Existing crop models can forecast yield in uncertain climate conditions

August 27 2015, by Darrin Pack

A study led by Indiana State Climatologist Dev Niyogi of Purdue University has determined that existing crop models can reliably forecast corn yields during times of climate variability, specifically the El Niño and La Niña systems that influence temperature and precipitation in certain growing seasons.

Knowing what kind of yield to expect even in uncertain growing conditions should help climatologists, farmers, agricultural planners and public policymakers more effectively manage the global food supply, Niyogi said.

"We talk about climate change, which occurs over time, but we all experience climate variability," Niyogi said. "This study proved that the models we use for looking at long-term trends are equally accurate for the shorter term, although there will still be anomalies, as we experienced this year."

He noted that the torrential rains that caused flooding and damaged crops across parts of the Midwest this season were not a result of El Niño or La Niña but an uncommon confluence of weather systems.

"Now that we have proven the validity of the concept, we can perhaps begin to think about ways of capturing data from this year so we can develop models for similar conditions in future years," Niyogi said.

The study, part of the Useful to Useable climate initiative at Purdue, was

designed to find out whether existing crop models could accurately capture the impact of previous El Niño and La Niña events on corn yields in the Midwest and whether there was a significant difference in accuracy between local and regional observations.

El Niño and La Niña are phases of the El Niño-Southern Oscillation cycle, also known as ENSO, a term for fluctuations in surface and atmospheric temperatures in the Pacific Ocean. The ENSO cycle has a significant, although temporary, impact on global weather. ENSO systems typically last 9-12 months.

Previous studies have shown that El Niño years tend to be cooler and wetter across the Midwest Corn Belt, resulting in higher corn yields. La Niña years have proven to be warmer and drier, with lower yields.

Based on the Ocean Niño Index, Niyogi and his team identified seven growing seasons that were influenced by El Niño and six impacted by La Niña during the period of 1981 to 2010. The team then ran yield simulations using three crop models of varying complexity and compared the results to the U.S. Department of Agriculture actual yield data for those years.

The study showed that there was no significant difference in the outcomes between the two site-specific models that were tested - Hybrid-Maize and Decision Support System for Agrotechnology Transfer - and the Integrated Science Assessment Model, which can function on a local, regional or global scale.

"One of the challenges in developing climate assessments is that we don't have data from our backyard," Niyogi said. "What we found is we should not be limited by lack of local information. We should have confidence in regional datasets to develop future projections."

Xing Liu, a graduate research assistant on the project, said the findings could lead to more accurate short-term yield forecasts.

"The regional assessments not only can be used by agricultural research communities, but also can provide useful information to policymakers," she said.

Otto Doering, a Purdue agricultural economist and member of the research team, said using the models to look at future conditions could change how growers plan their operations. If the models forecast lower yields due to drought conditions from a La Niña event, for example, a farmer might decide to invest in irrigation.

"If we have crop growth models that can track the impact of climate variability, we can look at economic costs into the future," he said. "In terms of new tools to manage decisions, this is really neat."

More information: "Crop models capture the impacts of climate variability on corn yield." *Geophys. Res. Lett.*, 42, 3356–3363. DOI: 10.1002/2015GL063841

Provided by Purdue University