



South Carolina Department of Health and Environmental Control

2016 Ozone Season CMAQ Model Feedback

Wes Behrend, SCDHEC Air Quality Forecaster

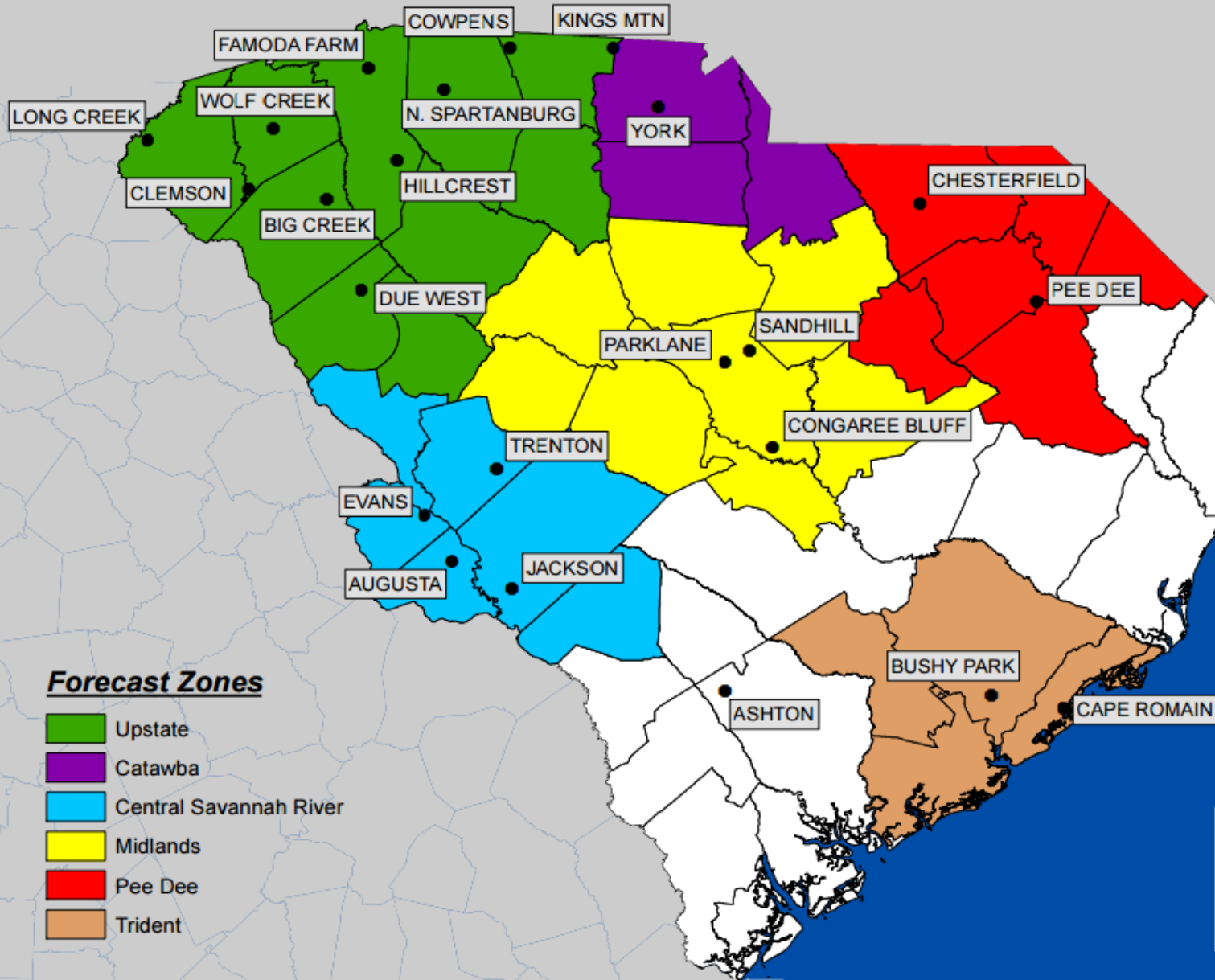
CMAQ Model Performance Methodology

- 12Z NOAA CMAQ model run was used exclusively for this study.
- Day 1 (today's forecast) and Day 2 (tomorrow's forecast) CMAQ NOAA model maximum 8-hour concentrations are extracted for every day since April 1st at all monitor sites that are used by South Carolina for ozone forecast verification.
- Differences between Day 2 and Day 1 CMAQ forecasts are used to remove model biases when producing day-to-day forecasts, and this same methodology is used for CMAQ performance testing in South Carolina.

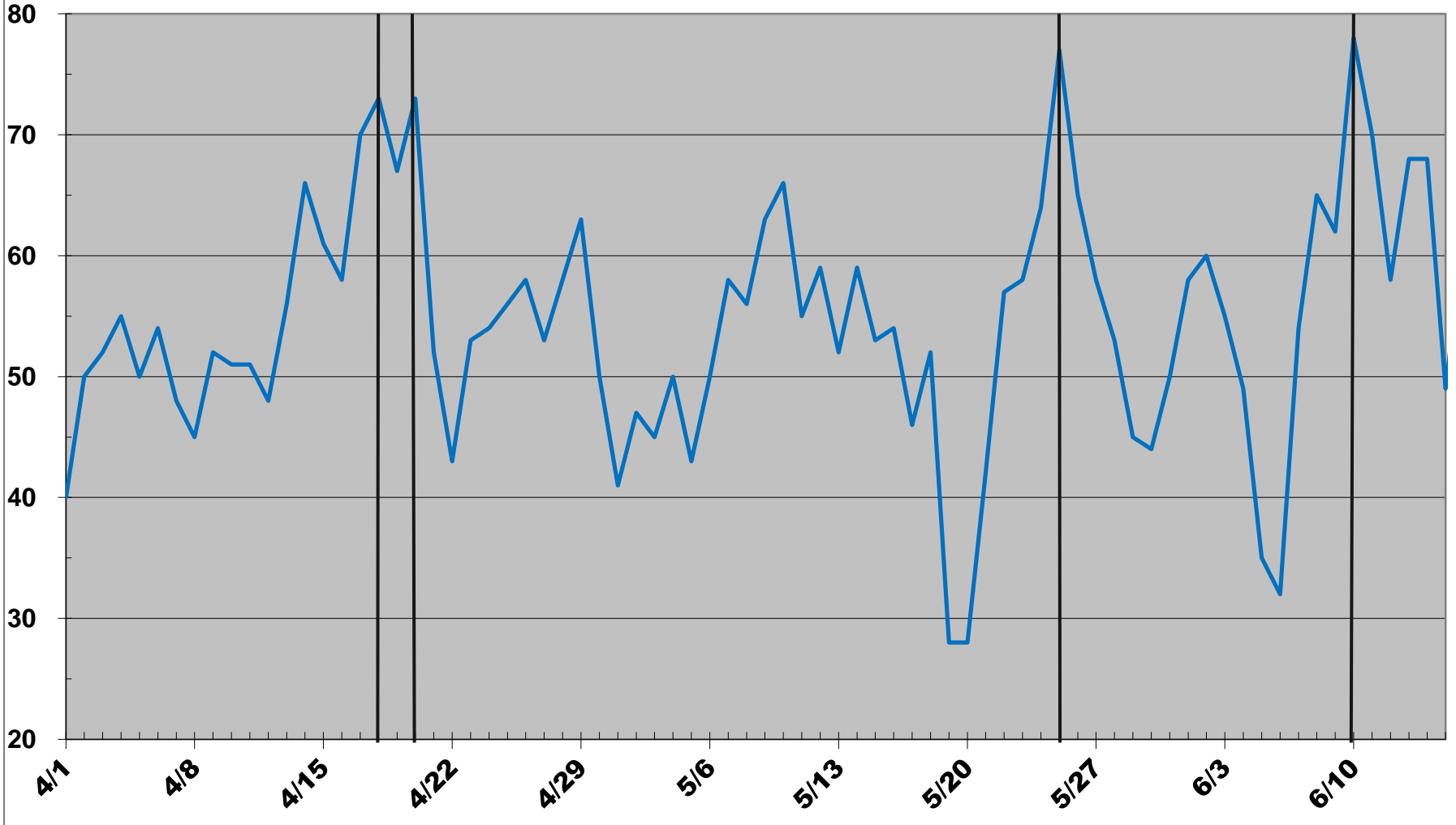
CMAQ Model Performance Methodology

- **“NOAA Value”** {maximum from all monitor locations in each zone}
(Day 2 zone max 8-hour CMAQ prediction) – (Day 2 zone max 8-hour monitor observation)
- **“NOAA Diff”** {from the maximum monitor difference in each zone}
[(CMAQ day 2 max zone prediction) – (CMAQ day 1 zone max 8-hour CMAQ prediction)] + (Day 1 zone max 8-hour monitor observation) – (Day 2 zone max 8-hour monitor observation)
- The South Carolina DHEC forecast biases are shown for comparison.
- Missing NOAA CMAQ data from June 17th through June 20th and June 25th through June 27th due to SCDHEC Linux downtime.

