VOC-HO_x-NO_x-O_3 chemistry & tracer relationships over California

H. B. Singh & ARCTAS Science Team

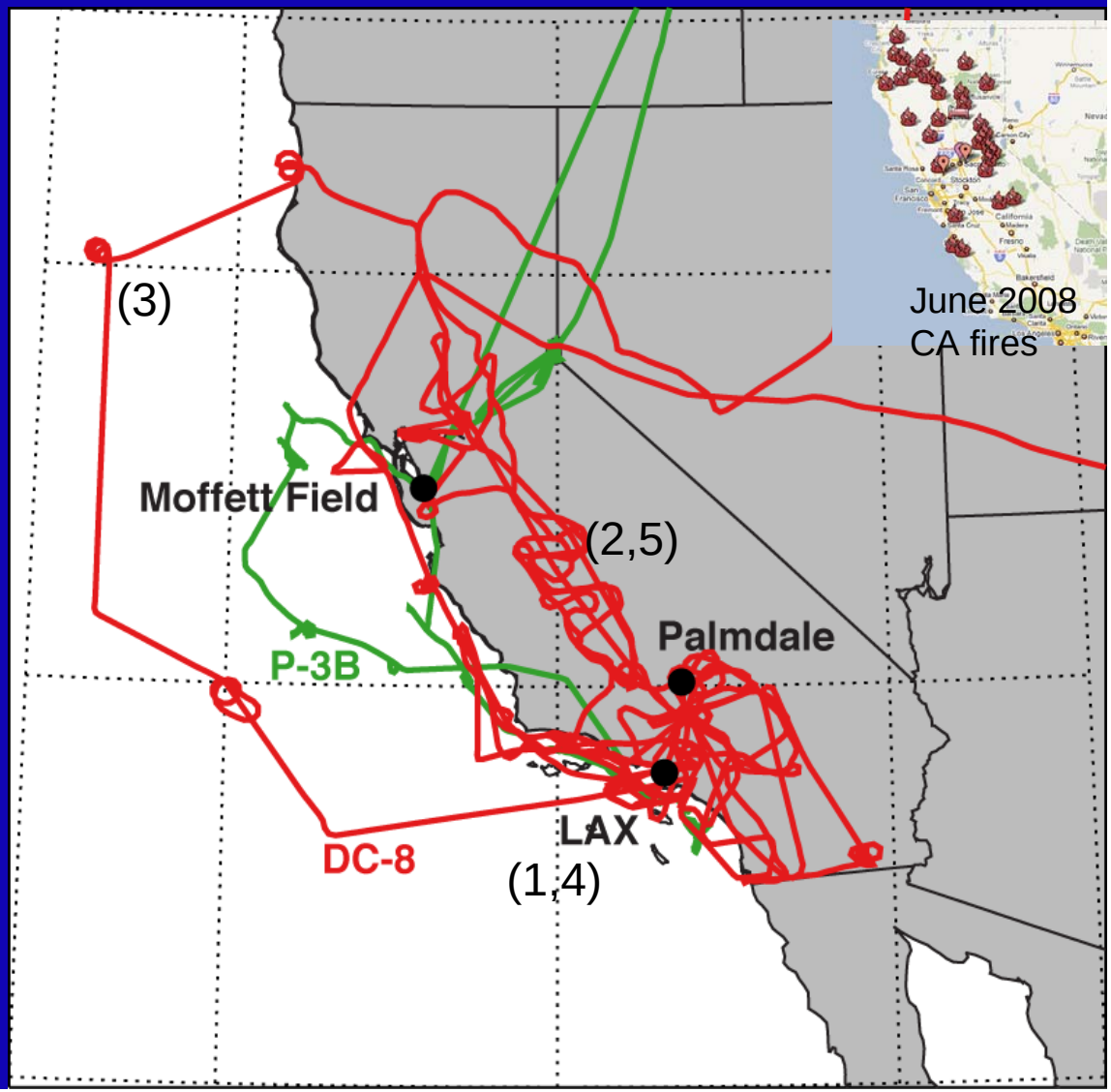
1. ***LA Basin and Offshore Ship Emissions (June 18)***

2. ***California Central Valley Emissions (June 20)***

3. ***California Upwind Boundary Conditions (June 22)***

4. ***LA Basin Diurnal Evolution and Offshore Ship Emissions (June 24)***

5. ***California Central Valley with/without fires (June 26/Jul 14)***

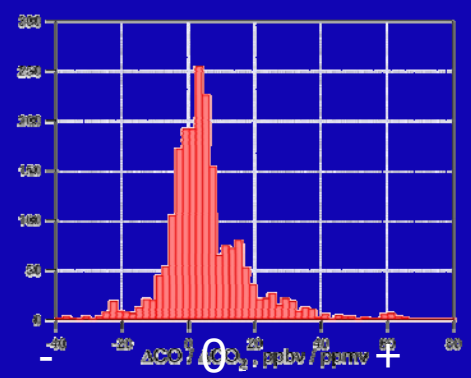


Indicators of pollution type & its sources

- CH_3CN, HCN, CH_3Cl (BB)
- CH_2Cl_2, C_2Cl_4, HCFCs, (AnThro)
- CO, $\Delta CO/\Delta CO_2$, $\Delta CH_4/\Delta CO$ (multiple),
- C_2H_2/CO, C_7H_8/C_6H_6, C_2H_6/C_3H_8, NO_x/NO_y (air mass age)
- Aerosol composition, hot-CN/CN, SO_4/NO_3
- Plus back trajectories & models

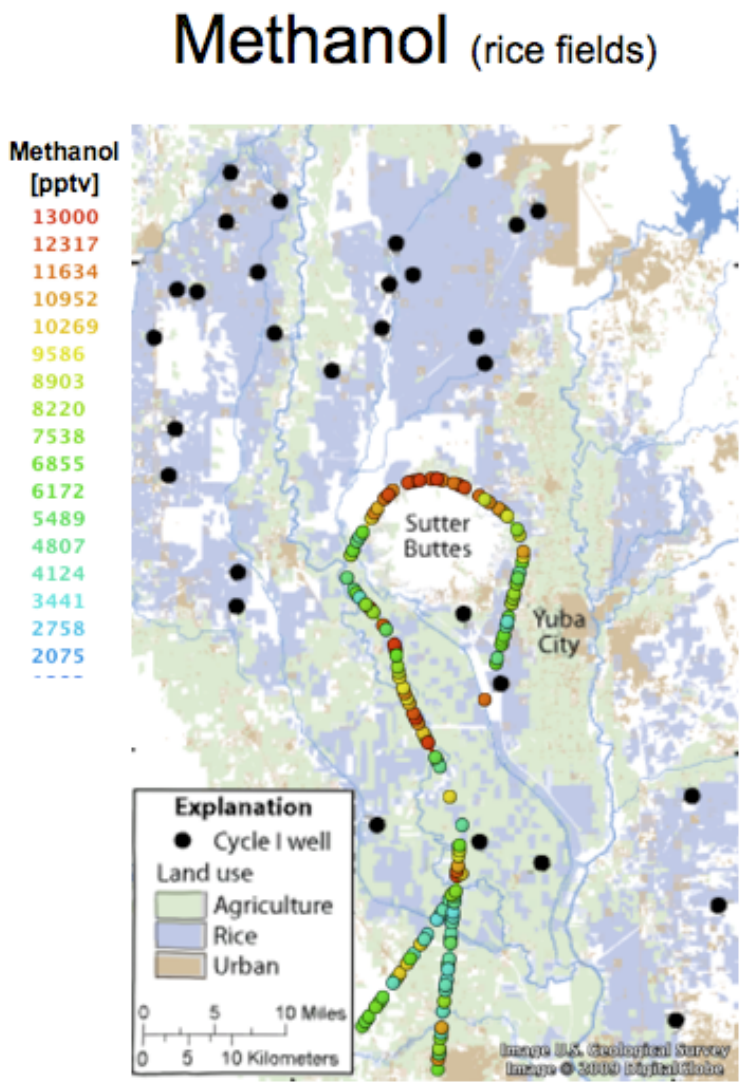
Example:

