Comment on "Wetland Sedimentation from Hurricanes Katrina and Rita"

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Turner *et al*. (Reports, 20 October 2006, p. 449) measured sedimentation from Hurricanes Katrina and Rita in coastal Louisiana and inferred that storm deposition overwhelms direct Mississippi River sediment input. However, their annualized hurricane deposition rate is overestimated, whereas riverine deposition is underestimated by at least an order of magnitude. Their numbers do not provide a credible basis for decisions about coastal restoration.

Turner *et al*. (*1*) provide valuable data on inorganic sedimentation in coastal Louisiana from Hurricanes Katrina and Rita. Their study reached conclusions with major implications for coastal restoration (*2*), namely that direct sediment supply from the Mississippi River is comparatively minor, that the overwhelming driver of deposition is hurricanes, and thus that river diversions would be an ineffective method of delta restoration. We show that Turner *et al*. overestimate the net contribution from hurricanes and underestimate the direct contribution of the river to deltaic sedimentation. Finally, we suggest that river diversions would likely enhance the hurricane-derived contribution.

Regarding hurricane contribution, Turner *et al*. rely on unauthenticated or outdated sources—instead of the National Oceanic and Atmospheric Administration's (NOAA) well-documented best-track database (HURDAT) (*3*)—to compile their list of historical hurricanes, which resulted in a flawed data set. Among the 17 hurricanes they used for the calculation of the return period of category 3+ hurricanes, 6 are below the cutoff intensity level at landfall, 2 are not Louisiana hurricanes, and 2 do not appear in the HURDAT database at all (*4*). Consequently, their return period of 7.88 years greatly overestimates the frequency of intense hurricanes and, therefore, the annualized rate of hurricane deposition.

Turner *et al*. intentionally selected only freshly deposited sediment for their study, and no erosion measurements are reported. However, conflating deposit volume with net sediment addition is equivalent to evaluating one's financial resources using only gross income. For example, sediment deposited inland of the coast during hurricanes is often associated with wetland erosion (*5*, *6*), not delta building. From Turner *et al*.'s analysis, we cannot determine the sign (±) of the net hurricane-induced sediment balance. In this context, we call attention to Turner *et al*.'s tripling of their measured value for storm deposition on wetlands by assuming, without observations, similar rates in open-water environments that may have experienced erosion, not deposition (*7*). Clearly, examining sediment dynamics in shallow water bodies during storm surges would be a fruitful line of future research.

Turning to the issue of direct river contribution, Turner *et al*. use a pre-levee fluvial overbank (including crevasse) deposition rate of 6.6×10^6 metric tons (MT) year^{-1}. Currently, the Mississippi River deposits sediment in three principal areas: the birdfoot, Atchafalaya, and Wax Lake deltas (Fig. 1). The present average annual deposition rate in the smallest of these (Wax Lake delta) is ~4.3 to 5.8×10^6 MT year^{-1} (*4*), that is, close to Turner *et al*.'s value for the entire delta. Their assertion that direct fluvial deposition cannot effectively build land is contradicted by the actively growing Wax Lake and Atchafalaya deltas (*8*), both due to (inadvertent) diversions of precisely the kind that they claim would be ineffective. Deposition in these deltas shares many characteristics, albeit at a larger scale, with the Caernarvon diversion discussed by Turner *et al*. that involves river-mouth sedimentation in shallow open water.

Quantifying wetland formation (to a large extent by overbank deposition and crevassing) over longer time scales is possible with data from Bayou Lafourche, an abandoned channel that fed a radial pattern of distributaries (Fig. 1) that was largely coeval with the present-day Mississippi River. Conservative estimates for the Lafourche subdelta area (10,000 km^2) and mean thickness (10 m) (*9*), time span of activity (1500 years) (*10*), and bulk density (1.5 g cm^{-3}) (*11*) yield a deposition rate of 100×10^6 MT year^{-1}. This number is similar to the average over one century for recent crevasse splays in the birdfoot delta (*12*), showing that comparable deposition rates were sustained over millennial time scales.

Finally, combining the rate of overbank deposition used by Turner *et al*. (6.6×10^6 MT year^{-1}) with a 19th-century Mississippi River sediment supply of $\geq 400 \times 10^6$ MT year^{-1} (*13*, *14*) would imply that ≤1.65% of the sediment is sequestered on the delta plain and the rest delivered to the sea. The Wax Lake delta shows a sequestration near 23% (*4*), and studies in other major deltas show values of ~20% to 80% (*15*–*17*), predominantly due to overbank deposition, including crevassing. Overall, Turner *et al*.'s estimate of fluviodeltaic deposition is at least an order of magnitude too low and underestimates the potential effectiveness of river diversions in the Mississippi Delta.

The morphology of the delta and the low-energy wave-current climate in the Gulf of Mexico point unambiguously to the dominant role of the Mississippi River and its distributaries as the sediment source for the Louisiana coast (*18*), including the chenier plain (Fig. 1). The Holocene evolution of the Mississippi Delta, one of the most intensively studied deltas on Earth, is characterized by distinctly lobate deposits that track shifts in the Mississippi River along the coast. This would not occur if the role of the river in supplying sediment were unimportant.

The contribution of Turner *et al*. should not be entirely dismissed because of the above objections. Hurricanes might indeed cause an import of sediment to the coastal plain (*19*), even if not as large as claimed, that may therefore merit consideration in coastal restoration. Enhanced delivery of

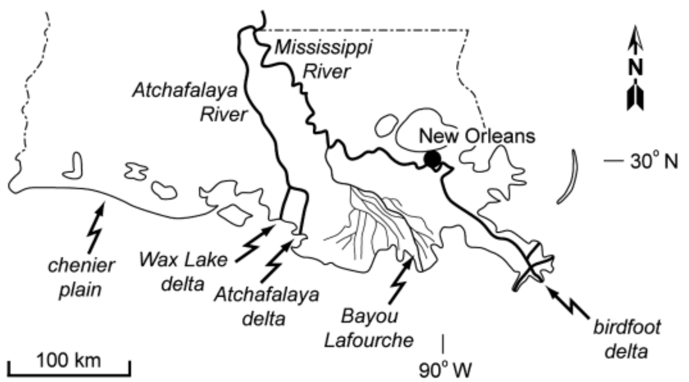

Fig. 1. Map of south Louisiana with geographic features discussed in the text.

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sediment by means of diversions that do not debouch into deep water like the birdfoot delta would augment wetland accretion from both riverine and shallow-marine sources. Finally, we note that river diversions deliver not only sediment but also freshwater and nutrients that are equally critical to maintain coastal wetland health (*20*).

References and Notes

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