Supplementary Material: Spatial Modeling of Extreme Temperature in Northeast Thailand

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1. Data

In this study, we use the daily maximum temperature data were observed between 1989 and 2019 for 25 stations. Figure S1 shows the location of 25 observation weather stations in the northeast region of Thailand. Table S1 shows locations of temperature monitoring station and the height above sea level for 25 stations.

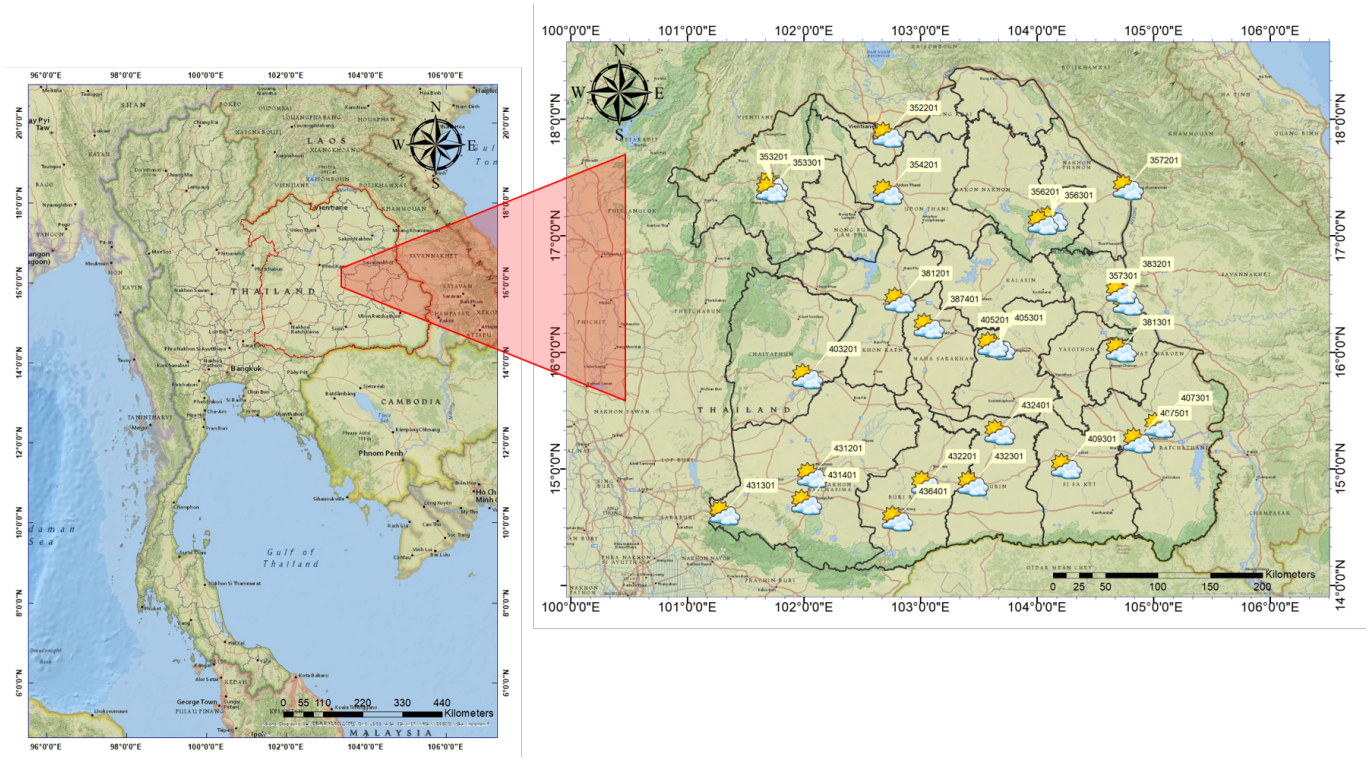

Figure S 1: The locations of 25 observation weather stations in the northeast region of Thailand.

Table S 1: Location of temperature monitoring station and the height above sea level for 25 stations in the northeastern region of Thailand.

