Supplement of Weather Clim. Dynam., 7, 439–452, 2026
https://doi.org/10.5194/wcd-7-439-2026-supplement

Supplement of

The role of atmospheric circulation changes in Western European warm season heat extremes

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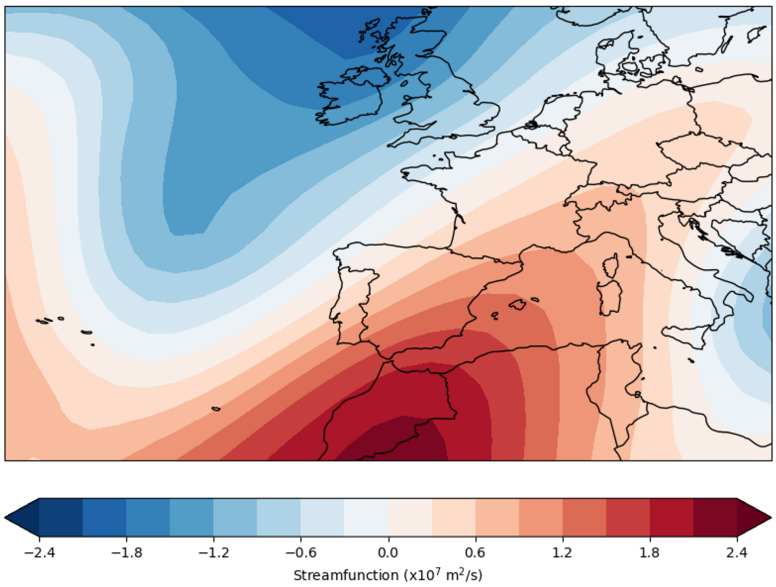

Figure S1: Analogue 500 hPa streamfunction field corresponding to the fifth percentile threshold for the frequency analysis.

