Michael Leach
Geoff Healan
Dallas Roebling
Scott Southwick

2024 NOAA Model Performance in Alabama

Ozone in Alabama

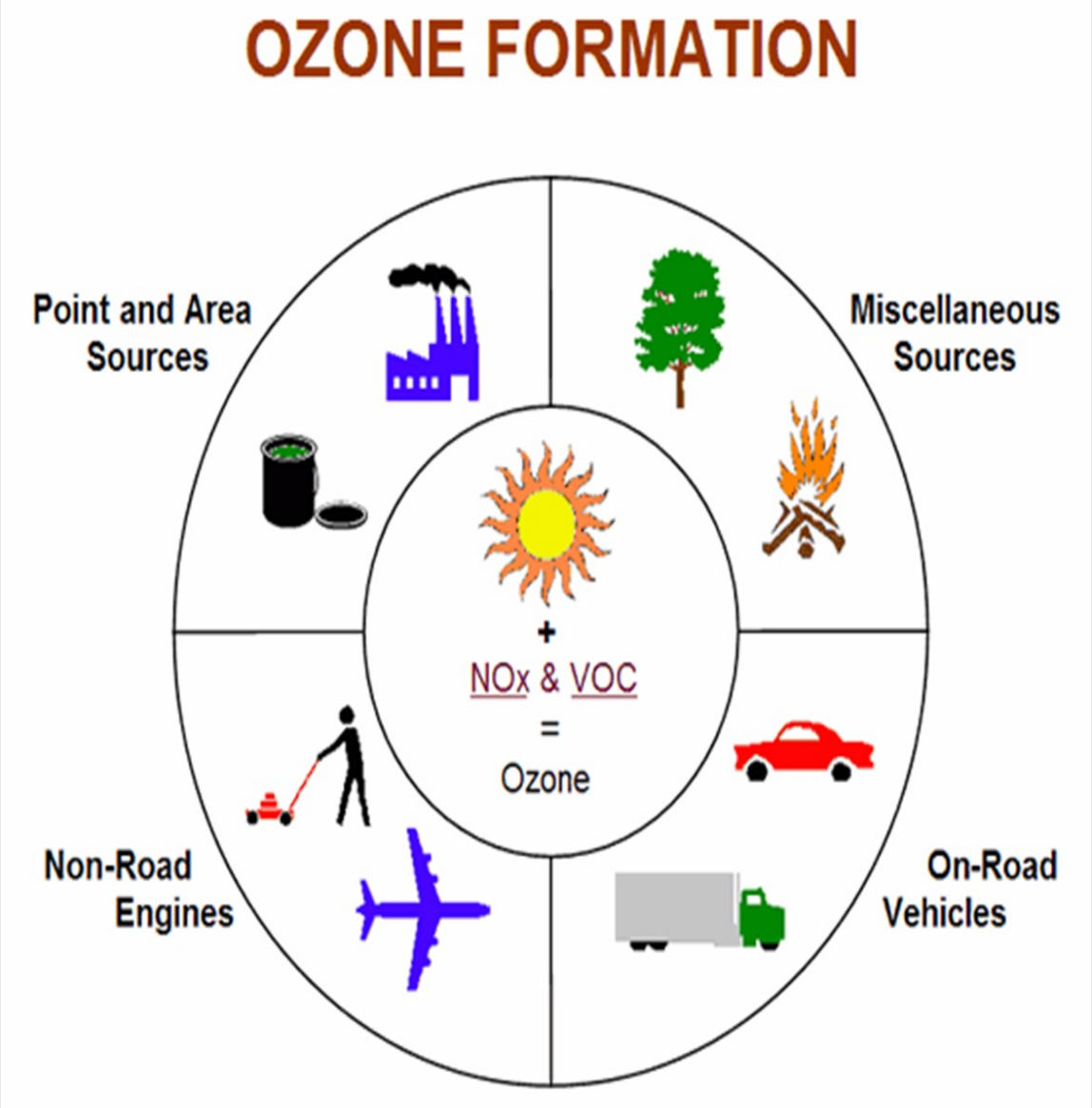
March 1, 2024 – October 31, 2024

Highest 8-hour Average YTD Huntsville: 63 ppb

Highest 8-Hour Average YTD Birmingham:76 ppb

Highest 8-Hour Average YTD Mobile: 64 ppb

Peak Ozone Month: June



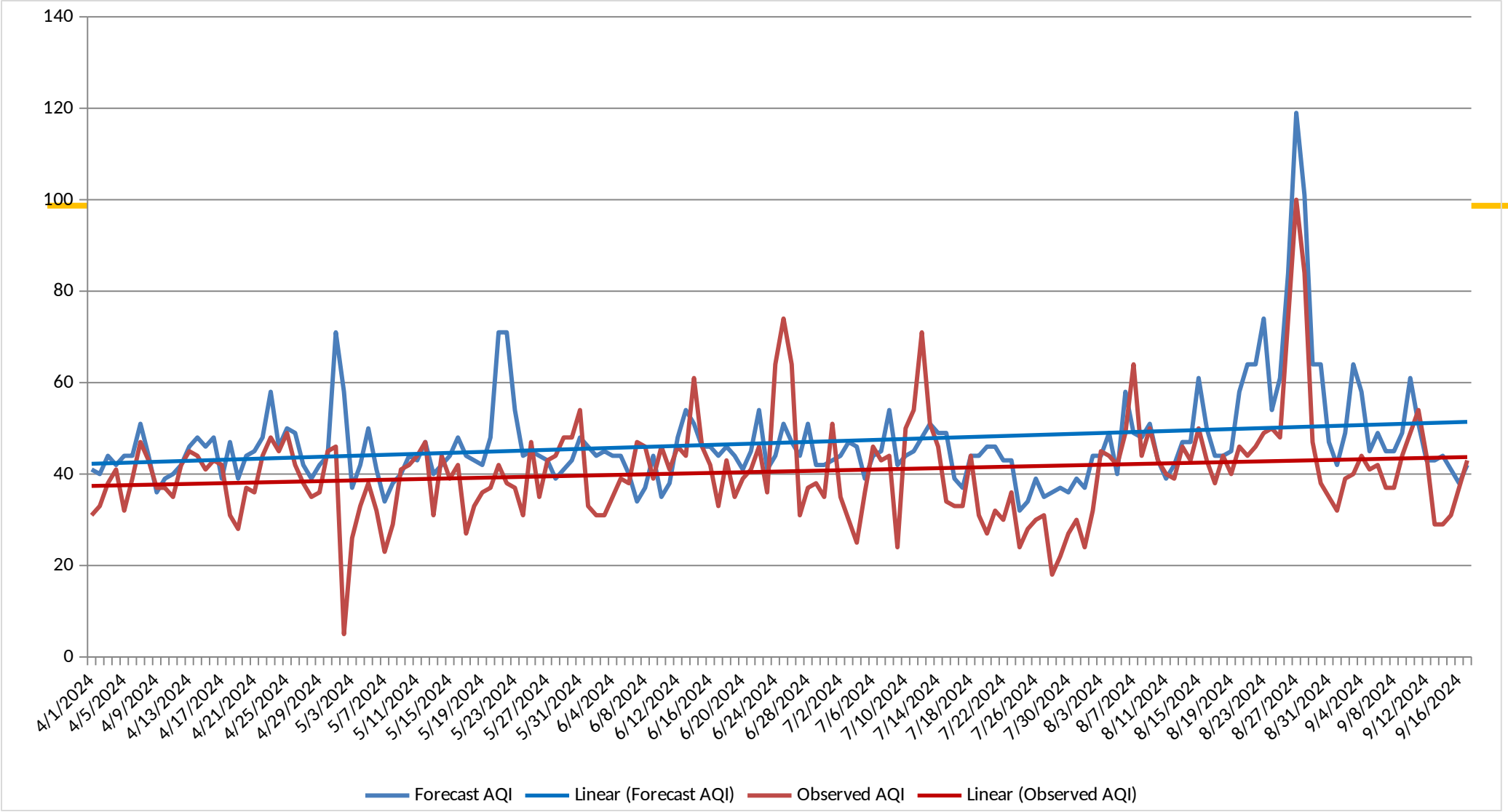
Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health alert: everyone may experience more serious health effects
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.
Crazy Bad	500+	Um, are you still convinced that the benefits of living in Beijing outweigh the risks?

