Supporting Information

Table S1 Estimation of the climate-yield relationship for spring maize

log(Y)	Model_1	Model_2	Model_3	Model_4	Model_5	Model_6
c	2.2566***	3.1491***	2.0742***	2.6624***	2.6220***	3.0321***
log(F)	0.3492***	0.3901***	0.3553***	0.3746***	0.3730***	0.3926***
gdd4		0.00047*		0.00048*	0.00045*	0.000363
gdd5		-0.00047*		-0.00050*	-0.00057**	-0.000207
gdd6		-0.00064**		-0.000319		-0.000402
gdd7		-0.00070**		-0.000217		-0.000788
gdd8		-0.00067**		-0.00073**	-0.00091***	-0.00063
gdd9		0.000291		0.000328		
p4			0.000224	0.000202		
p5			0.000375	1.01E-04		
p6			0.00127***	0.00100***	0.00122***	0.000268
p7			0.00067***	0.00055**	0.00062***	0.000504
p8			0.000118	7.13E-05		
p9			0.000357	0.000424		
Adj R^2	0.7362	0.7607	0.7569	0.772	0.7752	0.7769
AIC	-1.4481	-1.5329	-1.5169	-1.5581	-1.5991	-1.6041
SC	-1.3206	-1.3154	-1.2994	-1.2535	-1.3961	-1.4341

Note: ***/**/* indicate statistically significant at 1%, 5% and 10% level; all climate factors in Model_6 are significant although the PCA method failed to present the significance level.

Table S2 Estimation of the climate-yield relationship for summer maize

log(Y)	Model_1	Model_2	Model_3	Model_4	Model_5
c	1.1077***	2.108***	0.966***	1.942***	1.6282***
log(M)	0.1251***	0.1274***	0.141***	0.141***	0.1388***
t	0.0114***	0.0136***	0.0108***	0.013***	0.0125***
gdd5		-0.000856***		-0.000914***	-0.00089***
gdd6		-0.000494		-0.000415	
gdd7		-0.000609**		-0.000347	-0.00048*
gdd8		-0.000149		-0.000035	
gdd9		-0.000137		-0.000443	
p5			0.000258	0.000011	
p6			0.000341***	0.000288**	0.0003***
p7			0.00028***	0.000195*	0.000205*
p8			0.000135	0.000098	
p9			-0.000283*	-0.00041**	-0.000293*
Adj R^2	0.7088	0.7237	0.7219	0.731	0.7314
AIC	-0.9085	-0.9386	-0.9341	-0.9553	-0.9669
SC	-0.7529	-0.7344	-0.7302	-0.7067	-0.7627

Note: since Model_5 has kept in model all significant climate factors that were identified in Model_2 and Model_3, it need not to apply the PCA method. And accordingly, the Model_5 for summer maize was used to estimate its climate-induced losses.

Table S3 Estimation of the climate-yield relationship for winter wheat

log(Y)	Model_1	Model_2	Model_3	Model_4	Model_5	Model_6
c	1.308***	1.394***	1.272***	1.440***	1.321***	1.674***
log(F)	0.197***	0.194***	0.198***	0.199***	0.198***	0.211***
log(M)	0.143***	0.148***	0.142***	0.144***	0.139***	0.145***
gdd9		-0.000534*		-0.000535*		-0.000363
gdd10		0.000238		0.000279		
gdd11		-0.000325		-1.68E-04		
gdd12		6.42E-06		3.19E-04		
gdd1		-0.001761***		-0.001574**	-0.001787***	-0.002166
gdd2		-0.000373		-0.000145		
gdd3		-7.88E-05		7.74E-05		
gdd4		0.000228		0.000324		
gdd5		-0.000323		-0.000568*		-0.000415
gdd6		0.000453		0.000382		
p9			0.000696***	0.00049**	0.000581***	0.000452
p10			0.000555**	0.000545*		0.000295
p11			6.21E-06	2.91E-05		
p12			-0.000921*	-0.001429***	-0.001274***	-0.000745
p1			-0.000236	-3.03E-04		
p2			7.81E-05	-1.45E-04		
p3			0.000289	0.000271		
p4			-0.000513*	-0.000269		-0.000318
p5			0.000132	-5.39E-05		
p6			-0.000163	-9.19E-05		
Adj R^2	0.8656	0.8661	0.8684	0.8698	0.8701	0.8714
AIC	-0.8091	-0.8090	-0.8264	-0.8195	-0.8514	-0.8598
SC	-0.6352	-0.5492	-0.5665	-0.4785	-0.6484	-0.6486

Note: ***/**/* indicate statistically significant at 1%, 5% and 10% level; all climate factors in Model_6 are significant although the PCA method failed to present the significance level.

