


Historical and current policy-relevant research on GHGs and AQ in the Baltimore/Washington area

Russell Dickerson, UMD
UMD/URF Cessna and NOAA's ARC

2025 AiRMAPS Coordination Workshop
Sept. 2024



Maryland
Department of
the Environment

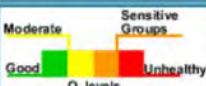

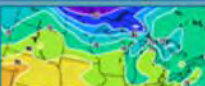
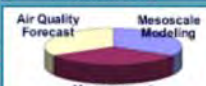


RAMMPP

Regional Atmospheric Measurement Modeling and Prediction Program

- Hot Topics
- Participants
- Publications
- Current Data
- Archives


What is RAMMPP?
 At the University of Maryland, College Park (UMD) we are developing a state-of-the-art scientific research tool aimed at a more informed understanding of the influences controlling air quality over the mid-Atlantic States. The Regional Atmospheric Measurement, Modeling and Prediction Program (RAMMPP) involves a number of integrated research elements:

Ozone Forecasting	Measurements	MesoScale Modeling	Chemical Transport Modeling
 <ul style="list-style-type: none"> - Daily ozone forecast for our area (mid-May to mid-September) 	 <ul style="list-style-type: none"> - Surface sites - Radiosondes - Light aircraft - Trace gases, fine particles, physics, optical properties - Upper air meteorology and chemistry 	 <ul style="list-style-type: none"> - Year round and daily numerical forecast for mid-Atlantic - Uses meso-scale model 5 (MM5) from Penn St. - Triply nested grid (36/12/4 km) 	 <ul style="list-style-type: none"> - Combined analysis using our EPA Models-3/CMAQ framework - Constrained and evaluated using assimilated field data

MDE

CAMx SIP

Air Quality Forecasts.




DEPARTMENT OF
ATMOSPHERIC AND OCEANIC SCIENCE

Department of Atmos & Oceanic Sci
University of Maryland
College Park, MD 20742


<https://www2.atmos.umd.edu/~rammpp/>
 (being updated)

MDE support
 (still have \$\$, no airplane now)



FLAGG-MD: Fluxes of Atmospheric Greenhouse Gases in Maryland

[Home](#)
[About](#)
[People](#)
[Project Updates](#)
[Data](#)



UMD Cessna

<https://www2.atmos.umd.edu/~flaggmd/#customizr-slider>

- Discovered CH₄ emissions inventories were Low.
- Lagrangian Modeling (Israel L-C)
- NIST Support

