Meteorological Model Performance Evaluation for 2019

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Topics

- What is Model Performance Evaluation or MPE?
- Measure Oriented Statistics
- Applications to 2019 Modeling Platform
  - Choice of vertical coordinate system
  - Alternative Weather Research and Forecasting (WRF) model configuration
  - Use of observational nudging file
- Conclusions

What is MPE?

- Goals/Purposes:
  - Identify and screen problems with model configuration.
  - Evaluate model sensitivities.
  - Used in state implementation plan documentation.
- MPE can be:
  - Measure oriented
  - Distribution oriented
  - Event oriented
- Focus on measure-oriented results for 2019 meteorological modeling.

Measure Oriented Statistics Routinely Used by TCEQ

Meteorological Variable	Emery et al. 2001	McNally, 2009	Kemball-Cook et al., 2005
Conditions	Simple	Complex	Complex
Temperature Bias	≤ ±0.5°K	≤ ±1.0°K	≤ ±2.0°K
Temperature Error	≤ +2.0°K	≤ 3.0°K	≤ 3.5°K
Mixing Ratio Bias	≤ ±1.0 g/kg	≤ ±1.0 g/kg	≤ ±0.8 g/kg
Mixing Ratio Error	≤ 2.0 g/kg	≤ 2.0 g/kg	≤ 2.0 g/kg
Wind speed Bias	≤ ±0.5 m/s	(not addressed)	≤ ±1.5 m/s
Wind Speed RMSE	≤ 2.0 m/s	(not addressed)	≤ 2.5 m/s
Wind Direction Bias	≤ ±10 degrees	(not addressed)	(not addressed)
Wind Direction Error	≤ 30 degrees	(not addressed)	≤ 55 degrees

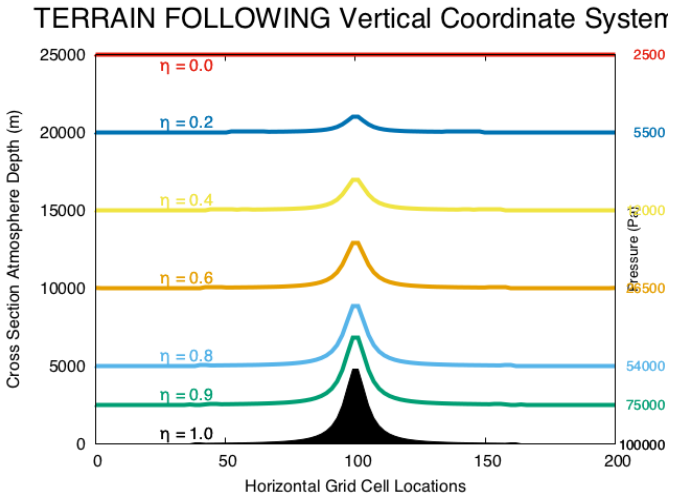
- Statistical form and threshold based upon Environ (Ramboll) 2001 under TNRCC contract.
- Thresholds based on survey of multiple models and "typical" performance.
- Performance targets vary based on met regimes and complex terrain.

Application to 2019 Modeling Platform

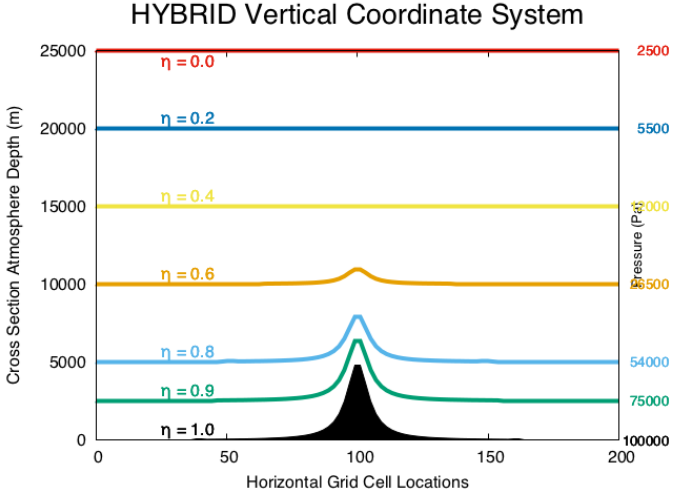
Case 1

Hybrid vs Terrain Sigma Coordinate

- Hybrid vertical coordinate on North American 12km grid
  - nesting to traditional sigma vertical coordinate over East Texas 4km (SVC case), or
  - nesting to hybrid vertical coordinate on East Texas 4km grid. (HVC case)

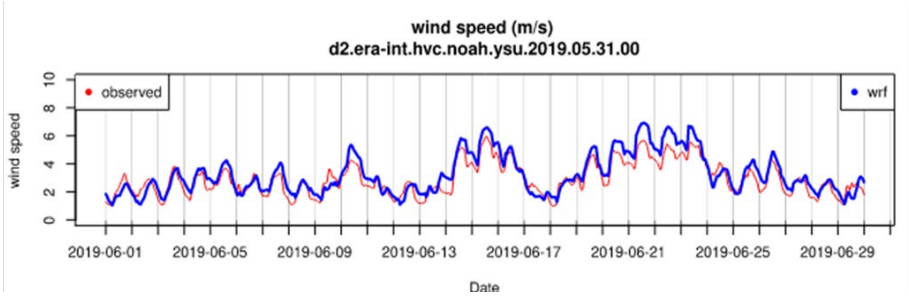


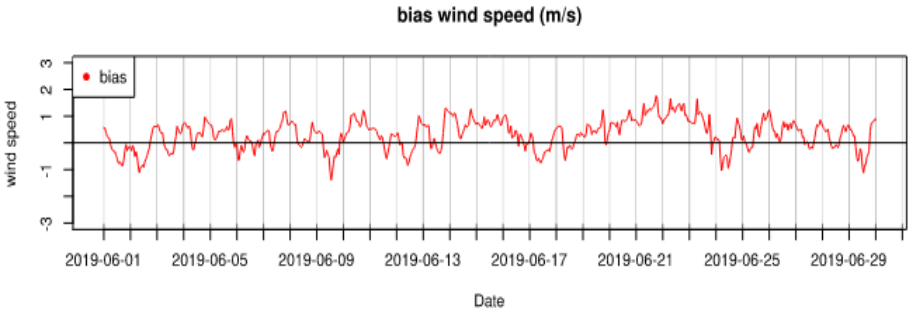
vs



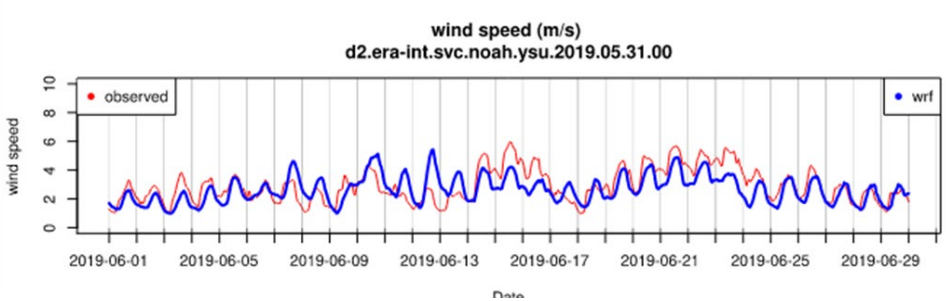
Time Series of Domain-Averaged Hourly Predicted Wind Speed and Bias

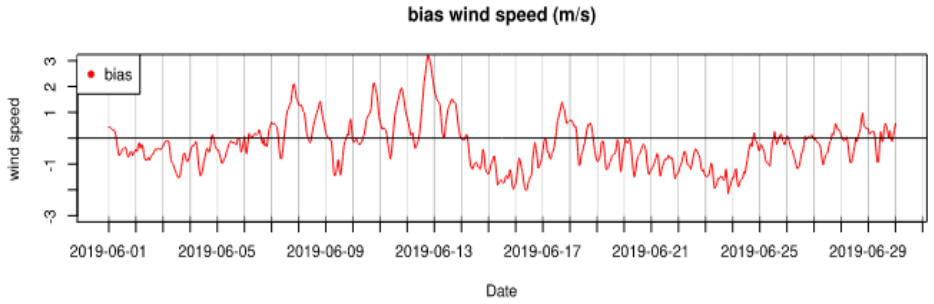
HVC





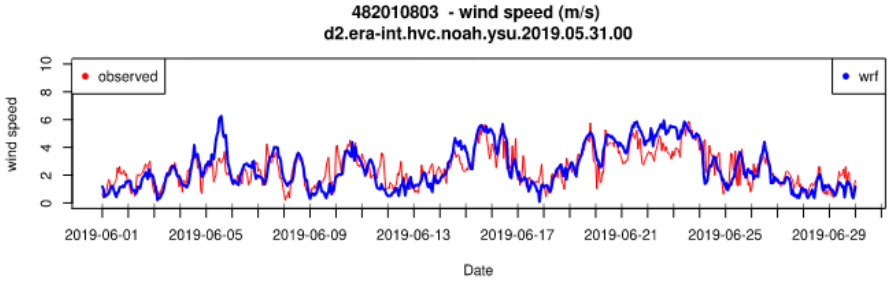
SVC

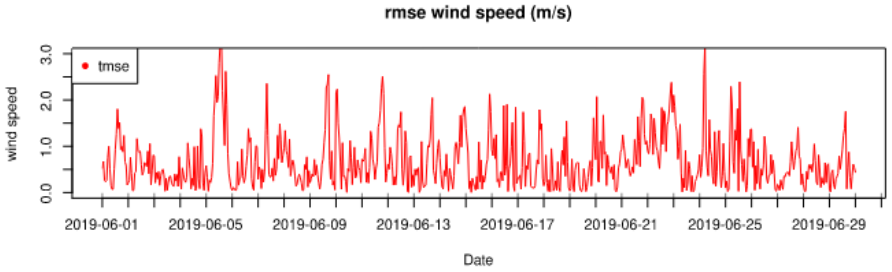


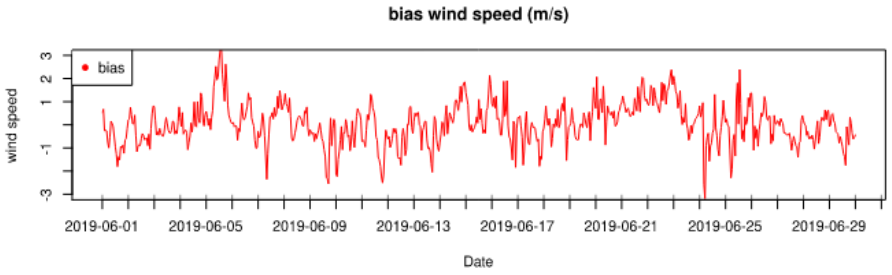


HRM3 June 2019

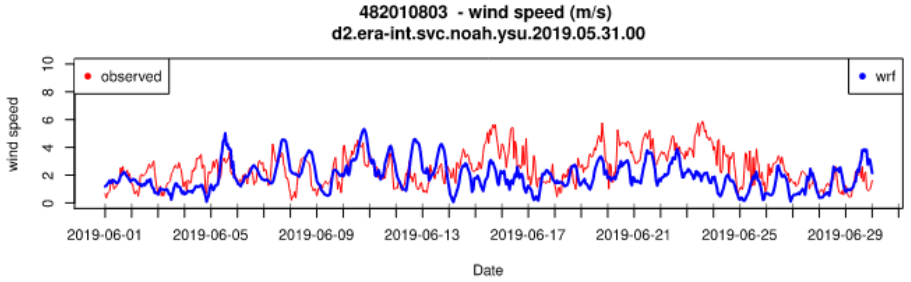
HVC

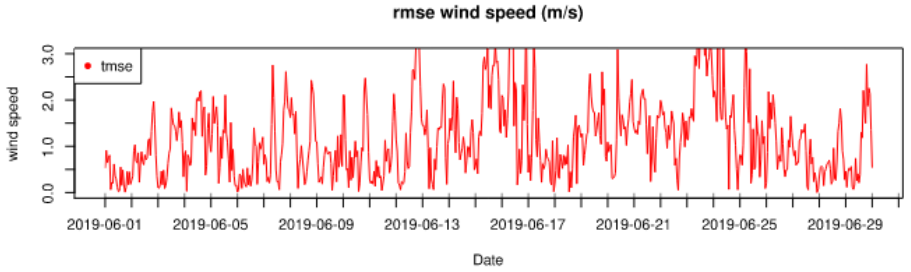


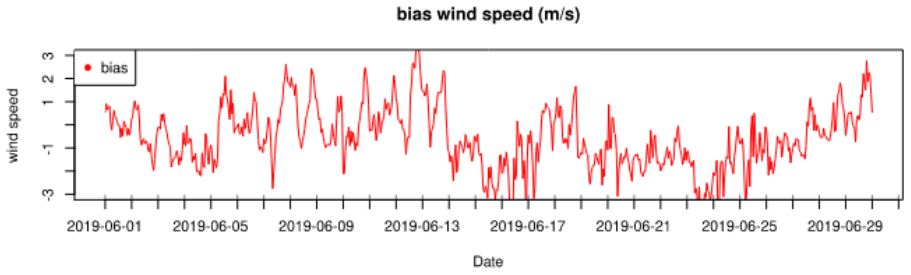




SVC







HVC shows improved performance in all metrics, especially in the June 15th to June 25th time frame, but more importantly on high ozone days of June 9 and June 12-14. Small differences matter.

Application to 2019 Modeling Platform

Case 2

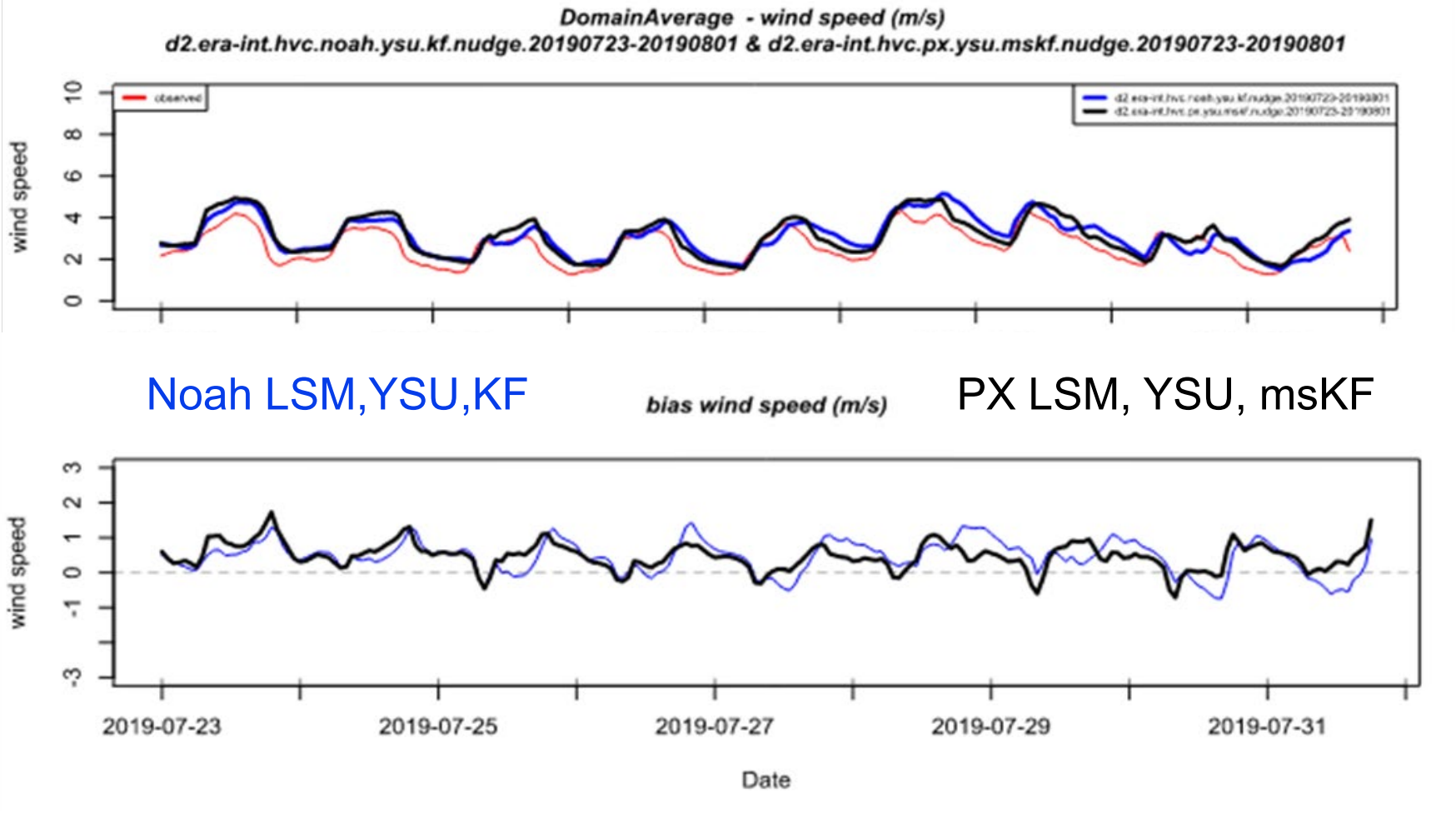
Alternate WRF Configuration Evaluation

- Comparing two WRF configurations on aspects other than vertical coordinate system:
  - Noah Land Surface Model (LSM)-Yong Sei University (YSU) Planetary Boundary Layer (PBL)-Kain-Fritsch (KF) Cumulus with observational nudging
  - Pleim-Xiu (PX) LSM-YSU PBL-Multiscale KF (msKF) Cumulus with observational nudging

- For selected periods of high ozone that overlap between DFW, San Antonio, and HGB:
  - June 7-18
  - July 23-31

- Monthly timeseries comparing model and observations and bias are very close. Individual monitors ***do*** vary.

