Projected Changes in the Near-Future Mean Climate and Extreme Climate Events in Northeast Thailand

Dibesh Khadka[a*], Mukand S. Babel[a], Matthew Collins[b], Sangam Shrestha[a], Salvatore G.P. Virdis[c], Albert S. Chen[b]

[a] Water Engineering and Management, School of Engineering and Technology, Asian Institute of Technology, Thailand

[b] College of Engineering, Mathematics and Physical Sciences, University of Exeter, UK

[c] Remote Sensing and Geographic Information Systems, School of Engineering and Technology, Asian Institute of Technology, Thailand

*__Corresponding Author:__

Dibesh Khadka

Water Engineering and Management, School of Engineering and Technology, Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathum Thani 12120, Thailand

Email: dibesh.khadka@ait.asia

Tel.: +66-81-348-8530

Appendix S1: Analysis of climate trends for the reference and the near-future periods

Trends for Tmax, Tmin, and rainfall during the reference and the near-future periods are shown in Fig. S1. For the reference period, spatially, the trends for Tmax and Tmin vary between 0.01 – 0.04°C/year and 0.01 – 0.03°C/year, respectively. Trends are more robust in the northeast and southwest for Tmax, while they are stronger in the western part of the basin for Tmin. The spatial variation of these trends appears to reduce in future projections. The near-future trends for Tmax and Tmin are projected to be between 0.014-0.020°C/year and 0.021-0.030°C/year for Case A and between 0.021-0.027°C/year and 0.029-0.039°C/year for Case B, respectively. Compared to CMIP5, CMIP6 models project significantly higher trends (0.042-0.057°C/year for Tmax and 0.048-0.064°C/year for Tmin). The annual average rainfall during the reference period also shows slightly increasing trends in most of the grids (Fig. S1i), and the results from the CMIP5 multimodel ensemble indicate that the increasing trend will prevail in the near-future period as well (trends under RCP8.5 are higher and up to 10 mm/year in the east). No significant trend is observed for most of the grid points using the CMIP6 multimodel ensemble.

Fig. S2 presents the trends in extreme temperature indices during the reference and the near-future periods. None of the three indices (TX90p, TN90, and WSDI) exhibit any significant trends during the reference period. However, the near-future period is marked by significant trends, particularly under RCP8.5. The increasing trends for TX90p are between 0.34-0.46, 0.55-0.80, and 1.3-1.9 days/year for Case A, Case B, and Case C, respectively (Fig. S2b – d). For these cases, trends for TN90p are between 1.4-2.2, 2.4-3.1, and 3.0-4.2 days/year, respectively (Figs. S2f – h). In addition, WSDI also shows increasing trends, between 0.24-1.5 days/year for all cases. These are indications that in the near-future period, hot spells will be more intense and longer than they are during the reference period. The CMIP6 climate models suggest a higher severity than CMIP5 climate models do. Fig. S3 presents the trends for SDII, R20, and R40 for reference and the near-future periods. All the indices show higher spatial variability and mixed trends during the reference period (Fig. S3a, e, i). Future projections show reduced spatial variation and magnitudes for all three cases. No significant trends for these indices can be seen for Cases A and C. However, some trends, especially for R20, can be seen in the eastern part of the basin for Case B (up to 0.3 days/year). In general, the trends for extreme rainfall indices are not as prominent and consistent as they are for temperature indices, which could be due to higher spatial and temporal variations in rainfall than in temperature and because of more uncertainties in the models with respect to rainfall.

The significance of the trend analysis for the climate indices is checked at 95% CL for each grid point. Fig. 10 is a boxplot providing information on the number of grids for which the trends are significant in the climate model ensemble during the reference and the near-future periods. The number of grids with trends significant at 95% CL is higher for temperature indices than the rainfall indices. During the reference period, the trends significant at 95% CL for annual Tmin are observed in 91 grids (entire basin) while they are significant in 75 grids for annual Tmax and 29 grids for annual rainfall. During the near-future period, median values from the climate model ensembles suggest that Tmin will have a trend significant at 95% CL in all the grids for all three cases, but the same is expected for Tmax for only Case B and Case C. The number of grid points with trends significant at 95% CL for annual rainfall will be less in the future compared to the reference period

