ARM AOS Aerosol Observations during TRACER

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with contributions of other AOS mentors

Environmental and Climate Sciences Department
Brookhaven National Laboratory

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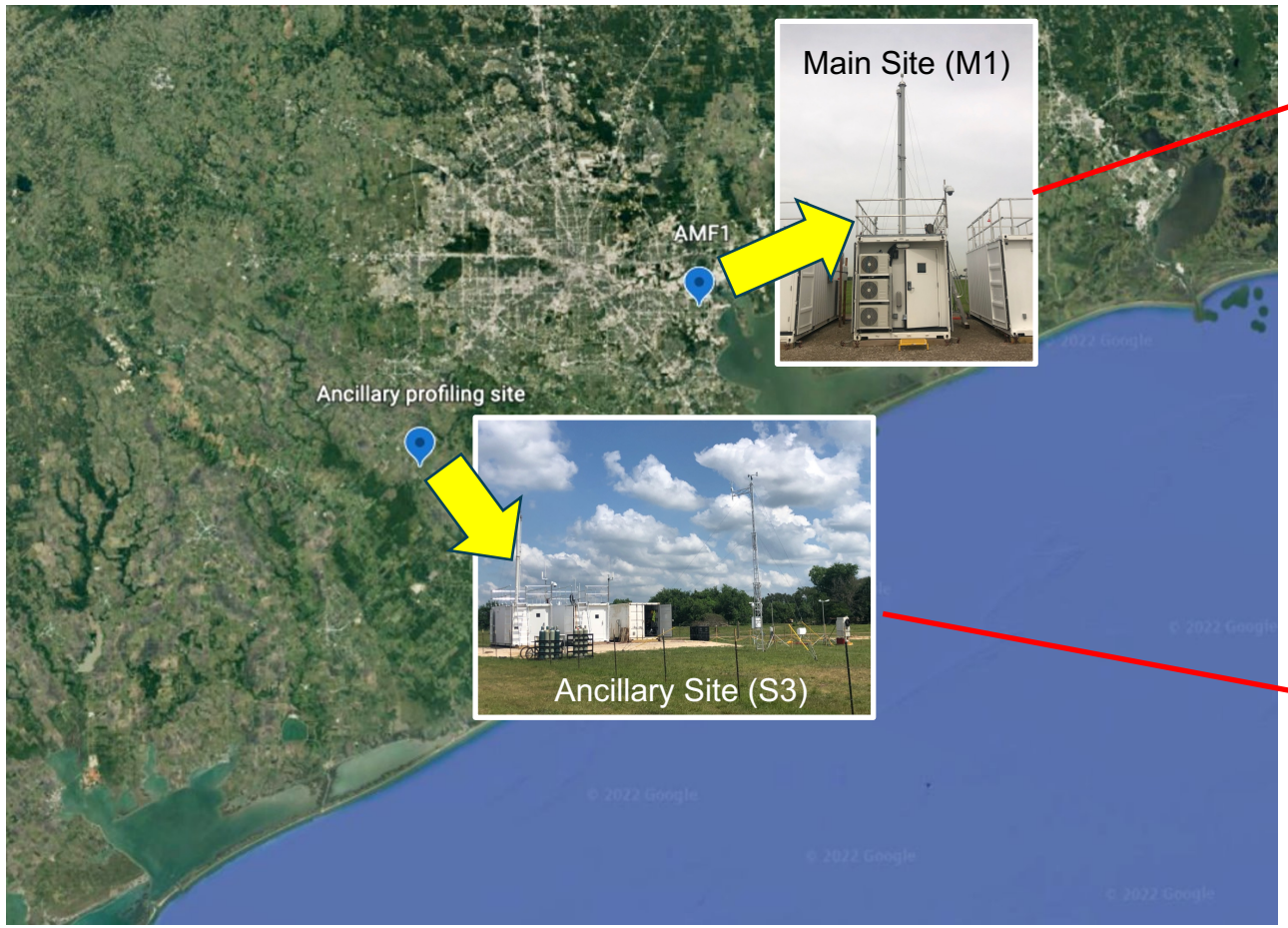
Outline

- Location and type of AOS measurements
- The AOS and the AOS Mentors
- Overview of on-going research involving AOS observations of aerosol composition and processing
- Chongai Kuang's results

ARM Aerosol Observing System (AOS): Measurements during TRACER



- **Number concentration and size**:
  SMPS, CPCu, CPCuf, APS, OPC, UHSAS
- **Hygroscopicity**:
  CCN, HT-DMA, Humidigraph
- **Chemical composition**:
  ACSM, SP2
- **Optical properties**:
  Nephelometer, Aethalometer, PSAP
- **Trace gases**:
  CO, SO_2, O_3
- **QuantAQ Low-cost sensor (LCS):**
  PM_{10},$PM_{2.5}$, $PM_{1,}$ CO, O_3, NO, NO_2, T, RH, wind speed, wind direction

