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The investigation of the formation of river delta deposits is an important subject in geomorphology. Recently a reduced complexity model which simulates the process of delta formation on geological time scales has been proposed Modeling River Delta Formation dimensional framework. In this paper we investigate details of the modelled dynamics applied to a river-dominated delta and compare them with observations of the formation of the Balize Lobe of the Mississippi River Delta. We show that the dimensionless parameters of the model may be rescaled to match the size of the delta, the lobe volume, observations of water and sediment inflows, and the duration of lobe formation. We show that the model is internally consistent from the process point of view and gives physically meaningful results. The erosion-deposition law generates both subaerial and subaqueous channel and lateral levee formations which are similar to natural ones. Finally we use detrended fluctuation analysis to show that the model produces long-term simulated dynamics of the delta formation process with a complex temporal correlation structure. A characteristic timescale separates periods of consistent delta growth by gradual sediment deposition at the mouths of distributary channels from periods at which random large scale channel avulsions lead to rapid change and the formation of new channels and subaqueous dominated deposition.

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