Overview of the 2023 Synergistic TEMPO Air Quality Science (STAQS) Field Study

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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, STAQS will:

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

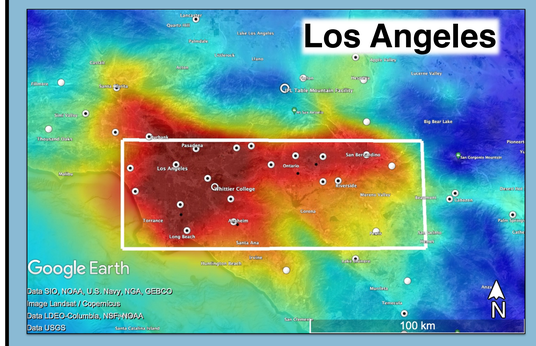
⇢ Prioritize repeated systematic sampling in predefined domains during morning, midday, and afternoon over at least 4 days in each primary target areas (LA, NYC, Chicago)

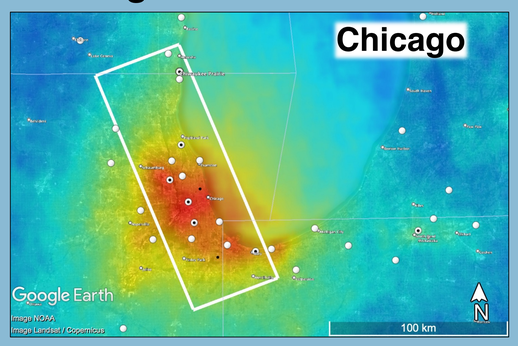
⇢ Collaborate with research teams engaged with multiple activities (AGES+) occurring in summer 2023 with federal and academic partners (NOAA AEROMMA, NSF GOTHAAM, NOAA CUPIDS and others!)

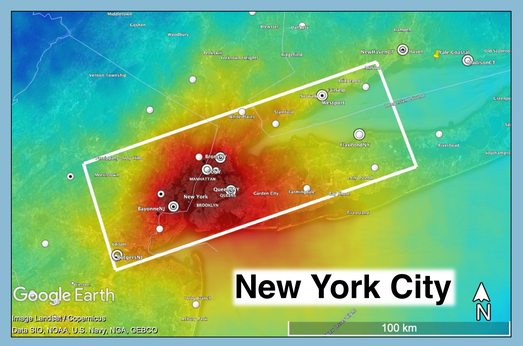
STAQ Science Objectives

1) Evaluating TEMPO level 2 products geo-physically, spatially, and temporally
2) Interpreting the temporal and spatial evolution of air quality events tracked by TEMPO
3) Improving temporal estimates of anthropogenic and biogenic trace gas and GHG emissions
4) Assessing the benefit of assimilating TEMPO data into chemical transport models
5) Linking air quality patterns to socio-demographic data

Regions of Focus







Priority is systematic sampling of the same area with the GV 3x per day (morning-midday-afternoon) and GIII 2x per day (morning-afternoon)

Aim for the final area would be to optimize emission sources and ground-site mapping.

Campaign Schedule

Gulfstreams:
Los Angeles: **June 19-July 7** (10-day window/4 flight days)
NYC/Chicago: **July 22-August 29th** (one month window/8+ flight days)
G-V: 120 Science Hours (~ 13 flight days/one 9 hours flight per day)
G-III: 104 Science Hours (~ 13 flight days/two 4-hour flights per day)

TOLNet:
Aiming for a 5-week window deployment for mobile systems to NYC and Wisconsin between **July 22nd and August 29th.** Timing TBD based on TEMPO's launch and consideration for other missions. Sonde efforts align with this timeline.

Pandora:
Leveraging existing Pandoras in the **Pandonia Global Network (PGN)** with at least a dozen spread over the primary domains with over 60+ within the TEMPO field of regard.

Collaborations

Summer 2023 will bring together researchers and stakeholders from all of the different field activities occurring during the summer of 2023 including, but not limited to:

⇢ Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (**AEROMMA**)

⇢ Coastal Urban Plume Dynamics Study (**CUPiDS**)
https://csl.noaa.gov/projects/aeromma/

⇢ Greater New York Oxidant Trace gas Halogen and Aerosol Airborne Mission (**GOTHAAM**)
https://gothaam.science/

⇢ A broad list of academic researchers

⇢ State air quality agencies and regional consortiums like LADCO and NESCAUM

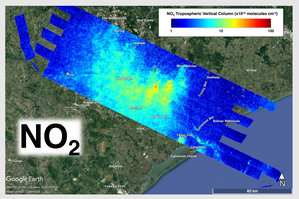
See more about these collaborations with (soon to be posted) presentations from the AGES+ workshop: https://csl.noaa.gov/events/ages2022/

