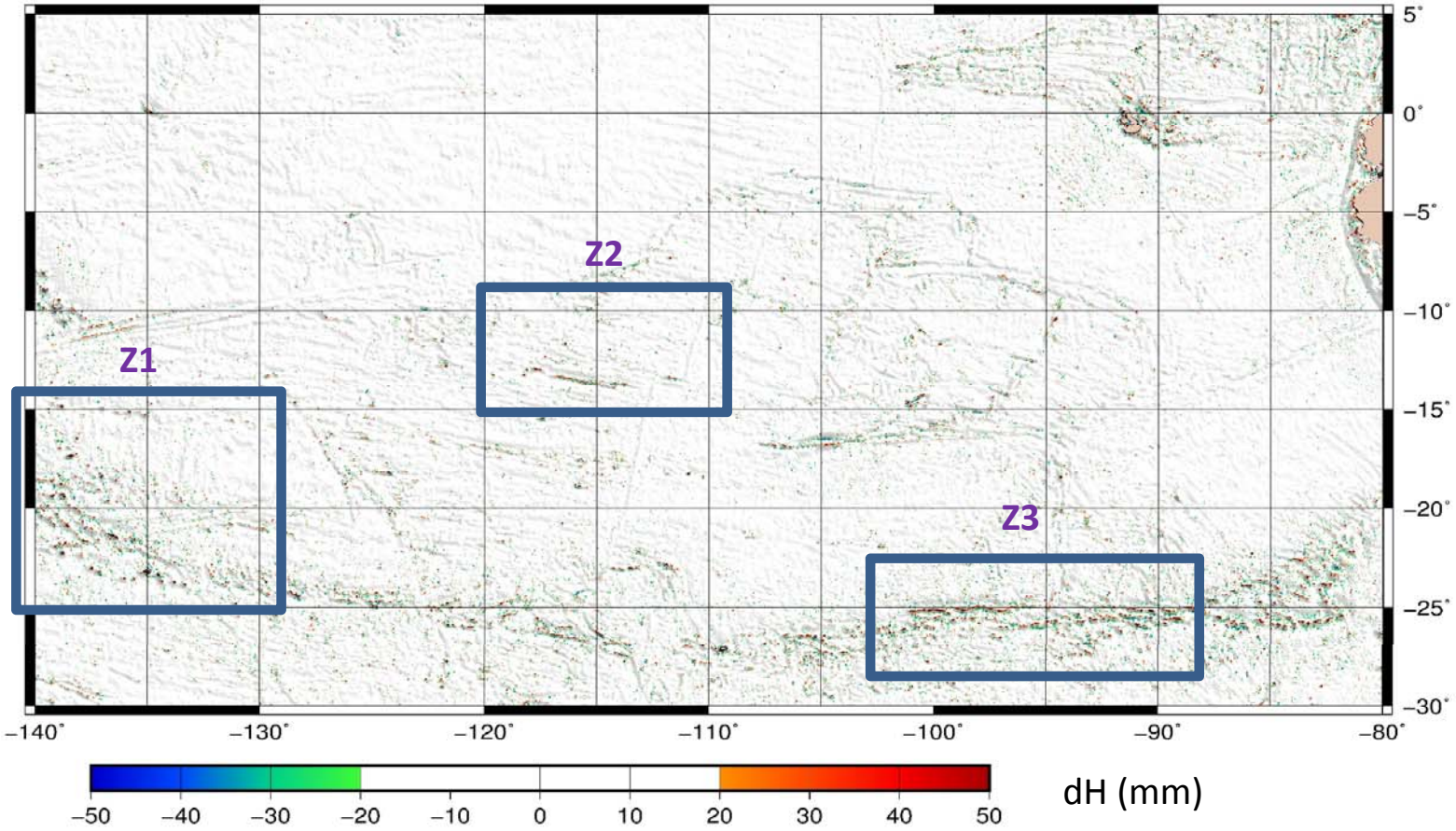
$\vec{x}$: in direction of the maximum slope (from nadir)



[*Sandwell and Smith*, 2014]

Improve the spatial resolution: preliminary results

Difference between **Scripps – CNES-CLS15** => improvements can reach over 5 cm !

