Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-146-AC3, 2018

Hydrology and Earth System Sciences
Discussions

HESSD

Interactive comment

Interactive comment on "Inundation mapping based on reach-scale effective geometry" *by* Cédric Rebolho et al.

Cédric Rebolho et al.

cedric.rebolho@irstea.fr

Received and published: 25 July 2018

Answer to the review comments of Reviewer#2

The Sobol method (Sobol, 1993) is a variance-based sensitivity analysis which aims to compute the fraction of the variance that can be attributed to each parameter. For this study, 2×500 sets of parameters were randomly chosen with a Latin hypercube sampling method, thus creating two 500×6 matrices, X_A and X_B. Each column of X_A has sequentially been substituted by a column of X_B, corresponding to one of the six parameters, leading to 6 other matrices. In order to limit the computation time, the interaction of several parameters (*i.e.* subsituting two or more columns of X_A by those of X_B) has not been assessed. Indeed, MHYST has been launched with the 4000 sets of

Printer-friendly version

Discussion paper

parameters, with a resolution of 50 m, which takes longer than the Morris method that only needed about a thousand simulations. The first-order Sobol indices S_i, which indicate the contribution of one parameter to the total variance, and the total-effect indices S_{-i} which calculate the total contribution of one parameter to the variance, including the possible interactions between parameters, have been computed. Then, with a bootstrap re-sampling method, the distributions of S_i and S_{-i} have been assessed, allowing to compute several characteristics such as the bias, the standard deviation and the confidence intervals.

The results of this analysis are presented in Table 1 for S_i and Table 2 for S_{-i}. The first-order indices confirm parts of what was concluded from the Morris analysis, interprating ω as the most influential parameter, K_{ch} and α as moderately influential and K_{fp} as not influential, despite the observations we made in the article when we calibrated the parameters. The total-effect indices complete the analysis and confirm the conclusions we made with the Morris method, adding β to the list of influential parameters.

Parameter	S_i value	bias	std. error	min conf. int.	max conf. int.
K_{ch}	0.121	0.004	0.193	-0.149	0.392
K_{fp}	0.043	-0.004	0.065	-0.071	0.156
α	0.158	0.013	0.205	-0.200	0.517
β	0.077	0.013	0.166	-0.187	0.341
δ	0.015	-0.0001	0.082	-0.116	0.146
ω	0.417	0.044	0.238	0.009	0.825

Table 1. Sobol first-order indices for the six parameters of MHYST.

The distributions of S_i and S_{-i} show that the values calculated are not biased, but the 95% confidence interval is rather large, which means that in some cases, the interpretation may differ. This might explain why when we set values for all downstream hydraulic geometry equations parameters (α, β, δ, ω) from regionalised studies or observations, K_{fp} has a greater influence which is not highlighted by the sensitivity analyses. These methodologies (Morris, Sobol) indeed explore widely the paremeters space, and even with reasonable boudaries, they can reach values that may not be consistent with the characteristics of the catchment studied. Another limitation is the fact that these analyses are only valid for this particular example (the Loing catchment and the event of May-June 2016). They should ideally be used with a larger set of catchments and events to be reliably trusted.

Parameter	S_{-i} value	bias	std. error	min conf. int.	max conf. int.
K_{ch}	0.201	0.013	0.135	-0.007	0.410
K_{fp}	0.009	-0.00007	0.085	-0.139	0.157
α	0.238	-0.002	0.156	-0.038	0.514
β	0.167	0.001	0.128	-0.054	0.389
δ	0.047	-0.001	0.068	-0.060	0.156
ω	0.476	-0.003	0.22	0.120	0.832

Table 2. Sobol total-effect index for the six parameters of MHYST.

In order to understand why Morris and Sobol give, contrary to our initial expectation, so little importance to K_{fp}, we conducted a quick Sobol analysis with fixed hydraulic geometry parameters, *i.e.* we considered the α, β, δ and ω values used in the original study and only made K_{ch} and K_{fp} vary. This time, the results confirm what we observed : $S_{K_{ch}} = 0.15$ and $S_{K_{fp}} = 0.85$, which means that K_{fp} is a major parameter in our situation, and that K_{ch} has a smaller role.

The hydraulic geometry parameters are clearly important, but if they are fixed to legitimate values estimated by observations or tables of regionalised values, their impact becomes minor in front of the Strickler coefficients.

These results will naturally be added in the manuscript to complete our analysis of MHYST's behaviour on the Loing catchment.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-

146, 2018.