

Comments on “Region-wide glacier mass balances over the Pamir-Karakoram-Himalaya during 1999–2011”, by J. Gardelle et al., *The Cryosphere Discussions*, 7, 975-1028 (2013)

Graham Cogley, April 2013

General Comments

This paper presents geodetic measurements of glacier mass balance for eight SPOT5 scenes spanning from the northern Pamir to southeastern Tibet and dating from 2008–2011, the measurements being derived by subtraction of SPOT5 elevations from those of the Shuttle Radar Topography Mission in 2000. The measurements build on the highly successful and reliable earlier work of the authors in other parts of south Asia. They confirm earlier patterns of spatial heterogeneity, and extend the region in which mass balance is zero or slightly positive northwards as far as the northern Pamir. In general the mass-balance rates for 2000–2011 rates are rather moderate, and when extrapolated from the SPOT5 scenes to the region as a whole are only slightly negative. Ancillary findings include further confirmation that debris-covered glacier tongues are not thinning at unusually low rates (although the measured rates are quite variable from scene to scene); new calculations of the contribution of glacier imbalance to the discharge of the major rivers draining the Himalaya and Karakoram; and new details about the prevalence of surging among glaciers of the Pamir and Karakoram, which is illustrated quite strikingly in the authors’ detailed maps of glacier thinning and thickening rates.

I am surprised at how few substantive comments I ended up with, and at how minor they are. This is a valuable and highly competent study that should be published rapidly.

Substantive Comments

P979

General

It might be helpful to draw attention to the anomalously negative balances reported (to WGMS) for Hamtah Glacier. I have been unable to find any description of how those measurements were made, and they affect regional estimates noticeably.

P982

L5-6

There are very small glaciers (especially in the Hindu Kush) with up to 100% debris cover, but they are on the way to becoming rock glaciers. Perhaps there is no need to mention them.

P984

L22

What is the “along-track angle”? The azimuth, as in “the azimuth of each SPOT5 ground track”?

P987

L6-11

It was worthwhile to include these two very large glaciers.

L15

The density of $850 \pm 60 \text{ kg m}^{-3}$ was introduced by Sapiano, J.J., W.D. Harrison and K.A. Echelmeyer, 1998, Elevation, volume and terminus changes of nine glaciers in North America, *Journal of Glaciology*, **44**(146), 119-135.

P989

L9-11

These decorrelation distances can presumably be thought of as typical valley half-widths. Were they different enough between the scenes for it to be worth tabulating them.?

L18-21

Avoid repetition; say just “Given the slender observational support for the seasonality correction (section 3.3 (v)), we assume its uncertainty to be $\pm 100\%$.”.

L24-26

Repeats material at P987 L14-16. The two should be merged, in one place or the other.

P994

L19ff.

“of thick debris”. The findings discussed in this section add to a growing body of evidence that debris cover does not retard ablation as much as might be expected. However the discussion does not mention, as it could, the possibility that one reason might be that much of the debris is thin (or discontinuous at a scale finer than that of a sensor pixel).

P997

L6-7

This sentence is weak and could be deleted, especially since the periods compared differ by only by two years out of 10–12.

L16-21 Say more clearly why the standard error of 0.08 at L16 has become 0.14 by L21, and explain the “100%” (0.14 is not twice 0.08).

P1011

Table 1

Although this is not the place to discuss it, the RGI overestimate of 88% for the glacierized area of the Hengduan Shan scene is remarkable and deserves further investigation. RGI version 2.0 is basically the (first) Chinese Glacier Inventory (1970s–1980s) in this location.

Stylistic Comments

P976

L6

“from the Pamir to the eastern Himalaya”. There are dozens of instances in the rest of the text of missing “the” before the names of mountain ranges.

L16

“than the previously”.

L21

“westerlies” (throughout text).

L22

Delete “by the PKH mountain ranges” (if it is kept, “by” should be “of”).

L23

“and contrasting patterns”.

P977

L9

“infrastructure by the release of glacial ... floods”.

L21

“measured on about ... and have revealed predominant retreat”.

L26

“shrinkage” rather than “shrinking”.

P978

L18

No need to capitalize “accumulation-area ratio”. Comma after “(AAR)”.

P979

L11

Delete “comprised”.

P980

L1

“present”, not “propose”.

L7

Delete “overall”.

P981

L2

Delete “a”.

L3

“These constraints make”. “large”.

