

Supplementary Figures

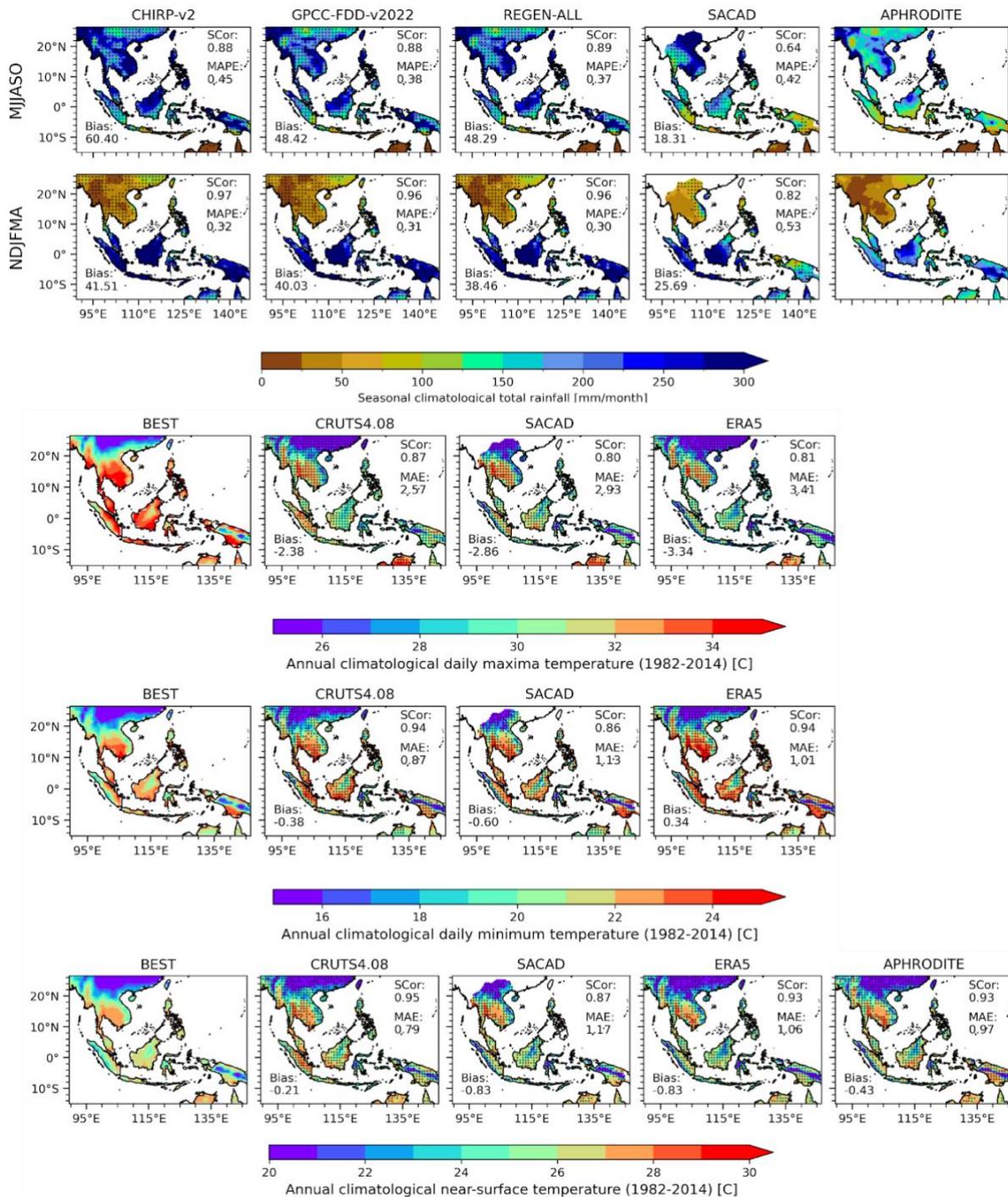


Figure S1. Climatology of seasonal total precipitation (mm/month) and annual mean, minimum, and maximum temperature during the 1982–2014 period across different observational datasets considered in this study. The spatial correlations (Scor), mean absolute percentage errors (MAPEs), and mean absolute errors (MAEs) calculated against APHRODITE (for precipitation) or BEST (for temperature) are shown in the upper-right corner. Regionally averaged biases to references are shown in the lower-left corner. Stippling indicates a significant difference at the 5% level of confidence, as determined by the Mann-Whitney test (for precipitation) or the Student t-test (for temperature).