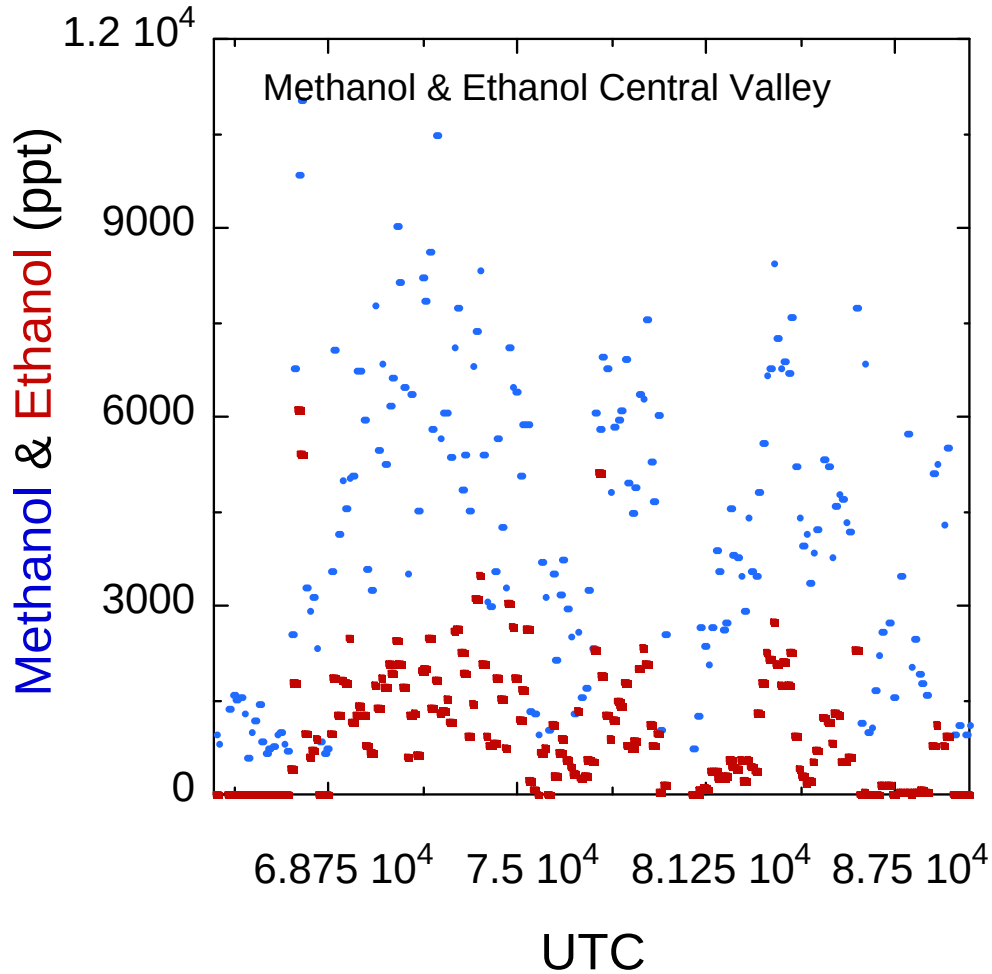
ΔCO / ΔCO_2 shows several modes
60 x 10^{-3} – biomass burning
5 x 10^{-3} – automotive
negative slope – drawdown ?



