Connecticut Department of Energy and Environmental Protection

Connecticut Department of
ENERGY & ENVIRONMENTAL PROTECTION

Connecticut Ozone Event Analysis for May 17-19, 2017

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CTDEEP
June 2017

Connecticut Ozone Event May 17-19, 2017

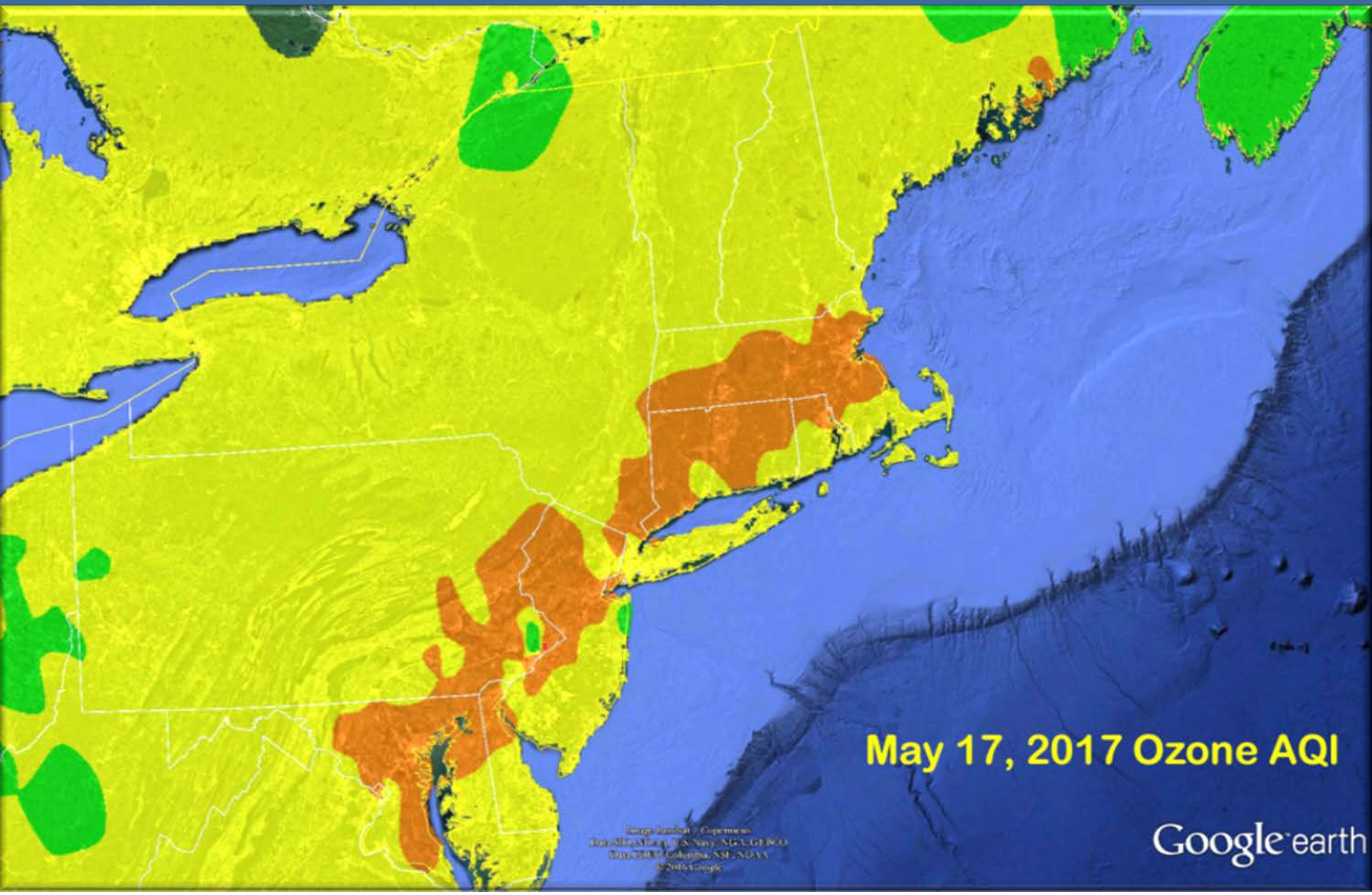
- This was a classic and widespread 3-day event for the I-95 corridor that quickly developed from a Bermuda high that setup off the east coast.
- All models correctly forecasted a USG event for the region but underestimated the areal extent, as the ozone plume pushed much further inland.
- Inland areas commonly have higher ozone levels earlier in the season than the coast, possibly because the sea breeze has a greater effect of pushing the plume inland than later in the season.
- The NOAA model doesn't assimilate gaseous smoke emissions into their ozone model, so that may have been responsible for some of the under predictions, since smoke may have enhanced the ozone.

Table of CT Monitoring Sites

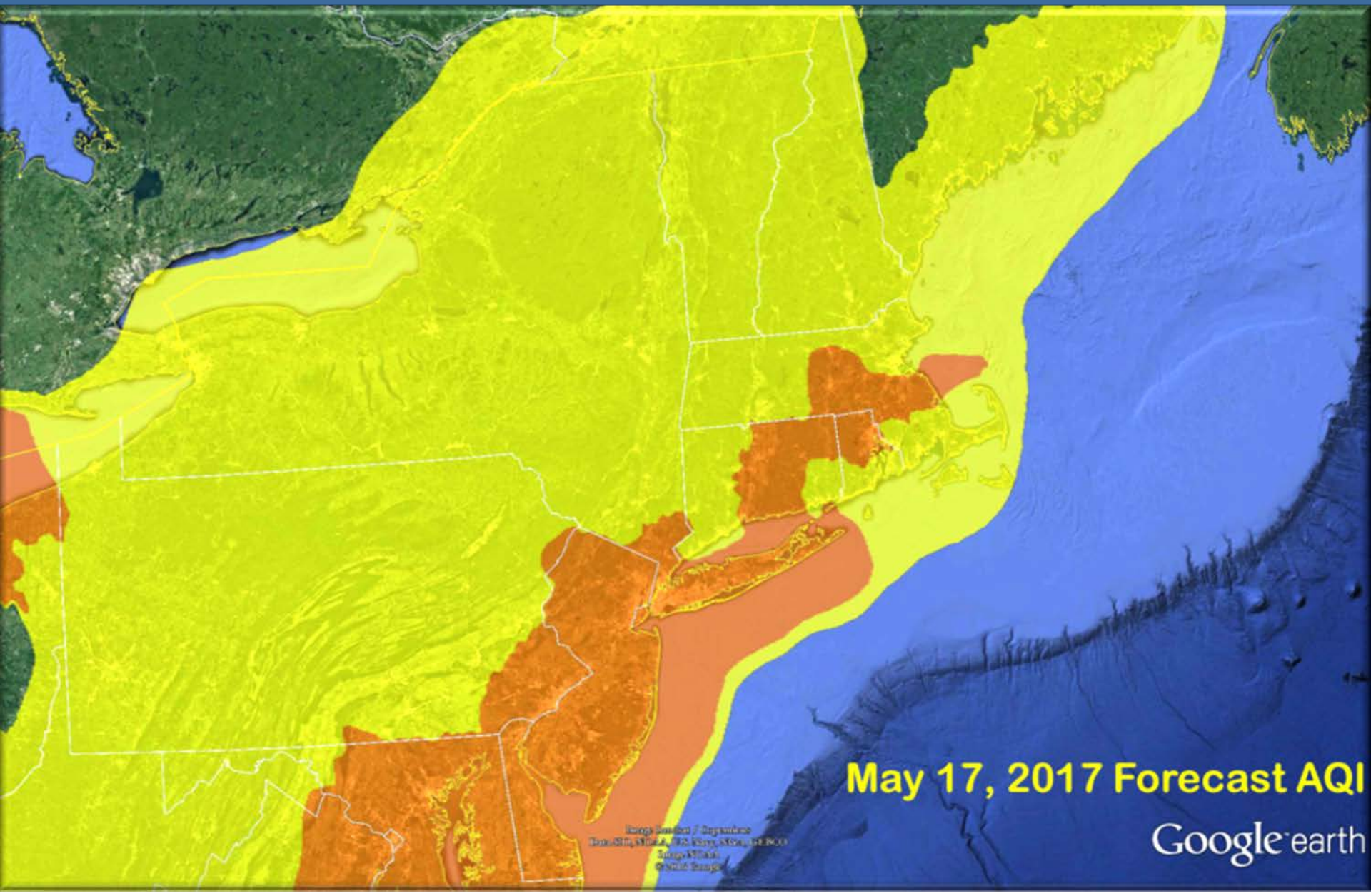
- Ozone peaked on May 18th, with every site, except Cornwall, exceeding the 8-hour NAAQS. Cold front stalled on Friday, allowing 2 coastal monitors in CT to exceed.

Date (LST)	5/17/2017	5/18/2017	5/19/2017
Greenwich/O3	74	86	59
Danbury/O3	78	72	58
Stratford/O3	71	91	70
Westport/O3	73	90	64
East Hartford/O3	78	75	52
Middletown/O3	81	86	58
Stafford/O3	84	77	54
Cornwall/O3	77	67	54
New Haven /O3	65	85	60
Groton /O3	67	90	76
Abington/O3	82	79	56
Madison /O3	70	90	75

