Simultaneous observations of solar-induced chlorophyll fluorescence by vegetation and atmospheric CO_2 dynamics by GOSAT

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In these decades, global warming has progressed owing to increase of greenhouse gases (GHGs) such as CO_2. To deal effectively with this issue by mitigation and adaptation, it is necessary to monitor emission and sequestration of GHGs with their underlying mechanisms including biogeochemical processes and human activities. Terrestrial ecosystem, which is the large carbon sink, absorbs 123 Pg carbon per year through plant photosynthesis (IPCC 2014). Satellite remote sensing has been used to monitor the spatial and temporal dynamics of terrestrial ecosystems that are responsible for such photosynthetic CO2 absorption. Such observation provides us with geographical information on the potential distribution of carbon sequestration by the aid of ecosystem models. However, as the photosynthesis of a given vegetation is quite sensitive to meteorological changes such as radiation, temperature and precipitation, we need to observe the photosynthetic ‘activity’ in a physiological sense, together with the atmospheric CO2 concentration over continental and global scales. Joiner et al. (2011) and Frankenberg et al. (2011) have suggested that TANSO FTS on Greenhouse Gases Observing Satellite (GOSAT) could detect overlapping part of solar-induced chlorophyll fluorescence (SIF) emitted by terrestrial vegetation and Fraunhofer line. The chlorophyll fluorescence is photons of red and far-red light that emitted by chlorophylls, and in plant ecophysiology it has been a biophysical index to examine the photosynthetic responses to environmental stresses such as extreme temperatures and drought. Thus SIF remote sensing is drawn considerable attention as a new technique to observe the photosynthetic activity of the vegetation. This paper will present our on-going and future challenges by GOSAT and GOSAT-2 to observe such photosynthetic activity of terrestrial ecosystems and its possible consequences with the atmospheric CO2 concentration from national, continental to global scales under climate change.

Keywords: carbon cycle of terrestrial ecosystem, photosynthetic production

