By Land and by Sea:
Air Quality Planning Challenges in NYC/Long Island Sound Region

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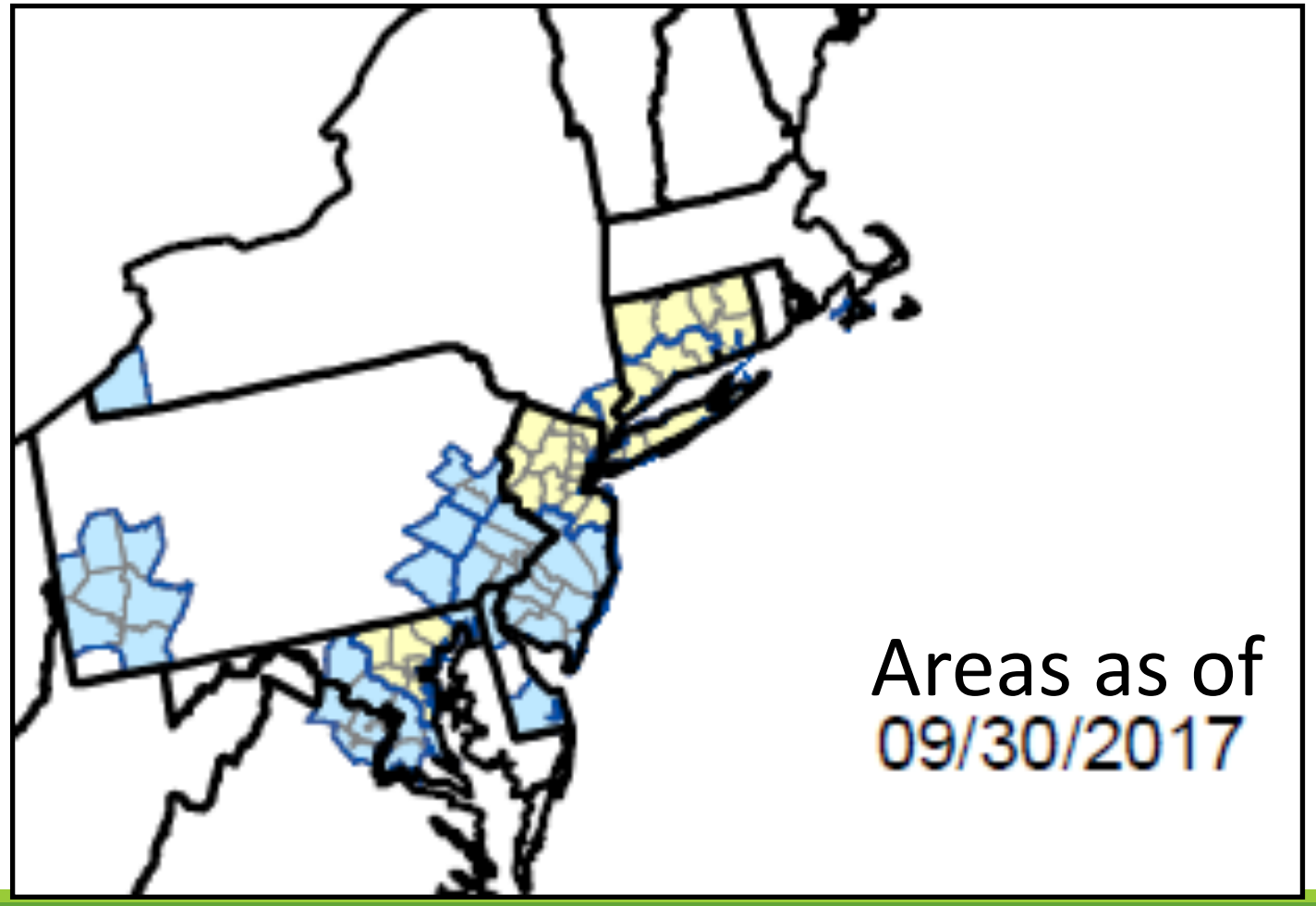
Talk Outline

- Regional Air Quality Challenges in Northeast
  - Ozone
  - Haze
- Areas for Investigation
  - Electricity generation on hot summer days
  - Transportation NOx
- NYC/Long Island Sound Research Activities & Opportunities
  - Univ. Maryland aircraft flights
  - GeoTASO
  - Pandora
- Aspirations for Summer 2018 and Beyond

