A diapycnal mixing budget on the Oregon shelf

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ABSTRACT: Although isopycnal mixing is undoubtedly important at global and gyre scales, the relative importance of isopycnal and diapycnal mixing on much smaller scales is uncertain. This issue is investigated using 35 d of data from a Lagrangian float deployed on a mid-depth isopycnal on the Oregon shelf. Measurements of temperature, salinity, and pressure maintain the float on the isopycnal; its high-frequency diapycnal deviations are used to estimate the diapycnal diffusivity using an inertial subrange method; lower-frequency deviations, including intentional profiles to the surface, are used to estimate diapycnal derivatives near the target isopycnal. Downward irradiance at 490 nm is used to calibrate chlorophyll fluorescence measurements and compute solar heating rates. Corrections for the diapycnal deviations provide a nearly continuous isopycnal time series of spice (a temperature and salinity combination nearly orthogonal to potential density) and chlorophyll. A new formulation of the diffusion equation in isopycnal coordinates is derived and used to test the accuracy of purely diapycnal mixing balances for spice and chlorophyll. On vertical scales of about 10 m and timescales of about 2 d, isopycnal spice variations are mostly controlled by diapycnal mixing, although other processes, presumably isopycnal mixing, are sometimes important. Processes other than diapycnal mixing control isopycnal chlorophyll variations on these scales. Likely candidates include isopycnal mixing with a nearby bloom, planktonic sinking out of this bloom, or possibly local phytoplankton growth. Thus both isopycnal and diapycnal mixing can be important at these small scales.

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