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Enhanced internal tidal mixing in the Philippine Sea mesoscale environment

Jia You[1], Zhenhua Xu[1], Qun Li[2], and Peiwen Zhang[1]
[1](youjia@qdio.ac.cn)
[2]Polar Research Institute of China, Shanghai, China (liqun@pric.org.cn)

Turbulent mixing in the ocean interior is mainly contributed by internal wave breaking; however, the mixing properties and the modulation effects of mesoscale environmental factors are not well-known. Here, the spatially inhomogeneous and seasonally variable diapycnal diffusivities in the upper Philippine Sea were estimated from ARGO float data using a strain-based finescale parameterization. Based on a coordinated analysis of multi-source data, we found that the driving processes for diapycnal diffusivities mainly included the near-inertial waves and internal tides. Mesoscale features were important in intensifying the mixing and modulating its spatial pattern. One interesting finding was that, besides near-inertial waves, internal tides also contributed significant diapycnal mixing for the upper Philippine Sea. The seasonal cycles of diapycnal diffusivities and their contributors differed zonally. In the mid-latitudes, wind-mixing dominated and was strongest in winter and weakest in summer. In contrast, tidal-mixing was more predominant in the lower-latitudes and had no apparent seasonal variability. Furthermore, we provide evidence that the mesoscale environment in the Philippine Sea played a significant role in regulating the intensity and shaping the spatial inhomogeneity of the internal tidal mixing. The magnitudes of internal tidal mixing was greatly elevated in regions of energetic mesoscale processes. The anticyclonic mesoscale features were found to enhance diapycnal mixing more significantly than did cyclonic ones.