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Storylines of the 2018 Northern Hemisphere heat wave at pre-industrial and higher global warming levels

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The 2018 summer was unusually hot in large areas of the Northern Hemisphere and simultaneous heat waves on three continents led to major impacts to agriculture and society. The event was driven by the anomalous atmospheric circulation pattern during that summer and it was only possible in a climate with global warming. There are indications that in a future, warmer climate similar events might occur regularly, affecting major 'breadbasket' regions of the Northern Hemisphere.

This study aims to understand the role of climate change for driving the intensity of the 2018 summer and to explore the sensitivity to changing warming levels. Model simulations are performed using the Community Earth System Model to investigate storylines for the extreme 2018 summer given the observed atmospheric large-scale circulation but different levels of background global warming: no human imprint, the 2018 conditions, and different mean global warming levels (1.5°C, 2°C, 3°C, and 4°C). The storylines explore the consequences of the event in an alternative warmer or colder world and thus help to increase our understanding of the drivers involved. The results reveal a strong contribution by the present-day level of global warming and provide an outlook to similar events in a possible future climate.