GOTHAAM

GreaterNY Oxidant, Trace gas, Halogen and Aerosol Airborne Mission

Funded by the US National Science Foundation (ACP, GEO)

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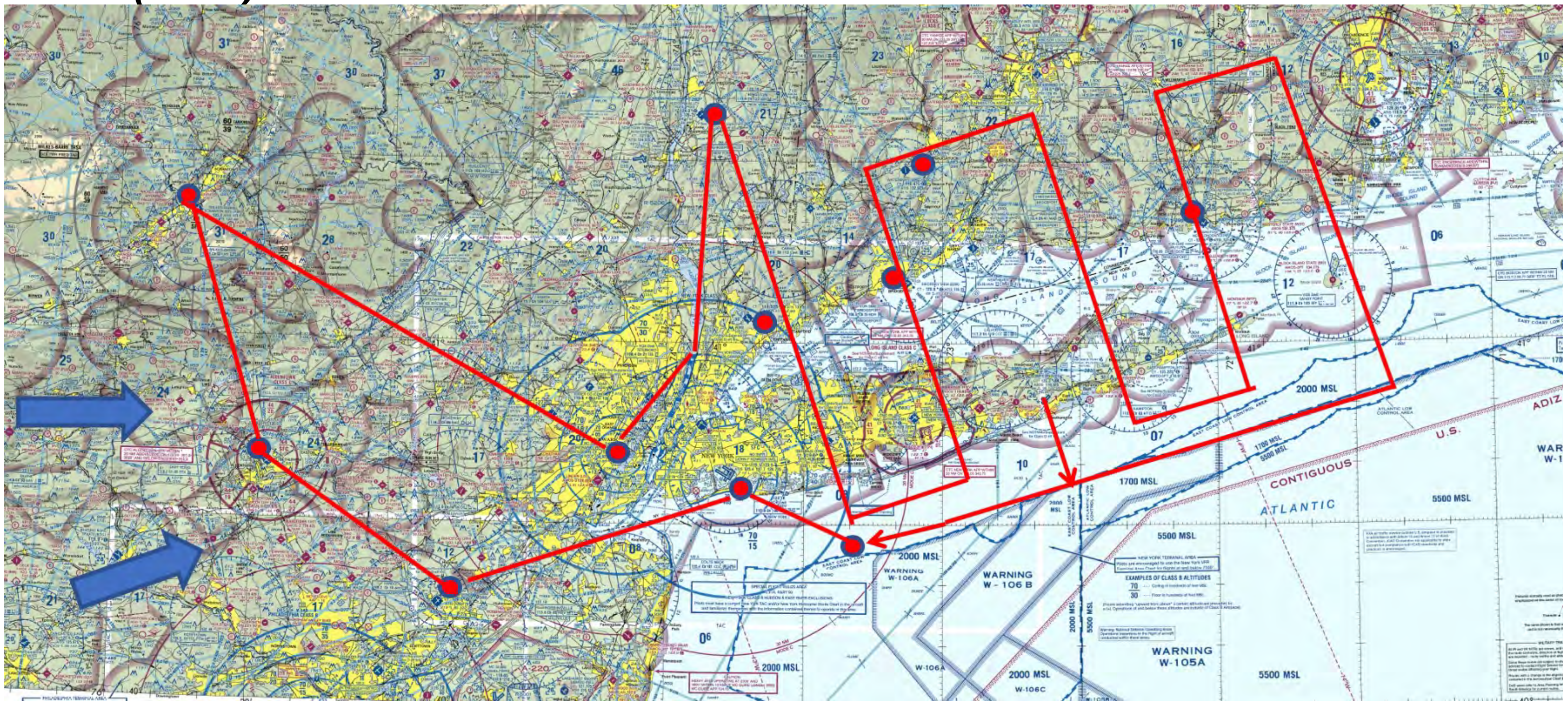
Location: ***Greater New York City***

Start-End Date: ***July 1-August 12 2023***

NSF ***C-130 Aircraft (EOL)***



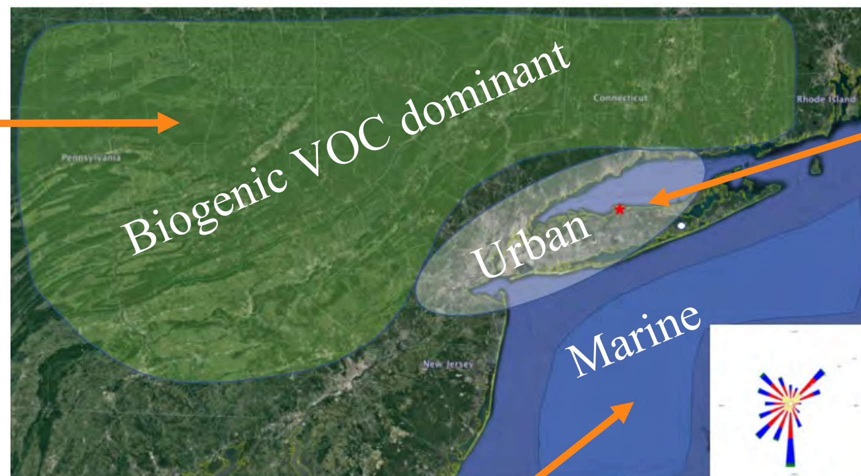
AGES 09/2022

The New York City region is comprised of three chemical systems:

- Biogenic/terrestrial (biogenic volatile organic compounds are dominant)
- Urban/industrial (NOx, Volatile Consumer Products (VCPs), VOC from fossil fuels, potentially leading to high O_3)
- Marine (halogen emissions)

Each system has characteristic trace species emissions that uniquely impact chemistry.

Biogenic summertime emissions surrounding NYC are very large; temperate forest coverage of the surrounding regions (NY, NJ, CT, MA, PA) is greater than 20 million hectares.



