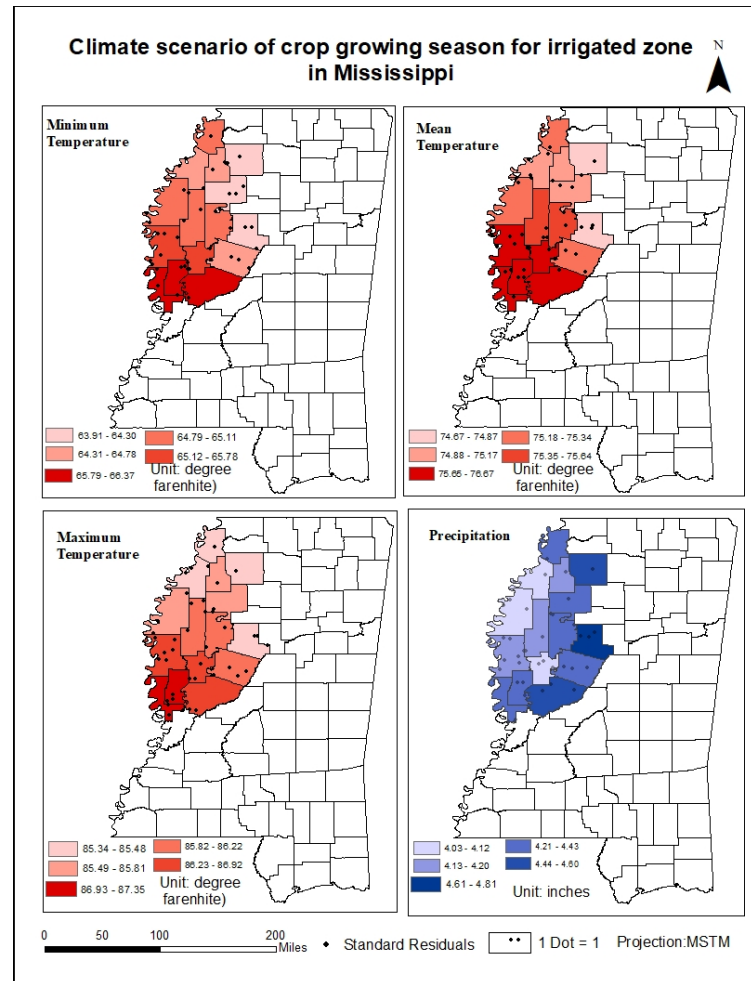


## **Supplementary Information**

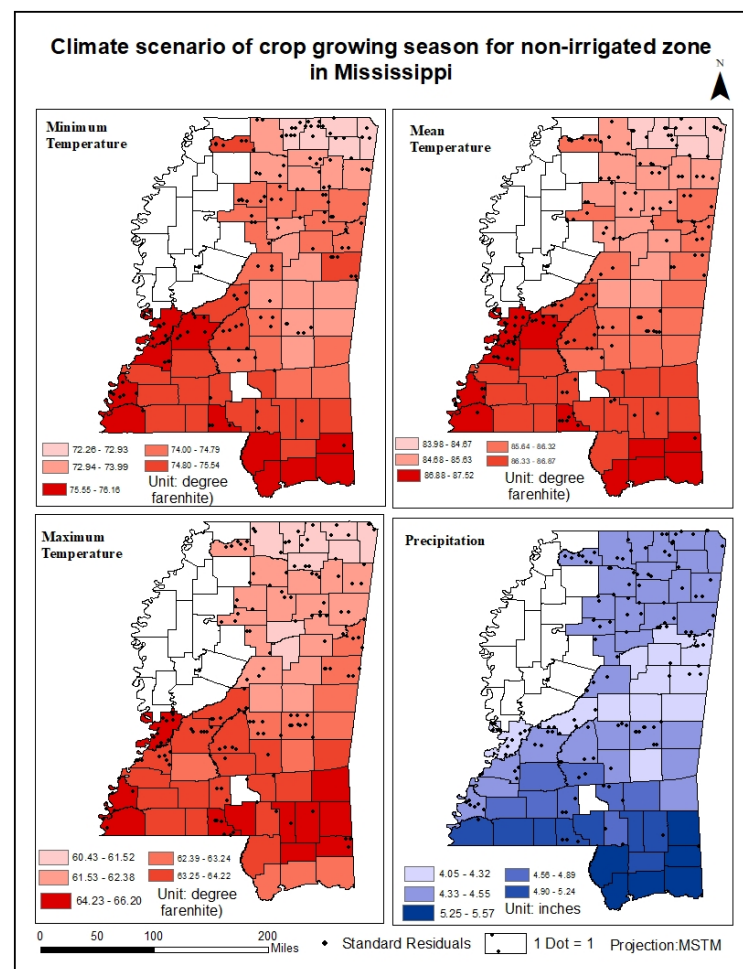
### **Modeling the impact of climate change on crop yield in Mississippi**

