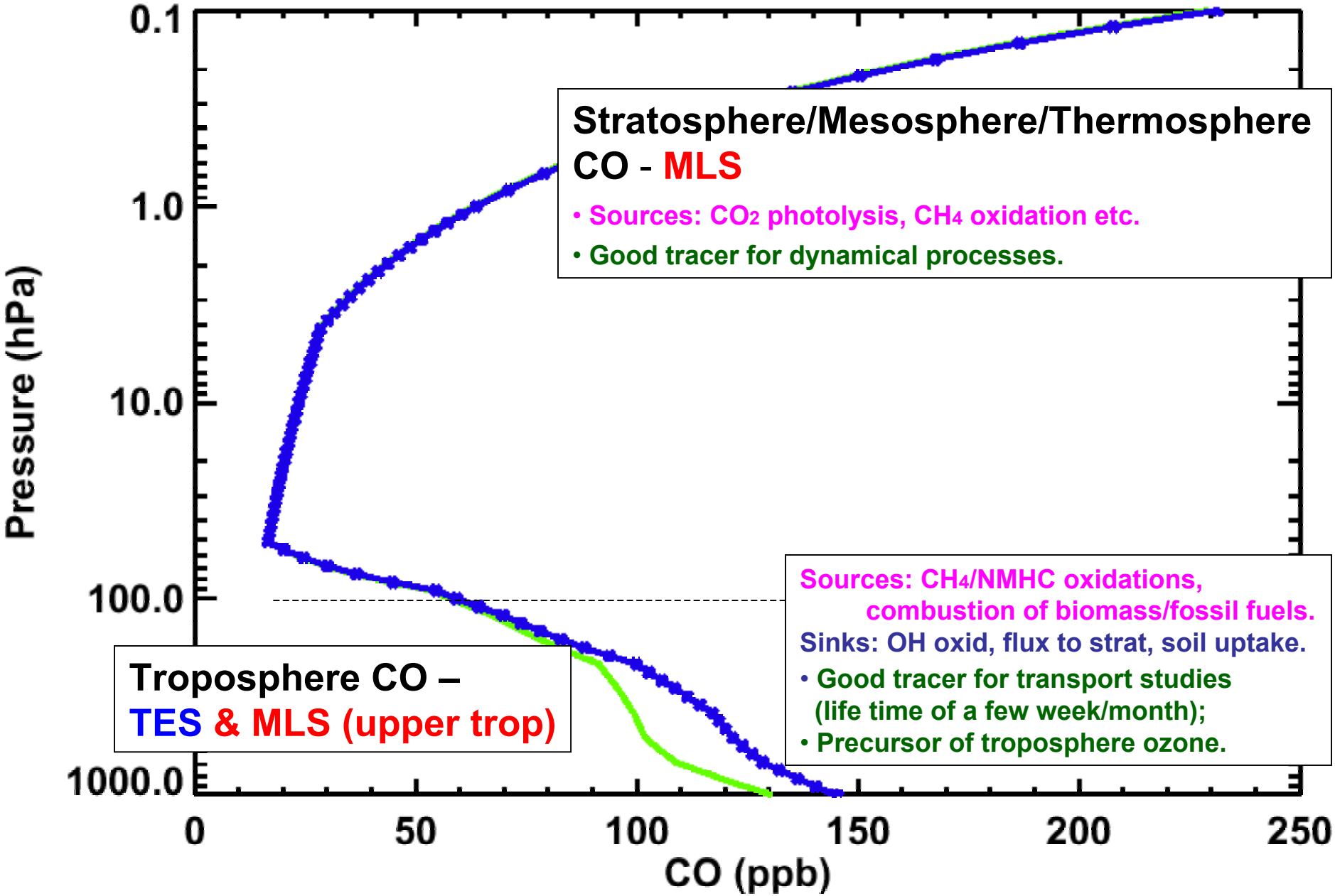
Summary for CO session

Ming Luo

Aura Validation Workshop
Boulder, Colorado
September 11-15, 2006


Stratosphere/Mesosphere/Thermosphere
CO - MLS
• Sources: CO2 photolysis, CH4 oxidation etc.
• Good tracer for dynamical processes.
Sources: CH4/NMHC oxidations,
combustion of biomass/fossil fuels.
Sinks: OH oxid, flux to strat, soil uptake.
• Good tracer for transport studies
(life time of a few week/month);
• Precursor of troposphere ozone.
Troposphere CO –
TES & MLS (upper trop)
Pressure (hPa)
0.1
1.0
10.0
100.0
1000.0
0
50
100
150
200
250
CO (ppb)

Troposphere CO

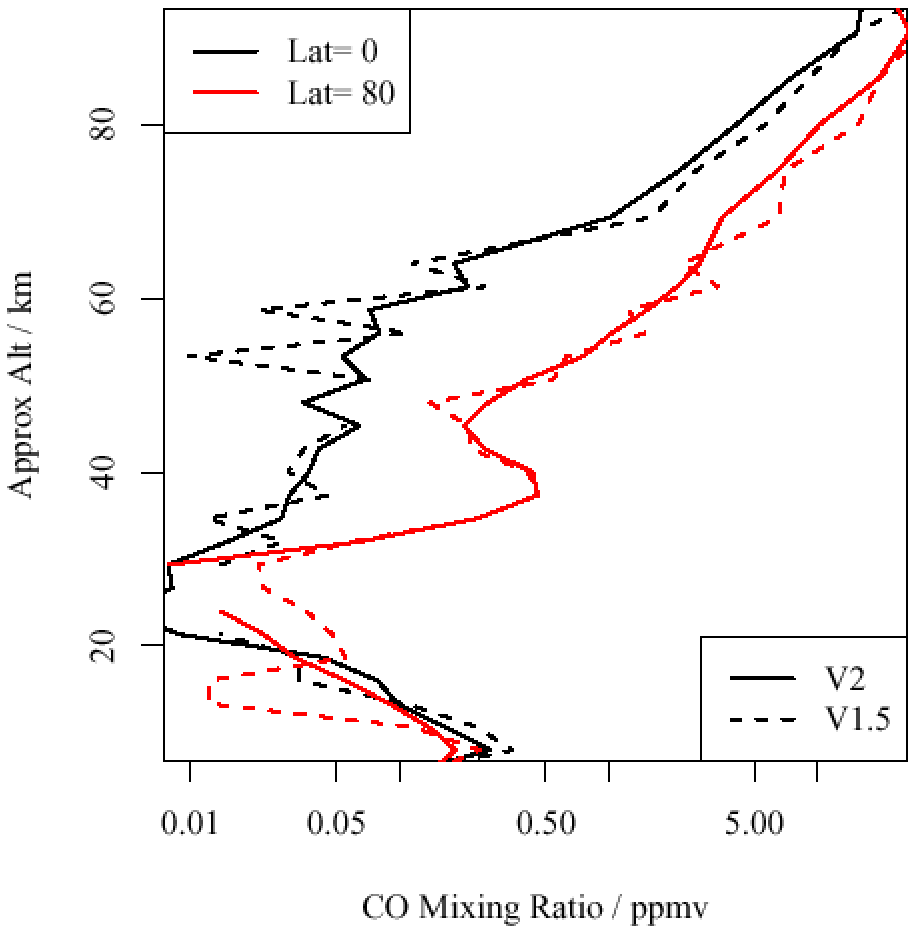
- Validation of MLS upper tropospheric CO — Nathaniel Livesey