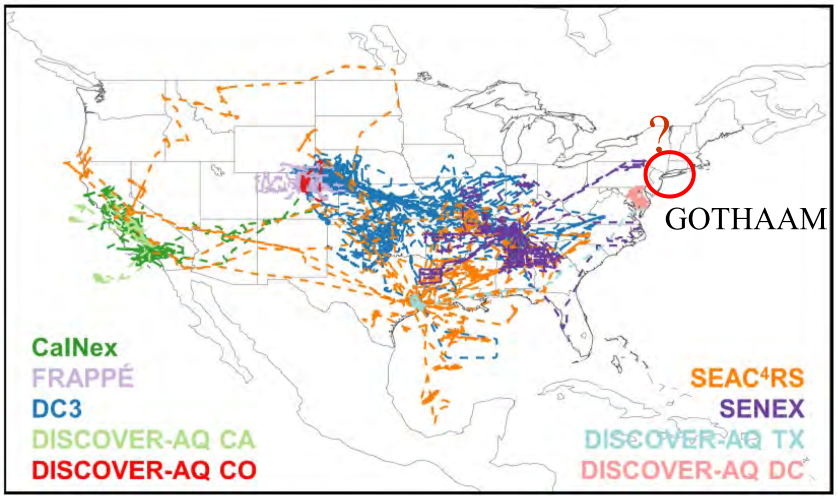
Urban plume (with high NOx, anthropogenic VOCs, VCPs, aerosol) mixes with Biogenic and Marine systems.

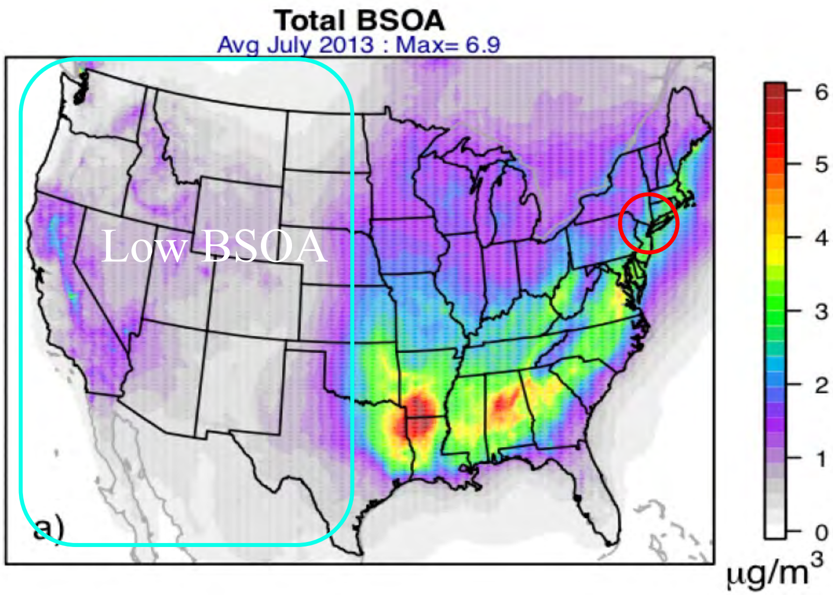
Nighttime Cl_2 in the **marine layer** can be very enriched in the NY region (black line) compared to the west coast (red line), leading to **rapid oxidation at sunrise.** (Spicer et al, Nature, 1998; Finlay and Saltzman, GRL, 2006)

Summertime flow is often from the S-W quadrant; polluted quadrant for NY Metropolitan area (>20 million people impacted).

What makes GOTHAAM unique?

- Biogenic precursors to SOA are among the highest outside SE US.
- Proposed diel study of night-into-day chemical mechanisms would be a first, especially with proposed instrumentation.
- The NYC region is the most densely populated region in CONUS (>23 million).
- There has not been a recent comprehensive airborne study of the atmospheric chemical processes focusing on this region.
- GOTHAAM's integrated state-of-the-art chemistry payload.





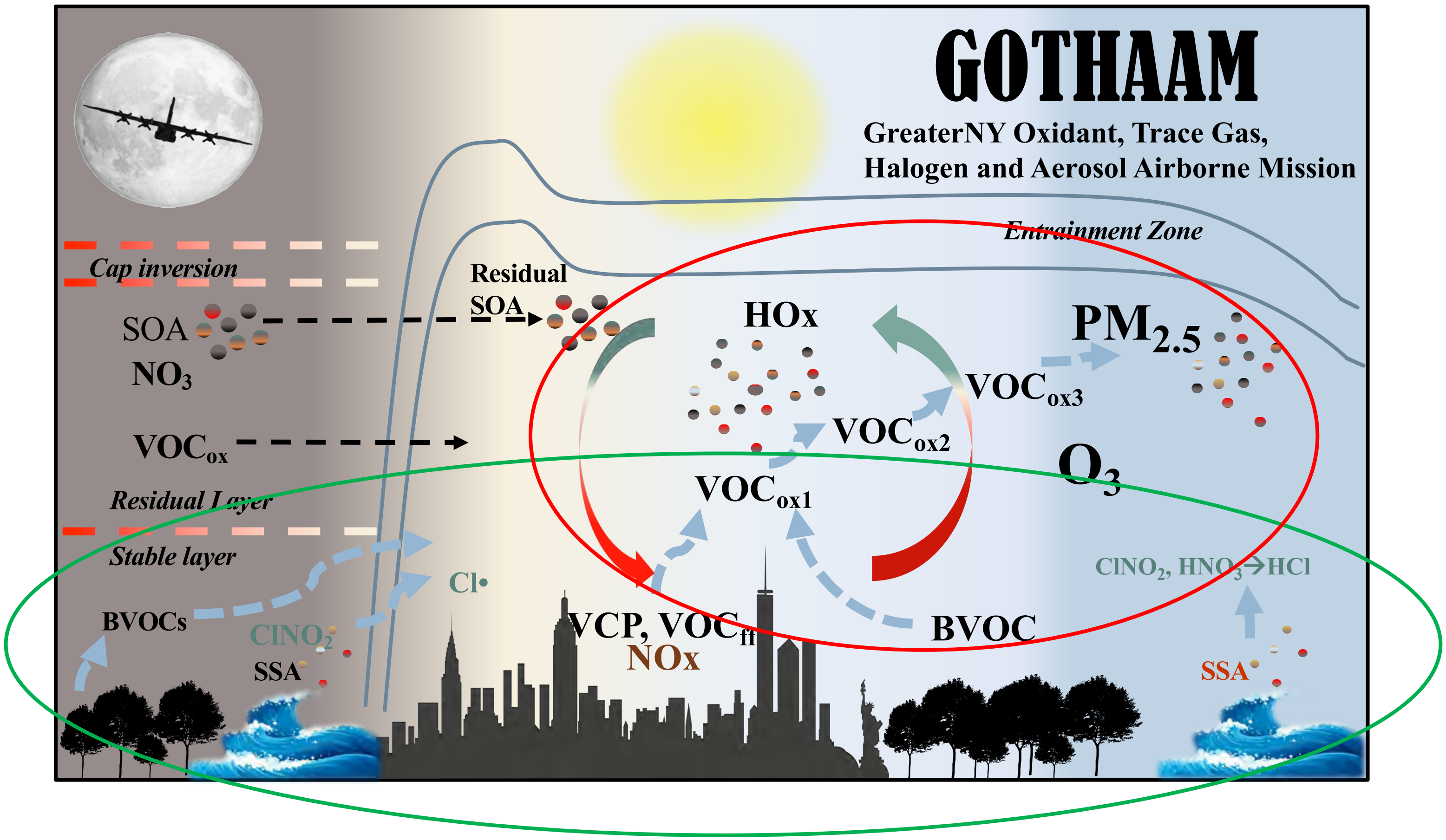
Recent VOC-centric aircraft campaigns* underscore the lack of information in the NE US (Chen et al., 2019). GOTHAAM encompasses VOC studies.

