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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "A high resolution global scale groundwater model" *by* I. E. M. de Graaf et al.

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1. Scientific Significance: Does the manuscript represent a substantial contribution to scientific progress within the scope of Hydrology and Earth System Sciences (substantial new concepts, ideas, methods, or data)?

The study is good to excellent. The global simulation of groundwater flows is very interesting. Unfortunately, this article is Fair to Poor. The article is too confusing and important contributions are not presented in a very informative way. The article lacks a depth of consideration needed to translate model development and results to useful take away lessons. This is addressed further under Presentation Quality using some specific examples. However, only examples are presented. The same kind of analysis

presented for those examples needs to be considered for every aspect of the paper.

2. Scientific Quality: Are the scientific approach and applied methods valid? Are the results discussed in an appropriate and balanced way (consideration of related work, including appropriate references)?

I see no real problems with the scientific method to the extent I understand it. The problem is that it is poorly explained.

3. Presentation Quality: Are the scientific results and conclusions presented in a clear, concise, and well-structured way (number and quality of figures/tables, appropriate use of English language)?

The article is very confusing as presently written. There are problems with both the description of methods and the presentation of results. These are solvable problems within the present length of the article.

Two examples of difficulties with the description of methods:

a. There are three comments about the linear store in the PCR-GLOBWB model that are confusing. I think probably the method used is ok, but the description is too confusing to tell. The three comments are as follows.

i. Page 5222, around line 20, says that the linear reservoir of the PCR-GLOBWB model is replaced by MODFLOW.

ii. P. 5332 around line 21 says that "Because of the offline coupling and the lack of topographical detail in a 60 cell, the linear groundwater store is maintained, specifically for calculating baseflows above the drainage level to the surface water network using a cell-specific recession constant which accounts for aquifer properties and drainage density."

iii. P. 5228 describes how the MODFLOW head is used to calculate streamflow gains and losses. The role of the linear reservoir in calaculating baseflow is not described.

b. The method behind characterizing ranges and sediment basins is really confusing. I broke the confusion down into the following pieces.

i. A small thing is that the term ranges is vague – perhaps use mountain ranges or high elevation, steep terrain?

ii. On p. 5224, line 9, is it correct that it could be "Next, all 6' cells with floodplain. . ."? If this is correct, then note that the text is clear on how the floodplain level of each 6' cell is determined, but is not clear on how the surface level of each 6' cell is determined.

iii. The z-score of eq. 2 either needs motivation and clearer description, or to be removed from the paper, described more clearly in another report or paper, and referenced from here. One example of confusion is that equation is presented in the context of the surface level and, while the figure being referred to (fig 3a) is described as "Cumulative probability of aquifer thickness". Associated with this, figure 2 lower panel is not referred to in the paper.

I think part of the confusion comes from it not being clearly stated that the PCR-GLOBWB model is transient while the MODFLOW model is steady-state with forcings equivalent to long-term averages from the PCR-GLOBWB model.

The presentation of results is difficult because the global scale figures are hard to evaluate and there are too many of them. Some ideas are as follows.

a. Figure 3. put the top panel in auxiliary material or another pub with a better description of how it is obtained. This allows the thickness and T maps to be larger and easier to read.

b. Figure 4. Choose a location and show detailed inset for each figure. This might require another figure. Choose the location to that a them can be followed and a transferable lesson told.

c. Figure 5. Just show panel B and in the caption say that this is the dominant parameter. Say the other two parameters had very little sensitivities and the figure with all

parameters varied looks a lot like the one shown. In the new figure, include an inset for the same area in the new figure.

d. Figure 6. Make the print on the axes much bigger. The caption says A and B are pretty similar, so it is not clear that the distinction shown is very important. Omit one panel? I think the red points are in the sedimentary basins and the blue are in the ranges, but this is not in the caption. I may have missed item but I do not recall that the obs consistently being larger than the simulated values is discussed. Any thoughts on why this is so?

e. Figure 7 is very hard to read. Decide what message is most important and focus the figure accordingly.

f. Figure 8 is not presented at a scale that allows the dotted areas to be distinguished, as far as I can tell. I am not sure what "whither colors" refer to – the lighter shades? Perhaps take the same area for which detailed insets are provided and do the same for this figure?

g. Figure 09. This is the inset idea, but I think at too large a scale to make the figure very meaningful. Use the same location used for the other figures?

Again, I commend the authors for their fine study of an important topic.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 5217, 2014.