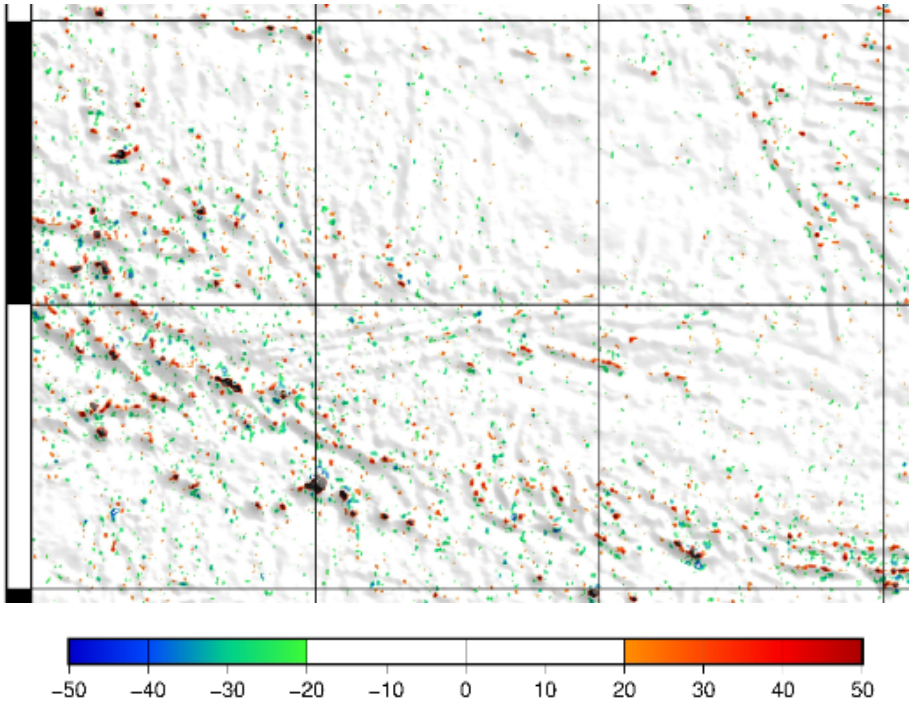


Improve the spatial resolution: preliminary results

Difference between **Scripps – CNES-CLS15**

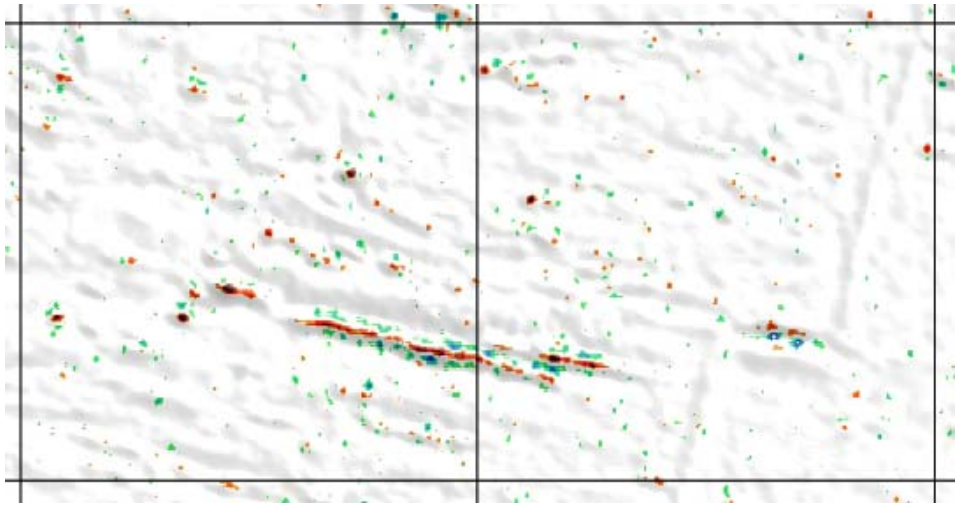
- improvements exceed several cm for many structures !
- Some of these geophysical structures have wavelengths less than 30 km !

