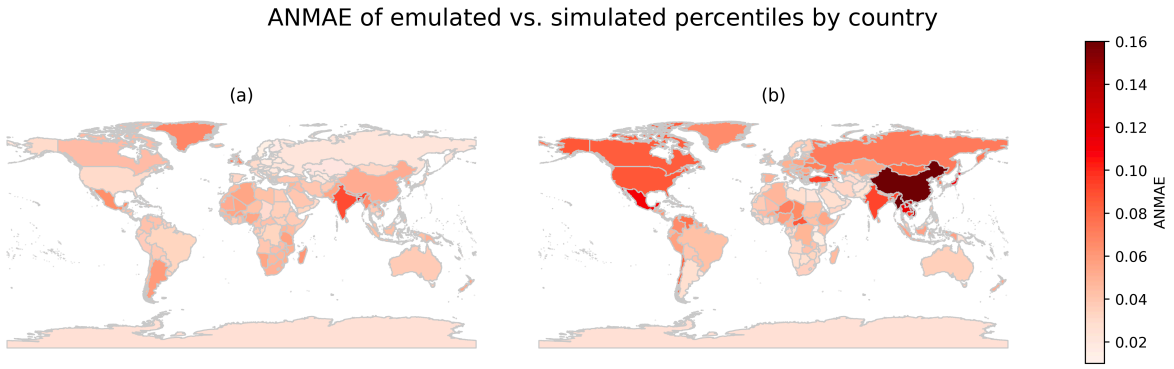

Figure 1: The average normalized mean absolute error (ANMAE) of emulated vs. simulated percentiles in each country. Panel (a) shows the annual average regional surface temperature compared to the 1995-2014 baseline for SSP1-2.6 in °C, and panel (b) shows the annual average regional precipitation compared to the 1995-2014 baseline for SSP1-2.6 in percent.

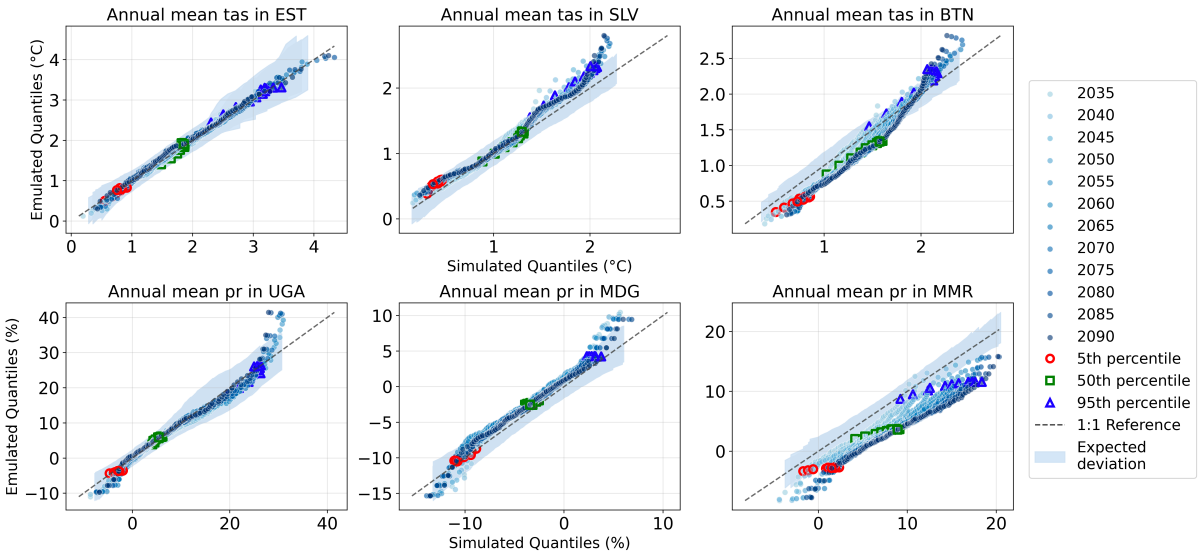

Figure 2: Q-Q plots showing the emulated and simulated percentiles from the CMIP6 ensemble as described in section 3, but using SSP1-2.6 as the test scenario. From left to right, the examples illustrate the emulator performance for regions where the emulator showed the best, median, and worst performance as measured by the average normalized mean absolute error. In the first row, we show the emulated and simulated percentiles of the annual average regional temperature (tas) compared to the 1995-2014 baseline in °C for selected regions. In the second row, we show the emulated and simulated percentiles of the annual average regional precipitation change indicator (pr) in % for selected regions.

