

Supplementary information for

A recent doubling of global warming rate signals a 1.5 °C breach by 2028

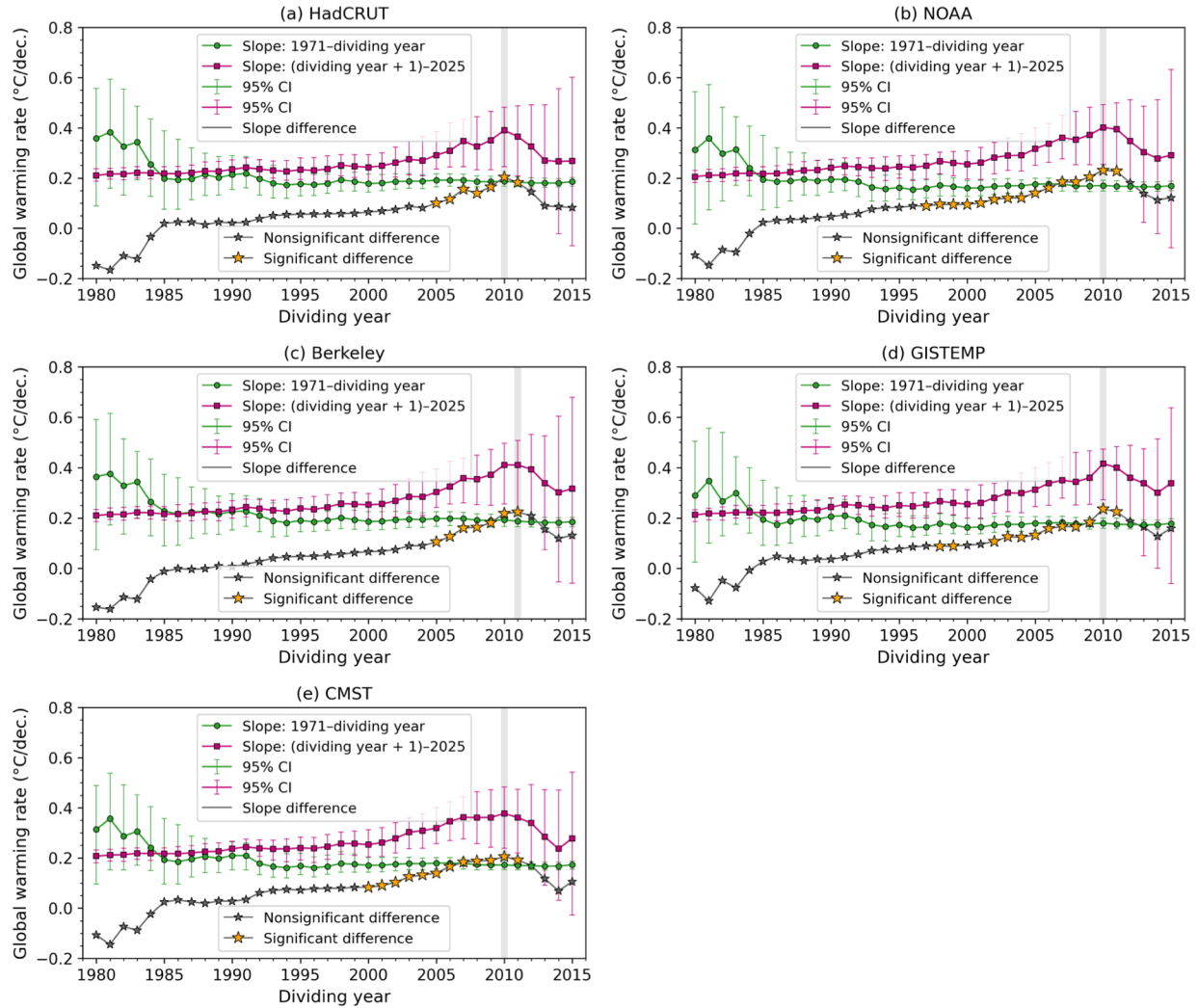
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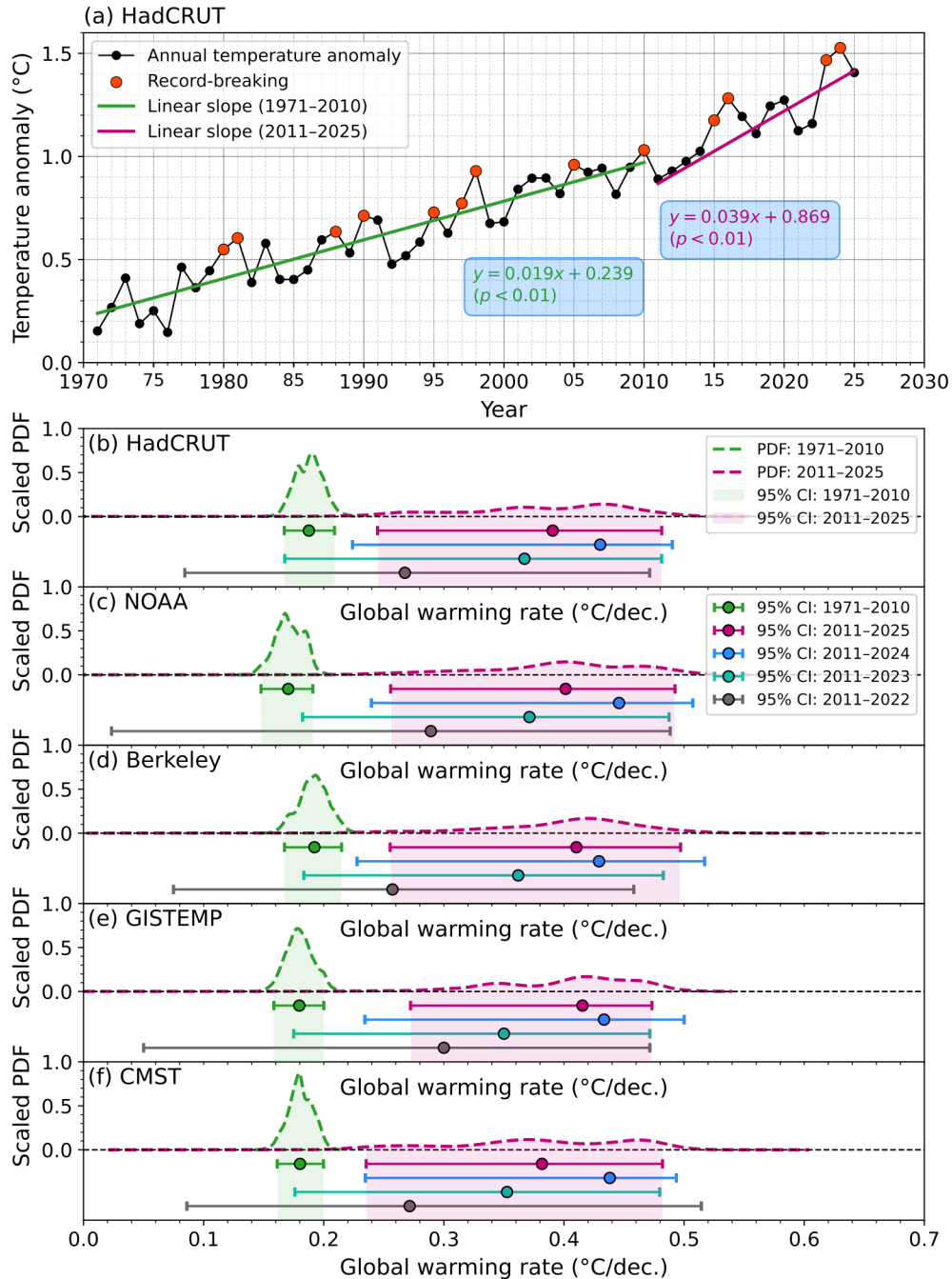
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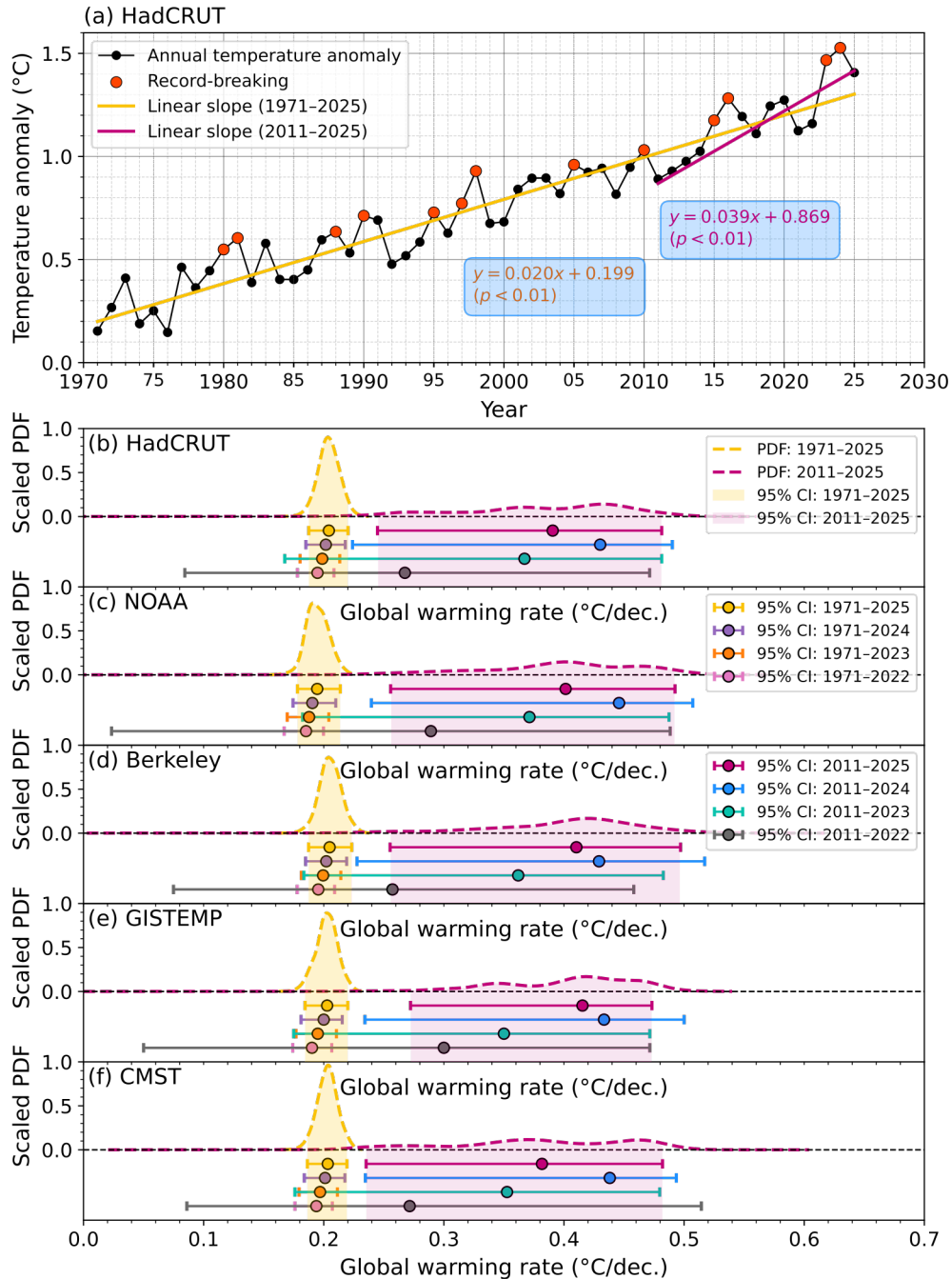
- Supplementary Figs. 1–7



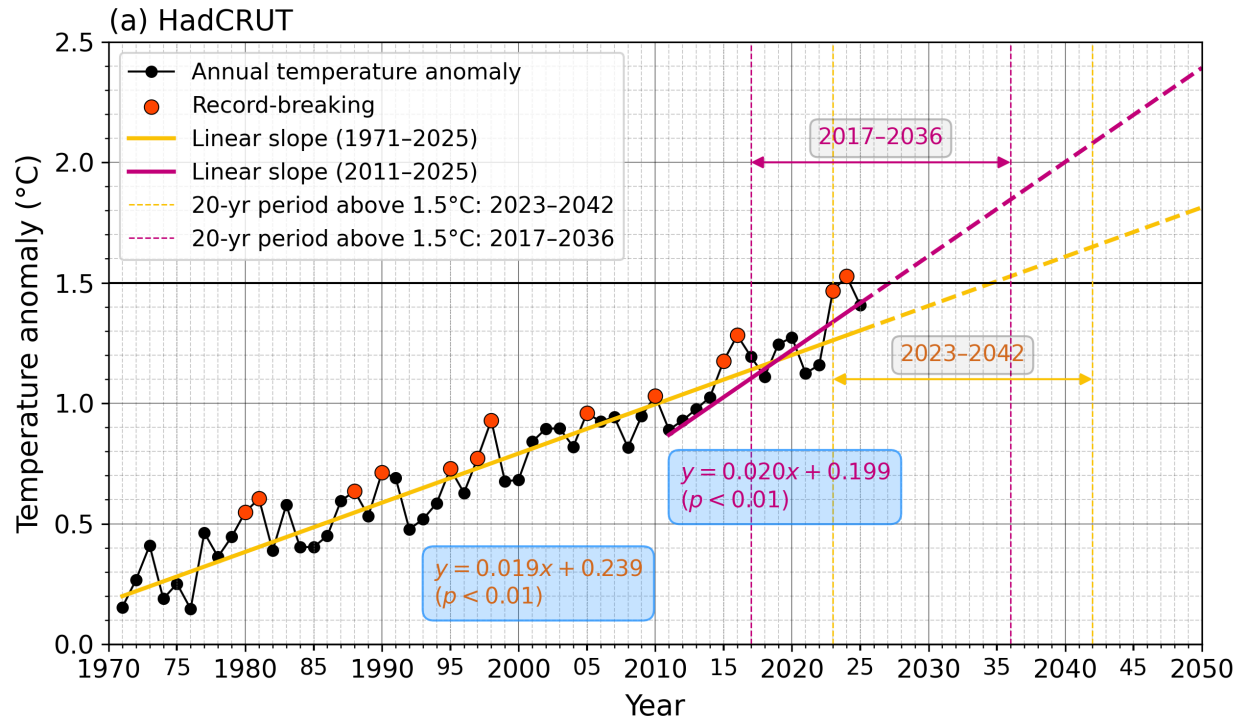
Supplementary Fig. 1 | Comparison of global warming rates during two divided segments of 1971–2025. The two segments are from 1971 to the dividing year and from one year after the dividing year to 2025. Each segment contains at least ten-year data, so the dividing year shifts from 1980 