Challenges and opportunities for remote sensing of air quality: Insights from DISCOVER-AQ

Jim Crawford [1], Ken Pickering [2], Bruce Anderson [1], Andreas Beyersdorf [1], Gao Chen [1], Richard Clark [3], Ron Cohen [4], Glenn Diskin [1], Rich Ferrare [1], Alan Fried [5], Brent Holben [2], Jay Herman [6], Ray Hoff [6], Chris Hostetler [1], Scott Janz [2] , Mary Kleb [1], Jim Szykman [7], Anne Thompson [2], Andy Weinheimer [8], Armin Wisthaler [9], Melissa Yang [1]

[1] NASA Langley Research Center, [2] NASA Goddard Space Flight Center, [3] Millersville University, [4] University of California-Berkeley, [5] University of Colorado-Boulder, [6] University of Maryland-Baltimore County, [7] Environmental Protection Agency, [8] National Center for Atmospheric Research, [9] University of Innsbruck

http://discover-aq.larc.nasa.gov/

Thanks to Partners

Maryland Department of the Environment (MDE)
San Joaquin Valley Air Pollution Control District (SJV APCD)
California Air Resource Board (CARB)
Bay Area Air Quality Management District (BAAQMD)
Texas Commission on Environmental Quality (TCEQ)
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University of California, Davis; University of California, Irvine
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Baylor University; Princeton
University of Colorado-Boulder; Colorado State University

Investigation Overview

Deriving Information on Surface Conditions from Column and VERtically Resolved Observations Relevant to Air Quality

A NASA Earth Venture campaign intended to improve the interpretation of satellite observations to diagnose near-surface conditions relating to air quality

Objectives:

1. Relate column observations to surface conditions for aerosols and key trace gases O_3, NO_2, and CH_2O

2. Characterize differences in diurnal variation of surface and column observations for key trace gases and aerosols

3. Examine horizontal scales of variability affecting satellites and model calculations

Deployment Strategy

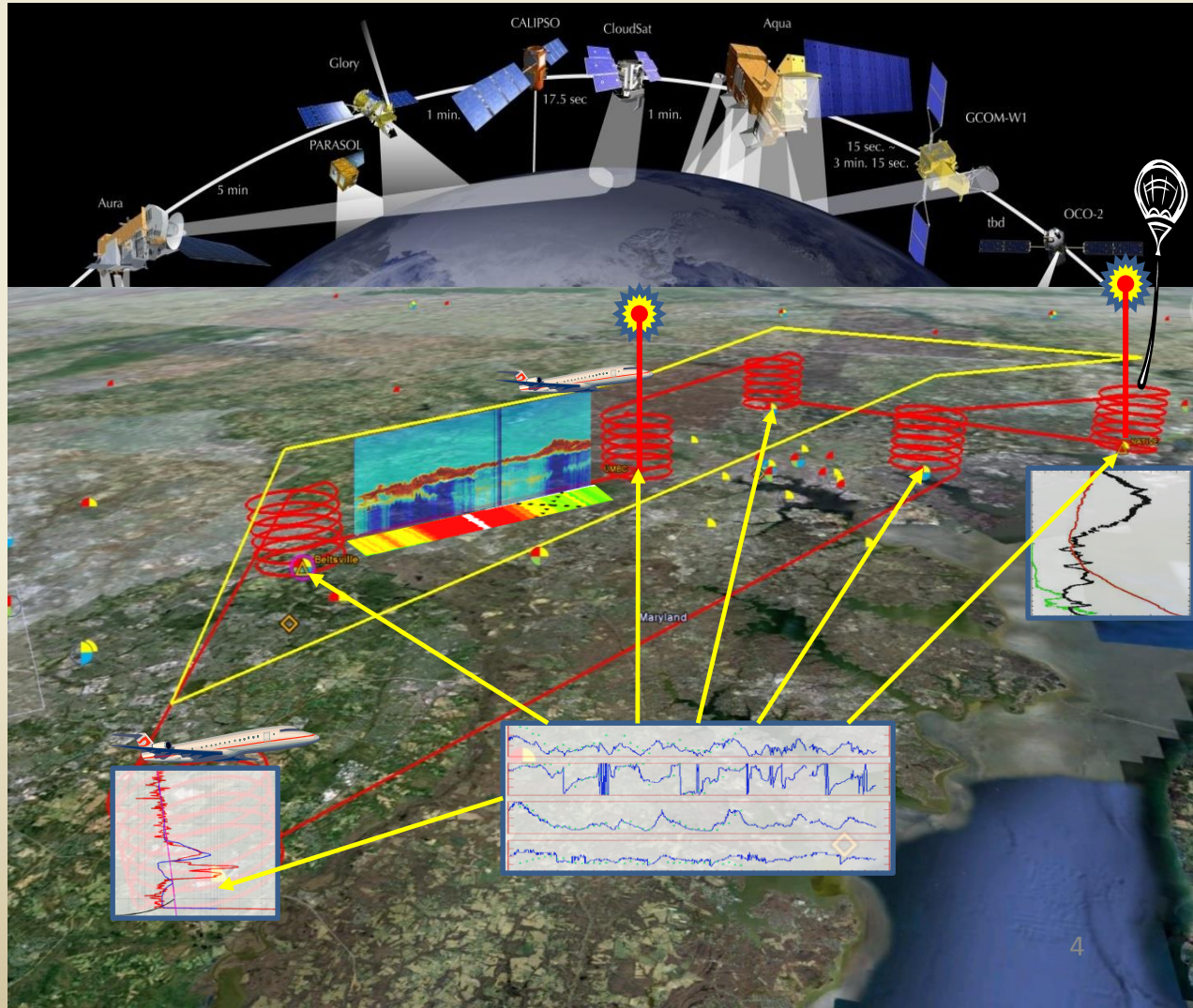
Systematic and concurrent observation of column-integrated, surface, and vertically-resolved distributions of aerosols and trace gases relevant to air quality as they evolve throughout the day.

Three major observational components:

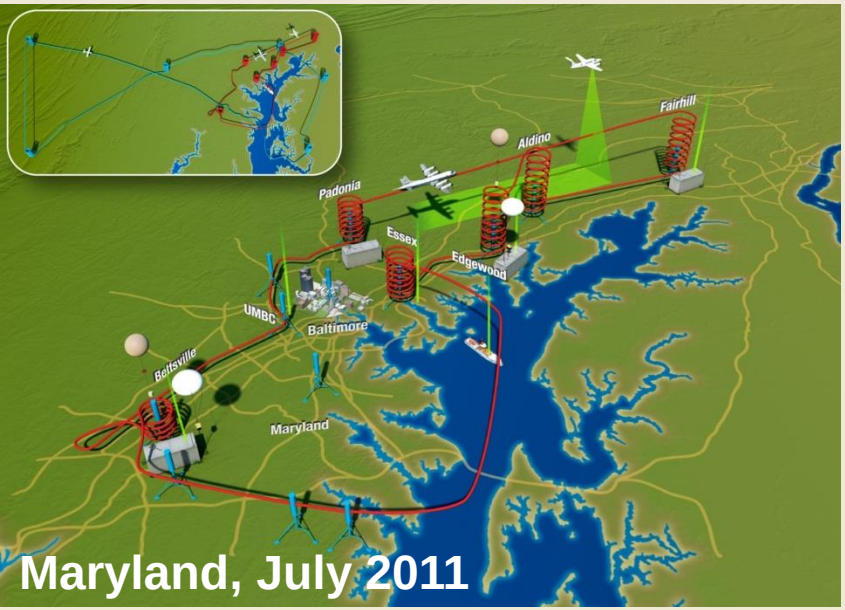
<u>NASA UC-12 (Remote sensing)</u>
Continuous mapping of aerosols with HSRL and trace gas columns with ACAM

<u>NASA P-3B (in situ meas.)</u>
In situ profiling of aerosols and trace gases over surface measurement sites

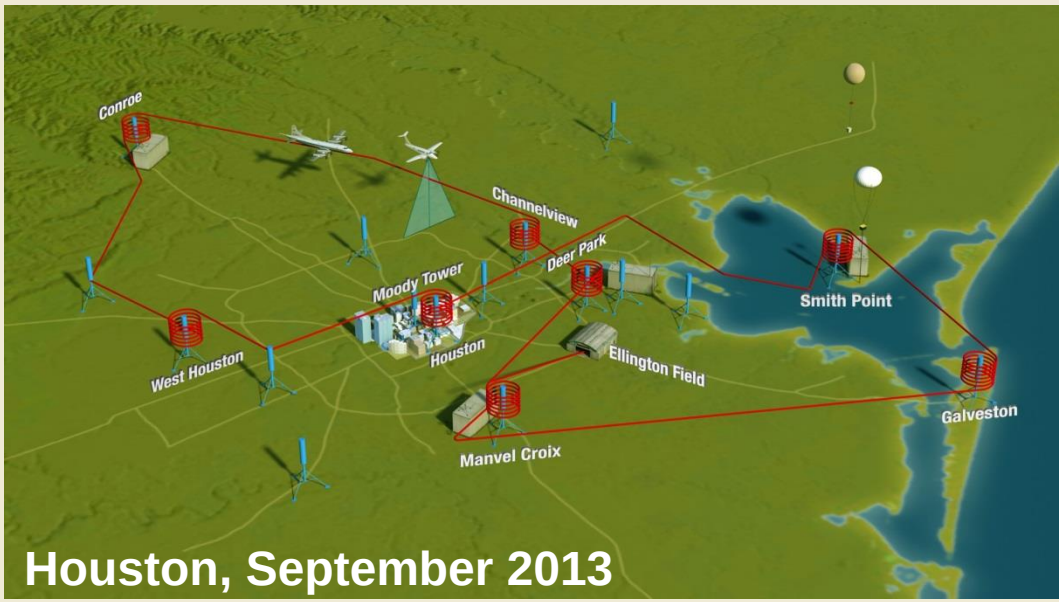
<u>Ground sites</u>
In situ trace gases and aerosols
Remote sensing of trace gas and aerosol columns
Ozonesondes
Aerosol lidar observations