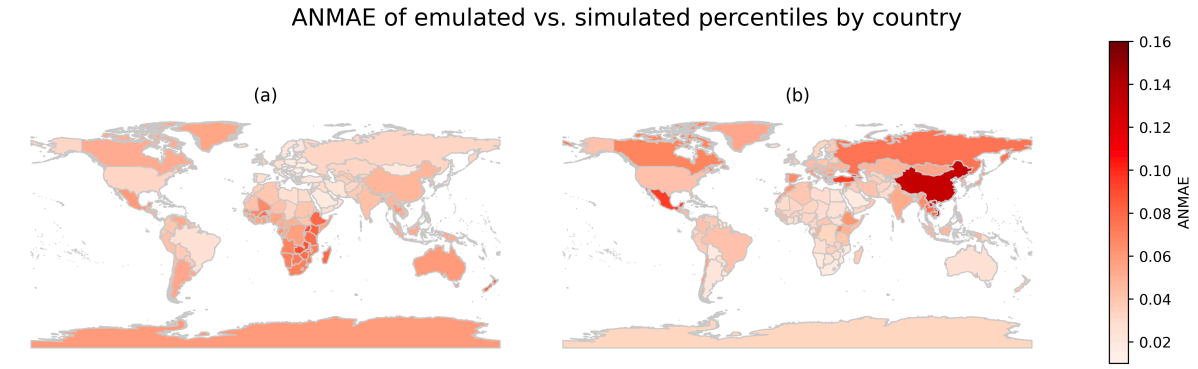

Figure 3: The average normalized mean absolute error (ANMAE) of emulated vs. simulated percentiles in each country. Panel (a) shows the annual average regional surface temperature compared to the 1995-2014 baseline for SSP3-7.0 in °C, and panel (b) shows the annual average regional precipitation compared to the 1995-2014 baseline for SSP3-7.0 in percent.

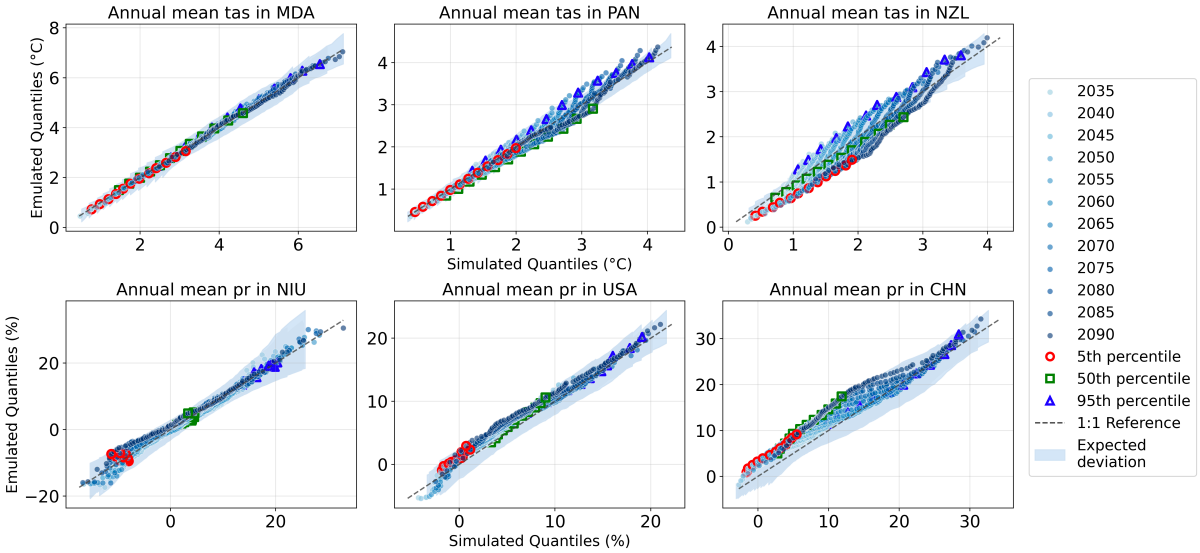

Figure 4: Q-Q plots showing the emulated and simulated percentiles from the CMIP6 ensemble as described in section 3, but using SSP3-7.0 as the test scenario. From left to right, the examples illustrate the emulator performance for regions where the emulator showed the best, median, and worst performance as measured by the average normalized mean absolute error. In the first row, we show the emulated and simulated percentiles of the annual average regional temperature (tas) compared to the 1995-2014 baseline in °C for selected regions. In the second row, we show the emulated and simulated percentiles of the annual average regional precipitation change indicator (pr) in % for selected regions.

