Statistical Physics Seminar

March 6th, 2019.
Wednesday, 11.00

ELTE TTK Northern Building 2.54

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Eddy census over the oceans: overview of methods, and a super-vortex proxy

Mesoscale eddies are energetic, swirling, time-dependent circulatory flows on a characteristic scale of around 100 km, which are observed almost everywhere in satellite altimetry data of global sea surface height. The total volume transport by drifting eddies is comparable in magnitude to that of the large-scale wind-driven and thermohaline circulations, therefore mesoscale eddies play a crucial role in global material and heat transport and mixing of oceans. In spite of their importance, it is far from trivial to identify and characterize such eddies from remote sensing data. The vast majority of the related studies is based on some automatic algorithm that identifies and tracks the eddies from gridded maps of sea level anomaly. I give a short overview of Lagrangian and Eulerian methods to identify mesoscale eddies. The algorithms based on searching for finite-time Lagrangian coherent structures obey a better theoretical foundation, nevertheless a recent test of twelve different approaches revealed that the various methods often produce very different predictions for coherent structures with false positives and negatives. Our own empirical flow field data evaluation in a well studied ocean region along the U.S. West Coast revealed a surprisingly strong relationship between the surface integrals of kinetic energy and enstrophy (squared vorticity). This relationship defines a single isolated Gaussian super-vortex, whose fitted size parameter is related to the mean eddy size, and the square of the fitted height parameter is proportional to the sum of the square of all individual eddy amplitudes obtained by standard vortex census. This finding allows a very effective coarse-grained eddy statistics with minimal computational efforts. As an illustrative example, the westward drift velocity of eddies is determined from a simple cross correlation analysis of kinetic energy integrals.

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http://glu.elte.hu/~statfiz/index.html