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Storm Surge Flooding of Deltas Made Susceptible by Human Activities

J.P.M. Syvitski, G.R. Brakenridge, A.J. Kettner, and I Overeem

(James.syvitski@colorado.edu) Community Surface Dynamics Modeling System (CSDMS), Institute of Arctic and Alpine Research (INSTAAR), University of Colorado, Boulder CO, USA, 80309-0545

Deltas are densely populated, intensively farmed landforms, that are being threatened by marine flooding, not just by rising sea levels, but more so by sediment compaction from water, oil and gas mining, sequestration of sediment in upstream reservoirs, and from floodplain engineering. Visible and near-infrared Moderate Resolution Imaging Spectroradiometer (MODIS) satellite images in conjunction with the Advanced Microwave Scanning Radiometer (AMSR-E) were used to establish the extent of recent flooding on the deltas, whether the flooding was from coastal storm surges, and whether the floodwaters carried suspended sediment. Of 33 representative world deltas examined, 20 have experienced severe flooding in the last decade from storm surges, temporarily submerging 72,240 km2. Areas vulnerable to flooding may increase by 50% under projected 21st Century eustatic sea level rise, but this is a conservative estimate given the current trends in the reduction in deltaic sedimentation that would otherwise buffer deltas. Early indications suggest that the magnitude and frequency of hurricanes and cyclones may increase in coming decades, along with the onset of more intense precipitation events. All trends point to ever-increasing areas of deltas sinking below mean sea level. To keep the ocean off the landscape, coastlines are being strengthened through coastal barriers of untested strength. Human occupation and infrastructure development continues, through the development of megacities and their expanding footprint on deltas. River engineering near river mouths can be counterproductive: confinement of in-channel sediment load favors bed aggradation, even while areas behind protective levees are sinking. Whereas humans have largely mastered the everyday behavior of lowland rivers, they appear less able to deal with the fury of storm surges that can temporarily raise sea level by 3 to 10 m. It remains alarming how often deltas flood, whether from land or from sea, and the trends appear to be worsening.