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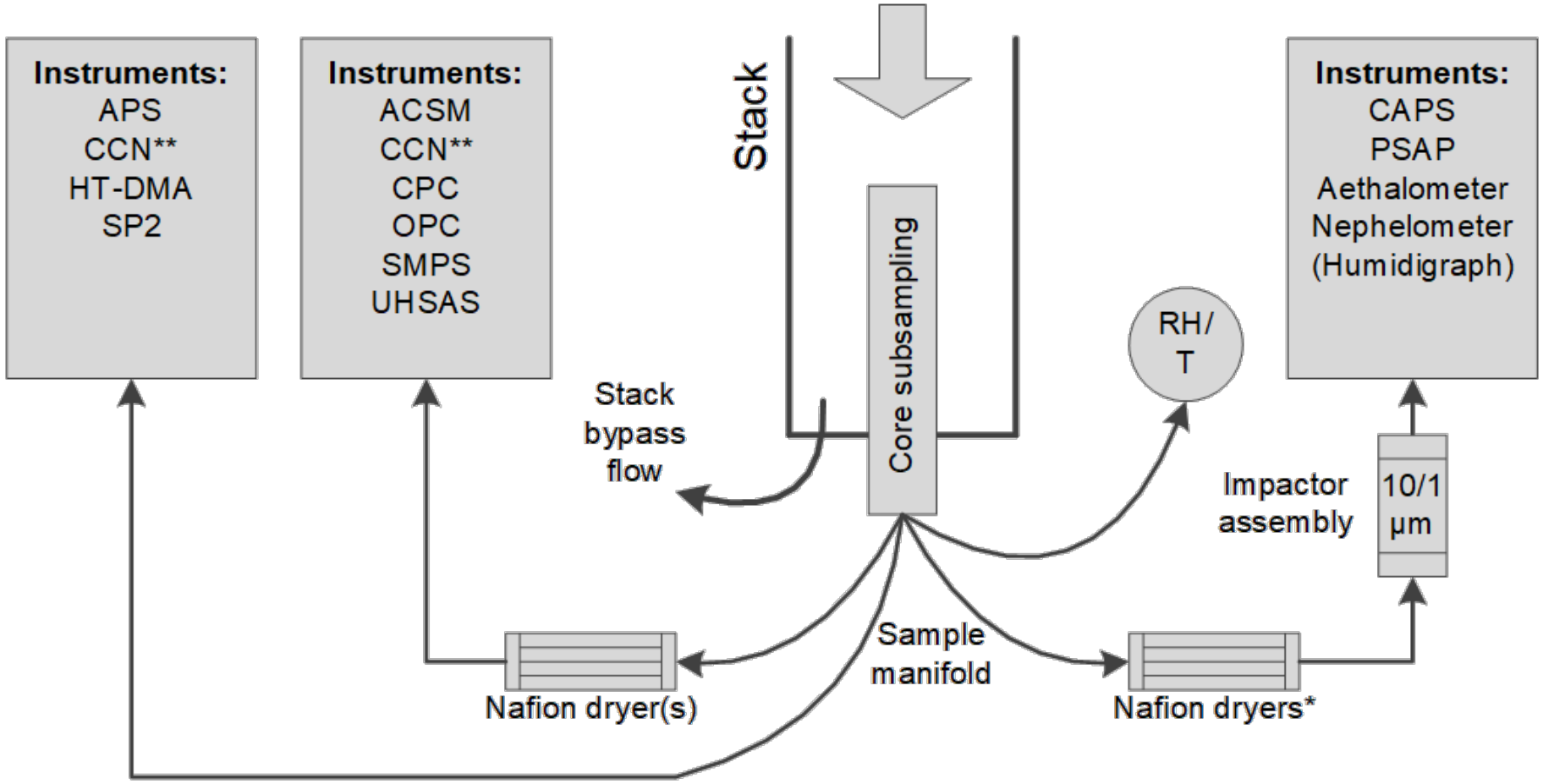
The ARM Aerosol Observing System (AOS)

- Self-contained platform (20-ft shipping container) **for ground-based aerosol (and trace gas) measurements**
- Part of larger ARM sites, 5 AOSes (fixed sites and mobile facilities)
- Stack (aerosol inlet) height – ca. 30 feet (10-m) above ground level.
- Inlet particle size cut (0.016 – 6.2 μm)
- Deployed in diverse locations and climate regimes since 1996.

