Representation and generation of resolved gravity waves in high-resolution global atmospheric models

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Abstract

Breaking and dissipating atmospheric gravity waves (GWs) are important drivers of middle atmosphere circulation. In most climate and low-resolution numerical weather prediction models GWs are unresolved and therefore their effect on the circulation is parametrized. The amplitude of parametrized GW drag is known to not only influences the middle-atmosphere circulation but also the stratosphere-troposphere dynamical coupling in both hemispheres. In the absence of whole middle atmosphere GW observations, high-resolution models which resolve GWs can provide constrain on GWs and inform parametrization design. In the first part of the talk, the distribution of GWs in unique global seasonal simulations with ECMWF IFS at 1 km, 4 km and 9 km horizontal resolution is presented and the impact of resolution and resolved deep convection on convectively generated GWs elucidated. It is shown that switching off deep convection parametrization at a too coarse horizontal resolution (9 km and 4 km) generates stronger convective GWs than in 1 km simulations with better resolved deep convection and in 9 km simulations with parametrized deep convection. In the second part of the talk, a novel mechanism where a GW is generated from a non-linear critical layer in the stratospheric polar night jet is presented. Using idealized high-resolution simulations, it is shown that a GW packet propagates large horizontal distances away from its source, questioning the single-column approximation employed in most GW drag parametrizations.