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Comment on hess-2021-15

Anonymous Referee #3

Referee comment on "Coupling saturated and unsaturated flow: comparing the iterative and the non-iterative approach" by Natascha Brandhorst et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-15-RC3, 2021

This article proposes two approaches for coupling saturated and unsaturated zones in a hydrological model. An explicit representation of the 3D flows is time consuming and a 1D approach to represent the unsaturated zone with a 3D approach to represent the saturated zone is an alternative which however raise the question of the representation the interface between these two environments which evolves over time. This lead, among other feature to variation in the specific yield. Two innovative approaches, one iterative and the other non-iterative, are presented in this article and compared to a 3D reference model.

General comments :

Even if the article is based solely on synthetic data, the presentation of the approach is clear and the results are convincing both in terms of the quality of the results and the efficiency of the calculation times. This makes it an interesting article that deserves to be published. My main concern is the conclusions on the lack of sensitivity of the unsaturated zone. To my point of view the constant monthly inflow may lead to a steady recharge of the saturated zone. It might be possible that with pronounced short term drying-wetting cycles, the role of surface parameter might be stronger, which could be amplified by the coupling between surface flux and soil water content due to transpiration regulation. In Figure 14 we can see that soil parameter have their strongest effect when changing the inflow regime (except the model warming period). I think the conclusion could be tempered on the prominent sensitivity of KGW

specif comments :

The shape of the equation is unusual. Considering that $\theta=S(hp)*\Phi$, I have difficulty to understand how $d(\theta)/dt$ lead to left member of equation 2 (θ being the volumetric soil

water content). Can the author give reference. The specific storage Ss is not clear (dS/dhp ?)

L154 : How the saturation determined into the new cells (is water mass in the unsaturated layer preserved?

L162 1 ratio and three terms. Not clear

In Table 3 : Are KGW and KUZ conductivity at saturation? Here there is a decoupling of K Values. What happen in area that might belonging to the two domains.

L393-396 Is the feature described here expected? May be can be addressed when discussing the yield values in part 4.5.

Figure 12: errors are located in particular areas. Is there some explanation (boundary conditions, but not everywhere, heterogeneity patterns)?

L397 not clear what the ration is

Section 4.4 Are the parameters leading to exfiltration (data removed) cover particular domain, that might be meaningfull

Fig 14-16 : is t[a] correspond to year unit (you may consider t[y]