



Combined ACE and MLS Work at JPL and NMT: Meteorology Update and UTLS and USLM Studies

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with

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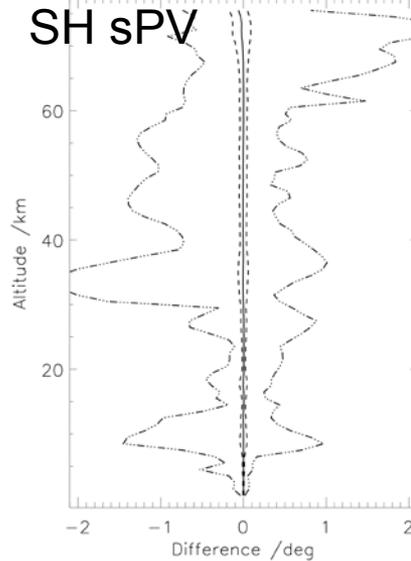
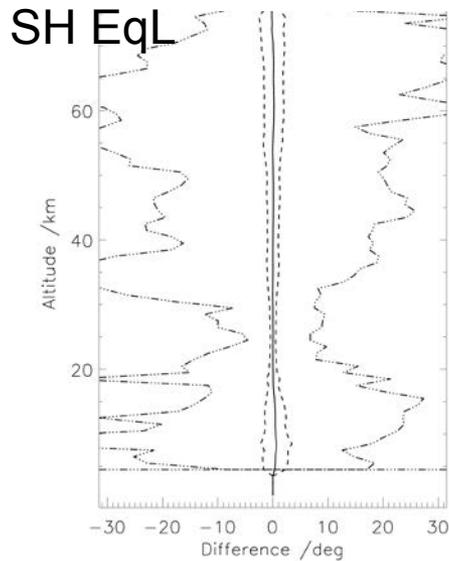
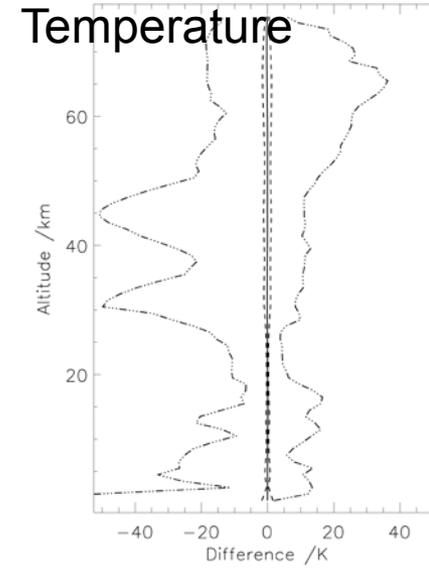
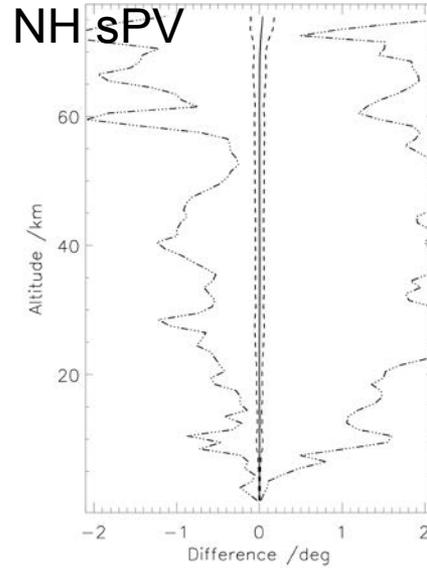
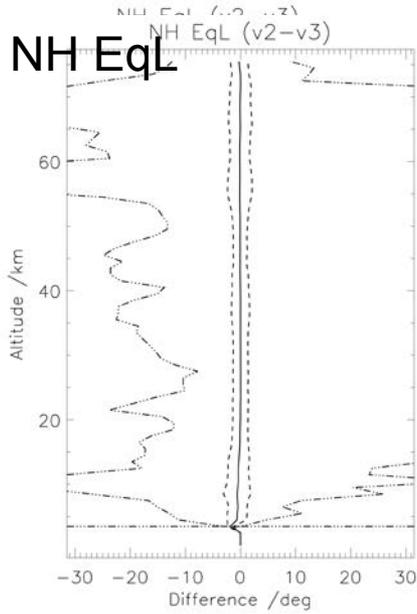
ACE Science Team Meeting, Waterloo, Ontario, Canada
11–12 May 2011

