Modeling internal waves and associated turbulent heat flux induced by drifting sea ice

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Drifiting sea ice may play important roles for vertical heat transport in the arctic ocean through the dynamic interraction between mooving ice keel and background stratification during the melting period.
In the present study, two-dimensional idealized numerical experiments wer performed to investigate the turbulent mixing and associated heat and momentum flux induced by keels of drifting sea ice using a non-hydrostatic ocean model, where the domain is 600 m wide, 120 m height and a Gaussian-shaped ice keel is located at the center. Since the model does not support moving boundary, we fixed the frame of domain relative to the position of the keel, and an oscillating inflow/outflow was applied at the horizontal boundaries to simulate the oceanic turbulence induced by circular drift of the keel.
We performed total 108 cases with varying drift speed (5, 10, 20 cm/s), keel width (10, 30, 50, 100 m), keel height (10, 20, 30 m) and the mixed layer depth (0, 10, 20 m), integration time is 24 hours (two inertial periods) for each. The results show lee waves at downstream for all cases, whose wavelength mainly depends on the drift speeds. The associate heat flux is significantly affected by whether the keel tip intersects the mixed layer base. The results of present study suggest that the size distribution of ice keels is very important for the subsurface mixing and upward heat flux since a few largest-class ridges/keels may play a major role for transporting heat and momentum.

Keywords: internal waves, vertical heat flux, non-hydrostatic model, sea ice keel

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