

The TRacking Aerosol Convection interactions ExpeRiment (TRACER): Aerosol Related Activities



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Brookhaven National Laboratory

Joint ARM User Facility and ASR PI Meeting

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@BrookhavenLab

TRacking Aerosol Convection interactions ExpeRiment (TRACER)

<https://www.arm.gov/research/campaigns/amf2021/tracer>

- Who? DOE ARM, DOE Atmospheric System Research
- What? First ARM “Mobile” Facility
C-band Scanning ARM Precipitation Radar, Tethered Balloon System
Many Guest Instruments
- Where? Houston Metropolitan Region
- When? 01 October 2021 – 30 September 2022
01 June – 30 September 2022 (Intensive Observational Period)



DOE-supported sites during TRACER

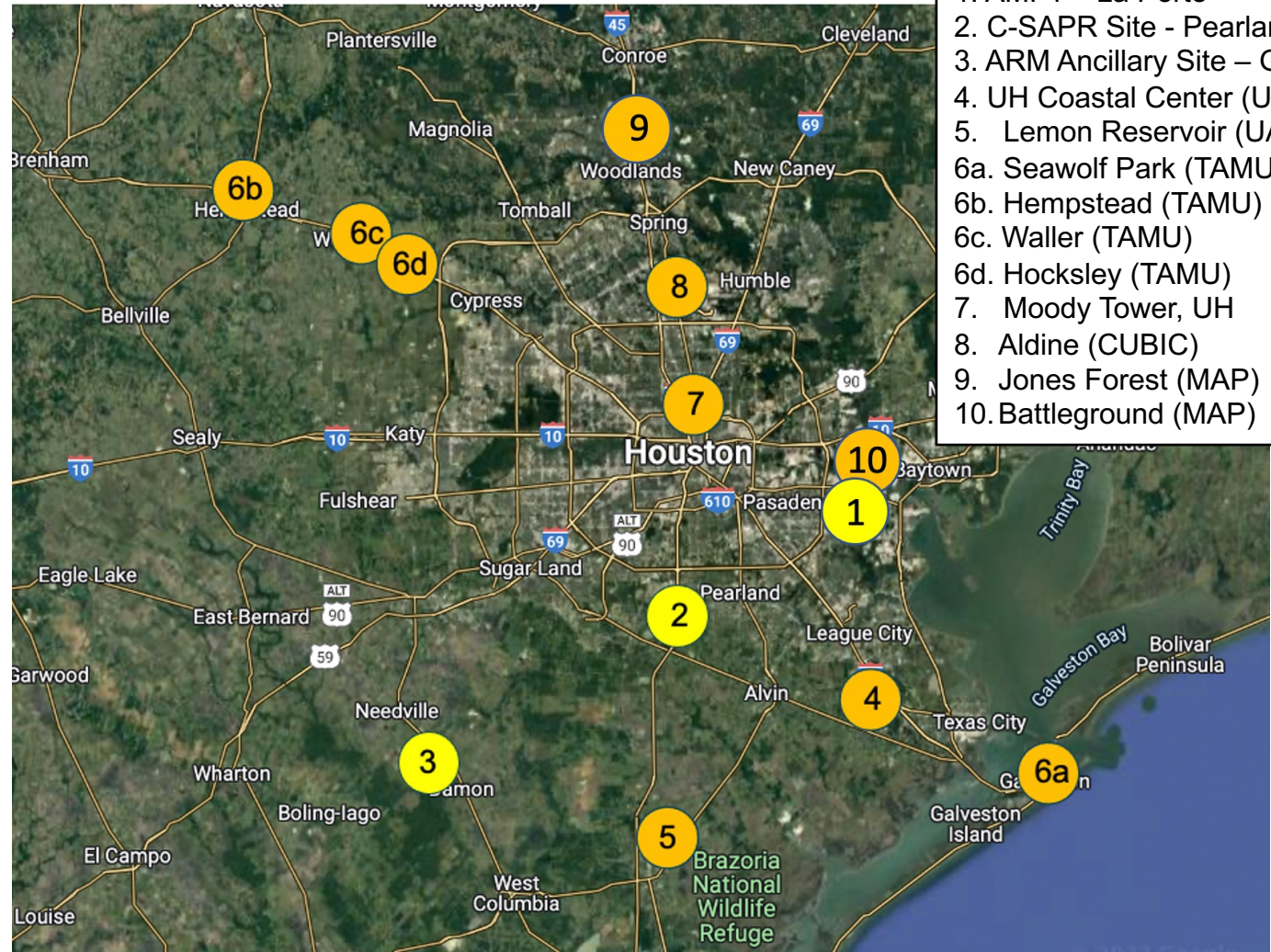
<https://www.arm.gov/research/campaigns/amf2021/tracer>

