Hydrology and Earth System Sciences Discussions

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Comment

Interactive comment on "Physically-based modelling of hydrological processes in a tropical headwater catchment in Benin (West Africa) – process representation and multi-criteria validation" *by* S. Giertz et al.

Anonymous Referee #1

Received and published: 9 June 2006

The dataset, on which this article is based, is most likely the best dataset available for an experimental watershed in West Africa. It simply is extremely difficult to gather such a dataset. As such, it is important that the data and the analysis are published. The authors chose to analyze the dataset through a relatively complicated/parameter rich, physically based model. Such an approach is quite valid, although I don't think that the objective and final outcome should be just another hydrological model that performs well. The objective should be to better understand the hydrological processes and their relative importance. The authors do quite a good job describing these processes

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based on their observations. In general, the model performed well and described not just discharge but also shallow soil moisture, although the description of deeper soil moisture was less satisfactory. The multi-criterion analysis did not come out so well, because the calibration was done manually and it is not explained how different variables were weighted in this process. It is stated that most variables were measured directly. It is hard to see how this was done, however, without further description of the methods used to measure all these difficult parameters such as, for example, minimal stomatal resistance. In my opinion, it is more the data-based process analysis than the models, that represents the real value of this article. In terms of detailed comments, I would just like to say that the English should be proof red by a native English speaker to get rid of all the minor errors such as "metamorphosed".

Having some hydrological knowledge of the region, I would say most processes are indeed well described. I would just like to differ, where it comes to the analysis of surface runoff. Because this is HESS Discussions, I would like to ask the authors to comment on the following, in the hope to come to a better understanding through discussion.

For the calculation of surface runoff, the Smith-Parlange model is used. This seems a bit over-parameterized, and simpler models would probably do as well. In general, it is hard to judge the model validity because little detail is provided about integration methods, time steps, spatial discretization, how boundary values from the Smith-Parlange model and root uptake enter Richard's equation, etc. More important is that surface runoff is averaged per hillslope area. In this article, no values for Ksat are given, nor any rainfall intensity measurements (they should, for final publication). The Ksat values given in a previous article seem very low (100-200 mm/d) for this region because they imply that almost no rainfall would infiltrate during a rainstorm, which typically has intensity values of over 2400 mm/d. This means that, as observed elsewhere in the region, and as implied by the presented data, a lot of the surface runoff has to re-infiltrate before it reaches the stream. It is stated, however, that runoff is calculated for different

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Ksat values and then averaged over the hillslope. This does not seem to be the best way to go about it. It is recognized that surface runoff routing is not part of the model, and it would be difficult to implement. My problem is that not all point runoff will make it to the bottom of the slope. Much will infiltrate down the slope. A patch with low Ksat only generates streamflow if it is connected to the stream over a complete corridor with low Ksat values (as may be the case along footpaths, as was remarked by the authors). Somehow, this effect would have to be taken into account in a better way if we want to do more then to be right (=OK predictions) for the wrong reasons/processes.

Concluding for now, I would say that this article is a valuable contribution to our knowledge of tropical hydrology. One may argue about the value of a parameter rich model as the one used here but it may be a way to get a better understanding of the governing processes. The treatment of surface runoff seems unsatisfactory and should be improved upon. More details on the models should be provided so that the outcome can be verified.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 595, 2006.

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