OOS 2-2 - A convergent spectroscopy-based approach for Vcmax across leaf age and growth environments

Start
Browse by Day
Author Index

Meeting Information

Meeting Website
Meeting Registration
ESA Website
About Portland

Monday, August 7, 2017: 1:50 PM

Portland Blrm 255, Oregon Convention Center

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Background/Question/Methods

Understanding the temporal patterns of leaf photosynthetic capacity (the maximum rate of RuBP carboxylation, V_{cmax}) is critical for determining the seasonality and controls over terrestrial carbon, water, and energy fluxes. However, efficient prediction of V_{cmax} using the spectroscopy approach across space and time is still lacking. Here, we leverage previous studies which have successfully linked leaf spectroscopy to leaf V_{cmax} and leaf age respectively, with a specific goal to explore the potential use of leaf spectroscopy as a general means to rapidly estimate and monitor temporal changes in V_{cmax}. Here we address three questions: (1) whether there exists a convergent relationship between leaf V_{cmax} and spectroscopy across tropical forest sites, species, leaf age, and growth environments, (2) how well can the spectroscopy approach predict temporal variation in leaf V_{cmax} (or V_{cmax}-age relationship) compared with the field observed V_{cmax}-age relationship, and (3) how do spectroscopy-derived V_{cmax}-age relationships vary across species and growth environments?

To address these questions, we used field data collected in two tropical evergreen forests in Panama (n=18 species) and one in Brazil (n=6 species). These data include detailed field

measurements of leaf age, full range reflectance spectroscopy (i.e. 350-2500 nm), V_{cmax} (derived from leaf gas exchange measurements), and growth environments (i.e. sun vs. shade).

Results/Conclusions

Our results suggest that leaf reflectance spectroscopy can accurately predict leaf V_{cmax} at the fully expanded age status (or mature leaf age class, 3-5 months old), across tropical forest sites (R^2=0.7, p<0.001). However, this single-age spectra-V_{cmax} relationship requires recalibration when it is applied to broader demographic classes (i.e. young and old age classes). Our next step will be to explore whether a single spectra-V_{cmax} model can be developed for leaves spanning both leaf life cycles and growth environments. We will use this potential generalized spectra-V_{cmax} relationship to further explore how well the spectra-derived V_{cmax} and leaf age (or spectra-derived V_{cmax}-age relationship) can be used to capture the temporal trajectories of V_{cmax} across leaves' entire life cycles. This will aid development of remote sensing methods to characterize temporal variation of leaf photosynthetic metabolism across spatial and temporal scales, and enable remotely based parameterization of earth system models.

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