Atmospheric Science and Chemistry mEasurement NeTwork (ASCENT): Advanced, Ground-based Aerosol Measurement Network Across the United States

ASCENT
Atmospheric Science and Chemistry mEasurement NeTwork

https://ascent.research.gatech.edu

Home | About | People | Measurement Sites | Instrumentation | Database | Education & Outreach | News & Events | Join Mailing List

Presented by Sean Raffuse at the 2024 National Ambient Air Monitoring Conference, August 14, New Orleans

PI: Nga Lee (Sally) Ng, Georgia Institute of Technology

Steering Committee:
Nga Lee (Sally) Ng, Georgia Institute of Technology
Roya Bahreini, University of California, Riverside
Ann Dillner, University of California, Davis
Armistead Russell, Georgia Institute of Technology

NSF

Site/Instrument Mentors: James Flynn (University of Houston), Drew Gentner (Yale University), Robert Griffin (Roger Williams University), Lelia Hawkins (Harvey Mudd), Jose Jimenez (University of Colorado, Boulder), Jingqiu Mao (University of Alaska, Fairbanks), Shane Murphy (University of Wyoming), Albert Presto (Carnegie Mellon University), Allen Robinson (Carnegie Mellon University), John Seinfeld (California Institute of Technology), Jason Surratt (University of North Carolina, Chapel Hill), Joel Thornton (University of Washington)

Data Management: Sean Raffuse, Veronica Scott, Rudi De Marco, Brian Trout (University of California, Davis); Eric Nienhouse (National Center for Atmospheric Research)

Collaboration Networks: NCore, IMPROVE, PAMS, SCAQMD, NEON, HNET, CASTNET, NATTS, AERONET, ACTRIS


AfroGSA
Carnegie Mellon University

Objectives

- Establish a **new, long-term, ground-based aerosol measurement network** in the US for comprehensive and high time-resolution characterization of aerosol chemical composition and physical properties

- Develop a standardized framework for advanced aerosol measurement **protocols**, create a **database** for data discovery and visualization, and long-term data preservation

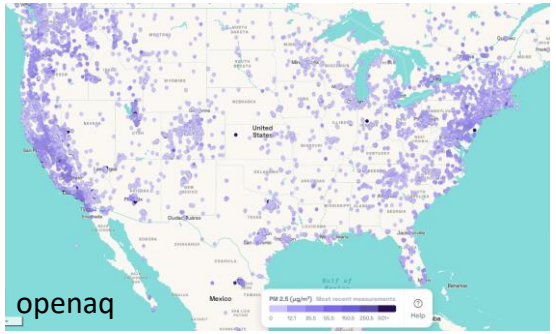
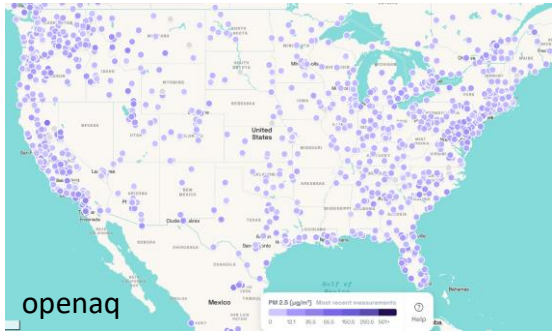
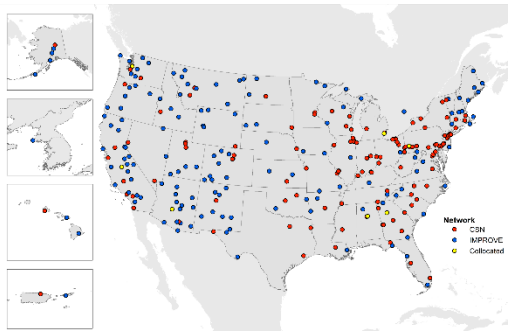
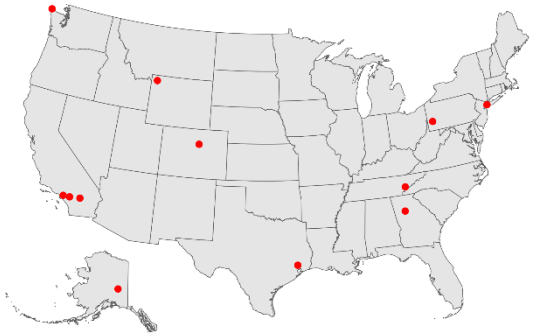
- **Enhance training** of students and current professionals engaged in atmospheric, climate, and air quality research

- Catalyze and support future development of an integrated and long-term atmospheric observation research infrastructure for aerosols, clouds, and trace gases in the US and to **strengthen collaborations with international atmospheric observation networks**

Particle Monitoring Spectrum

CSN/IMPROVE

ASCENT

	Low-cost sensors	Federal Reference Monitors	Chemical Speciation	Online Speciation
				
Site Costs	$100s	$1,000s	$10,000s	$100,000s
Deployed	10,000s	1,000s	100s	12
Provides	PM estimates	PM mass	PM speciation	PM speciation in near real time
Key Uses	Citizen science; community monitoring	NAAQS compliance monitoring; air quality forecasting	Understanding sources; tracking atmospheric changes	Understanding sources; tracking atmospheric changes; new research

YOU ARE HERE

ASCENT Site Map

Leverage Existing Sites/Infrastructure

NCore: National Core Network
- $PM_{2.5}$ mass and speciation; O_3, CO, SO_2, NO, and NO_y

PAMS: Photochemical Assessment Monitoring Stations, VOCs

IMPROVE: Interagency Monitoring of PROtected Visual Environment network
- $PM_{2.5}$ mass; gas-phase measurements

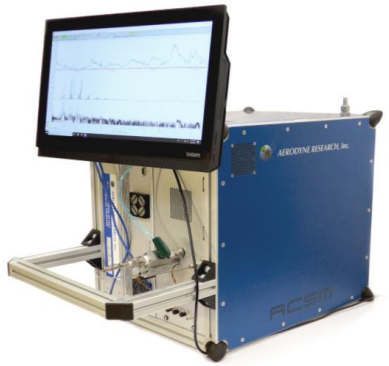
SCAQMD: South Coast Air Quality Management District

NEON: National Ecological Observatory Network

HNET: Houston Network of Environmental Towers

High Time-Resolution Aerosol Instrumentation

Instrument	Model and Manufacturer	Measurements
Aerosol Chemical Speciation Monitor (ACSM), $PM_{2.5}$	ToF-ACSM, Aerodyne Research	Organics, sulfate, nitrate, ammonium, chloride
Xact, $PM_{2.5}$	625i, Cooper Environmental	Trace metals: Sb, As, Ba, Cd, Ca Cr, Co, Cu, Fe, Pb, Hg, Mn, Ni, Se, Ag, Sn, Ti, Tl, V, Zn, more available
Aethalometer, $PM_{2.5}$	AE33, Magee Scientific	Wavelength-dependent absorption; black and brown carbon
Scanning Mobility Particle Sizer (SMPS), PM_1	3938W89, TSI	Particle number size distribution, number concentration

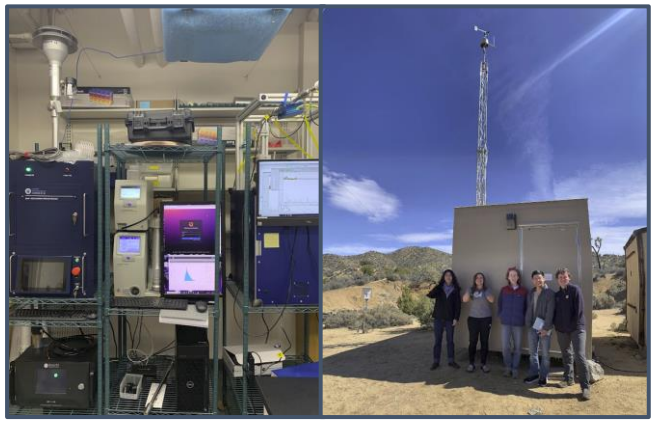


Instrument Delivery and Installation

- Project funded in October 2021
- All instruments delivered to universities in Jan 2023
- Also deployed low-cost sensors (PurpleAir, QuantAQ MODULAIR-PM) @ all ASCENT sites and MODULAIR at selected sites

