The effect of bottomset on fluviodeltaic land-building process: Numerical modeling and physical experiment

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Loss of coastal delta area is an emerging topic across the scientific community, as many countries have been suffering from land loss due to accelerating relative sea-level rise. Various methods have been attempted to mitigate the land loss. Among these methods, river diversion, which makes use of the natural river delta-building process, has been proposed and examined. Prior numerical models predicted possible ranges of new land-building rates and verified the feasibility of reduction in land loss by river diversions. These models, however, only considered the topset and foreset of the delta without incorporating the mud bottomset, as the subaerial portion of the delta mostly consists of sand, and mud was considered as washload. Since muddy bottomsets are observed in most coastal river deltas and less than 20% of the total sediment load is sand (while the rest is comprised of mud), it is critical to understand deposition of mud in deltas. Here, we show that mud retention in the bottomset has significant effects on land building using a new numerical model and flume experiment that includes an additional moving boundary at the foreset-bottomset break. We find that bottomset aggradation can accelerate the shoreline progradation by decreasing the foreset length. We also applied our model to a field scale based on parameters taken from the Wax Lake Delta and the results suggest that when the 20~50% mud supplied from the river was retained in the bottomset, delta-building area increases 9.3~25.4% compared to that in non-bottomset delta. Our results implicate that even with a limited volume of supplied sand, abundantly available mud deposition in the bottomset can significantly improve the land-building rate. Therefore, considering bottomset in land-building model can provide more accurate prediction for new land building by river diversions.