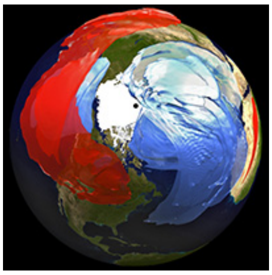

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Global gravity wave distributions observed from satellites and resolved in the ECMWF-IFS

Thursday, 21 November 2019 09:00 (30 minutes)

In order to derive global distributions of gravity waves (GWs) and gravity wave momentum flux (GWMF), temperature observations from various satellite instruments are analyzed for fluctuations. Temperature amplitudes and horizontal and vertical wavelengths are inferred. From these, GWMF is calculated via the polarization relations. This requires different analysis methods for along-track data from limb-sounders, for which current instruments can provide only absolute GWMF, and 3D data from nadir sounders, which allow also to infer the horizontal propagation diretion. The analysis leads to global distributions of GWMF. Qualitatively, global distributions of GWs resolved in the ECMWF-IFS are in good agreement with satellite observations. The salient features in the mid-stratosphere are subtropical convective maxima in summer and enhanced GWMF in the winter polar vortices. There, localized maxima above major mountain ranges show particularly high and intermittent GWMF. The source for the generally enhanced GWMF in particular in the southern polar vortex is still not completely understood. Evidence is presented that oblique propagation of GWs in the upper troposphere and lower stratosphere transfers GWMF from the storm tracks and from orography around 40°S into the polar vortex centered around 60°S. Other mountain regions, such as the Rocky Mountains and the Himalayas are visible only in the lower stratopshere. These waves cannot propagate to higher altitudes because of directional wind shear or wind reversal in the lower stratopshere. In addition to GW filtering, the background winds are shaping the distribution by shifting the vertical wavelengths in and out of the observational filter, in particular for nadir sounding instruments observing only GWs of very long vertical wavelengths. A quantitative assessment of GWMF is not trivial. The global distributions deduced from satellite measurements are influenced by the instruments observational filter. However, even for model fields which provide regular sampling and all dynamical variables, inferred GWMF has uncertainties. This is because pseudomeomentum flux is formulated for single GWs of well defined amplitude whereas in reality (or in high-resolution model fields) there is a superposition of multiple scales and high spatial and temporal variation. Finally, we want to revisit previous work by Lane et al. (2005) indicating that grey-zone simulations may highly overestimate GWMF from short horizontal wavelengths.

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