

Supplementary materials

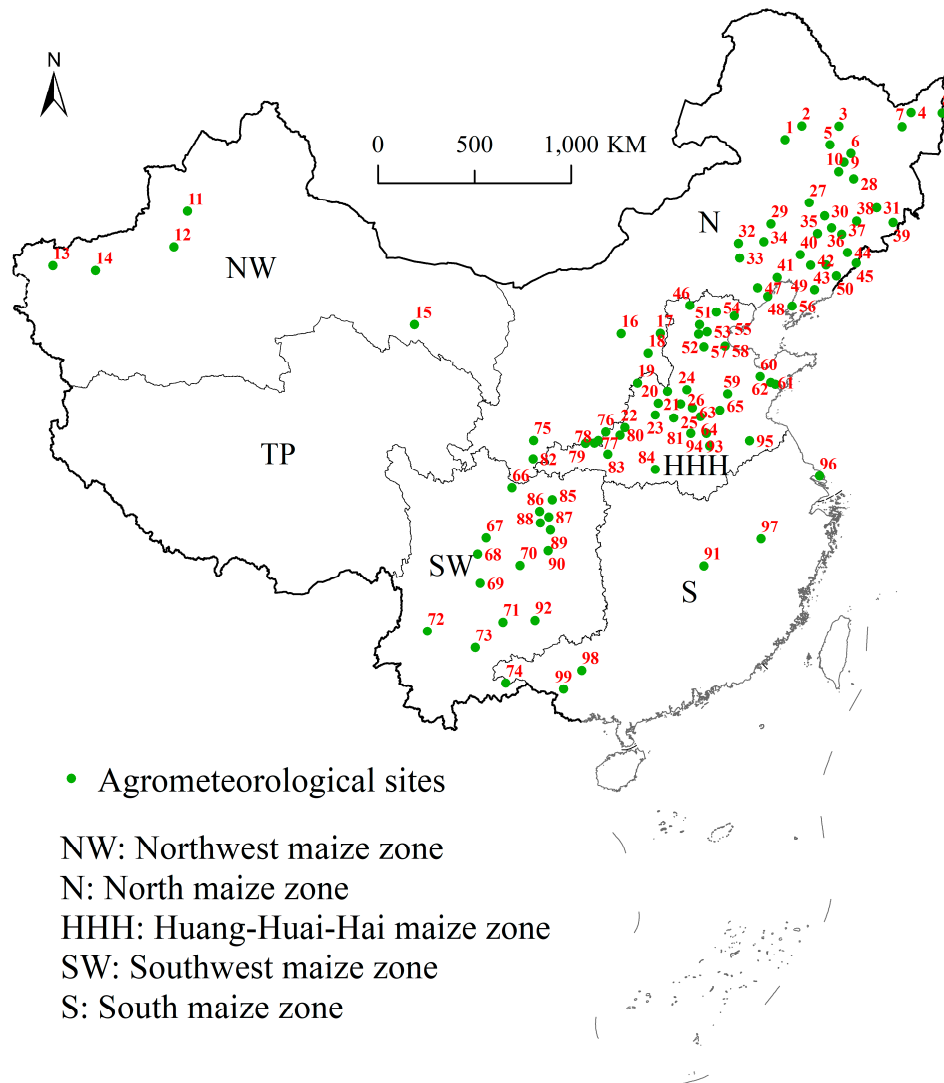


Figure. S1. The spatial distribution of agricultural meteorological stations. (North (N) spring maize zone; Huang-Huai-Hai (HHH) summer maize zone; Southwest (SW) maize zone; South (S) maize zone; Northwest (NW) maize zone).

