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A parameterization of convective gravity waves based on the ray theory and its validation using satellite data

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A parameterization of gravity wave drag (GWD) induced by cumulus convection is developed based on the ray theory and implemented into the NCAR Whole Atmosphere Community Climate Model (WACCM). Comparison with column-based parameterization through one-month simulations indicates that the overall structures of GWD are similar to one another, but the magnitude of GWD in the new scheme is significantly larger in the lower stratosphere and equatorial troposphere whereas it is less in the upper mesosphere. This magnitude difference is due mainly to the vertical convergence of GW packets. In climate simulations, it is found that the zonal-mean zonal winds in the equatorial stratosphere and along the axis of the polar night jet are improved in the new parameterization. Also, interannual variability in the equatorial lower stratosphere associated with QBO is significantly enhanced. The parameterization is validated by off-line calculations using the global reanalysis data, and then the resultant temperature variance is compared with that observed in satellites. It is found that the new parameterization produces much more realistic distribution of gravity waves than the currently used column-based parameterization, although the result is sensitive to some factors included in the parameterization. Among them, the wave-propagation direction will be discussed in detail in the meeting.