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The evolution of the Brewer-Dobson Circulation from 1960-2100 in simulations with the Chemistry Climate Model EMAC

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First results of research performed within the new DFG Research Unit Stratospheric Change and its Role for Climate Prediction (SHARP) will be presented. SHARP investigates past and future changes in stratospheric dynamics and composition to improve the understanding of global climate change and the accuracy of climate change predictions.
SHARP combines the efforts of eight German research institutes and expertise in state-of-the-art climate modelling and observations. Within the scope of the scientific sub-project SHARP-BDC (Brewer-Dobson-Circulation) the past and future evolution of the BDC in an atmosphere with changing composition will be analysed.

Radiosonde data show an annual mean cooling of the tropical lower stratosphere over the past few decades (Thompson and Solomon, 2005). Several independent model simulations indicate an acceleration of the BDC due to higher greenhouse gas (GHG) concentrations with direct impact on the exchange of air masses between the troposphere and stratosphere (e.g., Butchart et al, 2006). In contrast, from balloon-born measurements no significant acceleration in the BDC could be identified (Engel et al, 2008). This disagreement between observations and model analyses motivates further studies. For the future, expected changes in planetary wave generation and propagation in an atmosphere with increasing GHG concentrations are a major source of uncertainty for predicting future levels of stratospheric composition.

To analyse and interpret the past and future evolution of the BDC, results from a transient multi-decadal simulation with the Chemistry-Climate Model (CCM) EMAC will be presented. The model has been integrated from 1960 to 2100 following the SCN2d scenario recommendations of the SPARC CCMVal initiative for the temporal evolution of GHGs, ozone depleting substances and sea surface temperatures as well as sea ice. The role of increasing GHG concentrations for the BDC will be assessed by comparing the SCN2d-results with a ‘non-climate change’ (NCC) simulation, in which greenhouse gases have been kept fixed at their 1960 concentrations.