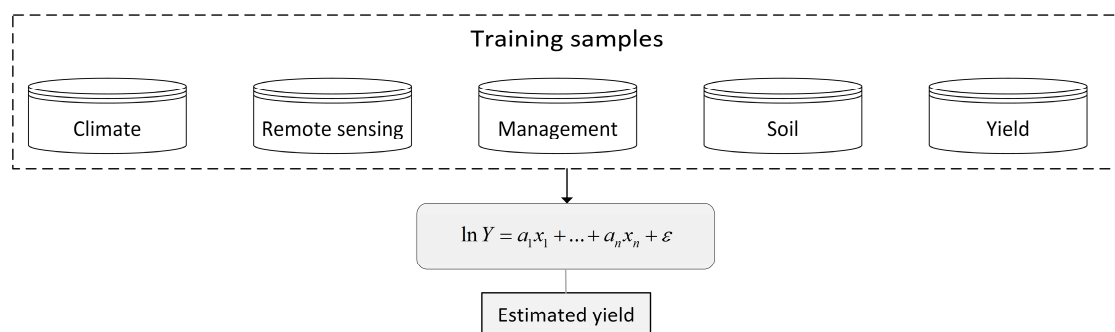


Figure. S2. Flow chart of MLR. Here, Y is the maize yield, x_1, \dots, x_n is the predictors, and a_1, \dots, a_n is the parameters to be fit.

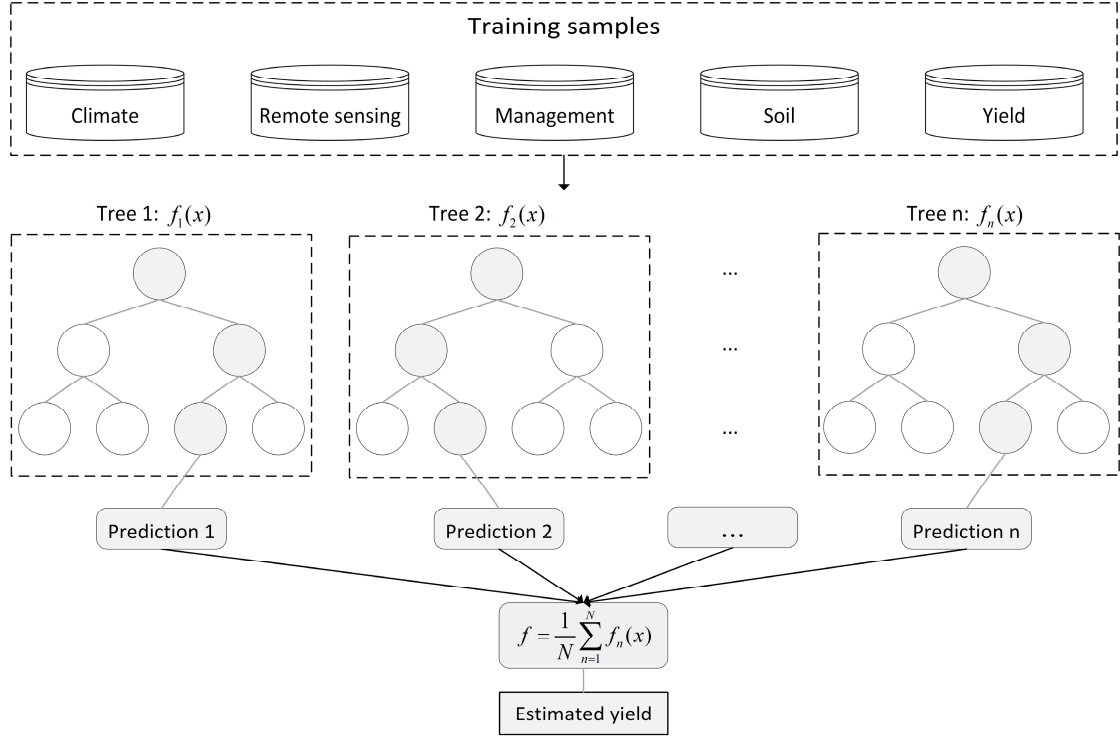


Figure. S3. Flow chart of RF. Here, N is the number of trees, x is the predictors, and $f()$ is the regression tree.

