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Internal wave energy in the Denmark Strait Overflow plume from finestructure strain parameterisation

Rebecca McPherson
University of Hamburg, Institute of Oceanography, Experimental Oceanography, Germany
(rebecca.mcpherson@uni-hamburg.de)

The Denmark Strait Overflow (DSO) plume supplies approximately half of the dense water formed in the Nordic Seas into the North Atlantic. The volume transport of the plume increases through the Denmark Strait principally as a result of vertical turbulent processes which drives plume entrainment. In the stratified ocean interior, internal waves are a major cause of turbulent mixing. In this study, the role of internal waves in the supply of energy to turbulence in the DSO plume are quantified. Over 2800 conductivity-temperature-depth (CTD) profiles from within the Denmark Strait were used to generate estimates of turbulent dissipation rates (ϵ) derived from isopycnal strain. Stratification (N^2) in the shear-stratified interfacial layer between the main body of the plume and the ambient above exceeded $N^2 = 10^{-5}$ s^{-2}. Estimates of the vertical mixing induced by the breaking of internal waves within the DSO plume shows elevated vertical diffusivities of up to 10^{-3} m^{2}s^{-1} and rates of ϵ reaching 10^{-6} W kg^{-1}. The dissipation rates are comparable with those determined by an indirect Thorpe scale approach. A method to compute internal gravity wave energy from finescale strain information alone was also applied. Typically, the Denmark Strait region is highly energetic with a mean internal gravity wave energy of 10^{-3} m^{2}s^{-2}. Within the DSO plume, values were approximately one order of magnitude greater at 10^{-2} m^{2}s^{-2} and maximum peaks of internal wave energy exceeded 10^{-1} m^{2}s^{-2}. This suggests that the elevated internal gravity wave field within the Denmark Strait is a significant driver of the enhanced overflow turbulent mixing.