Early analyses of SWOT 1-day cycle nadir and KaRIn data

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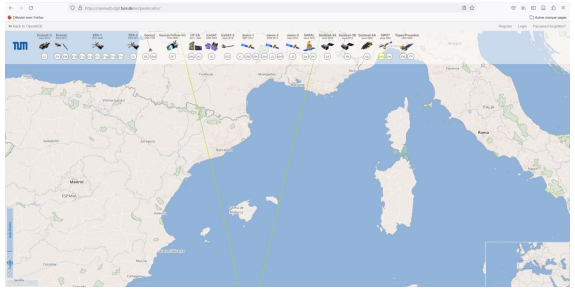
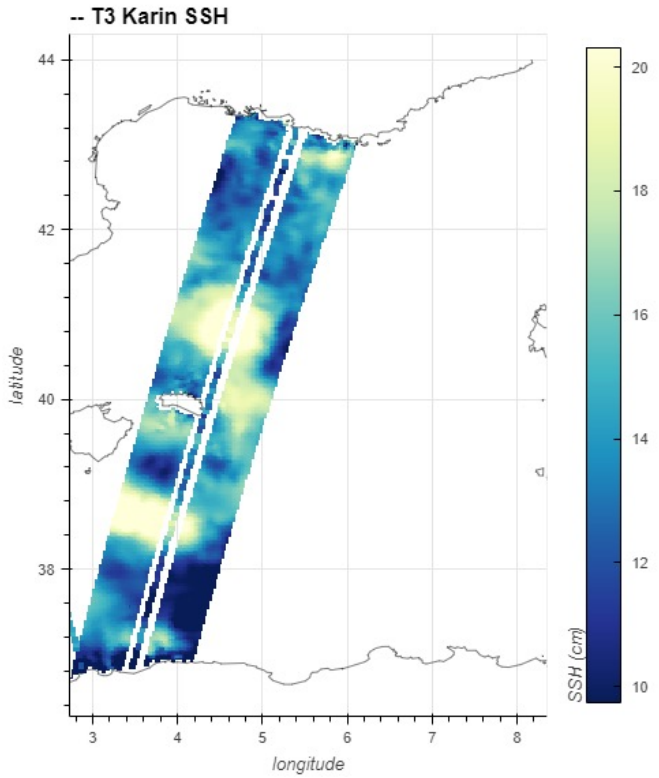
CTOH/LEGOS

