

Interactive comment on “Modelling dominant runoff production processes at the micro-scale – a GIS-based and a statistical approach” by C. Müller et al.

C. Müller et al.

Received and published: 9 September 2008

The authors would like to thank the anonymous referee #3 for his suggestions.

Overall Comments

Review Comment: The paper addresses an interesting topic of hydrology: delineating dominant runoff process (DRP) from spatial data sources (DEM, geology, soil, land use). Two approaches are presented, one rather simple and the other statistical. The results are compared with a reference map of DRP (Schobel, 2005) delineated based on the method of Scherrer and Naef (2003). I suppose, in many catchments of low mountain ranges there is a lack of detailed spatial data, e.g. DEM, soils etc. Therefore,

the typical way of delineating DRPs in this kind of catchments is to do extensive field work and implement the received results into a hydrological model for further analysis. For me, it is one of the challenges today to find new ways of delineating DRP with limited spatial data sets as is not feasible to go the described way for every single (ungauged) catchment. This, however, requires not only new approaches but also a regionalization of them to account for the different types of landscapes. For investigating new approaches, a comparison of simple and complex types is a good way to understand which parameters are crucial for the different DRP even if the DRP might not be causally determined. In my opinion, a paper about this topic does not necessarily need to present the whole story from process research over delineating DRP to hydrologic modelling. However, the paper in this form is more or less about an attempt to reproduce a DRP reference map with two different approaches ("modelling" is definitely the wrong word for it) with a lot of hydrological background information and discussion missing.

Author Comment: The authors agree with referee #3 concerning the word modelling. Please see also general author comment concerning this issue. The results of the original method of Scherrer and Naef (2003) (i.e. maps with dominant runoff processes) have no direct relation with quantitative aspect of hydrographs. Therefore, the use of hydrographs is not suited to validate neither the results of the original method of Scherrer and Naef (2003) nor the results of the developed approaches, since they depict the integrated response of a basin. The authors refrained therefore from using hydrographs. This topic will be addressed and discussed in detail in the revised manuscript.

Review Comment: The reader does neither learn much about the delineation of the DRP with spatial data nor about the differences between both approaches with respect to (regional) limitations or validation. Furthermore, he does not learn much about GIS-techniques as both approaches are not technically new, what per se is not critical when the results are appropriately discussed and leading further.

Author Comment: In the revised manuscript the authors will describe more clearly the delineation of the DRP with spatial data and the potential of both approaches for further use. With respect to regional limitations and/or validations a second basin will be introduced into the manuscript. See also general author comment.

Review Comment: The delineation of DRP from catchment characteristics is not trivial. However, in low mountain ranges topography has a dominant influence on runoff generation. Therefore, it is not surprising that for an "acceptable" percentage of the catchment area, DRP can be delineated with topography and one or two more parameters. But if you take a closer look at some areas, as the authors state, (p1687 ll 25, 26) "topographical parameters cannot differentiate these different dominant runoff processes". Unfortunately, the paper touches this topic ("the challenging rest") only briefly.

Author Comment: The authors agree with the referee comment and will discuss this topic more intensively in the revised paper. It was not the intention of the authors to discuss the suitability of the original method of Scherrer and Naef (2003) to define soil functional groups. Therefore the authors agree that they should discuss the challenging rest more deeply. In the opinion of the authors it is not possible to identify some of the areas only by topographical descriptors, so fieldwork is needed. But with the application of the approaches one is able to identify where one should concentrate the fieldwork and where one should look for other parameters than topography.

Review Comment: There is also only limited information on different GIS-based approaches in the literature. The information for the delineation of DRP of the parameters like topography, geology and soils is very different. Soil data and geology actually represent different level in a 3D environment. The use of one instead of the other raises many questions. This is not discussed.

Author Comment: The authors will introduce references about GIS-based approaches. Furthermore, relationships between topography, geology and soils with respect to the

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delineation of the DRPs will be discussed in the revised manuscript. The authors agree that soil data and geology actually represent different levels in a 3D environment. However, concerning the use of soil data the objective of the study is to derive DRP maps with a view to regionalization to areas where this soil information is lacking. Therefore, the authors choose to refrain from taking soil characteristics more into account. This is also the major topic in which this study differs from Scherrer and Naef (2003) and Schmocker-Fackel et al. (2007). This will be stated more clearly in the revised manuscript.

Review Comment: The genesis of table 2 (dependency of DRP on slope/land use) for the first approach is not explained, is it "calibrated" or how are the DRPs related to the slope classes (what does "assumed" mean)? In this kind of approach (decision tree like) all the knowledge about the DRP of the catchment should be used when the assigning DRP to the different catchment parameters. This should be addressed in more detail.

