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Brewer-Dobson circulation, age of air in stratosphere and distribution of trace gases

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More than 60 years since the Brewer-Dobson (B-D) circulation was proposed based on the distribution of column ozone with latitude and seasons. This serves as one the major benchmarks for evaluating present day atmospheric general circulation models (AGCMs). The strength of the B-D circulation determines vertical and meridional gradients in trace gases in the troposphere. Thus measurements of chemically inert species, such as CO2 and SF6, are used for estimating transport time in the stratosphere since the species crossed the tropical tropopause from the troposphere. We used balloon-borne SF6 vertical profile measurements for calculating age of air in the stratosphere, which are then compared with the simulated age of air in the CCSR/NIES/FRCGC AGCM. We find the simulated age of air is largely underestimated in the lower stratosphere of the mid-latitude to polar region. Implications of this younger age of air in the global chemistry-transport models on calculating columnar abundance of tracer species will be discussed. A younger age of air in the high latitude stratosphere (faster B-D circulation) will make the stratospheric column thicker and thus the tropospheric column thinner. The biased thin tropospheric column would imply a weaker source or stronger sink of greenhouse gases in the high latitudes.