Orographic waves signatures visible in SWOT ?

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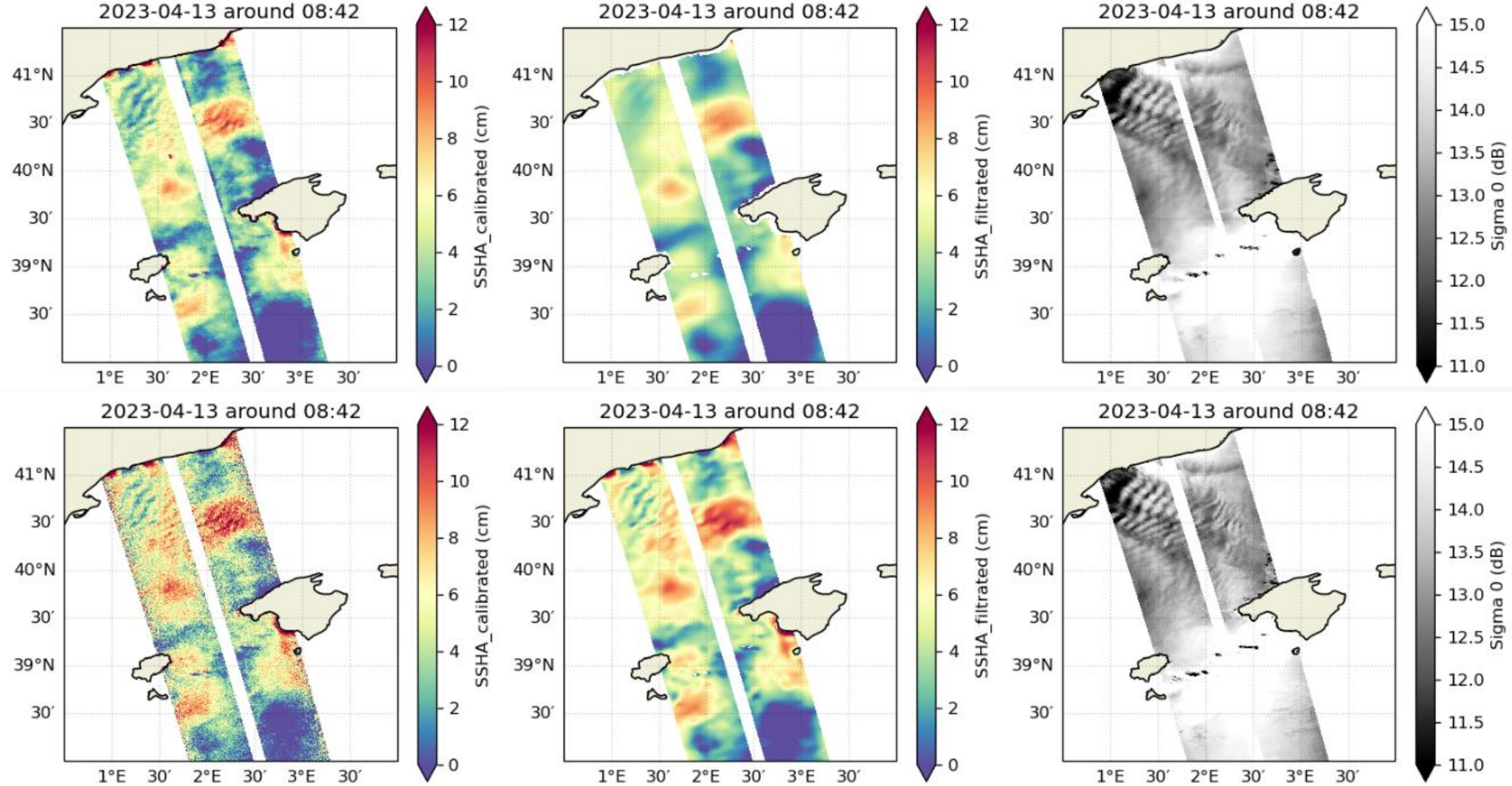
L3 V2.0.1_CALVAL, cycle 489, pass 16, over Baleares islands

