Preliminary Data and Analysis From The ASCENT Network at Cheeka Peak Observatory

Olivia Hakan[1], Olga Garmash[1], Odelle Hadley[3], Phil Rund[1], Courtney Winck[2], Joel Thornton[1]
University of Washington[1], Makah Tribe/EPA[2], Olympic Region Clean Air Agency[3]

NW AirQuest Meeting 10/26/23

UNIVERSITY of WASHINGTON

ASCENT

The Atmospheric Science and Chemistry mEasurement NeTwork

> Funded by the NSF to establish a long-term real-time high resolution aerosol measuring network.

> Currently in its first year of operation.

> Each of the 12 sites has four distinct aerosol measuring instruments.

> These sites are in a variety of locations and will allow for the differentiation between organics, source apportionment, and analysis of diurnal and spatial profiles.

> The University of Washington's site is located at Cheeka Peak Observatory (CPO)

UNIVERSITY *of* WASHINGTON
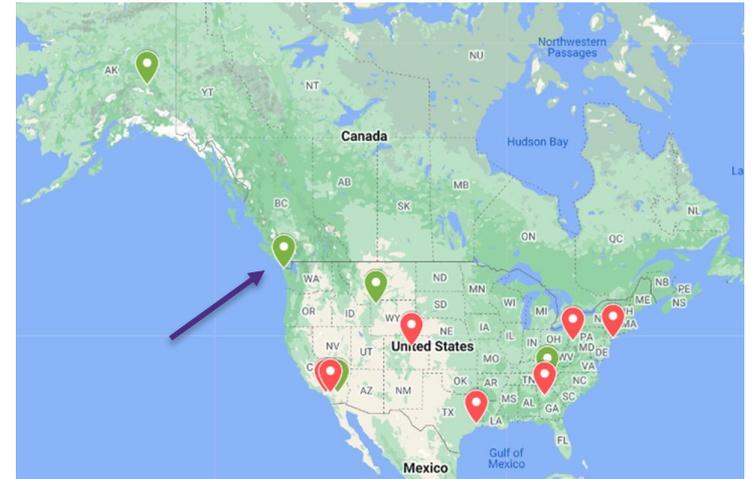
Instrumentation

> **Aerosol Chemical Speciation Monitor (ACSM):** Measures speciated non-refractory aerosol mass concentration.
>   – Aerosols are accelerated through a time-of-flight chamber and separated based on their mass to charge (m/z) ratio. These fragments are used to determine aerosol speciation and concentration.

> **Scanning Mobility Particle Sizer (SMPS):** Measures total particulate matter concentration and size distribution.
>   – The instrument is composed of an electrostatic classifier connected to a condensation-based particle counter (CPC).
>   – Measures from 2-1000 nm and from $1-10^7$ particles/cm3.

> **Aethalometer (AE33):** Measures light absorbing aerosols including black and brown carbon.
>   – Light transmission through a filter is used to determine the concentration.

> **Multi-Metals Monitoring System (Xact):** Measures 46 different metals and elements simultaneously.
>   – Aerosols collected on a filter are irradiated with X-rays. The subsequent fluorescence emission acts as a fingerprint for each element.

