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Assessing Suitability and Benefits of Cover Crops in Illinois
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One-page summary:

An integrated approach to assessing cover crops as an adaptation to improve resilience of the US Midwest agroecosystems

The US Corn Belt produces nearly 45% of the world's corn and roughly 30% of the world's soybeans, forming the backbone of the US agricultural economy. How to make this critical US Midwestern corn-soybean agroecosystem more resilient and continuously lead the global crop production is a great challenge. Cover crops have been proposed as a straightforward and promising adaptation to increase the resilience and sustainability of the US Midwestern agriculture. However, the current knowledge on the impact of cover crops remains limited and localized, and thus the adoption rate of cover crops has been low. To address these critical gaps, we used a comprehensive and integrated approach to assess the impact of cover crops at the regional scale for the State of Illinois. We will use data synthesis (field level data and literature) and advanced process-based modeling to assess the suitability and potential benefits (e.g. biophysical, agronomical and environmental aspects) of proposed cover crop practices under current and future climate conditions, combined with economic analysis to assist farm management decisions. We will disseminate the results to a large pool of audiences, including farmers and policymakers, through Illinois Farm Economic Summits and farmdoc forum. In this project, we will focus on the suitability and economic assessment of the two dominate cover crops for Illinois, i.e. cereal rye (grass) and hairy-vetch (legume).

In the year of 2019, we mainly focus on the process-based modeling by conducting implementation and validation work (Object 2). We finished the tuning and validation of *Ecosys* in (1) simulating carbon-water-energy flux and carbon allocation among organs at flux tower sites, (2) simulating corn and soybean yield at regional scale over the 3I states, and (3) simulating cover crop (ryegrass) biomass growth. For the flux-tower scale validation, we found that *Ecosys* simulated GPP, NEE, LE, and LAI matched well with the observations, and the simulated carbon allocation is also consistent with the observations. The excellent performance of *Ecosys* model in the surface carbon-water-energy flux simulation ensures the application of *Ecosys* model for the current and future climate scenario assessment. For the regional scale corn and soybean yield simulation, the spatio-temporal patterns of *Ecosys* simulated corn and soybean yield are consistent with those of USDA NASS reported crop yield after calibrating the external ground water distance and rubisco carboxylation of corn and soybean. The excellent performance of *Ecosys* model in the surface carbon-water-energy flux and crop yield simulation ensures the application of *Ecosys* model for the current and future climate scenario assessment. For the cover crop biomass simulation, the tuned *Ecosys* model could simulate the biomass growth of cover crop with a high R^2 (0.86) and low bias (-5%), which ensures the assessment of the benefits of cover crop at regional scale using *Ecosys* model.

With the good performance of site-scale cover crop biomass simulation and regional-scale crop yield simulation, we will test the suitability of cover crops in the current and future climate conditions, and to answer where, when and how cover crops will be suitable, assess the potential benefits of cover crop and quantify the model uncertainty in 2020.

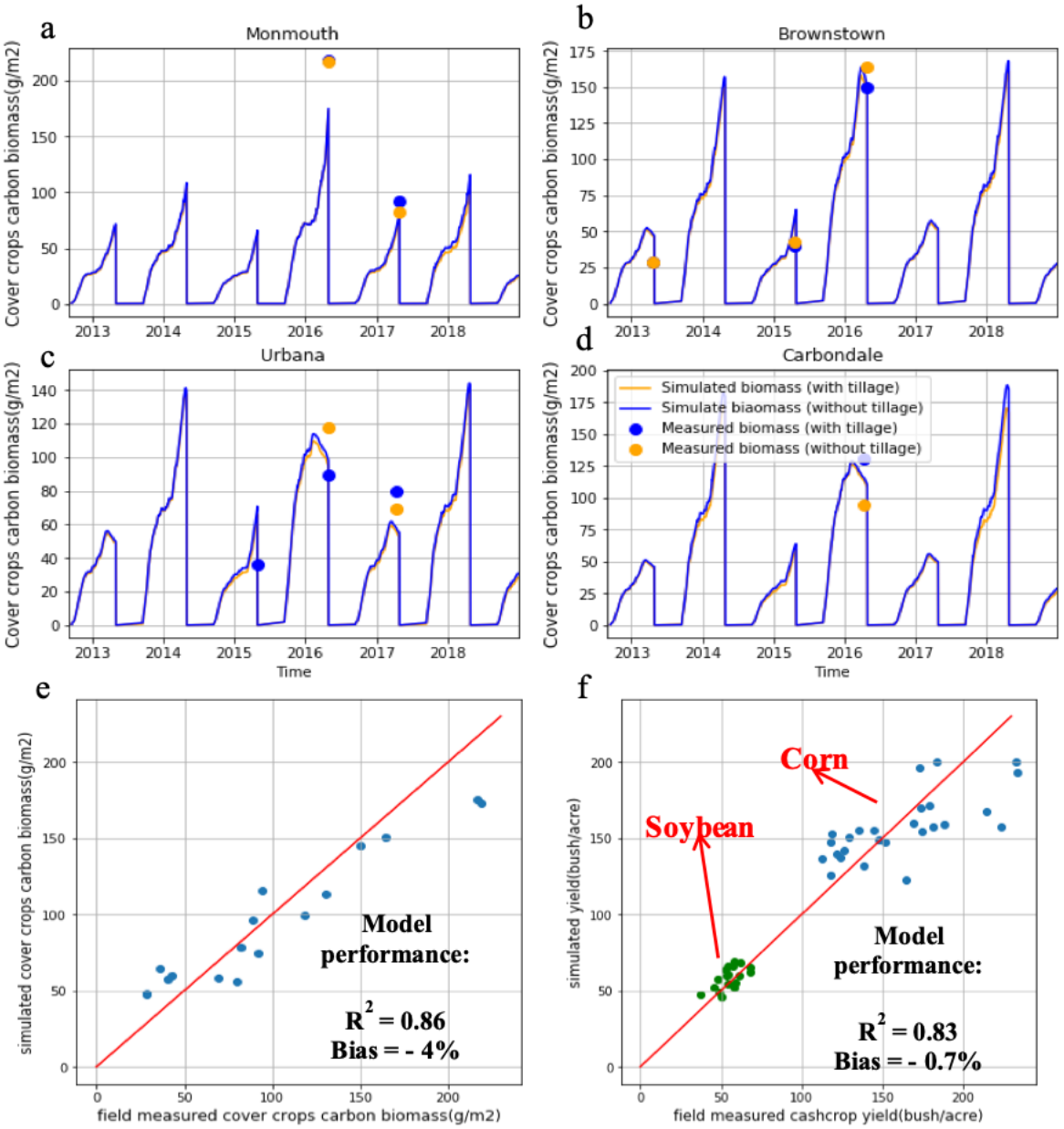

Fig. 1. Comparing simulated cover crop biomass (a-e) and cash crop yield (f) with site measurements. All the sites located in Illinois. Cover crop type is Rye Grass.