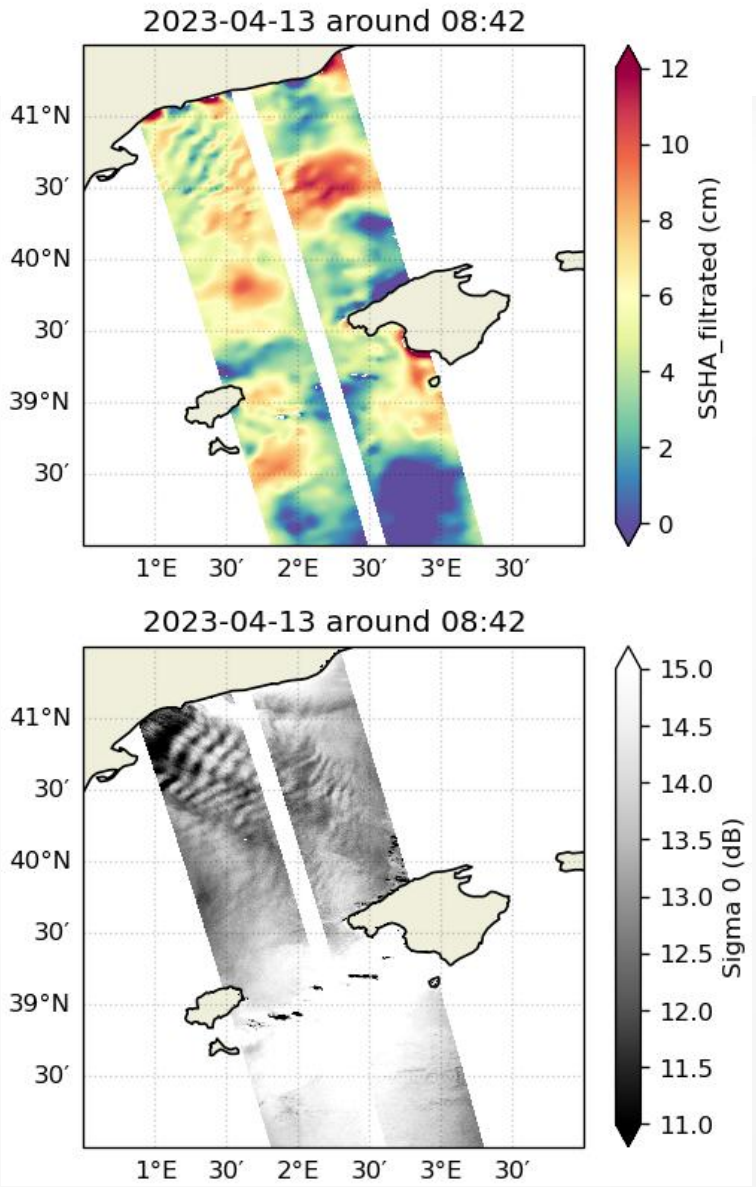
2km

250m

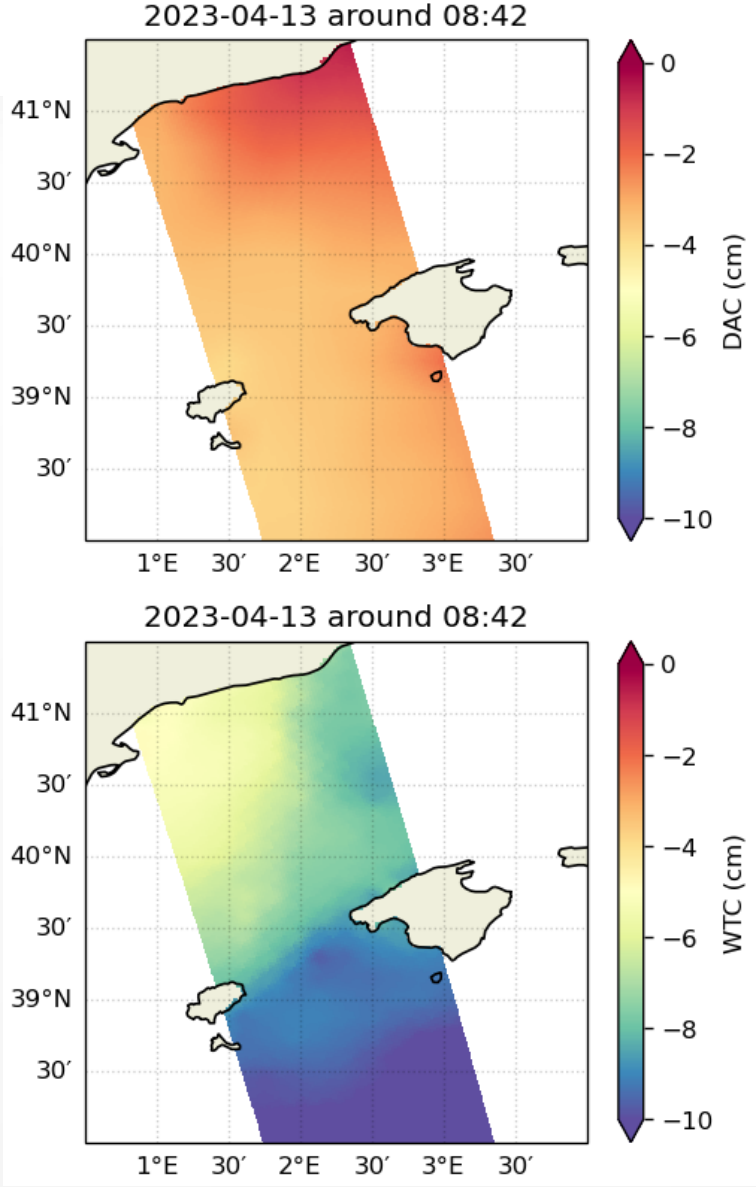


- Very fine-scale waves are observed both in the SSHA and the sigma0 => link to atmospheric phenomena (orographic waves following the passage of wind over a topography gradient).
- Real ocean response or atmospheric corrections errors ? => check DAC, WTC and SSB