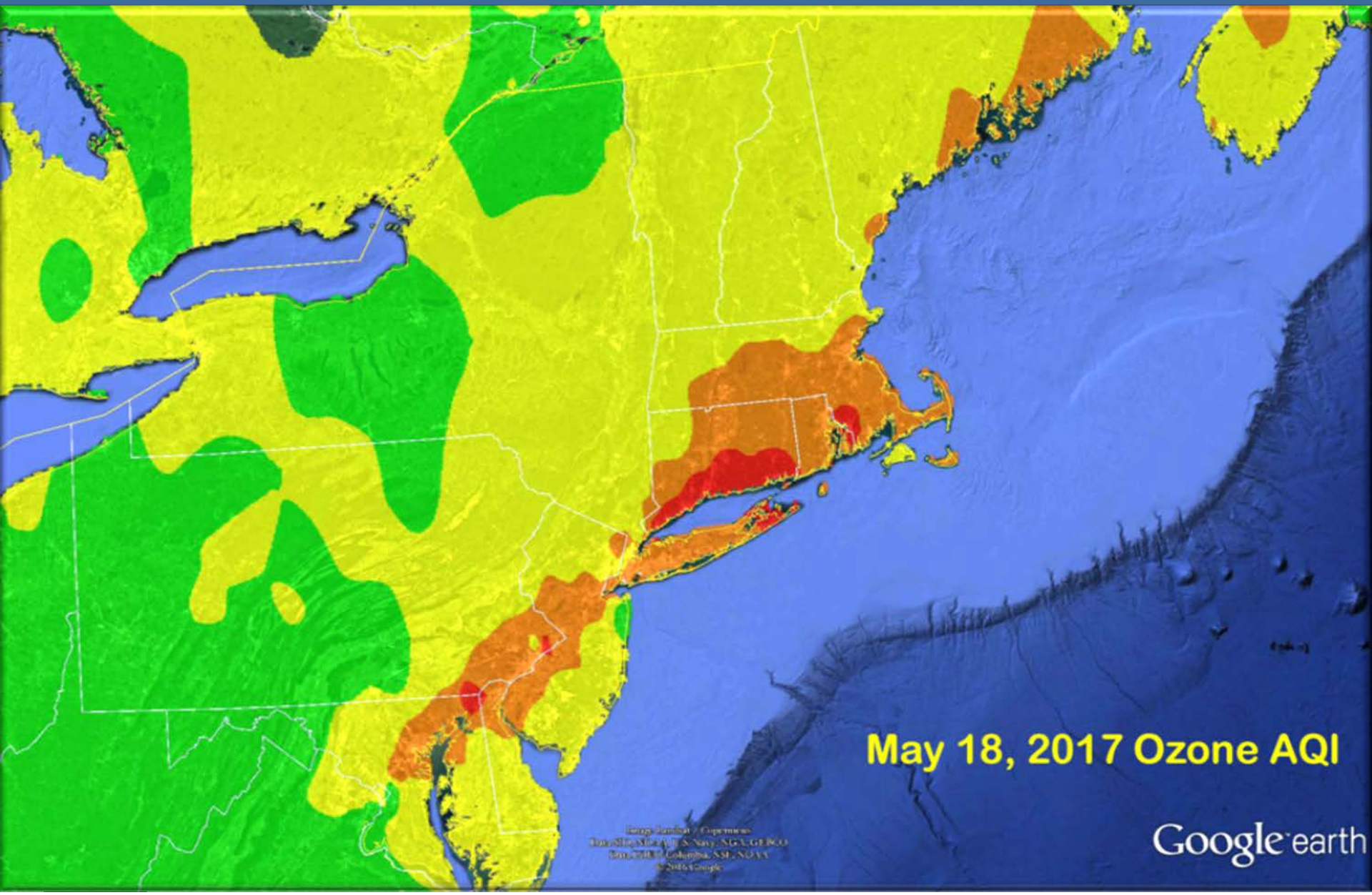
1st Day of I-95 Corridor Ozone Episode



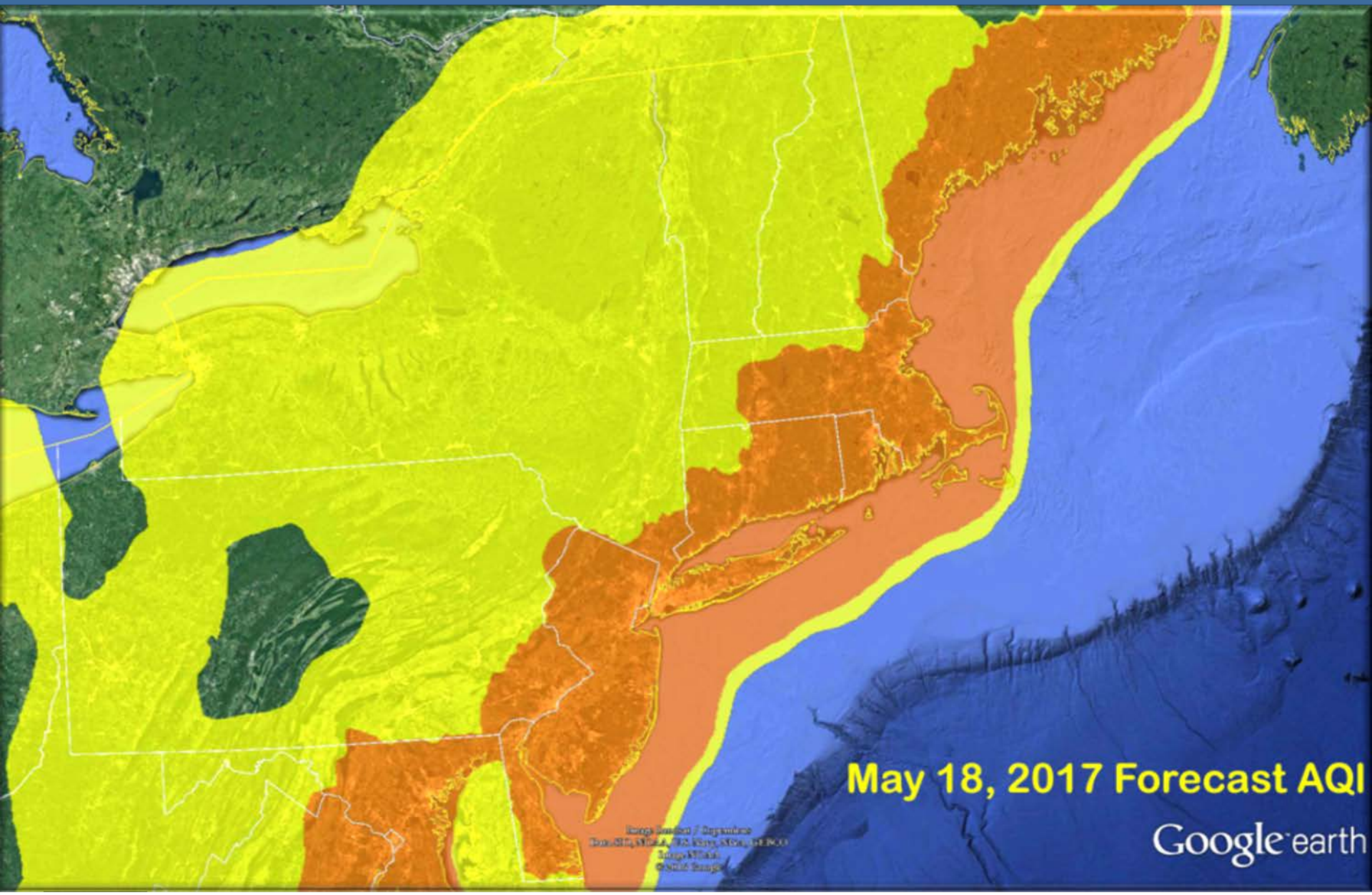
May 17, 2017 Forecasted AQI



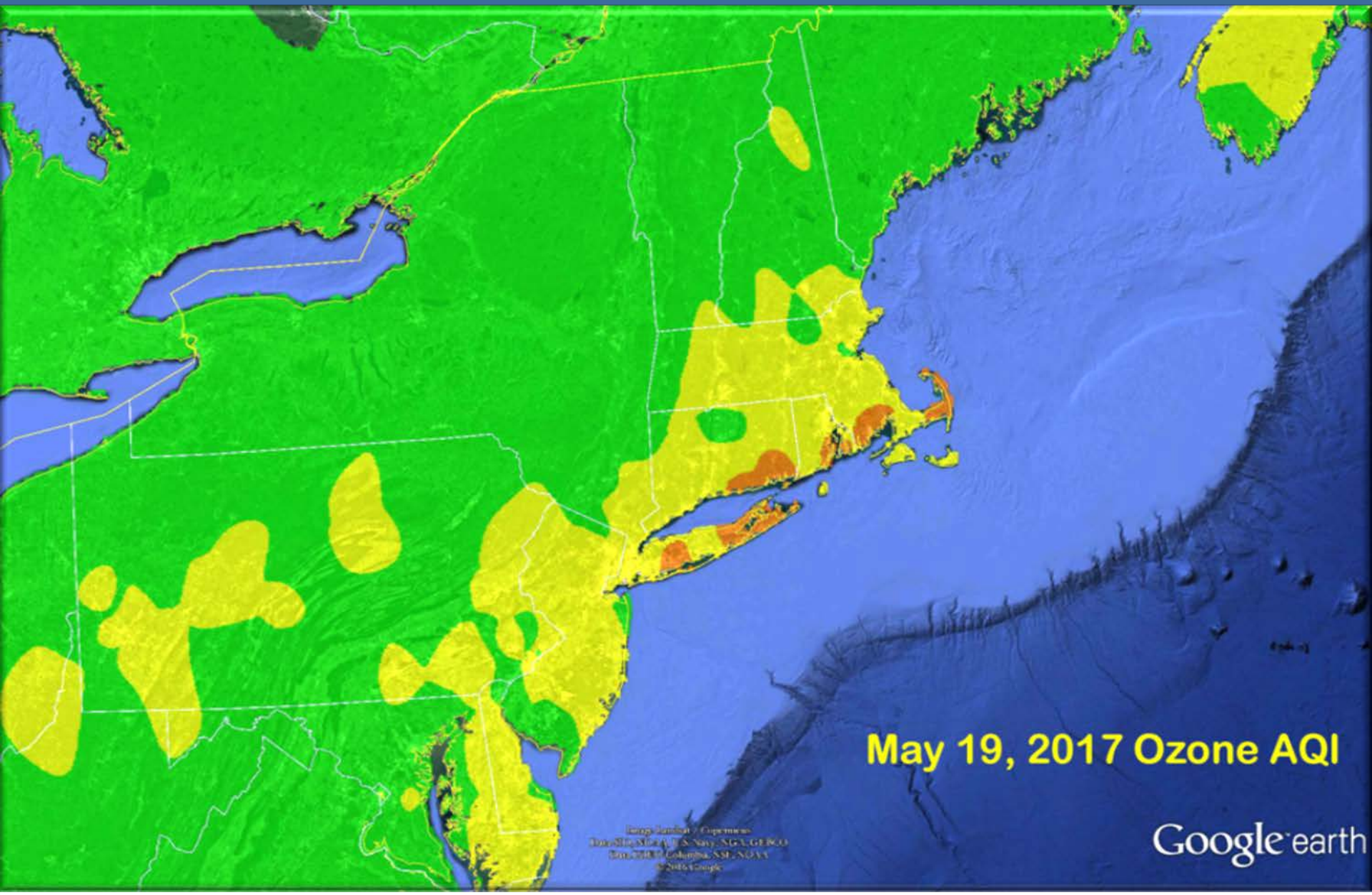
2nd Day of I-95 Corridor Ozone Episode



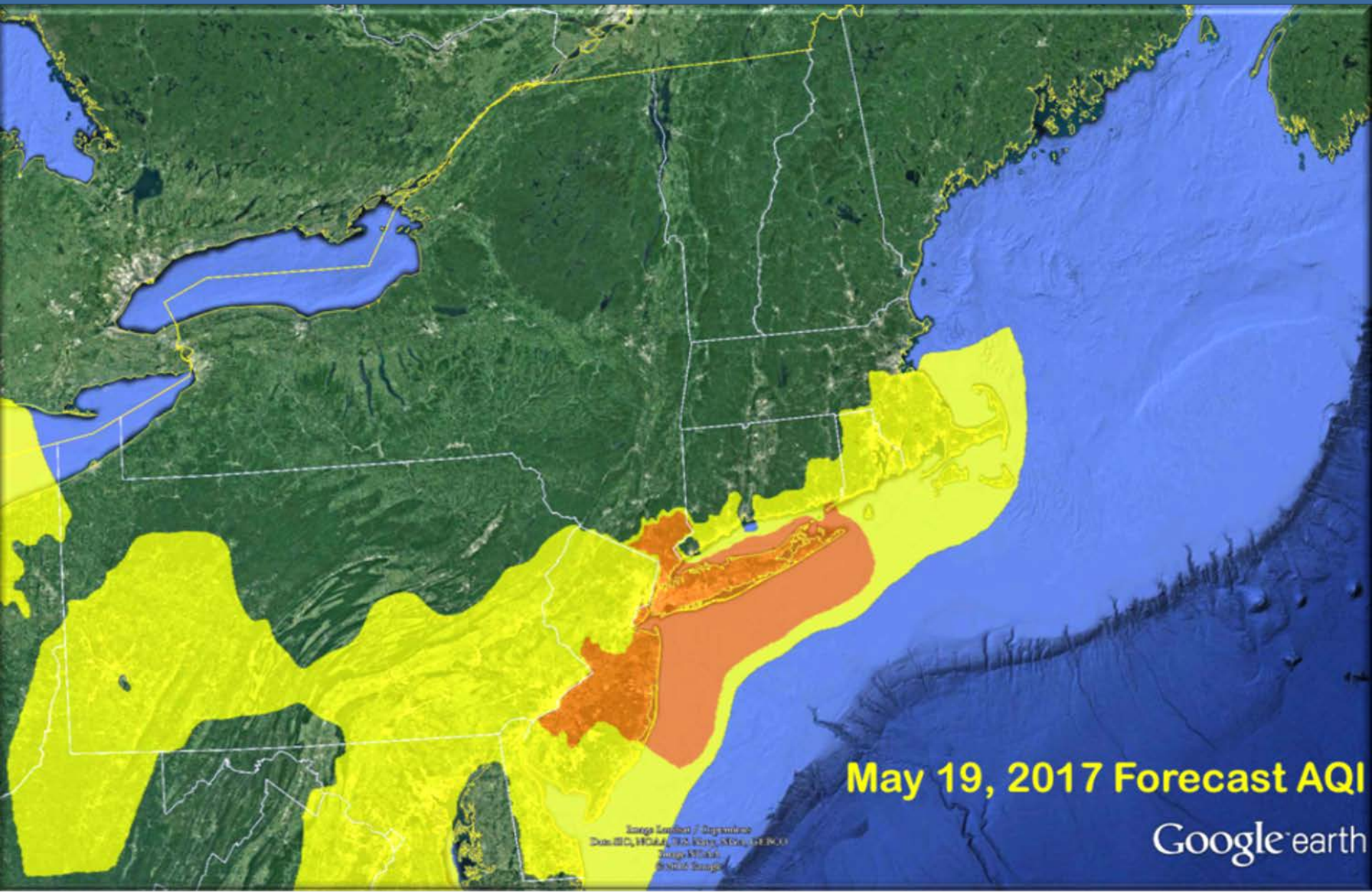
May 18, 2017 Forecasted AQI



3rd Day of I-95 Corridor Ozone Episode



May 19, 2017 Forecasted AQI

