Evaluation of the Ocean Surface Winds From Reanalyses in the Nordic Seas

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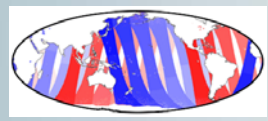
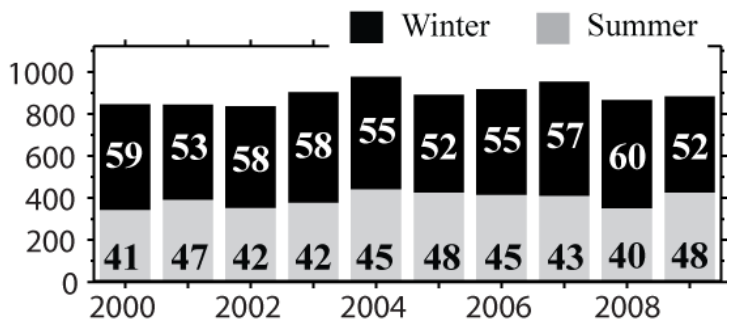
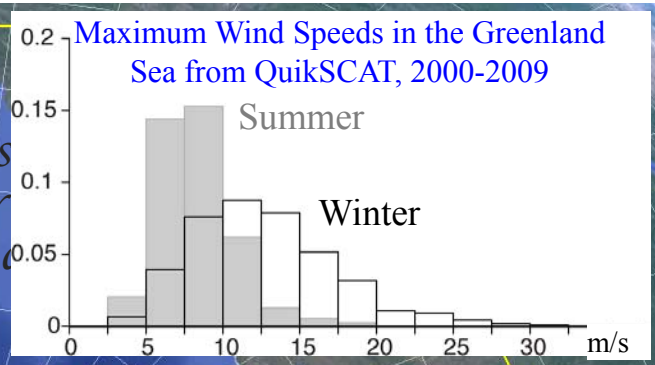


Acknowledgment: The study is funded by the **NASA OVWST & ONR NOPP**. This work was supported by a grant of computer time from the DoD High Performance Computing Modernization Program at NRL SSC.

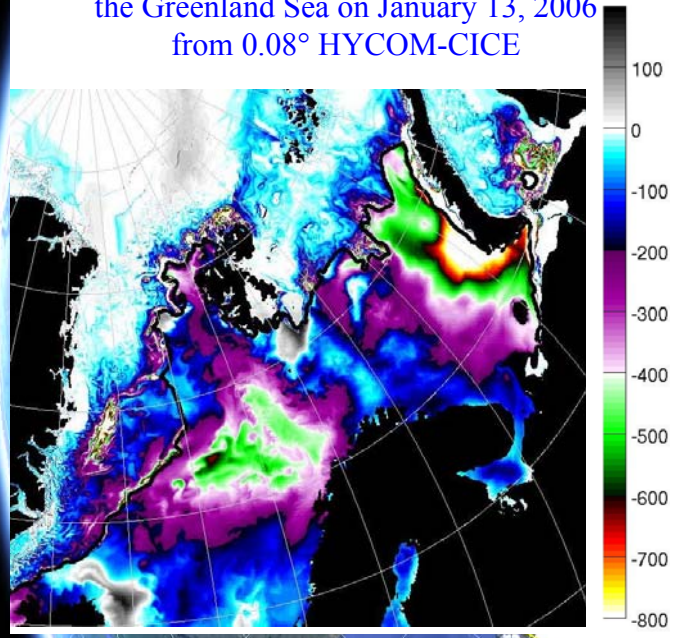
Number of Cyclones in the Nordic Seas from CCMP



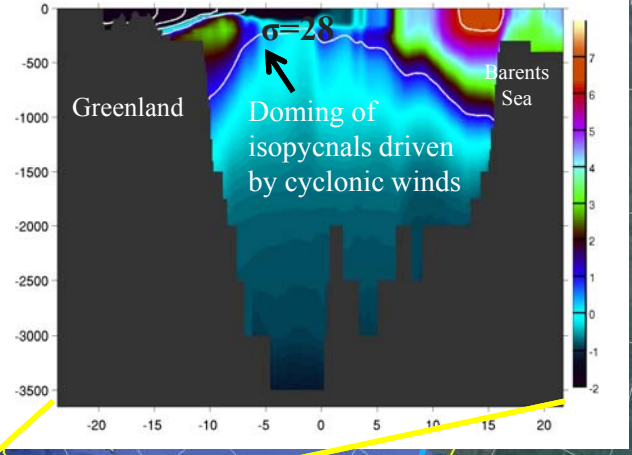
Maximum Wind Speeds in the Greenland Sea from QuikSCAT, 2000-2009



Net Surface Heat Flux (W/m^2) during a Storm in the Greenland Sea on January 13, 2006 from 0.08° HYCOM-CICE



