

Interactive comment on “A comparative analysis of projected impacts of climate change on river runoff from global and catchment-scale hydrological models” by S. N. Gosling et al.

Anonymous Referee #2

Received and published: 3 November 2010

This paper addresses uncertainties in quantifying future climate change impacts on river runoff. Uncertainties due to the degree of spatial aggregation in the hydrological model are compared to uncertainties caused by variations in future climate change predicted by various climate models.

The paper is well written, clearly structured, and of interest to the HESS readership. Overall, the work constitutes a nice contribution and should be suitable for publication after minor revisions. Briefly, additional discussion is needed to address issues related to methods and conclusions, and some changes to the presentation are suggested to

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improve impact.

Methods and conclusions

- One of the main conclusions is that climate model uncertainty dominates hydrological model uncertainty. However, this conclusion is based on the prior uncertainty assigned to both climate and hydrological models; in other words, the (subjective) selection of models and scenarios included in the analysis determines the outcome. Two questions arise:

1. Do the selected models adequately account for model structural uncertainty? For example, one could argue that hydrological model uncertainty is underestimated since only two hydrological models are considered in each basin.

2. Can the prior uncertainty be reduced by confronting the models (climate and hydrological) to historical data? For example, it may turn out that some climate models perform much better on historical data from the specific basins in this study than other models, thereby reducing climate (posterior) model uncertainty.

The authors touch upon this at the end of the discussion section, but I think this issue should be made more explicit throughout the paper.

- Can the authors discuss other uncertainties that have not been accounted for, such as within-model uncertainties (due to parameter errors, data mismatch...)?

- An implicit assumption is that the CHM can be used as a reference to evaluate the GHM (see eg p. 7205, line 27). It seems that the CHMs should indeed be better since they were calibrated on the specific basins, but that should be shown with explicit numbers in a table by comparing all models to historical data.

- I believe that ideally all models should have been calibrated using downscaled GCM output, as that is what is used to estimate future impacts. That would make for a more consistent approach and allow the model parameters in calibration to compensate for some of the errors in the downscaled GCM output. Can the authors comment on this?

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- p. 7197, line 12: since GHM grids are disconnected, why not run the model for only the grid cells in the basins of interest? That would reduce the computational load to a few hundred grid cells (based on numbers in Table 1).

Presentation

- A diagram or flowchart may be beneficial in clarifying the various uncertainties that come into play when assessing climate change impacts on river runoff. This would clearly show which uncertainties are accounted for here and which uncertainties are ignored; that may also help the discussion later on.

- Hydro-models calibration results: I understand that details of the model calibrations have or will be reported in separate papers; however, it would still be necessary to report here a summary of the calibration results, for example listing some performance metrics of each model in each basin in a table or figure. That would give the reader some feeling for the relative performance of these models, including how the CHMs compare to the GHM.

- Please clarify in the abstract already that the main difference between the GHM and CHMs is the level of spatial aggregation of hydrological processes. And I guess also the fact that the GHM does not include lateral flow between elements.

- Abstract, line 21: specify here how big the “substantial differences” are

- Throughout the paper I suggest replacing “inter-comparison” by “comparison”

- Section 3.1: instead of showing global maps of projected precipitation changes (figs. 2 and 3), it would be more relevant to show specific results for the basins studied in this paper, eg time-series plots of climate time-series for each basin.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 7191, 2010.

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