LAND-ATMOSHPERE EXCHANGE OF CARBON AND ENERGY AT A TROPICAL PEAT SWAMP FOREST IN SARAWAK, MALAYSIA

by

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ABSTRACT

Tropical peatlands comprise 11% of the global peat area of ca. 400 Mha and are estimated to store about 89 Gt of carbon (C). However, considerable uncertainties remain about their present role in global C cycle as interannual ecosystem-scale measurements of undisturbed tropical peat forests have not been measured to date. Hence, an eddy covariance tower was instrumented in a tropical peat forest in Sarawak, Malaysia over four years from 2011 to 2014. We found that the forest was a net source of CO_2 to the atmosphere during every year of measurement. The inter-annual variation in net ecosystem CO_2 exchange (NEE) was largely modulated by the variation in gross primary production (GPP), which was jointly controlled by vapor pressure deficit (VPD) and leaf area index (LAI) in addition to photosynthetically active photon flux density (PPFD). Greater reduction of GPP in 2011 and 2012, are likely attributed to the relative low atmospheric transmission due to massive peat fires in Indonesia.

Similarly, no analysis to our knowledge has measured whole-ecosystem methane (CH_4) flux from a tropical peat forested wetland to date despite their importance to global CH_4 budget. The two-month average of C-CH_4 flux measurements, on the order of 0.024 g C-CH_4 m^{-2} d^{-1}, suggests that tropical peat forests are not likely to be disproportionally important to global CH_4 flux. Results demonstrate a limited ability for simple models to capture the variability in the diurnal pattern of CH_4 efflux, but also consistent responses to soil moisture, water table height, and precipitation over daily to weekly time scales.

The sensible heat flux (*H*) and latent heat flux (*LE*) and their ratio (the Bowen ratio, *Bo*) at the study ecosystem were relatively invariant compared to other tropical rainforests. The average daily *LE* across the calendar year tended to be higher at MY-MLM (11 MJ m^{-2} day^{-1}) than most other tropical rainforest ecosystems in the FLUXNET2015 database. Results demonstrate important differences in the seasonal patterns in water and energy exchange in tropical rainforest ecosystems that need to be captured by models to understand how ongoing changes in tropical rainforest extent impact the global climate system.