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Modelling of stratospheric transport time distributions for chemically active species

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The transport along the Brewer Dobson circulation is often described by age of air (AoA) derived from trace gas measurements. The according distribution is the age of air spectrum which is the propagator of the concentrations. However, for realistic tracers chemical depletion poses a known error in the derivation of this measure. Therefore Engel et al. (2018) developed a concept to break up the spectrum into arrival and release time distribution weighted by the amount of the species that has been depleted (fractional release factor). In the chemistry climate model EMAC (ECHAM MESSy Atmospheric Chemistry) we implemented pulsed tracers that are depleted in the same fashion as the chemical species under investigation, namely long-lived and short-lived ozone depleting substances containing chlorine and bromine. By doing so the path dependency of the depletion is considered. The pulses allow to derive the actual release and arrival time distributions, fractional release factors and path dependent mean lifetimes for the respective species. So far, only simple assumptions have been available for the distributions. Passive pulse tracers are available as a reference to provide the age spectrum and analyse the transport. The considered distribution are derived in similar fashion as in Ploeger and Birner (2016).

In our time slice simulations we investigate 2000 and 2100 conditions. In case of the 2100 conditions we consider simuletions with 1) changed greenhouse gas (GHG) concentrations, 2) changed ODS concentrations, and 3) changed GHG and ODS concentrations.

Thereby the influence of the changed transport on the tracer distribution and the fraction which is depleted can be understood.

References:

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