Supplementary materials

Supplementary Figure caption:

Figure S1. Annual variation characteristics of aridity index (AI), reference evotranspiration (ET_0) and precipitation (Pre).

Supplementary Tables caption:

Table S1. Seasonal and annual trend analysis of climatic factors in each region of the HRB during 1961–2014.

Table S2. Contributions of climatic factors to ET_0 trends in each time scale and subregion of the HRB when using the detrending method (R_{ET0}) and the differential equation method (C_{ET0}, mm·a^{-2}).

Table S3. Contributions of Pre and four main climatic factors to AI trends in each time scale and subregion of the HRB.

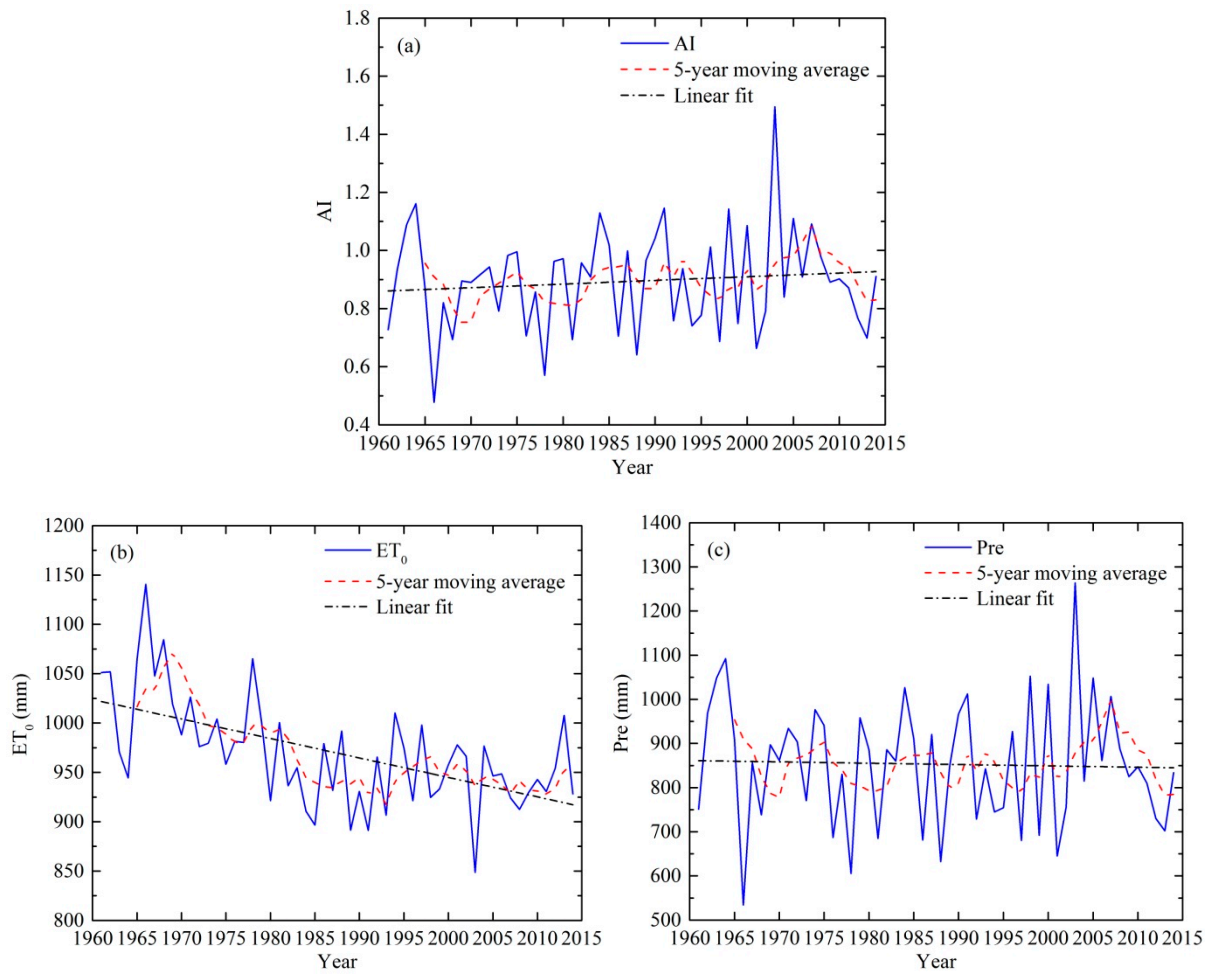**Table S4.** Contributions of Pre and ET_0 to AI trends in each time scale and subregion of the HRB.

