A Wind-Wave-Current Data Assimilation Scheme for the 3D-Real Time Mesoscale Analysis

A NOAA-JTTI Project with NOAA EMC and NOAA CSL Collaboration

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Project Goals and Objectives

To advance the science and technology of data assimilation of surface wind, sea wave, and surface ocean current in the 3D-RTMA.

- Data QC for new marine and ocean observations
- Regional MOM6 ocean model
- Field-alignment on background fields
- Background error covariance wind-wave modeling
- Data assimilation scheme for mesoscale windwave-current fields

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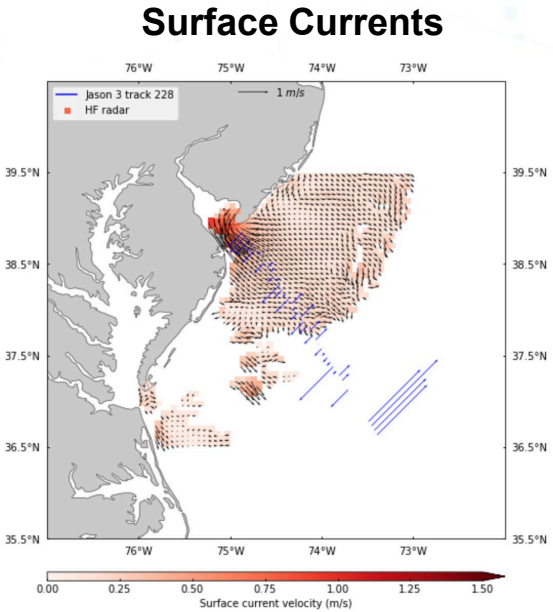
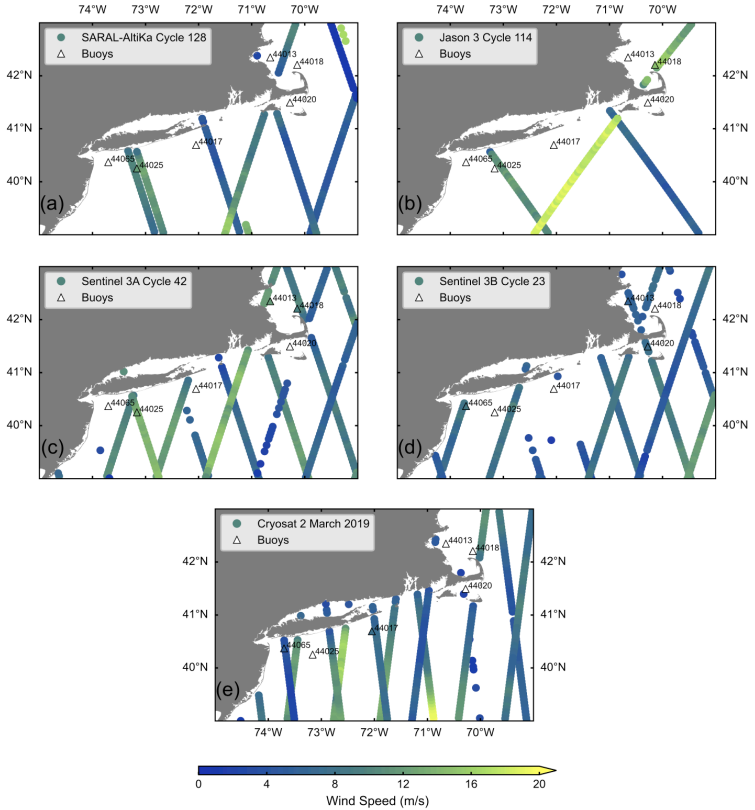
Datasets for validation of 3DRTMA

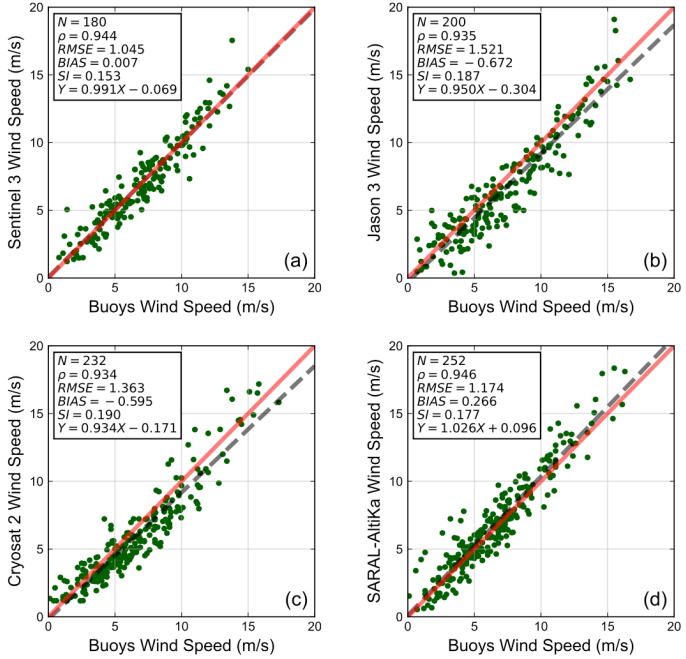
- Increase the robustness of the data quality control system for marine and ocean variables–especially the High-Frequency Radar and Satellite Altimetry data,