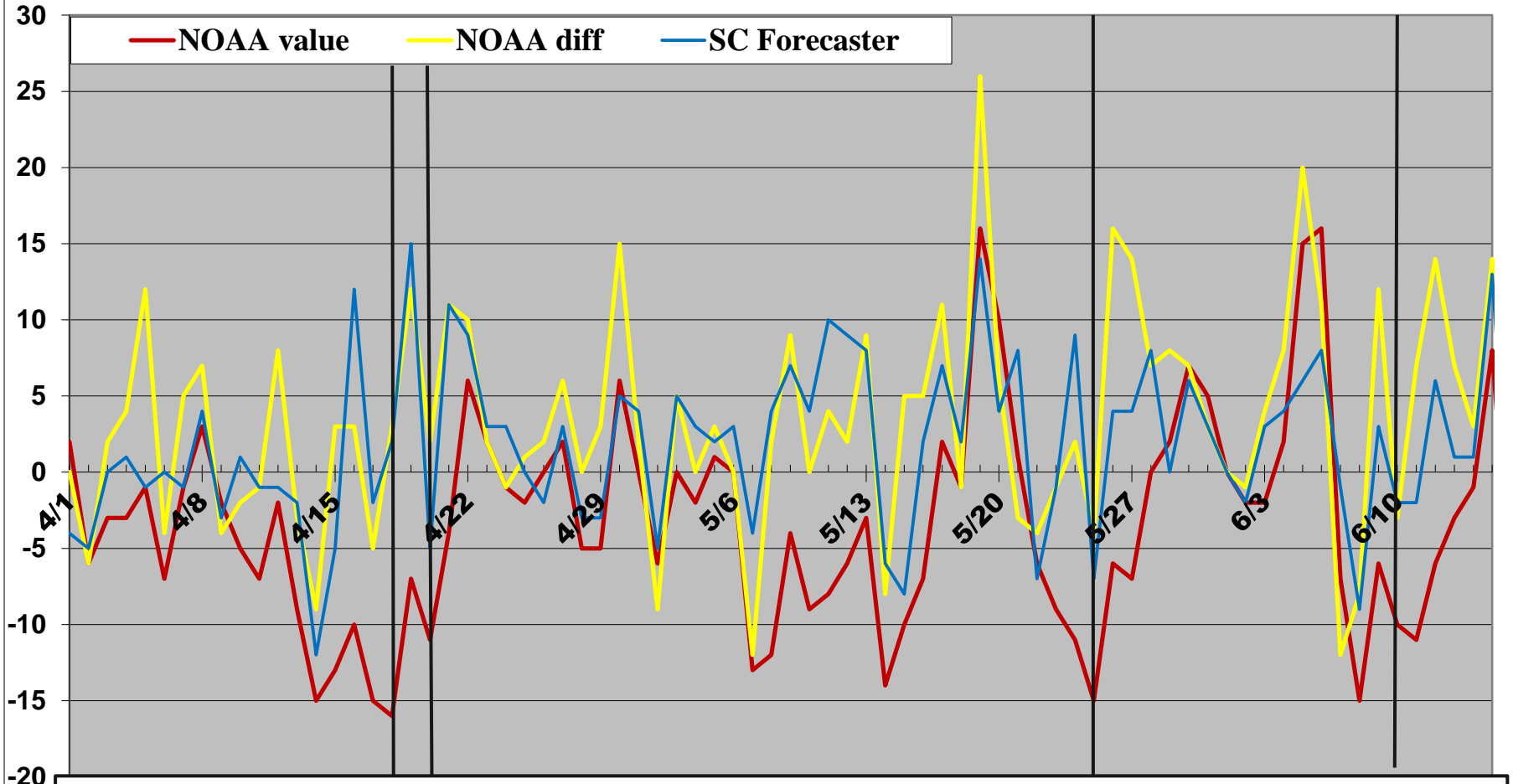
Ground-Level Ozone -- Forecast Zones and Monitors



Spring 2016 Max Ozone Observed (ppb) – Upstate (GSP Area)

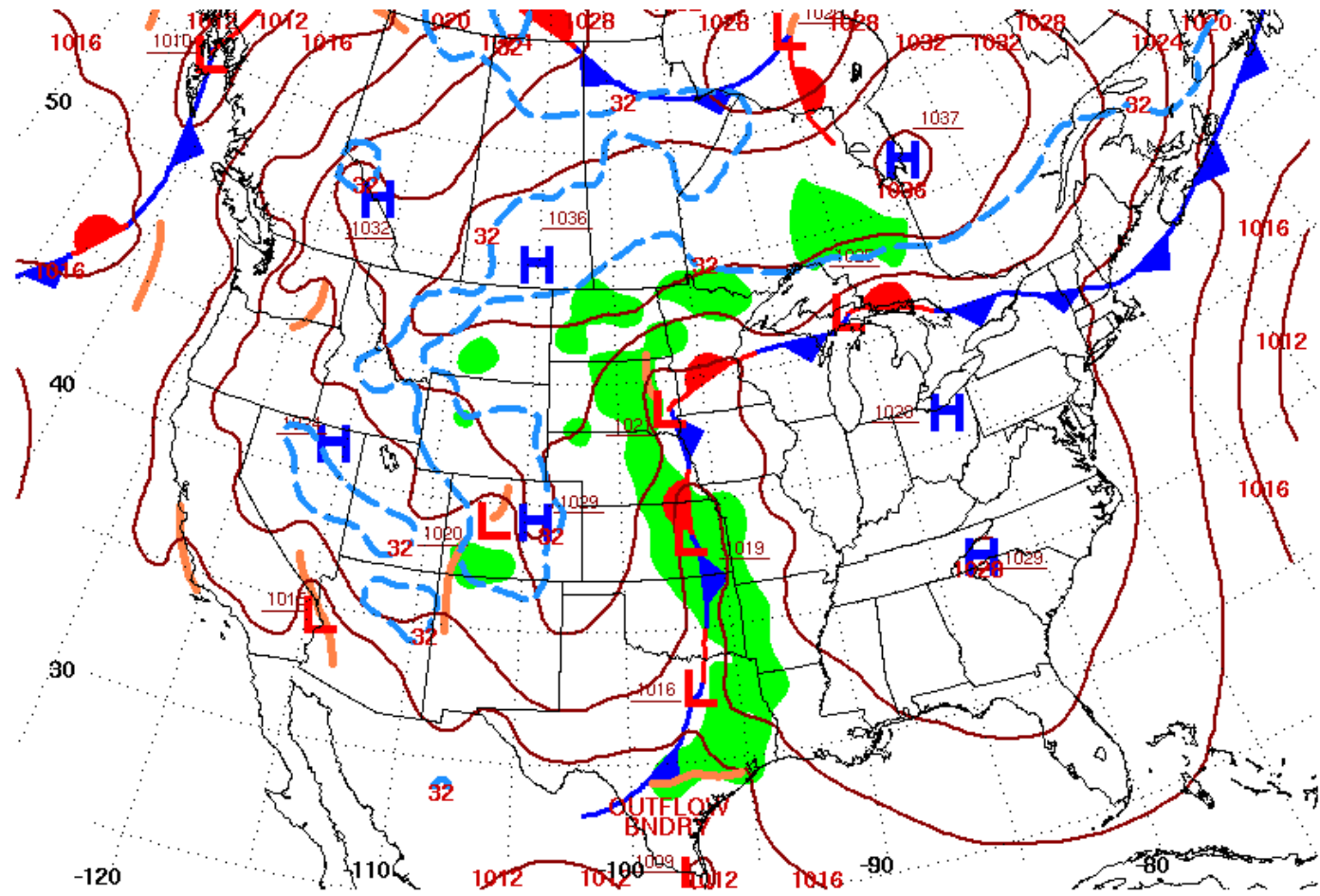


Spring 2016 Forecast Errors (ppb) – Upstate (GSP Area)



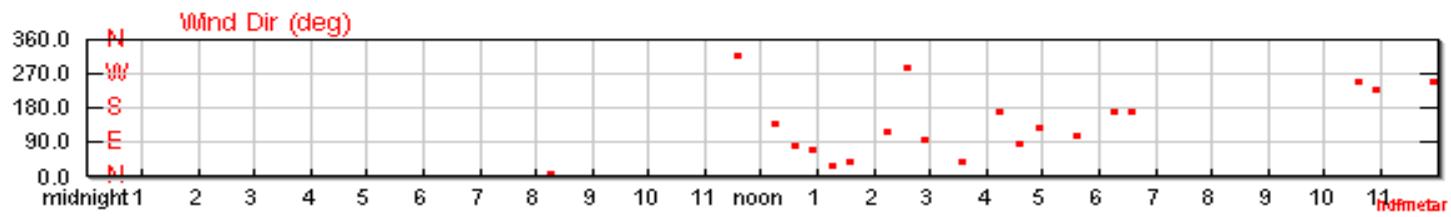
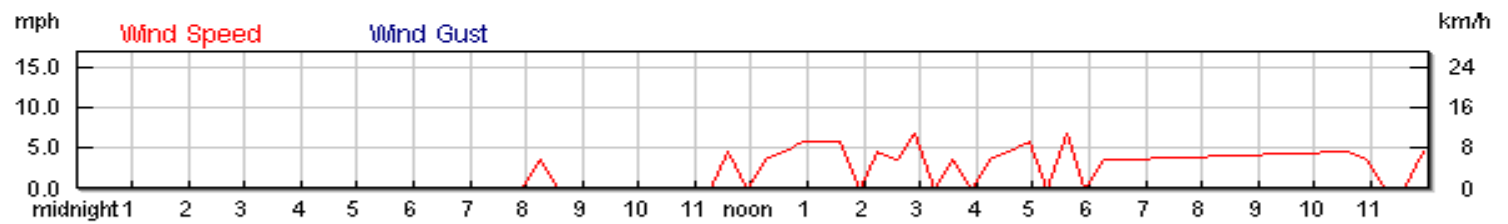
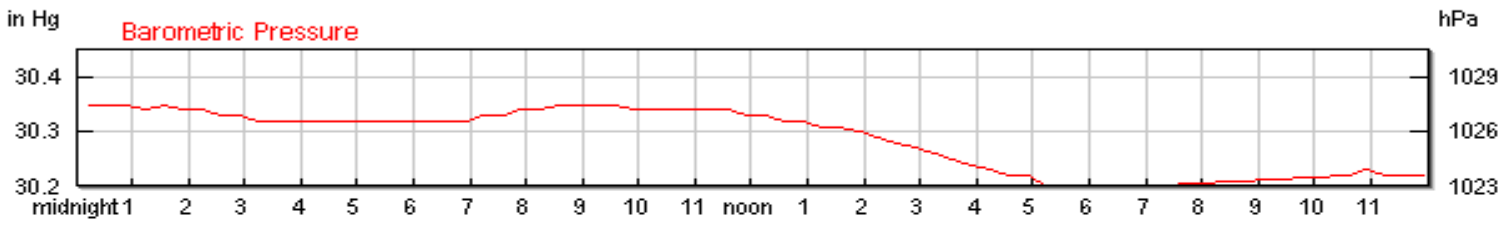
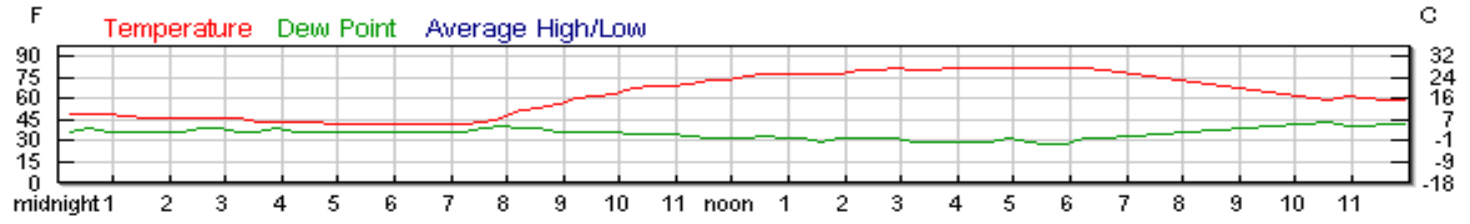
Ozone Observations > 70ppb on 4/18 (73), 4/20 (73), 5/25 (77), and 6/10 (78)

