Air Management Advisory Group Quarterly Meeting

June 1, 2023

Hybrid Meeting Guidelines

- Attendees in the room can raise their hand and will be called on. Members may also turn up their name card.
- Online attendees should use the raise hand feature and will be called upon by the meeting host
- The host will attempt to respond to all messages received, but some messages may be missed.
- Participants will join the meeting with their video disabled. We ask that you keep your video disabled for the duration of the meeting, unless called on by the host.

Air Management Advisory Group
Quarterly Meeting Agenda

- Opening remarks
- Agenda review
- Staffing Updates and Introductions
- Proposed guidance, rules and legislative update
- Budget
- Environmental Justice Update
- Member Updates
- Ozone Topics

Staffing Updates

- Pat Stevens – AMAG Co-Chair
- Natalene Cummings – Forest County Potawatomi
- Kristin Hart – Field Operations Director
- Brianna Denk – Acting AQPS Section Chief
- Jordan Munson – Acting Permitting Section Chief

Proposed Guidance, Rules and Legislative Update

Kristin Hart, Field Operations Director

Jordan Munson, Acting Permits and Stationary Source Modeling Section Chief

Brianna Denk, Acting Air Quality Planning and Standards Section Chief

Proposed/Final DNR Rules

Proposed DNR rule	Description	Phase
AM-05-21	Proposed revisions to ch. NR 428 - NOx Reasonably Available Control Technology (RACT)	Public Comment Period - Public hearing held May 31
AM-05-22	Proposed revisions to ch. NR 439 - related to reporting, recordkeeping, testing, inspection and demonstration of compliance	Rule Drafting Period

Proposed EPA Rules/Guidance

Proposed EPA rule/guidance	Docket	Comments due
Reconsideration of the National Ambient Air Quality Standards for Particulate Matter	EPA-HQ-OAR-2015-0072	03/28/2023
Draft Guidance on Nonattainment Area Contingency Measure Requirements for Ozone and Particulate Matter	EPA-HQ-OAR-2023-0063	4/24/2023
Findings of Substantial Inadequacy and SIP Calls to Amend Provisions Applying to Excess Emissions During Periods of Startup, Shutdown, and Malfunction (SSM)	EPA-HQ-OAR-2022-0814	04/25/2023
NESHAP: EtO Emission Standards for Sterilization Facilities	EPA-HQ-OAR-2019-0178	6/12/2023
NESHAP: Coal and Oil-Fired EGUs (MATS)	EPA–HQ–OAR–2018–0794	6/23/2023
NSPS and NESHAP Synthetic Organic Chemical Manufacturing	EPA-HQ-OAR-2022-0730	6/26/2023
GHG Emissions Standards for Heavy-Duty Engines and Vehicles-Phase 3	EPA-HQ-OAR-2022-0985	6/16/2023
NOx and GHG Standards for Light-Duty and Medium-Duty Engines	EPA-HQ-OAR-2022-0829	7/05/2023
GHG Standard and Guidelines for New and Existing Fossil Fuel-Fired Power Plants	EPA-HQ-OAR-2023-0072	7/24/2023

Finalized EPA Rules/Guidance

Finalized EPA rule/guidance	Link	Date finalized
40 CFR Part 63 – Subpart HHHHH – NESHAP for Miscellaneous Coating Manufacturing	EPA-HQ-OAR-2018-0747	2/22/2023
Federal "Good Neighbor" Plan for the 2015 Ozone NAAQS	Pre-publication	3/15/2023

Legislative Update

- Joint Finance Committee Actions impacting Air Management

Environmental Justice Update

Kristin Hart
Air Management Program Field Operations Director

Environmental Justice in Air Permitting

Meaningful engagement

- Continue to enhance permit website to make permit information more accessible and easier to understand
- Provide outreach as appropriate to groups potentially impacted by permit actions

Disproportionate Impacts

- Use existing EJ screening tools to determine which applications may need an EJ analysis
- Continue to work with EPA and regulated sources on approaches to determining and mitigating disproportionate impacts

Member Updates

Ozone Topics

Katie Praedel
Air Monitoring Section Chief

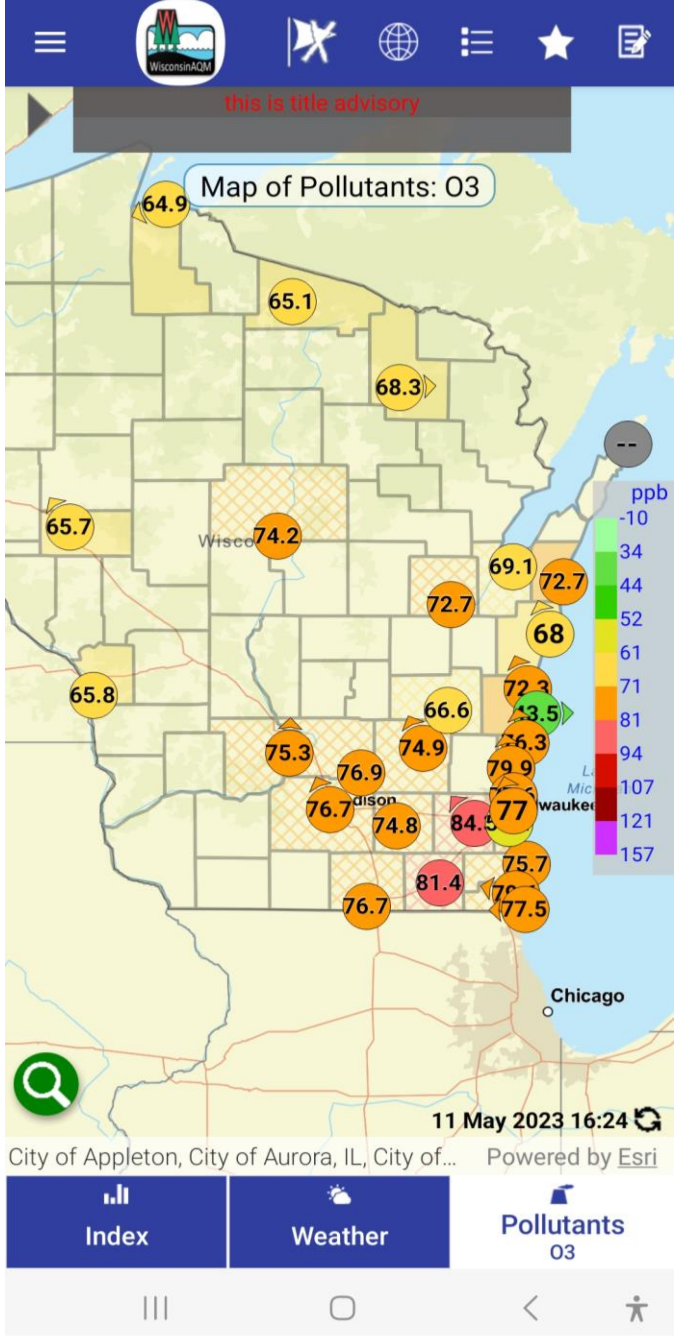
Brianna Denk
Acting Air Quality Planning and Standards Section Chief

Brad Pierce
UW Space Science and Engineering Center Director

Spring Ozone Season 2023

- Began sampling April 1, 2023 at most sites
    - Exceedances
    - Advisories

- Patterns of ozone in the Spring



Wisconsin's Preliminary Design Values 2023

Top Four 8-Hour Average Ozone Concentrations - as of June 1, 2023

Monitor Name	Monitor ID	1st high		2nd high		3rd high		4th high		4th high values		2023 Critical values		Days at/above C.V.		Current 2021-2023 "Design Value"
		conc (ppb)	date	conc (ppb)	date	conc (ppb)	date	conc (ppb)	date	2021	2022	2008 std	2015 std	2008 std	2015 std	
Appleton	550870009	81	5/30	77	5/23	70	5/11	70	4/14	63	63	102	87	0	0	65
Bad River	550030010	67	4/11	66	5/23	63	4/12	62	5/31	63	56	110	94	0	0	60
Bayside	550790085	73	4/14	73	5/30	72	5/11	70	5/31	72	74	82	67	0	6	72
Beloit	551050030	86	5/30	77	5/23	75	5/29	74	5/31	66	65	97	82	0	1	68
Chiwaukee	550590019	82	4/14	77	5/30	76	5/11	72	5/31	79	70	79	64	1	11	73
Columbus	550210015	82	5/30	78	5/23	75	5/31	73	5/29	65	62	101	86	0	0	66
Devils Lake	551110007	79	5/30	74	5/31	72	5/11	71	5/29	65	60	103	88	0	0	65
Eau Claire	550350014	74	5/23	71	4/12	69	5/31	69	5/30	67	58	103	88	0	0	64
Elkhorn	551270006	79	5/30	78	5/23	77	5/11	75	5/31	69	70	89	74	0	4	71
Fond Du Lac	550390006	77	5/30	71	5/23	65	5/29	65	5/11	65	64	99	84	0	0	64
Grafton	550890008	75	5/11	73	4/14	73	5/30	70	5/31	72	72	84	69	0	5	71
Green Bay-UW	550090026	81	5/30	76	5/23	69	4/14	67	5/11	64	65	99	84	0	0	65
Harrington Beach	550890009	73	4/14	73	5/11	72	5/30	69	5/31	73	71	84	69	0	5	71
Horicon	550270001	82	5/30	78	4/28	78	5/23	73	5/29	68	65	95	80	0	1	68
Jefferson	550550009	79	5/30	75	5/23	72	5/11	72	5/29	65	63	100	85	0	0	66
Kenosha-WT	550590025	79	4/14	75	5/11	72	5/30	70	5/31	72	71	85	70	0	4	71
Kewaunee	550610002	75	5/30	72	5/29	69	5/11	68	5/12	68	72	88	73	0	1	69
La Crosse	550630012	77	5/30	69	5/29	67	5/31	67	5/22	62	56	110	95	0	0	61
Lake Dubay	550730012	79	5/30	74	5/31	72	5/11	70	5/28	60	57	111	96	0	0	62
Madison East	550250041	81	5/30	77	5/31	77	5/23	73	5/29	66	62	100	85	0	0	67
Manitowoc	550710007	66	5/30	66	5/11	66	4/14	64	5/29	70	81	77	62	0	5	71
Milwaukee-16th	550790010	65	4/14	61	5/30	60	5/12	59	5/29	66	65	97	82	0	0	63
Milwaukee-UPark	550790068	71	4/14	71	5/11	71	5/12	70	5/30	71	70	87	72	0	0	70
Newport	550290004	73	4/14	71	4/15	71	5/11	70	5/12	70	75	83	68	0	5	71
Potawatomi	550410007	76	5/30	73	5/31	72	5/12	67	5/11	58	59	114	96	0	0	61
Racine	551010020	76	4/14	74	5/30	72	5/11	70	5/31	78	70	80	65	0	6	72
Sheboygan-Haven	551170009	74	5/30	70	4/14	69	5/11	66	5/23	66	71	91	76	0	0	67
Sheboygan-KA	551170006	78	4/14	75	5/31	72	5/30	72	5/12	73	77	78	63	2	13	74
Trout Lake	551250001	76	5/30	74	5/23	73	5/31	69	5/29	59	57	112	97	0	0	61
Waukesha	551330027	78	4/14	78	5/30	78	5/11	76	5/23	70	69	89	74	0	4	71

Highlighted values are above the 2015 NAAQS level (70 ppb).

color-coded by #

71-75 ppb

>75 ppb

Notes:

The critical value is the fourth high value at and above which the three-year design value would exceed the standard.

2023 data have not been QA'ed or certified and are subject to change.