- TES CO validations — Ming Luo
- Preliminary Comparisons between TES CO and MOPITT pre-V4 CO products — Ben Ho
- Plans/results for TES/AIRS/MOPITT CO validations — Juying Warner
- Assimilation of the CO-sensitive radiances in the CTM: Implications for comparisons between the multi-sensor CO retrievals. — Valery Yudin

Stratosphere/Mesosphere/Thermosphere CO

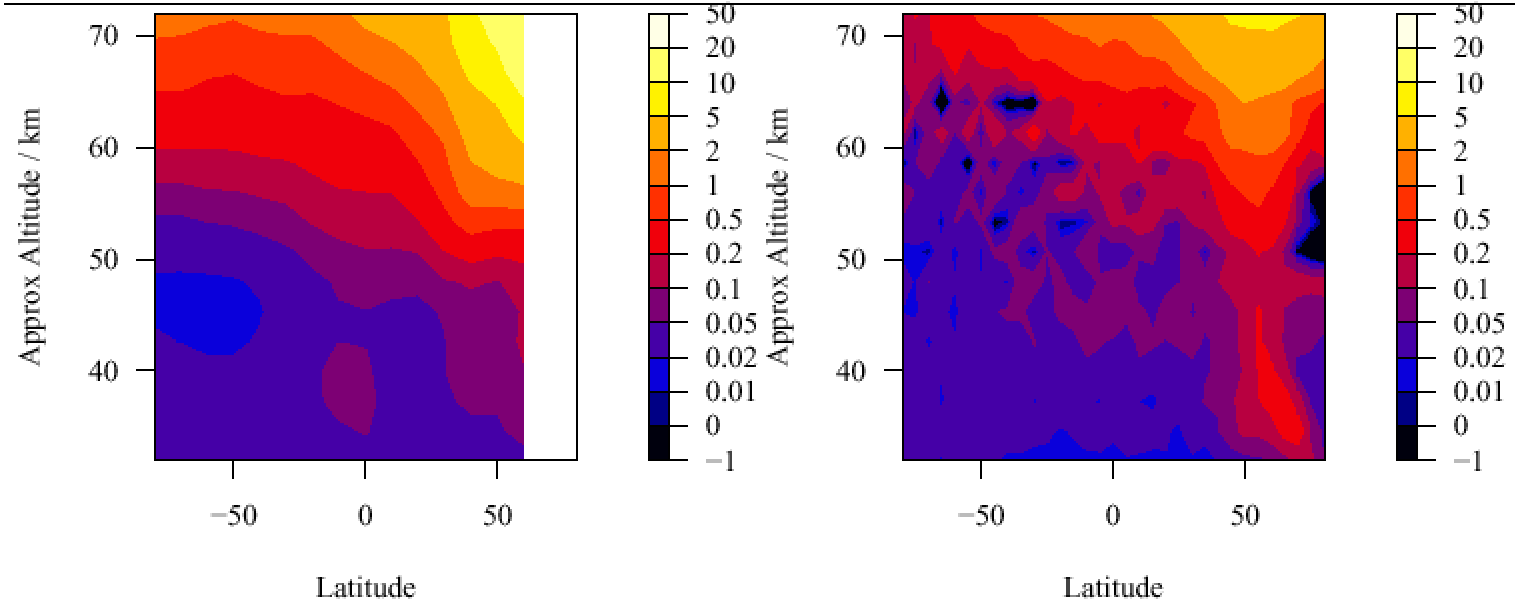
- Validation Status Report: Carbon Monoxide from MLS in the middle atmosphere. — Bob Harwood / Hugh Pumphrey

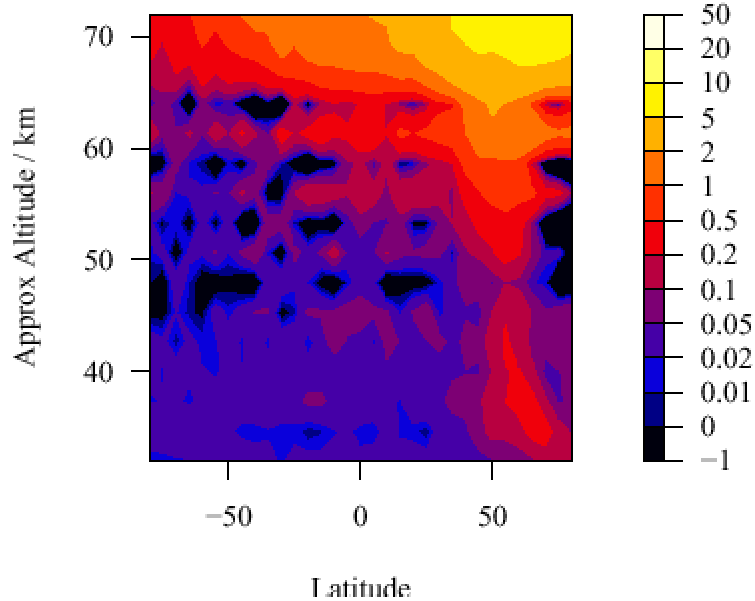
The MLS CO product



- Data shown are daily zonal means in 10° bins, for 2005d028.
- Current version (V1.5x – dashed lines) rather jagged and biased. All mission to date processed.
- New version (V2.x – solid lines) in final testing. Several days processed.
- Validation paper will describe V2.x
- Accuracy and resolution still being assessed

