



# Using SWOT for Ocean Monitoring and Prediction off Canada's West and East Coasts

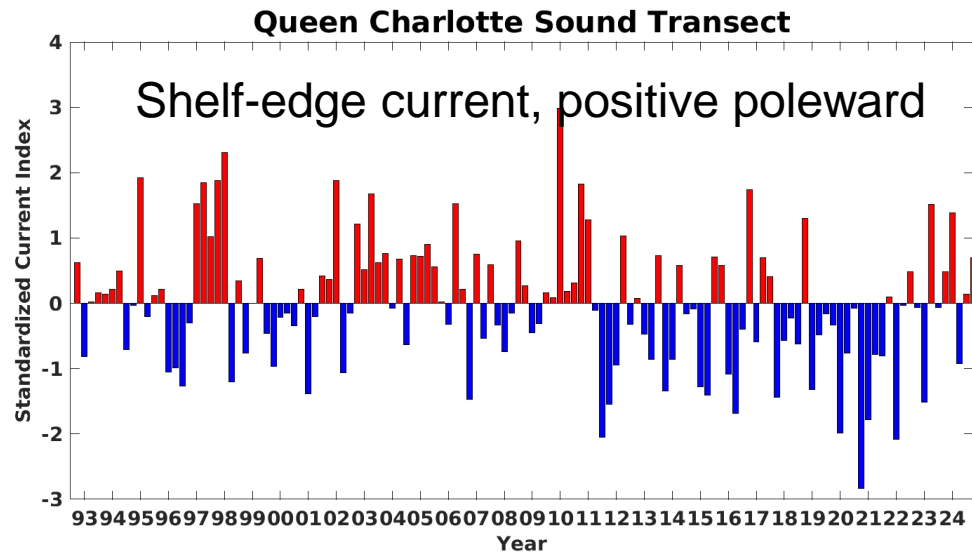
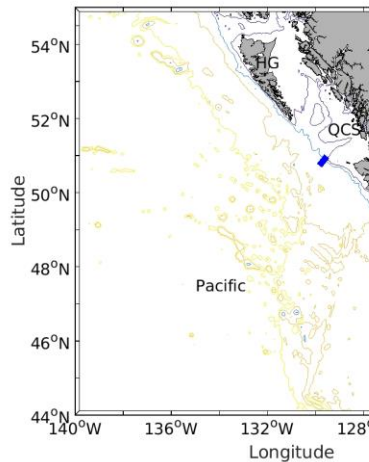
Guoqi Han, Fisheries and Oceans Canada