Wisconsin's Preliminary Design Values 2023

Top Four 8-Hour Average Ozone Concentrations – as of June 1, 2023

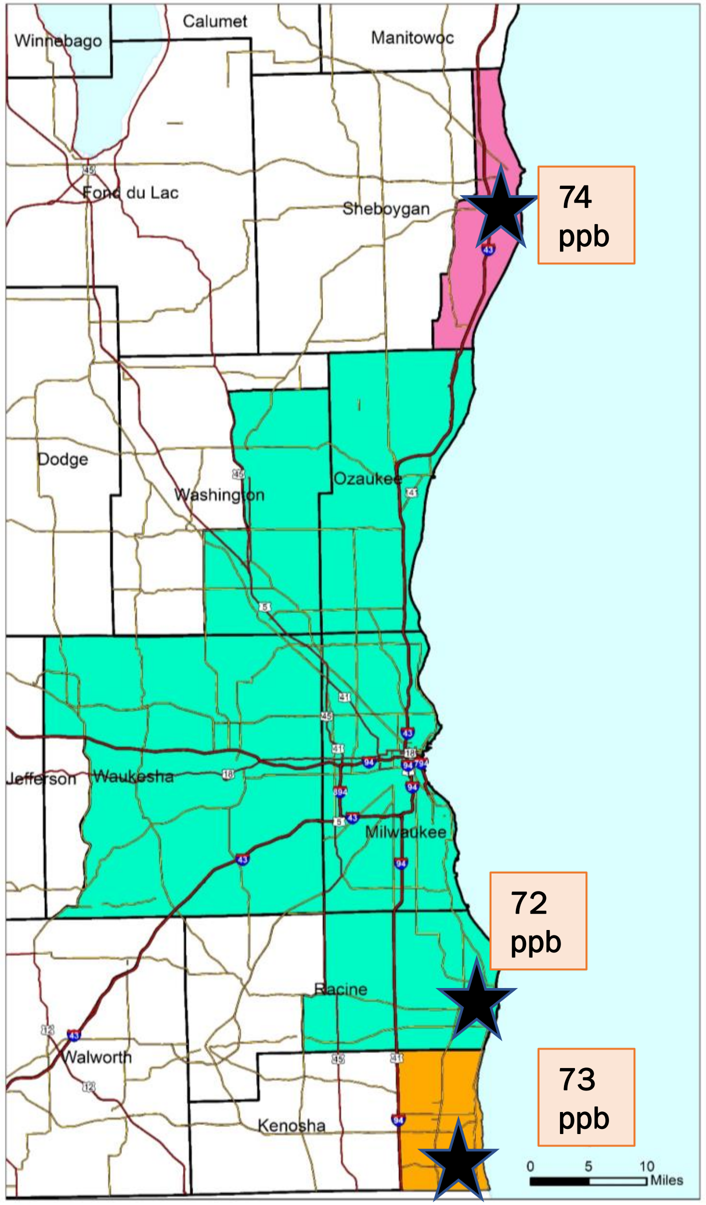
Wisconsin Sites	Concentrations (ppb)				2023 Critical Values (2015 standard)	Days at/above Critical Values (2015 standard)	Preliminary 2021-2023 "Design Value" (2015 standard)
	1st high	2nd high	3rd high	4th high			
Bayside	73	73	72	70	67	6	72
Beloit	86	77	75	74	82	1	68
Chiwaukee	82	77	76	72	64	11	73
Elkhorn	79	78	77	75	74	4	71
Grafton	75	73	73	70	69	5	71
Harrington Beach	73	73	72	69	69	5	71
Horicon	82	78	78	73	80	1	68
Kenosha-WT	79	75	72	70	70	4	71
Kewaunee	75	72	69	68	73	1	69
Manitowoc	66	66	66	64	62	5	71
Newport	73	71	71	70	68	5	71
Racine	76	74	72	70	65	6	72
Sheboygan-KA	78	75	72	72	63	13	74
Waukesha	78	78	78	76	74	4	71

2015 NAAQS: 70 ppb	Reached Critical Value	Exceeded Standard

Note: 2023 data have not yet been QA'ed or certified and are subject to change. Values are only shown for monitors that exceeded their critical value at least once.

Impact on Ozone Nonattainment

- Moderate area attainment date for 2015 NAAQS is August 3, 2024.
- Reclassification to Serious will be based on 2021-23 design values.
- Timeline:
  - Moderate area attainment date: August 3, 2024
  - Serious reclassification: Spring 2025
    - Major source threshold 50 tons per year



*Preliminary 2023 DV calculated through May 31, 2023

Federal Implementation Plan “Good Neighbor Plan” Addressing Regional Ozone Transport for the 2015 Ozone Standard

2015 Final ‘Good Neighbor Plan”

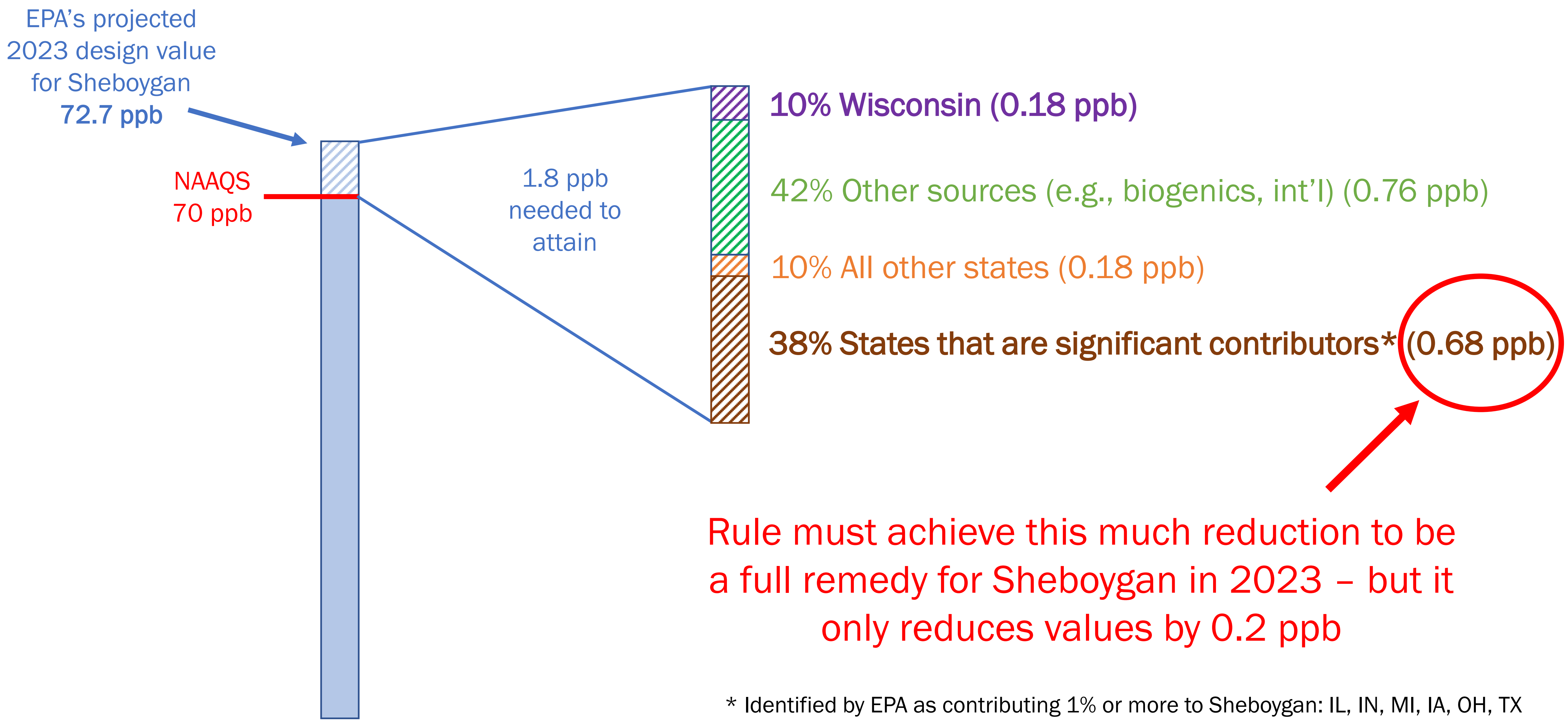
- On March 15, 2023 EPA signed the final ‘Good Neighbor Plan’ for the 2015 ozone standard
  - NOx Allowance Trading Program for Fossil Fuel-Fired Power Plants
    - Starts in 2023
    - Includes Wisconsin
  - NOx Emissions Standards for Nine Large Industries
    - Starts in 2026 (phase in)
    - Does not include Wisconsin
- Does not reduce VOC or mobile source emissions
- Includes analysis of all Wisconsin nonattainment monitors
- EPA’s 2023 modeling continues to underpredict lakeshore ozone
- Minimal air quality impact benefits for nonattainment areas

Limited air quality impacts of final GNP

Monitor	2023			2026			Current status
	Base Case (ppb)	With Final GNP (ppb)	Improvement (ppb)	Base Case (ppb)	With Final GNP (ppb)	Improvement (ppb)	Draft 2021-23 DVs (ppb)
Sheboygan	72.7	72.5	0.2	70.8	70.5	0.3	74 - Nonattainment
Kenosha (Chiwaukee Prairie)	70.8	70.7	0.1	69.2	69.0	0.2	73 - Nonattainment
Racine	69.7	69.6	0.1	68.0	67.8	0.2	72 - Nonattainment

Final rule only improves ozone values by
0.1 - 0.3 ppb

Fully resolving transport for Sheboygan



Rule must achieve this much reduction to be a full remedy for Sheboygan in 2023 – but it only reduces values by 0.2 ppb

* Identified by EPA as contributing 1% or more to Sheboygan: IL, IN, MI, IA, OH, TX

Regional and National Ozone Research

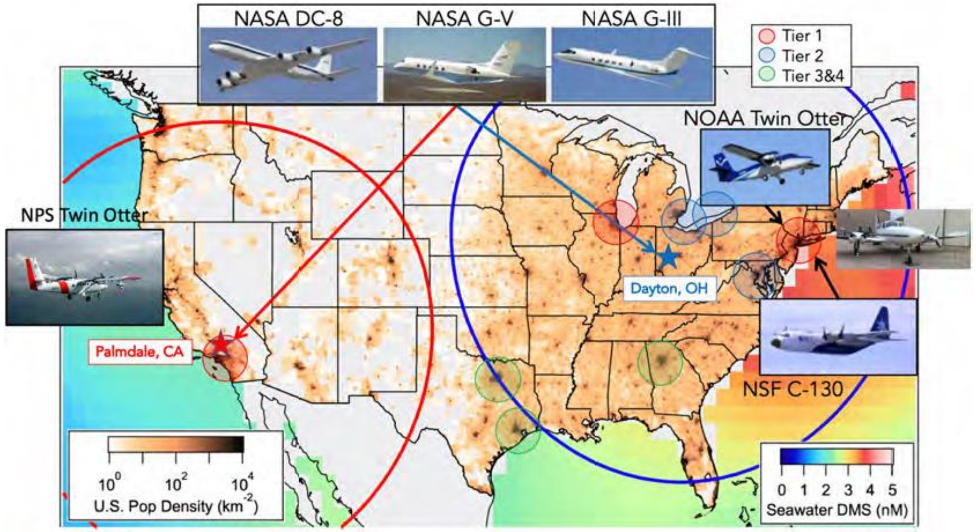
Bradley R, Pierce
Director
Space Science and Engineering Center
University of Wisconsin-Madison

DNR 2023 Enhanced Ozone Monitoring Program
Links to NASA/NOAA Airborne Field Campaigns and TEMPO science

STAQS

TEMPO

CUPiDS
Coastal Urban Plume Dynamics Study
2023



Tropospheric Ozone Lidar Network
TOLNet

NOAA 2023
AEROMMA
Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas

Brad Pierce
University of Wisconsin-Madison

The Wisconsin Department of Natural Resources (WDNR) and the Lake Michigan Air Directors Consortium (LADCO) played a key role in the 2017 Lake Michigan Ozone Study (LMOS 2017)

US-EPA deployed remote sensing instruments at WDNR air monitoring sites for mixed layer height, cloud layer height (Ceilometers), column NO2, and column ozone (Pandora)

- Ceilometers were deployed at Grafton, Milwaukee, and Zion.
- Pandora spectrometers were installed at Sheboygan, Grafton, Milwaukee, Zion, and Schiller Park (Chicago).

