Partitioning Ecosystem Canopy Transpiration to Evaluate the Sensitivity Stomatal Conductance to Changing Climate Indicators.

Eric Ward (ejward3@ncsu.edu) - North Carolina State University, Jean-Christophe Domec (PI), John King and Asko Noormets, North Carolina State University (Co-PIs).

Two-thirds of terrestrial water fluxes to the atmosphere are through the process of transpiration (T), making this a key variable linking hydrological and biological processes. Transpiration is highly coupled with photosynthesis and is critical to modeling watershed hydrology and carbon uptake. The partitioning T from total evapotranspiration (ET) has been one the greatest uncertainties in the water budgets of many ecosystem studies, owing to the lack of catchment scale measurements and large uncertainties in stomatal conductance. A major reason for this difficulty is that T is often derived as the residual of the water balance once other processes are explicitly measured or modeled.

Variations in the water balance across space and time are a function of interactions among species, environmental conditions, stand age, and management practices. However, evaluating the effects of environmental drivers on forest wetland ecosystems and the water budgets in coastal regions of the U.S.A. has not been the focal point of considerable research. Increasing variability of rainfall patterns and water table fluctuations requires a detailed understanding of the pathways of water loss from ecosystems to optimize carbon uptake, as well as land use and management choices.

At the Alligator River National Wildlife Refuge, eddy covariance, micro-meteorological and sap flux techniques were used to derive transpiration values from the four dominant overstory species (tupelo, bald-cypress, loblolly pine and red maple). Canopy transpiration represents more than 60% of total ET, a value significantly higher than in managed ecosystem. Canopy transpiration and stomatal conductance was highest in tupelo, followed by bald-cypress, red maple and then loblolly pine. Transpiration from subdominant trees and shrubs represented 20-35% of evapotranspiration. Indicating that understory was a significant part of the water budget. Annually, soil evaporation represented about 15% of evapotranspiration. Tree sensitivity to climate variables decreased under flooded periods with the tupelo being the most sensitive, altering water flux partitioning and carbon uptake.