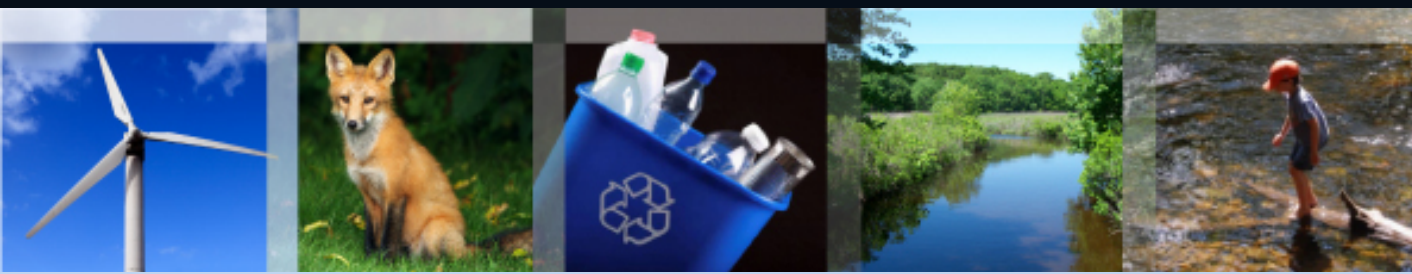




Connecticut Department of Energy and Environmental Protection



2018 NOAA Model Performance Analysis for Connecticut

September 27, 2018
Michael Geigert



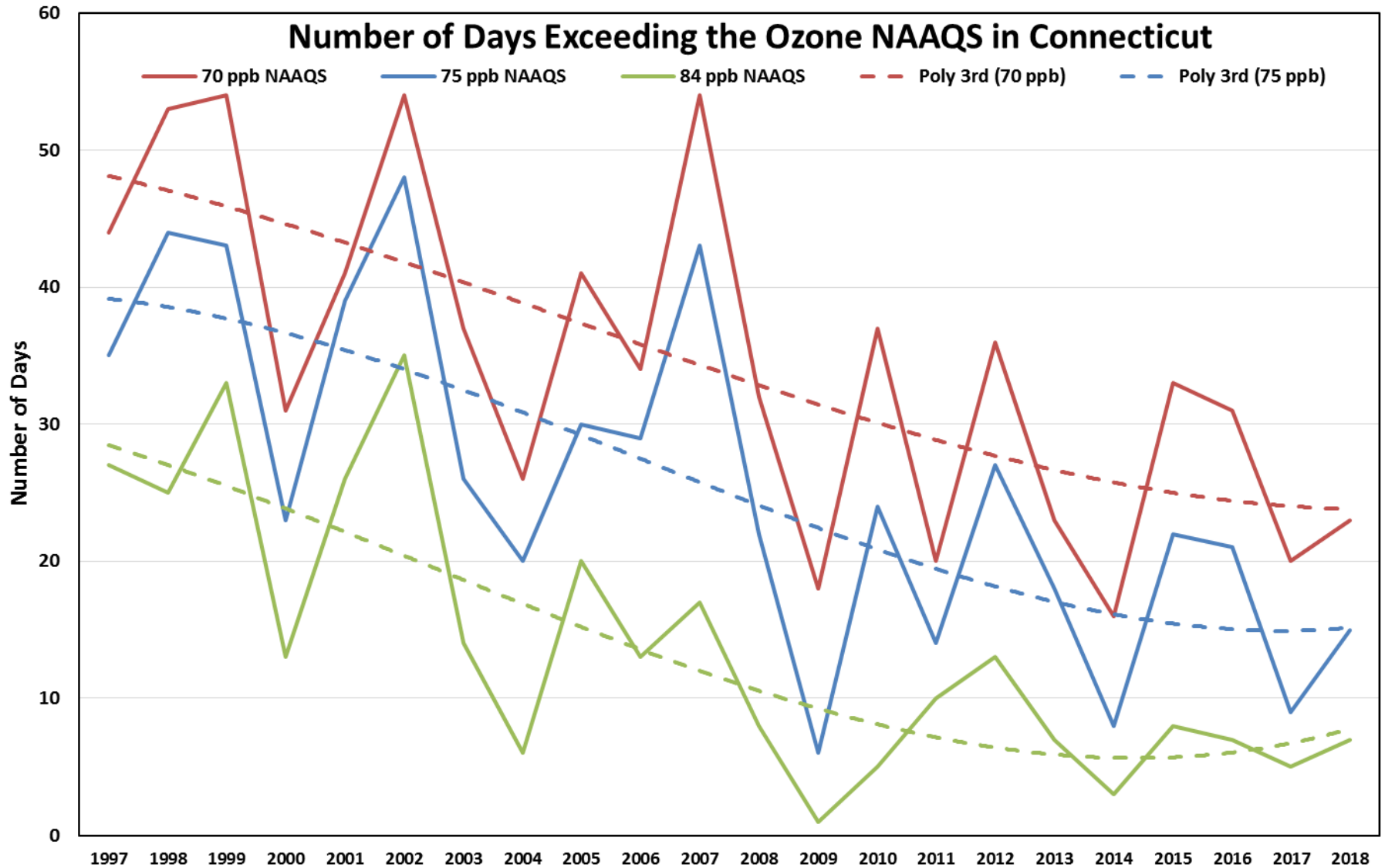
Connecticut Department of Energy and Environmental Protection

Ozone in Connecticut 2018

- 23 exceedance days in 2018 through September 20th

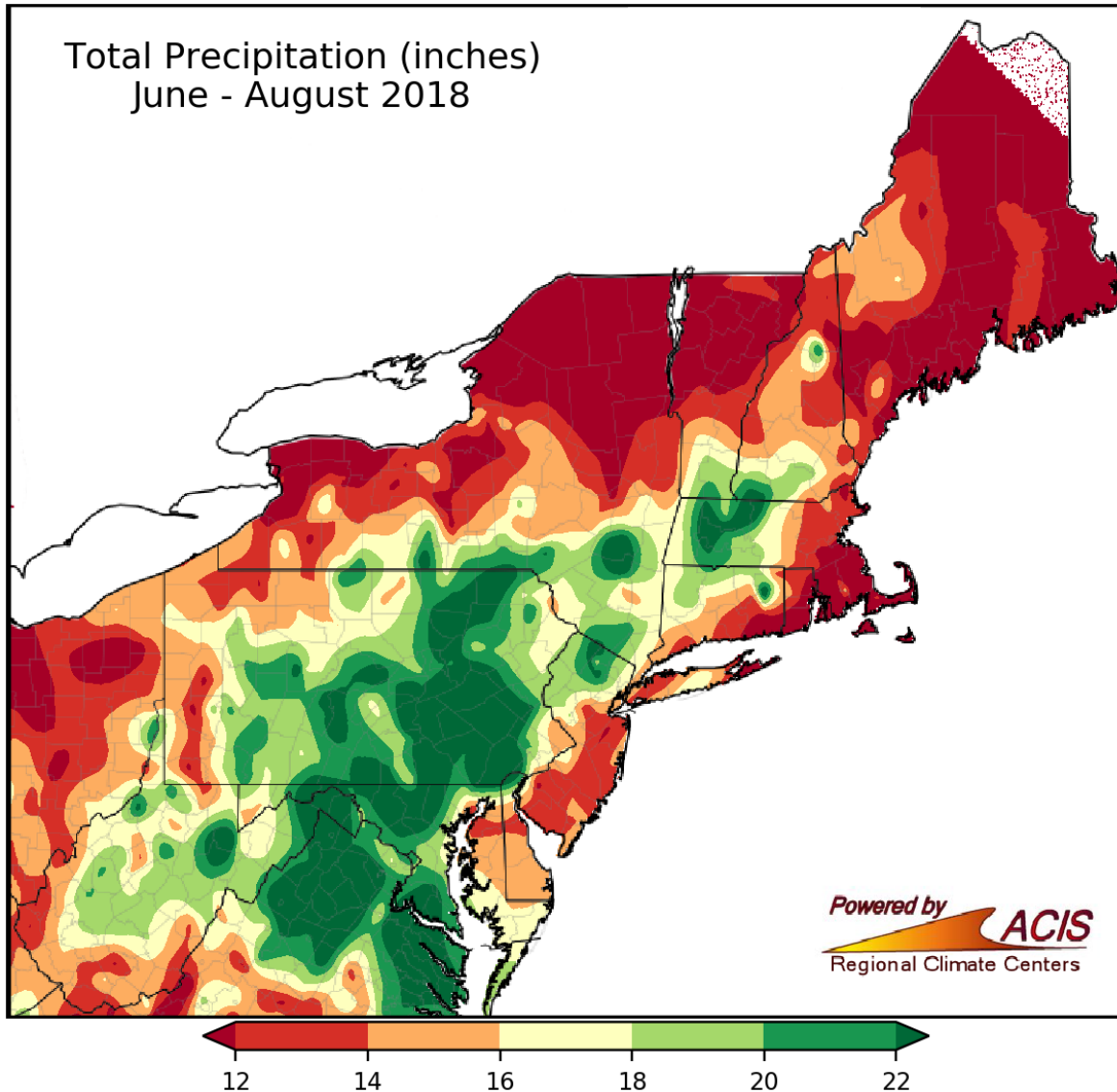
| 2018 Exceedances | May | | | | June | | | July | | | | | | | | August | | | | | | Sept | Count | |
|---------------------------|-----|----|----|----|------|----|----|------|----|----|----|----|----|----|----|--------|----|----|----|----|----|------|-------|----|
| Site | 2 | 3 | 25 | 26 | 17 | 18 | 30 | 1 | 2 | 9 | 10 | 13 | 14 | 16 | 28 | 6 | 7 | 8 | 16 | 27 | 28 | 29 | 6 | |
| Abington | 79 | 76 | M | M | 62 | 68 | 54 | 50 | 55 | 59 | 72 | 55 | 38 | 64 | 48 | 50 | 60 | 51 | 45 | 48 | 71 | 69 | 50 | 4 |
| Cornwall | 72 | 58 | 71 | 68 | 60 | 70 | 61 | 65 | 80 | 58 | 64 | 62 | 61 | 75 | 45 | 57 | 58 | 49 | 49 | 48 | 53 | 59 | 48 | 4 |
| Danbury | 75 | 66 | 72 | 68 | 62 | 82 | 74 | 48 | 92 | 65 | 70 | 62 | 69 | 81 | 57 | 51 | 72 | 57 | 52 | 49 | 56 | 58 | 53 | 7 |
| East Hartford | 66 | 62 | 67 | 62 | 59 | 83 | 59 | 53 | 59 | 65 | 60 | 59 | 57 | 67 | 54 | 54 | 70 | 67 | 30 | 44 | 63 | 57 | 47 | 1 |
| Greenwich | 71 | 68 | 67 | 77 | 60 | 74 | 60 | 57 | 72 | 86 | 95 | 72 | 77 | 81 | 79 | 86 | 64 | 84 | 61 | 73 | 83 | 69 | 69 | 14 |
| Groton | 75 | 61 | 68 | 74 | 69 | 53 | 61 | 69 | 81 | 61 | 82 | 46 | 30 | 69 | 49 | 61 | 52 | 53 | 55 | 56 | 74 | 74 | 62 | 6 |
| Madison | 71 | 64 | 71 | 80 | 72 | 59 | 64 | 77 | 71 | 75 | 86 | 49 | 57 | 73 | 52 | 70 | 52 | 64 | 71 | 61 | 77 | 87 | 74 | 13 |
| Middletown | 78 | 76 | 77 | 70 | 64 | 74 | 56 | 55 | 58 | 73 | 77 | 58 | 57 | 73 | 52 | 58 | 67 | 66 | 47 | 55 | 77 | 66 | 61 | 8 |
| New Haven | 65 | 59 | 59 | 82 | 54 | 45 | 58 | 59 | 67 | 63 | 88 | 61 | 66 | 85 | 59 | 63 | 60 | 72 | 50 | 47 | 68 | 58 | 66 | 4 |
| Stafford | 73 | 63 | 71 | 65 | 58 | 82 | 61 | 51 | 54 | 59 | 66 | 52 | 42 | 61 | 48 | 51 | 71 | 58 | 41 | 43 | 56 | 53 | 44 | 4 |
| Stratford | 70 | 67 | 70 | 83 | 58 | 63 | 64 | 75 | 72 | 77 | 99 | 65 | 72 | 80 | 68 | 74 | 61 | 78 | 71 | 71 | 87 | 90 | 78 | 14 |
| Westport | 71 | 70 | 75 | 84 | 59 | 66 | 60 | 62 | 64 | 80 | 94 | 64 | 77 | 77 | 70 | 77 | 67 | 84 | 57 | 64 | 84 | 77 | 72 | 12 |
| # days > Federal Standard | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | |

Trend Graph- Exceedance Days



2018 Summer Precipitation Summary

- Overall, a wetter summer for the Northeast.

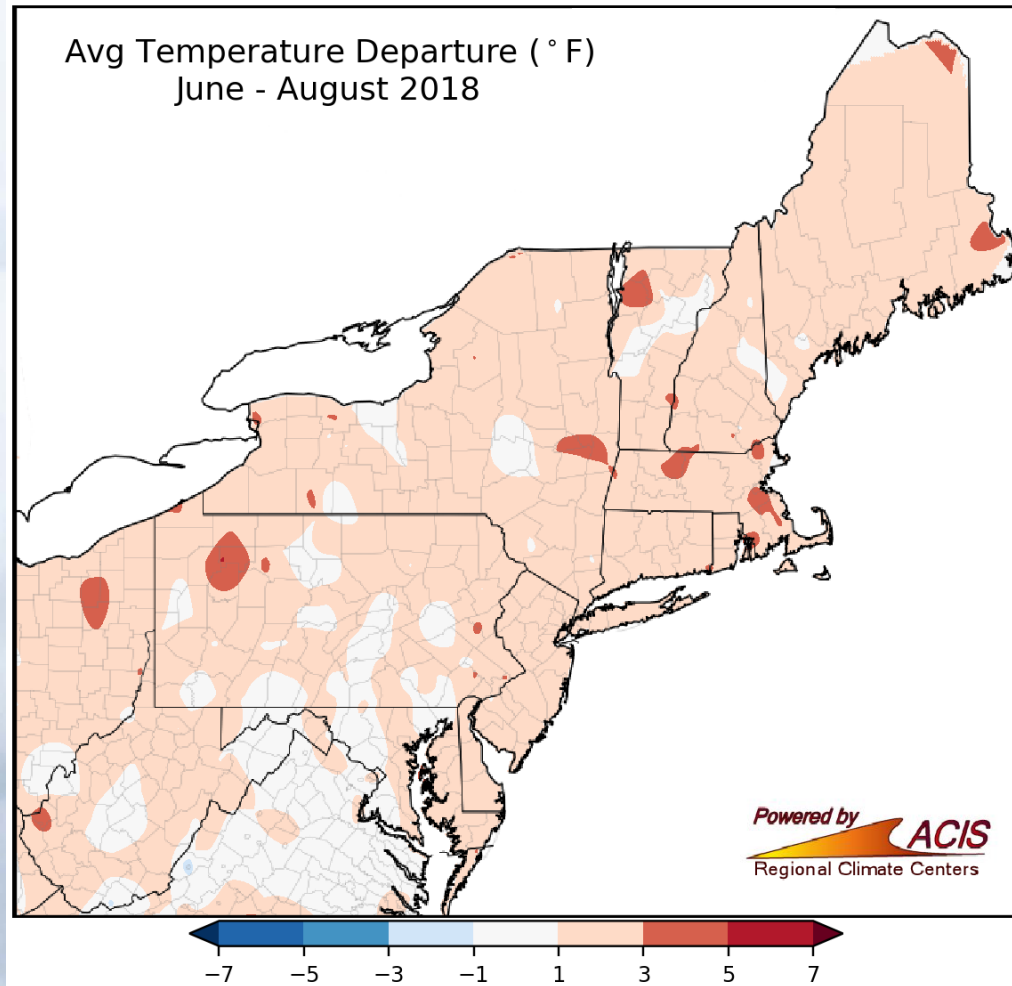


Co

tection

Summer Temperature summary

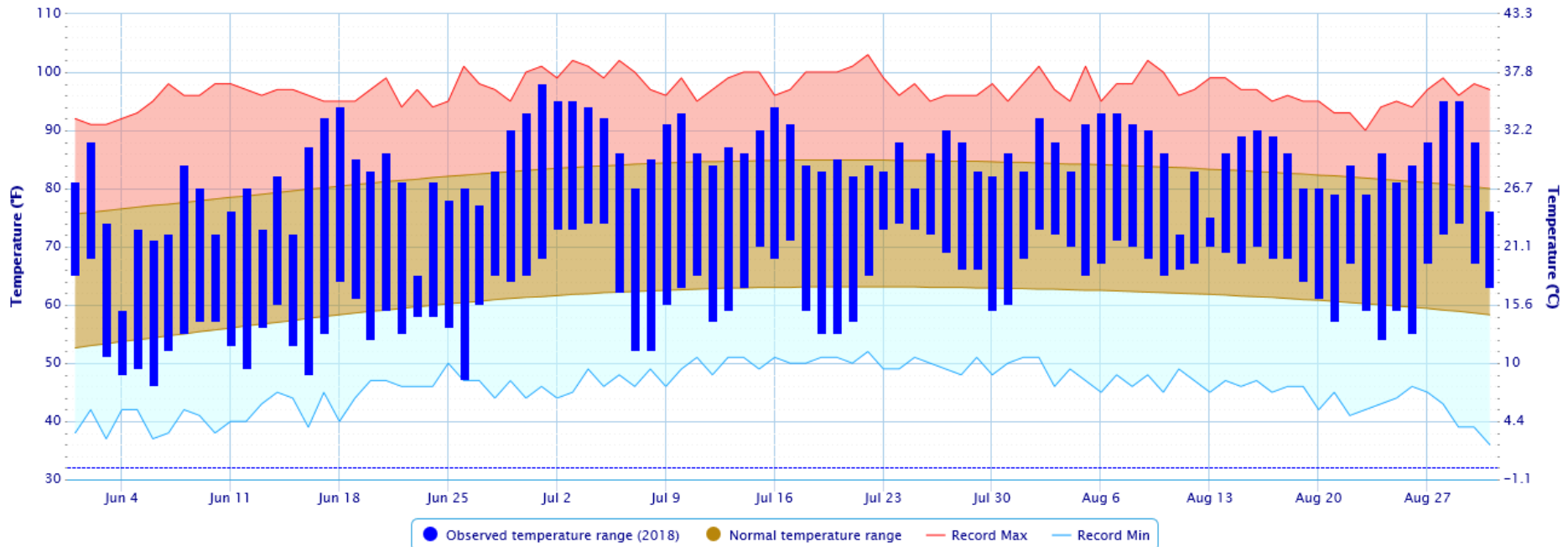
- Generally, above normal temperatures over the Northeast.



23 Days 90+ degrees at BDL Hartford

Daily Temperature Data – HARTFORD–BRADLEY INTERNATIONAL AIRPORT, CT

Period of Record – 1949-01-01 to 2018-09-18. Normals period: 1981-2010. Click and drag to zoom chart.



