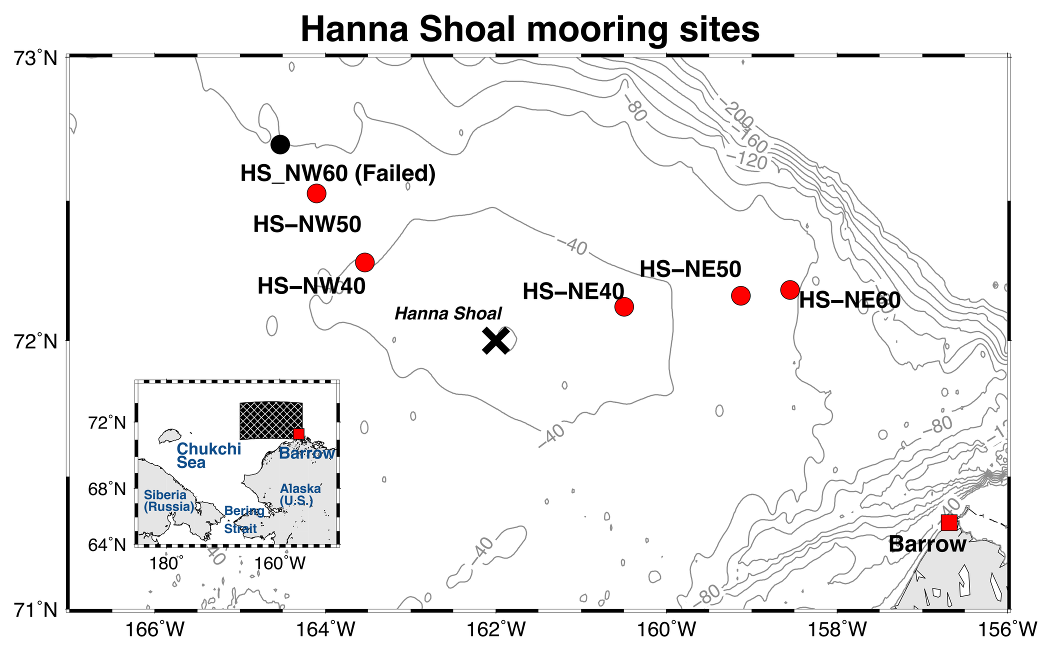
The Circulation Structure Around Hanna Shoal on the Northeastern Chukchi Sea Shelf

Ying-Chih Fang (yfang2@alaska.edu), Thomas Weingartner,
Rachel Potter, Chase Stoudt and Elizabeth Dobbins

School of Fisheries and Ocean Sciences, University of Alaska, Fairbanks, Alaska, USA

