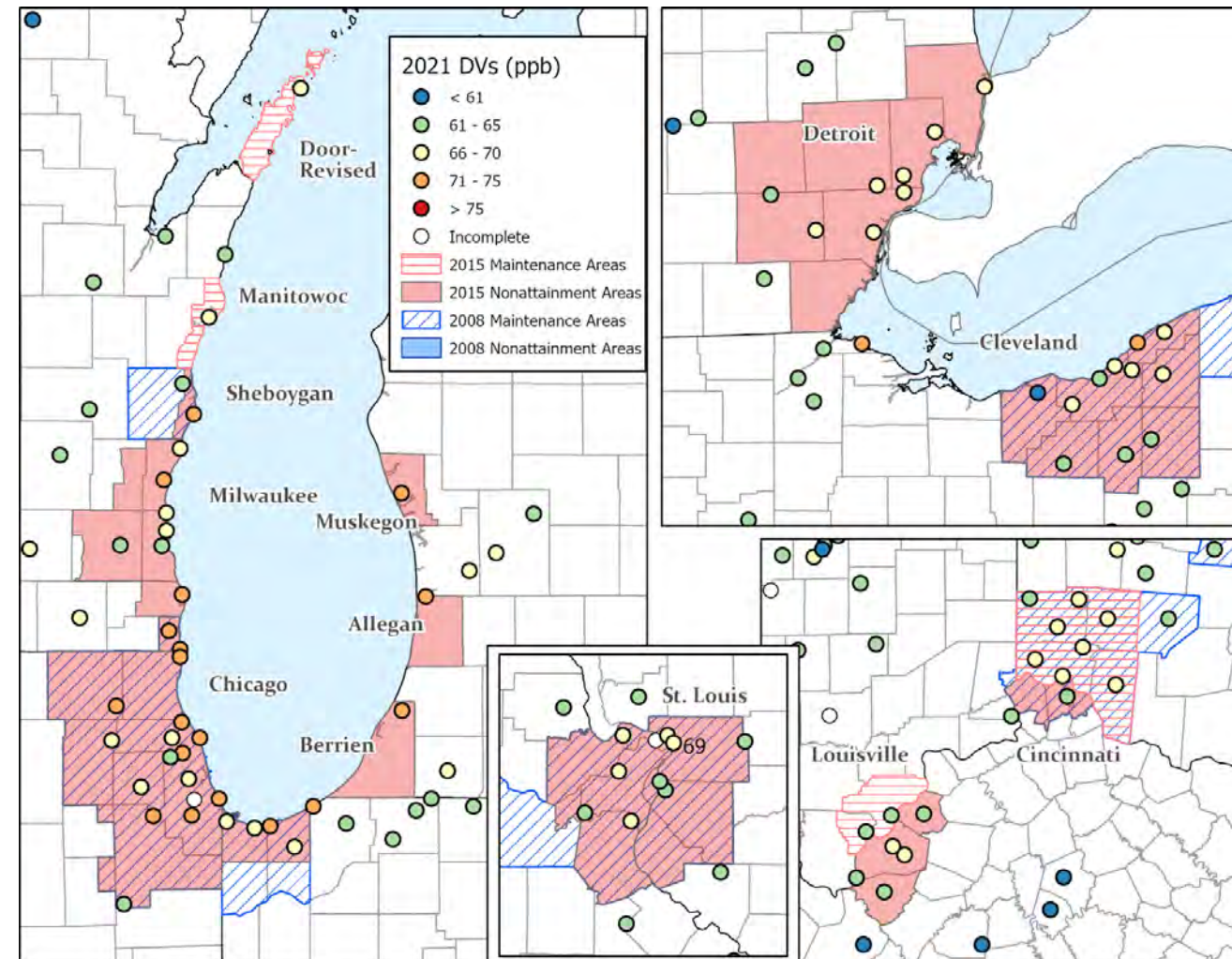


Lake Michigan/Chicago Regional Activities (Brad Pierce, UW-Madison)