Deployment Locations

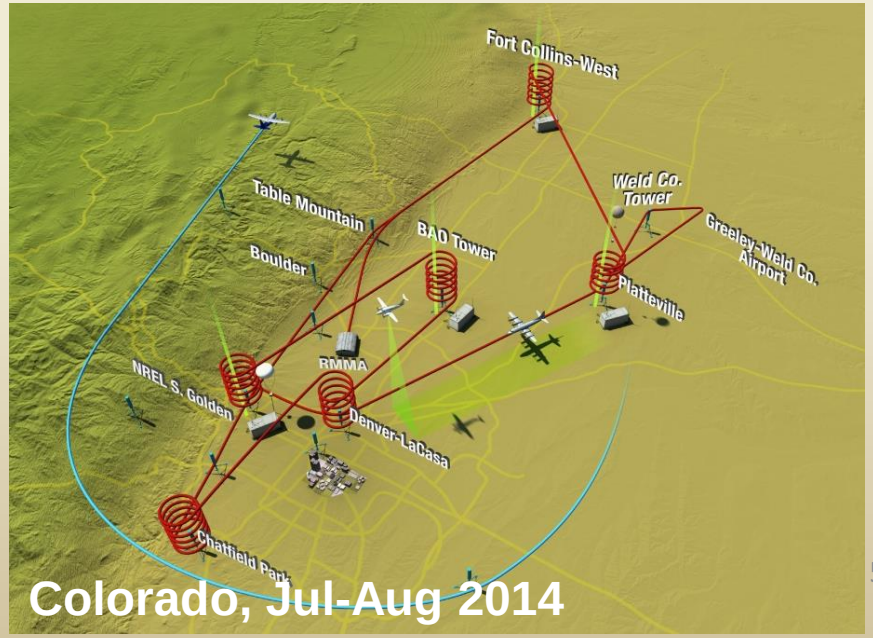


Maryland, July 2011



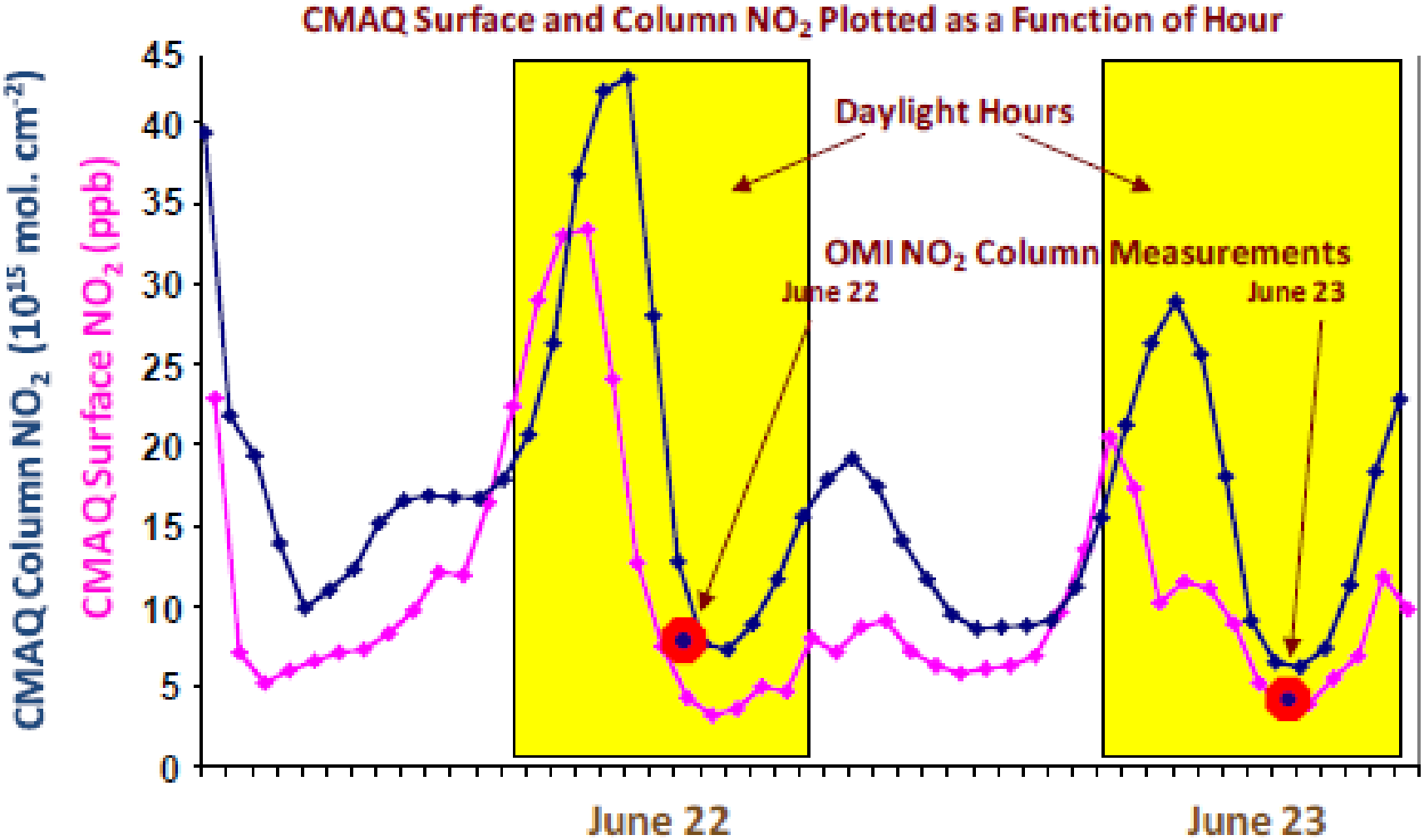
Houston, September 2013

California, Jan-Feb 2013



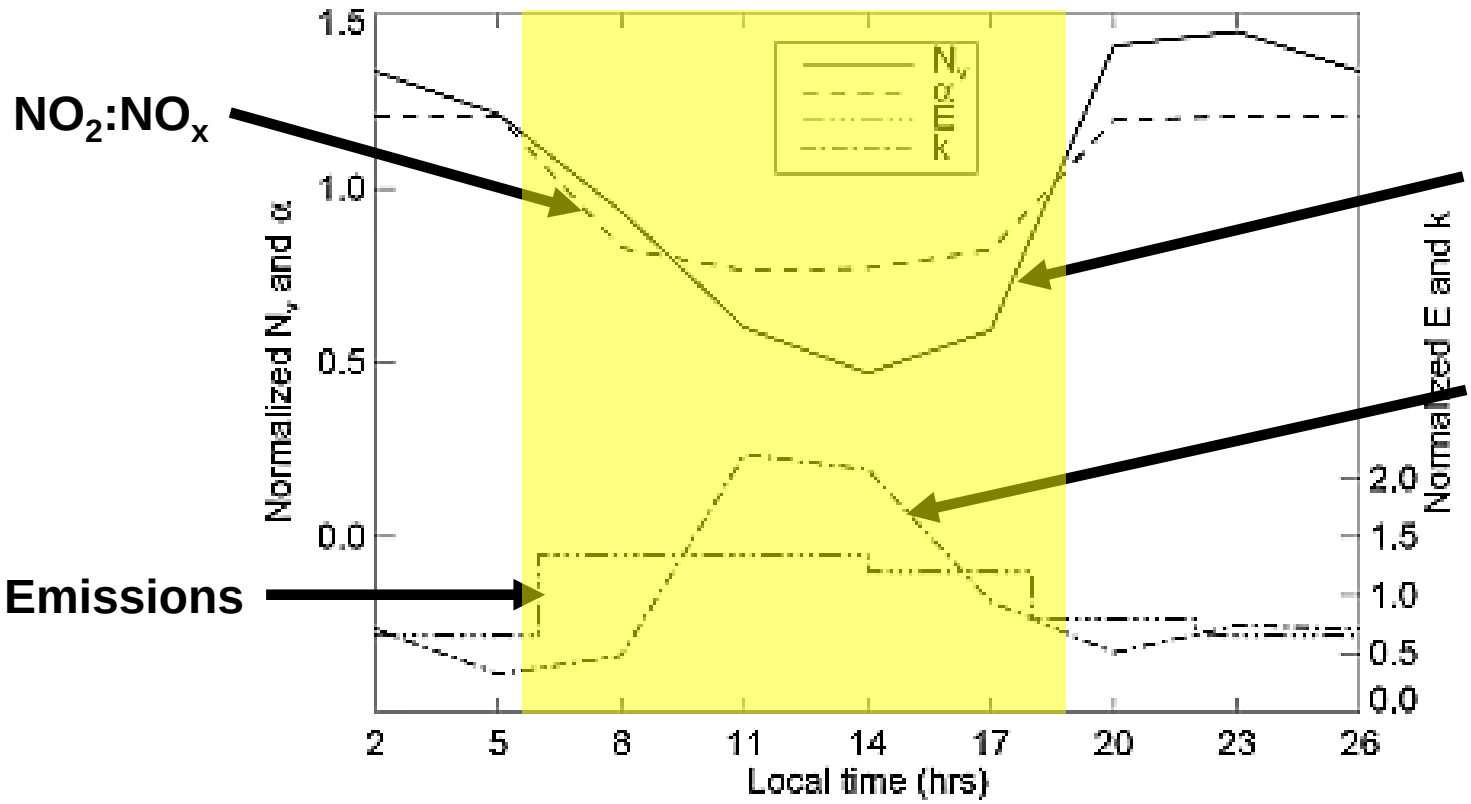
Colorado, Jul-Aug 2014

Predicted NO_2 Column Behavior