Gregory Smith, Environment and Climate Change  
Canada



Fisheries and Oceans  
Canada

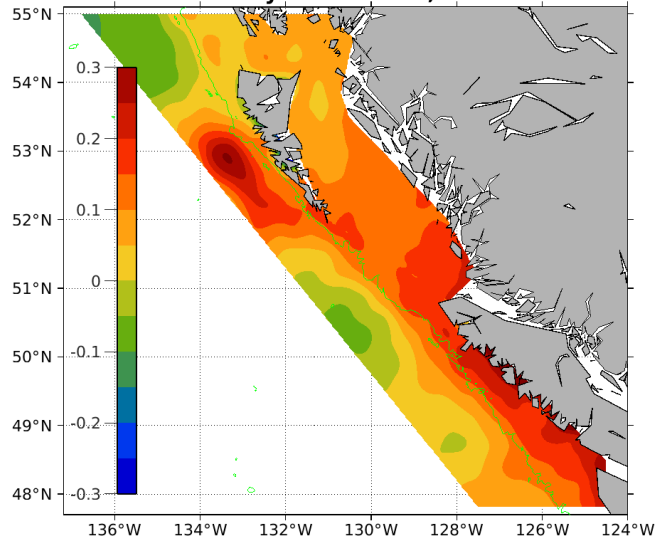
Pêches et Océans  
Canada



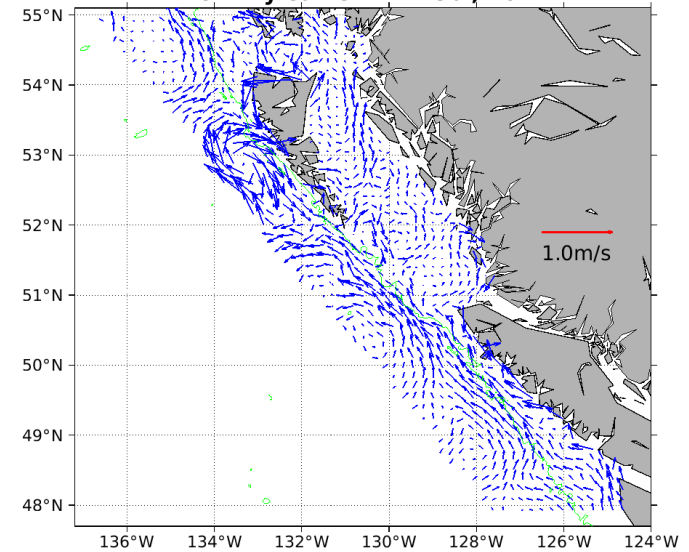
- **Objective:** Provide monthly/weekly SSH anomaly fields and associated geostrophic currents to support the state of the ocean reporting
- **Data:** L3 2 km SSH from Aug. 2023 to May 2025
- **Method:** Statistical reconstruction with a prescribed covariance function
- **Verification:** Hourly current meter data located over the shelf break (E03) and the shelf (E01)

# Reconstructed SSH and Geostrophic Current Anomalies

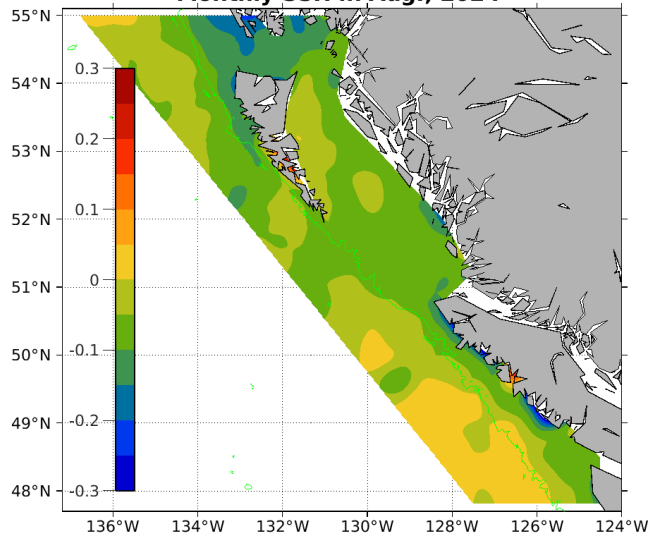
Monthly SSH in Feb., 2024



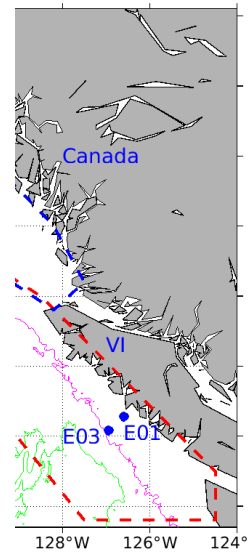
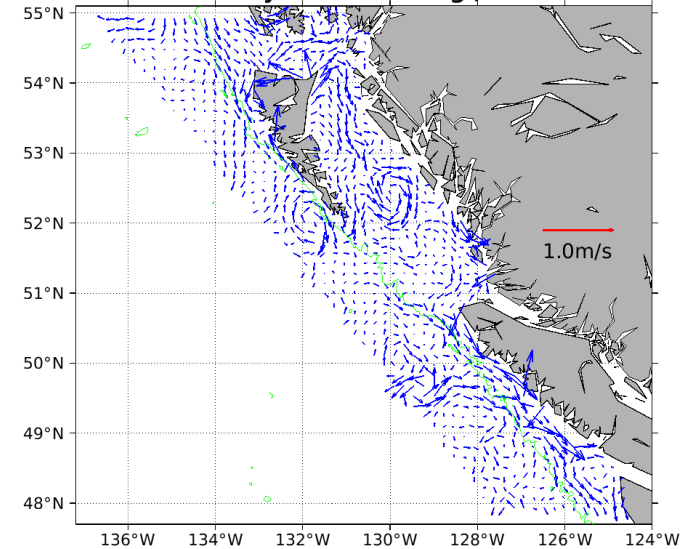
Monthly current in Feb., 2024



