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Test of fine-scale parameterizations of turbulent mixing using microstructure measurements in the Lucky-Strike segment of the Mid-Atlantic Ridge

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In the ocean, turbulent mixing, although occuring at very small scales, has a large impact on the stratification of the thermohaline circulation. Ridges are particularly actives in terms of turbulent mixing. The Mid-Atlantic Ridge (MAR) is one of these major topographic structure and experiments have taken place in the Lucky Strike segment of the MAR to investigate Ocean circulation in the this section. Turbulent mixing can be directly estimated using microstructure measurements. These measurements are very acurate but also expensive and infrequent, which motivates the developement of fine-scale parametrizations based on mechanisms which lead to turbulent mixing. We compare here microstructure measurements with the output of parametrizations inferred from fine-scale data.

Microstructure and finescale measurements were made in August 2006 during the Graviluck campaign, on the axial valley of the MAR area. The studied site, a submarine volcano near the Azores, is located between two passages separating two deep semi-isolated basins. There is a mean northward flow along the site, creating strong shear under 1800m by interactions with the flow trough the passage. Direct measurements of dissipation rate are about (1-3)$\times 10^{-9}$ W.kg^{-1} along the thermocline and increase with depth. Some high values of the order of 10^{-6} W.kg^{-1} can be reached near the bottom, downstream of the eastern passage, where gravity current cascades down the slope. Elsewhere, turbulent mixing is mainly due to the breaking of internal waves. These waves can be generated by the interactions of batropic tidal currents over the bathymetry. Parametrizations that relate the turbulent dissipation rate (ε) to characteristics of the internal wave field, such as internal wave shear and strain, allow us to estimate turbulent mixing. These estimates were compared to the observations.

Through the whole water column, shear and strain spectrum are well above Garret and Munk model values. We find that two third of the estimates of ε reproduced the observed ε within a factor of 2. Parametrization from Gregg et al.(2003) fit better the observed data than Kunze et al. (2006), mainly due to the fact that the former parametrization used a varying upper bound for the integration of the shear spectrum. Estimations of ε were also inferred from Thorpe overturns, which present more scatters than other estimations.