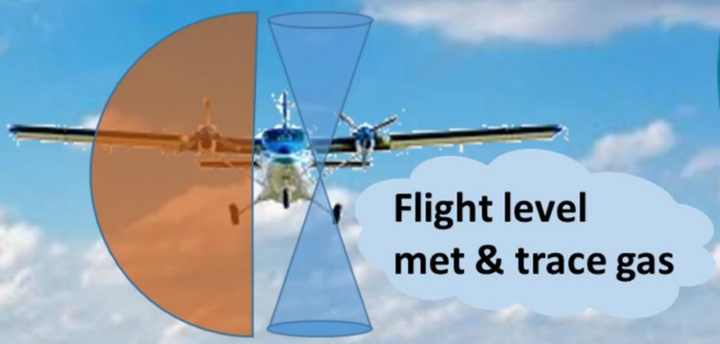
NASA, NOAA and DOE will be conducting an even larger campaign over Chicago in August 2023

Stanier, C. O., and Coauthors, 2021: Overview of the Lake Michigan Ozone Study 2017. *Bull. Amer. Meteor. Soc.*, 102, E2207–E2225, https://doi.org/10.1175/BAMS-D-20-0061.1.

Three major airborne field campaigns will be conducting flights over Chicago and Lake Michigan during July and August 2023 including:

- Coastal Urban Plume Dynamics Study (CUPiDS)
- Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA)
- Synergistic TEMPO Air Quality Science (STAQS)

CUPiDS: Coastal Urban Plume Dynamics Study-Chicago



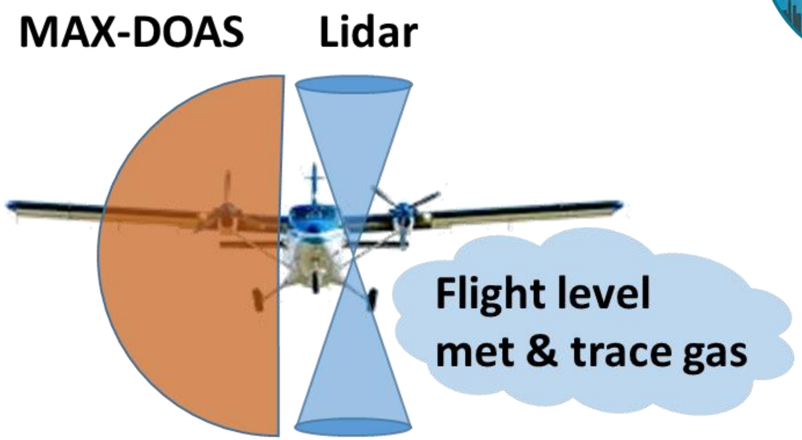
NOAA Twin Otter

Sunil Baidar, Alan Brewer, Steven Brown
NOAA Chemical Sciences Laboratory
Boulder, Colorado

Target dates in Chicago/Lake Michigan area:
1 – 11 July 2023

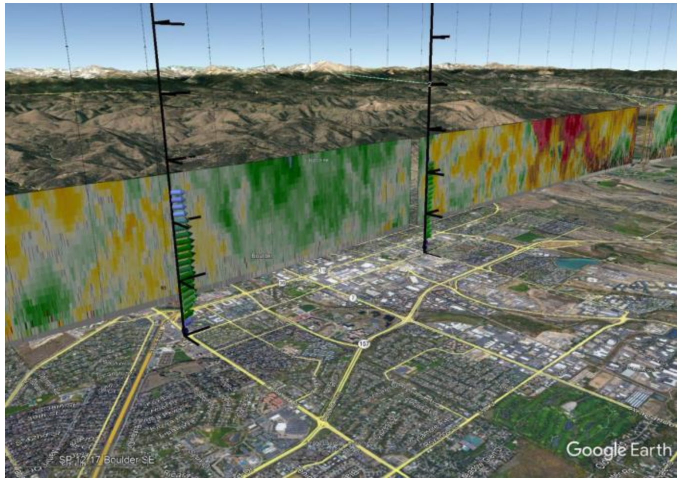
Instrumentation and Schedule

CUPiDS instruments	Measured Species
Scanning Doppler Lidar	Wind, turbulence and aerosol profiles Boundary layer height
MAX-DOAS	NO_2, formaldehyde, glyoxal columns Profiles during missed approaches
NO_XCaRD	In-situ NO, NO_2, NO_y, O_3 (<50 pptv precision, 1 Hz)
Picarro	In-situ CO_2, CH_4, CO, H_2O
Radiometer	Surface albedo at 360, 477, 577, and 630 nm (corresponds to O_4 bands), Surface temperature
Filter radiometer	Up and downwelling NO_2 photolysis rate (jNO_2)
Meteorological probe	Temp, Pres, RH, flight level winds, GPS



NOAA Twin Otter

Unique package for dynamics and ozone photochemistry



Scanning Doppler Lidar: Boundary layer depth and wind fields to characterize dynamics and flows over water, land and shorelines

MAX-DOAS: Spectral retrievals of major UV-VIS absorbing trace gases, particularly NO_2 and CH_2O as O_3 precursor proxies, in both column (nadir viewing) and forward facing

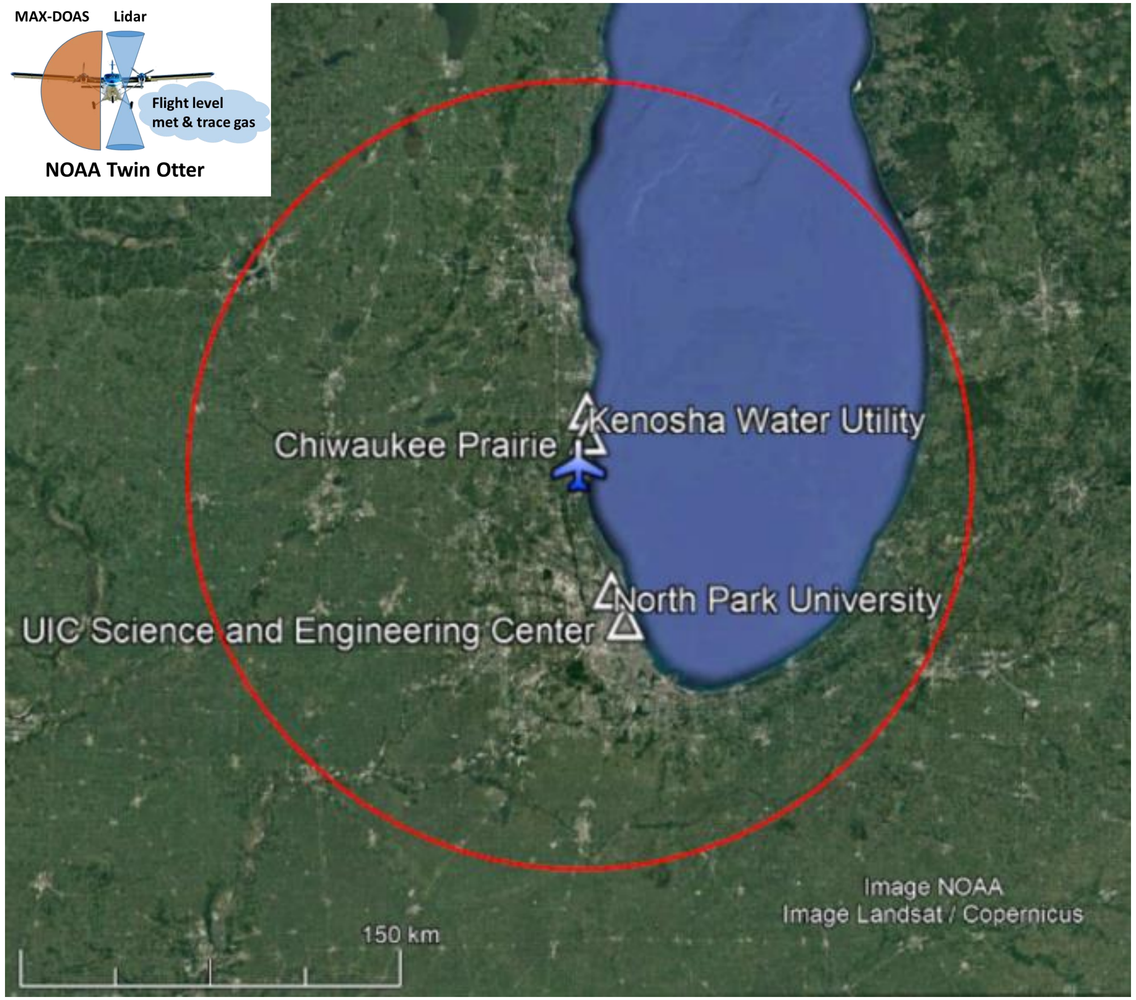
NOxCaRD: In-situ NO_x, NO_y and O_3 to characterize emissions, aging (NO_x/NO_y), and O_3 production efficiencies

Picarro: In-situ greenhouse gases and CO (tracer for urban emissions)

Radiometers: $j(NO_2)$ for rates of O_3 photochemistry

Instrumentation and Schedule

CUPiDS Coastal Urban Plume Dynamics Study 2023



Approximate range ring for NOAA Twin Otter operations considering 4 hour flight endurance and a base in Kenosha, WI

Twin Otter Flight Characteristics

Cruising Speed ~ 60 m s^{-1} (~120 knots)

Lowest cruise altitude: 1000 feet / 300 m over land
500 feet / 150 m over water

Lower altitude / profiles from missed approaches to airfields or lower legs upon request (TBD)

Max altitude: ~20,000 feet / 6 km with oxygen
12,500 feet / 3.8 km without oxygen

Endurance: 3.5 – 4 hours depending on payload weight

Campaign Schedule

Target dates in Chicago area: 1 – 11 July 2023

Flight days: 4 to 5 within 10 day campaign interval

Flights per day: 2 back to back flights (7-8 hours total)