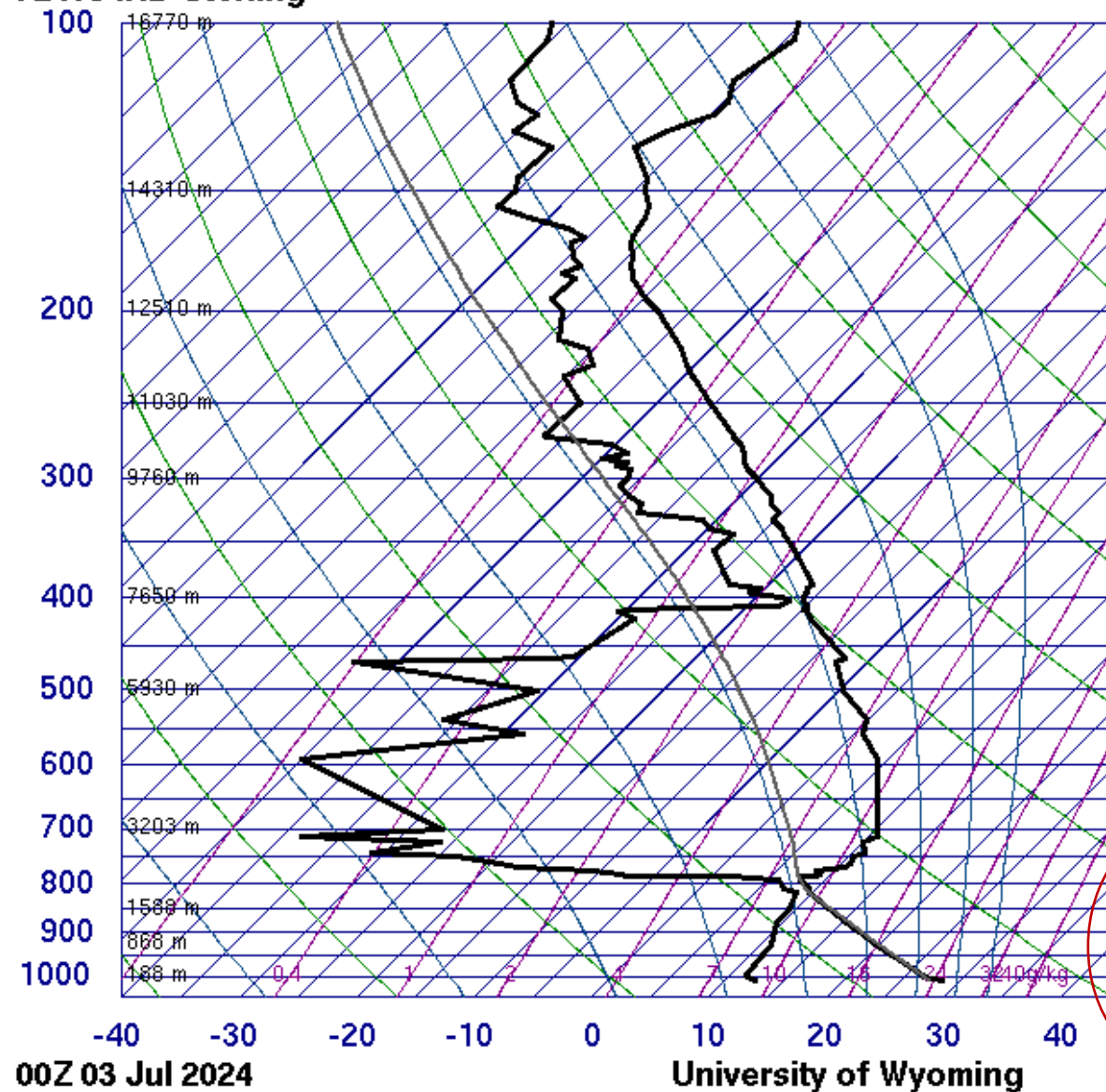
Typical summer winds
Veer from S to W or NW aloft.