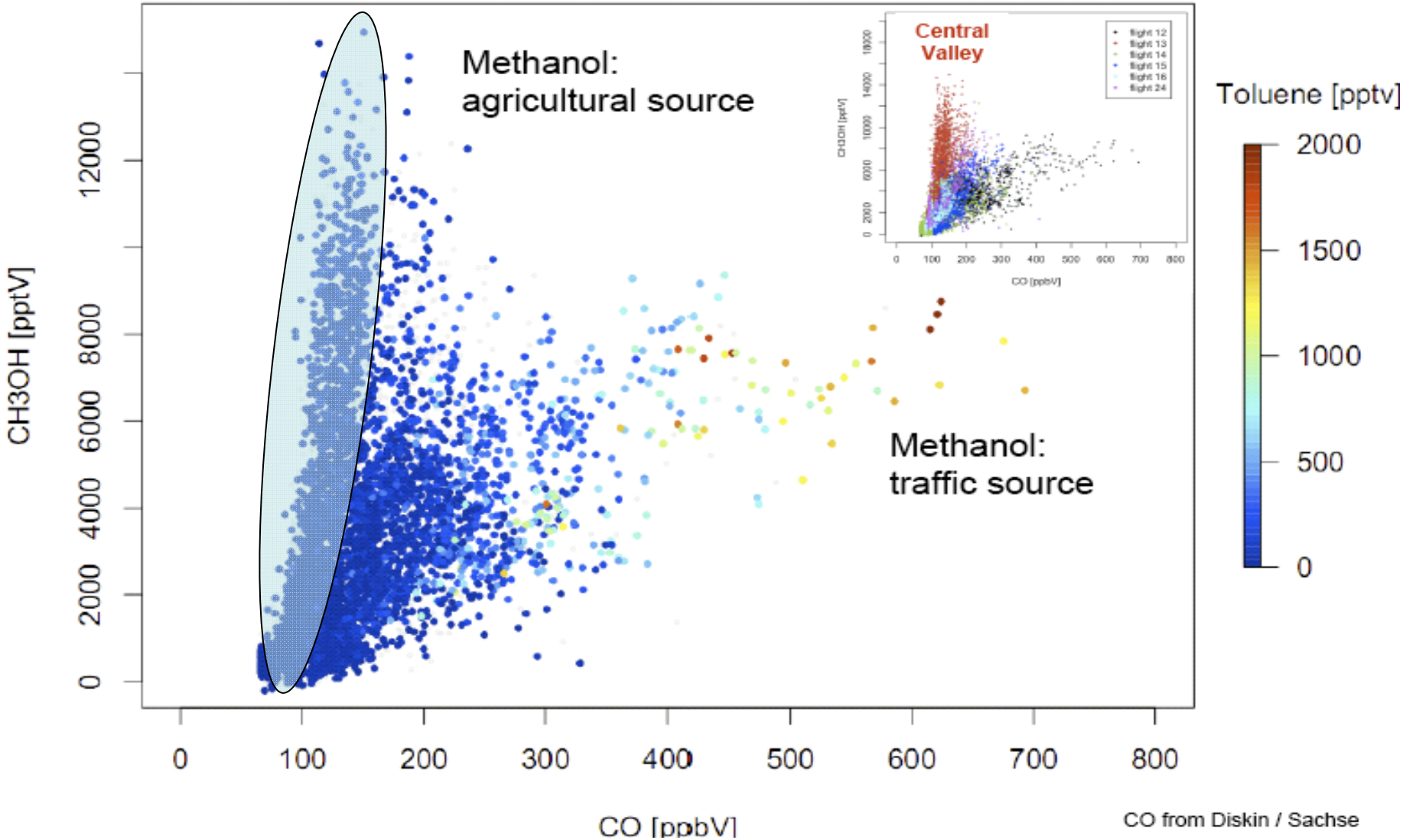
$\Delta CO/\Delta CO_2$

CH_4 and CH_3OH elevated over agricultural field

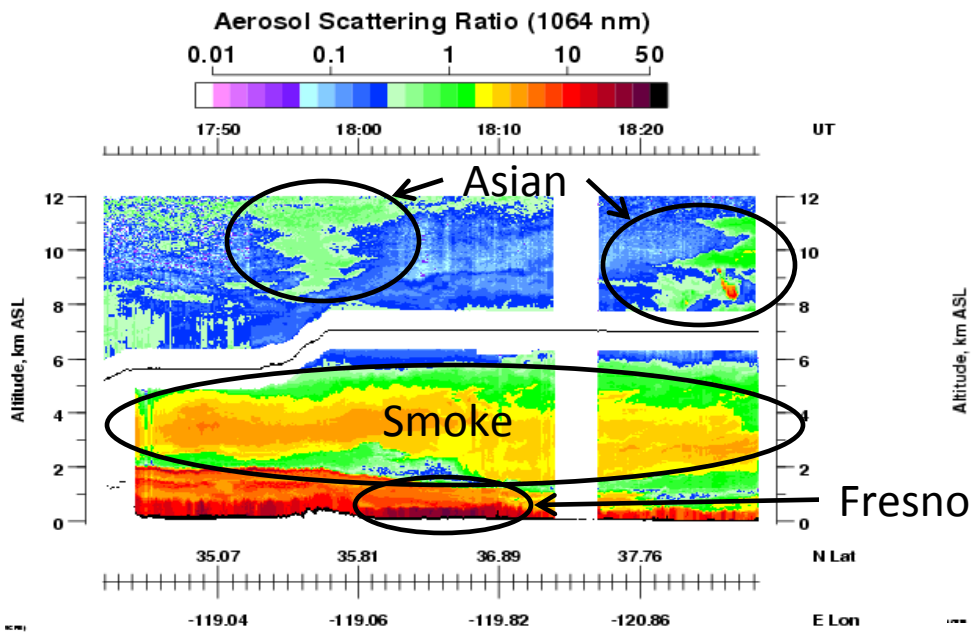


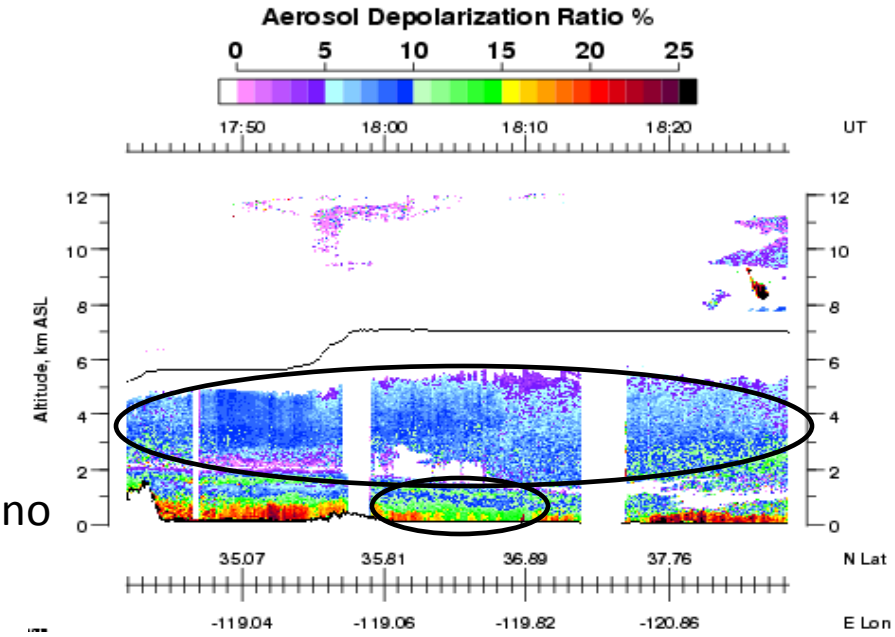


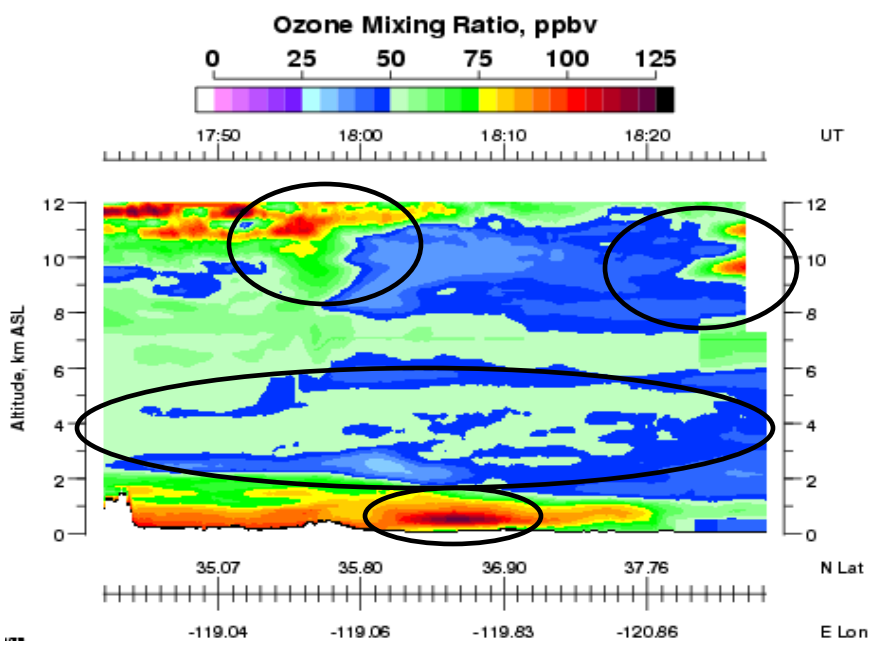
OVOC sources over CA: methanol



CARB # 2 Central Valley (northbound) 20 Jun 08

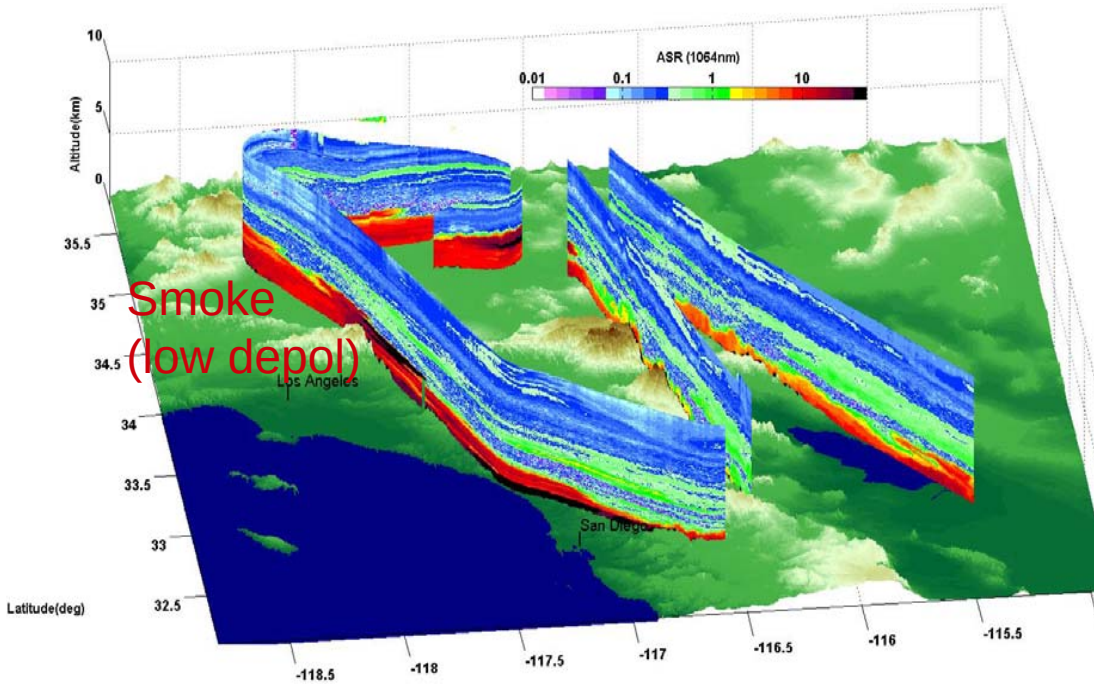




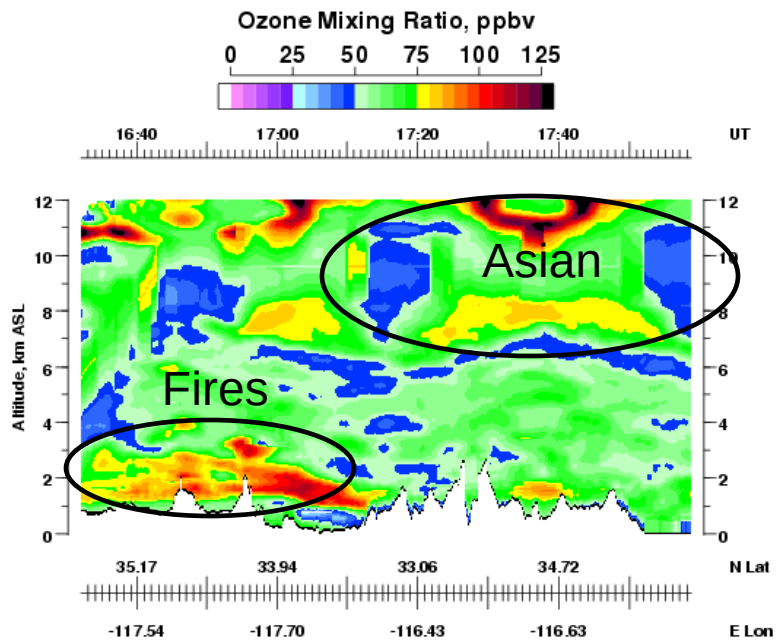


- Boundary layer heights <500m in Central Valley noted from aerosol scattering.
- Aged smoke plumes ~2-5km throughout valley.
- Increased aerosol loading and ozone near Fresno.
- Possibly Asian aerosols in UT with correlated enhanced ozone.

