

Constraints on Methane Emissions from California's Central Valley using CalNex WP-3 Aircraft Data and a Lagrangian Transport Model

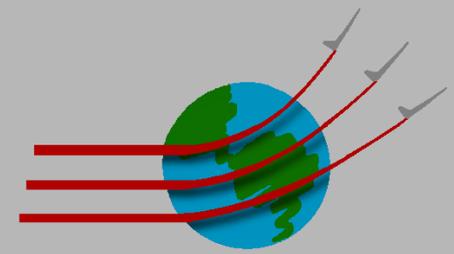
Gregory Santoni¹, Bin Xiang¹, Eric Kort¹, Bruce Daube¹, Roisin Commane¹, Elaine Gottlieb¹, Jeff Peischle², John Holloway², Tom Ryerson², Michael Trainer², Thomas Nehr Korn², Wayne Angevine², Steven Wofsy¹

1 - Harvard University, School of Engineering and Applied Sciences and Department of Earth and Planetary Sciences, Cambridge, Ma, U.S.A.

2 - National Ocean and Atmospheric Administration

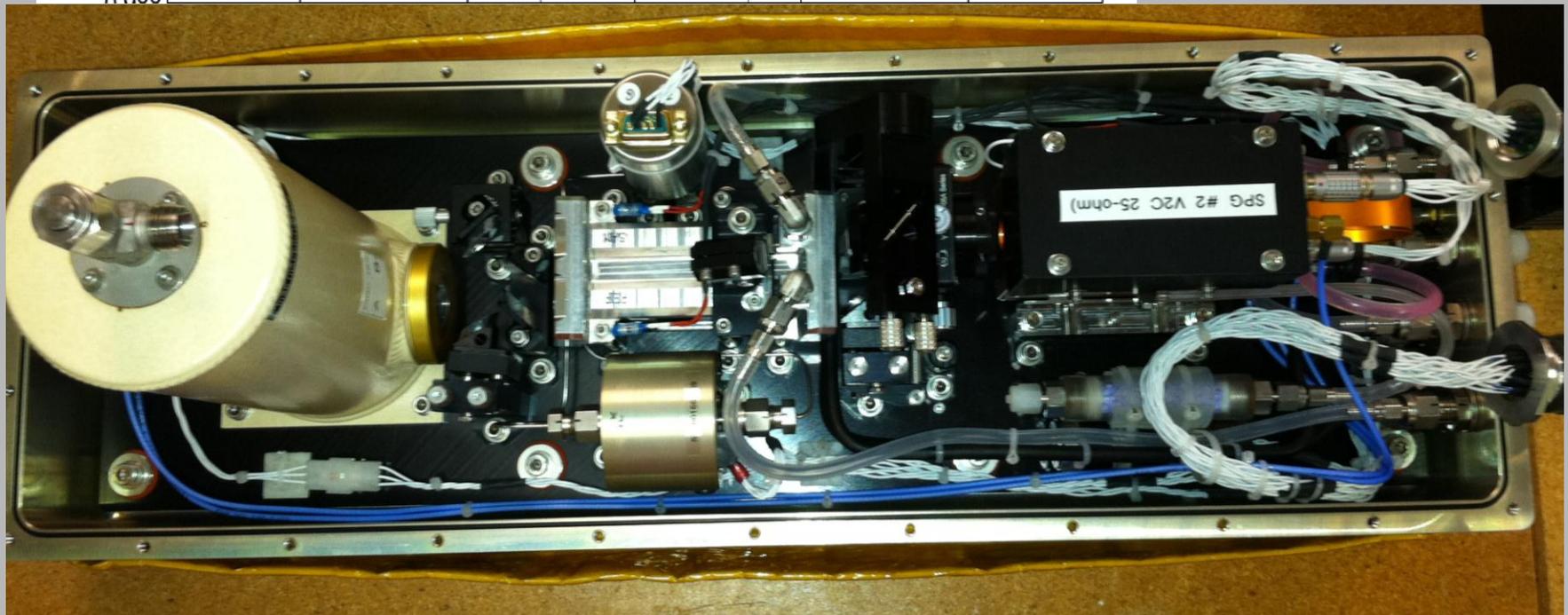
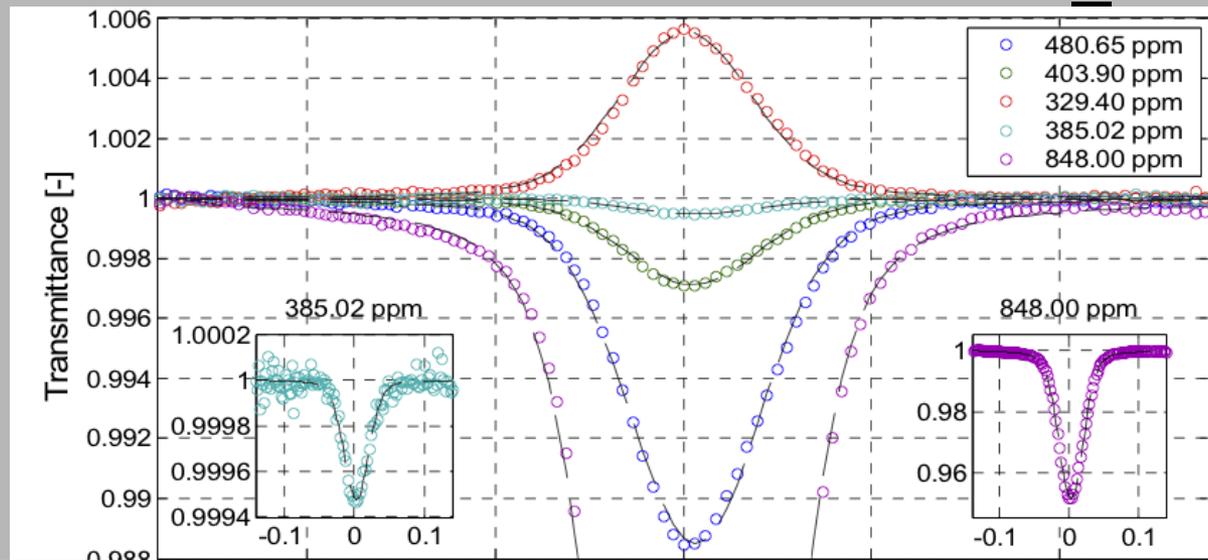


QCL Spectrometer: CO₂

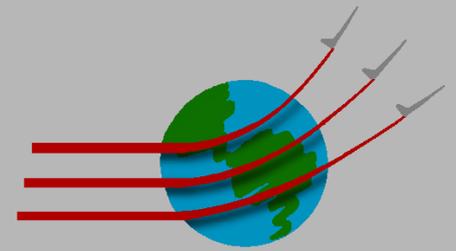


Rodrigo Jimenez
Sunyoung Park
Bruce Daube
J. Barry McManus
David D. Nelson
Mark S. Zahniser

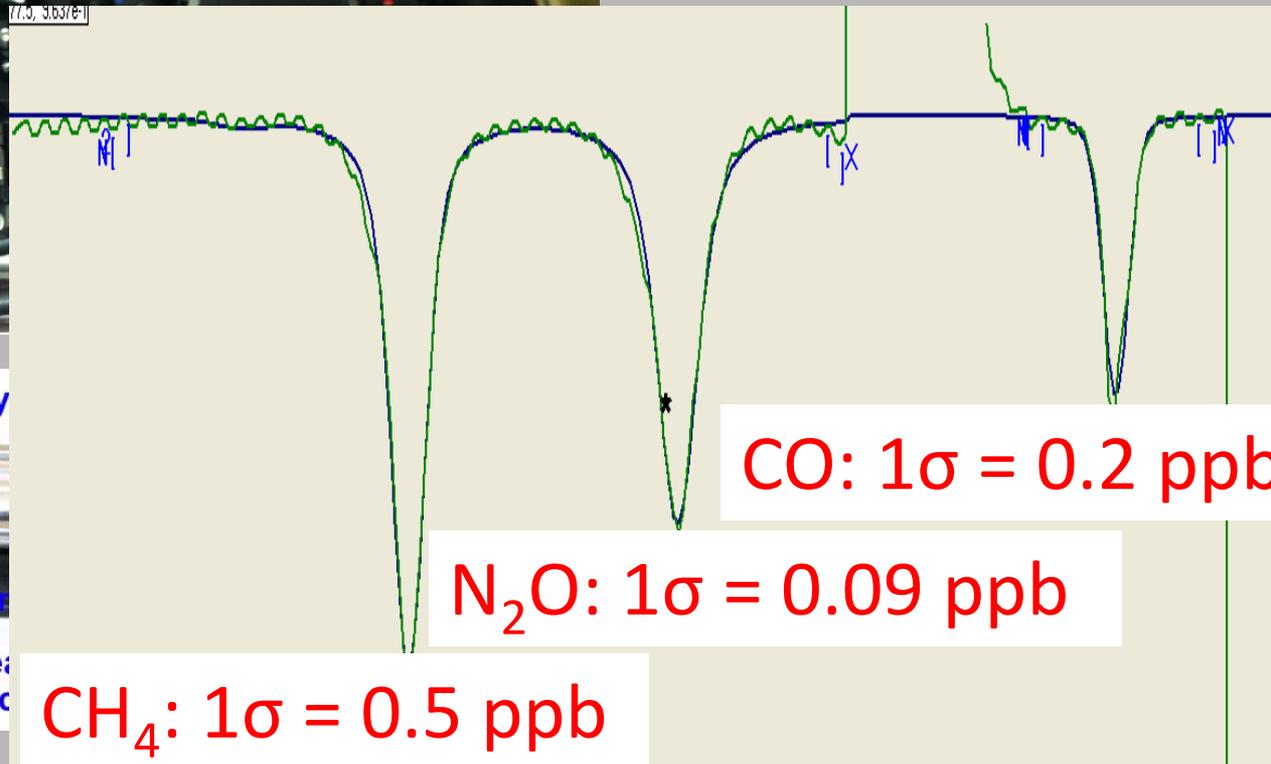
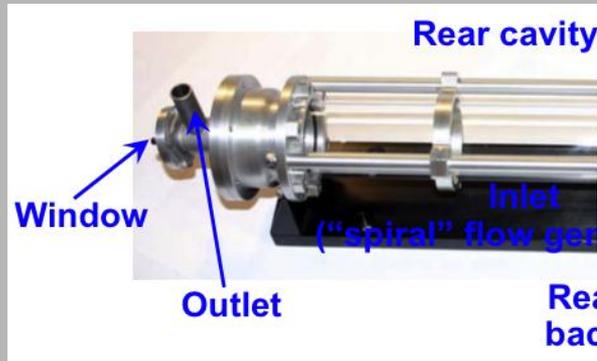
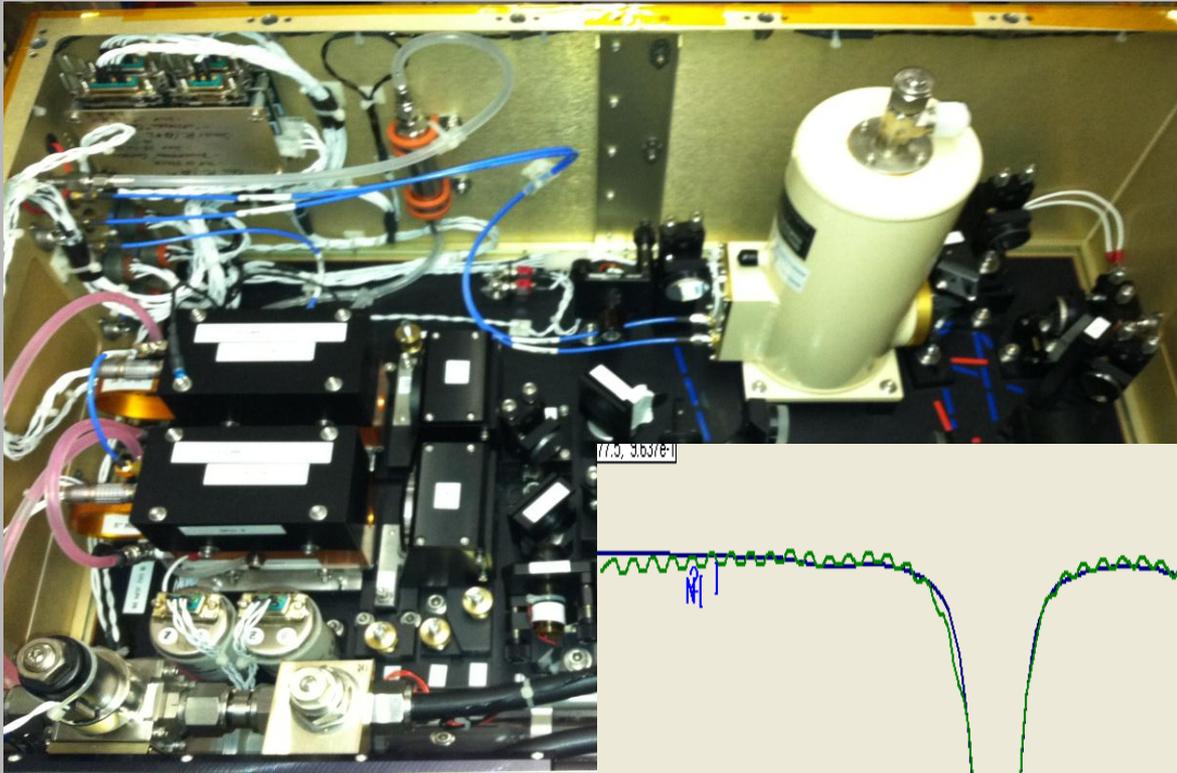
CO₂: 1 σ = 20 ppb



