***Authors Response to Interactive comments on* "Shallow water table effects on water, sediment and pesticide transport in vegetative filter strips: Part B. model coupling, application, factor importance and uncertainty" by C. Lauvernet an*d* R. Muñoz-Carpena et al.**

RC2- S. Reichenberger (Referee)

Thank you very much for the careful review and edits to the initial submission. Below we address the main comments raised on the initial submission. Please note that we uploaded the revised manuscript as a supplement to RC1 response comments, with your suggested changes also there. [RC2-#: Reviewer 2 comment #; AR-#: Authors response to comment #).

RC2-1. I think this paper is of good quality and that it complements its companion paper (HESS-2017-405) well. However, I have a few comments (see below).

General comments: As already pointed out by Marnik Vanclooster in his comment, the Morris sensitivity screening and eFAST are not really complementary methods: Both methods produce indices with similar interpretation, as you state yourselves: "Interestingly, the Morris indices (μ, σ) have been found to provide a good approximation to the eFAST indices (STi, STi-Si) at a much lower computational cost (Saltelli et al. 2004, Campolongo et al. 2007) making it ideal for large and computationally expensive models." The main advantage of the Morris sensitivity screening is that is computationally much more efficient than eFAST, especially if one has a large number of input factors. Usually, Morris and a true variance-based method such as eFAST are used in sequence: First, a Morris sensitivity screening is performed to identify and eliminate non-sensitive input factors. In the second step, eFAST is run with a reduced set of input factors (i.e. without the ones identified with Morris as non-sensitive). This two-step approach makes sense because most modellers do not have the computational resources available for a "brute force" approach. If, however, after the Morris sensitivity screening one runs eFAST with the same number of input factors as before, the Morris sensitivity screening becomes obsolete. As a justification of using the same sets of input factors for both Morris and eFAST, you wrote "In this study, both methods were run with the full set of inputs as a check for the consistency of the GSA results." If you want to keep both sensitivity analyses in the paper, maybe you should expand this further. However, this would draw the focus from the new VFSMOD version with shallow water table. Maybe an in-depth comparison of Morris and eFAST results should be the subject of another paper?*

> AR-1. Yes, Morris is generally used as a screening step in large model evaluations. However, as explained in our comments to reviewer one, our rationale was other. Our rationale when including both GSA approaches was to ensure the robustness of the results. Admittedly, under common conditions, both types of analysis provide comparable results. However, methods have not been compared often in studies with complex environmental models where non-linearities can be high, although doing this allows for testing the robustness of the sensitivity indices (Pianosi et al. 2016). We should not ignore that initially Morris is a "qualitative" method since it is based on a sparse sampling (in our case with r=10 and k=18 (no WT) and 20 (with WT), N=r(k+1) =190 and 210 samples for each scenario) that could lead to inaccurate results when the model is highly non-linear or discontinuous in some region of the input factor space, compared to variance-decomposition methods like eFAST based on dense sampling (M=497, N=Mk=8946 and 9940). To increase the reliability of Morris, improved sampling techniques have been developed (e.g. Khare, Muñoz-Carpena et al., 2015) that intend to increase the robustness of the method and approximate more quantitative, comparable to those of variance methods results. This opens important opportunities for application to large models where only Morris might be feasible (e.g. see Srivastava, Graham, Muñoz-Carpena et al., 2014). In addition, we believe that the Morris plots provide an intuitive and clear way to assess the importance of the input factors and their interactions. On the other hand, the

dense variance-based sampling allows for a follow up quantitative uncertainty analysis. Thus, the inclusion of the two methods in this work and the results obtained further corroborates the Morris efficiency for complex models and confirms the sensitivity of the input factors of the model.

In spite of this rationale, we agree that the inclusion of both methods shifts the main focus away from the main objective of the paper related to analysis of WT effects in the coupled processes that occur in a vegetative filter strip. We now focus on the Morris in the revised manuscript and moved the eFAST figure to Supplementary Materials. For the interested reader, we leave a brief comment in the GSA results section (with reference to Supp. Mat.) on the robustness and insights that eFAST results lend to the work.

RC2-2. p. 5, l. 130: equation 4: deltaRO is defined as the "change of cumulative excess rainfall" within a given time step. Maybe this quantity would be easier understandable if referred to as "surface runoff volume within a given time step"? In general, I think that "surface runoff" would be easier to understand than "excess rainfall" (which is a sort of ambiguous term).

AR-2. Notice that in strict hydrological terms these are not exactly the same. "Excess rainfall" is a "point value" in the landscape, where "runoff" refers to the aggregation of the excess rainfall along the slope into surface overland flow. However, we changed it to "surface runoff" as suggested for clarity.

RC2-3. p. 5, l. 140: equation 8: As pointed out by Marnik Vanclooster in his comments on the companion paper (part A), the infiltration rate f cannot be a function of the vertical coordinate z.

