

Investigating the Impact of the Spatiotemporal Bias Correction of Precipitation in CMIP6 Climate Models on Drought Assessments

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Table S1. Area percentage statistics of precipitation correlation levels between different corrections and CRU TSV4 for seven CMIP6 models.

Correlation (%) \		AWI-CM-1-1-	CMCC-	CNRM-CM6-1-	FIO-ESM-	GFDL-	INM-	MRI-
Model		MR	ESM2	HR	2-0	ESM4	CM5-0	ESM2-0
Model	[0, 0.2)	5.98	1.92	4.59	1.94	3.66	3.93	7.13
	[0.2, 0.4)	11.18	11.05	10.57	11.00	8.51	15.92	12.23
	[0.4, 0.6)	11.64	16.72	15.40	13.58	21.78	24.49	10.73
	[0.6, 0.8)	39.14	25.31	36.63	27.24	38.60	48.51	29.51
	[0.8, 1.0)	32.06	45.00	32.82	46.23	27.45	7.16	40.40
QM	[0, 0.2)	6.48	2.48	4.60	2.81	4.05	5.46	8.45
	[0.2, 0.4)	11.17	12.95	11.66	11.90	13.64	20.71	13.15
	[0.4, 0.6)	12.83	15.81	14.24	13.35	19.58	18.69	10.04
	[0.6, 0.8)	39.67	23.67	23.74	25.52	41.09	41.16	24.67
	[0.8, 1.0)	29.84	45.08	45.77	46.42	21.63	13.98	43.69
HQ	[0, 0.2)	0.82	0.13	1.44	0.16	1.31	0.53	1.15
	[0.2, 0.4)	4.55	3.67	4.63	5.63	5.72	4.87	3.05
	[0.4, 0.6)	12.66	12.45	15.08	11.56	17.64	17.28	14.25
	[0.6, 0.8)	30.66	27.97	23.46	28.16	30.93	39.93	23.64
	[0.8, 1.0)	51.31	55.78	55.39	54.49	44.41	37.39	57.92

Table S2. Area percentage statistics of PET correlation levels between different corrections and CRU TSV4 for seven CMIP6 models.

Correlation (%) \		AWI-CM-1-1-	CMCC-	CNRM-CM6-1-	FIO-ESM-	GFDL-	INM-	MRI-
Model		MR	ESM2	HR	2-0	ESM4	CM5-0	ESM2-0
Model	[0, 0.2)	8.19	7.86	1.14	5.79	1.20	0.00	3.53
	[0.2, 0.4)	5.45	3.33	4.26	3.18	4.80	0.39	2.60
	[0.4, 0.6)	16.36	20.01	8.45	6.76	7.57	2.99	14.86
	[0.6, 0.8)	43.43	46.36	52.93	67.17	37.78	18.22	59.94
	[0.8, 1.0)	26.57	22.44	33.21	17.10	48.66	78.40	19.06
QM	[0, 0.2)	6.77	6.76	0.21	4.70	0.23	0.00	2.28
	[0.2, 0.4)	3.40	2.33	2.14	2.90	3.01	0.53	2.44
	[0.4, 0.6)	11.92	8.63	7.43	5.27	5.58	2.76	5.69
	[0.6, 0.8)	34.50	47.25	38.57	57.47	25.81	18.18	31.74
	[0.8, 1.0)	43.42	35.03	51.64	29.66	65.36	78.52	57.85
HQ	[0, 0.2)	1.03	0.71	0.00	0.24	0.00	0.00	0.00
	[0.2, 0.4)	0.96	1.36	0.00	1.10	0.00	0.00	0.00
	[0.4, 0.6)	2.09	3.29	1.41	2.52	0.00	0.06	0.54
	[0.6, 0.8)	8.26	5.62	3.95	5.76	12.22	3.79	6.28
	[0.8, 1.0)	87.66	89.01	94.64	90.38	87.78	96.15	93.18

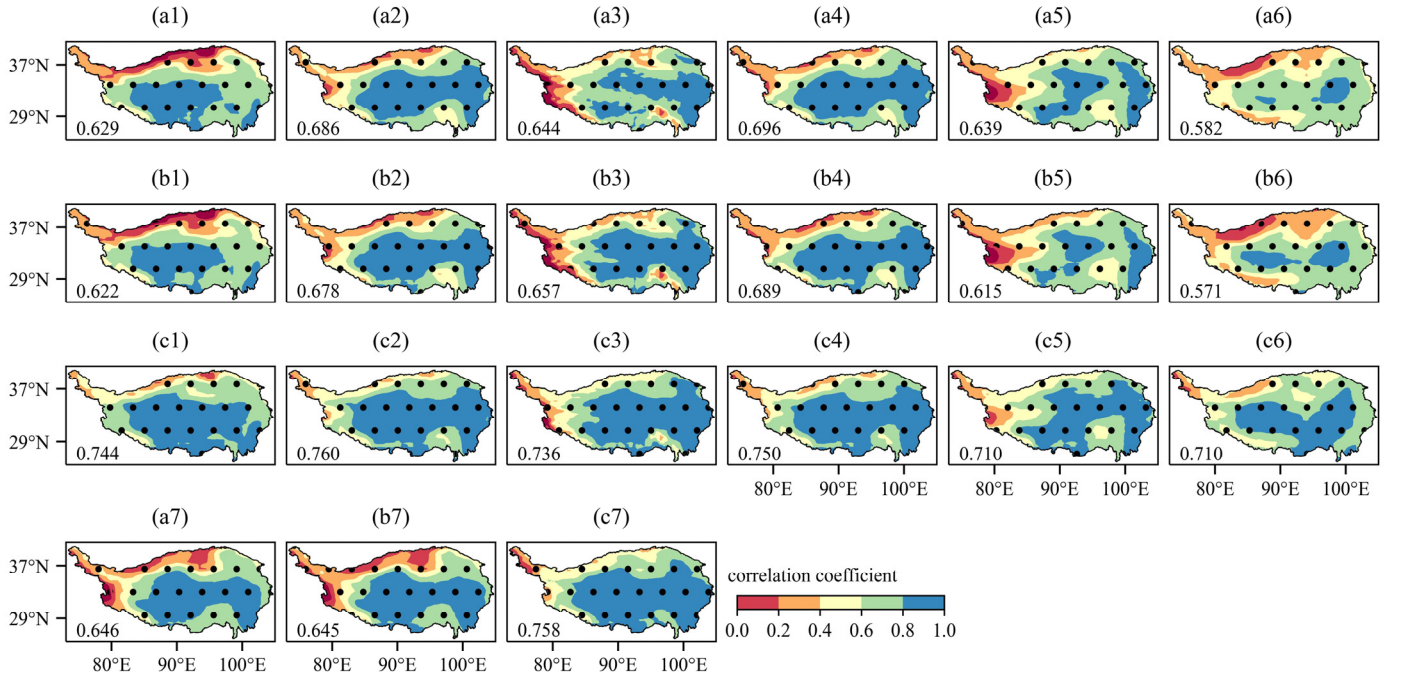


Figure S1. The correlation coefficient for precipitation between the CMIP6 model and CRU TSV4 in the historical scenarios. a, b and c represent the correlation coefficient between the original, and the QM-corrected and the HQ-corrected with CRU TSV4, respectively. a1-a7 are seven CMIP6 models respectively.

