

Supplementary Materials

Can satellite and atmospheric reanalysis products capture compound moist heat stress-floods?

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Introduction

This document provides 11 supplementary figures and 4 supplementary tables, which are referred to in the main text as Fig. S1-S11, Tab. S1-S4.

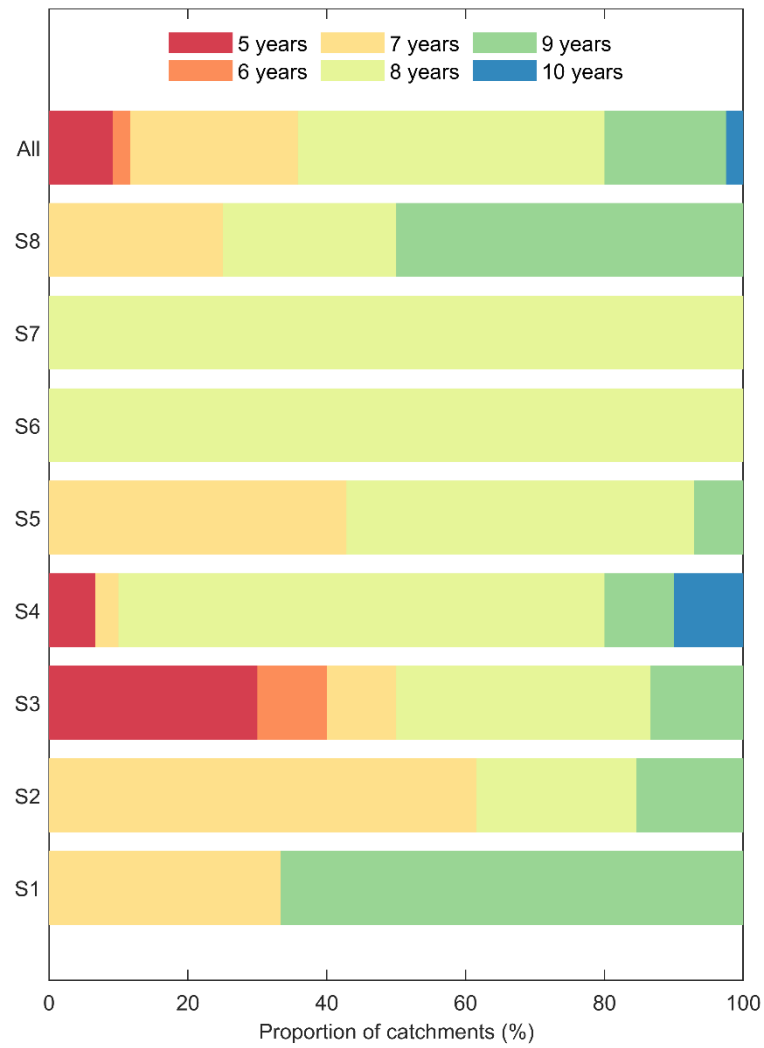


Figure S1. The proportion of catchments for the 5-, 6-, 7-, 8-, 9-, 10-year daily streamflow record lengths in S1-S8 sub-regions and whole areas, respectively.

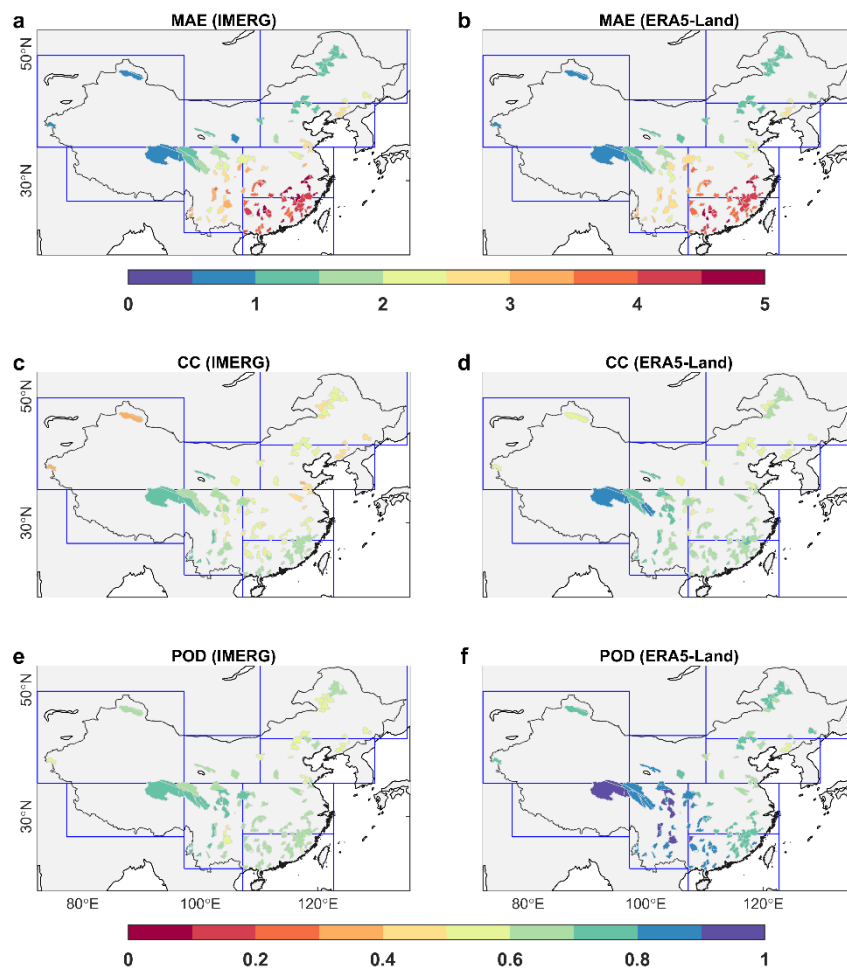


Figure S2. The MAE, CC and POD metrics of IMERG and ERA5-Land precipitation products in 120 catchments over mainland China.