CPO Location
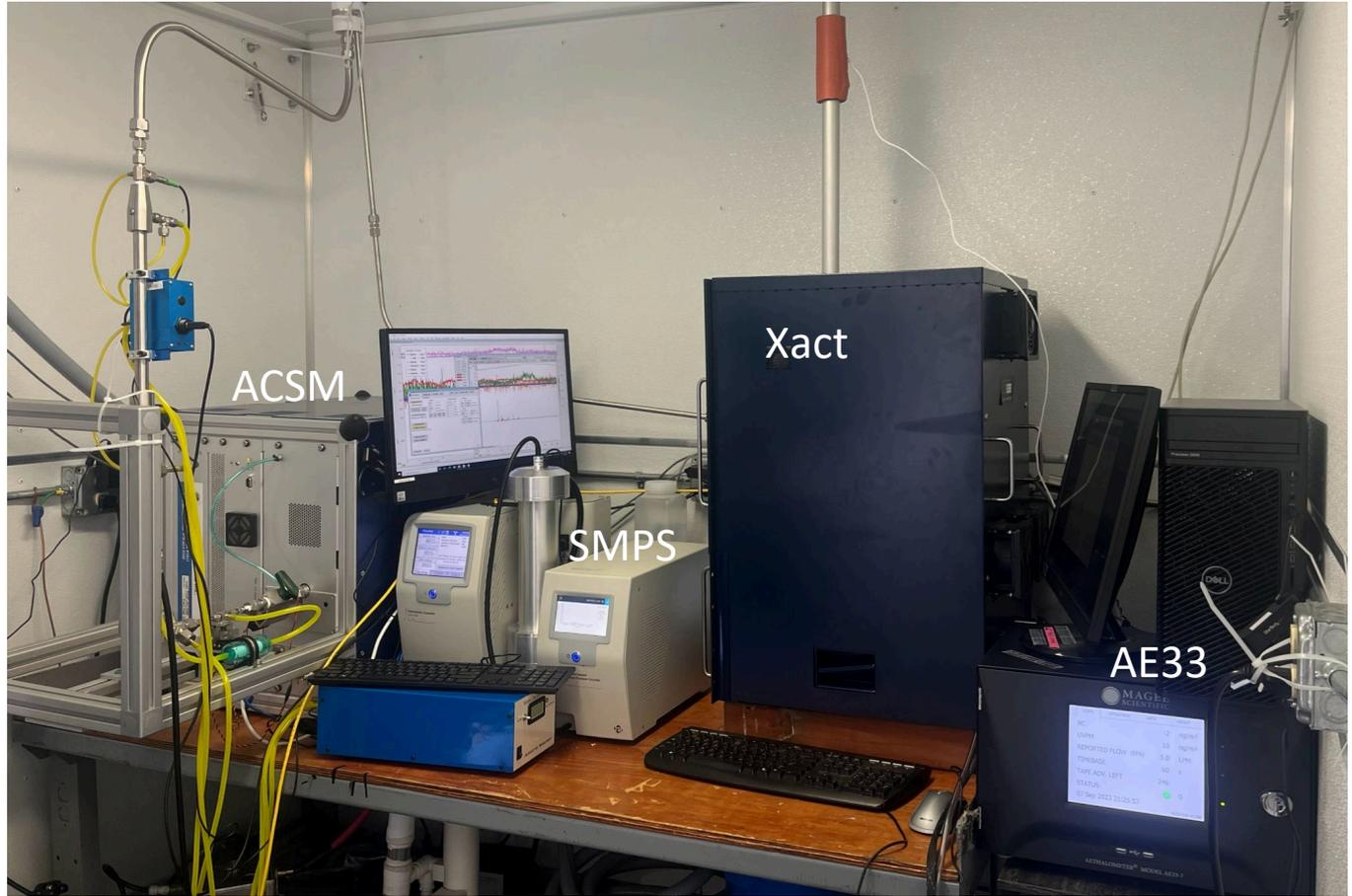


UNIVERSITY of WASHINGTON
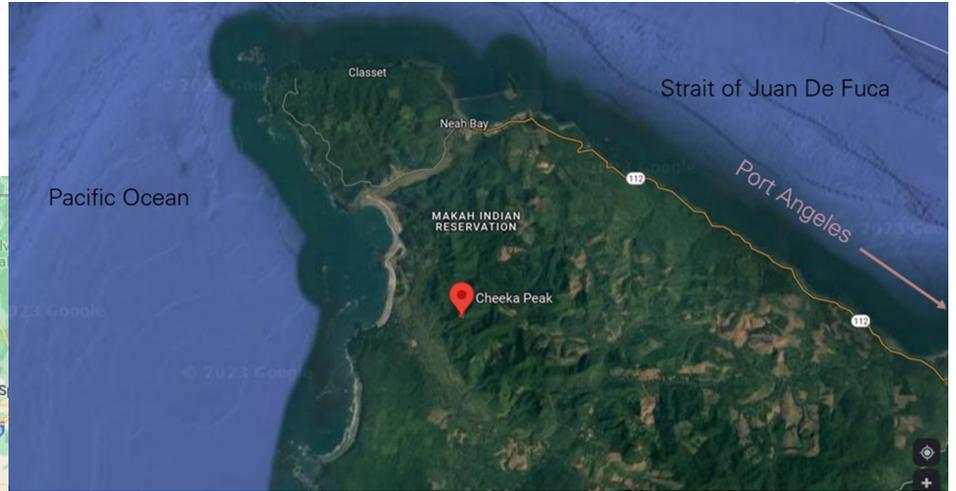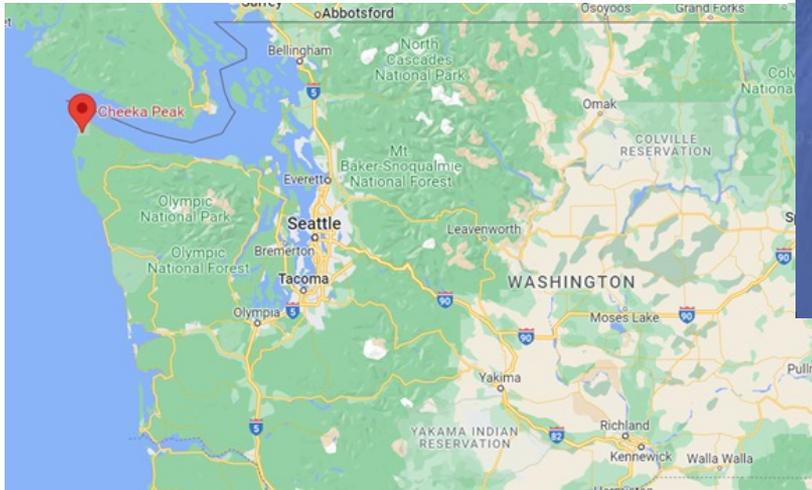
UNIVERSITY *of* WASHINGTON

Site History

> **1984–1995:** Bob Charleson and Dave Covert, from University of Washington began work at CPO monitoring rain, cloud droplet, and aerosol chemistry.
>> – Looking for a marine boundary layer with minimal land/urban influence.

> **1996 – 1998:** Dan Jaffe began collaborating at CPO under an NSF grant.
>> – Was the first to identify Asian pollutants crossing the Pacific Ocean.

> **1999 – 2006:** Dan Jaffe was the sole research group at CPO.

> **2007 – current:** ORCAA and Makah tribe received EPA funding to run NCore and IMPROVE national network sites at Cheeka Peak.

