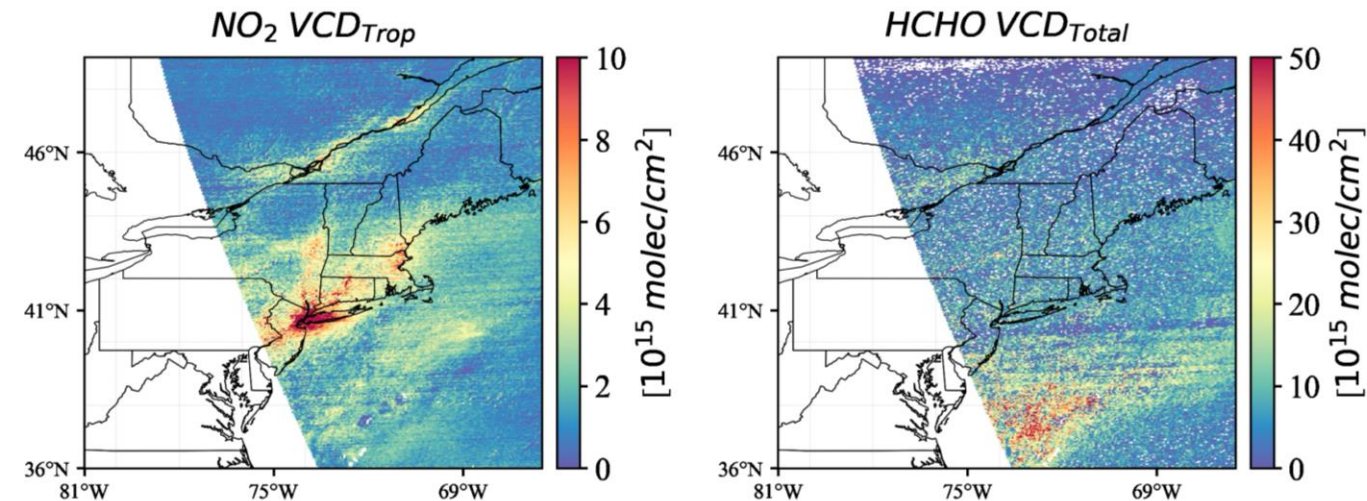


Updates from a 2023 Tiger Team: Analysis to support air quality and health TEMPO applications for surface ozone

The new view now possible with TEMPO!

Friday May 24th 2024: a warm day in the NE USA with ozone alerts

EDT-20240524 06:41:37



M. Tao (Columbia/MIT)

Kelly Chance, Xiong Liu, Caroline Nowlan, Gonzalo Gonzalez Abad (Harvard CfA/SAO)

HAQAST PIs/Co-Is:

Arlene Fiore (MIT and LDEO/Columbia), Daniel Goldberg (GW), Tracey Holloway (U WI Madison), Jen Kaiser (Georgia Tech), Jingqiu Mao (U AK Fairbanks), Talat Odman (Georgia Tech), Randall Martin (WUSTL), Ted Russell (Georgia Tech), Daniel Tong (GMU), Chris Uejio (FSU), Jun Wang (U Iowa), Amber Soja (NASA LaRC); Emily Gargulinski (NIA) & many other collaborators

Stakeholder groups:

LADCO, MDE, CT DEEP, NYS DEC, GA EPD, Tracking California, US EPA, UCS, HEI, Urban Institute & others

Arlene M. Fiore

amfiore @ mit.edu | teampaccc.mit.edu



COLUMBIA CLIMATE SCHOOL
LAMONT-DOHERTY EARTH OBSERVATORY



HAQAST Meeting
Cambridge, MA
June 4, 2024

We are prioritizing activities based on 30-min listening sessions with 10 stakeholder organizations conducted last summer

Topics

- Exposure burdens (Gaige Kerr)
- Fire smoke and ozone exceedances (Amber Soja)
- Understanding and communicating uncertainties (Randall Martin)
- Emission inventories (Ted Russell)
- Ozone-forming chemistry (Arlene Fiore)

