Global Chemical Data Assimilation Studies of long-range Pollution Transport During INTEX-B

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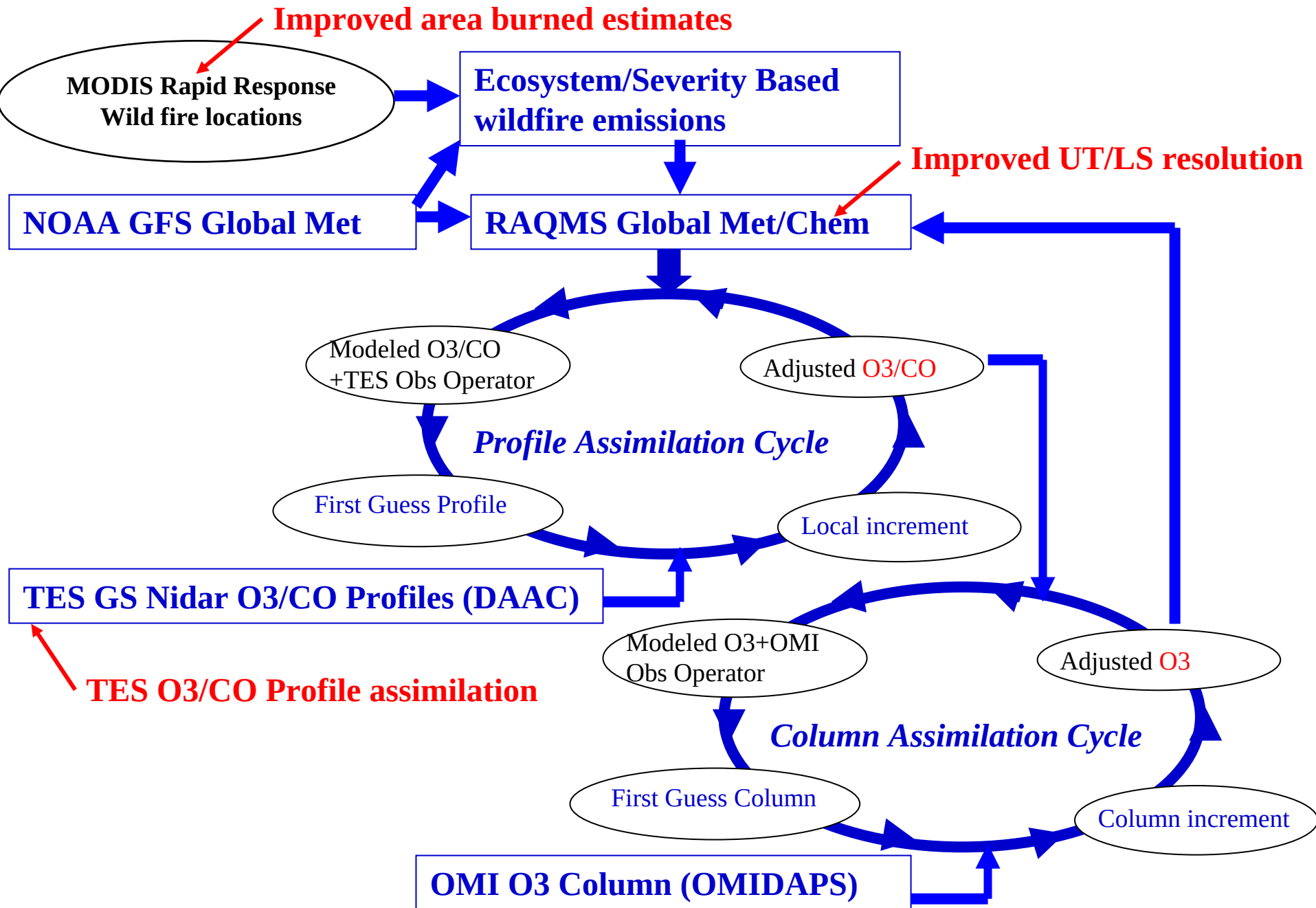
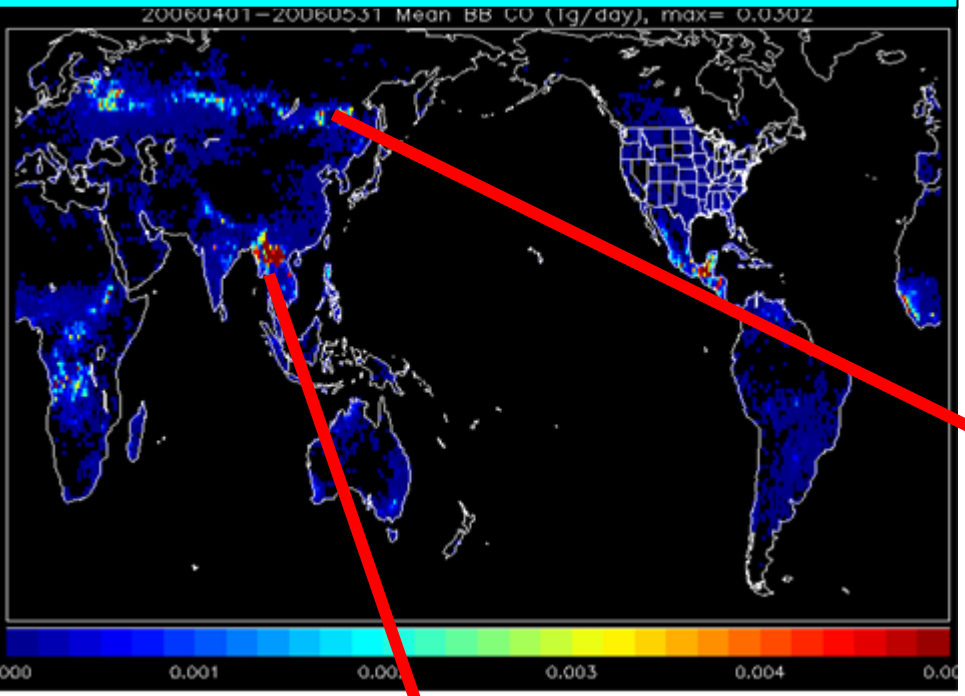
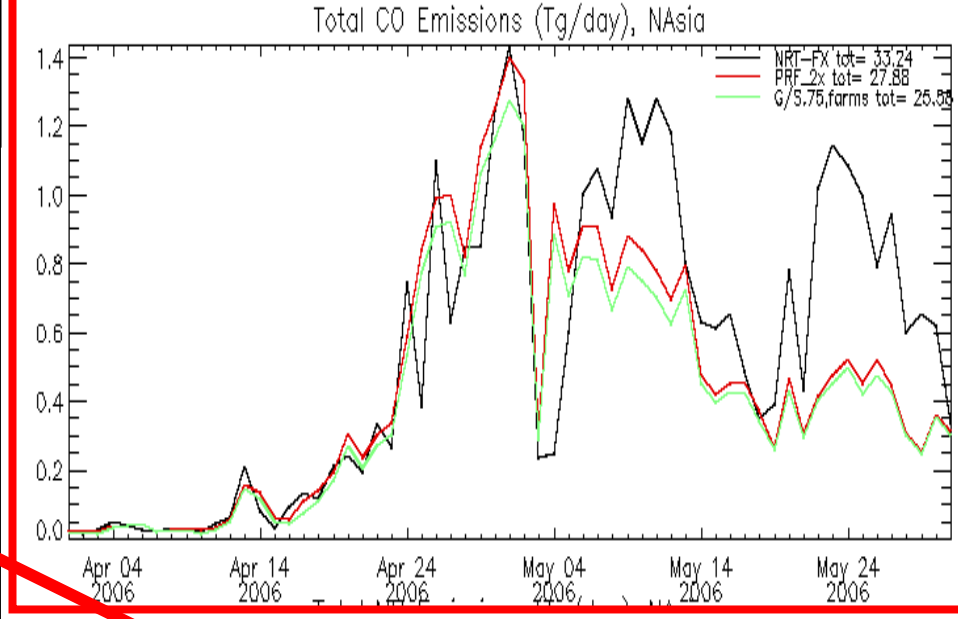
$RAQMS_{global}$ (2x2) OMI/TES Reanalysis O3/CO Assimilation Procedure