Total flight hours: 25 – 40

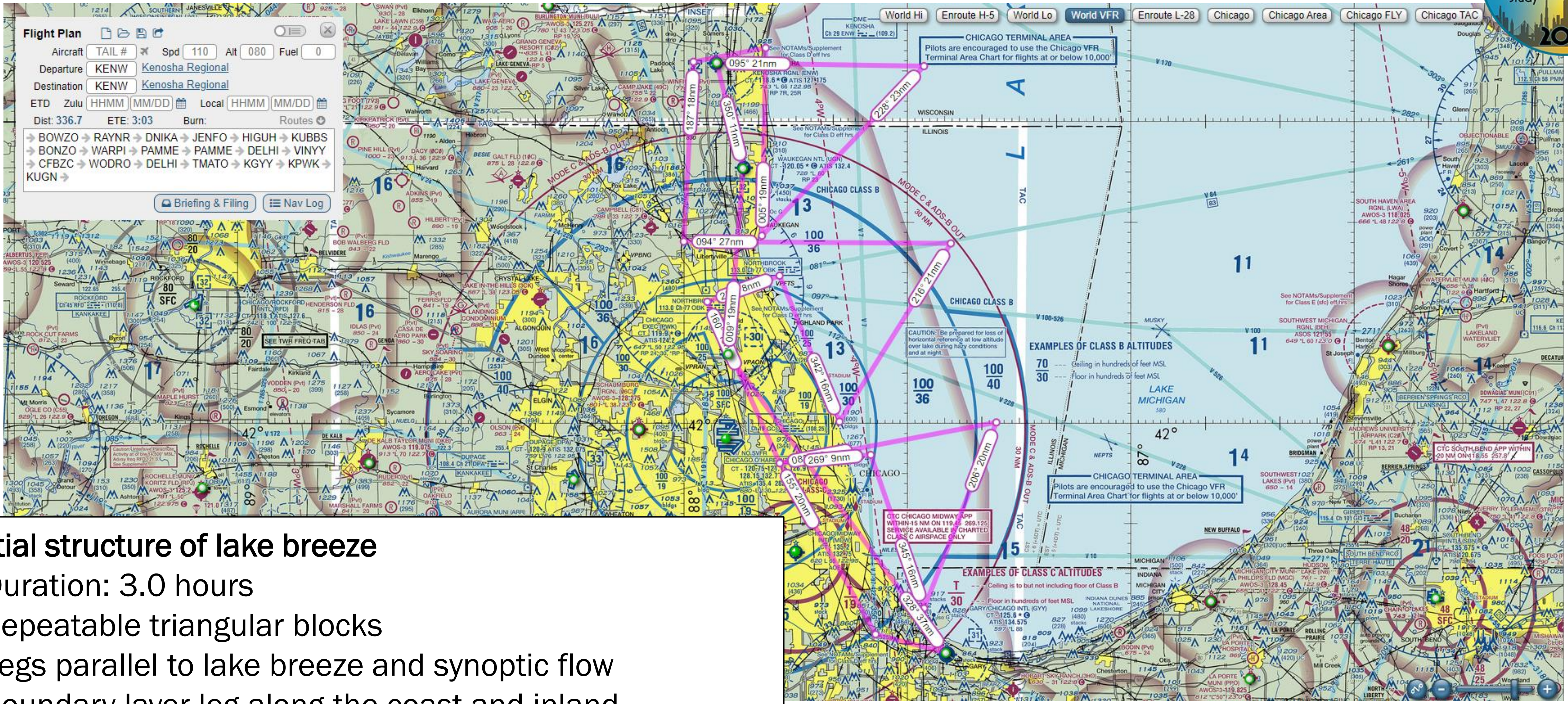
Major scientific objectives

High O_3 days with lake breeze impacts, if they occur

Vertical profiles of pollutants over land and water

Mass flux of NO_y (NO_x), CO, CH_2O and O_3 from major regional sources

Example Flight Plan: Lake Breeze



Spatial structure of lake breeze

- Duration: 3.0 hours
- Repeatable triangular blocks
- Legs parallel to lake breeze and synoptic flow
- Boundary layer leg along the coast and inland
- Flight altitudes: 10 kft and < 1 kft (outside and inside BL)
- Profiles at over water and inland (KGYY, KPWK, KUGN)

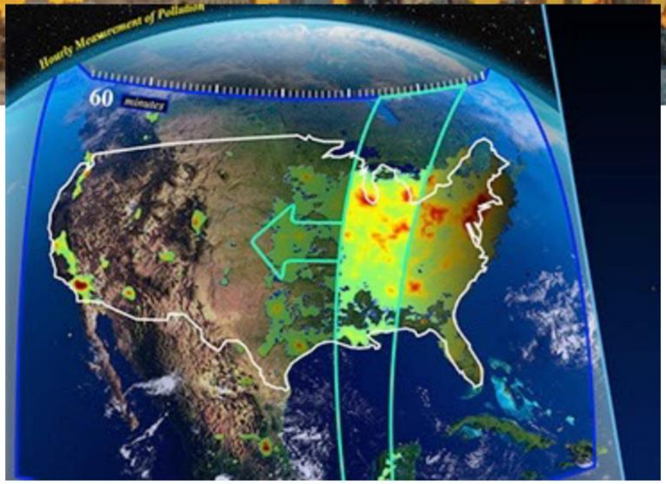
A similar flight plan can be executed to the north to encompass the Kenosha to Sheboygan region

AEROMMA:

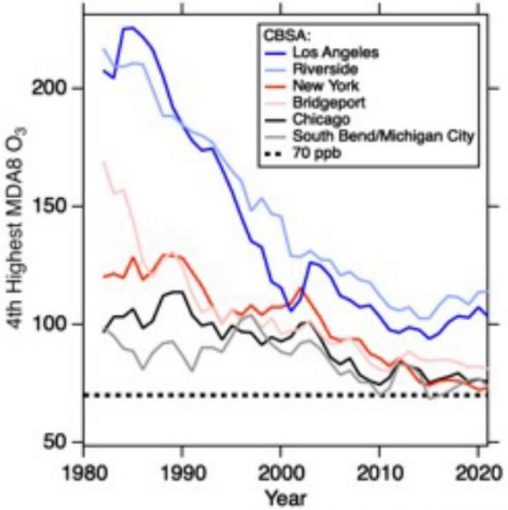
Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas

https://csl.noaa.gov/projects/aeromma/

Target dates in Chicago/Lake Michigan area:
1 – 17 August 2023

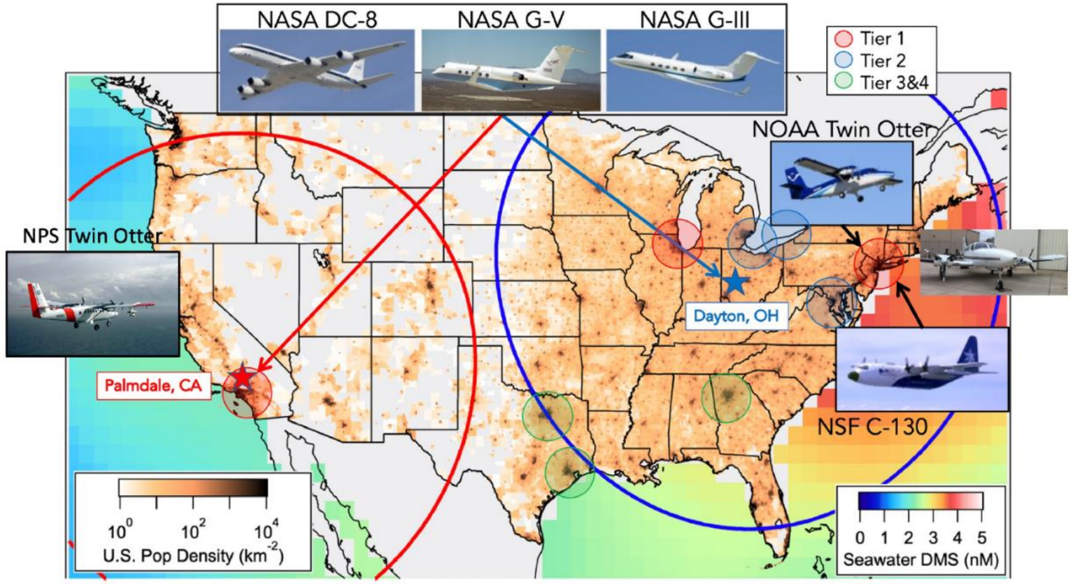


Motivation: Generally ozone has been declining since the 1980s in major US cities, but over the last decade ozone has been stabilizing above the US EPA standard

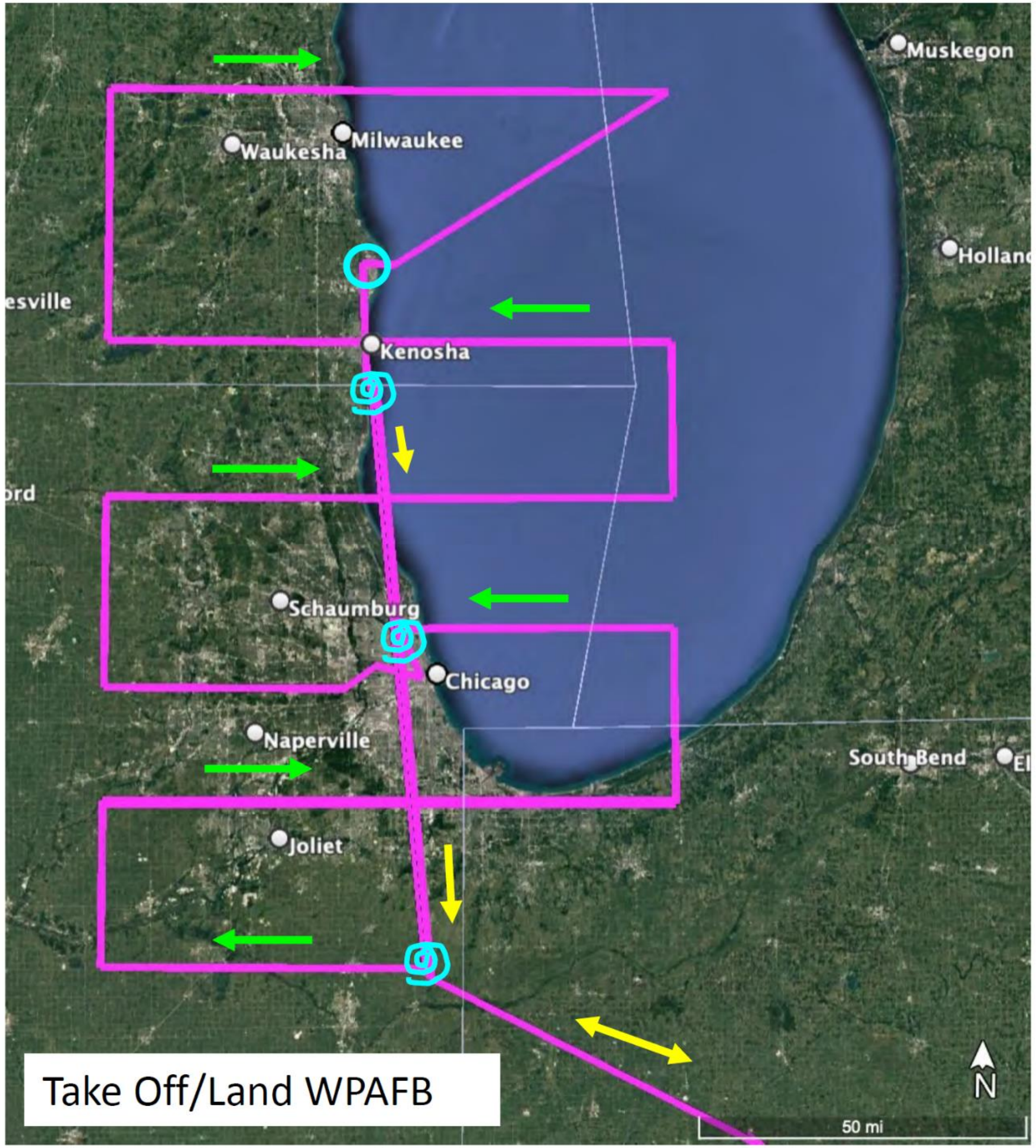


Goal: Better understand current urban emissions and chemical formation of major air pollutants such as ozone and aerosols to determine why this stabilizing is occurring using both aircraft and geostationary satellites

AEROMMA is part of a large effort across many platforms from NASA, NOAA, NSF, and the university community to study urban air pollution in the summer of 2023



Chicago: Target Goals



- Repeat the magenta flight track for 3 days
  - 1 Weekday take off at 10 am
  - 1 Weekday take off at 12 pm
  - 1 Weekend take off at 10 am
- Priorities for choosing flight days
  - 1) Cloud free
  - 2) AQI Yellow/Orange
  - 3) Multi-day event especially Friday/Saturday or Monday/Sunday, so get a clear weekend/weekday contrast under similar meteorological conditions
- The repetition of the magenta flight track provides:
  - daily variability
  - diurnal variability
  - weekend/weekday impact
- For the fourth flight, we will aim for a lower ozone condition to get variability for the model/satellites. Possibly, lower expected ozone when wind is from the South/Southwest or when the wind is from the North when ozone production is typically lower.

Synergistic TEMPO Air Quality Science

In June-August 2023, STAQS seeks to integrate TEMPO observations with traditional and enhanced air quality monitoring to improve the understanding of air quality science for increased societal benefit.

