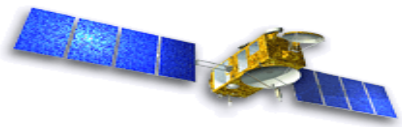


Altimetry Observations in the Gulf of Maine and Middle Atlantic Bight region

H. Feng and D. Vandemark: University of New Hampshire, USA
R. Scharroo: Altimetrics LLC,USA
J. Wilkin: Rutgers University, USA
G. Han: Fisheris and Oceans, Canada

Fourth Coastal Altimetry Workshop, 14-15 October 2010, Porto, Portgual

Talk Outline

- Motivation/Objectives
- NW Atlantic shelf/Gulf Maine
  - Study region
  - Overview of altimeter observations
    - Issues
    - Reprocessing
- Evaluation/Validation
- Summary

Motivation/objectives

Motivation

Evaluate local altimeter SSH observations and improve data quality for enhanced use in the GoM/MAB coast/shelf region (for seasonal to interannual sea level dynamics, NRT circulation modeling, etc)

Objectives

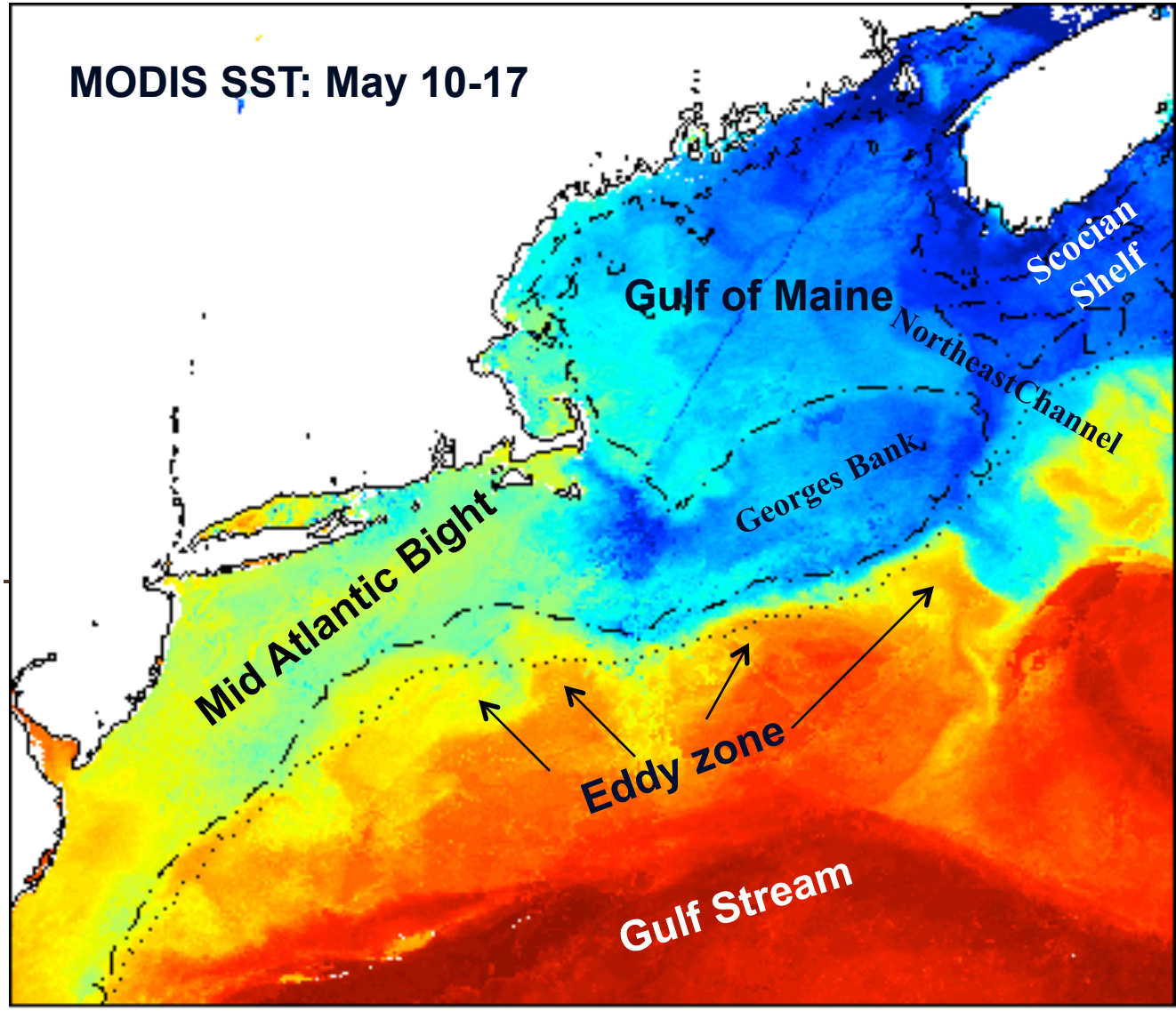
- to develop an altimeter SSHA reprocessing methodology dedicated to the US northeast GoM-MAB coastal zone and shelf region with improved SSHA quality
- to assess the SSHA and the along-track SSHA - estimated across-track surface geostrophic velocity anomalies in comparison with *in situ* coastal observations (coastal tide gauge and buoy-based currents and winds)
- to exploit the potential applications of altimeter observations in this coast-shelf region

A complex/dynamic coastal system in GoM/MAB

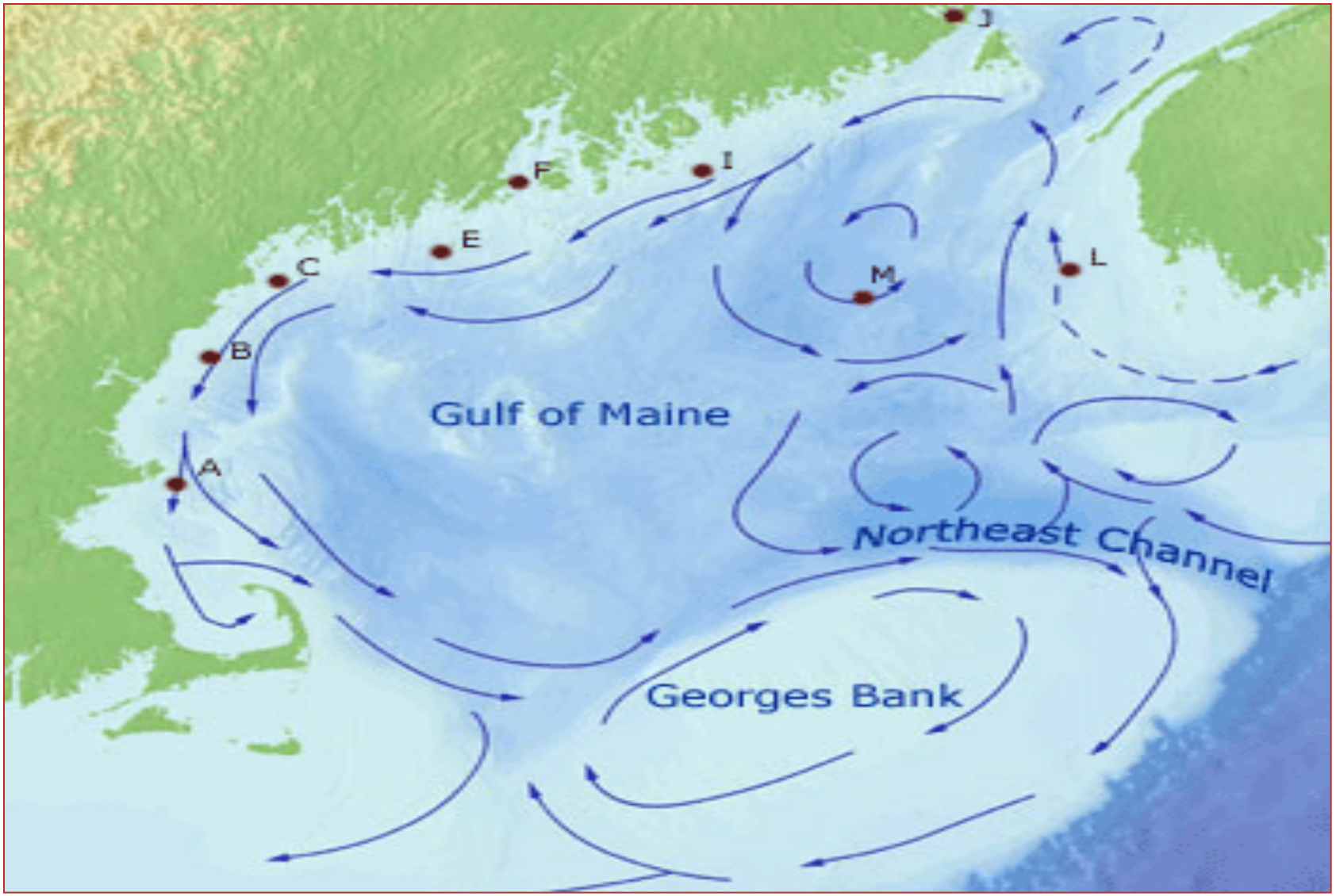
influenced by

- **Local:** Winds/River Runoff/Tides/Shelf break
- **Remote:** Cold-fresh Scotian Shelf Water inflow
- **Offshore:** Gulf Stream induced meso- to submeso-scale eddies

