Supplement understanding of the relative importance of biophysical factors in determination of photosynthetic capacity and photosynthetic productivity in rice ecosystems

Extensive variation in gross primary production (GPP) among growing seasons in rice ecosystems, which has previously been reported, may be caused by a number of biophysical factors. Two field-based studies, one on *Oryza sativa* L. cv. Odae in the Haean Basin and the other on *O. sativa* L. cv. Unkwang in Gwangju, South Korea, were conducted to evaluate physiological regulators of the ecosystem. A literature survey across climatic zones was additionally undertaken to unravel the roles of relevant climatic factors. The results from the two field studies showed that the correlation between the fraction of canopy light interception (fPAR) and leaf area index (LAI) across all data sets exhibited a common trajectory. Analogous values of canopy light use efficiency (LUE_c) at similar growth stages of the two rice crops, but, clearly varietal and nutritional differences in LAI development were present, which implies that temporal differences in carbon gain capacity are related to modifications in LAI, thereby influencing fPAR. The literature survey revealed that most variations in growing season GPP can be explained by changes in daily solar radiation (SR) which is negatively correlated to the proportion of rainy days; this is supported by the two field studies. In the context of temperature warming, a reduction in SR noticeably exacerbated impacts on photosynthetic productivity. Moreover, global values of maximum carbon gain capacity over the growing season ($GPP_{day\text{-}max}$) in field-cultivated rice were significantly affected by SR. We suggest that: 1) temporal differences in carbon gain capacity and variations in $GPP_{day\text{-}max}$ are jointly driven by LAI development, which varies according to nutrient availability and rice genotypes, and SR, especially at the reproductive stage; 2) although photosynthetic productivity of rice ecosystems is vulnerable to temperature increasing and prolonged growth duration contributes to larger photosynthetic productivity, its fluctuations across growing seasons are profoundly mediated by SR, which statistically correlates with the amount of precipitation; and 3) the important regulating implication of SR changes is attributed to the structure rather than physiology dependent light sensitivity of canopy photosynthesis at the reproductive stage. Further researches regarding interactions among climate change, phenology and canopy carbon dynamics are discussed.