Monthly SSH in Aug., 2024

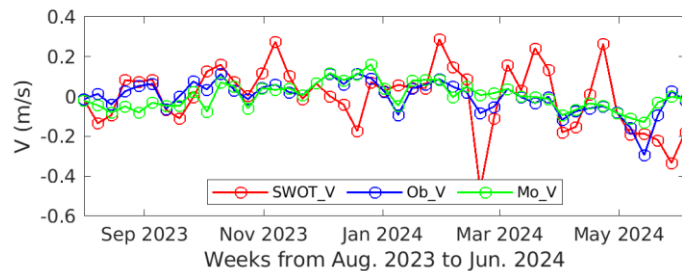
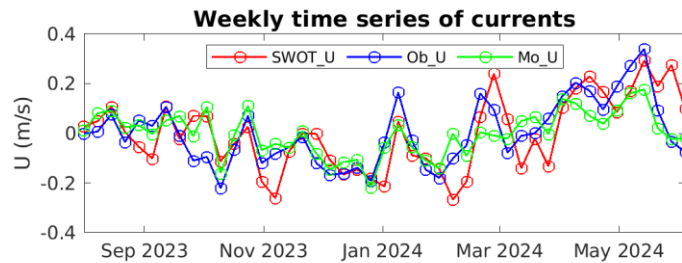
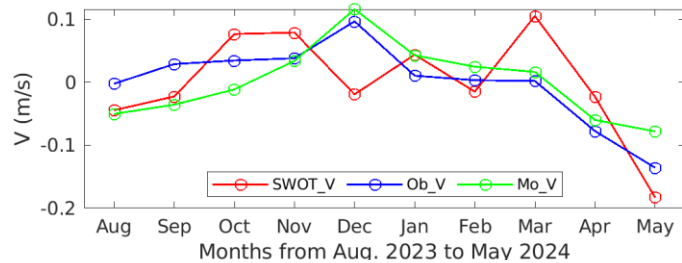
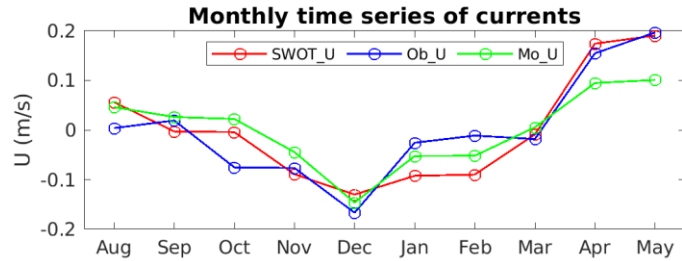