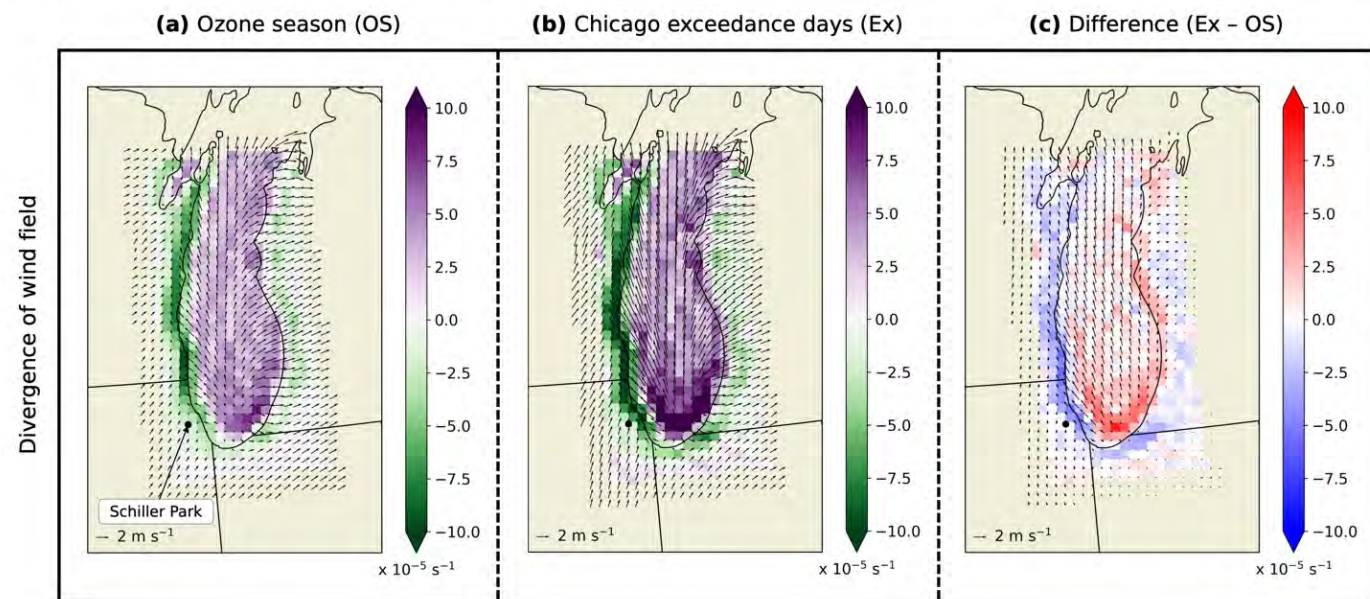
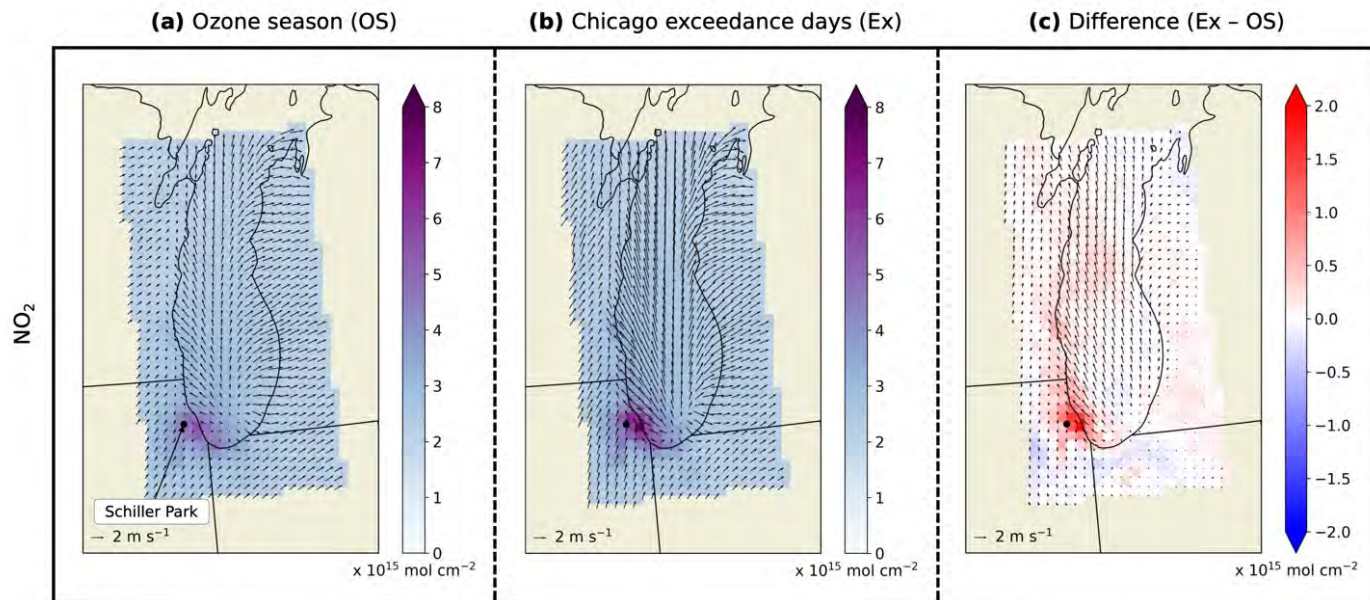
2019-2021 ozone design values for the LADCO region
(as of July 2022, From Dickens¹, 2022)

- Ozone concentrations at surface monitors in parts of the LADCO region have consistently violated National Ambient Air Quality Standards (NAAQS) for O₃ over the last 40 years.
- Emissions of the O₃ precursors, nitrogen oxides (NO_x) and volatile organic compounds (VOC), have decreased dramatically since the 1990s
- O₃ concentration reductions have lagged behind reductions in precursor emissions.



