Instrument Team Presentations: Organic Gases

Moderator: Jessica Gilman, NOAA CSL

September 28, 2022

14:00 to 15:00

AEROMMA
Organic Gases

Formaldehyde Measurements on Two Planes

AEROMMA

Nidhi Desai
GA Tech

Jen Kaiser
GA Tech

GOTHAAM

Reem Hannun
U. Pitt.

Tim Canty
U. MD

Abby Sebol
U. MD

The Help

Glenn Wolfe
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NASA GSFC

Andrew Swanson
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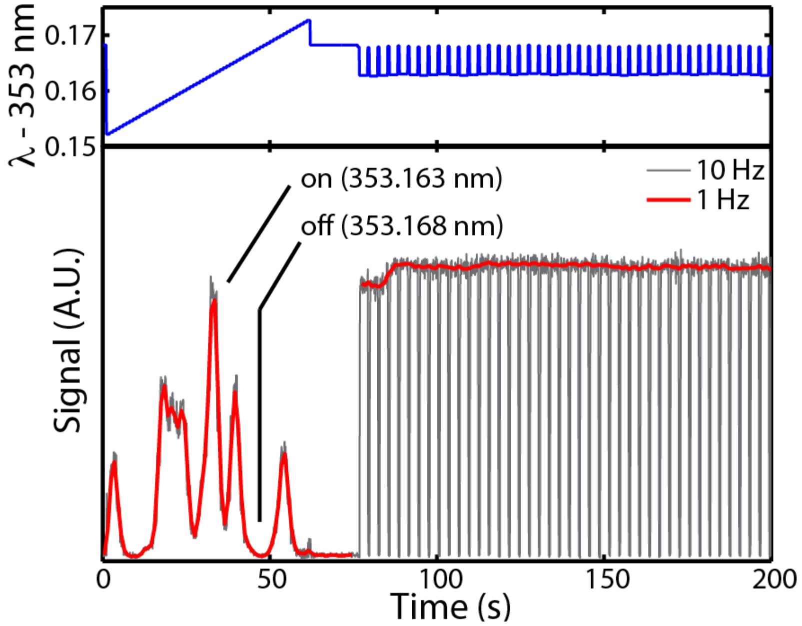
In Situ Airborne Formaldehyde (ISAF)

Technique: laser-induced fluorescence (LIF)

A laser is continuously tuned between a large formaldehyde (HCHO) rotational transition and a non-resonant wavelength.

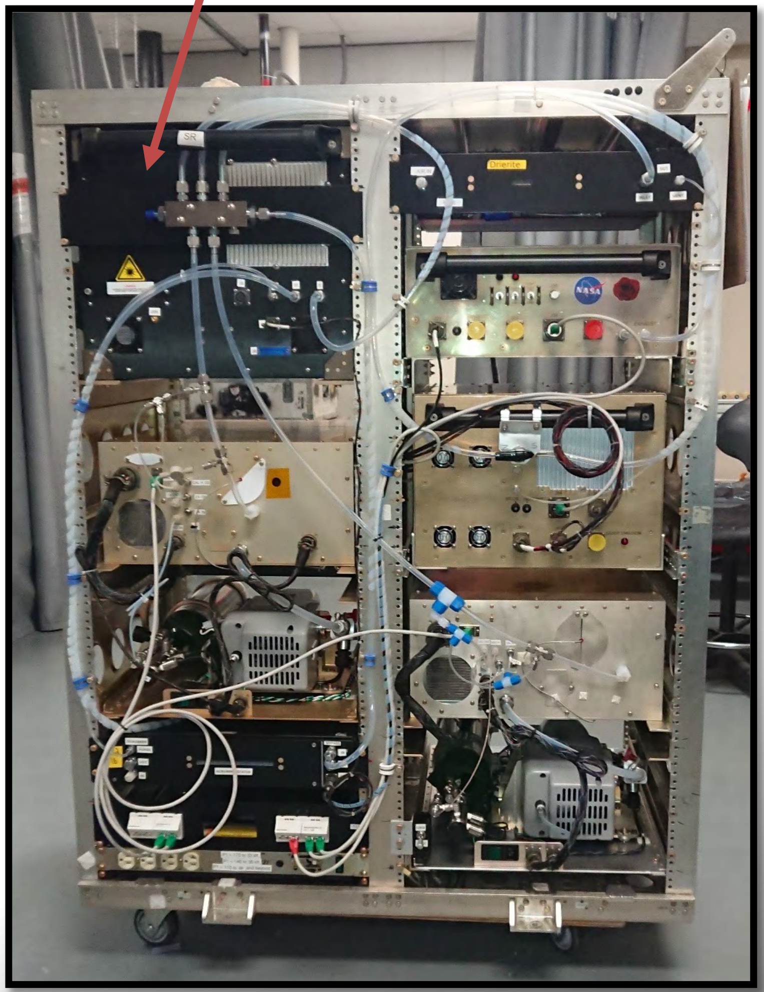
The concentration of HCHO is proportional to the difference between the online and the offline signals.

Reference: Cazorla et al., Atmos. Meas. Tech., 8(2), (2015).

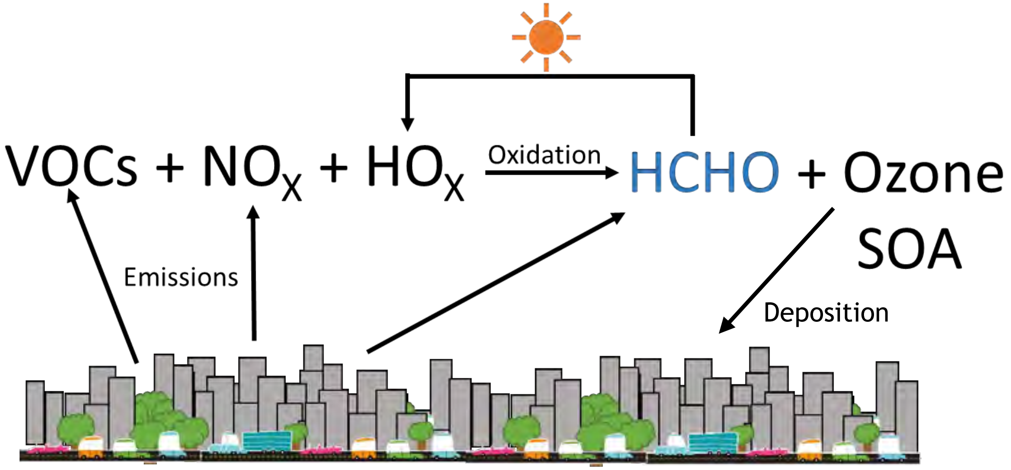


Detection Limit: 35 pptv/s
Accuracy: 10%
Time Resolution: up to 5 Hz

ISAF



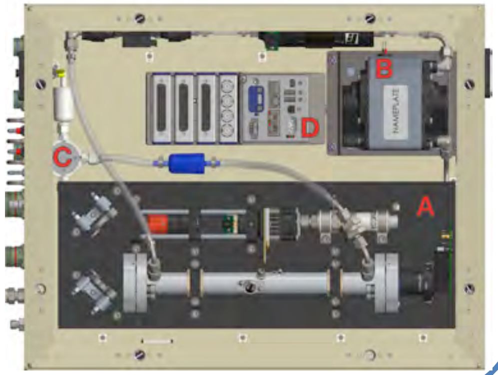
Fun Things to do with HCHO and Friends



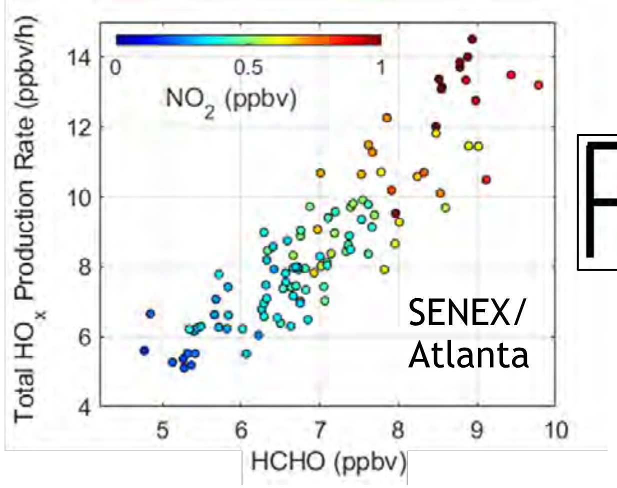
Ozone Deposition to Urban Surfaces

Rapid Ozone Experiment (ROZE)

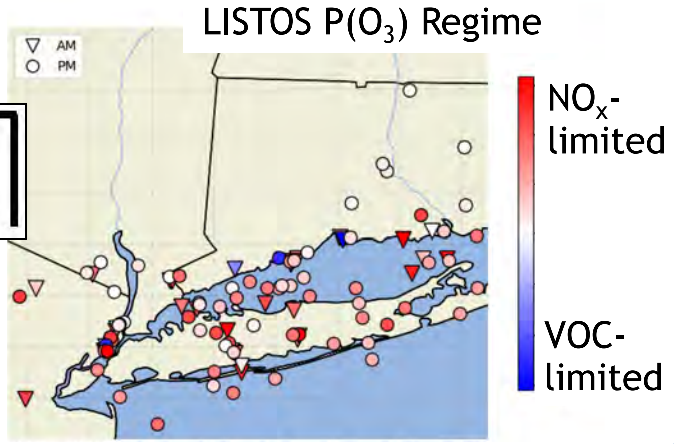
Hannun et al., AMT (2020)



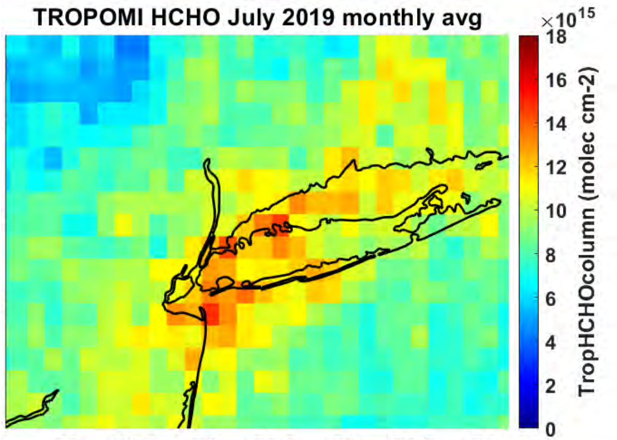
VOC Oxidation



Ozone Production



Satellite Retrieval Validation and Upscaling



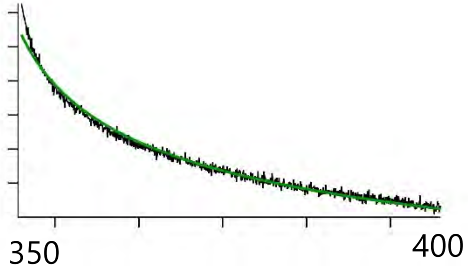
ACES (Airborne Cavity Enhanced Spectrometer)