Exchange between PBL and LFT.

Transport from Balt/Wash to NE.

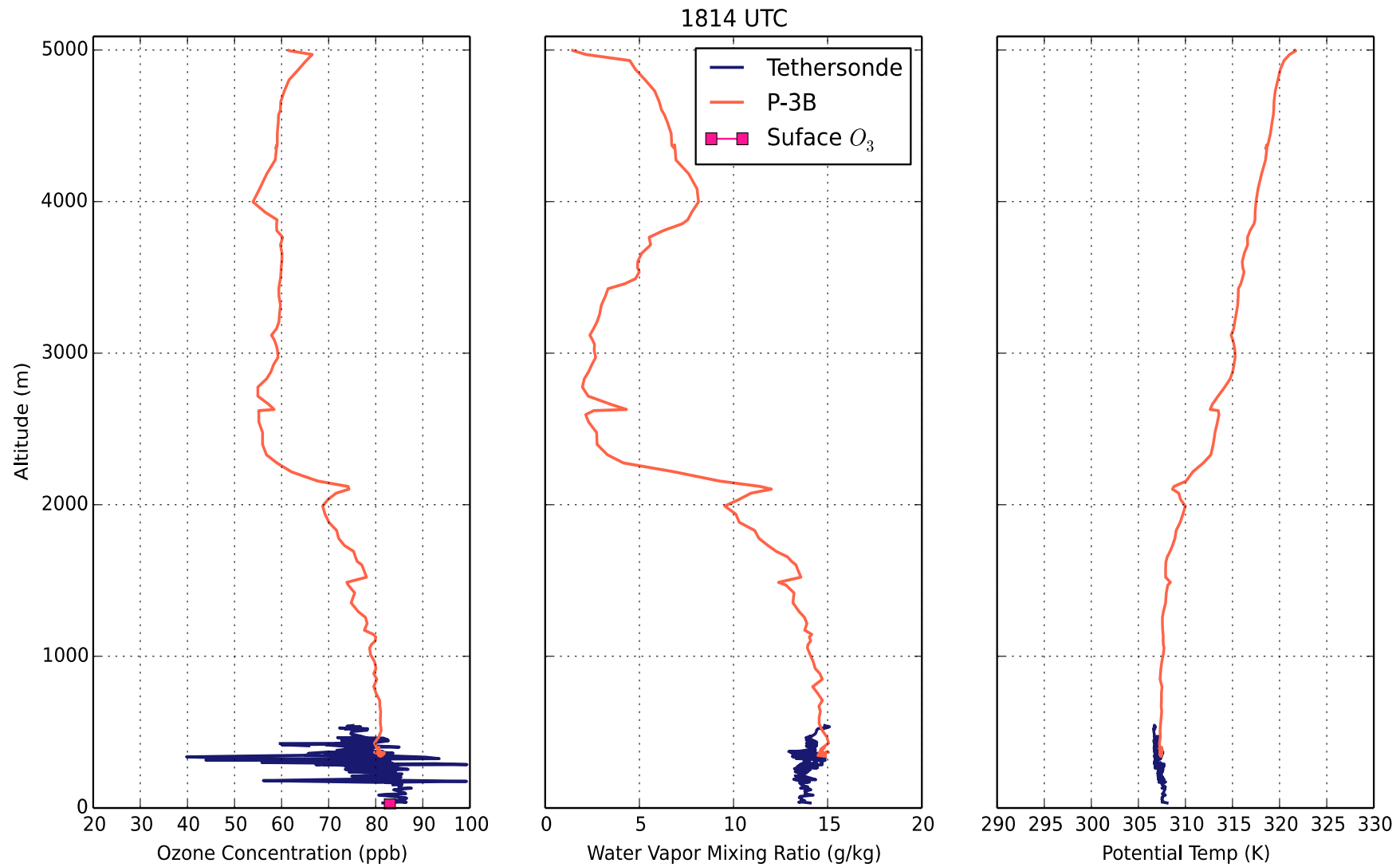
Hao et al.