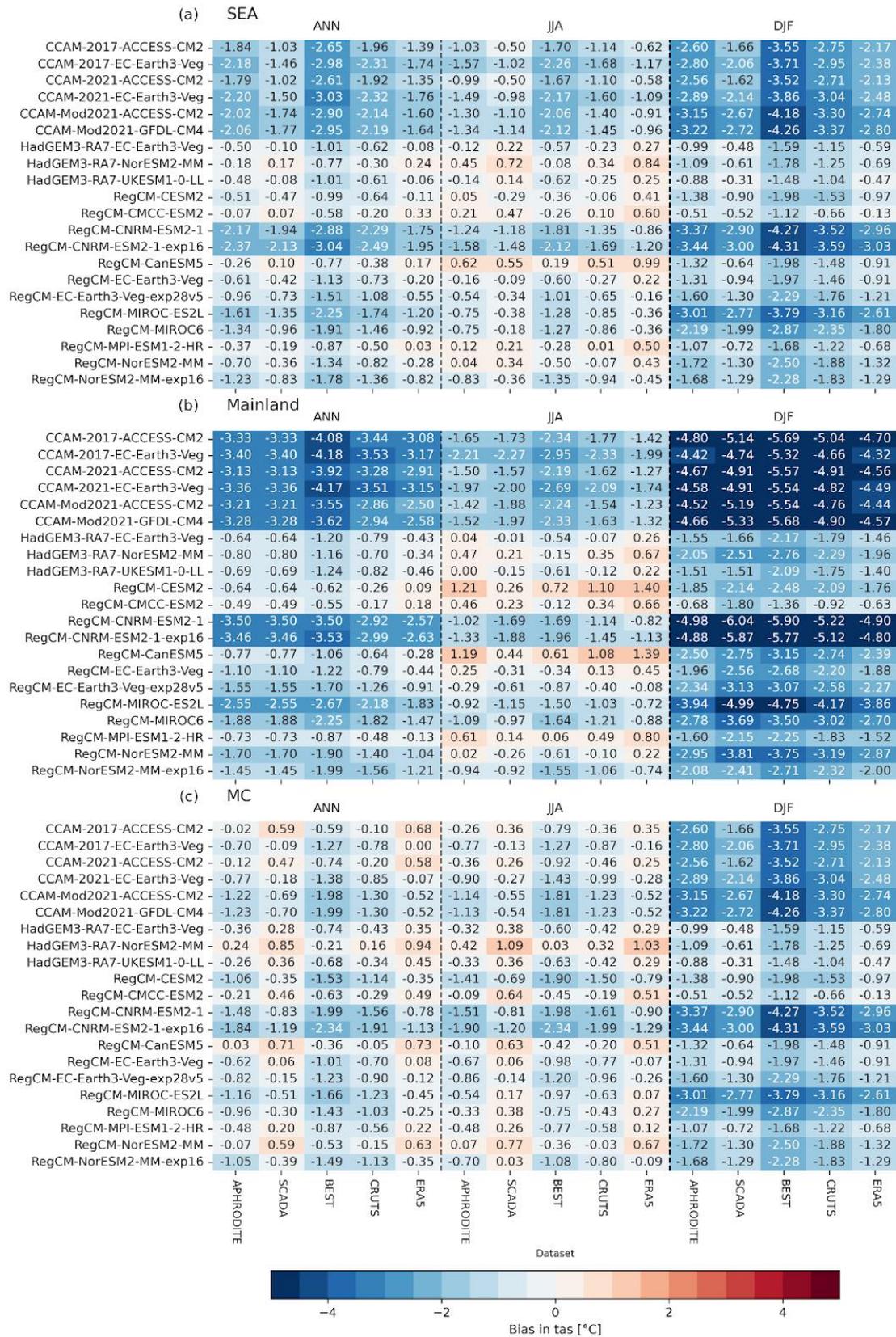


Figure S2. Heat map of the area-weighted average of biases in annual (ANN) and seasonal (JJA and DJF) mean daily temperature (tas, in °C) between models and multiple observational references (a) across Southeast Asia and its two sub-regions: (b) Mainland and (c) MC between models and multiple observational references.



Figure S3. Area score for comparison of regionally averaged daily near-surface temperature between CMIP6 CORDEX-SEA simulations and multiple references, considering different temporal scales: the whole climatological period (1982–2014) (ANN), the boreal summer (JJA), and the winter season (DJF) (a) across Southeast Asia and its two sub-regions: (b) Mainland and (c) MC between models and multiple observational references.

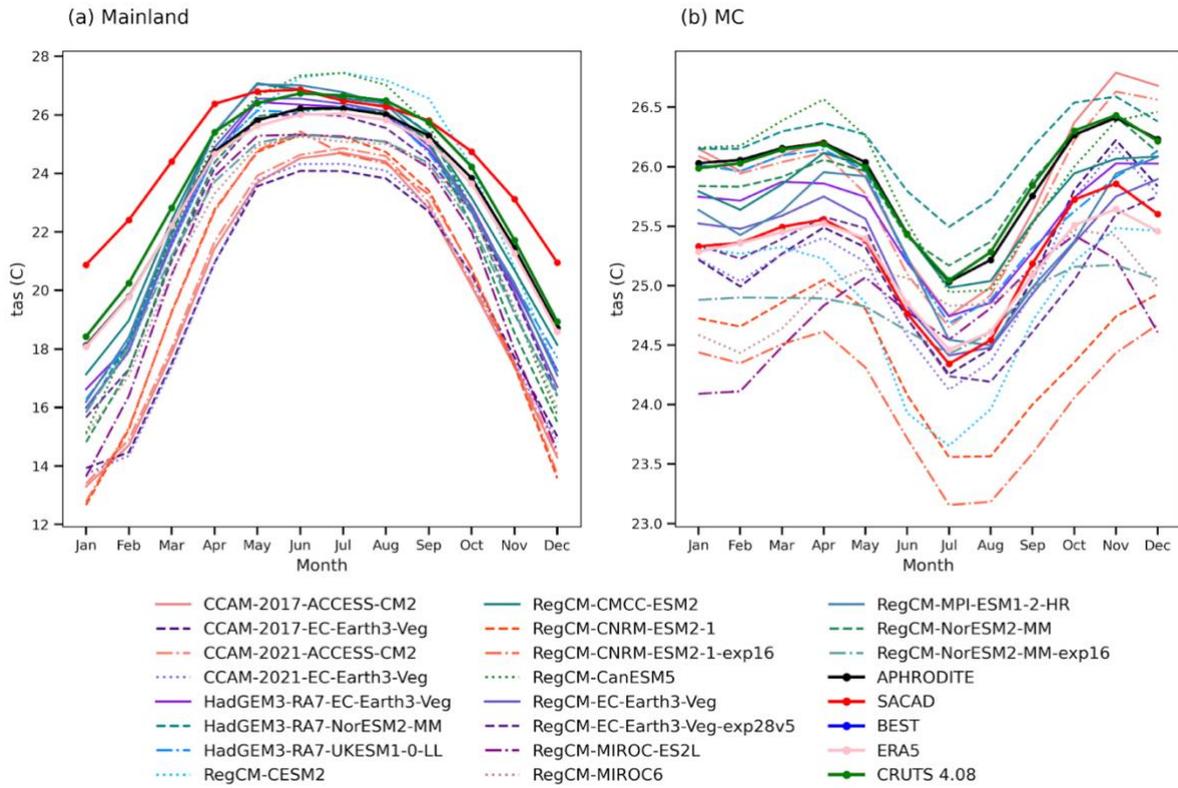


Figure S4. The climatological (1982–2014) latitudinally weighted average daily mean temperature (tas , in $^{\circ}\text{C}$) over two sub-regions: (a) the Mainland (5°N – 27.5°N ; 89°E – 147°E) and (b) the Maritime Continent (MC) (15°S – 5°N ; 89°E – 147°E). Color indicates different RCM simulations. Multiple observational data used as references are shown in different marked solid lines.

