Benefits of Icesat-2 for DUACS Multimission coastal Sea level products *(and swot Calval)*
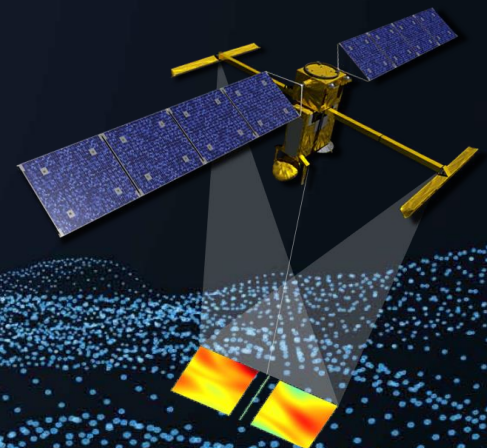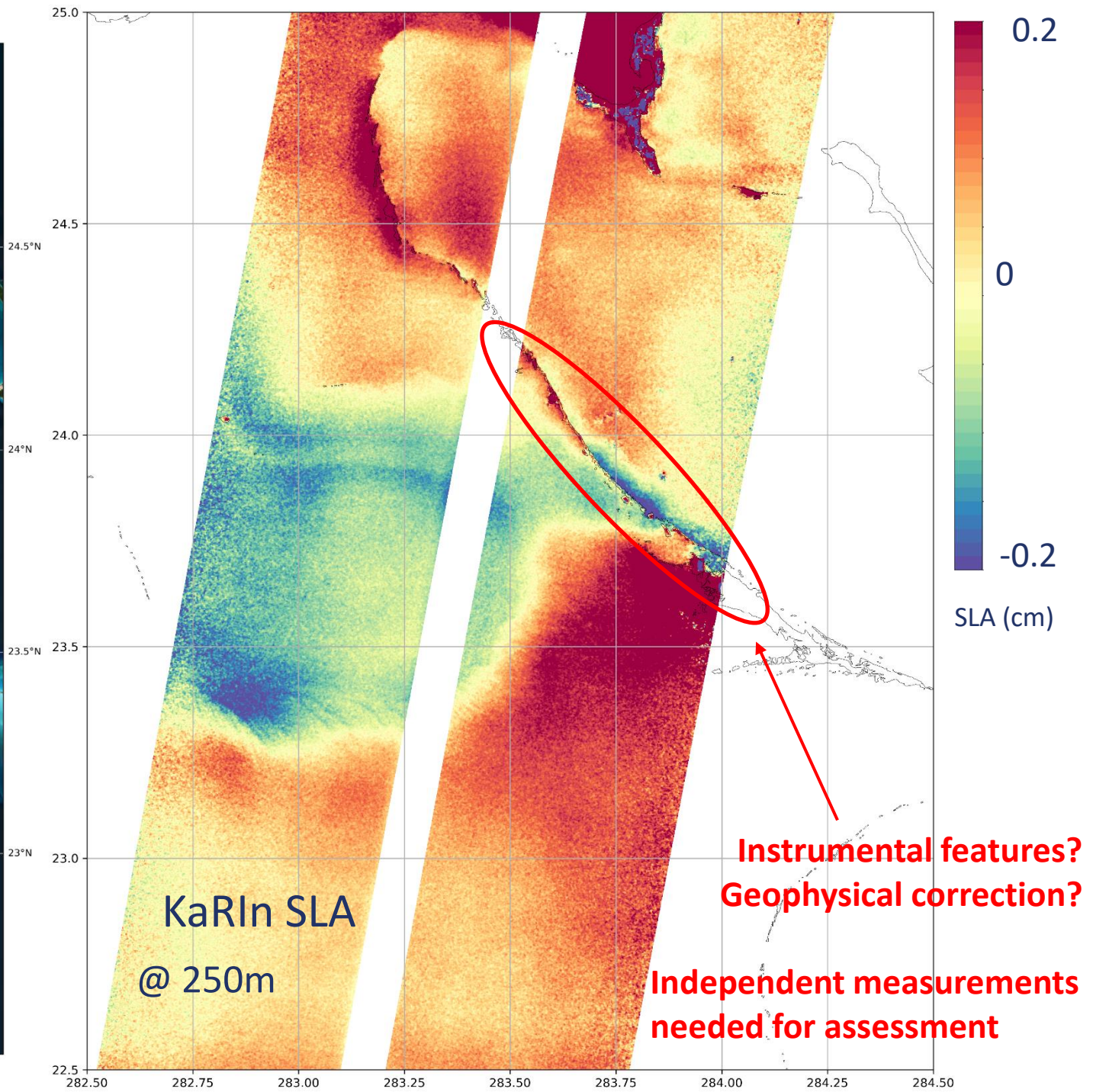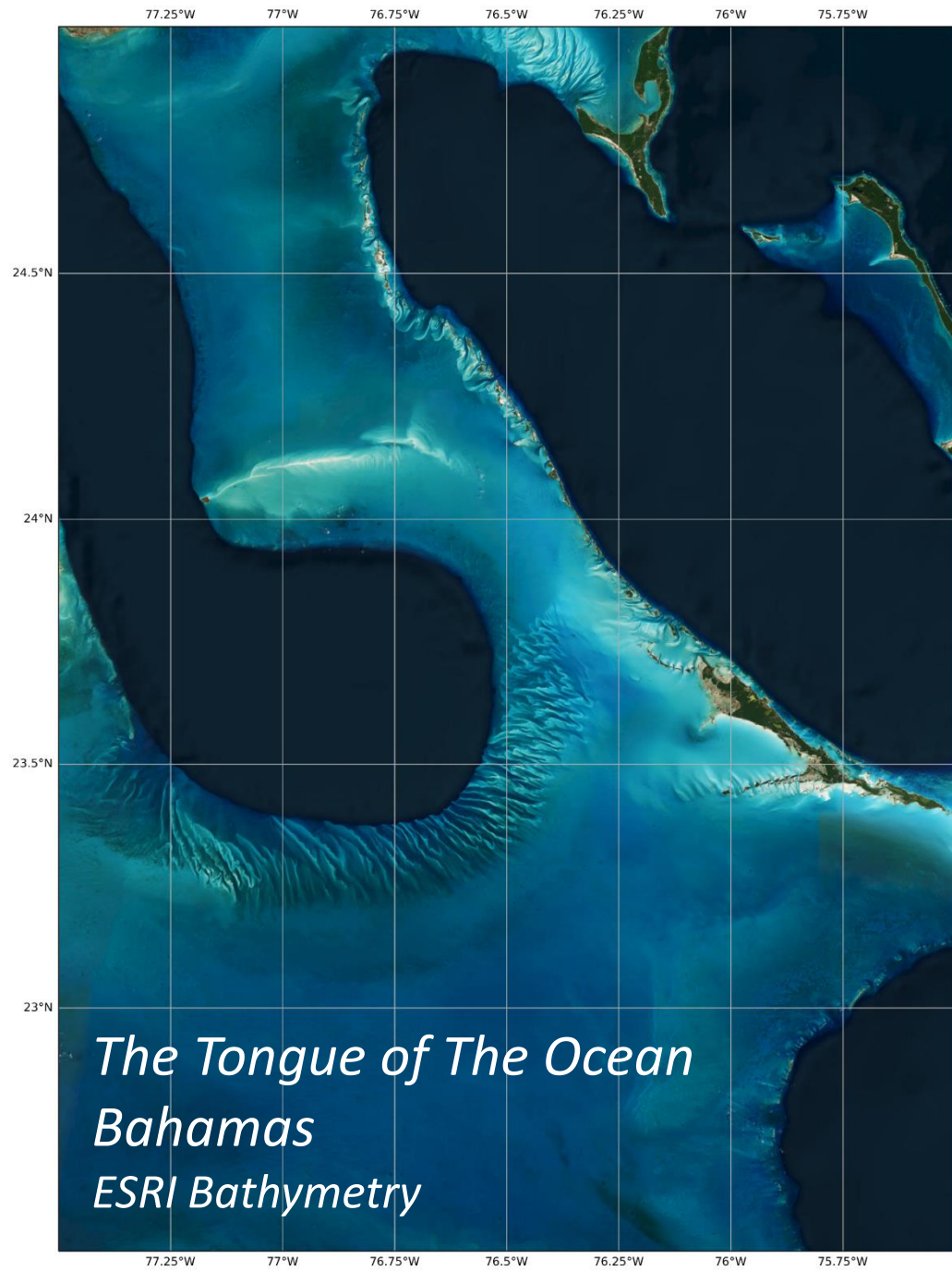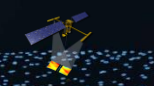
Yannice Faugere, Tom Semblanet, Pierre Veillard,
A Delepoulle Mei Ling Da Bat, Loren Carrere (CLS)
Gerald Dibarboure (CNES)

