

Influence of Lower Stratospheric Ozone Variation on Tropospheric Climate in the Northern Hemisphere Summer

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The influence of the lower stratospheric ozone variation on the tropospheric temperature and mean meridional circulation in the Northern Hemisphere mid latitude summer is examined. The data used are ozone data in Randel and Wu [2007] and National Center for Environmental Predictions/Department of Energy Atmospheric Model Intercomparison Project-II (NCEP/DOE AMIP-II) Reanalysis dataset. It is found that an increase in the lower stratospheric ozone strengthens static stability at the tropopause, then the vertical propagation of the planetary wave is trapped there more efficiently. The deceleration of the mean zonal flow due to the wave forcing induces the anomalous residual mean circulation, which causes anomalous cooling in the troposphere through the sensible and latent heat transport. This anomalous cooling is larger than anomalous warming of the radiative heating in the troposphere. Thus, the tropospheric temperature decreases associated with the stratospheric ozone increasing.

An analysis of the outputs from Center for the Climate System Research/National Institute for Environmental Study (CCSR/NIES) chemistry climate model (CCM) under the Chemistry Climate Model Validation 2 (CCMVal2) REF0 scenario and a sensitivity experiment using the CCM has been carried out to examine the tropospheric responses to the stratospheric ozone increasing. The result shows a statistically significant response similar to the observations. The consistence between the observation and CCM suggests a possibility of climate change in the troposphere due to the stratospheric ozone variation.