Monthly Webex Tag-up, 28 January 2016

Agenda

1. Update on Science Progress

2. Science Presentations

Science Progress

- ***A search on Web of Science indicates that publications associated with the project have increased from 26 to 40 since last fall (41 if you include the paper just published in ACP by Andreas Beyersdorf).***
- ***There are still many potential manuscripts that we need to monitor. We will be combining the lists from the science team meeting and AGU to see where we stand.***
- ***Don't forget that we still have enough funding to pay publication costs.***
- ***NASA's ROSES solicitation will be released in February. During the next telecon we will discuss what opportunities are available to propose for additional analysis.***

Evaluation of Vertical Mixing and Pollutant Shape Factors in WRFChem during DISCOVER-AQ July 2011

Clare Flynn, Melanie Follette-Cook, Kenneth Pickering, Christopher Loughner, Rich Ferrare, Amy Jo Scarino, James Crawford, Andrew Weinheimer, Glenn Diskin

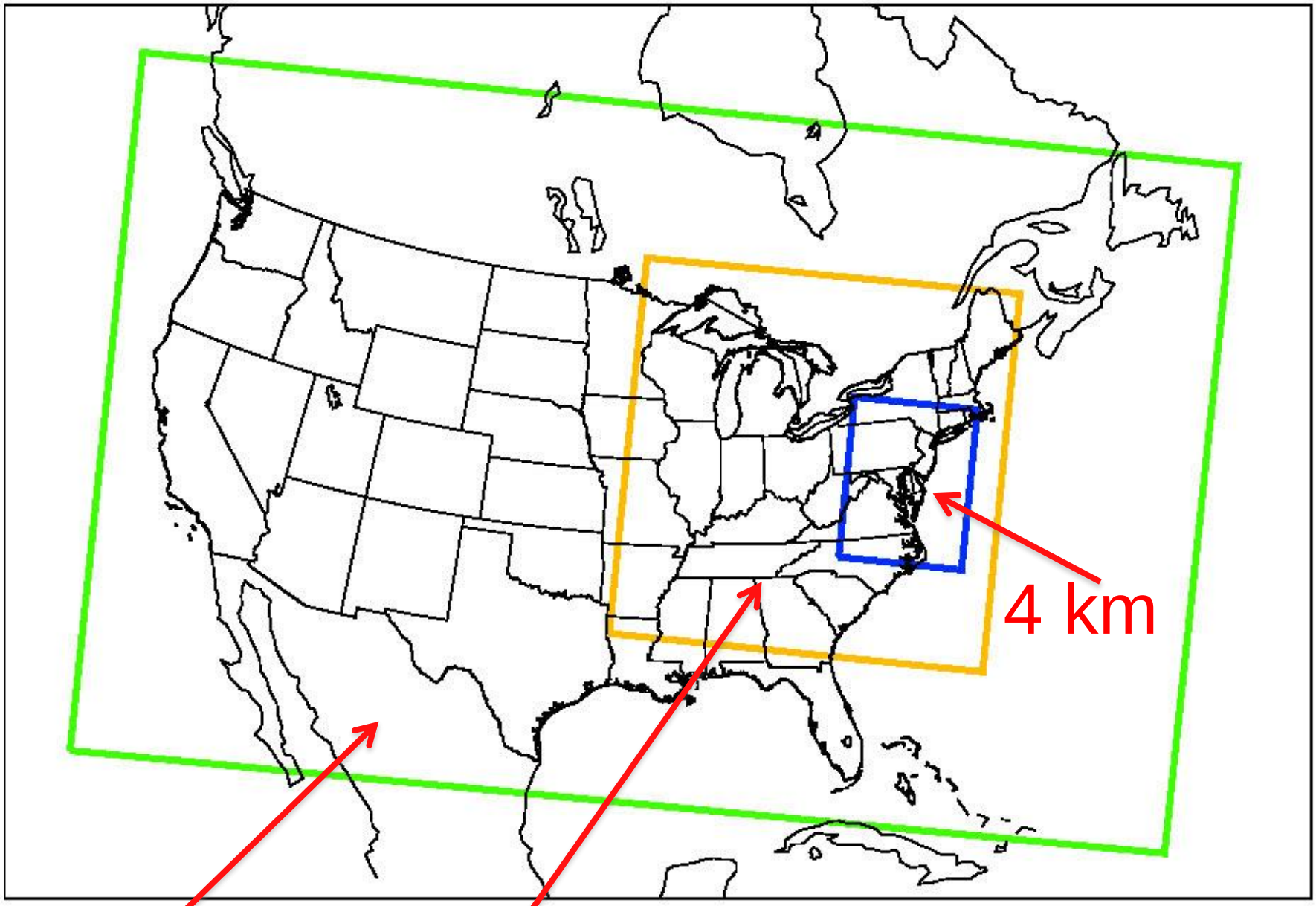
January 28, 2016

Motivation

- Model profiles are used a *a priori* information in the conversion of satellite-retrieved slant column abundances to vertical column abundances

- Column-surface correlations in CMAQ vs. P3B indicate that the WRF/CMAQ model system overestimations vertical mixing, with effects on the simulated profile and hence column-surface connection

- How well do model profiles represent those observed during DISCOVER-AQ Maryland?


4 km
36 km
12 km

WRFChem v3.7.1 Simulation Options

Maryland D-AQ Campaign	
Time Period	July 22 through August 1, 2011 Focus of analysis: July 26-29, 2011
Chemical mechanism	CBM-Z
Aerosols	MOSAIC with 4 aerosol bins
Radiation	Longwave - RRTM Shortwave - Goddard
Meteorology and Chemical Inputs	NARR; MOZART-4 CTM
Land Surface Model	unified Noah LSM
Photolysis	Fast-J
Nudging	Observational and analysis nudging
Damping	Vertical velocity and gravity waves damped at top of modeling domain

PBL Schemes Evaluated

- Local mixing schemes
  - Mixing between adjacent vertical layers only (K-theory)
  - Based on diagnosis of turbulent kinetic energy (TKE) at each grid point
  - Solve for eddy diffusivities from TKE and the mixing length scale at each grid point

