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Direct numerical simulations of ice melting in a turbulent ocean[1]

LOUIS-ALEXANDRE COUSTON, British Antarctic Survey — In this talk I will present preliminary results of direct numerical simulations of ice melting in a stratified turbulent ocean. The model solves the evolution of the turbulent fluid phase and of the diffusive solid ice phase, due to melting and freezing, in a fully coupled way. This is done by combining a highly-efficient fully-spectral Direct Numerical Simulation (DNS) code with a novel formulation of the equations for the solid and liquid phases of water based on the phase-field method, which is routinely used in metallurgy. DNS enables turbulent motions to be simulated without approximation, i.e. solving Navier Stokes equations, while the phase-field method allows the ice-ocean interface to be rough and evolve in response to melting. I will present results on the turbulent boundary layer and on the self-generated roughness at the ice-ocean interface for fresh water. The ultimate goal of this work is to propose a new DNS-based parameterization of the melting process at rough ice-ocean boundaries that takes into account the effects of temperature and salt stratification, and flow velocities.

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