> Over 30 published papers using data collected at Cheeka Peak since 1984

> ASCENT is collocated with NCORE, IMPROVE, PNSN (Pacific Northwest Seismic Network), PANGA (Pacific Northwest Geodetic Array), and UNAVCO network sites

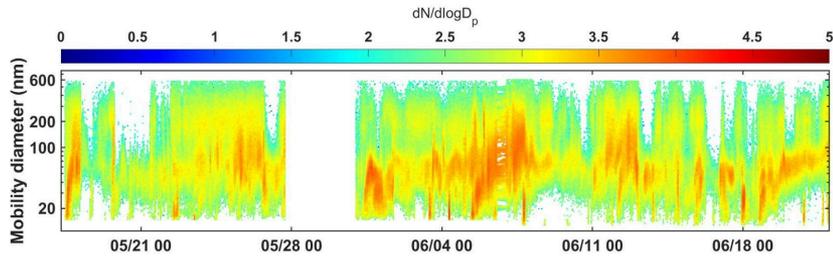UNIVERSITY *of* WASHINGTON

ACSM

SMPS

Xact

AE33

UNIVERSITY *of* WASHINGTON

AE33 Time-Series
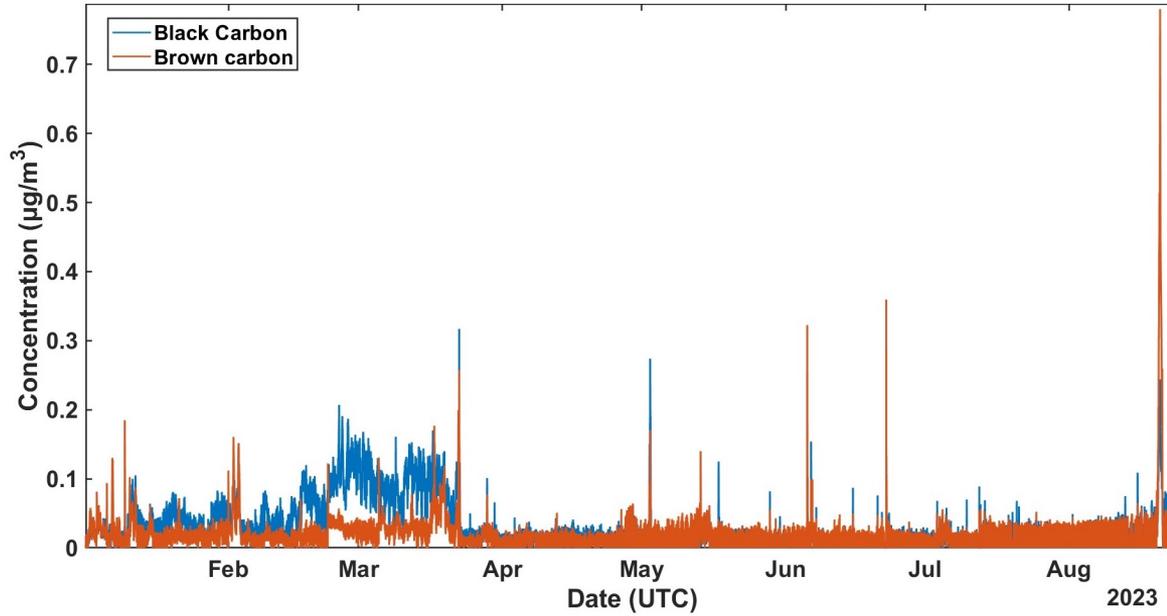
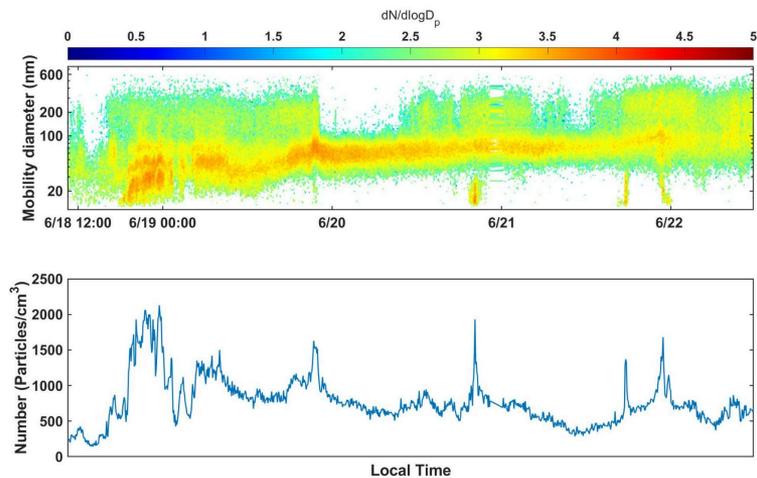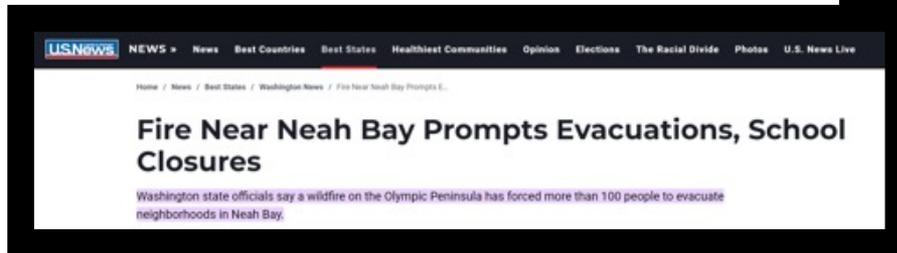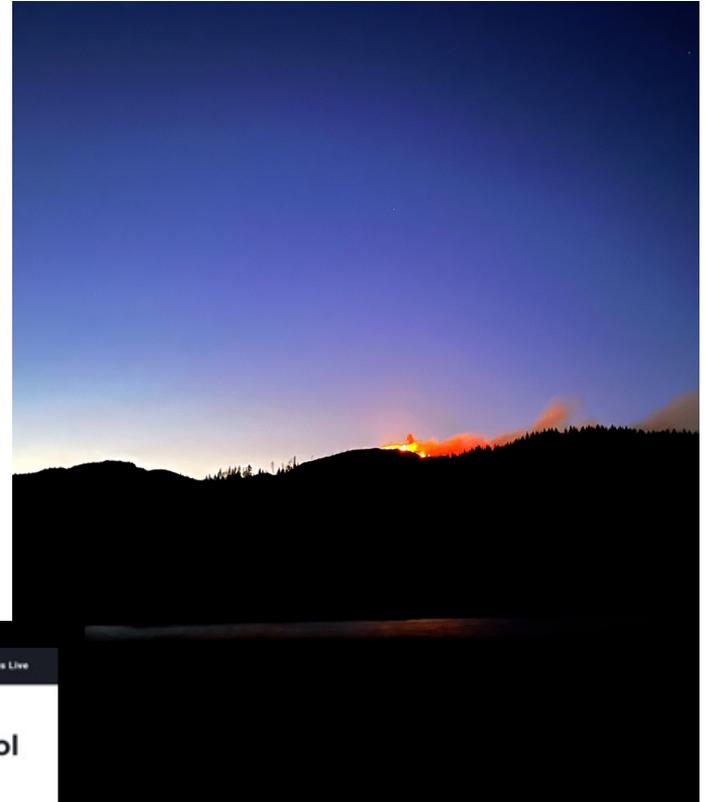# ACSM Time-Series