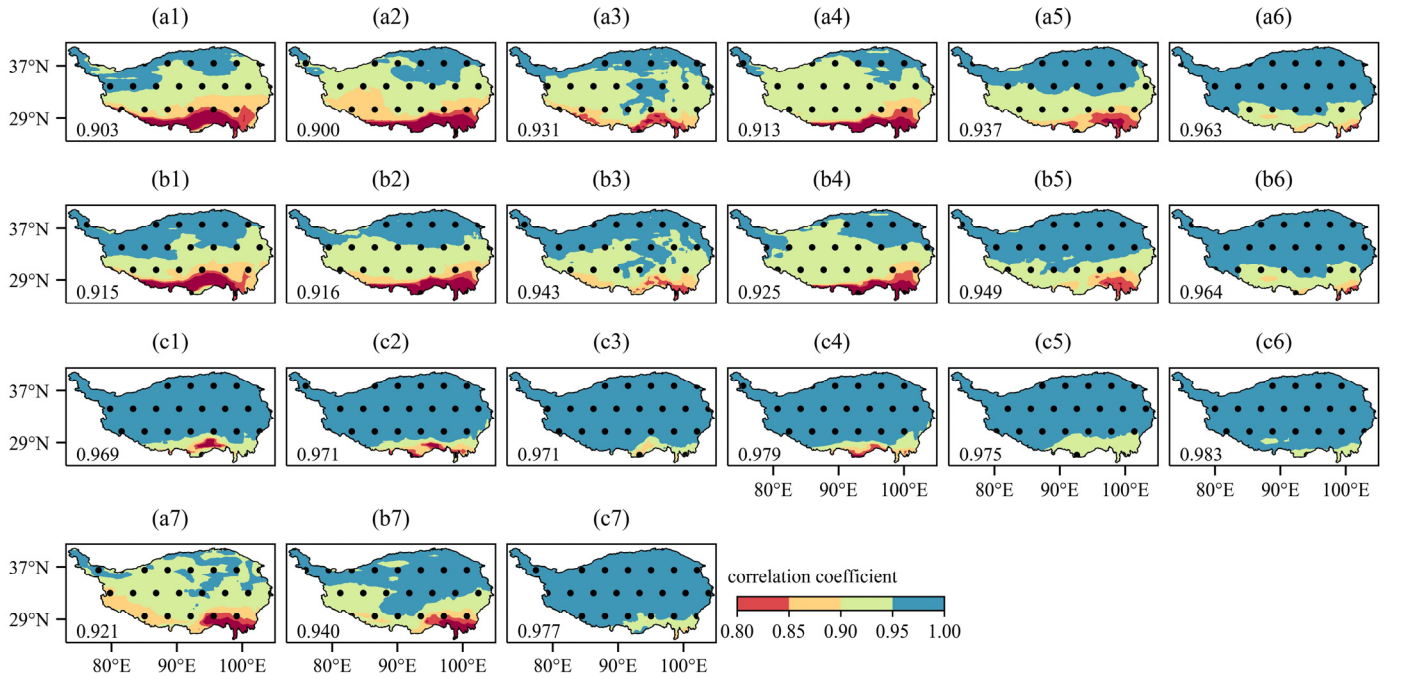


Figure S2. The correlation coefficient for PET between the CMIP6 model and CRU TSV4 in the historical scenarios. a, b and c represent the correlation coefficient between the original, and the QM-corrected and the HQ-corrected with CRU TSV4, respectively. a1-a7 are seven CMIP6 models respectively.

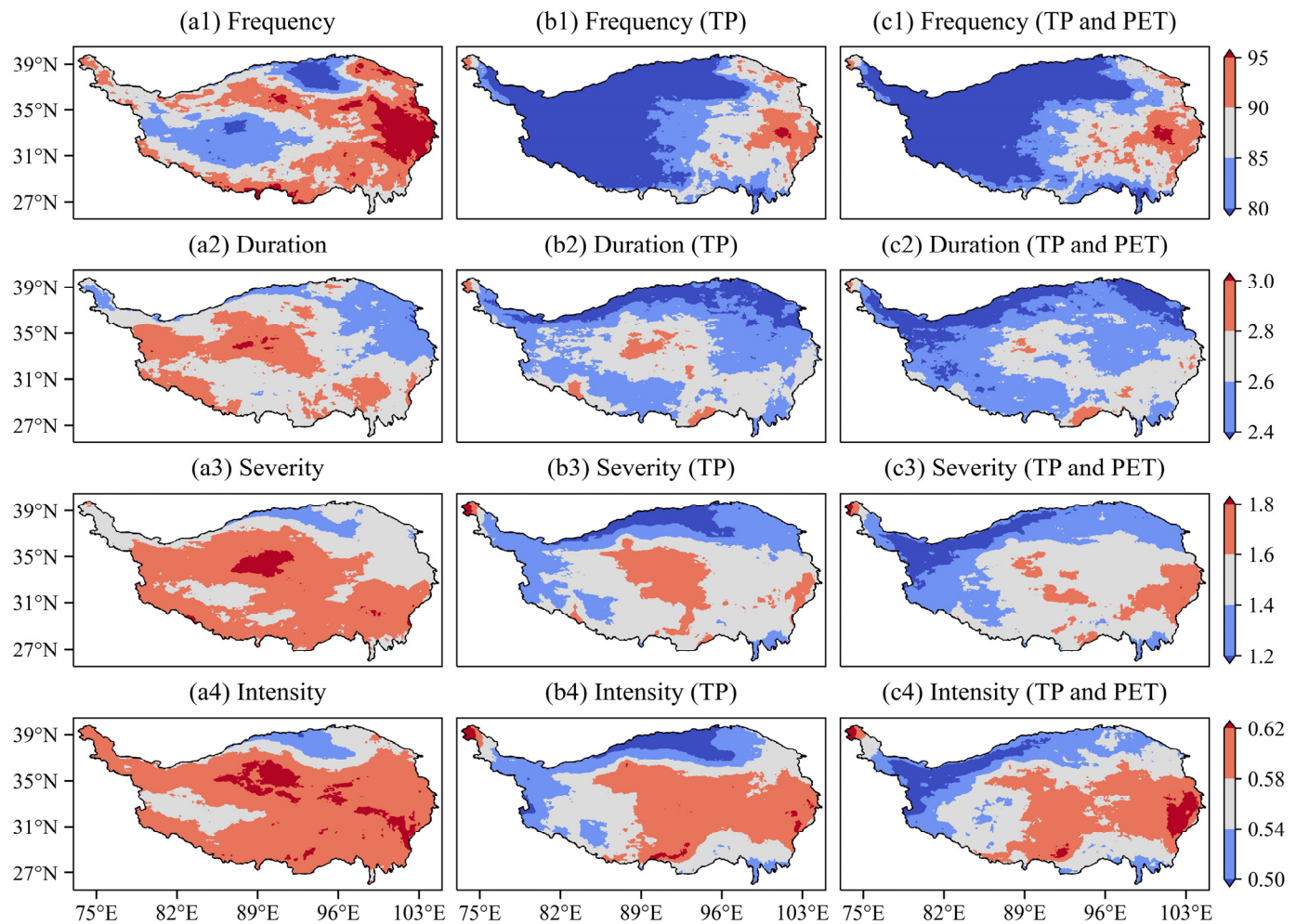


Figure S3. Spatial distribution of drought characteristics in the historical scenarios. a1-a4 are the total drought frequency, the duration, severity, and intensity of each drought event, respectively. a-c are respectively the drought characteristics of the original, the QM-corrected, and the HQ-corrected ensemble model. Frequency (TP) is the frequency of SPEI (only TP corrected), and frequency (TP and PET) is the frequency of SPEI (TP and PET corrected).