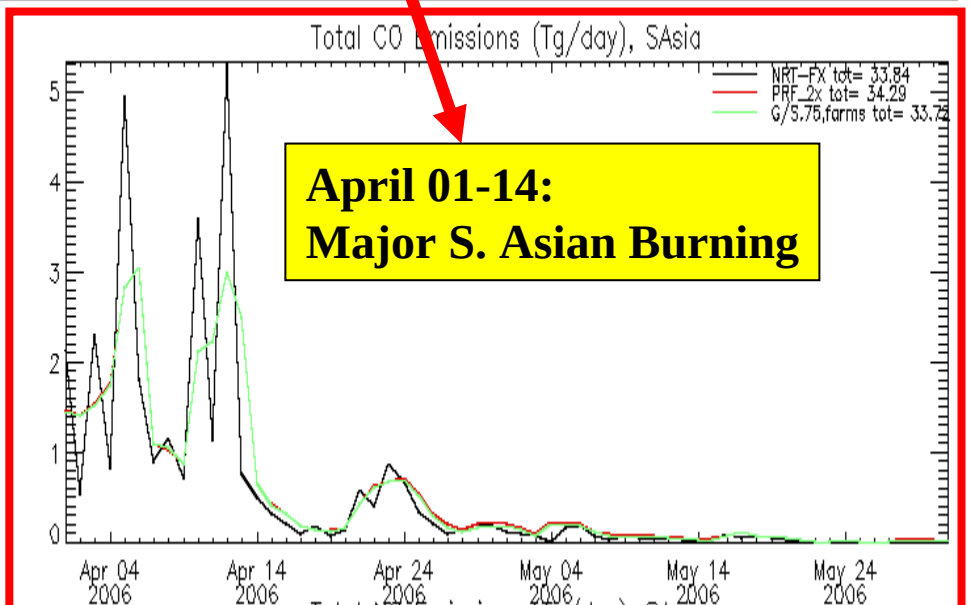


Biomass Burning CO Emissions
April-May 2006 Time series





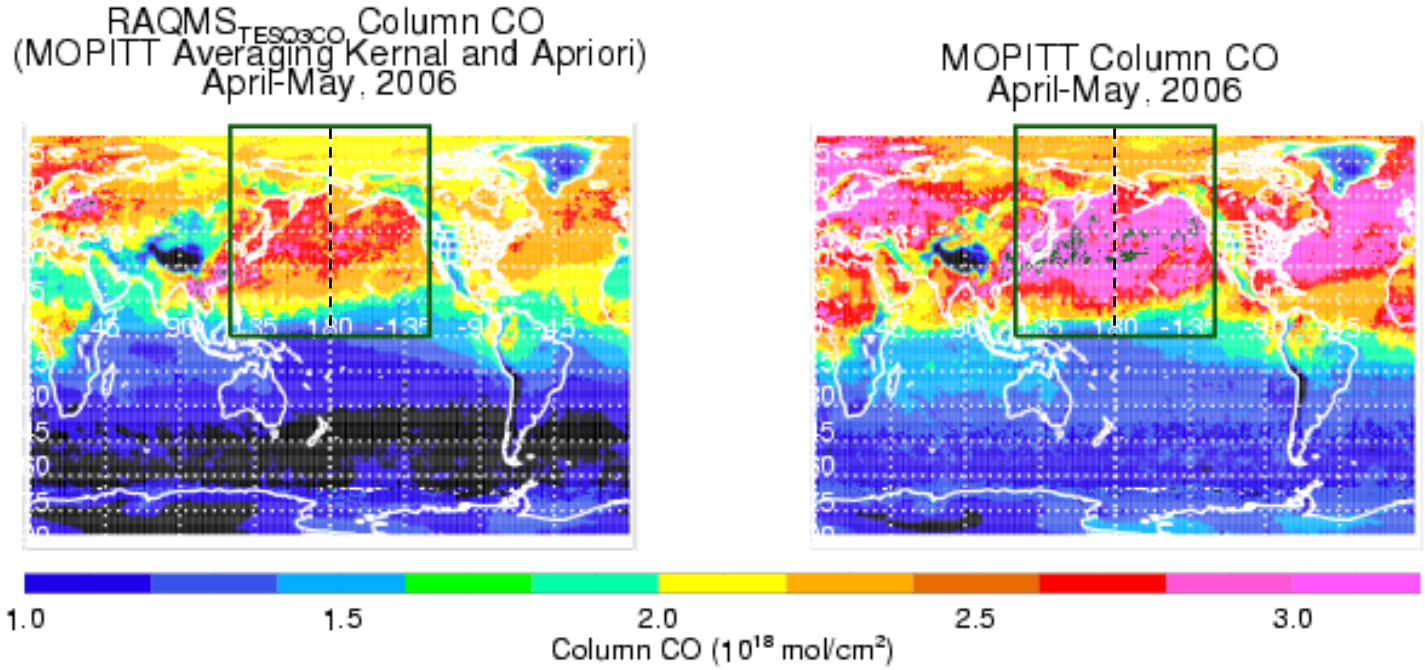
April 24-May 14: Siberian Burning

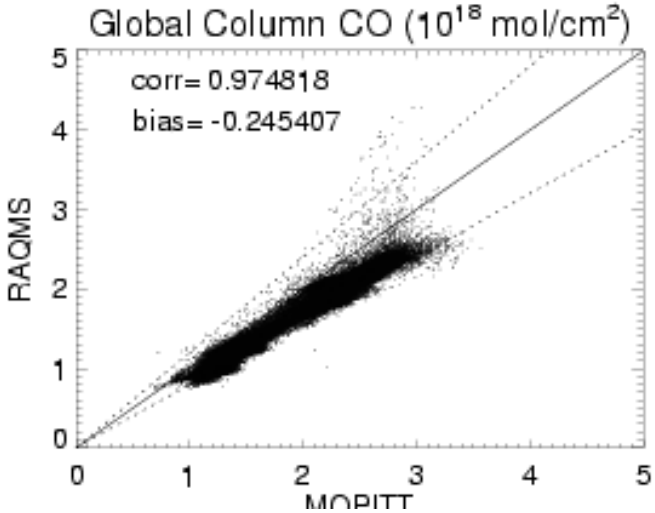


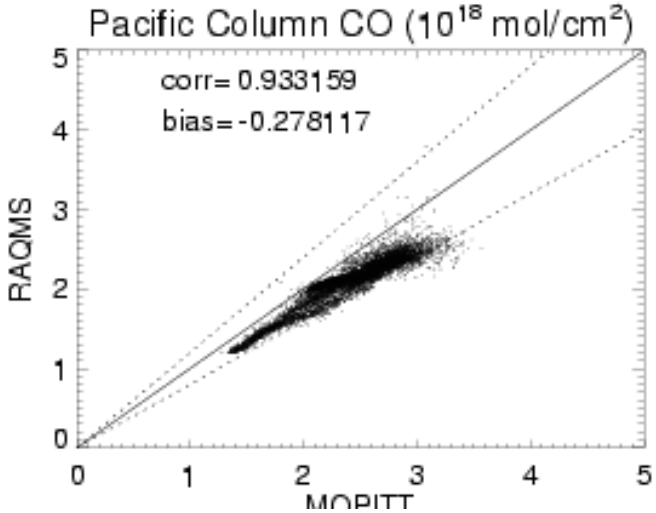
April 01-14: Major S. Asian Burning

Black=NRT,
Red= 48hr Multiple Detect filter,
Green= Red + 75% Grassland Savanna

RAQMS vs MOPITT Column CO April-May, 2006

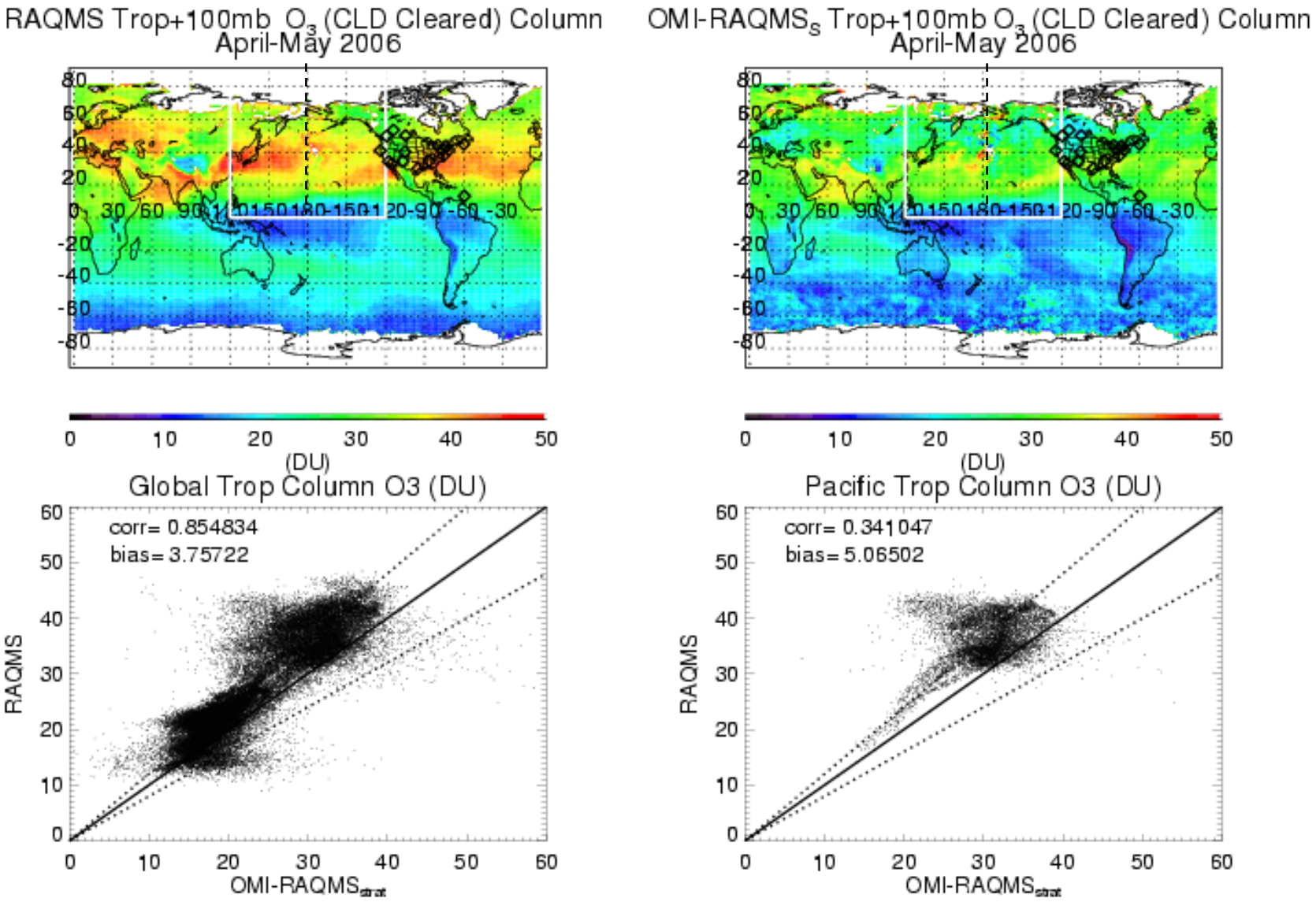