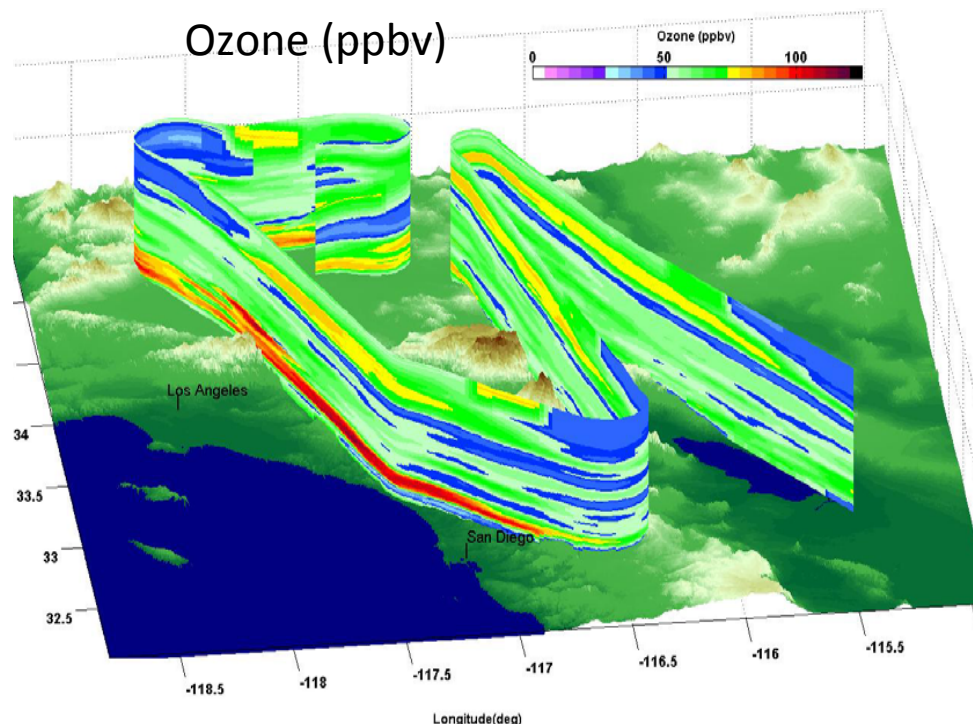
CARB # 4 - SoCal & Border
24 Jun 08



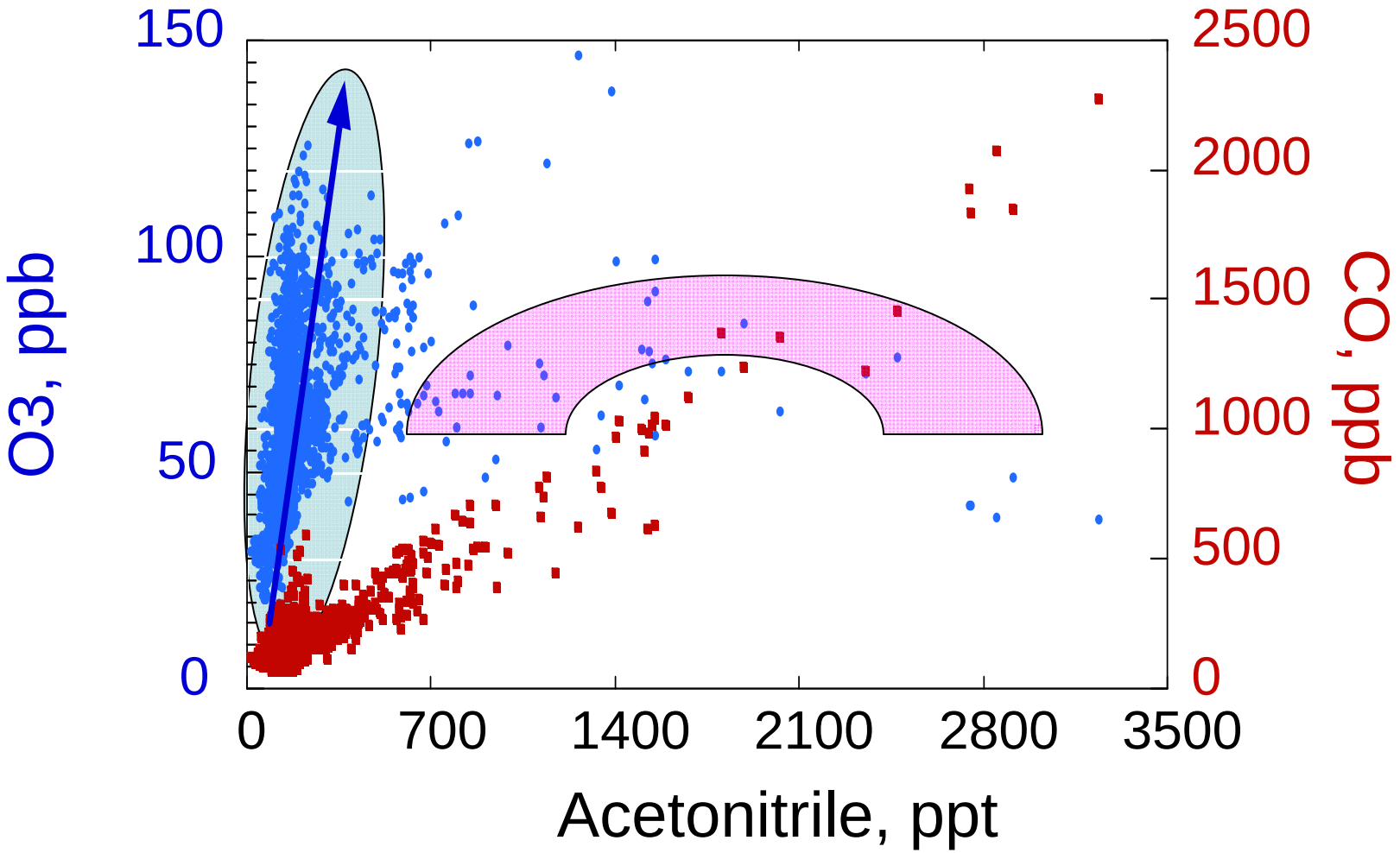
Aerosol Scattering



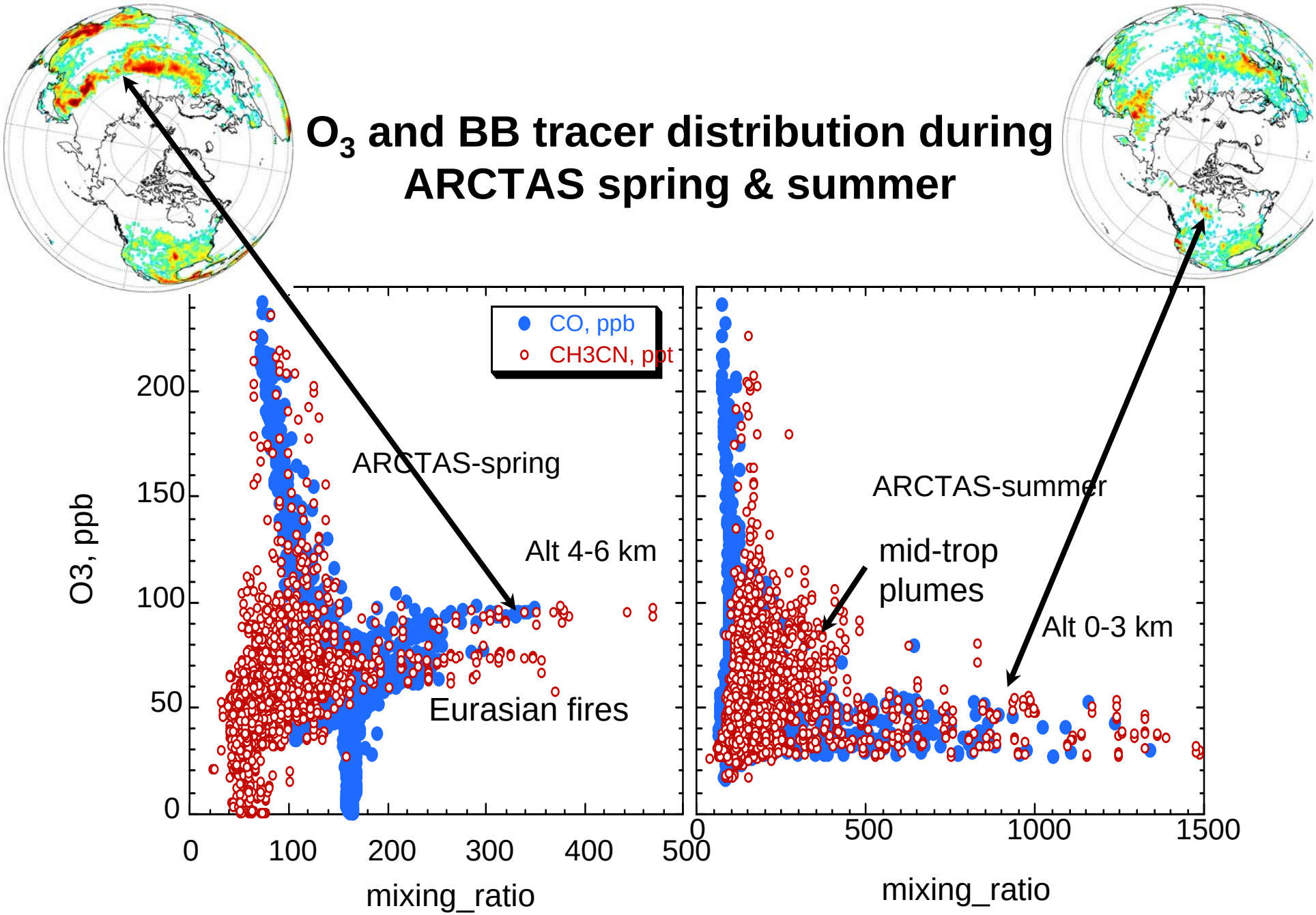
Ozone (ppbv)



