Abstract View

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The Melting of Ice in Cold Stratified Water

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ABSTRACT

We consider the melting of ice in cold water vertically stratified with salt. The study extends previous investigations of ice melting in cold water at uniform salinity and in warm water with a salinity gradient. We find, in agreement with the results of the latter study, that the meltwater spreads out in a series of horizontal layers. This motion tends to convert the initially smooth salinity distribution into one with much larger gradients in the interfaces between the layers. The thickness of the layers is well represented by

$$h = 0.65[\rho(T_{fp},S_{\infty}) - \rho(T_{\infty},S_{\infty})]\ (/d\rho dz;)^{-1},$$

where T_{fp} is the freezing point at the mean far-field salinity and dp/dz is the vertical density gradient due to salinity. We also discuss the results of an experiment with a stratified region above a region of uniform salinity. The convective plume that formed in the lower region penetrated into the upper region, while a series of horizontal layers in the upper region extended beyond the plume. We conclude the paper with a discussion of the application of our experimental results to oceanographic conditions.

top

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