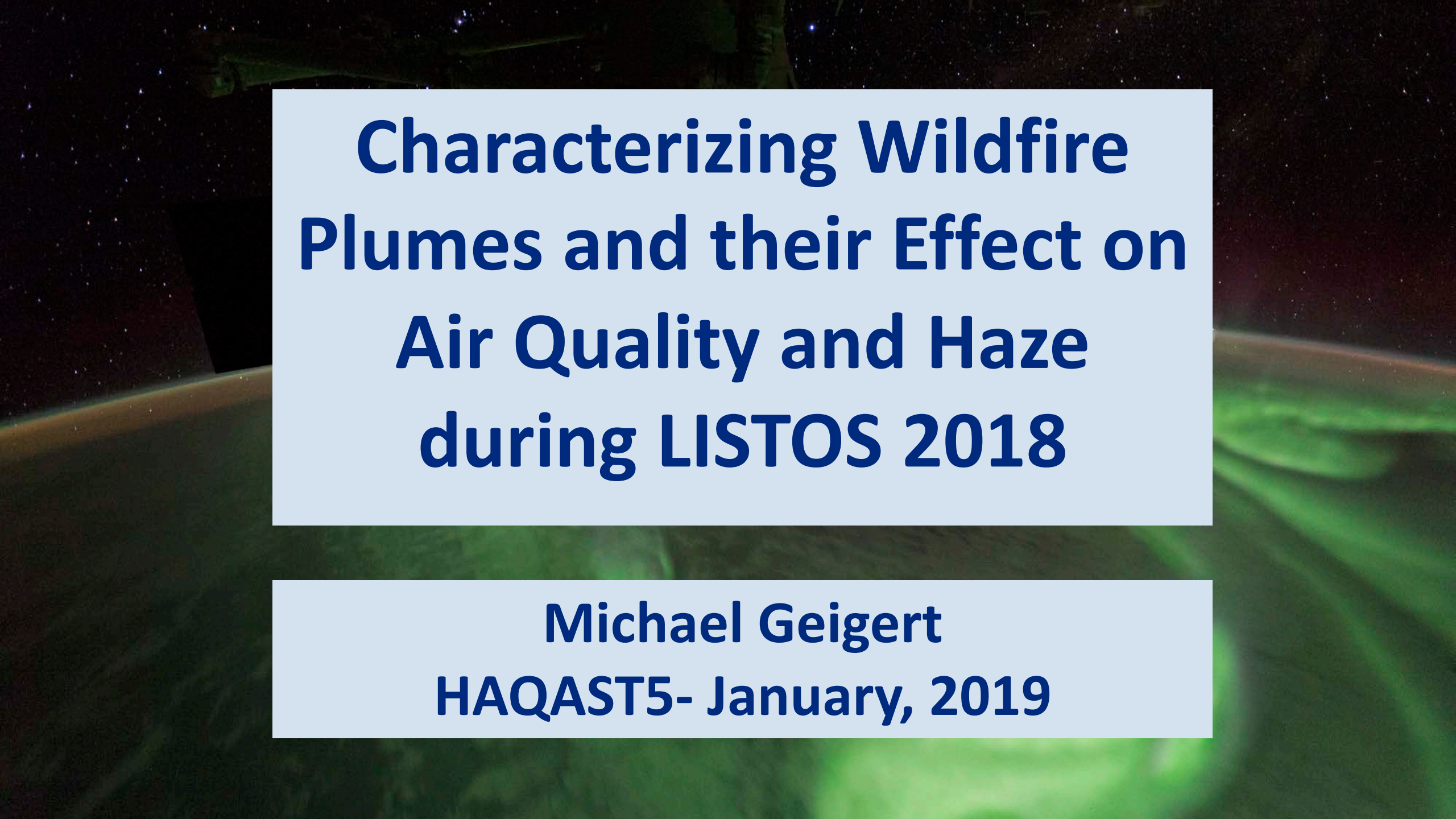




Connecticut Department of Energy and Environmental Protection





Characterizing Wildfire Plumes and their Effect on Air Quality and Haze during LISTOS 2018

**Michael Geigert
HAQAST5- January, 2019**

Introduction

In order to better characterize the ozone events around LIS during the summer of 2018, a group of researchers and State Agencies collaborated on a study called **LISTOS** – Long Island Sound Tropospheric Ozone Study. This included:

- NASA GeoTASO/GCAS flights and UMD Cessna flights;
- Pandora instrument measurements;
- Vertical ozone profiles from ozonesondes;
- Wind profiler and ozone/aerosol LIDAR images;
- NO₂ Tropospheric column measurements from TROPOMI;
- Ozone LIDAR time series.

Various Research Studies Over Long Island Sound 2018

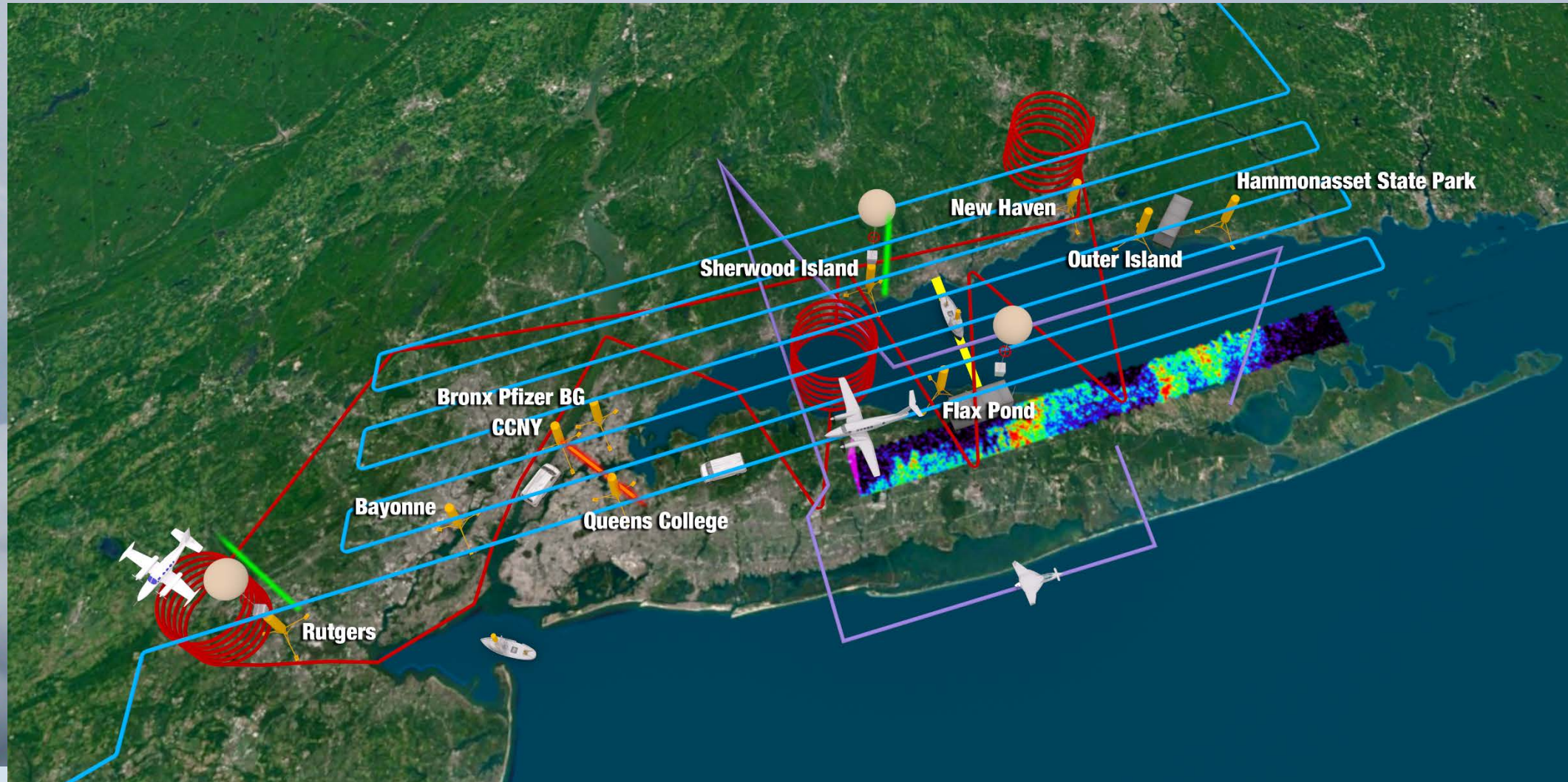
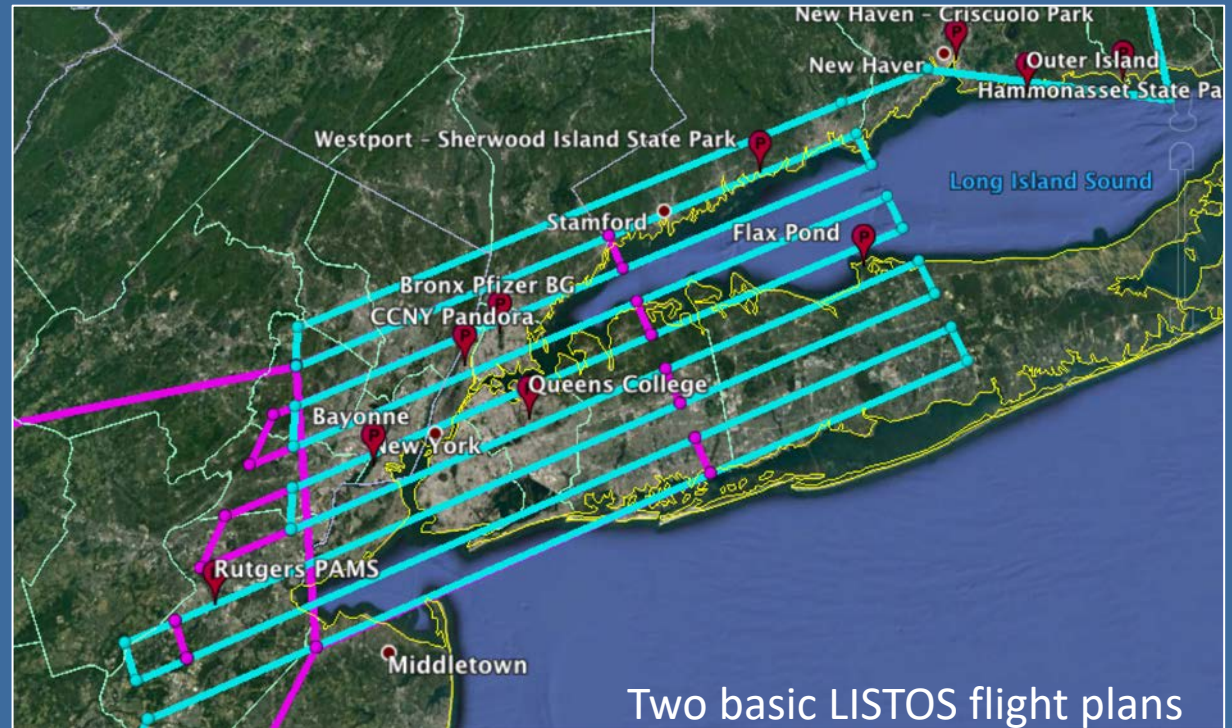
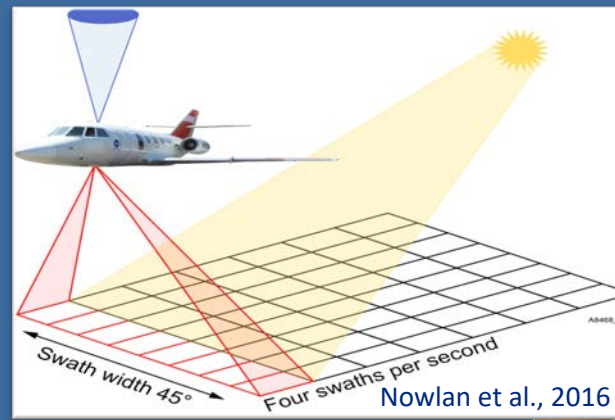