Table S4 Estimation of the climate-yield relationship for spring wheat

log(Y)	Model_1	Model_2	Model_3	Model_4	Model_5	Model_6
c	1.885***	2.301***	1.818***	2.516***	2.444***	2.476***
log(F)	0.392***	0.437***	0.393***	0.449***	0.441***	0.453***
gdd3		-0.001729		-0.001891*		-0.0013
gdd4		0.000118		0.000076		
gdd5		0.000279		0.00072		
gdd6		-0.000884**		-0.001265**	-0.001272***	-0.001226
gdd7		-0.000096		-0.000452		
p3			0.001874	0.001311		
p4			0.001085	0.001257		
p5			0.000759	0.001757*	0.001543**	0.001077
p6			0.000911*	-0.000325		
p7			-0.000439	-0.000641		
Adj R^2	0.7315	0.7380	0.7329	0.7429	0.7454	0.7487
AIC	-1.1480	-1.1437	-1.1241	-1.1344	-1.1895	-1.2086
SC	-1.0141	-0.9140	-0.8944	-0.8090	-1.0172	-1.0555

Note: ***/**/* indicate statistically significant at 1%, 5% and 10% level; all climate factors in Model_6 are significant although the PCA method failed to present the significance level.

Table S5 Comparison with the robust estimates of climate-yield relationship for spring maize

log(Y)	Model_2	Model_2_r	Model_2_b	Model_3	Model_3_r	Model_3_b
c	3.14914***	3.14914***	3.14914***	2.07417***	2.07417***	2.07417***
	(15.83)	(11.18)	(12.82)	(43.11)	(26.54)	(21.83)
log(F)	0.39009***	0.39009***	0.39009***	0.35535***	0.35535***	0.35535***
	(16.88)	(8.75)	(9.49)	(19.62)	(8.75)	(9.94)
gdd4	0.00047*	0.00047***	0.00047***			
	(1.84)	(3.53)	(3.42)			
gdd5	-0.00047*	-0.00047	-0.00047			
	(-1.92)	(-1.19)	(-1.29)			
gdd6	-0.00064**	-0.00064**	-0.00064**			
	(-2.41)	(-2.46)	(-2.56)			
gdd7	-0.0007**	-0.0007**	-0.0007**			
	(-2.12)	(-2.06)	(-2.32)			
gdd8	-0.00067**	-0.00067	-0.00067*			
	(-1.98)	(-1.57)	(-1.69)			
gdd9	0.00029	0.00029	0.00029			
	(0.98)	(0.79)	(0.80)			
p4				0.00022	0.00022	0.00022
				(0.35)	(0.44)	(0.48)
p5				0.00038	0.00038	0.00038
				(0.91)	(0.76)	(0.83)
p6				0.00126***	0.00126***	0.00126***
				(4.06)	(4.02)	(4.20)
p7				0.00067***	0.00067***	0.00067**
				(3.06)	(2.87)	(2.51)
p8				0.00012	0.00012	0.00012
				(0.58)	(0.35)	(0.29)
p9				0.00036	0.00036	0.00036
				(1.05)	(1.53)	(1.42)

Note: Model_2 and Model_3 are the origin model in table S1, and the suffix _r and _b represent the estimates with robust and bootstrap techniques. The comparison indicates that the effect of GDD4 on spring maize yield becomes more significant, while the effects of GDD5, GDD8 and P7 become less significant.

Table S6 Comparison with the robust estimates of climate-yield relationship for summer maize

log(Y)	Model_2	Model_2_r	Model_2_b	Model_3	Model_3_r	Model_3_b
c	2.10805***	2.10805***	2.10805***	0.96598***	0.96598***	0.96598***
	(8.30)	(7.03)	(7.09)	(21.67)	(12.92)	(9.99)
log(M)	0.12744***	0.12744	0.12744	0.14094***	0.14094	0.14094
	(3.00)	(1.10)	(0.92)	(3.33)	(1.17)	(1.07)
t	0.01359***	0.01359**	0.01359*	0.01081***	0.01081	0.01081
	(5.67)	(2.05)	(1.70)	(4.59)	(1.53)	(1.36)
gdd5	-0.00086***	-0.00086***	-0.00086***			
	(-3.26)	(-3.44)	(-3.53)			
gdd6	-0.00049	-0.00049**	-0.00049**			
	(-1.50)	(-2.11)	(-2.16)			
gdd7	-0.00061**	-0.00061**	-0.00061**			
	(-1.99)	(-2.01)	(-2.07)			
gdd8	-0.00015	-0.00015	-0.00015			
	(-0.47)	(-0.63)	(-0.63)			
gdd9	-0.00014	-0.00014	-0.00014			
	(-0.46)	(-0.53)	(-0.54)			
p5				0.00026	0.00026	0.00026
				(1.54)	(1.26)	(1.27)
p6				0.00034***	0.00034***	0.00034***
				(3.15)	(3.47)	(3.35)
p7				0.00028***	0.00028*	0.00028**
				(2.75)	(1.87)	(2.00)
p8				0.00013	0.00013	0.00013
				(1.12)	(1.06)	(1.19)
p9				-0.00028*	-0.00028	-0.00028
				(-1.67)	(-1.46)	(-1.41)

Note: Model_2 and Model_3 are the origin model in table S2, and the suffix _r and _b represent the estimates with robust and bootstrap techniques. The comparison indicates that the effect of GDD6 on summer maize yield becomes significant, while the effect of P7 becomes less significant.

