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Impacts of introducing a parameterization of gravity waves from cumulus convection upon tropical stratospheric variability in the Met Office Unified Model

Young-Ha Kim (1), Andrew Bushell (2), David Jackson (2), and Hye-Yeong Chun (1)

(1) Dept. of Atmospheric Sciences, Yonsei University, Seoul, Korea, Republic Of (kimyh@yonsei.ac.kr), (2) Met Office, Exeter, United Kingdom

A parameterization of internal gravity waves (GW) generated by cumulus convection is introduced in the Met Office Unified Model (MetUM), and impacts of the parameterization upon the variability in tropical stratospheric wind are investigated using a climate configuration of the MetUM. A pair of AMIP-type experiments is performed with and without the convective GW (CGW) parameterization (CC and CTL experiments, respectively) for 12.5 years from September 1978. We replace a significant amount of GW momentum flux in the CC experiment, which is originally launched by the background GW parameterization of the MetUM, with the momentum flux launched by the CGW parameterization. The momentum flux from CGWs in the tropics has a stronger annual cycle and a broader wave spectrum that is explicitly determined by the convective sources than the momentum flux launched by the background GW parameterization. Compared to the CTL experiment, including the CGW parameterization results in a larger asymmetry between the easterly and westerly phases of the stratospheric quasi-biennial oscillation (QBO) and a greater variability in the duration of each QBO phase, which is closer to observed. Including the CGW parameterization also strengthens the annual cycle of zonal wind in the tropical upper stratosphere, which closely matches reanalyses. This allows for stronger annual modulation of the semi-annual oscillation (SAO) in the upper stratosphere and lower mesosphere. In addition to the QBO and the annual cycle, the tropical variability of the zonal wind on scales shorter than one year is increased significantly in the mesosphere by parameterizing the CGWs. Total variance of the anomalies on these scales in the CC experiment is similar to that in the reanalysis.