

SWOT Science Team Meeting, 2025
Arcachon, France

SWOT-based intertidal topography retrieval using mission-only data: validation and potential applications

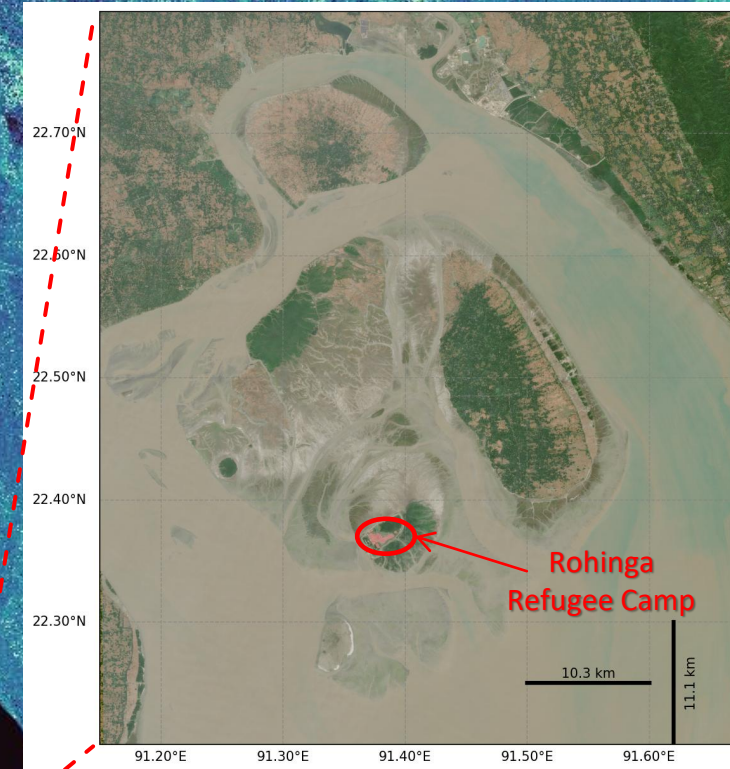
Nushrat Yeasmin, Laurent Testut, Valérie Ballu
La Rochelle Université, LIENSs
14th October, 2025

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Coastal Region of Northern Bay of Bengal in Bangladesh

- ❖ Mild sloping low lying delta
- ❖ Cyclone prone region
- ❖ ~32 Million people living in the coastal zone
- ❖ Macrotidal tide regime with ~2m to 5m tide range (Khan et. al, 2020)
- ❖ 500~1,100 Mega-tonnes/year sediment influx (Raff et.al, 2023)
- ❖ Annual maximum monthly discharge of 82,000 m³/sec (Papa et. al, 2012)
- ❖ Highly dynamic intertidal zone of ~1200 km² (Khan et. al, 2019, Murray et. al, 2019)



Sentinel 2 acquired on
2023-12-17

North Eastern Tidal Flats
of Meghna River Estuary

3 times of Arcachon
Bay intertidal zone

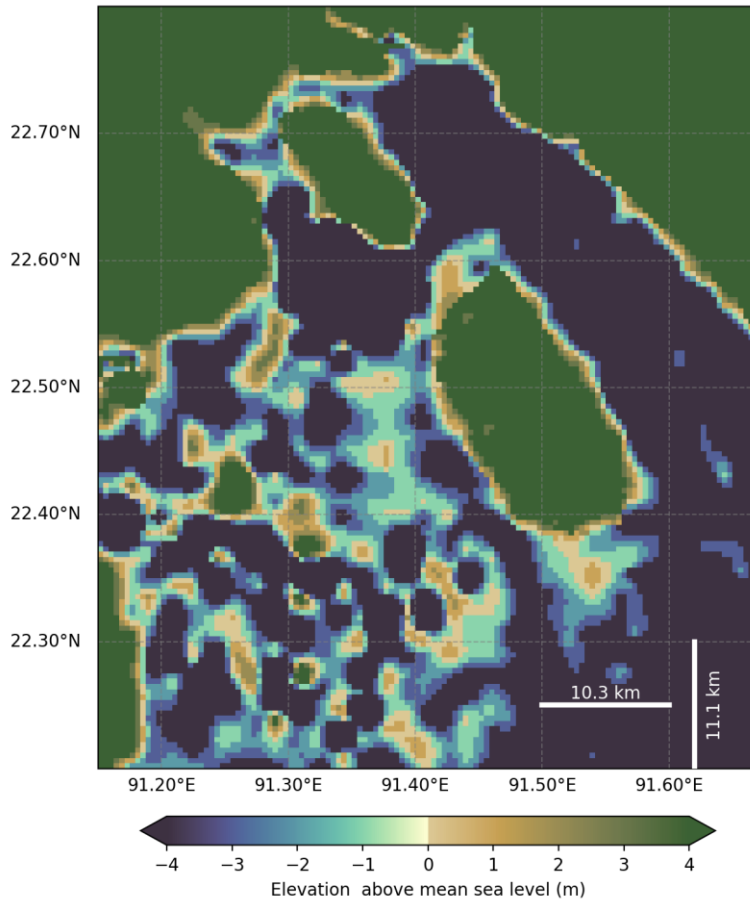


(Image: Salameh et. al, 2020)