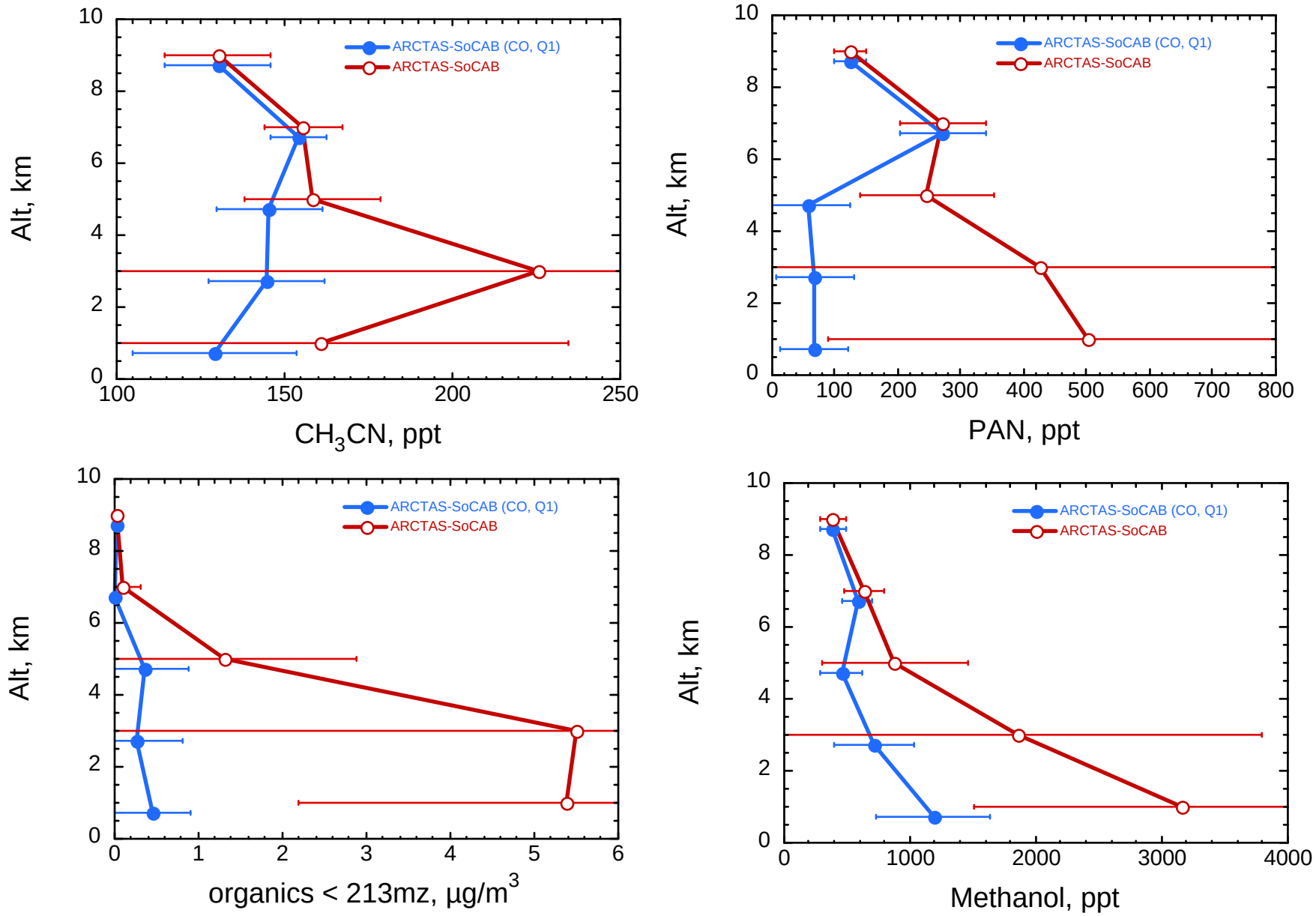
Ozone & tracer relationship over California



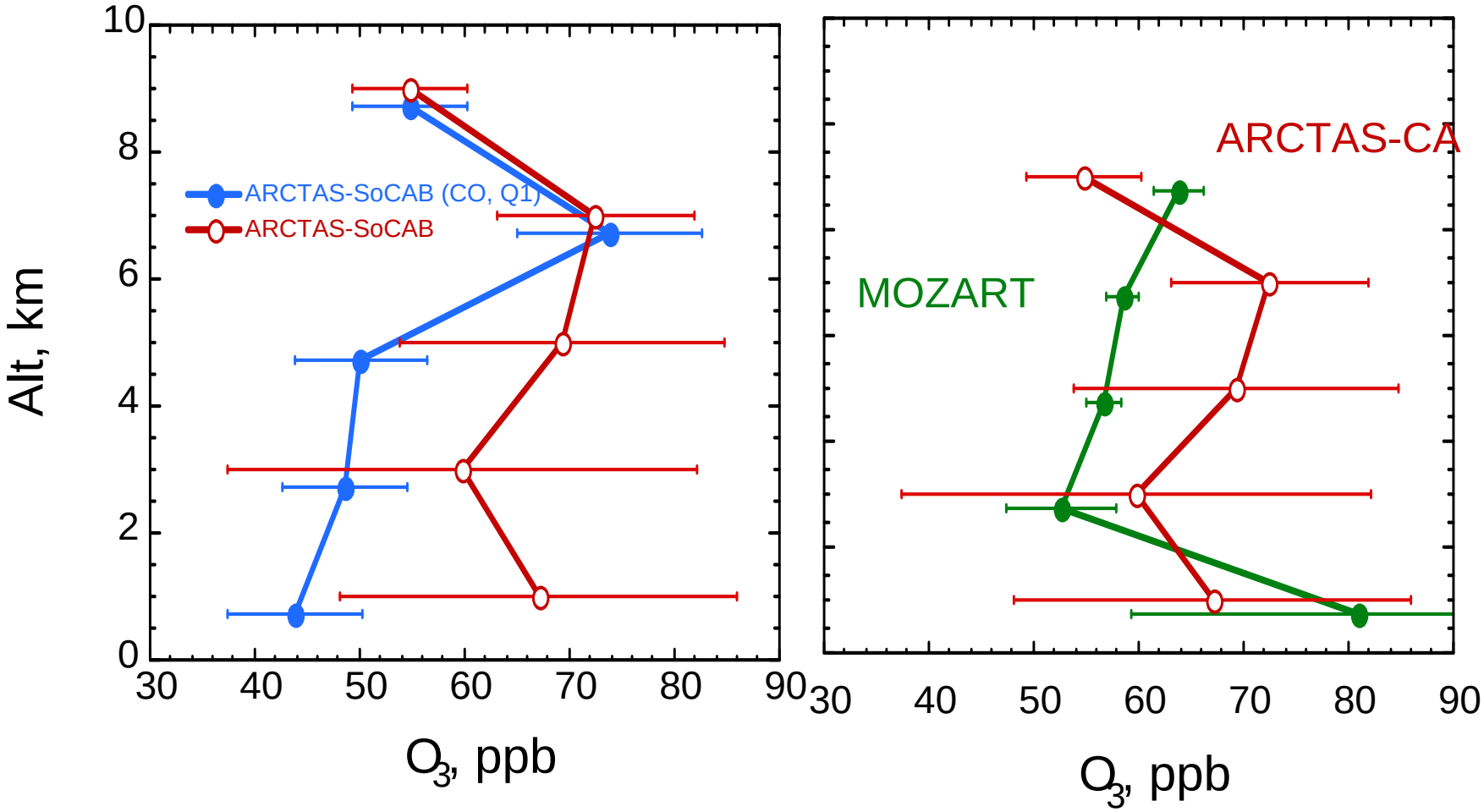
O_3 and BB tracer distribution during ARCTAS spring & summer



