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Numerical simulations of 12-years evolution of the Po River morphodynamics

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Morphological variations of alluvial river beds, driven by the hydrological variability, are relatively slow if compared with the hydraulic changes. Therefore, to evaluate the feedback of changing morphodynamics on hydraulic infrastructures located along a watercourse, like bridge piers, it is necessary to perform long-term simulations, combing CFD runs with field data and remote observations that can be used to calibrate the code. Moreover, given the necessity to interact with water managers and final users, numerical models should also be integrated with GIS environments, simplifying the interpretation of the modelling outcomes.

Within the Italian project INFRASAFE (infrasafe-project.com), the 12-years evolution of a 10-km reach of the Po River close to Ostiglia, in Italy, is simulated by means of the numerical suite iRIC (i-ric.org) and its 2D solver MFlow-02. The geometrical input refers to the 2005 bathymetry acquired with am multibeam having a resolution of two meters, while the hydrological boundary conditions are the 2005-2016 monthly discharges and levels at the upstream and downstream ends, respectively. To simulate the sediment transport, equilibrium conditions are considered and the grainsize composition concerns samples taken along the reach in the past years. The overall domain consists of a grid with triangular meshes having a maximum area of 3000 m^2, while nested grids are adopted in the middle part to better characterize the evolution of the reach between two bridges (1000 m^2 and 250 m^2) and close to three piers of the downstream bridge (50 m^2) that deeply affect the local morphodynamics with scour phenomena. Thanks to the model structure, the numerical results can be easily exported to be integrated in a GIS environment, combining them with field observations and satellite maps, eventually improving the readability for non-experts.

Preliminary simulations show a good agreement between the numerical outcomes and the field data on velocity and erosion/deposition processes acquired during a campaign performed in October 2017. From such results, one can observe that the Po riverbed morphology is principally driven by high flow conditions at the short-term, but also that subsequent small but persistent floods can change it over long periods. Therefore, a better evaluation of the long-term hydro-morphodynamics close to the bridge piers is necessary to address the local erosive phenomena, possibly accounting for a 3D detailed description, which could be performed by means of a coupling approach using the same suite iRIC, changing the solver and imposing the MFlow_02 results as boundary conditions.