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Statistical post-processing of precipitation forecasts using circulation classifications and spatiotemporal deep neural networks

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Supplement

Contents of this file

Tables S1 to S3 show the statistical relationship between each circulation pattern and precipitation in spring, autumn and winter, respectively, including the percent of each circulation pattern, the percent of rainy days, and the percent of precipitation contribution.
Figures S1 to S3 respectively show the circulation pattern at the lead time of 1 day in spring, autumn and winter during 2007-2021.
Figure S4 shows the diagram of CNN model sub-grid data extraction.
Figure S5 shows the spatial distributions of the RMSE for SOM-CNN-LSTM method and raw forecasts at the lead time of 1 day.
Figure S6 shows the spatial distributions of the RB for SOM-CNN-LSTM method and raw forecasts at the lead time of 1 day.
Figure S7 shows the RMSE of different methods for each summer over 1-15 lead days from 2007 to 2021.
Figure S8 shows the CC of different methods for each summer over 1-15 lead days from 2007 to 2021.
Figure S9 shows the RB of different methods over 1-15 lead days in summer at different intensities of (a) no rain, (b) light rain, (c)moderate rain, (d) heavy rain, and (e) violent rain.
Figure S10 shows the CC of different methods over 1-15 lead days in summer at different intensities of (a) no rain, (b) light rain, (c)moderate rain, (d) heavy rain, and (e) violent rain.

Table S1 Contribution of different circulation patterns(CPs) to spring precipitation at the lead time of 1 day during 2007-2021

Category	CP1	CP2	CP3	CP4	CP5	CP6
CPs days	274	204	191	232	211	268
Precipitation days	54	21	44	96	89	93
Total precipitation(mm)	254	66	212	746	719	610
Percent of CPs days(%)	19.86	14.78	13.84	16.81	15.29	19.42
Percent of rainy days(%)	19.71	10.29	23.04	41.38	42.18	34.70
Percent of precipitation contribution(%)	9.74	2.53	8.13	28.62	27.58	23.40

Table S2 Contribution of different circulation patterns(CPs) to autumn precipitation at the lead time of 1 day during 2007-2021

Category	CP1	CP2	CP3	CP4	CP5	CP6
CPs days	361	173	116	306	209	200
Precipitation days	123	36	15	127	53	62
Total precipitation(mm)	772	165	50	982	401	378
Percent of CPs days(%)	26.45	12.67	8.50	22.42	15.31	14.65
Percent of rainy days(%)	34.07	20.81	12.93	41.50	25.36	31.00
Percent of precipitation contribution(%)	28.09	6.00	1.82	35.74	14.59	13.76

Table S3 Contribution of different circulation patterns(CPs) to winter precipitation at the lead time of 1 day during 2007-2021

Category	CP1	CP2	CP3	CP4	CP5	CP6
CPs days	205	242	243	246	260	158
Precipitation days	28	24	30	48	53	35
Total precipitation(mm)	122	125	141	226	242	227
Percent of CPs days(%)	15.14	17.87	17.95	18.17	19.20	11.67
Percent of rainy days(%)	13.66	9.92	12.35	19.51	20.38	22.15
Percent of precipitation contribution(%)	11.27	11.54	13.02	20.87	22.34	20.96

