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An integrated land–sea approach for cost-effective improvement of coastal water quality: joint planning of land-based pollution mitigation and managed realignment

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Coastal waters have long been experiencing multifaceted, high-strength, and compound effect of the socioeconomic, environmental management activities, and climate change. The integrated consideration of the ecological and socioeconomic links between the land and sea realms is fundamental for optimal practice in systematic management planning. However, the existing management planning of water quality has focused on measures of land-based pollution reduction, whereas efforts on sea have lagged by several decades. In this study, numerical analysis based on long-term coastline changes and pollution emission data reveals the synergistic effect of land-based pollution mitigation and managed realignment on water quality improvement, showing the potential of cross-realm management. An innovative approach optimizing the cost-effectiveness of management between land and sea realms is established. A new land–sea management pattern is suggested for the Jiaozhou Bay, China, which can achieve the environmental targets with increased efficiency and in a more cost-effective manner compared with existing methods. These findings validate superior efforts of a novel approach for coastal areas with serious pollution and and high pollution discharge demands, as well as those characterized by weak hydrodynamic and sedimentary conditions coupled with high rates of reclaimed land vacancy.