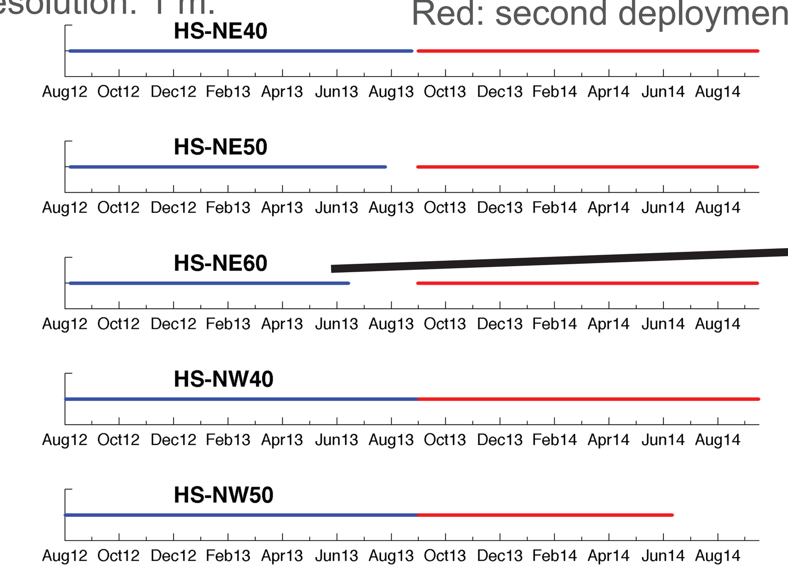
Study area and mooring locations



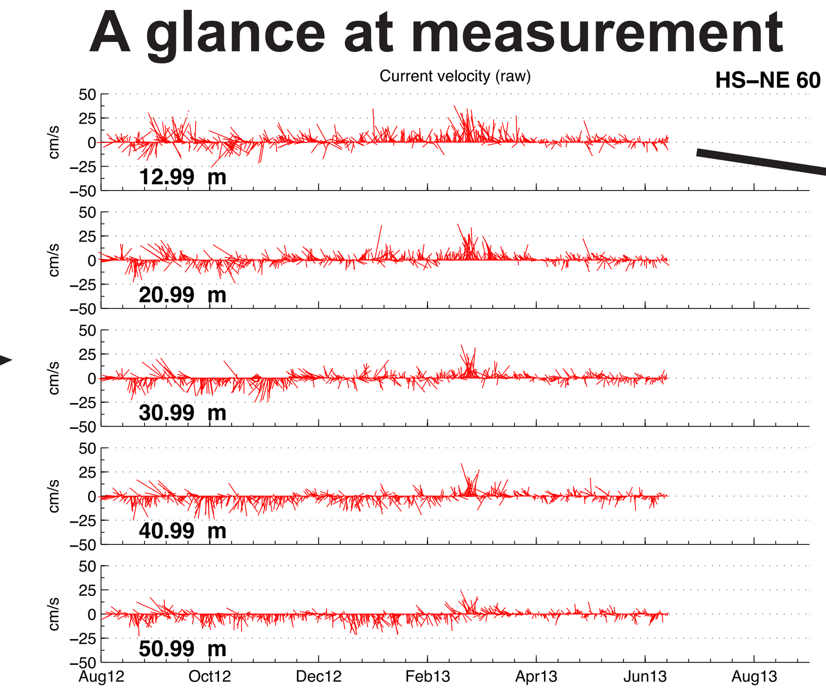
Six ADCP moorings (red dots) were deployed along 40-, 50- and 60 m isobaths northwest and northeast of Hanna Shoal. The X shows the grid point of local winds derived from the North American Regional Reanalysis (NARR) wind field.

Mooring service coverage

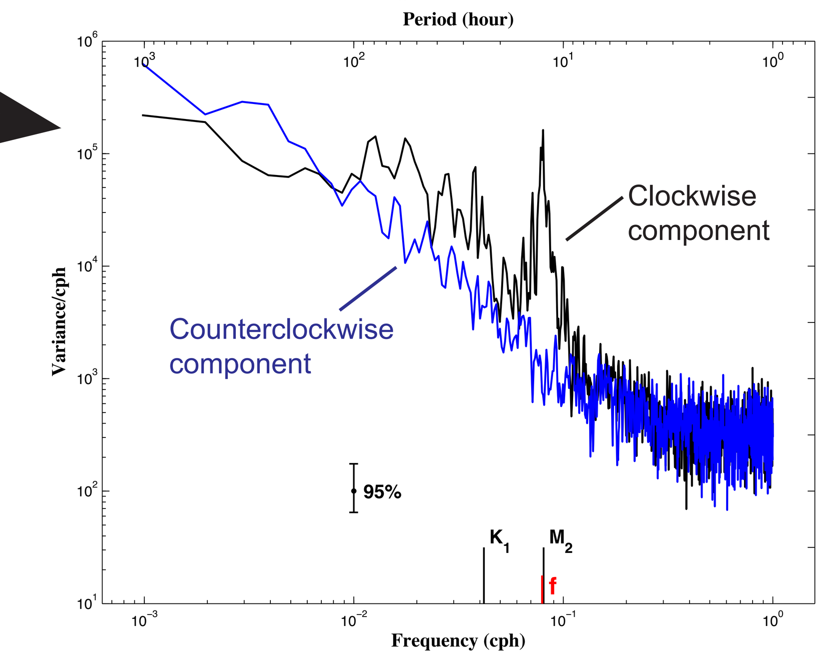
Sampling interval: 30 min.
Resolution: 1 m.
Blue: first deployment
Red: second deployment



