Unexpected short-term behavior of meandering rivers under flow variability

Francesca Bassani, Politecnico di Torino, Turin, Italy (presenting author), and Matteo B. Bertagni, and Luca Ridolfi, and Carlo Camporeale

Decades of research have offered insights into the dynamics of meandering rivers. However, the role of flow variability on their evolution has been poorly investigated. In this study, we show that unsteady flows yield to unexpected behaviors with respect to the usually studied cases with a constant discharge (e.g., the bankfull discharge). To this aim, we numerically simulate the short-term dynamics of a river morphology forced by both a stochastic flow, obtained through a compound Poisson process, and a constant discharge equal to the mean of the stochastic process. After a similar meander evolution in the initial linear dynamics – namely, the meander wavelength in the unsteady case is the same as the one in the steady case – the flow variability considerably slows down the growth of meander bends, delays the occurrence of cutoff events and induces lower curvilinear wavelengths. It turns out that such a counterintuitive behavior is rooted in the linear stability analysis and can be explained by using some exemplifying morphodynamical behaviors of Kinoshita's curve as a prototype of nonlinearity-induced meander planform. These results may help to revise the procedure for the calibration of the erodibility coefficient from aerial historical maps and the computation of the sediment reworking rate of a floodplain.