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Dissipation in mesoscale eddies impinging on topography

D Gwyn Evans (1), Eleanor Frajka-Williams (2), and Alberto Naveira Garabato (1)

(1) University of Southampton, NOCS, Ocean and Earth Sciences, United Kingdom (dge105@soton.ac.uk), (2) National Oceanography Centre, Southampton

Oceanic mesoscale eddies are ubiquitous. They propagate westward and disappear along the western boundaries of ocean basins. Here, we assess whether eddies disappear due to direct cascade of energy though turbulent processes at the boundary using a multi-scale observational study. We use data from a ship-based microstructure survey, an 18-month mooring deployment and an autonomous glider to examine the dissipation of energy in mesoscale eddies impinging on the slope east of the Bahamas in the north Atlantic Ocean. The ship-based observations revealed high levels of turbulence where the steep and rough slope modified the elevated northward flow associated with, in particular, anticyclonic eddies. Elevated dissipation was observed both near-bottom and at mid-depths. Near-bottom turbulence was observed in the lee of a protruding escarpment where upward propagating internal wave energy was apparent from ship and mooring-based time-series. Elevated dissipation at mid-depths occurred in regions of strong vertical shear where the slope modified the vertical structure of the northward eddy flow. The importance of these processes to the decay of a mesoscale eddy are explored by comparing eddy energy to the sinks of eddy energy. The eddy energy is determined from the amplitude and diameter of the eddy away from the influence of topography using satellite-based altimetry and eddy tracking. Ship, mooring and glider-based observations are then used to determine the loss of energy associated with internal wave generation and dissipative processes. This energy budget is then discussed in terms of mesoscale eddies in the global ocean energy budget.