Monthly current in Aug., 2024

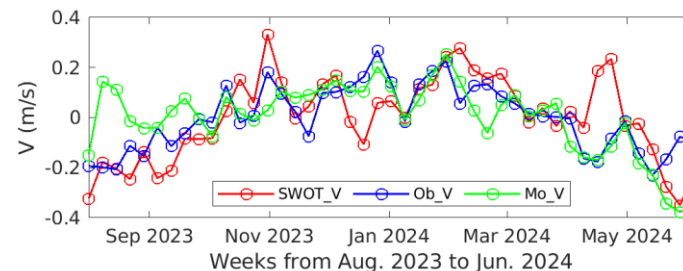
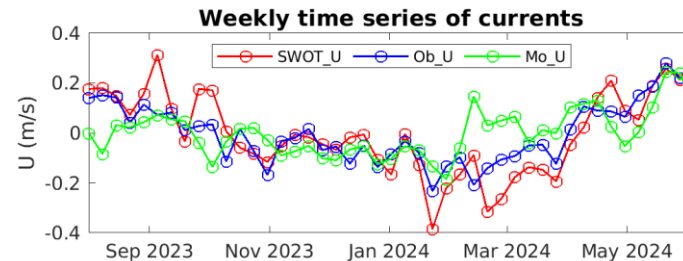
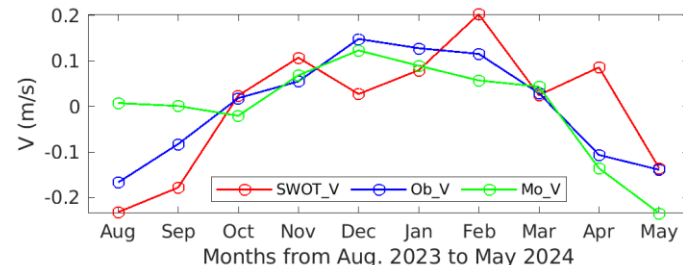
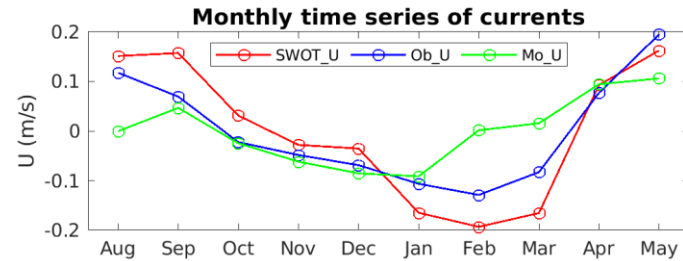