A glance at measurement

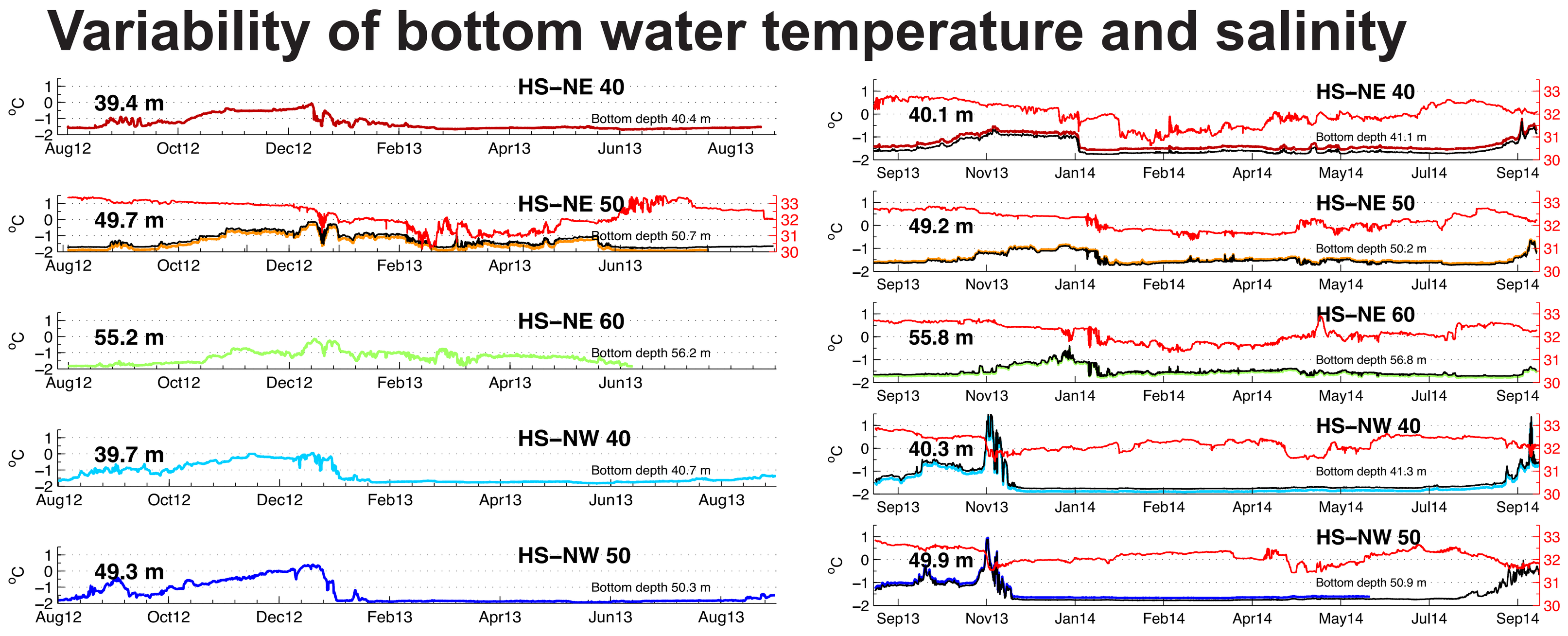


Rotary spectra



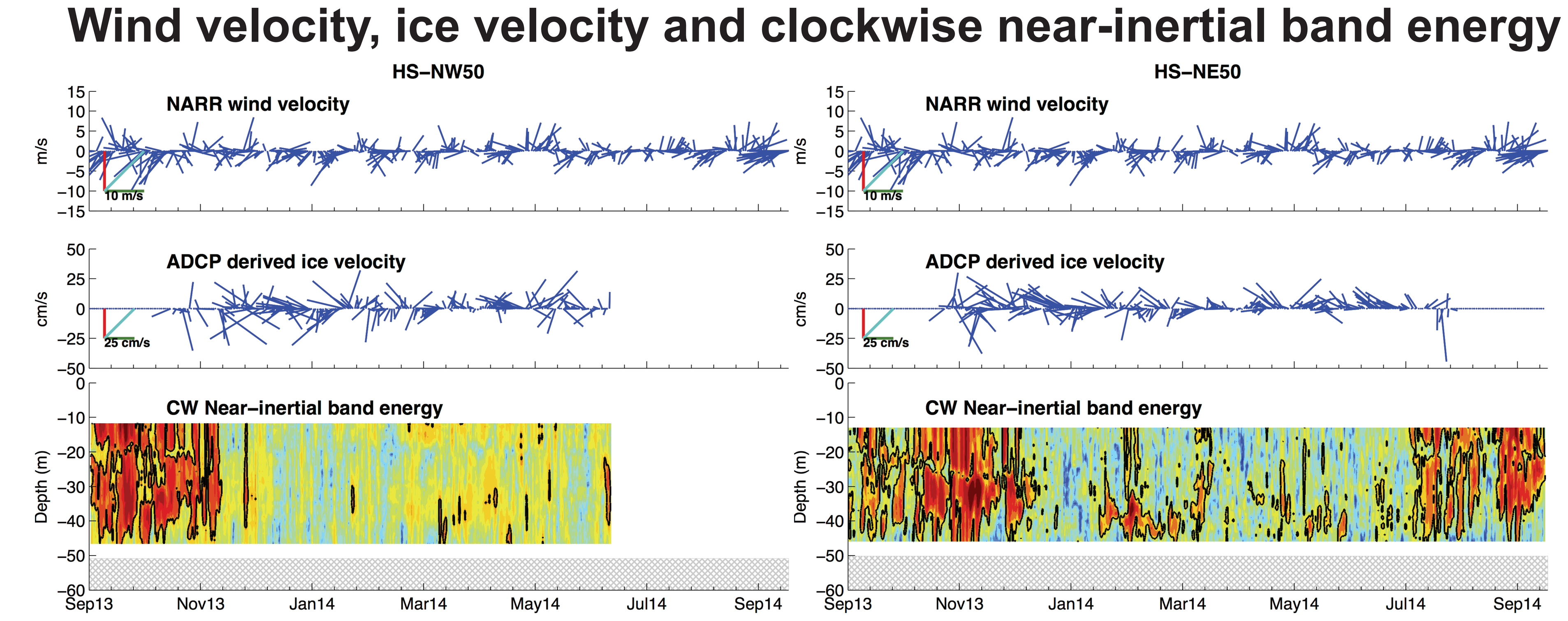
The current measurements show veering vectors, which indicate the existence of wind-induced inertial currents and tides. The tides appear to explain 15% - 35% of the total variance, and the amplitude is generally weak. Spectral analysis confirms significant energy at local inertial frequency.