Technique: 2-channel UV-vis absorption spectrometer

Species measured: NO_2, glyoxal (CHOCHO), and total aerosol extinction (NEW)

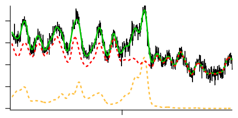
2σ LOD (1 sec): 74 pptv (NO_2), 40 pptv (CHOCHO), 1.1 Mm^{-1} at 365 nm (aerosol extinction)

Channel 1:
UV aerosol



Measured spectrum
Fit, attributed to aerosol

Channel 2:
Vis gas-phase



Measured spectrum
Fit
0.5 ppbv NO_2
0.5 ppbv CHOCHO

435

480

NOAA / CIRES ACES team

Carrie Womack
ACES PI
caroline.womack@noaa.gov

Wyndom Chace
NightNOx

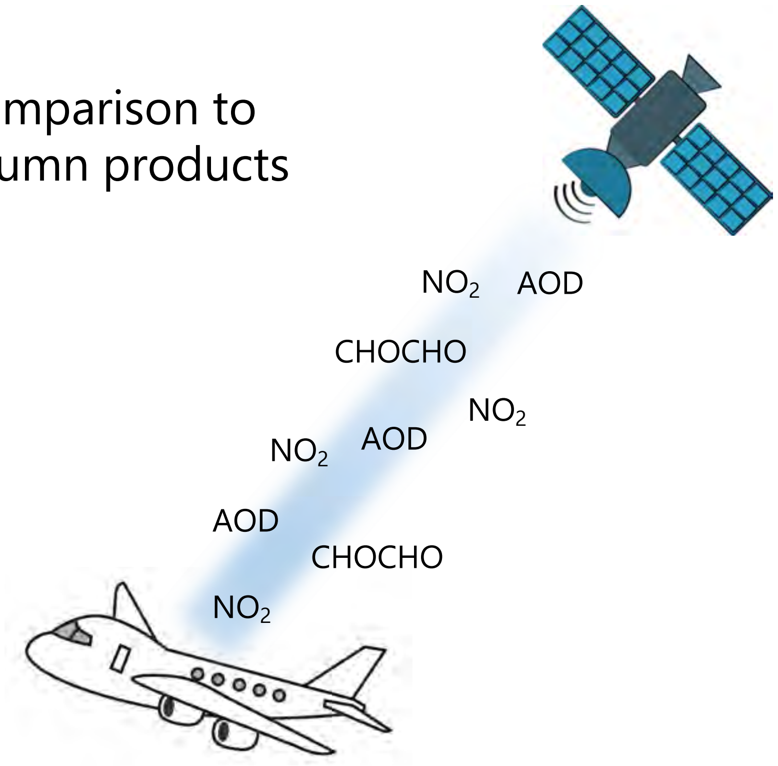
???

Additional
summer student?

Steve Brown

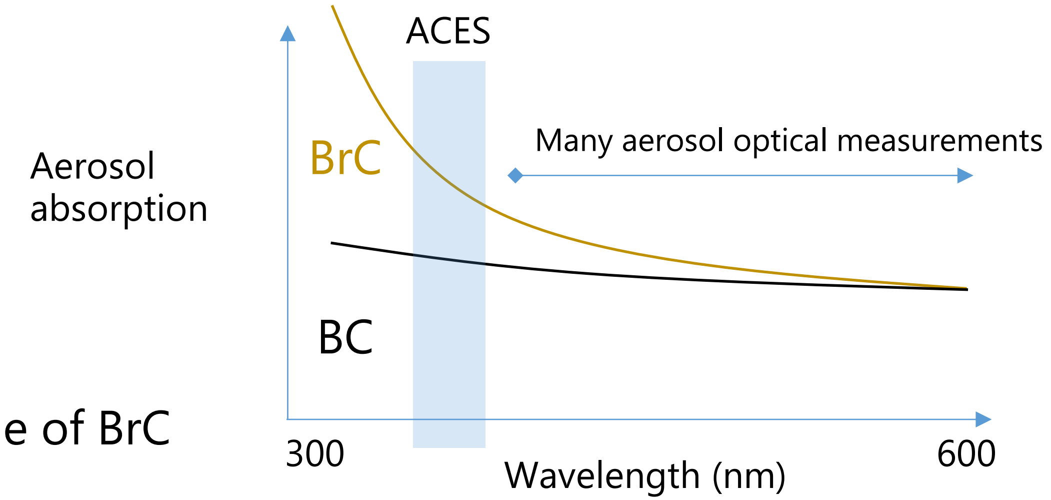
ACES science goals during AEROMMA

1. Direct comparison to TEMPO column products



2. Role of NOx and small VOCs (i.e. glyoxal) in ozone formation

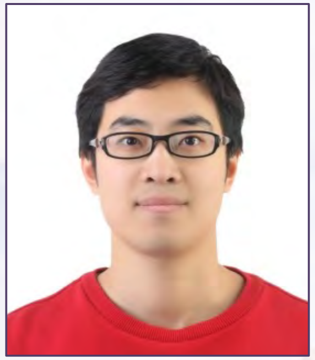
NOx + VOCs - - -→ CHOCHO - - -→ O_3, PM



3. Aerosol extinction in the UV → role of BrC

NOAA VOCUS PTR-ToF-MS on NASA DC8 measuring VOCs

Chelsea Stockwell
Instrument PI
CIRES/NOAA



Lu Xu
Instrument PI
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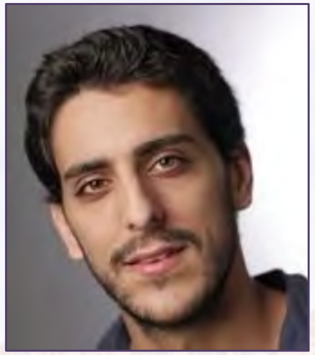

Georgios Gkatzelis
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Matt Coggon
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Carsten Warneke
Team Leader
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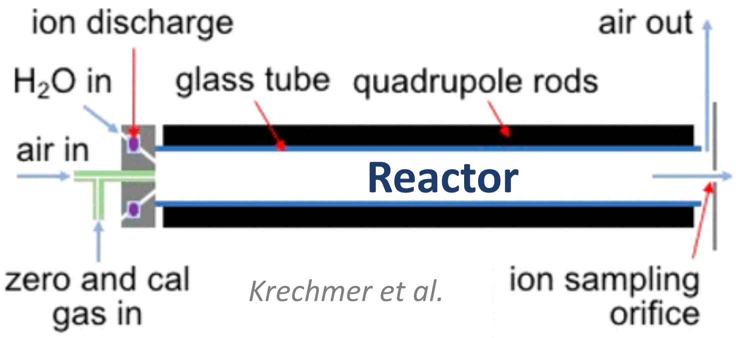
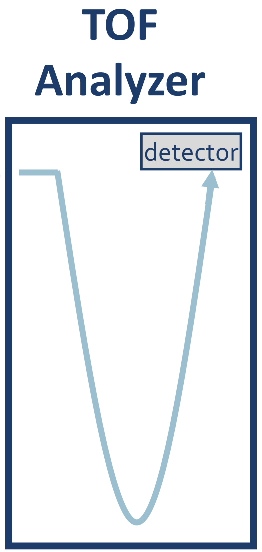
NOAA CHEMICAL SCIENCES LABORATORY

CIRES

NOAA VOCUS PTR-ToF-MS on NASA DC8 measuring VOCs





Tofwerk VOCUS reactor inlet coupled to high-resolution TOF mass spectrometer

Targeted Species

Biogenic: isoprene, monoterpenes
Oxygenates : alcohols, ketones, aldehydes
Aromatics: benzene, toluene, C8-C10 aromatics
Furanoids: furan, methyl furan, furfural
VCPs: D5-siloxane, PCBTF, texanol

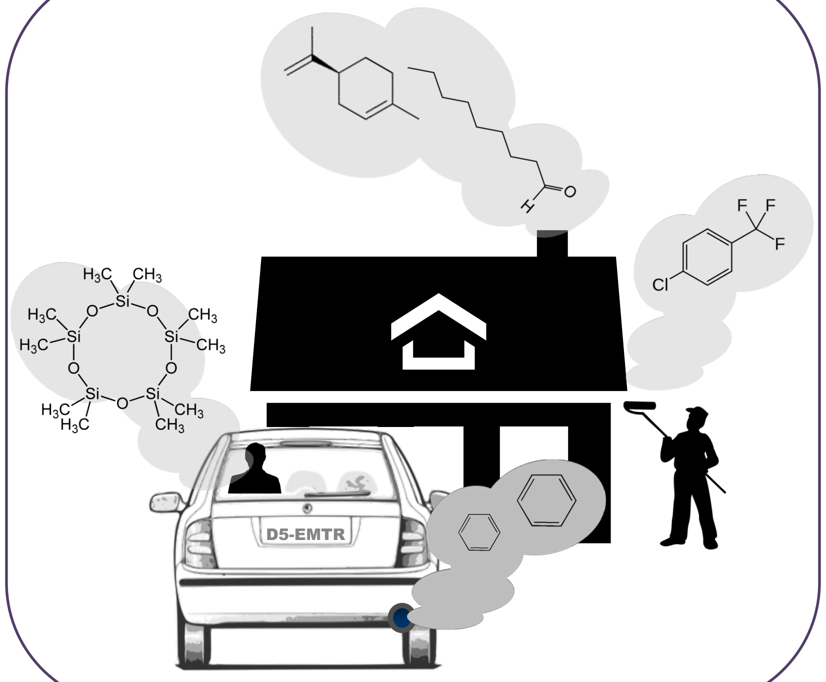
Instrument Performance

Time resolution: up to 10 Hz
Detection limits: <50 ppt for 1s
Precision: signal dependent
Accuracy: 30-100%
Mass resolution: up to 5000 m/Δm