Inside view of the SGP AOS

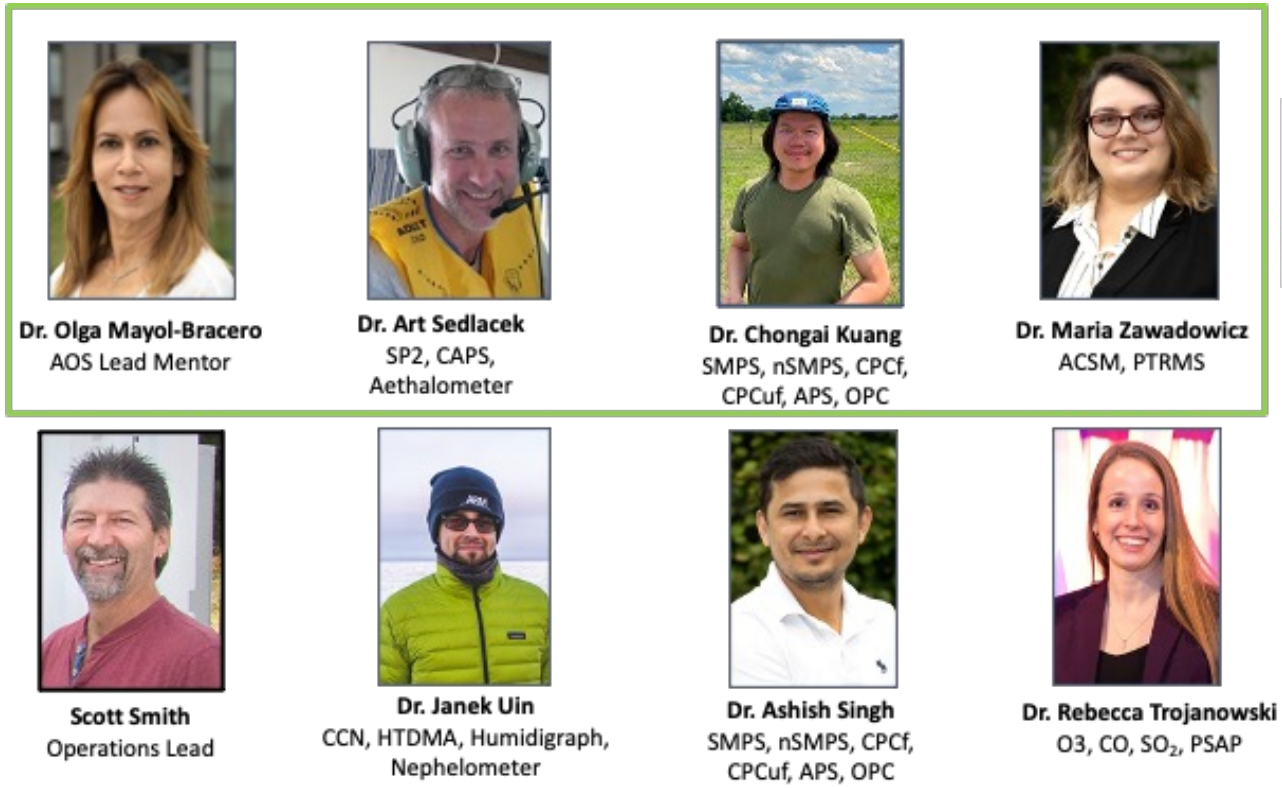
AOS: How it Works?



There are provisions in the AOSs for accommodating ARM-approved guest instrumentation.

AOS Mentors

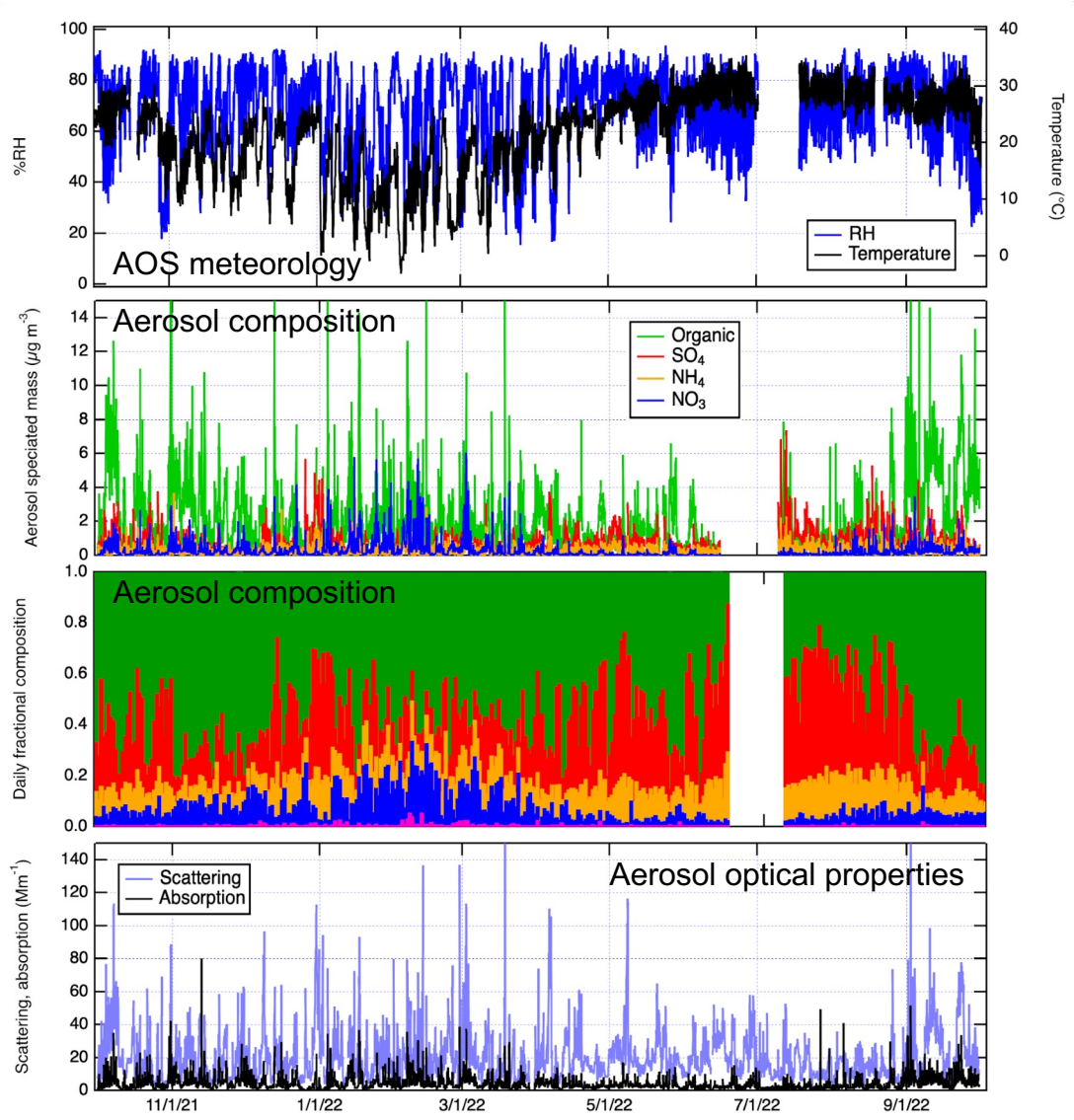
Aerosol mentors are active participants in TRACER science.

