The EOS AURA Tropospheric Emission Spectrometer (TES)

Reinhard Beer

Science Division
The Jet Propulsion Laboratory
California Institute of Technology

Topics

Instrument Status

Data Processing Status

Science Highlights

TES Instrument Status

- TES is working well
  - Optical performance, especially for the CO channel, would be significantly enhanced by warming the optics bench by 6K
- Since instrument activation in September 2004, 120 Global Surveys & 91 Special Observations have been acquired.
- Detector icing rate has decreased dramatically
  - Time between de-icing has increased from 2 weeks to 2 months.
- Interferometer drive system (ICS) is showing signs of age (increased friction), but is working within specifications.

ICS Performance

- We have eliminated limb views from the Global Survey to preserve ICS lifetime.
  - Replaced by 3 nadir views and x3 enhancement in observation density
  - Limb views (at 0.1 cm^{-1} resolution) are still available in “campaign” mode
- ICS motor current, velocity & distance traveled are carefully monitored.
- However, the ICS will continue to be a cause for concern.
  - The friction will increase, but we have ample reserve drive voltage to keep the system operating

Data Processing Status

- We have been given new evaluation criteria for the delivery of products to the Langley DAAC (ASDC)

- Nevertheless, it must be emphasized that we are on (even a little ahead of) the delivery schedule established before launch

May 2006 Evaluation

- Evaluation Criteria:
  - *Provide all nadir observation L2 products to the DAAC by May 2006 and then regularly thereafter using the current version of the processing software.*
- Nadir products only
- Total number of Global Surveys to process = 213
- **This can be accomplished with present capabilities**

Sept. 2006 Evaluation

- Evaluation Criteria:
  - *Provide all L2 products to the DAAC by Sept 2006 using an advanced version of the processing software and work closely with the research community to enhance their understanding of usefulness and limitations of the data and facilitate their use.*

- Includes both Nadir and Limb products (74 limb surveys)
- Total number of Global Surveys to process = 494

- **This is much more challenging, therefore we are planning a major improvement in our throughput capabilities**

Status of TES L2 Products

Preliminary TES L2 Products in “IDL Save” format have been available at the Aura Validation Data Center (AVDC) since March 2005. These are primarily TES Special Observation data taken during the AVE-2004 campaign plus Global Surveys between November 2004 and January 2005. Data from the PAVE campaign were added in September 2005

TES L2 products (v001) have been available at the NASA-Langley Atmospheric Data Science Center (ASDC) since July 2005 (Global Surveys only)

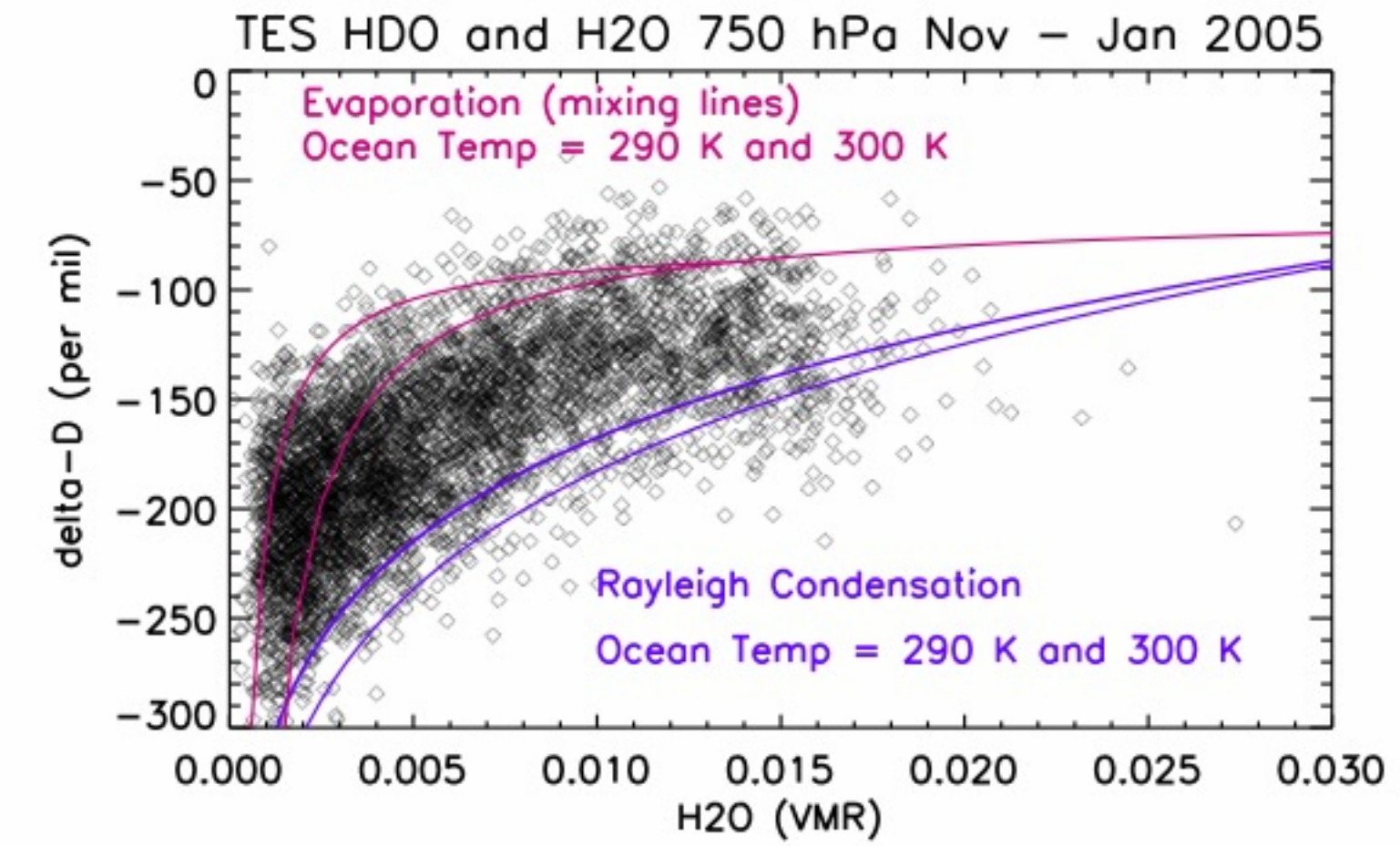
TES L2 data (v001) have undergone a preliminary validation analysis.