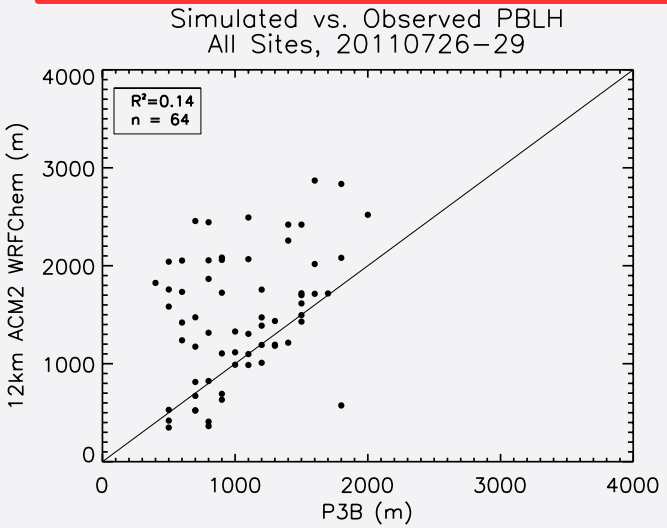
  - WRF PBL Schemes: MYJ, QNSE, BouLac

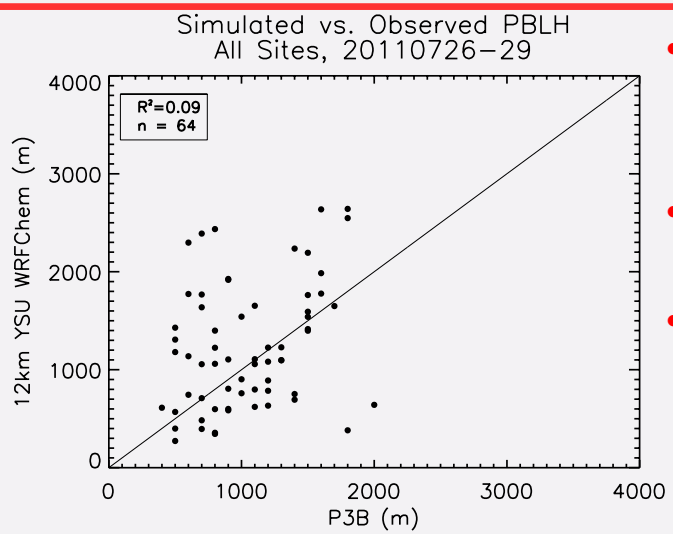
PBL Schemes Evaluated

- Non-local mixing schemes
  - Fluxes exchanged between non-adjacent vertical layers under convective conditions
  - Local mixing theory (K-theory) used to parameterize mixing under all other conditions
  - Diagnose a PBL top and then compute vertical profiles for eddy diffusivities

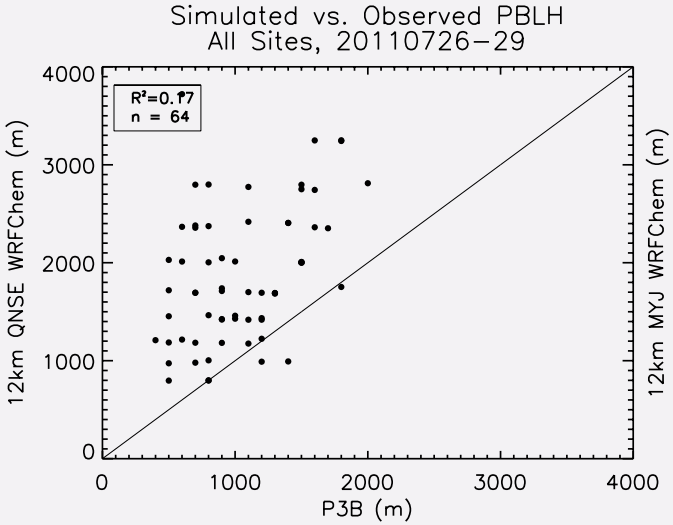
  - WRF PBL Schemes: YSU and ACM2

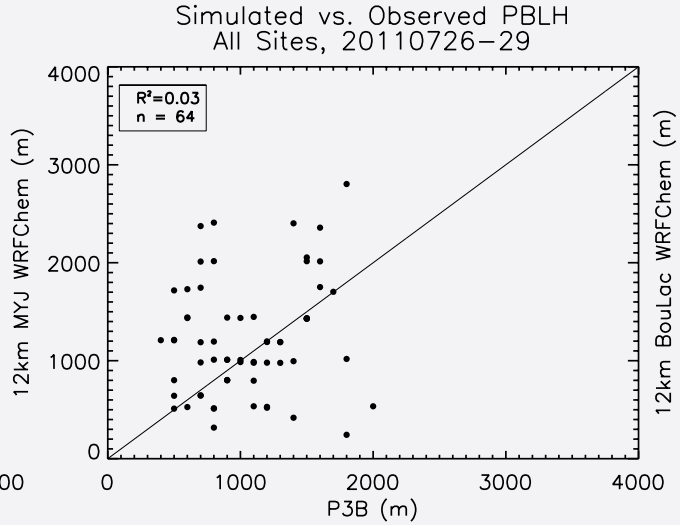
Comparison of PBLH Values

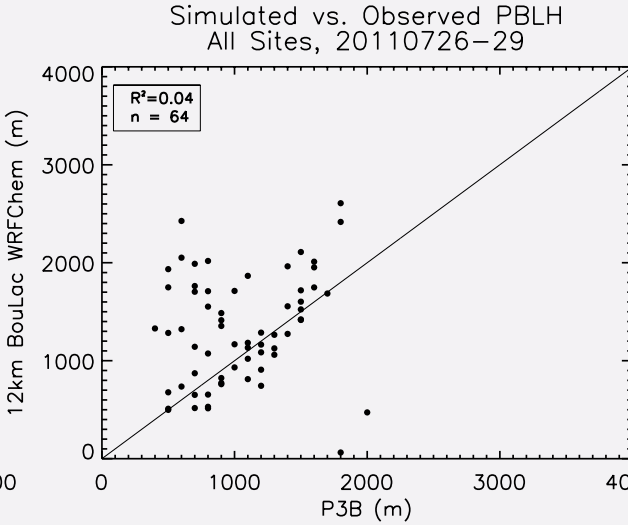




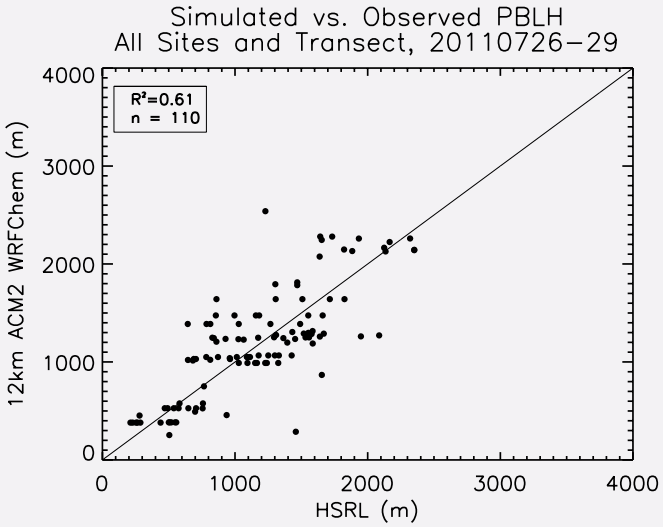
- P3B PBLH values are instantenous whereas WRFChem is hourly!
- Thus no scheme compares well
- Differences in model bias among the 5 schemes – all schemes overpredicting

