

## Consistent negative response of US crops to high temperatures in observations and crop models

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High temperatures are detrimental to crop yields and could lead to global warming-driven reductions in agricultural productivity. To assess future threats, the majority of studies used process-based crop models, but their ability to represent effects of high temperature has been questioned. Here we show that an ensemble of nine crop models reproduces the observed average temperature responses of US maize, soybean and wheat yields. Each day above  $30^{\circ}$ C diminishes maize and soybean yields by up to 6% under rainfed conditions. Declines observed in irrigated areas, or simulated assuming full irrigation, are weak. This supports the hypothesis that water stress induced by high temperatures causes the decline. For wheat a negative response to high temperature is neither observed nor simulated under historical conditions, since critical temperatures are rarely exceeded during the growing season. In the future, yields are modelled to decline for all three crops at temperatures above  $30^{\circ}$ C. Elevated CO<sub>2</sub> can only weakly reduce these yield losses, in contrast to irrigation.