Title: **Mangrove ecosystems under stress: from carbon sink to source**

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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. Mangroves likewise provide a critical carbon sink sequestering carbon at a rate disproportionate to ecosystem extents. However, these delicate systems are threatened by anthropogenic activity and changes in climate. This project supports mangrove monitoring in four sites across the globe: from humid (Panama) to arid (Abu Dhabi) and at the northern (Texas) and southern (Victoria, Australia) growth limits. At the northern and southern extents, mangrove range expansion is limited by freezing conditions. We show eddy covariance fluxes of carbon and water exchange in the newly constructed Port Aransas, Texas mangrove monitoring station during the prolonged hard freeze in February 2021. As a result of the freezing conditions, mangroves in the site lost >90% of their leaf area causing the ecosystem to rapidly shift from a carbon sink to a carbon source. Encouragingly, we see evidence of a fast recovery and the mangrove population re-sprouting from roots.

Modeling the water and carbon dynamics of mangrove forests is a critical task for developing robust models of coastal climate processes. Here, 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. Studies have shown that many such traits can be highly plastic and vary spatiotemporally. Therefore, we leverage our extensive field study and a greenhouse based study of mangrove hydraulic traits and their variability. Our four field study sites are positioned to promote analysis of 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. Within the greenhouse, we are able to test for species and population differences in adaptation and

acclimation of different hydraulic traits to fluctuating humidity and temperature environments. These data will ultimately be used to parameterize the FETCH2 halophyte model with the ultimate goal to integrate FETCH2 into DOE's functionally assembled terrestrial simulator (FATES) within E3SM.