Key references for Instrument Capabilities

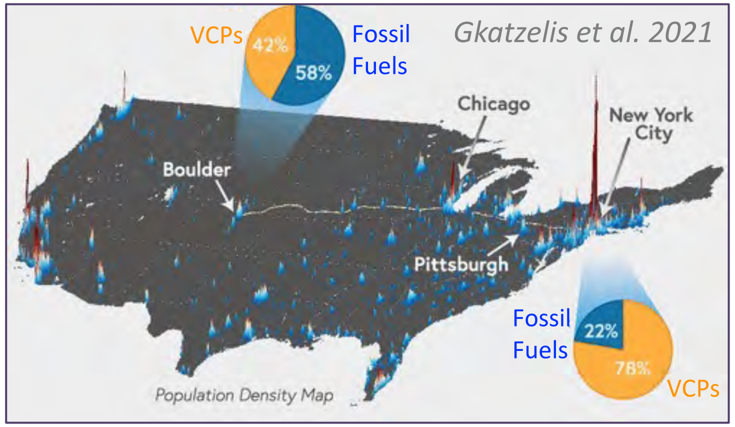
Krechmer et al. (2018), An. Chem., DOI: 10.1021/acs.analchem.8b02641
Gkatzelis et al. (2021), ES&T, DOI:10.1021/acs.est.0c05467

Science Goals and Foci

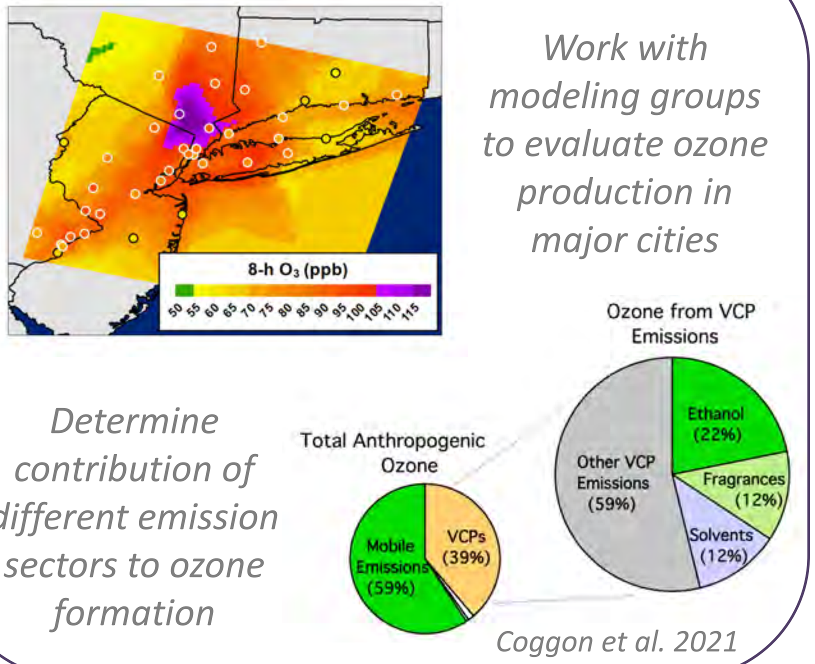


Use measurements to identify and quantify VOC source profiles

Work with modeling groups to evaluate VOC emission inventories across cities



Work by Gkatzelis et al. show differences in VOC mixtures across cities of different population densities



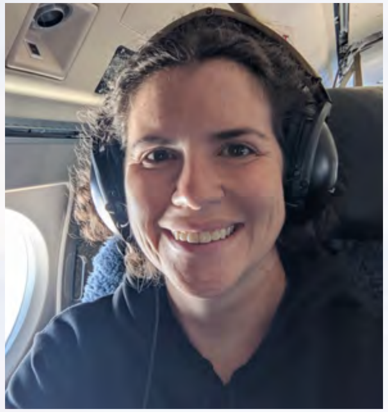
Work with modeling groups to evaluate ozone production in major cities

Determine contribution of different emission sectors to ozone formation

Evaluate VOC chemistry and incorporate observations into chemically explicit models

NOAA Integrated Whole Air Sampling System (iWAS) for speciated VOC measurements aboard NASA DC-8

Jessica Gilman
Instrument PI
NOAA CSL



Victoria Treadaway
Instrument co-PI
CIRES/NOAA

Colby Francoeur
Graduate Student
CIRES/NOAA

PTR-MS Team
Expert
"Can Openers"

Contact: Jessica.Gilman@noaa.gov

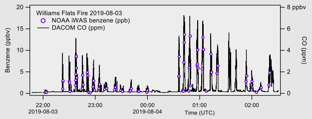
NOAA CHEMICAL SCIENCES LABORATORY

CIRES

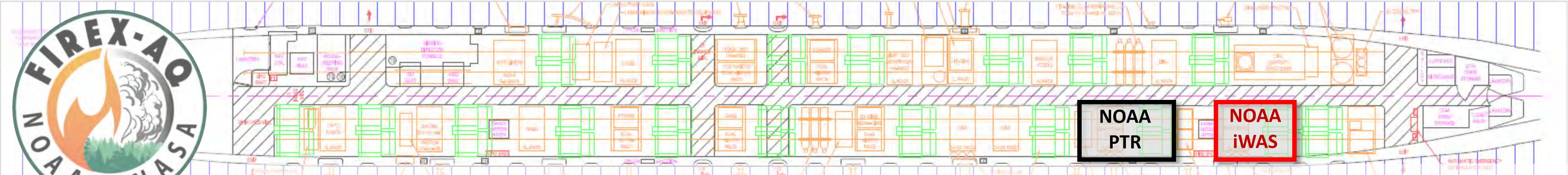
NOAA Integrated Whole Air Sampling System (iWAS) for speciated VOC measurements aboard NASA DC-8

1. Collect whole air samples

- **Expanding to a maximum of 144 samples per flight!** Typical flight will collect 72 samples.
- **Fill time 3-10 seconds depending on altitude.** Filled to 50 psia via s.s. bellows compressor (>50 SLPM).
- **Computer controlled sampling:** automatic intervals or manual control for plume-specific analysis



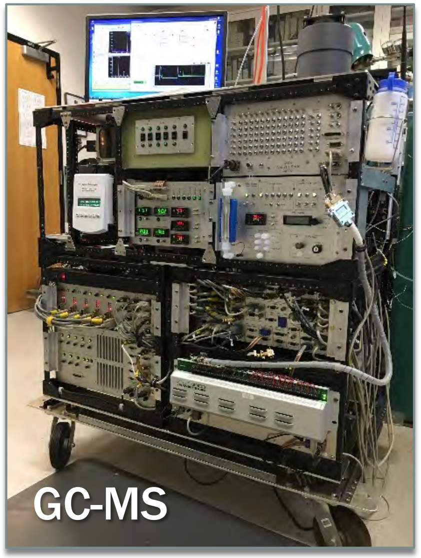
Fast-fill, on demand sampling allowed for multiple samples to be collected across individual plume transects during FIREX-AQ. Can use real-time data from PTR and CO to determine when to collect iWAS samples.



NASA DC-8 FIREX-AQ Payload Floorplan. NOAA PTR and iWAS at same stations for AEROMMA.

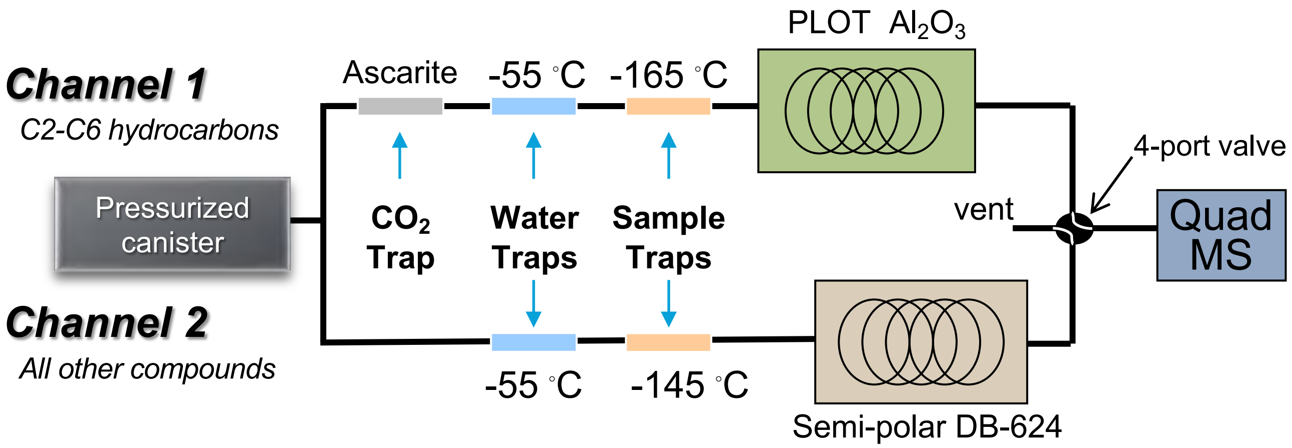
NOAA Integrated Whole Air Sampling System (iWAS) for speciated VOC measurements aboard NASA DC-8

2. Post-flight analysis via automated GC-MS



- 2-channel GC with single quadrupole MSD
- "Cryomechanical" cold traps to preconcentrate VOCs
- **Fully automated analysis; 20 min per sample**
- Most canisters analyzed with 1-4 days of collection

> - C2-C10 HCs, OVOCs, N-, S-, halogenated VOCs
> - iWAS/GC-MS system is designed to be deployed at the airport to minimize sample aging and shipping hassles



3. Clean and condition WAS for reuse

- Evacuate/flush with N_2 three times while heating to 80°C
- Evacuate and fill with ~10 torr water vapor

Lerner et al. (2017) *Atmos. Meas. Tech.*

Scientific goals and areas of interest

1) **Characterize and compare VOC emissions downwind of urban centers**
   - Emissions, transport, and chemistry
   - Compare to 2019 airborne and 2021 ground-based measurements in Los Angeles

2) **Identify VOC source signatures for each city**
   - Mobile sources, VCPs, oil and gas emissions, cooking, biogenics, biomass burning, other industrial emissions

3) **Investigate the potential O_3 and SOA formation from measured VOC emissions**
   - Reactivities to OH, O_3, NO_3 and SOA potential