72403 IAD Sterling



SLAT	38.98
SLON	-77.46
SELV	93.00
SHOW	8.81
LIFT	8.83
LFTV	8.49
SWET	143.7
KINX	-10.1
CTOT	14.10
VTOT	17.50
TOTL	31.60
CAPE	0.00
CAPV	7.38
CINS	0.00
CINV	-1.07
EQLV	-9999
EQTV	784.7
LFCT	-9999
LFCV	796.2
BRCH	0.00
BRCV	0.29
LCLT	281.5
LCLP	802.9
LCLE	325.4
MLTH	299.7
MLMR	8.68
THCK	5742.
PWAT	23.34

P-3B & Balloon Soundings Edgewood, MD_2011-07-29

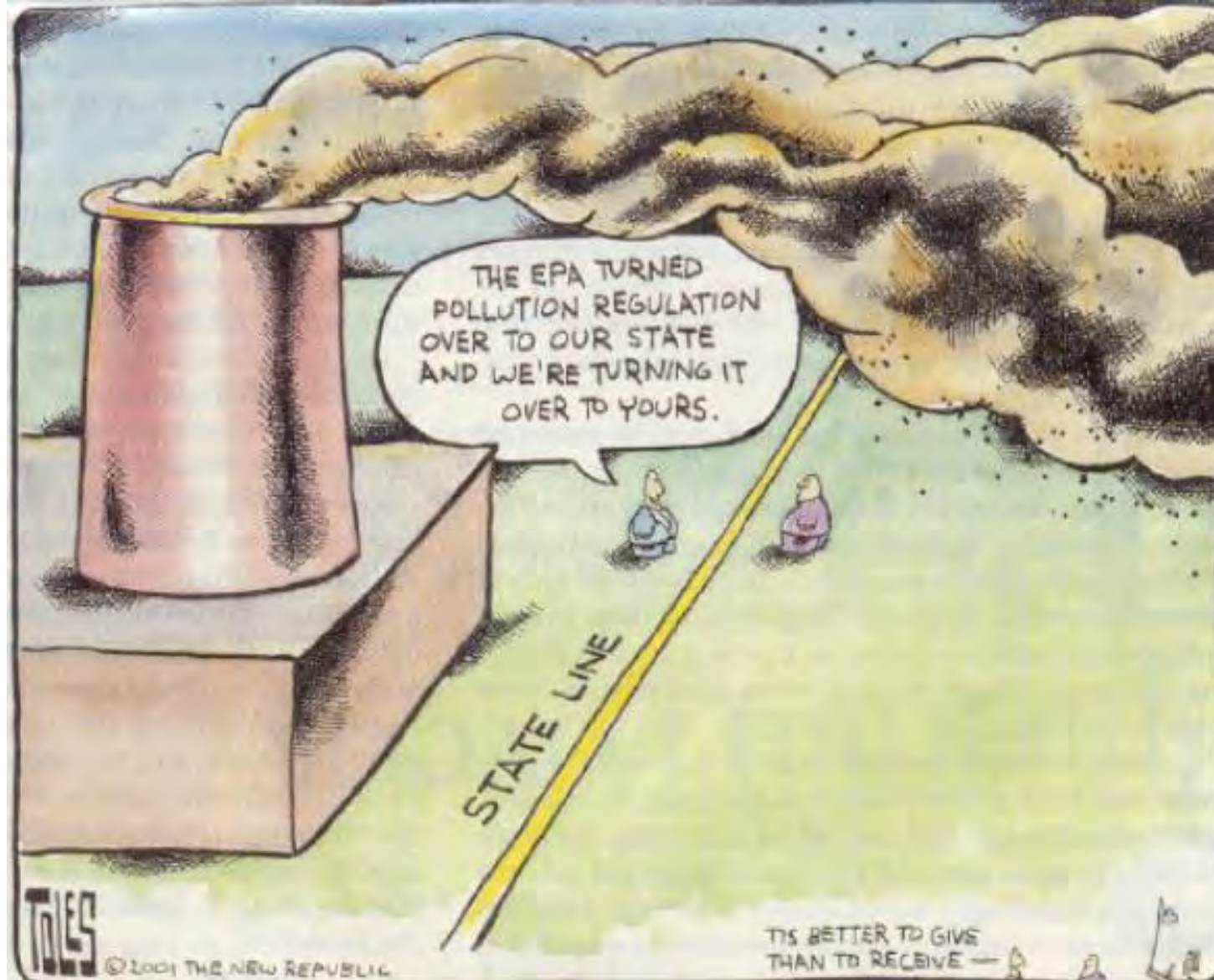


Mazzuca tether sonde

History and ongoing projects

- Interstate Transport
Supreme Court
- Emissions
NO_x, CO₂, CH₄, H₂O, BC
- PBL venting & transport
- Sea and Bay breeze.
- Photolysis rates $j(\text{NO}_2) = f(z)$ (NH₄)₂SO₄ vs. Bc vs. BrC.
- Biomass burning
- Modeling & remote sensing.
 - Lifetime alkyl nitrates & NO_x
 - Which VOC's?

Go to Court: 2013: Homer City Generation L.P. vs. EPA and American Lung Assoc.





Supreme Court
2024 – refused to consider

RAM

rief.

No. 23-1157 (and the consolidated cases)

IN THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT
OF COLUMBIA CIRCUIT

State of Utah, by and through its Governor, Spencer J. Cox, and its Attorney
General, Sean D. Reyes,

Petitioner,

v.

Environmental Protection Agency and Michael S. Regan, in his official
capacity, as Administrator of the U.S. Environmental Protection Agency,

History and ongoing projects

- Interstate Transport
Supreme Court
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NO_x, CO₂, CH₄, H₂O, BC, VOCs, C₅H₈
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REVIEW: NATURAL VOLATILE ORGANIC SUBSTANCES AND THEIR EFFECT ON AIR QUALITY IN THE UNITED STATES

CENSORED

Environmental Sciences Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, U.S.A.

(First received 18 October 1982; in revised form 8 April 1983 and received for publication 12 May 1983)

Abstract—The literature on sources, emission rates, emission inventories, ambient air concentrations, lifetimes and reaction products of natural volatile organic compounds has been reviewed. Relationships between emission inventories and air quality measurements are considered. The effectiveness of natural hydrocarbons in contributing to ozone formation and aerosol formation in ambient air are discussed. It is concluded that natural hydrocarbons do not contribute substantially to the formation of either ozone or aerosols in ambient air.

Emissions models are improving.

