Hydrology and Earth System Sciences Discussions

Interactive comment on "Effect of GPR-derived within-field soil moisture variability on the runoff response using a distributed hydrologic model" *by* J. Minet et al.

Anonymous Referee #1

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General Comments:

This work presents an established proximal GPR methodology to determine the soil moisture distribution across five fields, creates seven different soil moisture patterns (called scenarios, including the measured one) classified as deterministic or stochastic, and subjects the fields and associated scenarios to a rainfall event typical for Belgium. The response to the rainfall event is simulated with a distributed hydrological model. No validation data for soil moisture or catchment discharge are included in this work.

The paper is well-organized, with clear tables and figures.

This work is similar to the work cited by Marz and Plate (1997), Merz and Bardossy (1998) and Bronstert and Bardossy (1999). The work presented by previous authors was more informed by observed data and details about the catchments in question than this study, but this study advances the works cited by having high-resolution soil moisture data and by having 10 field acquisitions, at different average moisture conditions. With these two additions, this work does not provide a radically new contribution, but confirms the findings of previous works.

While the use of GPR is a novel approach to collecting many points in the field, this methodology in itself is not a novel contribution to this work. For example, a field campaign using TDR, while more time consuming, would also have provided the same true map of soil moisture. The title of this study may be a bit misleading to imply that the GPR technique is somehow necessary for better determination of soil moisture fields.

This work can be better informed with information about topography, the soil types and associated soil physical parameters, and antecedent precipitation. Knowing the porosity, field capacity and wilting point vol. moisture contents would help interpret the GPR soil moisture data. Knowing the topography would help understand the likelihood of existing contributing areas, and thus inform the reader about the likelihood that the TWI (or any of the stochastic patterns) is a good distribution for the right reason. Typically, the TWI works when soil moisture redistribution occurs in the subsurface. Do these soils allow for such redistribution? Also, the GPR moisture readings are only for near surface soil moisture content (the reader should be told how deep and at what accuracy), so how do these represent the soil moisture at greater depth?

Detailed comments:

I like the use of threshold moisture contents that trigger runoff generation. Authors should provide an approximate value for this threshold moisture content (by field), based on simulated results. The importance of the threshold moisture content should be emphasized in the abstract of the paper.

Please consider rewording two statements on Page 8958: 1) "fine-scale statistical properties of soil moisture can be found in the literature" – this seems very optimistic; and 2) "even without high- resolution soil moisture data, similar scenarios of high-resolution soil moisture maps as in this paper could be constructed using solely a mean soil moisture, topography data and adequate soil moisture statistical relationships" – this likely is not true for areas especially where the TWI is not a correct predictor.

The correlation between soil moisture and TWI was pretty small (Table 2). The justification for using TWI despite this low correlation is addressed in section 3.2.1, but the speculation as to the applicability of the TWI is still a little weak to justify its use in this study. Line 20 in the abstract is therefore not based on the actual data, but on speculation. As noted above, if subsurface redistribution is a factor, it would be another strengthening argument for its use.

Specific (editorial) comments:

Page 8948, line 5: remove 'the' before 'runoff'

The idea of the 'best scenario' is confusing in introduction.

Page 8949, lines 1-3: This statement requires a citation.

Page 8949, lines 4-24: replace larger/largest discharge with greater/greatest discharge. As I interpret discharge as an instantaneous volume/time, do you mean peak discharge or overall discharge and thus refer to an elevated hydrograph?

Page 8949, line 25: remove 'on'; remove 'moreover'

Page 8950, line 12: remove 'moreover'

Page 8950, line 17: replace 'In a near future' with 'In the near future' or with 'In the future'

Page 8950, line 18: replace 'largely' with 'greatly'

Page 8950, line 22/23: replace 'potentialities' with 'potential'; remove 'the' before 'soil moisture'; remove 'a' before 'high resolution'

Page 8950, line 29: remove 'a' before 'particular interest'

Page 8951, line 2/3: why use a new term 'soil moisture organisation' and 'soil moisture scenario' here, while above you only refer to soil moisture variability or soil moisture pattern?

Page 8951, line 18: remove 'moreover'

Page 8954, line 2: replace 'has' with 'was'

Page 8955, line 17/18: remove 'the' before 'hydrologic modelling'; write out 7 as 'seven'

Page 8955, line 24: 'permuted' must be 'purmutated'?

Page 8956, line 2/3: remove 'The' and start sentence with 'Scenarios'; remove 'the' before 'scenarios'

Page 8956, line 4: replace 'performed' with 'created'?

Page 8956, line 14/15: replace 'maximal' with 'maximum'; add 'having an' as in 'that avoids having an empty pixel'

Page 8956, line 25: same resolution as . . .?

Page 8958, line 8/9: place 'moreover' at the beginning of the sentence as: 'Moreover, the true. . .'

Page 8961, line 13: replace 'has' with 'have'

Page 8967, line 1: replace 'in average' with 'on average'