V2.0.1_CALVAL, cycle 489, pass 16



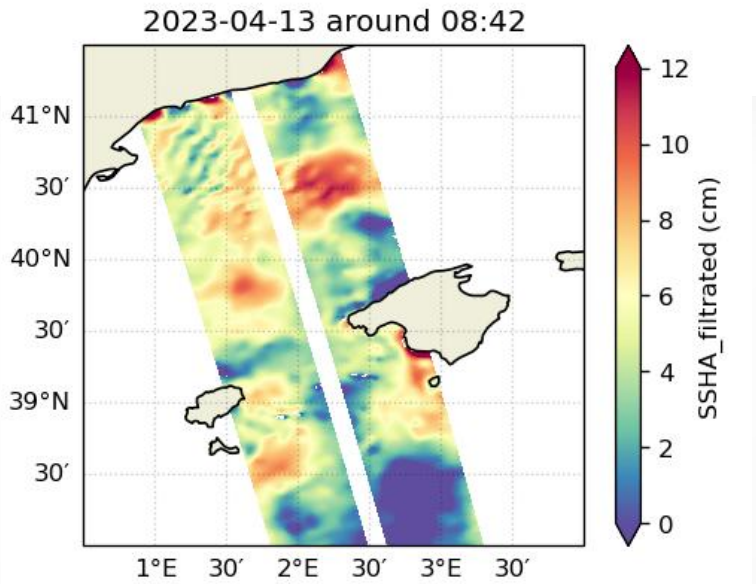
DAC (L3) and WTC (L2) of SWOT

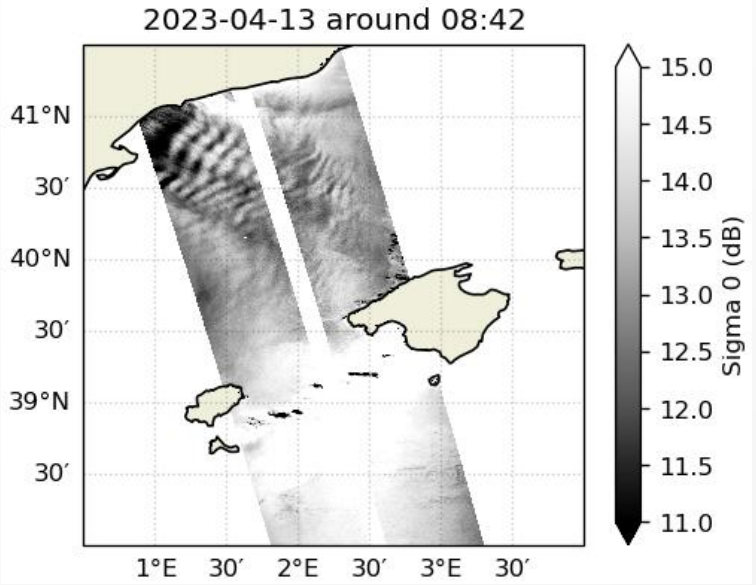


Analysis of atmospheric corrections included in SWOT products:

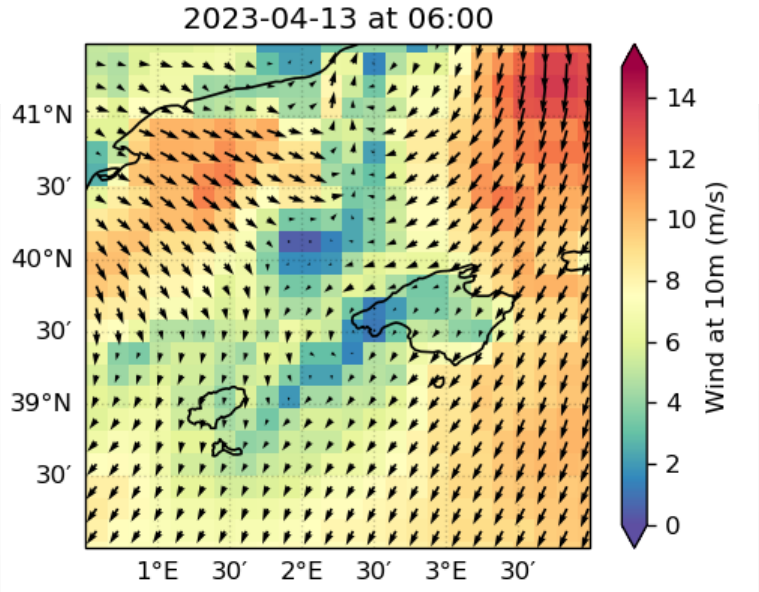
- On the right, the dynamic atmosphere correction (DAC) and wet troposphere correction (WTC model).
- Both corrections do not represent the fine-scale waves seen in the SWOT data on the left.