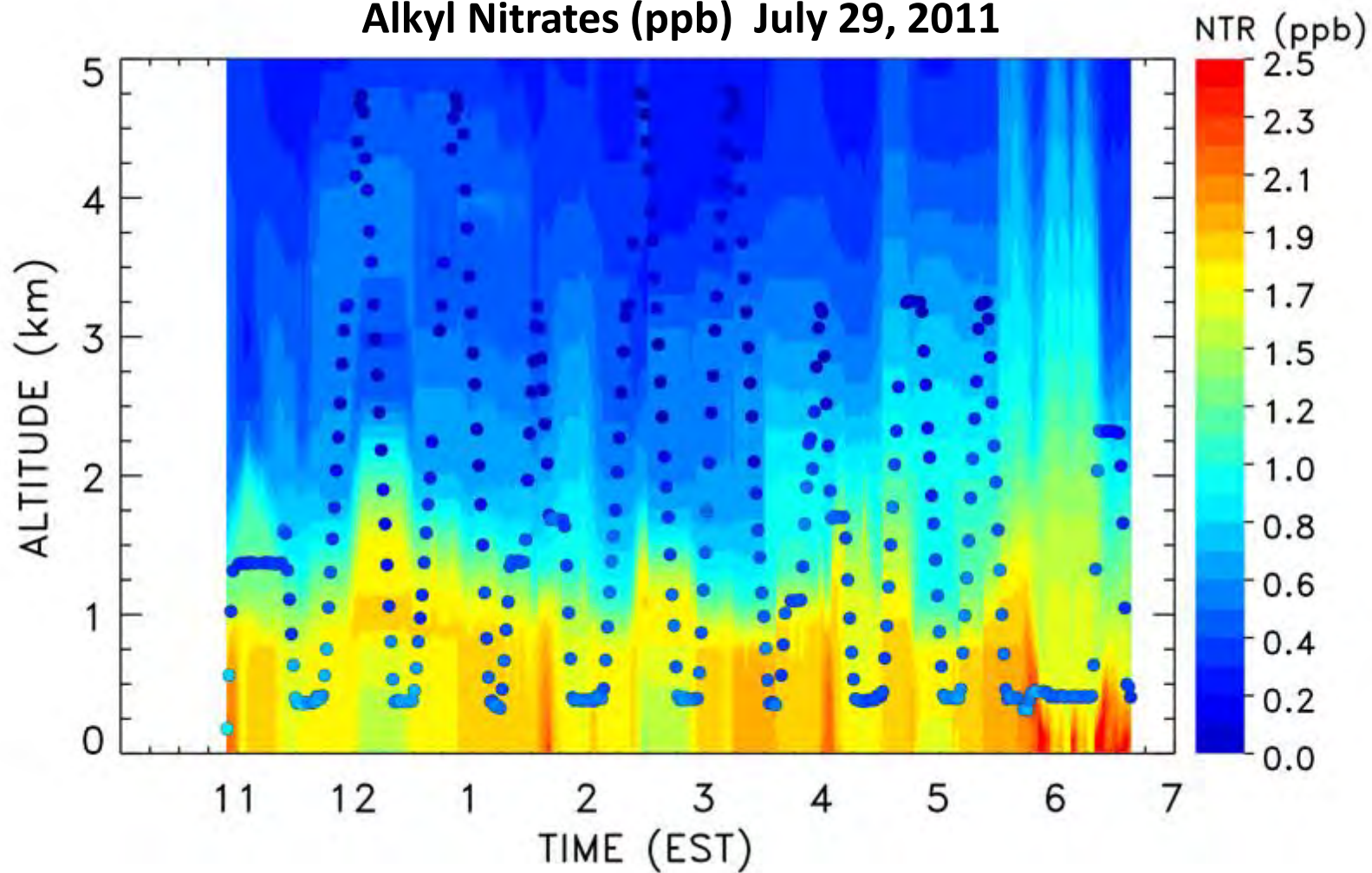
A. Christiansen et al.: Constraining long-term NO_x emissions



