

Review of “Groundwater-surface water exchanges in an alluvial plain subjected to pumping: a coupled multitracer and modeling approach” by Texier et al.

The paper is generally well written (although I got lost in a few paragraphs). The main purpose of this paper is to introduce a multi-tracer approach to quantify GW-SW exchange. I fully agree with the authors that complementary information from tracers (and especially natural tracers) can (and should) be used more often in such alluvial river-aquifer contexts to better constrain decision-based model predictions. However, I must admit that I was disappointed to see that the information from the tracers was not really valorized in the modelling exercise. The model was only calibrated against steady-state hydraulic head.

More generally, the paper lacks details on the modeling setup which make it very difficult to understand the main goal of the model (what do they want to predict??). Overall, the so-called approach is not clear to me.

My last concern is that I also felt that the authors did not perform a complete literature review in the introduction. The authors stated that the use of radon in transport models is rarely discussed, but I strongly disagree. The authors are missing some relevant papers. ^{222}Rn (and natural tracers in general) have been used extensively to study river-groundwater interactions under losing river conditions.

Please see the following not exhaustive list of publications: Bertin and Bourg, 1994; Hoehn and Cirpka, 2006; Hoehn and Von Gunten, 1989; Hoehn et al., 1992; Popp et al., 2021; Stellato et al., 2013; Vogt et al., 2010.
See also Peel et al., 2022, Gilfedder et al., 2019, Liao et al., 2021, and Delottier et al., 2022 for explicit simulation of tracers.

In the end, I am not really sure where is the scientific contribution of that paper. In the present form, it is not really clear. For these reasons, I cannot recommend publication of that paper in HESS.

Detailed comments

Line 28: PEST suite.

Line 29: Is that really reactive transport for Radon ?

Groundwater-river; aquifer-surface water etc. Please be consistent in the paper.

Line 108: I would just say a calibrated model. If a model is badly calibrated, it is better to say that it is not calibrated.

Line 114: tracers are observations (not techniques). Here the author refer to method and technique but I think it is observations right ?

Figure 1: Not really easy to see where are pumping wells and where are piezometers. Need more detailed legend.

After reading Part 2.1, I am still not sure about the location of the pumping wells. For the aquifer geometry, a geological cross section would be welcome.

Line 226: Specific yield

Line 220: Why do you name it a synthetic model? Is that not a model developed in a real case study?

Line 236: Is the Rhone river represented with a Dirichlet BC ? If so, this can lead to enormous amount of water in the model. Again, the description of the model is not so clear. Why not used a Cauchy type BC?

Lines 238,239,240: This means that there is only one layer for the entire model? So this is a pseudo 2D model?

Line 240: permeability field? Is this considered homogeneous or Heterogeneous? If so, is there zones of piecewise constancy or pilot points? Not clear. How many parameters involved in the model calibration?

Line 242: PEST optimization tool. This means that you have used the CMAES global optimisation scheme? Not clear.

Line 245: Not production of radon in the groundwater? Not clear. How the production of radon can be simulated with an injection well? More information is needed here to better understand how Radon was simulated in the model.

Line 250: This is not a classical way to simulate radon. Usually an end-member equilibrium activity is needed for that seeks.

Figure 3: The use of an inverse distance method to draw a piezometric map is not ideal. The piezometric map seems strange with geometric 90° change of orientation. Is this because of the method or because of strong heterogeneity at the site scale?

Figure 4: Not clear. What is the meaning of the grey circle in the Figure? The large grey band ? Not easy to follow.

Line 297: explain the meaning of GMWL (global meteoric water line I guess).

Line 303: meteoric groundwater recharge.

Line 335: this method? I should admit that I am getting lost in the end of this paragraph.

Section 3.4: Is there any uncertainty on the temperature models used to interpret the data? It would be good to discuss the reliability of the results of these models regarding the uncertainty.

Figure 8: I don't find the C) section in this figure. This is unfortunate since I also find that the A) and B) are far from being informative to support model calibration.

Line 350: I do not see how the calibrated model reproduces the observed data. This is not clear at all in the figure.

Section 3.5.1: How the results of the model are sensitive to the estimated parameters? At least, a sensitivity analysis should be applied.

Section 3.5.2: As I understand, the radon and isotopic information were not added at all in the model calibration? Why?

References

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