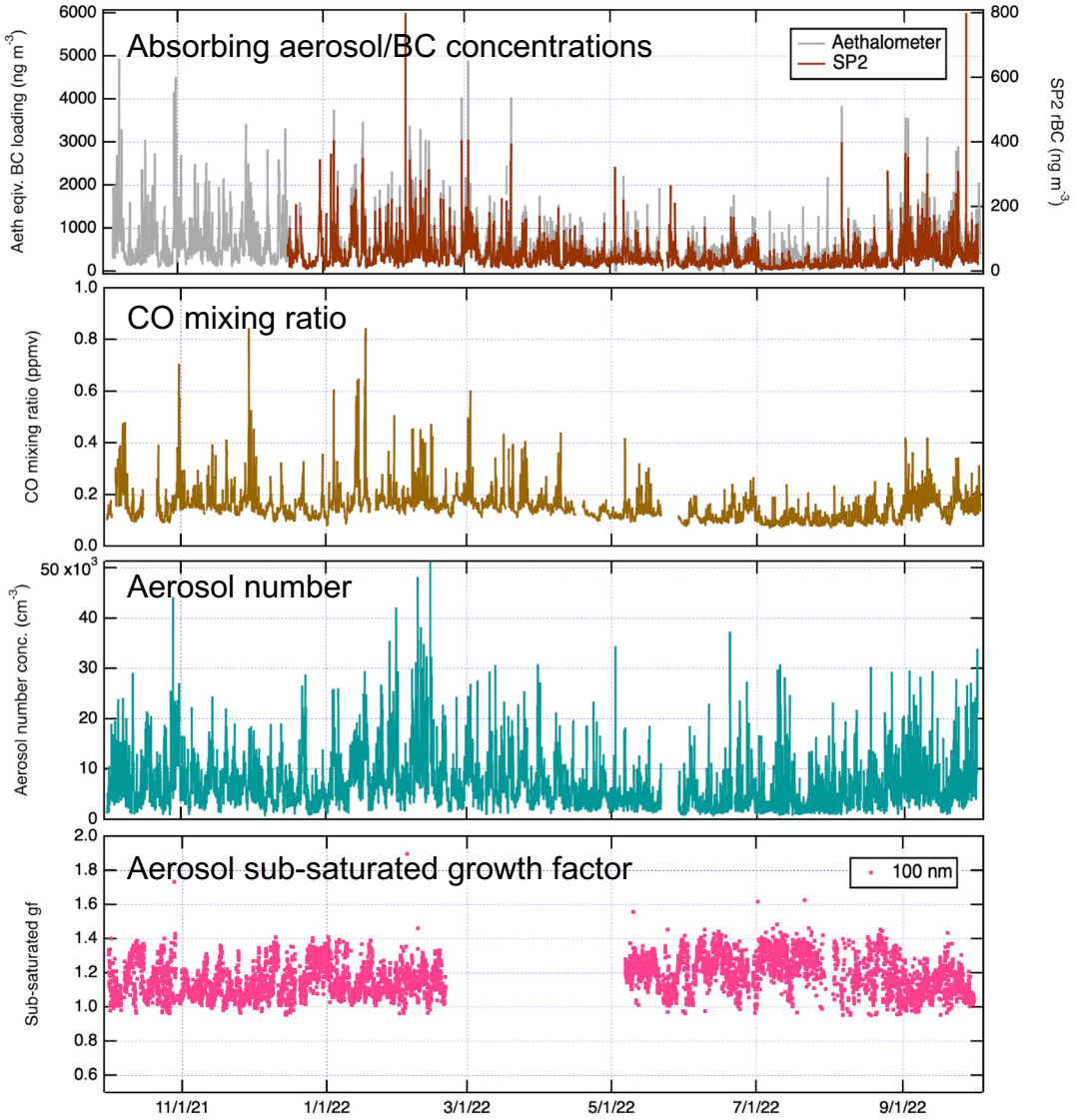


also ASR Scientists

- Individual instruments are operated under the direction of the instrument mentors (BNL), who are experts in their respective instruments.
- They run the instruments, perform and oversee calibrations and maintenance, and work with ARM in the data processing.

