Seasonal changes in the photosynthetic capacity and chlorophyll fluorescence in canopy leaves of *Quercus crispula* in a cool-temperate forest

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In recent years, climate change has occurred around the world. To explore and predict the cause of such climate change, it is indispensable to elucidate the behavior of carbon cycles on the earth. To estimate gross primary production (GPP) of terrestrial ecosystems, one of the largest carbon flux, is an urgent task of mankind. Solar-Induced Fluorescence (SIF) is expected to represent GPP and to include photosynthetic physiological information on vegetation. However, it remains unclear what regulate the SIF at the canopy scale across the growing season. I examined the effect of seasonal photosynthetic capacity (V_{cmax25}) and leaf area index on SIF and SIF yields at the leaf and canopy scale, using the fluorescence-photosynthesis model (van der Tol et al., 2014) and retrieved canopy SIF data in a cool-temperate deciduous forest at Tomakomai Experimental Forest, Hokkaido, Japan. I conducted gas exchange measurements for canopy leaves of Quercus crispula Blume and calculated V_{cmax25} once a month, from June to October in 2016. Using the seasonal changes in V_{cmax25}, air temperature, photosynthetically active radiation (PAR), SIF at the leaf scale was simulated. Additionally, seasonal changes in leaf area index (LAI) was estimated from enhanced vegetation index (EVI) of Hemispherical Spherical spectroRadiometer. My results show that the seasonal variation of V_{cmax25} had little impacts on simulated SIF (4.9 % in averege of growing season) compared to xed V_{cmax25}. In addition, simulated SIF at the leaf scale was strongly correlated to APAR (r^2 = 0.99), which indicates that SIF is emitted according to absorbed light photon. As a result of comparing the SIF simulated at the canopy level and the retrieved SIF, r^2 = 0.91 for SIF and r^2 = 0.64 for SIF yield (canopy SIF / APAR), both of which were highly correlated. This values were higher than the comparison of the SIF simulated at the leaf scale and the retrieved SIF (r^2 = 0.73 for SIF, r^2 = 0.34 for SIF yield). Thus, SIF retrieved at the canopy scale had stronger relationship with SIF simulated at the canopy scale than with that at the leaf scale, which indicates the amount of leaves affects canopy SIF. I also examined the relationship between retrieved SIF yield (SIF / APAR) and LAI. As a result, SIF yield was found to have a high correlation with LAI (r^2 = 0.65). My results suggests that seasonal changes in SIF is more affected by LAI and APAR while physiological factors had little impacts on SIF.

Keywords: Remote Sensing, Solar-Induced Fluorescence (SIF), Leaf Area Index (LAI), Carbon cycle, Non-Photochemical Quenching (NPQ)