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Statistical analysis of AIRPACT ozone forecasts in the Treasure Valley of southwest Idaho

Kimi Smith, Technical Services Division

Motivation

- In 2019, AIRPACT added no skill when forecasting daily AQI compared to the IDEQ regional forecasters
- Ozone is a pollutant of concern in SW Idaho

Table A3. 2017–2019 ozone preliminary design values.

Site	County/ AQS ID	4th-Highest Daily Maximum 8-Hour Average (ppm)			3-Year Design Value (ppm)
		2017	2018	2019	
Boise—White Pine	Ada 160010017	0.076/0.068	0.068/0.064	0.052/0.052	0.065/0.061
Meridian— St. Luke's	Ada 160010010	0.071/0.069	0.067/0.066	0.057/0.057	0.065/0.064

Notes: A monitor violates the 8-hour ozone National Ambient Air Quality Standard if the 3-year average of the annual 4th-highest daily maximum average exceeds 0.070 parts per million (ppm). Concentration data are denoted with/without exceptional event data included. AQS = air quality system; ID = identification

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Data

- From the AIRPACT website: downloaded modeled hourly ozone concentrations and AIRNow observations at the St. Luke's site in Meridian for 2017, 2018, 2019, 2020 (Aug.)

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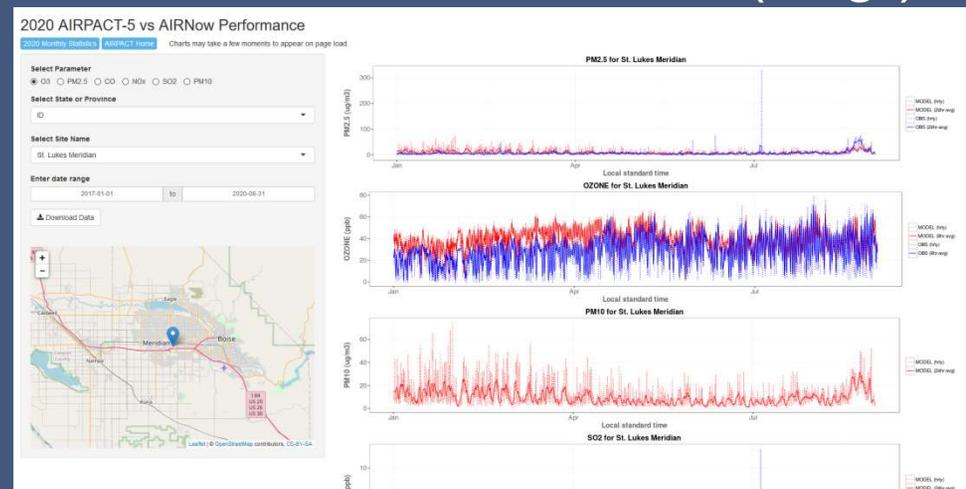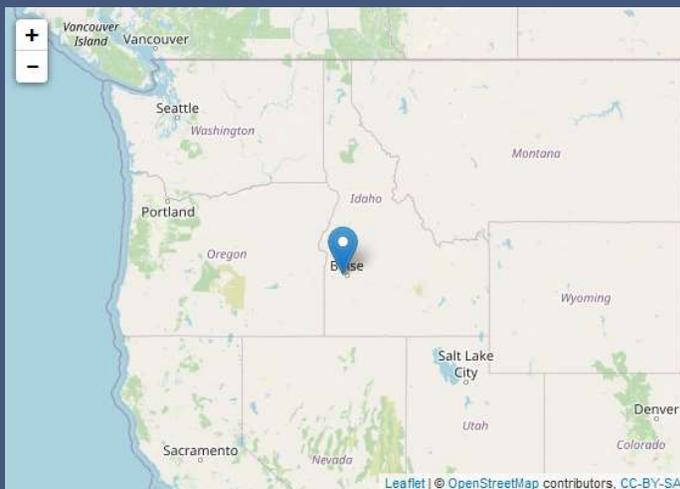
Methods

- Completed a statistical analysis including:
  - Categorical and error statistics: false alarm rate (FAR), probability of detection (POD), critical success index (CSI), root mean square error (RMSE), scatter index (SI), mean absolute error (MAE)
  - Forecast verification: two-category forecast table

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Categorical and Error Statistics

- Selected AQI > 50 as the threshold because IDEQ forecasters are most accurate at forecasting AQI below that threshold
- Accuracy drops off considerably at AQI values above 50 – most critical for public health
- Is AIRPACT helpful for forecasting values above AQI 50?
- AQI 50 = 54 ppb of ozone