*SOAS, NOMADDS cover the similar region as SENEX

Biogenic derived SOA (BSOA) in July 2013 illustrates the significant production in the GOTHAAM region. There is a large difference between the NYC region and the central/western US. (Carlton et al., 2018)

GOTHAAM Scientific Objectives

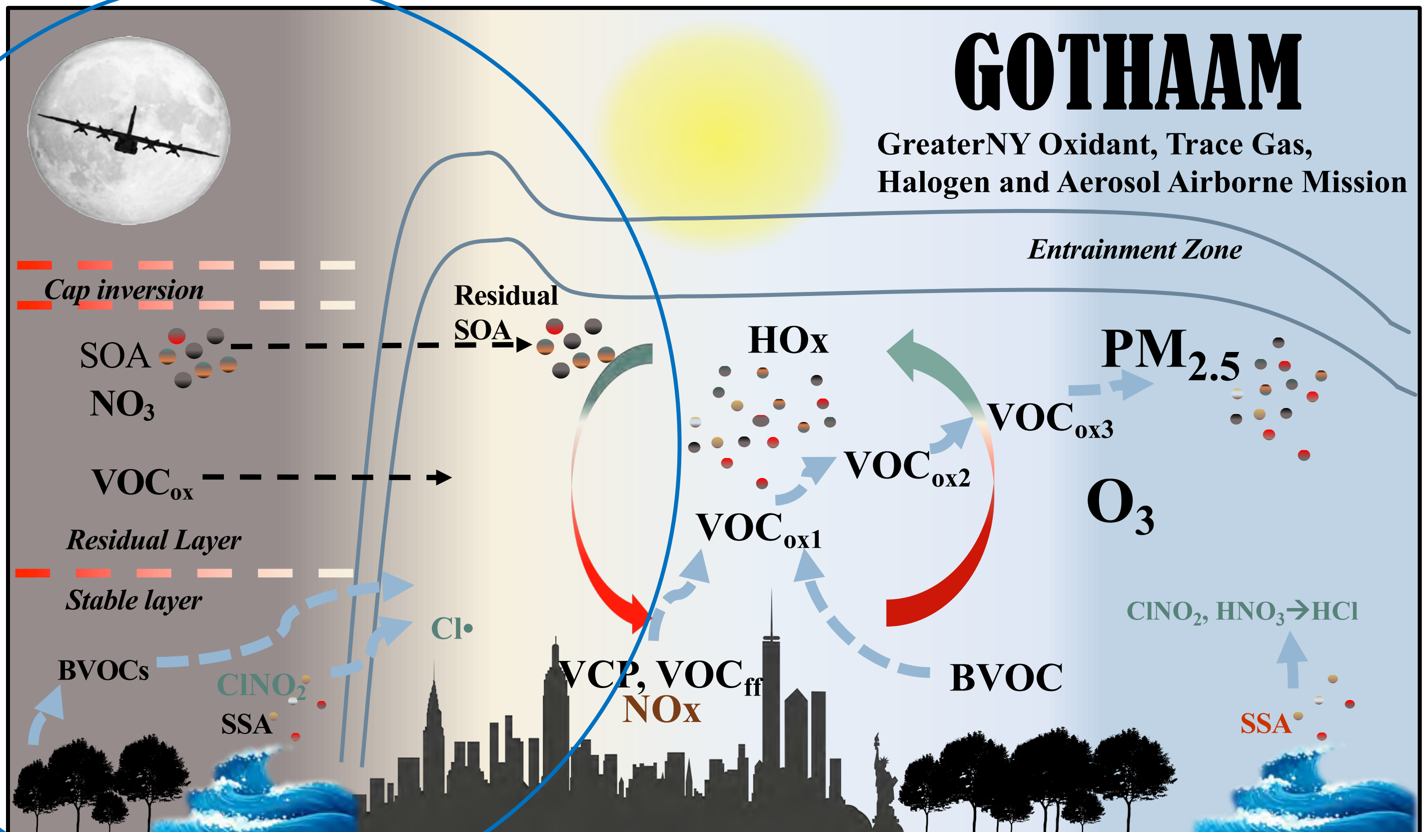
Objective 1. Quantify the relative contributions from the various volatile organic compound (VOC) sources (biogenic, fossil fuel, combustion, consumer products) and how they contribute to chemical reactivity.