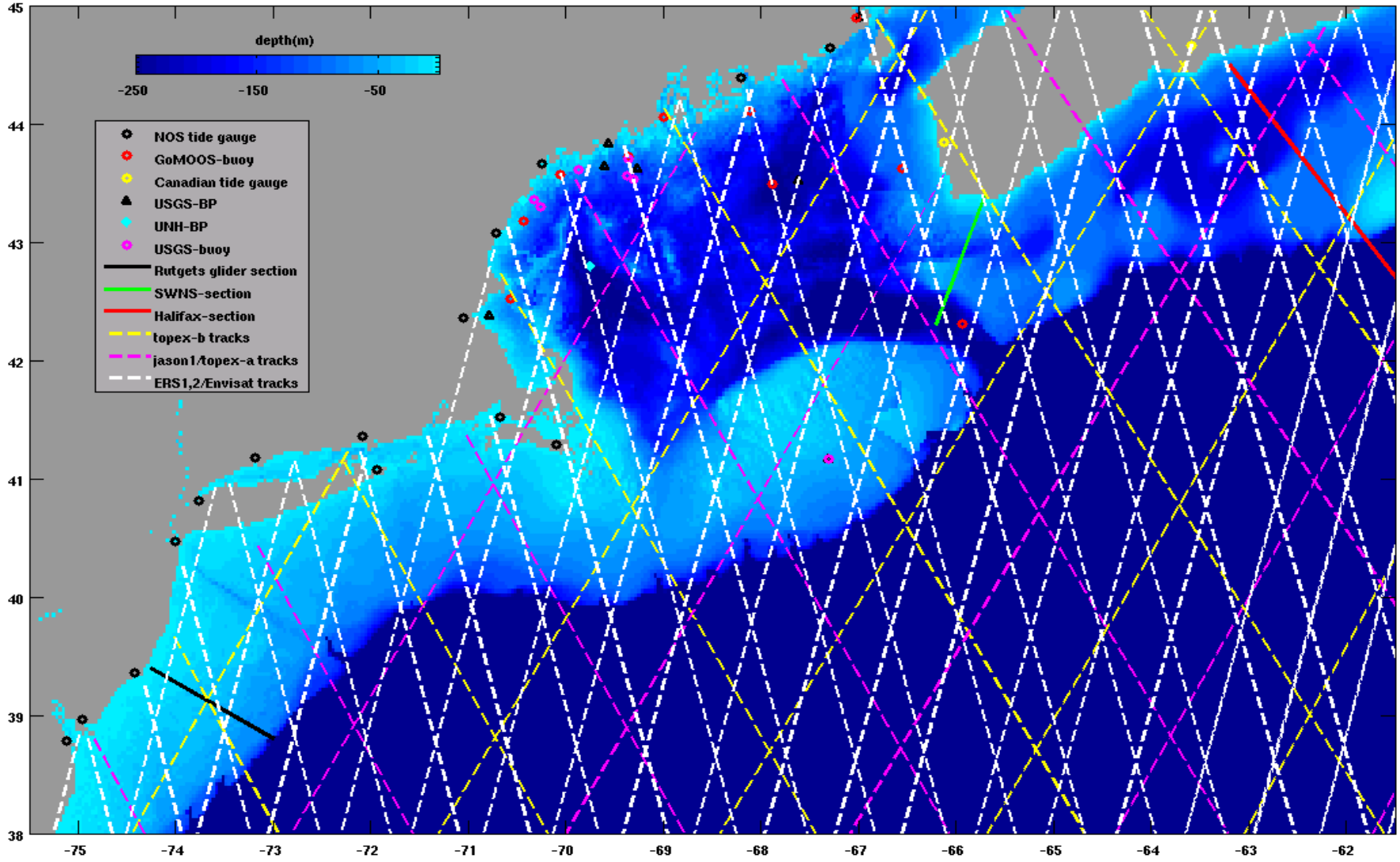
Complexity: all forcings vary significantly in space and time



GoM schematic mean circulation pattern

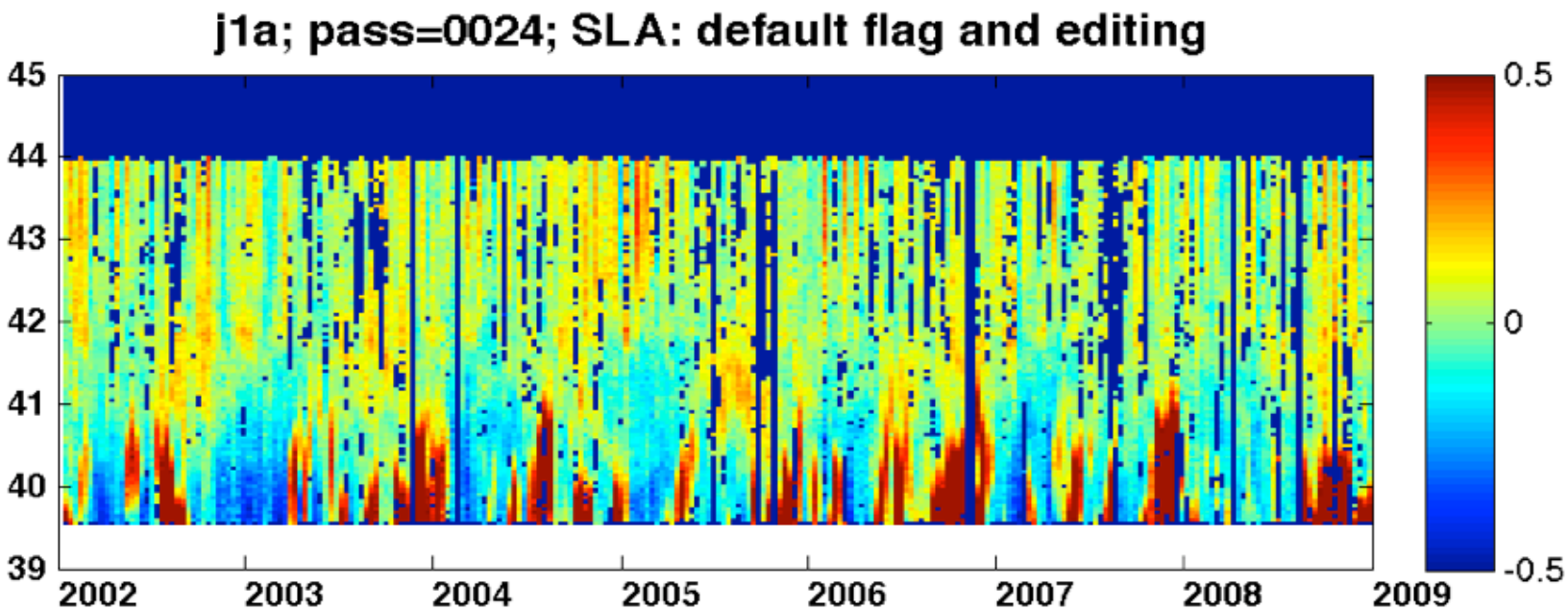


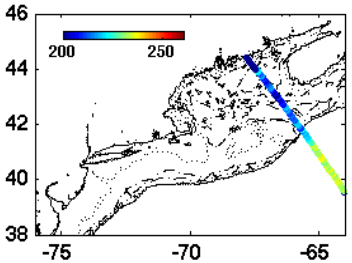
TOPEX, JASON-1, -2, Envisat passes (1993-present) within a well-developed regional coast observing system



Coastal altimeter SSH data issues (1)

- Significant % missing data – from coast to shelf break





What are the leading causes of data gaps ?

What can be recovered?

Coastal altimeter SSH data issues (2)

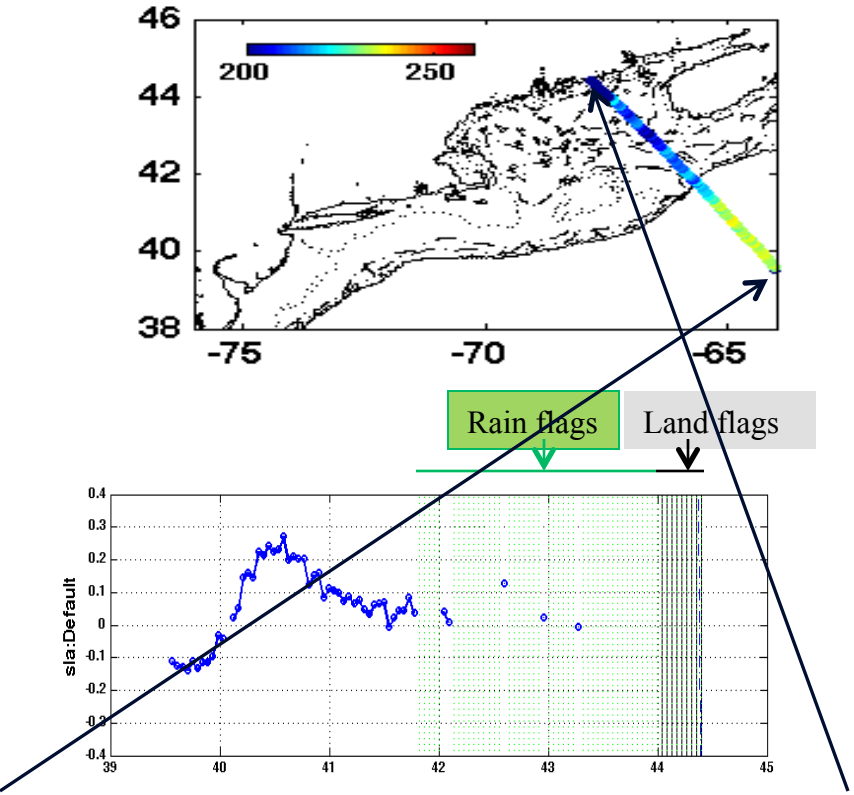
- **Inaccurate geophysical and environmental corrections:**
  - High frequency signal corrections
    - tidal correction by models (GOTxx, FESxxxx, Webtide which is better ?)
    - winds/atmosphere barotropic sea level corrections (IB, MOG2D-G, ..)
  - Water vapor correction by microwave radiometry in a 50-70km coastal contaminated zone
  - Sea state bias - wind and wave dependent with HF noise
- **Radar range errors near the coastline (<10km):**

