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Hydrology and Earth System Sciences Discussions

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.

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The authors would like to thank the anonymous referee #1 for the comments.

General comments

Review Comment: The other major aspect of the paper is its complete subordination to the original Scherer & Naef (2003) approach, both in terms of method and reference truth.

Author Comment: The aim of the study was to develop to different approaches, which simplify the complex original method of Scherrer and Naef (2003), but use the original

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Interactive Discussion

Discussion Paper

method to validate results. For the application of the original method numerous data (16 basic data sources are needed: soil profiles; soil maps; agricultural land evaluation; topographical maps; geo-morphological maps; vegetation maps; geological maps; hydrological maps; geo-technical maps; geo-ecological maps; drilling points with soil description; infiltration tests; digital maps (ATKIS); forestry maps; remote sensing data and drainage plans (Scherrer 2006)) and long field observations (15 different soil properties have to be studied in the field in combination with a final appreciation of the soil via a decision trees to determine the dominant runoff process) are needed. This makes the original method time consuming and mainly applicable at the micro-scale. The results of the two approaches presented in this study should resemble both in terms of method and reference truth the original Scherer & Naef (2003) approach. However, the presented approaches (3 basic data sources are needed: simplified geological map in terms of impermeability, land use and a digital elevation model) have a different procedure in predicting the dominant runoff processes as the original method, which makes them not only applicable for larger areas, but also less time consuming. This will be stated more clearly in the revised manuscript.

Review Comment: No observations on hydrological processes or soil features are reported, and the validity of the DRPs obtained with the original method is not discussed.

Author Comment: In the revised manuscript features on hydrological soil properties will be reported. Since the reference map of Schobel (2005) was acquired by the accurate application of the original method of Scherrer and Naef (2003) this reflects the results of the original method. If the DRP-maps of both approaches are compared in the results (4.1 and 4.2) with the reference map, they are compared with the original method. This will be stated more clearly in the revised manuscript.

Review Comment: Crudely speaking, the main purpose of the work is to obtain simple GIS methods which use easily available information for obtaining DRP maps that mimic those obtained with the original method which needs time-consuming field work.

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Author Comment: In the opinion of the authors this is a beneficial procedure to develop, since it provides DRP maps with a view to regionalization.

Review Comment: Although the authors claim to be successful, they should consider that this is a calibration exercise, so they did not verify the validity of their approaches in a new area (with diverging climate and physiography) where their approaches and the reference one would be independently applied: it seems to me that the new methods might be useful for relaxing the density but not substituting the field observations needed to obtain DRP maps.

Author Comment: Since there are very few existing DRP maps obtained with the original method of Scherrer and Naef (2003), the verification of the developed method becomes difficult in areas with different climate and physiographical conditions. However, the authors see the need of validation. In the opinion of the authors an application in a new area with similar climate and physiographic properties could already be useful. This offers the opportunity to detect methodological errors in the new approaches more clearly. In the revised manuscript an extra basin is introduced in which the two approaches will be applied and compared with the results of the original method. 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. Furthermore, the referee is correct in stating that field observations are still needed to verify the results of both approaches. This will be stated more clearly in the revised manuscript.

Review Comment: Yet, the results are compared with those obtained with another indirect approach, but not with observed (or simulated with another kind of method) hydrological processes, so the question on the validity and usefulness of these DRP maps remains open.

Author Comment: The reference DRP map of Schobel (2005) was obtained by the literal application of the method of Scherrer and Naef (2003) and therefore, according

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to the authors not an application of another indirect approach. Any other experienced operator using the underlying method of Scherrer and Naef (2003) will obtain the same reference map. The reference DRP map of Schobel (2005) is of first class quality due to the immense field data accounted (constructed on the basis of 728 soil drilling points and 15 soil profiles in a field campaign during several weeks) and therefore assuredly consisting of observed soil-hydrological data. The reference map represents a spatial distribution of the hydrological behaviour of the soil during intense rainfall events and with this map areas relevant for the formation of floods can be identified. Concerning the usefulness of the DRP-maps, Schmocker-Fackel (2007) argued that such maps could help to improve rainfall runoff modelling of flood events. In addition, they might be used to predict potential risk areas like for pesticide loss or soil erosion.