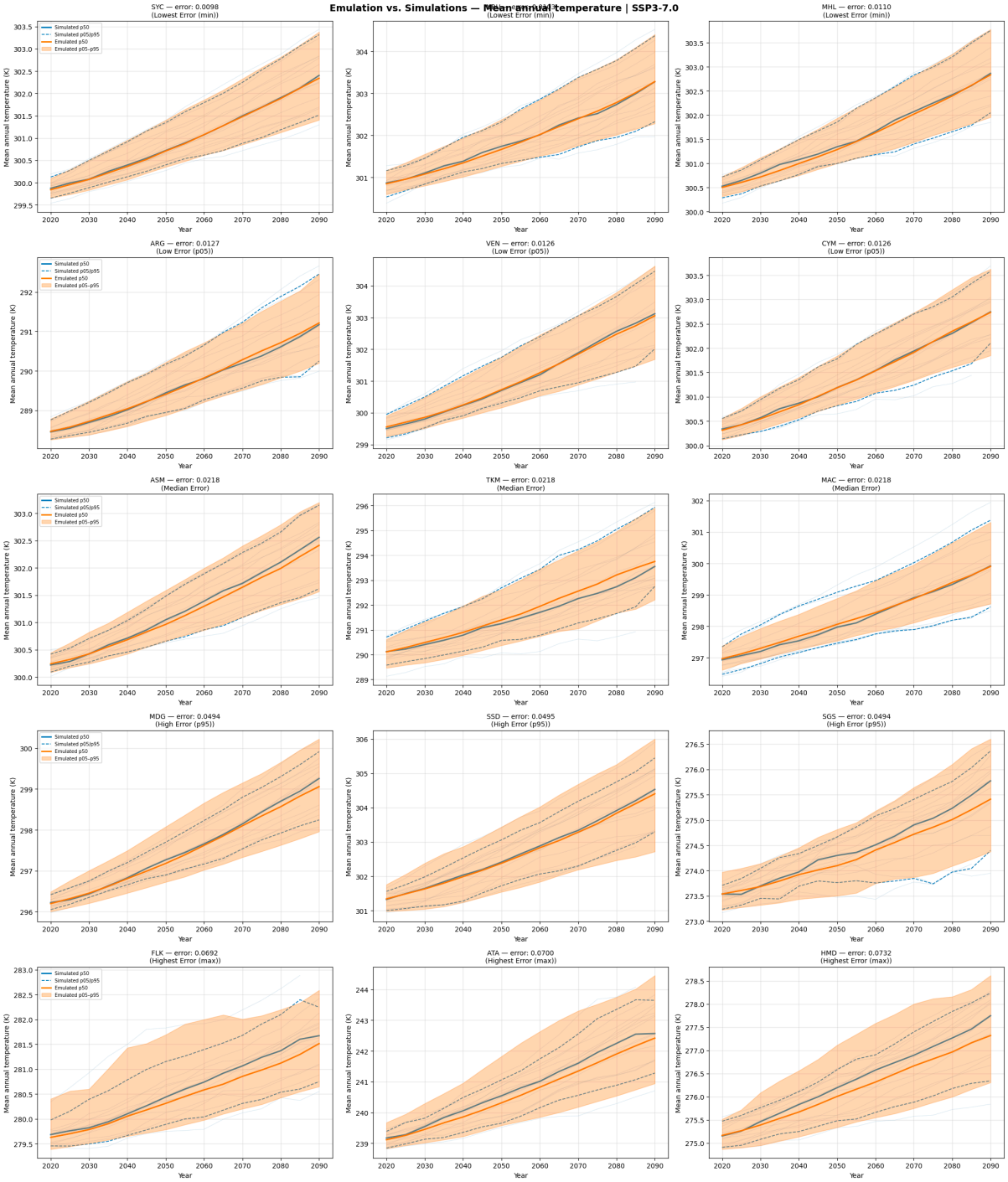

Figure 5: Time series of the 5th, 50th, and 95th percentile values of mean annual temperature (K) as emulated by RIME-X for the SSP3-7.0 scenario, compared to the corresponding empirical percentiles derived from ISIMIP simulations. The figure shows results for 15 selected regions: the three regions with the lowest, median, and highest normalized mean absolute error, as well as three regions each around the 5th and 95th percentiles of the error distribution.