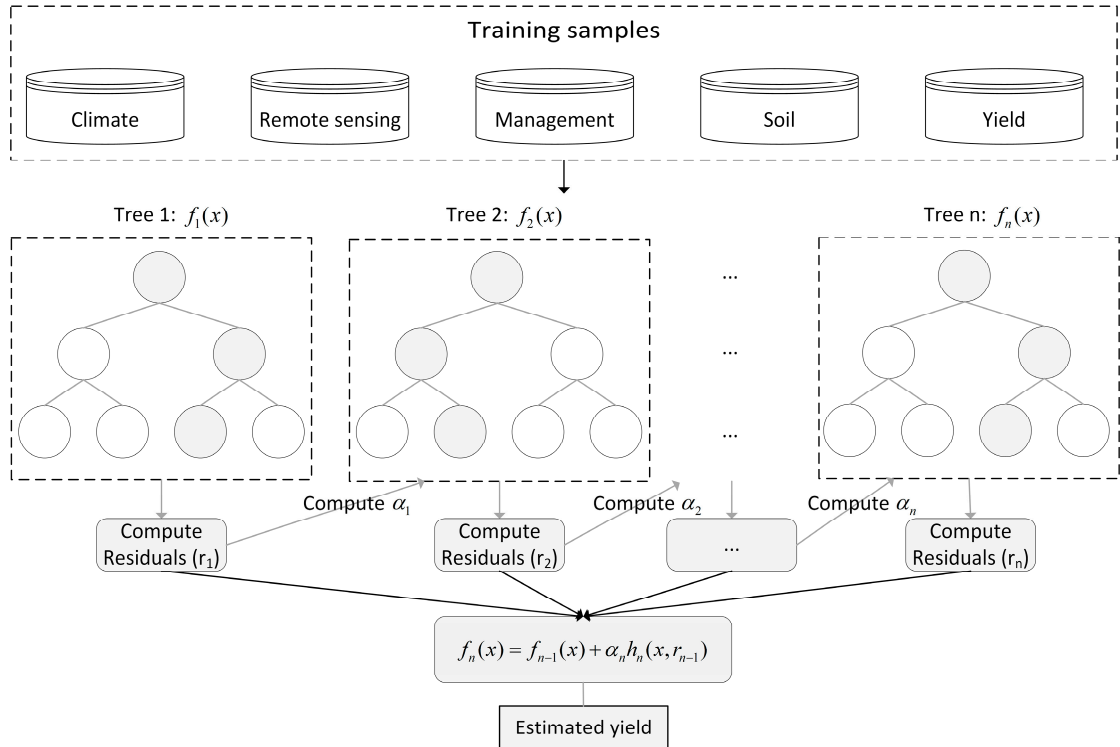


Figure. S4. Flow chart of XGB. Here, α is the regularization parameter, r is the residual, $f()$ is the regression tree, and $h()$ is the function trained to predict the residual.