Requested Deliverables

Plain-Language tip sheets

Use-case documents

Usable datasets & tools

**Next Team Zoom Meeting:
Tuesday June 18th at 2pm Eastern**

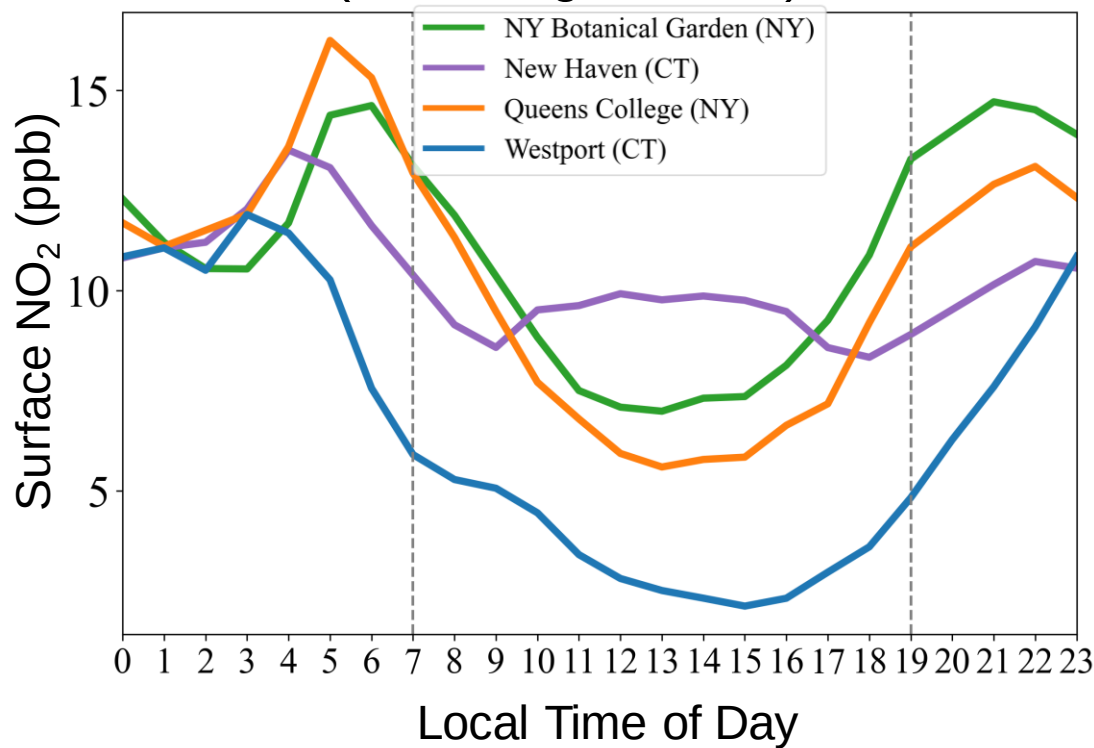
**To join, email
Arlene Fiore (amfiore@mit.edu) or
Jenny Bratburd (bratburd@wisc.edu)**

What urban-rural gradients might we expect to see with TEMPO?

