

SUPPLEMENTARY MATERIALS

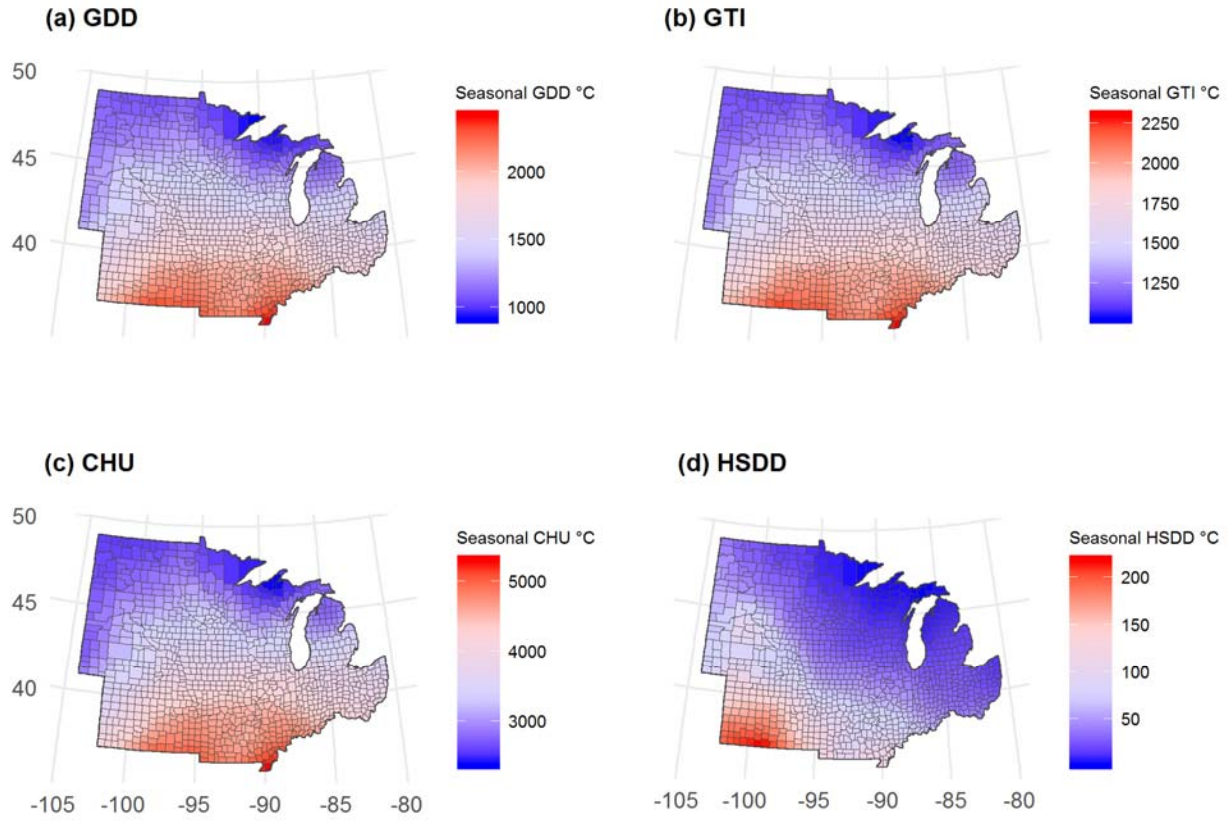


Figure S1. Mean frost-free thermal time for 1950-2017: (a) GDD, (b) GTI, (c) CHU, and (d) HSDD.