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**Figure S1.** The grid map of Climatic variables, such as minimum temperature (a), mean temperature (b), maximum temperature (c), Precipitation (d), and residuals from best yield model for the irrigated zone of Mississippi.



**Figure S2.** The grid map of Climatic variables, such as minimum temperature (a), mean temperature (b), maximum temperature (c), Precipitation (d), and residuals from best yield model for the non-irrigated zone of Mississippi.

Table S1. The results of Mann-Kendal test for the Tmin, Tmean, Tmax, Precipitation, and Yield from time series of 1980-2019 for irrigated and non-irrigated zone of Mississippi.

Zone	Parameter	Trend	Hypothesis	P-value	Z-value	Kendall Tau	Mann-Kendall's score
Irrigated	Tmin	Increasing	True	<0.00001	7.855	0.237	28359
	Tmean	Increasing	True	<0.00001	5.0011	0.151	18054.0
	Tmax	No trend	False	0.141	1.469	0.044	5307.0
	Precipitation	Increasing	True	<0.00001	4.794	0.145	17309.0
	Yield	Increasing	True	0.000	24.987	0.755	90202.0
Non- irrigated	Tmin	Increasing	True	<0.00001	4.097	0.0641	105929
	Tmean	No trend	False	0.979	-0.026	0.0004	-678.0
	Tmax	Decreasing	True	<0.00000	-5.147	-0.081	-133047
	Precipitation	Increasing	True	<0.00001	6.201	0.097	160313.0
	Yield	Increasing	True	0.0000	49.685	0.777	1284239

Hypothesis used  
"there is a trend of  
the data for the

increase or decrease of the values for each variable of the study period". P-value is the level of significance. The details are explained in the following link ([https://vsp.pnnl.gov/help/vsample/design\\_trend\\_mann\\_kendall.htm](https://vsp.pnnl.gov/help/vsample/design_trend_mann_kendall.htm))

Table S2. The results of linear and multilinear models for each 10- year period from time series of 1980-2019 for irrigated county of Mississippi.

Period	Model name	Intercept	Model Slope for different parameters				Adjusted R-square	BIC	AIC
			Tmax	Tmean	Tmin	Precipitation			
1980-1992	Y[Tmax] <sub>92i</sub>	181.62	-1.84	.	.	.	0.26	150.4	151.1
	Y[Tmax,Precipitation] <sub>92i</sub>	260.13	-2.68	.	.	-1.62	0.35	144.4	145.5
	Y[Tmax,Tmin,Precipitation] <sub>92i</sub>	264.87	-6.36		5.04	-4.80	0.65	120.2	117.7
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>92i</sub>	240.78	-7.94	3.77	3.12	-4.62	0.66	120.4	117.2
1993-2002	Y[Precipitation] <sub>02i</sub>	14.65	.	.	.	3.26	0.13	348.4	347.6
	Y[Tmax,Tmean] <sub>02i</sub>	114.50	-8.40	8.43	.	.	0.37	318.2	316.1
	Y[Tmax,Tmean,Precipitation] <sub>02i</sub>	70.13	-7.70	8.15	.	1.37	0.38	318.4	316.0
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>02i</sub>	69.71	-8.12	9.29	-0.75	1.36	0.38	320.0	317.5
2003-2012	Y[Tmin] <sub>12i</sub>	-62.91	.	.	1.57	.	0.04	464.9	463.1
	Y[Tmax,Tmin] <sub>12i</sub>	-82.04	-2.04	.	4.57	.	0.12	456.1	453.9
	Y[Tmax,Tmin,Precipitation] <sub>12i</sub>	-112.14	-1.55	.	4.33	0.89	0.12	456.9	454.6
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>12i</sub>	-112.28	-1.49	-0.16	4.44	0.89	0.11	459.0	456.6
2013-2019	Y[Tmin] <sub>19i</sub>	-41.37	.	.	1.41	.	0.08	382.5	381.4
	Y[Tmax,Tmin] <sub>19i</sub>	143.52	-4.80	.	4.89	.	0.29	357.5	355.3
	Y[Tmax,Tmean,Tmin] <sub>19i</sub>	154.70	-4.30	-1.42	5.72	.	0.29	359.1	356.7
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>19i</sub>	158.72	-4.39	-1.39	5.73	-0.11	0.28	361.2	358.7

Note: In the model name the notation 92 is for the time 1980 to 1992; 02 is for 1993-2002; 12 is for 2003 to 2012; and 19 is for 2013 to 2019 and ‘i’ is for irrigated zone.

