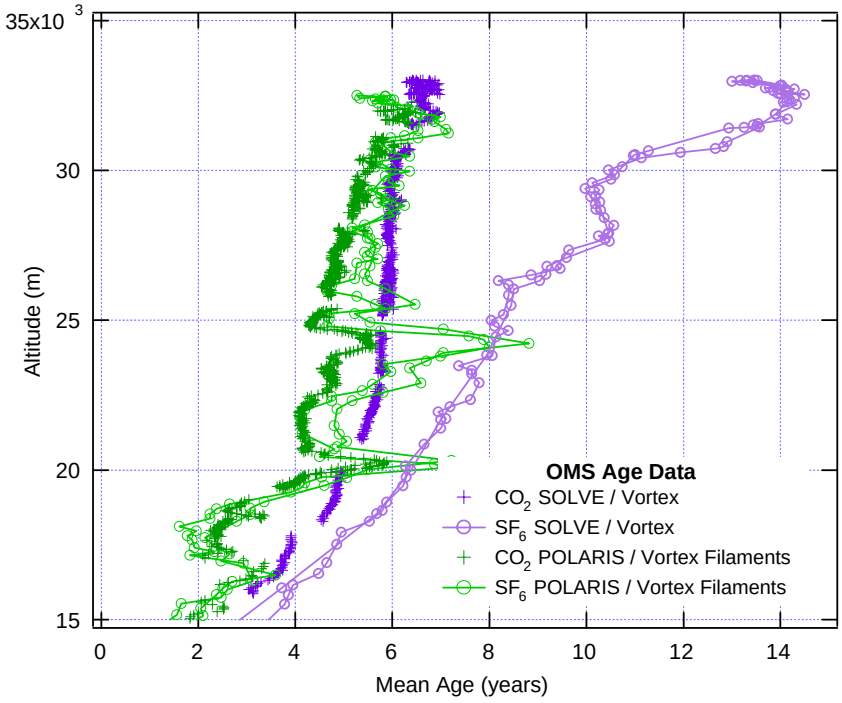
Measured SF_6 Loss and Its Influence on Age of Air Calculations

F. Moore[1,2], E. Ray[1,3], J. Elkins[2], A. Andrews[4], B. Daube[4] and S. Wofsy[4]

[1]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder 80309; 303-497-7068, Fax: 303-497-6290; E-mail: fmoore@cmdl.noaa.gov
[2]NOAA Climate Monitoring and Diagnostics Laboratory, Boulder, CO 80305
[3]NOAA Aeronomy Laboratory, Boulder, CO 80305
[4]Harvard University, Cambridge, MA

In situ measurements from the Lightweight Airborne Chromatograph Experiment (LACE) inside the northern vortex taken during the SOLVE and POLARIS campaigns show air with very low mixing ratios of SF_6. Elevated H_2 mixing ratios indicate that this air had originated primarily in the mesosphere, where SF_6 is believed to undergo photochemical destruction. Near 32 km altitude, age of air estimates using SF_6 measured in the vortex are 5 years older than mean age of air estimates using CO_2 (figure). This age difference, combined with the mesospheric origin of this vortex air, indicates that large losses of SF_6 had occurred. Based on this observed loss of SF_6 and a simple model of the vortex in each hemisphere, a SF_6 global lifetime of 600 years is estimated. This mesospheric loss is shown to have a small to negligible effect on mean age of air estimates using SF_6 in the midlatitude and tropical stratosphere. This is due to the relatively small mass of vortex air containing depleted SF_6 compared to the mass of the midlatitude and tropical stratosphere.



Shown are mean age estimates from CO_2 and SF_6 for vortex air during the SOLVE campaign (purple), and for vortex remnants from the POLARIS campaign (green.). Except for a known six-month offset, differences between CO_2 and SF_6 mean age estimates are assumed to be due to mesospheric loss of SF_6.