

## Supporting Information

### **XIS-Temperature: A daily spatiotemporal machine-learning model for air temperature in the contiguous United States**

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Figure 5 shows how accuracy and SD vary across regions and over time.

Figure 5: Weighted SD (upper) and RMSE (lower) from mean-temperature CV for each region and year.

Table 6 shows unweighted CV results among isolated stations, which are defined as stations that are at least 7 km away from all other stations in the same year. We chose 7 km for being the median distance of all cells in a 1-km grid from the nearest station in 2019.

Table 6: Unweighted SDs and RMSEs (K) for isolated stations in yearly CV.

Year	Observations	Sites	Min temp.		Mean temp.		Max temp.	
			SD	RMSE	SD	RMSE	SD	RMSE
2003	594,991	3,148	10.09	2.21	10.56	1.68	11.72	2.27
2004	851,425	3,827	9.82	2.00	10.18	1.55	11.15	2.09
2005	994,078	4,351	10.03	2.03	10.40	1.48	11.42	1.97
2006	1,308,564	5,173	9.77	2.03	10.14	1.43	11.13	1.95
2007	1,460,914	5,513	10.49	2.04	10.88	1.46	11.97	2.03
2008	1,558,947	5,962	10.53	1.87	10.82	1.35	11.80	1.83
2009	1,683,213	6,353	10.32	1.85	10.57	1.34	11.49	1.82
2010	1,750,342	6,466	10.32	1.85	10.73	1.34	11.81	1.80
2011	1,841,909	6,703	10.53	1.86	10.91	1.35	11.91	1.78
2012	2,025,917	7,431	9.80	1.84	10.21	1.30	11.26	1.72
2013	2,175,188	7,865	10.72	1.84	10.97	1.34	11.85	1.77
2014	2,269,121	8,051	10.81	1.83	10.97	1.33	11.87	1.73
2015	2,321,919	8,119	10.49	1.78	10.57	1.29	11.38	1.71
2016	2,669,956	9,115	10.08	1.79	10.37	1.34	11.30	1.74
2017	2,998,009	10,165	10.17	1.80	10.54	1.33	11.54	1.81
2018	3,313,489	11,550	11.03	1.73	11.27	1.30	12.13	1.83
2019	3,379,795	11,699	11.02	1.72	11.20	1.20	12.17	1.77
2020	3,527,349	11,490	10.22	1.75	10.38	1.19	11.38	1.69
2021	3,316,838	11,016	10.54	1.77	10.68	1.20	11.65	1.68

Tables 7 and 8 examine accuracy during hot and cold days. Here, the SDs are calculated relative to the overall mean for the year and DV in question, rather than the mean of the hot or

cold subset. This tactic ensures that the trivial model represented by the SD, like our actual model, does not benefit from foreknowledge of which days are hot or cold.

Table 7: Unweighted SDs and RMSEs (K) from station-days with a max temperature of 92 °F (33.33 °C) or greater.

Year	Observations	Sites	Min temp.		Mean temp.		Max temp.	
			SD	RMSE	SD	RMSE	SD	RMSE
2003	78,002	3,367	14.01	2.30	16.06	1.80	18.49	2.64
2004	77,630	3,720	13.94	2.17	15.92	1.67	18.31	2.42
2005	151,833	6,139	14.41	1.91	15.93	1.43	17.94	2.14
2006	222,594	8,119	14.18	1.97	15.67	1.43	17.63	2.24
2007	245,796	9,138	14.07	2.02	15.54	1.54	17.77	2.63
2008	227,261	9,463	14.81	1.90	16.43	1.49	18.61	2.17
2009	250,842	10,266	14.73	1.85	16.42	1.39	18.67	2.11
2010	363,402	12,482	14.98	1.65	16.12	1.31	17.93	1.93
2011	468,249	13,747	15.00	1.62	16.37	1.26	18.16	1.83
2012	624,260	19,771	13.13	1.61	14.57	1.19	16.41	1.75
2013	493,774	19,469	14.78	1.63	16.23	1.26	18.12	1.90
2014	519,484	18,279	14.46	1.64	15.78	1.25	17.71	1.92
2015	648,694	21,454	13.77	1.55	15.05	1.27	16.87	1.95
2016	773,841	24,018	13.69	1.50	14.85	1.32	16.46	2.00
2017	778,205	25,576	13.34	1.70	14.88	1.48	16.92	2.33
2018	1,001,685	28,419	13.94	1.57	15.41	1.42	17.25	2.27
2019	974,755	29,240	14.34	1.50	15.46	1.14	17.39	2.14
2020	1,092,429	33,559	13.34	1.67	14.61	1.20	16.61	2.08
2021	998,004	32,324	13.08	1.68	14.40	1.23	16.39	2.07