Ozone Monitor Locations

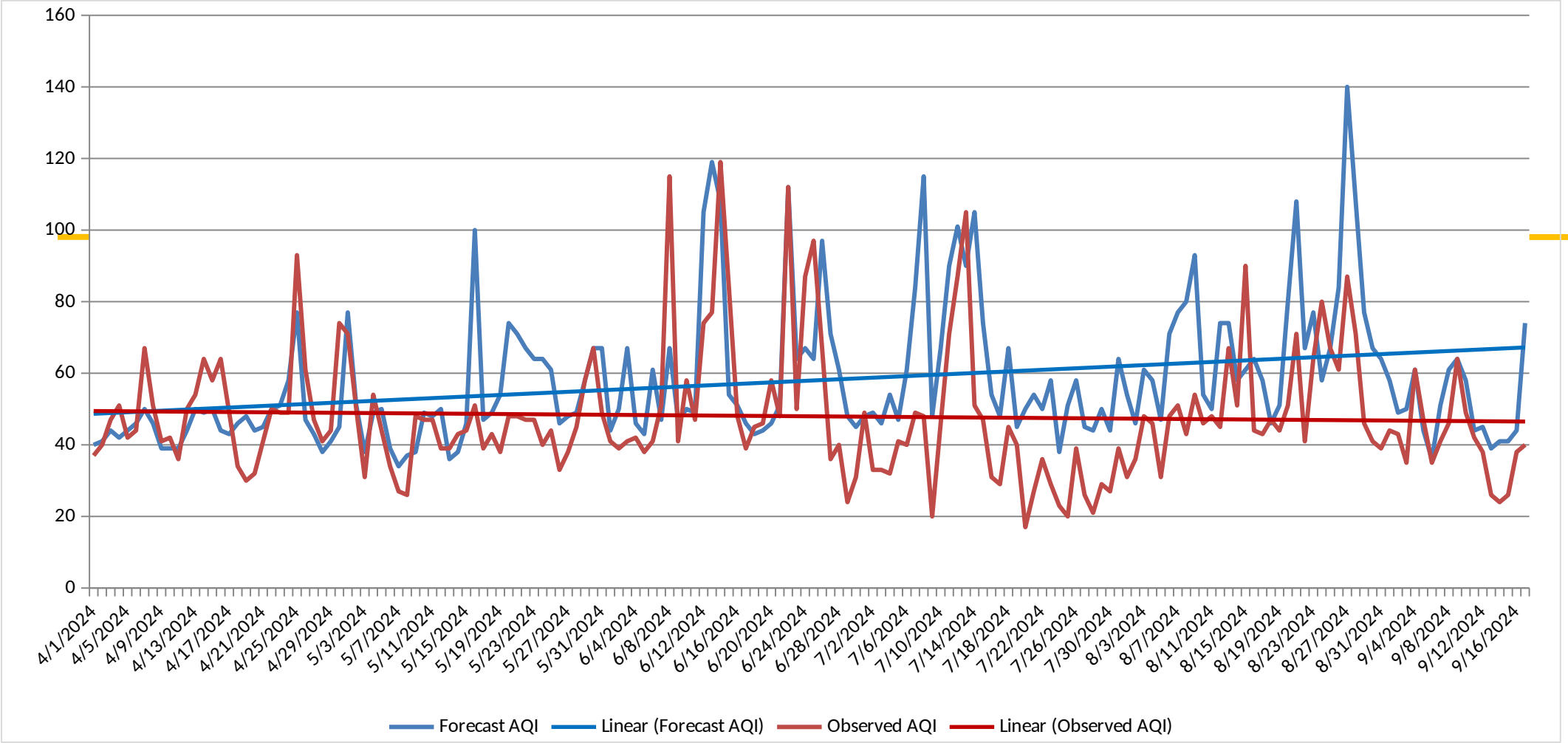
18 Ozone Monitors

Operated March 1-October 31

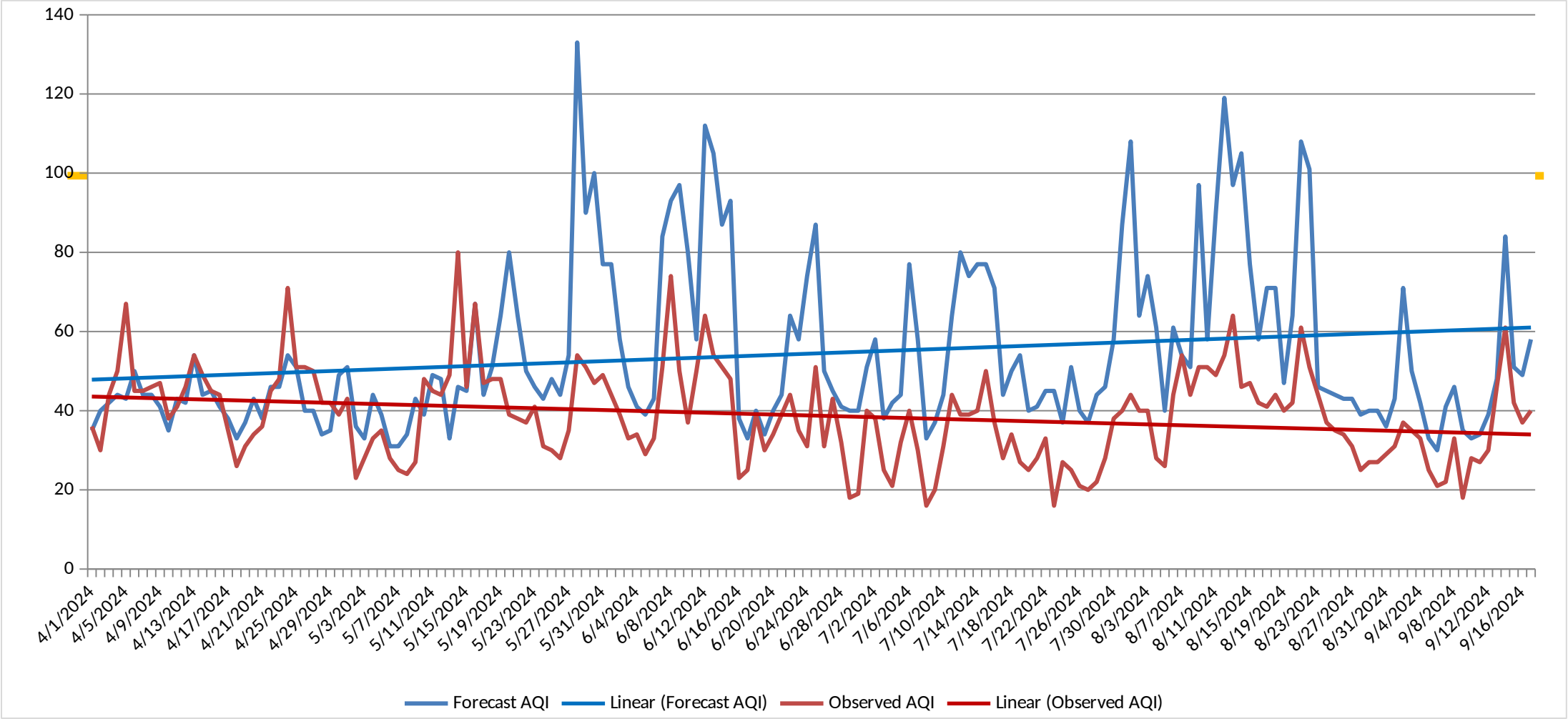
Huntsville Forecast vs. Observed



Birmingham Forecast vs. Observed



Mobile Forecast vs. Observed



Model Statistics

Forecast City	NOAA Model Percent Correct (Color Code)	NOAA Model Bias (ppb)
Huntsville (O_3)	81	2.29
Birmingham (O_3)	63	1.80
Mobile (O_3)	71	2.91