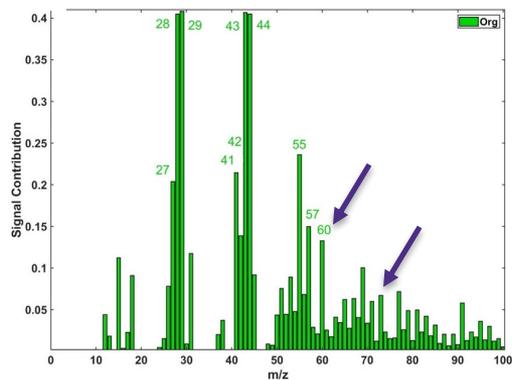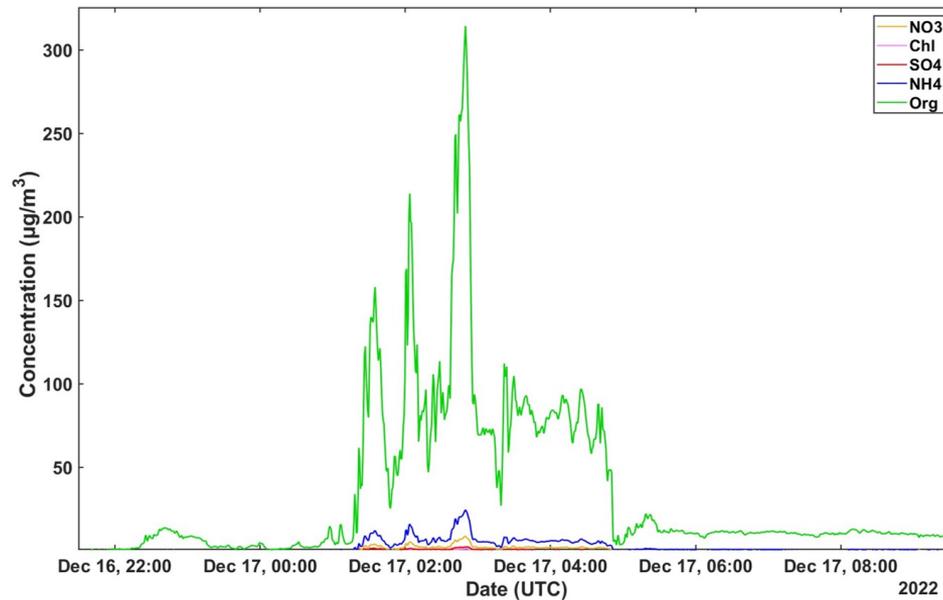# SMPS Time-Series