Capture variability in:

- Convective lifecycle (radar cell-tracking)
- Aerosol loading (more vs. less polluted)
- Boundary layer structure (sea-breeze, bay-breeze, urban heat island)
- Vertical profile (aerosol, thermodynamics)
- Diurnal Cycle
- Seasonal Cycle

Leverage existing measurements:

- TCEQ meteorology and AQ
- Lightning Mapping Array
- GPS (water vapor) network
- NEXRAD radar



1. AMF1 – La Porte
2. C-SAPR Site - Pearland
3. ARM Ancillary Site – Guy
4. UH Coastal Center (UAV, CUBIC)
5. Lemon Reservoir (UAV)
- 6a. Seawolf Park (TAMU)
- 6b. Hempstead (TAMU)
- 6c. Waller (TAMU)
- 6d. Hocksley (TAMU)
7. Moody Tower, UH
8. Aldine (CUBIC)
9. Jones Forest (MAP)
10. Battleground (MAP)

TRACER aerosol measurements

Aerosol Measurements at main site (La Porte, TX)

- **Aerosol Observing System at M1 site La Porte**
- Particle Flux Measurements (Petters)
- Carbonaceous Aerosol Thrust (LANL, Cappa)
- Ultrafine Aerosol Formation and Impacts (Smith)
- INP (Brooks, ARM)
- Ozonesonde (Walter)

Ancillary site measurements (Guy, TX)

- ARM – ACSM, PTRMS
- Hygroscopicity and CCN (WUSTL Wang)
- Aerosol Characterization Experiment (Kuang)
- INP (Brooks, ARM)

Tethered Balloon System

- Vertically-resolved NPF & Transport (Kuang)
- Primary Biological Aerosol (Steiner)
- Vertical Profile of Aerosol (China)
- Chemical Markers of ACI (Goldstein)
- VOCs (Usenko)
- Ozonesonde (Walter)