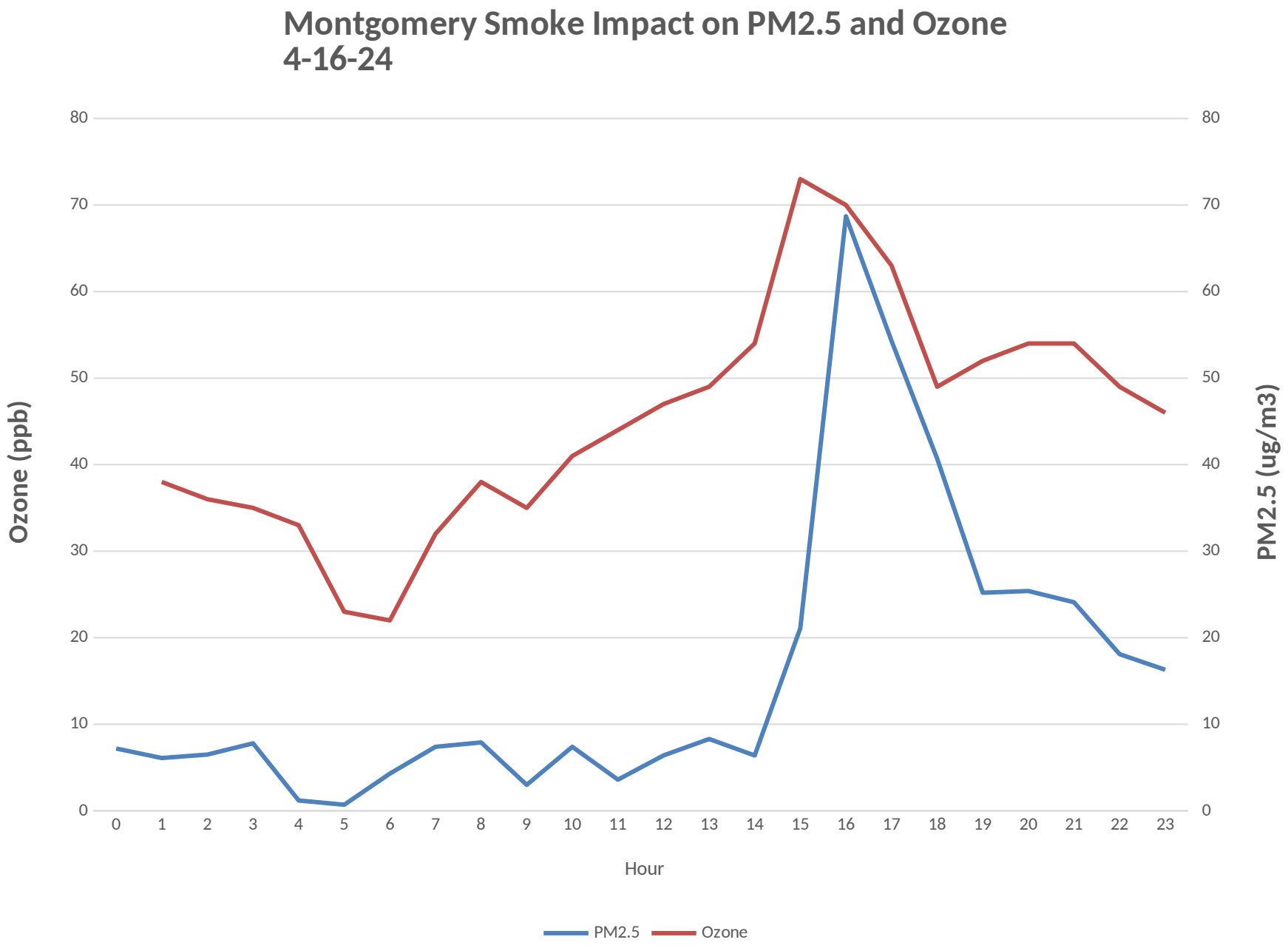
Ozone Model Statistics 2023 vs. 2024

Forecast City	NOAA Model Percent Correct (Color Code)
Huntsville (2023)	78
Huntsville (2024)	81
Birmingham (2023)	71
Birmingham (2024)	63
Mobile (2023)	79
Mobile (2024)	71

NOAA Model Conclusions

- The NOAA Model did a decent job of forecasting ozone across Alabama in 2024.
- The percent correct by color code decreased in Birmingham and Mobile when compared to 2023; however, the bias improved. This indicates that most of the days the NOAA model missed were borderline green/yellow days.
- The NOAA model tends to have the highest bias (overprediction) at Mobile, likely due to the sea-breeze along the coast and the tendency to bring higher ozone values offshore to areas just along the coast.

Case Study April 16, 2024 Montgomery, Alabama (Smoke Impact)


Montgomery Smoke Impact on PM2.5 and Ozone
4-16-24
Ozone (ppb)
PM2.5 (ug/m3)
Hour
0
10
20
30
40
50
60
70
80
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
PM2.5
Ozone