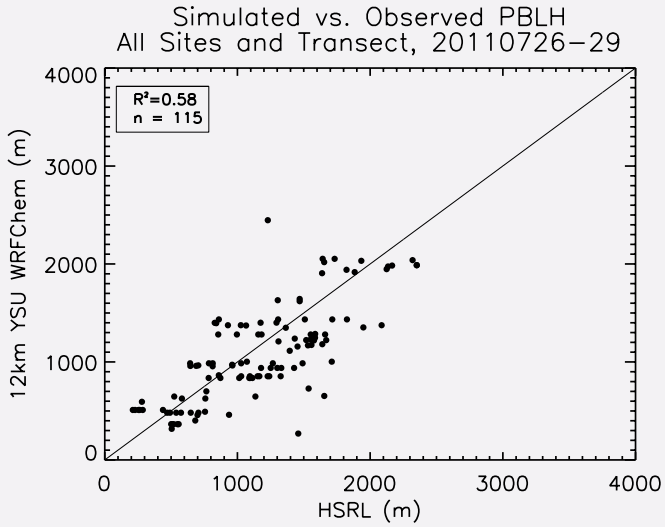




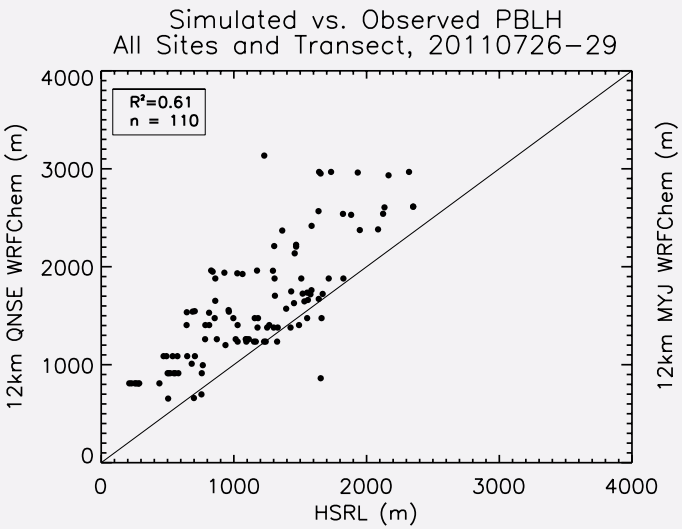


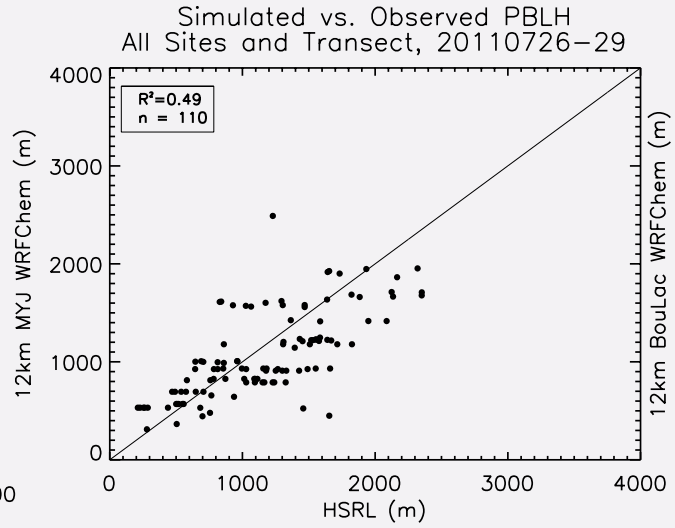
Comparison of PBLH Values

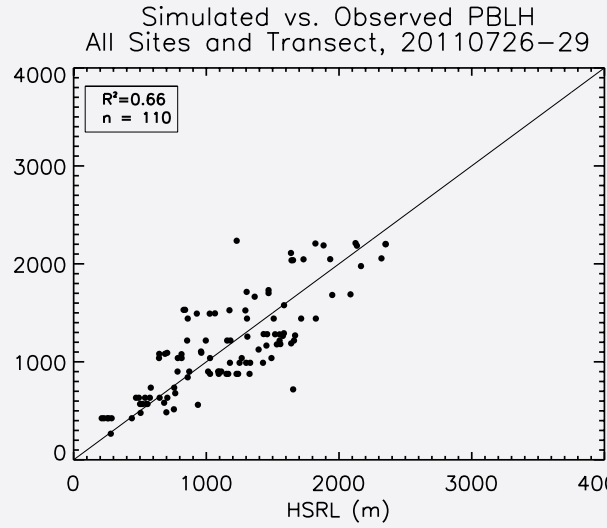




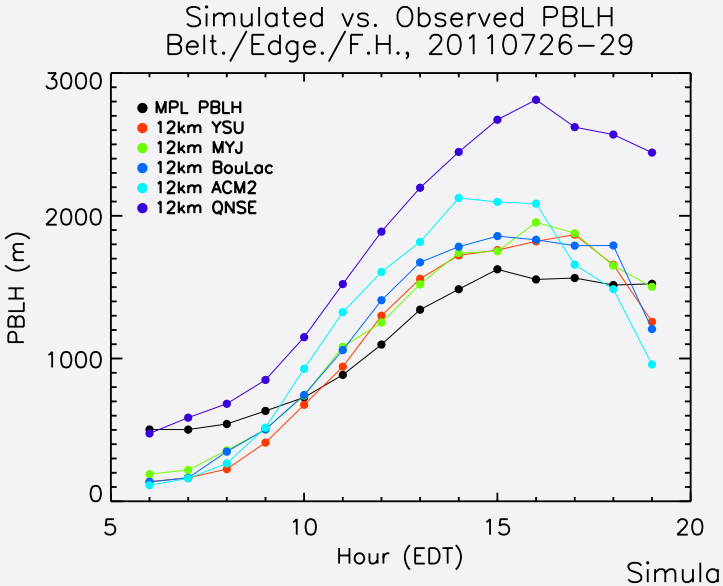
- Lidar PBLH values AND WRFChem are hourly!
- The 5 schemes compare well to HSRL and MPL
- QNSE stands out with consistent high bias