With support from CNES

1st site : low EKE, Mediteranean Sea

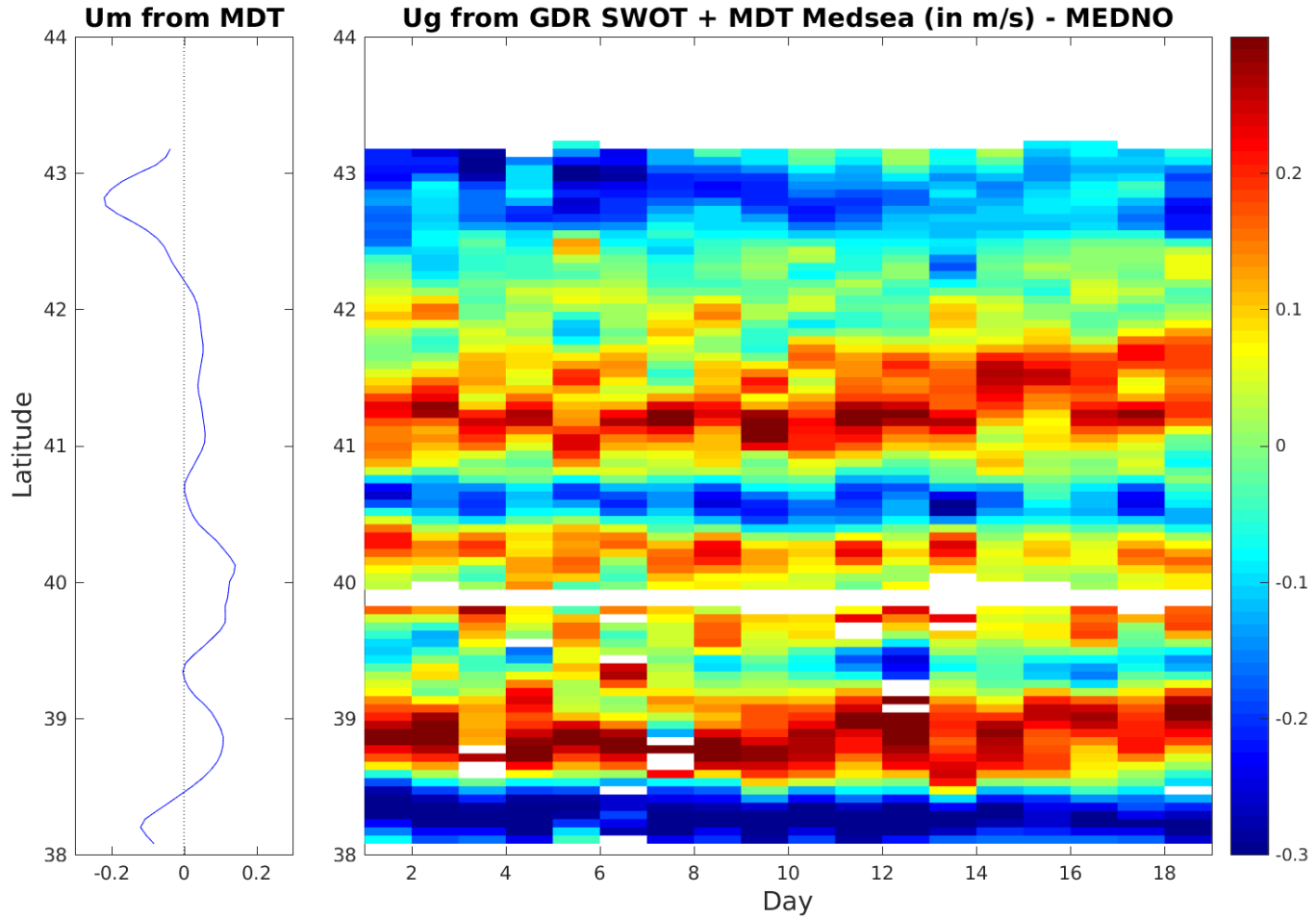




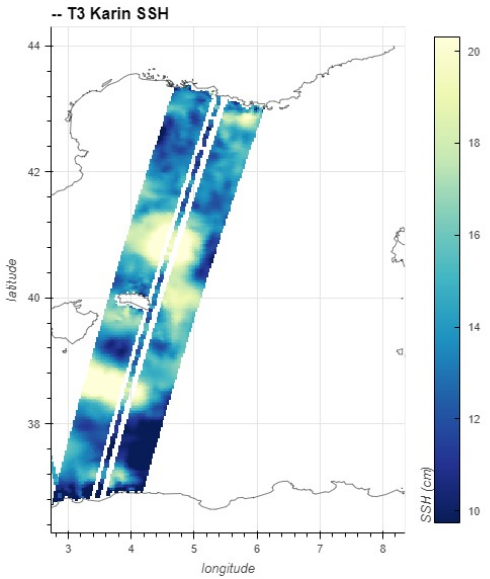
Track 3, Daily repeat Fast sampling Phase, passes from Algeria to Toulon, France

1) **Analysis of SWOT daily nadir data** from 21/06/23 to 10/07/23 :

