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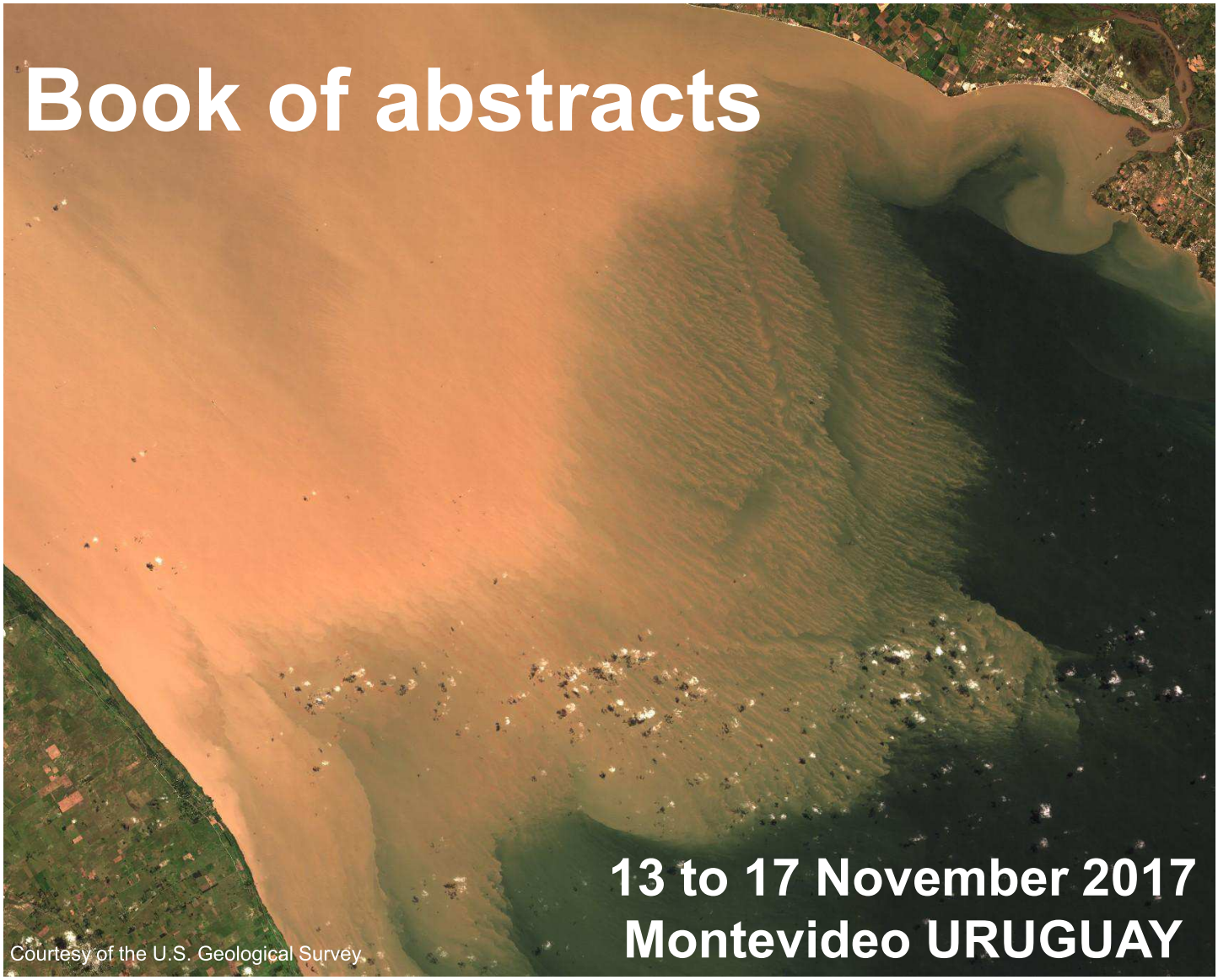
Publication date
2017

INTERCOH 2017
Montevideo - Uruguay
November 13 - 17

14th International Conference on Cohesive Sediment Transport Processes



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How important is mud transport on large scale estuarine and deltaic morphodynamics?

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Abstract

Sediment transport provides a critical bridge between hydrodynamics and morphodynamics. Sediment transport behaviour has obvious impacts on morphodynamic development. Long-term morphodynamic modelling enables examination of large scale morphological patterns, such as channel-shoal patterns in estuaries and deltaic channel structures. Non-cohesive sand is mostly used as the material in shaping morphology. However, most of estuaries and deltas in nature are partly or fully dominated by cohesive sediment or mud. There are researches on sand-mud interactions and their implications on total sediment transport (van Ledden, 2003). It is increasingly aware that adding mud to the system can make a big differences on the large scale morphodynamic development behaviour (Edmond and Slinger, 2009; Gelynese et al., 2010; Caldwel and Edmond, 2014). However mud transport is notoriously difficult to be defined properly in the model given the combined sensitivity to a few fundamental parameters (Partheniades, 1965; Mehta, 2014). It is thus not clearly known how mud have controls on development of large scale morphodynamics and the sensitivity to the mud property.

In this work we construct a long-term morphodynamic model based on the DELFT3D in an idealized 300 km long and 100 km wide river-estuary-sea system. Long-term simulation is assisted by the morphological factor approach. Both sand and mud are put on the river bed for erosion while the river supplies mud into the system as well. Dry bed erosion is considered to stimulate sand bar and channel migrations. Sand and mud interactions are considered by defining transport layers. By varying the content of mud and the mud properties, we run a number of sensitivity scenarios under combined river and tidal forcing.

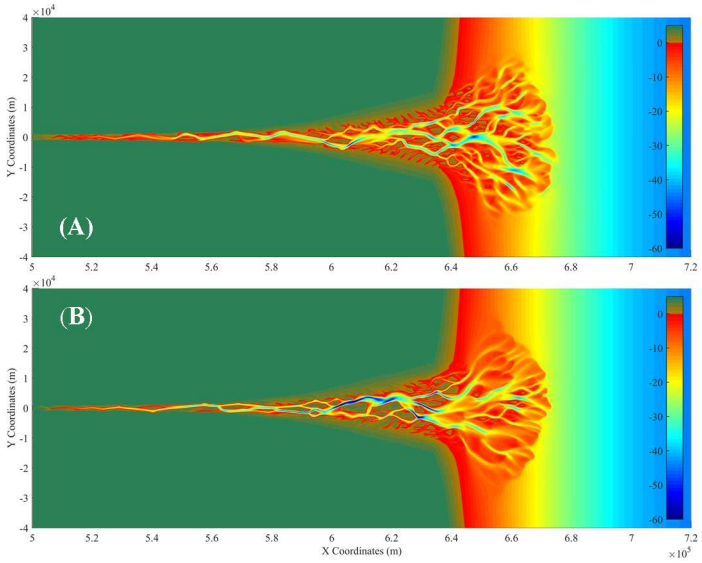

Figure 1. Modeled morphology after 100 years in scenarios with (A) sand only and (B) sand plus 30% of mud

The model results suggest that inclusion of mud on the sandy environments induces less bifurcated and less braided channel-shoal pattern (Figure 1). Instead, more merged sand bars and less meandered channels forms in sand-mud mixture environment. Increasing mud content leads to straighter channel pattern. The tidal flats and sand bars are more accreted in elevation and more sediments are retained inside the estuary due to the presence of mud. We argue that the impacts of mud on large scale estuarine and deltaic morphodynamic development can be explained by its

cohesiveness which increases erosion resistance and fine sediment transport rate once in motion. More sensitivity simulations and in-depth analysis results will be presented in the conference.

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