A Fused Radar–Optical Approach for Mapping Coastal Marsh Wetlands and Deepwater Habitats

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Science Question

Tidal wetlands are critically important ecosystems that provide ecosystem services including carbon sequestration, storm surge mitigation, water filtration, and wildlife habitat provision while supporting high levels of biodiversity. Yet, monitoring these systems over large scales remains a major challenge, inhibiting effective monitoring and management of these vulnerable coastal ecosystems and their response to future pressures.

Analysis

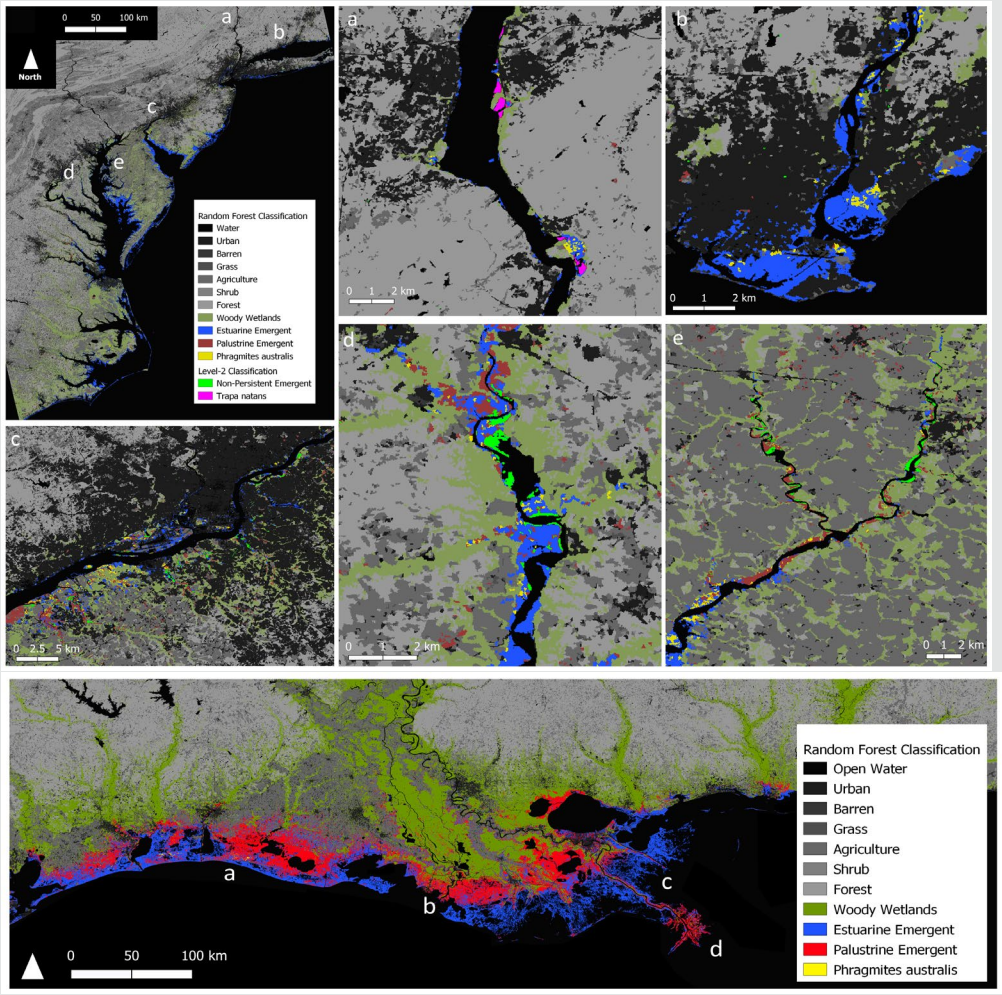
We fused time-series Sentinel-1 C-band SAR (synthetical aperture radar) vegetation inundation, structure and phenology identifications with Landsat optical imagery to classify tidal wetlands and deepwater systems within Mid-Atlantic and Gulf Coast regions.

Results

Emergent wetlands and adjacent deepwaters were classified with user's and producer's accuracies better than 90%. Persistent and non-persistent marsh vegetation was classified with greater than 93% accuracy. Additionally, we mapped two invasive species: *Phragmites australis* (common reed) with greater than 80% accuracy and *Trapa natans* (water chestnut) with greater than 96% accuracy, with important implications for improved coastal ecosystem management and habitat restoration.

Significance

Tidal processes drive nutrient and carbon exchange between coastal marsh wetlands and the marine environment. This study demonstrates a unique methodology employing a combination of microwave SAR and Optical/IR datasets to characterize tidal marsh wetlands environments enabling accurate identification of seasonally non-persistent marsh vegetation, an important identifier of tidal freshwater environments. Monitoring change in non-persistent vegetation locations provides a critical capability for identifying shifting salinity regimes resulting from changing coastal environments. The effective separation of non-persistent emergent vegetation from floating aquatic *Trapa natans* also provides an ideal tool for natural resource managers to identify areas under threat from expansion of this U.S. invasive species.



Emergent wetlands and open water across the Mid-Atlantic (upper panel) and Gulf Coast (lower panel) regions were mapped with > 90% accuracy, with clear applications for monitoring wetland loss and degradation.

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