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Can Upscaling Ground Nadir SIF to Eddy Covariance Footprint Improve the Relationship Between SIF and GPP in Croplands?

Background/Objective

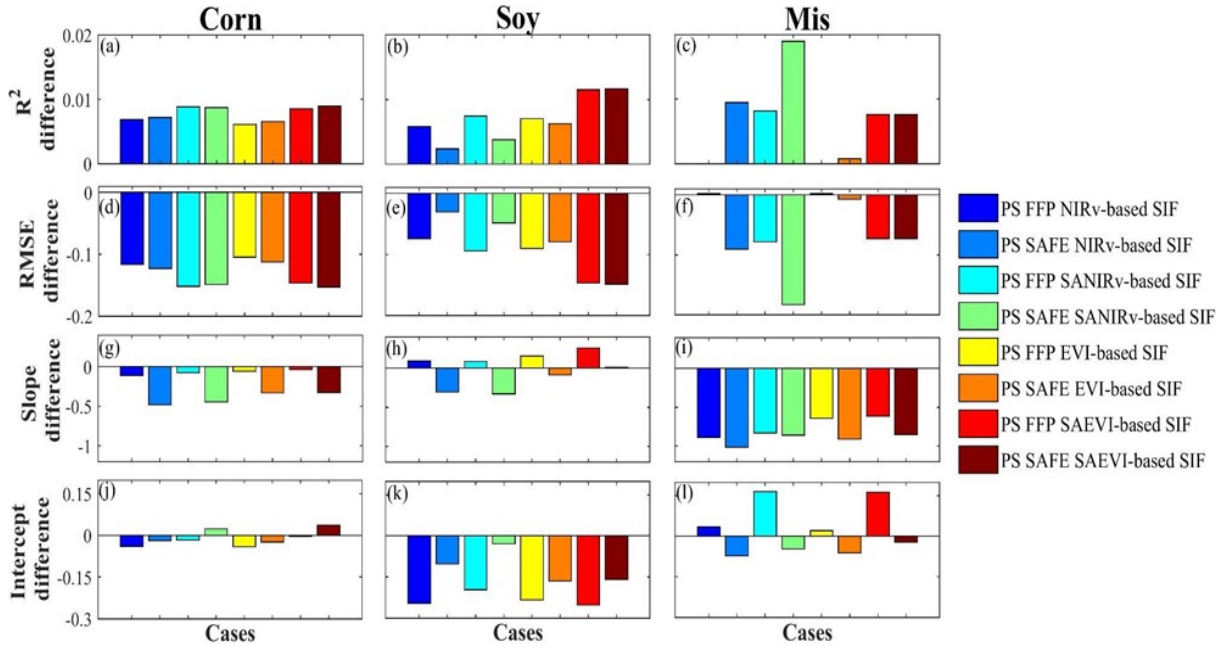
- Ground solar-induced chlorophyll fluorescence (SIF) is important for the mechanistic understanding of the dynamics of vegetation gross primary production (GPP) at fine spatiotemporal scales.
- However, eddy covariance (EC) observations which are commonly used to calculate GPP generally cover larger footprint areas than ground SIF observations (a bare fiber with nadir). This footprint mismatch between nadir SIF and GPP could complicate canopy SIF-GPP relationships.
- This work aims to upscale tower SIF measurements to the EC footprint to facilitate understanding the potential of SIF in bioenergy crop GPP estimation.

Approach

Satellite vegetation indices (VIs) with high spatiotemporal resolutions were used to upscale ground nadir SIF to the EC footprint across 13 site-years for corn, soybean, and miscanthus. Different VIs, satellite data, and EC footprint models were used.

Results

SIF-GPP relationships were not substantially changed after upscaling nadir SIF to the EC footprint under any of the three cropping systems. Different VIs, EC footprint models, and satellite data led to marginal differences in the SIF-GPP relationships when upscaling nadir SIF to EC footprint.



The overall half-hourly SIF-GPP relationship change (R^2, RMSE, regression slope, and intercept) after the SIF footprint correction for each species. A total of 8 cases using PlanetScope (PS) data, two EC footprint models (FFP and SAFE), and four VIs (NIRv, SANIRv, EVI, and SAEVI) were considered. All cases led to marginal change in SIF-GPP relationships after nadir SIF upscaling.

Significance/Impacts

Our study demonstrated that the spatial mismatch between ground nadir SIF and GPP might not significantly affect the SIF-GPP relationship and may improve remotely sensed photosynthesis and yield estimates in largely homogenous croplands such as bioenergy cropping systems.

Wu et al. 2023. "Can Upscaling Ground Nadir SIF to Eddy Covariance Footprint Improve the Relationship Between SIF and GPP in Croplands?" *Agricultural and Forest Meteorology.* DOI:10.1016/j.agrformet.2023.109532.