Author comments (ACs)

The authors thank the reviewers for their constructive comments. The comments are shown in black font, and our responses are in regular blue font.

RC1: 'Comment on hess-2022-294', Anonymous Referee #1, 22 Oct 2022

In general, I found the paper to be well written and the study well-designed and carried out.

I found – however – some points to be limited that needs to be addressed. First, the research gap was not clarified and the presented hypothesis was already addressed in other studies (see comments below). Some additional explanation on why the approach observation/modeling was used, would help the readers to capture the study design and idea early on in the work. I also found that the modeling was no explained with the necessary detail and should be accompanied by an uncertainty assessment.

We respond in detail below.

Line 50 "the water balance"

The word "the" will be included

L60: what about porosity and soil particle surface area?

We will analyze the effect of porosity and soil particle surface area on weathering depth gradient.

The break from L62 to L64 is quite harsh.

We will include a transition sentence in the line 64 vegetation role on soil weathering.

L89 and 90: We already know that the hypothesis is true. It has been shown in numerous studies before. The paper would greatly benefit to make the research gap more clear and have the hypothesis and questions clearly linked to that. While the intro gives a good overview of what has been done, the research gap is only vaguely noted "Soil vegetation-water interactions are not fully understood". After that, the authors summarize things that are known, and not what is wrong in our current status quo. Points that are made e.g. in L116, should be in the introduction. This applies in general for section 2. Points that are made related to the research gap need to move into the intro.

We will sharpen this part and make the research gap clearer. While section 1 gives an overview of SoA and knowledge gaps in the field of soil ecohydrology and biogeochemical weathering, section 2 is more specific for the paramo ecosystem. We prefer to keep this structure, with section 2 focusing more on specificities of the paramo ecosystems

An explanation on the methodological choices would be helpful, which type of measurement supports which question and for what is the modelling needed?

We will add a sentence in the intro that relates the measurement and modelling to the research questions.

L123-125: not needed/relevant

We will delete the first sentence "The páramo ecosystem supplies drinking water to more than half a million inhabitants of Ecuador's capital, Quito (EPMAPS and FONAG, 2018)."

L215: what are the sensitive parameters? Do you enforce that the relation between ksat from one depth to the other is retained? What parameter ranges were used for the inverse simulation? Why? In general, 3.4. lacks the necessary details to reproduce or understand the simulation setup.

The details of the modelling are included in the Supplementary material 3. We will include details of sensitive parameters and the inverse simulation in the text.

Fig. 3. I guess the horizontal grey bars indicate the boundaries of a horizon. Yet, this needs to be explained in the captions and not left for guessing. CU-UR and TU-UP should also be explained in the caption or written out to make the figure stand-alone from the text.

We will include the explanation of the horizontal gray bars in the caption of Figure 3.

L309ff. Do the authors have any idea on the general variation of these soil properties beyond the two profiles? I am wondering if the difference is random or if this is really an effect/linked to the vegetation. I understand that the sampling is laborious, but I guess we all know sites where ksat does change by several orders of magnitude on very small spatial differences. Even though I agree that the A horizons of the sites seem to be quite different.

We observed the same distribution of soil properties in six other soil profiles described in Páez-Bimos et al., 2022, and in the larger study area that was surveyed for soil mapping by Erauw (2019). We will include a sentence indicating that the variation of soil properties is associated to vegetation types.

Páez-Bimos, S., Villacís, M., Morales, O., Calispa, M., Molina, A., Salgado, S., ... & Vanacker, V. (2022). Vegetation effects on soil pore structure and hydraulic properties in volcanic ash soils of the high Andes. Hydrological Processes, 36(9), e14678.

Erauw A. 2019. Soil horizon thickness as indicator of soil production and transport along slopes.Master thesis, Université catholique de Louvain, Louvain-la-Neuve, Belgium.

L327: What are the calibrated values and how do they differ between the profiles and to the measured values? What are the "sensitive paramters" (L.215).

We will include in this section the sensitive parameters and the calibrated values. We will compare them in relation to the measured values.

L333: I would partly disagree. When you have a KGE of 0.08, you barely explain anything of the observed behavior. So what is the problem? What could be the problem? Preferential flow? Also, a full uncertainty analysis of the simulation should be added rather than 3 simulations in Figure 4. Furthermore, I am having a hard time to distinguish the different lines on the plot.

We have reworked the manuscript, and have done a full uncertainty analysis. We will also compare the KGE value with reference values given in Knoben et al. (2019).

Knoben, W. J., Freer, J. E., & Woods, R. A. (2019). Inherent benchmark or not? Comparing Nash–Sutcliffe and Kling–Gupta efficiency scores. Hydrology and Earth System Sciences, 23(10), 4323-4331.

L521: Replace "The soil hydrology' simulations" by "The simulation of the soil water balance"

We will replace it

L558: Can you estimate the residence time? Or the general difference between your sites?

We will remove the part related to residence time

L585ff. In this section, mostly literature is cited, however it would be more straightforward to argue from your observation rather than relying on a reference. Of course, other work can then be references.

We take this point, and will rewrite this section and argue directly from our observations. This will be done in section 5.2 from L585 onwards.