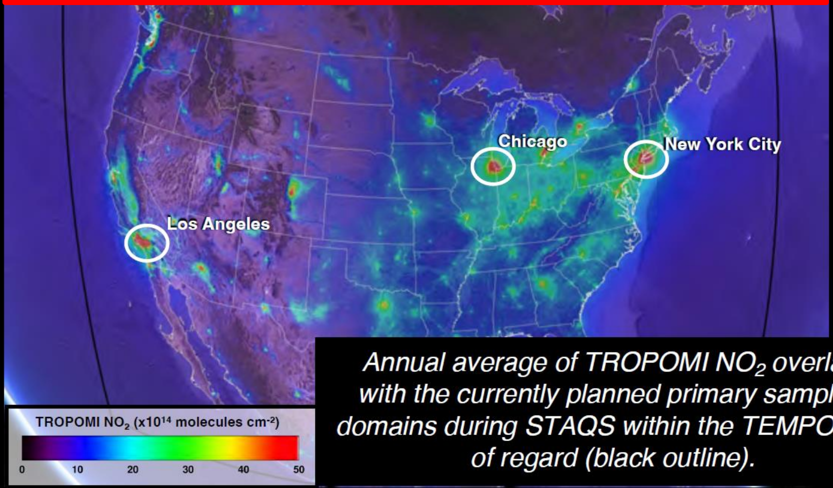
Under TEMPO, we will:

→ Build an integrated observing system consisting of ground-, airborne-, and satellite-based platforms and air quality models.

→ Prioritize repeated systematic sampling in predefined domains during morning, midday, and afternoon over at least 4 days in each primary target areas (LA, NYC, Chicago).

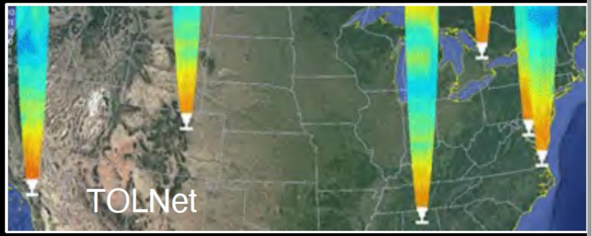
→ Collaborate with research teams engaged with multiple activities (AGES+) occurring in summer 2023 with federal and academic partners.

Target dates in Chicago/Lake Michigan area:
1 – 17 August 2023



Annual average of TROPOMI NO_2 overlaid with the currently planned primary sampling domains during STAQS within the TEMPO field of regard (black outline).

Includes deployment of airborne and ground-based remote sensing observations

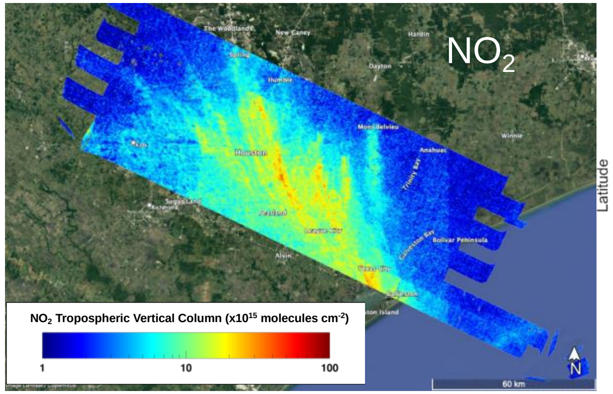


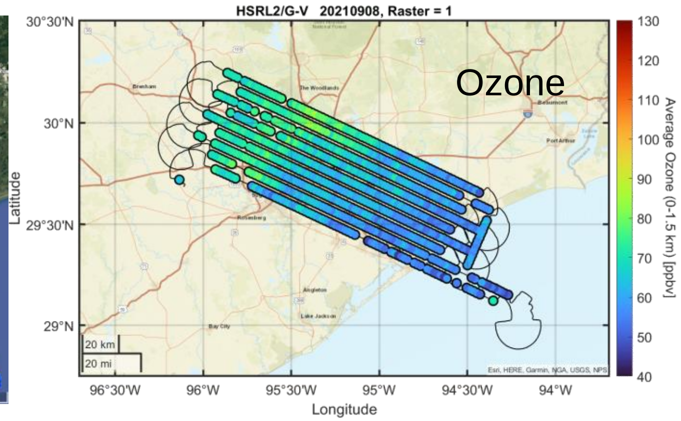
Synergistic TEMPO Air Quality Science (STAQS) Airborne Payloads

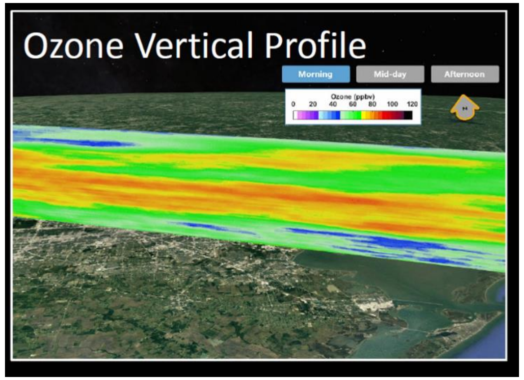
Platform	Instrument	Data Products	Sampling Strategy
NASA JSC G-V	GCAS	NO_2 Column (250 x 560 m) HCHO Column (750 x 1680 m)	Systematic sampling of a ~ 50 x 140 km area 3x per day (morning-midday-afternoon)
	HSRL2/DIAL	Ozone profiles, aerosol profiles, mixed layer height	
NASA LaRC G-III	AVIRIS-NG	CH_4 (> 10 kg/hr) and CO_2 (large point sources) emissions	Systematic sampling of a ~ 50 x 140 km area 2x per day (morning-afternoon)
	HALO	CH_4 columns, aerosol profiles, mixed layer height	

Chicago Flight Pattern

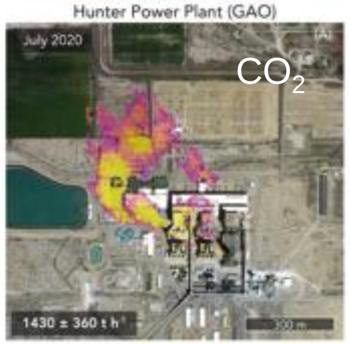
AQ data examples: TRACER-AQ Houston, TX

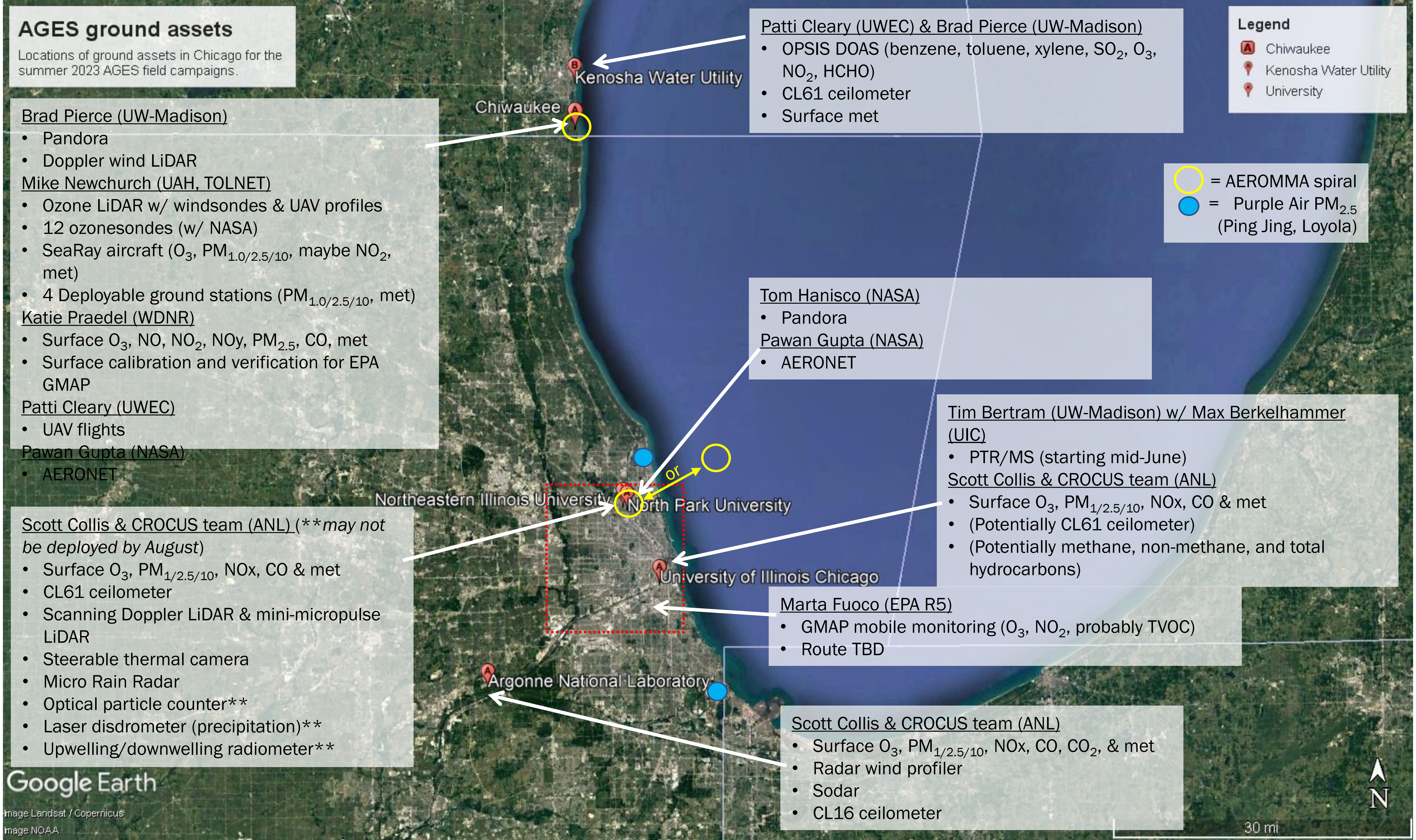






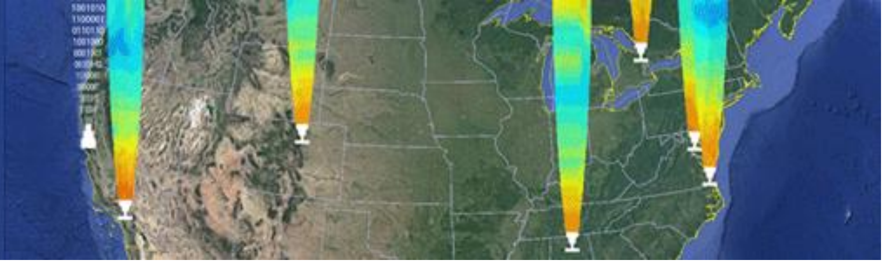
GHG data examples




AGES ground assets
Locations of ground assets in Chicago for the summer 2023 AGES field campaigns.
Patti Cleary (UWEC) & Brad Pierce (UW-Madison)
• OPSIS DOAS (benzene, toluene, xylene, SO_2, O_3, NO_2, HCHO)
• CL61 ceilometer
• Surface met
Legend
Chiwaukee
Kenosha Water Utility
University
Kenosha Water Utility
Chiwaukee
Brad Pierce (UW-Madison)
• Pandora
• Doppler wind LiDAR
Mike Newchurch (UAH, TOLNET)
• Ozone LiDAR w/ windsondes & UAV profiles
• 12 ozonesondes (w/ NASA)
• SeaRay aircraft (O_3, $PM_{1.0/2.5/10}$, maybe NO_2, met)
• 4 Deployable ground stations ($PM_{1.0/2.5/10}$, met)
Katie Praedel (WDNR)
• Surface O_3, NO, NO_2, NOy, $PM_{2.5}$, CO, met
• Surface calibration and verification for EPA GMAP
Patti Cleary (UWEC)
• UAV flights
Pawan Gupta (NASA)
• AERONET
= AEROMMA spiral
= Purple Air $PM_{2.5}$ (Ping Jing, Loyola)
Tom Hanisco (NASA)
• Pandora
Pawan Gupta (NASA)
• AERONET
or
Northeastern Illinois University
North Park University
Tim Bertram (UW-Madison) w/ Max Berkelhammer (UIC)
• PTR/MS (starting mid-June)
Scott Collis & CROCUS team (ANL)
• Surface O_3, $PM_{1/2.5/10}$, NOx, CO & met
• (Potentially CL61 ceilometer)
• (Potentially methane, non-methane, and total hydrocarbons)
Scott Collis & CROCUS team (ANL) (**may not be deployed by August)
• Surface O_3, $PM_{1/2.5/10}$, NOx, CO & met
• CL61 ceilometer
• Scanning Doppler LiDAR & mini-micropulse LiDAR
• Steerable thermal camera
• Micro Rain Radar
• Optical particle counter**
• Laser disdrometer (precipitation)**
• Upwelling/downwelling radiometer**
University of Illinois Chicago
Marta Fuoco (EPA R5)
• GMAP mobile monitoring (O_3, NO_2, probably TVOC)
• Route TBD
Argonne National Laboratory
Scott Collis & CROCUS team (ANL)
• Surface O_3, $PM_{1/2.5/10}$, NOx, CO, CO_2, & met
• Radar wind profiler
• Sodar
• CL16 ceilometer
Google Earth
Image Landsat / Copernicus
Image NOAA
30 mi
N