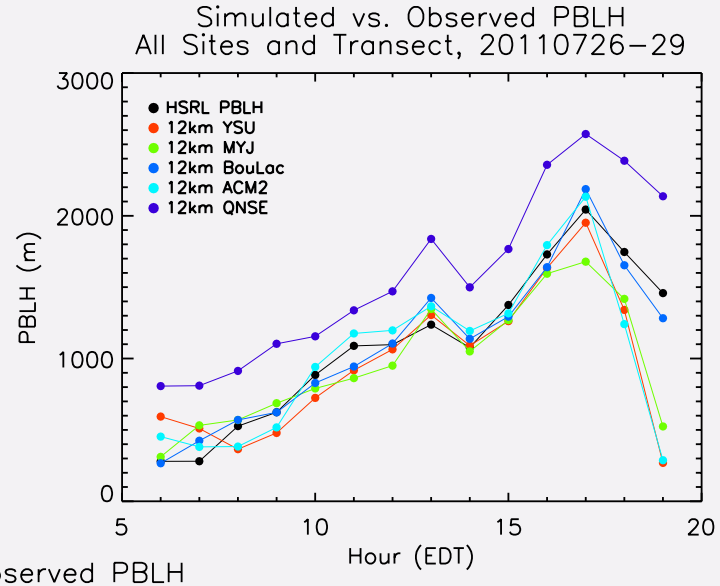


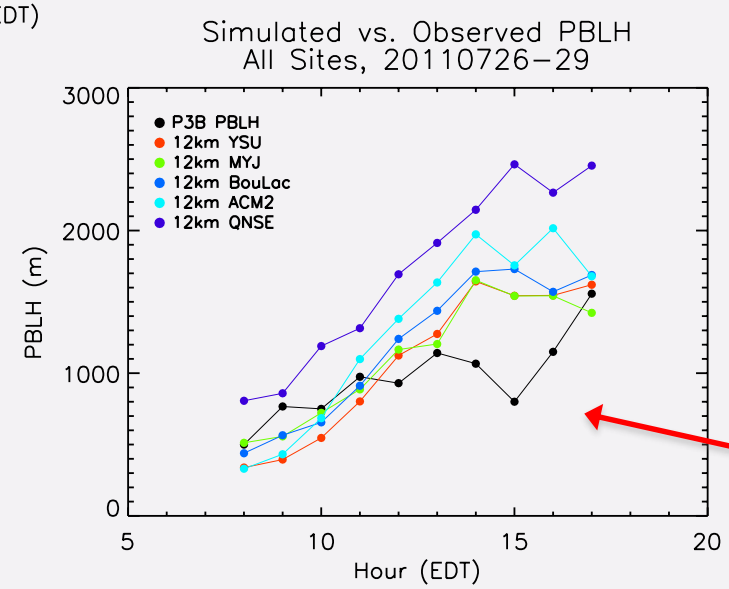




PBLH Average Diurnal Behavior



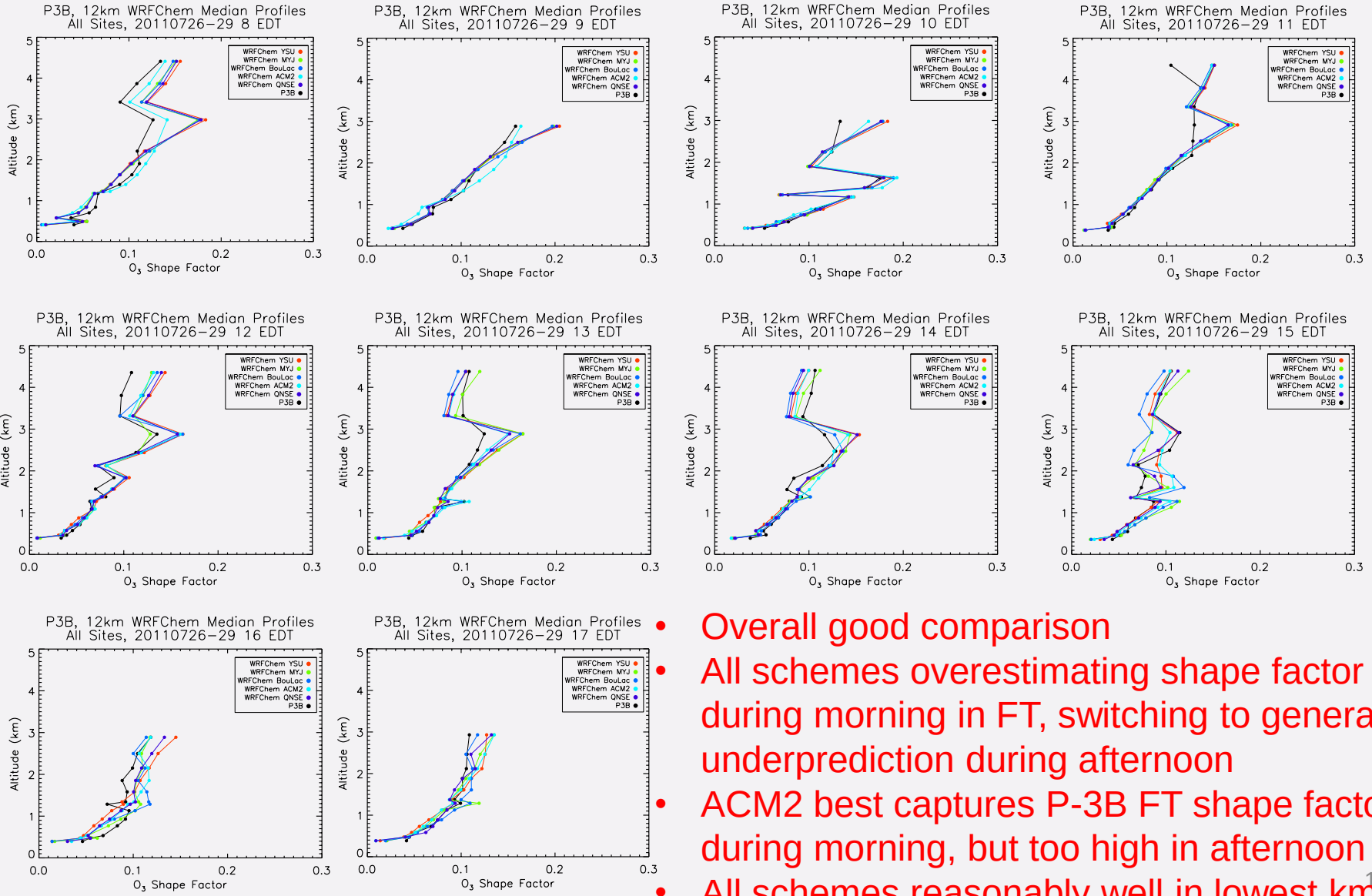




QNSE clear, consistent high bias in PBLH vs. all three observational data sets

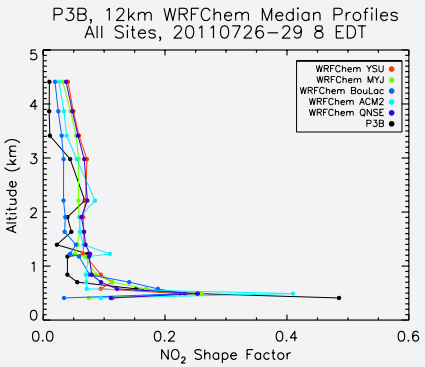
Due to low values at Aldino, Beltsville, and Padonia, on July 28 and 29

