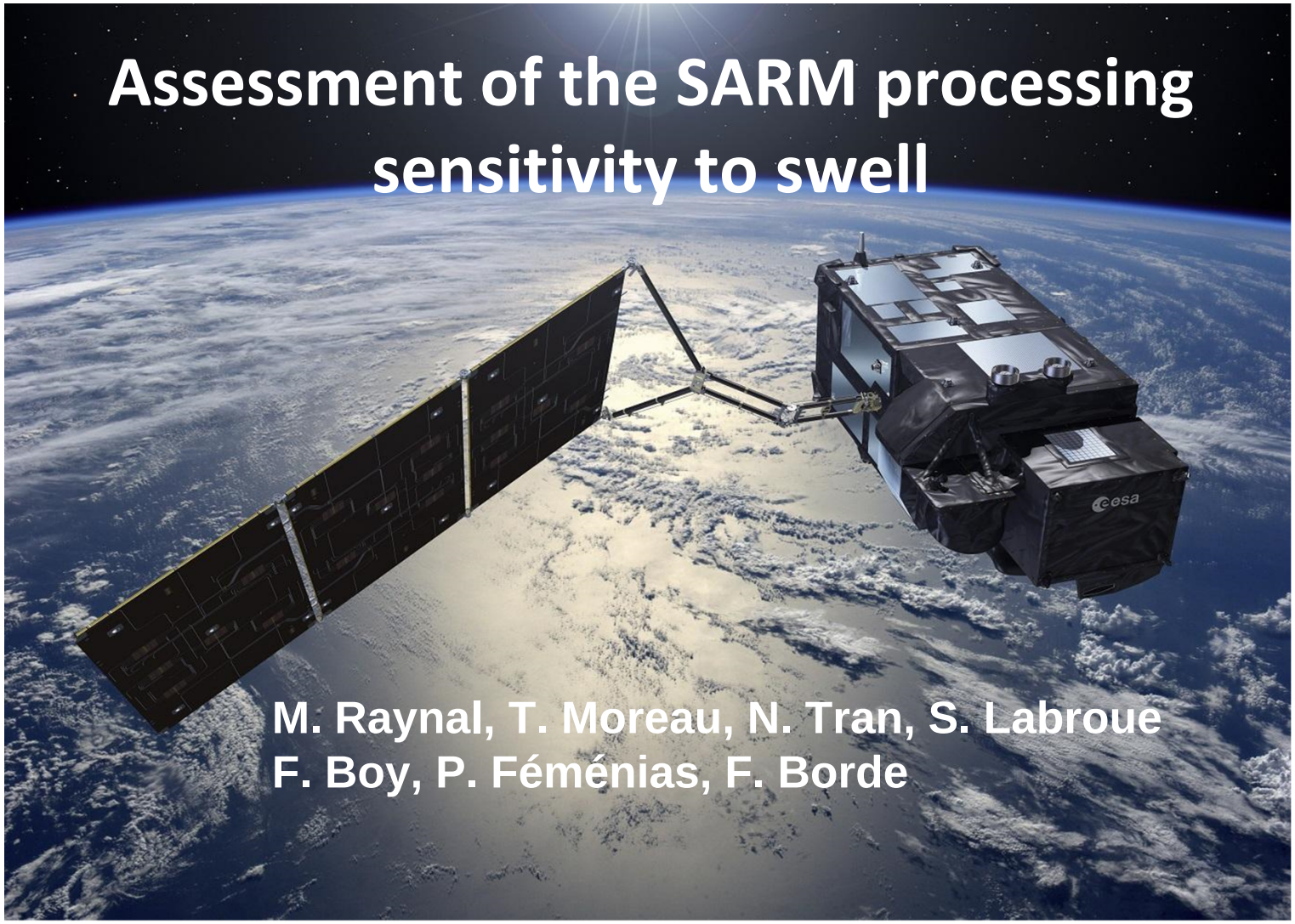
Assessment of the SARM processing sensitivity to swell



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Context

SARM was recommended to be activated for the first time at global scale by the scientific community and the Copernicus Services

➢This presentation aims at giving an overview of the sensitivity of the Sentinel-3A SARM observations to swell

➢Moreau et al (2018) have already shown the impact on SWH based on simulations and Cryosat-2 SARM data

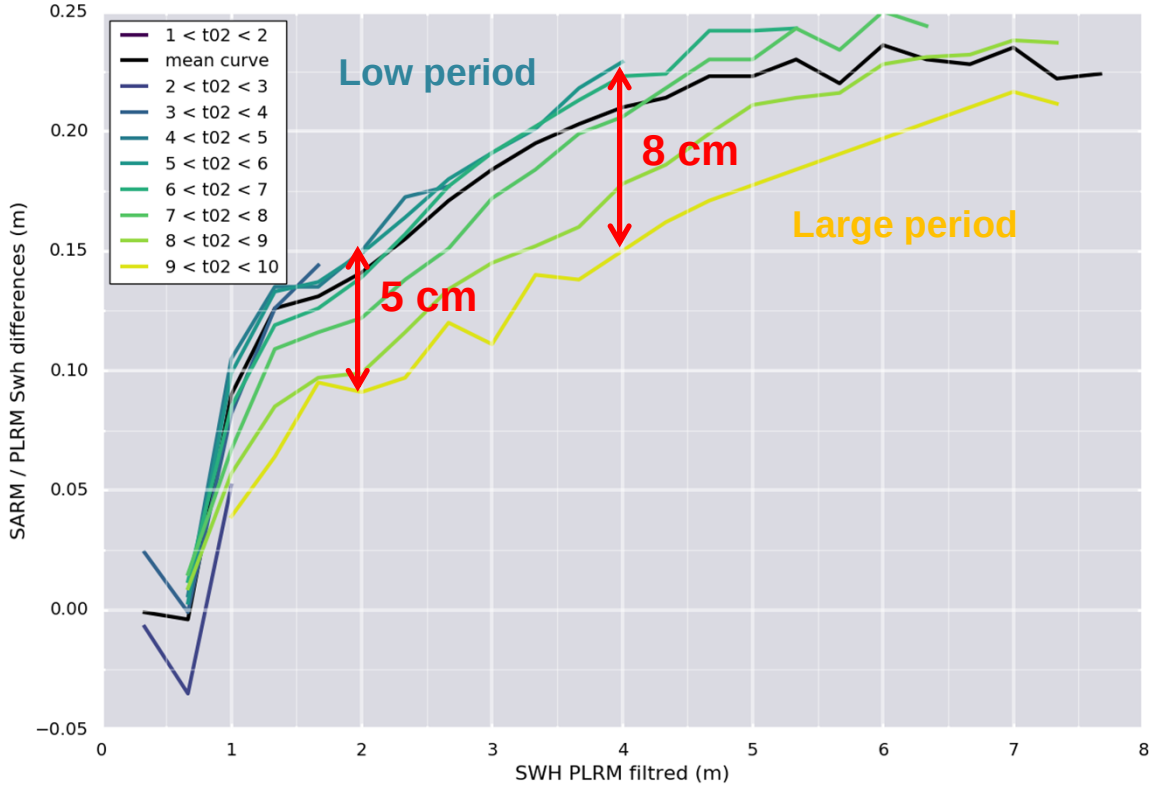
➢We confirm these findings and go further in the assessment thanks to the global coverage of Sentinel-3A mission

