We question the assertions by Nittrouer and Viparelli that deltas are 50–70% sand and that sand supply has not decreased owing to dam construction. Thus we question the conclusion that there is a stable and sustainable supply to rebuild the Mississippi delta. We note that previous morphodynamic models found that the amount of deltaic land that can be built by engineered diversions, using all available sediment loads, is only about 25% of the landscape that might be submerged by 2100[4]. For this reason, we favour diversions that are farther upstream and maximize trapping of all grain-size fractions on the vegetated delta plain[1,2]. ❐

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Reply to 'Is sand in the Mississippi River delta a sustainable resource?'

Nittrouer and Viparelli reply — Blum and Roberts[1] contend our assertion that the sand supply rate at Tarbert Landing has been stable and unaffected by Missouri River dam closures. We used data since 1972 because we could obtain the raw data, and because the protocol for acquiring it is well documented. A US Army Corps of Engineers report[2] presents a corresponding analysis for 1959 to 2005; however, we did not use this data because we could not obtain it in raw form. The report nevertheless shows the same result: a stable sand supply rate. We are neutral regarding the quality of available data from 1949 to 1957, as its provenance has proved difficult to verify. The closing of the Fort Randall Dam on the Missouri River in 1953 (Fig. 1a, ref. 1) could not have affected sand load at Tarbert Landing by 1959, nor will it affect sand supply there for a few centuries hence. As our morphodynamic model shows, the intervening sand bed acts as a capacitor that strongly dampens the downstream propagation of the reduction in sand supply upstream. Blum and Roberts offer neither a statistical analysis of the data to verify their claim of sand reduction, nor modelling results or a physical basis to explain how the signal of reduced sand supply due to dam closure in 1953 could propagate over 3,000 km down a sand-bed river in less than a decade.

We emphasize the role of sand in building land because it has been demonstrated to be effective over the socioeconomically relevant timescales of decades to a century. In sand-bed rivers that carry mud as wash load, the efficiency of mud deposition is markedly lower than sand. In the channel–floodplain complex of the Bogue Chitto River, Louisiana, for example, the characteristic distance for sediment exchange between channel and floodplain is approximately 10 km for sand and approximately 200 km for mud[3]. A similar trend in depositional efficiency was observed during the Mississippi River flood of 2011. The opening of the Bonnet Carré spillway resulted in the deposition of 7.8 Mt of sand, nearly all of which was emplaced proximally in the spillway[4], and up to 3.8 Mt of mud dispersed over the bed of Lake Pontchartrain[5]. Mud deposition in Lake Pontchartrain from 10 spillway openings over 83 years[4] has not produced subaerial land. In contrast, 100 km^2 of land has formed in the Wax Lake delta since the mid 1970s; greater than 50% of this deposit is sand, whereas approximately 75% of the mud delivered to the delta escapes to the subaqueous marine environment[6].

Blum and Roberts state that other numerical models[7] have found that only 25% of the deltaic landscape that might be submerged by 2100 can be saved by engineered sediment diversions. However, these simulations consider the specific case for utilizing approximately 37% of all available sediment just upstream of the Old River Control Structure, which includes sand and an equal part mud, to build new land in the Mississippi River delta. The point is that the more sediment that is diverted, the more land that can be built. ❐

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