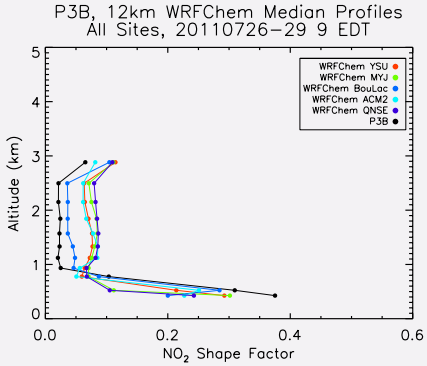
O_3 Median Shape Factors – Diurnal Cycle

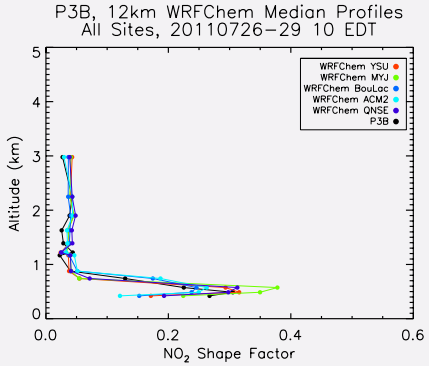


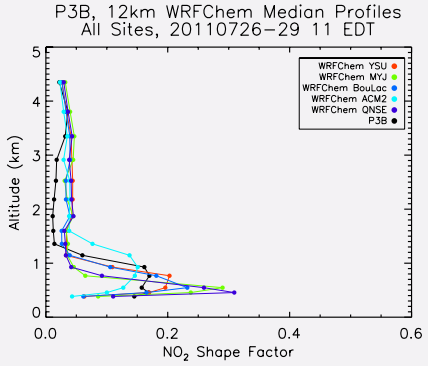
- Overall good comparison
- All schemes overestimating shape factor during morning in FT, switching to general underprediction during afternoon
- ACM2 best captures P-3B FT shape factors during morning, but too high in afternoon
- All schemes reasonably well in lowest km

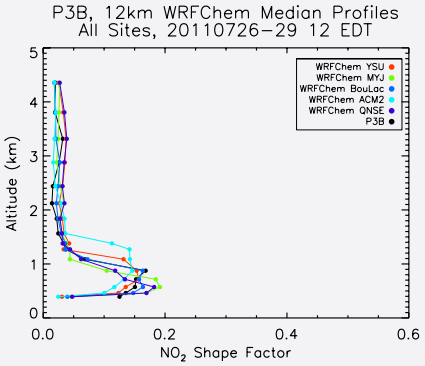
NO_2 Median Shape Factors – Diurnal Cycle

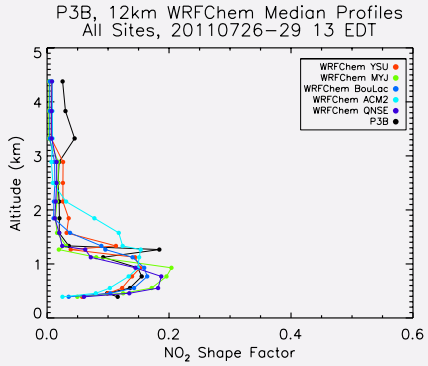


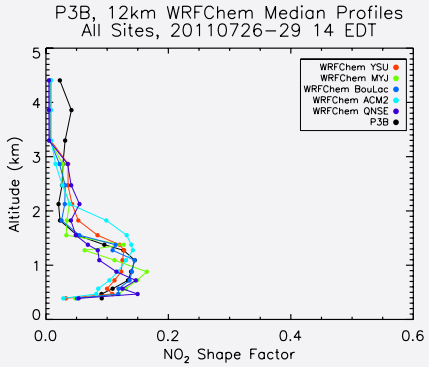


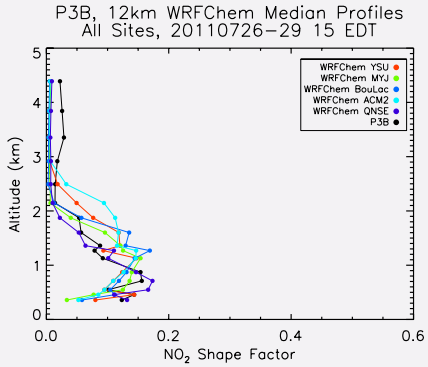


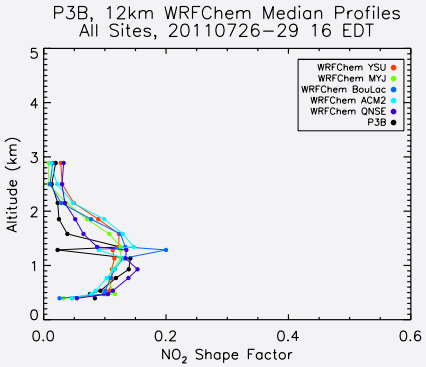


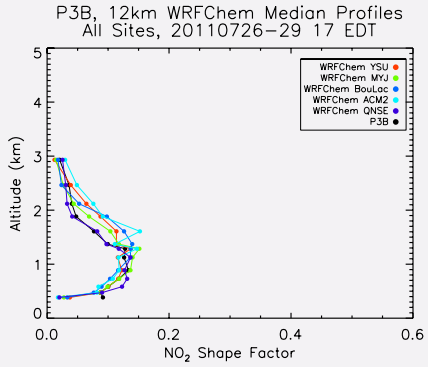












- ACM2 again performs best relative to P-3B during morning, but no scheme compares well
- ACM2 overpredicts during most of afternoon, though ACM2 seems to pick up on features other schemes miss
- Shape factor behavior in the lowest levels difficult for PBL schemes to capture

Some Conclusions

- No clear winners emerged among WRFChem PBL schemes relative to P-3B, MPL, or HSRL PBLH or MLH values – QNSE clearly overpredicting relative to other schemes, observations

- Each WRFChem PBL scheme captured the average diurnal cycle of PBLH relative to the observations