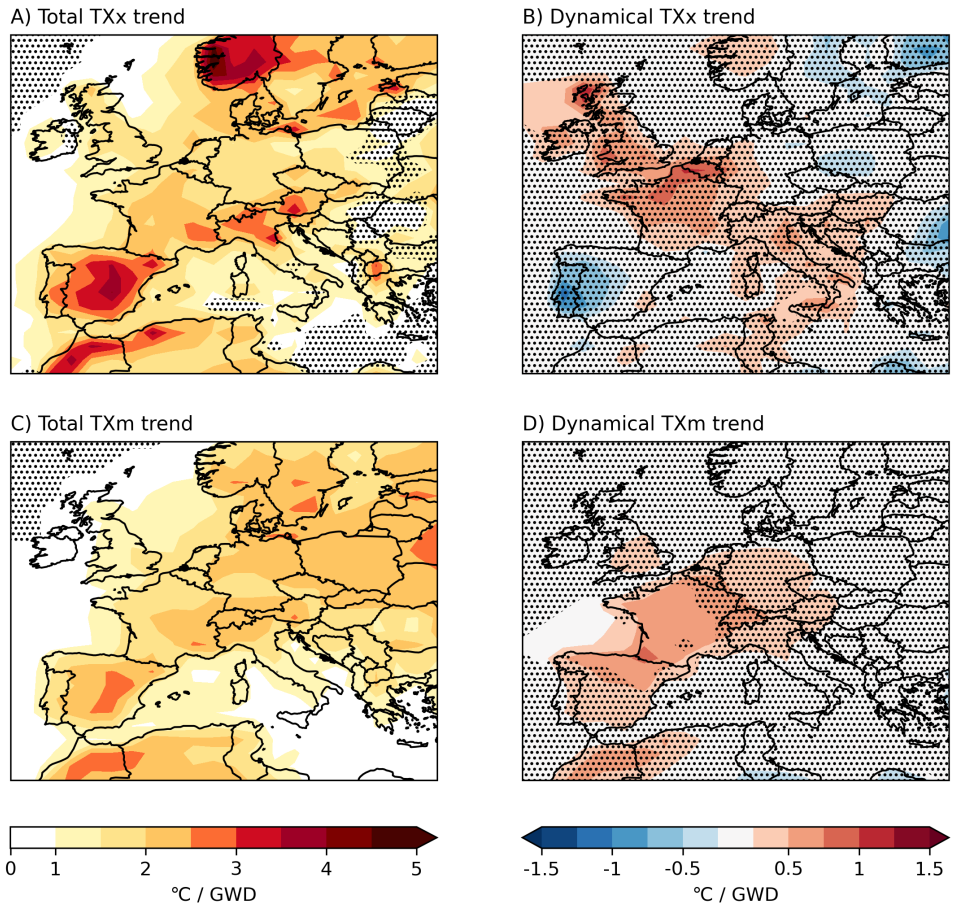

Figure S2: The total trends in spring temperature extremes and the dynamical contributions to these trends, expressed in the amount of warming, in degrees Celsius, per GWD. Dotted areas represent regions where the trend is not significant on a 95% confidence level. Trends are calculated using anomalies instead of absolute temperatures. Anomalies for each day are calculated as the difference with the mean temperature on that day over all years in the 1950–2023 period.

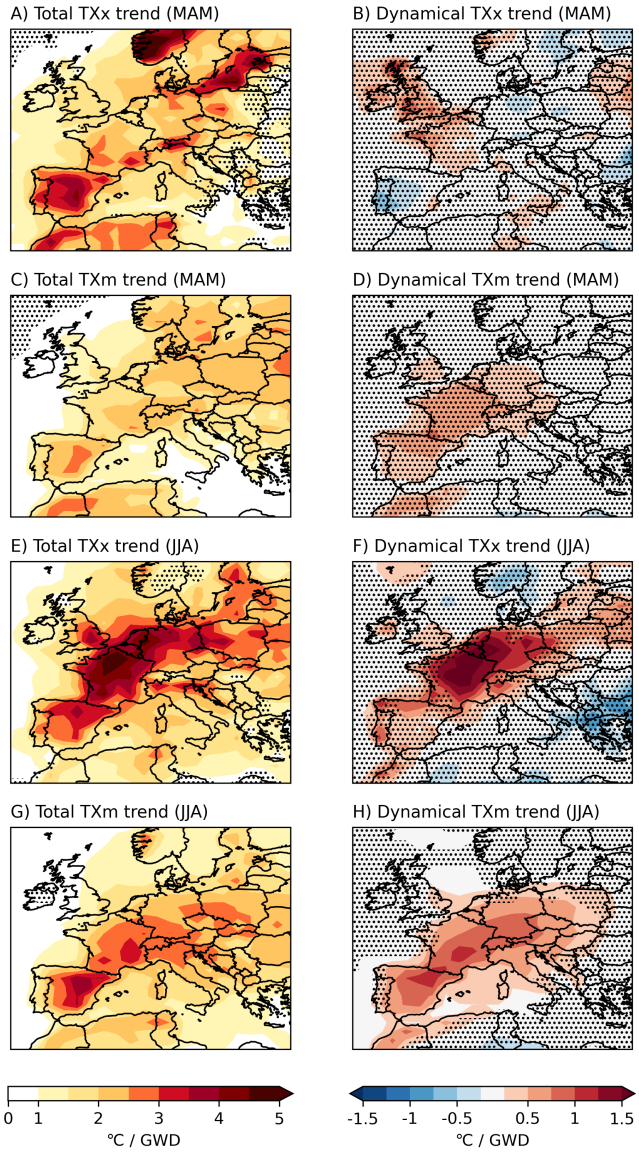

Figure S3: The total trends in the maximum (TXx) and the mean (TXm) of the daily maximum temperatures in a season, for spring and summer, and the dynamical contributions to these trends. Trends are calculated using the ERA5 dataset and are expressed in the amount of warming, in degrees Celsius, per global warming degree (GWD). Dotted areas represent regions where the trend is not significant when controlling the false discovery rate, using $\alpha = 0.1$ since the trends are spatially correlated.

