Transforming Climate Variability and Change Information for Cereal Crop Producers

Intent of Objective 1:

Use existing data to develop a knowledge base of potential biophysical and economic impacts related to climate changes and consider the relative risks they pose. We hope to better understand the contributions of anomalous weather to crop productivity and implications for future management options.

Two primary goals have been identified:

1. Run several crop simulation models on a gridded data set across the entire 12-state region.
2. Identify impacts of climate and management decisions on crop yields and farm profitability.

Research produced by the Objective 1 working group will be used in the development of decision support tools for farmers and farm advisors in project years 3-5 (2013-2016). Key climate-related issues addressed by Objective 1 include:

a. impact of timing of nitrogen application on corn yields for heavy rain conditions as well as under different climate scenarios
b. impact of weather and climate on soil moisture and resulting fieldwork opportunities
c. impact of planting date on yield
d. climate and crop cultivar growing degree/maturity group requirements
e. end of season crop dry-down rates
f. economic feasibility of climate-affected longer term investments in cropping systems, such as irrigation or tiling

Approach:

Three models (DSSAT, Hybrid-Maize, and ISAM) will be used to simulate crop yields under past and future climate conditions. The models are being calibrated and validated using high quality site-specific climate, agronomic, and soil data from across the region. Supplementary county-level agronomic data will be referenced as needed in data-sparse locations. In early 2012, the models will be run on a 4-km grid spanning all 12 states using, when possible, common historical NLDAS[1]-based gridded data. The results will be an ensemble of crop simulation (yield) output from 1979-2010 and high resolution datasets for soil moisture, soil temperature and evapotranspiration. Gridded and site-specific model inputs and outputs will be managed and visualized using the HUBzero™ web-based collaboration environment. The HUB will play a critical role in establishing a common platform for model simulations and data access within and across project objectives.

[1] North American Land Data Assimilation System (NLDAS)

Spatial and temporal trends of simulated and observed agro-climatological variables for historical and projected future periods will be analyzed. We will look at the connection between yields and anomalous (below normal/ above normal) climatic conditions (seasonal/ sub-seasonal temperature and rainfall). Long-term analysis, preferably back to 1900, will be assessed at several individual Historical Climatology Network sites in the region. Potential future impacts of climate on crop yields will be investigated at representative locations using statistically downscaled NARCCAP[2] climate scenarios (2041-2070). From the gridded and location-specific analysis, critical thresholds, correlations, and analogs will be identified, forming the basis of our decision support tools.

An assessment of historical National Agricultural Statistics Service (NASS) Field Work Days (FWD) data is underway for crop reporting districts in Indiana, Illinois, Iowa, and Missouri. Initial analysis will look at correlations with precipitation, temperature, and soil moisture. This information will be used to quantify changes in field work opportunities over time (1980-2010) and the role of climate-related variables that explain experienced FWDs. Estimated historical relationships and downscaled climate predictions will be used to evaluate changes in field work opportunities due to climate change, with a focus on planting and harvest periods.

The interaction of climate-related variables and nitrogen application/timing (e.g. fall post-harvest, spring pre-plant, split application, etc.) will be investigated as it relates to field work opportunities, yields, and crop management decisions. An assessment of currently available nitrogen decision tools and producer needs is underway. A plan for addressing this task is being developed, and work will begin in mid-2012.

Also beginning in mid-2012, we will develop four case studies based on typical corn-based farming operations in Indiana, Iowa, Michigan, and Nebraska. Crop mix, rotation, and other management practices affecting profitability will be evaluated using an economic optimization model to determine how optimal crop management decisions may change under future climate scenarios.

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[2] North American Regional Climate Change Assessment Program

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