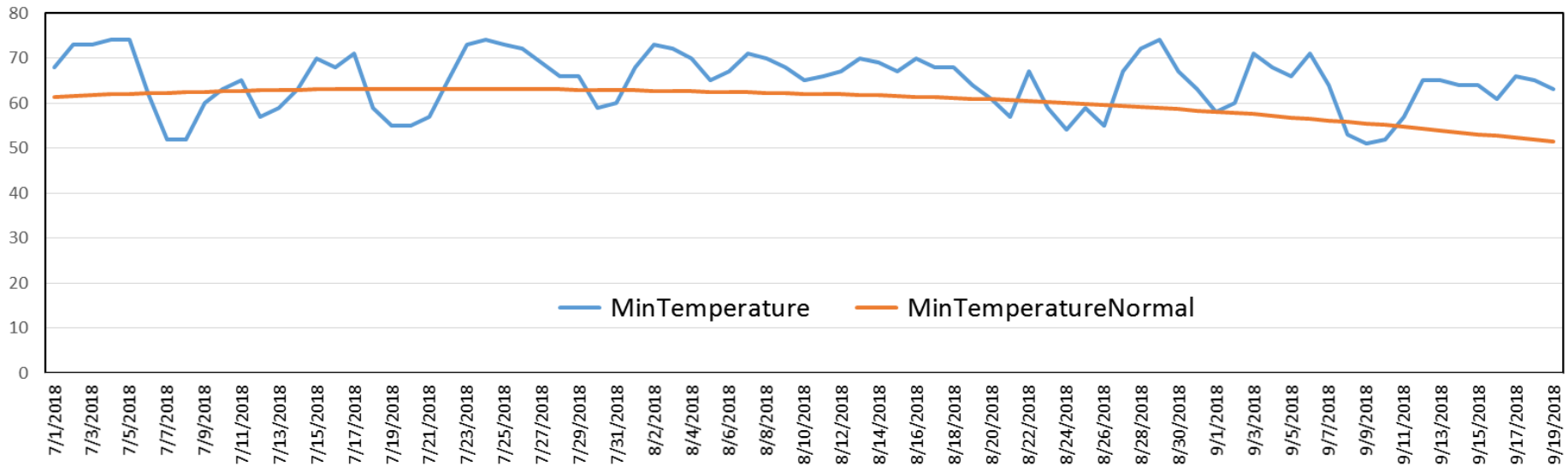
Powered by ACIS



Connecticut Department of Energy and Environmental Protection

Higher Dewpoints Reflected in Minimum Temperatures

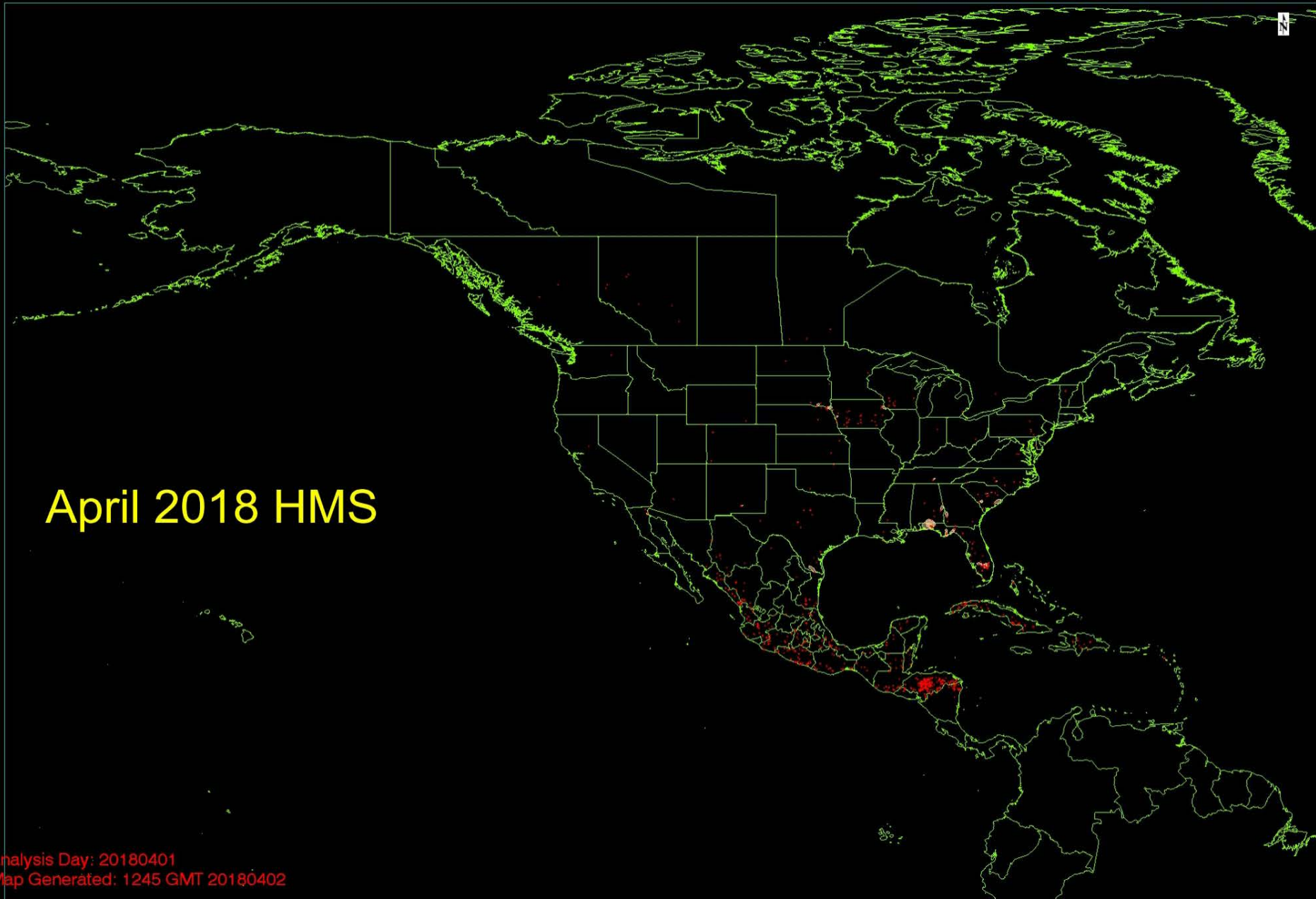
BDL Minimum Temperatures July- September 2018



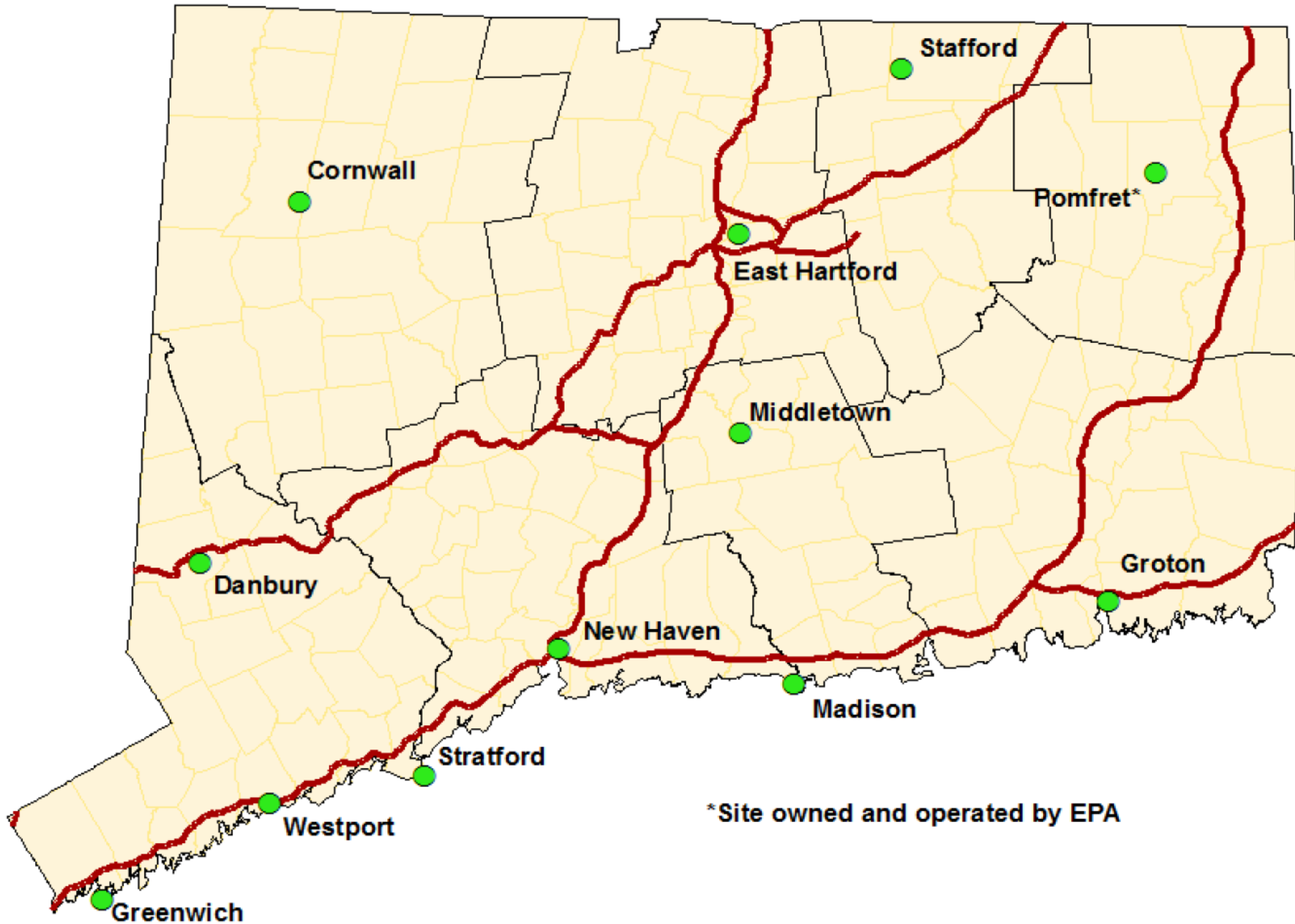
Did I mention that there was a lot of smoke?

April 2018 HMS

Analysis Day: 20180401
Map Generated: 1245 GMT 20180402

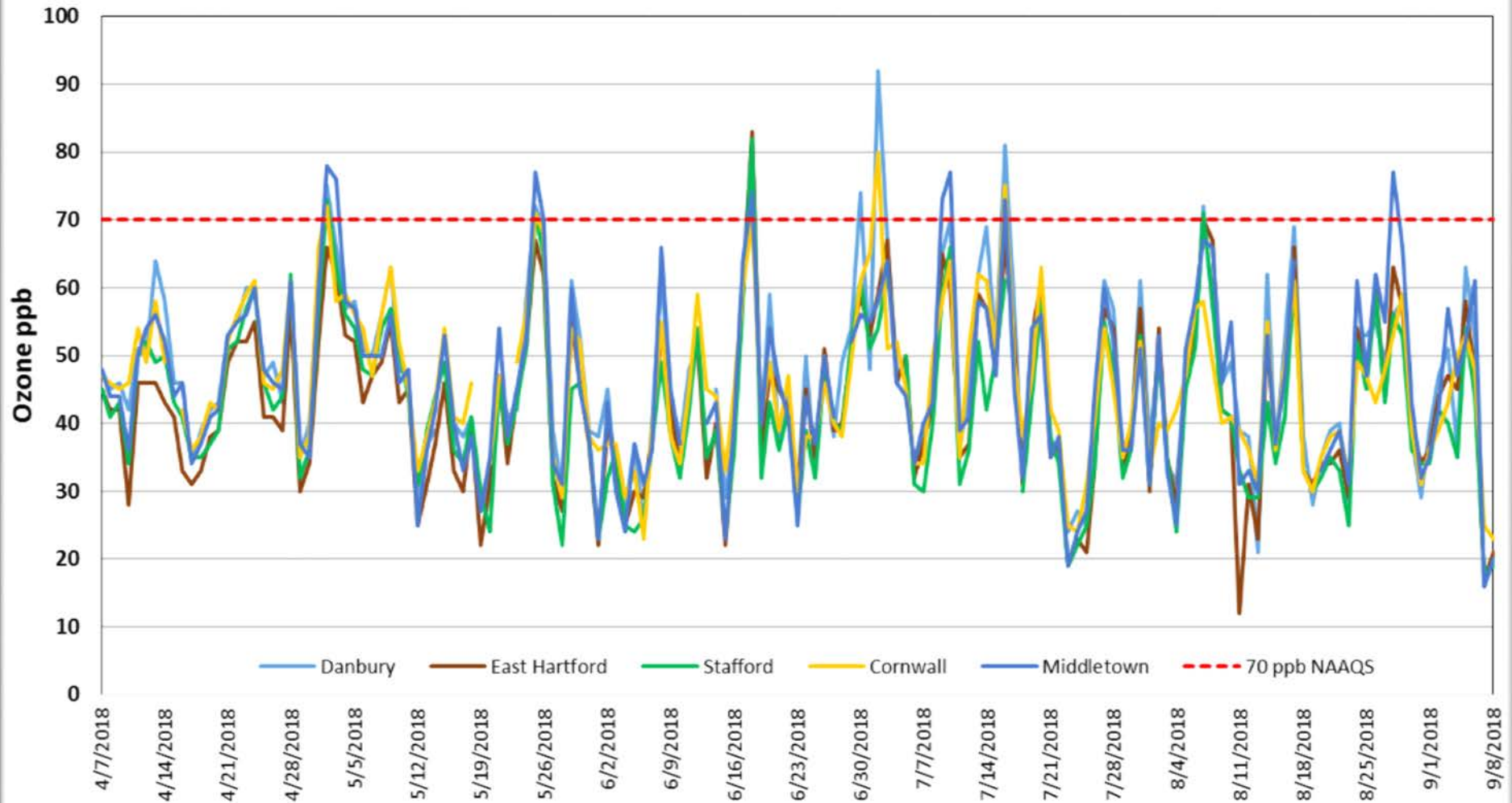


CT Ozone Monitors



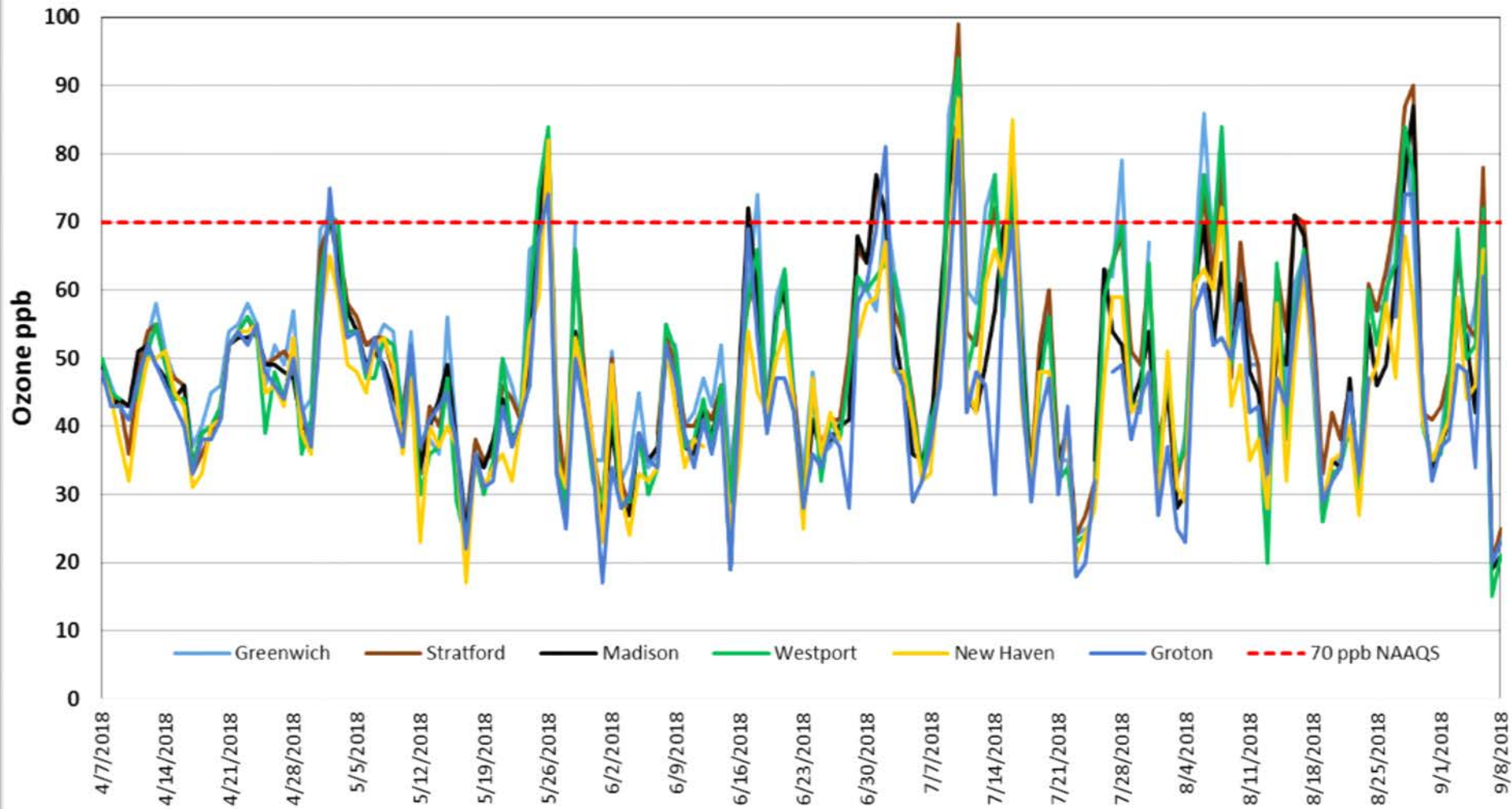
Inland Monitors

Daily Maximum 8-Hour Ozone CT Inland Monitors



Coastal Monitors

Daily Maximum 8-Hour Ozone CT Coastal Monitors

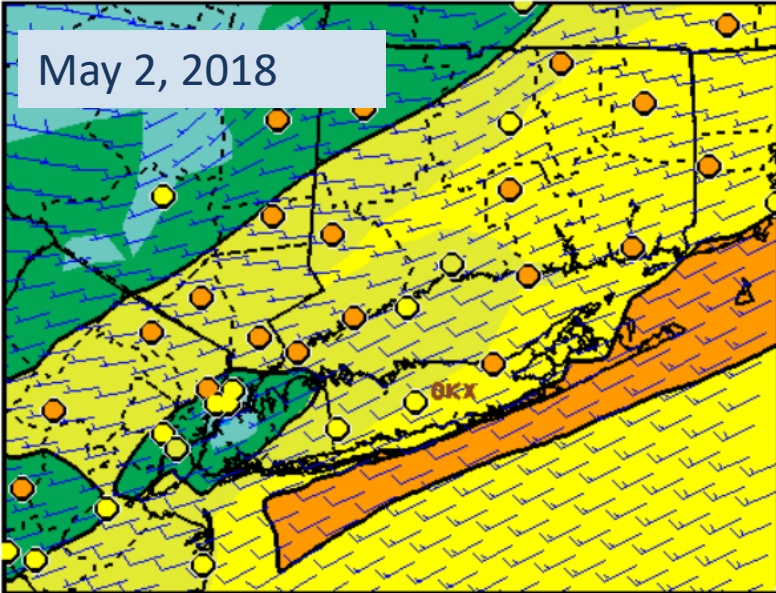


NOAA Model Performance

- The following charts were produced (mostly) from the 06z PROD Day 2 model runs;
- The model generally under predicted during May;
- Over predictions began in June and continued into late August, however there were several days of under predictions thrown in.
- The weather pattern was more tropical during July-August that allowed more mixing from the marine boundary layer.