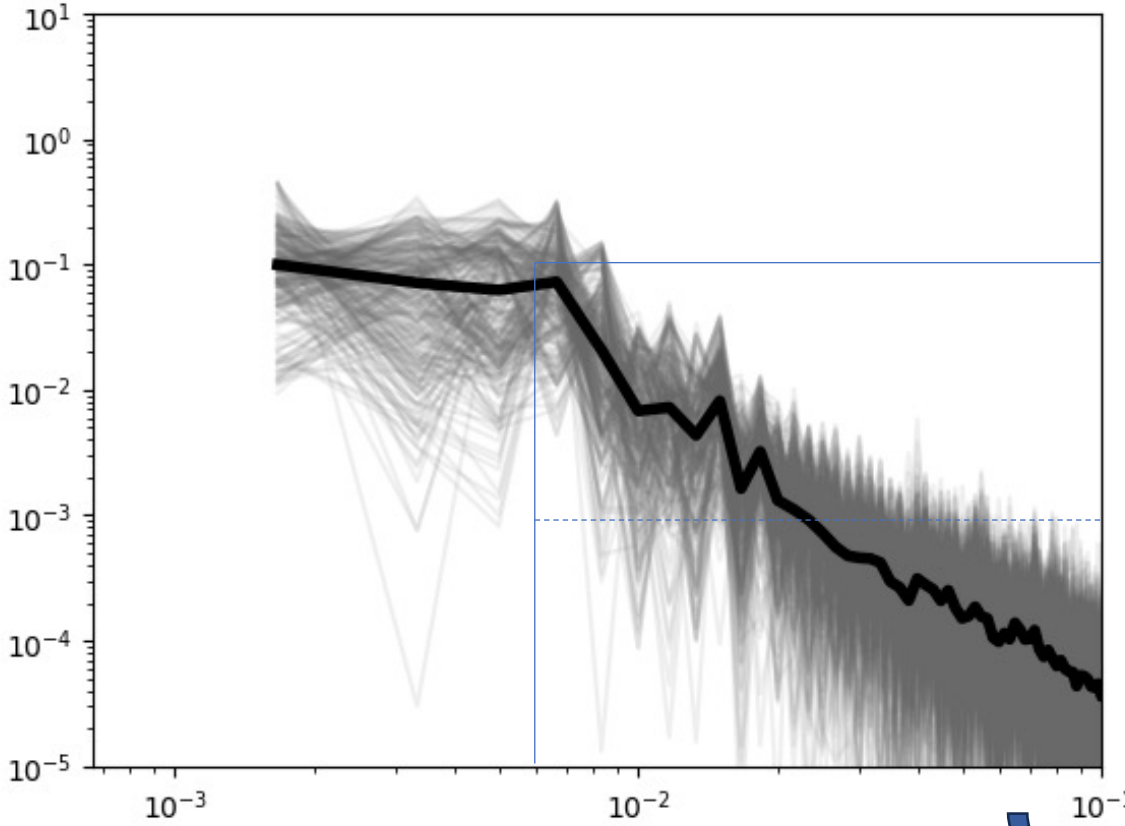
- Geostrophic currents derived from SWOT nadir + MDT Rio MedSea 2014
- Rapid daily variations. Convention : Negative/Positive to west/east



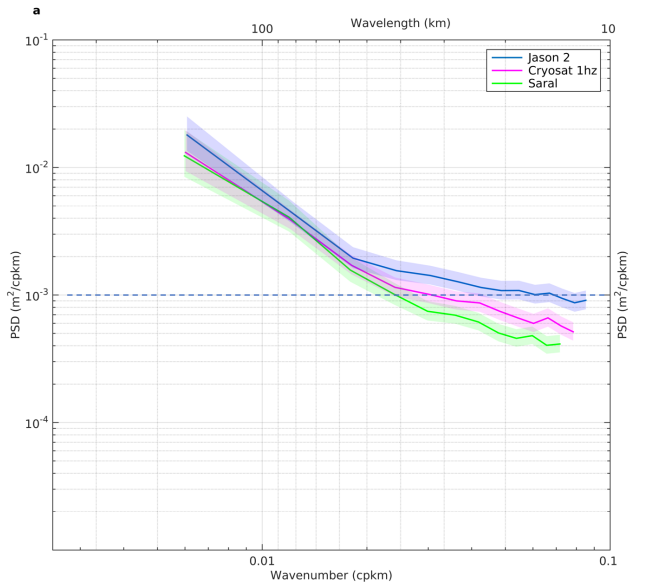
1st look at regional 1D SSH wavenumber spectra : W Mediterranean Sea



Regional 1D SSH wavenumber spectra from KaRIn
10 days of data, every 2 km over two 50km swaths



1D SSH wavenumber spectra from conventional altimetry
3-years of Jason-2, CR2 and Saral data

