EGU21-1133
https://doi.org/10.5194/egusphere-egu21-1133
EGU General Assembly 2021

Numerical Study on the Effects of Vegetation on the Intradelta Lobe Avulsion

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Coastal wetlands play an important role for both human society and coastal ecosystems. The intradelta lobe avulsion, which causes channel shift inside the delta lobe, can create new coastal wetlands and benefit wetland restoration. Previous studies suggest that intradelta lobe avulsion is controlled by the river mouth bar stagnation that results in back filling of the river channel, which further increases the overbank flow at the natural levees and eventually leads to the avulsion. However, the natural levees are commonly colonized by vegetation, and its relevant effects on the avulsion at the levees are still elusive. In this study, we aim to quantify the effects of vegetation on the occurrence of intradelta lobe avulsion at the natural levees through numerical experiments using Delft3D. Numerical simulations of vegetated and non-vegetated scenarios were conducted with different combination of vegetation height and density, river discharge, suspended-sediment concentration and Chezy coefficient. The model results show that the existence of vegetation results in shorter levee length and river mouth bar distance relative to those of non-vegetated scenarios. The levee length and the river mouth bar distance are primarily dictated by the Chezy coefficient and the representative Chezy coefficient for non-vegetated and vegetated scenarios, respectively. In addition, the time scales of river mouth bar stagnation and the intradelta lobe avulsion tend to be shorter for vegetated scenarios, which is presumably due to the shorter river mouth bar distance that leads to a smaller accommodation space for back filling of the river channel. Our findings have important implications for predicting the future avulsion of intradelta lobe and improving the management of deltas and estuaries.