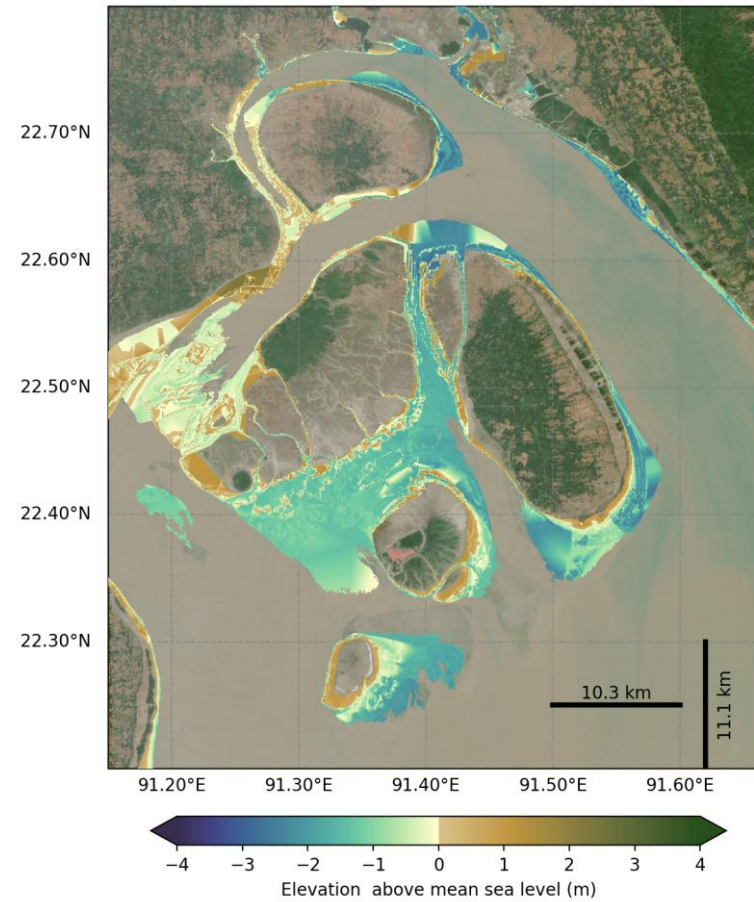


Case Study: Tidal Flats of Meghna Estuary

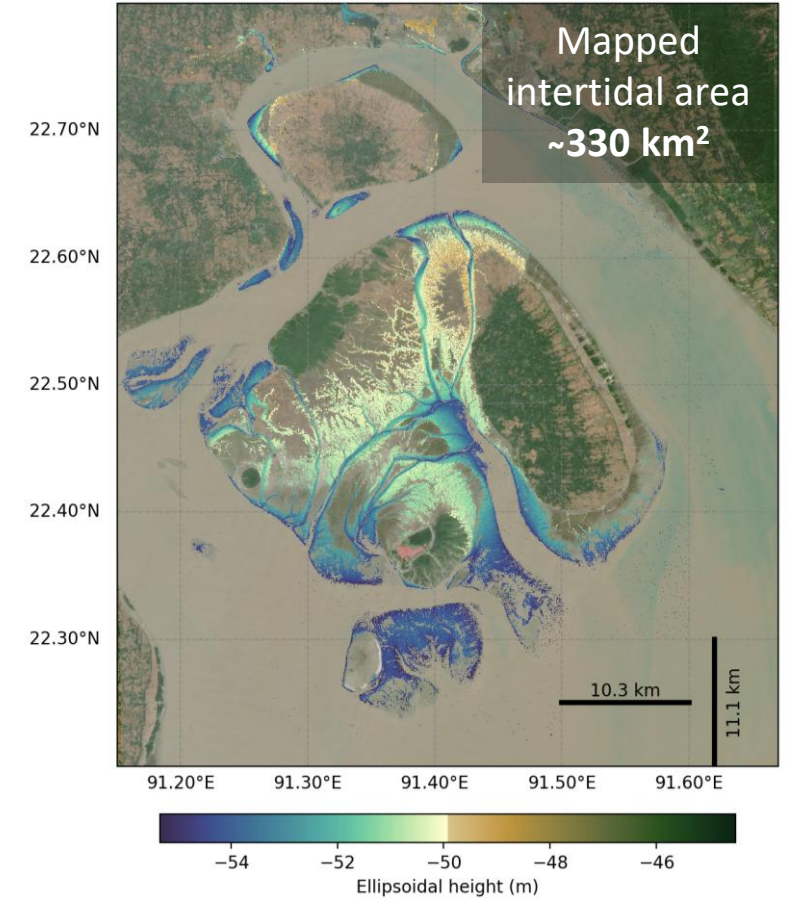
GEBCO 2025



Topography using waterline method
with Sentinel-2 (2017-2019)
(Khan et. al, 2019)



