Hydrology and Earth System Sciences Discussions

Interactive
Comment

Interactive comment on "A modeling study of heterogeneity and surface water-groundwater interactions in the Thomas Brook catchment, Annapolis Valley (Nova Scotia, Canada)" *by* M. J. Gauthier et al.

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1. The introduction gives an overview of previous and recent work in this field but doesn't really explain the necessity for the presented work. What can the results of modeling experiment contribute to the real society, not only from the scientific view?

A sentence has been added to the first paragraph of the introduction: "This work can be viewed as part of an integrated management plan for a rural region, for which spatial

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distribution of recharge and knowledge of the water budget are crucial."

2. The scenarios themselves are well explained, however, it is not explained why these scenarios have been chosen. Could you please provide a bit more background information to explain about these scenarios? Or, these scenarios are decided randomly.

In the design of the scenarios, our strategy was to incorporate in sequence those features deemed most important and for which data were available. See Response 1 to Reviewer #2.

3. The numerical model is a physically based model with a number of calibration parameters. Uniqueness and robustness of the calibration is not sufficiently demonstrated. The physical meaning of various model parameters (applied in this case study) is not well discussed in detail.

Hydrogeological parameters (K, n) were not calibrated. They were assigned according to local or regional values. See previous responses for more on calibration issues. The model parameters common to all scenarios are described in Table 2, and references for further information on these parameters are provided as well in this table.

Specific comments

1. P8 Line 9, What was the 'other criteria'?

The sentence has been changed: "The distinction between grid cells belonging to the hillslope and stream network systems can be made according to three different threshold-based options, based on criteria such as upstream drainage area, local terrain slope, and land surface curvature."

2. P9 Line16-17, it wasn't clear to me which version of gOcad and ArcGIS.

ArcGIS 9.0 and gOcad 2.0.8.

3. In section 2 'Description of the study area', why not mention land cover distribution of the catchment which will have great impact on its hydrological cycle? Some details

about the horizontal spatial variability of land use and cover could be introduced.

Land use and land cover information is not directly utilized by the CATHY model (unlike more "land surface"-oriented models such as SWAT). This information can be indirectly used when linked to soil parameters (for instance setting a low surface K for urban areas). Land cover maps were not used in our study, which relied exclusively on geological data for model parameterization.

4. The instrumentation (type and location) for the measurement of rainfall, stream flow, groundwater should be described.

Data on total precipitation came from Environment Canada (http://climate.weatheroffice.ec.gc.ca/Welcome_f.html) Streamflow data came from a local study in Nova Scotia (one of our partners). These sources are now mentioned in the Acknowledgments. Groundwater data came either from dataloggers (installed by us) in two residential wells or from instantaneous measurements in visited residential wells (using a probe). In the paper we refer several times to these "measured groundwater levels".

5. In Section 4.1, because the study area is a major agricultural region of Canada, do people in this valley pump any groundwater for agricultural water use? How to consider the impact of human activities on groundwater recharge? Or, does this model only consider the most ideal and natural condition without any human interruption?

For the moment, the majority of water dedicated to irrigation comes from surface water (approximately 80%). Pumping (withdrawals) probably represents a small percentage of total precipitation (and even recharge).

6. P12 Line 11-12, which hydrogeological parameters were assigned based on fieldwork results? Which parameters are based on database? Where are the databases?

K and n in both cases. For scenarios 1 to 7 (local values), most values came from acquired data (fieldwork). For scenarios 8 and 9 (regional values), data came from the

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provincial database.

7. Results and discussion: The different stream discharge time series are only shown in figures. It would be useful for comparison if you can quantify their distribution by, for example, the variance.

We do not think that, for streamflow, variance is a relevant characteristic. We present daily data graphically so that the appropriateness (location and height) of the peaks can be discerned.

8. The model also produces overland flow, interflow, and groundwater. Why then not compare them? The title is "A modeling study of heterogeneity and surface water–groundwater interactions", how about their interaction through the modeling study?

Overland flow and return flow are presented in Table 3 for each scenario. However, these variables were not measured in the field. Recharge is also presented in Table 3 and the mean annual value estimated with another method is provided in the last line. Finally, Figure 8 presents a comparison between measured and simulated GW elevations.

9. P34 (Figure 6), 38 (Figure 10), and 39(Figure 11), is the date in the x-axis of data French? Can you change them to English?

Done.

10. P35 Figure 7, in the block 2, "n=0,20" should be " n=0.20".

Done.

11. P41 and 42, the numbers and labels in the x and y axis are too small to be read clearly. Can you modify them?

Done.

12. P45, in figure 15, I could not see clearly the dotted line. Which line is for which

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scenario? Can you improve the quality of this figure?

In colour the dotted lines are quite clear.

13. Figure 8, can you tell me the meaning of ASL?

"Above sea level".

14. How the model transfers from Potential evapotranspiration to Actual evapotranspiration? Can you briefly describe it in your article since it is very important at a catchment scale study?

See the response to "line 15-17" of Reviewer 2.

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