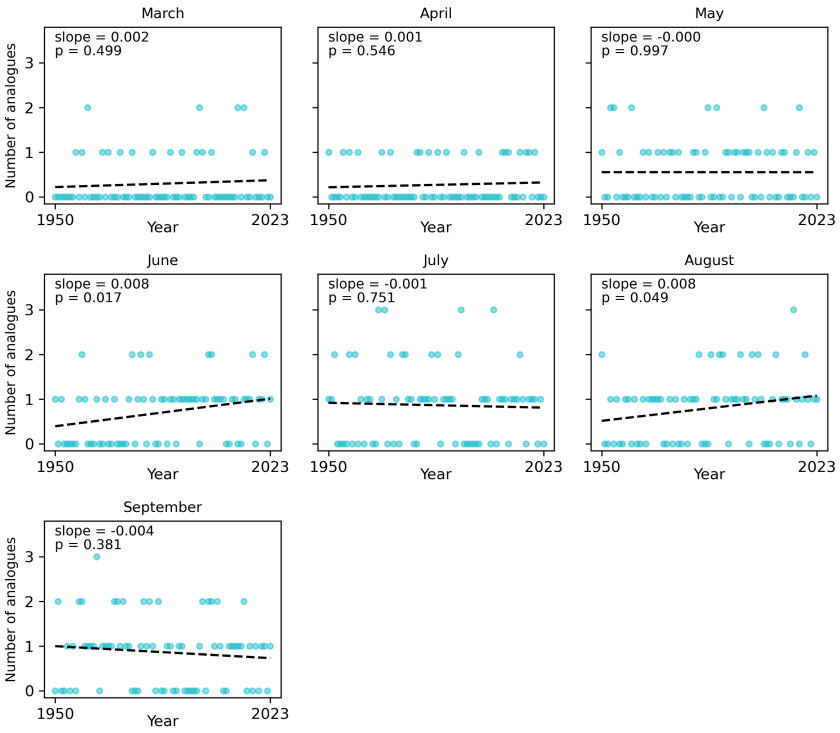

Figure S4: The number of analogues in each year for the different months, with the trend in frequency, the slope of the regression line, and the p-value from a Wald test with the alternative hypothesis that the slope is different from 0.

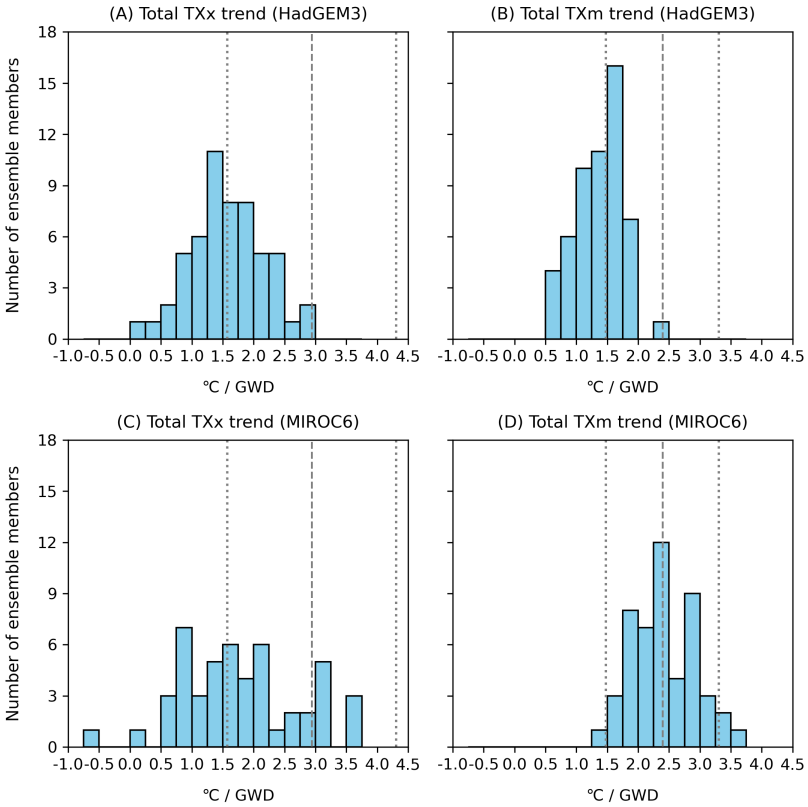

Figure S5: The distribution of the trends in the maximum (TXx) and the mean (TXm) of the daily maximum spring temperatures, averaged for Western Europe, as found by 105 ensemble members from the HadGEM3 and MIROC6 models. The dashed grey lines represent the trends found in ERA5, with dotted lines showing their 95% confidence interval.