OSTST Meeting, PUERTO RICO, Nov. 7 to Nov. 11, 2023

The Tongue of The Ocean
Bahamas
ESRI Bathymetry

KaRIn SLA

@ 250m

SLA (cm)

Instrumental features?
Geophysical correction?

Independent measurements
needed for assessment

- Nominal footprint of 17 m / along-track resolution of 0.7 m
- Capacity to retrieve the SSH over a very narrow surface which is of interest for land/sea ice topography but also coastal Sea Level studies
- many publications over ice/sea ice, not so many over ocean & coasts
  - ✓ **Buzzanga et al 2021**: ICESat-2 Seal Level trend analysis
  - ✓ **Tomic, 2023:** evaluation of ICESat-2 along the Norwegian coast, to improve the existing coastal Mean Sea Surface
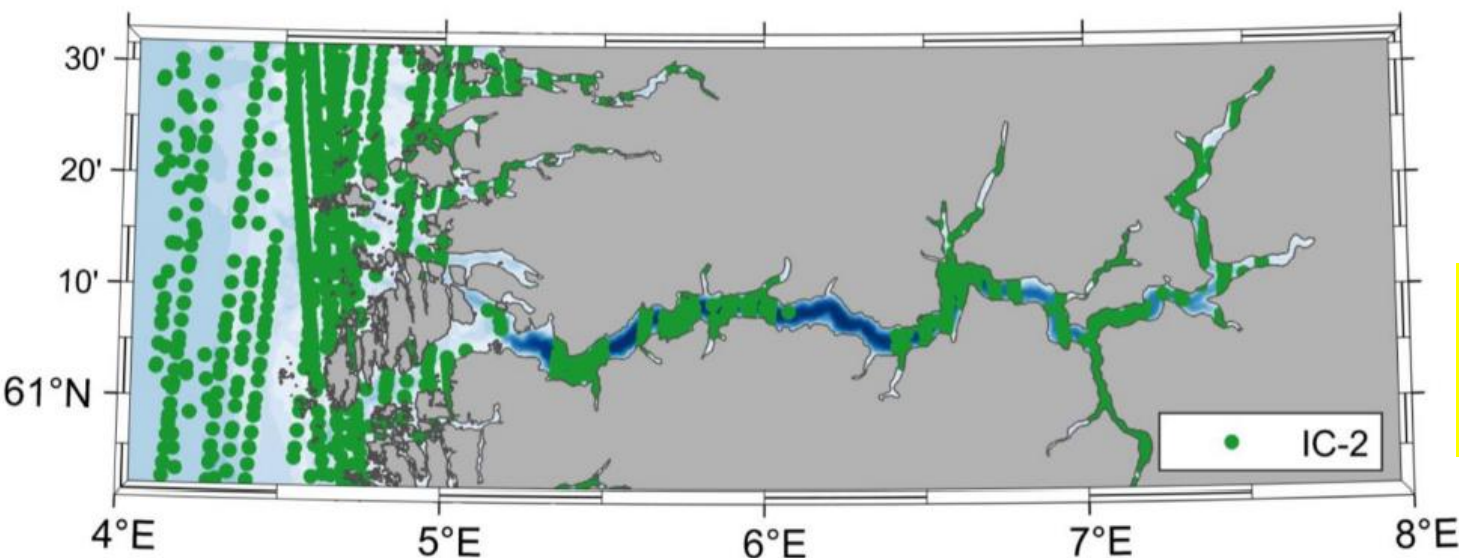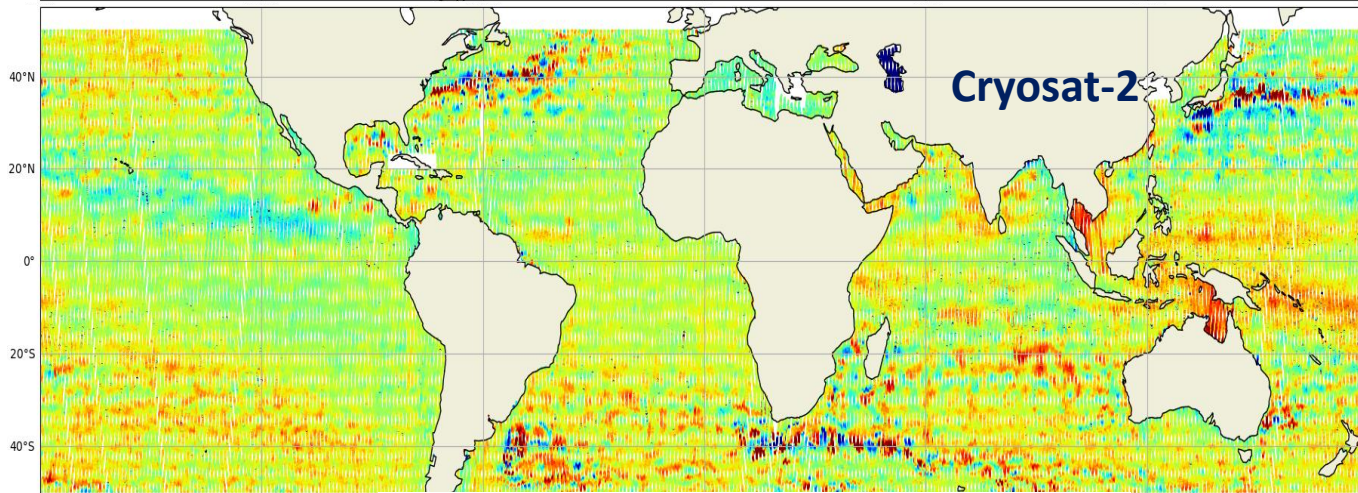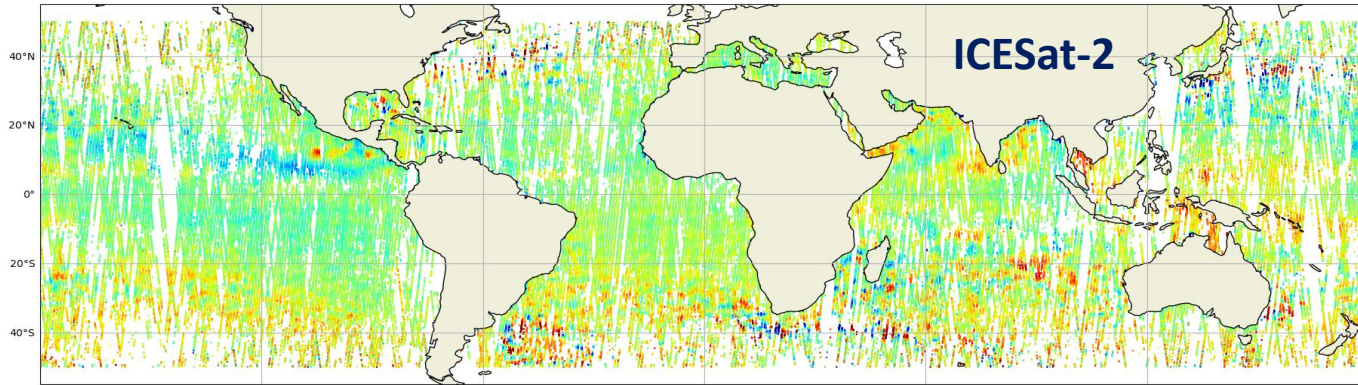

