SOIL Discuss.,
https://doi.org/10.5194/soil-2020-22-RC1, 2020

Interactive comment on "Understanding the role of water and tillage erosion from $^{239+240}$Pu tracer measurements using inverse modelling" *by* Florian Wilken et al.

Anonymous Referee #1

Received and published: 7 May 2020

General comments:

I very much enjoyed reading this manuscript. It shows how soil erosion models can be used to understand relevant processes and to test hypotheses about a system – in this case, that soil redistribution in the studied catchment is primarily controlled by tillage erosion. The manuscript is well written in clear fashion and provides a strong contribution to the field. I have a few minor questions and comments, mostly on the modelling side.

Specific comments:

L 82: I don't think parameter space is the term you are looking for here. Consider

changing this to "parsimonious parameter set".

Equation 3: This formulation of WaTEM/SEDEM looks a little different to what I usually see (e.g. Tc = Ktc R K (LS-aSIR)). Is this correct?

Equation 5: Is ktil calculated by this equation? I thought it was being sampled from a pre-defined range during the inverse modelling.

Are the raster outputs from equations 3 and 5 summed? A flow-chart explaining the modelling might be helpful to guide the readers.

L246: Why qualitatively?

L247-253: Are these correlations calculated based on the best-fit model realization? Please inform this in the text.

L256-257: By looking at figure 6c I wouldn't say the predictions showed "hardly any sensitivity to erosion strength". The MEF ranges to -0.2 to 0.6, with higher values clearly associated to the positive deviations in water erosion from reference run. Of course, the effect of the tillage parameter is much more pronounced. Nevertheless, it would be a good idea to show univariate dotty plots of the sampled parameter space with their associated goodness-of-fit measure.

L260: I think it would be nice to look at the parameter space which produced acceptable model realizations (for instance, within the kriging variance or above a given MEF threshold), instead of focusing on the best-fit. That would make your approach more robust. There are multiple solutions to an inverse problem, and perhaps that should be more explicitly recognized. I mean, if you consider the error in the observed data (interpolated Pu map), there might acceptable model realizations produced with the contribution of the water erosion component. This also relates to the discussion in lines 307-310.

L309-310: Not sure I understand this. If none of the sampled parameter values produced adequate system representations, why would we need to assume the reference

parameterisation is the most appropriate?

Technical corrections:

L209: “Results” is repeated.

L307-308: “Inverse modelling” is repetitive at the end of the sentence.

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