

Solar-induced chlorophyll fluorescence in rice paddy field ecosystem detected by high spectral resolution

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Precise detection of CO₂ uptake at ecosystem level would provide a better understanding of carbon cycling, though its estimation has large limitation yet. Solar-Induced Chlorophyll fluorescence (SIF) is one of state-of-the-art variable, which has a strong correlation with GPP (e.g. Yang *et al*, 2018; Li *et al*, 2020), and has a great potential to enable us to conduct the photosynthesis activity measurement at multiple spatial scales from one station plot to the globe. However, SIF still needs to be validated by a ground-based assessment.

Rice is one of the majority crops in Asia, therefore, the remote-sensing of its photosynthesis activity should be demanded. The SIF was calculated from spectrum detected by the QE Pro (Ocean Optics, Dunedin, FL, USA) with 0.3 nm of the full-width at half maximum (FWHM) and 5 minutes interval time in rice (*Oryza sativa* L.; cultivar Koshihikari), at Mase eddy flux site, Tsukuba, Japan from April to September, 2019. The QE Pro was connected to optical fiber switch (LEONI Fiber Optics GmbH, Föritztal, Germany) which switches the three optical fiber channels. The first cable looked upward toward the sky (Field Of View (FOV) of 180°) to measure the total irradiance from the sun, the second one was pointed downward to detect the plant reflected radiance (FOV of 180°), and the third one, bare fiber, looked downward at a viewing zenith angle of 45° (FOV of 25°). SIF was calculated using the Spectral Fitting Method (SFM; Meroni *et al.*, 2009) and then compared with the gross primary production (GPP) and photosynthetically active radiation (PAR). The diurnal variation of SIF linearly correlated with the GPP in June and July with the coefficient of determination (r^2) of 0.65 and 0.73, respectively. Moreover, SIF showed a strong correlation with PAR in July ($r^2 = 0.89$). They imply that SIF is a potential proxy to track the photosynthesis activity at ecosystem level.

Keywords: Ground-based SIF measurement, Photosynthesis, Spectroradiometers