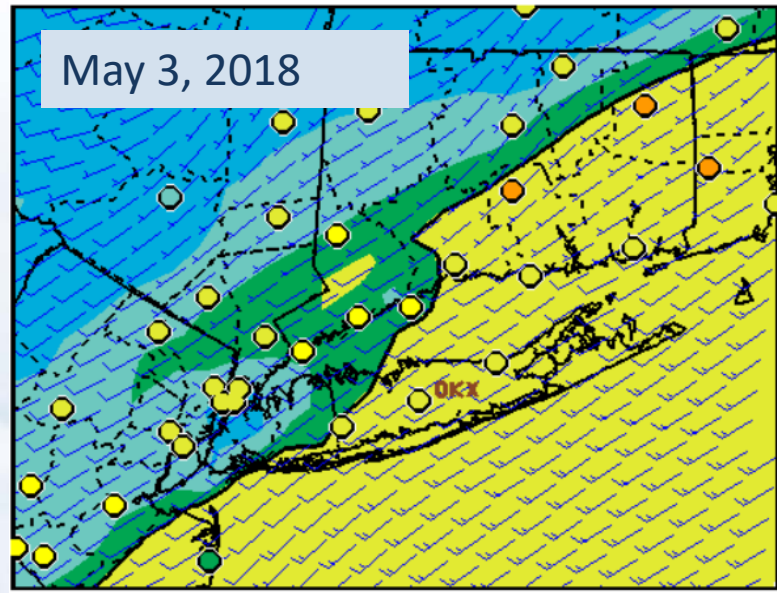
May 2018 Events

May 2, 2018



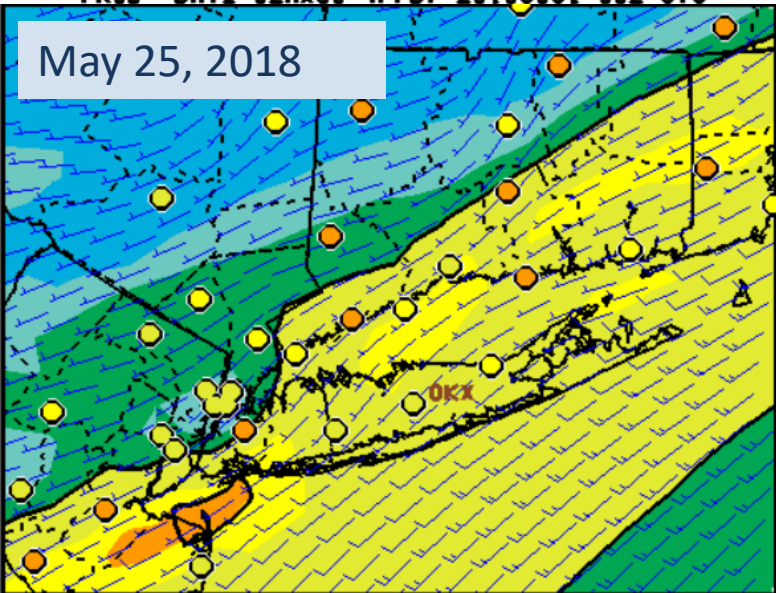
PROD DAY2 OZHX08 (PPB) 20180501 06Z CYC~

May 3, 2018



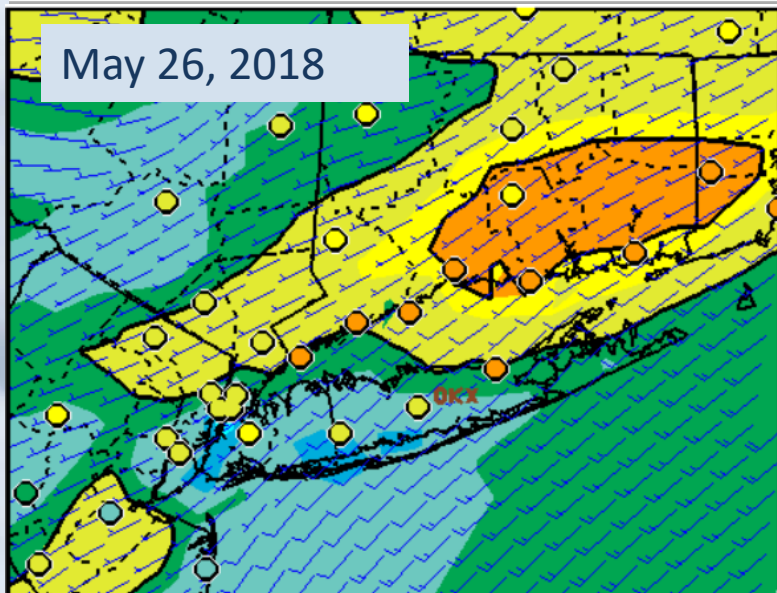
PROD DAY2 OZHX08 (PPB) 20180502 06Z CYC~

May 25, 2018



PROD DAY2 OZHX08 (PPB) 20180524 06Z CYC~

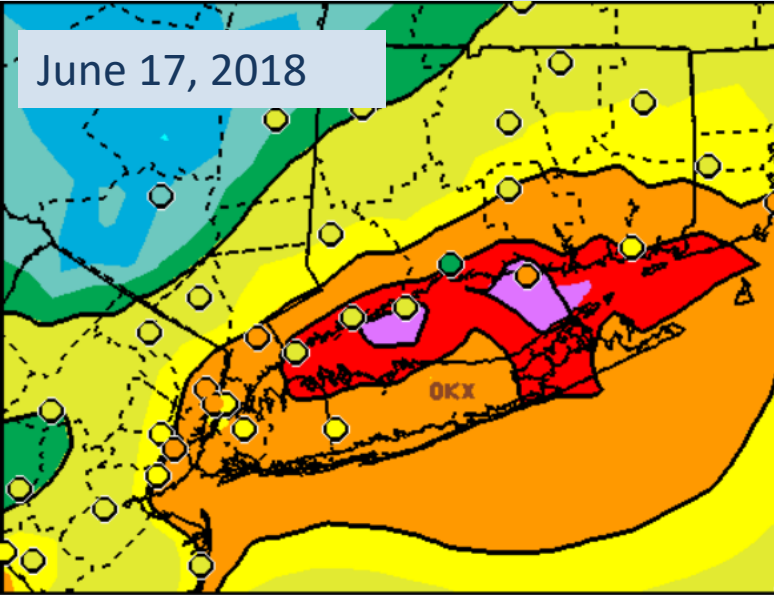
May 26, 2018



PROD DAY2 OZHX08 (PPB) 20180525 06Z CYC~

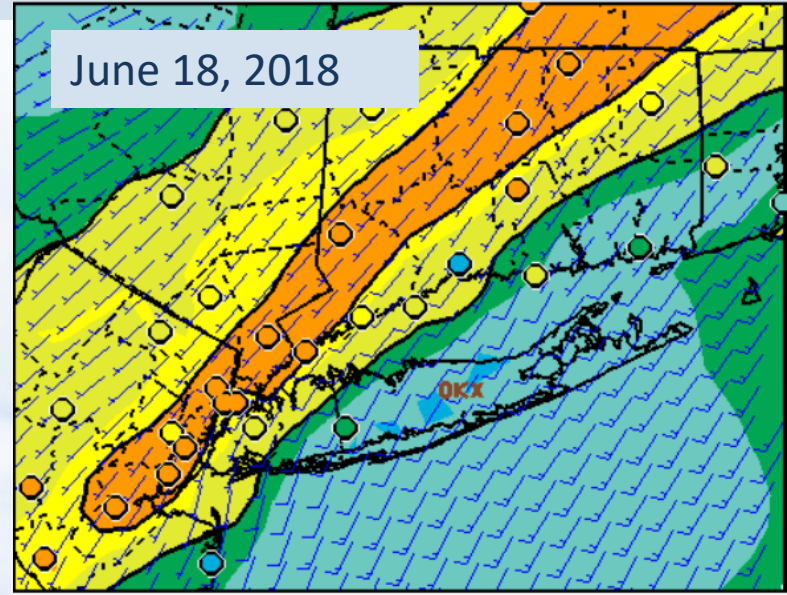
June 2018 Events

June 17, 2018



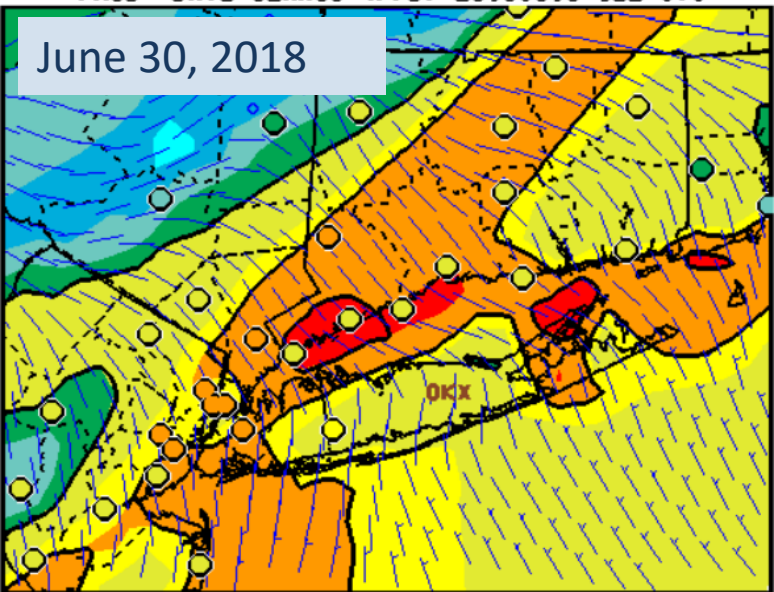
PROD DAY2 OZHX08 (PPB) 20180616 12Z CYC~

June 18, 2018



PROD DAY2 OZHX08 (PPB) 20180617 06Z CYC~

June 30, 2018

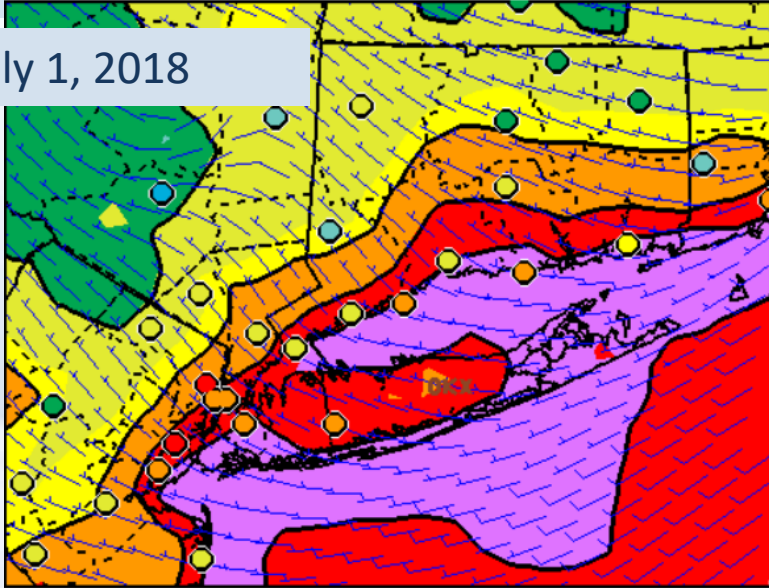


PROD DAY2 OZHX08 (PPB) 20180629 06Z CYC~

Department of Energy and Environmental Protection

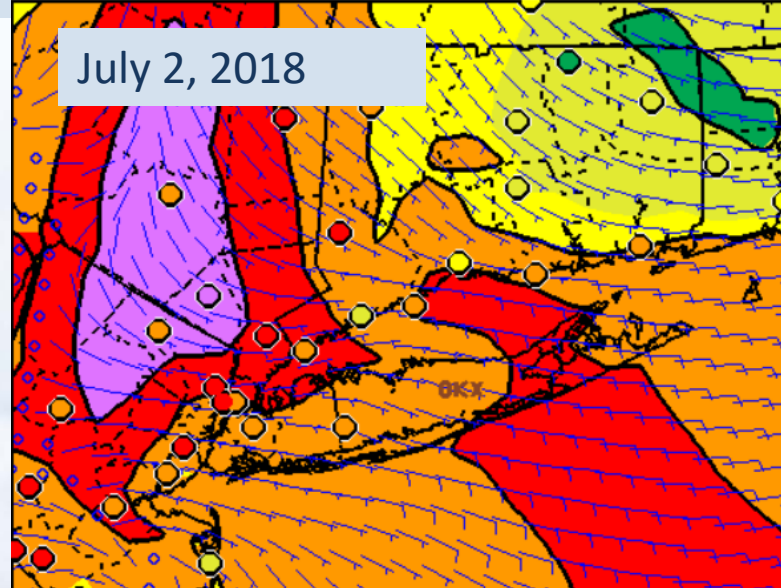
July 2018 Events

July 1, 2018



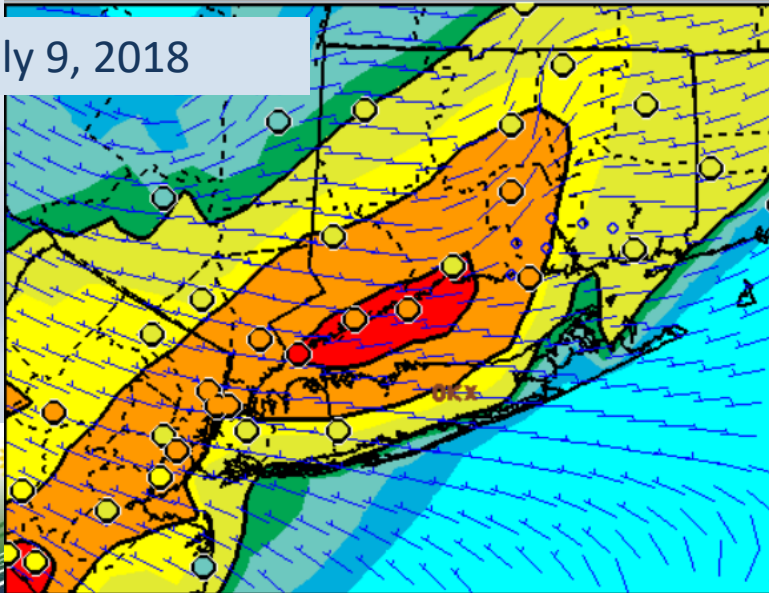
PROD DAY2 OZHX08 (PPB) 20180630 06Z CYC~

July 2, 2018



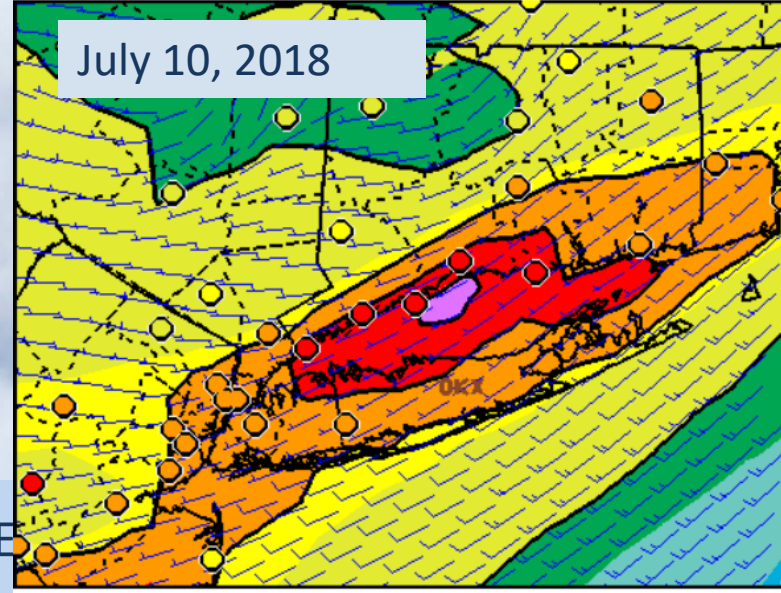
PROD DAY2 OZHX08 (PPB) 20180701 06Z CYC~

July 9, 2018



PROD DAY2 OZHX08 (PPB) 20180708 06Z CYC~

July 10, 2018

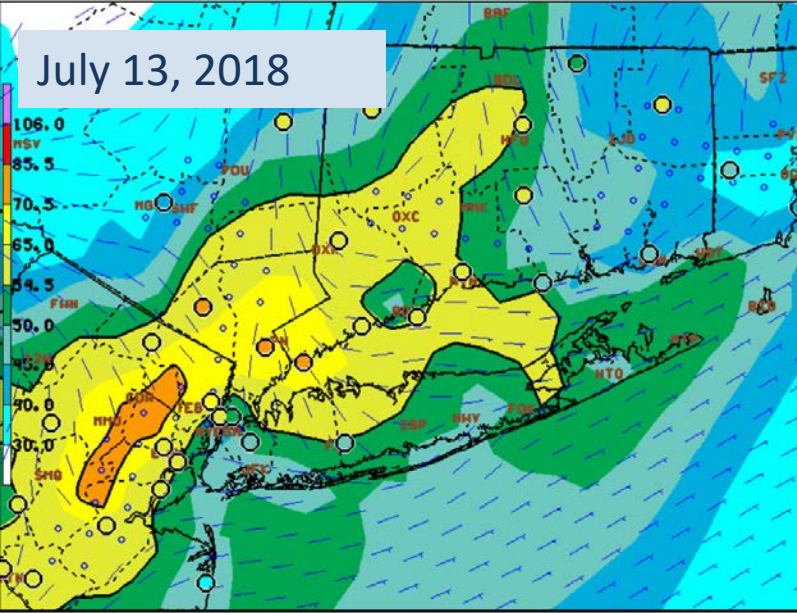


PROD DAY2 OZHX08 (PPB) 20180709 06Z CYC~

Energy and E

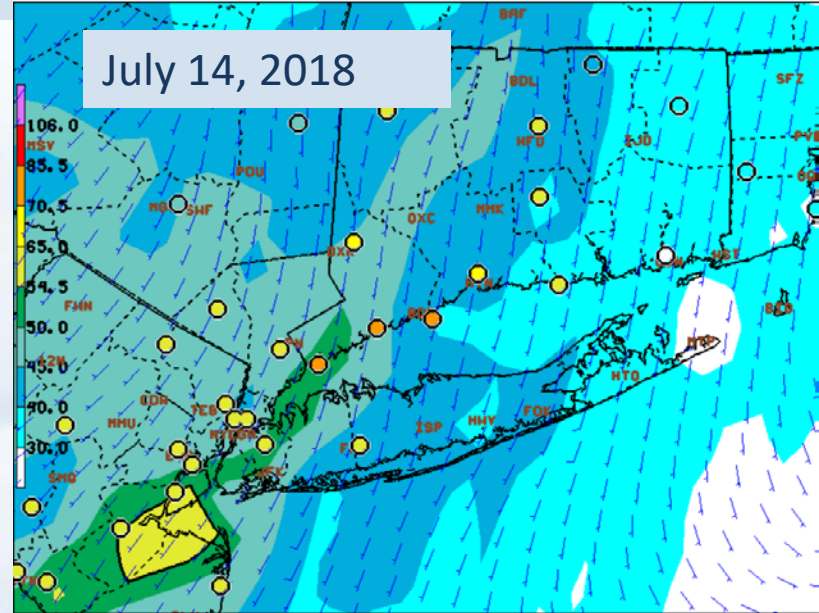
July 2018 Events

July 13, 2018



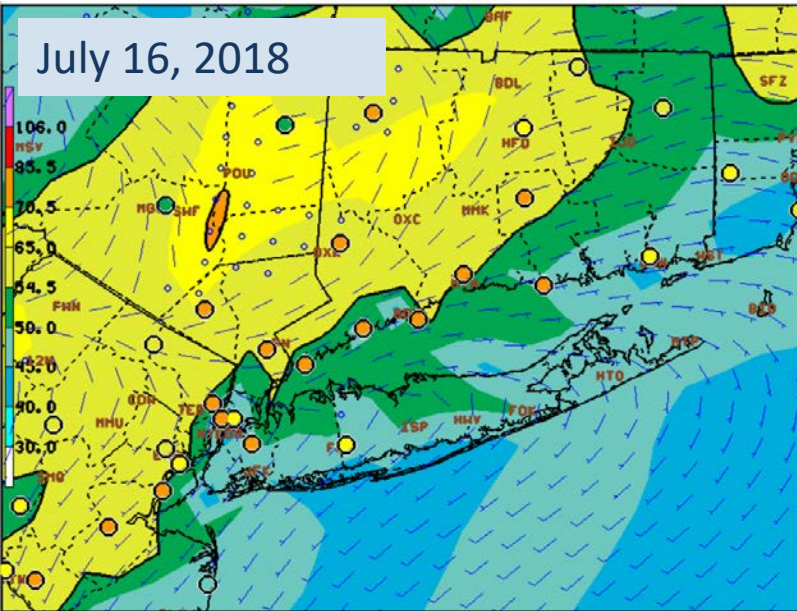
PROD DAY2 OZHX08 (PBB) 20180712 06Z CYC-

July 14, 2018



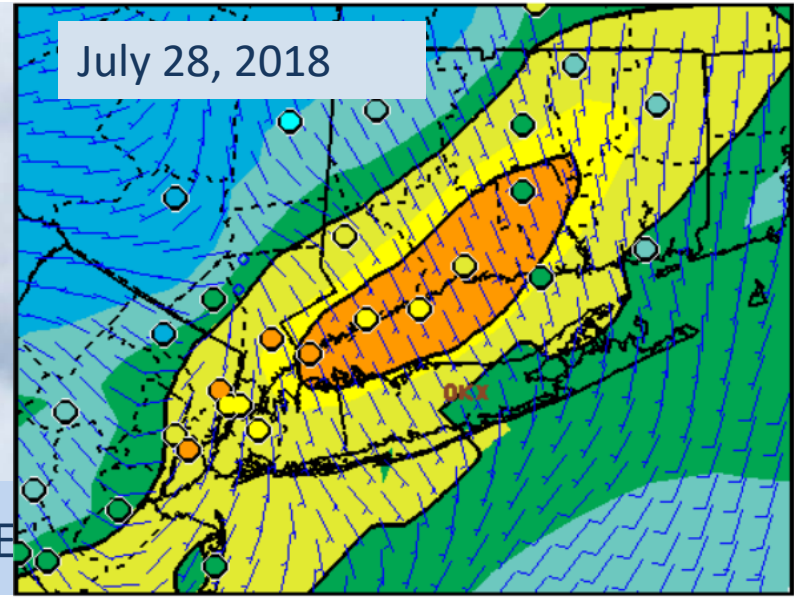
PROD DAY2 OZHX08 (PBB) 20180713 06Z CYC-