4/18/2016 Surface Map

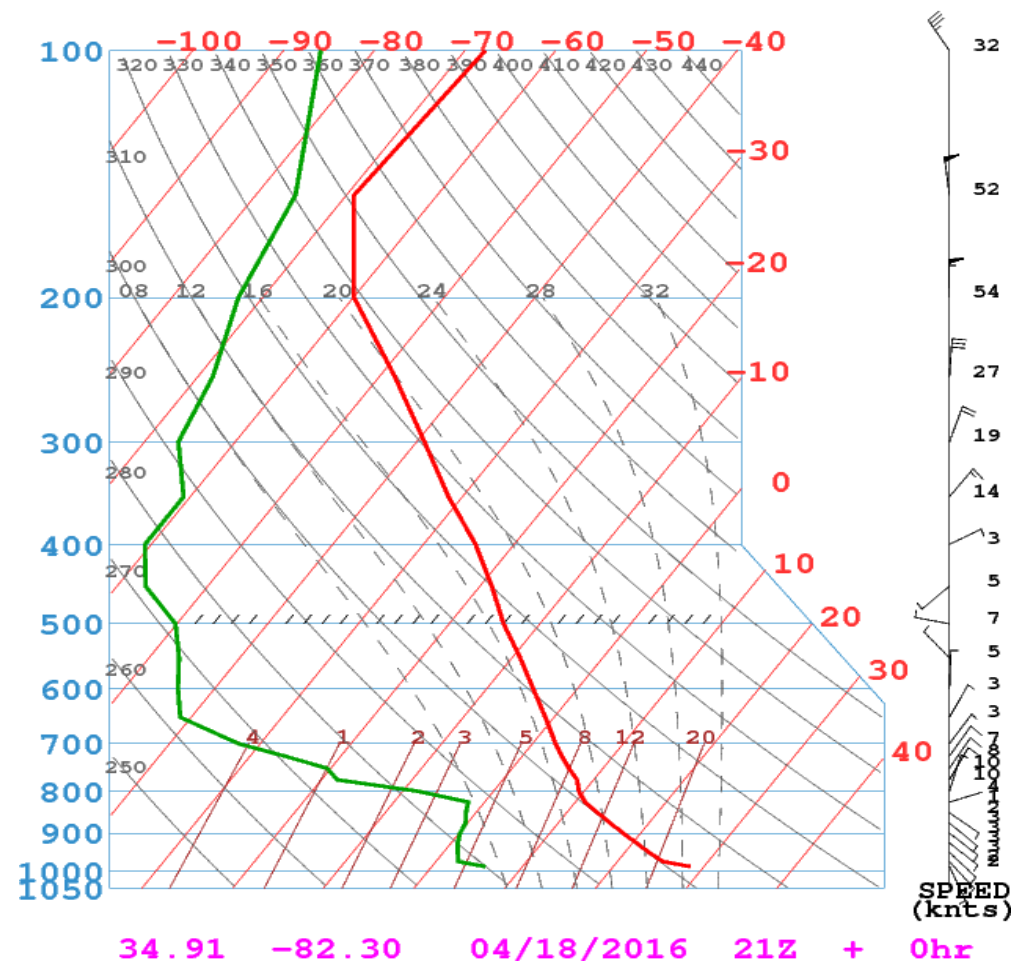


Surface Weather Map at 7:00 A.M. E.S.T.

