

ANALYSES OF THE NORTHERN EUROPEAN SUMMER HEATWAVE OF 2018

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As the event was a record since 1950 (Fig. 1c), we evaluate whether the probability of breaking a record changed between 1950–84 and 1985–2018. Following the approach of (Naveau et al. 2018), we assess whether the factual world (1985–2018) can generate events that would have been a record in the counterfactual world (1950–84). Therefore, we compute the probability $p_{1,2}$ that the factual climate generates higher record values than the counterfactual climate, where the factual climate is tested over a changing period of time. 90% confidence intervals are obtained by bootstrap over 500 samples.

Figure ES2b shows the estimated $p_{1,2}$ from 1950 to 2018 where the counterfactual climate goes from

1950 to 1984. We detect a significant change in the distribution of temperature starting from 1995, as the factual climate tends to produce higher values than the counterfactual climate. We find a probability of 0.7 that the factual climate in 2018 generates a higher record value than in the counterfactual climate.

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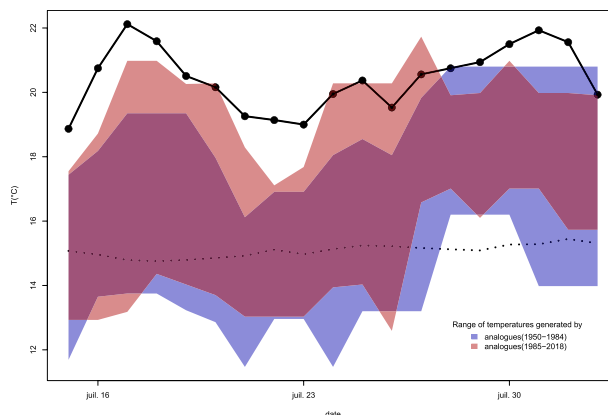


FIG. ES1. Time series of daily temperature from 15 Jul to 2 Aug 2018 (continuous line), with a plot of the seasonal cycle (dotted line). The shaded areas indicate the range of daily variations of analog temperatures.

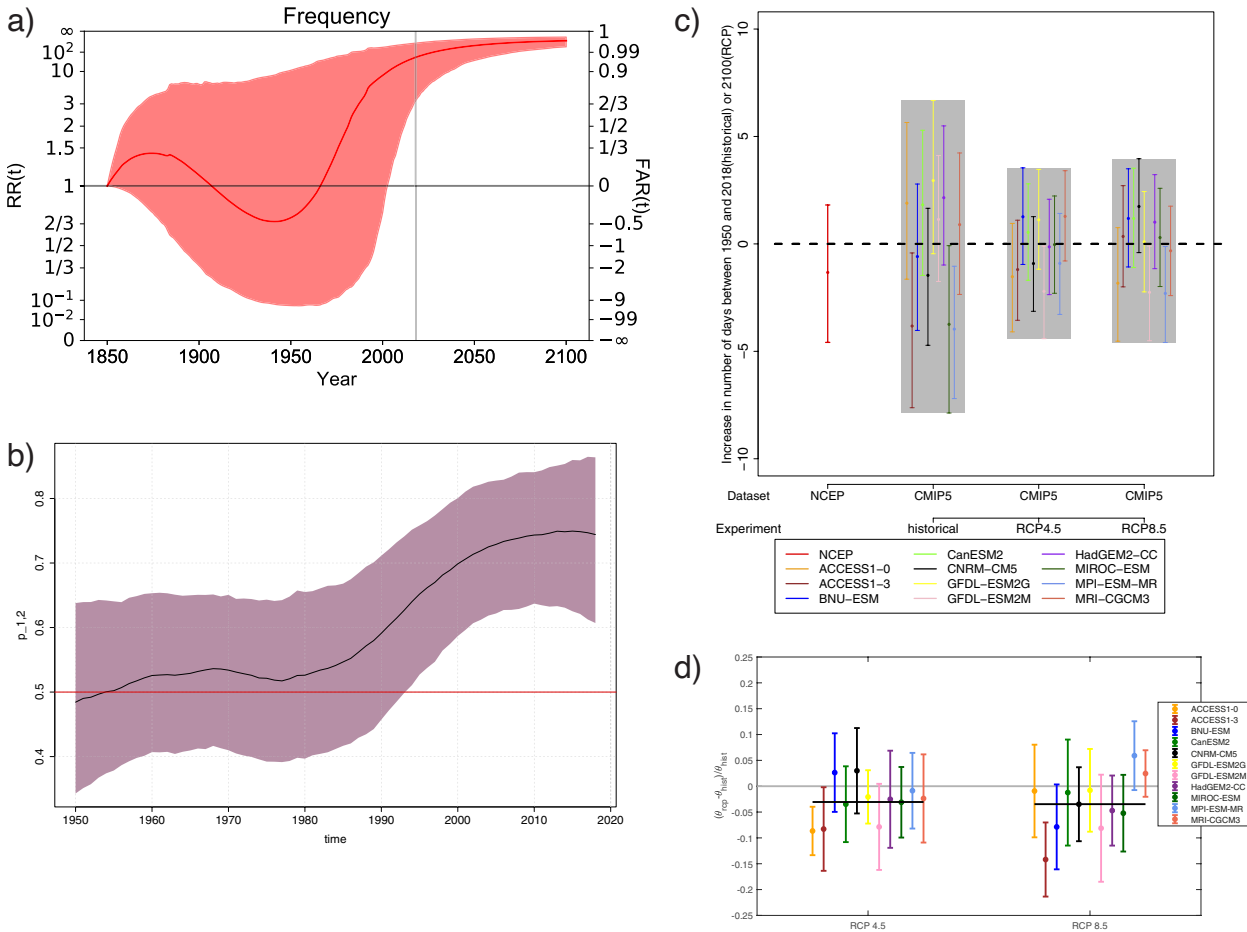


FIG. ES2. (a) Unconditional attribution (RR) from CMIP. The red continuous line is the best estimate for the risk ratio (RR), and the red zone is the confidence interval at level 95%. The vertical gray line is the date of the event (2018). The red shaded area represents the confidence interval at the 95% level, computed by a bootstrap procedure (1,000 samples). **(b) Evolution of $p_{1,2}$ from 1950 to 2018.** The black line is the best estimate. The shaded areas show the 90% confidence interval are provided by the shaded area and are computed by resampling bootstrap (500 samples). The red horizontal line is the value of $p_{1,2}$ that we would get if the factual and counterfactual climate were to follow the same distribution. **(c) Differences between the expected average number of close days to the circulation of the hottest day of the heatwave 17 Jul 2018 at the end and at the beginning of the time series for NCEP (in red) and CMIP5 (bars in gray shaded areas) for the historical, RCP4.5, and RCP8.5 experiments.** **(d) Relative changes in the persistence of the Z500 atmospheric circulation associated with the 2018 heatwave.** Each bar represents the median and the standard deviation of the persistence over the period for each CMIP5 model used. The black horizontal line represents the multimodel mean.