Collaboration Opportunities Stratospheric Intrusions

September 26, 2019

Typical Data Reviewed:

Air Now Maps

8-Hour daily maximum values across Four Corners

Hourly ozone at Gothic, CO and nearby monitors

1hr ozone and nearby meteorology at Gothic, CO

WACCM Results

NAM Tropopause Heights

RAQM Results

Skew-T Plots – Denver, CO

NCAR ACOM & RAL FIREX-AQ Flight Tool Results

Guidance on the Preparation of Exceptional Events Demonstrations for Stratospheric Ozone Intrusions

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

NOV - 8 2018

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Guidance on the Preparation of Exceptional Events Demonstrations for Stratospheric Ozone Intrusions

FROM: Richard Wayland, Director
Air Quality Assessment Division

Anna Marie Wood, Director
Air Quality Policy Division

TO: Regional Air Division Directors, Regions 1 – 10

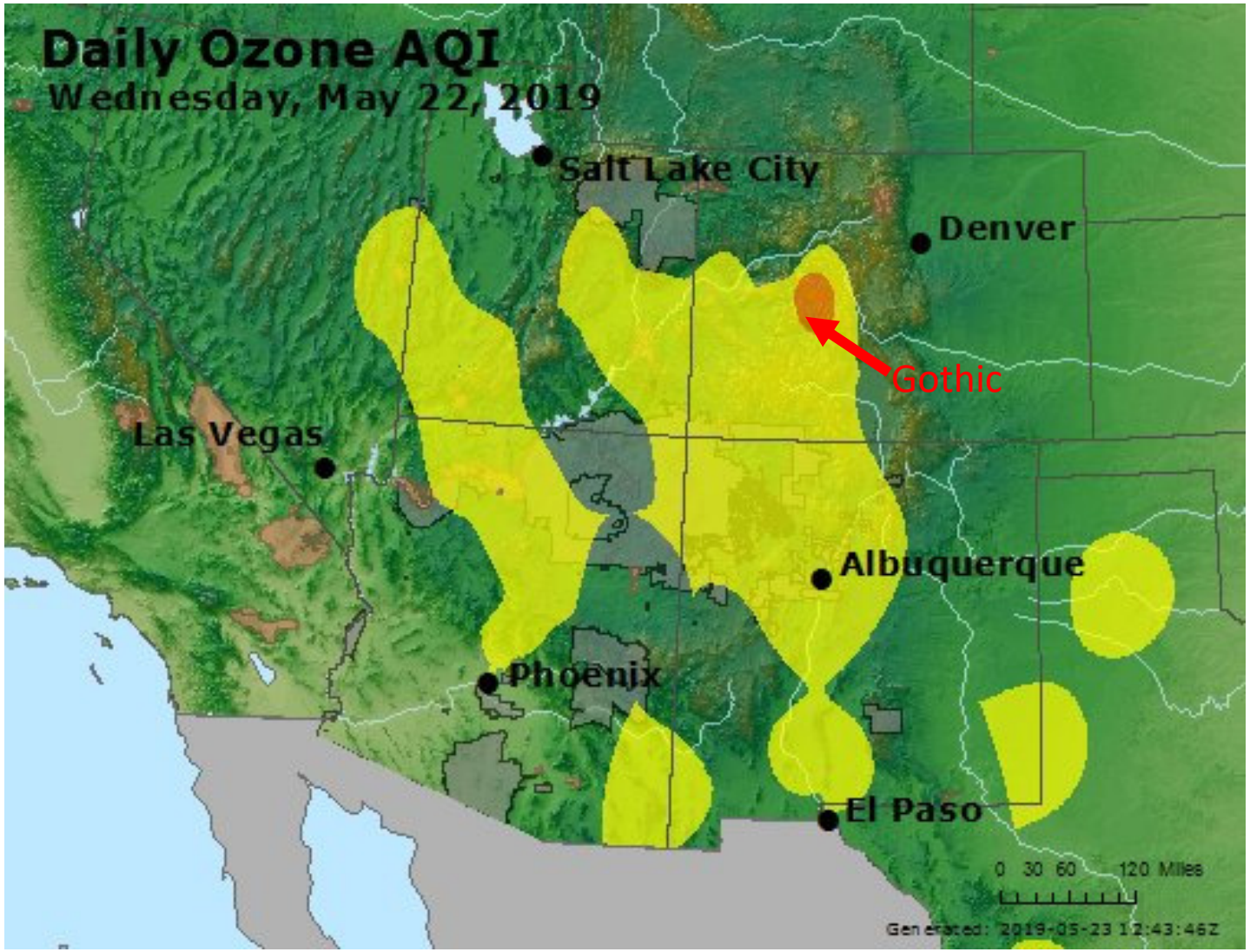
The purpose of this memorandum is to distribute a non-binding guidance document titled, "Guidance on the Preparation of Exceptional Events Demonstrations for Stratospheric Ozone Intrusions."

The EPA Headquarters and EPA Regional offices collaborated in the development of this guidance to assist air agencies with preparing exceptional events demonstrations for stratospheric ozone intrusions that meet the requirements of Clean Air Act section 319(b) and the Exceptional Events Rule signed on September 16, 2016, and posted on EPA's website at: *https://www.epa.gov/air-quality-analysis/exceptional-events-rule-and-guidance*.

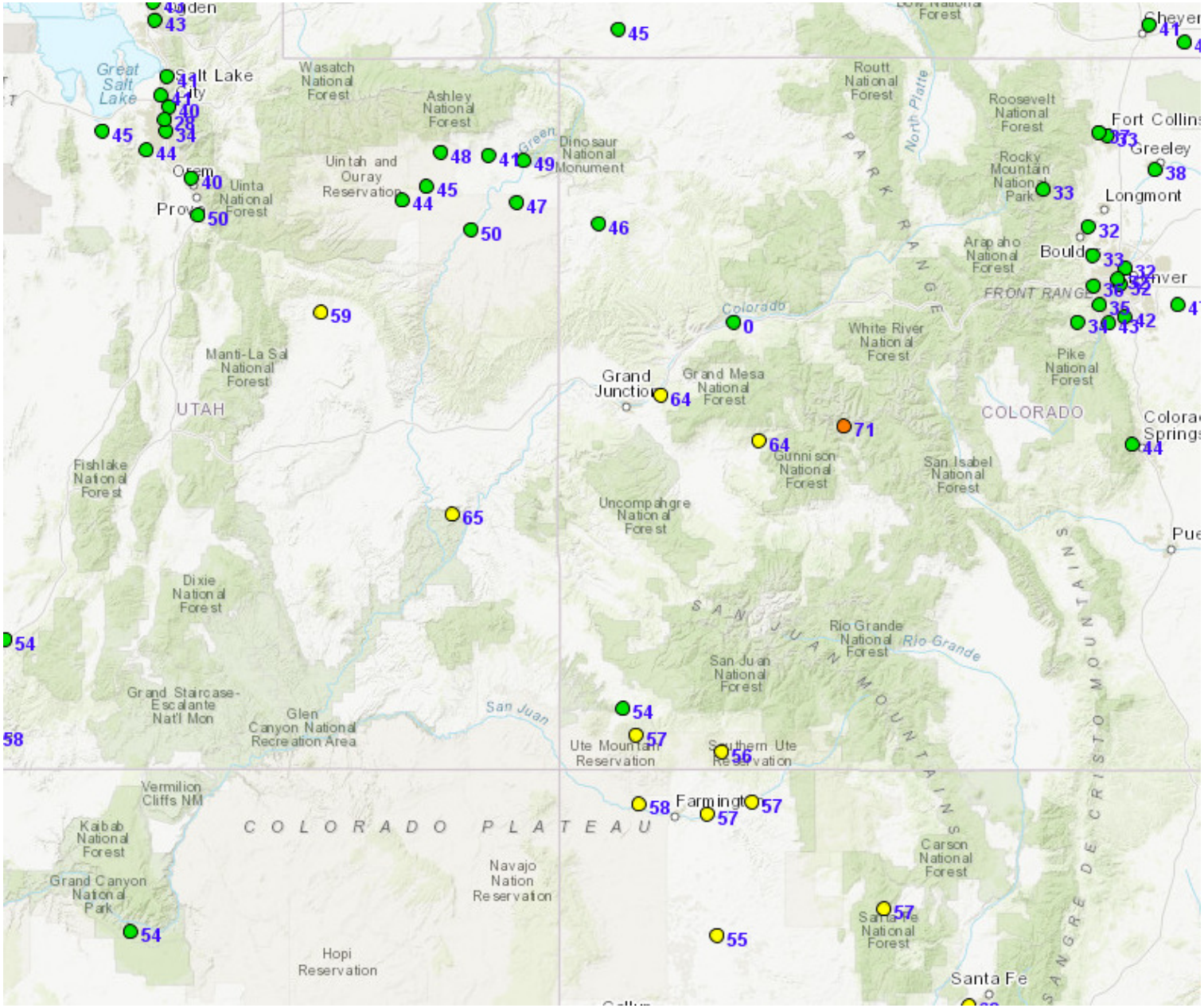
Please share this memorandum with appropriate contacts at state, local and tribal air agencies. If you have questions concerning this document, please contact Ben Gibson at (919) 541-3277 or *gibson.benjamin@epa.gov* for further information.