UNIVERSITY *of* WASHINGTON
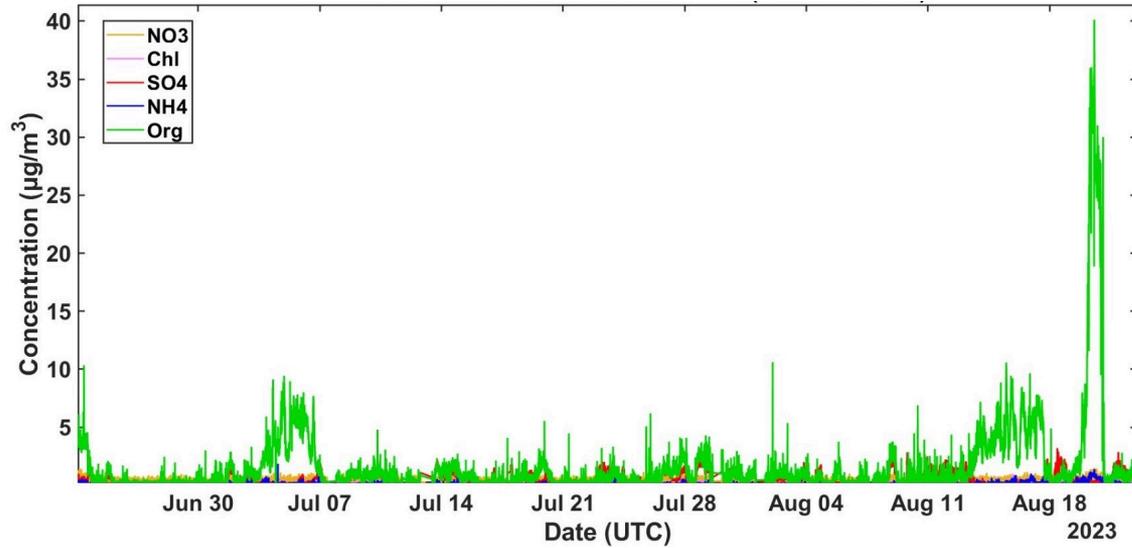
New Particle Formation
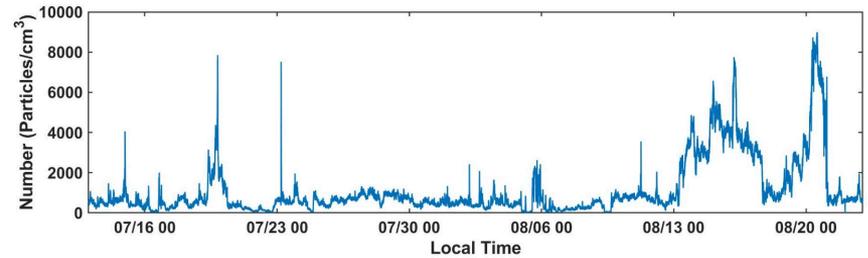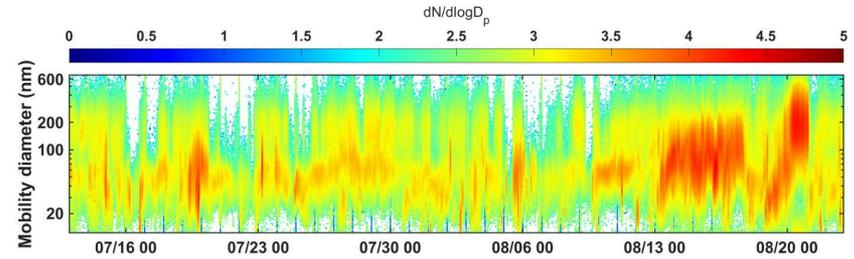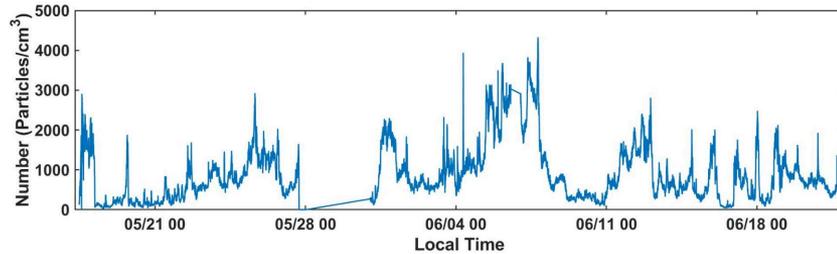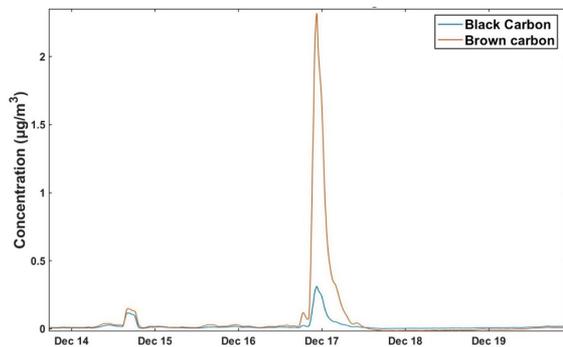

UNIVERSITY of WASHINGTON
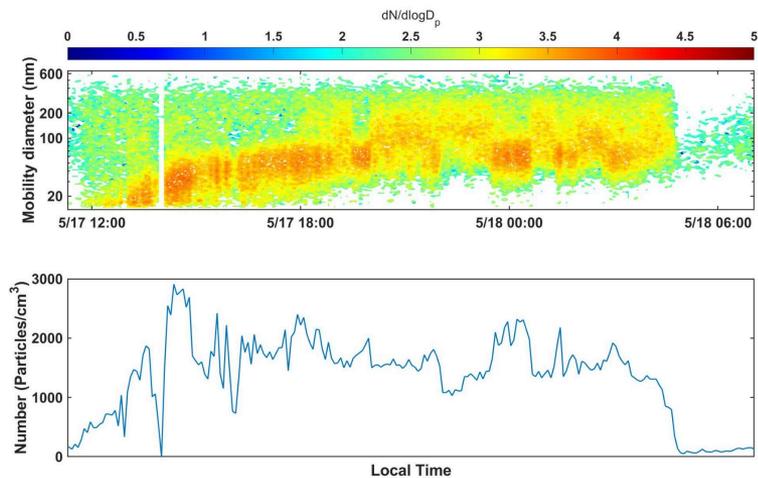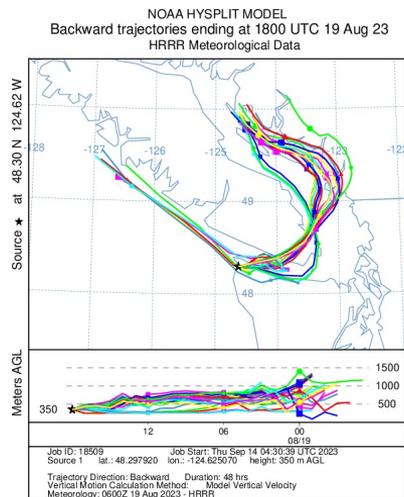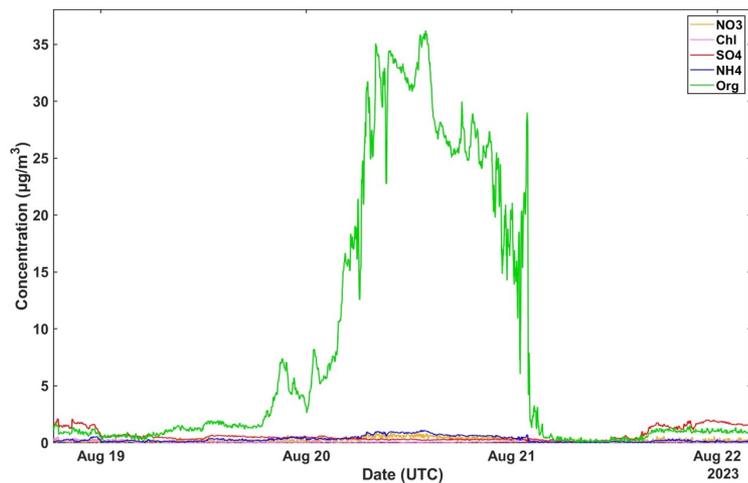
Biomass Burning (BB) at CPO

