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The Role of Time- and Space Scales in Estimating the Relative Importance of Isopycnal and Diapycnal Oceanic Mixing

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Large-scale thermal forcing and freshwater fluxes play an essential role in setting the ocean's temperature and salinity. The ratio of the relative contributions of haline and thermal forcing in the mixed layer is maintained by large-scale surface fluxes, leading to important consequences for mixing in the ocean interior. In a stratified ocean, mixing processes can be either isopycnal or diapycnal. The contribution of these processes to the total mixing rate in the ocean can be estimated from the large-scale forcing by evaluating the production of thermal variance, salinity variance and temperature-salinity covariance. A number of surface heat- and freshwater flux estimates are used to evaluate these terms and combine them to generate estimates of the production of density and spice variance. This variance production at the surface is used to estimate the relative importance of isopycnal and diapycnal mixing in the ocean. While isopycnal and diapycnal processes occur on very different length scales, we find that surface-driven production of density and spice variance requires an approximate equipartition between isopycnal and diapycnal mixing in the ocean interior. Here, dissipation estimates are produced using time-mean, monthly and daily flux estimates and surface variables, including Aquarius SSS and Optimum Interpolation SST to elucidate the importance of seasonal and daily forcing. While the inclusion of high-frequency variability increases the total dissipation required, it is likely that much of the resulting variance production is dissipated locally. The increase in diapycnal dissipation is greater than that of isopycnal dissipation, suggesting that more diapycnal dissipation occurs on short space- and time scales.