Intertidal topography acquired from
SWOT PIXC on 2023-12-12



SWOT Based Intertidal Topography with HR PIXC Dataset

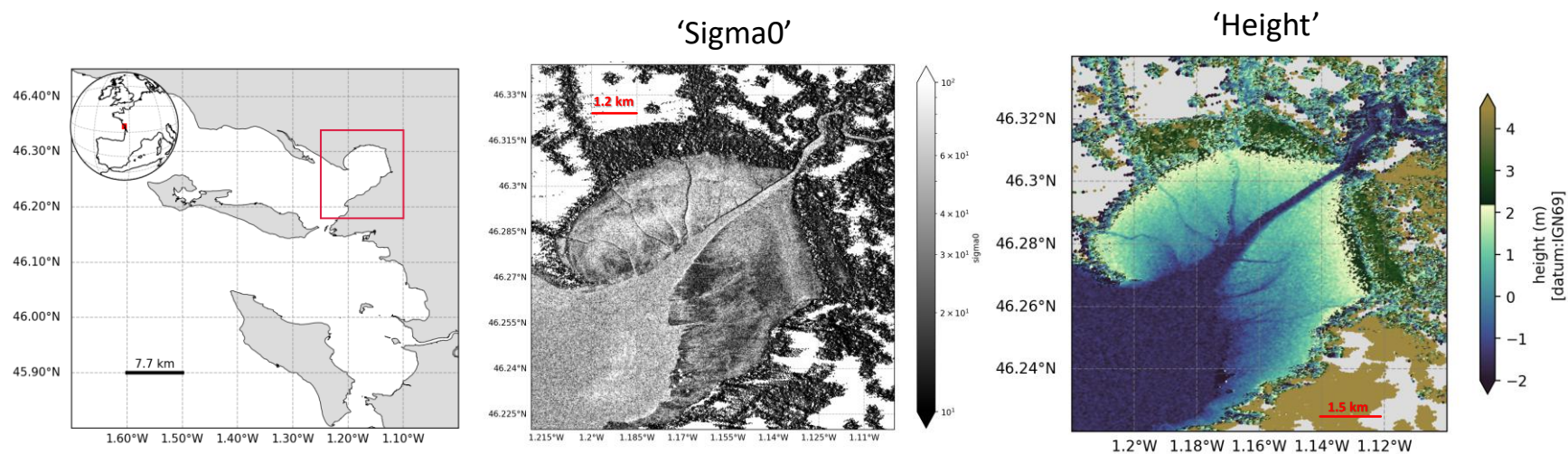
Intertidal Topography using good reflective property of wet surfaces



