

Impact of Soil Moisture Under Climate Change on Crop Yield - A Case Study of Rainfed Corn in Central Illinois

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ABSTRACT

Today the changes in weather risk factors for agriculture at the local level still remain highly speculative. Among various reasons, the following two are notable: First, regional and local climate change remains more uncertain; second, the details of climate change at the local scale are not clear or not included in the impact analysis. This paper exploits the impact of possible climate changes in 2055 on crop yield from a soil water balance perspective. A systematic approach is developed to quantify uncertainties in climate change projections, and incorporate those uncertainties into the generation of probability-based intra-seasonal weather at a local scale. The approach is applied to Central Illinois, the heartland of the cornbelt. The outputs show that in 2055 significant intra-seasonal variance may occur with the change of temperature, precipitation, and solar radiation in the cornbelt region. A drier and hotter summer during the corn growth season and wetter and warmer pre- and post-crop seasons is projected, which will cause soil water deficit levels to increase significantly in the flowering and yield formation stages, resulting in more variability and vulnerability in 2055 than at present. Considering crop production as a function of water balance, it is found that the rainfed corn yield in Central Illinois will decline significantly with the mean value declining by 13-21%, and exceedance probability of the mean value declining from 80%-95% at present to 30%-68% in 2055. This shows that the yield in 2055 may come out below the mean level at a probability of 32%-70%, a high risk.

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