AQRP Monthly Technical Report

PROJECT TITLE	Modeling analysis of TRACER-AQ and over-water measurements to improve prediction of on-land and offshore ozone	**PROJECT #**	22-008
PROJECT PARTICIPANTS	Yuxuan Wang, James Flynn, Paul Walter, Xueying Liu	**DATE SUBMITTED**	06/09/2023
REPORTING PERIOD	**From:** 05/01/2023 **To:** 05/31/2023	**REPORT #**	7

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 15th of the month following the reporting period shown above.

Detailed Accomplishments by Task for reporting period

Task 5. Sources of offshore high ozone.

We conducted process analysis in the CAMx model to identify key processes which led to simulated O_3 change during high-O_3 episodes relative to clean days. The process analysis is calculated over a subregion of the Gulf of Mexico with high O_3 mixing ratios observed and integrated across the lowest five model layers comparable to the morning PBL heights over water. The diurnal average of each process on clean and O_3 episode days is shown in Figure 1. Chemistry (CHEM) is the major O_3 source during daytime and becomes the primary O3 sink after sunset. Advection (ADV) serves as a pathway for an O3 sink for most hours, especially during the day, while vertical diffusion (DIF) mostly contributes as an O3 source. Deposition (DEP) constantly removes O_3 from the atmosphere at all hours, yet with a marginal value of 0.1 ppb/hr. During high-O_3 events, CHEM is the most important process causing higher O_3 levels over water relative to clean days, followed by vertical DIF (Figure 1b). We found that O_3 across the entire profile is higher on episode days than clean days, indicating an elevated O_3 background on high-O3 days. In addition, the O_3 gradient above and below the PBL is also higher on episode days, especially during morning hours, which can induce more vertical diffusion if downmixing occurs from above the PBL when the capping inversion is weak.

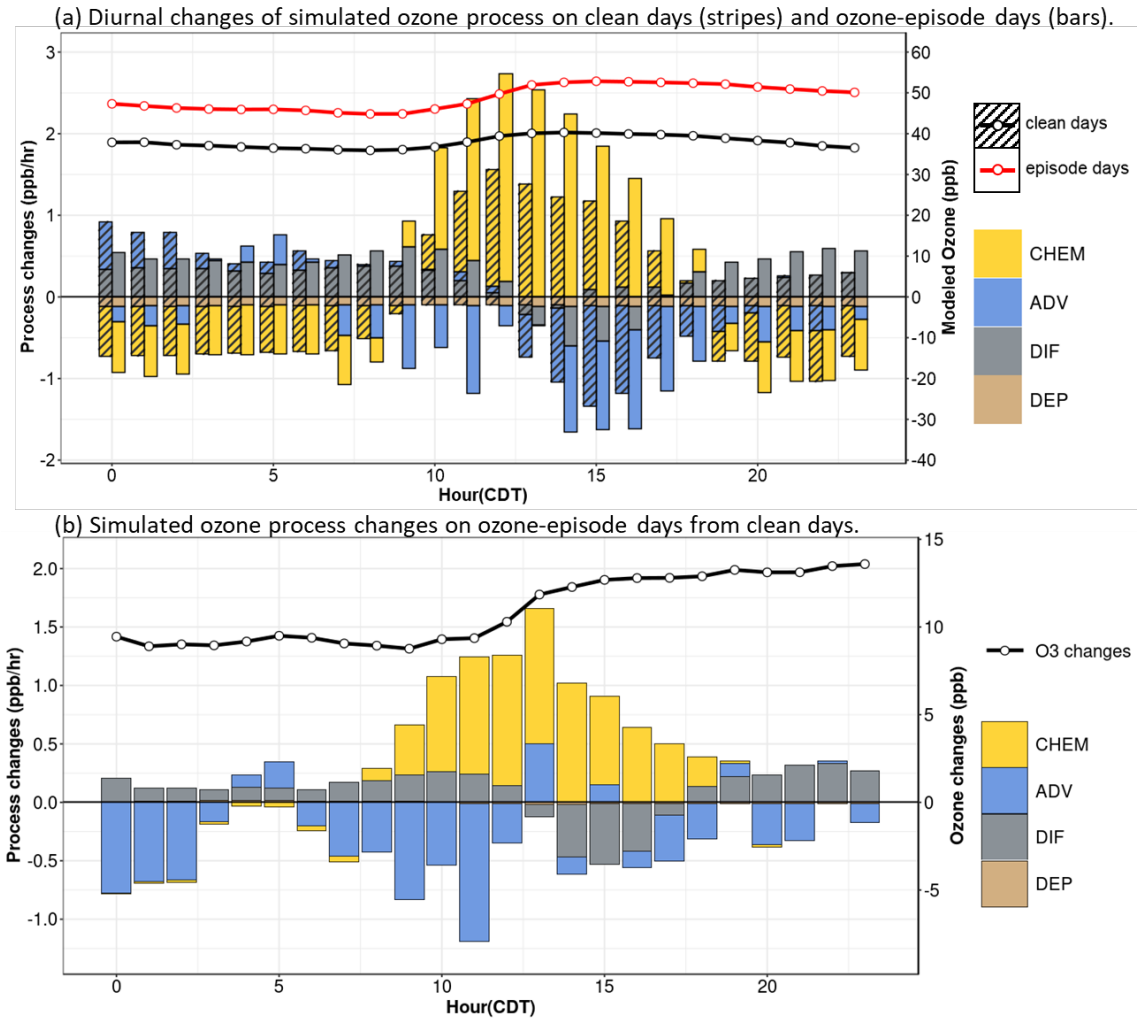

Figure 1. (a) Diurnal changes of simulated ozone processes over the Gulf of Mexico, including chemistry (CHEM), advection (ADV), vertical diffusion (DIF), and deposition (DEP) on clean days (stripes) and O_3-episode days (bars) integrated across the lowest five model layers. Overlaid lines and points are simulated hourly ozone on clean (black) and O_3-episode (red) days. (b) Process (filled bars) and O_3 (black line) changes during high-O_3 episodes relative to clean days.

