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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Hydraulic Shortcuts Increase the Connectivity of Arable Land Areas to Surface Waters" *by* Urs Schönenberger and Christian Stamm

Anonymous Referee #1

Received and published: 1 November 2020

The manuscript presents a simple and interesting model application that demonstrates the importance of hydraulic short-cuts in connecting runoff from agricultural land to water courses in Switzerland. I found the manuscript well-written, and the results and figures nicely displayed. The level of documentation and attention to detail, particularly in the supplementary material, are impressive. The field data are even more impressive.

Overall I believe the manuscript can be divided into two parts. In the first section, the authors map the location of every potential drainage shortcut in 20 small Swiss catchments. This information is then used to model the direct and indirect runoff connectivity

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of agricultural plots to water courses. In the second part, these results are extrapolated to the whole of Switzerland.

While I have only minor questions and comments about the first part of the manuscript, I have some criticism about second. As I explain in detail in the comments below, I do not agree with the methods used for extrapolating the catchment-based connectivity model to the national scale. In my opinion, the data from the 20 catchments already substantiates the point the authors are trying to make. In the end, I had the impression that the up-scaling only makes the paper lose traction and does not seem to be scientifically interesting.

In any case, I am looking forward to hear what the authors have to say about this issue and eventually to see this published.

Specific comments & technical corrections

L42: Please consider rephrasing to: “relevant process have to be understood”.

L116-117: I am curious to why shortcuts that drain into surface waters or treatment plants are treated same by the model. If you are looking at pollutant transport, shouldn’t there be a difference?

L182: Please consider rephrasing to: “In order to better understand. . .”

Figure 2: Please define WWTP/CSO in the legend.

L236: What are internal sinks?

L258: Regarding the connectivity model. . .Maybe I missed something, but how do you go from the upslope dependence output raster to defining if a cell is directly or indirectly connected?

L265: How was this “carving” performed? Did you use a stream burning algorithm?

L274-275 & Table 2: The 2m limit for the maximal flow distance seems unrealistically

low. Is there a reason why you chose this value?

L303: I think a reference to Beven and Kirkby (1979) should be given where you explain the TWI, not Tarboton 1997.

L329: What model output data did you use for the regression? The median of the MC simulations per catchment? Results from all simulations?

Here I must say that I found using the NECM as an explanatory variable somewhat strange. If I understand this right, you are fitting a linear model to predict the outcomes of your model (LSCM), based on the results of another model (NECM). But if the latter is such a good predictor of runoff connectivity, couldn't you just recommend using it at national scale? At least until you have enough data to parameterize the LSCM for all of Switzerland?

L355: Is meadow the correct term here?

L436-437: How?

L443: Here I had the impression you are changing the language with which you describe negative ("While certain areas change their classification...") or positive ("for other parts results are very consistent)" results. Please consider rephrasing.

Anyway, I found these results quite interesting. Would it be a good idea to look at where the model is consistent and where it is not? I mean, considering model uncertainty, which fields are consistently identified as highly connected? Could these areas be regarded at higher risk of pollutant transport than others? Moreover, if you find out where the models are inconsistent, you can try to figure out why?

Figure 5: I didn't understand the colour-ramp bars in the figure legend. Are they necessary?

L547-551: If you propagate the uncertainty in your linear model (e.g. by simulating posteriors of the slope and the intercept and then bootstrapping model predictions), it

is likely that these differences will be within your error bands. I guess my question here is: is your extrapolated national model sufficiently different from the NECM to justify its usefulness?

L652: I am curious: which kind of sink filling algorithm would you recommend in this case?

L693-697: Here you explain the improvements of the NSCM over the NECM regarding the representation of runoff connectivity, which was helpful. While I agree that the information on crop statistics might help your model, I do not see how the national map incorporates the advantages of the LSCM (i.e. all the impressive field data you collected). In the end I have the impression that this upscaling doesn't do justice to all the work you went through in the small catchments. Moreover, while you appropriately represent the uncertainty of the LSCM, this is somewhat neglected in the extrapolation to the national scale. Would you not expect grater errors in the NSCM than in the LSCM?

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