

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2  
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## **Comment on hess-2022-31**

Anonymous Referee #2

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Referee comment on "Numerical modeling of physical and biochemical processes in the subsurface and their impacts on the self-potential signature" by Xin Liu et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-31-RC2>, 2022

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The authors proposed a coupling model to simulate the complex bio-geochemical reactions in subsurface water flow and solute transport. The reactions are important and it is meaningful to include these in a traditional model. However, I got lost in reading through the manuscript. The work is interesting but I felt the authors failed to present a clear consistent streamline from the model development to calculation, simulation and verification.

### 1. Abstract

The abstract seems too long and a bit confusing. It is kind of hard to get your main contribution from this complicated abstract. Like you state that the development of the model is your research goal, but your results focus on detailed geochemical analysis and explanations. Thus which one is your most important point? The goal and results then are not logically consistent though for sure they are related. If the model is creative, it would be better to prove its accuracy and efficiency. If the bio-geochemical processes are the problem that need to be illustrated, then it is better to describe the significance of the geochemical environment. I suggest to modify your abstract to clearly present your contribution.

### 2. Introduction

Are there any try out of embracing SP to subsurface flow and transport modeling in previous studies? I am not an expert in SP model but can you directly transfer this signal into geochemical variables in subsurface porous media?

### 3. Model development

The authors described a bunch of equations. Are the basic water flow and solute transport... are set up by own developed code or a business code such as comsol/hydrus? I saw the authors mentioned this in the end of the manuscript, but it is better to be cleared out in the paper.

The same as the previous concern, is the SP code constructed by the authors or an adopted module? It is really hard to tell which equation is cited from other papers and which one is that you derived. Meanwhile, the authors introduced the flow and SP separately, but how the two parts are connected? How the variables in the two systems are connected? A section is needed here.

Many parameters and observations were enrolled in the modeling but how were they obtained from the physical-based experiment? And the model then has a high degree of freedom, how did you constrain your model in the simulation and verification? Also, the uncertainty is greatly increased in this process as stated in the literature: "Bayesian performance evaluation of evapotranspiration models based on eddy covariance systems in an arid region. Hydrology and Earth System Sciences. 2019, 23(7):2877-2895".

### 4. Results

As the problem mentioned above, it is not quite clear the performance of developed model. It is hard to say whether the approach is valid or not. It would be better to show what are your inputs and what are your outputs as too many reactions are taken into account here. How are the simulations compared with the observations for the most important parameters? And how the results performed by comparing to the model that ignores the SP.