Alternate bars in a sandy gravel bed river: generation, migration and interactions with superimposed dunes (Rodrigues et al. 2015) [1]

A field study was carried out to investigate the development of alternate bars in a secondary channel of the Loire River (France) as a function of discharge variations. We combined frequent bathymetric surveys, scour chains and stratigraphical analysis of deposits with measurements and modelling of flow dynamics. The channel exhibited migrating bars, non-migrating bars and superimposed dunes. Possible mechanisms of bar initiation were found to be chutes associated with changes of bank direction and instability resulting from interactions between existing bars during the fall in water level after floods.

We propose that the reworking of bar sediments during low flows (high width-to-depth ratio β), reinforced by high values of the Shields mobility parameter, can explain the formation or re-generation of new alternate migrating bars during a subsequent flood. The migration pattern of the bars was found to be cyclic and to depend mainly on (i) channel layout and (ii) the dynamics of superimposed dunes with heights and lengths depending on location and discharge value. For instance, the hysteresis affecting the steepness of dunes influences the flow resistance of the dunes as well as the celerity of migrating bars during flood events.We compare the findings from the field with results from theoretical studies on alternate bars. This gives insight in the phenomena occurring in the complex setting of real rivers, but it also sheds light on the extent to which bar theories based on idealized cases can predict those phenomena.

KEYWORDS: sandy-gravelly rivers; alternate bars; field study; geometrical discontinuities; width-to-depth ratio; bar theory; dune roughness; Loire River; discharge variations; fluvial morphology

Publication Date:

Thursday, 6 November 2014

Full reference:

Rodrigues, S., Mosselman, E., Claude, N., Wintenberger, C. L. and Juge, P. (2015) Alternate bars in a sandy gravel bed river: generation, migration and interactions with superimposed dunes. Earth Surf. Process. Landforms, 40: 610–628.

Link to DOI:

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REFORM has received funding from the European Union's Seventh Programme for Research, Technological