

LANL DOE ARM PROGRAM



**Los Alamos National Laboratory
Earth & Environmental Sciences Division**

TRACER: TRacking Aerosol Convection Interactions Experiment

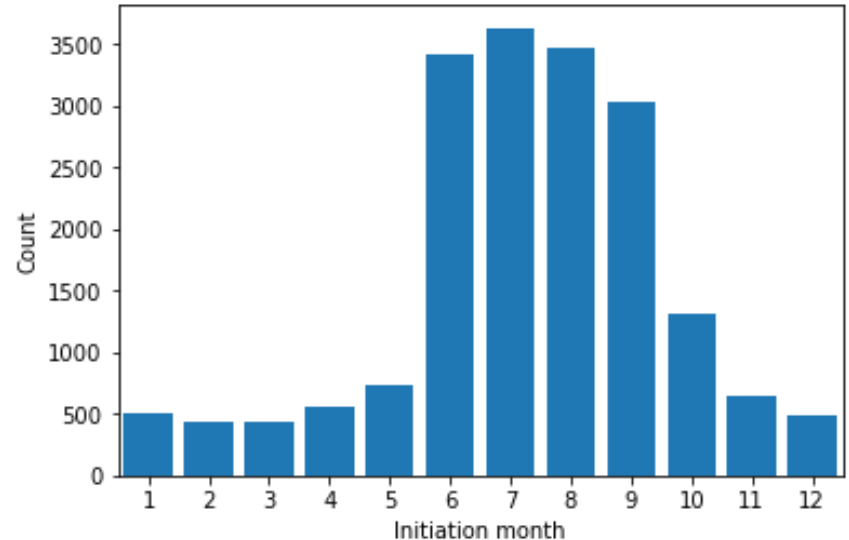
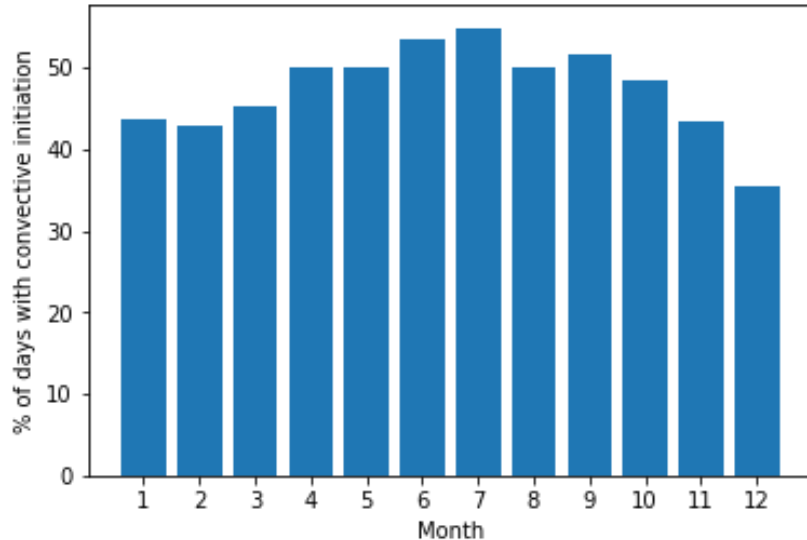
Why Houston?

Precise forecasting of convection and rain intensity is challenging.
We need more observations to improve forecast models.
Houston has lots of convection, thunderstorms and existing measurements.