Attachment

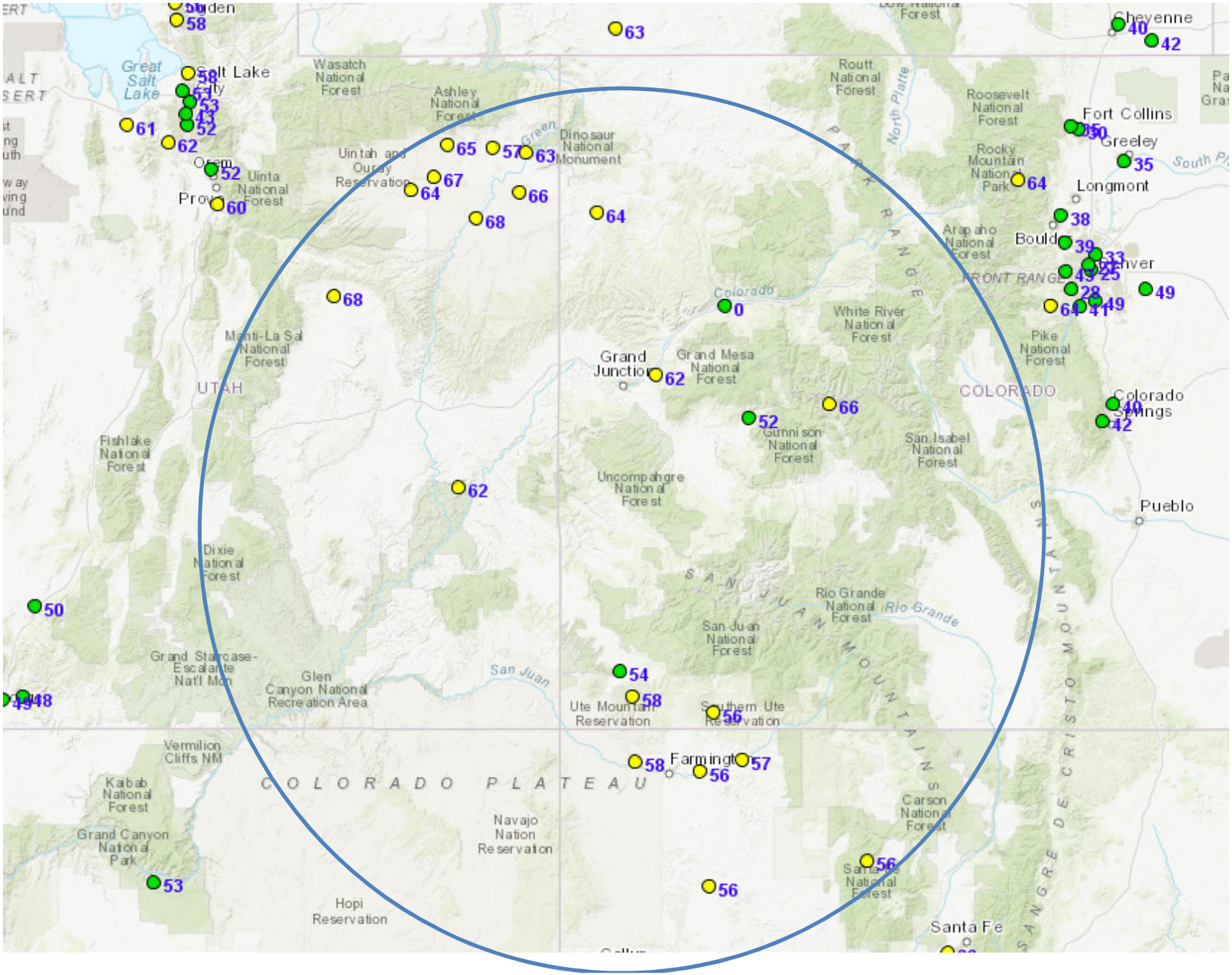
AirNow Daily Ozone AQI on May 22, 2019

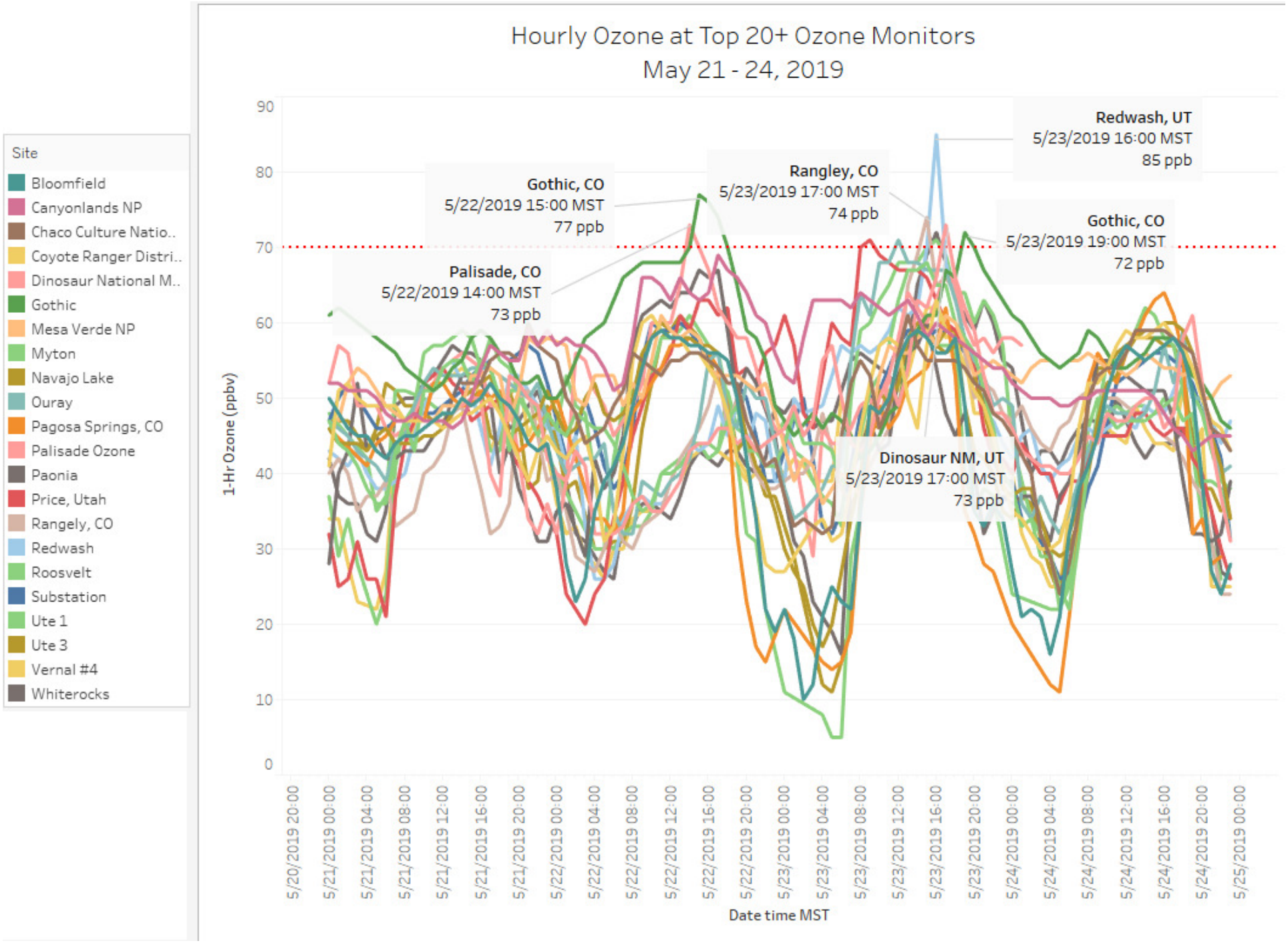


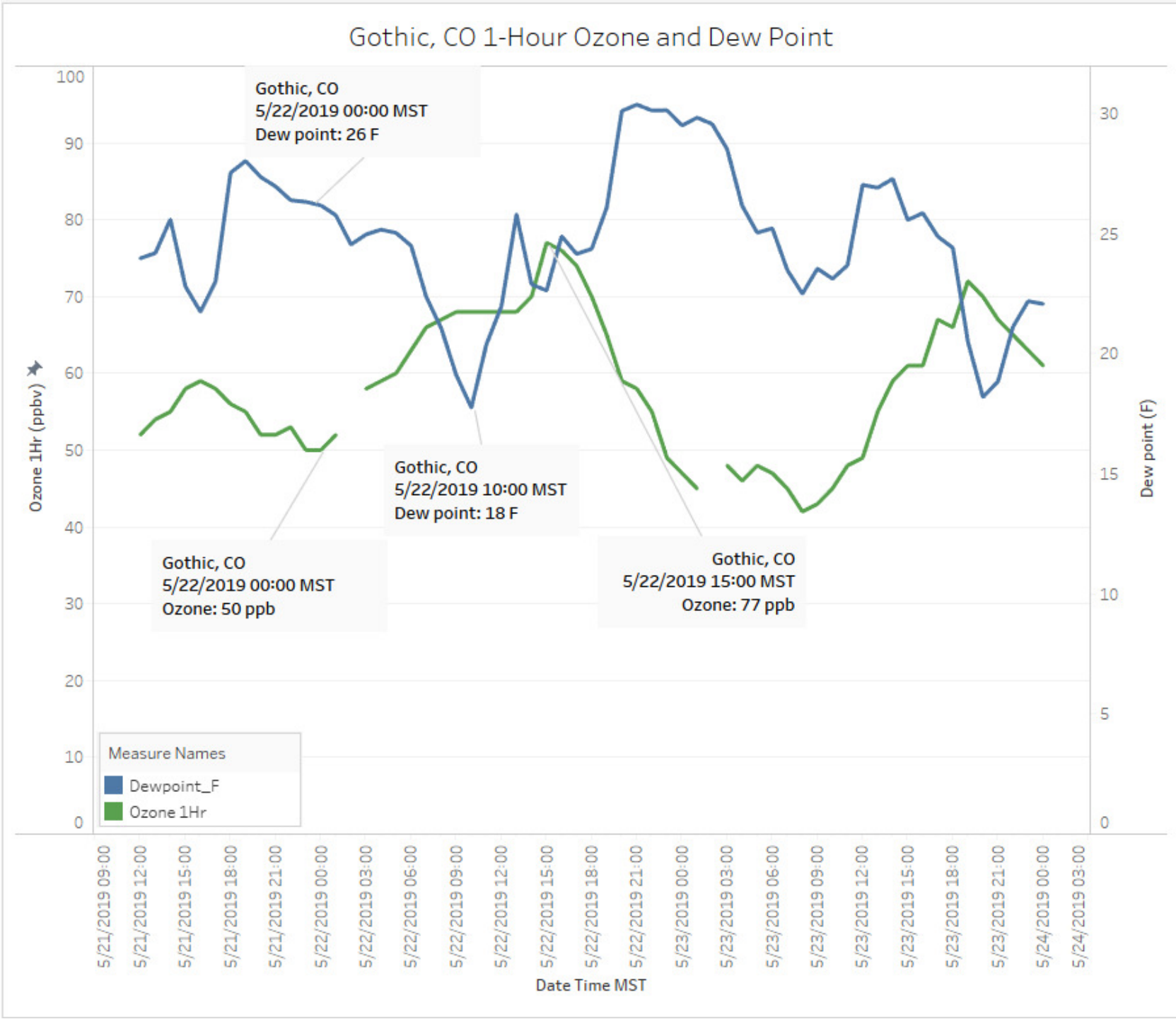
8-Hourly Daily Maximum Values on May 22, 2019



8-Hourly Daily Maximum Values on May 23, 2019




Hourly Ozone at Top 20+ Ozone Monitors
May 21 - 24, 2019
Site
Bloomfield
Canyonlands NP
Chaco Culture Natio..
Coyote Ranger Distri..
Dinosaur National M..
Gothic
Mesa Verde NP
Myton
Navajo Lake
Ouray
Pagosa Springs, CO
Palisade Ozone
Paonia
Price, Utah
Rangely, CO
Redwash
Roosvelt
Substation
Ute 1
Ute 3
Vernal #4
Whiterocks
1-Hr Ozone (ppbv)
0
10
20
30
40
50
60
70
80
90
Redwash, UT
5/23/2019 16:00 MST
85 ppb
Gothic, CO
5/22/2019 15:00 MST
77 ppb
Rangley, CO
5/23/2019 17:00 MST
74 ppb
Gothic, CO
5/23/2019 19:00 MST
72 ppb
Palisade, CO
5/22/2019 14:00 MST
73 ppb
Dinosaur NM, UT
5/23/2019 17:00 MST
73 ppb
5/20/2019 20:00
5/21/2019 00:00
5/21/2019 04:00
5/21/2019 08:00
5/21/2019 12:00
5/21/2019 16:00
5/21/2019 20:00
5/22/2019 00:00
5/22/2019 04:00
5/22/2019 08:00
5/22/2019 12:00
5/22/2019 16:00
5/22/2019 20:00
5/23/2019 00:00
5/23/2019 04:00
5/23/2019 08:00
5/23/2019 12:00
5/23/2019 16:00
5/23/2019 20:00
5/24/2019 00:00
5/24/2019 04:00
5/24/2019 08:00
5/24/2019 12:00
5/24/2019 16:00
5/24/2019 20:00
5/25/2019 00:00
Date time MST