ACE DMP Processing Update

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- Current operational DMP processing is complete through early Sep 2010 for v2.2 and through late March 2011 for v3.0:
 - ✧ GEOS-5 DMPs available for ~25,350 occultations for v2.2, all of those for which we have sufficient information to calculate DMPs, that is, good ACE-FTS data files and/or geolocation files
 - ✧ MetO DMPs available through 11 Nov 2009 for v2.2; old DMP software doesn't work after that because of MetO file format changes
 - ✧ ~5500 v2.2 occultations without good geolocation files (missing, bodyless, or all zeros) have DMPs calculated using the latitude/longitude value in the .asc files
 - ✧ GEOS-5 DMPs available for ~23,000 v3 occultations, only ~6500 of those did we have v3 GLC files for, rest used lat/lon values from .asc files
 - ✧ Prototype GEOS-5 EDMPs have been run for most/all v3.0 occultations (with some incomplete fields).

ACE v2.2 vs v3.0 GLCs



Differences between DMPs calculated from v2.2 and v3.3 GLC files (mean, std dev, range) for ~6500 profiles

ACE DMP Processing Update

➤ Notes:

- ✧ GEOS-5 DMPs are GEOS-5.1.0 through early October 2008, GEOS-5.2.0 thereafter (substantial changes in USLM temperatures between the two)
- ✧ GEOS-5.1.0 or higher DMPs for the full ACE dataset have been available since fall 2008
- ✧ EDMPs prior to operational GEOS-5.2.0 will be produced using the MERRA reanalysis (GEOS-5.2.0 “late look”) – this is in the works, hopefully to be done in the next 1–2 months
- ✧ GEOS-5.x DMPs are strongly recommended over MetO DMPs since changes in MetO over ACE mission are much larger than those in GEOS-5.x
- ✧ MetO DMPs will not be brought up to date, or done for v3 until sometime after EDMP system is working for GEOS-5.2.0 (MERRA+operational)
- ✧ GMAO now starting transition to GEOS-5.7.0 – major changes

ACE DMP Processing Update/SSW Work

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- Nearly 60,000 ACE-related “generic” DMPs processed since last ACE meeting:
 - ✧ Bruker measurements for intensive and extended phases of 2011 Eureka campaign
 - ✧ Over 57,000 SMILES generic DMPs for (initially, expect other uses will be found as well!) Ashley’s intercomparisons
 - ✧ More in the works for this year’s Eureka campaign, other stations, “science” studies

