Supporting Material for “Spatiotemporal changes in temperature and precipitation extremes over Iran”

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S1. Spatiotemporal analysis of extreme precipitation

To investigate the influence of location (latitude and longitude), climate, and altitude on the extreme precipitation trend, the correlations between changes in extreme precipitation indices and these factors were calculated over Iran (Table S1). The results revealed that the annual precipitation changes have positive and negative correlations with altitude and latitude, respectively. All of extreme precipitation indices, including the number of wet days and annual maximum 3-hour, 6-hour, and 24-hour precipitation changes, were negatively correlated with elevation and longitude, with no statistically significant at a level of 0.05. The higher values of precipitation extremes appeared in relatively lower elevation areas. However, the extreme precipitation indices were positively ($P>0.05$) correlated with latitude, with correlation coefficients lower than 0.25.

Our investigation revealed that the extreme precipitation trend is complex across Iran. The different geographical characteristics of the selected stations over Iran can be recognized as the main reason for showing weak correlations between extreme precipitation and latitude, longitude, and altitude, according to [69]. In agreement with our results, numerous studies have indicated the contribution of elevation changes in extreme precipitation trends [70–73], although the relationships can vary around the world.

S2. Temporal trend analysis of temperature

Quantile regression was here applied to study the temporal change in the defined 3 indices based on the different quantiles for the data distribution to investigate the trend and changes in temperature over Iran (Table S2). The average annual temperature (Index 12) exhibited an increasing trend at 23 out of 26 (most stations had a statistically significant trend ($P<0.05$). The Khorramabad stations in all quantile regression lines and Shahrekord and Urmia stations in the upper quantile regression line had a negative trend, similar to the results of the Mann-Kendall method. The maximum annual temperature (Index 13) exhibited a decreasing significant trend at the Kermanshah and Khorramabad stations. Index 13 has a significant negative trend at the Urmia station in the slope of the 10th and 25th quantile regression lines and in the 90th quantiles at the Arak and Shahrekord stations. This index also has an increasing trend in most stations. In all quantile regression lines, the minimum annual temperature (Index 14) exhibited an increasingly significant trend at the Mashhad station and a decreasing significant trend at the Bandar Abbas station, similar to the results of the Mann-Kendall method. Index 14 in Gorgan and Urmia stations is increasing in the 25th percentile and decreasing in the other percentiles. Also, index 14 had an increasing trend in all stations except in Birjand and Khorramabad stations.

Table S1. Correlations between extreme precipitation indices and the positions of stations (no statistically significant at a level of 0.05

	Index 1	Index 2	Index 3	Index 4	Index 5	Index 6	Index 7	Index 8	Index 9	Index 10	Index 11
Elevation	-0.32	-0.25	-0.06	0.03	0.05	0.13	0.18	-0.29	-0.07	0.22	-0.15
Latitude	-0.04	-0.11	-0.33	-0.14	-0.15	-0.10	-0.10	-0.14	0.03	-0.18	0.08
Longitude	-0.05	0.05	0.25	-0.29	-0.29	-0.09	-0.04	-0.11	-0.14	0.00	0.05

Table S2. The quantile regression coefficients for temperature indices for selected percentiles ($\times 10^{-2}$). Blue and red numbers denote statistically significant at 0.05 critical level downward and upwards trends.

