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HORIZONTAL VARIABILITY SPECTRUM IN THE ARCTIC OCEAN

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Energy transfer from the atmosphere into the upper Arctic Ocean is expected to become more efficient as summer sea-ice coverage decreases and multiyear ice thins due to recent atmospheric warming. However, relatively little is known about how energy is transferred within the ocean by turbulent processes across the mesoscale to smaller scales. This is especially true in the presence of sea-ice where additional dynamical processes such as ice formation and brine rejection take place. It is important to understand energy exchange pathways within the Arctic and how they might change in future to ensure correct parameterisation of turbulent processes within models and accurate prediction of future climate.

Historic along track CTD data collected by submarines allows a unique examination of horizontal variability within several regions of the Arctic Ocean. We calculate horizontal wavenumber spectra under marginal and perennial sea-ice to assess if and how dynamics differ within regions of varying sea-ice cover. Within the halocline, energy spectra show a transition in scaling at wavelengths of approximately 5 to 7 km. At scales greater than the transition wavelength to 50 km, energy spectra are consistent with a k^{-3} scaling (where k is wavenumber) and interior quasi-geostrophic dynamics. The scaling and shape of spectra at these scales are extremely similar between regions of differing sea-ice cover, suggesting similar dynamics and energy exchange pathways. At wavelengths between 300 m and the transition wavelength, spectral scaling is flatter indicating a change in dynamics, potentially due to internal waves dominating variability at these small scales. Spectral analysis also indicates significant variability in potential energy variance across differing Arctic regions indicating differences in the strength of sources responsible for the observed variability.