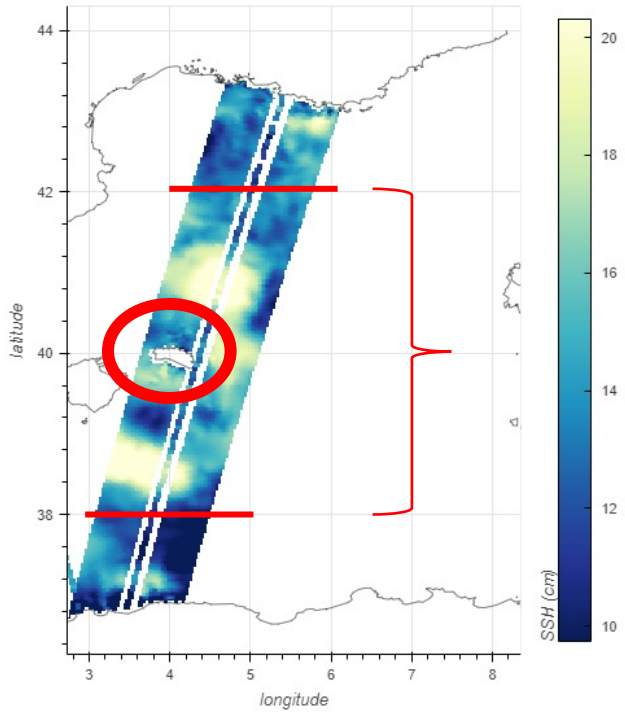


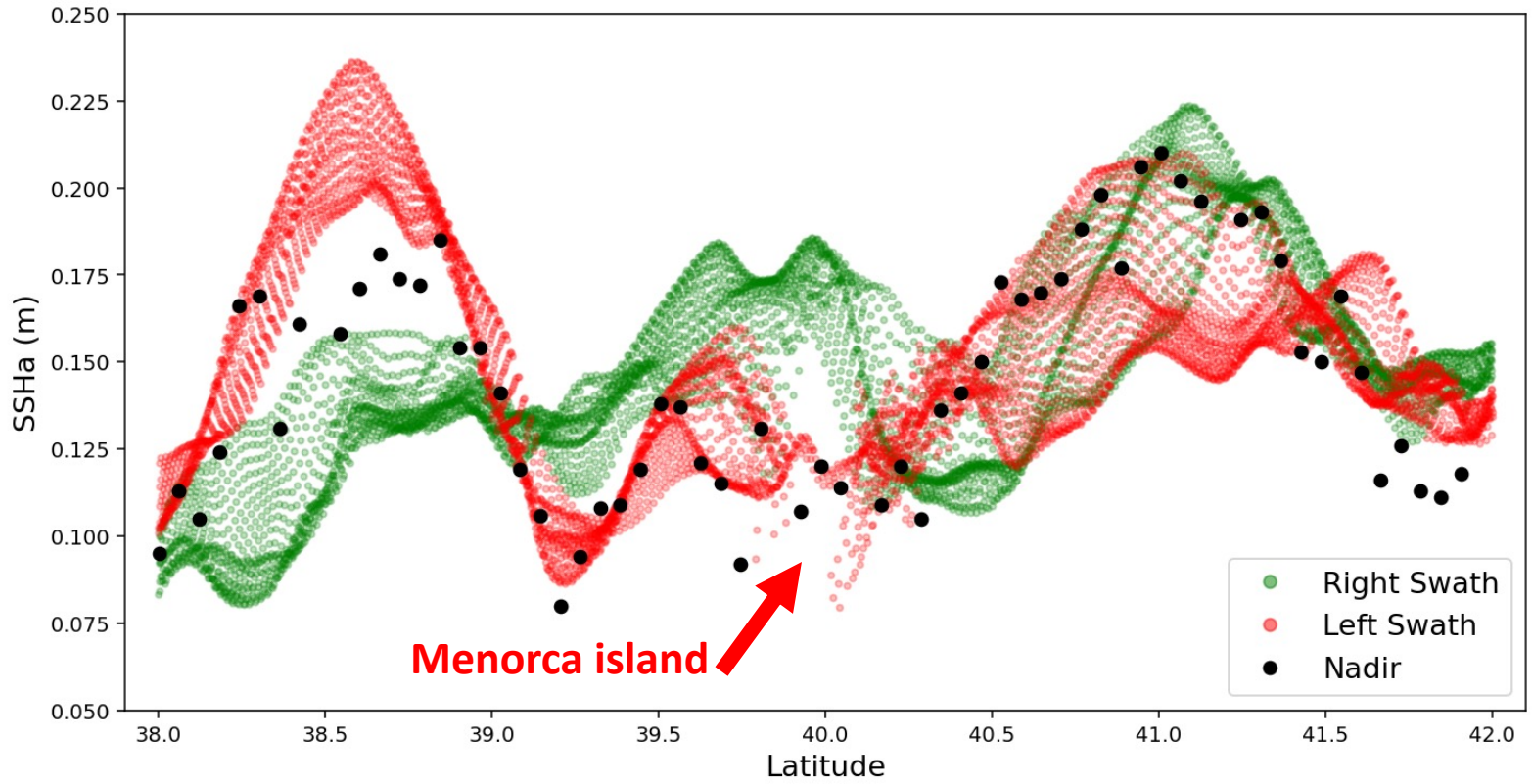
In W Med:

- Conventional altimetry noise floor is around 10^{-3} m²/cpkm
- SWOT KaRIN SSH cascades to much smaller scales

Morrow et al., 2017 Ocean Sciences.

