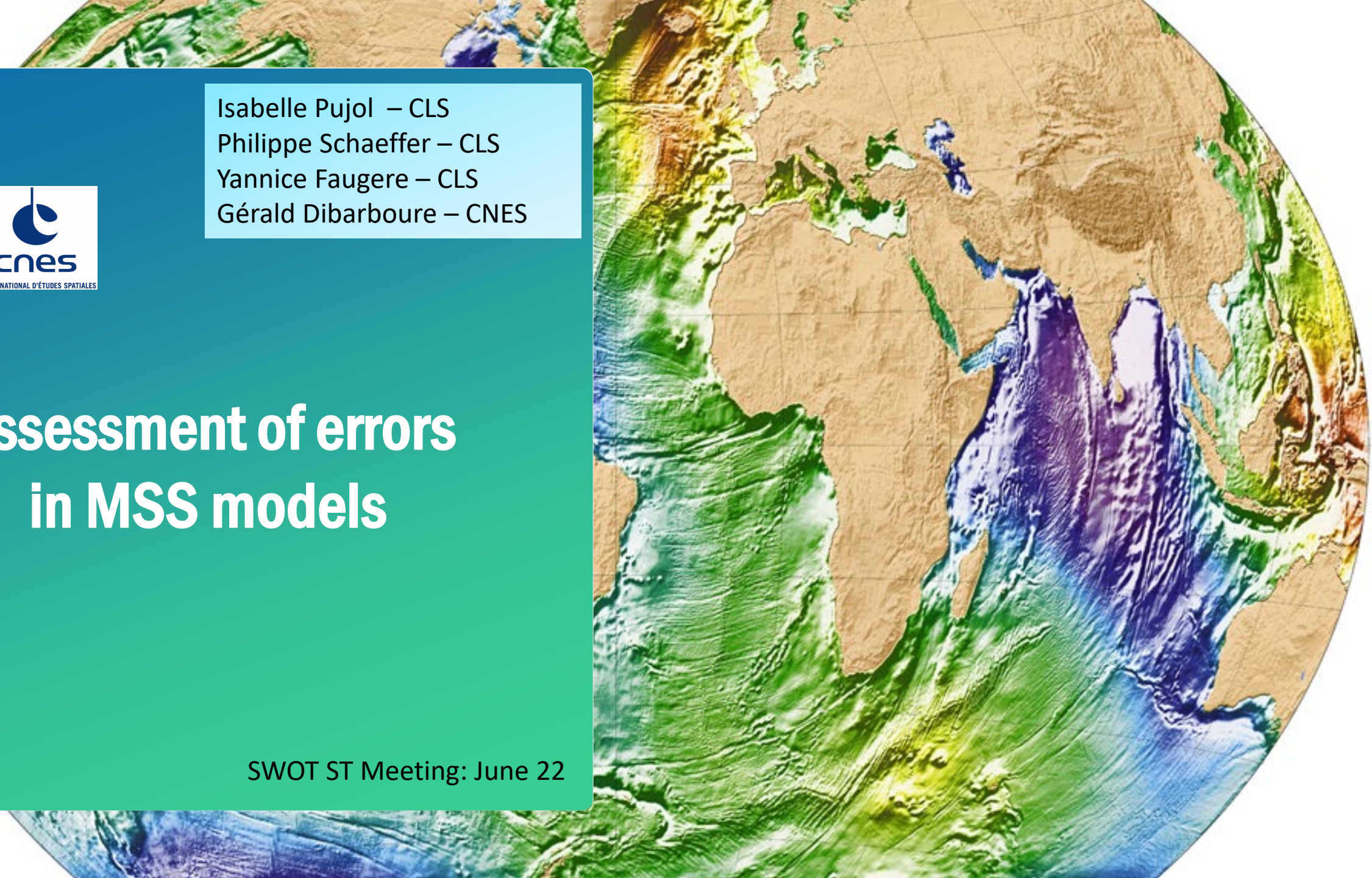
Isabelle Pujol – CLS
Philippe Schaeffer – CLS
Yannice Faugere – CLS
Gérald Dibarboure – CNES

Assessment of errors in MSS models

SWOT ST Meeting: June 22



Overview

- MSS models :
  - CNES_CLS_2022 : S3 not included
  - SCRIPPS_CLS21_UPDATED_S3 : version based on CNES_CLS_2022 including use of S3A/B
  - DTU_2021 (S3 included)