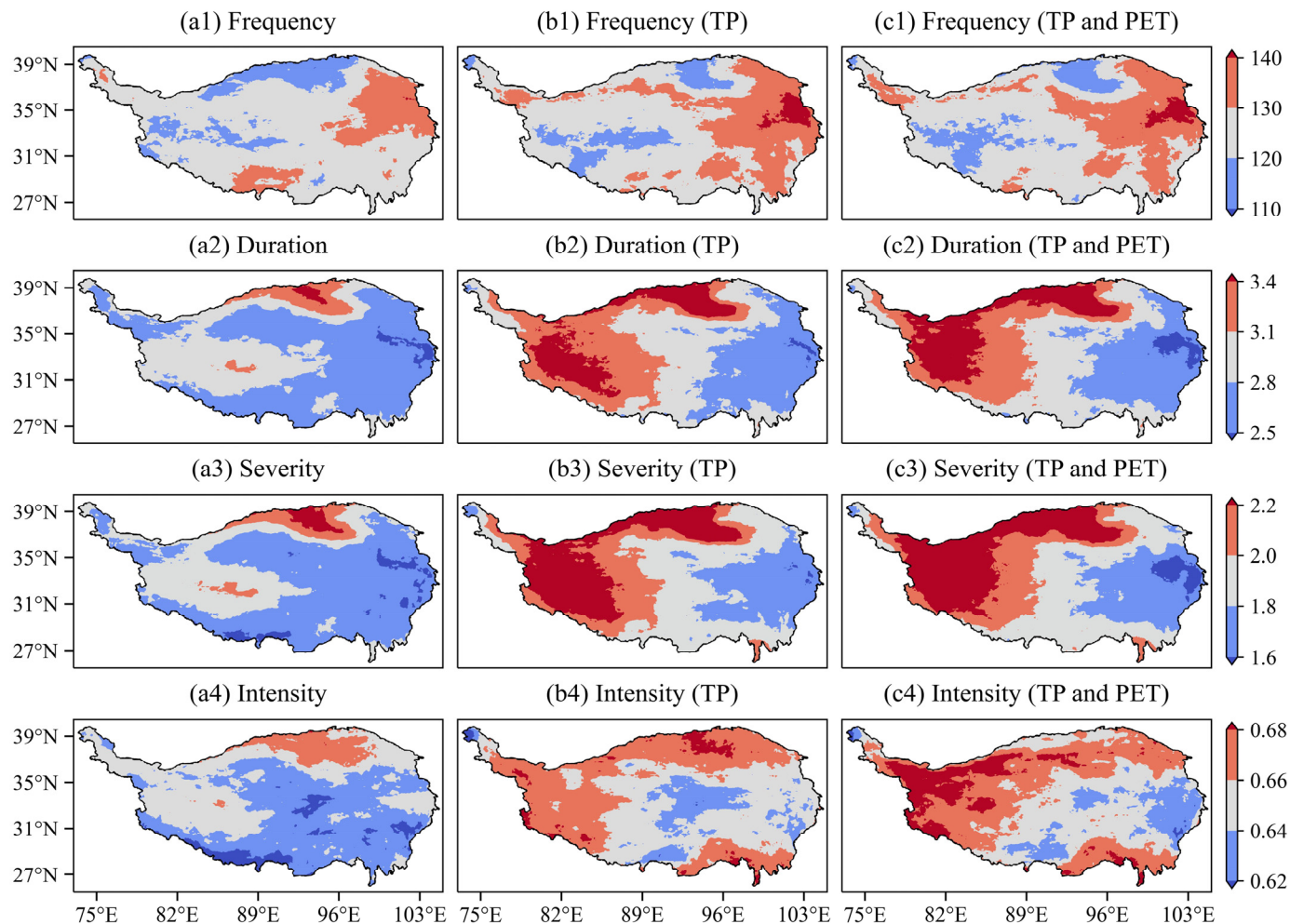


Figure S4. Spatial distribution of drought characteristics in the SSP1-2.6 scenarios. a1-a4 are the total drought frequency, the duration, severity, and intensity of each drought event, respectively. a-c are respectively the drought characteristics of the original, the QM-corrected, and the HQ-corrected ensemble model. Frequency (TP) is the frequency of SPEI (only TP corrected), and frequency (TP and PET) is the frequency of SPEI (TP and PET corrected).

