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Hydrology and Earth System Sciences Discussions

Interactive comment on "A comparison of regionalisation methods for catchment model parameters" *by* J. Parajka et al.

J. Parajka et al.

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Author response to review #2

We would like to thank Prof. Szolgay for his insightful questions and comments. In response to these comments we have modified the manuscript as follows:

Specific comments:

1. p. 510, l.24. We agree with the reviewer that the transfer of information is only a part of the regionalisation process. We have changed the sentence as follows: "Transferring information from neighbouring catchments to the catchment of interest is generally accomplished by hydrological regionalisation methods (Blöschl and Sivapalan, 1995)."

2. p. 511, l.24. We have added the information as requested:"...In their case study in Great Britain, homogeneous spatial clustering patterns of the regional flood frequency distribution were found ..."

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3. p. 512, l.10. We added the reference to Fernandez et al. (2000) and Hlavcová et al. (2000): " Fernandez et al. (2000) proposed a regional calibration approach that involves a concurrent calibration of the model parameters and the relationships between model parameters and catchment attributes at many sites in a region. This approach has led to nearly perfect regional relationships between model parameters and catchment characteristics, however, these relationships did not improve the streamflow predictions at ungauged sites. A similar approach was applied in Hlavcova et al. (2000) and Szolgay et al. (2003), where they intended to find regionally valid parameters of a monthly water balance model. They jointly calibrated a model using multiobjective calibration, where the catchments were pooled together using cluster analysis of selected physiographic catchment attributes."

4. p. 512, l. 28-30. We added a more detailed outline of the paper: "...This paper is organised as follows. We first provide a brief description of the dataset and give an overview of the hydrologic model and the calibration procedure. In the following section we describe the regionalisation approaches and the methodology used for cross-validation. We then present the results in terms of model performance of the different regionalisation methods and discuss the main findings of the paper." In our opinion the introduction already reviews the main findings of the relevant papers and evaluates recent tendencies in hydrological regionalisation. We have therefore chosen to leave this part of the paper as is.

5. p. 513, l. 1-30. We have added the following to the data section: "...a median of 196 km^2. 97 of these catchments range in area between 10 and 100 km^2, 106 catchments between 100 and 300 km^2, 64 catchments between 300 and 1000 km^2 and 55 catchments have areas of more than 1000 km^2. In preliminary analyses we carefully screened the runoff data for errors and removed all stations with significant anthropogenic effects. We also removed stations where we were not able to close the long term water balance. The spatial distribution ..."

6. p. 513, l. 27. The coefficient of variation (CV) is used along with other catchment

attributes in regionalisation. To avoid any potential misunderstanding we have spelled out CV as ”coefficient of variation”.

7. p. 514 - 520 Model calibration:

a) The snow correction factor is a model parameter that (in this type of conceptualisation) is not considered a causal correction of precipitation measurement errors induced by wind, evaporation losses, etc... It is one of the 11 model parameters which are typically calibrated against measured streamflow. In this paper we additionally used snow cover observations for calibration but this does not change the meaning of this correction. We think it is clearer not to extend the description of the hydrological model and this particular parameter as it has a similar role as other calibration parameters. For Austria, we evaluated the efficiency of this correction in Parajka et al. (2005).

b) The improvement in model performance is already indicated in the model calibration part (p.518): “The runoff performances (ME and VE) are somewhat better than those in Merz and Blöschl (2004) even though we used snow data in the objective function, which was not the case in Merz and Blöschl (2004). The differences are 0.03 and 0.05 in terms of ME for the calibration and verification periods, respectively. “. In the discussion part (p. 526) we have compared the regionalisation model performance: “...As compared to Merz and Blöschl (2004), the ME model performances increased by between 0.07 and 0.10 depending on the regionalisation method. This is mainly due to the improved model structure of allowing for elevation zones.”

c) In response to this comment we added the following in the text”: These consisted of sensitivity analyses that showed that the model results were only moderately sensitive to the choice of weights. “

d) We did not use the ratio (relative difference) of simulated and observed snow cover areas because it is not possible to derive this ratio for days where no snow has been observed.

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e) In the absence of more detailed information we have chosen the same lower and upper bounds of the beta distribution for all catchments. If more detailed information was available (for example from catchment attributes or from field studies) this assumption could be straightforwardly relaxed. We have added a comment to this effect in the manuscript. The beta function was chosen as a convenient unimodal and bounded function.

f) We did not find any significant decrease in model performance in the smallest catchments. For example, the calibration model efficiencies (ME) of the three smallest catchments in the dataset were ME = 0.71, 0.67 and 0.71 (the median over all 320 catchments was 0.72). The ME in the verification period for these catchments were 0.58, 0.81, 0.78 (the median was 0.66).

g) p. 519 - 521, Regionalisation methods: We have clarified what regionalisation methods have been used in the previous study by adding the following sentence: “Note that all similarity index based regionalisation methods as well as the geo-regression have not been used in Merz and Blöschl (2004) while the other regionalisation methods have also been examined in Merz and Blöschl (2004).” We feel, however, that the catchment scale issues are beyond the scope of this paper.

h) p. 519, l. 28. The number of catchments included in the local regionalisation methods differed regionally from 5 to 66 catchments, with an average of 31 catchments. These were all catchments within the selected search radius (50 km) without any restrictions on the number of catchments. We have added the following in the paper: “... by the ordinary least squares method. The number of catchments included in the local multiple regression and the georegression differed regionally. For a 50 km search radius as used here it ranged between 5 and 66 catchments, with an average of 31 catchments. Out of ...”

8. p. 521, l. 3. Results from the perfect similarity case have assisted us in assessing the criteria for the selection of catchment attributes applied in the similarity group of

regionalisation methods. We hence prefer not to skip this case. For clarity we have added the following explanations in the text (p. 521, end of the first paragraph): “This is a diagnostic case which probes the potential of the catchment model performance that can be achieved with an ideal donor catchment selection. In this study it helps assess the criteria for selecting the catchment attributes used for finding the donor catchment. In a practical application this is not a viable method as the model parameters are of course unknown at the ungauged site of interest.” In section 5 we have changed the sentence (second paragraph, p. 523) to: “The case of the “perfect” similarity index illustrates the model performance when a donor catchment with the most similar model parameters is applied in the water balance simulations.”

9. p. 521-524, The median and the difference of the two quantiles were chosen since the error distributions are skewed, so quantiles are better indices of the overall performance than the moments. An overall comment on the model behaviour, we think, would have to be quite general so we have chosen not add additional comments to the paper.

Technical corrections:

1. p. 514, l.3. We have changed the IH reference as suggested by the reviewer to Flood Estimation Handbook, Institute of Hydrology, Wallingford, 1999.

2. p.528, l. 22. We believe this citation is correct.

3. Figures in HESS will be larger and much clearer than in the HESSD format.

References: Parajka, J., Merz, R., Blöschl, G. (2005) Regional water balance components in Austria on a daily basis. (In German: Regionale Wasserbilanzkomponenten für Österreich auf Tagesbasis.) Österreichische Wasser- und Abfallwirtschaft, 3-4, 43-56.

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 509, 2005.