Why Houston? Convective Clouds are Abundant

- 4 years of Houston/Galveston NEXRAD (KGHX) observations

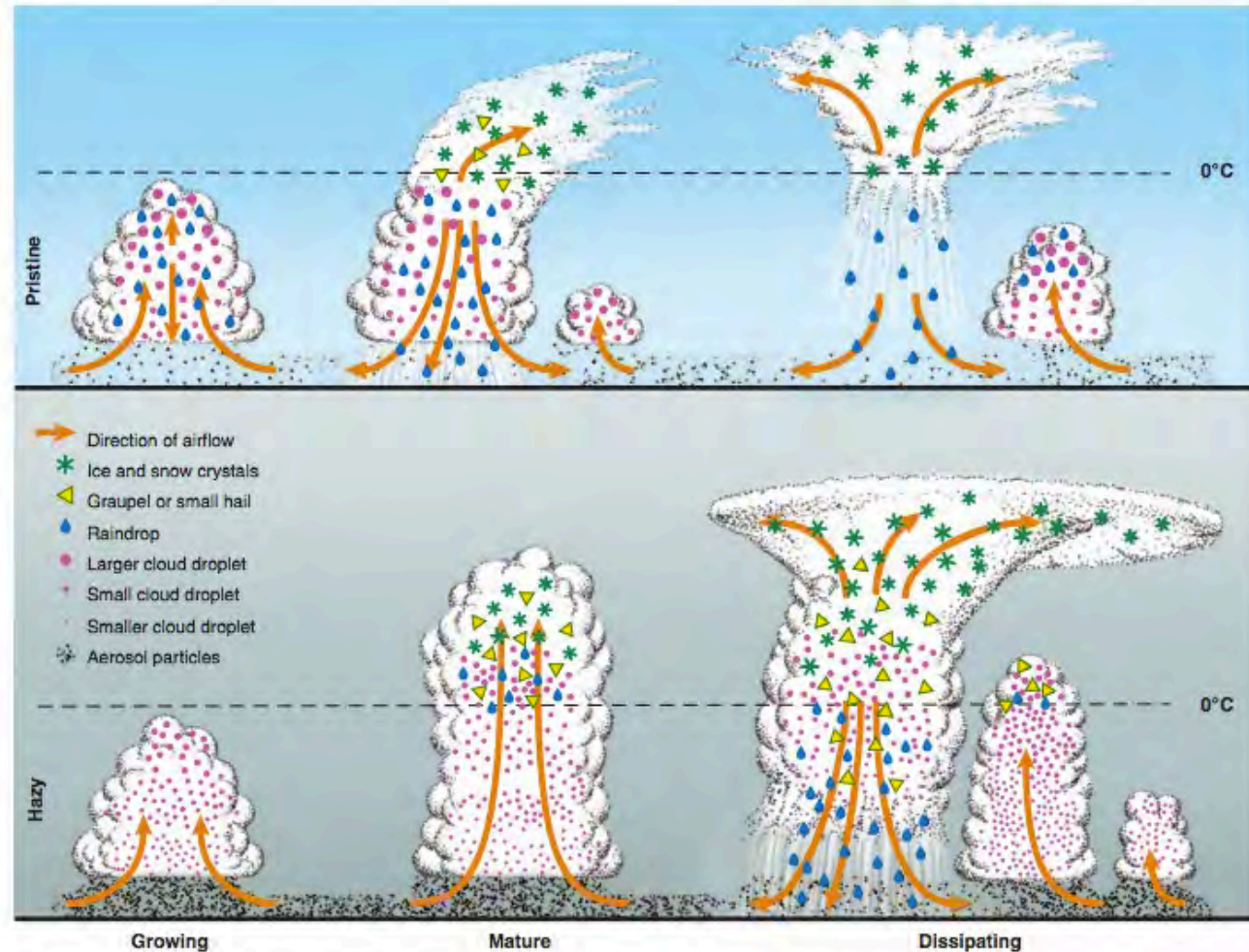


- Year-round about 40-50% of the days have some kind of convective cloud
- Project scheduled to collect measurements October 2021 – September 2022
- June-September have the most number of convective clouds, so the intensive studies will focus on these months.

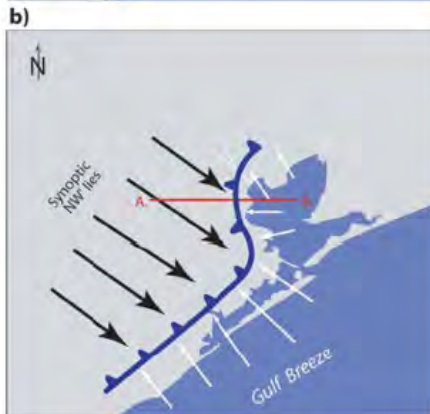
Aerosol Invigoration of Convective Clouds

Rosenfeld et al. 2008 Science

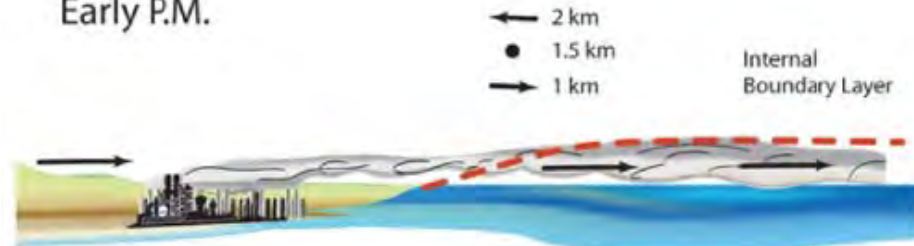
- Clean conditions
 - Some particles for water to condense on
 - Water turns to ice at the freezing level and rain begins to fall earlier
- Polluted conditions
 - Many more particles for water to condense and make more small droplets
 - Water stays liquid above freezing level causing larger storms
 - Delayed but heavier rain



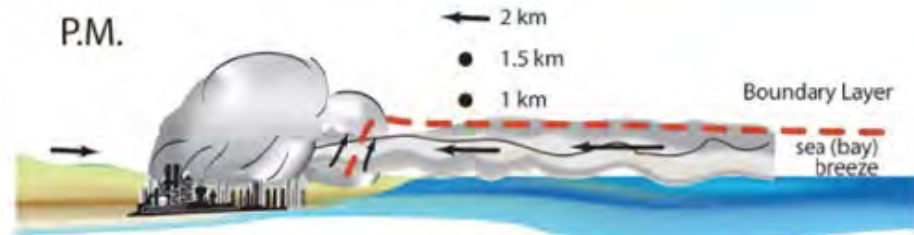
Why Houston? Gulf, Bay, and pollution interactions



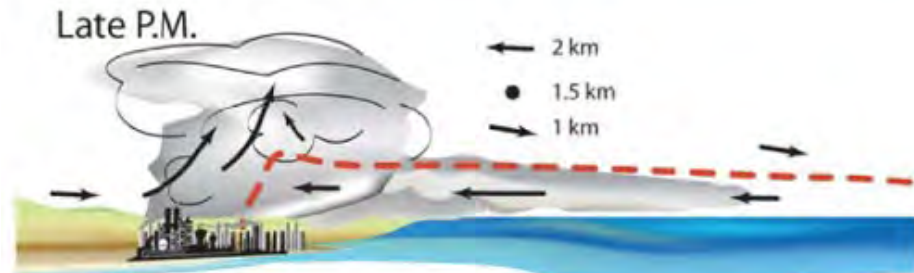
Early P.M.