The process analysis on a case-study day (September 9, 2021) over the Gulf of Mexico shows that ADV, in addition to CHEM, contributes to the enhanced O_3 levels at 10:00 and 13:00 (**Figure 2**), which respectively corresponds to the two plumes under northerly and easterly winds and highlights the importance of regional transport. This demonstrates that the contributions from ADV to the increase of O_3 can be high on some specific cases, although its mean contributions over multiple days are averaged out in **Figure 1**.

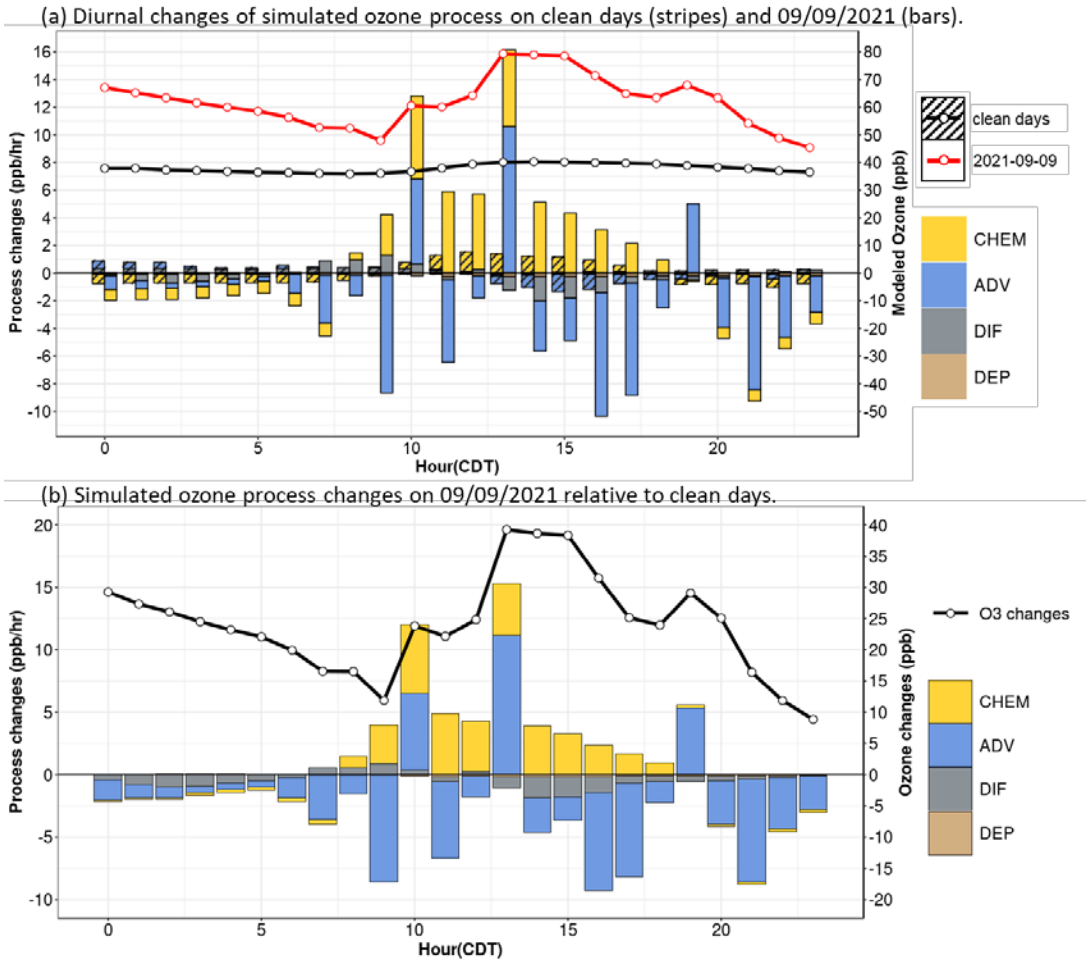

Figure 2. (a) Diurnal changes of simulated ozone processes over the Gulf of Mexico, including chemistry (CHEM), advection (ADV), vertical diffusion (DIF), and deposition (DEP) on clean days (stripes) and 09/09/2021 (bars) integrated across the lowest five model layers. Overlaid lines and points are simulated hourly ozone on clean (black) and 09/09/2021 (red) days. (b) Process (filled bars) and O_3 (black line) changes on 09/09/2021 relative to clean days.

Data Collected

None.

Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments

None.

Goals and Anticipated Issues for the Succeeding Reporting Period

Finish Task 5 (Investigation of Elevated Offshore Ozone's Sources) 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**

Li et al., Understanding offshore high-ozone events during TRACER-AQ 2021 in Houston: Insights from WRF-CAMx photochemical modeling. Submitted to *Atmospheric Chemistry and Physics*.

Liu et al., Evaluating WRF-GC v2.0 predictions of boundary layer and vertical ozone profiles during the 2021 TRACER-AQ campaign in Houston, Texas. Submitted to *Geoscientific Model Development (GMD)*

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**

Submitted to AQRP by
Yuxuan Wang