Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2020-37-RC2, 2020

Natural Hazards and Earth System Sciences Discussions
Open Access
EGU

Interactive comment on "Sensitivity and identifiability of rheological parameters in debris flow modeling" *by* Gerardo Zegers et al.

Mary Hill (Referee)

mchill@ku.edu

Received and published: 5 May 2020

Being able to match data with model results will always be an important part of people believing model results. However, those of us who understand what goes into developing a model and its application know that a good match to data is just the first step of how models can help people understand the many processes that define the world upon which our lives depend.

In this work, data and physical processes are modeled and explored. The results extend as far past just model fit as current technology supports. The DELSA method is used to reveal a considerable amount about which parameters are important to four defined metrics, and summarizes in some detail how this changes over parameter

Printer-friendly version

Discussion paper

space (fig. 3 and 4). The article also illustrates how new data can reduce parameter uncertainty and how this changes over likely parameter space (fig. 5). In both cases, the results provided by DELSA are a step towards being able to evaluate if the results suggest the model performs realistically – both because it fits the data reasonably well and because the parameters that are important and unimportant in different parts of parameter space make sense.

I have two points I would like to make in this review.

One is to highlight a potential of DELSA not noted in the paper. In line 117, this paper refers only to the first-order sensitivity capabilities of DELSA. While Rakovec et al (2014) first demonstrated the DELSA approach using first-order sensitivity indices, they also note that the approach has considerable unexplored potential for evaluation of parameter interactions. This requires that the sensitivity matrix include the prior information used for first-order statistics, and also derivatives related to observations, as noted in Rakovec et al (2014, paragraphs 11, 20, 66 and 67, and Figure 12 and Appendix A), and Hill and Tiedeman (2007, Appendix B).

The addition of observations in the sensitivity matrix allows calculation of statistics that address concerns such as those considered in Fig. 5 of this work. Commonly this is called a Value of Improved Information (VOII) analysis, and statistics such as OPR (Observation-PRediction) and PPR (Parameter-PRediction) could be used to explore the distribution of uncertainty measures throughout parameter space using the DELSA approach. OPR and PPR are described by Tiedeman et al. (2003, 2004), and Tonkin et al (2007). Parameter-value dependence of these or other statistics with similar goals has received little attention to my knowledge.

I imagine that the analyses in this article and those suggested are a small beginning of a future that will see models of complex processes used in ways we early modelers can scarcely imagine. We are riding on horseback while in the future there will be progressively more insightful ways to regard models and integrate their insights into society. This is what I imagine. I am excited that I might live to see what will happen in a few coming decades.

My second comment is much shorter. In line 215 of the article we find the text "Although sediment concentration is one of the main parameters controlling debris flow rheology, model results are insensitive to Cvmax. This is explained by its small range of variation compared to the feasible range of beta-1, ..." I can see how a narrow parameter range can explain uniformity in parameter sensitivity, but fail to see how it can explain its insensitivity. Perhaps there is something not quite explained well here.

I appreciate the opportunity to provide comments on this very fine paper. I hope my comments provoke a bit and are of some utility.

References cited

Hill, M. C, Teideman, C .R. (2007) Effective groundwater calibration, with analysis of data, sensitivities, predictions, and uncertainty, Wiley-Interscience, John Wiley and Sons, New York, 455p.

Tiedeman, C. R., M. C. Hill, F. A. D'Agnese, and C. C. Faunt (2003), Methods for using groundwater model predictions to guide hydrogeologic data collection, with application to the Death Valley regional groundwater flow system,Water Resources Research, 39(1), 1010, doi:10.1029/2001WR001255.

Tiedeman, C. R., D. M. Ely, M. C. Hill, and G. M. O'Brien (2004), A method for evaluating the importance of system state observations to model predictions, with application to the Death Valley regional groundwater flow system, Water Resources Research, 40, W12411, doi:10.1029/2004WR003313.

Tonkin, M. J., C. R. Tiedeman, D. M. Ely, and M. C. Hill (2007), OPRPPR, A computer program for assessing data importance to model predictions using linear statistics, U.S. Geol. Surv. Tech. and Methods Rep. TM-6E2, 115 pp.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2020-37, 2020.