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The future role of mangrove vegetation on soil organic matter in coastal wetlands

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I. Abstract

Recently, coastal swamps have been acknowledged for their capability to alleviate shorelines and defend coastal communities. Mangroves play a prominent role in obstructing water currents in riverbanks, shorelines, and coastal areas. Mangrove roots have the significant contribution to the resiliency of the vegetation structure. Yet, mangrove model has lately been called into question by lab experimental evidence. In this paper, the flow characteristics past root models are reviewed. coastal swamps are among the most fruitful and carbon-rich ecosystems on the planet. Long-term carbon putting away in coastal wetlands happens mostly below ground as soil organic matter. Mangrove servs as a carbon sink, impacts wetland ecosystem configuration, purpose, and firmness. To expect and ease the properties of climate change, there is a necessity to advance considerate of environmental controls on wetland. The impact of four soil formation factors are reviewed. Across the shorelines, soil organic matter was highest in mangrove forests and it was lower areas.

Keywords: mangroves, organic matter, roots, hydrodynamics, coastal ptotection.

II. Introduction

Coastal residents profit from the marine environment, but their vicinity to the ocean also brings severe risk to human life and property. Rising sea level is making populations in low-lying coastal areas increasingly vulnerable to catastrophic floods and coastal erosion. Wetland plants shape coastal geomorphology and coastal engineers suggest that coastal marshes and mangroves have the capacity to protect shorelines. Comprehending the coastal wetlands' ability to protect shorelines is critical to account for the full cost of wetland degradation and the value of restoration. Because wetland protection is a good alternative to barrier construction, the protection and restoration of coastal wetlands can be a cost-effective approach for rural communities to reduce storm damage that does not encounter with additional protection methods, such as early warning systems. Moreover, coastal wetlands provide multiple benefits for local coastal communities beyond just storm protection, such as support for fisheries, wood and non-wood products, and tourism opportunities. The scale of the hurricane Marina 2017 in Atlantic Ocean was almost unexpected. In areas with the maximum tsunami intensity, little could have barred catastrophic coastal destruction. Furtheraway, nonetheless, areas with coastal tree vegetation were evidently less damaged than areas without vegetation. Mangrove forests are the most significant coastal tree vegetation in the area and are one of the world's most vulnerable tropical ecosystems. Yet the ability of coastal wetlands to attenuate waves and protect coastal communities from storm damage has been called into question. After the devastating Atlantic Ocean of December 2017, which resulted in the loss of over 250,000 lives and several billion dollars in damage, worldwide attention focused on cultivating shoreline protection for vulnerable areas, and experts observed that intact mangrove forests protected villages from the worst destruction and that mangrove deforestation expanded storm damage and loss of life. By pushing mangrove protection and reforestation, concerns were raised about the degree to which mangrove forests, rather than correlated variables

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such as topography and shoreline geomorphology, were responsible for the reduced damages. Recent small-scale flume and field experiments have also tested the archetype that wetland vegetation lessens shoreline erosion. Coastal wetlands are among the most productive and carbon-rich ecosystems on Earth. Long-term carbon storage in coastal wetlands occurs primarily belowground as soil organic matter (SOM). In addition to serving as a carbon sink, SOM influences wetland ecosystem structure, function, and stability. To anticipate and mitigate the effects of climate change, there is a need to advance understanding of environmental controls on wetland SOM. Here, we investigated the influence of four soil formation factors: climate, biota, parent materials, and topography. Along the northern Gulf of Mexico, we collected wetland plant and soil data across elevation and zonation gradients within 10 estuaries that span broad temperature and precipitation gradients. Our results highlight the importance of climate–plant controls and indicate
that the influence of elevation is scale and location dependent. Coastal wetland plants are sensitive to climate change; small changes in temperature or precipitation can transform coastal wetland plant communities. Across the region, SOM was greatest in mangrove forests and in salt marshes dominated by graminoid plants. SOM was lower in salt flats that lacked vascular plants and in salt marshes dominated by succulent plants. We quantified strong relationships between precipitation, salinity, plant productivity, and SOM. Low precipitation leads to high salinity, which limits plant productivity and appears to constrain SOM accumulation. Our analyses use data from the Gulf of Mexico, but our results can be related to coastal wetlands across the globe and provide a foundation for predicting the ecological effects of future reductions in precipitation and freshwater availability. Coastal wetlands provide many ecosystem services that are SOM dependent and highly vulnerable to climate change