Case study along a transect through NYC: Surface NO₂ measurements

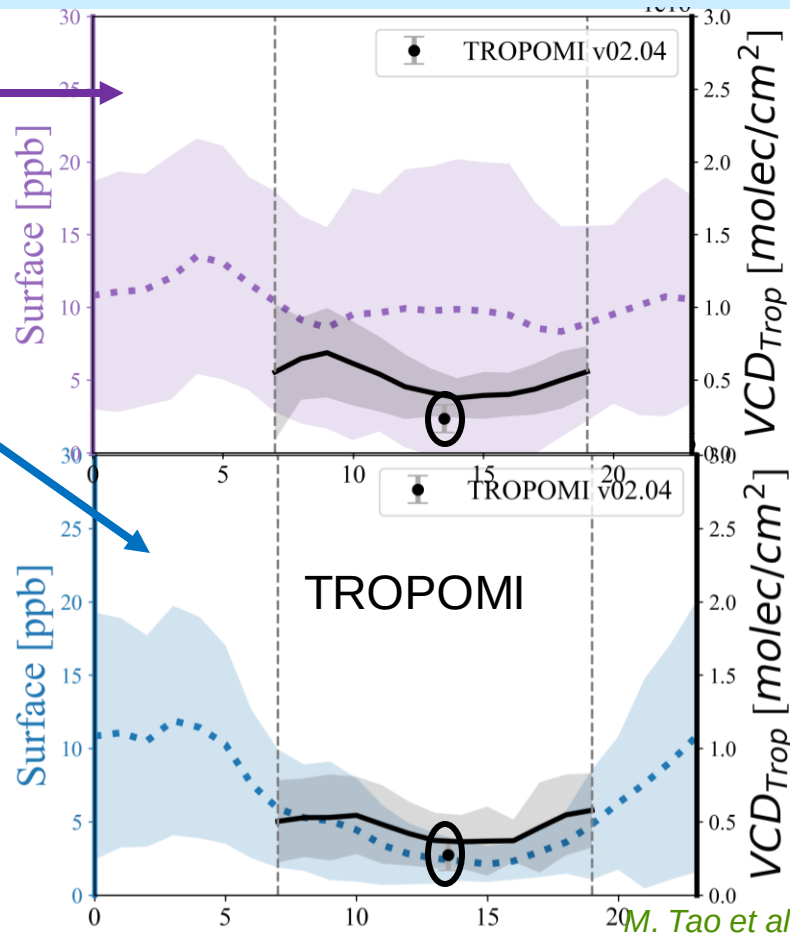
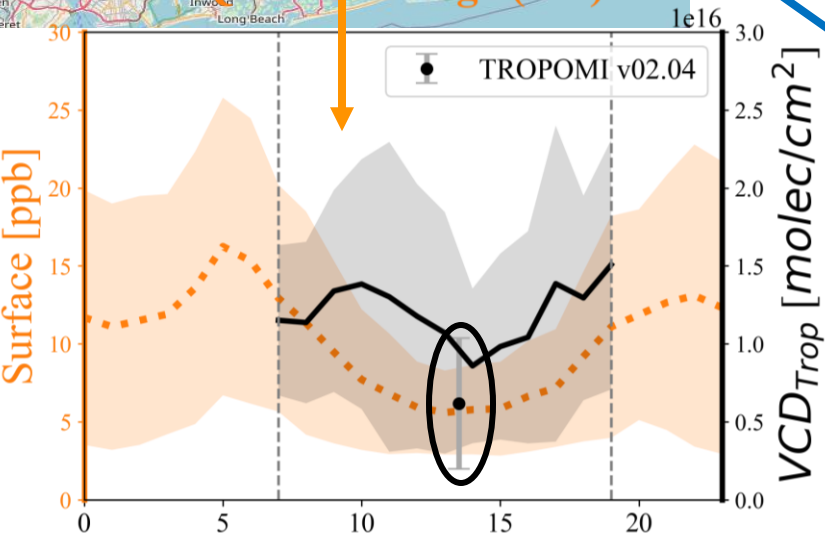


Observed Surface NO₂ Concentrations (June-August 2018)

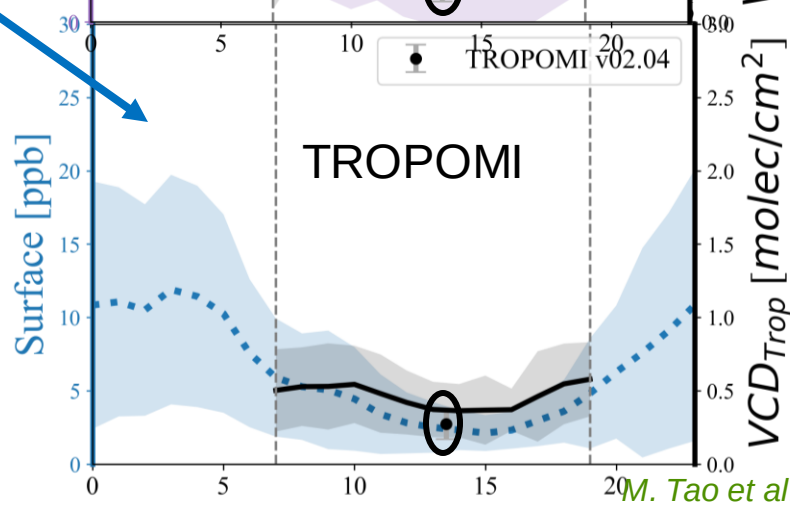


Delay in observed column (Pandora) versus **surface** (SLAMS) NO₂ peak

Different column-vs-surface intra-day variations relevant to interpreting satellite data