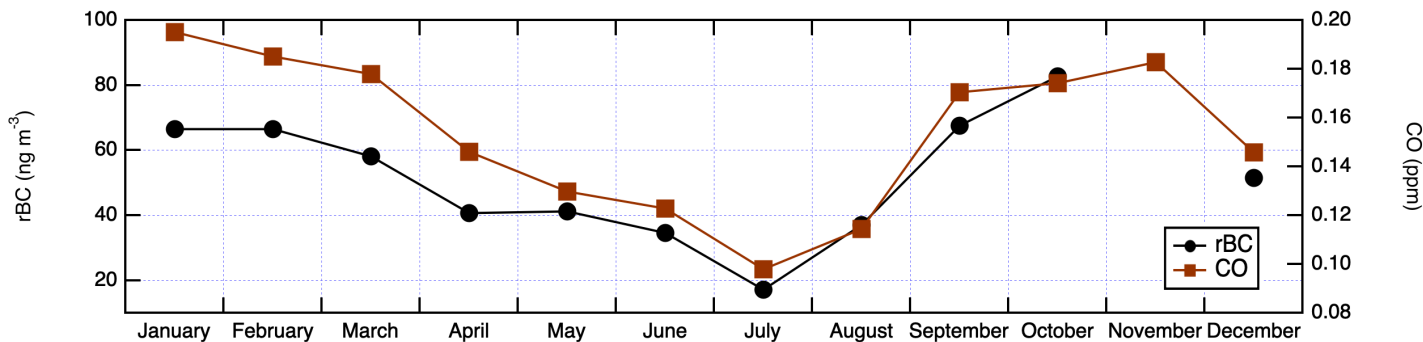
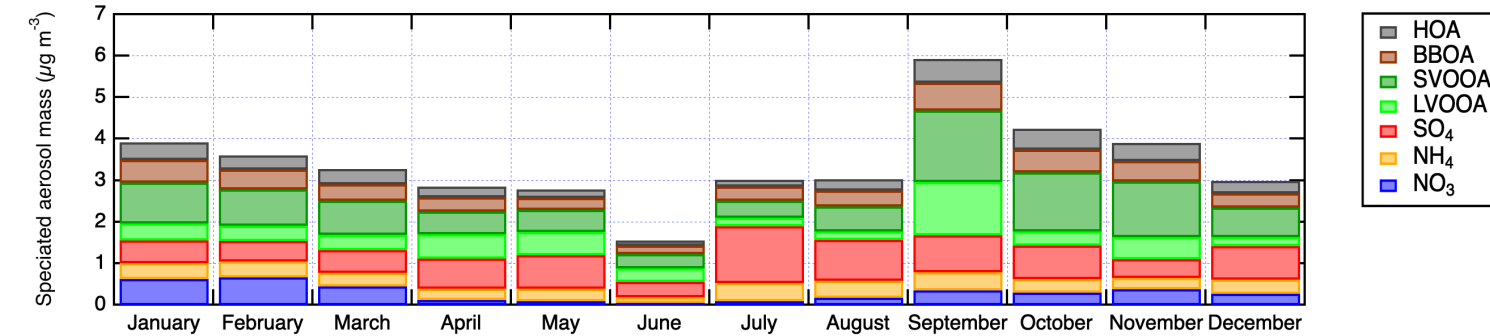
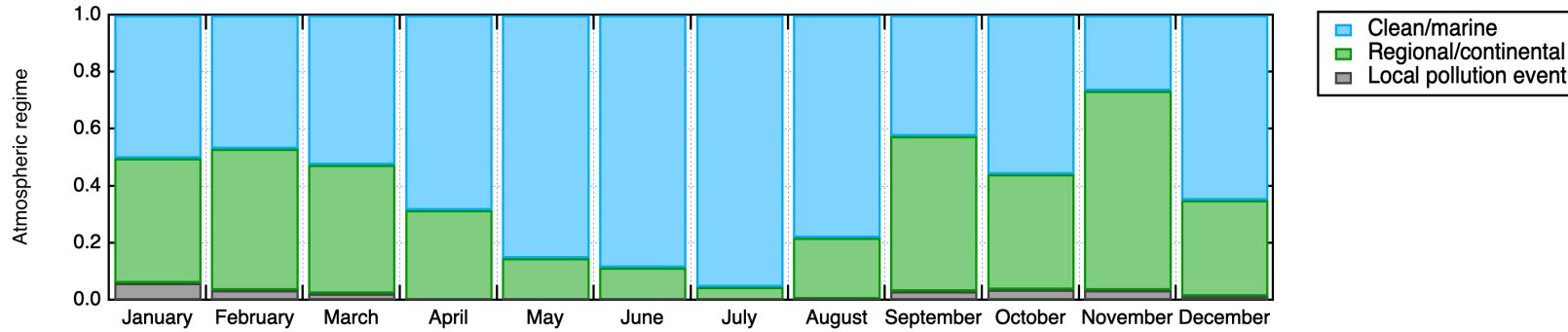
Mobile Aerosol Measurements

- Mapping Aerosol Across Houston (Sheesley)
- TRACER TAMU including INP (Rapp, Brooks)
- Uncrewed Aerial Vehicle (de Boer)

Other

- Black/Brown Carbon (Sheesley)

