Near-inertial wave transmission in the Arctic Ocean

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ABSTRACT

An evolving scenario of interest is the increasingly influential role near-inertial waves may play in the dynamics of the Arctic Ocean. Historically, the existence of protective ice cover has shielded the Arctic Ocean from atmospheric storms and as a result near-inertial wave energy levels in the region have been much weaker than in lower latitude oceans. The rapid loss of protective ice cover during summer months, however, suggests that change may be afoot. And in considering the associated evolution of near-inertial wave activity, a striking feature of the region that must be accounted for is the existence of complex stratifications, such as multiple pycnoclines and intricate double-diffusive staircase structures, these being a vertical series of mixed layers (i.e. effectively zero stratification) separated by thin stratified layers. Such layers are known to horizontally extend hundreds of kilometers.

To address this scenario, we consider the propagation of internal waves through stratifications with multiple layers. We start by outlining our analytical approach, accounting for viscosity so as to enable comparison with laboratory experiments. Then, we use a simple model to demonstrate that the presence of multiple layers has a nontrivial impact. To validate both the model and this fundamental insight, we present results of a direct comparison between theory and laboratory experiments. Thereafter, we apply our model to an Arctic Ocean stratification and assess the impact of a double-diffusive staircase on near-inertial wave propagation.

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