CO from UARS ISAMS (top left) and EOS MLS



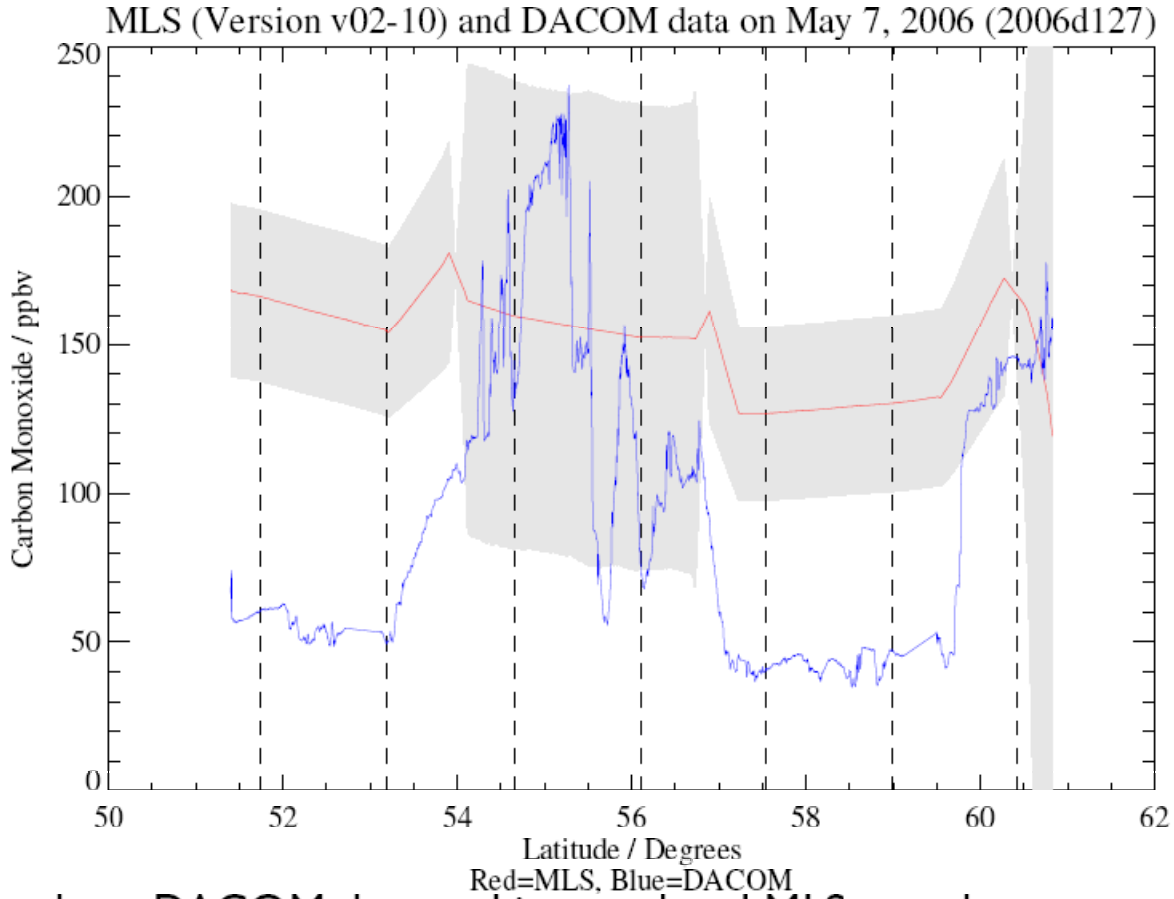


- MLS V1.5 (← left) V2 (↑ Above)
- MLS data are 2006d022, ISAMS are 1992d(013,015)
- Polar vortex very off-pole in 2006
- MLS V2 less ragged than V1.5
- Unlike ACE and SMR, ISAMS values seem to be *higher* than MLS in the mesosphere

Summary

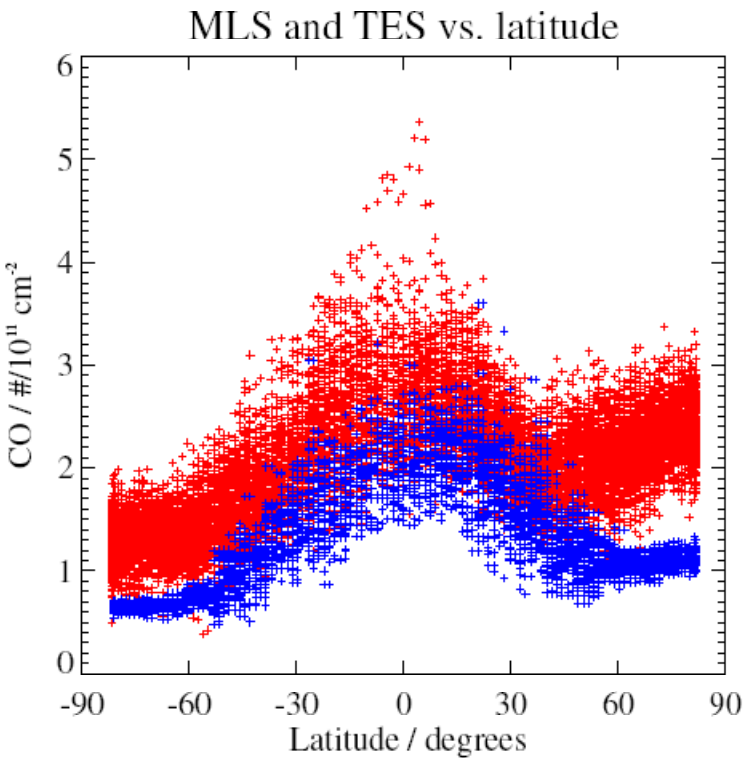
- Validation of MLS CO is proceeding well
- MLS CO has not sprung any scientific surprises in the middle atmosphere
- V2 will agree better with the correlative data than V1.5 does
  - Positive bias above 60 km much decreased in V2
  - Jaggedness (especially between 40 and 60 km) much reduced in V2

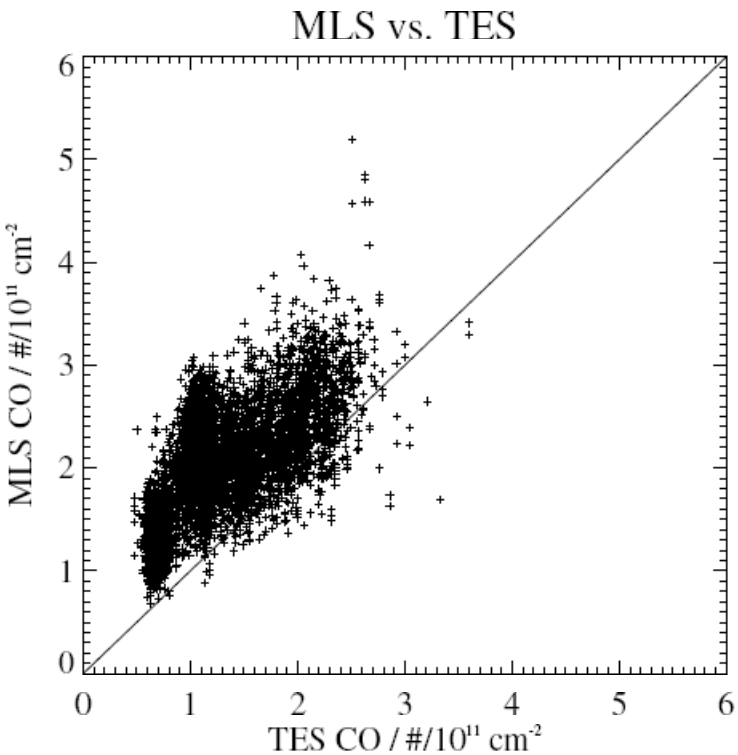
Same comparison as a timeseries



- Here we show DACOM data and interpolated MLS together
- While the high bias is evident there is some agreement on morphology (mainly reflecting vertical gradients and altitude changes)

