Estimation of the light use efficiency using *in situ* hyperspectral and eddy covariance measurements

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Accurate estimation of the light use efficiency (*LUE*) is one large source of model uncertainties for *LUE* models, therefore, studies on how to effectively improve the accuracy of remote estimation models for *LUE* were especially essential.

We estimated the *LUE* via vegetation canopy chlorophyll content (CCC_{canopy}) based on *in situ* measurements of spectral reflectance, biophysical characteristics, ecosystem CO_2 fluxes and micrometeorological factors over a maize canopy in Northeast China. The results showed that among the common chlorophyll-related vegetation indices (VIs), CCC_{canopy} had the most obviously exponential relationships with the red edge position (REP) (R^2=0.97, P<0.001) and normalized difference vegetation index (NDVI) (R^2=0.91, P<0.001). In a comparison of the indicating performances of NDVI, ratio vegetation index (RVI), wide dynamic range vegetation index (WDRVI), and 2-band enhanced vegetation index (EVI2) when estimating CCC_{canopy} by using all of the possible combinations of two separate wavelengths in the range 400−1300 nm, EVI2 [1214, 1259] and EVI2 [726, 1248] were better indicators, with R^2 values of 0.92 and 0.90 (P<0.001).

Remotely monitoring *LUE* through estimating CCC_{canopy} derived from field spectrometry data provided accurate prediction of midday gross primary productivity (*GPP*) in a rainfed maize agro-ecosystem (R^2=0.95, P<0.001). This study provides a new paradigm for monitoring vegetation *GPP* based on the combination of *LUE* models with plant physiological properties.