Rq: CNES_CLS2022 = CNES_CLS2021 + Leads in arctic aera

- Data for validation:
  - Sentinel-3A 20Hz LRRMC processing ; Cycles 26 & 38 (Jan et Dec 2018)

Reminder the results of the direct differences…

Differences between HR MSS

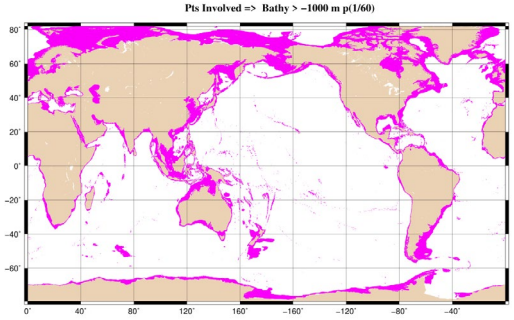
- Differences are calculated on grids at 1 min resolution.

Bathy > 1000 m

Diff	Nb Points	Mean (cm)	Std (cm) [3σ]
Scripps – CLS	119 439 521	0,06	0,80
CLS - DTU	118 365 843	0,09	1,38
Scripps – DTU	118 861 025	0,02	1,46

Bathy < 1000 m

Diff	Nb Points	Mean (cm)	Std (cm) [3σ]
Scripps – CLS	12 542 354	0,63	3,38
CLS - DTU	12 599 451	0,40	4,99
Scripps – DTU	12 535 188	-0,25	5,22



- The low values of the averages imply that these MSS are "centered" and therefore consistent in term of Sea Level Rise.
- The standard deviation values show that these MSS are close in terms of high-resolution content and also consistent with the expected accuracy of SWOT.
- We note a relative degradation of the accuracy near the coasts which remains one of the major difficulties concerning the processing of altimetric data.

Gridded MSSs errors at short WL

methodology:

- Based on SLA comparison between 2 cycles
- **Sentinel-3A** measurement used (CNES S3PP LR-RMC processing)
- Focus on WL [15, 100km]

3 assumptions:

1) There is no covariance between the SLA signal and the MSS errors → We use a mission/period independent from MSS computation: S3PP/CNES Sentinel-3A (20Hz)

2) The SLA signal is completely decorrelated between the two cycles considered → We chose A and B far enough from each other

3) The MSS error is the same whatever the cycle considered → we use a repetitive mission

We consider :

- **H** = SLA signal including the MSS errors (**e**) and the SLA signal free from MSS errors (**h**)
- **A** and **B** = two different cycles