Figure S1. Annual variation characteristics of aridity index (AI), reference evotranspiration (ET$_0$) and precipitation (Pre).

Table S1. Seasonal and annual trend analysis of climatic factors in each region of the HRB during 1961–2014.

Region	Climatic Factor	Annual		Growing Season		Spring		Summer		Autumn		Winter	
		Z	β	Z	β	Z	β	Z	β	Z	β	Z	β
Upper	T_a	3.48	0.01 ***	2.18	0.010 *	3.76	0.034 ***	−0.91	−0.007	2.51	0.015 *	2.76	0.025 **
	RH	−1.55	−0.035	−0.79	−0.027	−2.81	−0.133 **	2.09	0.056 *	−1.79	−0.065	−0.85	−0.051
	u_2	−9.37	−0.019 ***	−9.13	−0.019 ***	−8.30	−0.020 ***	−8.16	−0.019 ***	−8.31	−0.020 ***	−8.18	−0.020 ***
	R_s	−5.09	−0.030 ***	−4.36	−0.038 ***	−0.39	−0.005	−5.13	−0.062 ***	−2.27	−0.018 *	−3.52	−0.023 ***
Middle	T_a	3.57	0.018 ***	2.04	0.010 *	3.57	0.030 ***	−0.60	−0.004	3.18	0.016 **	3.49	0.032 ***
	RH	−0.55	−0.015	−0.13	−0.005	−1.33	−0.064	1.39	0.040	−1.61	−0.061	−0.64	−0.039
	u_2	−9.71	−0.022 ***	−9.58	−0.021 ***	−9.04	−0.024 ***	−9.09	−0.020 ***	−8.94	−0.021 ***	−8.56	−0.023 ***
	R_s	−6.01	−0.035 ***	−5.42	−0.045 ***	−1.09	−0.012	−5.82	−0.072 ***	−3.10	−0.026 ***	−4.15	−0.029 ***
Yi-Shu-Si	T_a	4.86	0.025 ***	3.63	0.017 ***	4.46	0.035 ***	1.03	0.006	3.67	0.021 ***	4.43	0.040 ***
	RH	−1.79	−0.042	−1.60	−0.035	−1.66	−0.075	−0.57	−0.012	−1.31	−0.050	−1.01	−0.053
	u_2	−8.97	−0.021 ***	−8.85	−0.021 ***	−8.55	−0.025 ***	−8.46	−0.019 ***	−7.80	−0.019 ***	−7.58	−0.020 ***
	R_s	−5.82	−0.030 ***	−5.18	−0.038 ***	−1.34	−0.010	−5.82	−0.062 ***	−3.27	−0.025 **	−3.83	−0.023 ***
Lower	T_a	4.67	0.027 ***	3.88	0.023 ***	4.79	0.039 ***	1.31	0.012	4.07	0.026 ***	3.89	0.034 ***
	RH	−4.79	−0.109 ***	−4.74	−0.120 ***	−4.01	−0.178 ***	−3.36	−0.085 ***	−3.60	−0.107 ***	−2.95	−0.098 **
	u_2	−8.76	−0.021 ***	−8.27	−0.019 ***	−8.58	−0.025 ***	−7.46	−0.017 ***	−7.33	−0.019 ***	−7.88	−0.022 ***
	R_s	−4.10	−0.018 ***	−3.27	−0.023 **	0.95	0.009	−4.18	−0.056 ***	−1.45	−0.009	−2.42	−0.017 *
Whole	T_a	4.06	0.021 ***	2.78	0.013 **	3.88	0.032 ***	0.10	0.001	3.52	0.018 ***	3.77	0.035 ***
	RH	−1.64	−0.038	−1.28	−0.028	−1.76	−0.083	0.18	0.005	−1.87	−0.062	−0.97	−0.054
	u_2	−9.64	−0.021 ***	−9.50	−0.020 ***	−8.98	−0.024 ***	−9.00	−0.019 ***	−8.64	−0.020 ***	−8.40	−0.022 ***
	R_s	−5.73	−0.030 ***	−5.25	−0.040 ***	−0.72	−0.007	−5.79	−0.066 ***	−3.07	−0.022 **	−3.80	−0.025 ***