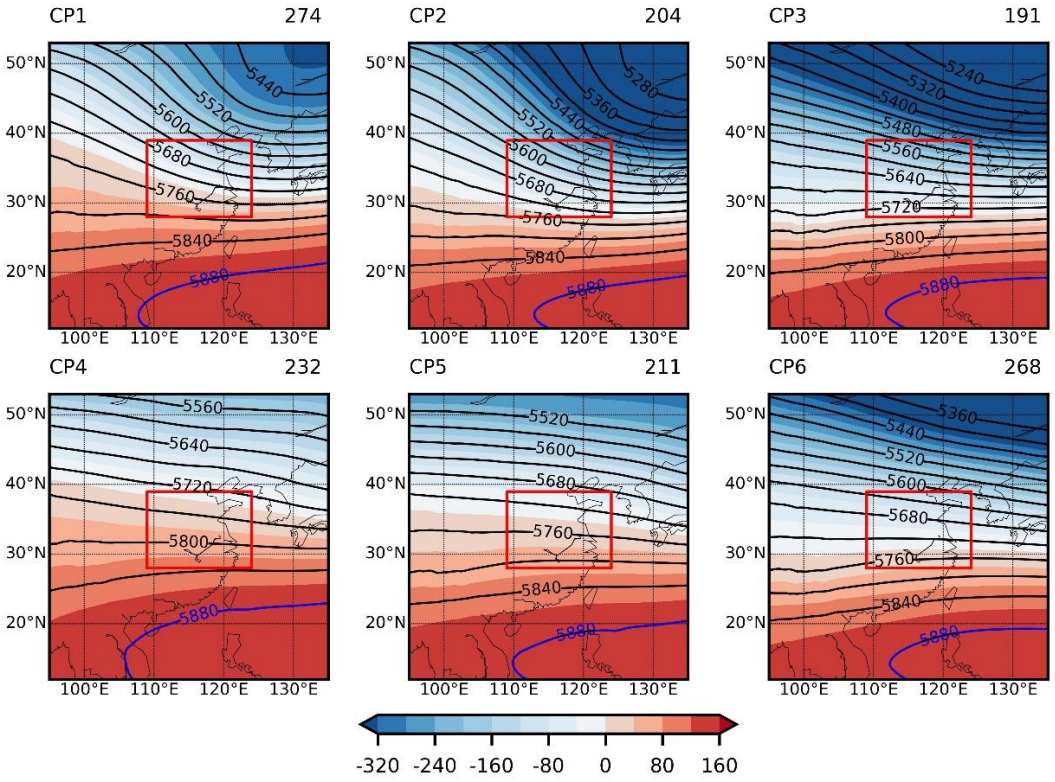

Figure S1 Circulation patterns at the lead time of 1 day in the spring of 2007-2021. The bold blue line (5880 gpm) is the characteristic position of WPSH; The red rectangle represents the scope of the Huaihe River basin; The colored shading stands for the geopotential height anomalies at 500 hPa; The numbers for each circulation pattern are shown in the upper right corner.

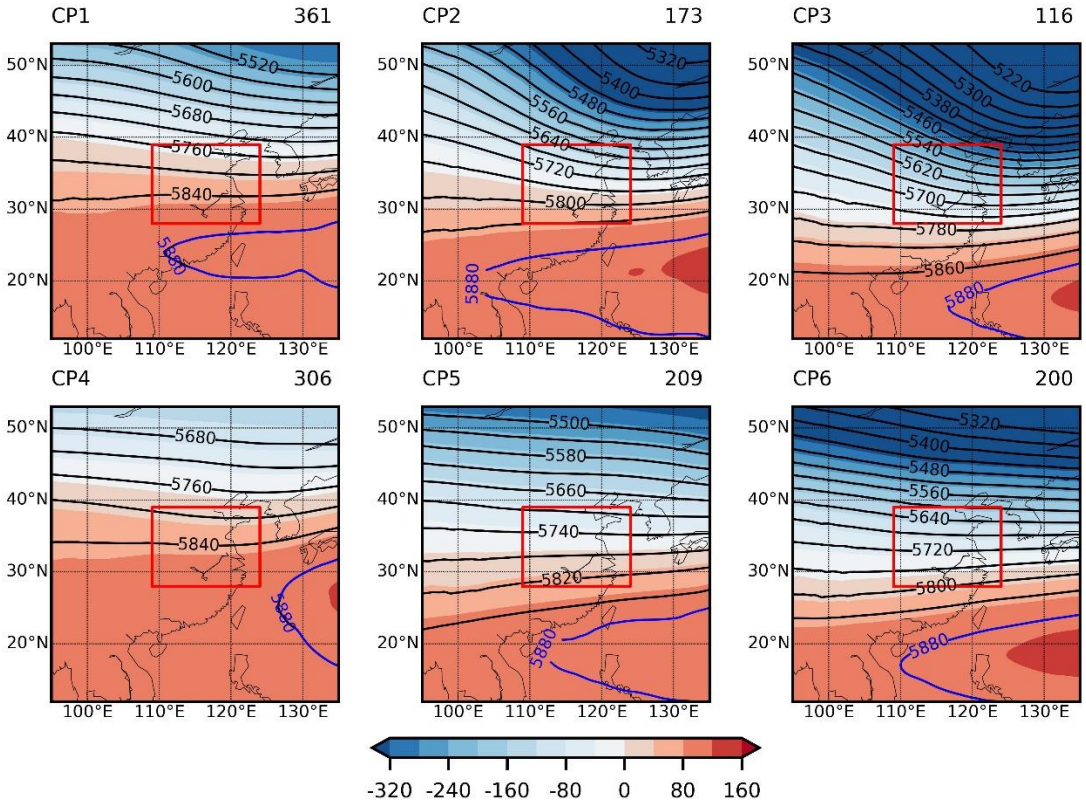

Figure S2 Circulation patterns at the lead time of 1 day in the autumn of 2007-2021. The bold blue line (5880 gpm) is the characteristic position of WPSH; The red rectangle represents the scope of the Huaihe River basin; The colored shading stands for the geopotential height anomalies at 500 hPa; The numbers for each circulation pattern are shown in the upper right corner.