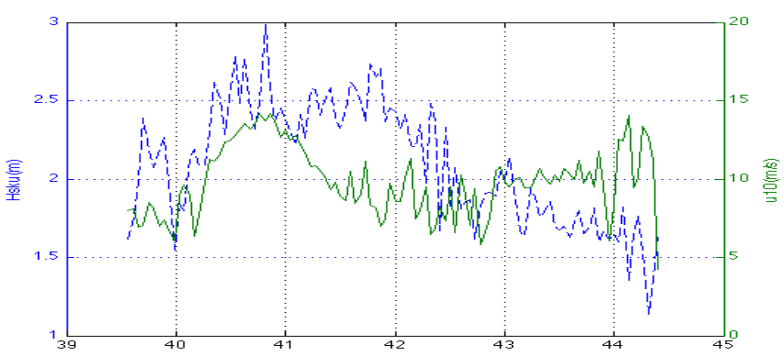
  Need for retracking?
- **Rain-flagged data:** now simply considered "bad" data
- **More ….**

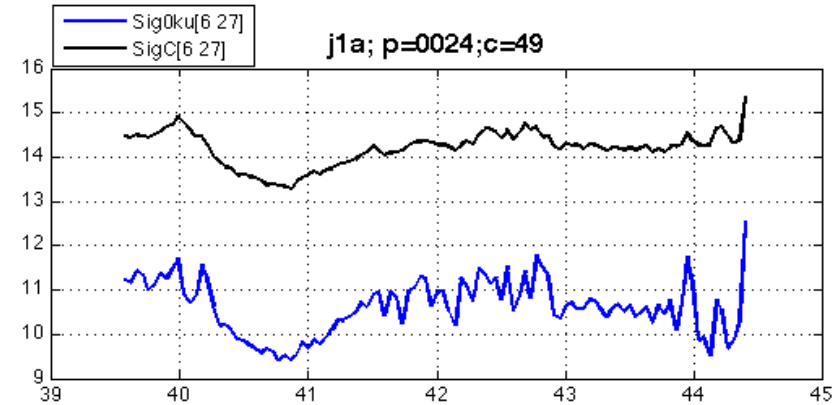
Reprocessing Approach

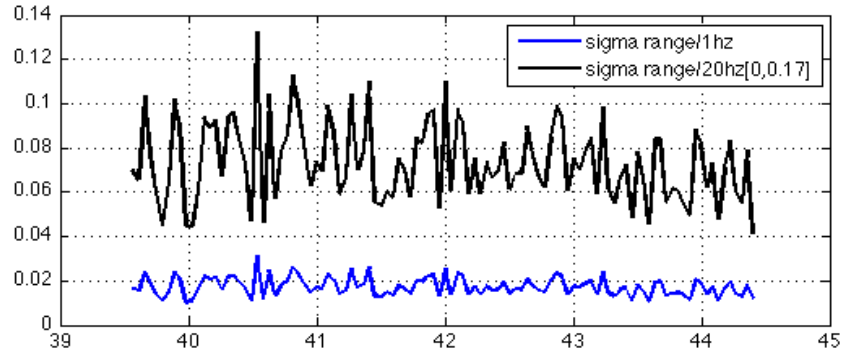
- Performance evaluation of geophysical corrections to determine a set of optimal corrections for the region
- Determination of missing data causes and attempted recovery :
  - Deflagging and editing criteria altered (less convervative)
  - Review each correction and flag to understand issues
  - Apply potential recovery algorithms to each offending correction
- Recovery algorithms including
  - Replace MWR-based wet-tropospheric corr at the coast contaminated observations by ECMWF model
  - Lift rain-flags lifted but apply the range error editing
  - Smooth SSB correction
  - Interpolation and extraplation

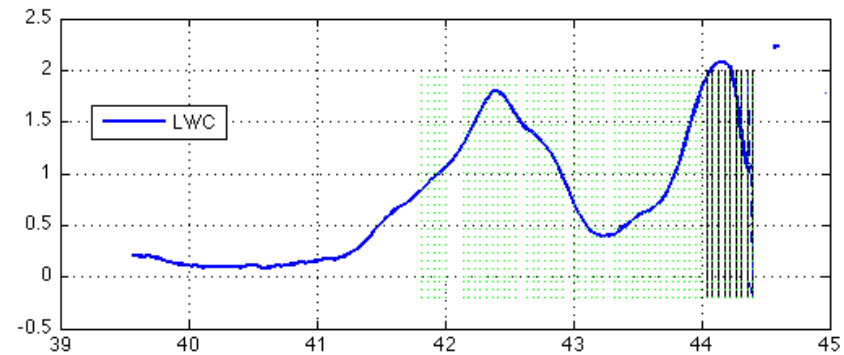
A Rain flag Case : j1a/ pass 24: Cycle 49





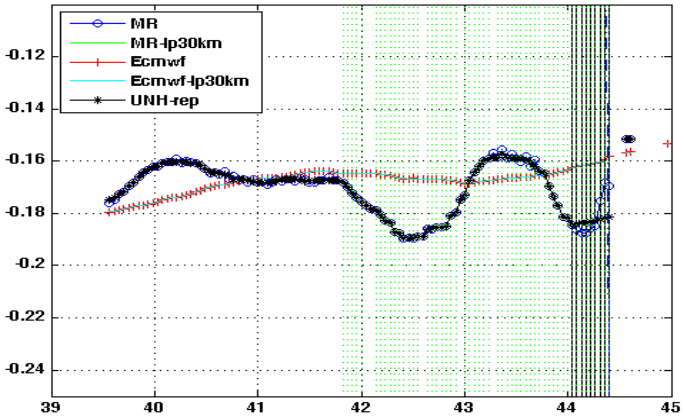




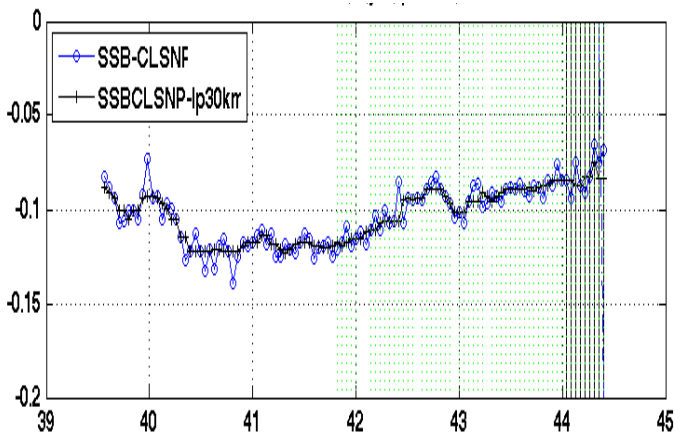


Simple reprocessing for the rain flag case : (j1a/ pass 24: Cycle 49)