Contact: Jessica.Gilman@NOAA.gov

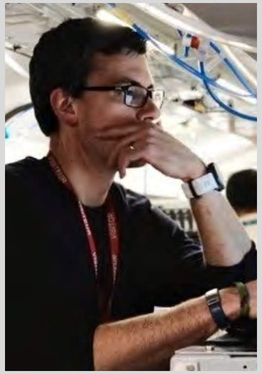
ENVIRONMENT AND CLIMATE CHANGE CANADA (ECCC)

Air Quality Processes Research Section (ARQP)

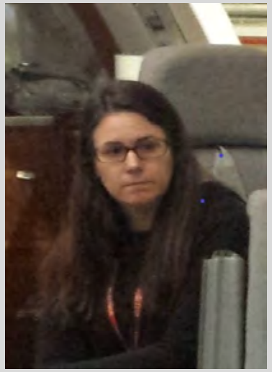
NH_4^+ and $C_6H_6^+$ Vocus/AIM LToF-CIMS on NASA DC8: Measuring VOCs and OVOCs

John Liggio

Team Lead
ECCC/ARQP



Jeremy Wentzell



Amy Leithead

Instrument CO-PIs
ECCC/ARQP

Samar Moussa

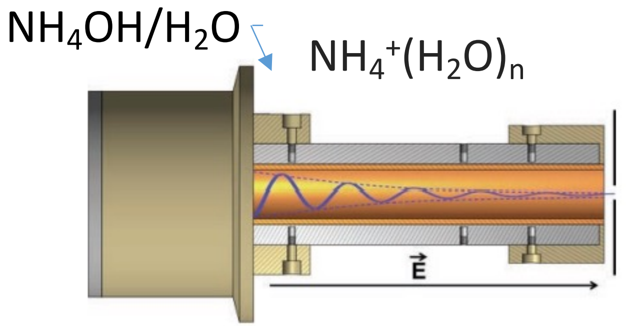
Sumi Wren

Kathy Hayden

Instrument operators & data analysis
ECCC/ARQP

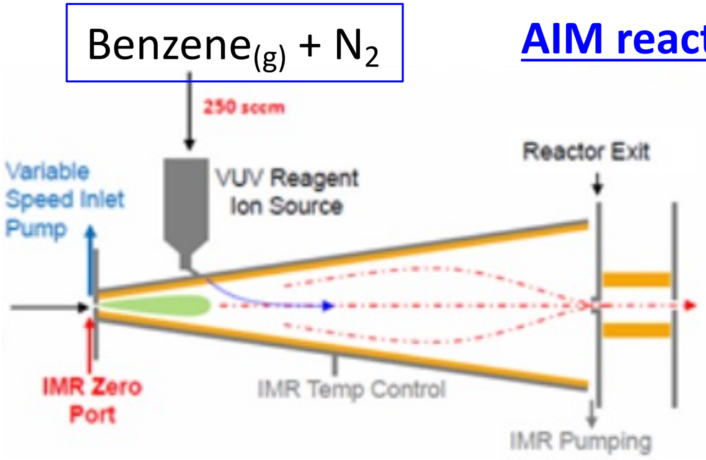
Vocus/AIM LToF-CIMS on NASA DC8

Environment and Climate Change Canada / Environnement et Changement climatique Canada

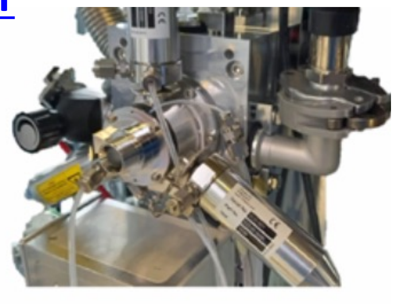


VOCUS Reactor
(www.Aerodyne.com)

$NH_4^+ \cdot (H_2O)_n + M \rightarrow NH_4^+ \cdot (M) + n\,(H_2O)$
where n=,1,2……



AIM reactor



(www.Aerodyne.com)

$C_6H_6^+ + VOC \rightarrow VOC^+$ (charge transfer)
$(C_6H_6)_2^+ + VOC \rightarrow VOC^+$ (charge transfer)
$(C_6H_6)_2^+ + VOC \rightarrow VOC \bullet (C_6H_6)^+$ (cluster)
$C_6H_6^+ + B \rightarrow BH^+$ (proton transfer)

Target Species

Highly oxidized VOCs : Acids, alcohols, ketones, aldehydes, Others TBD

Instrument Performance

Time resolution: up to 10 Hz
Detection limits: <50 ppt for 1s (species dependent)
Accuracy: 30-100%
Mass resolution: **up to 10000 m/Δm**

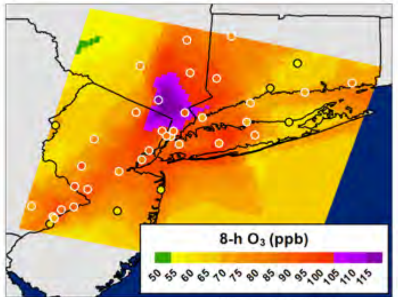
Target Species

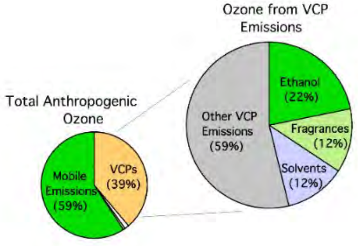
Unsaturated hydrocarbons: short & long chain olefins, mono & sesquiterpenes, aromatics, aromatic acids, others TBD
Sulfur containing compounds: DMS, Mercaptans, thiols...etc
Amines: DMA, TMA, MA, propyl amine, etc…others TBD

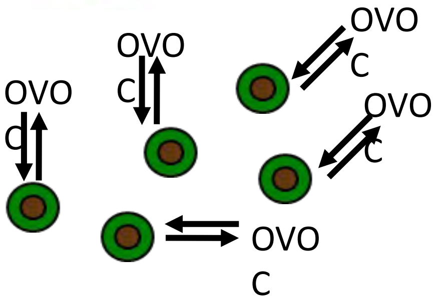
Currently working to unravel complex mass spectrum

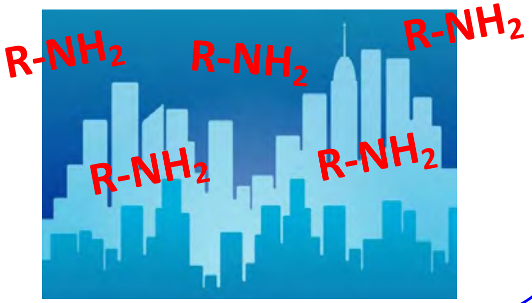
Some Science objectives:

Environment and Climate Change Canada
Environnement et Changement climatique Canada









- Evaluate OVOC/VOC emissions/chemical formation and relation to ozone production
- Compare to Canadian emissions inventory and Canadian regional model (GEM-MACH) (**especially for Toronto Flights**)
- Compare emissions/chemistry with a following winter season study in Toronto (SWAPIT)
- Improve understanding of gas-particle partitioning by comparing with particle data from Vocus Inlet for Aerosols (VIA) also using NH_4^+
- Evaluate $C_6H_6^+$ ionization for real-time unsaturated hydrocarbon detection (compare with Whole air sample data (WAS))
- $C_6H_6^+$ ionization is especially sensitive for sulfur species, amines and sesquitepenes; Urban sulfur species?? Relative importance of sesquiterpenes?? Urban reduced nitrogen & marine amine chemistry??

Caltech CIT-CIMS team on NASA DC-8 measuring inorganic acids and oVOC

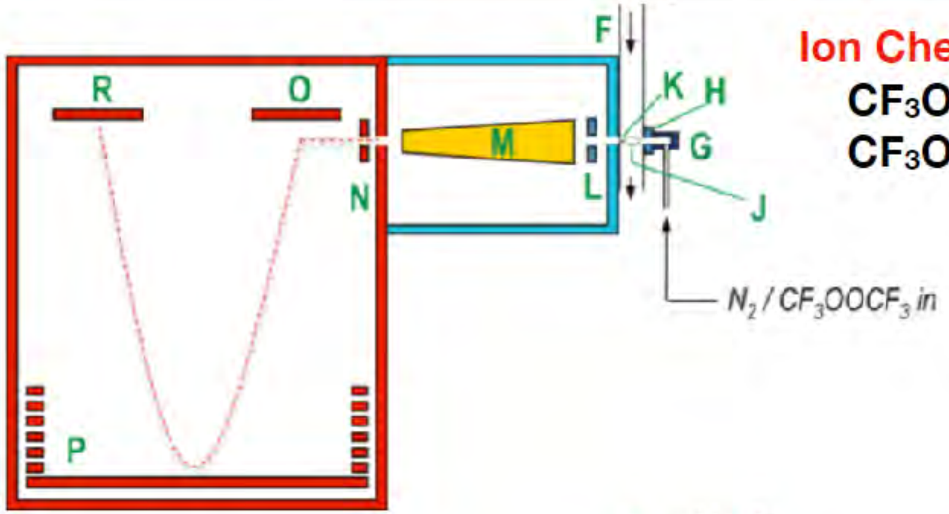
Kat Ball
Graduate student

John Crounse
Research Scientist

Paul Wennberg
PI

Caltech

Caltech CIT-CIMS on DC-8

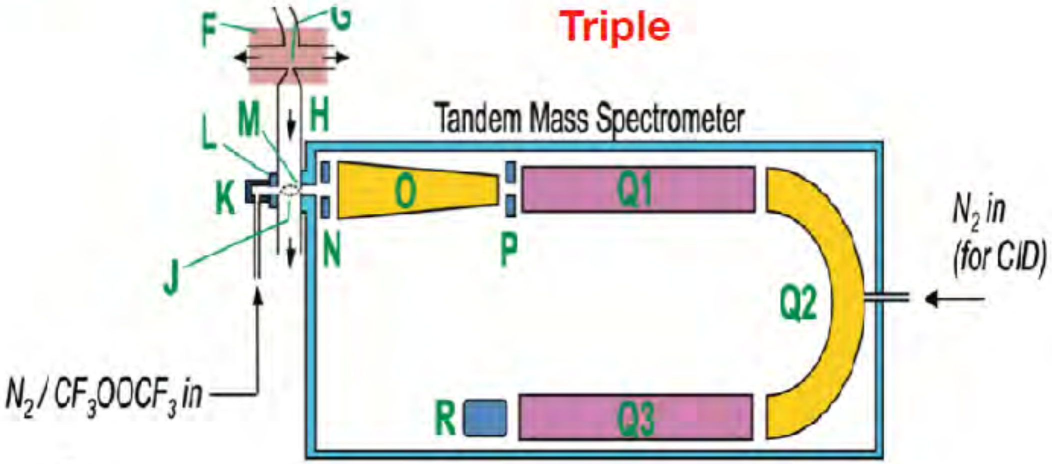


ToF

Ion Chemistry:

$CF_3O^- + HA \rightarrow CF_3O^-.HA$

$CF_3O^- + HA \rightarrow A^-.HF + CF_2O$



Triple

Key observations:

Inorganics: HCN, SO_2, HNO_3

Peroxides: H_2O_2, CH_3OOH, PAA

oVOC: hydroxyacetone, glycolaldehyde, isoprene epoxides, hydroxy nitrates and hydroxy peroxides from alkene oxidation, hydroperoxy carbonyls fro alkane autoxidation.

