Response to Comment on "Wetland Sedimentation from Hurricanes Katrina and Rita"

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Törnqvist *et al*. accept the usefulness of our data but confuse hurricane landfall location with hurricane storm surge impacts, misrepresent our data interpretation, and misattribute conclusions to our study. Our study did not attempt to address the overall effectiveness of river diversions used for management purposes. We agree that river mouth sedimentation is an important geological process that may lead to marsh colonization.

Törnqvist *et al*. (*1*) accept our data (*2*) as valuable but make at least two consequential errors in their comments about how we interpret these data. First, they emphasize hurricane landfall location and ignore the primary role of storm surge in sediment transport. Second, contrary to their assertion, we did not discuss the issue of sedimentation where a river meets the sea. Although we did not draw any conclusions about the overall merits of river diversions used for management purposes, we did conclude that hurricane-derived sediments deposition is much larger than those introduced by the Caernarvon diversion or from overbank flooding of the formerly unconstrained river channel within the past two centuries.

Sediment transport during hurricanes is the result of water transport as water moves more rapidly onshore than when it leaves during a storm surge. Hurricane landing location and category are imperfect estimates of storm surge characteristics. Hurricane wind speed and wind duration, air pressure, temperature gradients, and both shelf slope and topography, for example, influence the speed and direction of the water currents that lift and transport sediments. The slope of the continental land mass "can change the height of the surge by a factor of two for a given central pressure and/or maximum wind." (*3*). The following examples illustrate cases when storm surge was not related to hurricane category and landing location: (i) the eye of Hurricane Rita crossed at the Louisiana-Texas border (western Louisiana) and created a higher storm surge in Lake Ponchartrain (eastern Louisiana) than the storm surge from Hurricane Katrina, which landed at the Louisiana-Mississippi border [(*2*) and SOM Text]; (ii) Hurricane Flossy (1956), a storm ranked as Category 1 and 2 in various reports, would have had a storm surge <2.8 m if it had been a Category 2 storm, but it created a surge of 4 m on the eastern flank of the Mississippi River delta (*4*, *5*); and (iii) a 1915 hurricane landed in Galveston, Texas, and caused a 3-m storm surge in Barataria Bay, located 350 km to the east. A reassessment of our Supporting Online Material on hurricane frequency for those with a minimum 3-m storm surge results in an average frequency of about 7.9 years [(*2*) and SOM Text].

According to Törnqvist *et al*. (*1*), our "assertion that direct fluvial deposition cannot effectively build land is contradicted by the actively growing Wax Lake and Atchafalaya deltas, both due to (inadvertent) diversions of precisely the kind that they claim would be ineffective." This is a misrepresentation of our study's conclusions. We did not claim that such diversions would be ineffective, because we did not make any assertions about building land, except to set the general context for why it is important to improve the numbers in a sediment budget for this coast. Furthermore, we did not confuse sedimentation introduction and storage at the Caernarvon diversion with sedimentation processes at the mouth of a river delta. These are different geological issues. One freshwater source enters into freshwater marshes and the other into a salty estuarine bay. One flows intermittently and the other continuously. One is of water taken from the surface layer that is largely without sands, and the other is the whole river. We therefore made no claims about the amount of sediment stored at the delta mouth. The assertion of Törnqvist *et al*. (*1*) about "the dominant role of the Mississippi River and its distributaries as the sediment source for the Louisiana coast" implies that we stated otherwise. On the contrary, we said of sediments deposited by hurricanes that "most of the inorganics accumulating in them went down the Mississippi's birdfoot delta before they were deposited during large storms."

The reference cited to support Törnqvist *et al*.'s conclusion that erosion occurred (*6*) made no measurements of accumulation or erosion in open water after a hurricane. It seems unlikely that there would be sedimentation over the marsh but not in open water during a storm surge. We agree that some sediments will be eroded over time, and we also think that some of these eroded sediments will be stored in local waters and even remobilized to be transported back into the marsh by local storms. However, it has been shown several times that hurricane deposition results in a net sediment gain, not a net loss (*7*–*9*), and that a hurricane depositional signal appears in the sediments (*10*).

Finally, Törnqvist *et al*. (*1*) seem to think that we consider sediment storage at the delta to be inconsequential. This conclusion is incorrect. We do not disagree with the conclusion that delta mouth deposition is important. Our study did not attempt to address the overall potential effectiveness of river diversions as presently implemented, or delta river mouth processes. We compared the estimated hurricane deposition to the weight of sediments that went over or through a river levee (natural or constructed) and used published values for this comparison (*11*). These pathways are identified by us as "constrained" or "unconstrained" overbank flows, and we identify the data source for the estimates. These estimates do not represent estimates of deposition at the delta mouth. We looked at only one aspect of diversions and did not mean to imply that river mouth processes are equivalent to overbank processes. On the other hand, hurricanes leave a considerable amount of sediment across the coast, whereas delta mouth processes are more restrictive temporally and spatially. The chenier plain, for example, which comprises about half the coastline, has no river deltas or substantial source of sediments other than storm deposits.

How quickly some of the >2600 km^2 of wetland lost over the past 50 years can be restored by processes building them at about 1.5 km^2 annually over the course of 7 to 8 thousand years, and how to spend funds for wetland restoration most effectively, are important topics of dialogue for future research and management plans.. It would be unfortunate if either delta mouth sedimentation processes or hurricanes were excluded from these discussions.

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Supporting Online Material

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