TES L2 products currently ready for scientific use are nadir retrievals of ozone, carbon monoxide, temperature, water and surface temperature.

Science Highlights

Some recent examples of TES science

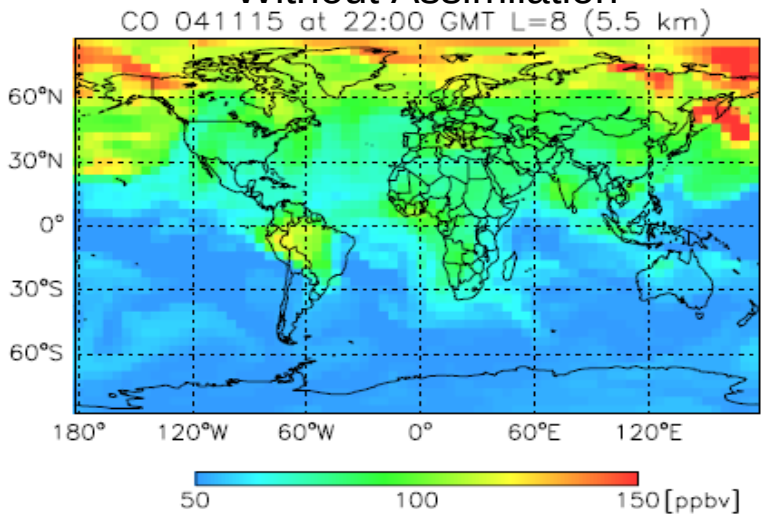
HDO/H2O from TES

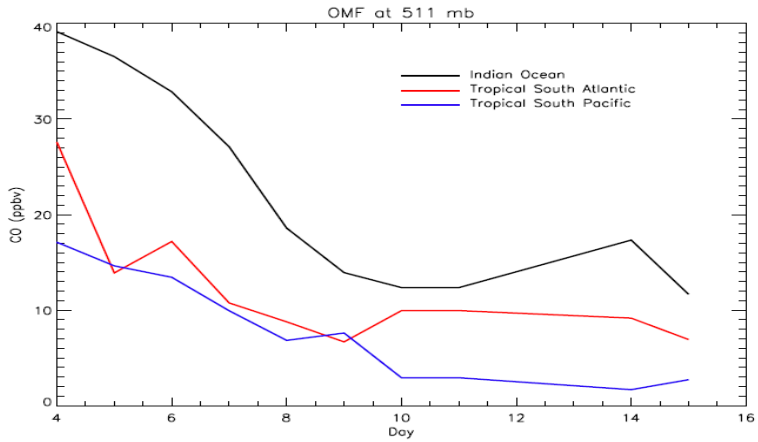


(John Worden *et al.*)