Validated by Salameh et. al, 2024

- in Bay of Veys, France
- with HR PIXC dataset

Example of HR PIXC data during low tide on Bay of Aiguillon, France

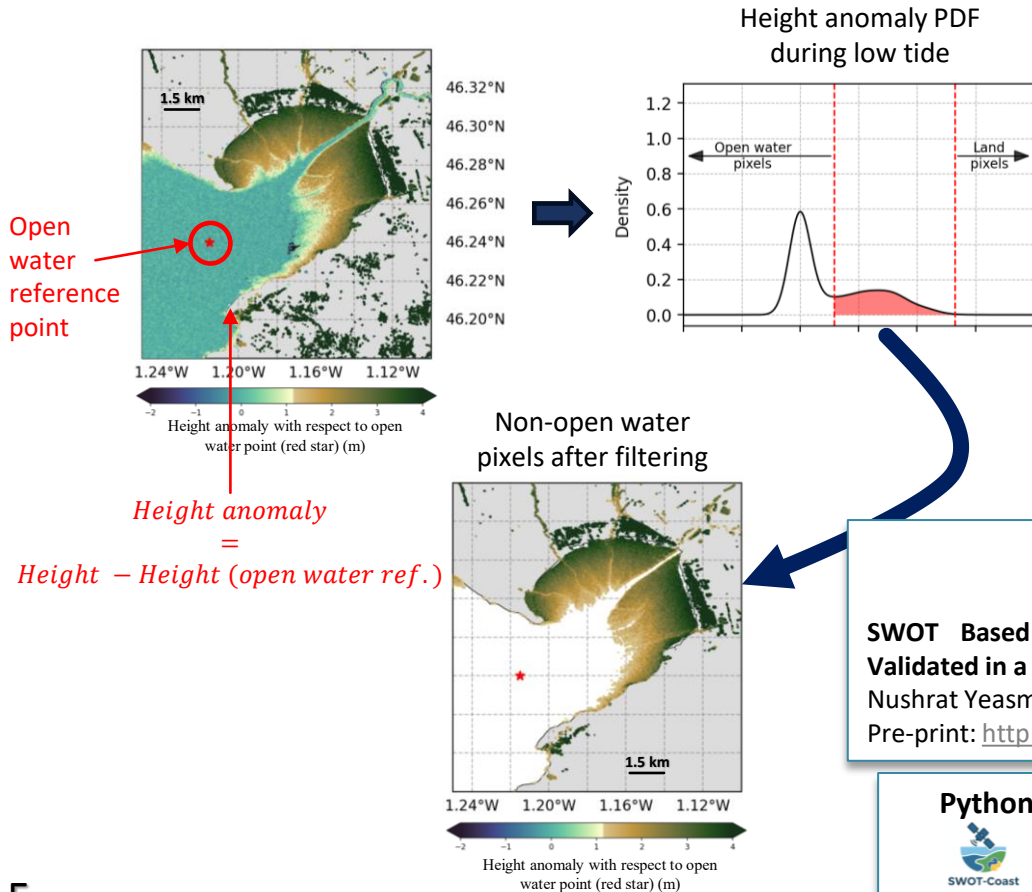


SWOT Based Intertidal Topography with HR PIXC dataset

Filtering Intertidal Pixels from Land and Ocean

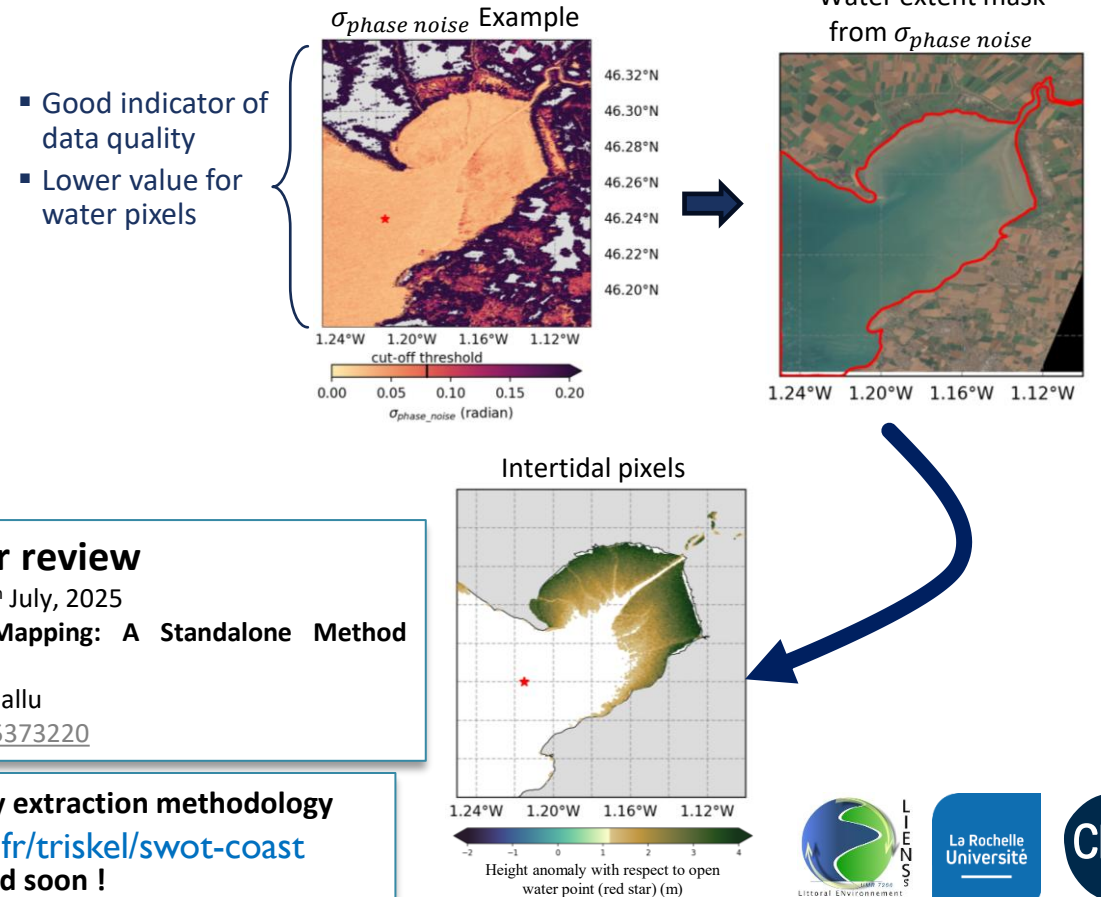
Filtering open water pixels

- Using probability density function (PDF) of height anomaly with respect to a reference open water point.



Filtering land pixels

- Using standard deviation of phase noise of the interferometric coherence, $\sigma_{phase\ noise}$, given as 'phase_noise_std' variable.



Article under review

Submitted on 30th July, 2025

SWOT Based Intertidal Topography Mapping: A Standalone Method Validated in a Complex Coastal Region

Nushrat Yeasmin, Laurent Testut, Valérie Ballu

Pre-print: <http://dx.doi.org/10.2139/ssrn.5373220>

Python Toolbox for topography extraction methodology



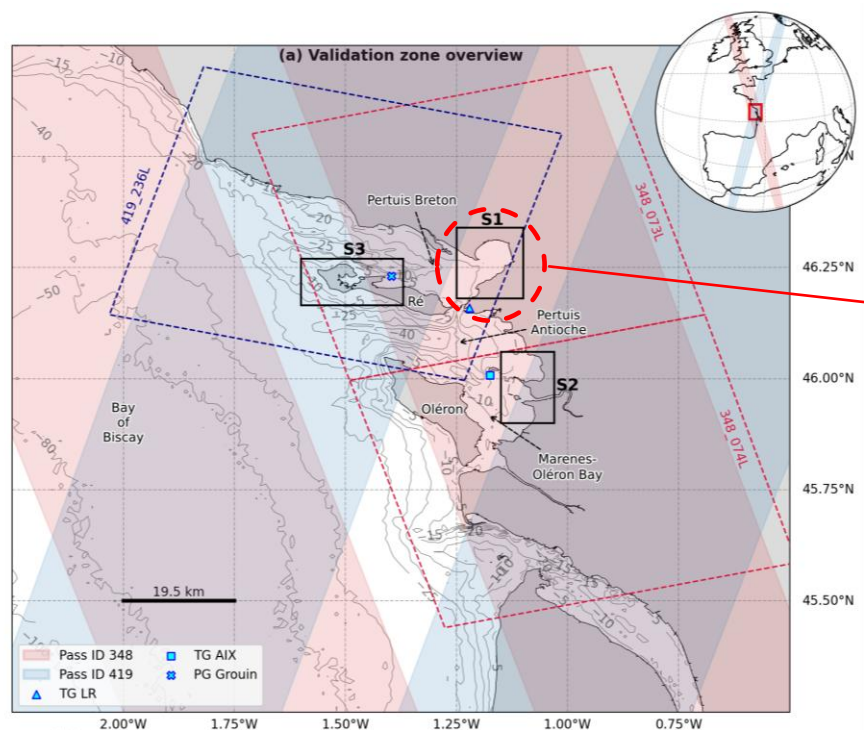
<https://gitlab.univ-lr.fr/triskel/swot-coast>

Will be opened soon !