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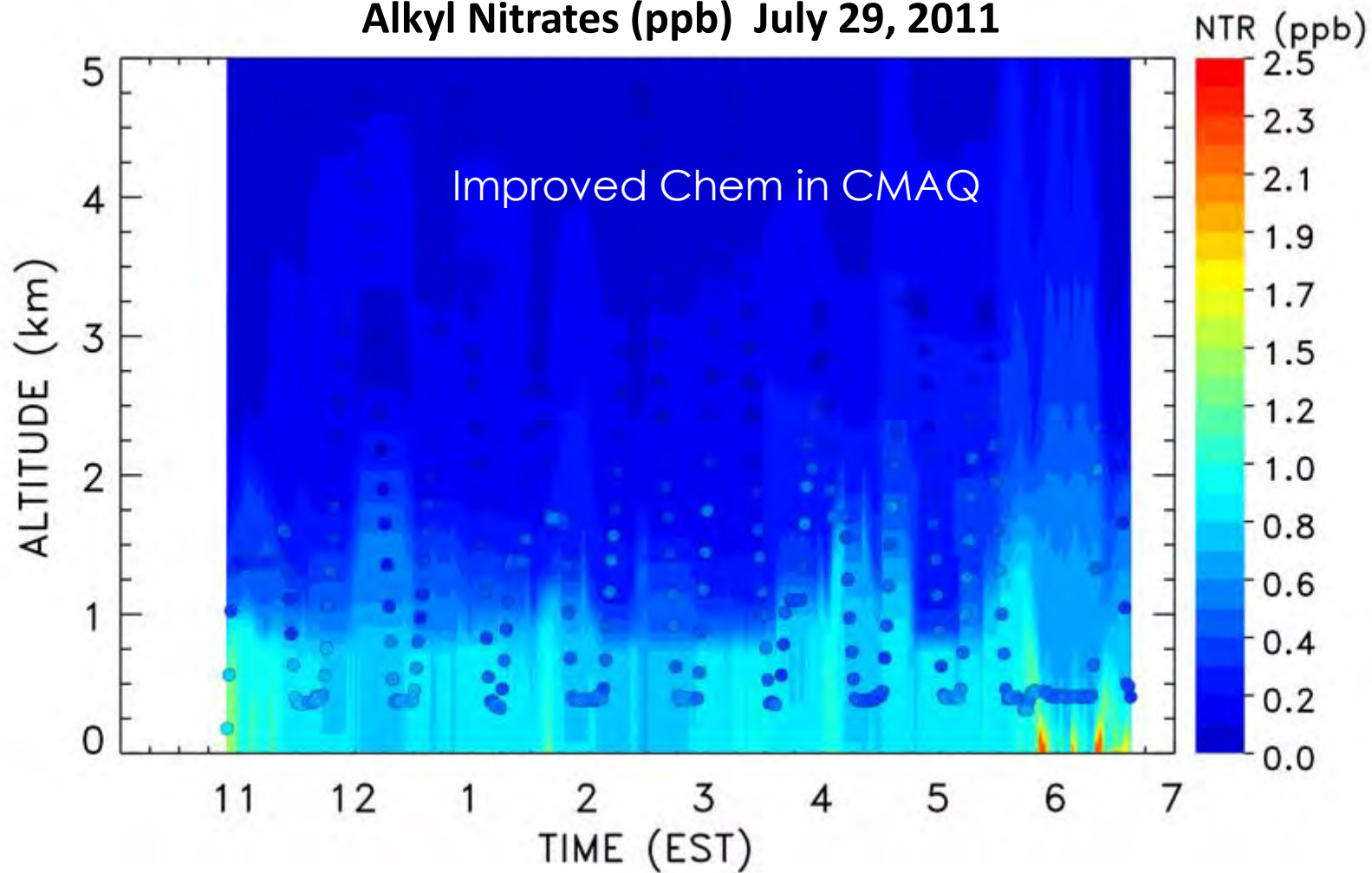
Alkyl Nitrates (ppb) July 29, 2011



Background Contour → CMAQ Baseline

Colored points → DISCOVER-AQ Flight #14

Alkyl Nitrates (ppb) July 29, 2011



Background Contour → CMAQ decreased NTR lifetime

Colored points → DISCOVER-AQ Flight #14

Ongoing and future projects (Discussion points)