Some preliminary TES comparisons





- Plot compares MLS (red) and TES (blue) column CO from 215–100 hPa
- MLS seems to be biased high compared to TES
- MLS simulations show a similar but smaller bias for this column quantity

Summary and plans for the CO validation paper

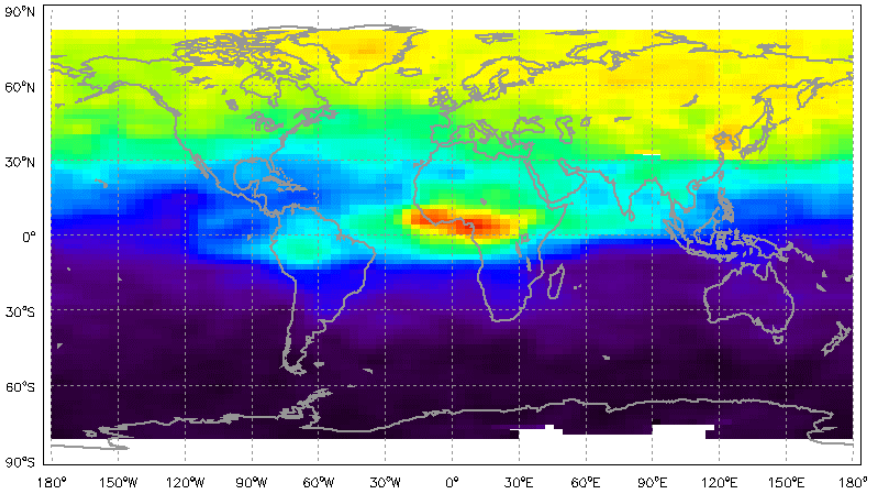
- While v2.1 CO are better than v1.5 some high bias remains at lower altitudes
- The MLS CO product is reliable (bias aside) for 215 hPa and lesser pressures
- The quality of the 316 hPa data needs further investigation
- Version 2.2 are likely to be very similar to v2.1

- Additional issues to be covered in the validation paper include:
- Full quantification of the various sources of systematic error
- More comparisons with satellite datasets
  - ⇨ TES (as shown), AIRS, MOPITT, ACE/FTS(?), ODIN/SMR(?)
  - ⇨ Will in most cases just compare partial columns
  - ⇨ However, we still need to consider averaging kernel and precision issues
- Distillation of in-situ comparisons shown above into summary statistics
- Summary and prioritization of issues to be resolved in later MLS versions

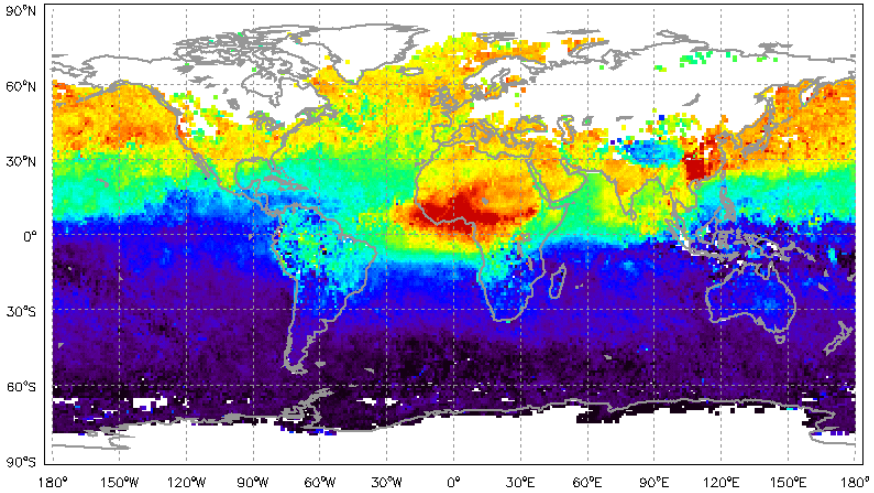
Comparison Sources	Progress	Results / problems
MOPITT	• Data from Sept 20-21, 2004. JGR paper in review for 85+ days! • Monthly	• Good agreement in global patterns • Influence of *a priori* constraints on CO retrievals of both instrument. The agreement much improved after adjusting the retrieval with *a priori* info. • MOPITT will release V4 data
ACE MLS AIRS	• Time trends with ACE data in upper trop • One day 2004 data with MLS in upper trop • AIRS in preparation	• Good agreement with ACE • MLS being too high • Understand AIRS AK
AVE (Argus) CARVE (Alias)	• Comparisons made AVE-04; paper will go to special JGR issue	• Agreement within CO area variability and the estimated errors of 10-20%.
INTEX-B (DACOM)	• Comparisons made; paper will go to special JGR issue	• Agreement within CO area variability and the estimated errors of 10-20%. in Houston area.
MOZAIC	• Comparisons made Sept 04 – May 05	• Agreement within CO area variability and estimated errors of 10-20% in most airports. • Waiting for data after May 2005.