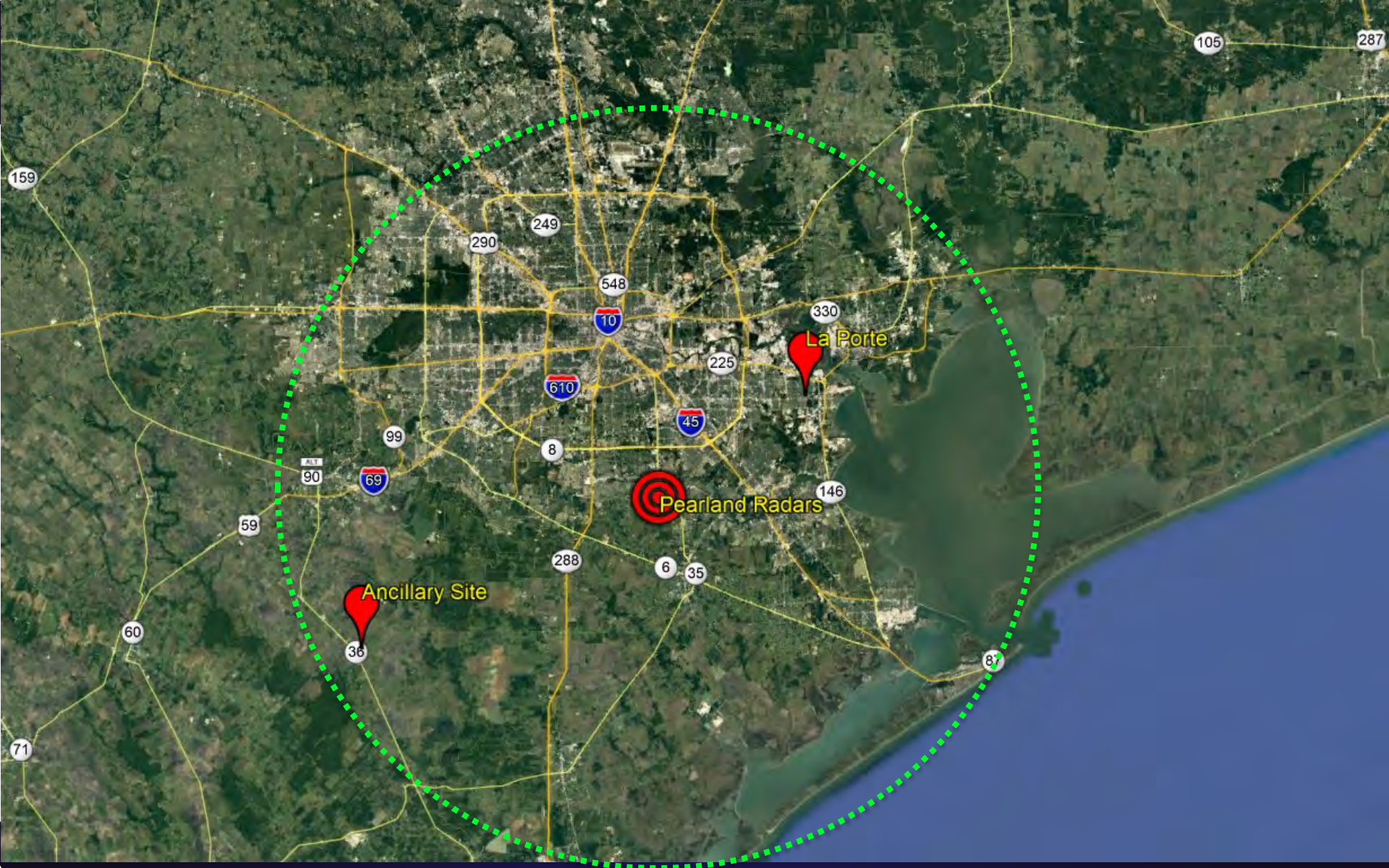
P.M.



Late P.M.



Banta, R. M., Senff, C. J., Nielsen-Gammon, J., Darby, L. S., Ryerson, T. B., Alvarez, R. J., Sandberg, S. P., Williams, E. J. and Trainer, M.: A bad air day in Houston, *Bulletin of the American Meteorological Society*, 86(5), 657–669, 2005.



Pearland Radars



Ancillary Site



La Porte

La Porte Airport Supersite



- The site will be accessed off of North D St
- Los Alamos controls access through application process
- Still planning minimal staff due to COVID restrictions
- We have worked through the City of La Porte's FAA contacts to coordinate the project
- Coordinating balloon launches with FAA and local flight schools
- Closest point is about 640' off the 23/05 centerline and 420' off the taxiway edge
- Power along Airport Blvd. has been upgraded to 3-phase to the last existing pole.
- AT&T fiber has been run up Airport Blvd. and will be connected out to the pad this week (hopefully)

ARM MOBILE FACILITIES

ARM Mobile Facilities (AMF): These facilities are mobile observatories with state-of-the-art instruments and equipment for collecting data about the earth's atmosphere. They are moved to a new location about every year.



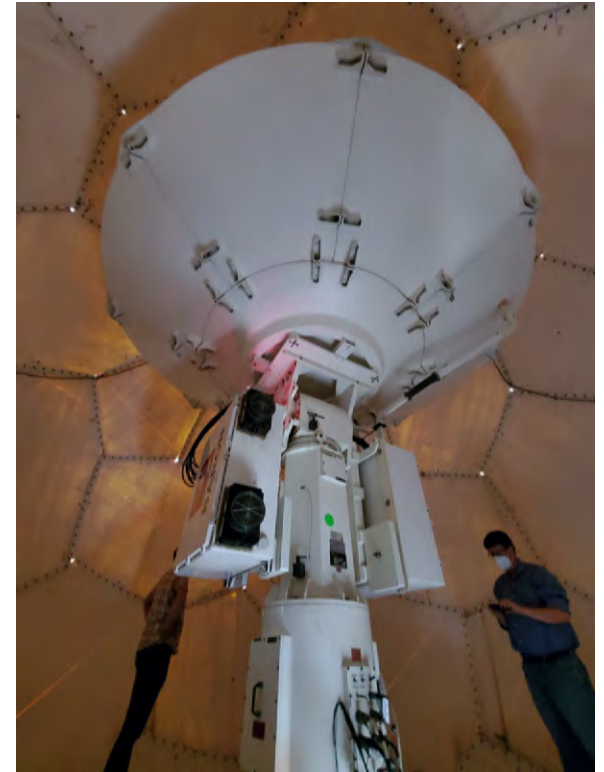
Pearland Radar site



Pearland Radar site

2nd generation C-band Scanning ARM Precipitation Radar (CSAPR2)

- Provides observations of convective clouds
- Implement focused-scanning cell tracking during IOP period



Estimated Schedule

- **September 2021:** Begin operations
 - 3 site technicians
 - weather balloon training
- **October 1, 2021:** **Official measurements began**
 - 3 site technicians + 12 balloon launch personnel
- **June – September 2022:** Intensive Operations Period (IOP)
 - Convective thunderstorm season – lots of measurements
 - Probably extra people
 - Extra balloon launches (up to 12 per day)
 - Other research aircraft, boats, mobile labs
- **September 30, 2022:** **End of measurements.** Begin pack up
- **December 2022:** Site being remediated back to normal!