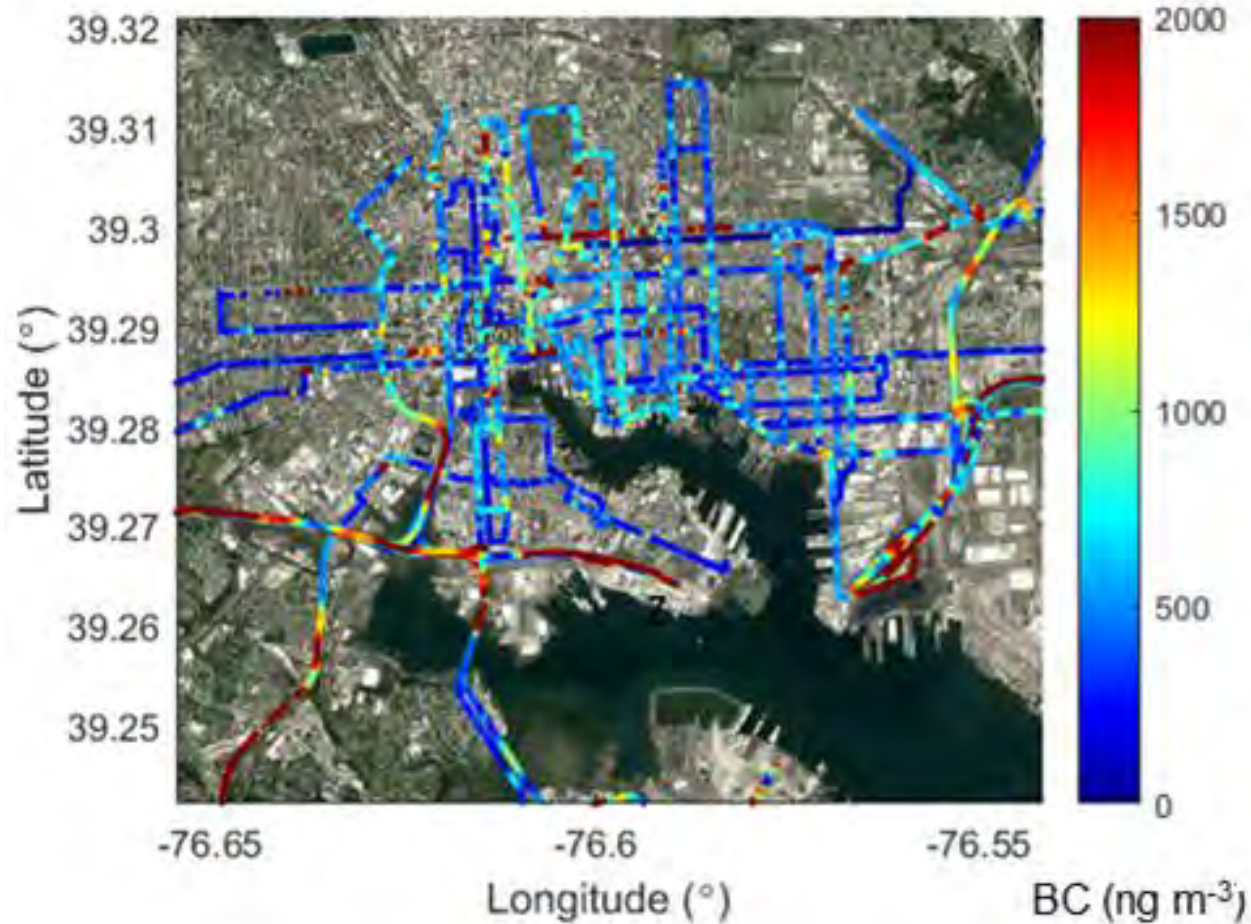
- Less fossil fuel burning, more Biomass burning (BrC)
- Biogenic CH₄ and Organic Aerosols, VCPs
- Increased attention on GHG's inc. N₂O
- BrC flux
- NH₃
- Plastics
- Environmental Justice. Hyper-local.
 - Short-lived or primary species e.g., BC, metals, PM₁₀