June-
August
2018

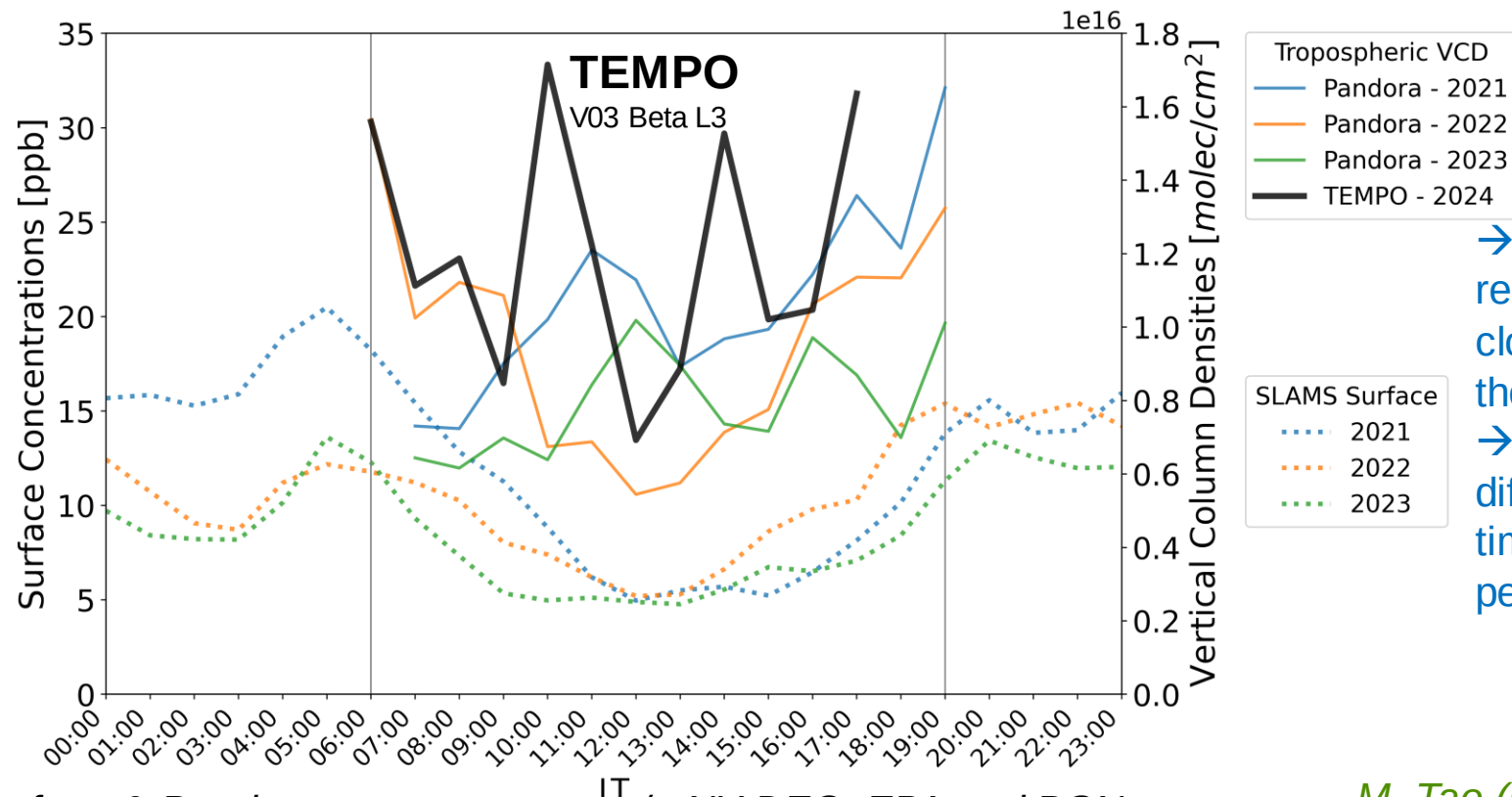


Surface &
Pandora obs
c/o NY DEC,
EPA and PGN

M. Tao et al., submitted to JGR

Initial view from TEMPO: May 13-23 mean (2024) tropospheric column NO₂ vs. Pandora columns + surface NO₂ (2021/2022/2023) at New York Botanical Gardens