Minor comments (specific and technical)

Review Comment: - The title is not adequate as model has currently another kind of meaning in Hydrology. Mapping would be a welcome term.

Author Comment: The title will be adapted. See also general comment.

Review Comment: - In the abstract, it should be stated that the existing DRP map was made on the basis of an intensive survey of soil properties (but not on the hydrological responses).

Author Comment: This will be included and stated more clearly in the abstract of the revised manuscript.

Review Comment: - The list of DRP in the introduction (lines 6-11 in page 1679) should be moved to the methods section.

Author Comment: This will be adapted in the revised manuscript.

Review Comment: - Gleying (line 1 on page 1681) should be substituted by water stagnation or a similar term.

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Author Comment: This will be adapted.

Review Comment: - explain or substitute the term meliorated in line 4, page 1681 (drained?).

Author Comment: Meliorating means optimizing/ upgrading the compacted (sub)-soil by using special agricultural equipment. This will be adapted.

Review Comment: - Approach 1: it is unclear if this approach was independently developed or if the available DRP map was used to calibrated it.

Author Comment: The available DRP map (reference map (Schobel 2005)) was not used to calibrate the new approach 1. This will be stated more clearly in the revised manuscript.

Review Comment: - In line 19, page 1683 it is not stated that S and LS factors were USLE factors, as reported later (page 1986). Please, refer which kind of algorithm you used for obtaining these factors.

Author Comment: LS and S factors were defined with the r. watershed command in GRASS GIS 6.3.0 (GRASS Development Team, 2008). The procedures are based on Weltz et al. (1987) for the LS-factor and McCool et al. (1987) for the S-factor. The references and a proper relation of the algorithm will be given in the revised manuscript.

Review Comment: - The comparison of the results with the available DRP map is unbalanced, as Approach 1 is compared using maps whereas Approach 2 is compared through tables. Both types of comparison should be made for both approaches.

Author Comment: The authors agree and will apply both types of comparison to both approaches.

Review Comment: - The written comparison between approach 2 and the available DRP map (page 1687) is too long; avoid repetition of data shown in tables.

Author Comment: The text will be adapted accordingly.

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Interactive Comment

Review Comment: - Conclusions: It is unclear that the first approach may be an alternative to the field campaigns in any other areas, as it will presumably depend on climatic and physiographic characteristics; the new approaches might presumably be useful for relaxing the density of the field observations to build DRP maps. Some kind of true hydrological validation of the DRP maps should be needed before its use for hydrological modelling (or this modelling might be used to verify its utility).

Author Comment: In addition to the application of both approaches (whether the first or the second), small field campaigns are always a necessity for validation purposes. This will be stated more clearly in the manuscript. In this study the authors have restricted themselves to only one geographical area in order to develop their methodology. Testing it in other areas is subject of further study. However, the first approach was developed based on the original method of Scherrer and Naef (2003). The original method of Scherrer and Naef (2003) incorporates climatic and physiographic characteristics. Results of the application of the original method reflect therefore changes in climate and physiographic characteristics. It has been applied successfully in Switzerland (Schmocker-Fackel 2007, Scherrer and Naef 2003). The authors assume that their approach is able to reflect changes in climate and physiographic characteristics, as is the case for the original method.

Review Comment: - Table 3 does not correspond to the citation in the text.

Author Comment: The citation in the text will be adapted

Review Comment: - Tables 4 and 5 are superfluous.

Author Comment: Table 4 is considered necessary for understanding the weight of each of the functions within the discriminant model. Nevertheless, the authors agree that the information and table extent can be reduced. Table 5 is considered to be necessary, because here the coefficients of the canonical functions are reported to reproduce the regression model.

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Interactive Comment

Review Comment: - Use uniform units on table 6 (ha or %).

Author Comment: Uniform units will be used in table 6.

Review Comment: - Figure 2b is not adequate: the graph does not depict the logics of the procedure, as the permeability of the substratum determines the set of functions used. Erase field mapping Zemmer box.

Author Comment: The authors agree on the mistake depicting the procedure, as the permeability of the substratum and the reference map are both needed for generating both sets of functions. To be coherent with Fig. 2a we will erase the box field mapping Zemmer.

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