Hydrol. Earth Syst. Sci. Discuss., 7, C1397–C1403, 2010
www.hydrol-earth-syst-sci-discuss.net/7/C1397/2010/

Hydrology and Earth System Sciences Discussions

Interactive comment on "The impact of climate change on hydrological patterns in Czech headwater catchments" *by* A. Benčoková et al.

A. Benčoková et al.

anna.bencokova@geology.cz

Received and published: 13 July 2010

We would like to thank to Anonymous Referee #3 for detailed revision providing many helpful comments and we apologize for the delay in our response.

RC: The English of the manuscript would benefit from the help of a native speaker.

AC: We have asked a native English speaker to check the manuscript.

RC: There is little information on the performance and sensitivity of the hydrological Brook90 model, particularly regarding high flow events (as the 1996 event) and the impact of temperature changes as simulated by the RCM.

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

AC: We have performed a local sensitivity analysis using parameter estimation software (PEST) to identify sensitive parameters. We have further combined it with the nominal range method calculating the percentage change of outputs due to the change of model inputs (relative to their baseline values). We tried to identify the change in individual months, since the effect of some parameters is seasonally determined. We have compared the effect of the parameters change on runoff in the present to future effect.

RC: I have some concern on the Brook90 input data, which are used to calibrate the hydrological model (see comments on the derivation of global radiation and air temperature from the meteorological station).

AC: The global radiation calculation was correct and we have changed the air temperature (see answer to specific comments below).

RC: I would replace “predicted” by “projected” or “simulated”.

AC: It has been replaced.

RC: Section 2.1 (Site description) please, add here information on the meteorological station (altitude, distance to the selected catchments). Besides, I would give mean air temperature and precipitation for the meteorological station (as these are measured values) rather than for the 2 catchments (there you apply inferred values and the way how you get these values is described later in the manuscript). I would also describe the 2 runoff stations under this section.

AC: We have changed the section based on your suggestions.

RC: Average runoff at Lysina (451 mm/yr) and Pluhuv Bor (276 mm/yr) differs from the corresponding values given in Table 1.

AC: It is because the data in section 2.1 referred to measured data while the data in Table 1 were simulated runoffs by Brook. It was confusing the data in Table 1 has been changed to measured. It has been emphasised which data are measured and which are simulated.

HESSD

7, C1397–C1403, 2010

RC: Is measured runoff really an input parameter of the Brook90 Model? I would expect streamflow to be one of the output parameters.

AC: Yes, but it is used only for calculation of evaluation statistics within the program.

RC: Section 2.3 (Input data) Line 20: Please, use ". . .daily precipitation" instead of "precipitation depth".

AC: We have corrected it.

RC: You apply an average temperature lapse rate of 0.65 °C/100 m, which is ok for annual mean air temperature. However, lapse rates can have a pronounced seasonal variation reflecting the more stable conditions in winter and intensified convection in the warm season. I would also expect that lapse rates are lower for minimum temperatures. Did you check this?

AC: Unfortunately not and you were right it differed notably especially in case of minimum temperature. Since we have not found a suitable lapse rate for minimum and maximum temperature that would be regionally valid, we calculated the lapse rates for individual months by linear regression relationships using data from 5 representative climatic stations (within the radius of 100 km) with elevation range of 519–1118 m. The decrease varied between 0.1–0.3 °C per 100 m for the minimum temperature and 0.3–0.7 °C for maximum temperature. The input data were changed accordingly.

RC: Global radiation cannot simply be calculated from the "length of the daylight"! You may use sunshine duration (confer Trnka et al. 2005).

AC: It is true. In fact we used sunshine duration data (confer Trnka et al. 2005) but called it length of the daylight. We have already corrected the length of the daylight to sunshine duration.

RC: What about wind speed – do you use daily mean wind speed at the meteorological station?

HESSD

7, C1397–C1403, 2010

AC: Yes, we have added the information to section to the corresponding section.

RC: Section 2.5 (RCM data) A description of the RCAO model under the PRUDENCE project is given in: Räisänen, J., Hansson, U., Ullersteig, A., Döscher, R., Graham, L.P., Jones, C., Meier, H.E.M., Samuelsson, P. and Willén, U. (2003) GCM driven simulations of recent and future climate with the Rossby Centre coupled atmosphere – Baltic Sea regional climate model RCAO. SMHI Reports Meteorology and Climatology 101, pp 61.

AC: We have added the citation to the corresponding section.

