

Interactive comment on “Potential and limitations of using soil mapping information to understand landscape hydrology”

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Reaction to the Interactive comment by J. Bouma on: “Potential and limitations of using soil mapping information to understand landscape hydrology” by F. Terribile et al., hessd-8-4927-2011.

We thank Johan Bouma for his thoughts concerning our research group and mainly for his comments that will be helpful in revising our paper. Our reply is structured as follows, we report all referee’s comments (indicated by R.) together with our reply in italic (denoted by A.).

- R. This is a valuable paper for at least three reasons:
The authors are correct that a thorough description of soil survey procedures is not easily available for hydrologists who are interested to explore the potential of using soil survey data for characterizing hydrological catchment behavior. By not only describing traditional procedures but also recent developments in terms of digital mapping and pedometrics, they provide a useful, be it somewhat wordy, account. The authors demonstrate in four case studies that soil maps and the associated soil databases can be used for modern quantitative hydrological characterization by linking soil data with hydrological parameters through the use of pedotransfer functions. This has been done before in literature, but the link has most often been made with abstract databases rather than with soil maps being linked to landscape characteristics. Besides, the authors clearly demonstrate that blind, mechanistic application of soil data leads to poor results and that additional field- work to fine-tune such applications is necessary.
The authors demonstrate convincingly that more complex models don’t necessarily produce better data and that consideration of costs versus benefits is (or better: should be) a crucial element in choosing methodologies. The Manna et al (2009) paper is a landmark paper in this regard. In general, this reviewer is of the opinion that Italian research groups are the leaders in field-tested hydrology.
- A. *Nothing to add or reply.*
- R. There are, however, several comments to be made. In general, the paper is long, rather wordy and occasionally rather repetitive. It has more the appearance of a chapter in a book rather than a paper in a scientific journal. A professional editor could perhaps assist in providing a briefer and sharper focus.
- A. *We will follow the suggestions to better focus the main goals of the paper. We have already identified where the paper can be shortened, avoiding repetitions.*
- R. Furthermore:
1. P.4930. The statement that “the question as to how data from soil databases could be useful for hydrologists has yet to be addressed” is not correct. Think of all discussions on pdf’s and on functional characterization of soils.
- A. *We fully agree with you and we will review the sentence. “Yet to be addressed by hydrologists” was an unfortunate (wrong) sentence. What we meant was the need to better explain and make easily understandable and available the large amount of information and data enclosed in standard soil databases. We aimed to emphasise the idea that despite the very nice available conceptualization, it is still rather unknown, to the scientific community of hydrologist, “how soil data from standard soil mapping databases (often the only soil data available) can be usefully employed”.*

- R. 2. P4938 and following. The statement is made that soil surveys have focused mainly on agriculture and that therefore data would not be useable for hydrology. I would question this statement. Think e.g. of the drainage classes in soil survey, of aquic suborders in soil classification and of the pdf's that are particularly useful for hydrology. Mottles by their morphology can indicate periodic surface stagnation of water (pseudogley) or permanent stagnation (stagnogley) that strongly affects hydrology. Locations of iron precipitates in relation to manganese precipitates can indicate the direction of water movement into or out of the soil matrix etc. As the authors indicate, a problem occurs when features are relict but this can usually be determined. Overall, this reviewer believes that soil survey has even more to offer than the contributions suggested by the authors and this aspect may need more emphasis.
- A. *The main idea underlying all the manuscript was "how to increase the contribute of pedology and hydropedology to hydrology scientific community" (e.g. chapter 3: Soil mapping: a hydrological view of the final results). So, the idea that because the soil surveys have focused mainly on agriculture themes the available data would not be useable for hydrology is very far from our thinking. Specifically, we agree that "soil survey has even more to offer than the contributions suggested". But we also believe that much care has to be taken when data from soil survey are employed without knowing potential/limitation behind each of these type of data. Probably, we gave a wrong idea of our thinking. To overcome this misunderstanding we will expand this session and then making clearer problems/potentialities on some key parameters such as those quoted (aquic SMR, Fe-Mn precipitates, etc.). Moreover the title of the chapter 4 will be changed in: Soil mapping and environmental hydrology: interaction yet to be completed.*
- R. 3. Case study 1 is good but the authors should better explain what they mean by "predictive ability" and by "performance indexes". The Manna et al paper is complex and the authors should make another effort to focus on the highlights in this paper in terms of its main results. To really understand what the Manna et al paper is all about the reader needs now to go to the paper itself. This is unfortunate. When talking about costs/benefits the main emphasis is on methods versus performance, which is usually crop/yield. This reviewer would like to learn more about what the users of the land would like to know. Possible yields? Or – more likely- improved management through, perhaps, precision agriculture? Here, pedological expertise can make significant contributions (e.g. Bouma et al 2008: Advances in Agronomy 97:175-237).
- A. *The Manna methodological paper is indeed focused on a specific crop and of course farmers are also interested in other domains including nitrate leaching (Nitrate Directive), conservative agriculture (lowering farming costs), precision agriculture. But we had no specific dataset to evaluate these other domains. Then we will enlarge this specific section of our paper making better reference to scientific literature*
- R. This is a general comment: the focus is rather inward looking into the scientific discours. That's OK for now, perhaps,, but ultimately users will have to conclude that hydropedology really helps them to reach their goals. Some reference to the users of soil information and their wishes would be usefull.
- A. *As above*
- R. 4. Case study 2 is interesting in its development of the d800 index. Here, and in all the other cases, the "representative" profile of mapping units is the (empirical) basis for hydrological characterization. This represents a choice on the basis of expert knowledge and hardly offers a possibility to express internal variability within a mapping unit. Additional field observations have been reported for several of the

