Hydrol. Earth Syst. Sci. Discuss., 6, C3016–C3021, 2010
www.hydrol-earth-syst-sci-discuss.net/6/C3016/2010/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Effect of the spatial distribution of physical aquifer properties on water table depth and stream discharge in a headwater catchment" *by* C. Gascuel-Odoux et al.

Anonymous Referee #2

Received and published: 3 January 2010

General comments:

This is an interesting paper on the effects of spatial variation in hydraulic conductivity (and drainable porosity) on modeled hillslope flow and water table responses. In addition to uniform soil hydraulic properties, four different spatial models (linear, 2 different models based on the topographic index, and a threshold function) were used. It was found that the model with uniform properties was able to represent streamflow well but not the water table responses. The threshold model represented the observed water table responses best but was still not able to represent the responses at all locations.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

This study is of interest to readers of HESS and highlights the importance of water table measurements at upslope locations for model calibration and validation. Unfortunately, a few shortcomings of the model and especially the effects they may have on the results are not discussed in the paper. These include the uncertainty in the hillslope flow estimates and the uniform soil depth assumption (see specific major comments below). Furthermore, even though there is soil information available for the watershed, there is no discussion of how the four models used in this study represent the observed spatial variation in soil properties or what the spatial variation is. This manuscript would be significantly improved and more complete if these issues are discussed. I therefore recommend this manuscript for publication after these issues and the minor comments below have been addressed.

Specific major comments:

1.) P6934L3 (and section 4.4): What is known about the spatial distribution of the hydraulic conductivity (and drainable porosity) from these "intensive soil studies"? What information on saturated hydraulic conductivity is available from slug tests in the piezometers or from soil cores or from other soil information? Please give more background information about the observed spatial variation and how much variation there is. Which of the 4 models used in this study would 'fit' the observed data best or would because of the variability/uncertainty all models fit the data equally well?

2.) P6938L21: It is unclear why a constant soil depth was used in the model. It is mentioned several times in the manuscript that the soil depth is variable and varies between 0.5 and 1.5 m (e.g. P6934L15, 18-19; P6946L7; P6947L23). It is also mentioned that soil depth variability can have a large influence on modeled flow and water table responses (e.g. P6932L17). However there is no mention or discussion of how this uniform soil depth has influenced the results of this study. Would water table responses be better simulated if a variable soil depth was used? There should be at least a discussion of the effect of variable soil depth and how it may have influenced the results of this study.

HESSD

6, C3016–C3021, 2010

Interactive Comment

3.) P6939L13: How was hillslope discharge calculated from the stream discharge? Was the hillslope contribution assumed uniform along the stream-length? What about contributions from the riparian zone/stream channel interception? Was this a convex/concave/planar hillslope? I expect that hillslope contribution to the stream is highly spatially variable and that there are thus differences in both magnitude and timing of hillslope flow. How did this assumption influence the results? At a minimum it should be discussed how these uncertain estimates of hillslope discharge influenced the model results and model calibration and how this influenced the results of this study.

Specific minor comments:

1.) P6933L19: Did they simulate the water table for just one position? Clarify.

2.) P6934L10-11: What was the precipitation from 1994-2004? Was the ET measured of calculated from the water balance?

3.) P6935L7: How many transects are there in total? Discuss here why this transect/hillslope was chosen (earlier than P6936).

4.) P6936L20-22: This sentence is not clear and does not correspond to equation 1 since equation 1 still has an exponential decline component as well. Rewrite to "we included a constant hydraulic conductivity at deeper depths"?

5.) P6938L12: What was the resolution of the DEM? How was it obtained?

6.) P6939L21-22: Give the dimensions of the hillslope earlier (either in the site description or on P6936L12) (and/or shade the area in figure 1)

7.) P6940L13: Rewrite this sentence as it does not describe equation 5. Replace "difference in the average level (D)" by "average difference in the water level (D)"?

8.) P6940L15: Why were only 3 of the 6 wells used? Why these 3? Explain. Without an explanation is seems like you are hiding something.

9.) P6941L20: What period was used for the validation?

HESSD

6, C3016–C3021, 2010

10.) Figure 2: Show the discharge in figure A as well. Replace “time” on the x-axis by “day since xxx” or is it “Day of Year” or replace the axis labels by actual dates. The caption does not fit the figure as more than “two” wells are shown and “discharge” is not shown.

11.) Figure 3b: Typo on the y-axis “factor of variator”

12.) Figure 4: Caption does not fit the figure as 6 wells are shown instead of 5. Label the x-axis.

13.) Figure 7: Insert an x-axis. There seems to be some wrong data (sudden drops in water level – was the recorder temporarily lifted out of the piezometer?) for pg 1, pg3 and pg4. Was this data excluded from the model calibration and the calculation of the efficiency?

Minor editorial suggestions:

*Title: insert “modeled” in front of “water table” in order to better capture the essence of the paper?

* P6930L2: replace “dynamics is” by “dynamics on hillslopes are” and remove “upslope”?

* P6930L7: insert “different” after “two”

* P6930L12: replace “with” by “by”

* P6930L17: replace “investigation” by “investigations”

* P6931L12: rewrite this sentence. It is not very clear.

* P6932L6: insert “drainable” in front of “porosity”

* P6932L25: replace “as well” by “as well as” and “functioning” by “functional”?

* P6933L11: insert “of” before “catchments”

HESSD

6, C3016–C3021, 2010

* P6933L18: replace “homogenous” by “homogeneity”?

* P6933L22: replace “challenging” by “necessary”?

* P6934L28-29: replace “discharges were” by “discharge was”. From figure 1 it seems that there is only 1 gauging station.

* P6935L11: replace “until” by “when’?

* P6935L29: rewrite this sentence.

* P6936L6: replace “remain” by “remained”

* P6937L12: replace “a m parameter” by “the m parameter”

* P6937L16: replace ‘or a parameter m” by “or the m parameter”

* P6937L17: replace “we have considered” by “we considered”

* P6937L20: insert “towards the” before “toeslope”

* P6938L7: either number the different models listed or replace “similarly to 3” by “similar to the mono index model”

* P6938L18: replace “year” by “winter” or “wet season” because it is not a full year.

* P6938L20-22: move this sentence to the model description

* P6939L3: move this information to the model description

* P6939L27: rewrite this sentence – “into account the set of parameters that provides the best fit”?

* P6940L3: replace “between 10 and 40 m” by “10-40 m”

* P6941L3: rewrite this sentence. It is not clear.

* P6941L6: “average water table depth” this is not what is calculated by equation 5 (see minor specific comment 7)

HESSD

6, C3016–C3021, 2010

* P6942L8: replace “presented” by “present”

* P6945L3: improvement in what? And observations of what?

* P6945L10: remove “as well”

* P6945L13: “Ko” instead of “Ks”

* P6945L13: replace “solutions” by “solution”

* P6945L24: replace “have been” by “were”?

* P6946L3: replace “successful” by a different word – “improved”? as the models were improved but not very successful – see P6946L17 “unsatisfactory”

* P6947L5-6 “2) The. . ...environments” by P6947L10-11 “;2) Hillvi is. . ..processes”.

* P6947L18: replace “very” by “greatly” or another word

* P6961 – rewrite the caption of figure 5 – replace “-and with different” by “for different”

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 6929, 2009.