SESSSION H2.4
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Probabilistic Flood Mapping and Visualization Issues: Application to the River Ubaye, Barcelonnette (France)

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Motivation

- The associated uncertainty in flood inundation models hampers the accuracy of the output (Götzinger & Bárdossy, 2008). However, these models are very important in the delineation of hazard extent.
- Uncertainty is attributed to Model structure, model parameters and observation data.
- The branch of science associated with uncertainty analysis has been developed over the past few years (see Montanari, 2007, Shrestha & Solomatine, 2008)
- However, effective uncertainty communication of model output remains the challenge. As mentioned in literature, that mis-communication may lead to misunderstanding. Thus instead of suppressing the uncertainty information the potrayal would enable decision makers to make informed decisions (Refsgaard et al., 2007, Ramos et al., 2010).

Objectives

The objective of the study is to produce probabilistic maps derived from a Monte-Carlo analysis of input and model parameter values uncertainty using a raster based simple model structure; LISFLOOD-FP (Bates et al., 2010). With the aim of improving uncertainty depiction in inundation maps.

Stakeholder participation

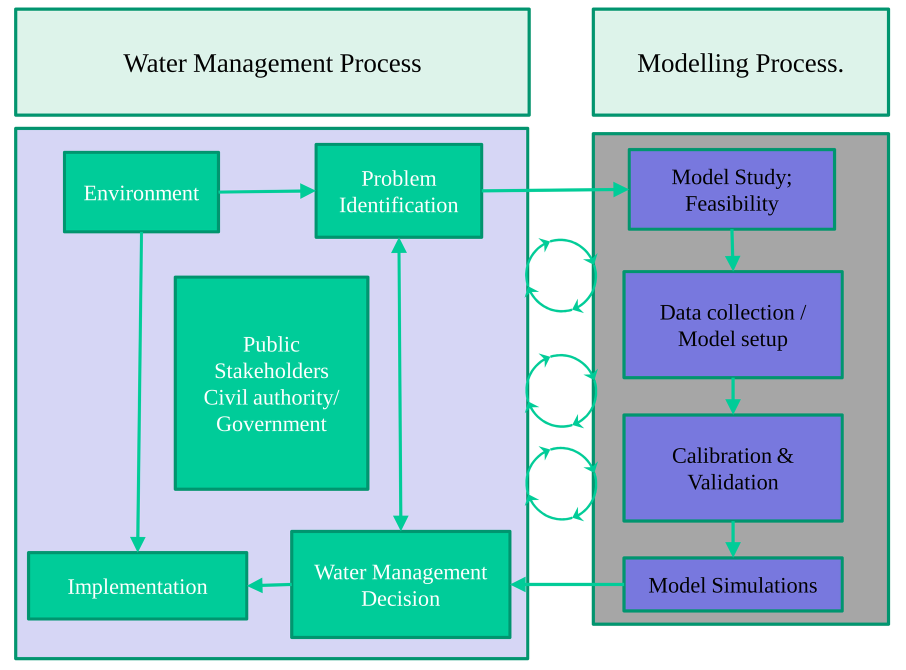

Fig.1 Refsgaard et al. (2007)

As a first step to improve the usefulness and confidence in the modelling output, The stakeholders of the project have had (and shall remain in) dialogue during the course of this study.

This process shall help overcome (reduce) mis-communication of uncertainty (Joslyn et al. 2011, Pappenberger & Beven, 2006, Montanari, 2007)

Input uncertainty

The Actual discharge, $Q = Q' + \varepsilon + \delta$

Where ε is the is the measurement error of the river flow data and Q' is the measured value, δ is the error due to the incorrect rating curve.

According to Di Baldassarre & Montanari(2009) and using measurement techniques prescribed by the European ISO rule (1997) it is proved that $Q = Q' + \varepsilon + \delta = Q'.(1+ \gamma_1 .\varepsilon' + \delta' \gamma_2)$

where ε' is Gaussian with zero mean and standard deviation equal to 1, while δ' is a binary variable taking the values +1 or −1 with equal probability. The value of γ_1 and γ_2 were taken as 0.027 and 0.384 from the results of the numerical experiment carried out by Di Baldassarre and Montanari (2009).

Model error assumptions: river stage measurement errors are negligible, the cross sections are stationary, the river measurement error and the error induced by the rating curve are independent and are summed up to obtain the total error.