Availability in a norway fjord « Sognefjorden » from *Tomic, 2023*
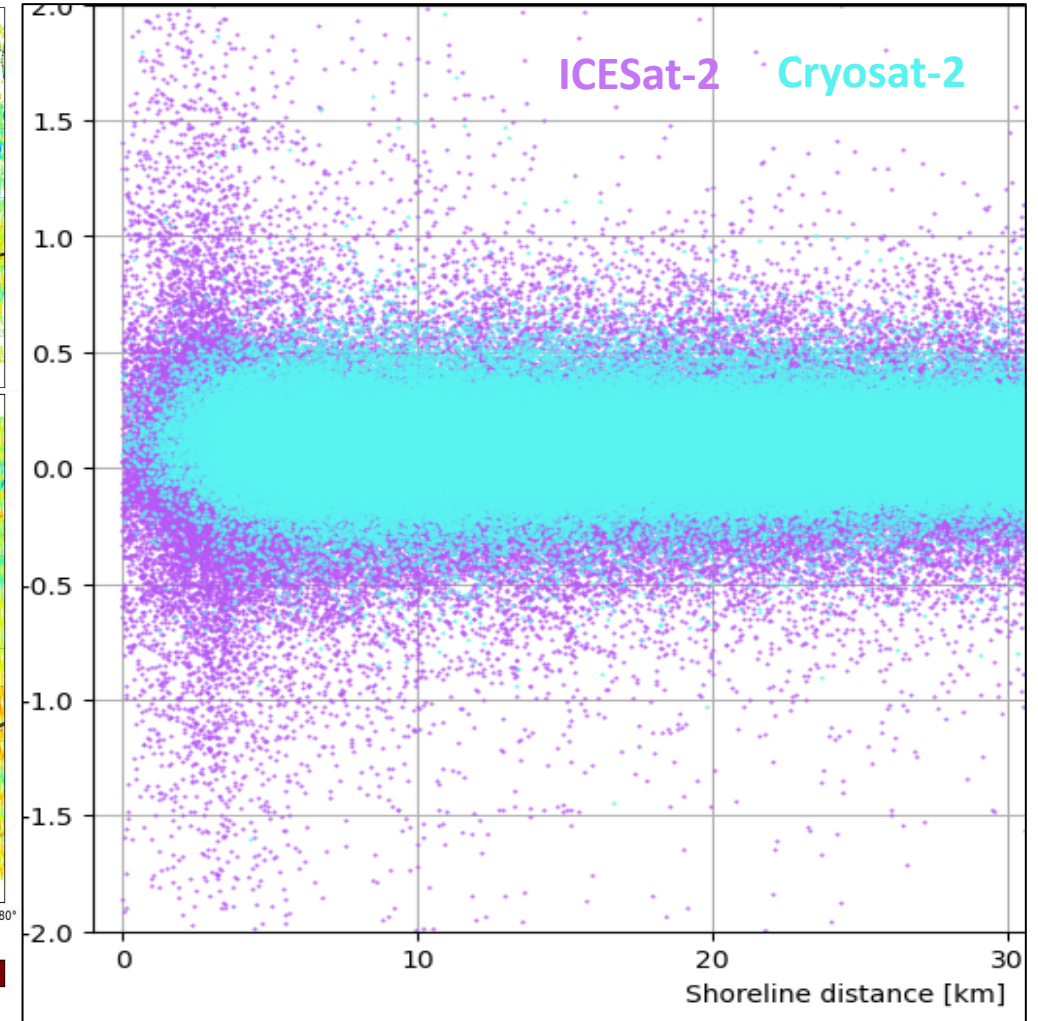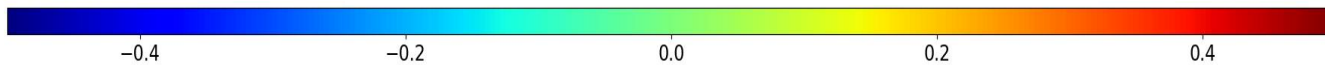
See posters GEO2023_006/7/8 COA2023_001

- ICESat-2 ATL12 version 5i s used for this study (year 2021 & 2022)
- 1 beam used (GT1L) among the 6 beams of photons available
- Geophysical correction upgraded to be consistent with DUACS DT21 & simple editing procedure
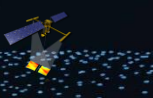
ICESat-2

Cryosat-2
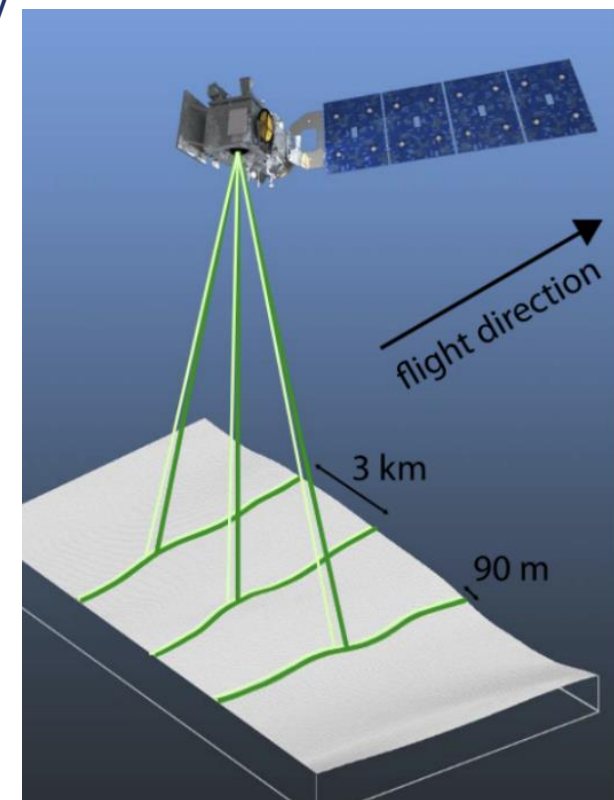
SLA – February 2022 (units in m)

