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Nitrogen removal in coastal wetland habitats and ecotones: a fine-scale study

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Coastal wetlands play an important role as natural connections between oceanic and terrestrial ecosystems, acting as important carbon sinks and as biogeochemical filters that reduce nitrogen loads to coastal waters.

Coastal wetlands include various habitat types, such as seagrass meadows, estuarine, mudflats, mangroves and oyster reefs. Coastal wetlands are recognized as ecosystems with high environmental heterogeneity, that are always observed to be comprised of multiple habitat types. Such variations in environmental factors may lead to different biogeochemical and ecological features that bring uniqueness of ecological functions to different habitat types. However, due to the complexity collecting samples and getting a comprehensive picture of these environmental heterogeneity, small-scaled biogeochemical studies are often overlooked as most studies focus on larger regional or even global scale.

This research focuses on quantifying the potential and actual sediment nitrogen removal rate of the four selected habitats: mangrove, seagrass meadow, oyster bed, and mudflat, within a smaller habitat scale (<100 meter square). Slurry and intact core incubation experiments with the application of revised-isotope pairing technique (r-IPT) was done to quantify denitrification, anammox and dissimilatory nitrate reduction to ammonium (DNRA) rates of sediment samples from the habitats and their ecotones.

By resolving nitrogen removal capacity across a habitat mosaic, this research identifies hotspots of nitrogen removal in coastal wetlands and clarifies the balance between nitrogen removal (denitrification and anammox) and retention (DNRA). The findings aim to enhance nature-based solutions for nutrient pollution mitigation and coastal wetland restoration by linking habitat configuration and biogeochemical functions.