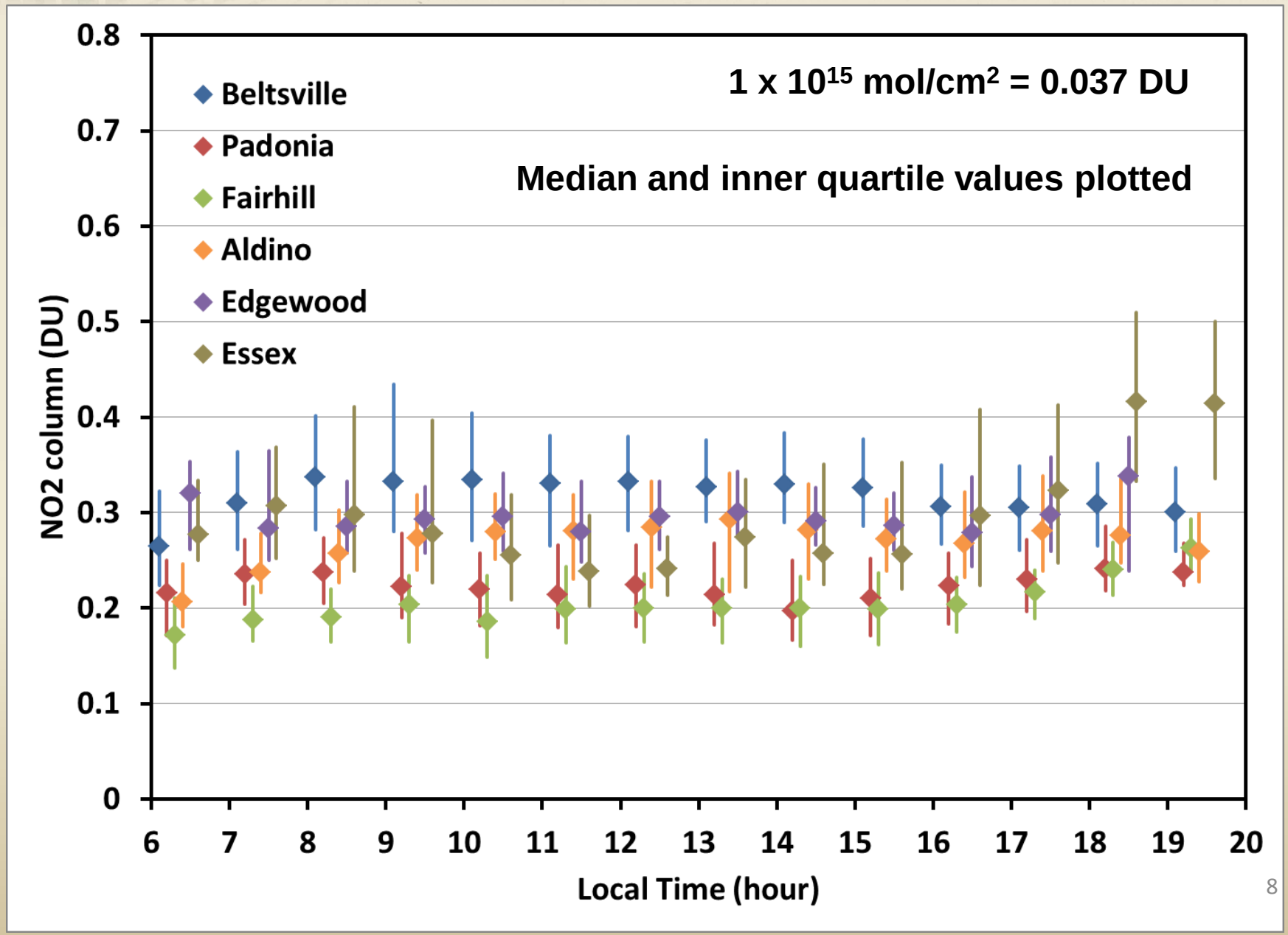
Taken from Fishman et al., BAMS, 2008

Predicted NO_2 Column Behavior



Taken from Boersma et al., JGR, 2008

Pandora Statistics-Maryland



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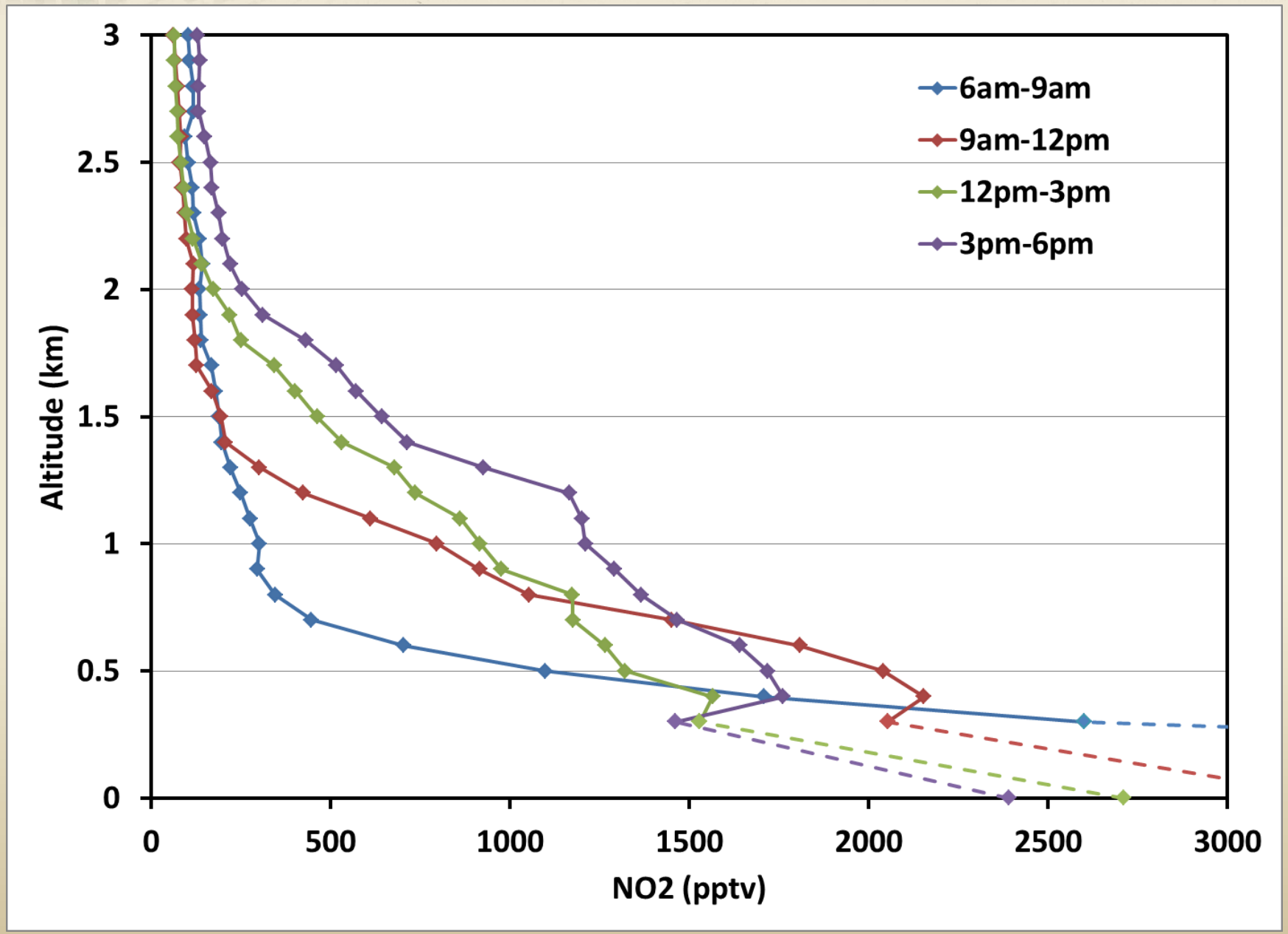
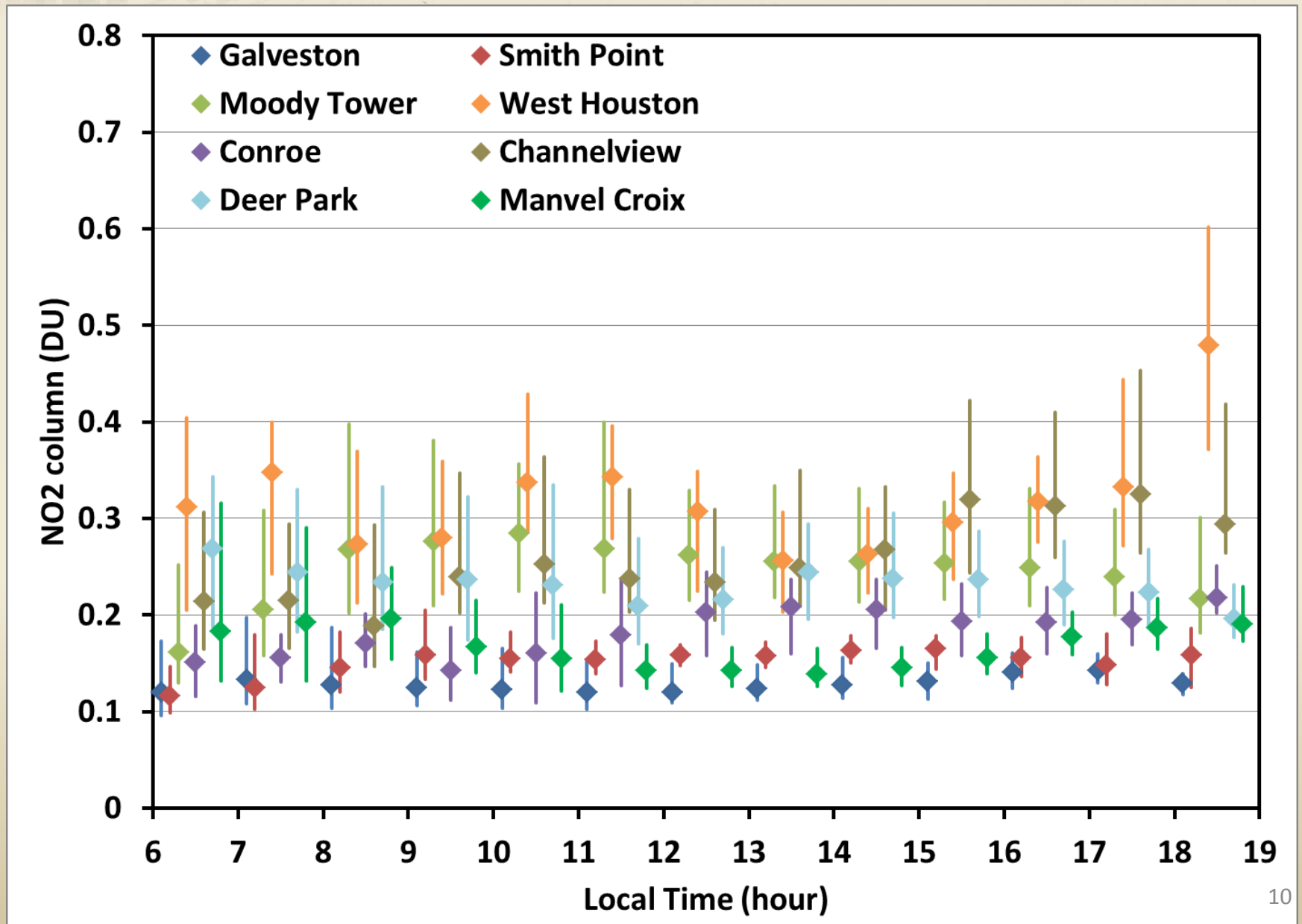