ICESat-2   **Cryosat-2**

Shoreline distance [km]

Good overall consistency in open ocean at large scales signals. High density of coastal Sea Level measurements
Less data in region in western boundary currents (cloudy condition). Entire passes edited
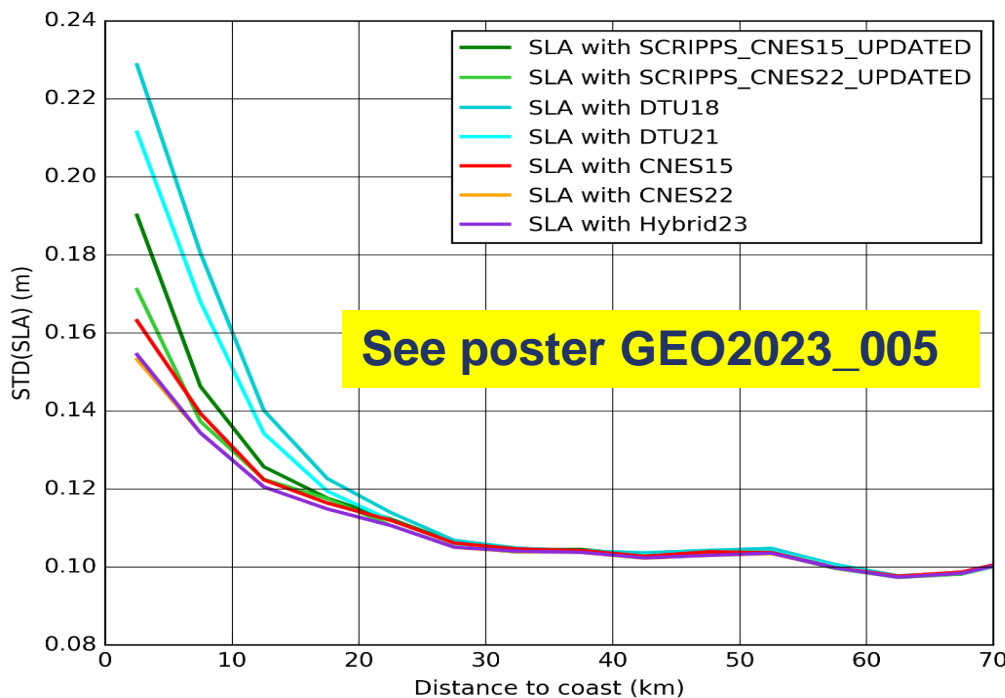
The 2023 Hybrid Mean Sea Surface

Combination of recent models considered as the most precise which are the SCRIPP_CLS22, CNES_CLS22, and DTU21 MSS's. **Resolution 1/60°.** See Aviso pages
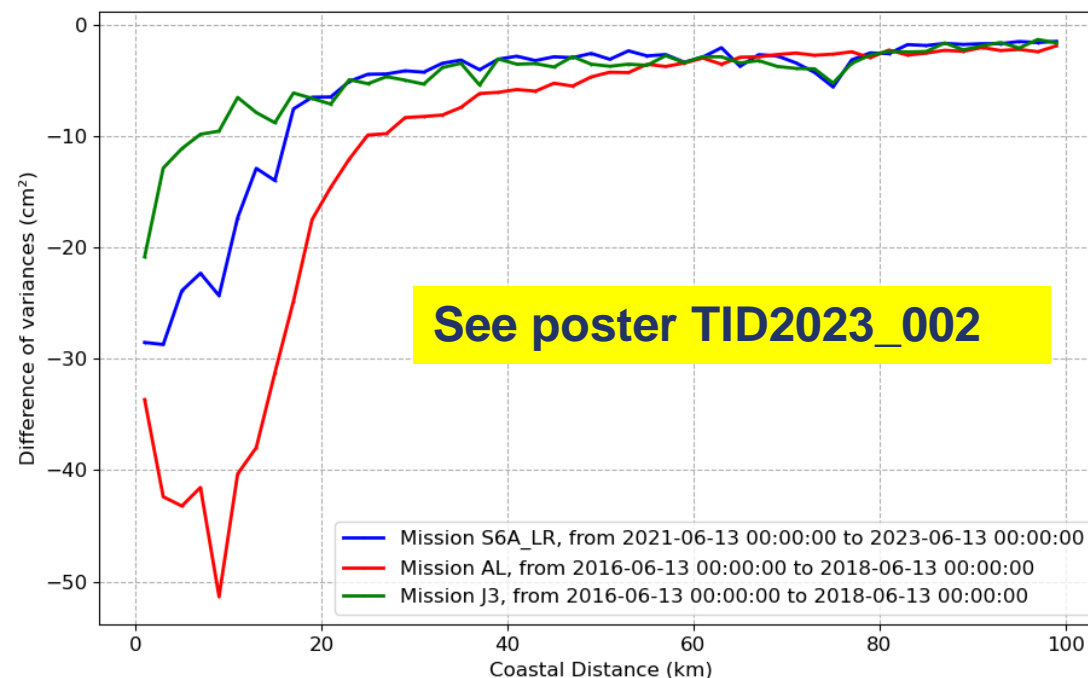
The FES22 Tide model

Hydrodynamic model with improved bathy & assimilation of all altimeter time series + Tide Gauge. New high-resolution mesh: 1/30° cartesian grids

SLA stdev as a function of the distance to the coast

See poster GEO2023_005

SLA variance reduction when using FES2022 vs FES2014

See poster TID2023_002

MSS and and ocean tide new solutions model strongly improved in shelf => **Crucial to upgrade Icesat-2 with new standards** (as SWOT). **Error level still needs to be reduced near the coasts (<20km)**
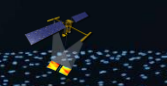
Local analysis of 1 year of ICESat2 data (2022)
=> Classic 20cm SLA range observed in the middle of the Strait of Ormuz
=> Strong values around between Qeshm Island and Iran (negative bias >50cm)

Instrumental error or wrong geophysical correction?

