

The Brewer-Dobson circulation and total ozone from seasonal to decadal time scales

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The effect of the winter Brewer-Dobson circulation (BDC) on the seasonal and decadal evolution of total ozone in both hemispheres is investigated using satellite total ozone data and outputs from two chemical climate models (CCM). Combining data from both hemispheres a linear relationship between the winter mean extratropical 100 hPa eddy heat flux and the ozone ratio with respect to fall ozone levels exists and is statistically significant for tropical as well as polar ozone. The high correlation at high latitudes persists well into the summer months until the onset of the next winter season. The anti-correlation of the cumulative eddy heat flux with tropical ozone ratios, however, breaks down in spring as the polar vortex erodes and changes to a weak positive correlation similar to that observed at high latitudes. The inter-annual variability and decadal evolution of ozone in each hemisphere in winter, spring, and summer are therefore driven by the cumulative effect of the previous winter's meridional circulation. This compact linear relationship is also found in two different chemical climate models (FUB-EMAC, DLR-E39C-A) indicating that current models realistically describe the variability in stratospheric circulation and its climate effect on total ozone. Both models show a positive trend in the winter mean eddy heat flux (and BDC strength) in both hemispheres until year 2050, however the interannual variability (peak-to-peak) is two to three times larger than the mean change between 1960 and 2050.