Seasonal variability of near-inertial internal waves and its kinetic energy in the ice-diminishing Arctic Ocean

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In the Arctic ocean, the internal wave activity and its contribution to the turbulent mixing has been considered to be quite low. In the modern era, the Arctic sea-ice extent has been dramatically diminishing, and therefore there is an increased chance of kinetic energy input from the air at ocean surface. In this study, the seasonal change of near-inertial internal wave (NIW) kinetic energy is examined in comparison with local sea ice compactness and draft thickness. The local sea-ice information was obtained using an ice profiling sonar mounted at top of a moored instrumentation in the Northwind Abyssal Plain. The band-passed kinetic energy was recorded with a moored ADCP for depths within upper 110 m. The data clearly documented that the depth-integrated NIW kinetic energy varied in line with the ice seasonality, i.e., ice thickness and mobility. During ice covered months, the upper water NIW kinetic energy was approximately 1/10 of the Garrett-Munk (GM) canonical level. In the meantime, during the ice absent months of September and October, the kinetic energy levels built up closer to the GM level. The fine-scale parameterization (Gregg, 1989) estimates the turbulent mixing dissipates the incident wave energy at a rate of $O(10^{-10}-10^{-9}\ \mathrm{W\ kg^{-1}})$. According to a mixed layer slab model (Pollard & Millard 1970), the energy input from the ice movement was 1.6 kJ m^{-2}, in which 13% was presumably dissipated through the wave-wave interaction in the upper 110 m. The ice-water combined velocity data also indicated that the mobility of sea ice floes can affect the kinetic energy amount in the upper water, suggesting the occurrence of increased turbulent energy as more unconsolidated ice exists in the future.

Keywords: Arctic Ocean , Near-inertial internal wave, Sea ice retreat