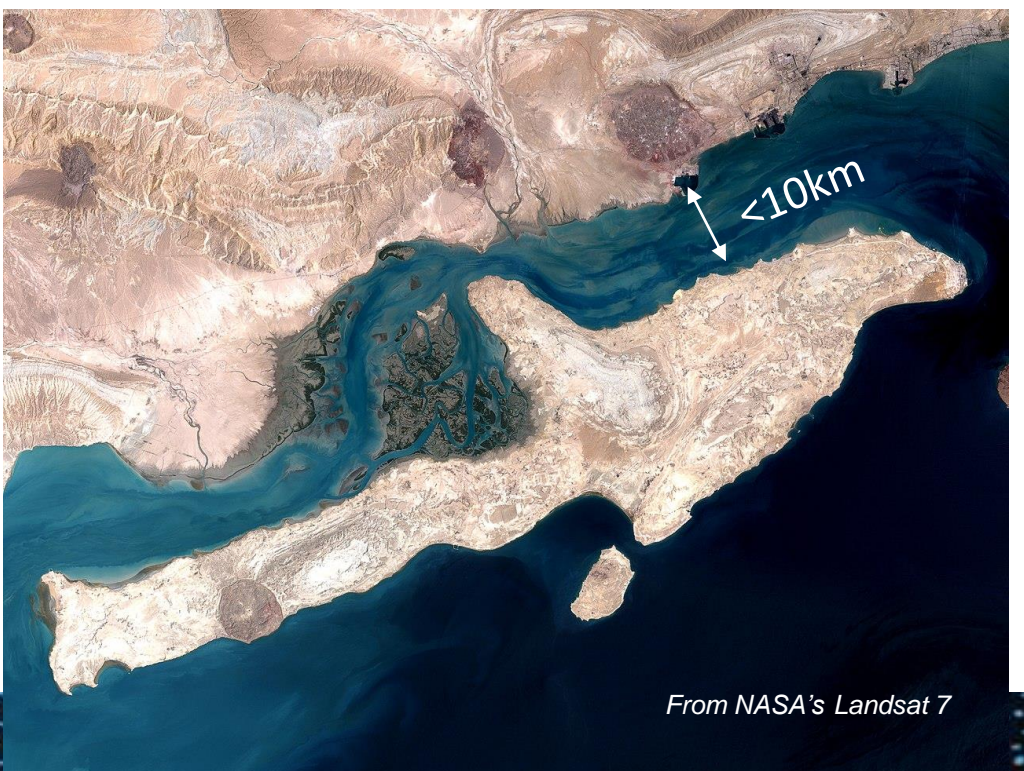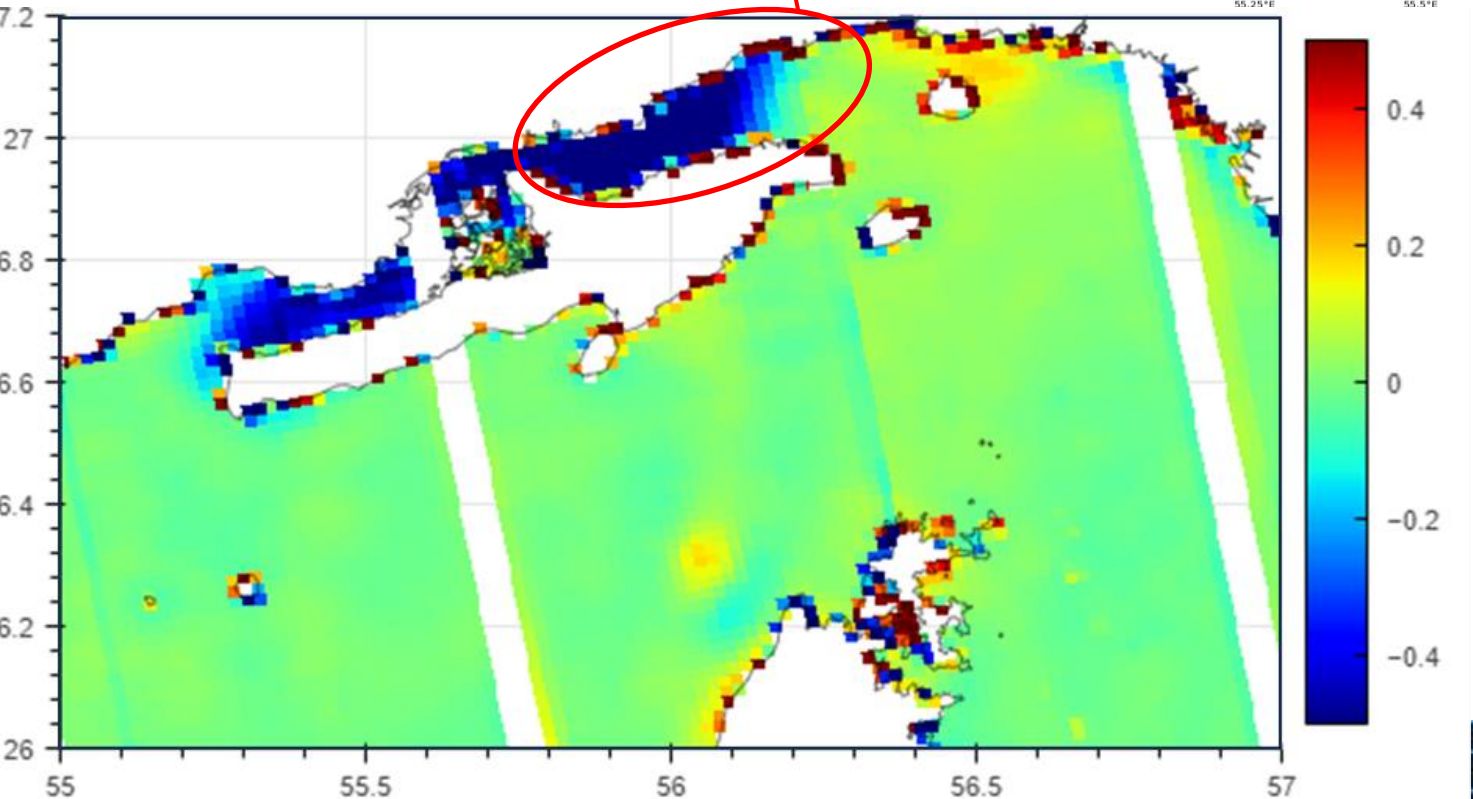Associated uncertainties are low (given in ATL12 product)