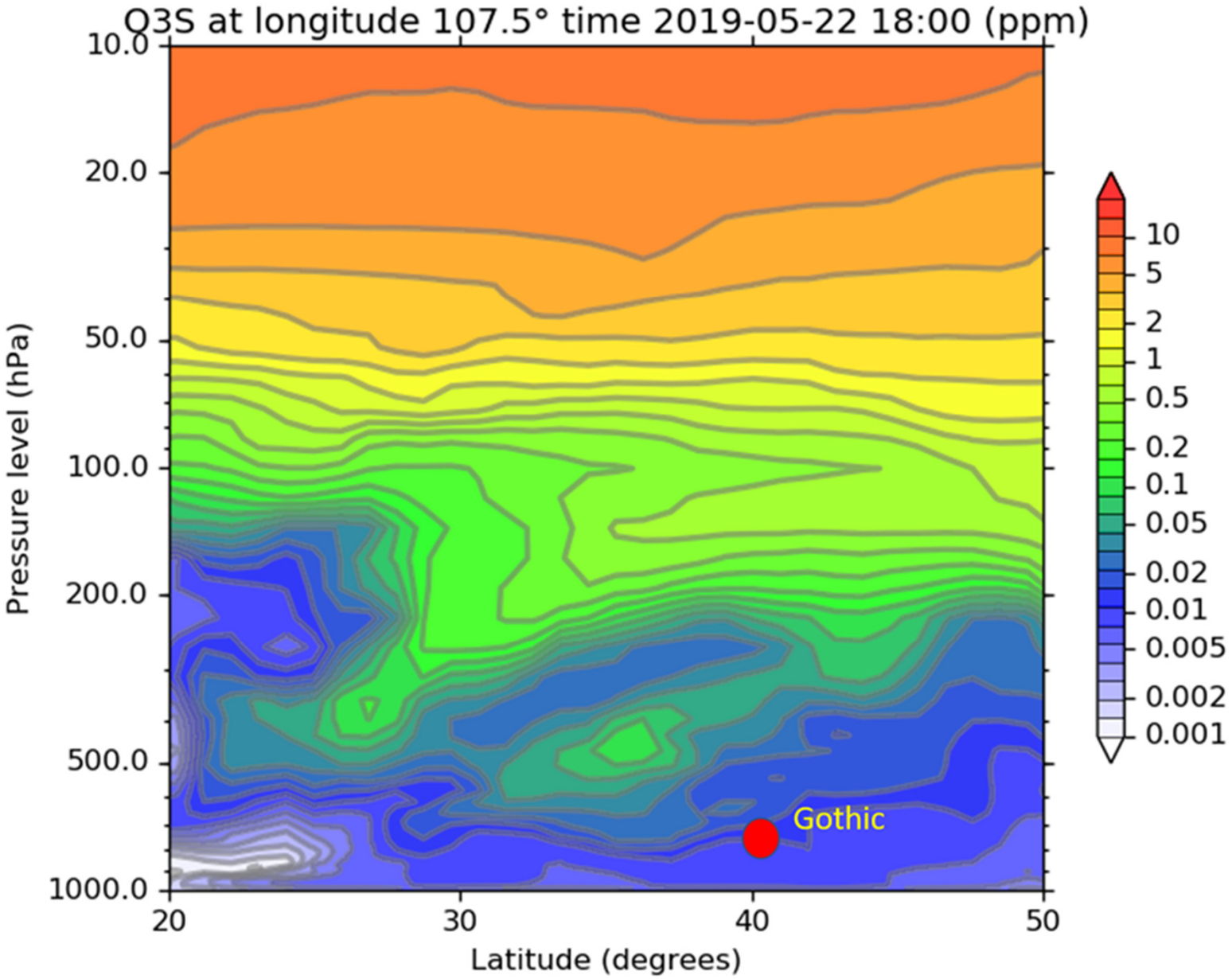

Gothic, CO 1-Hour Ozone and Dew Point
Gothic, CO
5/22/2019 00:00 MST
Dew point: 26 F
Gothic, CO
5/22/2019 10:00 MST
Dew point: 18 F
Gothic, CO
5/22/2019 00:00 MST
Ozone: 50 ppb
Gothic, CO
5/22/2019 15:00 MST
Ozone: 77 ppb
Ozone 1Hr (ppbv)
Dew point (F)
Measure Names
Dewpoint_F
Ozone 1Hr
Date Time MST

WACCM Results

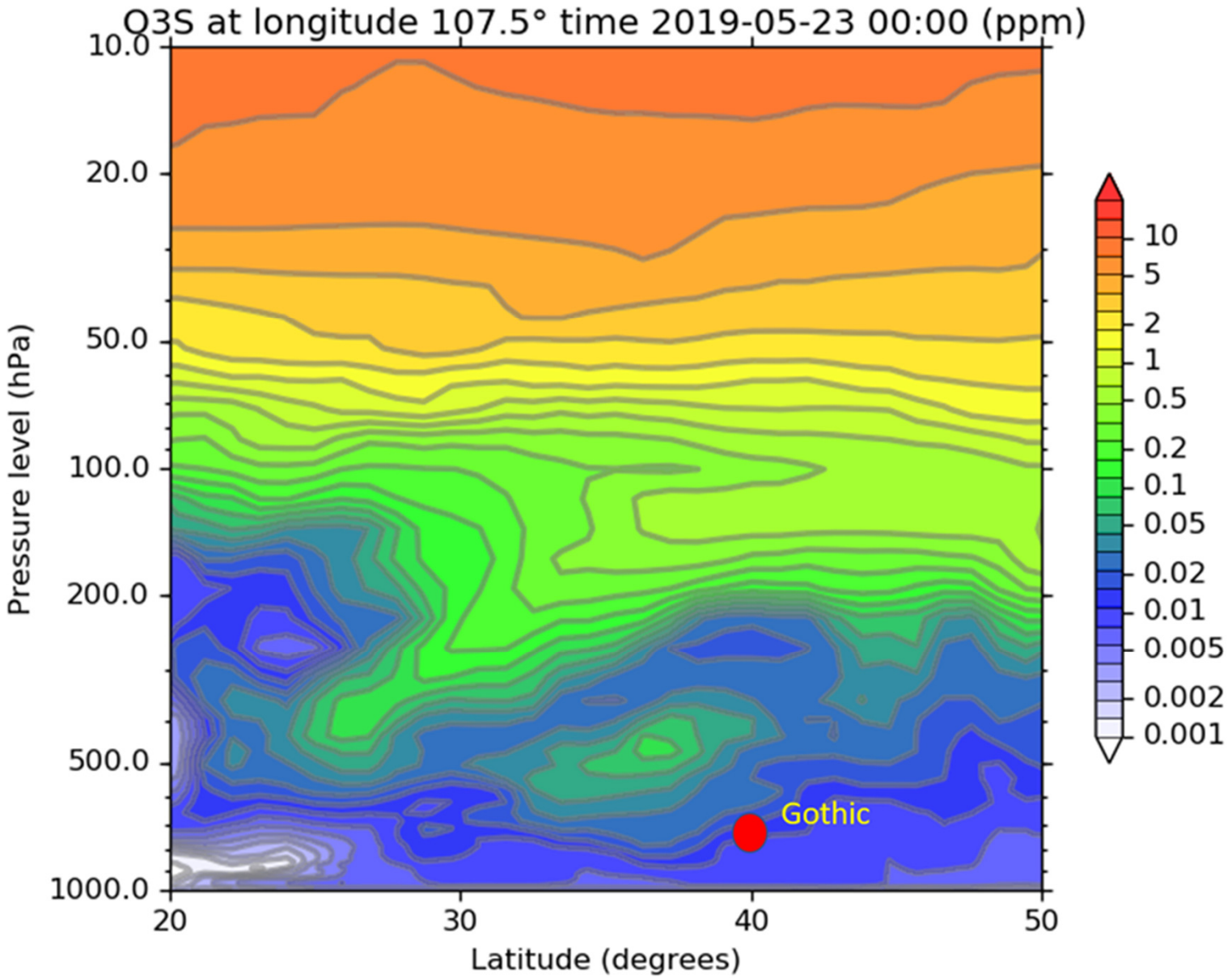
Vertical profiles at 11AM MST and 5PM MST (1800 and 2300 UTC) May 22, 2019

