Supplement

S1: How to select a threshold for GPD.

To fit a GPD, a threshold needs to be selected. We selected the thresholds in the following ways. Figure S.3 repeatedly fits the GPD to the data for a series of threshold choices along with uncertainty (Gilleland and Katz, 2016). Figure S.4Figure S.4 plots the mean excess values for a sequence of threshold choices with some variability information (Gilleland and Katz, 2016). As discussed in Gilleland and Katz (2016), choice of a threshold is subjective. Because a good choice of the threshold is near the inflection point of the right tail of the distribution, the value of 1.0 is selected as a threshold. This selection of 1 seems to yield estimates that will not change much as the threshold increases further from Figure S.3. Also, Gilleland and Katz (2016) suggests selecting a threshold whereby the graph is linear within uncertainty bounds in the plot of the mean excess values. Following this, the threshold value of 1 is a reasonable choice in Figure S.4. Furthermore, if I use this value for the threshold, the exceedance percentile of the threshold (a ratio of the number of exceedance to the number of total data) is 0.210 in the Southwest and 0.26 for both the northwest and east. Therefore, it is reasonable to use a threshold of 1.0.

S2: Figures

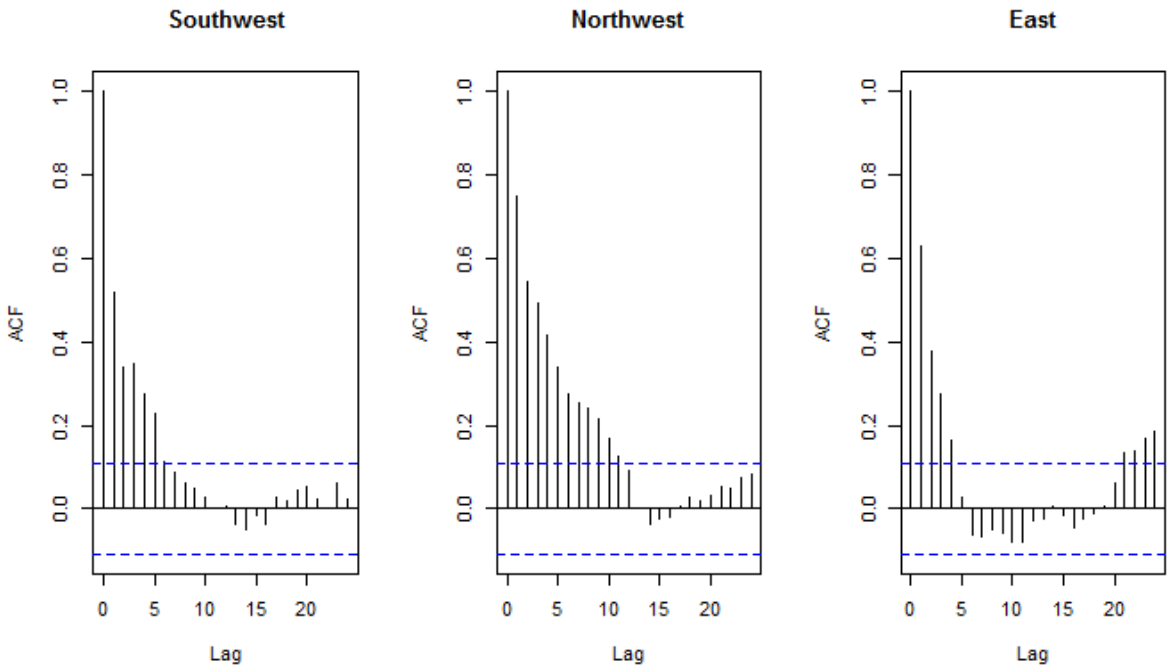

Figure S.1: ACF of the tree-ring reconstructed PDSI in each cluster.