Table S3. The results of linear and multilinear models for each 10- year period from time series of 1980-2019 for non-irrigated county of Mississippi.

Period	Model Name	Intercept	Model Slope for different parameters				Adjusted R-square	BIC	AIC
			Tmax	Tmean	Tmin	Precipitation			
1980-1992	Y[Tmax] <sub>92ni</sub>	83.53	-0.73	.	.	.	0.07	2878.5	2877.1
	Y[Tmax,Tmean] <sub>92ni</sub>	67.79	-2.31	2.03	.	.	0.16	2784.3	2782.6
	Y[Tmax,Tmean,Tmin] <sub>92ni</sub>	60.85	-4.46	6.77	-2.55	.	0.19	2745.2	2743.3
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>92ni</sub>	68.50	-4.54	6.51	-2.23	-0.42	0.20	2737.0	2734.9
1993-2002	Y[Precipitation] <sub>02ni</sub>	11.21	.	.	.	3.09	0.15	1246.6	1245.9
	Y[Tmax,Tmean] <sub>02ni</sub>	136.57	-6.59	6.08	.	.	0.39	1129.2	1127.1
	Y[Tmax,Tmean,Precipitation] <sub>02ni</sub>	119.74	-6.20	5.82	.	0.63	0.39	1128.9	1126.8
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>02ni</sub>	118.84	-6.46	6.43	-0.35	0.64	0.39	1130.7	1128.5
2003-2012	Y[Precipitation] <sub>12ni</sub>	23.09	.	.	.	2.22	0.10	1063.1	1061.9
	Y[Tmean,Tmin] <sub>12ni</sub>	21.53	.	-5.38	6.52	.	0.28	1005.7	1003.7
	Y[Tmean,Tmin,Precipitation] <sub>12ni</sub>	-5.69	.	-4.34	5.67	0.95	0.28	1004.3	1002.1
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>12ni</sub>	-6.06	0.04	-4.41	5.69	0.96	0.28	1006.3	1004.1
2013-2019	Y[Precipitation] <sub>19ni</sub>	26.98	.	.	.	2.67	0.08	744.8	743.2
	Y[Tmax,Tmean] <sub>19ni</sub>	82.65	-5.98	6.28	.	.	0.15	730.5	728.6
	Y[Tmax,Tmean,Precipitation] <sub>19ni</sub>	53.80	-4.77	5.19	.	1.34	0.17	729.0	726.9
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>19ni</sub>	75.79	-4.34	2.97	1.70	1.20	0.17	728.8	726.5

Note: In the model name the notation 92 is for the time 1980 to 1992; 02 is for 1993-2002; 12 is for 2003 to 2012; and 19 is for 2013 to 2019 and 'ni' is for non-irrigated zone.

Table S4. The results of linear and multilinear models for time series of 1980-2019 for irrigated agricultural districts of Mississippi.