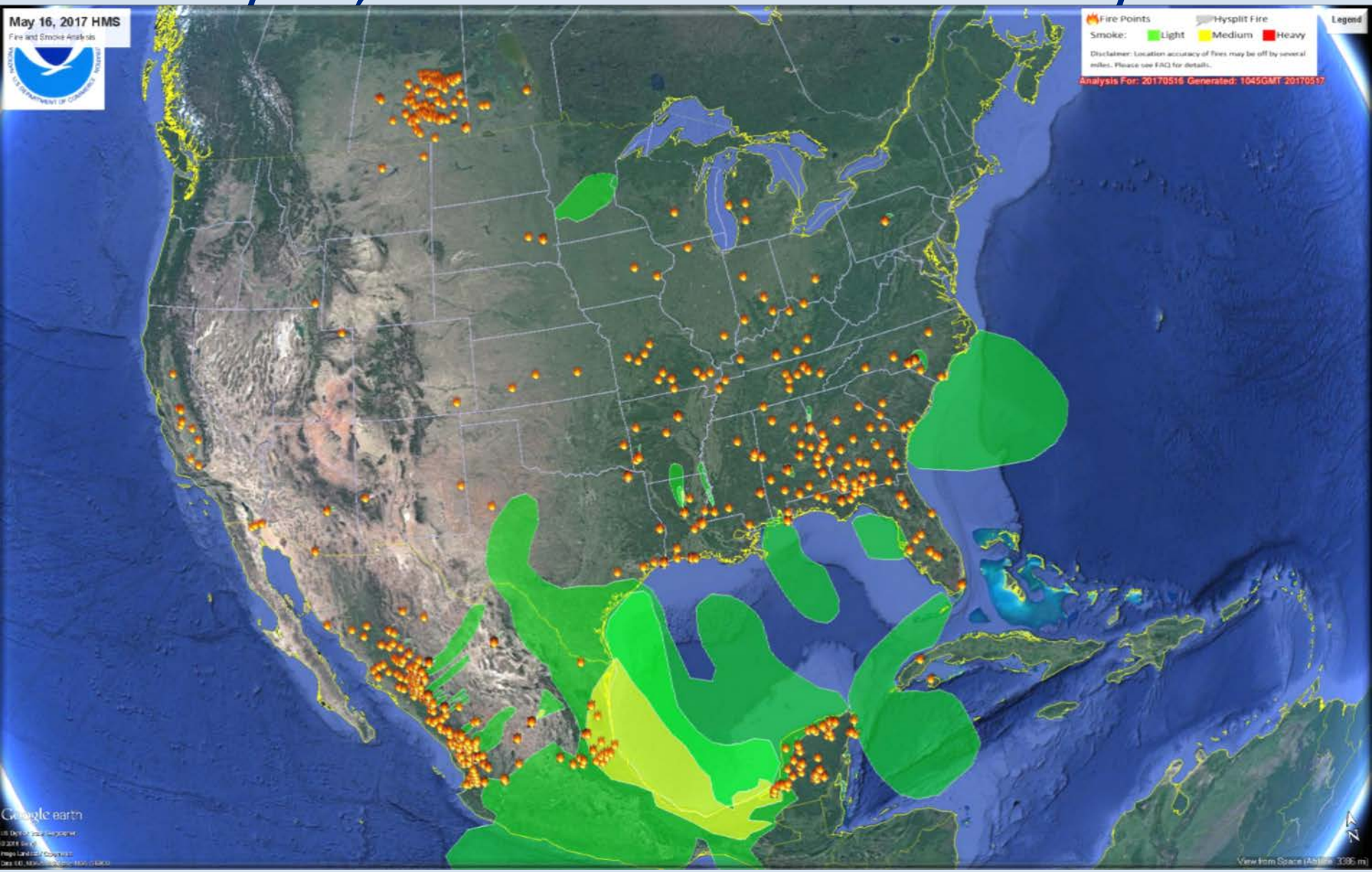


Possible Smoke Influence Analysis

- This was not an exceptional event, but there is evidence that residual smoke pollutants from the southern U.S. and Mexico may have ‘enhanced’ the ozone concentrations;

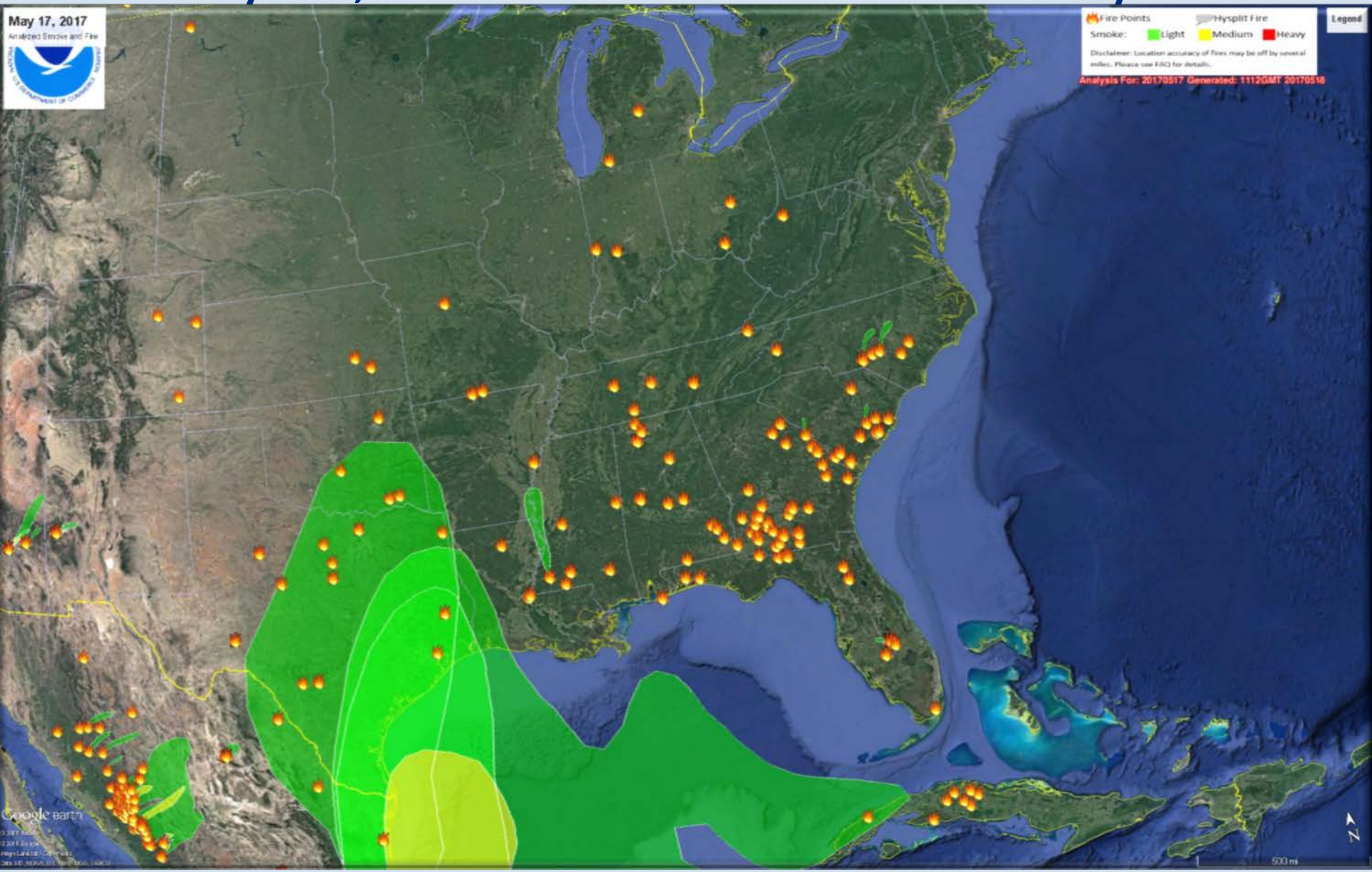
- Agricultural burning is common in these areas during the Spring and must be monitored by forecasters.