05-13T05-23 | NO₂ | New York Botanical Garden NYSDEC (USEPA AQS ID 36-005-0133)



→ TEMPO-retrieved columns close to those at the Pandora site
→ Year-to-year differences in timing of column peaks

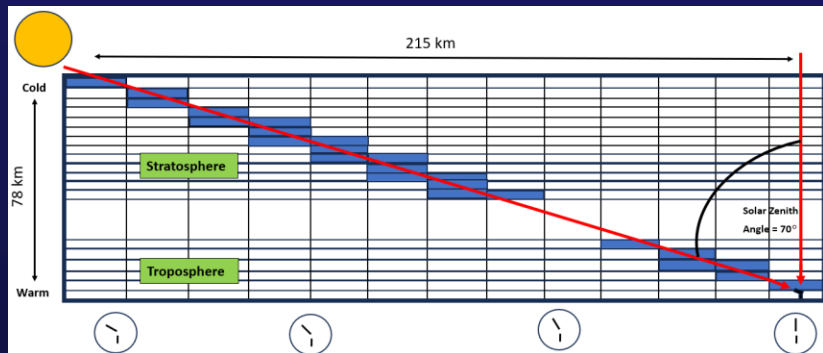
Surface & Pandora measurements c/o NY DEC, EPA and PGN

M. Tao (Columbia/MIT)

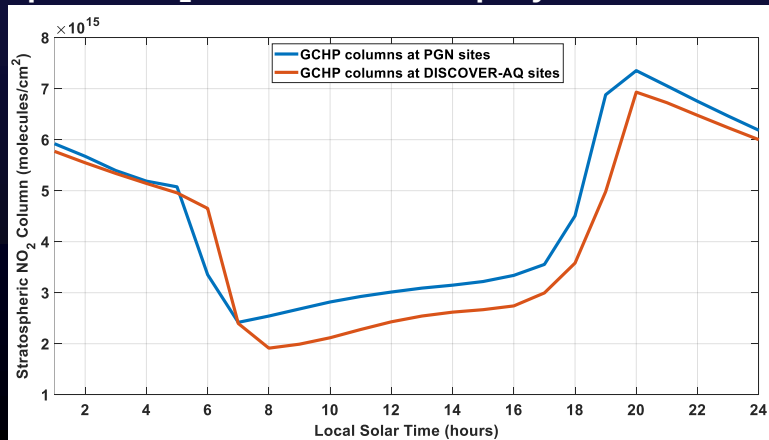
Evaluating and Representing the Hourly Column-to-Surface Relation for TEMPO NO₂ Needs to Account for Pandora Observation Characteristics and Entire Column at Fine Resolution

Pandora Line-of-Sight Instantaneously Measures Different Local Times and Temperatures

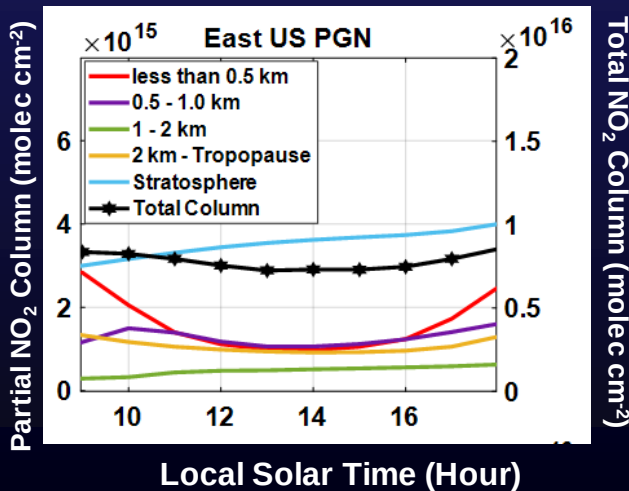
Temperature Affects NO₂ Measurement Efficiency