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Similarly, for TX90p and WSDI, the number of grids with trends significant at 95% CL is low (closer to zero) for the reference period and the CMIP5 ensemble under both emission scenarios. However, most CMIP6 models show that TX90p and WSDI trends are significant in the grids. In all three cases, trends for TN90p are found significant at 95% CL by most of the models. For projected extreme rainfall indices, most of the climate models in all three cases show trends significant at 95% CL in only a few grids (below 20), which is even lower than during the reference period. However, some of the models from CMIP5 (such as CanESM2, MIROC5) under RCP8.5 have trends significant at 95% CL is about half the grids in the near-future period. Overall, the analysis suggests more confidence in the increase in temperature extremes than in rainfall extremes. It is also evident that temperature extremes will be felt across a larger spatial extent.

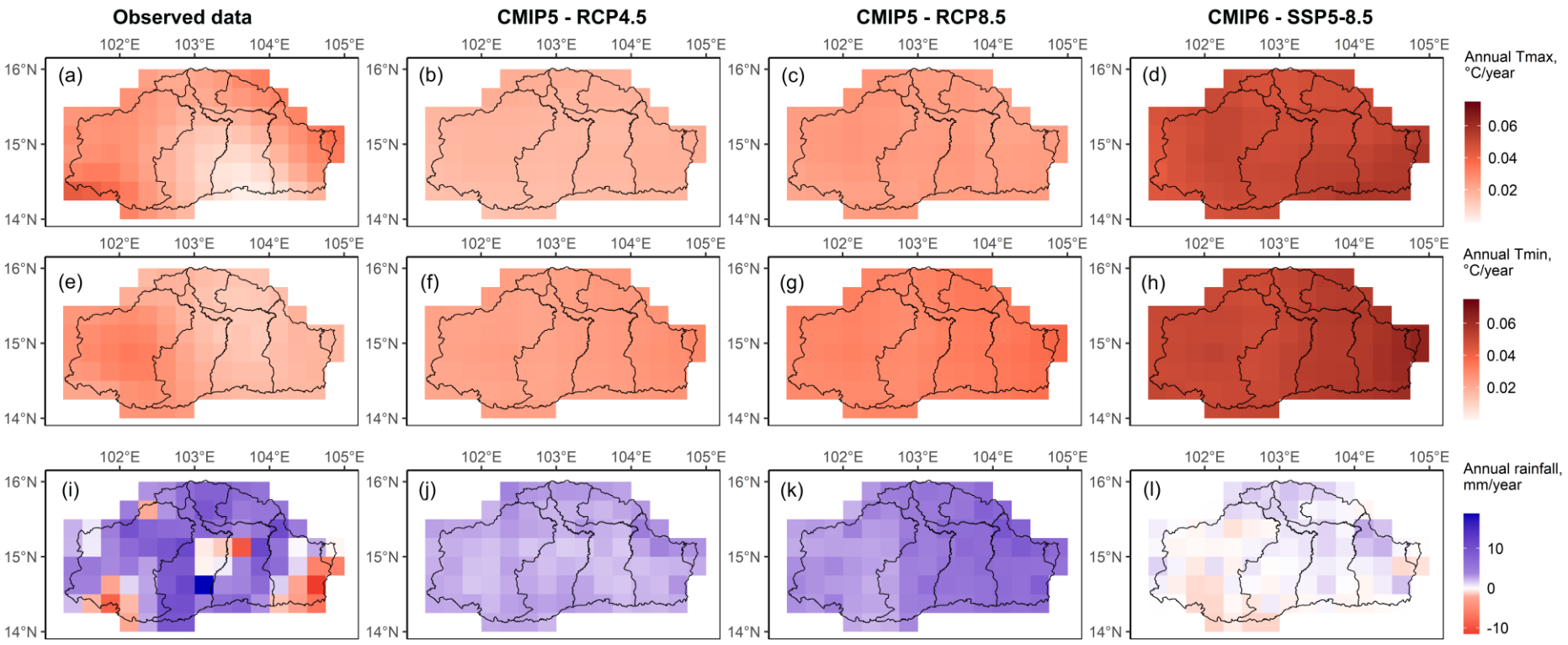


Fig. S1: *Trends in annual average Tmax (top), Tmin (middle), and rainfall (bottom) for the reference (left) and the near-future periods. The values are averages taken from the multi-model ensembles.*