Year-Long (AQI > 50)			
Statistic	**2017**	**2018**	**2019**
FAR	3.39	1.34	13.95
POD	45.71	21.67	71.43
CSI	40.00	20.31	16.39

Ozone Season (April - September)			
Statistic	**2017**	**2018**	**2019**
RMSE	12.89	8.03	8.42
Scatter Index	0.25	0.16	0.19
MAE	7.84	6.32	6.48
FCST-OBS avg	-1.60	-4.08	4.54

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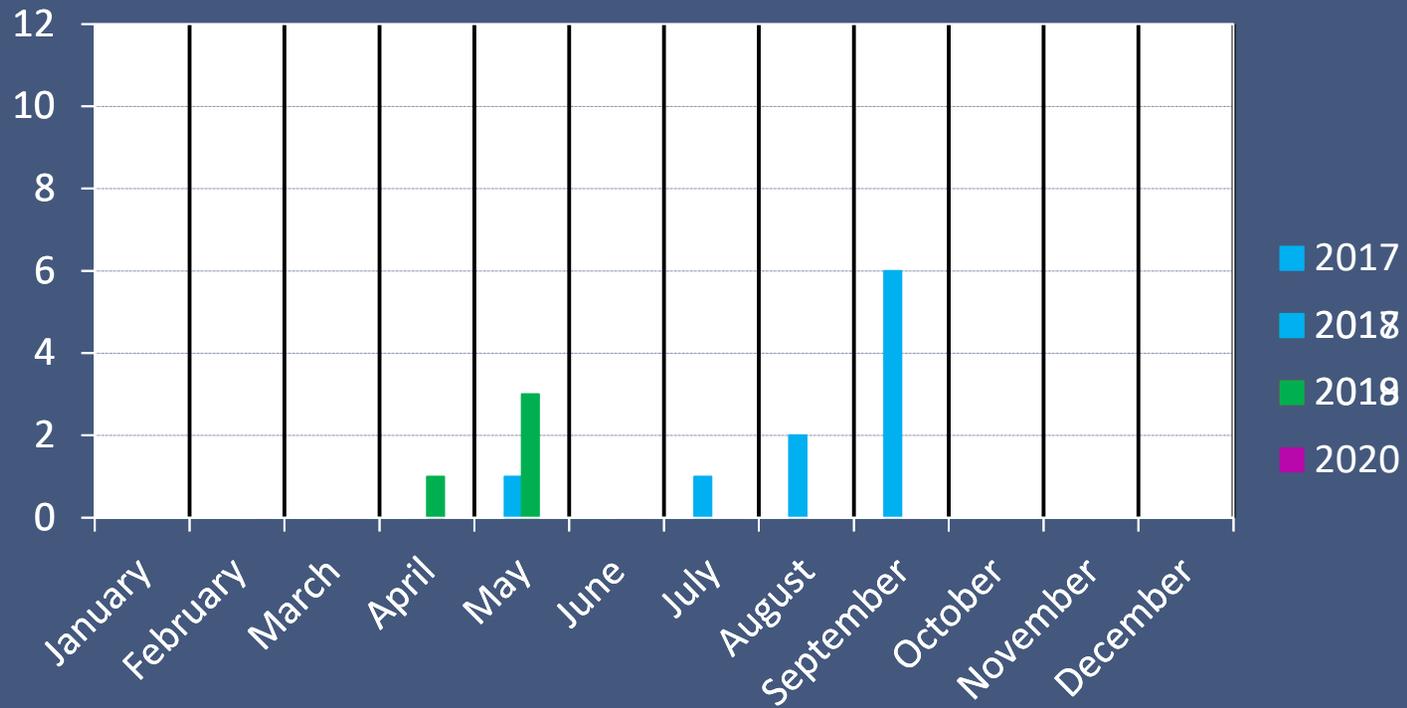
Forecast Verification

TWO-CATEGORY FORECAST TABLE		Observed		
		Yes	No	Total
Forecast	Yes	**Hit**	**False Alarm**	Forecast Yes
	No	**Miss**	**Correct Negative**	Forecast No
	Total	Obs. Yes	Obs. No	Total