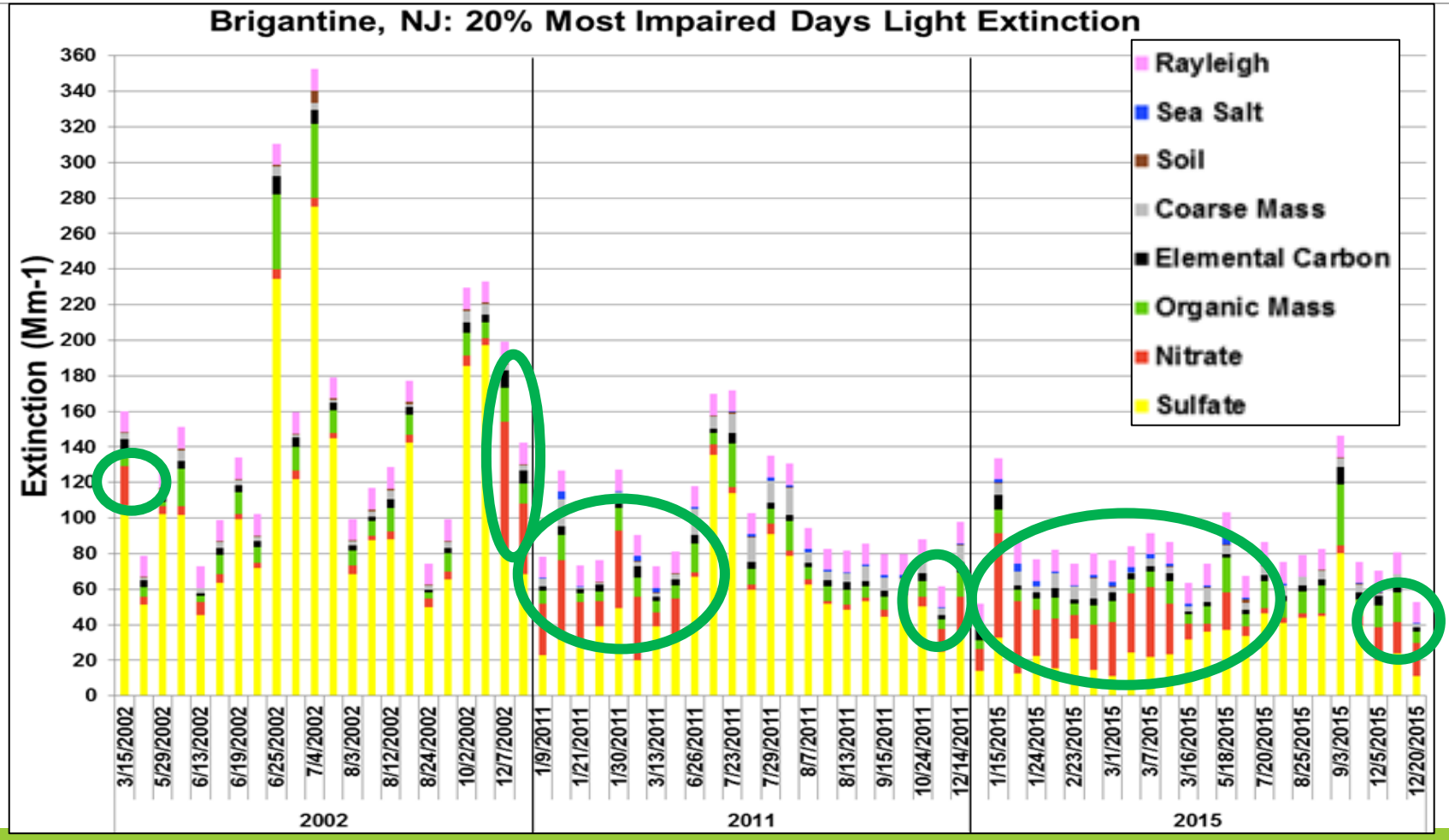
Air Quality Challenges in Northeast

1. Regional planning to meet ozone national air quality standards
   - *NYC metro area/Long Island Sound*
2. Regional planning to improve visibility in national parks and wilderness areas