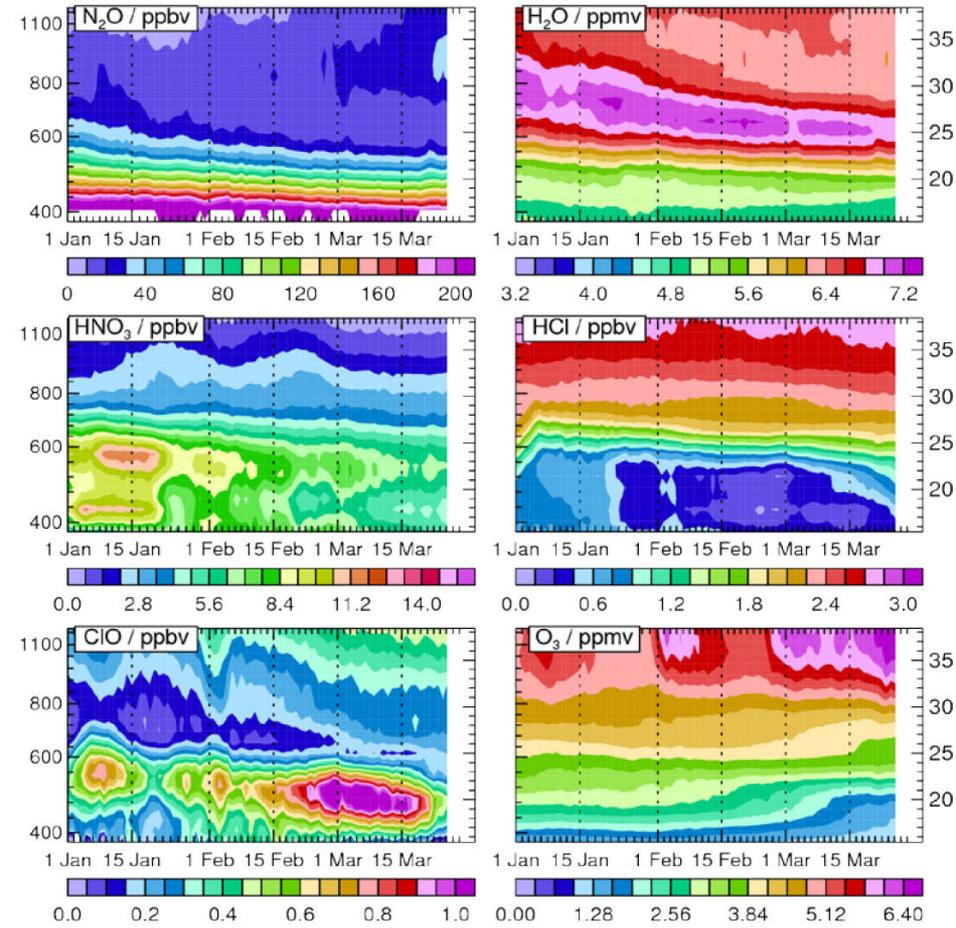