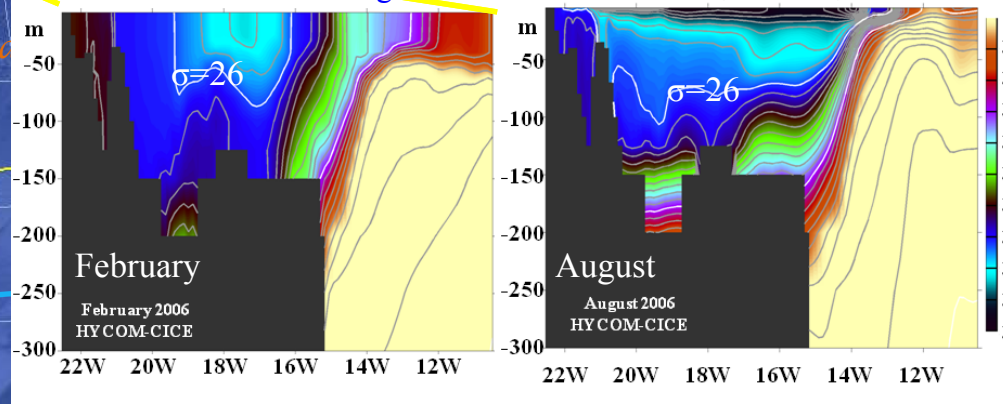
Preconditioning of Deep Convection



East Greenland Current: A western-intensified southward flow is a western-boundary current that balances the northward Sverdrup flow driven by

$$V = \frac{1}{\rho_0 \beta_0} \hat{k} \cdot \nabla \times \tau$$

Ekman Straining of the East Greenland Current in Winter



Research Goals, Objectives, Approaches

National Center for Environmental Prediction Reanalysis II (NCEP/ DOE)

NCEP Climate Forecast System Reanalysis (CFSR)

Arctic System Reanalysis (ASR)

Cross-Calibrated Multi-Platform Ocean Surface Wind Components (CCMP v1.1)

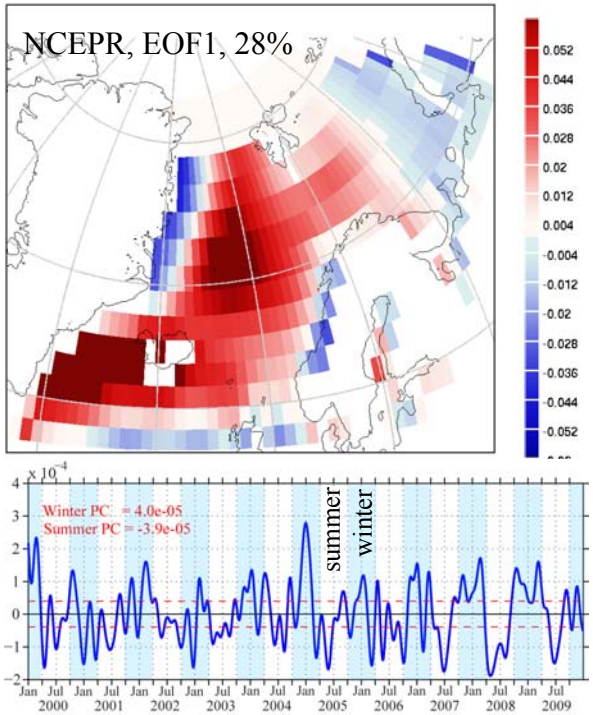
Evaluate uncertainty in the wind forcing data sets and assess the influence of the discrepancies on the Arctic Ocean models

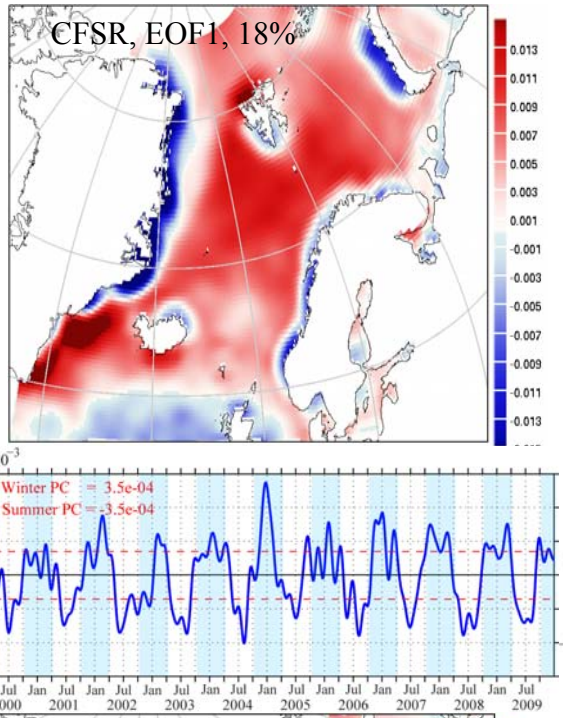
Wind comparison at different spatial and temporal scales, 2000-2009:

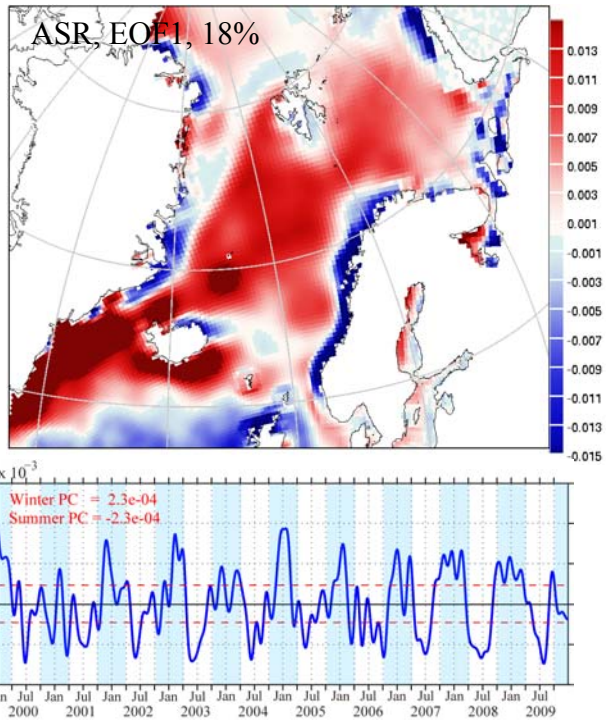
- Climatology, seasonality, synoptic events
- Basin-scale circulation, mesoscale, sub-mesoscale

Approach:

- Intercomparison of wind data sets and comparison to RSS QuikSCAT
- Comparison to meteorological buoy observations
- Sensitivity numerical experiments with different wind data sets





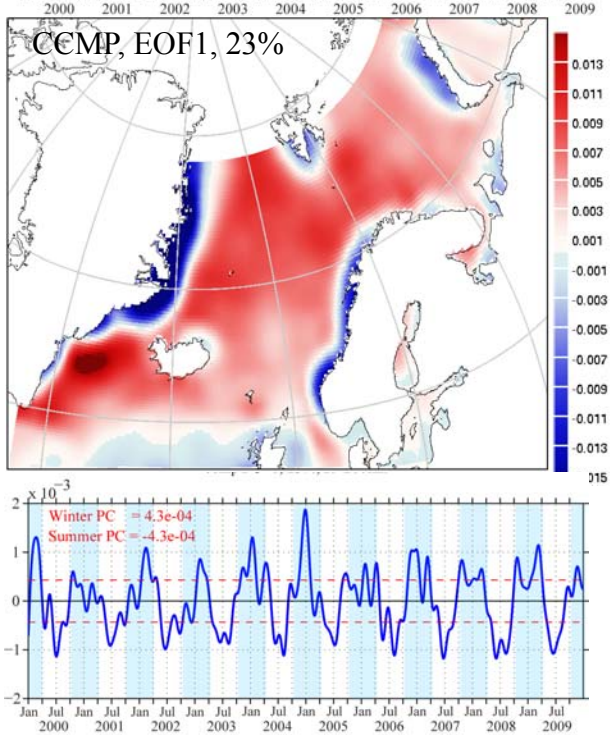


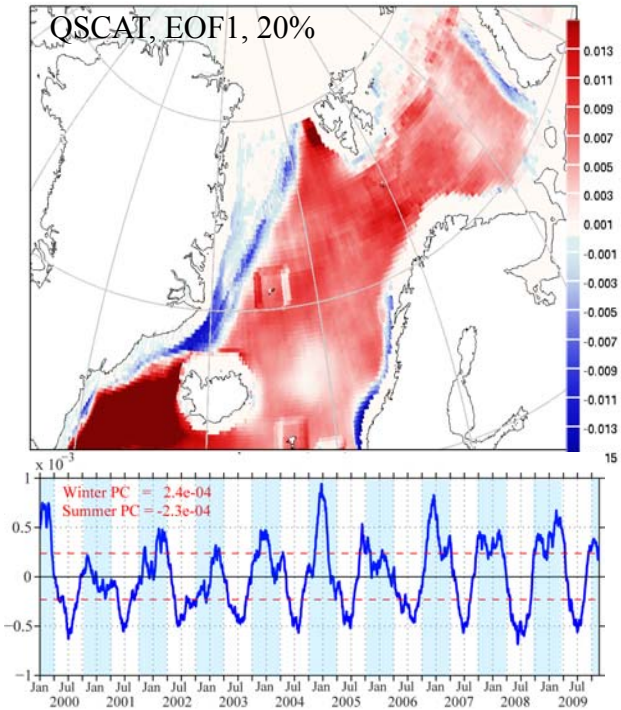
Spatial Eigenvectors of the 1st EOF and Principal Components of the Area-Mean Vorticity

Bourassa and Ford, JAOT, 2010:

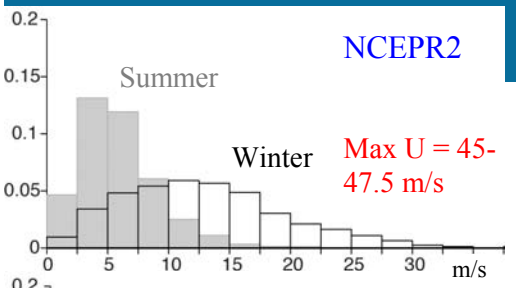
$$C = \oint \boldsymbol{v} \cdot d\boldsymbol{l} \qquad \zeta = \frac{C}{A}$$