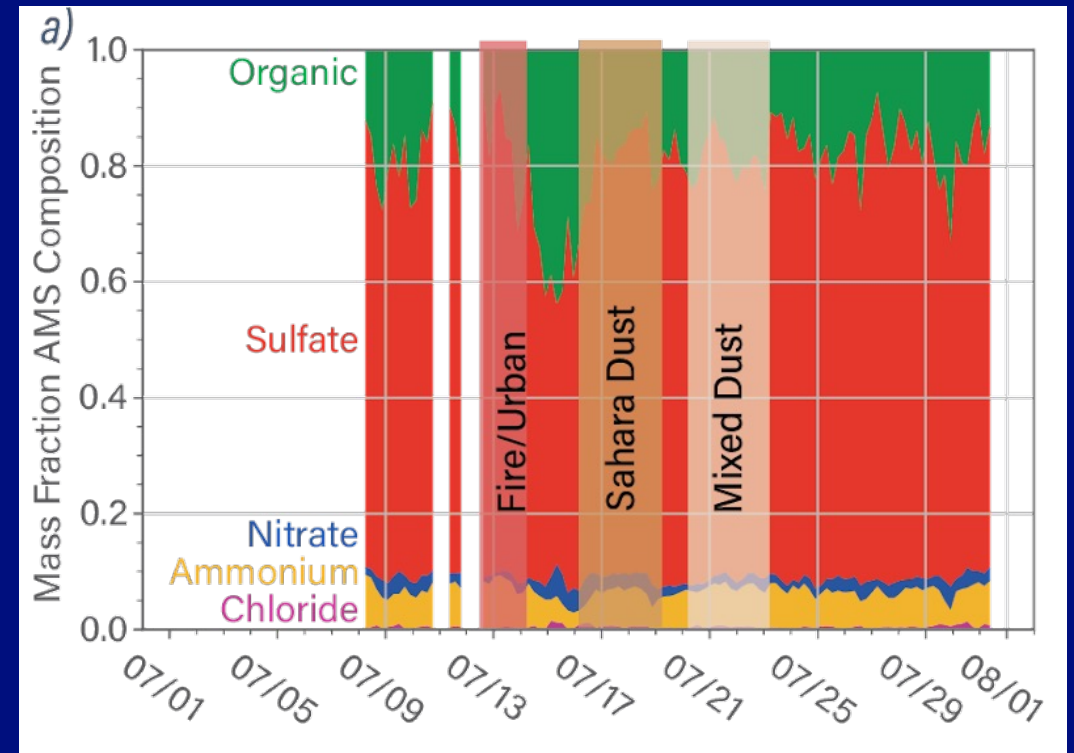
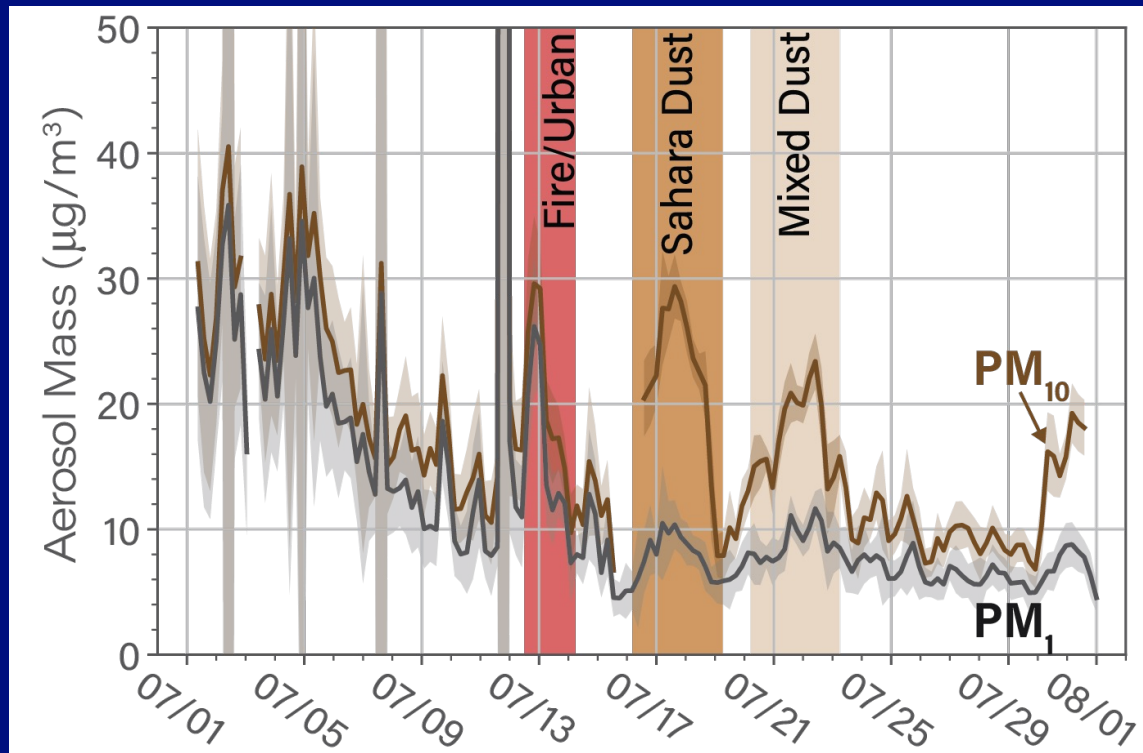
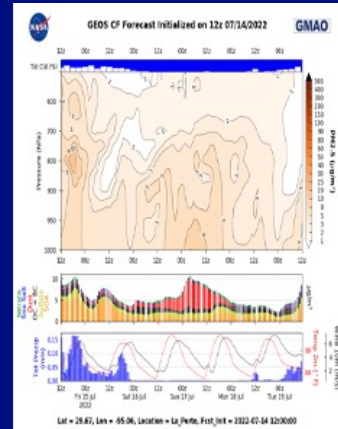
TRACER aerosol seasonal characteristics