Northeast Ozone Nonattainment Areas 2008 8-hr NAAQS 0.075 ppm

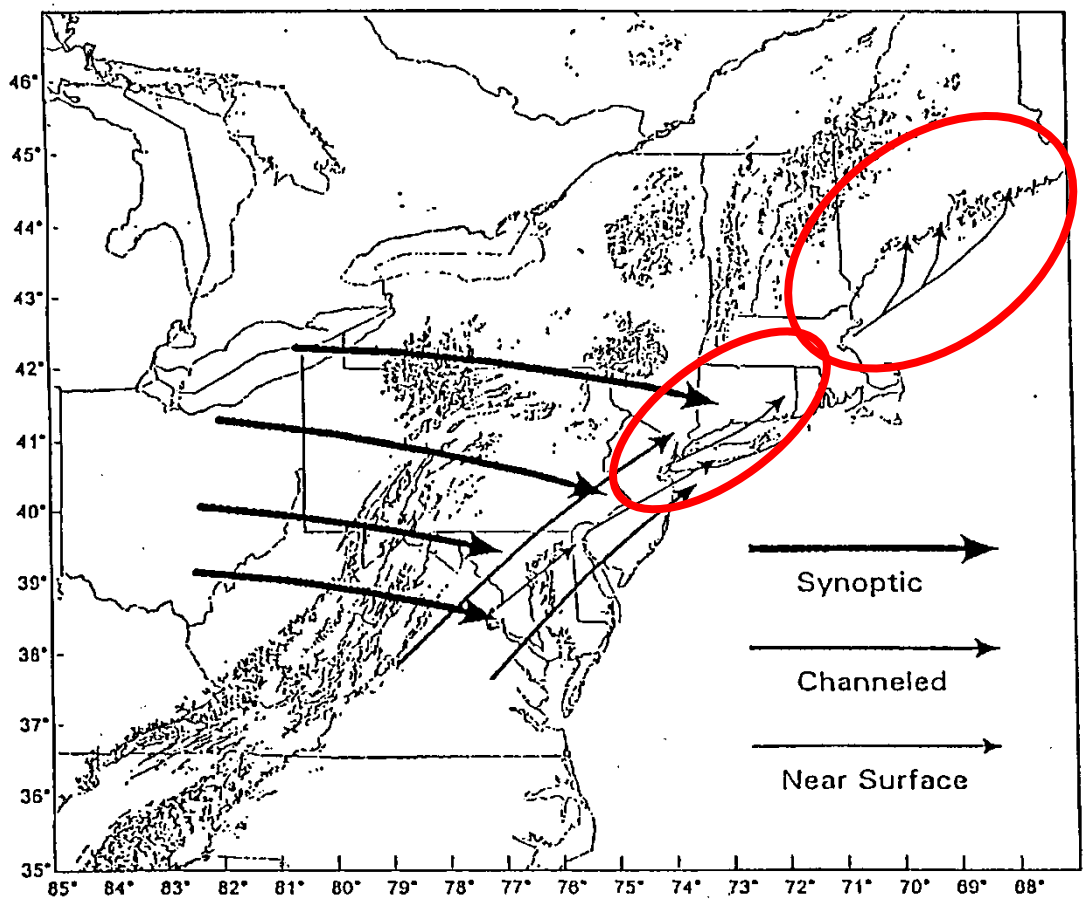


Visibility:
Nitrate PM Backfilling Sulfate PM



Source: MANE-VU

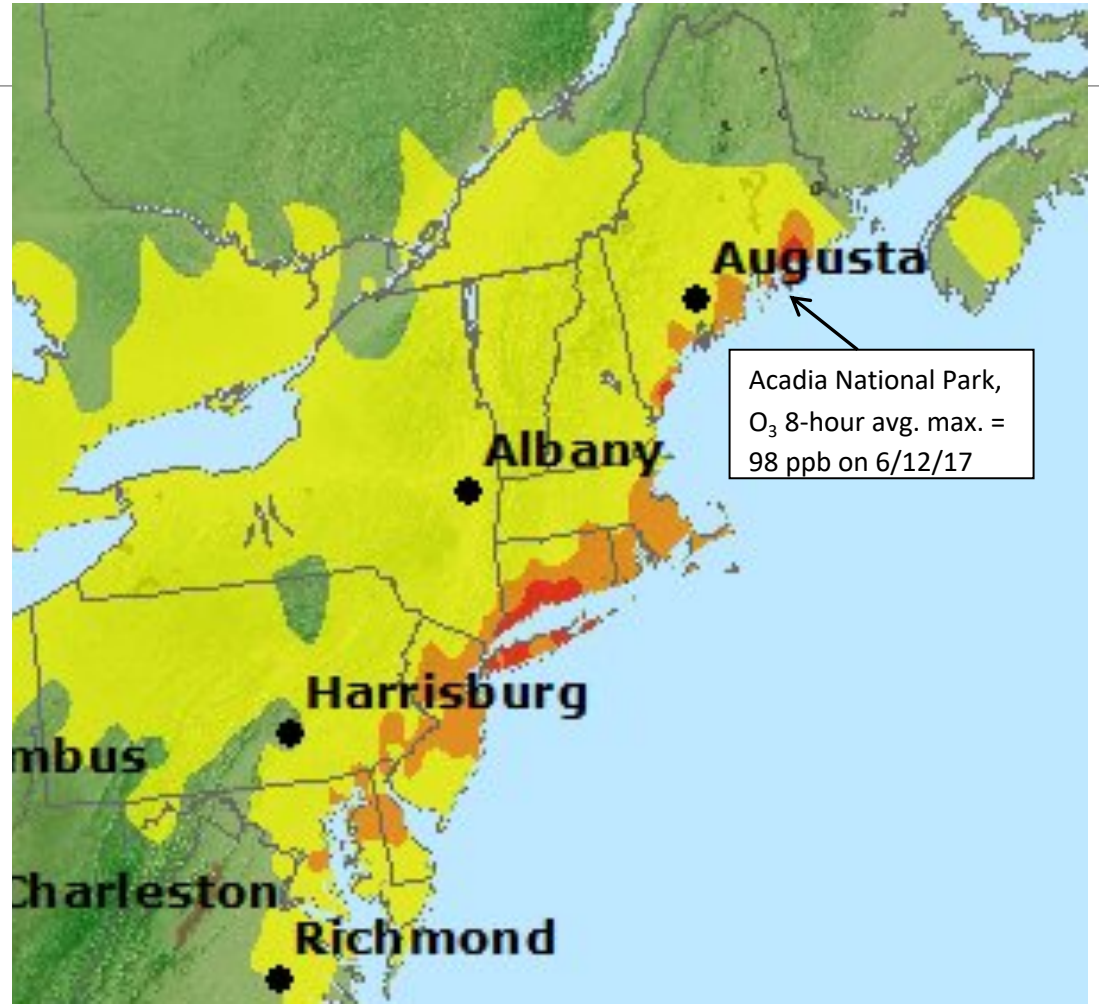
The Land & Sea Part



Transport Regimes Observed During NARSTO-Northeast

Over water transport

Recent Example – June 12, 2017



We Might Be Getting to the Details

Areas for Investigation

- Electric generating units (EGUs) on hot summer days
- Transportation NOx

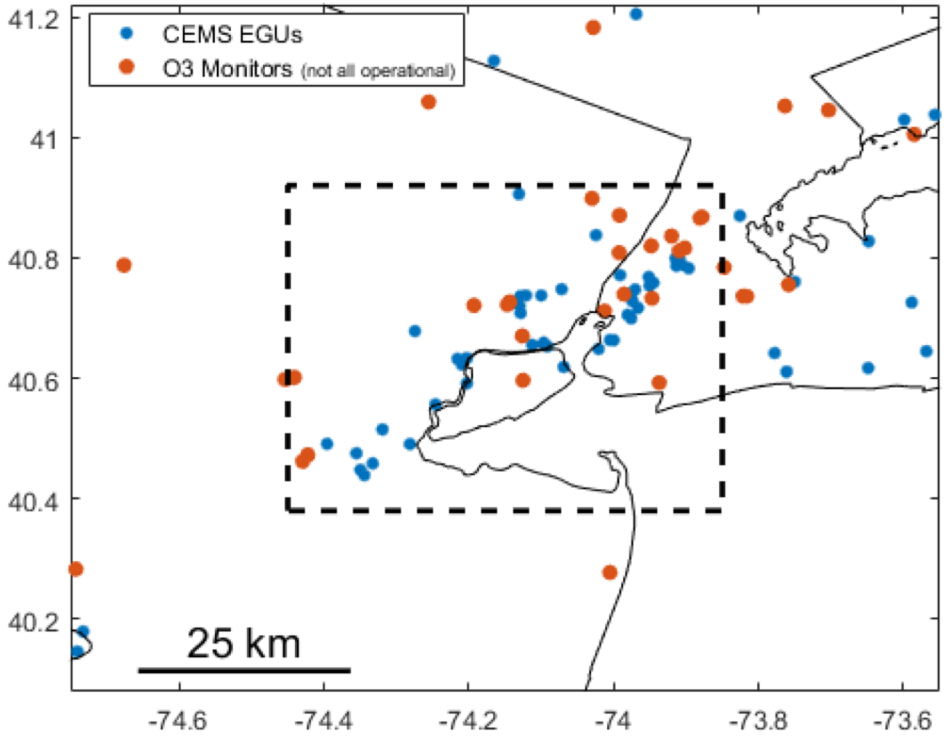
High Regional Ozone Days are High NYC EGU NOx Days

	CEMS EGU NOx rates	Max. Daily Avg. 8-hr (MDA8)
Top 10% of MDA8 days:	10,534 lbs/hr	73.9 ppb
Bot 90% of MDA8 days:	4,151 lbs/hr	46.1 ppb

--CEMS Jun/Jul/Aug, Tues-Fri, 12PM – 5PM, 2010 – 2016 by LOCAL AVERAGE

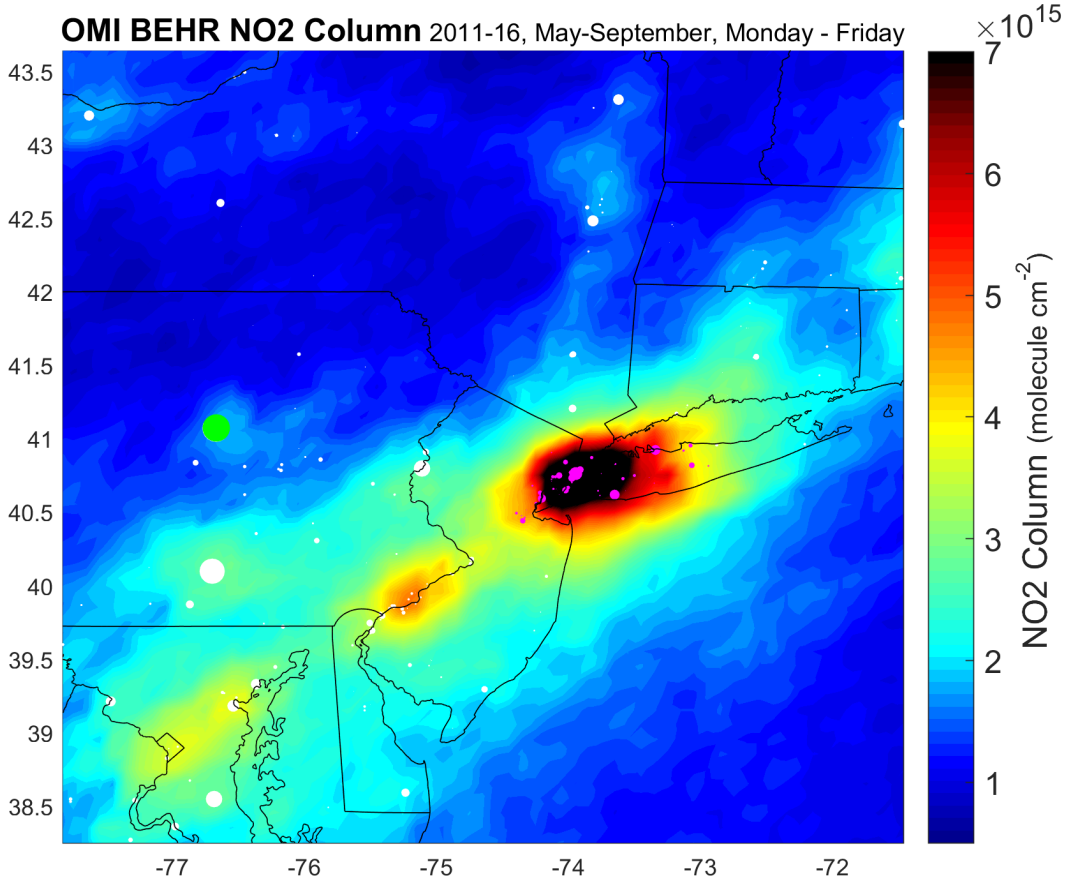
--There is almost a factor of 2.5 increase of emissions nearest NYC (domain insert) **on days when ozone concentrations are high** (regional average of MDA8 at all monitors in the full domain) **relative to days when ozone concentrations are not high**

--Role of small distributed EGUs without CEMS uncertain



Credit: Luke Valin, EPA/NASA

A NYC NO_2 "Volcano"?



