Maximum Path Height Distributions: A Measurable Quantity Independent of Mean Age and Age Distributions for Model Comparisons

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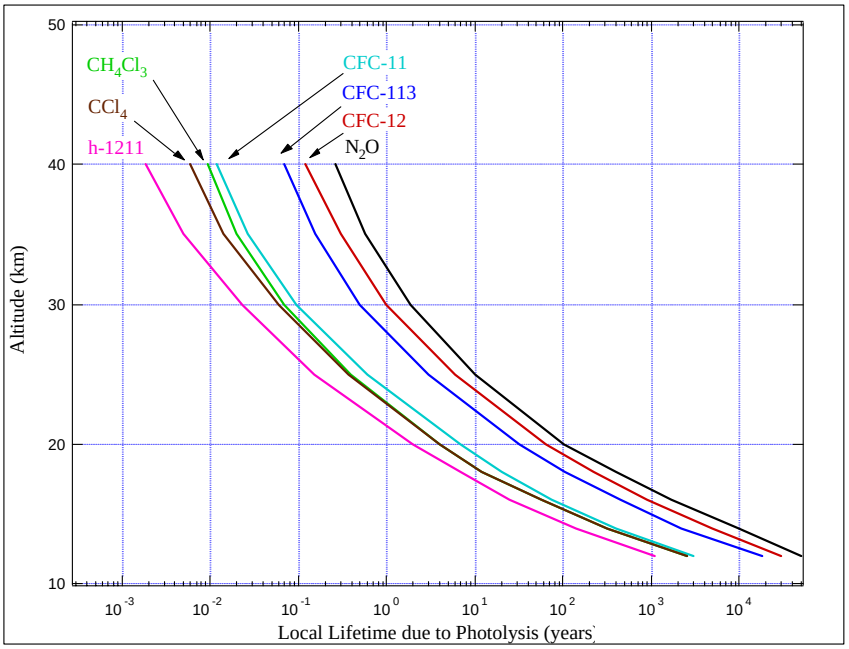
The stratospheric lifetimes of nitrous oxide and the halocarbons measured by the LACE in situ gas chromatograph are dominated by simple photolysis. Local lifetimes of these species span two orders of magnitude at any given altitude. Also, for each specie, the local photolytic lifetime reduces by more than two orders of magnitude in going from the tropopause to 32 km (figure). The range of lifetimes covers the time scales of stratospheric transport. Therefore, mixing ratios of these halocarbons are extremely sensitive to the maximum altitudes reached by air parcels in the stratosphere, and provide a powerful tool for studying stratospheric dynamics.

The logarithmic decrease with altitude in the local photolytic lifetimes of halocarbons can be used to tag an irreducible element in terms of the maximum altitude it reached before arriving at the measurement location. In particular, this maximum height identifies which gases have undergone substantial loss. Measurements of these simple photolytic species at a given location in the stratosphere can be used to calculate the distribution of maximum heights reached by the irreducible elements that make up that particular air parcel.

Comparison of these measured "maximum path height distributions" to model estimates represents a check that would be independent from those obtained from comparisons to mean age and age distributions from SF_6 and CO_2 measurements.



Shown are the local photolytic lifetimes at 45° latitude for the trace gases measured by LACE. Of interest is the logarithmic decrease in local lifetimes with altitude.