Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2020-391-RC2, 2020

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 #2

Received and published: 17 November 2020

The paper provides an approach to assess the presence of hydraulic shortcuts on arable land. As the authors admit, the high prevalence of hydraulic shortcuts caused by field and road drainage systems is somewhat specific for Switzerland. Nevertheless, the approaches presented may provide insightful inspiration for researchers with similar questions. The combination of topographic source area modelling and a connectivity model is to my knowledge new and well adapted to the specific conditions and data availability. The model conceptualizes many assumptions about recipient areas, shortcuts and land cover specific responses. Data acquisition and calculations are described in great detail. My major point of criticism concerns the complete lag of calibration / validation for realistic model predictions and parameter uncertainty. This fact is

briefly acknowledged in the discussion but should be explored in the 'further research' section. E.g. by suggestion of appropriate monitoring or deterministic modelling studies. In the same light, the upscaling to national level seems premature. The value of a national map of directly / indirectly connected areas remains unclear without knowing, whether elevated connected proportions correspond to higher or faster hydrological response and respectively increased pesticide wash-off. Given the longer than average extent of the draft, the authors may consider splitting the paper in two parts and adding a more comprehensive risk assessment for the national scale, that also includes pesticide application, hydrologic conditions (see specific comments, below). For the sake of conciseness, some of the definatory and data source specific considerations could have been documented in a separate technical report. References and supplementary material are appropriate and sufficient.

Specific comments:

(1) Lines 106 ff: Shortcut definition should be moved to section 2.2 Assessment of hydraulic shortcuts

(2) Lines 125 ff: The probability of selection was proportional to the total area of arable land. . . How was this represented in the random selection?

(3) Lines 156 ff: How did you prevent selection bias due to drainage plans? I.e. how did you rule out, that no available drainage plan did not correspond to no existing drainage system

(4) Line 243: Elaborate under which circumstances hedge infiltration may be active or inactive

(5) Line 271 ff: Conceptually, the parameter "maximal flow distance" should depend on soil properties and cultivation phase, was this considered?

(6) Line 283: It is unclear how "all possible flow distances were evaluated" with 100 model realizations

(7) Line 295: Suggested section title change to ‘hydrological boundary conditions’

(8) Line 312 ff: Although crop type and rain intensity probably don’t differ systematically within one catchment, they do impact runoff generation. Should this not be systematically evaluated e.g. across catchments?

(9) Line 384 ff / Tab. 3: why is the destination of such a large number of drainage structures unknown? The maps (Figs. 5, S 2.2.1) suggest line / network structure for most inlets, was the outlet of these unclear? How were unknown drainage locations treated in the connectedness classification?

(10) Lines 419 ff: In Lines 147 ff the field survey was described as “we walked along roads and paths and mapped all the potential shortcut structures.” How was mapping accuracy of inlets (5%) and manholes (25.5%) on fields and other areas validated? Lower accuracy esp. in fields with dense vegetation seems likely. How are false positives from mapping ruled out to be false negatives (overlooked structures) from the field survey? How are false negatives from the aerial images quantified altogether?

(11) Line 463: Are the 21 % in Müswangen and 97 % in Boncourt medians / means of the MC ensemble results?

(12) Lines 504 ff: Apart from distribution similarity, how do wetness index and slope affect connected area proportions? I.e. do catchments with higher “hydrological activity” exhibit higher connected proportions?

(13) Lines 515 ff: I suggest to quantify the deviation between NSCM and LSCM with RSME or another goodness of fit measure.

(14) In Fig 7 the mean fraction not connected of LSCM appears to be roughly 15% higher than of NSCM but the text states it is 3% larger (l. 545), why do text and figure differ?

(15) Lines 554 ff: I disagree, that “map corresponds to a risk map of pesticide transport via hydraulic shortcuts”. Although hydraulic shortcuts contribute to the risk, surface

runoff proportion and volume, pesticide application intensity and retention in treatment facilities contribute to this risk as well. This is acknowledged in the discussion of NSCM (Lines 700 ff). (See also general comment above)

(16) Line 599: phrase starting with “In Buchs,. . .” is unclear.

(17) Line 633 – 687 the parameter discussion is somewhat self-referential without calibration data: Road carving depth, sink depth, and shortcut definition should be evaluated / calibrated by observed events. Assumptions such as ‘higher DEM resolution is better’ or ‘manhole sinks should not be filled completely’ seem plausible but can’t be substantiated by the results of this research. The impact of hydrological activity parameters may not differ between directly and indirectly connected areas of the same catchment, but among catchments and should be evaluated accordingly.

(18) Line 733: Suggested extension: End of pipe measures at shortcut / pipe outlets (treatment, sedimentation, filtration)

(19) In my view, the 2nd research question (line 104) can’t be fully answered with the present approach. It should be rephrased and / or referred in the conclusions section.

(20) Line 1116: the table title is confusing. I assume directly connected local surface connectivity model fraction was correlated to directly connected national erosion connectivity model fraction and so on. . .

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