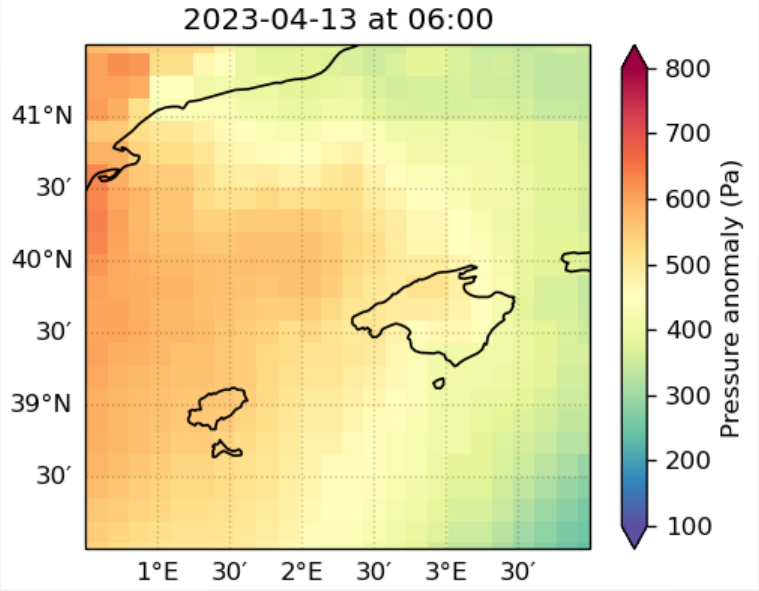
V2.0.1_CALVAL, cycle 489, pass 16





ECMWF, 6-hourly data

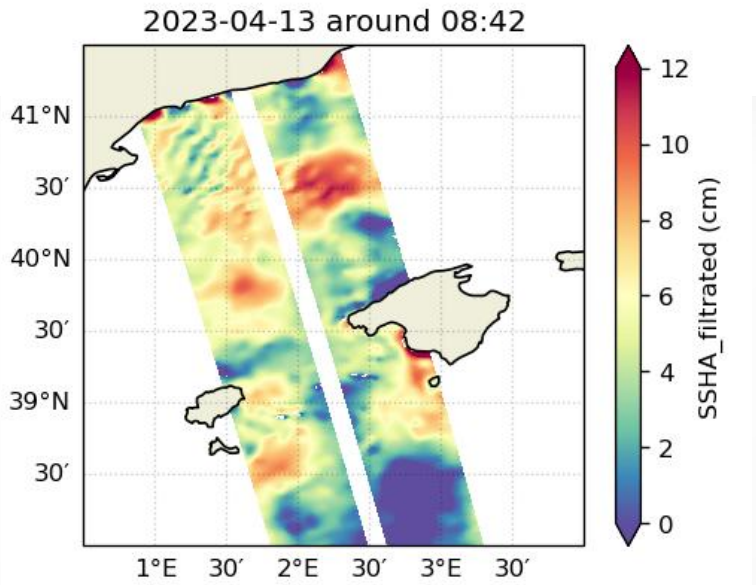


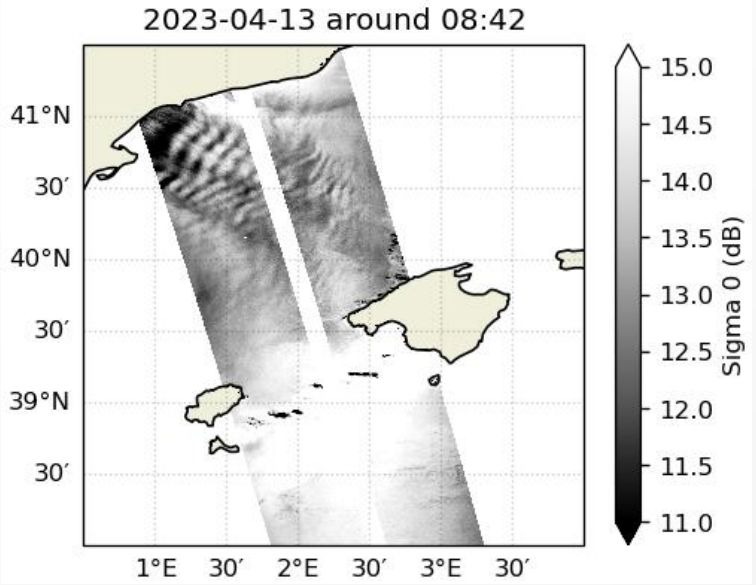


Analysis of ECMWF weather forcings used to force DAC (wind and pressure):

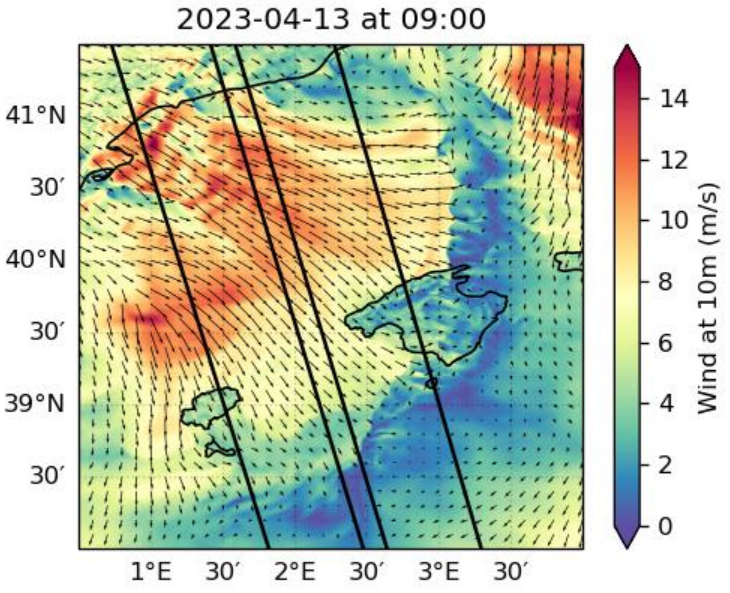
- Global model on N640 grid (native 01280)
- The resolution is not sufficient to represent fine scales.
- The wind field shows a wind coming from the land, which seems to corroborate the hypothesis of waves generated by wind propagation over a relief.