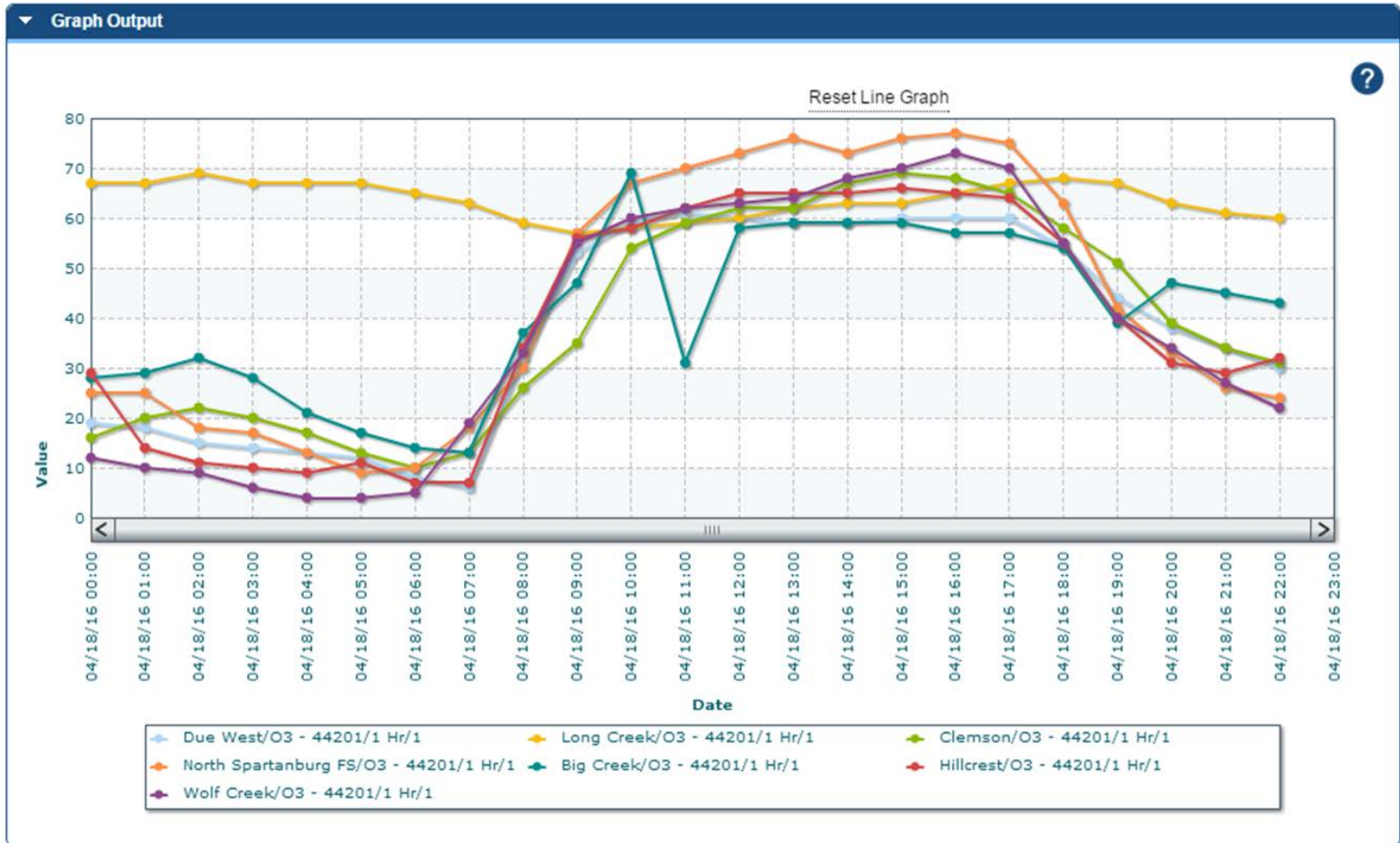
4/18/2016 GSP Meteorogram



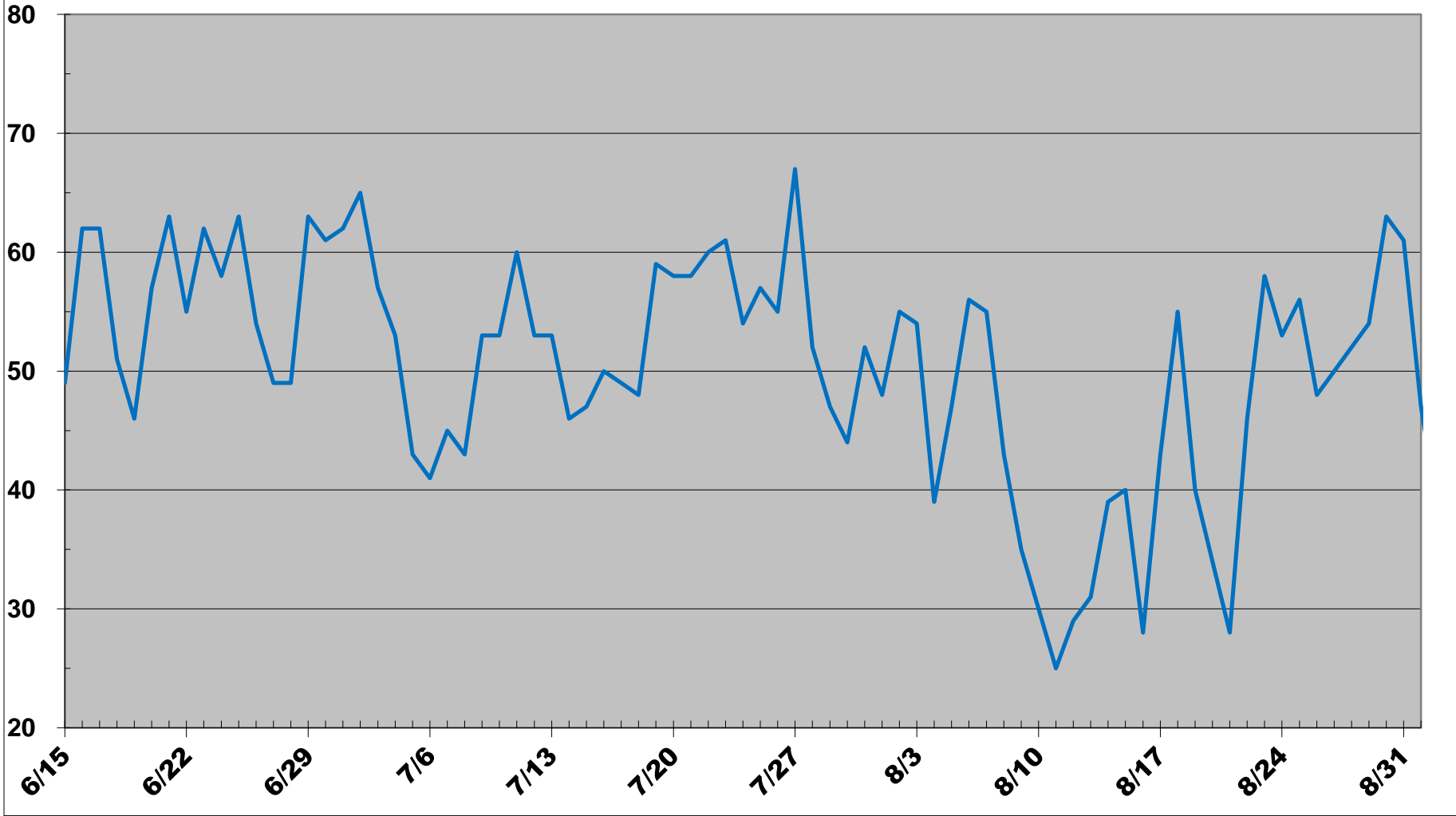
GSP Model Sounding at 21Z 4/18/2016



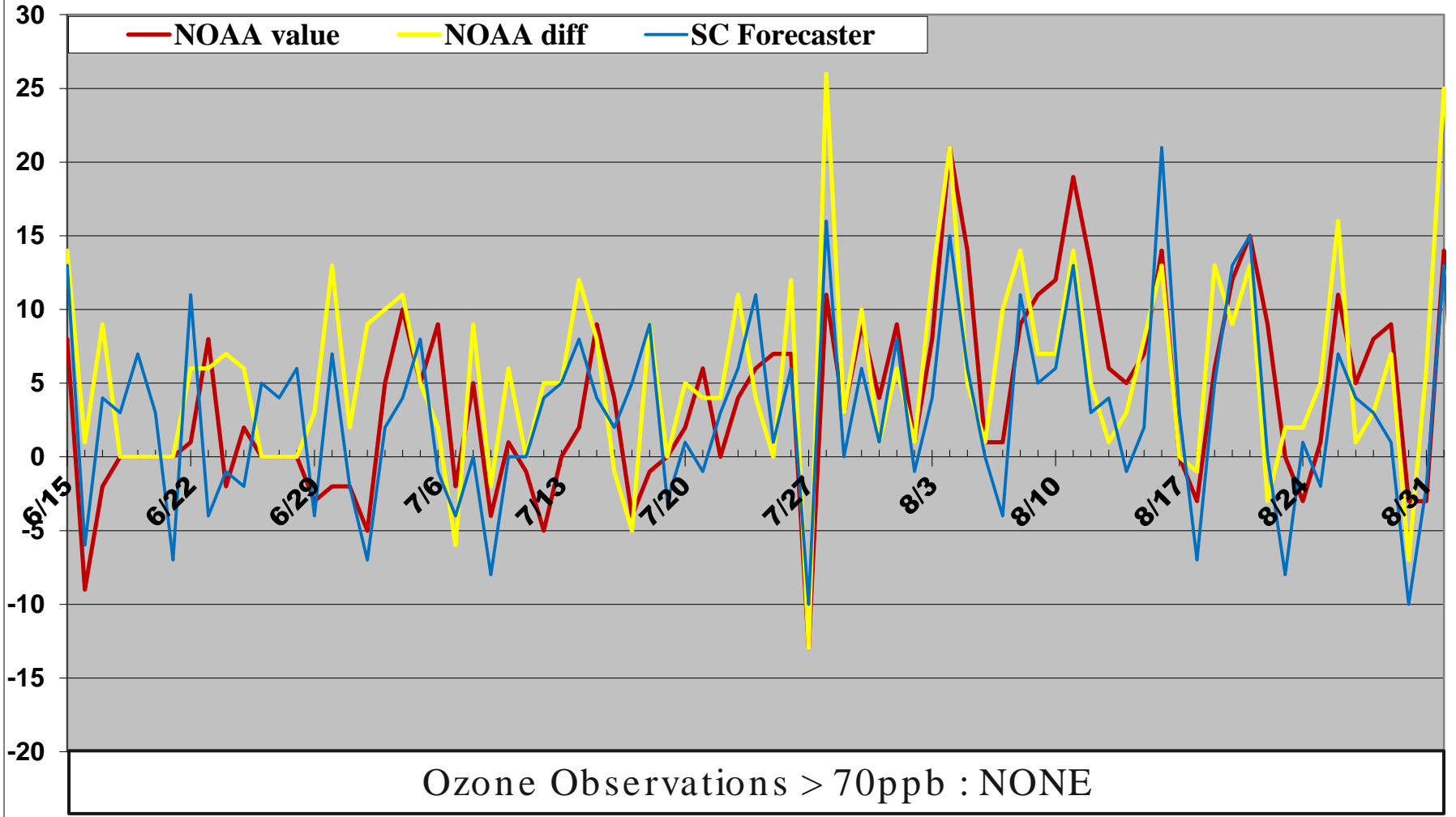
Hourly Ozone Values in the Upstate



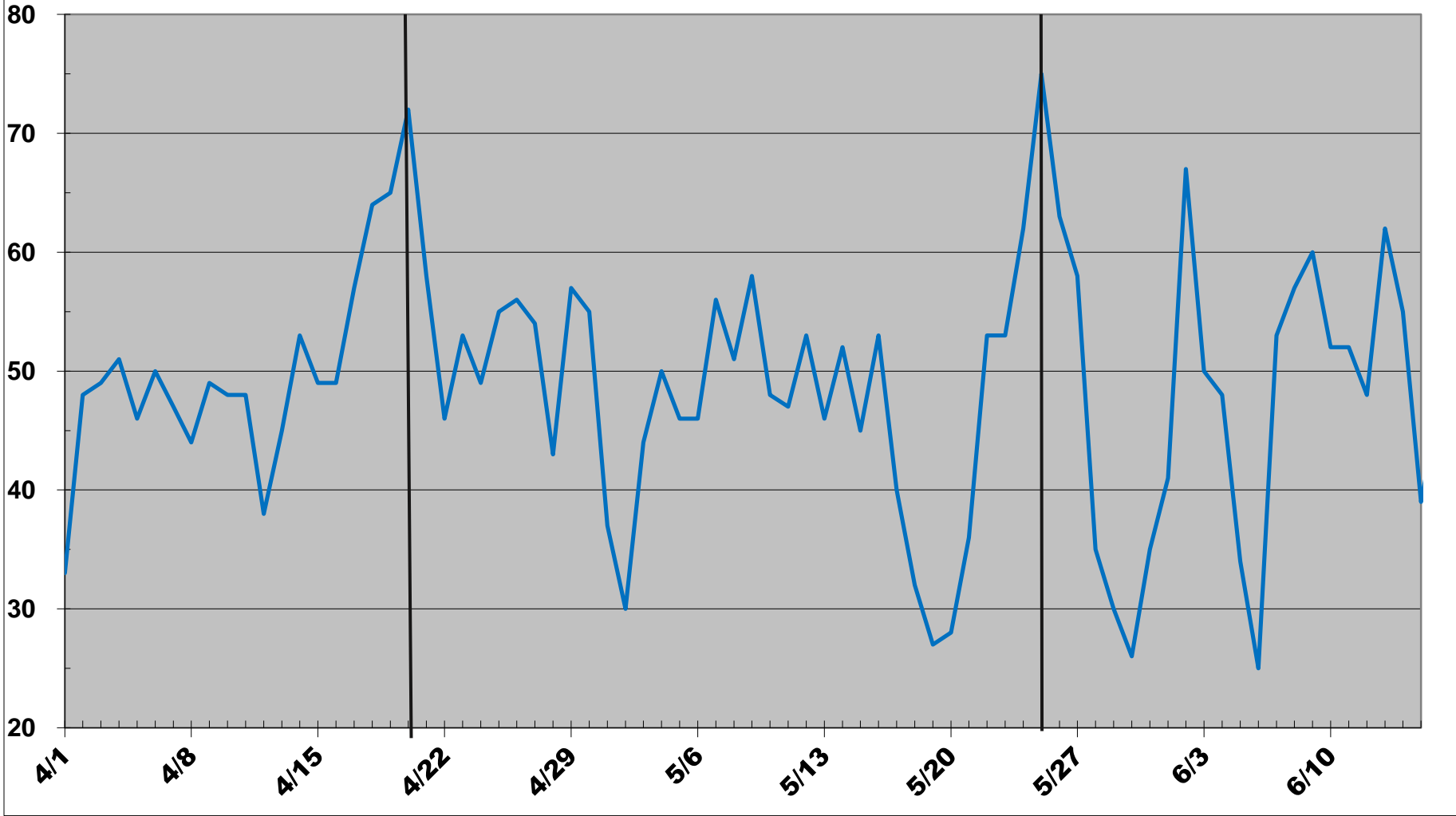
Summer 2016 Max Ozone Observed (ppb) – Upstate (GSP Area)



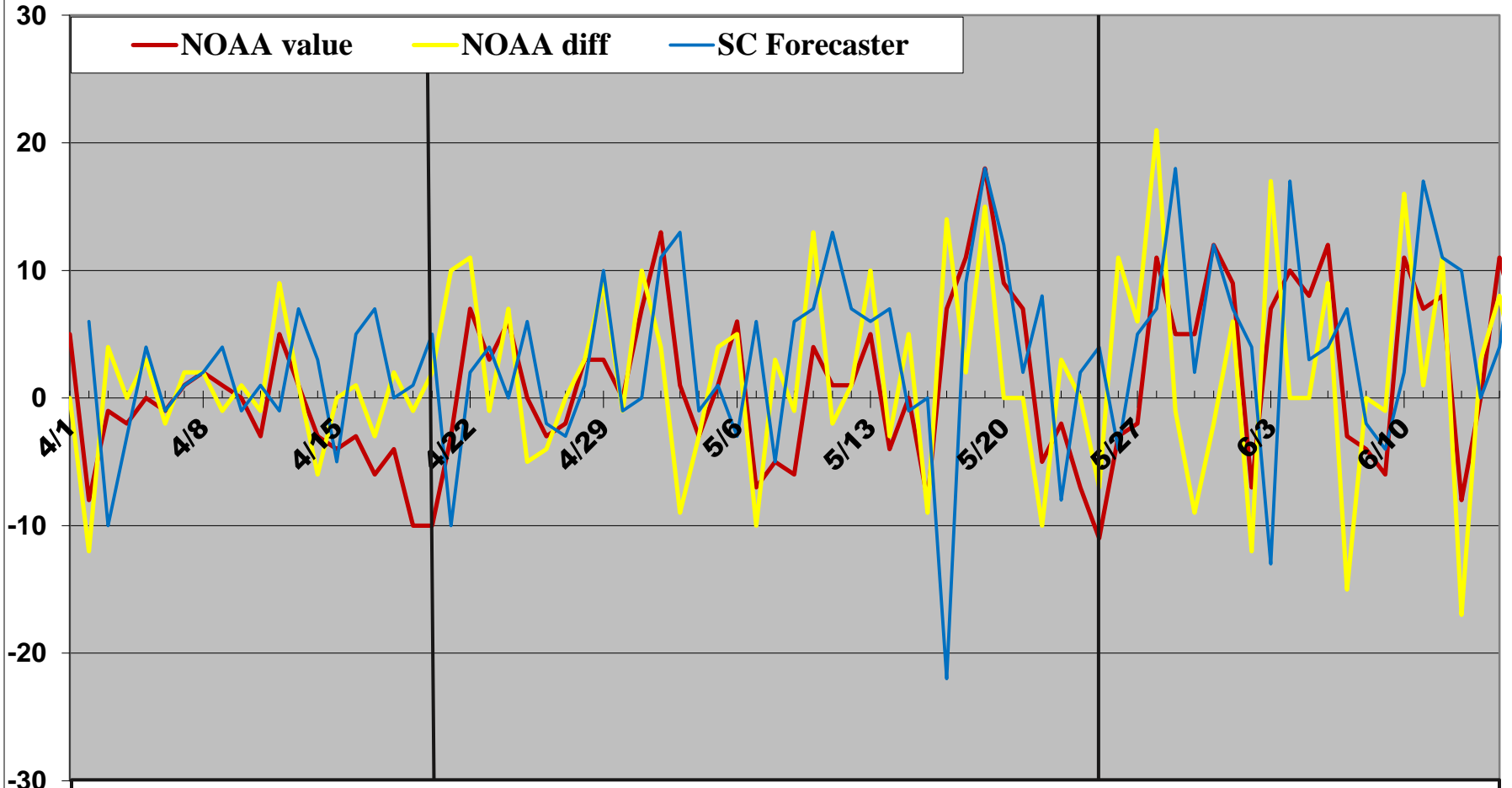
Summer 2016 Forecast Errors (ppb) – Upstate (GSP Area)