- Summer is generally cleaner than winter, spring and autumn. Marine-influenced air masses most frequent.
- Summer marine air masses are also associated with more hygroscopic particles.
- Strong seasonal control on aerosol properties at TRACER

Particulate Sources and Chemical Composition

- **PM₁ and PM₁₀ fractions highlight supermicron events**
 - Submicron growth events dominate the first half of July
 - Urban fire plume observed ~7/13
 - Supermicron events from Saharan dust and mixed plumes



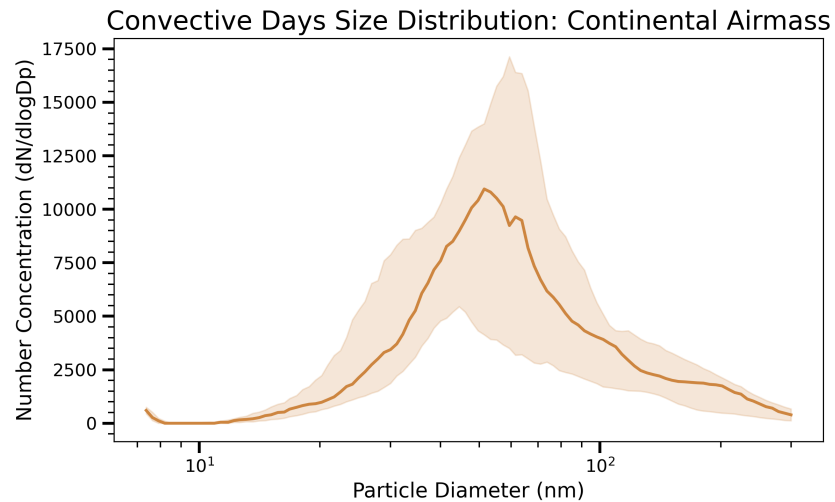
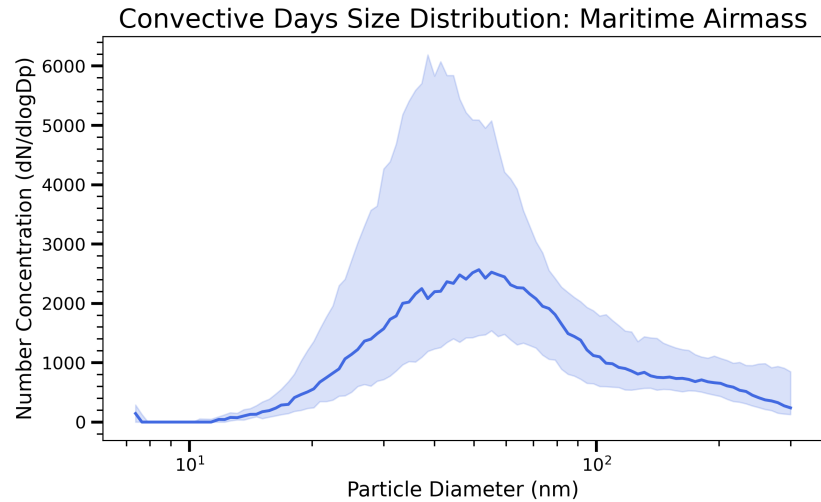
SMPS AND POPS AEROSOL NUMBER SIZE DISTRIBUTIONS