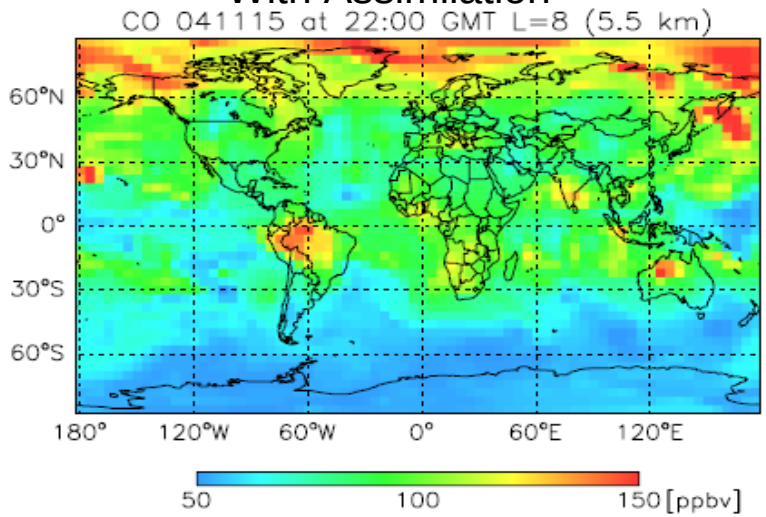
Constraining GEOS-Chem CO with TES Observations Through Data Assimilation

