AQRP Monthly Technical Report

PROJECT TITLE	Galveston Offshore Ozone Observations (GO3)	**PROJECT #**	20-004
PROJECT PARTICIPANTS	James Flynn (UH) Yuxuan Wang (UH) Paul Walter (St. Edward's University) Gary Morris (St. Edward's University)	**DATE SUBMITTED**	8/10/2021
REPORTING PERIOD	**From:** July 1, 2021 **To:** July 31, 2021	**REPORT #**	13

A Financial Status Report (FSR) and Invoice will be submitted separately from each of the Project Participants reflecting charges for this Reporting Period. I understand that the FSR and Invoice are due to the AQRP by the 14th of the month following the reporting period shown above.

Detailed Accomplishments by Task for reporting period

- Installed the two small sampling systems on the commercial boats (shrimp boat July 6, Red Eagle July 16)
- Launched 10 ozonesondes from Galveston Bay.
- Conducted 8 sampling missions with the UH pontoon boat, 5 of which were forecast as ozone action days.
- Finished WRF-GC simulation of the whole month of June 2021 over Houston-Galveston region.

Data Collected

There were eight sampling missions with the UH pontoon boat in July, five of which were forecast by TCEQ to be ozone action days. While at the marina in Kemah though, the system is continuously powered and operating. Outside of a few data and power issues (worn dock side power outlets) the data has been nearly continuous. Similarly, once initial issues (described below) were sorted out with the two commercial boats they too have been running nearly continuously. The Red Eagle (Gulf of Mexico) made 16 trips into the Gulf between July 16 and 31. The shrimp boat had less activity due to the significant rain which caused freshwater runoff into the bay, reducing the salinity and driving the shrimp population largely out of Galveston Bay. As a result, only 6 trips were conducted between July 6th and the end of the month.

Twice daily ozonesondes were launched from the pontoon boat in Galveston Bay on 13 July, 18 July, 21 July, and 26 July. On 22 July and 27 July, an ozonesonde was launched in the morning but not in the afternoon. The morning ozonesondes were launched between 9:15–10 am CDT (14:15–15:00Z or UTC), and the afternoon ozonesondes were launched

between 2–3 pm CDT (19:00–20:00Z or UTC). The vertical profiles of ozone, relative humidity, and potential temperature shown in **Figure 1**.

