



## **Exploring the effects of uncertainties on the choice of structural flood risk reduction measures along the lower stretch of the Po River**

Alessio Ciullo (1,2), Alessio Domeneghetti (3), Jan Kwakkel (2), Karin de Bruijn (1), Attilio Castellarin (3), Frans Klijn (1,2)

(1) Deltares, Department of Flood Risk Management, (2) Delft University of Technology, Faculty of Technology, Policy and Management, (3) University of Bologna, DICAM

The assessment of flood risk is affected by various uncertainties along the entire flood risk modelling chain, including the simulation of hydrological and hydraulic phenomena, the failure modelling of flood defence systems and the assessment of economic damage. Consequently, deciding on where and how to invest in flood risk reduction measures is not a trivial task. We explore the effects of uncertainties on the choice of alternative flood defence heightening schemes for the lower stretch of the Po River, from the city of Borgoforte to Pontelagoscuro. Uncertainties taken into account relate to the (1) flood peak and flood wave shape in generating the design event, (2) width of the breaches and (3) damage modelling. We do so by integrating into a Monte Carlo framework both a HEC-RAS model previously developed for the area under study and a damage model recently proposed for a nearby area. The analysis involves three steps. First, a global sensitivity analysis is carried out to understand which of the input factors drives the uncertain outcomes. Second, a Monte Carlo analysis is performed for three alternative flood defence heightening schemes. This step aims at understanding whether any of the schemes clearly outperforms the others under uncertainty in terms of risk reduction. Third, we comment on the robustness of the evidence provided by the analysis in a sensitivity auditing fashion. This last step is of paramount importance for effectively communicating policy outcomes and supporting flood risk management decisions.