

Interactive comment on “Brief Communication: Glaciers in the Hunza Catchment (Karakoram) are in balance since the 1970s” by Tobias Bolch et al.

Anonymous Referee #2

Received and published: 4 November 2016

This is a useful study that provides the first long-term information (since the 1970s) about geodetic glacier mass balance for a region of the Karakoram. This is a region where many recent papers have suggested that glaciers are changing little in mass, but prior to this study little previous information has been available about glacier elevation changes before ~2000. The techniques are well described, the errors are well quantified, and useful final conclusions are produced.

Most of my comments are relatively minor and focused on technical issues, but there are two useful analyses that could be undertaken that would help to strengthen the paper:

1. A computation of the total elevation changes over the period 1973-2009 should be completed. This would help to validate the patterns shown in the individual periods,

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potentially reduce the effect from individual surges, and provide evidence that mass balance has been stable over the long term.

2. Provide a plot and discussion of the change in geodetic mass balance with altitude for non surge-type glaciers. This could provide insight into whether changes are occurring at particular altitudes, even though the overall mass balance may be close to zero.

Individual comments:

P2, L22: there is actually this mass balance study available for a glacier in the Karakoram prior to 2000, although it only covers a 5 year period: Bhutiyani, M. R. 1999. Mass-balance studies on Siachen Glacier in the Nubra valley, Karakoram Himalaya, India. *Journal of Glaciology*, 45(149), 112-118.

P2, Fig. 1: it would be useful to label the location and names of some of the main peaks or towns in this region to make the map easier to follow. The lat/long labels around the margins are also currently too small to see.

P3, L11: the sentence ‘The major advantage...’ doesn’t really make sense as written. Please reword.

P3, L13: please provide the resolution and spatial extent of the KH-9 imagery. I also think that you mean to refer to Table S1 here, not Table 1

P3, L16: should be ‘database’ (one word)

P31, L21: a few words to explain what the ‘reseau grid’ is would be useful as it’s not a commonly used term. I also think that it should be spelled ‘Réseau grid’

P31, L23: change ‘GCPs have been collected...’ to ‘GCPs were collected...’. Also describe how and where the GCPs were chosen – e.g., Were they located on bedrock areas? How many were used? Were they chosen across a range of elevations?

P5, L5-6: I’m unclear as to why a 5% uncertainty was chosen for the glacier area map-

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ping. If there are good optical satellite images available for this area, then presumably it should be relatively straightforward to map the glacier areas with <5% uncertainty?

P6, Fig. 2: I find the labels and dots on these figures quite difficult to see as they're so small. Also please indicate the source of information for identifying which glaciers are surge-type. As mentioned above, it would also be very useful to produce a DEM difference map for the entire study period (1973-2009)

P7, Table 1: similar to the comment for Fig. 2, please include a column to show the glacier mass balance values for the entire study period 1973-2009.

P7, L11: 'where lower' should be 'were lower'

P8, L1-3: the first sentence in this para is difficult to follow. The rest of this para is also quite awkwardly worded, with quite a few typos. Please be sure to check carefully. E.g., L8: change 'allowed to detect the surge activity' to 'allowed for detection of surge activity'. Also – what does 'south exposed glacier' mean? Do you mean southerly facing?

P8, Fig. 3: also show the total change from 1973-2009

P9, L7-9: it would be useful to add a few words here (or elsewhere) about the relatively rapid surge periodicity in the Karakoram: i.e., that within a 40 year period it's likely that you've captured a large part of a surge cycle (or even more than one). This is different to locations such as Svalbard, where the active and quiescent phases are typically much longer.

Figure S1: it's unclear as to which dates refer to which areas, particularly for the 1999-2009 image. Colour coding the date label and associated box would help

Table S1: indicate what (P/R, K/J) indicate in the header for column 3

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