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Changes in the advective and mixing component of the Brewer-Dobson circulation in global models

Dr. Hella Garny[1], Prof. Martin Dameris[1], Thomas Birner[2], Dr. Harald Bönisch[3], Felix Bunzel[4], Dr. Simone Dietmüller[1], Dr. Sophie Oberländer-Hayn[5]

[1] Deutsches Zentrum für Luft- und Raumfahrt DLR

[2] Colorado State University

[3] Goethe-Universität Frankfurt am Main

4 Max Planck Institute for Meteorology

5 Freie Universität Berlin

Hella.Garny@dlr.de

The fate of the stratospheric transport circulation, the Brewer-Dobson circulation (BDC), in a changing climate is a much discussed topic in the last years. While models consistently simulate an increase in the strength of the BDC over the last and coming decades, the evidence from observations is still inconclusive.

In this talk, a review is given on research conducted within the SHARP-BDC project, focusing on modelling studies of changes in the BDC. The BDC is defined as the full transport circulation, and can be separated conceptually into advective transport along the residual circulation and transport by two-way mixing. In a first part, the drivers of changes in the residual circulation are examined. Changes in the circulation can be separated into shallow and deep branch changes. A mechanism for the intensification of the shallow branch changes is suggested: The strengthening of the subtropical jets allows wave propagation deeper into the stratosphere, therewith enhancing the wave forcing of the circulation in the (sub-)tropical lower stratosphere. In a second part, the effects of mixing on transport time scales through the stratosphere (Age of stratospheric air, AoA) are discussed. A method to quantify the contribution of two-way mixing on AoA is presented. Furthermore, simple conceptual models are used to reconstruct the distribution of AoA in global models and to illustrate the effects of mixing at different locations in the stratosphere.

The talk concludes by discussing open questions on the middle atmosphere circulation changes, and future research plans on the role of the dynamics of the middle atmosphere in a changing climate are presented.