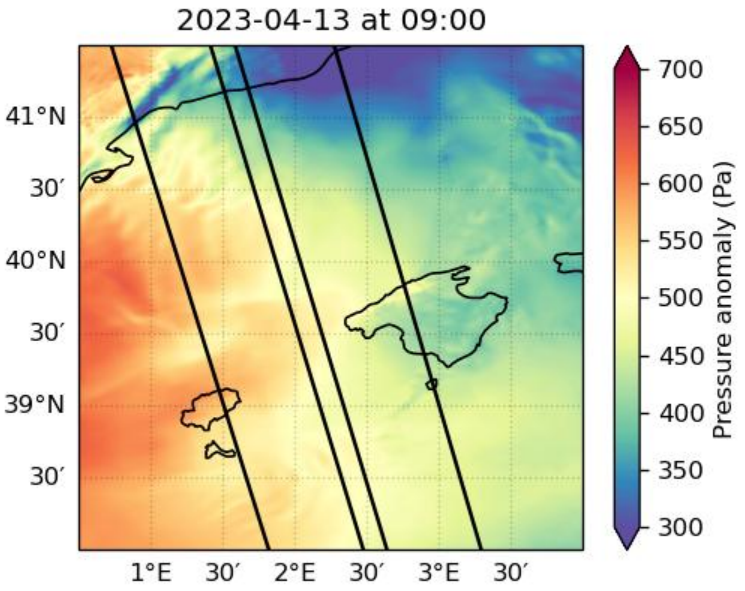
V2.0.1_CALVAL, cycle 489, pass 16

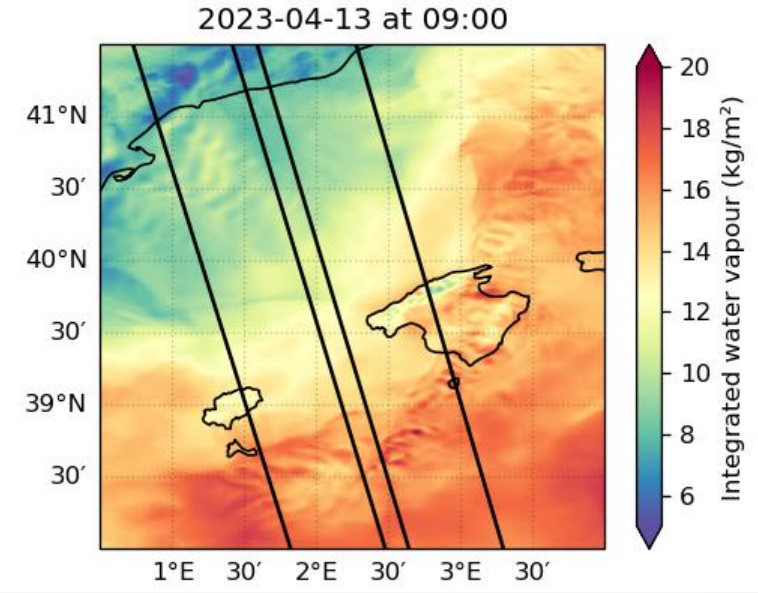




AROME 0.01, run from 13/04/2023 9am, step 0





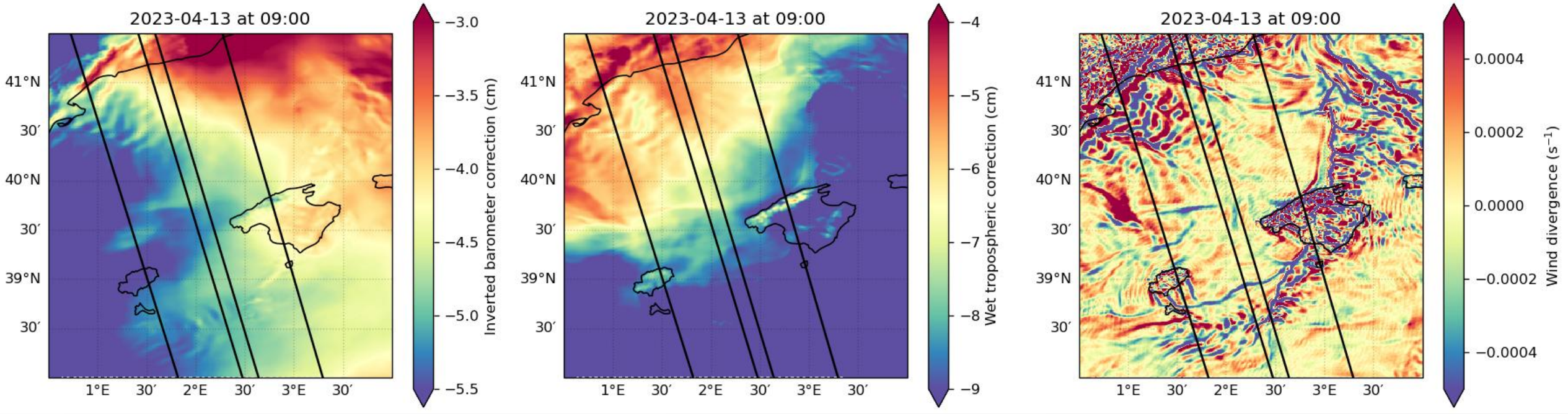


Analysis of HR weather simulations from the Météo-France - AROME model:

- Regional model at 1/100°.
- The AROME outputs show similar orographic waves patterns as the SWOT data (in winds, pressure and integrated water vapor content).

Calculation of altimeter corrections from AROME 0.01 data

