Geophysical Research Abstracts
Vol. 17, EGU2015-5394, 2015
EGU General Assembly 2015

Megascours: the morphodynamics of large river confluences

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River confluences are wildly acknowledged as crucial controlling influences upon upstream and downstream morphology and thus landscape evolution. Despite their importance very little is known about their evolution and morphodynamics, and there is a consensus in the literature that confluences represent fixed, nodal points in the fluvial network. Confluences have been shown to generate substantial bed scours around five times greater than mean depth. Previous research on the Ganges-Jamuna junction has shown large river confluences can be highly mobile, potentially 'combing' bed scours across a large area, although the extent to which this is representative of large confluences in general is unknown. Understanding the migration of confluences and associated scours is important for multiple applications including: designing civil engineering infrastructure (e.g. bridges, laying cable, pipelines, etc.), sequence stratigraphic interpretation for reconstruction of past environmental and sea level change, and in the hydrocarbon industry where it is crucial to discriminate autocyclic confluence scours from widespread allocyclic surfaces.

Here we present a wide-ranging global review of large river confluence planforms based on analysis of Landsat imagery from 1972 through to 2014. This demonstrates there is an array of confluence morphodynamic types: from freely migrating confluences such as the Ganges-Jamuna, through confluences migrating on decadal timescales and fixed confluences. Along with data from recent geophysical field studies in the Ganges-Brahmaputra-Meghna basin we propose a conceptual model of large river confluence types and hypothesise how these influence morphodynamics and preservation of 'megascours' in the rock record. This conceptual model has implications for sequence stratigraphic models and the correct identification of surfaces related to past sea level change. We quantify the abundance of mobile confluence types by classifying all large confluences in the Amazon and Ganges-Brahmaputra-Meghna basins, showing these two basins have contrasting confluence morphodynamics. For the first time we show large river confluences have multiple scales of planform adjustment with important implications for infrastructure and interpretation of the rock record.