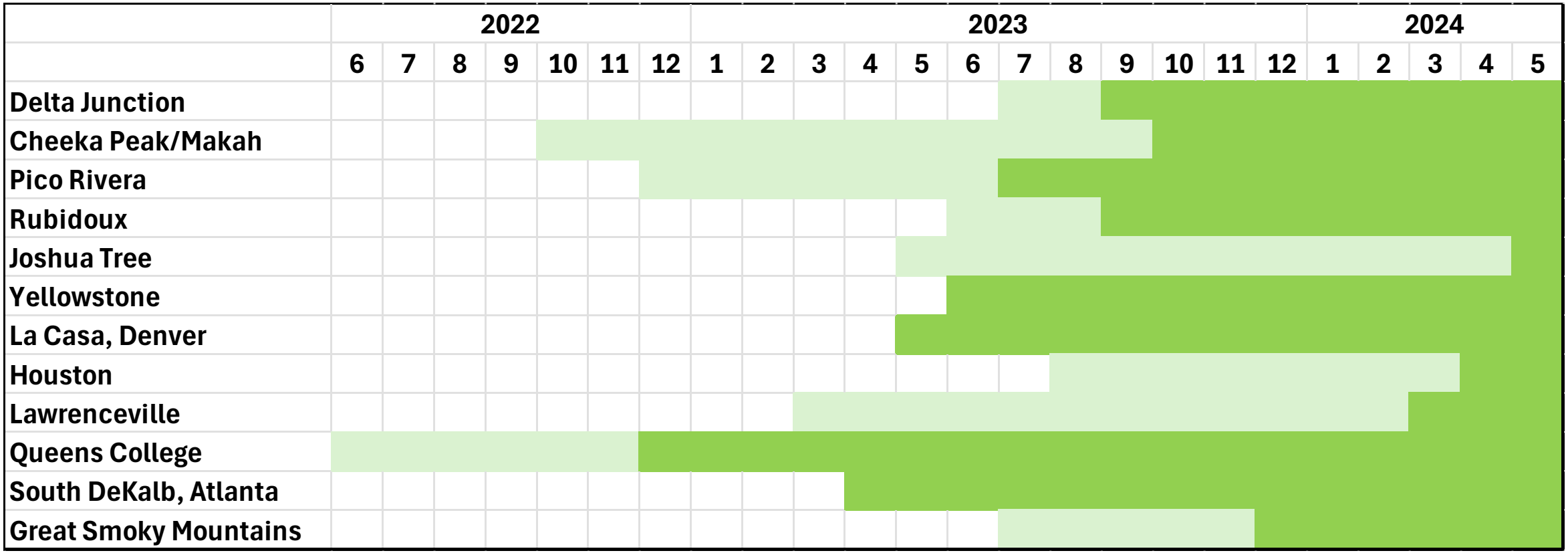
Above: South DeKalb Atlanta; Below Rubidoux