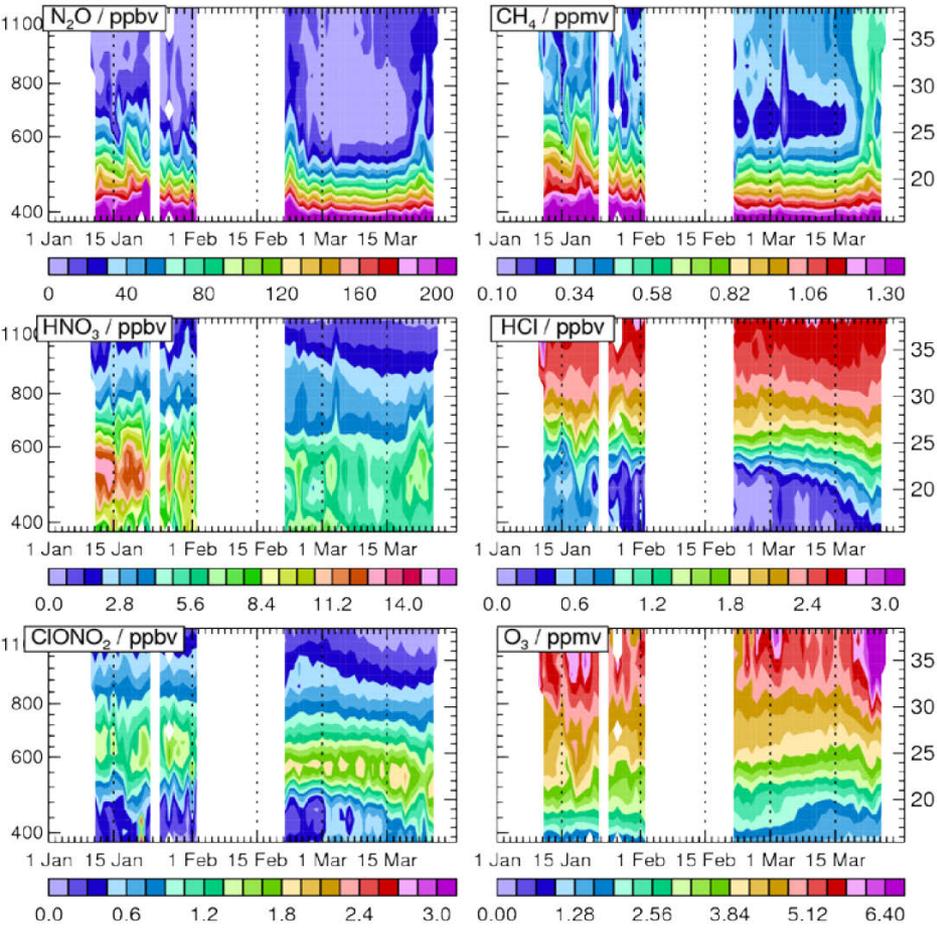


