Mass Wasting Processes and Products of the Mississippi Delta Front: Data Synthesis and Observation

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On river deltas dominated by proximal sediment accumulation (Mississippi, Huang He, others), the nearshore region commonly dominated by rapid accumulation of cohesive fluvial sediments is known as the "delta front." For such river-dominated systems, submarine landslides (referred to generally as "mass wasting") reshape the seabed, and are important geohazards. Mass transport is preconditioned in sediments by high water content, biogenic gas production, over steepening, and is commonly triggered by strong wave loading and other processes. This understanding is based on extensive Mississippi Delta field studies in the 1970's and 80's. Since that time, technologies for seabed study have improved greatly, but our understanding of these dynamic and hazardous seabed settings has lagged. Recent studies of the Mississippi River Delta Front are yielding new insights, in a time of anthropogenically reduced sediment loads, rising sea level, and catastrophic deltaic land loss. We have synthesized many industry data sets collected since ca. 1980, and conducted new pilot field and modeling studies of sedimentary and morphodynamic processes. These studies have yielded several key findings that diverge from historical understanding of this dynamic setting. First, delta distributary mouths have ceased seaward progradation, ending patterns that have been documented since the 18th century. Second, despite reduced sediment supply, offshore mass transport continues, yielding vertical displacements at rates of ~1 m/y. This displacement is apparently forced by wave loading from storm events of near-annual return period, rather than major hurricanes that have been the focus of most previous studies. Third, core analysis indicates that this vertical displacement is occurring along failure planes >3 m in the seabed, rather than in more recently deposited sediments closer to the sediment-water interface. These seabed morphodynamics have the potential to destabilize both nearshore navigation infrastructure, and seabed hydrocarbon infrastructure offshore. As well, these findings raise more questions regarding the future seabed evolution offshore of major river deltas, in response to anthropogenic and climatic forcing.