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Probabilistic damage scenarios from uncertain macroseismic data

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Nowaday, macroseismic data are still essential for the seismic hazard assessment in several regions because they provide important knowledge on preinstrumental earthquakes, nedeed to compile historical earthquake catalogs. This is especially true for Italy, which boasts a large and accurate macroseismic database, DBMI15, composed by 122701 macroseismic records related to 3212 earthquakes occurred from 1000 up to 2014. It should be noted that some records are incomplete or the available information is insufficient for the assignment of the intensity at a given site (e.g. intensity IX-X denotes that the level of damage at that site is uncertain and evaluated IX or X with a probability of 50% each). In order to respect both the ordinal nature of macroseismic intensity and its tendency to decrease with distance from the epicentre, we consider the beta-binomial model by Rotondi and Zonno (Ann. Geophys., 2004; Rotondi et al., Bull. Earthq. Eng., 2016) which describes the probability distribution of the intensity at a site, conditioned on the epicentral intensity and on the epicentre-to-site distance. The application of the beta-binomial model typically requires rounding-up or -down the observed intensities to the nearest integer values. We propose an extension of the beta-binomial model in order to include in the stochastic modelling the uncertainty in the assignment of the intensities. Then we exploit the advantages of the Bayesian approach for uncertainty quantification both in the estimation procedure and in the forecast of damage scenarios.