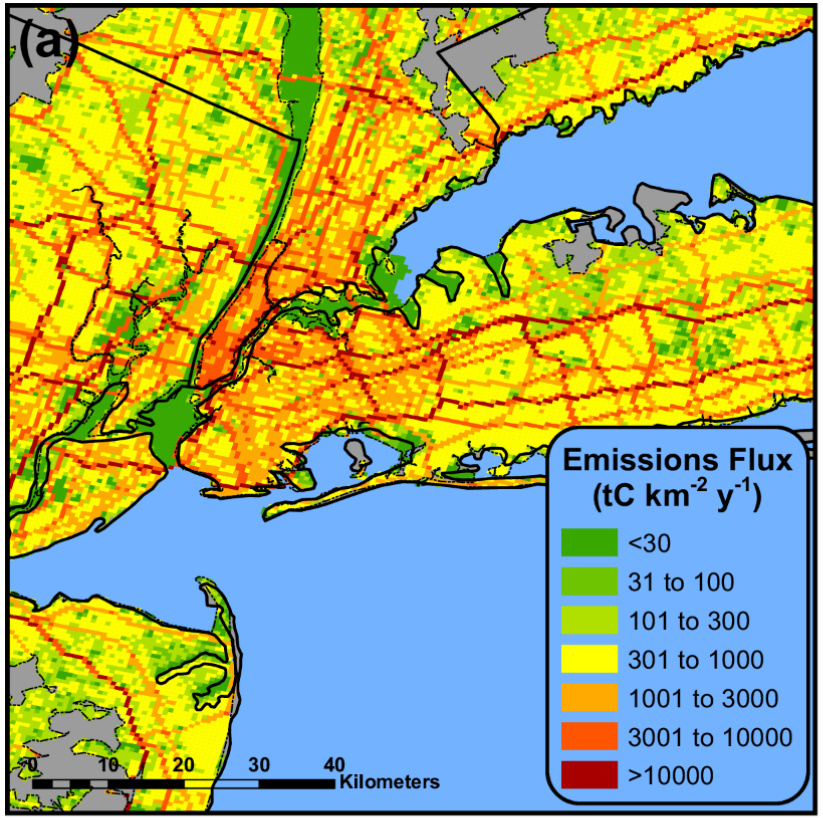
Transportation NOx

- Comparisons to MOVES estimates for on-road vehicles

- Emerging Issue: Heavy-duty truck “glider kits”

Fuel-Based Inventory of Vehicle Emissions (FIVE) vs. MOVES

Emissions = Activity (kg fuel) **x Emission Factor** (g/kg fuel)



State-level taxable gasoline and diesel fuel sales reports

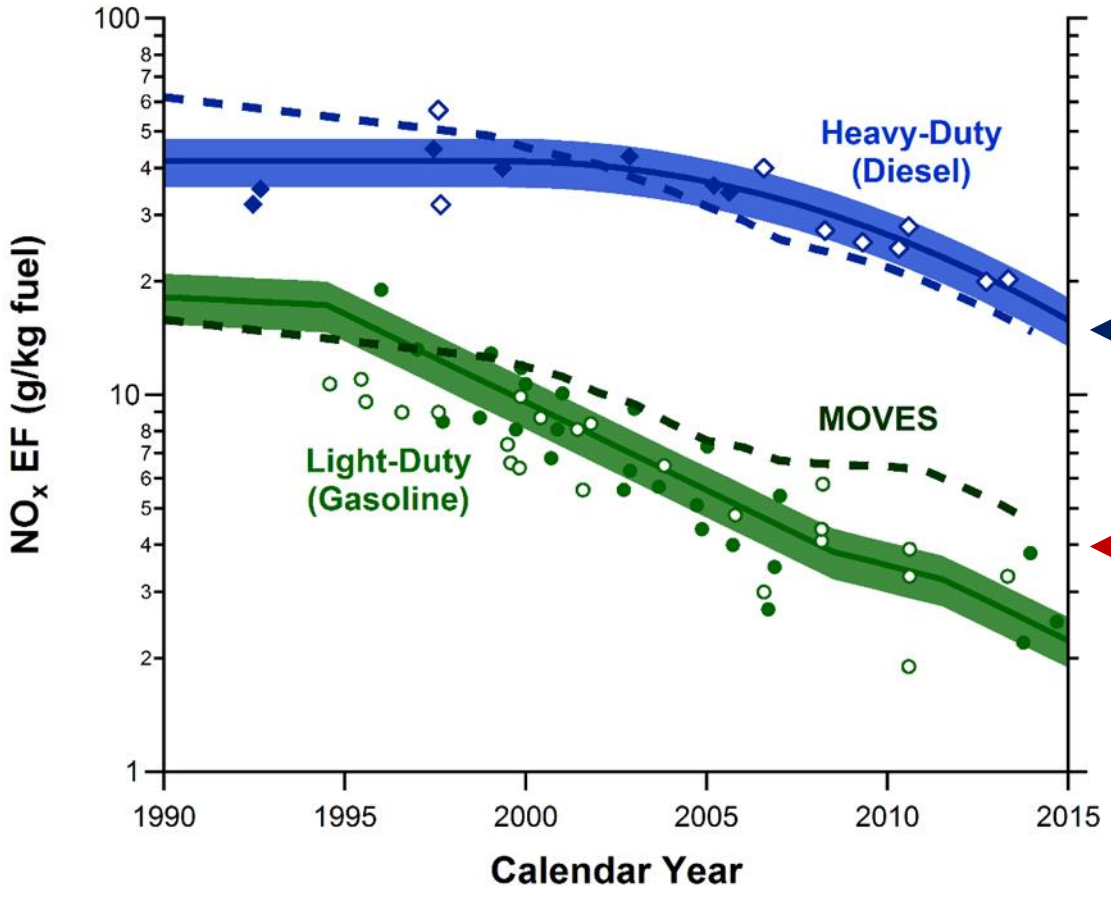
- Public and annual

Map on-road CO_2 emissions

- Using traffic count data
- Basis for scaling co-emitted combustion byproducts

Source: McDonald et al., *J. Geophys. Res.* 2014

Long-Term Trends in U.S. On-Road NOx Emission Factors



Diesel EF high within ~20%

Gasoline EF high by factor of ~2

(national defaults from MOVES shown)

Figure updated from McDonald et al. (*J. Geophys. Res.* 2012)

Q: What Is a Glider Kit?

