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Geoscientific Model Development Discussions

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 #1

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The authors present a coupling approach for a land surface hydrologic and groundwater flow model, mHm and OGS respectively. The manuscript contains sections on the coupling, model setup over a real catchment and verification of the results. The model coupling is not explained appropriately and it's not clear, whether the coupling approach satisfies the current state-of-the-art published in GMD. Based on the provided explanation, the results can not be assessed unfortunately.

Introduction The introduction is incomplete and misses some of the most important and heavily cited references of integrated models and modeling studies of the terrestrial water cycle. Apparently the authors are not aware of the state-of-the-art. Proper citation

of the mentioned models is missing. Is the sole goal of the introduction to promote the work of the co-authors (e.g. statement p 3, l 12-15 and citations throughout)?

Model description Section 2.1 and 2.2 must be expanded. At least, the reader must get some idea about the basic principles that are used to model the different processes mentioned in passing, in order to assess the validity of the coupling. In section 2.3, figure 1b, suggests one-way coupling only i.e. mHm provides "groundwater recharge and base flow as boundary conditions to mHm" (p 3, l 16-17). Since mHm does not include groundwater, how can the calculation of these fluxes be mechanistic (p 3, l 15), because groundwater recharge strongly depends on the dynamics of the water table? Thus, the scarce information provided in this section in combination with the statements in the introduction are misleading to the reader.

Section 2.3.2 with the title "Boundary condition-based coupling" provides the basic equations, yet leaves the reader wondering how the coupling is really done. Something is said about the exchange of fluxes via qe and qe' (p 7, l 3), but these are sources not boundary fluxes. What is equation 2? The upper boundary condition for the groundwater flow model? Shouldn't the coupling be performed via equation 2 as promised in the section title? In addition, the authors state that "the coupling interface converts time series of variables and fluxes to Neumann boundary conditions...". How does that fit in? This reader is left confused.

Figure 2 is not instructive. What is GIS2FEM doing? Interpolating? How does the coupling work in the vertical direction for each column? As I understand, mHm has a fixed column depth. Can the water table rise into the column along e.g. river corridors? And where does the baseflow go in OGS? How is groundwater storage in mHm (p 7, l 9-10) related to OGS? There is apparently no backward exchange with mHm due to baseflow and exchange with river networks, and no capillary rise. This reader is left confused.

On p 7, l 17-18, what do the authors mean by conversion between volumetric flux,

specific flux and water head? Where in the coupling is this conversion required and why does the cell sizes need to be adjusted (there is actual re-gridding going on)?

From table 2 it appears that in the author's eyes, coupling and integrated modeling of the terrestrial water cycle simply means to pass groundwater recharge values from a 1D hydrologic land surface scheme to a steady state groundwater flow model and return a head value back as some lower (boundary) condition for the hydrologic scheme (not indicated in figure 1). I feel, in the geosciences, we moved beyond this type of approach quite some time ago.

The description of the study area and model setup, calibration etc. belong into a separate section.

The results can not be assessed unfortunately, because of the poor explanation of the applied modeling and coupling techniques.

Language and grammar require considerable improvement.

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