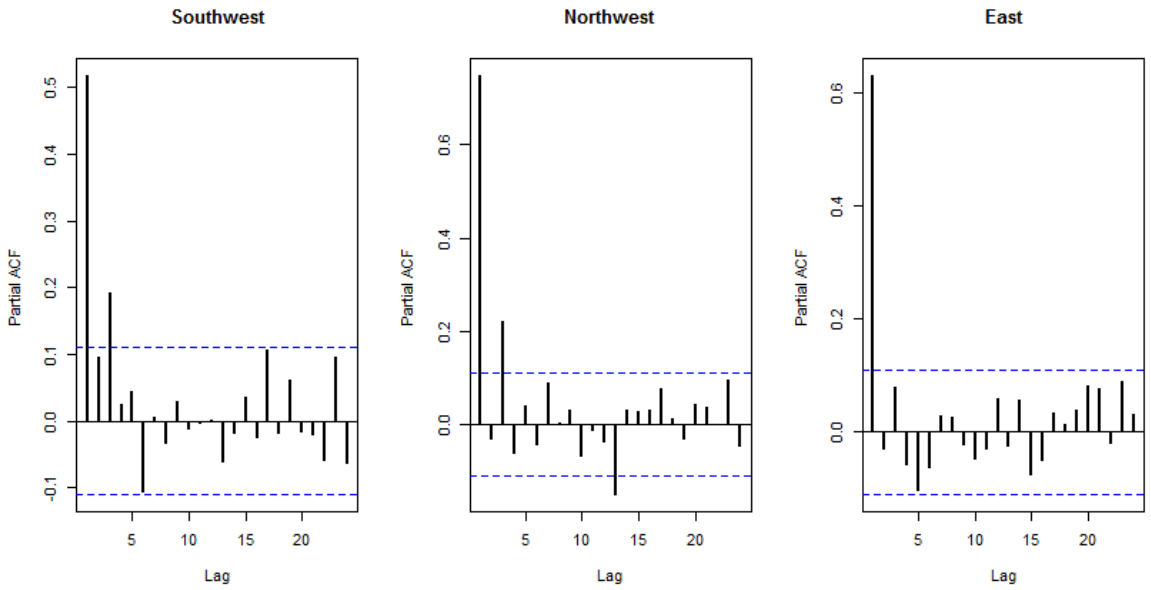

Figure S.2: PACF of the tree-ring reconstructed PDSI in each cluster.

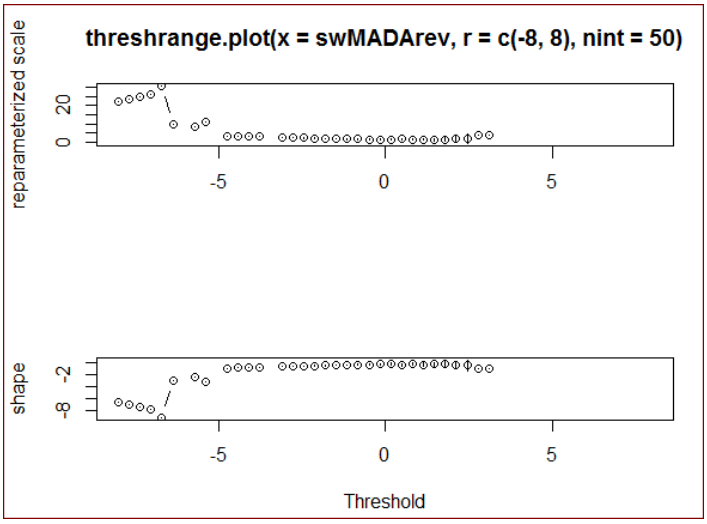

Figure S.3: Threshold Range Plot (1)

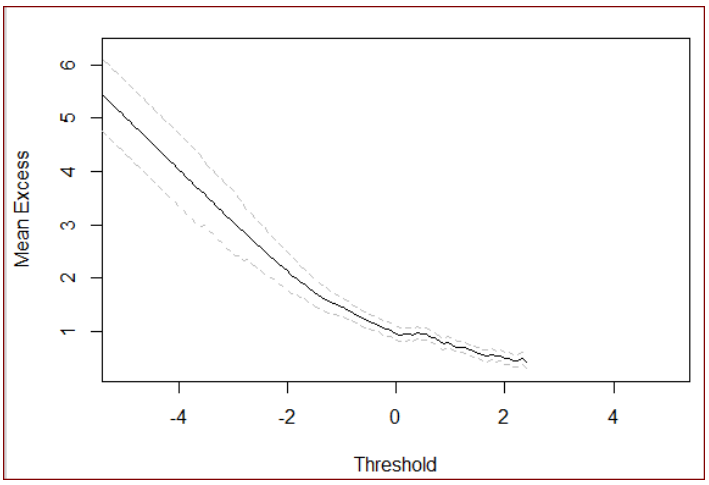

Figure S.4: Threshold Range Plot (2)

