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Model consistent generation of gravity waves and their effects on simulations of the middle atmosphere: A case study with the WACCM model.

F. Sassi, J. Richter, B.A. Boville, R.R. Garcia

National Center for Atmospheric Research

Boulder – CO – USA

(sassi@ucar.edu / Fax: + 303 497 1324 / Phone: + 303 497 1872)

Momentum deposition by unresolved gravity waves is significant in the middle atmosphere. Gravity waves can reverse the thermal gradient in the mesosphere and drive a mean meridional circulation from the winter to the summer hemisphere. By doing so, they can control the height and temperature of the summer mesopause, the coldest place in the atmosphere. Gravity waves can directly or indirectly affect the circulation of the stratosphere as well. While gravity waves are very important in the middle atmosphere, they need to be parameterized because they are not resolved by current general circulation models. Some aspects of the gravity wave parameterizations are largely *ad hoc* because there is little observational guidance. Wave amplitude, seasonal cycle, source level and spectral distributions are by and large unknown and specified in such a way to result in a momentum forcing that yields a reasonable climatology from the mesopause to the lower stratosphere. In this talk, we illustrate the difficulties of tuning gravity wave parameterizations in the context of a fully interactive chemistry-climate model, the Whole Atmosphere Community Climate Model version 3 (WACCM). The standard WACCM3 uses a Lindzen type parameterization in which a Reynolds stress is specified in mid-troposphere. The source is spatially uniform with a seasonal cycle; the spectrum is Gaussian and centered on the wind speed at source level. The effects of different choices for some unknown parameters (source level, source amplitude, spectral dimension) are illustrated. A modified version of WACCM3 that uses tropospheric convection and detection of frontal zones to generate upward propagating gravity waves is compared to the standard model. The benefits of using model-

consistent generation mechanisms of gravity waves are discussed.