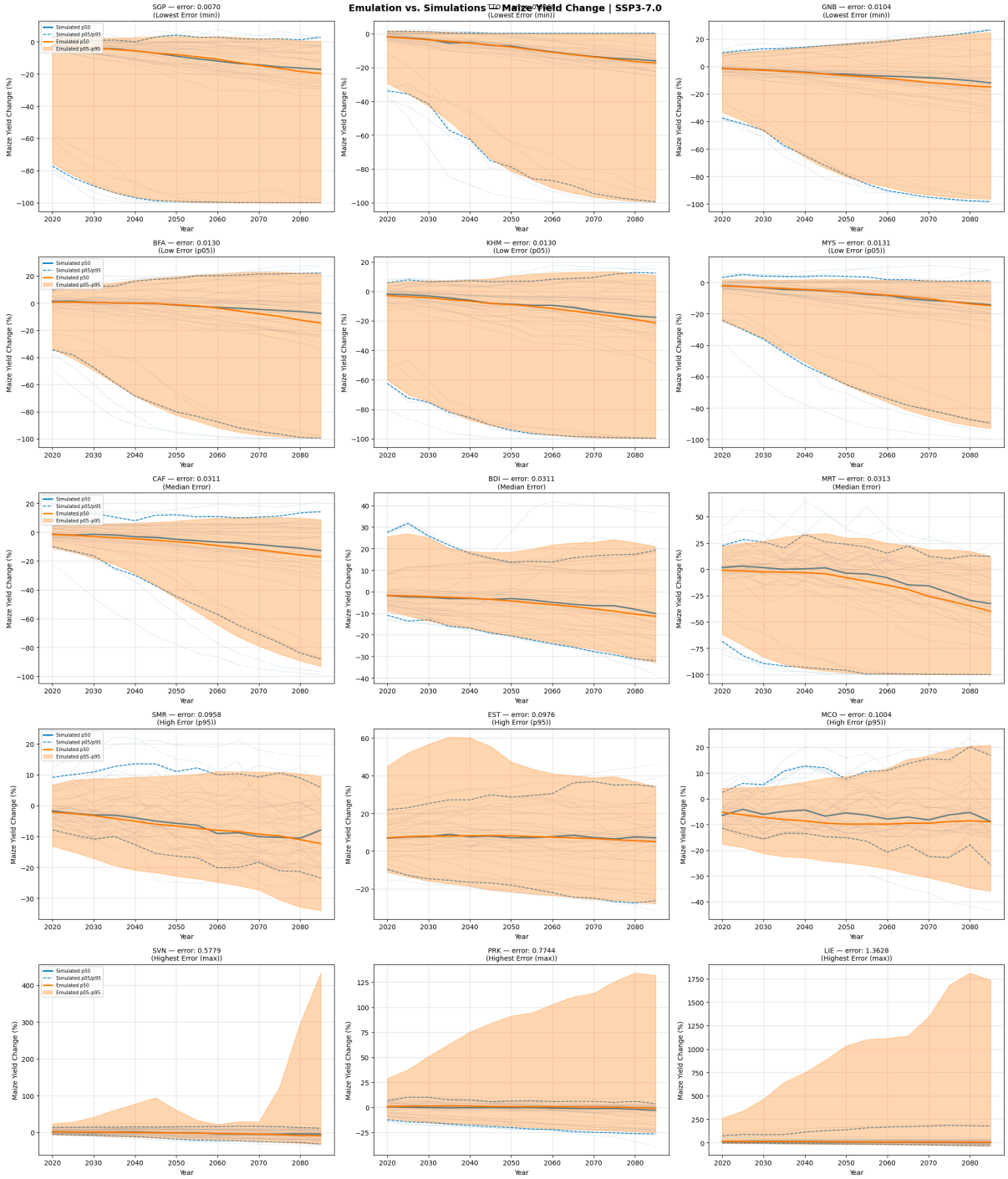

Figure 6: Time series of the 5th, 50th, and 95th percentile values of maize yield change (%) as emulated by RIME-X for the SSP3-7.0 scenario, compared to the corresponding empirical percentiles derived from ISIMIP simulations. The figure shows results for 15 selected regions: the three regions with the lowest, median, and highest normalized mean absolute error, as well as three regions each around the 5th and 95th percentiles of the error distribution. The particularly large maximum errors in the 95th percentile of this indicator can be traced to the impact model *DSSAT-Pythia*, which does not provide outputs for SSP3-7.0 but exhibits comparatively large values under SSP5-8.5. As a result, these values are included in the RIME-X–derived distributions but are absent

from the corresponding “ground truth” SSP3-7.0 simulations, leading to inflated errors in the upper quantiles.