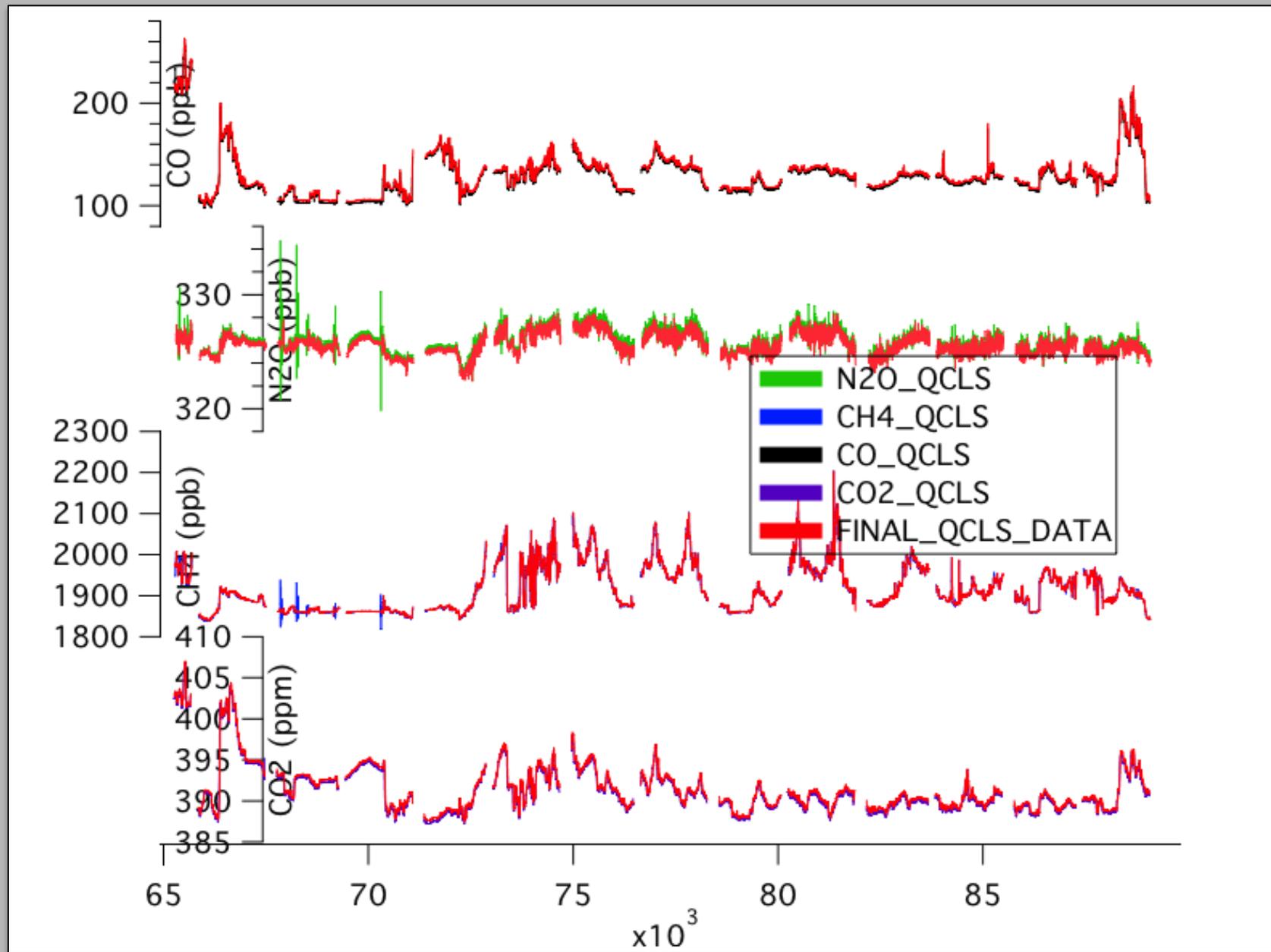
QCL Spectrometer: Dual



Rodrigo Jimenez
Sunyoung Park
Bruce Daube
J. Barry McManus
David D. Nelson
Mark S. Zahniser



