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Stratospheric age-of-air trends: Reanalysis v. climate models

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Knowing how the Brewer-Dobson circulation (BDC) has evolved in the recent past and will continue to evolve is crucial for atmospheric composition in the UTLS and stratosphere, as well as for feedbacks with climate. Most climate models have predicted an intensification of the stratospheric circulation with the increase in greenhouse gases concentrations, which translates into younger age-of-air (AoA) values modelled in the stratosphere. Nevertheless, balloon and satellite observations do not agree with the widespread modelled trend towards younger age-of-air for the recent past (Engel et al., 2009; Stiller et al., 2012; Haenel et al. 2015). Furthermore, a few recent studies with chemistry transport models (CTMs) driven by ERA-Interim reanalysis (Dee et al., 2011) have also shown agreement with the observed trends and not with those from climate models (e.g. Monge-Sanz et al., 2012; Diallo et al., 2012; Ploeger et al., 2015). To increase our confidence in climate-chemistry projections, the causes for the apparent disagreement in trends of age-of-air between observations and most climate models need to be identified.

In this study we have carried out simulations with a CTM to assess the stratospheric circulation with the ERA-Interim dataset produced by the European Centre for Medium-Range Weather Forecasts (ECMWF), as well as with data produced from an equivalent climate system. AoA trends from our model results with ERA-Interim fields are in good agreement with the recent age-of-air studies based on observations and differ from the results we obtain with the corresponding climate data. We will show that biases in the mean AoA values are also different for these datasets compared to observations. In addition we have used recent experimental datasets from the ECMWF system to identify potential causes for the differences in AoA distribution and trends. The validation of our model results has been performed against the new revised AoA dataset based on MIPAS SF6 observations (Haenel et al., 2015).

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