Inexpensive Stratospheric Profiling as a Basis of Stratospheric Transport Monitoring Program

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Climate change drives change in tropospheric weather. This in turn modifies the generation of wave activity, the major driver of stratospheric circulation. State-of-the-art coupled chemistry-climate models predict that the stratospheric overturning circulation has been strengthening in recent decades, and will continue to strengthen [e.g. *Butchart et al*., 2010]. Knowledge of the strength of the stratospheric circulation and how it may change is of significant importance. Examples are the recovery of ozone [*Butchart, et al*., 2010] and the concentration of stratospheric water vapor, which has been shown to influence climate [Solomon*et al*., 2010]. Climate-monitoring programs will benefit substantially by having a stratospheric-circulation monitoring component to track the coupling of these two regimes.

To validate model predictions of change in stratospheric circulation requires high quality, long-term measurements. The trace gases, SF_6, N_2O, CFC-12, CFC-113, CFC-11, and halon-1211, are uniquely influenced by stratospheric circulation time scales, through changes in the "age" of stratospheric air [*Waugh and Hall*, 2002], and stratospheric path and recirculation which manifests in both age distributions and, the "maximum path height" distributions [*Hall*, 2000] through photolytic loss. A recent study by *Engel et al.* [2009] and extended by *Ray et al.* [2010] pieced together available balloon-based SF_6 and CO_2 measurements over the past three decades to show that the mean age of stratospheric air had increased, in apparent opposition to the decreased mean age predicted by these models that have increase in stratospheric circulation.

This study highlighted the role long-lived trace gas measurements can play in helping to understand model predictions, but also clearly revealed the limitations of the currently available stratospheric measurements. Recent laboratory studies have proven the feasibility of using the low-cost AirCore techniques of *Tans* [2009] coupled with our fast chromatograph, *Moore et al.* [2003], to acquire such stratospheric data. We demonstrate that the data quality and cost is such that a sustainable long-term monitoring program for stratospheric circulation is feasible.

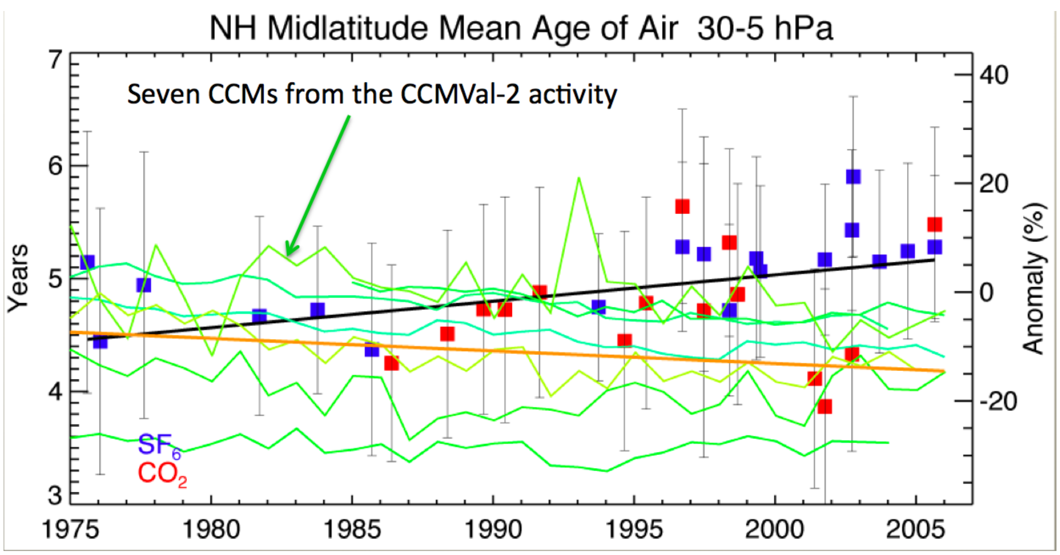

Figure 1. Decreasing mean ages caused by an increasing strength of the stratospheric circulation are consistent, robust results in nearly all CO_2 Concentrating Mechanisms (CCM), (green lines) yet appear to be inconsistent with age of air data (black line) Ray et al. [2010] .