CO Monthly Means at 681.3 hPa (TES) & 700 hPa (MOPITT): Jan 2006

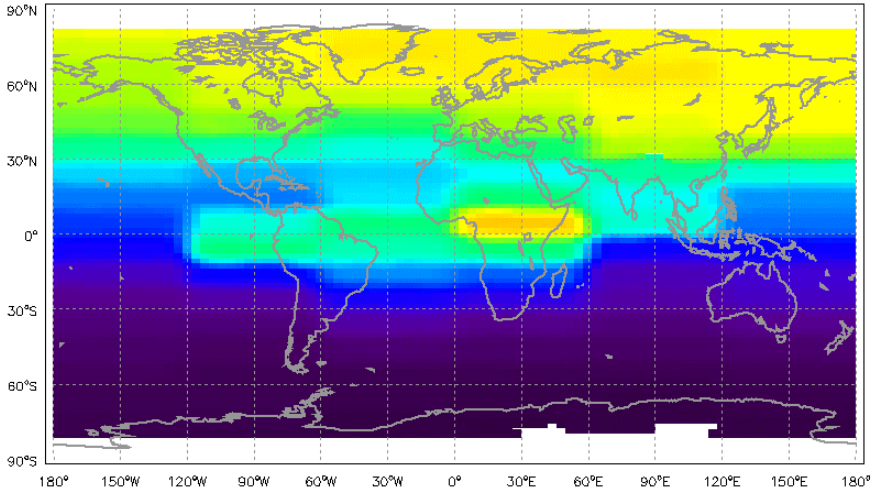
TES



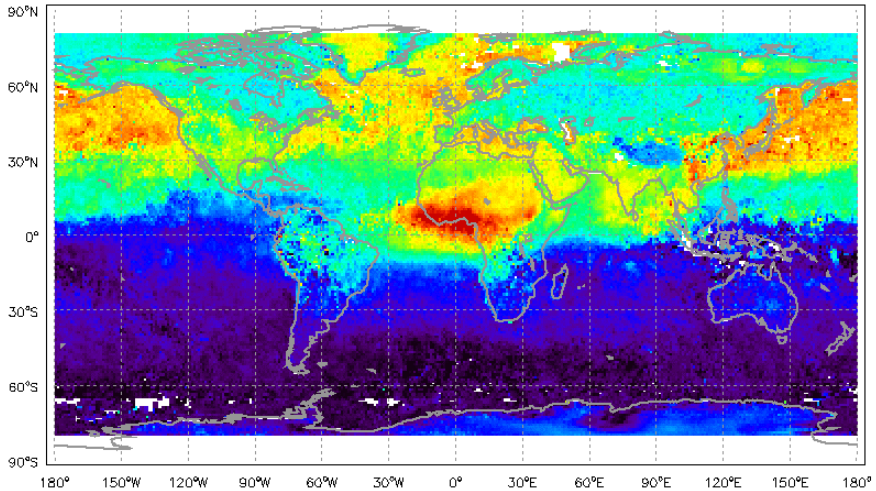
MOPITT day/night ave, aPriori Frac < 50%