Outline

- Assessment of the impact on SWH
- Assessment of the impact on Range
- What are the impacts for the users? (Sea Level and Sea State)

Large scales SWH

Difference between SARM and P-LRM SWH at long wavelength (m)



Mean wave period data from WW3 model (Ifremer)

Error on SARM SWH is correlated at first order with SWH

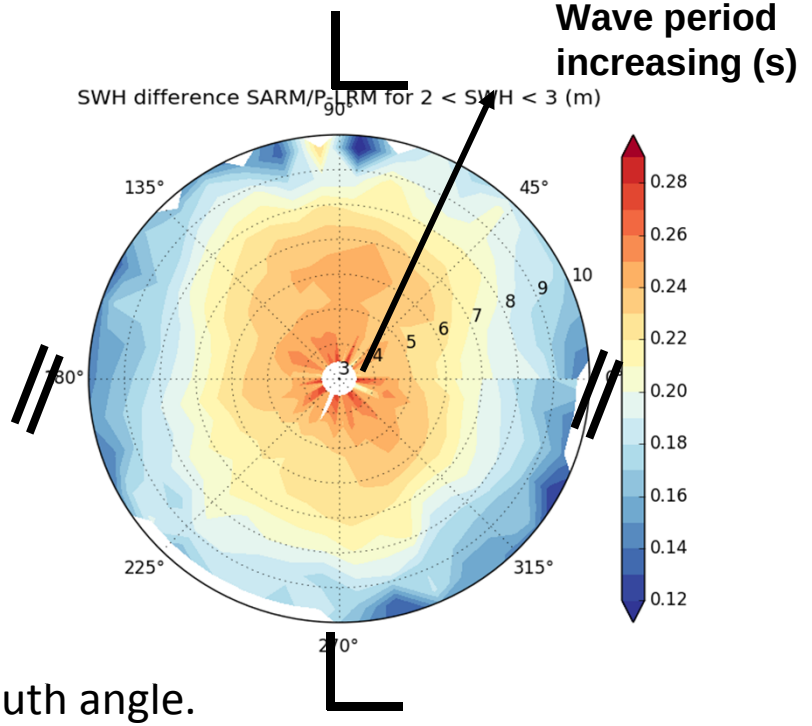
+

Strong impact of mean wave period on SARM SWH: Bias decreases with larger period (5 to 10 cm)

Long Wavelength analysis : SWH

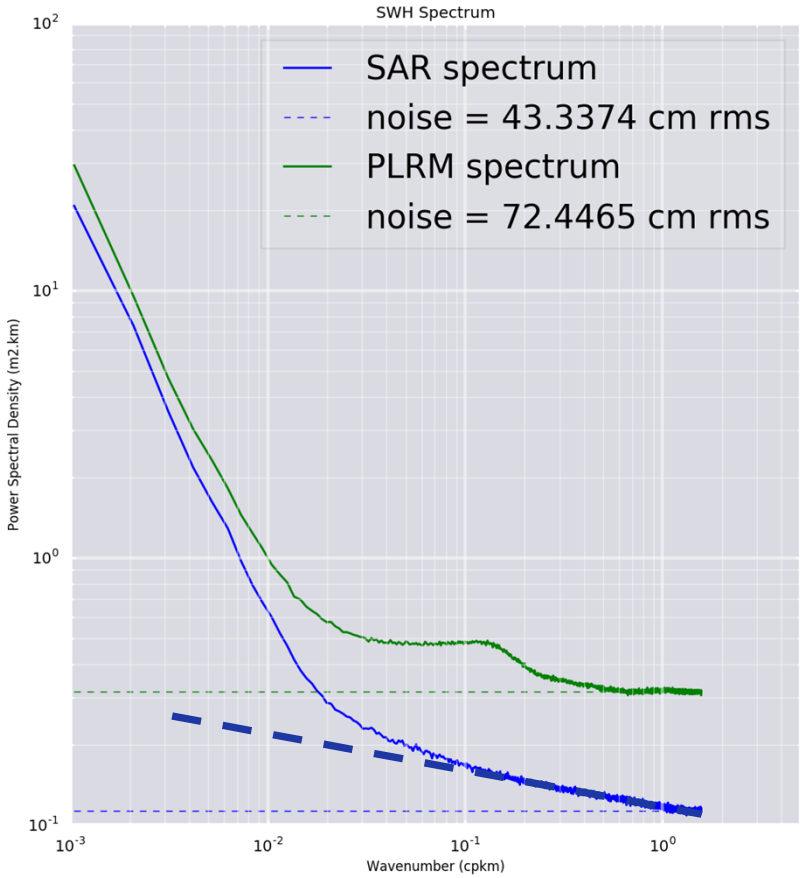
Difference between SARM and P-LRM SWH at long wavelength (m)

SARM/PLRM SWH bias for SWH = 2.5m	Perpendicular configuration (AZ = 90°)	Parallel configuration (AZ = 180°)
Lowest periods (4s)	17 cm	17 cm
Highest periods (11s)	10 cm	5 cm
	X1.7	**X3.7**



SARM SWH is also sensitive to the relative azimuth angle. The bias with respect to P-LRM waves has the largest decrease with the mean wave period for // propagations

