Advances in our understanding of stratospheric transport have been fuelled from two sources: observations (both satellite and in situ) of the distributions of trace gases, and improving understanding of the key aspects of stratospheric dynamics. Observations reveal, on the one hand, characteristic tracer isopleth shapes of that bulge upward in the tropics, and downward towards the poles, with sharp gradients in the subtropics and at the edge of the wintertime polar vortex...Further, across a wide range of spatial scales, mixing ratios of long-lived tracers exhibit remarkably compact mutual relationships which cannot be explained solely on the basis of their chemical sources and sinks. I will describe how these observed characteristics are dictated by the dynamics of the stratosphere; the essential determinants are the rapid isentropic stirring in the extratropical stratosphere, and the slower overturning circulation that is driven primarily by that stirring.

One “tracer” that is independent of chemical sources and sinks is “age,” a measure of the mean time that air at a specific location has been in the stratosphere. Age can be calculated, to a reasonable degree of accuracy, from observations of time dependent tracers (specifically, CO2 and SF6). Apart from being a useful vehicle for assessing model performance, interest in age as a measure of transport rates has been rekindled by evidence that the overturning circulation is speeding up, and will continue to so do as greenhouse gases increase. There are however, some apparent conflicts to be resolved.