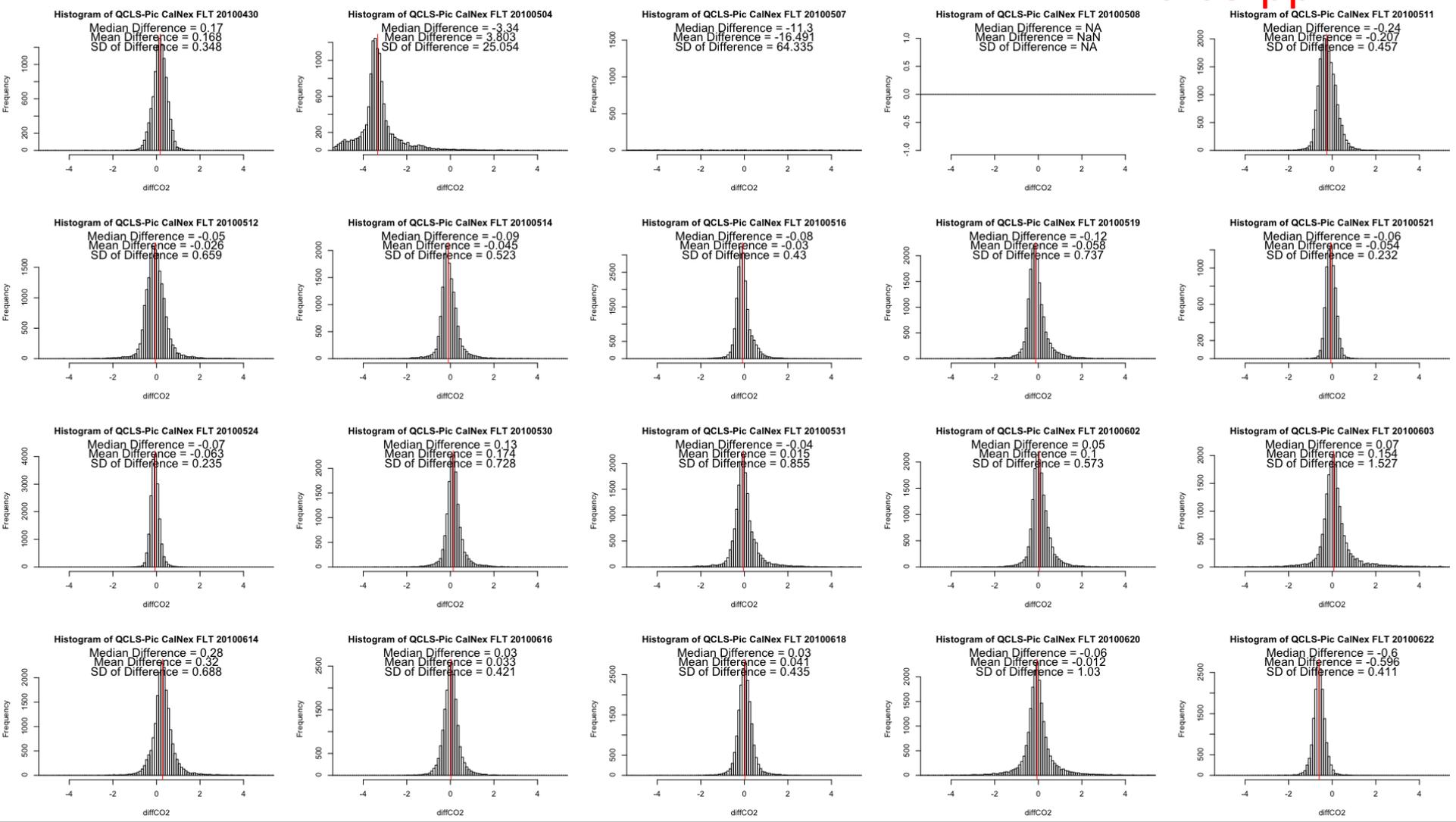
QCLS Final QA/QC vs. RA Data



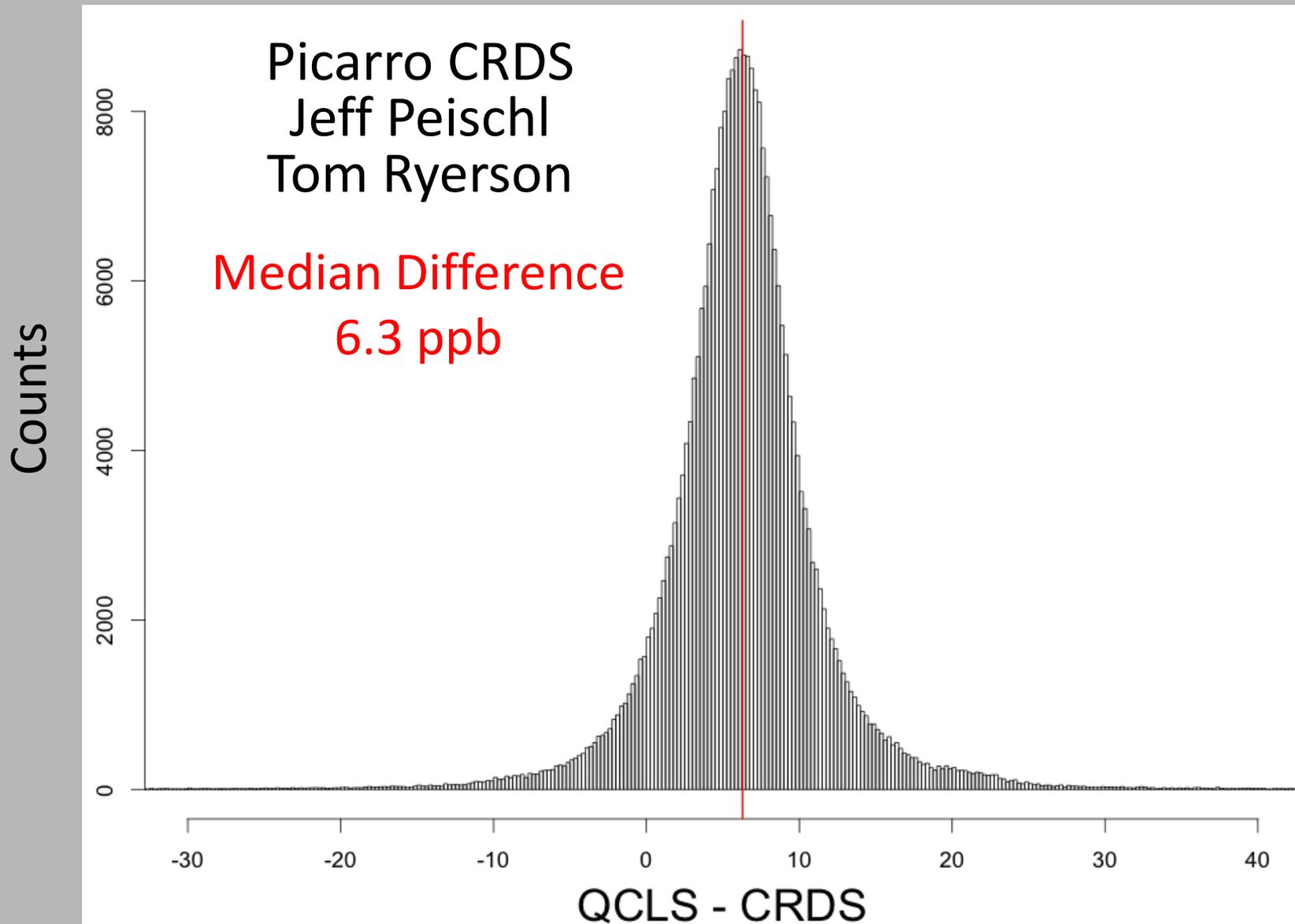
Instrument Intercomparison: CO₂

Jeff Peischl
Tom Ryerson

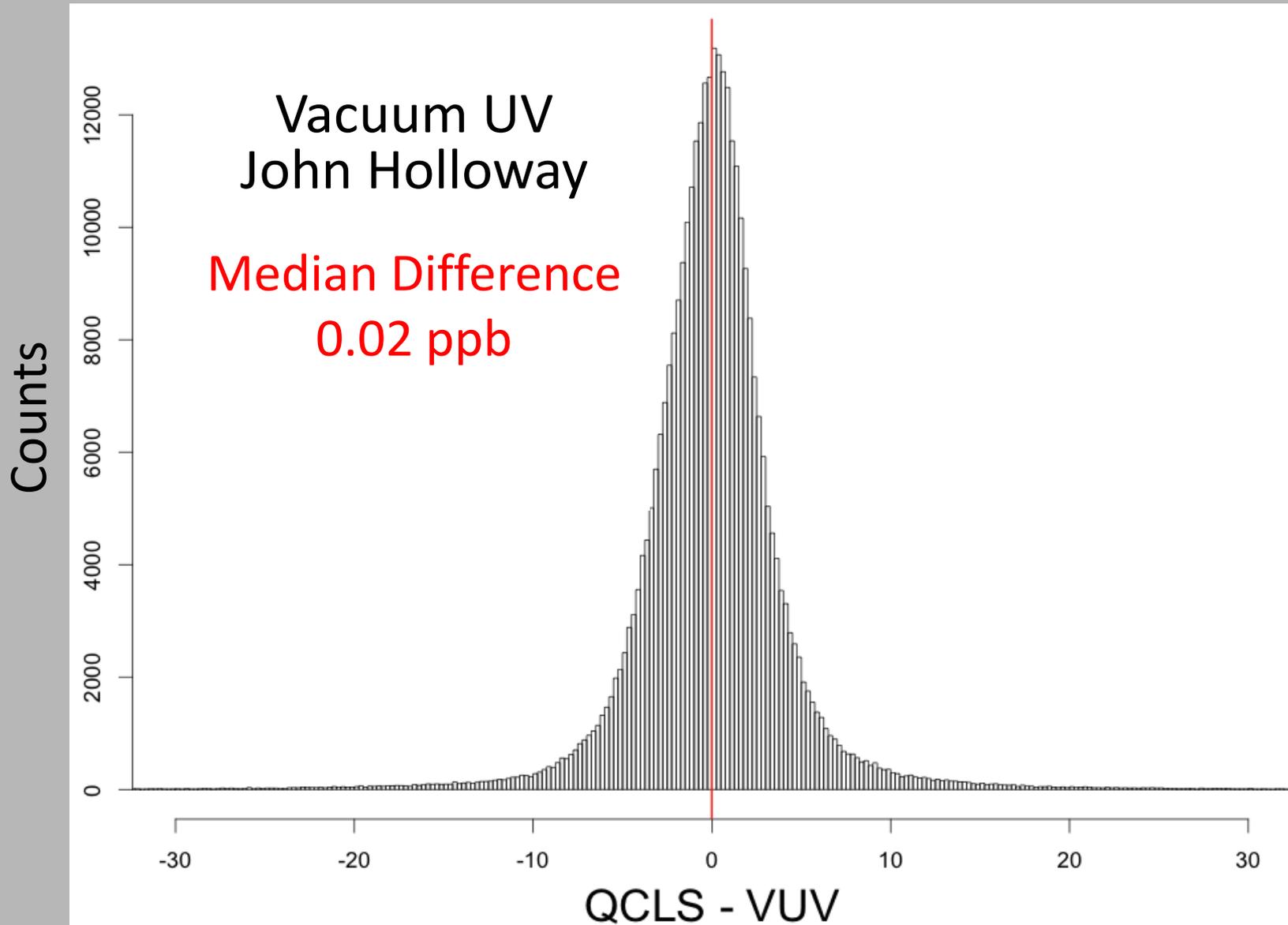
Picarro CRDS vs. QCLS CO₂ Median Difference
0.05 ppm



