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

G L Manney¹ and W H Daffer
Jet Propulsion Laboratory, California Institute of Technology
(¹also at New Mexico Institute of Mining and Technology)
with
M.I.Hegglin, S.McLeod, M.L.Santee, K.A.Walker, C.Boone,
M.J.Schwartz,
and the ACE and MLS Science Teams

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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
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 H2O/CH4 in USLM Vortex/Extravortex by CO

ACE N2O/CH4 where N2O > 100ppbv
Study of Enhanced Nitric Acid in the Stratosphere during Polar Winter

- Global measurements of HNO₃ were first observed in 1978 by LIMS onboard NIMBUS-7 satellite.
- Enhancements of HNO₃ 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

David Herceg, MS Thesis, NMT
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:

- HNO₃
- OH
- NO₂
- N₂O₅
- H⁺(H₂O)ₙ (Protonated Water)

Chemical and photochemical reaction rates

(Below) Plot comparing McLinden et al.’s photochemical box model calculation of diurnally averaged NO₂ (y-axis) versus our parameterization calculation of diurnally averaged NO₂ (x-axis)
We then compare the photochemical rate of change of nitric acid and the changes in the observed HNO₃.

- Our photochemical rate of change for nitric acid does not explain changes in observed HNO₃ 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 NO₂ and N₂O₅
  - 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
EDMPs: Science and Processing Plans

- 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 (i.e., “generic”) locations.
- Preliminary results using UTLS diagnostics have been presented at many meetings 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.
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