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Effects of gravity wave parameterization changes on the middle and upper atmosphere in the Whole Atmosphere Community Climate Model

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The most recent version of the Whole Atmosphere Community Climate Model (WACCM) includes a source oriented gravity wave parameterization: there is no arbitrary gravity wave source spectrum; instead gravity waves are launched from three sources: orography, frontal zones, and convection. Although the number of tuning parameters has been reduced in this approach, we find that there are still few remaining physical assumptions in the parameterization, which when changed, can cause a significant change in the dynamics of the middle atmosphere. In particular, we will address here the effects of the assumption of how gravity waves break: at the level when saturation is first reached (sudden death approach) vs. keeping gravity wave amplitude at saturation. Surprisingly, these two different approaches produce similar middle and upper atmospheric climate. We will also explore the issue of gravity wave heating by dissipation. We find that if gravity wave heating is turned off, the temperatures in WACCM in the mesosphere and lower thermosphere region (MLT) are in much closer agreement to temperatures observed by the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument. This suggests that gravity wave heating is perhaps overestimated by gravity wave parameterizations. Lastly, we show how the remaining tuning parameters in the convective gravity wave source parameterization affect the global mean temperatures in WACCM and compare them to SABER.