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Can fractional release be used as a diagnostic of changes in stratospheric transport?

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Mean age of air (AOA), the time elapsed since the entry of an air parcel into the stratosphere, is used as a diagnostic tool for changes in the stratospheric circulation. Different Chemistry Climate Models (CCMs) show a decrease in AOA which is indicative of acceleration of the Brewer-Dobson-Circulation (BDC). The available observation however cannot confirm this acceleration.

In principle, AOA could mask changes of the relative strength of different stratospheric transport pathways and thus may not be sufficient for general predictions on the BDC. We suggest to use the concept of fractional release factors (FRF) and their correlations with AOA as an additional tool to investigate changes in circulation. The FRF can be understood as the fraction of a trace gas that has been dissociated in the stratosphere by chemical processes. Changes of FRF at constant age surfaces for chemical active species with different stratospheric lifetimes may then be an evidence for circulation changes. Par example, the changing of the amount of recirculated stratospheric air parcels would alter the relation between FRF and AOA.

Analysing the temporal evolution of FRF for different CFC species calculated by the EMAC Model, we find an increase of FRF with time in the mid-latitudes which is in agreement with other CCMs. Observations of FRF and mean age are very sparse: We will present and discuss an analysis of FRF and its relation to AOA from available balloon and aircraft flights in comparison to the model results.