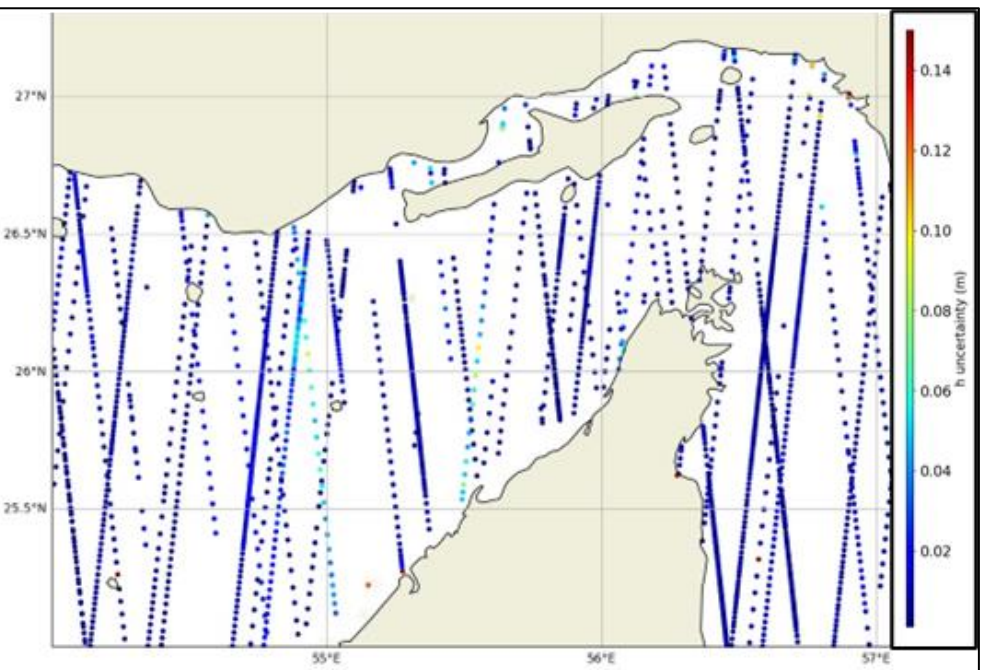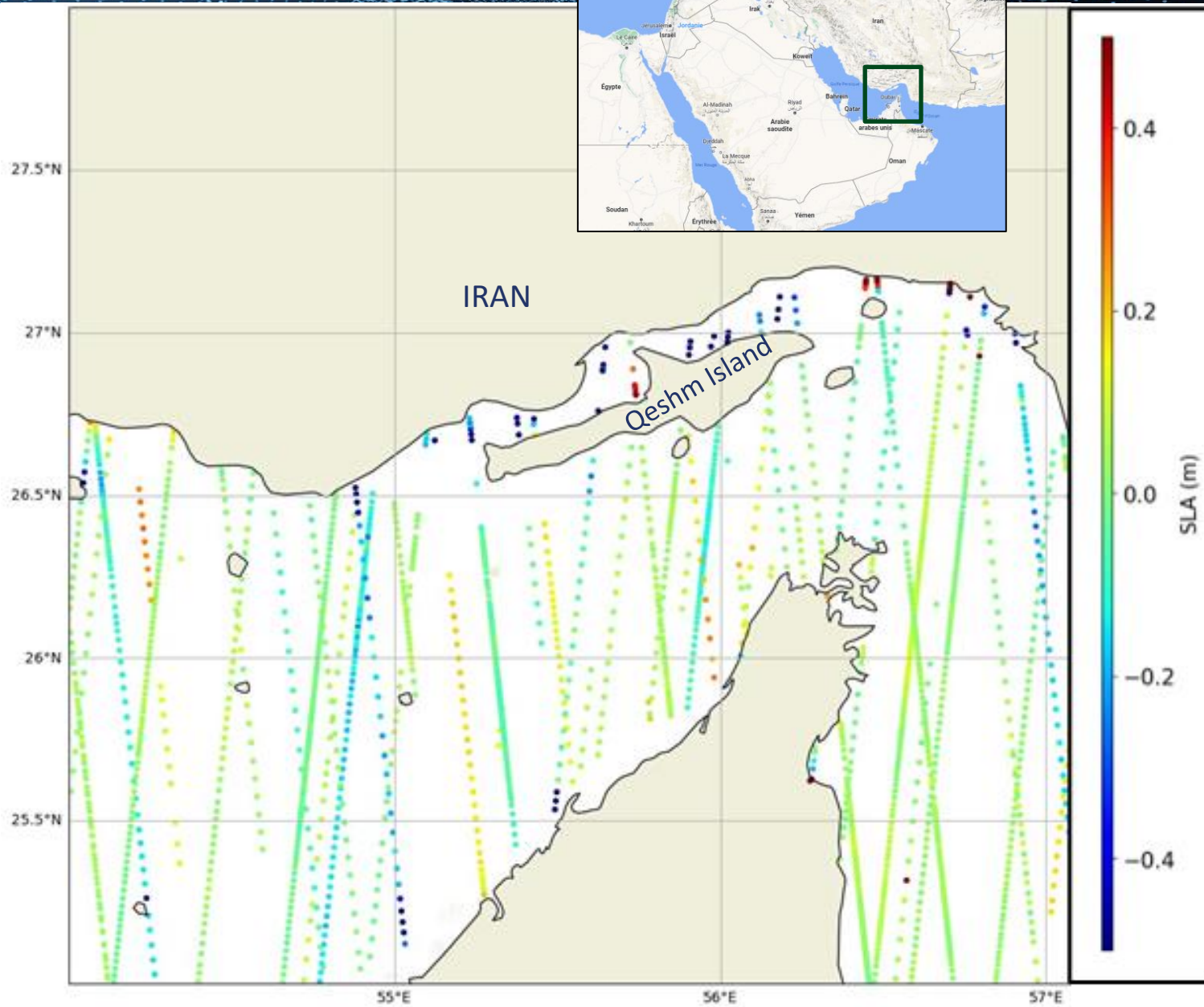
Comparison to SWOT measurements: Average of the 5 SWOT cycles in 2023 (21-day orbit)