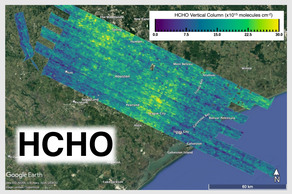
STAQS Team

- **Laura Judd (Airborne Lead)**
- **John Sullivan (Ground Lead/TOLNet PI)**
- **Scott Janz (GCAS PI)**
- **John Hair (HSRL2 PI)**
- **Taylor Shingler (HSRL2 co-lead for STAQS)**
- **Amin Nehrir (HALO PI)**
- **Robert Green (AVIRIS-NG PI)**
- **Tom Hanisco (NASA Pandora Project PI)**
- **Luke Valin (EPA Pandora Project Liaison)**
- **Paul Walter (Sonde-lead)**
- **Barry Lefer (Tropospheric Comp. Program Manager)**
- **Melissa Yang Martin (Atmos. Comp. Program Scientist)**
- **Gao Chen (Data Manager)**
- **Michael Shook (Data Manager)**

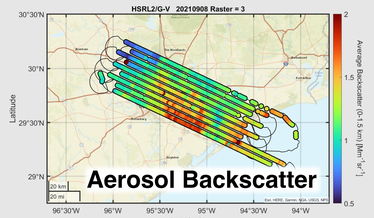
Airborne Measurements

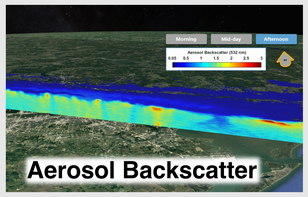
Visualizing chemical weather: example from TRACER-AQ with GCAS + HSRL2 on JSC G-V



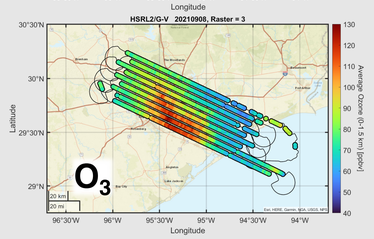


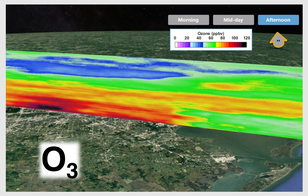
⇢The temporal sampling strategies give us a glimpse of the future with hourly view expected from TEMPO.





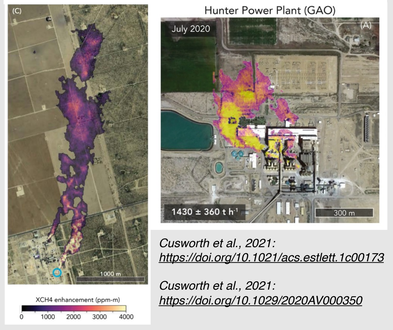
⇢Spatial scales of these measurements reveal information about these pollution that cannot be captured by a satellites.





Added perspective of GHGs with HALO and AVIRIS-NG on the LaRC G-III

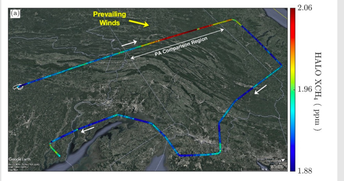
CH_4 and CO_2 emissions mapping from AVIRIS-NG



Cusworth et al., 2021: https://doi.org/10.1021/acs.estlett.1c00173

Cusworth et al., 2021: https://doi.org/10.1029/2020AV000350

Lidar CH_4 and aerosol characteristics from HALO



Barton-Grimley et al., 2022: https://doi.org/10.5194/amt-15-4623-2022

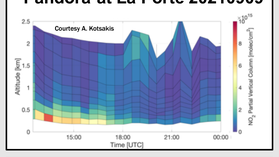
⇢These instruments will fly in tandem with GCAS and HSRL2 to measure as close to simultaneous as possible for synergistic analysis on AQ and GHG emissions

Ground Measurements

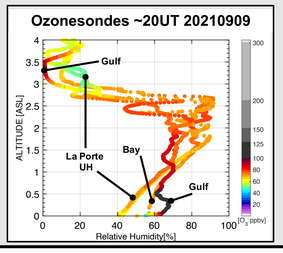
STAQS ground support includes deployment of multiple TOLNet systems, leveraging Pandora spectrometers from PGN, and ozonesonde launches with a primary focus in the NYC domain

The examples below show synchronous enhanced ground-based measurements from September 9th, 2021 during TRACER-AQ revealing vertical information about pollution.

Pandora at La Porte 20210909



Ozonesondes ~20UT 20210909



NASA TOLNet 20210909