The Impact of Convection and Gravity Waves on Stratospheric Water and Upper Troposphere Cloud Fraction

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Using our forward-domain-fill trajectory model we have run a series of experiments to explore the impact of convection and gravity waves on TTL cloud fraction and stratospheric water vapor. We compare results using MERRA convective fields and a satellite-based estimate of convective cloud heights. Gravity wave information comes from the Loon super pressure balloons. We compare our results to MLS stratospheric water vapor and CALIOP cloud fraction. The use of the high spatial resolution satellite-based convective cloud heights produces little change in model stratospheric water, but a nearly 50% reduction in model high cloud fraction (well below the observed cloud fraction) compared to the model results when we use the MERRA convective fields. Using the observed gravity wave temperature fields, cloud fraction increases, but the fluctuations produce too much cloud unless we attenuate the gravity wave fields below the tropopause –as is observed in radiosonde data. The end results, observed convection plus observed gravity waves, are in excellent agreement with observations. Overall, these results suggest that mid-frequency gravity waves play a more significant role in the cloudiness of the TTL region than previously recognized.

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