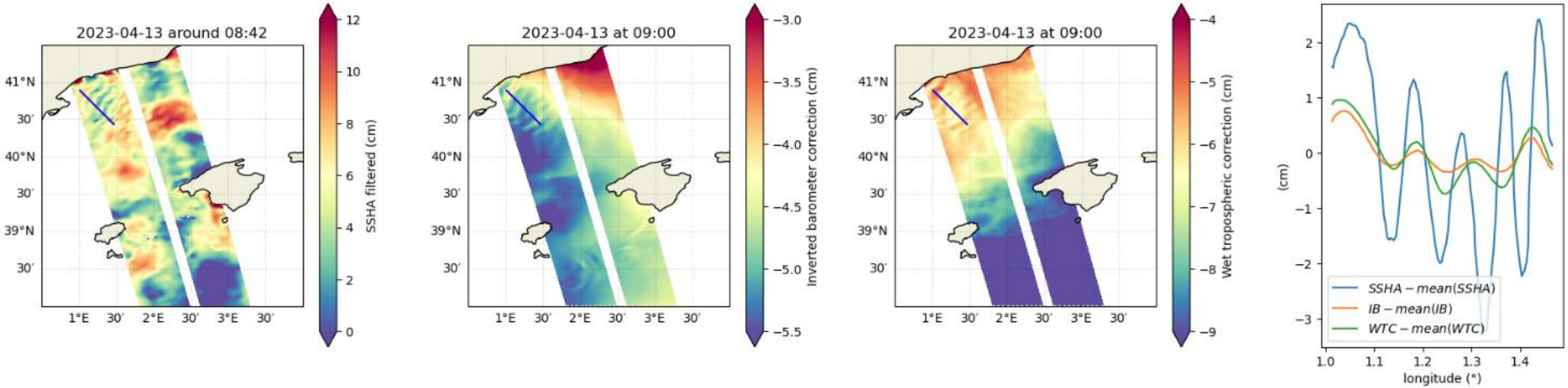
- run from 13/04/2023 9am, step 0 -



- We calculate the inverse barometer correction (IB, from the pressure field), the wet troposphere correction (WTC, from the integrated water vapour content and temperature at 2m) and the wind divergence
- Wind-related part of the DAC is derived from wind divergence, but we can't estimate it exactly without running a specific regional surge model.

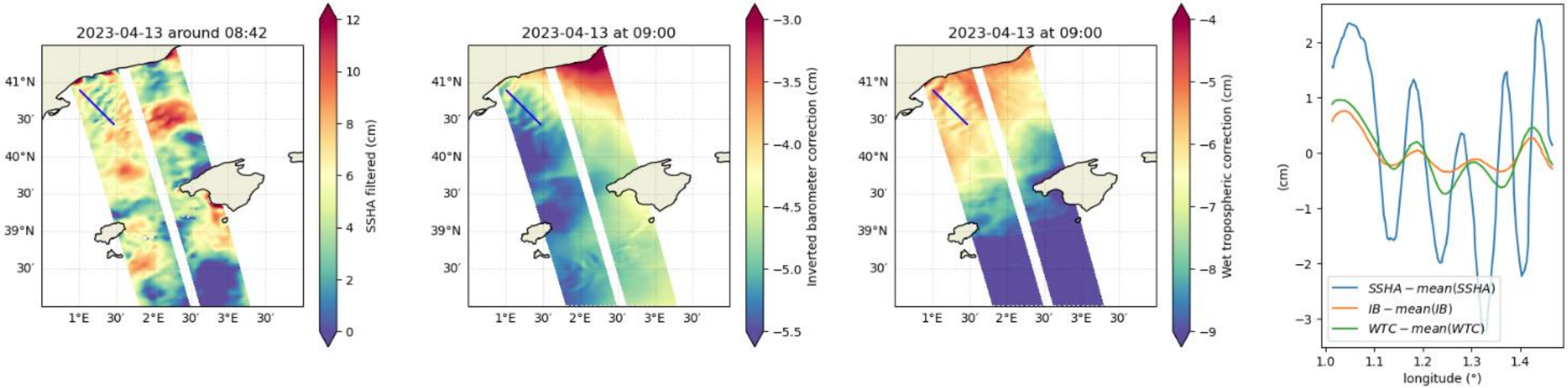
=> signature of orographic waves is visible in the 3 fields.