“Surprises”

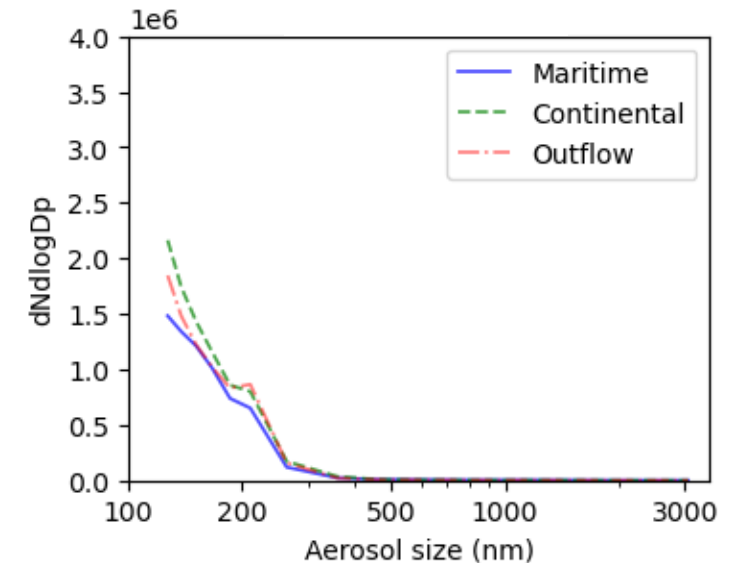
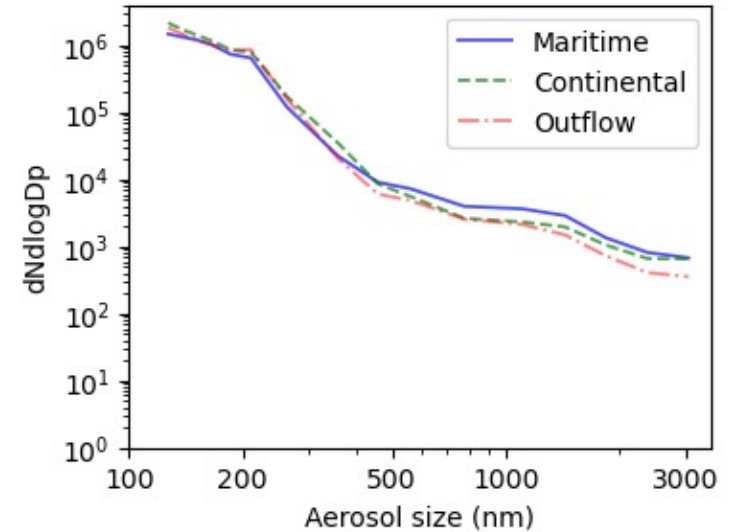
High aerosol concentrations in “clean” maritime airmass with low activation fractions

