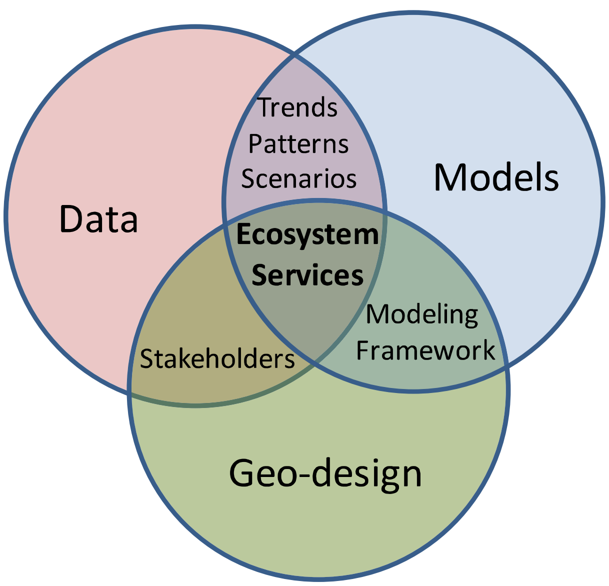
United States Department of Agriculture
Agricultural Research Service

Modeling Complexity in Agro-Production Systems
Proposed Research

Grazinglands Research Laboratory, El Reno, Oklahoma May 2017

Rationale: Agriculture is facing and will continue to face major challenges such as how to adapt our agro-production systems to limited water availability, improve yields to satisfy increasing demand for food production, and decrease environmental footprint. Addressing these challenges requires a thorough understanding of the fundamental biophysical and societal interactions at the local and regional scales in order to determine cost-effective adaptation plans. These systems are at the core of our societies, complex, and sustain our standard of living in which large scale experimentation is far an option. Today's actions have short and long term repercussions on the future that are difficult to predict. As a result, we rely on idealizations, computational models, expertise, and communities' feedbacks and perceptions to assess and quantify future outcomes of plausible scenarios in order to minimize the risk of undesired impacts while optimizing societal benefits.



Climate and water variability (runoff and groundwater) are dominant to the challenges faced by our agro-production system. Understanding the processes and interactions that drive significant changes in agro-production is central when implementing measures to ensure sustainability in agriculture. To achieve this, we rely on the capacity of models, expertise, and societal feedbacks to assess and quantify long-term historic and future responses in a realistic manner. Currently, most models use simplified equations to represent the complex environment without incorporating societal dimensions when exploring the impacts of probable future scenarios. Furthermore, advances in data collection techniques and analytics have resulted in a plethora of information that these models cannot incorporate as currently structured. As a result, these models simplify richer available spatio-temporal data that can provide significant details necessary to reduce the uncertainty associated to model prediction.

Objective: Our long-term goal is to better understand vulnerabilities and resilience of agro-production systems under changing scenarios (climate variability, population growth, economic stressors, urbanization expansion, groundwater depletion, and management), and their impacts on ecosystems services at local and regional scales.

We aim to promote capacity building, strengthen inter-institutional collaboration, encourage stakeholder engagement, and train and educate the next generation of scientists and practitioners to collectively address the challenges of an uncertain future.

What we are doing: We are idealizing and developing an integrated modeling framework to better represent fluxes of biophysical variables that take advantage of big data, with the capacity to incorporate feedback information from our stakeholders. We aim to improve the prediction of the responses of our agro-production systems, reduce uncertainties, and provide better decision making tools.

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