¹Angela Dickens, LADCO Technical Report: Ozone Formation Sensitivity to NO_x and VOC Emissions in the LADCO Region
https://drive.google.com/file/d/1Y_xF9v8xF4wBaE2Eyro0LHUGAbIBPhLf/view?usp=sharing

Composites of 2019-2021 TROPOMI tropospheric NO₂ and ECMWF 10m wind analyses¹



- The Chicago metropolitan area shows greater VOC-sensitivity during Chicago O₃ exceedance days than during the typical ozone season.
- The rest of the domain shows greater NO_x-sensitivity during Chicago O₃ exceedance days than during the typical O₃ season.
- Analysed 10-meter wind data shows that the lake breeze circulation is stronger during O₃ exceedance days compared to typical O₃ season days

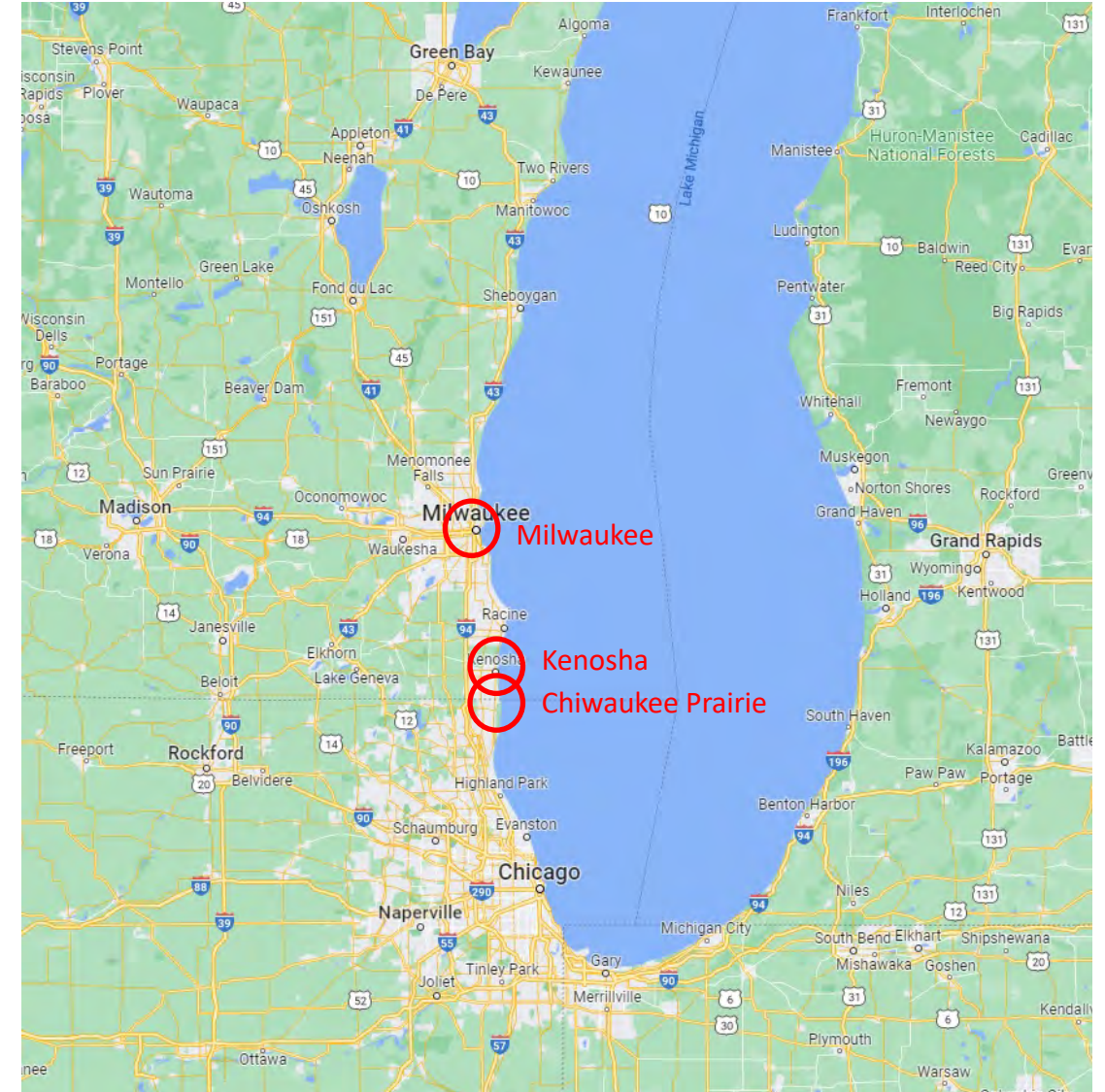
¹Acdan et al, 2022 Ozone-NO_x-VOC Sensitivity of the Lake Michigan Region Inferred from Satellite Observations and Ground-Based Measurements (in preparation)

