Geophysical Research Abstracts
Vol. 20, EGU2018-4168, 2018
EGU General Assembly 2018

A geometric representation of the eddy stresses underlying the emergence of jets in barotropic turbulence

Georgios Kontogiannis and Nikolaos Bakas
University of Ioannina, Department of Physics, Ioannina, Greece (nikos.bakas@gmail.com)

There are currently many efforts to improve the parametrization of unresolved eddies in global circulation models. A recently proposed framework for parametrizing eddy potential vorticity fluxes involves the expression of the fluxes as the divergence of the eddy stress tensor and the effort of parametrizing the elements of the tensor. An advantage of this framework is that the eddy variance ellipse, which is the visualization of the stress tensor, and its geometric properties, that is its shape and tilt are useful diagnostics for the characterization of the eddy field and its mean flow interactions. In this work we analyze the properties of the eddy variance ellipse in zonal jets that emerge in a barotropic turbulent flow on a beta-plane with turbulence sustained by homogeneous random stirring. In order to get a clear picture of the eddy ellipse we choose to study its characteristics within the framework of a second order closure of the statistical state dynamics of the flow. The reason is that this framework, which was shown by a number of previous studies to accurately capture jet formation in the barotropic turbulent flow, involves the deterministic equations for the evolution of the flow statistics and the thermal noise from the turbulence is absent. We show that jets form as the emerging jet shears the eddies and deforms the eddy variance ellipse in a way that the divergence of the stress tensor enhances the jet. For an isotropic forcing, the eddy variance which is circular due to isotropy is elongated by the shearing of the jet producing anti-hypper-diffusive fluxes. For an anisotropic forcing mimicking baroclinic instability, the eddy variance which is a straight line due to the forcing characteristics is tilted by shearing producing anti-diffusive fluxes.