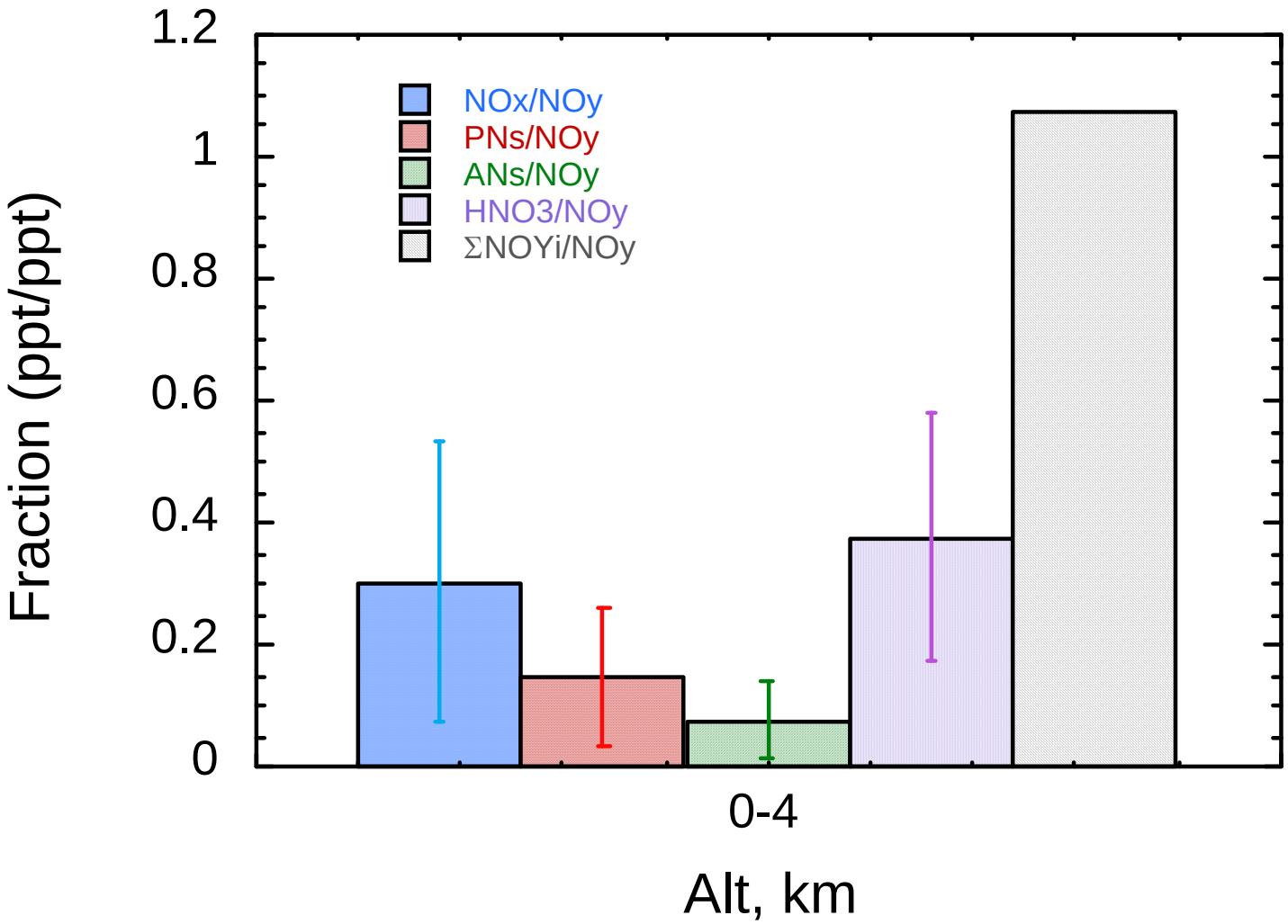
Pollution over the LA basin



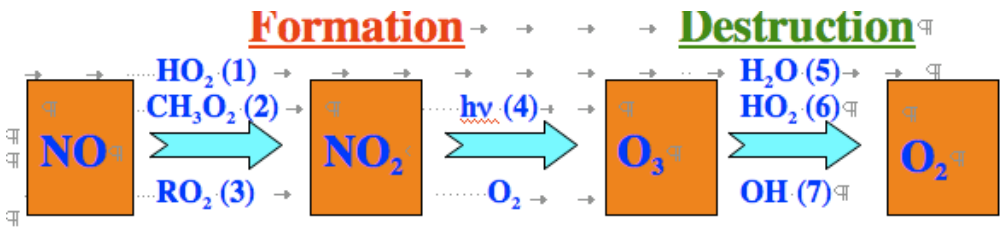
Observed & simulated O_3 over the Los Angeles Basin



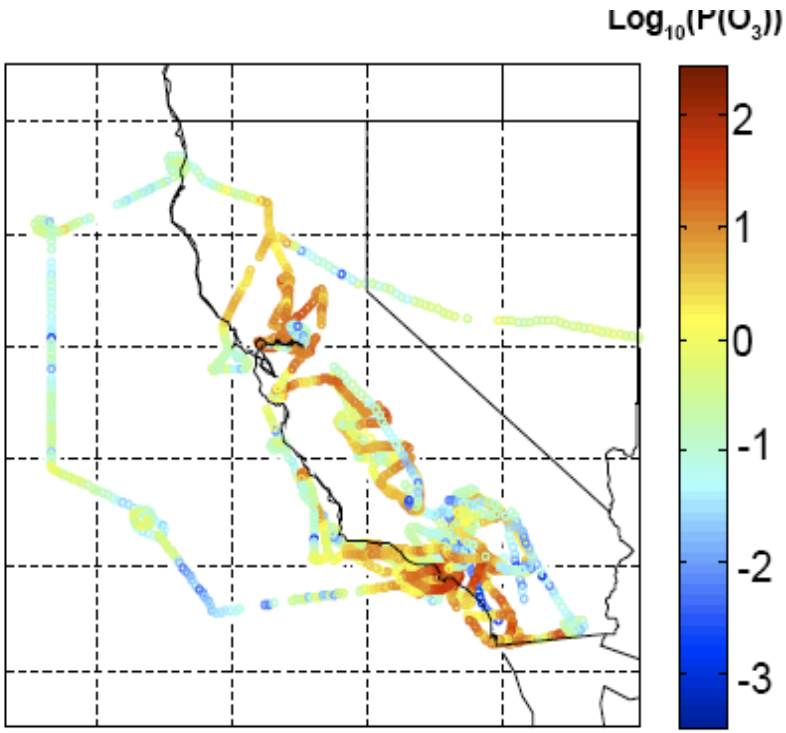
Reactive Nitrogen budget over SoCAB

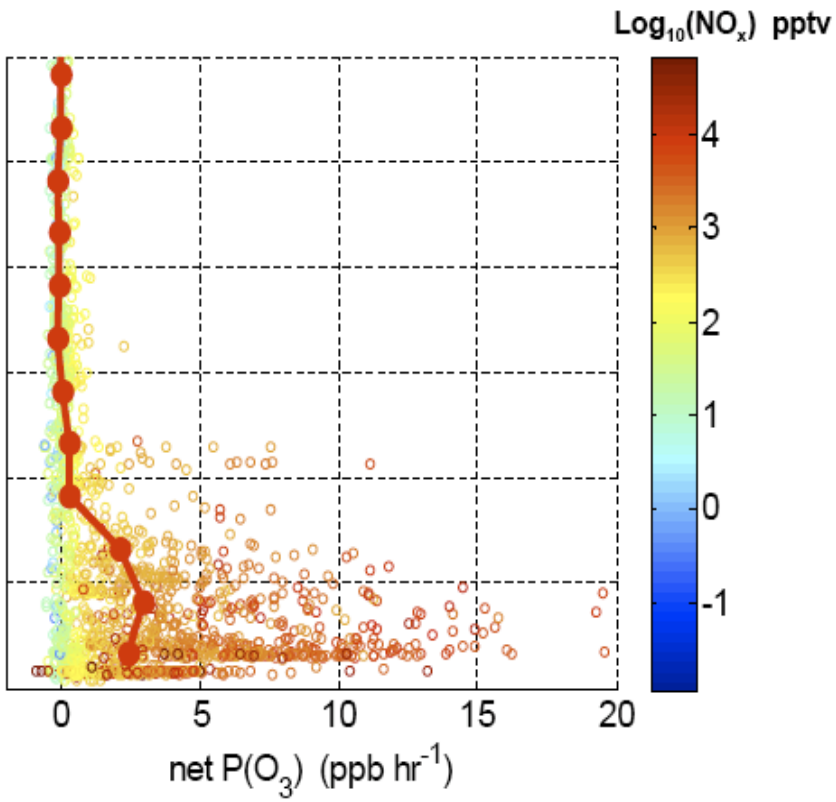


Ozone net production rates



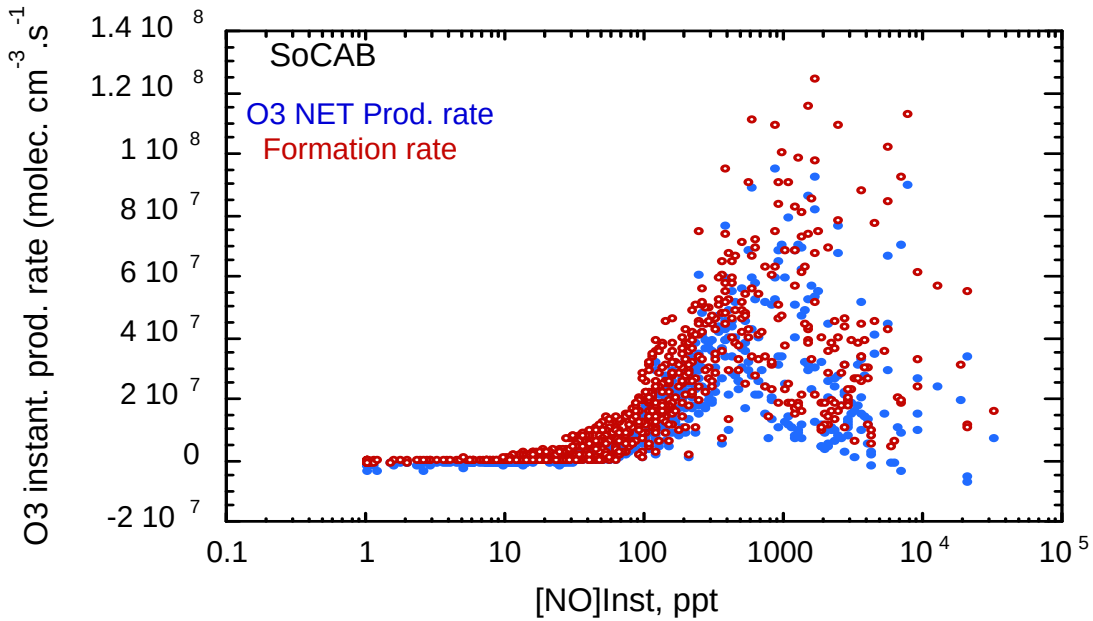
$$NET(O_3) = (k_1[HO_2] + k_2[CH_3O_2] + k_3[RO_2])[NO]$$
$$- (k_5[O(^1D)][H_2O] + k_6[HO_2][O_3] + k_7[OH][O_3])$$



