

Variability and trends in effective diffusivity from reanalysis, and their implications for stratospheric circulation changes

Sean Davis, Eric Ray, Karen Rosenlof

Effective diffusivity is one means of quantifying mixing in the upper troposphere and stratosphere. Here, we calculate the normalized effective diffusivity from reanalysis potential vorticity fields, and remove variability associated with known cycles (e.g., annual cycle, QBO, solar cycle) to compute trends from multiple reanalyses. We compare the variability and trends, highlighting regions of agreement and disagreement among the reanalyses. Although not in complete agreement, several reanalyses contain positive trends in effective diffusivity in the southern hemisphere stratosphere ($> \sim 400$ K) along the boundary between the upwelling and downwelling branches of the Brewer-Dobson circulation. These increases in effective diffusivity, if real, represent an increase in mixing between the so-called “tropical pipe” and midlatitudes. Using a simplified “tropical leaky pipe” model, we show that increases in mixing can help resolve some of the apparent discrepancy between the increase in midlatitude age-of-air in observations and intensified B-D circulation in GCMs and satellite observations.