ID	Name	Latitude	Longitude	Altitude (m)
352201	Nong Khai	17°52′	102°43′	167
353201	Loei	17°27′	101°44′	246
353301	Loei Agromet	17°24′	101°43′	311
354201	Udonthani	17°23′	102°43′	177
356201	Sakon Nakhon	17°09′	104°08′	168
356301	Sakon Nakhon Agromet	17°07′	104°03′	238
357201	Nakhon Phanom	17°25′	104°47′	141
357301	Nakhon Phanom Agromet	16°26′	104°47′	142
381201	Khon Kaen	16°27′	102°49′	168
381301	Tahpra Agromet	16°20′	104°43′	171
383201	Mukdaharn	16°32′	104°43′	162
387401	Maha Sarakham	16°14′	103°04′	161
403201	Chaiyaphum	15°48′	102°02′	209
405201	Roiet	16°03′	103°41′	147
405301	Roiet Agromet	16°04′	103°37′	161
407301	Ubon Ratchatani Agromet	15°23′	105°03′	118
407501	Ubon Ratchatani	15°15′	104°52′	126

Table S 1 : *Continued from previous page*

ID	Name	Latitude	Longitude	Altitude (m)
409301	Si Sa Ket	15°02′	104°15′	134
431201	Nakhon Ratchasima	14°57′	102°04′	204
431301	Pak Chong Agromet	14°38′	101°19′	551
431401	Chok Chai	14°43′	102°10′	187
432201	Surin	14°53′	103°30′	147
432301	Surin Agromet	14°53′	103°27′	144
432401	Tha Tum	15°19′	103°41′	144
436401	Nang Rong	14°35′	102°48′	185

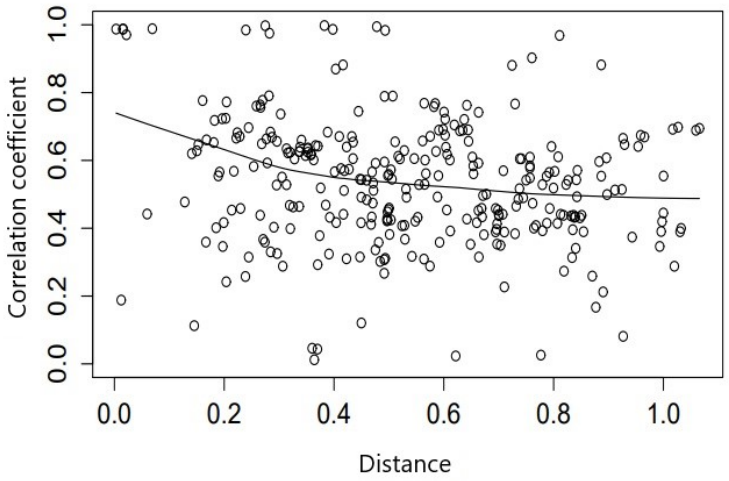

Figure S 2: Scatter plot of Spearman's correlation coefficients versus Euclidian distances obtained between every two station in the northeast region of Thailand.

The scatter plot of Spearman's correlation coefficients versus Euclidian distances obtained between every two stations is provided in Figure 2. There is moderate spatial dependence, approximately between 0.5 to 0.8, for the annual maximum daily temperature data, suggesting that spatial modeling might be good than independent modeling.

2. Results

2..1 The generalized extreme value (GEV) distribution

Table S 2: Point parameter estimates and in the 95 confidence interval, appropriate distribution and p-value of Kolmogorov-Smirnov (KS) test of each station from local GEV.

