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Climate Change Impacts on Maize-Yield Potential in the Southwestern United States

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Climate Change Impacts on Maize-yield Potential in the Southwestern United States

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Abstract

Agricultural productivity is strongly dependent on local climate conditions determined by meteorological parameters thus assessing the potential impact of the climate change and variability on regional agricultural systems has become crucial. To ensure food security, it is required to find under performing regions to investments and assess yields change in high-performing regions in coming decades under climate change and variability. In this study, we investigate the response of maize yield potential (Yp) on climate change scenario using Agricultural Production Systems sIMulator (APSIM) crop model over the Southwestern U.S. (SWUS) region.

APSIM's modules are essentially point-based models representing the system at a single point in space. We develop automated modeling framework (ApsimRegions, 2013), which allows the APSIM to be run over a large domain with about a thousand points over the study area. Using 21-year period (1991-2011) of North American Regional Reanalysis (NARR) data, we perform sensitivity test of the maize Yp to assess the relative contribution of climate variables, by adding standard deviation of the climatological values. The results show that maximum and minimum temperature greatly contribute to the variation of maize yields over the SWUS on the interannual time scale, depending on geographical locations with varied local climates.

In order to access data of present and future climate, we have completed high-resolution regional climate simulation by dynamically downscaling general circulation model results (GFDL-ESM2M) using regional climate models

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(WRF and OLAM). In this study, 20 years of integration period is selected in both historical period (1981-2000) and future period (2031-2050). The potential maize yields in the future period under the RCP8.5 greenhouse gas concentrations pathways show that the yields are significantly changed comparing to the historical period. In the generally rising temperature regime, the projected Yp shows strong geospatial variations according to the regional climate characteristics.

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Keywords: **Regional climate change; yield potential; crop model; regional climate model; maize; Southwestern United States**