Above: Pittsburgh Lawrenceville; Below Queens College

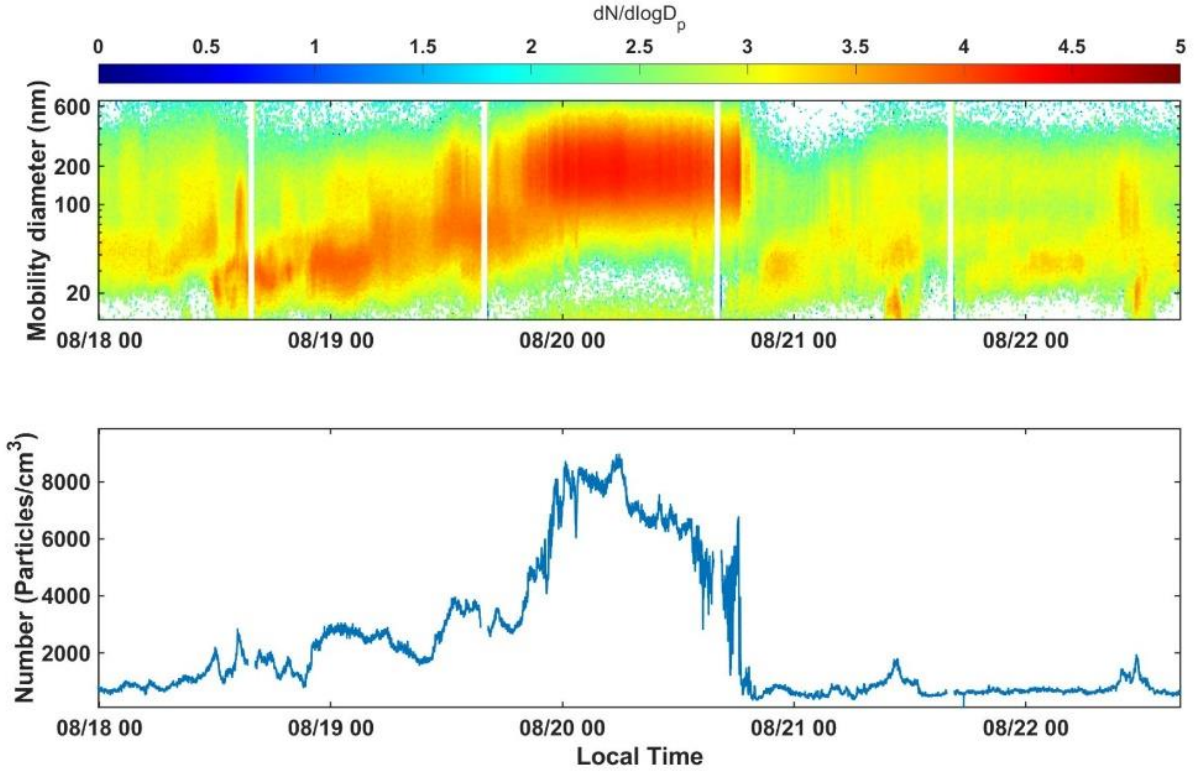


Above: Joshua Tree NP; Below: Great Smoky Mountains NP

Sampling Timeline



SMPS: new particle formation



Cheeka Peak/Makah

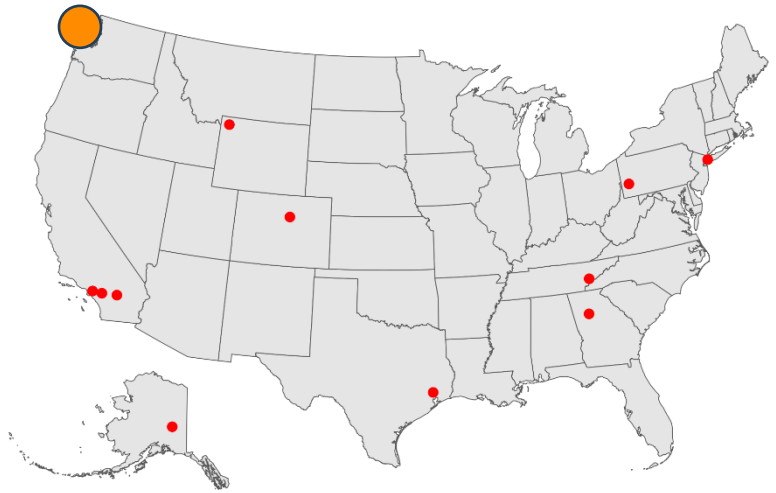
University of Washington


Joel Thornton

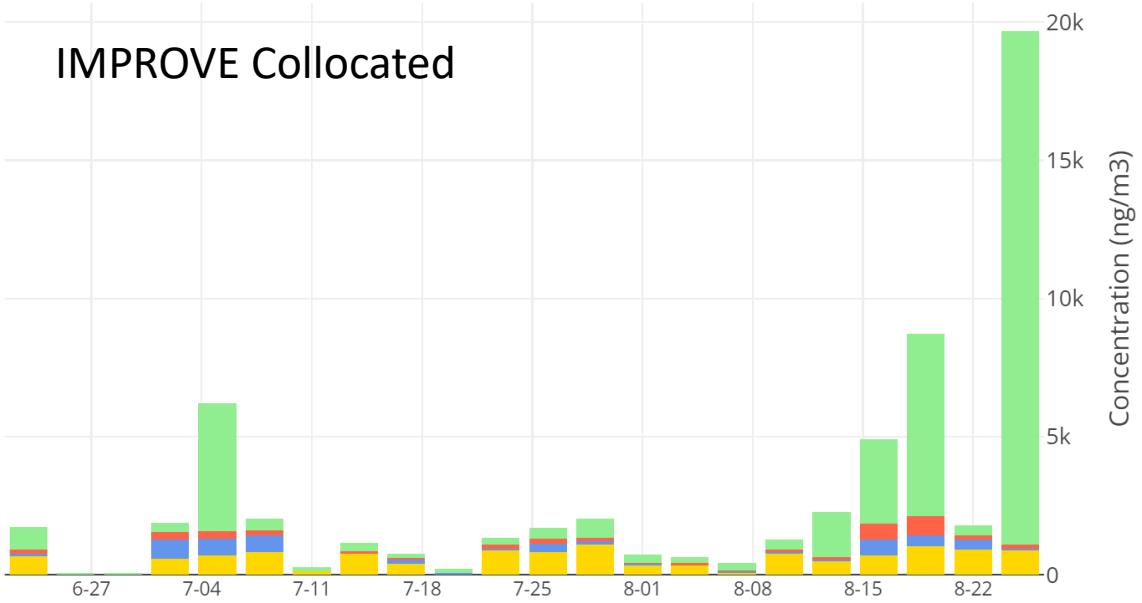

Olivia Hakan

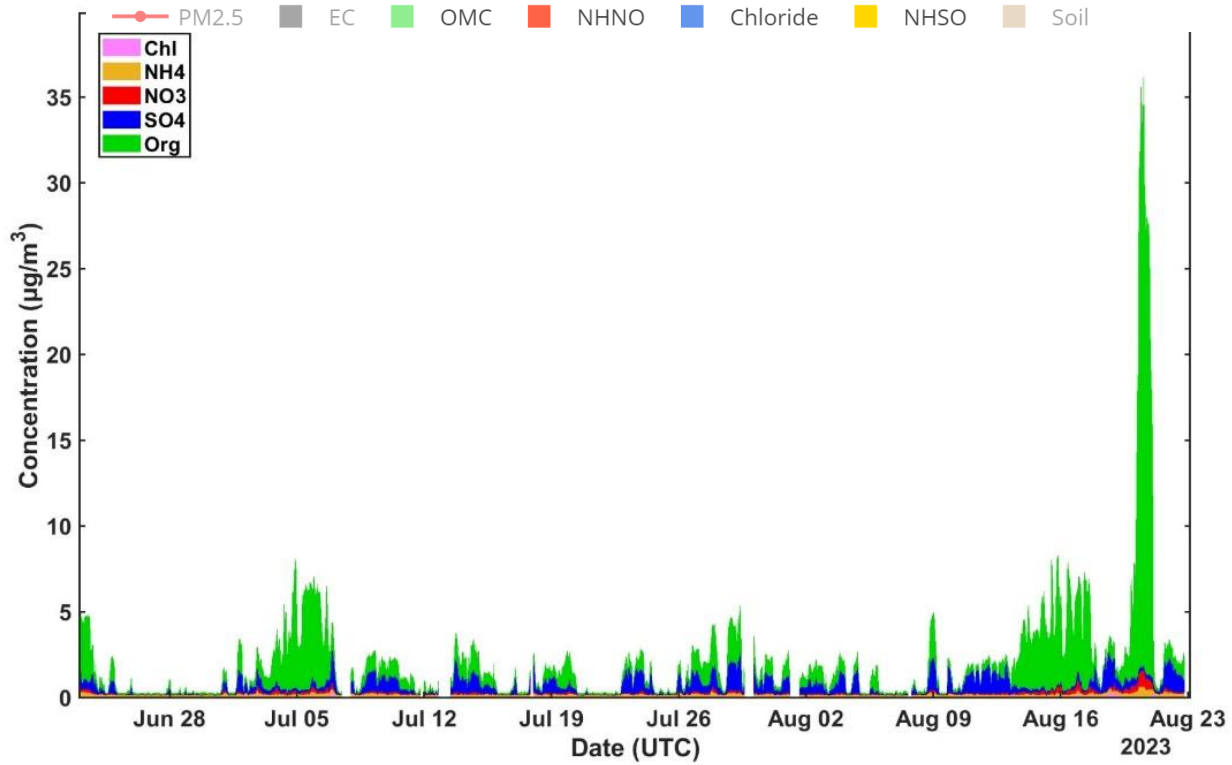

Phil Rund


Olga Garmash



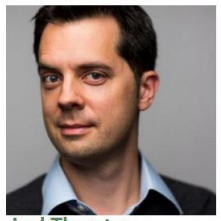
ACS



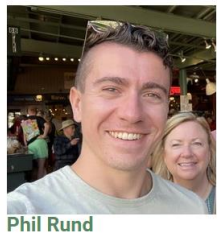