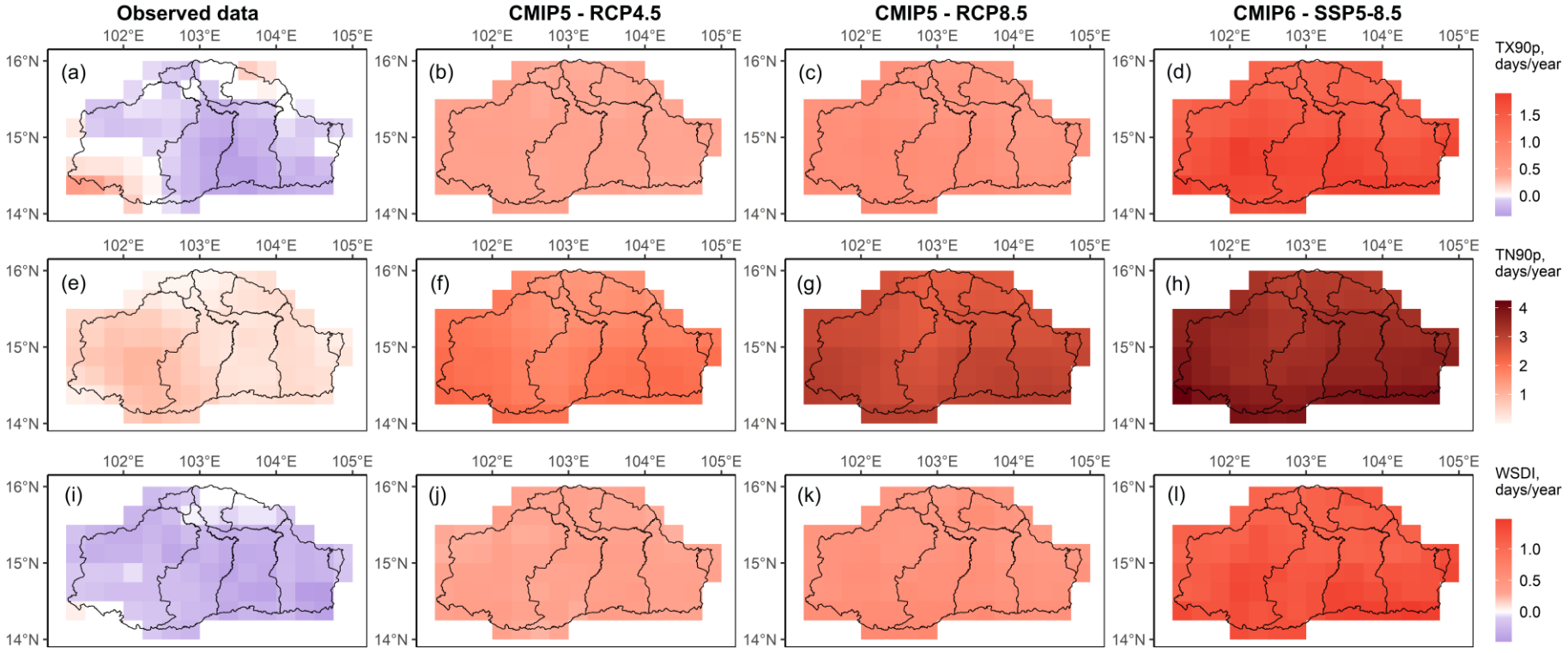


Fig. S2: *Same as Fig. S1 but for TX90p (top), TN90p(middle), and WSDI (bottom).*