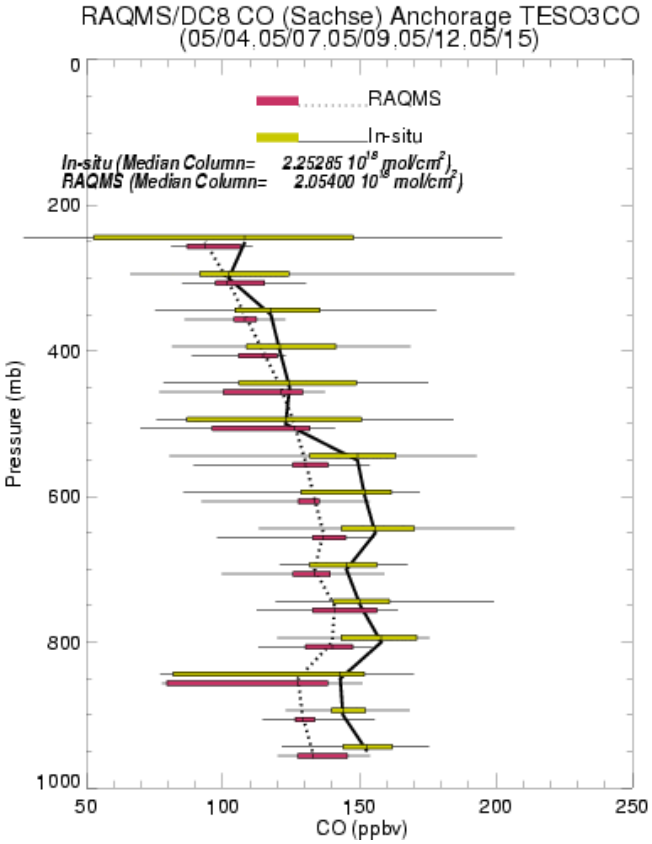
RAQMS <u>underestimates</u> MOPITT Column CO by 10-20%

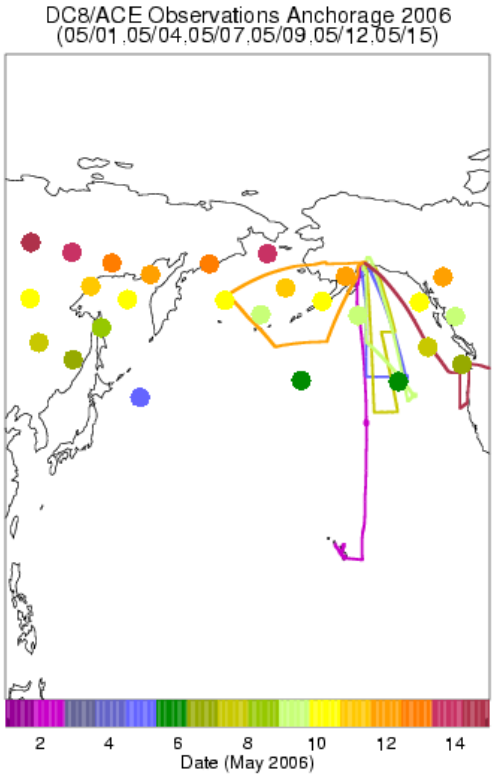
RAQMS vs OMI-RAQMS$_{strat}$ Tropospheric Ozone Column (TOC) April-May 2006

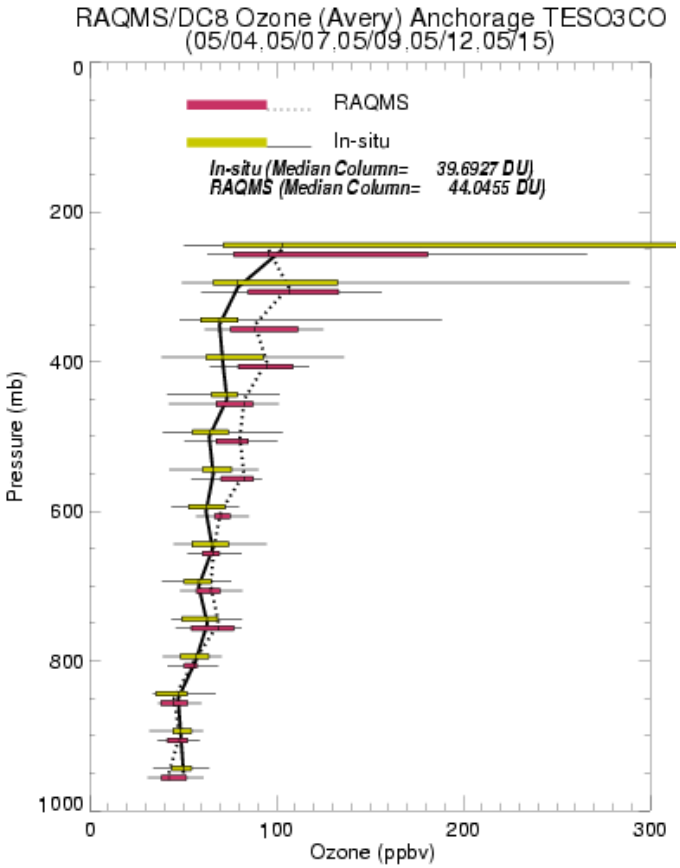


RAQMS <u>overestimates</u> OMI/RAQMS$_{strat}$ TOC by >20%

RAQMS vs NASA DC8 O3/CO: May 2006 Anchorage Flights
(*location of ACE May 02-15 Observations also indicated*)



