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Forced convective melting at an evolving ice-water interface[1] ESHWAN RAMUDU, BENJAMIN HIRSH, PETER OLSON, ANAND GNANADESIKAN, Department of Earth and Planetary Sciences, Johns Hopkins University —
The intrusion of warm Circumpolar Deep Water into the ocean cavity between the base of ice shelves and the sea bed in Antarctica causes melting at the ice shelves' basal surface, producing a turbulent melt plume. We conduct a series of laboratory experiments to investigate how the presence of forced convection (turbulent mixing) changes the delivery of heat to the ice-water interface. We also develop a theoretical model for the heat balance of the system that can be used to predict the change in ice thickness with time. In cases of turbulent mixing, the heat balance includes a term for turbulent heat transfer that depends on the friction velocity and an empirical coefficient. We obtain a new value for this coefficient by comparing the modeled ice thickness against measurements from a set of nine experiments covering one order of magnitude of Reynolds numbers. Our results are consistent with the altimetry-inferred melting rate under Antarctic ice shelves and can be used in climate models to predict their disintegration.

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