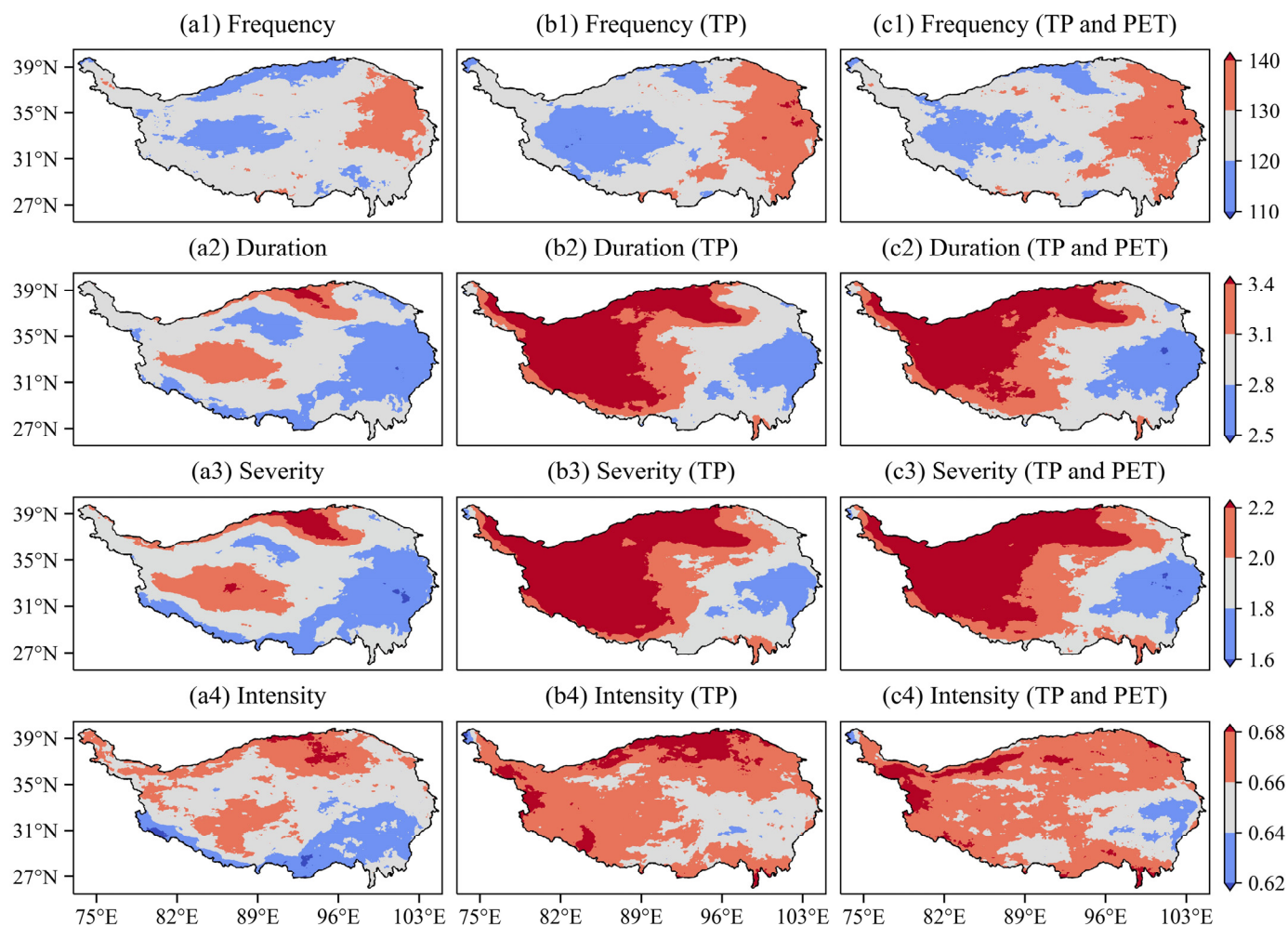


Figure S5. Spatial distribution of drought characteristics in the SSP2-4.5 scenarios. a1-a4 are the total drought frequency, the duration, severity, and intensity of each drought event, respectively. a-c are respectively the drought characteristics of the original, the QM-corrected, and the HQ-corrected ensemble model. Frequency (TP) is the frequency of SPEI (only TP corrected), and frequency (TP and PET) is the frequency of SPEI (TP and PET corrected).

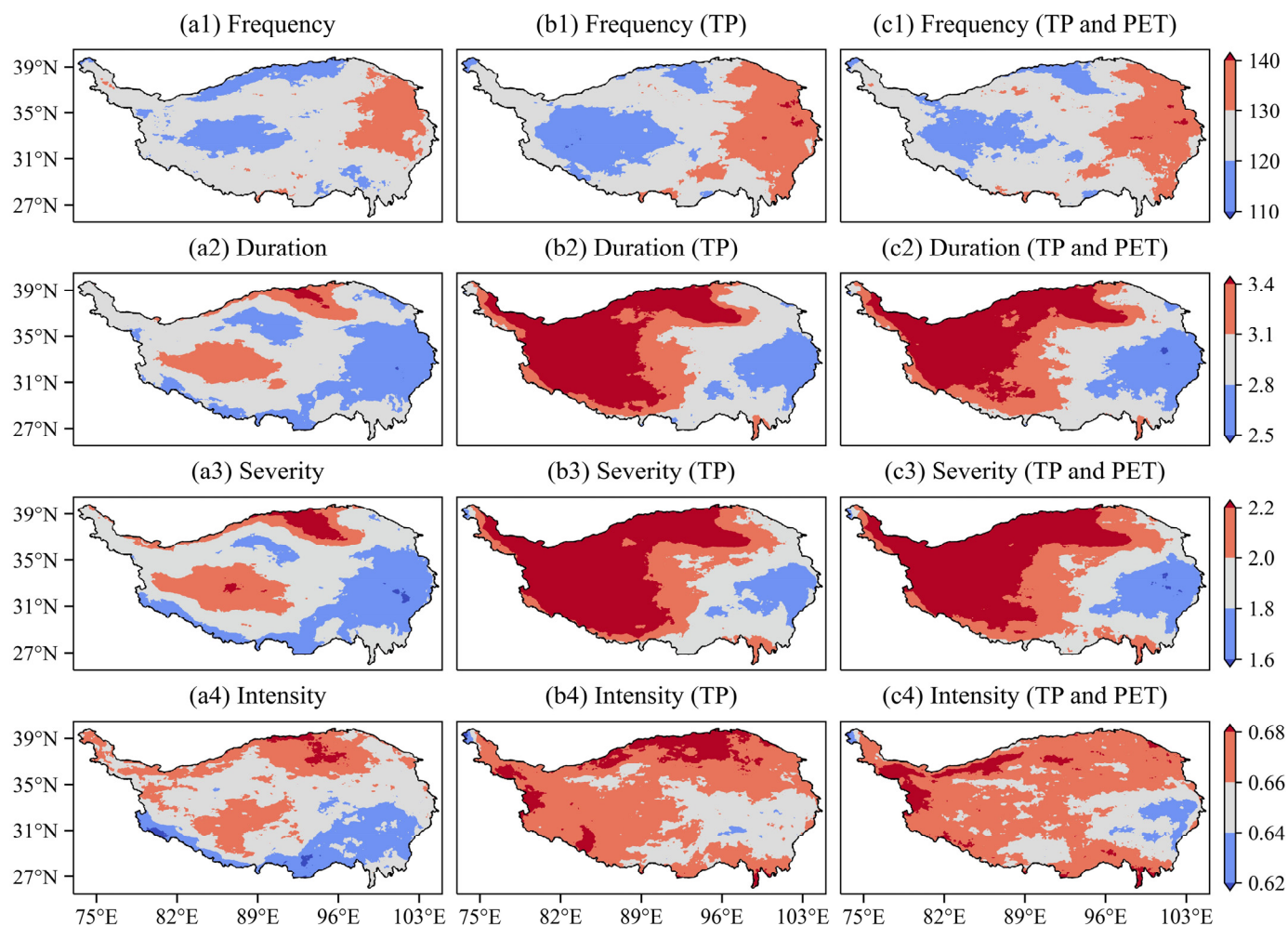


Figure S6. Spatial distribution of drought characteristics in the SSP5-8.5 scenarios. a1-a4 are the total drought frequency, the duration, severity, and intensity of each drought event, respectively. a-c are respectively the drought characteristics of the original, the QM-corrected, and the HQ-corrected ensemble model. Frequency (TP) is the frequency of SPEI (only TP corrected), and frequency (TP and PET) is the frequency of SPEI (TP and PET corrected).