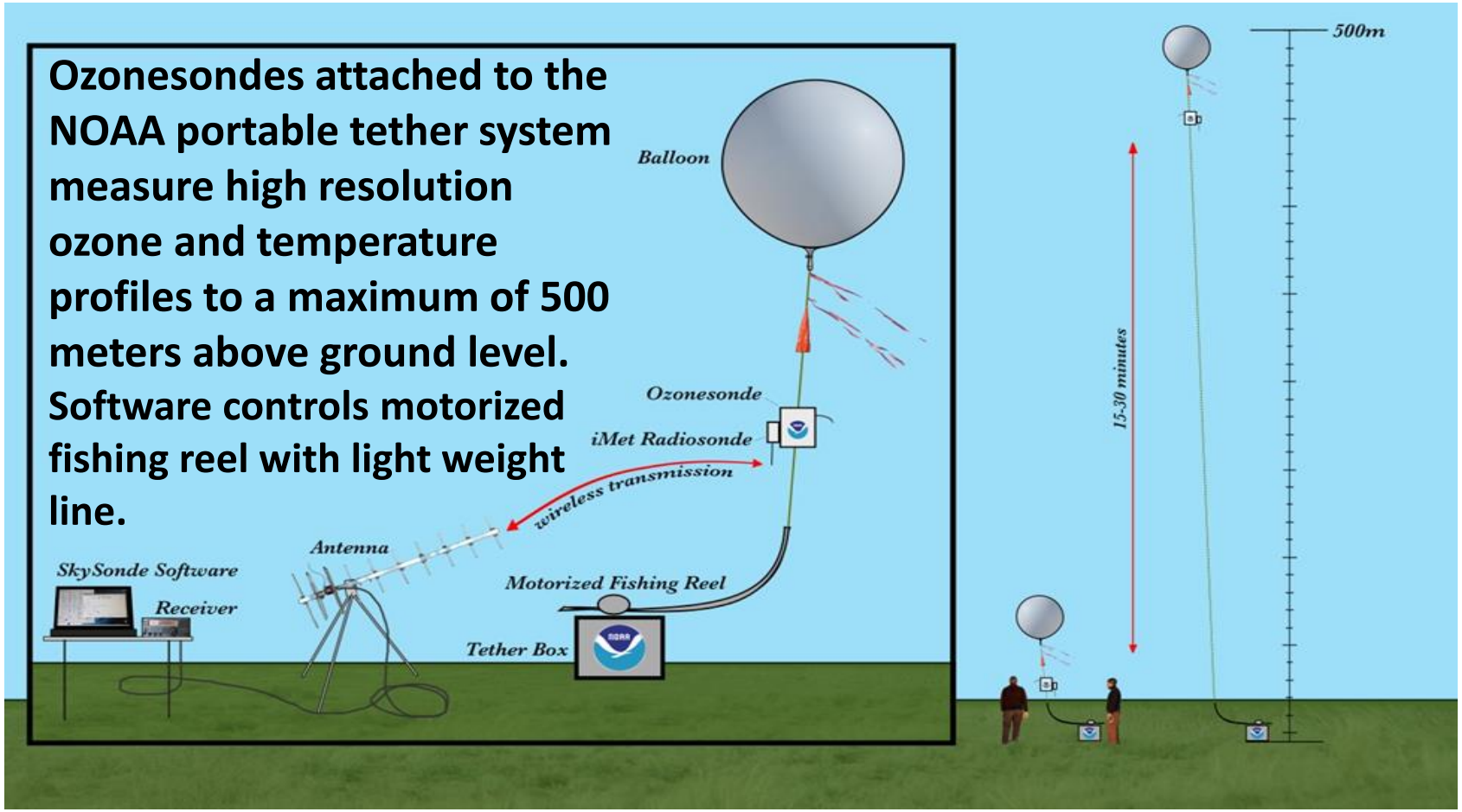
- Each PBL scheme captures the diurnal behavior of the observed P-3B O_3 median shape factors, except in the FT above ~2 km

- Each PBL scheme captures the diurnal behavior of the observed P-3B NO_2 median shape factors, except in the lowest model layers in the morning and in the mid to late afternoon at levels above 1-1.5km

- Next steps include determination of any modifications that can be made to the ACM2 scheme to improve its afternoon performance for NO_2, and testing ACM2 at 4km resolution

Tethered Ozonesonde Measurements during FRAPPE

Bryan Johnson, Chance Sterling, Patrick Cullis, Emrys Hall, Allen Jordan, Jim Wendell, Russ Schnell and Sam Oltmans NOAA Earth System Research Laboratory and University of Colorado, Boulder, CO



3 sites:

Location	Latitude (°N)	Longitude (°W)	Elevation (m)	# of tether profiles - dates
Chatfield State Park	39.5344	105.0704	1676	130 profiles - 7/27, 8/2, 8/12
Denver City Golf	39.7533	104.9487	1621	88 profiles - 7/20, 8/7, 8/11,
Fort Collins -West	40.5928	105.1413	1572	126 profiles - 7/26, 8/3, 8/18

