Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2017-616-RC2, 2018

Hydrology and Earth System Sciences
Discussions
Open Access
EGU

Interactive comment on "Including Effects of Watershed Heterogeneity in the Curve Number Method Using Variable Initial Abstraction" *by* Vijay P. Santikari et al.

Anonymous Referee #2

Received and published: 23 January 2018

GENERAL COMMENTS

This manuscript aims at improving the SCS-CN method and the estimation of the corresponding parameters when rainfall runoff data are available. The proposed approach is based on the hypothesis posed by Soulis and Valiantzas (2012) that "the observed correlation between the calculated CN value and the rainfall depth in a watershed reflects the effect of the inevitable presence of soil-cover complex spatial variability along watersheds". Based on this hypothesis they present a novel and really interesting analysis of the effects of this heterogeneity on initial abstraction and on CN. It includes nice theoretical justifications, and good examples. In a nutshell, their analysis provides

Printer-friendly version

Discussion paper

another more general perspective extending the work of Soulis and Valiantzas (2012, 2013) by considering separately the spatial variability of Ia and CN, which are linked in the previous studies. Finally, based on their analysis they introduce two modifications of the SCS-CN method considering the spatial variability.

The topic of this study is certainly interesting and relevant to the journal of Hydrology and Earth System Science, because the SCS-CN is the most widely used runoff estimation method, while it is based on previous studies published at this journal. The study is very well written and really easy to understand. The language is excellent and the presentation also of good quality. The theoretical part is also interesting and well written and the interpretations and the methodology scientifically sound.

However, there are also some important weaknesses that should be addressed.

The first important weakness is related to the citation of an unpublished paper. The citation of studies that are not published yet and thus are not available to the readers isn't helpful. This is not a significant problem at the first instance (Page 2, Line 6), where there is a general reference on "ways to account for the temporal variation of CN, each with its own advantages and shortcomings (Santikari and Murdoch, 2018)". In this instance the citation on the unpublished work should be removed and some citations on studies dealing with this issue should be added. However, in the second instance (Page 23, Lines 14-15) an unpublished paper is used to support the validity of the proposed approach and the performance of the proposed modifications ["Application of these modified models to data from real watersheds is discussed by Santikari and Murdoch (2018)"]. Any information concerning real watersheds examples should be presented in this paper (the part related to the proposed approach). Otherwise the readers will not be able to have a clear picture about the validity and the performance of the proposed approach. Furthermore, there are practical problems in citing unpublished papers. Are you certain that the future paper will be accepted and that it is going to be published before the final publication of this paper?

A second weakness, is related to the use of solely synthetic data for the evaluation of the proposed approach and of the proposed modifications. (Page 23, Lines 12-14: "The reason for using a synthetic watershed here is that the heterogeneity can be precisely defined and used to evaluate the predictions of heterogeneity by the lumped parameter models. In real watersheds the heterogeneity has to be determined by calibration, and there can be non-uniqueness when multiple HRUs are present.") I agree that using a virtual watershed allows the study and the evaluation of specific aspects of your approach in a controlled and accurate environment. The virtual watershed and the synthetic data follow the logic of your base hypothesis and your theoretical analysis. However, this hypothesis and this analysis, even if they are rational, they are not self-evident. The reason for using also real watersheds examples is that only in this way you may show that your hypothesis is sound, that it is able to describe the behaviour of real watersheds, and that the method actually works. By using only virtual data generated based on your hypothesis (which, I agree, seems reasonable) you cannot support your hypothesis and validate your methodology.

A final weakness concerns the literature review, which is limited and incomplete. For example:

1. Page 1, Lines 26-28: "One of the most popular techniques used for this purpose is the Curve Number method, which has been in use for more than half a century (Soil Conservation Service, 1956)." You should add some citations supporting this statement.

2. Page 2, Lines 2-3: "CN also varies with the magnitude and spatiotemporal distribution of rainfall." You should add some citations supporting this statement.

3. Page 2, Lines 3-5: "When heterogeneity is known at sufficient detail, CN variation can be accounted by using a distributed parameter model. Otherwise this approach can introduce more parameters than can be reliably estimated from the available data, and cause large uncertainties 5 in the predicted runoff." You should add the citations

supporting this statement, for example Soulis and Valiantzas (2012, 2013) referred later in the manuscript.

4. Page 2, Lines 5-9: “CN variation with the distribution of rainfall is usually ignored.” and “CN method is most commonly applied as an event-scale lumped parameter model, which is simple but also limited in its ability to account for the variations of CN. This diminishes the accuracy of its runoff predictions.” You should add some citations supporting these two statements (E.g. Grove et al. (1998); Soulis and Valianzas, 2012).