- ➢ Data a collected since 2006
- ➢ Surface current products
  - 2 km and 6 km resolution
- ➢ No operational QC algorithm
- ➢ Validation data ongoing
  - Pioneer array
  - ADCP and SOFAR drifting buoy

Satellite altimetry data vs. in situ surface winds





Mitsopoulos et al., 2023

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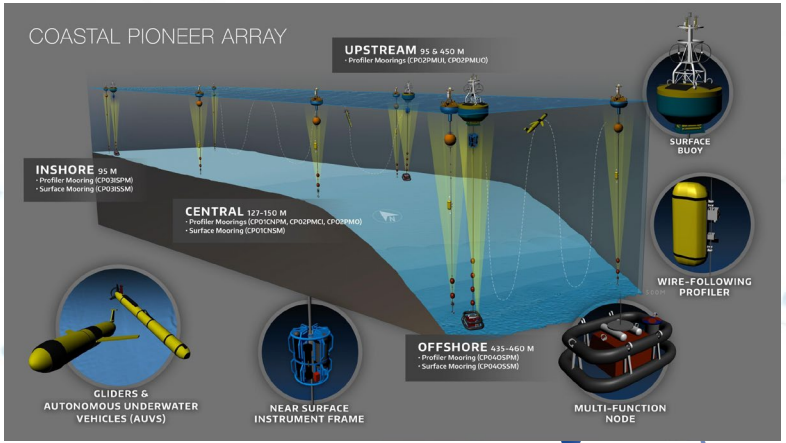
Tasks: Data Quality Control of New Observations

