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Turbulence in the Sicily Channel from microstructure measurements

Anda Vladoiu (1), Pascale Bouruet-Aubertot (1), Yannis Cuypers (1), Bruno Ferron (2), Katrin Schroeder (3), Mireno Borghini (4), Stephane Leizour (2), and Sana Ben Ismail (5)

(1) Sorbonnes Universités UPMC Paris 6, L'OCEAN, France (avlod@locean-ipsl.upmc.fr), (2) LPO, IFREMER, Brest, France, (3) CNR-ISMAR, Venice, Italy, (4) CNR-ISMAR, Lerici (SP), Italy, (5) Institut des Sciences et Technologies de la Mer, Tunis, Tunisia

The Sicily Channel controls the exchange between the Eastern and Western Mediterranean Basins, with a dynamics characterised by strong shear at the interface between the south-eastward surface flow and the strong north-westward bottom flow. Microstructure measurements taken in the two main deep passages of the Sicily Channel show that this region is a hotspot for turbulent mixing. At the north-eastern location (C01), just downstream of where the strong bottom flow crosses a sill, turbulent kinetic energy dissipation rates for the deep flow were of the order of 10^{-8}-10^{-7} W kg^{-1}. At the south-western location (C02) on the milder slope of Talbot Bank, the observed bottom flow was weaker and along the isobaths, with lower dissipation rates of the order of 10^{-9} W kg^{-1}. Furthermore, a recirculation of the western deep flow around Talbot Bank was hypothesised based on current measurements and a decrease in dissipation rates in the canyon north of C01. Strong shear, internal tides and interactions with the rough topography were found to be responsible for turbulence.

The dynamical regime was dominated by mechanically driven turbulence with a large range of turbulence intensities. Favourable conditions for double diffusive salt fingers and double diffusive convection also occurred, however double diffusion prevailed in only 0.5% of the observations. Mixing efficiency was computed from the microstructure measurements, and its variability was explored in the context of variable turbulence intensities. The vertical diapycnal diffusivity computed from the measurements was higher at C01 ($1.1\times10^{-3} \pm 3.2\times10^{-3}$ m^2 s^{-1}) than at C02 ($1.8\times10^{-4} \pm 7.6\times10^{-4}$ m^2 s^{-1}). Moreover, upward salinity dominated density fluxes of the order of 10^{-6} and 10^{-7} kg m^{-2} s^{-1} were found to be characteristic of the transitional and intermediate waters, respectively. Significant changes in water mass properties in the Sicily Channel were thus inferred.