Image courtesy of [NASA LARC -LISTOS– Long Island Sound Tropospheric Ozone Study 2018 Website](#)

GeoTASO/GCAS

- Geostationary Trace gas and Aerosol Sensor Optimization/ GEO-CAPE Airborne Simulator
- Hyperspectral mapping instruments utilized as a testbed for geostationary air quality retrievals
 - e.g. TEMPO
- Retrieving **NO₂** relative to an unpolluted reference spectrum via DOAS in the spectral window of 435-460nm
 - **Differential Slant Column (DSC)** of ~ 250 x 250 m pixels
 - Capabilities of retrieving other trace gases like HCHO
- Fly parallel flight lines spaced for gapless mapping of our area of interest (creating a raster map)
- Two goals: emissions sampling and ozone event sampling

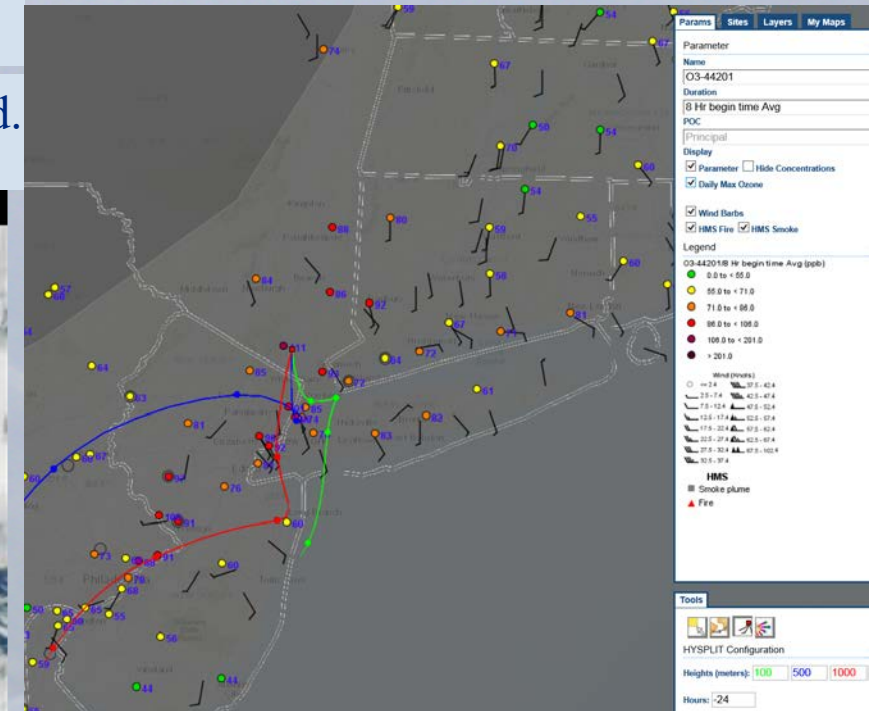


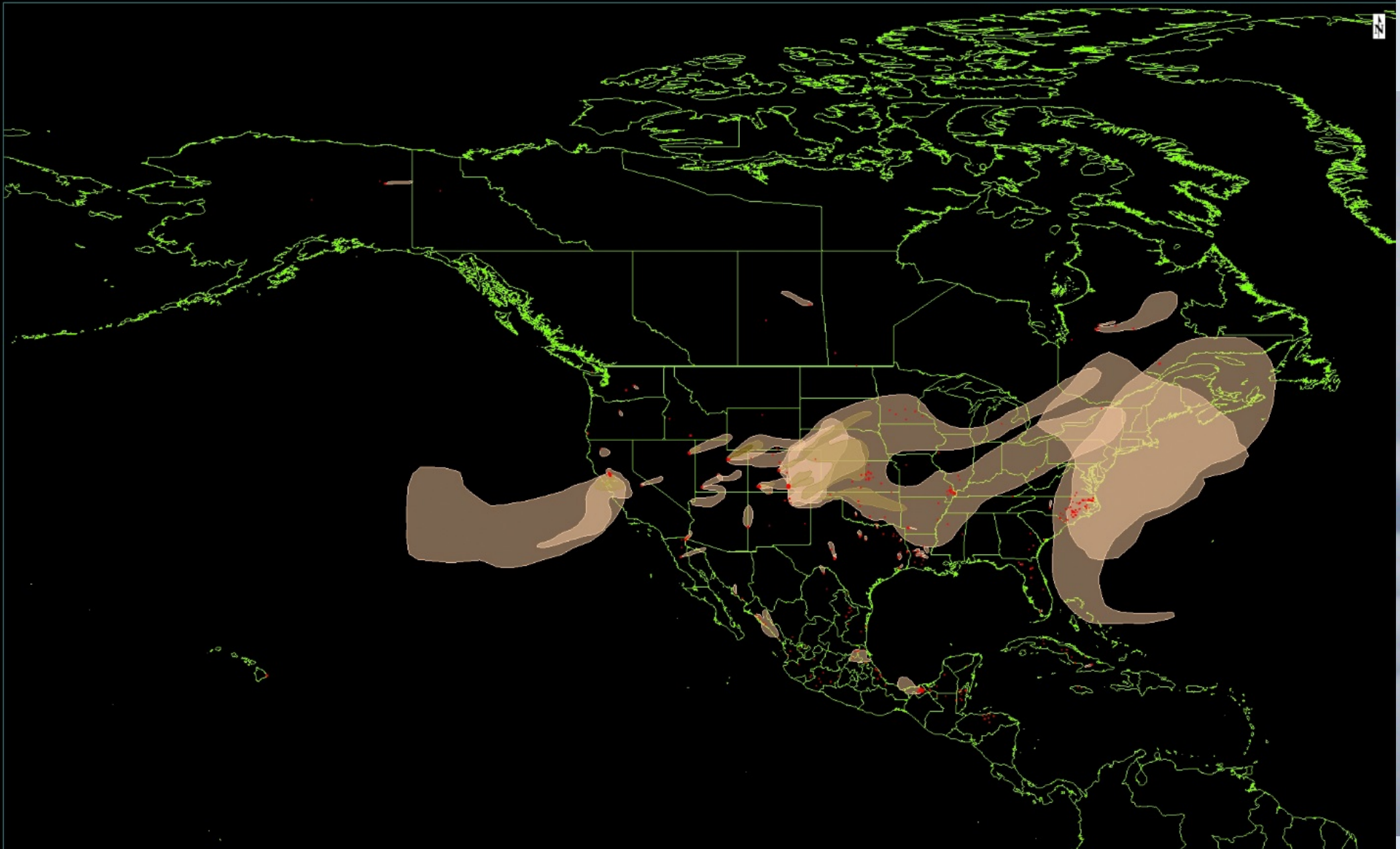
Frequent Wildfire Smoke Plumes in 2018

- 2018 started off with the usual spring agricultural burning in Mexico and the southeast States and Mississippi Valley;
- Major fires occurred in the U.S. mountain west and Canada during May and June that brought smoke plumes to the east coast.
- Extreme fires began in July in the western States and British Columbia that lasted until September. These produced thick plumes and extreme PM2.5 levels near the fires and then traveled eastward and enhanced ozone levels along the east coast.
- Smoke plume PM2.5 and ozone enhancement may have occurred on these days:
 - May 25-26;
 - July 2, 20;
 - August 7-8, 16, 27-28.

July 2, 2018 Ozone/ Smoke Event

The GOES-16 animation shows smoke over eastern New England circulating westward.





HMS Smoke Plume Animation June 30- July 2, 2018

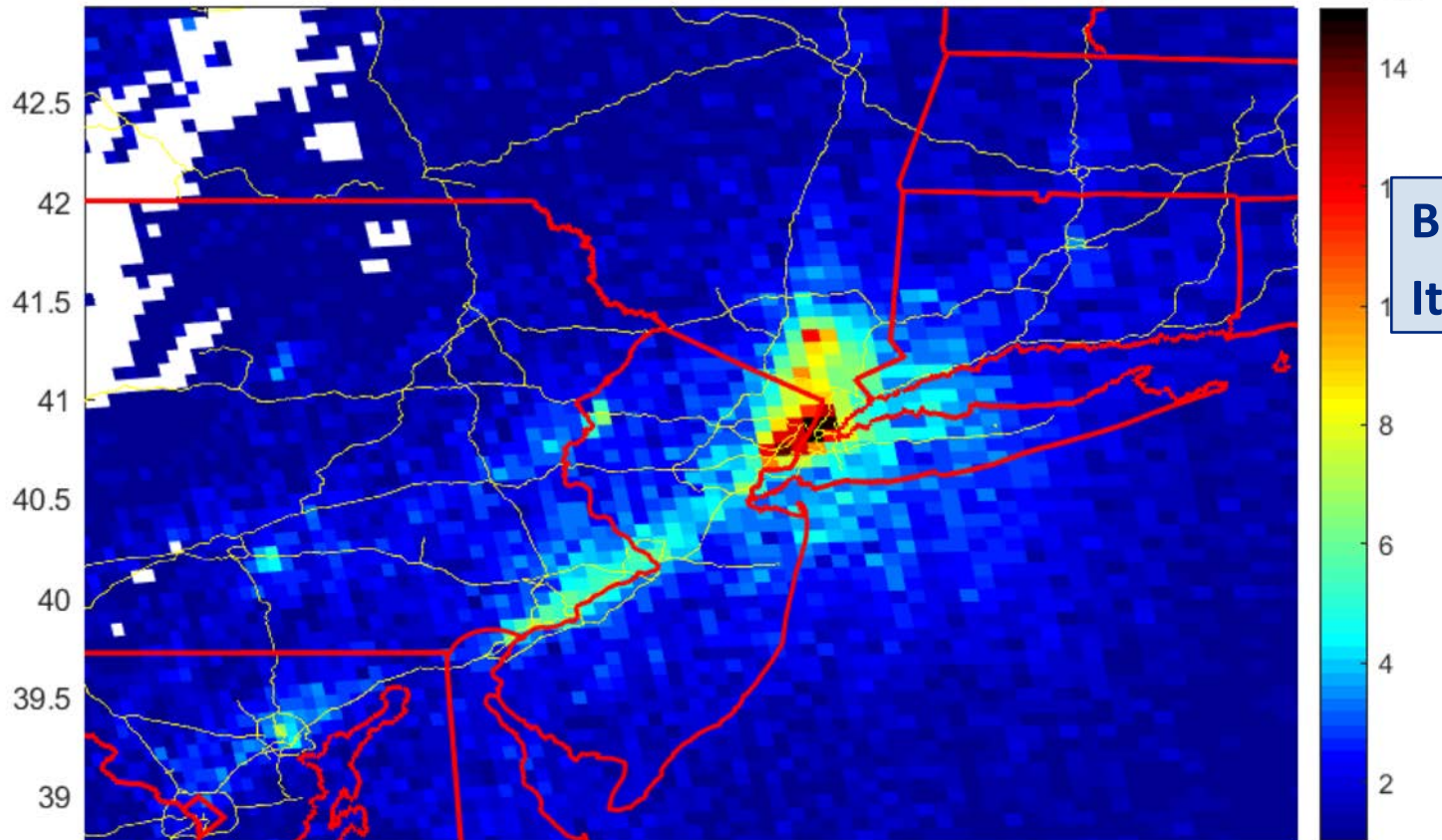


Analysis Day: 20180702
Map Generated: 1116 GMT 20180703

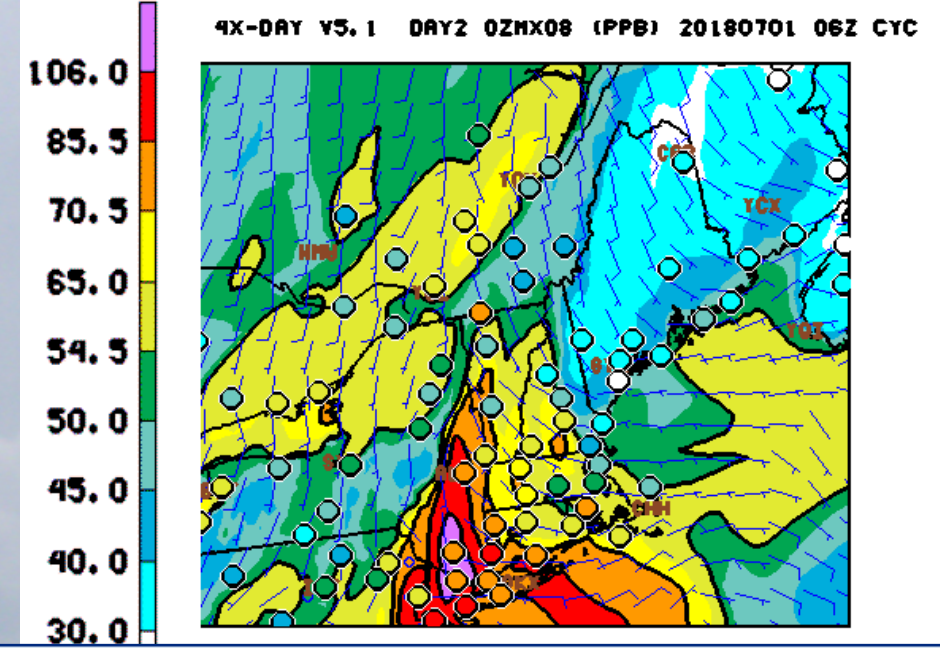
July 2, 2018 TROPOMI NO2

The NOAA PROD Ozone CMAQ model performed well on this day as easterly winds drove the NO2/ozone plume back over NYC. Rockland County NY recorded the highest ozone level.