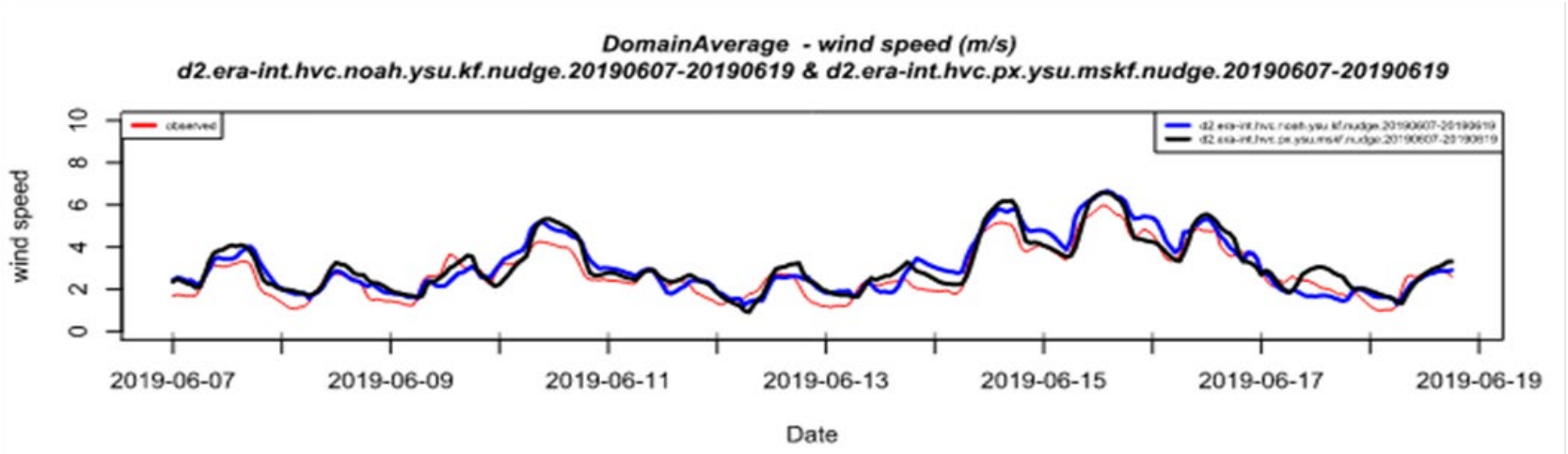
Domain-Averaged Windspeed July 23-31



For the July 23-31 evaluation period, both configurations perform comparably.

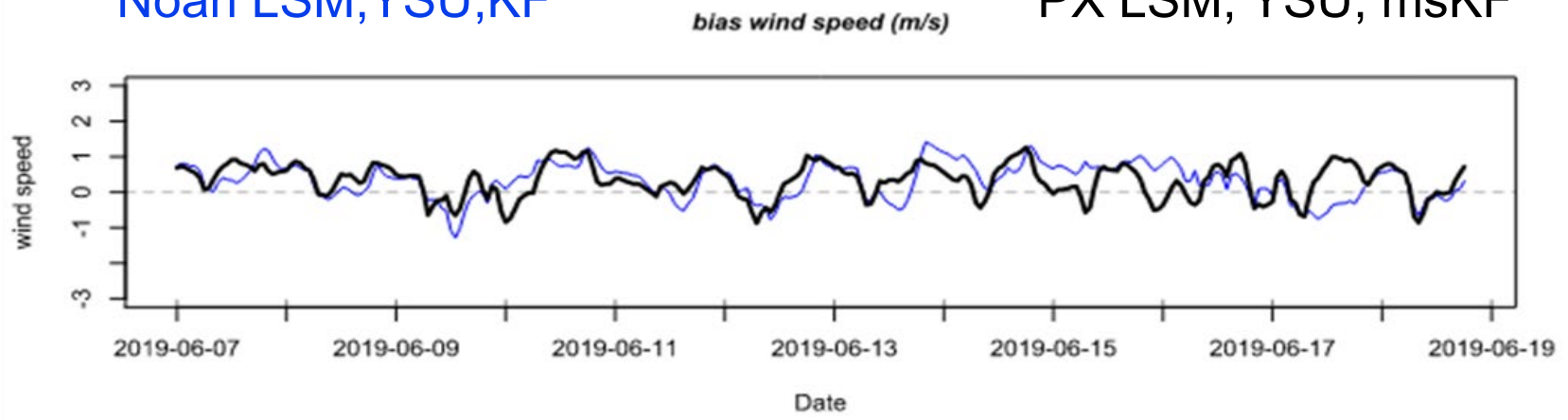
**Average across all monitors in the domain*

Domain Averaged Windspeed June 7-19



Noah LSM,YSU,KF

PX LSM, YSU, msKF



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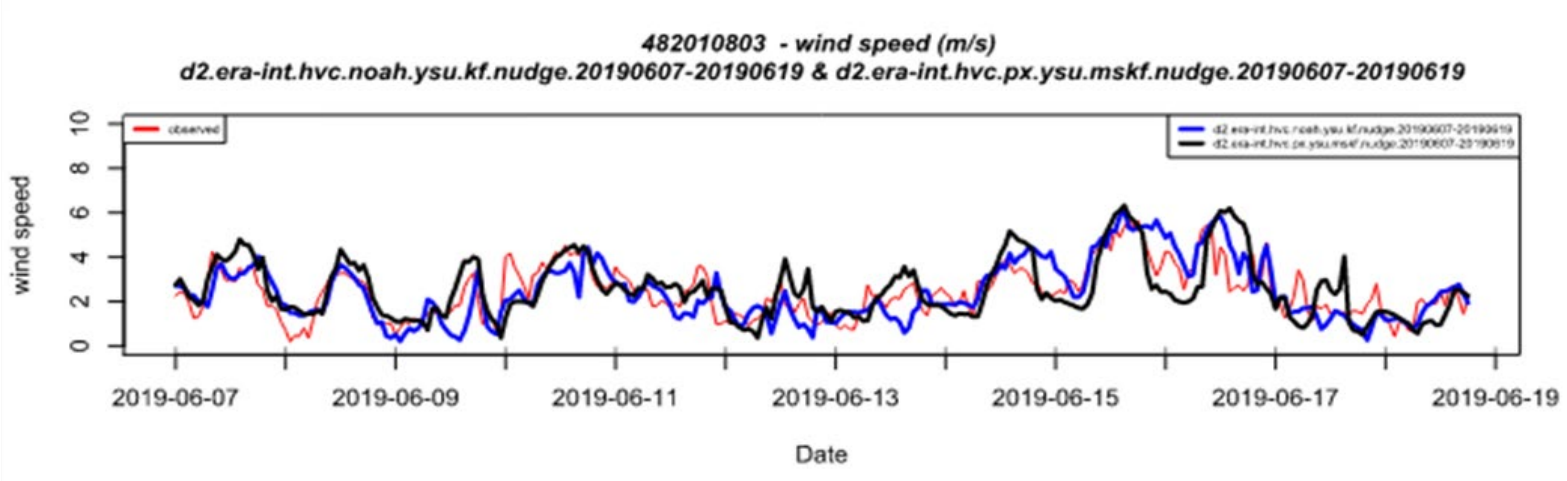
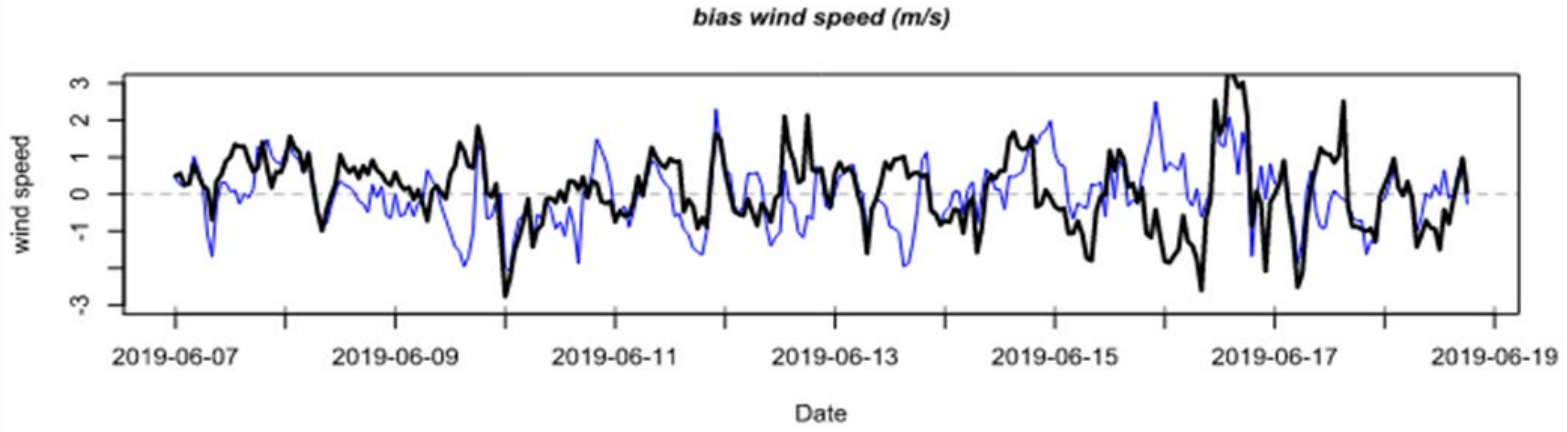
HRM3 June 7-18

