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## The impacts of hot-dry compound extremes on US Soybean yields

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The US agriculture system supplies more than one third of globally traded soybean, of which 90% is produced under rainfed agriculture. This makes the commodity particularly sensitive to weather and climate variability. Previous research has shown that annually averaged climate conditions explain about a third of global crop yield variability. Additionally, although less studied so far, crops are sensitive to specific short-term weather conditions, isolated or co-occurring at key moments throughout the growing season. Here we aim to identify key within-season weather and climate variables that can explain soybean yield variability in the US while exploring synergies between drivers that can have compounding impacts. The study combines weather data from reanalysis and satellite-based evapotranspiration and root-zone soil moisture with sub-national crop yield estimates using statistical methods that account for interaction effects. We also analyze the historic changes in identified key driving conditions in order to explore the effects of current climatic trends on yields. Our preliminary results indicate positive yield response to higher minimum temperature early and late in the season whereas the largest effect on soybeans is driven by the harmful co-occurrence of high temperature and low moisture levels during the summer flowering period significantly reducing yields on average in the US by one standard deviation. The magnitude of the response to climate drivers varies across the spatial domain highlighting the need to focus on local and season specific management strategies. On the bright side, recent trends in temperature have not increased the likelihood of low yields. This is because the overall warming conditions reduce the risk of frost early and late in the season. Conversely, a peculiar cooling trend during the summer period attributed to agricultural land use is beneficial for yields when crops are most sensitive to high temperatures. Our study provides a detailed understanding of the current relationship between climate and soybean yields in the US. This is particularly relevant for adaptation and mitigation strategies aimed at avoiding low yields in a context of increasing food demand and climate change.