

Supporting Information for

**Spatiotemporal Hysteresis Distribution and Decomposition of Solar Activities and Climatic Oscillation during 1900–2020**

Mingyang Li<sup>1</sup>, Tingxi Liu<sup>1,\*</sup>, Long Ma<sup>1,\*</sup>, Limin Duan<sup>1</sup>, Yixuan Wang<sup>1</sup>, Guoqiang Wang<sup>2</sup>,  
Huimin Lei<sup>3</sup>, Vijay Singh<sup>4</sup>

<sup>1</sup> Inner Mongolia Water Resource Protection and Utilization Key Laboratory; Water Conservancy and Civil Engineering College, Inner Mongolia Agricultural University, Hohhot 010018, China;

<sup>2</sup> College of Water Sciences, Beijing Normal University, Beijing 100875, China;

<sup>3</sup> State Key Laboratory of Hydrosience and Engineering, Department of Hydraulic Engineering, Tsinghua University, Beijing 100084, China;

<sup>4</sup> Department of Biological and Agricultural Engineering & Zachry Department of Civil Engineering, Texas A&M University, College Station, TX 77843, USA).

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**Table S1.** Median strong interaction periods between SN and T and P in seven regions of China (The significance level = 0.95).

Element Period (a)	T						Element Period (a)	P					
	0 ~ 5	5 ~ 10	10 ~ 30	30 ~ 60	60 ~ 90	90 ~ 120		0 ~ 5	5 ~ 10	10 ~ 30	30 ~ 60	60 ~ 90	90 ~ 120
NE	0.97	9.82	11.02	55.53	83.21	88.15	NE	1.03	9.82	11.02	55.53	83.21	88.15
NW	0.97	9.82	11.02	55.53	83.21	88.15	NW	1.03	9.82	11.02	55.53	83.21	88.15
N	0.97	9.82	9.82	55.53	83.21	88.15	N	1.03	9.82	11.02	55.53	83.21	88.15
SW	0.97	9.82	11.02	55.53	83.21	88.15	SW	1.03	9.82	11.02	55.53	83.21	88.15
E	0.97	9.82	11.02	55.53	83.21	88.15	E	1.03	9.82	11.02	55.53	83.21	88.15
C	0.97	9.82	11.02	55.53	83.21	88.15	C	1.03	9.82	11.02	34.98	83.21	88.15
S	0.97	9.82	11.02	55.53	83.21	88.15	S	1.03	9.82	11.02	55.53	83.21	88.15

Note: NE: Northeast China; NW: Northwest China; N: North China; SW: Southwest China; E: Eastern China; C: Central China; S: South China.

**Table S2.** Median strong interaction periods between CO and T and P in seven regions of China (The significance level = 0.95).

Element Period (a)	T						Element Period (a)	P					
	0 ~ 5	5 ~ 10	10 ~ 30	30 ~ 60	60 ~ 90	90 ~ 120		0 ~ 5	5 ~ 10	10 ~ 30	30 ~ 60	60 ~ 90	90 ~ 120
NE	1.03	9.82	11.02	58.84	83.21	88.15	NE	1.03	9.82	20.80	58.84	83.21	88.15
NW	1.03	9.82	20.80	58.84	83.21	88.15	NW	1.03	9.82	11.02	58.84	83.21	88.15
N	1.03	9.82	19.63	58.84	83.21	88.15	N	1.03	9.82	11.02	58.84	83.21	88.15
SW	1.03	9.82	19.63	58.84	83.21	88.15	SW	1.03	9.82	11.02	58.84	83.21	88.15
E	1.03	9.82	11.02	58.84	83.21	88.15	E	1.03	9.82	11.02	58.84	83.21	88.15
C	1.03	9.27	18.53	58.84	83.21	88.15	C	1.03	9.82	11.02	58.84	83.21	88.15
S	1.03	9.82	11.02	58.84	83.21	88.15	S	1.03	9.82	10.40	58.84	83.21	88.15

**Table S3.** Median hysteresis periods between SN and T and P in seven regions of China (The significance level = 0.95).

