Assessing leaf photosynthetic capacity using hyperspectral reflectance

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There are great uncertainty over the global exchange of carbon between the atmosphere and the terrestrial biosphere and an important source of it is related to the dependency of photosynthesis. Therefore, the maximum rate of carboxylation (V_{cmax}) and the maximum rate of electron transport (J_{max}) are key parameters. Walker et al (2014) reported that J_{max} was strongly related to Vcmax and thus we focused on V_{cmax} in this study.
Generally, V_{cmax} is estimated from photosynthetic CO_2 response curve and the measurements were conducted using a portable photosynthesis systems such as the LI-6400 open gas exchange system (Li-COR Biosciences, Lincoln, Nebraska, USA). However, this technique is only applicable for leaf scale and it is difficult to expand into large-scale monitoring.
Hyperspectral reflectance is one of the most attractive options for remotely estimating the biochemical, structural, and physiological traits of plant leaves and canopies based on their optical properties. Especially, the photochemical reflectance index (PRI, Gamon et al., 1992, 1997) has been used for evaluating photosynthetic status and ecosystem function. However, PRI was based on a linkage with photosystem II (PSII) efficiency by tracking the variation in xanthophyll cycle pigments, and thus it is not valid to directly evaluate photosynthetic capacity.
In this study, hyperspectral indices calculated from reflected spectra have been identified for evaluating V_{cmax} using the synchronous measurements of reflected spectra. The selection of the best indices was based on the leave one out cross validation and the ratio of performance to deviation (RPD). The result implies that the reflectance around 1600 nm and 2200 nm is useful to assess photosynthetic capacity.

Keywords: maximum rate of carboxylation, ratio of performance to deviation

