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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Understanding groundwater/surface-water interactions through hydropedological interpretation of soil distribution patterns" *by* Johan van Tol

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GENERAL COMMENTS

1. The author studied 21 catchments in South Africa with available stream attributes such the well-known BFI and an index of streamflow variability (CVB). Based on existing soil categorization the dominant soil distribution patterns in the studied catchments were determined. The soils of these catchments were interpreted and grouped into four classes based on their dominant hydrological response. The dominant soil distribution patterns in the catchments were also determined. Using the Pearson correlation coefficient the relationship between BFI (and CVB) and the area under each soil class is examined, which helps making inferences regarding the dominant process in surface

water/groundwater interaction.

2. Soils and their spatial distribution are known to play a crucial role in runoff generation, surface water/groundwater interaction and, ultimately, the management of water resources. The related research efforts in the past have failed to allow full understanding of the processes involved in surface water/groundwater interaction. As noted by the author, one of the factors that hindered progress in process understanding is the "scientific separation of sub-disciplines within hydrological sciences (e.g. geohydrology and surface hydrology)". In my view, this is the main reason for the lack of a unified framework or theory for hydrological processes at the basin scale. Focusing on modelling of a hydrosystem as a whole Nalbantis et al. (2011) have noted: "Very often, some parts of the studied system are modelled in detail (in space-time) while for other parts simplified models are employed; in that way essential interactions among system components may be poorly represented or even omitted ...". This situation is typical in studies that focus either on geohydology or on surface water hydrology. Naturally, the link between the two sub-disciplines is pedohydrology. Obviously, the advancement of knowledge in this sub-discipline has much to offer in process understanding. The paper can certainly contribute to such advancement. Its contribution is mainly related to the enhancement of knowledge with regard to the hydrology of a specific region.

3. The compilation of all methodological elements in one section (titled "Materials and methods") results in mixing existing knowledge with the contribution of this work. The fact that the presented work relies heavily on previous works makes it difficult to clearly discern the real contribution of the former. For this reason it is suggested to divide the aforesaid section into three sections. The first one will include existing knowledge regarding both the general methodology and the results of processing the same data set used in this study. Another section can follow, which will strictly include the author's methodological contribution. Reference to the Pearson correlation coefficient together with a test of its significance is required in this section. Using more mathematics in the description of methodology would, in my view, help enhancing the traceability of

results. Last, a brief description of the study basins and related data sets can be left for a subsequent section.

4. In his search for relationships between various variables the author employs the Pearson correlation coefficient, r. It is known that the fraction of explained variance (EV) of the dependent variable is equal to the square of r. So, the r values in the phrase "Significant positive correlation coefficients (r) exists between BFI and soil attributes such as depth (r = 0.72), clay content (r = 0.50) and percentage coverage by 'Recharge' soils (r = 0.78)" (lines 13-15, page 1) correspond to EV equal to 0.52, 0.25, and 0.61 respectively, which are rather low values. Other values of r found in the text correspond to low EV values also. Moreover, in the above phase, the qualifier "significant" will be interpreted by readers as "statistically significant". It is therefore necessary to provide information on the statistical significance of r.

5. The choice of the Pearson correlation coefficient as the measure of statistical dependence implies that the relationship between the examined variables is expected to be linear. However, nonlinearities in hydrological processes can lead to nonlinear relationships and, hence, low values for r, even if the examined variables are strongly related to one another. For this reason, it is suggested to use also another measure of dependence which avoids implying linearity (e.g., Spearman's rank correlation coefficient). I believe that the aforementioned results (in item 4) with low values of explained variance will be improved, which will potentially allow safer conclusions to be drawn.

6. A number of corrections in the text are needed since, in many parts of it, verbs appear in the third person and plural number, whereas the subject is in the singular number.

7. Abstract: Although the author pays attention to mentioning previous works (e.g., in the phrase "21 catchments in South Africa with available stream attributes"), there is still some ambiguity regarding the contribution of the work presented.

SPECIFIC COMMENTS

Page 1, lines 7-8: In the phrase "due to heterogeneities in landscapes on difficulties in measuring hydrological processes at different scales" using "in" and then "on difficulties in measuring" induces ambiguity; rewording is required.

Page 1, line 13: It is suggested to specify that these correlation coefficients are Pearson correlation coefficients.

Page 1, line 14: Is the "coverage" a percentage of basin area? If yes, better insert "of area" to clarify.

Page 1, line 17: In the phrase "are considerable differences ... in mechanisms" the differences are undefined and thus unclear.

Page 1, line 23: A closing phrase is needed which will refer to the usefulness and potential usage of these perceptual models.

