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The relationship between extreme weather and low crop yields

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It is well known that climate extremes and variability have strong implications for crop productivity. Previous research has estimated that annual weather conditions explain a third of global crop yield variability, with explanatory power above 50% in several important crop producing regions. Further, compared to average conditions, extreme events contribute a major fraction of weather induced crop yield variations. Here we aim to analyse how extreme weather events are related to the likelihood of very low crop yields at the global scale. We investigate not only the impacts of heat and drought on crop yields but also excess soil moisture and abnormally cool temperatures, as these extremes can be detrimental to crops as well. In this study, we combine reanalysis weather data with national and sub-national crop production statistics and assess relationships using statistical copulas methods, which are especially suitable for analysing extremes. Further, because irrigation can decrease crop yield variability, we assess how the observed signals differ in irrigated and rainfed cropping systems. We also analyse whether the strength of the observed statistical relationships could be explained by socio-economic factors, such as GDP, social stability, and poverty rates. Our preliminary results indicate that extreme heat and cold as well as soil moisture abundance and excess have a noticeable effect on crop yields in many areas around the globe, including several global bread baskets such as the United States and Australia. This study will increase understanding of extreme weather-related implications on global food production, which is relevant also in the context of climate change, as the frequency of extreme weather events is likely to increase in many regions worldwide.