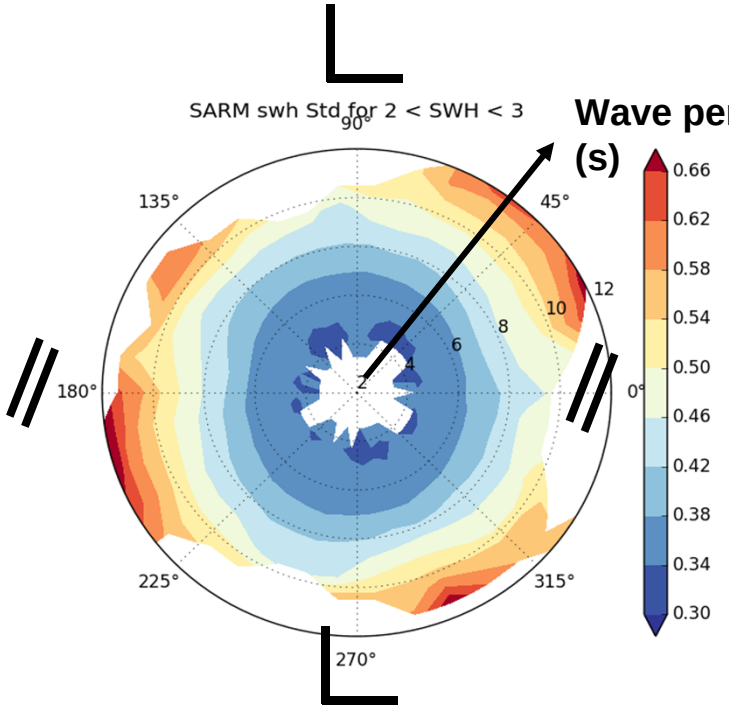
Short Spatial scales : SWH



While LRM altimeters present a white noise at 20 Hz, SARM data exhibit a red noise, when analysing a global PSD of SWH.

Short Spatial scales : SWH

Analysis done for SWH [2-3m]

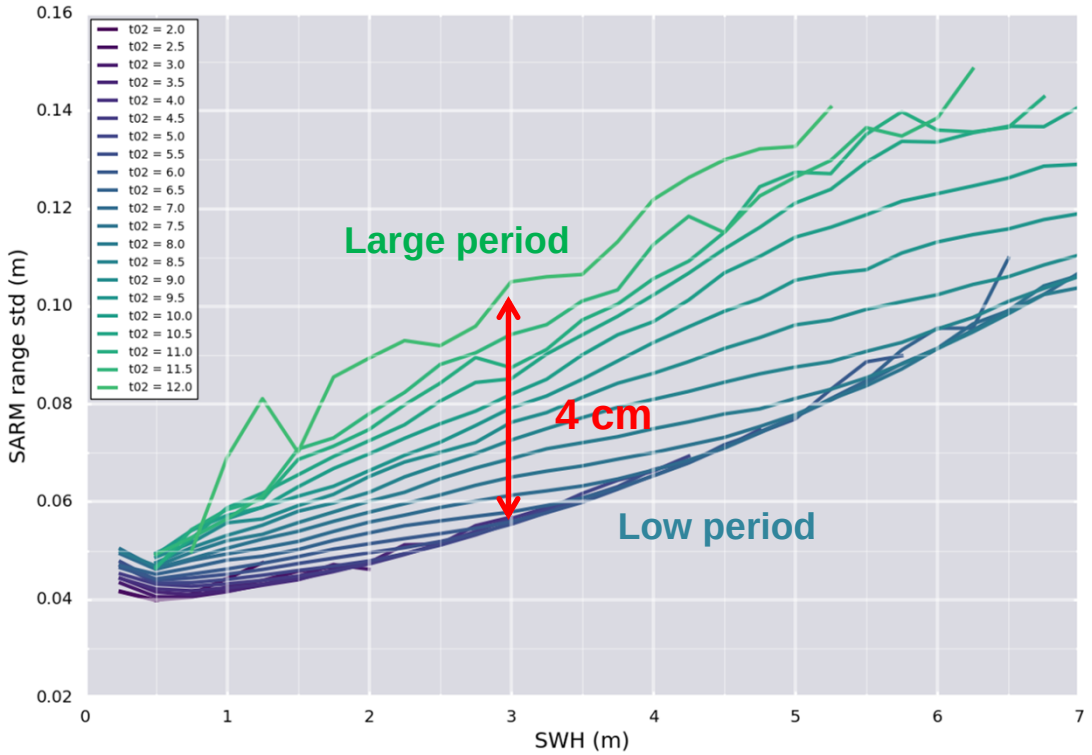


Wave period increasing (s)

SWH SARM noise in cm (wavelength < 7 km)

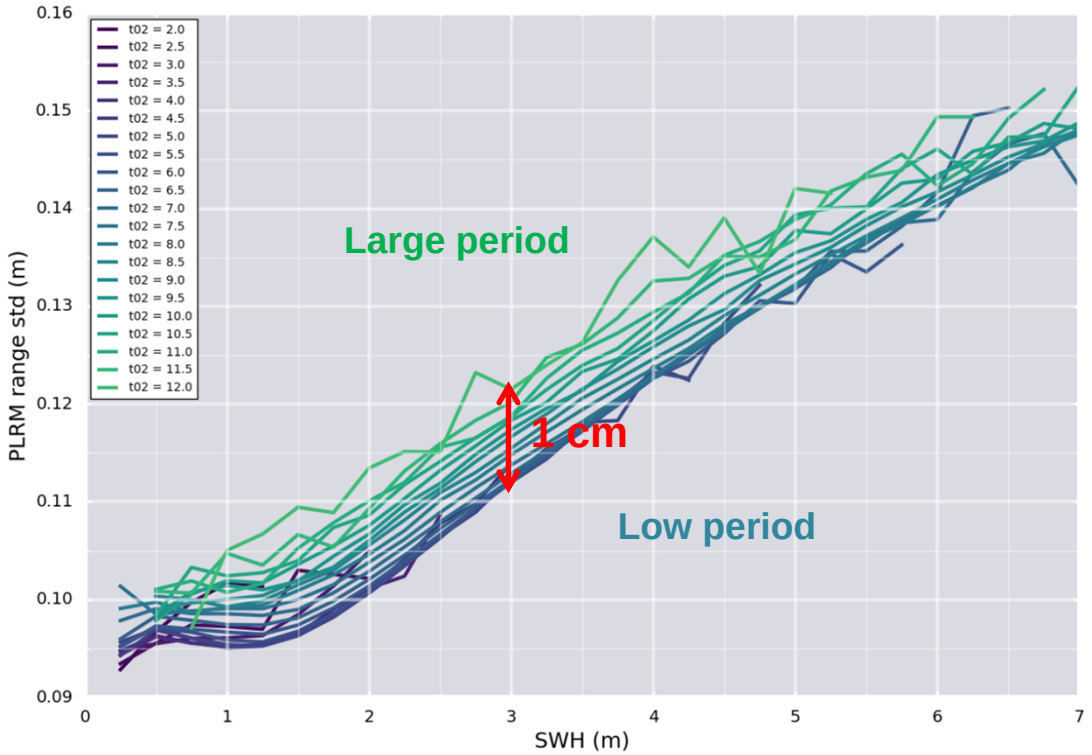
Moreau et al., 2018 showed that the noise level of Cryosat-2 SARM SWH is impacted by swell direction and period. This result is also observed on Sentinel-3A SARM SWH and noise increase is the largest for swell propagation parallel to the track.

