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Occurrence Frequency of Convective Gravity Waves during the North American Thunderstorm Season

Lars Hoffmann (1) and M. Joan Alexander (2)

(1) Forschungszentrum Jülich, Jülich Supercomputing Centre, Jülich, Germany (l.hoffmann@fz-juelich.de, +49-2461-61-6656), (2) NorthWest Research Associates, Inc., Colorado Research Associates Division, Boulder, CO, USA

Convective gravity waves are an important driver of the equator-to-pole circulation in the stratospheric summer hemisphere, but their nature is not well known. Previous studies showing tight relationships between deep convection and convective waves mainly focus on tropical latitudes. For mid-latitudes most analyzes are based on case studies. Here we present a new multi-year occurrence frequency analysis of convective waves at mid-latitudes. The study is based on radiance measurements made by the Atmospheric Infrared Sounder (AIRS) on-board NASA's Aqua satellite during the North American thunderstorm season, May to August, in the years 2003 to 2008. For this study we optimized an existing algorithm to detect deep convection in AIRS data to be applicable at mid-latitudes. We also present a new detection algorithm for gravity waves in AIRS data, based on a variance filter approach for 4.3 micron brightness temperatures. The new algorithm can detect plane wave perturbations in the altitude range from 20 to 65 km with vertical wavelengths larger than 15 km and horizontal wavelengths from 50 to 1000 km. By analyzing spatial and temporal correlations of the individual AIRS observations it can be shown that more than 95% of the observed gravity waves in a core region over the North American Great Plains are related to deep convective clouds, i.e. are likely being classified appropriately as convective waves. We conclude that the core region is a good location to observe and characterize the properties of convective waves at mid-latitudes. It is expected that the statistical analyzes presented here will become a valuable tool to validate parameterization schemes for convective gravity waves.