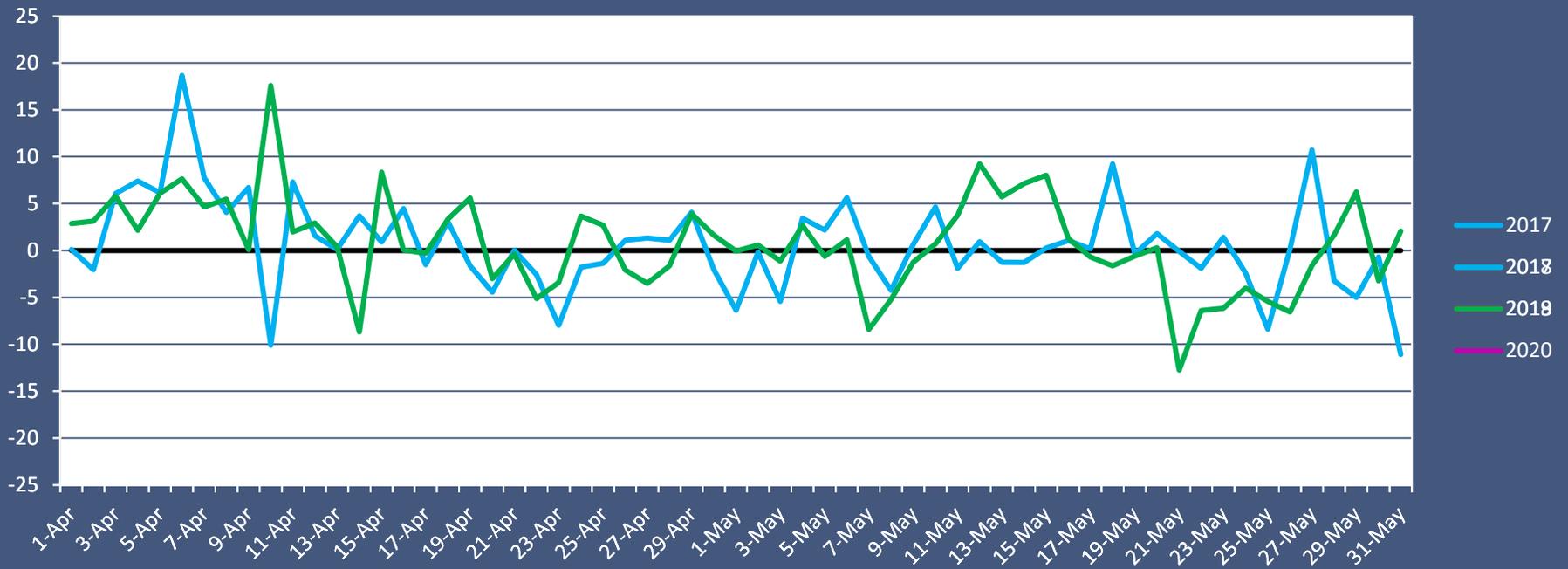| 2019 (AQI > 50)		Observed		
		Yes	No	Total
Forecast	Yes	**10**	**47**	57
	No	**4**	**290**	294
	Total	14	337	351

2018 (AQI > 50)		Observed		
		Yes	No	Total
Forecast	Yes	**3**	**4**	7
	No	**47**	**294**	341
	Total	50	298	348

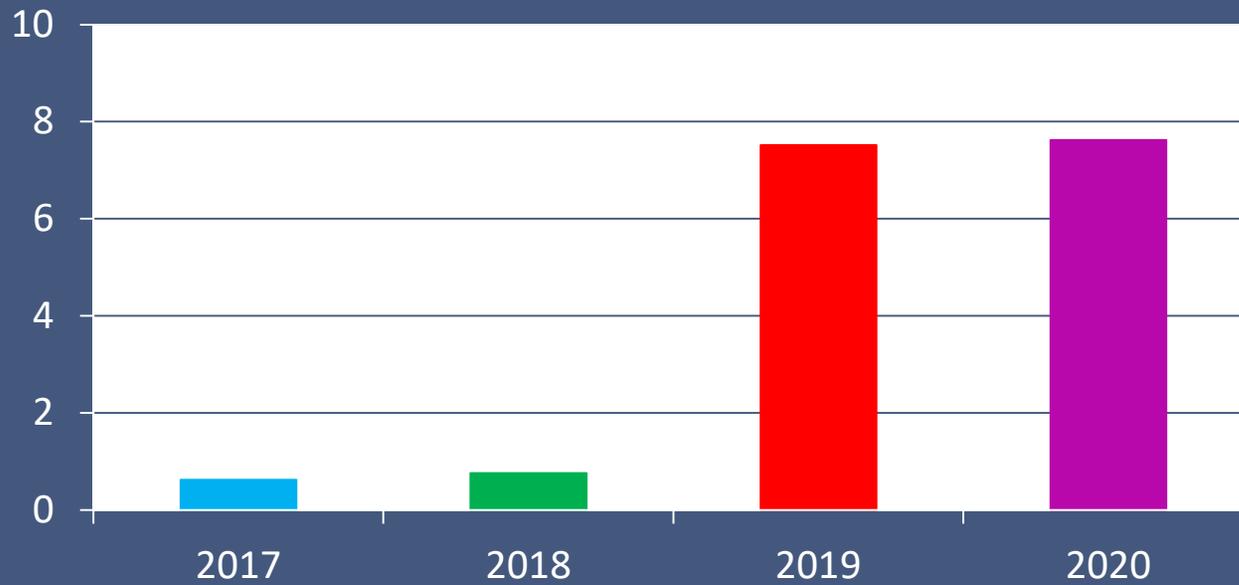| 2017 (AQI > 50)		Observed		
		Yes	No	Total
Forecast	Yes	**32**	**10**	42
	No	**38**	**285**	323
	Total	70	295	365