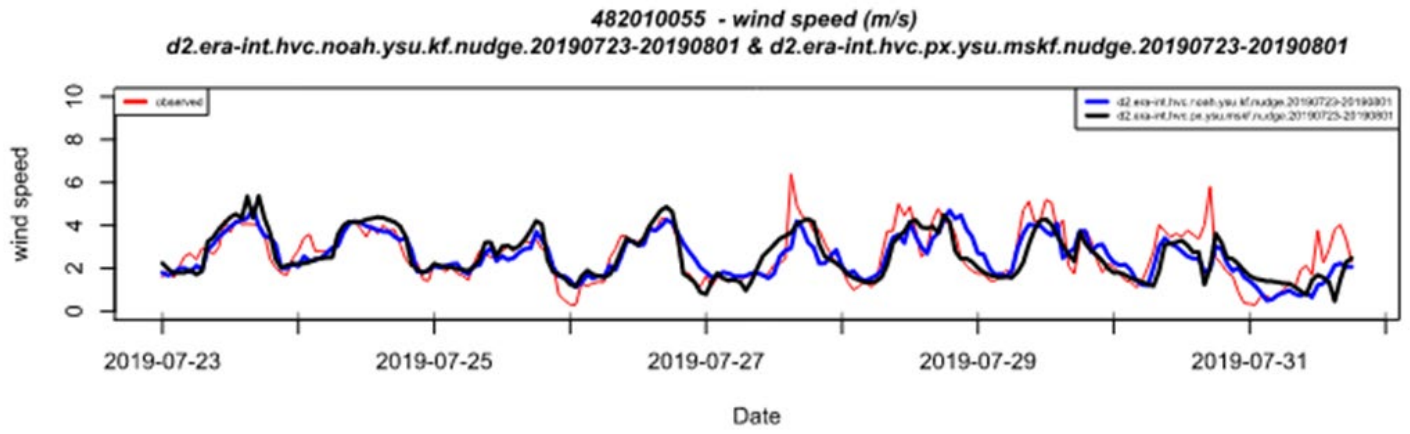


Noah LSM,YSU,KF

PX LSM, YSU, msKF

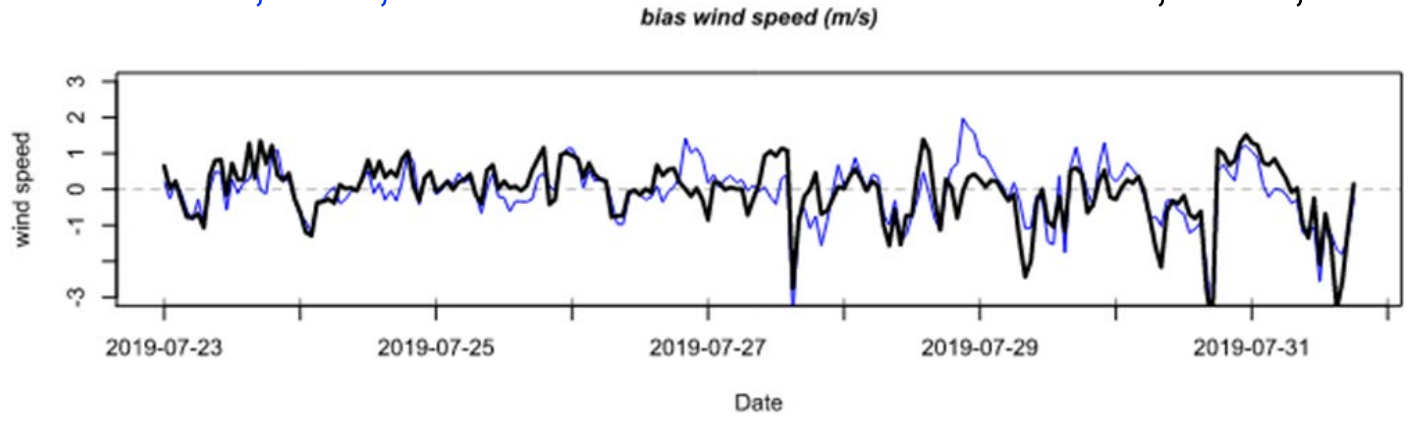


Bayland Park July 23-31

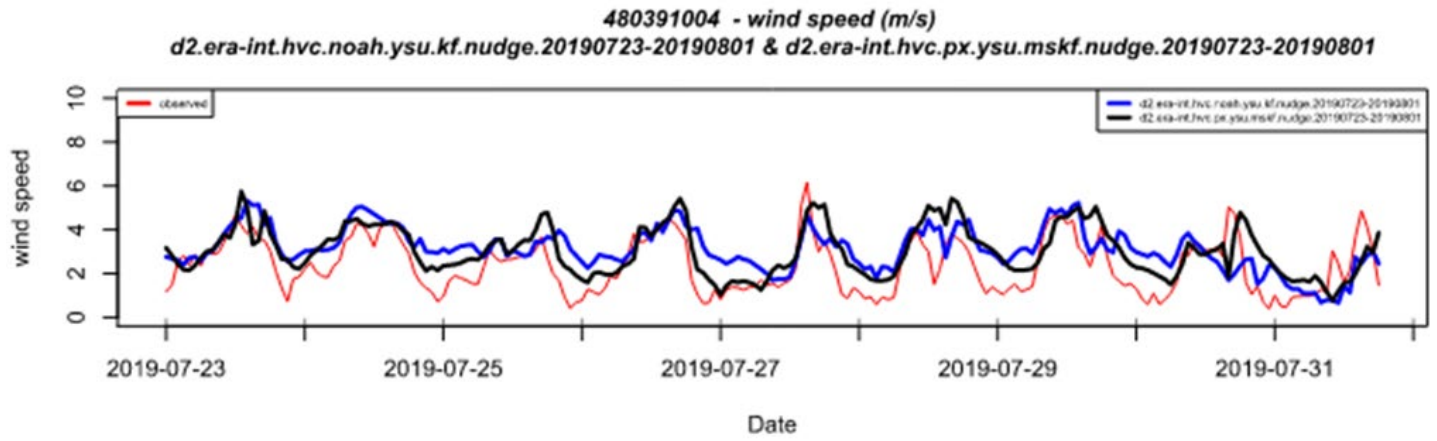


Noah LSM,YSU,KF

PX LSM, YSU, msKF



Manvel Croix July 23-31



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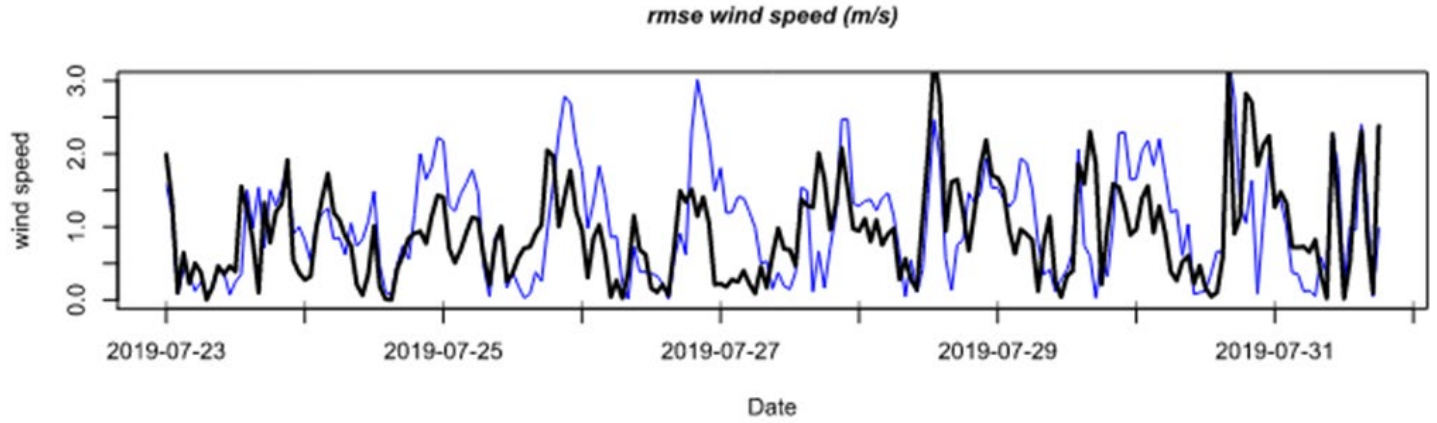
PX LSM, YSU, msKF



Application to 2019 Modeling Platform

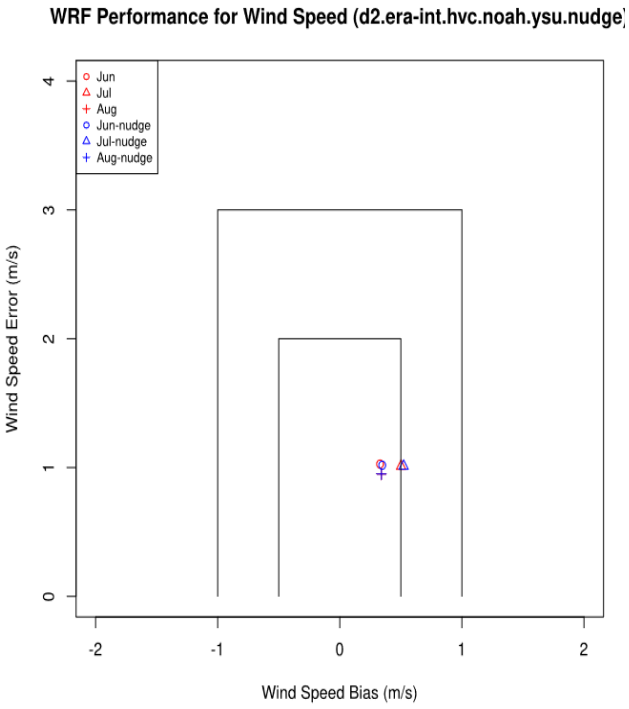
Case 3

Use of Observational Nudging

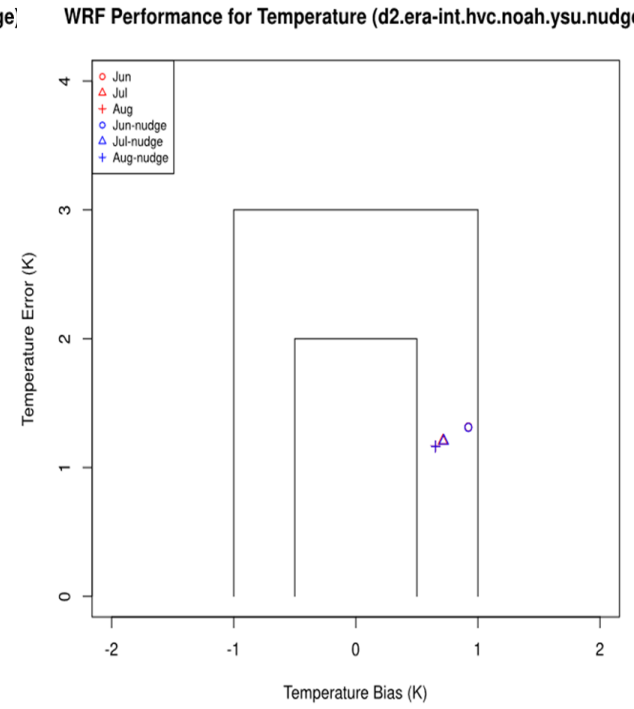
- Comparison of Noah LSM-YSU PBL-KF run with and without observational nudging completed for entire months of June, July, and August.
- Radar profiler observational nudging files have helped in the past.
- Data from Cooperative Agency Profiler (CAP) nearby is at La Porte.
- No significant benefit from using profiler data for these months.