Instrument Intercomparison: CH₄

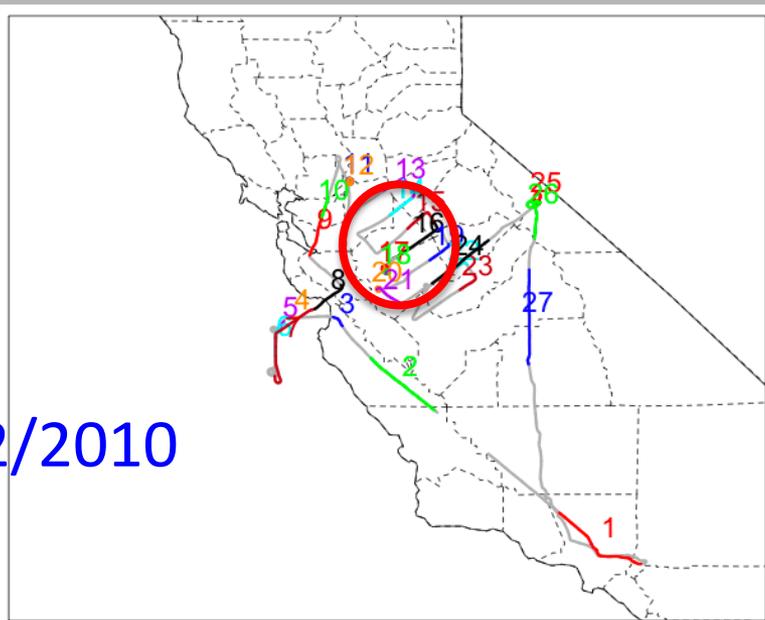


Instrument Intercomparison: CO

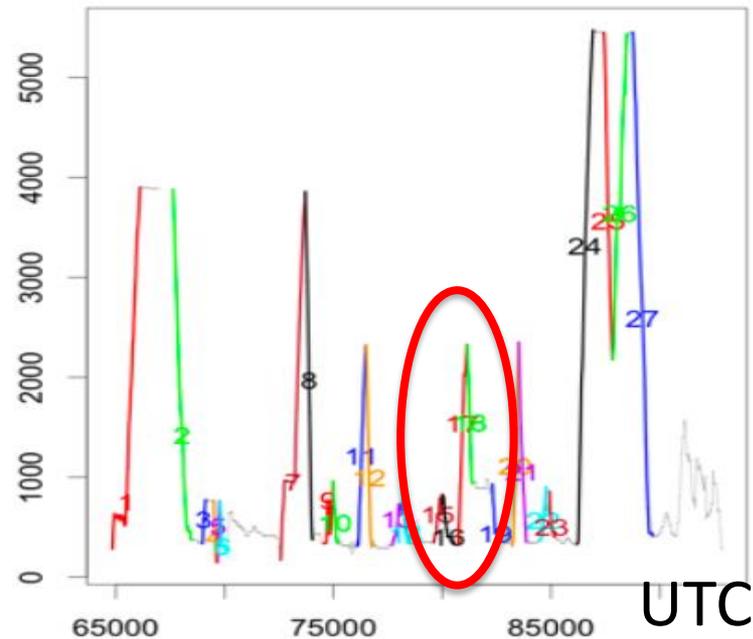


Central Valley Vertical Profiles

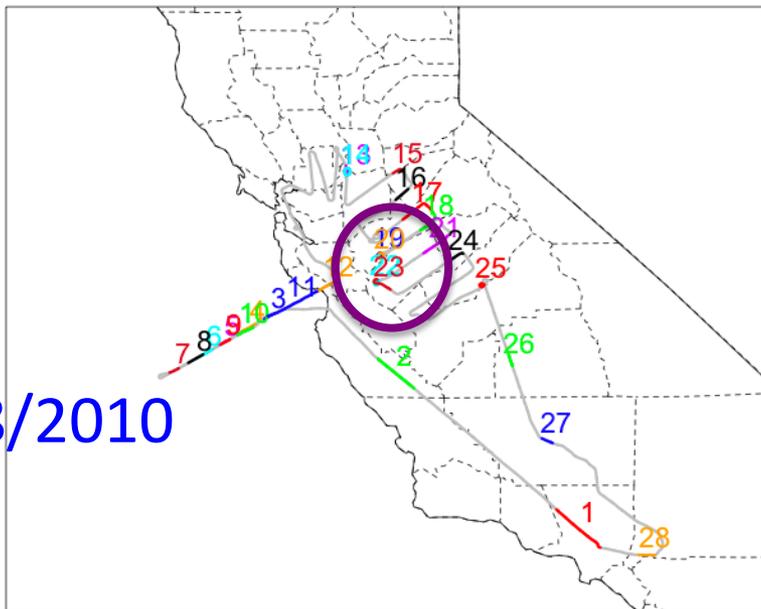
05/12/2010



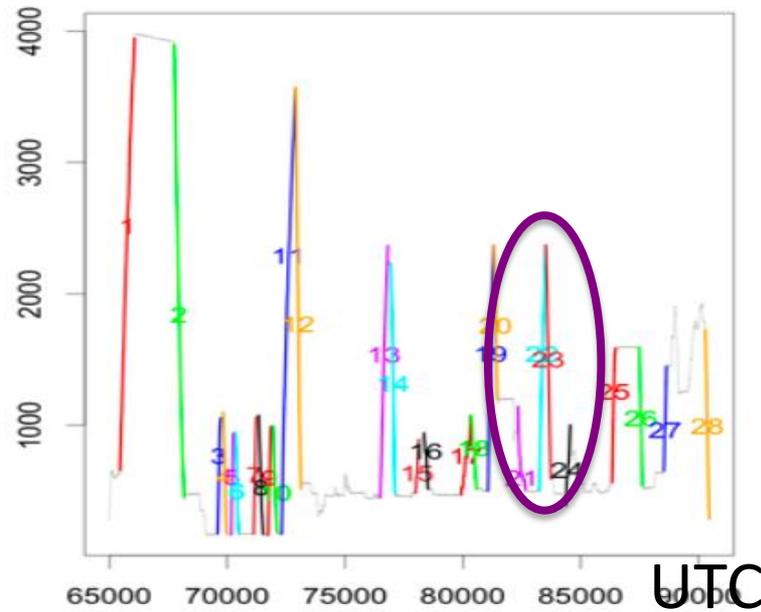
Altitude (m)



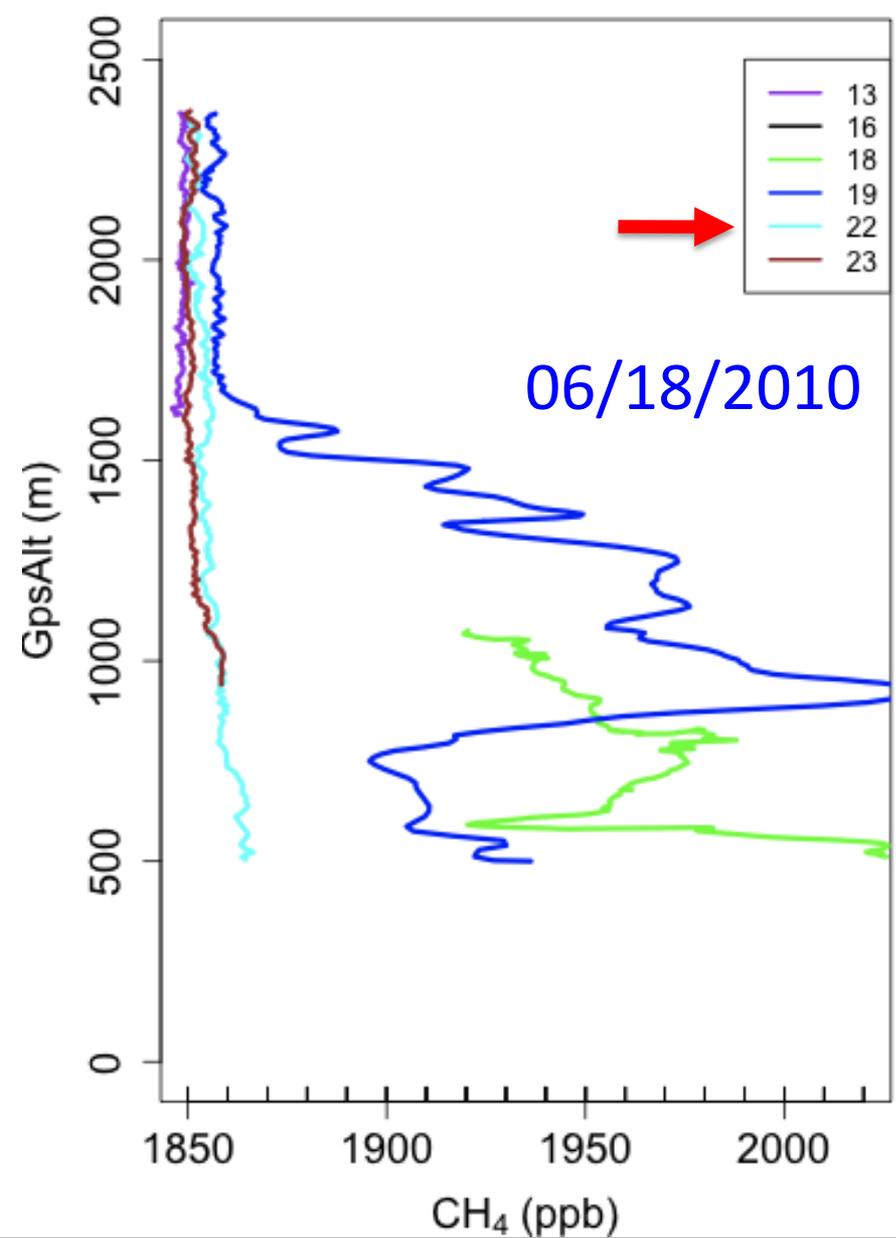
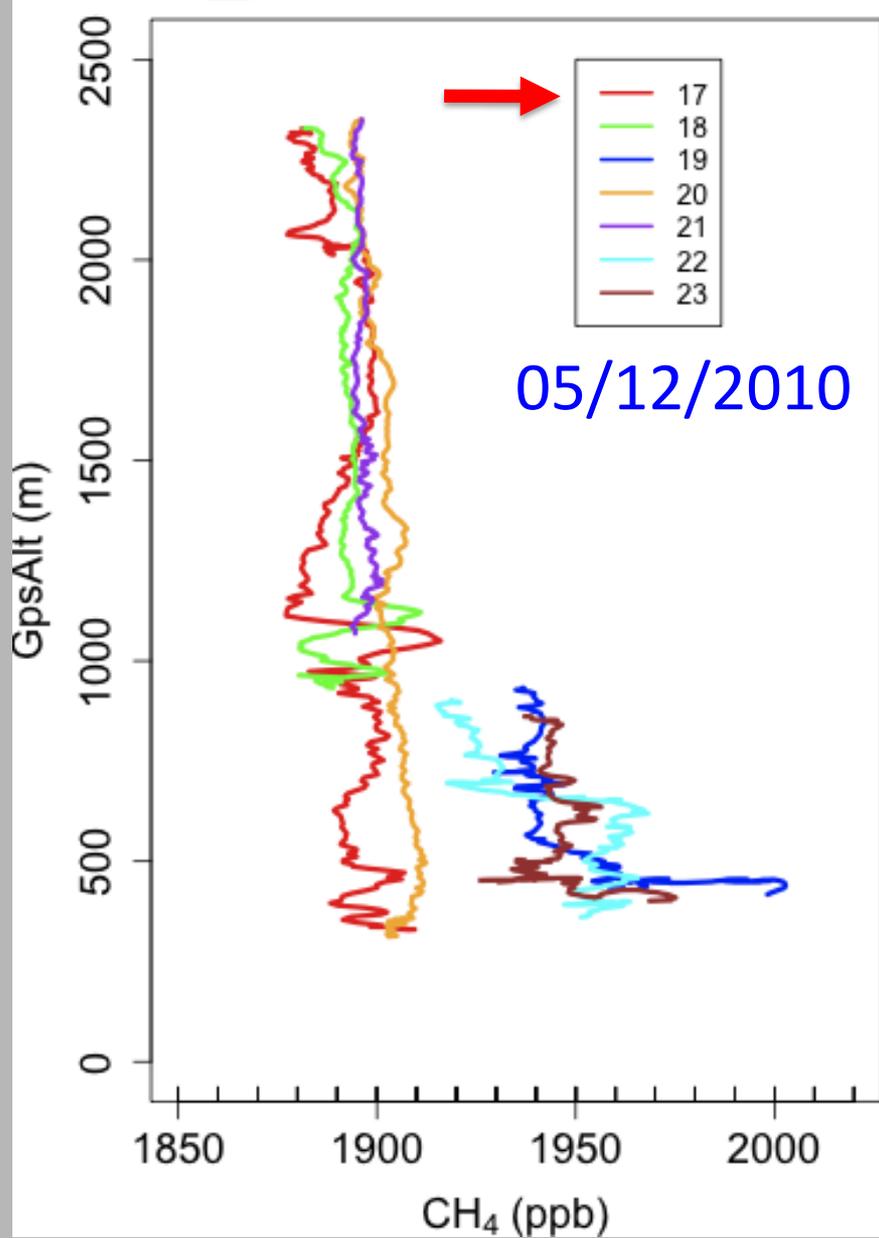
06/18/2010