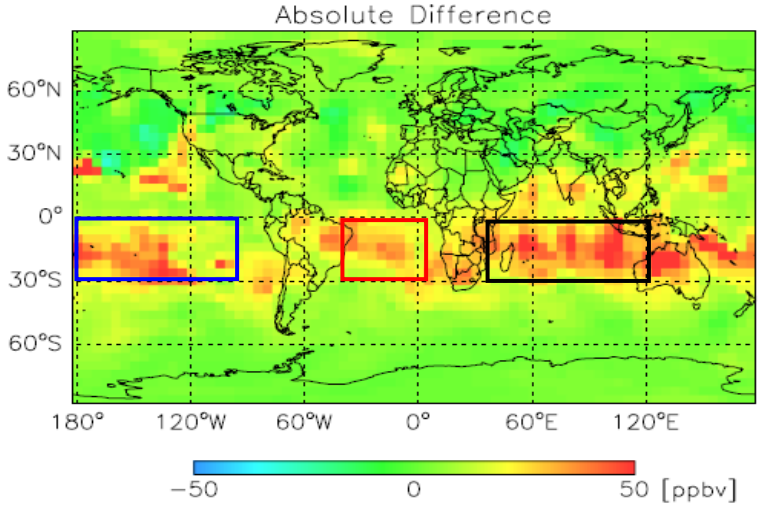
Without Assimilation





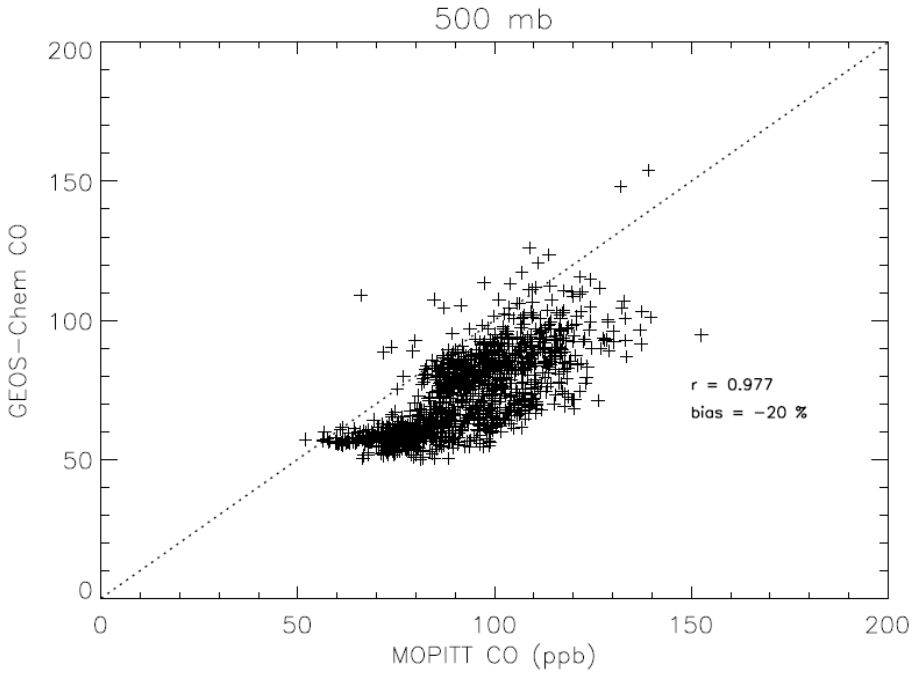
With Assimilation



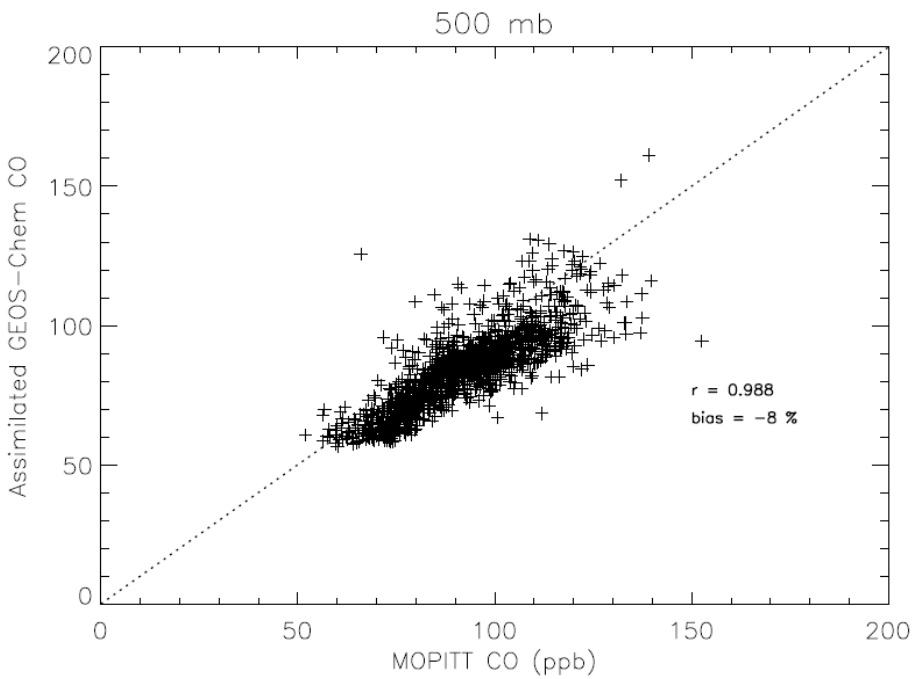


MOPITT vs assimilated and non-assimilated GEOS-Chem CO

Without Assimilation



With Assimilation

