South Louisiana's Twentieth Century Fault-Driven Transgression

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During the twentieth century the 5000-year long trend of deltaic progradation along Louisiana's coast was reversed and 5700 square kilometers (2200 square miles) of coastal lowlands representing more than 1000 years of delta building reverted to water. The problem was first defined in 1969, and as the catastrophe unfolded, it was attributed largely to anthropogenic causes (sediment capture by tributary dams, prevention of over bank deposition by levees, funneling of sediment into the Gulf by navigation channels, etc.). By the mid 1990s researchers began to realize that human activity was not the primary cause of coastal landscape collapse, but rather it was submergence of fault-bound blocks. Everything on the blocks was sinking: marsh surfaces, natural levee ridges, barrier islands, roads, and flood levees. Barrier islands were breaking up and the Gulf shore was retreating. Tectonic processes were driving the change.

From the mid 1960s through the 1970s, the region experienced accelerated land loss, surface displacement along faults and earthquake activity. During hurricanes Katrina and Rita in 2005, and Gustav and Ike in 2008 storm surge found little resistance from submerged and degraded coastal lowlands and rolled far inland. Faults underlying flood levees contributed to their failure.

Geological evidence suggests two other Late Quaternary intervals of increased tectonic activity in the region. Liquifaction formed “pimple mounds” centered around the Calcasieu River fracture zone may be associated with massive slumps on the continental slope that formed circa 20,000 years before present. Also, shift of the Mississippi River channel from the west to the east side of the alluvial valley about 4500 years ago may have been caused by tilting of fault-bound blocks and a major tectonic event.

Widely accepted models of Late Quaternary deposition and landform evolution in the region developed during the 1940s - 1960s place little importance on tectonic processes. A new model of province level gravity slump cells with associated linked tectonic systems provides a unified framework for understanding puzzling aspects of fault movement, earthquakes, changes in relative sea level and depositional and erosional events. Multi-billion dollar federal and state government programs for restoring Louisiana’s coastal lowlands and providing storm surge protection have fatal flaws because they are based on obsolete geological process-response models.