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Behavior and fate of nanoplastics in two vulnerable land-sea continuums

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Anthropogenic particles and emerging contaminants, particularly nanoplastics (<1µm), are now widespread in the environment due to mechanical abrasion and chemical oxidation of plastic debris. Both human-impacted tropical ecosystems such as mangroves, and remote, fragile environments such as Arctic glaciers receive multiple local and global inputs of nanoplastics through river inflows, oceanic currents and atmospheric transport. In the context of climate change, increasing rainfall in tropical regions and enhanced freshwater discharges and ice melt in the Arctic are now amplifying the particle fluxes toward coastal systems. This study investigates the behavior of nanoplastics along land-sea continuums associated with mangroves and glaciers, which are reactive interfaces influencing the colloidal distribution of pollutants. The aim is to determine how salinity gradients control nanoplastic dynamics and vertical distribution in the water column and how these processes ultimately shape their fate in the open ocean. To this end, water and sediment samples were collected in Guadeloupean mangroves in 2016 and 2026, and in Greenland fjords in the 2025. In both water and sediment samples, plastics were extracted from colloidal and particulate phases and characterized in terms of size and composition. In both ecosystems, along the salinity gradient, samples collected near the coast and influenced by freshwater inputs showed higher concentrations of nanoplastics in the colloidal phase. In contrast, samples collected in areas dominated by ocean influence exhibited a shift toward the particulate phase, where sediments are also more enriched. In addition, nanoplastic concentrations in Guadeloupean mangroves increased between 2016 and 2026, revealing a significant temporal intensification of plastic contamination over the past decade. Overall, this study demonstrates that the land-sea continuums strongly regulate nanoplastic fate and highlights the key role of these interfaces in contaminant distribution from coastal to open-ocean systems.