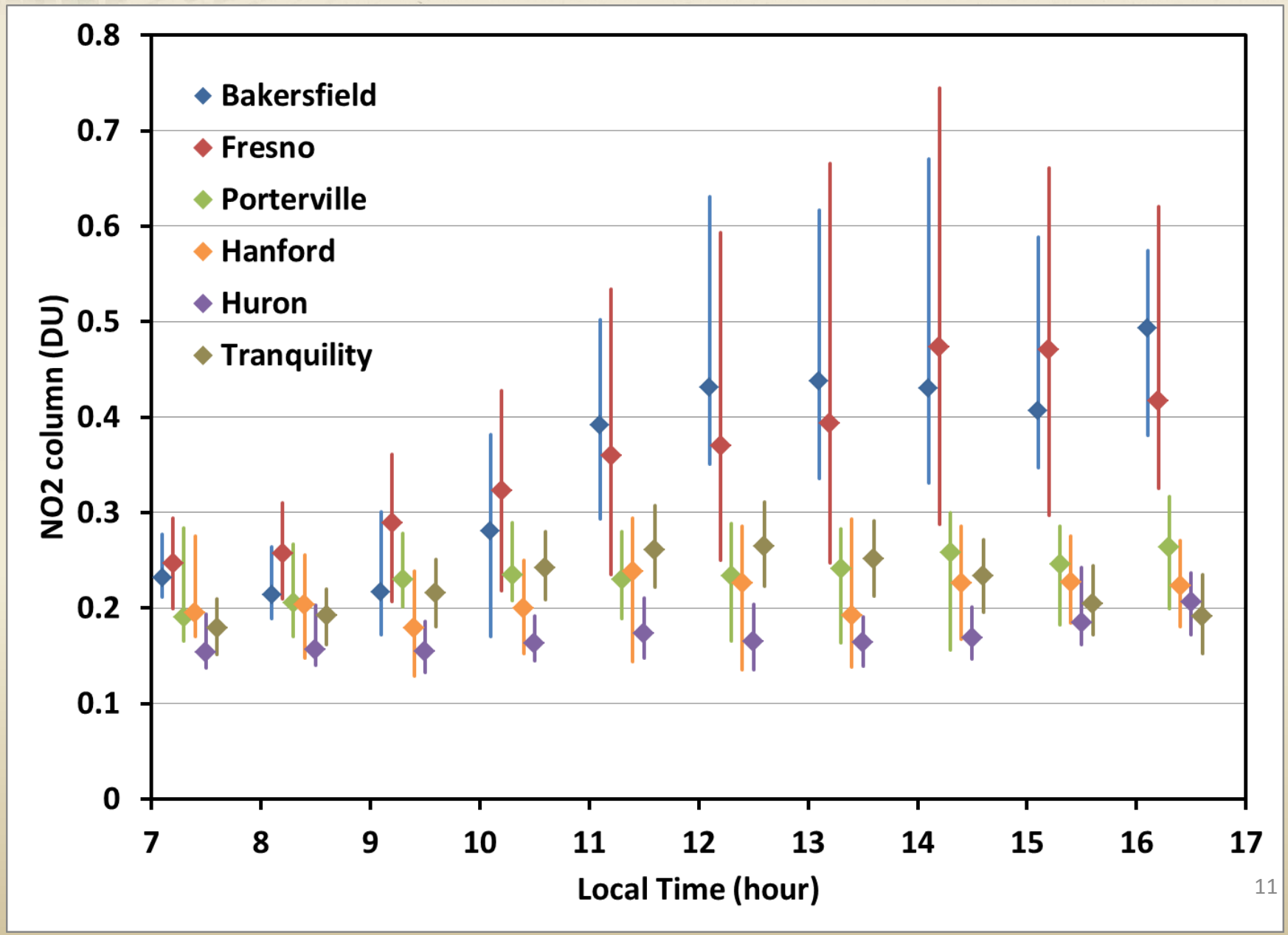
P-3B Average Profiles-Maryland



Pandora Statistics-Houston



Pandora Statistics-California



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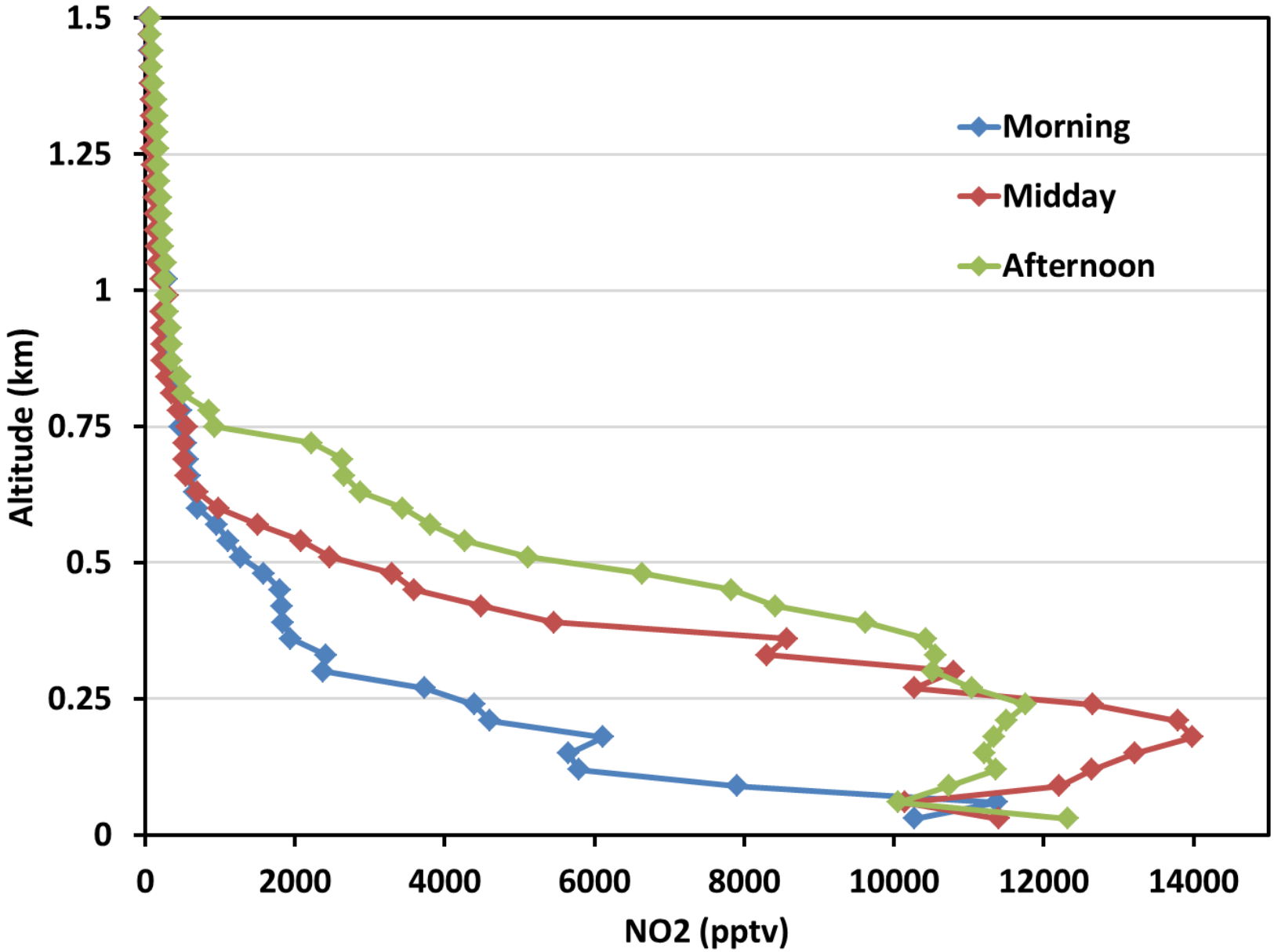
P-3B Profile Statistics-California