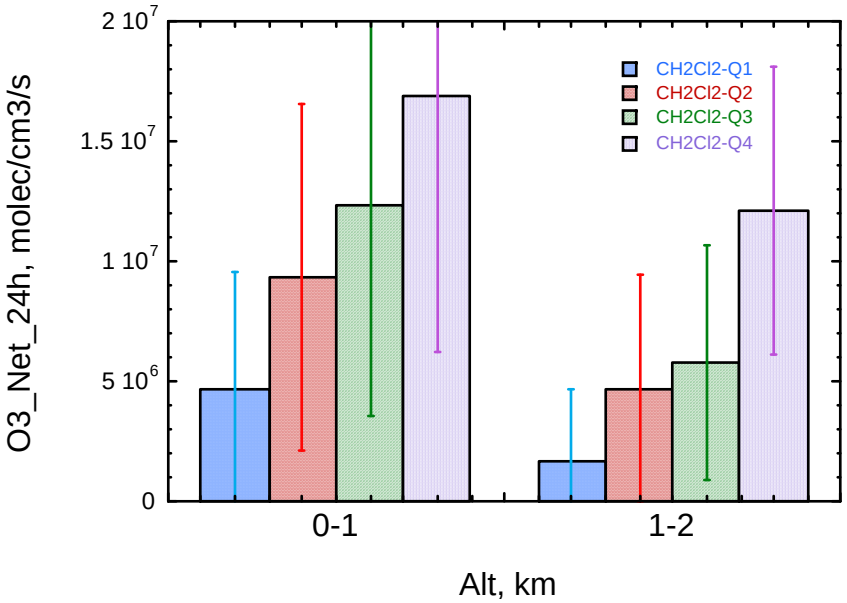


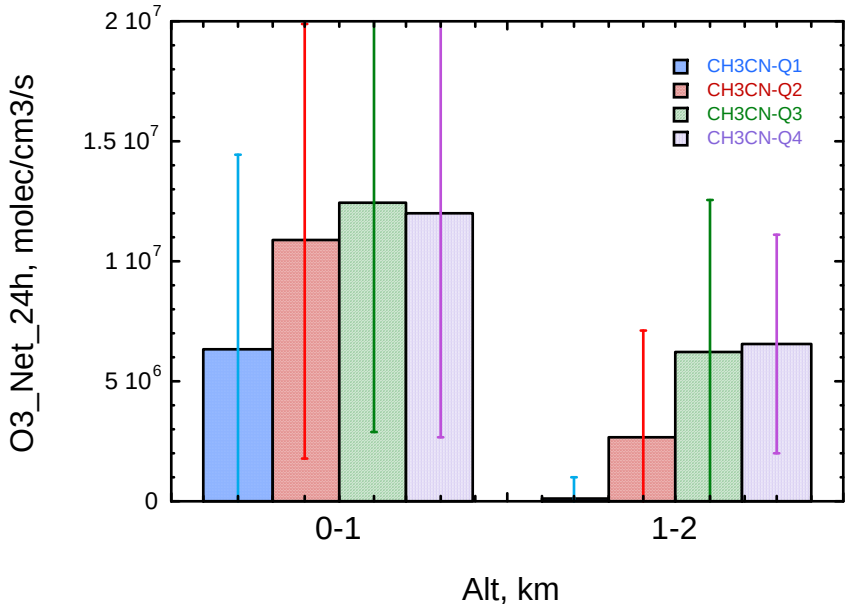
Ren et al.

Ozone production rates

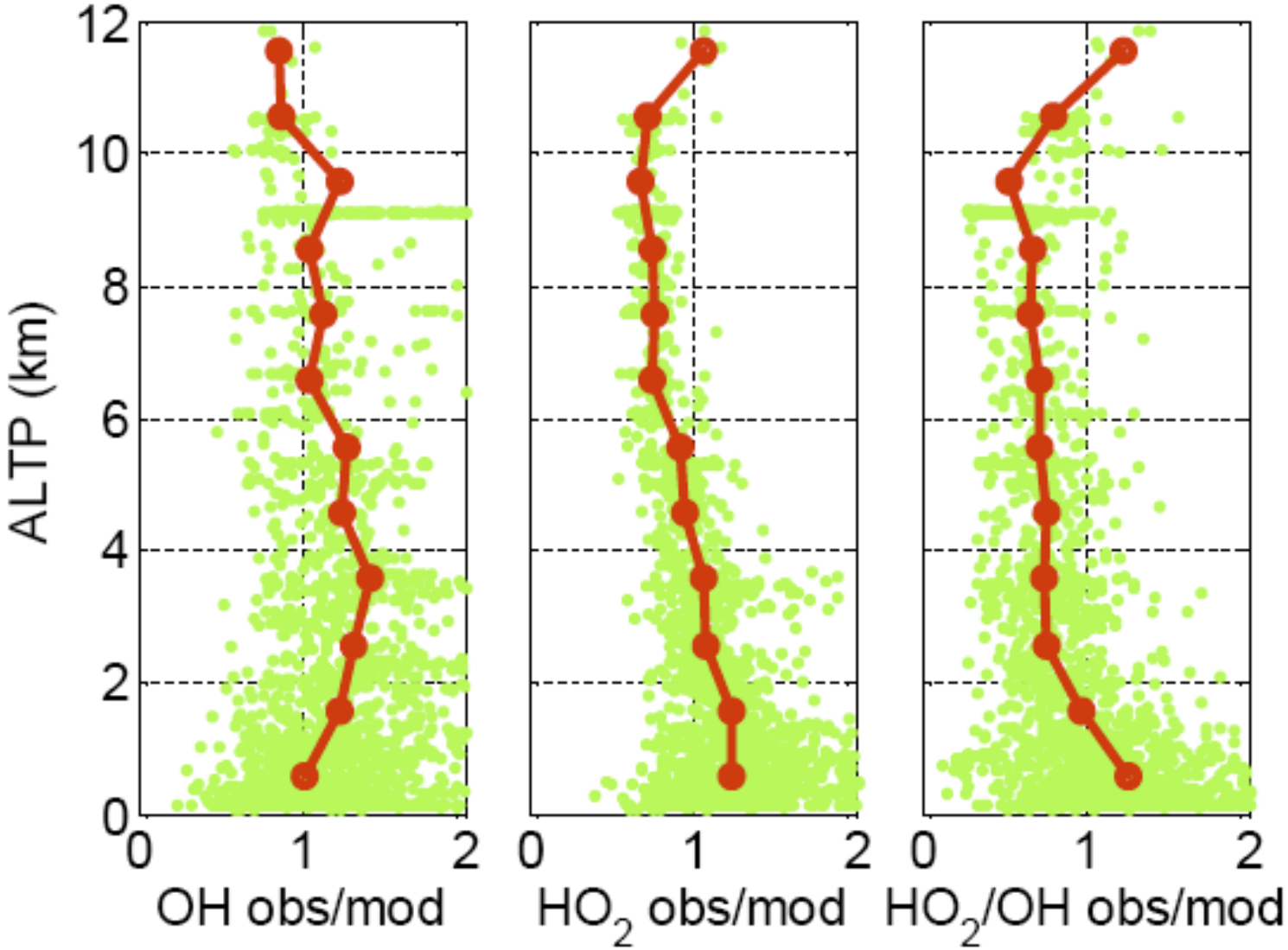


Langley box
Model (Olson et al.)