TOLNET

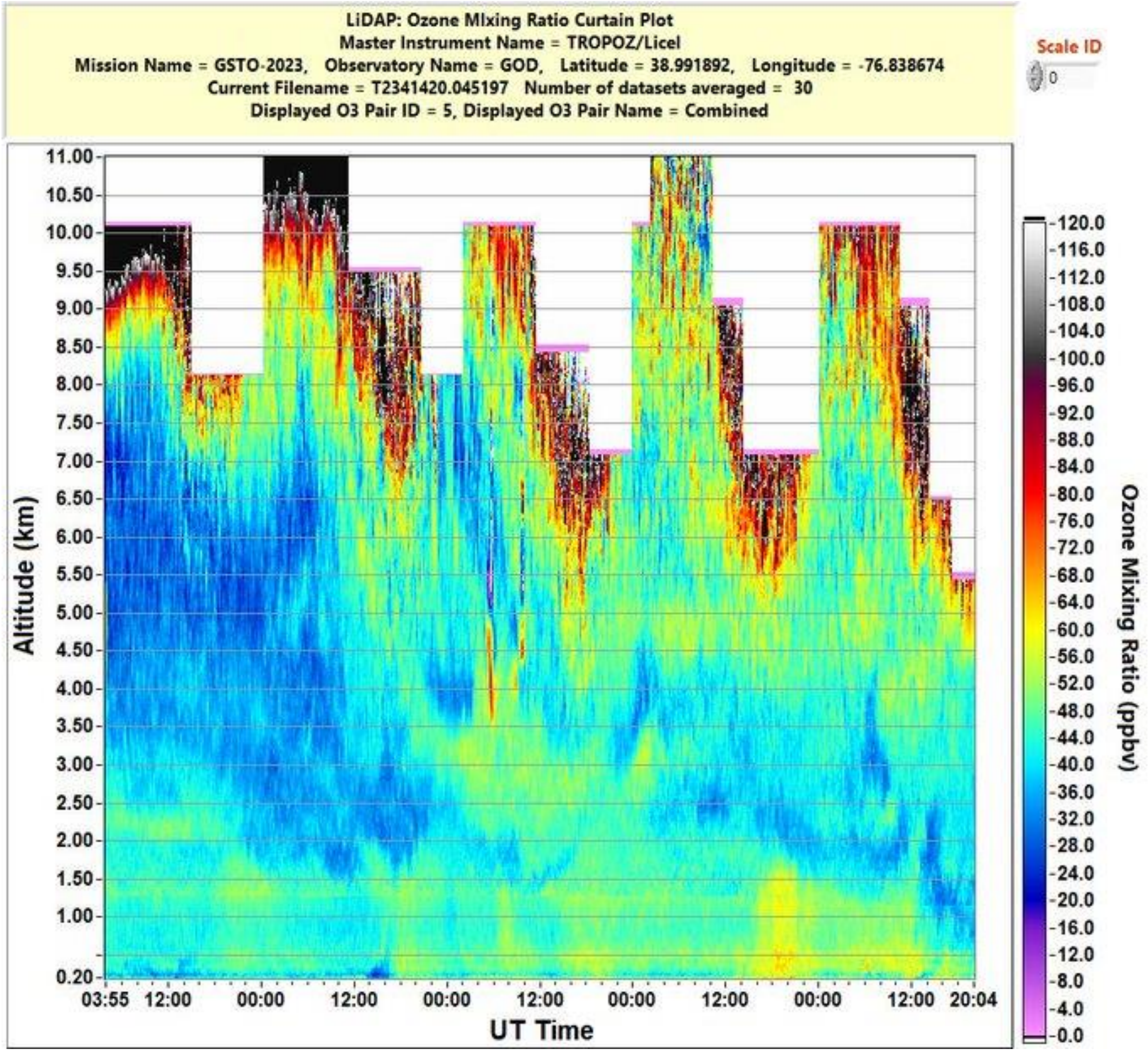
Tropospheric Ozone LIDAR Network



Ground-based Profiling of Tropospheric Ozone

Project Objectives

TOLNet was established in 2012 to provide high spatio-temporal observations of tropospheric ozone to (1) better understand physical processes driving the ozone budget in various meteorological and environmental conditions, and (2) validate the tropospheric ozone measurements of spaceborne missions.



Platforms and Instruments

Deployable Ground Stations

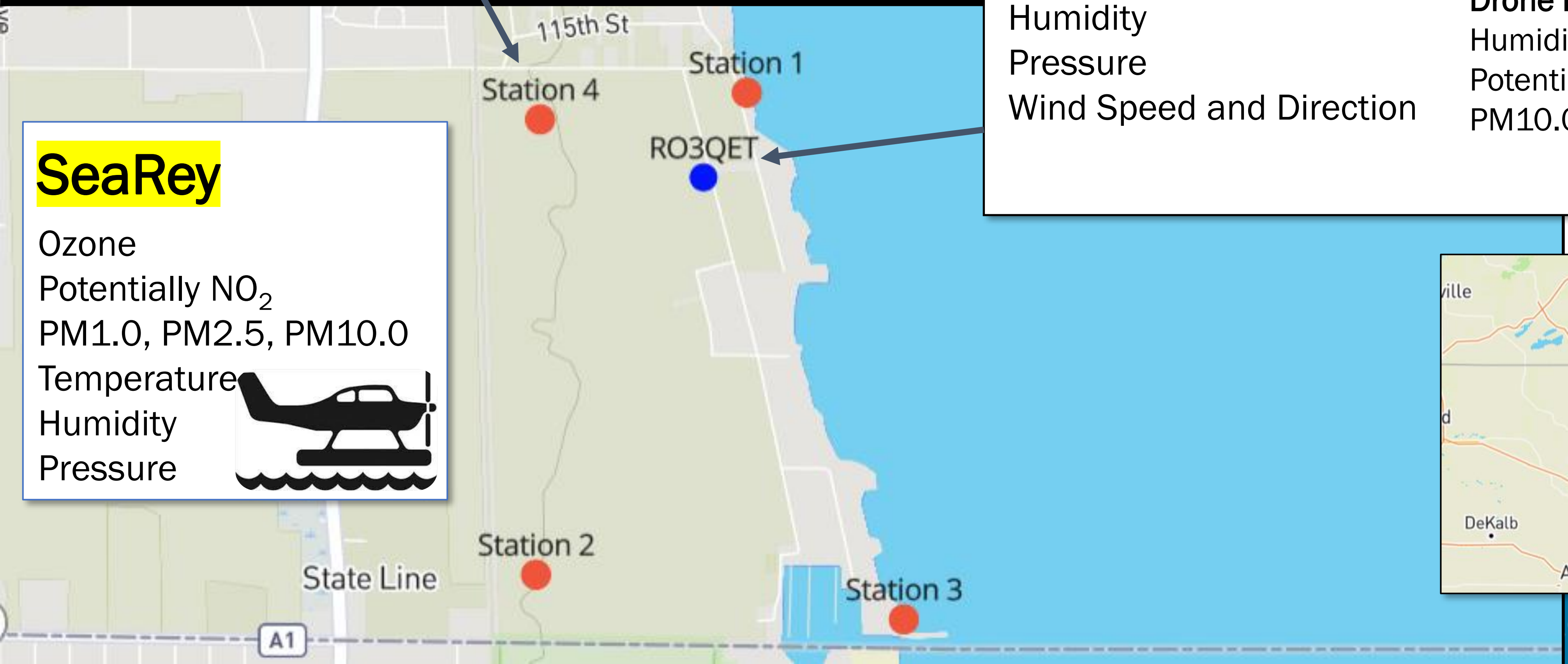
PM1.0, PM2.5, PM10.0
Temperature
Humidity
Pressure
Wind Speed and Direction

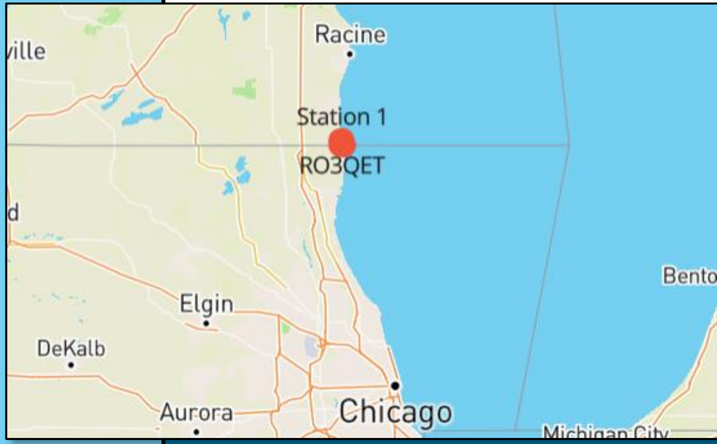
RO3QET

Ozone
PM1.0, PM2.5, PM10.0
Temperature
Humidity
Pressure
Wind Speed and Direction
Rainfall
Solar Flux
Windsonde Soundings: Temperature, Humidity, Pressure, Wind Speed and Direction
Drone Profiles: Temperature, Humidity, Pressure, Ozone, Potentially NO_2, PM1.0, PM2.5, PM10.0

