Changing Spatial Structure of the Brewer-Dobson Circulation in CCMI Simulations - Is There a Role for the Wave Driving?

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The mean age of stratospheric air (AoA) is a useful transport diagnostic and one of the best tools for accessing the Brewer-Dobson circulation (BDC) change. Analyzing AoA output from CCMI REFC2 model simulations we found a remarkable agreement among majority of models in projecting the largest mean age-of-air (AoA) negative trends and changes in localized regions in the extratropical LS on both hemispheres (approximately between 200000 and 250000gpm and 20°- 40°N and 20°- 40°S, MAX regions). The occurrence of those regions is a direct function of the climatological AoA distribution, upward shifting trend of the pressure levels and of widening of the AoA isolines due to a negative trend in aging by mixing. After accounting for the upward shift, the drag and residual circulation trends in the LS are diminished or vanish completely in the future (2000-2100). Only the AoA, residual circulation transit time and aging by mixing trends appear to be significant.

Generally, the negative AoA trend in the MAX regions is dominated by the negative aging by mixing trend, with approximately equally strong minor contributions of the upward shift effect and RCTT trends. The aging by mixing trends in MAX regions cannot be related to local trends of any analysed quantity (zonal mean drags, residual circulation). When accounting for the upward shift, the RCTT trends are solely driven by residual circulation trends outside (upwind) from the MAX regions. Possible hidden role of both resolved and parameterized drag for a resolved part of mixing is discussed, together with the need of new climate model output and methodology of analyses (3D, accounting for spatiotemporal intermittency and extremal values).

Key words: Brewer-Dobson circulation, wave driving, age of air