Towards a L3 KaRIn product for coastal applications

M-I Pujol; B Molero (CLS)

on behalf of the L3 KaRIn production team

SWOT Science Team Meeting,
Arcachon, Oct. 2025

User requirements:
first basic requirements collected

User first basic requirements

- **Coastal area definition :**
  - Depending on the dynamics; should include ocean plateau and full estuaries domain

- **Product resolution :**
  - 250m minimum resolution
  - Higher resolution required for very coastal applications

- **Product content:**
  - Need access to SSH non corrected from some geophysical corrections
  - SSH needs to be calibrated with other altimeters; SSH need to be continues with open ocean product
  - Need to be able to adjust the data selection to specific needs
  - Complementary variables of interest : SWH, Wind, sigma0, currents, SST, SSS, ….

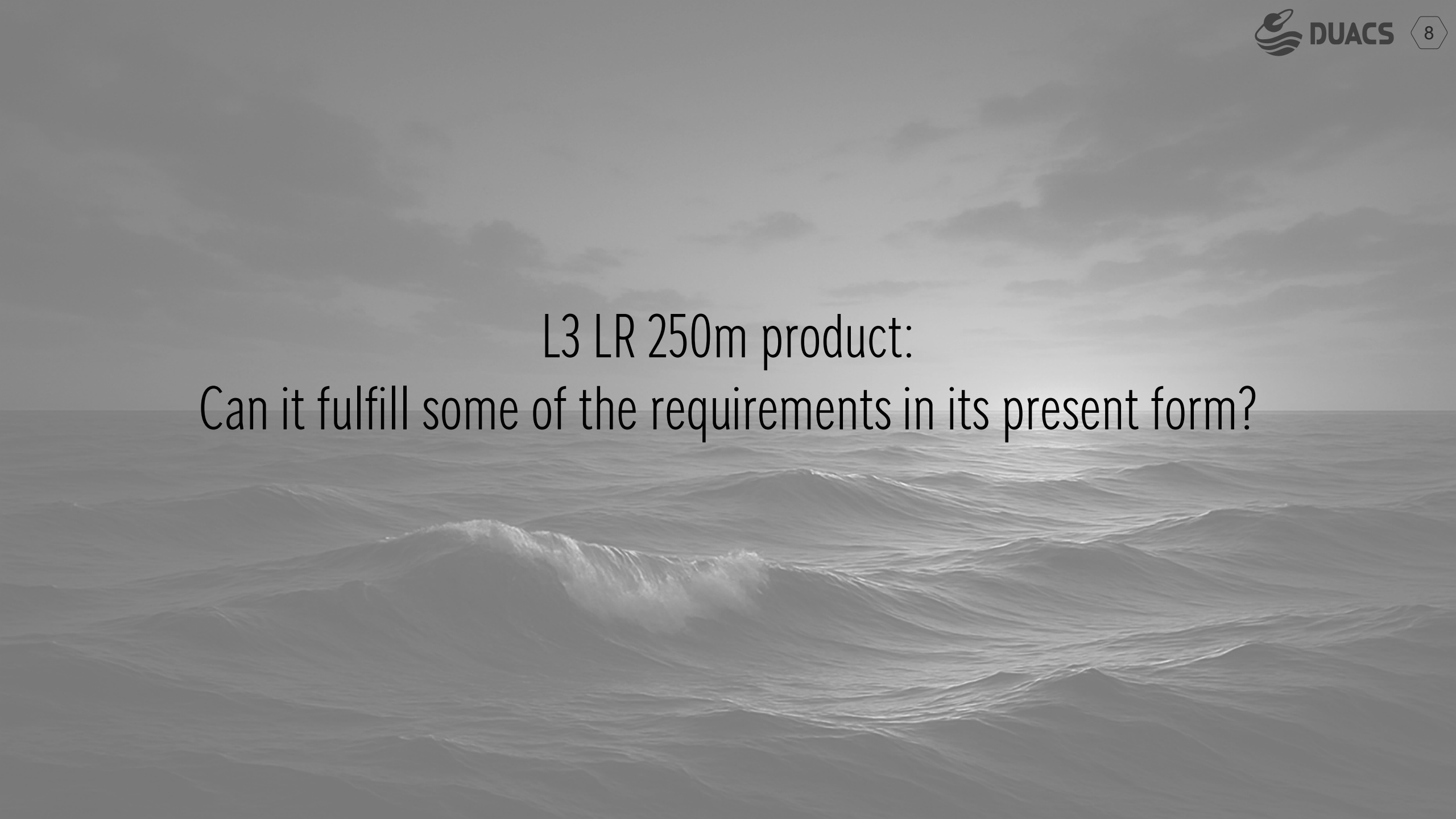
L3 product for coastal applications: different options to be envisaged

Different options for future L3 product for coastal applications

- L3 LR 250m product basis :
  - Adapt product content
  - Optimize different processing steps

- L3 product developed from HR raster/PICX
  - Define and implement L3 processing required;
  - Manage different behaviors between LR & HR (e.g. Waves)

- L3 hybrid LR/HR product



L3 LR 250m product:
Can it fulfill some of the requirements in its present form?

L3 LR 250m product

- **Derived from L2 LR unsmooth product**
- **Can this product be of interest for coastal community?**
  - —Contains SSHA, MSS and different geophysical corrections that allow to retrieve uncorrected SSH
  - —Includes a specific quality flag (different and simpler than L2 flag)
  - —SSHA is calibrated and compatible with other altimeter measurements (DUACS products)
  - —Contains sigma0, currents (geostr. approx.)
  - —Contains « filtered » (denoised) SSHA

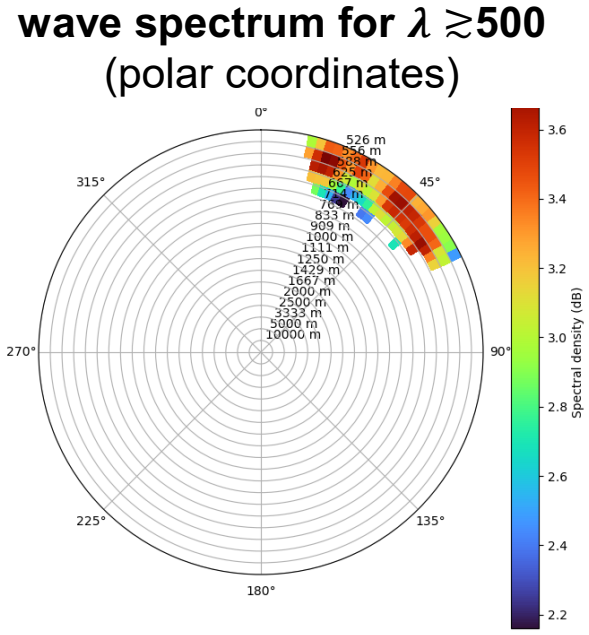
L3 product access

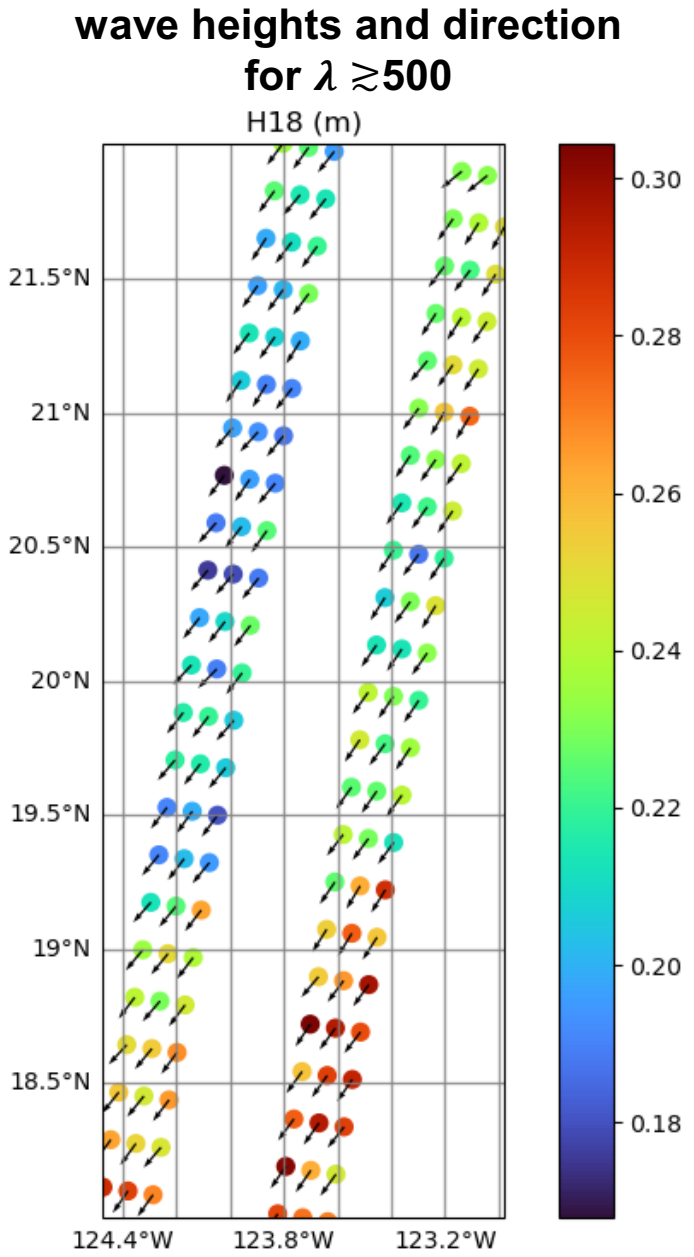
https://doi.org/10.24400/527896/A01-2023.018

- ➢ L2 or L3 LR 250m already used by some « coastal » users. Feedbacks are welcome.
- ➢ L3 v4 probable in mid 2026 → still in time simple changes could be integrated to address the coastal community's needs.

L3 Wind/Wave product: estimating long waves from SWOT heights

- The SWOT KaRIn Level-3 Wind Wave product (**L3_LR_WIND_WAVE**) is an innovative product derived from the **250m heights** of the Unsmoothed L3_LR_SSH product, based on the algorithm in **Ardhuin et al. (2024)**
- It takes advantage of the capability of the KaRIn Low Rate (LR) heights of **resolving waves greater than ~500 m in wavelength** with a very high precision (few cm)
- **~1 year of data is available at AVISO** website
- More and better data to come
- Can be useful for coastal applications?





L3 HR product
what should be the priority ?

Toward a L3 HR product ?

Raster 250m, raster 100m or PIXC:

- Different resolution, different anomalies, different noise levels
- Huge volume of data to manipulate

➢ Which of them may answer to most of the coastal needs ?

➢ Few areas of interest for first L3 product demonstration ?

➢ Which grid ? (regular; true location)

➢ Which L3 product format ?