July 16, 2018



PROD DAY2 OZHX08 (PBB) 20180715 06Z CYC-

July 28, 2018

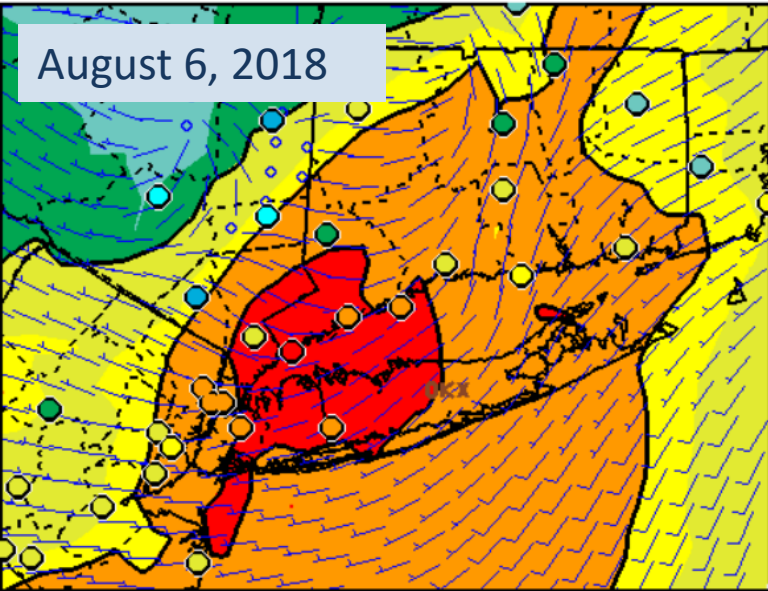


PROD DAY2 OZHX08 (PBB) 20180727 06Z CYC-

of Energy and E

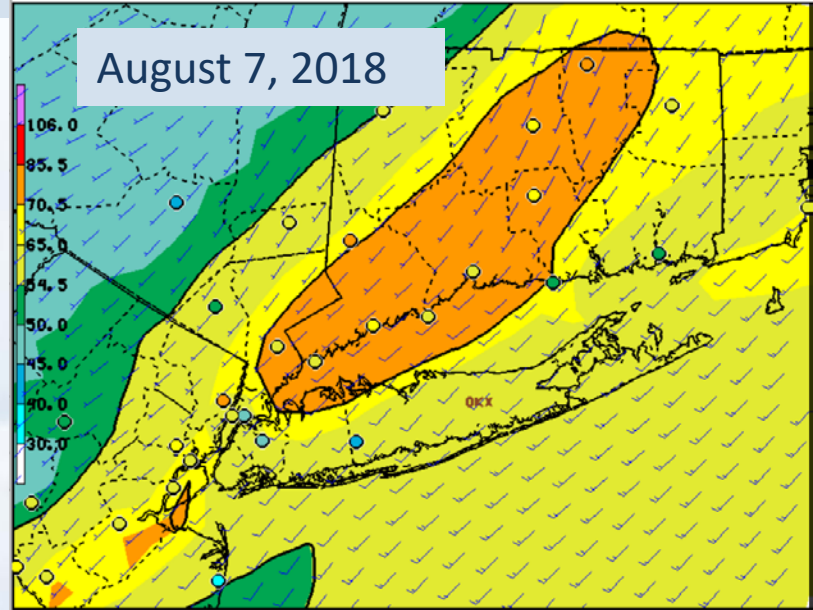
August 2018 Events

August 6, 2018



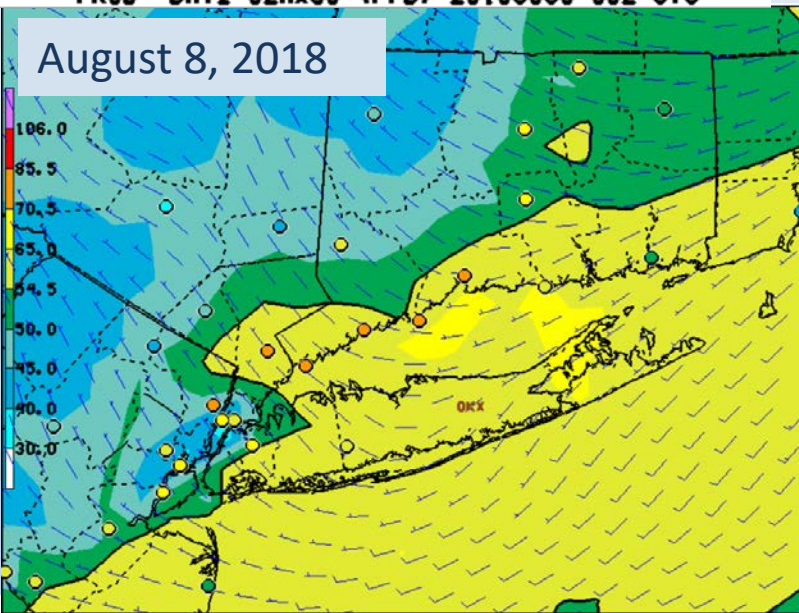
PROD DAY2 OZMX08 (PPB) 20180805 06Z CYC~

August 7, 2018



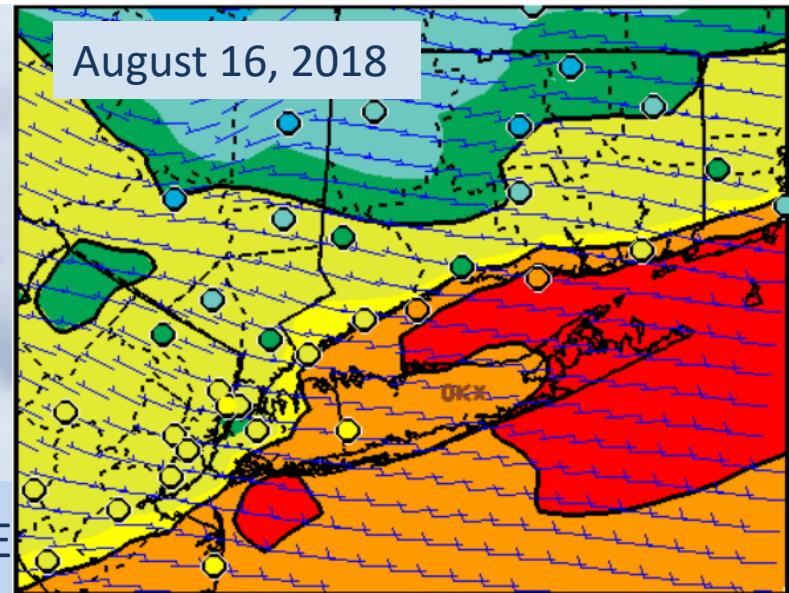
PROD DAY2 OZMX08 (PPB) 20180806 06Z CYC~

August 8, 2018



PROD DAY2 OZMX08 (PPB) 20180807 06Z CYC~

August 16, 2018

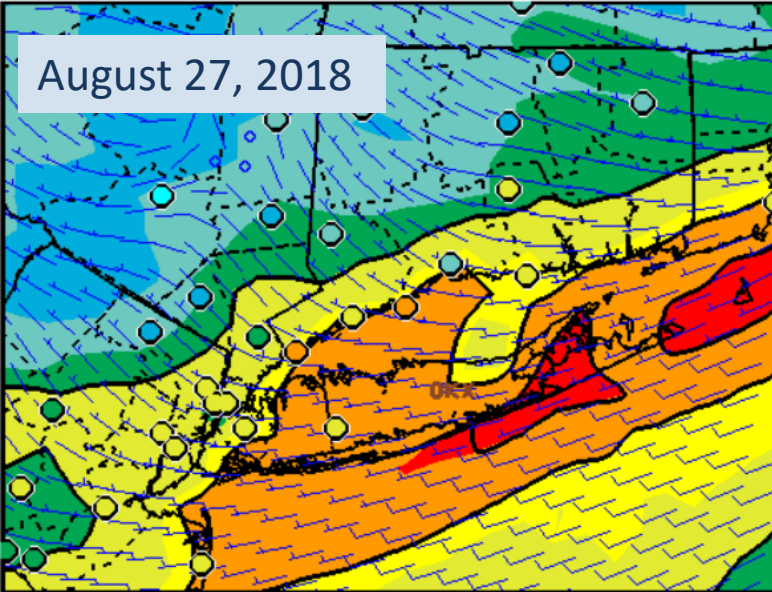


PROD DAY2 OZMX08 (PPB) 20180815 06Z CYC~

of Energy and E

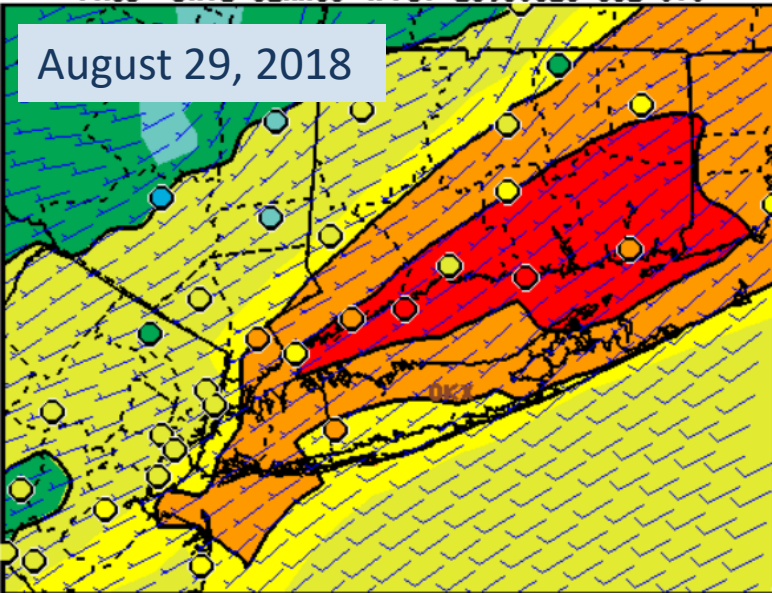
August-September 2018 Events

August 27, 2018



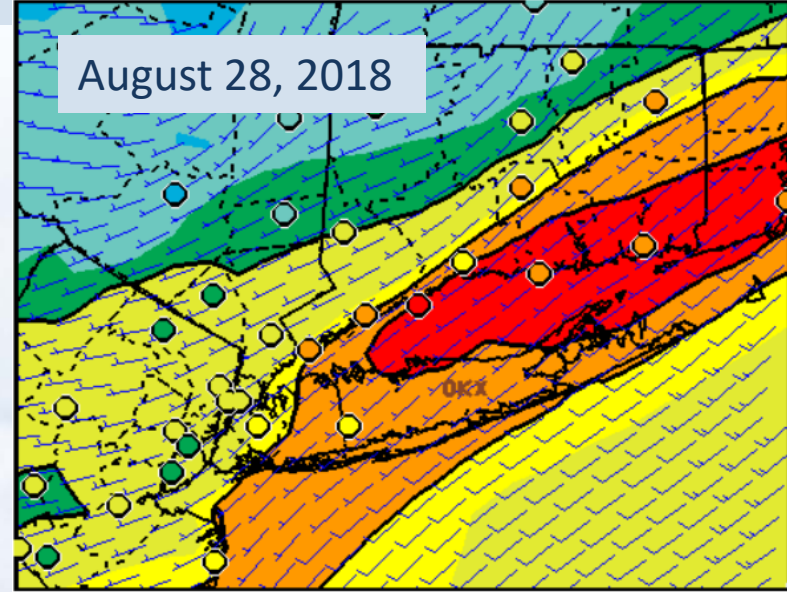
PROD DAY2 OZHX08 (PPB) 20180826 06Z CYC~

August 29, 2018



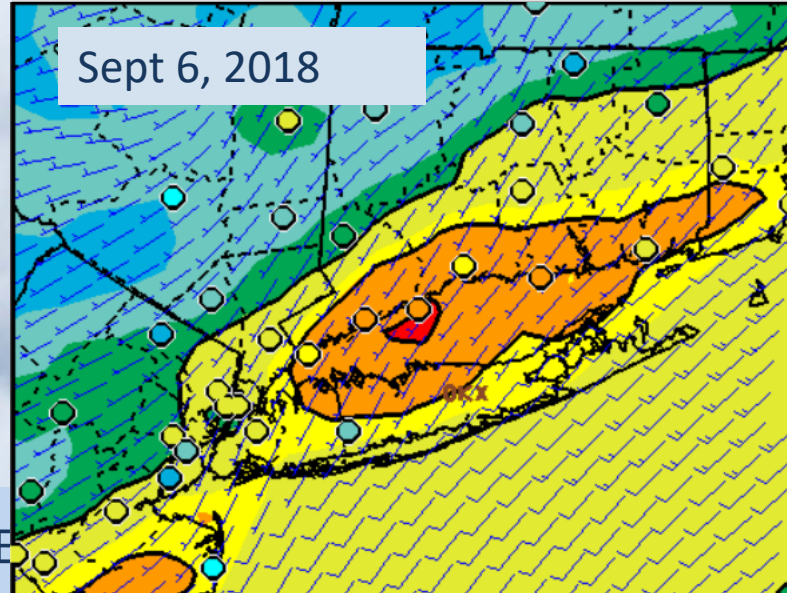
PROD DAY2 OZHX08 (PPB) 20180828 06Z CYC~

August 28, 2018



PROD DAY2 OZHX08 (PPB) 20180827 06Z CYC~

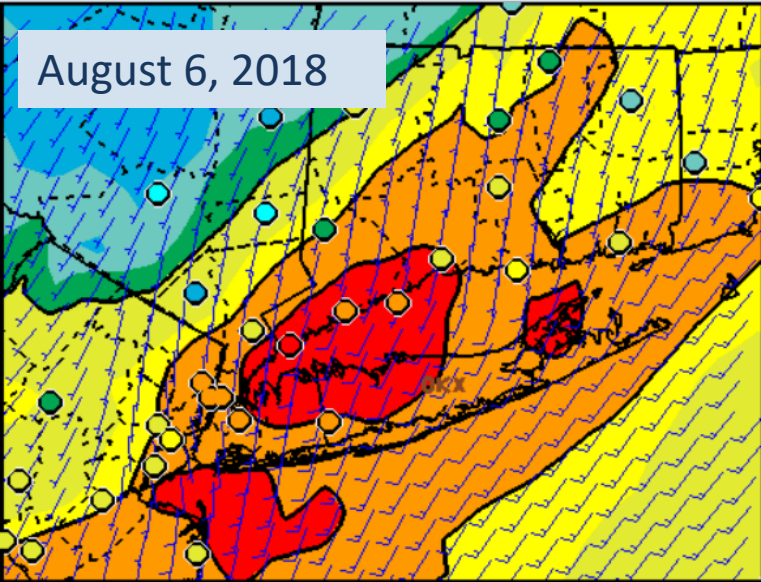
Sept 6, 2018



PROD DAY2 OZHX08 (PPB) 20180905 06Z CYC~

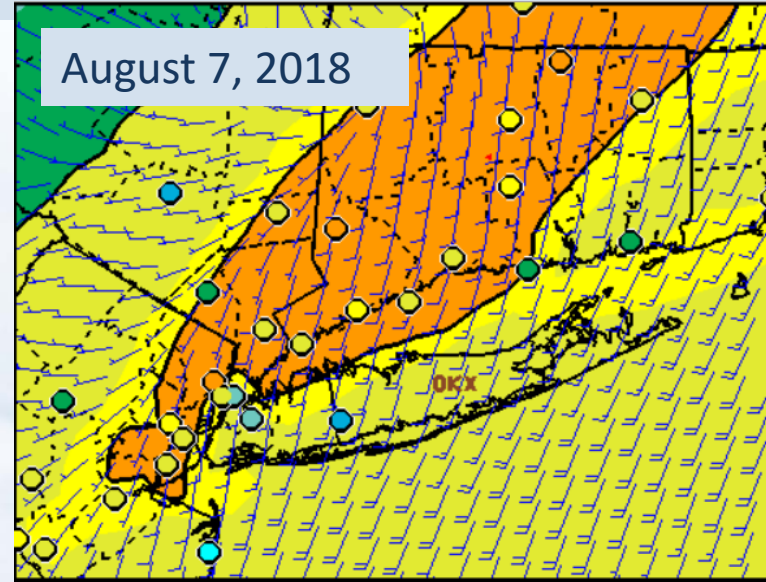
2014 NEI V2 Model Runs

August 6, 2018

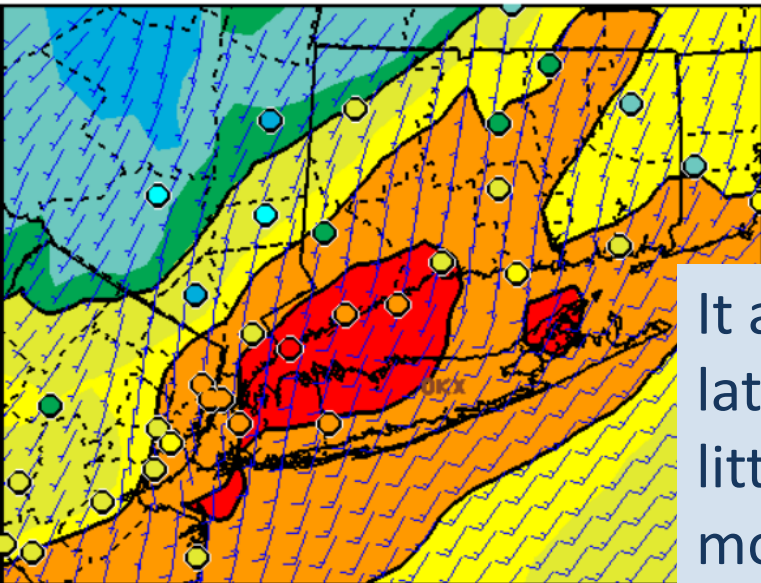


V502 NEI2014 PARA5 DAY2 OZMX08 (PPB) 20180805 12Z

August 7, 2018

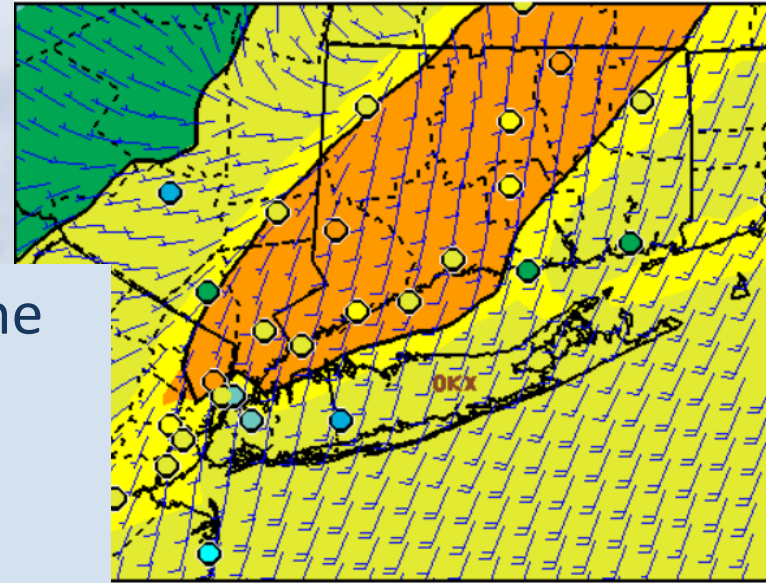


V502 NEI2014 PARA5 DAY2 OZMX08 (PPB) 20180806 12Z



It appears that the latest NEIv2 has little effect on model output.

