Geophysical Research Abstracts
Vol. 18, EGU2016-6847, 2016
EGU General Assembly 2016

Can zonally symmetric inertial waves drive an oscillating mean flow?

Torsten Seelig and Uwe Harlander

Brandenburg University of Technology Cottbus - Senftenberg, Aerodynamics and Fluidmechanics, Germany (seelig@b-tu.de)

In the presentation [5] zonal mean flow excitation by inertial waves is studied in analogy to mean flow excitation by gravity waves [3] that plays an important role for the quasi-biennial oscillation in the equatorial atmosphere. In geophysical flows that are stratified and rotating, pure gravity and inertial waves correspond to the two limiting cases: gravity waves neglect rotation, inertial waves neglect stratification. The former are more relevant for fluids like the atmosphere, where stratification is dominant, the latter for the deep oceans or planet cores, where rotation dominates. In the present study a hierarchy of simple analytical and numerical models of zonally symmetric inertial wave-mean flow interactions is considered and the results are compared with data from a laboratory experiment [4]. The main findings can be summarised as follows: (i) when the waves are decoupled from the mean flow they just drive a retrograde (eastward) zonal mean flow, independent of the sign of the meridional phase speed; (ii) when coupling is present and the zonal mean flow is assumed to be steady, the waves can drive vertically alternating jets, but still, in contrast to the gravity wave case, the structure is independent of the sign of the meridional phase speed; (iii) when coupling is present and time-dependent zonal mean flows are considered the waves can drive vertically and temporarily oscillating mean flows. The comparison with laboratory data from a rotating annulus experiment shows a qualitative agreement. It appears that the experiment captures the basic elements of the inertial wave mean flow coupling. The results might be relevant to understand how the Equatorial Deep Jets can be maintained against dissipation [1, 2], a process currently discussed controversially.

[1] Greatbatch, R., Brandt, P., Claus, M., Didwischus, S., Fu, Y.: On the width of the equatorial deep jets. J. Phys. Oceanogr. 42, 1729–1740 (2012)

[2] Muench, J.E., Kunze, E.: Internal wave interactions with equatorial deep jets. Part II: Acceleration of the jets. J. Phys. Oceanogr. 30, 2099–2110 (2000)

[3] Plumb, R.A.: Momentum transport by the thermal tide in the stratosphere of Venus. J. Roy. Meteor. Soc. 101, 763–776 (1975)

[4] Seelig, T.: Inertial wave propagation, focusing and mean flow excitation: theory and experiment. Cuvillier Verlag Göttingen, Ph.D. thesis (2014)

[5] Seelig, T., Harlander, U.: Can zonally symmetric inertial waves drive an oscillating zonal mean flow? Geophysical & Astrophysical Fluid Dynamics 109(06), 541–566 (2015). URL http://www.tandfonline.com/doi/abs/10.1080/03091929.2015.1094064