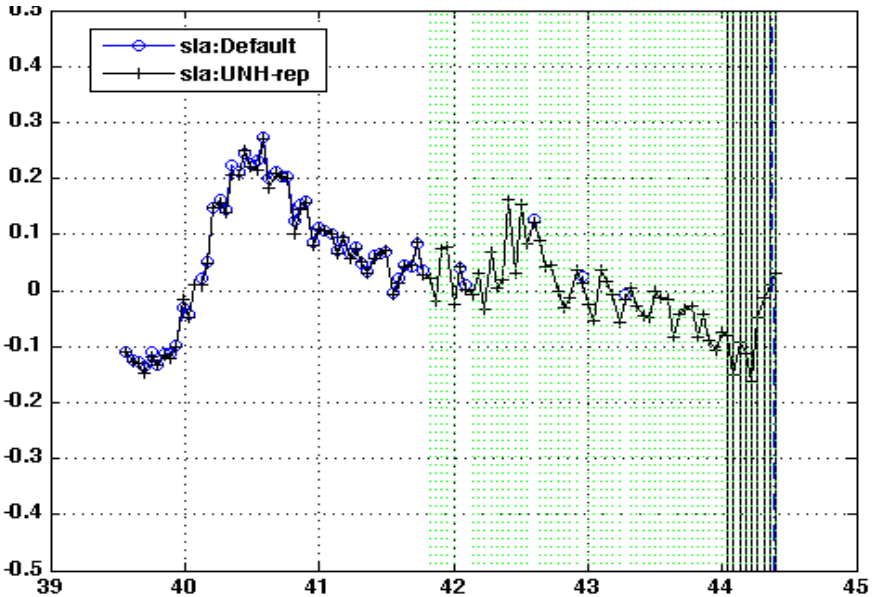
Wet-water vaper correction



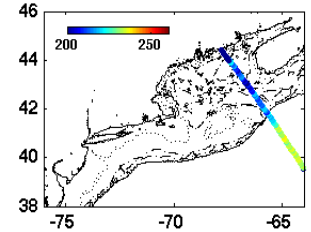
SSB correction



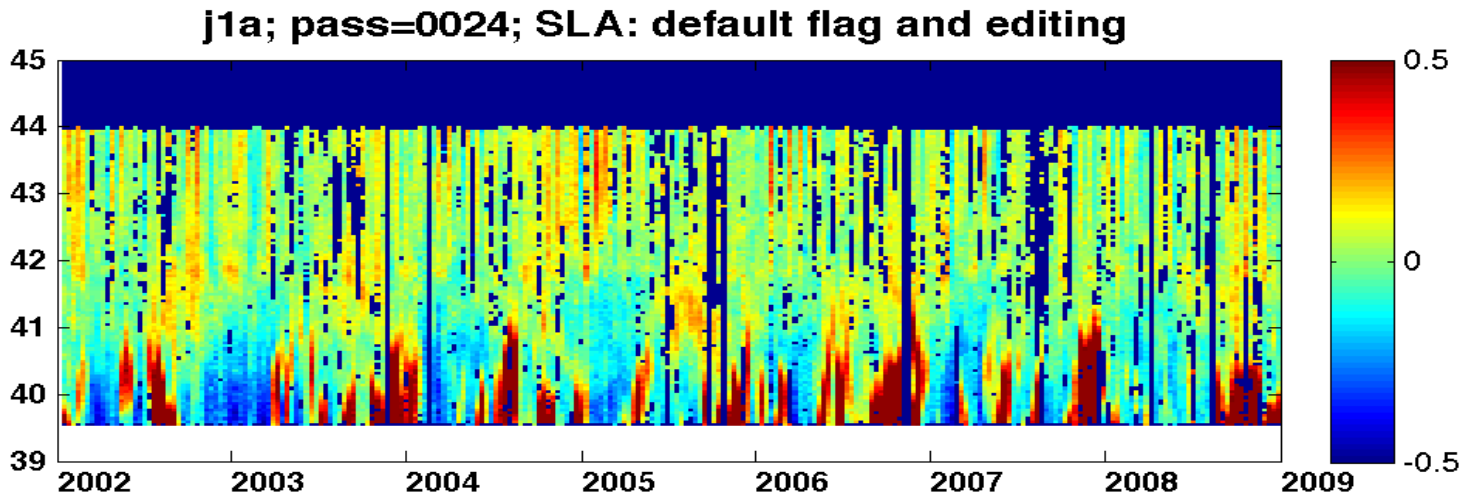
Reprocessed SLA



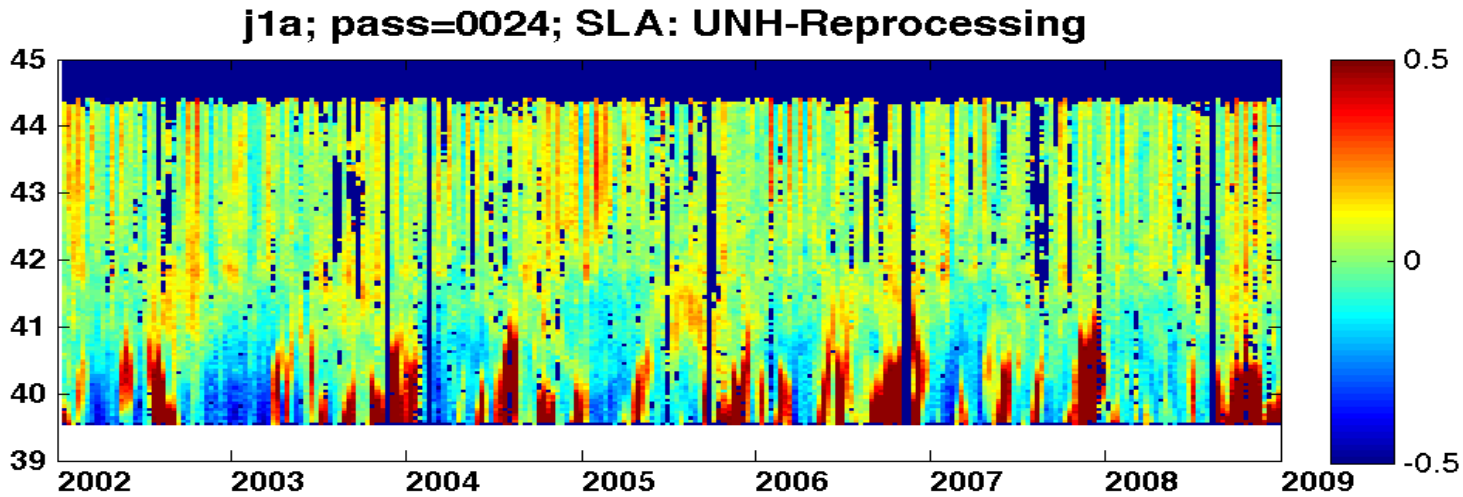
Comparison between SLA with (a) default and (b)UNH processing: J1 pass 024, cycles 1-260

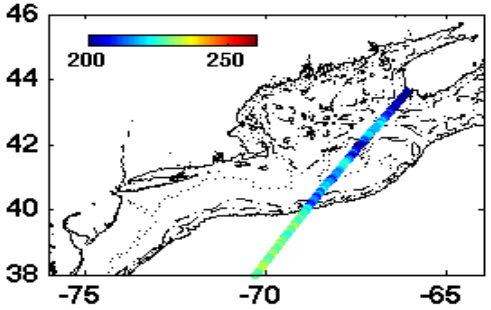


(a)



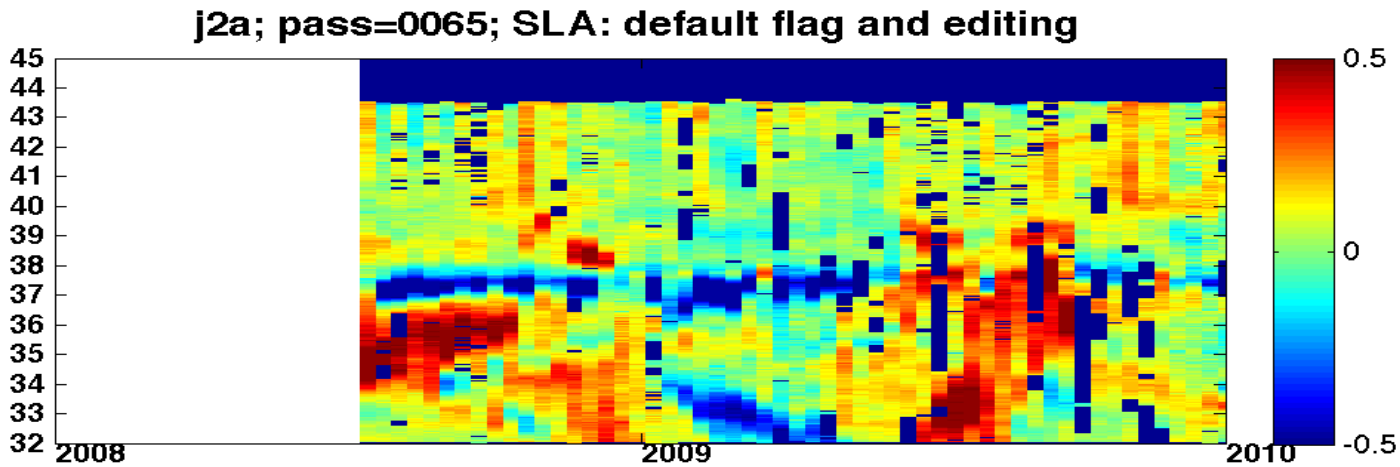
(b)



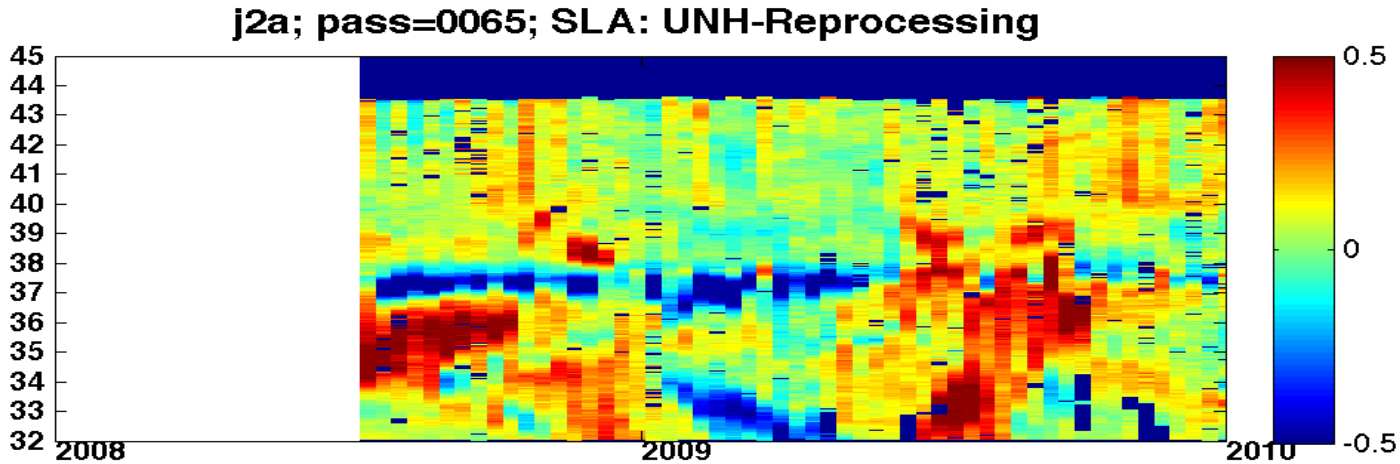


Comparison of SLA data by (a) default and (b) UNH processing: Jason-2 pass 65, cycles 1-72

(a)

