Mangrove expansion and climatic warming may help ecosystems keep pace with sea level rise

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Sea level rise and extreme weather events have become harsh realities for those living along the world's coasts. The record-breaking hurricanes of the past decade in the United States have led to staggering tolls on coastal infrastructure and communities, leading many local governments to consider the benefits of natural coastal barriers.

In a landmark study titled "Warming accelerates mangrove expansion and surface elevation gain in a subtropical wetland" a team of Villanova University biologists have documented that coastal wetlands in the southeastern United States are responding positively to rising temperatures both in their growth and in their ability to build soil to keep pace with sea level rise.

Published August 29 in the British Ecological Society's *Journal of Ecology*, the study's results are a ray of sunshine in the climate change forecast. Members of the research team included Glenn A. Coldren, J. Adam Langley, and Samantha Chapman, from Villanova University's Department of Biology, Villanova, PA and Ilka C. Feller of The Animal-Plant Interaction Lab, Smithsonian Environmental Research Center, in Edgewater.

The Villanova research team's two-year experiment, funded by grants from the National Aeronautics and Space Administration (NASA), was performed at the Kennedy Space Center (KSC) within the Merritt Island

National Wildlife Refuge (MINWR) on Merritt Island. The KSC was an ideal location to conduct the research being situated at the intersection of two wetland biomes, salt marshes and mangroves. The implications for the KSC are serious since coastal wetlands and sand dunes help protect NASA's $5.6 billion low-lying infrastructure against rising seas.

The large-scale warming experiment was conducted in place in the MINWR using large passive warming chambers to increase both marsh and mangrove ecosystem air temperatures. The Villanova researchers found that experimental warming both doubled plant height and accelerated the transition from marsh to mangrove.

Mangroves are woody trees with more complex roots than their grassy marsh plant counterparts. When subjected to temperatures similar to those that will occur in a warmer future, mangrove plots showed increased surface elevation which is a measure of the wetland's ability to build soil and keep pace with sea level rise.

"Our study provides some evidence that the ongoing reshuffling of species on earth's surface could allow for some adaptation to the same global changes that are causing them," says Chapman. "Conserving and restoring our coastal wetlands can help humans adapt to climate change."

With their unique structure and migration to higher latitudes caused by climate change, mangroves may help coasts keep pace with sea level rise and combat severe weather events like hurricanes. Expansion of these natural barriers in areas like the Kennedy Space Center may enhance the sustainability of coastal communities as they face accelerating sea-level rise in a warmer future.

"The study links the growth of individual plants, and particularly their roots, to the survival of an entire ecosystem. The long-term strength of the mangrove effects we identified may determine what the maps of our

southeastern coastlines look like in the future," says Langley. "This mangrove effect could benefit coastal wetlands around the world."

"Our experiment highlights the impact multiple interacting aspects of climate change, such as warming and sea level rise, can have on the outcome of species invasions resulting from climate change—and on the capacity of those communities to protect shorelines," concluded Coldren.

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