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Possibilities and limitations of physics-based meander migration predictions

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Meandering rivers are characterized by progressive growth and migration of their bends, which results from the combination of bank erosion and opposite bank accretion. In most physics-based meander migration models the main river channel shift is computed as a function of the flow velocity and depth near the eroding bank. Bend migration is obtained due to a space lag between the maximum near-bank flow velocity and the bend apex. The local channel shift rate is weighted by empirical coefficients, often known as “erodibility coefficients”. Their name refers to outer bank erosion, in which they represent the bank erodibility. However, in the absence of a separate opposite bank accretion law, these coefficients are in fact bulk parameters that represent the combined effects of bank erosion and opposite bank accretion. Besides, numerical tests and field applications of a physics-based meander migration model demonstrate that these coefficients also have to incorporate numerical effects, as well as the effects of overbank flows. The relation between the erosion coefficients and the local characteristics of the eroding bank is therefore only theoretical and hence the name of the coefficients is misleading. It is suggested to rather call these coefficients “migration coefficients”. Their values should be derived from model calibration based on historical river planimetric changes and not from the characteristics of the eroding bank. Notwithstanding these limitations, an application to the Dhaleswari River (Bangladesh) demonstrates that a model based on the De St Venant equations fully coupled to a sediment balance and sediment transport equations reproduces important aspects of the river planimetric behaviour, which makes this type of models a valuable and easy-to-use tool for a first assessment of river trends.