Element Period (a)	T						Element Period (a)	P					
	0 ~ 5	5 ~ 10	10 ~ 30	30 ~ 60	60 ~ 90	90 ~ 120		0 ~ 5	5 ~ 10	10 ~ 30	30 ~ 60	60 ~ 90	90 ~ 120
NE	0.64	3.58	8.91	7.97	5.71	6.66	NE	0.54	4.08	6.67	20.18	50.79	53.66
NW	0.25	1.66	4.02	7.30	16.35	17.62	NW	0.45	1.39	6.25	19.80	19.97	22.25
N	0.51	0.50	13.32	9.42	8.95	9.89	N	0.45	1.96	7.25	31.92	45.25	47.31
SW	0.56	2.61	3.58	8.60	16.71	18.05	SW	0.40	3.51	6.38	10.43	21.43	22.18
E	0.49	1.03	10.78	11.15	17.72	19.17	E	0.25	1.95	4.82	21.49	14.20	15.80
C	0.62	0.77	4.55	6.32	18.08	19.31	C	0.38	3.18	12.54	21.43	17.52	20.37
S	0.24	1.88	3.79	8.37	18.67	20.21	S	0.22	5.48	4.12	25.14	18.92	19.57

**Table S4.** Median hysteresis periods between CO and T and P in seven regions of China (The significance level = 0.95).

Element Period (a)	T						Element Period (a)	P					
	0 ~ 5	5 ~ 10	10 ~ 30	30 ~ 60	60 ~ 90	90 ~ 120		0 ~ 5	5 ~ 10	10 ~ 30	30 ~ 60	60 ~ 90	90 ~ 120
NE	0.54	4.08	6.67	20.18	50.79	53.66	NE	0.55	1.58	5.13	13.03	46.40	47.44
NW	0.45	1.39	6.25	19.80	19.97	22.25	NW	0.47	3.46	8.31	11.31	17.86	18.79
N	0.45	1.96	7.25	31.92	45.25	47.31	N	0.54	3.73	8.53	33.00	14.54	15.10
SW	0.40	3.51	6.38	10.43	21.43	22.18	SW	0.55	1.53	8.90	9.56	44.97	50.36
E	0.25	1.95	4.82	21.49	14.20	15.80	E	0.55	3.66	7.78	34.80	52.11	59.47
C	0.38	3.18	12.54	21.43	17.52	20.37	C	0.55	5.80	10.21	26.95	18.45	21.34
S	0.54	4.08	6.67	20.18	50.79	53.66	S	0.58	4.17	8.34	28.82	54.77	56.86

**Table S5.** Multivariate hysteretic decomposition (MHD) model parameters under six periodic scales (The significance level = 0.95).