Station	Parameter estimate			Distribution	p-value of KS
	$\hat{\mu}$**(s.e)**	$\hat{\sigma}$**(s.e)**	$\hat{\xi}$**(s.e)**		
	CI 95%	CI 95%	CI 95%		
352201	40.49 (0.22) (40.05, 40.92)	1.07 (0.17) (0.75, 1.40)	-0.21 (0.17) (-0.54, 0.12)	Gumbel	0.57
353201	40.19 (0.24) (39.72, 40.66)	1.15 (0.18) (0.79, 1.51)	-0.33 (0.18) (-0.69, 0.03)	Gumbel	0.96
353301	40.12 (0.23) (39.67, 40.57)	1.12 (0.17) (0.78, 1.45)	-0.31 (0.16) (-0.63, 0.00)	Gumbel	0.91
354201	40.51 (0.21) (40.09, 40.93)	1.08 (0.15) (0.79, 1.38)	-0.35 (0.11) (-0.57, -0.13)	Weibull	0.99
356201	39.81 (0.24) (39.35, 40.27)	1.18 (0.23) (0.73, 1.64)	-0.77 (0.20) (-1.16, -0.38)	Weibull	0.86
356301	39.79 (0.21) (39.38, 40.19)	1.05 (0.17) (0.71, 1.39)	-0.57 (0.14) (-0.85, -0.29)	Weibull	0.78
357201	39.04 (0.24) (38.57, 39.52)	1.16 (0.18) (0.79, 1.52)	-0.23 (0.18) (-0.58, 0.12)	Gumbel	0.85
357301	39.08 (0.24) (38.61, 39.55)	1.15 (0.18) (0.80, 1.50)	-0.24 (0.17) (-0.57, 0.09)	Gumbel	0.86
381201	40.53 (0.17) (40.19, 40.86)	0.83 (0.14) (0.56, 1.10)	-0.44 (0.18) (-0.80, -0.08)	Weibull	0.80
381301	40.51 (0.17) (40.17, 40.84)	0.85 (0.13) (0.60, 1.09)	-0.29 (0.14) (-0.57, -0.02)	Weibull	0.97
383201	40.25 (0.18) (39.90, 40.60)	0.90 (0.14) (0.63, 1.17)	-0.52 (0.14) (-0.79, -0.24)	Weibull	0.76
387401	40.56 (0.18) (40.19, 40.92)	0.87 (0.16) (0.56, 1.17)	-0.48 (0.21) (-0.89, -0.06)	Weibull	0.68

Table S 2: *Continue.*

Station	Parameter estimate			Distribution	p-value of KS
	$\hat{\mu}$**(s.e)**	$\hat{\sigma}$**(s.e)**	$\hat{\xi}$**(s.e)**		
	CI 95%	CI 95%	CI 95%		
403201	39.89 (0.18) (39.53, 40.25)	0.90 (0.14) (0.63, 1.17)	-0.31 (0.16) (-0.62, 0.01)	Gumbel	0.76
405201	39.83 (0.21) (39.43, 40.23)	1.01 (0.15) (0.72, 1.31)	-0.31 (0.14) (-0.59, -0.03)	Weibull	0.99
405301	39.86 (0.20) (39.47, 40.24)	1.00 (0.15) (0.71, 1.29)	-0.39 (0.13) (-0.64, -0.14)	Weibull	0.95
407301	39.84 (0.19) (39.47, 40.22)	0.94 (0.14) (0.66, 1.21)	-0.23 (0.14) (-0.51, 0.06)	Gumbel	0.99
407501	39.87 (0.19) (39.49, 40.24)	0.94 (0.14) (0.66, 1.23)	-0.34 (0.15) (-0.63, -0.04)	Weibull	0.99
409301	39.72 (0.19) (39.36, 40.08)	0.94 (0.13) (0.69, 1.19)	-0.22 (0.10) (-0.42, -0.01)	Weibull	0.69
431201	40.02 (0.21) (39.61, 40.43)	1.08 (0.15) (0.78, 1.38)	-0.45 (0.10) (-0.64, -0.25)	Weibull	0.98
431301	38.47 (0.19) (38.09, 38.84)	0.97 (0.14) (0.70, 1.24)	-0.38 (0.12) (-0.61, -0.14)	Weibull	0.89
431401	39.25 (0.15) (38.95, 39.55)	0.73 (0.11) (0.52, 0.95)	-0.22 (0.16) (-0.52 ,0.09)	Gumbel	0.96
432201	39.05 (0.15) (38.75, 39.36)	0.76 (0.11) (0.55, 0.98)	-0.18 (0.13) (-0.44, 0.08)	Gumbel	0.92
432301	39.91 (0.20) (39.52, 40.30)	1.00(0.15) (0.70, 1.31)	-0.46 (0.14) (-0.74, -0.19)	Weibull	0.95
432401	40.4214 (0.2341) (39.96, 40.88)	1.13 (0.17) (0.79, 1.47)	-0.24 (0.16) (-0.56, 0.08)	Gumbel	0.75
436401	40.25 (0.21) (39.85, 40.65)	1.02 (0.17) (0.68, 1.36)	-0.60 (0.17) (-0.93, -0.26)	Weibull	0.80