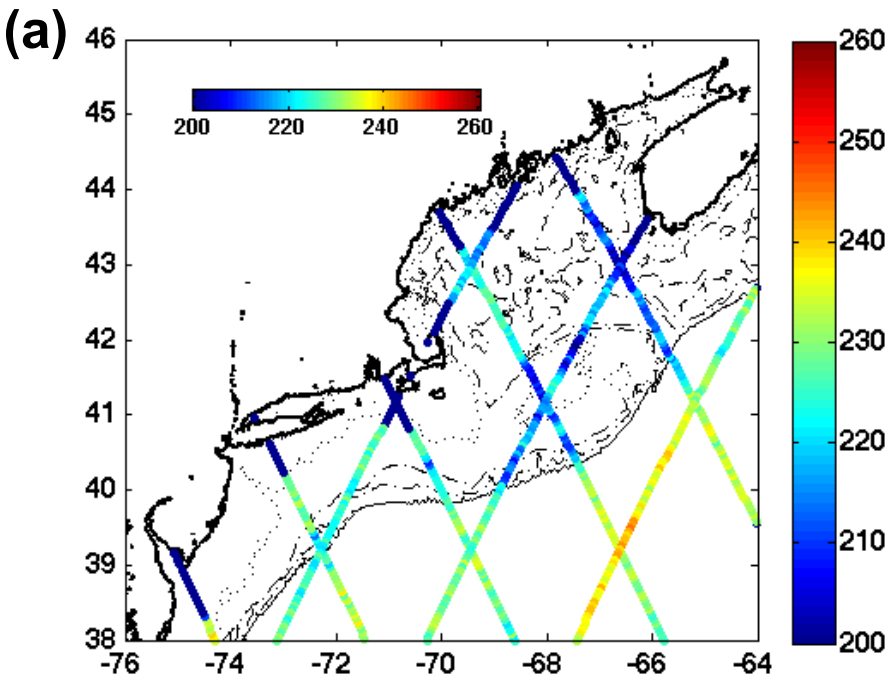


(b)

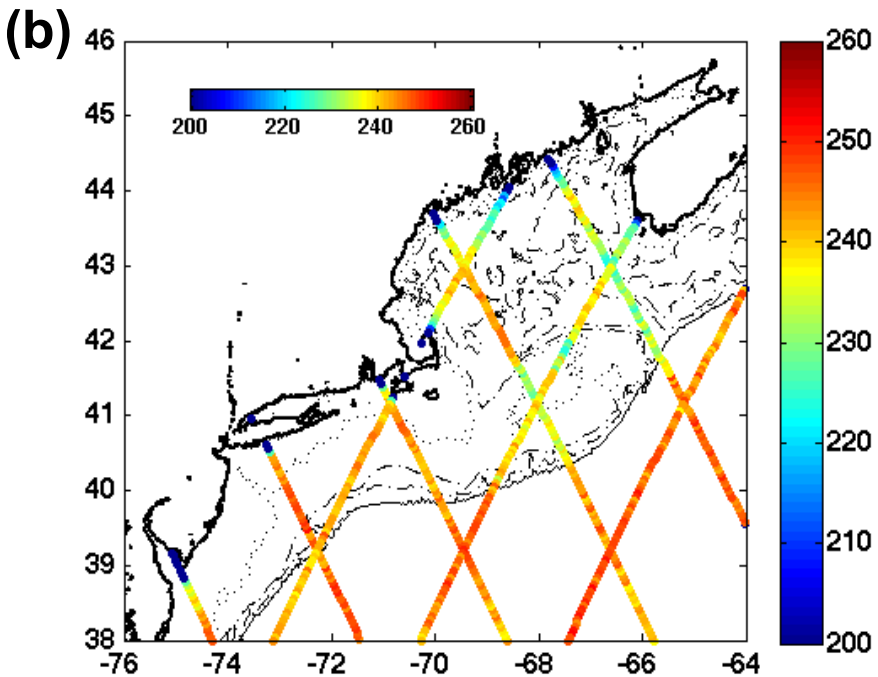


Number of valid SLA samples (out of 260) in (a) default and (b) UNH-reprocessing: Jason-1 eight tracks, Cycles 1-260

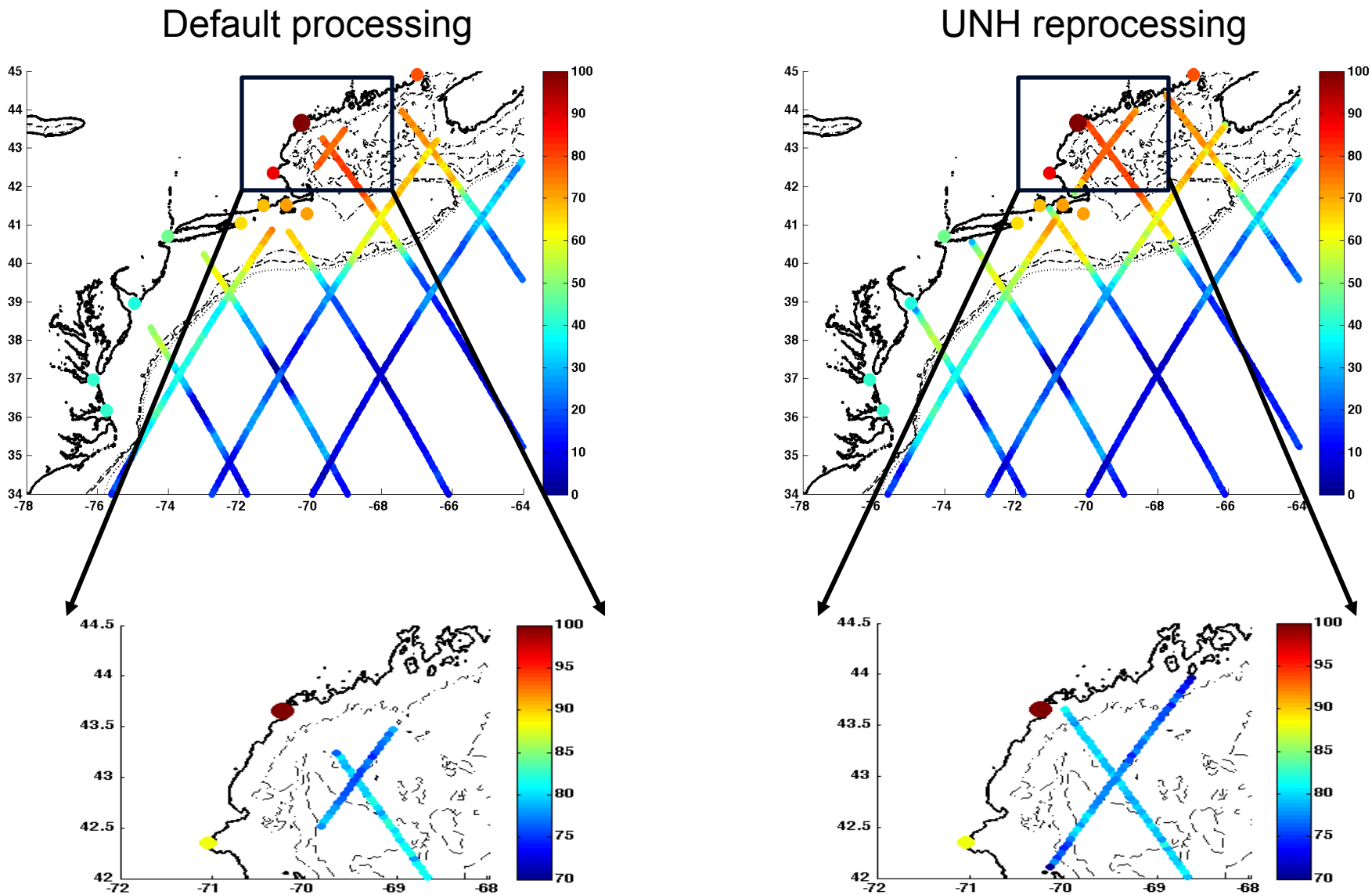
Default processing



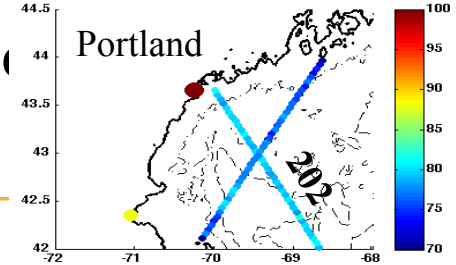
UNH reprocessing



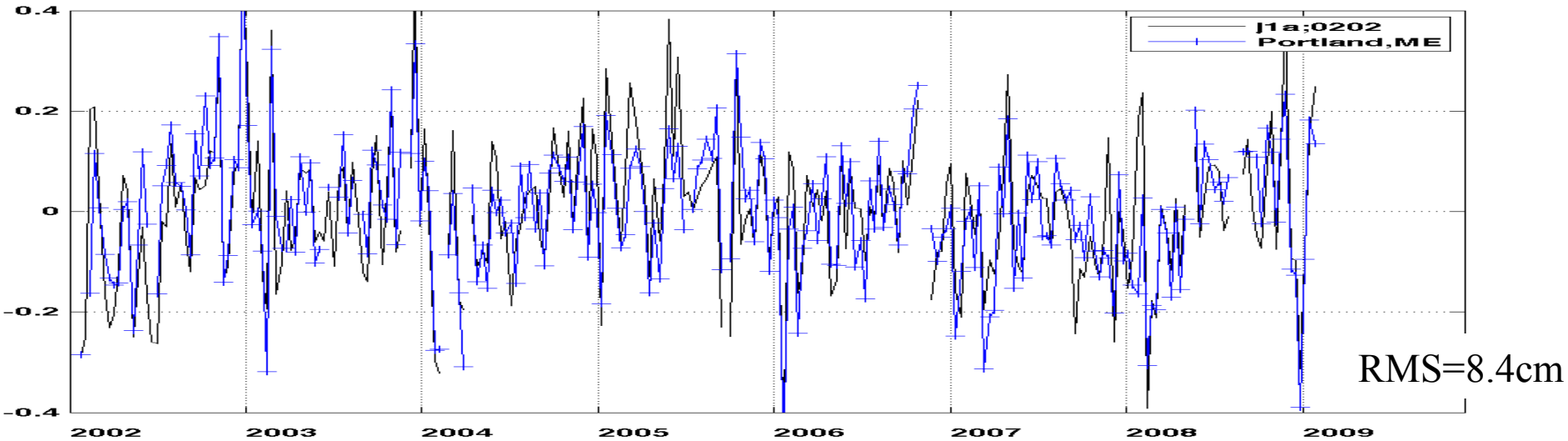
Mapped correlation (in %) between Jason1 (Cycles 1-260) SLA and the instantaneous tide gauge SLA at Portland (Default vs. Reprocessing). The Portland TG SLA correlations with other coastal TG stations are shown as well.