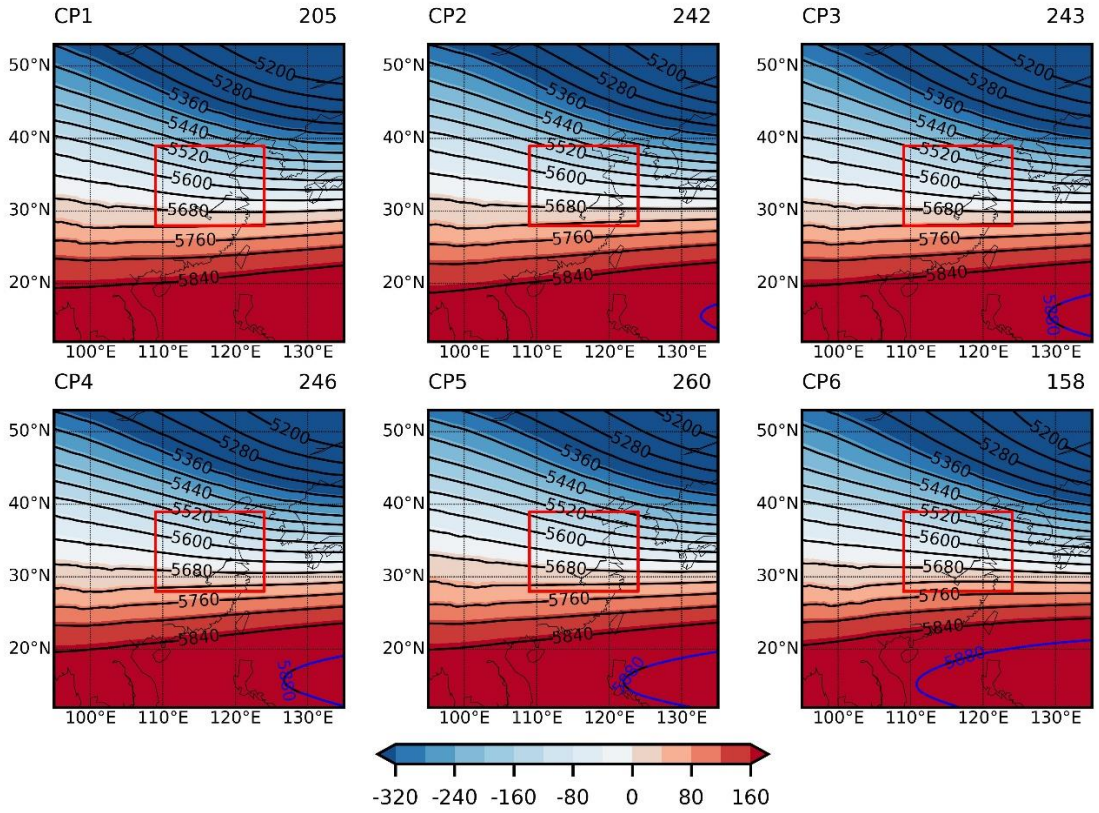

Figure S3 Circulation patterns at the lead time of 1 day in the winter of 2007-2021. The bold blue line (5880 gpm) is the characteristic position of WPSH; The red rectangle represents the scope of the Huaihe River basin; The colored shading stands for the geopotential height anomalies at 500 hPa; The numbers for each circulation pattern are shown in the upper right corner.