Curtis Bay, facing south. EPA/MDE/NOAA/UMD

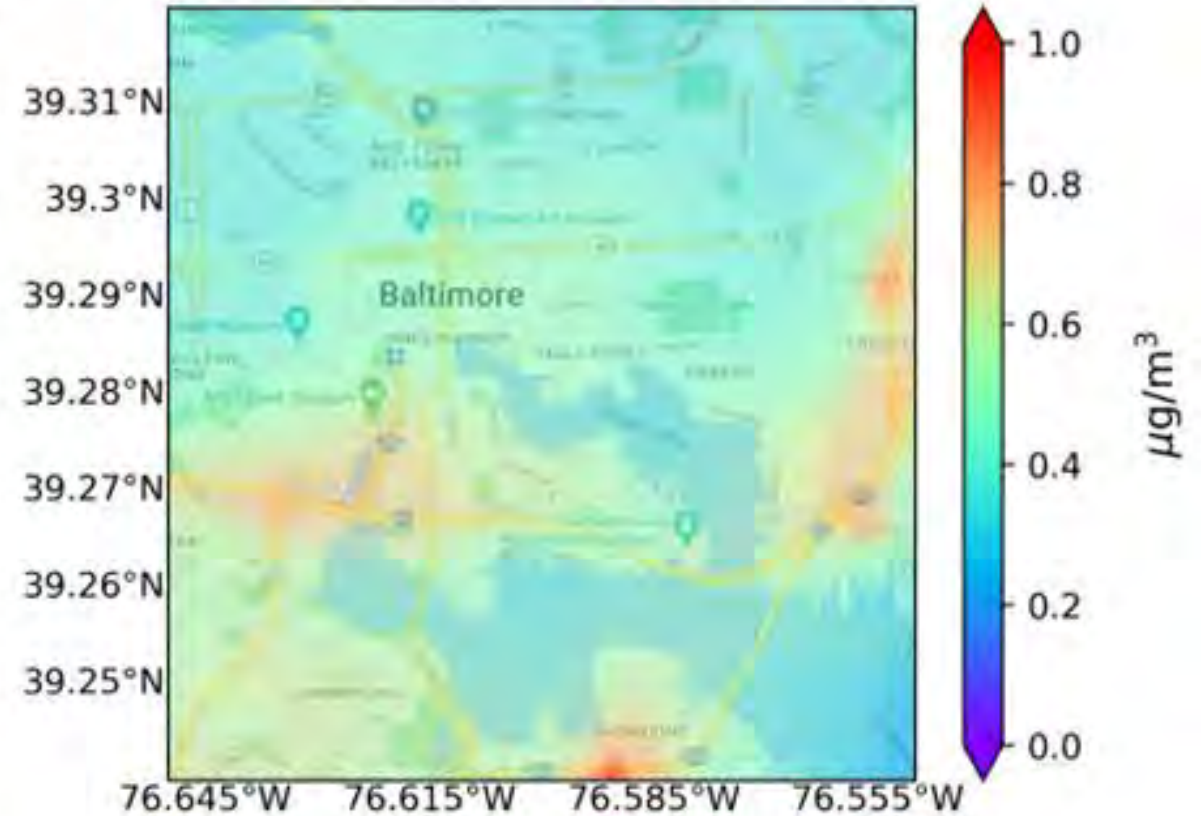
Photo credit: Summer Youth Environmental Justice Scholars; R. Gattis, Panorama drone photograph, 2023.



a) NOAA-ARC measurement



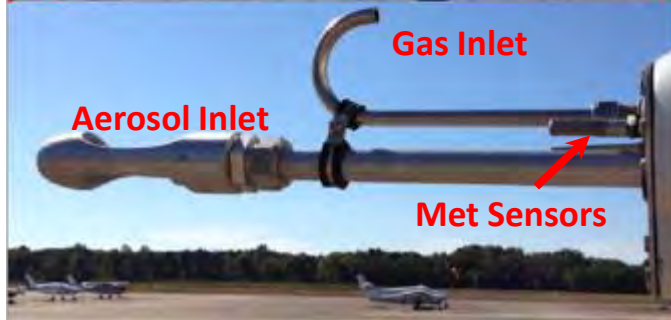
b) 0.44-km CMAQ simulation



High-resolution WRF-CMAQ (0.44 km) simulations resolve hot spots of BC seen by NOAA's-ARC.

Hao He; Prelim data, do not propagate.

UMD Research Aircraft Cessna 402B



What's missing?

Fast response C_2H_6 and other VOCs
Oxygenates

Isotopes

Aerosol composition

Ammonia

Lidar winds and aerosol scattering.

Summary and Questions

- Huge success on O_3 and $PM_{2.5}$
- Interstate (Synoptic/meso-scale) transport still important.
- Emissions of CH_4 , CO_2 , $N_2O(?)$, NO_x , VOC, BC, BrC... still uncertain.
- Despite attainment of NAAQS....
- Chem Transport Models continue to need improvement.
- Meso- or micro-meteorology can decide attainment or not.
- Environmental Justice emerging issue.

The Guilty Parties