Airmass heterogeneity over small spatial scales even higher than expected

SMPS



POPS



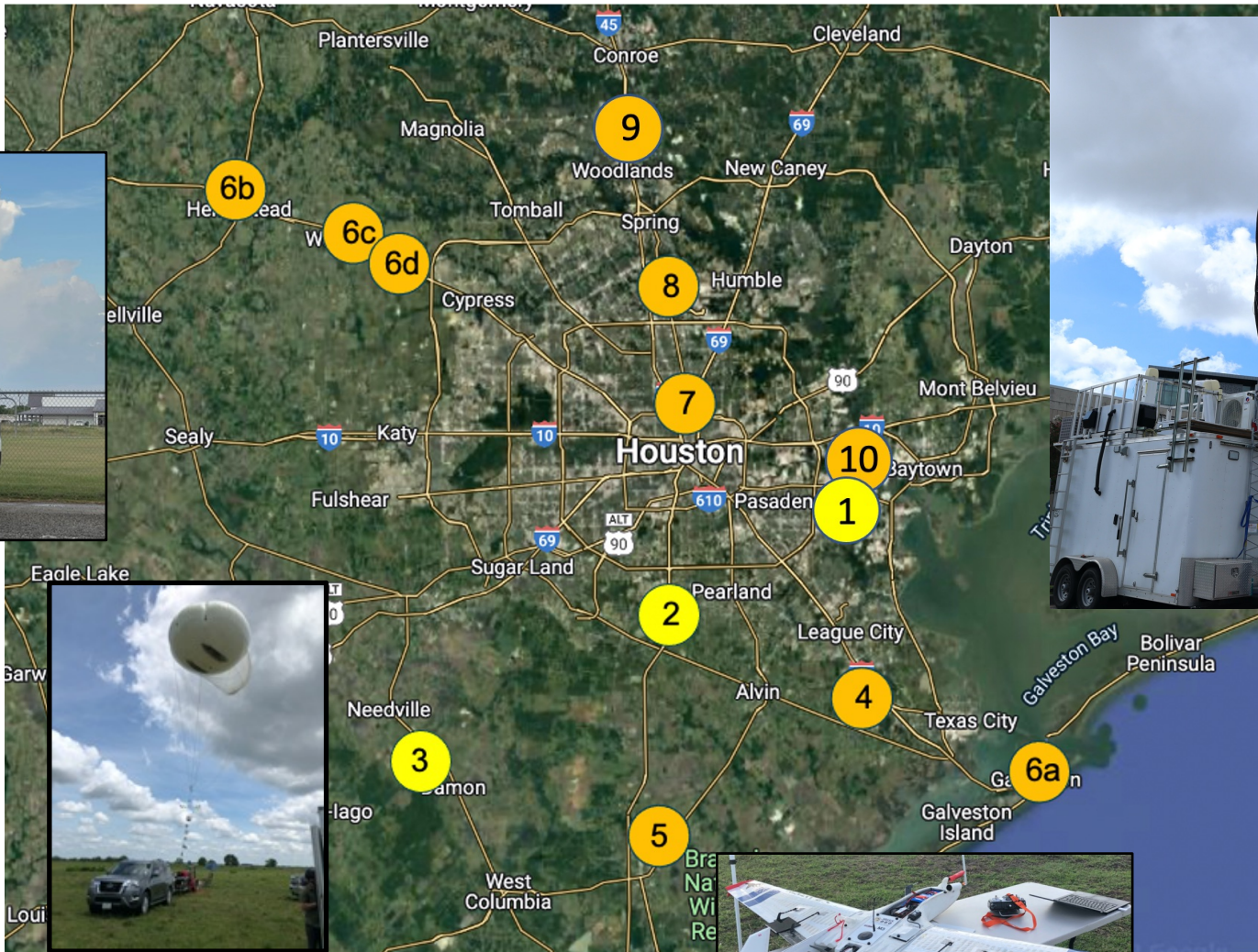
Maritime: Lower concentrations (but still high) and larger particles