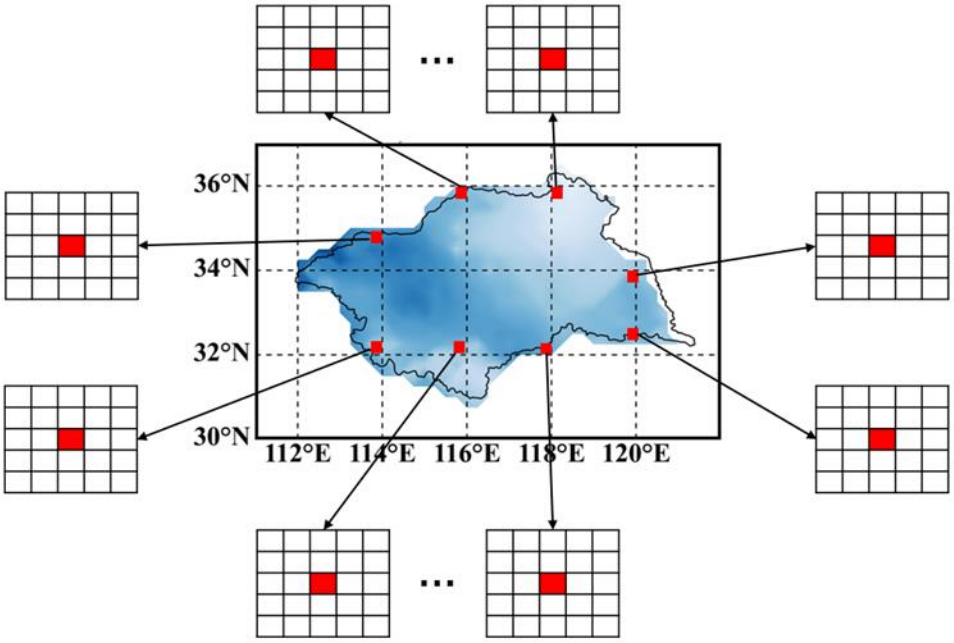

Figure S4 Diagram of CNN model sub-grid data extraction

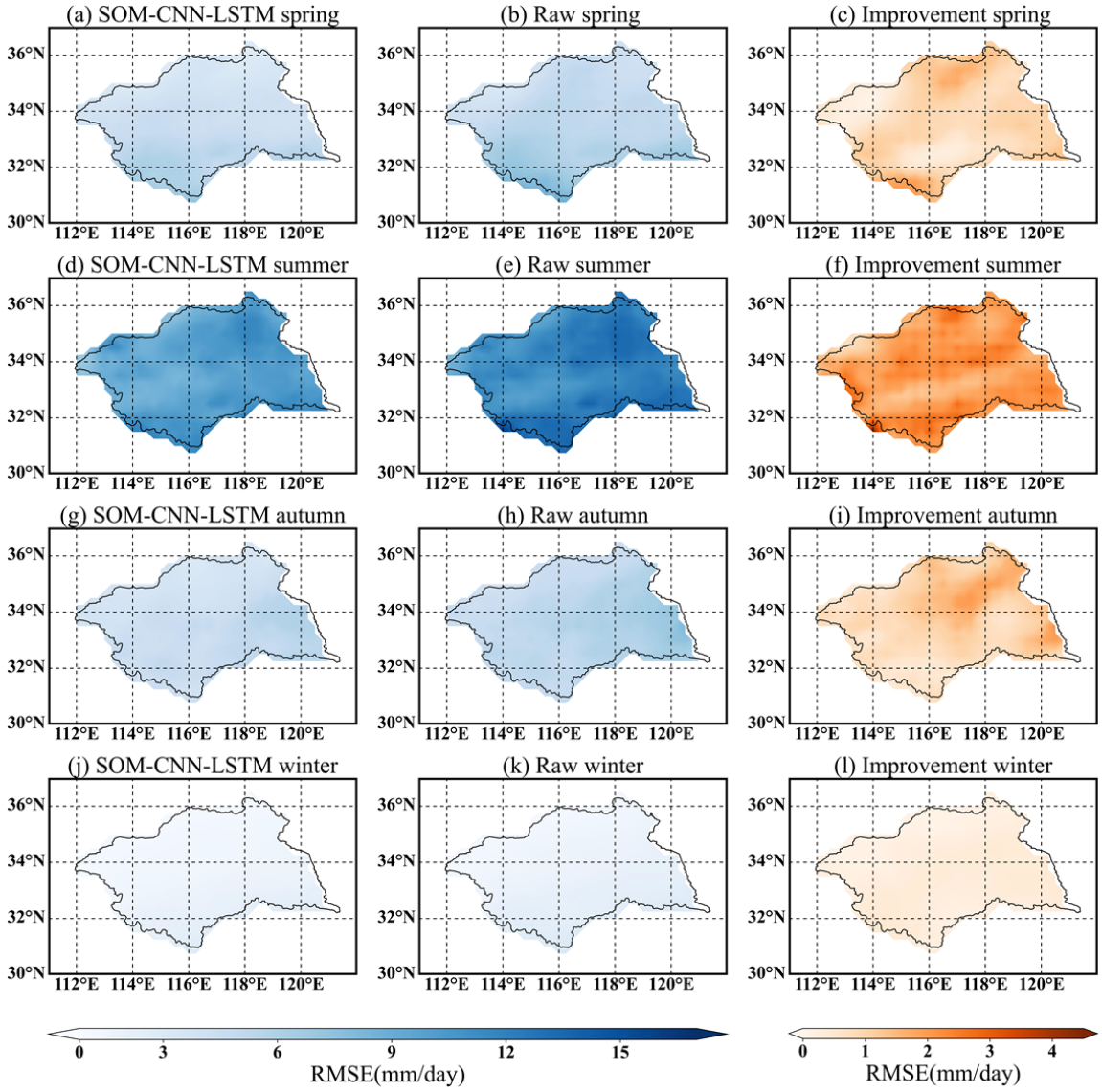

Figure S5 Spatial distributions of the RMSE for SOM-CNN-LSTM method and raw forecasts at the lead time of 1 day. The third column is the improvement of RMSE in spring, summer, autumn and winter.

