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Historical influence of irrigation on climate extremes

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Land irrigation is an essential practice sustaining global food production and many regional economies. During the last decades, irrigation amounts have been growing rapidly. Emerging scientific evidence indicates that land irrigation substantially affects mean climate conditions in different regions of the world. However, a thorough understanding of the impact of irrigation on extreme climatic conditions, such as heat waves, droughts or intense precipitation, is currently still lacking. In this context, we aim to assess the historical influence of irrigation on the occurrence of climate extremes. To this end, two simulations are conducted over the period 1910-2010 with a state-of-the-art global climate model (the Community Earth System Model, CESM): a control simulation including all major anthropogenic and natural external forcings except for irrigation and a second experiment with transient irrigation enabled. The two simulations are evaluated for their ability to represent (i) hot, dry and wet extremes using the HadEX2 and ERA-Interim datasets as a reference, and (ii) latent heat fluxes using LandFlux-EVAL. Assuming a linear combination of climatic responses to different forcings, the difference between both experiments approximates the influence of irrigation. We will analyse the impact of irrigation on a number of climate indices reflecting the intensity and duration of heat waves. Thereby, particular attention is given to the role of soil moisture changes in modulating climate extremes. Furthermore, the contribution of individual biogeophysical processes to the total impact of irrigation on hot extremes is quantified by application of a surface energy balance decomposition technique to the 90th and 99th percentile surface temperature changes.