Solibores, Tidal Beams, Hurricanes, and Density Currents: Processes Enhancing Diapycnal Mixing Above the Outer Shelf and Slope

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The edges of continental shelves generate a rich array of processes producing diapycnal mixing rates much larger than typically found in the open ocean. Recently we have werked over sLelves and slopes off Turkey, New England, and California. We sought to determine the diapycnal diffusivity, Kp, to identify the processes producing the mixing and to quantify the shear. Ultimately, we seek to produce a crude geography of mixing and shear similar to that slowly emerging from deep-water observations and to parameterize the mixing in terms of larger-scale variables.

The narrow Black Sea shelf north of the Bosphorus contains the widest range of mixing we observed. Kp averaged only 6.3 x 1o-7 m2 S-i across the sLelf and over the inner slope, in spite of the rim current along the outer shelf [Gregg and Ozsoy, 1999]. We attribute the very weak mixing to the absence of significant tidal currents. Close to the bottom, however, mixing was decades more intense in the gravity current exiting the PreBosphorus Channel. The current thinned to 1 m or less as it spread laterally. By using an altimeter on our microstructure profiler, we were able to regularly sample this thin flow as it crossed the shelf and cascaded down the slope. After cascading downslope for everal hundred meters the current the flow was so diluted by entrainment that it equilibrated with the offshore profile and formed thermobaline intrusions.

In late summer on the New England sLelf, mixing driven by the shear in solibores was up to 10 times background levels produced by internal waves, and hence was the dominant process producing Kp ~ 10-5 m2 s-1. Later, however, a hurricane homogenized the upper half of the water column and left Kp was 10-4-1o-3 m2 S-l in the stratified lower half.

During eff tide oflf California we observed a 50-m-thick tidal beam extending 4 km along th~ 1\42 characteristic from the sLelf break. Within the beam Kp ~ 10-2 m2 s-~. Below a section of weak mixing under the beam there was was a 100-m-thick region with equally intense mixing in strongly stratified water just above the bottom. Our time series was not as long, but it too seemed to be tidal and several hours out of phase with mixing in the beam.

Taken together, 'bachground' diapycnal mixing levels over the outer shelf and slope seem as weak as often found in the main thermocline far from shore. The dominant mixing, however, is significantly larger and episodic in time and space, greatly complicating the task of developing realistic numerical models of biological, chemical, and particulate fluxes.

References

Gregg, M.C. and E. Ozsoy, 1999. Mixing on the Black Sea shelf north of the Bosphorus. Geophys. Res. Ltrs., 26, 1869-1872.