The simulation model of energy partition in leaf scale to estimate GPP from SIF

*Yuma Sakai[1], Tomomichi Kato[1], Katsuto Tsujimoto[2], Hideki Kobayashi[3], Kenlo Nasahara[4], Tomoko Akitsu[4], Shohei Murayama[5], Hibiki M Noda[6], Hiroyuki Muraoka[7]

1. Research Faculty of Agriculture, Hokkaido University, 2. Graduate School of Life Science, Tohoku University, 3. Japan Agency for Marine-Earth Science and Technology, 4. Faculty of Life and Environmental Sciences, University of Tsukuba, 5. National Institute of Advanced Industrial Science and Technology, 6. National Institute for Environmental Studies, 7. River Basin Research Center, Gifu University

In the photosynthetic process, a part of the extra energy is emitted as chlorophyll fluorescence. In ecosystem scale, recently, it is known that the solar-induced chlorophyll fluorescence (SIF) is correlated to gross primary production (GPP), from remote sensing measurements such as field stations and satellites. Thus, it would appear that the GPP is estimated using SIF data.

The models are a one of the tools to analyze the correlation between the GPP and the SIF at leaf scale. The model, which is used in this study, is constructed based on reaction kinetics by means of the rate coefficients and quantum yields of photosynthesis, fluorescence and heat dissipations, and explains the behavior of the relationship between fluorescence and photosynthesis that has been reported in previous literatures. Most of the previous studies, the rate coefficients of each process are estimated using short-term chlorophyll fluorescence data measured by pulse amplitude-modulated (PAM), and the GPP is estimated using physiological data, such as the concentration of chlorophyll and the photosynthesis rate. However, the acquisition of these data from observation by field stations and satellites is difficulty. On the other hands, quantum yield of SIF is calculated by remote sensing data measured in Takayama site, Japan. Thus, in this study, we calculate the rate coefficients from remote sensing data (e.g. photochemical reflectance index(PRI)) to obtain the quantum yields of SIF and estimate the GPP from the SIF. Additionally, we examined the seasonal and annual changes in correlation between SIF and GPP at the leaf level.