Author Comment: Concerning the slope in table 2, the classification was based on the original decision trees of Scherrer (2006). Concerning the classification of permeable substratum the authors follow the original decision trees of Scherrer (2006) as well. Concerning the classification of impermeable substratum the authors follow partly the original decision trees of Scherrer (2006) and partly expert knowledge and knowledge obtained from field observations (Müller et al. 2007) in the study area. This will be stated more clearly in the manuscript.

Review Comment: There is also no validation in a catchment, which is not used for the development of the approaches. As a consequence, no statement can be made if the approaches actually have the potential to delineate DRP without previous extensive fieldwork.

Author Comment: In the revised manuscript an extra basin is introduced in which the two approaches will be applied and afterwards compared with the results of the original

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method of Scherrer and Naef (2003). In this new meso-scale basin, the original method of Scherrer and Naef (2003) has been applied point wise on 53 previously defined sites throughout the entire basin with a field campaign. This offers the opportunity to validate and detect methodological errors in the new approaches more clearly. Such field data (e.g. for the new basin 53 points) will always be necessary to check the results of both approaches. However, the magnitude of such a field campaign stands in no proportion to the amount of field data necessary applying the original method of Scherrer and Naef (2003). This will be stated more clearly in the manuscript.

Review Comment: Finally the paper lacks a clear message. Which approach should be used and why? Which approach may give better results if additional data is available? Which approach may be better for regionalization? Which DRP map is more consistent with the existing knowledge about the DRP although the objective classification results from GIS might be less good?

Author Comment: A more extensive discussion on the differences and applicability of both approaches will be introduced in the revised manuscript addressing the topics as mentioned by the referee. The discussion will also comprise the results of the new study area (see above).

Review Comment: In conclusion, I would suggest to - give more information on existing GIS/DRP-approaches in the introduction

Author Comment: See author comment above.

Review Comment: - give more information on the hydrological behaviour and the DRP of the catchments (e.g. summary of cited references, runoff diagrams etc.)

Author Comment: Concerning the hydrological behaviour see author comment above.

Review Comment: - shorten the description of the technical procedures and focus the comparison between results and reference map

Author Comment: The authors agree and will shorten the description. However, it

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has to be taken into account that for understanding and for repetition of the developed approaches, there is a need for detailed description of the procedures.

Review Comment: - discuss the results with respect to the different approaches (the two used + approaches in literature) in more detail

Author Comment: See also answer above.

Review Comment: - give a clear message for the reader

Author Comment: Due to the introduction of a new study area and the following discussion with implementation of the suggestions of the referee a clear message for the reader is intended.

Minor comments: Review Comment: P 1679 I 18: for me, the use of a coarse geological map (and only perm./imperm. information) is no compensation for a detailed soil map. Please explain why the detailed soil information can be substituted so easily.

Author Comment: The referee is correct that a coarse geological map is no compensation for a detailed soil map. Detailed soil information cannot be substituted easily. However, since detailed soil maps (i.e. 1:5000) are very often lacking, especially at the meso- and macro-scale, the use of detailed soil maps in this study was deliberately refrained from, since one of the objectives of the study was to develop to approaches with a view to regionalization (meso-scale). In the meso-scale geological maps are far more often available than detailed soil maps. This will be stated more clearly in the manuscript.

Review Comment: P1681 I 8: "two model approaches based on dominant runoff processes"; should be "two model approaches for the delineation of dominant runoff processes";

Author Comment: The authors will adapt this in the revised manuscript.

Review Comment: P1681 I 16: please give a short summary of the references

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Author Comment: The authors will give a short summary of these references in the revised paper.

Review Comment: P 1682 I 18: is the land-use information only necessary for the delineation of Dsof1 on urban areas?

Author Comment: Land-use place determines also the differences in DRPs when regarding grass- and cropland and forest (see also table 2). However, this will be stated more clearly in the manuscript.

Review Comment: Table 2: is there DP on permeable hillslopes above 40 % slope under prolonged rainfall?

Author Comment: The authors agree with the referee that this is a valid question. Since the authors follow the method of Scherrer (2006) and since Scherrer (2006) provides no information concerning DDP on permeable hillslopes above 40 % slope under prolonged rainfall, the authors will address this problem in the revised manuscript.

Review Comment: Table 5: please give some more background information for readers who are not too familiar with CDA

Author Comment: The authors will include a very short paragraph on the principles of CDA.

Review Comment: Figure 2 a/b: not necessary, better: runoff diagram

Author Comment: Concerning runoff diagrams, see answer above.

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HESSD

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