Planned Lake Michigan Measurements during AGES

- 1) Wisconsin DNR Enhanced Ozone Monitoring measurements
 - Mobile Air Monitoring Lab (MAML, Milwaukee, WI)
 - Chiwaukee Prairie Monitor (including Pandora)
 - Viking Expedition Cruise (through NOAA/GLERL Cooperative Research and Development Agreement)
- 2) University of Huntsville Rocket-city Ozone Quality Evaluation in the Troposphere (RO3QET) ozone LiDAR (Chiwaukee Prairie, WI)
- 3) University of Wisconsin OPSIS DOAS + CL61 Ceilometer (Kenosha, WI)

Potential additional ozone measurements

- 1) University of Wisconsin Chiwaukee Prairie UAS (Patti Cleary, tentative)
- 2) University of Huntsville SeaRey Amphibious Aircraft (Mike Newchurch, seeking funding)



Wisconsin's Enhanced Ozone Monitoring (EOM) Program

Mobile Air Monitoring Lab (MAML) Sheboygan, WI



MAML data: O3, CO, NO, NO2, NOx, PM2.5, PM10, winds, temperatures

Wisconsin's Enhanced Ozone Monitoring (EOM) plan provides data to help the Wisconsin Department of Natural Resources (DNR) understand the unique chemistry behind ozone development within counties along the Lake Michigan shoreline. The DNR works with external research partners to facilitate planning for and conducting EOM, May – October of each year.

Chiwaukee Prairie Monitor



Chiwaukee Prairie EOM data: O3, CO, NO, NO2 (Caps), NOx, NOy, PM2.5, PM10, winds, temperatures

Pandora 162

Contact: Katie Praedel, DNR air program monitoring section chief
(katie.praedel@wisconsin.gov)

Wisconsin Enhanced Ozone Monitoring – Lake Michigan Over-water Ozone study

08/27 08/28 08/29 08/30 08/31 09/01 09/02 09/03 09/04 09/05 09/06 09/07 09/08 09/09 09/10 09/11

- Cooperative Research and Development Agreement (CRADA) between NOAA and Viking Expeditions (Deborah Lee, Director of NOAA's Great Lakes Environmental Research Laboratory, PI)
- WDNR providing in-kind support (laboratory calibration, deployment, data telemetry and operation of federally approved air monitoring equipment) on-board Viking Expeditions Cruise Ship (Katie Pradel, WDNR, PI)



Level of Health Concern	Ozone Concentration (PPB)
Good	0-54
Moderate	55-70
Unhealthy for Sensitive Groups	71- 85
Unhealthy	86 -105
Very Unhealthy	106-200
Hazardous	> 201

	Ozone	NO2
Analyzer Make & Model	T400	T500U
Analyzer Cost (new)	\$9,500	\$18,500
Calibrator Make & Model	T703	T700U
Calibrator Cost (new)	\$13,000	\$25,000
Calibration gas	No	Yes
Calibration gas cost	No	500
Labor calibration, deploy, operation	\$2,000	\$2,000

Round Trip Dates: 8/27-9/10

Select...

- 7/16-7/30
- 7/30-8/13
- 8/13-8/27
- 8/27-9/10
- 9/10-9/24

Cruise: Milwaukee to Milwaukee

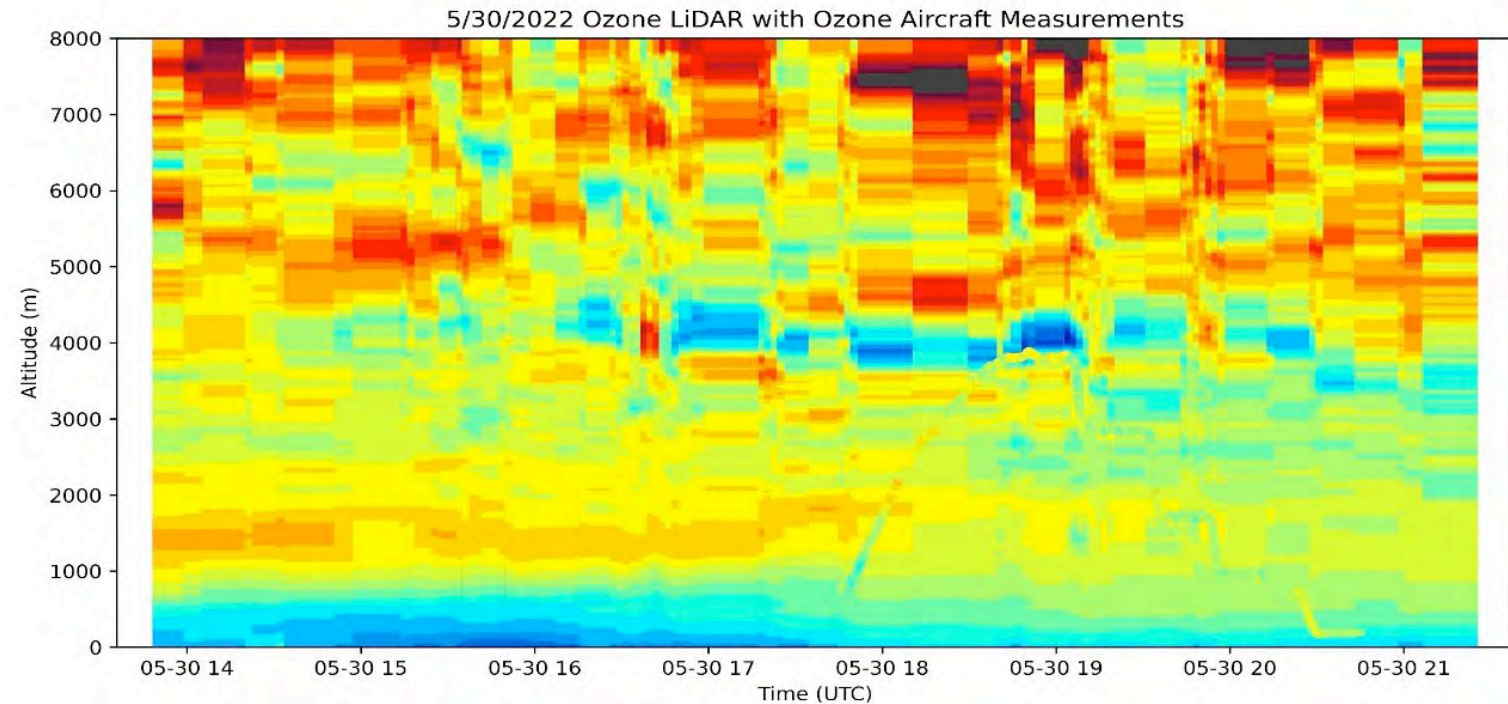
Select...