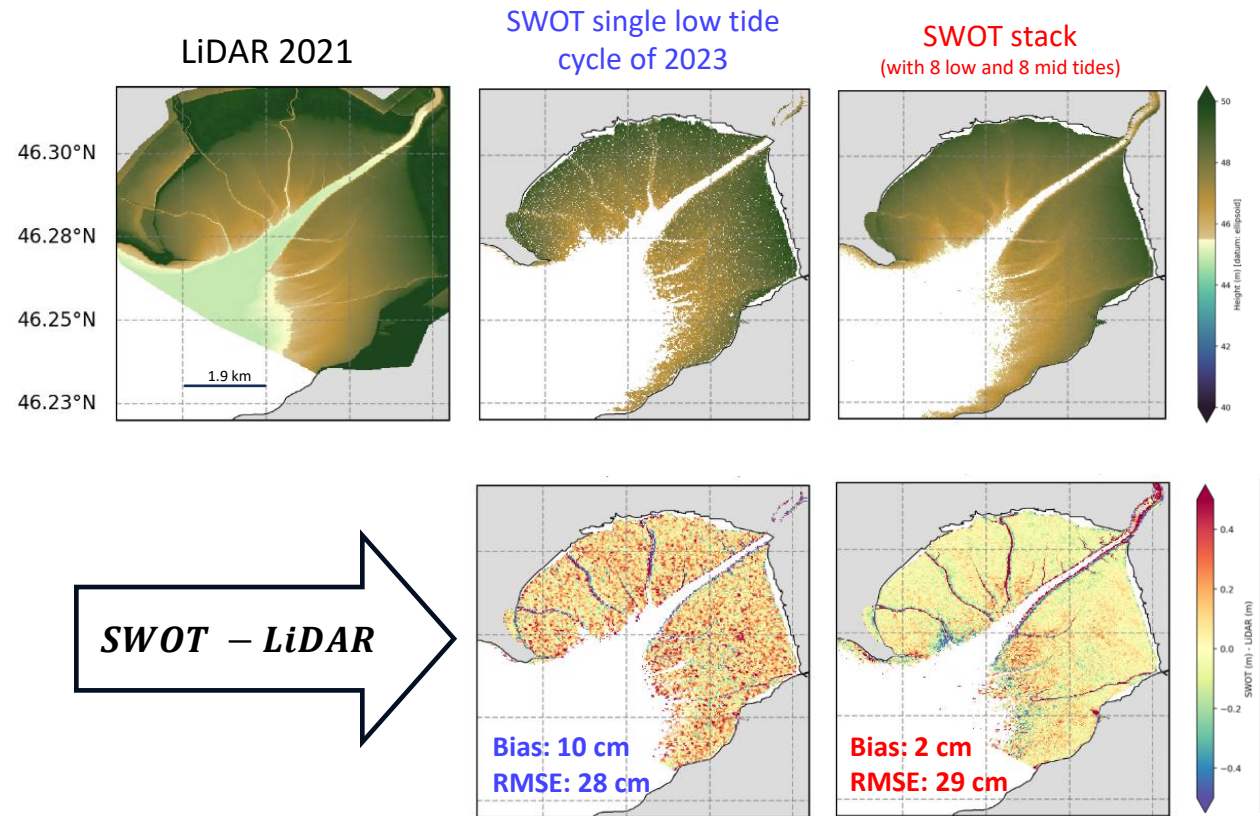


SWOT Based Intertidal Topography with HR PIXC Dataset

Validation in different geomorphological setting



Coastal region of Pertuis Charentais (Bay of Biscay, France) with macro-tidal tide regime (1.5 m to 5.5 m tide range)



Article under review

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Nushrat Yeasmin, Laurent Testut, Valérie Ballu

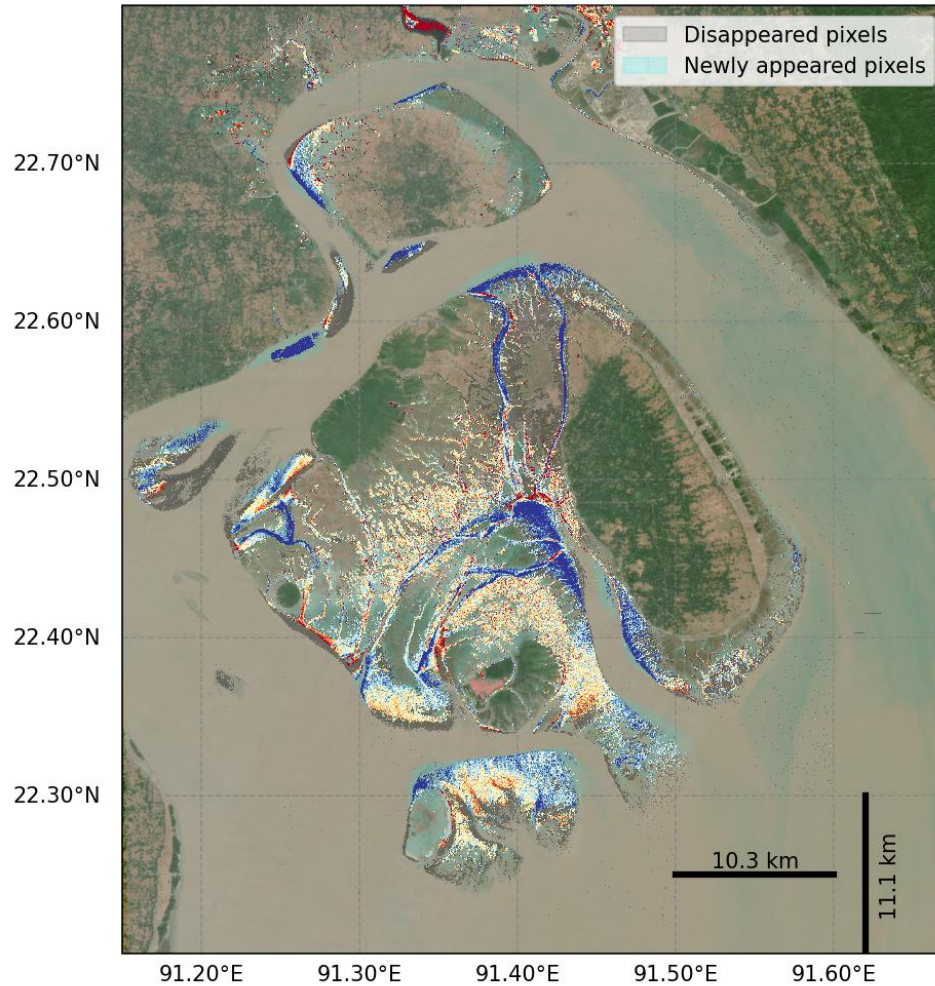
Pre-print: <http://dx.doi.org/10.2139/ssrn.5373220>