Z1

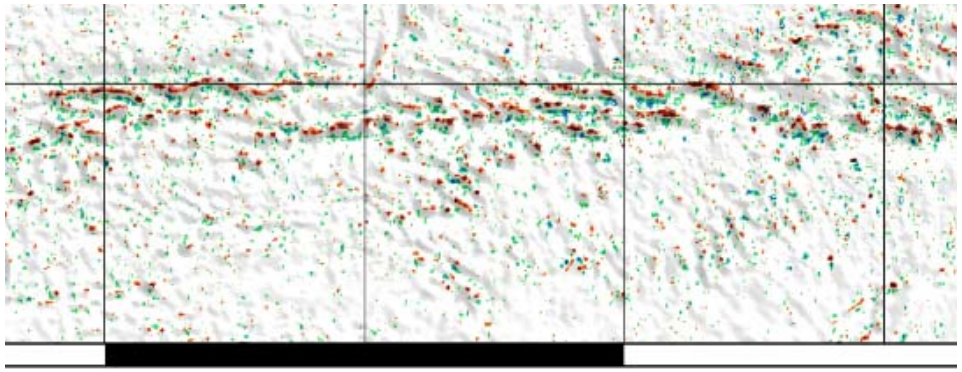


dH (mm)

Z2



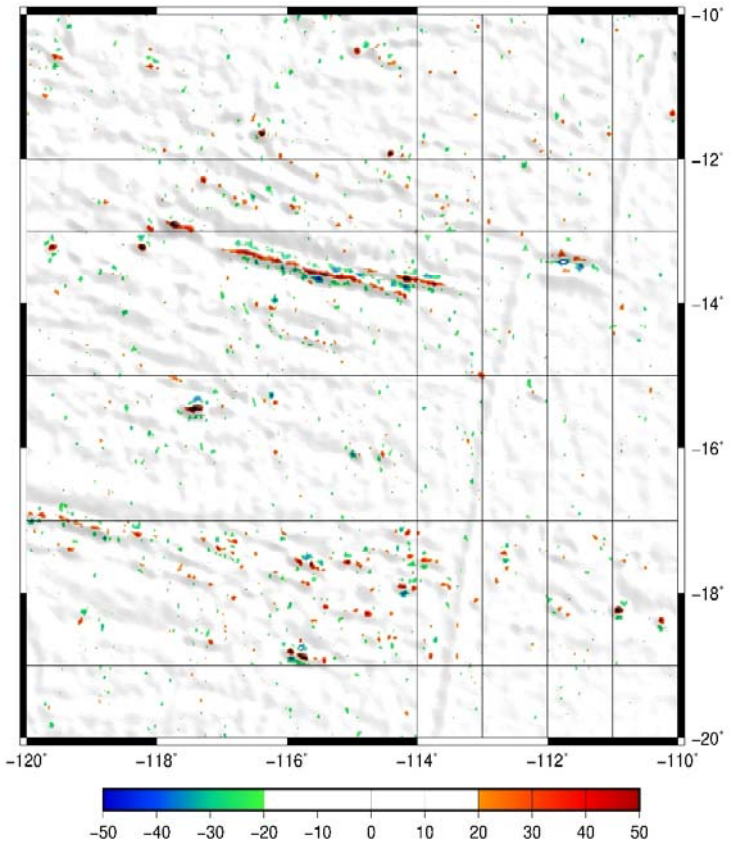
Z3



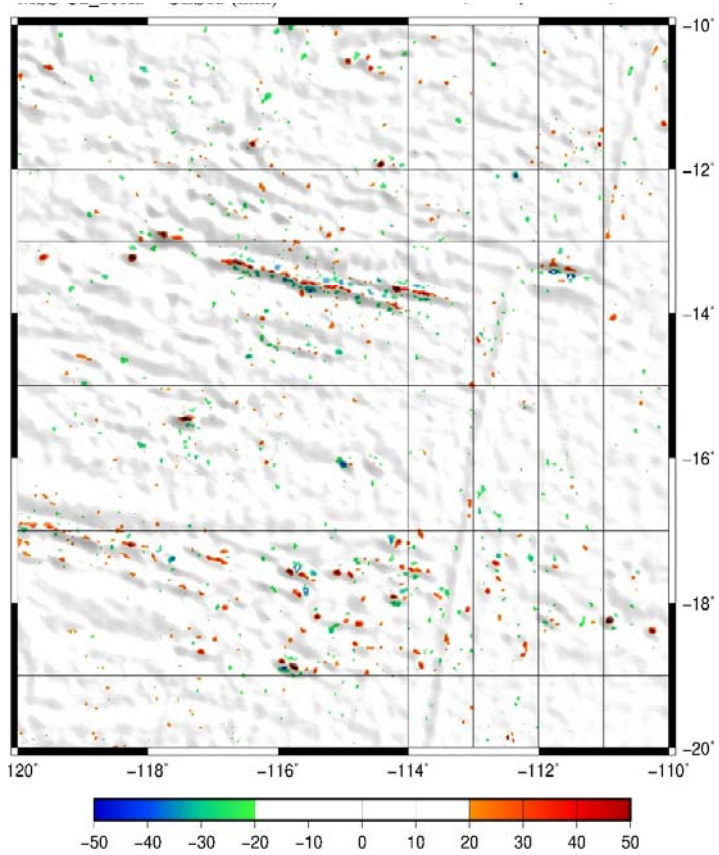
Improve the spatial resolution: preliminary results

- Comparisons between Scripps and CLS solutions
- ➢ Solutions look similar, differences come essentially from J1-GM and AltiKa (not include in CLS determination)