- IODA Software
- IODA Software to develop forward operator



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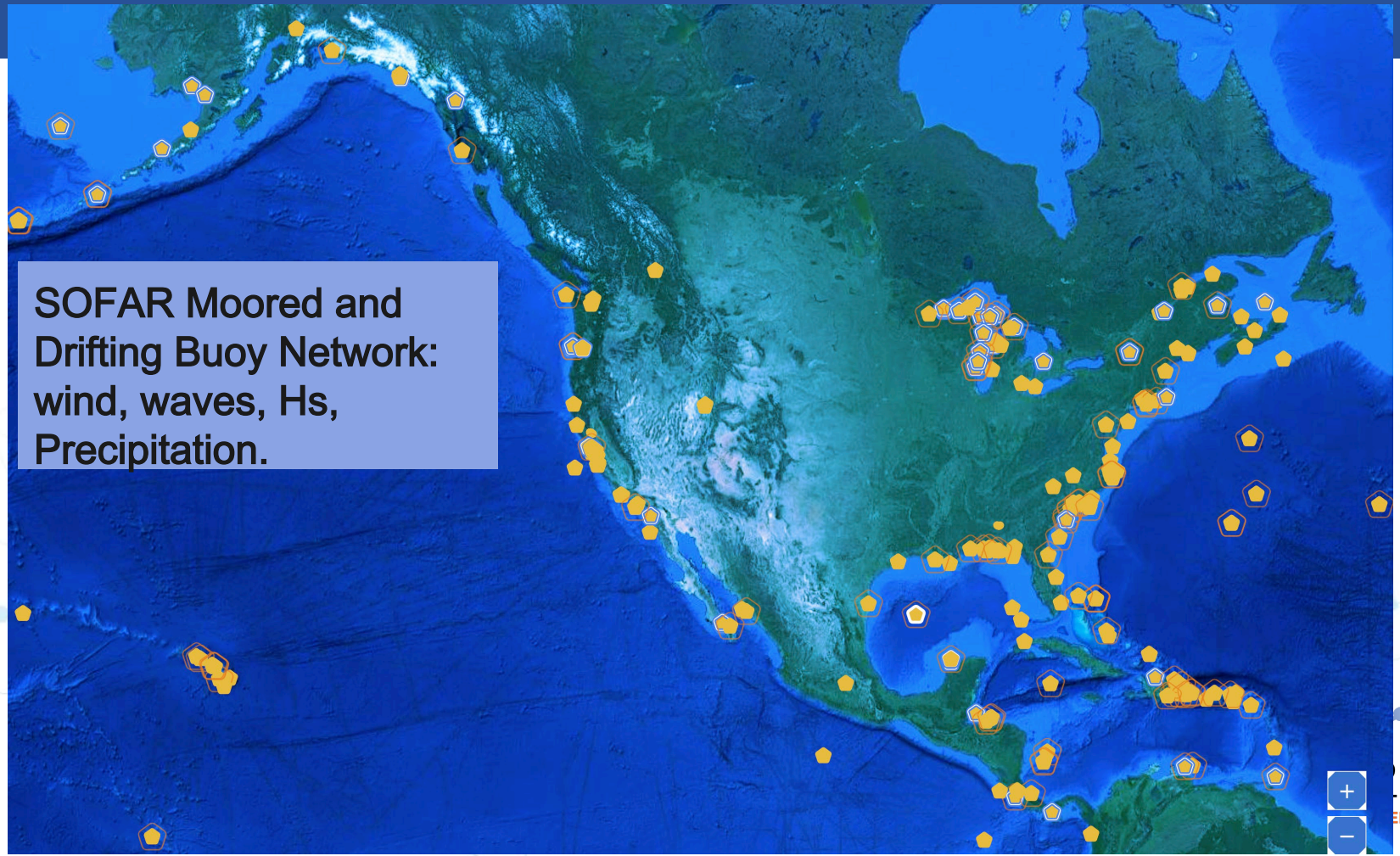
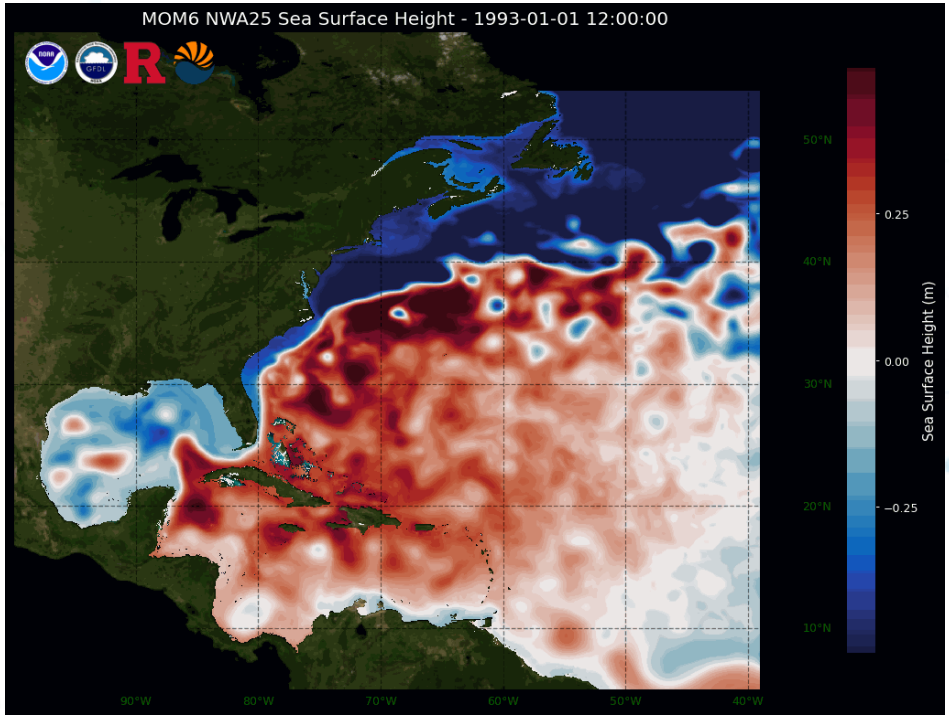
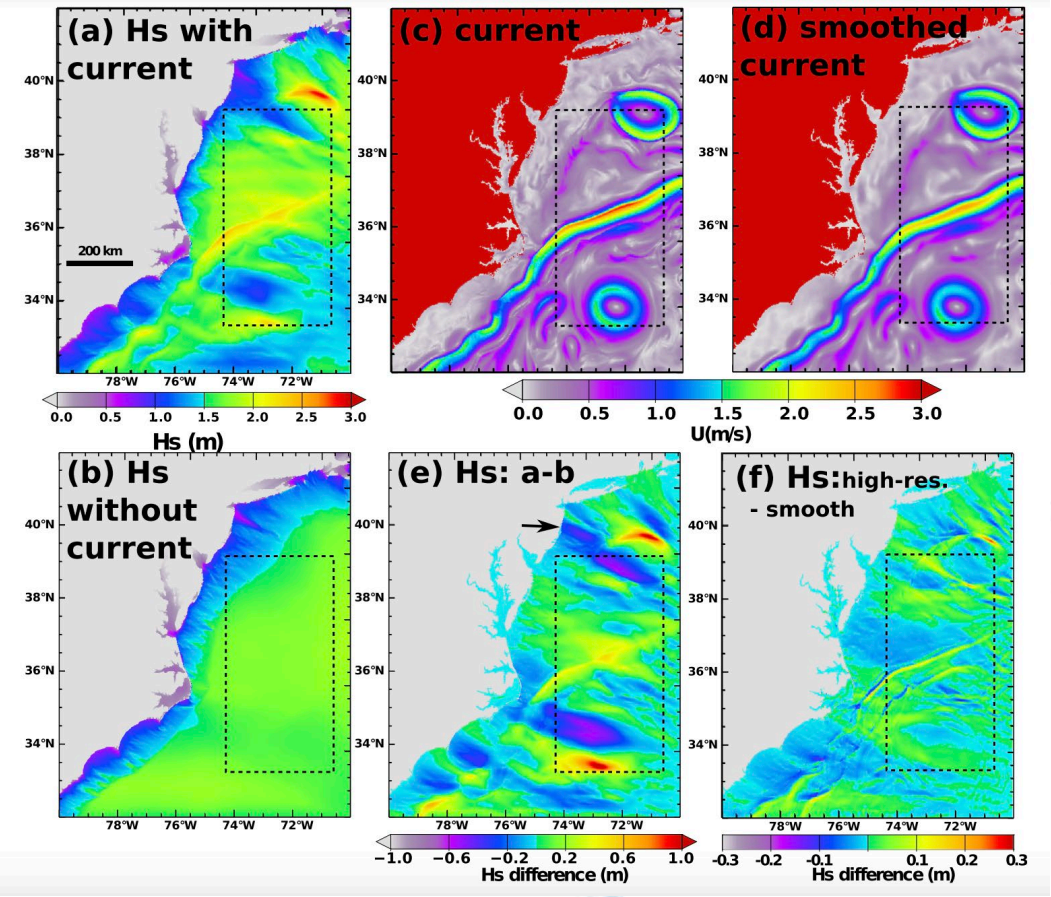