- PV maps with ACE overlays have been updated and uploaded to brutus
- As always, many thanks to William for taking care of all the operational work and shouldering much of the development as well

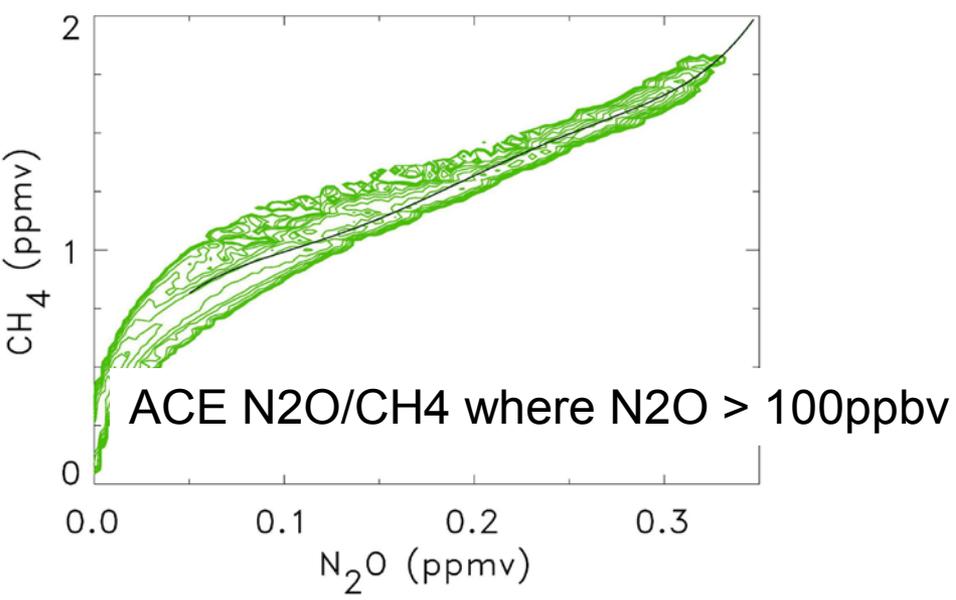
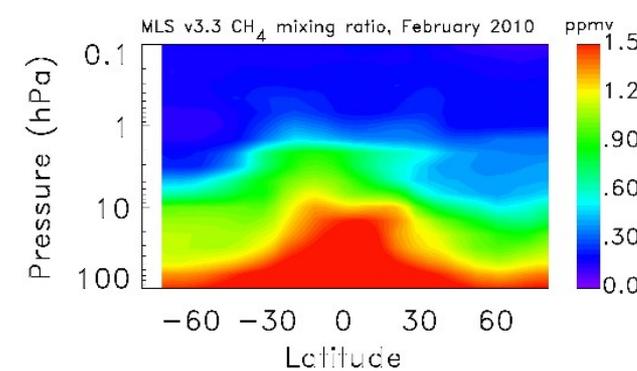
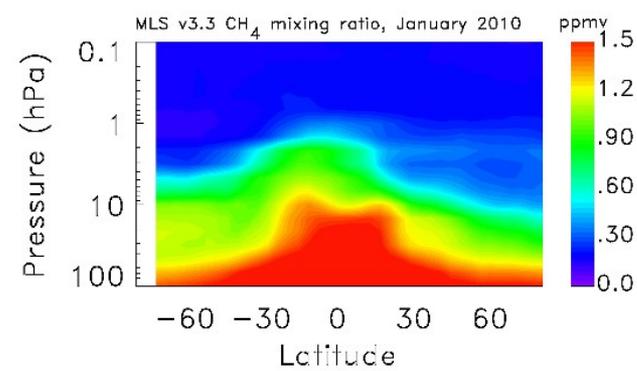
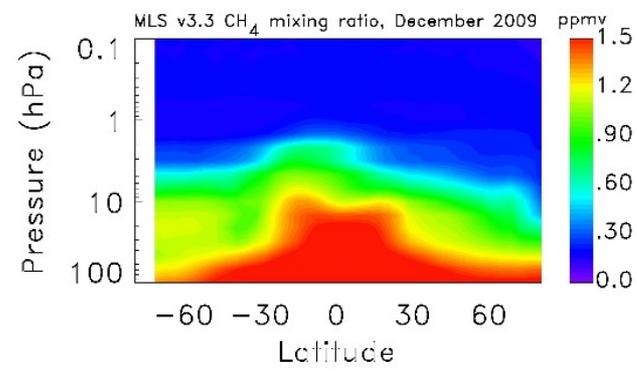
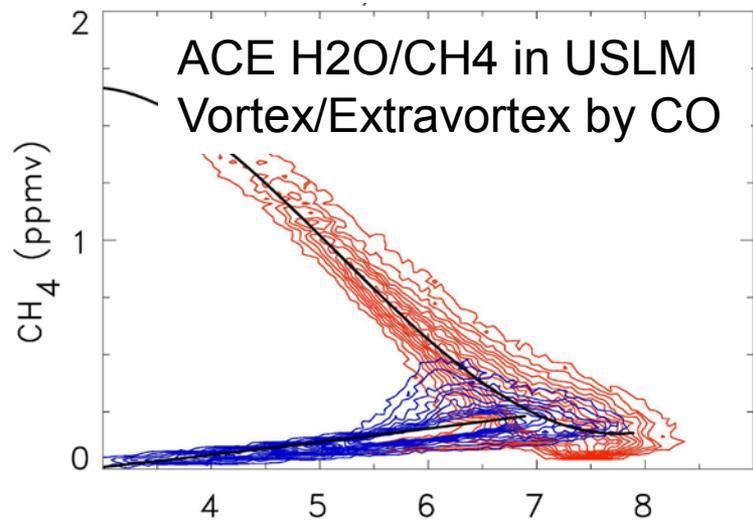
V3 MLS and ACE-FTS Vortex Averages in 2011