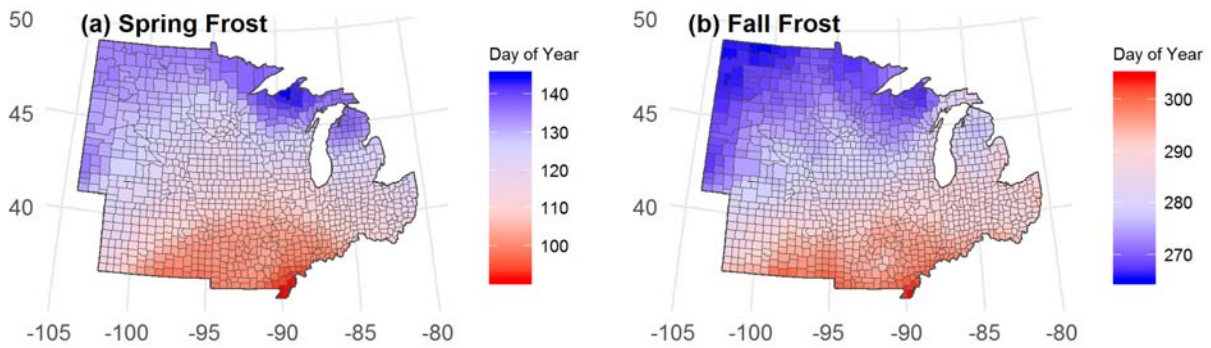


Figure S2. Midwest mean frost dates as Day of Year for 1950-2017: (a) spring frost date and (b) fall frost date.

Table S1. Counties resembling a non-normal distribution for frost-free thermal time in the Growing Degree Day, General Thermal Index, and Crop Heat Unit thermal models. Counties not included here had a p-value greater than 0.01 and met assumptions of normality.

County, State	p-value		
	GDD	GTI	CHU
Scott, IN	n/a	n/a	<0.01
Ashland, WI	n/a	<0.01	<0.01
Bayfield, WI	n/a	<0.01	<0.01
Douglas, WI	<0.01	<0.001	<0.01
Price, WI	<0.01	<0.001	<0.001
Rusk, WI	<0.001	<0.001	<0.001
Sawyer, WI	<0.001	<0.001	<0.001
Taylor, WI	<0.001	<0.001	<0.001
Vilas, WI	n/a	n/a	<0.01

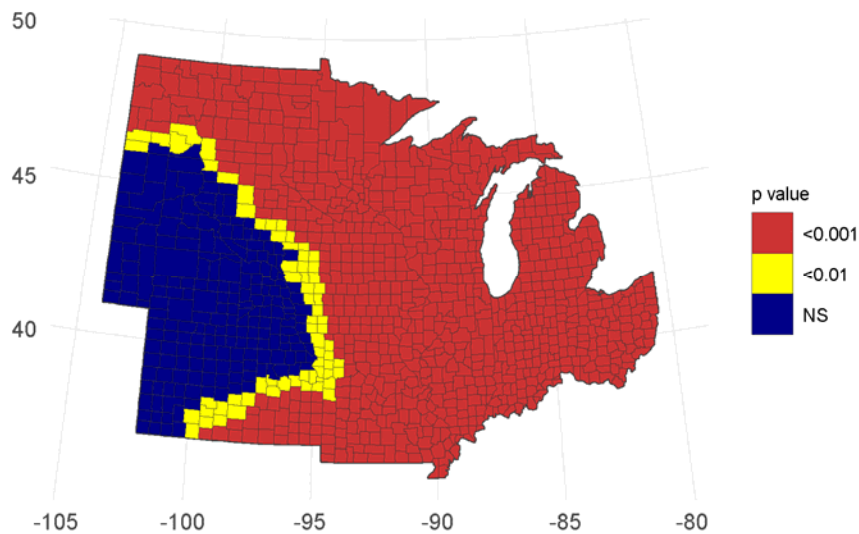


Figure S3. County residual significance with the HSDD model; 850 counties are significant at $p < 0.001$ or $p < 0.01$ and 204 counties not-significant.

Table S2. Fit between observed FFTT and predicted FFTT using Relative Root Mean Square Error. Significance is denoted only for the mean RRMSE value.