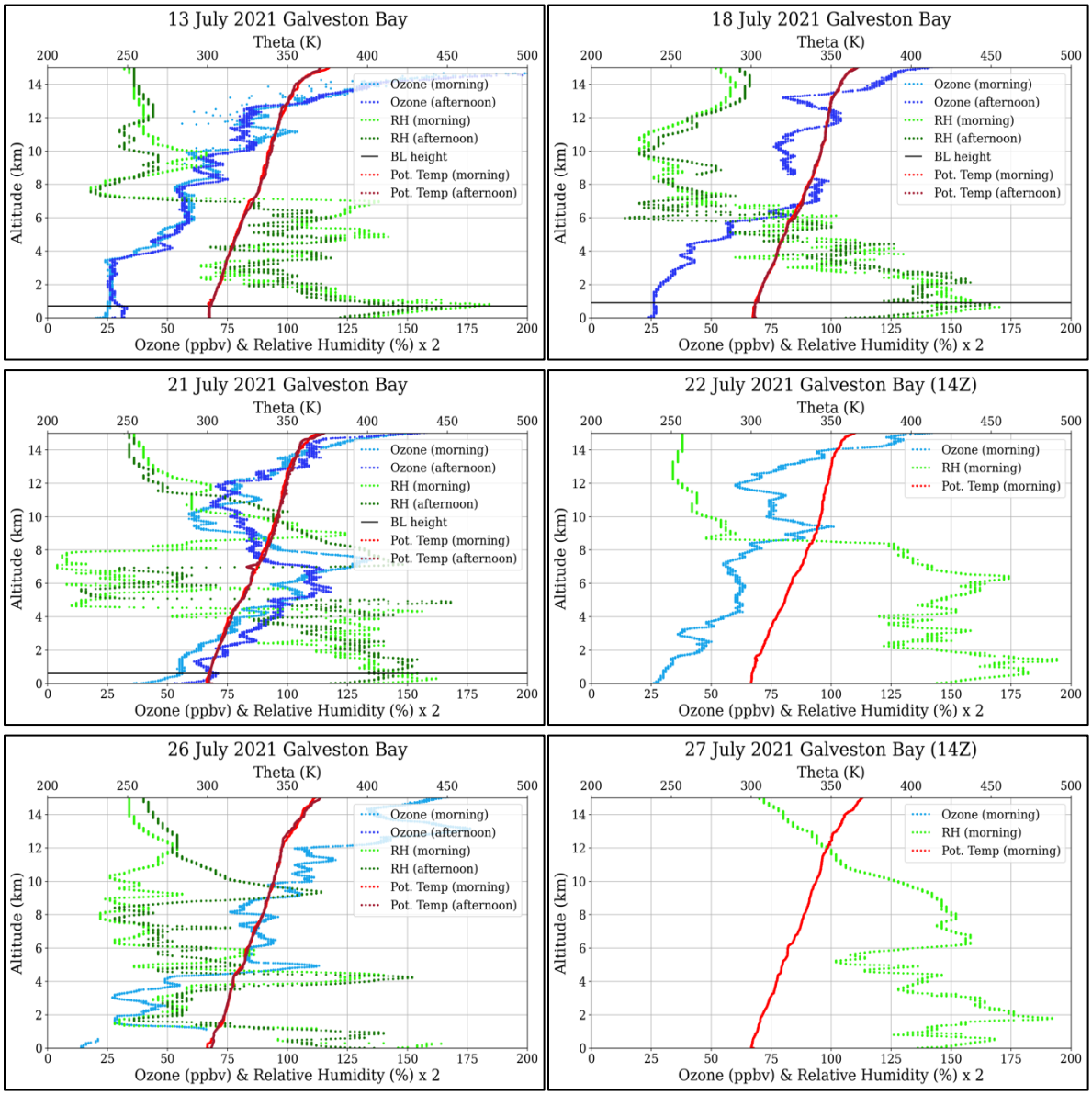

Figure 1: Tropospheric profiles (ascents only) of ozone (morning: light blue; afternoon: dark blue), relative humidity (morning: light green; afternoon: dark green), and potential temperature (morning: red; afternoon: dark red) from ozonesondes during July 2021 launched from the pontoon boat in Galveston Bay. The boundary layer heights of afternoon soundings are shown by the horizontal black line.

Preliminary Analysis

The morning sounding on 26 July shown in **Figure 1** had missing data during the ascent from ~560 m–1140 m. The profile does show a sizable ozone enhancement just above the surface. The maximum daily 8-hour average (MDA8) [O_3] was 97 ppbv at C35 Houston Deer Park #2.

Figure 2 shows the wind run for the C35 Deer Park #2 on 26 July. The wind run starts from the 00 CST hour, located at (0, 0) on the graph, and concludes on the 23 CST hour. The figures show wind vectors for each hour with distances in km. The color of the hourly wind vectors is based on the hourly ozone concentration, ranging from 0 ppbv (dark purple during the 5 am CST hour) to 130 ppbv (dark red during the 3 pm CST hour). The large black arrow represents the vector sum and its length is the transport distance L. The total distance of all of the hourly wind vectors (i.e., the sum of the magnitudes of the wind vectors) we denote S. The parameter related to the amount of potential recirculation is given by the ratio of 1 - L/S, which ranges from 0 (no recirculation) to 1 (much recirculation) (Levy, Dayan, and Mahrer 2008). Wind runs from different locations can show how much the wind pattern for a given day varies through the urban area. Quite often, ozone exceedance days exhibit distinctive wind run patterns (e.g., Li et al., 2020). Figure 2 shows a land breeze in the late morning changing to a bay breeze in the afternoon.

