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EDITED AND REVIEWED BY
Chunyan Li,
Louisiana State University, United States

*CORRESPONDENCE
Xiaolei Liu,
xiaolei@ouc.edu.cn

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Editorial: Sediment dynamics and geohazards in estuaries and deltas

Xiaolei Liu[1]*, J. Paul Liu[2] and Ya Ping Wang[3]

[1]Shandong Provincial Key Laboratory of Marine Environment and Geological Engineering, Ocean University of China, Qingdao, China, [2]Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, Raleigh, NC, United States, [3]State Key Laboratory of Estuarine and Coastal Research, School of Marine Sciences, East China Normal University, Shanghai, China

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Editorial on the Research Topic
Sediment dynamics and geohazards in estuaries and deltas

Estuaries and deltas are the most complex areas of the earth's dynamic system, where frequent interactions and transformation of energy and materials occur (Gao et al., 2014; Yang et al., 2020, Yang et al.). Human exploitation and utilization of the ocean are relatively concentrated in these areas because of the extremely fertile lands with abundant water and diverse vegetation. More than 600 million people live on or near estuaries and deltas, who occupy only 1% of the world's land mass, and the productive intersection of river and ocean has allowed port cities to flourish (Syvitski and Saito, 2007; Higgins, 2016). Therefore, estuaries and deltas have both important ecological and environmental values and socio-economic significance (Giosan et al., 2014).

However, most of the world's estuaries and deltas are deteriorating at an accelerated rate (Syvitski et al., 2009; Bergillos et al., 2016). Under the combined effects of hydrodynamics, human activities and climate change, the sediments undergo a series of dynamic changes, such as consolidation, liquefaction, erosion, resuspension, and transportation, as well as the dynamic changes of sediment composition, structure, physical, chemical, and geotechnical engineering properties (Morton and Sallenger, 2003; Liu et al., 2017; Burchard et al., 2018; Xiong et al., 2018; Albatal et al., 2019; Yang et al., 2019; Čelić et al., 2019; Glover et al., 2021). These sediment dynamic changes would induce the morphological evolution of estuaries and deltas and a series of geological disasters, such as coastal erosion, submarine landslides, gravity flow, which seriously threaten the marine engineering activities (Liu et al.; Maloney et al., 2020; Wang et al., 2020). Generally speaking, sediment dynamics in estuaries and deltas and its derivative disasters are important aspects of marine geology and engineering studies and is one of the foci of international interest.

In this Research Topic, we have gathered contributions from scientists working in diverse disciplines, from the geotechnical and engineering characteristics of sediments,

distribution and transport of suspended sediment, observation of geomorphic feature and geohazards in estuaries and deltas. We have got a varied group of authors to contribute. In total, 13 papers have been included, with a mixture of 12 original research articles and 1 review.

The geotechnical and engineering characteristics of sediments are important parameters in design of marine engineering such as offshore oil platforms, submarine pipelines, and offshore wind power foundations (Al-Bared and Marto, 2017). In this Research Topic, the evolution of strength and microstructure of clay were discussed, which emphasized the change in the cementation degree between clay particles and pore distribution is the fundamental reason for the strength of clay in the thixotropic process (Tang et al.). Liu et al. summarized the strength and deformation characteristics of gassy soil and its constitutive models which have been used in the current simulation of geological disasters.

In estuaries and deltas areas, the distribution and transport of suspended sediments play an important role in morphodynamics, and will affect the development and utilization of coastal resources and the economic development (Talke et al., 2009; Normandin et al., 2019; Yu and Mantravadi, 2019). In this Research topic, Li et al. and Li et al. studied Hangzhou Bay, established and validated a three-dimensional wave–current–sediment coupled numerical model, to quantify the effect of wave-current coupling mechanism on suspended sediment characteristics during normal weather and typhoons. Results show that there are two high-SSC areas in Hangzhou Bay, inducing the siltation at the mouth and center of the bay. Wave-current combined bottom stress can affect sediment resuspension process and thus the characteristics of SSC, especially in shallow water or during typhoon. In this process, the bottom drag coefficient (C_d) is one of the most important parameters to define the bottom friction and influence the velocity profile and turbulence. Qi et al. took the muddy deposit of Shandong Peninsula as an example, examined the variability of C_d, revealed the significant tidal asymmetry characteristics, and further determined the critical bottom wave orbital velocity $U_b \approx 0.1$ m/s. Xie et al. pointed out that advection and tidal pumping are the key control factors in determining suspended sediment, while the water column stratification inhibit the effective vertical diffusion. Li et al. analyzed the past 60 years' SSC data for the Nanliu River and pointed out that the SSC of Nanliu River shows a downward trend year by year under the influence of climate change and human activity.

The dynamic changes of sediment can result in serious geological disasters such as erosion, landslide, gravity flow and so on, and then affect the changes of coastline and seabed topography (Herman et al., 2001; Chen et al., 2020; Wang et al., 2020). It is of great significance for the construction and development of estuaries and deltas region to observe these hazard processes and reveal their evolutionary mechanism. In this research topic, using the remote sensing images and corresponding hydrodynamic data, Lu et al. analyzed the relationship between the supply of terrestrial and marine sediments and the dynamic changes of the coastline in the Yangtze River Delta, and discussed the internal and external driving factors and interactions between the long-term evolution of the coastline and human activities in the past 40 years. Zhu et al. described the distribution and morphological characteristics of hummocky patches in an accretional intertidal zone of Jiangsu Province, China, and pointed out that the key factor in controlling the formation of hummocky patches is erosivity variability caused by the difference in sediment properties. Yang et al. investigated and analyzed the distribution, morphological characteristics and migration direction of sand waves in Taiwan shoal, northern South China Sea, which laid the foundation for the study of sediment transport and marine engineering site selection in this area. Xue and Shan carried out the long-term *in situ* observation on the typically inclined seabed slope in the southwest of Zhujiajian Island in Zhoushan, China based on the independently developed observation system with the results showing that the Zhujiajian landslide creep accelerates under the action of waves. Fluid mud is widely developed in estuaries, including natural mud and fluid mud formed by sediment erosion, resuspension and liquefaction forced by waves and/or currents. Wang et al. investigated the rheological characteristics of natural mud and explained its "two-step" yielding process in detail, which laid a foundation for the study of its movement characteristics and morphology evolution. Taking the silty sediment from the subaqueous Yellow River Delta as the experimental seabed in a flume, Yu et al. reproduced the formation, movement, and deposition processes of wave-induced liquefied sediment gravity flow (WILSGF). The results clearly revealed that under the combined action of pore water seepage and environmental water entrainment, a coarsened seabed is finally formed along the transport path of WILSGF with the fine particles suspended into seawater.

This Research Topic presents some original research papers and review on sediment dynamics and geohazards. These studies lay the theoretical foundation for the establishment of sediment transport models, geomorphic evolution studies, water and sediment regulation and engineering construction in estuaries and deltas, and provide valuable reference for the development and ecological protection in these areas.

Author contributions

The Research Topic "*Sediment Dynamics and Geohazards in Estuaries and Deltas*" is edited by XL, PL and YW. XL wrote the manuscript with support from PL and YW.

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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