Note: *, **, and *** denote the significance levels of 0.05, 0.01, and 0.001, respectively. β is the estimated slope trend of climatic factors, β > 0 and β < 0 signify an upward and a downward trend, respectively. Z is the Mann–Kendall test statistic.

Table S2. Contributions of climatic factors to ET_0 trends in each time scale and subregion of the HRB when using the detrending method (R_{ET0}) and the differential equation method (C_{ET0}, mm·a^{-2}).

Region	Variable	Annual	Growing season	Spring	Summer	Autumn	Winter
Upper	T_a	0.71/0.572	0.44/0.248	1.56/0.324	–0.22/–0.056	0.80/0.103	1.70/0.133
	RH	0.51/0.236	0.31/0.111	**1.60/**0.296	–0.41/–0.153	0.66/0.121	0.63/0.066
	u_2	**–1.89/–1.300**	–1.48/–0.775	**–1.60/–0.334**	–1.09/–0.281	**–2.80/–0.386**	**–3.65/–0.289**
	R_s	–1.79/–1.217	**–2.16/–1.203**	–0.31/–0.057	**–3.51/–1.028**	–1.13/-0.191	–0.79/–0.122
Middle	T_a	0.71/0.584	0.37/0.225	1.28/0.297	–0.18/–0.039	0.92/0.121	2.16/0.158
	RH	0.20/0.054	0.03/0.008	0.62/0.141	–0.34/–0.123	0.59/0.105	0.34/0.047
	u_2	**–2.52/–1.777**	–1.95/–1.038	**–2.27/–0.488**	–1.59/–0.405	**–3.25/–0.446**	**–5.17/–0.389**
	R_s	–2.01/–1.383	**–2.40/–1.358**	–0.54/–0.115	**–3.72/–1.123**	–1.48/–0.257	–0.72/–0.125
Yi-Shu-Si	T_a	1.09/0.831	0.72/0.417	1.61/0.375	0.19/0.065	1.16/0.159	2.99/0.200
	RH	0.42/0.289	0.24/0.153	0.62/0.177	0.08/0.020	0.59/0.092	0.85/0.078
	u_2	**–2.42/–1.622**	–1.90/–0.977	**–2.63/–0.567**	–1.35/–0.321	**–2.93/–0.395**	**–4.82/–0.325**
	R_s	–1.70/–1.133	**–2.00/–1.130**	–0.41/–0.096	**–3.22/–0.986**	–1.28/–0.224	–0.49/–0.087
Lower	T_a	1.23/0.878	0.94/0.523	1.94/0.379	0.37/0.119	1.25/0.189	2.50/0.168
	RH	**1.76/1.012**	**1.59/0.768**	**2.50/0.467**	1.12/0.242	1.67/0.243	2.41/0.154
	u_2	–1.55/–0.983	–1.16/–0.540	–1.56/–0.285	–0.74/–0.157	**–2.12/–0.285**	**–3.33/–0.241**
	R_s	–1.20/–0.753	–1.42/–0.720	0.35/0.056	**–2.97/–0.869**	–0.40/–0.109	–0.45/–0.069
Whole	T_a	0.88/0.679	0.54/0.310	1.47/0.329	–0.02/0.004	1.01/0.137	2.38/0.167
	RH	0.46/0.254	0.29/0.151	0.90/0.207	–0.07/–0.046	0.72/0.122	0.73/0.071
	u_2	**–2.33/–1.608**	–1.81/–0.944	**–2.24/–0.473**	–1.39/–0.345	**–2.99/–0.411**	**–4.73/–0.347**
	R_s	–1.81/–1.222	**–2.15/–1.204**	–0.39/–0.080	**–3.48/–1.047**	–1.26/–0.223	–0.64/–0.108

Note: Bold indicates dominant factor in ET_0 trend in each time scale and subregion. R_{ET0} denotes the evaluation index of ET_0. The values to the right and left of the slash represent the R_{ET0} and C_{ET0} respectively

Table S3. Contributions of Pre and four main climatic factors to AI trends in each time scale and subregion of the HRB.