Agricultural district	Model Name	Intercept	Model Slope for different parameters				Adjusted R-square	BIC	AIC
			Tmax	Tmean	Tmin	Precipitation			
<b>Upper Delta (code:10)</b>	Y[Precipitation] <sub>AG10i</sub>	23.27	.	.	.	2.94	0.09	936.1	935.0
	Y[Tmax,Tmin] <sub>AG10i</sub>	20.51	-4.64	.	6.38	.	0.28	886.9	884.8
	Y[Tmax,Tmean,Tmin] <sub>AG10i</sub>	15.27	-5.30	1.58	5.50	.	0.28	888.3	886.1
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG10i</sub>	-6.32	-4.90	1.54	5.30	0.63	0.28	889.8	887.6
<b>Lower Delta (Code:40)</b>	Y[Tmin] <sub>AG40i</sub>	-239.77	.	.	4.28	.	0.16	1079.4	1077.8
	Y[Tmax,Tmin] <sub>AG40i</sub>	-164.43	-3.34	.	7.54	.	0.26	1053.7	1051.6
	Y[Tmax,Tmean,Tmin] <sub>AG40i</sub>	-175.04	-4.88	3.55	5.63	.	0.26	1053.4	1051.2
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG40i</sub>	-198.97	-4.48	3.56	5.41	0.67	0.26	1054.9	1052.7
<b>Central (Code:50)</b>	Y[Tmin] <sub>AG50i</sub>	-155.79	.	.	3.00	.	0.06	227.9	226.0
	Y[Tmin,Precipitation] <sub>AG50i</sub>	-210.18	.	.	3.61	3.43	0.13	225.8	223.3
	Y[Tmax,Tmean,Tmin] <sub>AG50i</sub>	-71.16	74.74	-155.26	83.18	.	0.12	227.4	224.6
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG50i</sub>	-142.77	66.67	-136.02	72.47	2.19	0.12	229.0	225.8

Note: In the model name, the notation AG10, AG40 and AG50 are for the agricultural district code 10, 40 and 50, respectively; The notation 'i' is for irrigated zone in the agricultural district.

Table S5. The results of linear and multilinear models for time series of 1980-2019 for non-irrigated agricultural districts of Mississippi.

Agricultural district	Model Name	Intercept	Model Slope for different parameters				Adjusted R-square	BIC	AIC
			Tmax	Tmean	Tmin	Precipitation			
<b>Upper Delta (code:10)</b>	Y[Tmax] <sub>AG10ni</sub>	185.75	-1.92	.	.	.	0.35	121.0	121.9
	Y[Tmax,Tmean] <sub>AG10ni</sub>	80.41	-5.59	5.63	.	.	0.53	108.1	108.6
	Y[Tmax,Tmean,Precipitation] <sub>AG10ni</sub>	116.91	-7.17	7.10	.	-2.72	0.73	89.1	86.1
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG10ni</sub>	118.47	-7.18	6.64	0.54	-2.89	0.73	91.1	87.8
<b>North Central (Code:20)</b>	Y[Precipitation] <sub>AG20ni</sub>	13.60	.	.	.	3.07	0.11	1341.8	1340.2
	Y[Tmax,Tmean] <sub>AG20ni</sub>	50.27	-5.86	6.43	.	.	0.19	1313.3	1311.3
	Y[Tmax,Tmean,Precipitation] <sub>AG20ni</sub>	8.49	-4.61	5.46	.	1.49	0.20	1310.0	1307.9
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG20ni</sub>	8.69	-4.57	5.38	0.05	1.49	0.20	1312.0	1309.9
<b>Northeast (Code: 30)</b>	Y[Precipitation] <sub>AG30ni</sub>	17.14	.	.	.	1.94	0.05	1247.2	1245.6
	Y[Tmax,Tmean] <sub>AG30ni</sub>	40.42	-4.17	4.63	.	.	0.15	1218.0	1216.0
	Y[Tmax,Tmean,Tmin] <sub>AG30ni</sub>	42.65	-3.68	3.13	1.07	.	0.15	1218.5	1216.4
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG30ni</sub>	50.71	-3.85	3.06	1.27	-0.33	0.14	1220.3	1218.1
<b>Lower Delta (Code:40)</b>	Y[Tmax] <sub>AG40ni</sub>	114.12	-1.03	.	.	.	0.04	436.9	435.1
	Y[Tmax,Tmean] <sub>AG40ni</sub>	71.13	-3.24	3.09	.	.	0.06	435.0	432.9
	Y[Tmax,Tmean,Tmin] <sub>AG40ni</sub>	72.87	-4.72	7.42	-3.10	.	0.09	432.7	430.4
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG40ni</sub>	68.12	-4.58	7.45	-3.27	0.20	0.08	434.8	432.3



Table S5. (continued...)