Short Spatial scales : Range



At SWH = 2.7 m, in SARM from shortest to longest swell periods the range noise increase is about 4 cm (70% increase).

Short Spatial scales : Range

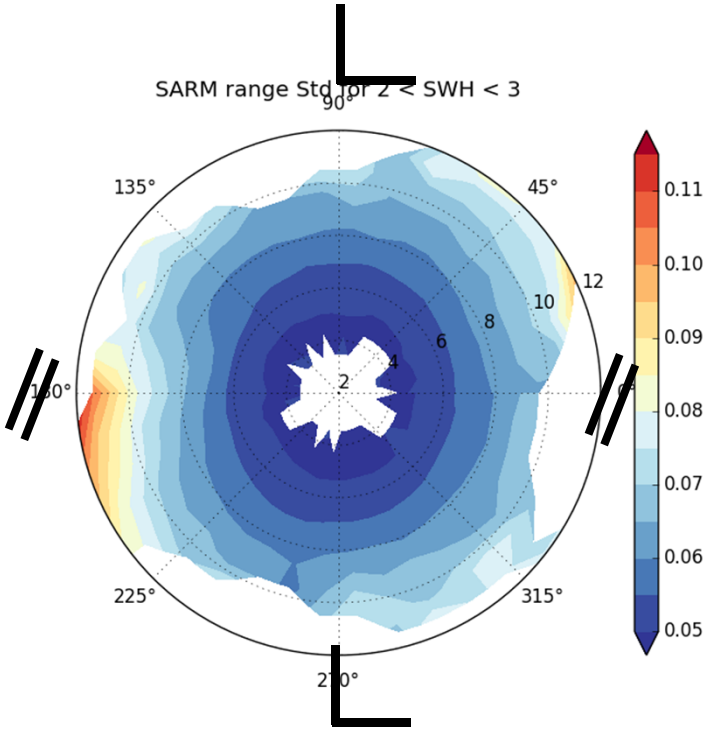


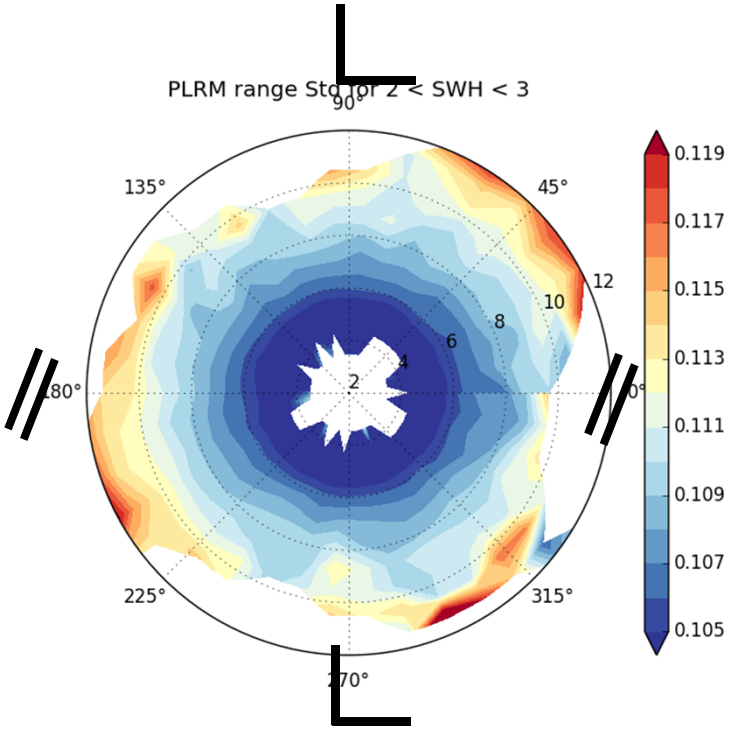
At SWH = 2.7 m, in SARM from shortest to longest swell periods the range noise increase is about 4 cm (70% increase). In P-LRM, it reaches 1 cm only.

Short Spatial scales : Range

Analysis done for SWH [2-3m]

