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A bivariate hydrological methodology for improving flood maps

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Flood risk is the combination of the probability of a flood event and the potential adverse consequences for the human health, the environment, the cultural heritage and the economic activity associated with a flood event (2007/60/EC). Usually, the potential consequence of a flood with a certain probability is evaluated through the flood stage raised in the analysed area, combined with the variables characterising the type of vulnerability. Indeed, flood damages are evaluated from stage-damage curves, also called damage functions. Recently, flood social vulnerability indexes are defined taking into account the flood stage as the primary hydraulic variable. The standard approach evaluates the flood stage starting by a univariate hydrological load, corresponding to one hydrograph with a peak discharge of a certain probability and adequate durations. This correspondence is a critical issue that is originated from the approximation of the river flood flow process. A bivariate hydrological methodology for improving flood maps is proposed. A consistent number of synthetic hydrographs composes the bivariate hydrological load, with peak discharge and volume belonging to their bivariate distribution. A flood map corresponds to each hydrograph. Each flood map is a grid developing through 2d hydraulic model. A specific flood stage value corresponds to each cell of the grid. The whole set of hydrograph produces a flood stage series for each grid cell. The flood map with a certain probability, i.e. return period, results from the interpolation of the corresponding quantile values for each grid cell. The methodology is applied to a case study. The resulting map is benchmarked with a map obtained by the standard hydrological approach. The proposed methodology is based on tools that are widely known and it is replicable by the public administrations or public entities that are interesting in the hydrologic and hydraulic risk assessment.