Same local bias visible on SWOT mean profile => systematic error, MSS is a good candidate for explaining the bias

SWOT 2km mean SLA (m)

Icesat instantaneous SLA, year 2022 (m)

<10km

From NASA's Landsat 7
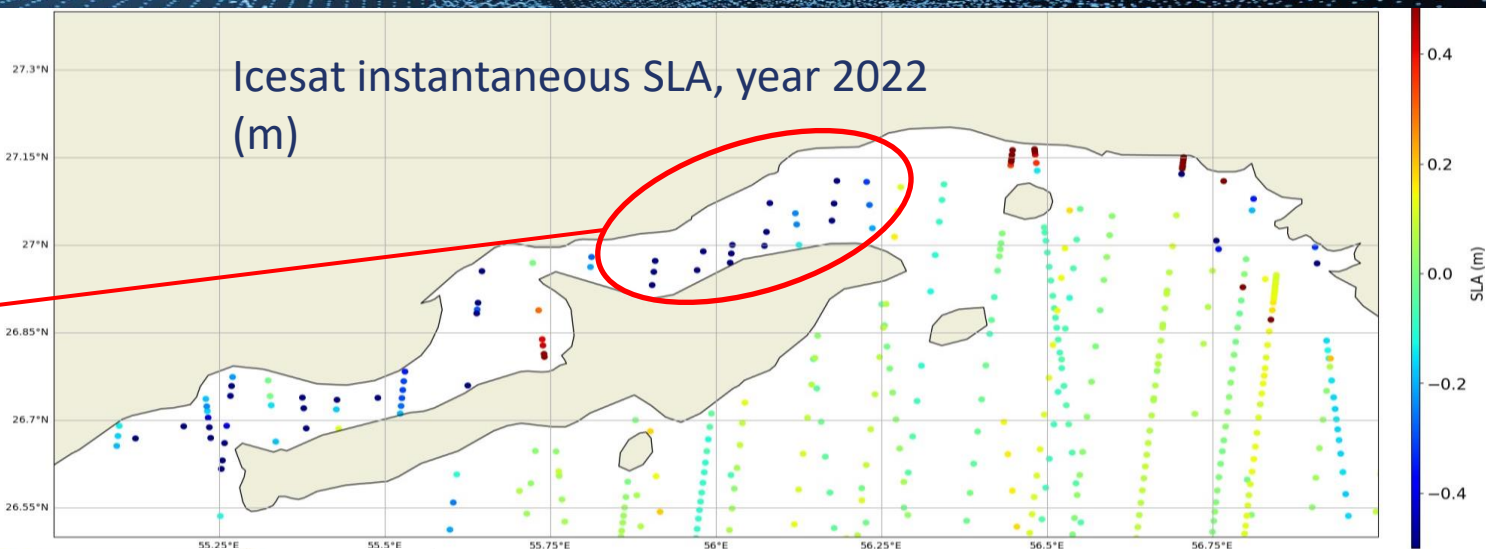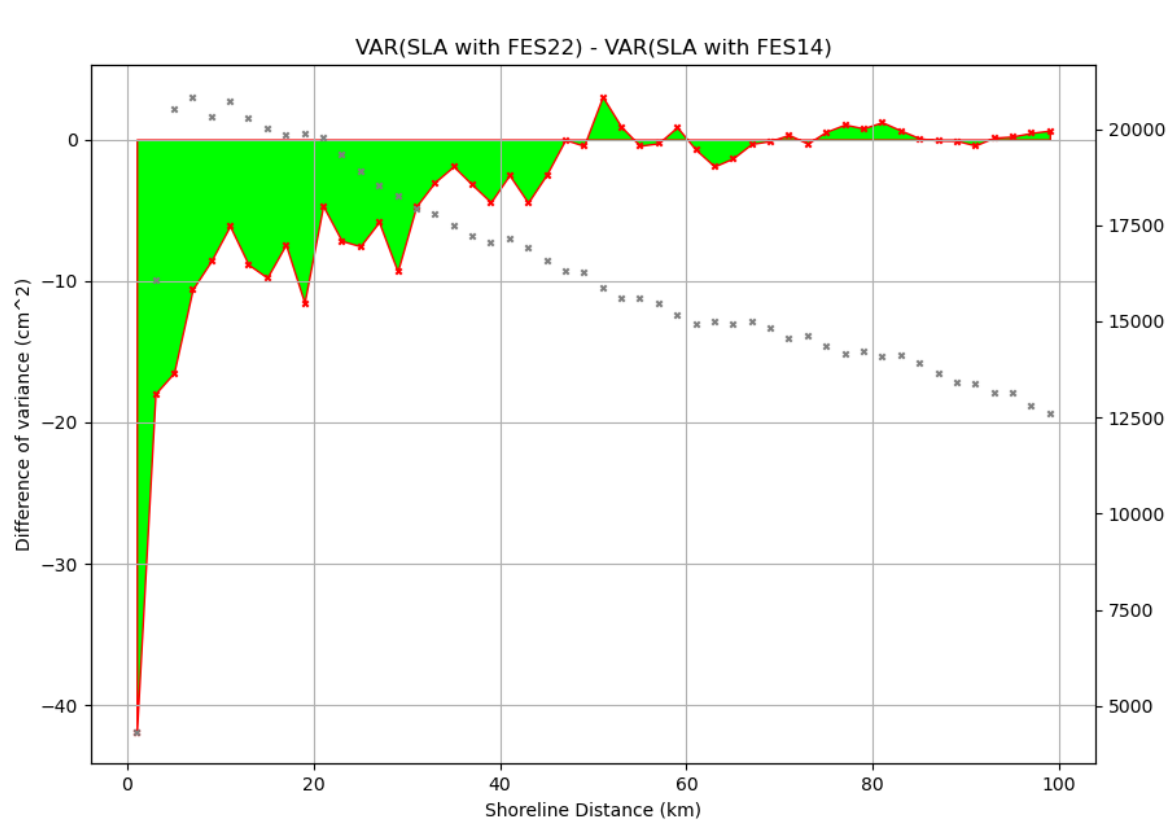
Improvements of the FES22 ocean tide model compared to the FES14 model in the coastal zone, by evaluating the gain in variance brought by the new model using Icesat-2 data
- results obtained are consistent with radar altimetry
- More data used at distance <1km t the coast, making the diagnostic more robust
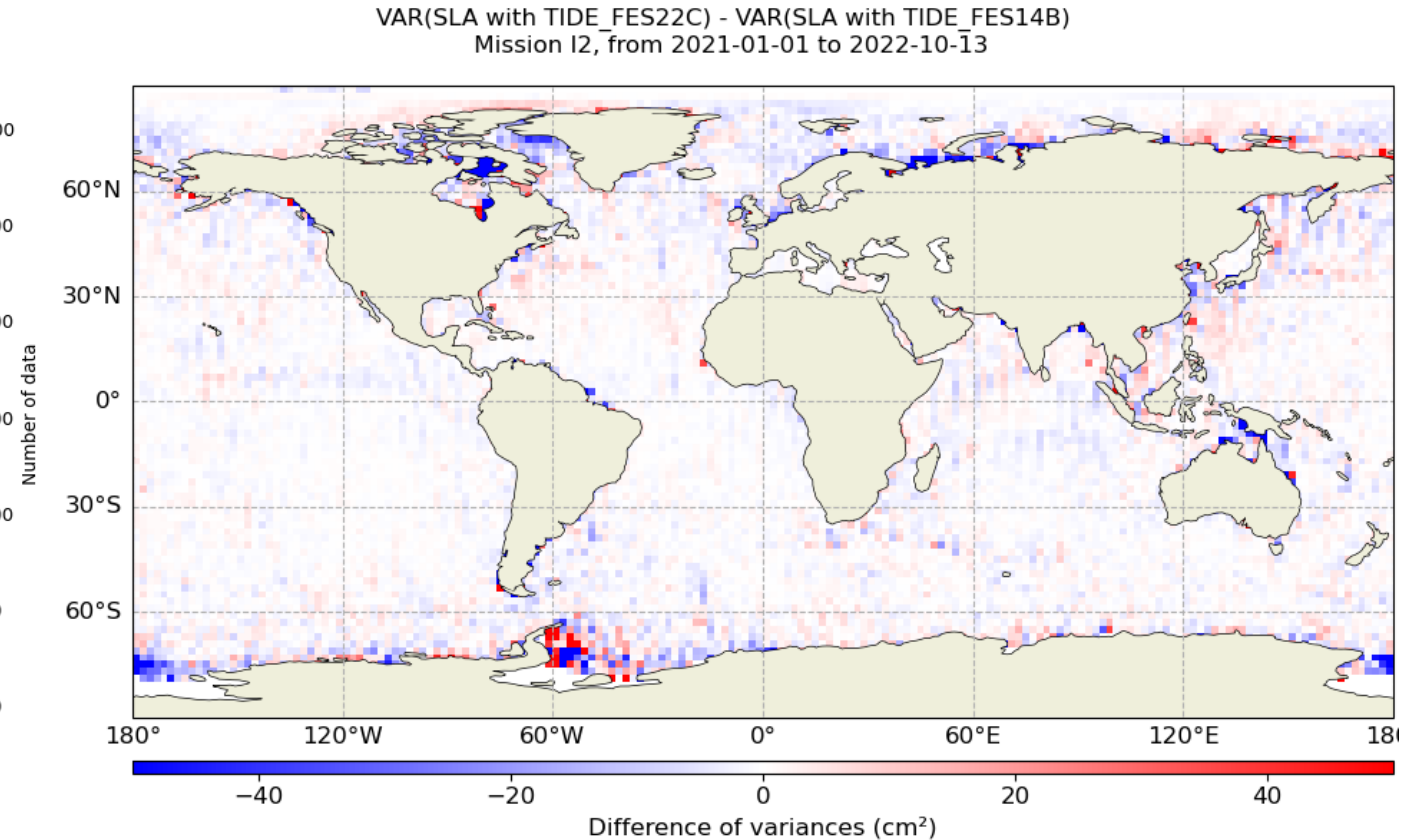
- Today the Cartesian grids are used to compute FES solution at altimeter nadir position
- **Higher resolution in the native Finite Element mesh: 1-4km in coastal areas (locally < 1km)**
- Plan to ue directly the original FES22 mesh in ground processing => strong impact for complex coastlines, Fjords, …