Table 8: Unweighted SDs and RMSEs (K) from station-days with a min temperature of 0 °C or less.

Year	Observations	Sites	Min temp.		Mean temp.		Max temp.	
			SD	RMSE	SD	RMSE	SD	RMSE
2003	287,335	4,887	13.50	2.19	13.98	1.67	15.13	2.19
2004	393,089	5,933	13.40	2.08	13.75	1.58	14.71	2.07
2005	553,422	8,380	13.45	2.08	13.84	1.47	14.93	1.91
2006	714,937	10,136	12.93	2.09	13.23	1.47	14.16	1.91
2007	906,240	11,795	13.97	2.03	14.49	1.46	15.72	1.95
2008	1,092,712	13,184	13.43	1.81	13.76	1.32	14.84	1.75
2009	1,120,995	14,218	13.78	1.84	14.02	1.34	14.94	1.77
2010	1,223,644	15,670	13.39	1.79	13.95	1.30	15.18	1.73
2011	1,353,371	17,520	13.85	1.80	14.14	1.31	15.10	1.71
2012	1,490,856	22,636	13.69	1.74	14.11	1.25	15.18	1.61

Table 8: Unweighted SDs and RMSEs (K) from station-days with a min temperature of 0 °C or less.

Year	Observations	Sites	Min temp.		Mean temp.		Max temp.	
			SD	RMSE	SD	RMSE	SD	RMSE
2013	2,126,367	24,807	13.76	1.72	14.05	1.23	15.02	1.61
2014	2,086,736	25,775	15.08	1.70	15.19	1.20	16.13	1.58
2015	1,958,109	28,164	15.44	1.74	15.48	1.22	16.32	1.57
2016	2,058,413	28,718	14.51	1.73	14.91	1.29	16.01	1.61
2017	2,294,484	31,119	14.57	1.75	15.09	1.31	16.24	1.66
2018	2,739,555	33,098	14.60	1.73	14.82	1.28	15.68	1.68
2019	2,831,247	36,205	14.91	1.73	15.07	1.20	16.06	1.71
2020	2,858,067	36,079	13.92	1.72	14.10	1.16	15.10	1.57
2021	2,751,100	35,295	14.55	1.70	14.82	1.14	15.94	1.54

Table 9 compares the weighted RMSEs of our model on private weather stations from Weather Underground (not used in model training) to those of PRISM, gridMET, and Daymet for max temperature.

Table 9: Between-model comparisons of weighted RMSEs (K) for max temperature.

Year	Observations	SD	PRISM	gridMET	Daymet	XIS
2014	2,874,710	11.99	4.78	2.13	2.01	1.70
2015	2,749,242	11.50	4.51	2.24	2.06	1.82
2016	2,718,814	11.49	4.48	2.17	2.10	1.87
2017	2,807,208	11.73	4.78	2.44	2.28	2.11
2018	2,729,138	12.37	4.88	2.56	2.48	2.25
2019	2,702,679	12.31	4.69	2.33	2.23	1.99
2020	3,114,743	11.48	4.63	2.17	2.09	1.90
2021	3,034,309	11.76	4.53	2.89	2.08	1.94