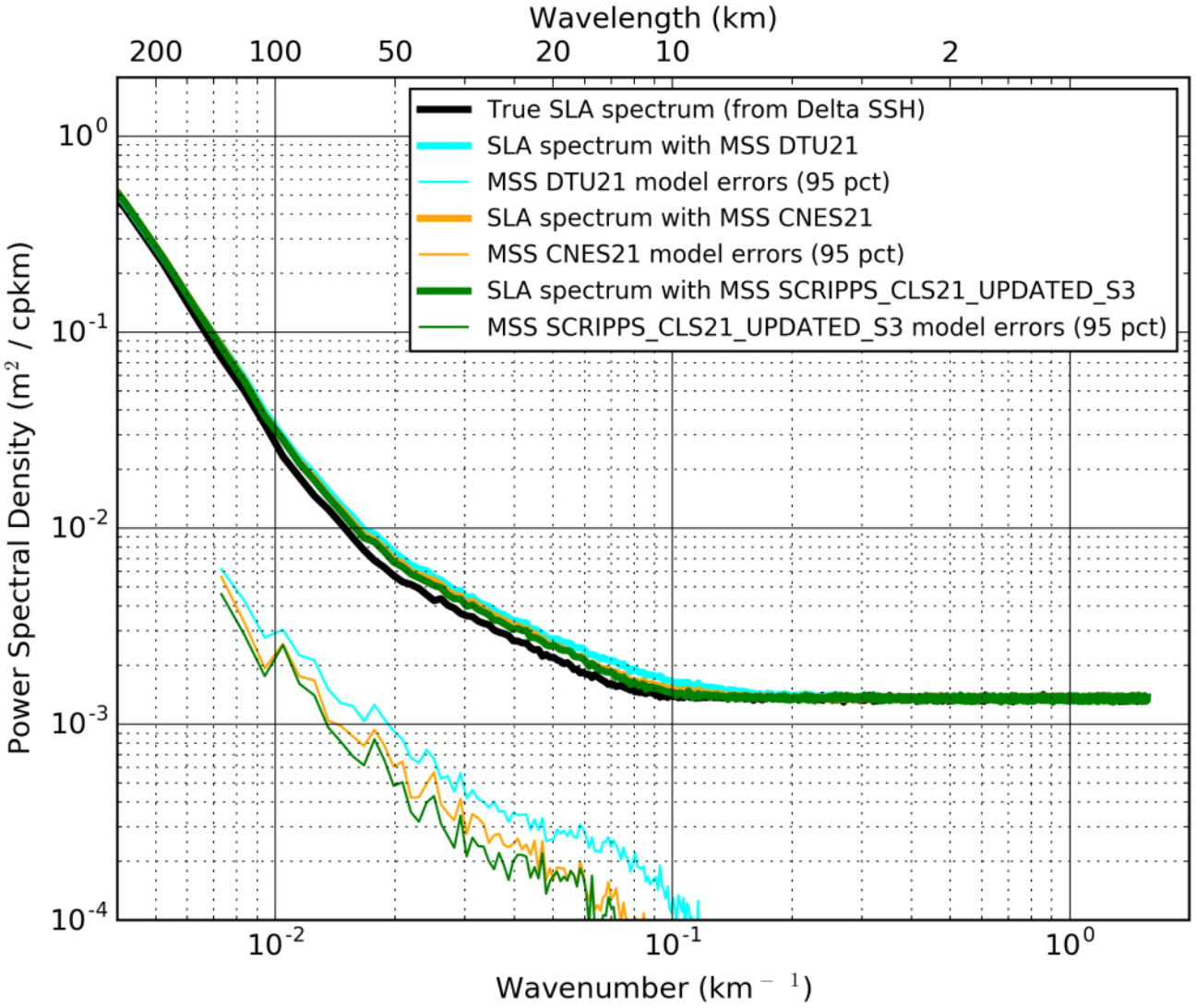
$$0.5\,\sigma^2(H_A - H_B) - 0.5\,\sigma^2(H_A + H_B) = 2\,\sigma^2(e)$$

Mean spectral content of the h signal

Mean spectral content of the h+e signal

Pujol et al (JGR 2018; https://doi.org/10.1029/2017JC013503)

