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Internal Tidal Bores And Turbulent Mixing At The Celtic Sea Shelf Break: An Ocean Glider Study

Matthew R. Palmer (1), Gordon Stephenson (2), and Jo Hopkins (1)

(1) National Oceanography Centre, Marine Physics and Ocean Climate, Liverpool, United Kingdom (rolm@noc.ac.uk), (2) School of Ocean Sciences, Bangor University, Wales

A key mechanism for diapycnal mixing in our oceans is internal waves that are generated through the interaction of stratified flow with topography, either via enhanced interfacial shear or wave breaking. One of the most dramatic examples of such processes are observed at the continental shelf break where energy is extracted from the barotropic tide to generate localized mixing hotspots and high amplitude internal waves are able to radiate energy onto the shelf and into the open ocean. The influence of this energy on diapycnal mixing over the continental shelf is still poorly understood due to 1) the difficulty of making sustained measurements of turbulence in the pycnocline, 2) the sporadic and small scale nature of pycnocline turbulence and 3) the spatial variability of the on-shelf interaction of topography with barotropic and baroclinic flow.

Here we present new observations made in June 2012 of the dissipation rate of turbulent kinetic energy (ε) with supporting hydrographic measurements that show the on-shelf propagation of turbulent bore-like features generated at the nearby Celtic Sea shelf break. Measurements of ε are provided by both a 'traditional' ship deployed vertical profiler that provides two, typically short timeseries (38 hours and 13 hours), and a glider mounted microstructure package, which provides 9 days continuous data. Both instruments identify the regular delivery of turbulent bores onto the shelf that increase diapycnal mixing by several orders of magnitude. The extended capability of the turbulence glider however reveals the temporal variability of these features and significantly increases our understanding of shelf break turbulence to provide greater confidence in our estimates of average diapycnal mixing rates.