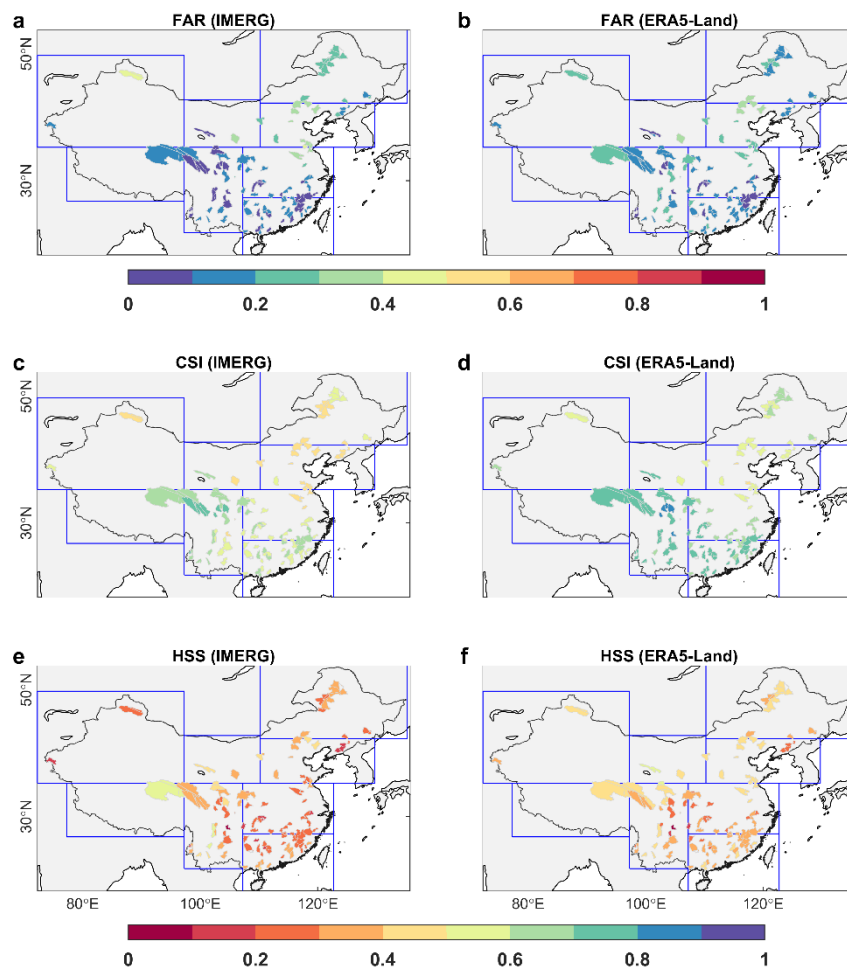


Figure S3. The FAR, CSI and HSS metrics of IMERG and ERA5-Land precipitation products in 120 catchments over mainland China.

