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**	11/10/2022
REPORTING PERIOD	**From:** 10/01/2022 **To:** 10/31/2022	**REPORT #**	3

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

For Task 3 (Meteorological model evaluation and improvement), we have conducted a new WRF simulation using daily re-initialization, namely [Re-init] in **Table 1**. The model simulation is broken into many 30-hour segments. The first 6 hours of each segment, that is 18:00-23:00 UTC of a previous day, will be discarded to permit spin-up. The subsequent 24 hours, that is 0:00-23:00 UTC of the following day, is used for analysis and as input for air quality models.

Table 1. List of model experiments. The first five simulations are conducted for another TCEQ-funded project. The last three are proposed in this AQRP project.

Simulations	BC Meteorology	PBL	Microphysics	Nudging	Reinitializing
[Base]	NCEP FNL	MYNN	2M	No	No
[WSM6]	NCEP FNL	MYNN	WSM6	No	No
[YSU]	NCEP FNL	YSU	2M	No	No
[ACM2]	NCEP FNL	ACM2	2M	No	No
[ERA5]	ECMWF ERA5	MYNN	2M	No	No
[HRRR]	HRRR	MYNN	2M	No	No
[Nudged]	NCEP FNL	MYNN	2M	Yes	No
[Reinit]	NCEP FNL	MYNN	2M	No	Yes

Preliminary Analysis

Offshore boat meteorological measurements are used to validate WRF simulations. The three simulations proposed in Task 3 is combined with five simulations from another TCEQ-funded project to select the simulations with best performance over water. **Figure 1** and **Table 2** show the spatiotemporal variability between boat-observed and WRF-modeled meteorology for five ozone episodes, that is Jul 28, Aug 25, Sep 6-11, Sep 23-26, and Oct 6-9 in 2021.