SARM noise shows the largest increase for // propagation



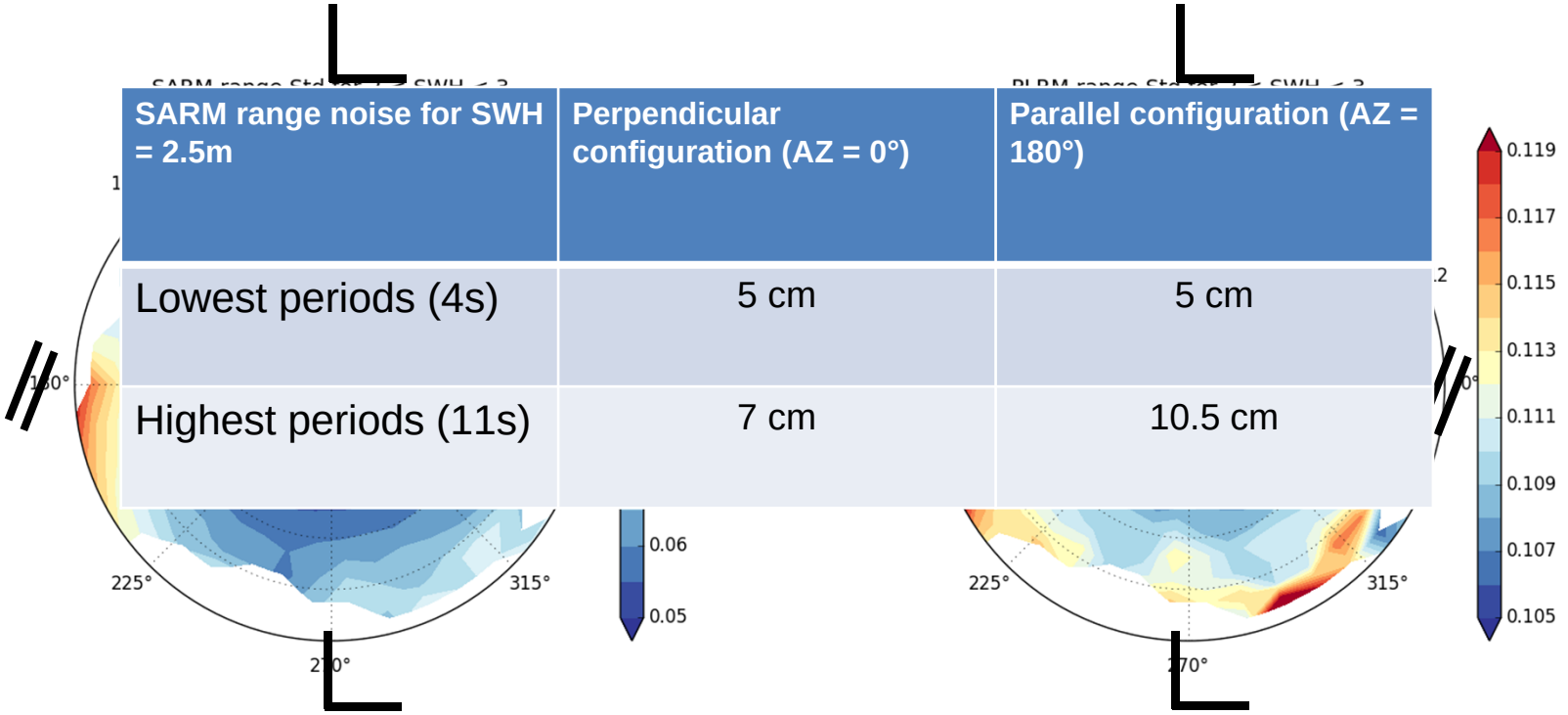


Short Spatial scales : Range

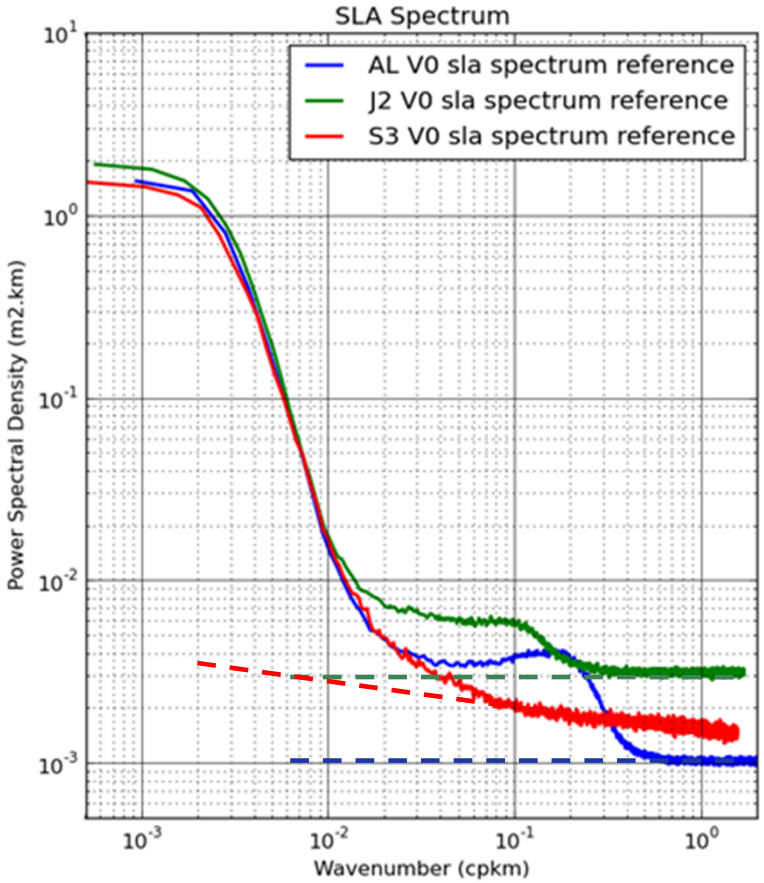
Analysis done for SWH [2-3m]

SARM noise shows the largest increase for // propagation

SARM range noise for SWH = 2.5m	Perpendicular configuration (AZ = 0°)	Parallel configuration (AZ = 180°)
Lowest periods (4s)	5 cm	5 cm
Highest periods (11s)	7 cm	10.5 cm

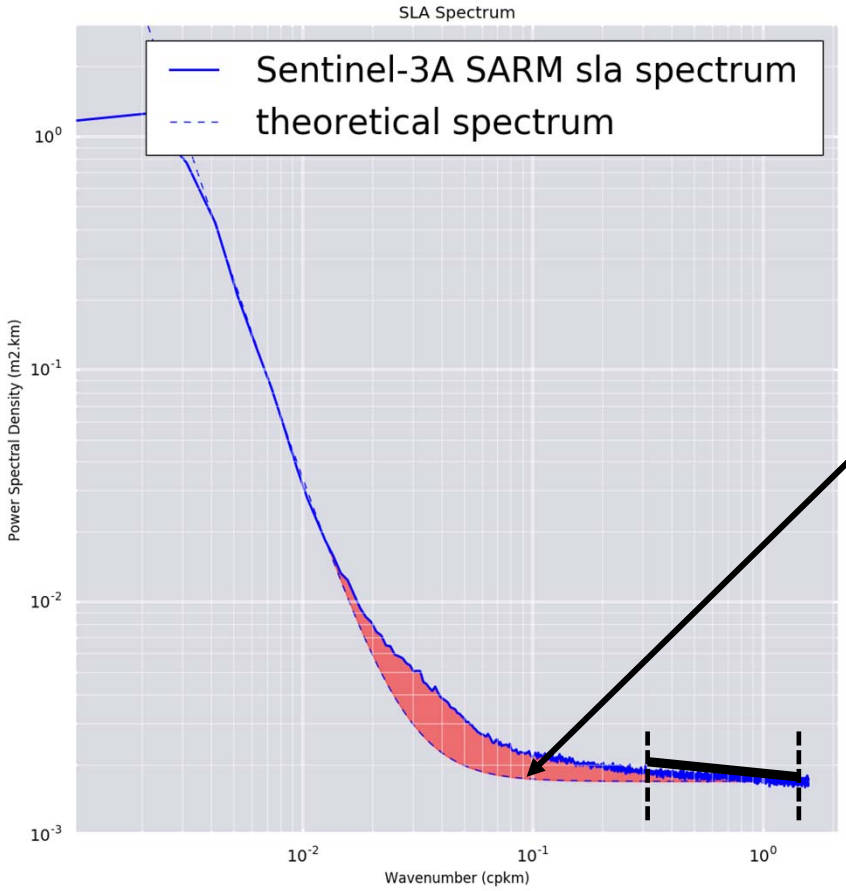


Short Spatial scales : Range



While LRM altimeters present a white noise at 20 Hz, SARM data exhibit a red noise, when analysing a global PSD of sea level.

