

# Future Changes in the Stratosphere-to-Troposphere Ozone Mass Flux

Ulrike LANGEMATZ, and Stefanie MEUL

*Freie Universität Berlin, Berlin, Germany*

Ozone in the troposphere has two sources: photochemical production involving ozone precursor species such as nitrogen oxides, carbon monoxide or methane, and the transport of ozone from the stratosphere into the troposphere (i.e. stratosphere-troposphere exchange, STE) (IPCC, 2001). Mass can be exchanged between the stratosphere and the troposphere along isentropic surfaces which intersect the tropopause in the lowermost stratosphere where the chemical lifetime of ozone is larger than the transport timescale. Mass exchange is also possible by slow cross-isentropic transport, driven by diabatic cooling through the large-scale vertical motion of air in the stratospheric Brewer-Dobson circulation (BDC). Model simulations consistently project an increase in the STE of ozone in the future as a result of a strengthened BDC and stratospheric ozone recovery.

In this study, future changes in STE, their drivers, and the change in the distribution of stratospheric ozone in the troposphere are investigated using the EMAC chemistry-climate model. The global mean influx of stratospheric ozone into the troposphere is found to increase between the years 2000 and 2100 by 53% under the RCP8.5 greenhouse gas (GHG) scenario. In the northern hemisphere (NH), we find the largest increase of STE in June due to increasing GHG concentrations. In the southern hemisphere (SH) the GHG effect is dominating in the winter months, while decreasing levels of ozone depleting substances (ODS) and increasing GHG concentrations contribute nearly equally to the increase in SH summer. We find that the GHG effect on the STE change is due to circulation and stratospheric ozone changes, whereas the ODS effect is dominated by the increased ozone abundance in the stratosphere. The increase of stratospheric ozone in the troposphere explains more than 80 % of the tropospheric ozone trend in NH spring and in the SH (except for the summer months).

Key words: ozone, stratosphere-troposphere exchange, chemistry-climate model

## References

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