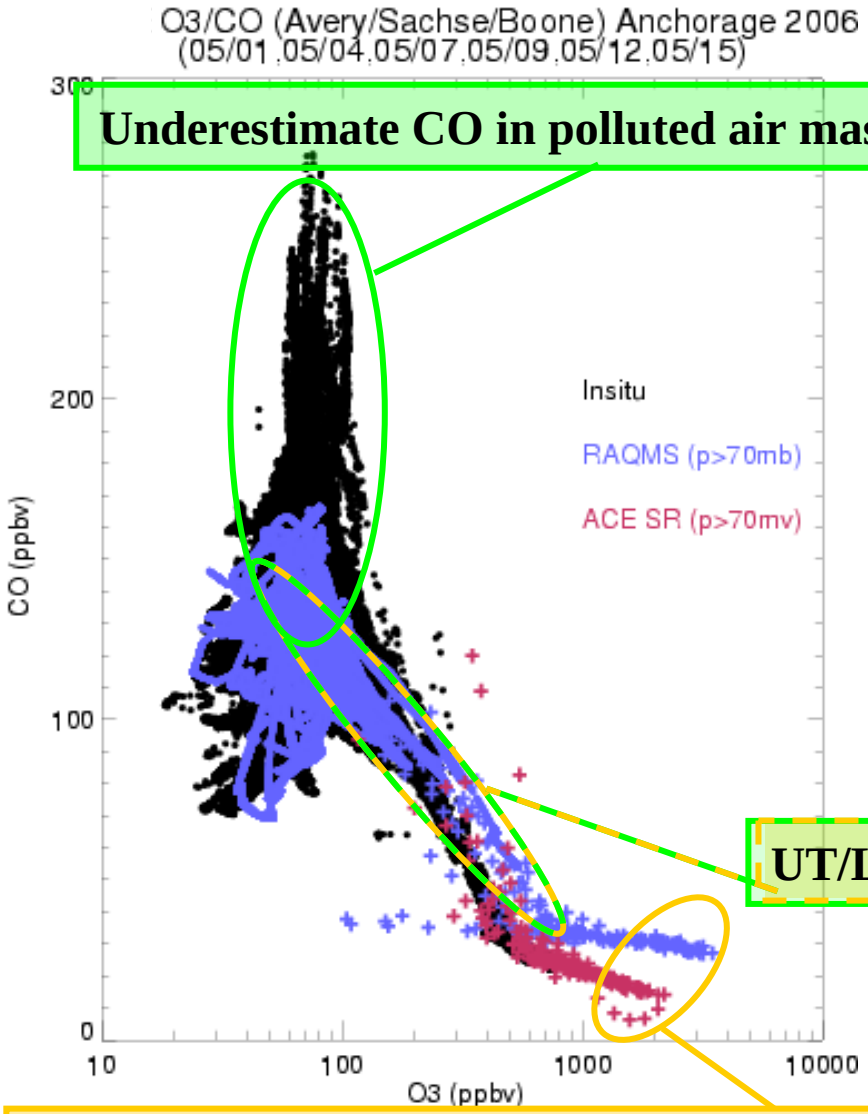




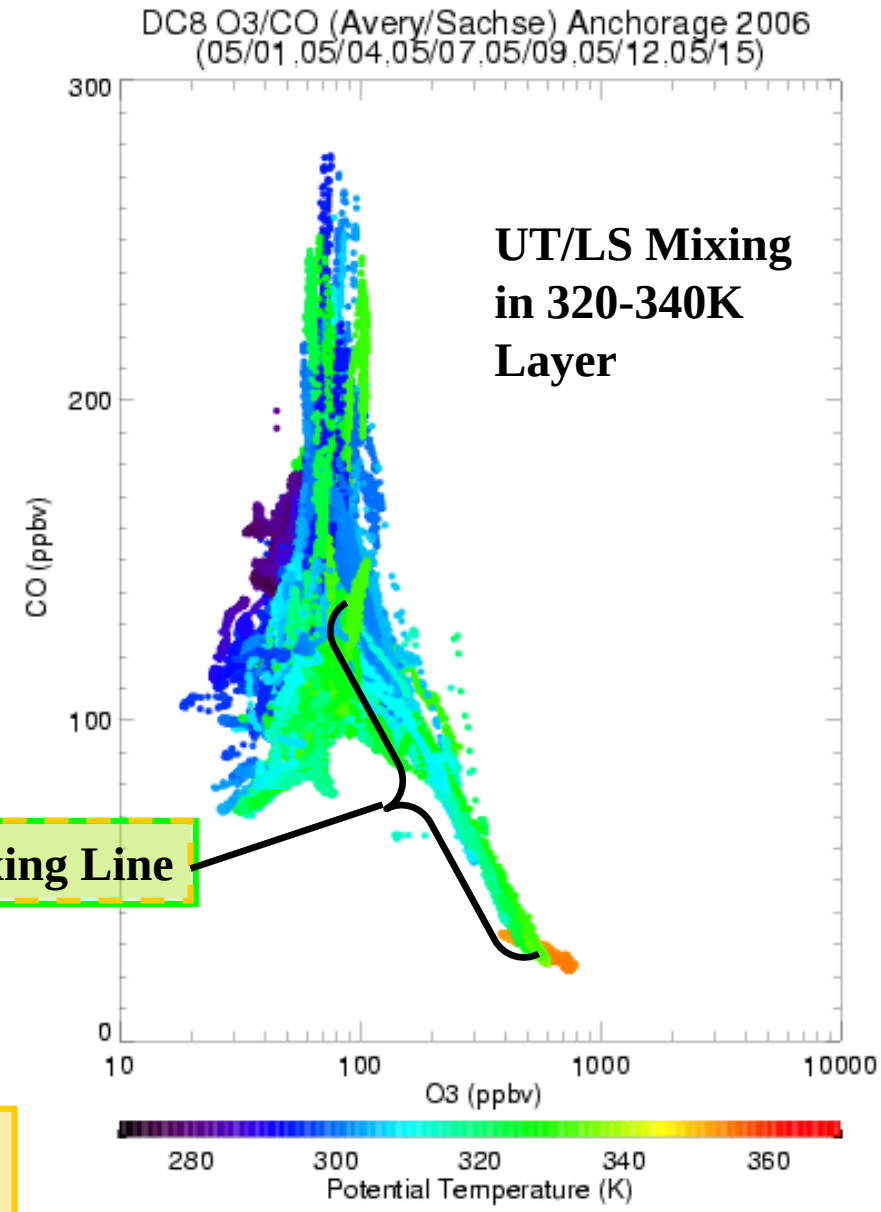
- **RAQMS <u>underestimates</u> median insitu DC8 CO column by 9%**
  (*consistent with, but lower limit of MOPITT-RAQMS bias*)

- **RAQMS <u>overestimates</u> median insitu DC8 O3 column by 11%**
  (*consistent with, but factor of 2 less than OMI/RAQMS$_{strat}$-RAQMS bias*)