Page 3, line 1: Please clarify this sentence by changing "and acts as water storage" into "and provide space for water storage, later feeding evapotranspiration" or similar.

Page 3, line 8: I presume that by "they formed." the authors meant "they (soils) have been formed."

Page 3, lines 8-9: The syntax of the sentence "The correct interpretation of spatially varying soil properties ... can serve as indicators ..." needs to be corrected; moreover, this is unclear and requires rewording.

Page 3, lines 15-16: The phrase "soils and their spatial distribution might be used to improve the characterization of groundwater/surface water interaction" is unclear; soils and their spatial distribution cannot improve groundwater/surface water interaction, but it is the knowledge of the spatial distribution of soils that can contribute to improving the knowledge on groundwater/surface water interactions.

Page 3, line 25: Since the paper deals with both surface and groundwater, when using the term "drainage density" a reference to the hydrographical network is necessary.

Page 5, lines 13-19: It is suggested to describe the procedure for finding the soil class distribution for each catchment (text “In order ... catchments”) in mathematical terms using appropriate variables and equations.

Page 5, line 23: Readers will normally expect to find a justification of the methodology for data processing, a detailed description of this methodology and the outputs of the methodology to be presented and discussed in the Results’ section that follows; unfortunately such material is missing.

Page 5, line 24: The reader is left to wonder what the “additional catchment attributes” are; it is suggested to provide a list of these catchment attributes.

Page 5, line 24: Reference to a specific package for statistical analysis is without meaning; this is expected to appear after the presentation of the methodology used (see specific comment on Page 5, line 23).

Page 6, line 10: From the previous section of the manuscript it is understood that categories of three levels are used in the analysis: land types, TMUs and soil classes; yet, readers find the term “soil type” which causes confusion; is it the soil class as defined in the previous section?

Page 7, lines 3-4: In the sentence “Strong negative correlations were observed between BFI and CVB and percentage covered by ‘Responsive (shallow)’ and ‘Interflow’ soils” there is some confusion regarding the variables that are correlated; please rephrase to clarify: is it the correlation between BFI and the percentage of area covered by either ‘Responsive (shallow)’ or ‘Interflow’ soils (i.e., the total for the two soil classes)? The same question is raised also for CVB.

Page 7, line 7: The author speaks about “were no significant correlations”; is it the result of a statistical test for significance of the correlation coefficient? Please specify.

Page 7, line 24: The term “holistic” refers to “understanding”, but this is likely to mean slightly different things for various readers; some clarification is necessary.

Page 8, line 2: I presume that just before the phrase “this small scale physical relationships” a word such as “although” is missing so that the phrase be meaningful.

Page 8, line 10: Does “opposed” mean “contradictory” here?

Page 8, line 10-11 and elsewhere: Do “inverse correlation” and “negative correlation” mean the same thing? If yes, it is suggested to keep only one of the two qualifiers; if no, please clarify.

Page 10, line 5: It is unclear if the statement “explained a considerable amount of variation in stream attributes” refers to the explained variance in the statistical sense; if yes, then this is also inaccurate, since the explained variance in linear relationships is given by the square of the correlation coefficient, r; thus, even a value of r as high as 0.80 corresponds to a fraction of explained variance equal to 0.64 (see also general comment 4); it is suggested to reword the sentence so as to avoid using the expression “explained considerable amount of variation ...”.

Page 10, line 11: It is suggested to replace “to some extent” with more detailed information.

TECHNICAL CORRECTIONS

Page 1, line 21: Please change “contribute” to read “contributes”.

Page 2, line 25: Please change “facilitates” to read “facilitate”.

Page 3, line 20: The words “Table 1 and Figure 1a - d” should normally be placed in parentheses.

Page 6, line 20: I presume that in the phrase “formation due a fluctuating water table”, “a” should be “to”.

Page 7, line 12: Please add “s” to read “but further suggests”.

Page 7, line 14: Please add “s” to read “and indicates”.

REFERENCES

Blöschl, G., 2006. Hydrologic synthesis: across processes, places and scales. Water Resources Research, 42, W03S02.

Nalbantis, I., Efstratiadis, A., Rozos, E., Kopsiafti, M., Koutsoyiannis, D., 2011. Holistic versus monomeric strategies for hydrological modelling of human-modified hydrosystems. Hydrol. Earth Syst. Sci., 15, 743-758, doi:10.5194/hess-15-743-2011.

Sivapalan, M., 2005. Pattern, process and function: elements of a unified theory of hydrology at the catchment scale. In: M.G. Anderson, ed. Encyclopedia of hydrological sciences. Chichester: Wiley, 193–219.

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