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Phenology and gross primary production of maize croplands from chlorophyll light absorption, solar-induced chlorophyll fluorescence and CO_2 flux tower approaches

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It is important to accurately quantify cropland gross primary productivity (GPP) for monitoring cropland status and the carbon budgets. Both sattellite-based light-use efficiency (LUE) models and process-based terrestrial biosphere models (TBM) have been widely used to quantify cropland GPP at different scales. Space-borne solar-induced chlorophyll fluorescence (SIF) has recently shown the ability to monitor photosynthesis from space. In this presentation, we compared the three approaches for estimating seasonal dynamics and magnitudes of maize cropland GPP during 2007-2011 at a cropland site in Nebraska, USA. Three approaches used were a satellite-based Vegetation Photosynthsis Model (VPM) with the concept of light absorption by chlorophyll, the process-based Soil-Canopy Observation of Photosynthesis and Energy (SCOPE), and space-borne SIF. Validations against flux tower estimates demonstrate that maize GPP can be accurately estimated with the three models. The SCOPE model provides the best simulation of maize GPP by incorporation of satellite SIF measurements. On the other hand, satellite-based VPM model shows the potential for scaling-up GPP estimation of intensified managed croplands with higher spatial resolution data from MODIS. The results show that the space-borne SIF data can be simply and directly used not only to monitor actual photosynthesis of crop without much ancillary information, but also to improve cropland GPP modeling by constraining process-based TBM.