Review Ali and Roy: A case study on the use of appropriate surrogates for antecedent moisture conditions.

The authors describe a study where a soil moisture data set was used to assess the appropriateness of surrogate antecedent moisture indices. This soil moisture data set has a relatively high spatial extent of 121 locations on a 15 by 15 m grid covering a catchment of 5 ha. At each location measurements were taken in 4 depths at 16 occasions. The antecedent moisture indices focus on meteorological indices such as the antecedent precipitation index for various time spans and the days-since-precipitation index. These indices were correlated with the point measurements of soil moisture, resulting in maps of degrees of correlation as well as maps of the correlation model types which produced the best fit (i.e. linear, quadratic, cubed, etc). In a next step the potential influence of topographical characteristics was analyzed by using by further correlation tests.

The authors found that the standard surrogates, the API for 7 or 10 days did not satisfactorily describe catchment soil moisture state. Furthermore the relationships between data and surrogates were found to be spatially heterogeneous (not very surprising given the known strong variability of soil moisture and soil physical characteristics), possibly indicating active or contributing areas and spatially variable threshold processes.

Overall I am most impressed by the soil moisture data set and the question of the appropriateness of surrogates for antecedent moisture conditions is an important one; however, the analysis of "best fit model types" remains vague and does not seem to offer a lot of additional information. In the discussion references are made to other publications of the same authors, two of which are in press and two of which are only listed as "submitted". These publications seem to contain data that would make the here described analysis more interesting and better founded. This could also be discussed as part of the introduction. However, there also seem to be some contradictions between these data sets and the here presented one, as mentioned by the authors. This should be discussed in more detail in the conclusions section.

p.3334 l.14 "Considering that both "active" and "contributing" areas are important in assessing a catchment initial state, do surrogate measures for AMCs reflect these dynamics? From a spatially-distributed point of view, the fact that all catchment areas are not "activated" at the same time may indicate that they are responsive to different hydro-meteorological factors. Similarly, the non-uniform contribution of source areas to streamflow may point towards different triggering hydro-meteorological factors." – It seems like a more straight forward hypothesis would be that the main factors controlling the activation of contributing areas are structure, topology and - as a result - connectivity, which is also a threshold process depending on antecedent conditions and event characteristics. What exactly are you referring to as "hydro-meteorological factors"? Please explain. You are also not looking at event response in this study – wouldn't it make sense to include the response in the analysis and look at what type of response is most likely connected with which antecedent conditions and then see if these conditions can or cannot be estimated by the proposed surrogate measures? Another possibility would be to classify catchment states in wet and dry and see for what conditions the surrogates are suited best.

p.3336, l. 20: how is the probe pushed into the soil? Manually? Does the soil have to be soft in order to do this? How problematic are stones and roots? Or are you using permanently installed access tubes? If not, how do you assure you are measuring the exact same spot on all 16 occasions?

p.3337, l. 15: is the mean soil moisture content calculated over all depths and sampling points?

p.3338, l.28: what does "tangible" mean in this case? Using only R^2 means that there is no "punishment" for the use of more complicated models. More complicated models however, are always likely to produce better R^2 values. Wouldn't it make sense to use the adjusted R^2 in this case?

p.3339, l.3: please explain the non-parametric Kruskal-Wallis test. Please also show some exemplary data and exemplary regressions.

p.3339, l.10: please also show some of the original soil moisture data – how different are the moisture contents for the different depths? Is there a clear pattern here? Is the main variability found from sampling time to sampling time, from location to location or from depth to depth?

p.3343, l. 12: "locations for which soil moisture is strongly related with AMCs can be labeled as source areas" – please explain why

when you are referring to AMCs here, do you mean surrogate measures for AMCs?

p.3343, l.17: " in order to substantiate this hypothesis" – which hypothesis are you referring to here?

p.3343, l.19: what do you mean by much of the catchment is "activated by short-term AMCs"? Please rephrase.

p.3343-p.3344: two main hypotheses are listed here:

1. linear relationships with AP1, AP2, AP5 at depths of 5 and 15 cm and non-linear relationships at greater depths are explained by the fact " that the soil storage capacity is a function of the amount and timing of precipitation in addition to evapotranspiration, hence the nonlinear relationships." How do you explain the linear relationships at 5 and 15 cm?

2. "Locations for which soil moisture is strongly related with catchment discharge can be considered as contributing areas." However, no statistically significant results were obtained that confirmed this hypothesis and the authors go on to say that "the obtained regression models may not necessarily reflect causal relationships".

In my opinion these statistical relationships might have the potential to help formulate hypotheses that then can be tested by additional data, data analysis or modeling but, as you say, they do not have to reflect causal relationships. However, keep in mind in your discussion that hypotheses can generally only be falsified. As to the hypotheses formulated as a result of this statistical analysis: maybe you could discuss how these hypotheses could be tested?

p.3345, first paragraph: did you check the relationship between mean soil moisture and the surrogate measures for AMCs? How do they compare? Is AP5 also the best surrogate measure in this case?

p.3345, l.18 and p.3346, l.1: you mention that your findings conflict with the findings of Kohler and Lindsey – do you have any suggestion why you obtained different results?

p.3346, l.6: the references to Ali et al. 2010 are unclear as there are 4 references this could refer to. Please clarify.

p.3346, l.8: what do you mean by broad and very large characteristic scale? This sentence is unclear. Please explain.

l.10: “the dynamics illustrated in Fig.5” – change dynamics to “patterns”.

l.14-18: what do you make of this contradiction?

p.3346, ll.3-18: the whole discussion of the influence of AP measures on different characteristic scales is slightly confusing as the type of analysis carried out in this study does not become clear. Also if the applicability of surrogate measures was already tested here, in what way does the here presented study give additional information? This could also be discussed in the introduction where reference to the prior studies should also be made.

p.3346, l.27: what do you mean by “scenarios”? event types?

p.3347, l.26: I would suggest changing “to understand the hydrologic behavior of a catchment” to "to describe the moisture conditions within a catchment”.

p.3348, l.6-8: “soil moisture was not related to cumulative rainfall amounts over antecedent temporal windows of 7 or 10 days” – this conclusion does not match with some of the findings of your other studies and you explain this by the type of relationship/regression model used – this should also be mentioned here or you should weaken the conclusion by limiting it to the types of regression models tested in the here presented study.

Figures:

Fig 1: the 15x15m grid cells do not match with the scale bar of 100 m – there should be about 7 pixels per 100m.

Fig.2: this figure is also presented in Ali et al. 2010 in WRR; however, I still think it is useful here.

What depth do the measurements presented here refer to?

Fig.4 and 5 – maybe the types of relationships would be easier to make out if the figures would be in color.

Fig. 7: please add the total number of points which make up each boxplot for the different relationships. I assume the data contained in the boxplots is the number of significant correlations found for each elevation and relationship type? Please clarify this in the figure caption.

Fig. 8: It seems like the plots showing the log of the contributing areas are not discussed in the text. You should either discuss the findings presented here or remove the plots.

Technical corrections

p.3341, l.16: correction – “…however, the higher the elevation, the higher the order of the relationship.”