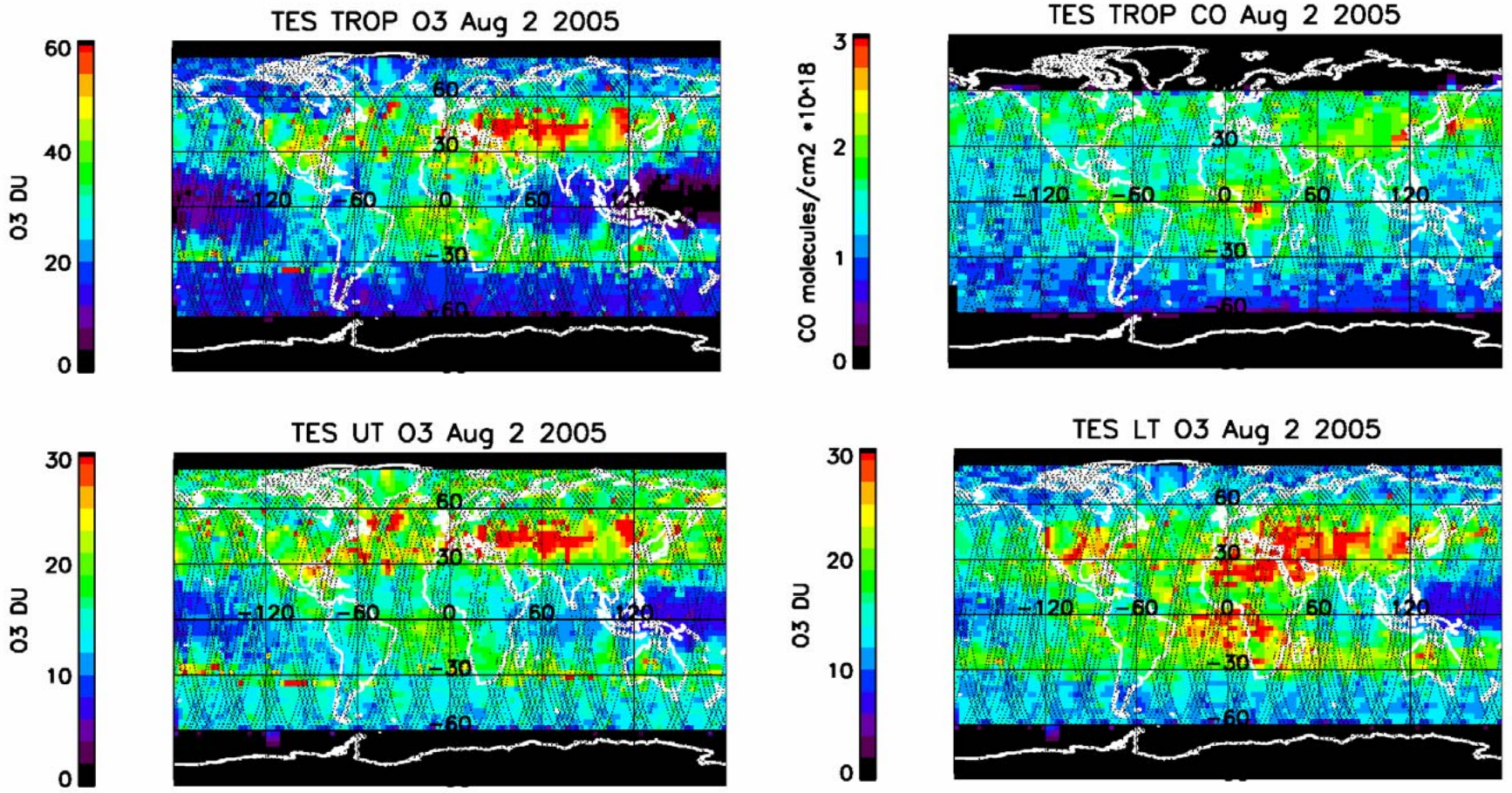


Bias = (Model – MOPITT)/MOPITT

(Nigel Richards)

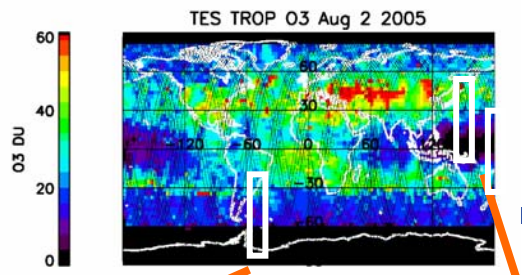
NH ozone present throughout the troposphere at this time of year.

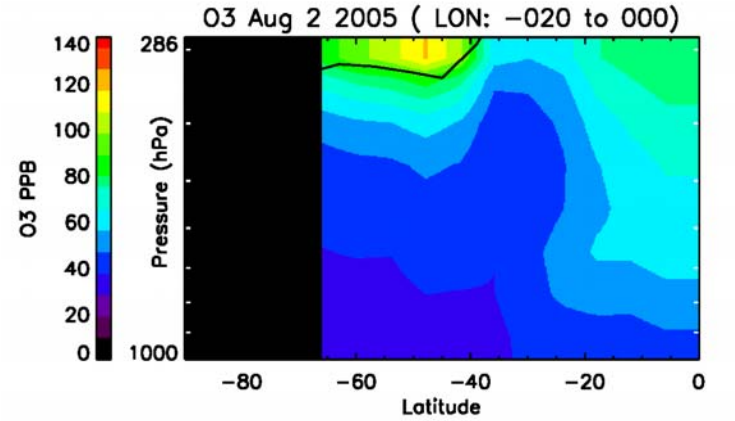
TES Observes CO and lower troposphere ozone in biomass burning region.