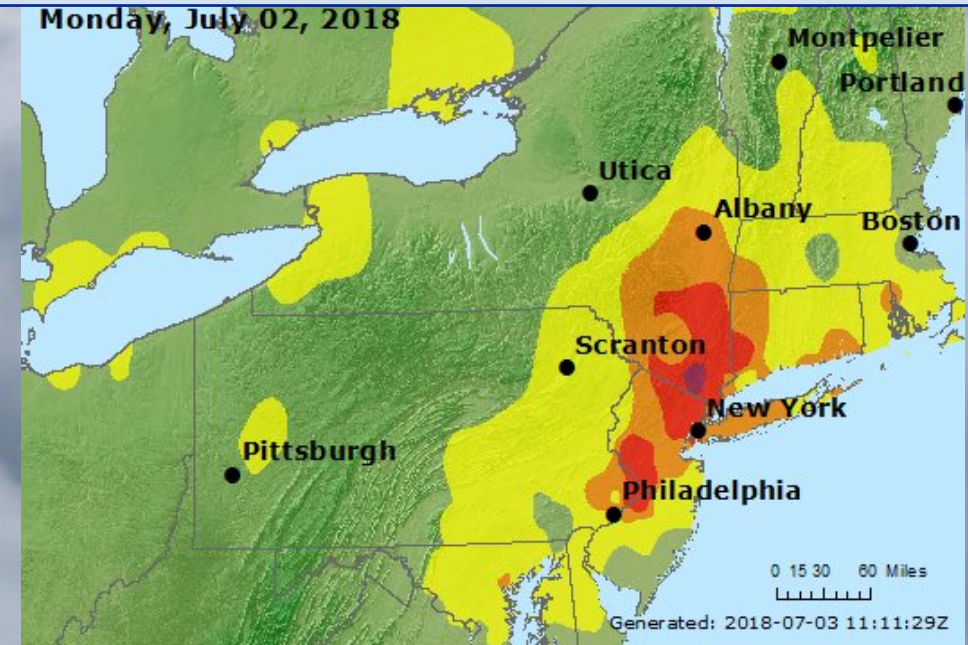
Tropomi NO2 July 2, 2018



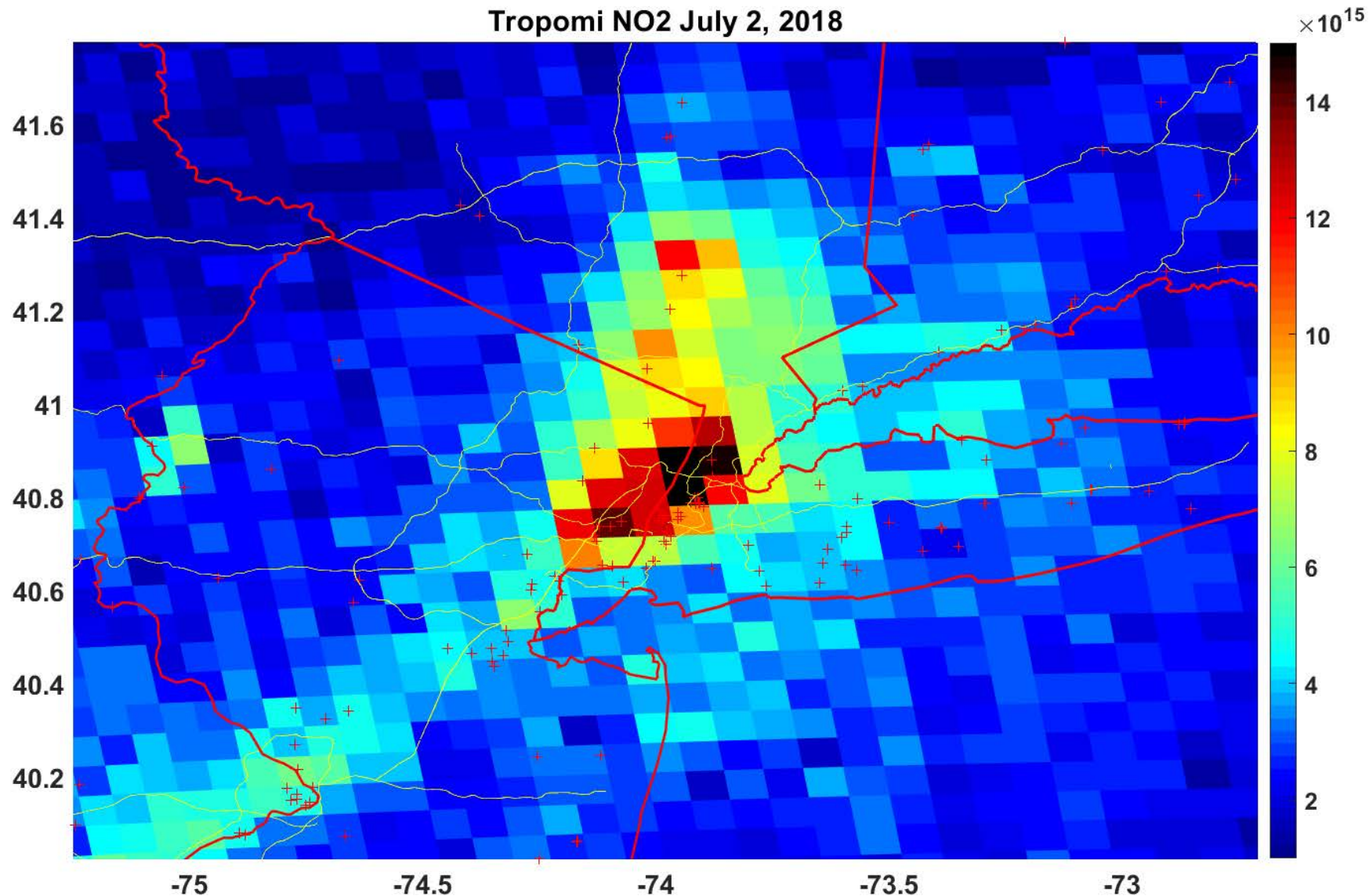
What is striking in the Tropomi NO2 images are the relative lack of NO2 emissions around the other major metropolitan areas along the I-95 corridor!



But... Was the model right for the wrong reasons?
It is known to over-estimate around LIS!



July 2, 2018 Tropomi Close-up with 2016 eGRID Sources

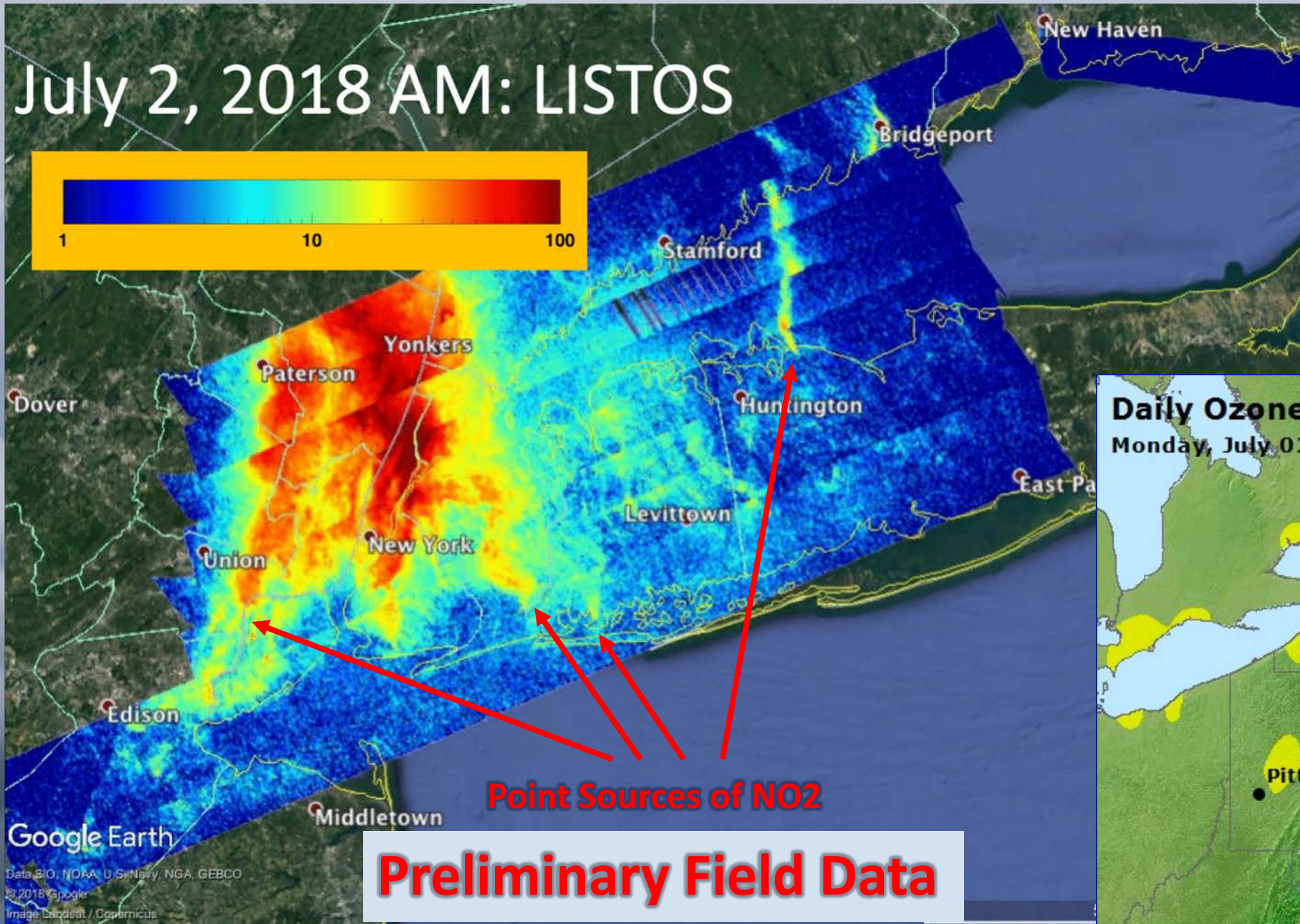
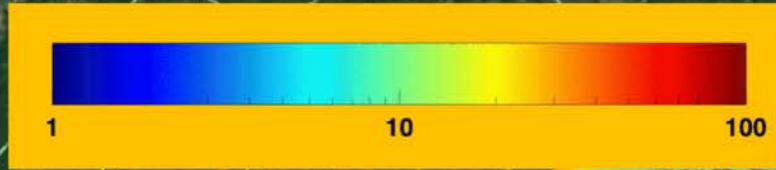


