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Editorial: Processes and management of altered estuaries and deltas in the Anthropocene

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Editorial on the Research Topic
Processes and management of altered estuaries and deltas in the Anthropocene

An estuary is an environment that provides various ecosystem services of both ecological and commercial value (Kennish, 2002). Estuaries and deltas have also been centers of human settlement due to their high biological productivity, protection from the sea, and the confluence of rivers with access to inland navigation. As a result, estuaries and deltas are subject to a wide range of human impacts, as many cities and ports around the world are constructed very close to estuaries (Kennish, 2017; McGranahan et al., 2007). Large-scale engineering projects, such as dredging, estuarine dams, and land reclamation, have significantly altered the natural properties of estuaries and deltas, leading to changes in river discharge, tidal patterns, and sediment dynamics. These alterations have caused severe ecosystem degradation over the last century (Lotze et al., 2006). Given their ecological and commercial value, it is critical that we manage estuaries and deltas in a way that balances the needs of human populations with the needs of these vital ecosystems.

Estuarine and deltaic processes are largely controlled by the interaction between climate-related sea level changes, environmental factors, such as the oceanographic regime, sediment availability, and tectonics, as well as anthropogenic impacts (Kench, 1999; van der Wal et al., 2002; Mulligan et al., 2019; Chang et al., 2020; Figueroa et al., 2020). While human impacts are indisputable in the 21th century during the Anthropocene, human influence has been also increasingly evident in the Holocene. In recent decades, efforts to restore altered estuaries and deltas have increased and it is imperative to understand the nature of the processes operating in altered estuaries and deltas and their responses to modifications. Therefore, the goal of this Research Topic is to share our increased knowledge on the nature of the altered processes, not only in the Anthropocene but also in the natural processes and altered processes in the Holocene.

Even in the Holocene, estuaries and deltas were influenced by human impact although not as significant as those during the Anthropocene. Through geochemical and grain size analysis of a long sediment core spanning more than 5500 years, Zou et al. found that the

construction of an ancient dam stabilized the sedimentary environment by regulating flash floods and providing water supply in Southern China. Guo et al. then reconstructed the human adaptations to environmental change by examining the salt production site on the southern coast of Laizhou Bay in Eastern China. On the other hand, by examining the evolutionary history of mud deposits using long cores through Holocene strata in the northwestern shelf of the South China Sea, Li et al. found that thick mud deposits initiated after 3 ka BP due to the enhanced sediment fluxes and strengthened winter monsoon. In recent years over the past millennium, heavy metals were enriched due to human activities.

In addition to human influence in the Holocene, we had contributions to the methods to reconstruct past environments. By using magnetic records of surficial sediment in the Yangtze river basin, Liu et al. found matching magnetic susceptibility between the upper basin and the lower estuary providing insights into the source-to-sink process of clastic materials. Then, Jiang et al. established, by examining the spatial distribution and composition of alive and dead benthic foraminifera (BF) in relation to different water masses off the Changjiang estuary, that taphocoenose BF in core sediments can be used to reconstruct the past marine environments. On the other hand, Song et al. reported that the shallow biogenic gas seepage in the Yangtze subaqueous delta and Hangzhou Bay is increasing due to global warming and seabed erosion related to sediment deficit.

In this Research Topic, several papers dealt with the sedimentary and geochemical responses due to the construction of an estuarine dam. Extending their earlier work on the impact of estuarine dams on the estuarine parameter space and sediment flux decomposition, Figueroa et al. examined the effect of different dam locations and freshwater discharge for four estuarine types (strongly stratified, partially mixed, periodically stratified, and well-mixed). The estuarine dam location affected the tide-dominated estuaries, while the discharge interval affected the river-dominated estuaries. Through a COAWST numerical modeling study, Chang et al. found that the impacts of the estuarine dam were highly significant over the impacts due to the land reclamation at least at the altered Nakdong estuary of Korea. Lee and An found that ammonium regeneration and uptake rates were high at the altered Yeongsan estuary by an estuarine dam. Small-size bacteria were responsible for most of the ammonium regeneration, not zooplankton because intermittent freshwater discharge prevented stable zooplankton community development. Relatively high ammonium regeneration and uptake rates indicate that the altered Yeongsan estuary has changed to an optimum condition for high ammonium regeneration as the turbidity decreased and water residence time increased after the construction of the estuarine dam. Finally, Zeng et al. tested the effectiveness of three Marine Protected Areas (MPAs) in the Yangtze River delta with the modified framework of potential drivers and conservation outcomes and found that MPAs that showed satisfactory environmental performance and that public awareness, participation, and regular monitoring and assessment can further improve management and environmental performance.

In conclusion, this Research Topic provided insight into the processes of human alterations in estuaries and deltas and data to support future sustainable management. The research focused on the nature and impacts of human alterations and subsequent reconstruction of the environments during the Holocene. In more recent years of the Anthropocene, environmental degradation due to human alterations is also becoming of greater interest. While we are understanding and improving our environment, it is suggested to require better public awareness regarding modern, rapidly changing estuaries and deltas.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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