

Climate Impact Modeling and Analysis Project (CIMAP)
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ABSTRACT

The specific objectives of CIMAP are: 1) To evaluate the performance of two identically-prepared process-based crop models (EPIC and CERES) forced with historical climate data by comparing individual components among the models and their outputs with observations; and to perform sensitivity analysis on model components. Our objective is to determine why two models purporting to simulate the same quantities produce divergent results using the same input climate data. 2) To determine the degree to which the EPIC and CERES models accurately predict observed yields under historical climate conditions that approximate those of climate change (i.e., growing seasons with excessive heat and moisture or drought) in order to establish a reference point for the accuracy of yield estimates derived of climate change scenarios.

The geographic focus of this research is on grain sorghum production in the southern and central Great Plains. Grain sorghum is a major feedgrain grown in the region and is of interest because of its potential for expansion because of its ability to tolerate heat and dry conditions—it is often cited as a potential alternate to corn and soybeans in coping with climate change in the Great Plains.

The specific research questions to be answered in this research are: 1) How accurately do process crop models simulate historical (NASS, experimental) Great Plains crop yields?: a) for the full range of climate conditions experienced over the historic record (1960-1995), and b) for subsets of years representing extremes in temperature and/or precipitation. 2) How accurately do component parts of process crop models (e.g., CO₂ fertilization schemes, thermal time schemes, photosynthesis schemes) reflect experimental data that were observed independently of data used to construct model algorithms? Which components are most accurate and which ones are least accurate?

The approach used in this research is to create identical input files for the EPIC and CERES crop simulation models consisting of soils, management, and climate data for several sites in the main sorghum production area of the southern and central Great Plains. Climate data are derived from the NOAA-HCN, soils data from STATSGO, and crop yield data from the NASS. In addition, crop trial data (including yields) will be acquired from Experiment Station experiments. The models will be compared with respect to phasic development, morphological development (temperature-driven), expansion growth, and 4) mass growth. Yield simulations will be compared with NASS observed yields and experimental yields under different classes of climate variability in historical climate record.

Deliverables will include: A fully documented, web-based, searchable database initially to be used to facilitate data exchange among participants and eventually presented on an updateable public outreach web site. Monographs and web-based summaries of crop model comparisons, with journal articles immediately to follow. A computerized probability distribution suitable for use in constructing and/or evaluating impact sub-models in integrated assessment models will be developed—journal articles will follow.