Geophysical Research Abstracts
Vol. 21, EGU2019-18710-1, 2019
EGU General Assembly 2019

Gravity waves in convection-permitting simulations of general circulation models

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Large uncertainties remain with respect to the representation of atmospheric gravity waves (GWs) in General Circulation Models (GCMs) with coarse grids. They mainly result from a lack of observational constraints on the parameters used in GW parameterizations and from oversimplifying assumptions about the generation and propagation of GWs. Increasing computational capabilities now allow GCMs to run at grid spacings that are sufficiently fine to resolve a major fraction of the GW spectrum. We present the first intercomparison of resolved GW momentum fluxes (GWMFs) in global convection-permitting simulations and those derived from satellite observations. Six simulations of three different GCMs are analyzed over the period of one month of August to assess the sensitivity of GWMF to model formulation and horizontal grid spacing. The simulations reproduce detailed observed features of the global GWMF distribution, which can be attributed to realistic GWs from convection, orography and storm tracks. Yet, the GWMF magnitudes differ substantially between simulations. Differences in the strength of convection may help explain differences in the GWMF between simulations of the same model in the summer low latitudes where convection is the primary source. Across models, there is no systematic change with resolution. Instead, GWMF is strongly affected by model formulation. The results imply that validating the realism of simulated GWs across the entire resolved spectrum will remain a difficult challenge not least because of a lack of appropriate observational data.