Transect analysis on the SWOT swath: focus on small-scale wave signatures



- Corrections are interpolated spatially only, as temporal interpolation tends to smooth the waves.
- AROME-based corrections show coherent oscillation with SWOT SSHA, but not totally in phase (longer wavelengths in the model).
- The amplitude of the WTC is greater than that of the IB correction.

Transect analysis on the SWOT swath: focus on small-scale wave signatures



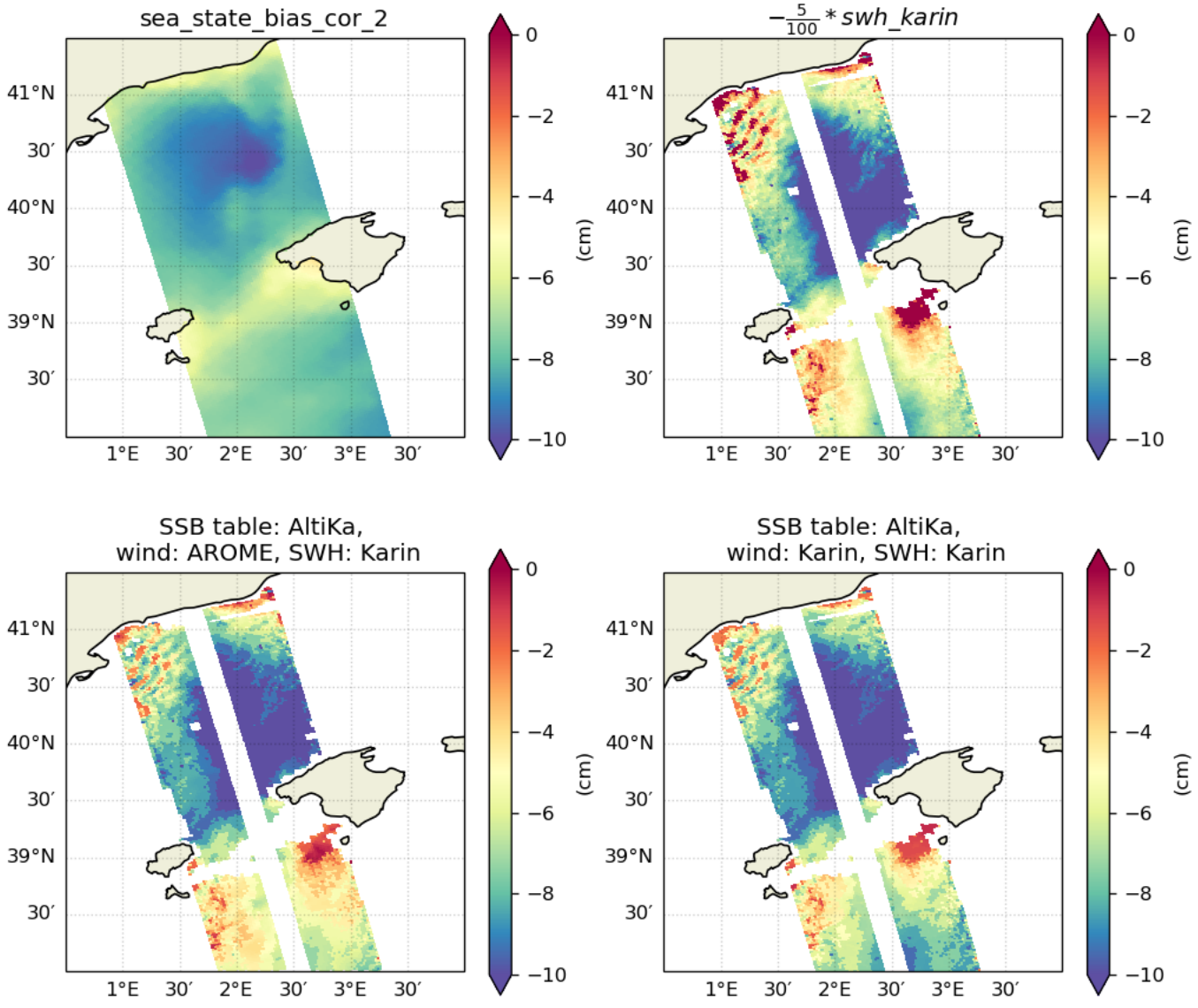
› Applying high-resolution corrections to this SSHA transect reduces the variance of SSHA :

Var(SSHA – IB) – Var(SSHA) = -0.53 cm² (-21%)

Var(SSHA – WTC) – Var(SSHA) = -0.76 cm² (-30%)

Var(SSHA – (IB + WTC)) – Var(SSHA) = -0.99 cm² **(-40%)**

Focus on the SSB correction



Analysis of several SSBs:

- Product SSB (sea_state_biais_cor_2) based on global SWH (does not represent scale<300km: cf B. Molero's presentation)
- SSB as a fraction of SWH
- Two different SSB calculated with the AltiKa table and the SWH Karin:
  - with AROME wind
  - with KaRIn wind
  - (the two are very similar as there is little effect of wind in the AltiKa table)

=>The product's SSB does not represent the fine scales, but the waves are visible in the other 3 SSB estimates from KaRIn.