ToF capabilities (upgrade to HToF):

Time resolution: 10 Hz
Mass resolution: ~3000 M/dM
Sensitivity: ~5-10 counts s^{-1} $pptv^{-1}$ (most species)

Triple Quad capabilities:

Time resolution: ~1 sec every 10 sec
Mass resolution: unit
Speciation: MS/MS
Sensitivity: ~2-5 counts s^{-1} $pptv^{-1}$ (most species)

References:

Crounse, et al, 2006: https://doi.org/10.1021/ac0604235
St. Clair, et al, 2010: https://doi.org/10.1063/1.3480552

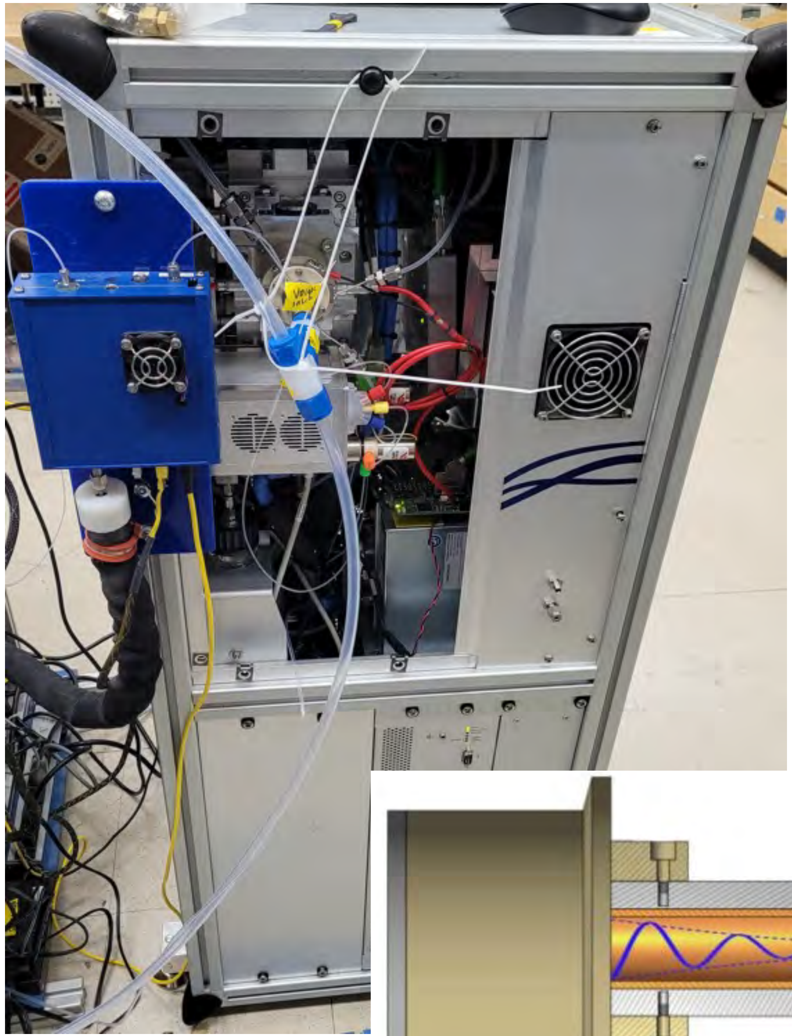
Science Goals

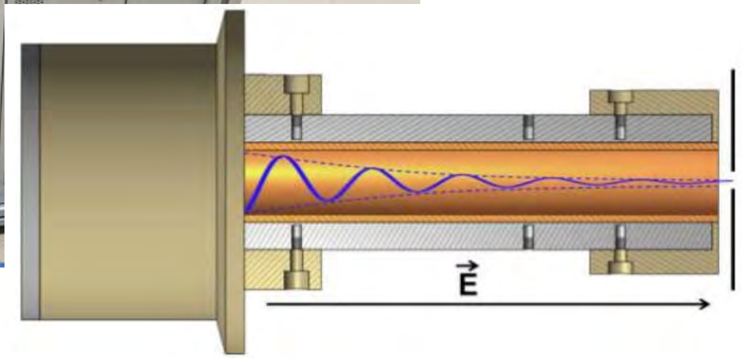
-Use observations and modeling to better understand the relative importance peroxy radical pathways and their contribution to formation of air pollutants across urban and marine environments

-Use observations and modeling to understand the contributions of biogenic emissions to the formation of air pollutants across urban and marine environments

GOTHAAM
Organic Gases

Vocus – Proton Transfer Reaction Time-of-Flight Mass Spectrometer





UW-Madison existing ground-based Vocus is currently being racked for deployment on the C-130.

Measurement:

Wide array of volatile organic compounds including (not limited to): ethanol, acetonitrile, acetone, isoprene, dimethyl sulfide, benzene, xylene, Σmonoterpenes, speciated siloxanes

Instrument Performance Metrics:

Mass resolving power: 5000 m/Δm (HR-ToF)
Accuracy: Molecule dependent (20% for DMS)
Detection Limit: Molecule dependent (2.5 ppt for DMS @ S/N = 3, 10s averaging)
Time resolution: plan to operate at 5Hz

Krechmer et al., *Analytical Chemistry*, 2018

THE UNIVERSITY of WISCONSIN MADISON

***Vocus** – Proton Transfer Reaction Time-of-Flight Mass Spectrometer*

THE UNIVERSITY of WISCONSIN MADISON

The owners

Operators (SBU)

Stony Brook University
School of Marine and Atmospheric Sciences

John Mak
Cong Cao (PhD student)
Julia Marcantonio (PhD student)
Postdoc TBD

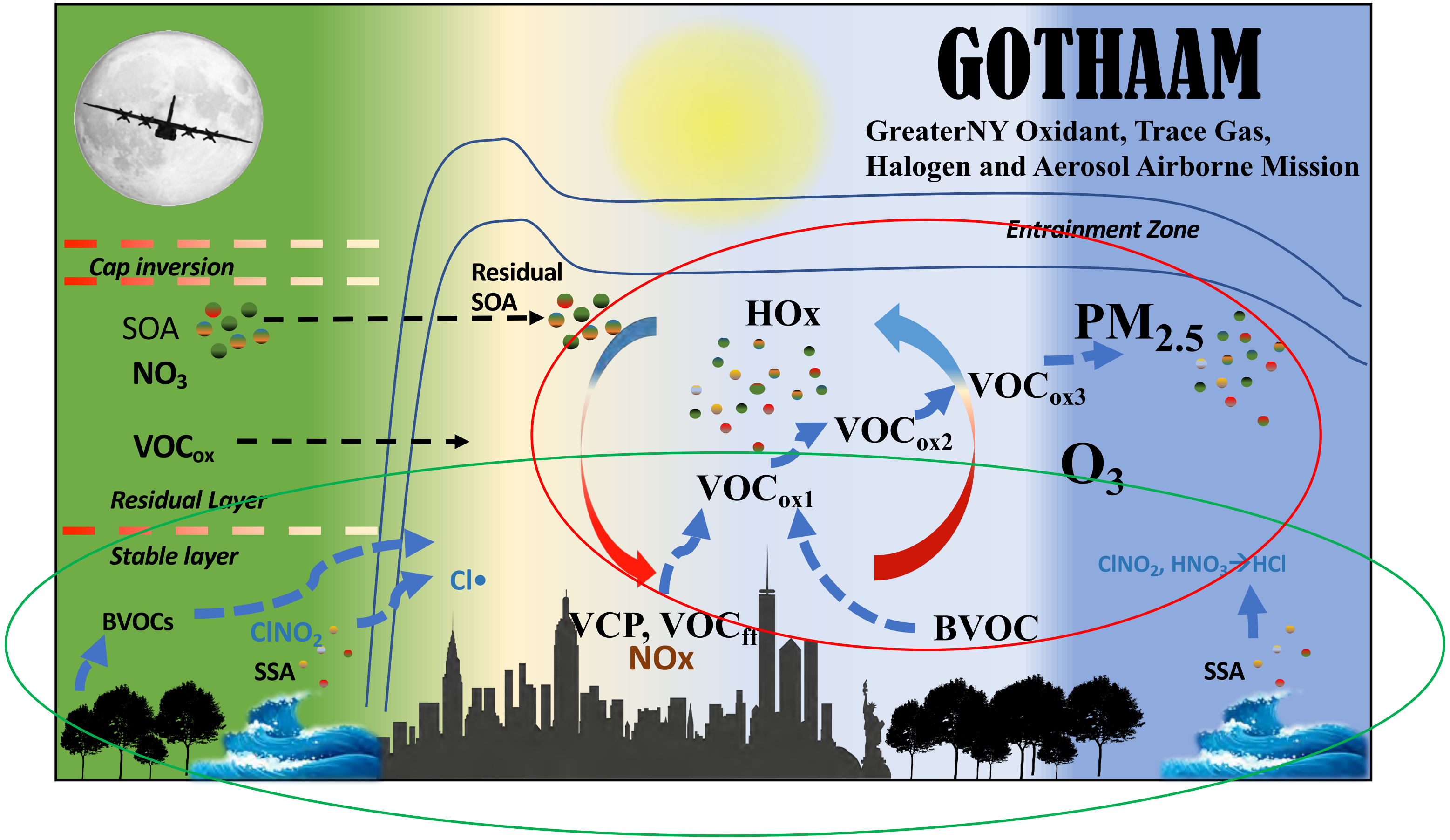
Subi Thakali
UW-Madison
Graduate Student

