Mathematics of the Weather 2024



Contribution ID: 14

Type: Contributed Talk

## The impact of transience in the interaction between orographic gravity waves and mean flow

Monday 7 October 2024 14:45 (15 minutes)

A Lagrangian gravity-wave parameterization (MS-GWaM, Multi-Scale Gravity-Wave Model) that allows for fully transient wave-mean-flow interaction and horizontal propagation is applied to orographic gravity waves for the first time. Both linear and nonlinear mountain waves are modeled in idealized simulations within the pseudo-incompressible flow solver PincFlow. Two-dimensional flows over monochromatic orographies are considered, using MS-GWaM either in its fully transient implementation or in a steady-state implementation that represents classic mountain-wave parameterizations. Comparisons of wave-resolving simulations (not using MS-GWaM) and coarse-resolution simulations (using MS-GWaM) show that allowing for transience leads to a significantly more accurate forcing of the resolved mean flow. The model is able to reproduce the transient forcing of linearly generated mountain waves that slowly propagate upwards, in contrast to the instantaneous distribution of wave energy in classic parameterizations. At high altitudes, wave breaking induces a wind reversal that is captured by the transient model but inhibited in steady-state simulations, due to the assumption of critical level formation. This shows that transience can have a substantial impact in the interaction between mountain waves and mean flow.

Primary author: JOCHUM, Felix (Institut für Atmosphäre und Umwelt, Goethe-Universität Frankfurt)

**Co-authors:** LOTT, Francois (Laboratoire de Météorologie Dynamique, École Normale Supérieure); VOELKER, Georg Sebastian (Leibniz-Institut für Ostseeforschung Warnemünde); WEINKAEMMERER, Jan (Institut für Biound Geowissenschaften: Agrosphäre (IBG-3), Forschungszentrum Jülich GmbH); CHEW, Ray (Institut für Atmosphäre und Umwelt, Goethe-Universität Frankfurt); ACHATZ, Ulrich (Institut für Atmosphäre und Umwelt, Goethe-Universität Frankfurt)

Presenter: JOCHUM, Felix (Institut für Atmosphäre und Umwelt, Goethe-Universität Frankfurt)

Session Classification: Parameterizations & Machine Learning