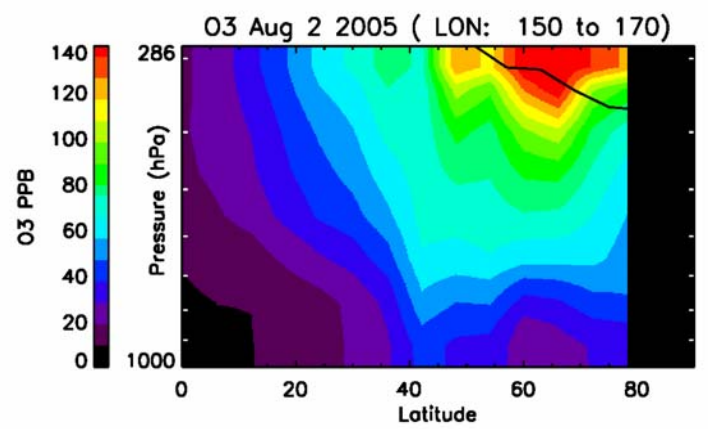


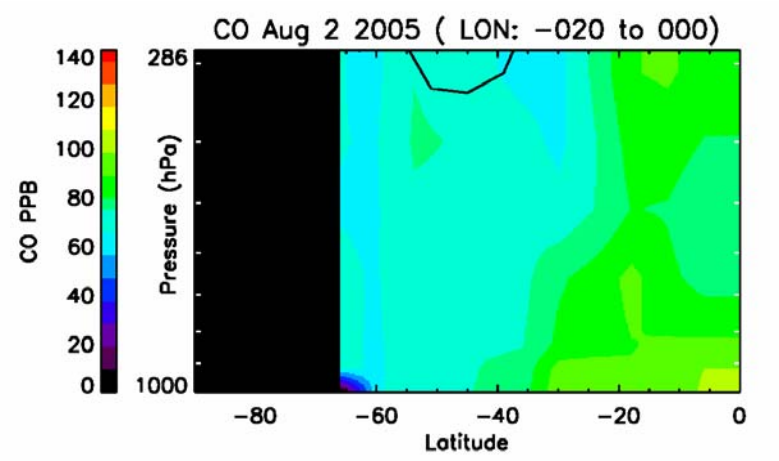
(Annmarie Eldering *et al)*

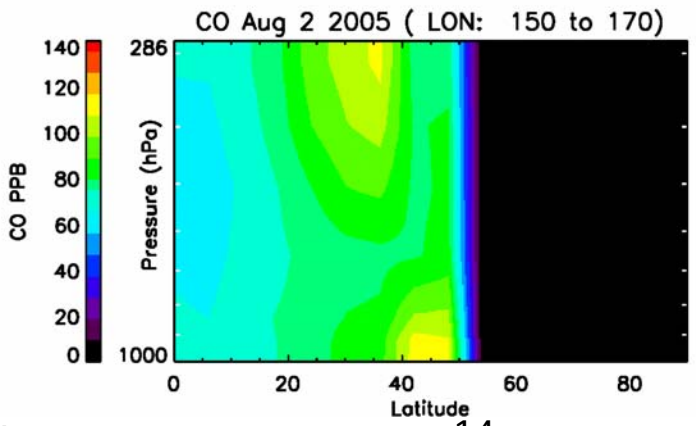
Vertical distribution of O3 and CO offer new insights into pollution formation.





