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Interaction between curvature-driven width oscillations and channel curvature in evolving meander bends. (English) Zbl 1430.86008

J. Fluid Mech. 876, 985-1017 (2019).

Summary: We study the morphodynamics of channel width oscillations associated with the planform development of river meander bends. With this aim we develop a novel planform evolution model, based on the framework of the classical bend theory of river meanders by *S. Ikeda* et al. [ibid. 112, 363-377 (1981; Zbl 0512.76052)], that accounts for local width changes over space and time, tied to the local hydro-morphodynamics through a two-way feedback process. We focus our attention on "autogenic" width variations, which are forced by flow nonlinearities driven by channel curvature dynamics. Under the assumption of regular, sinusoidal width and curvature oscillations, we obtain a set of ordinary differential equations, formally identical to those presented by *G. Seminara* et al. [ibid. 438, 213-230 (2001; Zbl 1034.76017)], with an additional equation for the longitudinal oscillation of the channel width. The proposed approach gives insight into the interaction between autogenic width variations and curvature in meander development and between forcing and damping effects in the formation of width variations. Model outcomes suggest that autogenic width oscillations mainly determine wider-at-inflection meandering river patterns, and affect their planform development particularly at super-resonant aspect ratios, where the width oscillation reaches its maximum and reduces meander sinuosity and lateral floodplain size. The coevolution of autogenic width oscillation and curvature occurs through temporal hysteresis cycles, whereby the peak in channel curvature lags behind that of width oscillation. Width oscillation amplitudes predicted by the model are consistent with those extracted from remotely sensed data.

MSC:

86A05 Hydrology, hydrography, oceanography
76E20 Stability and instability of geophysical and astrophysical flows

Keywords:

river dynamics; sediment transport

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PyRIS; SciPy; VODE

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