

# AQRP Monthly Technical Report

<b>PROJECT TITLE</b>	Modeling analysis of TRACER-AQ and over-water measurements to improve prediction of on-land and offshore ozone	<b>PROJECT #</b>	22-008
<b>PROJECT PARTICIPANTS</b>	Yuxuan Wang, James Flynn, Paul Walter, Xueying Liu	<b>DATE SUBMITTED</b>	01/10/2023
<b>REPORTING PERIOD</b>	<b>From:</b> 12/01/2022 <b>To:</b> 12/31/2022	<b>REPORT #</b>	5

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 15<sup>th</sup> of the month following the reporting period shown above.

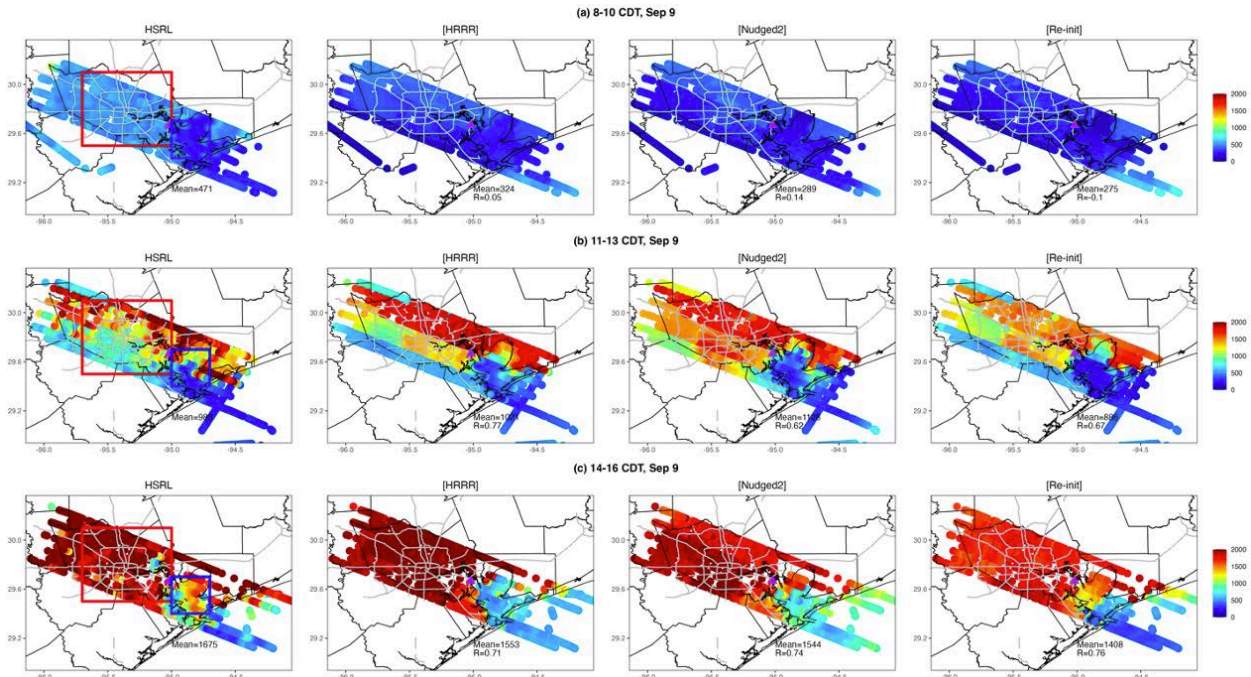
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## Detailed Accomplishments by Task for reporting period