SOFAR Moored and Drifting Buoy Network: wind, waves, Hs, Precipitation.

Objective 2. Surface ocean currents

- Stable version of RegMOM6 at 1/25th (4 km)
- Forcing: ERA-5 on the surface, Mercators' GLORYS for ocean open boundary conditions, NASA' TPXO for explicit tides.
- Period: 1993 to present.
- Yearly Perfect Restart
- All data is being post on THREDDS



Diagnosing consistency Wave-Currents



Impact of current field resolution and on H_s

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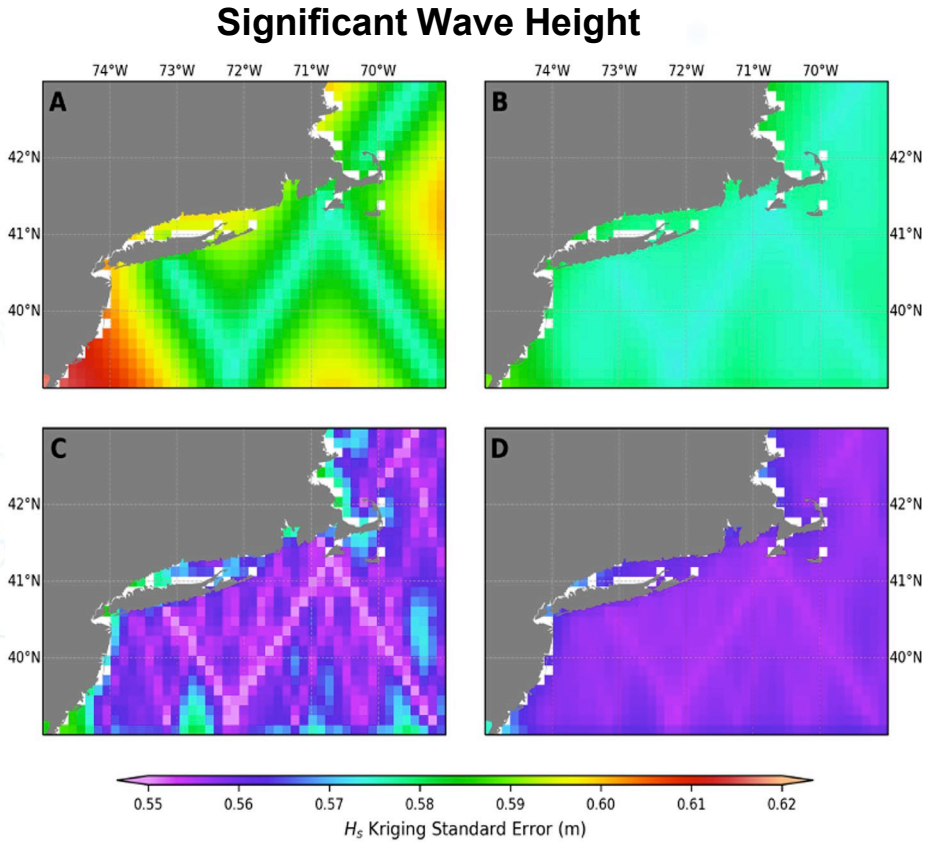
Diagnosing Data Impact



Accumulated analysis increments over time.
Analysis error reduction on each overpass.