L8

“both occur”.

L9

“At the other end of the range, in”.

L12-13

The main effect is likely to be drying by lifting rather than the physical stoppage of the flow. Say something like “as it dries out the southerly air flow and can even prevent the air mass from travelling further north”.

L18

Change “result in a reduced” to “reduce”.

L23-24

“between short active phases”. “quiescent”.

L26

“observed in the region”.

L27

Delete “, partially cyclic,” (or rearrange the sentence if this point is of some importance)

L28

“51 actively surging glaciers (Kotlyakov”.

P982

L1

“areas”.

L2

Delete “an”.

L4

“from a few”

L5

“debris cover” (no hyphen).

L11

“resulting from coalescence”.

P983

L9

“A threshold ... was applied to the ... to detect”.

L15-16

“which compensated while it was operational for”.

P984

L8

“glacier”.

L9

Delete “before”.

L13 “elevation”.

P985

L2 “related to”.

L14 “at this wavelength (~56 mm), the”.

L17 “The latter was acquired simultaneously with”. Comma after “swath”.

L20 “needs”. “expected to” could perhaps be supported with a reference to Ulaby et al. or another standard text.

P986

L5 “thereby, to measure”. “over an integer number”.

L8 “the correction is derived”.

L14 “smaller” rather than “lower”.

L19 “other”.

L24 “within each study site”.

L25 “does not hold for actively surging glaciers.”.

P987

L6 “for the large Siachen”.

L12 “requires knowledge”.

L20 “The region-wide mass balance”. Try to avoid “total” in the sense “region-wide” because many authors use it to distinguish specific balances (e.g. in m w.e.) from total balances (e.g. in Gt).

P988

L8 “change”.

L9 “(at 90% confidence)”.

L10 “of the SRTM”.

L11 Delete “to”, and change “i.e.” to “or”.

P989

L4-5 “in”, not “among”. Delete “that is considered”.

P990

L13 “especially those whose fronts were in contact”.

L22 Delete “in these areas”.

P991

L6 “pixel”.

L10 “parts”.

L25 “for the north-flowing”.

P992

L4 Delete the confusing “global”.

L12 “are equal”.

L28 “and we do not attempt”.

P993

L17 “flown) here than”.

L18 Delete “values”.

P994

L2 “areas”.

L3 Delete “an”. “They” is ambiguous; it could refer to the glaciers, but also to the rock walls or maybe even the debris.

L9-10 “as in general the gain in insulation then exceeds”.

L16 “with net thinning”.

L18 “thinning is greater”.

P995

L2 “PKH”. Same change at P999 L6.

L16 Delete “total”.

L21	“are”, not “is”.
L21-23	For clarity, say “we have calculated updated mass balances ... and find that they are consistent”. Comma after “error bars”.
P996	
L6	“to those of Nuimura”.
L16	Comma after “downwasting”.
L20	“explains”.
L22	“take”, not “took”.
P997	
L4	“balances”.
L5	“that, at least over these distances, the”.
P998	
L15	“in Heid and Käab (2012)”.
P999	
L3	“estimate”.
L6	“suggests”.
L8	“except in the Pamir”.
L11	“and insignificant”.
L18	“On the other hand”. (“On the opposite” is not idiomatic English.)
L21	“of greater surface”. And “aqueous” cannot be right; should it be “subaqueous”?
L24	Delete “overall”.
P1000	
L1	“western end”.
L16	“for reduced ablation”.
L18	“On the other hand”.
L19	Delete “potentially”.
L22	Change “as well as” to “and moreover”.
P1001	
L1	“, as recently”.
L3	“climate near to PKH”.
L7	“with restricted”.
L8	“time series” (no hyphen).
L18	“the part of the annual”.
P1002	
L3	“eight”.
L8	“to have been -0.12”.
L11	“in both the Pamir and the Karakoram”.
L17	“four”.
L18	Comma after “suggests”.
L24	“to evaluate more closely”.
Table 1	“eight study sites for”. “the percentage difference between”.
Table 2	“eight study sites”.
Table 5	“eight sub-regions to which”. What does “Mass variation” mean in the rightmost column?
Table 6	“from the Randolph”. “Numbers in parentheses”. Some work on the column headings would create space for a column giving the total discharge.
Table A1	“centred”.
Figure 1	“eight”.
Figure 3	“Quiescent” in the legend.
Figure 4	“in the ablation area”.