Objective 2. Determine the relative potential contribution of each VOC class to secondary organic aerosol (SOA) as the anthropogenic plume evolves.

GOTHAAM Scientific Objectives

Objective 3. Quantify the relative importance of the various oxidation processes for both gas phase and aerosol species, and how the relative importance of these processes vary across the diel cycle and as a function of the chemical system (biogenic/urban/marine).



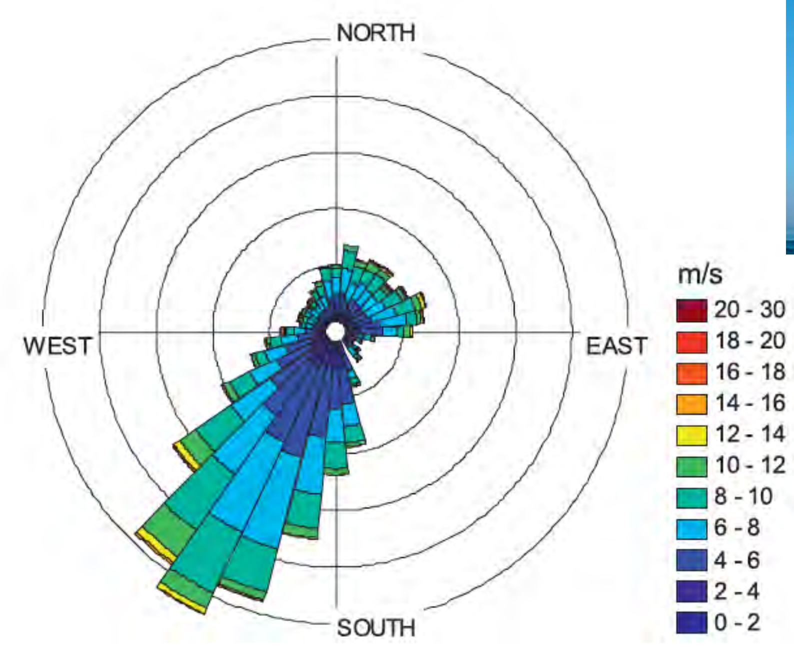
Objective 4. Investigate how nighttime chemical processes influence the subsequent day's initial chemical composition.

GOTHAAM instrumentation payload*

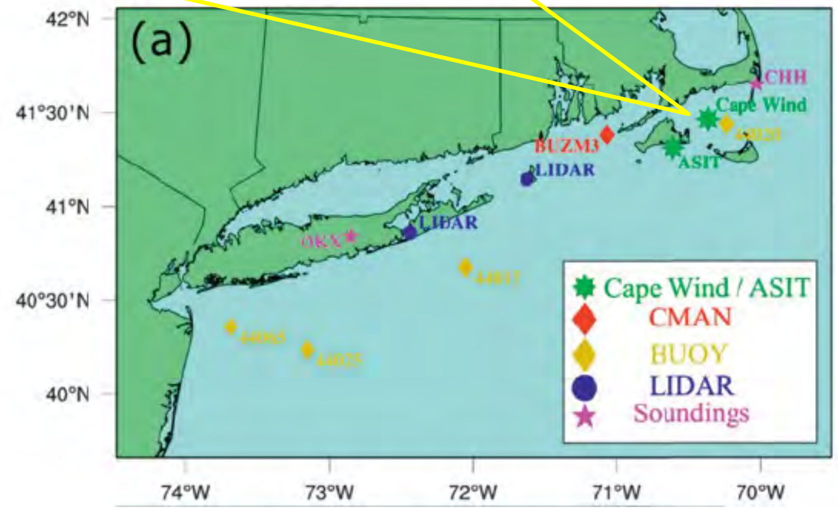
Instrument	Measurement	Requested or PI supplied	Relevant objectives
CIMS (CU)	OH, HO_2, RO_2, H_2SO_4	PI supplied	2,3,4
I-CIMS (UW)	VOCs, oxidation products, chlorinated species, $ClNO_2$, Cl_2, HONO, N_2O_5, etc	PI supplied	1,2,3,4
PTRTOFMS Vocus (UW)	VOCs (VCPs, VOC_{ff}, BVOC)	PI supplied	1,2,3,4
ATOFMS (UM)	Individual particle composition, including sea salt quantitation	PI supplied	2,3,4
AMS (CSU)	SOA composition	PI supplied	1,2,3,4
TOGA-TOF (ACOM)	Organic gases; ACOM	Requested	1,2,3,4
ISAF (UMd)	CH_2O	PI supplied	1,2,3,4
Fast NOx, NOy, O_3 (ACOM)	NOx, NOy, O_3	ACOM	2,3,4
PANs (ACOM)	PAN	ACOM	2,3,4
Picarro (ACOM)	GHG/CO/SO_2	ACOM	3,4
TRAC (SBU)	Aerosol impaction collector	PI supplied	2,3,4
Mini WAAS (ACOM)	VOCs	ACOM	1,2,3