Aerosol composition, optical properties, size distributions and hygroscopicity were directly measured during TRACER

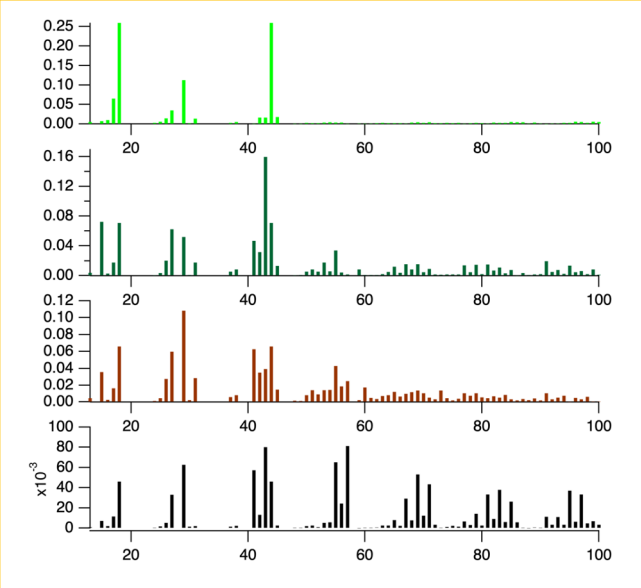




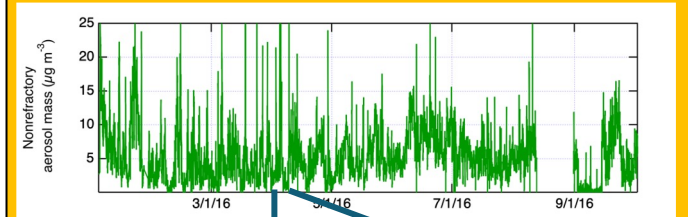
ACSM PMF PI product procedure

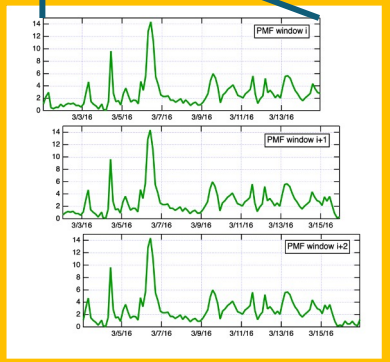
PMF algorithm performed 350 times for each season

Derive a set of reference profiles using clustering



Rolling PMF of the whole TRACER dataset using the ME-2 algorithm with HOA and BBOA constrained (+2 unconstrained factors)





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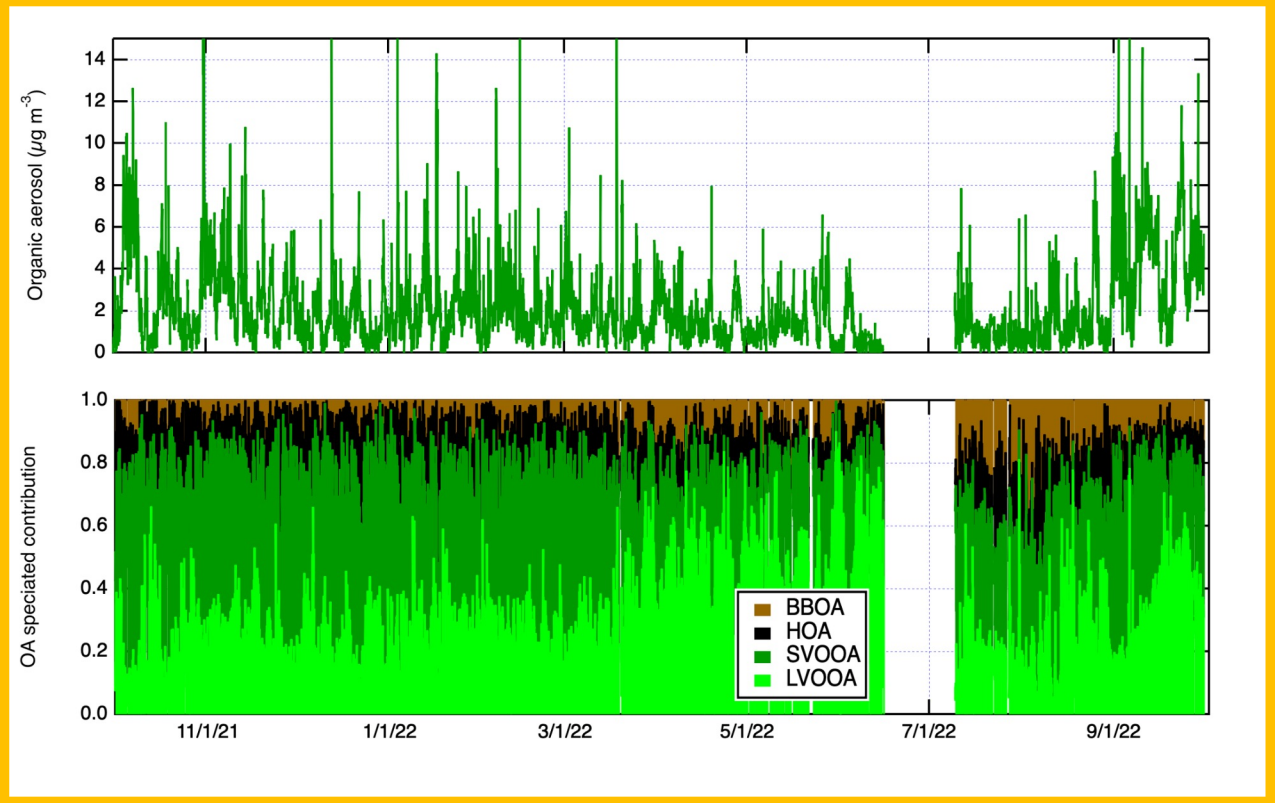
ACSM PMF PI product procedure

