**Poster #9-13**

**Sun-induced Chlorophyll Fluorescence and Its Importance for Modeling Photosynthesis from the Side of Light Reactions**

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Recent progress in the observation of sun-induced chlorophyll fluorescence (SIF) provides an unprecedented opportunity to advance photosynthesis research in natural environments. However, we still lack an analytical framework to guide SIF studies and integration with the well-developed active fluorescence approaches. Here we present this framework. We derive a set of coupled fundamental equations to describe the dynamics of SIF and its relationship with $C_3$ and $C_4$ photosynthesis. We show that SIF is dynamically as complex as photosynthesis. However, the measured SIF simplifies photosynthetic modeling from the side of light reactions because it integrates over the dynamic complexities of photosynthesis. Specifically, the measured SIF contains direct information about the actual electron transport from photosystem II to photosystem I, giving a quantifiable link between light and dark reactions. With much-reduced requirements on inputs and parameters, the light reactions-centric, SIF-based model complements the traditional, dark reactions-centric biochemical model of photosynthesis. The SIF-photosynthesis relationship, however, is nonlinear because photosynthesis saturates at high light while SIF has a stronger tendency to keep increasing as fluorescence quantum yield is relatively insensitive to light levels. Successful applications of the SIF-based model of photosynthesis will depend on predictive understanding of the dynamics of fraction of open photosystem II reaction centers, canopy escape probability of SIF photons, stomatal and mesophyll conductance, etc. Advances can be facilitated by coordinated efforts in plant physiology, remote sensing, and eddy covariance flux observations.