May 16, 2017 Smoke and Fire Analyses



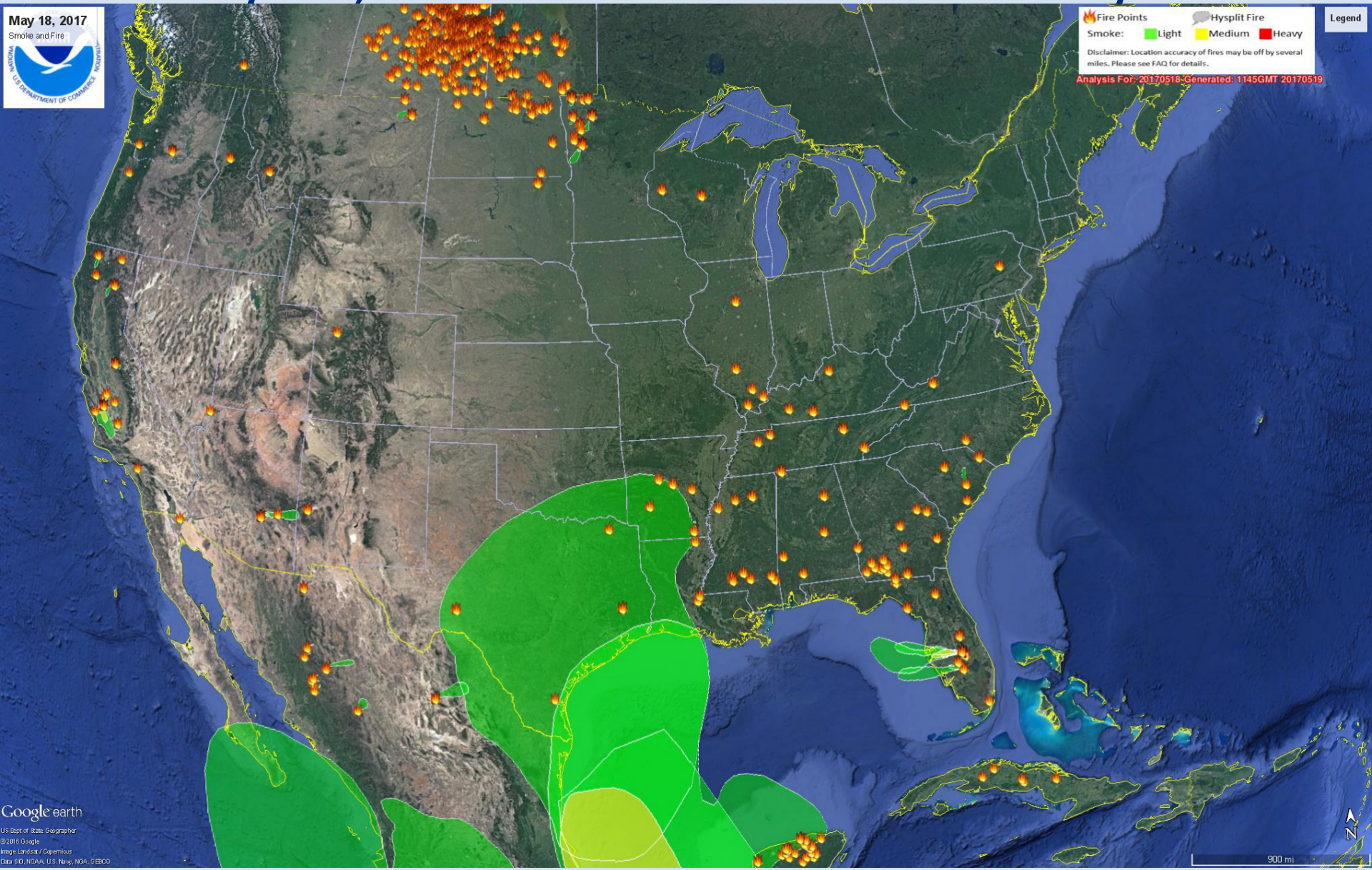
Agricultural burning from Central America and the southeast States was advecting smoke towards the Mid-Atlantic States and New England

May 17, 2017 Smoke and Fire Analyses



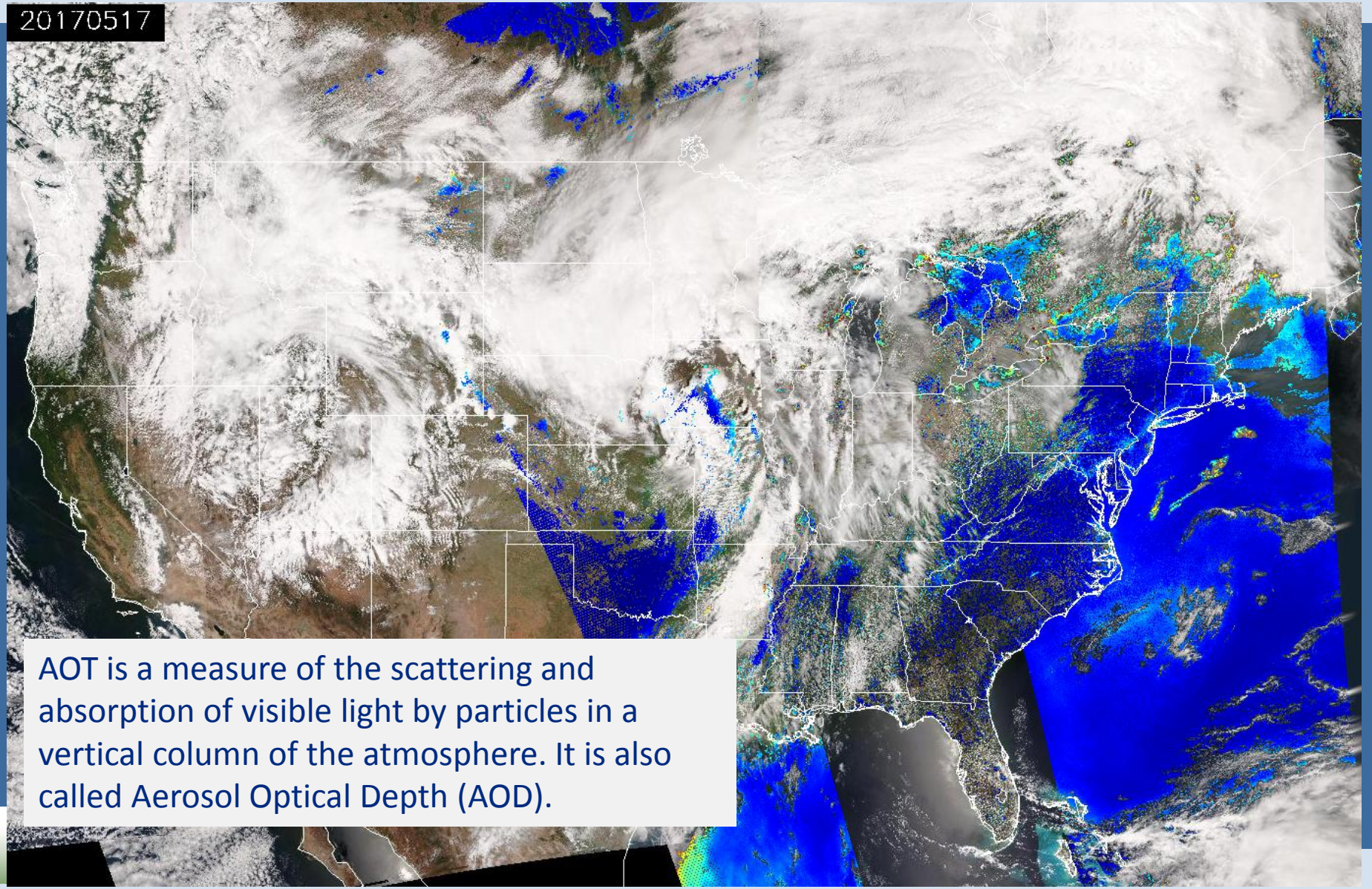
Agricultural burning from Central America and the southeast States was continuing to advect smoke towards the Mid-Atlantic States and New England during the May 17th ozone event, but was a diffuse plume.

May 18, 2017 Smoke and Fire Analyses



Agricultural burning from Central America and the southeast States continued to burn and advect smoke towards the Mid-Atlantic States and New England during the May 18th ozone event.

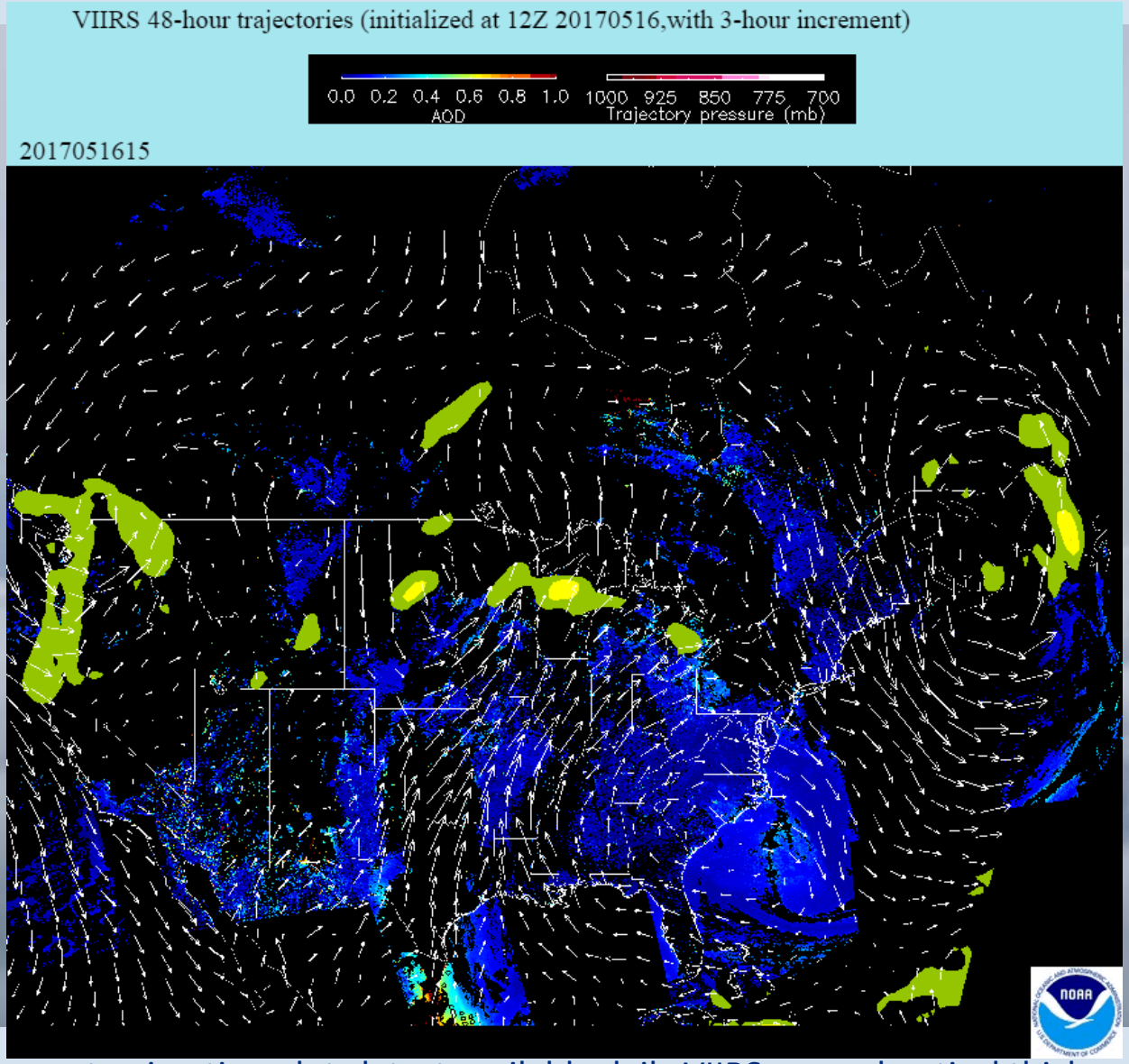
May 17, 2017 VIIRS AOT Image



AOT is a measure of the scattering and absorption of visible light by particles in a vertical column of the atmosphere. It is also called Aerosol Optical Depth (AOD).

