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Hydrology and Earth System Sciences
Discussions



# *Interactive comment on* "Assessing the response of groundwater quantity and travel time distribution to 1.5, 2 and 3 degrees global warming in a mesoscale central German basin" *by* Miao Jing et al.

**Anonymous Referee #2**

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The authors of the manuscript propose a combined three-level modeling approach to investigate the influence of climate change on the groundwater levels and groundwater travel time in a small agricultural watershed in central Germany. They use 5 different global circulation models, which provide climate data for mesoscale Hydrologic Model mHM. In turn, mHM predicts values of groundwater recharge, which are in turn used as input in a 3D saturated groundwater flow model implemented in OpenGeoSys. Thus, their work is a valuable contribution to the development of comprehensive modeling approaches describing hydrologial systems. This type of analysis is much needed in



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Discussion paper

view of the discussion on the possible effects of global warming. The main finding is that the influence of climate change on the groundwater travel time is more pronounced than the influence on groundwater levels.

I agree with the comments of the first reviewer, who pointed out important limitations of the manuscript. They are related to (i) neglecting of unsaturated zone processes and the influence of shallow groundwater table on surface hydrology, (ii) use of coarse-grid model for calculating recharge rates, (iii) other possible sources of uncertainty, besides the differences between climate models. In the revised version, these issues were addressed by providing additional simualtions and extended discussion.

My general comments related to the current version of the manuscript are as follows: 1. I would like to see more information about the actual values of recharge and recharge/precipitation ratio in different scenarios. Does the recharge change proportionally to the precipitation in all scenarios, or maybe there were some nonlinear effects, such as those mentioned by the authors on page 3, lines 2-4?

2. What was the spatial variability of recharge obtained from mHM ? Even using 5x5 km grid you should see some differences in the watershed area. Was the degree of variability similar in all scenarios?

3. On page 17, lines 10-15 the authors mention that their model is able to simulate correctly the appearance of additional groundwater discharge zones when the water table rises, as shown in Fig.9. This should be explained in more detail. How is this kind of boundary condition treated in OpenGeoSys? Is it possible that groundwater heads in the top layer of cells are above the ground level ? It would be nice to see actual model results supporting the concept shown in Fig. 9.

Technical correction: Page 5, last line "C" after "degree" symbol seems redundant.

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