- **ICESat-2 interesting dataset particularly interesting for this perspective**
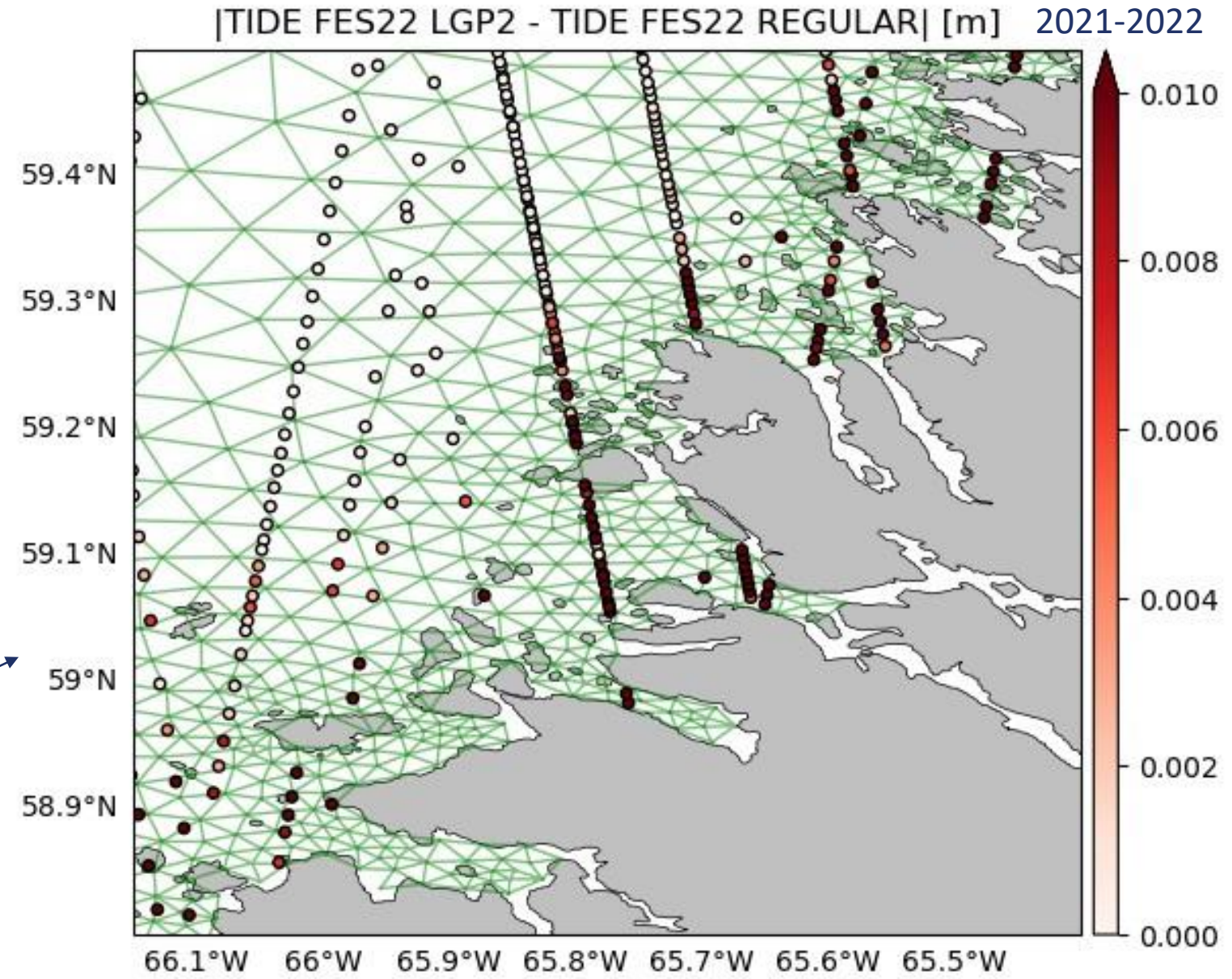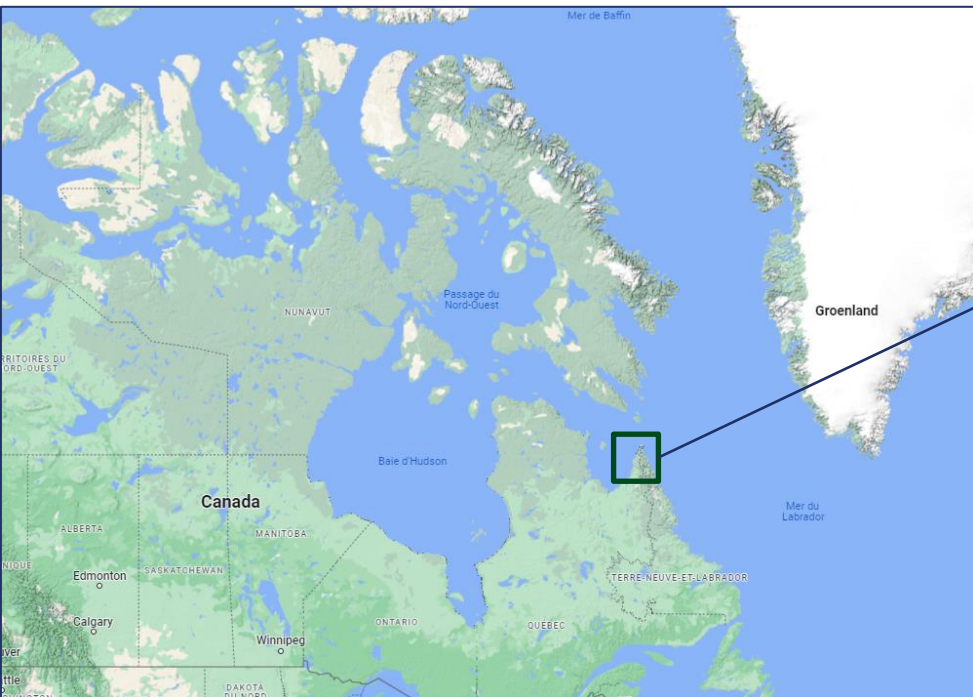
- This preliminary analysis confirms the results of recent publication: **ATL12 V05 ocean products is a very interesting dataset** with valuable topography information **at distance <10km from the coast**.

- Swot is a game changer for coastal sea level studies. **Icesat-2 should be used for the assessment of the so-called "unsmoothed dataset" with 250m spatial resolution**
       => Extensive study is necessary with the full 2018-2023 Icesat-2 period

- **Following this work, Mean Sea surface and Ocean Tide model** will be upgraded in the coming years benefiting to the entire radar time series & ICESat-2 itself

- Ocean/hydro continuum: **Assessment of SWOT at the junction between ocean and land (estuaries) should also be done**

- Synergy: **links between OSTST and ICESat-2 ocean community needs to be strengthened**