5. Page 4, Lines 26: There more studies providing important information on this issue e.g. Hjelmfeld et al. (2001) and Soulis et al., (2009)

6. Page 7, Lines 10-17: the studies of Soulis and Valianzas, (2012, 2013) should be also mentioned at this point.

More important, you should consider previous studies dealing with the same issue with similar or different approaches. I have in mind for example two really important studies by Steenhuis et al., 1995 and its continuation by Tilahun et al., 2016 that investigate the variation of Ia using the concept of “Variable source runoff areas” and propose a very attractive approach to consider it in the SCS-CN method. You should discuss these studies.

You should also state more clearly that the proposed approach is based on the hypothesis posed by Soulis and Valiantzas (2012) that “the observed correlation between the calculated CN value and the rainfall depth in a watershed reflects the effect of the inevitable presence of soil-cover complex spatial variability along watersheds”. You should also make it clear and add a citation to Soulis and Valiantzas (2012, 2013) in Page 15, Lines 9-10: “Therefore, it is probably more appropriate to refer to any “CN decreasing with P” trend as standard behavior, because it is caused by the inevitable presence of heterogeneity in a watershed.”

Finally, you should discuss your results in comparison with other approaches/methods especially at the final section “6.2. Model Suitability”. You should also mention other limitations such as the compatibility of the resulted CN values with standard method. For example, CN values with different λ values are not compatible.

SPECIFIC COMMENTS

-Page 5, Line 28: You should mention what is presented in the figure.

-Figure 2, legend: “(see Santikari and Murdoch (2018) for study area description)” You should avoid citing unpublished work (see previous comments). You should provide at least a short description of the case study.

-Page 7, Lines 23-24: How Ia values in Figure 2 were calculated?

-Please avoid using plural in parameters symbols. For example, in “Iais” I was initially confused if s was for plural or part of the symbol. You may use other explosion such as “Iai values”.

-Page 9, Lines 9-11: As it is explained in Soulis and Valiantzas (2012), the reason is the non-linear form of the SCS-CN formula. So, the average of the results is not equal with the result using average value of the parameters.

-Page 9, Line 13: “to be”

-Page 9, “2.2. Ia in a Heterogeneous Watershed”: It should be mentioned that the following justification is valid in the case that each subarea is directly connected with the drainage network. This is a logical assumption in most cases, especially when there is a dense drainage network, however, it is still an assumption.

-Page 34, Lines 9-14: You could use additional evaluation criteria e.g. the relative NSE (rNSE) and the NSE with logarithmic values (lnNSE) to reduce the problem of the NSE sensitivity to extreme values (see Krause et al., 2005).

-“Model Suitability” section: It would be interesting if you could at least discuss (if it

is not possible to compare) with the Soulis and Valiantzas 2012 and 2013 methods, which provided the base for this study.

Conclusively, based on the above comments, I believe that this paper is really interesting and worth being published in case that the authors are able to address the above issues.

REFERENCES

Grove, M., Harbor, J., and Engel, B.: Composite vs. Distributed curve numbers: Effects on estimates of storm runoff depths, J. Am. Water Resour. As., 34, 1015–1023, 1998.

Hjelmfelt Jr., A. T., Woodward, D. A., Conaway, G., Plummer, A., Quan, Q. D., Van Mullen, J., Hawkins, R. H., and Rietz, D.: Curve numbers, recent developments, in: Proc. of the 29th Congress of the Int. As. for Hydraul. Res., Beijing, China (CD ROM), 17–21 September, 2001.

Krause, P., Boyle, D.P., Base, F., 2005. Comparison of different efficiency criteria for hydrological model assessment. Adv. Geosci. 5, 89–97.

Soulis, K. X., Valiantzas, J. D., Dercas, N., and Londra P. A.: Analysis of the runoff generation mechanism for the investigation of the SCS-CN method applicability to a partial area experimental watershed, Hydrol. Earth Syst. Sc. 13, 605–615, doi:10.5194/hess-13-605-2009, 2009.

Soulis K.X. and Valiantzas J.D. 2012. SCS-CN parameter determination using rainfall-runoff data in heterogeneous watersheds - the two-CN system approach. Hydrol. Earth Syst. Sci. 16:1001-1015. doi: 10.5194/hess-16-1001-2012.

Soulis K.X. and Valiantzas J.D. 2013. Identification of the SCS-CN parameter spatial distribution using rainfall-runoff data in heterogeneous watersheds. Water Resour. Manage. 27:1737-1749. doi: 10.1007/s11269-012-0082-5.

Steenhuis, T.S., Winchell, M., Rossing, J., Zollweg, J.A., and Walter, M.F. (1995). SCS

runoff equation revisited for variable-source runoff areas, J. Irrig. Drain. Eng. ASCE, 121, 234–238,.

Tilahun, S.A., Ayana, E.K., Guzman, C.D., Dagnew, D.C., Zegeye, A.D., Tebebu, T.Y., Steenhuis, T.S. (2016). Revisiting storm runoff processes in the upper Blue Nile basin: The Debre Mawi watershed. Catena, 143, 47-56. doi:10.1016/j.catena.2016.03.029

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2017-616, 2017.

Printer-friendly version

Discussion paper