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Using cost-benefit concepts in design floods improves communication of uncertainty

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Flood frequency analysis, i.e. the study of the relationships between the magnitude and the rarity of high flows in a river, is the usual procedure adopted to assess flood hazard, preliminary to the plan/design of flood protection measures. It grounds on the fit of a probability distribution to the peak discharge values recorded in gauging stations and the final estimates over a region are thus affected by uncertainty, due to the limited sample availability and of the possible alternatives in terms of the probabilistic model and the parameter estimation methods used. In the last decade, the scientific community dealt with this issue by developing a number of methods to quantify such uncertainty components. Usually, uncertainty is visually represented through confidence bands, which are easy to understand, but are not yet demonstrated to be useful for design purposes: they usually disorient decision makers, as the design flood is no longer univocally defined, making the decision process undetermined.

These considerations motivated the development of the uncertainty-compliant design flood estimator (UNCODE) procedure (Botto et al., 2014) that allows one to select meaningful flood design values accounting for the associated uncertainty by considering additional constraints based on cost-benefit criteria. This method suggests an explicit multiplication factor that corrects the traditional (without uncertainty) design flood estimates to incorporate the effects of uncertainty in the estimate at the same safety level.

Even though the UNCODE method was developed for design purposes, it can represent a powerful and robust tool to help clarifying the effects of the uncertainty in statistical estimation. As the process produces increased design flood estimates, this outcome demonstrates how uncertainty leads to more expensive flood protection measures, or insufficiency of current defenses. Moreover, the UNCODE approach can be used to assess the "value" of data, as the costs of flood prevention can get down by reducing uncertainty with longer observed flood records. As the multiplication factor is dimensionless, some examples of application provided show how this approach allows simple comparisons of the effects of uncertainty in different catchments, helping to build ranking procedures for planning purposes.

REFERENCES

Botto, A., Ganora, D., Laio, F., and Claps, P.: Uncertainty compliant design flood estimation, Water Resources Research, 50, doi:10.1002/2013WR014981, 2014.