A statistical method to estimate outflow volume in case of levee breach due to overtopping

Luigia Brandimarte (1), Mario Martina (2), Francesco Dottori (3), and Maurizio Mazzoleni (4)

(1) University of Uppsala, Uppsala, Sweden, (2) IUSS Pavia, Pavia, Italy, (3) Joint Research Center, Ispra, Italy, (4) UNESCO-IHE, Delft, The Netherlands

The aim of this study is to propose a statistical method to assess the outflowing water volume through a levee breach, due to overtopping, in case of three different types of grass cover quality. The first step in the proposed methodology is the definition of the reliability function, a the relation between loading and resistance conditions on the levee system, in case of overtopping. Secondly, the fragility curve, which relates the probability of failure with loading condition over the levee system, is estimated having defined the stochastic variables in the reliability function. Thus, different fragility curves are assessed in case of different scenarios of grass cover quality. Then, a levee breach model is implemented and combined with a 1D hydrodynamic model in order to assess the outflow hydrograph given the water level in the main channel and stochastic values of the breach width. Finally, the water volume is estimated as a combination of the probability density function of the breach width and levee failure. The case study is located in the in 98km-braided reach of Po River, Italy, between the cross-sections of Cremona and Borgoforte. The analysis showed how different counter measures, different grass cover quality in this case, can reduce the probability of failure of the levee system. In particular, for a given values of breach width good levee cover qualities can significantly reduce the outflowing water volume, compared to bad cover qualities, inducing a consequent lower flood risk within the flood-prone area.