➢ Feedbacks and existing « home made » processing are welcome

Contact:

mpujol@groupcls.com

Backups

V3 Evolutions: L3 Calibration

- Improved calibration algorithm with a better estimation of low frequency correction

→ Reduction of uncorrected KaRIn systematic errors with calibration v3.0, especially in polar ocean and near land areas

→ Addition of a low frequency calibration in the technical product which absorbs less geophysical error residues

→ Important improvement for hydrology (1-day phase calibration is based on L3 algorithm)

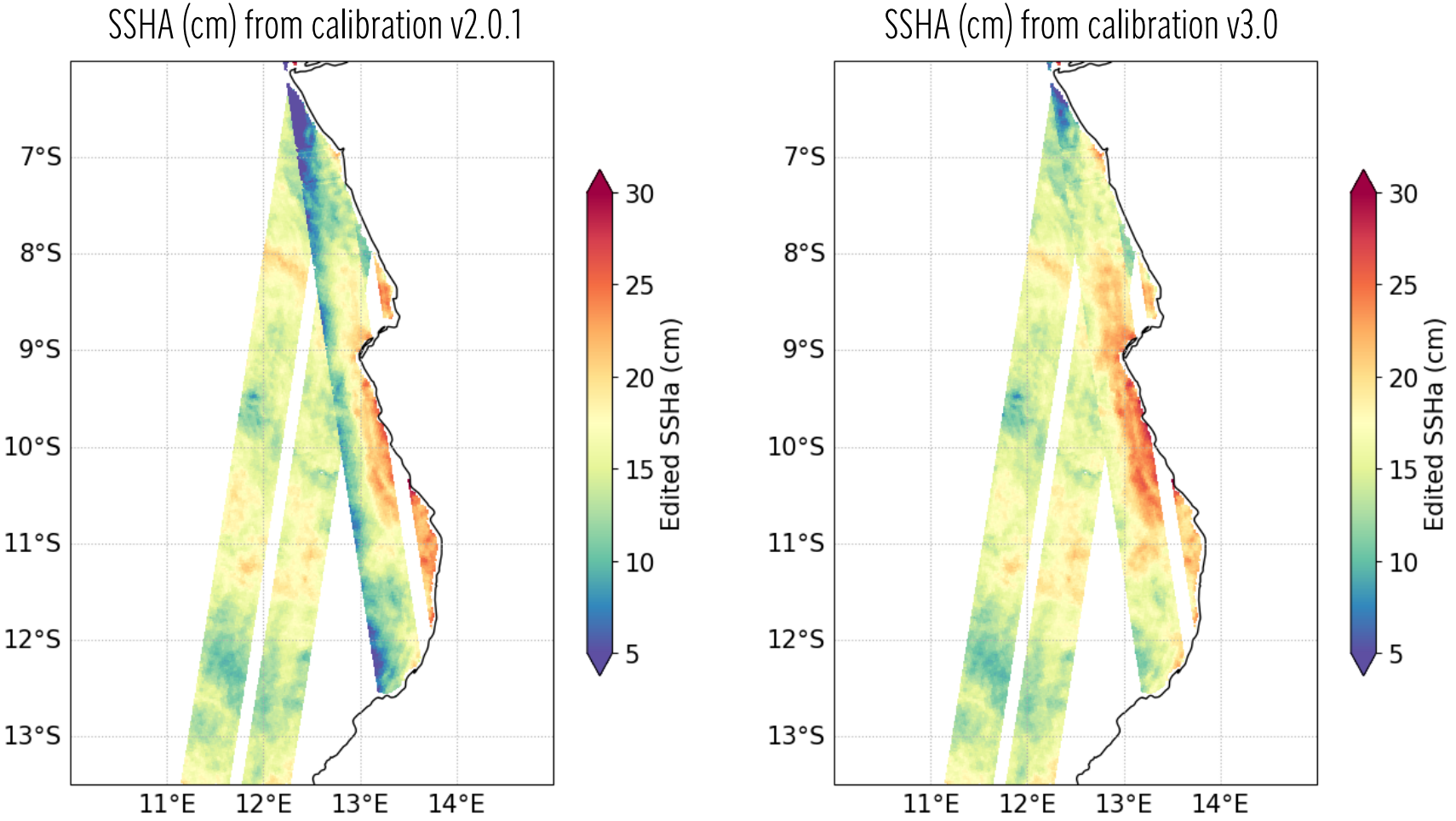
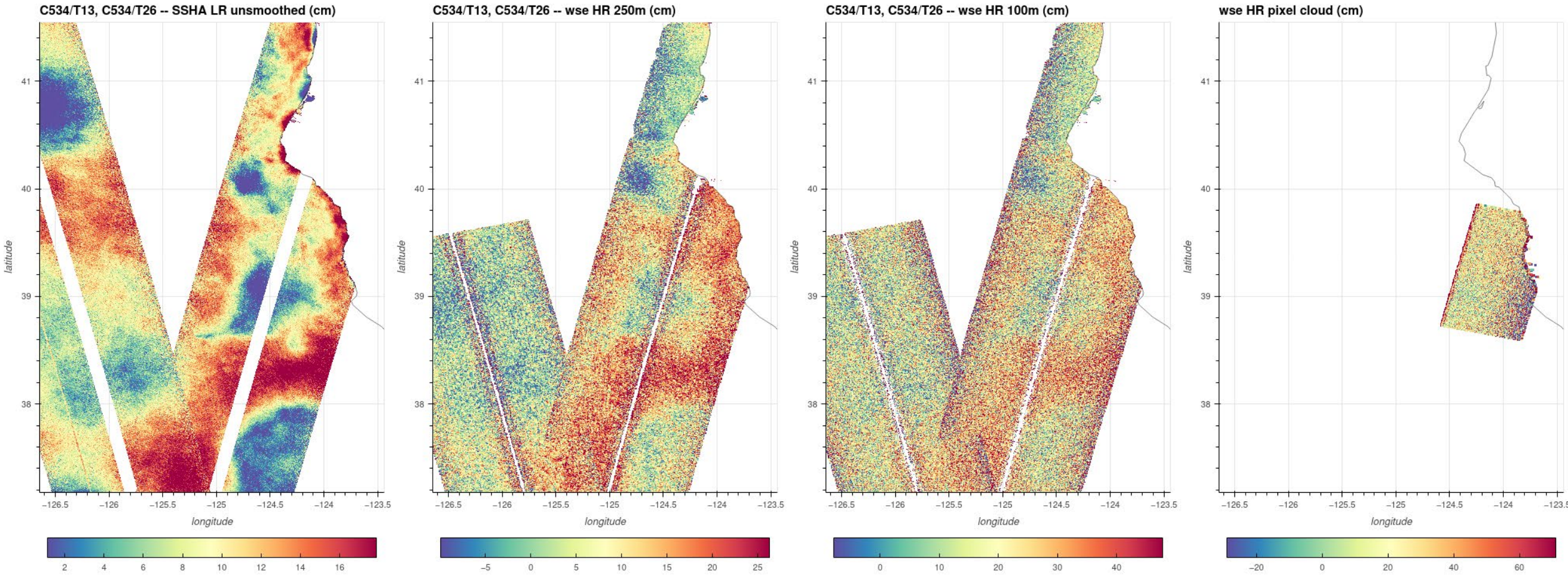


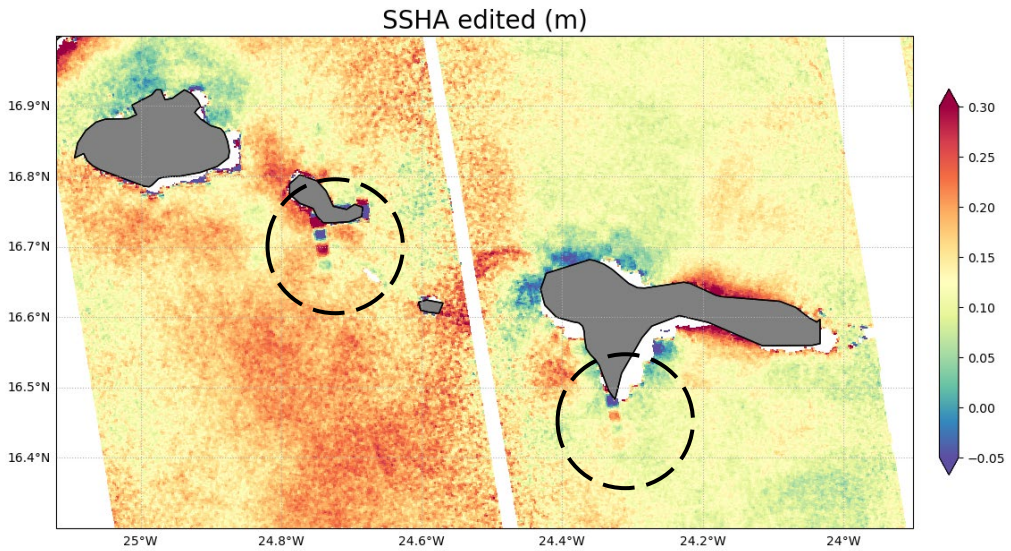
Figure: Signature of uncorrected satellite roll angle in SSHA now removed by calibration v3.0

