Evaluating Extreme Precipitation Change during the Mei-yu season from CMIP6 Future Projections

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Data and Method

Models

CMIP6	
BCC-CSM2-MR	MRI-ESM2-0
EC-Earth3	MIROC6
EC-Earth3-Veg	MPI-ESM1-2-HR
CESM2	CanESM5
CESM2-WACCM	IPSL-CM6A-LR

All of the model precipitation are interpolated to 1.5 degree by 1.5 degree prior to further analysis. The ensemble average of 10 models is shown in this study.

Table1. List of 10 models in the CMIP6 multi-model dataset used in this study.

Shared Socioeconomic Pathways(SSPs)

	SSP	W/m²
SSP126	SSP1 (Sustainability)	2.6
SSP245	SSP2 (Middle of the road)	4.5
SSP370	SSP3 (Regional rivalry)	7.0
SSP585	SSP5 (Fossil-fueled development)	8.5

Table2. Baseline Scenarios of SSPs

Method

- Daily precipitation during 1985-2014 in the historical experiment and 2071-2100 in all future scenarios were analyzed.
- Mei-yu season is defined as 5/16-7/24 [Chou et al. 2009; Chen, et al. 2019].
- The Wilcoxon-Mann-Whitney test is used to evaluate the statistical significance of the differences at the 5% level.

Results

RX1day (Maximum 1-day precipitation, units: mm)

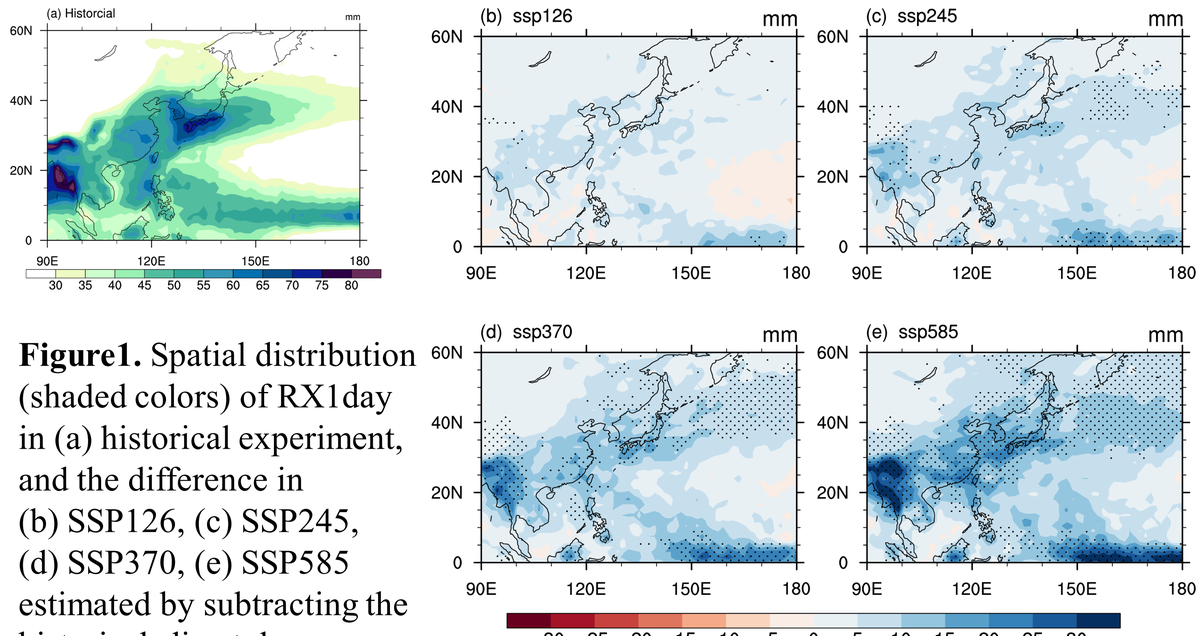

Figure1. Spatial distribution (shaded colors) of RX1day in (a) historical experiment, and the difference in (b) SSP126, (c) SSP245, (d) SSP370, (e) SSP585 estimated by subtracting the historical climatology.
Dotted regions represent more than one-half models show the statistically significant change consistent with the ensemble average.

