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Interactive
Comment

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Discussions

Interactive comment on "Spatial patterns in glacier area and elevation changes from 1962 to 2006 in the monsoon-influenced eastern Himalaya" by A. Racoviteanu et al.

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Dear colleagues,

I just stumbled upon this very interesting contribution and would like to concisely give some ideas, since I widely agree with the reviewers' comments. We conducted a quite similar study for the eastern Nyainqêntanglha Range at the eastern syntaxis of the Himalayas, approximately 600 km east from your study area (Loibl et al., 2014). Even though the investigated timespan differs (LIA maximum - 1999), I think a comparison of the trends evident in the data sets and the interpretations regarding the forcing mechanisms would be highly valuable.

Thank you for these comments, we appreciate it. This is an important point, than you for bringing it out. It is true we have not compared our results with areas much further east, but we agree that a comparison is valuable, given that the time span and the methodology are very relevant. This is a good point also since we have focused the discussion so that we out our results in the larger context of the Himalaya. We have made reference to Loibl et al, 2014 in the revised version of the manuscript, and have presented our area changes with respect to surrounding areas, Khumbu to the west, Bhutan to the east and further east in Tibet.

For example, you speculate that the location of your study area in the monsoon-influenced area may be leading to lower sensitivity toward climate change. In contrast, our results indicate increasing sensitivity with increasing monsoonal influence (cf. also Loibl and Lehmkuhl, 2014). This also seems to be in accordance with large-scale studies (e.g., Gardelle et al., 2013; Neckel et al., 2014 and references therein) and local ground measurements (e.g., Zhou et al., 1991; Zheng et al. 1999). I am also not sure, whether it is

correct to assign your study area and the eastern Nyainqêntanglha (falsely called 'Hengduan' by Gardelle et al., 2013, in my opinion) to the "same climatic zone" (cf. 3966L5), because there are noticeable differences in precipitation (cf. Maussion et al., 2014). Nevertheless, the conclusions drawn regarding the influence of topographic factors are widely similar.

We agree with these two points, particularly that glaciers in the monsoon-influenced areas experience more sensitivity to climate, with perhaps different impact of changes in precipitation and/or changes in temperature. We had speculated that the role of precipitation may be an important factor here, and that glaciers might be less sensitive because their accumulation areas might be better maintained. However, do not have good support nor evidence for the impact of climate factors in this area of the Himalaya, so we have revised our statement (see section 4.2). This part now reads:

Precipitation was also found to be significant in controlling glacier area loss, but the correlation was less strong than the glacier elevation factors mentioned above (Pearson's r = -0.25). In contrast, Loibl et al. (2014) showed that glaciers located in a monsoon-influenced area were more sensitive to climate change. This is in agreement with larger-scale studies (Gardelle et al. 2013), which indicated a tendency for enhanced glacier wastage in the eastern, monsoon-influenced parts of the Himalaya. With respect to climatic factors in this area, Basnett et al. (2013) reported an increase in mean annual temperature, more significantly in the winter (+2°C yr^{-1} in the last four decades). Increasing temperatures on the south slopes of the Himalayas were noted in other studies (Shrestha et al. 2000; Thakuri et al. 2014) based on instrumental data, but were estimated to have less effect on glacier area than changes in precipitation because of the orientation of these glaciers towards the prevailing monsoon circulation. In our study, the climatic control on glacier area is not conclusive, and finer-resolution, more accurate temperature and precipitation datasets would be needed. Furthermore, similarly to areas further east (Loibl et al. 2014), average annual solar radiation and latitude were not found to be significant controls on glacier area change in our study. Other factors such as supra-glacial debris cover might have a more important role than climate controls in preserving glacierized areas.

Further, I have only some remarks regarding your figures:
Fig. 3: Coarse resolution of climate data – why not use the freely available HAR data?

At the time this paper was started, we were not aware of this dataset, nor have we tested its accuracy for this area. It is a good point for a future paper, in which we plan to include a few more variables in a more sophisticated model.

Fig. 4a: I suggest a different grouping/logarithmic scaling to make this more figure more informative.

Good point, but a little late to change now. Left as is.

Fig. 4b: Isn't it km?

Changed.

Fig. 5: Labeling of axis?

I think labeling of rose chart axis is not necessary. You mean perhaps "N", "S"? We labeled the axis using the 0 – 360 degrees.

Fig. 7: We used similar diagrams in Loibl et al. (2014) but used symbols for clean and debris-covered the other way (i.e., triangle for debris-coverd, circle for clean). Maybe similar usage would be beneficial?

It would be nice, but at this point we don't consider necessary given the time constraints.

Fig. 10: Many glaciers show thickening at glacier termini, which I found very interesting I would like more ideas on this phenomena in the discussion.

Unfortunately this section is not mature/conclusive yet due to the uncertain quality of the topographic map, and therefore we have removed this section. We will address this in a different paper using perhaps different (an hopefully more accurate) elevation datasets.

I'm looking forward to the final version of your manuscript.
Kind regards,
David Loibl

Thank you very much,

Adina Racoviteanu

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