**Hydrology and
Earth System
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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 #2**

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General Comments:

The authors present an interesting paper looking at the very important problem of sensitivity analysis and parameter estimation for distributed hydrological models. This manuscript has some interesting points, but also some shortcomings that I believe the authors need to address before their paper is suitable for publication. This could be a very valuable paper, but the authors need to strengthen their argument and develop more corroborating evidence!

My main point of criticism is that it is always difficult to show that one particular method should be used if it is not either compared to other approaches or if its limitations are

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explored as well. In this particular case the authors use adjoint sensitivity analysis and infer from the fact that the results seems sensible that the approach works. This is a weak justification, in particular, since the authors themselves point out the limitations of local methods at several points in their paper. If the authors want to show that the local approach is feasible, then they need to find a way to show that the fact that a nominal point has to be chosen does not impact their general conclusions regarding the parameter importance! Retrieving the 'true' parameters in an error free low dimensional search (Fig. 10) is insufficient to achieve this in my opinion.

The authors should read the manuscript over a few times to correct some of the English. Some sentences are incorrect (grammar). In addition, some of the sentences using absolute terms like 'most' or 'all' need to be softened (examples below). The authors should also include some more detail on the model (e.g. number of cells, cell connectivity).

Specific Comments:

My points regarding content are in particular:

- The abstract of the manuscript is far too short. It needs to provide the reader with a succinct (but sufficient) overview of the paper's content, including the main results and conclusions. - The authors state the problem with the use of local methods in hydrological modeling as identified by Duan et al. (1992). However, they then move on to evaluate the sensitivity of the model parameters around a single point in the parameter space. This seems inconsistent to me. If you want to show that a local sensitivity analysis method can be applied reliably then you either have to compare it to a global method, or you have to pick multiple (but equally feasible) points in the parameter space and show that applying the local method leads to the same conclusions regarding parameter importance. - "SA is mostly perceived as an additional information derived from stochastic simulationsĚ (p.365)". There are plenty of applications of deterministic approaches to sensitivity analysis in the hydrological literature - e.g. Mc-

Cuen work, Liang work, or in a lot of papers dealing with more complex land-surface models. The authors should also mention some of those papers for comparison. On page 373 they state that most applications of sensitivity and uncertainty analysis have been performed in statistical frameworks. This is only true for applications in the last years, before that deterministic one-at-a-time sensitivity analysis was the norm, and it still is in areas of hydrology where highly complex models are used. The authors should adjust this statement and include more references to local sensitivity analysis methods and their application in hydrological modeling. - (p.365) What is meant by "multi-dimensional averaging"? - (p.365-366) I assume the authors mean that dimension reduction is necessary for spatially distributed models? - The authors compare their model performance with the performance of their model. So reporting Nash-Sutcliffe Efficiency values is highly misleading (e.g. Table 3). The authors should at least state in the caption of table 3 that they are using synthetic error free data. - Most (if not all) figure and table captions are too brief. I should be able to understand the figures and tables (at least their content) without having to find the related text in the manuscript. For example Fig. 1 states catchment topography. What do the figures means? Please add a legend. For example Table 4. What are the abbreviations? For example Fig. 5, what do the colors represent? Etc. - On page 380, the authors repeat the problem of derivative based methods being only valid around nominal values - how does this impact the results of this study? - Page 380, what does it mean if the approach applied by the authors does not recover the optimal (and I assume possible?) Nash-Sutcliffe Efficiency value of 1?

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

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