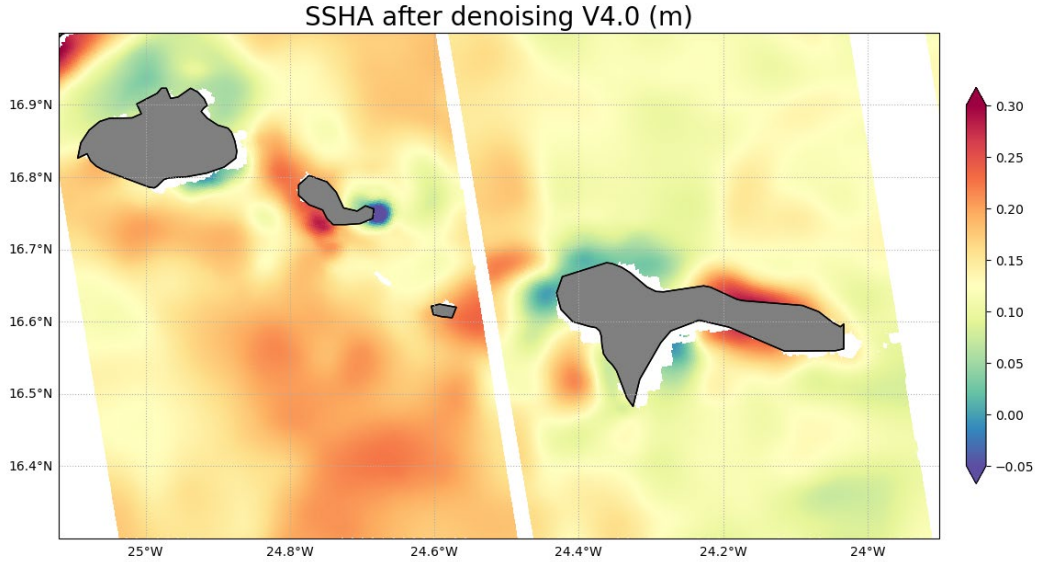
See the poster ST2025OS1_018

LR 250m / HR / PIXC



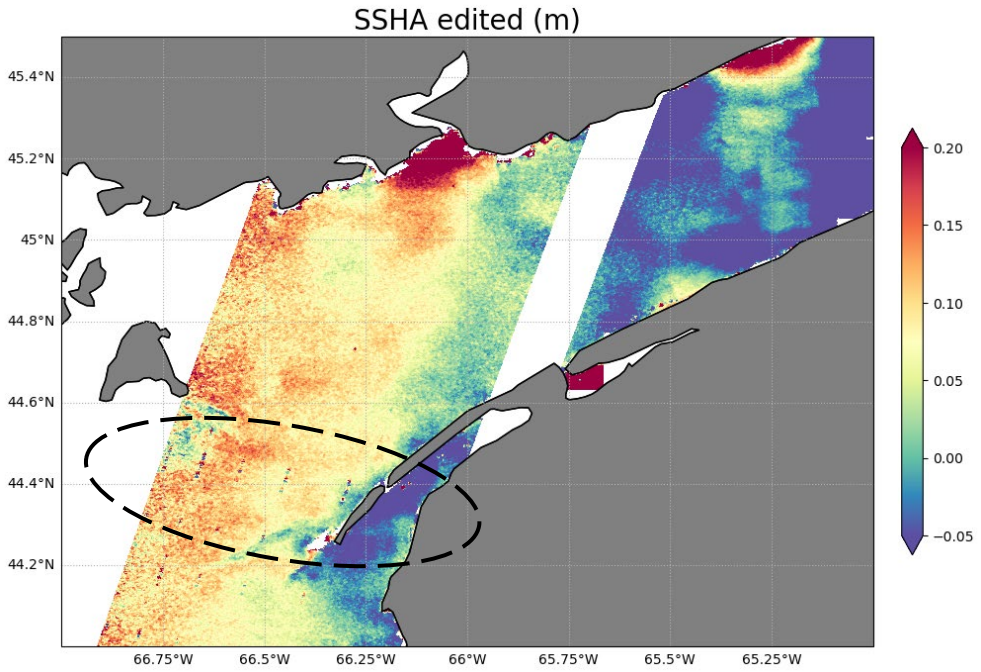
Example LR 250m

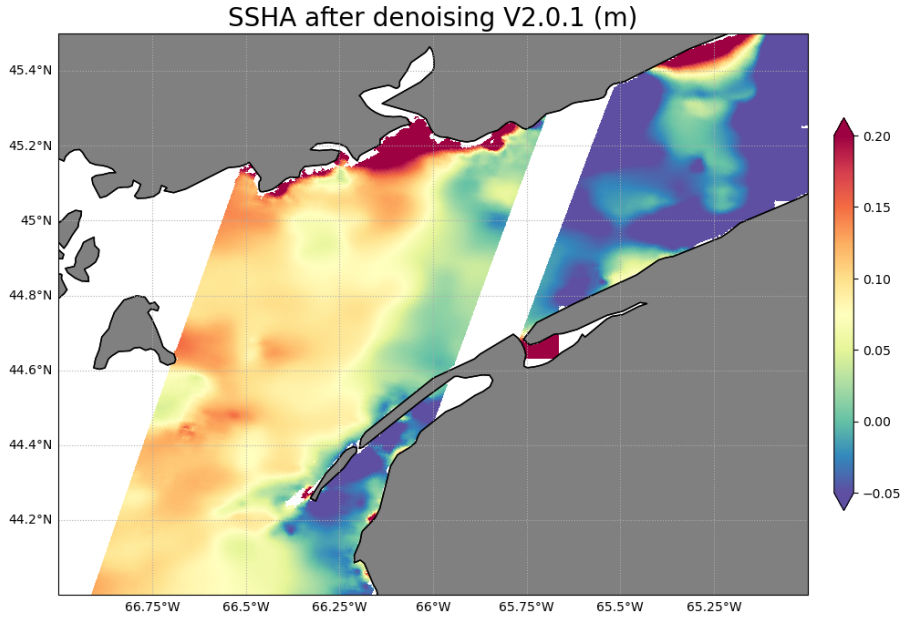


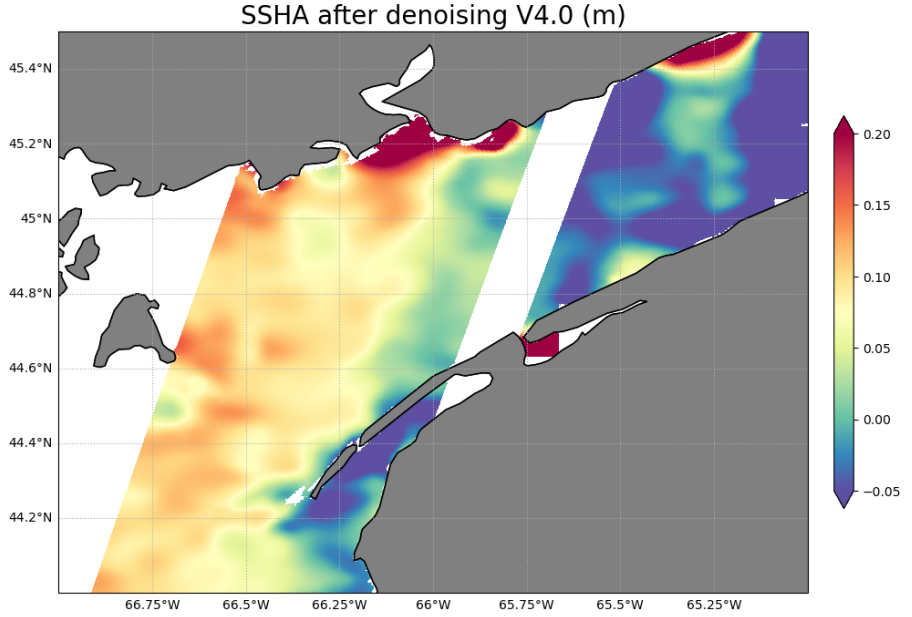


- Some imperfections of the editing (here no detection of specific anomalies)
- Can be attenuated with denoising/filtering

Example LR 250m

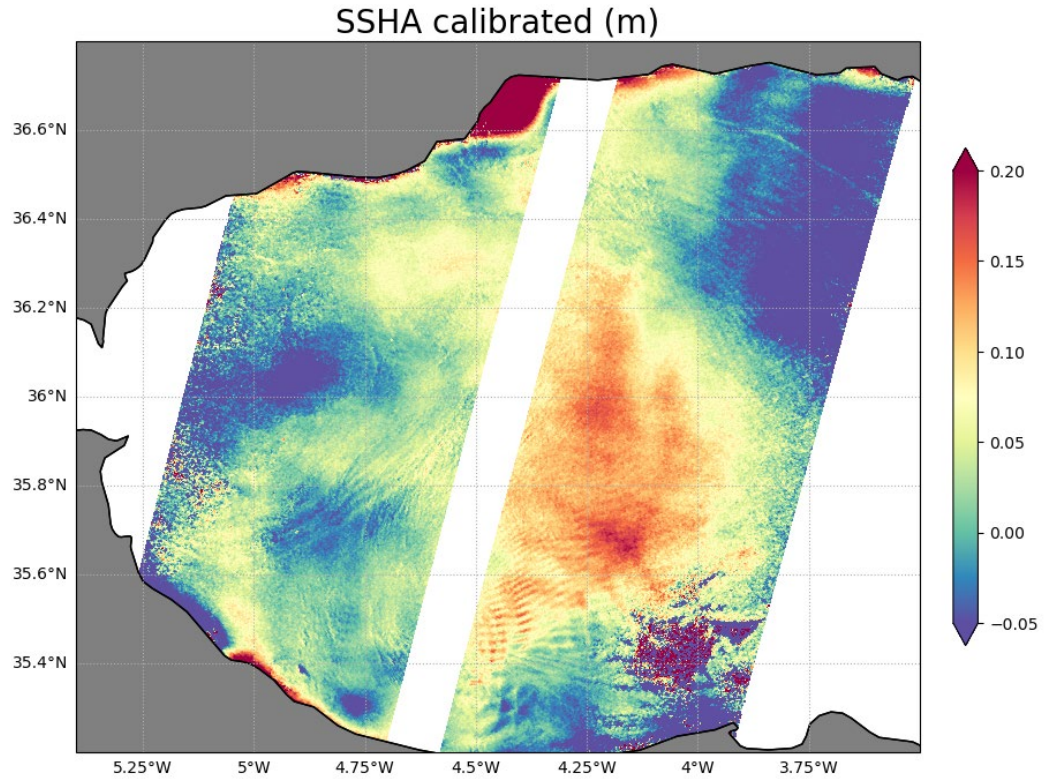


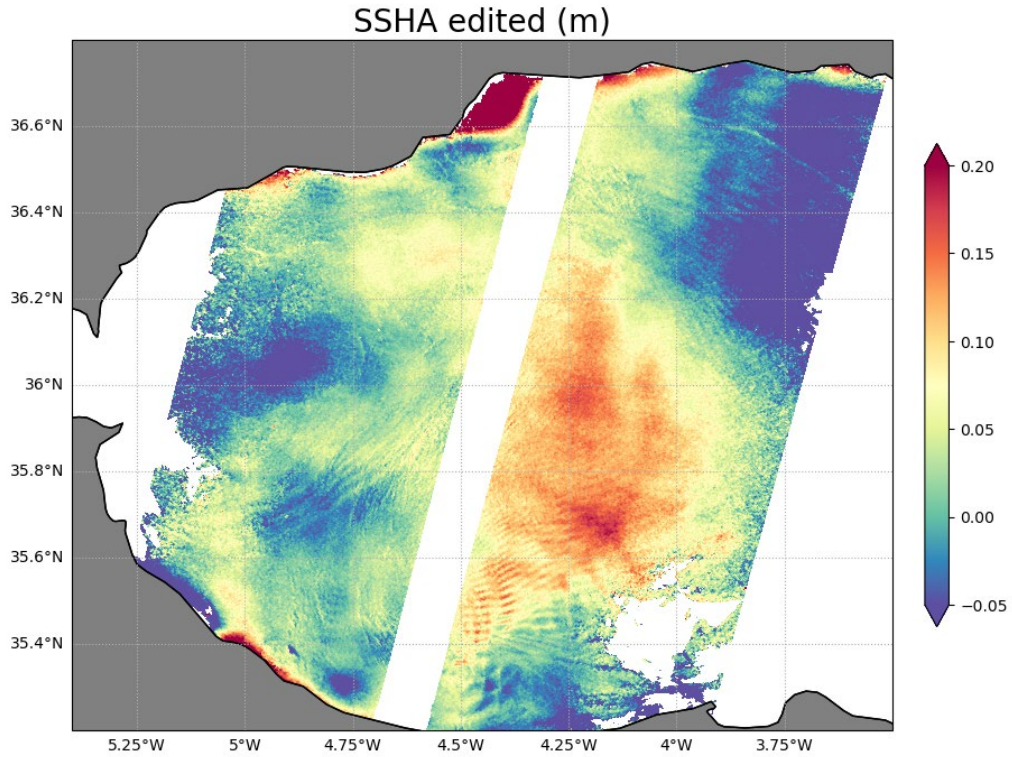




- Some imperfections of the editing (here no detection of specific anomalies)
- Can be attenuated with denoising/filtering