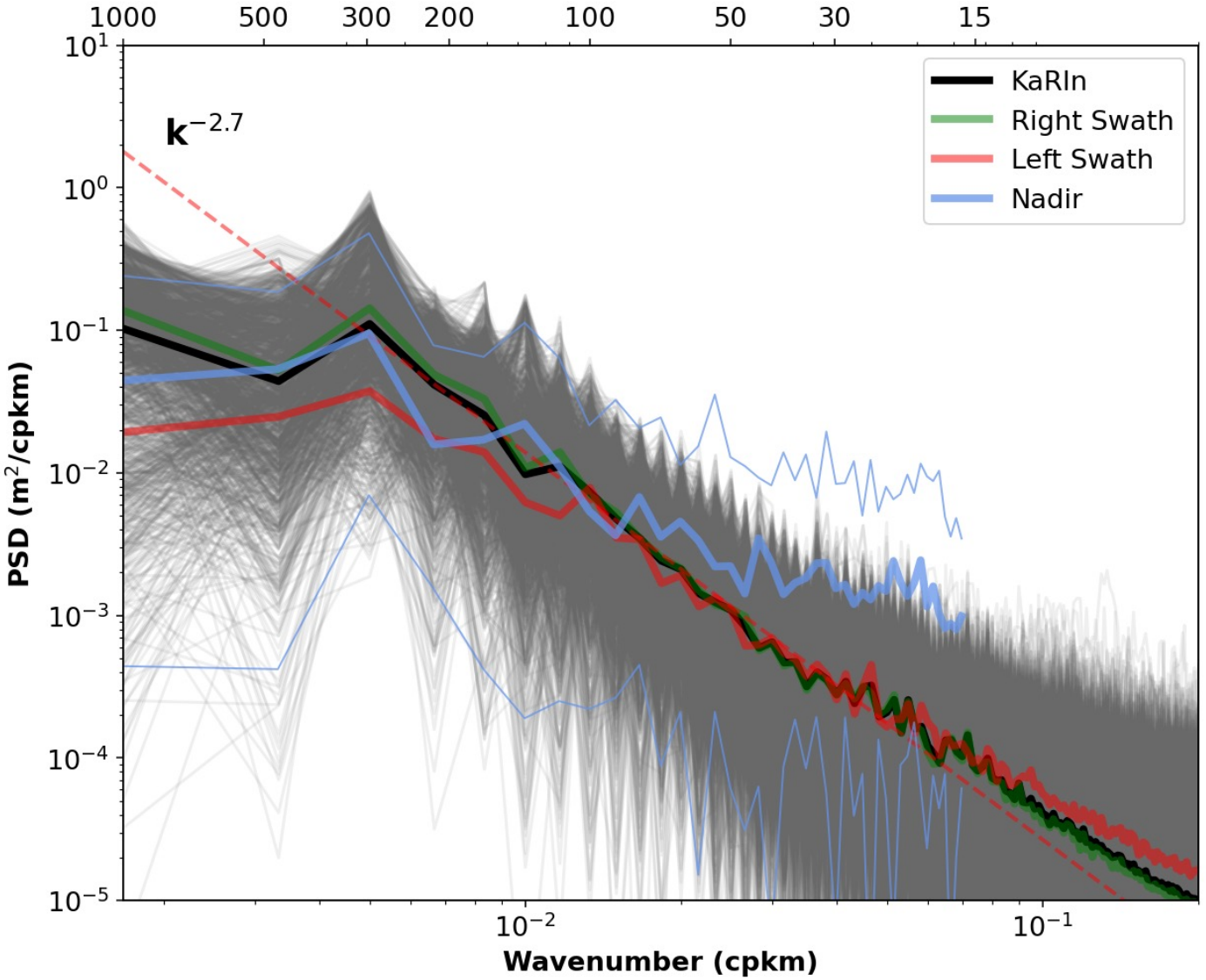
Strong regional spatial variation : left swath and right swath





