Geophysical Research Abstracts,
Vol. 11, EGU2009-8398, 2009
EGU General Assembly 2009

Quantifying the chemical 11year solar response on stratospheric ozone using a 3-D CTM and CCM

S. Dhomse, M.P. Chipperfield, W. Tian, and W. Feng
University of Leeds, School of Earth & Environment, Leeds, United Kingdom (martyn@env.leeds.ac.uk, 44 113 6716)

The atmospheric response to the 11-year variation in solar flux is primarily linked with the changes in ozone as largest flux changes occur in UV region
of the solar spectrum. However, most studies which have quantified this response show large uncertainties in the tropical stratosphere, where the response is expected to be maximum. This is basically due to the lack of a homogeneous long-term ozone profile dataset, changes in stratospheric aerosol loading and inconsistencies in the meteorological (reanalysis) datasets (which are used to separate dynamical variability). Here we use an off-line 3-D chemical transport model (CTM, SLIMCAT) and a coupled chemistry-climate model (CCM, UMSLIMCAT) to quantify the c̈hemical onlyätmospheric response to the time varying solar fluxes under different chemical and dynamical conditions. We compare the ozone response profile to latest versions of satellite datasets.

UMSLIMCAT and SLIMCAT simulations have been performed for the 1960 -2006 and 1979-2006 time periods respectively. In general, the solar responses in total ozone in both SLIMCAT and UMSLIMCAT simulations (up to 4-6 DU in tropics and 6-8 DU at higher latitudes) are in agreement with most of the earlier studies. In the upper stratosphere SLIMCAT simulations show the largest O3 response between 10-1 hPa (3̃ % at 5 hPa) which is in agreement with profile data from satellite instruments such as SAGE II and HALOE, but lower than SBUV data which shows a larger response (4̃ %) at higher altitudes (1 hPa). In the lower stratosphere, the SLIMCAT simulation (near 20hPa) does not show the second maximum observed in the satellite data (SAGE II and HALOE), but is rather in agreement with SBUV data. SLIMCAT experiments with and without time-varying aerosol loading, show that these discrepancies in the modelled and observed response profile are principally due to changes in the stratospheric aerosol loading after large volcanic eruptions.

Detailed analysis of UMSLIMCAT simulations with and without a solar cycle show that although the model captures general features of the estimated solar response in the stratosphere (without any QBO nudging in dynamical fields such as temperature and winds), the magnitude of estimated solar response is lower than that of estimated solar response in zonal winds and temperatures from reanalysis data sets (NCEP and ERA40). This is due to a weaker Brewer-Dobson circulation in UMSLIMCAT.