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Feedback from uncertainties propagation research projects conducted in different hydraulic fields: outcomes for engineering projects and nuclear safety assessment.

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In recent years, in the context of hydraulic risk assessment, much effort has been put into the development of sophisticated numerical model systems able reproducing surface flow field. These numerical models are based on a deterministic approach and the results are presented in terms of measurable quantities (water depths, flow velocities, etc...). However, the modelling of surface flows involves numerous uncertainties associated both to the numerical structure of the model, to the knowledge of the physical parameters which force the system and to the randomness inherent to natural phenomena. As a consequence, dealing with uncertainties can be a difficult task for both modelers and decision-makers [Ioss, 2011].
In the context of nuclear safety, IRSN assesses studies conducted by operators for different reference flood situations (local rain, small or large watershed flooding, sea levels, etc...), that are defined in the guide ASN N°13 [ASN, 2013]. The guide provides some recommendations to deal with uncertainties, by proposing a specific conservative approach to cover hydraulic modelling uncertainties. Depending of the situation, the influencing parameter might be the Strickler coefficient, levee behavior, simplified topographic assumptions, etc. Obviously, identifying the most influencing parameter and giving it a penalizing value is challenging and usually questionable.
In this context, IRSN conducted cooperative (Compagnie Nationale du Rhone, I-CiTy laboratory of Polytech'Nice, Atomic Energy Commission, Bureau de Recherches Géologiques et Minières) research activities since 2011 in order to investigate feasibility and benefits of Uncertainties Analysis (UA) and Global Sensitivity Analysis (GSA) when applied to hydraulic modelling. A specific methodology was tested by using the computational environment Promethee, developed by IRSN, which allows carrying out uncertainties propagation study. This methodology was applied with various numerical models and in different contexts, as river flooding on the Rhône River (Nguyen et al., 2015) and on the Garonne River, for the studying of local rainfall (Abily et al., 2016) or for tsunami generation, in the framework of the ANR-research project TANDEM. The feedback issued from these previous studies is analyzed (technical problems, limitations, interesting results, etc...) and the perspectives and a discussion on how a probabilistic approach of uncertainties should improve the actual deterministic methodology for risk assessment (also for other engineering applications) will be finally given.