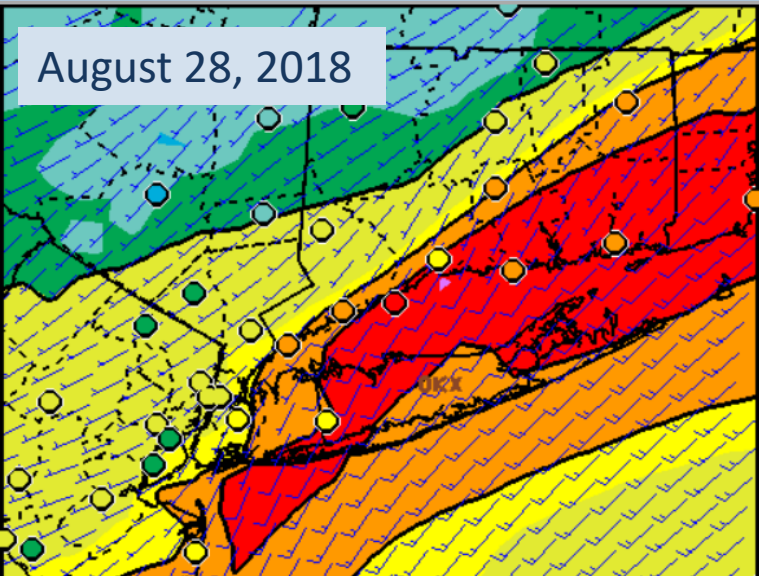
PROD DAY2 OZMX08 (PPB) 20180805 12Z CYC~



PROD DAY2 OZMX08 (PPB) 20180806 12Z CYC~

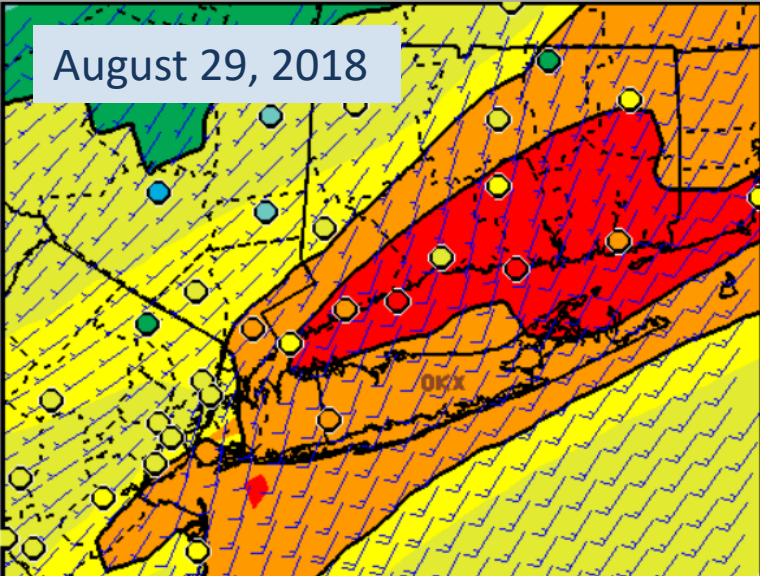
2014 NEI V2 Model Runs

August 28, 2018

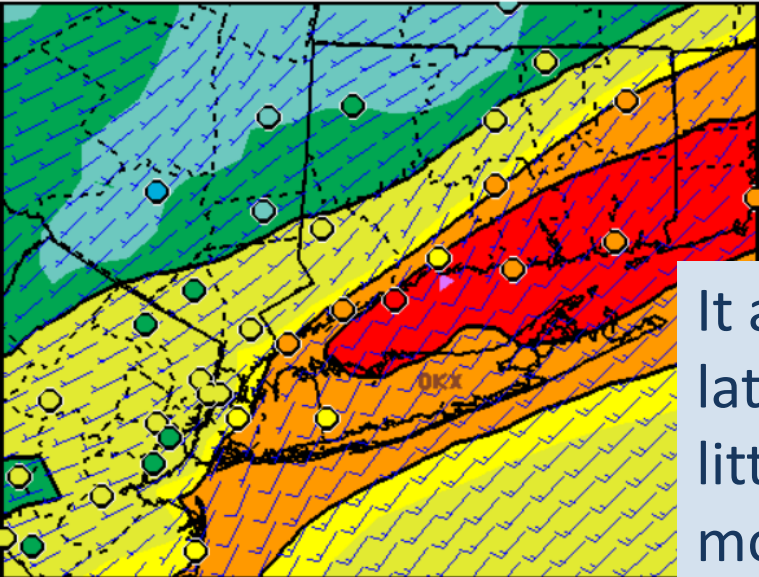


V502 NEI2014 PARA5 DAY2 OZMX08 (PPB) 20180827 12Z

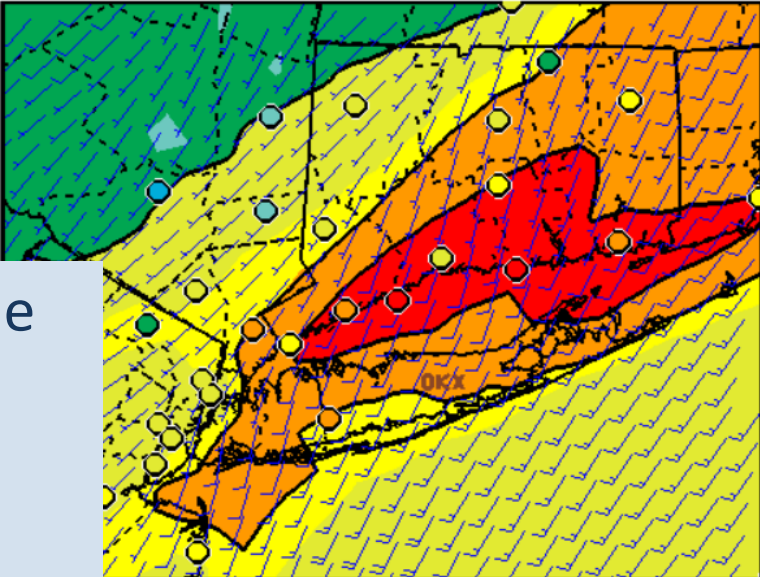
August 29, 2018



V502 NEI2014 PARA5 DAY2 OZMX08 (PPB) 20180828 12Z



PROD DAY2 OZMX08 (PPB) 20180827 12Z CYC~

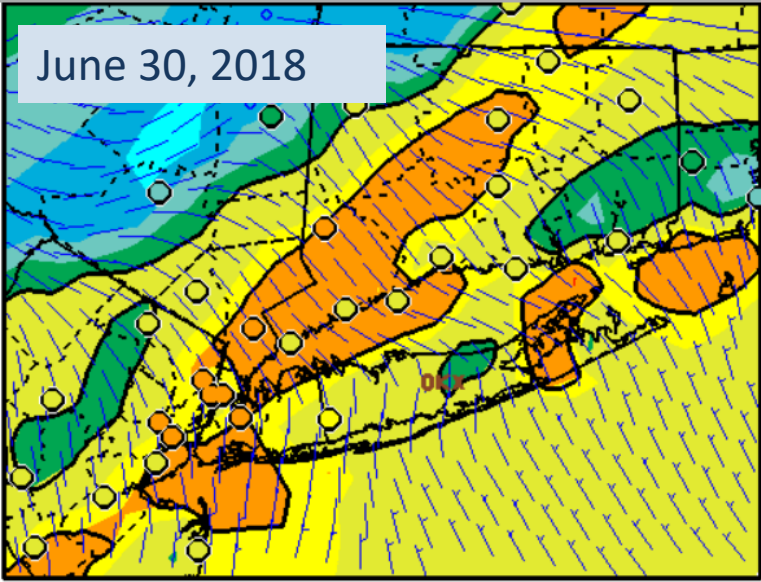


PROD DAY2 OZMX08 (PPB) 20180828 12Z CYC~

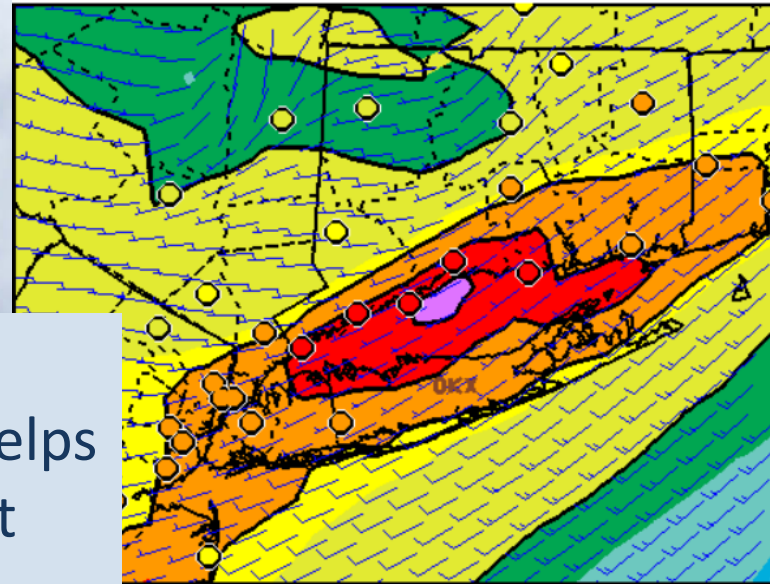
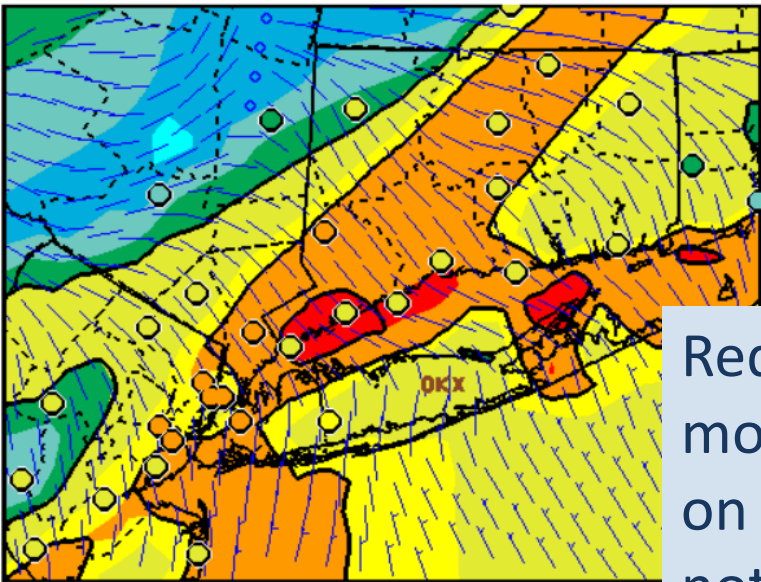
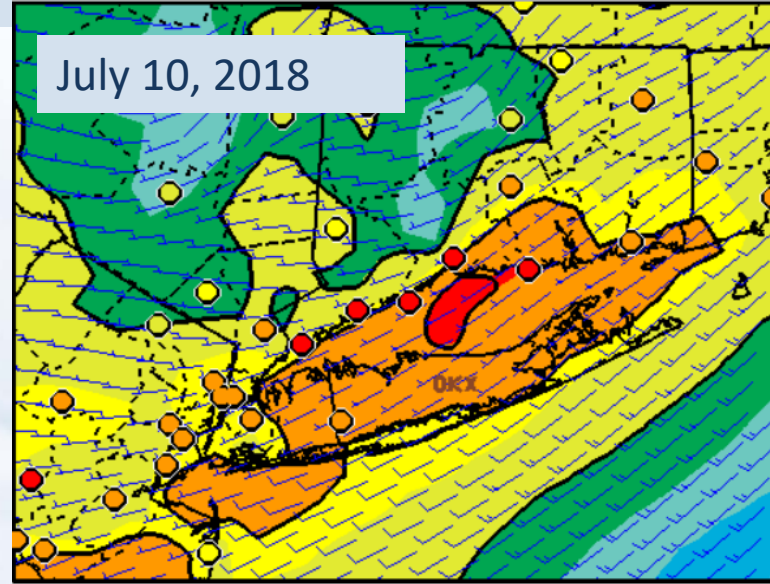
It appears that the latest NEIv2 has little effect on model output.

Bias Correction Reduces Ozone

June 30, 2018



July 10, 2018



Reducing the modeled ozone helps on some days, but not on others!

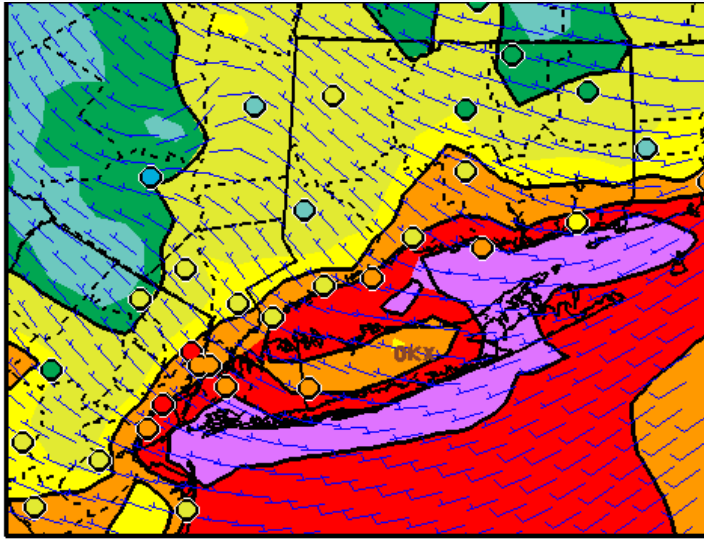
PROD DAY2 OZMX08 (PPB) 20180629 06Z C...

PROD DAY2 OZMX08 (PPB) 20180709 06Z CYC...

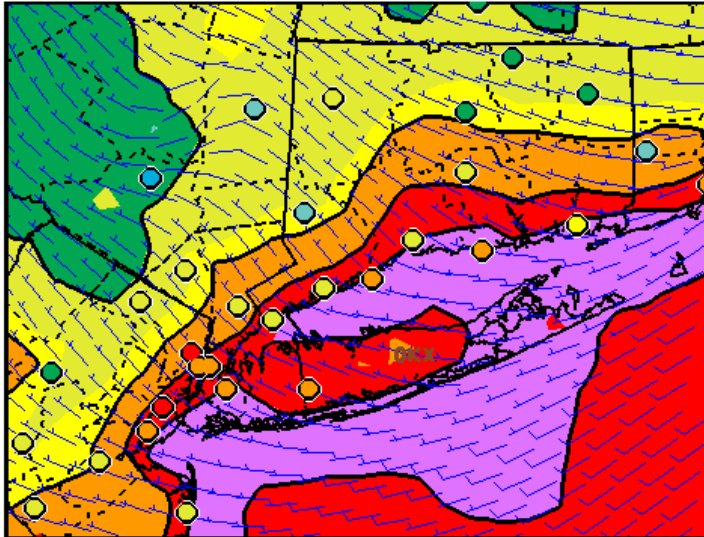
July 1, 2018 Ozone Event

Bias-corrected performed better, but day 1 showed no improvement in either.

DAY 2

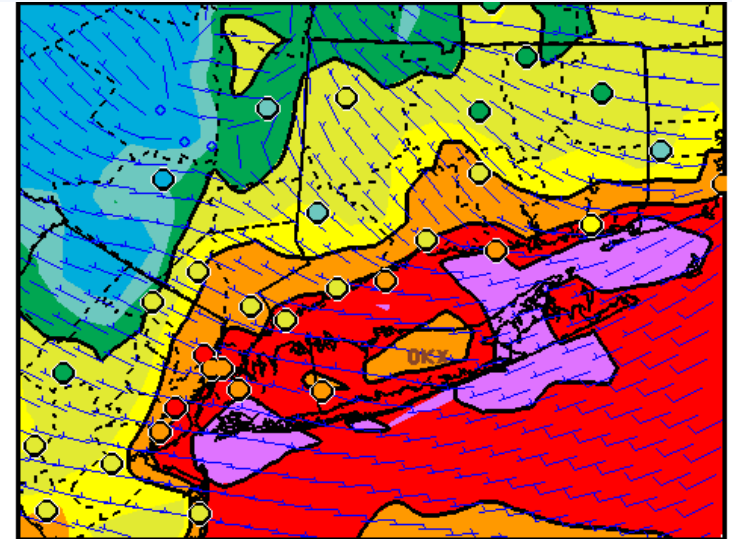


PARABCY8 BIAS COR V8 DAY2 OZMX08 (PPB) 20180630 06Z CYC

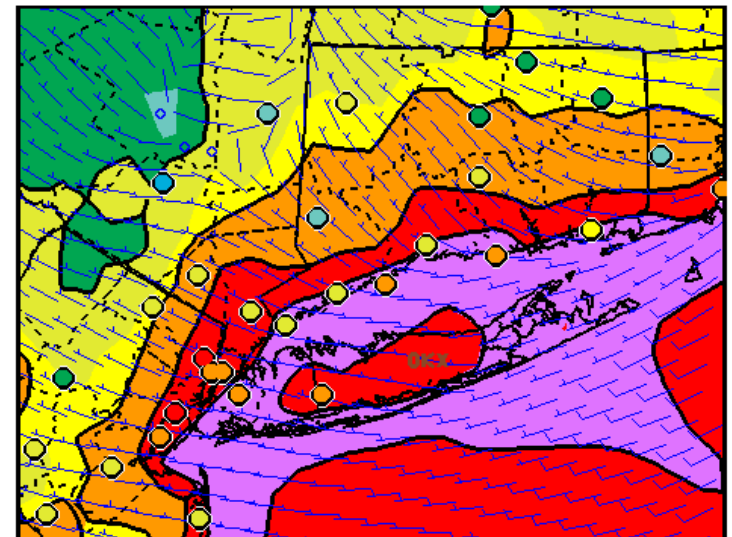


PROD DAY2 OZMX08 (PPB) 20180630 06Z CYC

DAY 1



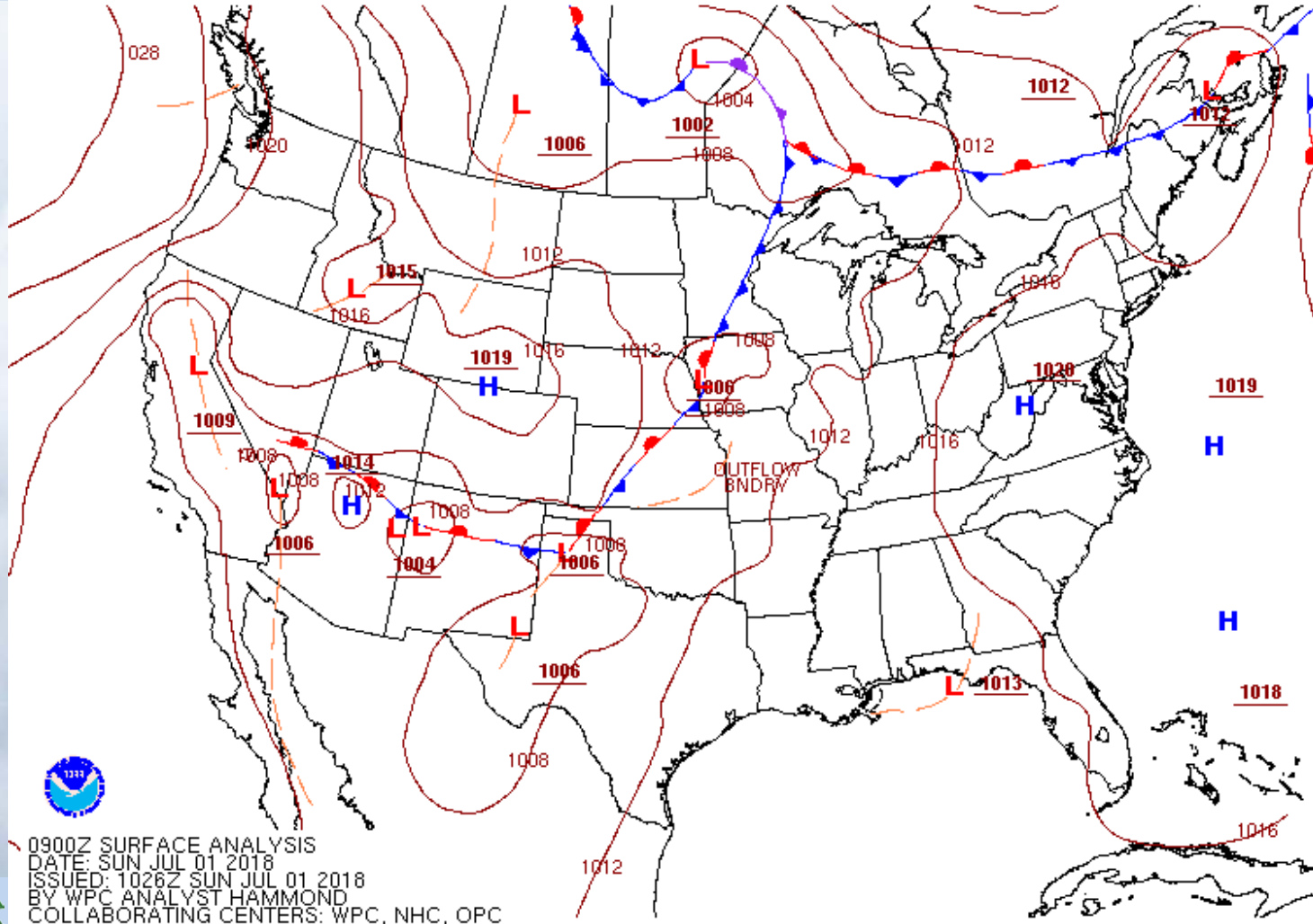
PARABCY8 BIAS COR V8 DAY1 OZMX08 (PPB) 20180701 06Z CYC