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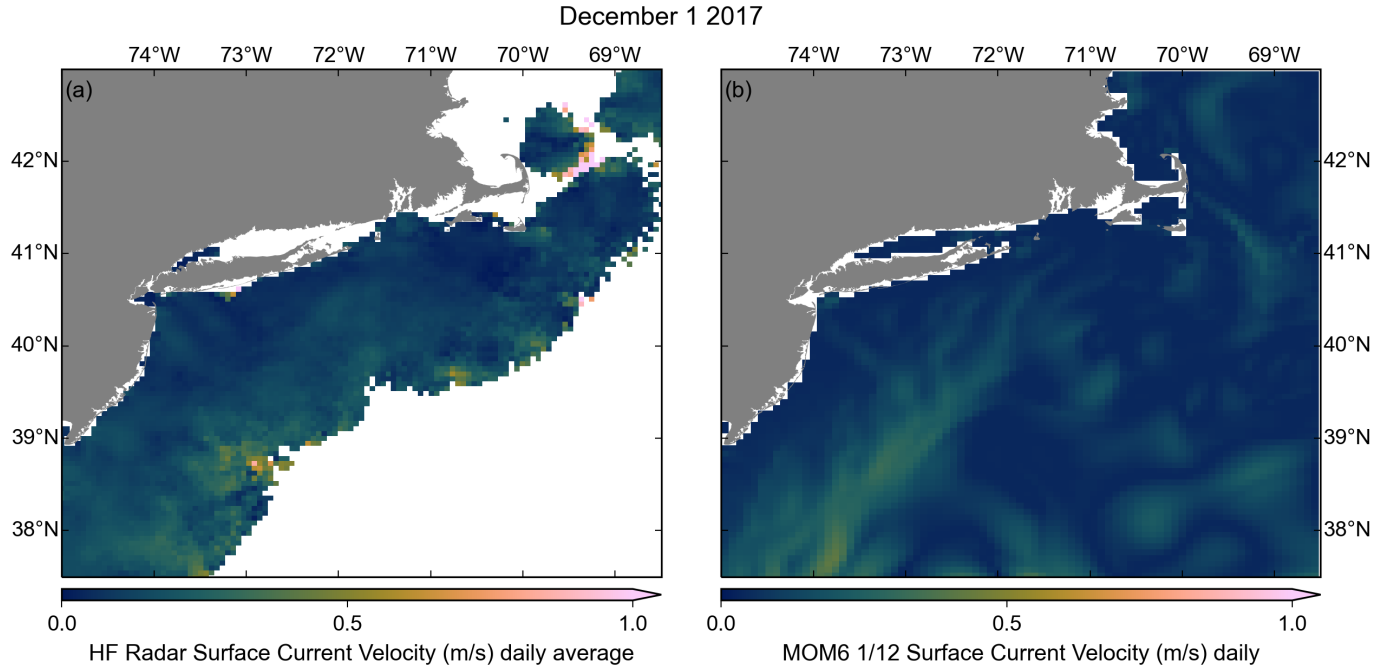
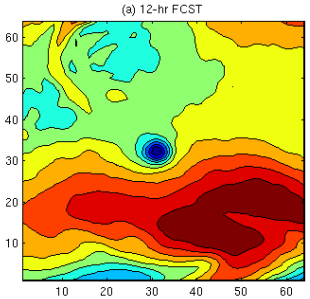
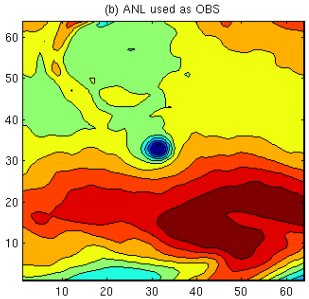
HF-Radar vs. MOM6 currents

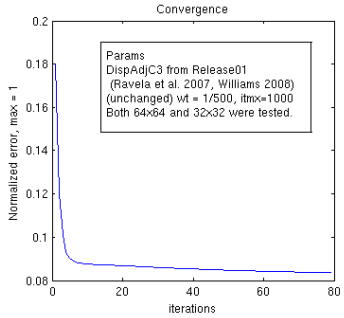
- Implement a field-alignment processing scheme for positional and amplitude error reduction in the background fields,

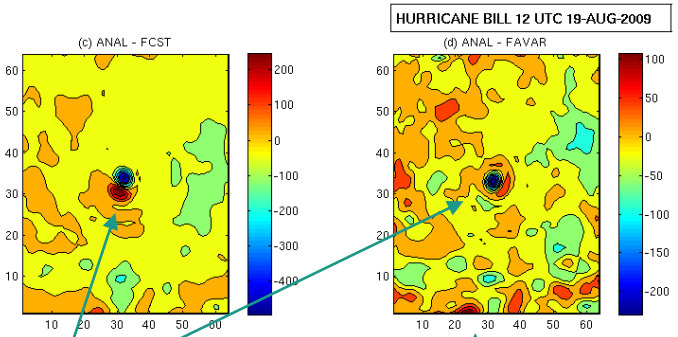


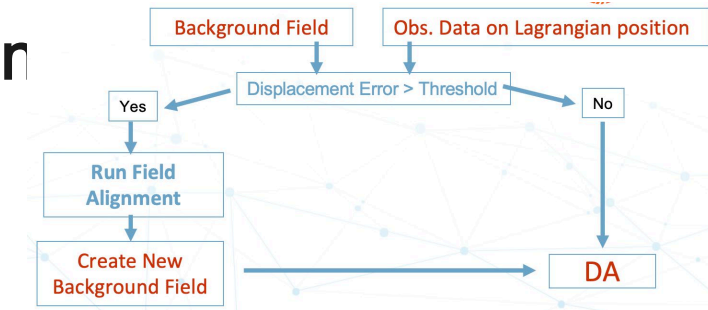
Objective 3. Field Alignment Experimen











After 10 iterations acceptable solution is found

The y-axis (latitude) is reversed in this fig.