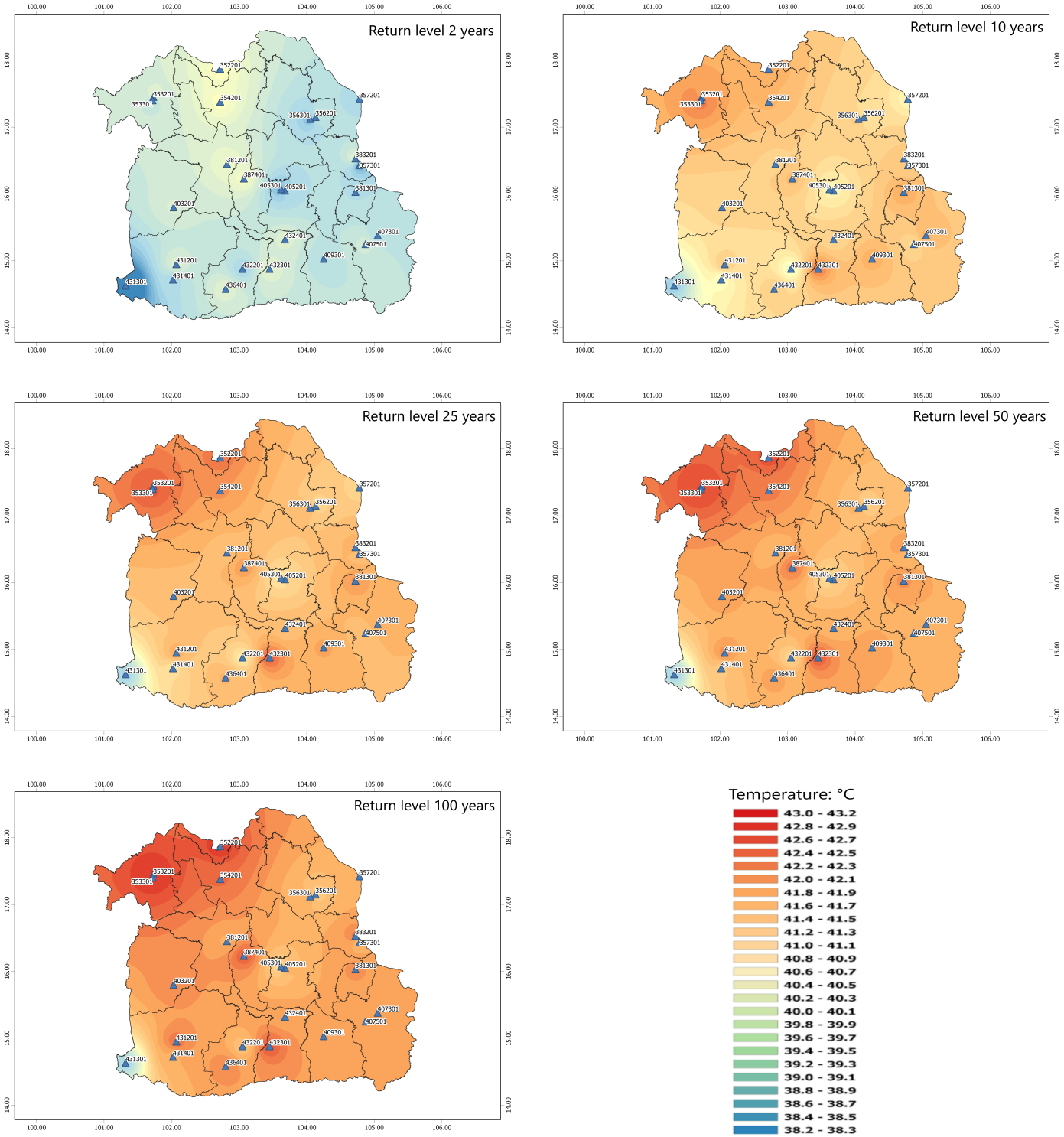

Figure S 3: The return level maps for 25 stations correspond to 2, 10, 25, 50, and 100 years return periods in northeast region of Thailand (unit: $^{\circ}C$). The return levels are obtained from local GEV models.

2..2 The spatial generalized extreme value distribution

Table S 3: The return levels (unit: $^{\circ}C$) for 200 return period year ($T = 200$) of each station from spatial generalized extreme value distribution.

station ID	Station Name	200 years
352201	Nong Khai	43.46
353201	Loei	42.94
353301	Loei Agromet	42.87
354201	Udonthani	43.28
356201	Sakon Nakhon	42.78
356301	Sakon Nakhon Agromet	42.61
357201	Nakhon Phanom	42.84
357301	Nakhon Phanom Agromet	42.76