Gridded MSSs errors at short WL – S3A LR-RMC reference



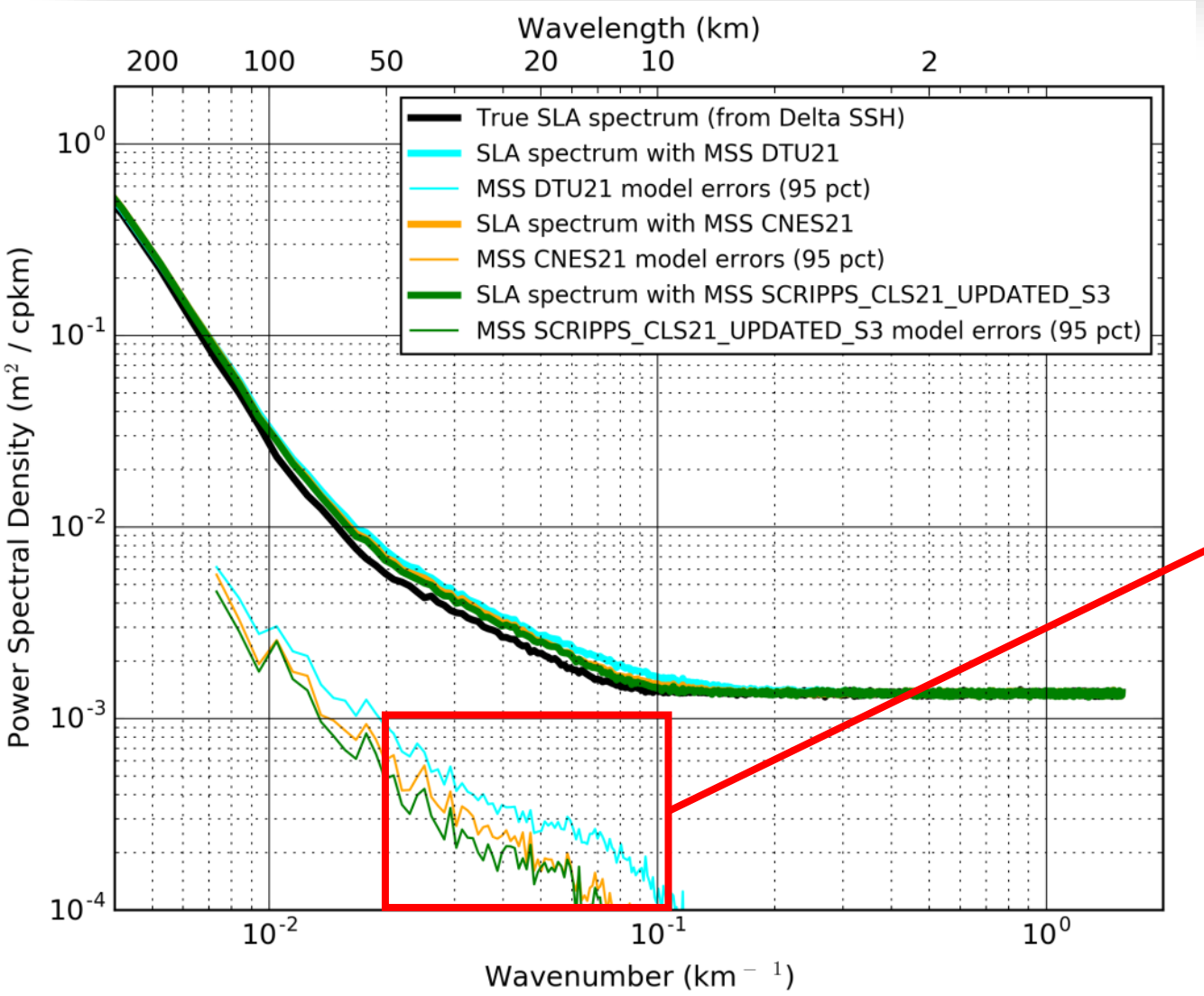
MSS	Error [15, 100 km]	
	cm²	% for SLA (noise free) variance*
SCRIPPS CLS21 updated_S3	**0.21**	**18**
CNES_CLS21	0,24	21
DTU21	0,34	29

