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The impact of climate extremes on US agricultural production and the buffering impacts of irrigation

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In recent years, droughts and floods have occurred over many of the major growing regions of the world, resulting in decreased agricultural production and increased global food prices. Many climate projections call for more frequent extreme events, which could have significant impacts on agricultural yields and water resources in irrigated agricultural regions. In order to better understand the potential impact of climate extremes and the spatial heterogeneity of those impacts, we examine the associations between climate and irrigated and rain fed crop yields, focusing on four main staple crops: wheat, rice, soy, and maize. Because the United States has high spatial resolution data for both yields and weather variables, the analysis focuses on the impact of multiple extremes over these four crops in the US using statistical methods that do not require any assumptions of functional relationships between yields and weather variables. Irrigated and rain fed agricultural yields are analyzed separately to understand the role irrigation plays either as a buffering against climate variability and extremes such as drought, heat waves, and extended dry spells or a mechanism that leads to varied relationships between extremes of climate and yield fluctuations. These results demonstrate that irrigation has varying effects depending on the region, growing season timing, crop type, and type of climate extreme. This work has important implications for future planning of the coupled water-food system and its vulnerabilities to climate.