Cheeka Peak/Makah

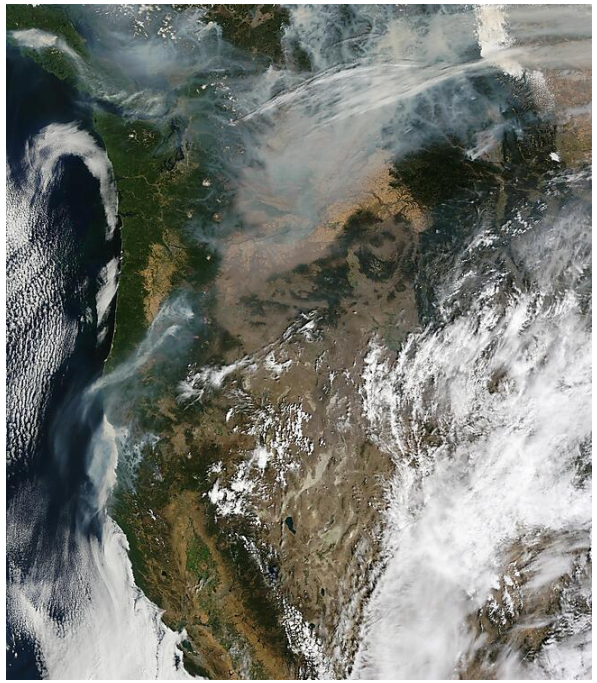
University of Washington


Joel Thornton


Olivia Hakan


Phil Rund


Olga Garmash



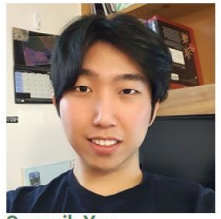
Aethalomater: black carbon

Denver – La Casa

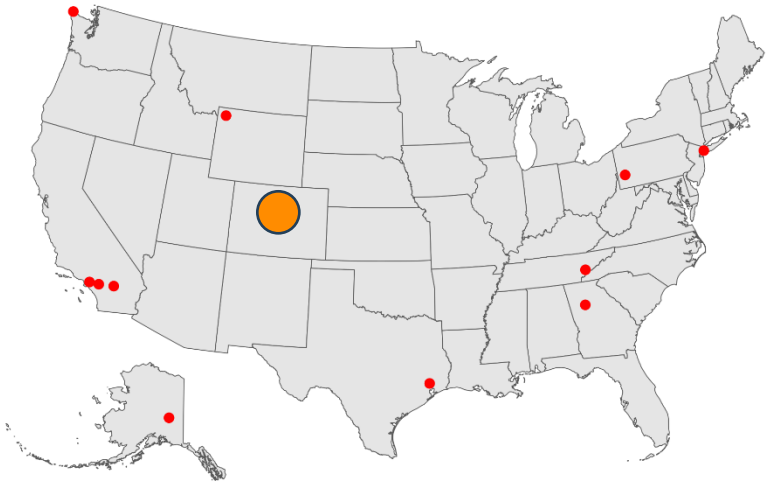
University of Colorado, Boulder

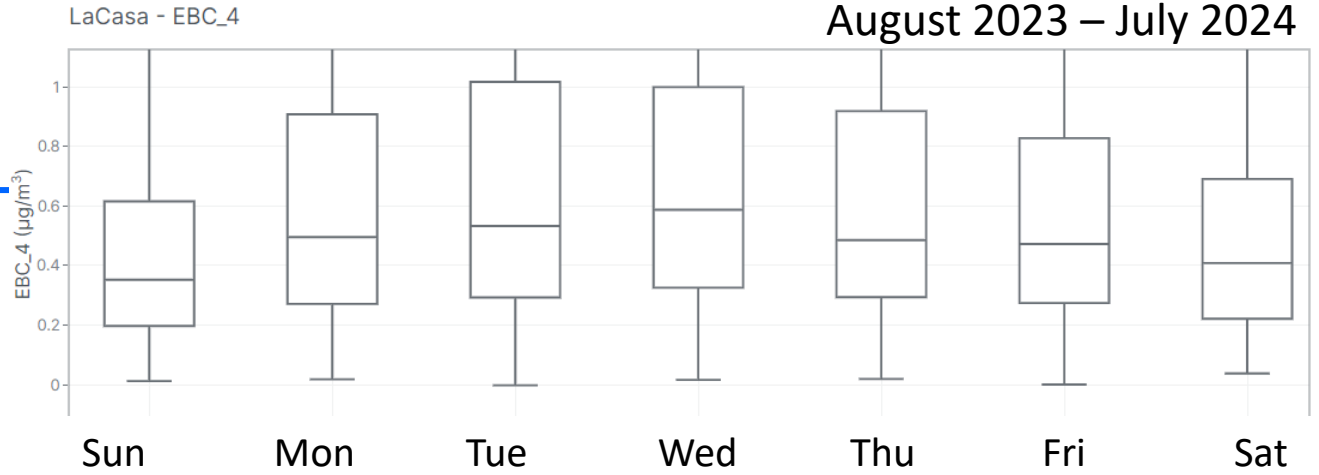

Jose Jimenez

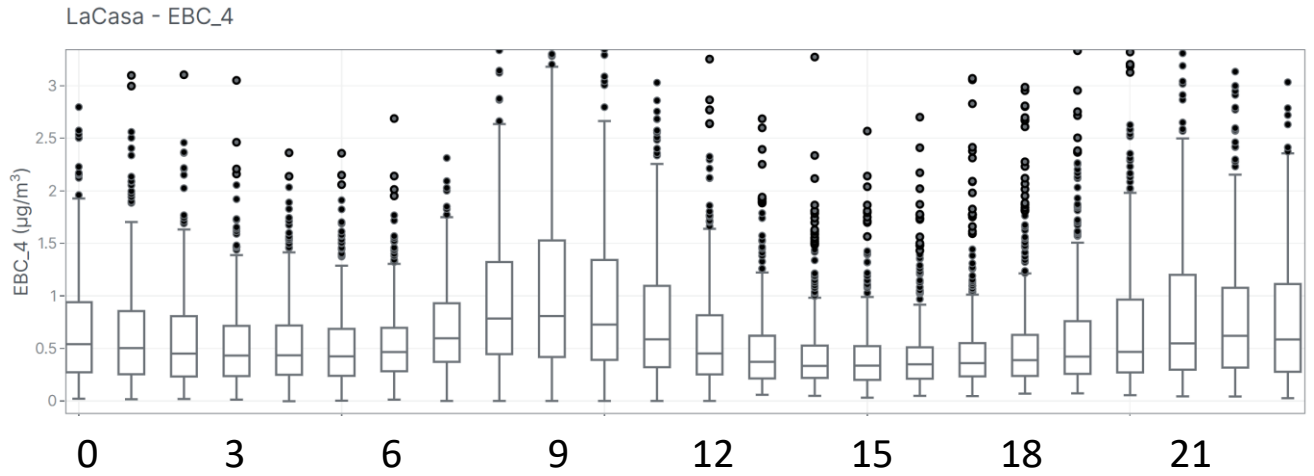

Doug Day

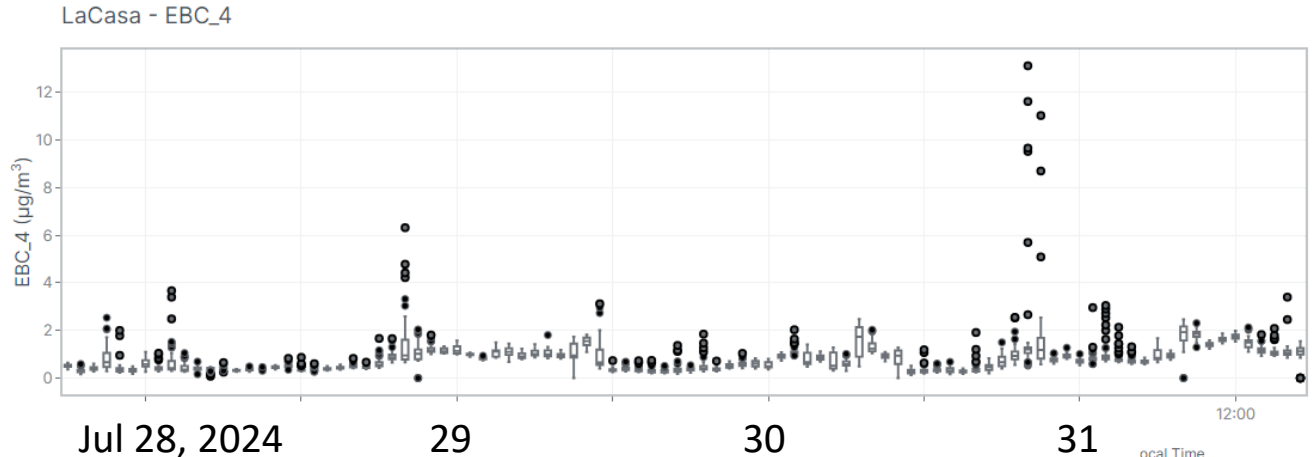

Seonsik Yun


Anne Handschy