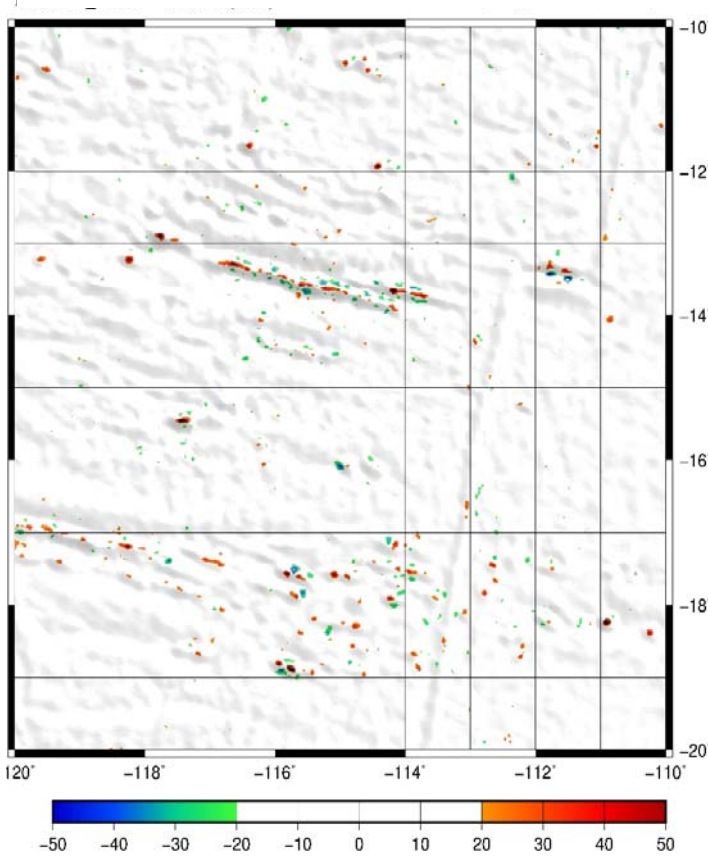
Scripps (slope 5 Hz) – CNES_CLS15



C2[SSH 20Hz/white noise] – CNES_CLS15



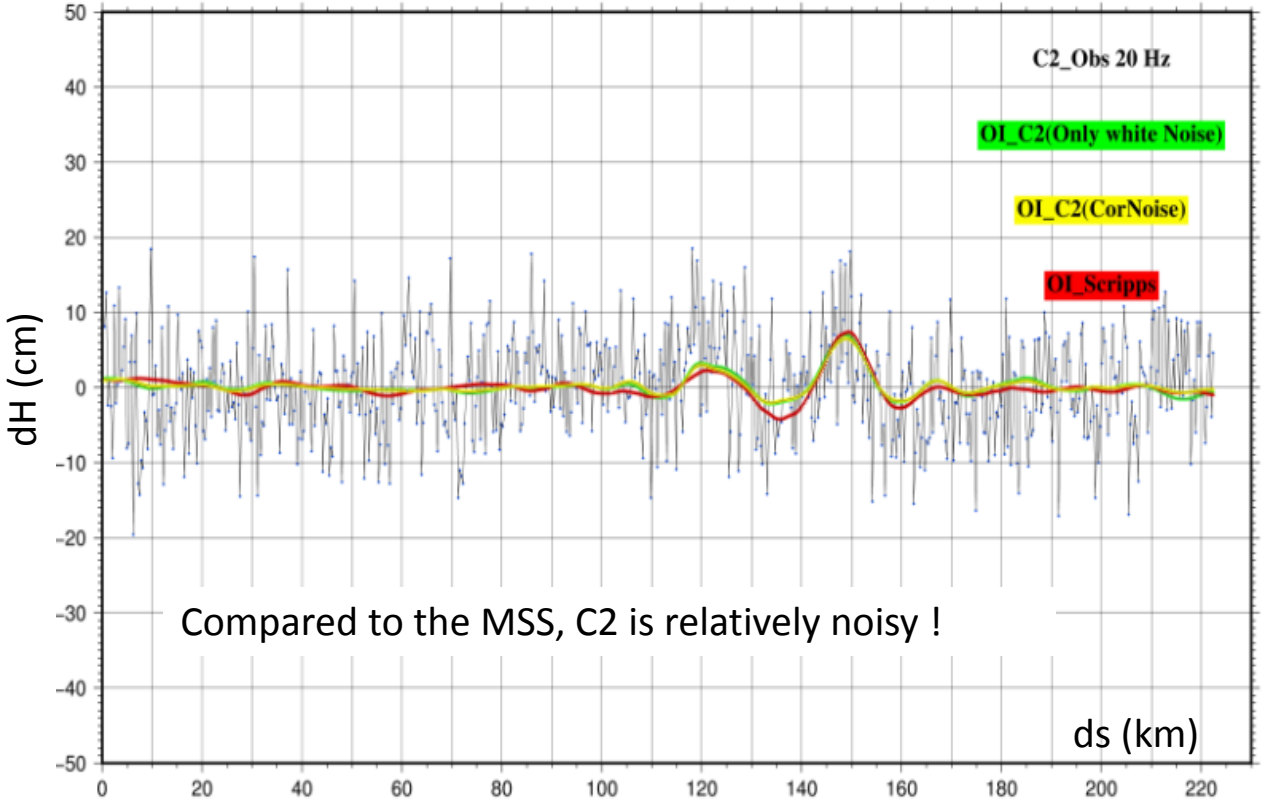
C2[SSH 20Hz/corelated_noise] – CNES_CLS15