Study Area

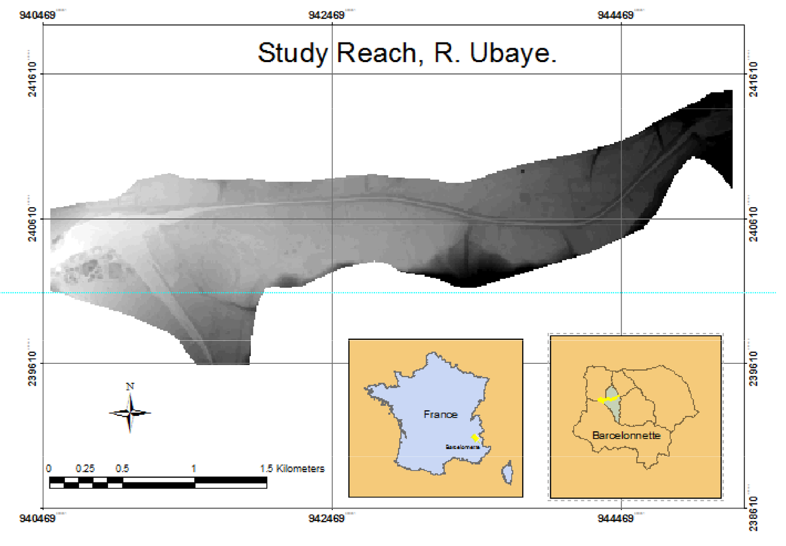

Fig.2

Barcelonnette , South France is a touristic town located in the Ubaye valley (French Alpes)

The town is constantly under the threat of landslides and river flooding.

For the purposes of this study the flood hazard is analysed, especially due to the fact that the town suffered a devastating flood in 1957.

Model Calibration & Validation

Model calibration was carried out by varying the main channel and flood plain roughness as Main Channel roughness ~U(0.01, 0.05) and Flood plain roughness ~U(0.05, 0.11) see Chow (1959).

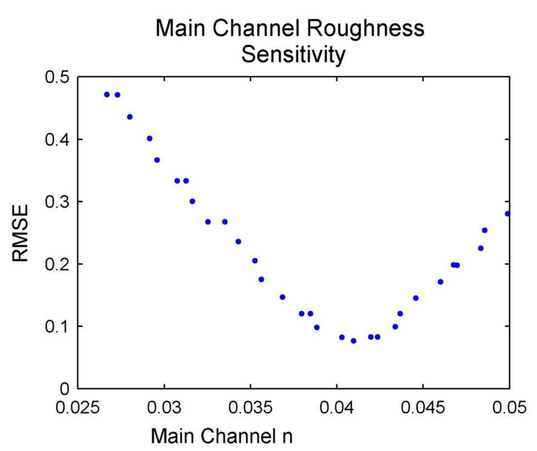

Fig.3

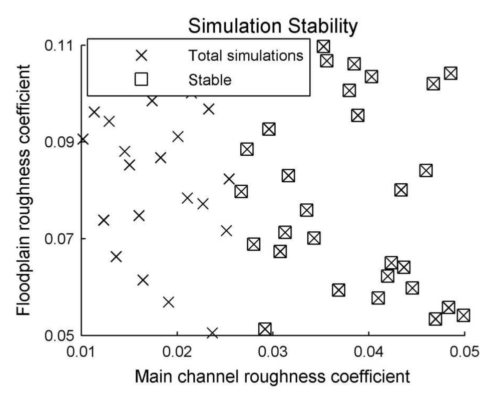

Fig.4

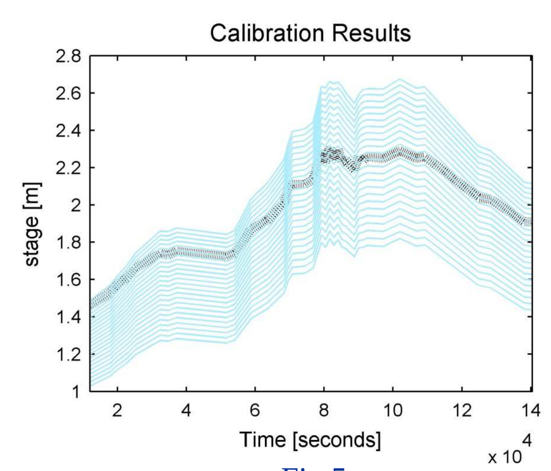

Fig.5

Model performance was based on RMSE (Root Mean Square Error) of the simulated and observed water levels of a mild flood event in 2008, at Abbatoir, an internal gauging station.

The calibration results show that the LISFLOOD-FP model, performed poorly for simulations that had main channel roughness values less than 0.027. The main channel roughness of 0.041 was the optimal value for the model.

Model Simulations

The first case of using input uncertainty is applied to the best estimate of the 1957 flood event (480 m^3/s) to derive an ensemble of outputs.

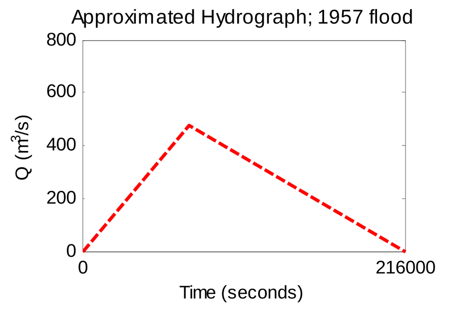

Fig.6

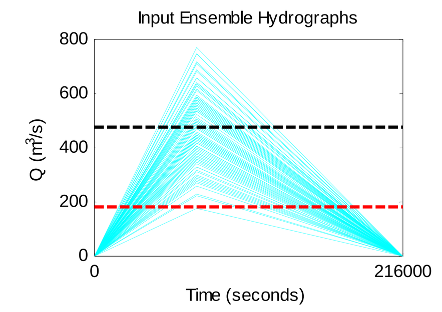

Fig.7

A total of 100 simulations were realised using the ensemble. The level of uncertainty for each cell is a normalised value of the frequency of inundation.

$$C_j = \frac{\sum_i L_i w_{ij}}{\sum_i L_i}$$

Horrit (2006)
Eq.(1)

Where C is the weighted average flood state, L is the weight for each simulation and w is 0 for dry and 1 for wet cells.