Ans: A new truck … or is it?

Figure I.1 Typical Incomplete Glider Kit Configuration

Glider Kits are…

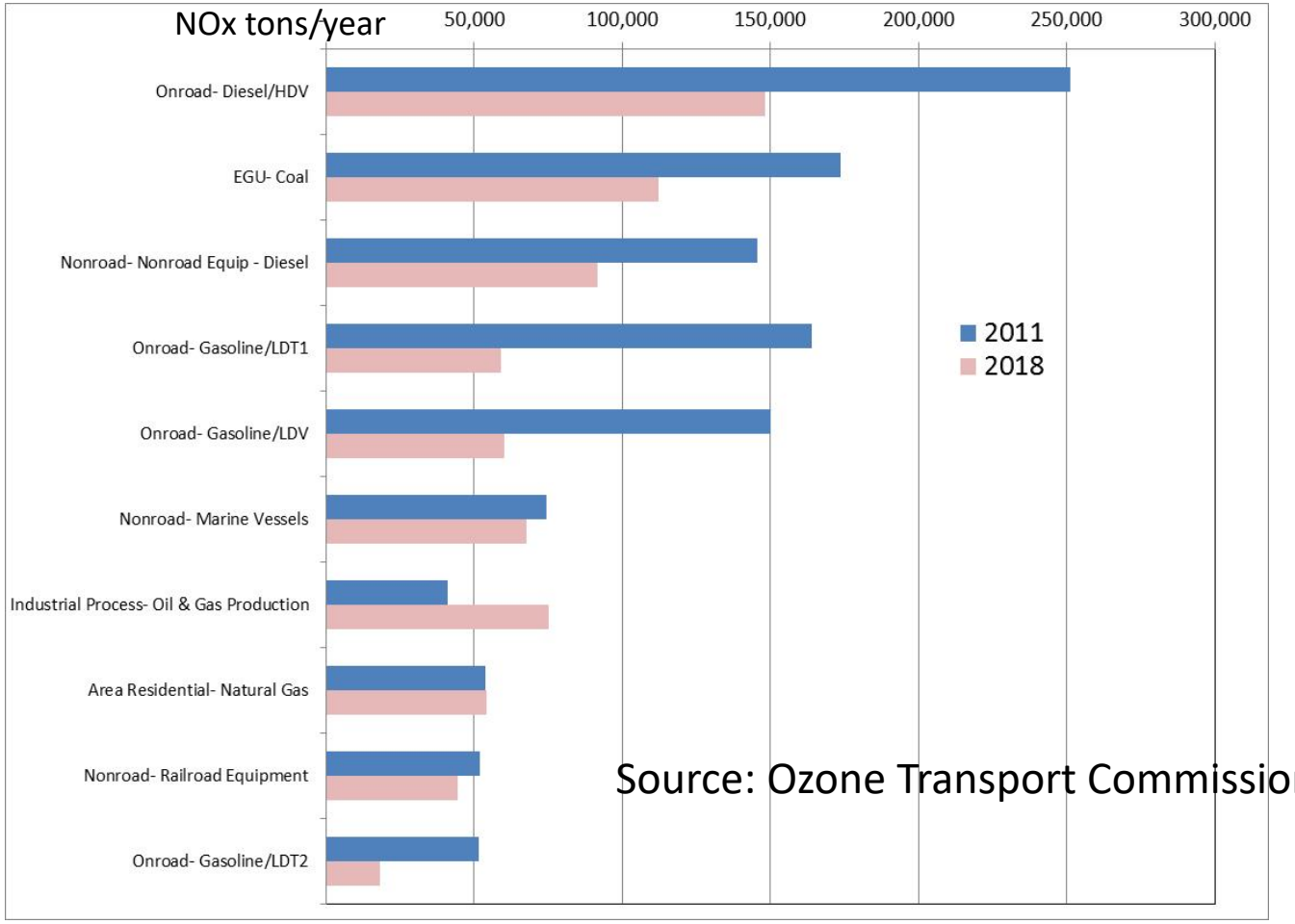
…a new truck chassis from the factory, without engine, transmission, or rear axles

Historically, engines/transmissions/axles from salvageable wrecks would go into gliders

Lately, expanding market to install rebuilt diesel engines (not from wrecks) pre-dating EPA 2010 engine NOx and PM emission standards

Q: Why Are Gliders an Issue in Northeast?

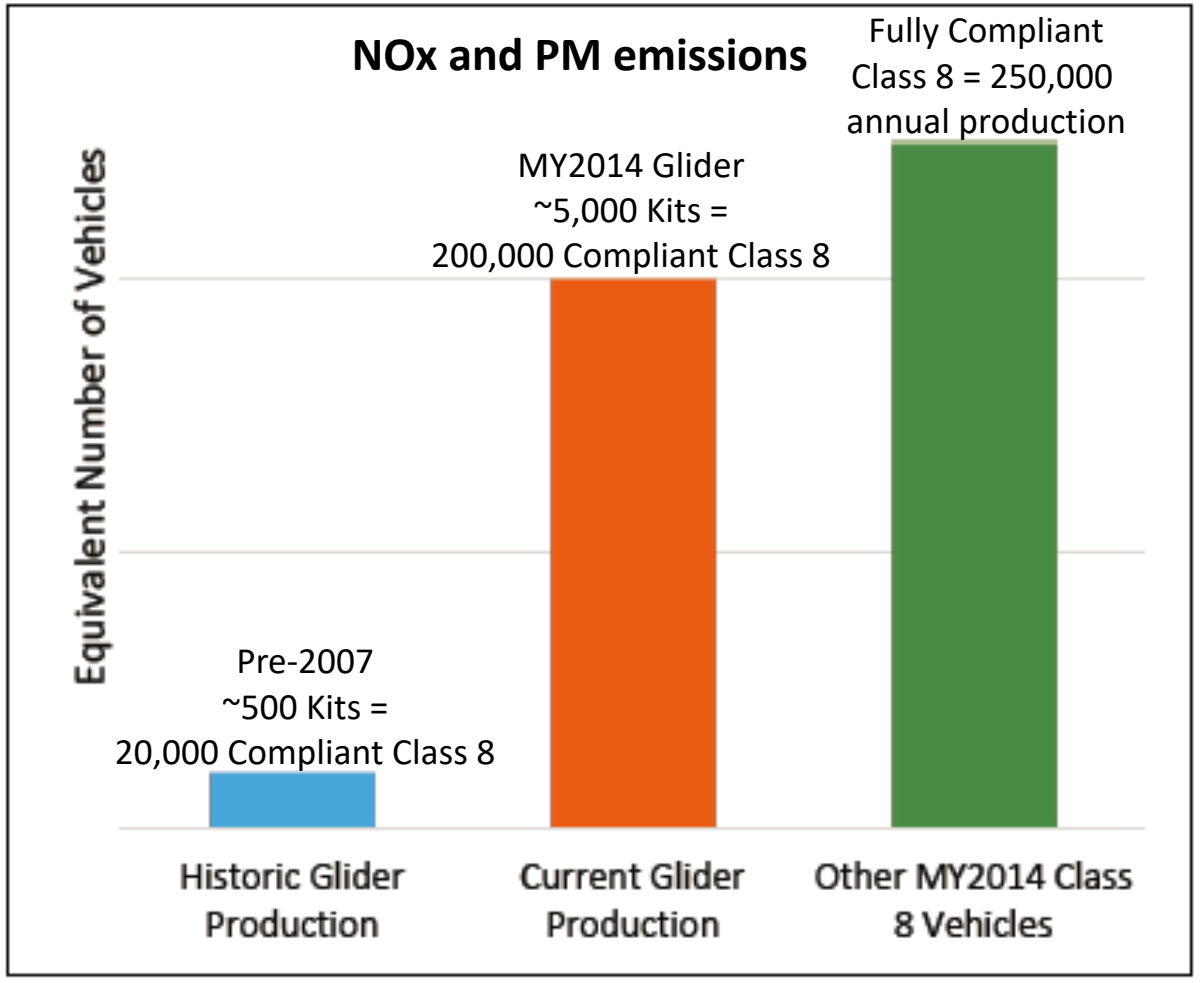
A: On-road heavy-duty diesel trucks large share of past and future NOx inventory