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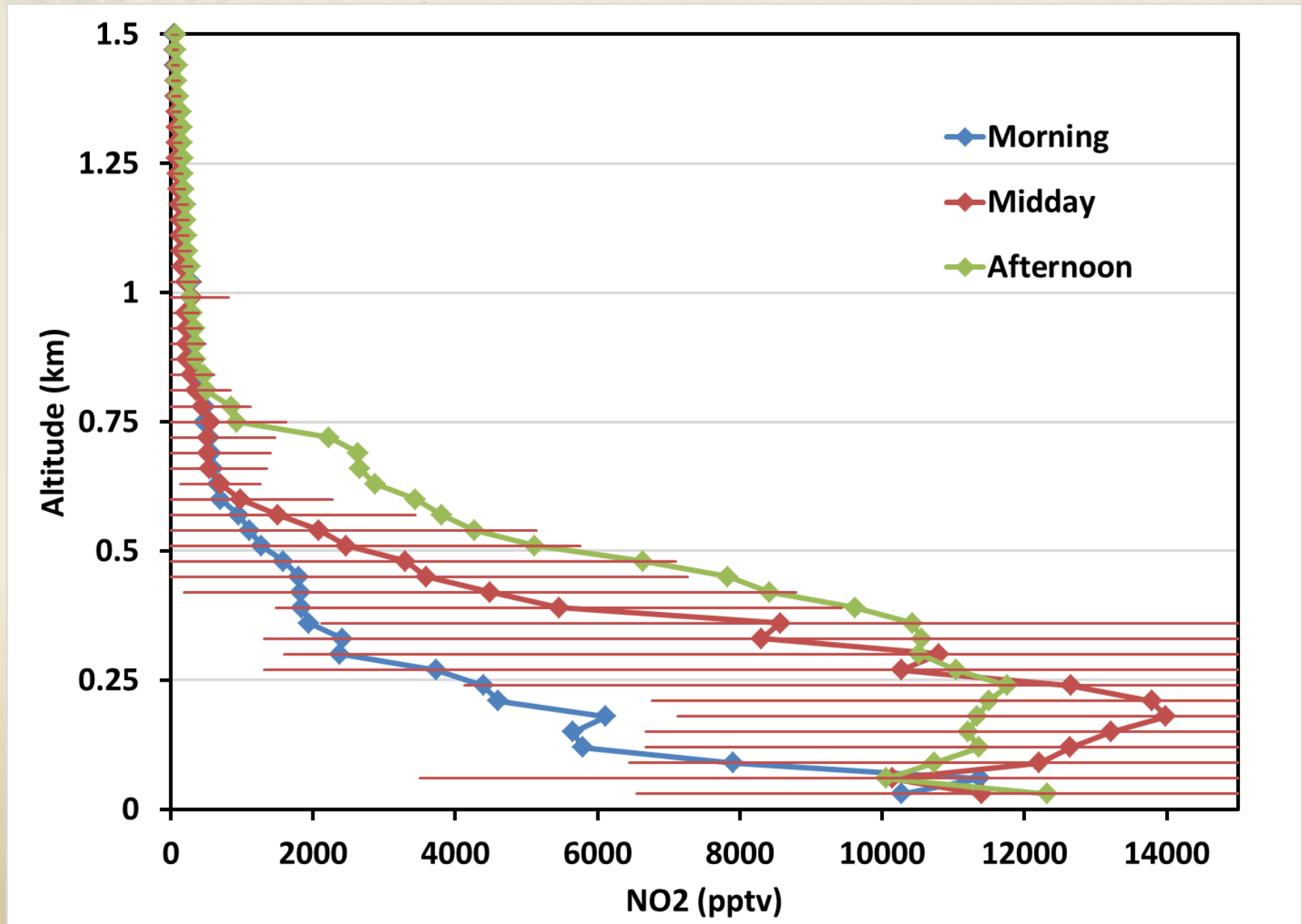

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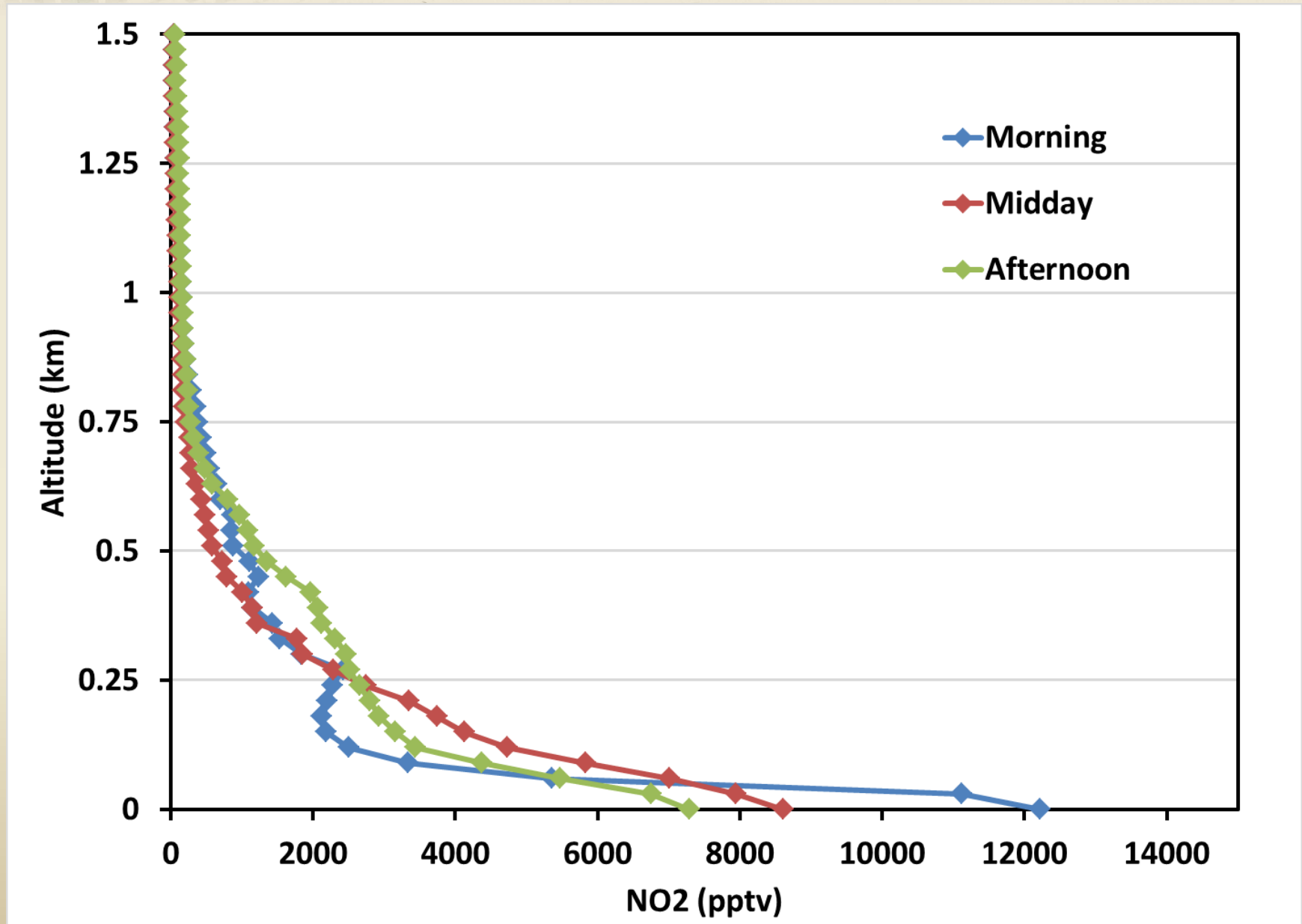
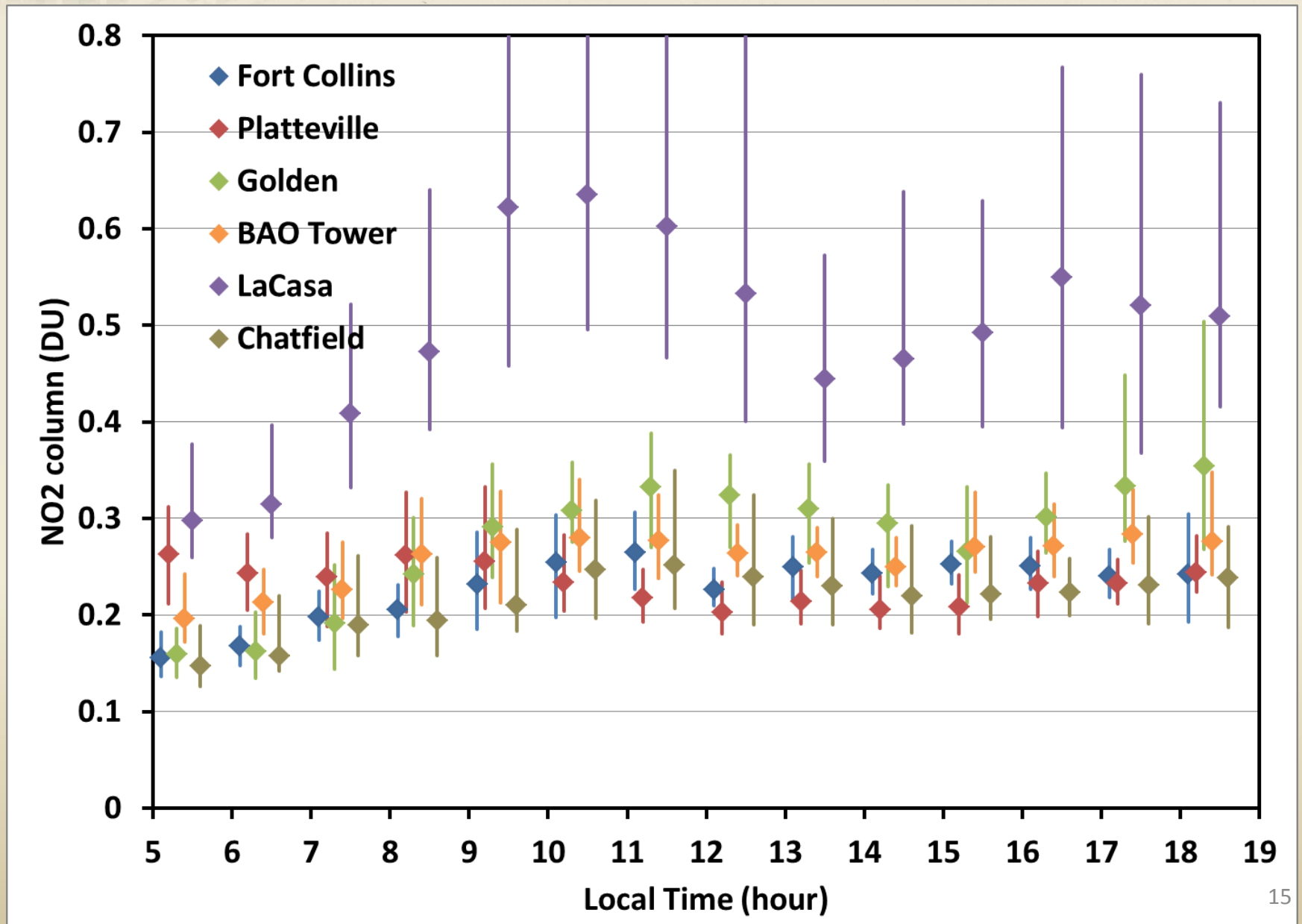
P-3B Profile Statistics-California