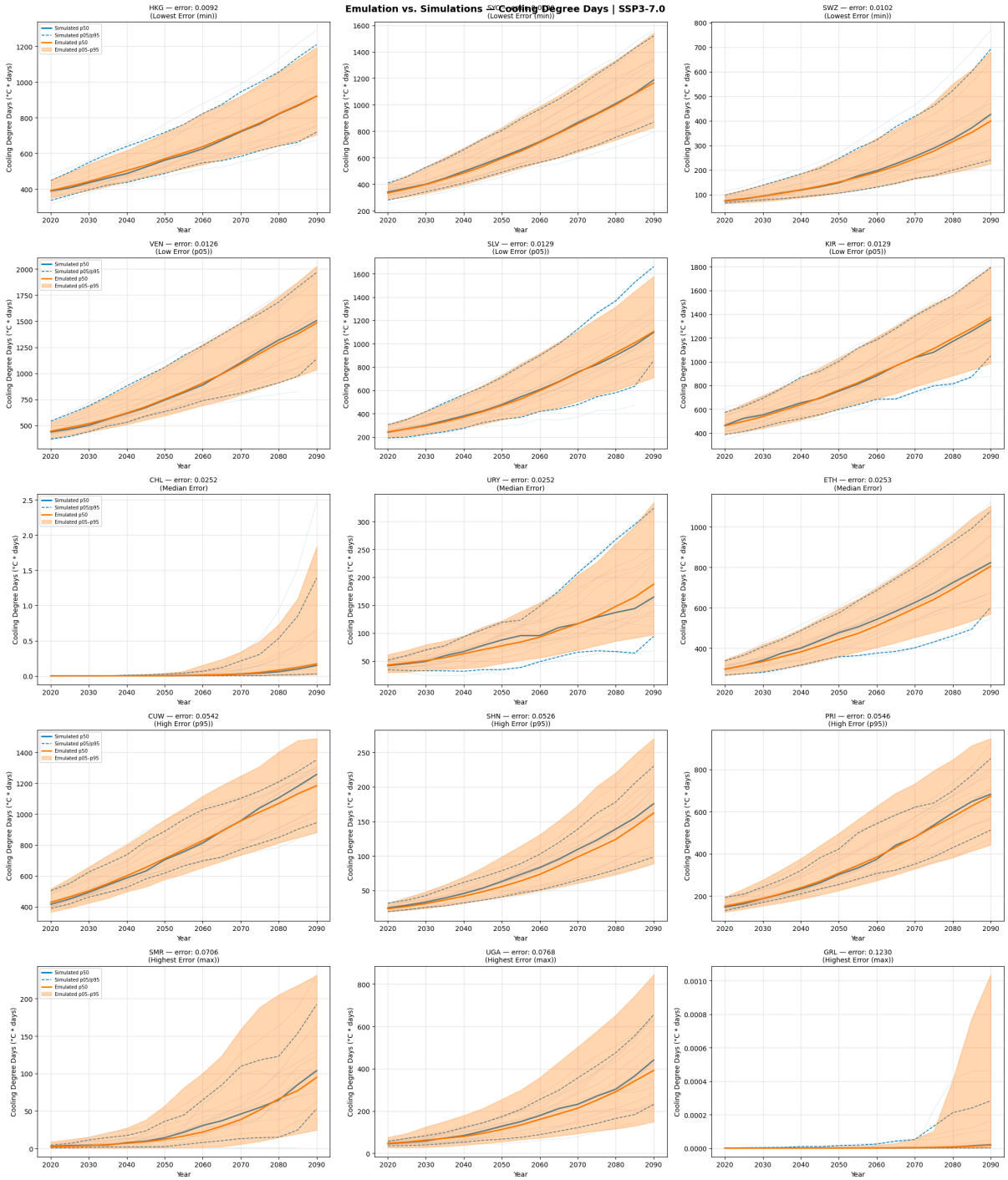

Figure 7: Time series of the 5th, 50th, and 95th percentile values of cooling degree days (°C * days) as emulated by RIME-X for the SSP3-7.0 scenario, compared to the corresponding empirical percentiles derived from ISIMIP simulations. The figure shows results for 15 selected regions: the three regions with the lowest, median, and highest normalized mean absolute error, as well as three regions each around the 5th and 95th percentiles of the error distribution.