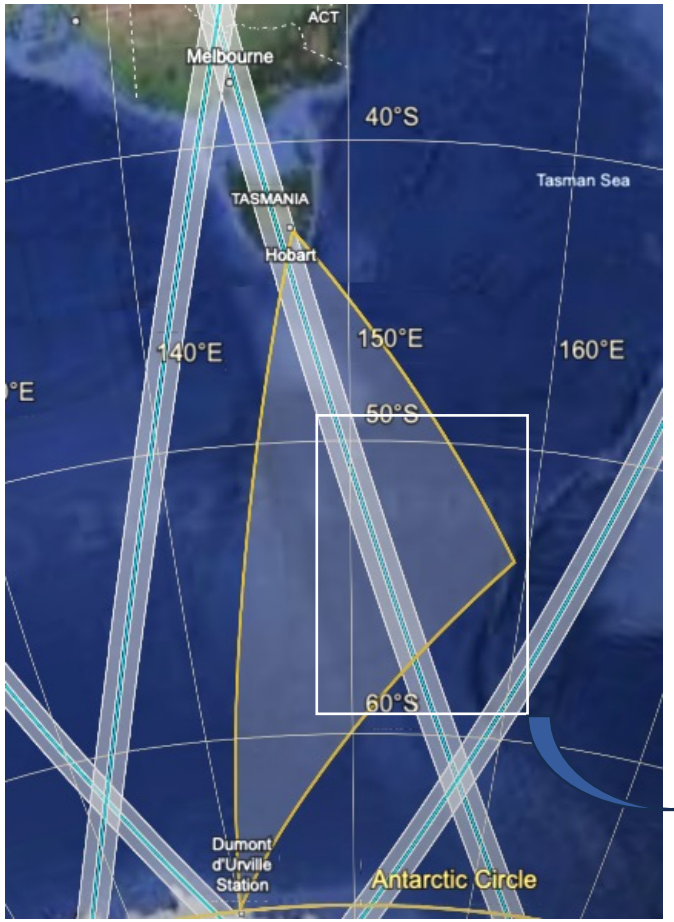
- Overall, KaRIn and POS5 nadir show an excellent agreement. Lower instrumental noise and higher spatial resolution allow KaRIn to resolve much smaller scales than the nadir instrument.
- Still, some artifacts remain close to coastal regions (cf. Right vs Left swaths). Spatial series was truncated near european and african coasts.

Regional 1D SSH wavenumber spectra : W Mediterranean Sea : left vs right swaths vs nadir