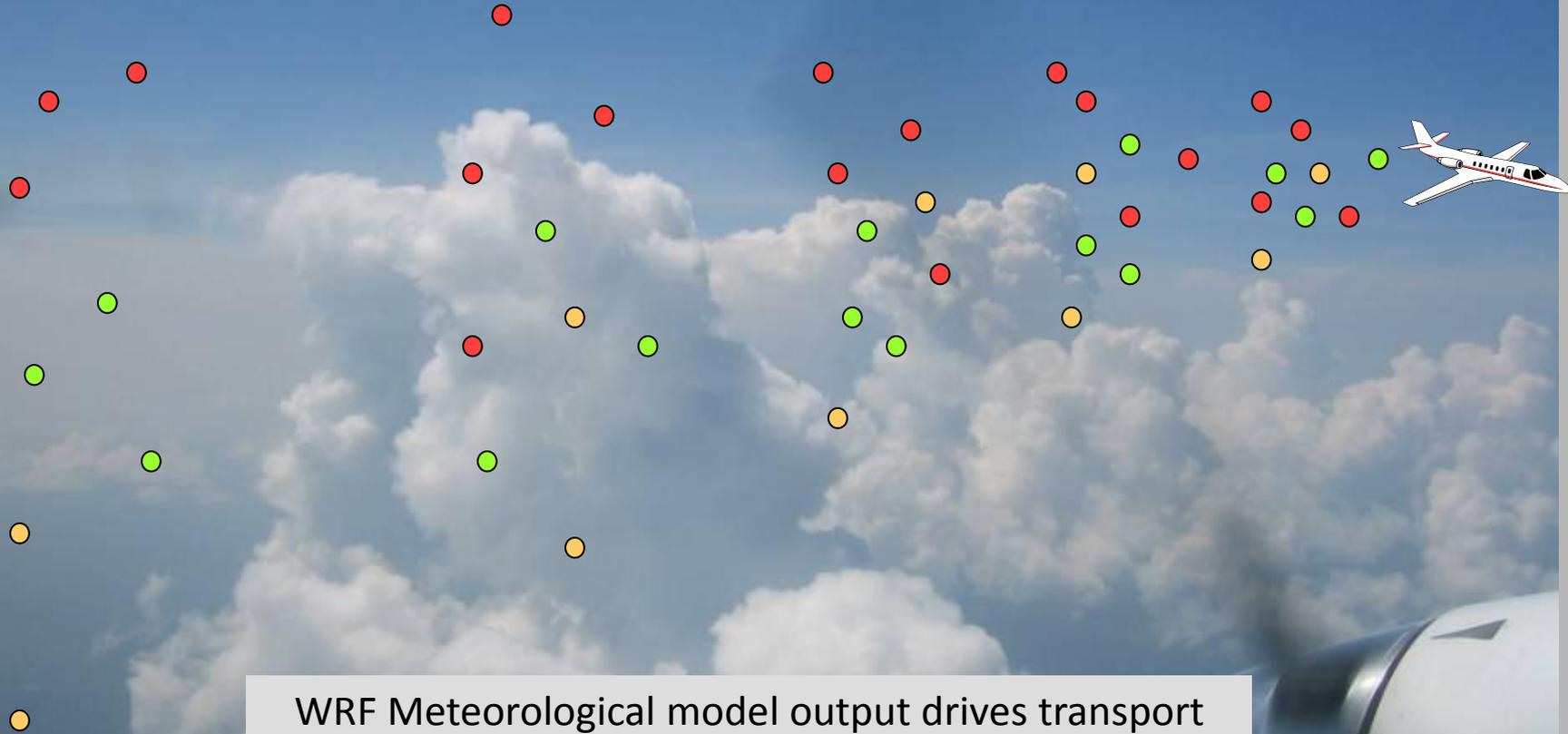
Altitude (m)



CH₄ Profiles



Modeling Framework

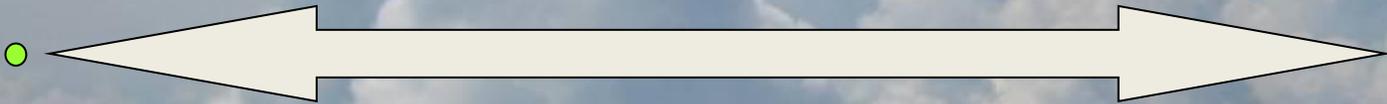


Stochastic Time-Inverted Lagrangian Transport model

Receptor-oriented time-inverted model

Modeling Framework

-
- Particles tell where air is arriving from and link observations with upstream sources/sinks
-
-

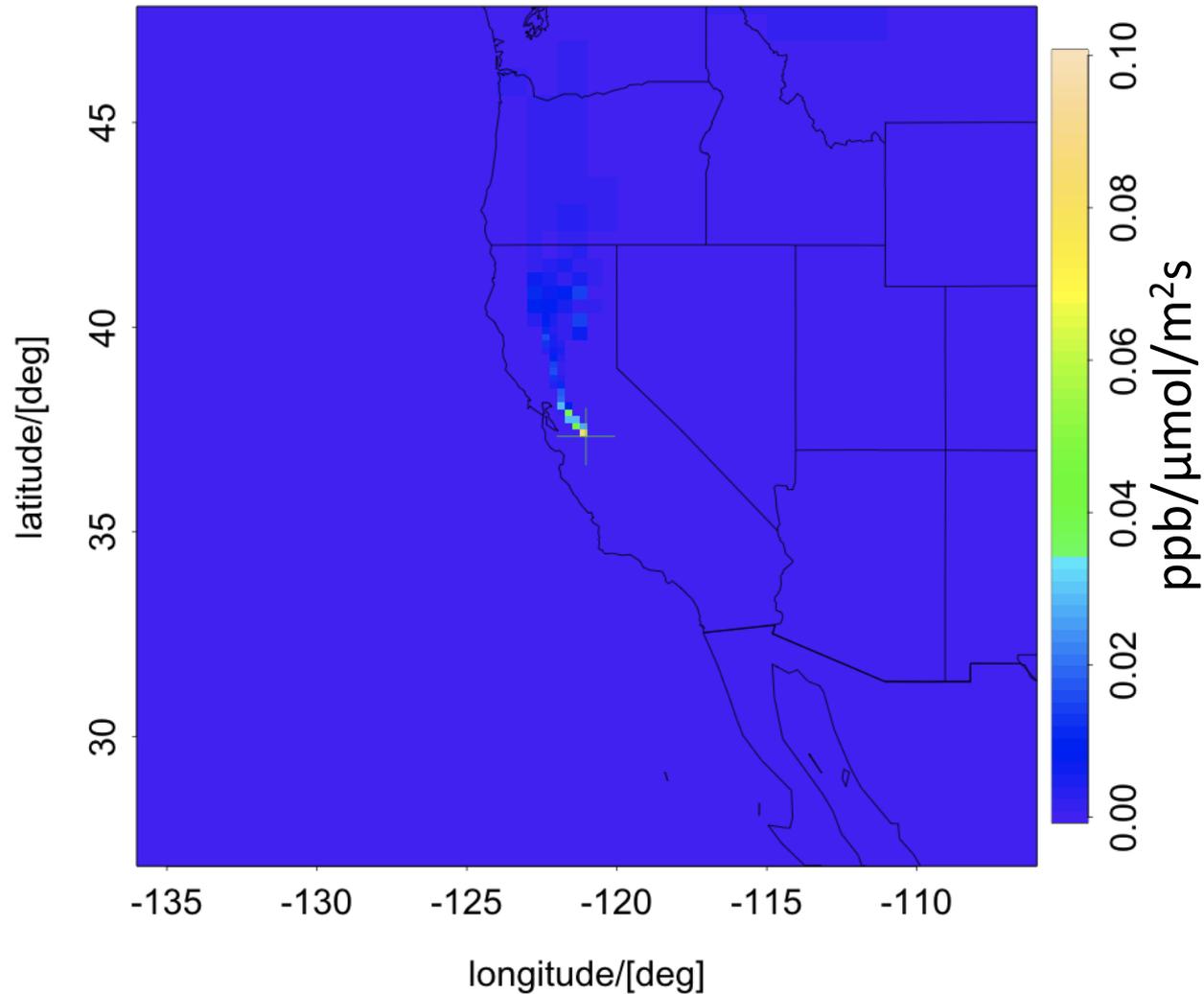


- Modeled surface fluxes, emission inventories, chemistry, and boundary conditions determine concentrations of air encountered
-