Kevin Wokosin
UW-Madison
Graduate Student

Tim Bertram
UW-Madison
Instrument PI

GOTHAAM Scientific Objectives

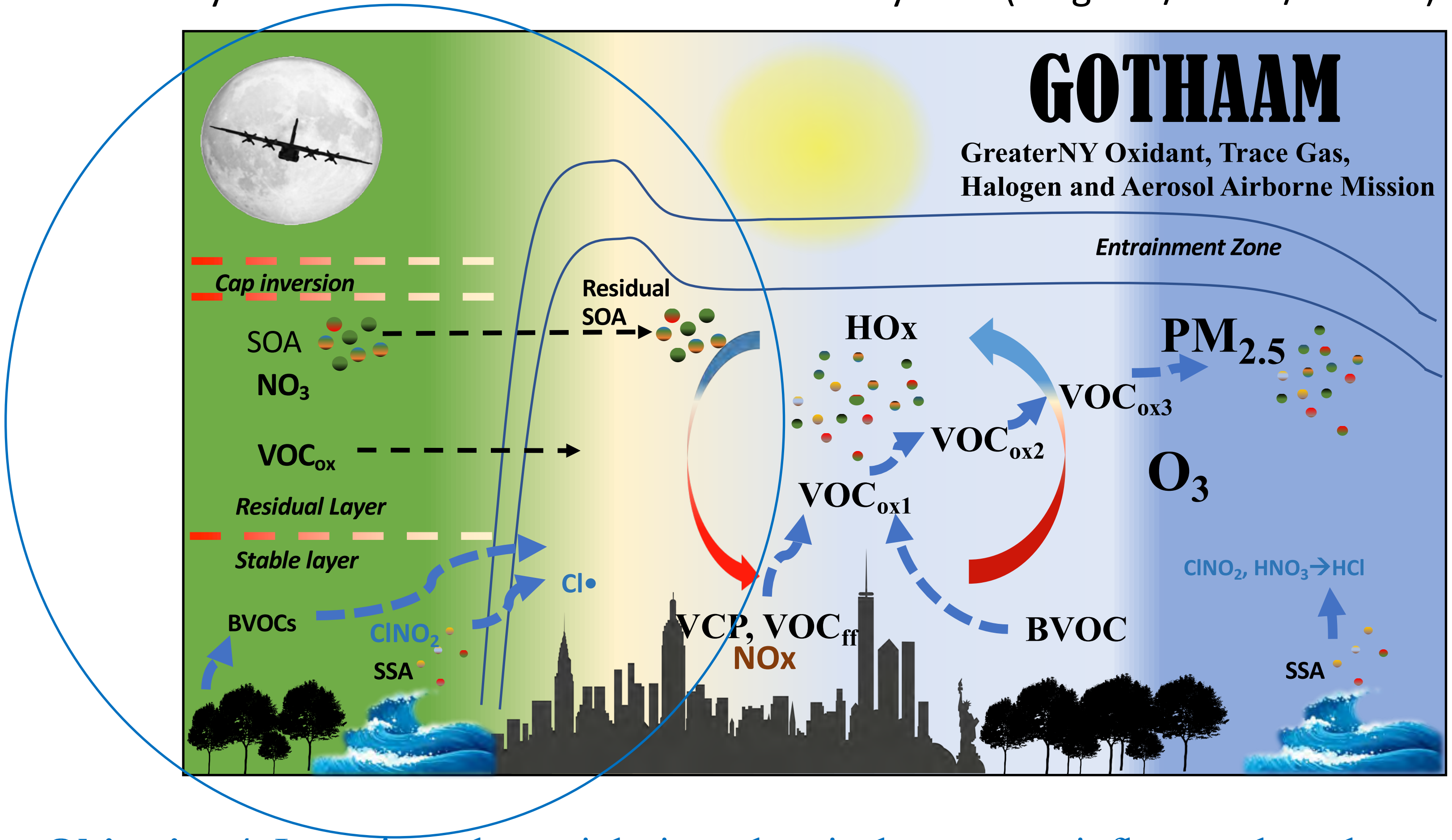
Objective 1. Quantify the relative contributions from the various volatile organic compound (VOC) sources (biogenic, fossil fuel, combustion, consumer products) and how they contribute to chemical reactivity.



Objective 2. Determine the relative potential contribution of each VOC class to secondary organic aerosol (SOA) as the anthropogenic plume evolves.

GOTHAAM Scientific Objectives

Objective 3. Quantify the relative importance of the various oxidation processes for both gas phase and aerosol species, and how the relative importance of these processes vary across the diel cycle and as a function of the chemical system (biogenic/urban/marine).



Objective 4. Investigate how nighttime chemical processes influence the subsequent day's initial chemical composition.

UW HR-ToF-CIMS on NSF C-130

Christopher Kenseth and Joel Thornton
Department of Atmospheric Sciences
UNIVERSITY *of* WASHINGTON

September 28, 2022

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UW HR-ToF-CIMS

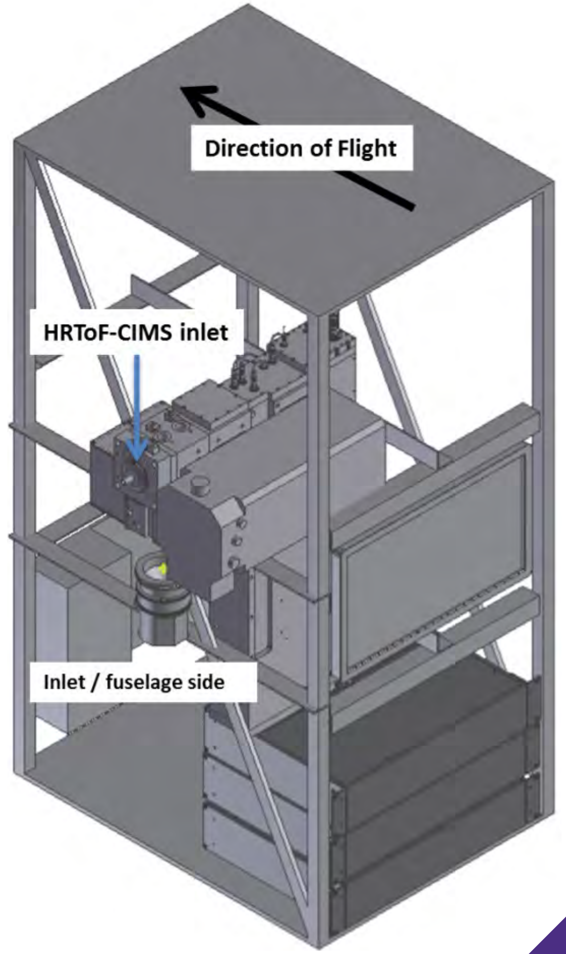
- **NSF C-130** during **WINTER 2015** and **WE-CAN 2018**.

$$\mathbf{I^- \cdot H_2O + X \longrightarrow I^- \cdot X + H_2O}$$

- Instrument Performance
  - Time resolution: **>2 Hz**
  - Mass resolution: **m/Δm > 4500**
  - Mass accuracy: **<10 ppm**
  - Detection limits: **<10 ppt**
  - Uncertainty: **± 30–50%**

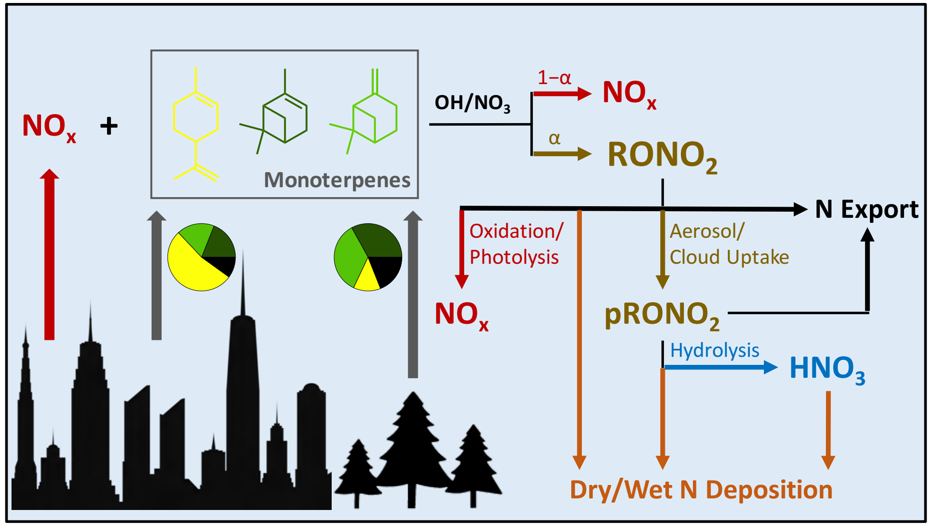
- Measured Species
  - **N_2O_5**, **$ClNO_2$**, **HNO_3**, **HNCO**, **HONO**, HCN, $ClNO_3$
  - **Cl_2**, **HCl**, **HOCl**
  - **Br_2**, HBr, BrCl, HOBr
  - **HCOOH**, **SO_2**
  - 100s of OVOCs [**ROH**, **RC(O)OH**, **$RONO_2$**, ROOH]

