An R package for hybrid uncertainty analysis in natural and environmental risk assessments using probability, imprecise probability and possibility distributions

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Uncertainty analysis is an unavoidable risk assessment task either for natural hazards such as landslides, earthquakes, floods, volcano eruptions, etc., or for environmental issues like groundwater or soil contamination. In situations where data are scarce, incomplete or imprecise, the systematic and only use of precise probabilities can be debatable. Over the last years, several alternative mathematical representation methods (e.g., probabilities and intervals; or probabilities and fuzzy numbers) have been developed to handle in a more flexible manner the lack of knowledge related to input parameters of risk assessment models. To date and to the authors' best knowledge, only a few open-source solutions exist to jointly handle different uncertainty mathematical tools in uncertainty analysis of risk assessments.

To fill this gap, we present a newly developed R-package called "HYRISK" (available at https://cran.r-project.org/web/packages/HYRISK/index.html) dedicated to jointly handling different mathematical representation tools, namely probabilities, possibility distributions and probability functions with imprecise parameters, for the different stages of uncertainty treatment in risk assessments (i.e. uncertainty representation, propagation, sensitivity analysis and decision-making). We support the description of each of these stages using the case study of a dike stability analysis.