Spring 2016 Observed O3 Max (ppb) – Midlands (CAE Area)

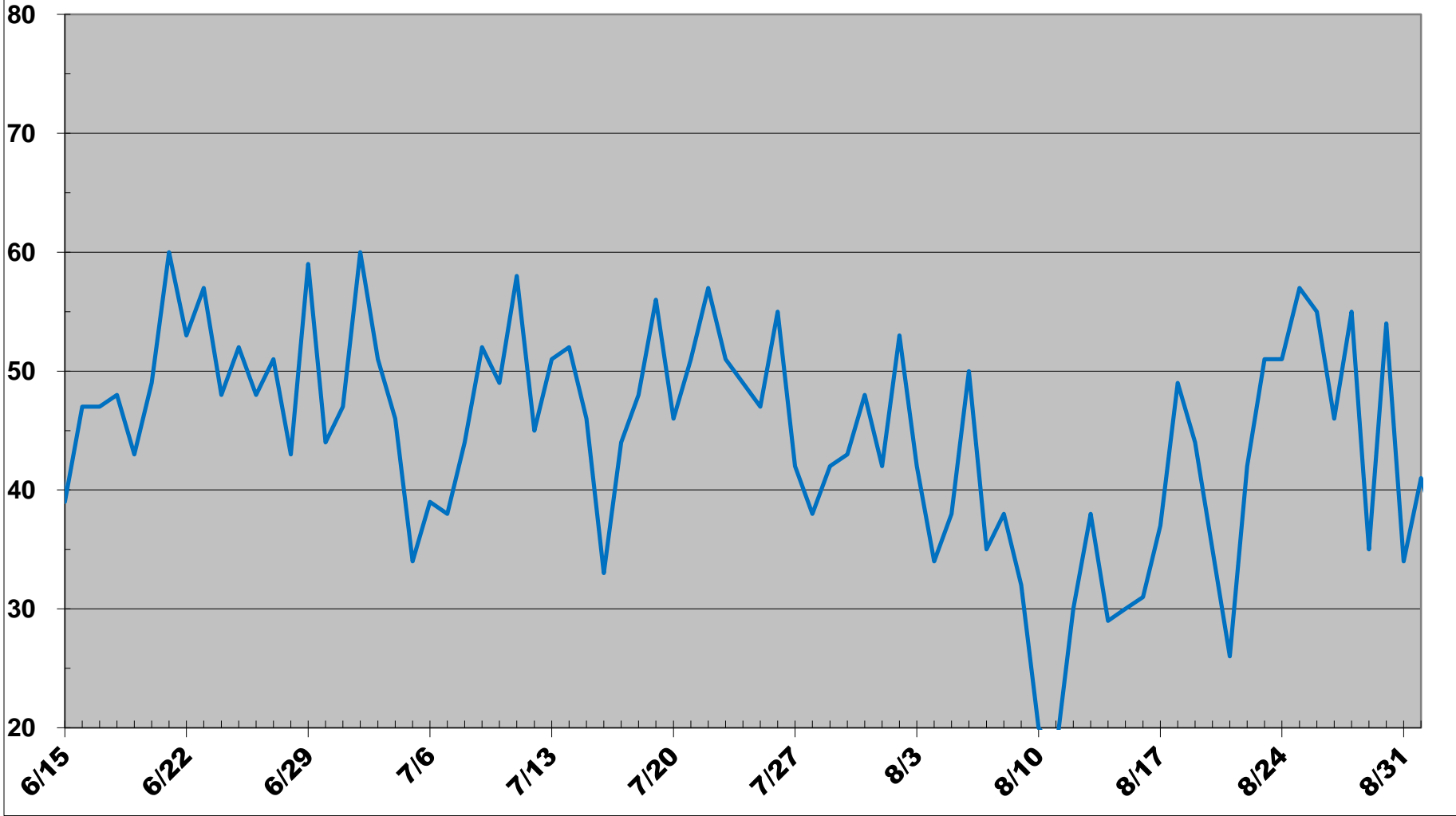


Spring 2016 Forecast Errors (ppb) – Midlands (CAE Area)

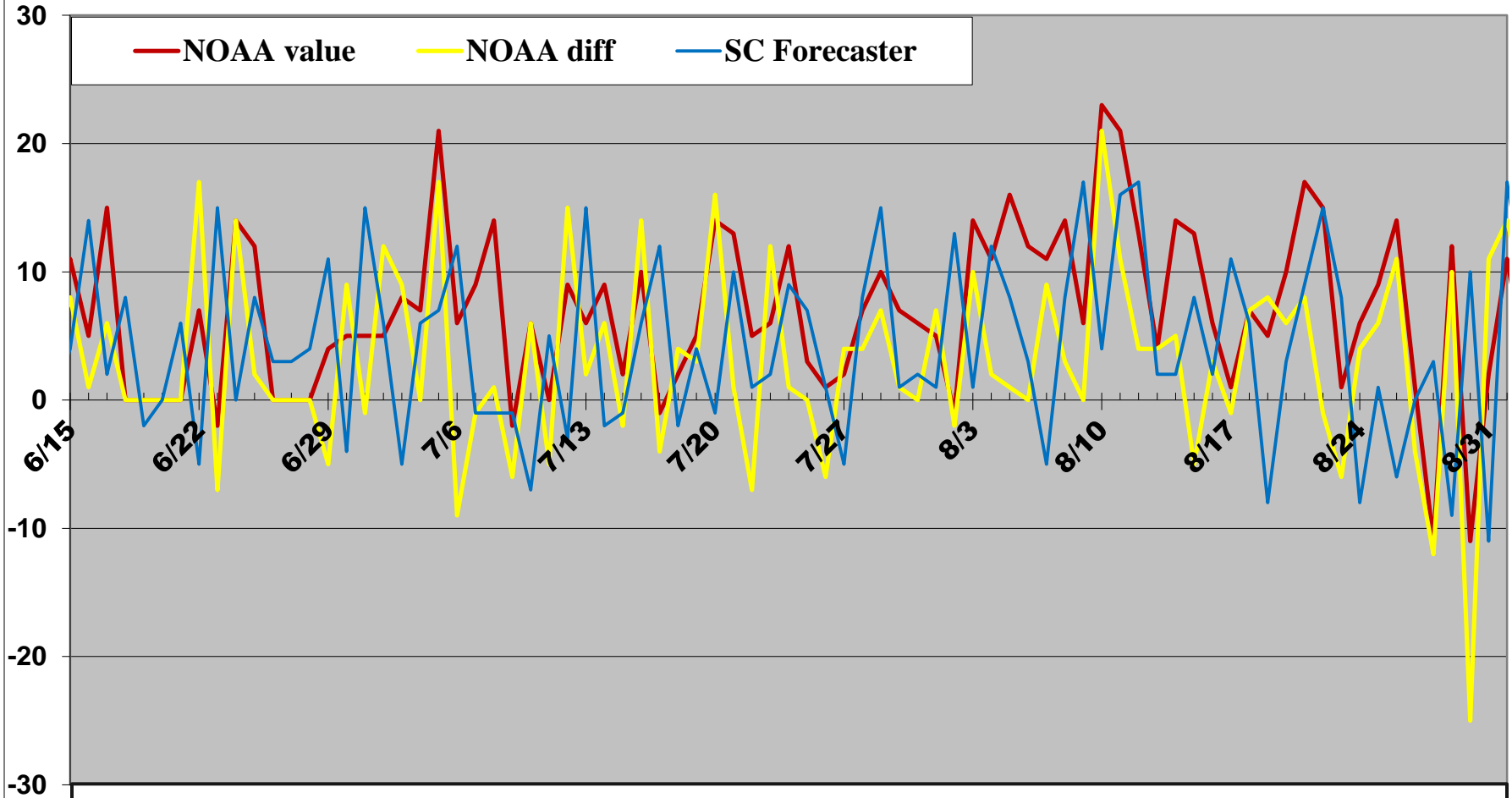


Ozone Observations > 70ppb on 4/20 (72 ppb) and 5/25 (75 ppb)

Summer 2016 Observed O3 Max (ppb) – Midlands (CAE Area)

