Hydrol. Earth Syst. Sci. Discuss., 4, S160–S163, 2007
www.hydrol-earth-syst-sci-discuss.net/4/S160/2007/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Sensitivity analysis and parameter estimation for the distributed modeling of infiltration excess overland flow" *by* W. Castaings et al.

Anonymous Referee #3

Received and published: 15 April 2007

General comments :

The paper aims to present a methodology to study the sensitivity analysis and parameter estimation for distributed hydrological modeling of infiltration and surface runoff. The methodology is based on the variational method approach, and the adjoint sensitivity analysis is used for the resolution of the inverse problem and for model calibration. This is an interesting method and its application in the field of hydrological modeling is new. This topic is of international interest, however the paper lacks of soundness, and needs to be strengthen before publication. My principal comments concern :

i) Method comparison : In several parts of the text, the authors say that the variational

method performs better than other classical methods. However, the authors didn't make any comparison between various sensitivity analysis and calibration methods, in order to compare their performances. This assumption needs justification. When and why the variational method performs better than other methods, and when the other methods perform better? A figure or a Table representing the successive steps of the methodology can help the reader to better understand the various phases and the conclusions from each step.

ii) Distributed hydrological modeling : The title of the paper announces "distributed modeling of infiltration and excess overland flow". However, the introduction presents the state of the art for only sensitivity analysis and calibration procedures. Is the hydrological model used herein a simple application case? It is not clear from the text, how the methodology can be generalized for other distributed hydrological models including other hydrological processes (evapotranspiration, non saturated and saturated flow, pollutants, erosion, etc.). The domain and limit of application of the methodology must be discussed. Can this approach be applied for all distributed hydrological models? Is their any limitations depending on the model type, the model equations, the number of variables and/or parameters, or the time of calculation?

iii) Application case : The methodology was applied on a virtual case without any available discharge data and on only one flood event. Why the authors didn't choose a real case? It is not clear how data (rainfall, roughness, hydraulic conductivity at natural saturation, etc.) were estimated, and how topographic data were spatialized in MARINE (slope, length, channel network transversal section)? What is the spatial resolution of the grid?

iv) Equifinality : The authors doesn't deal with the problem of equifinality. The application was conducted on only one virtual flood event, and consequently the optimum corresponds to the set of parameters of Table 1 which gives a Nash criteria equal to 1. How to deal with real cases (with measured discharge data), when the model optimum Nash criteria is less than 1, and when the optimization procedure can lead to more

HESSD
4, S160–S163, 2007

EGU

than one set of optimal parameters.

Specific comments :

1. The abstract is too short. It must be rewritten in order to present clearly the objectives, the methodology, the data, and the main results.

2. In some equations, some variables and parameters are not explained : example to and tf in equation (2); x and T in equation (3), etc.

3. Table 1: Discuss why the initial soil moisture (0.5) is superior than the porosity (0.398). What about the other soil properties such as water content at natural saturation (to be compared to the porosity), and the residual water content. Does the "hydraulic conductivity K" means the hydraulic conductivity at natural saturation?

4. Why the five parameters of Table 1 are not all used in the study of Figure 10?

5. The definition of all variables in Tables 2, 3 and 4 must be explained in the Table legend.

6. Explain briefly the automatic differentiating system "TAPENADE" : justify the choice of TAPENADE in comparison to other systems; domain and limits of applications; what kind of hydrological models, or what degree of complexity can be analyzed by TAPENADE.

7. Give detailed legends for colors in Figures 1 and 5. Add the scale and the north. Add the altitude ranges in Figure 1.

8. Define the sensitivity in Figures 2 and 3, respectively as the relative error on volume and peakflow.

9. Define v1 and v2 in the legend of Figure 4. Why the x-axis represents only K, n and theta (for reaches and hillslopes). What about the two remaining parameters : suction and porosity?

HESSD

4, S160–S163, 2007

10. Give in the text the characteristics of the studied rainfall event : mean value, standard deviation, comparison between the radar data and the measured data.

11. Define u1 and u2 in the legend of Figure 9.

12. The text must be checked to correct English errors.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 363, 2007.