

New Insights on the Impact of Ozone Depleting Substances and the Antarctic Ozone Hole on the Brewer-Dobson Circulation

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In addition to greenhouse gases, anthropogenic emissions of ozone depleting substances (ODS) can induce long-term trends in the Brewer-Dobson circulation (BDC). It has been recently shown that a large fraction of the BDC acceleration over the last decades of the 20th century can be attributed to increasing ODS (Polvani et al. 2018).

Here we show that ODS impact the BDC through two different pathways. In the *chemical* pathway, the Antarctic ozone depletion induces changes in the dynamics of the SH lower stratosphere. In the *radiative* pathway, the ODS act as greenhouse gases and induce a warming at the ocean surface, which in turn drives changes in the BDC. We separate these two pathways by comparing sensitivity runs with coupled ocean and prescribed sea surface temperatures (SST) of the chemistry-climate model WACCM.

The results show that ODS warming impact on SST dominates the global annual mean BDC response, while the the ozone hole impact is larger but regionally and seasonally confined. Finally, we examine how the trends in age of air in the ozone hole region result from combined changes in residual circulation and isentropic mixing.

Key words: Brewer-Dobson circulation, trends, ozone depleting substances, Antarctic ozone hole

References

Polvani, L., Abalos, M., Garcia, R.R., Kinnison, D.E., and Randel, W.J., 2018: *Geophysical Research Letters*, **45**, 401–409, doi: 10.1002/2017GL075345.