CO and O3S side-by-side maps at 1000, 700, 500, and 300 hPa 11AM MST (1800 UTC) May 22, 2019

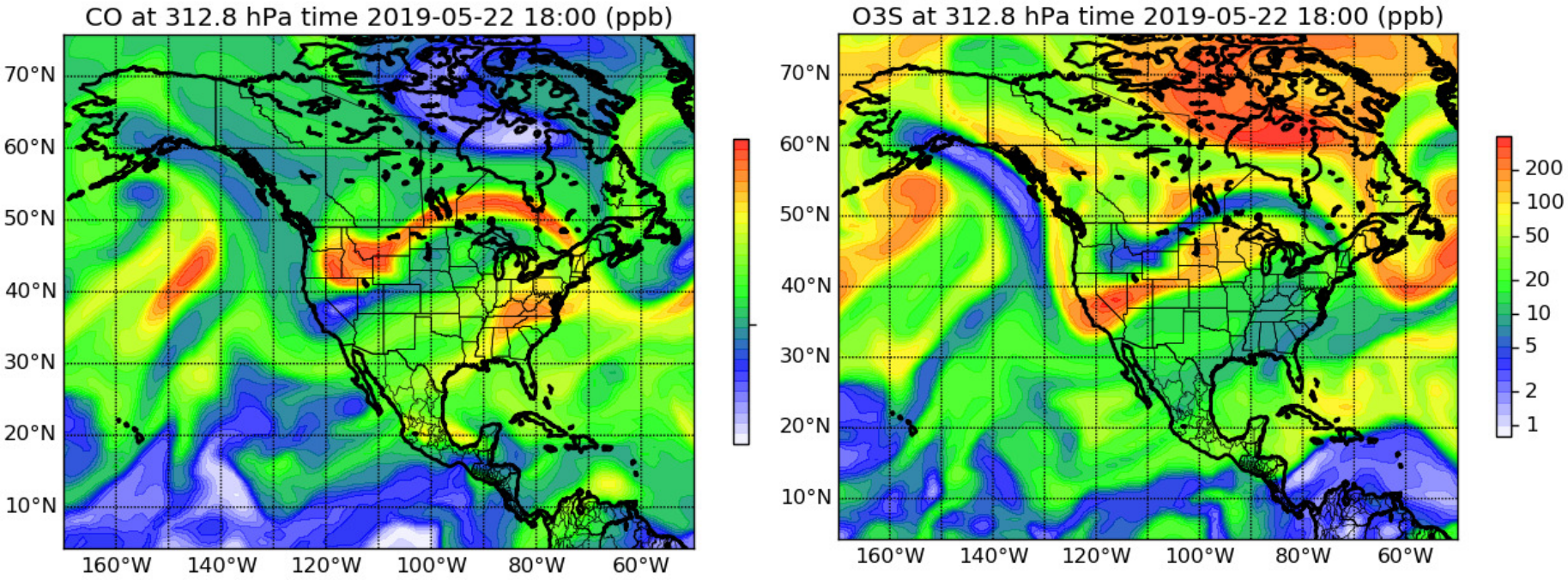
Ozone Cross Section at 11AM MST



Ozone Cross Section at 5PM MST



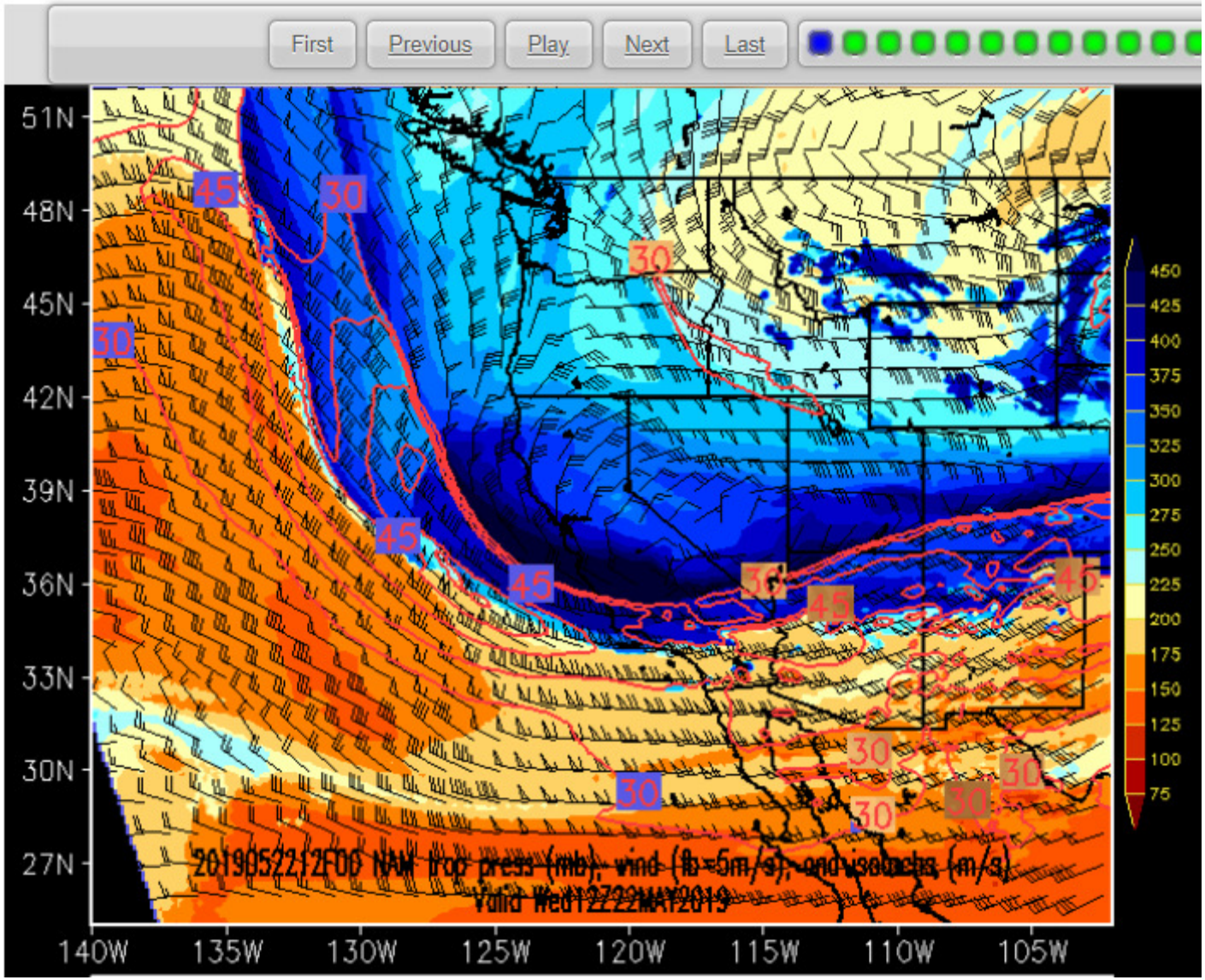
Anticorrelation between Ozone and CO at 300 hPa
5/22/2019 18:00 UTC (11 AM MST)