ACE-FTS

MLS

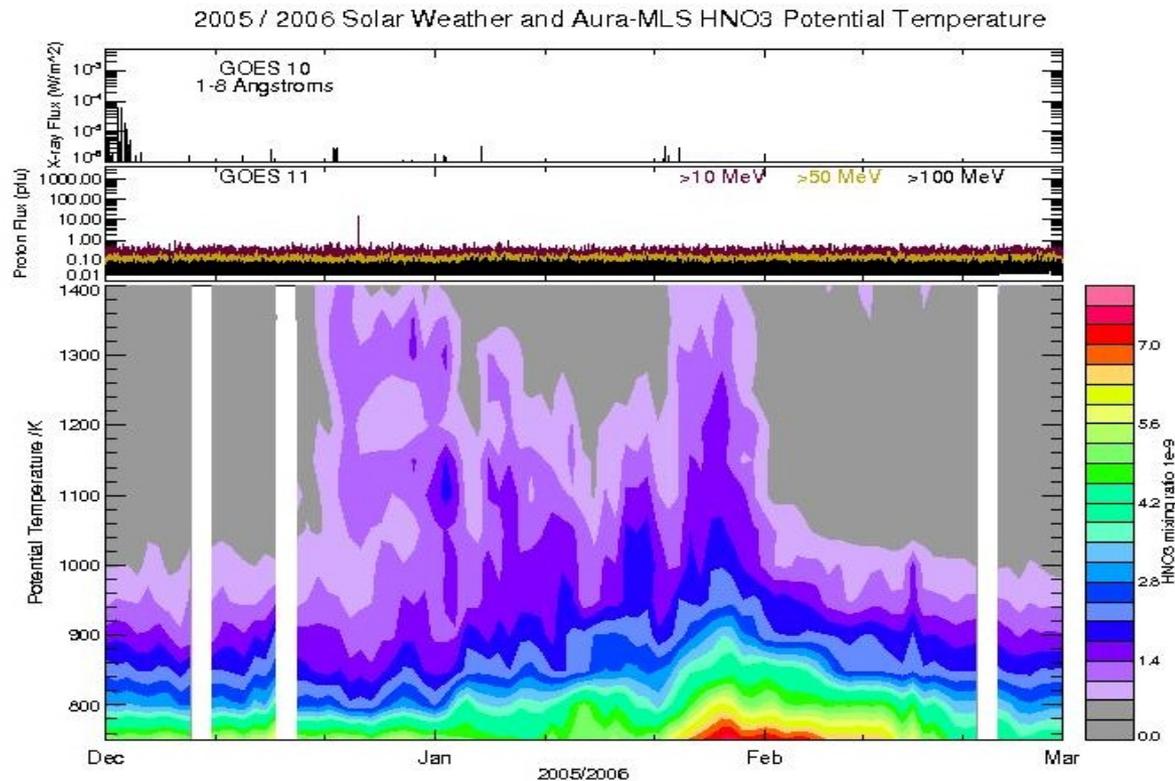
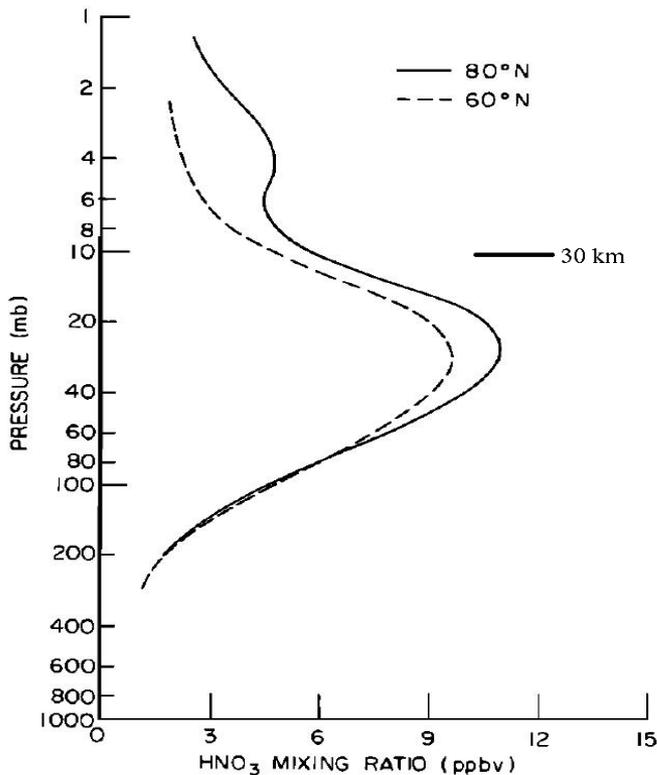


JPL/NMT USLM Work (w/ Ken Minschwaner)



Study of Enhanced Nitric Acid in the Stratosphere during Polar Winter

- ◆ Global measurements of HNO_3 were first observed in 1978 by LIMS onboard NIMBUS-7 satellite.
- ◆ Enhancements of HNO_3 have been observed to occur above 30 km every year.
- ◆ (Below left) Plot of LIMS data from Austin et al. [1986]
- ◆ (Below Right) Plot of solar weather during the 2005-2006 NH polar winter



Study of Enhanced Nitric Acid in the Stratosphere during Polar Winter

◆ We examine the photochemical rate of change of nitric acid in an attempt to understand the observed enhancement.