*EOL requested aerosol instruments not shown

NYMR observations, July-August

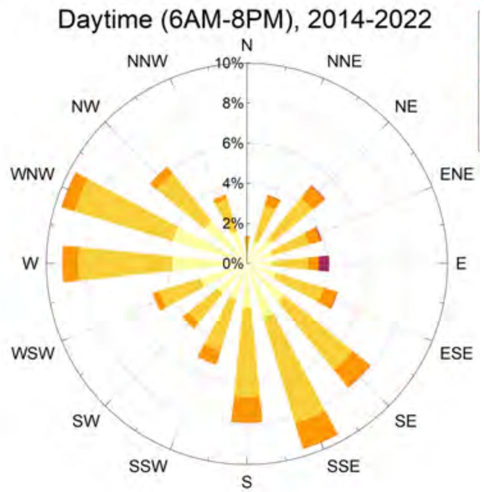


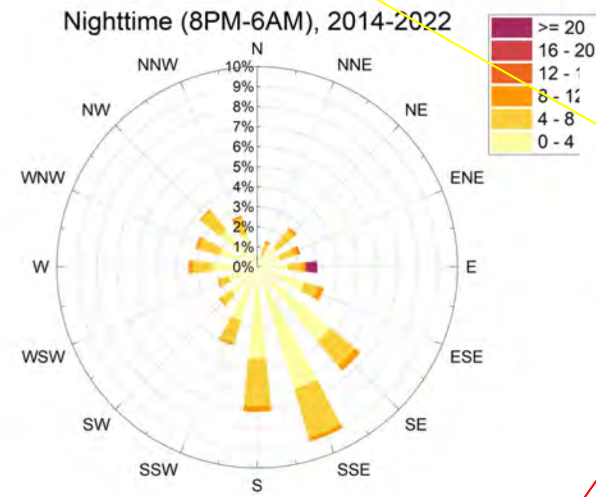
Wind rose from Cape Wind offshore Tower (@20m MSL), JJA 2003-2007 (Colle et al., BAMS, 2016)

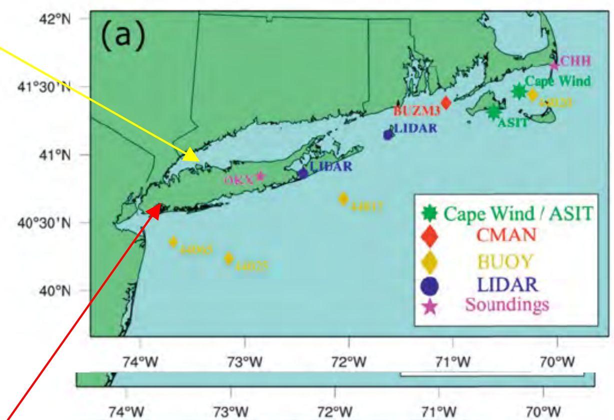


Regional met observations, July-August

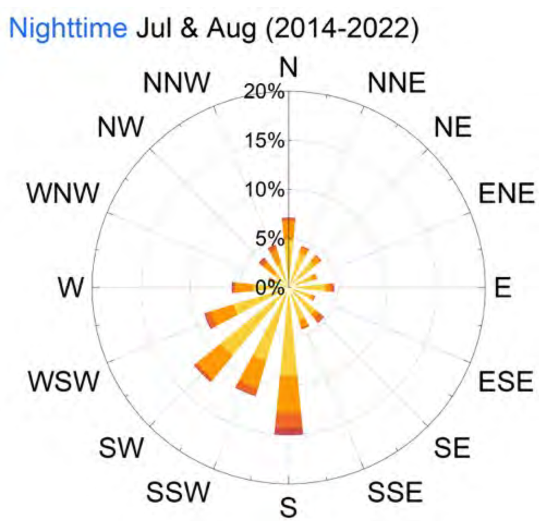
Stony Brook University obs

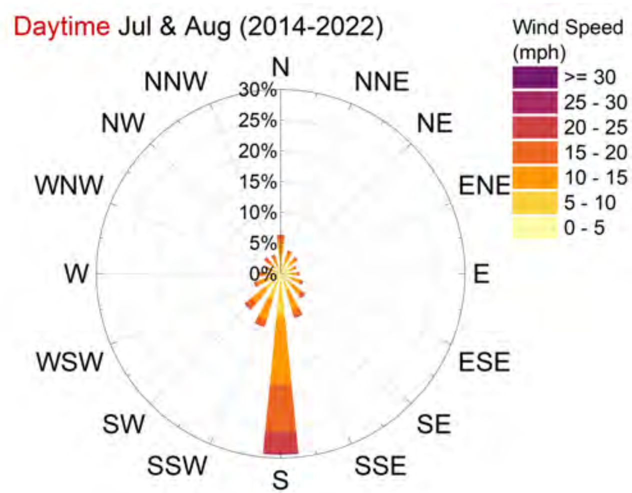






JFK obs





Variations in diurnal transport are a little more complicated than this, with evolution of the sea breeze and LLJs (e.g., Colle et al., 2016 and refs therein)

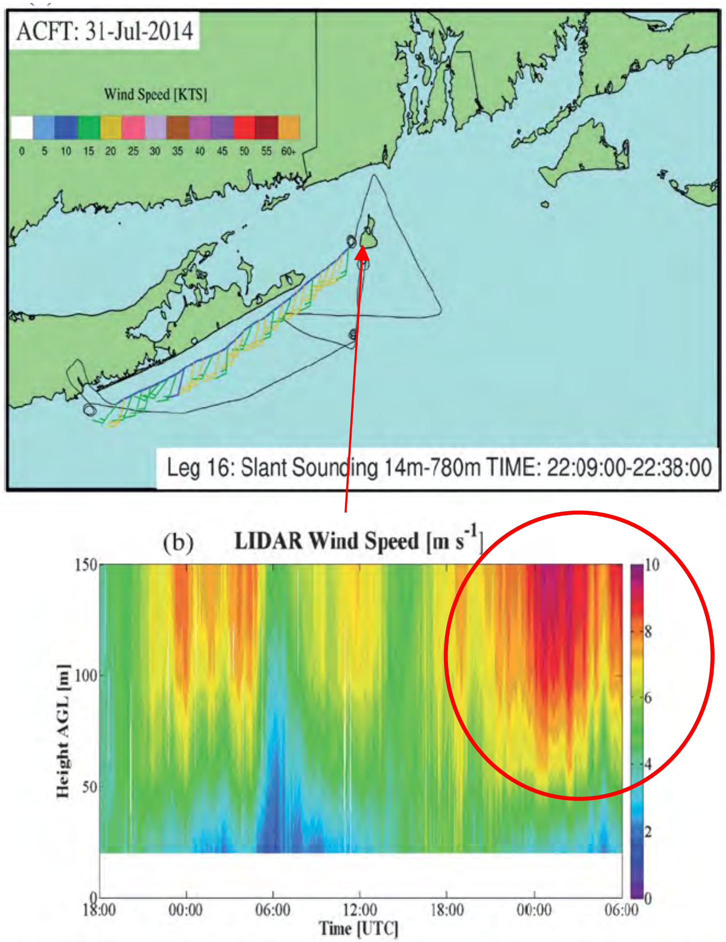


FIG. 10. (a) Flight track and flight-level winds (shaded; kt; full barb ~5 m s^{-1}) between 30 and 700 m MSL from the Long-EZ aircraft for 2209–2238 UTC 31 Jul 2014. The location of the lidar is given by the Block Island (BI) location. (b) Lidar wind speed (shaded; m s^{-1}) from 1800 UTC 30 Jul 2014 to 0600 UTC 1 Aug 2014.