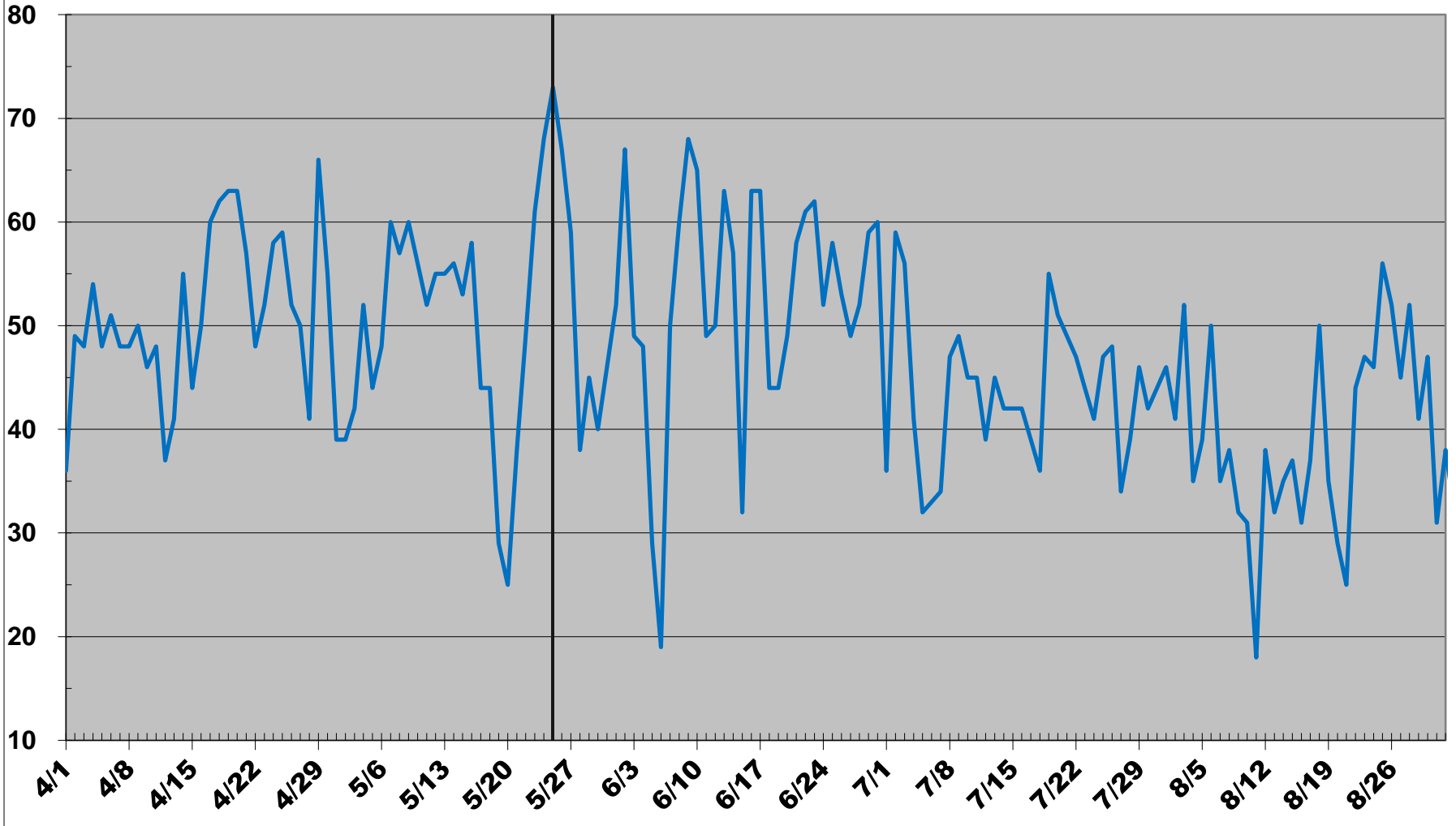


Summer 2016 Forecast Errors (ppb) – Midlands (CAE Area)

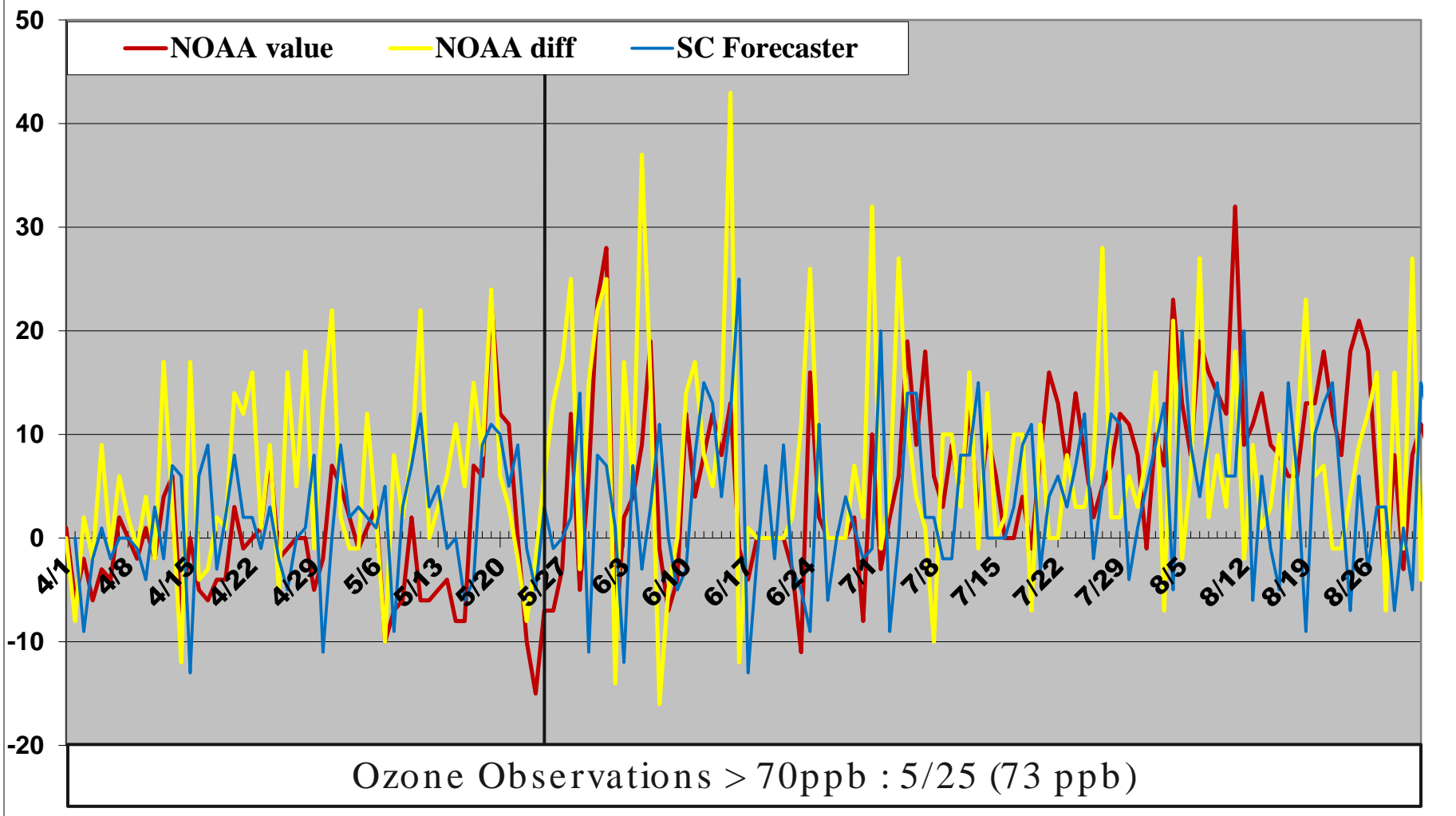


Ozone Observations > 70ppb : NONE

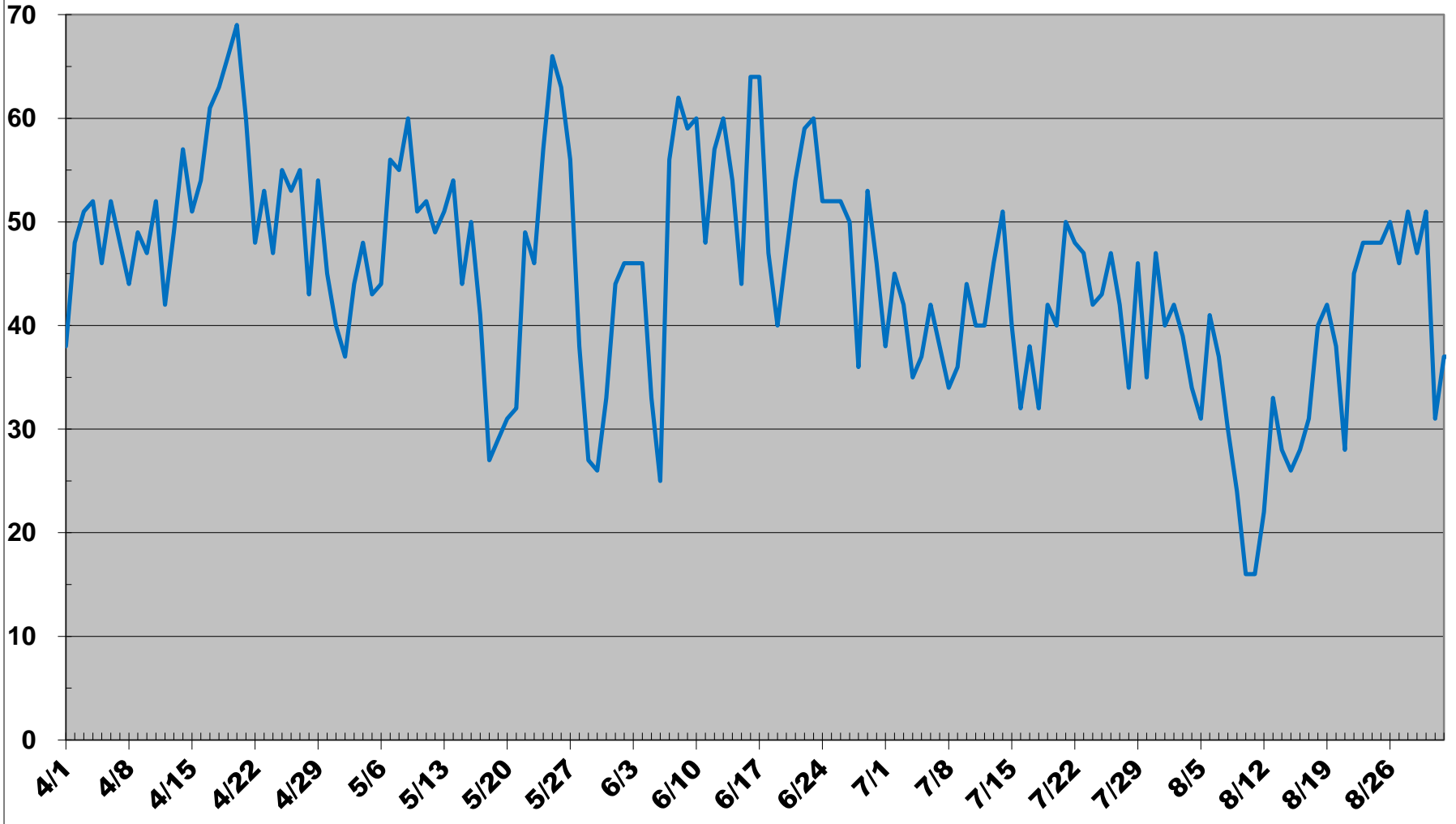
2016 Observed O3 Max (ppb) – CSRA (AGS Area)