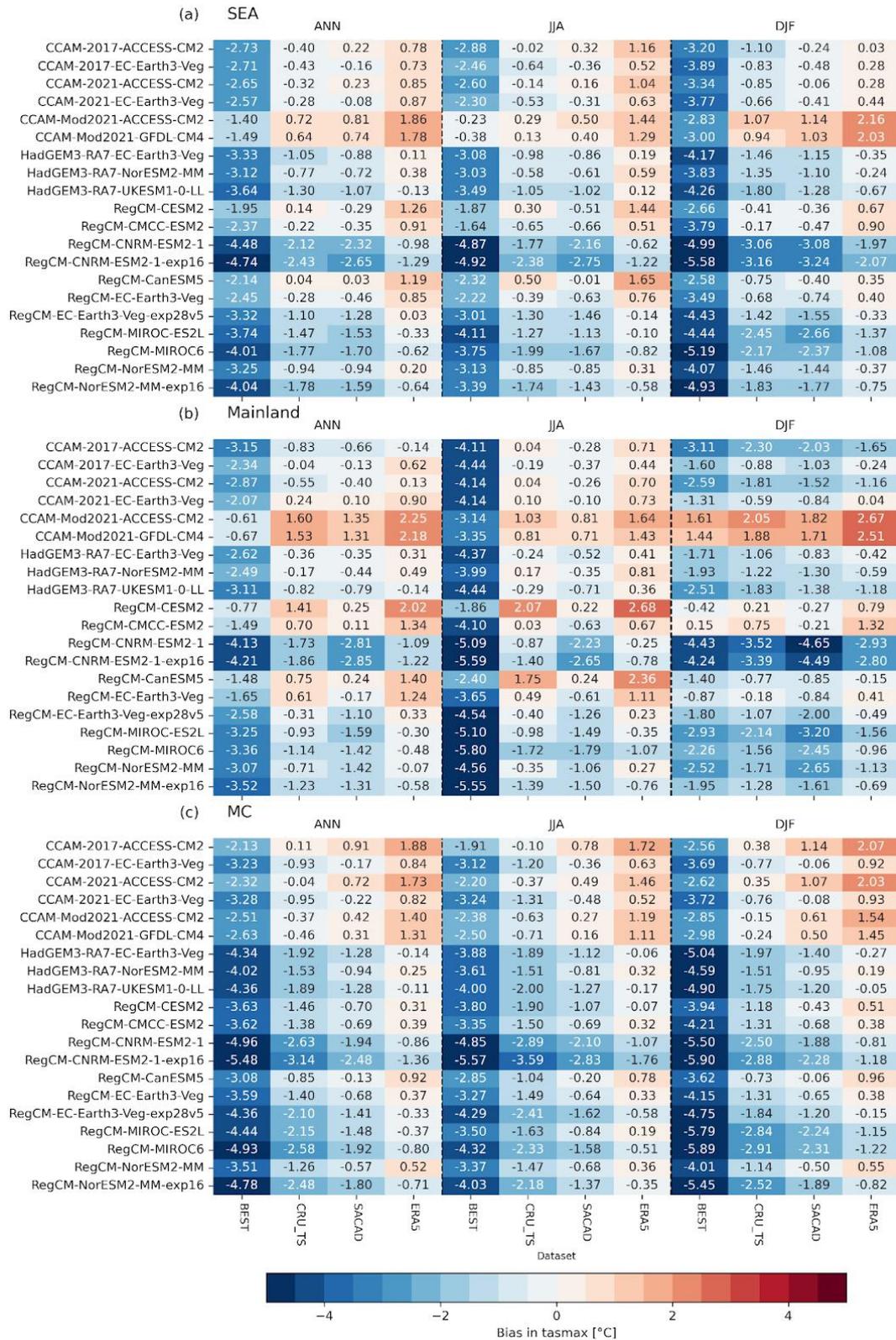


Figure S5. As Fig. S2, but for daily maximum temperature (tasmax, in °C).

