**Title**: **Incorporating Halophyte Hydrodynamics in Plant Hydraulics Models to Capture Mangrove Forest Responses to a Changing Climate**

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**Project**: Exploring halophyte hydrodynamics and the role of vegetation traits on ecosystem response to disturbance at the terrestrial-aquatic interface (University Project)

**Project Website**: http://www.jsg.utexas.edu/matheny/halophyte-hydrodynamics/

**Project Abstract**: Mangroves grow along coastlines and intertidal zones, and are therefore very rarely limited by water availability. However, during the dry season, these ecosystems behave more similarly to semi-arid ecosystems than like well-watered forests. The process of salt exclusion from sea- and brackish waters during water uptake provides an additional energy and rate limiting step in the soil-plant-atmosphere continuum. Salt exclusion is responsible for high xylem tensions that result in stomatal closure and reductions in transpiration, in spite of adequate water availability. Atmospheric demand for water vapor and soil water availability are the primary determinants of vegetation water stress for terrestrial plants. Yet, in the unique case of mangroves, salinity supersedes the control of soil water availability.

We present the initial development of a salt-tolerant water uptake model for the FETCH2 advanced vegetation hydrodynamics model that will be capable of mechanistically simulating osmoregulation by halophytes. FETCH2 approximates water flow through xylem as flow through porous media and accounts for dynamic changes to conductance and capacitance of plant tissues caused by changes in water content. Parameter sets within FETCH2 are based on measurable hydraulic traits. However, studies have shown that many such traits can be highly plastic and vary spatiotemporally. Therefore, we couple our model development with an extensive field study of mangrove hydraulic traits, their variability, and their influence on plant and ecosystem level fluxes of carbon, water, and energy. Our field study analyzes mangrove forest function across both humidity and salinity gradients which are predicted to change in response to disturbances such as sea level rise, precipitation variability, inundation frequency, and increased atmospheric $CO_2$. We combine ecosystem scale measurements of carbon, water, and energy fluxes with plant-level observations of sap flux, biomass water content, and leaf level gas exchange in three field sites spanning a humidity gradient from Panama (humid), to the Texas Coast (subhumid), and Abu Dhabi (hyperarid). Our ultimate goal is to integrate FETCH2 into DOE's functionally assembled terrestrial simulator (FATES), to enable assessment of coastal forests in the Exascale Energy Earth System model.