- There have been several slash-and-burn fires in the nearby vicinity over the last year.

- In particular, during November 2022 three of these fires spread uncontrollably due to high winds.

**Fire Near Neah Bay Prompts Evacuations, School Closures**

Washington state officials say a wildfire on the Olympic Peninsula has forced more than 100 people to evacuate neighborhoods in Neah Bay.

UNIVERSITY *of* WASHINGTON

December 2022 BB

August 2023 BB

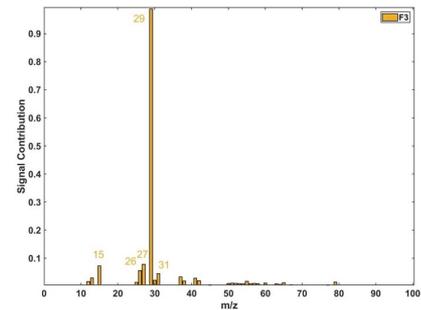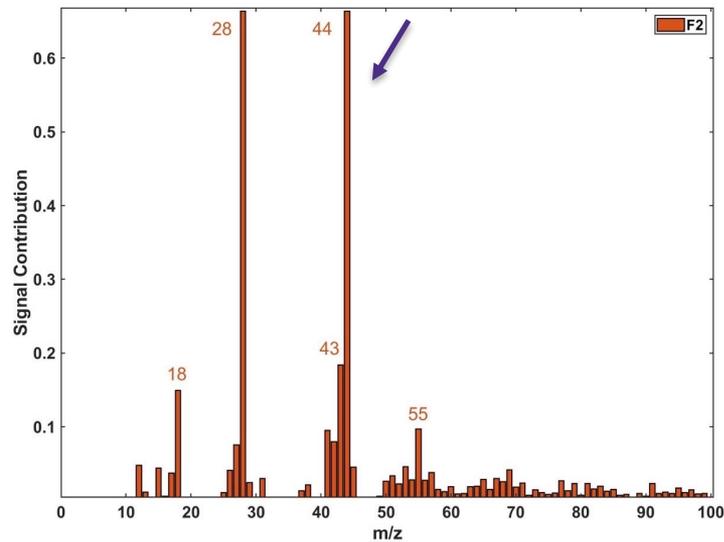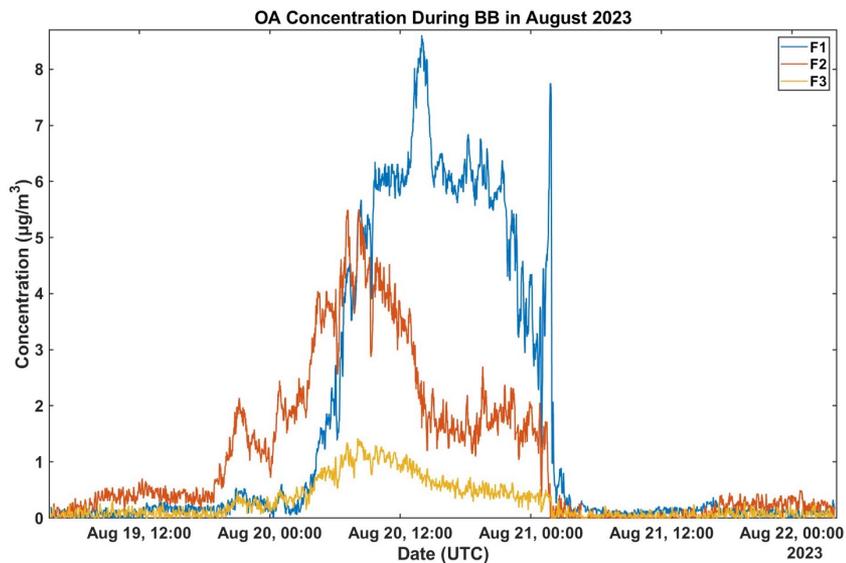# Non-Negative Matrix Factorization (NNMF)

> NNMF is a method to apportion distinct sources to a large data set.

> An n x m matrix is introduced, in this case n was the time points for the ACSM data, and m was organic fragments m/z 1-100.

> An optimal factorization rank is chosen by the user.