Pandora Statistics-Colorado



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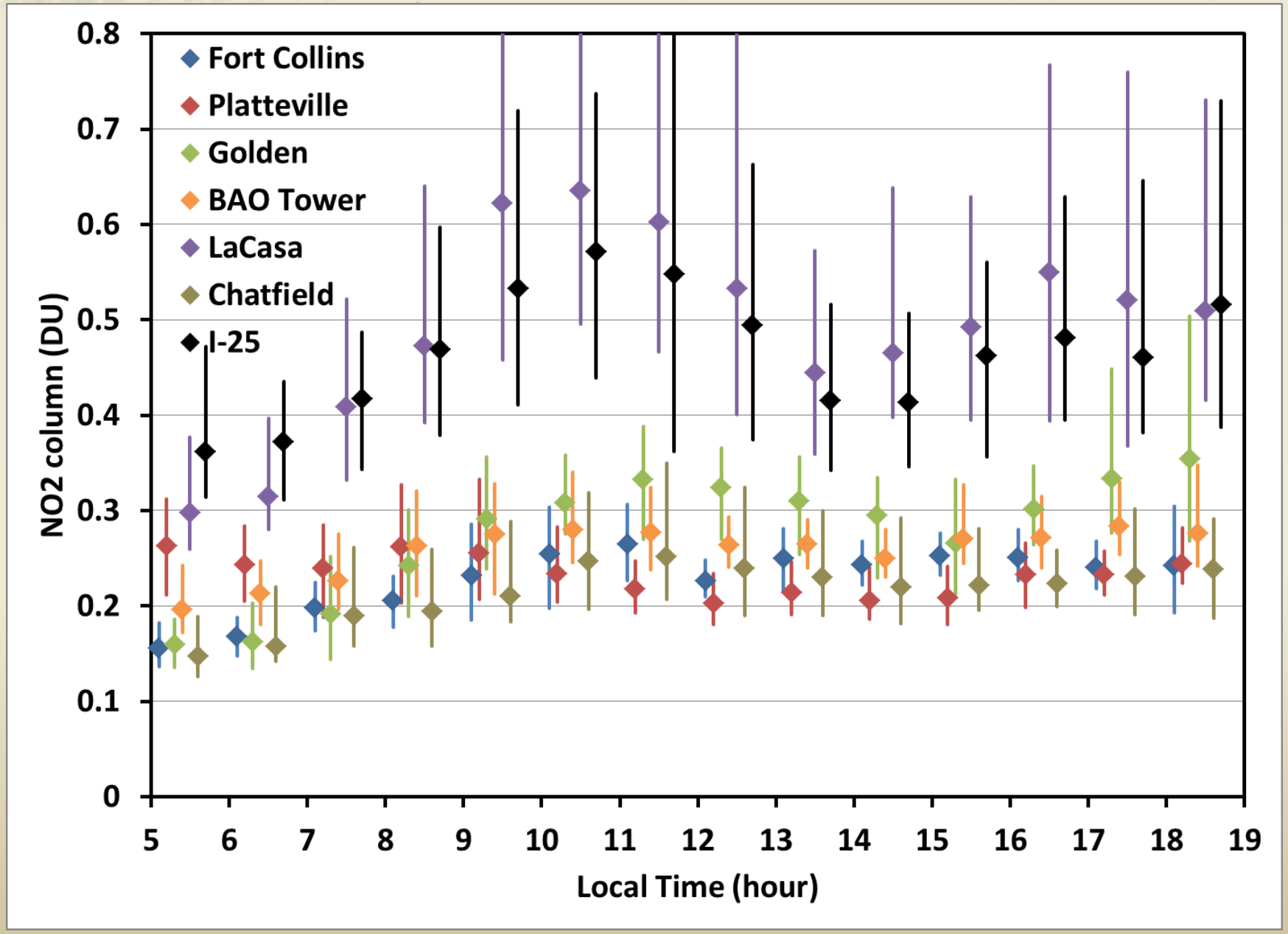
Pandora Statistics-Colorado



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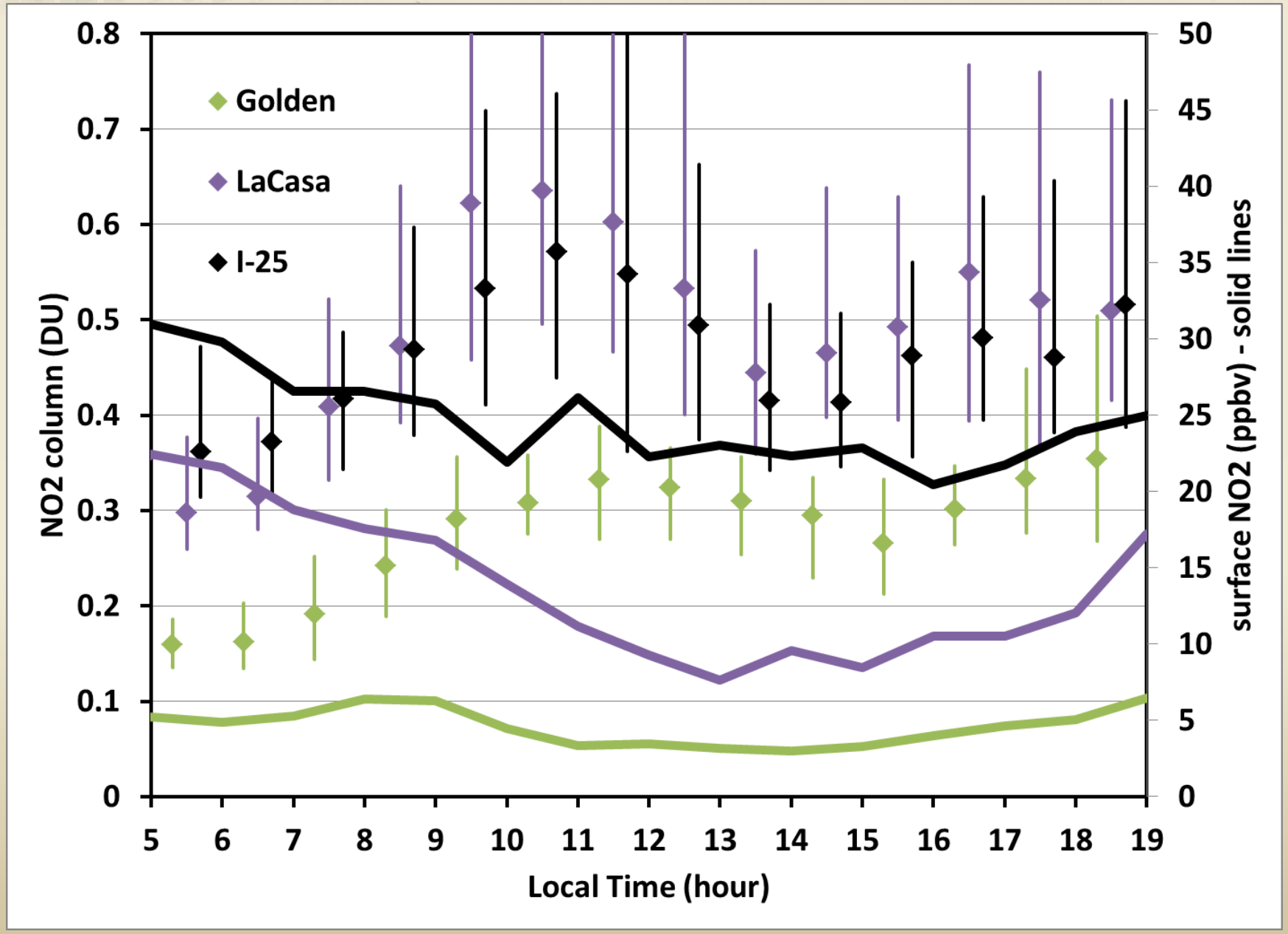
Pandora vs Surface-Colorado



