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# Atmospheric gravity waves: Challenges and steps towards possible solutions

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## Abstract

A major source of uncertainty in current climate-chemistry models are internal gravity waves (GWs), represented by oversimplified parameterizations (e.g. Fritts and Alexander 2003). The presentation will discuss some central questions to be addressed, and some interesting respective results. One focus will be on the theory and numerically stable modelling of the two-way interaction between subgrid-scale waves, either GWs or geostrophic modes, and the resolved flow (e.g. Achatz et al. 2010, Rieper et al. 2013, Muraschko et al. 2015). Another will be on the spontaneous emission of gravity waves from large-scale flow, with a special eye on the reproducibility of this process in the laboratory (e.g. Borchert et al. 2014). This is to feed into the work of a German/Swiss research unit on the multiscale dynamics of GWs (MS-GWaves, <https://ms-gwaves.iau.uni-frankfurt.de/index.php>) where explicit models of GW excitation, propagation, and dissipation are to be formulated in a physically and mathematically consistent way, and where these will be tested by implementation into a state-of-the-art numerical-weather-prediction and climate model, and by reference to data from dedicated measurement campaigns and laboratory experiments.

## References

Achatz, U., Klein, R., Senf, F., 2010: Gravity waves, scale asymptotics and the pseudo-incompressible equations. *J. Fluid Mech.*, **663**, 120-147

Borchert, S., U. Achatz and M.D. Fruman, 2014: Gravity Wave Emission in an Atmosphere-like Configuration of the Differentially Heated Rotating Annulus Experiment. *J. Fluid Mech.*, **758**, 287-311

Fritts, D. C., and M. J. Alexander, 2003: Gravity wave dynamics and effects in the middle atmosphere. *Rev. Geophys.*, **41**, 1003

Muraschko, J. , Fruman, M. D. , Achatz, U. , Hickel, S., and Y. Toledo, 2015: On the application of WKB theory for the simulation of the weakly nonlinear dynamics of gravity waves. *Q. J. Roy. Meteorol. Soc.*, **141**, 676–697

Rieper, F., Achatz, U. und Klein, R., 2013: Range of validity of an extended WKB theory for atmospheric gravity waves: one-dimensional and two-dimensional case. *J. Fluid Mech.*, **729**, 330-363

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