** Reference SLA noise free variance = 1.16 cm²*

SCRIPPS CLS21 updated_S3 & CNES_CLS22 : Closest results

Scripps CLS21 : the smallest error from the point of view of S3A

Gridded MSSs errors at short WL – S3A LR-RMC reference

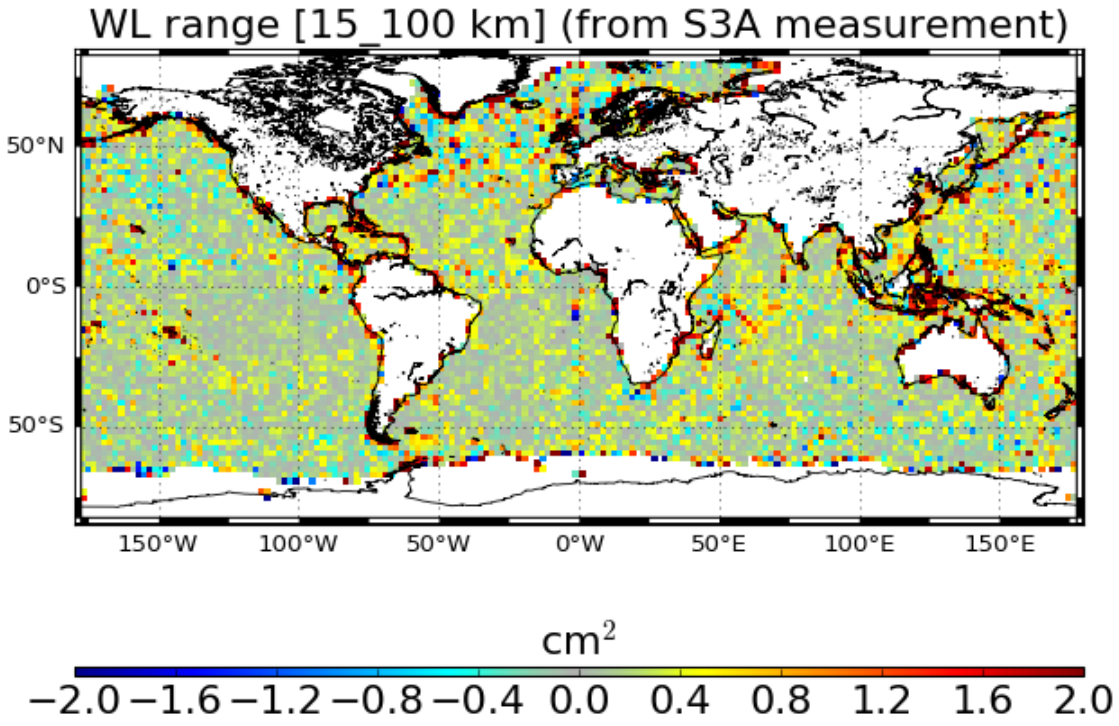


If we look at the wavelengths between 50 and 10 km: the integral of the differences between the curves is less than 0,5 cm in std !

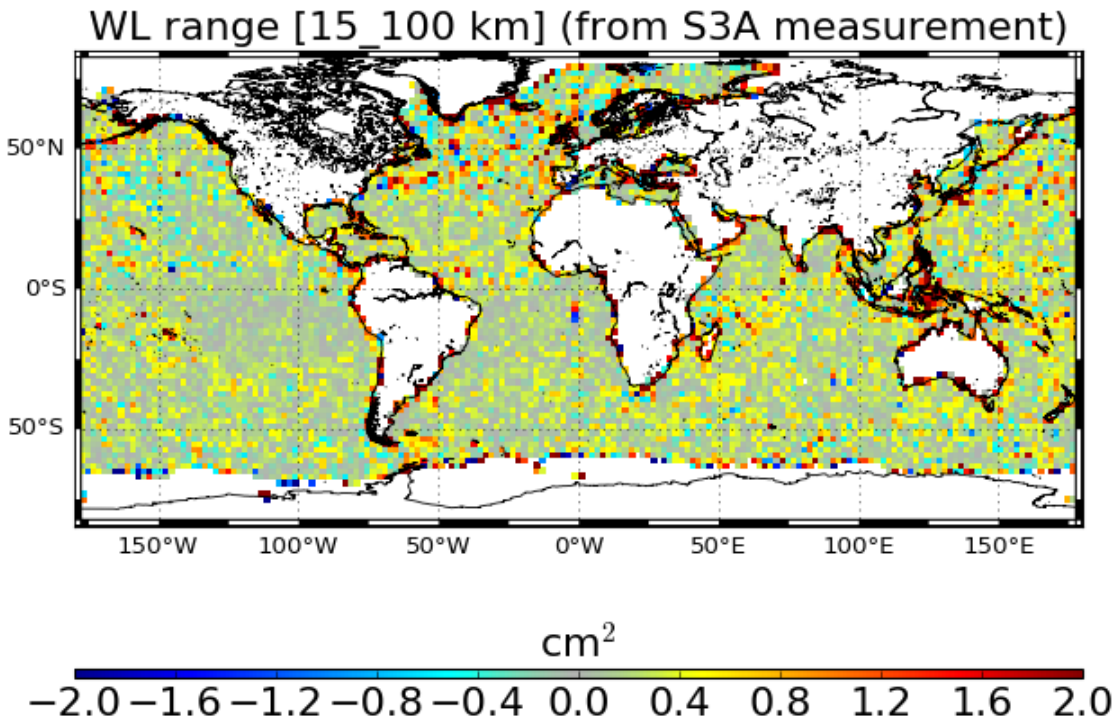
Error map calculated in 2 degrees boxes

- Globally slight reduction of the variance for SCRIPPS (mean an improvement of HR)