Source: Ozone Transport Commission

EPA Projection of Glider Kit Emissions

Glider vehicles with pre-2001 engines have 20x to 40x higher NOx & PM emissions than fully compliant modern truck

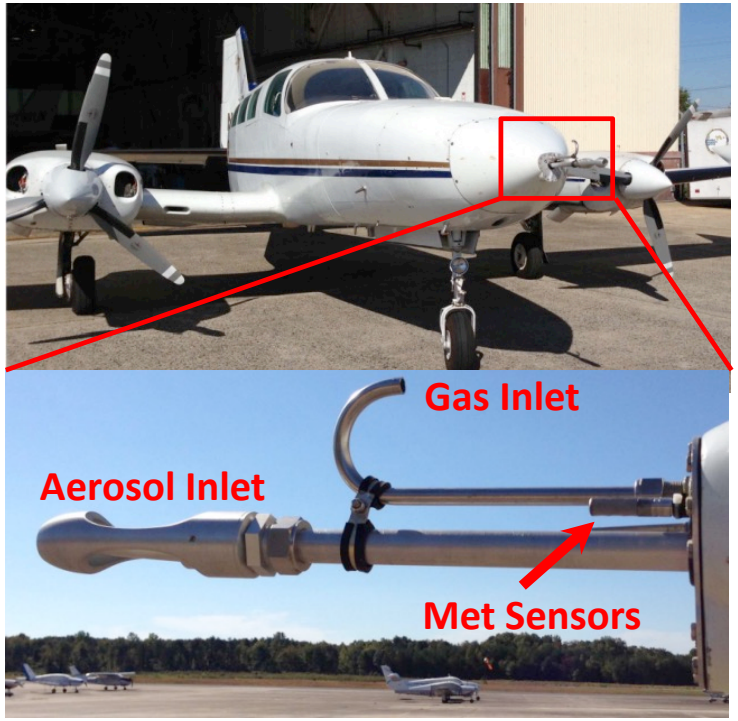


US EPA, FAQ Gliders
EPA-420-F-15-904
July 2015

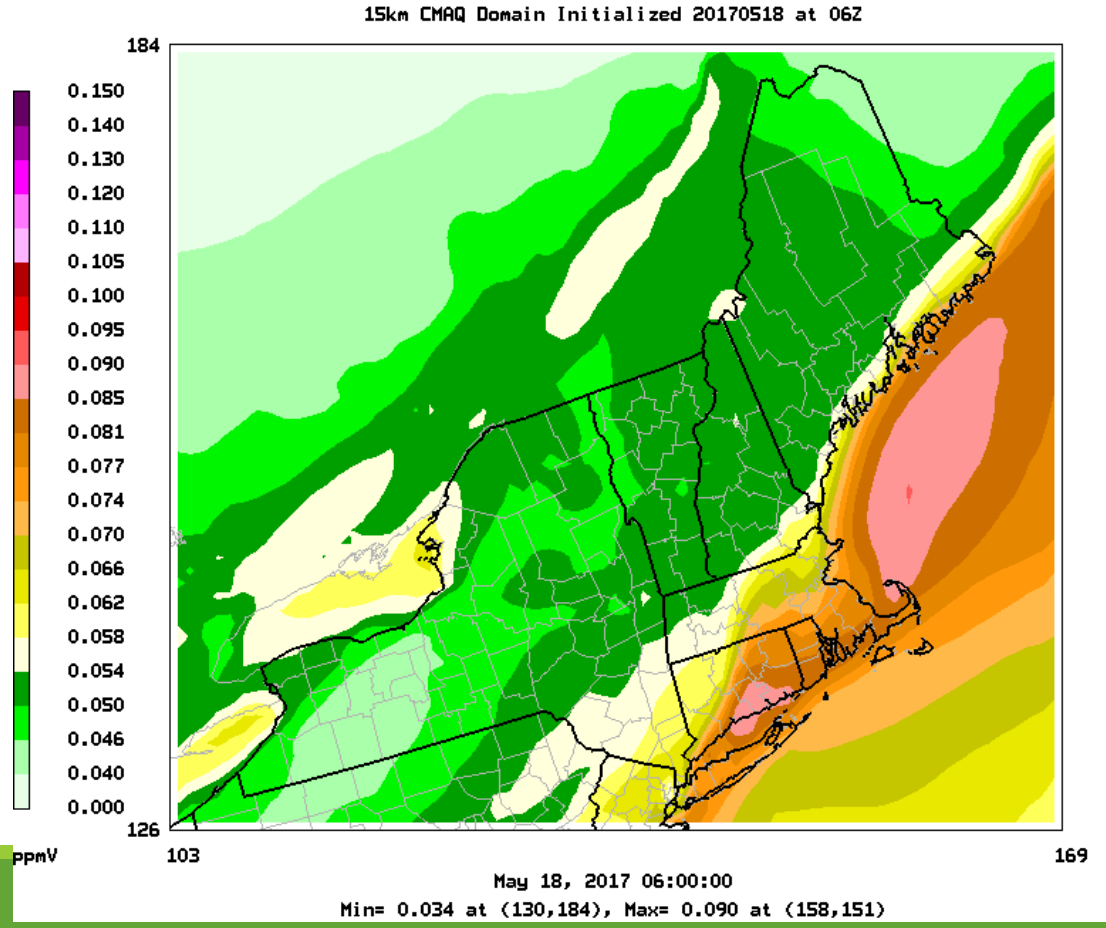
NYC/Long Island Sound Research Activities & Opportunities