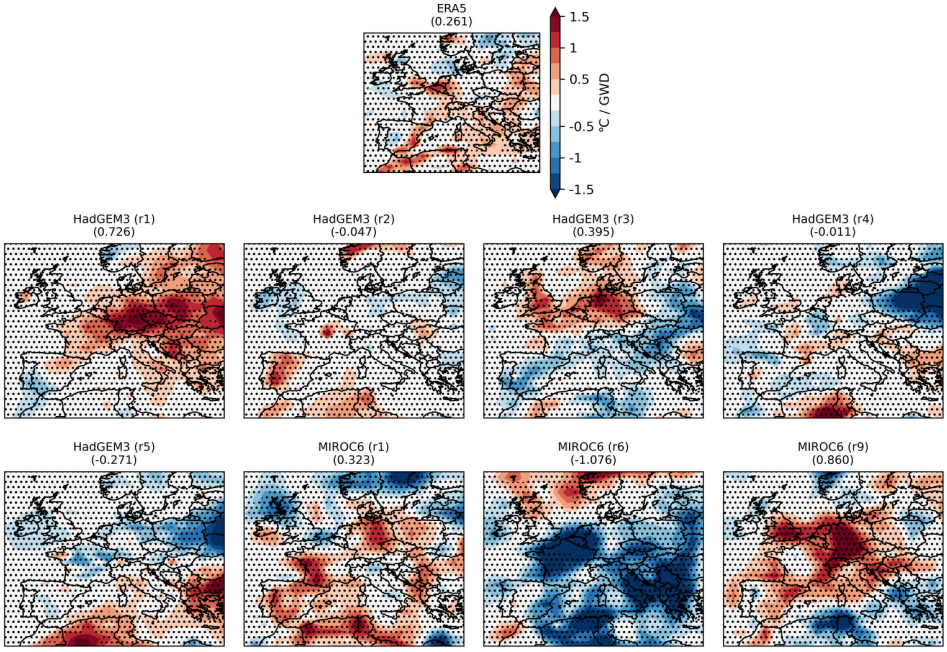

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Figure S6: The dynamical components of the TXx trends for ERA5 and eight model ensemble members using data from 1950–2014. Dotted areas represent regions where the trend is not significant on a 95% confidence level. The title of each plot indicates the data source, ensemble member if applicable, and average trend for Western Europe.

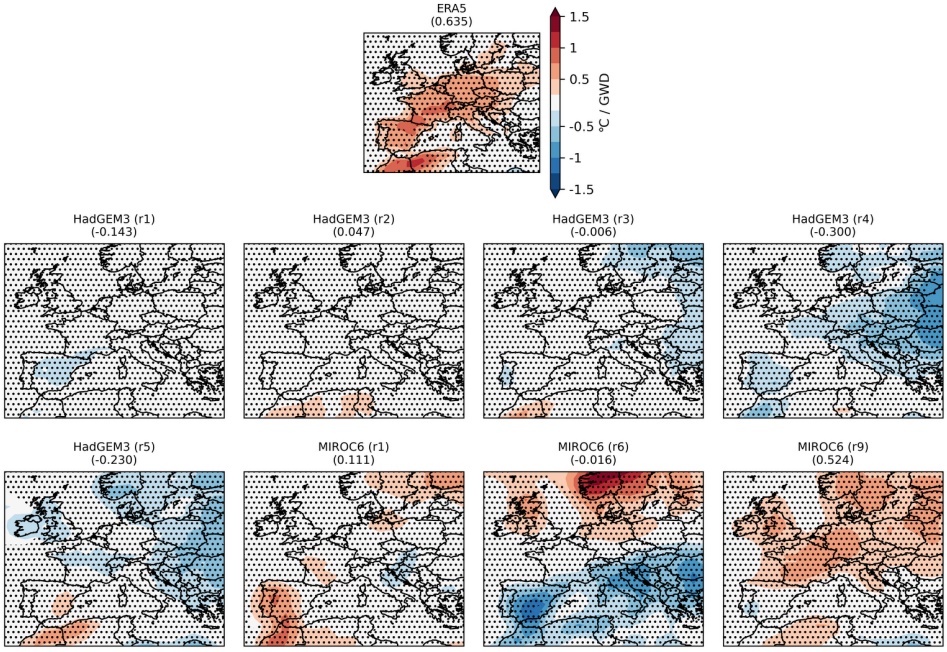

Figure S7: The dynamical components of the TXm trends for ERA5 and eight model ensemble members using data from 1950–2014. Dotted areas represent regions where the trend is not significant on a 95% confidence level. The title of each plot indicates the data source, ensemble member if applicable, and average trend for Western Europe.

