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How exceptional was the September 2023 global heat?

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In September 2023, the global mean surface temperature (GMST) anomaly reached a new maximum, exceeding the previous record by an unprecedented 0.5 °C. This is not only the highest monthly anomaly ever recorded, but also stands out compared to the more moderate anomalies seen during the record-breaking summer of 2023. It is likely that developing El Niño conditions are at least partly responsible for the anomalous heat. However, it remains unclear if such a sharp rise in global mean temperature is to be expected due to our warming climate and internal climate variability or if the September 2023 GMST was a rare event even for the current global warming level. In other words, could we soon witness even more intense monthly temperature anomalies? Moreover, are climate models able to adequately reproduce such extreme records?

To address these questions, we analyze observations as well as CMIP6 model simulations and employ techniques from extreme event attribution. These statistical approaches typically focus on regional-scale weather and climate extremes. Here, we apply them to the September 2023 global heatwave to investigate the occurrence probability of this event, considering the influence of global warming as well as El Niño.