> NNMF extracts basis components (G matrix) and mixture coefficients (F matrix) for each factor where GF approximates the original data set X.
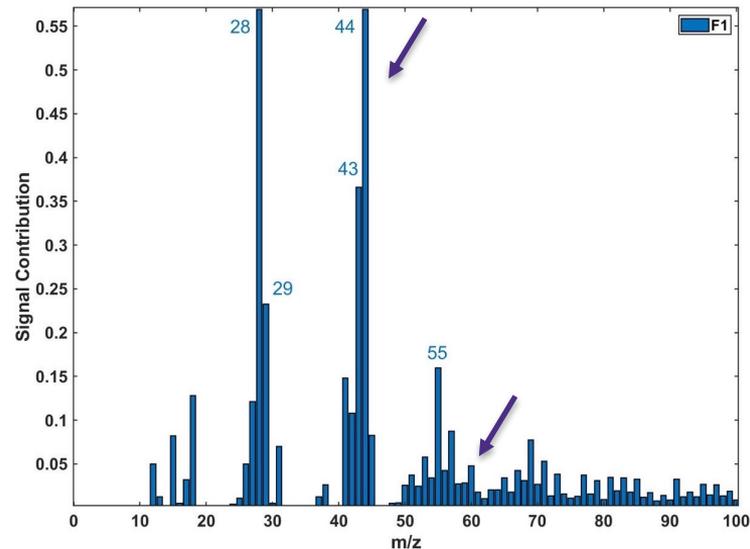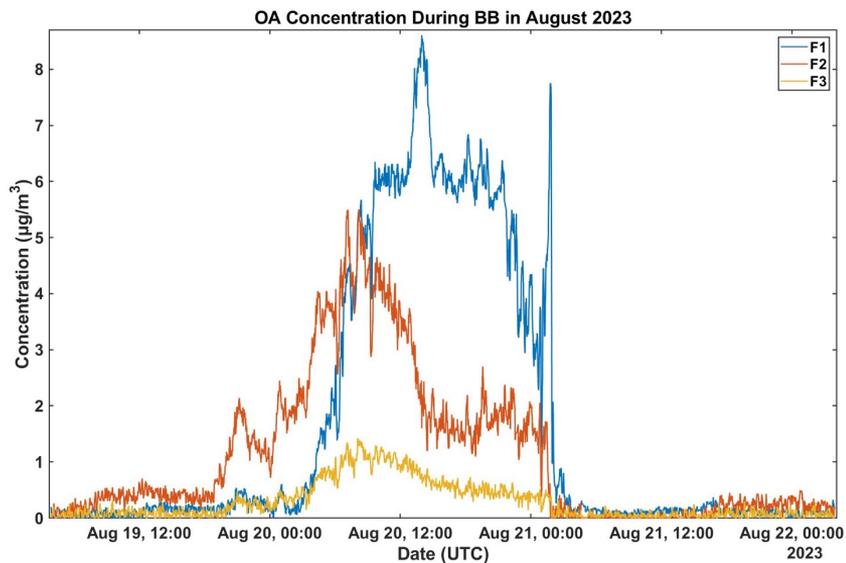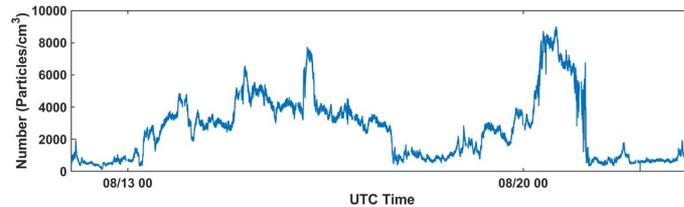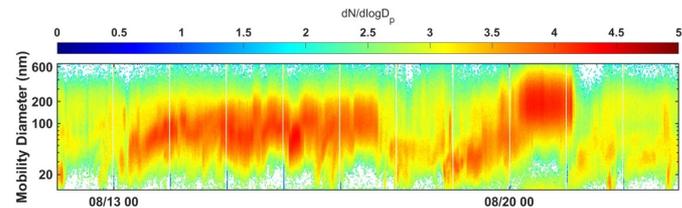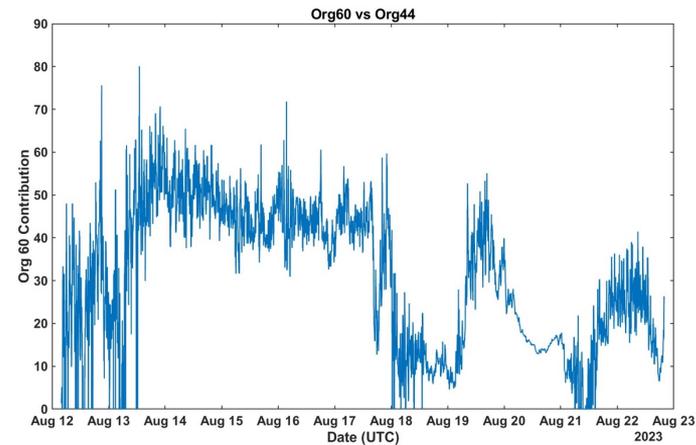
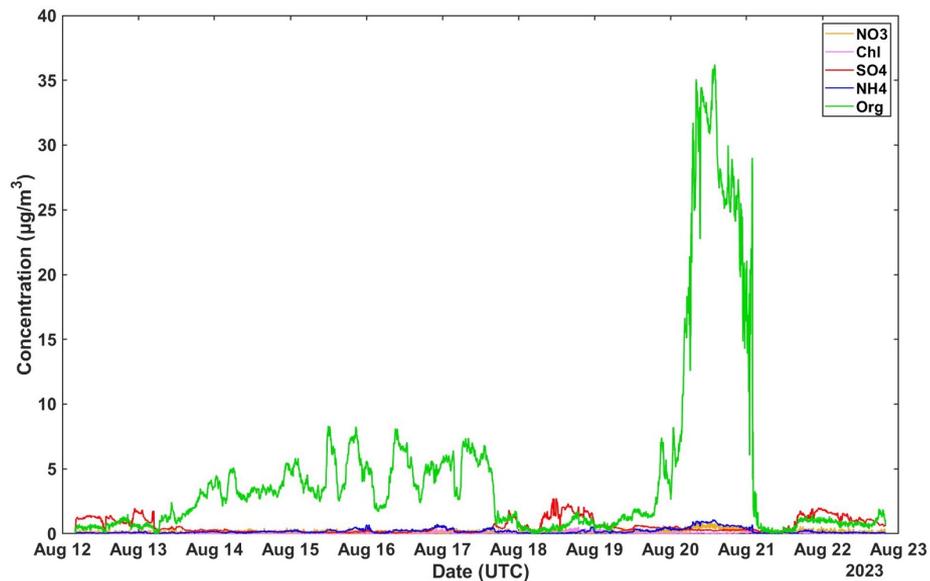# August 2023 BB Cont.

