Abstract View

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Melting of Ice in Sea Water: A Primitive Model with Application to the Antarctic Ice Shelf and Icebergs

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ABSTRACT

Steady-state conditions are assumed to exist everywhere in the case of melting of the underside of an infinite slab of ice floating in sea water. Basic transfer equations for heat and salt are established and solutions derived for the interior corresponding to given far field values of the temperature and salinity of the water. The solutions are discussed in the *T-S* diagram where the behavior is particularly simple. Determining parameters are the characteristic velocities k_s/d and K_s/h, where k_s and K_s are the molecular and turbulent diffusivities, respectively, of salt, d and h the thicknesses of the corresponding laminar and turbulent layers. Also the nonmelting/nonfreezing case is discussed and the determining parameter established. Application of the theory to the Ross Ice Shelf (Little America V) gives acceptable results with $d = 2 \times 10^{-3}$ m and $K_s = 20 - 30 \times 10^{-4}$ m^2 s^{-1}. Analysis of the static stability of the melt water mixtures reveals that with ambient temperatures approaching 17°C, the stratification becomes unstable. Icebergs brought to tropical waters will cause melt water mixtures to intrude at subsurface levels. Finally, convection obtained in laboratory experiments with melting ice in sea water is reported to be in concordance with the theoretically derived stability criterion.