Geophysical Research Abstracts
Vol. 21, EGU2019-7157, 2019
EGU General Assembly 2019

A new atmospheric-like differentially heated rotating annulus configuration to study spontaneous emission of gravity waves from jet/front systems.

Costanza Rodda (1), Uwe Harlander (1), Steffen Hien (2), and Ulrich Achatz (2)

(1) BTU Cottbus-Senftenberg, Department of Aerodynamics and Fluid Mechanics, Cottbus, Germany (rodda@b-tu.de), (2) Institute for Atmospheric and Environmental Sciences, Goethe-University, Frankfurt am Main, Germany

Significant internal gravity wave activity has been frequently observed in the vicinity of jet/front systems in the atmosphere. Although many studies have established the importance of these non-orographic sources, the mechanisms responsible for spontaneous wave emissions is still not fully understood. The complexity of the three-dimensional flow pattern and distribution of the sources over large areas point towards the need of laboratory experiments and idealised numerical simulations to help with the correct interpretation of the fundamental dynamical processes in a simplified, but yet realistic flow. In this study, we emphasise that the differentially heated rotating annulus experiment, classically showing an aspect ratio of about one, is not a particularly favourable set-up to investigate atmosphere-like emission of gravity waves from baroclinic jets due to an unrealistic ratio between the buoyancy frequency N and the Coriolis parameter f. The latter is much larger than one for the atmosphere but smaller than one for the classical annulus. Hence we offer a newly built laboratory experiment, supported by numerical simulations [1], as a better choice, i.e. with a more realistic N/f. The conditions for gravity wave emission in this new configuration are examined in detail. Moreover, we compare numerical simulations and experimental data focusing on the variations of the temperature T and N. It becomes clear that despite the fact that the global structure and baroclinic instability characteristics are very similar, model and experiment show deviations in N with implications for gravity wave emission. The complex horizontal structure of N with largest values along the baroclinic jet axis lend credence to the experimentally observed trapped inertia-gravity waves [2].

References

[1] S. Hien, J. Rolland, S. Borchert, L. Schoon, C. Zülicke, and U. Achatz, "Spontaneous gravity wave emission in the differentially heated rotating annulus experiment," J. Fluid Mech., 838:5–41, 2018.

[2] C. Rodda, I. Borcia, P. Le Gal, M. Vincze and U. Harlander, "Baroclinic, Kelvin and inertia-gravity waves in the barostrat instability experiment," Geophysical and Astrophysical Fluid Dynamics, pages 1-32, 2018,