Poster #1-60

Evaluating Leaf Photosynthesis and Stomatal Conductance Models against Diurnal and Seasonal Data from Two Contrasting Panamanian Tropical Forests

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Tropical forests play a key role in regulating the global carbon (C), water, and energy cycles and stores, as well as influence climate through the exchanges of mass and energy with the atmosphere. However, projected changes in temperature and precipitation patterns are expected to impact the tropics and the strength of the tropical C sink, likely resulting in significant climate feedbacks. Moreover, the impact of stronger, longer, and more extensive droughts not well understood. Critical for the accurate modeling of the tropical C and water cycle in Earth System Models (ESMs) is the representation of the coupled photosynthetic and stomatal conductance processes and how environmental and other drivers impact these processes. Moreover, the parameterization and representation of these processes is an important consideration for ESM projections. We use a novel model framework, the Multi-Assumption Architecture and Testbed (MAAT), together with the open-source bioinformatics toolbox, the Predictive Ecosystem Analyzer (PEcAn), to explore the impact of the multiple mechanistic hypotheses of coupled photosynthesis and stomatal conductance as well as the additional uncertainty related to model parameterization. Our goal was to better understand how model choice and parameterization influences diurnal and seasonal modeling of leaf-level photosynthesis and stomatal conductance.

We focused on the 2016 ENSO period and starting in February, monthly measurements of diurnal photosynthesis and conductance were made on 7-9 dominant species at the two Smithsonian canopy crane sites. This benchmark dataset was used to test different representations of stomatal conductance and photosynthetic parameterizations with the MAAT model, running within PEcAn. The MAAT model allows for the easy selection of competing hypotheses to test different photosynthetic modeling approaches while PEcAn provides the ability to explore the uncertainties introduced through parameterization. We found that stomatal choice can play a large role in model-data mismatch and observational constraints can be used to reduce simulated model spread, but can also result in large model disagreements with measurements. These results will be used to help inform the modeling of photosynthesis in tropical systems for the larger ESM community.