to 2015. The grey vertical bar highlights the dividing year when the trend difference is the largest. Five datasets are used and shown in **(a)** HadCRUT, **(b)** NOAA, **(c)** Berkeley, **(d)** GISTEMP, and **(e)** CMST.



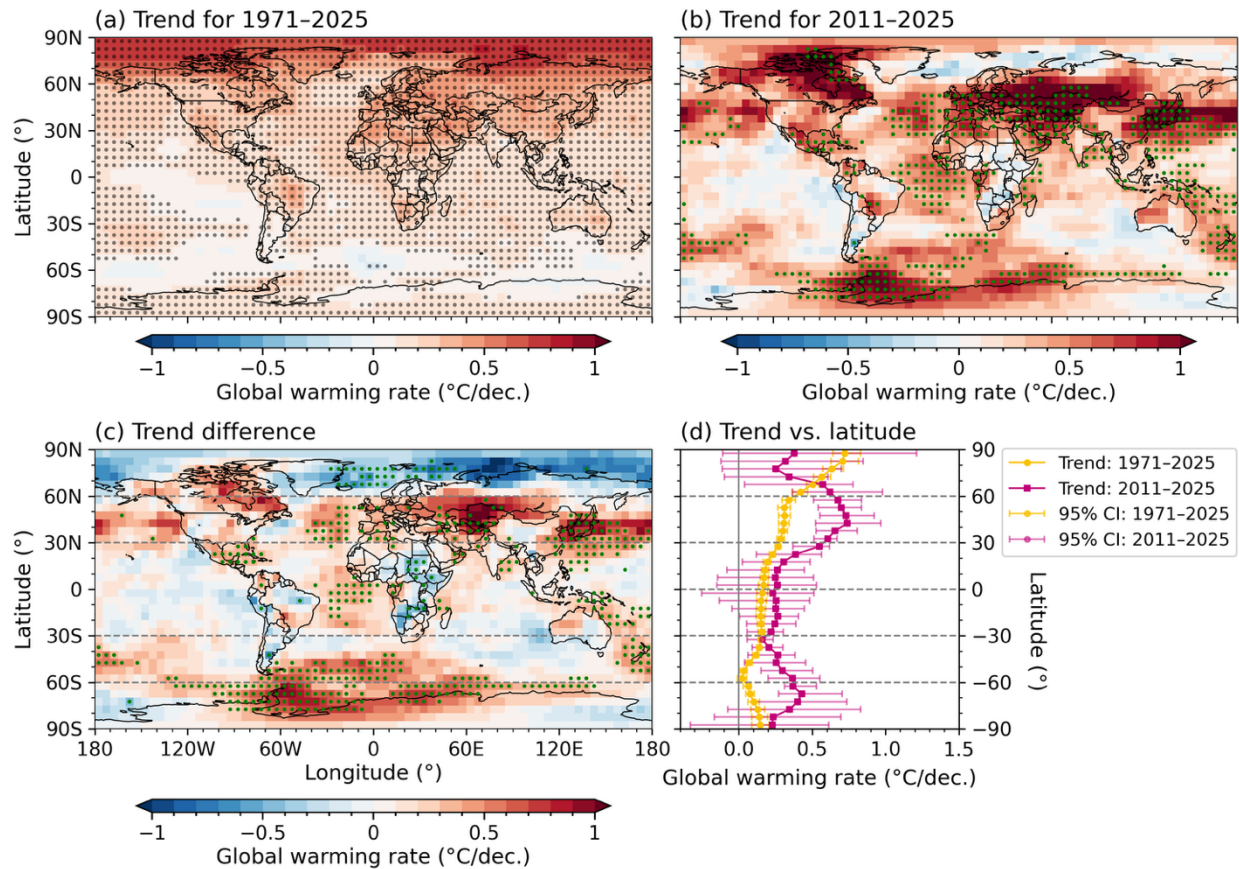
Supplementary Fig. 2 | Linear trends of the global mean surface temperature (GMST; °C per decade) for 1971–2010 and 2011–2025. (a) Time series of the GMST annual anomalies associated with the linear regression lines and equations for the two periods. The ENSO index is represented by the Niño 3.4 index. (b)–(f) Comparison of temperature trends and their PDFs for 1971–2010 vs. periods starting in 2011 but ending in years from 