TROPOMI:
7 km x 3km
grid
resolution

July 2, 2018 GCAS NO2

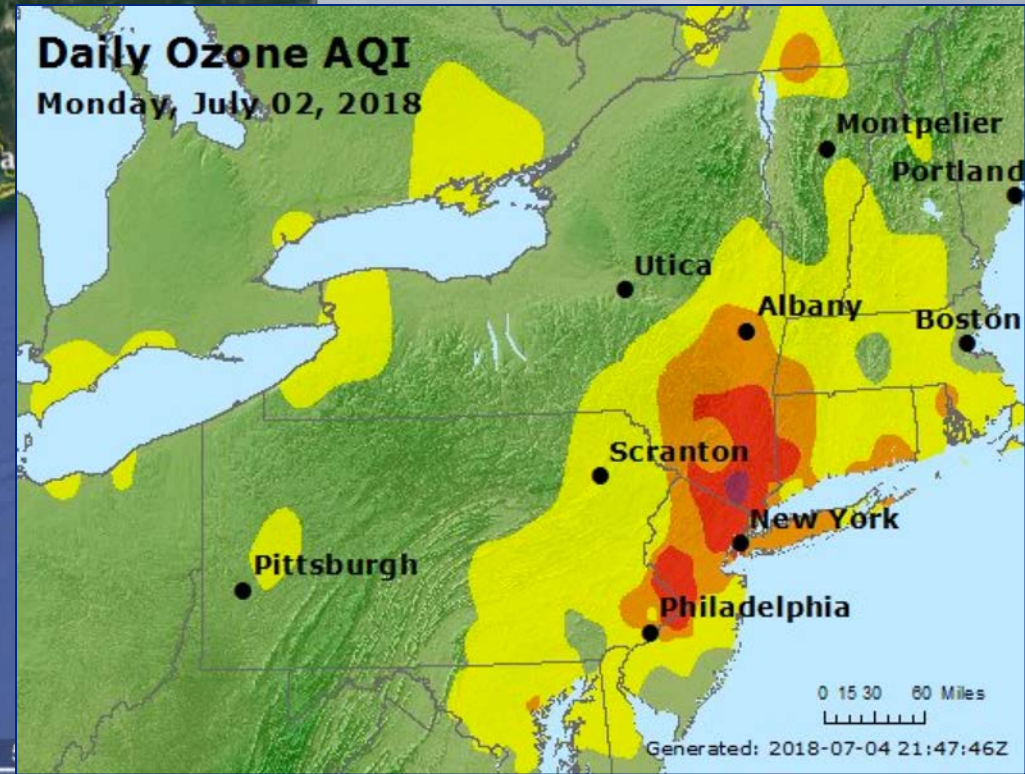
**Differential Slant
Column (DSC) of ~
250 x 250 m pixels**