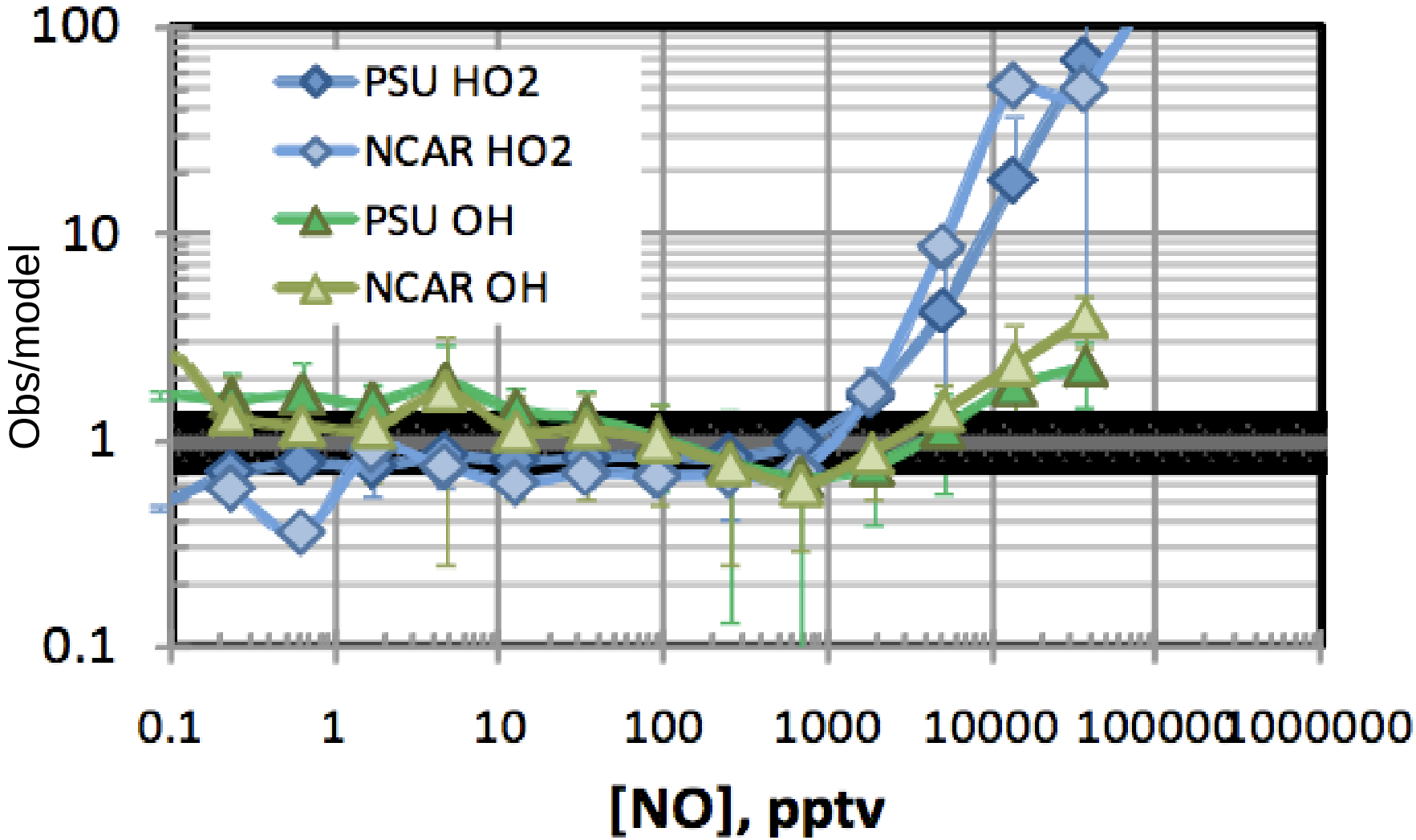


Box Model Comparison: Vertical Profile



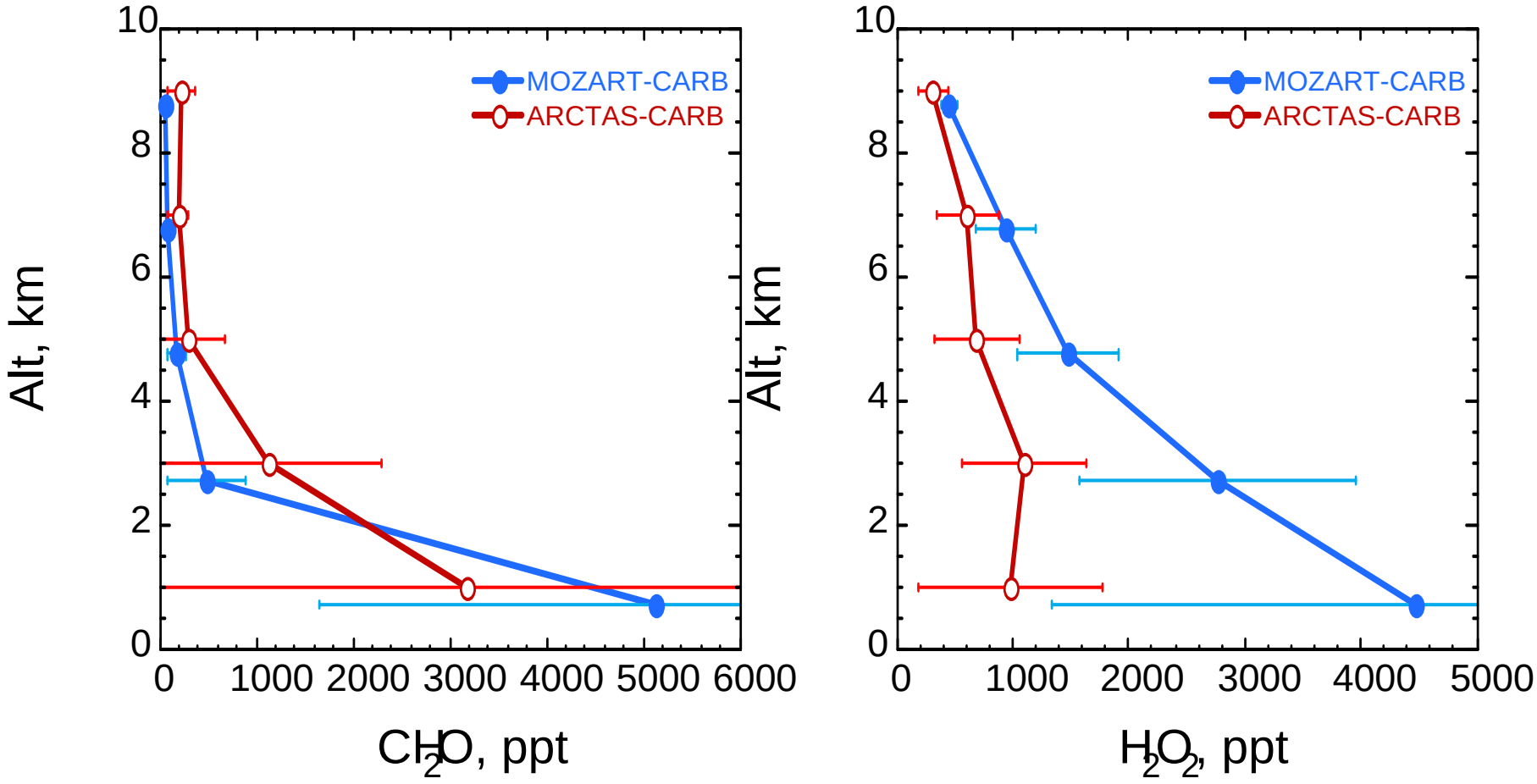
Ren et al., Penn State

HO_x measurements show unexplained behavior for high NO_x and isoprene

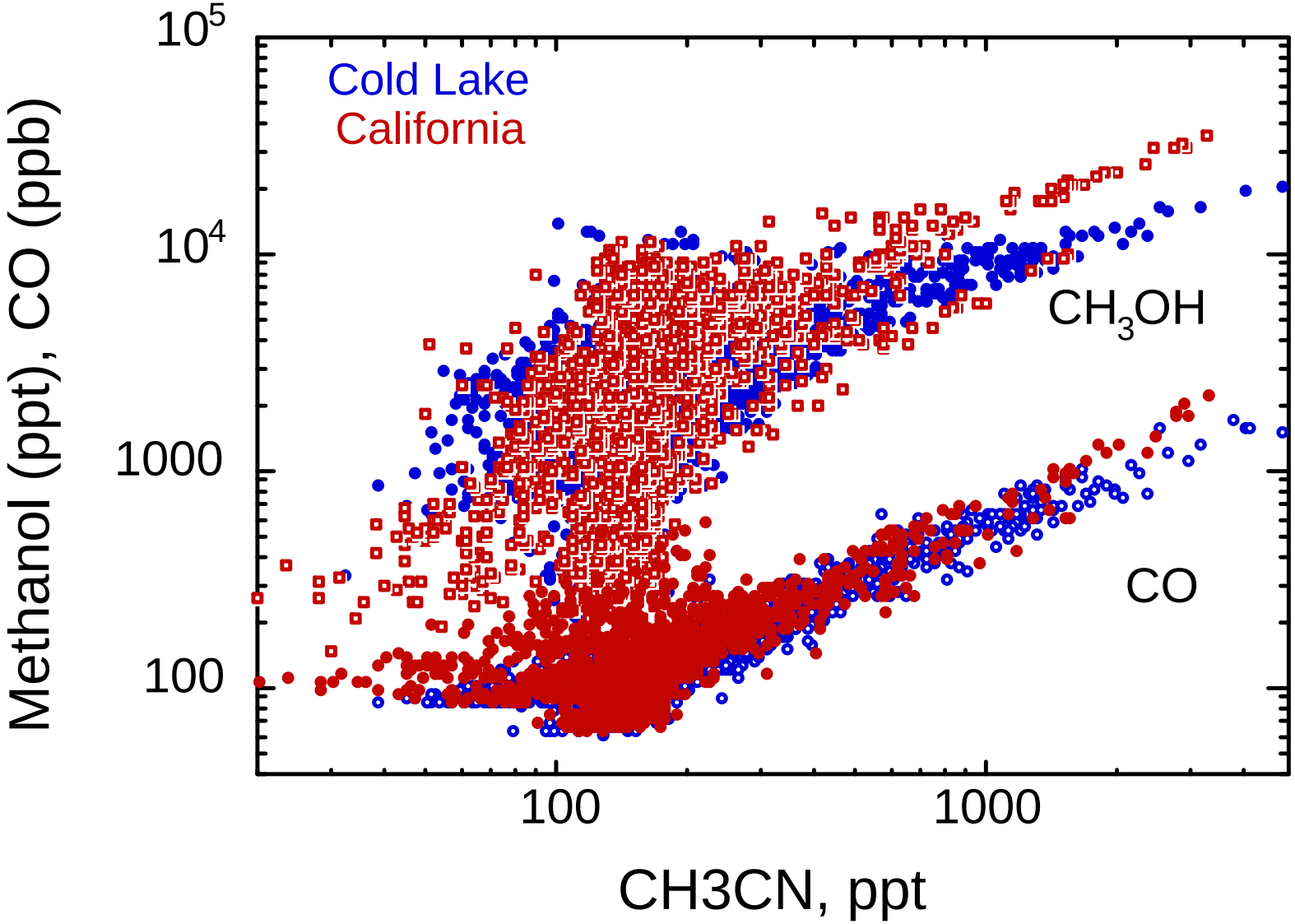


Brune/Cantrell et al

3-D simulations of HO_x precursors: MOZART



Fire emissions: California vs Boreal fires



Summary

- Extensive photochemical and tracer data to test and validate photochemical theories & Air Quality modeling predictions in forecast & analysis modes
  - Complete characterization of ozone & precursors (Reactive N-H-C)
  - Detailed characterization of HO_x/NO_x/VOC chemistry over urban and rural areas of California
  - 3-Dimensional O_3 and aerosol distributions
  - Boundary conditions for use in CA regional air quality models & test of global models for boundary conditions
- Data analysis and simulations continue with limited available resources

THANK YOU!
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