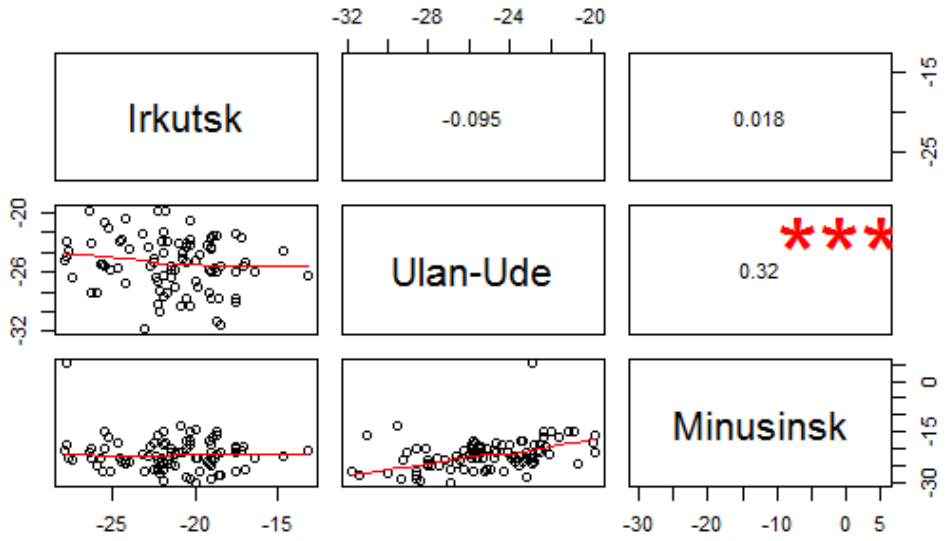

Figure S.5: Scatterplots between winter minimum temperature in three Siberia stations.

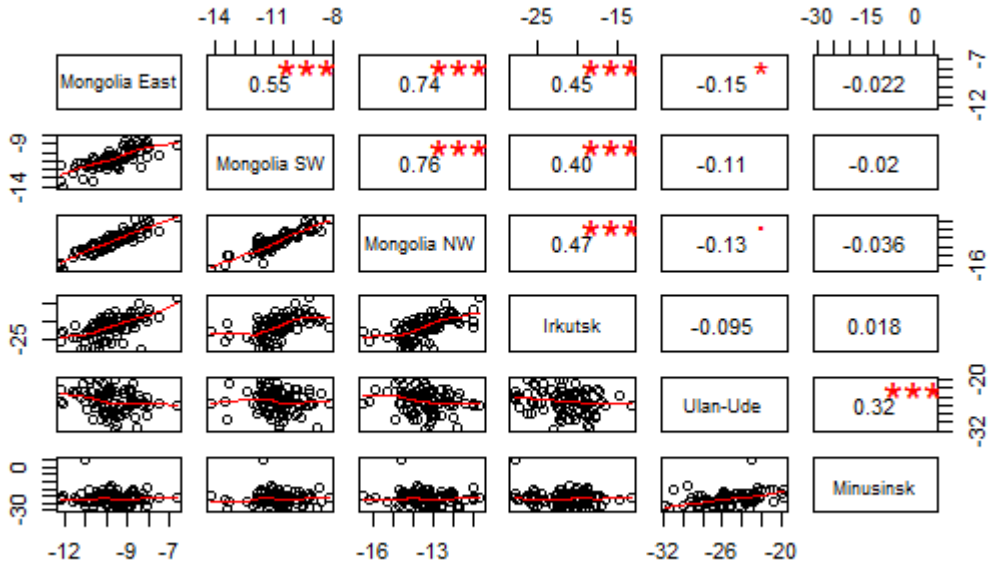

Figure S.6: Scatterplots of winter average temperature in three Siberia and three Mongolia clusters.

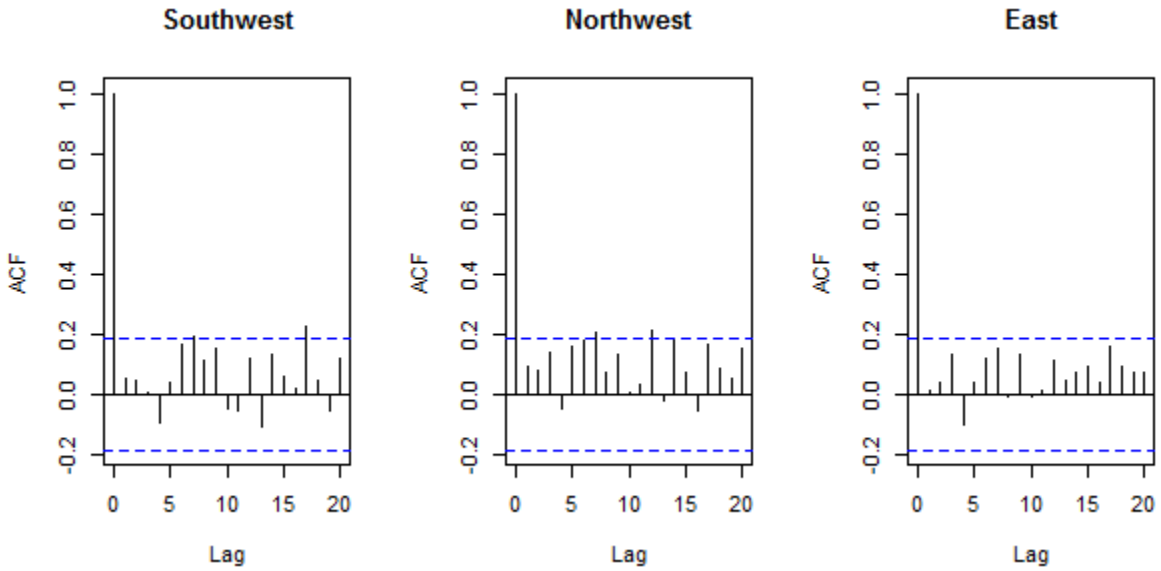

Figure S.7: ACF of residuals between data from Irkutsk Siberia and the winter average temperature of each cluster.

