A comparative study of ecohydrologies of a tropical mangrove and a broadleaf deciduous forest using eddy covariance measurement

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Abstract

Evapotranspiration denotes the transport of water vapor between an ecosystem and atmosphere comprising the biotic (transpiration) and abiotic (evaporation) components. Additionally, the water vapor transports the energy used for its vaporization, the latent heat. In the present study we compare the ecohydrological cycle of a mangrove on the Bay of Bengal coast in southeast India with a broadleaf deciduous forest in northeast India using eddy covariance flux measurement for the very first time. Similar to a semi-arid ecosystem the evapotranspiration from mangrove is dominated by the dry sensible heat flux throughout the year, except pre-monsoon when it behaves like a well-watered ecosystem with evapotranspiration dominating the sensible heat flux. Such behavior is in stark contrast with the broadleaf deciduous forest which provides stronger evapotranspirative heating than sensible heat throughout the year including the dry seasons. The evaporative fraction remains consistently much lower at the mangrove than the broadleaf deciduous forest. Compared to the broadleaf deciduous forest, the mangrove ecosystem remains tighter coupled with the atmosphere. Transpiration contributes the larger share to the evapotranspiration of mangrove even in the dry seasons, whereas transpiration and evaporation contribute maximum to the evapotranspiration of broadleaf deciduous forest periodically through the year. Based on principal component analysis we show that both transpiration and evaporation at the mangrove are most strongly coupled with salinity, much different from the broadleaf deciduous forest where transpiration and evaporation are most tightly coupled with root-zone soil moisture and wind speed, respectively. The salinity regulation of transpiration has an important implication for the carbon cycle of mangrove and its appropriate parameterization in ecosystem and climate models.