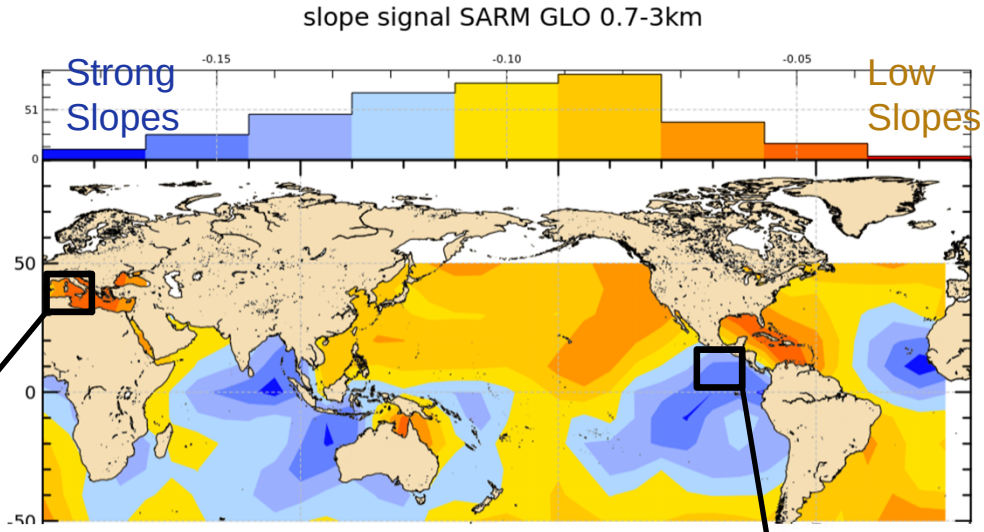
Short Spatial scales : Range



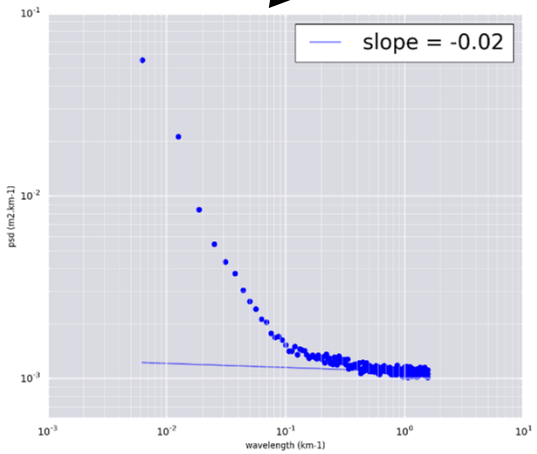
Additionnal error to be understood

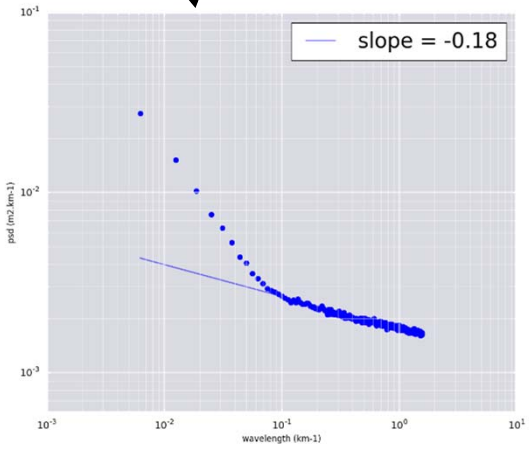
Focus on slope [0.7 – 3 km]

Mean map of red noise slope (1 year)