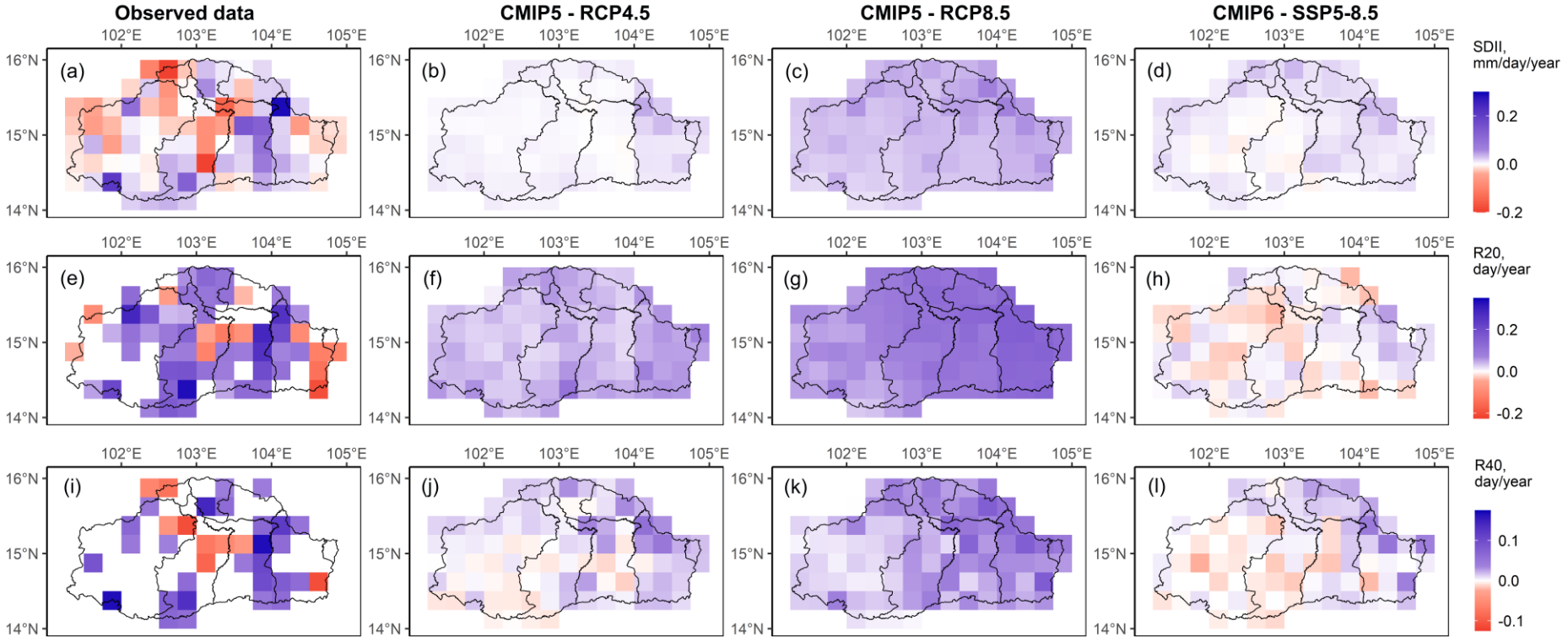
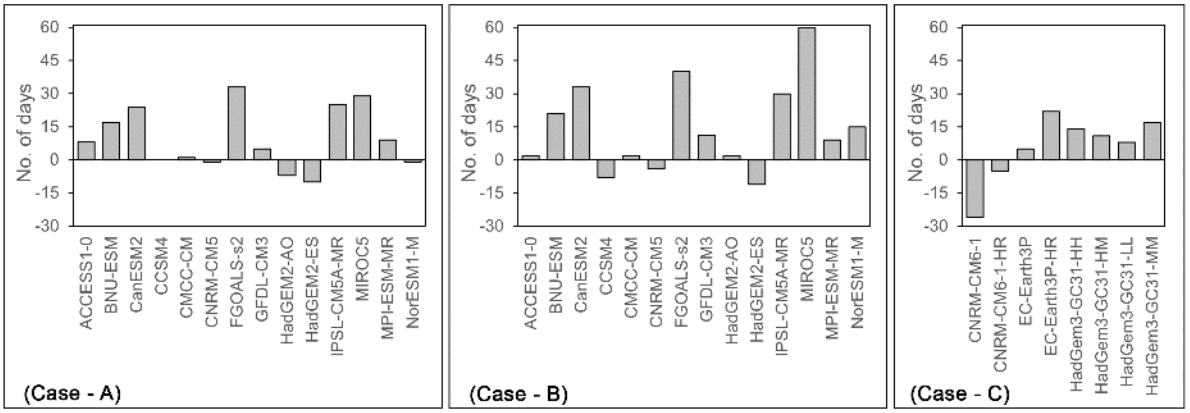
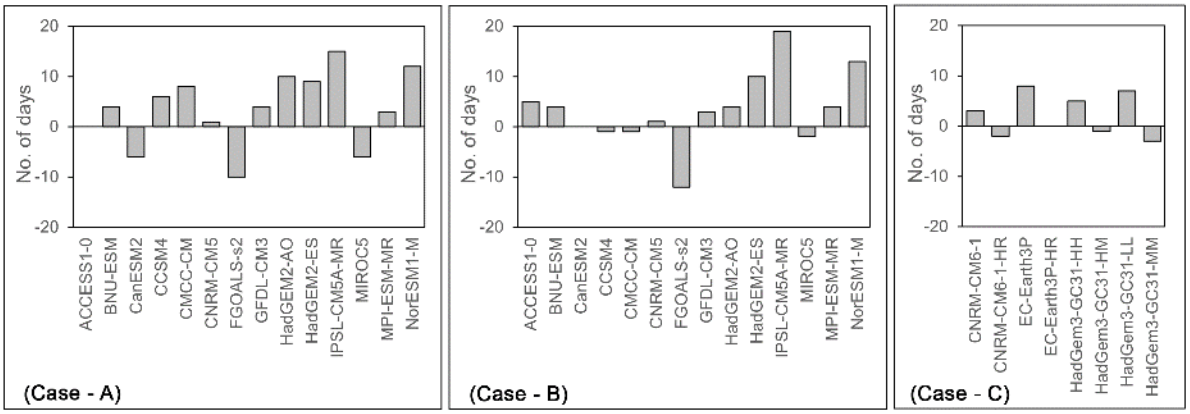