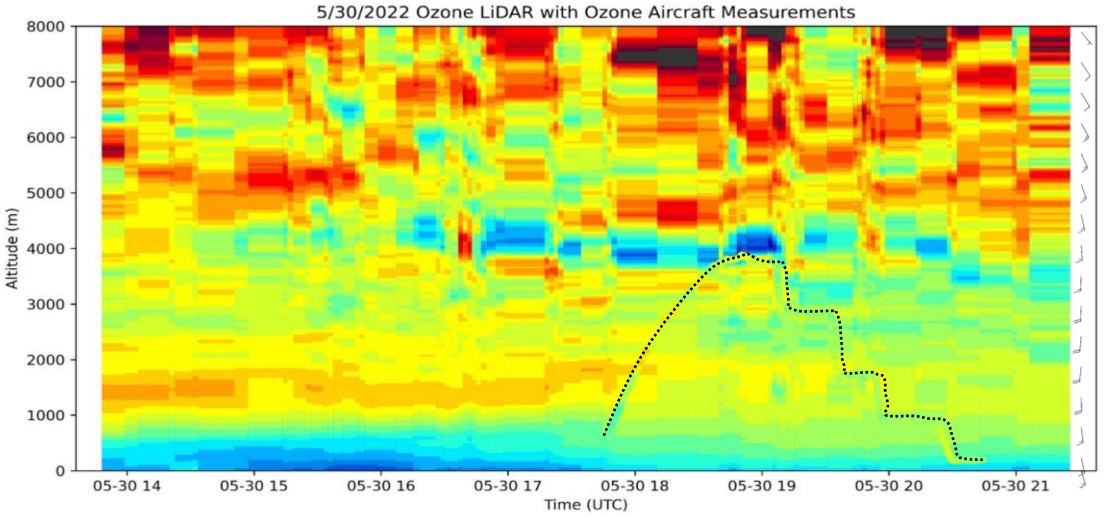
SeaRey

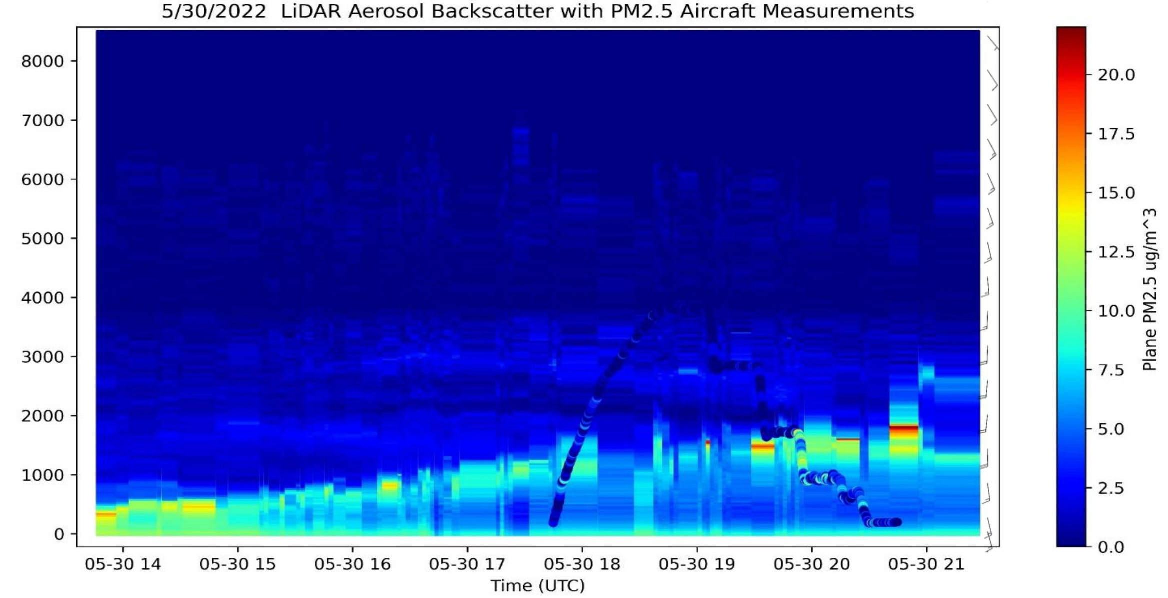
Ozone
Potentially NO_2
PM1.0, PM2.5, PM10.0
Temperature
Humidity
Pressure

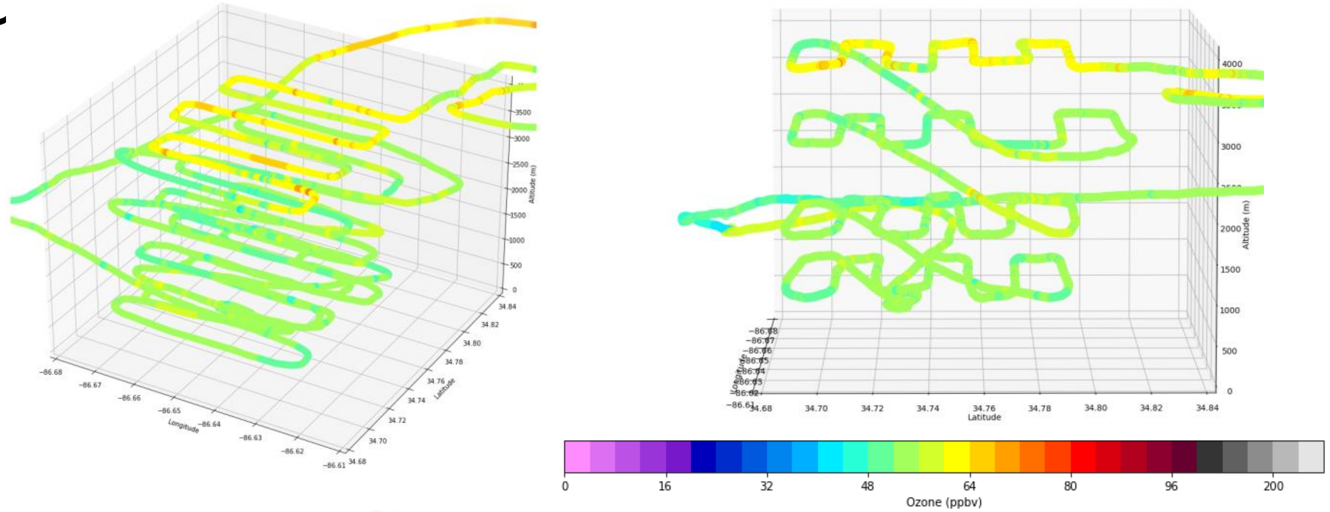


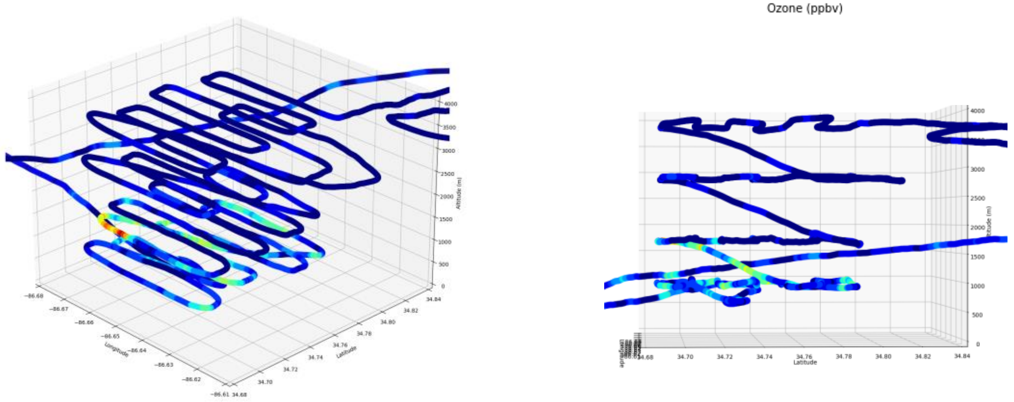


Previous Flight Exa



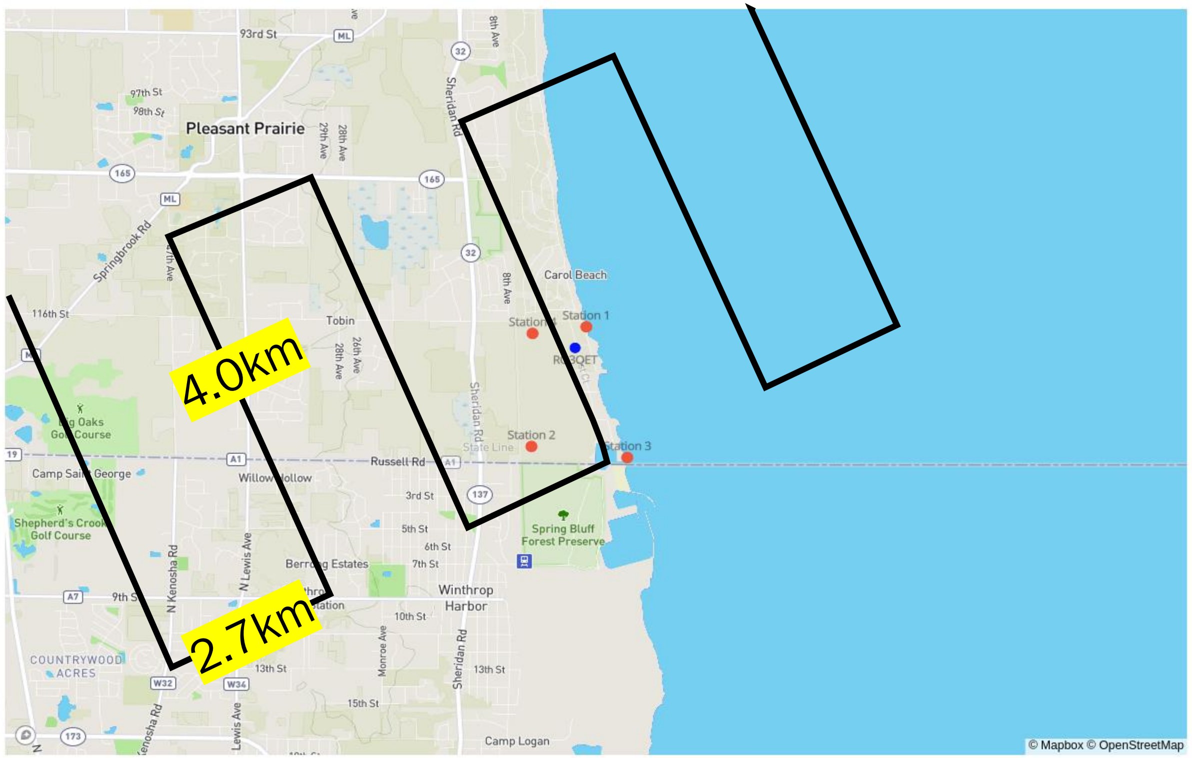




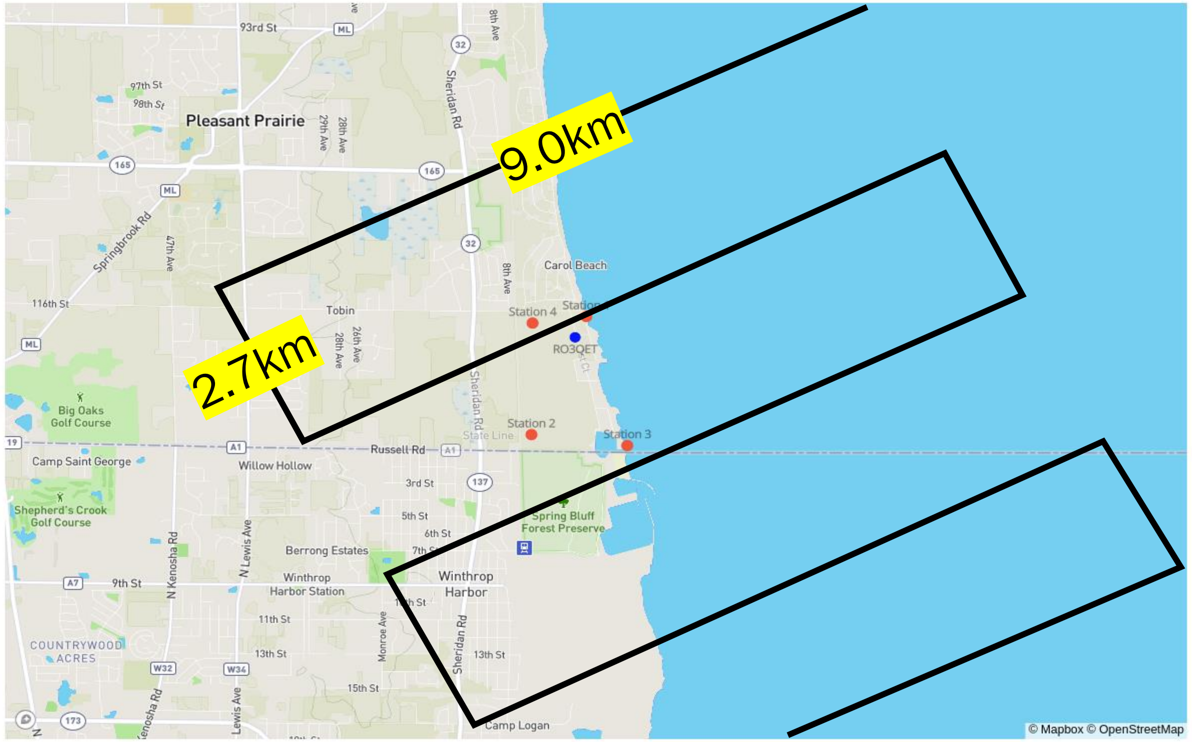


Past example aircraft and LiDAR ops examples; Visualizing 3D flight grids with **Ozone and PM2.5** measurements can quantify small scale **spatial/temporal gradients** present in both the lower and upper PBL.

