Decadal Predictions of the Probability of Occurrence for Summer Temperature Extremes in the Northern Hemisphere

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Teaser for an Oral presentation accompanying this Display on 5th May, 17:20 CET

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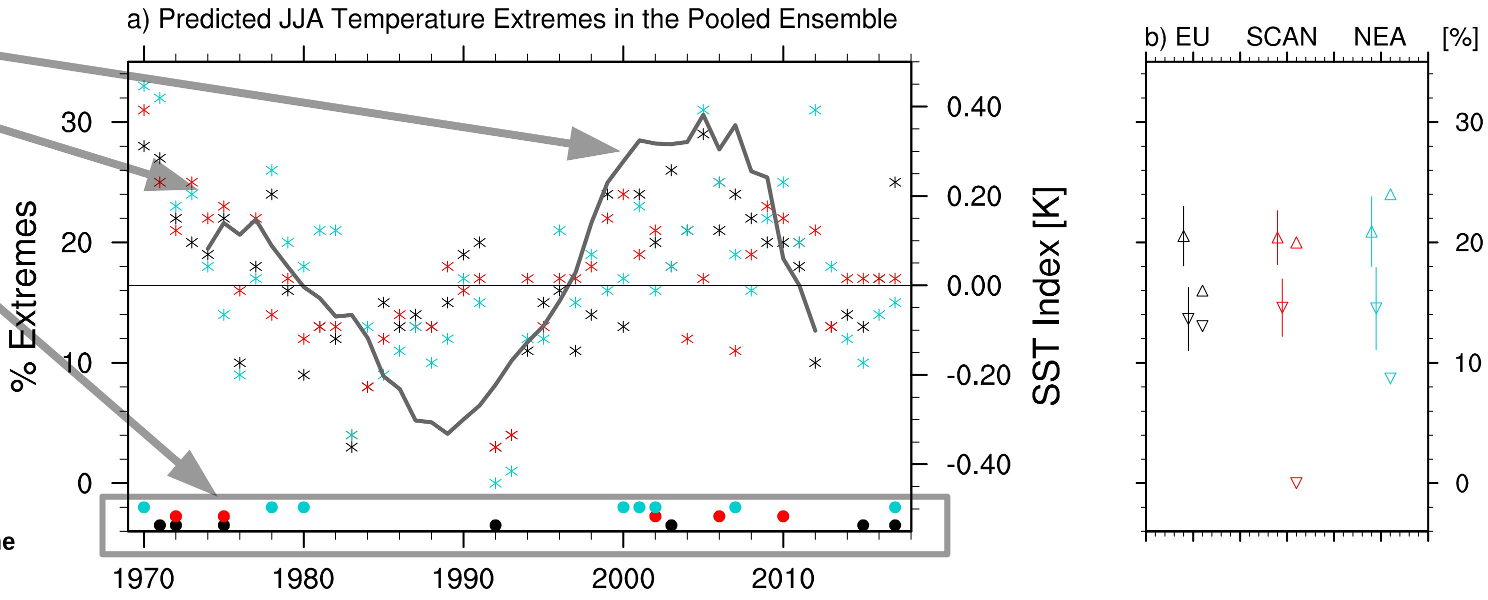
The probability for an extremely warm summer to occur in the next 10 years in several regions in the Northern Hemisphere can be inferred from predictions of North Atlantic SST

(1) North Atlantic SST varies.

(2) Warm SST favors the prediction of an extremely warm summers to occur (asterisks)

(3) Extremely warm summers occur preferably when SST is warm



- North Atlantic **SST varies** on the (multi-) decadal time scale (fig. 1a, grey line)
- The MPI-ESM-HR model **predicts warm summer temperature extremes** in several regions to be significantly (fig. 1b) **more likely to occur when the North Atlantic is warm** than when it is cold (fig. 1a, asterisks)
- In **Scandinavia and northeast Asia**, the different predicted probabilities of occurrence for extremely warm summers **agree with observations** (fig. 1a, dots; fig. 1b)

Fig. 1: (a) Probability of occurrence for summer SAT extremes in the regions EU (black), SCAN (red), and NEA (cyan). Dots at the bottom show the occurrence of a summer SAT extreme in the respective region in the assimilation run. Asterisks indicate the percentage of pooled hindcast realizations that produce a warm summer SAT extreme in any given year in the respective region. The gray line shows the 10-year running mean SPG SST index from the assimilation run. (b) Triangles indicate average predicted (with uncertainty bar) and assimilation run-based (without uncertainty bar) probabilities of occurrence for warm summer SAT extremes in the respective regions. Probabilities of occurrence are shown for warm (upward pointing triangles) and cold (downward pointing triangles) SPG phases. Uncertainty bars show one standard deviation around the mean.

More information on the methods used can be found here.

The paper is available here. This topic will also be presented on May 5th 2020 at around 17:20 CET.

Data sets and methods

- For a detailed description of our methods, please consult the paper
- We use the CMIP6 version of the MPI-ESM-HR model (Müller et al., 2018), running 10 ensemble members of 10-year long decadal hindcasts (Pohlmann et al., 2019), initialized yearly between 1960 and 2018
- For temperature observations, we use HadCRUTv4 (Morice et al, 2012) as well as the assimilation run

- Extreme summer temperature is defined June-July-August mean temperature exceeding two standard deviations
- All analyses are performed on linearly detrended time series
- North Atlantic SST are defined as average SST in the box 80–0W, 50–70N
- The other examined regions are defined as EU: 0-35E, 45-52N; SCAN: 10-50E, 50-65N; and NEA: 90-130E, 40-50N. This selection is based on a physical criterion (paper)
- Observed probabilities of occurrence for summer temperature extremes were calculated by dividing the count of observed extremes over time by the time series length
- In the model, we pool the available realizations of for each year between 1970 and 2018 together. 10 ensemble members * 10 start years that include each year between 1970 and 2018 means that we have 100 realizations available for each of these years (fig.2).
- **The pooling approach enables a clean derivation of the predicted probability of occurrence of a rare event in the hindcast simulations (more info in the paper)**

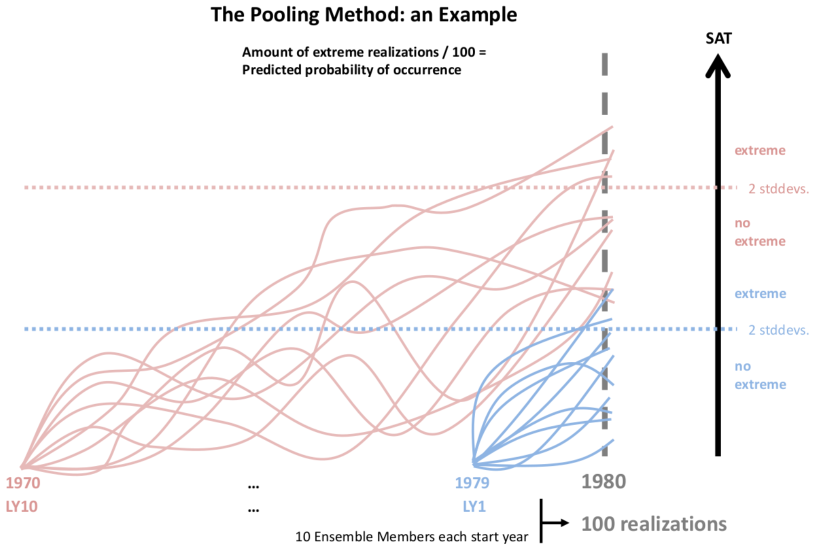


Fig. 2: An illustration of the pooling approach applied in this study