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Intercomparing the utility of Landsat-, Sentinel- and HyspIRI-like observations for retrieving vegetation characteristics

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Remote sensing observations in the visible to shortwave infrared region of the electromagnetic spectrum have the potential to reliably estimate plant biochemical and biophysical properties essential for monitoring vegetation function, health and productivity. However, developing versatile physically-based retrieval methodologies that can be applied with high fidelity over a wide range of land cover types, soil background and environmental conditions is challenging, due to model uncertainties and limitations in the information carried by the radiometric signal. Regularization strategies that introduce additional information, are typically needed to increase robustness and accuracy of retrieved properties and more reliably separate soil, leaf and canopy variables.
This study applies the REGularized canopy reFLECtance model (REGFLEC) to a large dataset of reflectance spectra collected with a portable spectroradiometer over agricultural fields in California. REGFLEC facilitates joint retrievals of leaf chlorophyll and leaf area index through a multi-step LUT-based inversion approach that incorporates various spatial and temporal regularization constraints. Here, different spectral band combinations were input to the retrieval system to investigate the achievable accuracy of vegetation retrievals using multi-spectral, super-spectral and hyper-spectral data streams, respectively, as provided by current (e.g. Landsat) and up-coming satellite missions (e.g. Sentinel-2 and Hyperspectral Infrared Imager (HyspIRI)). Model performances were evaluated using an extensive dataset of measured aboveground biomass for alfalfa, cotton, maize, and rice. The study identifies optimal spectral band combinations and regularization constraints, and assesses improvements in crop biomass prediction expected from utilizing the enhanced (compared to Landsat) radiometric information content afforded by soon-to-be launched Sentinel-2 (10 spectral bands at 10-20 m resolution) and the proposed HyspIRI mission, envisioned to provide global coverage of hyperspectral data at 60 m spatial resolution.