

Manuscript: Climate model uncertainty vs. conceptual geological uncertainty in hydrological modeling

Major remarks

The authors present an uncertainty analysis on groundwater and discharge related future projections using an ensemble of climate change projections from 11 GCM-RCM combinations that are used to force various versions of a distributed hydrological model (HM) with 6 different geological model setups. This analysis is a valuable contribution to HESS, but it requires a few clarifications and revisions before it may be published.

- 1) Future changes are considered by comparing two 20-year periods. While this may be sufficient for temperature changes, this might be too short if hydrological changes are considered. For precipitation, at least 30 years need to be considered to get a robust climatology as for shorter periods decadal variability may significantly impact the temporal precipitation averages over such periods, and this is usually impacting other hydrological variables in the same way, at least those that strongly depend on precipitation. In this study this is certainly the case for discharge. Thus, it should be either shown that decadal variability does not play a role in the considered region, especially for discharge, or the considered time periods need to be extended to 30 years.
- 2) The treatment or behaviour of the capture zone is not clear to me. I understand that a capture zone defines the area from which a specific well gets its water from. In my opinion this is purely defined by geological characteristics and should not depend on any climate forcing, i.e. the capture zone should neither depend on the climate model nor should it change under climate change conditions. Thus, if there are such dependencies on climate, then the definition of the capture zone seems to be wrong or there are some model errors.
- 3) Similarly, simulated travel times may only depend on climate if, in addition to their dependency on geology, they also depend on the amount of flowing water. Thus, to understand the behaviour of travel time with respect to climate forcing, it should be indicated how the travel times/flow velocities in each of the HM versions used depend on the flow volume.

In summary, I suggest some revisions to be conducted before the paper may be accepted for publication.

Minor Comments

In the following suggestions for editorial corrections are marked in *Italic*.

In several places the use of singular and plural is erroneous. Thus, the manuscript should be carefully checked to correct those grammar errors, e.g. p.4356 – 1.21 “*is*” instead of “*are*”, p.4363 – 1.18 “*show*”, p.4364 – 1.6 “*depend*”, p.4364 – 1.13 “*are*”, p.4367 – 1.11 “*depend*”. In addition, cross-references to tables and figures (and even some literature references) are often set within Commas, which interrupts the text flow. In my opinion they should be placed in brackets. Examples: p.4356 – 1.24,p.4357 – 1.11, p.4357 – 1.15,

p. 4353 – line 16

... uncertainty *due to* the climate ...

p. 4356 – line 23

... models *using* between ...

p. 4356 – line 25

... models *comprises* two ...

p. 4358 – line 4

...Model *pairings* ...

p. 4359 – line 9/10

... hydrological *variables* is ...

p. 4361 – line 3

No reference geology is defined and *as due to the DC method, the same reference climate is used for all projections, the uncertainty* ...

p. 4362 – line 10

Figure 4 also shows that ...

p. 4363 – line 8

It is written: “The relative change is almost constant for the six models ...”

In this paragraph, you are still dealing with the absolute values of discharge and the respective standard deviations, not with the future changes. Thus, I don't understand this sentence.

p. 4363 – line 25

...than to *the* geological ...

p. 4364 – line 6

... on *the* geological ...

p. 4376 - Table 5

The figure caption suggests that all numbers in Table 5 are standard deviation. But this does not make sense for the column denoted as mean change. The overall standard deviation of the change relative to the reference climate cannot be significantly smaller (or even zero) than the standard deviations associated with the sub-ensembles of geology and climate, such as is the case for Head and summer discharge. I assume that mean change does not denote a standard deviation but the projected mean change. This should be made clear in the caption.

p. 4379 – Figure 3 caption

... are *forced* by ...

p. 4379/80 – Figure 3/4

I suggest using the same y-axis scaling in Fig. 3b and Fig. 4 to allow an easier comparison between the two figures.