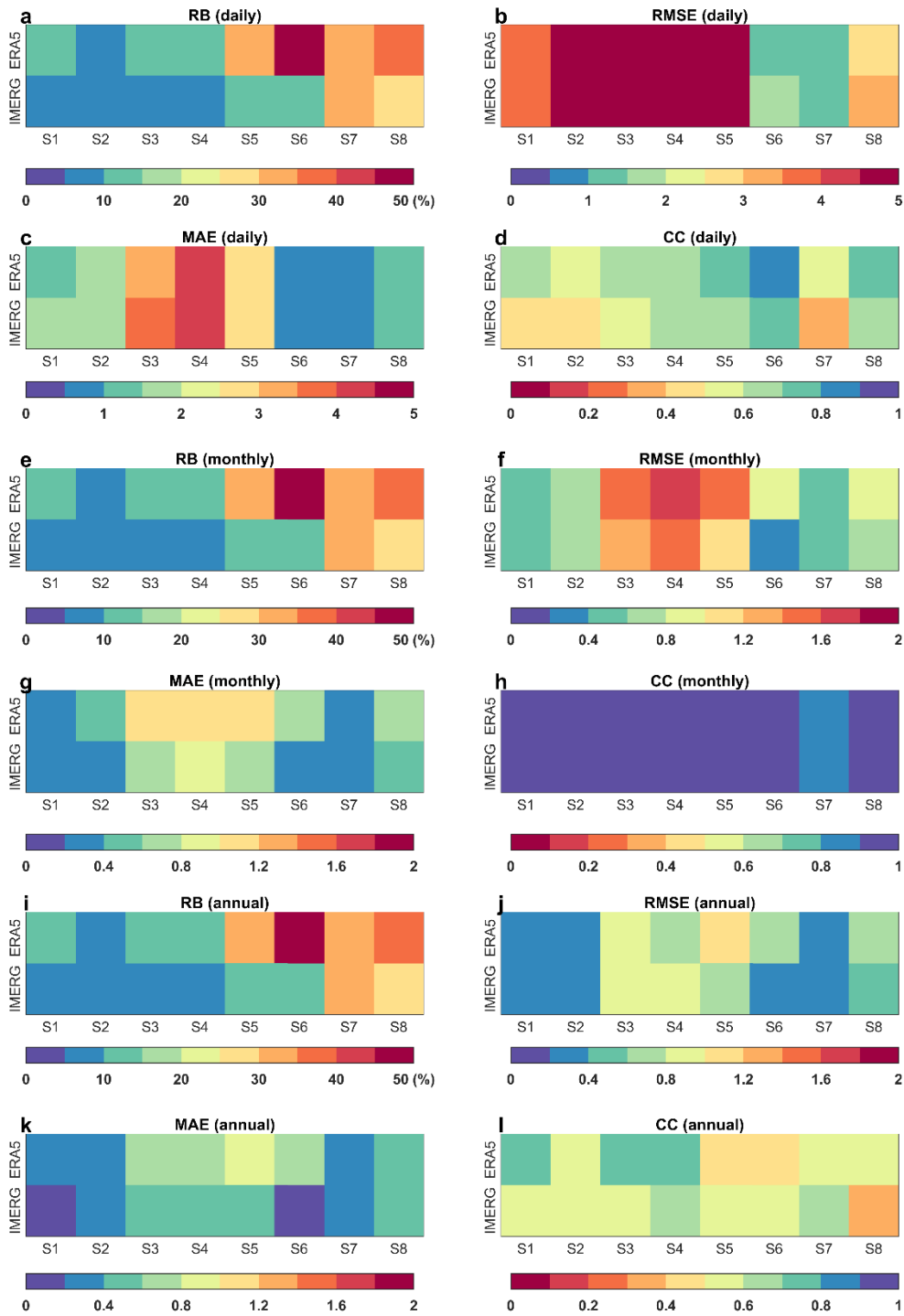


Figure S4. Daily-, monthly- and annual-average statistical metrics of IMERG (IMERG) and ERA5-Land (ERA5) precipitation products in eight sub-regions over mainland China. RB denotes relative bias (absolute mean values across catchments in each sub-region, to avoid offset between positive and negative biases); RMSE refers to root mean square error.

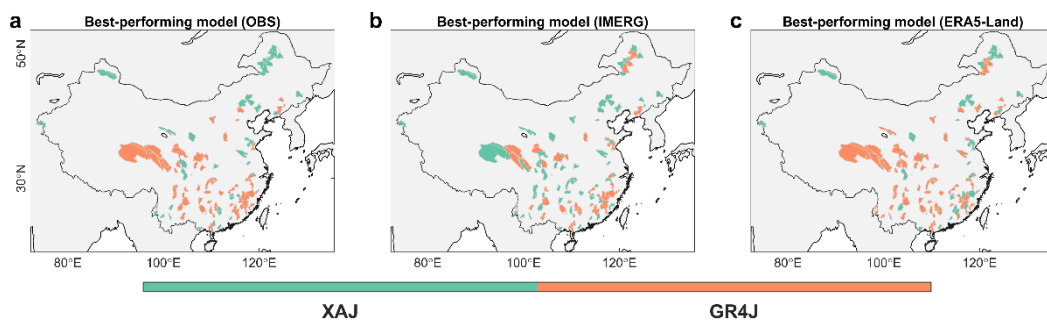


Figure S5. The best-performing hydrological model calibrated by gridded observations, IMERG and ERA5-Land precipitation datasets during calibration and validation periods over 120 catchments.

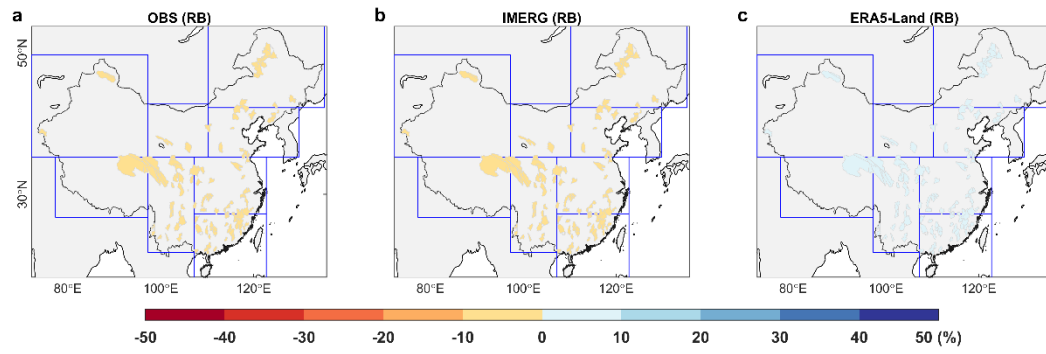


Figure S6. The relative bias ($RB = (\text{simulation} - \text{observation}) / \text{observation}$) of hydrological simulations forced by gridded observations, IMERG and ERA5-Land precipitation datasets against streamflow records over 120 catchments.