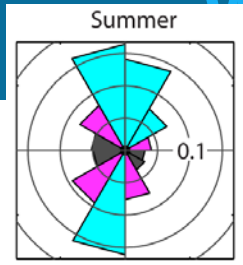
Diameter of the closed cells is 200 km

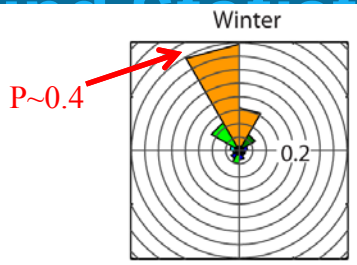


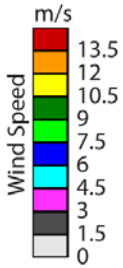


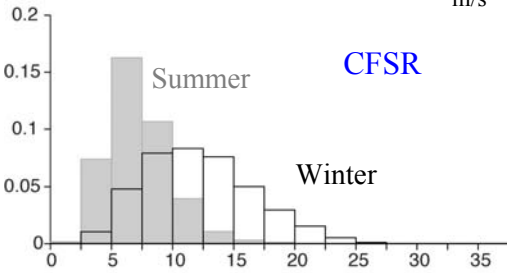
Wind Statistics

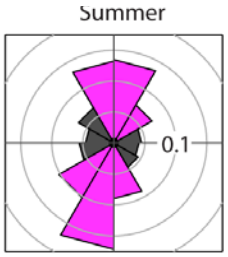


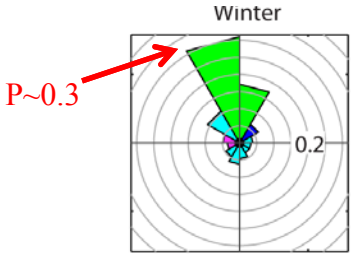


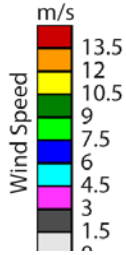


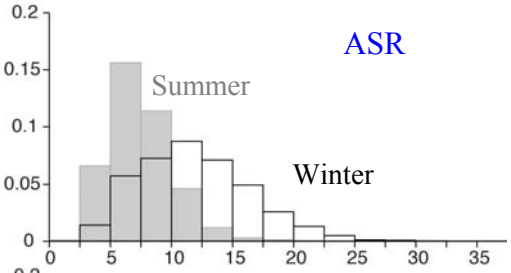


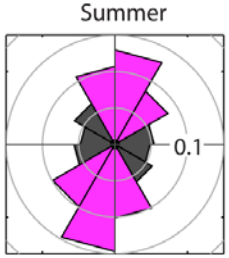


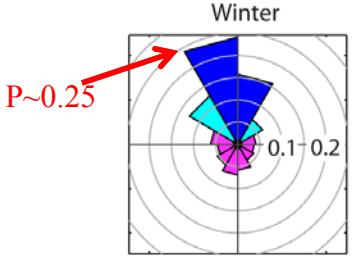


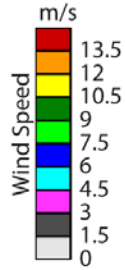


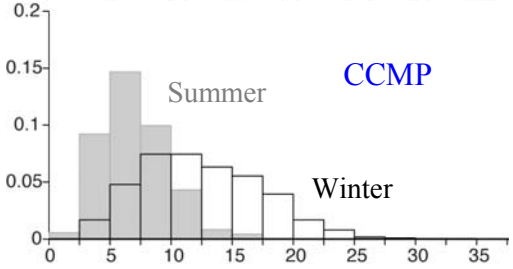


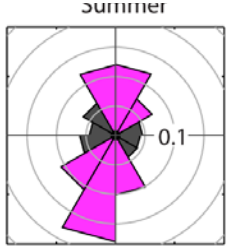


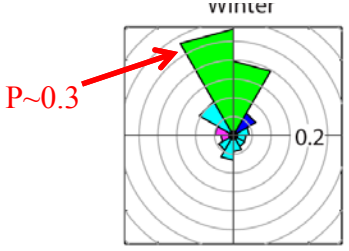


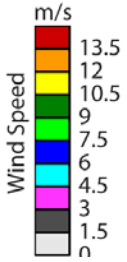


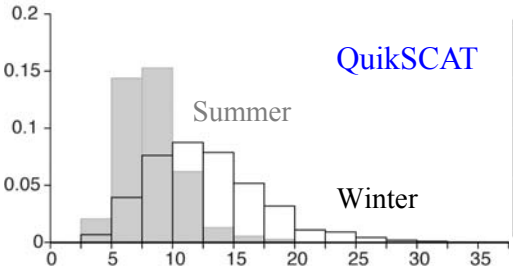


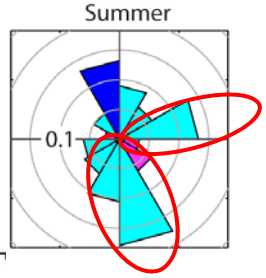