RC: Page 1252, lines 2-5: What do you mean with ". . .the model emphasizes. . ."? And: ". . .the resulting changes of meteorological variables correspond with the east-west gradient across the Czech republic" – please, specify which variables, which gradients.

AC: Unfortunately, the authors of the original paper did not provide a more detailed explanation, nor supported the claims with results. Therefore, we decided not to mention the statement in order to avoid possible misinterpretation.

RC: Line 17: ". . .were downloaded from the web-page of the PRUDENCE project. . ." (http://prudence.dmi.dk)

AC: We have added the link.

RC: Lines 22-23: Resolution of PRUDENCE grids was 0.44_ (not 50X50 km). I suggest to use "scenario period" instead of "predicted period".

AC: We have corrected it.

RC: Sections 2.6 and 3.2 I would merge both sections under Chapter 2. The text of Section 3.2 could be shortened and replaced by Figures demonstrating the effect of the "bias-correction".

AC: We have merged the section and replaced the text with corresponding Figures.

HESSD

7, C1397–C1403, 2010

RC: Section 2.6 You refer to 3 papers applying different methods of “bias-correction” – please, describe the method you have applied in more detail.

AC: We have tried to describe our approach in more detail.

RC: Section 3.1 (Model performance) I would skip Fig. 2 – the major information is already given in the text.

AC: The Fig. 2 has been removed.

RC: Sections 3.3 – 3.6 Reading these sections has left me quite confused with all the numbers, percentage changes, etc. Maybe a different arrangement of your results could help the reader to catch the major topics and results of these sections. I suggest to discuss the 2 catchments separately and to change the figures accordingly, i.e. show – separately for each catchment – percentage change of precipitation, runoff and evaporation (with the same scale for each component of the water balance). The current figures 5-7 show the distinct components at both catchments – this is not supported by the text, as you do not focus on the different behaviour of the 2 catchments.

AC: We have shortened these sections significantly and changed the Figure design to show actual data and not percentage change. It enabled us to see some of the previously discussed values in the charts. Rather than discussing the catchment separately we transferred some of the data to tables to the appendix.

RC: Simulated daily discharge (page 1259, line 10): it would be helpful to show a cumulative frequency distribution of present day and simulated future daily discharge.

AC: We have added the figure.

RC: Section 4 (Discussion) I do not agree with your statement on bias-correction (“. . . more consistent with RCMs than . . .the delta-change method”), which is based on the experiences of Lenderink et al. (2007). The authors applied a very simple form of the delta change. A more sophisticated form of the delta-change method may cause different results (as Lenderink et al. state in their paper). Here, I would not enter the

HESSD

7, C1397–C1403, 2010

discussion on advantages and shortcomings of bias-correction and delta-change – you have only applied one form of “bias-correction”.

AC: It is a reasonable objection; we have changed the discussion according to your comment.

RC: What do you mean with the second paragraph?

AC: We have omitted the second paragraph; since it has referred to something obvious that might not to be absolutely clear from the description. We wanted to point out the fact that regional climate model data can be compared with measured data only by means of the long-term statistical behaviour. It is due to the fact that even though they represent the same period (meant the control period) the RCM data are not based on direct observation at certain location. Therefore, we cannot expect them to capture an individual event on a specific day (this refers to the temporal attachment).

RC: Page 1262, line 26: What do you mean with the “redistribution of precipitation” – that runoff is sensitive to changes in the seasonality of precipitation?

AC: Yes. We have changed the sentence.

RC: Page 1263, line 29: (Déqué et al., 2007) instead of (Déqué, 2007)

AC: It has been corrected

RC: In view of the uncertainty in the overall modelling I would refrain from giving exact percentage changes in the discussion (like 11%, 19% etc.).

AC: We agree therefore we have avoided using such exact numbers.

RC: Figures and Tables Figure captions of Fig. 4-7 should be altered: “Percentage change in monthly precipitation, etc.

AC: We have changed the Figure design to show actual data and not percentage change.

HESSD

7, C1397–C1403, 2010

RC: Table 1: Considering the long-term water balance, precipitation exceeds the sum of evapotranspiration and runoff by 70 – 110 mm/yr. How do you explain this difference, is it storage, deep seep, etc?

AC: We assume it is a deep seepage. We have mentioned it in the discussion section.

RC: Figure 1: What does 37-47 mean? Number of Prudence grids?

AC: Yes, it was mentioned in section 2.5.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 1245, 2010.