May 2006 Pacific RAQMS/DC8/ACE O3/CO Correlations



Underestimate CO in polluted air masses

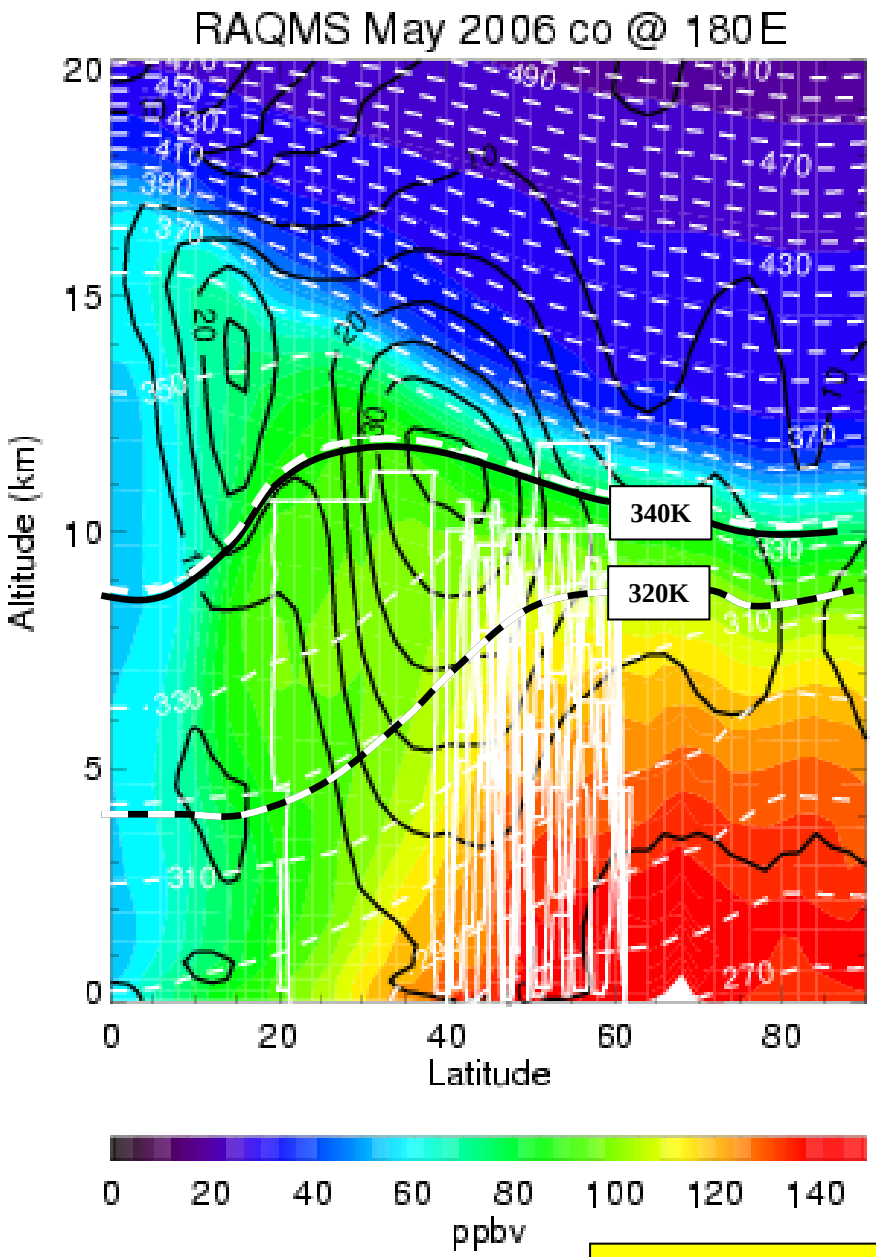


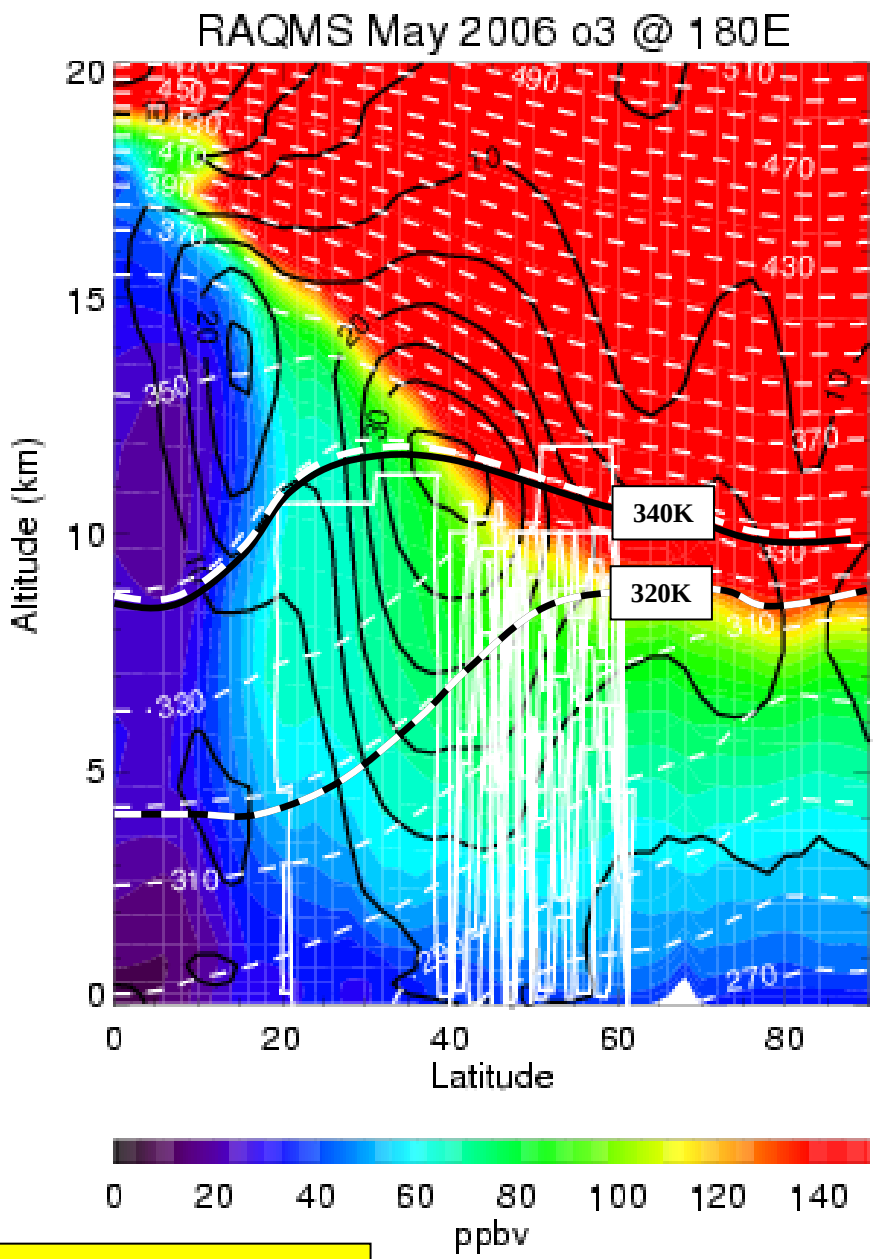
UT/LS Mixing in 320-340K Layer

UT/LS Mixing Line

Overestimate CO/O3 in Lower Stratosphere (*high bias in O3 may account for OMI/RAQMS$_{strat}$ – RAQMS TOC bias*)

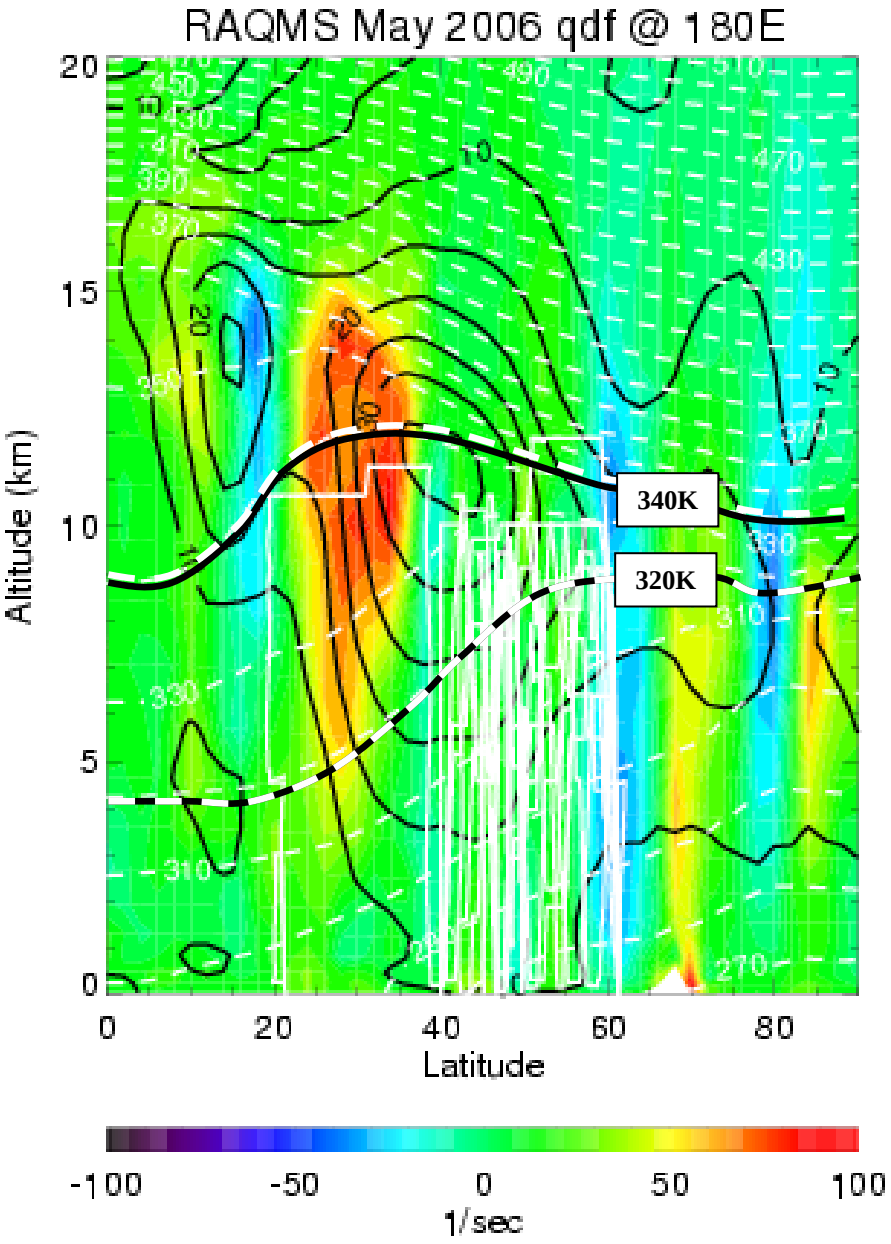
May 2006 Pacific X-Section (180E) CO and O3

