

Improving understanding and modeling of hydrology-carbon interactions in NGEE-Tropics

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The U. S. Department of Energy is initiating a Next Generation Ecosystem Experiment (NGEE) in the tropics with the overarching goal of improving the ability of Earth System Models for predicting whether tropical forests will act as net carbon sinks through the 21st Century. As climate models projected increasing frequency and intensity of drought in the future, a key question that will be addressed is how tropical forests respond to drought. Through changes in water availability, drought can influence stomatal conductance that affects transpiration and carbon assimilation and allocation. Understanding and modeling hydrology-carbon interactions are thus critical to determining tropical forest response to drought and the impacts on the carbon cycle. This presents significant challenges for earth system modeling as the processes involved span a wide range of temporal and spatial scales, and plant response depends on hydraulic traits that may vary substantially across the diverse species of the tropical forest. Previous studies using data from drought experiments showed that models have limited skill in predicting drought response, but introducing mechanistic processes such as plant hydraulics into physiological-based models can improve prediction of drought-induced mortality. There are large uncertainties in modeling carbon assimilation due to uncertain parameters partly related to the use of fitted gas exchange data, and uncertain model structures because of different assumptions about canopy physiological processes. Similarly, hydrology models with different process representations and abilities to capture spatial heterogeneity may simulate very different soil moisture and groundwater accessible by plants under droughts. This poster will discuss a set of initial research activities in NGEE Tropics to quantify uncertainty and address gaps in modeling hydrology and carbon processes. A pilot study in the Amazon will provide an integrative test-bed for hydrology-carbon interactions. Building on the existing infrastructures at Manaus, the pilot study will contribute additional co-located hydrology and carbon measurements. Combined with the development of synthesized datasets, quantifying model uncertainty, and evaluating different modeling approaches, we aim to make important progress towards modeling of tropical forest response to drought in a pan-tropical context.