Intercomparisons of Aura MLS, ACE, and HALOE Tracers using the LaRC Lagrangian Chemistry and Transport Model

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LaRC LCTM Model Description:
• Model tracks transport, mixing, and photochemical evolution of parcels initialized from observations.
• NASA GEOS-4 DAS meteorological data:
• 6-hour average horizontal winds and vertical pressure velocity from DAS to kinematically advect parcels.
• Overhead column O3 calculated from GEOS-4 DAS PV and Aura MLS O3 mapping for each run day.
• Other species in standard stratospheric chemical mechanism initialized using parcel diagnostics output every 6 hours.
• Type 1 and Type 2 PSC Parameterization included.

Run Description:
• Overhead column O3 calculated from GEOS-4 DAS PV and Aura MLS O3 mapping for each run day.
• Type 1 and Type 2 PSC Parameterization included.

Introduction:
• We use the LaRC Lagrangian Chemistry and Transport Model (LCTM) [Considine et al., 2007; Pierce et al., 2003] to intercompare ACE, Aura, and HALOE observations of long-lived trace species.
• The LCTM calculates the transport, mixing, and photochemical evolution of an ensemble of parcels that have been initialized from ACE-FTS measurements.
• We focus on late November, 2004 comparisons, due to the previous 3-week period of continuous HALOE observations and MLS v2.2 data on November 29, 2004.
• DAS-driven transport and relatively short trajectory lifetimes protect strong influence of initializing observations on subsequent LCTM constituent distributions.
• Large number of model parcels produces more coincident measurements for intercomparisons and allows comparison of meridional and longitudinal variations.

LaRC LCTM correlations with ACE observations: To evaluate the model capability to transfer information forward in time, we compare ACE-initialized LCTM parcels with subsequent ACE observations. Shown above is ACE-initialized N2O correlation plots on November 29, 2004. For each ACE N2O measurement the set of coincident parcels is determined and averaged. The correlation coefficient is high, the slope is close to unity, and the uncertainty is small.

Conclusions:
• Comparison of ACE-initialized LCTM with HALOE observations show LCTM N2O in NH upper stratosphere is strongly affected by excessive downwelling in developing NH polar vortex.
• Upper stratosphere low biases in LCTM HCl indicate low Cly initialization.
• Otherwise relatively low uncertainties and high correlations.

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References:

Horizontal distributions of MLS and ACE LCTM N2O at 3, 21.5, and 46.4 hPa. The low slope of the HCl correlation plot indicates a low bias of LCTM Cly in the upper stratosphere.

Horizonal distributions of MLS and ACE LCTM NO at 3, 21.5, and 46.4 hPa. The LCTM profile agrees well with observations in the SH and in the NH between 100 hPa - 1 hPa. Percent diffs at ~2 hPa in the NH exceed 10%, indicating a problem with LCTM transport or previous ACE measurements used to initialize LCTM.