2022 to 2025 using four datasets. The PDF of each trend is estimated based on a bootstrap procedure, as explained in the **Method** section. “CI” in the legends means confidence interval.



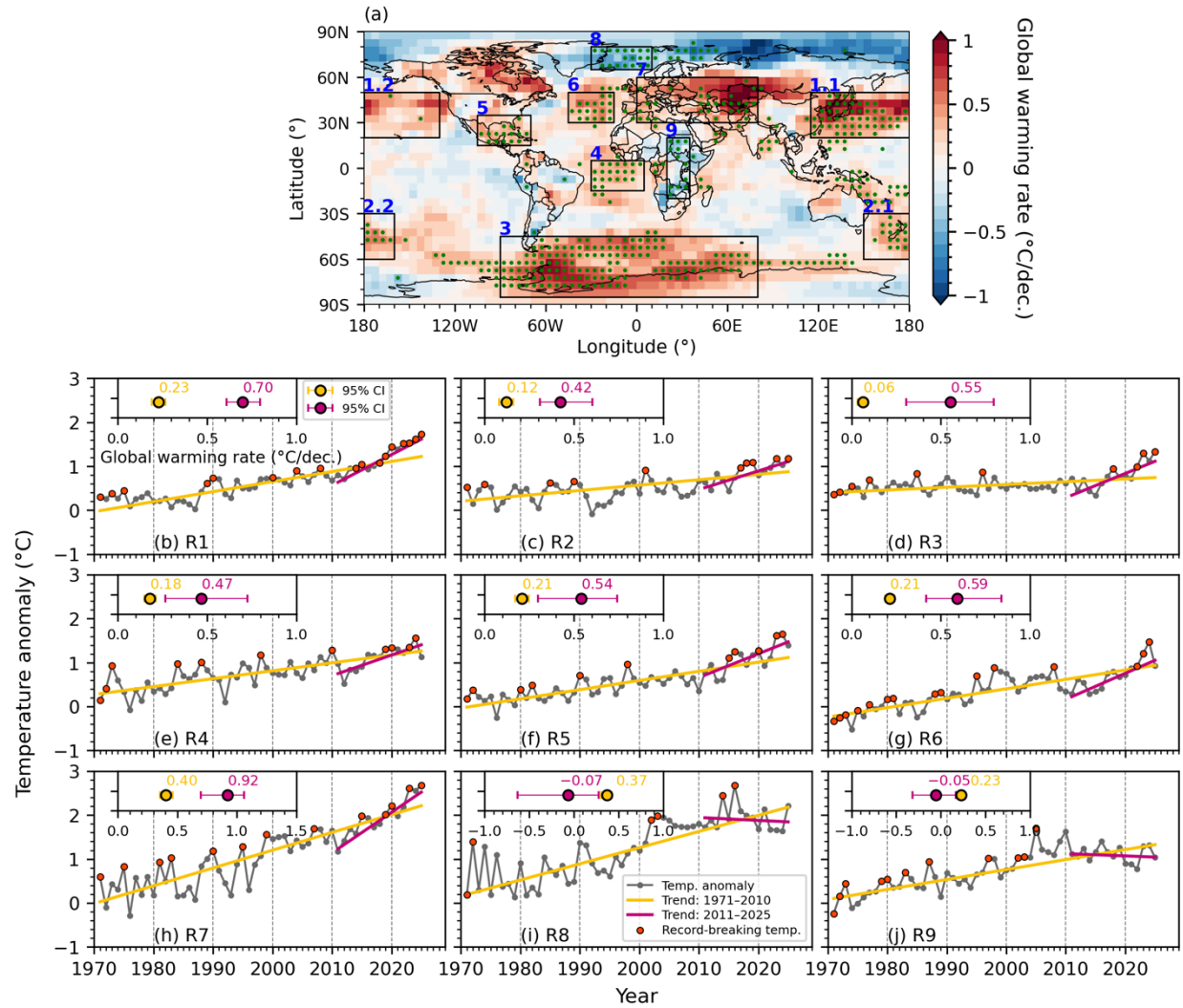
Supplementary Fig. 3 | Linear trends of global mean surface temperature (GMST; $^{\circ}\text{C}$ per decade) for 1971–2025, and 2011–2025. (a) Time series of the GMST annual anomalies associated with the linear regression lines and equations for the two periods. **(b)–(f)** Comparison of temperature trends and their PDFs for periods starting in 1971 but ending in years from 2022 to 2025 vs. periods starting in 2011 but ending in years from 2022 to 2025. The