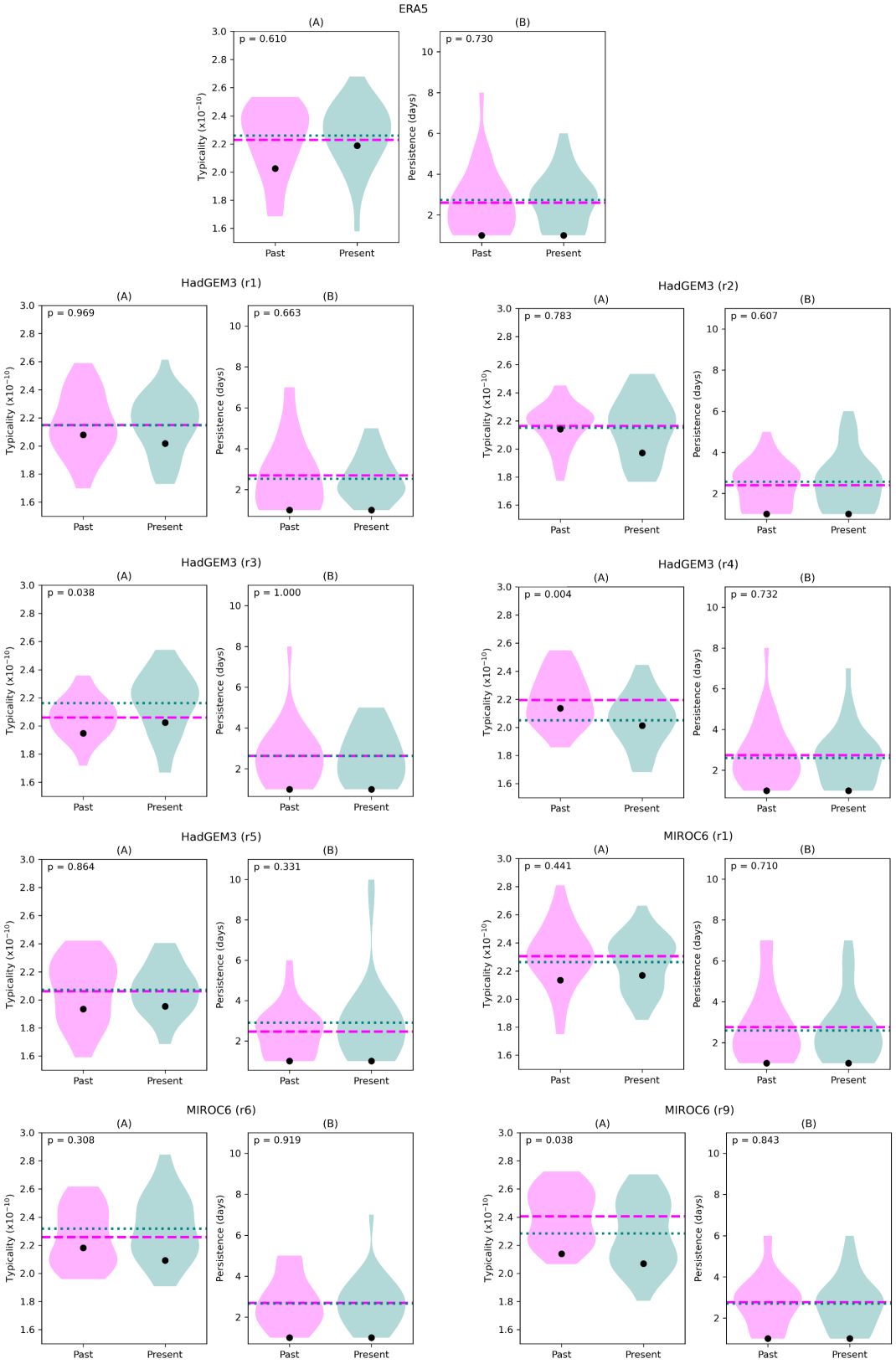

Figure S8: The changes in typicality (A) and persistence (B) between the past (1950–1979) and present (1985–2014) periods for ERA5 and eight model ensemble members. Black dots indicate the typicality and persistence of the event. The violins show the distribution of the $t_{analogue}$ and $p_{analogue}$ values, whose means are represented by dashed lines for the past period and dotted lines for the present period. The p-value indicates the statistical significance of the difference between these means.