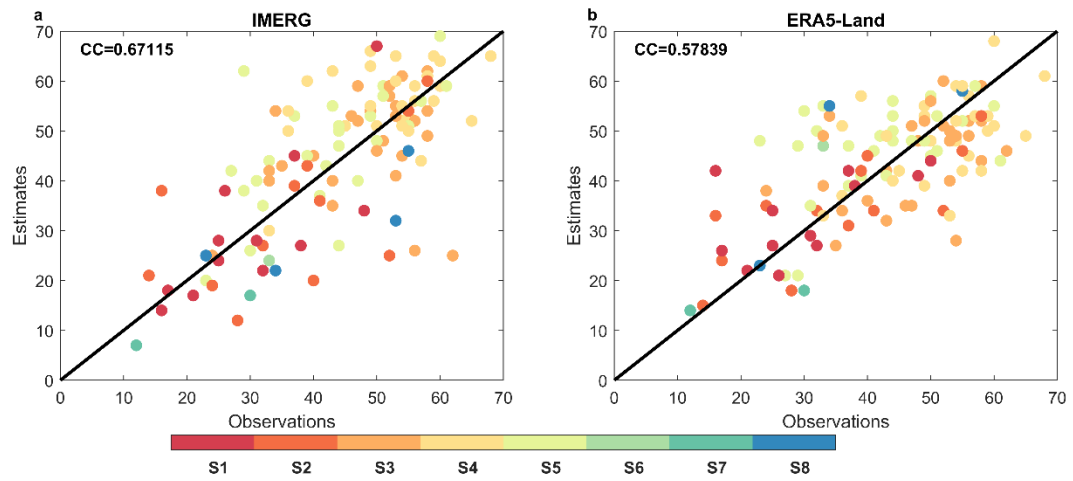


Figure S7. Scatter plots of flood frequency from IMERG and ERA5-Land products against gridded observation (CN05.1) in 120 catchments of China.

