Hydrometeorological sensitivities of net ecosystem carbon dioxide and methane exchange of an Amazonian palm swamp peatland

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Tropical peatlands are a major, but understudied, biophysical feedback factor on the atmospheric greenhouse effect. The largest expanses of tropical peatlands are located in lowland areas of Southeast Asia and the Amazon basin. The Loreto Region of Amazonian Peru contains ~63,000 km^2 of peatlands. However, little is known about the biogeochemistry of these peatlands, and in particular, the cycling of carbon dioxide (CO_2) and methane (CH_4), and their responses to hydrometeorological forcings. To address these knowledge gaps, we established an eddy covariance (EC) flux tower in a natural palm (*Mauritia flexuosa* L.f.) swamp peatland near Iquitos, Peru. Here, we report ecosystem-scale CO_2 and CH_4 flux observations for this Amazonian palm swamp peatland over a two-year period in relation to hydrometeorological forcings. Seasonal and short-term variations in hydrometeorological forcing had a strong effect on CO_2 and CH_4 fluxes. High air temperature and vapor pressure deficit (VPD) exerted an important limitation on photosynthesis during the dry season, while latent heat flux appeared to be insensitive to these climate drivers. Evidence from light-response analyses and flux partitioning support that photosynthetic activity was downregulated during dry conditions, while ecosystem respiration (RE) was either inhibited or enhanced depending on water table position. The cumulative net ecosystem CO_2 exchange indicated that the peatland was a significant CO_2 sink ranging from −465 (−279 to −651) g C m^{-2} y^{-1} in 2018 to −462 (−277 to −647) g C m^{-2} y^{-1} in 2019. The forest was a CH_4 source of 22 (20 to 24) g C m^{-2} y^{-1}, similar in magnitude to other tropical peatlands and larger than boreal and arctic peatlands. These measurements have been used to help parameterize the Energy Exascale Earth System Model (E3SM) land surface component (ELM). Initial modeling results demonstrate that ELM can capture the seasonal and diel cycles of CO_2 and CH_4 fluxes. Further, we identified that the photosynthetic response at this tropical peatland site is very sensitive to air temperature, while CH_4 production is more sensitive to water condition, which can significantly influence its carbon budget. Ongoing model analyses are exploring potential biophysical feedback processes associated with changes in hydrometeorology for this region.