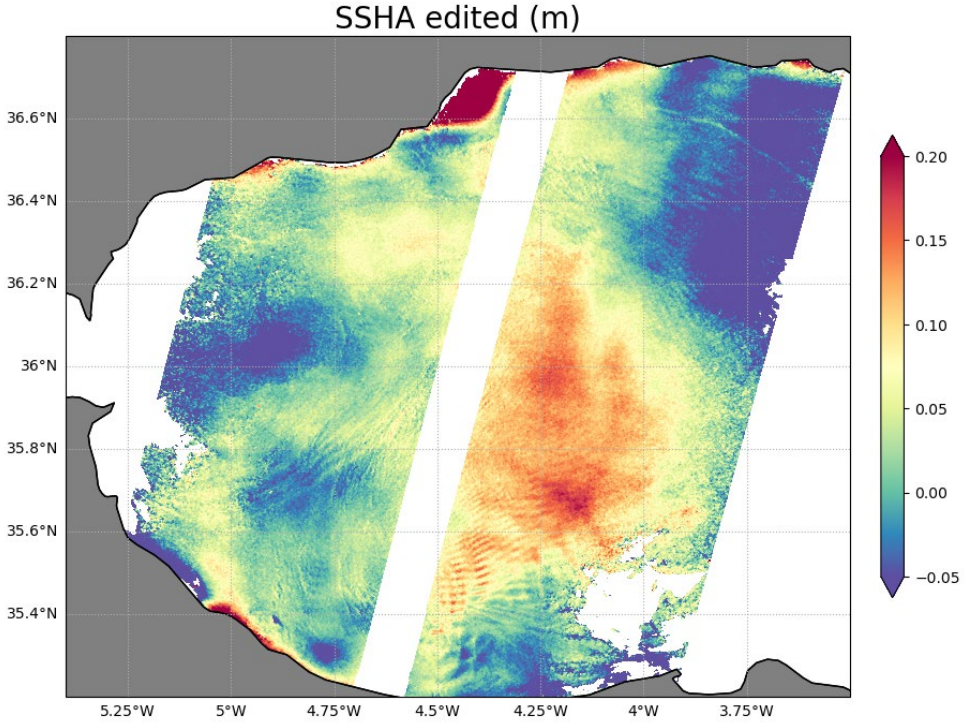
Example LR 250m

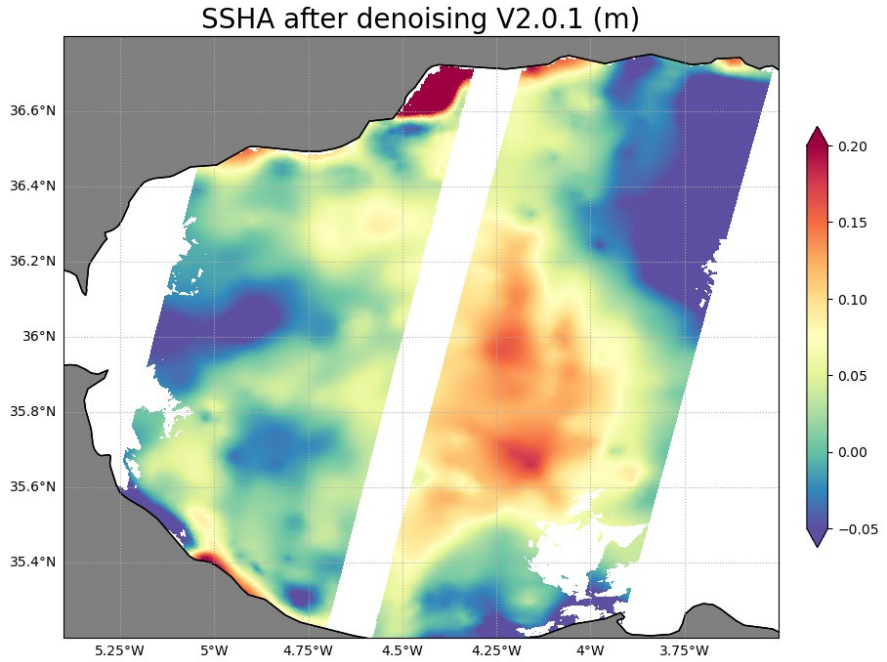


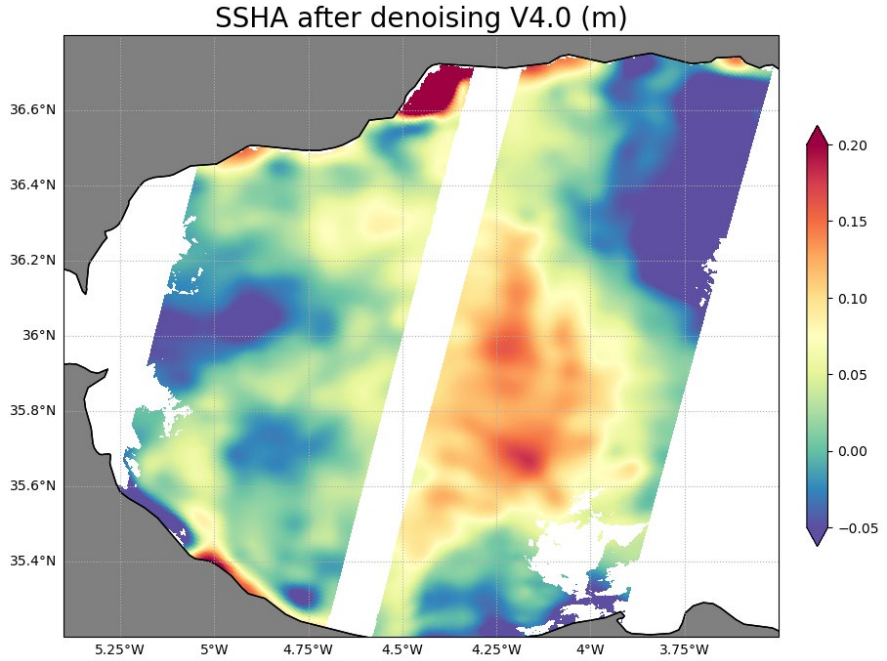


Example LR 250m

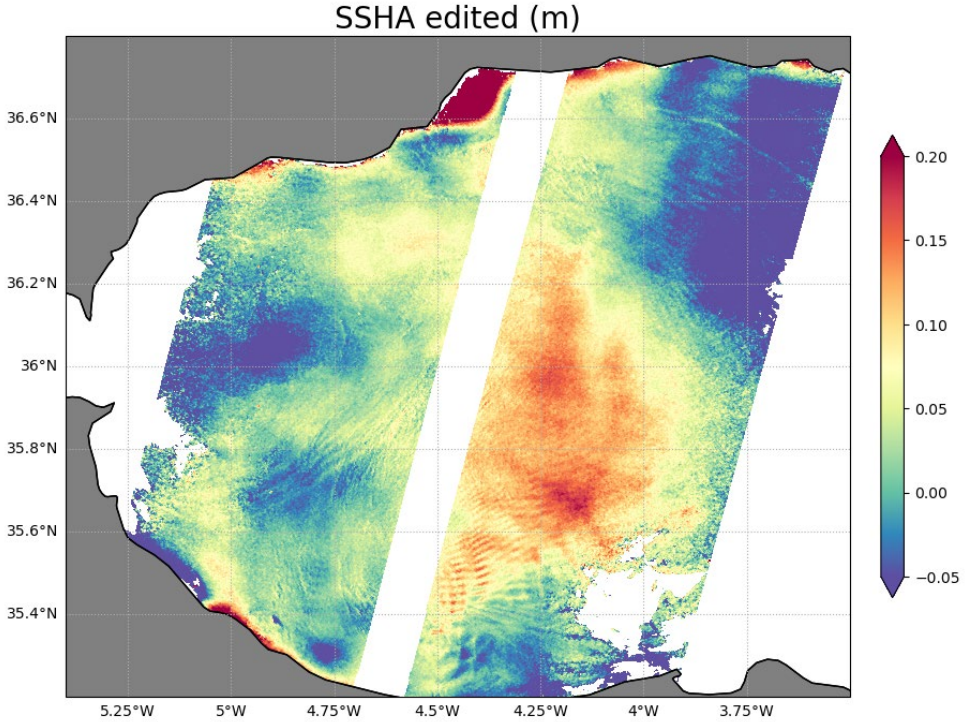
- Denoising/filtering : absorbs noises and very small WL signals (here tides)

