Geophysical Research Abstracts
Vol. 18, EGU2016-11844, 2016
EGU General Assembly 2016

Large deviations and averages of Reynolds stresses for atmosphere jets

Freddy Bouchet (1), John Bradley Marston (2), Tomas Tangarife (1), and Eric Woillez (1)

(1) Laboratoire de physique, CNRS, ENS de Lyon, Université de Lyon, Lyon, France (Freddy.Bouchet@ens-lyon.fr), (2) Brown University, Providence, USA

Classical stochastic approaches, for instance closures or stochastic averaging, usually describe typical states or low order statistics only. Large deviation theory is a very interesting alternative to these classical methods. It can in principle describe both typical and extreme fluctuations. One goal is to predict, in relation with large deviation of Reynolds stress, the dynamics that may lead to changes of regimes and changes of attractors in atmospheric jet dynamics, as observed on Jupiter during the last century.

We consider the dynamics of atmosphere jets in a quasi-geostrophic framework. We will present new results in which an explicit analytic formula can be derived for the Reynolds stress average. This striking expression depends only on the energy injection rate and on the local mean flow properties. From these results, we predict multiple attractors in dynamics similar to Jupiter's one. In order to prepare the study of rare transitions between these attractors, we compute the large deviation rate function of zonally averaged Reynolds stresses. We explain a recent theoretical approach were large deviations can be computed efficiently from the solution of a Riccati equation. This new approach is the first one that can address the dynamics of rare or extreme events in turbulent flows from first principles.