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BYMUR software: a free and open source tool for quantifying and visualizing multi-risk analyses

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The BYMUR software aims to provide an easy-to-use open source tool for both computing multi-risk and managing/visualizing/comparing all the inputs (e.g. hazard, fragilities and exposure) as well as the corresponding results (e.g. risk curves, risk indexes). For all inputs, a complete management of inter-model epistemic uncertainty is considered. The BYMUR software will be one of the final products provided by the homonymous ByMuR project (http://bymur.bo.ingv.it/) funded by Italian Ministry of Education, Universities and Research (MIUR), focused to (i) provide a quantitative and objective general method for a comprehensive long-term multi-risk analysis in a given area, accounting for inter-model epistemic uncertainty through Bayesian methodologies, and (ii) apply the methodology to seismic, volcanic and tsunami risks in Naples (Italy).

More specifically, the BYMUR software will be able to separately account for the probabilistic hazard assessment of different kind of hazardous phenomena, the relative (time-dependent/independent) vulnerabilities and exposure data, and their possible (predefined) interactions: the software will analyze these inputs and will use them to estimate both single- and multi- risk associated to a specific target area. In addition, it will be possible to connect the software to further tools (e.g., a full hazard analysis), allowing a dynamic I/O of results.

The use of Python programming language guarantees that the final software will be open source and platform independent. Moreover, thanks to the integration of some most popular and rich-featured Python scientific modules (Numpy, Matplotlib, Scipy) with the wxPython graphical user toolkit, the final tool will be equipped with a comprehensive Graphical User Interface (GUI) able to control and visualize (in the form of tables, maps and/or plots) any stage of the multi-risk analysis. The additional features of importing/exporting data in MySQL databases and/or standard XML formats (for instance, the global standards defined in the frame of GEM project for seismic hazard and risk) will grant the interoperability with other FOSS software and tools and, at the same time, to be on hand of the geo-scientific community. An already available example of connection is represented by the BET_VH(**) tool, which probabilistic volcanic hazard outputs will be used as input for BYMUR.

Finally, the prototype version of BYMUR will be used for the case study of the municipality of Naples, by considering three different natural hazards (volcanic eruptions, earthquakes and tsunamis) and by assessing the consequent long-term risk evaluation.

(**)BET_VH (Bayesian Event Tree for Volcanic Hazard) is probabilistic tool for long-term volcanic hazard assessment, recently re-designed and adjusted to be run on the Vhub cyber-infrastructure, a free web-based collaborative tool in volcanology research (see http://vhub.org/resources/betvh).