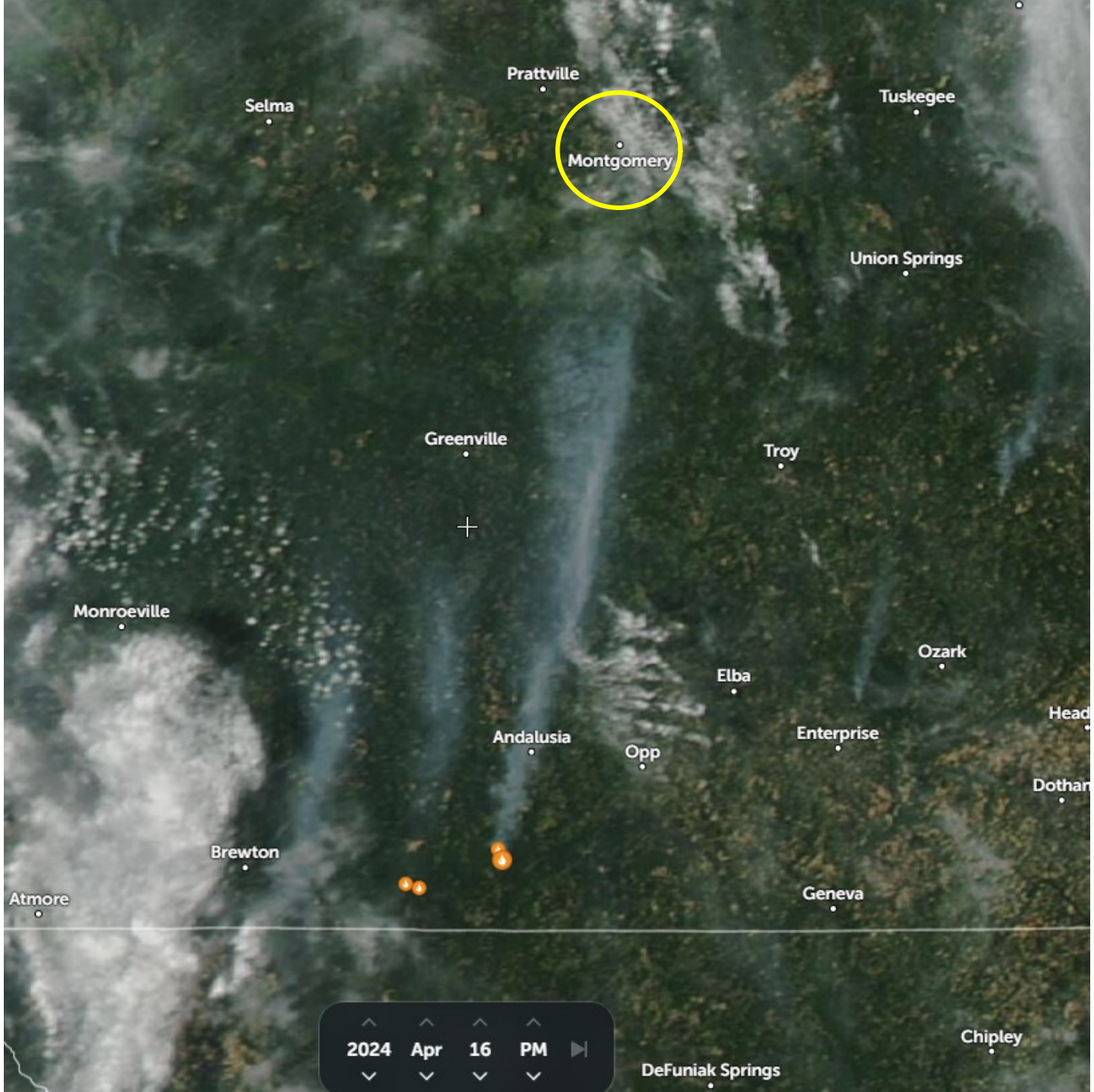
Montgomery Airport Weather Observations 4/16/24

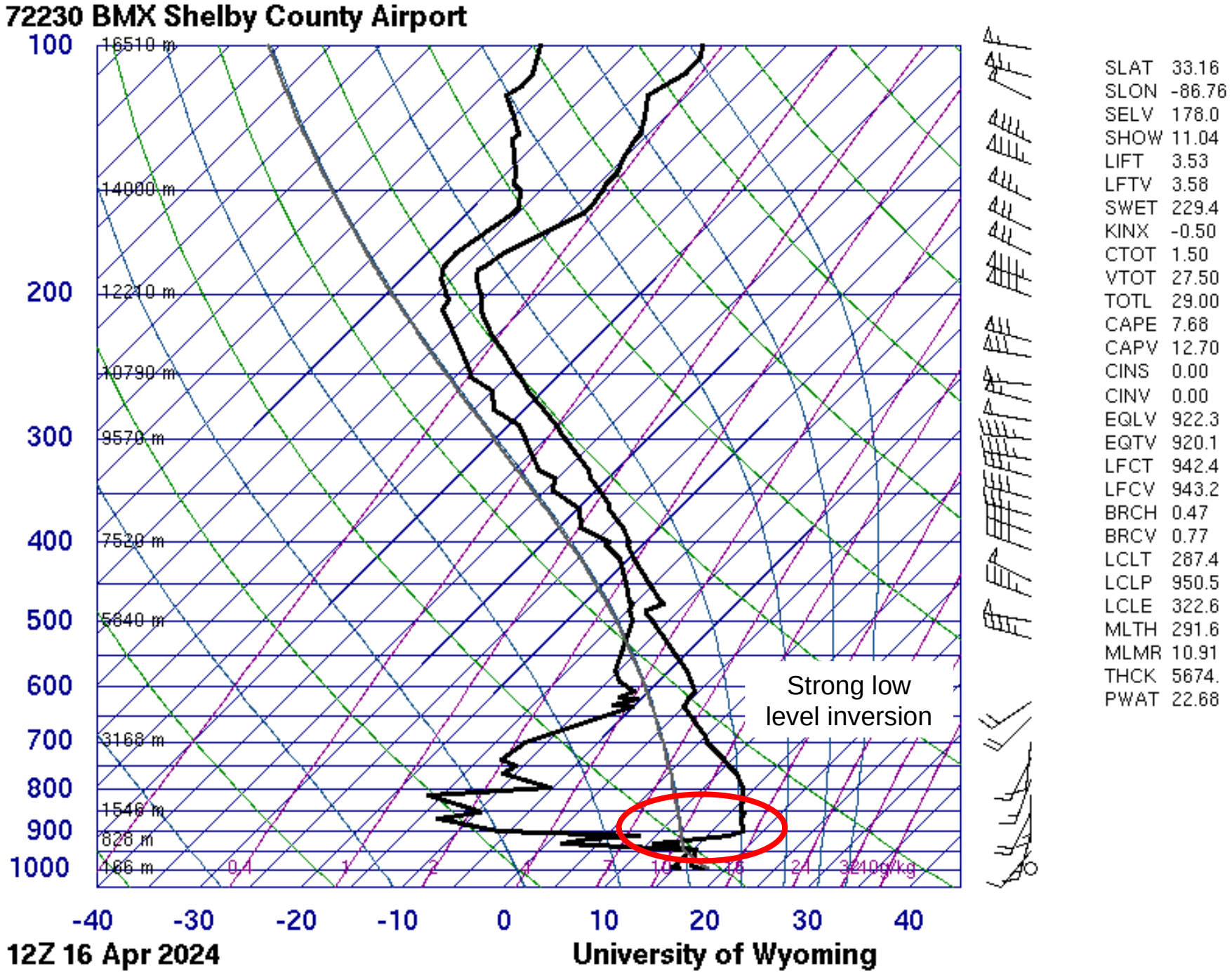
Time	Temperature	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
10:53 AM	71 °F	62 °F	73 %	ESE	12 mph	0 mph	29.84 in	0.0 in	Partly Cloudy
11:53 AM	76 °F	59 °F	56 %	S	8 mph	0 mph	29.87 in	0.0 in	Fair
12:53 PM	78 °F	58 °F	50 %	SW	8 mph	0 mph	29.87 in	0.0 in	Fair
1:53 PM	82 °F	57 °F	42 %	SSW	9 mph	16 mph	29.86 in	0.0 in	Fair
2:53 PM	83 °F	56 °F	39 %	S	10 mph	0 mph	29.84 in	0.0 in	Fair
3:53 PM	84 °F	58 °F	41 %	SSE	8 mph	0 mph	29.82 in	0.0 in	Fair
4:53 PM	83 °F	60 °F	46 %	SSE	10 mph	0 mph	29.82 in	0.0 in	Fair
5:53 PM	81 °F	62 °F	52 %	SSE	10 mph	0 mph	29.81 in	0.0 in	Fair
6:53 PM	77 °F	60 °F	56 %	SSE	7 mph	0 mph	29.82 in	0.0 in	Haze
7:53 PM	75 °F	53 °F	46 %	S	8 mph	0 mph	29.83 in	0.0 in	Haze
8:53 PM	72 °F	53 °F	51 %	S	6 mph	0 mph	29.86 in	0.0 in	Fair
9:53 PM	71 °F	54 °F	55 %	SSW	6 mph	0 mph	29.86 in	0.0 in	Fair
10:53 PM	70 °F	55 °F	59 %	SSW	6 mph	0 mph	29.85 in	0.0 in	Fair
11:53 PM	66 °F	56 °F	70 %	SSE	3 mph	0 mph	29.86 in	0.0 in	Fair