Second deployment planned for 2023

University of Huntsville RO3QET ozone LiDAR (Chiwaukee Prairie, WI)

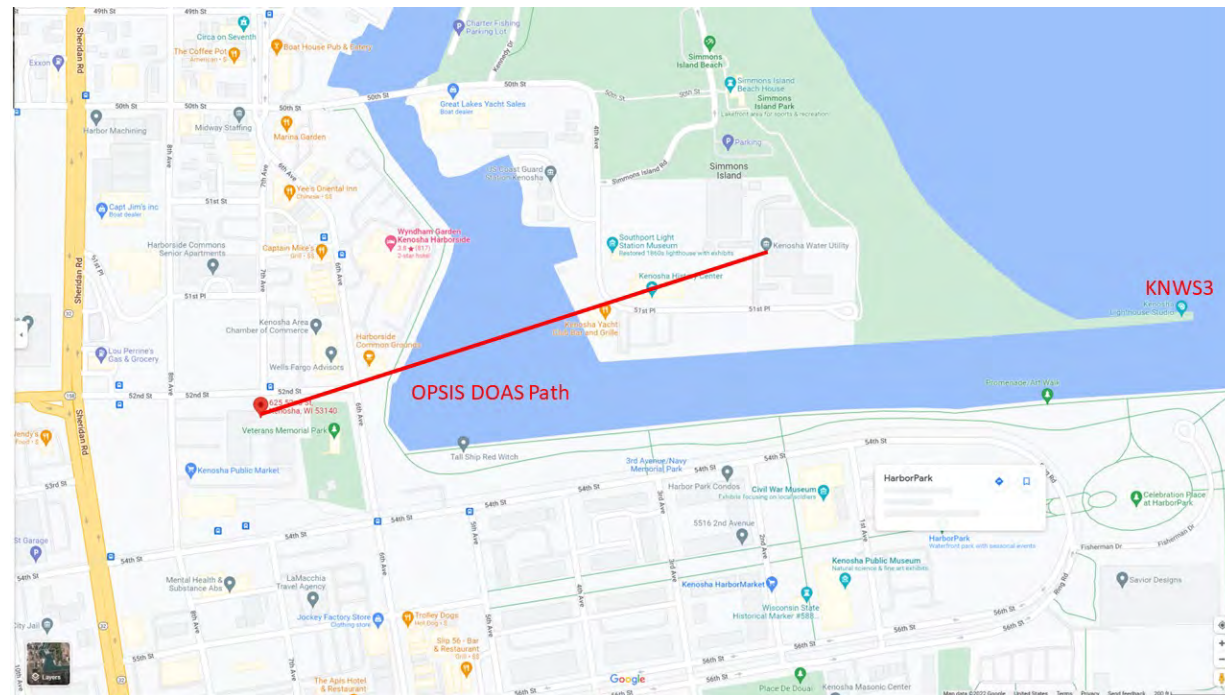
The Rocket-city Ozone (O_3) Quality Evaluation in the Troposphere (RO₃QET) lidar is a Differential Absorption Lidar (DIAL) and is one of the six systems of the Tropospheric Ozone Lidar Network (TOLNet) (<http://www-air.larc.nasa.gov/missions/TOLNet>)