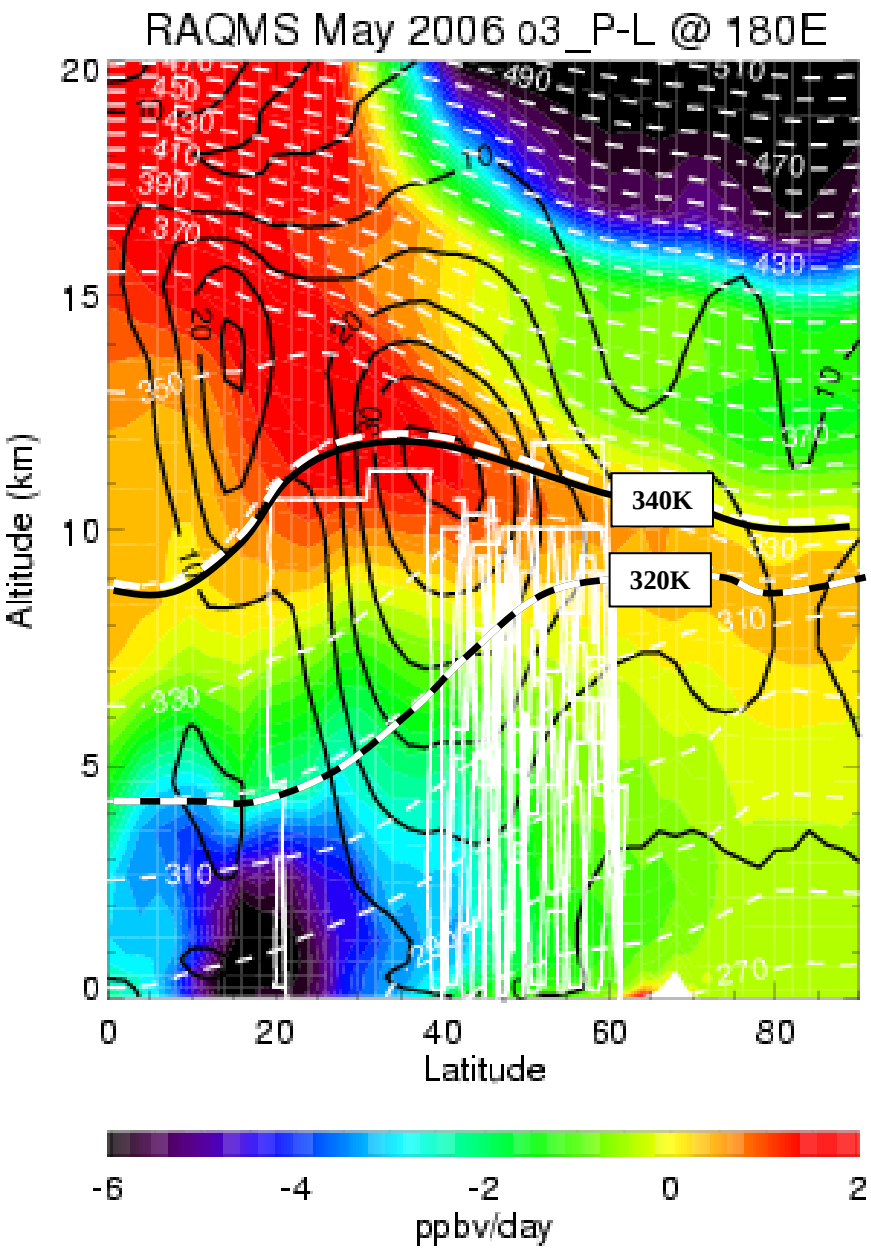




DC8 Flight Tracks shown in white

May 2006 Pacific X-Section (180E) Mixing Efficiency (qdf) and O3 P-L

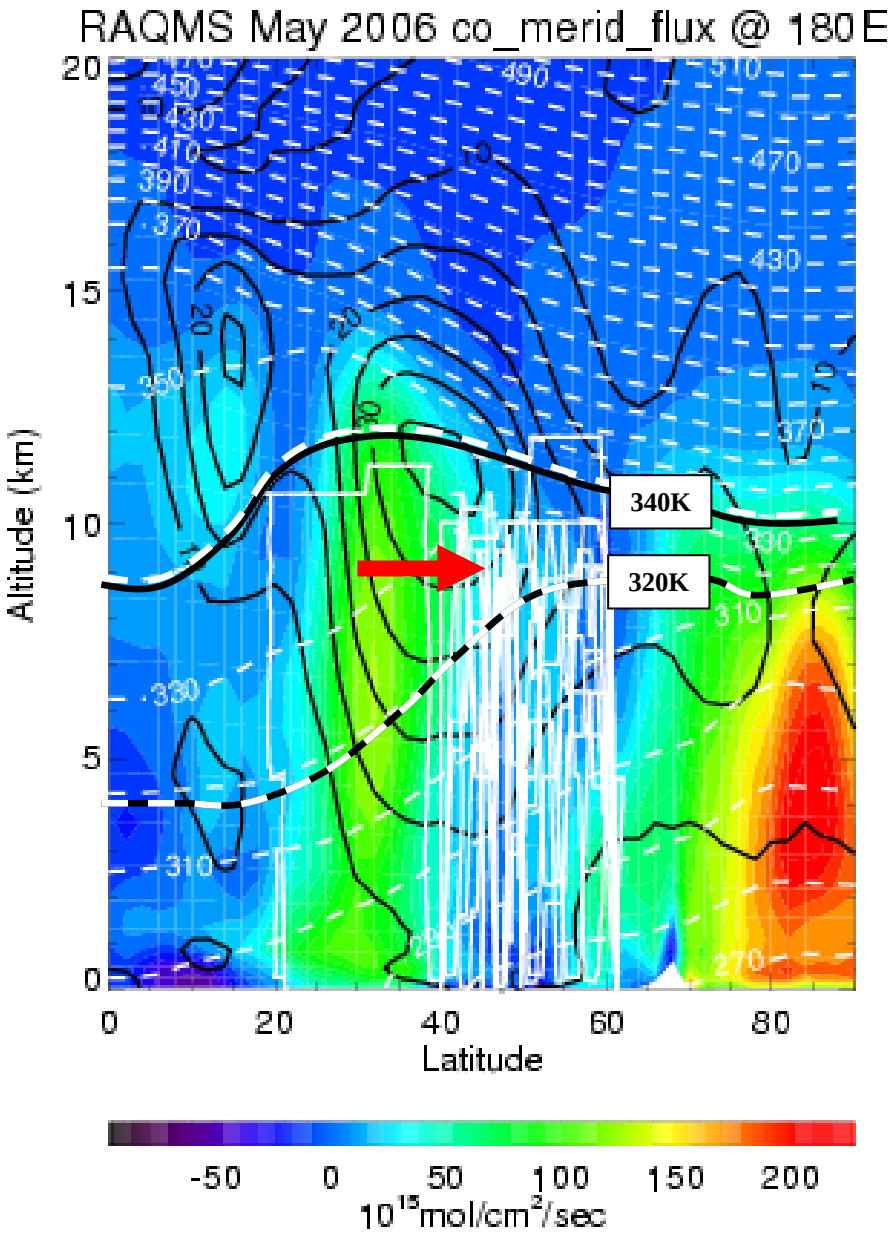


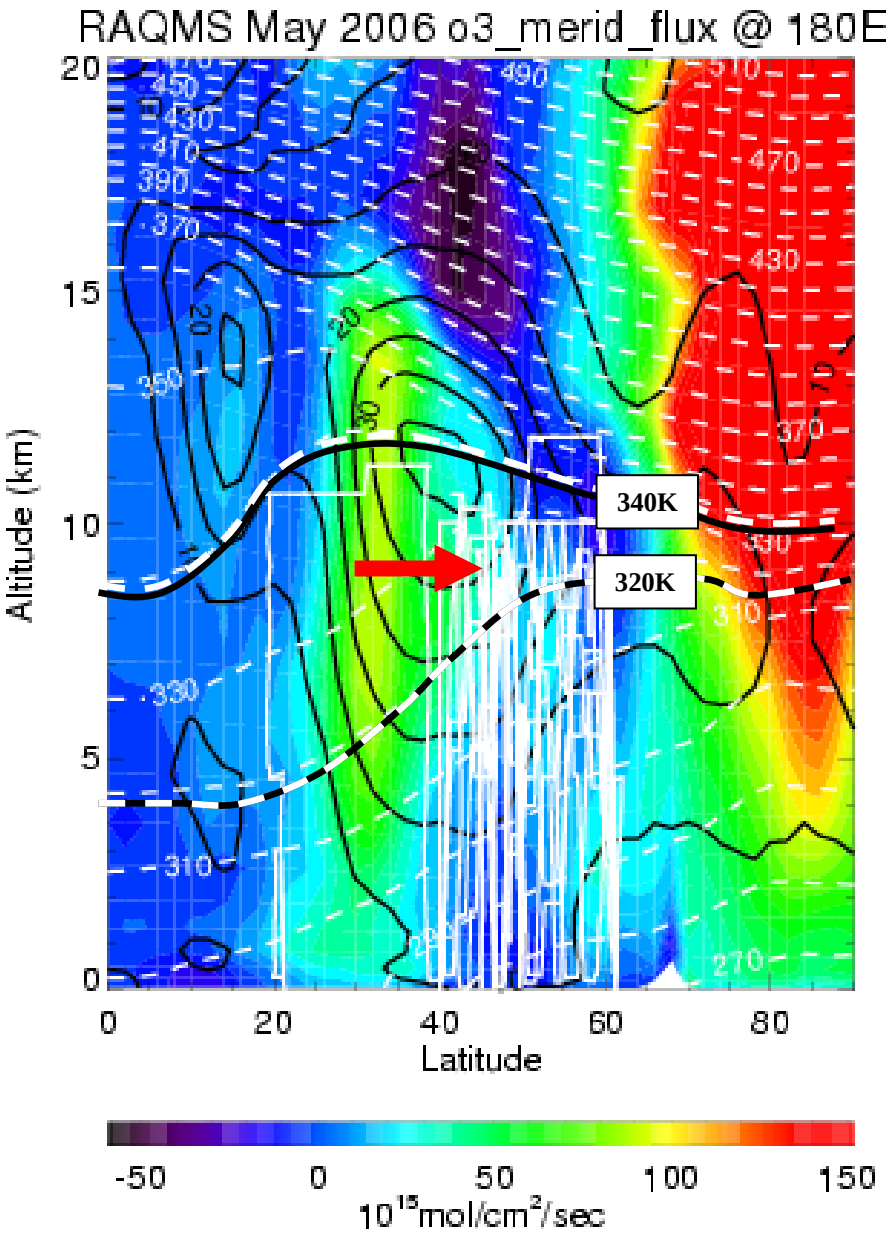


Enhanced Mixing South of Jet Core

Net O3 P-L along 340K isentrope

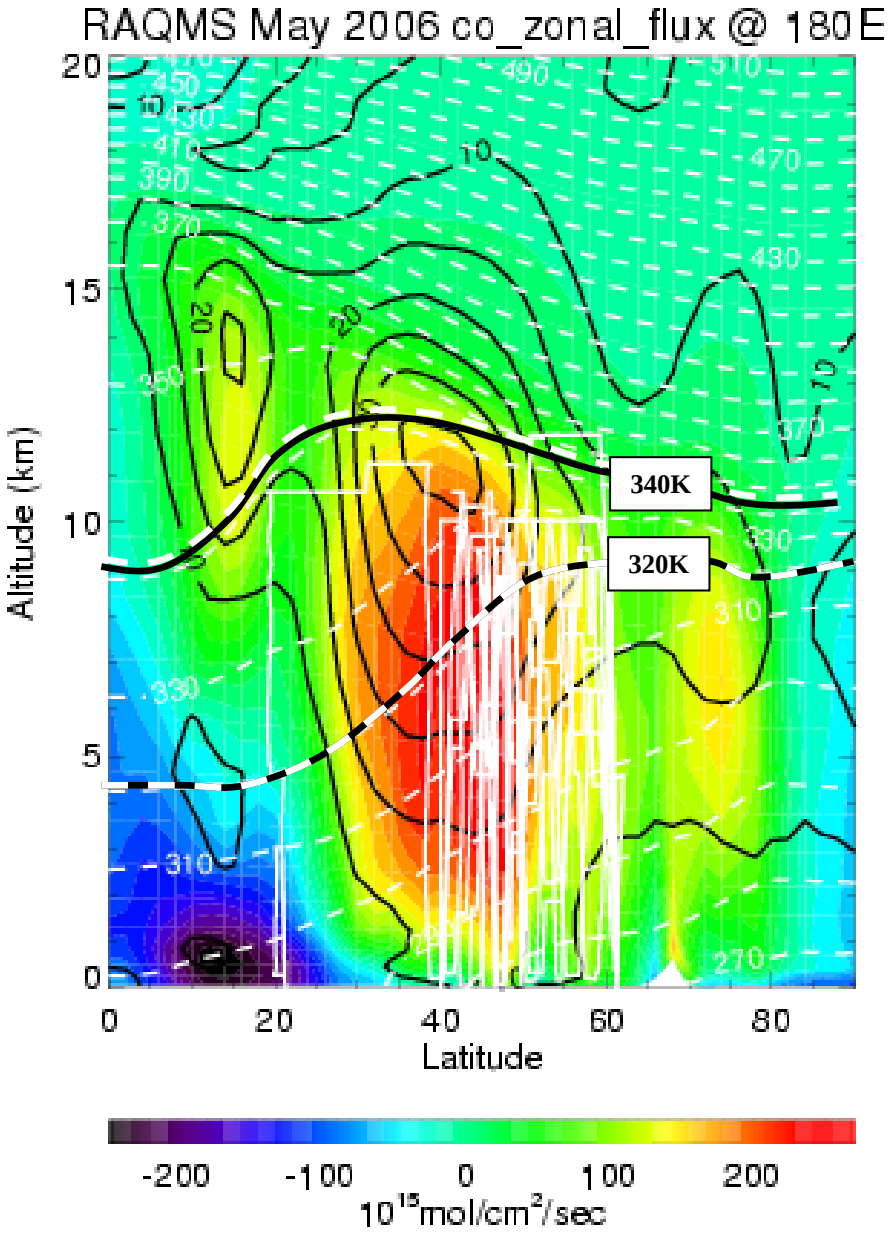
May 2006 Pacific X-Section (180E) Meridonal CO & O3 Flux

