

Interactive comment on **“Projection of future glacier and runoff change in Himalayan headwater Beas basin by using a coupled glacier and hydrological model”** by Lu Li et al.

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Dear authors,

This is a very useful study that has been conducted for the data-scarce Himalayan Basin. I have gone meticulously through the paper and I have the following queries:

1) Line 24. The study helps to understand the hydrological impacts of climate change in North India and make a contribution to stakeholders and policymakers with respect to the future of water resources in North India. -However, since only one GCM (BCC_CSM 1.1) is used for the study, how accurate would be the predictions to be able to be referred by the policymakers? -How is the use of this particular GCM, ‘Beijing Climate Center Climate System Model’ (BCC_CSM 1.1), justified for use over the Himalayan basin? Please elaborate on this issue.

- Thanks for your positive evaluation in general and for your professional comment. We agree with it and we will add two ensembles of four GCMs the same as in glacier projections (Lutz et al. 2016) for a more comprehensive comparison and uncertainty investigation for the future water cycle and availability in this Himalaya headwater Beas river basin.

2) Line 237. Authors should present a figure showing the location of Chhota Shigri glacier in the Beas Basin. Because according to SERB report (Ramanathan, 2011), Chhota Shigri glacier is a part of the Chandra Basin. Chandra basin is a sub-basin of the Chenab river basin according to IndiaWRIS basin maps and the SERB report by Ramanathan (2011).

- Thanks for the comment and reference. We have corrected it in the manuscript: “The Beas river basin is located in Spiti-Lahaul region, where the available glaciological mass balance series published for comparison are the Chhota Shigri glacier and Bara Shigri glacier (Berthier et al. 2007). The Chhota Shigri glacier is the only one which has been well studied and has detailed and longer period of glacier mass balance data, which also has geodetic mass balance data for validation (Azam et al. 2016). The Chhota Shigri Glacier is a part of the Chandra Basin, which is a sub-basin of the Chenab river basin (Ramanathan, 2011), but it is attached to northeast boundary of Beas river basin, which is close to Manali and Bhunter stations (Fig 1.). In this case, it is used for glacier module calibration in the study, which is to be comparable to the simulation.”

We have also added the location of Chhota Shigri glacier in the Fig. 1 of the revised manuscript. Please see the Fig 2 in the “reply to the RC1”.

3) Line 150. Chhota Shigri glacier Area is about 16 Km² (Ramanathan, 2011), the resolution

of the hydrological model GSM-WASMOD is $10 \times 10 \text{ Km}^2$. The limitation measured on line 306 also mentions the same thing. However, I feel that the model in the study is too coarse to be able to accurately represent the outflow from the glacier melt. How is such a coarse model justified to be used for representing glacier melt from such small area glaciers and the glacier evolution?

- Reply: Thanks for the comment. We understand the concern from you. We used mass balance data of Chhota Shigri glacier for comparison with the simulation of the study, because it is the well monitored and studied glacier whose data are available for using. From the revised new Figure 1, we can see that the Chhota Shigri glacier is very small glacier compared with the whole glacier cover in the Beas river basin. In the study, we are looking at the whole glacier extent of Beas river basin and its impact to the total basin runoff, instead of a single Chhota Shigri glacier, which has been done by several previous papers (i.e. Berithier et al. 2007, Azam et al. 2016).

Furthermore, in the replies to the comments of previous two reviewers, we have explained the reason for choosing $10 \times 10 \text{ km}$ resolution in our original version of the manuscript. Following reviewers' suggestions, we are now re-running the model on $3 \times 3 \text{ km}$ resolution and if the results are found to be better, we will replace the old results.

4) Line 115. Since the outlet station is Thalout station used for calibration of discharge, I would like to know what is the area of the Beas basin upto Thalout?

- Thanks for the comment and reference. We added the mark of watershed area up to Thalout in the new Fig 1. (please see Fig. 2 in the "reply to the RC1").

Reference: Ramanathan, AL. (2011). Status Report on Chhota Shigri Glacier (Himachal Pradesh), Department of Science and Technology, Ministry of Science and Technology, New Delhi. Himalayan Glaciology Technical Report No.1, pp-88p.