Error vs Bias for Observed-Predicted Pairs by Month

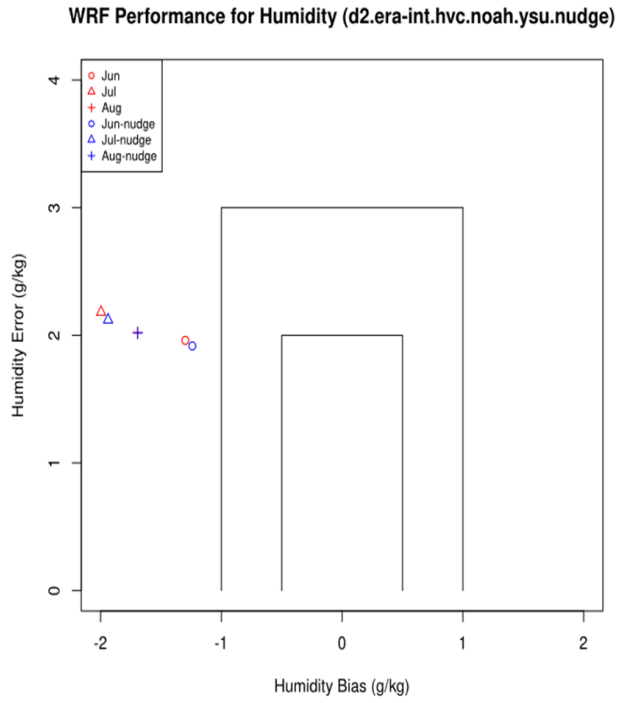
Wind Speed



Temperature

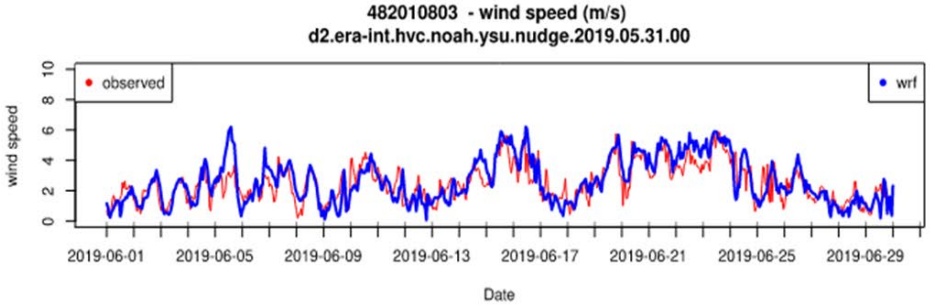


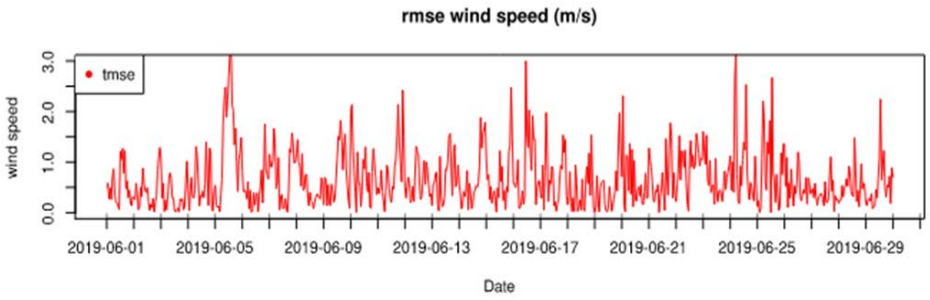
Humidity

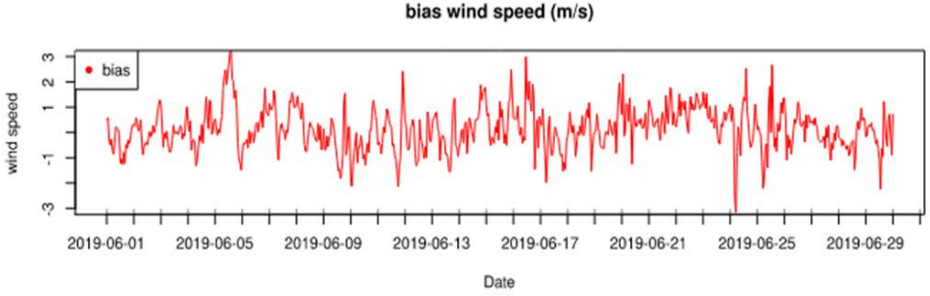


HRM3 June 2019

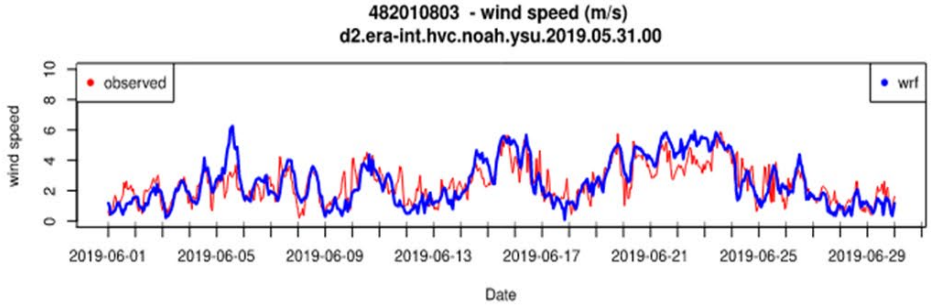
Observational Nudging

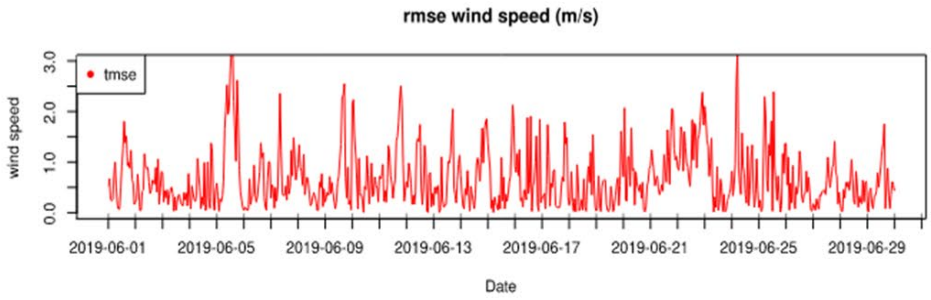


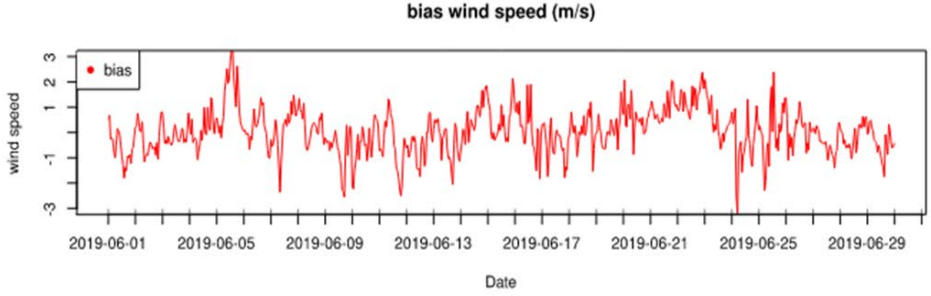




No Observational Nudging

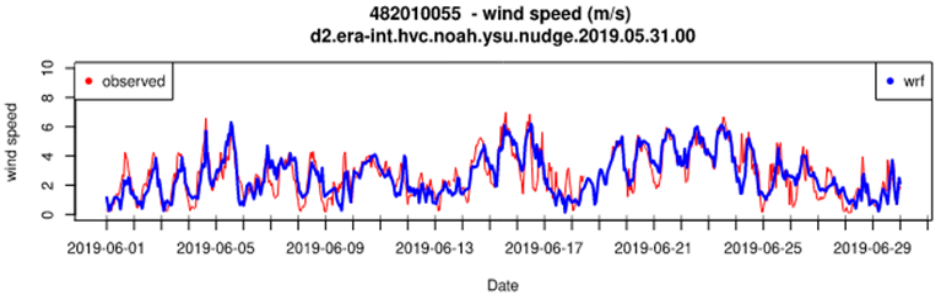


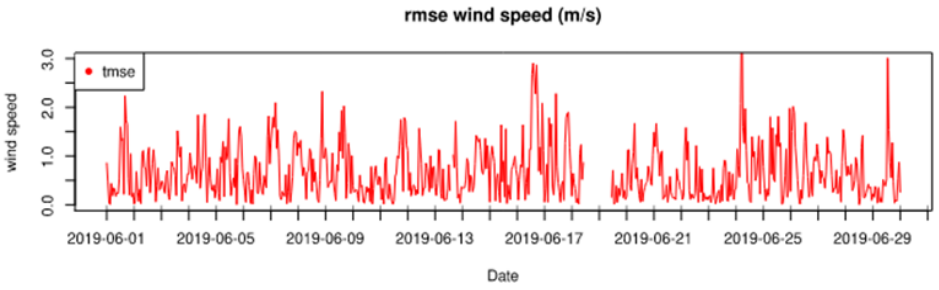


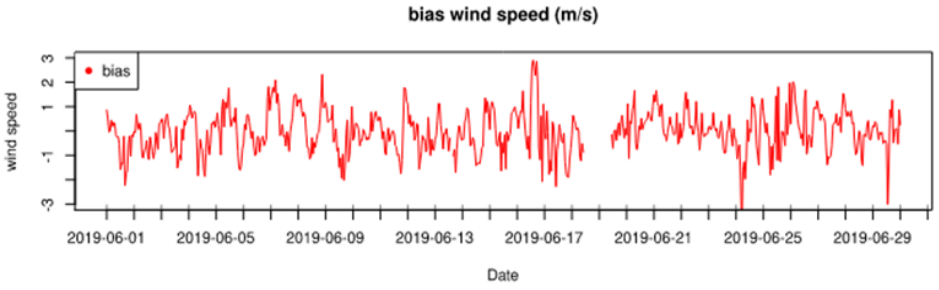


Bayland Park June 2019

Observational Nudging







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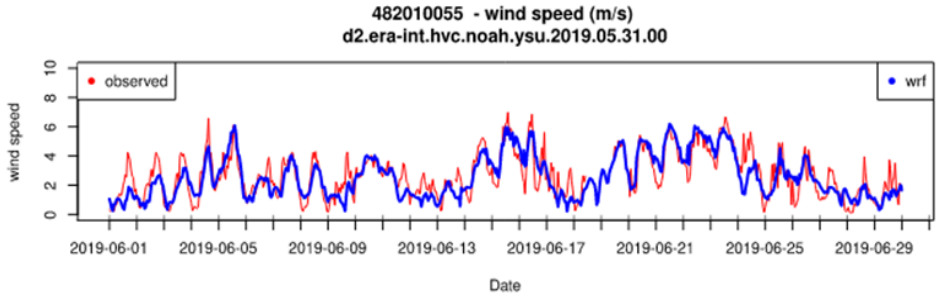
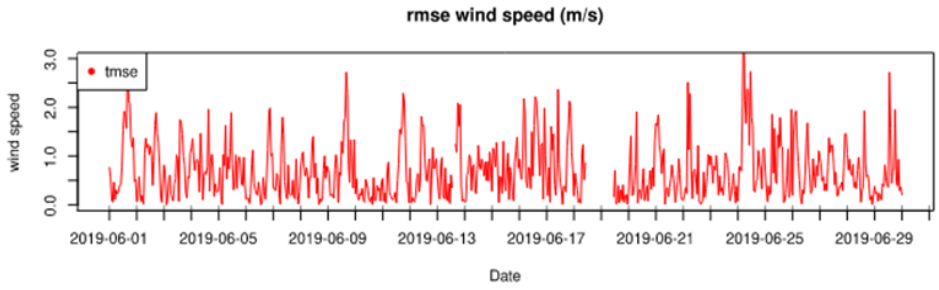
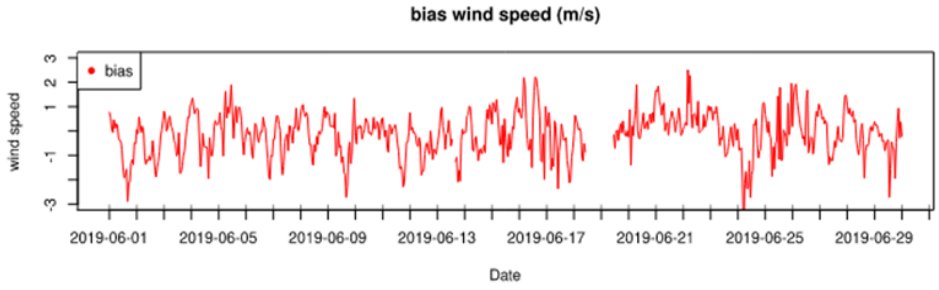






Application to 2019 Modeling Platform

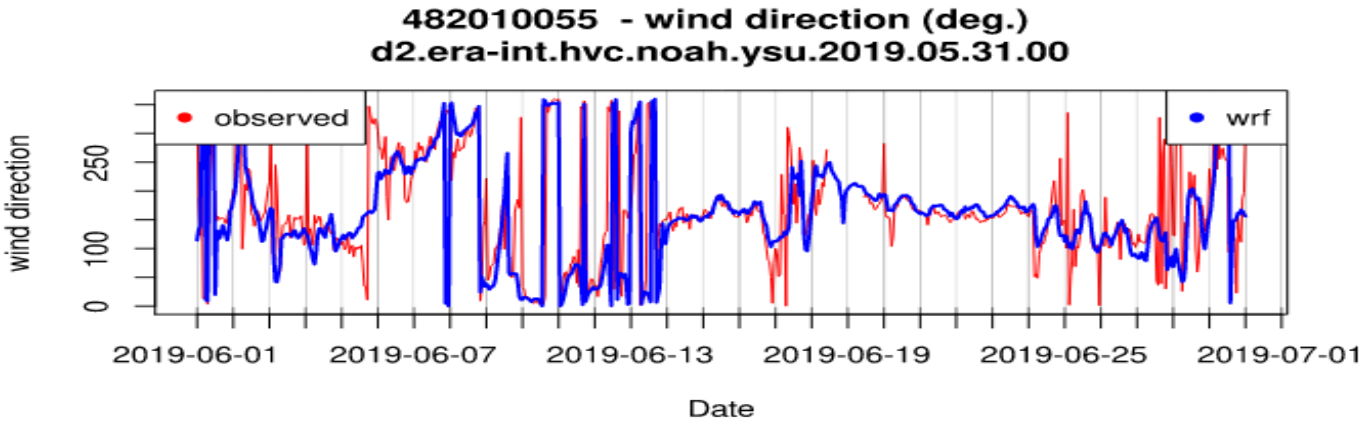
Case 4

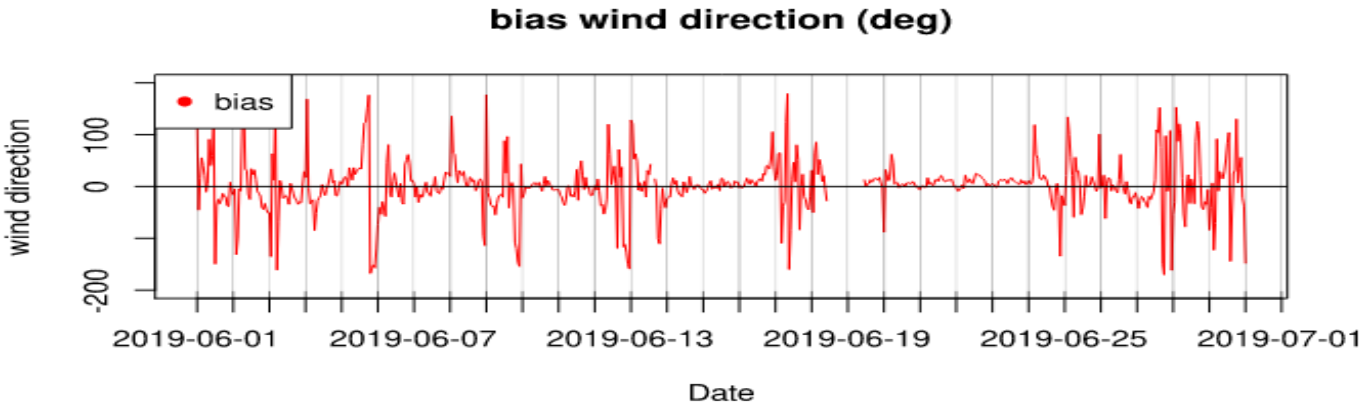
2019 Modeling Platform
WRF Configuration

- WRF configuration for the 2019 Modeling Platform:
  - Hybrid vertical coordinate system
  - Noah LSM-YSU PBL-KF Cumulus based upon overlapping DFW, SA, and HGB days
  - No observational nudging

- Considerations for meteorological performance
  - Focus on windspeed in HGB: Short source-monitor distances and gradients - large complexity over small distances
  - Timeseries: Day-by-day variation through month
  - Monthly scatter plots: Total errors and biases per site but lose daily information
  - Check biases in temperatures and windspeed: Gradients driving land-sea breeze
  - Consider difficulties with surface energy budget: Planetary boundary layer height, and clouds

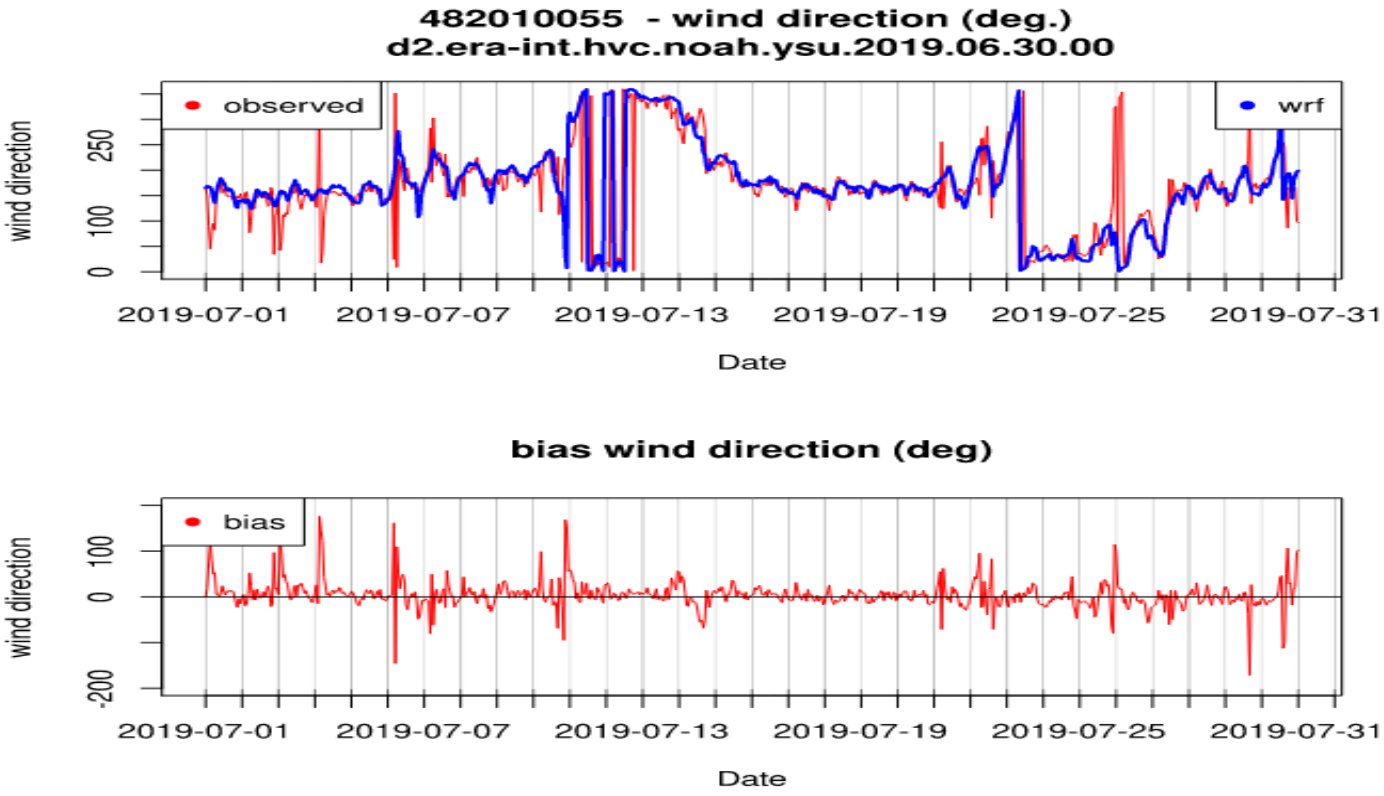
Bayland Park June 2019





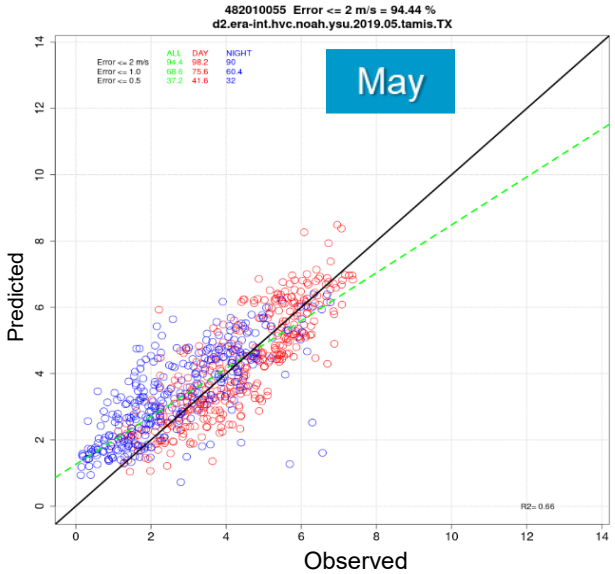
0 and 360 both indicate winds from north, frequently due to frontal passages.
High ozone days: 1, 3, 9, 11-14, and 17

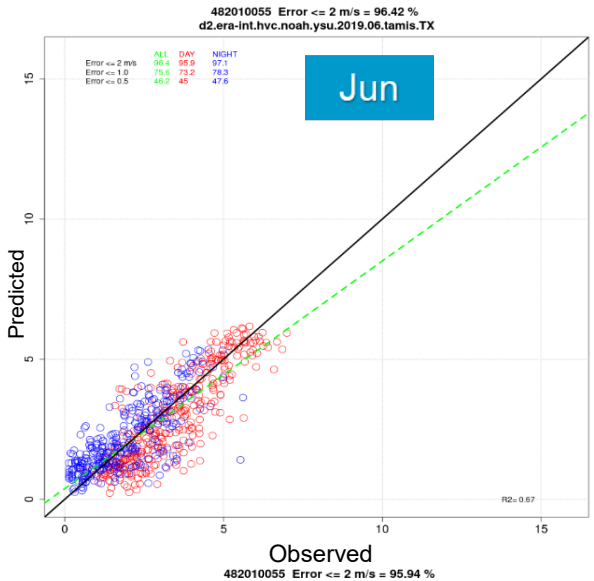
Bayland Park July 2019

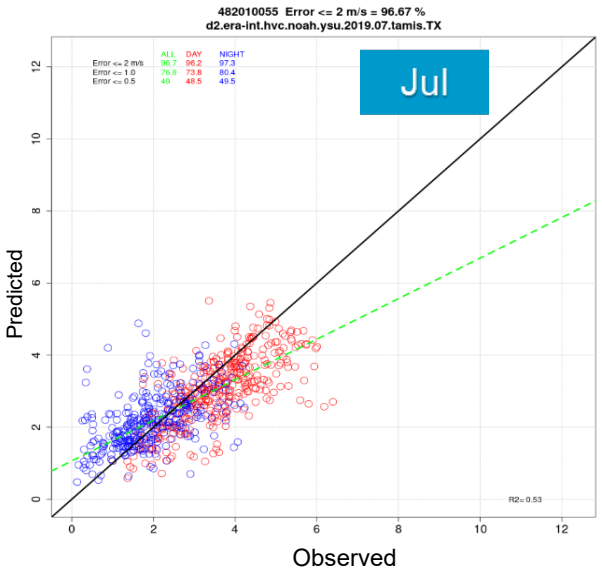


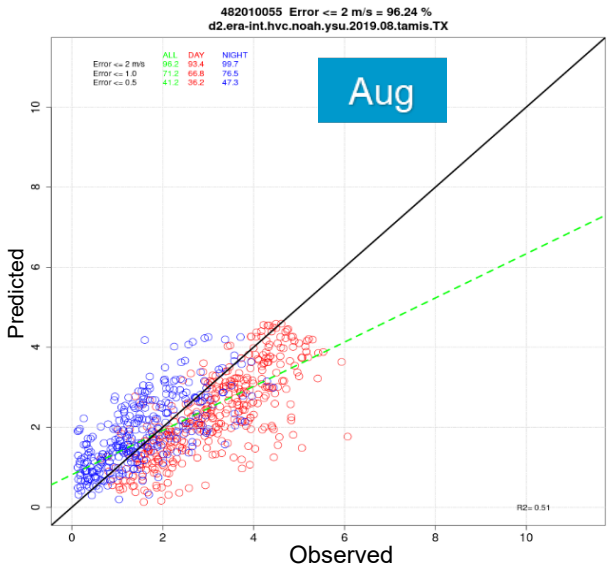
Winds were from the northeast on the high ozone days of July 25 and 26.