MSS SCRIPPS_CLS21_UPDATED_S3 error



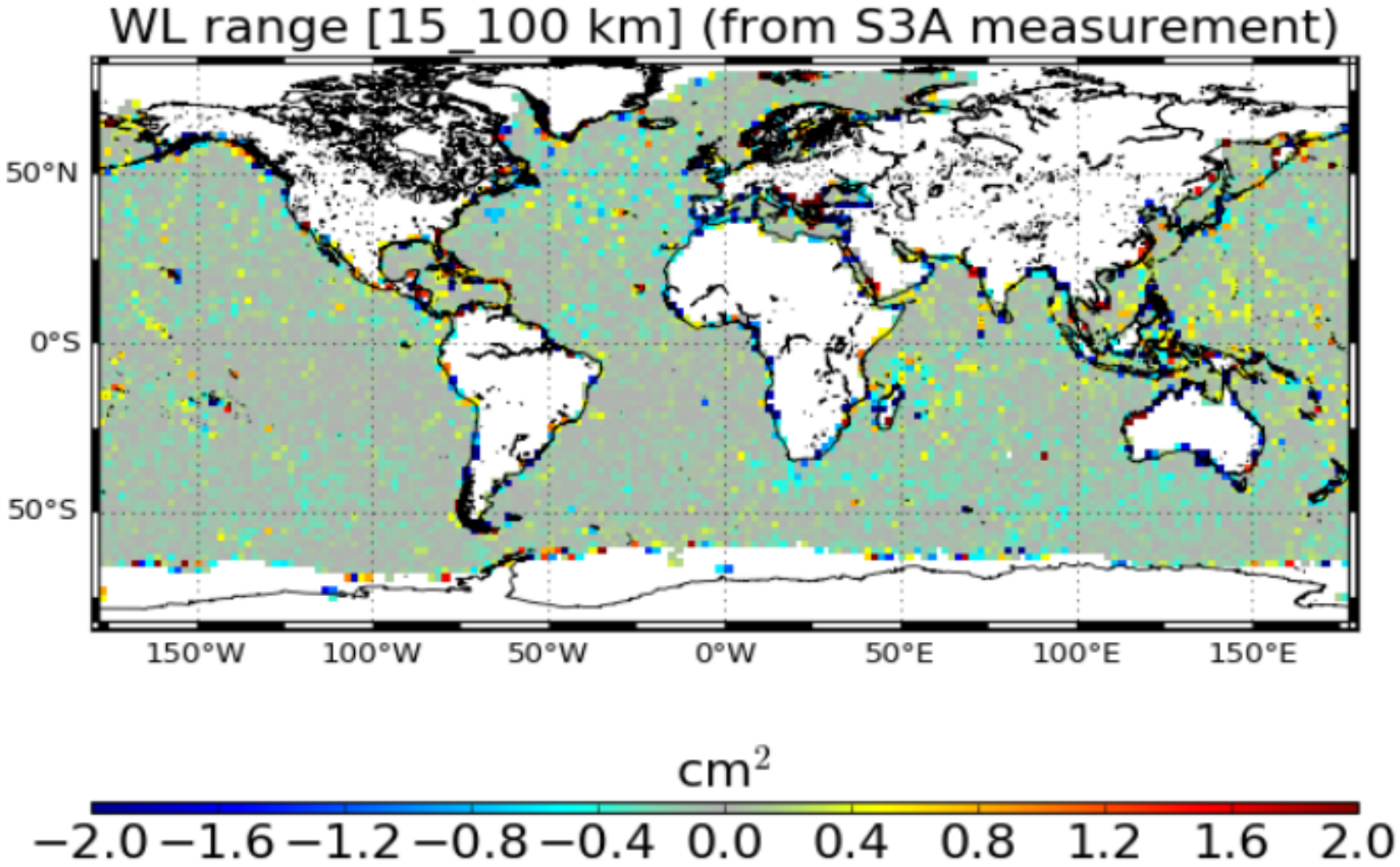
MSS CNES21 error



Error map calculated in 2 degrees boxes

Difference: Error Scripps_CLS22 – Error CNES_CLS21

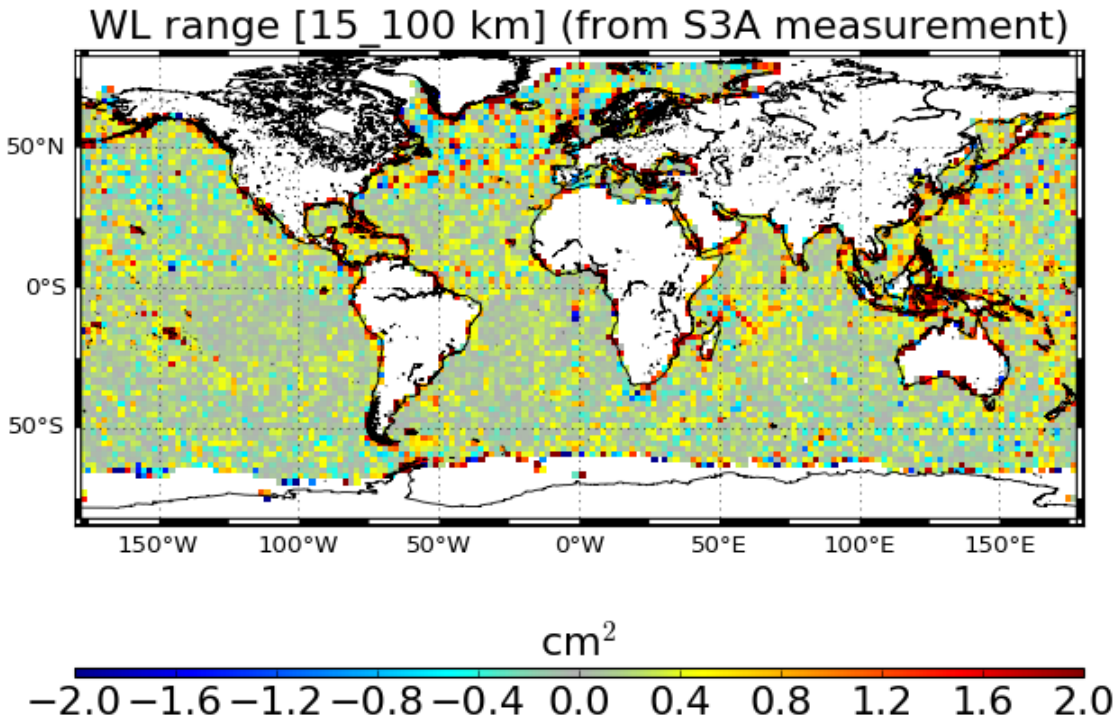