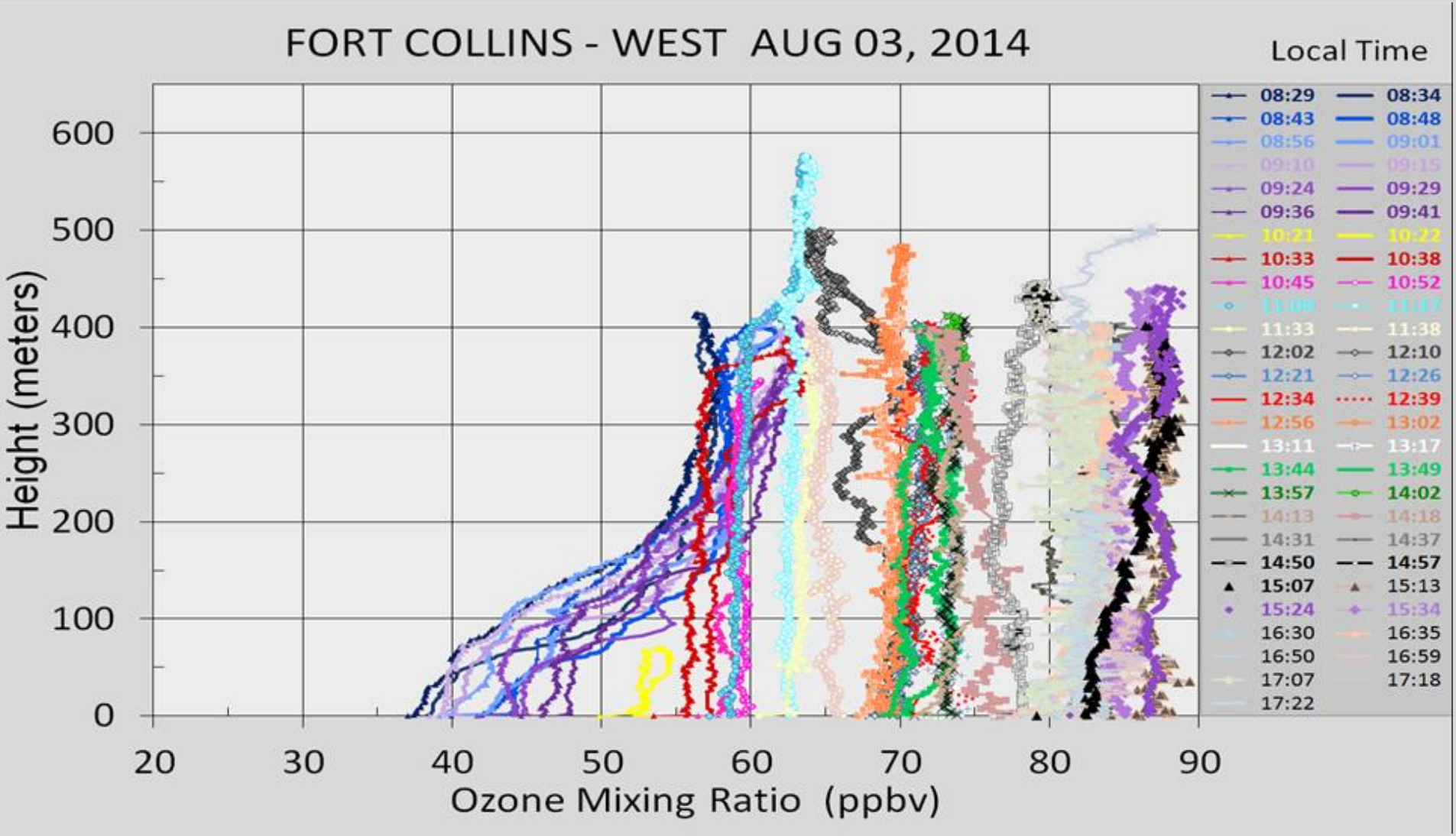


Figure 1a. Ozone mixing ratio versus height above surface showing 54 profiles measured at Fort Collins – West during high ozone day on Aug 3.

FORT COLLINS – WEST AUG 03, 2014

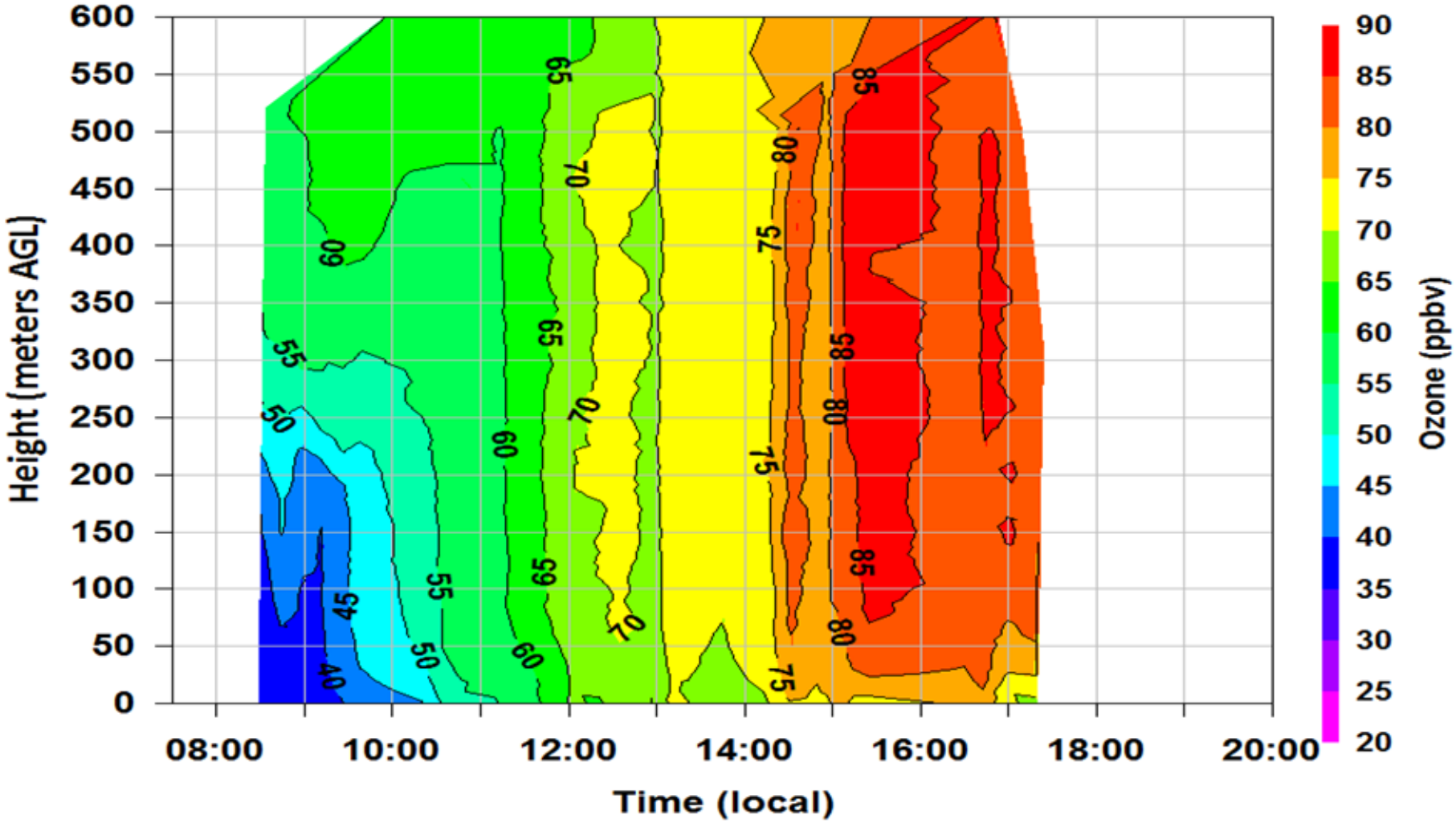


Figure 1b. Contour of ozone mixing ratio from Fort Collins – West on Aug 03. Ozone increases by ~ 6 - 10 ppbv /hour from morning to early afternoon at surface to 200 meters.