- Univ. Maryland aircraft flights
- GeoTASO
- Pandora

University of Maryland Aircraft Flights

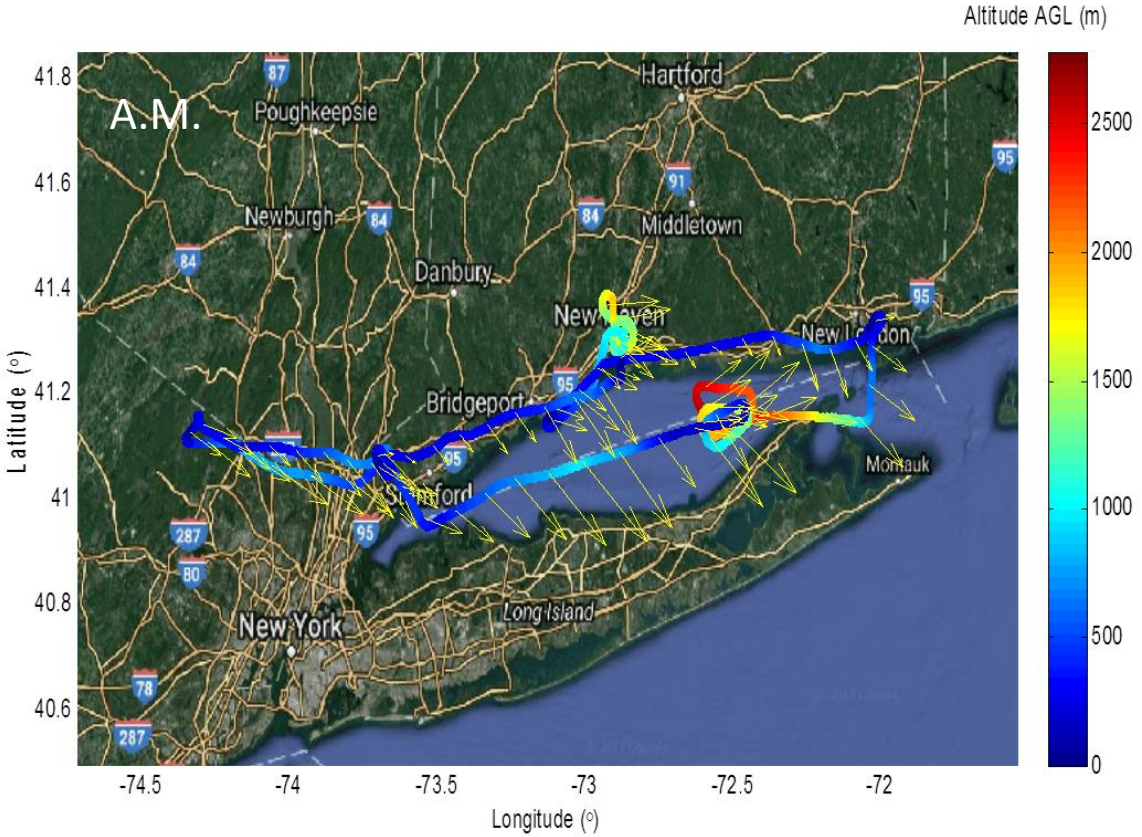


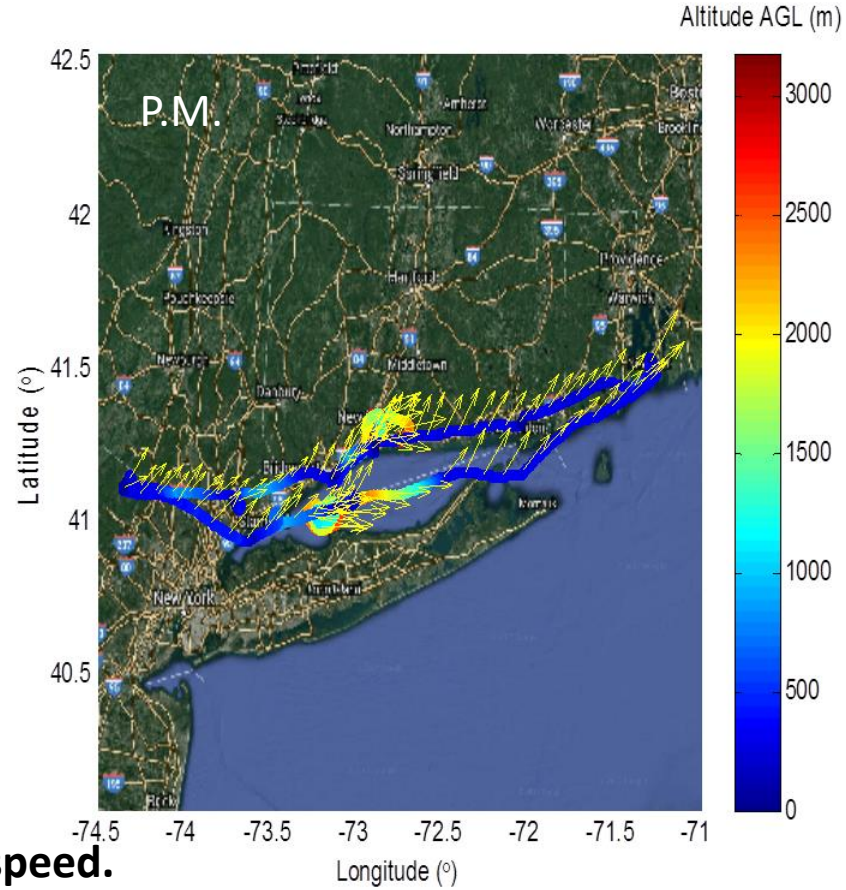
May 18, 2017 air quality forecast



Credit: Xinrong Ren, NOAA; Russ Dickerson, UMD

May 18, 2017 Morning & Afternoon Flights





Yellow arrows show observed wind direction and relative wind speed.