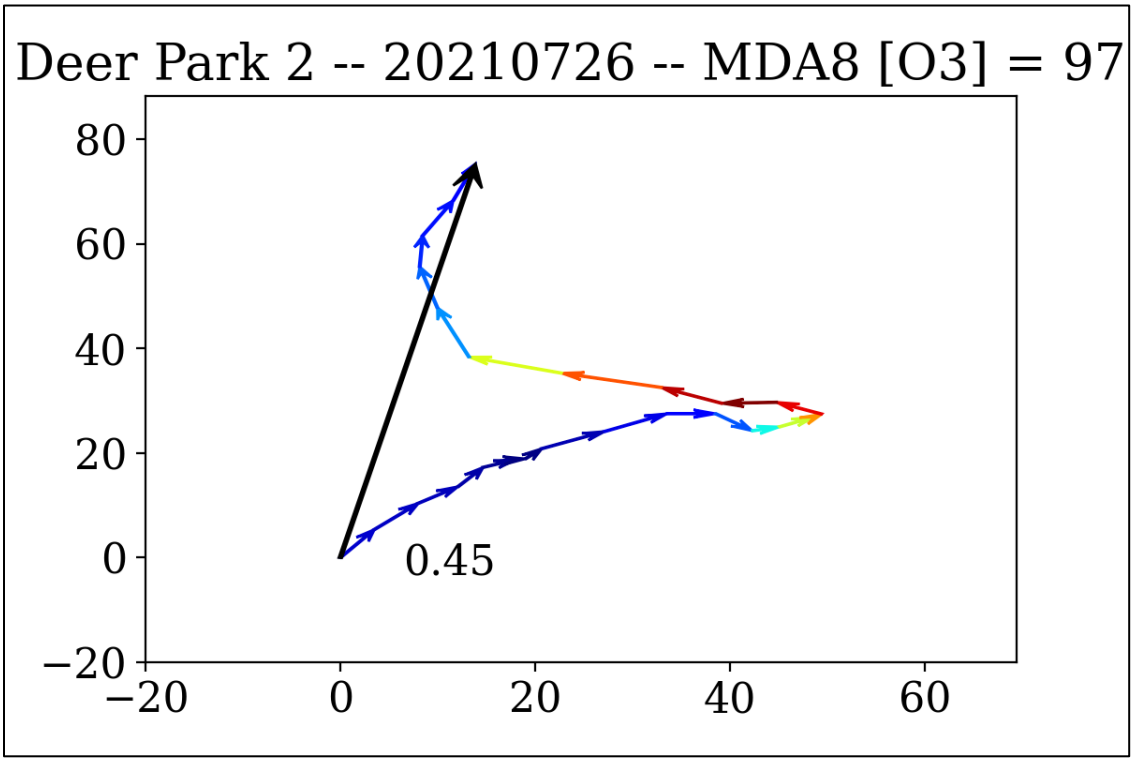

Figure 2: The 24-hour wind run for C35 Houston Deer Park #2. Details described in tex

Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments

- The morning sounding on 18 July did not measure valid ozone data. The inlet straw likely came loose from its connection to the ozonesonde, and thus the air being sampled was inside the Styrofoam box. The ozone measurement is then an order of magnitude or two too low. The morning sounding on 27 July did not measure valid ozone data, partly for the same reason. We are now using tape to help keep the inlet straw in place.
- During the afternoon sounding on 26 July, just after the launch the ozonesonde ECC cell current quickly dropped to zero. Once it reached the tropopause, the cell current returned

and for the remainder of the flight. On the morning sounding on 27 July the cell current dropped to zero once when the ozonesonde was in the stratosphere. After the balloon burst, the cell current returned and remained on for the descent. This problem potentially suggests a connectivity issue where the ECC cell leads connect to the circuit board. Testing in the lab to find other cases and rule out other possible causes is ongoing.

- The morning sounding on 26 July had a telemetry issue where after the launch the signal was soon lost at an altitude of ~560 m. A backup system used and was able to start tracking the flight from an altitude of ~1140 m for the rest of the flight. They initial issue was likely due to the SDR receiver in the initial telemetry setup not working properly. That SDR has been removed and another one has since been used in its place.

Goals and Anticipated Issues for the Succeeding Reporting Period

- Continue to support and maintain the commercial boat packages
- Continue to sample with the UH pontoon boat on days conducive to sampling on the Bay (no storms, winds less than 10–15 kts, water conditions calm, small swells)
- Conduct WRF-GC simulation for July 2021 over Houston-Galveston region.
- Contact our observational team for field data to do model-observation comparison.
- Prepare for AQRP presentations

Detailed Analysis of the Progress of the Task Order to Date

The project is going quite well and a significant O_3 exceedance day was captured on July 26 which may be an example of the land-bay recirculation conceptual model. The biggest disappointment is that the NO_2 photocell supplier has not been able to deliver working units despite several trips back and forth for repairs. We hope that we can get at least one system, likely the UH Pontoon, outfitted with NO_2 measurements by September. Beyond that, the project team is excited about the progress being made with the modeling and the ongoing sampling and sonde launches. We look forward to a more in-depth analysis of this data in the future.

Do you have any publications related to this project currently under development? If so, please provide a working title, and the journals you plan to submit to.

☐**Yes** ☒ **No**

Do you have any publications related to this project currently under review by a journal? If so, what is the working title and the journal name? Have you sent a copy of the article to your AQRP Project Manager and your TCEQ Liaison?

☐ **Yes** ☒ **No**

Do you have any bibliographic publications (ie: publications that cite the project) related to this project that have been published? If so, please list the reference information. List all items for the lifetime of the project.

☐ **Yes** ☒ **No**

Do you have any presentations related to this project currently under development? If so, please provide working title, and the conference you plan to present it (this does not include presentations for the AQRP Workshop).

☐ **Yes** ☒ **No**

Do you have any presentations related to this project that have been published? If so, please list reference information. List all items for the lifetime of the project.

☐ **Yes** ☒ **No**

Have any personnel changes occurred that were not listed in the original proposal? If so, please include a detailed description of the personnel change(s) below.

☐ **Yes** ☒ **No**

Are any delays expected in the progress of the research? If so, please include a detailed description of the potential delay below.

☒ **Yes** ☐ **No**

The AQRP and TCEQ have requested the deployment to be delayed into CY2021.

Describe any possible concerns/issues (technical or non-technical) that AQRP should be made aware of.

☐ **Yes** ☒ **No**

Are you anticipating using all the available funds allocated to this project by the end date? If not, why and approximately what is the amount to be returned?

☒ **Yes** ☐ **No**

Acronyms/Abbreviations:

CST: Central Standard Time
CDT: Central Daylight Time
MDA8: Maximum daily 8-hour average
NO_2: Nitrogen Dioxide
O_3: Ozone
ppbv: Parts per billion by volume
SDR: Software Defined Radio
UTC: Universal Time Coordinated
WRF-GC: A regional air quality model that couples the Weather Research and Forecasting (WRF) meteorological model and the GEOS-Chem atmospheric chemistry model

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Submitted to AQRP by

James Flynn