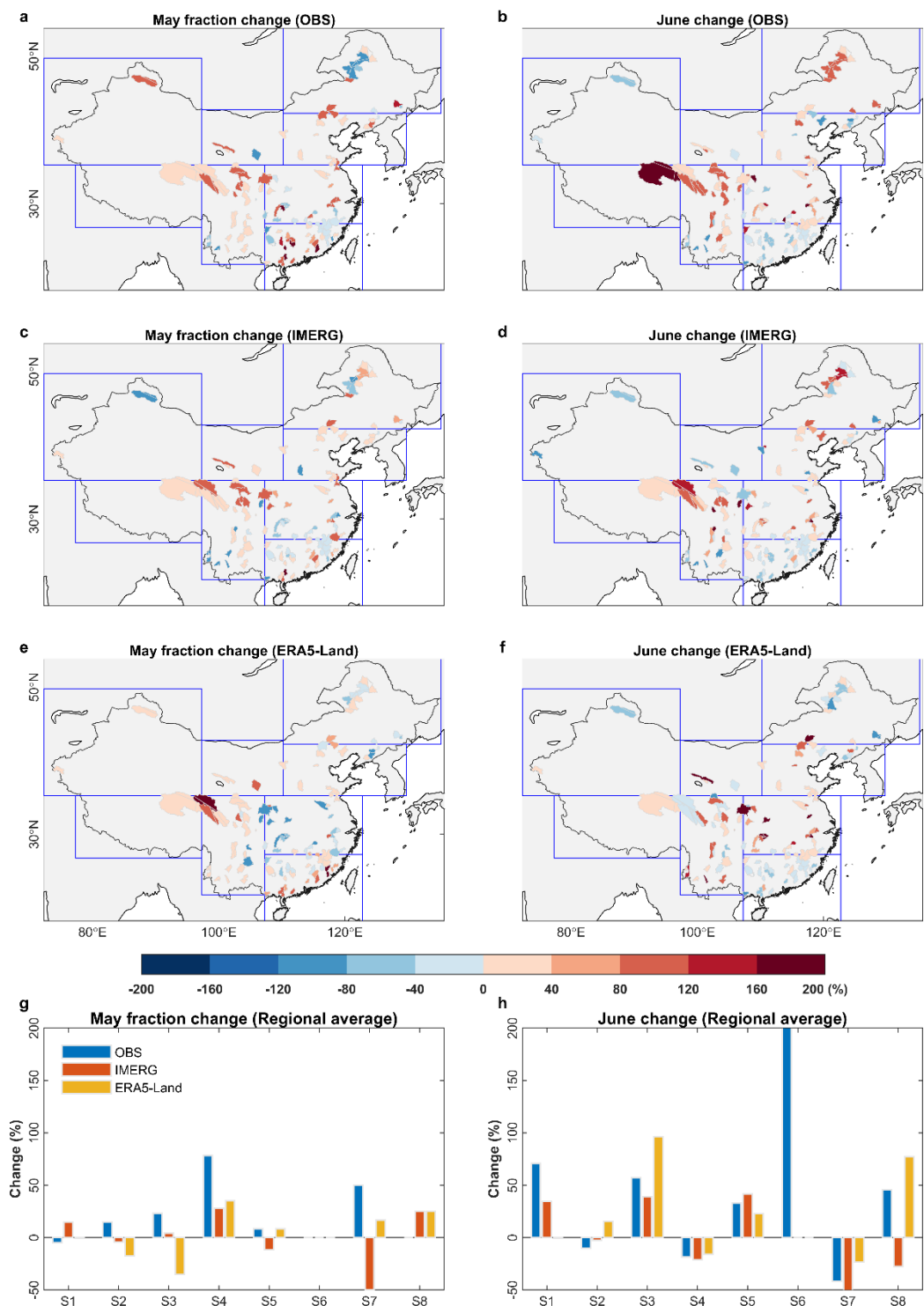


Figure S8. The changes of average flood fraction in May (May) and June (June) of 2011-2020 against 2001-2010 period for each catchment and eight spatial regions by gridded observations, IMERG and ERA5-land datasets.

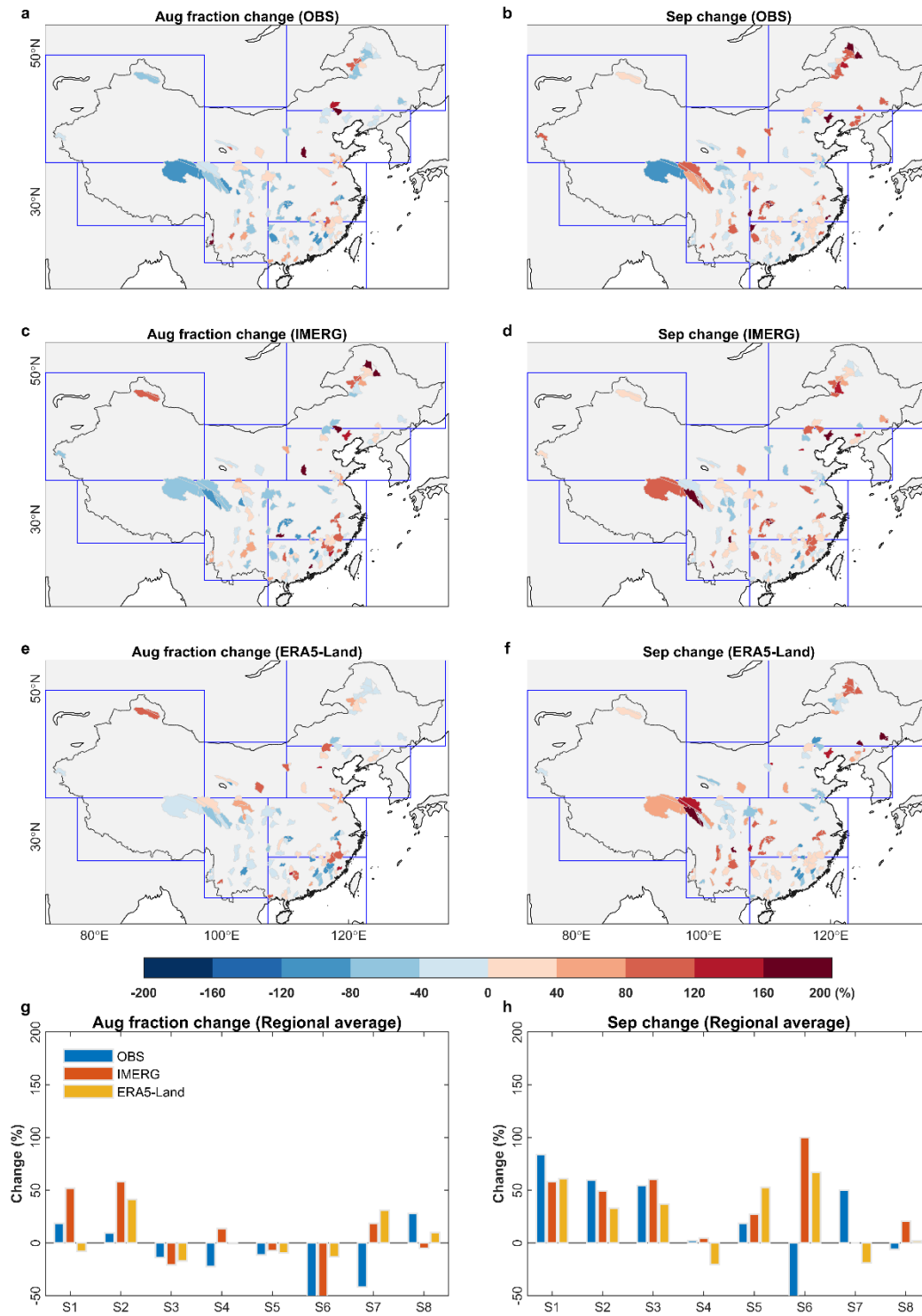


Figure S9. The changes of average flood fraction in August (Aug) and September (Sep) of 2011-2020 against 2001-2010 period for each catchment and eight spatial regions by gridded observations, IMERG and ERA5-land datasets.