Data availability

The screenshot shows the ARM TRACER website interface. At the top left is the ARM logo. The main header is "TRACER - ARM Field Campaigns". On the right, there is a "Login" button with a user icon. Below the header is a navigation bar with the following items: Dashboard, Campaign Overview, Reports, **Plots** (highlighted with a red circle), Maps & Locations, Maintenance Reports, Tools & Links, and Contacts. The current time is displayed as "Current time: 2022-01-04 23:21:24 UTC".

The main content area features a "7 day forecast for Houston, TX" with the following details:

Day	Forecast	Temperature
This Afternoon 1/4	Sunny	64°F
Wednesday 1/5	Partly Cloudy	72°F
Thursday 1/6	Sunny	68°F
Friday 1/7	Sunny	59°F
Saturday 1/8	Thunderstorm	50%-60% 73°F
Sunday 1/9	Cloudy	40%-90% 76°F
Monday 1/10	Cloudy	59°F

Below the forecast is a text box with the following text:

During the Tracking Aerosol Convection Interactions Experiment (TRACER), scientists will use the first ARM Mobile Facility (AMF1), the second generation C-band ARM Scanning Precipitation Radar (CSAPR2), and a small satellite site with radiosonde and aerosol measurements to learn more about cloud and aerosol interactions in the deep convection over the Houston area.

The Houston region offers a unique environment where isolated convective systems are common and experience a spectrum of polluted aerosol conditions from urban and industrial areas. In addition, surrounding areas also show significantly lower background aerosol concentrations.

A climatological analysis of radar observations from the Houston/Galveston area NXRAD (KHGX) show that convective initiation occurs in this area on 40 to 55 percent of the days each month of the year. The total number of convective events is strongly peaked during the months of June through September. An intensive operational period will be held June 1, 2021, to September 30, 2021, to capture these events.

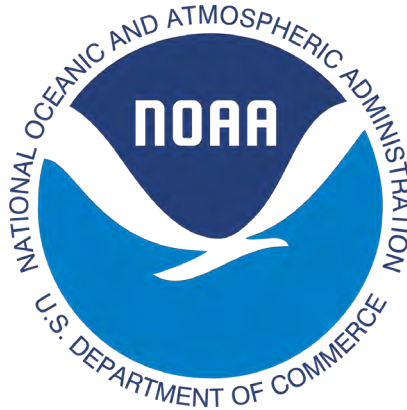
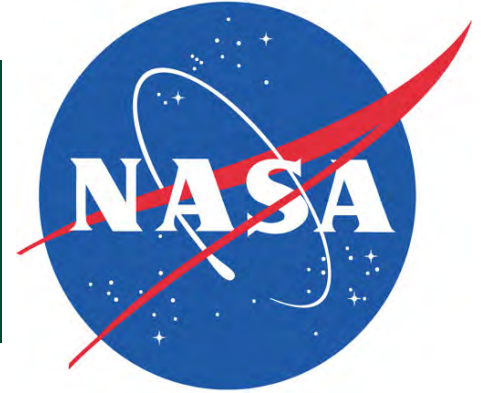
For more information about TRACER, please visit [AMF2021TRACER](#)

On the right side of the text box, there are two buttons: "Submit Daily Report" and "View Reports".

At the bottom of the page is the ARM logo.

- <https://adc.arm.gov/afcd/#/tracer/overview>

Largescale Collaborative Research Campaign



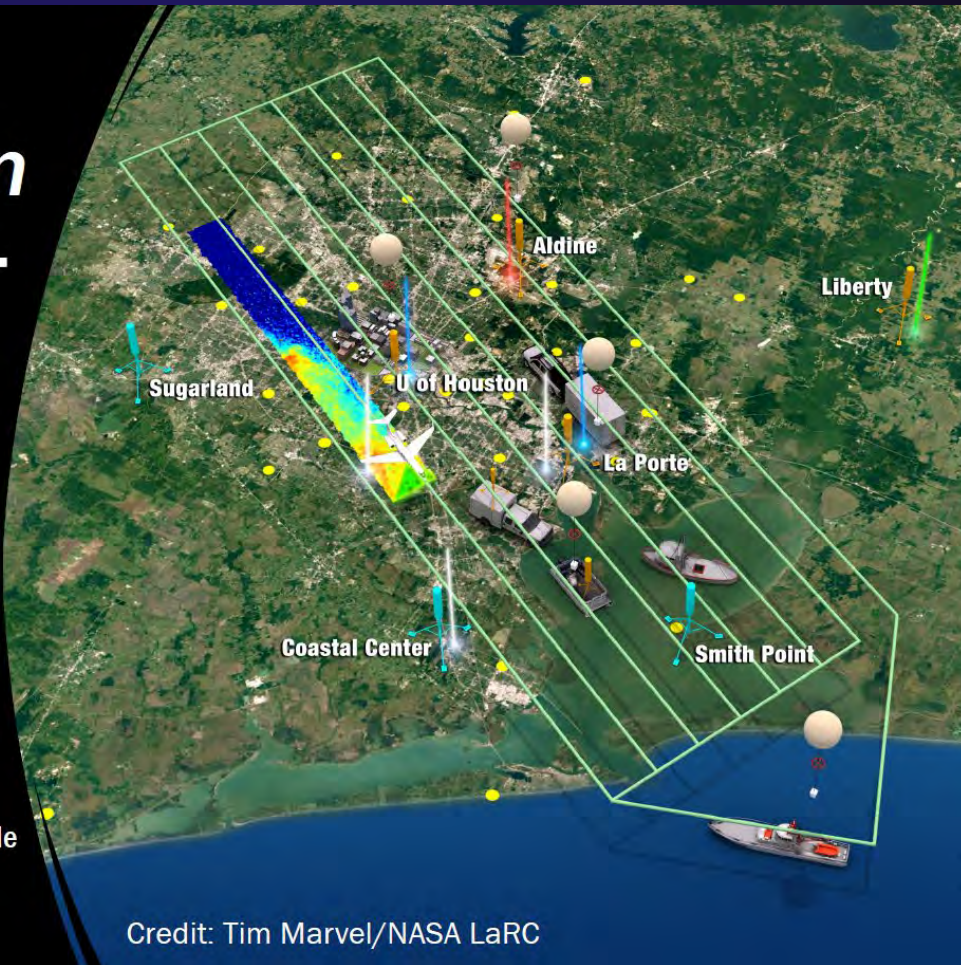
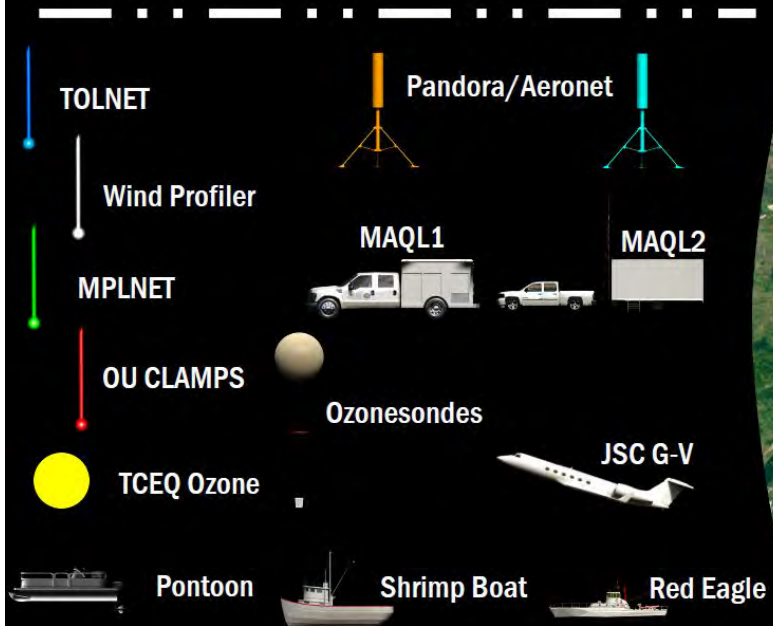
Numerous supplemental projects (I'll focus on a UH collaboration...)