July 2, 2018 AM: LISTOS

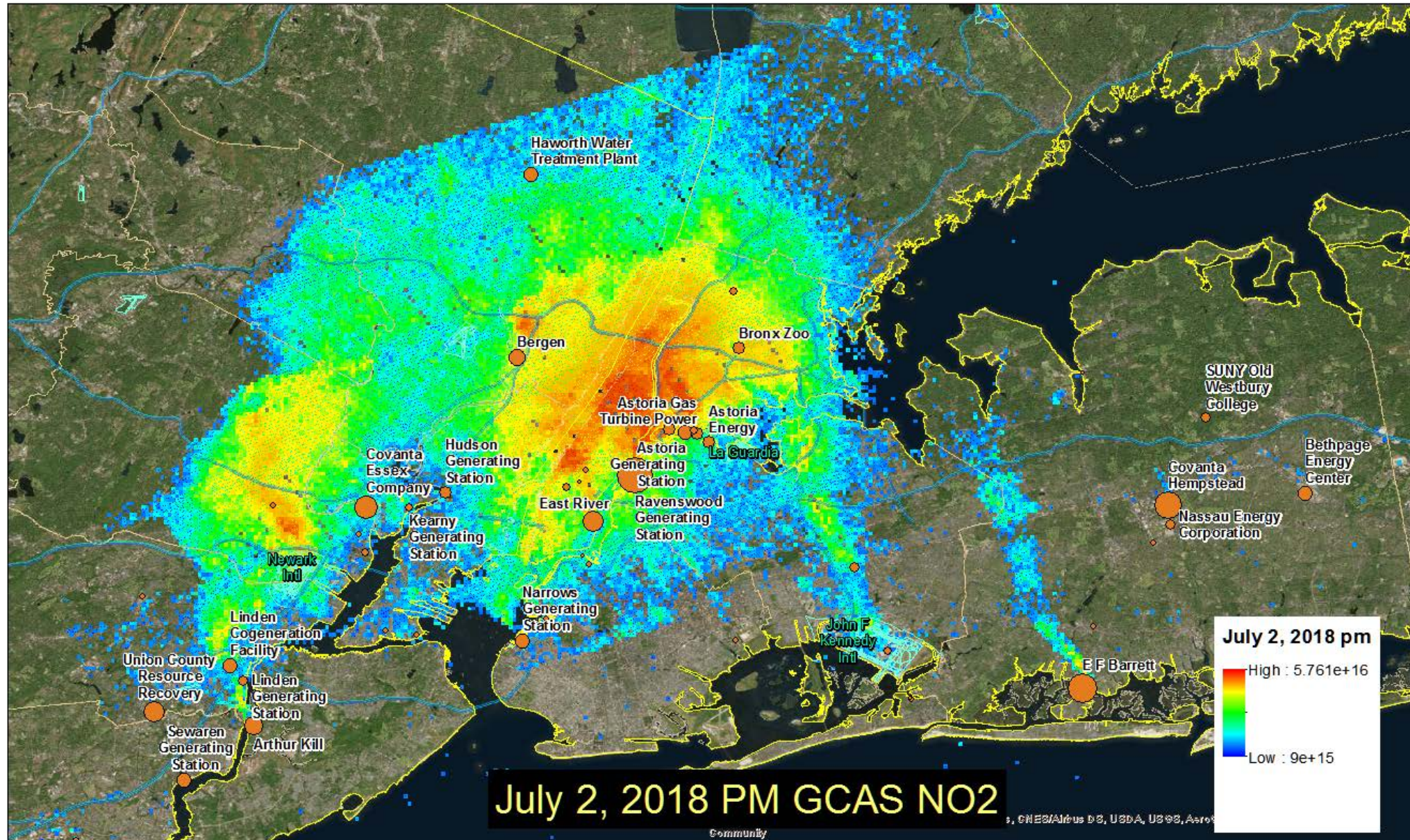


Point Sources of NO2

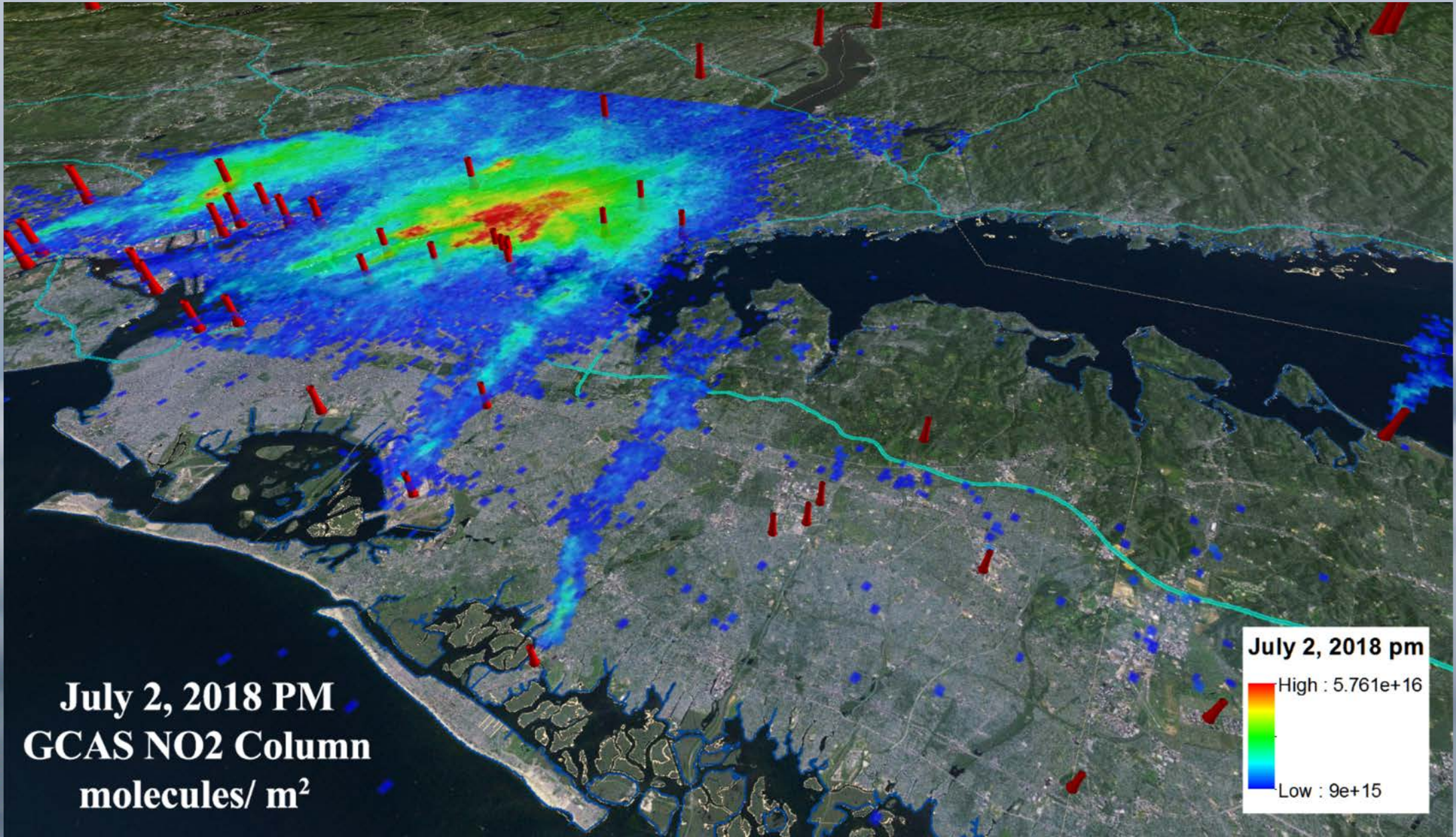