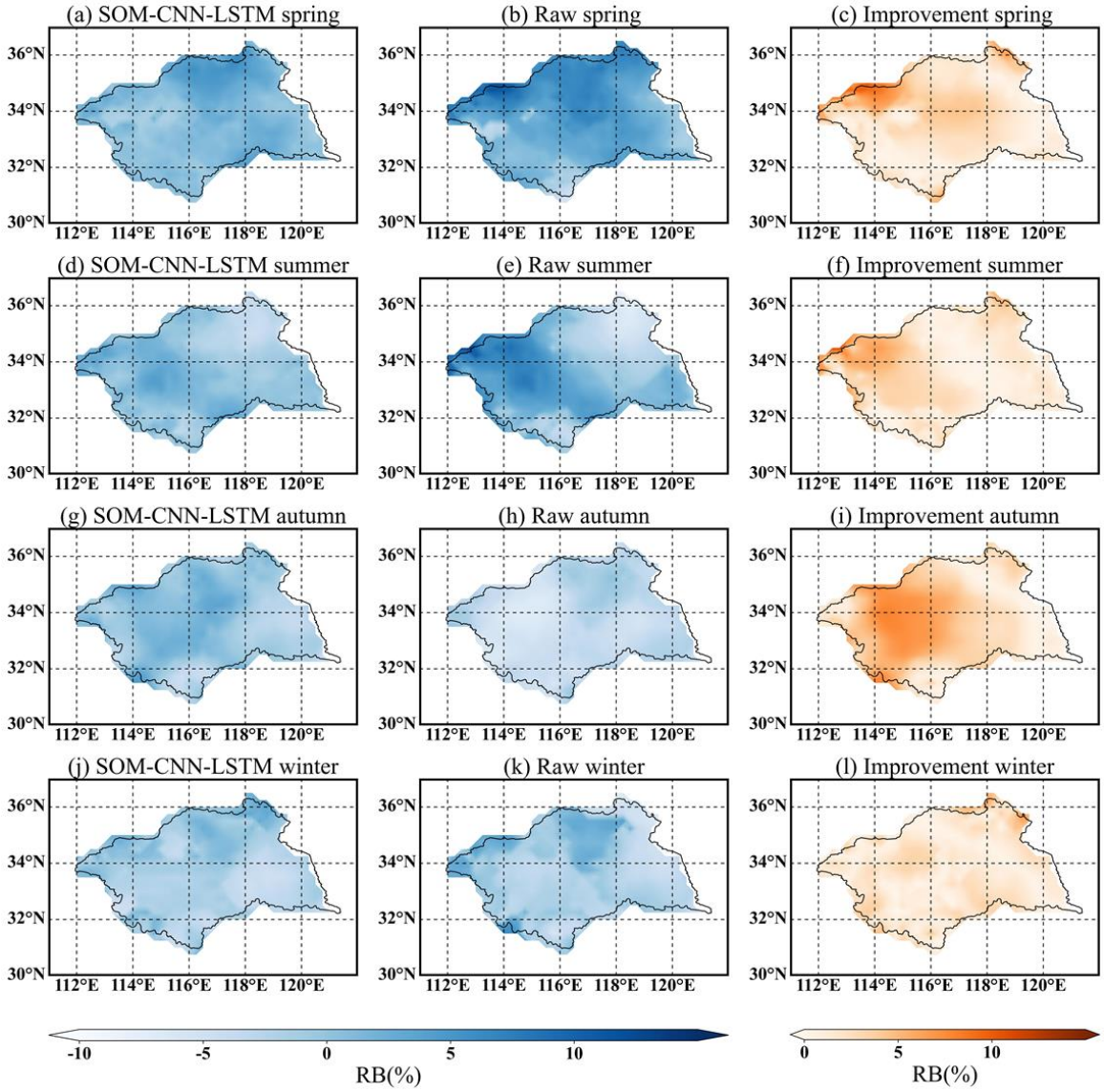

Figure S6 Spatial distributions of the RB for SOM-CNN-LSTM method and raw forecasts at the lead time of 1 day. The third column is the improvement of RB in spring, summer, autumn and winter.