Relative Root Mean Square Error

Model	Min.	Q1	Median	Mean \pm SE	Q3	Max.	IQR[†]	Skew
GDD	5.59	7.25	7.88	8.09 \pm 0.03 a	8.66	12.84	1.40	0.918
GTI	5.71	7.08	7.63	7.76 \pm 0.03 b	8.24	11.16	1.16	0.784
CHU	5.27	6.60	7.06	7.19 \pm 0.03 c	7.61	10.71	1.01	0.929

[†]Interquartile range calculated as the difference between Quartiles: Q3 – Q1.

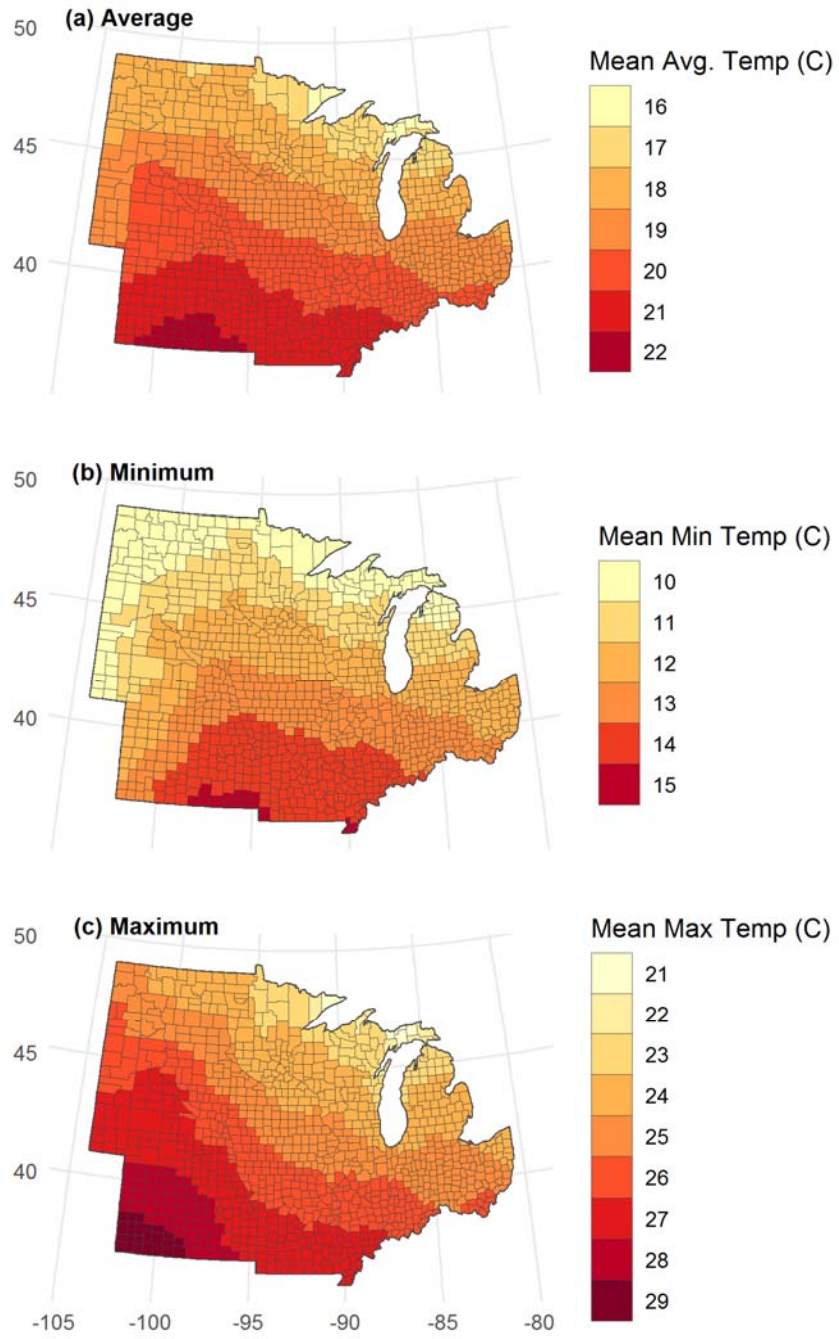


Figure S4. Midwest mean temperatures for (a) average, (b) minimum, and (c) maximum during the frost-free period for 1950-2017.