PDF of each trend is estimated based on a bootstrap procedure, as explained in the **Method** section. “CI” in the legends means confidence interval.



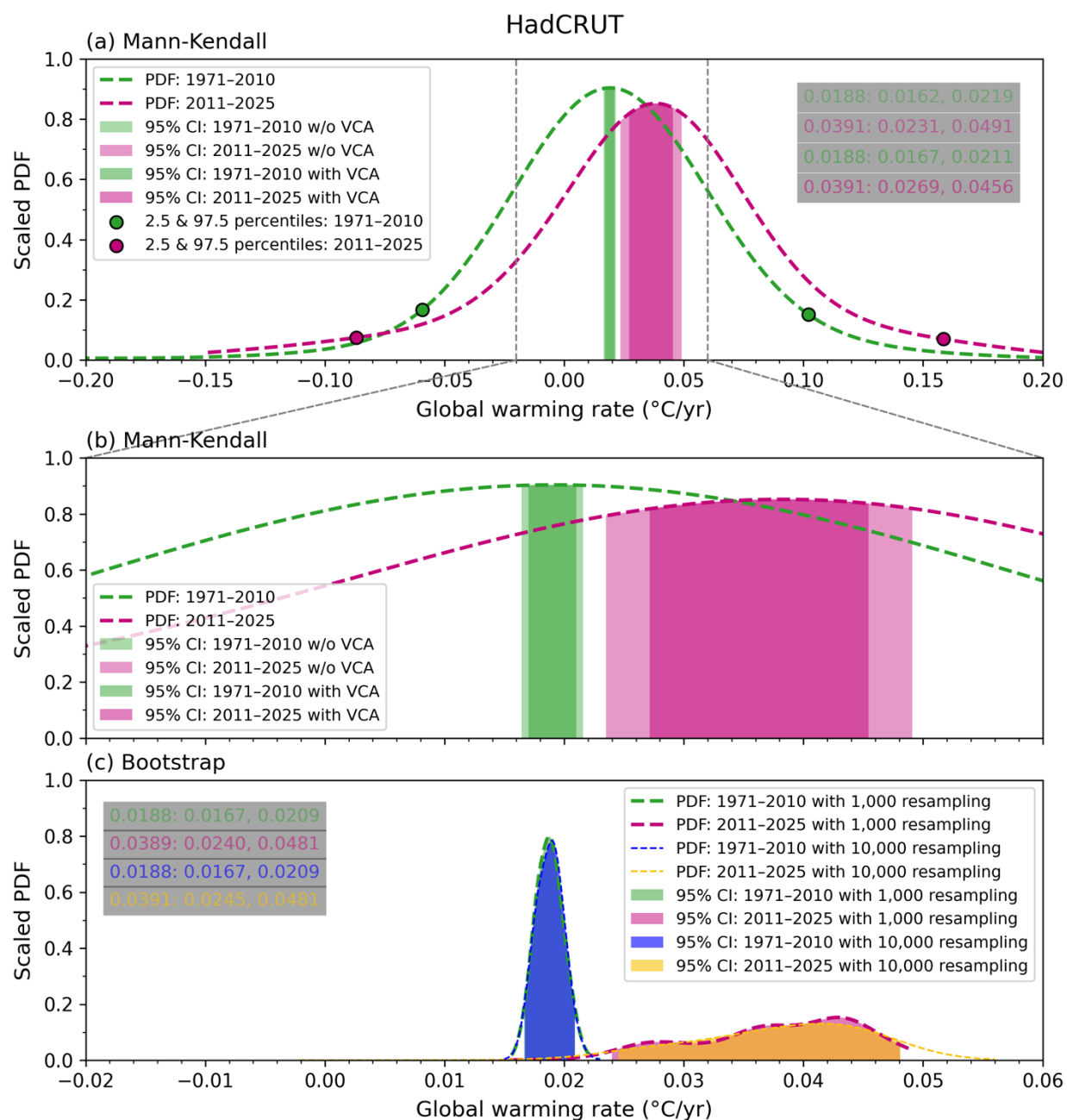
Supplementary Fig. 4 | Time series of GMST. (a) The time series is extrapolated from 2026 to 2050 based on two linear trends during the periods of 1971–2025 and 2011–2025. HadCRUT data are used.



Supplementary Fig. 5 | Spatial patterns of temperature linear trends. Trends are shown for 1971–2025 **(a)**, 2011–2025 **(b)**, and their differences **(c)**. The latitudinal distribution of the linear trends of the zonal-mean temperature is shown in panel **(d)**. Dots represent grid cells with significant trends or trend differences at 95% confidence level. HadCRUT data are used.