Preliminary Field Data



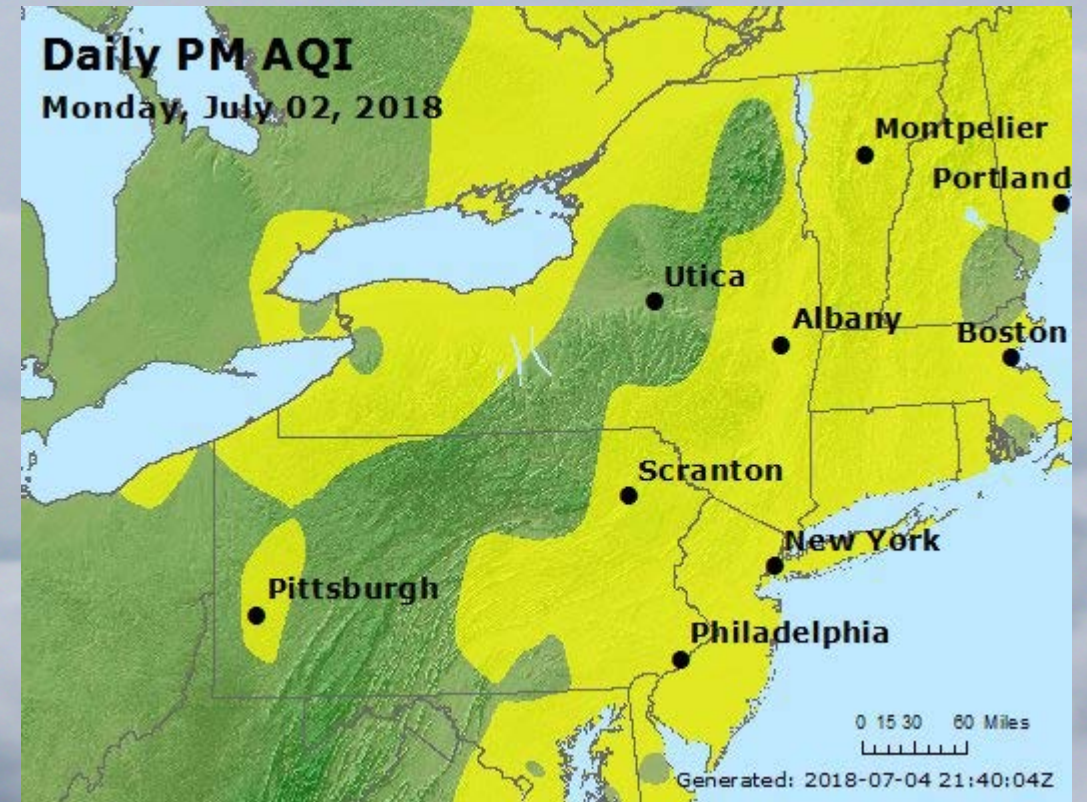
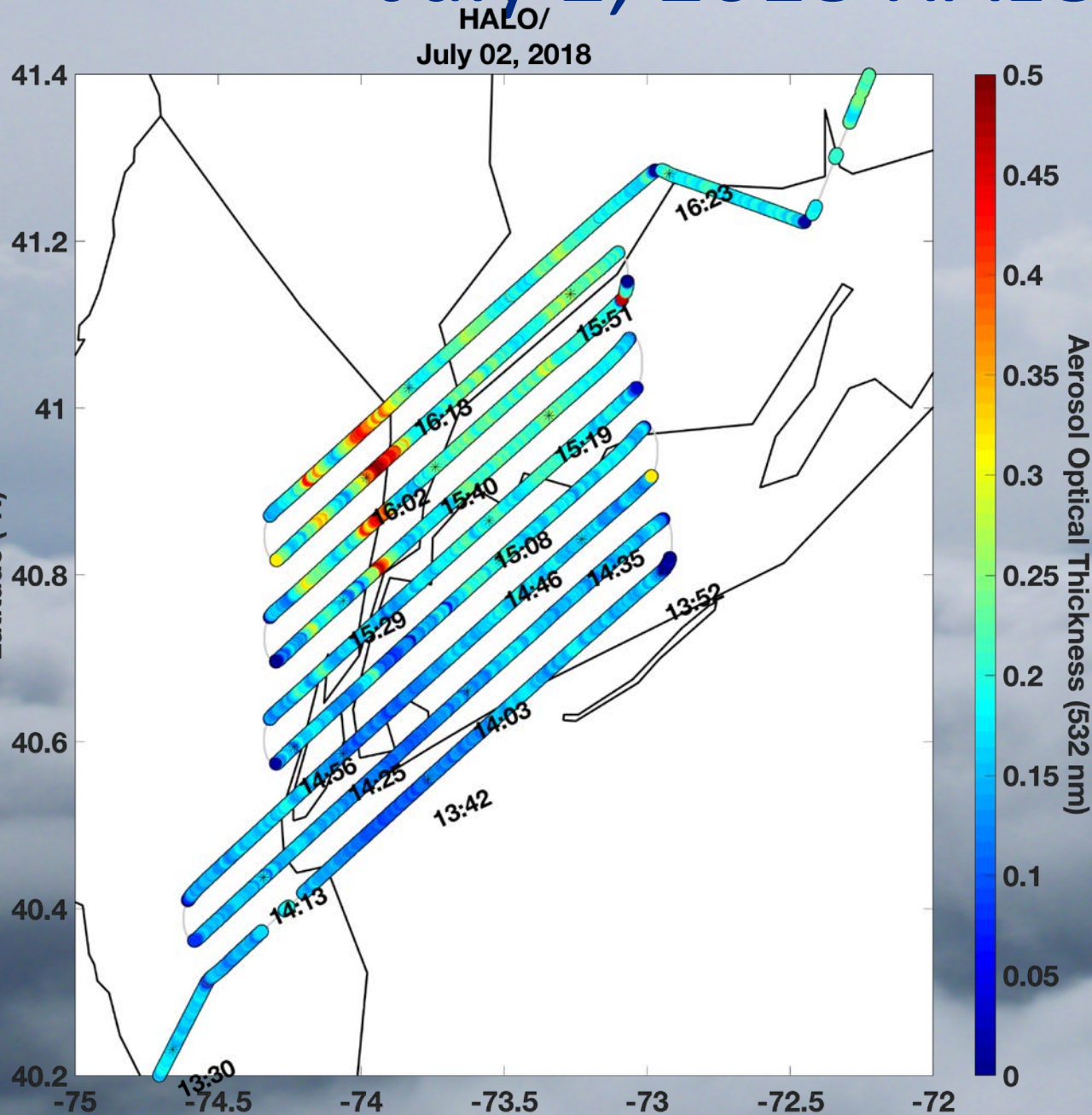
July 2, 2018 (PM) GCAS NO2