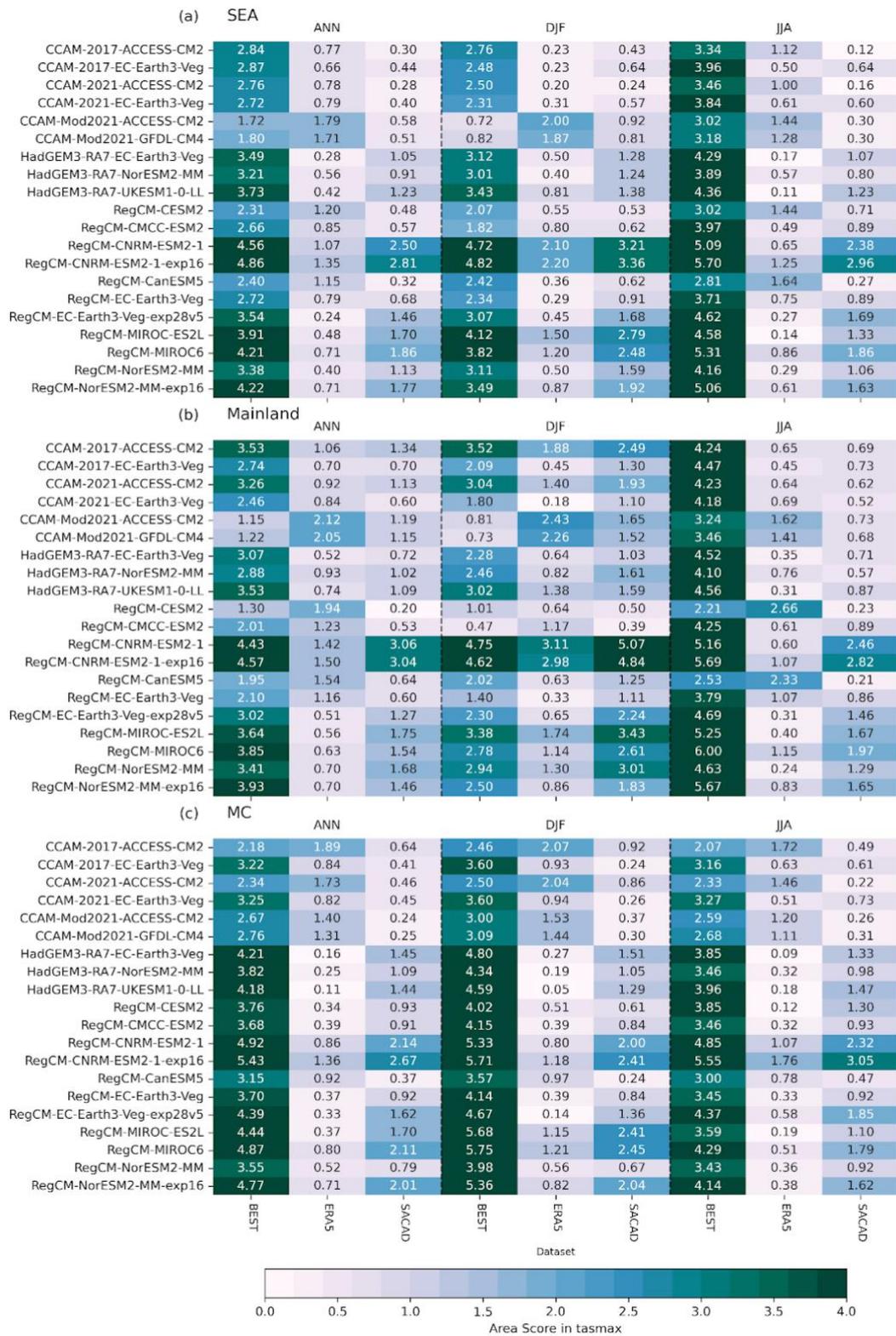


Figure S6. As Fig. S3, but for daily maximum temperature (tasmax)

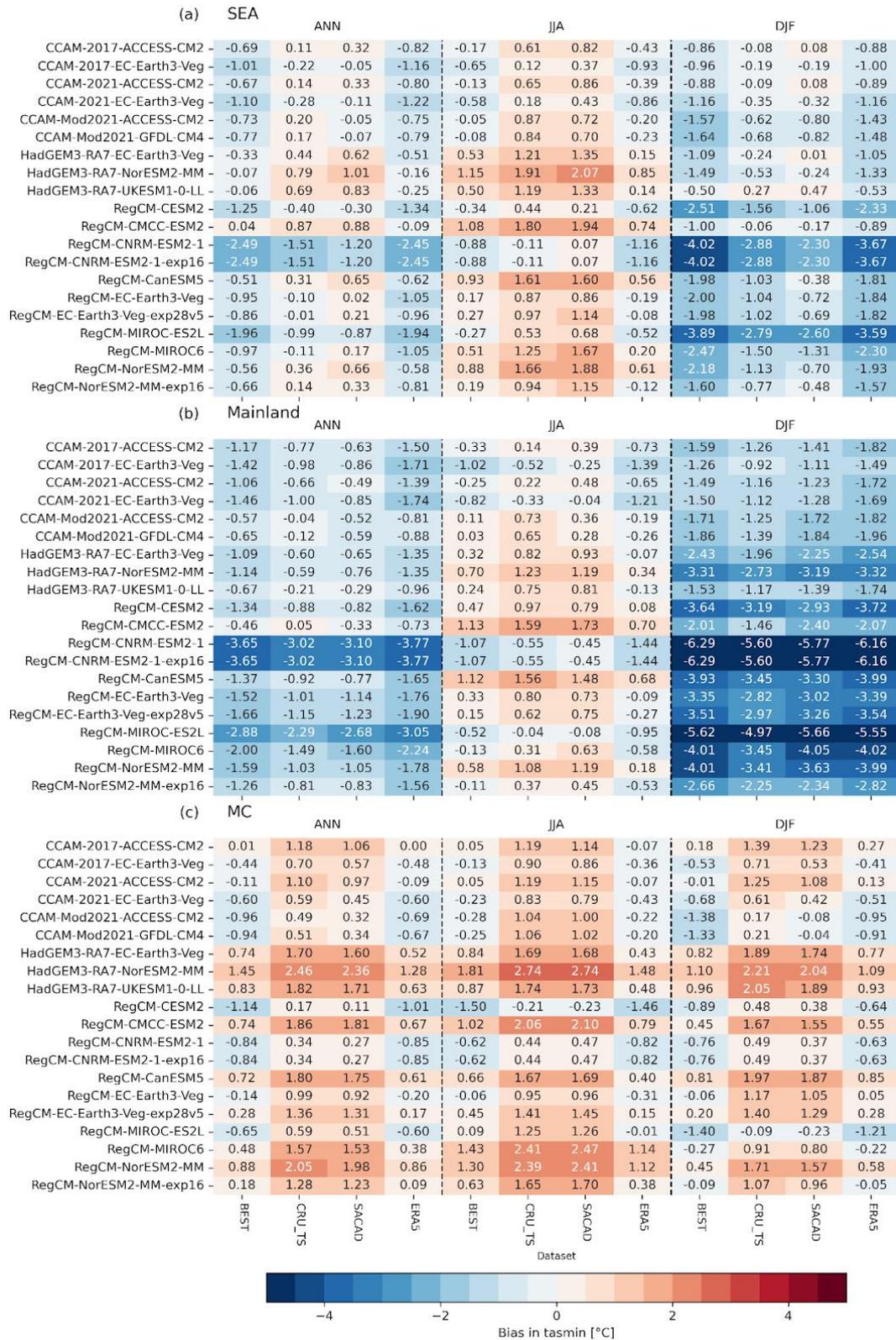


Figure S7. As Fig. S2, but for daily minimum temperature (*tasmin*, in °C)



Figure S8. As Fig. S3 but for *tasmin*.