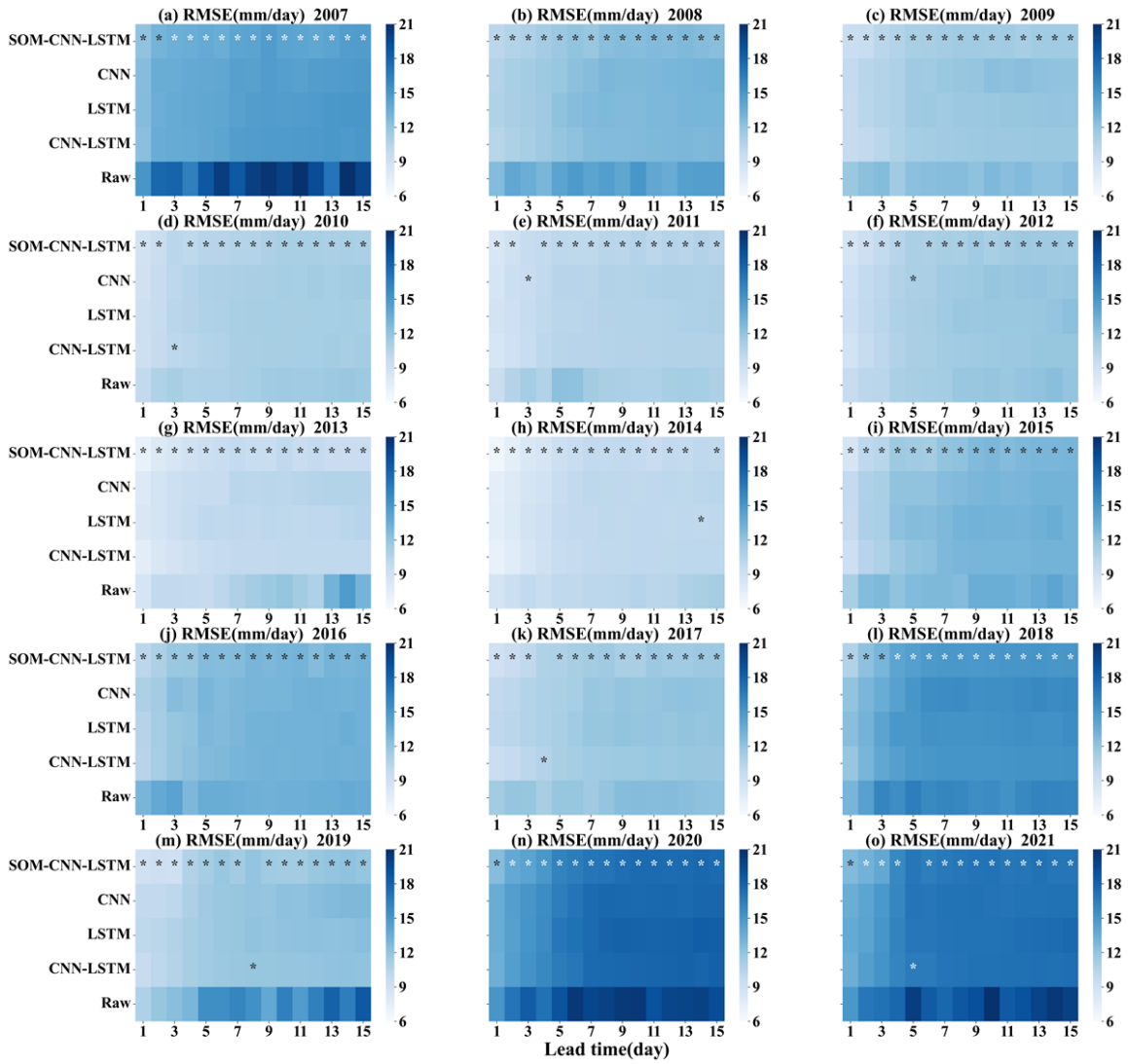

Figure S7 RMSE of different methods for each summer over 1-15 lead days from 2007 to 2021. The"*" indicates the best method with the lowest RMSE for each lead time.