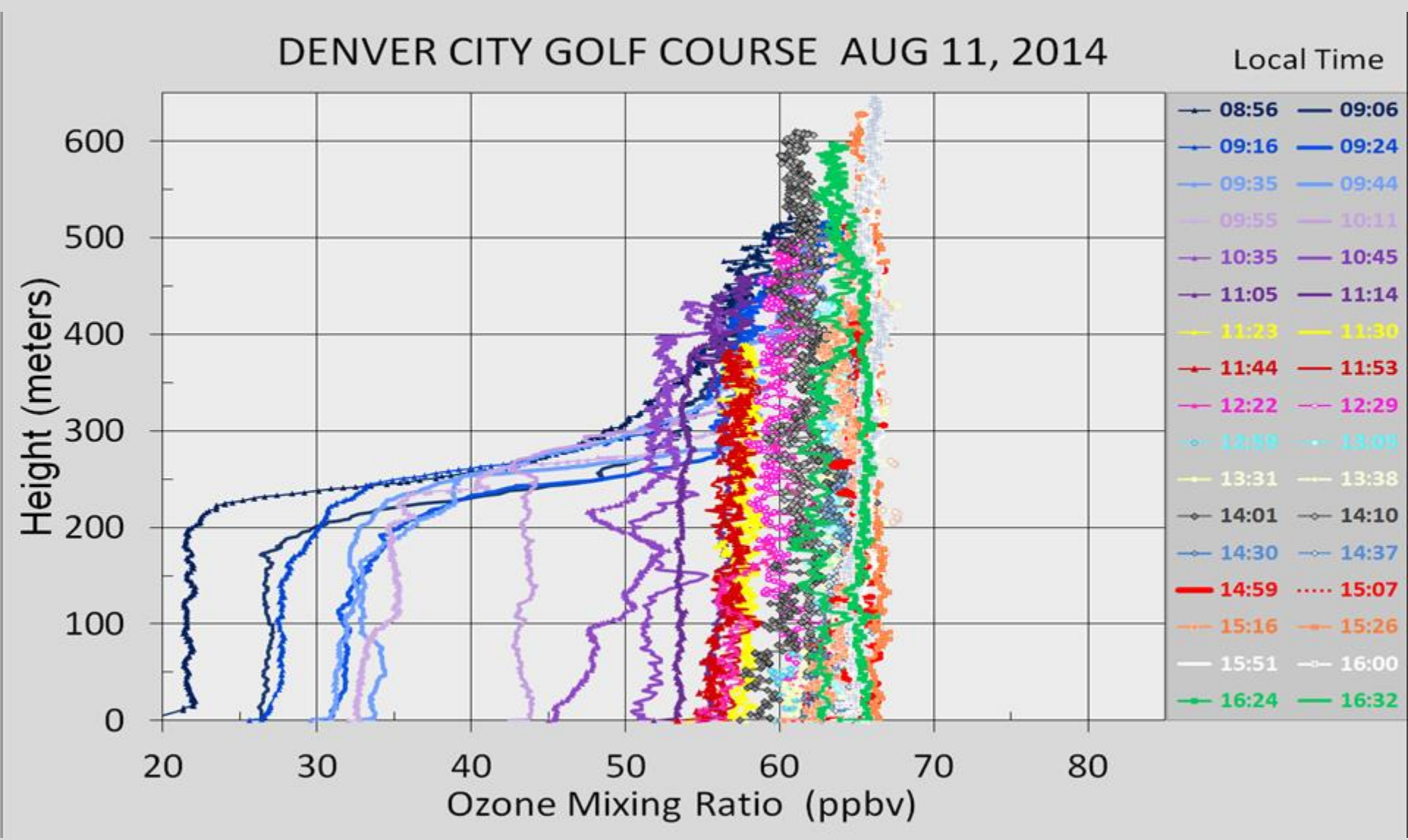


Figure 2a. Ozone mixing ratio versus height above surface showing 36 profiles measured at Denver City Golf Course on Aug 11. Note the cap on the ozone production in the morning due to a temperature inversion at 200 m that reduced mixing.

DENVER CITY GOLF COURSE AUG 11, 2016

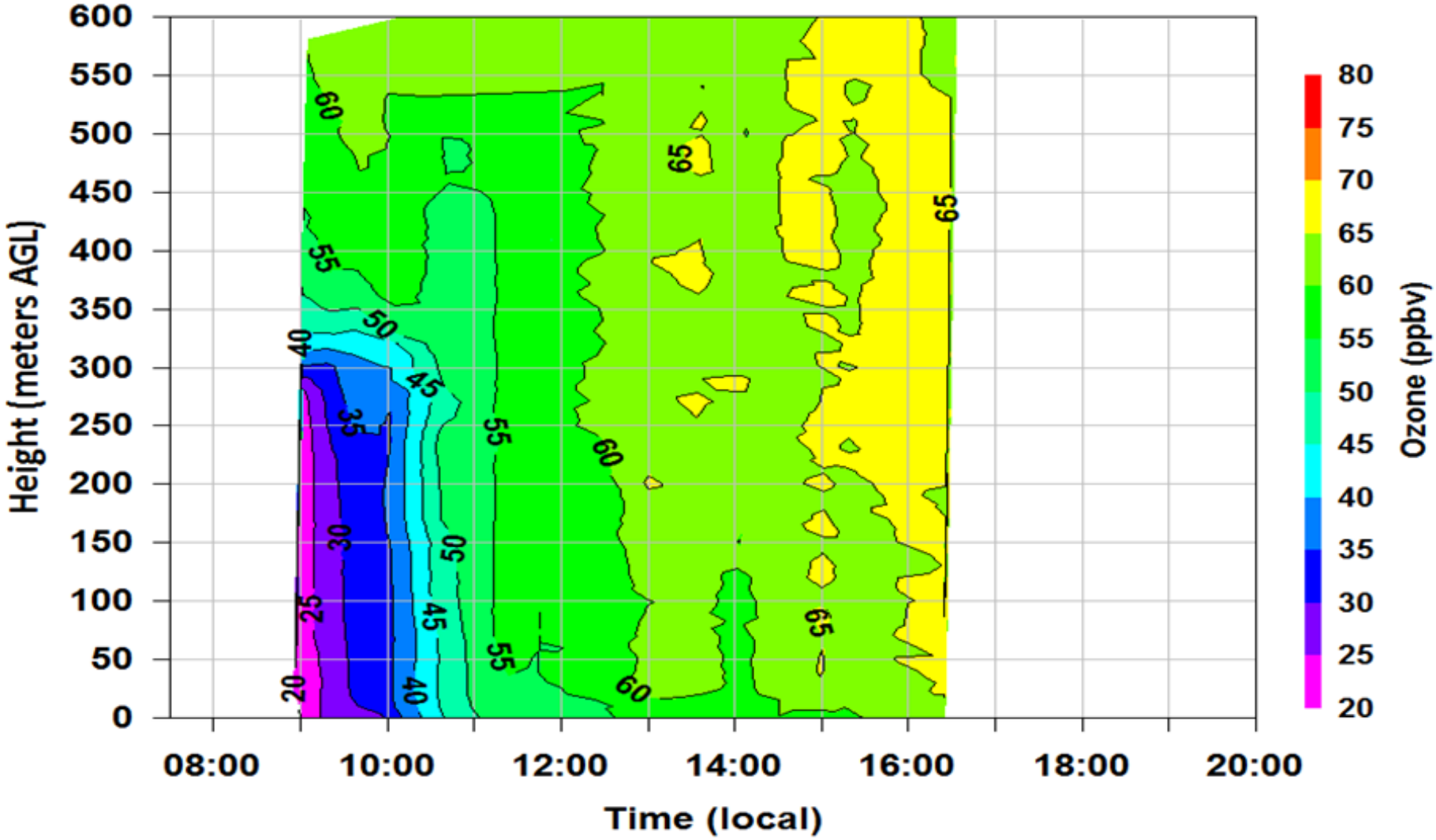


Figure 2b. Contour plot of ozone mixing ratio from Denver City Golf Course on Aug 11.