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The Response of Deltas to Sea Level Rise under Natural- and Human-impacted Conditions

Carles Ibañez (1), Liviu Giosan (2), Enrique Reyes (3), and John W. Day (4)

(1) IRTA, Aquatic Ecosystems Program, 43540 Sant Carles de la Ràpita, Catalonia, Spain (carles.ibanez@irta.cat), (2) Woods Hole Oceanographic Institution, Geology & Geophysics, Woods Hole, MA 02543, USA, (3) East Carolina University, Department of Biology, Greenville NC 27858, USA, (4) Louisiana State University, Department of Oceanography & Coastal Sciences, Baton Rouge, LA 70803, USA

The response of deltas to sea level rise (SLR) has been either studied from a perspective of human impacts or from a perspective of natural changes associated to glacial cycles. Time scales, methods and disciplines of each approach are different, and to date there is no comprehensive framework to analyze the changes that deltas undergo when both natural and human-impacted conditions occur. The goals of this study are: a) to review the scientific literature concerning the effects of SLR on deltas under natural and human-impacted scenarios and; b) to propose a unified framework to understand future changes according to the intensity and type of human impacts. The current paradigm in both scenarios is that relatively high rates of SLR (> 1 cm/yr) led to destructive phases for deltas, characterized by a coastal retreat and the progressive flooding of the delta plain. However, we hypothesize that deltas can withstand high rates of sea level rise under certain natural and human-managed scenarios, through a series of mechanisms that makes them more resilient to sea level rise than other non-deltaic coastal systems. Deltas can withstand high rates of SLR provided that: a) there is enough sediment supply from the river; b) the slope of the continental shelf through which the deltas migrate is smooth enough, c) the human impact does not tend to isolate the delta plain from the riverine and marine dynamics. Two main mechanisms allow deltas to cope with SLR and they are self-enforced as the rates increase: a) the river switching and formation of new lobes in shallow areas and; b) increased overflowing from the river that increases the sediment and nutrient inputs to the delta plain and its trapping efficiency. These mechanisms can be enhanced through management measures based on natural system functioning and ecological engineering methods.