- Very close results in open ocean



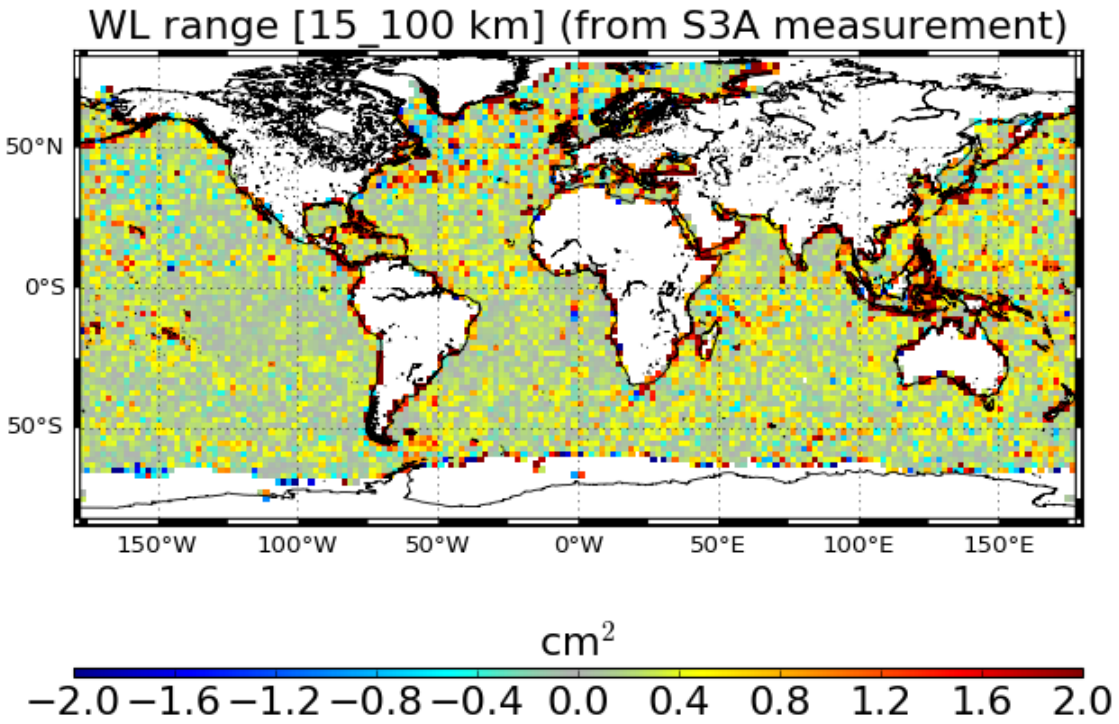
Error map calculated in 2 degrees boxes

- A little more oceanic variability over high current areas for DTU
- Globally a bit more variance for DTU (means better HR for Scripps)

