Coastal Subsidence and Accelerated Sea-Level Rise: A Dual Threat for the Mississippi Delta

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The US Gulf Coast in general, and the Mississippi Delta in particular, belong to the world's most vulnerable shorelines due to coastal subsidence and accelerated sea-level rise. Rational policy making and coastal management requires a comprehensive and quantitative understanding of the processes at play. We use a combination of detailed reconstructions of Holocene relative sea-level (RSL) change in coastal Louisiana plus deformed late Pleistocene long profiles of the Lower Mississippi River to quantify long-term vertical movements of the Earth's crust, and use this evidence to constrain a geophysical model that considers the effects of ice, water, and sediment (un)loading. Our previous work within the Mississippi Delta indicated that considerable portions of its subsurface subside much slower than several earlier studies had suggested. More recent investigations have focused on the Louisiana Chenier Plain that exhibits a Holocene RSL history broadly comparable to that of the delta, but with some subtle differences. Specifically, RSL data from the Chenier Plain mostly plot slightly higher than RSL data from the Mississippi Delta, indicating that significant portions of the deltaic crust subside at a rate of ~0.15 mm/yr relative to that of the Chenier Plain. These differential rates are indistinguishable from long-term (Neogene) deltaic subsidence rates obtained from well logs and biostratigraphic data. It should be noted that a larger driver of millennial-scale subsidence throughout coastal Louisiana is glacial-isostatic adjustment (related to the melting of the Laurentide Ice Sheet), which accounts for ~0.5 mm/yr. In the grander scheme of things, all these rates are relatively modest. It is now widely understood that the premier cause of land-surface subsidence in coastal Louisiana is the compaction of relatively shallow Holocene strata, with millennial-scale rates of up to 5 mm/yr. In addition, the rate of RSL rise along the US Gulf Coast has increased dramatically during the past century. This is evident when comparing the rates of RSL rise during the 20th century with those for the late Holocene - doing so shows a fourfold increase in the rate of rise. Given the wide consensus that the rate of climate-driven sea-level rise will likely continue to accelerate during the next century, this will become an increasingly important contributor to RSL rise in the Mississippi Delta.