NAM Tropopause Height

May 22, 2019 0500 MST
(10-hours prior to peak ozone)

NAM Tropopause height, 5:00 am MST, May 22

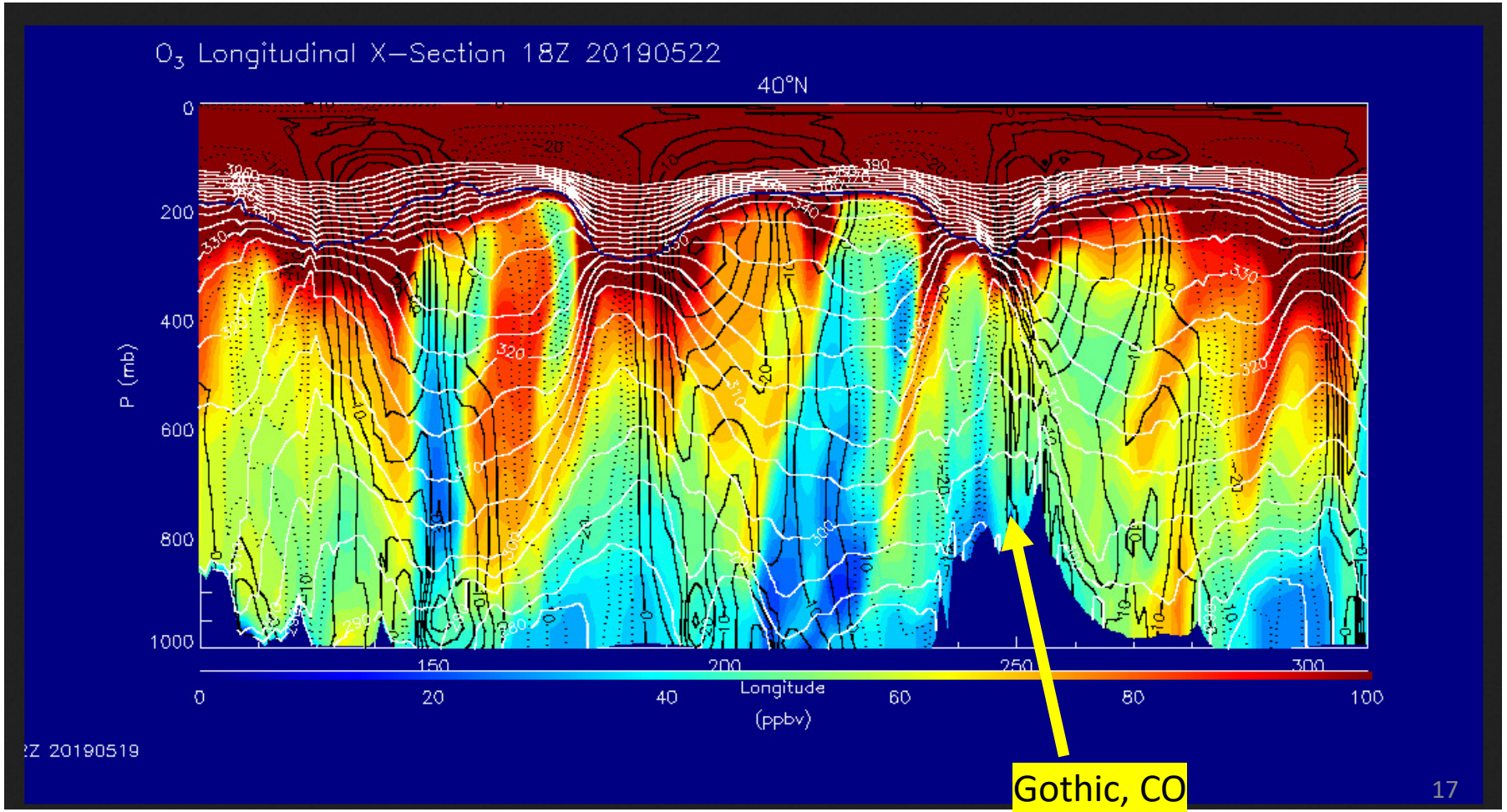


RAQM Results

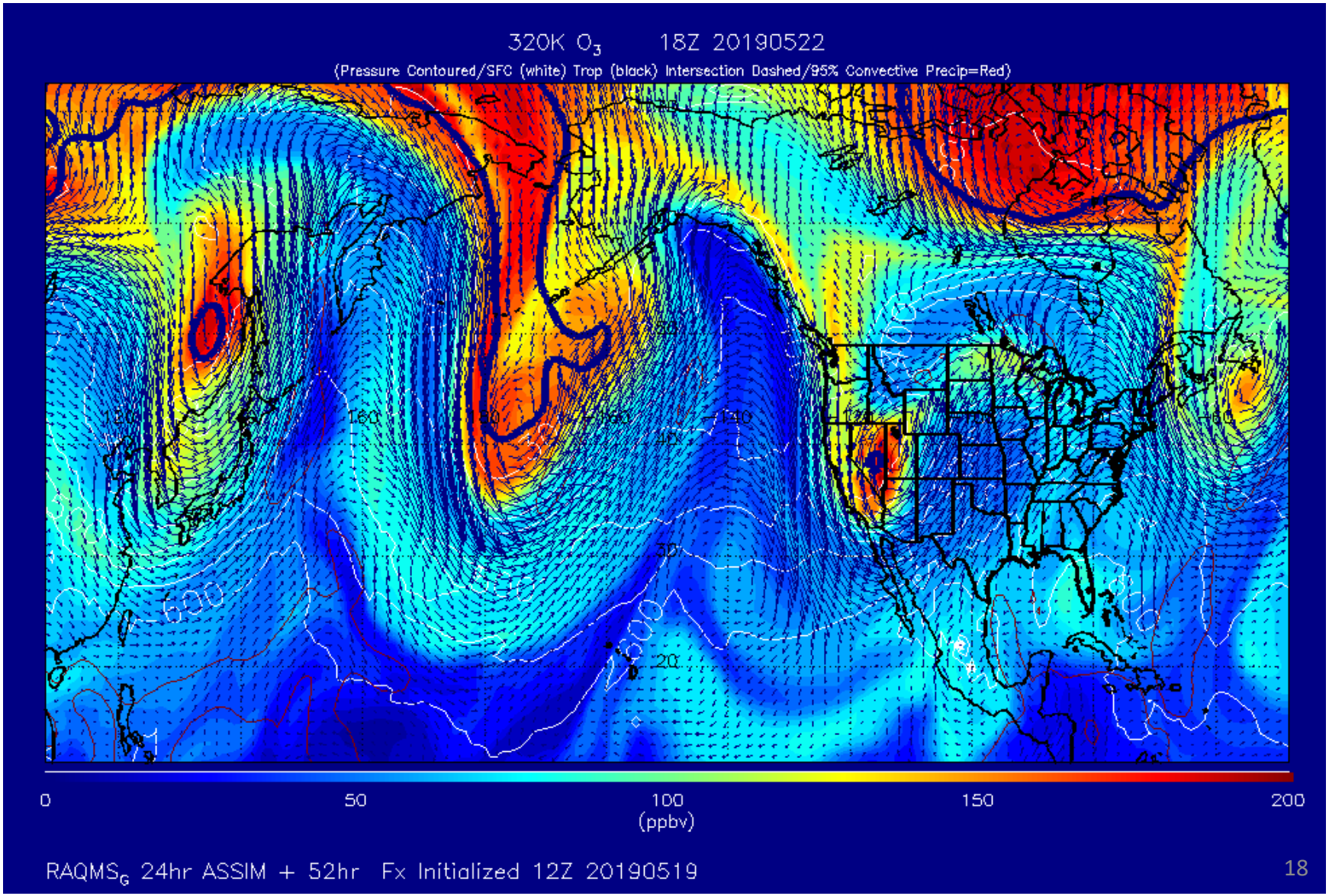
Longitudinal Ozone X-Section at
May 22, 2019 1100 MST
(3-hours prior to peak ozone)