# Comparison with Current Meter Data and Model Results

## Shelf Site, E01

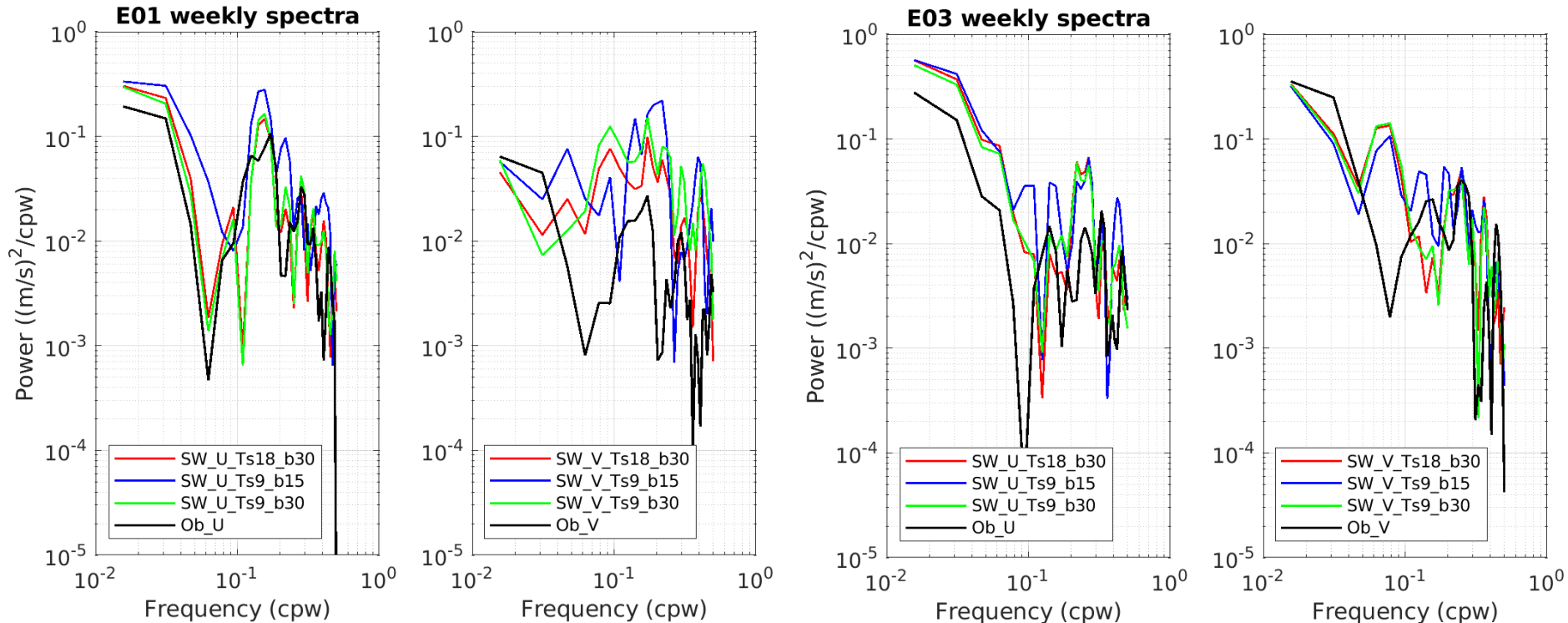


## Shelf-break Site, E03





# Influence of Temporal and Spatial Scales



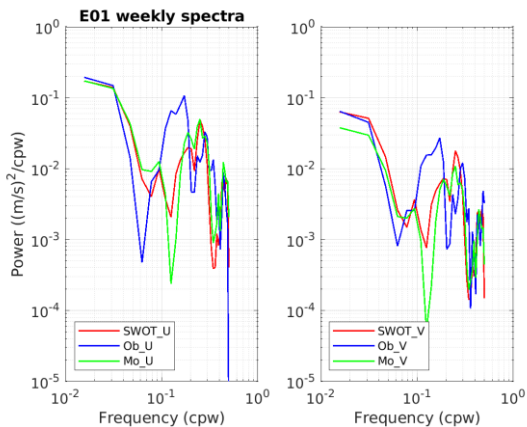
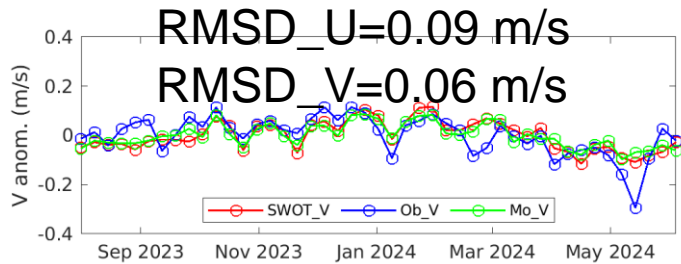
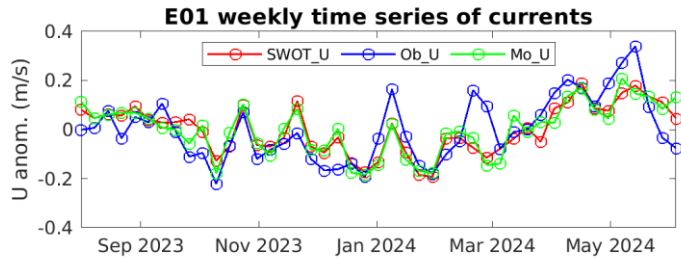
Change from 15 km to 30 km shows some improvement, especially at the shelf site E01