Stations	Index 12					Index 13					Index 14				
Quantile Re.	**0.1**	**0.25**	**0.5**	**0.75**	**0.9**	**0.1**	**0.25**	**0.5**	**0.75**	**0.9**	**0.1**	**0.25**	**0.5**	**0.75**	**0.9**
Ahvaz	7.5	5.3	4.7	4.1	2.8	4	3.81	2.22	1.82	3.5	1	4	3.39	2.96	1.5
Bandar Abas	1.4	1.1	0.2	-0.03	-0.5	3.13	4.22	4.7	2.9	1e-7	-3.08	-4.3	-4.6	-4.7	-5.2
Bushehr	1.2	6.1	7.1	7.6	6.8	8.8	3.7	4.17	-0.3	2.7	-6.4	2.1	6.3	5.5	5.3
Ilam	0.27	0.72	2	2.71	0.9	13	11.4	8.2	8.3	8.4	0.83	4	-3	-8	-3.5
Kermanshah	4.6	2.76	2.93	2.56	2.09	-0.3	-0.2	-1e-6	-3e-7	-1e-7	11.3	15.85	8.5	1.2	-0.4
Khorramabad	-0.76	-0.53	-1.04	-1.8	-2.2	-8e-7	-3e-7	-1e-7	-3e-7	-2e-7	0.78	3.8	-1.4	-2.9	-2.2
Sanandaj	8.42	5.68	4.18	3.15	2.54	4.2	3	3.4	2.6	2.1	21.8	23.7	8.7	6.4	3.3
Shahrekord	0.17	-1.3	-1.4	-1.42	-0.3	3.75	0.9	-2.3	-1.9	-3.5	-0.1	7.8	3.1	4.7	-12
Yasuj	1.1	-0.4	1.76	2.31	5.84	6	5.19	2.1	2.2	2.2	30	6.9	1.7	4.4	2.4
Arak	1.9	2.2	1	0.9	0.5	1e-6	3e-6	1.5	-1.4	-3	5.85	4.35	9.35	1.05	-6.9
Birjand	0.9	1.1	0.6	-0.2	-0.1	-2e-6	-2	-1.6	-2.3	-0.8	-5.7	-9	-6.2	-4.6	-5.6
Esfahan	2.6	2.6	2.4	2.9	2.5	0.46	2	1.5	3e-6	1.6	0.8	6e-7	1.3	1.28	0.68
Hamedan	8.12	5.12	5.26	3.42	3.98	6.3	3.67	1.9	1.4	-1.1	24.8	15.7	13.8	10	-12
Kerman	3.68	3.28	3.56	2	0.07	2.69	2.5	2.55	1.7	1.9	19.05	2.86	1.8	-1	-3.9
Qazvin	6.85	3.63	1.92	1.57	0.84	-1.5	1.7	1.2	2	2.6	10.4	4.75	4.6	0.7	-0.4
Semnan	3.71	3.73	3.07	1.68	1.4	-4e-6	1.3	1.4	2e-3	0.4	4.7	4.3	3.14	1.6	0.8
Shiraz	3.65	2.92	3.27	2.4	2.8	2.6	2.7	0.6	1.5	2.6	7.5	3.3	-0.8	-1	0.4
Tehran	4.38	4.36	3.8	4.18	3.54	1.35	3.2	0.8	1e-6	1	10.4	10	5.4	5.2	3
Yazd	5	4.85	4.23	3.34	2.9	2.27	0.86	-8e-7	0.83	-2e-6	3e-6	7.8	7.2	6	3.8
Urmia	2.17	2.1	-0.38	-1.17	-1.5	-2.22	-2.3	0.6	0.9	1.8	8.6	1e-6	-2.2	-0.5	-0.4
Tabriz	4.89	3.58	3.74	3.15	3.4	1.38	-0.4	1.7	1.9	1.3	10.6	2.3	5.6	6.5	5.8
Bandar Anzali	3	2.3	2	1.9	1.8	1e-6	-3e-7	-0.5	3e-6	1.94	1e-6	2.7	3.4	1.8	2.7
Gorgan	3.6	1.6	1.57	-0.12	-0.6	4	4.6	3.1	1.5	0.8	0.25	-1e-6	-2.8	-5	-5.8
Zanjan	4.25	1.9	1.4	2.34	2.2	-1.25	2.61	-1e-5	2	1.7	4.1	2.35	7.6	2.5	-1.9
Zahedan	2.79	3	2.76	1.8	1.89	1.14	8e-6	1	7e-7	0.4	4.9	0.5	-1.6	-1e-5	1.9
Mashhad	7.05	6.44	5.13	5	4.96	1.11	3.96	4.62	3.9	3.8	15.3	15.5	9	9.8	10