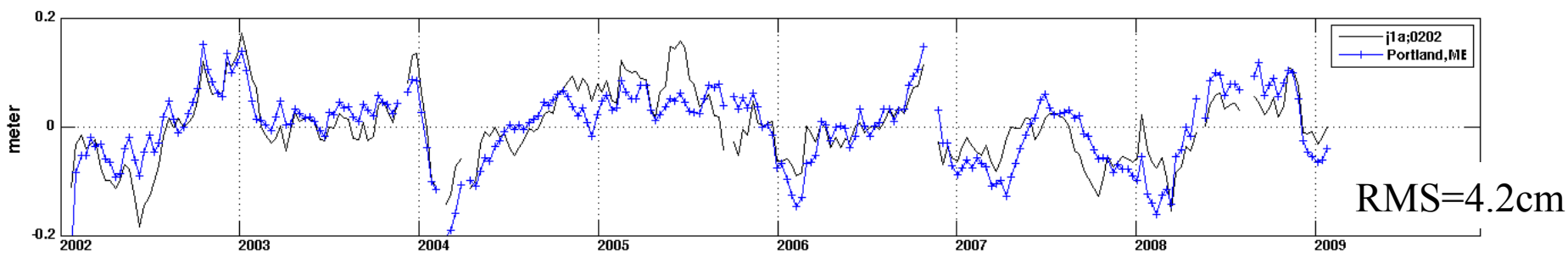
Jason1-track 202 SSHAs vs. Tide Gauge SLAs at Portland at the max correlation position (UNH reprocessing)



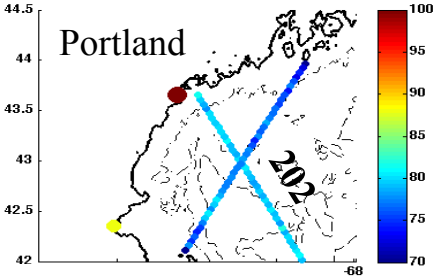
a) Instantaneous TG SLA vs. alt SSHA



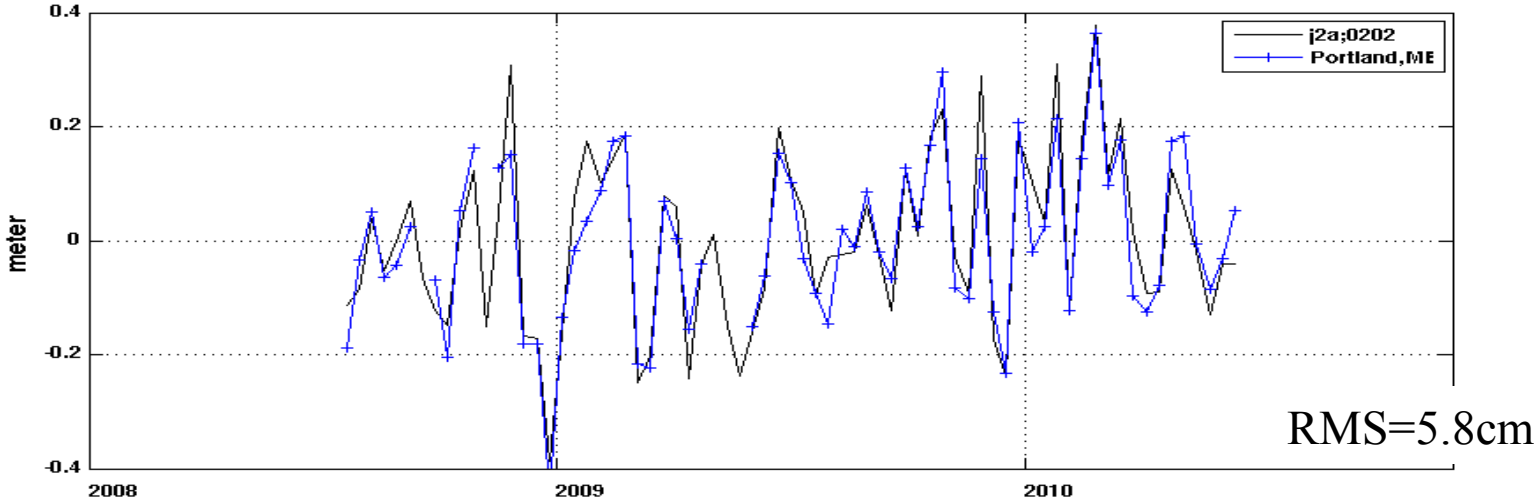
b) 60-day low pass filtered TG and alt SSHA



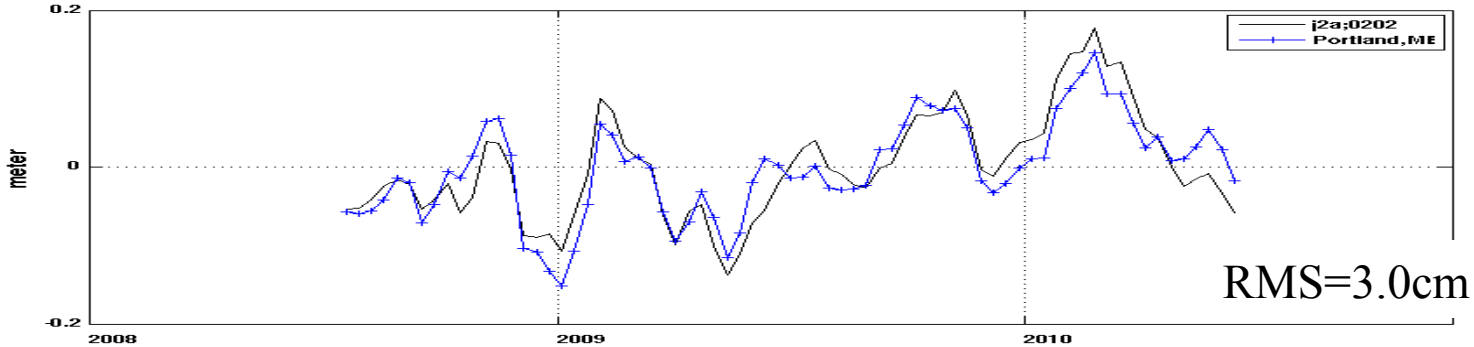
Jason2-track 202 SSHA vs. Tide Gauge SLA at Portland at max correlation position (UNH processing)



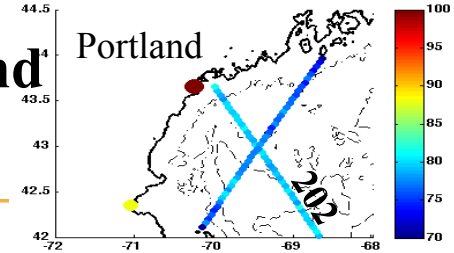
a) Instantaneous TG SLA vs. alt SSHA



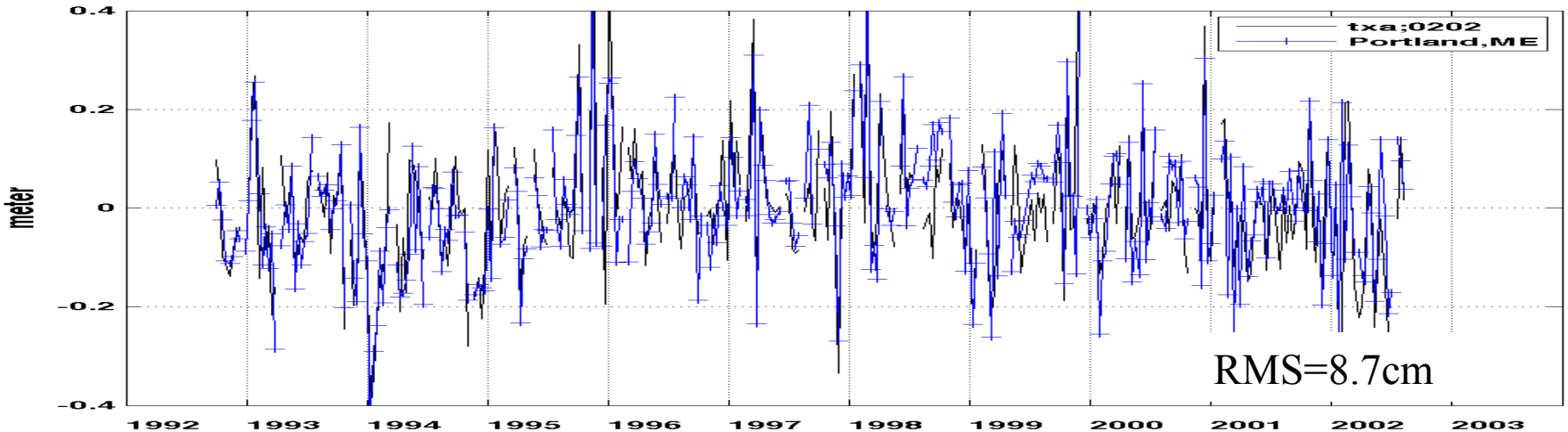
a) 60day mean filtered TG SLA vs. alt SSHA