PROD DAY1 OZMX08 (PPB) 20180701 06Z CYC

July 1, 2018 Surface Analysis Animation

- Weak High pressure was anchored over the east coast, with a meso-low that tracked across Connecticut



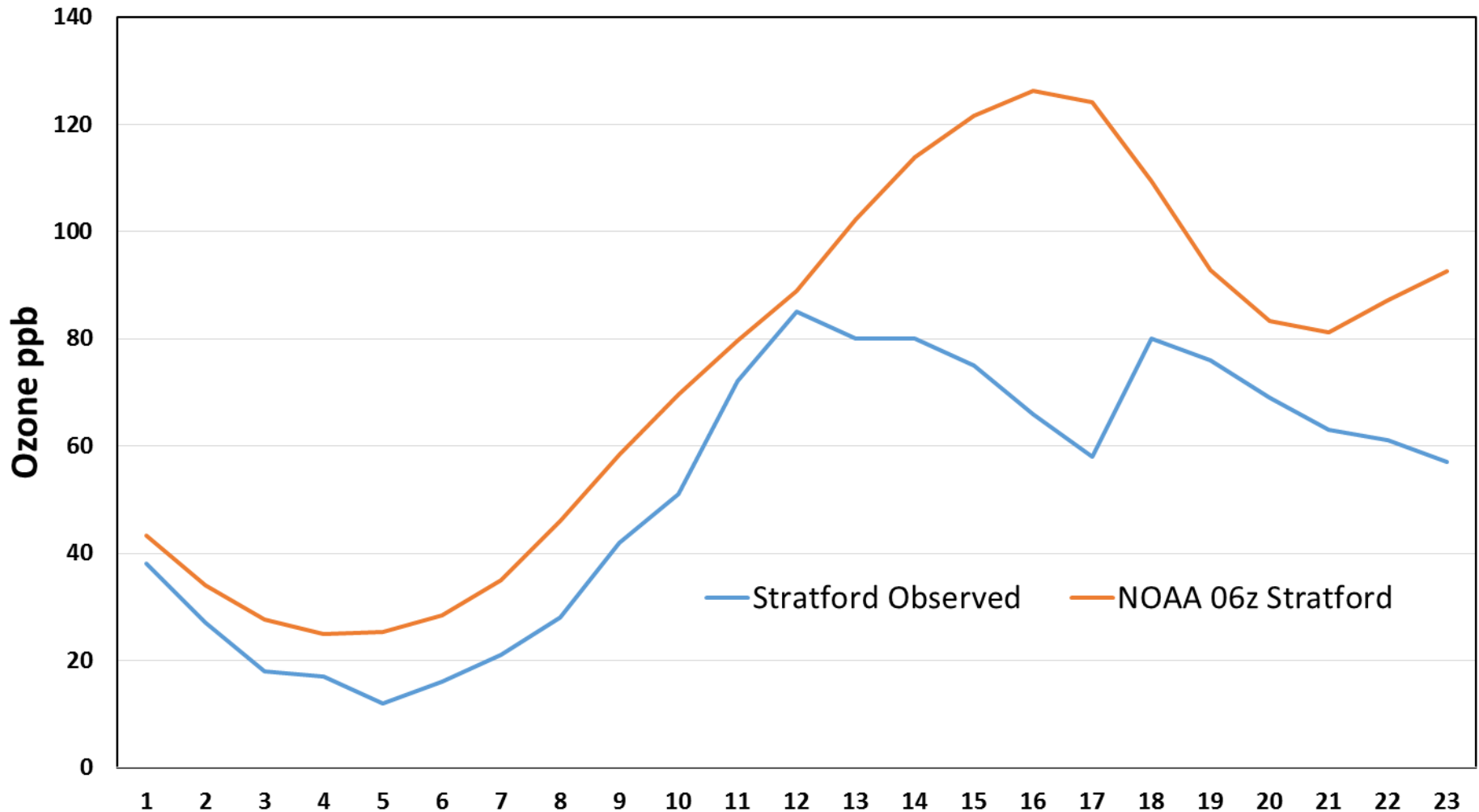
0900Z SURFACE ANALYSIS
DATE: SUN JUL 01 2018
ISSUED: 1026Z SUN JUL 01 2018
BY WPC ANALYST HAMMOND
COLLABORATING CENTERS: WPC, NHC, OPC



July 1, 2018 NOAA Model vs. Observed Stratford

- The modeled numbers look realistic for a high-end event, but it appears that the ozone production stopped during the afternoon.

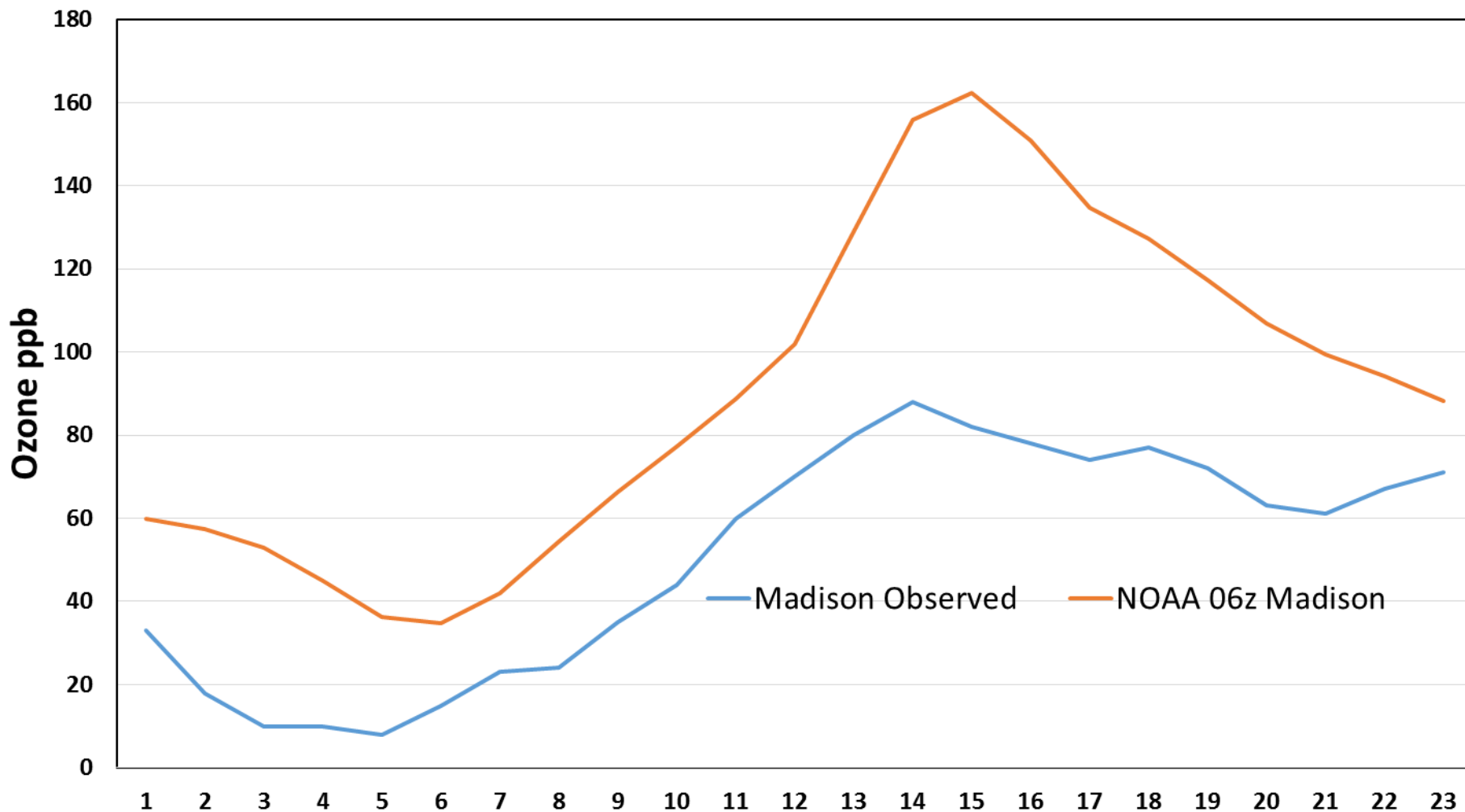
July 1, 2018 NOAA Day 06z vs Observed Stratford



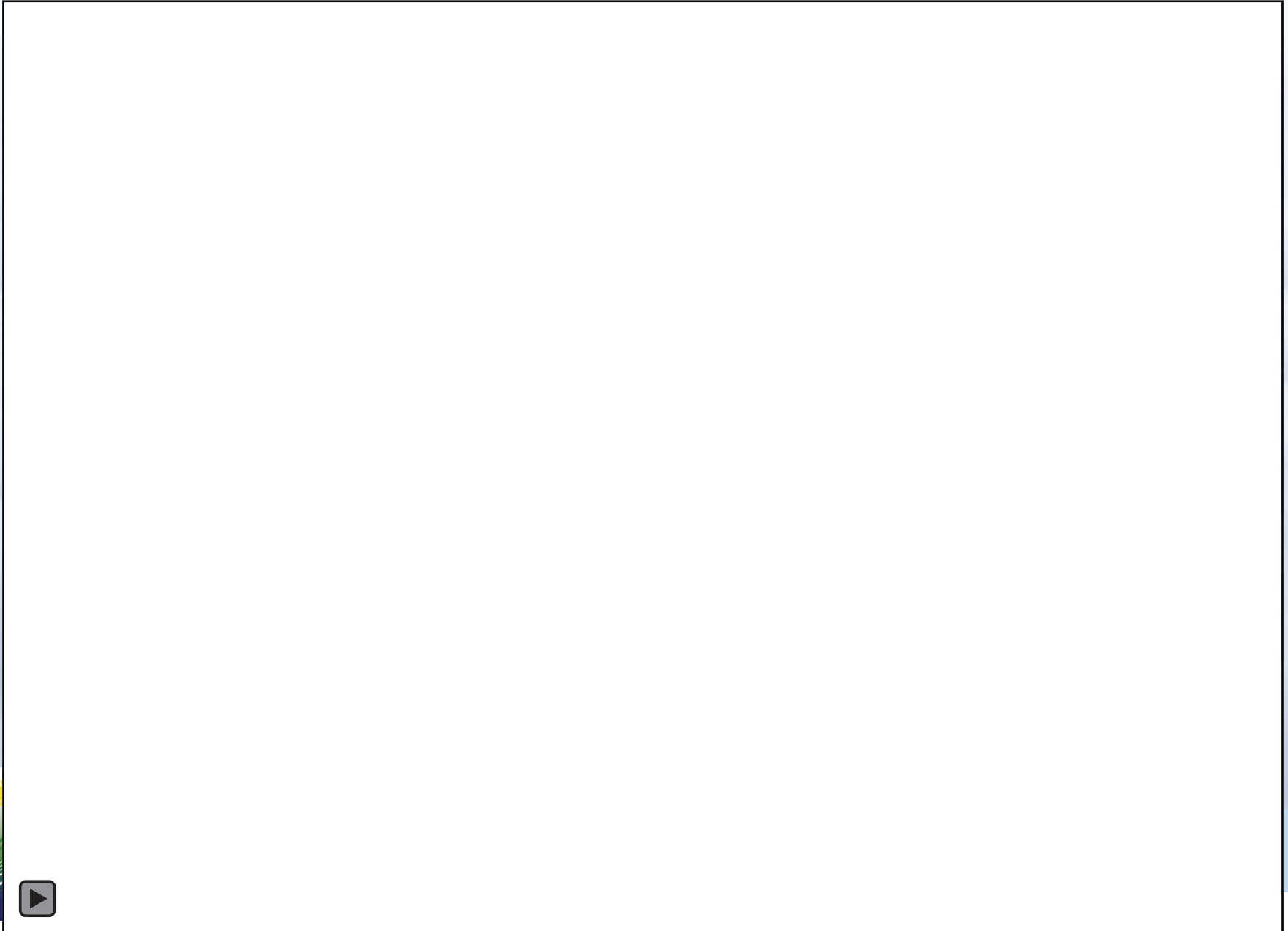
July 1, 2018 NOAA Model vs. Observed Madison

- These modeled numbers are not realistic for a high-end event.

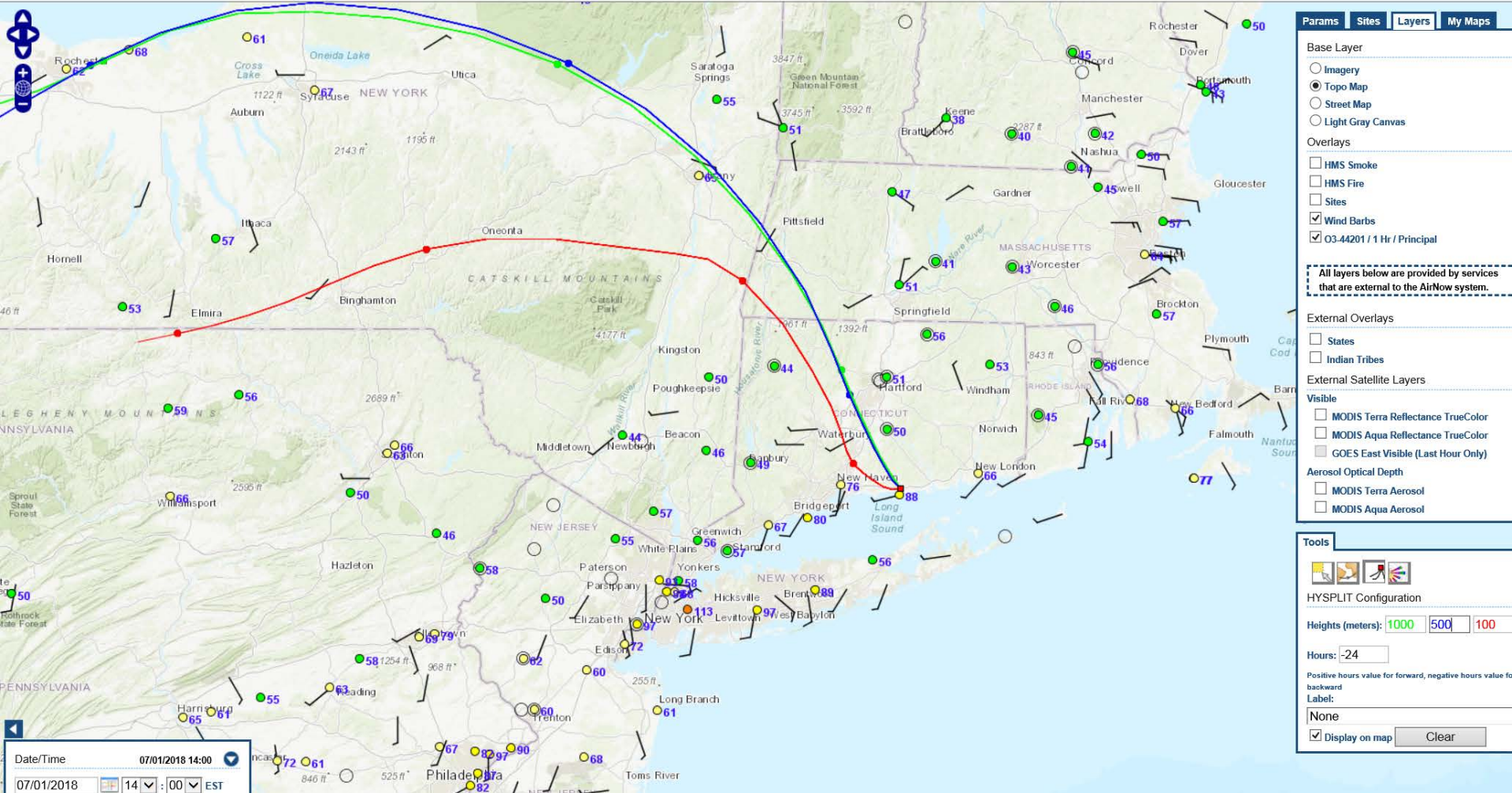
July 1, 2018 NOAA Day 06z vs Observed Madison



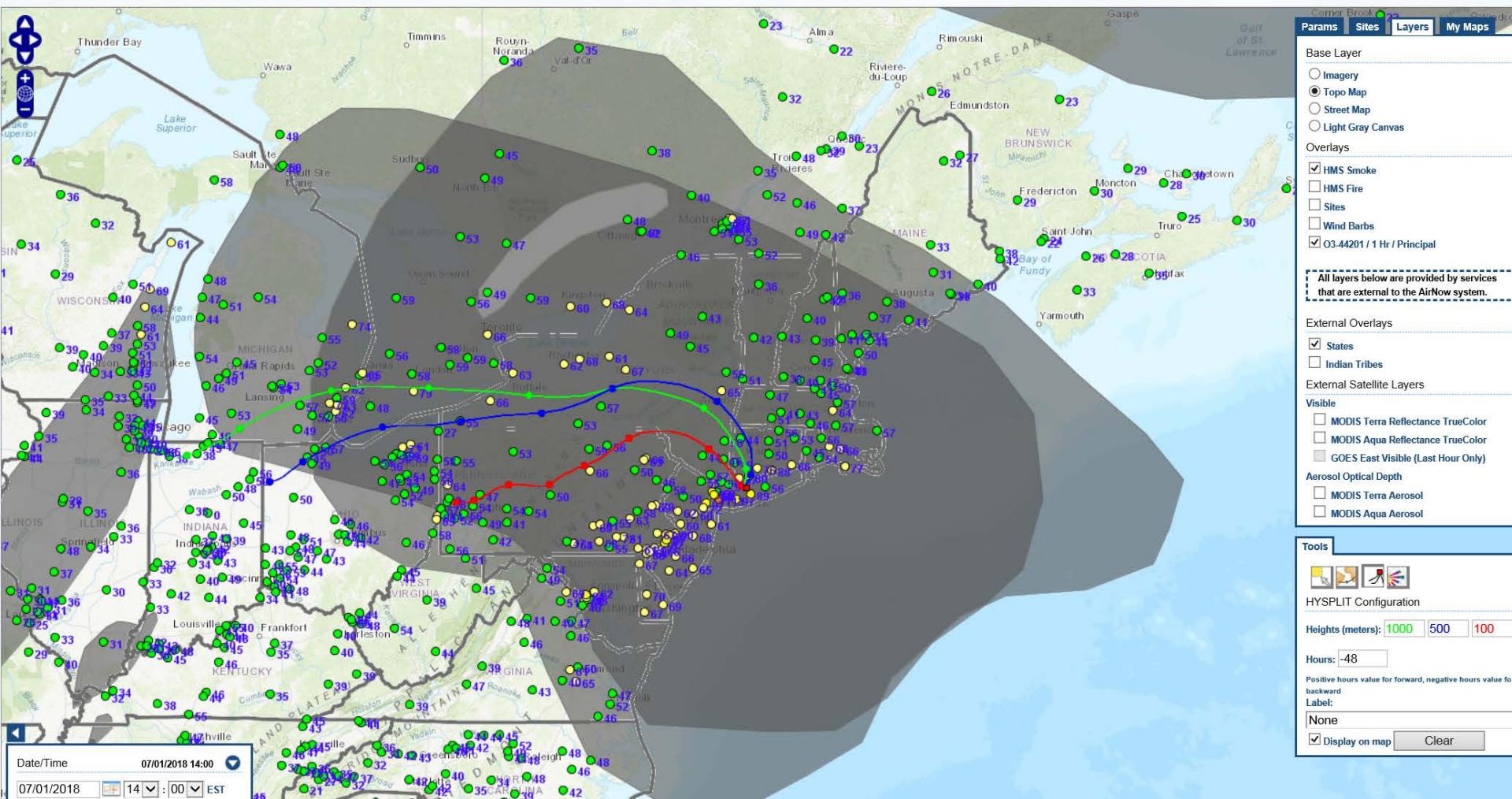
July 1, 2018 Satellite



July 1, 2018 Trajectories



July 1, 2018 Smoke



We need more studies as to how smoke plumes affect both monitored and modeled ozone data.

