Geophysical Research Abstracts
Vol. 20, EGU2018-7990, 2018
EGU General Assembly 2018

Rossby waves in the Stratosphere: The effect of mean flow on the accuracy of quasi-geostrophic solutions

Yair De-Leon, Chaim I. Garfinkel, and Nathan Paldor
The Hebrew University of Jerusalem, Institute of earth sciences, Jerusalem, Israel (yair.deleon@mail.huji.ac.il)

Quasi-Geostrophic (QG) theory forms the underpinnings of our understanding of stratospheric dynamics and stratosphere-troposphere coupling (e.g. Charney and Drazin 1961; Matsuno 1970). The underlying assumptions of the theory restrict the relevance of the solutions, at least formally, to scenarios when these assumptions are satisfied. However, planetary waves of relevance to the stratosphere can violate two of the basic QG assumptions: βL≪f_0 (where L is the length scale), and L not too much larger than the Rossby radius of deformation. Here, we develop a Shallow Water Equations (SWE) setup on the β-plane for Rossby waves in order to quantify the biases introduced by QG theory in the presence of a uniform mean flow. When the radius of deformation is of the order of the zonal flow's meridional extent, QG theory accurately describes the propagation speed of Rossby waves but errs in describing their associated meridional structure when the mean flow's speed increases, when compared to exact solutions. When the radius of deformation is smaller than the zonal flow's meridional extent the QG theory fails to predict both the phase speeds of Rossby waves and their meridional structure (which is trapped near the equatorward boundary rather than oscillatory) when compared to exact solutions. Unlike QG theories the maximal mean flow's speed in the SWE is bounded by geostrophy. The formulation of the SWE developed here can be applied to more complex mean flows.