AR-3. Fixed in this revision.

RC2-4. p. 6, l. 149: "phytosanitary products": This term is very French. In English one would say "crop protection products".

AR-4. Changed as suggested.

RC2-5. p. 6, l. 151: Please mention the soil type according to WRB or FAO, if available.

AR-5. Table 1 provides the widely used USDA Soil Taxonomy classification.

RC2-6. p. 6, l. 154: Feel free to mention that the Jaillière site is also the basis of the regulatory scenario FOCUSsw D5 (La Jaillière)

AR-6. Good point, thanks! We added this.

RC2-7. p. 6, l. 163: "on Morcille", "on Jaillière" It should be "at", not "on"

AR-7. Corrected.

RC2-8. p. 6, l. 1746: "complementary": In what sense are the two methods complementary? (cf. above)

AR-8. See response above on AR-1 and action taken.

RC2-9. p. 6, l. 177: "a variance-based method is computed": either "variance-based measures are computed" or "a variance-based method is run/applied"

AR-9. Changed to "a variance-based method is applied"

RC2-10. p. 6, l. 190 f.: You mention only three groups. Would a fourth group (low mu and high sigma) be mathematically possible? (cf. comment by Marnik Vanclooster)*

AR-10. Agreed, fixed.

RC2-11 p. 9, l. 245: "end-vertical boundary condition": you mean bottom boundary condition?

AR-11. It is an "end" as it only applies after t>tw. Added "bottom" the first time it appears to "end vertical bottom boundary condition, hereon referred to as vertical boundary condition"

RC2-12 p. 10, l. 279: "average soluble properties": better "average sorption properties". In practice, the distribution between water and soil or water and sediment is usually governed only by the adsorption parameters (Kf and nf for Freundlich adsorption, Kd for linear sorption) and not by water solubility, since concentrations in solution usually stay way below solubility limits.

AR-12. Agreed. Changed as suggested.

RC2-13 p. 10, l. 291: "sub-saturates": What do you mean by that?

AR-13. Changed to "saturates from the bottom"

RC2-14 p. 10, l. 294: "This is exacerbated with WT": There is something missing here before WT.

AR-14. Changed to "With WT, the infiltration is limited even further in these fine soils, where…"

RC2-15 p. 11, l. 326: What is a "formal" uncertainty analysis? Can you explain briefly how you did the uncertainty analysis (probably better in the methods section)?

AR-15. "Formal" means that the variance method provides a large number of results that lend themselves to the construction of output probability distribution curves and calculation of statistics of uncertainty like median, percentiles, 95CI (Fig. 8 and Table S3). We changed "formal" to "quantitative".

RC2-16 p. 11, l. 335: "Diflufenicanil" –> diflufenican

AR-16. Corrected

RC2-17 p. 11, l. 336: "Reduction . . . higher than the other two pesticides": There is something missing here. Maybe: "higher than for the other two pesticides" or "higher than reduction of the other two pesticides"

AR-17. "higher than reduction of the other two pesticides"

RC2-18 p. 13, l. 369: "rivers drainage networks": "river drainage networks"

AR-18. Changed as suggested.

RC2-19 p. 13, l. 375 ff.: Just for information: The GERDA software package which was developed for the German EPA (UBA) as a future regulatory tool for surface water does include VFSMOD simulations with a shallow water table where present. However, while the final report of the GERDA project has been published recently (https://www.umweltbundesamt.de/publikationen/bewertung- des-eintrags-von-pflanzenschutzmitteln-in), the GERDA tool itself is not publicly available yet.

AR-19. Good point, thanks! We added this.

RC2-20 p. 18, l. 542: "UIPAC": This reference seems to be wrong. First, it should be IUPAC. Second, the link http://sitem.herts.ac.uk/aeru/iupac/index.htm is just a mirror of the original PPDB homepage (http://sitem.herts.ac.uk/aeru/ppdb/en/index.htm), and both pages and the PPDB are maintained by AERU, University of Hertfordshire, UK

AR-20. Yes, corrected.

RC-21 Figure 7: The legend needs clarification. I presume that the grey bars denote Si, the black bars (STi – Si) and the sum of both bars STi?

AR-21. Yes, we corrected the caption to reflect this. Notice that this is now Fig. S1 in Supplementary Materials following Reviewers 1 and your comments.

RC-22 Figure 8: "Uncertainty analysis results": Some further explanations needed. It seems that these are probability density functions?

AR-16. This means that the variance method provides a large number of results that lend themselves to the construction of output probability distribution curves and calculation of statistics of uncertainty like median, percentiles, 95CI (Fig. 8 and Table S3). We changed the caption to "Probability density functions from the uncertainty analysis of eFAST simulations on output variables […]"

References

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