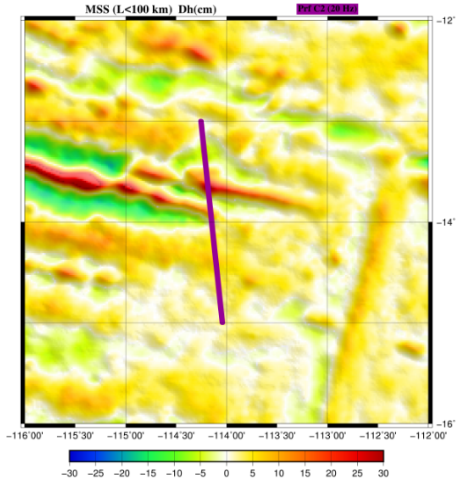
dH (mm)

Improve the spatial resolution: preliminary results

Prf C2 20 Hz & MSS H-CNES_CLS15 MSS



Cross-section along C2 profile



Std of differences H – CNES-CLS15 MSS

C2 Prf:	std = 6.6 **=> C2 (20Hz) noise of SAR ~ 5.0 cm**
OI_C2(white noise):	std = 1.5
OI_C2(correlated noise):	Std = 1.3 (correlated noise = 3 cm/5km + white noise 6 cm)
OI _Scripps:	Std = 1.6

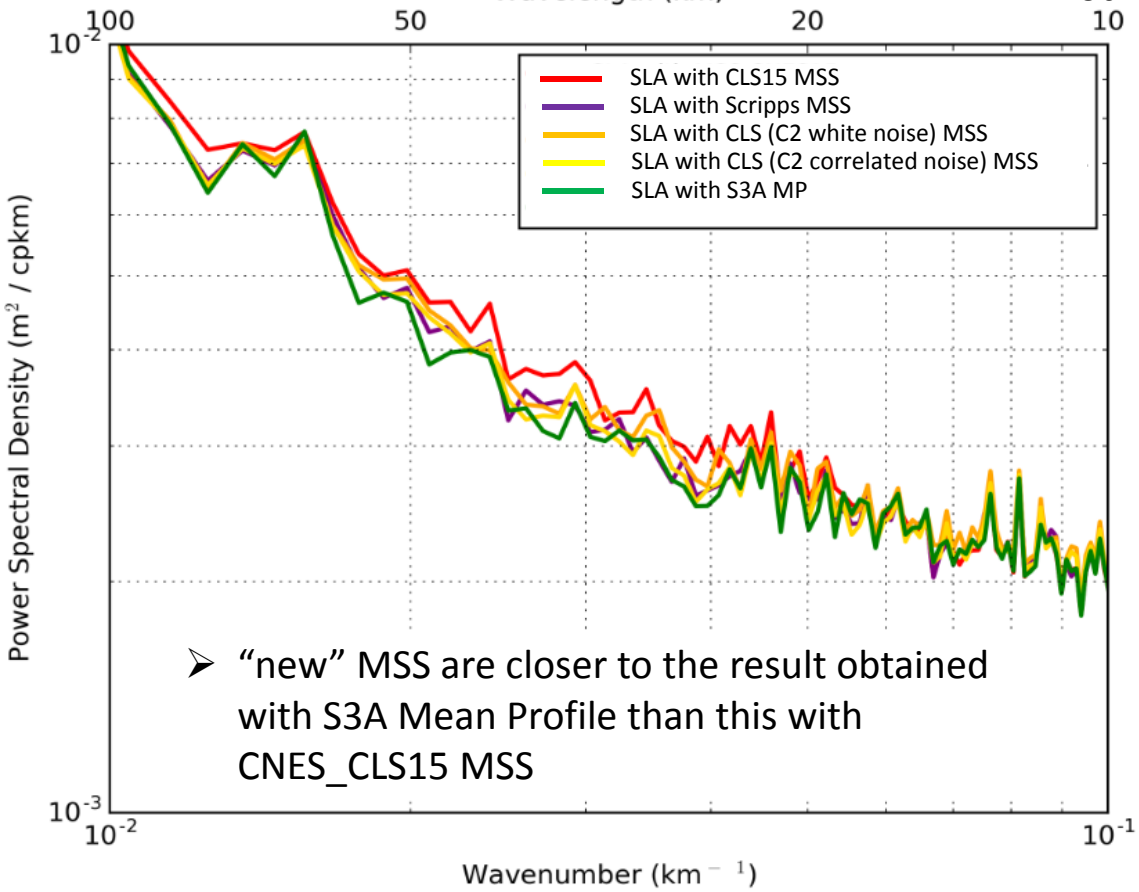
A part of these std can be considered as an improvement of the CNES_CLS15 MSS