RO3QET at Dauphin Island July 2022



Contact: Mike Newchurch (mike.newchurch@nsstc.uah.edu)

University of Wisconsin OPSIS DOAS (Kenosha, WI)



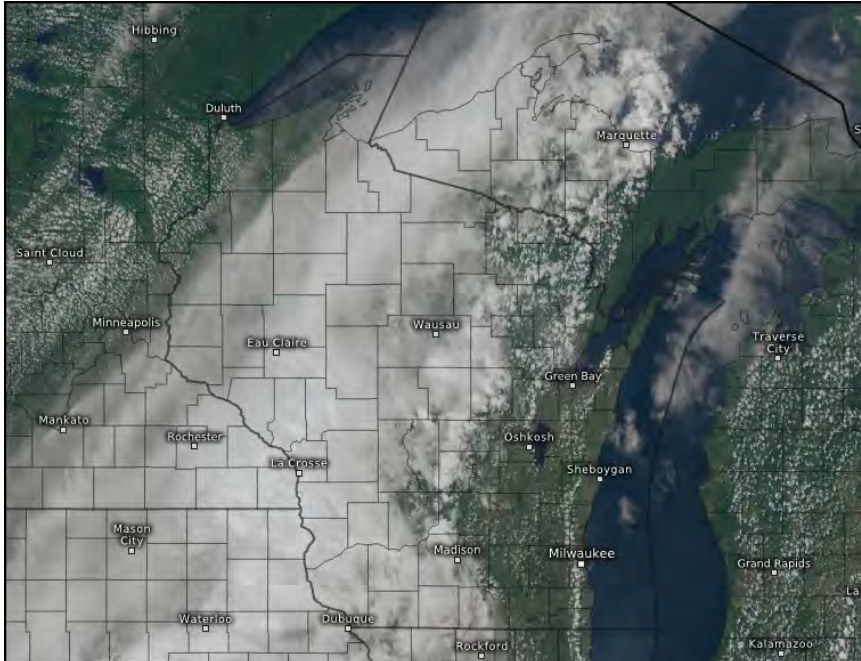
Measurements: Benzene, Toluene, Xylene, SO₂, O₃, NO₂, formaldehyde (Pathlength 59m, single pass)

NOAA has mounted meteorological sensors (wind speed and direction, pressure, and temperature) to the top of the Kenosha lighthouse as part of the National Buoy Data Network (KNWS3).

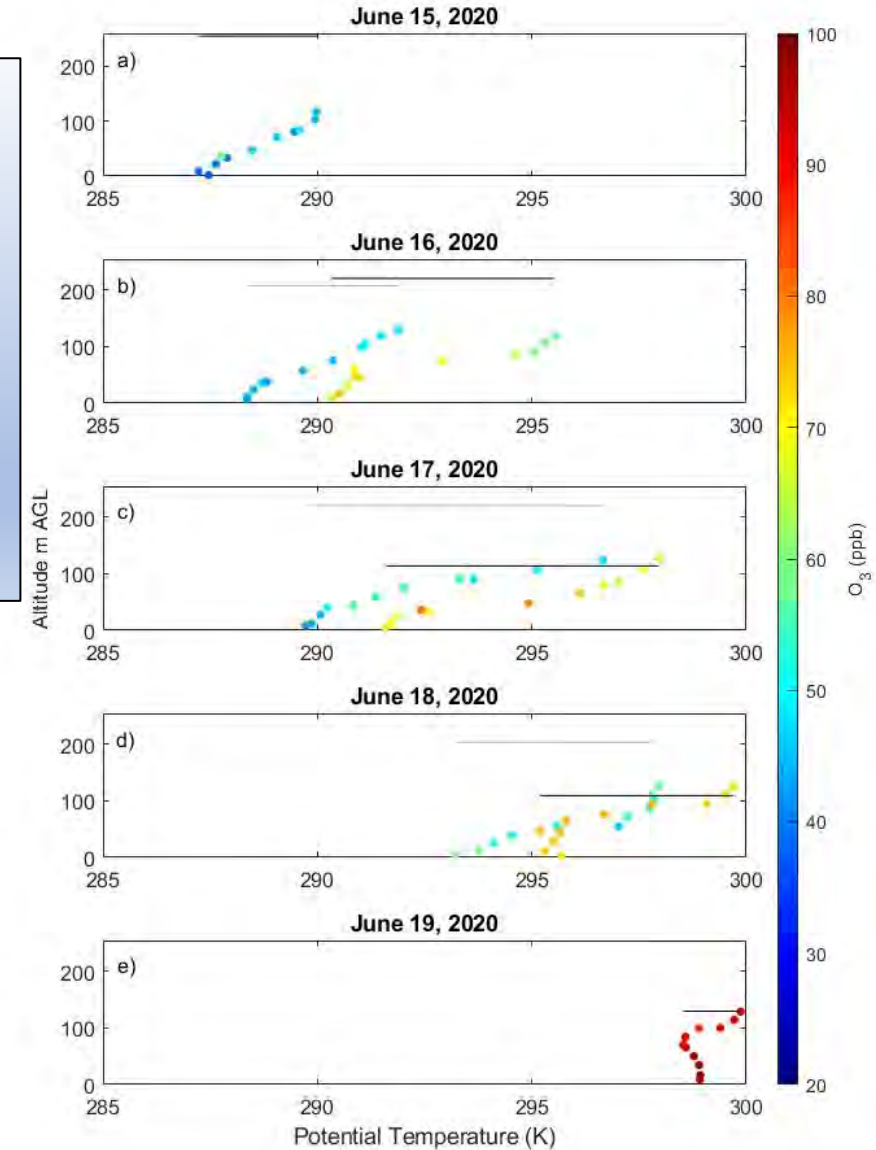
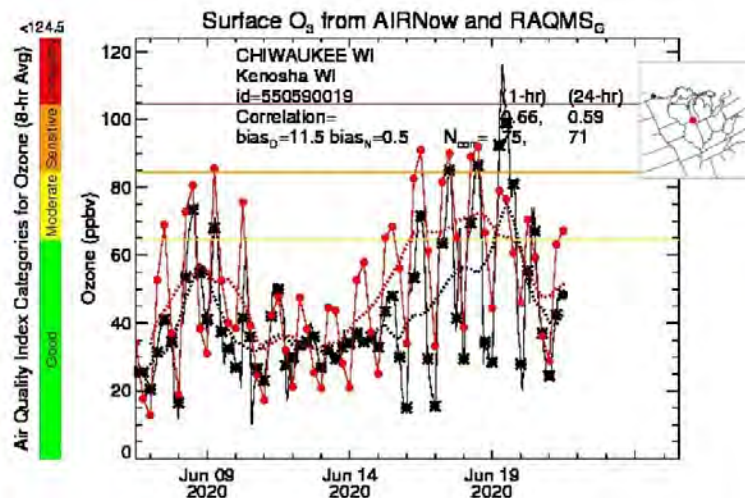
Potential additional ozone measurements

