Sulfur Hexafluoride Lifetime Adjustment Based on Measured Loss in the Stratospheric Polar Vortex

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The current best estimate of the atmospheric lifetime of sulfur hexafluoride (SF_6) is 3200 years (Ravishankara et al., 1993). This lifetime, as for other long-lived trace gases, is dependent on estimated transport through the region where rapid loss occurs. In this study we use *in situ* measurements in the polar vortex, where the entire mesosphere is descended each winter, to sample air with extensive SF_6 loss and calculate an SF_6 lifetime based on the observed loss. The measurements were taken in the winter of 1999-2000, during which the vortex was relatively undisturbed so that we sampled mesospheric air in the vortex from 16 to 32 km altitude. Comparison of these measurements with output from the Whole Atmosphere Community Climate Model (WACCM) show large differences with very little SF_6 loss in the modeled polar vortex. However, comparisons between other trace gases in the vortex with mesospheric production or loss, such as carbon monoxide (CO) and hydrogen gas (H_2), show very close agreement, suggesting WACCM transport into the vortex is accurate and an SF_6 loss mechanism is missing in the model. Based on the measurements and estimates of the size of the vortex, we calculate an SF_6 lifetime of 800 years with an uncertainty range from 580-1150 years. This estimate is considered an upper limit since our calculation does not include mesospheric air that left the vortex before we sampled it as well as mesospheric air that descended outside the vortex into the stratosphere. Based on this revised lifetime the global warming potential of SF_6 will decrease only slightly for short time horizons (up to 5% for < 100 years), but will decrease substantially for long time horizons (50-75% for > 2000 years).

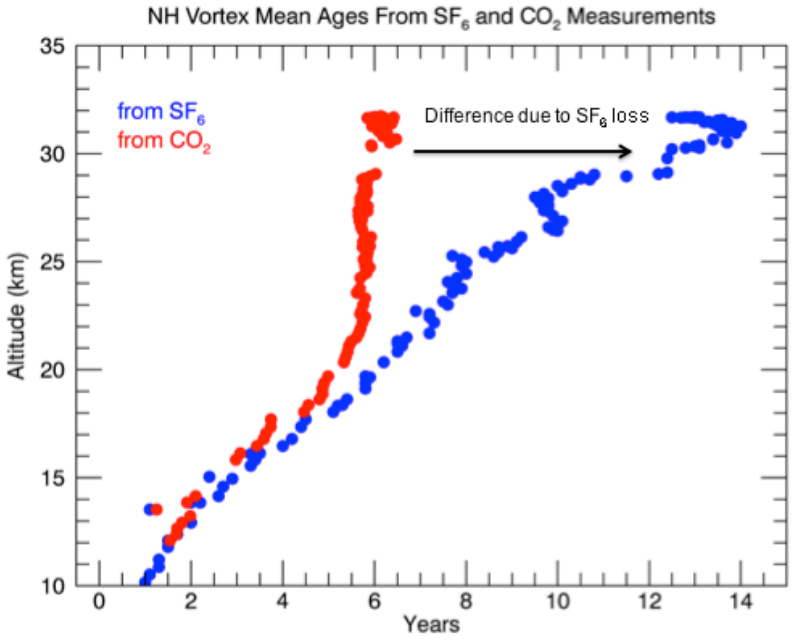

Figure 1. Profiles of mean age of air in the Northern Hemisphere polar vortex based on *in situ* measurements of SF_6 and CO_2 from a balloon flight at 67°N on March 5, 2000.