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TITLE: Mangrove expansion and contraction at a poleward range limit: climate extremes and land-ocean temperature gradients

AUTHOR: ['Michael J. Osland', 'Richard H. Day', 'Courtney T. Hall', 'Marisa D. Brumfield', 'Jason L. Dugas', 'William R. Jones']

ABSTRACT:

Within the context of climate change, there is a pressing need to better understand the ecological implications of changes in the frequency and intensity of climate extremes. Along subtropical coasts, less frequent and warmer freeze events are expected to permit freeze-sensitive mangrove forests to expand poleward and displace freeze-tolerant salt marshes. Here, our aim was to better understand the drivers of poleward mangrove migration by quantifying spatiotemporal patterns in mangrove range expansion and contraction across land-ocean temperature gradients. Our work was conducted in a freeze-sensitive mangrove-marsh transition zone that spans a land-ocean temperature gradient in one of the world's most wetland-rich regions (Mississippi River Deltaic Plain; Louisiana, USA). We used historical air temperature data (1893-2014), alternative future climate scenarios, and coastal wetland coverage data (1978-2011) to investigate spatiotemporal fluctuations and climate-wetland linkages. Our analyses indicate that changes in mangrove coverage have been controlled primarily by extreme freeze events (i.e., air temperatures below a threshold zone of -6.3 to -7.6°C). We expect that in the past 121 yr, mangrove range expansion and contraction has occurred across land-ocean temperature gradients. Mangrove resistance, resilience, and dominance were all highest in areas closer to the ocean where temperature extremes were buffered by large expanses of water and saturated soil. Under climate change, these areas will likely serve as local hotspots for mangrove dispersal, growth, range expansion, and displacement of salt marsh. Collectively, our results show that the frequency and intensity of freeze events across land-ocean temperature gradients greatly influences spatiotemporal patterns of range expansion and contraction of freeze-sensitive mangroves. We expect that, along subtropical coasts, similar processes govern the distribution and abundance of other freeze-sensitive organisms. In broad terms, our findings can be used to better understand and anticipate the ecological effects of changing winter climate extremes, especially within the transition zone between tropical and temperate climates.

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