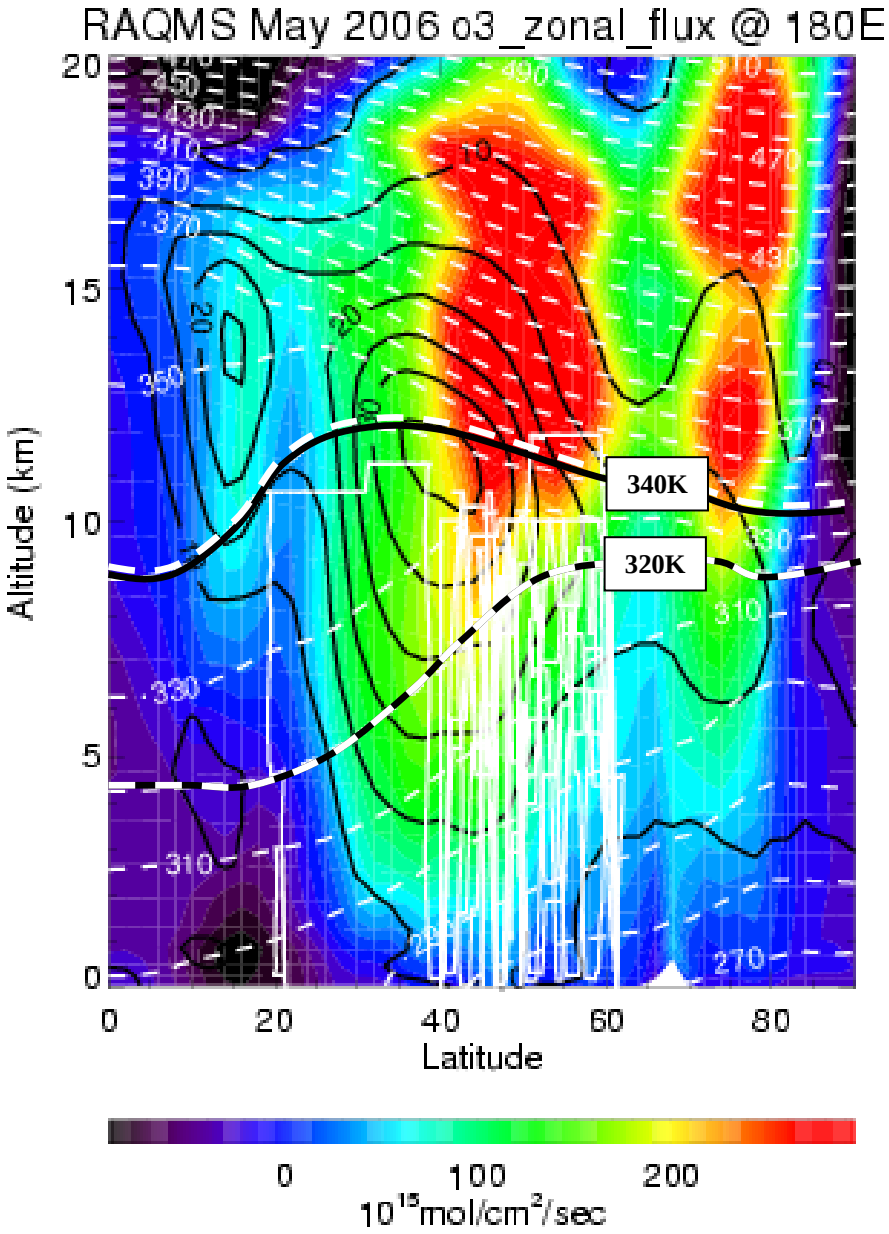




Northward CO/O3 Flux transports "mixed" airmasses towards DC8 sampling region

May 2006 Pacific X-Section (180E) Zonal CO & O3 Flux

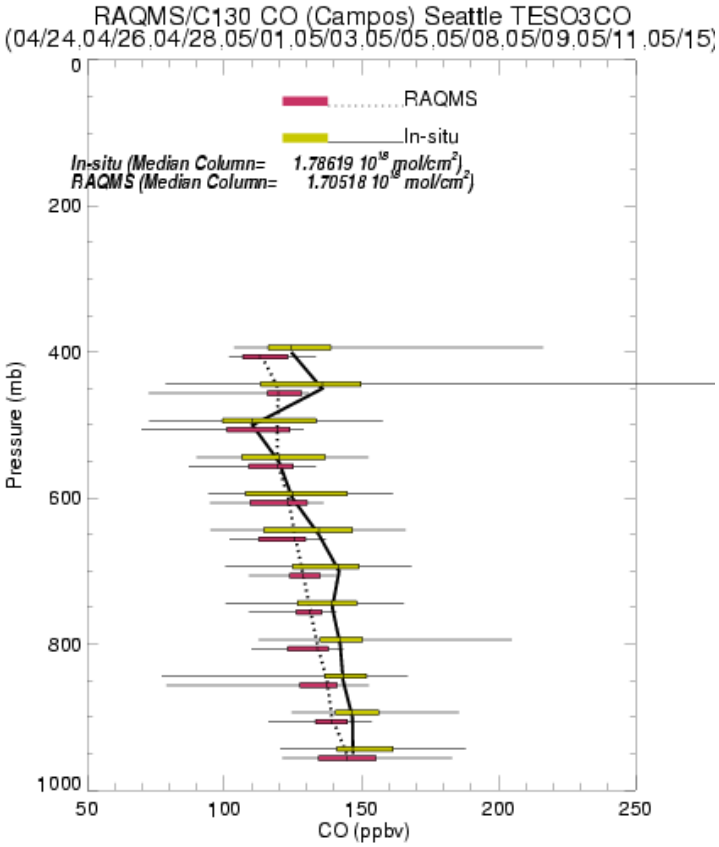


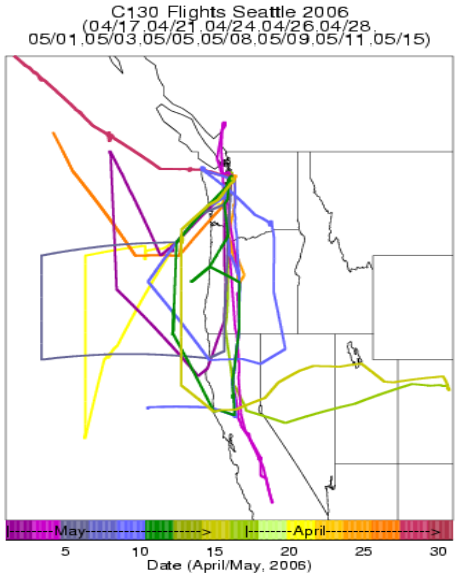


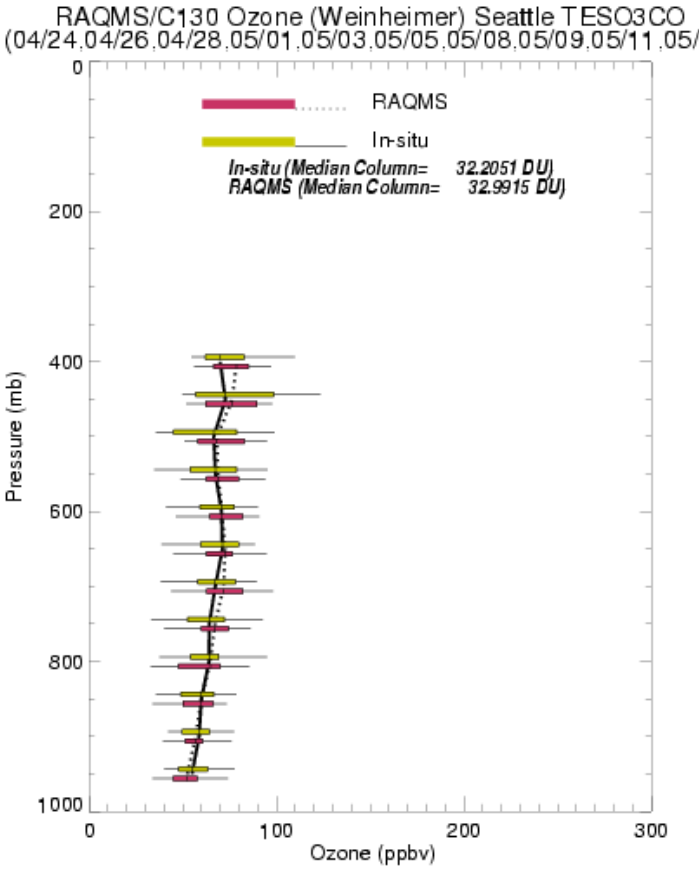
Maximum westward CO flux in Jet core

Maximum westward O3 flux North of Jet

RAQMS vs NSF C130 O3/CO: April-May 2006 Seattle Flights



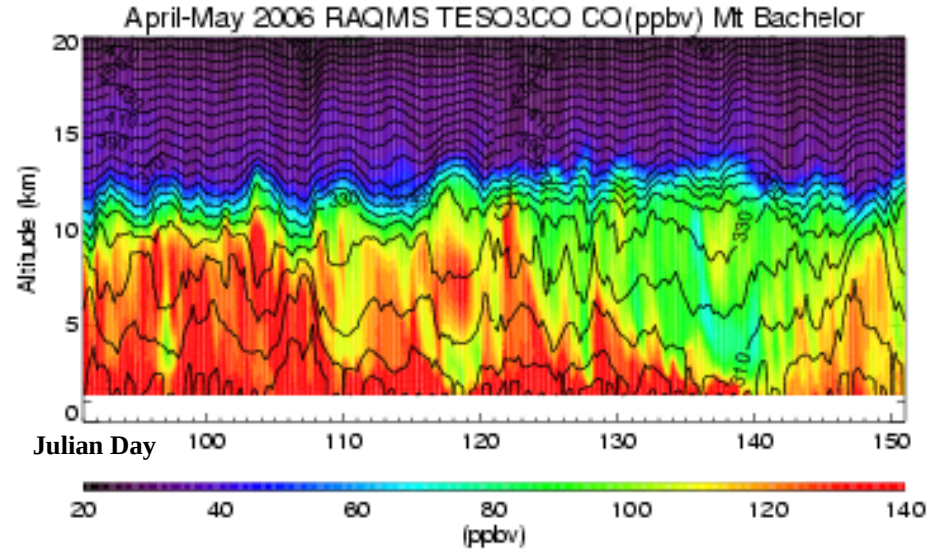


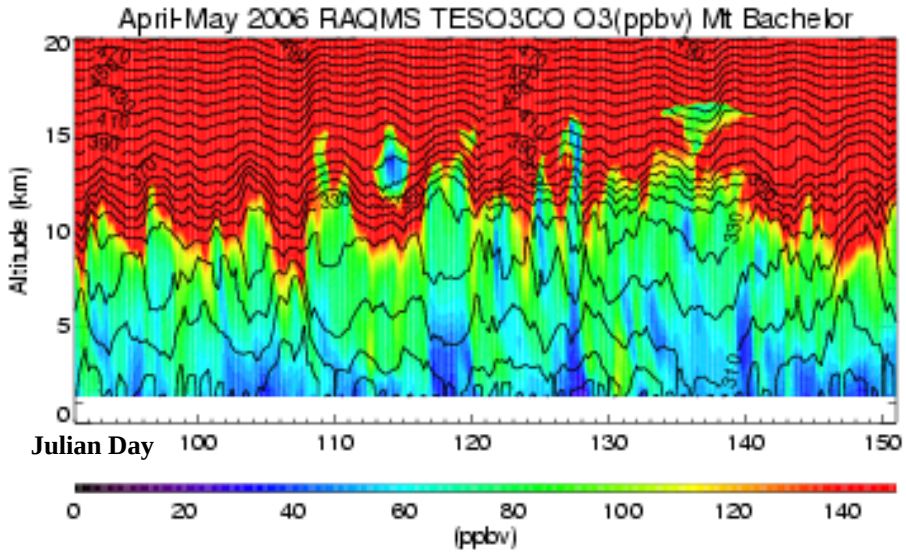


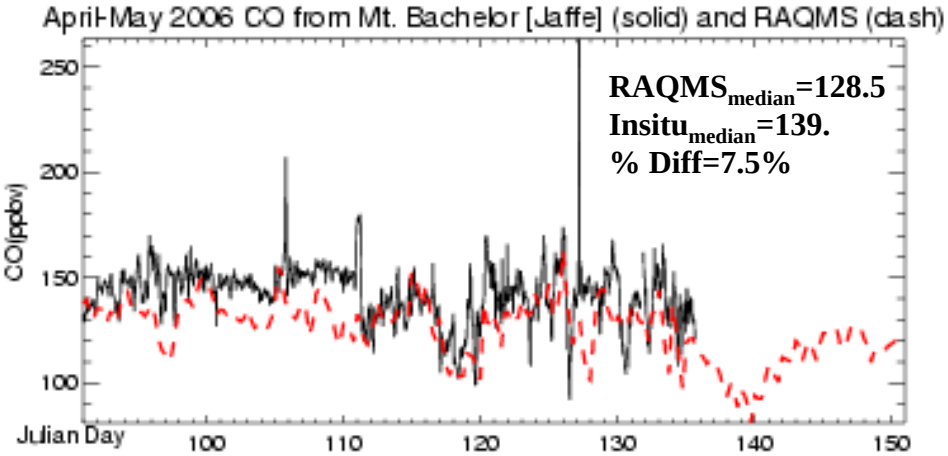
- **RAQMS is <u>within 5%</u> of median C130 CO column (significantly less than MOPITT-RAQMS bias)**

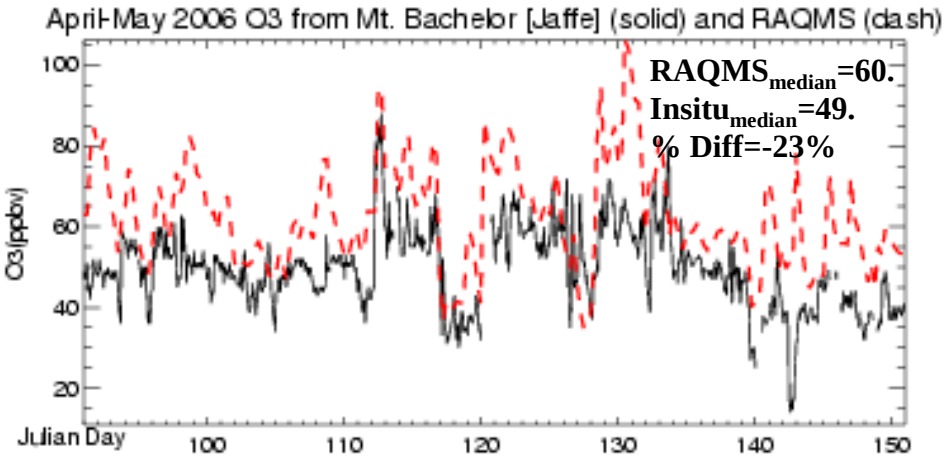
- **RAQMS is <u>within 2%</u> of median C130 O3 column (significantly less than OMI/RAQMS$_{strat}$-RAQMS bias)**

RAQMS vs Mt Bachelor CO/O3: April-May 2006









- **Largest free tropospheric CO enhancements occur in early April**
- **Moderate free tropospheric CO enhancements occur in late April-early May**
- **Surface ozone overestimated by ~23%**

Conclusions:

•Combining DC8 and ACE O3/CO observations shows clear evidence of mixing between the polluted and stratospheric air masses.

•RAQMS captures the main features of this mixing process but tends to underestimate CO within highly polluted air masses and overestimate CO in the lower stratosphere.

•RAQMS flux calculations show that:

CO fluxes (pollution) occur in conjunction with large O3 fluxes (stratospheric) in the upper troposphere (320-340K) over the N. Pacific during May 2006.

Large-scale shear deformation on the southern flank of the Pacific Jet leads to efficient mixing of polluted and stratospheric air masses.

Westward transport across the N. Pacific leads to enhanced CO along the west coast of the US.

•Results are consistent with insitu observations from the C130 and Mt Bachelor.