필터 기반의 근접표면 센서를 이용한 태양유도 엽록소 형광 관측

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Monitoring Sun-induced Chlorophyll Fluorescence using a Filter-based Near-surface Remote Sensing System

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The sun-induced chlorophyll fluorescence (SIF) has advanced our ability to understand structural and physiological dynamics of vegetation. Substantial efforts have been made to monitor SIF through ground-based observations, but continuous and long-term field observation data are still sparse. This is at least partly due to 1) lack of commercially available complete and proven ready-to-use systems and 2) challenges of sensor calibration and maintenance in the field in order to meet the strict requirements necessary for high-quality SIF retrieval. Here, we present the filter-based smart surface sensing system (4S-SIF) to overcome technical challenges of monitoring SiF in the field as well as to decrease sensor cost for more comprehensive spatial sampling. To monitor SIF, we combined ultra-narrow band pass filters and photodiode detectors to observe electromagnetic radiation at specific wavelengths (760nm, 756nm and 770nm). We verified the satisfactory spectral performance of the bandpass filters and confirmed that Digital Numbers (DN) from 4S-SIF exhibited linear relationships with the DN from the QEpro hyper-spectral spectroradiometer in each filter band ($R^2>0.99$). To verify that 4S-SIF can actually detect the SIF signal, we installed the sensor on a plotscale strawberry equipped with the hyper-spectral spectroradiometer. The 4S-SIF represents a strong linear relationship with QEpro-SIF either variation of density of plant or DCMU treatment. In addition, we confirmed that 4S-SIF shows no variation of dark current value and wavelength shift at various air temperatures. We believe that 4S-SIF will be a useful tool for collecting in-situ data across multiple spatial and temporal scales.

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