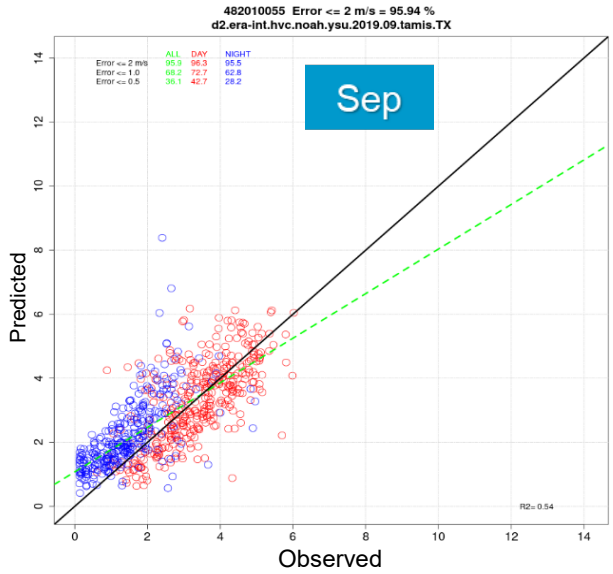
Bayland Park Windspeeds May-September 2019





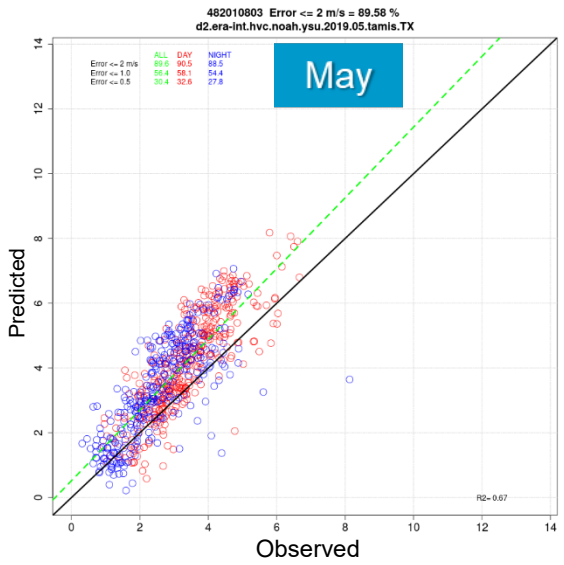


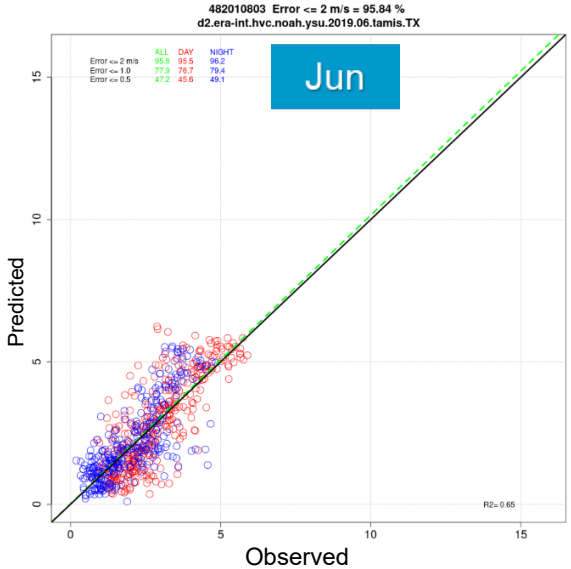


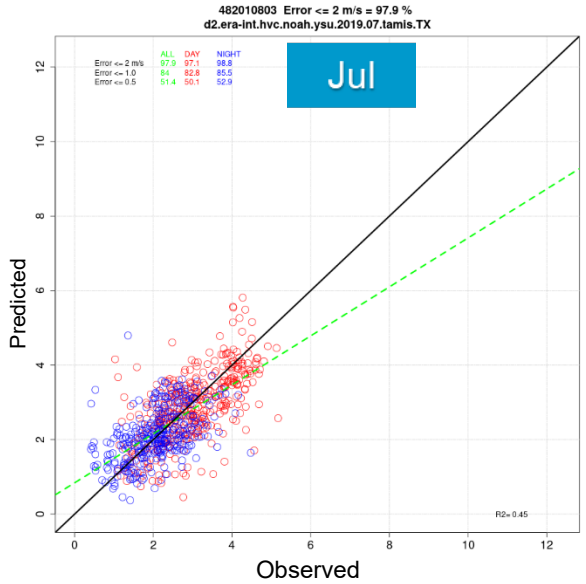


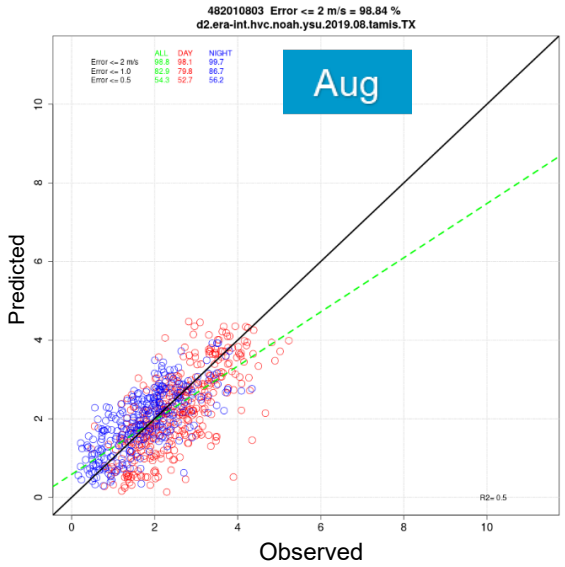
High Nocturnal Bias observed in May, August, and September.

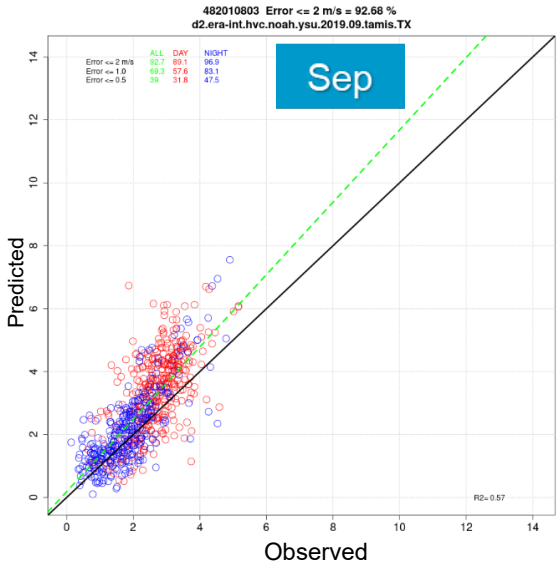
HRM3 Windspeeds
May-September 2019



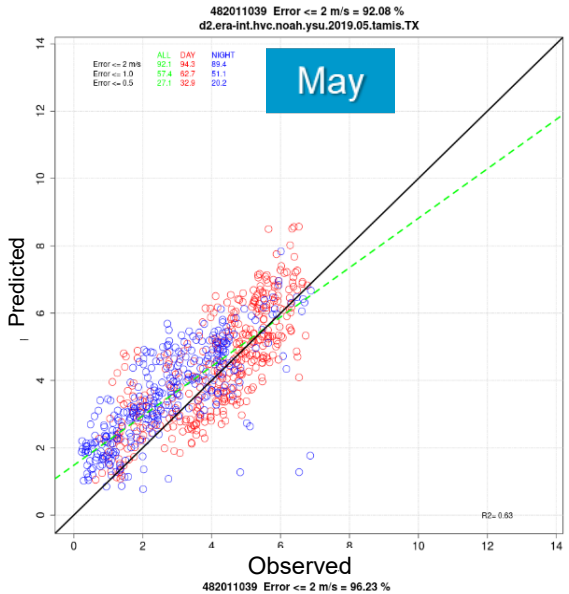


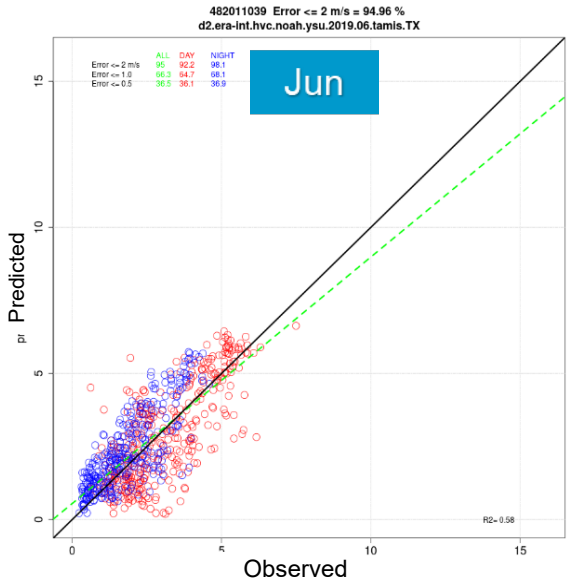


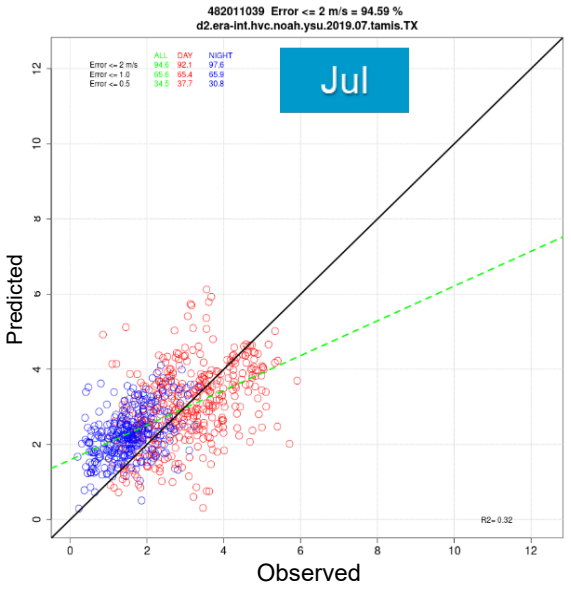


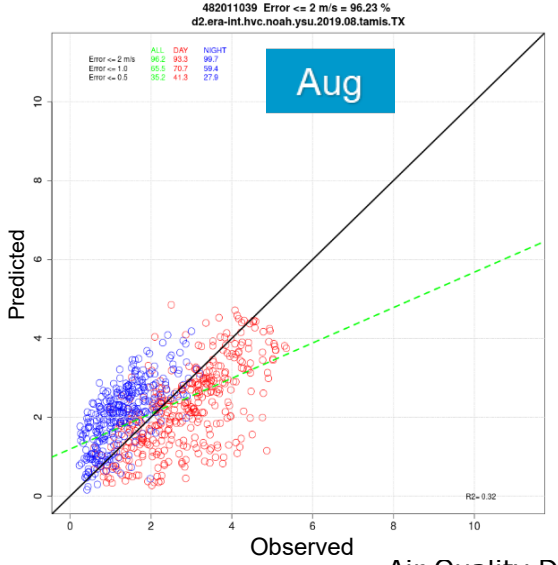


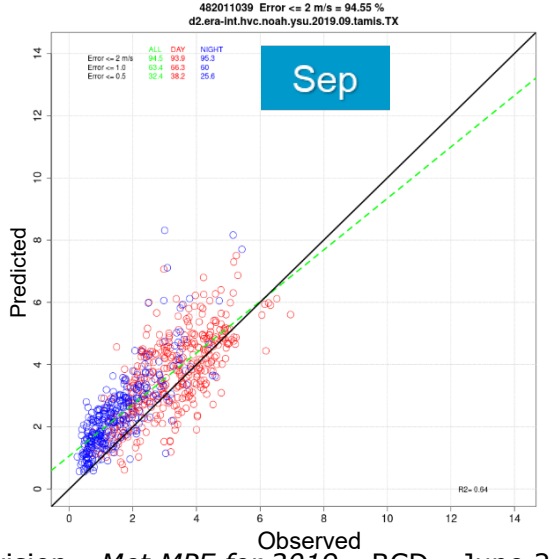
Deer Park Windspeeds May-September 2019





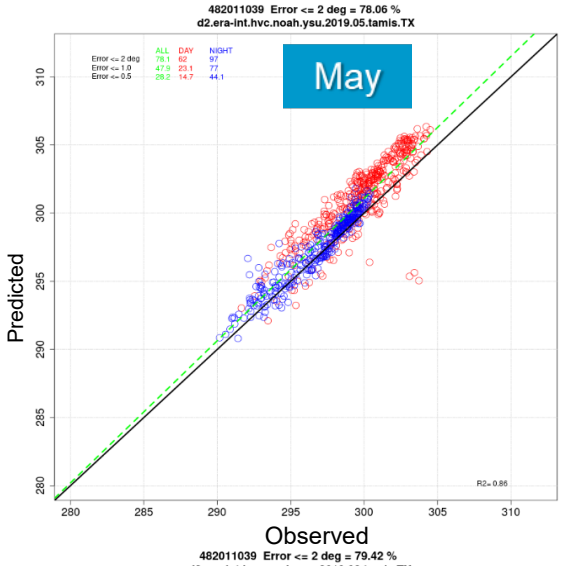


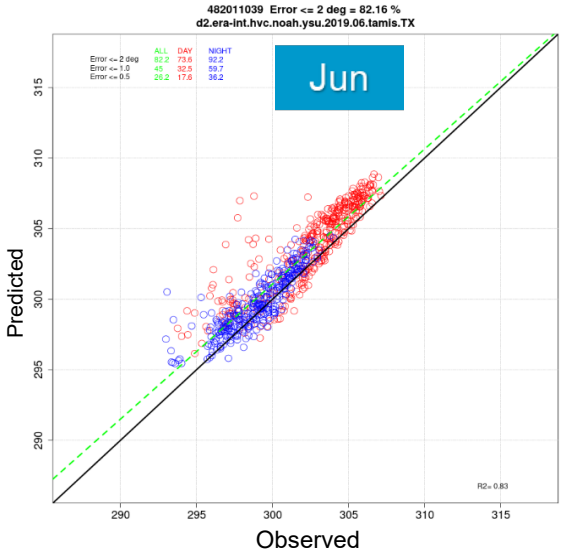


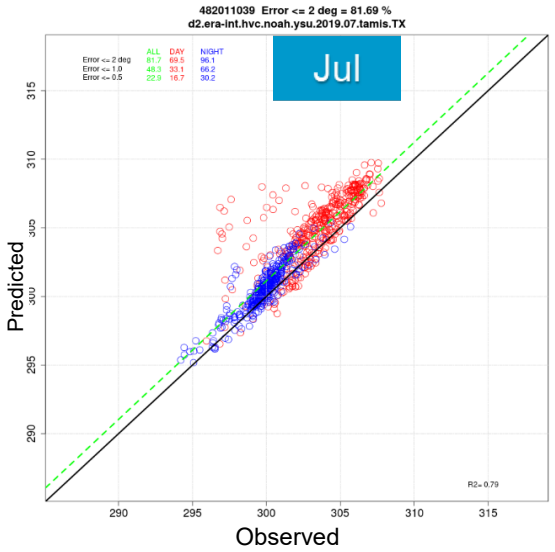


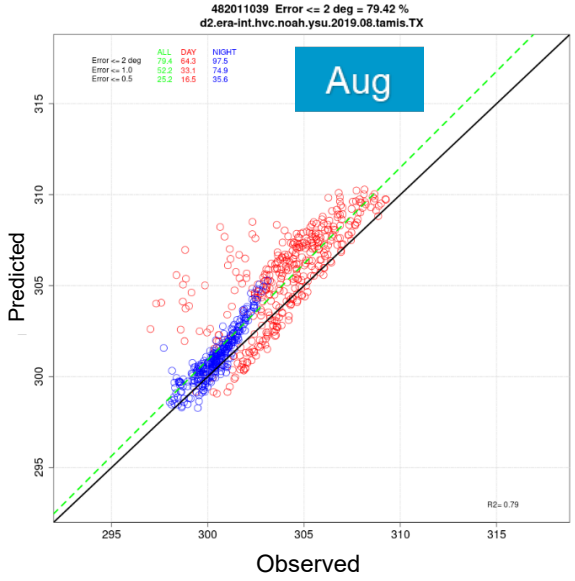
Biases may contribute to ozone underprediction in August.