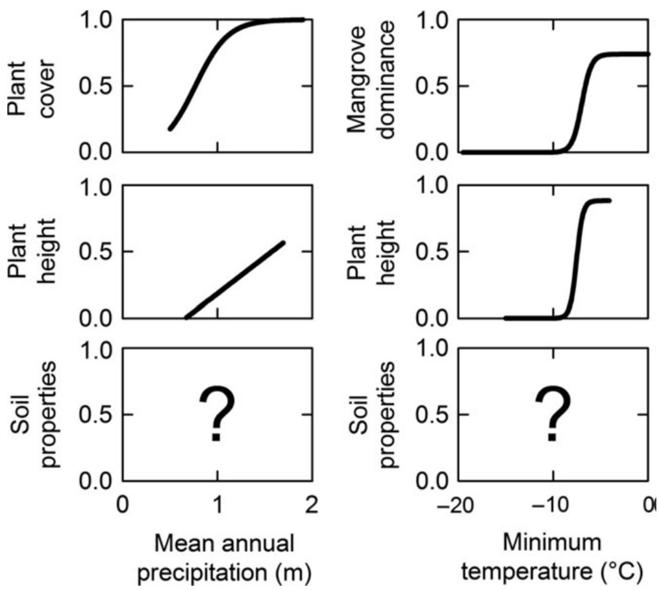


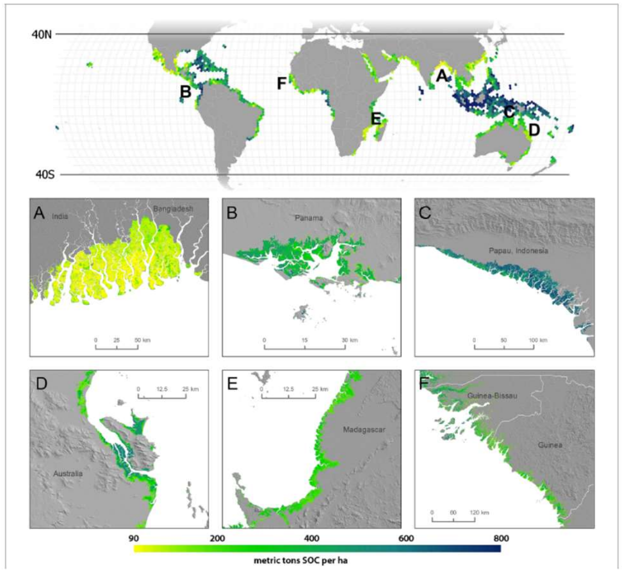
Figure 1. Data are from the eastern of Pacific Ocean.

