Convection of Long and Very Short Lived Trace Gases into the UT/LS and TTL

F.L. Moore[1], G.S. Dutton[1], J.W. Elkins[2], B.D. Hall[2], D.F. Hurst[1], and J.D. Nance[1]

[1]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309; 303-497-7068, Fax: 303-497-6290, E-mail: Fred.Moore@noaa.gov
[2]NOAA Earth System Research Laboratory, 325 Broadway, Boulder, CO 80305

NASA and our airborne project programs have shifted emphasis down from the stratosphere into the free troposphere. The Aura Validation Experiment (AVE) missions have focused on understanding the convective process that couple the source regions within the trapped boundary layer and lower free troposphere, to the upper troposphere (UT), the lower stratosphere (LS), and the tropical tropopause layer (TTL). Transport and chemistry within the troposphere involves a much larger distribution of time and spatial scales than is required in the stratosphere. In addition, it is rare that the three spatial dimensions can be collapsed into a smaller set, as is done in the stratosphere due to conservative mixing within the midlatitudes and within the tropics. To tackle the larger issues of climate forcing and climate change will require a bridging of local micro-physics, like cloud dynamics, to large-scale global chemistry and transport representations based on satellite data. Data sets like those generated by our airborne project team, coupled with our surface network data can help bridge this gap. In this poster we highlight the use of PANTHER data to identify the influences of convective transport on upper tropospheric composition, with an emphasis on the very short-lived species (VSLS). For many VSLS the source region for this convective influence is restricted to the trapped boundary layer, where local production dominates over local losses, resulting in elevated tracer concentrations. For this class of VSLS, short lifetimes and lack of sources above the boundary layer result in negligible ”background” concentrations above the boundary layer. An example is CH_3I. A second category of VSLS are those with lifetimes long enough to retain measurable quantities and or a gradient in the lower free troposphere. Influences of convective input from above the trapped boundary layer are observable with these trace gases. An example is PAN whose lifetime ranges from minutes in the boundary layer to days in the lower free troposphere.

Local lifetimes of some VSLS are substantially lengthened in the upper troposphere and TTL. Here, the dry air and cold temperatures reduce losses by OH and other reactions responsible for scavenging in the free troposphere. Convection can couple the source regions in the trapped boundary layer and lower free troposphere to the TTL and above the tropopause. This will bypass the free troposphere where rapid mixing and scavenging takes place. In addition, the TTL can be isolated from the free troposphere for days to a month. Measurements of trace gases with similar lifetimes of days to a month within the UT, TTL, and LS can identify these convective events and reveal information about primary entry points, possible entrainment, and convective outflow.

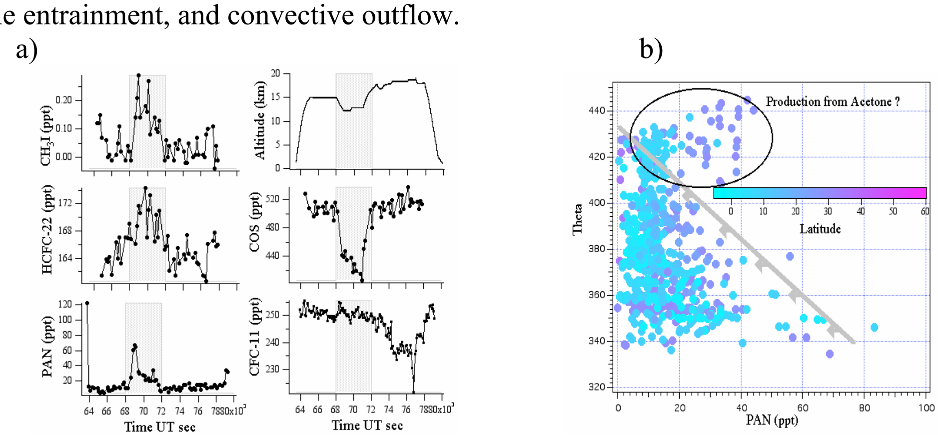

Figure 1. a) Elevated concentrations of CH_3I and PAN at 13 km indicate a convective event from the boundary layer. COS shows evidence of strong vegetative uptake in the boundary layer source region for this convective event. b) Influence of convection integrated over a month is seen in the PAN data from all the AVE missions.