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FACE 実験におけるモデルを使った生理パラメータの感度分析
Model-Aided Analysis of FACE Effects on Rice Canopy Photosynthesis, Transpiration, and Water Use Efficiency

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Sustainable agricultural practice requires promising crop productivity with efficient water use. Given the projected increase in atmospheric CO_2 concentration [CO_2], our understanding on the CO_2 effects on rice productivity (i.e., photosynthesis) and water use (i.e., transpiration) on a leaf scale improved in the last few decades, particularly with Free-Air CO2 Enrichment (FACE) experiments that enable a simulation of a future agricultural field with high [CO_2]. However, very few information is yet available as to how the investigation on a leaf-level response of photosynthesis and transpiration to [CO_2] is translated to the whole canopy photosynthesis and transpiration (Shimono et al., Glob. Change Biol., 2013; Yoshimoto et al., Agric. For. Meteorol., 2005). This is partly due to the limited size of a FACE ring where it is difficult to apply top-down measurements, such as the eddy covariance technique. In this study, we quantified the effect of [CO_2] on rice canopy photosynthesis, transpiration and water use efficiency, using a multi-layer model with the model parameters obtained from single-leaf photosynthesis and transpiration measurements. With the model parameters carefully determined, we delineated the effects of [CO_2] on the canopy photosynthesis and transpiration through the changes in physiological and micrometeorological conditions for a better understanding on future rice productivity and water use.