Improve the spatial resolution: preliminary results

- MSS Error based on comparison of SLA with independent cycle of S3A (Pujol et al. 2018)

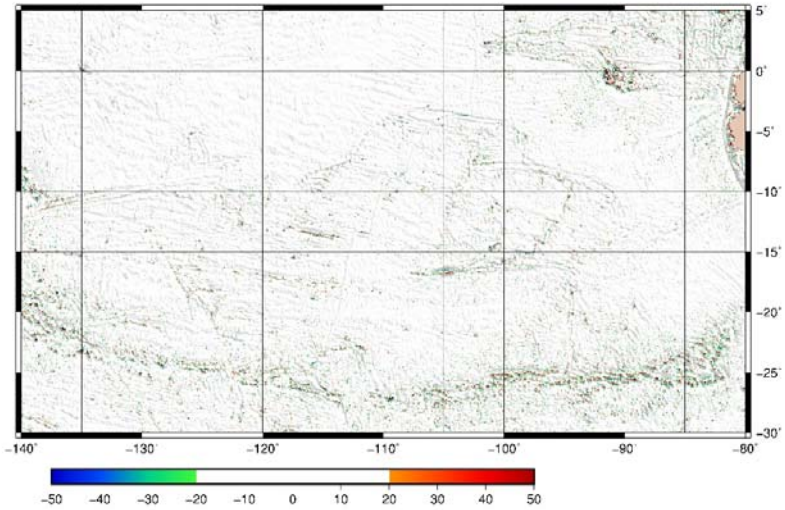
S3A Cycle 11 (independent)

- Not in MSS
- Not in MP



➢ "new" MSS are closer to the result obtained with S3A Mean Profile than this with CNES_CLS15 MSS

