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Recurrence spectra of European temperature in historical climate simulations

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The analysis of recurrences of trajectories in dynamical systems allows the identification of rare states of the systems. We analyse and quantify the recurrences of European temperature extremes using 32 historical simulations (1900–1999) of the fifth Coupled Model Intercomparison Project (CMIP5) and 8 historical simulations (1971–2005) from the EUROCORDEX experiment. We compare the former simulations to the 20th Century Reanalysis (20CR) dataset. We use the recurrence analysis method developed by Faranda and Vaienti (2013) to compute recurrence spectra of temperature in Europe.

We find that, 1) the spectra obtained by the model ensemble mean are generally consistent with those of 20CR; 2) spectra biases have a strong regional dependence; 3) the resolution does not change the order of magnitude of spectral biases between models and reanalysis, 4) the spread in recurrence biases is larger for cold extremes. Our analysis of biases provides a new way of selecting a subset of the CMIP5 ensemble to obtain an optimal estimate of temperature recurrences for a range of time-scales.

Reference

Faranda D, Vaienti S (2013) A recurrence-based technique for detecting genuine extremes in instrumental temperature records. Geophys. Res. Lett. 40(21):5782–5786