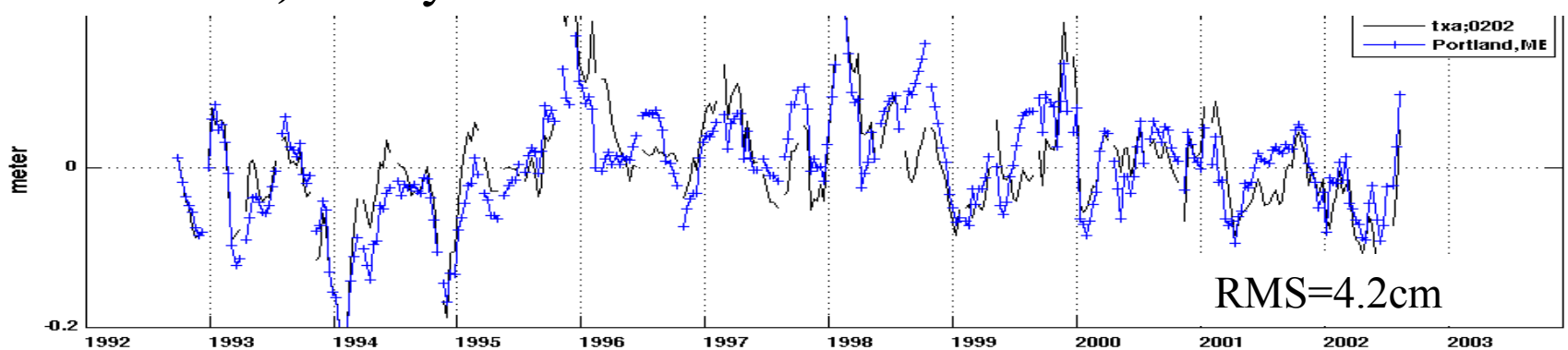
TOPEX track 202 SSHAs vs. Tide Gauge SLAs at Portland at the max correlation position (UNH reprocessing)



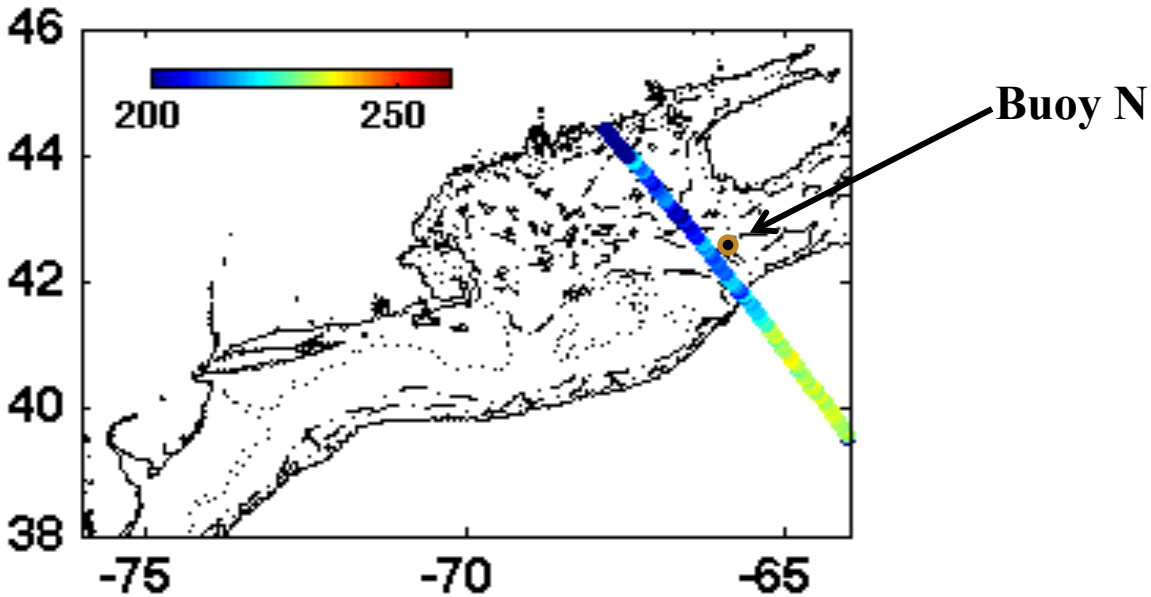
a) Instantaneous TG SLA vs. alt SSHA



b) 60day mean filtered TG SLA vs. alt SSHA



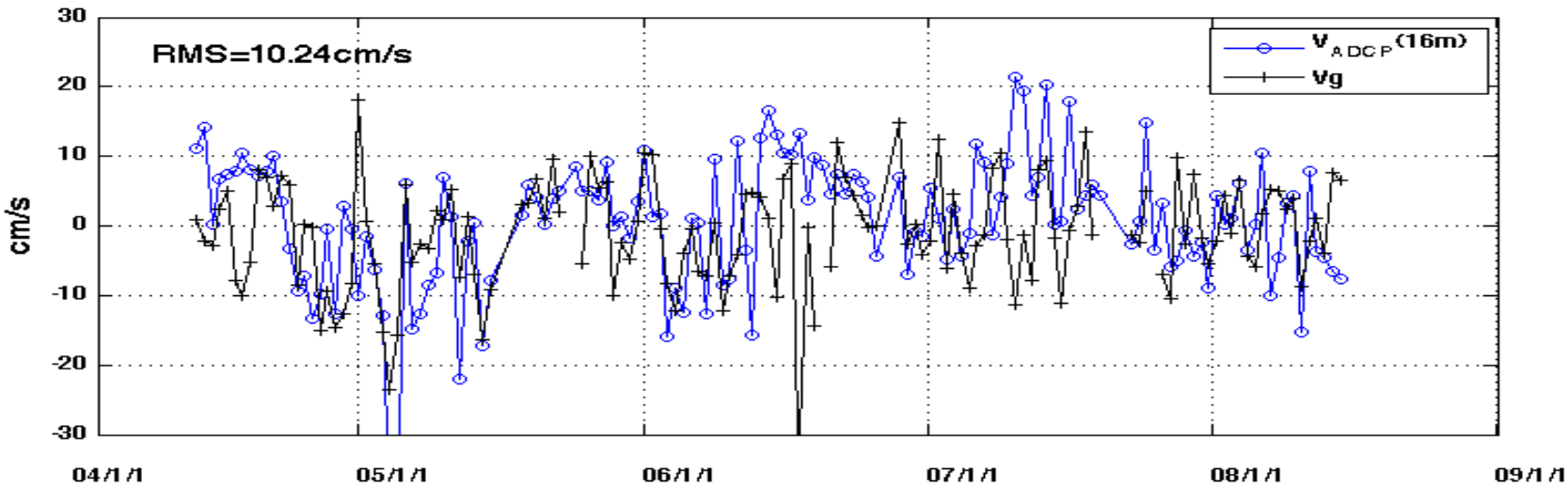
Jason1 derived geostrophic velocity vs. buoyADCP current (Track 024 at GoMOOS Buoy N)

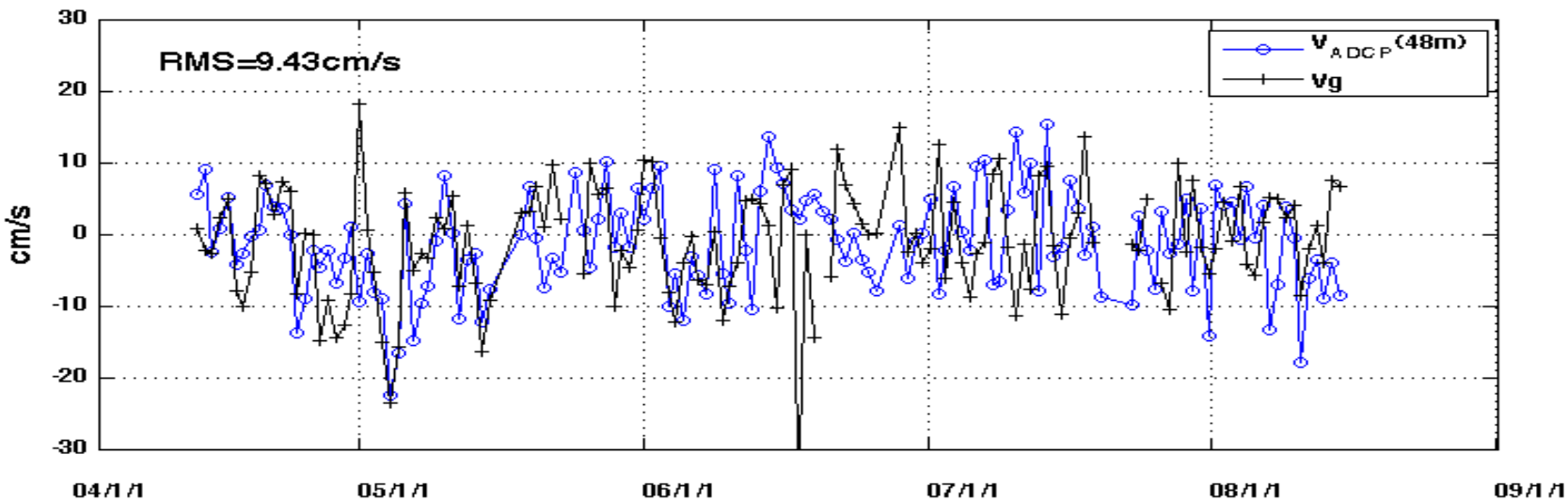


- ADCP current V_{ADCP} detided/ projected to cross track
- Jason1 cross-track surface geostrophic Vg is derived by
  - centered difference over ~62 km (10 ground points)
  - 3-point running mean filter is applied along track