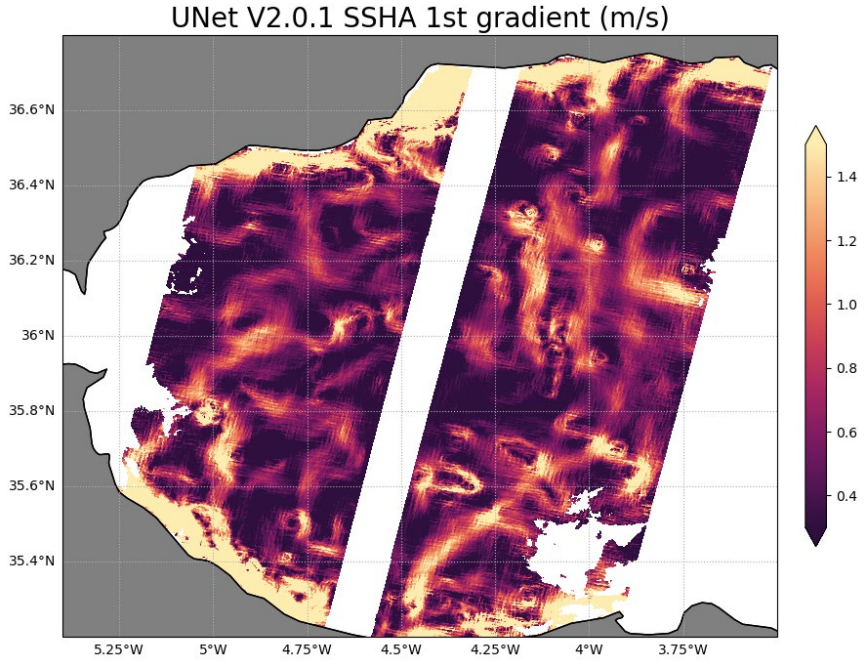


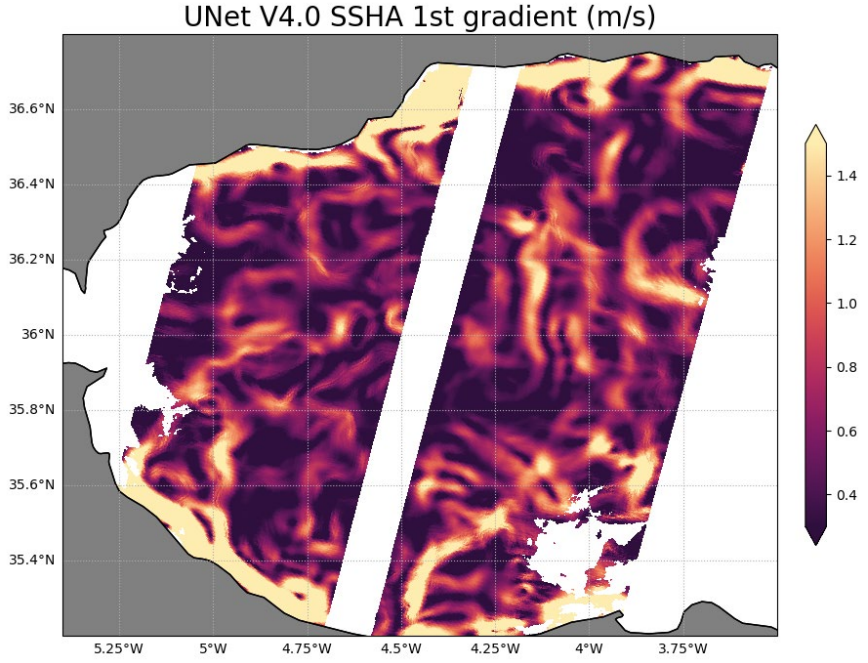




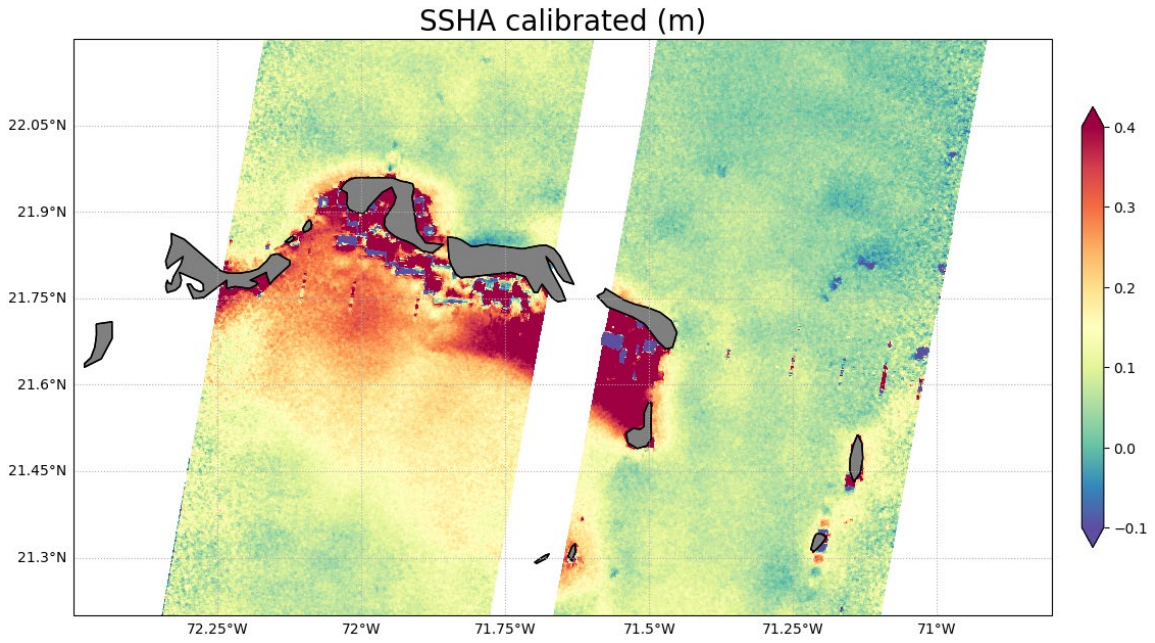
Example LR 250m

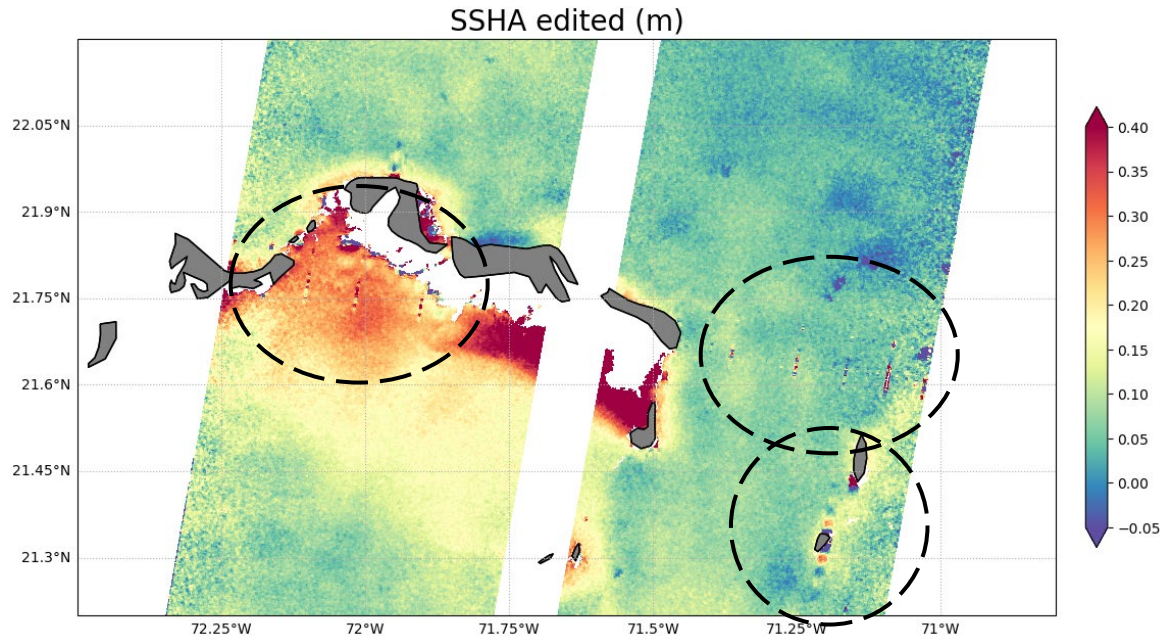






Example LR 250m

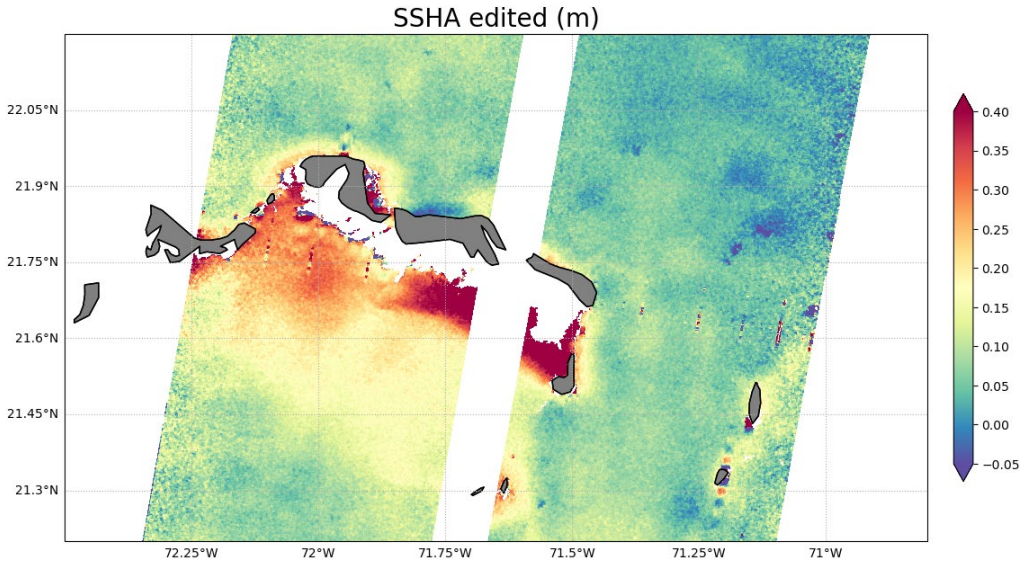


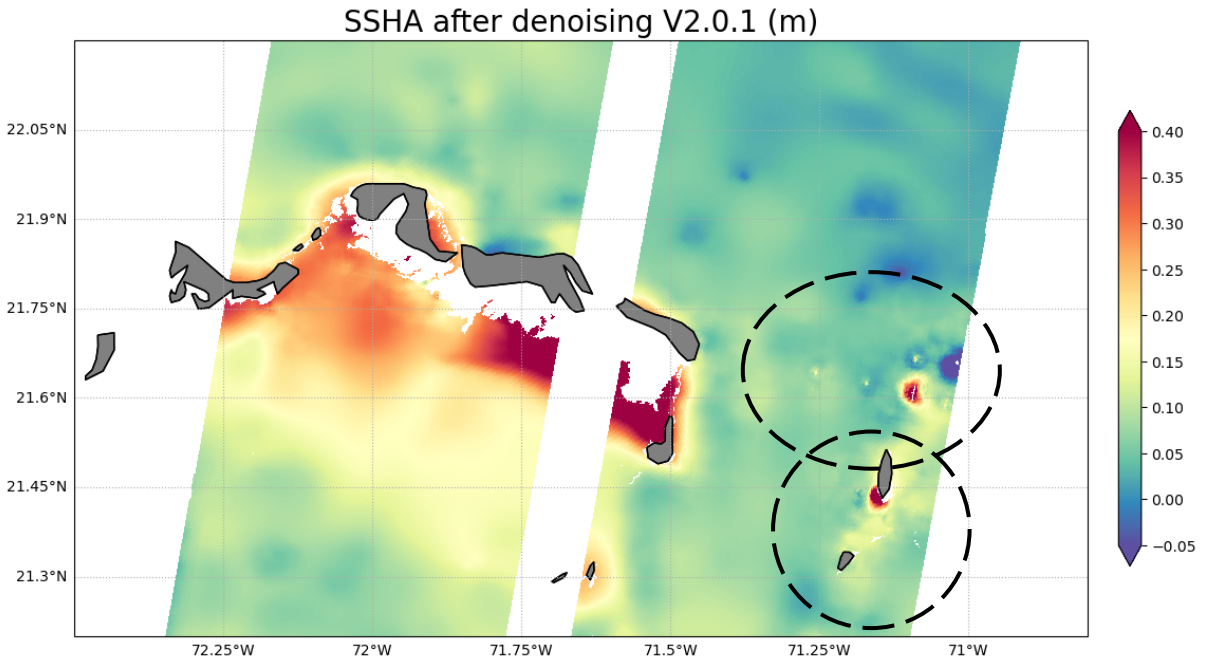


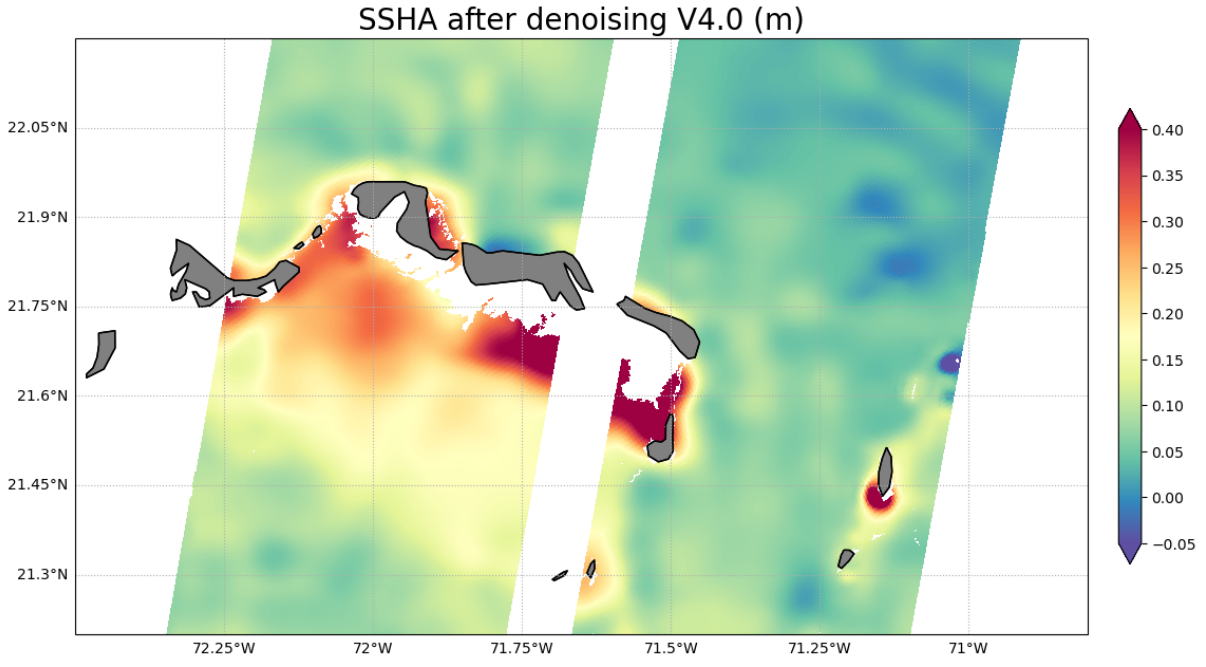
- Some imperfections of the editing (here no detection of specific anomalies + possible over-editing in some cases)

Example LR 250m

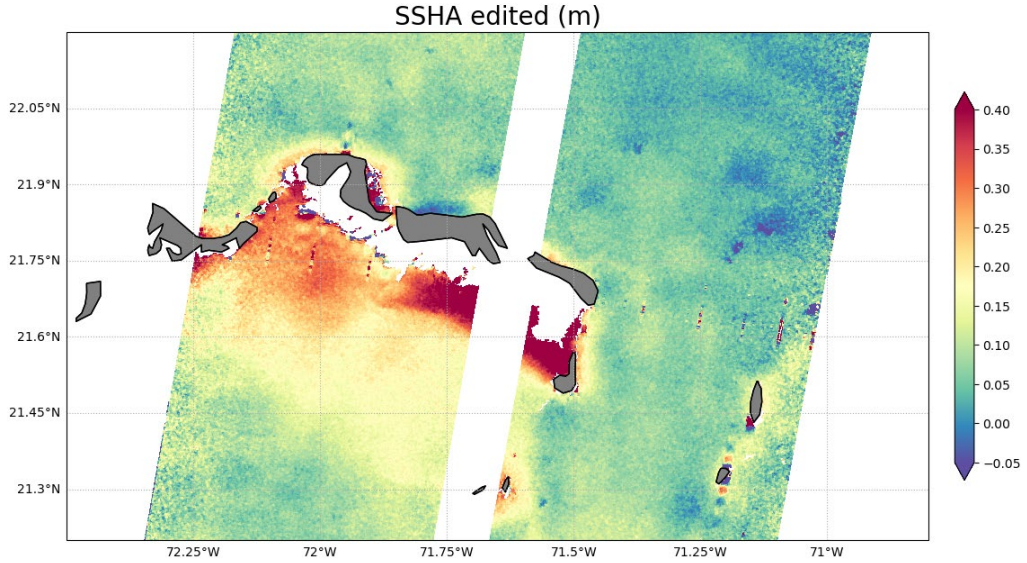
- Some imperfections of the editing attenuated by denoising/filtering processing. Better performances for v4 version (2026)