320k ozone maps at 22, 10, and 3 hours prior to peak ozone

Longitudinal Ozone X-Section 3 Hours Prior to Peak Ozone



320K Ozone 3 Hours Prior to Peak Ozone

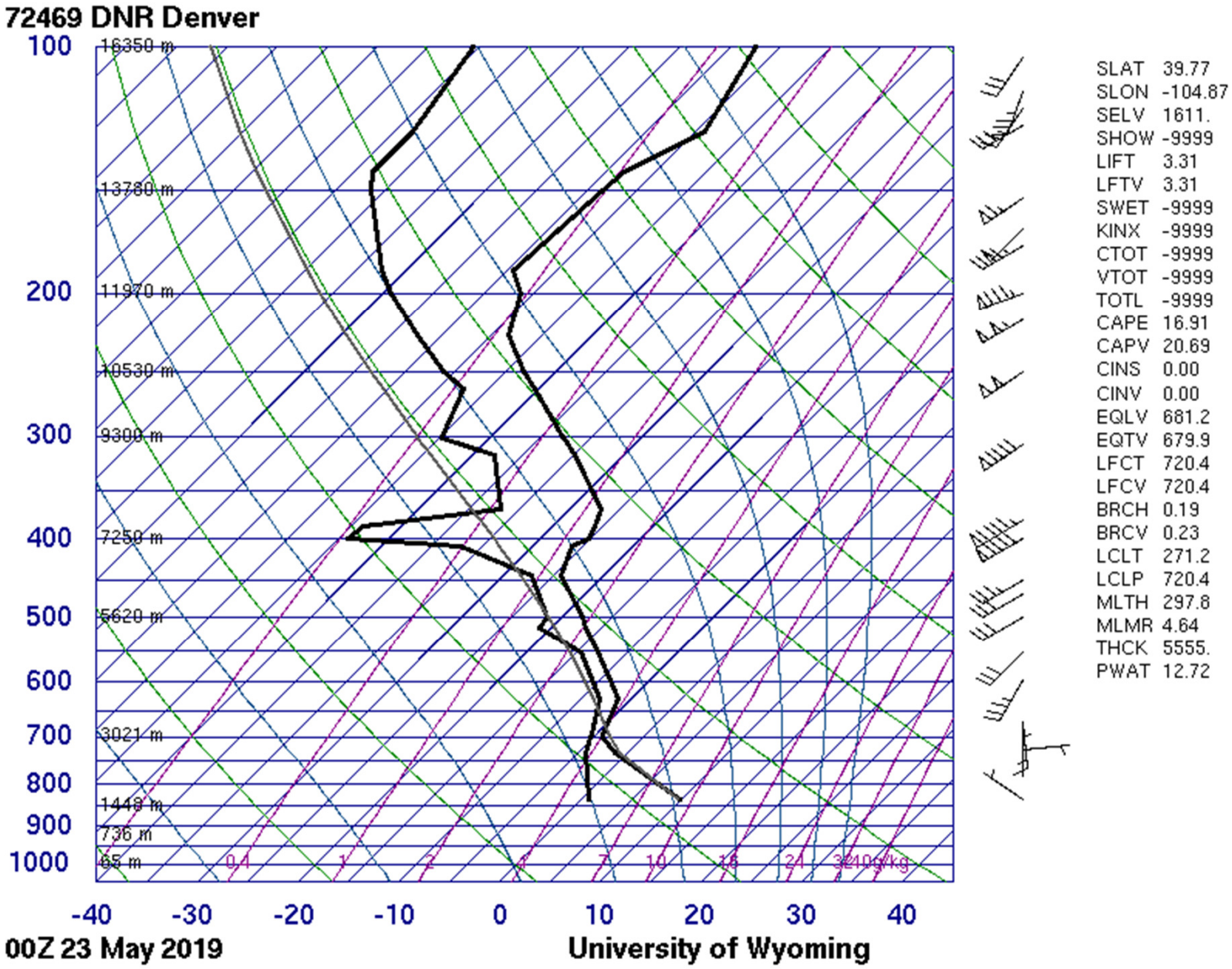


Skew-T Plots

DNR Denver

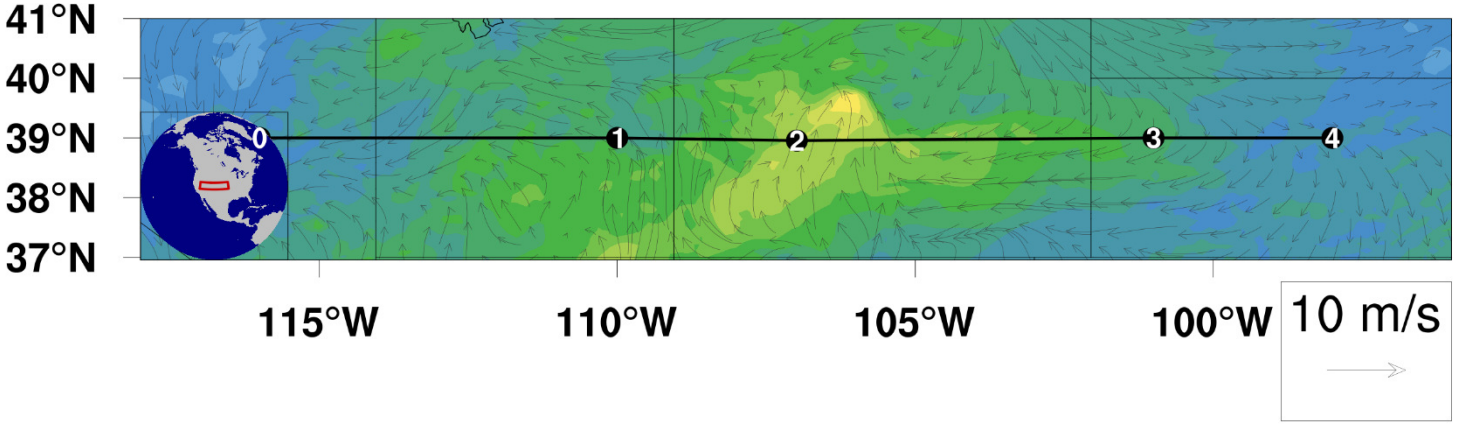
(approximately 120 miles northeast of Gothic)

