EGU23-8547, updated on 06 Dec 2023
https://doi.org/10.5194/egusphere-egu23-8547
EGU General Assembly 2023

The temperature response of photosystem II quantum yield is an important driver of leaf photosynthesis: a review and data synthesis

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Photosystem II quantum yield (φ_{PSII}) measures the efficiency with which photosystem II converts absorbed light to photochemistry, and thus variation in φ_{PSII} directly affects leaf CO_2 assimilation. Given the sensitivity of photosystem II to temperature stress, increasing our understanding of the φ_{PSII} temperature response could improve model estimates of terrestrial carbon cycling in an increasingly warm and erratic climate. We reviewed the literature to establish what is known of the φ_{PSII} temperature response and highlighted potential underlying physiological and molecular mechanisms. We then used φ_{PSII} temperature response data collated from our review to generate a new and improved temperature response function for φ_{PSII}. After examining how a subset of land surface models currently represent φ_{PSII} and its temperature response, we incorporated our new temperature response function into the Farquhar, von Caemmerer, and Berry C_3 photosynthesis model. The model output showed that RuBP-limited photosynthesis is most affected by the φ_{PSII} temperature response as leaf temperatures increase or decrease further from the optimum temperature of φ_{PSII}. In addition to providing a new φ_{PSII} temperature response function, we also highlight key unanswered questions surrounding the φ_{PSII} temperature response that, if addressed, could bolster efforts to predict the effects of temperature on photosynthesis.