

Interactive comment on “A simulation model to assess groundwater recharge over Europe’s karst regions” by A. Hartmann et al.

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This manuscript describes a first attempt to estimate groundwater recharge over a regional scale in Europe through the use of a simulation model. The approach presented is novel in that (1) it separates the study area into four karst landscapes by cluster analysis, and (2) the ranges of parameter values were determined by a step-wise process that used observation data and a priori information. Model uncertainty was assessed by evaluating the ranges of model outputs that resulted in the range of Monte Carlo parameter inputs. The manuscript is clearly written, except where noted, and rigorous and is suitable for publication in GMD after some moderate revisions.

The introduction states that a novel approach considers the sub-grid heterogeneity of karst using statistical distribution functions; however, this approach already was used

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in a previous version, called VarKarst, as described in Section 2.1. The novel parts of the manuscript are outlined in my opening paragraph above and are better described in the Conclusions of the manuscript.

Section 2.1 is a brief summary of equations previously published by the Author and appears to be shown here for the purpose of explaining the four parameters. This could be stated more clearly because it’s not totally clear whether these are new equations or not. Also, the reader would need to read the previous papers to fully understand their meaning. One reason for the confusion is that this is described as being a new version (VarKarst-R), but the equations have not changed (unless I missed something). Therefore, please explain what was modified in the new version.

Section 2.5 states that VarKarst-R simulated recharge was compared to estimates previously published (Table 3); however, table 3 shows only the values estimated by the other studies and not VarKarst-R estimates. I can find no such comparison in this manuscript. It would be very informative to show the VarKarst-R estimated values for these same areas in table 3 for direct comparison.

Other comments:

Section 2.3.1, 7894 lines 21-23 – “. . .we assume that differences among the karst landscapes are due to differences in relief and climate, and the consequent processes of landscape evolution including the weathering of carbonate rock.” This neglects several other factors, including depositional environments, tectonics (fracturing), and rain acidity, which could be stated here explicitly. It also could be pointed out that this simple categorization presented seems to be useful nonetheless, and it is also universally applicable and can be objectively applied.

p. 7896 line 5 – What is a reasonable number? Apparently 250 is reasonable because that is the number given later.

p. 7896 lines 8-9 – At first look, a positive correlation seems like a very low threshold

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criterion, but when we consider the large uncertainty of recharge estimates, it seems more reasonable. It would be useful to comment briefly on this.

p. 7896 lines 19-20 – In the application of a priori information, it is stated that this assessment would indicate whether or not information applied in steps 1 and 2 is biased. But it does not state what is done if this is the case. Later we see that confinement step 3 is used to further narrow the parameter ranges. Please clarify.

Fig 1a – This depiction is not clearly explained in the caption or in the manuscript body.

Fig 4 – Please explain AI, DS, and RA.

Fig 5 – Parameter labels are missing to show the four different columns.

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