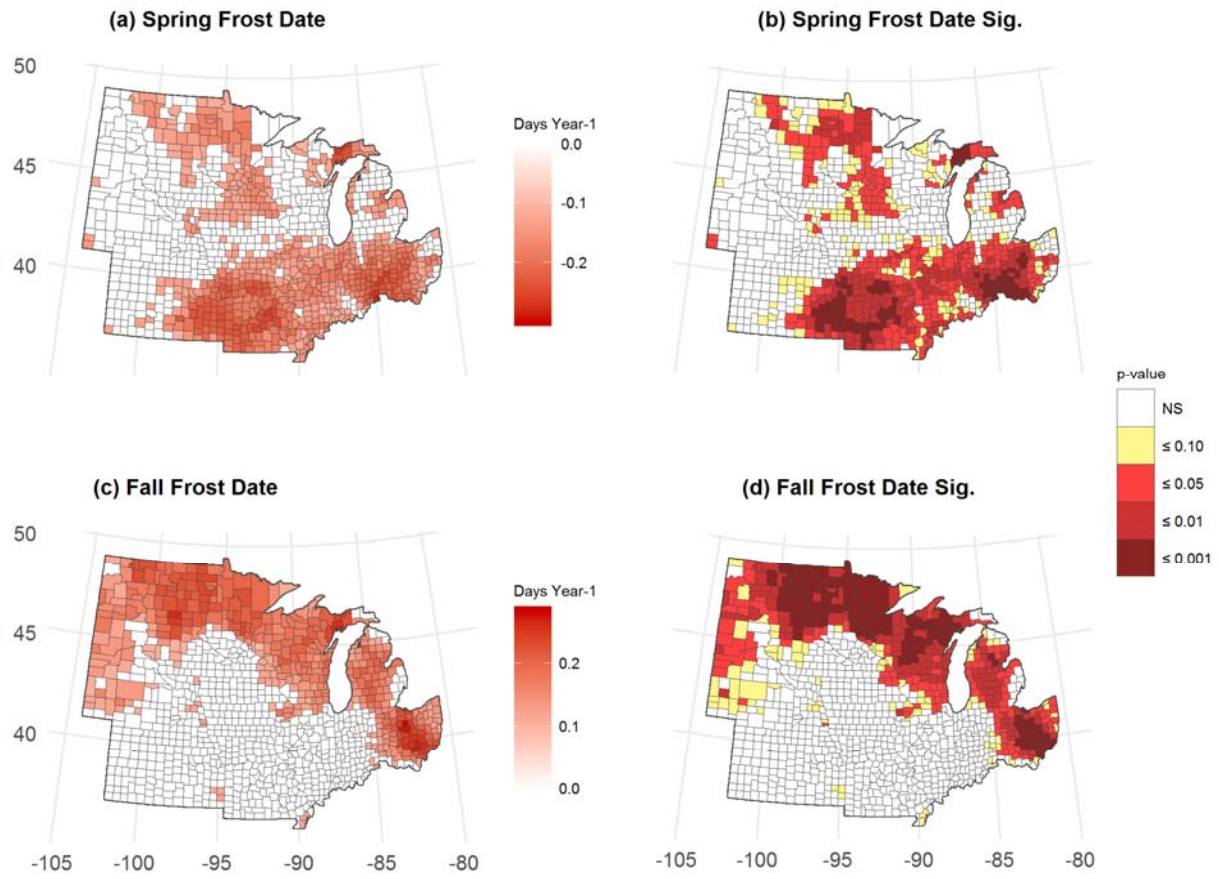


Figure S5. Change in spring and fall frost dates as (a, c) days per year and (b, d) p-value for the slope parameter from the linear regression model.