Stratospheric NO₂ Column Varies Rapidly Near Sunrise & Sunset



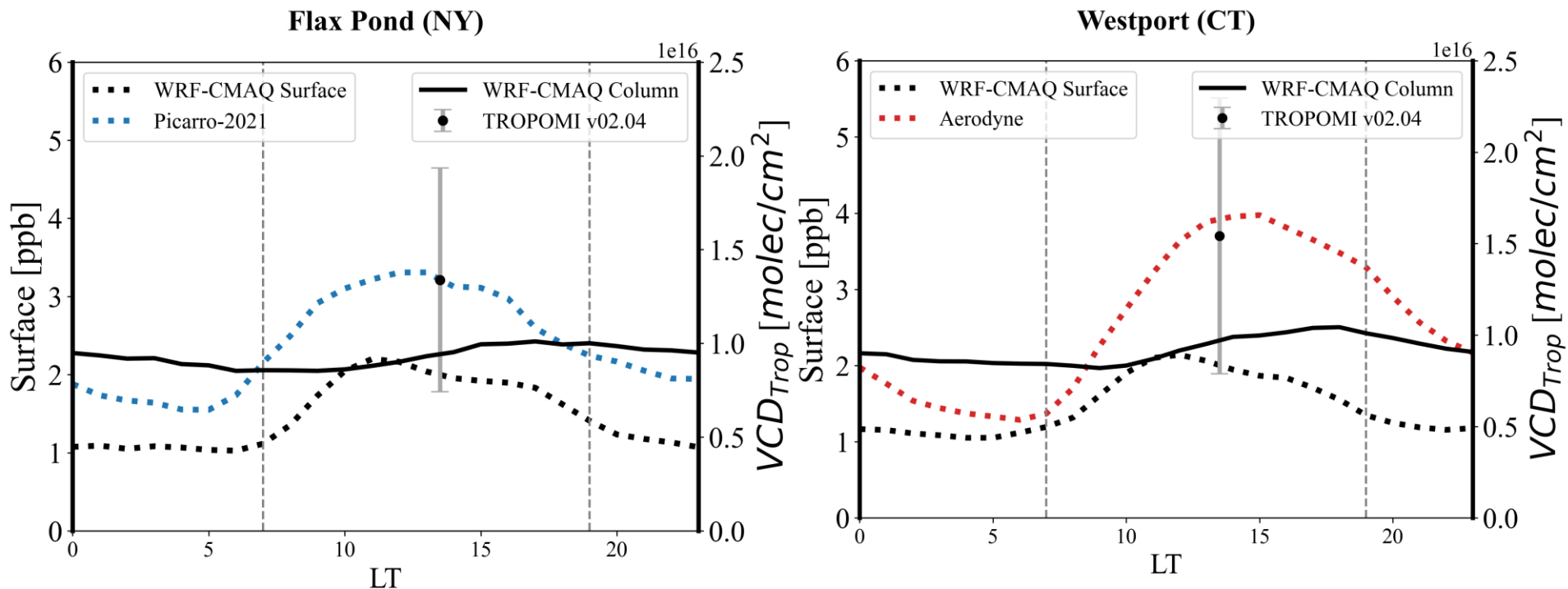
GEOS-Chem High Performance at 12 km



HAQAST PI Randall Martin

Chatterjee et al., ACPD, 2024

Model (WRF-CMAQ) formaldehyde (HCHO) columns indicate a delay in timing of the daily maximum relative to surface concentrations



In situ surface HCHO measurements (c/o EPA & NYS DEC)
suggest local differences in diurnal cycles

Mapping population exposure to ozone & precursor gases in preparation for new insights from TEMPO

Delivered data & related guidance to support stakeholders in their analysis of:

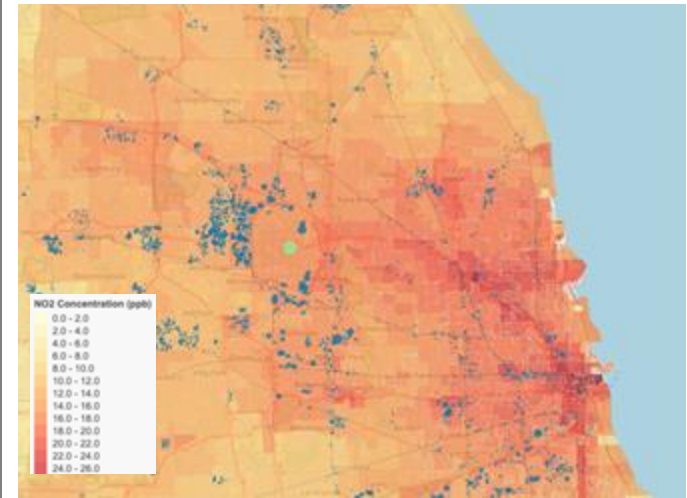
- long-term air quality trends
- new PM_{2.5} and ozone NAAQS
- emission reduction strategies