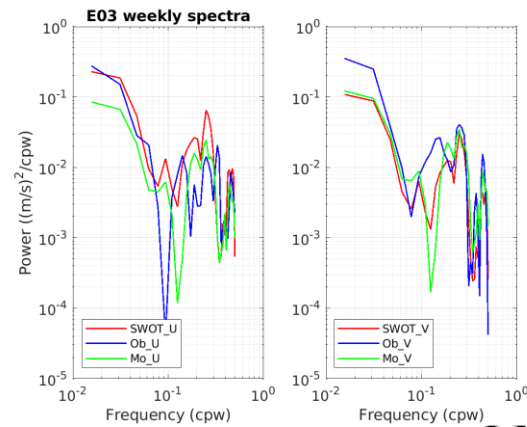
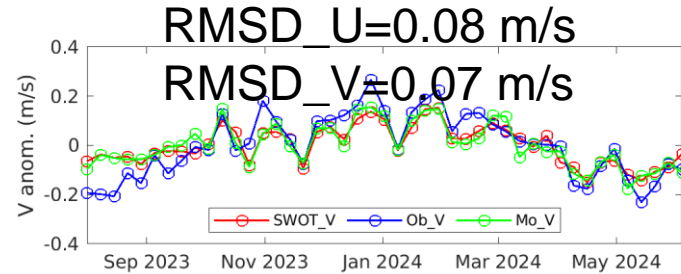
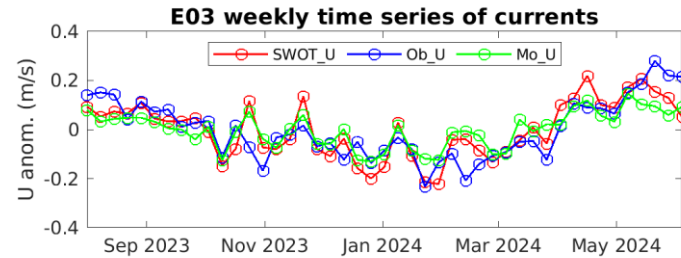
# Comparison with Current Meter Data

## SWOT and Model: 1st EOF Mode

### Shelf Site, E01



### Shelf-break Site, E03



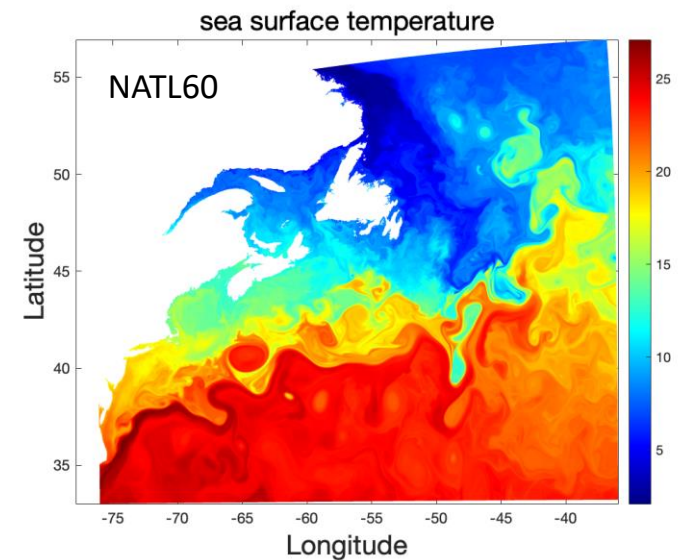
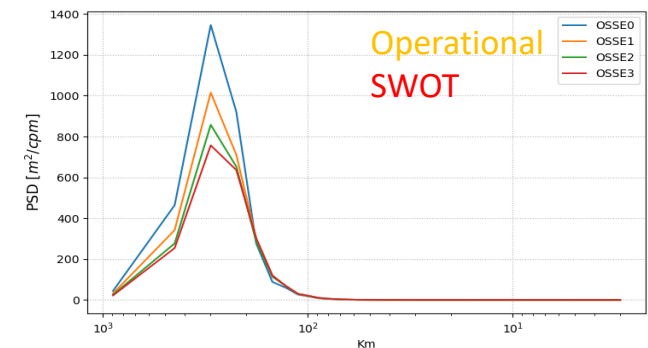
# Preparation for assimilation of SWOT data in ECCO ocean analysis systems