Jason1 derived cross-track geostrophic velocity vs. buoyADCP current (Track 024 at GoMOOS Buoy N)

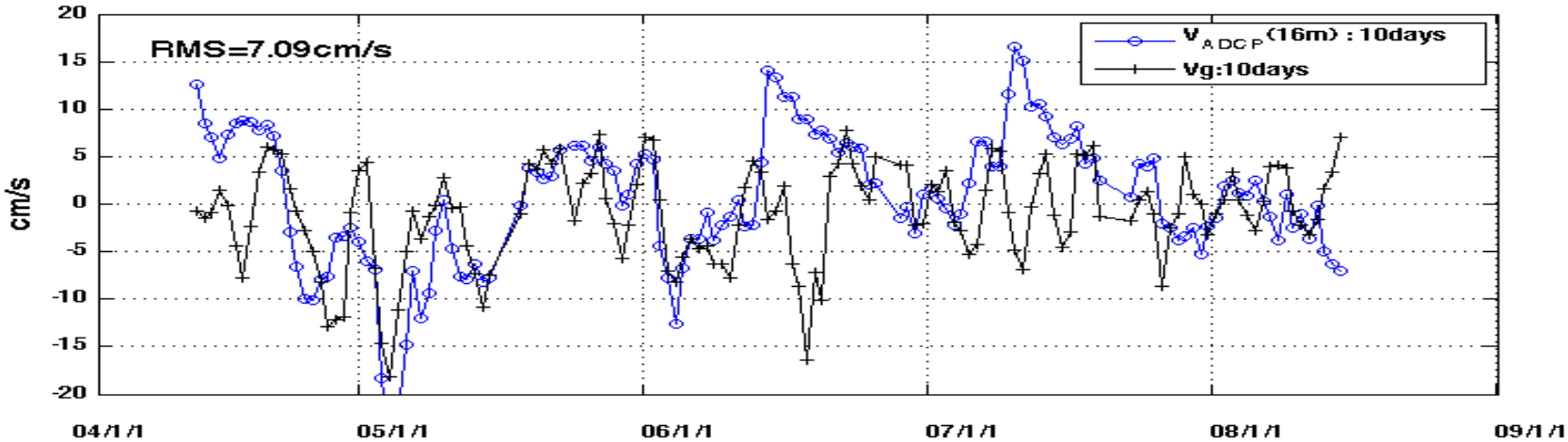
Instantaneous 10-day sampling V_{ADCP} and V_g

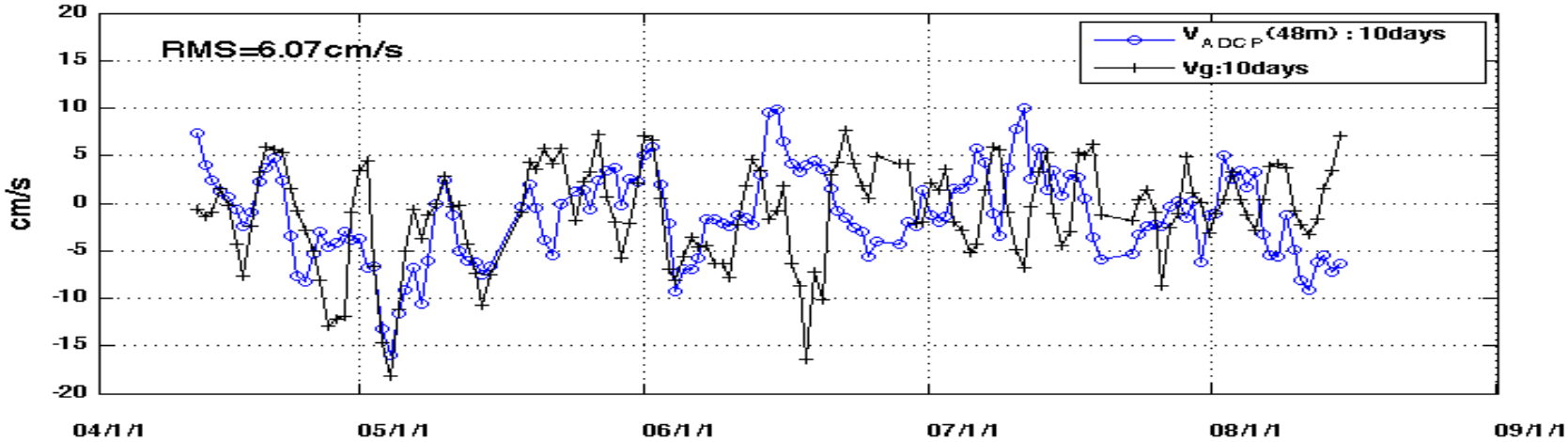




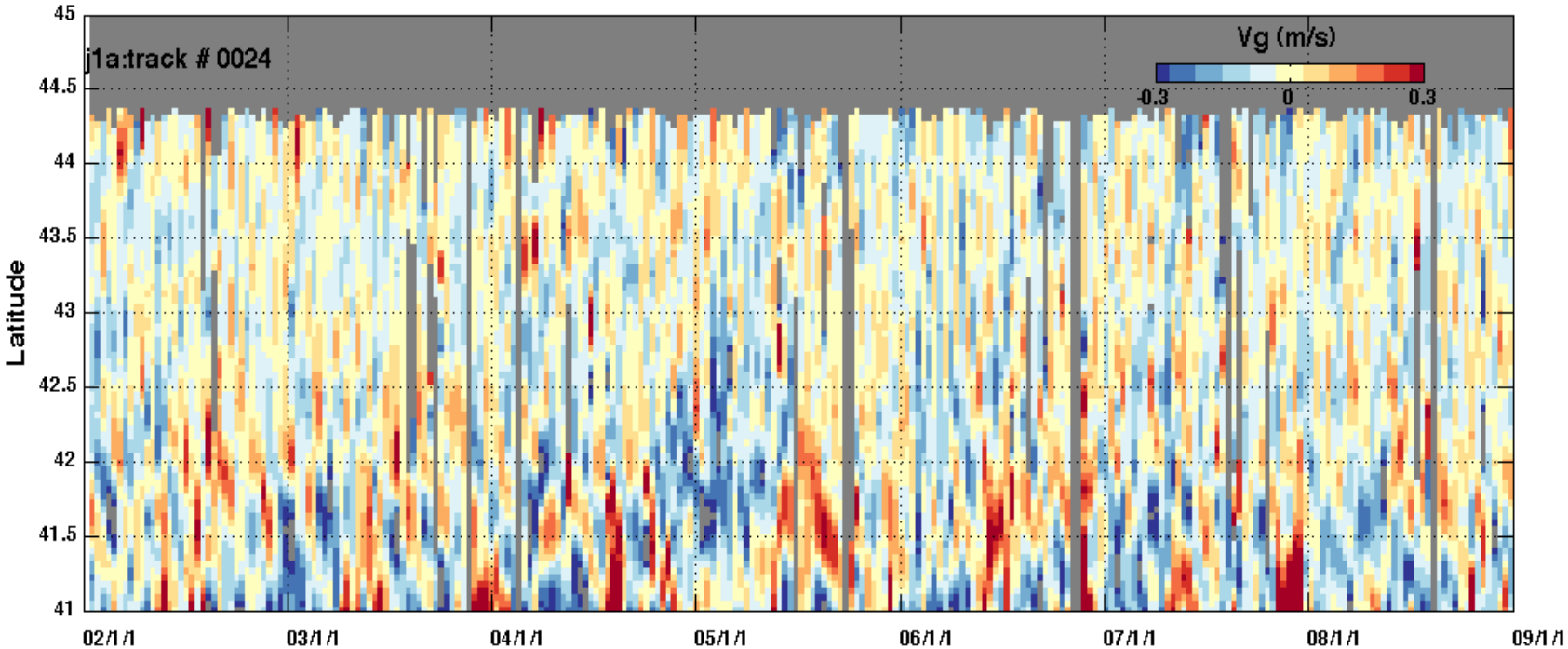
Jason1 derived cross-track geostrophic velocity vs. buoyADCP current (Track 024 at GoMOOS Buoy N)

60-day moving mean V_{ADCP} and V_g





Jason-1 along-shelf geostrophic current velocity (pass 024)



Summary

- Reprocessing can recover
  - 5-10% of rain-flagged data by deflagging/re-editing
  - Land-contaminated observations by deflagging/using model wet-tropo corrections
- Validation
  - TG sea level vs. Alt-SSHA
  - Buoy current vs Alt-Vg
- Future work
  - Feng et al., Marine Geodesy Vol. 2 in preparation
  - Coastal barotropic variability – coastally-trapped waves
  - Seasonal and longer scale intra-basin flow in GoMaine
  - Shelf break and along shelf flow with Wilkin, Lopez, et al.

Acknowledgements

NASA's Science Directorate Physical Oceanography Program

Radar Altimeter Database System (RADS)