July 2, 2018 (PM) GCAS NO2



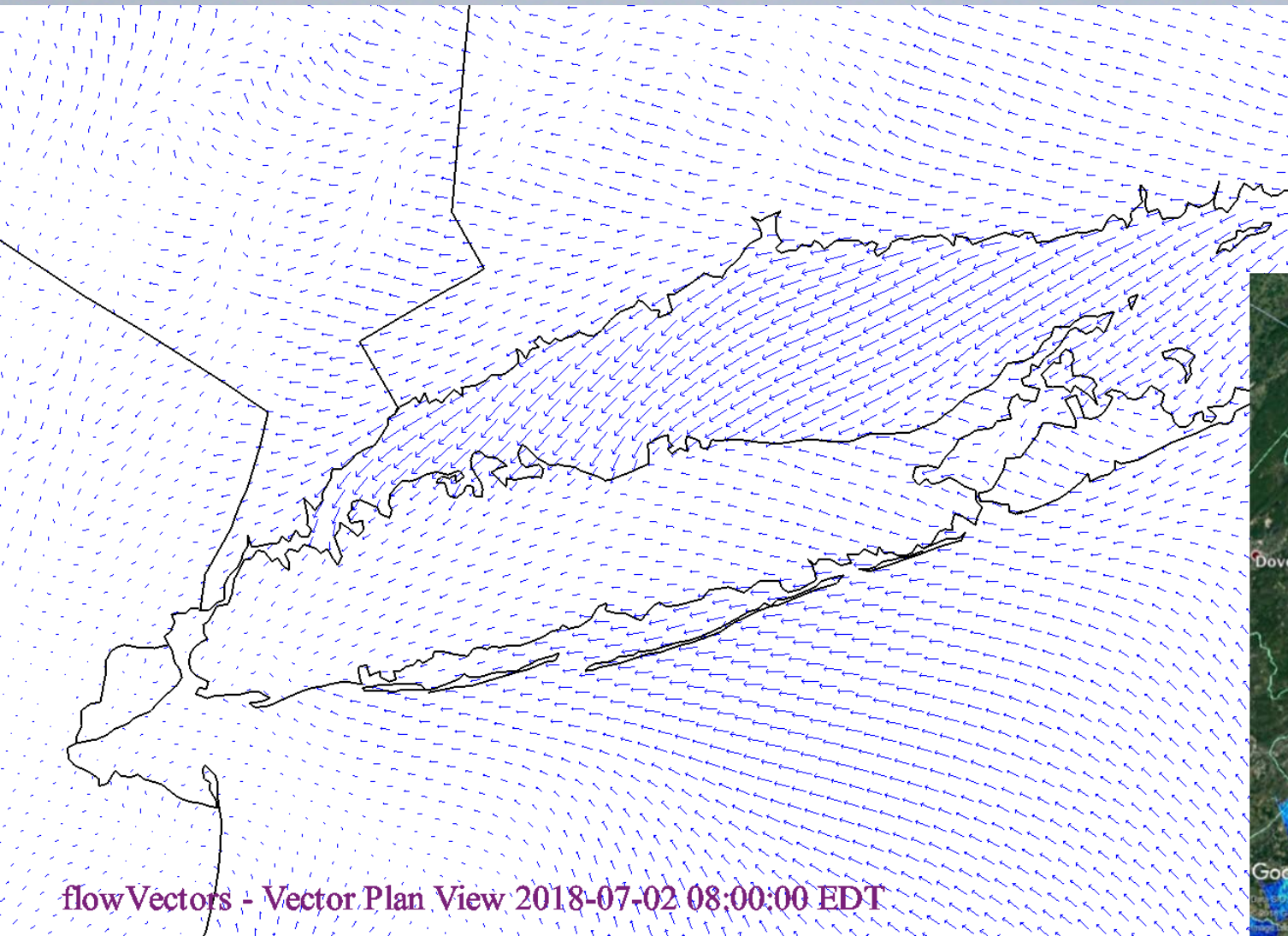
July 2, 2018 HALO (LIDAR) Aerosols



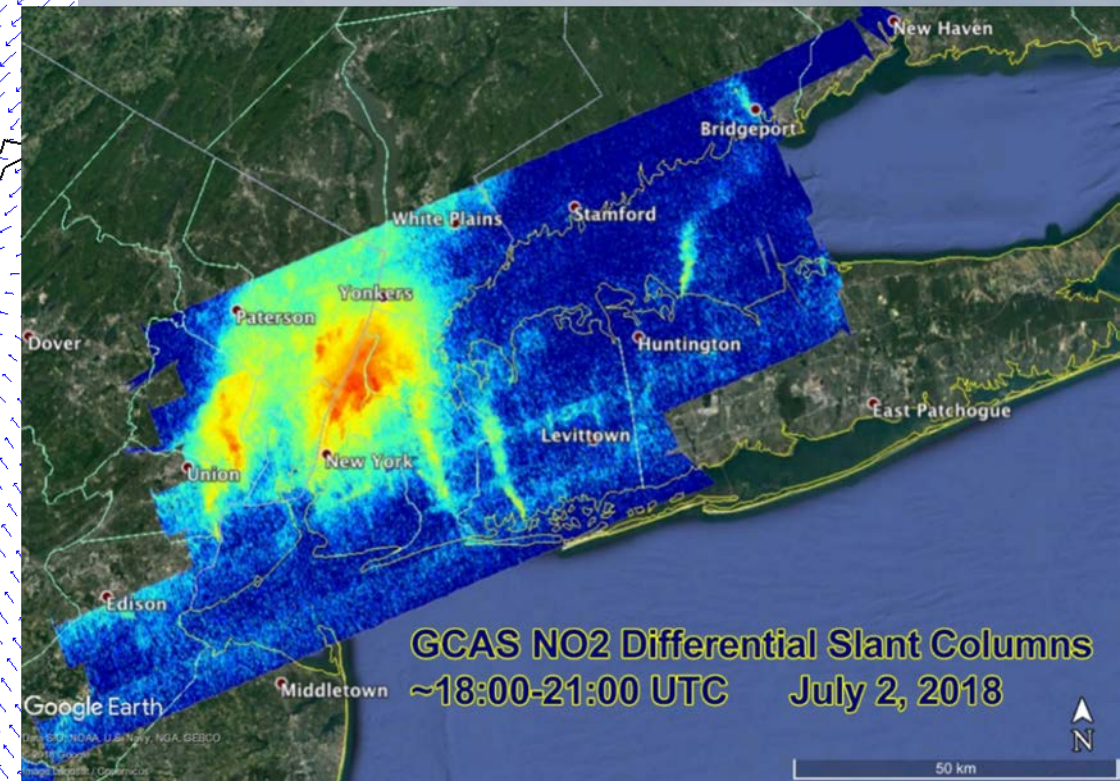
- HALO AOD lines up with ozone maximum.