**CSA Funded project:** Collaboration between G. Smith (ECCC), W. Perrie (DFO), G. Liu (Dal), A.-A. Gauthier (ECCC) and M. Benkiran (MOi)

- Evaluation using Regional Ice Ocean Prediction System (RIOPS)
  - Focus on Gulf Stream region
  - Gulf of Maine, Gulf of St. Lawrence and Labrador Shelf
- Perform Observing System Simulation Experiment (OSSE) using synthetic SWOT data
  - Build on previous efforts (Carrier et al., 2016; Bonaduce et al., 2018; D'Addezio et al., 2019)
  - Use NATL60 (J. LeSommer) as Nature Run (Fraternal twin)
  - Generate synthetic observations
    - Use JPL SWOT Simulator for SWOT (nadir and Karin)
    - Conventional obs: SST, T-S profiles and nadir altimeters
  - Four experiments run Oct. 2012 – Sep. 2013
    - OSSE0: Free run (no assimilation)
    - OSSE1: Conventional observations only (no SWOT)
    - OSSE2: SWOT instead of nadir altimetry (withheld nadir)
    - OSSE3: All observations (SWOT, nadir, SST, T-S profiles)
  - Assess impact on ability to constrain RIOPS toward NATL60
    - Can SWOT help constrain smaller scales than using conventional altimetry?

*Liu et al., Front. in Mar. Sci., 2024*

## Wavenumber spectrum of SSH errors

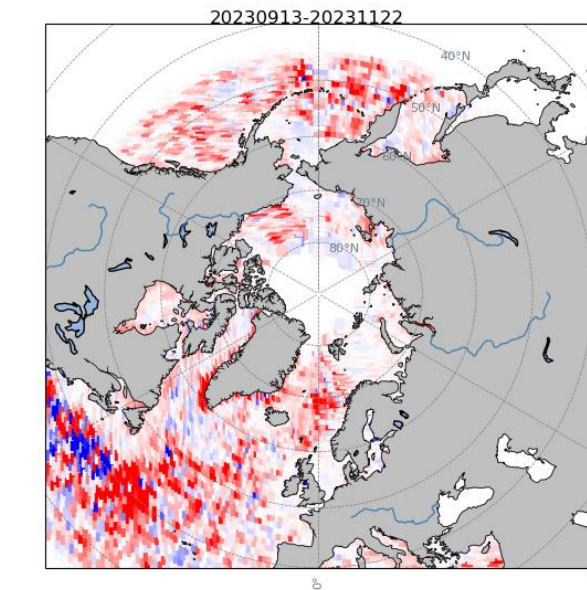


## Preliminary results of assimilation of early SWOT observations

- AVISO Level 3, release v0.3
- Evaluated for 2023-09-13 to 2023-11-22
- OSE1: Operational configuration (6 nadir altimeters)
- OSE2: Assimilate only 2 altimeters (Cryosat2, Jason3)
  - same as OSSE experiments
- OSE3: Impact of SWOT+2 nadir
- OSE4: Operational + SWOT
- **Reduction of RMS differences over much of the domain!**

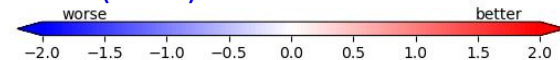
| Expmt | SWOT | S3a, S3b, S6, AI | C2, J3 | T-S profiles, SST, Ice |
|-------|------|------------------|--------|------------------------|
| OSE1  |      | X                | X      | X                      |
| OSE2  |      |                  | X      | X                      |
| OSE3  | X    |                  | X      | X                      |
| OSE4  | X    | X                | X      | X                      |

RMS difference compared to all SLA observations



2 nadir (OSE2)

2 nadir + SWOT (OSE3)



*Liu et al., Front. in Mar. Sci., 2024*



## Summary

- SWOT geostrophic current anomalies capture approximately weekly variations in the major shelf currents off West Vancouver Island
- Assimilation of SWOT data improves the skill of ECCO's Regional Ice-ocean Prediction System