



The River Po flood inundation of 1951: reconstruction and analysis

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The aim of this study is to reconstruct the 1951 flood inundation of the Polesine Region (Italy). The 1951 event was one of the worst catastrophes of the XX century in Europe and is of particular hydrological, historical and economic interest, leading to the inundation of an area of 1080 km² and producing devastating social consequences, with the displacement of more than 180.000 people.

The objective of this research is two-fold: (1) to show the applicability of flood inundation models in reconstructing historical inundation events, and (2) to reconstruct, by using the last and innovative methods for hydrological modeling, discharges and water stages at the Pontelagoscuro's gauging station (downstream the 1951's levee breach), focusing on the extrapolation of the rating curve beyond the measurement range, where, as of today, the greater uncertainty is found.

To address these objectives we first run a 1D hydraulic model (HEC-RAS) of a 90-km reach of the lower portion the Po River (from Ostiglia to Papozze) by using the 1954 topography. This model was used to reconstruct the rating curve beyond the measurement range at Pontelagoscuro, which is between Ostiglia and Papozze. Secondly, the outflow through the levee breach was computed by imposing the breach's characteristic according to the recorded historical data. Lastly, the large inundation in the flood-prone area was simulated by means of a 2D hydraulic model (SOBEK) and qualitatively compared to the observed flood extent. In particular, a hybrid methodology was used to perform the numerical simulations, using a 1D-2D approach. A one-dimensional model was used to simulate the flow into the river and to compute the overflow through the levee breach, which was then adopted as inflow condition for the two-dimensional model of the inundated area. The results of these procedures led to a fair comparison between the patterns of the 'observed' and reconstructed inundation areas. The timing of the progression of inundation also compared well with the information derived from the historical chronicles.

According to the results of the flood inundation modelling exercise, some technical considerations about the relation between water stages and discharges, could be drawn. The maximum discharge simulated in the lower portion of the River Po is sensibly lower than the one estimated in past, and this difference seems to justify some incongruities that occurred on the estimation of water stages during relevant floods.