SSB correction and SWH

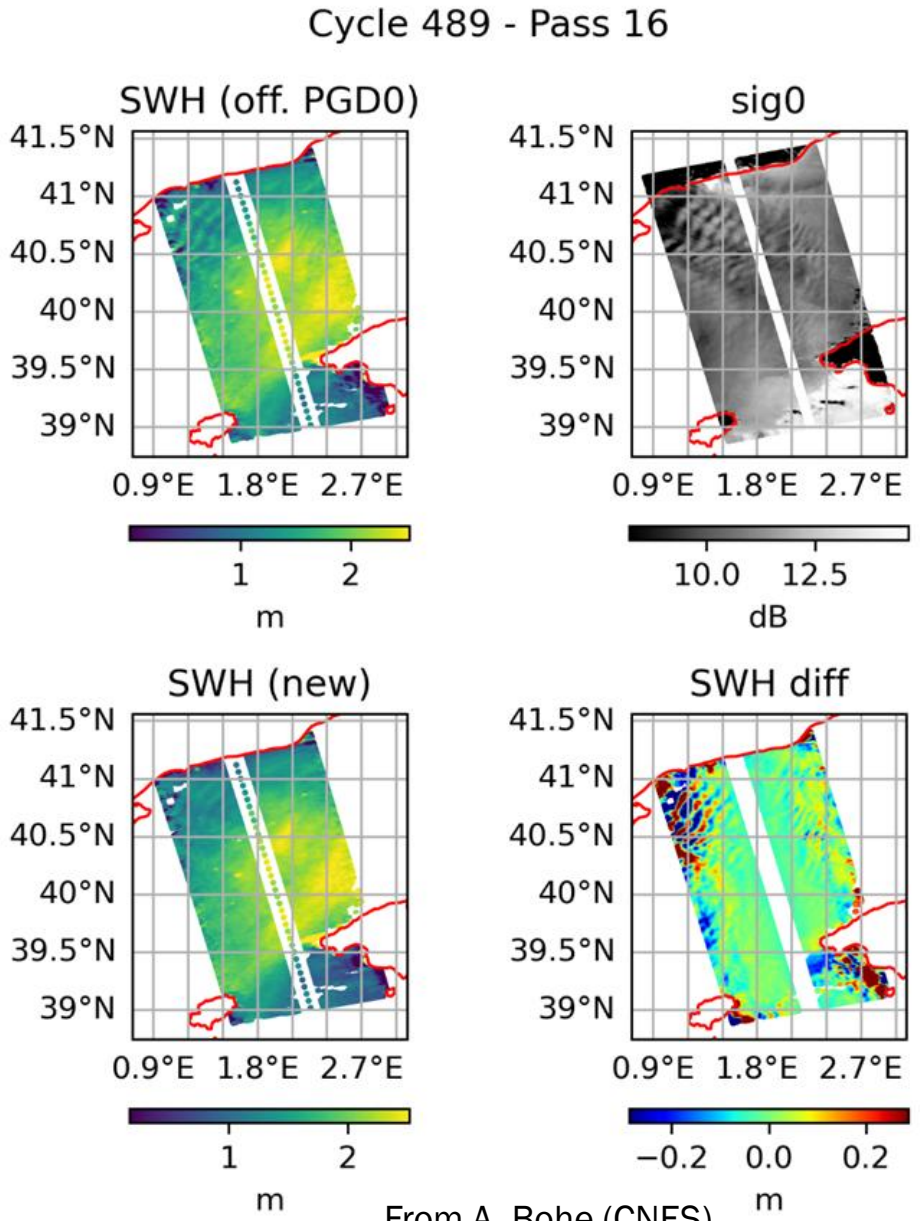
Fine scale only visible when small SWH occur :

- 0-1 m SWH estimation is not reliable & SWH impacted by strongly contrasted sigma0 (see A. Bohe's presentation)

=> SSB oscillations are due to measurement errors in the SWH, due to strong gradients of sigma0 (cf A. Bohe's presentation yesterday)

New SWH estimation using new algorithm (use Sigma0 to estimate geometric decorrelation: cf A. Bohe)

=> most oscillations disappear



From A. Bohe (CNES)

Conclusions and perspectives

- Global product's atmospheric corrections are very smooth
- HR WTC explains about 30% of the SSHA variance
- HR IB explains ~20% of the SSHA variance =>patterns/amplitude suggest an ocean response to atmospheric forcing

- Product's SSB (sea_state_bias_cor_2) does not show very fine-scale waves as what is visible in the SWOT SSHA and sigma0.
- HR SSB : small scales SWH oscillations are mostly measurement errors

- **Next :**
  - Estimate the impact of wind & pressure forcing on the SSHA => regional simulation (collaboration with NOVELTIS & LEGOS)
  - Check surface currents
  - Scientific publication to be submitted