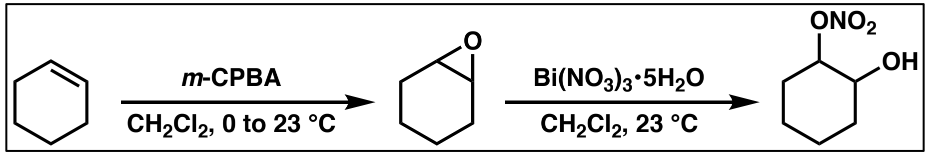
Bold = Directly Calibrated

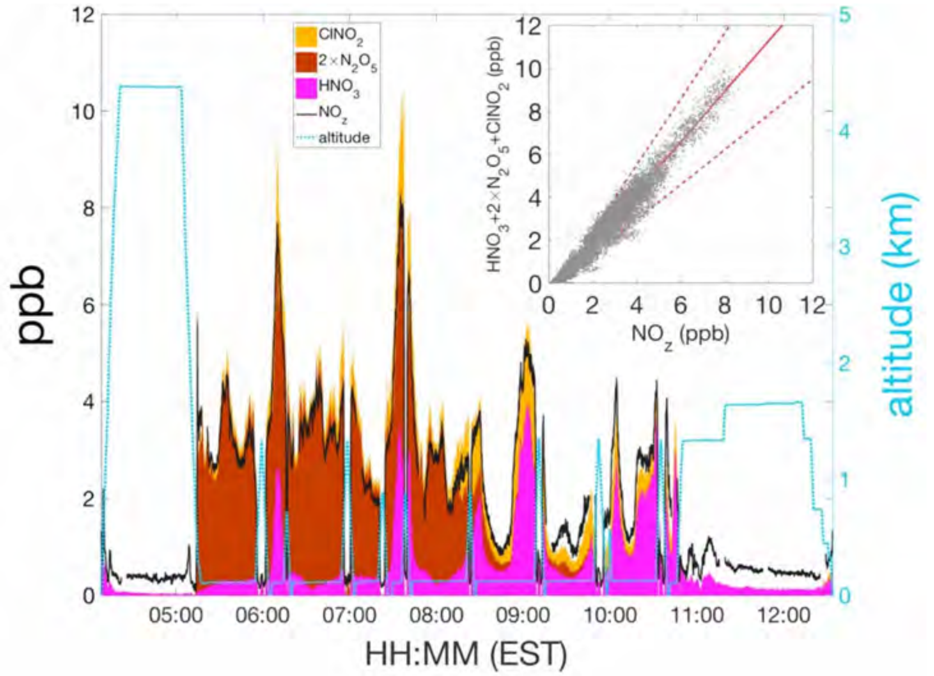


1. Lee, B.H. et al. *Environ. Sci. Technol.* **2014**, *48*, 6309.
2. Lee, B.H. et al. *J. Geophys. Res. Atmos.* **2018**, *123*, 7670.
3. Palm, B.B. et al. *Atmos. Meas. Tech.* **2019**, *12*, 5829.

Science Goals







- *Evaluate* ***monoterpene RONO$_2$*** *and impact on* ***NO$_x$, O$_3$,*** *and* ***aerosol*** *using* ***GOTHAAM*** *measurements,* ***GOES-Chem*** *modeling,* ***lab*** *experiments, and organic* ***synthesis****.*

- ***Identify*** *and* ***quantify*** *species that comprise* ***NO$_z$*** *for* ***NO$_y$ budget closure****.*[1]

- *Assess (positive)* ***coupling*** *between* ***NO$_x$, HOM****, and* ***SOA****.*[2]

1. Lee, B.H. et al. *J. Geophys. Res. Atmos.* **2018**, *123*, 7670.
2. Pye, H.O.T. et al. *Proc. Natl. Acad. Sci. U.S.A.* **2019**, *116*, 6641.

TOGA-TOF - the Trace Organic Gas Analyzer with a Time-of-Flight Mass Spectrometer

PI: Eric Apel, Alan Hills, Rebecca Hornbrook (NCAR/ACOM)

NCAR | ATMOSPHERIC CHEMISTRY OBSERVATIONS & MODELING

NMHCs	LLOD; ppt
Alkanes	
Propane	5
Isobutane	1
n-Butane	1
Isopentane	1
n-Pentane	1
2-Methylpentane	0.5
3-Methylpentane	0.5
n-Hexane	0.5
n-Heptane	1
2,2,4-Trimethylpentane	0.5
n-Octane	0.5
Alkenes	
Propene	5
1-Butene/Isobutene	1
cis-2-Butene	1
trans-2-Butene	1
Isoprene	1
α-Pinene	1
β-Pinene/Myrcene	1
Camphene	1
Limonene/3-Carene	1
Tricyclene	1
Aromatics	
Benzene	0.3
Toluene	0.3
Ethylbenzene	0.2
p-/m-Xylene	0.2
o-Xylene	0.2
Styrene	0.1
Ethynylbenzene	TBD

OVOCs	LLOD; ppt
Aldehydes	
Formaldehyde (HCHO)	20
Acetaldehyde (CH_3CHO)	5
Propanal	2
Isobutanal	TBD
Butanal	1
Acrolein (CH_2CHCHO)	1
Methacrolein	1
2-Butenal (Crotonaldehyde)	2
Furfural	TBD
3-Furaldehyde	TBD
Ketones	
Acetone	5
MEK	0.5
MVK	0.5
2,3-Butanedione	TBD
Alcohols	
Methanol (CH_3OH)	5
Ethanol (C_2H_5OH)	2
2-Propanol	4
Ethenol	TBD
MBO (2-Methyl-3-Buten-2-ol)	1
Esters	
Methyl Formate	TBD
Methyl Acetate	TBD
Methyl Propionate	TBD
Ethyl Acetate	TBD
Ethers/Furans	
MTBE (Methyl t-Butyl Ether)	0.3
Furan	1
THF (Tetrahydrofuran)	TBD

OVOCs	LLOD; ppt
Ethers/Furans (cont'd)	
2-Methylfuran	0.5
3-Methylfuran	0.5
2,3-Dimethylfuran	TBD
2,4-Dimethylfuran	TBD
2,5-Dimethylfuran	TBD
2-Ethylfuran	TBD
3-Ethylfuran	TBD
2-Vinylfuran	TBD
3-Vinylfuran	TBD
1,3-Dioxolane	TBD

Nitrogen-containing VOCs	LLOD; ppt
Nitriles	
HCN (Hydrogen Cyanide)	5
Acetonitrile (CH_3CN)	1
Propanenitrile	1
Acrylonitrile	1
Methylacrylonitrile	2
Nitrates	
Methyl Nitrate	TBD
Ethyl Nitrate	TBD
Isopropyl Nitrate	2
n-Propyl Nitrate	2
t-Butyl Nitrate	2
2-Butyl Nitrate/Isobutyl Nitrate	2
n-Butyl Nitrate	2
Other	
Pyrrole	TBD
Nitromethane (CH_3NO_2)	TBD

Halogenated VOCs	LLOD; ppt
CH_3Cl	1
CH_2Cl_2	1
$CHCl_3$	1
CCl_4	1
C_2Cl_4	0.1
1,2-Dichloroethane	0.5
CH_3CCl_3	0.5
CH_3Br	1
CH_2Br_2	0.03
$CHBr_3$	0.1
CH_3I	0.03
CH_2I_2	0.05
C_2H_5I	0.5
CH_2ICl	0.05
$CHBrCl_2$	0.05
$CHBr_2Cl$	0.03
CFC-11	5
CFC-12	1
CFC-113	1
CFC-114	1
HCFC-22	1
HCFC-141a	1
HCFC-142b	TBD
HFC-134a	1

Sulfur-containing VOCs	LLOD; ppt
OCS	1
CS_2 (Carbon Disulfide)	0.2
CH_3SH (Methanethiol)	TBD
DMS (Dimethyl Sulfide)	1
C_3O_2 (Carbon Suboxide)	TBD

In support of GOTHAAM science goals, we will make continuous *in-situ* 35-s observations of a large suite of C_1-C_{10} VOCs, reported every ≈2 minutes

NYC-METS
Organic Gases

Online and offline measurements of VOCs-SVOCs at NYC-METS: Vocus PTR-ToF, I-CIMS, GC-ToF/MS

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Mia Tran
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Rob Roscioli
Instrument PI
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Manjula Canagaratna
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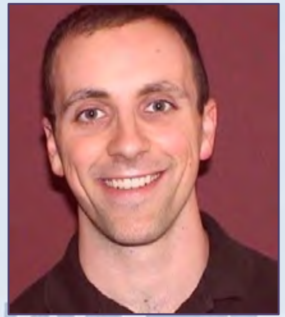

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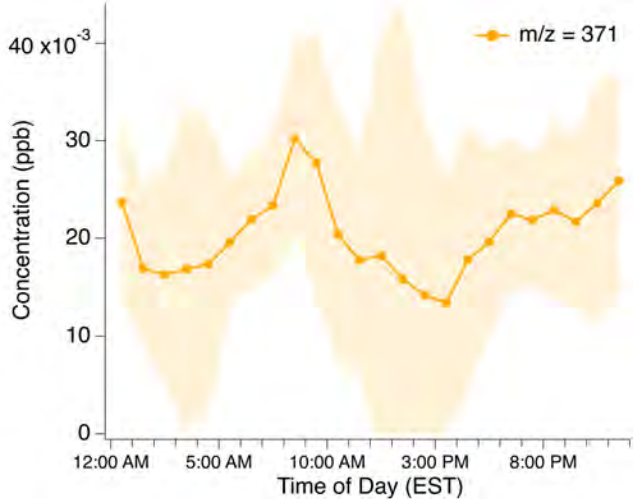
Aerodyne Research

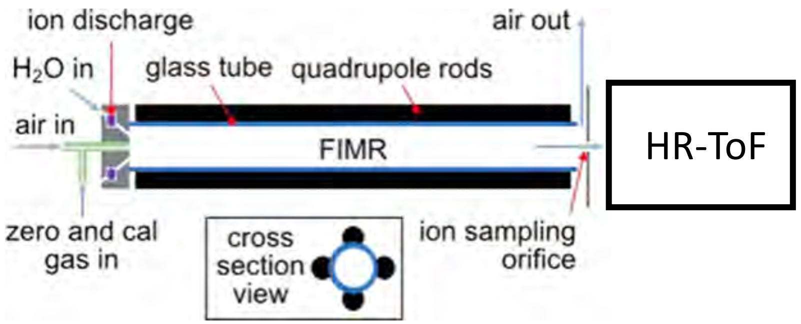
Yale ENVIRONMENTAL ENGINEERING

Online gas-phase measurements at NYC and coastal CT

VOCUS-PTR-ToF-MS (at Manhattan & coastal CT)

D5 Average Diurnal Profile
(NYC 2022 prelim data)