LIS Minute Ferry Data

MV Park City, Bridgeport & Port Jefferson Ferry



Starting monitoring in late May, 2018, but ferry broke down in late August, so we missed the August 27-29 event.

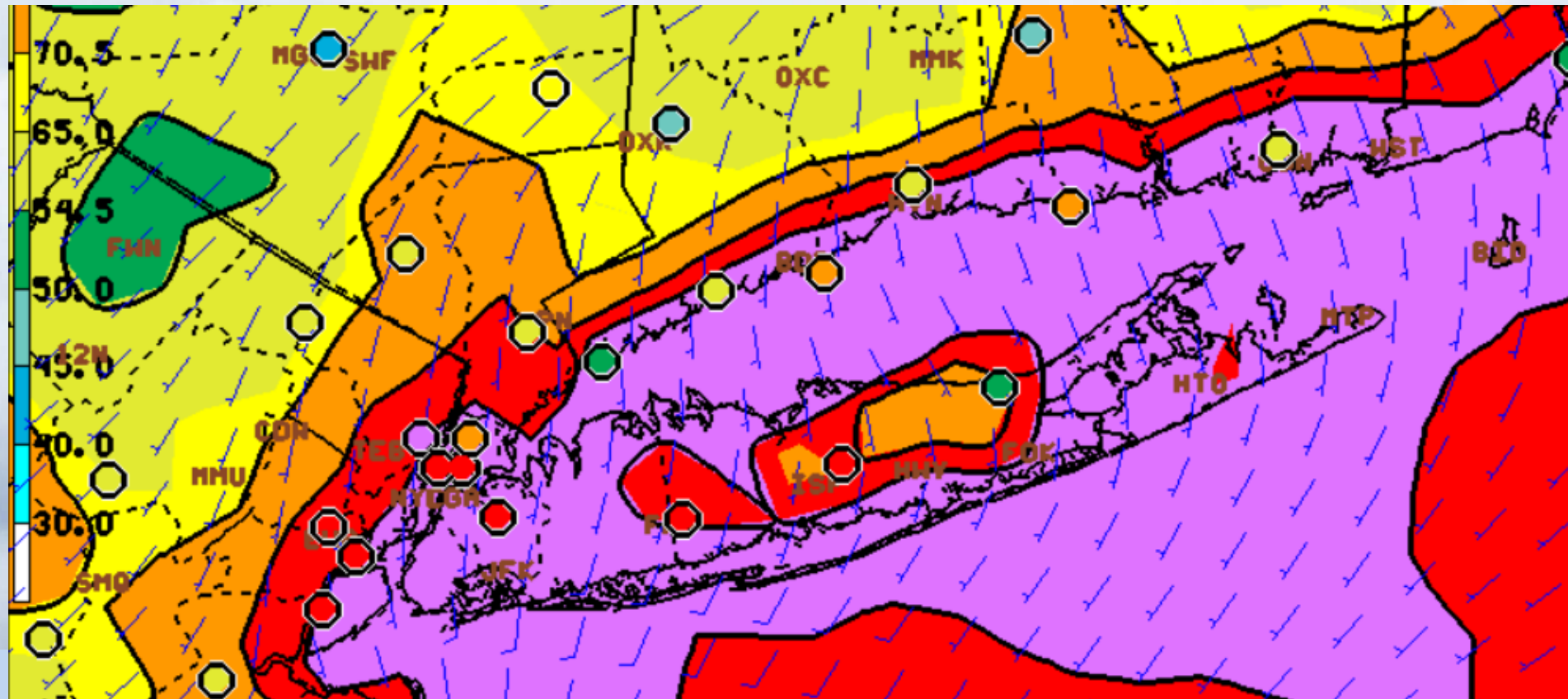


Typical transit path for the Park City Ferry



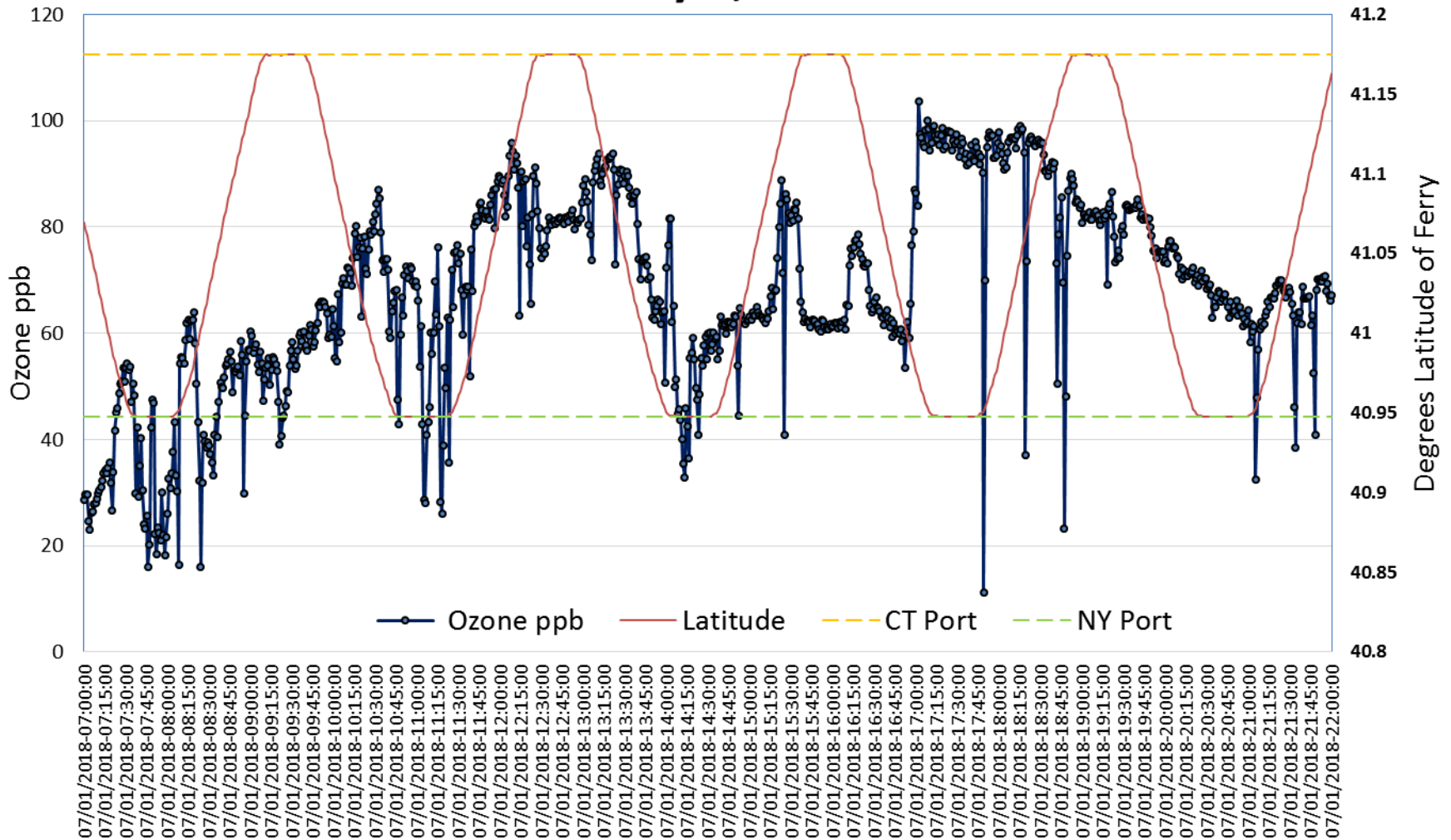
July 1, 2018 LIS Minute Ferry Data

The Model predicts ozone exceeding 106 ppb at 2100z (16:00EST), while the Ferry monitors levels between 90-100 ppb during the same time period



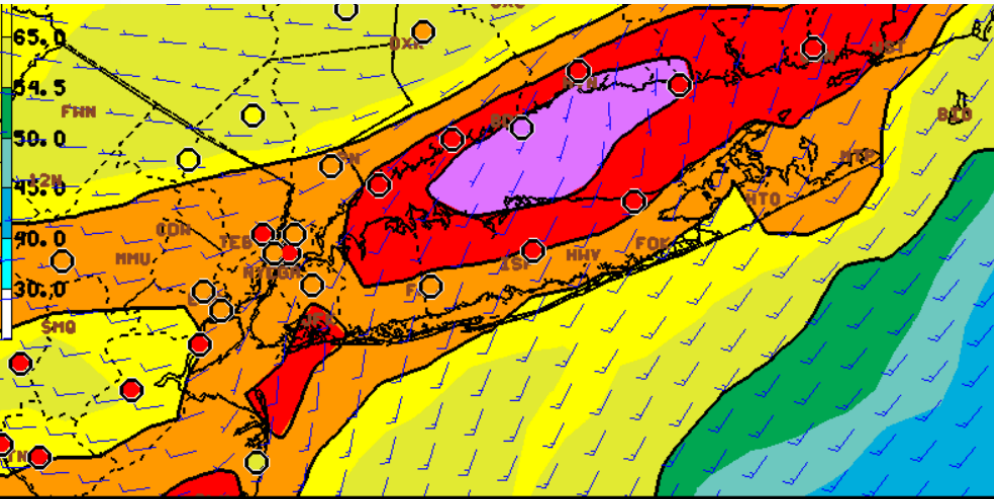
July 1, 2018 LIS Minute Ferry Data

Park City Ferry Hourly Ozone ppb July 1, 2018



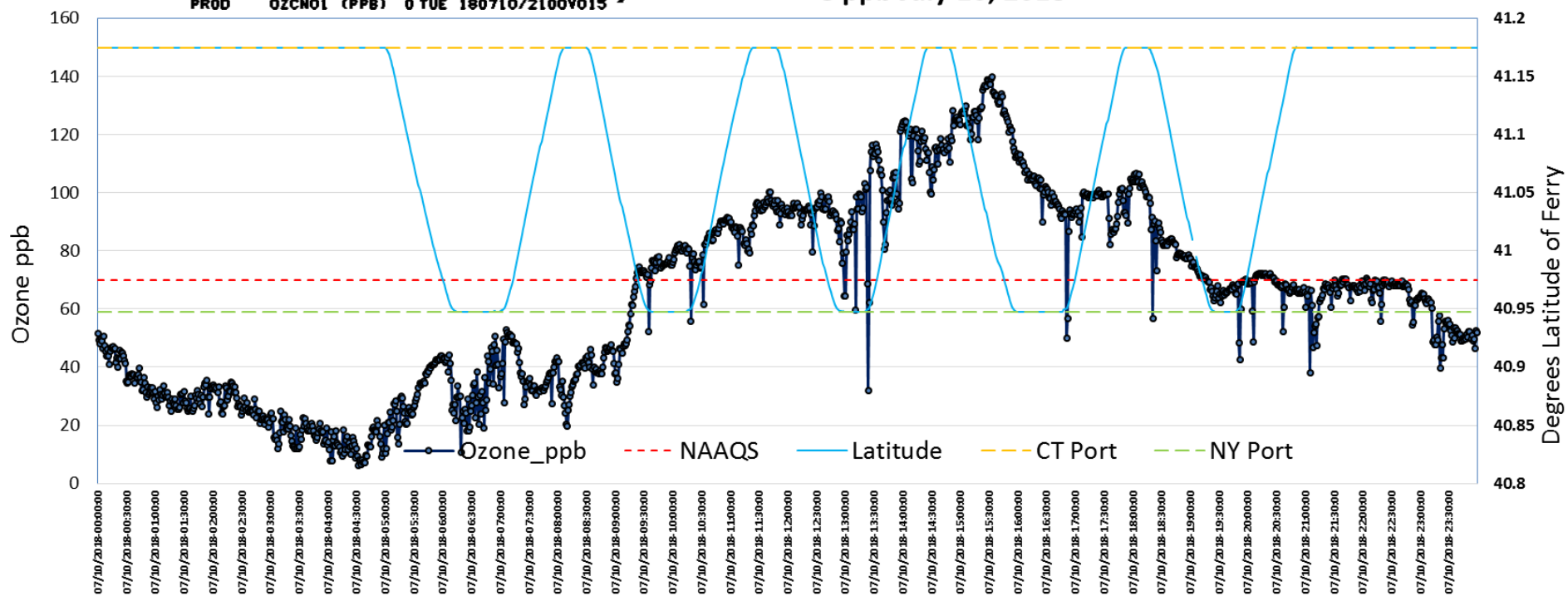
July 10, 2018 LIS Ozone

The minute ferry data does reach 140 ppb, so the model output at 2100z is fairly realistic on this day!