A.3: Tables

Table S.1: 95% Confidence intervals of parameters based on the normal approximation for each region.

	95% lower CI	Estimate	95% upper CI
Southwest			
Location (α_0)	-0.56	-0.42	-0.28
Scale (β_0)	0.75	0.95	1.15
Scale (β_1)	0.001	0.002	0.003
Shape (ε)	-0.29	-0.23	-0.17
Northwest			
Location(α_0)	-0.87	-0.67	-0.46
Scale (β_0)	1.53	1.68	1.82
Shape (ε)	-0.32	-0.25	-0.18
East			
Location(α_0)	-0.93	-0.73	-0.52
Scale (β_0)	1.51	1.65	1.80
Shape (ε)	-0.38	-0.31	-0.24

Table S.2: 95% Confidence intervals of parameters, using other climate variables based on the normal approximation

	95% lower CI	Estimates	95% Upper CI
Southwest			
Location (α_0)	2.49	3.63	4.77
Location (β_1)	-0.18	-0.14	-0.11
Scale (β_0)	0.96	1.12	1.28
Shape(ε)	-0.33	-0.21	-0.10
Northwest			
Location (α_0)	4.84	6.25	7.67
Location (α_1)	-0.17	-0.15	-0.12
Scale (β_0)	1.60	2.38	3.17
Scale (β_1)	-0.48	-0.31	-0.14
Shape (ε)	-0.20	-0.07	0.06
East			
Location (α_0)	3.01	5.09	7.17
Location (β_1)	-0.17	-0.13	-0.08
Scale (β_0)	1.26	1.48	1.71
Shape (ε)	-0.39	-0.24	-0.10

Table S.3: 95% Confidence intervals of parameters, using other climate variables based on the normal approximation

	95% lower CI	Estimate	95% upper CI
Southwest			
Scale (β_0)	0.33	0.78	1.24
Shape (ε)	-0.64	-0.20	0.22
Northwest			
Scale (β_0)	0.78	2.02	3.25

Shape(ε)	-1.01	-0.53	-0.05
East			
Scale(β_0)	0.85	1.88	2.91
Shape(ε)	-1.13	-0.65	-0.18

Table S.4: Pearson and Spearman correlation coefficients in winter minimum temperature between Mongolia data and Siberia data

	Southwest	Northwest	East
Pearson correlation coefficients			
Irkutsk, Siberia	0.57	0.72	0.76
Ulan-Ude, Siberia	-0.14	-0.13	-0.21
Minusinsk, Siberia	-0.04	-0.09	-0.16
Spearman correlation coefficients			
Irkutsk, Siberia	0.52	0.61	0.60
Ulan-Ude, Siberia	-0.14	-0.19	-0.22
Minusinsk, Siberia	-0.02	-0.08	-0.08

Table S.5: Estimated parameters based on the best GEV model fitted to the winter minimum temperature in Southwest using Irkutsk data.

	Estimate	Standard Error Estimates
Southwest		
Location (α_0)	11.82	1.22
Location (α_1)	0.39	0.06
Scale (β_0)	1.90	0.14
Shape (ε)	-0.25	0.06
Northwest		
Location (α_0)	12.67	1.00
Location (α_1)	0.52	0.05
Scale (β_0)	0.35	0.66
Scale (β_1)	0.06	0.03
Shape	-0.18	0.06
East		
Location (α_0)	10.20	0.80
Location (α_1)	0.48	0.04
Scale (β_0)	1.40	0.10
Shape (ε)	-0.38	0.05

Table S.6: Estimated parameters based on the best GPD model fitted to the winter minimum temperature in Southwest using Irkutsk data.

	Estimate	Standard Error Estimates
Southwest		
Scale (α_0)	-4.18	1.60

Scale (α_1)	0.34	0.09
Shape	-0.54	0.13
Northwest		
Scale(β_3)	2.30	2e-08
Scale (β_4)	0.35	2e-08
Shape	-1.15	2e-08
East		
Scale	-1.63	2e-08
Scale (β_4)	0.26	2e-08
Shape	-1.06	2e-08

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