Geophysical Research Abstracts
Vol. 14, EGU2012-13684, 2012
EGU General Assembly 2012

Fractional Vorticity Equations

D. Schertzer (1), I. Tchguirinskaia (1), S. Lovejoy (2), and A. Tuck (1)

(1) U. Paris-Est, Ecole des Ponts ParisTech, LEESU, Marne-la-Vallee , France (daniel.schertzer@enpc.fr, +33-(0)1-64153764), (2) McGill U., Phys. dept., Montreal, Quebec, Canada

As a result of a thorough discussion (Schertzer et al., Atmos. Chem. Phys., 12, 327–336, 2012) of the limitations of the quasi-geostrophic approximation and turbulence, fractional vorticity equations were obtained. This was done with the help of an anisotropic scaling analysis, instead of the classical scale analysis, as done to derive the quasi-geostrophic approximation. This breaks the rotational symmetry of the classical 3D vorticity equations and *a priori* yields a $(2 + H_z)$-dimensional turbulence $(0 \leq H_z \leq 1)$. This corresponds to a first step in the derivation of a dynamical alternative to the quasi-geostrophic approximation and turbulence.

The corresponding precise definition of fractional dimensional turbulence already demonstrates that the classical 2-D and 3-D turbulence are not the main options to understand atmospheric and oceanic dynamics. Although $(2 + H_z)$-dimensional turbulence (with $0 < H_z < 1$) has more common features with 3-D turbulence than with 2-D turbulence, it has nevertheless very distinctive features: its scaling anisotropy is in agreement with the layered pancake structure, which is typical of rotating and stratified turbulence, but not of the classical 3-D turbulence.

In this presentation, we further discuss the properties of this set of deterministic-like equations, especially how they can generate a statistical scaling anisotropy, as well as the relevance of the theoretical value $H_z = 5/9$.