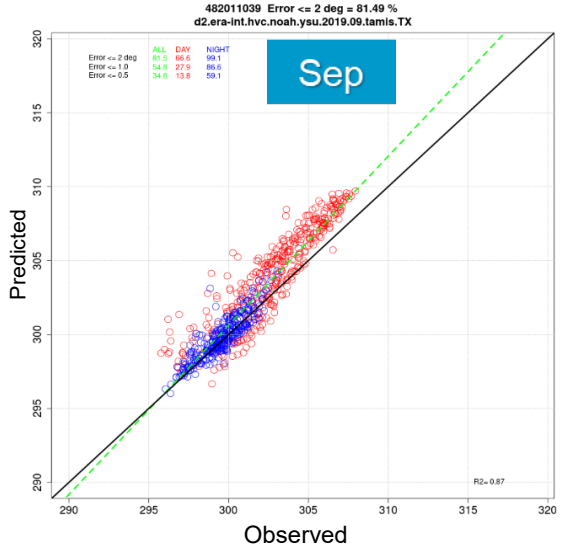
Deer Park Temperatures May-September 2019











Biases might be attributed to clouds or surface energy budget.

Conclusions

- WRF configuration testing for the 2019 Modeling Platform suggests:
  - Select hybrid vertical coordinate system.
  - Select Noah LSM-YSU PBL-KF Cumulus options.
  - Observational nudging does not add to model performance and need not be used.
  - This choice yields reasonable performance based upon traditional measure-oriented statistics.
  - Statistical performance is consistent with benchmarks for met inputs used in photochemical modeling.

Questions?

Bright Dornblaser

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Backup Slides

June 2019

Dallas-Fort Worth																															
Ft. Worth Northwest C13/AH302	2	51	58	36	26	25	52	43	54	48	43	43	50	60	65	39	45	59	57	34	39	33	26	34	54	45	27	31	35	37	57	2	Ft. Worth Northwest C13/AH302
Keller C17	2	56	58	39	29	28	53	42	50	51	43	51	50	59	66	40	NV	61	59	35	41	34	26	40	63	47	27	33	38	36	53	2	Keller C17
Frisco C31/C680	1	65	56	49	44	23	56	43	46	52	46	53	51	51	67	43	50	53	76	46	50	35	30	51	59	55	38	44	53	42	45	1	Frisco C31/C680
Midlothian OFW C52/A137	1	48	40	37	23	24	54	45	64	42	50	47	58	63	56	36	44	69	55	43	33	27	22	39	42	39	29	29	33	40	44	1	Midlothian OFW C52/A137
Denton Airport South C56/A163/X157	1	52	49	45	36	31	51	41	44	54	40	54	48	50	66	41	44	52	67	42	42	35	28	42	65	55	34	43	49	42	46	1	Denton Airport South C56/A163/X157
Arlington Municipal Airport C61	1	50	45	36	23	25	59	45	59	44	45	47	56	68	60	38	48	76	60	NV	NV	26	21	37	NV	37	26	27	32	42	48	1	Arlington Municipal Airport C61
Dallas North No.2 C63/C679	1	66	56	45	32	18	64	46	48	49	45	47	54	56	64	41	47	60	71	43	40	30	25	46	60	47	32	37	44	53	45	1	Dallas North No.2 C63/C679
Rockwall Heath C69	1	54	37	28	25	6	66	36	34	38	40	39	46	44	51	32	41	45	51	NV	NA	NA	NA	NV	38	33	24	NA	NA	NV	34	1	Rockwall Heath C69
Grapevine Fairway C70/A301/X182	1	55	57	40	32	24	56	42	43	50	43	43	48	53	62	40	45	53	61	38	37	29	24	42	62	43	29	36	40	42	47	1	Grapevine Fairway C70/A301/X182
Kaufman C71/A304/X071	1	50	44	42	27	19	65	52	43	42	44	48	63	51	61	41	49	NV	56	36	31	27	20	44	46	40	36	26	31	42	37	1	Kaufman C71/A304/X071
Granbury C73/C681	1	47	46	35	21	36	53	44	60	47	46	46	49	64	62	37	41	55	49	44	36	32	28	32	44	39	26	28	30	37	46	1	Granbury C73/C681
Eagle Mountain Lake C75	1	46	48	38	33	31	54	46	49	56	45	52	53	60	70	41	45	57	55	37	40	35	29	39	68	51	30	35	36	38	62	1	Eagle Mountain Lake C75
Parker County C76	1	49	45	37	25	41	51	44	55	52	43	50	49	65	62	40	41	51	49	40	38	31	28	37	53	49	26	29	32	35	57	1	Parker County C76
Cleburne Airport C77/C682	1	53	48	40	29	33	60	49	72	52	56	52	59	73	76	43	48	69	58	49	47	39	30	40	NV	42	30	33	36	42	53	1	Cleburne Airport C77/C682
Dallas Hinton St. C401/C60/AH161	3	61	51	39	25	19	NV	46	51	NV	NA	NV	53	58	60	39	47	66	65	40	36	28	23	44	52	40	29	32	37	53	45	3	Dallas Hinton St. C401/C60/AH161
Dallas Executive Airport C402	1	54	NV	NV	26	22	67	50	65	NV	NV	NV	59	67	64	42	52	74	66	44	38	NV	24	44	50	40	32	33	39	55	46	1	Dallas Executive Airport C402
Greenville C1006/A198	1	57	44	38	35	14	56	41	40	44	42	41	52	46	60	47	43	47	61	NV	36	27	22	44	40	37	33	26	36	43	40	1	Greenville C1006/A198
Pilot Point C1032	1	53	44	53	41	30	48	43	46	52	45	60	48	51	70	44	48	50	72	53	52	39	33	48	50	NV	41	47	60	41	45	1	Pilot Point C1032
Italy C1044/A323	1	NA	NA	NA	NA	NV	48	46	NA	NV	52	NV	NV	NV	NV	NV	NV	NA	45	40	NV	NA	NA	NA	NA	NA	NA	NA	NA	NV	44	48	1	Italy C1044/A323
Corsicana Airport C1051	1	49	41	42	31	21	55	60	46	47	46	47	70	49	62	39	47	46	58	45	33	25	20	44	42	40	36	31	31	41	47	1	Corsicana Airport C1051

San Antonio																															
San Antonio Northwest C23	2	34	30	27	16	29	49	55	76	52	40	34	57	78	55	33	28	59	53	38	34	27	26	27	44	45	26	29	35	31	38	2	San Antonio Northwest C23
Camp Bullis C58	1	38	34	32	15	27	55	57	58	58	40	32	50	70	59	35	32	51	55	43	38	27	27	28	43	49	27	30	38	34	35	1	Camp Bullis C58
Calaveras Lake C59	1	29	28	27	23	39	48	63	59	50	50	42	58	63	53	29	29	54	42	30	28	27	27	24	44	41	22	25	28	34	41	1	Calaveras Lake C59
Elm Creek Elementary C501	1 N	28	25	22	19	34	44	54	69	47	39	36	68	70	47	29	30	61	43	30	28	24	23	24	39	38	19	23	25	25	36	1	Elm Creek Elementary C501
Fair Oaks Ranch C502	1 N	38	32	30	12	23	46	52	53	54	38	31	44	56	55	32	33	44	50	38	36	25	25	23	40	45	21	31	35	25	31	1	Fair Oaks Ranch C502
Bulverde Elementary C503	1 N	35	32	28	10	23	48	49	48	54	38	28	43	57	54	31	27	43	49	41	35	23	23	24	36	43	21	28	34	29	26	1	Bulverde Elementary C503
New Braunfels Airport C504	1 N	29	23	24	18	33	45	51	56	47	44	34	59	53	55	26	23	50	43	30	28	22	24	20	39	36	19	23	29	32	32	1	New Braunfels Airport C504
City of Garden Ridge C505	1 N	28	24	24	14	25	49	51	55	45	41	33	60	66	52	26	28	45	46	31	27	22	23	22	38	37	19	21	29	38	30	1	City of Garden Ridge C505
Seguin Outdoor Learning Center C506	1 N	28	23	25	17	30	40	47	53	46	43	31	52	57	55	26	23	44	41	30	25	21	21	19	40	34	19	20	28	25	36	1	Seguin Outdoor Learning Center C506
Heritage Middle School C622	1 N	25	23	23	17	33	45	58	57	46	41	35	NV	57	47	23	29	53	37	25	22	21	22	19	39	37	18	21	24	32	42	1	Heritage Middle School C622
CPS Pecan Valley C678	1 N	27	26	23	14	31	46	55	68	47	38	30	59	62	49	26	23	58	40	29	24	19	18	21	37	38	19	22	24	25	40	1	CPS Pecan Valley C678
Government Canyon C1610	1 N	31	27	24	13	25	45	53	72	48	36	33	48	71	49	29	25	42	47	30	31	21	22	21	32	38	22	25	27	25	31	1	Government Canyon C1610

June 2019

Area	Monitoring Site	POC	June 2019																												POC	Monitoring Site
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Houston-Galveston-Brazoria																																		
	Houston East C1/G316	2	65	40	57	34	11	62	56	55	88	36	52	65	53	64	22	31	76	58	27	18	15	19	21	40	17	19	22	39	32	38	2	Houston East C1/G316
	Houston Aldine C8/AF108/X150	2	81	48	72	43	17	62	59	56	72	42	58	70	64	71	22	40	81	61	35	21	20	21	25	47	22	19	28	55	34	50	2	Houston Aldine C8/AF108/X150
	Channelview C15/AH115	3	71	47	45	30	18	56	57	NV	NV	42	50	62	59	67	21	37	76	58	30	19	14	19	23	43	17	18	29	47	33	58	3	Channelview C15/AH115
	Northwest Harris Co. C26/A110/X154	2	42	36	58	42	17	48	54	48	63	41	54	56	54	66	25	NV	NV	49	27	21	22	22	27	51	24	23	22	37	30	34	2	Northwest Harris Co. C26/A110/X154
	Hou.DeerPrk2 C35/235/1001/AFH139FP239	1	63	37	48	32	19	60	59	60	74	45	68	78	66	67	22	37	65	57	25	21	17	22	23	47	21	23	30	32	34	45	1	Hou.DeerPrk2 C35/235/1001/AFH139FP239
	Seabrook Friendship Park C45	1	56	34	37	28	21	43	56	63	57	43	59	67	63	63	20	37	59	46	22	17	16	21	22	47	23	20	27	33	34	56	1	Seabrook Friendship Park C45
	Houston Bayland Park C53/A146	1	46	33	44	30	20	56	59	61	83	54	78	91	80	68	25	43	70	NV	NV	19	22	24	24	50	22	22	22	37	35	40	1	Houston Bayland Park C53/A146
	Conroe Relocated C78/A321	1	41	42	61	51	21	47	51	48	43	40	48	55	50	83	28	43	60	54	36	27	32	29	31	55	33	26	32	38	32	49	1	Conroe Relocated C78/A321
	Manvel Croix Park C84	1	NA	NA	NA	NA	NV	52	52	59	62	54	80	90	79	61	18	38	52	46	21	17	16	19	20	46	20	17	NA	NV	31	28	1	Manvel Croix Park C84
	Clinton C403/C304/AH113	3	55	34	45	26	15	53	51	53	92	44	58	73	62	54	NA	NA	NV	40	20	13	14	17	21	40	13	17	15	27	32	31	3	Clinton C403/C304/AH113
	Houston North Wayside C405	1	66	38	59	32	14	50	49	49	73	39	49	62	53	60	16	31	67	50	24	15	14	16	19	38	14	17	21	36	28	37	1	Houston North Wayside C405
	Houston Monroe C406	1	44	30	41	27	17	54	55	58	69	41	67	81	71	55	19	37	55	49	22	16	15	19	20	43	20	18	24	28	32	32	1	Houston Monroe C406
	Lang C408	2	55	37	51	33	15	52	54	51	88	41	60	74	62	64	23	40	75	51	31	21	20	21	24	43	22	16	21	42	30	41	2	Lang C408
	Houston Croquet C409	2	33	25	35	23	16	48	50	53	68	47	83	84	75	58	20	34	61	46	21	15	17	18	18	42	20	NV	18	28	30	33	2	Houston Croquet C409
	Houston Westhollow C410/C3003	1	39	34	41	27	19	48	52	56	76	47	67	70	65	61	24	43	55	49	22	18	16	19	NV	47	22	21	21	32	30	36	1	Houston Westhollow C410/C3003
	Park Place C416	1	49	33	46	30	14	56	56	57	88	49	68	82	72	61	21	35	65	NV	NV	17	17	21	23	45	20	20	21	31	37	36	1	Park Place C416
	Baytown Wetlands Center C552	1 N	44	30	25	19	12	40	NV	NA	NA	NA	NV	50	48	52	16	23	55	37	14	10	9	13	12	23	8	10	12	16	16	38	1	Baytown Wetlands Center C552
	Crosby Library C553	1 N	50	49	41	28	13	54	37	42	49	35	40	47	42	59	19	29	56	54	28	19	14	18	17	34	16	15	23	45	22	48	1	Crosby Library C553
	West Houston C554	1 N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV	55	56	21	36	48	42	20	16	16	19	21	43	19	NV	NV	NV	NA	NA	1	West Houston C554
	La Porte Sylvan Beach C556	1 N	37	24	24	19	15	30	37	42	35	28	39	45	51	51	17	28	46	32	13	12	12	18	18	35	17	15	NV	29	32	52	1	La Porte Sylvan Beach C556
	Tom Bass C558	1 N	NV	NA	NA	NA	26	55	55	60	73	54	79	91	80	62	33	39	60	52	28	23	25	NA	NV	38	26	24	27	30	35	35	1	Tom Bass C558
	Katy Park C559	1 N	41	33	43	28	19	41	49	55	71	41	60	58	58	65	23	41	51	47	21	17	16	14	17	47	22	21	22	30	31	35	1	Katy Park C559
	Atascocita C560	1 N	53	40	46	29	12	39	38	35	39	28	35	43	39	59	30	32	56	43	26	15	13	15	18	38	15	12	23	38	22	38	1	Atascocita C560
	Meyer Park C561	1 N	56	39	63	45	16	43	48	45	60	NA	NA	NV	53	68	23	37	63	47	28	20	23	22	24	48	23	22	21	39	27	40	1	Meyer Park C561
	Huffman Wolf Road C563	1 N	29	36	30	21	13	33	30	27	28	25	27	31	27	40	14	24	36	35	24	18	13	15	16	27	15	13	17	25	19	32	1	Huffman Wolf Road C563
	HRM-3 Haden Road C603/A114	1 N	69	41	52	32	14	59	55	54	86	40	53	64	56	59	19	33	75	57	27	18	15	19	24	42	15	NV	26	39	31	41	1	HRM-3 Haden Road C603/A114
	Wallisville Road C617	1 N	56	53	37	28	22	65	57	53	62	42	52	58	53	66	22	38	76	61	28	NA	NV	25	27	46	21	22	26	48	33	57	1	Wallisville Road C617
	Danciger C618	1 N	23	20	24	18	19	43	36	52	57	60	53	57	73	55	19	40	50	42	18	19	17	21	18	47	22	20	20	23	28	30	1	Danciger C618
	Texas City 34th St. C620	1 N	46	31	42	28	24	51	54	73	74	47	72	83	77	68	23	44	59	51	25	20	20	26	26	55	26	23	30	38	35	47	1	Texas City 34th St. C620
	UH Moody Tower C695	1 N	52	36	50	32	16	62	59	59	93	49	69	83	75	65	23	39	77	58	26	19	18	22	25	48	23	22	25	37	38	40	1	UH Moody Tower C695
	UH WG Jones Forest C698	1 N	59	48	71	55	20	49	55	51	51	43	53	60	55	83	28	NV	64	NV	35	26	30	28	30	59	32	27	29	36	31	52	1	UH WG Jones Forest C698
	UH West Liberty C699	1 N	40	57	43	28	18	57	49	43	44	40	43	51	46	65	21	38	58	55	37	NV	18	21	25	43	23	19	25	46	31	51	1	UH West Liberty C699
	Lynchburg Ferry C1015/A165	1	70	44	38	NV	NV	58	55	48	69	32	49	58	61	66	22	38	77	53	27	21	17	22	25	46	18	19	26	47	31	59	1	Lynchburg Ferry C1015/A165
	Lake Jackson C1016	1	23	21	22	20	22	38	35	50	48	63	54	57	68	59	20	42	47	41	18	17	17	21	18	49	25	22	24	26	29	31	1	Lake Jackson C1016
	Baytown Garth C1017	1	57	55	39	30	23	68	58	53	63	42	49	56	52	67	24	40	76	63	30	22	19	25	28	50	24	23	28	50	36	58	1	Baytown Garth C1017
	Galveston 99th St. C1034/A320/X183	1	43	24	38	28	25	53	43	81	73	44	72	73	81	70	21	45	51	48	29	17	20	25	23	55	29	26	29	38	40	42	1	Galveston 99th St. C1034/A320/X183
	UH Smith Point C1606	1 N	NV	NV	NA	NA	NV	NA	NA	NV	NA	NV	NV	NV	NV	NA	NA	NA	NA	NV	26	NV	NA	NA	NV	NV	NA	NA	NV	NV	NV	56	1	UH Smith Point C1606
	Oyster Creek C1607	1 N	NV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV	32	15	12	NA	NA	NA	NA	NA	NA	NV	29	31	33	1	Oyster Creek C1607

