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# Effects of groundwater flow and benthic bioturbation on blue carbon cycle in coastal wetlands

**KAI XIAO**

Yantai Institute of Coastal Zone Research, Chinese Academy of Sciences

Coastal groundwater, as a critical component of the global hydrological cycle, exerts profound impacts on nearshore marine ecosystems through hydrodynamic processes. During seaward migration, tidal-driven subterranean flows create dynamic oxic-anoxic transition zones that shape unique microbial habitats. The mixing of freshwater and seawater within subterranean estuaries triggers intricate biogeochemical reactions, particularly nutrient transformation, establishing a natural filtration barrier through redox-controlled precipitation. However, current marine pollution assessments predominantly focus on riverine inputs while neglecting the pervasive yet cryptic groundwater discharge pathways, owing to the inherent spatiotemporal heterogeneity and monitoring challenges of coastal aquifer systems. Emerging studies have revealed that coupled physical-biogeochemical processes between wetland groundwater flows and benthic bioturbation (e.g., by polychaetes and crabs) critically regulate blue carbon dynamics: (1) subsurface advection drives the lateral transport of dissolved organic carbon while modulating sediment redox gradients, suppressing methanogenesis through sulfate enrichment; (2) bioirrigation enhances sediment porosity and oxygen penetration depth, accelerating labile carbon mineralization and concurrently sequestering refractory organic matter into deeper strata. This presentation synthesizes recent advances in quantifying groundwater-biota interactions across tidal wetlands, advocating for the integration of hydrogeochemical frameworks into blue carbon ecosystem models to refine climate feedback projections and coastal management strategies.