<b>Central (Code:50)</b>	Y[Tmin] <sub>AG50ni</sub>	-130.46	.	.	2.49	.	0.11	1144.9	1143.3
	Y[Tmin,Precipitation] <sub>AG50ni</sub>	-137.03	.	.	2.40	2.78	0.20	1117.3	1115.3
	Y[Tmax,Tmean,Precipitation] <sub>AG50ni</sub>	-130.17	-3.26	5.72	.	2.41	0.22	1114.0	1111.8
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG50ni</sub>	-131.82	-3.51	6.36	-0.39	2.45	0.21	1116.0	1113.8
<b>East central (Code: 60)</b>	Y[Tmin] <sub>AG60ni</sub>	-113.27	.	.	2.20	.	0.09	1024.1	1023.0
	Y[Tmax,Tmean] <sub>AG60ni</sub>	-27.06	-8.06	10.00	.	.	0.28	969.7	967.8
	Y[Tmax,Tmean,Precipitation] <sub>AG60ni</sub>	16.36	-10.11	11.89	.	-1.71	0.30	964.3	962.1
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG60ni</sub>	14.98	-11.41	14.57	-1.39	-1.67	0.30	966.2	963.9
<b>Southwest (Code: 70)</b>	Y[Tmin] <sub>AG70ni</sub>	-219.04	.	.	3.81	.	0.23	832.8	831.5
	Y[Tmax,Tmean] <sub>AG70ni</sub>	-106.64	-8.23	11.21	.	.	0.34	804.0	802.1
	Y[Tmax,Tmean,Precipitation] <sub>AG70ni</sub>	-35.22	-9.86	12.25	.	-1.82	0.36	799.6	797.4
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG70ni</sub>	-26.33	-8.24	8.47	2.11	-1.92	0.36	800.4	798.1
<b>South Central (Code: 80)</b>	Y[Tmin] <sub>AG80ni</sub>	-162.45	.	.	2.92	.	0.17	602.1	600.6
	Y[Tmax,Tmin] <sub>AG80ni</sub>	-53.66	-2.48	.	4.60	.	0.25	587.5	585.7
	Y[Tmax,Tmin,Precipitation] <sub>AG80ni</sub>	16.53	-3.88	.	5.57	-2.26	0.29	580.7	578.4
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG80ni</sub>	12.64	-4.87	2.09	4.51	-2.22	0.29	582.6	580.2
<b>Southeast and Coastal (Code: 90)</b>	Y[Tmax] <sub>AG90ni</sub>	130.46	-1.25	.	.	.	0.08	648.6	646.6
	Y[Tmax,Tmean] <sub>AG90ni</sub>	124.33	-1.48	0.35	.	.	0.08	650.2	648.1
	Y[Tmax,Tmean,Tmin] <sub>AG90ni</sub>	123.80	-3.41	4.26	-1.98	.	0.07	651.6	649.4
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>AG90ni</sub>	121.52	-3.39	4.33	-2.07	0.16	0.07	653.5	651.2

Note: In the model name, the notation AG10, AG20, AG30, AG40, AG50, AG60, AG70, AG80, and AG90 are for the agricultural district codes 10, 20, 30, 40, 50, 60, 70, 80, and 90, respectively; The notation 'ni' is for non-irrigated zone in the agricultural district.

Table S6. The results of linear and multilinear models for irrigated and non-irrigated zone of Mississippi of 1980-2019 period.

Zone	Model Name	Intercept	Model Slope for different parameters				Adjusted R-square	BIC	AIC
			Tmax	Tmean	Tmin	Precipitation			
<b>Mississippi Irrigated</b>	Y[Tmin] <sub>MSi</sub>	-165.10	.	.	3.12	.	0.11	2292.4	2291.0
	Y[Tmax,Tmin] <sub>MSi</sub>	-90.53	-3.52	.	6.64	.	0.23	2224.2	2222.2
	Y[Tmax,Tmin,Precipitation] <sub>MSi</sub>	-138.02	-2.62	.	6.09	1.50	0.24	2220.0	2218.0
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>MSi</sub>	-144.86	-3.93	2.96	4.48	1.48	0.24	2218.3	2216.2
<b>Mississippi Non-Irrigated</b>	Y[Precipitation] <sub>MSni</sub>	19.60	.	.	.	1.33	0.03	7703.7	7702.2
	Y[Tmax,Tmean] <sub>MSni</sub>	53.55	-4.47	4.77	.	.	0.14	7486.6	7484.6
	Y[Tmax,Tmean,Precipitation] <sub>MSni</sub>	59.04	-4.68	4.95	.	-0.26	0.14	7487.1	7485.0
	Y[Tmax,Tmean,Tmin,Precipitation] <sub>MSni</sub>	58.88	-4.71	5.02	-0.04	-0.26	0.14	7489.1	7487.0

Note: In the model name, the notation MS is for Mississippi state; The notation 'i' is for irrigated zone and 'ni' for non-irrigated zones in the Mississippi state.