Regional met observations, July-August

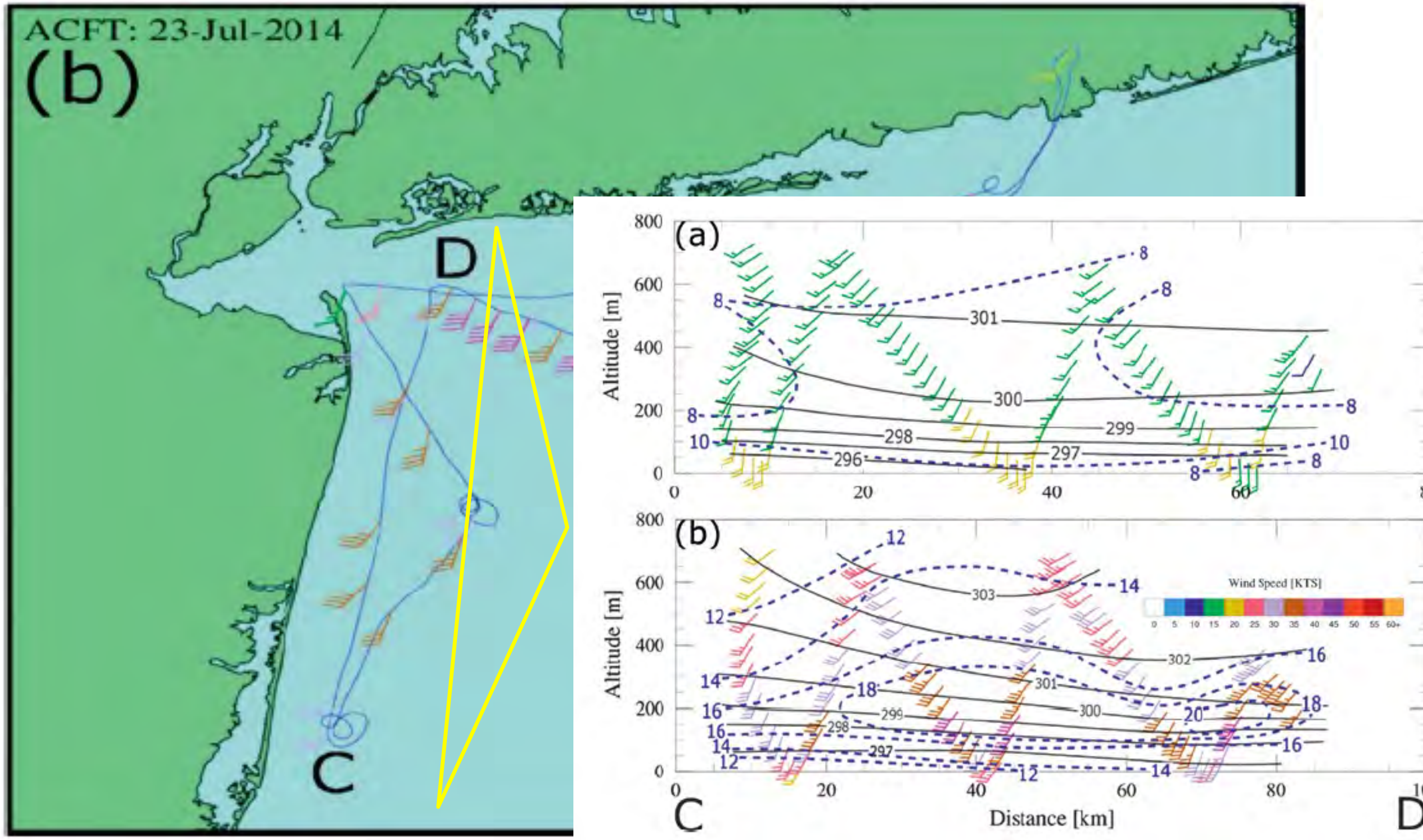
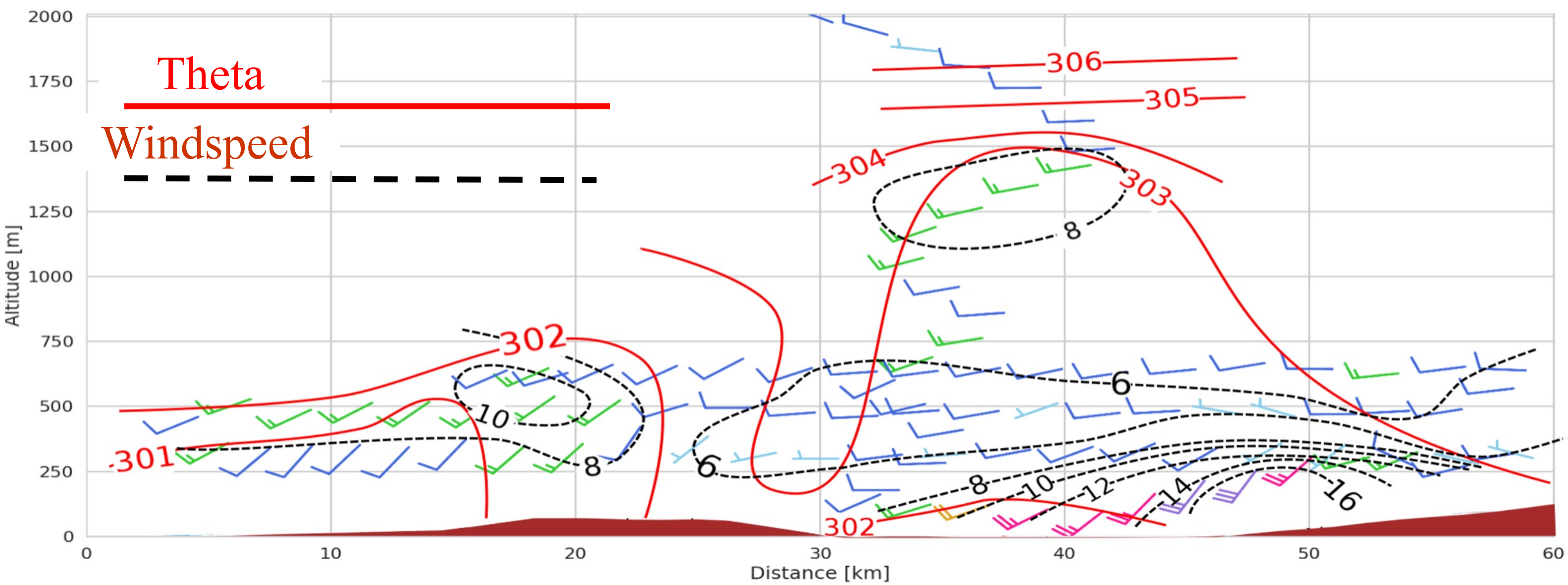


