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Impact of ozone depleting substances on the stratospheric Brewer-Dobson circulation

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The Brewer-Dobson circulation (BDC), responsible for tracer and heat transport in the stratosphere, is expected to strengthen due to increasing greenhouse gas emissions. While this robust result has been supported by a large body of literature, substantially less attention has been paid to the impact of ozone depleting substances (ODS). Here we will present recent modeling evidence that anthropogenic ODS emissions are also key drivers of long-term trends in the BDC. It will be shown that ODS have contributed to about half of the BDC trends over the last decades of the 20th century, and that the phasing out of ODS emissions as a consequence of the Montreal Protocol will lead to a considerable reduction of the acceleration trends in the 21st century. A distinction will be made between two pathways for ODS impact on the BDC. In the chemical pathway, ODS cause Antarctic ozone depletion which then induces dynamical changes in the SH stratosphere. In the radiative pathway, ODS act as greenhouse gases and induce tropospheric warming, which in turn drives changes in the BDC. It will be argued that the radiative pathway is strongly coupled to the ocean response, while the chemical pathway is decoupled from the ocean and leads to interhemispheric asymmetry in BDC trends. Finally, a comparison of the BDC trends in the model with those obtained from reanalysis data will show that ODS have been the main driver of observed austral summer trends over the last decades of the 20th century. This is the case for the two components of the BDC: the residual circulation and isentropic mixing.

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Refreshments 3:15 p.m
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