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False Alarm Days by Month

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April-May Comparison

Difference between AIRPACT forecast ozone and observed ozone (ppb)

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2020 Forecast Verification (So Far)

- Data from January through August

2020 (AQI > 50)		Observed		
		Yes	No	Total
Forecast	Yes	**15**	**35**	50
	No	**10**	**184**	194
	Total	25	219	244

2019 (AQI > 50)		Observed		
		Yes	No	Total
Forecast	Yes	**9**	**45**	54
	No	**4**	**175**	179
	Total	13	220	233

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Summary

- AIRPACT over-predicted ozone in 2019 and 2020 compared to 2017 and 2018
  - Most frequent over-prediction occurred in the spring months (March, April, May)
- AIRPACT doesn't appear to improve daily AQI forecasts in SW ID when the AQI is above 50

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Potential Causes?

- Meteorology-related?
  - Slightly cooler and much wetter in spring 2019 compared to spring 2017/2018; spring 2020 similar to 2017/2018 – we plan to look into the meteorology further
- Biomass burning-related?
- Possible change(s) in AIRPACT?

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Future Work

- Compare AIRPACT performance with observations at other sites in/around Idaho
- Evaluate AIRPACT forecasts for other pollutants (PM)

Thank you!

- We welcome any thoughts and/or feedback!