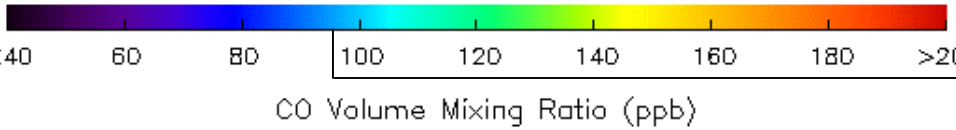


TES a Priori

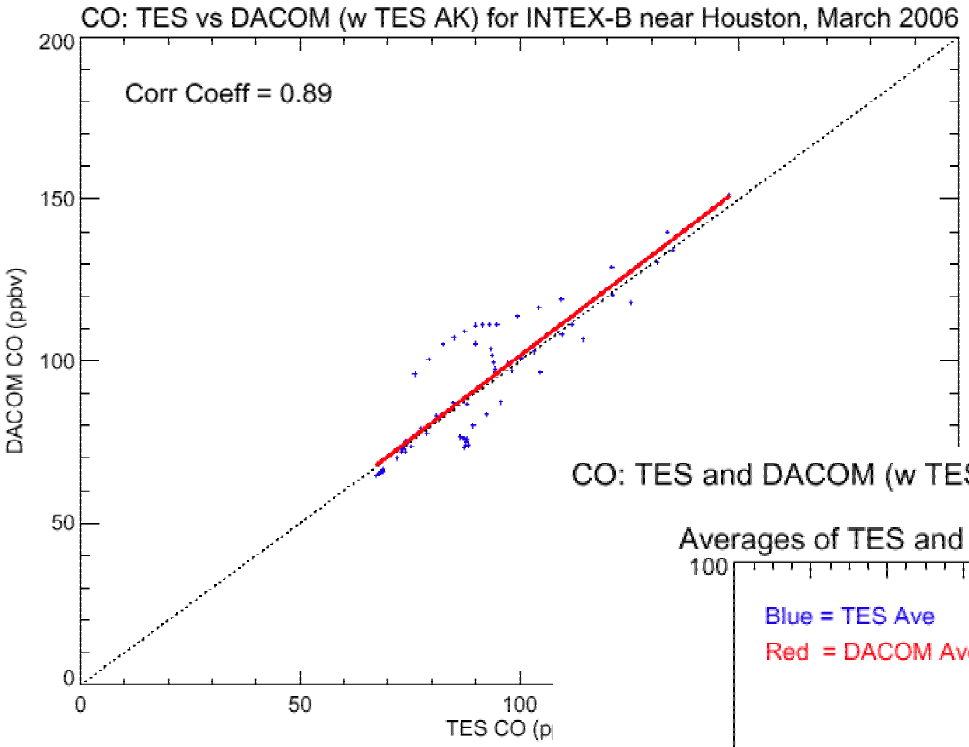


MOPITT day/night ave, all data

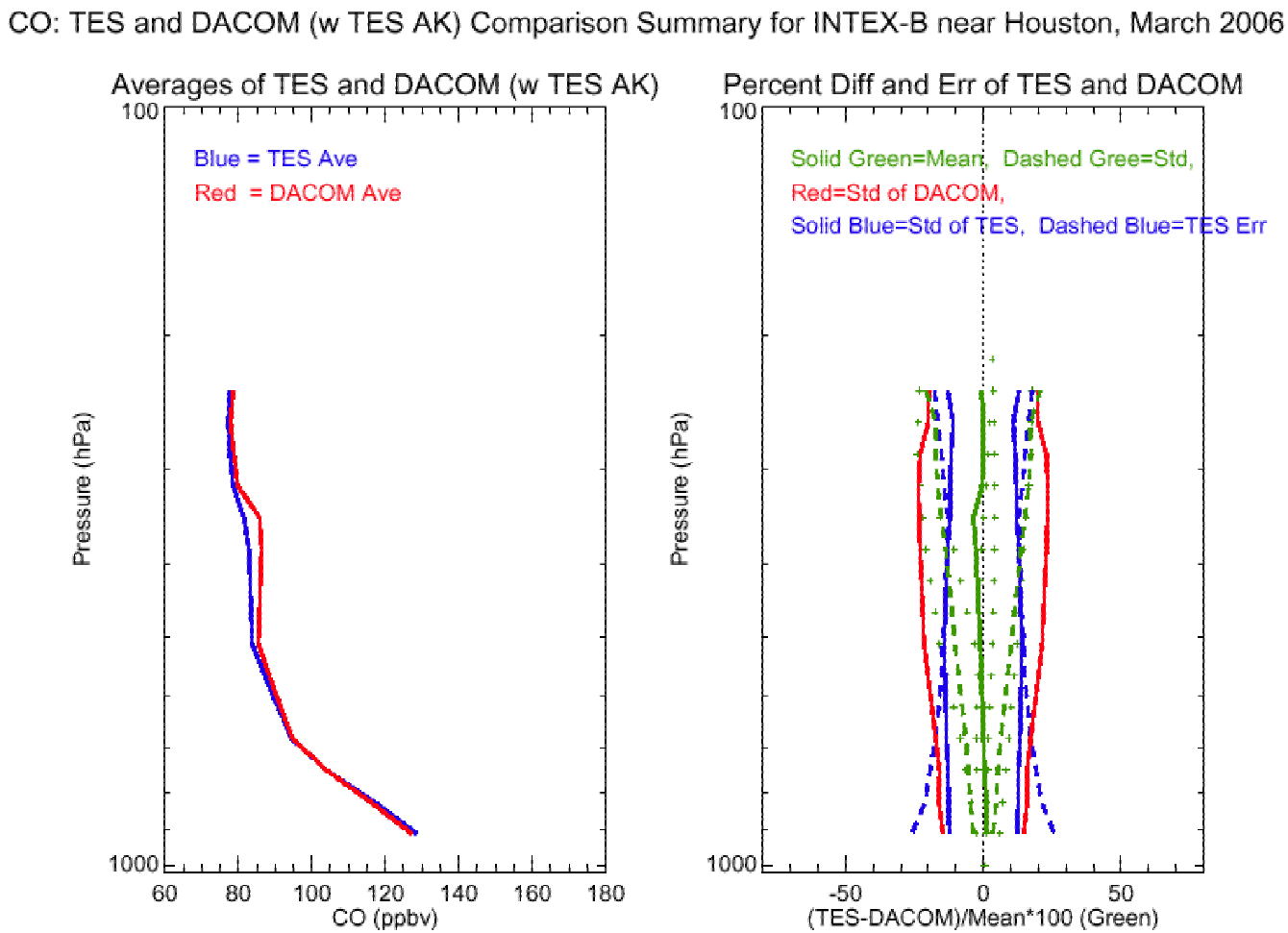




MOPITT a priori = 94 ppb



Houston Only
(Best Coincident Profiles)

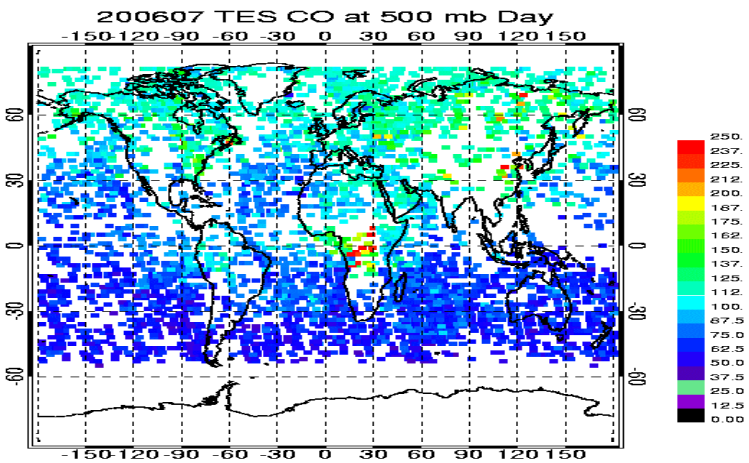


Motivations

Purpose : to use the MOPITT CO products to quantitatively validate TES CO profiles and understand the possible causes of the differences between these two datasets

Outlines :

- Difficulties
- Comparison Method
- Comparison Results :
  1) Global CO distributions
  2) 1x1 grid CO at different levels
  3) Zonal mean comparisons
- Conclusions and Future Works



