Hydrol. Earth Syst. Sci. Discuss., 10, C4272–C4275, 2013
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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Impacts of climate and forest changes on streamflow and water balance in a mountainous headwater stream in Southern Alberta" *by* V. Mahat and A. Anderson

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Received and published: 21 August 2013

General remarks: The manuscript (MS) demonstrates the effects of climate change and forest change on streamflow in a mountainous catchment in Alberta, Canada. The impacts are shown with the HBV-EC model, which is calibrated based on data from a climate station within the study area. Disaggregated data are used to simulate different scenarios and to compare the effects under different conditions.

The manuscript presents an interesting and current issue and is well structured, but I believe it needs some changes and more details before it can be published in HESS.

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Main concerns are the lack of basic information on how forest change is treated within the approach. It should also be clarified in more detail, which parameters of the HBV-EC model were calibrated, why these parameters were included, etc. For more details, please see the specific comments below.

Specific remarks: Section 2, P. 8507, L 12ff: You name the different tree species. Here, listing fractions (%) of the land cover (grass, brushes, forest or else) would be of great value. Later on, you could refer to that when you define the forest change in your simulations (there is more on that issue below).

Section 2, P. 8507, L. 18ff: I believe that one climate station in a catchment of >300 km^2 with an elevation range of more than 1000 m leads to a high degree of uncertainty, especially if the area is dominated by snowfall (P. 8507, L. 18). You mention that there are additional climate stations with shorter time series. Did you check how the data relate for existing temporal overlaps? Could you give some hints on this? You may at least get an idea of how your climate data behave, compared to each other and it may increase the reliability of your input data. Additionally: Why don't you add the average annual amount of precipitation from your Coleman climate station (in context with the 50-70% in P. 8507, L. 18)? It would be interesting to learn about some long-term average of climate parameters in your catchment. Could you present the average temperature, precipitation, evapotranspiration, etc. from your available data set? A comparison with the average annual streamflow would also be great.

Section 2, P. 8508, L. 3ff: Could you give the recording intervals of your monitored climate and streamflow data.

Section 3.3.1/3.3.2: Here, more information on the whole modeling approach is needed. The short description of the model is ok, but details on your calibrated parameters would allow to reproduce your work. Did you include all parameters in the calibration? If not, which ones were included and why were they included? Was there any kind of sensitivity analysis prior to calibration? Did you validate the model? While

HESSD

10, C4272–C4275, 2013

dealing with scenarios, a validation is very supportive, I think. Additionally, you have a valuable long time series, which you can easily split up into a calibration and validation period. Maybe you can add a table with the most important parameters you calibrated. There, you can also show the parameter values (and obtained NSEs) of your best performance, for example.

Section 3.3.1, P. 8512, L. 22: With regard to the following forest change, it would be helpful to be more specific on land use types at this point. Which land use types did you include, and what is the share on the total area?

Section 3.3.2: In section 3.2 (P. 8511, L. 18), you state that you [. . .use stochastically generated climates to provide input to the hydrological model to simulate reference period streamflow. . .] for a better comparison of the scenarios. In section 3.3.2 (P. 8512, L. 19), you write that [. . .the model is driven by the thirty two years of climate data recorded at the Coleman climate station. . .]. Does this mean you calibrated the model with observed data from the Coleman climate station and recomputed the time period with generated data to compare the performance of the model?

Section 3.3.4: Please give details on how the 100 parameter sets were obtained. How many runs were necessary to fulfill your criteria? What range were your NSEs in? What is your threshold?

Section 3.3.5: As forest change is a major issue of the presented study, the MS would benefit of a revision of this section. I believe it is ok to give references for methods (P. 8513, L. 18ff), and not describing them in detail in your own MS, but some short information on how the quoted authors deal with the changes would be supportive. To me, it is not clear how you incorporated the forest change in your model. You say you removed the forest (P. 8513, L. 22ff). All of it? For the whole simulation period? How about 'regrowth', or do you assume your catchment remains with bare soils during the whole simulation period? If your soil does not remain 'bare', with which land use type did you exchange forest? Is a complete forest removal a realistic scenario for the study

HESSD

10, C4272–C4275, 2013

site? How about comparing different degrees and different locations of forest removal? For instance, remove only 25%, 50% or any chosen fraction, or, remove forest only from specific parts of the area (along the riparian zone, in the upper area, or elsewhere). It would be interesting to see how this affects your streamflow. I would recommend to add at least another variation of forest removal to your scenarios.

Section 4.4, P. 8516, L. 27: Could you give NSE values?

Section 4.6, P. 8517, L. 7: How were the best 100 parameter sets defined? Which parameters were included in the calibration (please see comment above)? Could you give the NSE ranges?

Section 5, P. 8518, L. 22: [. . .Performance of mean precipitation and temperature were good. . .]. Could you define 'good'?

Section 6: With regard to your title, you should mention the effect of forest change on streamflow in your conclusion, somehow.

Figures and Tables

Table 1: I assume the changes/deviations in Table 1 are given with regard to the Coleman station data?

Figure 3: To me, it seems a little confusing that the axis title says 'Mean daily T. . .', while you are presenting monthly values. In your MS you write 'monthly mean values of daily T. . .'. Maybe you could name this the same.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 8503, 2013.