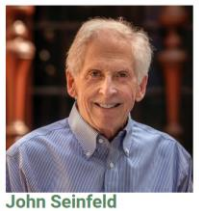




Xact: trace metals

Los Angeles – Pico Rivera

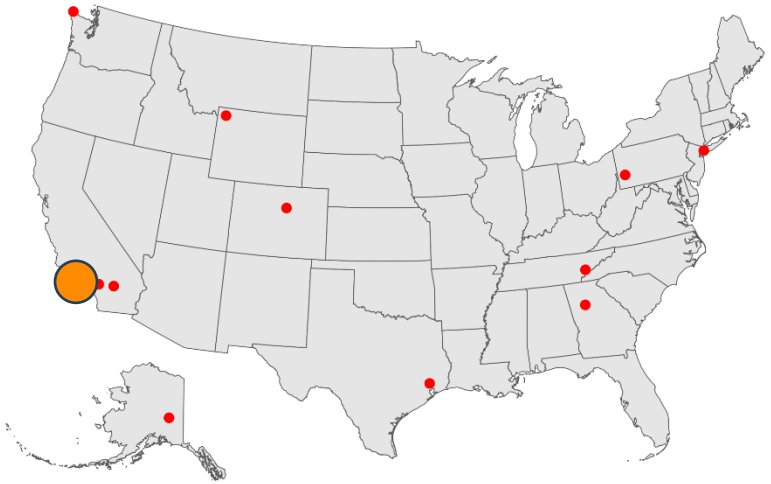
California Institute of Technology

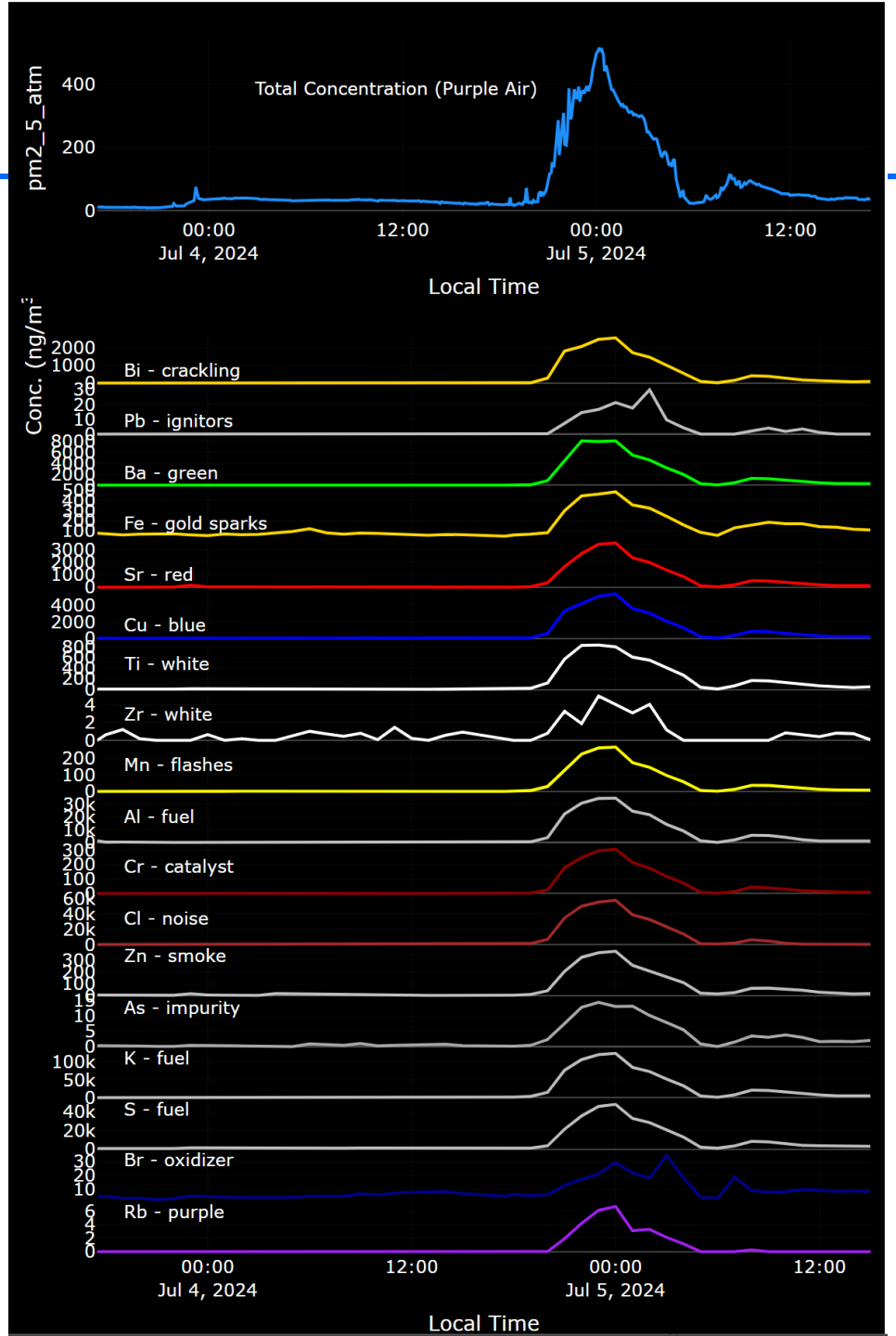

John Seinfeld


Richard C. Flagan


Haroula Baliaka


Ryan Ward





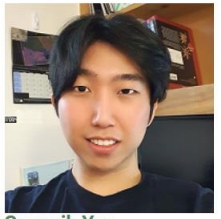
La Casa, Denver: Aerosol Composition

May 2 – October 31, 2023

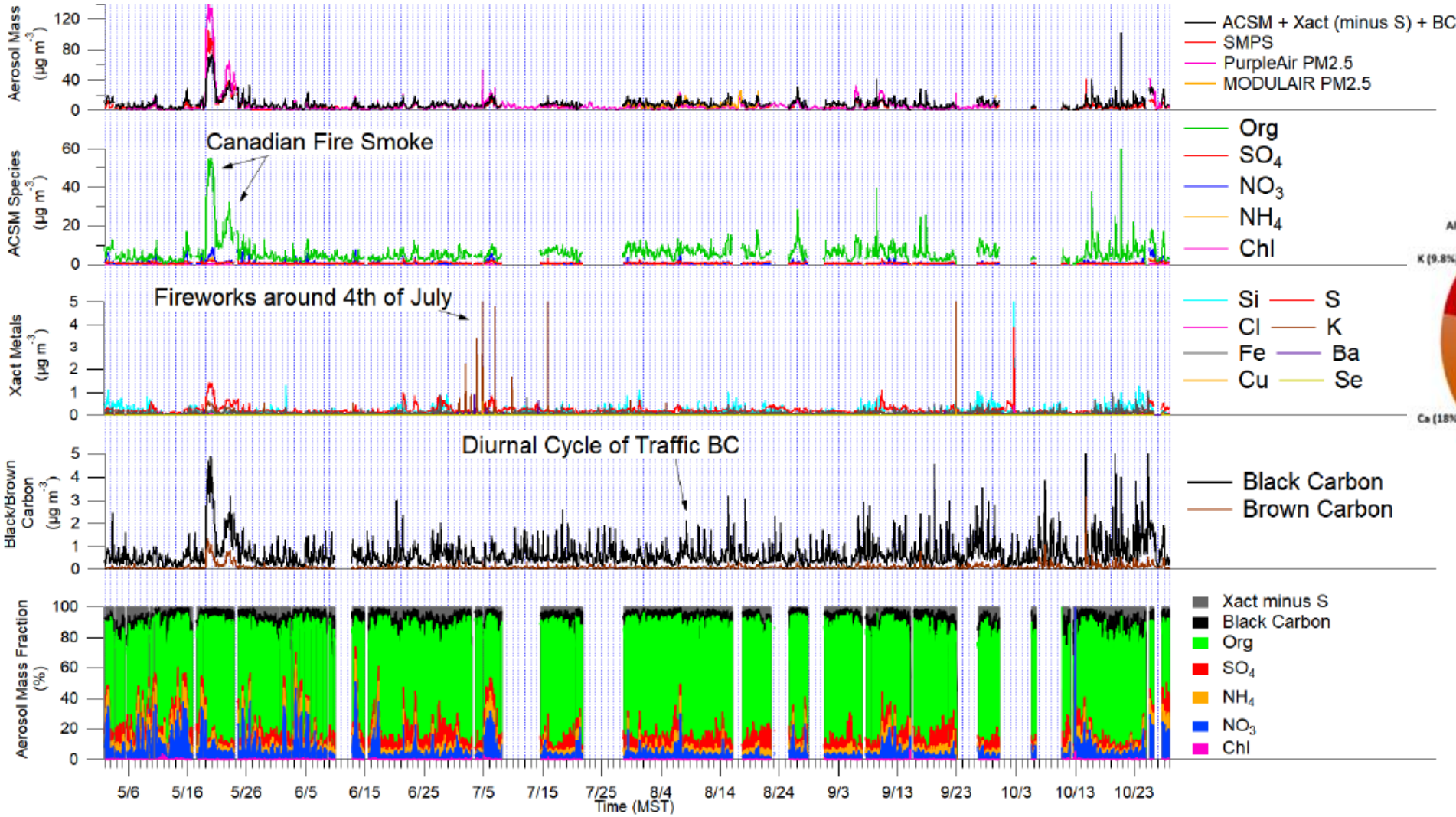
University of Colorado, Boulder

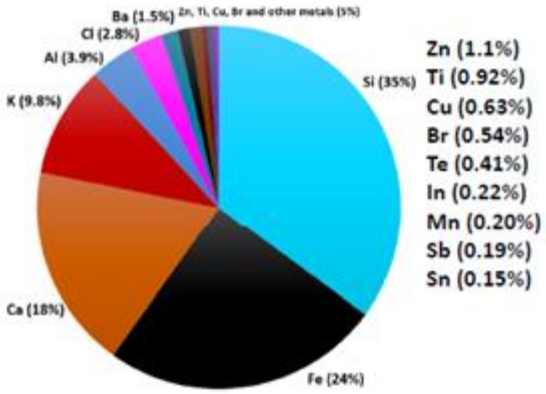

Jose Jimenez