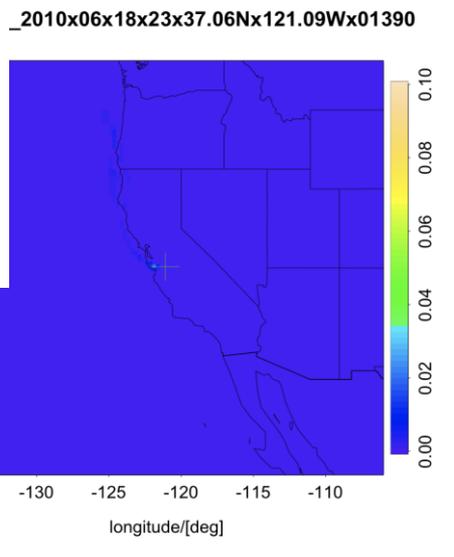
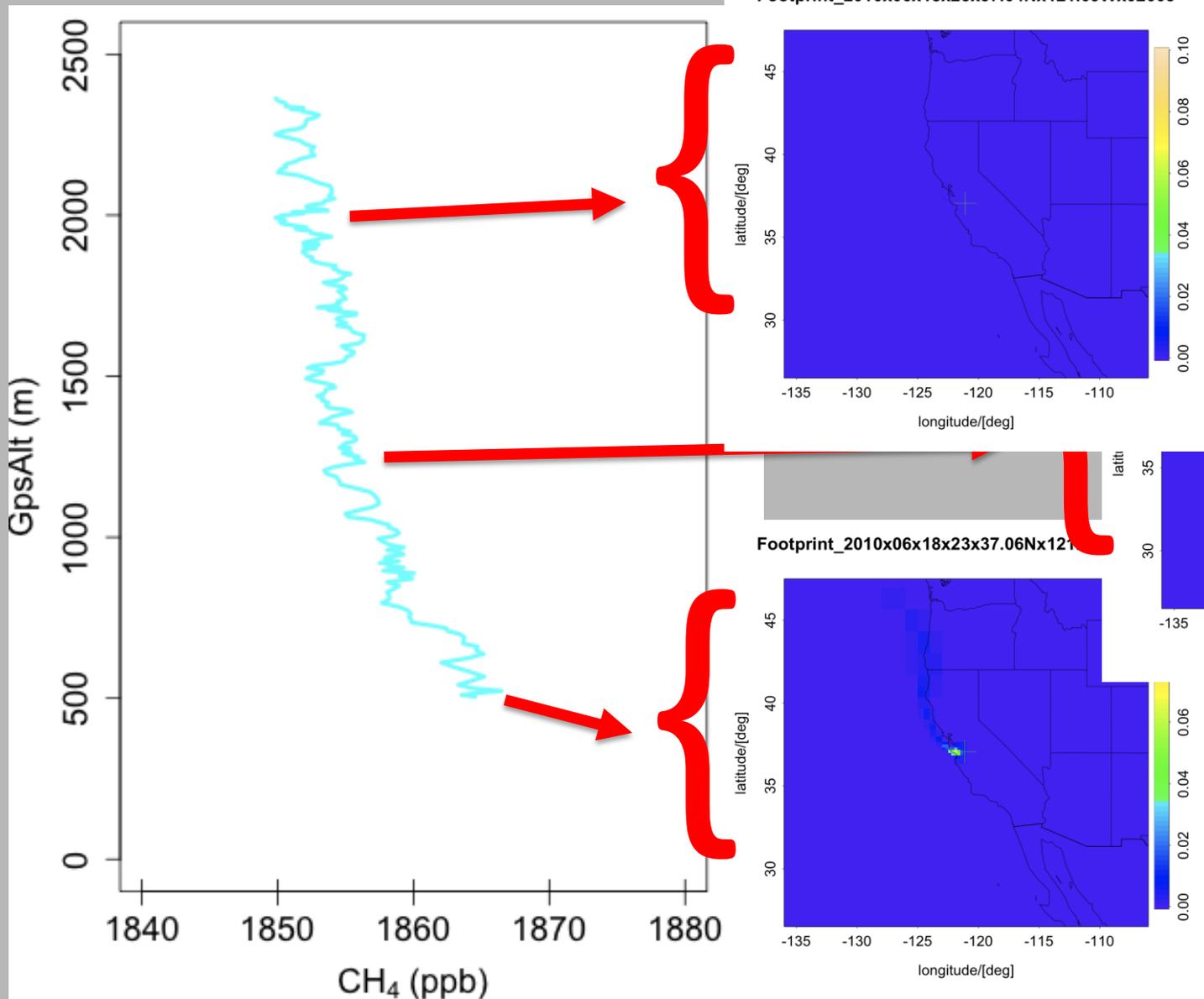