▲ We calculate diurnally averaged values based on observations from Eos-Aura MLS and ACE-FTS satellite instruments and the SIC model

◆ HNO_3

◆ OH

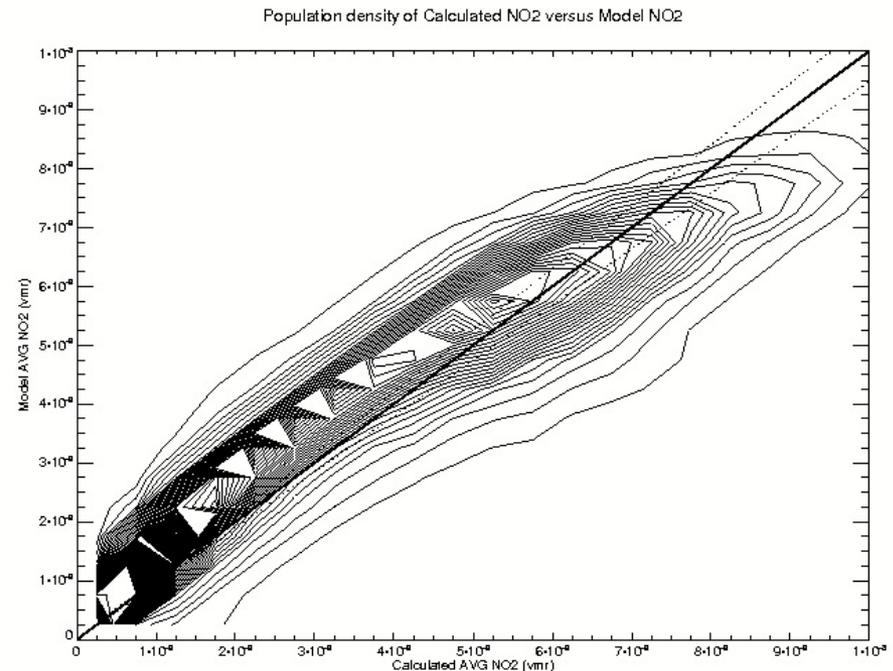
◆ NO_2

◆ N_2O_5

◆ $\text{H}^+(\text{H}_2\text{O})_n$ (Protonated Water)

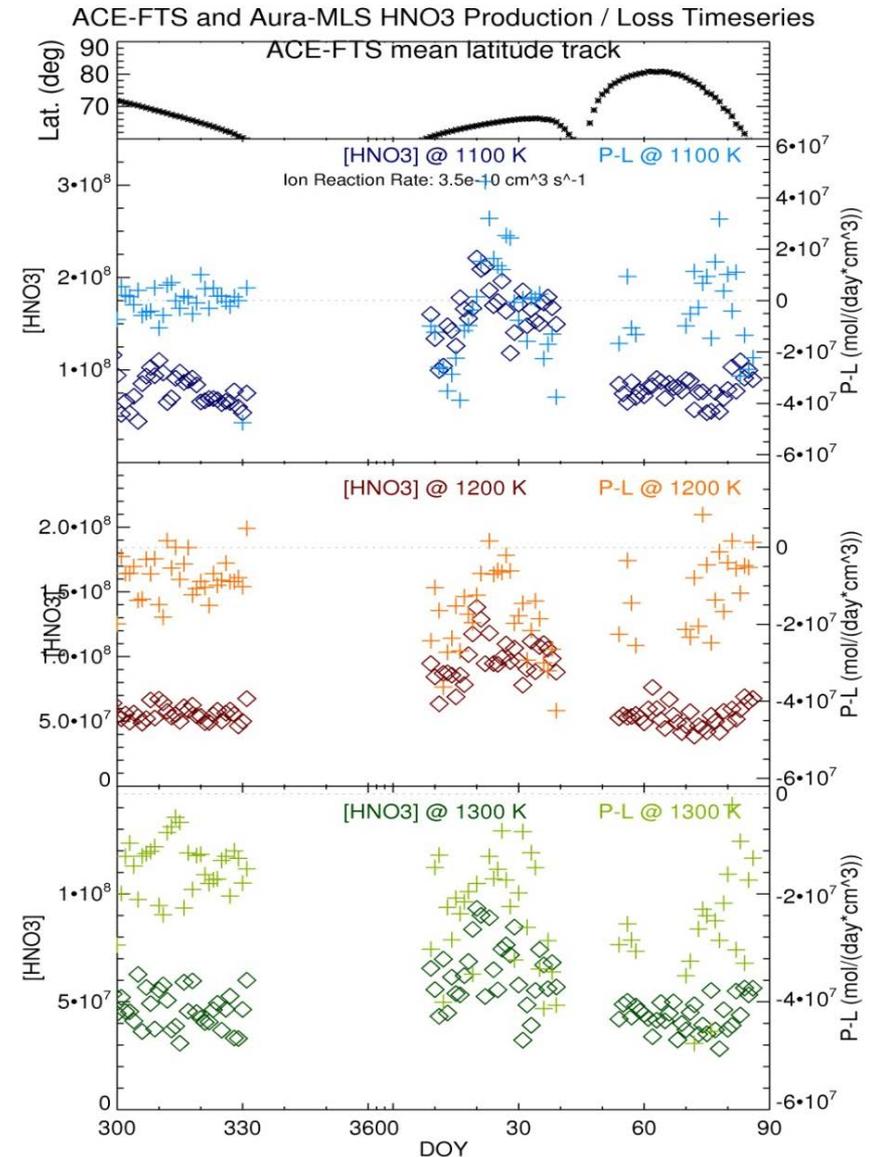
◆ Chemical and photochemical reaction rates