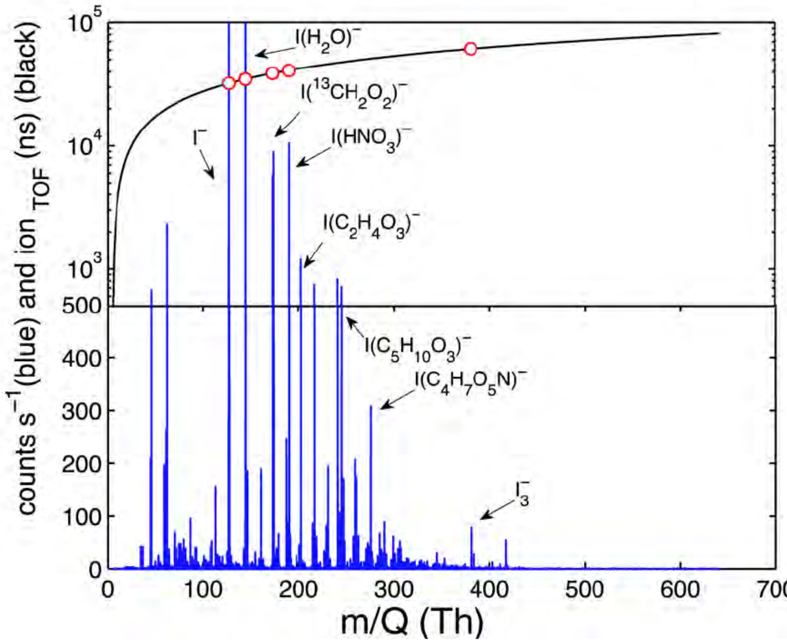


Krechmer *et al.* 2018, *Anal. Chem.*

- Time resolution: **4-10 Hz**
- Detection limits: **<50 ppt (for 1 s)**
- Mass resolution: **up to 10,000 m/Δm**
- Volatility range: **VOCs - SVOCs**
- Inlet locations:
    - **NYC: 90 m ASL (60 m AGL)**
    - **Coastal CT: 10 m ASL**
- Targeted species, including primary emissions and oxidation products:
    - **Oxygenated VOCs - SVOCs**
    - **Aromatics (BTEX, etc.)**
    - **Terpenoids & oxy-terpenoids**
    - **VCP tracers (D4, D5, PCBTF)**
    - **Others (e.g., DMS)**

HR-ToF-I-CIMS (at Manhattan)

- Time Resolution: **1 Hz**
- Detection limits: **<10 pptv (for 1 s)**
- Mass resolution: **up to 6,000 m/Δm**
- Targeted Species: **Highly-functionalized VOCs-LVOCs, HONO, $ClNO_2$, Cl_2, HNO_3, HCOOH, oxidation products (e.g., $C_5H_{10}O_3$, $C_{10}H_{15}NO_4$, $C_{10}H_{16}O_X$)**



Example spectra from Lee *et al.* 2014, ES&T

Yale ENVIRONMENTAL ENGINEERING

Offline VOC-SVOC measurements at NYC and coastal CT

Agilent 6550 Q-ToF
Mass accuracy: 1 ppm
Mass resolution: up to 40,000 m/Δm
Configuration: with GC or LC

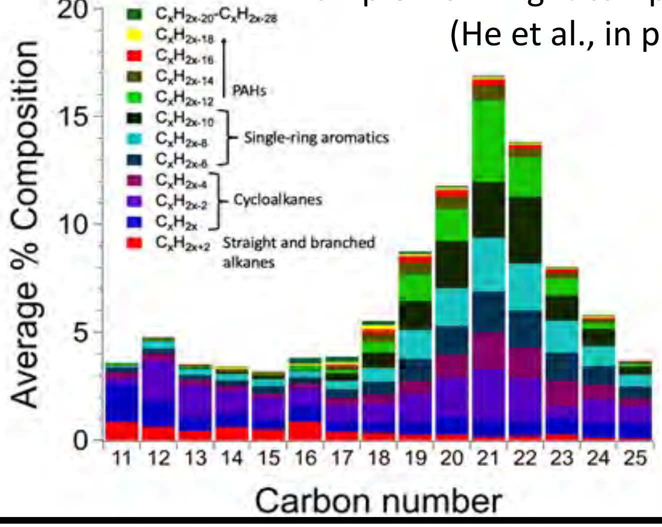
- Collection media: Custom adsorbent tubes
- Time resolution: Multi-hour offline samples
- Volatility range: IVOCs-SVOCs and larger VOCs
- Analysis approach: Thermal desorption (GERSTEL) with GC separation and column effluent split to:

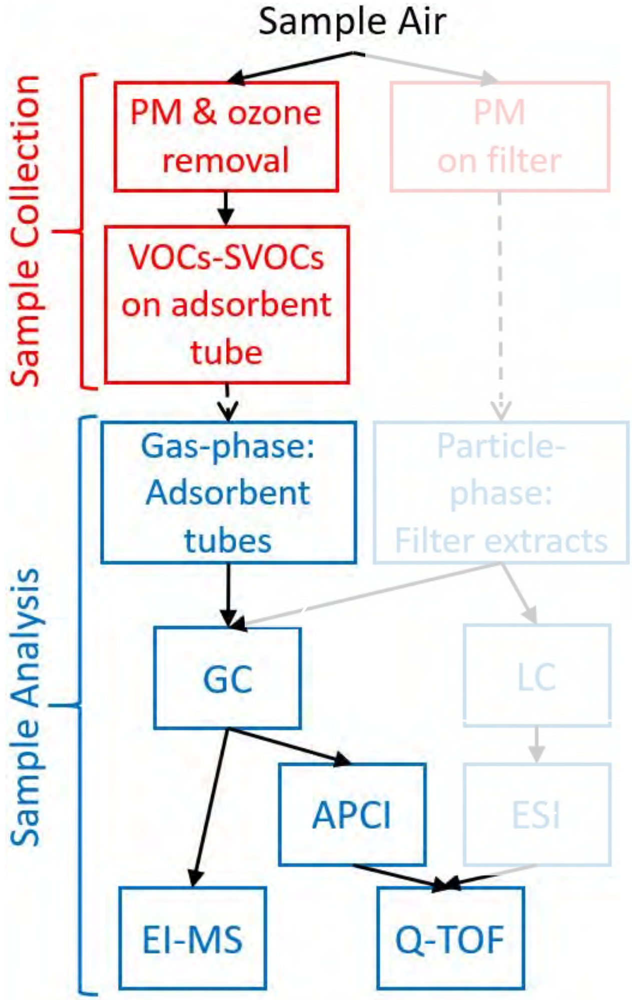
(1) APCI-ToF (atmospheric pressure chemical ionization) for targeted complex mixture speciation and supplemental unknowns analysis

(2) EI-MS (electron ionization) for single compound measurements and supplemental identifications

Complex Mixture Speciation via GC-APCI-ToF

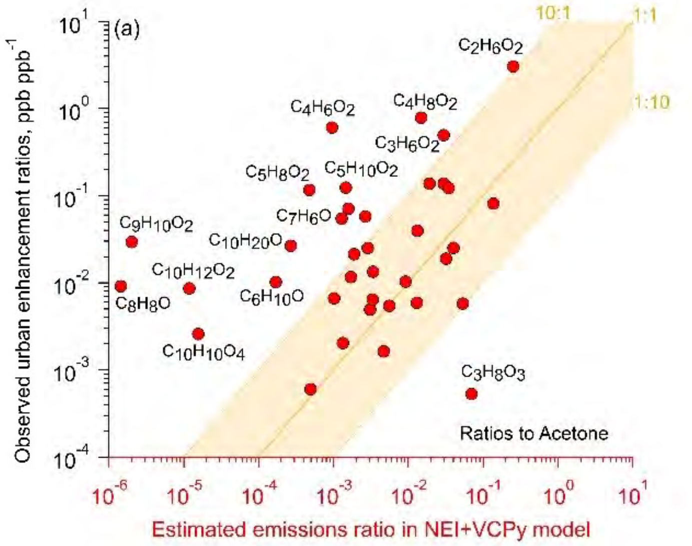
Example from flight campaign (He et al., in prep.)





Overview of science goals and foci

- Multi-site online and offline VOC-SVOC measurements spanning hydrocarbons to highly-functionalized organics
- Examining emissions and apportionment to traditional and emerging sources using VOC-SVOC and other measurements
- Comparisons to emissions inventories and models in collaboration with modelers
- Contributions to SOA, ozone, and OVOC formation affecting urban and downwind air quality, examined using gas and aerosol measurements
- Understanding present day and future AQ in NYC and downwind



Example of regionally-resolved NYC emission inventory comparison (Khare *et al.* 2022, *ACPD)*

Aerodyne Research

Yale ENVIRONMENTAL ENGINEERING

Speciated measurements of VOCs in NYC by an *in situ* GC-TOF-MS for the characterization of primary emissions in urban air

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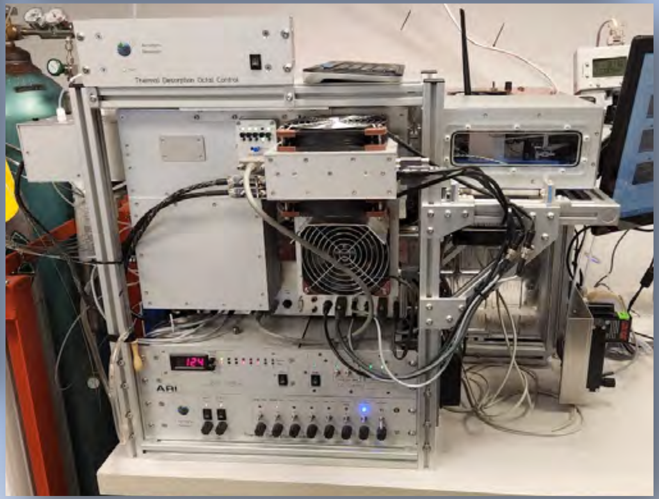
The University of Texas at Austin

AERODYNE RESEARCH, Inc.

2-Channel GC with EI-TOF-MS at NYC-METS ground site

Aerodyne 2-channel *in situ* gas chromatograph (GC) with thermal desorption preconcentration (TDPC) and election ionization time-of-flight mass spectrometric (EI-TOF-MS) detection



- NYC-METS Measurement Intensives
  - 4 weeks each: Summer 2022, 2023
- Targeted Species
  - Alkanes, alkenes: $C_3 – C_{12}$
  - Biogenics: isoprene, monoterpenes
  - Aromatics: BTEX, C_9 aromatics
  - Oxygenates: alcohols, ketones, aldehydes, ethers, esters
  - Halocarbons, siloxanes, nitrogen containing species
- Instrument Performance
  - Time resolution: 30 min cycle
  - Each cycle contains 8.5 minute sample collection period
  - Typical detection limits: < 5 ppt (0.85 L preconc. sample)
  - Mass resolution of EI-TOF-MS: 4000 m/Δm

Science Goals

- VOC measurements
- Quantitative timeseries
- Emission ratios
- Photochemical clocks
- Source apportionment
- Impact of meteorological events (e.g. heat) on VOC composition
- Integrating our data with other VOC measurements at the ground site (e.g. PTR-MS)
- Summer 2022 data status: QA/QC and HR processing

First Look at GC-TOF data from Summer 2022 NYC-METS