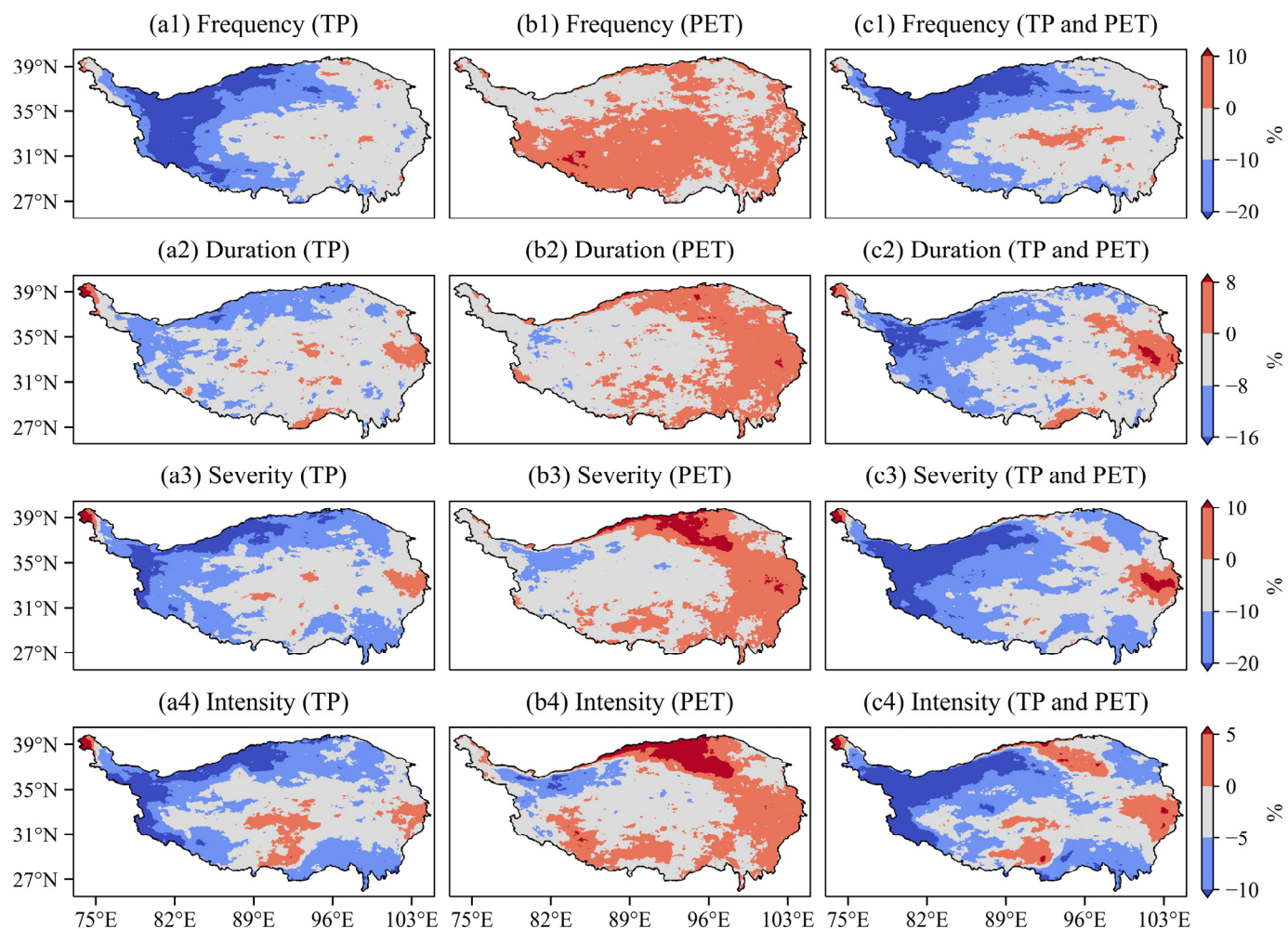


Figure S7. Spatial distribution of the percentage between the corrected amount of drought feature and drought feature of the original ensemble model in the historical scenarios. a1-a4 are the total drought frequency, the duration, severity, and intensity of each drought event, respectively. a-c are respectively the correction of drought features in temporal, spatial, and spatiotemporal dimensions. $\text{Frequency (TP)} = (\text{Frequency (TP) (Fig.S3)} - \text{Frequency (Fig.S3)}) / \text{Frequency (Fig.S3)}$. $\text{Frequency (PET)} = (\text{Frequency (TP and PET) (Fig.S3)} - \text{Frequency (TP) (Fig.S3)}) / \text{Frequency (Fig.S3)}$. $\text{Frequency (TP and PET)} = (\text{Frequency (TP and PET) (Fig.S3)} - \text{Frequency (Fig.S3)}) / \text{Frequency (Fig.S3)}$.

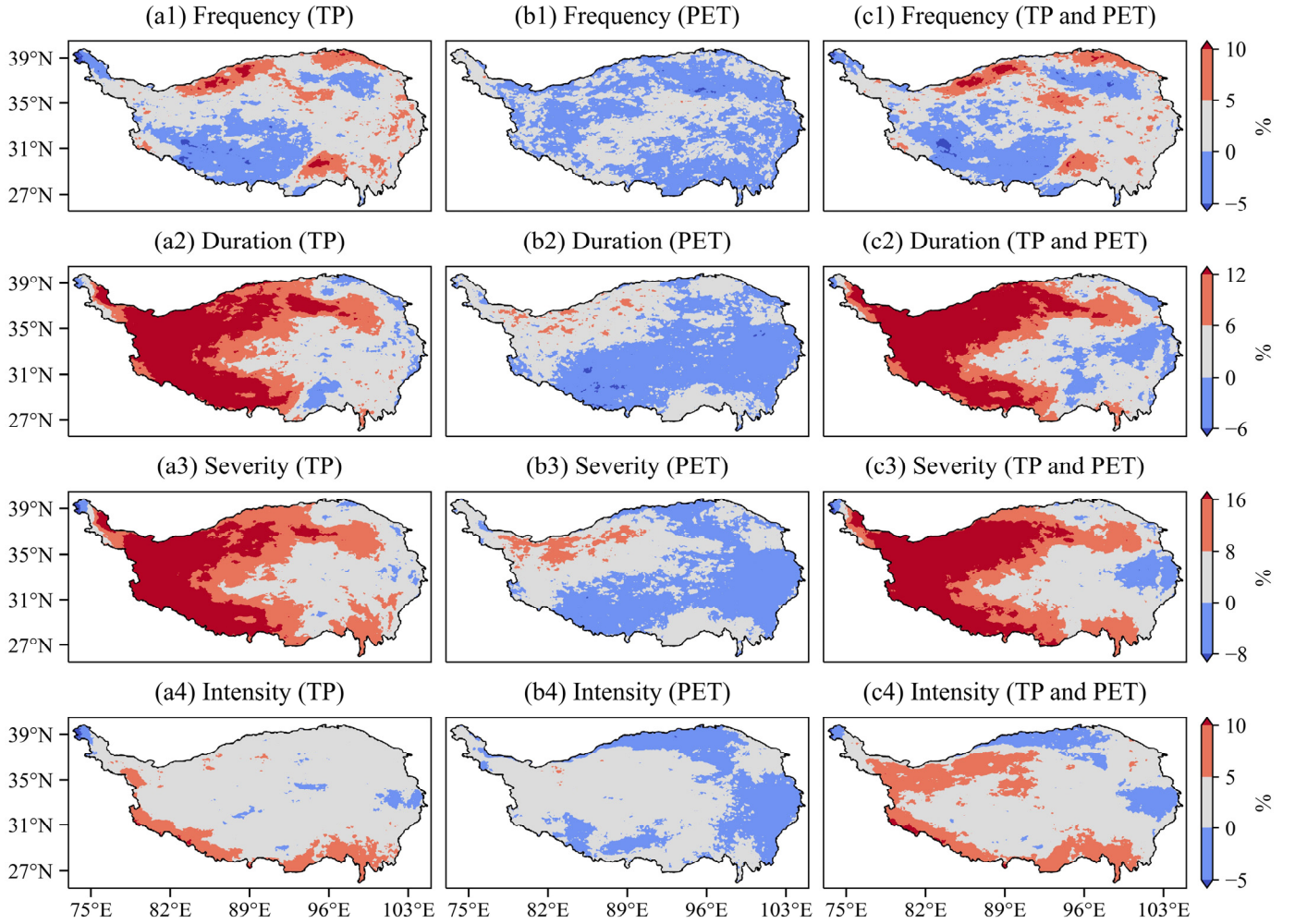


Figure S8. Spatial distribution of the percentage between the corrected amount of drought feature and drought feature of the original ensemble model in the SSP1-2.6 scenarios. a1-a4 are the total drought frequency, the duration, severity, and intensity of each drought event, respectively. a-c are respectively the correction of drought features in temporal, spatial, and spatiotemporal dimensions. Frequency (TP) = (Frequency (TP) (Fig.S4) - Frequency (Fig.S4)) / Frequency (Fig.S4). Frequency (PET) = (Frequency (TP and PET) (Fig.S4) - Frequency (TP) (Fig.S4)) / Frequency (Fig.S4). Frequency (TP and PET) = (Frequency (TP and PET) (Fig.S4) - Frequency (Fig.S4)) / Frequency (Fig.S4).

