

## ***Interactive comment on “Improved representation of groundwater at a regional scale – coupling of mesocale Hydrologic Model (mHM) with OpeneGeoSys (OGS)” by Miao Jing et al.***

### **Anonymous Referee #2**

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Improved representation of groundwater at a regional scale Miao Jing et al.

Overall:

This is a poor paper. The two models the authors have used in their catchment simulation are not described in sufficient detail to enable a reader to understand how all the processes have been implemented. Particularly lacking is how the exchange fluxes are handled. This is surprising given that the focus of the paper is on model coupling (as stated in the title). In addition, the groundwater model is incomplete, as the authors do not describe how a water table is handled in the model, specifically the role of specific yield. This is a major omission, given the influence it has on water table dynamics, a

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key measure used to assess the model performance. Finally, there is no mention of river geometry (e.g. river width) and how water levels are converted into flows. Given this incompleteness, it is not possible to give any comment on the quality of the model simulations presented in the paper and the author need to address these details in any subsequent resubmission.

Specific remarks:

Eq1 refers solely to changes in pressure head being governed by the specific storage coefficient. However, this refers to changes in storage due to water and rock compressibility (see Freeze and Cherry, 1979) and, therefore, is primarily associated with storage change in confined aquifers. In an unconfined aquifer, which is the focus of the paper here, storage changes are largely governed by changes in the water table and the wetting and dewatering of pores, which is typically characterised by the specific yield. It is not clear from the description of model how this is handled. Furthermore, there is no reference to specific yield in the text and, as this is an important parameter which has a major influence on groundwater dynamics, its omission makes commenting on the model's performance rather difficult.

Eq1. There are two fluxes  $q_s$  and  $q_e$  included in the groundwater continuity equation.  $q_s$  is defined as a specified rate source/sink. Presumably, this refers both to abstractions of water from wells as well as recharge from rainfall infiltration in contrast to the flux  $q_e$ , which is defined as the exchange with surface water. Furthermore, in Eq3. the surface water continuity equation, a flux  $q'_e$  is referred to as the exchange rate with surface water. It is not clear to me what are the differences between these two terms, mainly because, in both cases, no details are given on how these fluxes are calculated. This is particularly problematic, as a key feature of the paper (and referred to in the title) is the coupling between the surface and subsurface models. I would, therefore, have expected to see an equation that includes both  $\psi_p$  and  $\psi_s$  showing how the models are explicitly coupled.

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The authors cite Camporese et al. (2010) in their discussion on the two coupling terms, however, there are some important differences. Camporese et al. (2010) do not appear to have an equivalent flux for  $q_e$ . They have a term in their surface water balance equation that looks to be the equivalent of  $q_e'$  (which they refer to as  $q_s$ ), however, even here the exact definition is not given. Furthermore, Camporese et al. (2010) solve Richards' equation, rather than the saturated groundwater flow equation, in their subsurface model and, therefore, where the water table is below the base of the river, the coupling would be completely different.

Finally, in connection with the surface-subsurface coupling, there isn't any reference to river geometry and its role in calculating exchange fluxes and river flow (e.g. as shown in Fig 10).

Typographic errors:

Eq1. Note  $z$  as specified here denotes depth. The description of vertical coordinate is not clear.

Eq. 2, the pressure term, should have a  $p$  subscript.

Reference:

Freeze, R.A., and Cherry, J.A., 1979, Groundwater: Englewood Cliffs, NJ, Prentice-Hall, 604 p.

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