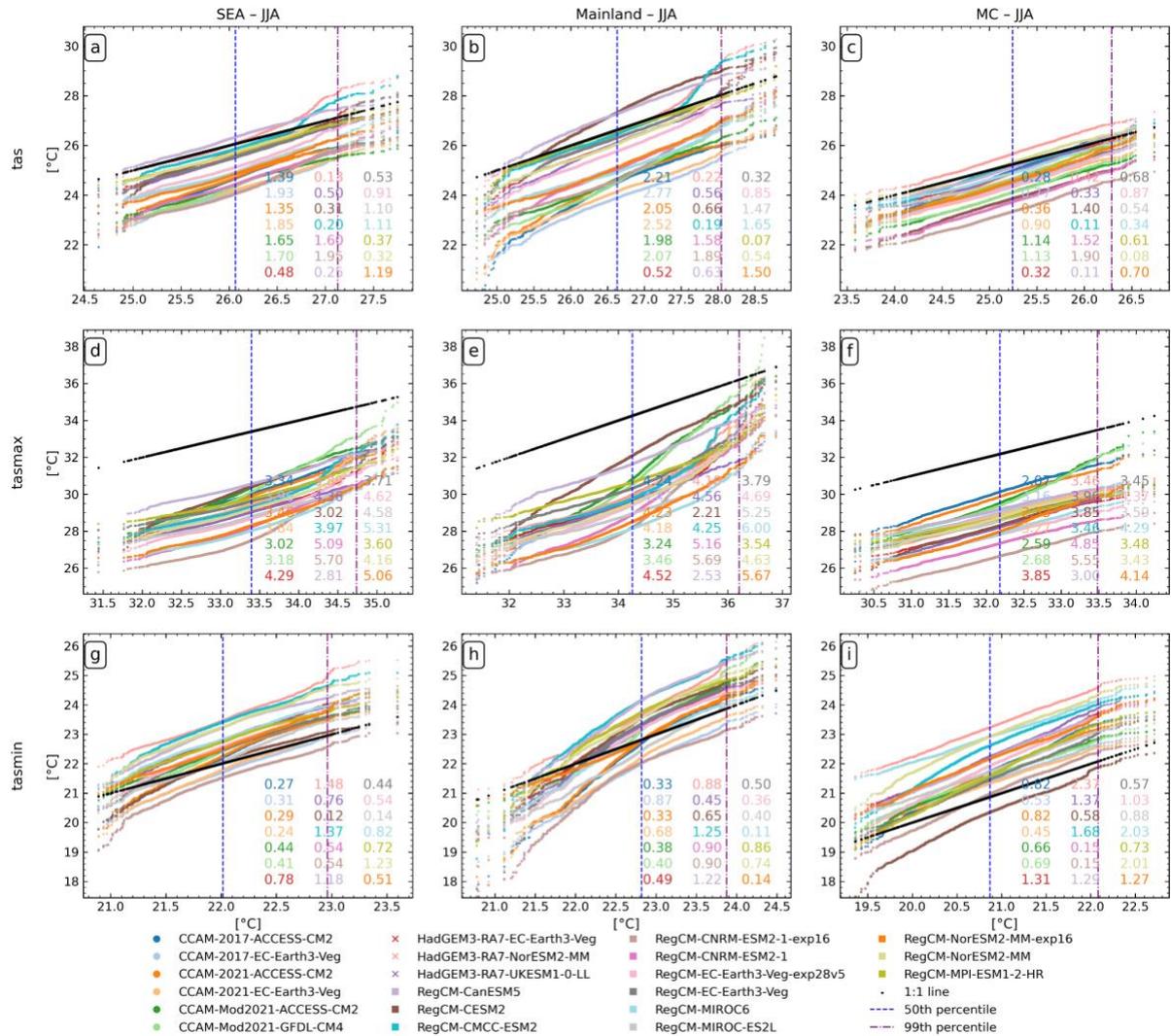


Figure S9. Quantile-quantile plots for regionally averaged daily near-surface temperature (tas; a-c), maximum temperature (tasmax; d-f), and minimum temperature (tasmin; g-i) across SEA and its two sub-regions of the Mainland and MC during the boreal summer (JJA) of the climatological period of 1982–2014. Units are in °C. The inserted number indicates values of the area score metric (ASM), which measures the proximity between the two distributions: model and observation (BEST, Rohde et al., 2020). The vertical lines indicate the 50th percentile (blue) and 99th percentile (purple), respectively.