- **TRACER-MAP (Baylor, UH, Rice, UC-Riverside)**
- Aerosol and trace gas variability and processing pre- and post-storms **July – August 2022**. (supported by National Science Foundation)
- Stationary measurements in a variety of locations within radar coverage area.
- Aerosols – size, composition, optical properties, ability to form clouds
- Gas phase – VOCs, O₃, NO, NO_x, NO_y, CO, CO₂, SO₂
- Met & Position – mixing height, winds, T/P/RH, sunlight, GPS
- Generator only used when shore power is unavailable.
- **TRACER-AQ support** (less aerosol size, composition, clouds formation ability) **September 2021/22** (supported by NASA/TCEQ)

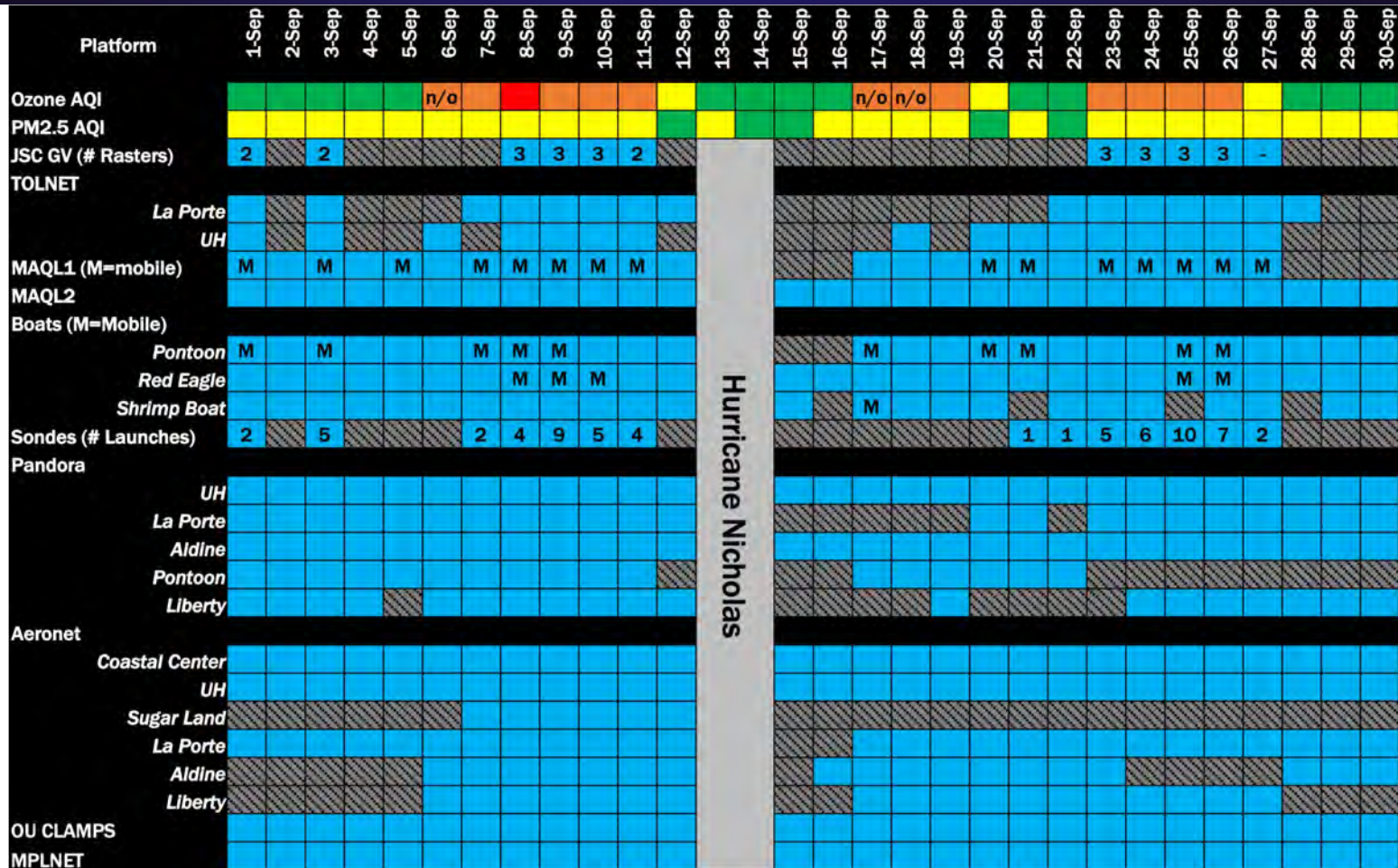


TRACER-AQ (September 2021)