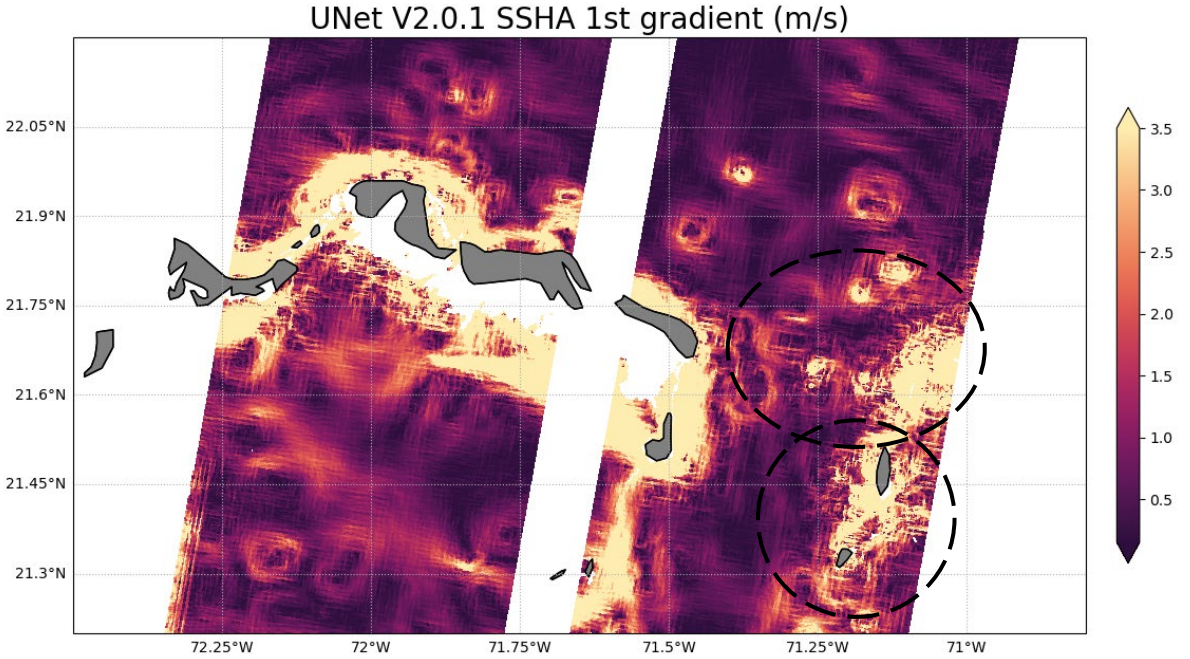


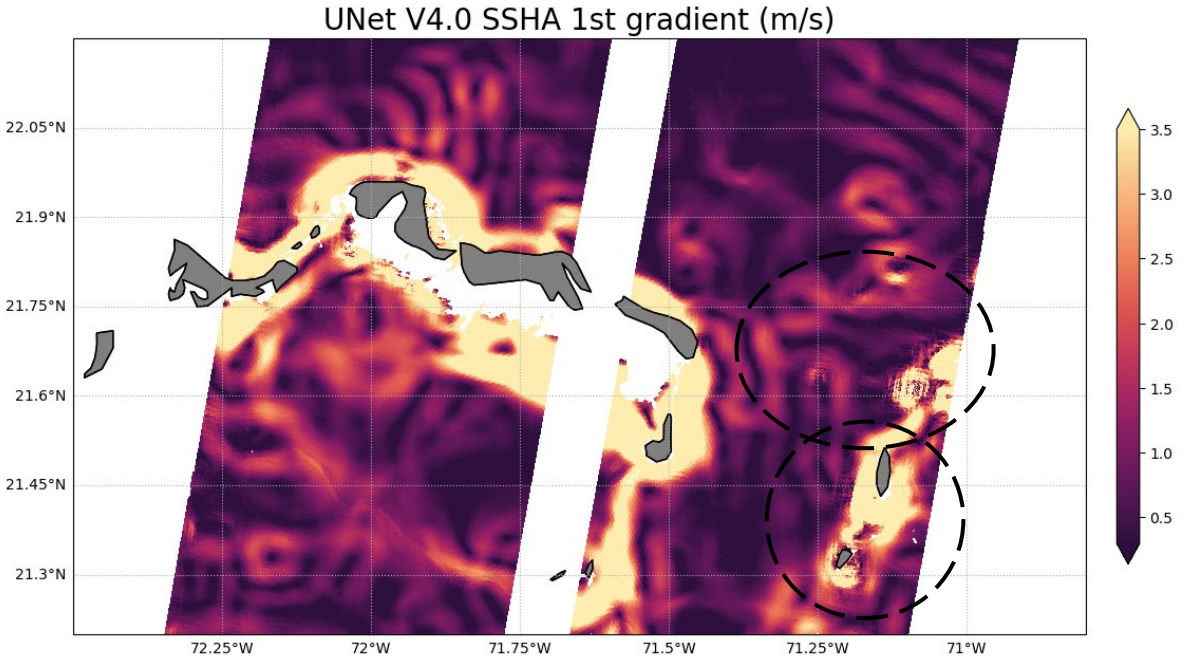




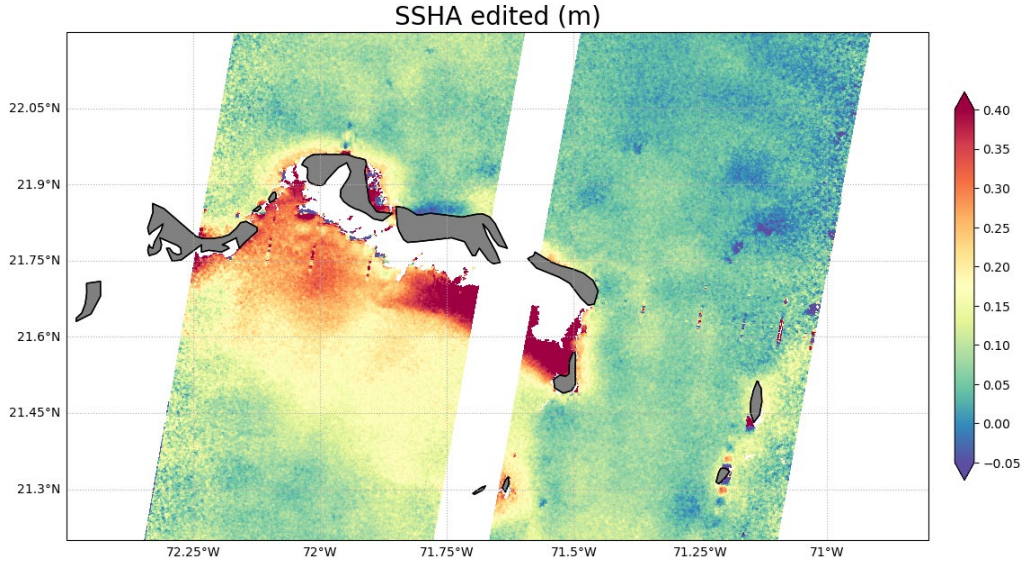
Example LR 250m

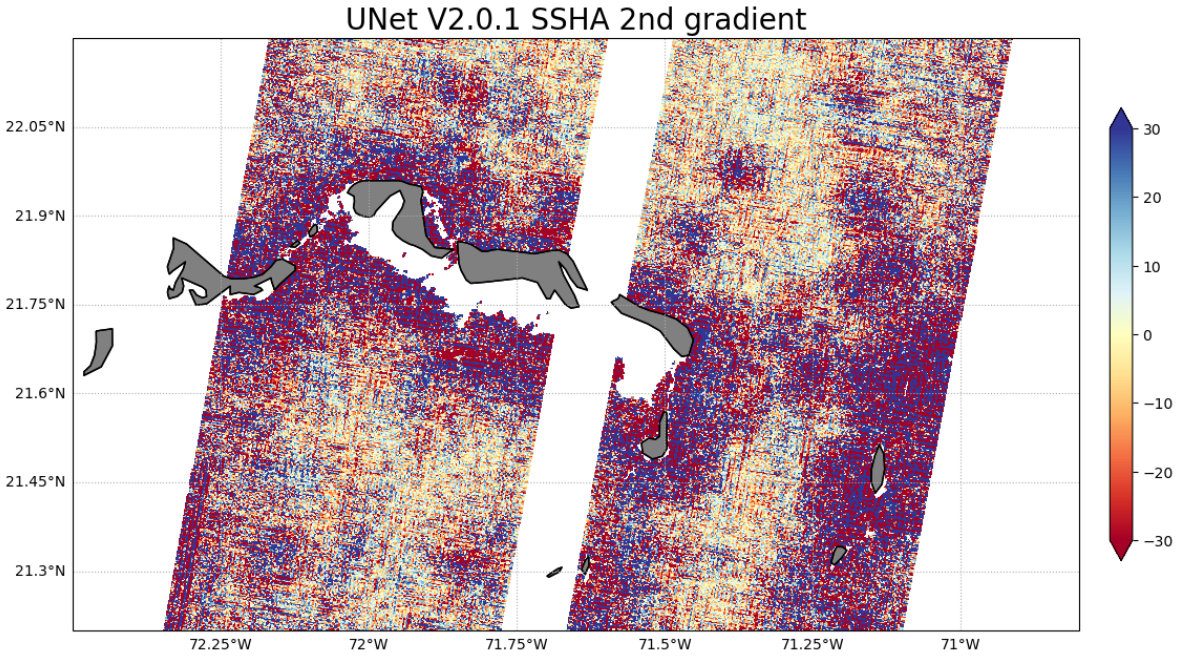


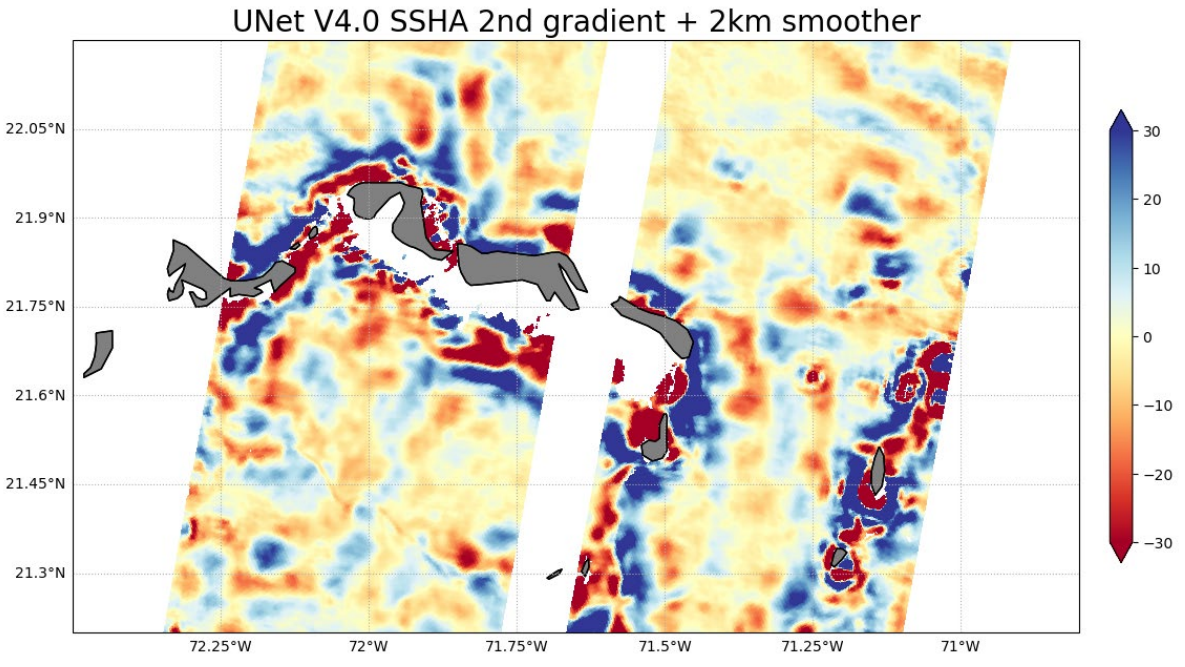




Example LR 250m

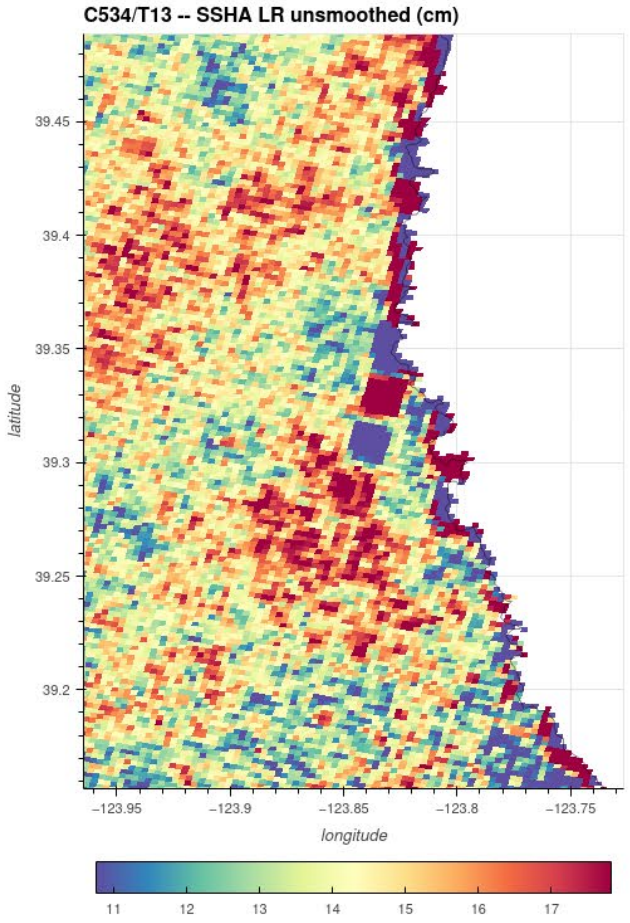




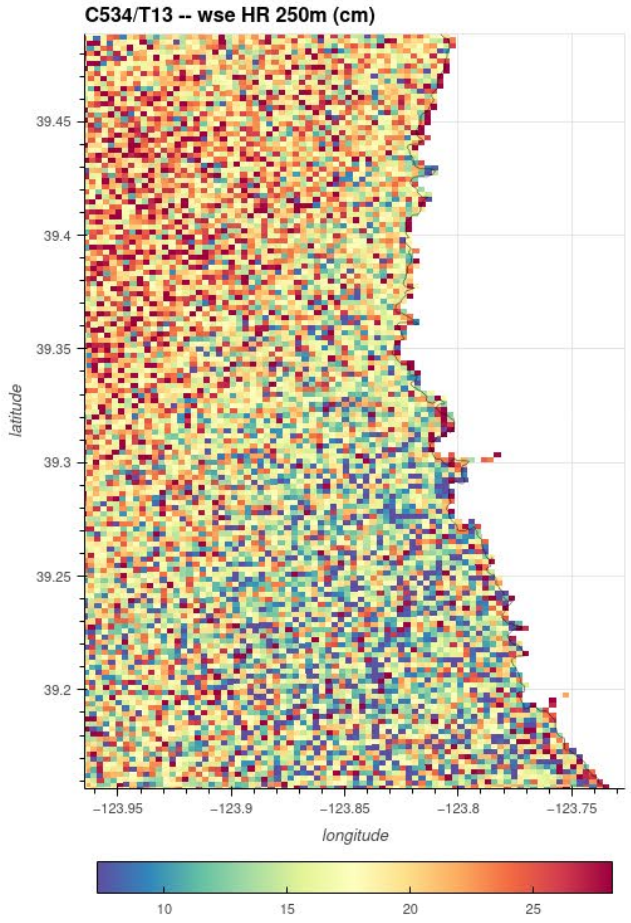


LR 250m / HR / PIXC

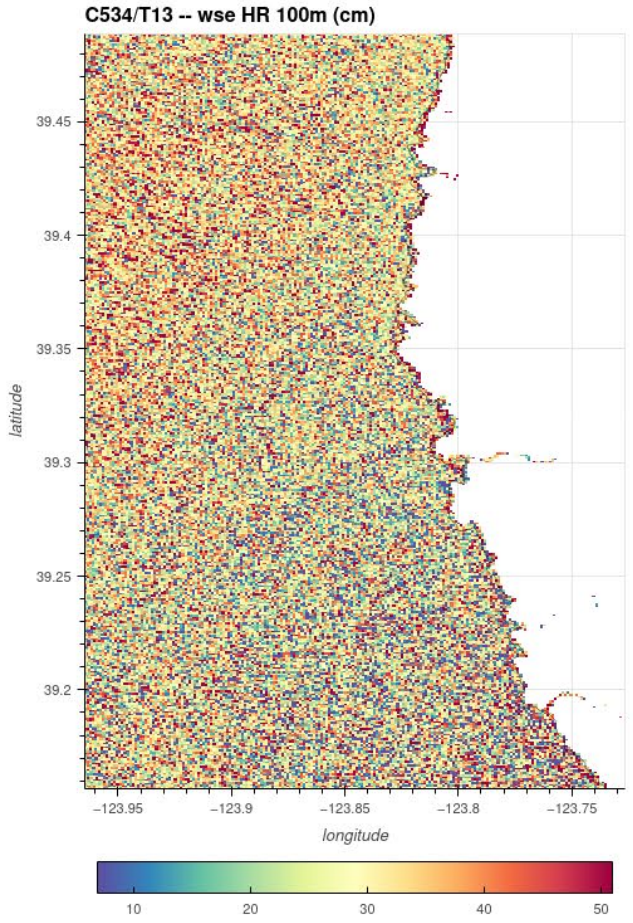
SSHA LR 250m



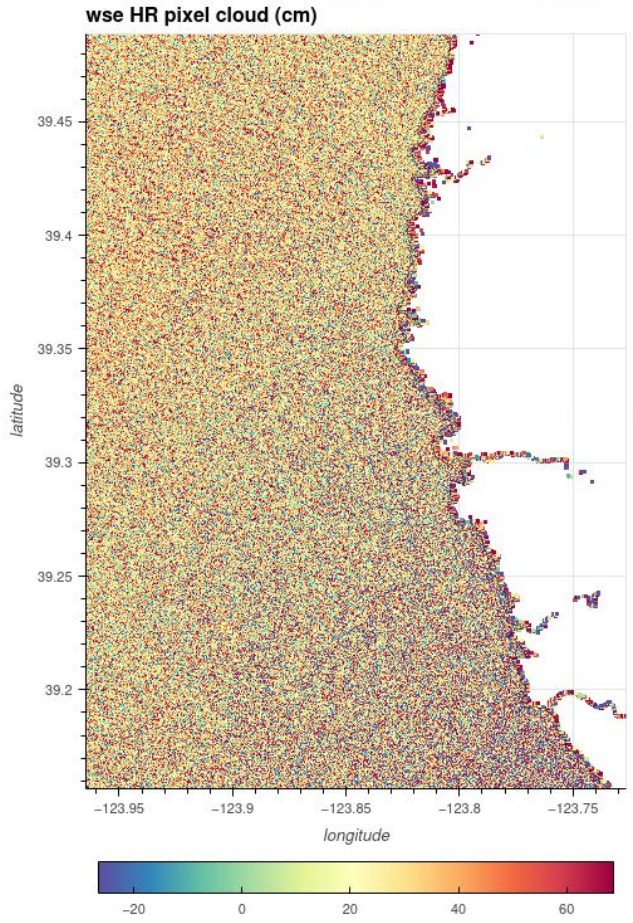
WSE HR 250m



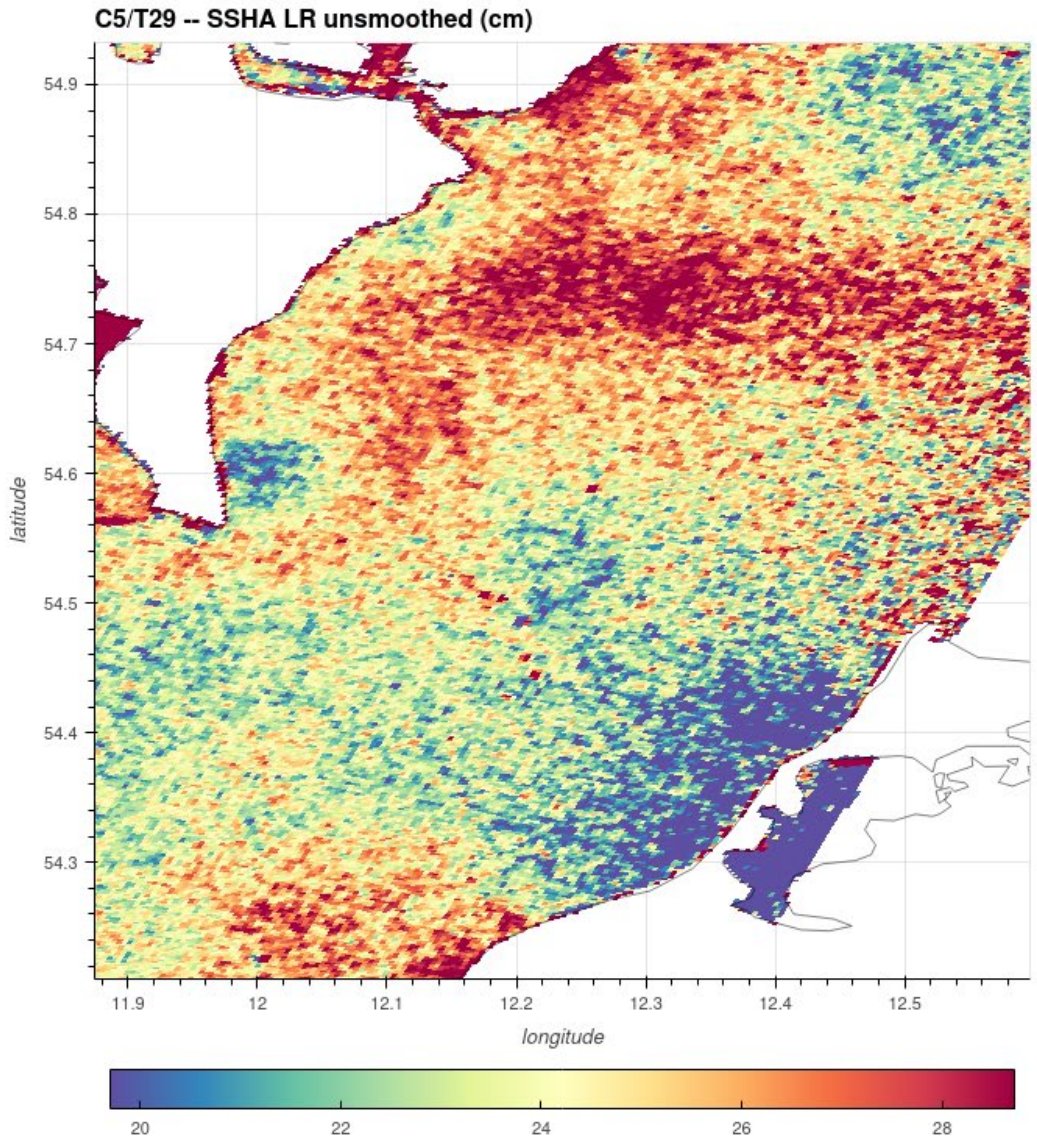
WSE HR 100m

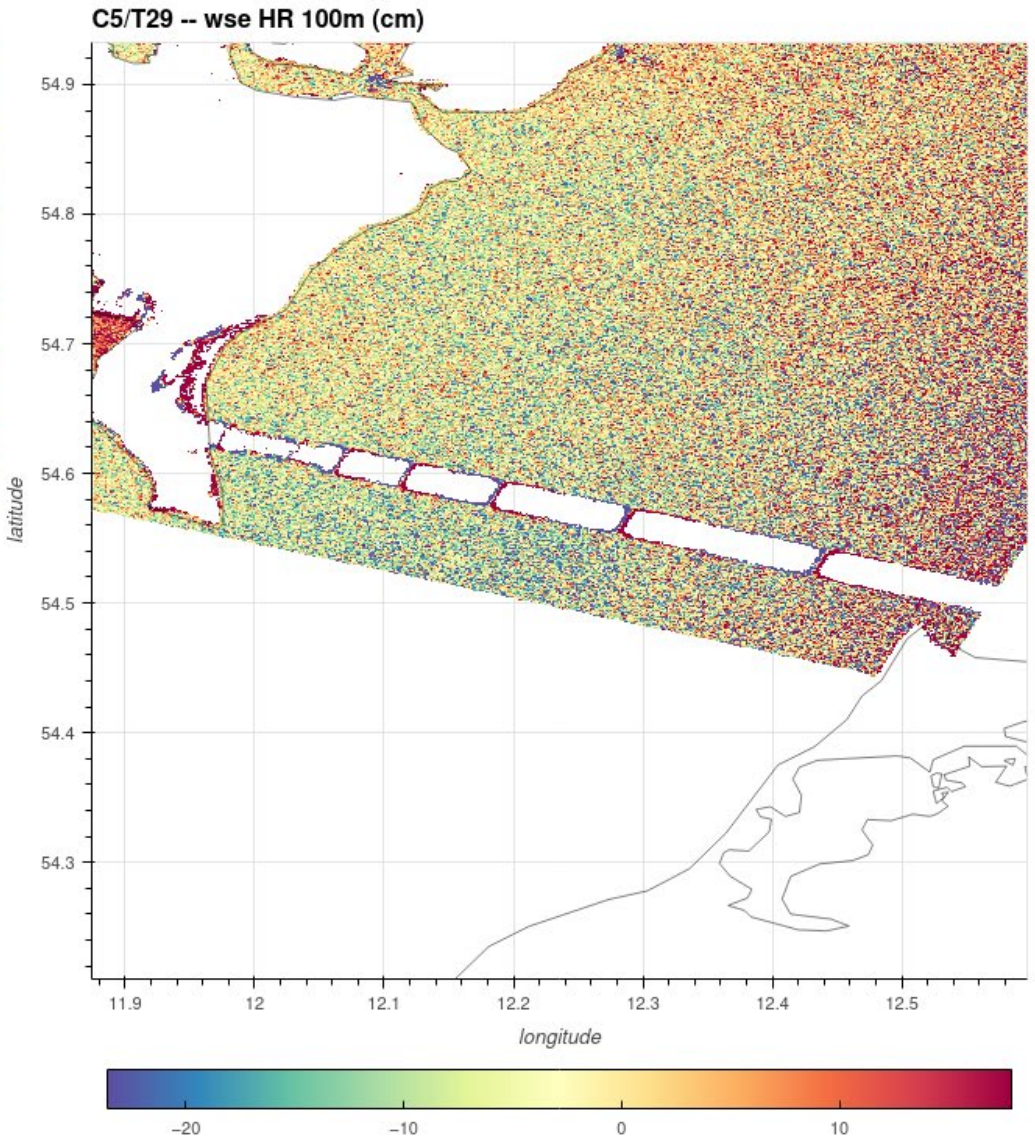


WSE PIXC

