

## Uncertainty and sensitivity analysis for natural hazard risk and adaptation appraisal modelling with CLIMADA- no more excuses

Modelling societal, ecological and economic costs of natural hazards in the context of climate change is subject to both strong aleatoric and ethical uncertainty. Dealing with these is challenging on several levels -- from the identification and the quantification of the sources of uncertainty, to their proper inclusion in the modelling, and the communication of these in a useful manner to both experts and non-experts. One particularly useful approach is global uncertainty and sensitivity analysis, which can help to quantify the confidence in the output values and identify the main drivers of the uncertainty, while considering potential correlations in the model. Here we present applications of global uncertainty and sensitivity analysis in natural hazard modelling using the new uncertainty module of the CLIMADA (CLIMate ADaptation) platform.

CLIMADA is a fully open-source Python program that implements a probabilistic multi-hazard global natural catastrophe damage model, which also calculates averted damage (benefit) thanks to adaptation measures of any kind (from grey to green infrastructure, behavioral, etc.). With the new uncertainty module one can directly and comprehensively inspect the uncertainty and sensitivity to input variables of various output metrics, such as the spatial distribution of risk exceedance probabilities, or the benefit-cost ratios of different adaptation measures. This global approach does reveal interesting parameter interplays and might provide valuable input for decision makers. For instance, a study of the geo-spatial distribution of sensitivity indices for tropical cyclones damage indicated that the main driver of uncertainty in dense regions (e.g. cities) is the impact function (vulnerability), whereas in sparse regions it is the exposure (asset) layer.