TRACER-AQ Observing System



TRACER-AQ Observations



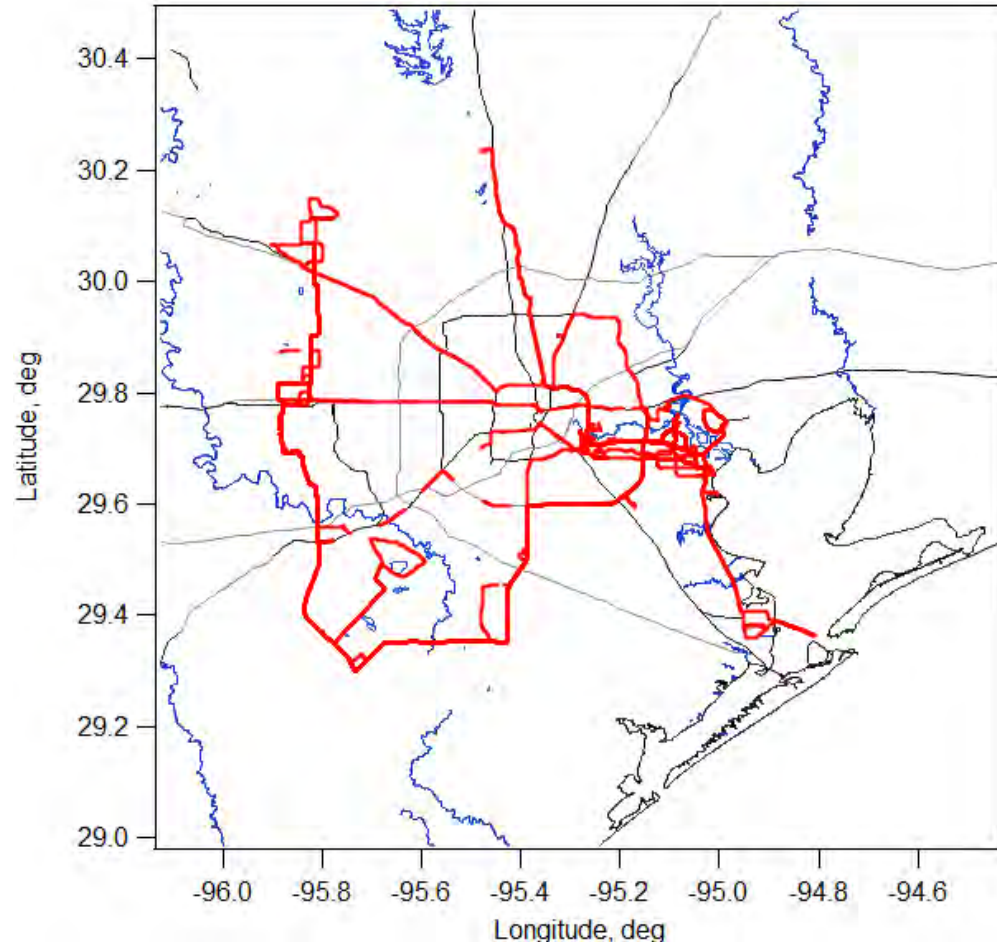
TRACER-AQ Support (UH, Baylor)

- Examining the impact of local circulation on urban photochemistry and spatial variability of ozone and precursors between stationary sites using the UH Mobile Air Quality Laboratory (MAQL).
- **August – September 2021**
- Measurements:
 - **O₃**, NO, **NO₂**, NO_Y, CO, **SO₂**, **HCHO**, VOCs
 - Met & Position: T/RH/P, winds, sunlight, GPS, all sky camera, HD cameras (front, rear, left, right)
 - Measurements in **bold** are observable by NASA's airborne satellite simulator