July 2019

Area	Monitoring Site	POC	July 2019																													POC	Monitoring Site
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
Dallas-Fort Worth																																			
	Ft. Worth Northwest C13/AH302	2	36	34	35	32	31	31	35	32	41	45	51	53	50	33	42	37	32	33	34	34	33	41	46	60	64	62	64	32	37	57	61	2	Ft. Worth Northwest C13/AH302
	Keller C17	2	39	35	34	30	32	NV	33	30	41	48	46	45	49	32	47	42	35	37	36	36	38	NV	42	59	71	64	64	33	39	60	60	2	Keller C17
	Frisco C31/C680	1	51	43	41	36	37	43	43	48	45	56	50	45	42	29	52	49	41	39	38	40	45	45	44	52	57	58	60	39	43	62	57	1	Frisco C31/C680
	Midlothian OFW C52/A137	1	32	32	32	27	29	27	30	29	33	37	54	54	49	33	43	36	32	32	30	33	31	47	48	56	51	50	55	30	34	55	48	1	Midlothian OFW C52/A137
	Denton Airport South C56/A163/X157	1	51	45	42	35	35	32	38	35	46	57	49	45	49	31	41	46	40	40	40	40	42	43	45	52	64	71	70	40	43	62	71	1	Denton Airport South C56/A163/X157
	Arlington Municipal Airport C61	1	32	32	32	28	29	27	NV	29	33	NV	NV	59	45	29	48	35	31	32	30	30	30	45	48	64	53	54	57	29	33	61	49	1	Arlington Municipal Airport C61
	Dallas North No.2 C63/C679	1	43	37	37	32	32	40	45	42	38	49	47	46	44	30	60	44	NV	34	34	34	37	45	42	50	56	54	57	33	40	60	55	1	Dallas North No.2 C63/C679
	Rockwall Heath C69	1	24	NV	NA	NA	NA	NV	NA	NA	NV	27	38	36	NA	NV	NV	NA	NA	NA	NA	NV	26	36	37	NV	52	50	50	NA	NV	NV	NV	1	Rockwall Heath C69
	Grapevine Fairway C70/A301/X182	1	42	35	34	30	31	37	33	35	37	51	44	45	43	27	49	39	33	33	32	33	35	40	43	53	62	60	59	32	36	60	59	1	Grapevine Fairway C70/A301/X182
	Kaufman C71/A304/X071	1	29	30	29	24	27	24	29	27	33	37	42	40	34	23	51	28	29	29	31	33	32	48	40	45	49	48	49	30	35	56	47	1	Kaufman C71/A304/X071
	Granbury C73/C681	1	32	33	33	33	30	27	32	26	39	40	60	61	53	35	35	37	33	35	35	34	31	46	50	80	57	57	67	33	39	42	57	1	Granbury C73/C681
	Eagle Mountain Lake C75	1	40	39	39	35	34	NV	NA	NA	NV	52	54	52	52	35	39	41	36	37	38	38	37	47	50	64	82	74	74	36	39	58	68	1	Eagle Mountain Lake C75
	Parker County C76	1	35	34	35	34	29	28	32	NV	39	46	53	53	52	36	34	38	34	36	35	35	33	46	45	62	68	61	68	34	35	53	60	1	Parker County C76
	Cleburne Airport C77/C682	1	33	37	38	34	37	28	32	27	43	45	72	83	60	40	41	39	37	38	36	38	33	41	60	75	60	59	69	33	39	47	55	1	Cleburne Airport C77/C682
	Dallas Hinton St. C401/C60/AH161	3	34	32	33	28	28	35	38	34	33	42	47	48	44	29	56	38	31	30	30	27	33	44	43	52	56	51	54	28	33	59	48	3	Dallas Hinton St. C401/C60/AH161
	Dallas Executive Airport C402	1	37	34	36	31	31	32	37	36	37	45	55	56	48	34	63	37	34	34	33	32	37	53	48	62	59	54	58	30	38	67	50	1	Dallas Executive Airport C402
	Greenville C1006/A198	1	36	30	29	28	26	29	39	34	NV	35	43	40	34	23	44	32	30	31	30	32	29	44	40	43	49	50	51	32	23	53	45	1	Greenville C1006/A198
	Pilot Point C1032	1	55	51	48	41	42	NV	43	37	50	57	49	44	48	30	43	53	45	44	44	44	50	43	46	51	56	58	63	46	43	60	58	1	Pilot Point C1032
	Italy C1044/A323	1	36	32	33	27	28	31	31	33	31	42	53	52	45	35	38	35	NV	NA	NV	30	32	53	47	NV	55	52	55	28	39	43	49	1	Italy C1044/A323
	Corsicana Airport C1051	1	29	32	29	25	29	27	31	31	35	39	40	45	36	27	38	31	34	32	32	34	35	44	NV	50	56	53	52	29	29	40	43	1	Corsicana Airport C1051
San Antonio																																			
	San Antonio Northwest C23	2	44	35	28	30	29	30	32	37	37	50	46	54	48	39	50	31	29	33	34	33	32	44	46	57	76	75	66	27	31	36	47	2	San Antonio Northwest C23
	Camp Bullis C58	1	47	38	31	31	32	35	35	45	41	56	46	53	49	39	59	35	32	37	37	36	36	50	46	58	69	76	67	29	35	42	50	1	Camp Bullis C58
	Calaveras Lake C59	1	39	30	25	25	27	27	30	32	33	36	52	55	51	49	35	NV	26	30	31	29	28	29	53	57	57	64	57	25	27	32	35	1	Calaveras Lake C59
	Elm Creek Elementary C501	1 N	36	29	23	26	25	26	26	29	27	34	47	63	52	41	38	26	25	28	30	28	27	28	44	59	67	69	50	23	27	27	31	1	Elm Creek Elementary C501
	Fair Oaks Ranch C502	1 N	43	36	28	30	30	33	31	40	37	51	40	44	43	33	53	32	29	34	34	33	33	42	42	49	60	67	62	25	33	38	46	1	Fair Oaks Ranch C502
	Bulverde Elementary C503	1 N	40	33	26	25	27	30	31	39	39	48	41	47	42	30	52	32	28	33	33	32	31	43	41	51	58	64	54	25	33	43	45	1	Bulverde Elementary C503
	New Braunfels Airport C504	1 N	35	29	22	22	24	25	29	32	32	32	48	52	43	34	40	27	26	29	28	27	28	30	42	51	54	57	49	21	28	28	34	1	New Braunfels Airport C504
	City of Garden Ridge C505	1 N	36	29	24	23	24	26	30	30	33	35	46	54	44	34	44	27	25	30	29	27	28	38	46	56	56	60	48	21	24	39	34	1	City of Garden Ridge C505
	Seguin Outdoor Learning Center C506	1 N	35	27	20	20	24	24	28	29	32	30	44	49	42	34	37	26	25	29	29	28	28	26	44	47	52	57	47	20	28	27	32	1	Seguin Outdoor Learning Center C506
	Heritage Middle School C622	1 N	34	24	22	21	23	24	26	27	29	30	46	52	49	45	32	25	22	27	28	26	25	21	48	55	56	60	52	21	23	23	28	1	Heritage Middle School C622
	CPS Pecan Valley C678	1 N	34	26	20	20	23	22	26	30	29	33	46	54	48	41	35	26	23	28	29	27	26	31	44	56	59	61	54	22	25	25	34	1	CPS Pecan Valley C678
	Government Canyon C1610	1 N	39	31	24	28	27	26	26	31	24	45	39	43	47	35	45	27	26	29	30	28	27	39	42	52	72	55	57	23	28	30	42	1	Government Canyon C1610