Doug Day


Seonsik Yun

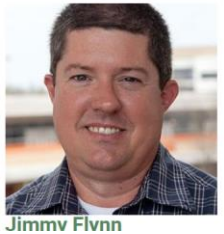

Anne Handschy





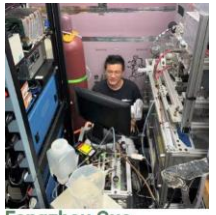
Houston: Aerosol Composition

University of Houston

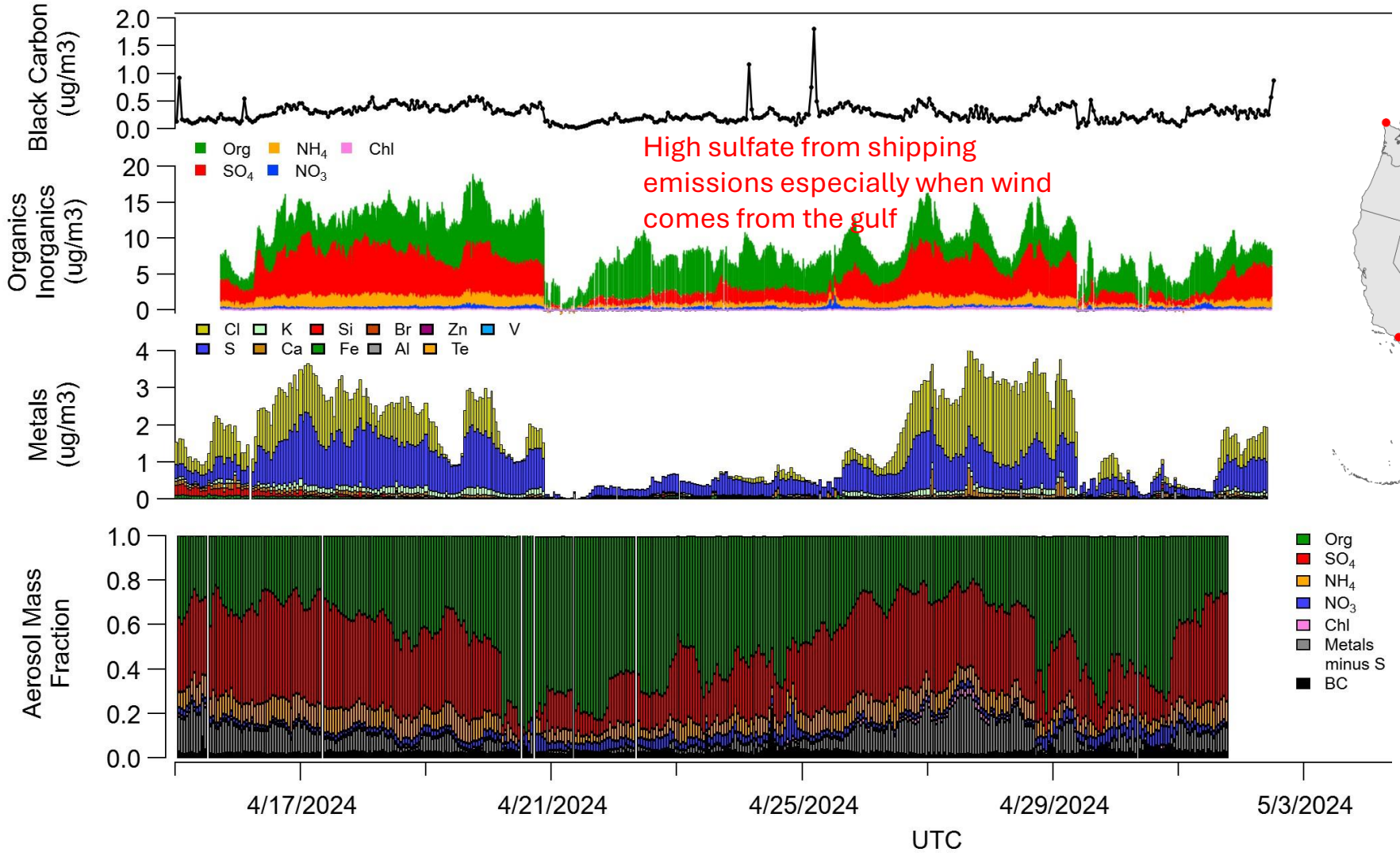

Jimmy Flynn

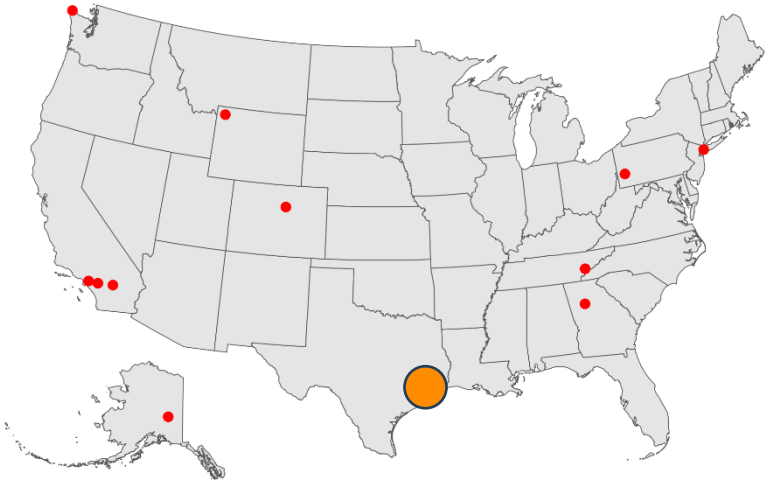

Subin Yoon


Robert Griffin


Fangzhou Guo


Shan Zhou





Atlanta: Aerosol Composition

Georgia Institute of Technology

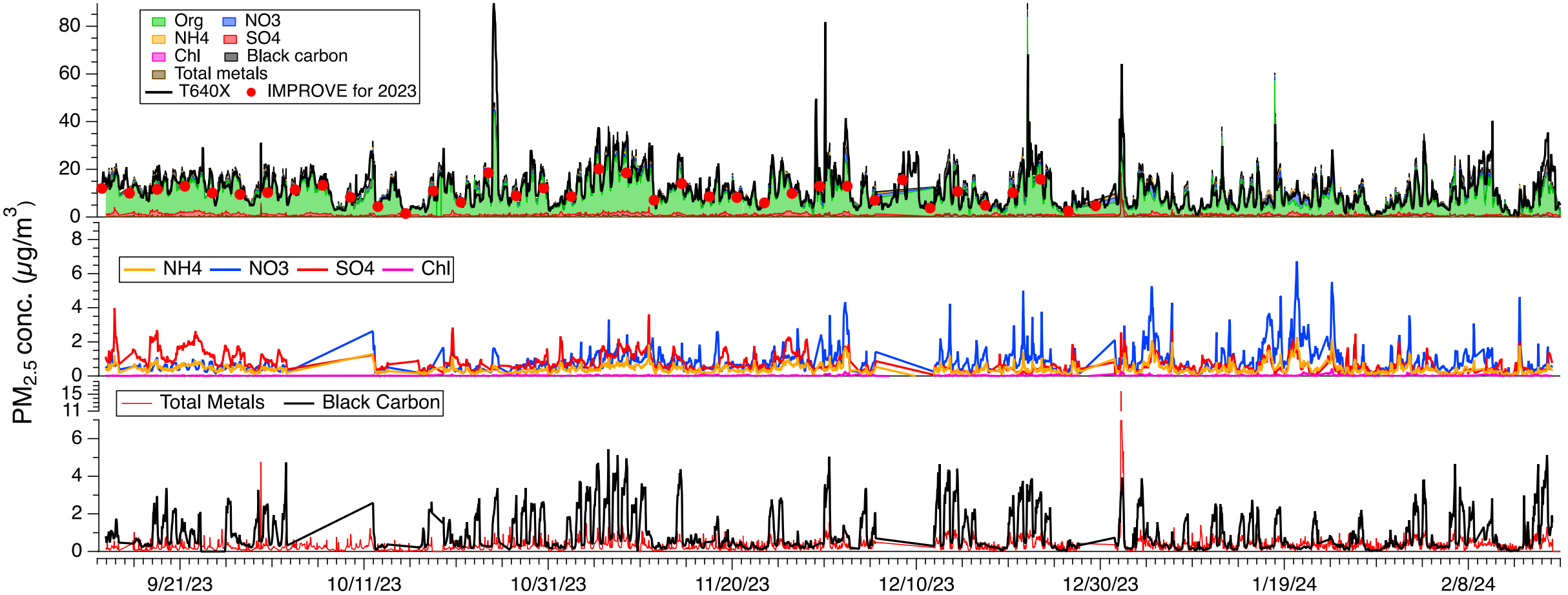

Nga Lee Ng


Ruizhe (Evan) Liu

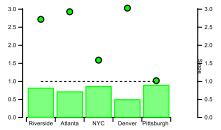

David Pando


Alison Fankhauser

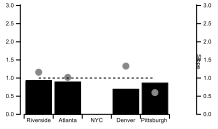
Avg. $PM_{2.5}$ = 12 μg/m^3



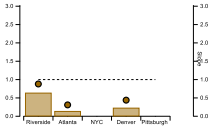
Overview of Comparison with CSN



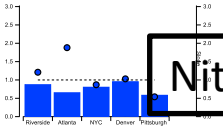
Organics



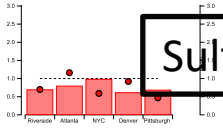
Black Carbon



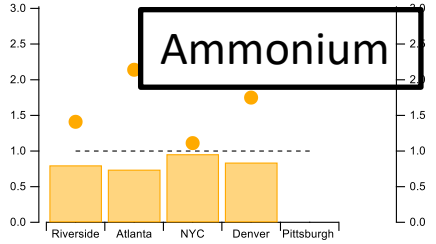
Soil



Nitrate



Sulfate



Ammonium

Value-Added Products

- **FT-IR functional group analysis**: Develop parameterizations to relate functional groups to mass spectra