RX5day (Maximum 5-day precipitation, units: mm)

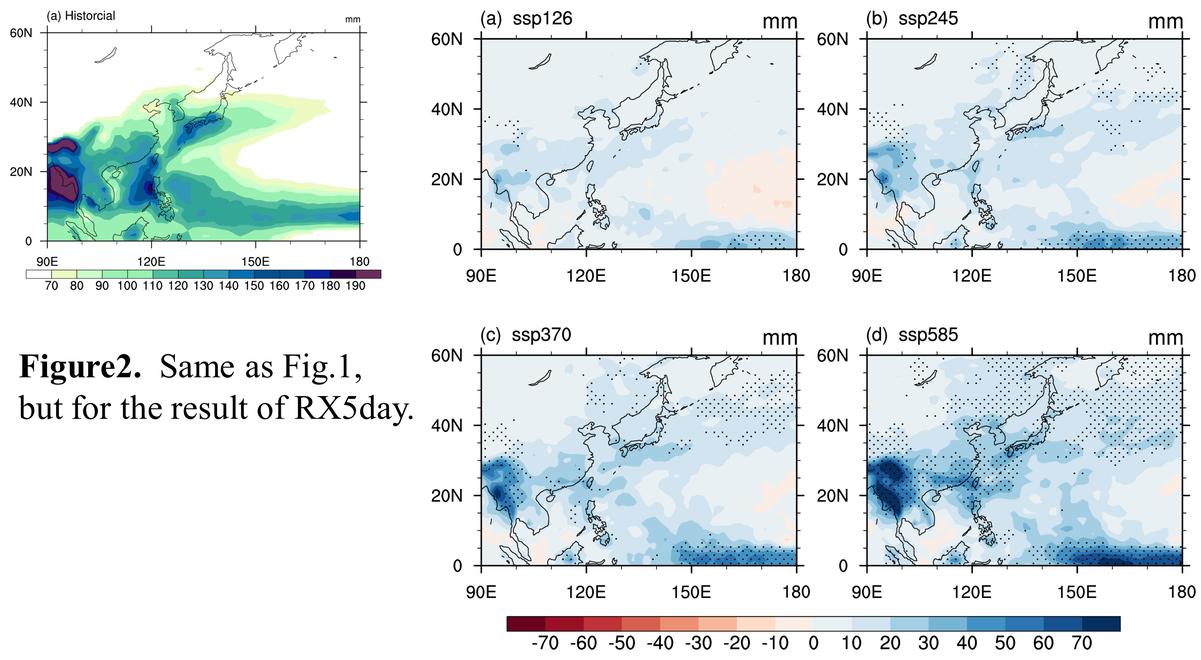

Figure2. Same as Fig.1, but for the result of RX5day.

SDII (Simple daily intensity, units: mm/day)