Results:



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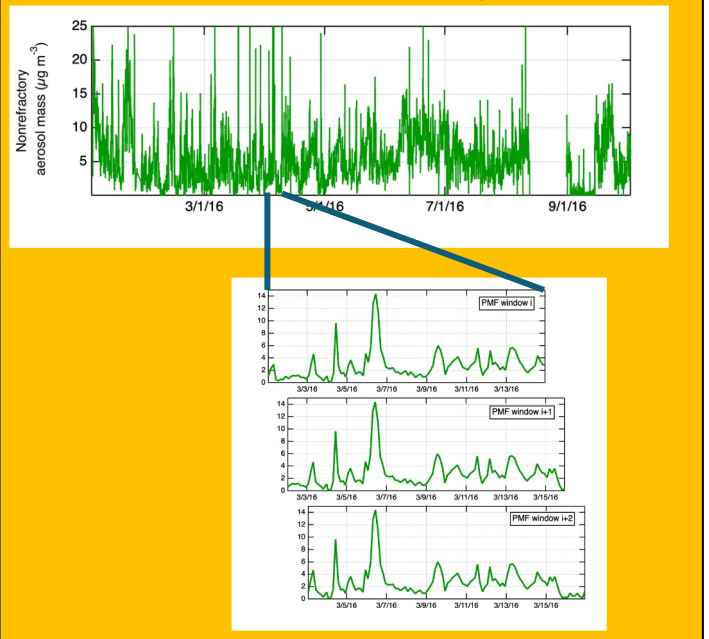