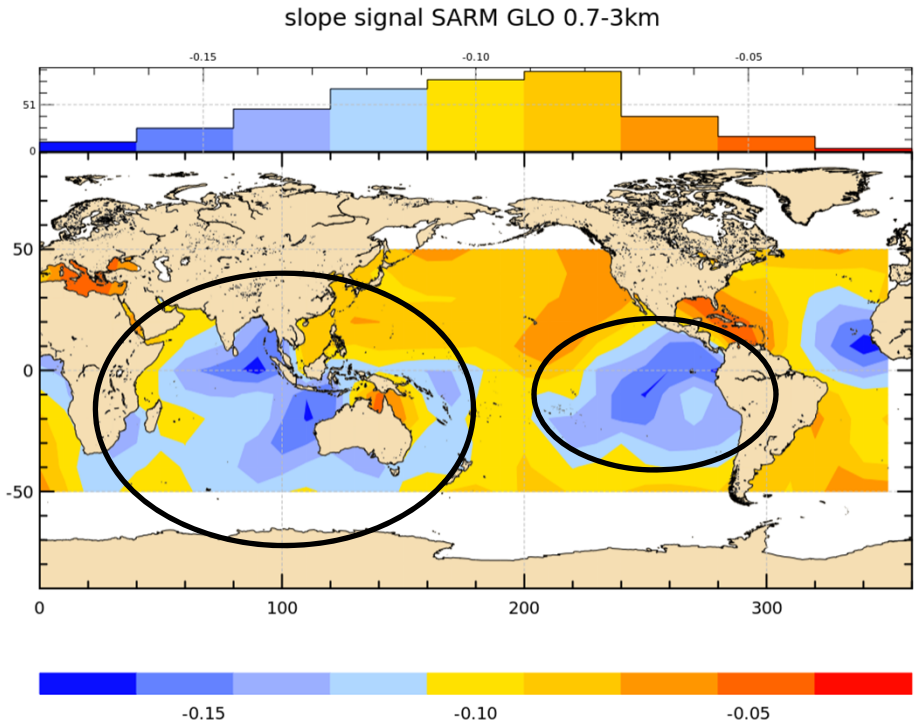


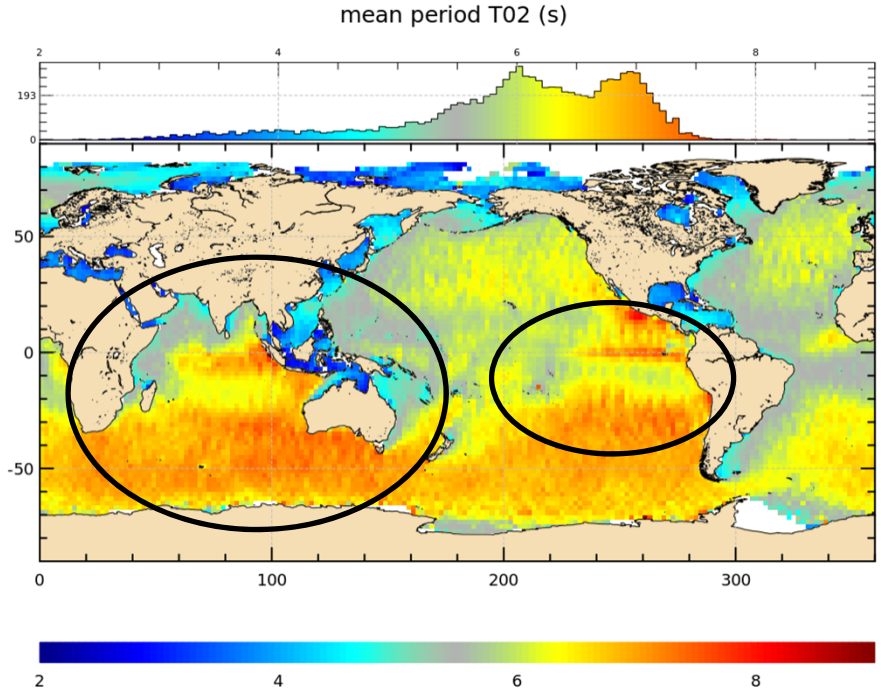
Slope x9 between both locations





Short Spatial scales : Range

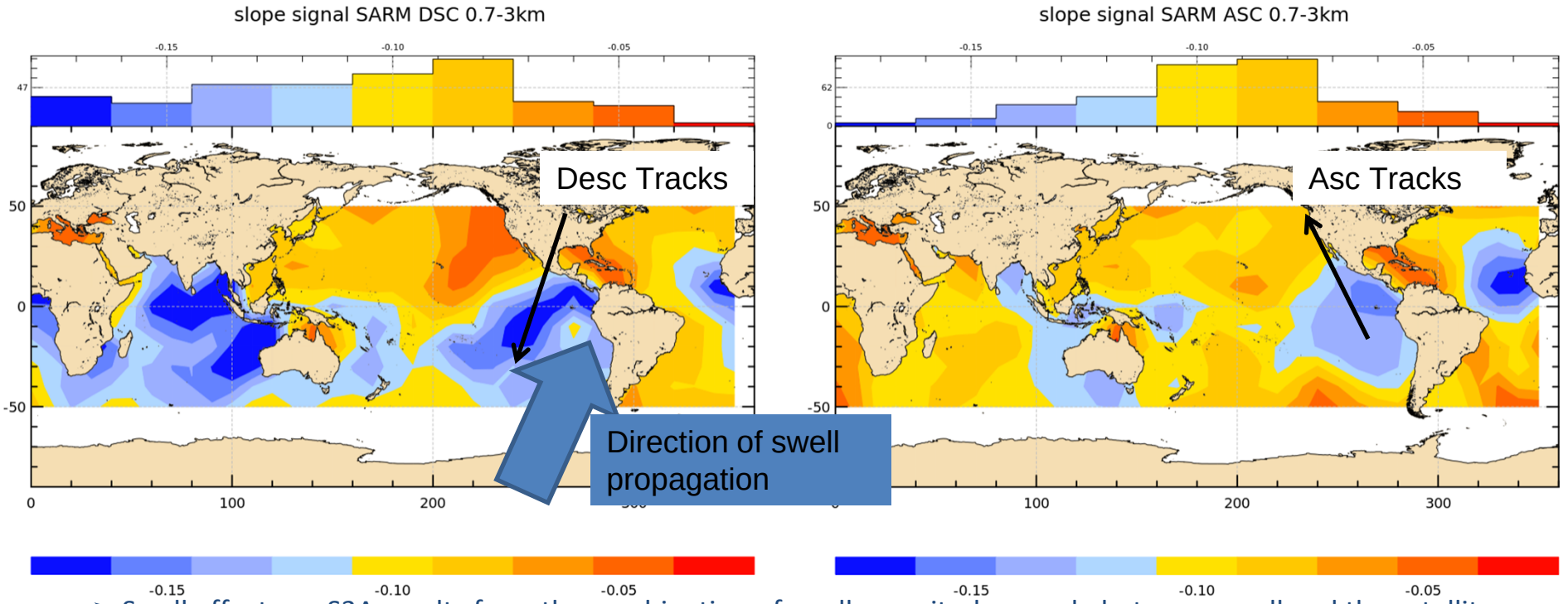




➢Stronger red noise slope (0.7- 3 km) are correlated with areas of swell dominated areas (better correlation in South hemisphere)

➢Red noise on SARM observations of sea level are due to swell effects on SARM range

