Development of a 3D solar induced chlorophyll fluorescence simulator for satellite fluorescence observation

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Recent studies show that the vegetation canopy scale chlorophyll fluorescence can be observed from satellite, such as GOSAT and OCO-2, using Fraunhofer lines (e.g. Frankenberg et al., 2011). Satellite-based fluorescence can be used to infer the photosynthetic capacity of plant canopy. To understand how the canopy scale bidirectional fluorescence observations are related to three-dimensional fluorescence distribution within a plant canopy, it is necessary to evaluate canopy scale fluorescence emission using a detail plant canopy radiative transfer model. In this study, we developed a three-dimensional plant canopy radiative transfer model that can simulate the bidirectional chlorophyll fluorescence radiance. This modeling was based on the 3D radiative transfer model, forest light environmental simulator (FLiES) (Kobayashi and Iwabuchi, 2008). FLiES is a Monte Carlo raytracing model to simulate radiative field in shortwave (solar domain) and long-wave (thermal infrared) radiation in 3D landscape. To realize individual tree crown shapes, the original FLiES model used geometric objects such as cone, cylinder, and spheroid. Recently, FLiES has been extending to utilize voxel-based tree crown datasets, which are favorable to LiDAR based tree crown data sets. In this presentation, we show the current status of the development of the 3D chlorophyll fluorescence simulator.

Keywords: GOSAT, plant canopy radiative transfer model, chlorophyll fluorescence, GPP