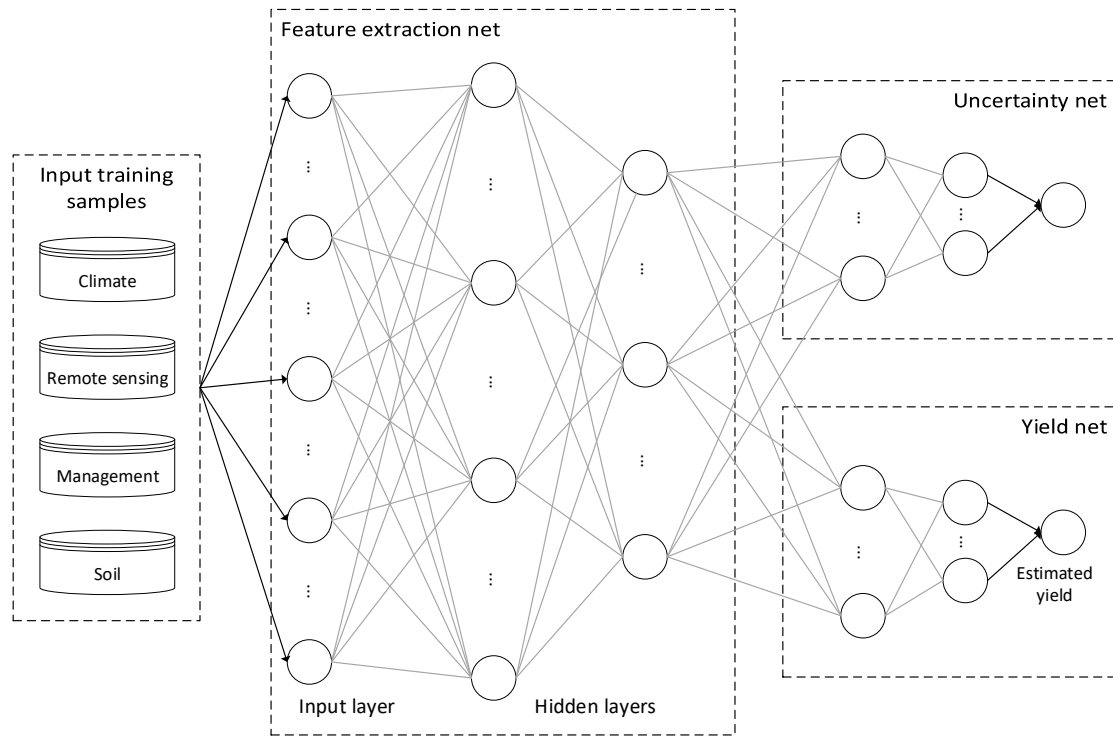


Figure. S5. The architecture of the BNN used in this study

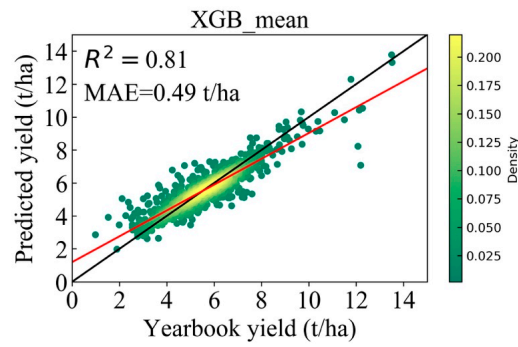


Figure. S6. Scatter plots between estimated and statistical yields at the prefecture-scale for the test set. Black and red solid lines show 1:1 and regression lines, respectively.