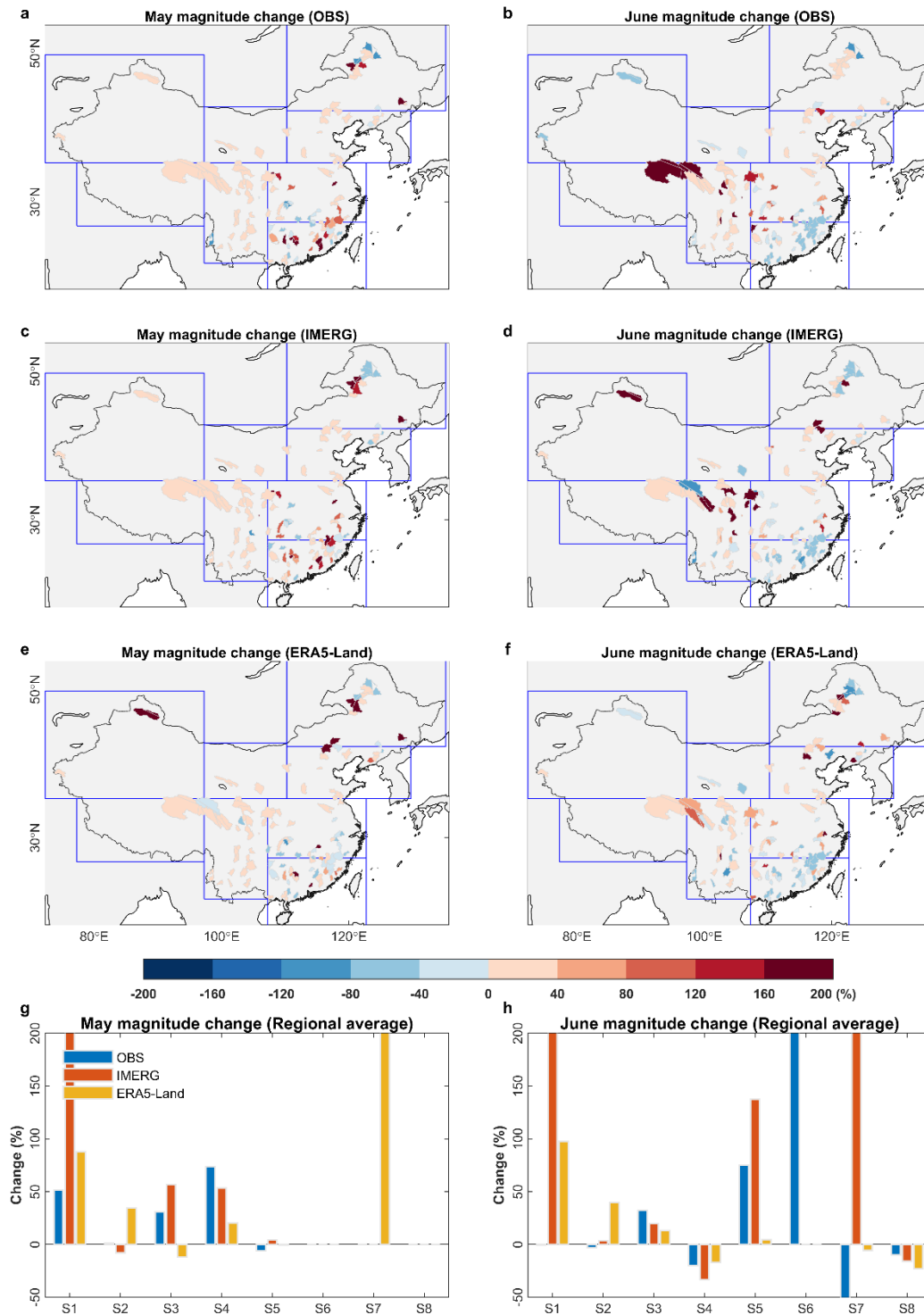


Figure S10. The changes of average flood magnitude in May and June of 2011-2020 against 2001-2010 period for each catchment and eight spatial regions by gridded observations, IMERG and ERA5-land datasets.