- Noise level is higher in single cycle topography
- Stacking reduce noise and bias
- SWOT performs well in any type (mud, sand, rock) of wet surfaces with topography slope below 1°

Application of SWOT Based Intertidal Topography

Tracking morphological change

Dry season 2025 – 2024

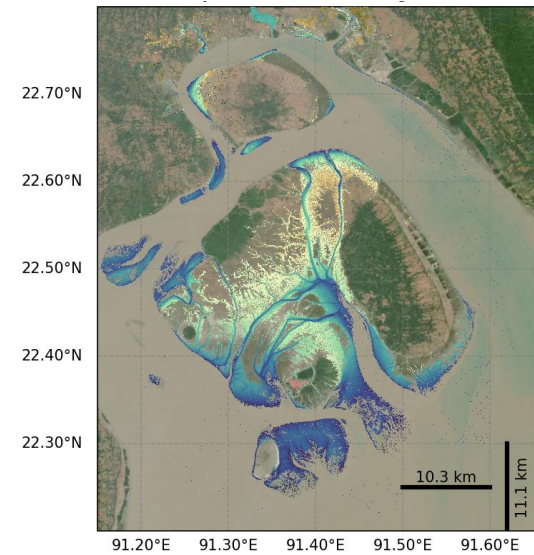


Stack 1

(Dry season, 2024)

Two low tide cycles:

- Cycle 7 (2023-12-12)
- Cycle 10 (2024-02-13)

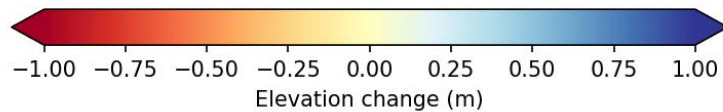
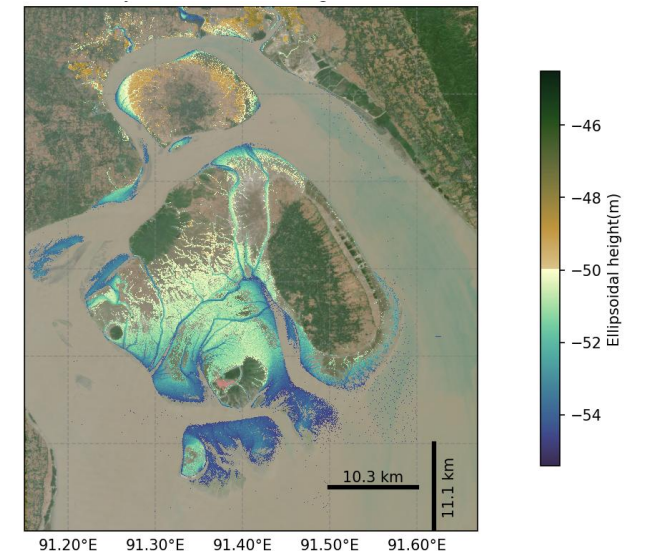


Stack 2

(Dry season, 2025)

Two low tide cycles:

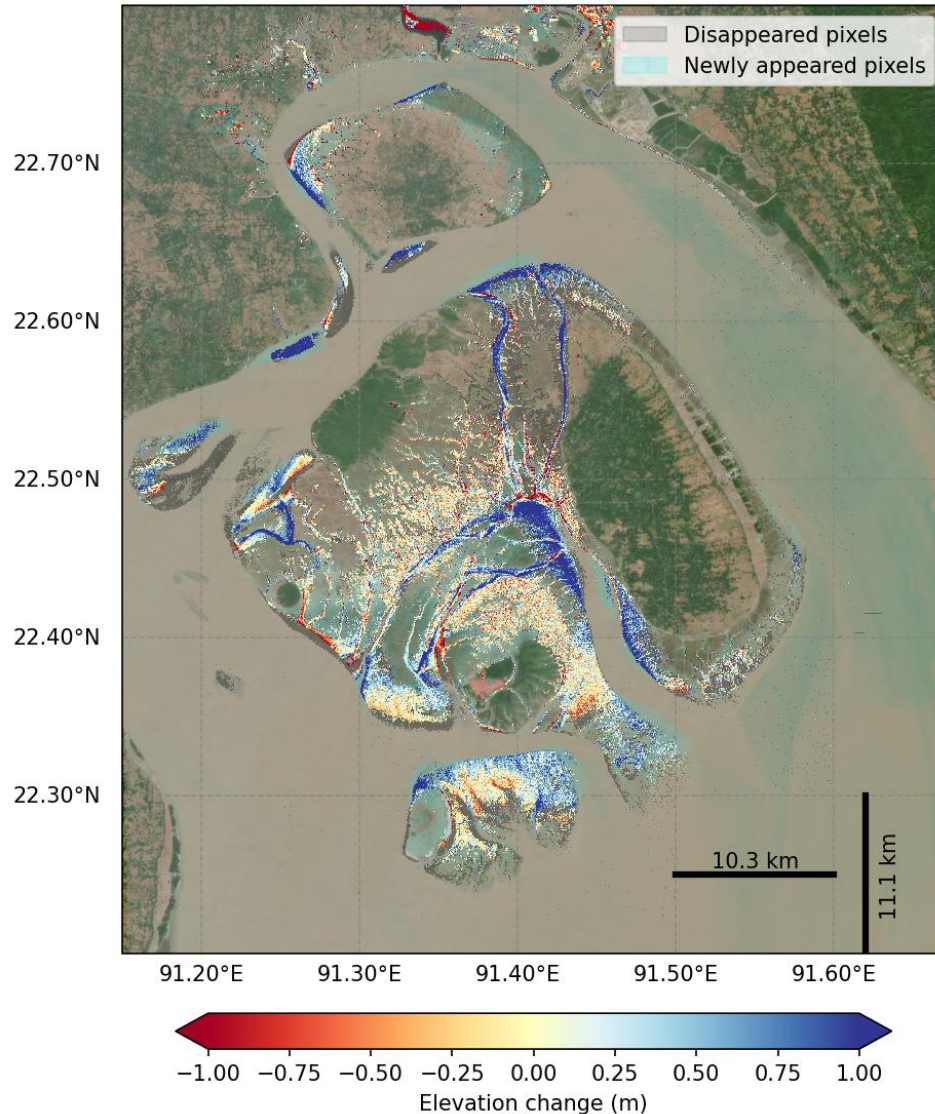
- Cycle 29 (2025-03-15)
- Cycle 32 (2025-05-17)



Application of SWOT Based Intertidal Topography

Tracking morphological change

Dry season 2025 – 2024



Stack 1

(Dry season, 2024)

Two low tide cycles:

- Cycle 7 (2023-12-12)
- Cycle 10 (2024-02-13)

Stack 2

(Dry season, 2025)

Two low tide cycles:

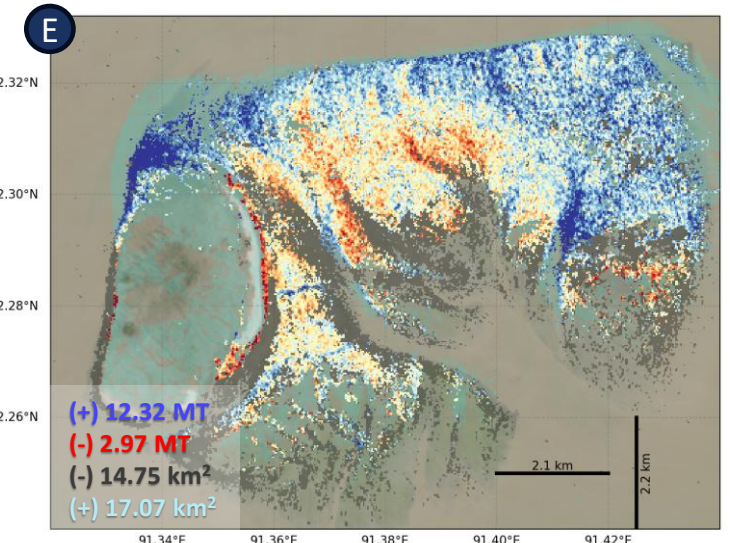
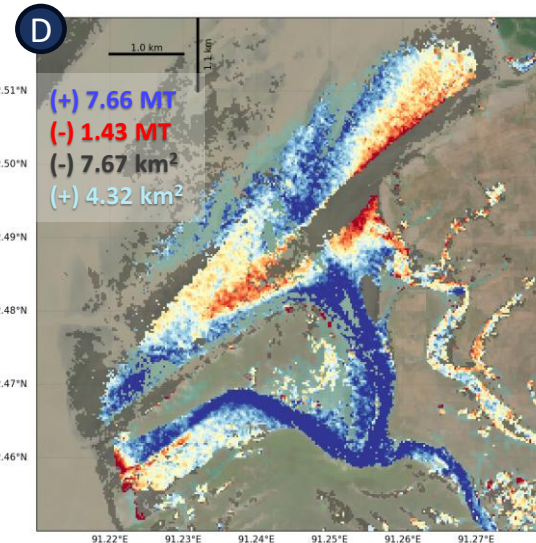
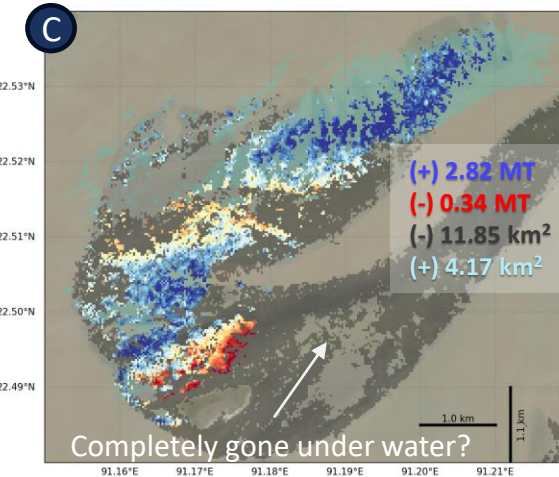
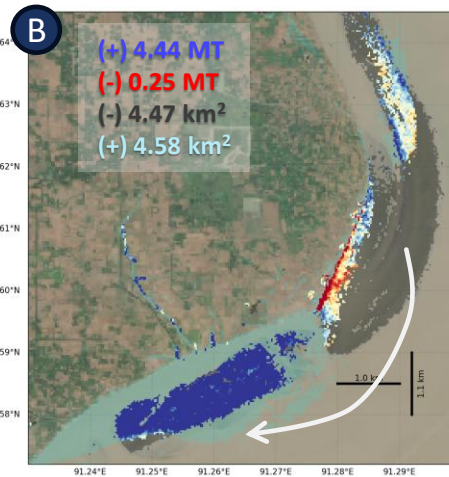
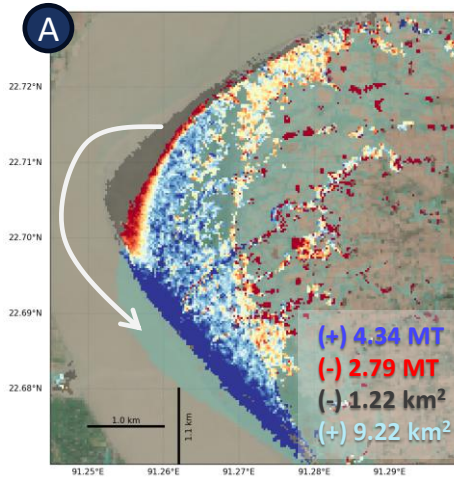
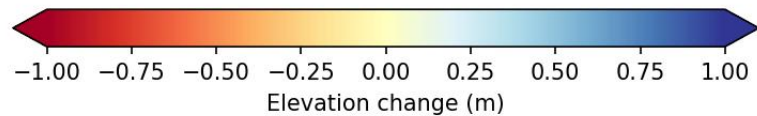
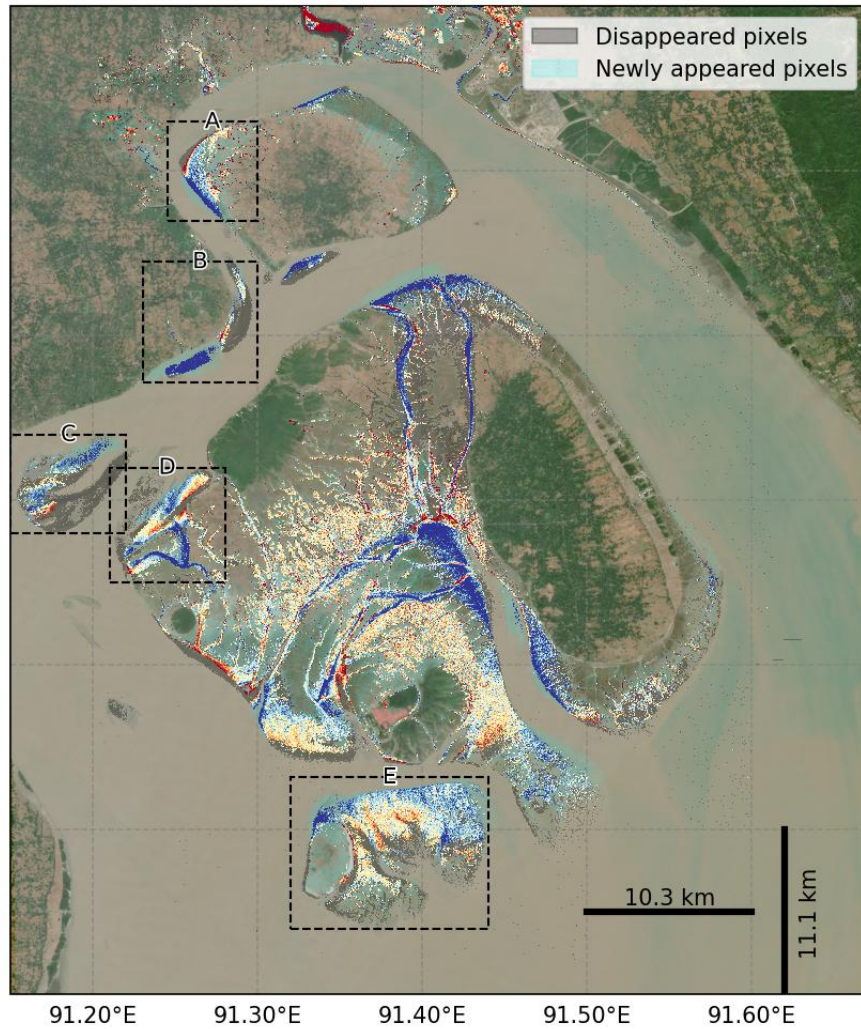
- Cycle 29 (2025-03-15)
- Cycle 32 (2025-05-17)

68 Mega-tonnes of net volume change with:

- Accretion : (+) 119 Mega-tonnes
- Erosion: (-) 51 Mega-tonnes

Application of SWOT Based Intertidal Topography

Tracking morphological change



Article in preparation

Conclusion and Perspective

SWOT HR PIXC dataset based intertidal topography:

- ❖ Good agreement with LiDAR with RMES < 30 cm
- ❖ Consistent performance for any bottom type with slopes < 1°
- ❖ Higher noise levels in single cycle topography while stacking can reduce the noise

Possible application:

- ❖ Updated intertidal bathymetry for model development
- ❖ Tracking morphological changes in highly dynamic zones, specially large deltas

Recommendation

Inclusion of intertidal pixel class in the PIXC product

In coastal region, the usefulness of HR PIXC dataset is immense!

Global coastal coverage of this dataset would be very helpful!



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Thank You

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Image: Band B11 of Sentinel 2
images from 2020 - 2025