Period	Group	$\alpha_1$	$\alpha_2$	$\tau_1$	$\tau_2$	$\tau_3$	$\rho_1$	$\rho_2$	$\rho_3$	$\delta$
0 to 5 a	I	-0.5165	0.0672	-0.0003	0.0037	0.1664	0.0015	-0.0004	0.0151	0.1922
	II	-0.8189	0.1571	0.0035	-0.077	0.2691	-0.0021	0.0017	-0.0083	0.2917
	III	-1.5205	0.1857	-0.0031	-0.0986	0.6459	-0.0026	0.0009	0.0104	0.6569
	IV	-1.4135	-0.1058	-0.0131	-0.1811	0.5978	-0.0005	0.0013	0.0057	0.6103
	V	-1.2227	-0.0835	-0.0044	0.0188	0.4902	0.0021	0.0007	0.0004	0.506
	VI	-0.5373	0.0269	-0.0005	-0.0392	0.1085	0.0021	0.001	0.0033	0.136
5 to 10 a	I	0.8059	-0.0472	-0.0001	-0.2463	-0.1471	0.0131	-0.0077	0.0004	-6.0461
	II	-0.189	-1.8573	0.0004	0.1298	-0.464	0.0016	0.0231	-0.1027	4.3298
	III	-0.6629	1.1034	0.0002	0.0077	0.2756	0.031	0.0066	-0.2605	2.5912
	IV	-0.58	-4.5186	0.0007	-0.2701	-0.2432	-0.0264	0.0134	-0.1786	9.2226
	V	-0.1348	-3.5601	-0.002	-0.1631	0.1565	-0.0306	0.001	0.1656	2.2969
	VI	-1.2865	-1.086	-0.0027	0.28	0.0329	-0.0311	0.0069	-0.0339	13.4102
10 to 30 a	I	0.2315	-1.2554	0.0021	-0.4587	-0.105	-0.0581	0.0668	-0.1314	-2.8077
	II	0.2352	2.6913	0.0048	-0.6032	-0.1971	-0.0335	0.0736	0.1925	-9.0533
	III	0.4548	2.7071	0.0028	-0.3443	-0.0733	-0.0049	-0.0072	0.0409	-2.1104
	IV	1.4141	17.7787	-0.0006	-0.0886	-0.1039	-0.0177	0.046	0.3451	-26.8089
	V	0.194	-0.2865	-0.0038	-0.5235	-0.0385	-0.0171	0.0045	-0.1391	-0.5154
	VI	0.4721	5.3347	-0.0014	-0.08	-0.106	0.033	0.0195	0.1975	-9.4731
30 to 60 a	I	0.0233	2.433	-0.0008	0.1103	-0.0919	0.1342	-0.0044	0.8493	0.6378
	II	-0.1686	2.8135	-0.0014	-0.0978	0.2431	0.2215	-0.0254	0.7189	-8.9337
	III	-0.1376	0.8498	-0.0009	0.1751	0.2351	0.2181	-0.0351	0.2493	-10.0245
	IV	-0.0661	30.8438	0.0014	0.186	-0.1769	0.077	-0.1889	1.9328	15.2735
	V	0.1444	21.1293	0.0004	-0.2047	-0.1737	0.0302	-0.0852	-0.277	1.4021
	VI	0.1229	-1.2327	0.0012	0.3299	0.0999	0.0225	-0.0849	0.9941	-2.7241
60 to 90 a	I	-0.5816	8.7484	-0.0015	-0.9798	0.4221	0.3244	-0.2857	0.3081	29.5432
	II	0.1414	14.1589	0.0003	-1.2022	0.0045	-0.2668	-0.1357	-0.0936	-1.6696
	III	-0.4225	6.0583	0.0013	-2.3243	0.2678	-0.0184	-0.0948	-0.7904	-11.8956

	IV	-0.0763	1.6957	0.0001	1.3275	0.001	0.0077	0.0099	-0.0699	-14.8342
	V	-0.4238	-1.8188	-0.0006	1.107	0.0158	-0.0235	0.0001	0.0118	19.7606
	VI	-0.0528	2.9651	-0.0026	-0.8805	0.1928	0.1194	-0.068	-0.0392	-3.088
90 to 120 a	I	0.2785	10.4859	-0.0012	-1.1341	0.3032	0.2434	-0.2986	0.3848	-34.3641
	II	-20.8869	18.8804	0.0004	-1.4547	21.5393	-0.2606	-0.1365	-0.3835	-52.9784
	III	-0.2027	8.8825	0.001	-2.3945	-0.2035	0.0498	-0.0543	-0.8099	0.9864
	IV	1.9471	9.0987	0.0013	-0.1843	-1.5884	-0.2994	-0.0849	-0.0563	-3.878
	V	0.6615	-9.3078	0.0003	0.162	-0.0259	-0.1945	-0.0454	0.2027	-39.8326
	VI	0.2029	-5.9463	-0.0021	-0.8335	-0.0458	0.055	-0.0864	-0.0702	2.6432

Note: I to VI are the groups in Supplementary Figure S3.