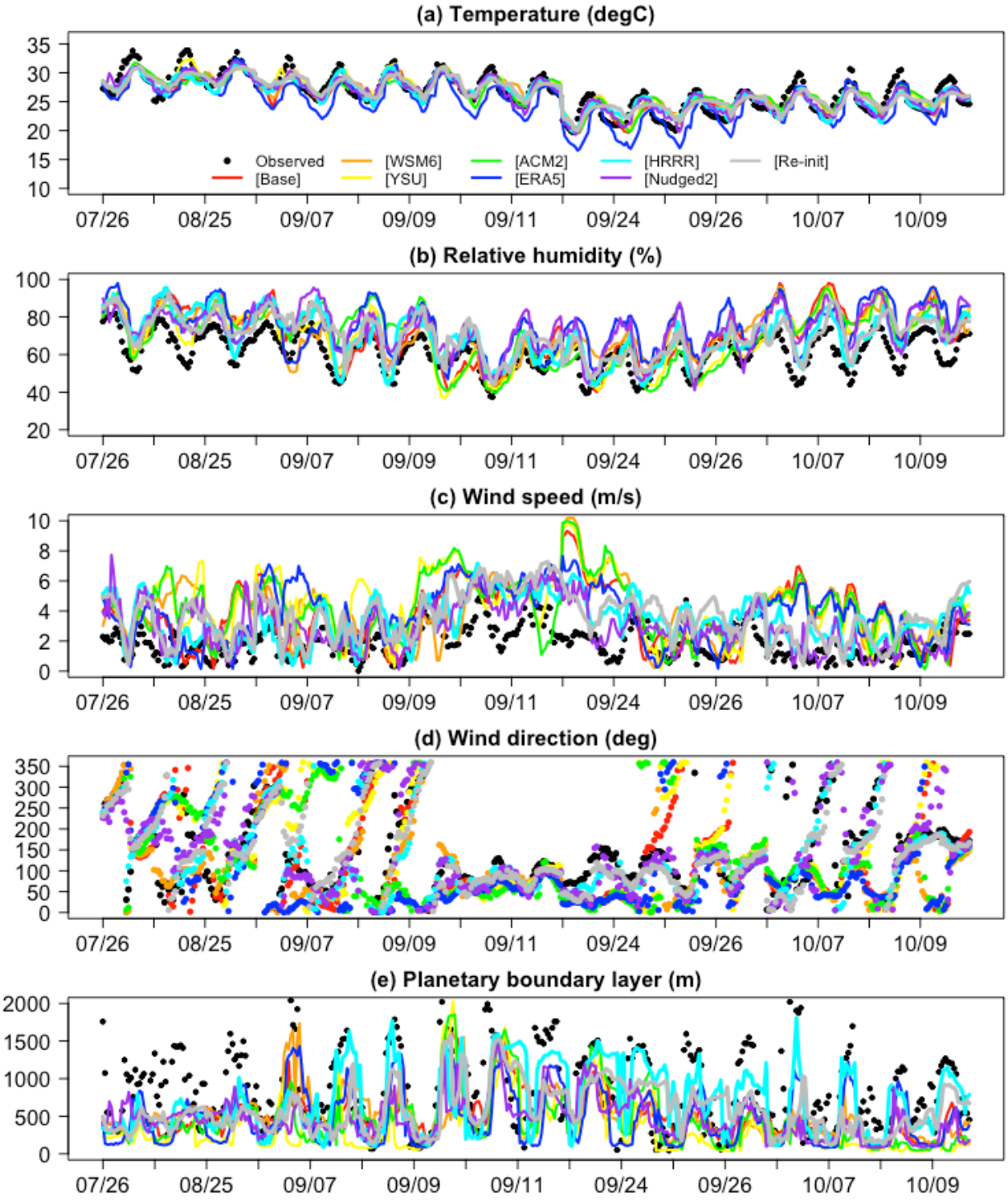

Figure 1. Time series of (a) air temperature, (b) relative humidity, (c) wind speed, (d) wind direction and (e) boundary layer height between 1-min boat observations and WRF model simulations for five ozone episodes, that is Jul 28, Aug 25, Sep 6-11, Sep 23-26, and Oct 6-9 in 2021.

Table 2. Performance metrics of spatiotemporal variability between boat-observed and WRF-modeled meteorology for five ozone episodes. 1-minute meteorology is used for calculation of performance metrics below. All metrics have the same unit as meteorological variables, except that correlation coefficient (R) and normal mean bias (NMB) are unitless.

Variables	Simulation	OBS	MOD	R	NMB	MB	MAE	RMSE
Temperature (°C)	[Base]	26.55	26.45	0.77	0.00	-0.11	1.71	2.14
	[WSM6]		26.50	0.75	0.00	-0.05	1.77	2.20
	[YSU]		26.78	0.78	0.01	0.22	1.71	2.10
	[ACM2]		26.51	0.75	0.00	-0.04	1.78	2.21
	[ERA5]		24.85	0.75	-0.06	-1.70	2.21	3.00
	[HRRR]		26.30	0.75	-0.01	-0.25	1.89	2.29
	[Nudged]		26.30	0.87	-0.01	-0.25	1.26	1.65
	[Re-init]		26.53	0.76	0.00	-0.02	1.71	2.15
Relative humidity (%)	[Base]	60.96	70.24	0.64	0.15	9.28	11.95	14.59
	[WSM6]		71.09	0.61	0.17	10.14	11.76	14.38
	[YSU]		68.20	0.65	0.12	7.24	10.96	13.29
	[ACM2]		69.35	0.56	0.14	8.40	12.75	15.33
	[ERA5]		74.38	0.60	0.22	13.42	14.66	17.23
	[HRRR]		69.20	0.70	0.14	8.24	10.38	12.68
	[Nudged]		73.35	0.75	0.20	12.39	12.87	14.92
	[Re-init]		69.68	0.67	0.14	8.72	10.25	12.42
Wind speed (m/s)	[Base]	0.73	2.47	0.16	0.74	1.67	2.20	2.78
	[WSM6]		2.62	0.14	0.82	1.85	2.33	2.92
	[YSU]		2.17	0.13	0.99	2.22	2.63	3.19
	[ACM2]		1.99	0.15	0.92	2.07	2.49	3.09
	[ERA5]		1.89	0.22	0.78	1.74	2.21	2.72
	[HRRR]		1.68	0.52	0.59	1.32	1.69	2.05
	[Nudged]		1.75	0.37	0.41	0.92	1.57	1.96
	[Re-init]		2.02	0.30	0.69	1.55	2.00	2.41
Wind direction (deg)	[Base]	144.15	118.78	0.32	-0.08	-11.45	57.74	75.38
	[WSM6]		113.5	0.26	-0.13	-19.10	60.40	77.29
	[YSU]		135.77	0.26	-0.11	-16.44	63.52	81.13
	[ACM2]		125.25	0.27	-0.11	-17.20	68.93	85.92
	[ERA5]		96.69	0.18	-0.17	-25.20	69.00	85.30
	[HRRR]		137.93	0.58	-0.08	-12.53	41.54	58.16
	[Nudged]		146.95	0.45	-0.05	-7.68	47.87	65.51
	[Re-init]		146.96	0.62	-0.10	-14.98	42.98	59.66
Boundary layer height (m)	[Base]	855.58	499.27	0.32	-0.42	-356.30	529.63	699.67
	[WSM6]		526.69	0.30	-0.38	-328.88	526.38	691.82
	[YSU]		322.22	0.30	-0.62	-533.36	612.29	817.16

	[ACM2]		443.60	0.30	-0.48	-411.97	562.12	747.06
	[ERA5]		464.75	0.47	-0.46	-390.83	507.51	680.30
	[HRRR]		671.27	0.38	-0.22	-184.31	461.30	637.68
	[Nudged]		462.09	0.41	-0.46	-393.48	516.18	696.37
	[Re-init]		569.57	0.25	-0.33	-286.00	518.21	689.22

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 evaluate the three WRF simulations of Task 3 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**

Submitted to AQRP by
Yuxuan Wang