Displacement error of the vortex's center is eliminated

Analysis minus new forecast field

Domain's boundary is non-zero: Discontinuity generated

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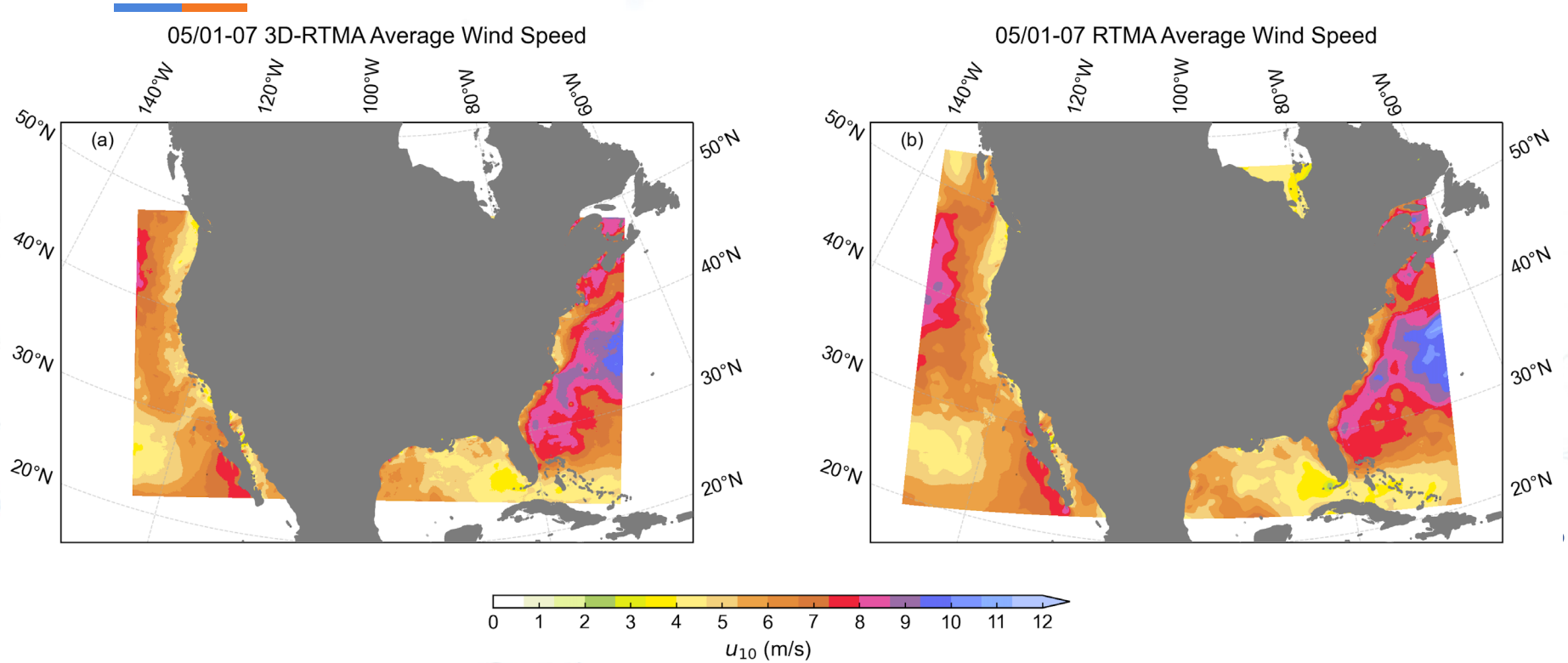
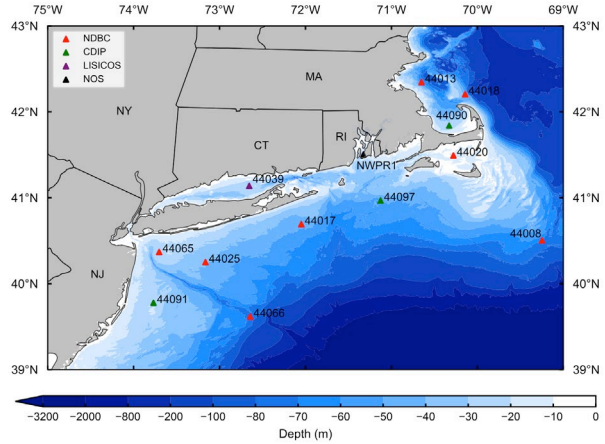
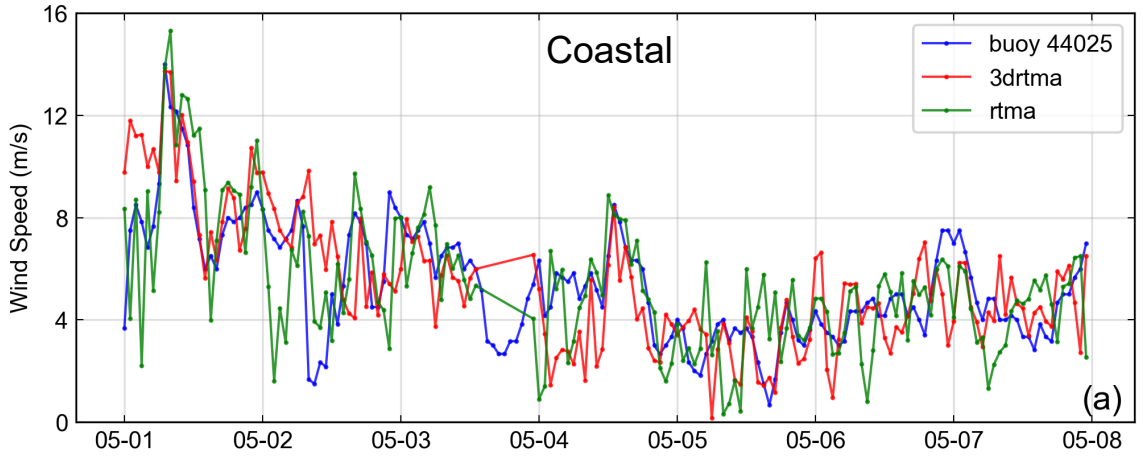
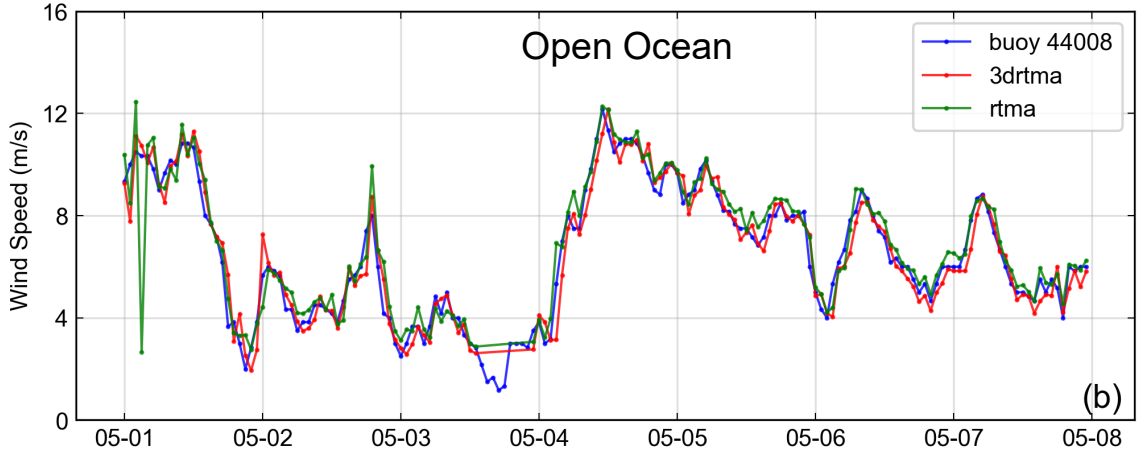
3DRTMA vs RTMA Wind Speed



