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Potential social-ecological development of coastal Bangladesh through the 21st century

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Deltas occupy only 1% of global land surface area, but contain 7% of the global human population (ca. 500 million). The influence of changing and interacting climates, demography, economy, land use and coastal/catchment management on deltaic social-ecological systems is complex and little understood. We apply a new and innovative integrated assessment model: The Delta Dynamic Integrated Emulator Model (ΔDIEM) to coastal Bangladesh to explore a range of plausible future scenarios and quantify the sensitivities of selected environmental and socio-economic outcomes to key external and internal drivers. ΔDIEM is a tightly coupled integrated assessment platform considering climate and environmental change, demographic changes, economic changes, household decision making and governance, and designed to support the delta planning in Bangladesh. ΔDIEM allows the testing of a large number of water-based structural and policy interventions within a robust scenario framework, as well as quantify different development trajectories and their trade-offs. In this sensitivity analysis, we quantified the impact of (i) climate (precipitation, temperature and runoff), (ii) relative sea-level rise, (iii) cyclone frequency, (iv) embankment maintenance, (v) population size, (vi) economic changes at household level such as selling price of crops, cost of food, etc., (vii) land cover, and (viii) farming practices on trajectories of inundated area, soil salinity, rice productivity, poverty, income inequality and GDP/capita, assuming two contrasting scenarios in a more Positive and a more Negative World. Trajectories of these plausible futures showed a clear separation and the long-term trends are greatly influenced by the combinations of scenario assumptions. Our systemic results indicate a diverse potential set of futures for coastal Bangladesh, where good governance and adaptation could effectively mitigate the threat of sea-level rise-induced catastrophic inundation and other adverse impacts of the changing climate. However, societal inequality requires special attention otherwise climate-sensitive population groups may be left behind.