2 Hours After Peak Ozone

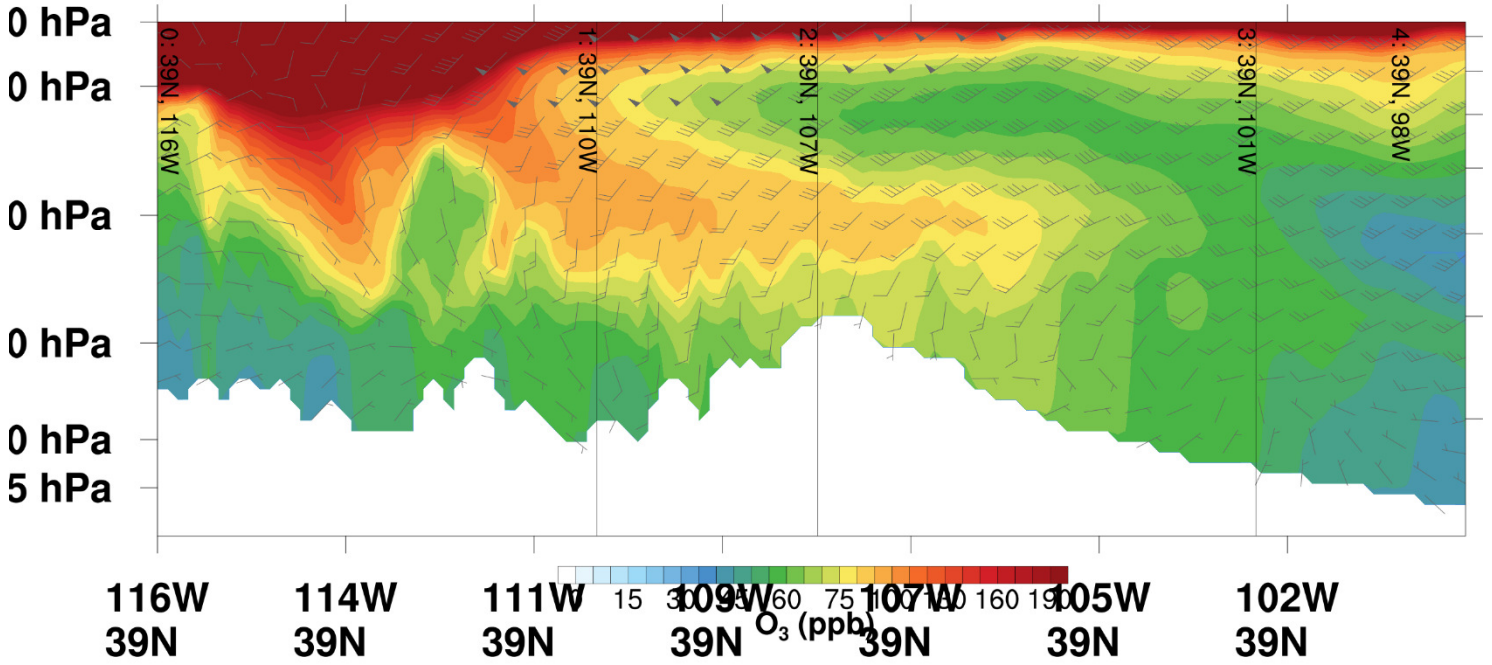


FIREX-AQ Flight Tool

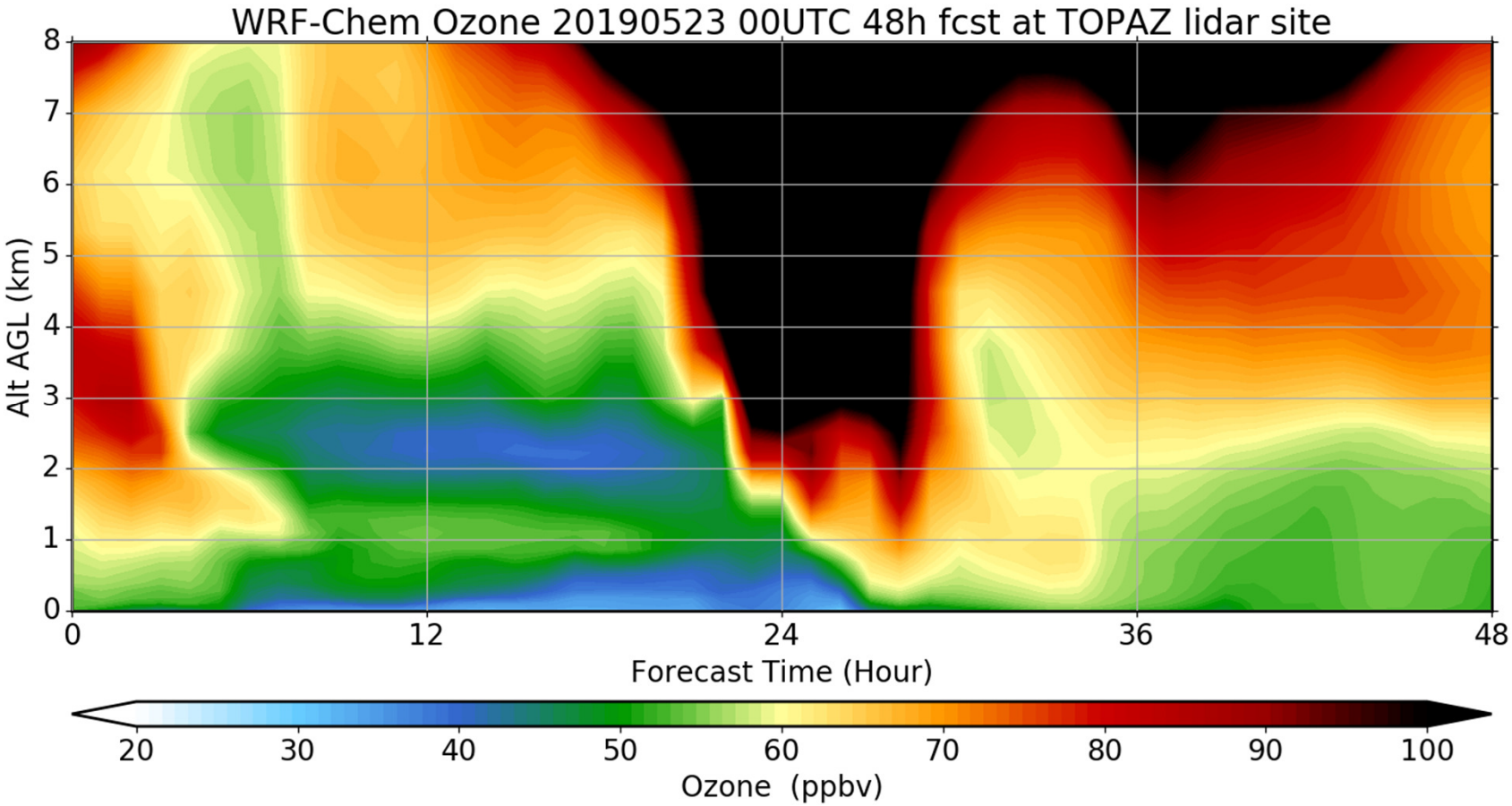
Surface O_3 & transect locations



O_3 curtain & wind profiles



WRF-Chem


WRF-Chem Ozone 20190523 00UTC 48h fcst at TOPAZ lidar site
Alt AGL (km)
0
1
2
3
4
5
6
7
8
0
12
24
36
48
Forecast Time (Hour)
20
30
40
50
60
70
80
90
100
Ozone (ppbv)

Conclusion

Surface ozone concentrations, nearby meteorology, radiosconde data, WACCM/RAQM/FIREX-AQ model results all point to the Gothic, CO ozone concentrations being influenced by a stratospheric intrusion.

Region 8 indicated that this is a Tier 1 event

- It would require less compelling evidence to support an exceptional event demonstration.

A couple of things I learned from this work (both suggestions from Region 8):

Changes in dewpoint may be more compelling than changes in relative humidity.

RAQM and WACCM curtain plots do not necessarily show SI ozone down to the ground, but is likely due to limitations of the models' vertical resolution.

Discussion

Launch a PANDORA at Gothic?

Other measurements?

Other suggestions?