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The physical sustainability of the coastal zone of the Ganges-Brahmaputra-Meghna delta under climatic and anthropogenic stresses

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The Ganges-Brahmaputra-Meghna (GBM) delta is one of the world's largest deltas, and consists of large areas of low flat lands formed by the deposition of sediment from the GBM rivers. However, recent estimates have projected between 200~1000 mm of climate-driven sea-level rise by the end of the 21st century, at an average rate of ~6 mm/yr. Eustatic sea-level rise is further compounded by subsidence of the delta, which in the coastal fringes varies from 0.2 to 7.5 mm/yr, at an average value of ~2.0 mm/yr. Therefore, the combined effect of sea-level rise and subsidence (termed relative sea-level rise, RSLR) is around 8.0 mm/yr. Such high values of RSLR raise the question of whether sediment deposition on the surface of the delta is sufficient to maintain the delta surface above sea level. Moreover, as the total fluvial sediment influx to the GBM delta system is known to be decreasing, the retained portion of fluvial sediment on the delta surface is also likely decreasing, reducing the potential to offset RSLR. Within this context, the potential of various interventions geared at promoting greater retention of sediment on the delta surface is explored using numerical experiments under different flow-sediment regime and anthropogenic interventions. We find that for the existing, highly managed, conditions, the retained portion of fluvial sediment on the delta surface varies between 22% and 50% during average (when about 20% of the total floodplain in the country is inundated) and extreme (> 60% of the total floodplain in the country is inundated) flood years, respectively. However, the degree to which sediment has the potential to be deposited on the delta surface increases by up to 10% when existing anthropogenic interventions such as polders that act as barriers to delta-plain sedimentation are removed. While dismantling existing interventions is not a politically realistic proposition, more quasi-natural conditions can be reestablished through local- sediment management using tidal river management, cross dams, dredging, bandal-like structures and/or combinations of the above measures.