Some of these data are now disseminated through public-facing tools developed and maintained by stakeholder partners (Z. Adelman, LADCO)



For datasets & possible development of new guidance documents, contact Gaige Kerr (gaigekerr@gwu.edu).

Gaige Kerr (GWU)

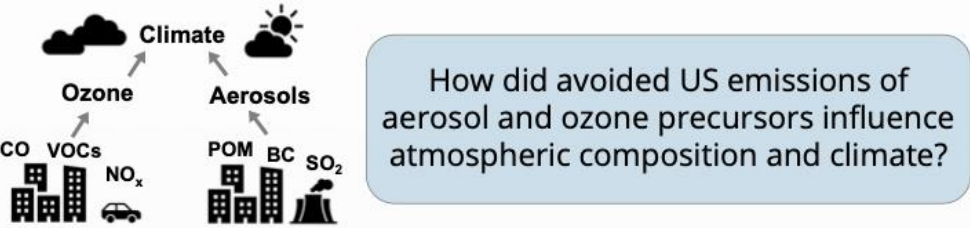


We've developed an R Shiny app to view ambient NO₂ concentration data at the census tract level, industrial and energy NO_x emissions sources, and warehouses on an interactive online map. The ambient 2019 NO₂ data are from satellite retrievals that were regridded to census tracts. The NO₂ concentrations and warehouse data were provided by the [Air, Climate, and Health Lab at George Washington University](#); the NO_x emissions are from the [U.S. EPA's 2022v1 Emissions Modeling Platform](#).

Interactive mapping created by Zac Adelman (LADCO) and available at www.ladco.org/mapping-no2-pollution-and-sources/. Shading shows 2019 NO₂, blue scatter shows warehouses, and green scatter represents NO_x emissions.

Please check out other updates from our Columbia/MIT HAQAST team & HAQAST-relevant projects

Poster: Steph Elkins (EAPS, MIT)



Poster: Renato Berlinghieri & David Burt (EECS/LIDS, MIT)

Motivating example



A person needs to go out during the day to take care of a sick family member. They want to minimize their exposure to PM_{2.5}. Can they decide when to go out based on model forecasts available in the morning?

Can you trust PM_{2.5} forecasts to plan your day during extreme events?

INPUT EXPOSURE DATASETS
Daily PM_{2.5}

EQUATES (EPA Air QUALity Time Series)

Bi et. al 2019

FAQSD (Fused Air Quality Surface Using Downscaling)

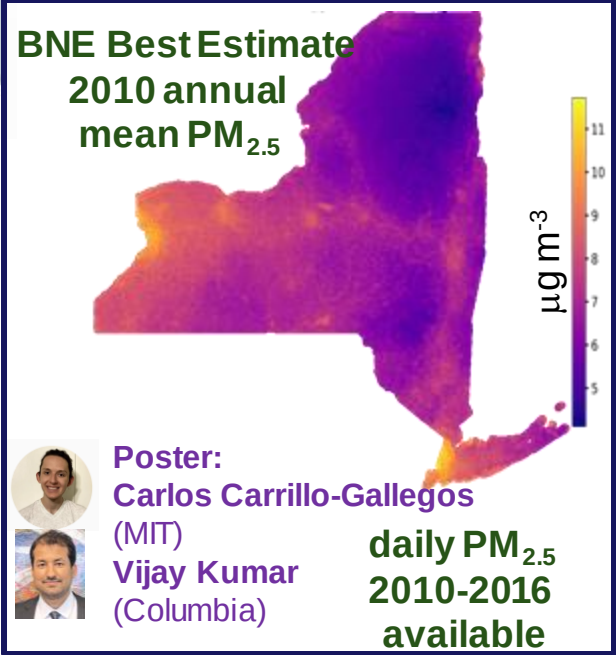
Di et. al 2021

WRF-CMAQ with AOD, CO (R. Kumar et. al 2021)