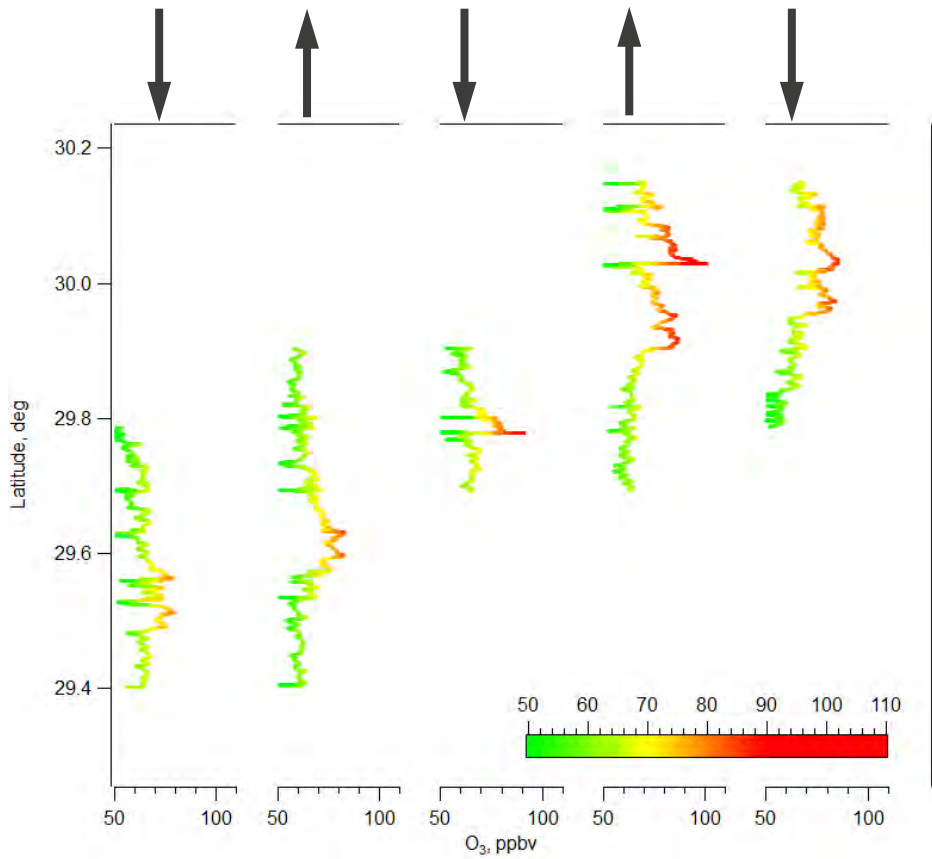


TRACER-AQ Support (UH, Baylor)

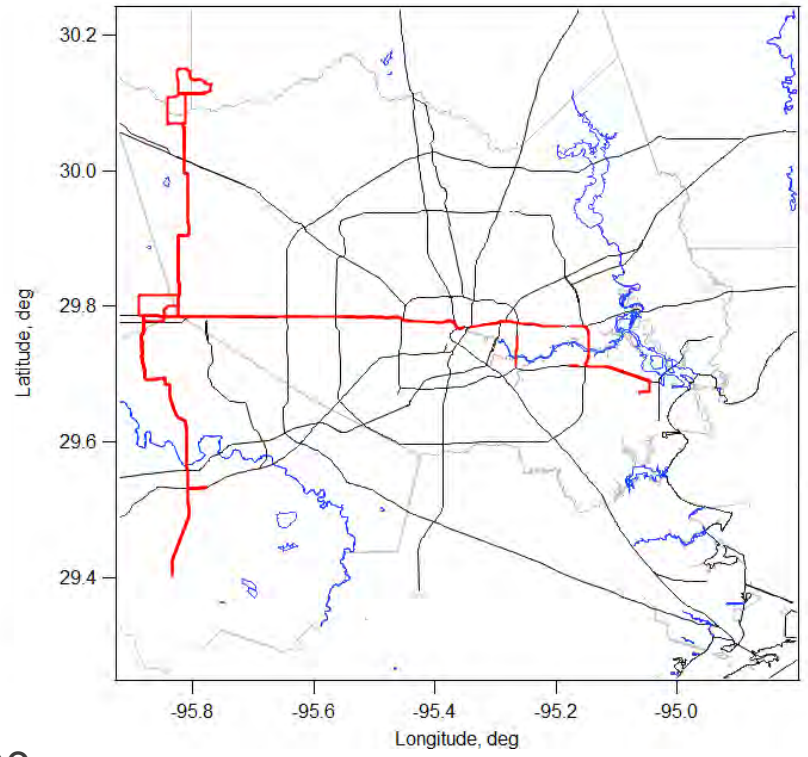
- Mobile lab measurements focused on
 - Industrial areas
 - Downwind of urban area
 - Neighborhood scale measurements
 - Intercomparisons with other measurement platforms



September 11, 2021 (UH & Baylor)