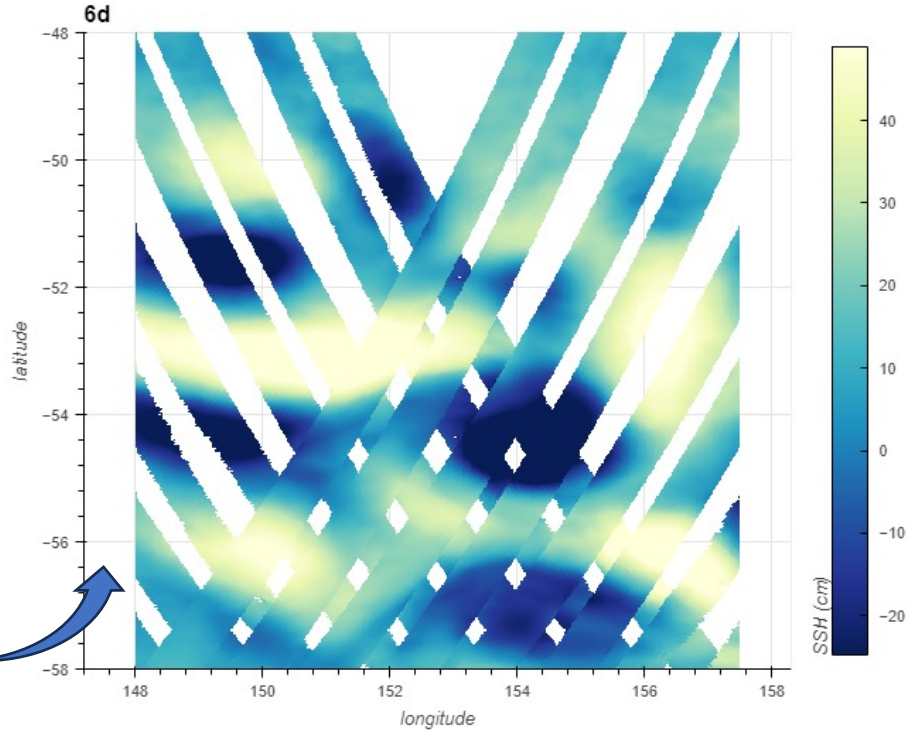


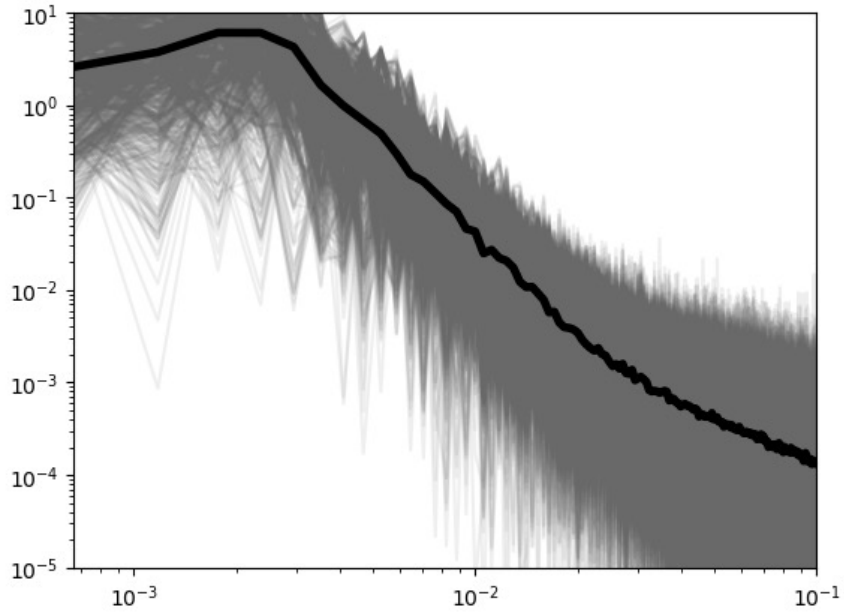
- Impact of regional spatialisation on wavenumber spectra
- KaRIn's higher resolution allows for a better resolution over all spatial scales.
- POS5 nadir instrumental noise kicks in near the 90km wavelength limit, whereas KaRIn shows a smooth energy cascade down to several tens of km wavelength.
- Left/Right swath analysis show the impact of imperfect data editing near Menorca island (higher energy of left swath at small scales). Lower energy for the Left swath compared to the right one at large scales is a byproduct of the track segmentation due to the presence of the island.

2nd site : High EKE, Antarctic Circumpolar Current, SW of Tasmania : 21-day Science Phase



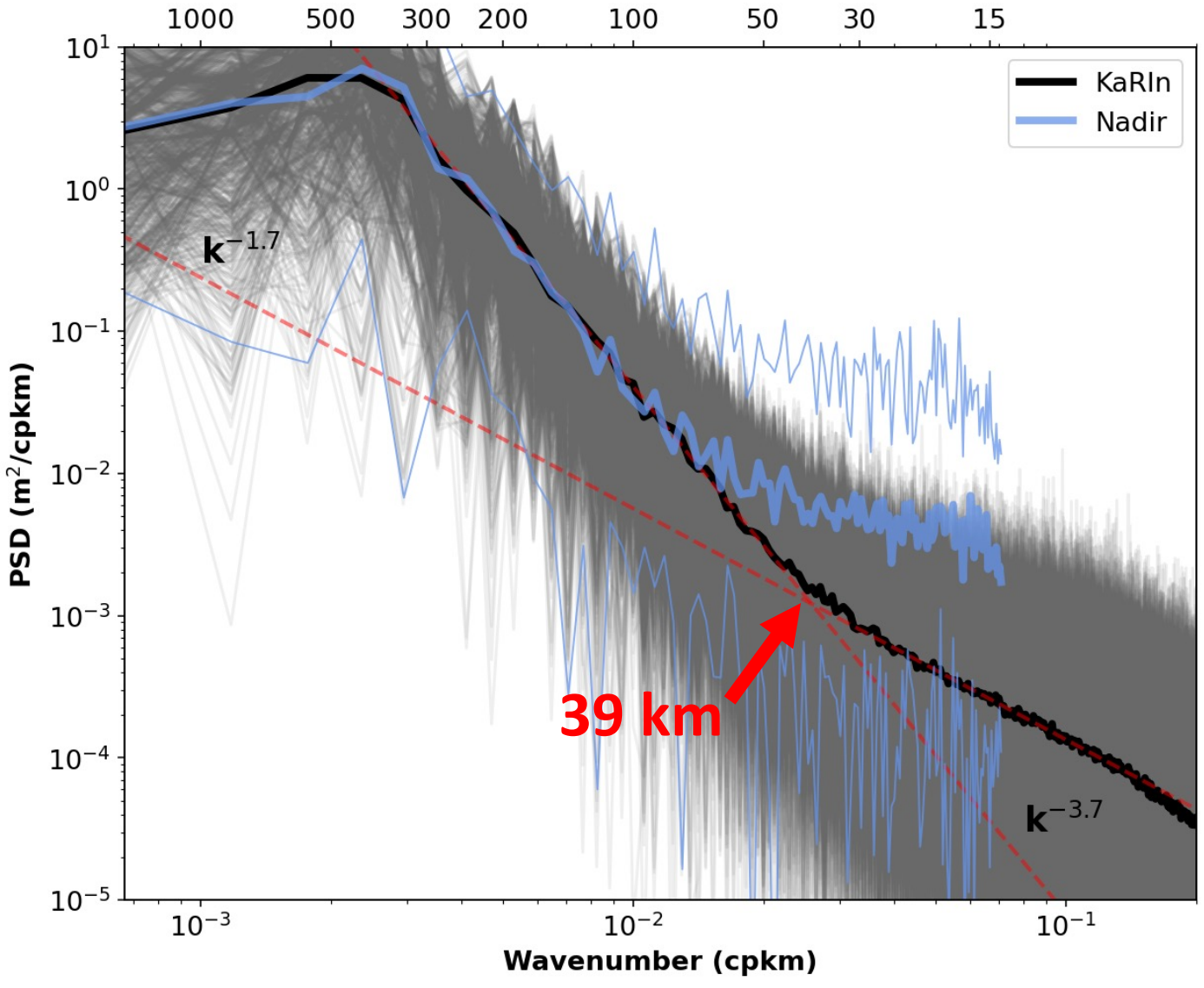
6 days of SWOT KaRIn swaths in this 10°x10° region
– tracks laid down consecutively to the west