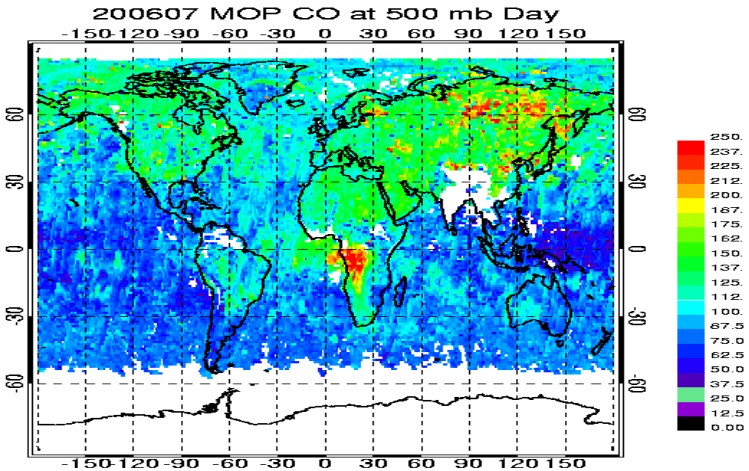
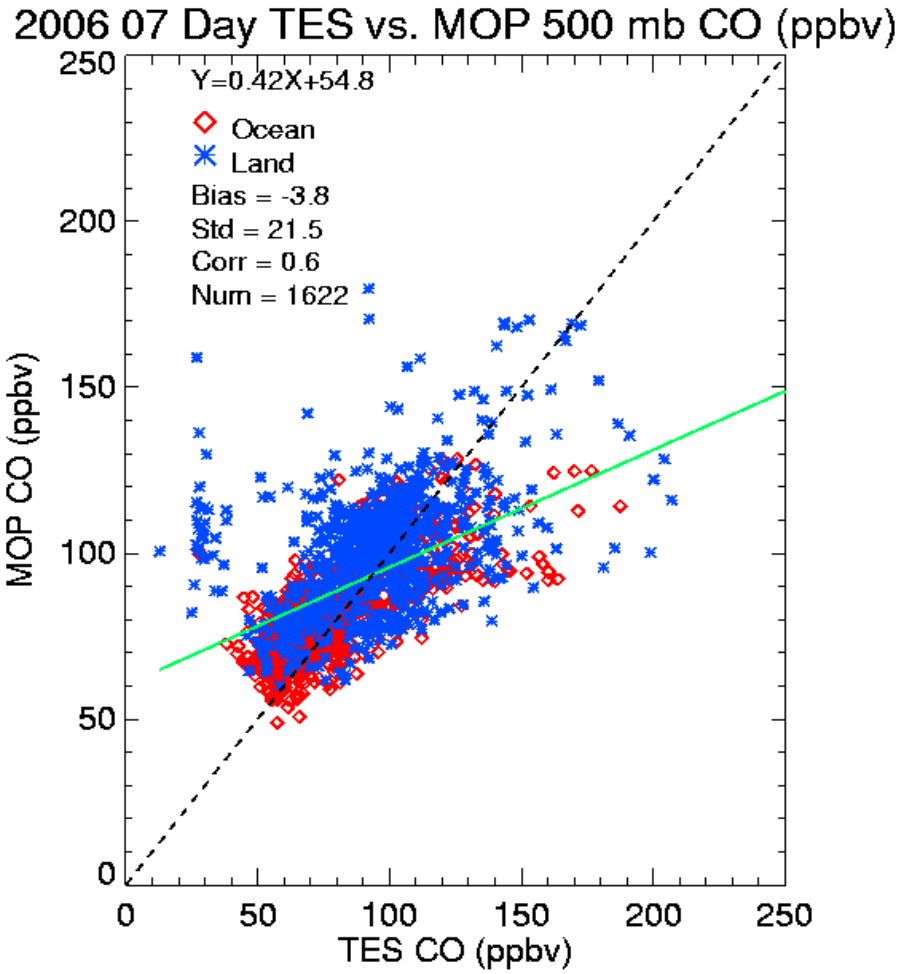
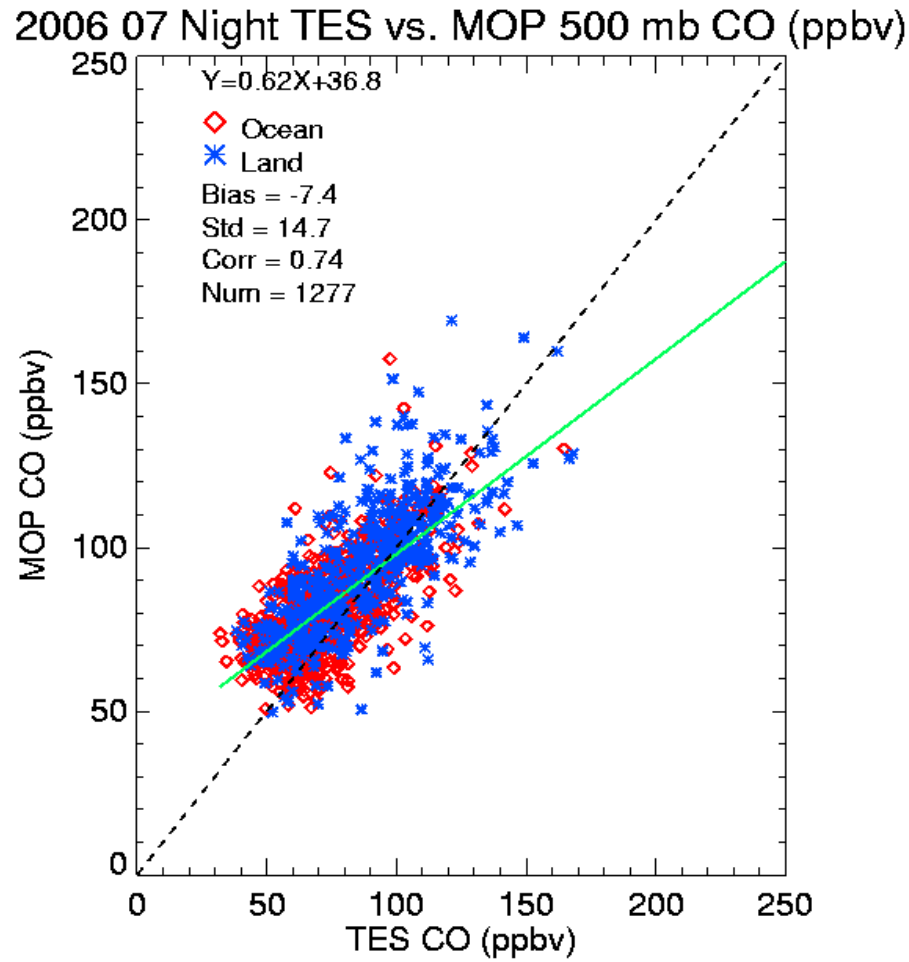


Fig. 2

MOP vs. TES CO in 1x1 Grid at 500mb



Day



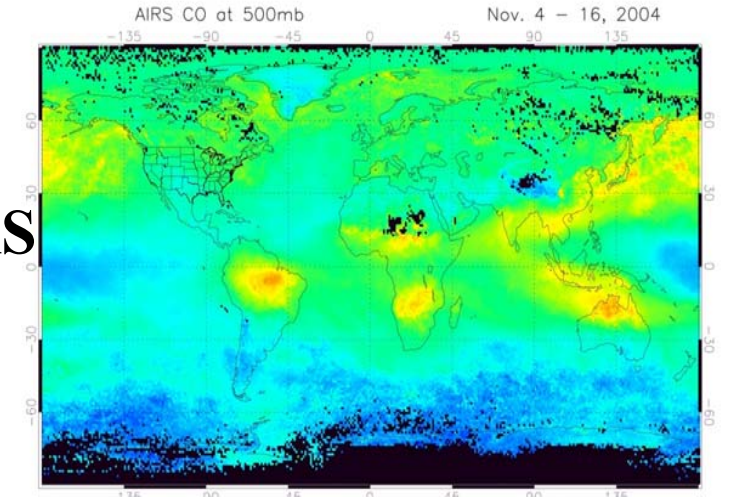
Night

Fig. 5

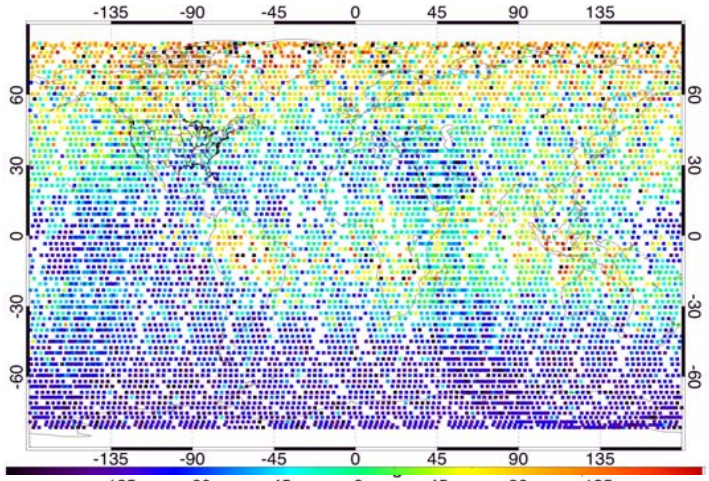
AIRS/MOPITT/TES Nov. 4 - 16, 2004

- This TES dataset is before the TES bench warming in 2005 and no quality control is applied
- All three sensors capture the large features of the elevated CO.
- MOPITT and TES agree more at low CO values over the Southern Hemisphere oceans than with AIRS.
- TES high values at high Northern Hemisphere latitudes seems be artificial.