Region	Variable	Annual	Growing season	Spring	Summer	Autumn	Winter
Upper	Pre	–1.33	–1.60	**–6.99**	2.89	**–8.96**	**4.47**
	T_a	–0.73	–0.44	–1.63	0.22	–0.81	–1.78
	RH	–0.51	–0.31	–1.67	0.41	–0.67	–0.64
	u_2	**1.80**	1.42	1.52	1.06	2.60	3.30
	R_s	1.71	**2.05**	0.31	**3.22**	1.10	0.77
Middle	Pre	0.30	–0.36	**–5.77**	2.79	**–3.73**	**7.56**
	T_a	–0.73	–0.38	–1.32	0.18	–0.94	–2.28
	RH	–0.20	–0.03	–0.63	0.34	–0.60	–0.34
	u_2	**2.36**	1.85	2.12	1.52	2.98	4.51
	R_s	1.91	**2.26**	0.53	**3.40**	1.42	0.71
Yi-Shu-Si	Pre	–1.84	**–2.59**	–0.97	–2.22	**–4.73**	**5.67**
	T_a	–1.12	–0.73	–1.68	–0.20	–1.19	–3.22
	RH	–0.43	–0.24	–0.63	–0.08	–0.60	–0.86
	u_2	**2.27**	1.81	**2.45**	1.30	2.72	4.25
	R_s	1.63	1.90	0.41	**2.97**	1.24	0.49
Lower	Pre	–0.38	**–2.46**	**–4.88**	2.55	**–11.87**	**12.22**
	T_a	–1.27	–0.96	–2.04	–0.38	–1.29	–2.67
	RH	**–1.84**	–1.65	–2.66	–1.15	–1.74	–2.56
	u_2	1.48	1.11	1.48	0.72	1.99	3.04
	R_s	1.17	1.37	–0.36	**2.76**	0.40	0.44
Whole	Pre	–0.52	–1.35	**–4.71**	1.28	**–5.39**	**7.42**
	T_a	–0.90	–0.55	–1.53	0.02	–1.04	–2.53
	RH	–0.46	–0.29	–0.92	0.07	–0.74	–0.75
	u_2	**2.19**	1.72	2.10	1.33	2.76	4.18
	R_s	1.73	**2.04**	0.39	**3.19**	1.22	0.62

Note: Bold indicates dominant factor in AI trend in each time scale and subregion.

Table S4. Contributions of Pre and ET_0 to AI trends in each time scale and subregion of the HRB.

Region	Variable	Annual	Growing season	Spring	Summer	Autumn	Winter
Upper	Pre	–1.32	–1.61	**–6.96**	2.86	**–8.90**	**4.46**
	ET_0	**2.12**	**2.56**	–1.87	**4.70**	1.80	1.84
Middle	Pre	0.32	–0.34	**–5.75**	2.81	**–3.73**	**7.60**
	ET_0	**3.34**	**3.68**	0.66	**5.32**	2.58	2.97
Yi-Shu-Si	Pre	–1.83	–2.59	**–1.04**	–2.20	**–4.62**	**5.63**
	ET_0	**2.34**	**2.66**	0.67	**3.85**	1.96	1.47
Lower	Pre	–0.40	**–2.47**	**–4.89**	2.52	**–11.86**	**12.18**
	ET_0	**–0.46**	–0.14	–3.96	2.01	–0.82	–1.11
Whole	Pre	–0.51	–1.34	**–4.75**	1.28	**–5.32**	**7.42**
	ET_0	**2.43**	**2.80**	–0.35	**4.40**	1.92	1.78

Note: Bold indicates dominant factor in AI trend in each time scale and subregion.