Abstract View

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An Experimental and Theoretical Study of the Turbulent and Laminar Convection Generated under a Horizontal Ice Sheet Floating on Warm Salty Water

Seelye Martin

Department of Oceanography, Washington, of Seattle 98195

Peter Kauffman

Department of Atmospheric Sciences, University of Washington, Seattle 98915

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ABSTRACT

In an experimental and theoretical study we model a phenomenon which occurs in the summer polar oceans; namely, the melting of flat sheets of either glacial ice or desalinated sea ice which float over sea water held at a temperature above freezing. Our laboratory results show when the solution salinity is such that the temperature of maximum density is below the freezing temperature, or for sea water salinities greater than 25‰, the heat transfer to the ice takes place in three regions. First, just beneath the ice, there is a boundary layer across which the salinity increases almost to its far-field value and the temperature increases linearly. Below this, there is an unstable convective boundary layer, which appears to be part double-diffusive, part pure thermal convection. Finally, there is a region of deep thermal convection. From comparison of a one-dimensional theoretical model of the heat transfer with the laboratory study, we find that the ice melts about twice as fast for this convective case as for a purely diffusive heat transfer model.