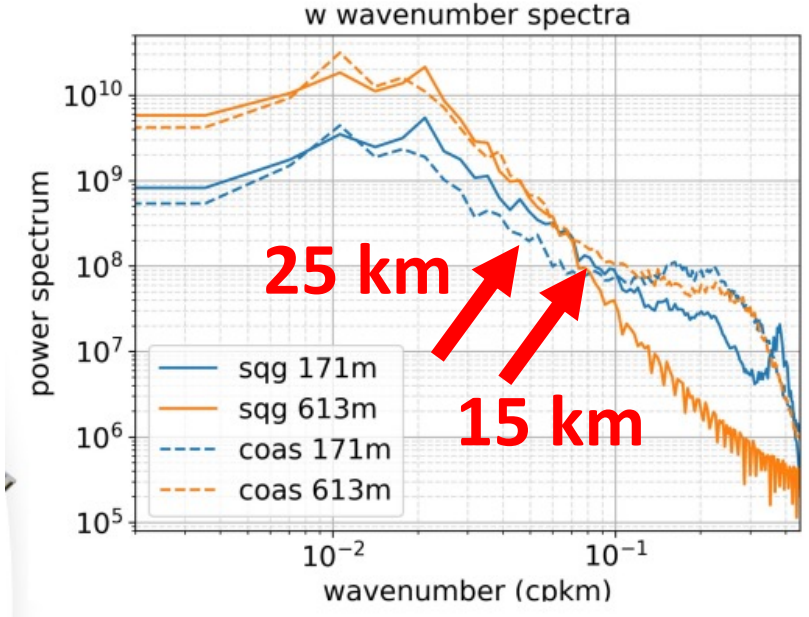


Regional SSH wavenumber spectra from KaRIn
6 days of data, every 2 km over two 50km swaths

Science phase over the ACC: 1-month analysis



- Consistent with Med observations: KaRIn and POS5 nadir are in near perfect agreement at large scales down to sub 100-km wavelength, where POS5 nadir instrumental noise kicks in.
- For the first time on non-denoised altimetry SSH data, KaRIn allow us to observe a spectral slope break at 40 km wavelength.
- Spectral slopes shift from a typical sQG regime towards a IGW type regime has been documented in mid-to low latitudes in alongtrack data (Vergara et al., 2023), but is hidden by nadir altimeter noise at high latitudes.
- This shift is also seen by HR OGCM vertical velocity spectra in the region.



Conclusions

- Early SWOT analyses of daily repeat data highlight the rapid temporal variability and strong spatial variability in regional seas, such as the W Mediterranean Sea
- KaRIn and POS5 nadir are in near perfect agreement at large scales down to sub 100-km wavelength, where POS5 nadir instrumental noise kicks in, for the 1-day and 21-day repeat cycles
- KaRIn SSH wavenumber spectra shows a smooth energy cascade down to several tens of km wavelength, whereas nadir altimetry noise blocks wavelengths < 70-100 km.
- For the first time on non-denoised altimetry SSH data, KaRIn allow us to observe a spectral slope break at 40 km wavelength in the ACC.