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Faculty Abstract

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Crops and Temperature Extremes: Damage, Prediction, and Adaptation.

ABSTRACT: High temperatures damage crops, and the warming expected in coming decades raises concerns regarding future yields. This talk briefly reviews several lines of work to model crop damage from high temperatures, quantify potential adaptation to hotter conditions, and improve prediction of changes in extreme temperatures.

Sensitivity of US maize yield to high temperature varies by an order-of-magnitude across climate zones. Using this extant adaptation across space as a proxy for adaptability to future warming suggests that production losses in the Southern US from a moderate warming of mean temperature would be counterbalanced by increased Northern production. Changes in other moments of the temperature distribution are also possible, of course, and we identify significant trends in variance and skew to accompany mean warming. Curiously, the hottest growing season temperatures in the US Midwest are found to be trending cooler. Only a small fraction of Midwest cropland is irrigated, and the wider cooling effect appears to be that agricultural intensification is associated with greater capacity for transpiration. Crops increasingly cool ambient air temperature through evaporation, though this moderating effect is lost during drought conditions, whereupon temperatures revert back to historic highs. Finally, in exploring long-range prediction of heat waves, we identify a mode of ocean-atmosphere variability in the mid-latitude Pacific that permits for skillful predictions more than 40 days in advance. If this predictive horizon can be further extended, perhaps through improved ocean forecasting, heat-wave probabilities could be factored into planting decisions.