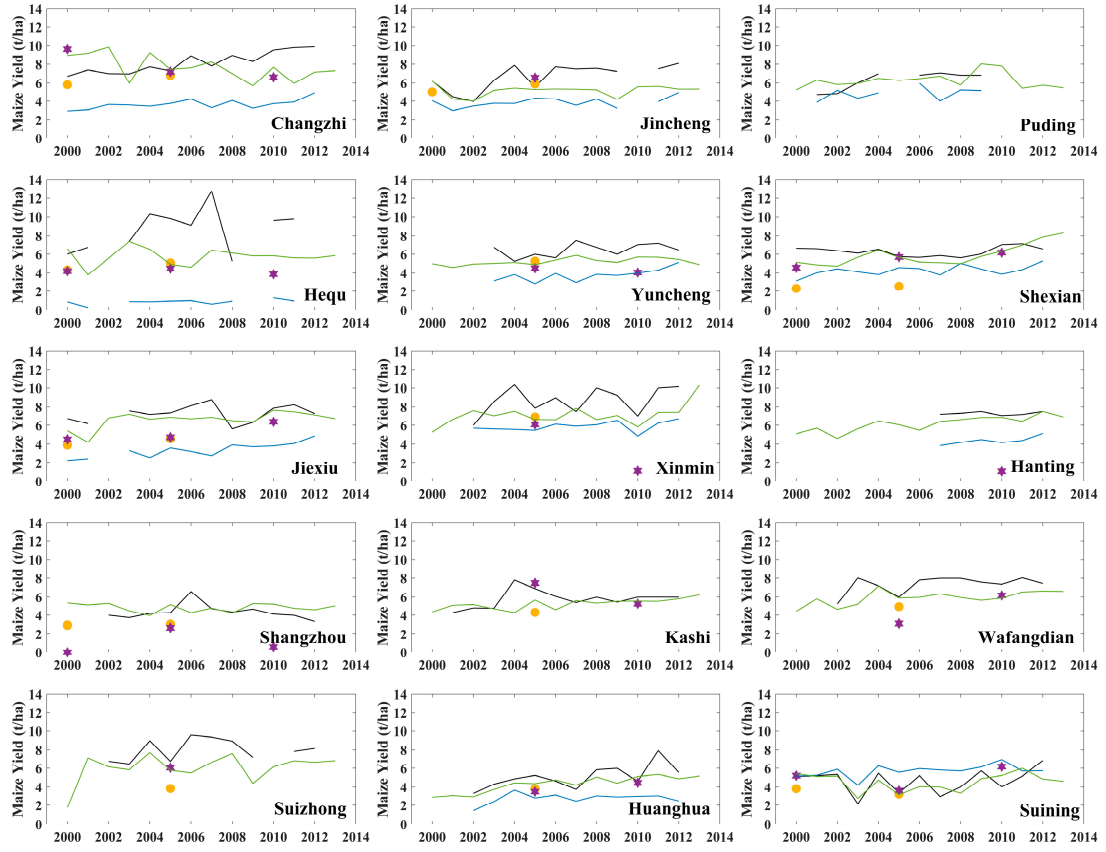


Figure. S7. Yield times series in the selected locations for different datasets.

Table S1 Default parameters of XGB and RF

Model	Parameters	Default values
XGB	learning_rate	0.3
	n_estimators	100
	max_depth	6
	min_child_weight	1
	gamma	0
	n_estimators	10
RF	max_depth	None
	min_samples_split	2
	min_samples_leaf	1
	max_features	auto

Table S2 The RMSE and R2 between different datasets and site records.

Number	Name	Longitude	Latitude	RMSE (t/ha)						R ²	
				Our result	GDHY	Our result	SPAM	Our result	earthstat	Our result	GDHY
1	Longjiang	123.18	47.33	3.45	2.87	3.74	5.31	3.74		0.59	0.08
2	Fuyu	124.48	47.8	2.84	3.16	1.70	1.41	1.68	0.23	0.23	0.04
3	Hailun	126.97	47.43	1.32	1.03	1.43	1.62	1.43		0.40	0.46
4	Fujin	131.98	47.23	4.03	4.93	2.39	1.84	2.39		0.48	0.16
5	Qinggang	126.1	46.68	1.95	2.06	0.78	0.35	0.78		0.42	0.63
6	Bayan	127.35	46.08	2.39	2.79	1.65	2.01	1.65		0.24	0.31
7	Jixian	131.13	46.71	3.62	3.29	3.01	3.76	3.01		0.67	0.40
8	Raohe	134	46.8	1.37	3.49	1.16	7.11	1.16		0.06	0.56
9	Haerbin	126.77	45.75	1.84	2.24	1.36	4.27	1.36		0.24	0.10
10	Shuangcheng	126.3	45.38	2.02	2.39	1.68	1.31	1.68		0.48	0.65
11	Xinyuan	83.3	43.45	3.61		3.58	2.00	1.22	1.69	0.18	
12	Kuche	82.95	41.72	1.23		1.45	0.80	1.90	1.17	0.30	
13	Kashi	75.98	39.47	1.22		0.92	0.66	0.92		0.02	
14	Bachu	78.57	39.8	1.18		0.08	6.63	0.08		0.38	
15	Jiuquan	98.48	39.77	2.59		1.67	9.68	1.29	1.86	0.26	
16	Hequ	111.15	39.38	3.75	8.10	3.60	4.66	4.39	3.58	0.00	0.01
17	Fanzhi	113.53	39.26	3.73	3.60	2.17	3.75	2.16	2.88	0.40	0.48
18	Xinzhou	112.7	38.41	4.06	4.08	2.68	1.24	2.06	2.62	0.15	0.23
19	Jiexiu	111.93	37.05	1.06	4.03	0.81	2.16	0.38	2.78	0.36	0.00
20	Changzhi	113.06	36.05	2.11	4.55	1.68	2.38	1.32	0.72	0.23	0.51