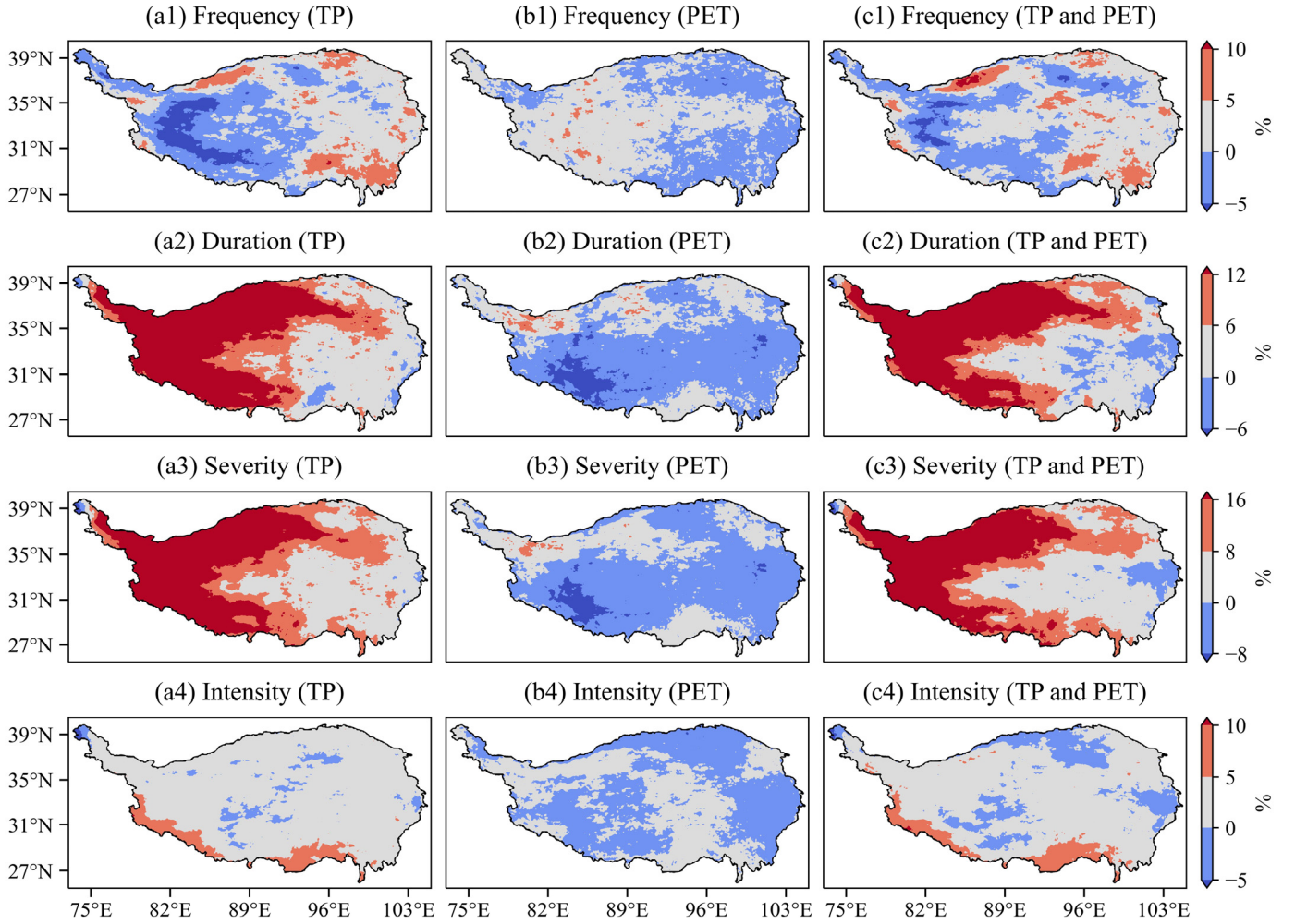


Figure S9. Spatial distribution of the percentage between the corrected amount of drought feature and drought feature of the original ensemble model in the SSP2-4.5 scenarios. a1-a4 are the total drought frequency, the duration, severity, and intensity of each drought event, respectively. a-c are respectively the correction of drought features in temporal, spatial, and spatiotemporal dimensions. Frequency (TP) = (Frequency (TP) (Fig.S5) - Frequency (Fig.S5)) / Frequency (Fig.S5). Frequency (PET) = (Frequency (TP and PET) (Fig.S5) - Frequency (TP) (Fig.S5)) / Frequency (Fig.S5). Frequency (TP and PET) = (Frequency (TP and PET) (Fig.S5) - Frequency (Fig.S5)) / Frequency (Fig.S5).

