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Direct evidence for enhanced turbulence in a submesoscale mixed-layer front

Lars Umlauf, Jen-Ping Peng, and Peter Holtermann
Leibniz-Institute for Baltic Sea Research, Warnemünde, Germany

Previous theoretical and numerical studies have shown that density fronts in the ocean surface layer are often amenable to inertial and symmetric instabilities. Such instabilities may induce a forward energy cascade, which is, according to numerical simulations, reflected in enhanced energy dissipation rates inside fronts. Field observations supporting this picture are, however, virtually lacking at the moment, mainly due to difficulties in obtaining combined stratification, shear, and mixing parameters at sufficient resolution across quickly evolving submesoscale features. Here, a recent data from a frontal region in the Baltic Sea will be presented, providing first direct evidence for enhanced energy dissipation inside a submesoscale mixed-layer front. Our measurements include repeated, densely-spaced cross-front turbulence microstructure transects and simultaneous high-resolution velocity measurements. These data reveal a narrow (width: 1-2 km) frontal region inside a 55 m thick surface layer, where the titled isopycnal structure of the front delineates a 20 m thick layer with strongly enhanced dissipation rates. Based on the observed background parameters, the possibility of different instability mechanisms (inertial, symmetric, and shear instability) will be discussed. It is found that the trapping of near-inertial waves inside the front provides an important energy source for frontal turbulence. This study supports the important role played by submesoscale motions as a route to energy dissipation of balanced larger-scale motions.