August 2023 BB Cont.

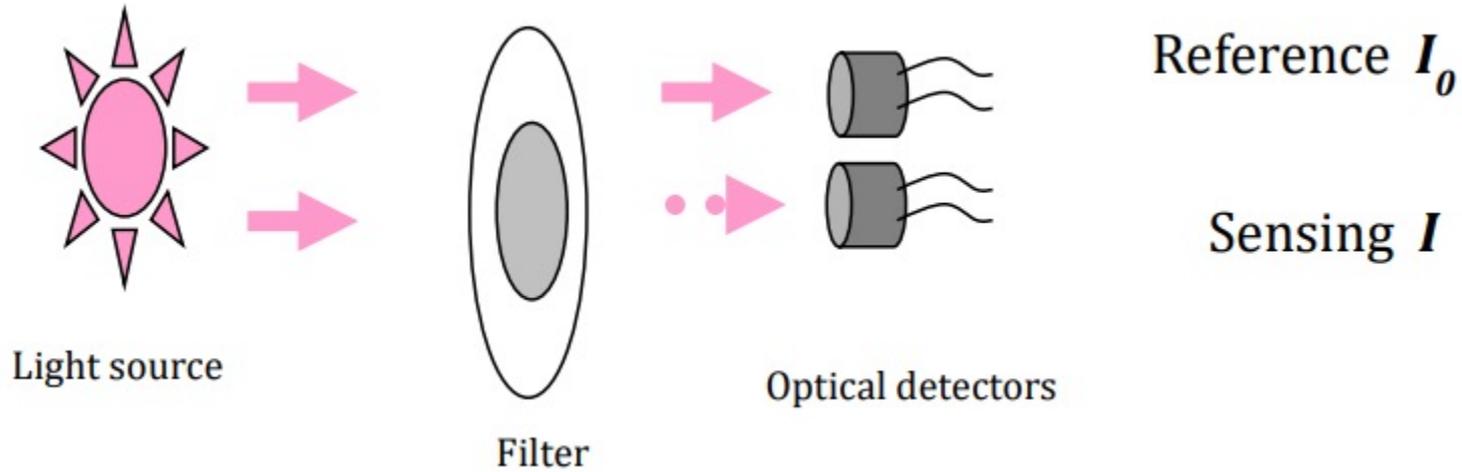OA Concentration During BB in August 2023

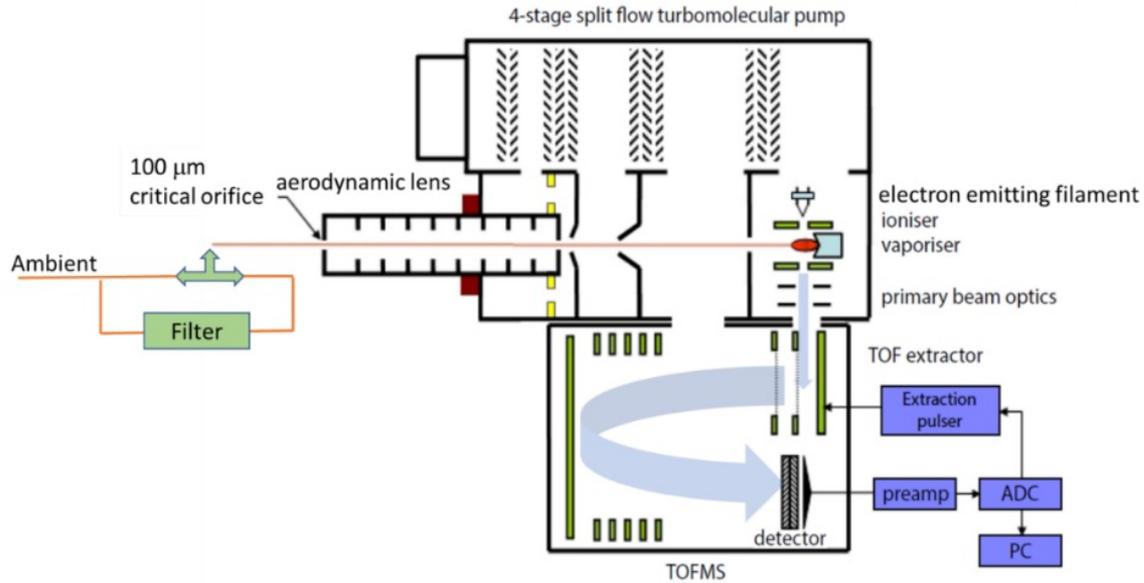UNIVERSITY *of* WASHINGTON

August 2023 BB Cont.

Questions?

Extra Slides

UNIVERSITY of WASHINGTON

AE33

Light source

Filter

Optical detectors

Reference I_0

Sensing I

SMPS

ACSM

Xact

Heated sample inlet

X-ray tube

Detector

Temperature humidity sensor

Tape feed

Uptake reel

Flow Meter

incident X-ray photon

e⁻ photo electron

X-ray fluorescence photon

K

L

M