EGU22-9970
https://doi.org/10.5194/egusphere-egu22-9970
EGU General Assembly 2022

Bankfull parameters of meandering rivers in long term average state

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In the last two decades several models have been proposed to analyse the evolutionary trajectories of meandering rivers (e.g., Seminara et al., 2001; Camporeale et al, 2007; Frascati et al., 2009; Frascati & Lanzoni, 2013; Eke et al., 2014; Bogoni et al., 2017; Monegaglia et al., 2019). These models are based on the assumption that channel migration, which is locally driven by the differential excess of flow speed at the banks, is globally governed by the average bankfull geometry. Previous studies suggest that bankfull parameters strongly affect meander development. More specifically, the planform shape depends on the width ratio falling below or above a resonant threshold: sub-resonant meanders are typically downstream skewed, while super-resonant meanders exhibit upstream skewed loops and are prone to evolving much faster. Therefore, the model adopted to define, at each time step, the variation of bankfull parameters fundamentally affects the morphodynamic regime of meanders. A common strategy to initialize the simulations and to set the reference values of bankfull parameters is the use of a quasi-straight configuration. This is a legitimate way to obtain a fully developed meandering planimetry; however, this initial configuration is often used in conjunction with bankfull parameters derived from field data, which implies that the values of the external independent variables, water discharge and sediment supply, that characterize the simulated configuration are similar between such initial state and the fully developed one. However, when combined with the widely adopted assumption that the channel slope must decrease proportionally to meander elongation, this leads to significant variations of bankfull parameters, with a dramatic drop of the transport capacity, as the channel length can increase by two-four times. Therefore, the values of bankfull parameters of the statistical steady-state that the system eventually achieves in long-term simulations (Camporeale et al., 2008; Bogoni et al., 2017) can be quite different from those selected as initial reference values, which may lead to simulating unrealistic evolutionary scenarios and shifts of the morphodynamical regime. However, such a strong variation of bankfull parameters must be viewed as a gimmick introduced by the initial quasi-straight configuration. Based on these considerations, results of long-term simulation need to be revisited taking the bankfull parameters of the statistical steady-state as reference values.

In our work we analyze planimetry features, such as the sinuosity, and their oscillations, when we vary these bankfull parameters. Moreover, we look into the dependency on the aspect ratio of the fully developed state to better understand how super or sub-resonant regime affects the

planimetrical configuration.