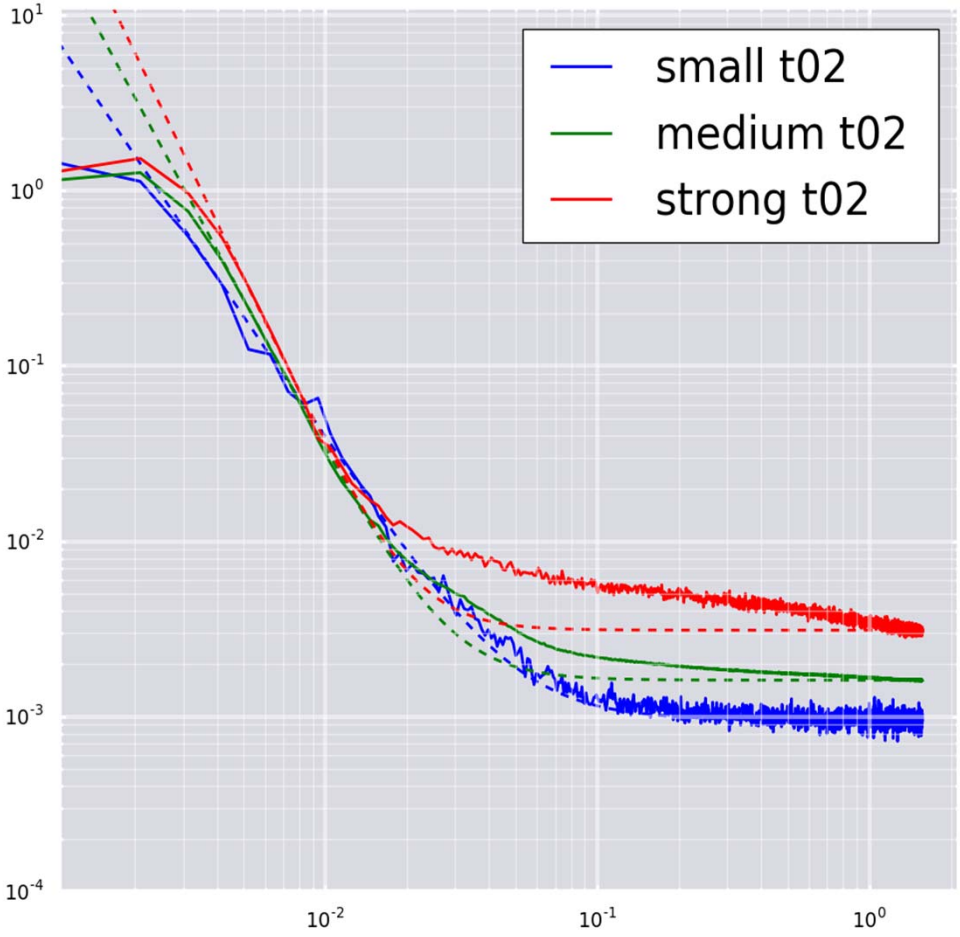
Short Spatial scales : Range



➢Swell effects on S3A results from the combination of swell magnitude + angle between swell and the satellite
=> they are larger when swell propagates along the satellite tracks
➢ Effect is larger on the descending tracks in Pacific and Indian ocean

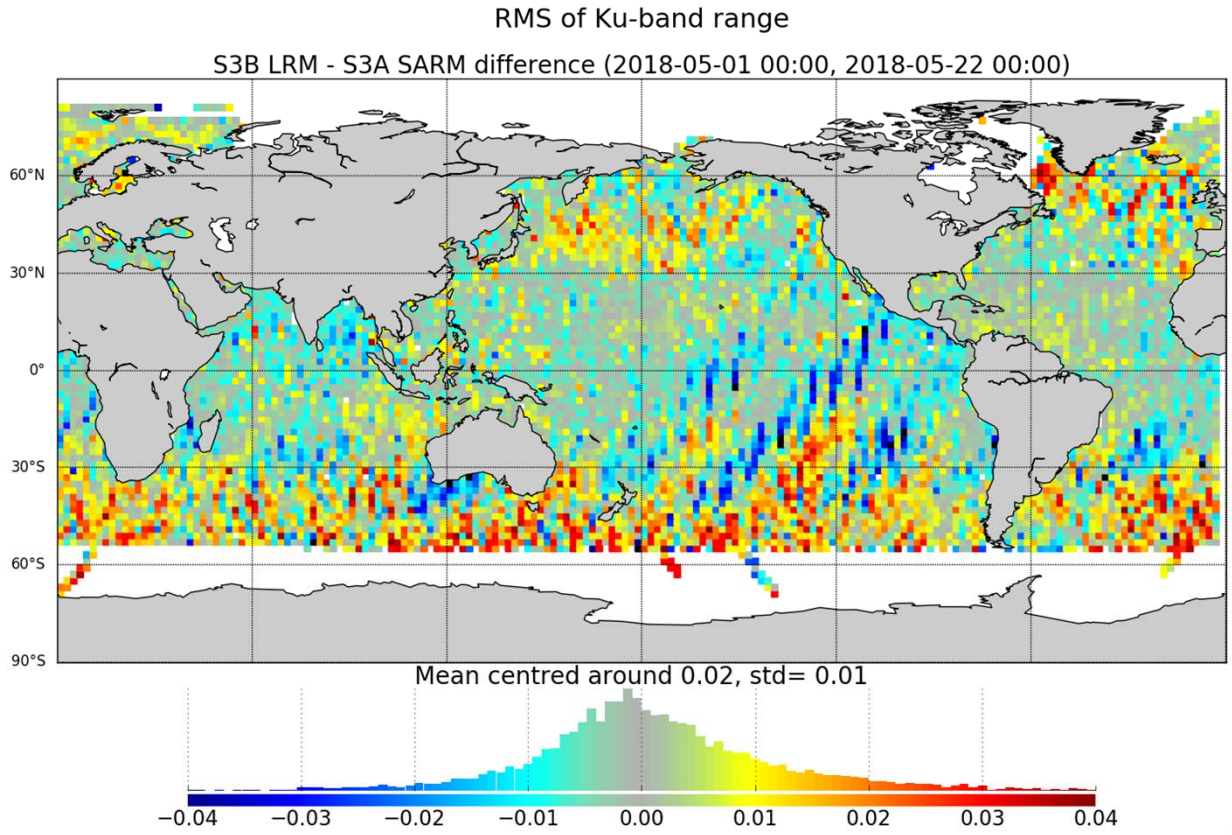
Short Spatia

- Drastic selection on T02 values:
  - Small < 4 s **0,4 %**
  - 4s < Medium < 8s **97,9 %**
  - Strong > 8s **1,7%**
- Very small fraction of the ocean not impacted by swell
- Red noise slope is observed over all regions with continuous increase



Short Spatial scales : Range

➢Swell signature observed during S3B commissioning phase when comparing S3B LRM and S3A SARM range noise



All positive values are expected :
LRM noise > SARM noise

Negative patches are swell signature

Impact for users

Sea Level

➢Swell effects corrupt the observation of the shortest scales of the ocean. Even if progress were made with SARM thanks to instrumental noise reduction, the red slope prevents from a full exploitation of the SARM observations below 20 km

➢New LR-RMC processing cancels such error (Faugere talk in Error session)

SWH

➢Same effect on the red slope at shortest scales, also cancelled by LR-RMC processing

➢What remains today: large scale bias correlated with the mean wave period (10 cm) that will corrupt sea level through the SSB (3 mm)

➢SARM SWH quality altered by swell confirmed by Abdalla and Aouf


Thank you for your attention
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