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Spatially concurrent heatwaves and their relevance for global crop production

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The magnitude and extend of heatwaves are projected to increase in many land regions with climate change. Extreme heatwaves can have many effects on society and cause severe damage for society, environment and economy. Particularly they have been observed to severely affect human health as well as crop yields and other ecosystem services such as carbon uptake. While single events can have devastating impacts, the impacts of heatwaves occurring at the same time in different regions may be much more severe as the effects do not add linearly. In such a case, aggregating independent estimates of risk associated with regionally limited heatwaves may underestimate risks of impacts at a larger scale. Recent studies investigated the concurrence of heat waves and droughts on a regional scale. However, our current knowledge about spatially co-occurring heatwaves is very limited and an analysis at the global scale is still lacking.

We analyze the co-occurrence of heatwaves in temperature data from observations, reanalyses and global climate models. We focus specifically on regions, which are important for agricultural production such as wheat, maize rice and soy bean production as this of importance to meet global food security. We compute present day probabilities for spatial concurrent heatwaves. We further investigate how climate change will affect the risk of concurrent heatwaves in the future, and whether this might threaten crop yields and hence global food production. Changes in spatial co-occurrence of heatwaves may be related to changes in spatial coherence of temperature variations. Hence, we investigate whether spatial coherence has changed over time and will change in future. Our analysis identifies regions in which spatially co-occurring heatwaves need to be considered for an appropriate assessment of risk for a larger region. Moreover, this approach can then be applied to other types of climate extremes such as droughts.