Oceanography Seminar

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Inferring Mixing from Echosounder Observations of Double-Diffusive Staircases in the Arctic Ocean

1200 Thursday, February 13, 2020
Spanagel Hall, Room 316

Double-diffusive convection may occur where temperature and salinity both increase with depth, such as in the Arctic Ocean. Double-diffusive convection is identifiable by its distinct staircase structure, consisting of thick mixed layers separated by high-gradient interfaces in temperature and salinity. In the Arctic Ocean, these staircases are widely present in the interior basin and responsible for transporting heat upwards to the overlying sea ice cover. However, they are largely absent around basin boundaries; this is likely due to the effect of intermittent turbulence. Recent echosounder (acoustic) observations of the Arctic Ocean provide a high-resolution method of visualizing an individual staircase evolve in both space and time. By analyzing these acoustic observations, we track the spatial/temporal evolution of individual interfaces in a double-diffusive staircase. A comparison between measurements of temperature/salinity and reflected acoustic signals, as well as a simple mathematical model, suggest that the magnitude of these reflected acoustic signals is proportional to the strength of the stratification for a given interface. Further, the acoustic data are sufficiently high resolution that individual interface thicknesses may be resolved. These results indicate that acoustic measurements may be used to infer mixing levels in double-diffusive staircases and understand staircase persistence and evolution in a setting of weak background turbulence.