

Multiscale crop modeling effort required to assess climate change adaptation

May 14 2020, by Lois Yoksoulian



Researchers Bin Peng, left, and Kaiyu Guan led a large, multi-institutional study that calls for a better representation of plant genetics data in the models used to understand crop adaptation and food security during climate change. Credit: Fred Zwicky

Crop modeling is essential for understanding how to secure the food

supply as the planet adapts to climate change. Many current crop models focus on simulating crop growth and yield at the field scale, but lack genetic and physiological data, which may hamper accurate production and environmental impact assessment at larger scales.

In a new paper published in the journal *Nature Plants*, researchers identify a series of multiscale and multidisciplinary components—from crop genetics up to global factors—that are critical for finding environmentally sustainable solutions to food security.

Many crop models focus on understanding how plant characteristics such as leaf size play into the crop yield at the field scale, the researchers said. "Modeling at this scale is critical, but we would like to incorporate information from gene-to-cell and regional-to-global scale data into our modeling framework," said Bin Peng, a University of Illinois at Urbana-Champaign postdoctoral researcher and co-lead author.

The study identifies components that could help generate a more informative modeling framework. "Multiscale modeling is the key to linking the design of [climate change](#) adaptation strategies for crop and field management with a large-scale assessment of adaptation impact on crop production, environment, climate and economy," Peng said.

The study calls for a better representation of the physiological responses of [crops](#) to climate and environmental stressors—like drought, extreme rainfall and ozone damage. "Many physiological processes would be important to simulate the crop growth under stressed conditions accurately," Peng said. Examples include water moving from soil to plant to atmosphere driven by canopy energy balance, he said.

"We should also include a better representation of crop management," Peng said. "That would be extremely important for assessing both crop production and environmental sustainability, as well as their tradeoffs."

The researchers said there are opportunities to close a variety of data gaps, as well. "Integration of remote-sensing data, such as the work performed in our lab, will be extremely valuable for reducing data gaps and uncertainties," said natural resources and environmental sciences professor and project investigator Kaiyu Guan. "One of the advantages of remote sensing is its vast spatial coverage—we can use remote sensing to constrain crop models over every field on the planet."

The authors also propose a model-data integration pathway forward. "Doing the right simulation of crop responses to climate change factors is critically important," Guan said. "The most challenging part is whether crop models can capture those emergent relationships, which can be derived from empirical observations."

"No single scientist or research lab can produce these models on their own," said study co-author and plant biology professor Amy Marshall-Colón. "This type of effort will require patience and collaboration across many disciplines."

More information: Bin Peng et al, Towards a multiscale crop modelling framework for climate change adaptation assessment, *Nature Plants* (2020). [DOI: 10.1038/s41477-020-0625-3](https://doi.org/10.1038/s41477-020-0625-3)

Provided by University of Illinois at Urbana-Champaign

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