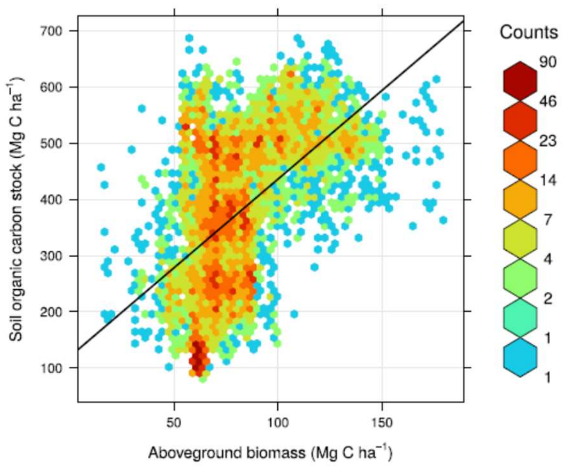
III.Review discussions

We address coastal concerns in this review, by assessing the evidence for shoreline protection by salt marshes and mangroves. Measurement of forces and modelling of fluid dynamics suggest by Kazemi et al. [12-15] propose that tree vegetation may shield coastlines from tsunami damage by reducing fluid energy. Experimental models show that physical models may reduce the maximum tidal flow pressure by more than 90%. Empirical and field based evidence is limited, however. Kazemi et al. [19], in Florida provided a unique experimental setting to test the benefits of coastal tree vegetation in reducing coastal devastation by tidal flows. Atlantic Ocean has a relatively straight shoreline, a uniform beach profile, and a uniform continental slope. Moreover, the shoreline includes vegetated as well as no-vegetated areas. The force of the flow impact in Atlantic Ocean is illustrated by the central part of our study area (Figure. 1). At the river mouth, the flow ruined parts of a village and removed a sand spit that previously blocked the river. However, areas with mangroves and tree shelterbelts were significantly less damaged than other areas. Damage to communities also varied distinctly. In the north, stands of mangroves had five related villages, two on the coast and three behind the mangrove. The communities on the coast were destroyed, whereas those behind the mangrove hurt no destruction even if the waves damaged areas unprotected by vegetation north and south of these communities.

The patch consists of cylinders with a uniform diameter of 0.9525 cm. A rectangular computational flow domain surrounds the patch. Water, as an incompressible fluid, flows from left to right in the domain at four constant uniform velocities. The flow field around the cylinder is modeled as two-dimensional flow with the axis of the cylinder perpendicular to the direction of flow. The origin is the center of patch circle.

According to Kazemi et al. [12–15], mangroves are modeled as arrays of circular cylinders. They studied the flow in the wake of the circular cylinders (patch). They found that unlike for a solid obstruction, there is a delay in the onset of Von Kármán street due to the presence of an exit velocity from trailing edge of the patch. They also presented the unsteady wake of the von Kármán vortex street using soap film flow visualization [19].





. The results for different Reynolds numbers are compared with Ortiz et al [8] and Chen et al [13] and Tinoco and Cowen [14].

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IV. Conclusion

As Our analyses use data from the Gulf of Mexico, but our results can be related to coastal wetlands across the globe. Our reviews provide a foundation for predicting the ecological effects of future reductions in precipitation and freshwater availability. Our precipitationand salinity-driven results are especially relevant for coastal wetlands located along coasts that currently receive low rainfall. In addition tothe western Gulf of Mexico, coastal wetlands located within and near arid and semi-arid climates in the following areas are likely to be highly sensitive to changes in precipitation and freshwater availability: (a) western North America, (b) western South America, (c) Caribbean; (d) central Brazil; (e) southeastern South America; (f) Europe; (g) northwestern Africa; (h) southwestern Africa; (i) southeastern Africa; (j) Madagascar; (k) northeastern Africa; (l) Middle East; (m) eastern India; (n) northeastern Asia; (o) western Australia; (p) northern Australia; (q) eastern Australia; (r) southern Australia; and (s) New Zealand (Figure 9). These are climate-sensitive areas where there is a need for ecologists to advance understanding of climate and land use change effects on coastal wetland ecosystems. Collectively, our results indicate that the most important drivers of regional wetland SOM variation in the northern Gulf of Mexico are precipitation, salinity, and plant productivity. Topographic variation in elevation plays a very important but variable role across the region, and sediment input appears to modulate the effects of precipitation on SOM. Precipitation in this region appears to have a greater effect on SOM than temperature. The effects of precipitation on SOM, however, appear to be indirect. SOM was greatest in mangrove forests and in salt marshes dominated by graminoid plants. SOM was lower in salt flats that lacked vascular plants and in salt marshes dominated by succulent plants. Low precipitation leads to higher salinity, which limits plant productivity and appears to constrain SOM accumulation. Conversely, our results indicate that high precipitation decreases salinity, increases plant productivity, and increases SOM. Our analyses provide a foundation for future investigation, and there is a need for studies that evaluate the mechanismsthat may be responsible for the identified relationships between precipitation, salinity, productivity, and SOM. There is also a need to test our findings across prominent precipitation gradients in other parts of the world (e.g., western North America, eastern and western South America, Europe, China, western and eastern Africa, Australia)(Figure 9). Within the context of climate change, our results indicate that changes in SOM and plant productivity, due to changes in precipitation, freshwater availability, and salinity, could impact wetland stability and affect the future supply of some wetland ecosystem services.

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