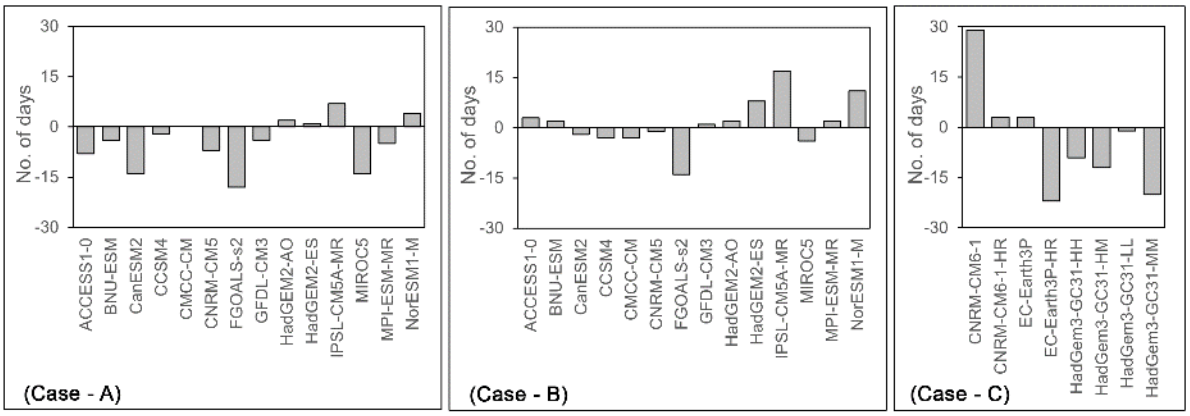
Fig. S3: *Same as Fig. S1 but for SDII (top), R20(middle), and R40 (bottom).*



(a) Projected shift in the onset date of the rainy season



(b) Projected shift in the retreat date of the rainy season



(c) Projected change in the length of the rainy season

Fig. S4: *Projected change in the (a) onset date; (b) retreat date; and (c) length of the rainy season in the near future period projected for Case A (CMIP5 – RCP4.5), Case B (CMIP5 – RCP8.5), and Case C (CMIP6 – SSP5-8.5). In fig (a) and (b), positive values show delay in onset/retreat dates and negative values show early onset/retreat dates.*