◆ (Below) Plot comparing McLinden et al.'s photochemical box model calculation of diurnally averaged NO_2 (y-axis) versus our parameterization calculation of diurnally averaged NO_2 (x-axis)



Study of Enhanced Nitric Acid in the Stratosphere during Polar Winter

- ◆ We then compare the photochemical rate of change of nitric acid and the changes in the observed HNO_3 .
 - ▲ Our photochemical rate of change for nitric acid does not explain changes in observed HNO_3 values.
 - ▲ Possible changes that might improve calculation:
 - ✦ Modifying the protonated water profile
 - ✦ Modifying the reaction rate for the ion chemistry (lots of ambiguity in the literature about this!)
 - ▲ Improvements that would help the analysis:
 - ✦ Increased global coverage on a daily timescale for NO_2 and N_2O_5
 - ✦ More high latitude measurements during the month of December



- Our “enhanced DMP” (EDMP) project comprises:
 - ✧ Systematically designed, documented (well, William tries to clean up after me!) IDL software
 - ✧ Diagnostics useful for stratopause and upper stratosphere/lower mesosphere (USLM) studies
 - ✧ Comprehensive diagnostics for studying the upper troposphere/lower stratosphere (UTLS), especially the “extra-tropical transition layer” (ExTL)
- Also plan to include:
 - ✧ Information for tangrid as well as 1-km gridded files
 - ✧ Line-of-sight temperature and PV gradient information

- Software for tropopause/jet diagnostics and current DMP products (excepting vortex edge, on which testing is in progress) using GEOS-5 is available for ACE, Aura MLS, and user-defined (ie, “generic”) locations
- Preliminary results using UTLS diagnostics have been presented at many meeting since 2009
- Initial paper on jet/tropopause characterization methods, with MLS and ACE examples, is in “final response” phase in ACPD; reviews largely positive, revisions will be completed next week
- A subset of EDMP products are being used to provide “v2.0 DMPs” for ACE & MLS (next page)
- Plan to work towards making jet and multiple tropopause diagnostics publicly available after we (and collaborators – just talk to me if interested) get some work out using them

DMPs/EDMPs: V3 MLS and ACE-FTS Data

- Current DMP processors are running for V3 MLS and ACE-FTS data, using GEOS-5.1.0/5.2.0 data (before/after 15 Sep 2008)
- GMAO's MERRA reanalysis provides GEOS-5.2.0 data from 1979 to present
- MERRA is being incorporated into EDMP products being packaged as v2.0 MLS and ACE DMPs – hopefully within a couple of months
- Also working on putting vortex edge criteria (EqL distance from "VEO", "VEC", "VEI") in new system
- When these two things are done (or possibly before the VE work), will begin making these available to the ACE team in .asc-type format
- Current GEOS-5 DMPs, while less than ideal, will continue to be produced operationally until "v2.x" DMPs complete to the extent of including everything that is in the v1.1 DMPs
- Some new things, e.g., line of sight PV and T gradients, may take a bit longer