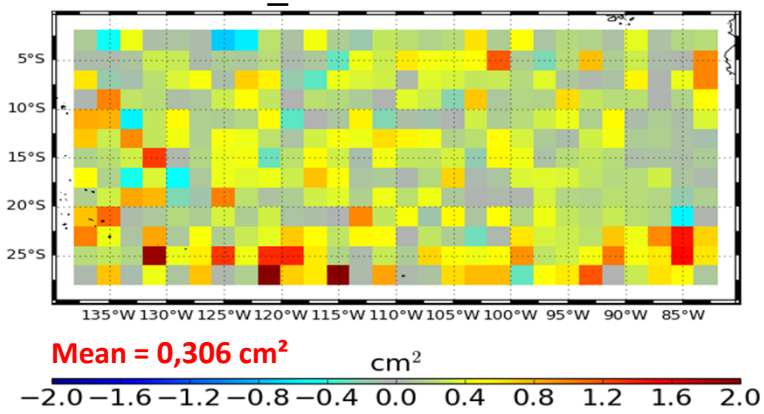
Validation in the Pacific region



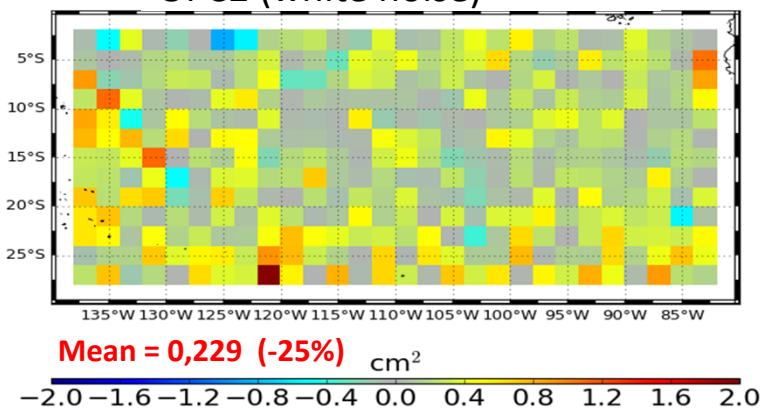
Improve the spatial resolution: preliminary results

- Validation based on the same method but in box-average & for 15 < λ < 100 km
- Comparisons between S3A & various MSS (percentage of improvement relative to CNES_CLS15 MSS)

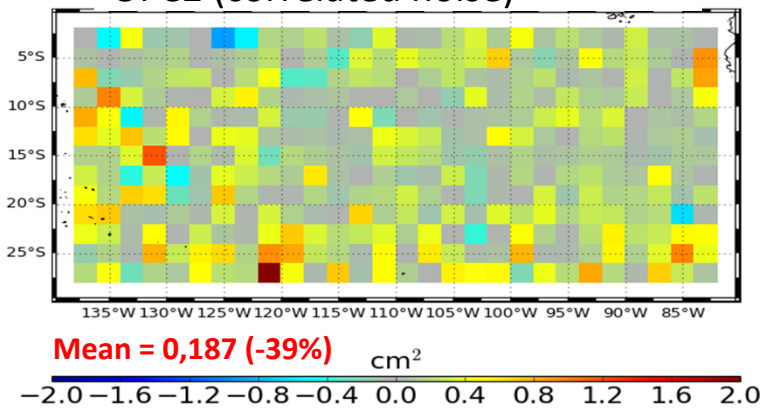
CNES_CLS15 MSS



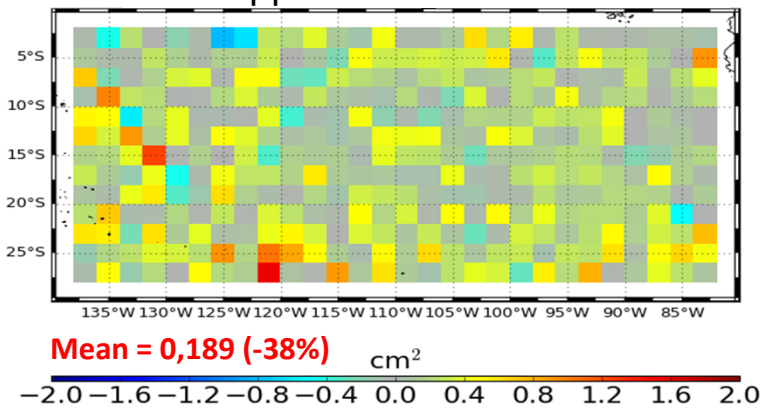
OI C2 (white noise)



OI C2 (correlated noise)



OI Scripps



➢ From a statistical point of view, CLS OI with correlated noise and Scripps OI are the closest solutions, and improvements are close to 40%.

Conclusion & Perspective

- High Resolution data from GM allows us to strongly improve the short wavelengths of the MSS
- We need to continue investigations to reduce the residual effect of the oceanic variability (in particular for wavelengths less than 200 km)
- We need more extensive analyses concerning the noise(s) of HR data (amplitude & type depending on frequencies domain)

➢ New MSS and also determination of gravity anomalies are planed for next year