Results and Further work

What likelihood level best illustrate the usefulness of the uncertainty communication, not limited to the mean, max, past flood events.

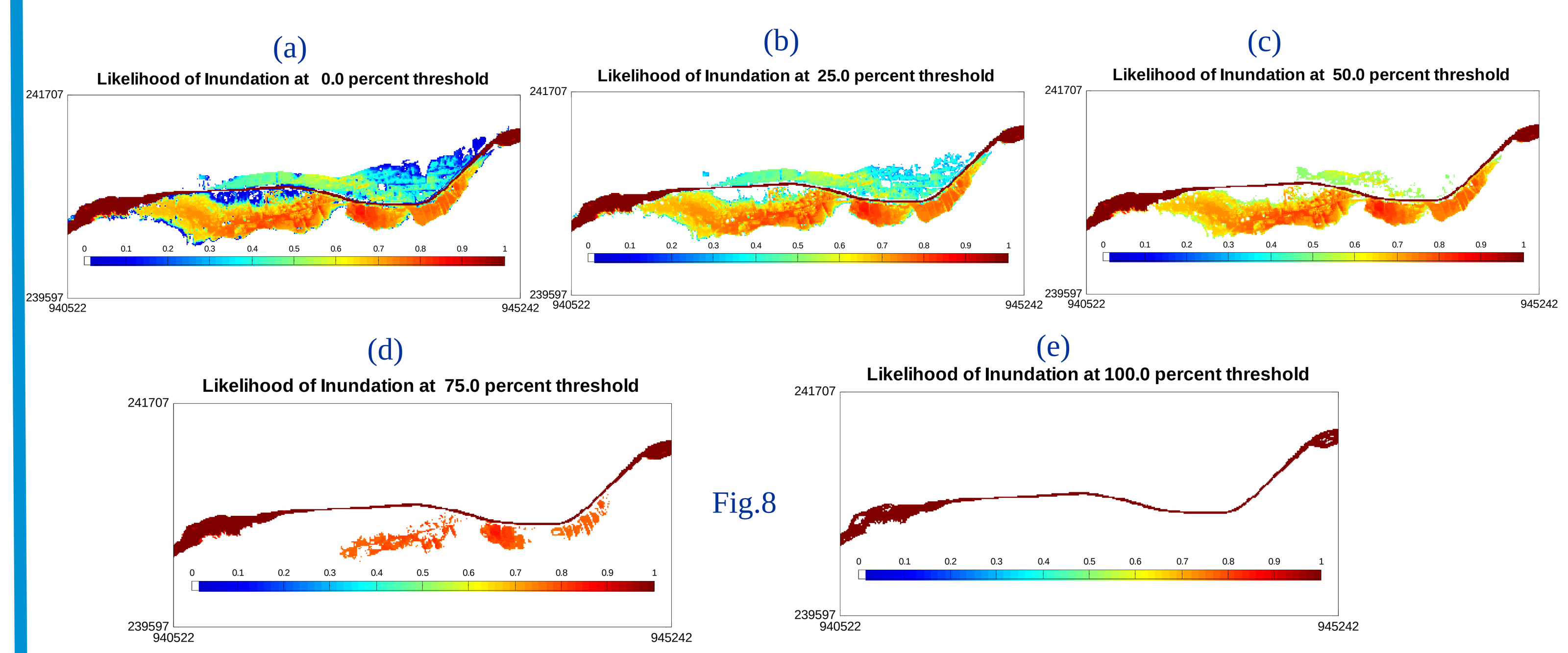

Fig.8

References

Götzinger J, Bárdossy A (2008) *Generic error model for calibration and uncertainty estimation of hydrological models*. Water Resources Research
Joslyn SL, LeClerc JE (2011) *Uncertainty forecasts improve weather-related decisions and attenuate the effects of forecast error*. Journal of Experimental Psychology: Applied
Montanari A (2007) *What do we mean by 'uncertainty'? The need for a consistent wording about uncertainty assessment in hydrology*. Hydrological Processes
Pappenberger F, Beven K (2006) *Ignorance is bliss: Or seven reasons not to use uncertainty analysis*. Water Resources Research
Di Baldassarre G, Montanari A (2009) *Uncertainty in river discharge observations: a quantitative analysis.* Hydrology and Earth System Sciences
Di Baldassarre G, Laio F, Montanari A (2011) *Effect of observation errors on the uncertainty of design floods.* Physics and Chemistry of the Earth, Parts A/B/C
Refsgaard JC, van der Sluijs JP, Højberg AL, Vanrolleghem PA (2007) Uncertainty in the environmental modelling process – A framework and guidance. Environmental Modelling &amp
Horritt MS (2006) A methodology for the validation of uncertain flood inundation models. Journal of Hydrology