Contact
Kimi Smith
kimi.smith@deq.idaho.gov

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Statistic Calculations
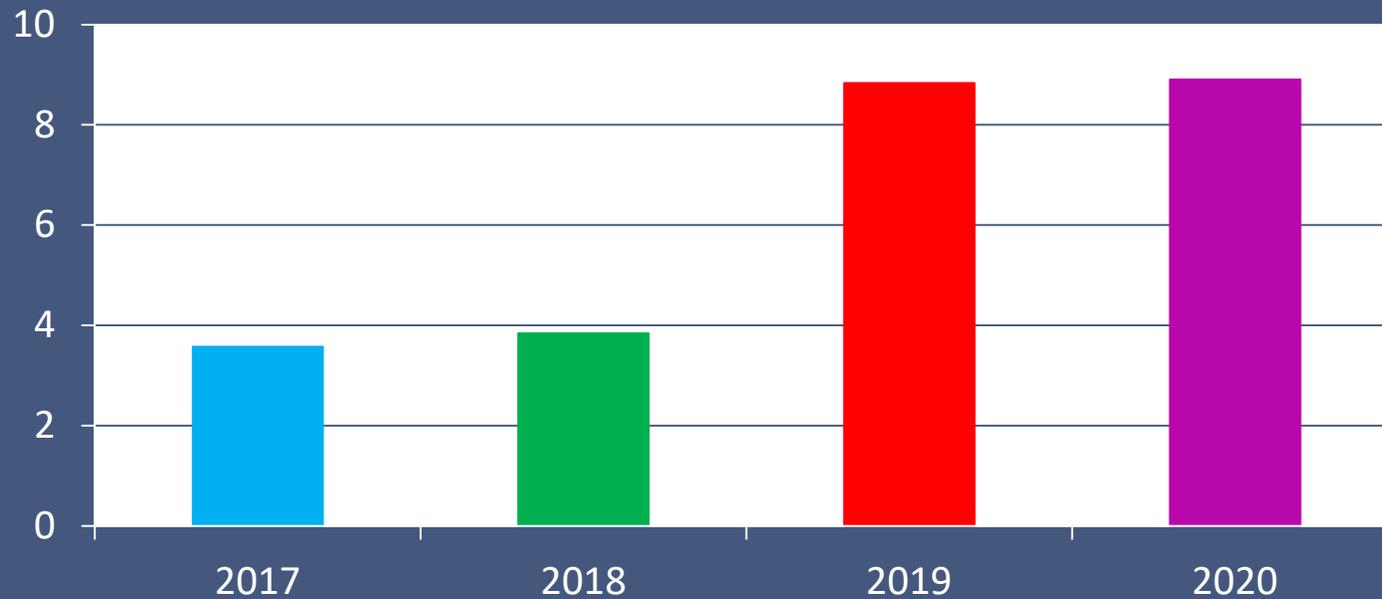
- **False alarm rate (FAR)**
  - Percent of time the event was forecast but did not occur
  - False Alarms / (False Alarms + Hits) * 100
- **Probability of detection (POD) / hit rate**
  - Ability of model to predict events
  - Hits / (Hits + Misses) * 100
- **Critical success index (CSI) / threat score**
  - How well events were predicted
  - Hits / (Hits + False Alarms + Misses) * 100
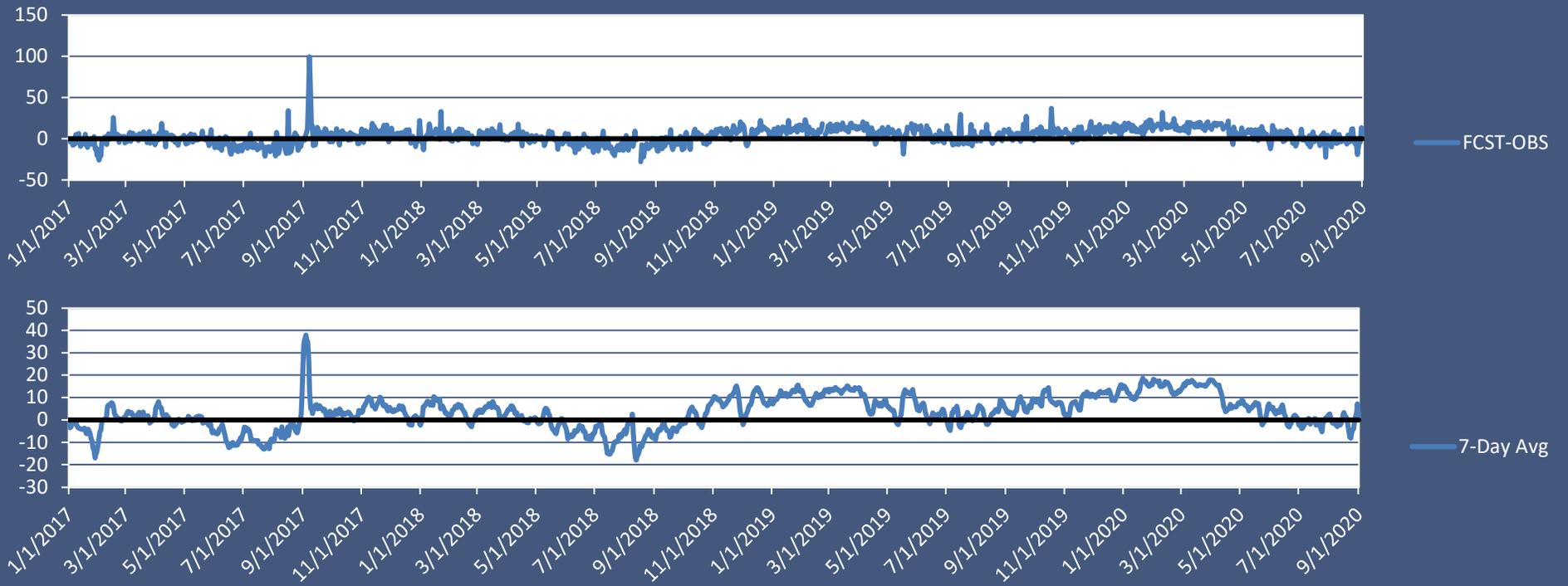
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Statistic Calculations

- **Root mean square error (RMSE)**
  - Average magnitude of forecast errors; puts more weight on larger errors
  - SqRt(SumSq(Forecast – Observed)/Total)
- **Scatter index (SI)**
  - Expected error within one standard deviation; if above 1 (or 100%), error is more than one deviation
  - RMSE / Average(Total)
- **Mean absolute error (MAE)**
  - Average magnitude of forecast errors; calculated on the absolute value of the differences
  - Average(AbsoluteValue(Forecast – Observed))

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2017-2020 FCST-OBS & 7-day MA

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2017-2020 14-day & 30-day MA

A5

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