Geophysical Research Abstracts
Vol. 16, EGU2014-7030, 2014
EGU General Assembly 2014

Characteristic of gravity waves resolved in ECMWF anaylses

Peter Preusse, Manfred Ern, Martin Riese, and the ESA GW study Team
Juelich Research Center, IEK-7, Juelich, Germany (p.preusse@fz-juelich.de)

Gravity waves (GWs) influence the circulation of the atmosphere on global scale. Can we employ global models such as the ECMWF high-resolution GCM to infer quantities of resolved GWs? Does this give us insight for the characteristics and relative importance of real GW sources? And can we use such data savely for, e.g., campaign planing? We here apply techniques developed for an ESA study proving the scientifc break-through which could be reached by a novel infrared limb imager. The 3D wave structure of mesoscale GWs is exploited to determine amplitudes and 3D wave vectors of GWs at different levels (25km, 35km and 45km altitude) in the stratosphere. Similar to real observations, GW momentum flux is largest in the winter polar vortex and exhibits a second maximum in the summer subtropics. Based on the 3D wavevectors backward ray-tracing is employed to characterize specific sources. For instance, we find for the northern winter strong GWMF associated with mountain waves from Norway and Greenland as well as waves emitted in the lower troposphere from a storm approaching Norway. Waves from these sources spread up to several thousand km in the stratosphere. Together these three events form a burst in the total hemispheric GWMF of a factor of 3. Strong mountain wave events are also found e.g. at Tierre del Fuego and the Antarctic Peninsula, regions which are in the focus of observational and modeling studies for a decade. Gravity waves in the tropical region are likely generated above deep convection in the upper troposphere. They have significantly larger horizontal wavelengths but shorter vertical wavelengths than indicated by observations. They also exhibit lower phase speeds than waves simulated by mesoscale modeling of deep convection events. This difference is not due to the model resolution. Rather, GWs in ECMWF are excited aloft of the convection in the altitudes of largest wind-shear and least dynamical stability. GWs which are excited by resonant forcing, however, seem to be missing in ECMWF. Likely, the reason is that the convective parameterization of ECMWF treats convection inside a single model cell and couples only the net effects to the global dynamical fields. For instance, ECMWF vertical winds do not exhibit any strong updrafts normally found in deep convection. In summary, the study demonstrates that larger scale MWs and waves from storms are represented in a realistic fashion, while convective gravity waves are not. This is not a resolution problem, but depends on the convective parameterization. The day-to-day variability of GWMF is huge, even for total hemispheric fluxes - and could be even underestimated by ECMWF. Finally, it is demonstrated that an infrared limb imager would provide novel inside into real GWs similar as this study for the ECMWF model.