Continental: Higher concentrations and smaller particles

Variability (Time/Space) Aerosol Properties

Need to understand characteristics of aerosols ingest into convection

TAMU ROAM-V



BU/UH/RU MAQL

TCEQ Network
Satellite retrievals
Reanalysis
ESCAPE Aircraft



ACPC TRACER Model Intercomparison Project

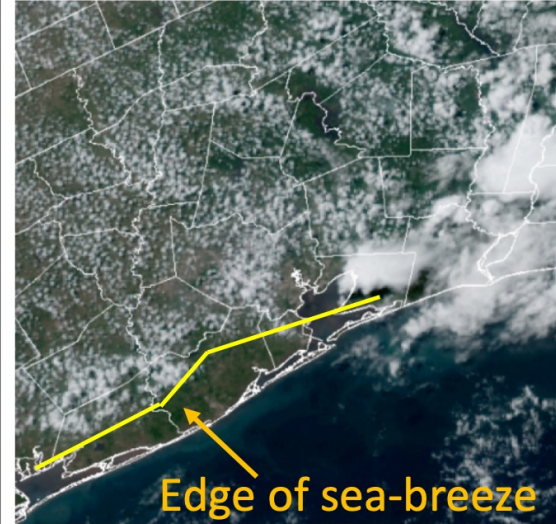
Organizers: Steve Saleeby, Jiwen Fan

Project Goals

- Identify model deficiencies and measure performances.
- Use TRACER data for case study assessment.
- **Examine processes leading to model biases and large model spread in order to help reduce uncertainty in ACI.**
- **Open to new participants.**

17 June

GOES-EAST GEOCOLOR
2022-06-17 - 15:01 LT

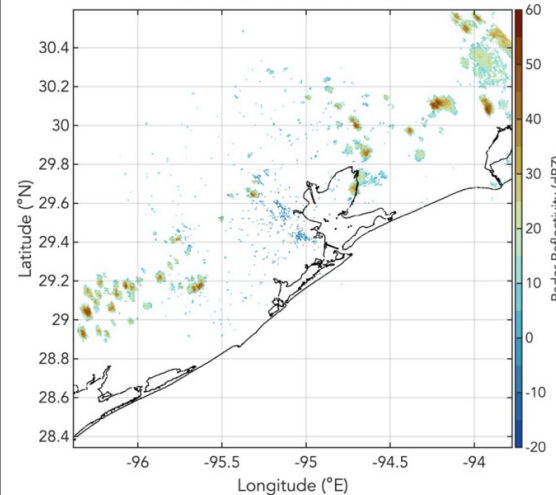


07 August

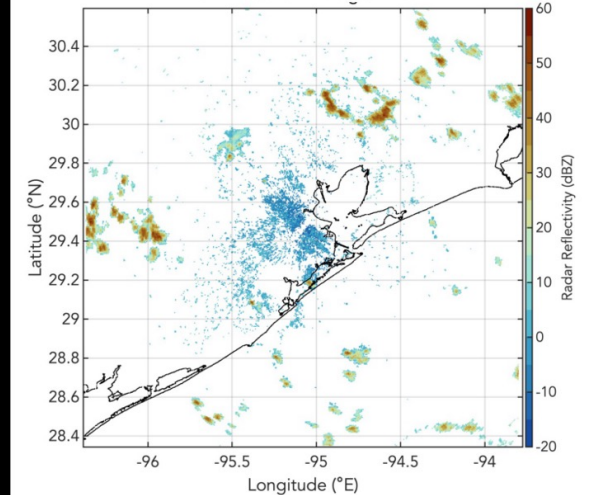
GOES-EAST GEOCOLOR
2022-08-07 - 15:01 LT



1.5km NEXRAD CAPPI
2022-06-17 - 15:03 LT



1.5km NEXRAD CAPPI
2022-08-07 - 15:04 LT



Observational Data Needs

Needs for model setup:

Aerosol (accumulation mode and ultrafine) number, size distribution, kappa or fractional solubility, as well as vertical profiles for aerosols in the urban air and marine air.

Further, need minimum and maximum aerosol number to bound the simulation experiments.

Needs for model evaluation and analysis:

Precipitation, radar reflectivity, cloud top height, vertical velocity, etc.

Meteorological conditions, sea breeze analysis, and PBL properties

Questions?

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