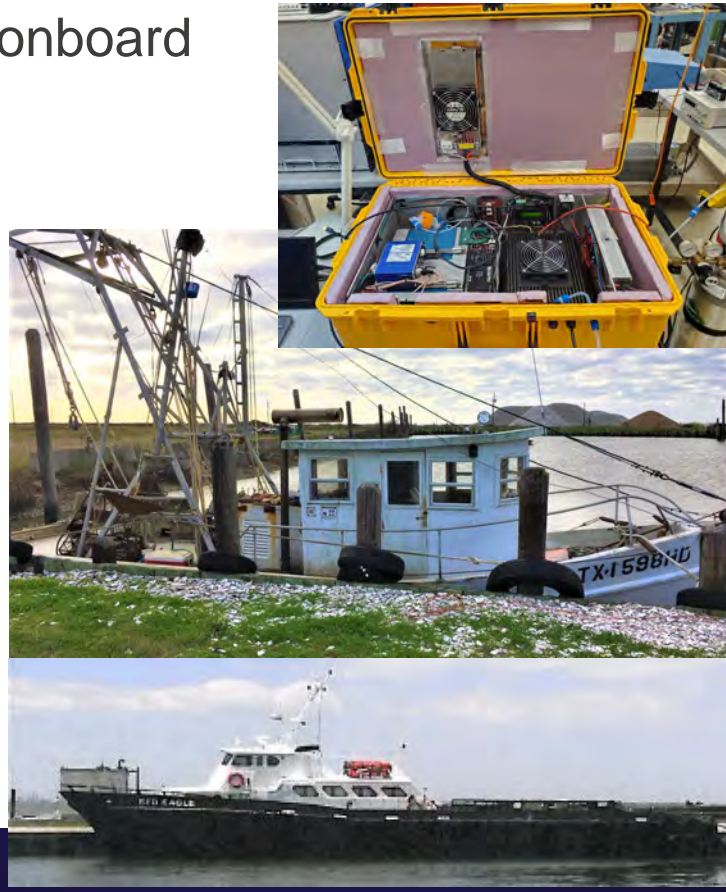


10:35-11:25 12:55-14:25 16:35-17:30
11:25-12:45 14:25-16:35

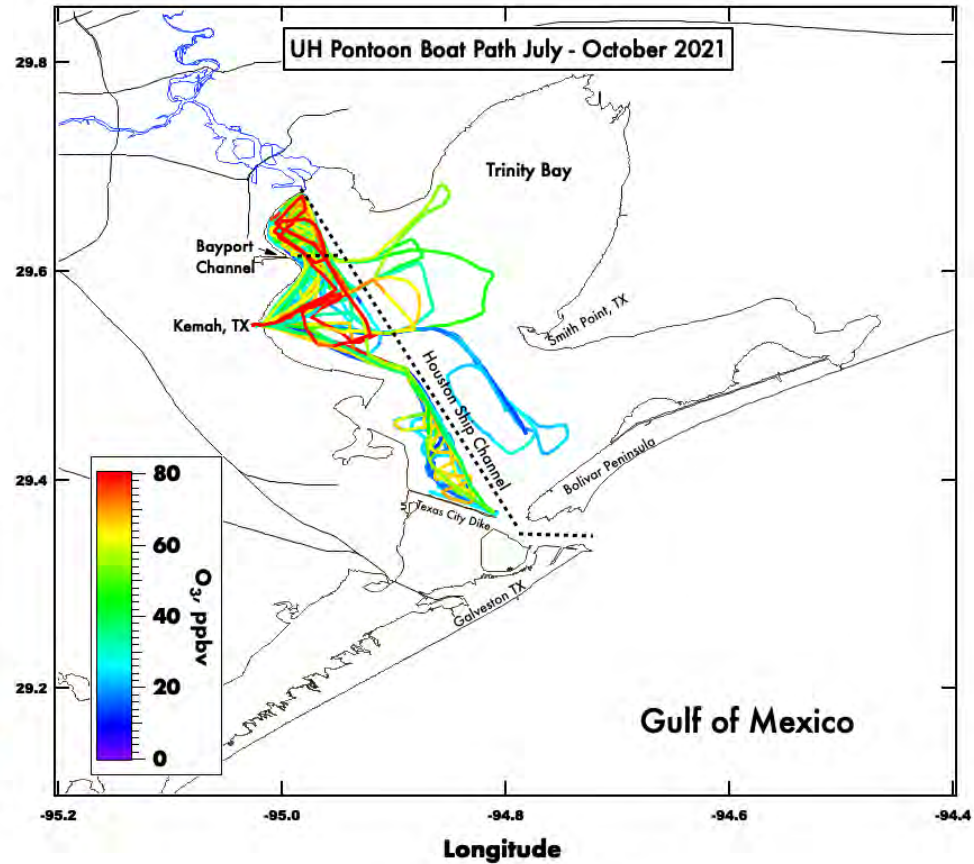
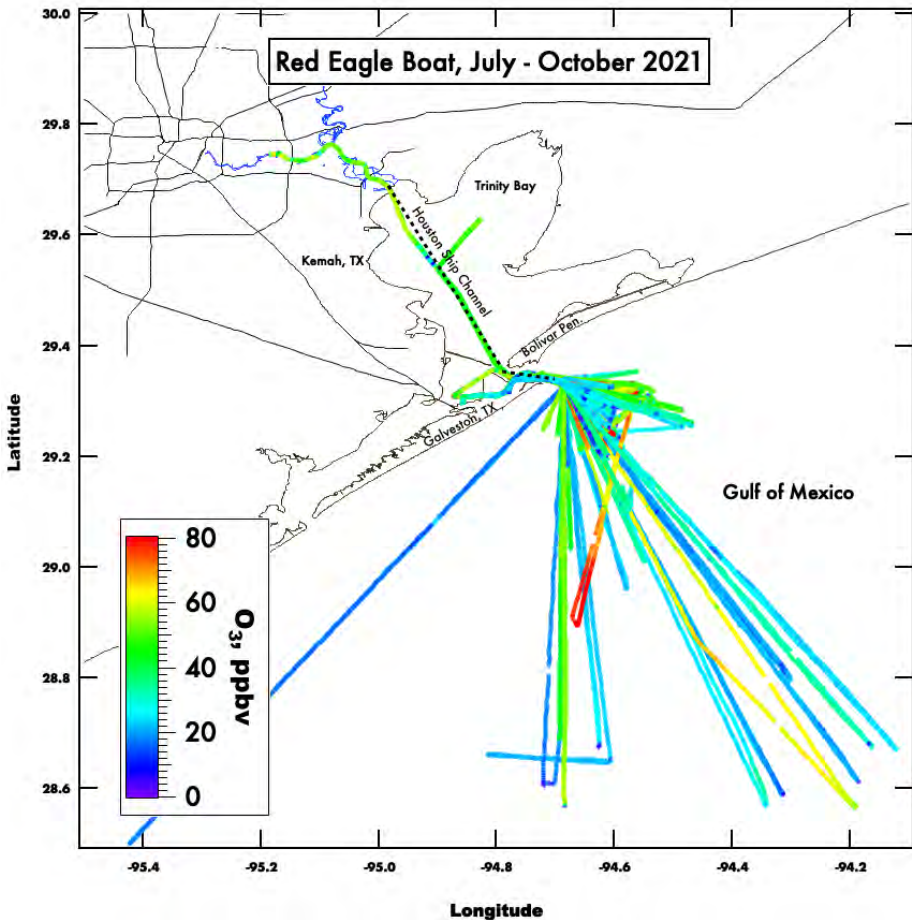


Galveston Offshore Ozone Observations – GO₃ (UH, St. Edward's University)

- Automated offshore measurements of O₃, NO₂, T/P/RH, winds on two commercial boats in Galveston Bay & coastal Gulf of Mexico
- Dedicated measurements onboard the UH pontoon boat
- Pontoon boat (+ charters) launched ozonesondes
- Pontoon and shrimp boat also measured mixing layer heights
- NASA Pandora was installed on pontoon in August 2021.



Galveston Offshore Ozone Observations – GO_3 (UH, St. Edward's University)



Future work for TRACER-AQ

- Initial data processing nearly complete for mobile labs and boats.
- Current funding will be working on a Rapid Science Synthesis document
- Working with TCEQ on funding to conduct a more in-depth scientific analysis and modeling of 2021 measurement
- A second year of measurements in 2022 is also being planned, however the NASA involvement is likely going to be limited to the small automated sensor networks
- Hopefully additional future funding to analyze and model 2022 measurements and compare to 2021 results

Questions?

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Disclaimer:

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