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DAYCENT assessment under multiple treatment-measurement scenarios in bioenergy sorghum production

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Abstract: Intermediate complexity biogeochemical models are usually composed of several sub-models which are interrelated. Model assessment using a single treatment or measurement may not be adequate to fully examine the comprehensiveness of model use in actual production or has the risk of biased parameterization. In order to evaluate the simultaneous performance of all sub-models in DAYCENT and the model capability in reflecting the effects of various field management practices, the model was parameterized using field measurements of soil temperature and water, aboveground biomass carbon (C), soil organic C (SOC), and carbon dioxide (CO_2), and nitrous oxide (N_2O) emissions from an 8-year field trial of bioenergy (biomass) sorghum with treatments of residue return, nitrogen (N) fertilization, and tillage. An overall satisfactory fit was obtained when comparing simulated outputs to measured data, with a Nash-Sutcliffe efficiency (NSE) range of 0.2-0.8. However, future model development directions were also suggested by model limitations indicated by model prediction results. First, there was limited yield differences among different residue return levels with sufficient fertilization. The reason might be the model does not include a mechanism to represent increases in soil water holding capacity resulting from incorporated litter. Second, a smaller SOC drop was demonstrated for early harvest seasons followed by high precipitation. This could be caused by model's sensitivity to the impact of soil moisture content on SOC decomposition did not accurately represent field observations, Third, underestimation of plant yield and greenhouse gas (GHG) emissions was shown in treatments with N limitation. The possible deficiency is DAYCENT does not explicitly model SOC distribution throughout the soil profile, only to a conceptual 20-fcm depth.

Keywords: DAYCENT; model assessment; bioenergy sorghum