Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04862, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04862
EGU General Assembly 2008

Long-Term Trends in the Tropical Cold Point Tropopause: Simulation Results and Attribution Analysis

T. Reichler (1) and J. Austin (2)

(1) Department of Meteorology, University of Utah, Salt Lake City, UT 84112, USA, (2) UCAR/NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ 08542, USA (thomas.reichler@utah.edu / Phone: +01 801-5850040 / Fax: +01 801-5814362)

The tropical tropopause layer exerts an important control on the dynamics, radiation, and chemistry of the stratosphere above. For example, tropopause temperature determines the amount of water vapor entering the stratosphere, which in turn contributes to the chemistry and the radiative budget of the stratosphere. On the other hand, tropopause height and temperature may be influenced by the strength of the Brewer-Dobson circulation. Therefore, changes in tropical cold point parameters are closely related with stratospheric climate change, but the exact cause-and-effect relationship between the two and the role of tropospheric climate change for such change still remains to be determined.

Here, we use a model-based approach to investigate tropical tropopause trends and how they relate to stratospheric and tropospheric climate change. In particular, we investigate three simulations with a coupled chemistry climate model and explore long-term trends in tropical tropopause parameters over the period 1960 to 2100. We find that the tropopause height increases almost steadily during the 140 simulation years. On the other hand, tropopause temperature shows a marked and climatically important transition near the year 2000, with cooling in the past and warming in the future.

Using multi-linear regression, we show that long-term trends in tropopause parameters can be fit to high accuracy to terms representing total column ozone, tropical mean sea surface temperatures, and tropical mass upwelling. The change in tropopause

temperature trend near the year 2000 is related to the change in the sign of the stratospheric ozone trend. We further use a conceptual tropopause model to relate tropopause change to stratospheric and tropospheric climate change. The results confirm the regression analysis in showing the importance of tropospheric warming and stratospheric cooling. In the past, global warming and ozone depletion have opposite effects on the tropopause temperature, which consequently decreases. For the future, global warming and ozone recovery are expected to reinforce, which consequently increases the tropopause temperature.