Coastal and Open Ocean Wind Analyses







Bias correction Methods

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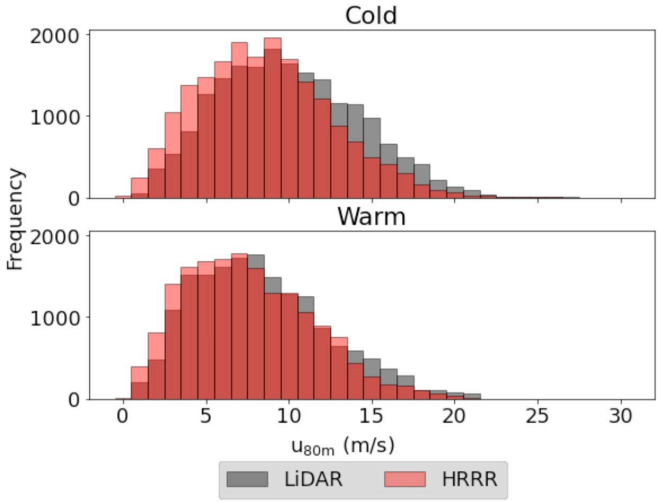
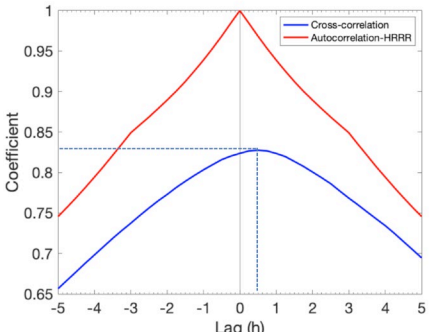
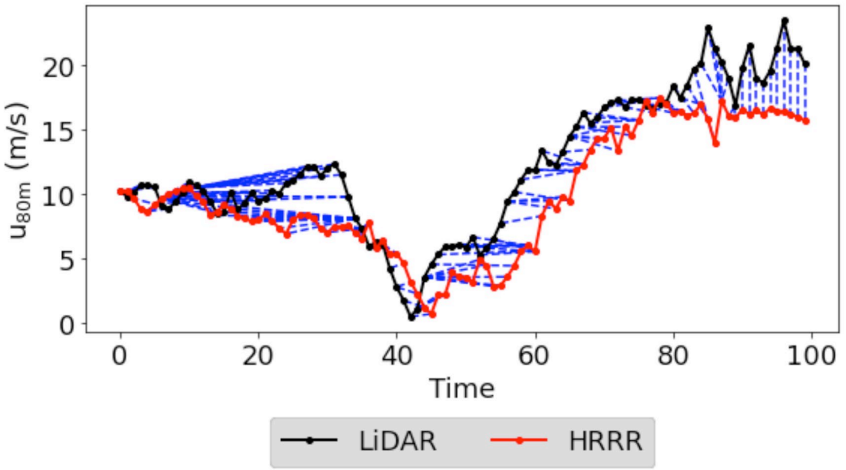
80-m wind timeseries in the HRRR

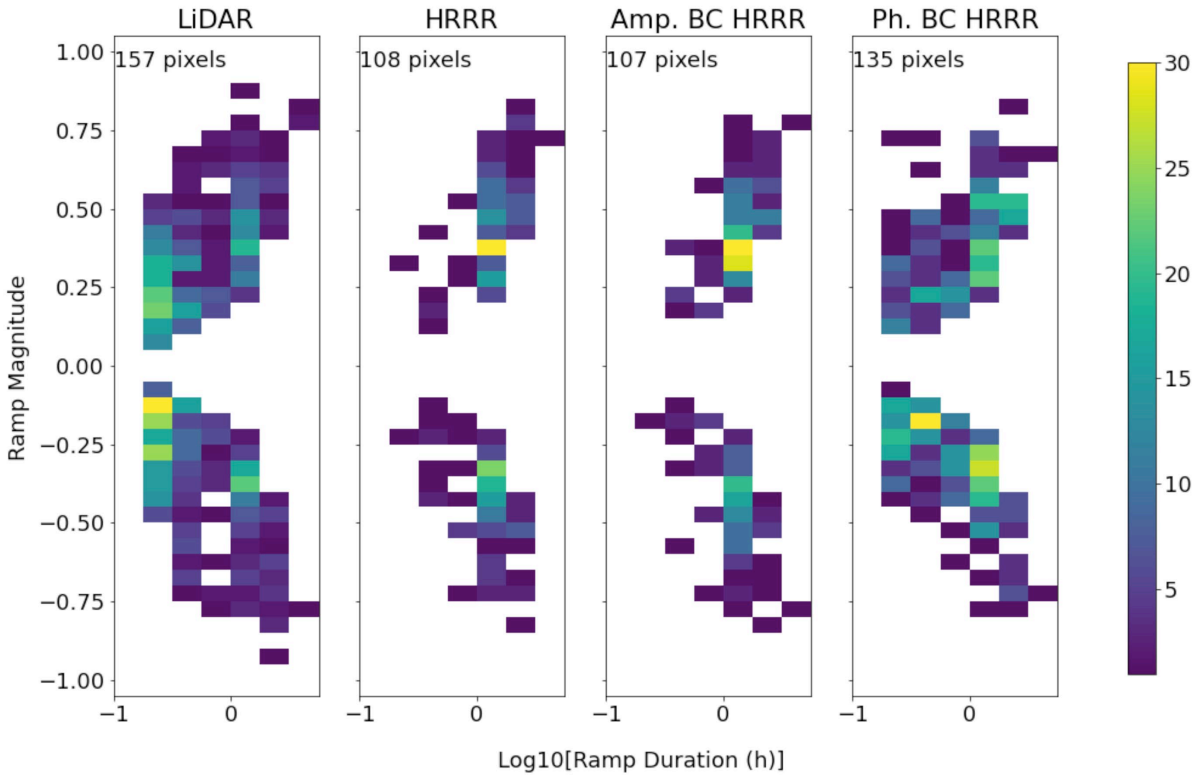




Dynamic Time Warping



Wind Ramps Statistics



Future Work

- RegMOM6 to be ported to the UFS framework
- Workflow management to integrate new software
- Background Error Covariance of wind-wave
- Metrics for Consistency
- Determine suitable configuration of RegMOM6