BNE
best estimate + uncertainty



Jaime Benavides (Columbia) Flash Talk



Poster: Carlos Carrillo-Gallegos (MIT) Vijay Kumar (Columbia)



→ epi studies
Co-I Kioumourtzoglou (Columbia) Session 5B
→ CIESIN/SEDAC
Co-I S. Adamo CIESIN/Columbia Flash Talk

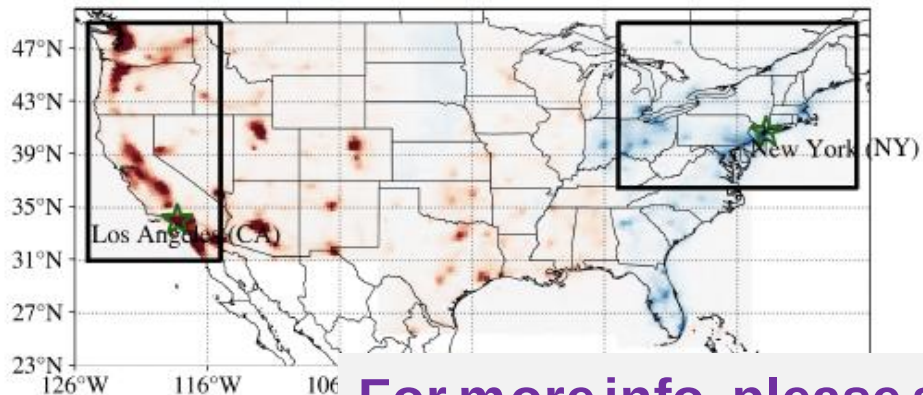


Hourly timing of NO_x emissions influences monthly mean NO_x (& O_3) abundances

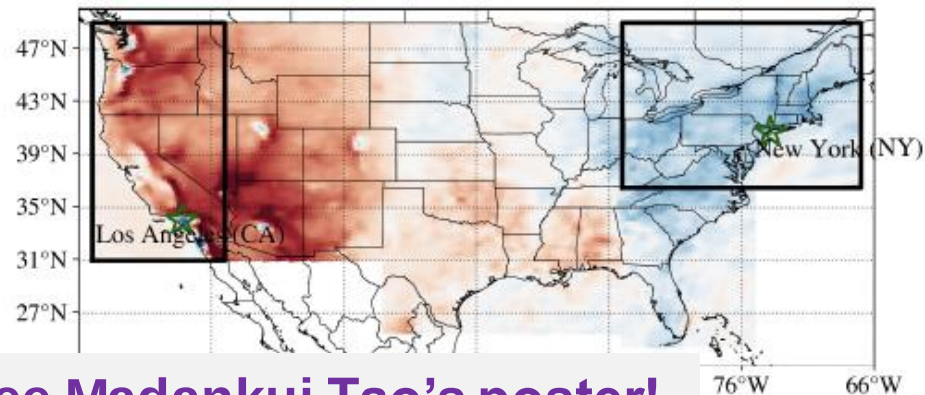
MUSICA-v0 chemistry transport model (14km resolution over the U.S.A.; ~100 km global)

Daytime (9AM-5PM) July Mean NEI_hourly_NO – NEI_daily_NO

Surface NO_2



Surface O_3



For more info, please see Madankui Tao's poster!



→ Implications for inferring NO_x emissions (& O_3 sensitivity) from space?

Interested to join the “TEMPO-for-ozone-applications” Tiger Team?

Topics

- Exposure burdens (Gaige Kerr)
- Fire smoke and ozone exceedances (Amber Soja)
- Understanding and communicating uncertainties (Randall Martin)
- Emission inventories (Ted Russell)
- Ozone-forming chemistry (Arlene Fiore)

Requested Deliverables

Plain-Language tip sheets

Use-case documents

Usable datasets & tools

Next Team Zoom Meeting:

Tuesday June 18th at 2pm Eastern

To join, email:

Arlene Fiore (amfiore@mit.edu) or

Jenny Bratburd (bratburd@wisc.edu)

Current call schedule is 3rd Tues of the
month @ 2pm Eastern