From Trajectories to Footprints

Footprint_2010x05x12x22x37.33Nx121.03Wx00313



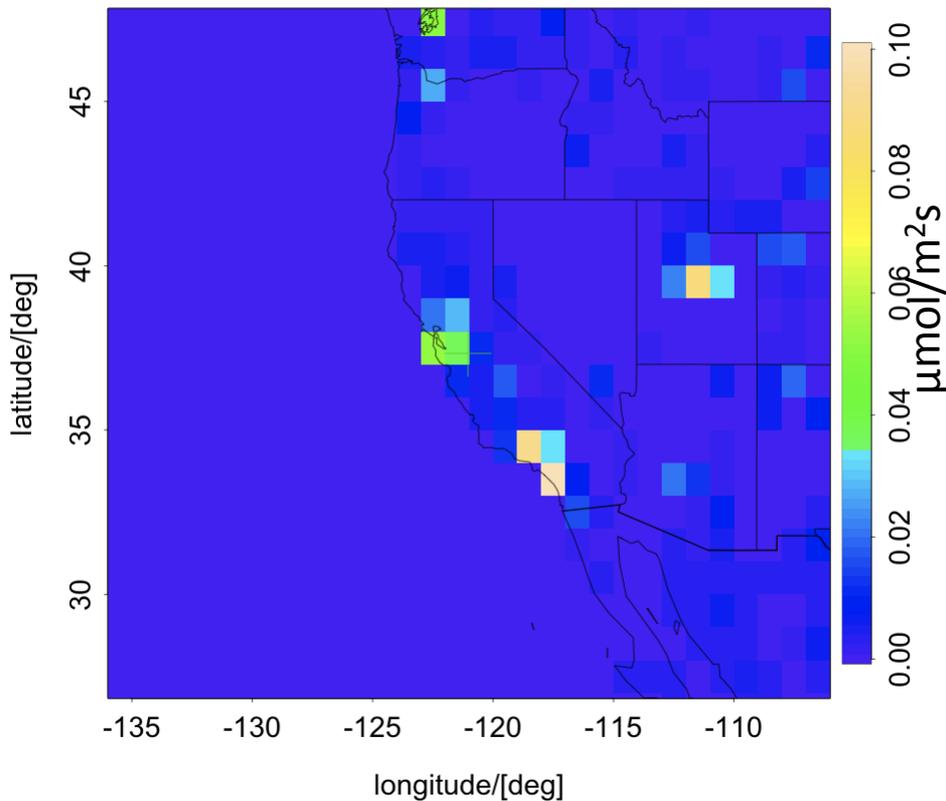
Footprints for 06/18 Profile



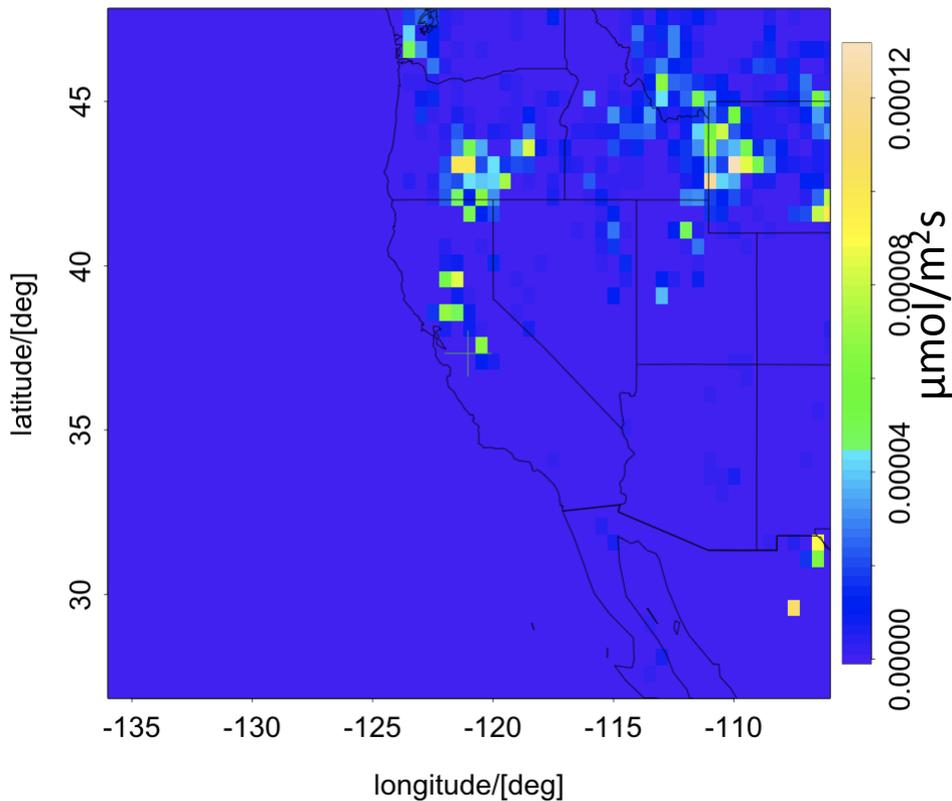
Emission Inventories

Emission Inventory * Footprint + B.C. = Observed Mixing Ratio

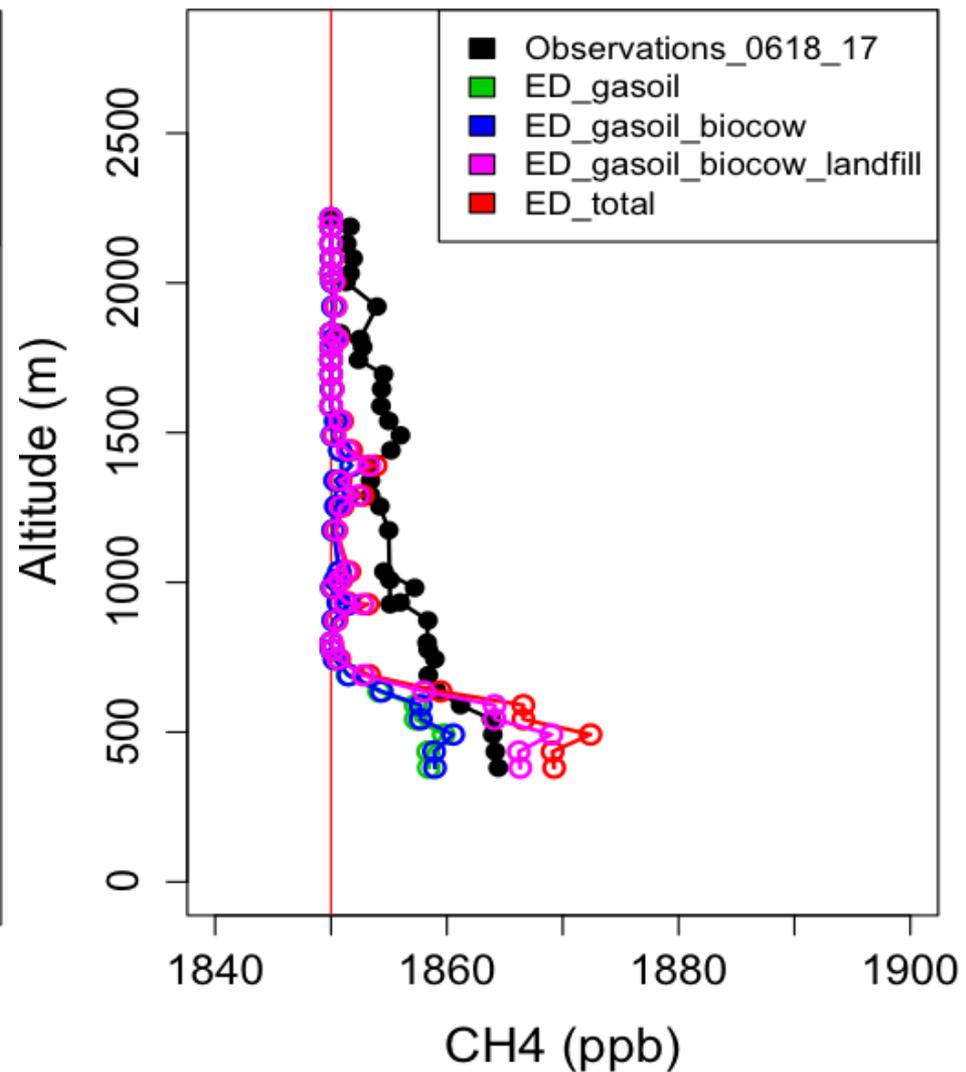
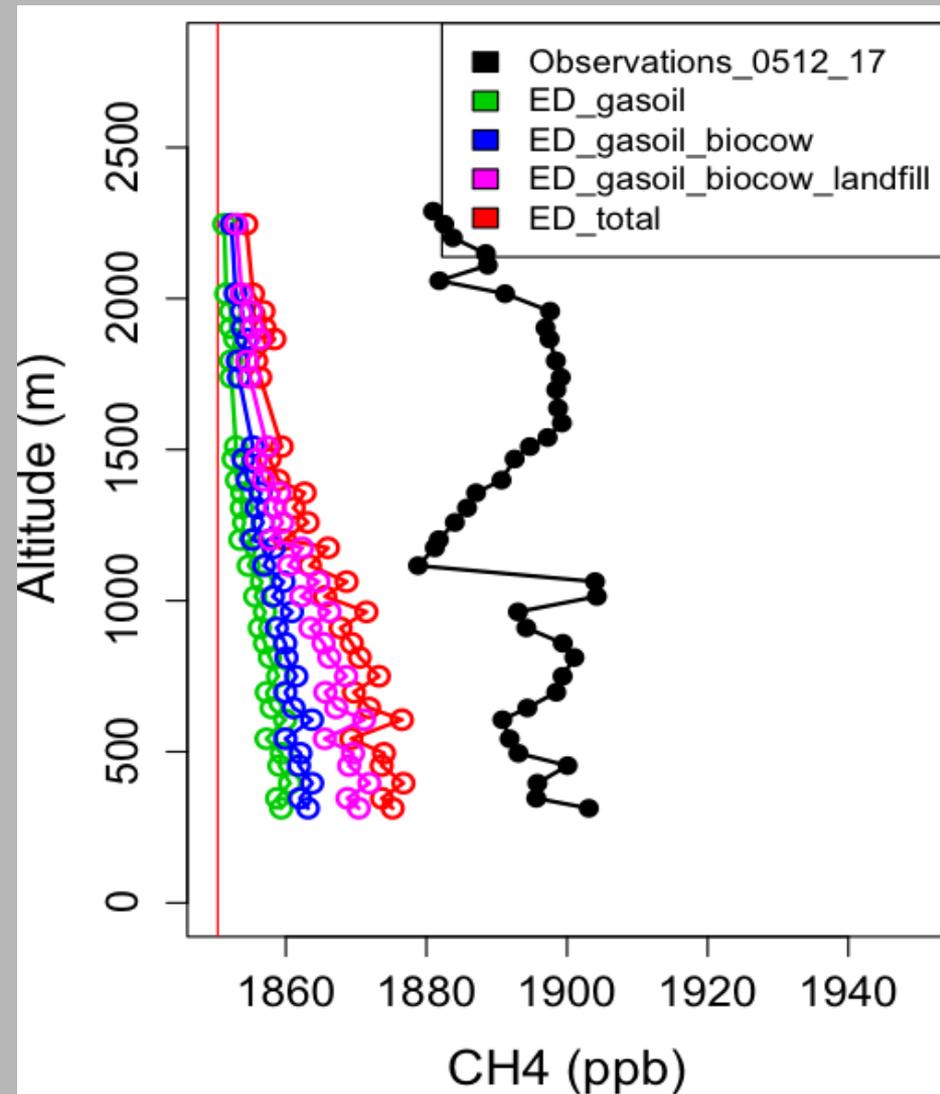
EDGAR: Emissions Database for
Global Atmospheric Research.
Total Anthro annual CH₄ emissions
1° x 1° resolution



Jed Kaplan's wetlands
May
1/4° x 1/6° resolution

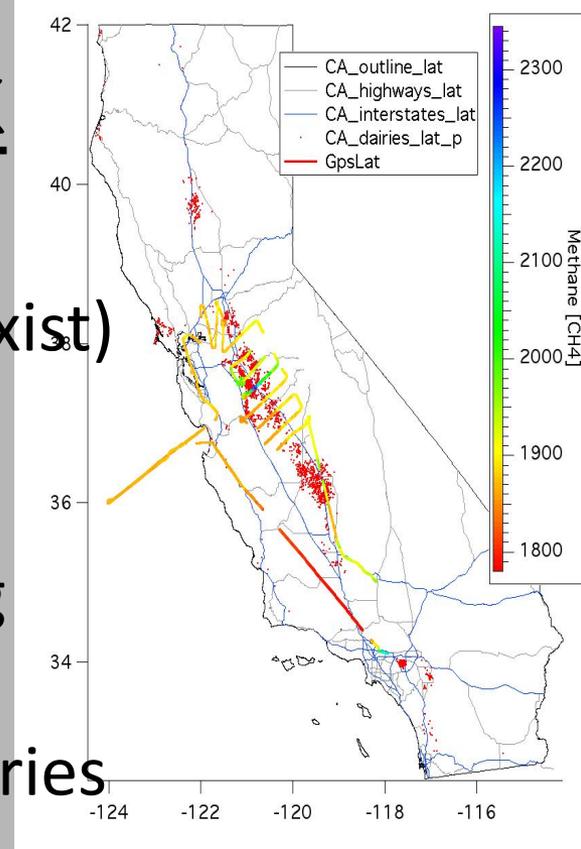


Modeled Profiles



Conclusions/Future Work

- Need for finer resolution inventories
 - both point and area sources (these exist)
- Appropriate boundary conditions
 - difficult in California
- 100+ profiles outside of L.A. basin during ~50 flight hours
- Inversions onto *a priori* emission inventories
- Comparisons to Flexpart

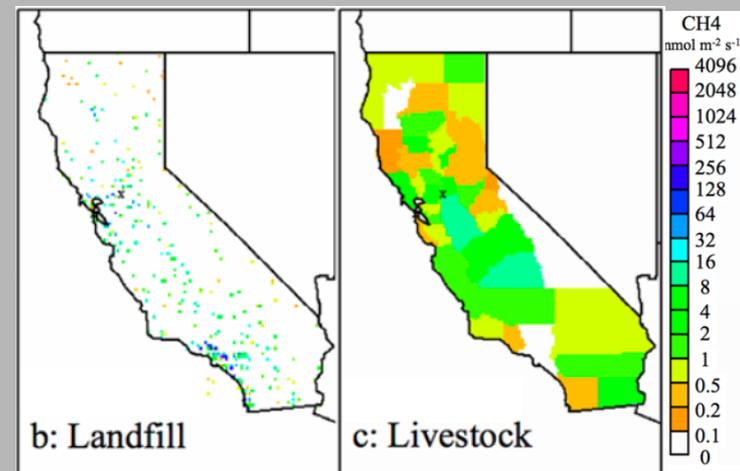


From Zhao et al. (2009)

Acknowledgements

WP-3 Flight Crew, NOAA instrument teams,
John Lin, Christoph Gerbig, NSF Graduate
Research Fellowship

