

Interactive comment on “Assessing the perturbations of the hydrogeological regime in sloping fens through roads” by Fabien Cochand et al.

Anonymous Referee #3

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This paper deals with a quite specific topic. The authors studied sloping fens and how their hydraulic processes/regimes are affected by roads. Referring to numerous studies, they nicely pointed out the importance of that topic. Despite a couple of typos, the majority of the manuscript is well written. However, I had the impression that the quality decreased a bit towards the end. At the beginning, the paper looked quite promising to me. After reading the entire manuscript, I was a bit disappointed as I expected a bit more. The field work and the modelling are totally decoupled. You somehow argue that a quantitative comparison is difficult due to preferential flow path, but couldn't it be realized by mapping and incorporating subsurface heterogeneities? A quantitative combination of your tracer tests and modelling, e.g. using results from

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the tracer test for model calibration, would add some salt to the soup. With it you could prove the reliability of your model and subsequently you could run different adaptations (slopes etc.). Moreover, conclusions from the tracer test as well as model results are quite trivial (L-drains cause high flow velocities at their outlet and the higher the slope the stronger the effect). Actually, you don't need a model for such a conclusion. You raise a couple of interesting points, e.g. gully erosion and drying up of fens. Resulting questions are: What is the velocity threshold for gully erosion? How large is the area and to which extent fens downslope of the road are drying up in case of L-drains? Why don't you extend your story a bit towards these questions? From my point of view, the present manuscript lacks a bit of novelty and creativity. In order to meet the requirements for a journal like HESS, the story needs to be extended, e.g. regarding the above-mentioned ideas.

Below, you find a couple of minor comments:

General: Sometimes you are using spaces between numbers and operators and sometimes not. Please, check the guidelines of the journal.

Line 59: Capital “V” for Von Sengbusch. It's the start of a new sentence.

Figure 1: The cross-sectional view suggests that the water could easily pass underneath the road. However, in the text you mentioned that the top soil is very thin so that the road blocks the water flow to a large extent (also indicated by the lower figure). Isn't the figure a bit misleading? I would just increase a bit the size of the road and additionally sketch the impermeable bedrock.

Line 126: “similar” or “comparable” instead of “same” would be a more suitable word in this regard.

Line 131: I would add “bed” to “road bed structures”.

Line 156: I wouldn't use the term “indirectly indicates”. I would write something like “clearly shows”. At least, I would skip “indirectly”.

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Line 157: Here, it is the other way around. Instead of writing “this indicates that there is no connection”, I would be more careful by writing “this indicates a strongly hampered hydraulic connection”.

Line 158: I would delete “and finally a decrease in EC is not expected”. (It is just too obvious.)

Figure 3: For me, the cross sectional view is a bit superficial, but I guess this is a matter of taste. . . Still, the spaces before the question marks should be deleted. Moreover, I would just write “Piezometer” instead of “Mini-piezometer”.

Line 163: What does “variable saturated” means? Sometimes saturated, sometimes unsaturated or variable hydraulic parameters? This should be explained more specific. (I guess it is a terminology from HGS.)

Line 166: I would replace “produce a sensitivity analysis and explore their sensitivities in” just by “analyse their impact on”. Calling it sensitivity analysis is not really wrong, but for my taste not well fitting.

Section 2.2.1: I would strongly shorten this section, as it is not really a part of your story. If somebody is interested in the mathematics behind your model, he/she would read the original publication of HGS. I would write a couple of lines mentioning the basic assumptions and methods, but no equations. In case you really want to keep them, I have some minor suggestions:

(i) You should give the equations in the same order as referred to in the text, i.e. 1st Richard, 2nd Saint Venant, 3rd Darcy. Or just mention the diffusion a bit later in your text; (ii) Eq 1 and Eq 2 are modified versions of the Richards and Darcy. This should be mentioned. (iii) Line 176: No need to explain “Nabla”. It’s the common notation; (iv) Line 178: Commonly, “Uppercase Theta” is used for water content and not for porosity; (v) Line 180: I would add “saturated”. K is the “saturated” hydraulic conductivity. . . (Multiplying with k_r results in the actual hydraulic conductivity.)

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Line 207f: “was used on the right face” – left and right are just a matter orientation. Maybe you better write something like: The lowest cells of the slope constitute a constant head boundary condition.

Line 218: Missing space between “2” and “m”.

Line 234: Generally, I prefer the use of SI units, i.e. m/s instead of m/d.

Line 256f: What do you mean by “length scale of one to several meters”. Is this a common expression?

Line 257: “629uS/am” – What is this? I guess 629 $\mu\text{S}/\text{cm}$. . .

Line 279: “local drying up of the soil”) – If you consider this as a problem, it would be quite easy to further investigate it with your numerical model. This would allow answering the question: how large is the affected area and to which extent it dries out?

Figure 7: In column 2 and 3 you are showing EC values. I am wondering why you are using totally different graphical representations. Moreover, if you are interpolating (I am not a big fan of interpolation, if it is not really necessary. . .), you should state which method you are using. What kind of background map you are using? Does it tell us something?

Line 288-292: For me, these lines are superficial. I would just delete them.

Line 293-301: This is very trivial and doesn’t need any explanation. It can be directly derived from the Darcy equation (at least for the base case model).

Line 316f: Are you sure that “may be” is the right expression here?

Figure 8-10: It is not very comfortable to analyse the differences between the different slopes. Can’t you just put all figures together using a slope specific colour?

Line 451: Is the year 2005 correct? I guess you want to refer to the manual, or? The one, I found, is from 2010.

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