Aerosol plume riding up the east coast is clearly visible, which likely increased the ozone levels monitored along the I-95 corridor during the May 17th ozone event.

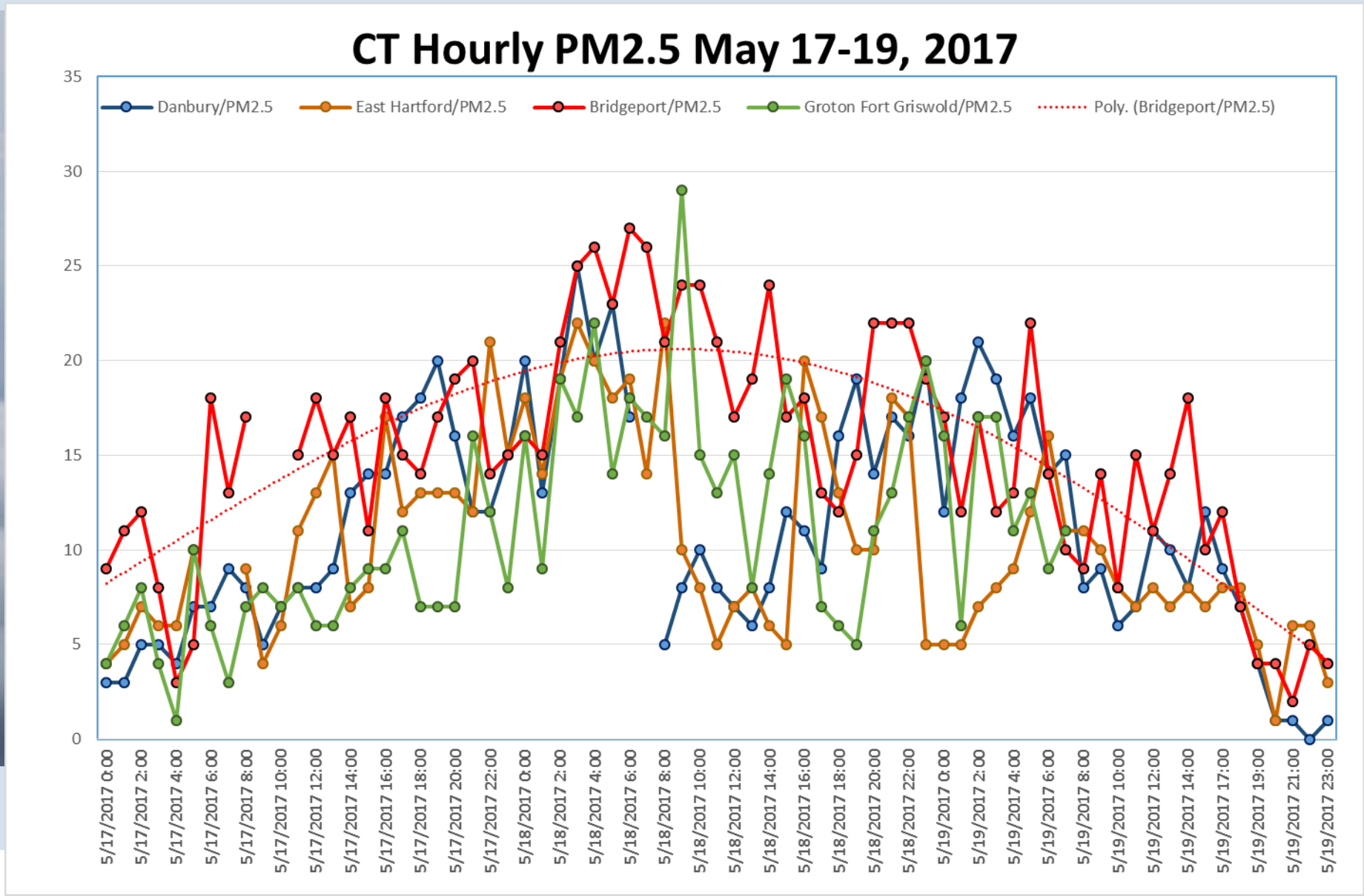
May 16-18, 2017 VIIRS AOT Image Animation



The trajectory forecast animation plots latest available daily VIIRS aerosol optical thickness AOT (in blue-red rainbow color), an animated ~48 hour air parcel trajectory forecast (in magenta-white colors), and the 3hr accumulated precipitation (in yellow).

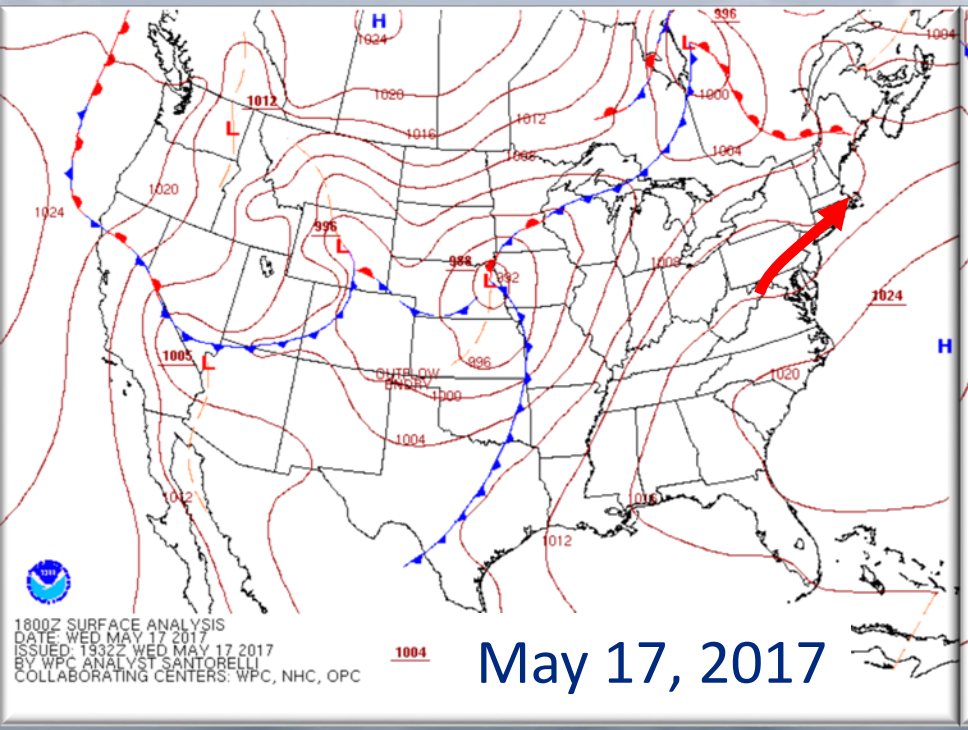
CT PM2.5 Monitors May 17-19, 2017

- Several hours over 20 µg/m^3 were recorded, especially at Bridgeport.

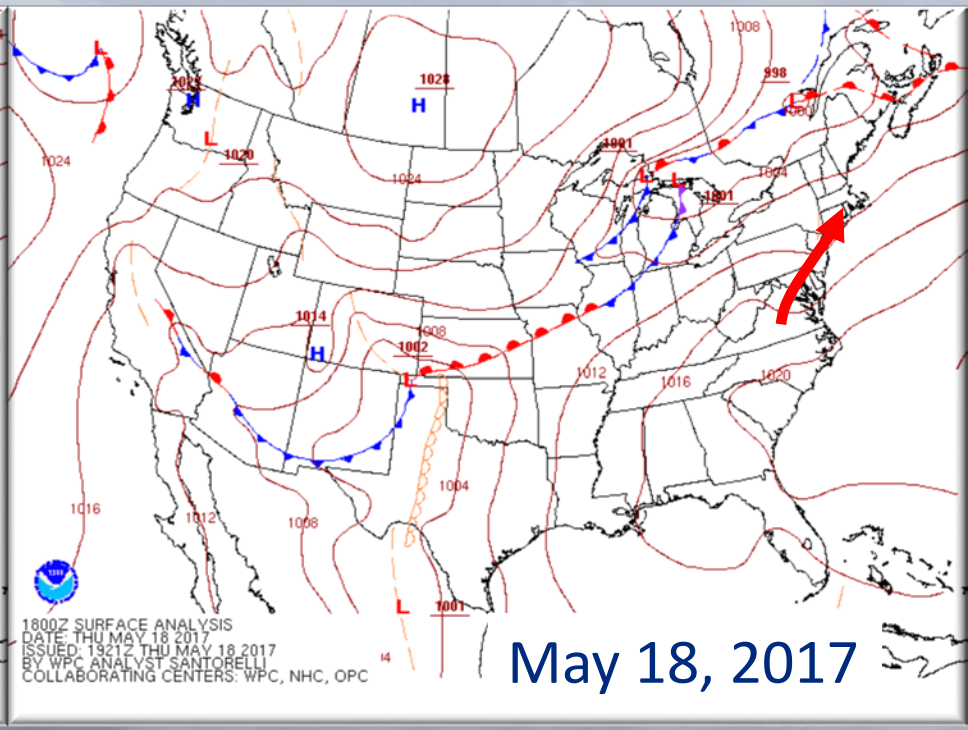


May 17-18, 2017 Surface Analysis

- High pressure moves over Bermuda, giving the east coast the set up for a classic northeast corridor ozone event.