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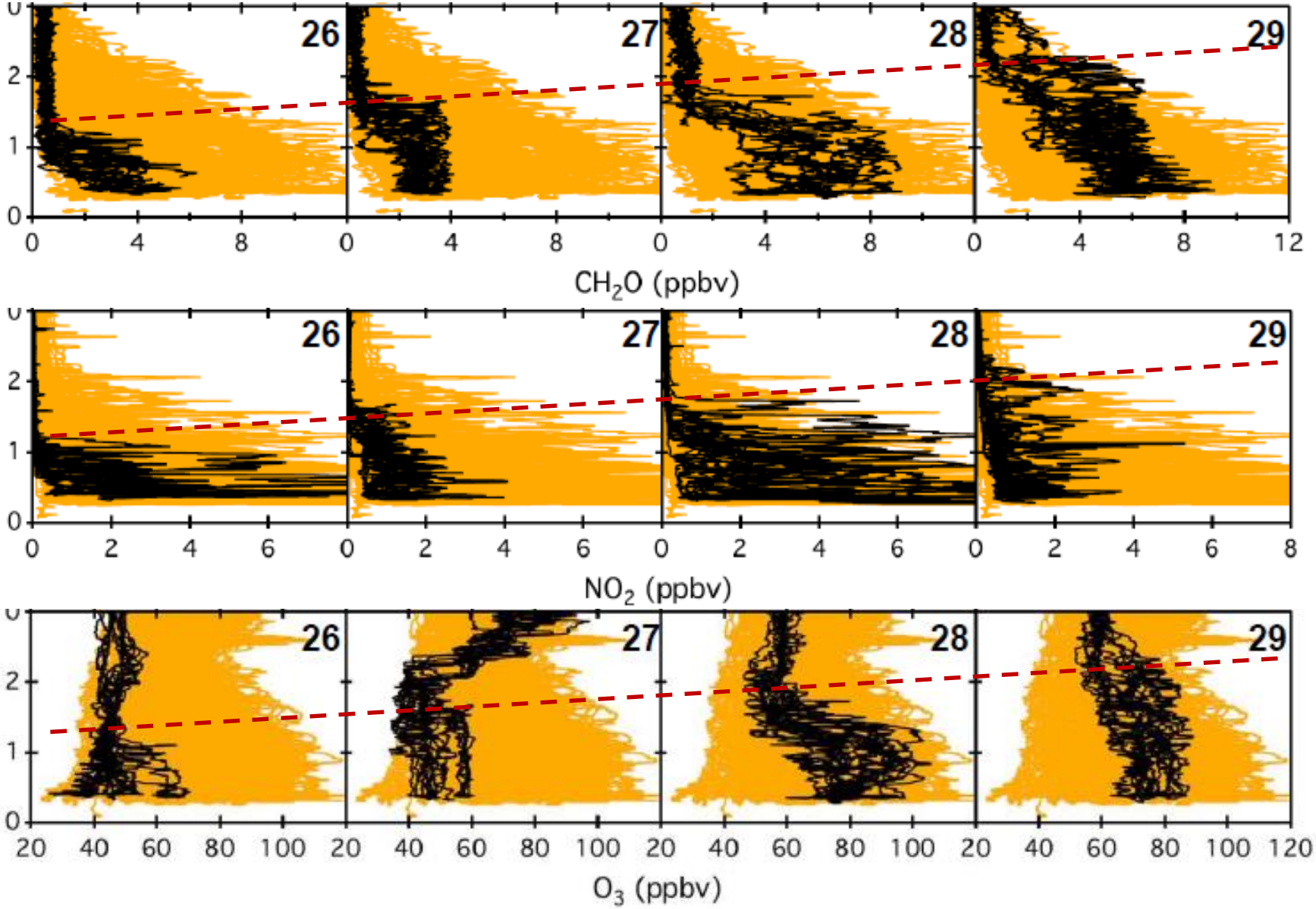
P-3B Profiles, 26-29 July-Maryland



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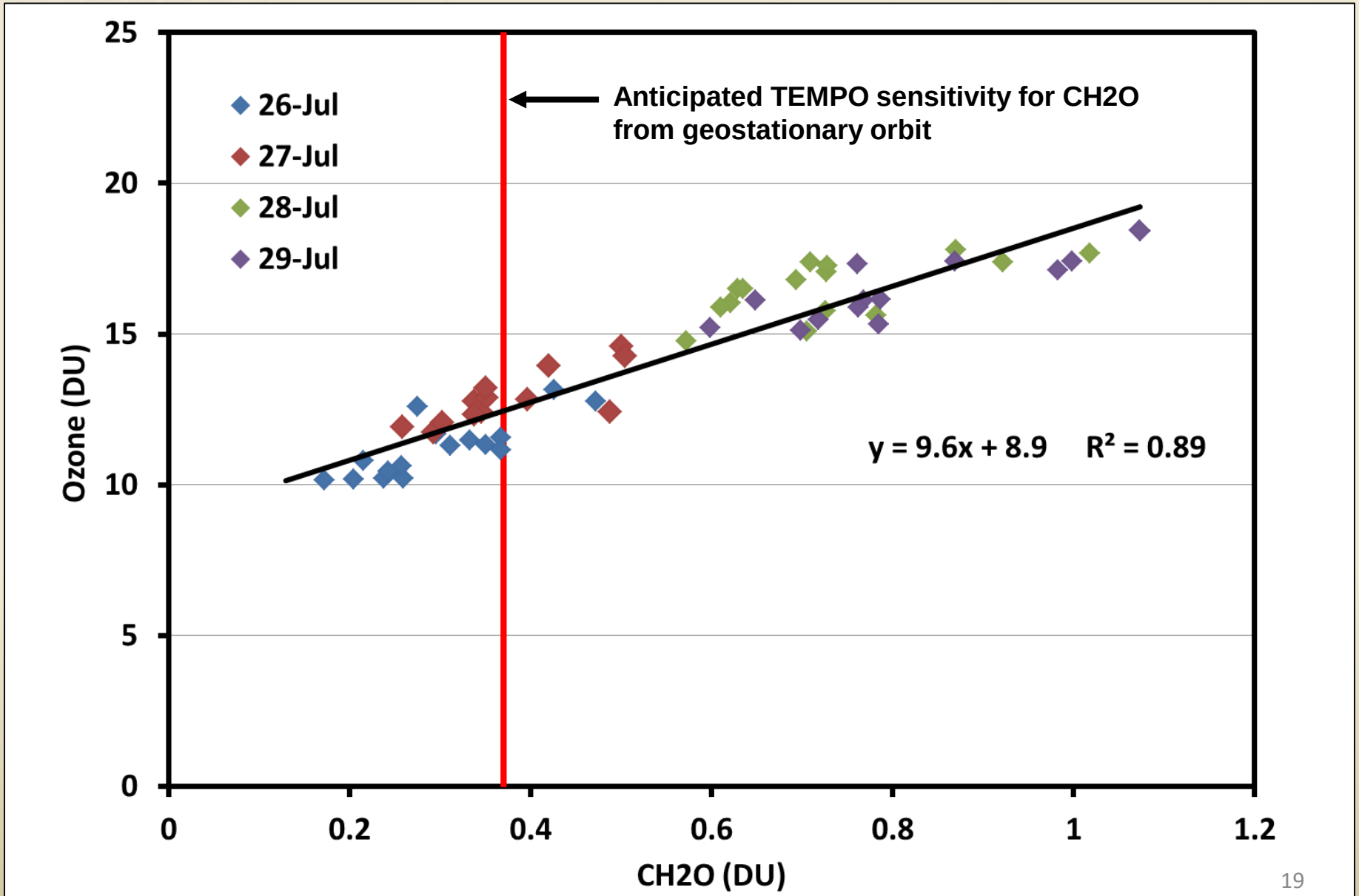
P-3B Integrated Column Densities