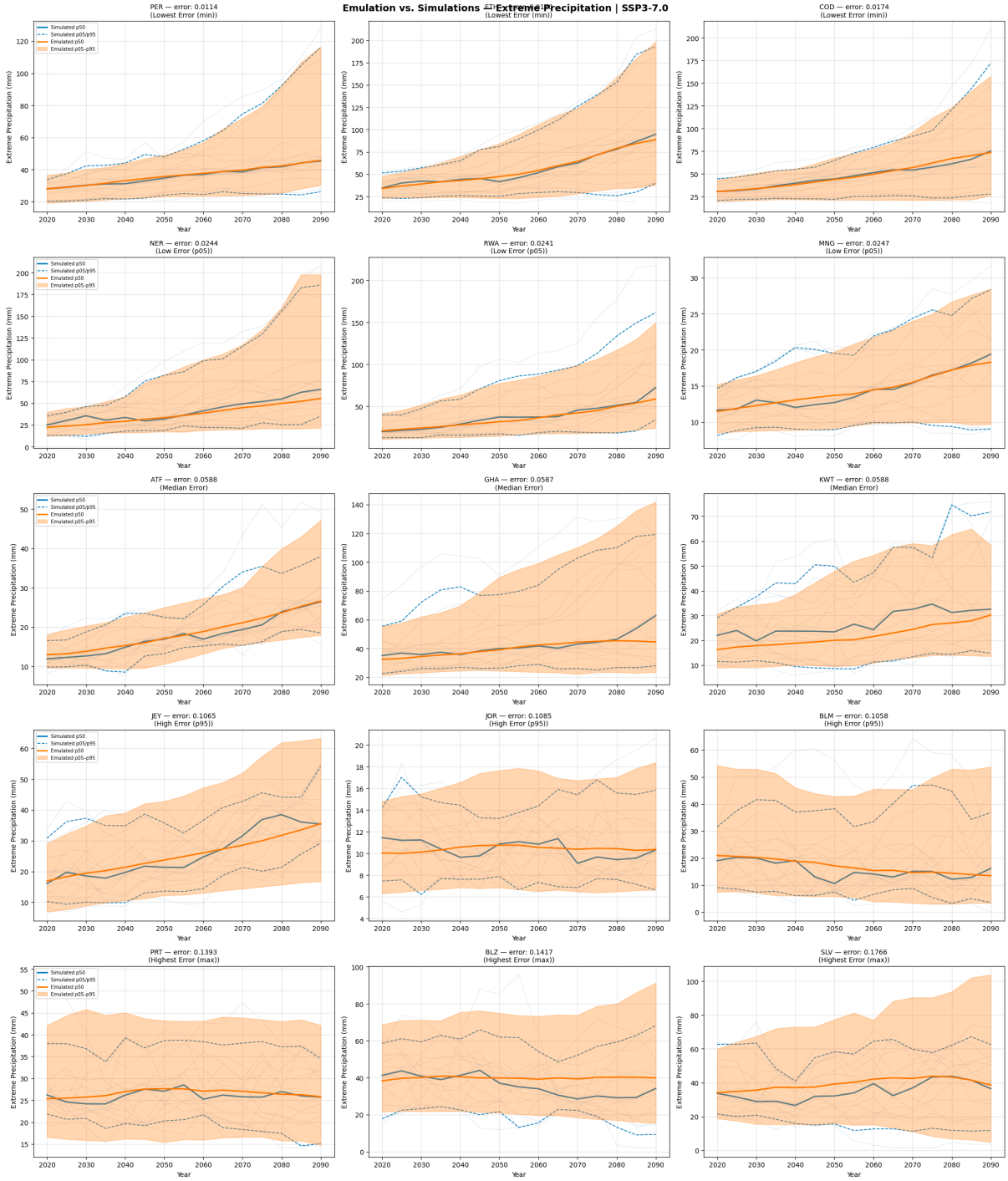

Figure 8: Time series of the 5th, 50th, and 95th percentile values of extreme precipitation (mm) as emulated by RIME-X for the SSP3-7.0 scenario, compared to the corresponding empirical percentiles derived from ISIMIP simulations. The figure shows results for 15 selected regions: the three regions with the lowest, median, and highest normalized mean absolute error, as well as three regions each around the 5th and 95th percentiles of the error distribution.

