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Long timescale planform evolution of meandering channels

A. Frascati and S. Lanzoni

Department IMAGE, University of Padova, Italy.

(frascati@idra.unipd.it / Fax: + 39 049 8275446 / Phone: + 39 049 8275445)

Modelling hydrodynamic and bed topography of natural rivers has long attracted the attention of scientific community in the field of hydraulic engineering and fluvial geomorphology. In the present contribution we focus our attention on meandering rivers, a very common pattern in nature, which belongs to a class of dynamical system occurring at the spatial scale of channel width and driven by the coexistence of complex linear and nonlinear processes. On short timescale, the formation of meandering patterns can be essentially explained by an instability process, driven by bank erosion (bend instability). Usually, bank erosion is an intermittent process, whose mechanism are rather complex. However, on the very slow timescale associated with channel planimetric development, erosion and deposition processes can be seen as contemporaneous events and, consequently, bank erosion may be modelled as a continuous process which keeps nearly constant the average width of the river. From mathematical point of view, the problem of planform evolution of movable bed channels can be described by a nonlinear integro-differential equation which must be complemented by a suitable erosion law relating the lateral bank migration rate to the flow field in sinuous erodible channels. On longer timescales channel shortening via cutoff processes introduce a further highly nonlinear mechanism which must be properly accounted for. Depending on the description adopted for the flow field, various mathematical models can be developed. In the present contribution, in order to understand the role played by the filtering action exerted by neck cutoff events, we compare the fully developed meandering patterns resulting from numerical simulations based on the use of different linearized flow field models. The comparison is pursued following two different ap-

proaches. In the first we analyze the sizes of the abandoned channels (oxbow lakes), locally and instantly formed by neck cutoff processes during the channel planform evolution. The second approach is based on a complete statistical method of pattern recognition in high-dimensional space accounting for a wide set of morphometric variables. This methodology is also used to to test the ability of long term predictions to reproduce correctly the geometric features of natural planimetric patterns extracted from Landsat mosaic images.