Variability of bottom water temperature and salinity



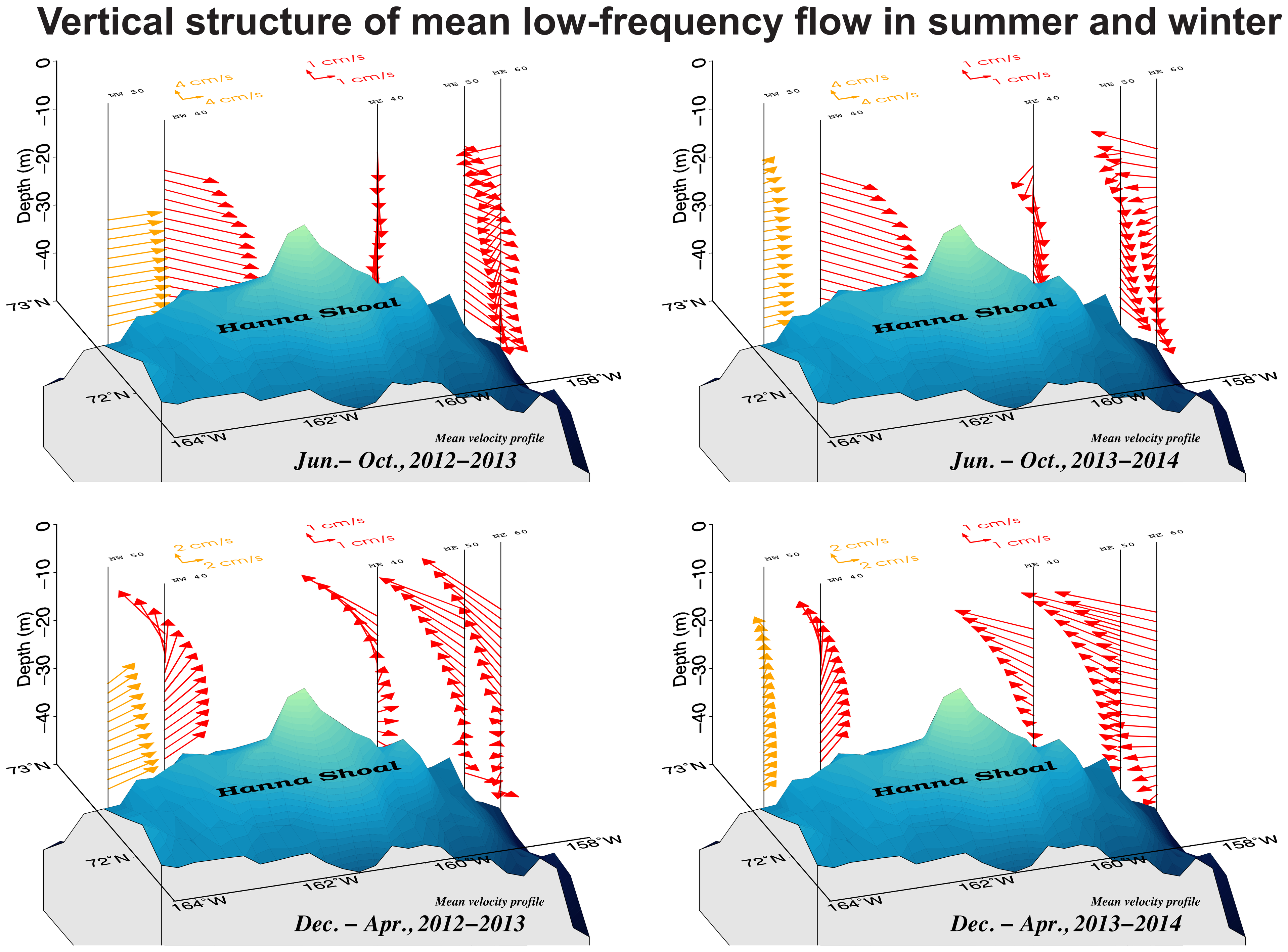
Water temperature and salinity were measured. When the bottom water freezes on the NW side, the water temperature and salinity are still fluctuating on the NE side of the shoal.