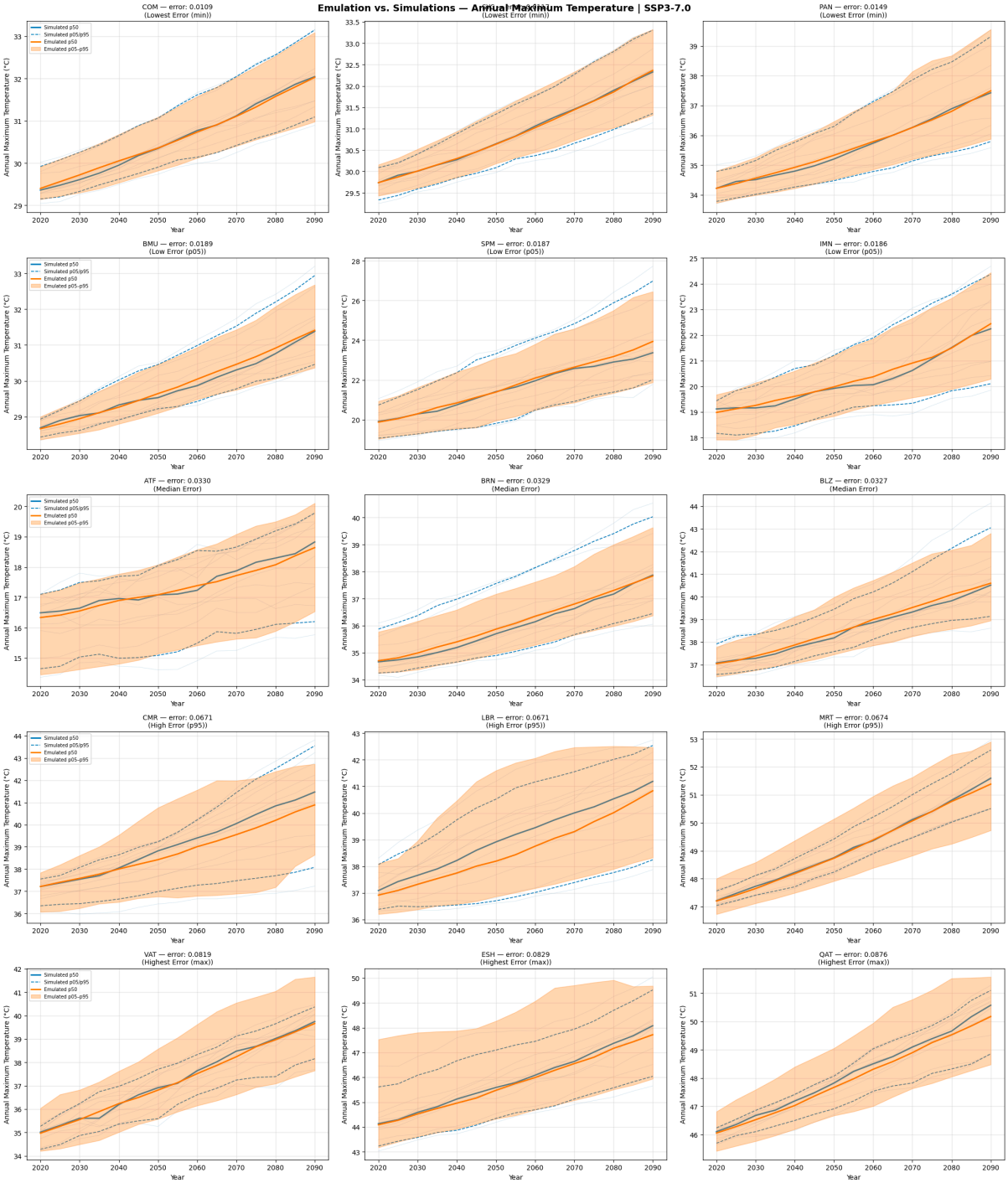

Figure 9: Time series of the 5th, 50th, and 95th percentile values of annual maximum temperature (°C) as emulated by RIME-X for the SSP3-7.0 scenario, compared to the corresponding empirical percentiles derived from ISIMIP simulations. The figure shows results for 15 selected regions: the three regions with the lowest, median, and highest normalized mean absolute