Table S7 Comparison with the robust estimates of climate-yield relationship for winter wheat

log(Y)	Model_2	Model_2_r	Model_2_b	Model_3	Model_3_r	Model_3_b
c	1.39440***	1.39440***	1.39440***	1.27188***	1.27188***	1.27188***
	(6.10)	(4.92)	(4.87)	(14.49)	(8.26)	(6.70)
log(F)	0.19388***	0.19388***	0.19388***	0.19761***	0.19761***	0.19761***
	(5.71)	(2.93)	(2.86)	(6.11)	(2.87)	(2.99)
log(M)	0.14792***	0.14792**	0.14792**	0.14170***	0.14170***	0.14170***
	(5.40)	(2.57)	(2.51)	(5.30)	(2.58)	(2.65)
gdd9	-0.00053*	-0.00053	-0.00053*			
	(-1.87)	(-1.58)	(-1.65)			
gdd10	0.00024	0.00024	0.00024*			
	(0.90)	(1.63)	(1.65)			
gdd11	-0.00033	-0.00033	-0.00033			
	(-1.10)	(-1.18)	(-1.20)			
gdd12	0.00001	0.00001	0.00001			
	(0.01)	(0.02)	(0.02)			
gdd1	-0.00176***	-0.00176***	-0.00176***			
	(-2.66)	(-4.63)	(-3.97)			
gdd2	-0.00037	-0.00037***	-0.00037**			
	(-1.11)	(-2.60)	(-2.47)			
gdd3	-0.00008	-0.00008	-0.00008			
	(-0.28)	(-0.32)	(-0.31)			
gdd4	0.00023	0.00023*	0.00023*			
	(1.03)	(1.64)	(1.71)			
gdd5	-0.00032	-0.00032	-0.00032			
	(-1.29)	(-0.72)	(-0.75)			
gdd6	0.00045	0.00045	0.00045			
	(1.49)	(0.77)	(0.84)			
p9				0.00070***	0.00070***	0.00070***
				(3.46)	(2.86)	(2.80)
p10				0.00056**	0.00056**	0.00056**
				(2.05)	(2.09)	(2.22)
p11				0.00	0.00	0.00
				(0.02)	(0.03)	(0.03)
p12				-0.00092*	-0.00092**	-0.00092
				(-1.89)	(-2.33)	(-1.64)
p1				-0.00024	-0.00024	-0.00024
				(-0.55)	(-0.65)	(-0.42)
p2				0.00008	0.00008	0.00008
				(0.18)	(0.16)	(0.14)
p3				0.00029	0.00029	0.00029
				(1.05)	(1.25)	(1.10)
p4				-0.00051*	-0.00051*	-0.00051

	(-1.66)	(-1.78)	(-1.52)
p5	0.00013	0.00013	0.00013
	(0.58)	(0.60)	(0.60)
p6	-0.00016	-0.00016*	-0.00016
	(-1.23)	(-1.69)	(-1.61)

Note: Model_2 and Model_3 are the origin model in table S3, and the suffix _r and _b represent the estimates with robust and bootstrap techniques. The comparison indicates that the effects of GDD10, GDD2 and GDD4 on winter wheat yield becomes significant, while the negative effect of P12 becomes insignificant in the bootstrap estimate.

Table S8 Comparison with the robust estimates of climate-yield relationship for spring wheat

log(Y)	Model_2	Model_2_r	Model_2_b	Model_3	Model_3_r	Model_3_b
c	2.30130***	2.30130***	2.30130***	1.81773***	1.81773***	1.81773***
	(7.28)	(10.06)	(10.23)	(24.06)	(15.80)	(19.22)
log(F)	0.43662***	0.43662***	0.43662***	0.39291***	0.39291***	0.39291***
	(12.45)	(9.93)	(9.51)	(15.89)	(9.33)	(8.76)
gdd3	-0.00173	-0.00173	-0.00173			
	(-1.54)	(-1.33)	(-1.21)			
gdd4	0.00012	0.00012	0.00012			
	(0.37)	(0.51)	(0.52)			
gdd5	0.00028	0.00028	0.00028			
	(0.73)	(0.83)	(0.97)			
gdd6	-0.00088**	-0.00088**	-0.00088**			
	(-2.12)	(-2.26)	(-2.29)			
gdd7	-0.0001	-0.0001	-0.0001			
	(-0.20)	(-0.21)	(-0.25)			
p3				0.00187	0.00187	0.00187
				(0.74)	(0.77)	(0.76)
p4				0.00109	0.00109	0.00109
				(0.74)	(0.61)	(0.65)
p5				0.00076	0.00076	0.00076
				(0.95)	(0.62)	(0.69)
p6				0.00091*	0.00091	0.00091
				(1.72)	(0.65)	(0.68)
p7				-0.00044	-0.00044	-0.00044
				(-0.88)	(-0.67)	(-0.73)

Note: Model_2 and Model_3 are the origin model in table S4, and the suffix _r and _b represent the estimates with robust and bootstrap techniques. The comparison indicates that the effects of climate variables on spring wheat yield are relative stable, except for the effect of P6 which becomes insignificant in the robust and bootstrap estimates.