EGU24-5796, updated on 14 Jan 2025
https://doi.org/10.5194/egusphere-egu24-5796
EGU General Assembly 2024

Future changes in spatially compounding hot, wet or dry events and their implications for the world's breadbasket regions

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Recent years were characterized by spatially co-occurring hot, wet or dry years around the globe. Spatially compounding extreme events can strongly amplify societal impacts as economic supply chains are increasingly interlinked, highlighting the increasing importance of advancing our knowledge of the effects of human-induced climate change on such events. We assess the occurrence of spatially compounding hot, wet and dry years under different future warming levels of 1.5°C , 2°C, 3°C and higher levels of global warming. We focus our analysis on the top-producing agricultural regions that have historically provided the global food systems with large quantities of wheat, maize, soybean or rice. The occurrence of spatially compounding events and area affected in future climates is determined using Earth System Model simulations from the 6th Phase of the Coupled Model Intercomparison Project (CMIP6). The simulations project a strong increase in the global land area that is concurrently affected by hot, wet and dry extremes under continued global warming. On regional scales, the world's breadbasket regions are particularly affected by strong increases in the simultaneous occurrence of hot, wet or dry extremes under continued global warming. The spatial extent of agricultural land potentially threatened by climate extremes will increase drastically if global mean temperatures shift from +1.5 °C to +2.0 °C, and will be further amplified with every tenth of degree of warming. This highlights that ambitious climate action needs to be taken in order to limit global warming if we want to keep the global agricultural land in a safe climatic space.