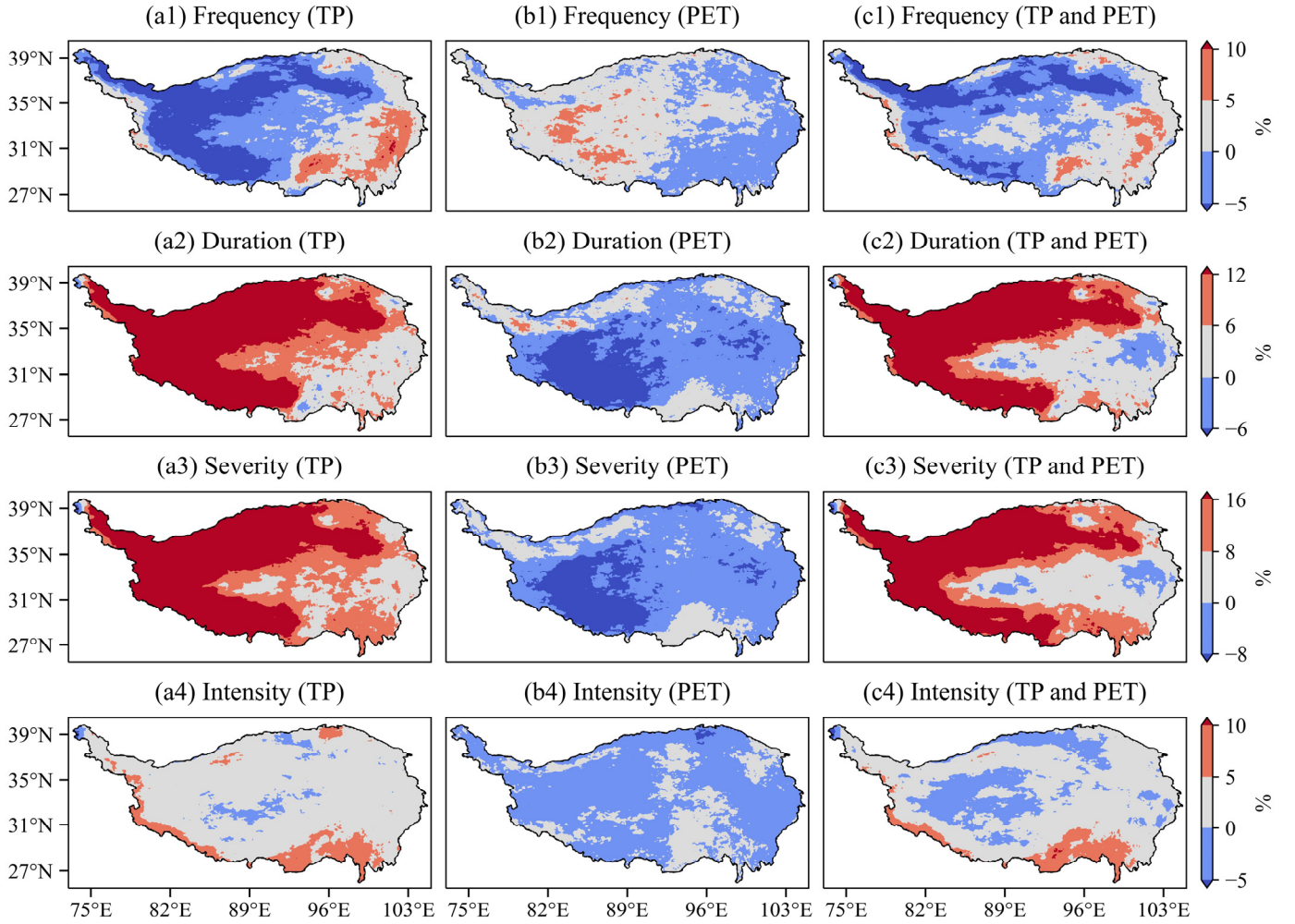


Figure S10. Spatial distribution of the percentage between the corrected amount of drought feature and drought feature of the original ensemble model in the SSP5-8.5 scenarios. a1-a4 are the total drought frequency, the duration, severity, and intensity of each drought event, respectively. a-c are respectively the correction of drought features in temporal, spatial, and spatiotemporal dimensions. Frequency (TP) = (Frequency (TP) (Fig.S6) - Frequency (Fig.S6)) / Frequency (Fig.S6). Frequency (PET) = (Frequency (TP and PET) (Fig.S6) - Frequency (TP) (Fig.S6)) / Frequency (Fig.S6). Frequency (TP and PET) = (Frequency (TP and PET) (Fig.S6) - Frequency (Fig.S6)) / Frequency (Fig.S6).

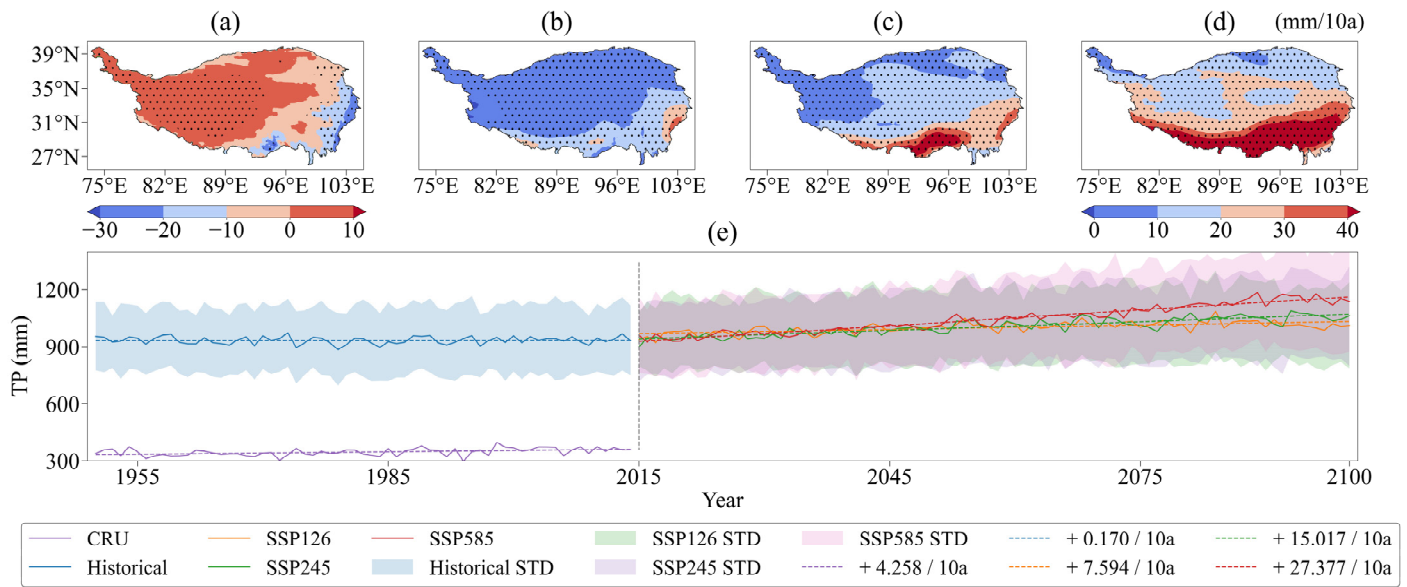


Figure S11. Trend test results of precipitation for the original ensemble model. a-d represents the spatial trend of temperature in the historical and future scenarios, respectively. The black dots are significant points with $P < 0.05$. e represents the change curve of the SPEI of the ensemble model in the historical and future scenarios. The filling on both sides of the line represents the respective standard deviation, and the dashed line is the trendline.

