Vegetation red-edge spectral modeling for solar-induced chlorophyll fluorescence retrieval at O$_2$-B band

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Remotely sensed solar-induced chlorophyll fluorescence (SIF) has been considered an ideal probe in monitoring global vegetation photosynthesis. However, challenges in accurate estimate of faint SIF (less than 5% of the total reflected radiation in near infrared bands) from the observed apparent reflected radiation greatly limit its wide applications. Currently, the telluric O$_2$-B (~688nm) and O$_2$-A (~761nm) have been proved to be capable of SIF retrieval based on Fraunhofer line depth (FLD) principle. They may still work well even using conventional ground-based commercial spectrometers with typical spectral resolutions of 2~5 nm and high enough signal-to-noise ratio (e.g., the ASD spectrometer). Nevertheless, almost all current FLD based algorithms were mainly developed for O$_2$-A, a few concentrating on the other SIF emission peak in O$_2$-B. One of the critical reasons is that it is very difficult to model the sudden varying reflectance around O$_2$-B band located in the red-edge spectral region (about 680-800 nm). Diurnal

This study investigates a new method by combining the established inverted Gaussian reflectance model (IGM) and FLD principle using diurnal canopy spectra with relative low spectral resolutions of 1 nm (FlorMOD simulations) and 3 nm (measured by ASD spectrometer) respectively. The IGM has been reported to be an objective and good method to characterize the entire vegetation red-edge reflectance. Consequently, the proposed SIF retrieval method (hereinafter called IGMFLD) could exploit all the spectral information along the whole red-edge (680-800 nm) to obtain more reasonable reflectance and fluorescence correction coefficients than traditional FLD methods such as the iFLD. Initial results show that the IGMFLD can better capture the spectrally non-linear characterization of the reflectance in 680-800 nm and thereby yields much more accurate SIFs in O$_2$-B than typical FLD methods, including sFLD, 3FLD and iFLD (see figure 1). Finally, uncertainties and prospect of the IGM-FLD, in contrast with sFLD, 3FLD and iFLD, were discussed here. This study may provide a test-bed for developing more robust methods to retrieve SIF in O$_2$-B from aircraft (e.g. AisaIBIS fluorescence imager) or satellite (FLEX-FLORIS) remote sensing measurements.
Figure 1