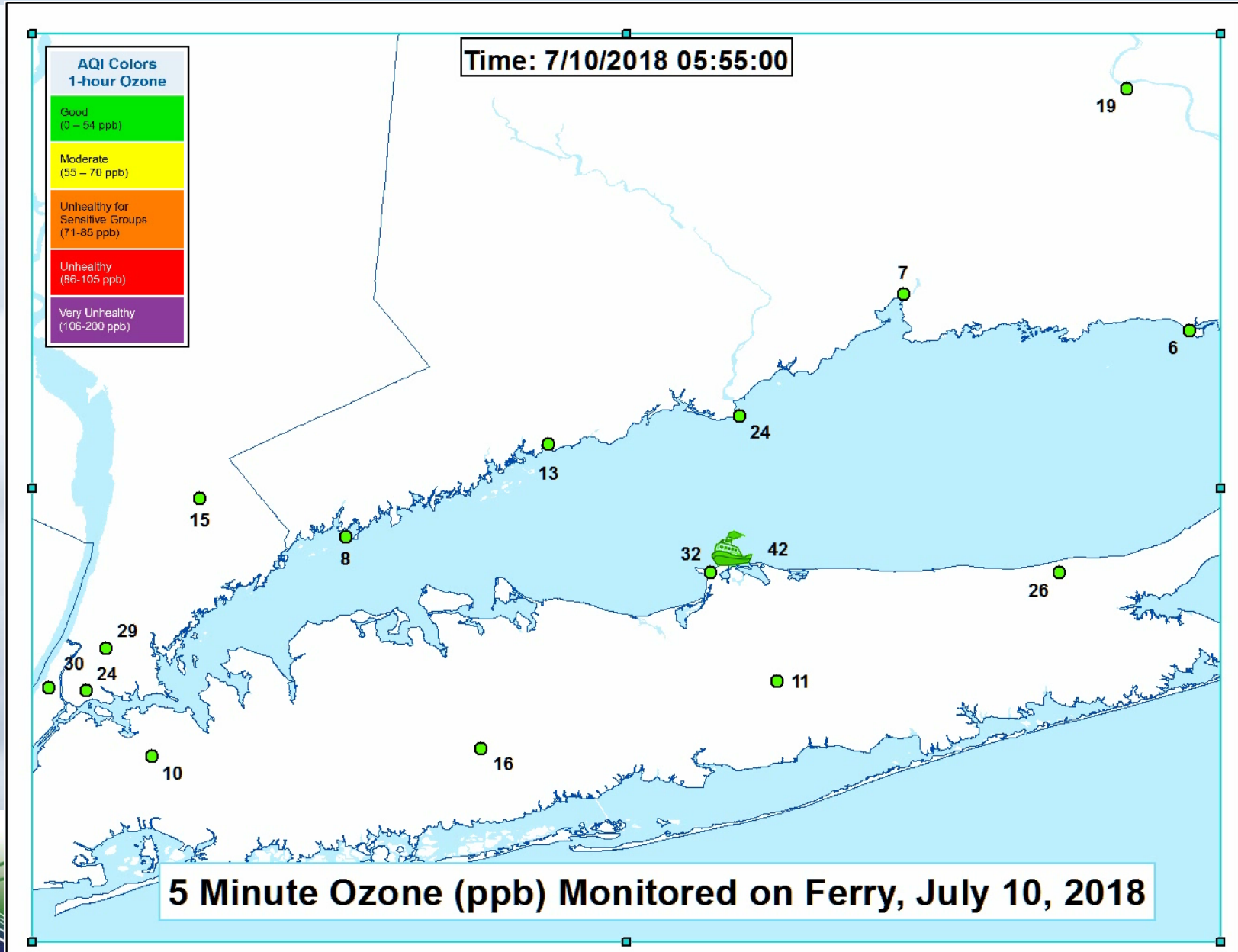


PROD OZCNO1 (PPB) 0 TUE 180710/2100V015 -

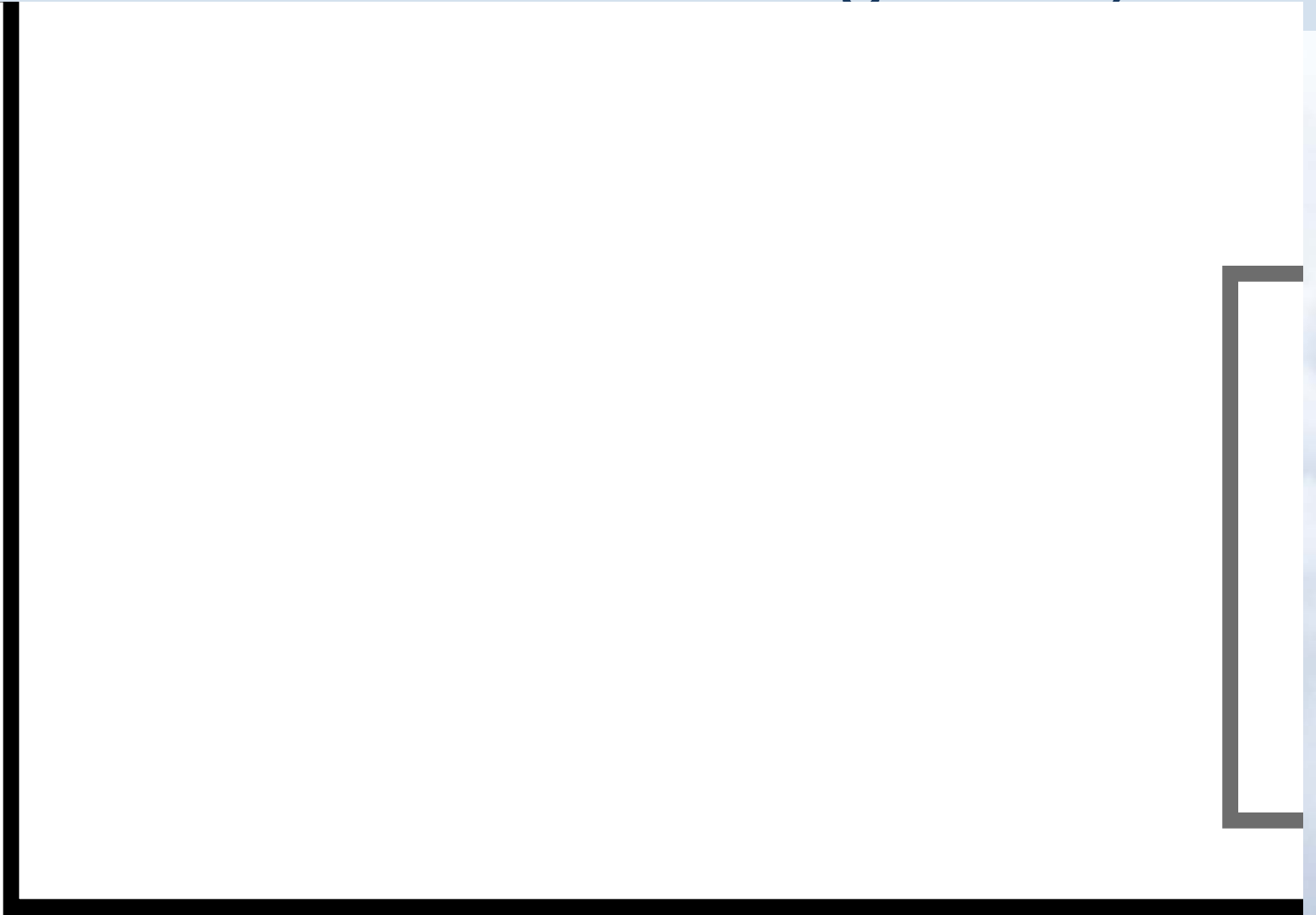
e ppb July 10, 2018



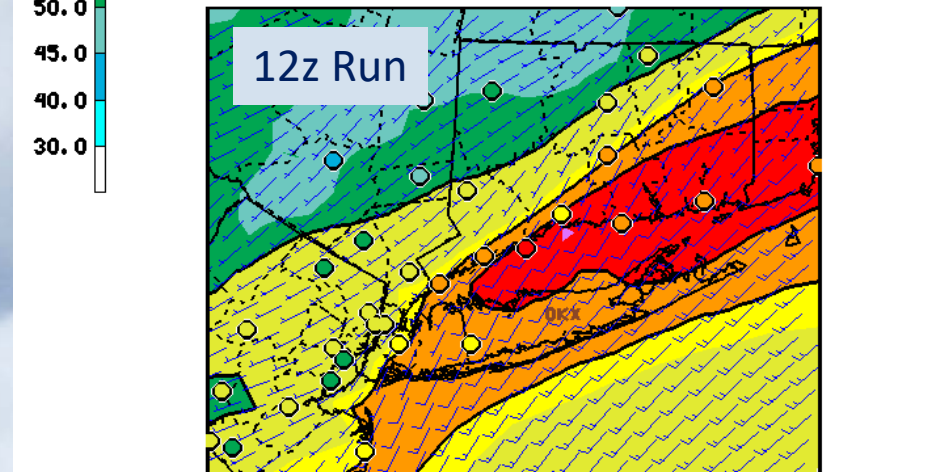
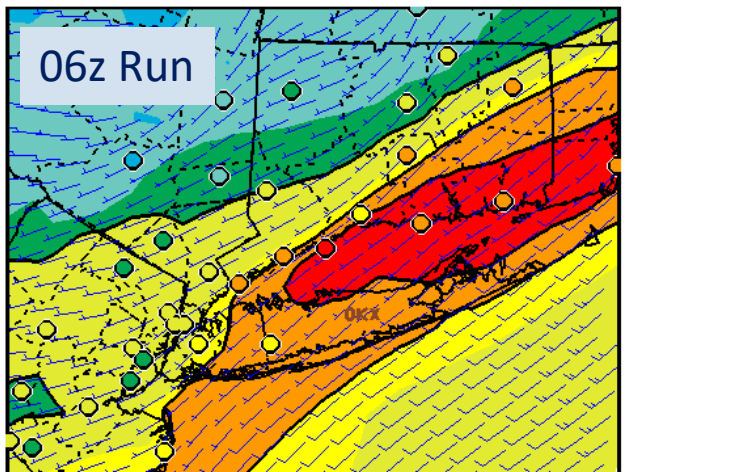
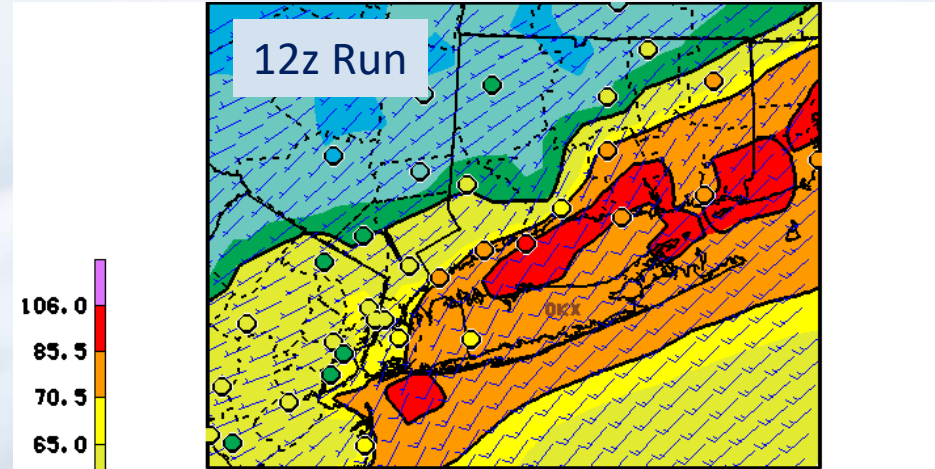
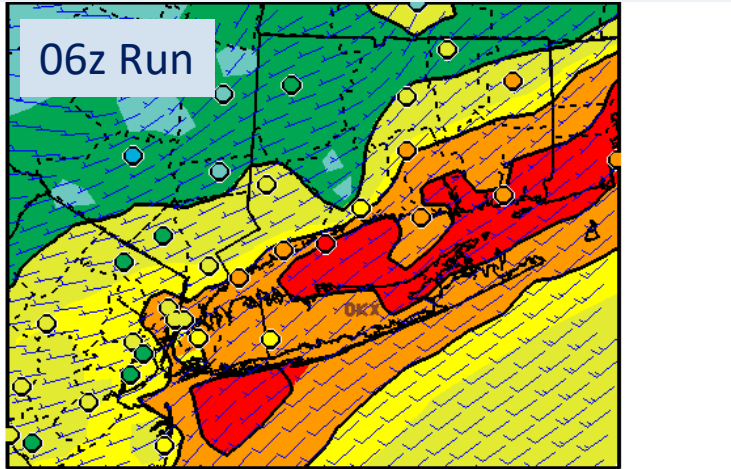
July 10, 2018 LIS Ozone



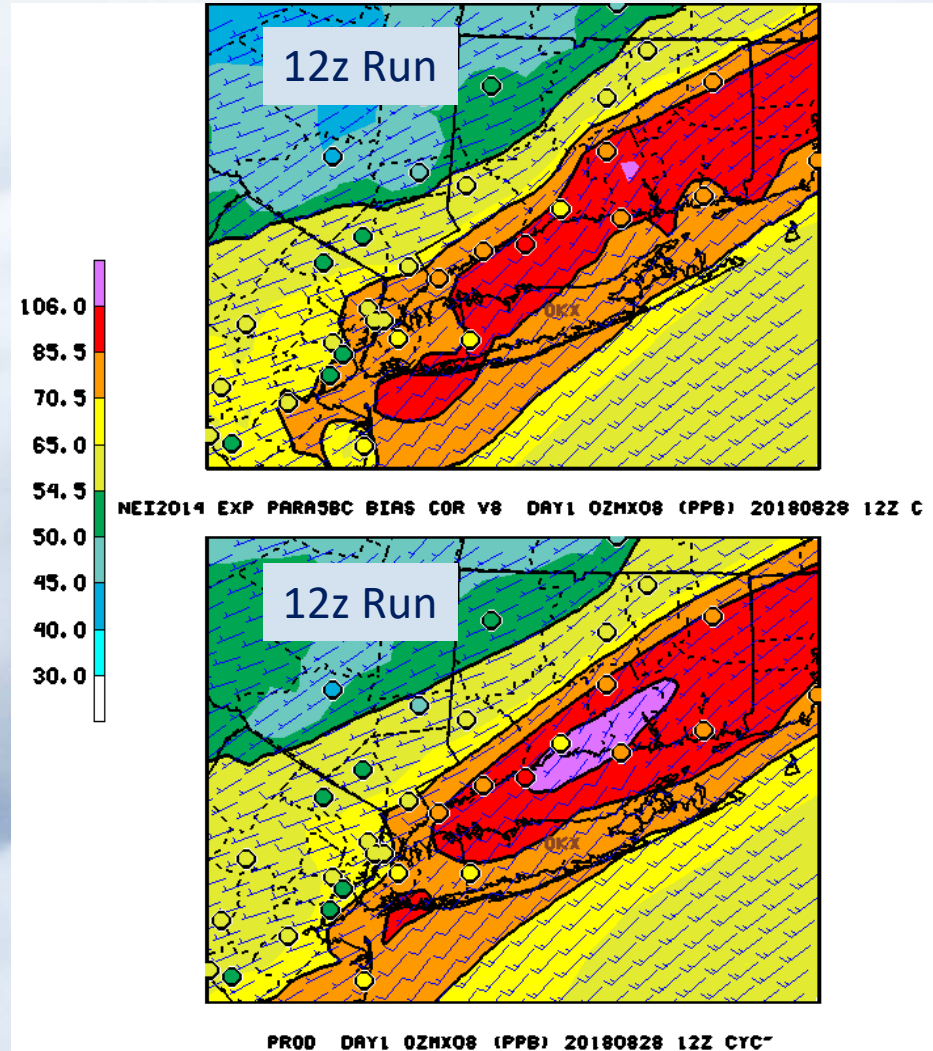
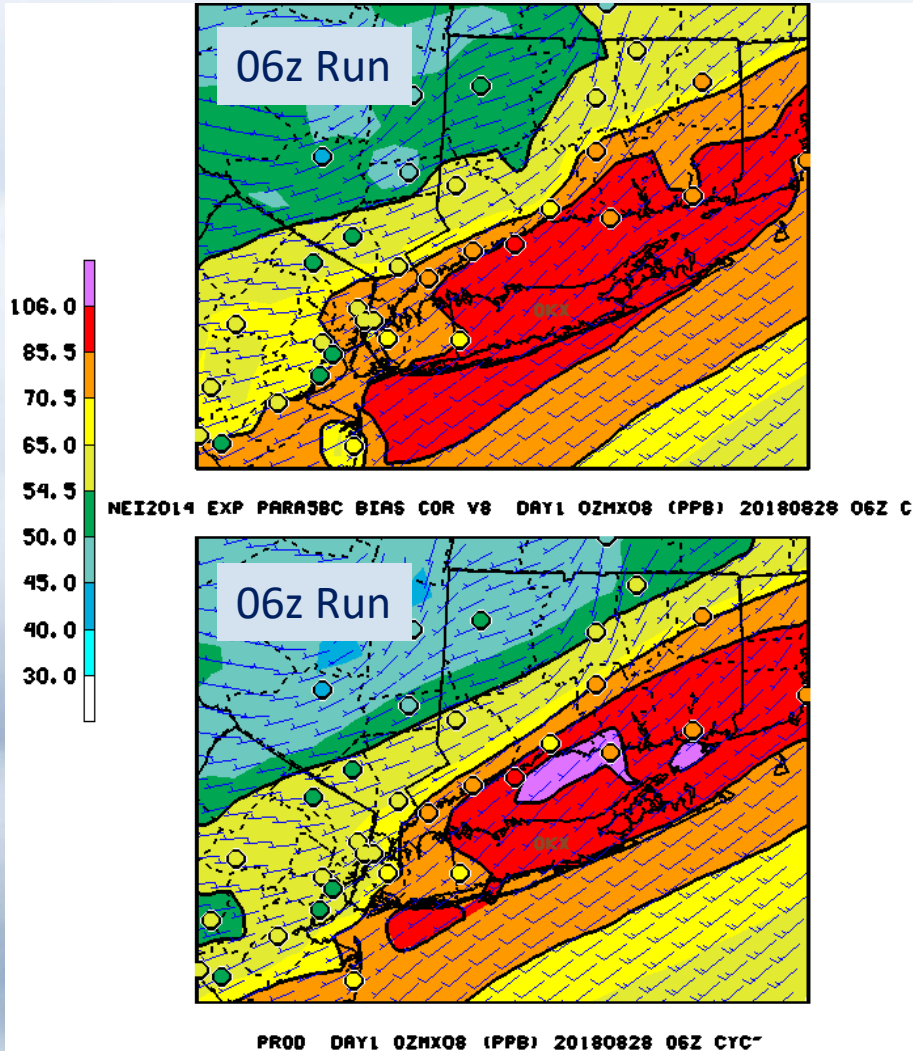
Connecticut Ozone Event August 28, 2018



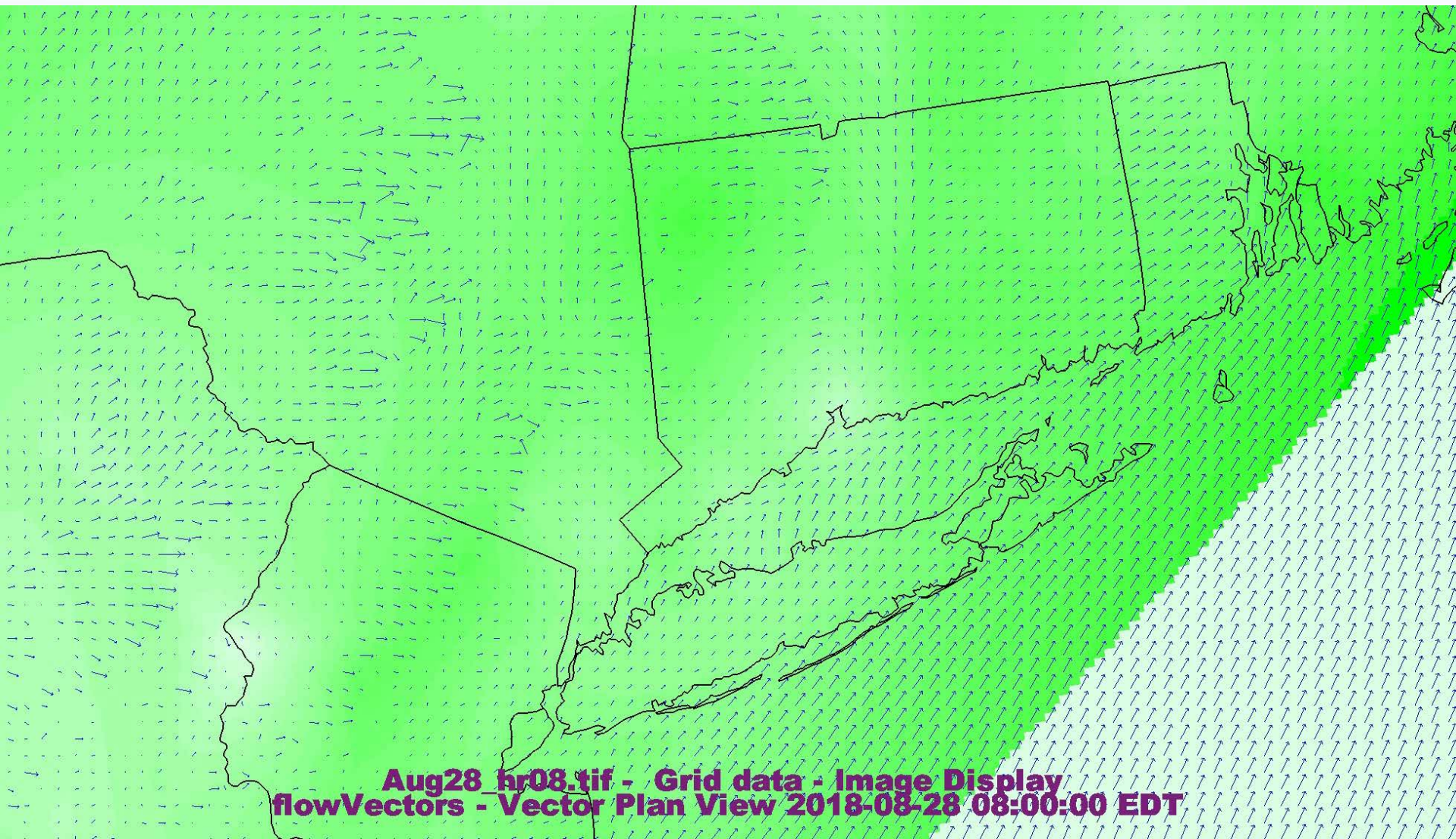
NOAA Model August 27, 2018 Day 2 for August 28th



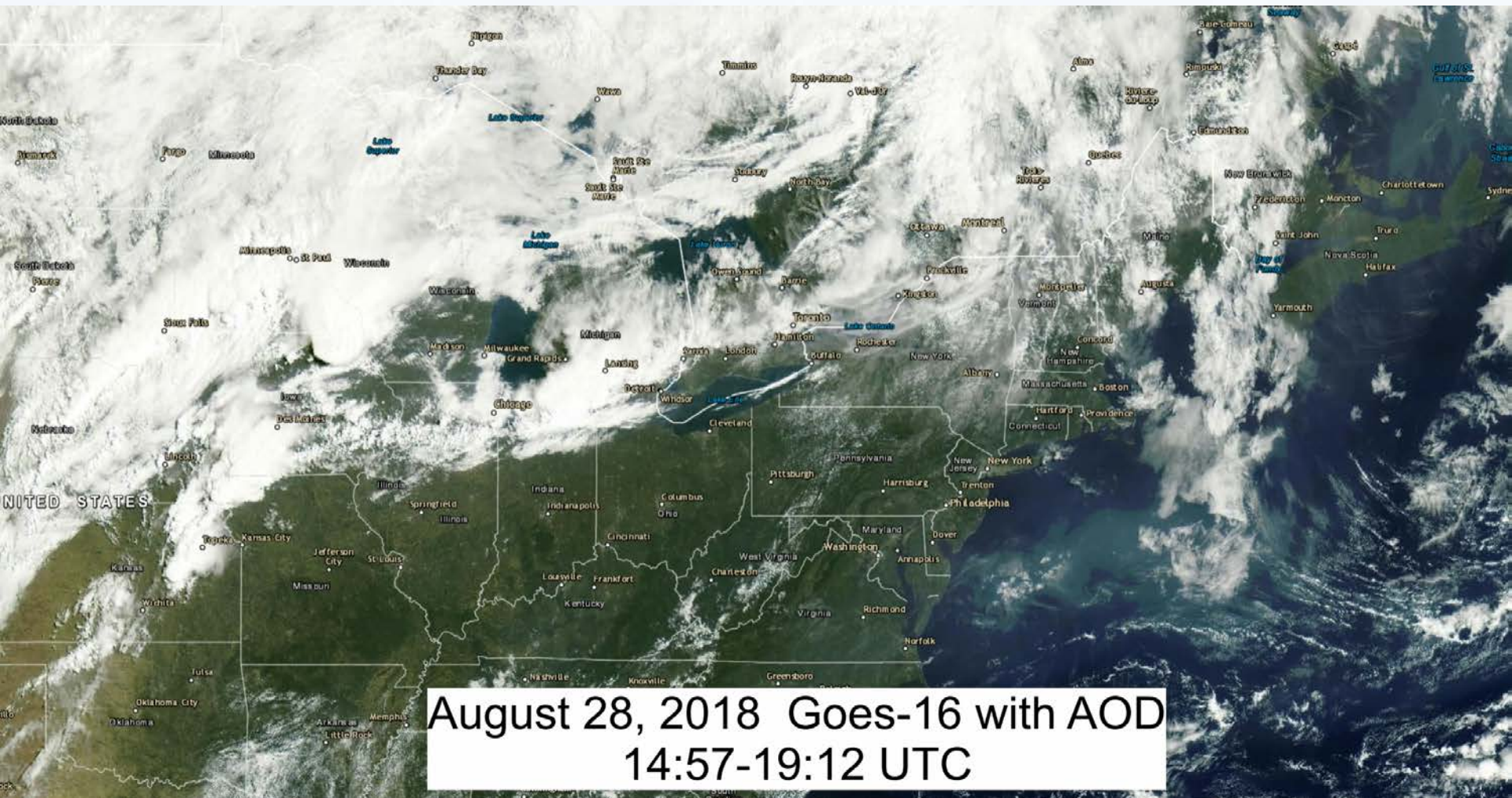
NOAA Model August 28, 2018 Day 1



Connecticut Ozone Event August 28, 2018



Connecticut Ozone Event August 28, 2018



Conclusions

- 23 exceedance days in 2018, compared with 20 in 2017;
- The NOAA model generally under predicted in May, possibly due to smoke from agricultural fires;
- Tropical weather pattern set up in July, which tended to push highest ozone further west;
- When we know that NOAA model is over predicting, we generally lower the ozone levels by as much as 10-20 ppb.
- Smoke was present for several events during the summer, which may have hindered the model performance due to solar attenuation.