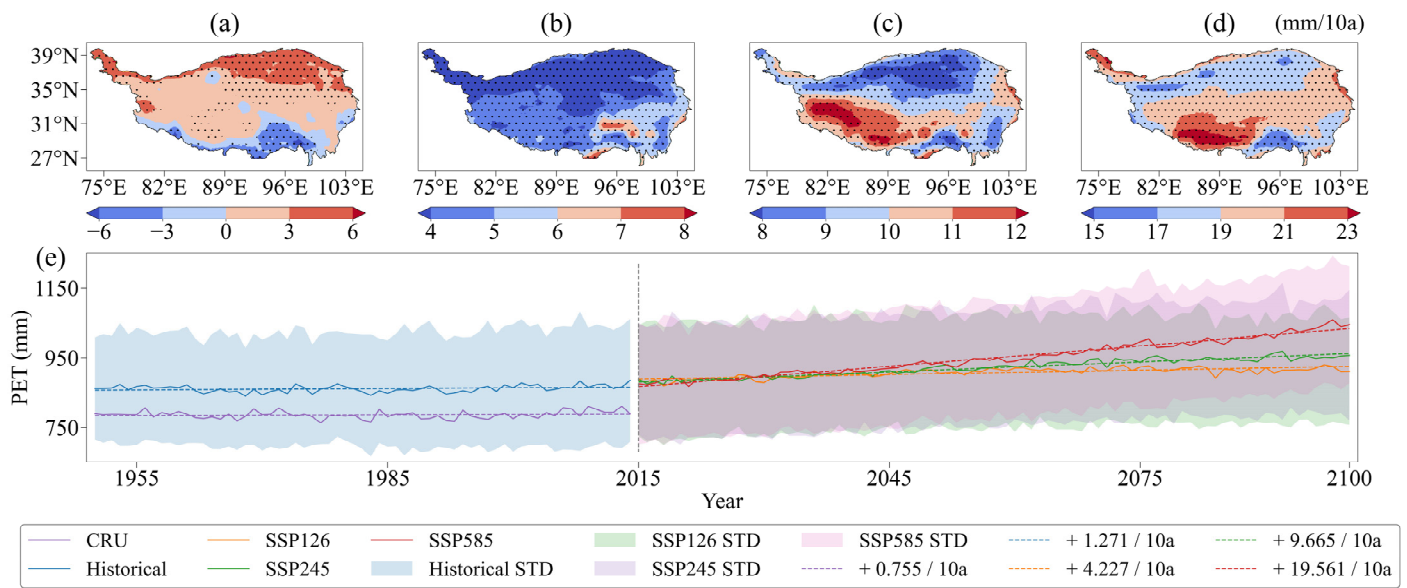


Figure S12. Trend test results of potential evapotranspiration for the original ensemble model. a-d represents the spatial trend of temperature in the historical and future scenarios, respectively. The black dots are significant points with $P < 0.05$. e represents the change curve of the SPEI of the ensemble model in the historical and future scenarios. The filling on both sides of the line represents the respective standard deviation, and the dashed line is the trend line.

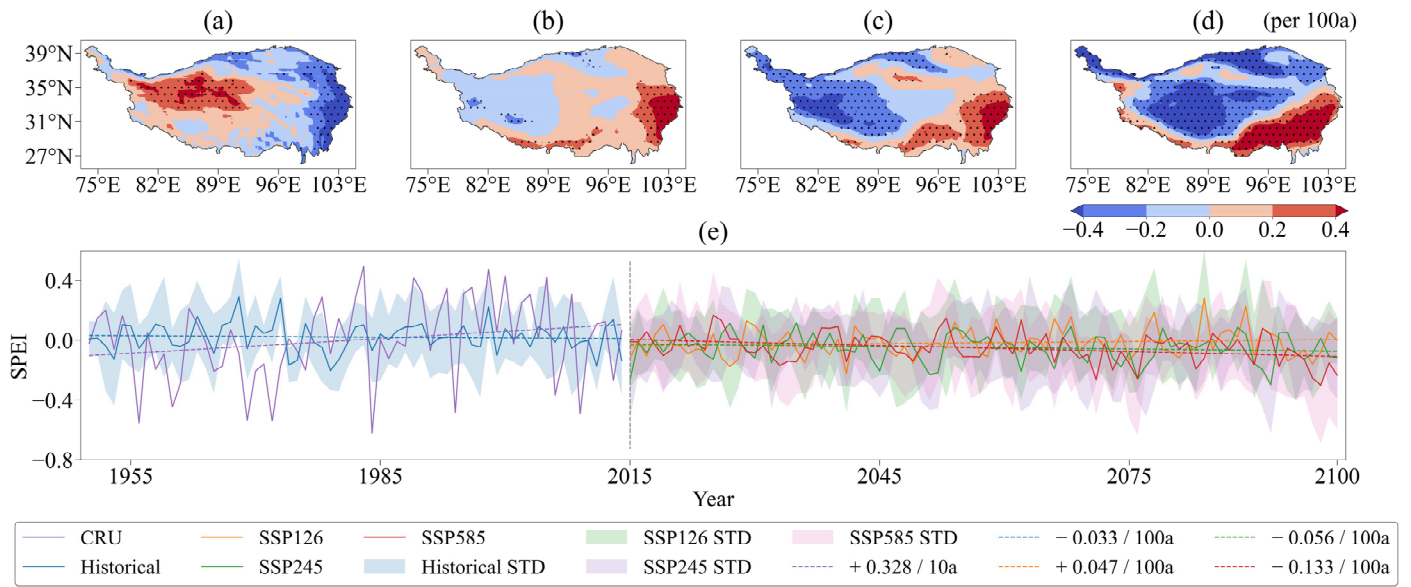


Figure S13. Trend test results of SPEI for the original ensemble model. a-d represents the spatial trend of SPEI in the historical and future scenarios, respectively. The black dots are significant points with $p < 0.05$. e represents the change curve of the SPEI of the ensemble model in the historical and future scenarios. The filling on both sides of the line represents the respective standard deviation, and the dashed line is the trend line

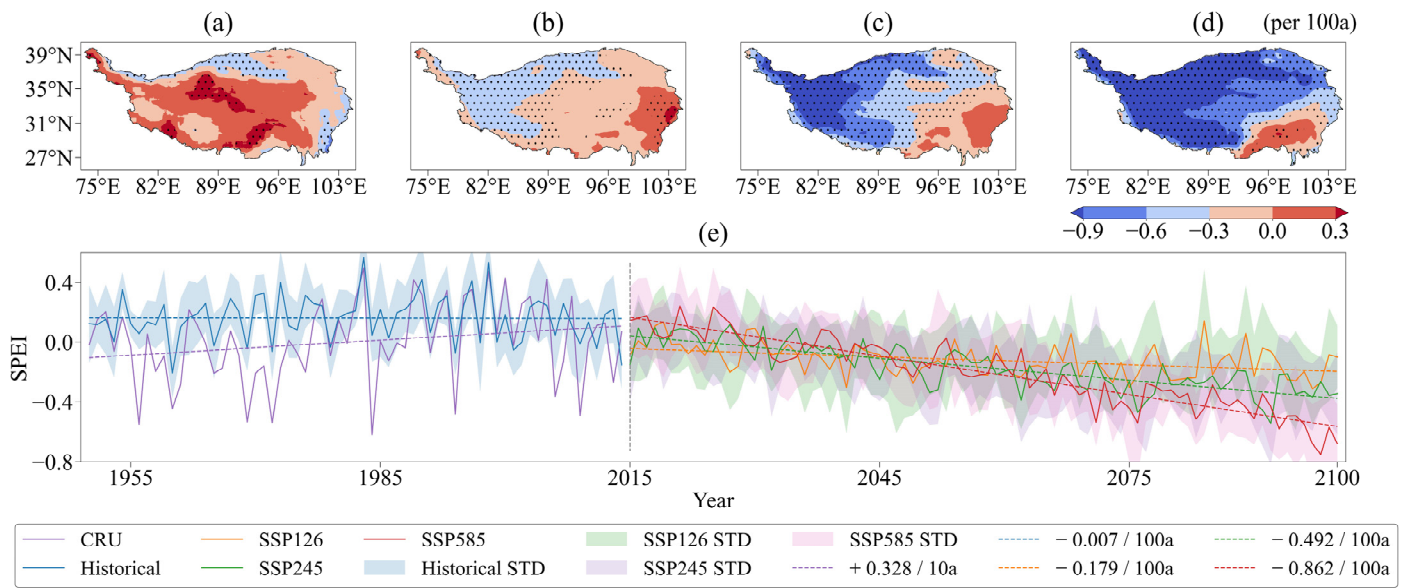


Figure S14. Trend test results of SPEI for only TP-corrected ensemble model. a-d represents the spatial trend of SPEI in the historical and future scenarios, respectively. The black dots are significant points with $p < 0.05$. e represents the change curve of the SPEI of the ensemble model in the historical and future scenarios. The filling on both sides of the line represents the respective standard deviation, and the dashed line is the trend line.