381201	Khon Kaen	43.31
381301	Tahpra Agromet	43.17
383201	Mukdaharn	42.75
387401	Maha Sarakham	43.32
403201	Chaiyaphum	43.20
405201	Roiet	43.04
405301	Roiet Agromet	42.92
407301	Ubon Ratchatani Agromet	42.36
407501	Ubon Ratchatani	42.59
409301	Si Sa Ket	42.78
431201	Nakhon Ratchasima	42.89
431301	Pak Chong Agromet	41.51
431401	Chok Chai	42.83
432201	Surin	42.80
432301	Surin Agromet	42.85
432401	Tha Tum	43.01
436401	Nang Rong	42.68

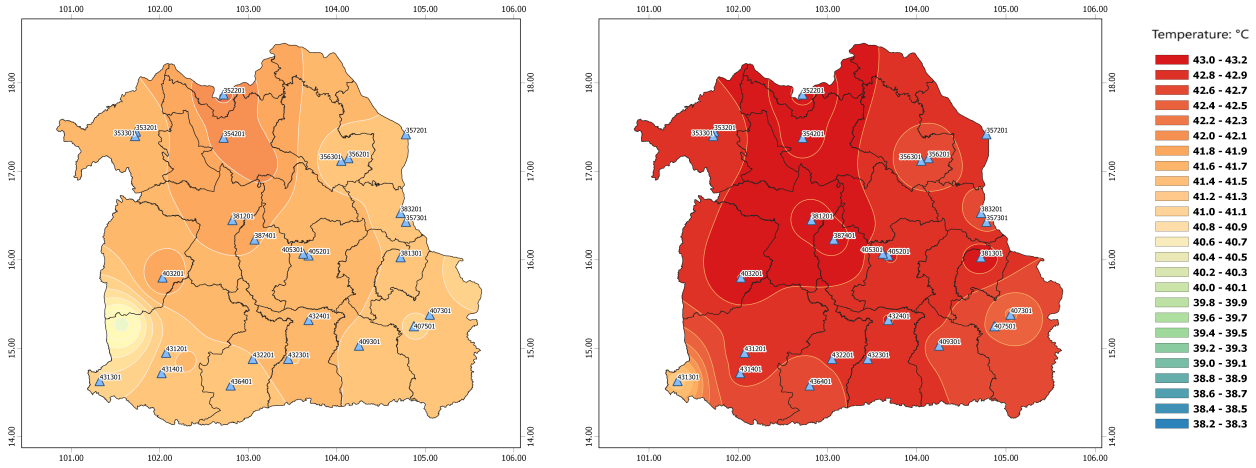

Figure S 4: The return level maps for 25 stations correspond to 5 years (left) and 200 years (right) return periods in northeast region of Thailand (unit: $^{\circ}C$). The return levels are obtained from Max-stable process models.