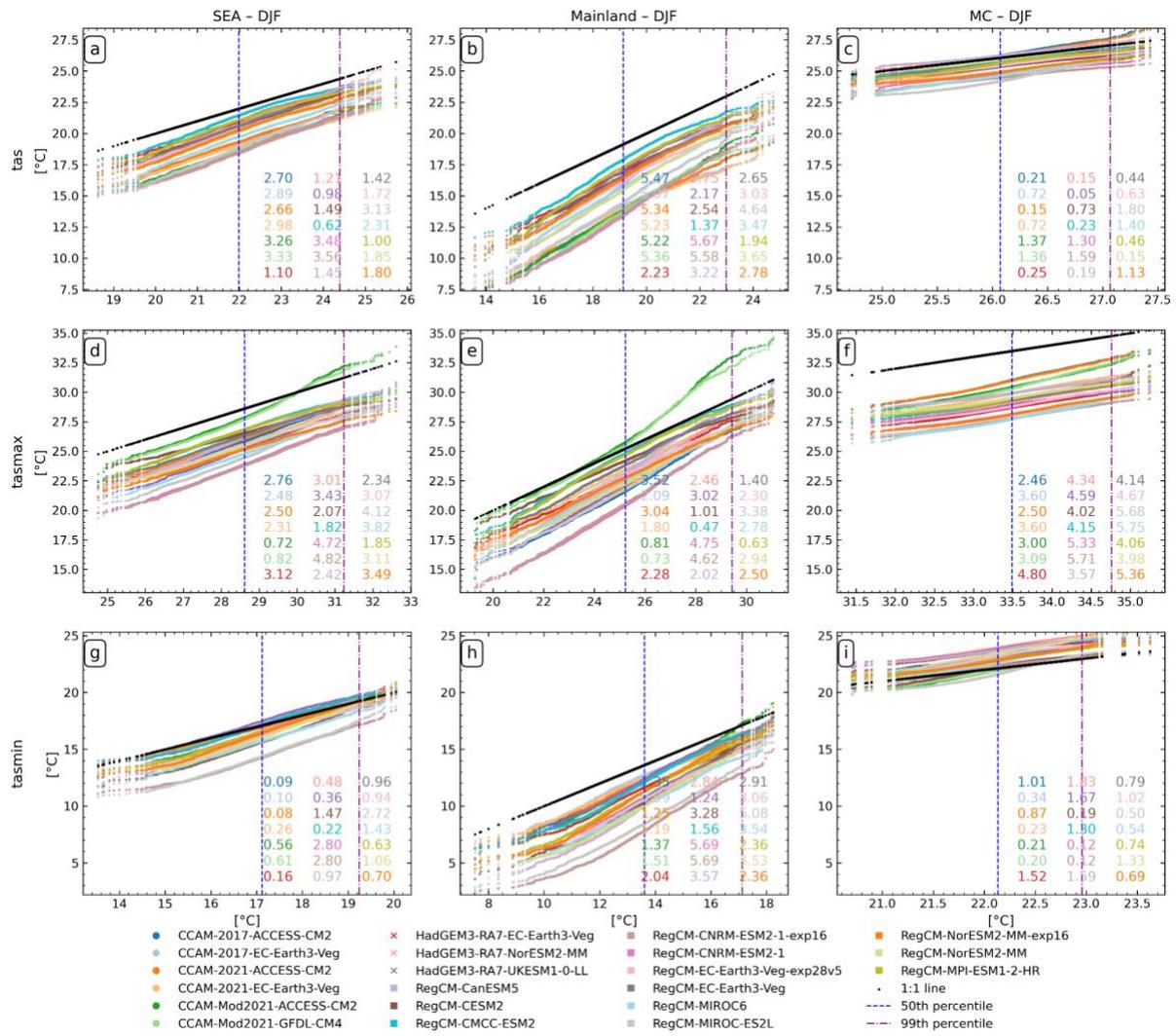


Figure S10. Similar to Fig. S9 but for the boreal winter (DJF) season.

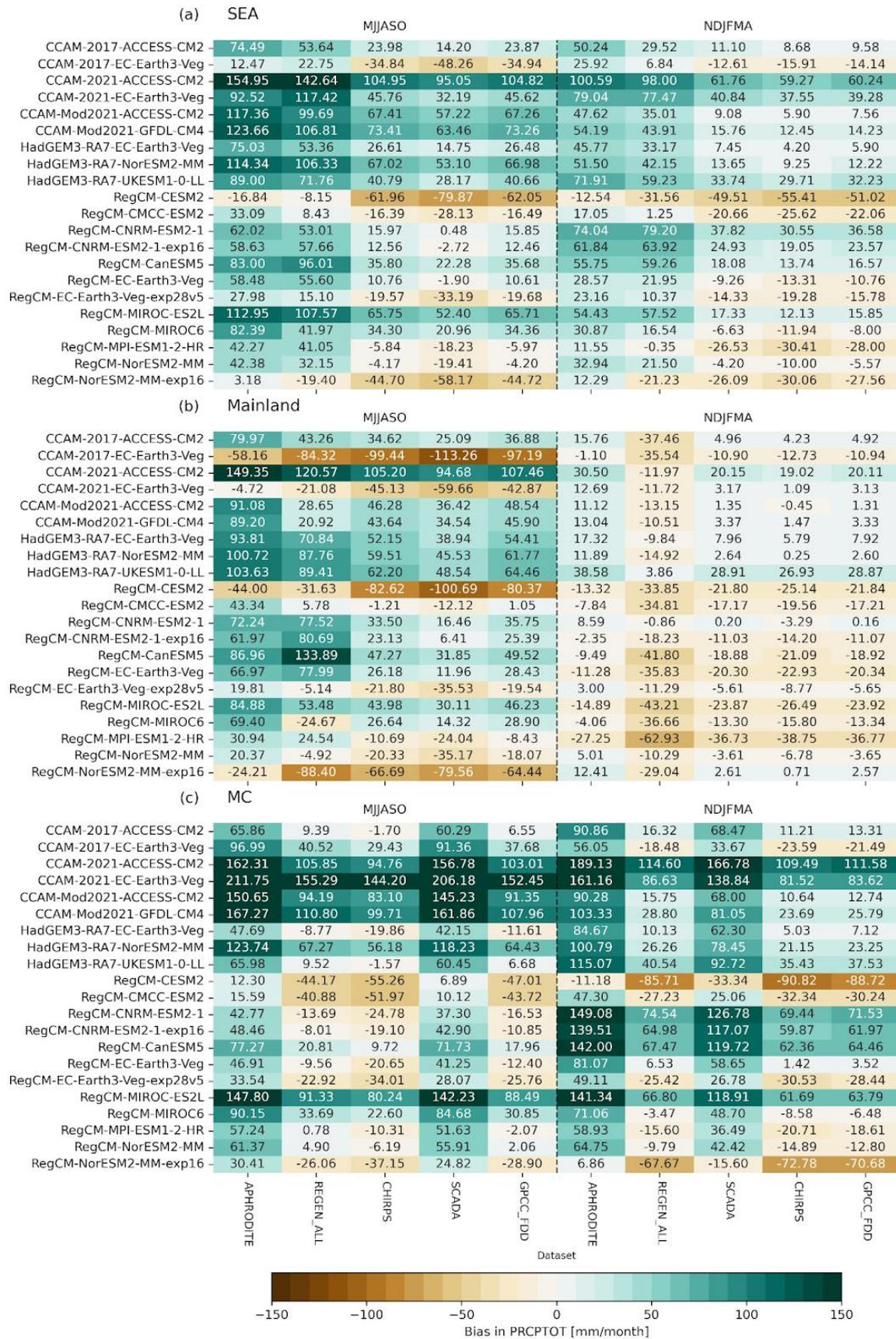


Figure S11. As Fig. S2 but for seasonal monthly total precipitation (prcptot, in mm).

