Hydrology and
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Discussions

# *Interactive comment on* "Analyzing runoff processes through conceptual hydrological modelling in the Upper Blue Nile basin, Ethiopia" *by* M. Dessie et al.

**Anonymous Referee #1**

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The paper develops a rainfall-runoff model of medium complexity, distinguishing between groundwater, direct runoff and interflow; and splitting the catchments into three using topography. The parameter estimation uses a combination of calibration and estimation of parameters based on soil properties. The work is a brave attempt to develop and test a model for an area that suffers from limited flow, precipitation and hydrological properties data. However the paper does not really provide significant advances in understanding hydrological responses or innovation in modeling. The quality of model outputs is declared good, but this is arguable and a detailed analysis of model errors has not been reported. While recognizing the data issues, the authors claim that peri-

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ods of data are relatively high quality; however this has not been shown, for example the reader cannot judge the degree of rainfall and flow data errors. The model is rather complex given the data restrictions, shown by the sensitivity analysis. The conclusions about hydrological processes cannot be justified given the data issues, the use of text book values of parameters of unknown applicability here, and the apparent limited performance of the model. There are various gaps in the description of the method, as I explain in my comments below. Overall, I am not confident that this model or the conclusions made about processes are justified, and all the evidence points to the model being over-complicated. The authors may have been better using a stricter application of the methods of Fenicia et al. 2008 to gradually build up the complexity of the model to the justified level, with more explicit attention to errors in inputs and outputs. Below are a few more detailed comments that may help in a revised version; however in my opinion the aims and approach need re-thought.

5293, 3. Model is modified from what? Not clear what is being modified. 5293, 10. Differently from what?

Eq 8 and 9. Equations applicable at hill-slope scale? Needs some further justification.

How can all these parameters be justified? Why are there only seven – they need estimated for each of the three slope classifications?

5300, 1-4. Local relevance of the text book values? Really the textbook should provide ranges, which are fed into calibration (further increasing the calibration problem).

5300, 12. We need to see location map of these gauges – as precipitation is the key input –and know something about their accuracy. Was the PE spatially variable?

What assumptions have been made about stream flow routing and stream-groundwater interactions?

Figure 6. Does not look like great performance to me. Needs some more insightful plots to elucidate magnitude and nature of errors.

Eq 20, 21. Authors claim that the gauged flow data are high accuracy – it would be useful for the reader to see the rating curves, together with the range of levels to which the rating curves were applied.

Stochastic optimization implies the stochastic nature of the input errors were considered? How are rainfall errors considered? Stochastic optimization gives stochastic outputs, which is misprepresented, or at least under-utilized, by reporting optimal parameter values..

5302, 5. Why only 7 parameters? Each catchment was split into different runoff production units to represent variation in catchment properties using topography, so why not 21 parameters?

Can the splitting into three areas be shown on a map, e.g. using color coding?

5304, 5. Figures 5 and 6 do not show this very well. Some more insightful plots about the errors are needed. In Figure 5, it seems there are some rather serious errors. E.g. the wetting up period deserves some discussion, In Fig 6, I cannot really see the nature or magnitude of the errors; however there are clearly some systematic errors that need critical discussion. The flow regime / climate in the validation period seems quite similar to the calibration period, so comparable performance is expected. Validation should ideally test the model to breaking point.

5304, 14. I didn't follow what this meant. Which data are averaged over the year?

5305-5306. I don't see how these observations are meaningful given the errors in the model. There seem to be large errors in the flow peaks, so the model cannot be used as a basis for concluding upon importance of direct runoff.

Figure 7. Local sensitivity analysis – value of this is unclear give high uncertainty in parameter values. Global analysis would be more useful.

5307 - Sensitivity analysis results support the view that the model is too complex; or at least components of it are too complex

5307, 23. This is not an encouraging performance. Probably a two or three-parameter model could achieve this.

5309, 10. This conclusions is not justified from the results. The effect of the topographically-based division of the catchment has not been explored at all?

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