UNI- AND MULTI-VARIABLE MODELLING OF FLOOD LOSSES: EXPERIENCES GAINED FROM THE SECCHIA RIVER INUNDATION EVENT

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STUDY AIM

Are uni- and multi-variable models reported by the literature suitable for quantifying flood losses in geographical and socio-economic contexts that differ from those for which they were originally developed? We addressed the open problem of transferability of empirically obtained damage models into different contexts. Because of the lack of reliable literature damage models in the Italian context, we derived uni- and multi-variable damage models from post-event data collected after floods in Italy; then, we compared their performance in estimating direct economic damages with those of literature damage models, developed in different socio-economic and geographical contexts.

EMPirical DAMAGE MODELS

- Uni-variable models (water depth as the only explanatory variable)
- SE (Scachia Empirical), obtained by combining the median value for the observed data for considered water depth classes of 25 cm
- SSRR (Scachia Square Root Regression), obtained from the relationships between observed relative losses and maximum water depth (SSRR wd), maximum water velocity (SSRR vw), and building area (SSRR ba), taken at one time.
- Multi-variable model (combination of several explanatory variables): SBT (Scachia Bagging Decision Trees), which considers an ensemble of regression (decision) trees, built with the Random Forest algorithm creating multiple data set samples using the resampling bootstrap method.

RESULTS

- Data and time: 19/01/2014, 06:30 am
- Event location: S. Matteo (Modena, Italy; see Fig. 2)
- Estimated overflowed volume: 36.3 ± 38.7·10^6 m^3
- Total estimated flooding damages: 500 million €
- Flooded area: 52 km^2 (mainly including the municipalities of Bastiglia, Bomporto and the Northern part of Modena, which remained flooded for more than 48 hours; see Fig. 7)
- Reconstruction of the inundation event: Telemac-2D finite element numerical model (unstructured computational mesh with elements of variable size from 1 to 200 m in the flat zones, covering a study area of 112 km^2 area; see Fig. 1 and 4)
- Absolute damages to movable properties [building area [m^2] × building value [€]] and differences of absolute total damages.

AVAILABLE DATA

1330 forms available, filled by citizens about observed damages to real estate and movable properties. All data were geocoded with a GIS procedure and merged with additional predictive variables, retrieved by external sources or simulated by means of the 2D model.

CONCLUSIONS

- Uni- and multi-variable models developed on the basis of observed data set estimate more accurately flood losses than literature ones.
- The multi-variable approach slightly outperforms the uni-variable one for this specific case study.
- The results highlight the need for a comprehensive collection of post-event data, aiming at validating existing models, or developing new ones in case existing literature models are proven to be unreliable.
- Literature damage models, originally developed for specific socio-economic and geographical contexts, should be prudently exported to different contexts.

REFERENCES