

Are We Approaching a Water Ceiling to Maize Yields in the United States?

Background/objective

Atmospheric vapor pressure deficit (VPD), the driver of crop water loss (evapotranspiration; ET), is projected to increase from ~2.2 kPa today to ~2.7 kPa by midcentury, primarily due to temperature increase. Our objective was to investigate if an increase in VPD without irrigation will create a ceiling to future increases in maize yields.

Approach

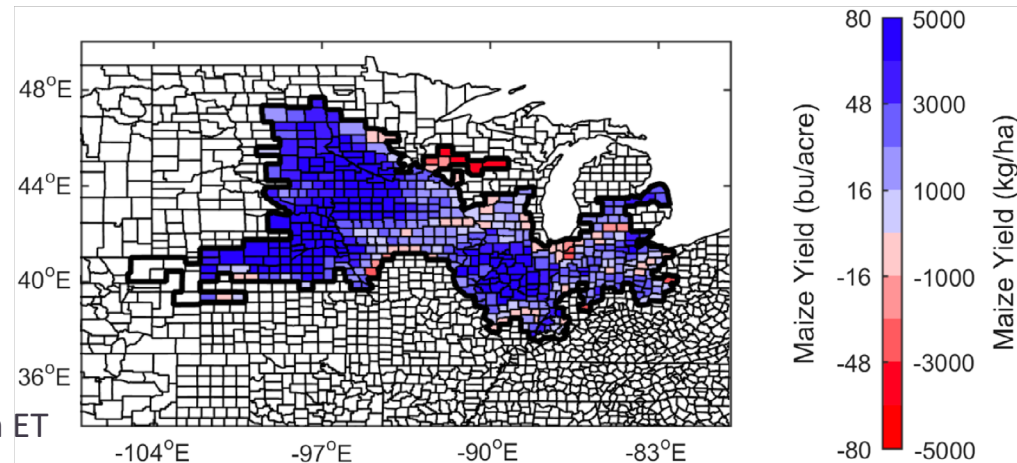
- ❖ We calculated current and future growing season ET based on biomass, water use efficiency, and the amount of yield these levels of ET would support for maize production in the Midwest U.S.
- ❖ We assumed increased grain production will necessitate proportional increases in biomass and ET.

Results

- ❖ As VPD increases, maintaining current maize yields (2013-16) will require greater than threefold expansion of irrigation in areas currently supported by rain.
- ❖ The average currently projected yield for 2050 would not be possible under predicted increases in VPD, creating a water ceiling to maize yields.

Significance

- ❖ Substantial increases in maize yields — and the production of high-yielding grasses for bioenergy — will require developing cultivars with greater water use efficiency, a trait that has not been a priority for breeders in the past.



Difference between the projected maize yields by 2050 and the maximum projected yield under current precipitation but with the future projected atmospheric VPD in 2050