The long-term observation of PRI and LUE and phenology changes in a temperate Japanese cypress forest at Kiryu Japan.

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The light-use efficiency (LUE) of vegetation is one of the most essential parameters in production estimation models for terrestrial ecosystems. LUE generally expressed as the ratio of gross primary production (GPP) to absorbed photosynthetically active radiation (APAR). Due to the characteristic of photochemical reflectance index (PRI), which is sensitive to changes in carotenoid pigments (e.g. xanthophyll pigments) in live foliage. We recorded the canopy spectral reflectance data onto hemispherical spectroradiometers to calculate the PRI. Then we sorted and analyzed the diurnal, seasonal, and inter-annual changes of PRI to try to figure out the LUE in temperate Japanese cypress forest. We measured and recorded the CO_2 flux data onto the canopy by using the eddy covariance method to calculate the GPP. We also documented the micrometeorological data of the temperate Japanese cypress forest such as temperature, wind speed and photosynthetically active radiation (PAR) since 2014.

We made use of the digital camera to monitor the canopy phenology changes. The digital camera takes photos in 3 hours interval, and we extracted the RGB channels of image data to calculate the greenness indices.

Combining with the vegetation indices data and the phenology changes data can allow us to figure out the Japanese cypress forest phenology changes patterns and deeply knowledgeable about the relationships between PRI and LUE.

Our findings demonstrated that LUE has a good relationship with the PRI. Correlation coefficient calculated results shows that LUE and PRI significantly associated in 297 fine days ($R>0.75$). During the monitoring period, apparent seasonal and diurnal change of the PRI observed at temperate Japanese cypress forest. Furthermore, the PRI was observed that reaches the peak in September and the valley in February. We also found out distinct phenology changes patterns with the phenological analysis results. The greenness index showed similar seasonal changes with that of PRI. When the redness index reaches the peak, the PRI reaches the valley. It suggested that leaf redding phenomena causes the decline of PRI and LUE.

Keywords: Japanese cypress, photochemical reflectance index (PRI), photosynthetic light use efficiency(LUE), phenological analysis