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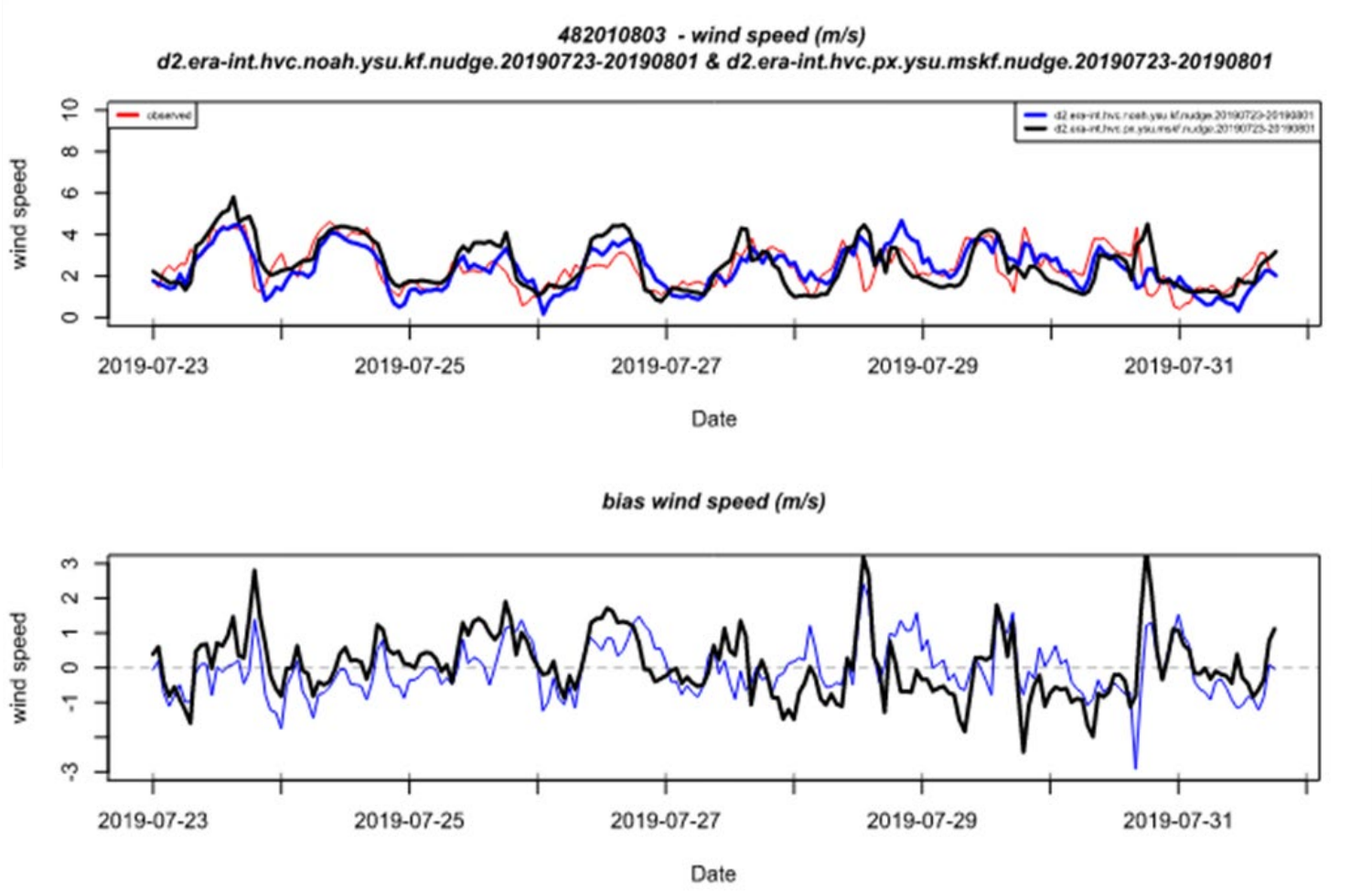
Houston-Galveston-Brazoria																																			
Houston East C1/G316	2	43	28	25	18	24	42	38	29	31	57	39	43	33	39	26	26	25	24	22	24	26	23	28	36	NV	NV	46	23	19	30	54	2	Houston East C1/G316
Houston Aldine C8/AF108/X150	2	52	33	30	24	33	47	42	38	45	66	39	NV	37	40	27	30	30	32	30	29	33	36	37	51	54	64	55	28	24	34	52	2	Houston Aldine C8/AF108/X150
Channelview C15/AH115	3	45	28	23	21	25	61	45	30	31	56	39	48	33	41	26	27	23	23	23	25	30	24	33	41	48	57	44	23	22	32	39	3	Channelview C15/AH115
Northwest Harris Co. C26/A110/X154	2	43	31	29	22	27	36	28	30	32	36	40	47	35	36	29	27	28	30	29	30	26	26	37	49	51	60	54	21	23	27	42	2	Northwest Harris Co. C26/A110/X154
Hou.DeerPrk2 C35/235/1001/AFH139FP239	1	43	28	25	19	21	37	32	23	27	44	50	49	36	40	28	26	22	24	23	23	26	25	36	47	64	59	47	25	22	31	47	1	Hou.DeerPrk2 C35/235/1001/AFH139FP239
Seabrook Friendship Park C45	1	41	24	23	18	17	35	33	22	23	33	46	44	34	34	23	20	20	19	20	19	24	24	30	40	51	47	37	21	19	24	37	1	Seabrook Friendship Park C45
Houston Bayland Park C53/A146	1	44	29	NV	21	23	34	35	29	33	49	59	59	42	40	27	24	28	27	25	27	28	NV	43	60	74	73	56	28	23	31	53	1	Houston Bayland Park C53/A146
Conroe Relocated C78/A321	1	56	35	43	31	47	51	34	39	48	42	33	47	35	33	30	35	NV	43	44	43	28	32	38	47	46	51	45	29	28	27	32	1	Conroe Relocated C78/A321
Manvel Croix Park C84	1	36	19	16	NV	NV	NV	30	25	27	42	NA	NV	42	36	24	19	23	24	20	22	22	23	39	55	79	57	44	24	18	26	37	1	Manvel Croix Park C84
Clinton C403/C304/AH113	3	33	21	18	17	19	31	30	22	25	53	47	49	37	39	22	22	21	21	18	22	24	20	36	44	59	62	45	23	15	24	46	3	Clinton C403/C304/AH113
Houston North Wayside C405	1	41	25	22	18	24	37	35	26	30	54	39	43	32	33	20	23	23	23	22	23	25	24	32	40	45	55	47	22	18	25	49	1	Houston North Wayside C405
Houston Monroe C406	1	37	22	23	18	20	31	29	23	25	39	52	49	40	37	24	24	23	21	19	21	22	22	31	45	69	53	43	25	20	NV	39	1	Houston Monroe C406
Lang C408	2	42	30	26	20	25	40	35	31	39	53	45	47	36	39	29	24	28	27	26	27	28	26	34	50	60	64	59	25	20	28	56	2	Lang C408
Houston Croquet C409	2	39	23	22	17	19	28	29	22	24	43	54	53	37	36	23	21	25	23	21	24	24	24	37	54	77	60	49	24	18	29	42	2	Houston Croquet C409
Houston Westhollow C410/C3003	1	39	28	26	21	23	37	31	25	28	NV	53	52	36	NV	25	25	25	24	23	26	27	23	41	58	73	76	64	24	21	NV	49	1	Houston Westhollow C410/C3003
Park Place C416	1	40	24	25	20	24	34	33	26	29	48	54	51	40	40	27	26	27	24	23	24	25	23	34	45	69	61	48	26	20	30	47	1	Park Place C416
Baytown Wetlands Center C552	1 N	24	15	10	9	10	24	19	13	14	31	22	32	22	28	12	11	13	18	20	23	27	22	34	45	54	54	38	22	19	30	36	1	Baytown Wetlands Center C552
Crosby Library C553	1 N	41	26	20	17	27	54	37	29	32	41	34	45	31	40	26	27	27	26	26	27	32	29	31	40	47	59	39	26	24	31	34	1	Crosby Library C553
West Houston C554	1 N	NA	NV	28	30	21	37	26	29	24	NV	NV	44	24	33	17	NV	27	24	23	25	NV	19	37	42	NV	46	54	35	23	24	51	1	West Houston C554
La Porte Sylvan Beach C556	1 N	38	22	22	17	16	32	30	21	21	32	38	42	31	34	21	18	19	18	19	19	24	22	28	39	44	42	34	21	16	27	32	1	La Porte Sylvan Beach C556
Tom Bass C558	1 N	41	27	28	22	24	32	30	27	27	41	59	48	43	40	24	26	23	25	24	24	28	27	38	51	82	59	45	31	23	31	45	1	Tom Bass C558
Katy Park C559	1 N	36	26	25	18	18	26	28	24	24	32	40	43	35	36	26	22	23	23	23	25	26	25	42	57	70	81	53	NV	NV	NV	NA	1	Katy Park C559
Atascocita C560	1 N	41	23	20	15	26	43	31	29	31	43	25	33	23	27	19	22	21	20	28	29	28	25	30	40	41	54	45	23	22	27	39	1	Atascocita C560
Meyer Park C561	1 N	45	27	25	21	29	41	31	32	37	46	38	44	32	33	26	27	27	32	30	31	26	27	38	53	54	63	56	22	21	26	43	1	Meyer Park C561
Huffman Wolf Road C563	1 N	29	19	18	15	25	37	26	24	26	27	21	28	18	19	16	20	19	20	NV	NA	NA	NV	36	43	47	64	47	33	33	34	37	1	Huffman Wolf Road C563
HRM-3 Haden Road C603/A114	1 N	42	26	22	NV	NV	41	NV	27	29	52	36	43	32	36	25	19	25	25	22	23	26	NV	33	42	55	60	40	22	19	30	47	1	HRM-3 Haden Road C603/A114
Wallisville Road C617	1 N	NV	NV	25	24	28	52	50	32	34	56	38	48	33	39	29	25	28	26	27	28	33	28	36	44	51	61	45	26	25	36	46	1	Wallisville Road C617
Danciger C618	1 N	34	23	20	16	15	25	25	19	20	25	48	56	37	35	20	19	19	19	17	18	22	21	45	66	66	57	41	17	17	26	28	1	Danciger C618
Texas City 34th St. C620	1 N	43	29	28	23	20	35	35	24	24	33	61	58	46	38	29	25	25	24	24	23	27	29	42	48	65	52	43	25	23	24	41	1	Texas City 34th St. C620
UH Moody Tower C695	1 N	42	27	28	21	26	36	38	28	32	55	53	54	42	41	28	29	28	27	25	25	27	29	39	50	67	70	53	28	23	31	54	1	UH Moody Tower C695
UH WG Jones Forest C698	1 N	57	40	39	28	41	50	35	39	49	42	39	50	37	35	31	35	38	41	43	40	31	31	41	51	51	57	50	26	27	28	41	1	UH WG Jones Forest C698
UH West Liberty C699	1 N	42	29	23	22	35	53	42	37	40	42	32	45	27	32	26	29	27	30	28	29	30	27	32	40	44	61	41	28	30	31	33	1	UH West Liberty C699
Lynchburg Ferry C1015/A165	1	42	29	22	20	20	50	38	24	25	52	30	38	27	36	26	25	22	21	23	23	25	23	28	38	47	53	42	23	21	30	40	1	Lynchburg Ferry C1015/A165
Lake Jackson C1016	1	37	23	19	17	15	24	26	17	18	19	59	60	38	35	22	21	19	19	17	18	20	21	47	52	63	NV	NA	NA	NV	21	30	1	Lake Jackson C1016
Baytown Garth C1017	1	44	29	25	23	27	53	52	34	34	57	37	47	33	38	28	24	27	26	26	26	32	29	35	43	49	60	44	25	24	36	43	1	Baytown Garth C1017
Galveston 99th St. C1034/A320/X183	1	40	27	25	21	20	32	32	20	19	25	66	52	45	34	29	22	22	21	22	20	25	26	35	46	59	48	39	24	20	20	34	1	Galveston 99th St. C1034/A320/X183
UH Smith Point C1606	1 N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV	37	1	UH Smith Point C1606
Oyster Creek C1607	1 N	39	25	23	17	15	26	29	17	18	20	55	62	40	30	24	20	19	NV	17	17	21	21	46	49	58	50	37	19	18	21	31	1	Oyster Creek C1607

August 2019

Area	Monitoring Site	POC	August 2019 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	POC	Monitoring Site
El Paso-Juarez																																			
	El Paso UTEP C12/A125/X151/G125	2	57	59	64	65	83	62	75	59	57	72	57	46	51	58	75	54	50	47	67	57	55	57	50	52	54	51	68	66	62	62	50	2	El Paso UTEP C12/A125/X151/G125
	Ascarate Park SE C37/A332/A172/X159	1	60	NV	NA	NA	NA	NA	NV	57	54	68	52	42	NV	56	73	55	52	52	NV	49	45	NV	49	49	50	48	56	59	63	NV	NA	1	Ascarate Park SE C37/A332/A172/X159
	Chamizal C41/AH126	1	63	61	60	65	79	64	71	62	61	75	NV	NV	50	53	71	58	53	51	65	53	49	65	51	56	56	51	61	65	66	62	47	1	Chamizal C41/AH126
	Socorro Hueco C49/F312	1	57	50	54	57	67	61	65	71	64	67	57	49	52	56	61	58	56	55	50	50	47	64	62	54	57	56	53	53	59	58	46	1	Socorro Hueco C49/F312
	Skyline Park C72	1	68	64	54	60	76	61	75	61	64	78	59	47	51	57	62	57	50	53	56	53	51	64	57	54	51	51	59	68	63	70	47	1	Skyline Park C72
	Ivanhoe C414/F514	1	59	58	50	59	71	60	71	66	65	70	58	46	49	55	74	60	51	55	61	48	47	70	57	54	55	54	53	56	65	64	43	1	Ivanhoe C414/F514

Area	Monitoring Site	POC	August 2019 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	POC	Monitoring Site
Houston-Galveston-Brazoria																																			
	Houston East C1/G316	2	53	57	55	36	37	30	25	27	27	25	28	33	38	54	74	NV	19	18	20	22	24	25	16	38	23	NV	27	43	49	38	48	2	Houston East C1/G316
	Houston Aldine C8/AF108/X150	2	55	64	55	50	60	41	33	38	35	31	36	46	51	54	69	68	NV	NA	NA	NV	33	33	25	45	23	25	34	34	65	50	56	2	Houston Aldine C8/AF108/X150
	Channelview C15/AH115	3	44	51	55	42	52	33	28	30	31	27	29	35	45	51	57	59	26	21	24	24	28	25	22	39	26	24	35	35	43	38	47	3	Channelview C15/AH115
	Northwest Harris Co. C26/A110/X154	2	46	46	35	39	38	36	26	31	30	26	30	33	34	33	47	55	29	23	32	21	31	50	30	45	26	28	33	40	70	54	53	2	Northwest Harris Co. C26/A110/X154
	Hou.DeerPrk2 C35/235/1001/AFH139FP239	1	46	67	64	35	35	31	22	29	29	25	29	31	33	59	107	62	22	18	22	NV	25	29	22	37	29	24	29	44	44	43	52	1	Hou.DeerPrk2 C35/235/1001/AFH139FP239
	Seabrook Friendship Park C45	1	34	47	48	29	29	25	19	27	25	18	23	25	27	45	90	53	19	15	18	21	21	24	24	30	25	20	25	28	37	44	46	1	Seabrook Friendship Park C45
	Houston Bayland Park C53/A146	1	73	69	60	38	42	32	25	34	33	28	28	36	38	52	73	51	25	21	24	26	29	35	29	49	26	26	27	47	NV	37	76	1	Houston Bayland Park C53/A146
	Conroe Relocated C78/A321	1	40	44	35	39	39	47	39	34	44	39	36	47	41	33	41	51	34	29	45	35	40	35	27	29	28	37	48	31	52	42	49	1	Conroe Relocated C78/A321
	Manvel Croix Park C84	1	38	47	44	32	28	24	18	25	23	19	23	25	25	41	63	36	19	16	18	19	21	26	22	36	23	21	21	32	44	29	56	1	Manvel Croix Park C84
	Clinton C403/C304/AH113	3	57	60	57	35	NV	26	19	23	20	21	25	24	30	51	78	48	18	17	19	18	21	26	17	36	23	18	16	39	46	35	46	3	Clinton C403/C304/AH113
	Houston North Wayside C405	1	49	51	50	39	44	31	23	26	24	23	28	34	41	46	64	56	21	17	22	20	27	31	16	39	21	20	25	32	54	40	47	1	Houston North Wayside C405
	Houston Monroe C406	1	49	58	53	32	31	25	19	25	23	21	26	NV	NV	NV	82	49	20	19	20	21	21	28	21	35	24	21	22	40	50	32	61	1	Houston Monroe C406
	Lang C408	2	60	67	52	39	45	33	27	31	33	33	28	38	41	48	64	54	25	21	27	24	32	36	24	49	23	27	31	38	69	42	63	2	Lang C408
	Houston Croquet C409	2	56	57	51	32	33	25	19	25	23	20	23	27	27	45	65	40	20	16	18	20	22	28	25	39	23	22	21	37	50	30	65	2	Houston Croquet C409
	Houston Westhollow C410/C3003	1	72	62	49	37	35	29	22	27	26	24	28	27	33	44	60	43	24	20	25	21	25	34	31	46	23	24	27	40	60	38	67	1	Houston Westhollow C410/C3003
	Park Place C416	1	59	70	61	34	36	29	21	27	25	22	28	29	31	56	86	55	22	18	23	24	26	29	24	41	25	23	24	49	61	36	58	1	Park Place C416
	Sheldon C551	1 N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV	29	1	Sheldon C551
	Baytown Wetlands Center C552	1 N	35	57	60	33	39	31	21	27	27	20	26	29	32	54	67	49	20	14	17	20	24	23	22	29	29	20	27	33	31	33	46	1	Baytown Wetlands Center C552
	Crosby Library C553	1 N	36	45	47	39	43	39	31	30	30	29	34	41	49	39	41	49	26	20	28	28	34	25	25	34	25	26	39	24	43	35	40	1	Crosby Library C553
	West Houston C554	1 N	45	57	41	33	35	29	19	50	49	20	34	33	31	33	65	NV	NA	NA	NV	15	NV	NA	NA	NA	NA	NA	NV	38	62	38	61	1	West Houston C554
	La Porte Sylvan Beach C556	1 N	30	42	47	26	29	25	17	23	22	16	21	23	23	49	72	49	18	14	15	18	20	22	23	26	23	16	21	26	31	38	41	1	La Porte Sylvan Beach C556
	Mercer Arboretum C557	1 N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NV	22	31	29	25	33	18	27	37	23	45	46	43	1	Mercer Arboretum C557
	Tom Bass C558	1 N	52	56	53	35	35	NV	NA	NV	24	21	24	27	27	48	74	44	21	18	21	22	23	30	24	39	24	23	24	40	53	31	62	1	Tom Bass C558
	Katy Park C559	1 N	NA	NA	NA	NA	NA	NV	22	27	25	22	25	27	32	39	55	44	24	21	24	21	25	37	33	45	22	25	25	38	56	37	59	1	Katy Park C559
	Atascocita C560	1 N	41	43	43	44	49	37	31	31	28	29	32	43	45	33	NV	NV	27	23	30	28	35	29	27	34	26	29	41	17	46	44	45	1	Atascocita C560
	Meyer Park C561	1 N	49	51	44	43	44	32	26	28	30	33	31	39	43	36	50	58	26	23	33	22	35	44	25	47	22	28	36	34	67	61	55	1	Meyer Park C561
	Bunker Hill Village C562	1 N	NA	NA	NA	NA	NA	NA	NV	24	26	27	24	29	33	40	55	33	17	15	17	16	23	28	23	39	17	23	24	33	54	29	58	1	Bunker Hill Village C562
	Huffman Wolf Road C563	1 N	43	44	42	46	42	46	40	39	41	40	38	51	51	39	42	52	33	28	37	40	40	28	30	34	30	34	46	26	49	39	45	1	Huffman Wolf Road C563
	HRM-3 Haden Road C603/A114	1 N	50	60	54	36	40	28	24	NV	NV	24	28	33	41	53	NV	NV	22	NV	NV	24	24	28	18	40	26	23	31	49	44	40	48	1	HRM-3 Haden Road C603/A114
	Wallisville Road C617	1 N	41	55	54	42	49	39	29	NA	NA	NA	NA	NA	NV	42	43	50	24	21	24	26	31	25	27	37	32	28	35	35	38	35	48	1	Wallisville Road C617
	Danciger C618	1 N	32	35	36	30	18	24	NV	NV	23	20	25	24	24	28	NV	NV	21	NA	NA	NV	9	14	12	16	10	13	10	12	NV	NV	43	1	Danciger C618
	Texas City 34th St. C620	1 N	40	47	51	35	30	25	NV	28	25	NA	NA	NV	NA	NA	NA	NA	NA	NA	NA	NV	19	20	27	26	29	28	19	25	31	42	47	50	1	Texas City 34th St. C620
	UH Moody Tower C695	1 N	66	67	63	37	43	33	23	29	27	24	28	34	39	58	88	61	24	20	26	26	29	33	26	45	26	25	28	54	67	40	66	1	UH Moody Tower C695

HRM3 July 23-31



Noah LSM,YSU,KF

PX LSM, YSU, mfKF