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TITLE: Multi-decadal variations in delta shorelines and their relationship to river sediment supply: An assessment and review

AUTHOR: ['Manon Besset', 'Edward J. Anthony', 'Frédéric Bouchette']

ABSTRACT:

The inception, growth, and decline of numerous large and small river deltas on Earth have been strongly influenced by human population dynamics and interventions on catchments, notably deforestation and reforestation. Over the last half century, the effects of catchment conditions in determining fluvial sediment supply have been exacerbated or moderated by dams and reservoirs. The sediment balance of river deltas, crucial in terms of delta shoreline stability, advance or retreat, and subsidence, has, in turn, been affected by variations in fluvial sediment supply. The shoreline mobility and resulting subaerial coastal area changes of a selection of 54 of the world's deltas was quantified over 30 years based on data culled from the literature and from satellite images. These changes were analyzed alongside fluvial sediment loads. Delta shoreline mobility in response to changing fluvial loads has been variable, reflecting the miscellaneous factors that influence the supply of sediment to deltas. 29 deltas are in overall erosion, 18 show shoreline advance, whereas seven do not show any significant change. The sediment loads received by 42 deltas diminished relative to values prior to 1970, by more than 50% for 28 of them. Ten deltas showed advance, some significantly, notwithstanding fluvial sediment load decreases exceeding 25%. Overall, with the exception of the Colorado (Tx) and the Indus, losses in subaerial coastal area have been rather low. It would appear that diminishing fluvial sediment supply, the driving force in deltaic equilibrium at a multi-decadal timescale, has not, thus far, had a significant negative impact on multi-decadal delta shoreline mobility. This is important in terms of gauging currently perceived delta vulnerability. Notwithstanding, a clear link exists between the mobility of delta shorelines and the reduction in fluvial sediment loads. Eroding deltas have been affected by a reduction that is twice as important as that of stable or advancing deltas since 1970. Dams currently in place will reduce, in the future, the sediment load to their deltas of 25 of the 54 rivers by more than 50% and 100% for 15 of them. It is important to envisage the supply of sediment to deltas less in terms of its direct role in generating accretion, and eventual delta shoreline advance, and more in terms of an agent of resilience. The reduction of fluvial sediment supply to deltas will negatively impact their resilience to other drivers in the future: anthropogenic, climate change, and sea-level rise. The variability of delta shoreline behavior in the face of changing fluvial sediment loads also calls for more in-depth studies of individual deltas in order to build up future management plans addressing vulnerability and loss of resilience to marine forcing, subsidence, and sea-level rise.

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