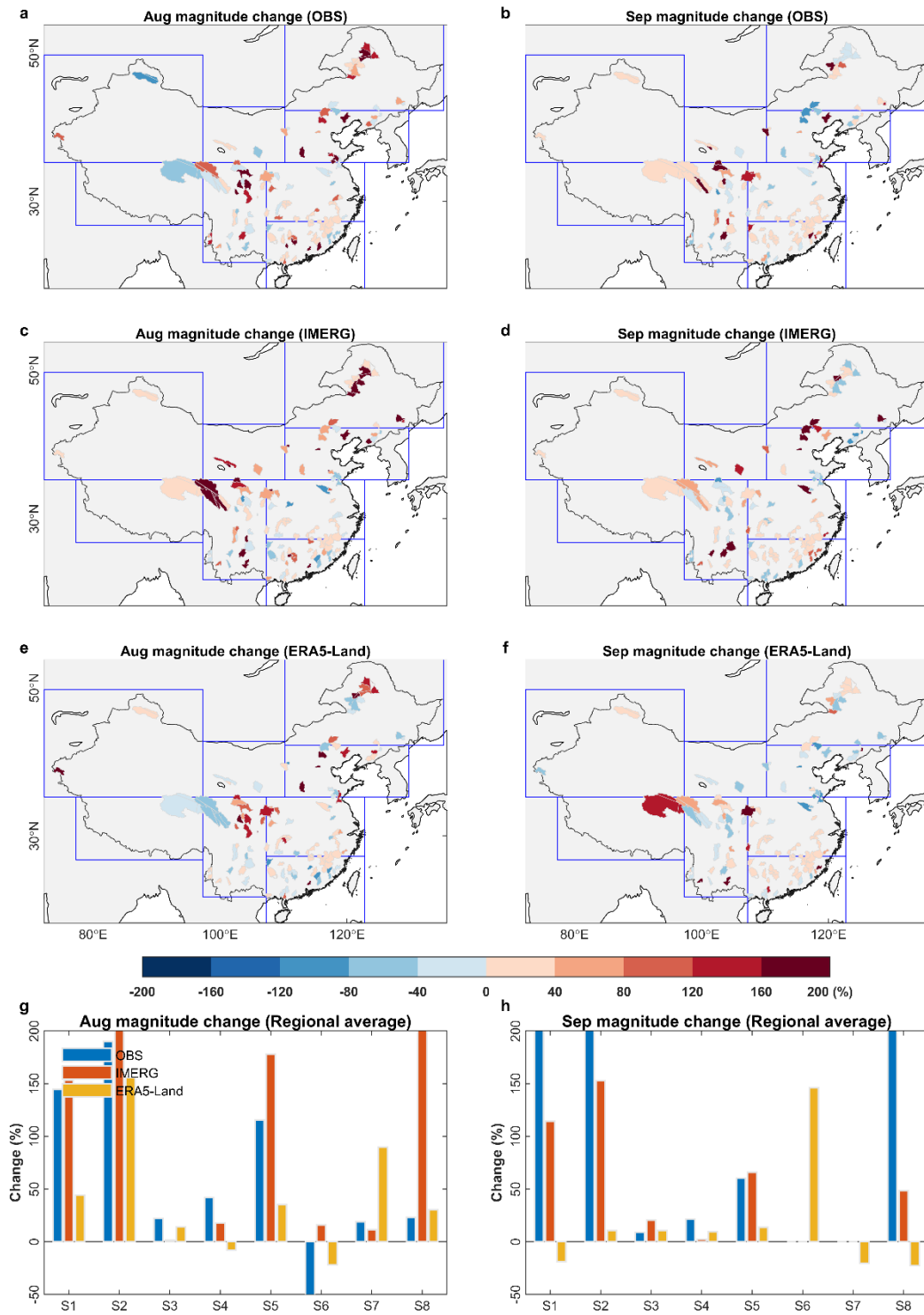


Figure S11. The changes of average flood magnitude in August and September of 2011-2020 against 2001-2010 period for each catchment and eight spatial regions by gridded observations, IMERG and ERA5-land datasets.

Table. S1 The difference of monthly flood fractions of IMERG (ERA5 Land) against OBS (Unit: %).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
IMERG-OBS												
S1	0.05	NaN	NaN	0.59	3.02	-1.56	-1.08	-3.40	1.67	-0.03	NaN	NaN
S2	0.20	0.21	1.40	0.42	-0.09	0.04	1.91	-8.54	2.30	1.37	0.07	NaN
S3	0.55	0.60	-0.17	0.83	1.91	-2.74	-1.84	1.18	-2.15	-0.10	0.80	1.12
S4	0.64	-0.55	-0.88	-1.23	1.43	-1.18	0.19	1.68	-0.71	-0.24	0.15	0.69
S5	-0.07	NaN	NaN	-0.03	-0.60	-1.65	-0.40	2.83	0.04	0.10	-0.41	NaN
S6	NaN	NaN	NaN	NaN	NaN	NaN	7.20	8.33	5.68	NaN	NaN	NaN
S7	NaN	NaN	NaN	NaN	2.98	1.04	7.83	-5.62	NaN	NaN	NaN	NaN
S8	NaN	NaN	NaN	NaN	-0.38	-2.04	-5.94	-3.51	4.36	6.05	NaN	NaN
ERA5 Land-OBS												
S1	-0.03	NaN	NaN	2.14	6.34	3.24	-2.81	-4.41	-4.86	0.39	NaN	NaN
s2	0.41	-0.05	0.33	2.96	1.43	1.48	-2.88	-1.95	-1.34	1.08	-1.68	NaN
S3	-0.05	-0.23	-0.38	1.61	1.30	-0.79	1.38	0.87	-2.83	-0.99	0.24	-0.13
S4	-0.31	-0.37	-0.07	-0.69	1.09	2.72	-2.10	1.62	-0.42	-0.03	-1.01	-0.43
S5	NaN	NaN	NaN	-0.13	-0.35	-0.92	3.92	2.11	-1.32	-2.52	-0.59	NaN
S6	NaN	NaN	NaN	NaN	NaN	NaN	-6.90	11.35	12.51	NaN	NaN	NaN
S7	-0.60	NaN	NaN	NaN	-0.60	1.67	- 11.83	5.24	6.11	NaN	NaN	NaN
S8	NaN	-0.19	0.29	NaN	-0.17	-2.21	1.31	-8.88	4.09	3.63	NaN	NaN

Note: NaN means there is no floods occur in certain month simulated by the IMERG, ERA5 Land or OBS datasets.