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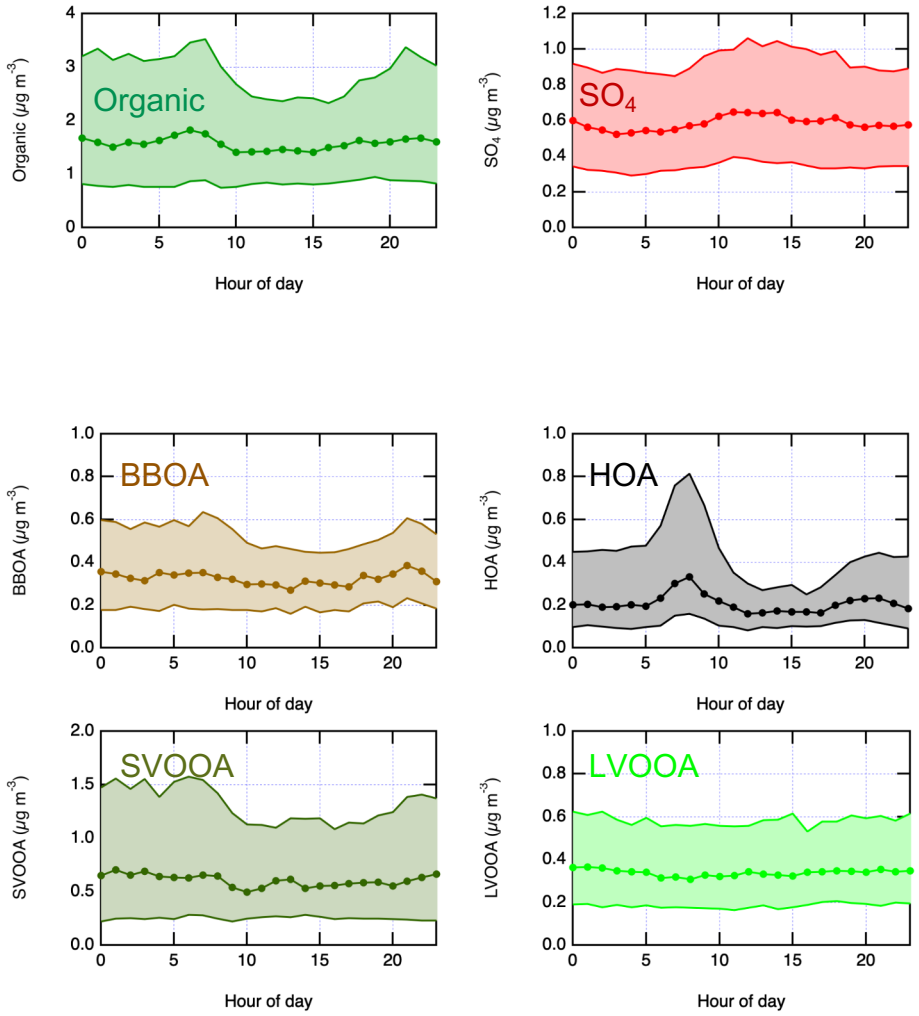
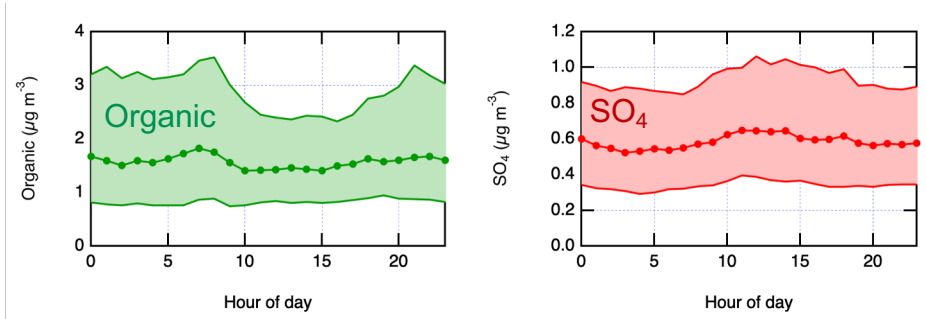
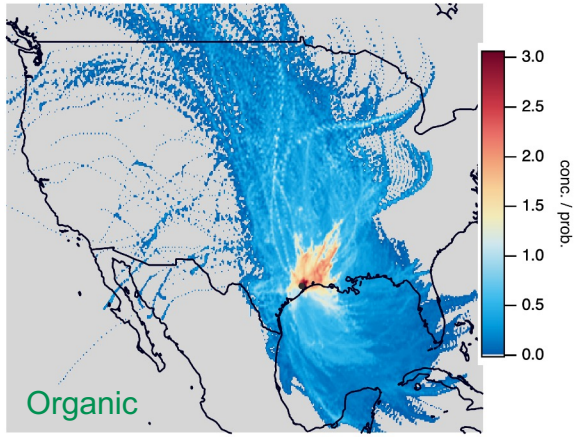
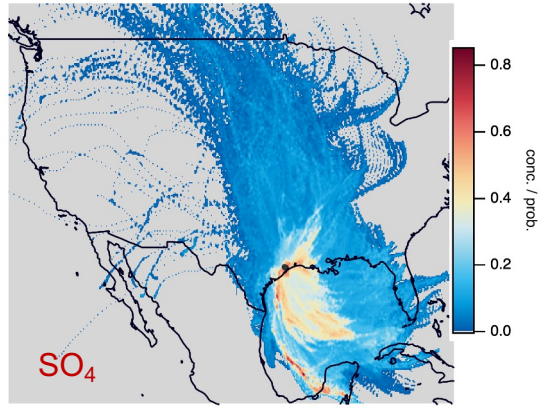
Diurnal cycles of OA and sulfate



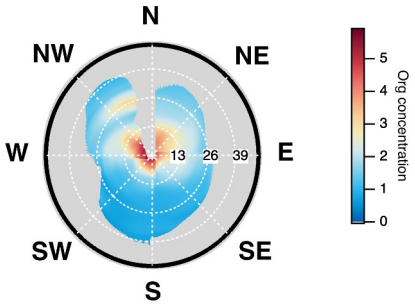
Nonparametric wind regressions of OA and sulfate