Satellite Data

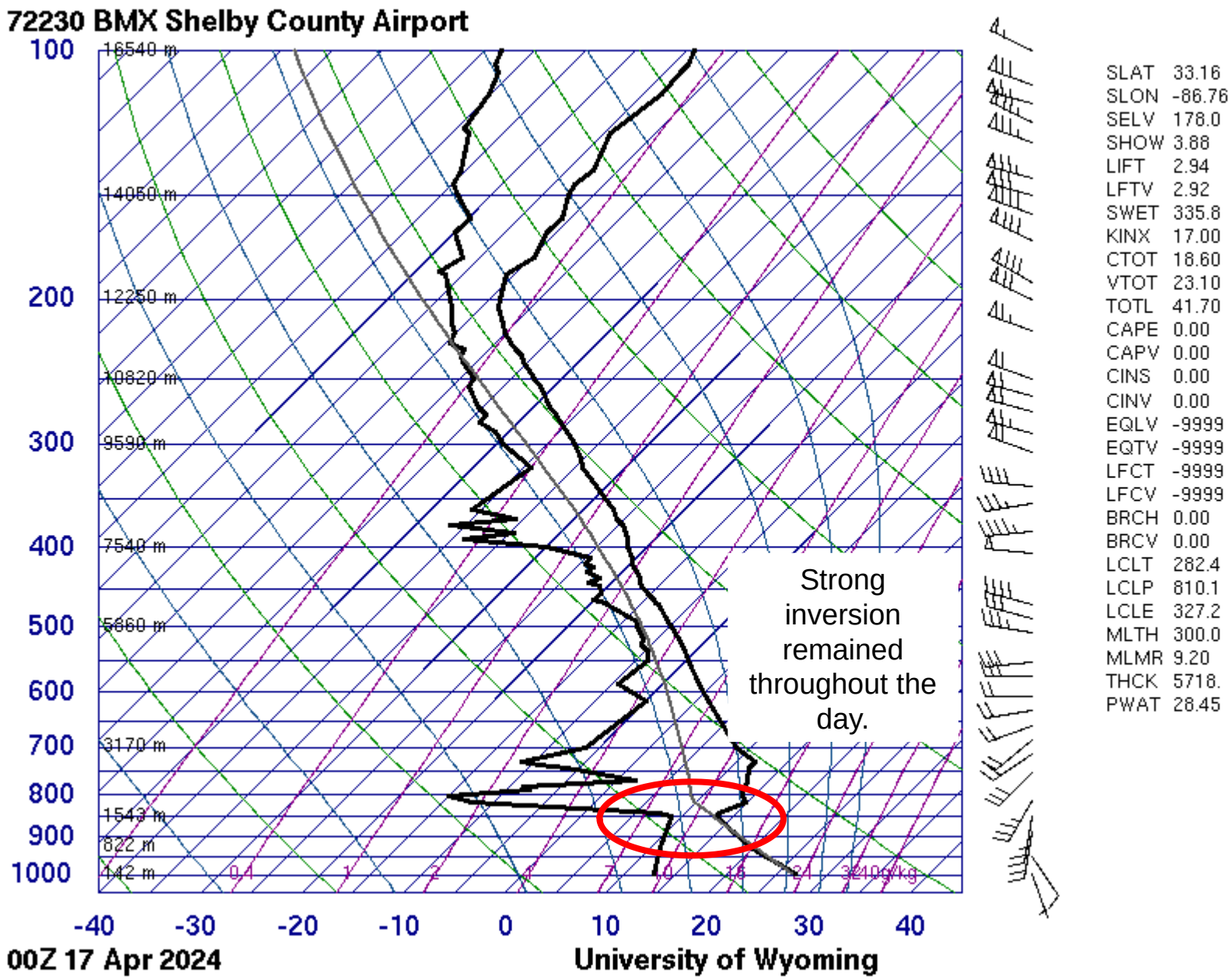
4/16/24

Source – Zoom Earth
https://zoom.earth





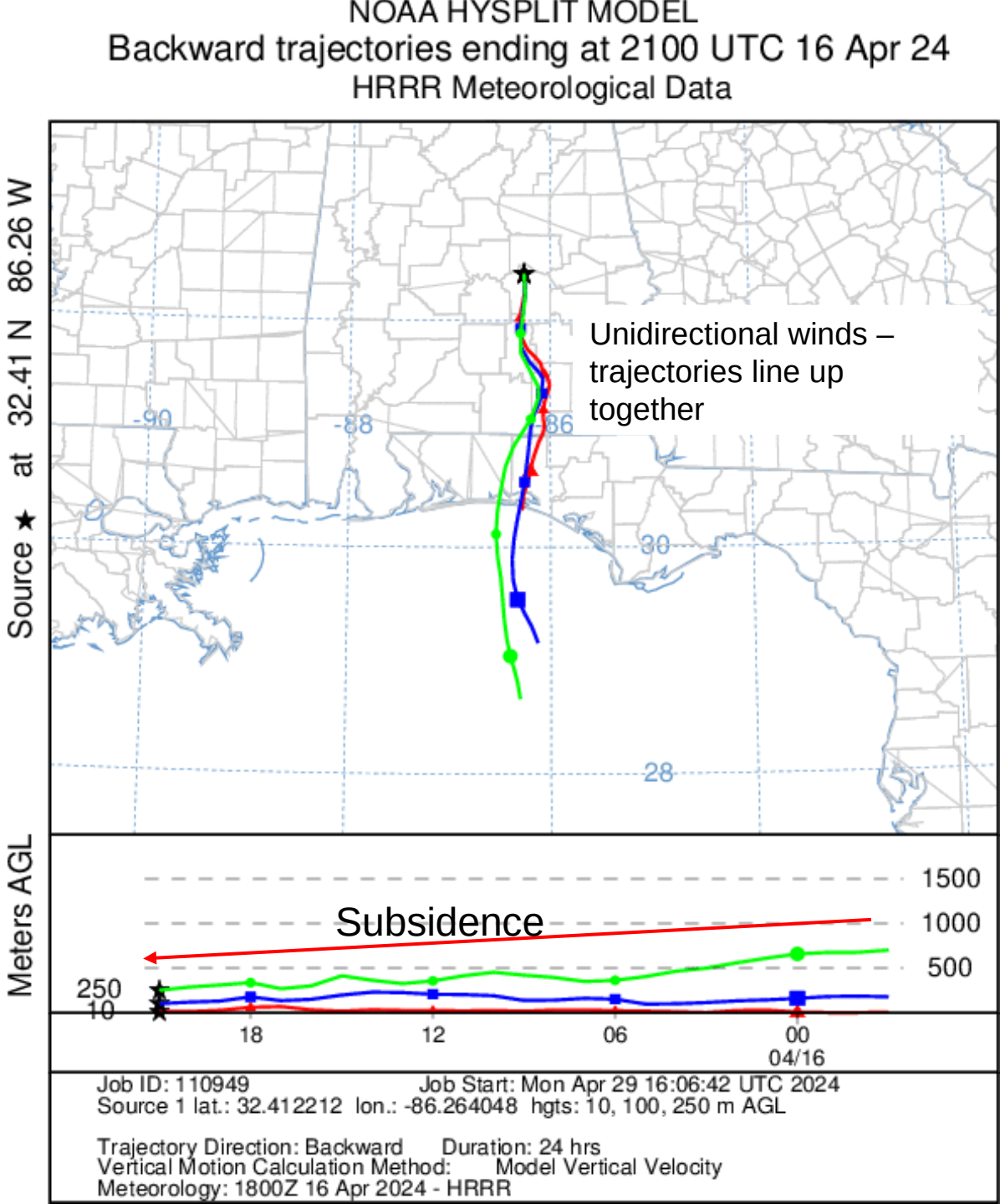
SLAT	33.16
SLON	-86.76
SELV	178.0
SHOW	11.04
LIFT	3.53
LFTV	3.58
SWET	229.4
KINX	-0.50
CTOT	1.50
VTOT	27.50
TOTL	29.00
CAPE	7.68
CAPV	12.70
CINS	0.00
CINV	0.00
EQLV	922.3
EQTV	920.1
LFCT	942.4
LFCV	943.2
BRCH	0.47
BRCV	0.77
LCLT	287.4
LCLP	950.5
LCLE	322.6
MLTH	291.6
MLMR	10.91
THCK	5674.
PWAT	22.68



SLAT	33.16
SLON	-86.76
SELV	178.0
SHOW	3.88
LIFT	2.94
LFTV	2.92
SWET	335.8
KINX	17.00
CTOT	18.60
VTOT	23.10
TOTL	41.70
CAPE	0.00
CAPV	0.00
CINS	0.00
CINV	0.00
EQLV	-9999
EQTV	-9999
LFCT	-9999
LFCV	-9999
BRCH	0.00
BRCV	0.00
LCLT	282.4
LCLP	810.1
LCLE	327.2
MLTH	300.0
MLMR	9.20
THCK	5718.
PWAT	28.45

- Back trajectories at all levels from the fire to the Montgomery monitor, indicating that the plume stayed intact vertically

- Subsidence, sinking air, is also shown in the vertical velocity. This traps any pollutants close to the ground.