21	Shexian	113.66	36.56	0.95	2.20	0.96	1.29	0.52	3.81	0.26	0.11
22	Yuncheng	111.02	35.03	1.21	2.84	1.23	2.36	1.23		0.49	0.00
23	Jincheng	112.83	35.51	1.91	3.01	0.24	0.96	0.34	0.86	0.29	0.25
24	Feixiang	114.8	36.55	0.75	1.24	1.15	1.42	1.15		0.50	0.20
25	Xinxiang	113.88	35.31	1.03	1.40	0.58	0.16	0.58		0.11	0.24
26	Tangyin	114.35	35.93	2.28	2.88	1.90	3.64	1.90		0.03	0.08
27	Changling	123.97	44.25	2.32	6.37	2.60	2.80	2.91		0.39	0.70
28	Wuchang	127.15	44.9	3.19	2.64	1.25	7.97	1.25		0.02	0.12
29	Kailuxian	121.28	43.6	4.00	7.13	5.03	2.01	5.21	3.13	0.08	0.29
30	Gongzhuling	124.8	43.52	3.46	4.54	2.28	2.30	2.78	2.70	0.29	0.22
31	Dunhua	128.2	43.37	3.04	2.41	2.80	2.44	2.87	2.20	0.10	0.15
32	Wengniuteqi	119.03	42.95	4.78	9.89	5.19	4.90	3.75	3.16	0.25	0.37
33	Chifeng	118.97	42.27	5.57	7.42	5.54	1.93	4.36	2.82	0.18	0.25
34	Naimanqi	120.65	42.85	6.78	10.32	6.50	5.23	6.69	4.23	0.58	0.35
35	Changtu	124.12	42.78	3.74	2.81	3.40	1.25	3.40		0.13	0.04
36	Liaoyuan	125.08	42.92	4.52	3.44	2.99	2.90	2.81	0.67	0.11	0.43
37	Meihekou	125.63	42.53	2.43	1.74	1.90	2.09	1.24	0.62	0.10	0.27
38	Huadian	126.75	42.98	2.77	1.69	2.55	2.47	2.68	0.94	0.24	0.21
39	Helong	129	42.53	3.21	3.87	5.00	7.43	3.19	7.26	0.76	0.59
40	Xinmin	122.8	41.98	2.18	3.05	1.22	4.32	1.22		0.02	0.33
41	Jinzhou	121.12	41.13	4.76	5.88	1.18	0.68	1.18		0.80	0.97
42	Dengta	123.32	41.42	1.70	1.28	0.88	1.26	0.88		0.00	0.36
43	Benxi	124.28	41.3	1.05	4.64	0.18	3.15	0.18		0.35	0.22
44	Tonghuaxian	125.75	41.66	1.63	1.38	0.59	2.43	0.41	2.80	0.02	0.11

45	Jian	126.15	41.1	1.98	2.75	1.94	2.09	2.24	2.01	0.41	0.18
46	Huailai	115.5	40.4	5.92	5.23	3.74	3.79	3.74		0.01	0.04
47	Jianchang	119.82	40.8	1.76	2.13	2.29	1.69	2.29		0.41	0.16
48	Suizhong	120.35	40.35	2.02		0.97	0.69	0.97		0.21	
49	Xiuyan	123.28	40.28	2.62	2.33	2.25	4.51	2.25		0.01	0.00
50	Kuandian	124.78	40.72	2.66	3.62	1.95	2.50	1.95		0.05	0.19
51	Zhuozhou	115.96	39.48	2.97	2.48	2.41	1.43	2.41		0.64	0.80
52	Rongcheng	115.85	39.05	1.31	1.54	1.03	0.78	1.23	1.21	0.61	0.13
53	Bazhou	116.38	39.12	1.34	1.71	1.34	0.62	1.37	2.18	0.68	0.31
54	Sanhe	117.08	39.96	2.12	2.28	1.48	0.38	1.48		0.28	0.38
55	Tangshan	118.15	39.67	4.26	4.60	4.07	2.56	3.65	3.88	0.10	0.19
56	Wafangdian	121.75	39.73	1.57		1.04	2.19	1.04		0.20	
57	Hejian	116.08	38.45	2.90	3.61	2.60	2.18	2.60		0.54	0.23
58	Huanghua	117.35	38.37	1.05	2.56	0.72	1.24	0.72		0.53	0.25
59	Taian	117.15	36.16	1.44	2.92	1.19	1.86	0.80	0.84	0.15	0.40
60	Hanting	119.18	36.75	0.60	2.93	0.20	5.94	0.20		0.35	0.47
61	Gaomi	119.75	36.41	1.26	2.03	1.32	5.13	1.32		0.45	0.80
62	Jiaozhou	120	36.3	1.07	1.32	0.76	0.91	0.72	1.06	0.52	0.34
63	Puyang	115.01	35.7	1.23	1.22	1.10	2.30	1.34	1.08	0.29	0.14
64	Heze	115.43	35.25	2.39	2.69	2.40	1.78	2.72	2.08	0.32	0.29
65	Jining	116.58	35.45	1.03	3.26	0.88	2.02	0.74	1.29	0.44	0.00
66	Pingwu	104.52	32.42	0.99	6.13	0.78	3.41	0.92	2.83	0.04	0.14
67	Mingshan	103.13	30.1	0.98	1.39	0.07	4.73	0.07		0.31	0.19
68	Hanyuan	102.68	29.35	2.57	2.98						