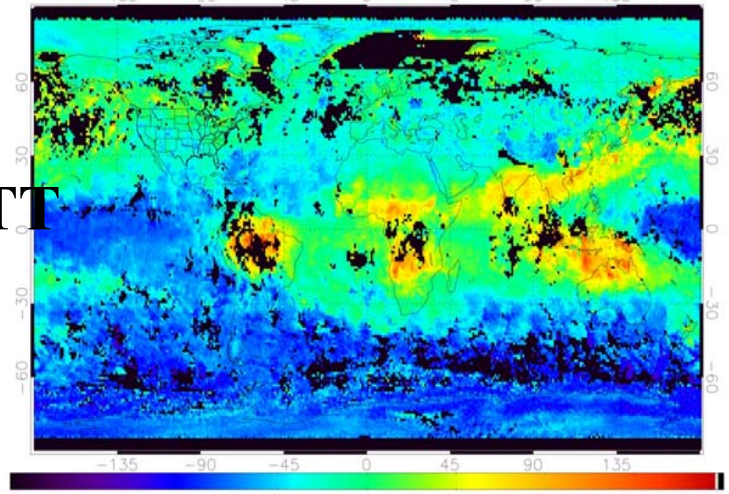
AIRS



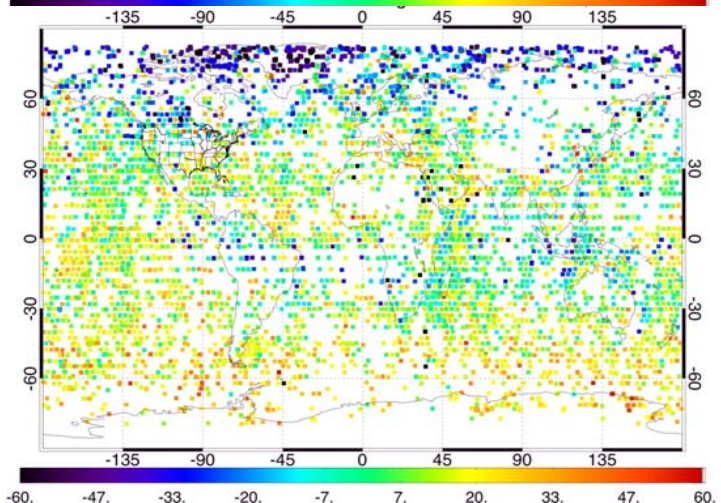
TES



MOPITT



AIRS -TES



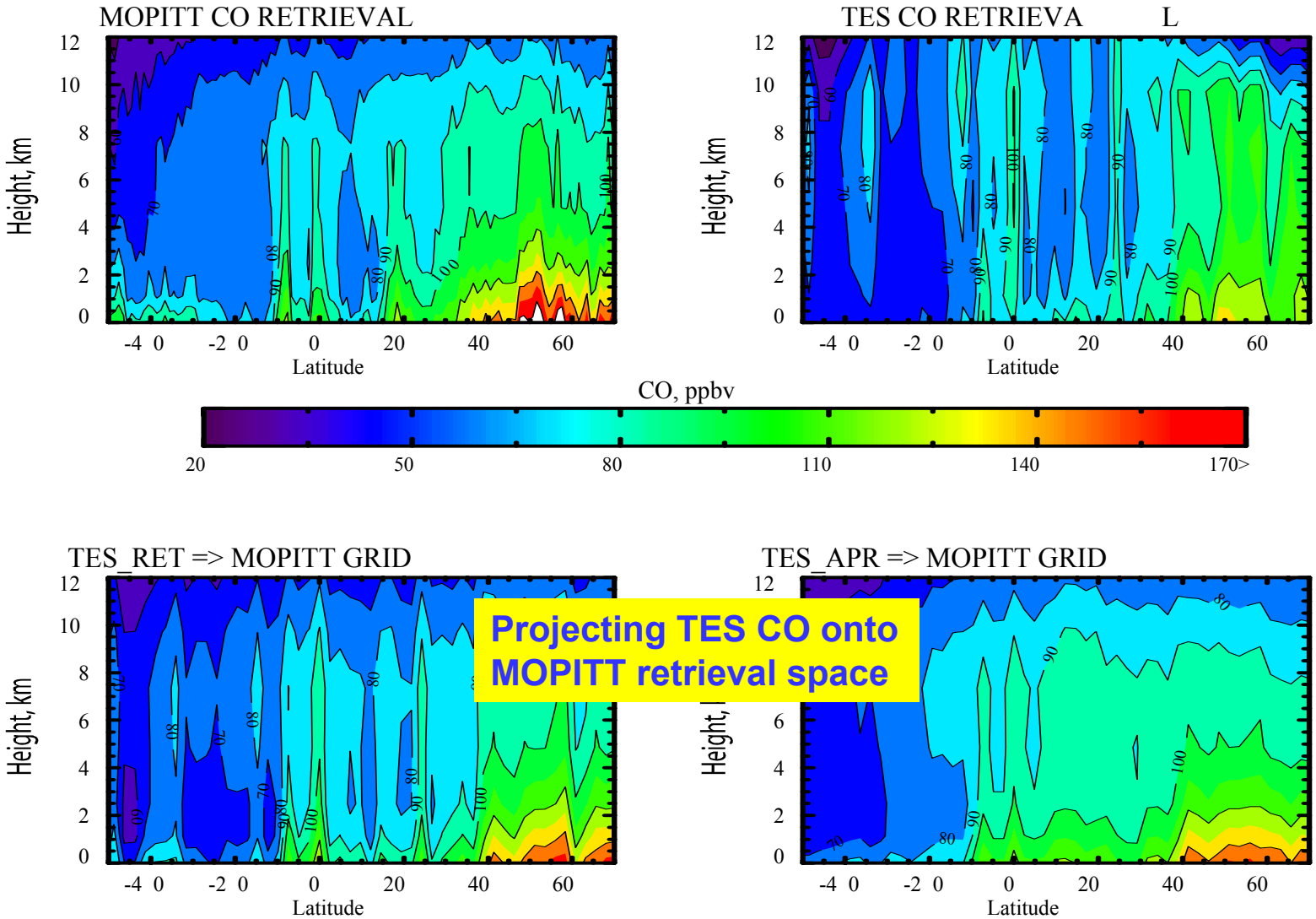
Data Assimilation of CO-sensitive Radiances in the CTM: Implications to Comparisons of Multi-sensor Data

V. A. Yudin, D. P. Edwards, J. C. Gille, and G. L. Francis.

National Center for Atmospheric Research, Boulder, Colorado, USA

Boulder, AURA Science Team Meeting,

September 11, 2006

Mapping TES CO retrievals and TES a priori to MOPITT "space" with MOPITT a priori and averaging kernels

(*all quantities are the "zonal" means*).