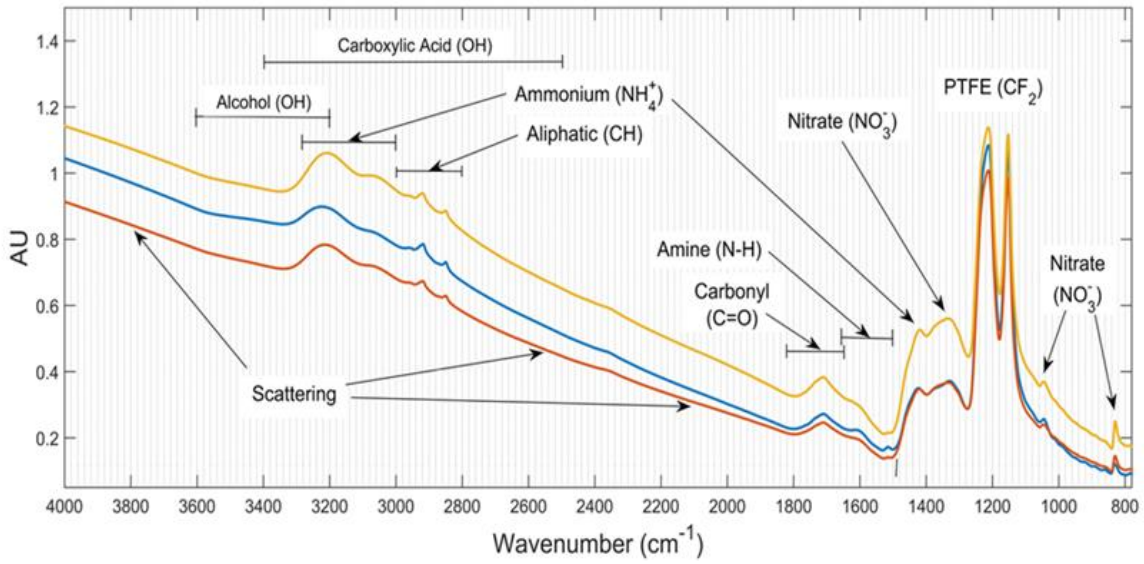
Ann Dillner Mona Mao

UC Davis

- (Near) Real time source apportionment

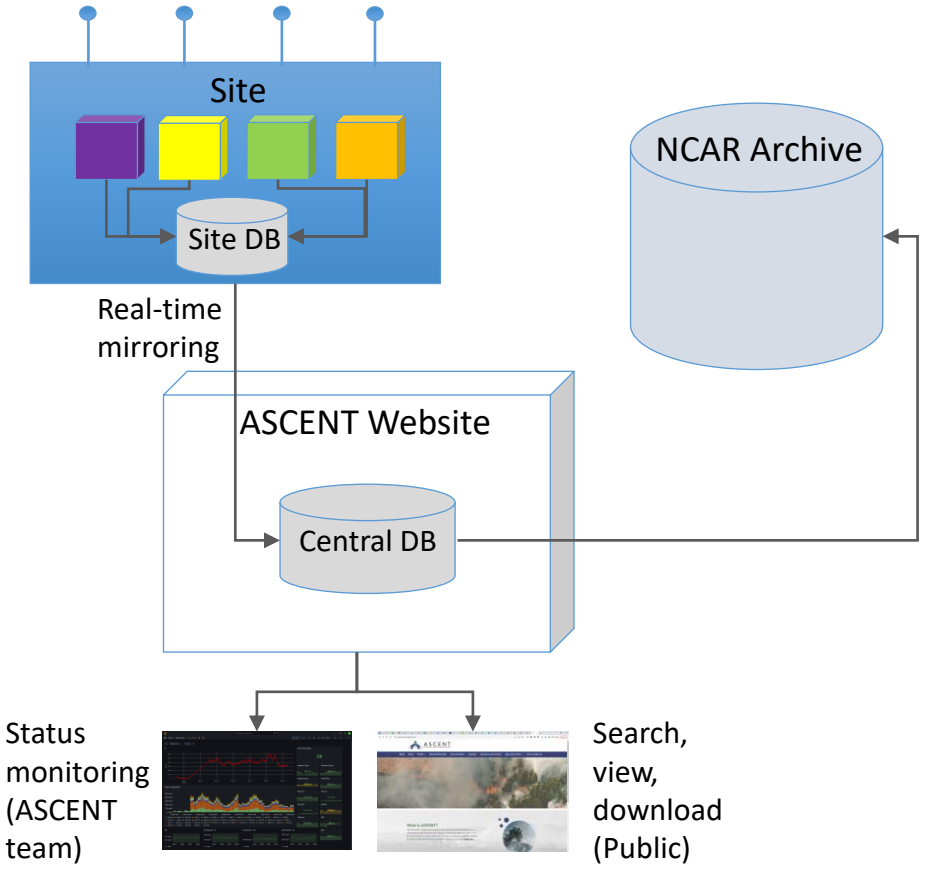
Value-Added ACSM-FTIR

- FT-IR analysis provides chemical specificity through functional groups

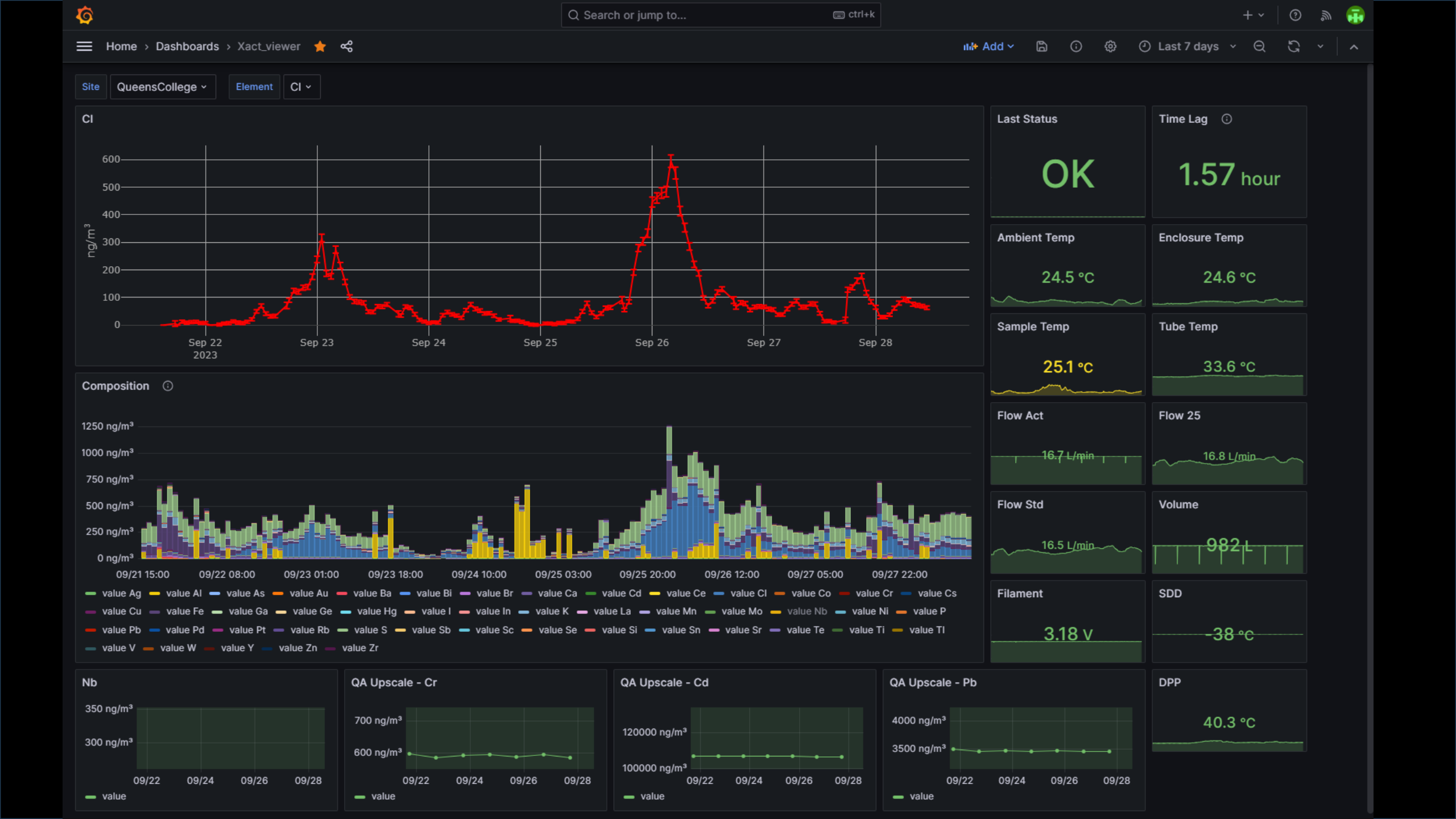


- Analyze organic functional groups in parallel by FT-IR and ACSM
  - Develop parameterizations of ACSM data to increase the chemical resolution of organic aerosols from the ACSM

Components of the ASCENT Data Management System



1. Data acquisition from each instrument
2. Database for storing analytical and operational data
3. Data streaming from each site to a central database
4. Instrument monitoring, QC, and status alerting
5. Software for automated QC and database support for flagging and invalidation
6. Tools for manual data validation, visualization, and analysis
7. Public site for interaction with real-time data
8. Formatted export of data and metadata for long-term archive


Search or jump to... ctrl+k
Home › Dashboards › Xact_viewer
Add
Last 7 days
Site QueensCollege
Element Cl
Cl
ng/m³
600
500
400
300
200
100
0
Sep 22 2023
Sep 23
Sep 24
Sep 25
Sep 26
Sep 27
Sep 28
Composition
1250 ng/m³
1000 ng/m³
750 ng/m³
500 ng/m³
250 ng/m³
0 ng/m³
09/21 15:00
09/22 08:00
09/23 01:00
09/23 18:00
09/24 10:00
09/25 03:00
09/25 20:00
09/26 12:00
09/27 05:00
09/27 22:00
value Ag value Al value As value Au value Ba value Bi value Br value Ca value Cd value Ce value Cl value Co value Cr value Cs
value Cu value Fe value Ga value Ge value Hg value I value In value K value La value Mn value Mo value Nb value Ni value P
value Pb value Pd value Pt value Rb value S value Sb value Sc value Se value Si value Sn value Sr value Te value Ti value Tl
value V value W value Y value Zn value Zr
Last Status
OK
Time Lag
1.57 hour
Ambient Temp
24.5 °C
Enclosure Temp
24.6 °C
Sample Temp
25.1 °C
Tube Temp
33.6 °C
Flow Act
16.7 L/min
Flow 25
16.8 L/min
Flow Std
16.5 L/min
Volume
982 L
Filament
3.18 V
SDD
-38 °C
Nb
350 ng/m³
300 ng/m³
09/22
09/24
09/26
09/28
value
QA Upscale - Cr
700 ng/m³
600 ng/m³
09/22
09/24
09/26
09/28
value
QA Upscale - Cd
120000 ng/m³
100000 ng/m³
09/22
09/24
09/26
09/28
value
QA Upscale - Pb
4000 ng/m³
3500 ng/m³
09/22
09/24
09/26
09/28
value
DPP
40.3 °C

Research Capabilities

- **Infrastructure, Energy, and Land Use Change**
  - Emissions, sources, chemistry
  - Advance atmospheric aerosol modeling
- **Climate Change and Feedbacks**
  - Shifts in regulations, impacts of aerosols on climate
  - Natural and anthropogenic aerosols, cloud formation and properties
- **Public Health and Equity**
  - PM composition and health effects
  - PM size distribution and health effects
  - Disparities in pollution exposure
- **Satellite Validation**
  - MAIA, TEMPO
- **Field campaign sites, mobile platforms, test beds to develop and evaluate the next generation of low-cost sensors, etc.**

Thank you!

https://ascent.research.gatech.edu