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Hydrology and Earth System Sciences Discussions

Interactive comment on "Estimation of future groundwater recharge using climatic analogues and Hydrus-1D" *by* B. Leterme et al.

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General Comments This paper discusses a risk analysis of future climate related recharge for a nuclear waste disposal site. The approach uses "analogue stations" to develop climate scenarios which are fed through a 1-D Richard's equation based model. The conclusions suggest that actual recharge will decline even with higher rainfall in warmer climates due to the higher ET. While this is an interesting approach, the current manuscript lacks depth to be accepted for publication. 1. The assumption is that the main change for future risk analysis is the purely the change in climate, in particular rainfall and temperature. The interesting thing with climate analogue stations is that represent also a change in radiation due to change in latitude, which would not immediately be expected under a climate change scenario (temperature change is due

to atmospheric changes not radiation changes unless there is global dimming). I think the authors would need to spend a bit more time on this issue. Why was the climate analogue used with the radiation data? Why was not the local radiation data used in the model simulation? 2. Additionally, the assumption here is that the vegetation response will not change. It is unclear to me, but worth discussing whether we would expect the vegetation response to be stationary and how a non-stationary response (i.e. a change in the PET to AET relationship due to vegetation changes) would change the response. Which effect is likely to dominate? The plant response or the climate response? There is mention of "the dependency between climate and landuse is being investigated" (p1400 l12) but I would think this would be a crucial part of the current investigation into risk. 3. I am confused why such a small number of model realisations was performed. Wouldn't it not be easier to actually derive statistical parameters for the analogue stations and create much longer and many more realisations of the expected analogue climates and thus representing a much higher variability to feed through the model? Following up on this question, is climate variability not more important than climate change? Would this not be expected to impact the risk analysis in a major way? 4. I couldn't find any indication in the paper how verifiable the "current climate" estimate of 314 mm/yr was. Is there any observed data? I think the authors need to decide whether this is a conceptual study about the impact of climate change and variability on recharge or whether this is an operational study that can be matched to field data. There is talk of "field observations" on page 1397 l5ff, but I could not find this data in the tables or figures. 5. I also think the role of the bottom boundary and possible impact of shallow groundwater on the simulation should be investigated further. Capillary fluxes, groundwater uptake and drainage boundary conditions are crucial for this to be thorough. 6. The abstract is not really representative and does not cover the overview of the results of the different other climate analogues tested. 7. The introduction speaks of risk analysis over millennia, but the actual analysis only uses relatively short timeseries. 8. With the vegetation model and given that the vegetation was assumed to be grass, why is so much emphasis in the model on interception? Is

that as important for a grass as it is in a forest? 9. Finally, and this is something I am personally always interested in, how much of your results are explainable by the actual structure of the model and how much of the results are a “surprise”, show unexpected feedbacks etc. I could not work this out because I am not sure how Hydrus might influence this. I think it would be interesting to use a different model for the same analysis and to see if you get comparable results.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 1389, 2012.