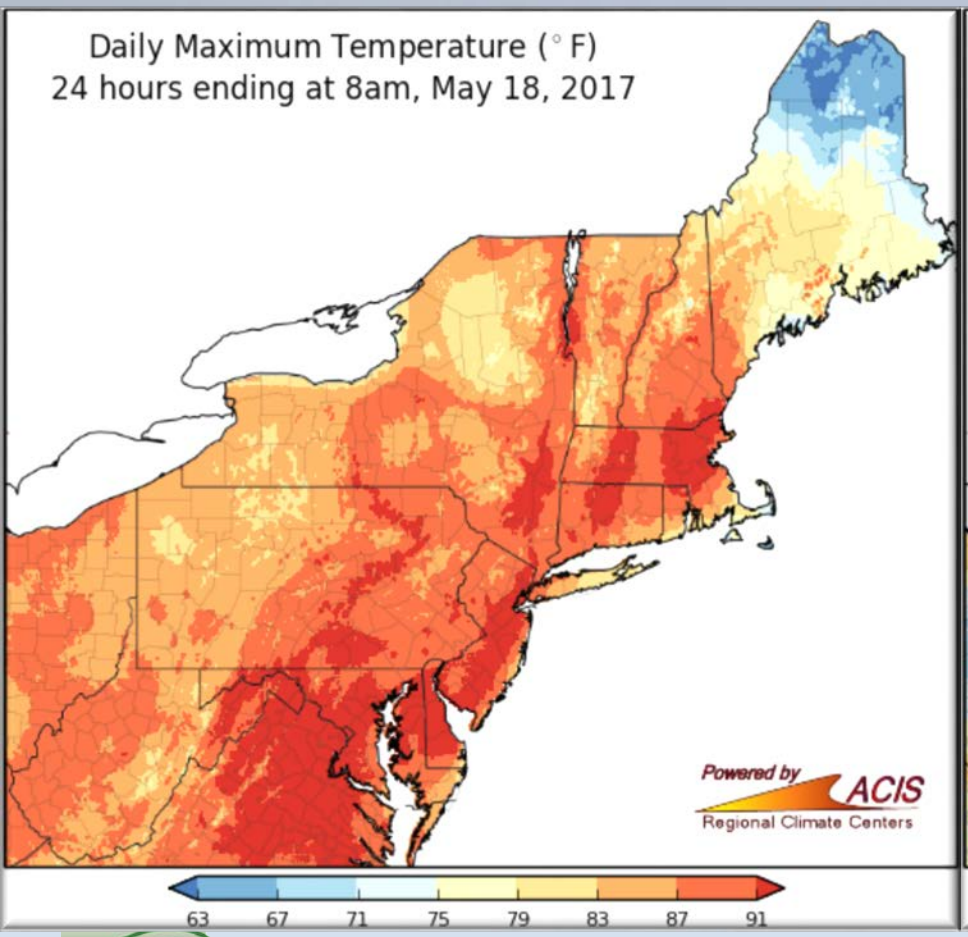
May 17, 2017

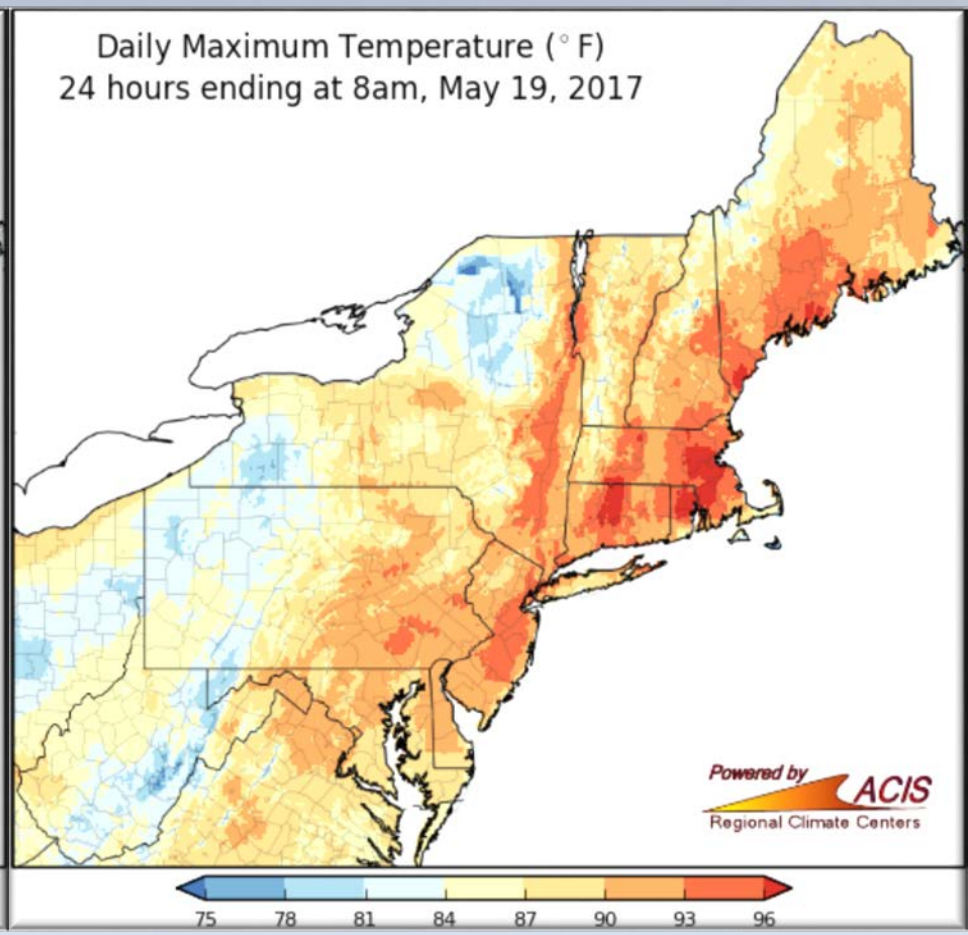


May 18, 2017

May 17-18, 2017, Maximum Temperatures

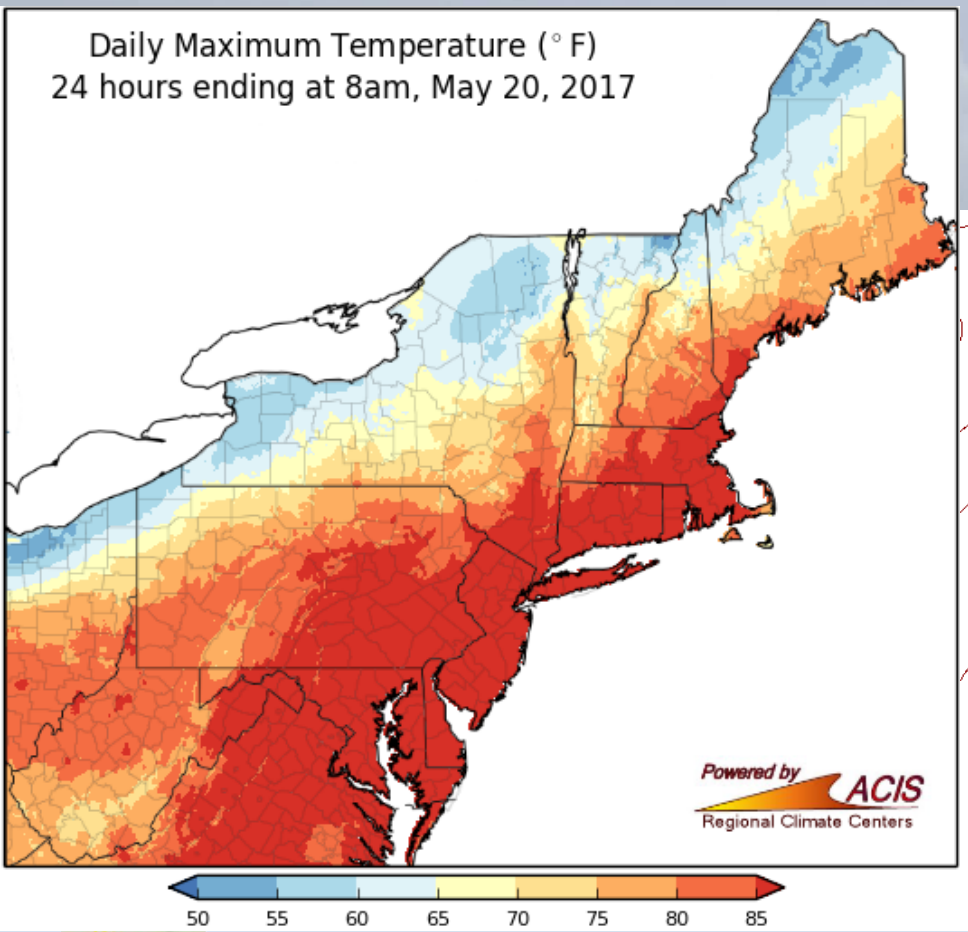
- Many areas experienced high temperatures of 90°+ on both days.

