

## Impact of human activities on subaqueous topographic change in Lingding Bay of the Pearl River estuary, China during 1955–2013

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Estuaries have been the site of intensive human activities during the past century. The decadal time-scale evolution of subaqueous topography in estuaries enables us to understand the effects of human activities on estuaries. From 1955 to 2010, land reclamation decreased the area of Lingding Bay by 10% ( $\sim 170\text{km}^2$ ), and the water volume of Lingding Bay decreased by  $615 \times 10^6 \text{ m}^3$ . This shows a net decrease of  $11.2 \times 10^6 \text{ m}^3$  a year, indicating that approximately 14.5 Mt/yr of sediment was deposited in Lingding Bay during that period. Before 1980, Lingding Bay was mainly governed by natural processes with slight net deposition, whereas after 1980 dredging in the bay and large port engineering projects changed the subaqueous topography by shallowing the shoals and deepening the troughs in the bay. Between 2012 and 2013, large-scale human activities including continuous dredging and a surge of sand excavation were found clearly with water depth changes of  $\pm 5 \text{ m/yr}$ , far exceeding the magnitude of natural topographic evolution in Lingding Bay. Human activities such as reclamation, dredging, and navigation-channel projects remove about 8.4 Mt/yr of sediment from Lingding Bay, accounting for 29% of the sediment input to the bay, and these activities have increased recently.

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