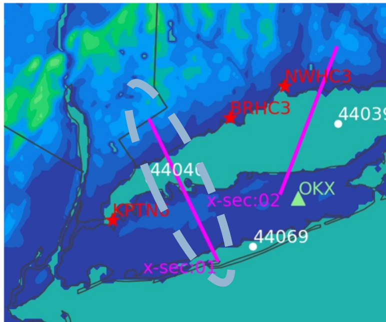
Fig. 9. (a) Potential temperature (contoured every 2 K), wind barbs (colored; kt; full barb ~5 m s^{-1}), and wind speed (dashed blue; every 2 m s^{-1}) from the Long-EZ observations along track CD shown in Fig. 8b from 1604 to 1623 UTC 23 Jul 2014. (b) As in (a), but for flight 2 in Fig. 8b from 2123 to 2141 UTC 23 Jul.

We’ve observed (by plane) very low lying, strong southerly jets off the coasts of New Jersey and CT in the PM that accompanies progression of the sea breeze S-N that can impact evening/nite air mass characteristics to the N.

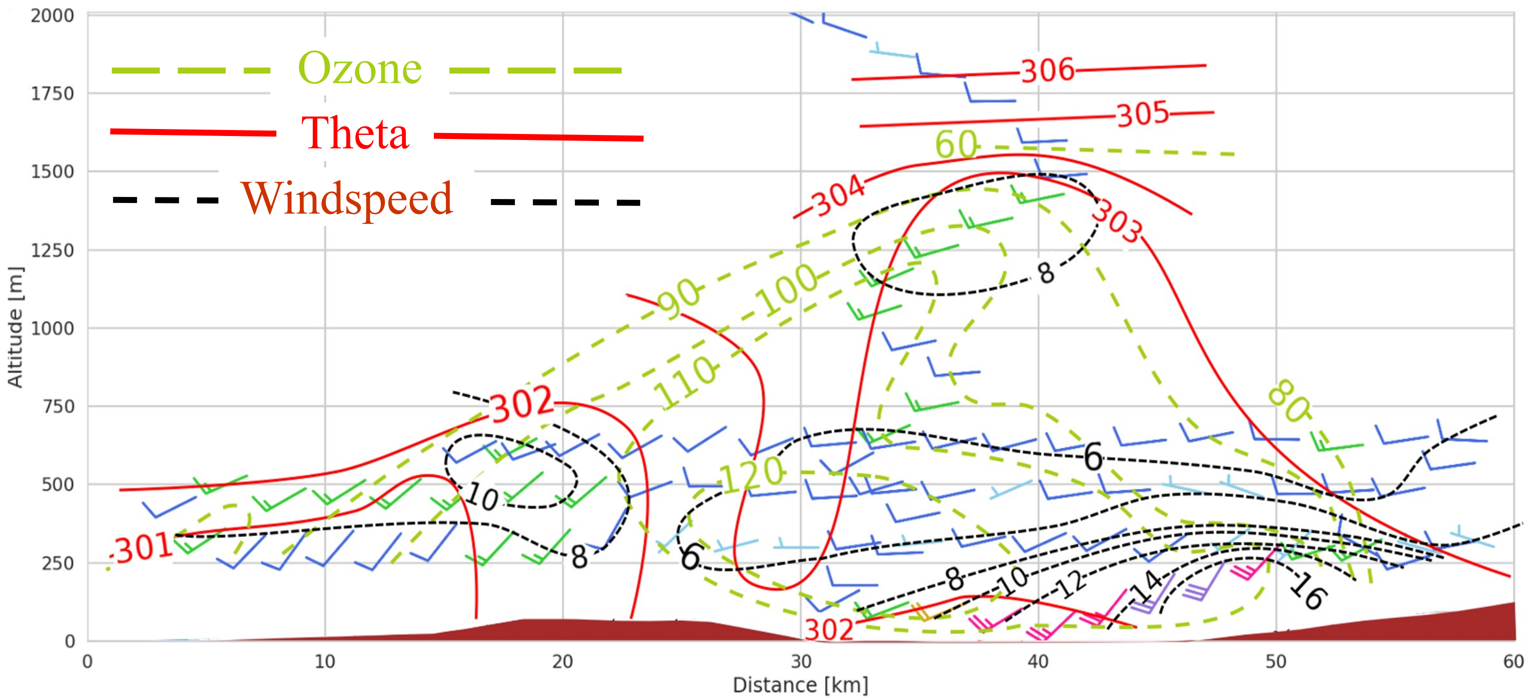
Regional met observations, July-August



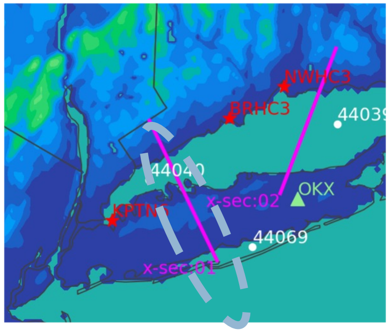
Low lying jet observed (first time) along the CT shoreline just to the E of NYC (July 10 2018, LISTOS Campaign)



Regional met observations, July-August



This jet may transport precursors and other stuff from NYC along LIS (like a very dirty swimming car).



