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Hydrology and Earth System Sciences Discussions

Interactive comment on "Estimation of future glaciation and runoff in the Tanimas basin, Eastern Pamirs" *by* W. Hagg et al.

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This paper proposes to generate future water balance scenarios for a catchment in the Eastern Pamirs. As far as I see, it does not present any new methods. It is a classical climate change impact analysis, proceeding as follows

1. Take current state of the system and observed meteorology / hydrology, calibrate a conceptual hydrological model
2. Generate climate change scenarios
3. Make an informed guess about future system state
4. Apply the hydrological model with this scenario and draw conclusions

There are certainly special cases where such a procedure might give useful results, but it is now well understood that there is often not much value to such studies (Blöschl and Montanari, 2010). This probably also holds for this paper, since the presented case study shows an important number of drawbacks:

- A hydrological model developed for temperate climate is applied to an arid catchment; I would not have any confidence that such a model can actually simulate correctly the water balance components and especially not evaporation; how potential evaporation is obtained is not mentioned
- Only the glacier surface is updated; potential changes to other land uses are not even mentioned
- The method to update the glacier surface has certainly been developed at different locations/climates (different accumulation / ablation behavior); I would expect here a discussion of whether it is appropriate or not
- There is no evidence that the individual components of the simulated water balance have anything to do with reality; such evidence has to be provided before applying the model to future climate;
- The model is tuned manually, why? how can we know that the parameters are actually the ones that give the "correct" water balance terms? could other parameters not give completely different terms? such a manual model calibration can be justified in some circumstances but, it is in general not state-of-the-art; the effect of parameter uncertainty on water balance has to be assessed (especially, since as is stated in the paper, the values could be different if the model was calibrated on a different period).
- Only one meteo station is used for a 4300 km2 catchment; without any further data, this is difficult to "accept" (even in data sparse regions), especially because

catchment-wide precipitation is calibrated with some correction factors; there are satellite-derived products around that could give an idea of precipitation amounts and variation in space (Bookhagen and Burbak, 2009; Winsemius et al, 2008) but also of actual evaporation (Winsemius,et al., 2008).

To my view, this study is merely an analysis of the sensitivity of HBV-ETH to a modified climate.

Detailed comments

- I do not understand the elevation-dependent glacier surface update; why and how Kuhn's result of 170 m of ELA change per °C of temperature change is used? is this value not influenced by precipitation changes? and by the selected degree-day factor? and does it hold only at certain places? what are the assumptions behind? why is the corresponding value not directly obtained from the HBV-ETH simulations? why is only a temperature change considered for deglaciation (section 4.1) and not temperature and precipitation? clearer details on how the deglaciation is obtained are required.
- What is the melt factor for ice?
- Information on seasonality of precipitation input seems to be missing
- Many cross-references are wrong
- Uhlenbrook reference is missing; this is certainly not the most appropriate reference for parameter uncertainty
- Calibration / validation on monthly values is not really interesting; the monthly time step is the easiest to simulate and, due to temporal integration, will always give the best results; an annual integration is much more useful, since at the

annual time step, the water balance has to be closed, which is more difficult to achieve

- Given the size of the catchment and the glacier regime, mimicking discharge is a fairly simple task for a model, as discussed in many recent glacio-hydrological papers; in any case, achieving good Nash-values cannot be the main objective here.

References

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