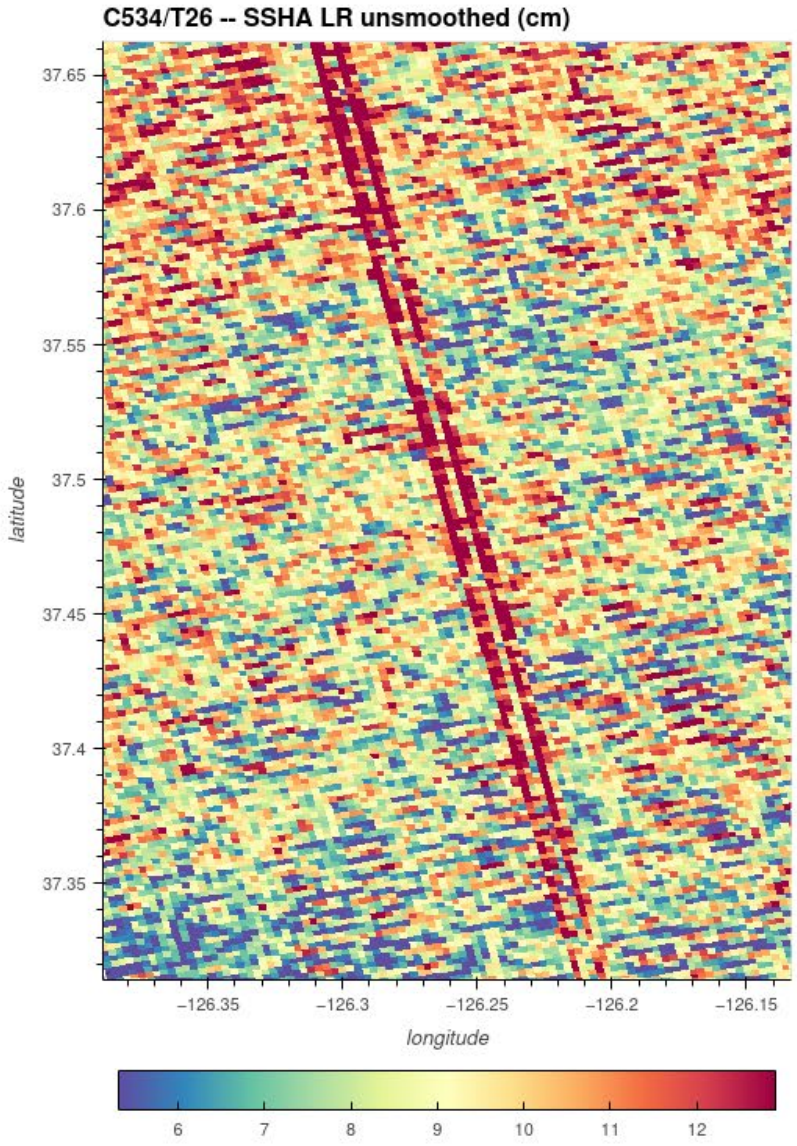


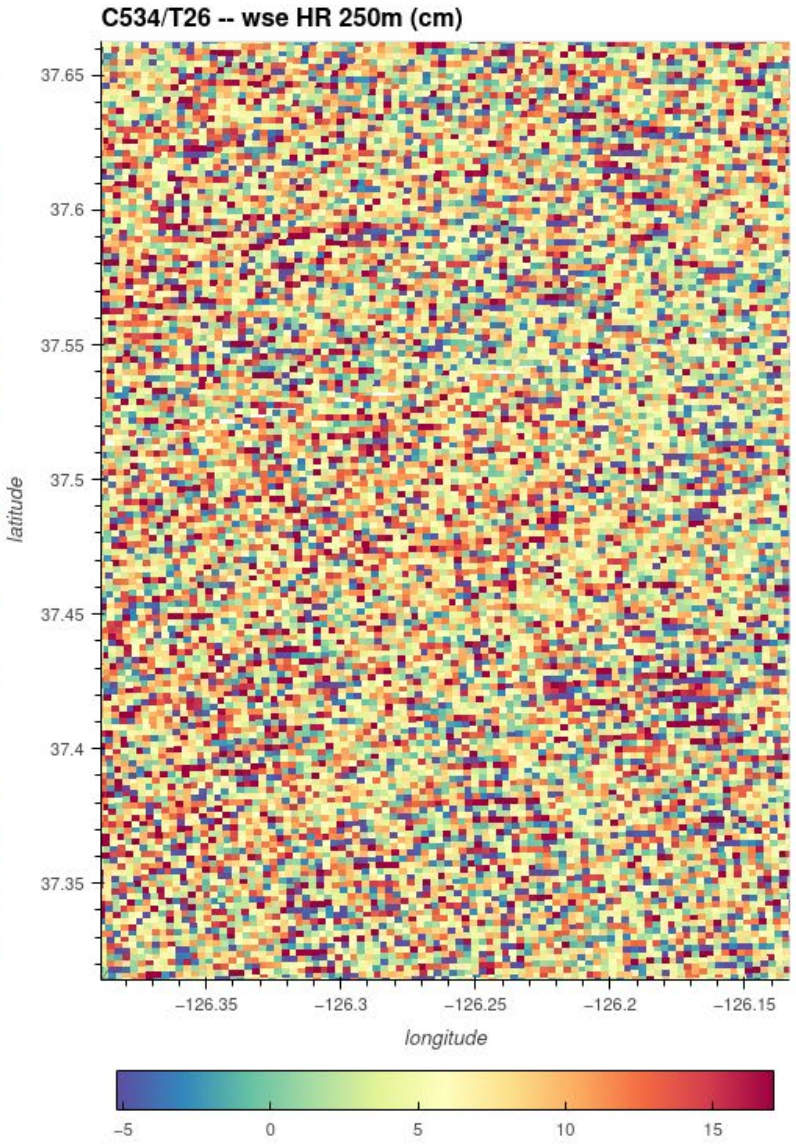
LR 250m / HR

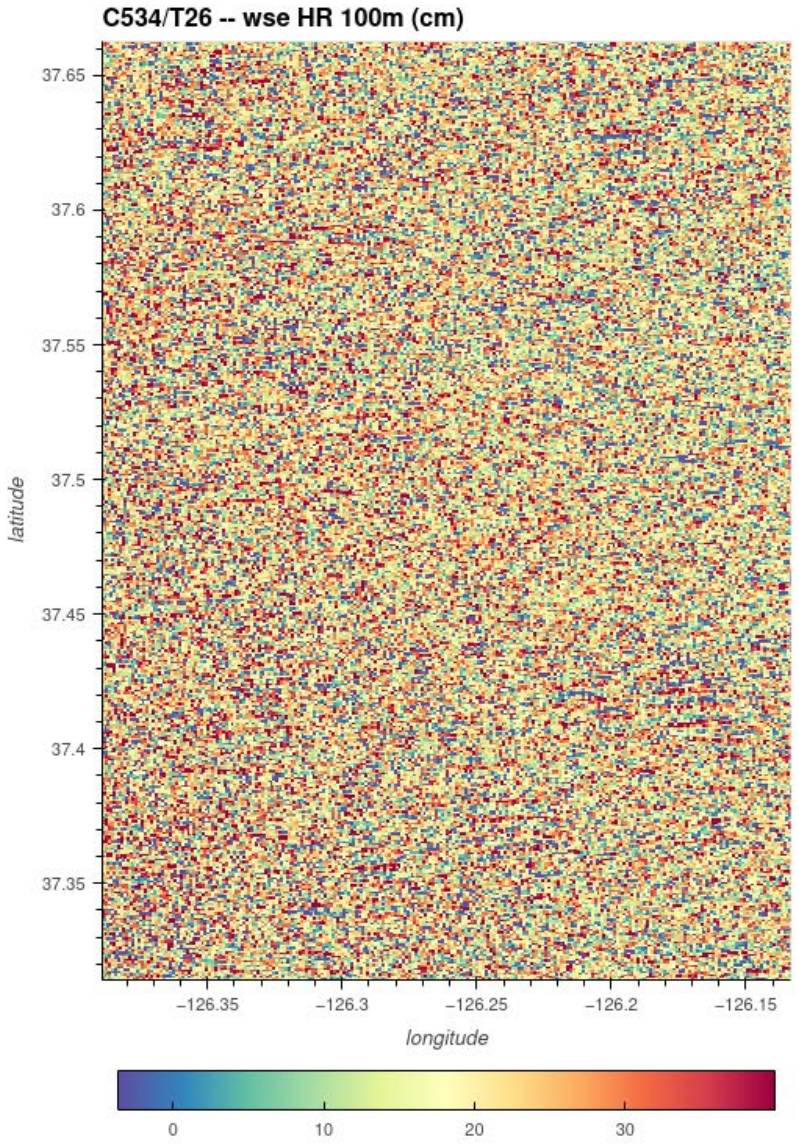

C5/T29 -- SSHA LR unsmoothed (cm)
54.9
54.8
54.7
54.6
54.5
54.4
54.3
latitude
11.9
12
12.1
12.2
12.3
12.4
12.5
longitude
20
22
24
26
28


C5/T29 -- wse HR 100m (cm)
54.9
54.8
54.7
54.6
54.5
54.4
54.3
latitude
11.9
12
12.1
12.2
12.3
12.4
12.5
longitude
−20
−10
0
10

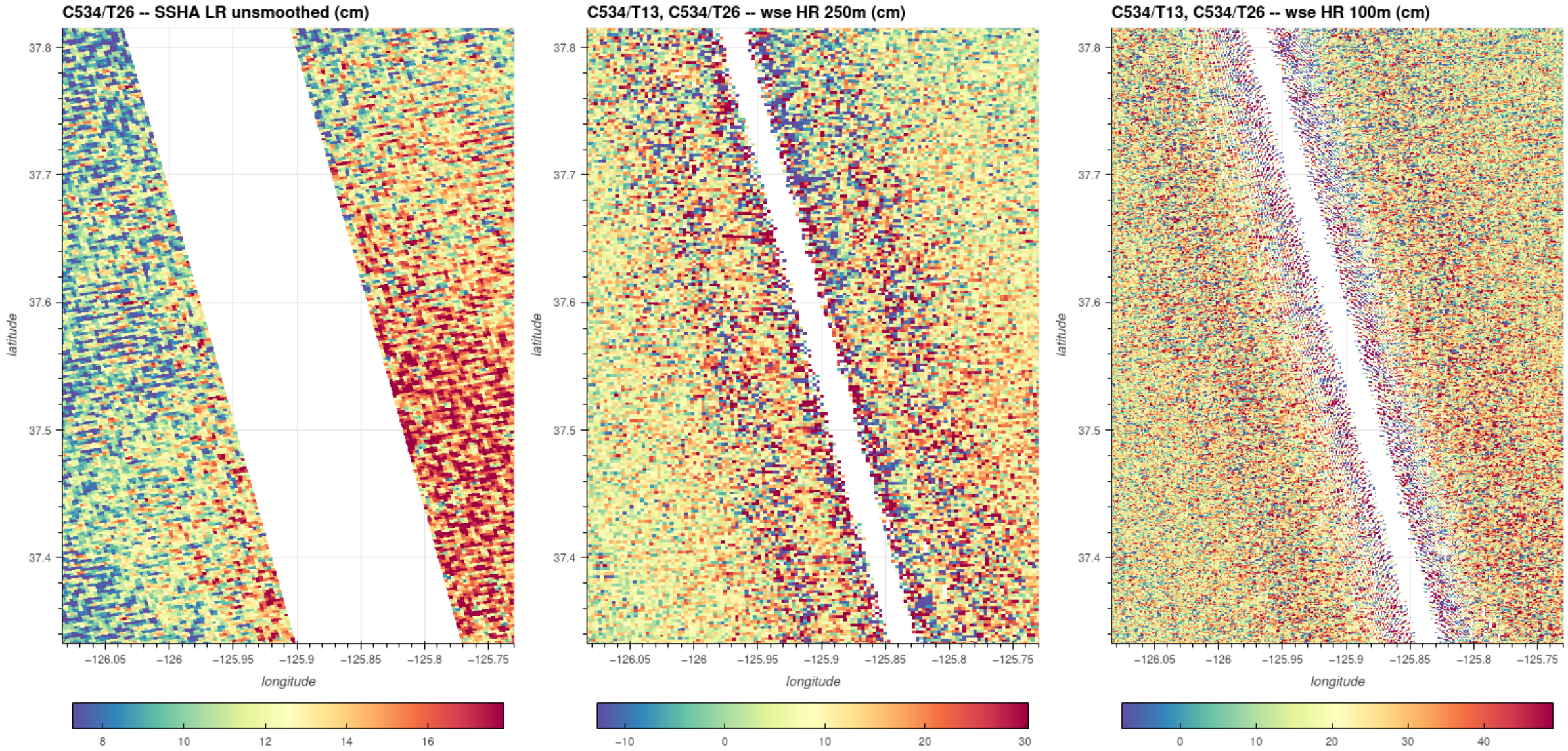
LR 250m / HR


C534/T26 -- SSHA LR unsmoothed (cm)
37.65
37.6
37.55
37.5
37.45
37.4
37.35
latitude
−126.35
−126.3
−126.25
−126.2
−126.15
longitude
6
7
8
9
10
11
12


C534/T26 -- wse HR 250m (cm)
37.65
37.6
37.55
37.5
37.45
37.4
37.35
latitude
−126.35
−126.3
−126.25
−126.2
−126.15
longitude
−5
0
5
10
15


C534/T26 -- wse HR 100m (cm)
37.65
37.6
37.55
37.5
37.45
37.4
37.35
latitude
−126.35
−126.3
−126.25
−126.2
−126.15
longitude
0
10
20
30

LR 250m / HR


C534/T26 -- SSHA LR unsmoothed (cm)
C534/T13, C534/T26 -- wse HR 250m (cm)
C534/T13, C534/T26 -- wse HR 100m (cm)
latitude
longitude
37.8
37.7
37.6
37.5
37.4
−126.05
−126
−125.95
−125.9
−125.85
−125.8
−125.75
8
10
12
14
16
−10
0
10
20
30
0
10
20
30
40

LR 250m / HR / PIXC