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Transpiration by trees under seasonal water logging and drought in monsoon central Cambodia

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Cambodia is situated in the center of Indochina Peninsula and experiences severe drought for 5 months of dry season and subsequent rainy season. Around the Tonlesap Lake where both natural and secondary forests exist without intensive destruction by human activity, forest hydrology is characterized by seasonal water logging in mid rainy season. Tree- and stand-scale transpiration is thought to be influenced by the changing soil water conditions and trees' site-specific adaptation to the environment, but less is measured about transpiration and leaf ecophysiological traits in this region. The objectives of this study is to reveal the ecophysiology of the two native (Dipterocarpus obtusifolius and Shorea roxburghii) and two exotic species (Acacia auriculiformis and Eucalyptus camaldulensis) and to detect the effects of soil water conditions on day to week scale transpiration in mid rainy and dry season. Seasonal leaf-level photosynthesis measurements suggested that photosynthetic capacity (Vcmax25) showed no clear seasonal change in each species without clear interspecific variation. Two native species had stomatal control in response to the environment different from previous studies and showed stomatal conductance higher than most woody species in other seasonal tropical forests, suggesting the species- and site-specific adaptation to the easy access to the ground water. Sap flow rate per leaf area was expressed in two parameters: measured transpiration rate based on the continuous sap flow measurements (Esap) and modeled transpiration rate (Emod) using a multilayer model based on the measured data of atmospheric environments, radiation and the leaf ecophysiological traits. Esap was lower in rainy season than those in dry season, with short but pronounced drop near the end of the dry season, although Emod was higher in rainy season than in dry season. In dry season, Emod well fit the diurnal and day to day trend of Esap, suggesting that soil drought did not limit transpiration. On the other hand, in rainy season, Emod overestimated Esap under high light intensities but not at low Emod conditions, suggesting that leaf water demand exceeded the water supply capacity, possibly due to the water logging effects on root activity. This study provided us new insights into the site specific transpiration patterns in this region, and the usefulness of the comparison between modeled and measured transpiration rate to detect the environmental and biological influence on transpiration for successful model prediction of forest transpiration at large time and spatial scales.