



Did European temperatures in 1540 exceed present-day records?

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There is strong evidence that the year 1540 was exceptionally dry and warm in Central Europe. Here we infer 1540 summer temperatures from the number of dry days (NDDs) in spring (March–May) and summer (June–August) in 1540 derived from historical documentary evidence published elsewhere, and compare our estimates with present-day temperatures. We translate the NDD values into temperature distributions using a linear relationship between modeled temperature and NDD from a 3000 year pre-industrial control simulation with the Community Earth System Model (CESM). Our results show medium confidence that summer mean temperatures (T JJA) and maximum temperatures (TXx) in Central Europe in 1540 were warmer than the respective present-day mean summer temperatures (assessed between 1966–2015). The model-based reconstruction suggests further that with a probability of 40%–70%, the highest daily temperatures in 1540 were even warmer than in 2003, while there is at most a 20% probability that the 1540 mean summer temperature was warmer than that of 2003 in Central Europe. As with other state-of-the-art analyses, the uncertainty of the reconstructed 1540 summer weather in this study is considerable, for instance as extrapolation is required because 1540-like events are not captured by the employed Earth system model (ESM), and neither by other ESMs. However, in addition to paleoclimatological approaches we introduce here an independent methodology to estimate 1540 temperatures, and contribute consequently to a reduced overall uncertainty in the analysis of this event. The characterization of such events and the related climate system functioning is particularly relevant in the context of global warming and the corresponding increase of extreme heat wave magnitude and occurrence frequency.

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