OKLAHOMA EPSCoR UPDATE

Promoting Innovative Research

OK NSF Established Program to Stimulate Competitive Research | April 2021

Improved capacity for predicting gross primary production and grain production of maize and soybean agroecosystems in CONUS

Maize and soybean agroecosystems play an important role in food security and the carbon cycle. The U.S. is a major producer and top exporter of maize and soybean. Inter-annual change on maize and soybean planted and harvested areas as well as grain production in the contiguous U.S. (CONUS) affect the world trade and markets in grains. Accurate and timely information on maize and soybean production in the CONUS is vital for the agriculture sector and in the regional and global food security.

Hence, Dr. Xiangming Xiao from the University of Oklahoma's Department of Microbiology and Plant Biology led a team of graduate students, post-doctoral researchers and research scientists (Xiaocui Wu, Zhenwei Yang, Jie Wang, Jean Steiner, and Rajen Bajgain) in determining spatial-temporal dynamics of maize and soybean planted area, harvested area, gross primary production and grain production in the CONUS.

"We developed the Vegetation Photosynthesis Model (VPM) to estimate gross primary production (GPP) of crops, grass, and forests," Xiao said.

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By combing satellite images from the Moderate Resolution Imaging Spectroradiometer (MODIS), climate data, and USDA Cropland Data Layer data at 30-m spatial resolution, the team ran VPM over the 2008-2018 period and generated GPP data product (g C/m^2/day) of maize and soybean agroecosystems in the CONUS (Figure 1). The team quantified the relationships between

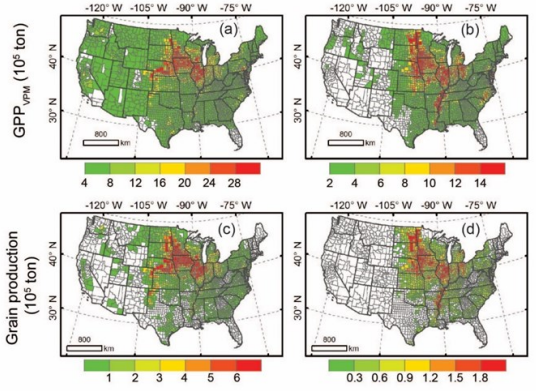

Figure 1. Spatial distributions of gross primary production (GPP) and grain production (GP) of maize and soybean in the CONUS at the county scale from the VPM model (Fig.1a&b) and USDA

GPP and grain production of maize and soybean at the county scale (Figure 2a&b). The team also used GPP to explore in-season forecast of county-scale maize and soybean grain production. By the end of July, GPP accounts for ~90% of variance in maize and soybean production (Fig. 2c&d), approximately two months before farms started to harvest. "We found strong relationships between GPP and county-scale grain production of maize and soybean," Xiao said.

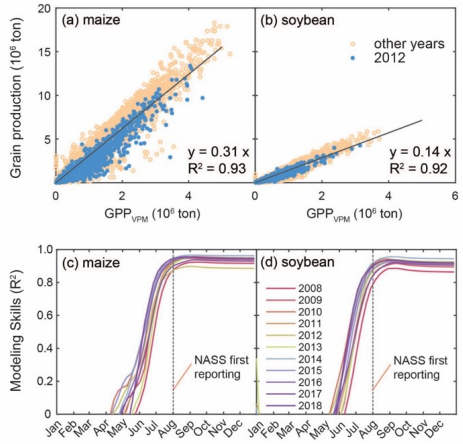

Figure 2. The relationship between gross primary production (GPP) and grain production (GP) of maize and soybean from the VPM model and USDA NASS agricultural statistics at the county scale (Fig. 2a&b) and the modeling skill (performance) of in-season forecast by using cumulative GPP over time to predict annual gran production (Fig. 2c&d).

"Our research demonstrates the potential of using GPP from VPM to improve in-season forecast and year-end estimation of maize and soybean grain production in CONUS at the county scale. These modeling tools and data products could help stakeholders make data-based decision in crop production, trade, and food security," Xiao added.

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