Influence of Extreme Weather and Climate Events on Crop Yields in China

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Extreme weather and climate events, such as extreme temperatures, droughts, and floods, cause significant yield losses and threaten global food security. Their frequency and intensity have increased in recent decades, a trend expected to continue. China is the world's largest grain producer and also a country where extreme events occur frequently. Nevertheless, the influence of extreme weather and climate events on crop yields in China is not yet well understood. This study quantified the impact of heat waves, frost, droughts, and floods on the yields of wheat, maize, rice, and soybean in China from 1970 to 2019, using the superposed epoch analysis (SEA) method, agricultural statistics collected from the National Bureau of Statistics of China, and crop calendar reanalysis dataset. Furthermore, the performance of 13 global gridded crop models (GGCMs) in simulating these impacts is evaluated. The results show that heat waves, frost events, droughts, and floods significantly decrease crop yields by 2.1\%, 1.0\%, 2.2\%, and 1.7\% for wheat, maize, rice, and soybean, respectively, accounting for 23.6\%, 10.5\%, 21.4\%, and 18.9\% of the interannual variability. Yields of different crop types in China are sensitive to specific extreme weather events. The GGCMs effectively capture the impact of droughts, with nine out of thirteen models detecting a significant effect, yet they struggle to accurately simulate the effects of heat waves, frost events, and floods, with only five, two, and two models detecting these impacts, respectively.