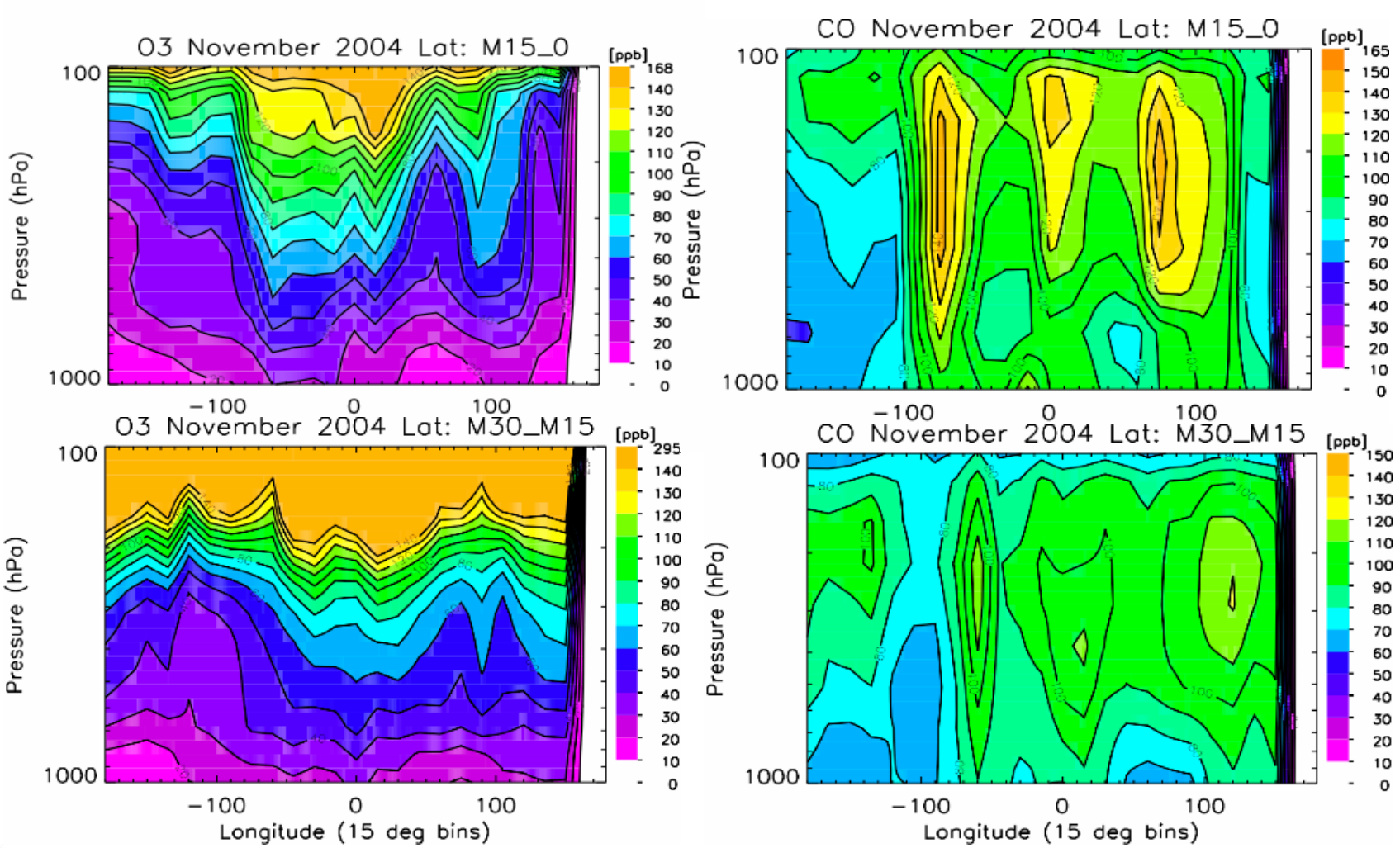






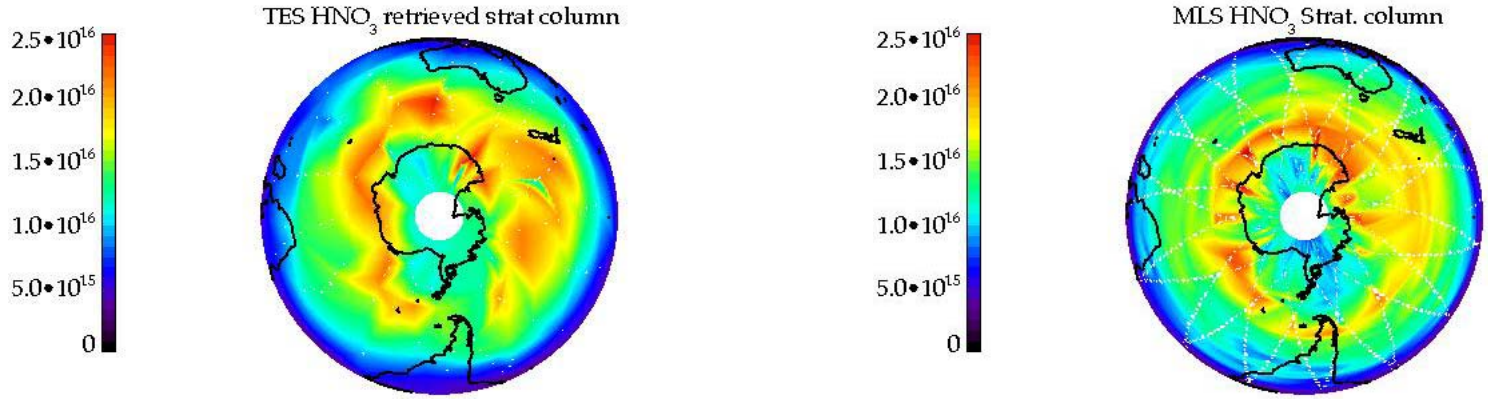
(Annmarie Eldering *et al)*

Monthly mean of tropical tropospheric O3 and CO

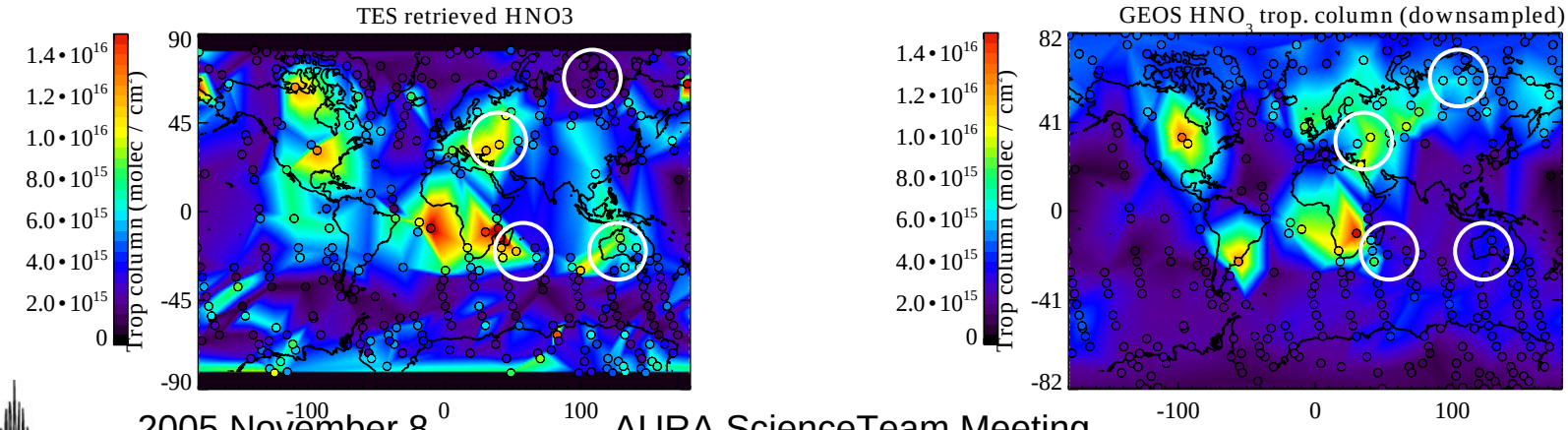


TES Limb HNO3 retrievals

TES vs. MLS stratospheric columns



TES vs. GEOS-CHEM tropospheric columns



The Active Players

Reinhard Beer	JPL	Qinbin Li	JPL
Kevin Bowman	JPL	Jennifer Logan	Harvard
Karen Cady-Pereira	AER	Mingzhao Luo	JPL
Tony Clough	AER	Gregory Osterman	JPL
Annmarie Eldering	JPL	Chiara Piccolo	Oxford
Brendan Fisher	JPL	Nigel Richards	JPL
Aaron Goldman	NCAR	David Rider	JPL
Michael Gunson	JPL	Curt Rinsland	LaRC
Robert Herman	JPL	Clive Rodgers	Oxford
Daniel Jacob	Harvard	Stanley Sander	JPL
Dylan Jones	Toronto	Mark Shephard	AER
Line Jourdain	JPL	Helen Worden	JPL
Susan Kulawik	JPL	John Worden	JPL
Michael Lampel	Raytheon	Lin Zhang	Harvard

BACKUP

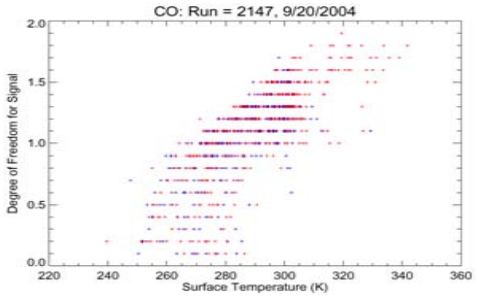
TES CO data availability, validation and application

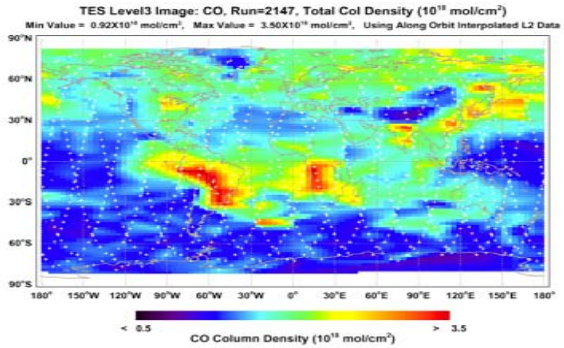
TES instrument performance and CO retrievals.

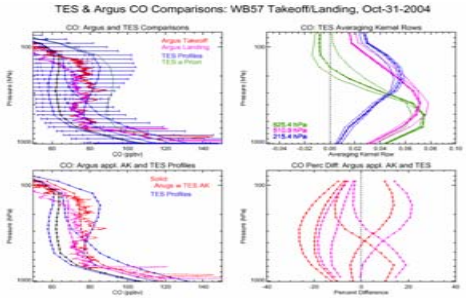
TES CO data validation status, comparisons to MOPITT, ACE, MLS, and *in situ* aircraft data (AVE & PAVE).

The influences of *a priori* and instrument characteristics on retrieved CO products and on data inter-comparisons, important to understand in applying remote sensing CO retrievals for scientific investigations.

Future TES CO validation plans and applications.







Points concerning monthly mean of tropical tropospheric O3 and CO

- Monthly mean over 15x15 deg bins. ~20 retrievals per bin
- Elevated amounts of ozone between -50W to 50E relative to -180W to -50 W and 50E to 180E is typical of the so-called “wave-one” pattern in the -15S to 0 latitude band.
- Interestingly, there are elevated amounts of ozone over the Indian Ocean
- Carbon monoxide is elevated over South America, Africa and the Indian Ocean
- It is unclear whether this elevated CO over the Indian Ocean is from biomass burning in Indonesia and Australia, or from Africa.
- The increase in ozone over the Indian Ocean suggests a source of NO, probably from lightning
- From -30S to -15S, there are elevated amounts of CO at 120E, just east of Australia, which experienced significant biomass burning as shown from MODIS firemaps.
- Note that there is also elevated CO at 200mb in the -180W to -150W in the Pacific. This elevated CO could be due to easterly transport of CO biomass burning from Australia, which appears to be the case based on NCEP reanalysis winds.