69	Zhaojiao	102.85	28	3.27	3.75	2.93	1.43	3.04	2.59	0.38	0.03
70	Nanxi	104.97	28.85	0.47	0.27						
71	Xuanwei	104.08	26.22	1.54	2.06	1.46	0.81	1.46		0.97	1.00
72	Dali	100.18	25.7	6.57	8.57					0.64	0.66
73	Kunming	102.68	25.02	4.37	5.67	3.84	10.50	3.84		0.17	0.02
74	Wenshan	104.25	23.38	3.04	3.56	3.78	6.11	2.27	4.65	0.01	0.00
75	Tianshui	105.75	34.58	3.92		5.66	5.56			0.50	
76	Dali	109.91	34.88	2.91						0.25	
77	Lintong	109.23	34.4	2.45		1.44	3.56	1.61	1.80	0.13	
78	Weinan	109.46	34.5	2.73		1.66	3.40	1.66		0.48	
79	Xianyang	108.71	34.4	0.63		0.51	0.57	0.51		0.28	
80	Ruicheng	110.71	34.7	1.18	2.67	0.90	1.45	0.90		0.98	0.41
81	Qixian	114.78	34.53	1.35	1.67	1.76	2.24	2.05	0.40	0.15	0.19
82	Chengxian	105.71	33.75	3.56							
83	Shangzhou	109.96	33.86	1.03		0.91	3.50	1.01	1.49	0.02	
84	Nanyang	112.58	33.03	2.07	1.33	2.80	2.76	2.80		0.01	0.13
85	Bazhong	106.76	31.85	1.81	2.83	1.37	2.07	0.43	1.72	0.27	0.20
86	Nanbu	106.05	31.33	1.06	0.39						
87	Yingshan	106.55	31.07	2.60	3.03					0.47	0.07
88	Nanchon	106.08	30.8	3.19	4.44					0.47	0.07
89	Guangan	106.63	30.47	1.44	1.22	0.81	0.95	0.81		0.00	0.00
90	Shapingba	106.48	29.52	0.40	1.28					0.25	0.95
91	Yifeng	114.78	28.41	2.82		2.63	5.50	3.56	3.40	0.17	
92	Puding	105.75	26.31	0.91	1.72					0.16	0.10

93	Shangqiu	115.66	34.45	1.15	1.89	2.52	2.31			0.76	0.09
94	Boxian	115.77	33.87	3.25	1.17						
95	Suining	118.06	33.88	0.91	1.56	0.73	1.24	0.87	0.93	0.47	0.14
96	Qidong	121.66	31.8	1.34		1.11	0.75	1.36	0.26	0.13	
97	Wuyuan	117.98	29.35	5.25		2.53	3.24			0.42	
98	Douan	108.1	23.93	1.31	1.28	2.06	0.87			0.07	0.00
99	Tiandeng	107.15	23.08	1.88	1.22	2.83	2.76	1.88	1.36	0.14	0.27
Average:				2.39	3.17	1.99	2.80	1.84	2.14	0.30	0.28