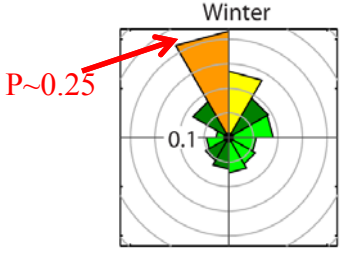


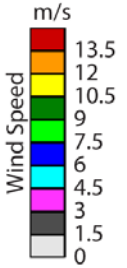












- NCEPR has higher probability of strong winds in winter (> 15 m/s) than the other wind data
- Probability of the low winds (<2.5 m/s) is markedly higher in the NCEPR compared to the other data sets

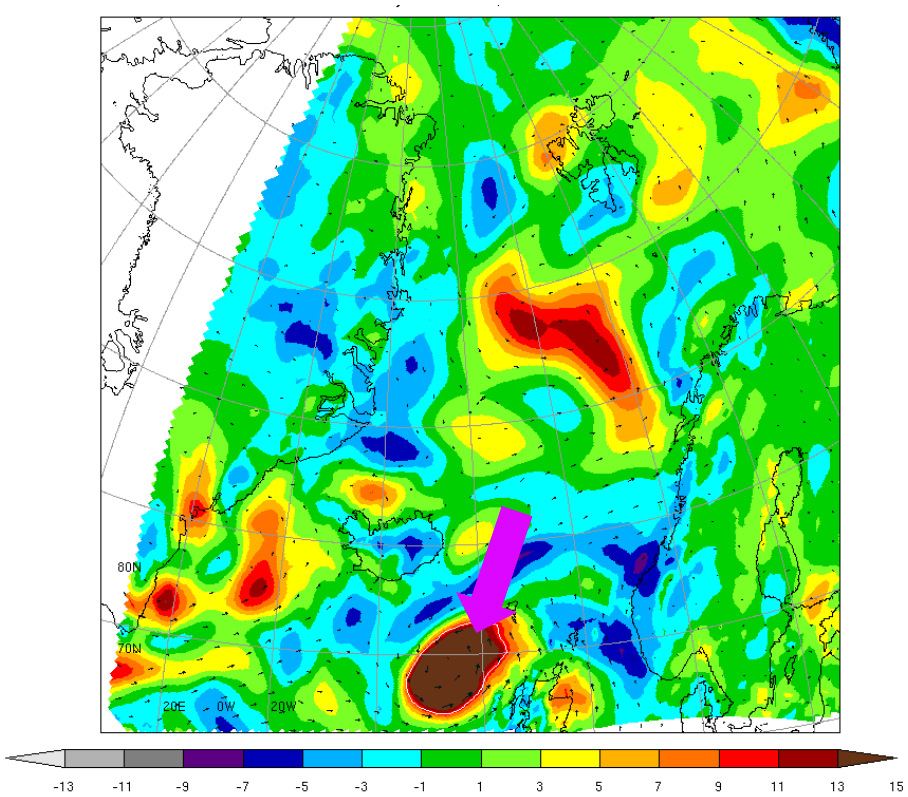
- The probability and magnitude of the northern winds in winter are too high in the NCERP
- Directional statistics of summer winds for QuikSCAT looks noticeably different. This has not been observed in other analyzed regions *(ice contamination due to proximity to the ice edge?)*

Cyclone Tracking
from the Wind Vorticity (ζ) and Speed Fields

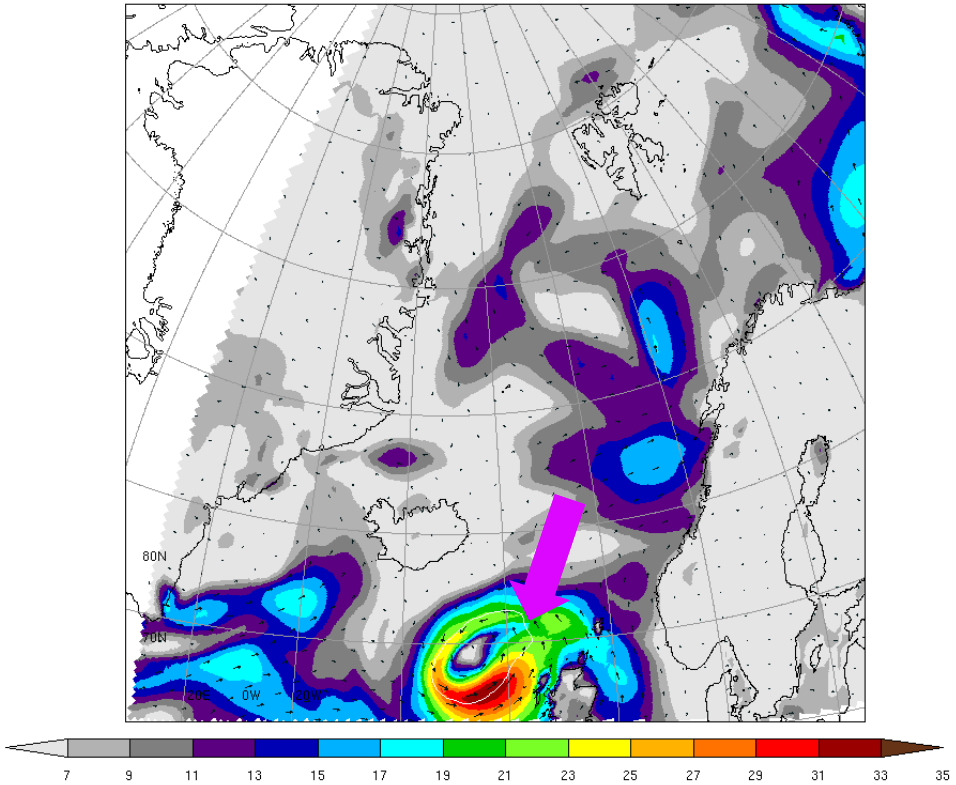
Tracking criteria:

- $\zeta \geq 9e\text{-}5\ s^{-1}$
- Closed ζ contour of a near-circular shape
- Inside the closed ζ contour, there exists local speed minimum
- Max ζ ~ coincides with local speed minimum

ASR, Wind Vorticity x 1e5, s^{-1}

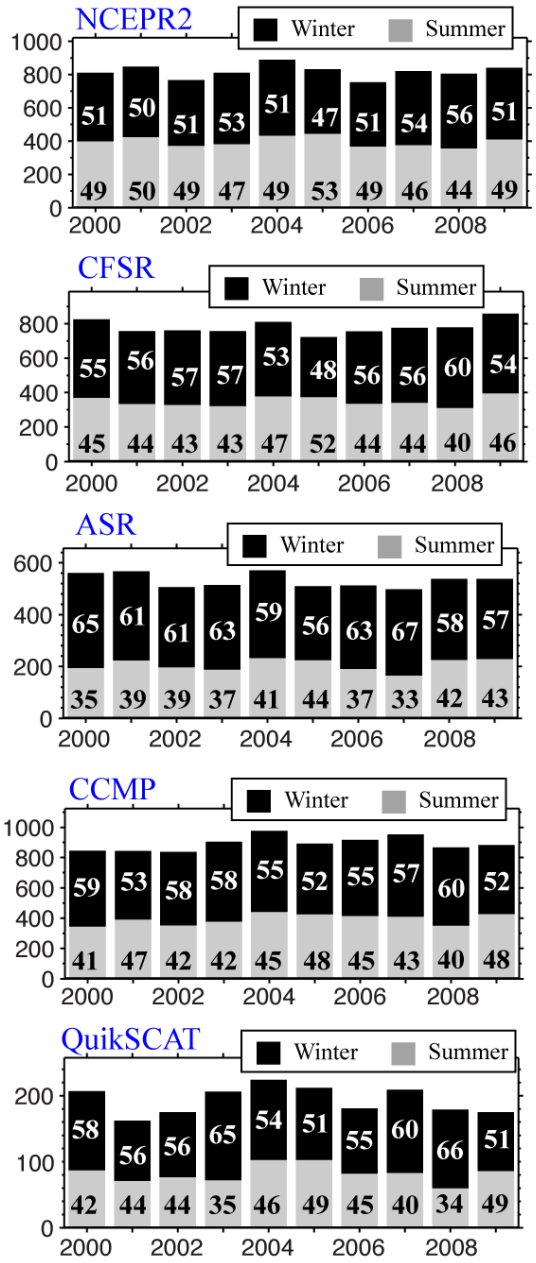