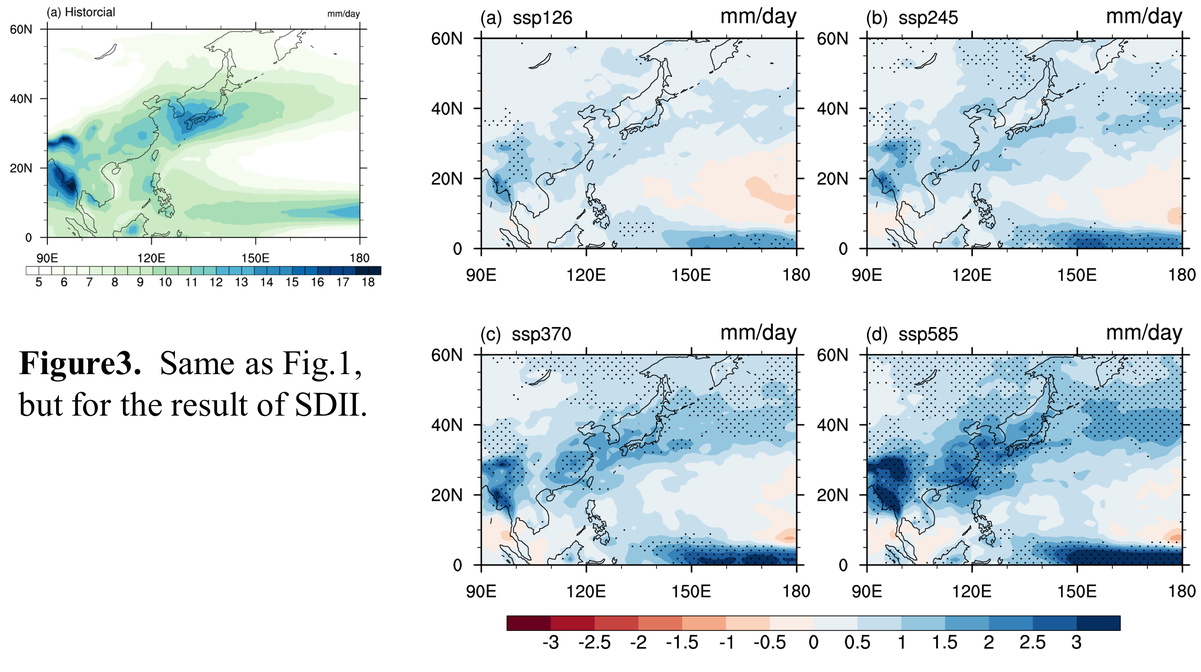

Figure3. Same as Fig.1, but for the result of SDII.

R99p (Extremely wet days, units: mm)

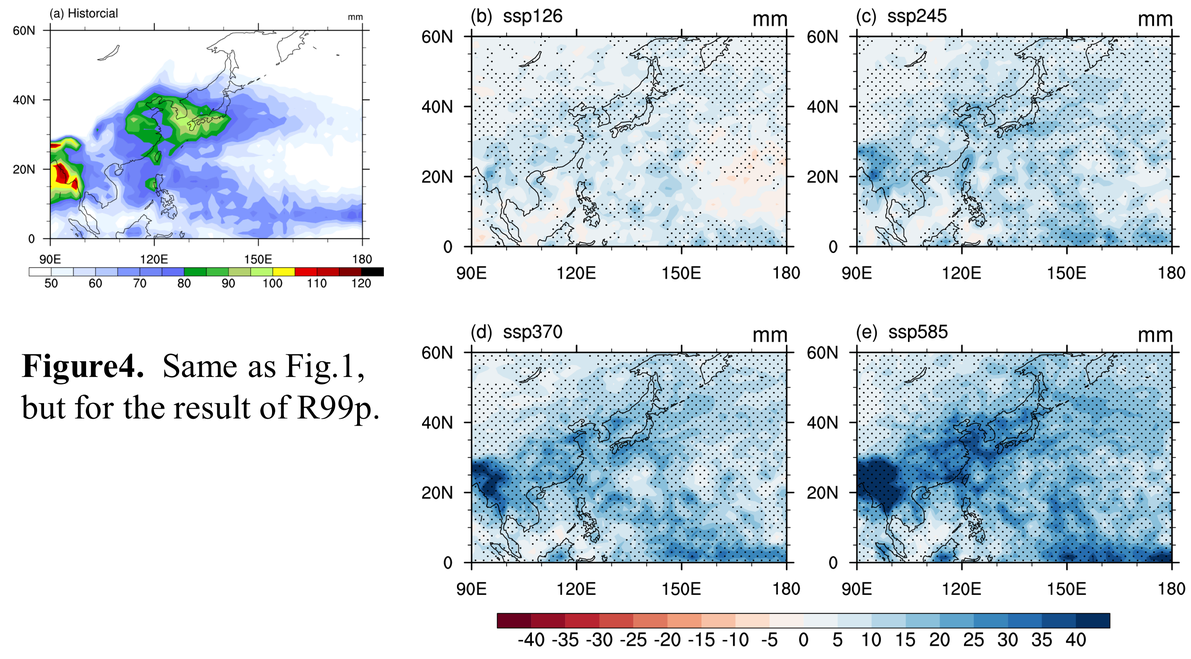

Figure4. Same as Fig.1, but for the result of R99p.