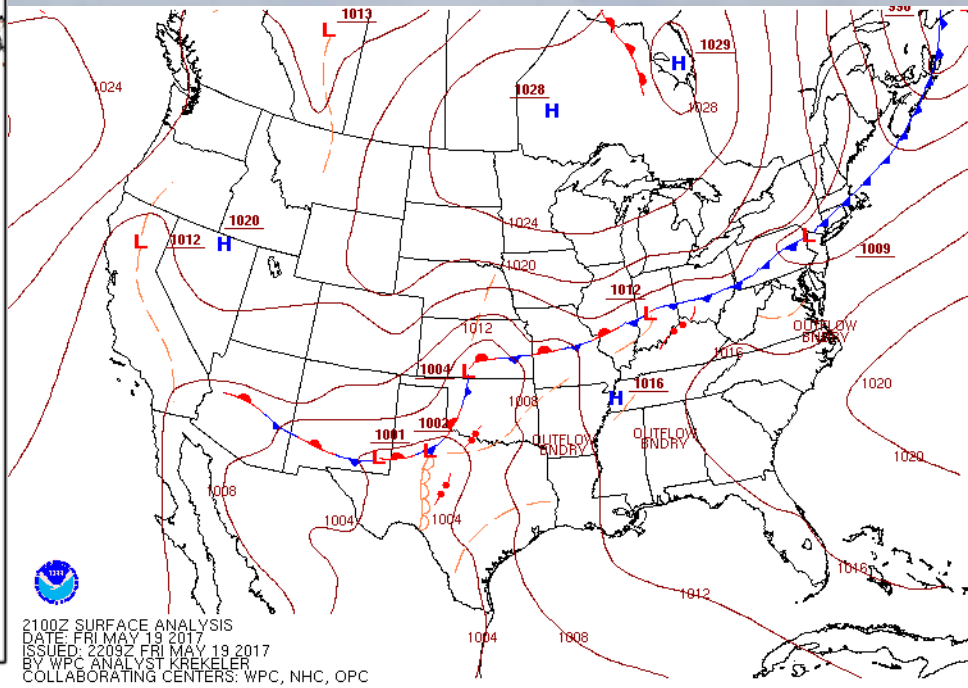




May 19, 2017, Maximum Temperatures

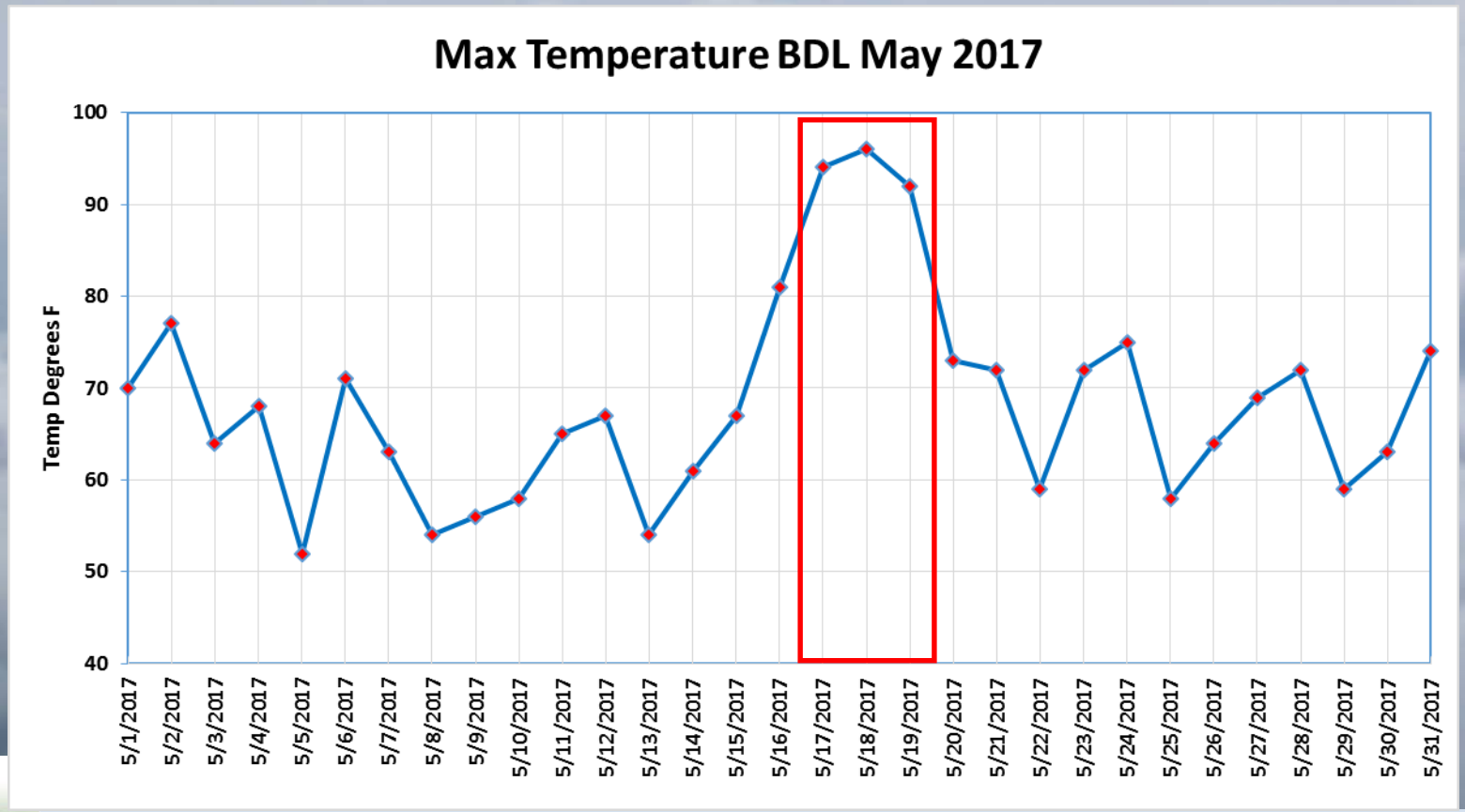
- Many areas experienced high temperatures of 90°+ for a third day as the cold front stalled along the coast until 21z.





May 2017, BDL Maximum Temperatures

- May 17-19, 2017 were the only hot days in Connecticut!



Long Island Sound AQ Field Study

- 3 flights over and along Long Island Sound
- 2-3 days of flying
- Option A: Flights on 3 consecutive days during ozone episode
- **Option B: Flights on 2 consecutive days, with 2 flights(am & pm) on one high-ozone day**
- VOC in-kind sample analysis by ME DEP
- Event analysis by Prof. Russ Dickerson, et al.,University of Maryland & NOAA
- First flights occurred on May 17-18th

Measured Parameters

Variable	*Method*
Position	GPS
Meteorology (T, RH, P, 2-D Wind)	Thermistor Hygristor, Capacitance Manometer, Garmin G600 system
Fast Greenhouse Gas Analyzer ($CH_4/CO_2/CO/H_2O$)	Cavity Ring Down Spectroscopy Picarro Model G2401-m
Ozone (O_3)	UV Absorption
Sulfur Dioxide (SO_2) (optional)	Pulsed Fluorescence
Nitrogen Dioxide (NO_2), Nitric Oxide (NO)	Cavity Ringdown, Los Gatos Chemiluminescence
VOCs	Grab Canisters/GC-FID
Aerosol Scattering, b_{scat} (450, 550, 700 nm)	Nephelometer
Aerosol Absorption, b_{abs} (565 nm)	Particle Soot Absorption Photometer (PSAP)
Black Carbon (370, 470, 520, 590, 660, 880, 950 nm)	Aethalometer

Long Island Sound AQ Field Study

Long Island Sound AQ Field Study Flight Paths

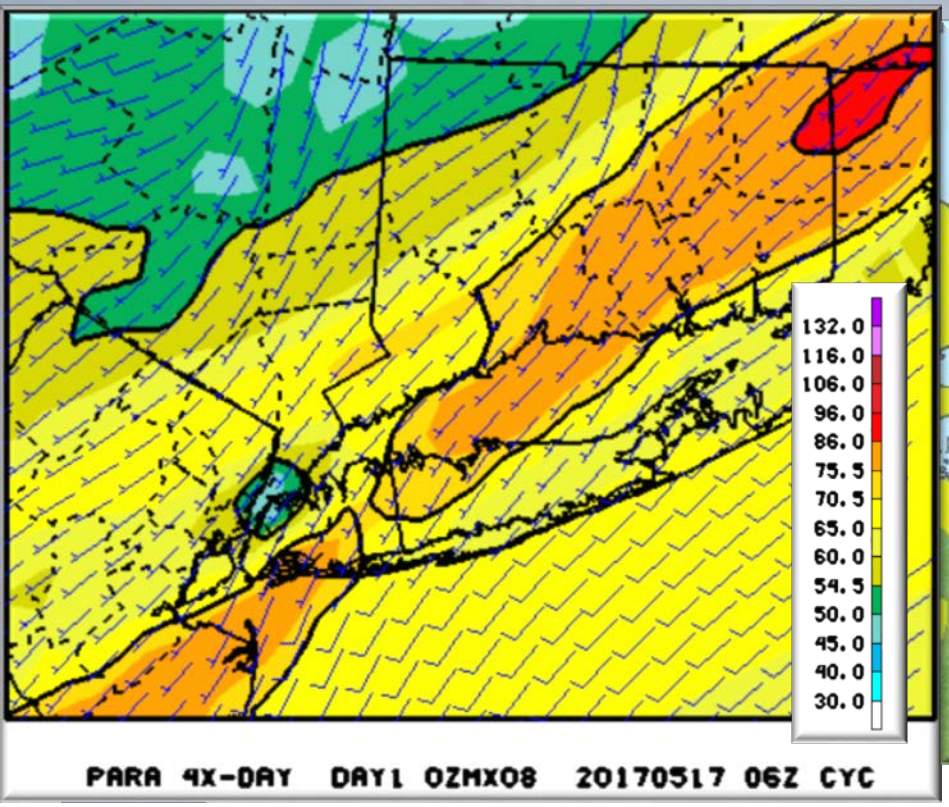
All flights originated from New Haven and headed west, completing at least one LIS and one inland vertical spiral sample.

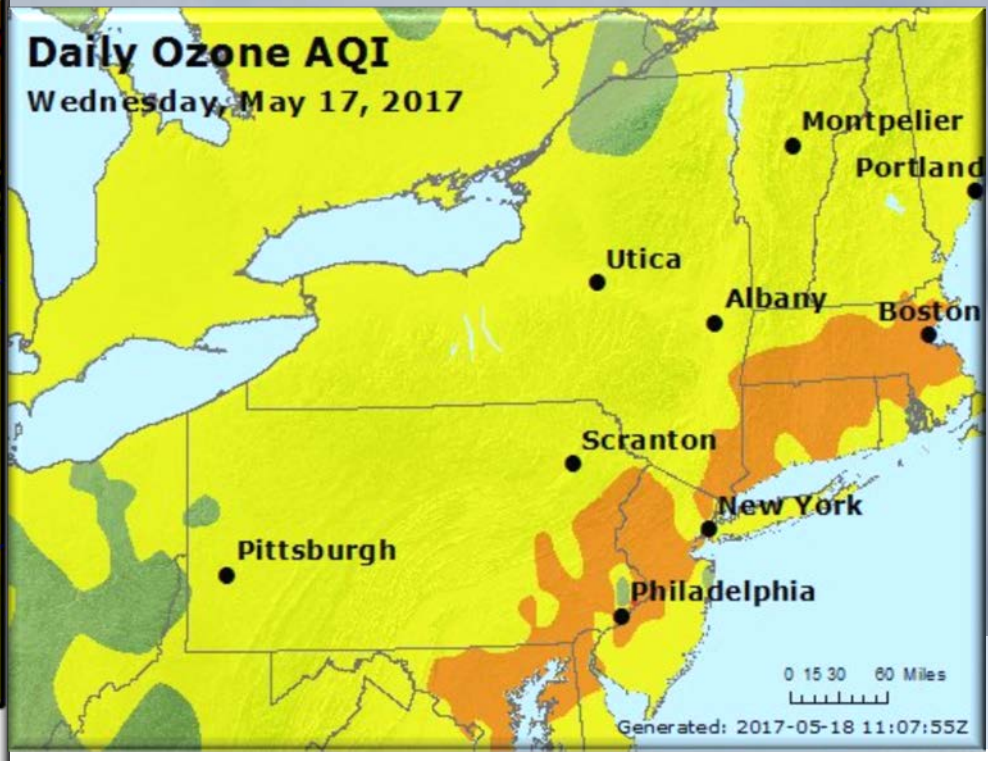
NOAA Model Performance

- Both the production (PROD) and parallel (PARA) performed well for the coastal sites, but generally under estimated the ozone at the inland locations;
- It is unclear whether a stronger sea breeze than modeled pushed the plume further inland or whether transported ozone within the above surface smoke plume mixed down.

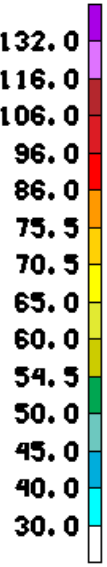
May 17, 2017 NOAA Model Performance

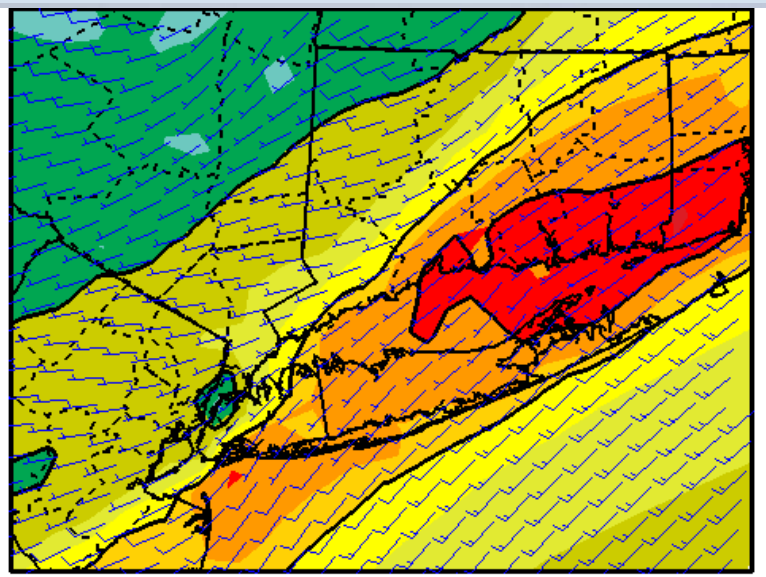
The same-day prediction showed a swath of USG with a sliver of ‘Unhealthy’ in far northeastern CT. The PARA model run is still experimental but due to become operational in June 2017.