Potential Kenosha Flight Patterns



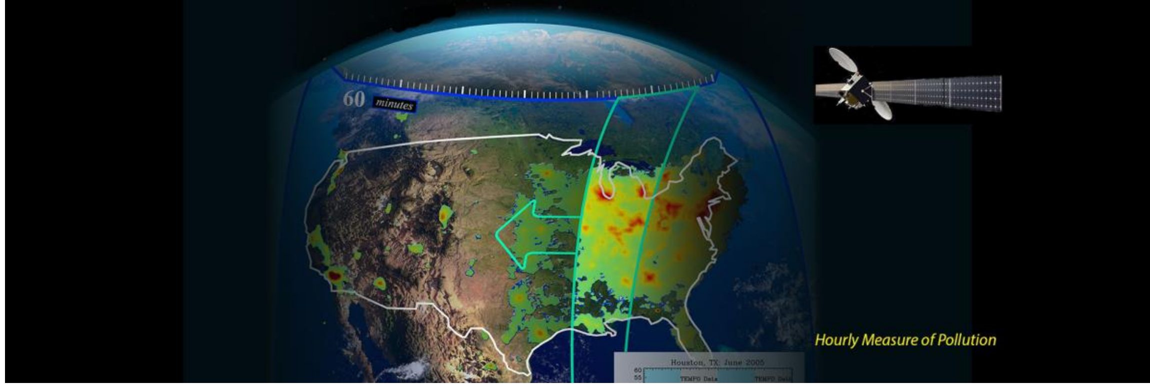
Flight grind positioned from southwest to northwest. Pattern is optimized for profiling larger scale land-to-water gradients.



Flight grind positioned from northwest to southeast. Pattern is optimized for profiling finer scale coastal gradients.

Flight patterns will be coordinated with the **ground RO3QET** team via radio. Using the ozone LiDAR, the RO3QET team will communicate if small scale spatial/temporal gradients are present in PBL; pilot will adjust flight path accordingly.

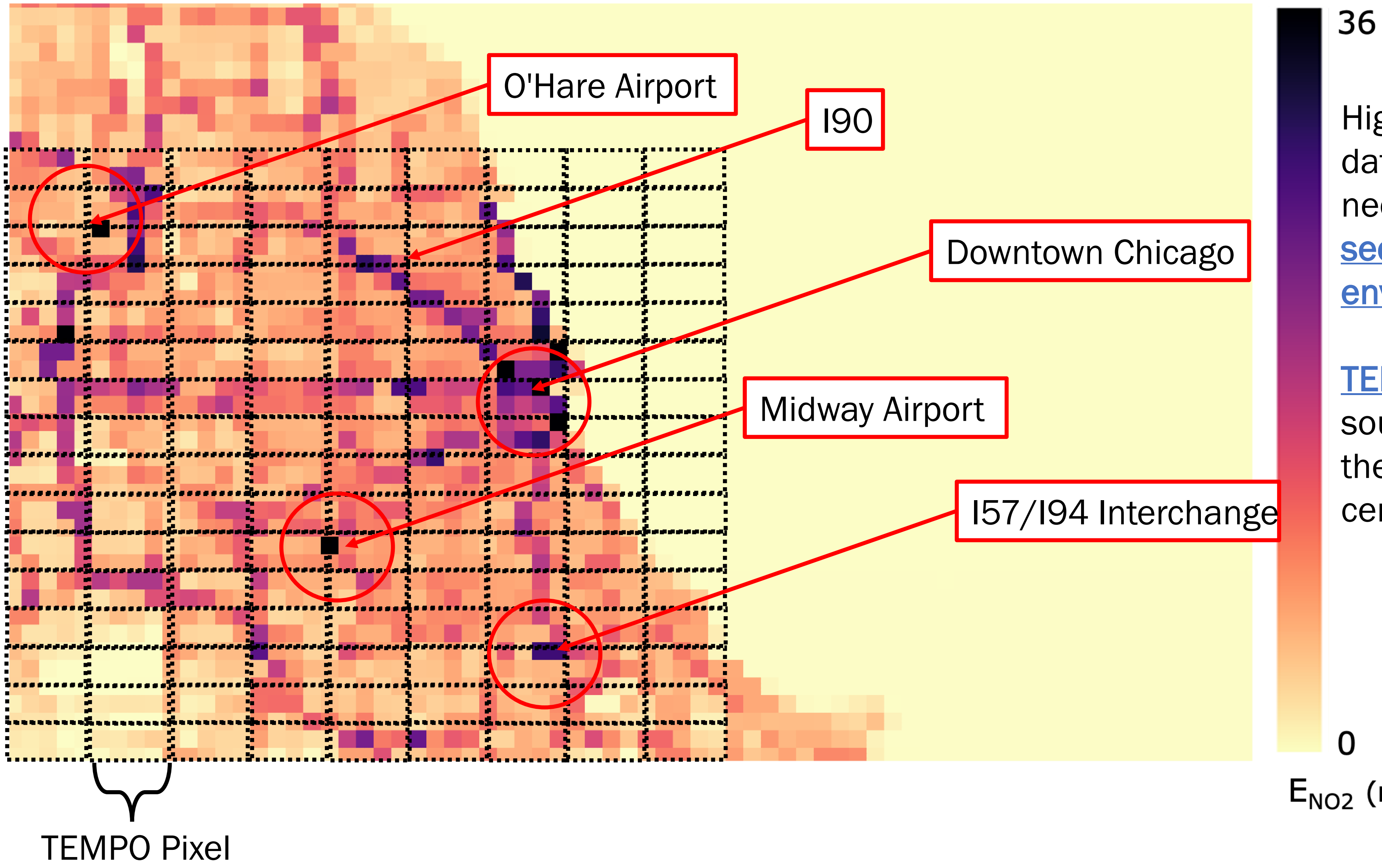
TROPOSPHERIC EMISSIONS:
MONITORING OF POLLUTION



Cape Canaveral, FL – On Friday, April 7 at 12:30 a.m. ET, a SpaceX Falcon 9 rocket blasted off from launch pad 40 at the Cape Canaveral Space Force Station in Florida. Its mission: to carry the satellite, Intelsat 40e — host of the NASA-Smithsonian instrument **TEMPO** — into space.

TEMPO will provide hourly measurements of HCHO and NO2 columns over Greater North America during daylight hours

NEMO 1-km NO_2 emissions – Mondays in August at 18Z



High spatial and temporal satellite data and emission inventories are necessary to isolate emission sectors within an urban environment

TEMPO: 2 km/pixel in the north-south direction, 4.75 km/pixel in the east-west direction at the center of the FOR (Field of Regard)

NEMO data provided by Daniel Tong and Siqi Ma (GMU), Figure provided by Jerrold Acdan (UW-Madison)

Ma, S., Tong, D.Q. Neighborhood Emission Mapping Operation (NEMO): A 1-km anthropogenic emission dataset in the United States. *Sci Data* 9, 680 (2022). https://doi.org/10.1038/s41597-022-01790-9

July-August 2023 will bring an unprecedented amount of airborne and ground based measurements to the Chicago/Lake Michigan area

- These campaign measurements will greatly enhance the DNR Enhanced Ozone Monitoring data and help improve our understanding of ozone formation in Wisconsin

- Measurements collected this summer will be used to validate TEMPO satellite retrievals so that TEMPO can be used to further improve our understanding of diurnal variations in ozone precursors in the Chicago/Lake Michigan region

Extra Slides

Proposed instrument layout for AEROMMA NASA DC-8 aircraft

Species Measured	Technique	PI	Institution
Gas Phase measurements			
NO, NO_2, NOy	Laser Induced Fluorescence (LIF-NOx)	Andrew Rollins	NOAA CSL
O_3	Chemiluminescence	Jeff Peischl Kristen Zuraski	NOAA CSL
HPMTF, PANs, HONO, OVOCs, $ClNO_2$, organic nitrogen	Iodide ToF-CIMS (I^- CIMS)	Patrick Veres	NOAA CSL
CO_2 / CH_4, N_2O / CO / H_2O	Cavity Enhanced Absorption	Jeff Peischl	NOAA CSL
SO_2	Laser Induced Fluorescence (LIF-SO2)	Andrew Rollins	NOAA CSL
ACOS	Cavity Enhanced Absorption	Andrew Rollins	NOAA CSL
NH_3	QC-TILDAS (QCLS NH_3)	Ilana Pollack	CSU
CH_3COCHO, CHOCHO, NO_2, UV aerosol extinction	Cavity Enhanced Spectrometer (ACES)	Carrie Womack	NOAA CSL
Speciated hydrocarbons and OVOCs	H_3O^+ Proton-Transfer Reaction Time-of-Flight Mass Spectrometry (VOCUS-PTR-MS)	Carsten Warneke	NOAA CSL
C_2-C_{10} Alkanes, C_2-C_4 Alkenes, C_6-C_9 Aromatics, C_1-C_5 Alkylnitrates, etc.	Integrated Whole Air Sampling (iWAS)	Jessica Gilman	NOAA CSL
Formaldehyde (HCHO)	Laser Induced Fluorescence (ISAF)	Jennifer Kaiser	Georgia Tech
Highly Oxygenated VOCs	NH_4^+ VOCUS ToF-CIMS (NH_4^+ CIMS)	John Liggio	ECCC Canada
OH reactivity	Direct OH loss rate by LP–LIF (OHR)	Hendrik Fuchs	FZ Juelich
H_2O_2, organic peroxides, organic acids, isoprene oxidation products,	CalTech-CIMS (CT-CIMS)	Paul Wennberg	CalTech

Proposed instrument layout for AEROMMA NASA DC-8 aircraft

Species Measured	Technique	PI	Institution
Aerosol measurements (physical/optical/chemical)			
Bulk aerosol composition, HNO_3	Filter sampling and mist chamber (PiLS-IC)	Amy Sullivan	CSU
BrC	Spectro-photometer (BrC PiLS)	Amy Sullivan Rodney Weber	CSU Georgia Tech
Aerosol absorption and extinction at multiple wavelengths and RH	Cavity ringdown extinction and photoacoustic absorption spectrometers (AOP)	Charles Brock	NOAA CSL
Aerosol scattering phase function at UV and visible (blue) wavelengths	Laser Imaging Nephelometer (Li-Neph)	Dan Murphy Adam Ahern	NOAA CSL
Aerosol number density, size distribution, and physical properties, CCN	Particle counters, nephelometers, etc. (UHSAS, CMASS, NMASS, CCN) (AMP)	Charles Brock, Rich Moore	NOAA CSL, NASA LaRC
BC concentration, size, mixing state	Humidified Dual Single Particle Soot Photometer (SP2)	Joshua Schwarz	NOAA CSL
Submicron aerosol composition	Aerosol mass spectrometer (HR-AMS)	Ann Middlebrook	NOAA CSL
Submicron aerosol composition	Vocus Inlet for Aerosols with NH_4^+ Long Time-of-Flight Chemical Ionization Mass Spectrometer detection (VIA-LToF-CIMS)	Carsten Warneke	NOAA CSL
Single particle composition	PALMS	Daniel Cziczo	Purdue

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Next Meeting

September 7, 2023

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"WILD WISCONSIN:
OFF THE RECORD"