Mesoscale eddy characteristics in the Labrador Sea from observations and a 1/60° numerical model

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Mesoscale eddies play an important role in lateral property fluxes. Observational studies often use sea level anomaly maps from satellite altimetry to estimate eddy statistics (incl. eddy kinetic energy). Recent findings suggest that altimetry derived eddy characteristics may suffer from the low spatial resolution of past and current satellite-tracks in high-latitude oceans associated with small Rossby radii. Here we present results of an eddy reconstruction based on a nonlinear damping Gauss-Newton optimisation algorithm using ship based current profiler observations from two research expeditions in the Labrador Sea in 2014 and 2016. Overall we detect 14 eddies with radii ranging from 7 to 35 km.

In order to verify the skill of the reconstruction we used the submesoscale permitting NATL60 model (1/60°) as a reference data set. Spectral analysis of the horizontal velocity implies that the mesoscale regime is well represented in NATL60 compared with the observations. The submesoscale regime in the model spectra shows deviations to the observations at scales smaller than 10km near the ocean surface. The representation of the submesoscale flow further decreases in the model with increasing depth.

By subsampling the NATL60 model velocities along artificial ship tracks, applying our eddy reconstruction algorithm, and comparing the results with the full model field, a skill assessment of the reconstruction is done. We show that the reconstruction of the eddy characteristics can be affected by the location of the ship track through the velocity field.

In comparison with the observed eddies the NATL60 eddies have smaller radii and higher azimuthal velocities and thus are more nonlinear. The inner core velocity structure for observations and NATL60 suggests solid body rotation for 2/3 of the radius. The maximum azimuthal velocity may deviate by up to 50% from solid body rotation.

The seasonality of the submesoscale regime can be seen in the data as the power spectrum is reduced from spring to summer in both the ship-based measurements and model.