Geophysical Research Abstracts
Vol. 14, EGU2012-8672, 2012
EGU General Assembly 2012

The Brewer-Dobson Circulation in a changing climate: Impact of the model configuration

F. Bunzel and H. Schmidt
Max Planck Institute for Meteorology, Germany (felix.bunzel@zmaw.de)

Different types of waves propagating into the stratosphere drive a stratospheric meridional overturning circulation, the Brewer-Dobson Circulation (BDC). As the critical layers for wave dissipation were found to underlie an upward shift caused by greenhouse gas induced tropospheric warming and simultaneous stratospheric cooling, the driving forces of the BDC are expected to be modified in a changing climate. Although most models produce a qualitatively similar response, an acceleration of the BDC, it is unclear to what extent the response depends on the representation of the stratosphere in a model. In order to investigate the impact of both vertical resolution and vertical extent of a model on derived trends in the BDC, we performed sensitivity simulations with the General Circulation Model ECHAM6 for three different model configurations and for three different boundary conditions, representing preindustrial, present-day and future climate conditions. Tropical upwelling velocities and age of stratospheric air are used as a measure for the strength of the BDC. Both consistently show a BDC strengthening from the preindustrial to the future time slice for all configurations of the model. However, amplitude and origin of this trend vary between the different setups. Application of the downward control principle shows that the low-top model version is capable of producing a similar BDC trend as the high-top configuration of the model. The type of wave drag responsible for the trend, however, differs between the different model setups. Analyses of the tropical upward mass flux indicate that in the low-top model the positive BDC trend in the lower stratosphere is primarily produced by resolved wave drag, while in the high-top model the parameterized gravity wave drag yields the main contribution to the BDC strengthening. We conclude, hence, that correct trends in the BDC may originate from the wrong causes, if the stratosphere is not sufficiently resolved in a model.