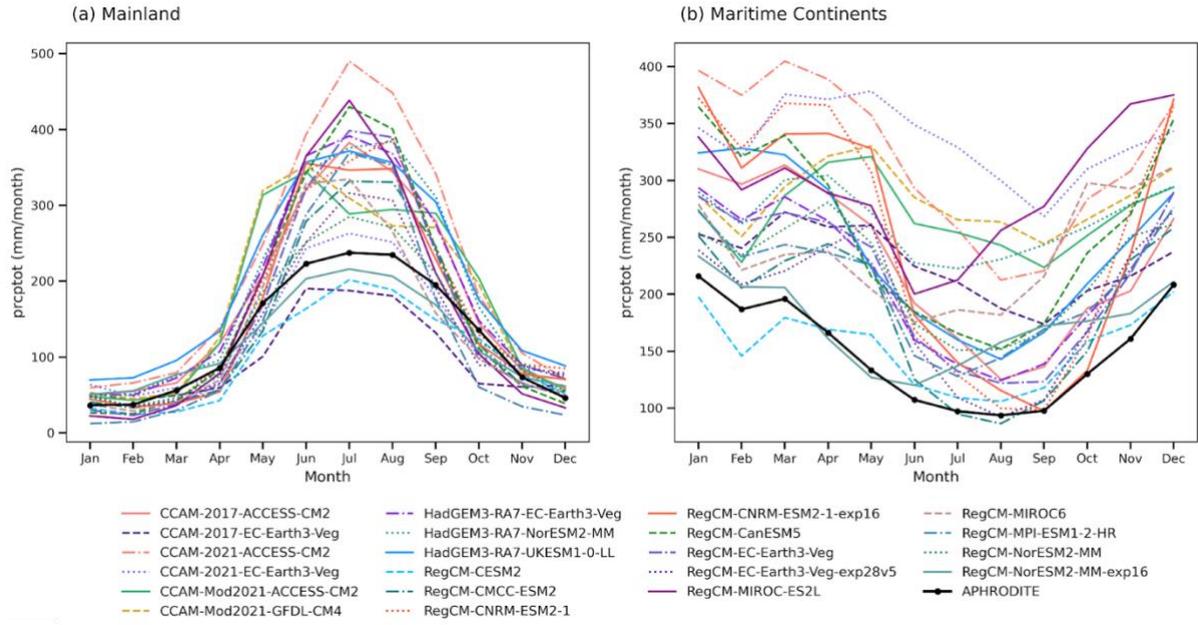


Figure S12. As Fig. S4, but for latitudinally weighted, average total monthly rainfall (prcptot). Color indicates different RCM simulations. APHRODITE data used a reference shown in black.