ASR, Wind Speed, m/s

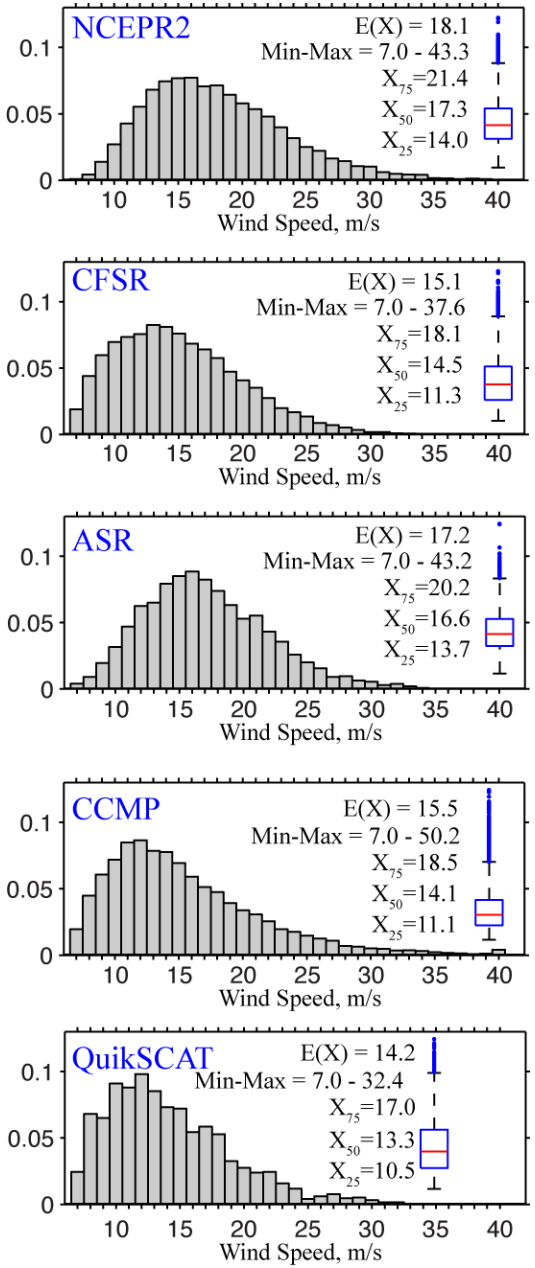


Cyclone Statistics

Cyclone Counts



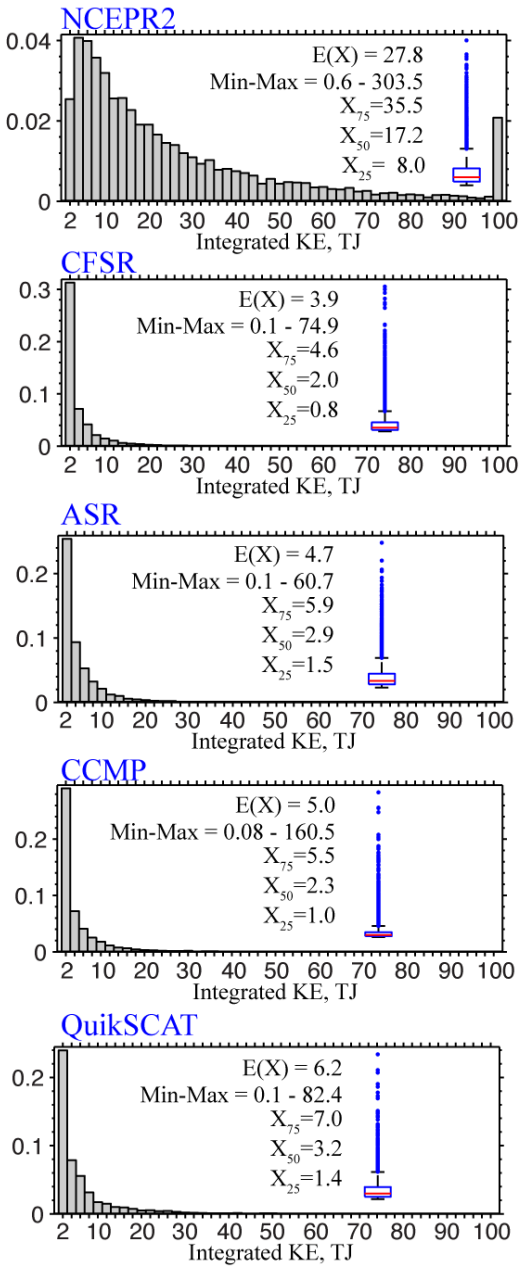
PDFs of CycloneWind Speed



PDFs of Integrated KE of Cyclones

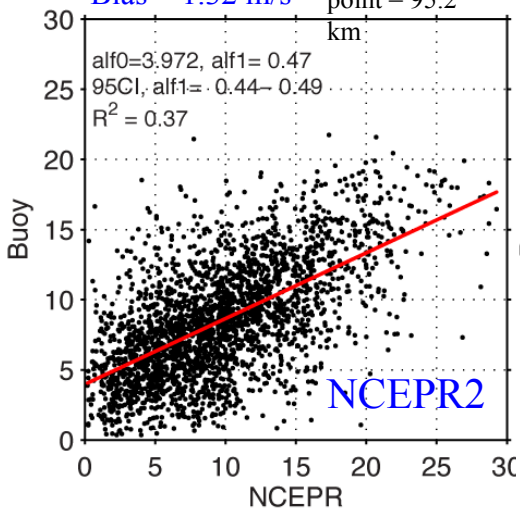
Similar to Powell & Reinhold (2007)

