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Wave-induced constituent transport in the middle and upper atmosphere

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Atmospheric gravity waves generated in the troposphere by a number of sources (convection, frontogenesis, orography etc.) can travel great vertical distances, propagating upwards to 80 - 120km where they influence the chemical and dynamical structure of the Mesosphere and Lower Thermosphere (MLT).

Current chemistry-climate models represent gravity waves, and their impact on the temperature and the chemical composition of the atmosphere, by means of parameterizations that take into account the turbulence and the mixing caused by breaking waves but largely neglect the dynamical and chemical constituent transport by vertically propagating non-breaking waves.

We present initial results from the WAVECHASM (Wave-Induced Transport of Chemically Active Species in the Mesosphere and Lower Thermosphere) project. By making use of a recent novel theoretical approach, where the effective wave diffusivity is expressed as a function of the eddy diffusivity and of the variances of the temperature perturbation and lapse rate fluctuations, the WAVECHASM project aims to incorporate the missing transport processes into global atmospheric chemistry models. We will show here that it is possible to modify the current gravity wave drag parameterization of NCAR's Whole Atmosphere Community Climate Model (WACCM) to explicitly account for the wave-driven vertical mixing associated with non-breaking gravity waves. This additional source of vertical mixing is expected to induce significant constituent transport in the upper atmosphere.