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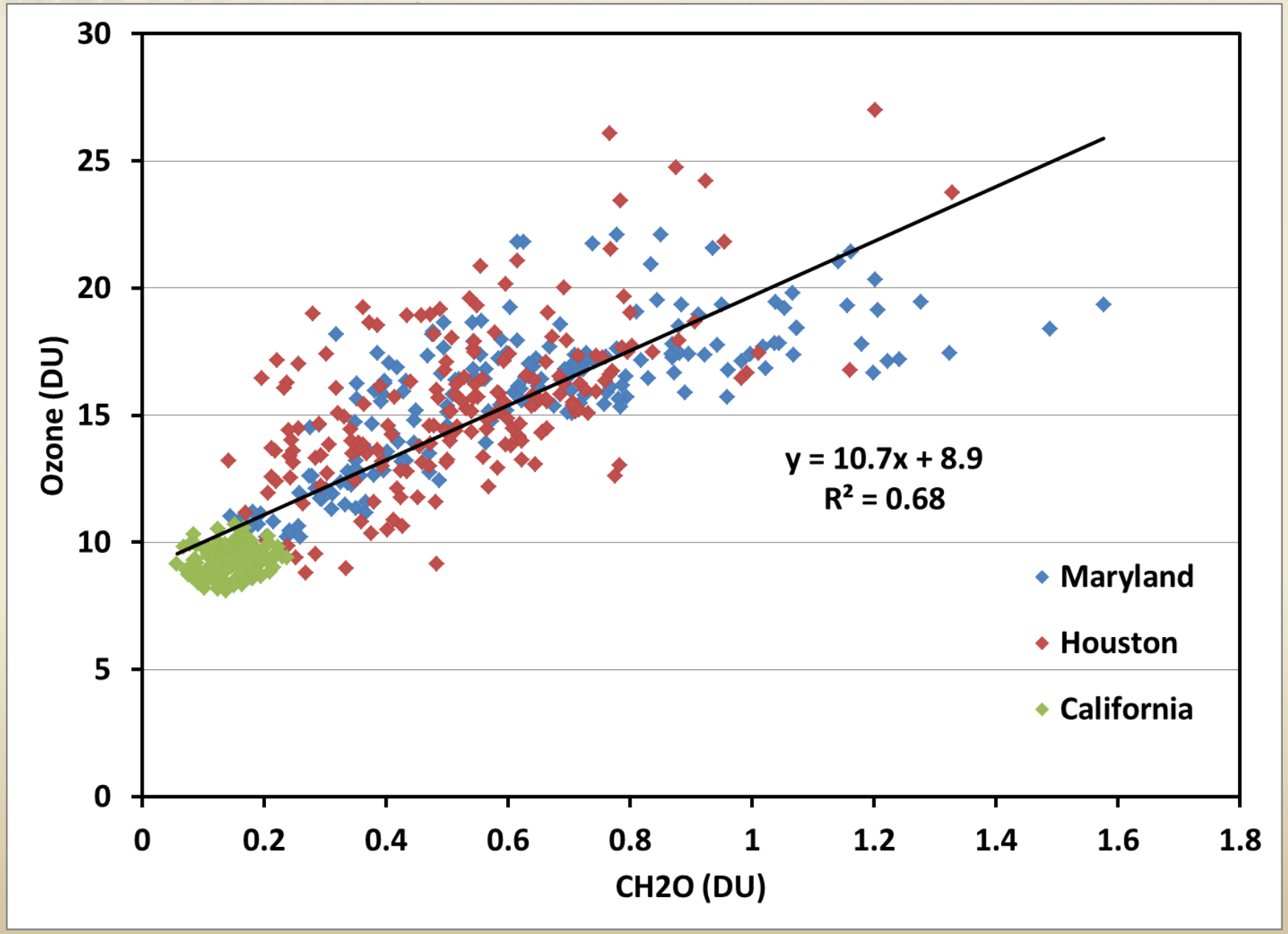
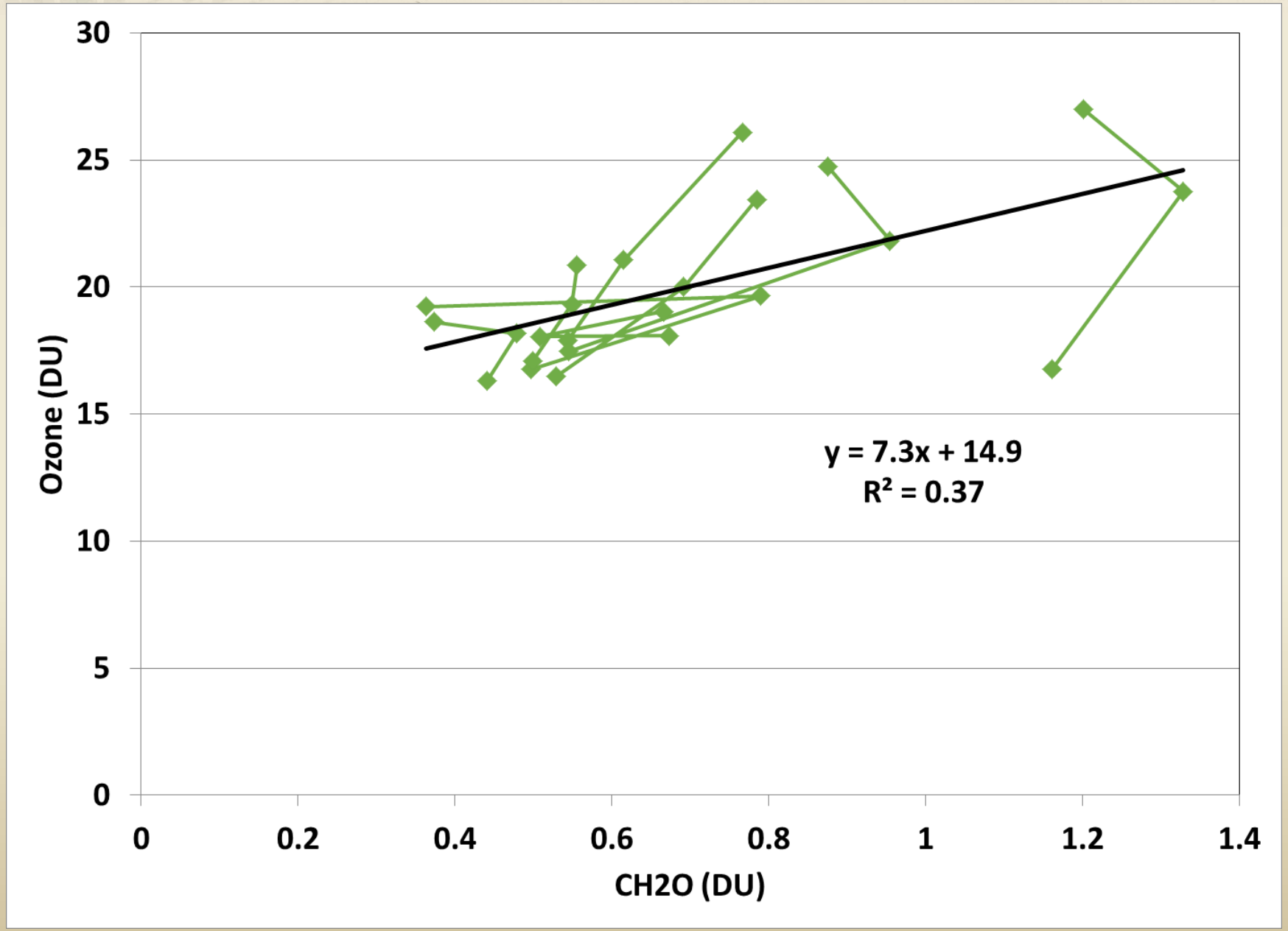
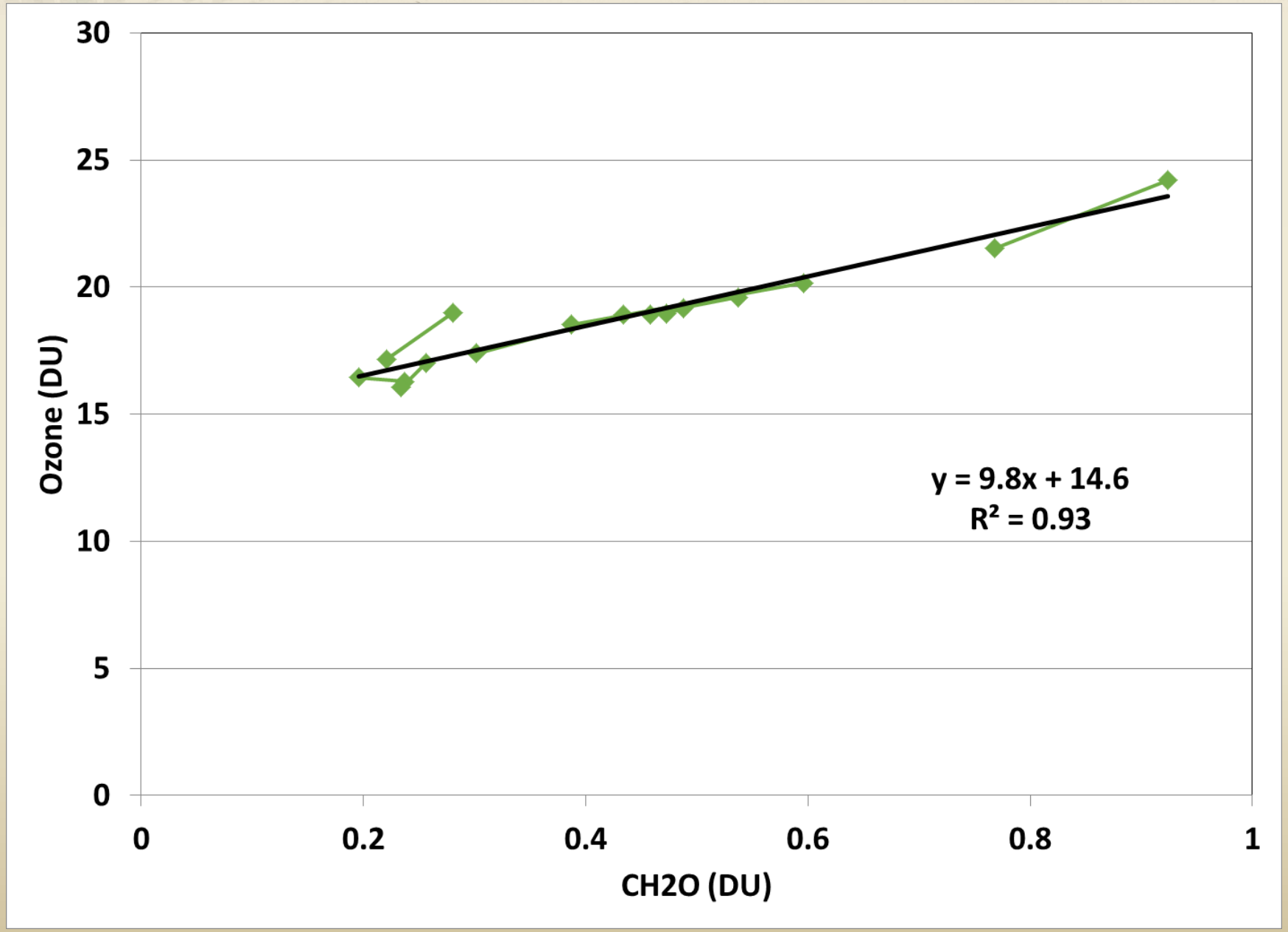
P-3B Integrated Column Densities



Houston, 25 September



Houston, 26 September



Summary

1. DISCOVER-AQ has collected a dataset of unprecedented detail on the diurnal trends in air quality as it is discerned from in situ and remote sensing methods.

2. NO_2 columns exhibit both unexpected and diverse diurnal trends that are consistent with vertically resolved profiles.

3. Correlations between column CH_2O and O_3 present an encouraging prospect for using satellite observations of CH_2O as a proxy for boundary layer O_3 production.