case studies adding to the cost but improving results in terms of a better characterization of internal variability of mapping units. However, no specifics are provided on sampling schemes followed: was there a statistically defined sampling scheme using geostatistics? Substantial work has been done to statistically define internal variabilities of mapping units. The authors should acknowledge this type of research (see examples in, for example, Bouma et al, 2008 as cited above).

- A. *In this point the reviewer posed the critical issue of the soil map unit (SMU) – internal variability, that is largely discussed in many scientific papers. Despite this issue is very complex, we agree that in the light of the example n.2 the variability issues should be (briefly) expanded. Specifically, we will (i) add information on the sampling scheme used (random sampling) generalizing the discussion on the alternatives (i.e., linear geostatistic, annealing simulations, etc) and (ii) valorize the applied PTF SMU-specific in the light of spatial variability issue. Concerning the latter, the soil hydraulic properties internal variability is difficult to characterize for the high time/cost associated to the measurement of water retention and hydraulic conductivity curves. The widely applied regressive pedotransfer functions, despite their undoubted utility, smooth the true hydraulic properties variability to the only texture variability. Indeed, our SMU-specific pedo transfer function has some advantages on the classical application of PTF: it has a strong physical bases, the empirism of the PTF is enclosed in the calibration procedure that produce a PTF strongly related to the soil characteristic, therefore, the calibrated relationship include a sort of “signature” of the soil structure. The given soil-specific relationships are capable to transform the texture in structural information (i.e., water retention function) and, definitively, it strongly reduces the smoothing effect of the regressive PTF.*
- R. In case study 3 an interesting aspect of using soil information was mentioned by demonstrating the occurrence of allophane with non-typical clay behavior. Examples like that are effective in showing the additional value of pedological input.
- A. *Nothing to add.*
- R. 5. In their conclusions the authors emphasize that the alluvial soils in case 1 were homogeneous, had 1D flow, no clear macropores, no hydrophobicity, no irregular rooting patterns and no slowly permeable soil horizons. So, conclusions reached do not apply universally because many soils in the field do have such heterogeneous properties and pedological descriptions of soils can be quite helpful in identifying such features and in formulating ways in which their effects can be expressed hydrologically. This, in fact, may represent the major contribution of pedology to hydrology! The authors may want to add a comment tot his effect indicating that their well-supported positive conclusions about using hydrology to improve hydrological studies has an even wider scope than is indicated in their paper.
- A. *We shall follow the suggestions*
- R. 6. An overall concern of this reviewer, also expressed by the authors of this paper, is the fact that soil databases can be used by anyone to mechanically derive hydrological characteristics using pdf's. Who needs soil scientists anymore? Next, models are fed with data obtained and results are not necessarily in agreement with real field conditions. In fact, results maybe wrong and misleading. The authors recommend additional fieldwork to fine-tune methods for data collection requiring and this important conclusion may need some additional emphasis.
- A. *We shall follow the suggestions*
- R. When the authors pay attention to comments made, this paper can make an important contribution to hydrology serving hydrology.

A. *We hope so.*