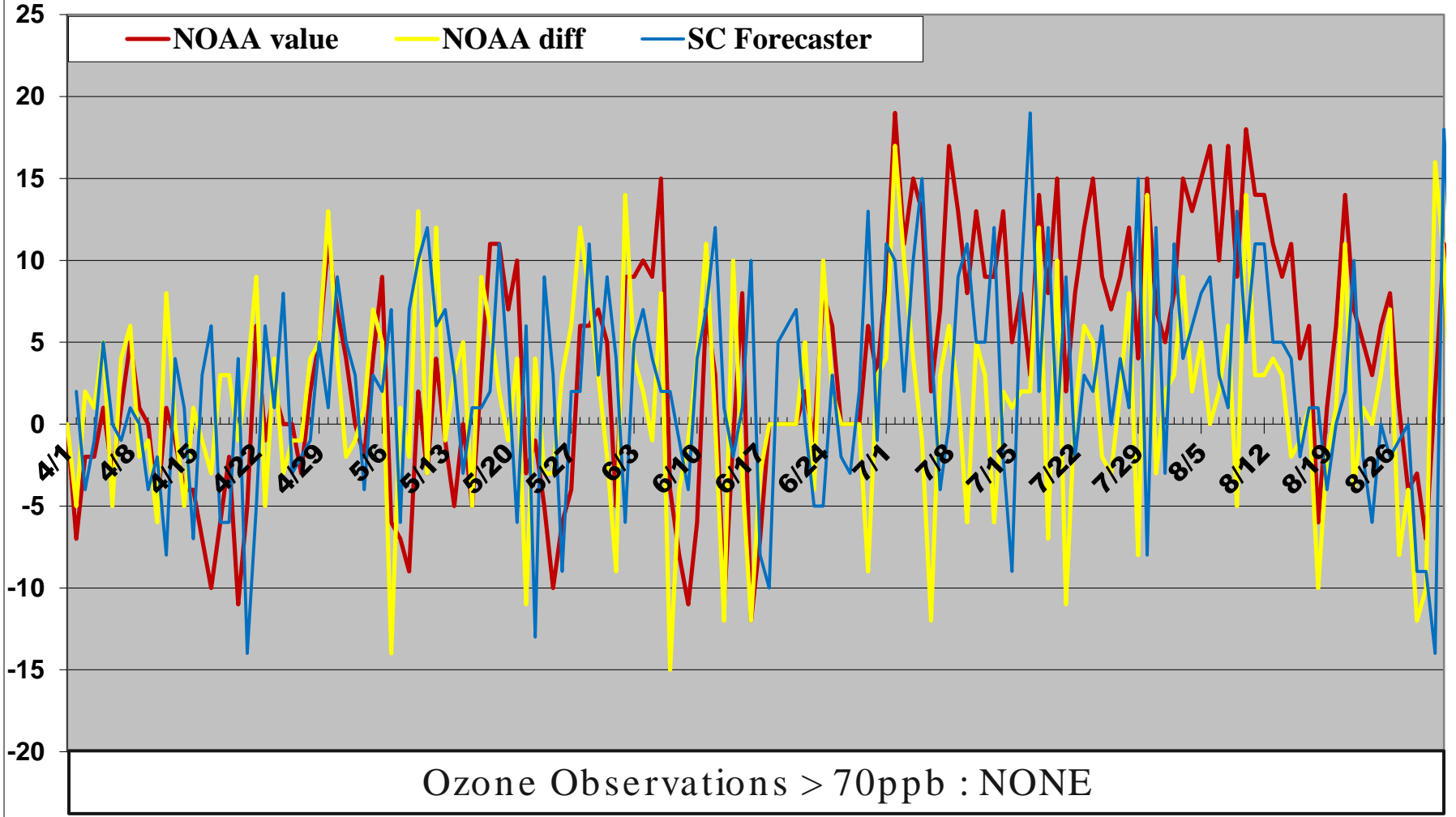
2016 Forecast Errors (ppb) – CSRA (AGS Area)



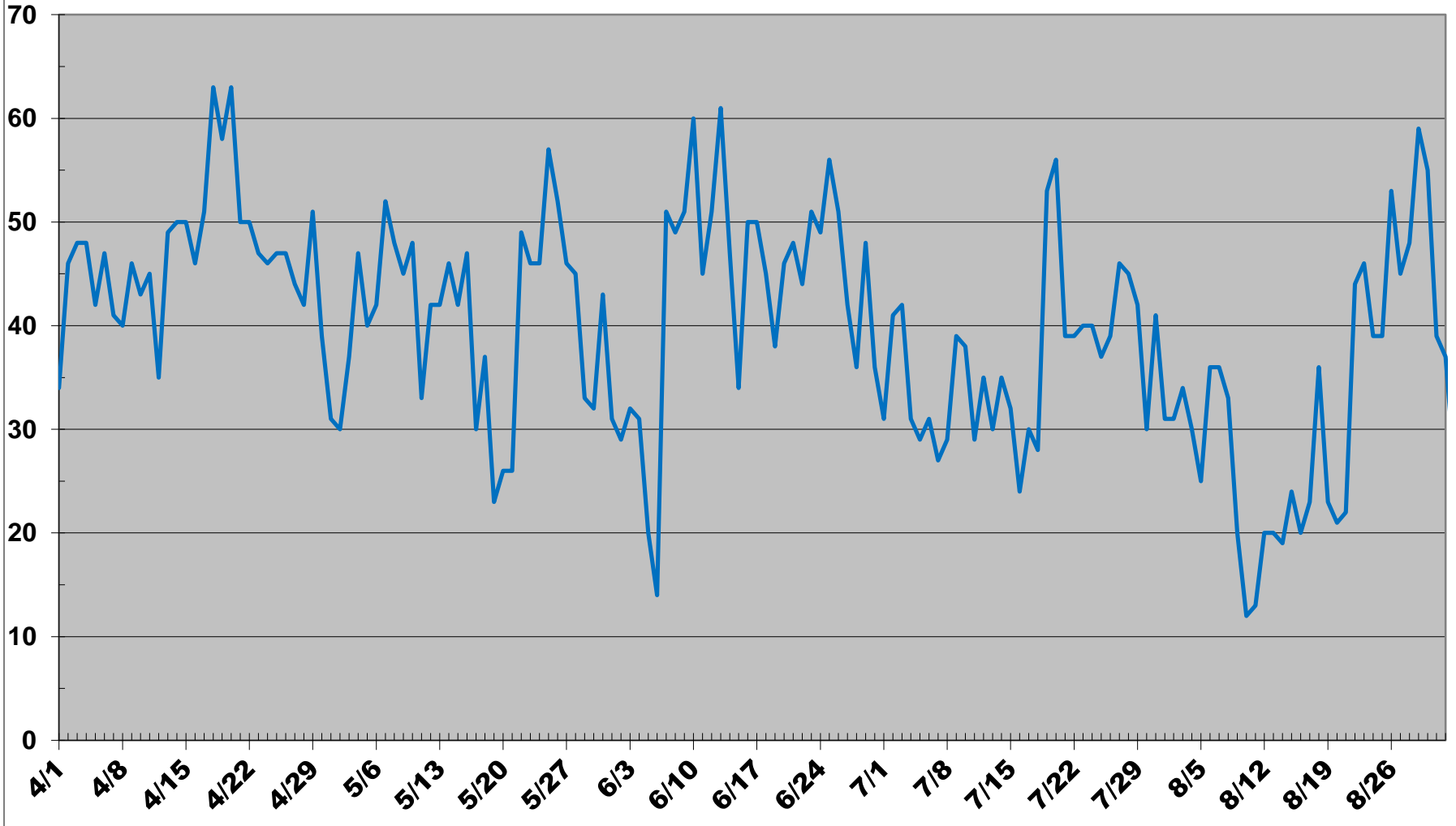
2016 Observed O3 Max (ppb) – Pee Dee (FLO Area)



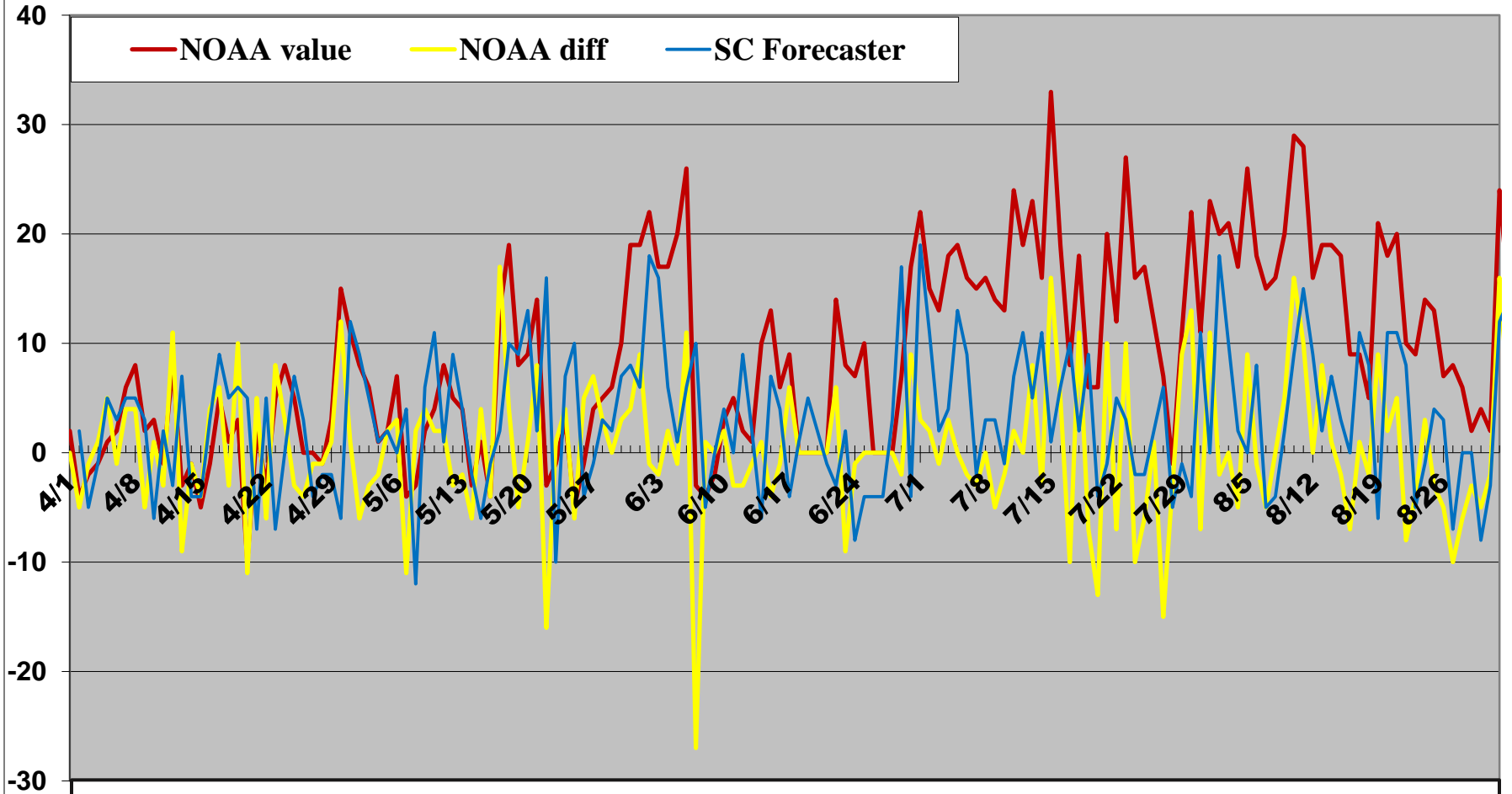
2016 Forecast Errors (ppb) – Pee Dee (FLO Area)



