



Mass transport induced by internal Kelvin waves beneath shore fast ice

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A one-layer reduced gravity model is used to investigate the wave-induced mass flux in internal Kelvin waves along a straight coast beneath shore fast ice. The waves are generated by barotropic tidal pumping at narrow sounds, and the ice is modeled as a no-slip rigid lid. The mean Lagrangian fluxes to second order in wave steepness are obtained by integrating the equations of momentum and mass between the material interface and the surface. The mean flow is forced by the conventional radiation stress for internal wave motion and the frictional drag at the boundaries. The equations that govern the mean fluxes are expressed in the terms of mean Eulerian variables, while the wave forcing terms are given by the horizontal divergence of the Stokes flux. The motion in the upper layer is assumed to be turbulent, and the dominant frictional drag at the ice is modeled in terms of the square of the mean Eulerian velocities. Analytical results show that the effect of friction induces a mean Eulerian flux along the coast that is comparable to the Stokes flux. In addition, the horizontal divergence of the total mean flux along the coast induces a small mass flux in the cross-shore direction. This flux changes the mean thickness of the upper layer outside the trapping region, and may facilitate geostrophically balanced boundary currents in enclosed basins. This is indeed demonstrated by numerical solutions of the flux equations for confined areas larger than the trapping region. Application of the theory to Arctic waters is discussed, with emphasis on the transport of biological material and pollutants in near-shore regions.