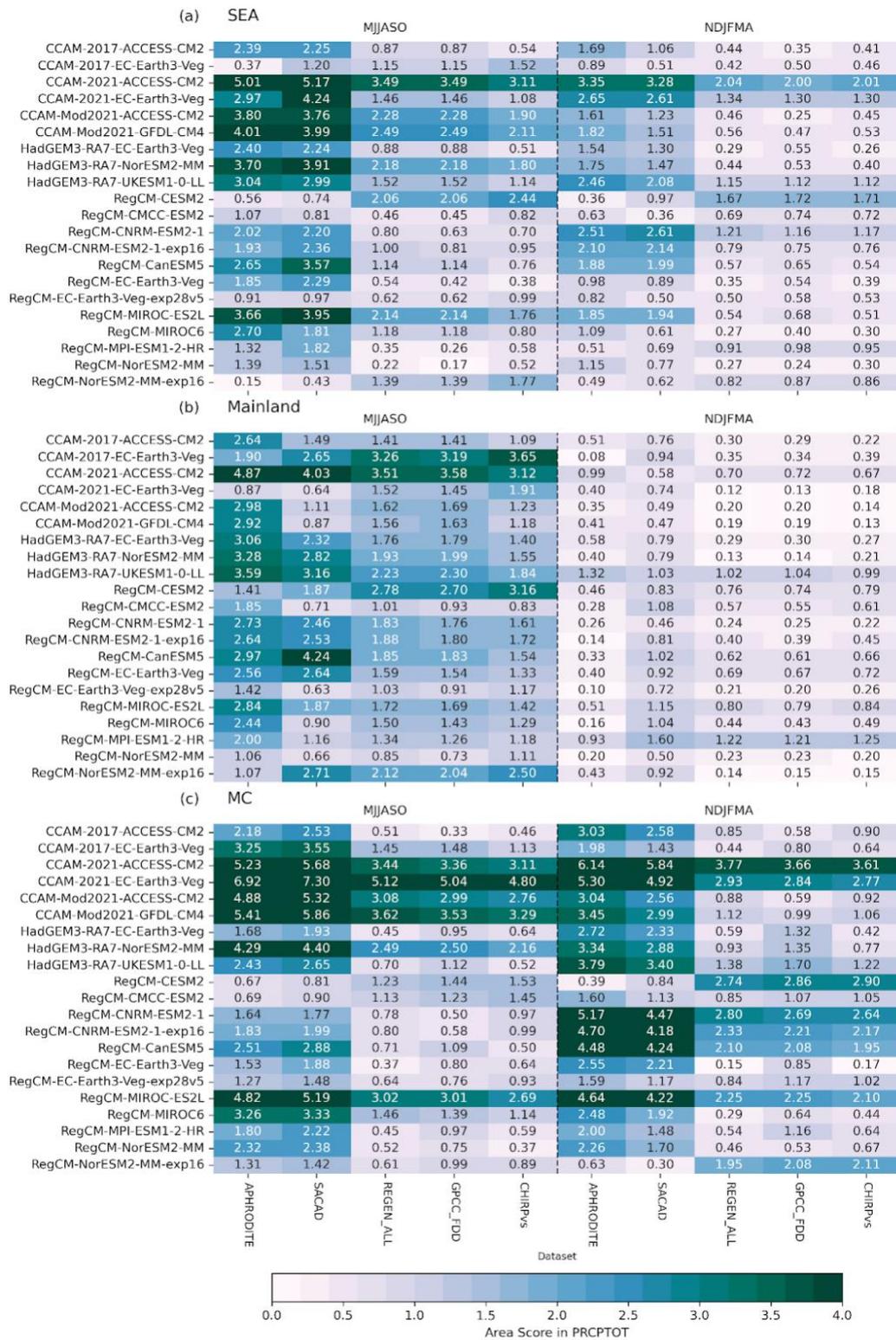


Figure S13. As Fig S3 but for regionally averaged daily precipitation.

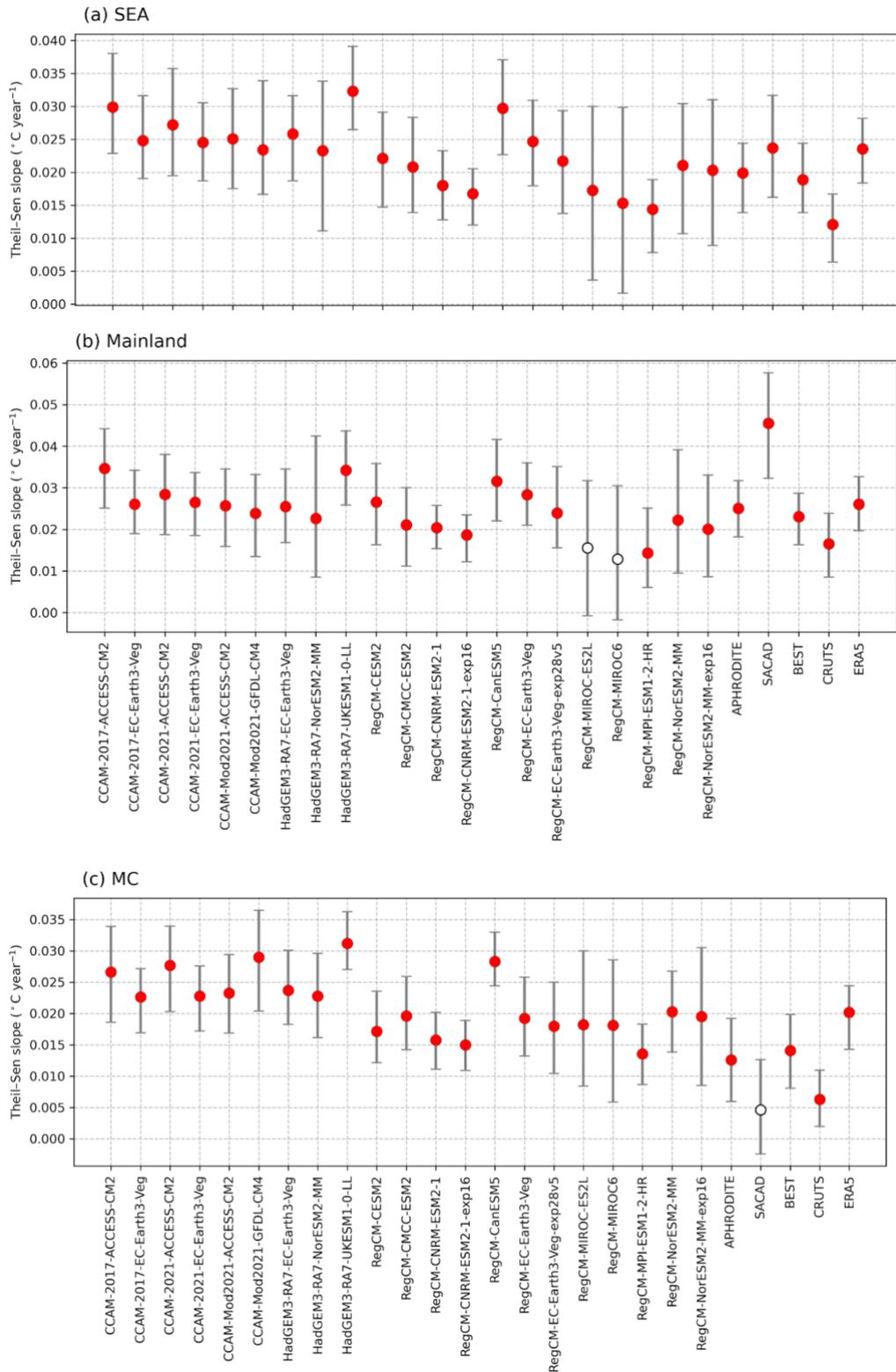


Figure S15. Trend in the annual time series of daily yearly *tas* during 1982-2014 over (a) across Southeast Asia and its two sub-regions: (b) Mainland and (c) MC, calculated for CORDEX-SEA RCM simulations and observations. The trend is estimated using the Theil-Sen estimator. Error bars indicate the confidence interval at a 90% level of confidence. A red-filled dot indicates a significant trend, as determined by the Mann-Kendall test at a 5% level of confidence.

Table S1. Comparison of multiple observational datasets over two sub-regions (using APHRODITE and BEST as references for precipitation and temperature respectively)

Sub-regions	MAPE of Precipitation								MAE of the annual mean temperature			
	MJJASO				NDJFMA				APHRODITE	ERA5	CRUTS4.08	SCADA
	REGEN_ALL	CHIRPSv2	GPCC-FDD	SCADA	REGEN_ALL	CHIRPSv2	GPCC-FDD	SCADA				
Mainland	0.22	0.3	0.22	0.39	0.2	0.22	0.21	0.85	0.9	0.89	0.7	1.02
Maritime Continent	0.55	0.63	0.57	0.44	0.42	0.44	0.43	0.3	1.07	1.28	0.91	1.3