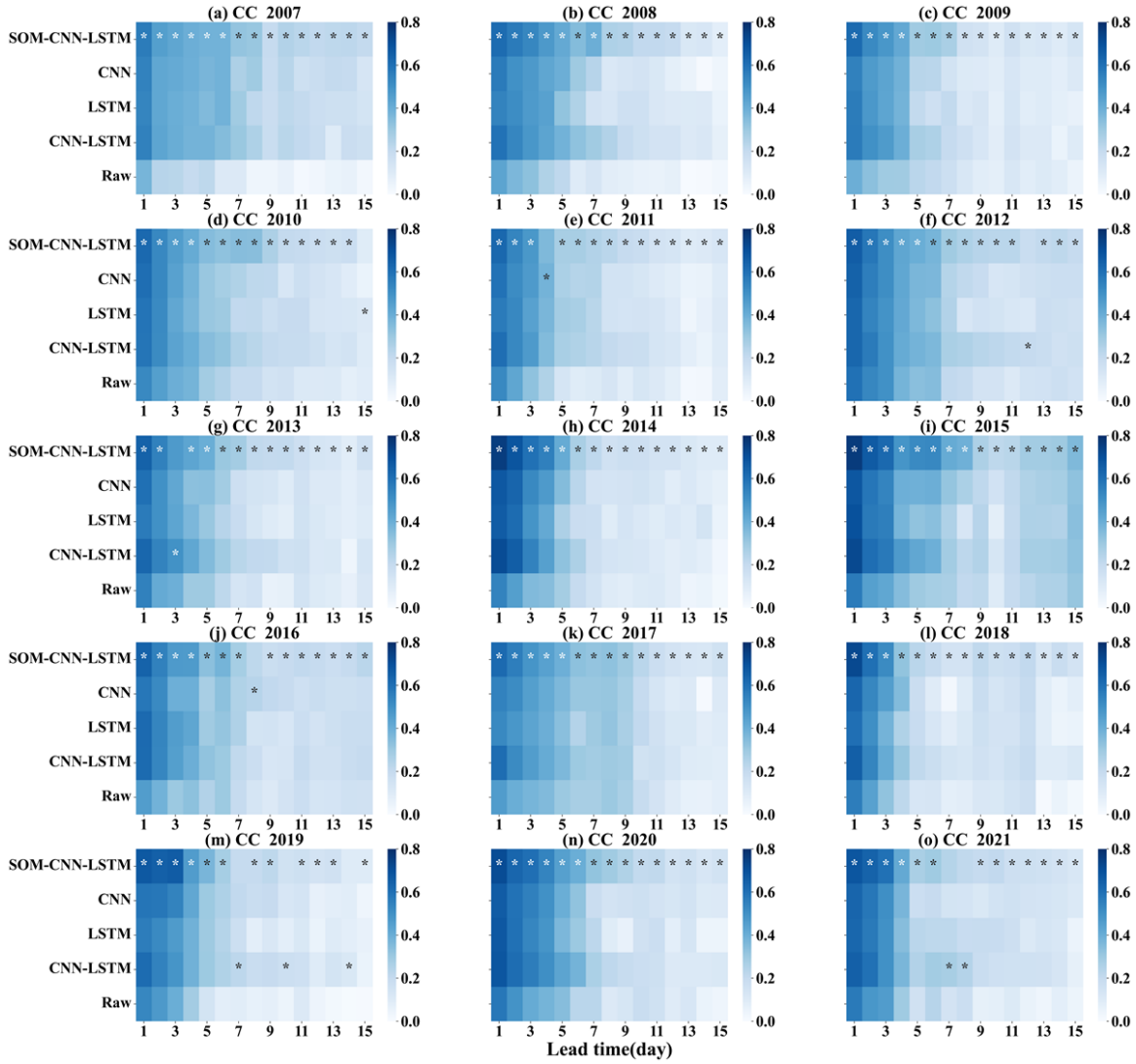

Figure S8 CC of different methods for each summer over 1-15 lead days from 2007 to 2021. The"*" indicates the best method with the highest CC for each lead time.

