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Mesoscale ocean turbulence and coherent structures as observed from Lagrangian data

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Lagrangian data provide direct information on ocean currents in terms of velocity and water particle dispersion. Extensive data sets of historical Lagrangian data are available today for most of the world oceans, both at the surface and in the ocean interior. Their statistical analyses have significantly contributed to improve our knowledge of the ocean circulation. In particular, Lagrangian data provide direct information about transport processes, allowing to identify the mesoscale eddy component. An important conceptual question is whether the eddy transport can be considered approximately diffusive, as assumed in climate modeling and parameterizations, or whether it presents significant deviations due to the presence of coherent structures such as vortices and waves.

In this talk, the question of how to characterize and parameterize oceanic turbulence in presence of coherent structures is addressed considering both the historical data set of subsurface floats at 700 m in the northwestern Atlantic and a corresponding numerical trajectory data set simulated by a high-resolution Miami Isopycnic Coordinate Ocean Model (MICOM). We consider the regions of the Gulf Stream extension and recirculation, which are characterized by the presence of strong vortices and rings as shown by a number of looping trajectories, the so-called “loopers”. We focus on the statistical and dispersion properties of the mesoscale turbulent field, and verify the applicability of an appropriate Lagrangian Stochastic Model capable of describing the observed features.