Living on the edge: An innovative model of mangrove-hammock boundaries in Florida

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The key to understanding how future hurricanes and sea level rise may trigger changes to South Florida's native coastal forests lurks below the surface, according to a new model linking coastal forests to groundwater. Just inland from the familiar mangroves that line the coasts lie hardwood hammocks that are sensitive to salinity changes in water found in the soils.

University of Miami (UM) Ecologist Donald L. DeAngelis, who is also a researcher for the U.S Geological Survey (USGS), has worked with collaborators to develop a novel computer model describing the underlying forces that maintain this vegetative boundary. The findings, published in the current issue of the journal *Landscape Ecology*, indicate that large pulses of saline water into the hammock vegetation may cause mangroves to invade areas now populated by hardwood hammocks.

"A high level of salt in the soil favors the mangroves and stresses the hardwoods," says DeAngelis, professor in the Biology Department at the UM college of Arts and Sciences and one of the principal investigators of this project "Hardwood hammocks are a unique feature of the Everglades, they are home to many species, and if they decrease in numbers that will mean a loss of habitat for some organisms."

During storm surges, the salty winds and waves rush into areas of brackish water. The likelihood of such salt water overwash from the coast is expected to increase as sea level rise affects the natural coastal processes in the region.

The study is one of the first to couple vegetation dynamics with hydrology and salinity of the area in order to study the factors affecting the forest boundary. The work reveals that the sharp mangrove-hammock boundary, or ecotone, is defined by a combination of factors such as water levels during the dry season, tides, changes in the land's features, and trees own ability to alter the environment to their benefit (a process known as positive feedback).

"Ecotones are of great interest to ecologists because many species like to live along the edges between different vegetation types, so you can get rich diversity in those areas," says Jiang Jiang, doctoral student in the Biology Department at UM College of Arts and Sciences and co-author of the study.

Changes in water management, such as the expected increase in freshwater from the implementation of the Comprehensive Everglades Restoration Plan, may help offset the possible effects caused by future salt water overwash and inundation.

"The USGS project that we are working on will include a big landscape hydrology model that will predict the freshwater flow into the southern Everglades and at the same time take into account sea level rise," says DeAngelis.

The study, supported and funded by the USGS, lays groundwork for a larger investigation in which the agency is developing models to look at how sea level rise will affect coastal regions in South Florida. Other co-authors are Thomas J. Smith III, ecologist at the USGS and co-principal investigator of the project; Su Yean Teh, lecturer at the School of Mathematical Sciences, Universiti Sains Malaysia; and Hock-Lye Koh, professor at the School of Civil Engineering, Universiti Sains Malaysia.

The scientists hope to extend the application of this model to include

other ecotones and other parts of the world that experience frequent storm surges. The researchers would like to be able to predict if salt water intrusion will have a long-lasting effect on vegetation, and on fresh water supply.

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