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Hydrology and Earth System Sciences Discussions

Interactive comment on "Hydropedological insights when considering catchment classification" *by* J. Bouma et al.

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In this paper the authors advocate an extended use of pedological information for modeling water dynamics and transport at the scale of catchments as has been proposed in the field of hydropedology. The paper does not provide new research and it cannot be considered as a review paper. It is a stimulation of discussion at the interface between hydrology and pedology. Being active in the field of hydropedology, I definitely agree with the main conclusions of Johan Bouma et al.. I think it is beyond controversy that a substantial part of uncertainty in predicting catchment response to atmospheric boundary conditions is actually due to the heterogeneity of the unsaturated zone.

While calibrated models are often in the position to reproduce observed hydropgraphs

quite satisfactory, this is typically not the case when solute transport is considered (i.e. travel time distributions). This indicates that the good match of hydrographs is rather a matter of calibration than of understanding what actually is going on. With respect to the aspired predictive power of our models this situation is definitely not satisfactory

Once perceived that the heterogeneity of the subsurface is one of the most critical hurdles it seems to be obvious that providing independent information on structural properties of the unsaturated zone is a promising avenue to follow and pedological knowledge can help a lot. However, the classical approach of pedotransfer functions to translate local material properties into some relevant model parameters might not be sufficient. Extrapolation of local data into spatially continuous parameter fields is a crucial step, required for typical problems at catchment scale.

Considering the first example presented in the manuscript, the estimation of water capacity and rootable depth to inform a SWAT model might be appropriate to derive evapotranspiration at the level of catchments. This is because the related upscaling problem is mainly additive. Regarding water and matter fluxes at catchment level the problem is much more challenging since potential flow pathways are typically highly anisotropic and the onset of fast (lateral) fluxes is a highly non-linear threshold like process. In this case the spatial pattern of hydraulic conductivity including the highly anisotropic flow paths are of critical importance and such properties cannot be inferred from classified HRUs.

Similarly in the second example, vertical bypass flow at the scale of soil profiles is derived from vegetation, soil texture and topography followed by an upscaling presumably done as well in an additive way. However, at catchment scale this type of preferential flow might be much less relevant compared to the fast lateral flux components be they above the soil surface or somewhat below. Hence, also in this case, the identification of lateral flow paths together with critical thresholds for their activity would be required but it is not clear how to infer such information from pedological knowledge.

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Example 3 adds a valuable supplement to pedological explorations which is remote sensing. In this way, spatially continuous information can be obtained which might be extremely helpful to better extrapolate point like soil information and to also capture anisotropic structures. The ultimate goal and the formidable challenge is to obtain continuous parameter fields to feed our diverse models so that they can be applied in a more predictive mode.

Beside the above comments which might be considered in the discussion, I have two more points which I think should be considered in a revised version of the manuscript:

- The authors do not claim to provide a comprehensive review on quantitative pedology, they concentrate on work which has mainly been done in the Netherlands. Nevertheless, I think a substantial part of international literature published in the framework of pedometrics and digital soil mapping is actually missing and should be mentioned in a revised paper.

- I am quite a bit reluctant to use the terms "hydropedological data", "hydropedological properties" and "hydropedological processes". Do we actually need such terms? Is it clear what is meant? I am afraid that the idea of hydropedology could be diluted by using such loose terms open for individual interpretation. Recently, I read these term quite often and typically it is not at all clear to me what is meant. I suppose the properties in mind have been called 'soil hydraulic properties' or 'soil hydromorphic features' before, and the related processes are known as preferential flow, inter flow surface runoff. The latter terms are well defined and we should continue to use them since we know then what we are talking about. From my point of view hydropedology is a new promising concept to explore soils as complex systems where water dynamics and soil development are closely linked and were various exploration techniques are combined in a fruitful manner. There is something like a hydropedological approach to our research questions but I see nothing like emergent hydropedological properties or processes.

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