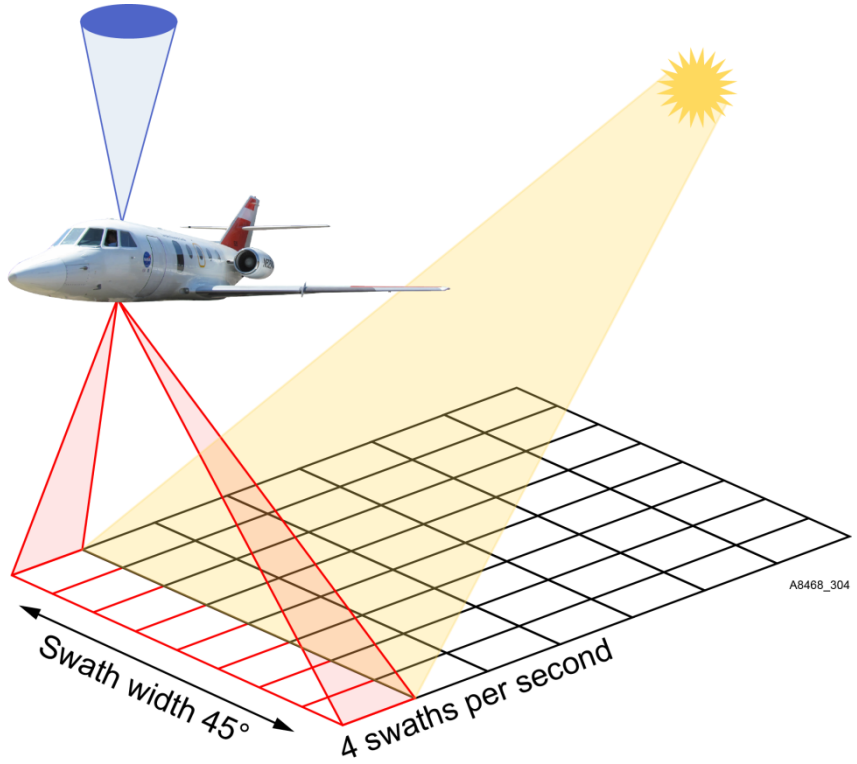
Credit: Xinrong Ren, NOAA; Russ Dickerson, UMD

Geostationary Trace gas and Aerosol Sensor Optimization (GeoTASO) Airborne Instrument

- GeoTASO is an airborne test bed for geostationary satellites, e.g., TEMPO
  - Investigate sensor artifacts/retrieval accuracy
  - Algorithm preparation/tuning
- Mapping of NO_2 and HCHO (when possible) over land and water
- Previous U.S. GeoTASO campaigns in:
  - Los Angeles
  - Texas
  - Colorado
  - Lake Michigan

Credit: Jay al-Saadi, et al. NASA

GeoTASO Observations

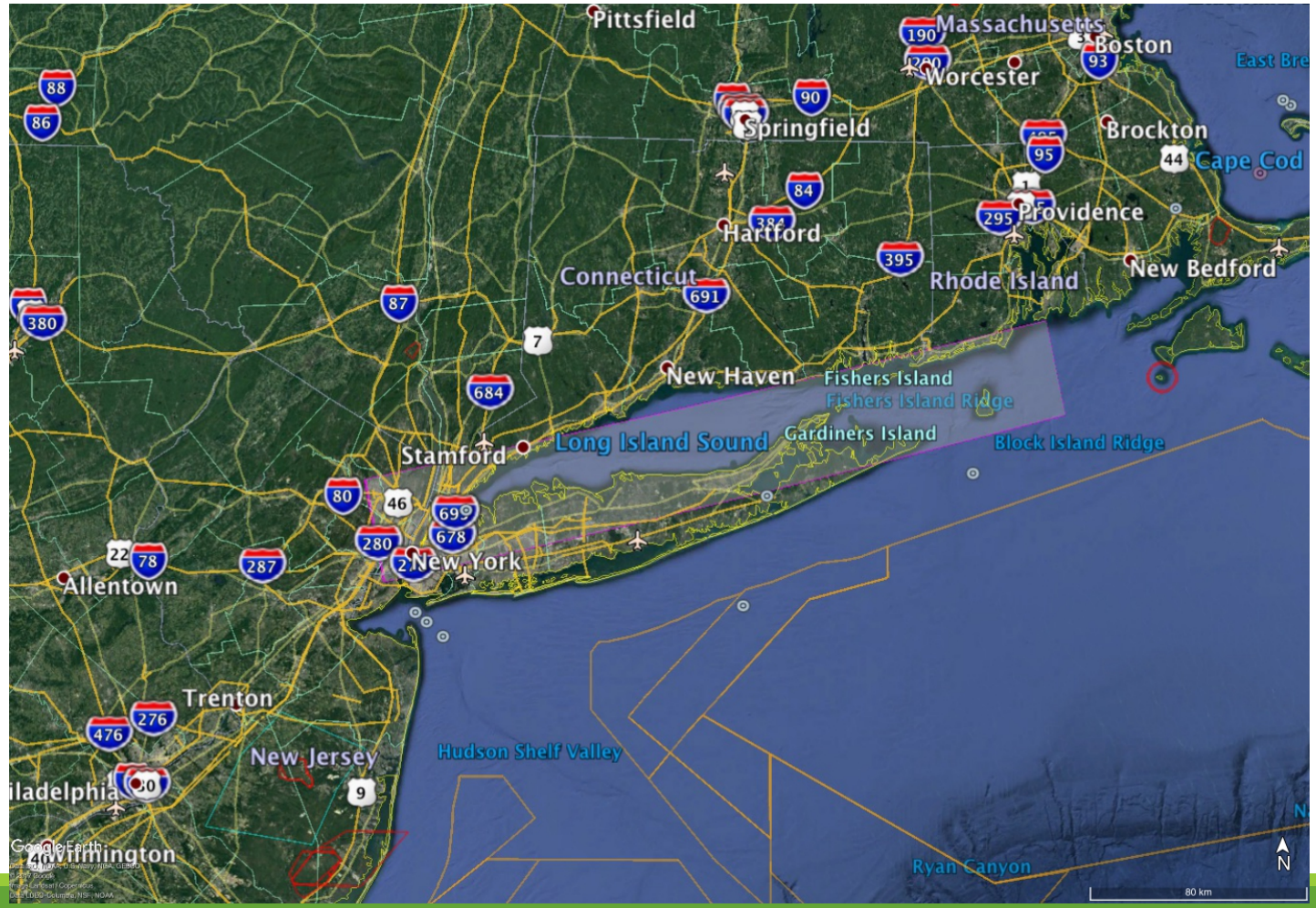


Native resolution is ~9 m x 50 m with SNR=65 (NO_2) and SNR=110 (HCHO)

- Co-add to reduce noise
- For NO_2, data at 250 m x 250 m

Credit: Jay al-Saadi, et al. NASA

Possible NYC/Long Island Sound Campaign



Credit: Jay al-Saadi, et al. NASA

Pandora Ground-Based Spectrometer

- Solar source spectrometer (280 - 525 nm: 0.6 nm resolution) – column NO_2, O_3, HCHO, and SO_2 every 80 sec.
- Developed as validation instrument for OMI measurements
- EPA working with NASA to site Pandoras at PAMS as research instrument to provide improved characterization of emissions and serve as a U.S. ground-based satellite validation network
- NO_2/HCHO to assess of formaldehyde as a radical source (primary and secondary) and O_3 formation in an urban and downwind environment

Credit: Jim Szykman, Luke Valin, et al. EPA

Aspirations for Summer 2018 and Beyond

- Apply FIVE to NYC region; compare to MOVES and measurements
- "Sandwich" GeoTASO, UMD, and Pandoras for vertical pollutant concentration and temporal profiles over and around Long Island Sound
  - GeoTASO ~20,000 ft looking down
  - UMD plane ~100-5,000 ft looking within
  - Pandora ground-level looking up

- Opportunistic – continuing to seek out research partners, ideas, tools & methods, funding sources

Thank You