NOAA Model Vs. Observed Data 4/16/24

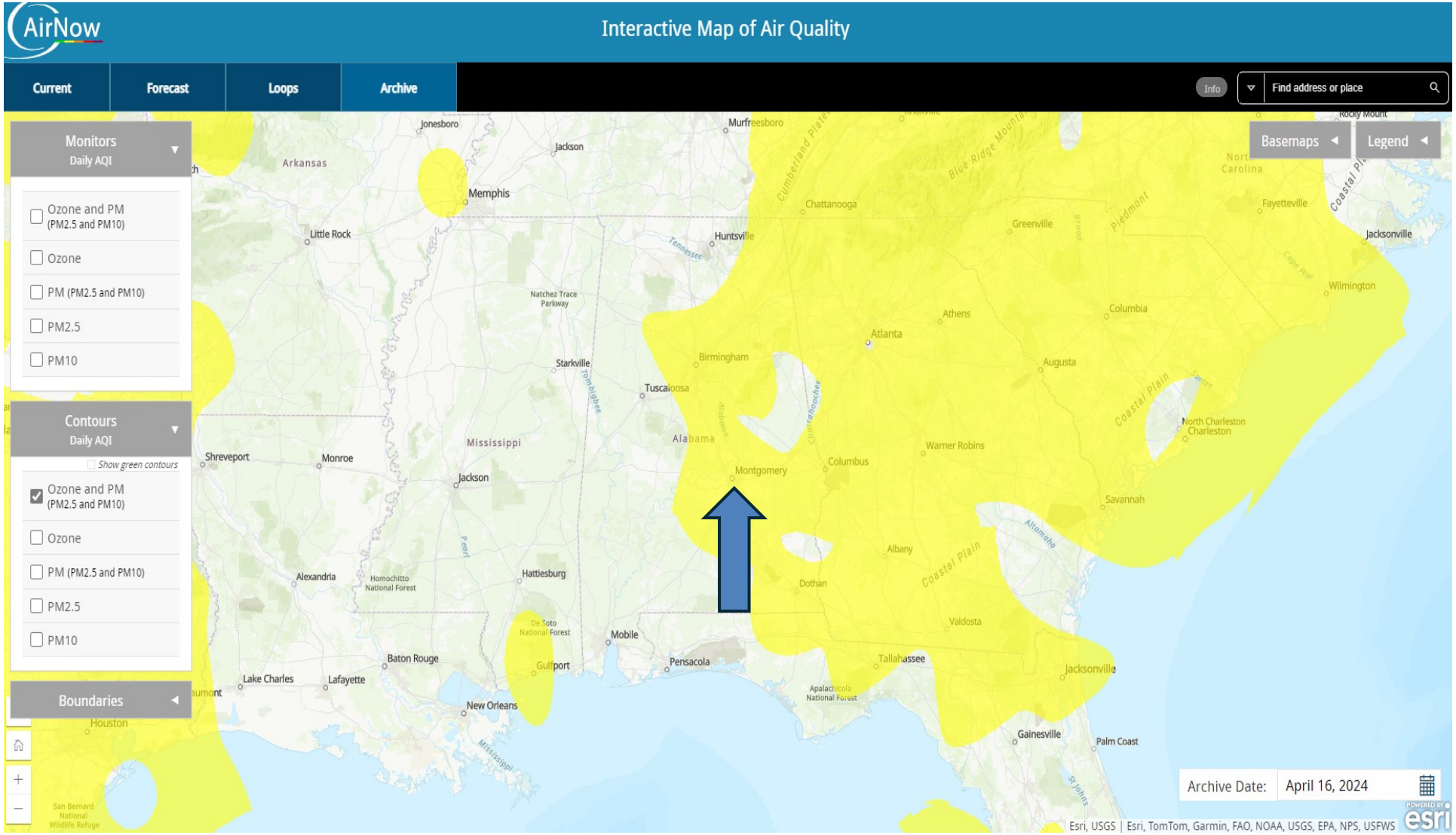
Ozone

Agency	City	Date	Forecast AQI	Forecast Category	Obs. AQI	Obs. Category
Alabama Department of Environmental Management	Montgomery	04/16/2024	41	1	61	2

$PM_{2.5}$

Agency	City	Date	Forecast AQI	Forecast Category	Obs. AQI	Obs. Category
Alabama Department of Environmental Management	Montgomery	04/16/2024	44	1	63	2

AirNow Map- 4/16/24



Case Study Conclusions

- This case study along with a few previous events show that it takes a dense localized smoke plume to increase ozone concentrations.
- This increase in ozone is due to the dense smoke plume having high levels of NO2 and VOC's. Which downwind, leads to ozone formation if the weather conditions are favorable.
- PM2.5 was also considerably higher than expected due to the dense smoke plume not dispersing.
- For a dense smoke plume to travel a long distance and cause increases in both ozone and PM2.5, certain weather conditions need to be present.

  -A strong low-level inversion seen on the sounding.

  -Unidirectional winds from the surface to the inversion shown in the back trajectory.
- Thoughts/Questions?