$$I_{KE} = \int_A \frac{\rho u_{10}^2}{2} dA$$

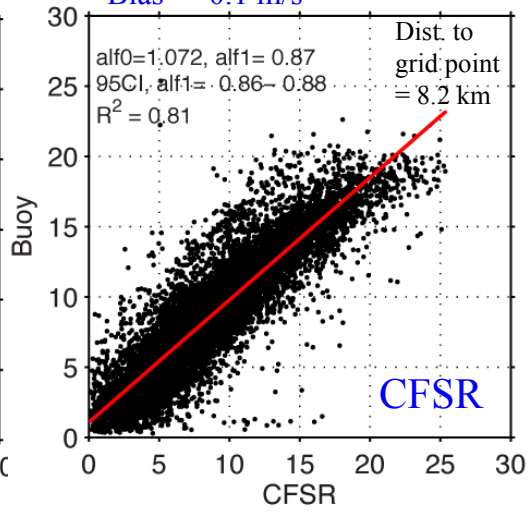


Comparison with Iceland Sea Buoy Data

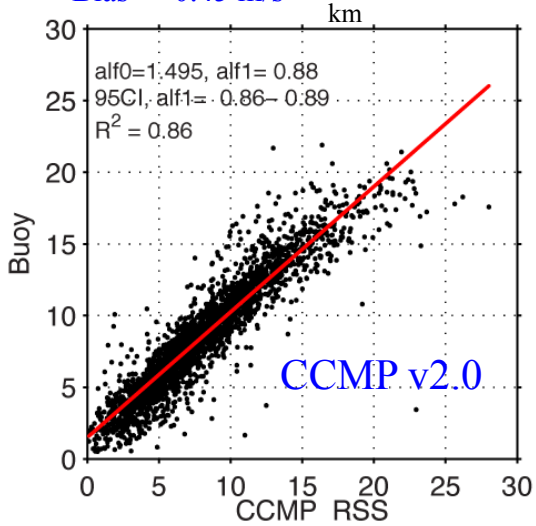
RMSE=4.3 m/s
Bias = 1.32 m/s
Dist. to grid point = 95.2 km



RMSE=1.9 m/s
Bias = -0.1 m/s
Dist. to grid point = 8.2 km



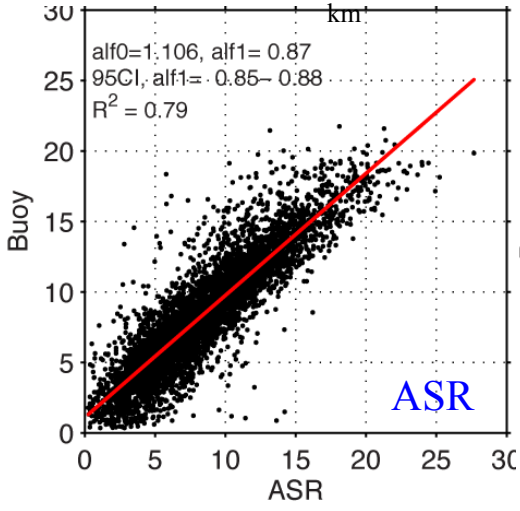
RMSE=1.6 m/s
Bias = -0.45 m/s
Dist. to grid point = 11.7 km



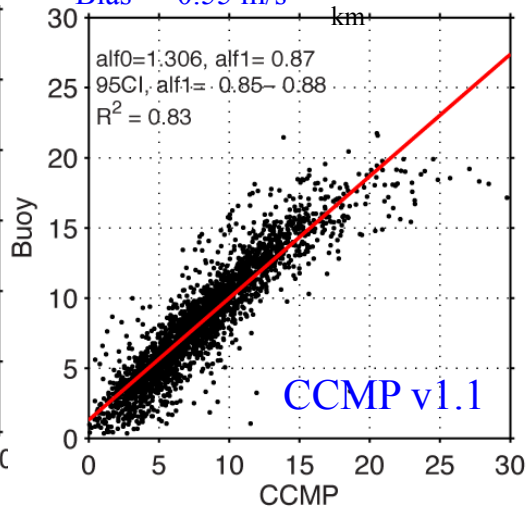
Conversion of the buoy winds to 10-m winds:

- equivalent-neutral winds (for comparison with CCMP & QuikSCAT)
- stability-dependent logarithmic profile (for comparison with the reanalysis winds)

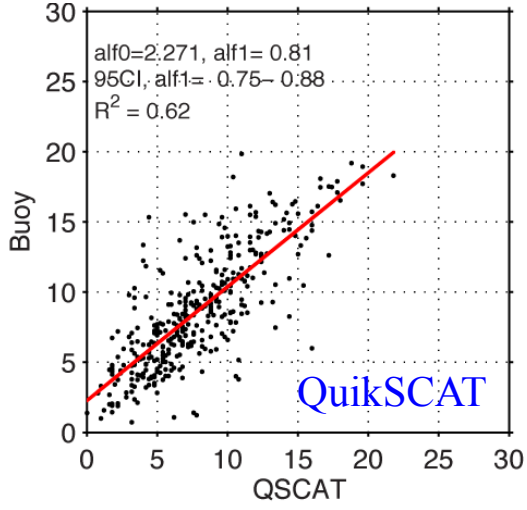
RMSE=1.9 m/s
Bias = -0.09 m/s
Dist. to grid point = 15.1 km



RMSE=1.8 m/s
Bias = -0.55 m/s
Dist. to grid point = 11.7 km



RMSE=2.8 m/s
Bias = -0.84 m/s
Mean Dist. to grid point = 12 km



Only considered are QuikSCAT data that were within the 20-minute interval about the time of the buoy observation