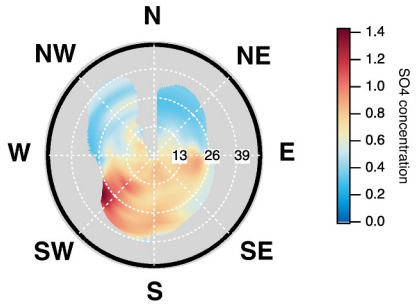




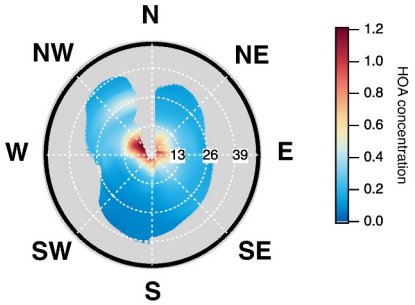
Organic



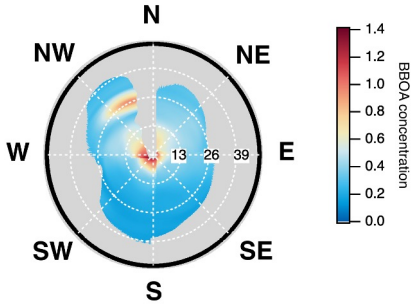
SO_4



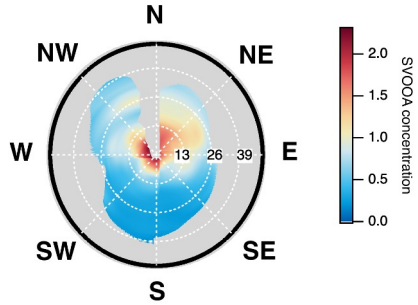
HOA



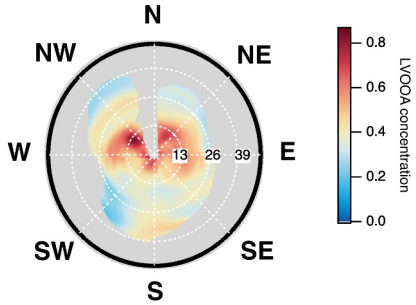
BBOA



SVOOA

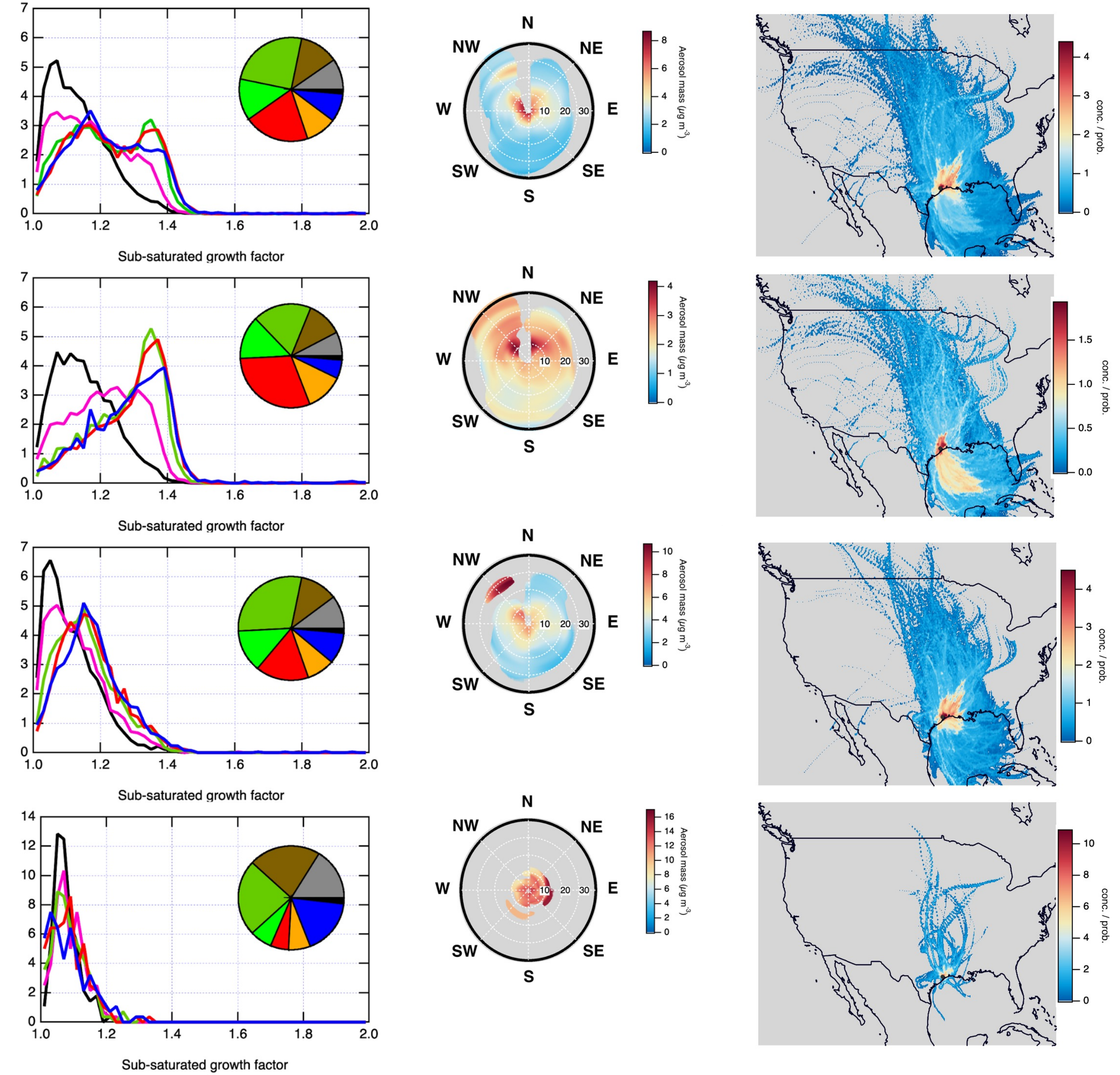


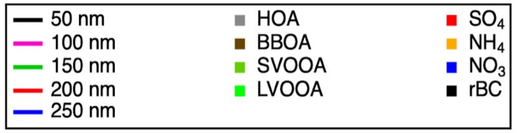
LVOOA



More oxidized

- 54% of hourly AOS observations were classified as “clean”: those were associated with marine aerosol with higher hygroscopicity
- 40% of hourly AOS observations were classified as “regional”: aged continental aerosols with lower hygroscopicity
- ~2% of hourly AOS observations fall into the ”local-polluted” category





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