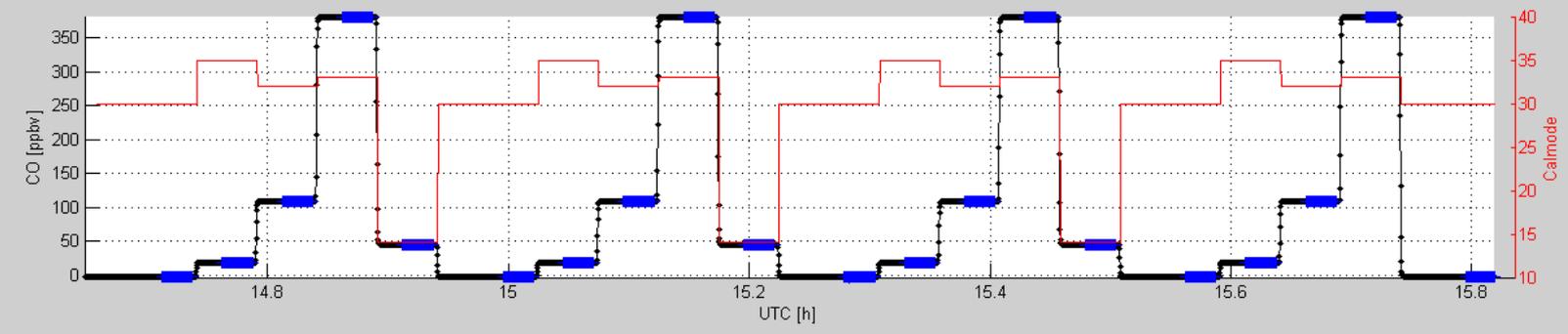
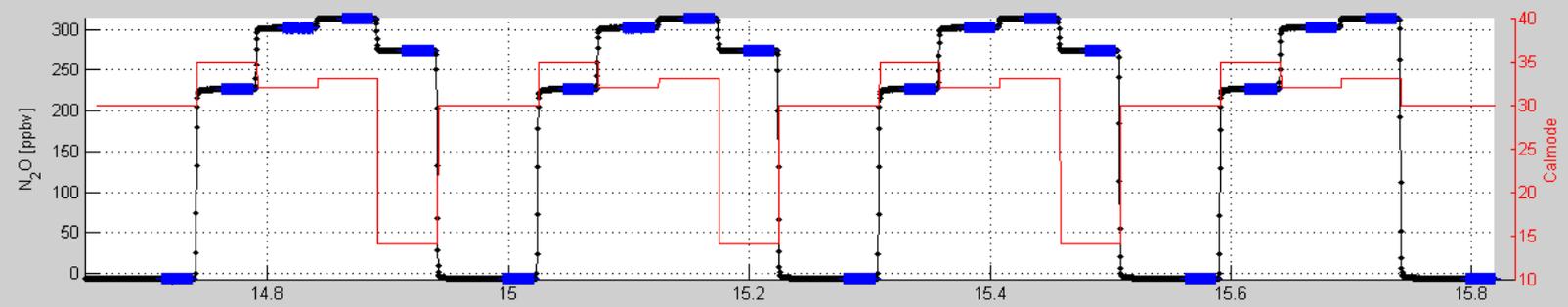
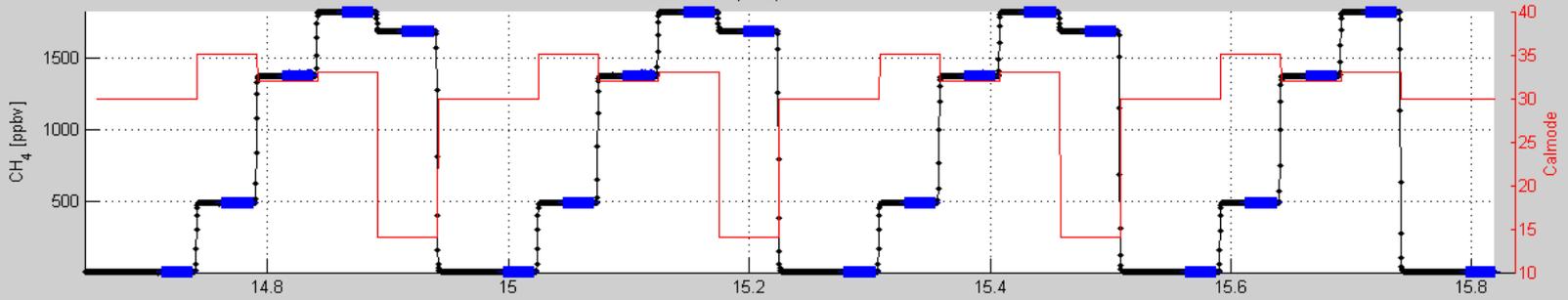
gsantoni@gmail.com



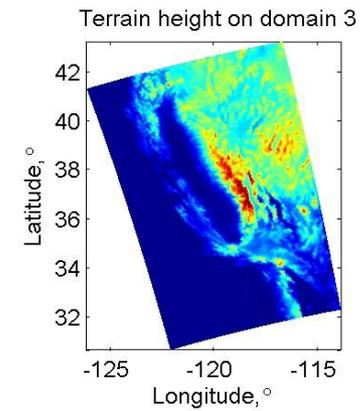
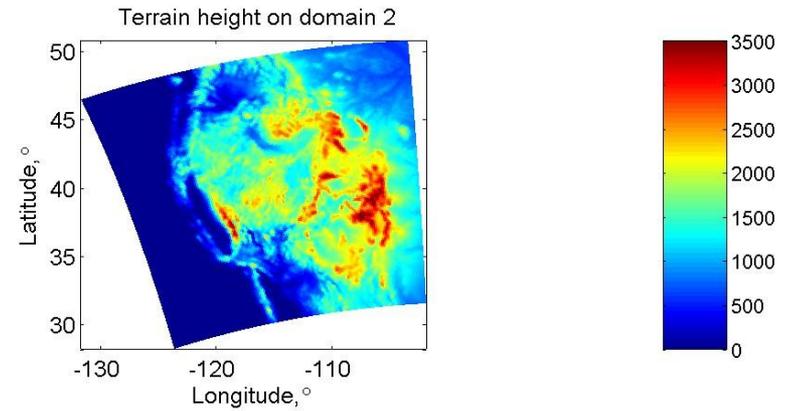
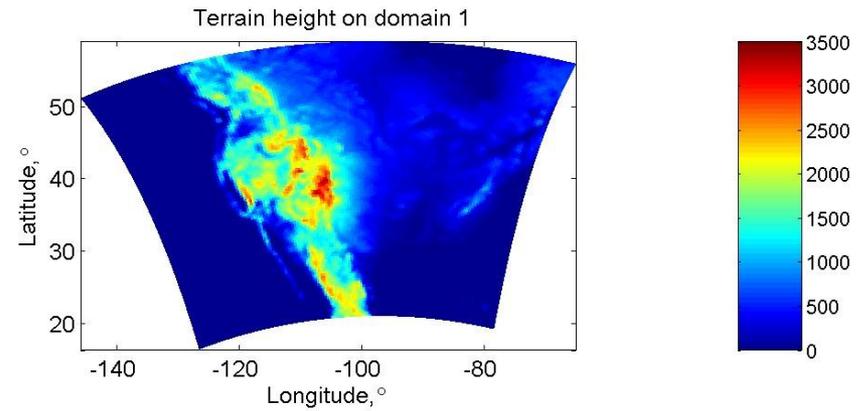
Calibration



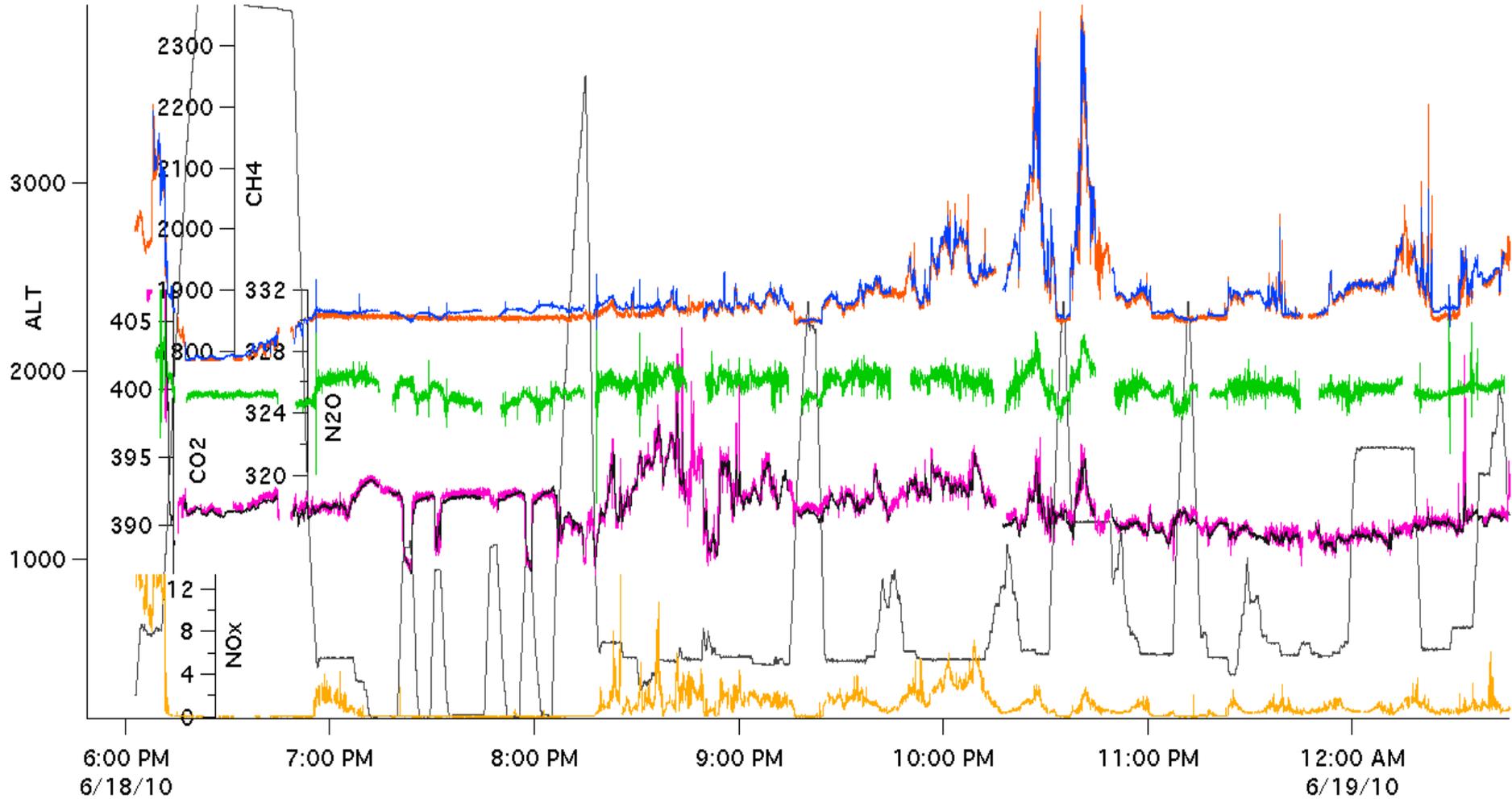
14-Jan-2011 - td30,t90,tt15 - Retrieved time series



WRF domains



June 18th, 2010 Time Series



Central Valley CH₄ June 18th, 2010