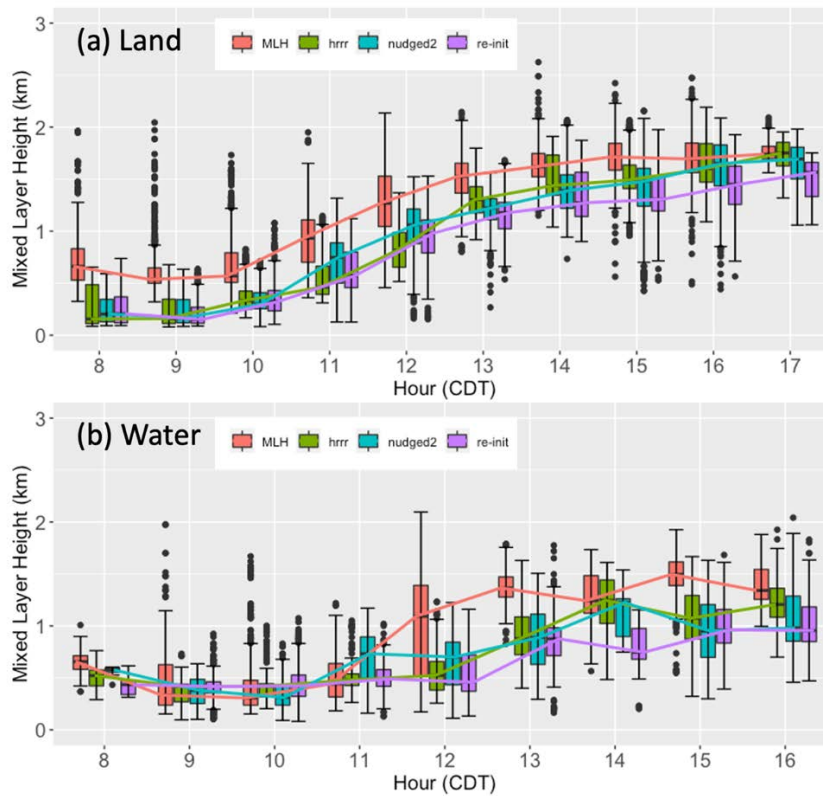
For Task 3 (Meteorological model evaluation and improvement), we evaluated the WRF-modeled planetary boundary layer (PBL) height with mixed layer height from the NASA Langley Research Center (LaRC) High Spectral Resolution Lidar-2 (HSRL2) instrument. The HSRL2 scanned Houston three times per day roughly at 8:00-10:00, 11:00-13:00, and 14:00-16:00 local time (CDT) for ten days during September 2021 and measured spatial distribution of mixed layer height.

## Preliminary Analysis

Below shows the evaluation of spatial (**Figure 1**) and diurnal (**Figure 2**) variabilities of the PBL from the three WRF model simulations, i.e. [HRRR], [Nudged2] and [Re-init], against the HSRL2 observations. The HSRL2 scans the greater Houston regions three times a day for ten non-consecutive days in September of 2021, that is September 1, 3, 8-11 and 23-26. Among these days, one ozone exceedance day, that is September 9, is taken as an example to demonstrate the PBL spatial variabilities in **Figure 1**. The model simulations show the mean morning, noon, and afternoon PBL heights of 275-324 m, 886-1128 m, and 1408-1555 m, in comparison with the observed values of 471 m, 983 m, and 1675 m, respectively. The model simulations capture spatial variabilities at noon ( $R=0.62-0.77$ ) and in the afternoon ( $R=0.71-0.76$ ) but have difficulties capturing that in the morning ( $R=-0.1-0.14$ ). Relatively less correlation in the morning is probably related to the presence of complex nocturnal PBL structure with both residual layer and stable surface layer. Despite less spatial correlation in the morning, land-water differences are well represented by the model throughout the day, with lower PBL heights over water than on land. Meanwhile, diurnal variations of PBL heights over the ten days are shown in **Figure 2**. Compared to water, land has a relatively stronger increase in PBL heights from early morning to afternoon. The model simulations capture the strong PBL variations on land with consistent minor underestimation throughout all hours, but the model has difficulty in capturing PBL variations over water particularly in the afternoon hours despite different configurations.



**Figure 1.** Spatial distribution of HSRL2-observed and modeled PBL (a) in the morning, (b) at noon, and (c) in the afternoon of September 9, 2021. Red and blue boxes denote land and water, respectively.



**Figure 2.** Diurnal variabilities of HSRL2-observed and modeled PBL (a) on land and (b) over water. Land and water are respectively defined as red and blue boxes in Figure 1.

## Data Collected

None.

**Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments**

None.

**Goals and Anticipated Issues for the Succeeding Reporting Period**

We will start Task 4 of photochemical model evaluation and model inter-comparison in the succeeding report period.

**Detailed Analysis of the Progress of the Task Order to Date**

N/A.

**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

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

**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**

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Submitted to AQRP by  
Yuxuan Wang