Title: **Biophysical Processes and Feedback Mechanisms Controlling the Methane Budget of an Amazonian Peatland**

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Project Abstract:

Tropical peatlands are one of the largest natural sources of atmospheric methane and are keystone ecosystems that play a significant role in regional and global carbon budgets. However, we have a poor understanding of how these ecosystems function and respond to climate variability leading to large uncertainties of their carbon cycle processes and budgets. In addition to the scarcity of tropical peatland observations, another challenge is how to mechanistically describe the complexity of biogeochemical processes in ecosystem models. Based upon the measurements at an eddy covariance flux site established in a tropical palm swamp peatland near Iquitos, Peru, this project seeks to understand the biophysical controls on carbon cycle processes in tropical peatlands, and to advance the predictive capability of DOE's E3SM land model (ELM) for the carbon budget.

Over the past year our team has conducted research focused on the following project objectives: **(a) Partitioning net ecosystem carbon fluxes and quantifying soil and stem carbon fluxes associated with varying microtopography and dominant tree species.** Average soil CO_2 and

CH_4 fluxes were 0.55±0.04 µmol m^{-2} s^{-1} and 16.06±0.86 nmol m^{-2} s^{-1} respectively. Average stem CO_2 fluxes from *M. flexuosa*, *M. aculeata,* and *T. insignis* were 0.06±0.01, 0.10±0.01, and 0.20±0.01 µmol m^{-2} s^{-1}, respectively, and average CH_4 fluxes were 0.23±0.15, 0.39±0.11, and 0.07±0.18 nmol m^{-2} s^{-1}, respectively. Our preliminary results during wet seasons indicate that there are no significant dial patterns or spatial heterogeneity for both soil and stem carbon fluxes. **(b) Applying satellite remote sensing observations to investigate the spatiotemporal patterns of vegetation productivity in the broader Pastaza-Marañón peatland basin.** This work incorporates high-resolution land cover data, sun-induced chlorophyll fluorescence and we are now working to bring in near-infrared reflectance from vegetation into the analysis to better match the spatial resolution of the land cover data. A major goal is to test for differences among vegetation types, specifically forests growing on peatland vs. mineral soil. **(c) Improving the ELM model for tropical peatlands.** We have identified the important controls of vegetation processes on the carbon budget in the Amazonian swamp peatland and found that different carbon feedbacks to warming and drought conditions exist in tropical and boreal peatlands. Together, our measurement and model results highlighted the unique properties of carbon flux components and the importance of vegetation (i.e. stomatal regulation, nitrogen-photosynthesis relationship, and phenology) and soil microbial (i.e. acetoclastic methanogens) processes for carbon cycling in the tropical swamp peatland.