Engineering Risk Analysis Group
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MSc thesis

Uncertainty Propagation in Telemac-2D Dam Failures Modelling and Downstream Hazard Potential Assessment

Layla Assila, August 2018

Background

In numerical river hydraulics, the input data numerical models often include uncertainties that propagate and influence the models' output. From a decision-making perspective, the deterministic point-estimates of input parameters is no longer sufficient. In fact, the inclusion of uncertainty propagation methods and sensitivity analysis can help provide reliable results, verify the robustness of the numerical model and determine the uncertain factors that have the most influence on the results variability. The main Objective of this thesis is the application of the global methodology for uncertainty propagation and sensitivity analysis (fig.1) in the case of a hydraulic dam failure 2D model.

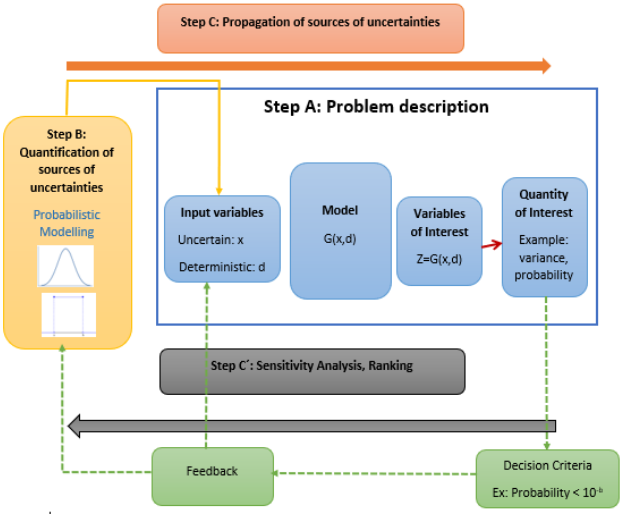

Figure 1 Uncertainty propagation framework

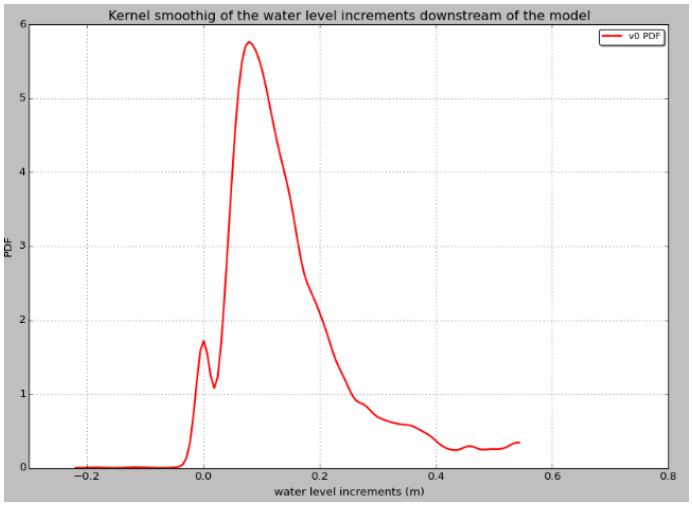

Figure 2 Fitted distribution to water level increments (8000 Monte Carlo simulations)

Methodology

The methodology described in fig.1 was applied by coupling the hydraulic model Telemac-2D with the uncertainty treatment library OpenTURNS via their APIs Python. The first step consisted of quantifying uncertain parameters based on the input data of the Telemac-2D model and defining adequate probability distributions based on expert judgment and previous specific EDF studies. Then, Monte Carlo algorithm and Polynomial Chaos Expansion (PCE) are carried out. Incremental flood damages were quantified using Floodrisk plugin of Qgis.

Conclusion

Water level (fig.2) and economic damages increments downstream of the model were quantified. The deterministic model was found to overestimate the increments. This means that the results of the deterministic model, although overestimated, are reliable. Sobol´ sensitivity indices were computed from a PCE meta-model. The indices showed a significant influence of the Strickler coefficients on the variability of the results and were coherent with expert judgment.

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