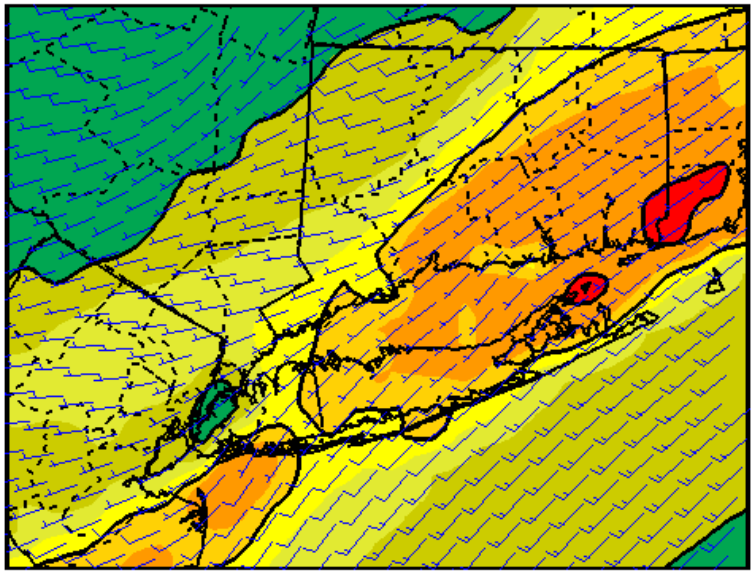


May 18, 2017 NOAA Model Performance

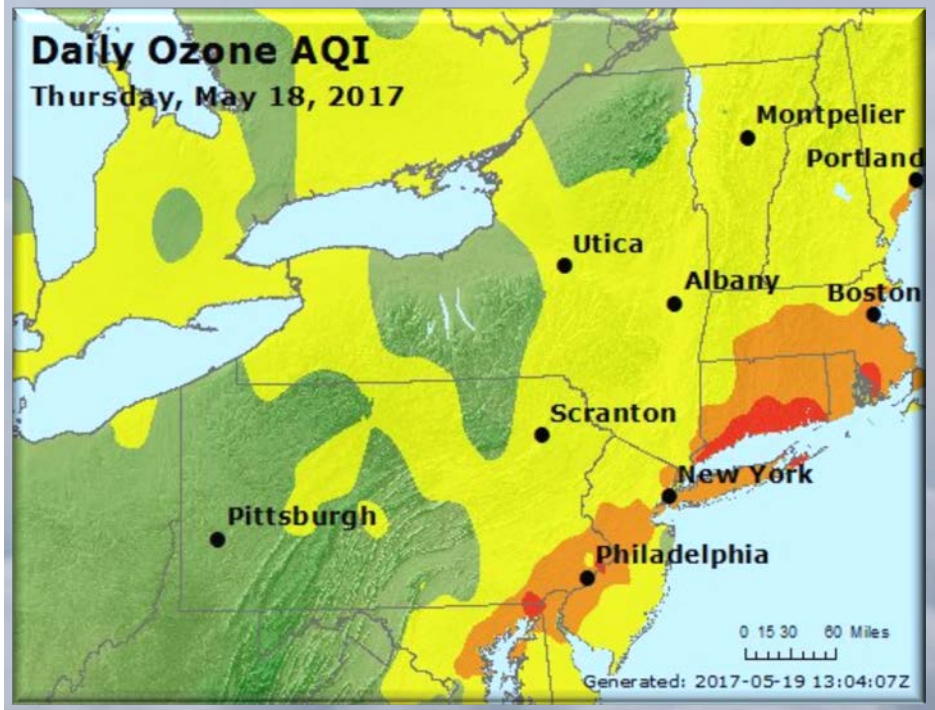




PARA 4X-DAY DAY1 OZMX08 20170518 06Z CYC

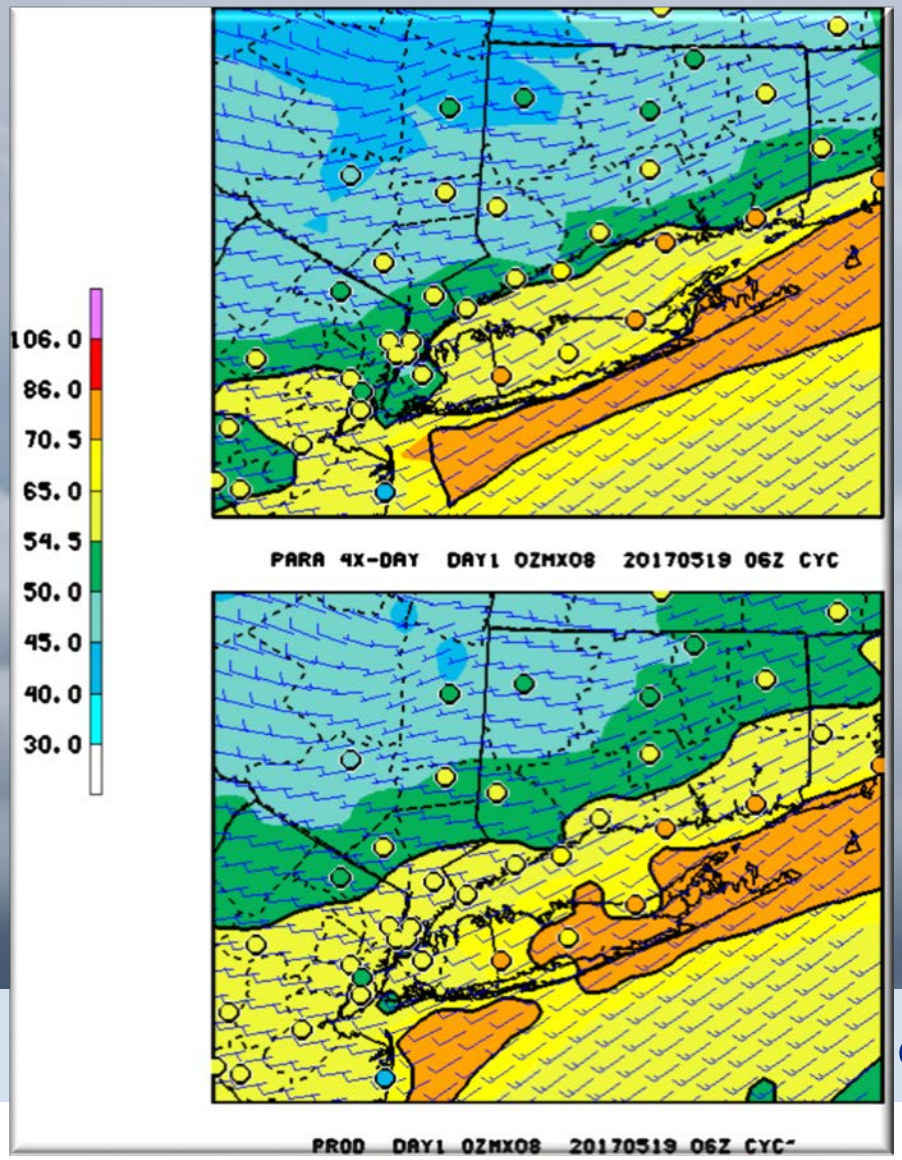


PROD DAY1 OZMX08 20170518 06Z CYC

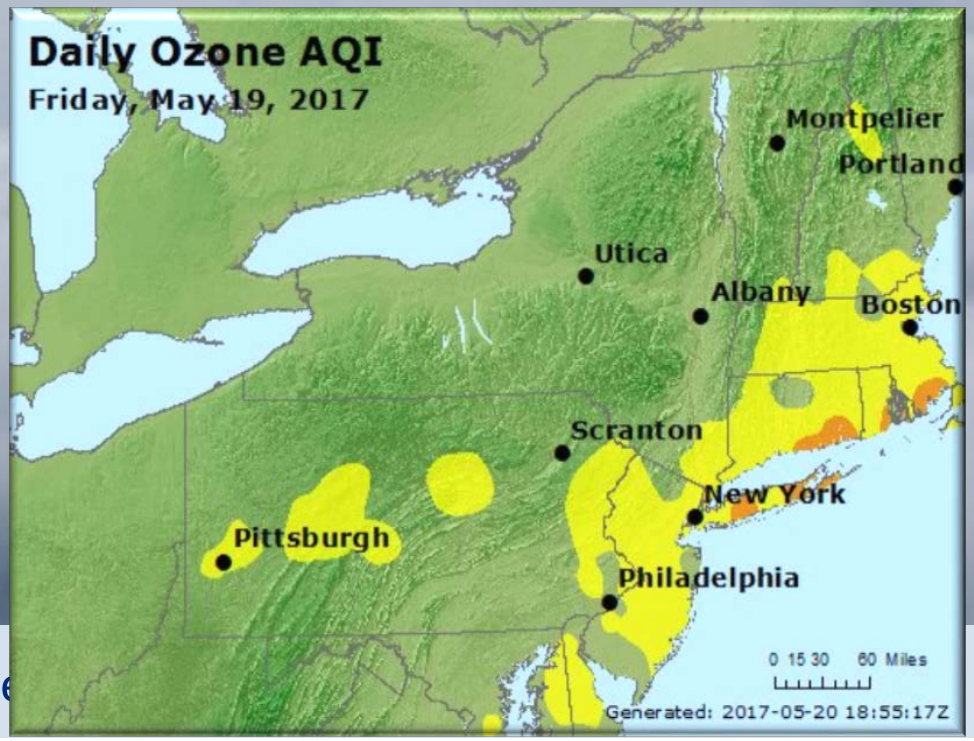


Both of the same-day 06z NOAA models predicted high USG levels and 'Unhealthy' levels for Connecticut. The PARA model run more accurately predicted the unhealthy areas.

May 19, 2017 NOAA Model Performance



Both of the same-day 06z NOAA models predicted moderate levels for coastal Connecticut. The cold front did not clear the coast until 8:00pm.



Conclusions

- 1st ozone event of the season was driven by the Bermuda High circulation over the I-95 corridor;
- Ozone levels were somewhat higher than modeled, possibly due to enhancement from smoke;
- NOAA ozone models provided excellent guidance and CT forecasters correctly forecasted exceedances on May 17-18;
- LIS AQ flights had 2 good sample days and will help to characterize ozone production over LIS.

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