Ground Far-Red Sun-Induced Chlorophyll Fluorescence and Vegetation Indices in the US Midwestern Agroecosystems

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Background/Objective

- Sun-induced chlorophyll fluorescence (SIF) provides an opportunity to study terrestrial ecosystem photosynthesis dynamics. However, mechanistic interpretation of signals from spatiotemporally coarse satellite SIF is challenging.
- Long-term ground SIF and vegetation indices (VIs) are important for satellite SIF validation and mechanistic understanding of the relationship between SIF and photosynthesis when combined with leaf and canopy-level measurements.
- This work provides a complete data processing protocol for ground far-red SIF and VIs.

Approach

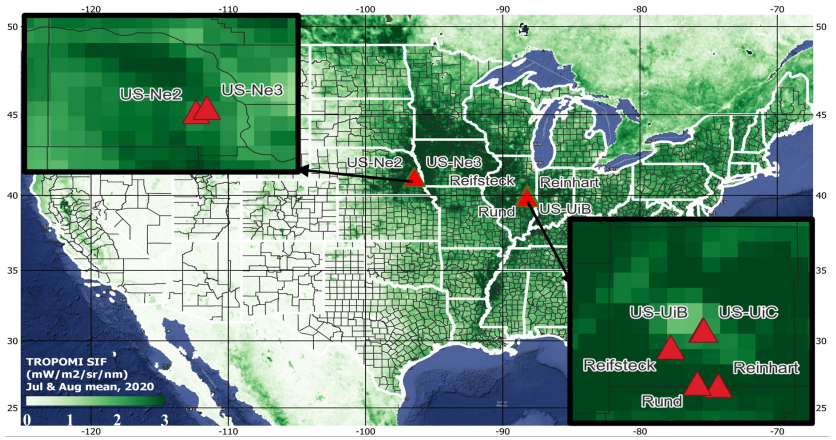
We analyzed 15 site-years of ground far-red SIF and VIs datasets from soybean, corn, and miscanthus grown in the U.S. Corn Belt from 2016 – 2021. The comprehensive data processing protocol includes different retrieval methods, calibration coefficient adjustment, and nadir SIF footprint upscaling to match the eddy covariance footprint.

Results

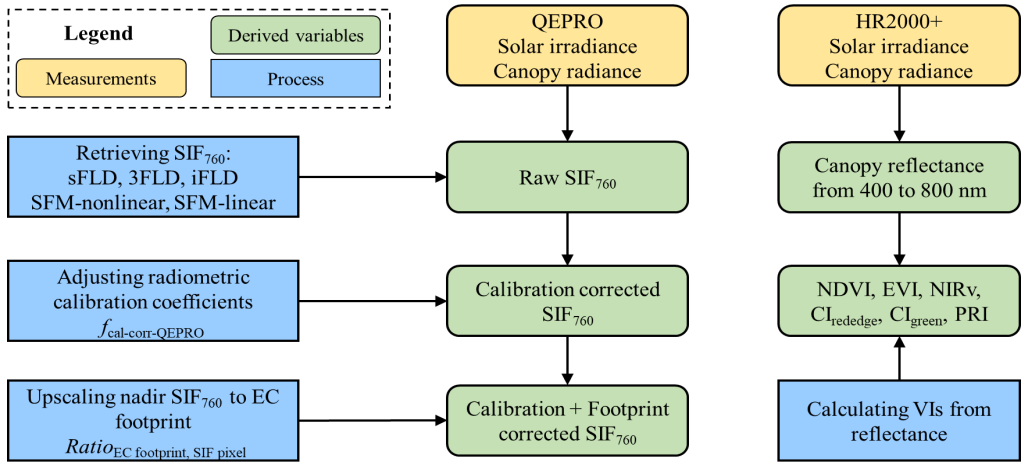
Various analytical approaches and comparisons have collectively corroborated the reliability of the dataset. For this dataset, we recommend the use of the iFLD-based SIF_{760} retrieval. Additionally, adjusting the radiometric coefficients caused by the degradation of the calibrating light source through cross-validation was essential, while upscaling ground nadir SIF_{760} to the eddy covariance flux footprint may not be necessary in the context of this dataset.

Significance/Impacts

This work both introduces a comprehensive data processing protocol and provides important data for far-red SIF interpretation as well as an understanding of the mechanistic relationship between far-red SIF and canopy photosynthesis across different crop species and environmental conditions.



Ground sites in US Midwestern agroeco-systems.



Data processing protocol.

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