# LARGE DEVIATIONS OF TURBULENT ATMOSPHERIC JETS

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**Abstract**

Rare or extreme events are of great interest in the climate system. No studies addressed yet these statistics from a dynamical or theoretical perspective. Classical statistical approaches, for instance closures or stochastic averaging usually describe typical states or low order statistics only [1, 2]. Large deviation theory is a very interesting alternative to these classical methods, in order to discuss the long time evolution of the jet and to predict the dynamics that may lead to change of regimes and change of attractors in atmospheric jet dynamics.

We consider the dynamics of atmospheric jets in a quasi-geostrophic framework and compute the large deviation rate function of the zonally averaged Reynolds stress, the most interesting quantity for the dynamics of jets. In the limit of a time scale separation between the large scales and the surrounding turbulence, we expect a quasi-linear approximation to descibe accurately the mean flow statistics [1]. Then, we derive an explicit equation for the large deviation rate function within this quasi-linear dynamics. These theoretical results are compared with empirical measures of the rate function, obtained from direct numerical simulations of the quasi-linear equations of motion.

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