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Toward a new ice-shelf melt rate parameterization with large-eddy simulations

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Predictions of ice shelf melting depend on dynamical insights into ocean boundary layers below ice shelves. Fundamental questions regarding the nature of stratified turbulence below the sloped and ablating ice shelf base remain. Laboratory experiments, direct numerical simulations, and observations have yielded important insights, but have yet to produce a robust relationship between ice shelf melt rates and shear- and buoyancy-driven mixing. This relationship is the target of our Large-Eddy Simulations (LES) of the ice-shelf ocean boundary layer. Several new developments were applied to the LES code PALM to produce dynamic melting as well as tides. In this presentation, we demonstrate these new model capabilities. We contrast profiles of vertical turbulent fluxes of heat, salt and momentum across different simulated ice shelf settings: cold, shear-dominated settings vs. warm, buoyancy-dominated settings. We also discuss our recent work toward a new ice-shelf melt parameterization for use in large-scale ocean models on the basis of these simulations. A new melt parameterization is a critical component of ongoing ice-ocean coupling efforts, both to place melt rate predictions on a more physical footing and to achieve convergence with vertical ocean model resolution, on which current parameterizations fail.