Wisconsin's Dynamic Influence of Shoreline Circulations on Ozone (WiscoDISCO) campaign

June 19, 2020 14Z True color GOES-East image



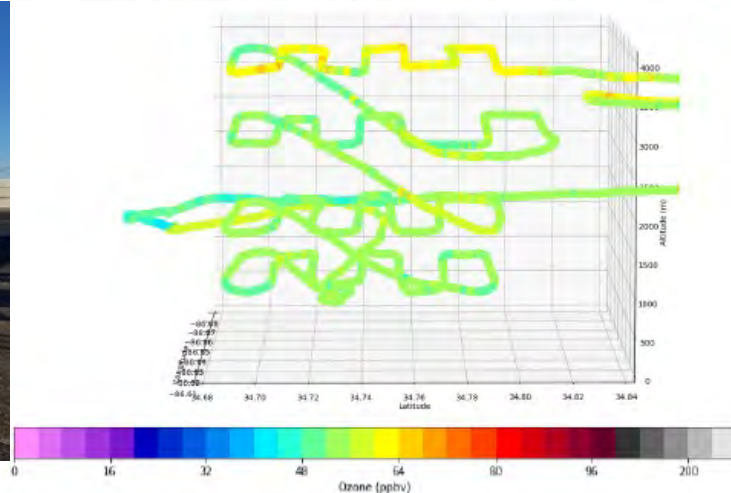
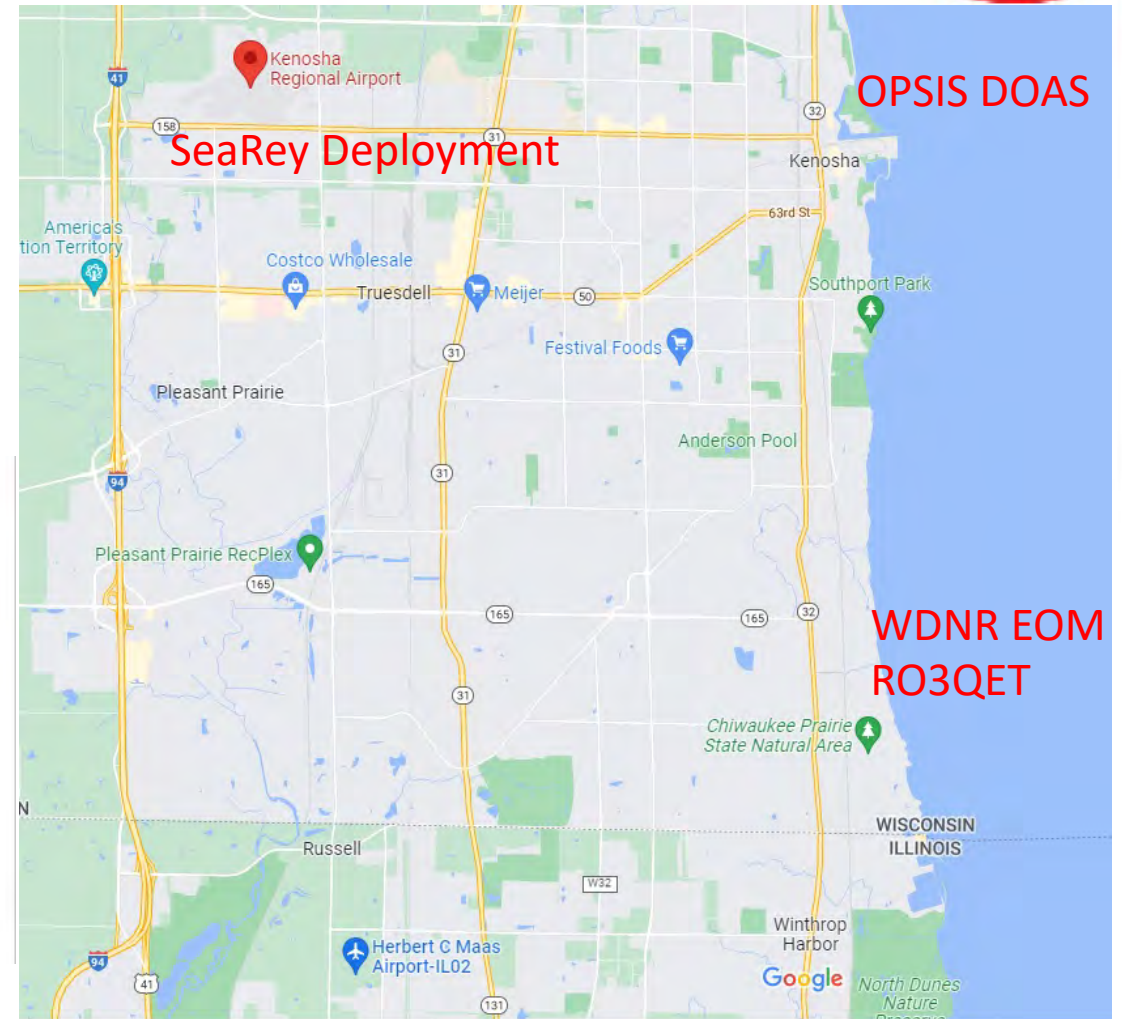
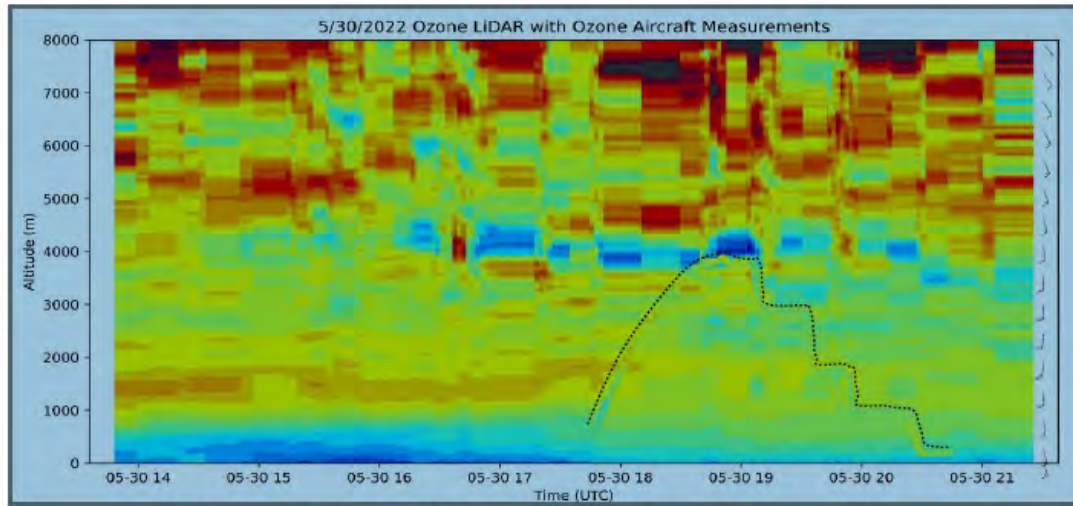
Wisconsin's Dynamic Influence of Shoreline Circulations on Ozone (WiscoDISCO¹) campaign was designed to investigate the marine inversion influence on ozone measurements at the Lake Michigan shoreline by using an UAS at Chiwaukee Prairie Natural Area in Kenosha County, WI.



¹Radtke et al, 2022, Observing Low Altitude Features in Ozone Concentrations in a Shoreline Environment via Unmanned Aerial Systems (submitted to ES&T)

University of Huntsville SeaRey Amphibious Aircraft (Mike Newchurch, seeking funding)

Preliminary Results from 5/30/2022 RO₃QET lidar and insitu SeaRey Measurements



SeaRey (2B-POM) Ozone

Deployed out of Kenosha Regional Airport