Review of the paper “Two-dimensional numerical simulations of mixing under ice keels” by Sam De Abreu et al.

The paper presents the results of numerical modelling to study the effects of sea water mixing by the keels of drifting ice. The authors considered 16 combinations of the Froude number and keel draft to describe different scenarios of water movement near the keels. The combinations represent typical sizes of ice ridges and speeds of sea currents under Arctic ice. The authors compared the mixing and stirring effects obtained from the simulations and demonstrated, in contrast to ice-ocean drag, that ocean mixing does not increase monotonically with larger keel depth and speed.

The conclusion about increasing ice-ocean drag was made based on previous studies. It is unclear whether this is true for numerical simulations described in the paper or not. It would be useful to estimate form and skin drags on ice keels for different combinations of the Froude number and keel draft based on simulation results.

From Table 2 it can be seen that diapycnal diffusivities are of the order of the kinematic viscosity and salt-mass diffusivity or even larger. The kinematic viscosity and salt-mass diffusivity set to 0.002 m2/s are much smaller the molecular kinematic viscosity (~1.8 10^-6 m2/s) and salt diffusivity (~10^-9 m2/s). Large values of these parameters may be reasonable for numerical simulations. However, a comparison with results from other studies of sea water mixing in the Arctic would be useful for the paper. For example, Liang and Losh (JGR, 2018) write on excessively strong vertical mixing of 1.25x10^-4 m2/s with the background diffusivity coefficient of 5.44x10^-7 m2/s. Fer (Atm. And Oceanic. Science Letters, 2009) reported about mixing coefficients of 10^-6-10^-5 m2/s estimated from the field observations in the Arctic.

I think that the paper needs to be elaborated according to two comments above.