error, as well as three regions each around the 5th and 95th percentiles of the error distribution.

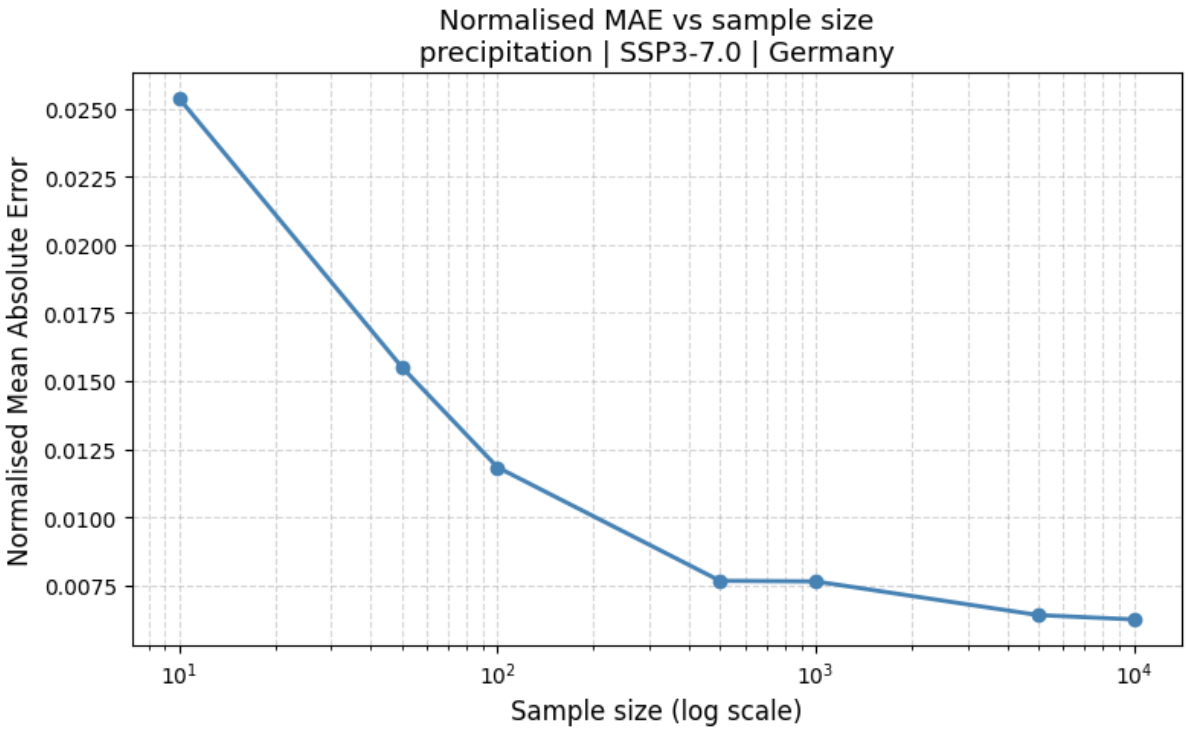

Figure 10: Example development of the Normalised Mean Absolute Error between the 5th, 50th and 95th percentiles emulated with the deterministic and the Monte Carlo sampling implementation of RIME-X, dependent on the sample size of the Monte Carlo Implementation.