CDD (Consecutive dry days, units: days)

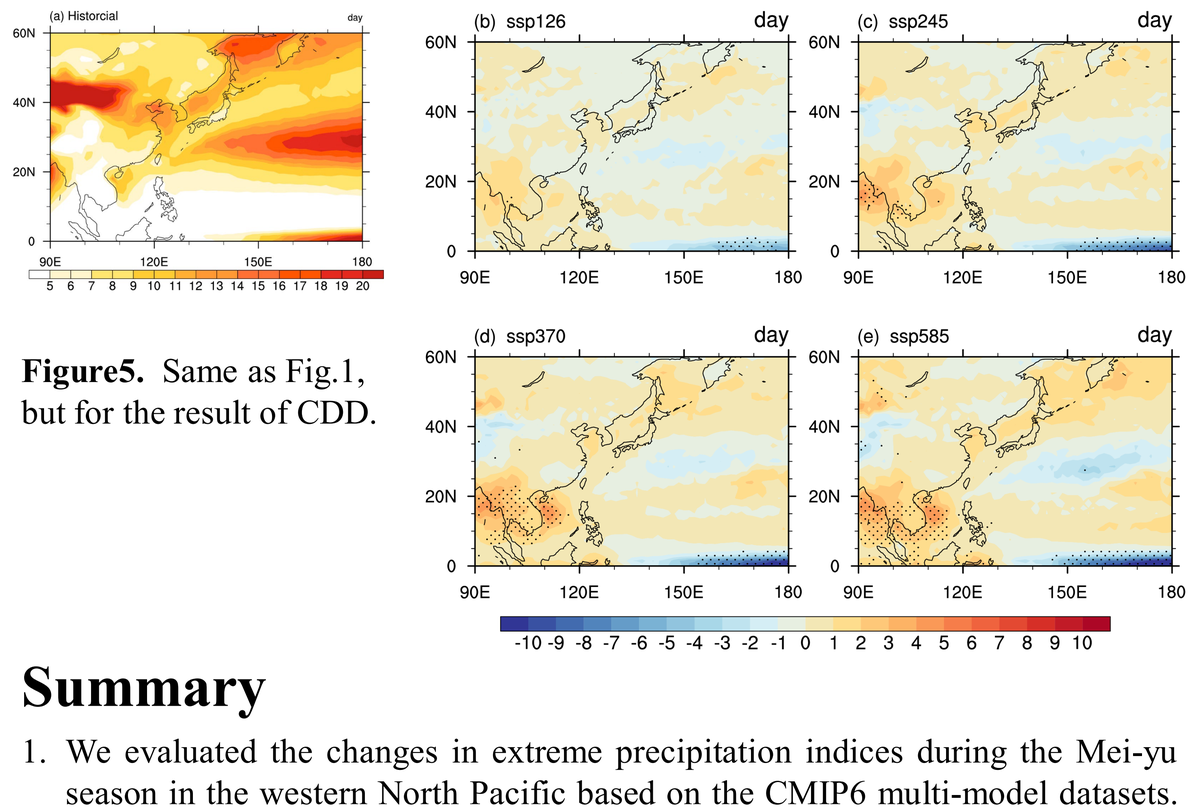

Figure5. Same as Fig.1, but for the result of CDD.

Summary

1. We evaluated the changes in extreme precipitation indices during the Mei-yu season in the western North Pacific based on the CMIP6 multi-model datasets. Five indices (RX1day, RX5day, SDII, R99p, and CDD) are analyzed. 10 CMIP6 models with 4 SSP scenarios are considered in this study.
2. The indices associated with extreme rainfall intensity (RX1day, RX5day, SDII, R99p) are generally enhanced. The enhancements are statistically significant over southern China, central China, Taiwan, the Korean Peninsula, and southern Japan. On the other hand, the duration of CDD is slightly prolonged.
3. The changes in the 4 rainfall intensity indices are more consistent between 10 models, but those of CDD are relatively inconsistent.
4. As the SSP level raises, the enhanced extreme rainfall intensity becomes more identifiable and statistically significant.
5. In addition, enhanced rainfall intensity and prolonged CDD are found in the eastern Bay of Bengal.

Reference

Chou et al. (2009) Annual cycle of rainfall in the western North Pacific and East Asian sector.

Chen et al. (2019) Seasonal precipitation change in the Western North Pacific and East Asia under global warming in two high-resolution AGCMs.