MSS SCRIPPS_CLS21_UPDATED_S3 error



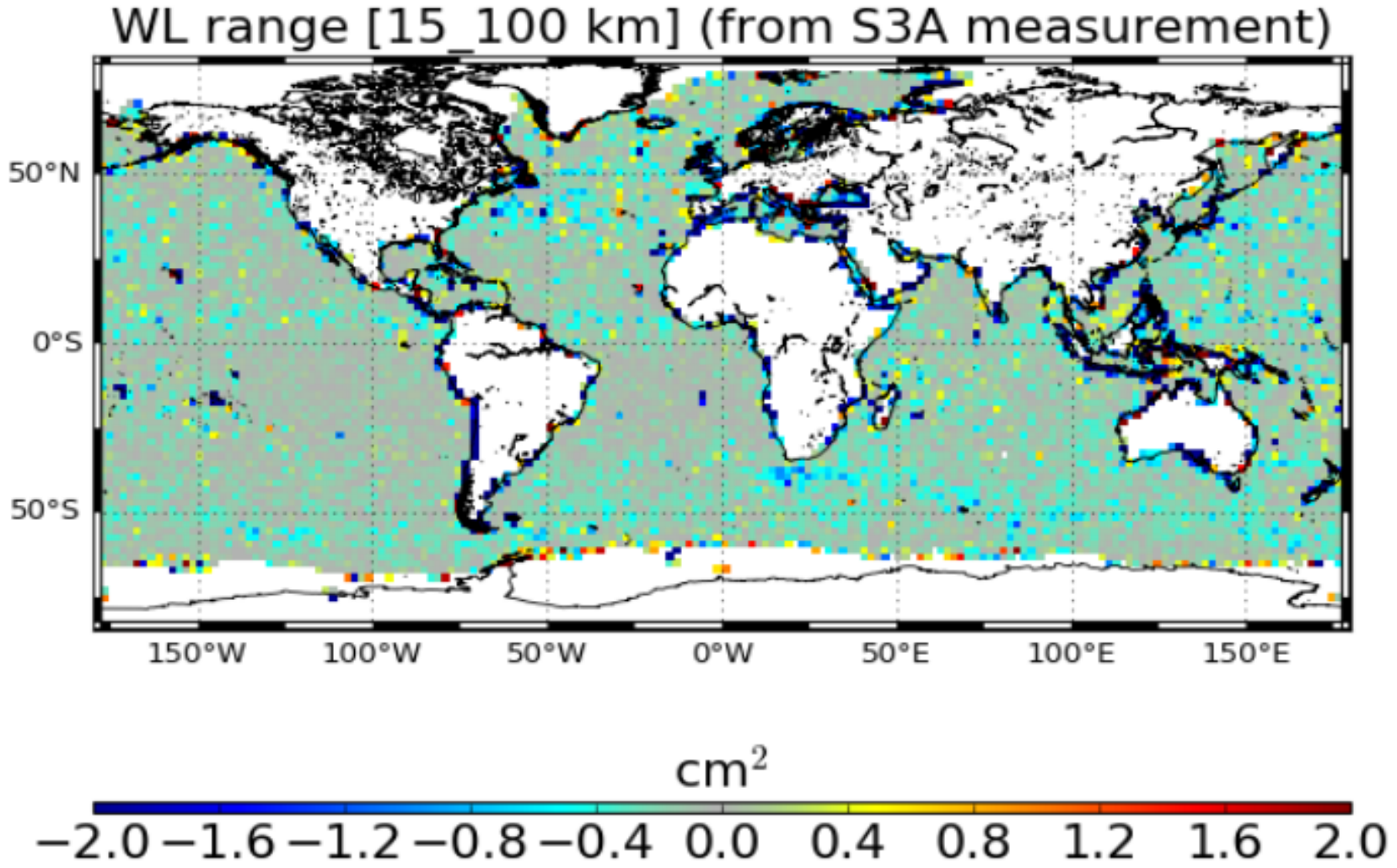
MSS DTU21 error



Error map calculated in 2 degrees boxes

Difference: Error Scripps_CLS22 – Error DTU21

- Differences in blue suggest that DTU contains more oceanic variability



Conclusion

- The S3A validation shows that these 3 MSS have a low level of error which is compatible with the needs for SWOT.

- WG MSS recommendation => use Scripps_CLS & DTU MSS for intercomparisons will allows us a better decorrelation between the *contribution* of MSS & SWOT

Perspective

- More investigations (assessment) near the coast …