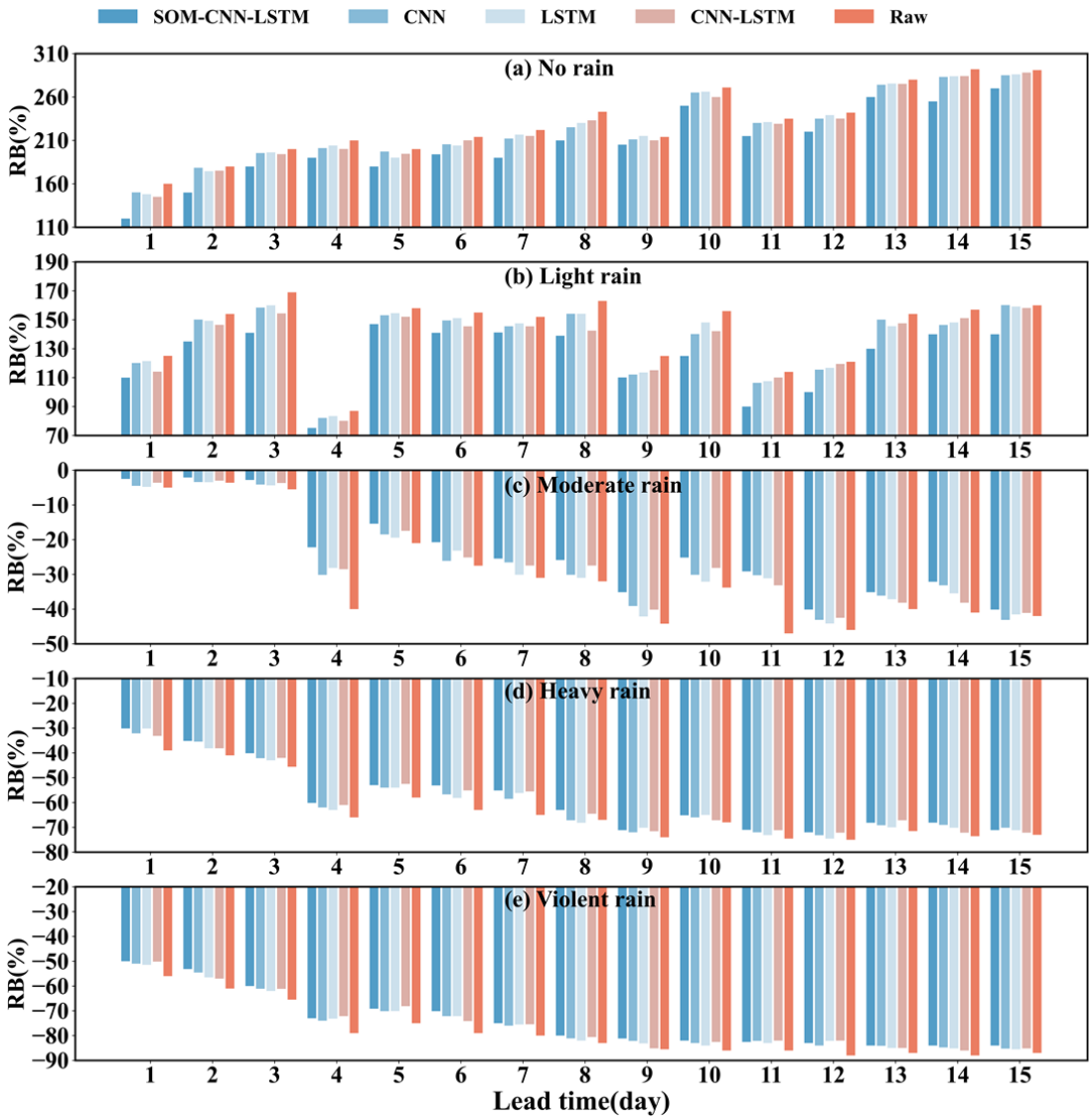

Figure S9 RB of different methods over 1-15 lead days in summer at different intensities of (a) no rain, (b) light rain, (c)moderate rain, (d) heavy rain, and (e) violent rain.

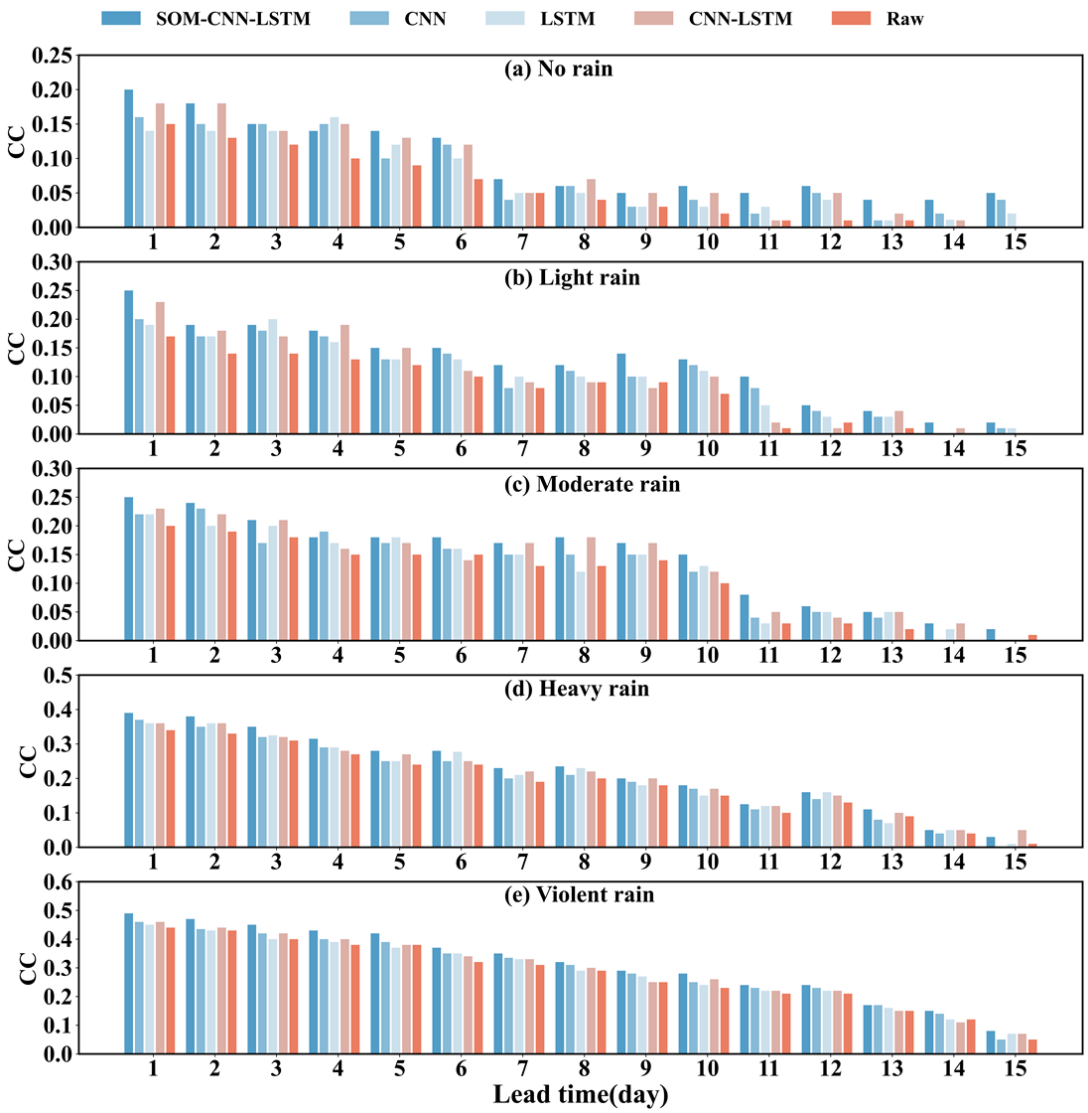

Figure S10 CC of different methods over 1-15 lead days in summer at different intensities of (a) no rain, (b) light rain, (c)moderate rain, (d) heavy rain, and (e) violent rain.