Wind velocity, ice velocity and clockwise near-inertial band energy



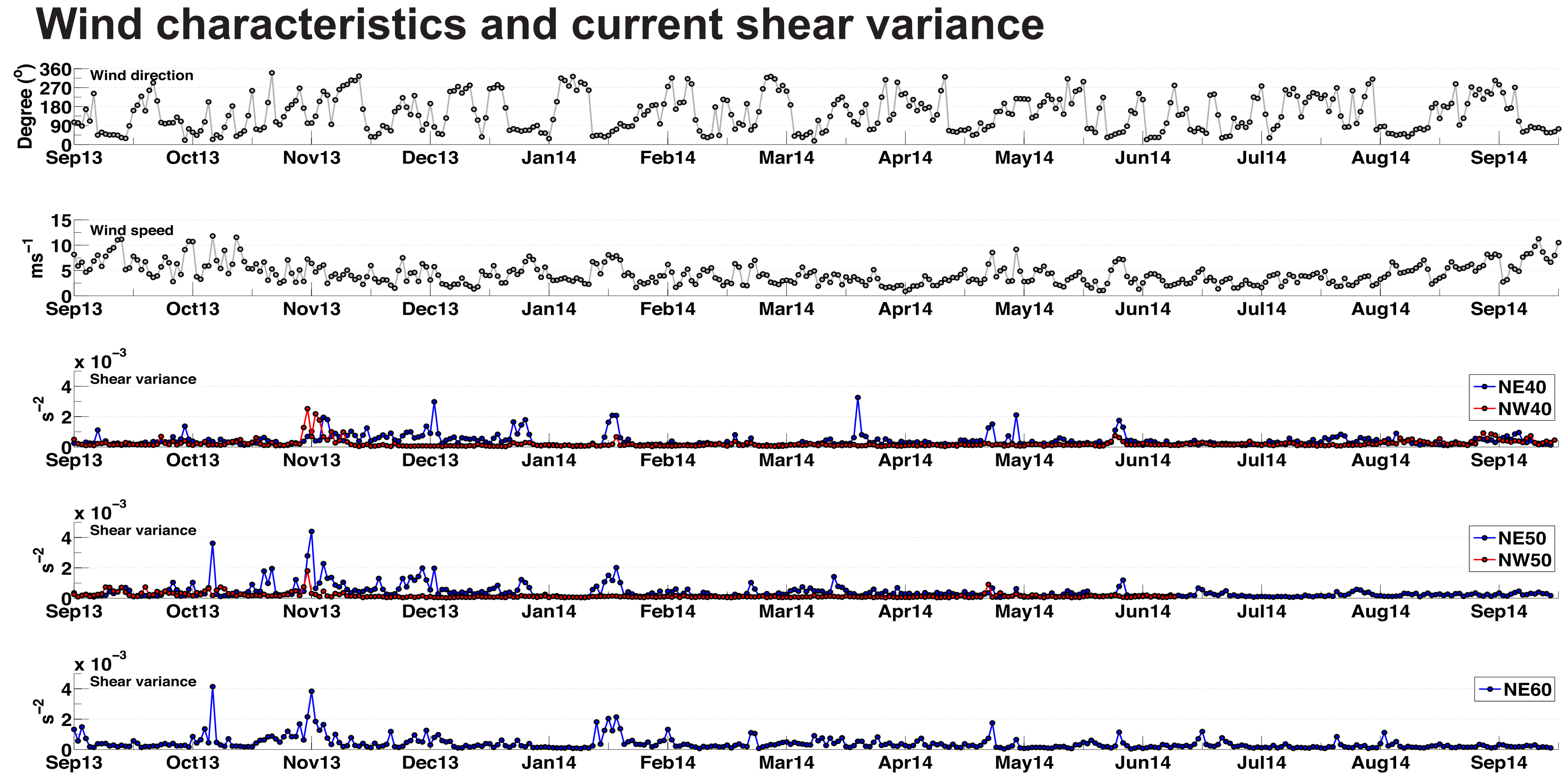
The influence of wind and sea ice shows no apparent connection to bottom water temperature. Wavelet analysis is applied to extract clockwise near-inertial band (8 - 16 h) energy. Results show significant near-inertial signal (contoured by black lines) on the NE side of the shoal. This suggests internal wave propagation and could result in the variability of the bottom water temperature.

Vertical structure of mean low-frequency flow in summer and winter



For each deployment, the mean low-pass filtered flow at all depths is computed for summer (June - October) and winter (December - April). The mean flow is eastward and relatively uniform on the NW side of Hanna Shoal during summertime. On the NE side of the shoal, the flow is sheared and veers with depth. During wintertime, the flow on the NW side becomes northward at shallow depths, and the sheared structure amplifies on the NE side. The Chukchi shelf is very shallow (~50 m) and thus influenced by wind stress.

Wind characteristics and current shear variance



The vertical structure of mean flow is examined by calculating the current shear variance along common depths (24 - 36 m depth). The flow is more variable and sheared on the NE side of the shoal. The shear variance seems to follow bursts of northeasterly wind, suggesting the sheared flow is amplified by wind. Historical hydrography also supports persistent stratification on the NE side of Hanna Shoal.

The cartoon on the right summarizes the results of this study. During summertime, on the NW side of Hanna Shoal the flow is relatively uniform and eastward. On the NE side of the shoal, persistent stratification maintains a thermal wind shear where surface flow is westward, and bottom flow is southward. During wintertime, bursts of northeasterly wind amplify sheared flow on the NE side and deflect surface flow on the NW side. Internal wave events found in wintertime match the timing of wind bursts and suggest waves generated by winds, but it is still not clear why internal waves are found only at the NE side of the shoal during wintertime.

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