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Spatio-temporal variations in sedimentary processes in the tidal river to estuarine reach of the Ayeyarwady Delta, Myanmar

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As the Ayeyarwady River approaches the Andaman Sea, it splits into numerous delta distributary channels, which together discharge >108 t/y of sediment to the coastal ocean. This study aims to understand: 1) sediment retention and geomorphic variability through the lower tidally influenced distributaries, 2) deltaic growth along mangrove shorelines, and 3) sediment export through this relatively natural, but rapidly changing deltaic system. We focus on three of the distributary channels that have differing fluvial discharge and marine tidal forcing. There is an order-of-magnitude difference between the discharge carried by the largest of the distributaries, the Yangon River, and the smallest studied, the Bogale River. From east to west, the tidal range at the distributary mouths decreases from ∼6 m at the eastern Yangon River, to 3.5 m at central Bogale River, to 3.2 m at the western Pathein River. Seasonal variations are associated with tropical monsoons, and our studies occurred during both high- and low-discharge conditions. During high-discharge conditions, suspended-sediment concentrations (SSC) and sediment dynamics are similar across all three distributary channels. They all carry sediment with a median grain size of 3-4 microns in suspension. During low-discharge, salinity intrusion extends many tens of kilometers upstream of the river mouths, shifting the dynamics within the distributaries from those of a tidal river to an estuary. In this regime, SSC values are observed to decrease in the Pathein River (10s mg/L), while in the Yangon River, SSC increases to >5 g/L. In addition to in-situ data collected during the two seasonal conditions, surface SSC derived from calibrated multispectral remote-sensing products provide a synoptic view of turbidity across the delta, and resolve long-term trends in surface SSC for the distributaries of the Ayeyarwady River. Landsat images suggest greater turbidity toward the apex of the Gulf of Mottama, and in all three distributaries, surface SSC is generally greater near the mouths, and decreases upstream, consistent with our observations. Relating suspended sediment transport in the distributaries to local morphology, we find that channel-bed sediment is primarily muddy sand, but mud deposits can be found in regions of the estuarine turbidity maximum. On the adjacent mangrove-forested intertidal surfaces, morphodynamic studies document sediment-accumulation rates of ∼1 cm/yr in the aggrading mangrove forest and prograding subaqueous shoal. Natural networks of dendritic tidal channels within the forest efficiently deliver sediment to intertidal land surfaces distal to the main channels. The mangrove forests of the Ayeyarwady Delta, while diminishing in size due to human factors, are an important sediment sink upstream of the coastal ocean. Due to its large sediment discharge, dynamic seasonal and tidal conditions, and intact mangrove forests, the Ayeyarwady Delta is an important and understudied component of global source-to-sink systems.