Supplementary Fig. 6 | Regional analysis of temperature linear trends. (a) Trend differences between 1971–2025 vs. 2011–2025. Nine regions are selected for further analysis. **(b)–(j)** Time series of temperature anomalies and their linear trends during the two periods in the 9 regions. Green and red straight lines are linear regression lines. The inset figures show the linear trends and their 95% confidence intervals. HadCRUT data are used.



Supplementary Fig. 7 | Comparison of the confidence intervals estimated from the Mann-Kendall and percentile bootstrap methods. (a) The scaled probability distribution function (PDF; dashed line) of the $\frac{n(n-1)}{2}$ temperature slopes (°C per year) when estimating the Theil-Sen slope for a time series of length n . Two PDFs are shown for temperature time series during 1971–2010 (green) and 2011–2025 (red). Shadings represent the 95% confidence intervals of the Theil-Sen slopes. The confidence intervals are estimated using the Mann-Kendall test with (shadings with greater opacity) and without (shadings with less opacity) the variance correction application (VCA) method. The dots stand for the 2.5th and

97.5th percentiles of the distributions of the $\frac{n(n-1)}{2}$ temperature slopes. The values of the Theil-Sen slopes and their 95% confidence intervals are shown in the upper right corner of the plot. **(b)** Same as (a) but zoomed in for temperature slopes within -0.02 and 0.06 °C per year. **(c)** The PDFs and 95% confidence intervals of the Theil–Sen slopes of temperatures, both of which are estimated using a bootstrap-based method. The bootstrapping process are performed by resampling the time series for 1,000 and 10,000 times to test the sensitivities of the PDFs and 95% confidence intervals to the resampling times. The values in the upper left corner of the plot show the Theil–Sen slopes and their 95% confidence intervals for two periods and two resampling times. The HadCRUT data are used in this figure.