Table. S2 The difference of monthly flood magnitudes of IMERG (ERA5 Land) against OBS (Unit: mm).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
IMERG-OBS												
S1	1.79	NaN	NaN	4.23	2.81	3.97	2.89	4.30	-7.68	-26.43	NaN	NaN
S2	-1.26	7.60	2.31	-0.18	0.79	-0.15	-2.03	2.60	-7.11	-1.66	3.87	NaN
S3	6.84	6.96	10.41	2.86	3.96	-1.30	-9.09	-1.85	-14.10	-5.40	-4.38	9.92
S4	18.18	35.80	10.19	9.34	1.99	-0.81	-3.80	-3.86	1.27	-8.23	5.97	6.56
S5	27.58	NaN	NaN	-1.59	3.66	-2.35	-0.72	-3.38	-4.61	2.25	4.16	NaN
S6	NaN	NaN	NaN	NaN	NaN	NaN	-1.07	-0.70	1.74	NaN	NaN	NaN
S7	NaN	NaN	NaN	NaN	-0.19	-0.31	10.14	21.45	NaN	NaN	NaN	NaN
S8	NaN	NaN	NaN	NaN	-0.52	-0.38	-1.29	0.07	-2.38	-6.33	NaN	NaN
ERA5-Land-OBS												
S1	-1.34	NaN	NaN	-1.88	0.28	2.37	0.21	-3.36	-12.70	-27.99	NaN	NaN
S2	-0.42	2.14	-2.30	-4.12	0.99	-1.69	-1.88	-1.49	-4.37	-4.70	5.45	NaN
S3	-11.98	2.76	-7.78	-1.48	-0.38	-6.41	-4.33	-10.38	-11.45	-8.41	-2.15	-6.97
S4	-1.99	-8.06	-9.47	-1.00	-4.95	-8.76	0.32	2.99	-4.27	-8.03	-14.26	-4.16
S5	NaN	NaN	NaN	22.11	-6.98	-3.72	-3.10	1.23	-4.23	0.22	7.33	NaN
S6	NaN	NaN	NaN	NaN	NaN	NaN	-1.99	-1.21	-0.17	NaN	NaN	NaN
S7	3.23	NaN	NaN	NaN	-0.26	1.28	-1.53	-7.78	0.90	NaN	NaN	NaN
S8	NaN	-7.01	0.13	NaN	-3.15	0.01	-2.15	-1.02	-4.28	-8.21	NaN	NaN

Note: NaN means there is no floods occur in certain month simulated by the IMERG, ERA5 Land or OBS datasets.

Table. S3 The difference of monthly CMHF fractions of IMERG (ERA5 Land) against OBS (Unit: %).

	Jue	Jul	Aug	Sep	Oct
IMERG-OBS					
S1	NaN	-17.80	-2.82	-3.81	NaN
S2	NaN	-18.54	-6.23	2.85	NaN
S3	-1.46	4.80	-0.02	-1.03	NaN
S4	-2.46	-3.34	-4.55	-12.87	NaN
S5	-5.74	-1.48	3.56	-0.15	NaN
S6	NaN	36.67	25.45	20.00	NaN
S7	NaN	-26.01	-16.07	NaN	NaN
S8	NaN	2.26	-17.53	5.09	-0.60
ERA5 Land-OBS					
S1	NaN	-9.32	-13.61	-8.19	NaN
S2	NaN	-10.12	-3.26	-3.60	NaN
S3	-1.85	5.54	-3.07	-3.27	NaN
S4	-0.52	0.49	-3.21	-3.32	NaN
S5	-0.36	-2.43	1.37	-2.95	NaN
S6	NaN	51.82	-2.16	10.77	NaN
S7	NaN	-5.56	-11.90	NaN	NaN
S8	NaN	-32.78	0.58	-7.52	NaN

Note: NaN means there is no CMHF occur in certain month simulated by the IMERG, ERA5 Land or OBS datasets (CMHF only occur in certain month during the warm season).

Table. S4 The difference of monthly CMHF magnitudes of IMERG (ERA5 Land) against OBS (Unit: mm).

	Jun	Jul	Aug	Sep	Oct
IMERG-OBS					
S1	NaN	3.94	3.14	-14.05	NaN
S2	NaN	-4.62	5.53	-11.82	NaN
S3	-38.56	-3.62	4.03	-16.89	NaN
S4	5.41	-7.82	-2.01	-19.36	NaN
S5	3.96	-5.04	-3.35	-8.44	NaN
S6	NaN	0.53	-0.76	4.68	NaN
S7	NaN	1.51	24.63	NaN	NaN
S8	NaN	0.24	0.65	-1.97	-33.63
ERA5 Land-OBS					
S1	NaN	0.19	-8.05	-3.48	NaN
S2	NaN	0.03	-6.66	3.19	NaN
S3	-24.00	-3.57	-2.43	-8.74	NaN
S4	-5.28	0.17	26.36	-22.00	NaN
S5	-10.22	-8.42	7.79	-4.71	NaN
S6	NaN	0.32	-1.04	1.38	NaN
S7	NaN	0.16	0.00	NaN	NaN
S8	NaN	0.15	-1.43	-7.76	NaN

Note: NaN means there is no CMHF occur in certain month simulated by the IMERG, ERA5 Land or OBS datasets (CMHF only occur in certain month during the warm season).