July 2, 2018 Wind Vector Animation

Note how the surface wind vectors (HRRR) pushed the NO₂ plumes west of LIS. Current 12km CMAQ model grids are unable to accurately model the land/sea interface.



Preliminary Field Data

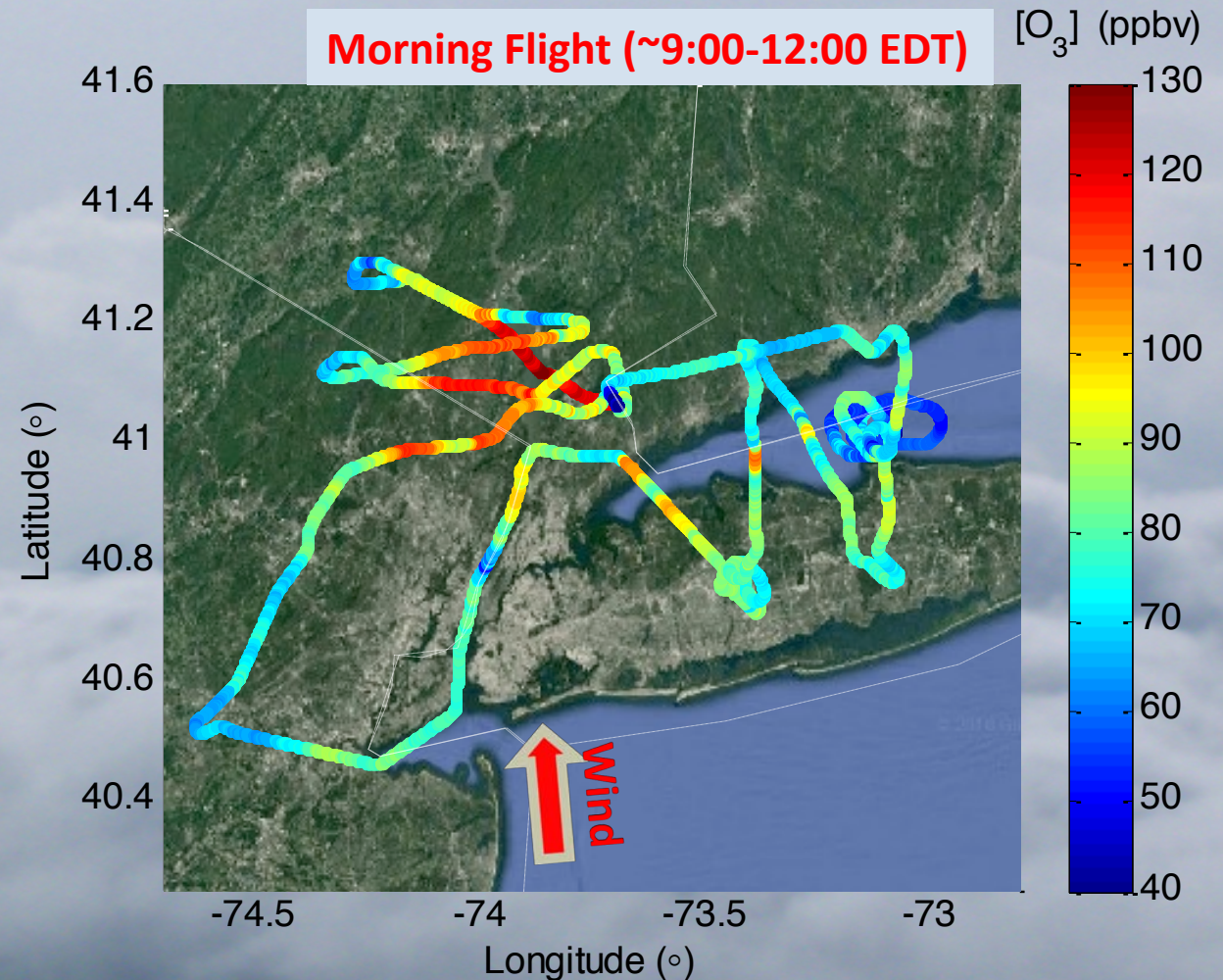


UMD Cessna LISTOS Flights on Monday, 7/2/2018

Monday Morning, July 2

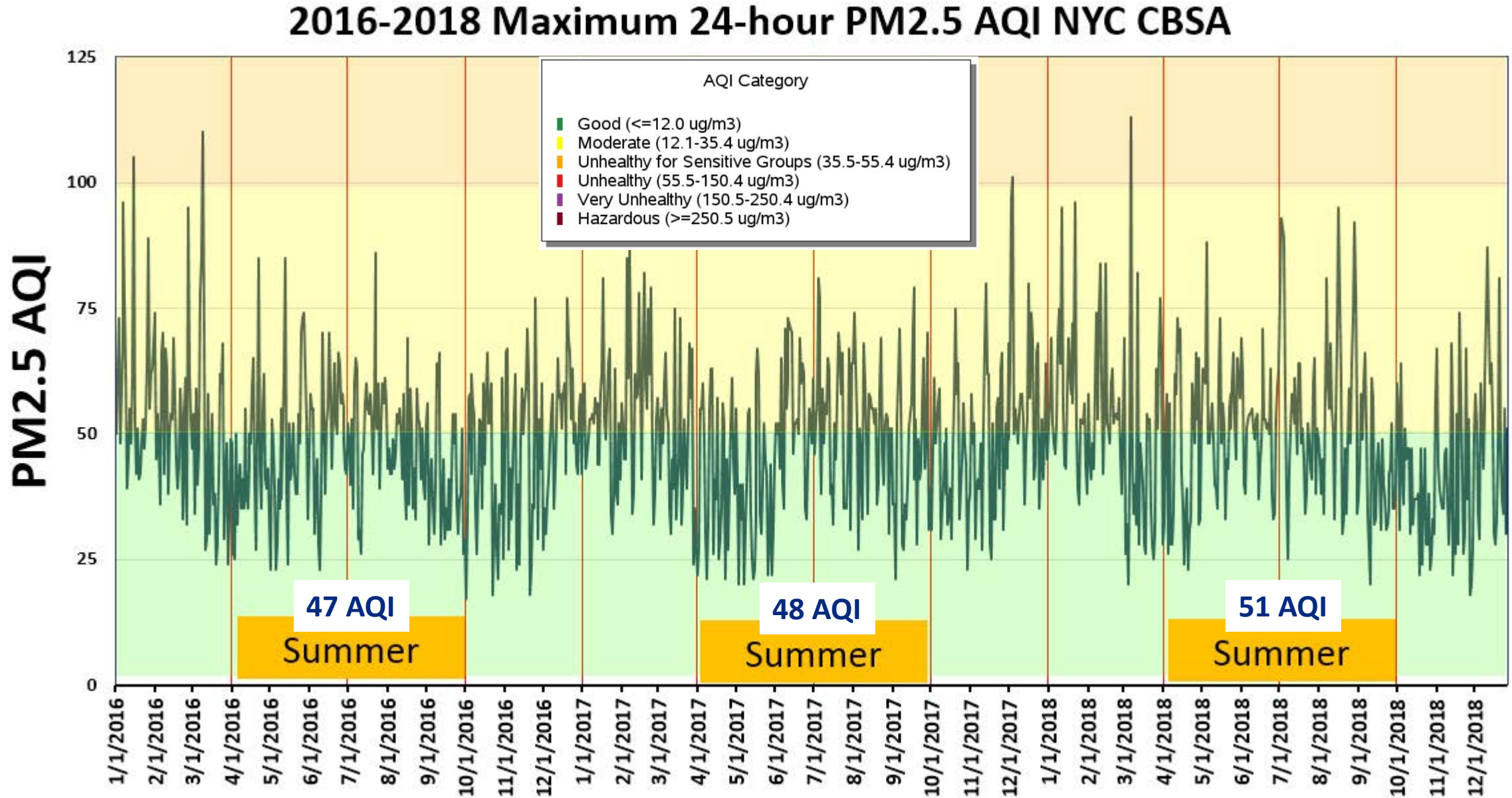


Very hazy over NYC



~130 ppb Ozone was already produced north of NYC in the late morning.

PM2.5 Trends- Possible Smoke influence?



Conclusions

- Frequent wildfire smoke plumes transported from the western States affected air quality over the northeast States.
- Elevated surface PM_{2.5} was observed to coincide with days of elevated ozone levels.
- LISTOS data shows days where NYC EGUs may still be a significant contributor to the high ozone levels generated over LIS.
- July 2, 2018 wind patterns over LIS likely concentrated both PM_{2.5} and ozone levels over NYC and to the northwest.