All these jets and the sea breeze might impact significantly the distribution of trace species during a diurnal cycle.

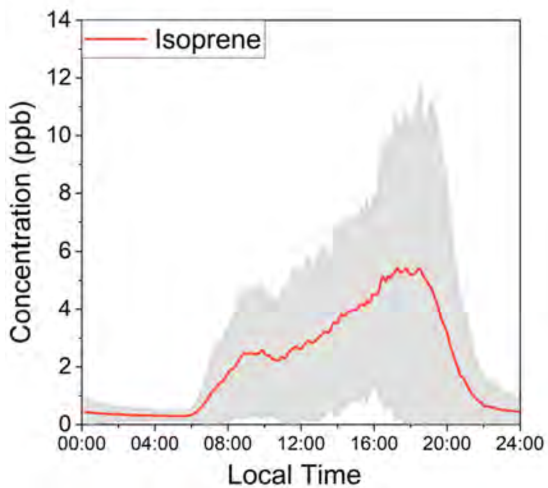
Flax Pond Marine Laboratory, Stony Brook, NY

- Flax Pond is a 0.6 km² preserve that encompasses an entire tidal wetland area.

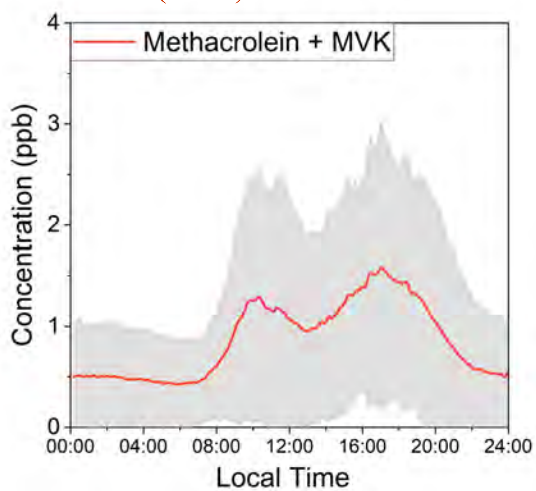
VOC Diurnal Plots

- Concentrations averaged over July and August for 2018, 2019, 2022 data from Flax Pond

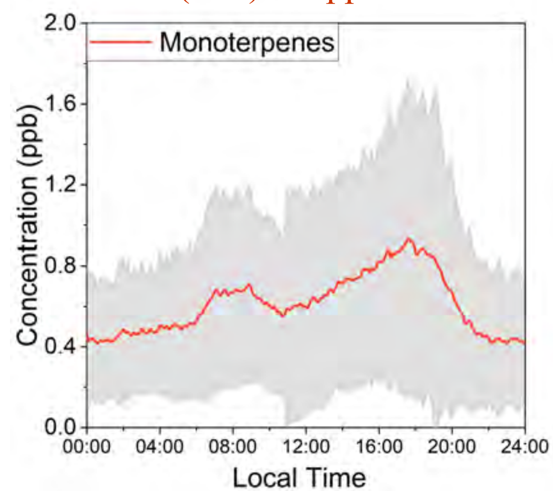
Max (1 hr) 52 ppb 8/10/18



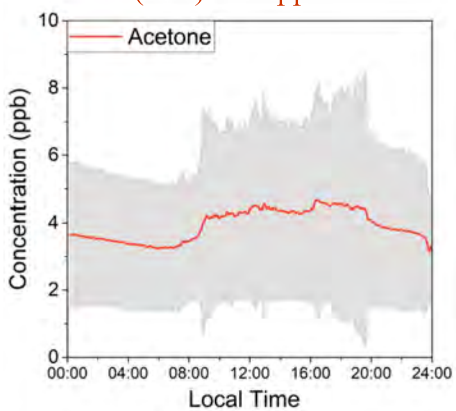
Max (1 hr) 8.4 8/7/18



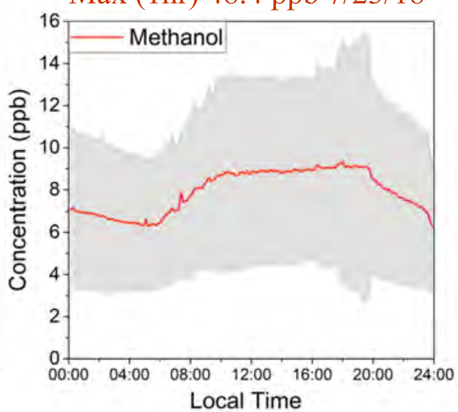
Max (1 hr) 5.3 ppb 7/21/22



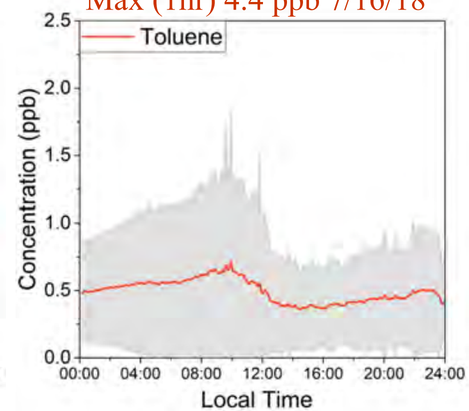
Max (1hr) 27.4 ppb 7/23/18



Max (1hr) 48.4 ppb 7/23/18



Max (1hr) 4.4 ppb 7/16/18



Max (1hr) 6.6ppb 7/2/18