

# Overall erosion of the Yangtze River delta under human interventions: spatial patterns and sediment budget

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## ABSTRACT

River deltas are actively propagating systems as redundant fluvial sediment accumulated hereon after part of the amount being taken away by marine currents. Anthropogenic activities in drainage basins strongly modified such propagation processes by increasing sediment productions over the past millennia and decreasing sediment loads in the past century. Though the definition of 'Anthropocene' in the geological sense is still controversial, there is no doubt that morphodynamics of world's deltas are altering from natural evolution driven to anthropogenic impact driven (Syvitski and Saito, 2007). The most significant feature is the delta erosion or flooding as a result of sediment trapping in upstream reservoirs in combination with relative sea-level rise. In addition, human interventions within deltaic regions may complicate the morphological patterns with strong spatial variations. Understanding the controlling factors and future trends of delta erosion is of high importance for sustainable development and comprehensive protection of these dense-populated areas.

The Yangtze River delta in China provide a nice example to address this issue. Previous studies have identified the delta erosion in local areas, including the inner estuary (Luan et al., 2016), the subaqueous delta (Yang et al., 2011) and the mouth area of the North Branch (Luo et al., 2017). However, a synthesized assessment on the entire Yangtze River delta using the latest data is rare, which is the main motivation of this study.

Based on bathymetric data observed in multiple years from 1958 to 2013, the overall evolution pattern of the Yangtze River delta is investigated. The results indicate that the entire system has converted from net accretion to net erosion since the early 2000s in response to fluvial sediment decline. Due to its large scale, the entire delta is divided into five sub-domains (Fig. 1). The accretion-erosion conversion occurred firstly in the inner estuary, and then the subaqueous and the mouth bar area successively. This was primarily determined by the intrinsic characteristics of the sediment transport processes and subsequent bed-level changes in different areas.

The sediment budget of the Yangtze River delta was proposed. Four stages were defined in terms of fluvial sediment decline and morphological processes. The first stage (1958-1978) represented high SD with overall accretion of the river delta. The SD began to decrease in the second stage (1978-1997) and the decreasing rate was accelerated after the closure of the TGD in the third stage (1997-2007). Large-scale estuarine engineering projects also played an important role during 1997-2007.

The fourth stage (2007-2013) represented the post-period of human impacts from both the river basin and the deltaic regions. It can be concluded that the regime shift of the Yangtze River delta from natural evolution driven to anthropogenic impact driven has occurred in terms of deltaic morphodynamics.

Because of the abundant sediment erosion, erosion of the Yangtze River delta is likely to continue in the coming decades until a dynamic equilibrium.

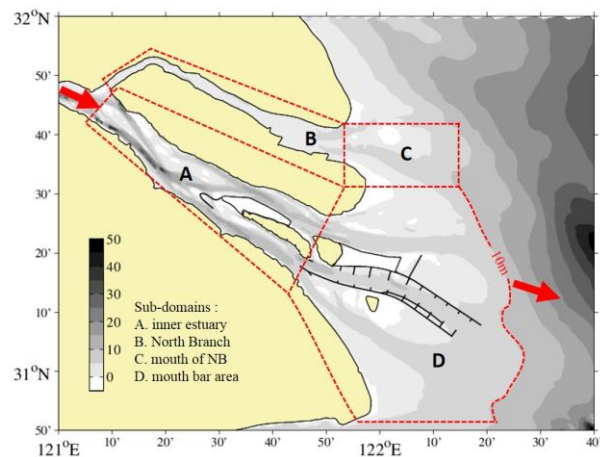


Figure 1 Domains for sediment budget analysis within the Yangtze River delta

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## REFERENCES

- Luan, H. L., Ding, P. X., Wang, Z. B., Ge, J. Z., Yang, S. L. (2016). Decadal morphological evolution of the Yangtze Estuary in response to river input changes and estuarine engineering projects. *Geomorphology*, 265, 12-23.
- Luo, X. X., Yang, S. L., Wang, R. S., Zhang, C. Y., Li, P. (2017). New evidence of Yangtze delta recession after closing of the Three Gorges Dam. *Scientific Reports*, 7.
- Syvitski, J. P. M., Saito, Y. (2007). Morphodynamics of deltas under the influence of humans. *Global and Planetary Change*, 57(3-4), 261-282.
- Yang, S. L., Milliman, J. D., Li, P., Xu, K. (2011). 50,000 dams later: Erosion of the Yangtze River and its delta. *Global and Planetary Change*, 75(1-2), 14-20.