2016 Observed O3 Max (ppb) – Catawba (UZA Area)

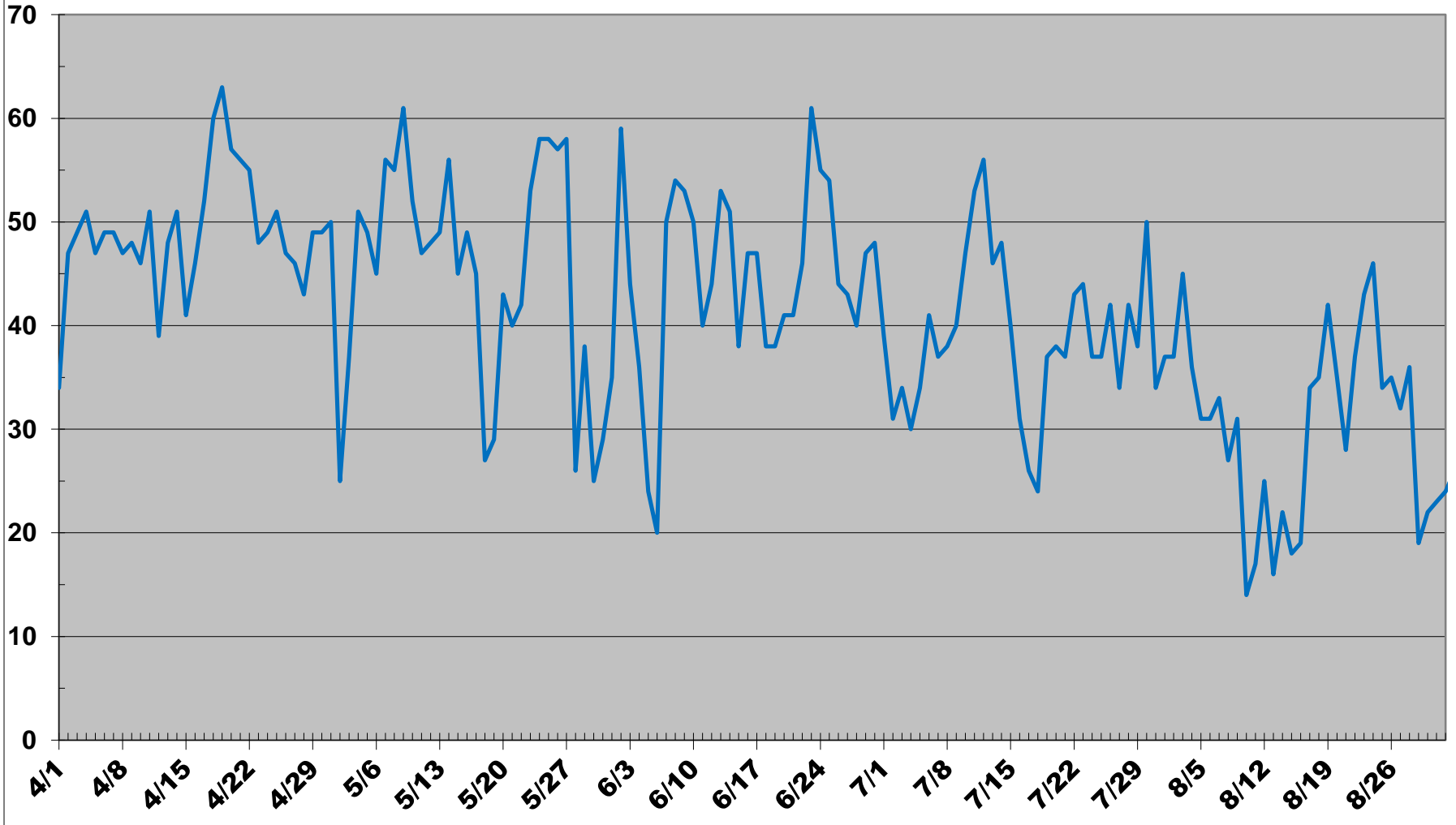


2016 Forecast Errors (ppb) – Catawba (UZA Area)

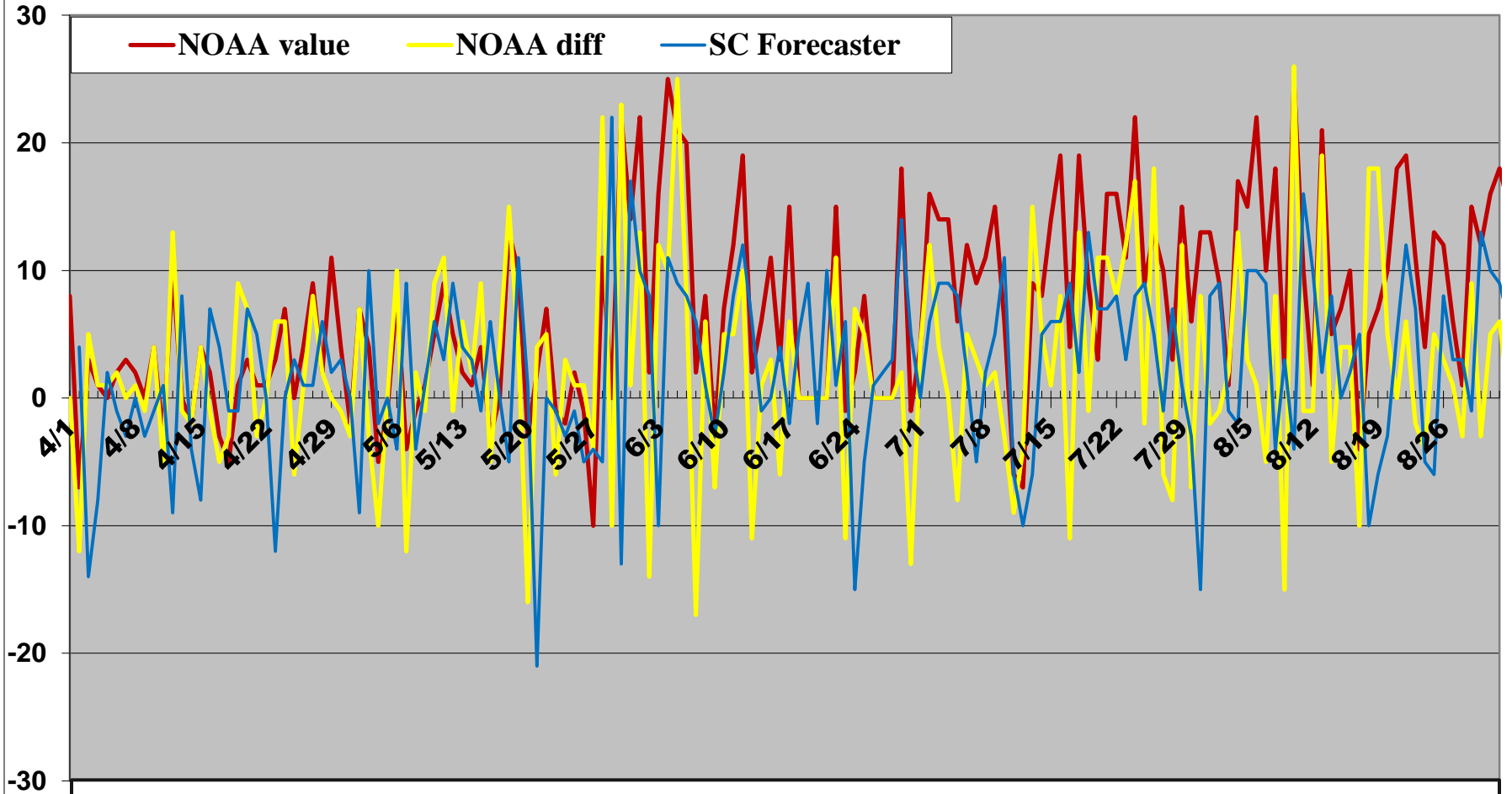


Ozone Observations > 70ppb : NONE

2016 Observed O3 Max (ppb) – Trident (CHS Area)



2016 Forecast Errors (ppb) – Trident (CHS Area)



Ozone Observations > 70ppb : NONE

CMAQ Model Performance for SC 2016

Forecast Bias (PPB)	Midlands (Columbia)			Upstate (Spartanburg)			Central Savannah (Augusta, GA)		
	BAQ	NOAA		BAQ	NOAA		BAQ	NOAA	
		Value	Diff		Value	Diff		Value	Diff
2016 Ozone Season (Apr 1 – Aug 31)	3.1	4.5	2.5	2.0	0.6	4.6	2.7	4.9	7.0
Spring (Apr 1 – June 15)	3.2	1.2	1.6	1.8	-3.4	3.4	2.3	0.9	6.9
Summer (June 16 – Aug 31)	4.1	7.5	3.2	2.7	4.0	5.6	3.9	8.2	7.0

Forecast Bias Color Key	<2	2-5	>5
-------------------------	----	-----	----

CMAQ Model Performance for SC 2016

Forecast Bias (PPB)	Pee Dee (Florence)			Catawba (Rock Hill)			Trident (Charleston)		
	BAQ	NOAA		BAQ	NOAA		BAQ	NOAA	
		Value	Diff		Value	Diff		Value	Diff
2016 Ozone Season (Apr 1 – Aug 31)	2.0	3.9	1.4	2.7	9.6	0.3	2.0	7.5	2.4
Spring (Apr 1 – June 15)	1.6	0.2	1.3	2.9	4.4	0.2	1.1	4.3	2.0
Summer (June 16 – Aug 31)	3.1	7.8	1.3	3.2	14.7	0.2	3.3	10.0	3.0

Forecast Bias Color Key	<2	2-5	>5
-------------------------	----	-----	----

Summary of SC Comments on NOAA Operational CMAQ Guidance

- “NOAA Value” (Day 2 CMAQ actual value) forecasts generally over-predicted ozone concentrations.
- “NOAA Value” over-predicted more often during Summer months (June-August). The bias was much closer to zero in April and May, but the Upstate zone was under-predicted slightly in Spring months.
- “NOAA Diff” CMAQ forecast daily differences (day 2 CMAQ value – day 1 CMAQ value + day 1 monitor observation) generally removes the day to day model bias on average. However, mean absolute error statistics do not show significant improvement.
- SC forecasters use the “NOAA Diff” methodology to develop a day 2 forecast.

Summary of SC Comments on NOAA Operational CMAQ Guidance

- During Summer months, the model tends to over-predict urban plumes during ideal ozone production conditions (dry, warm, sunny, little or no wind, subsidence, extended periods of a stable atmosphere). This is especially evident in the Augusta, Columbia, and Rock Hill areas.
- The model does fairly well with the Upstate zone, where concentrations are typically highest. Model biases in the Upstate are generally lower than the rest of the state.
- The data shown in this presentation are preliminary.
- Operational CMAQ output is excellent guidance!! Thanks!

Thank you!

CMAQ Feedback Presented by

Wes Behrend

behrenwr@dhec.sc.gov

(803) 898-4216

CMAQ Feedback Produced by

Greg Quina

quinags@dhec.sc.gov

(803) 898-3405

Additional Ozone SC DHEC Forecasters

Andrew Kingston

kingstap@dhec.sc.gov

(803) 898-0403

Steve Smutz

smutzsw@dhec.sc.gov

(803) 898-7854