The Cryosphere Discuss., 7, C2721–C2726, 2013
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The Cryosphere Discussions
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Interactive comment on "Tracing glacier changes since the 1960s on the south slope of Mt. Everest (central Southern Himalaya) using optical satellite imagery" *by* S. Thakuri et al.

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Received and published: 13 December 2013

Thakuri et al (2013) provide a data set on glacier changes in the basins on the south side of Mount Everest, Nepal. The combined examination of surface area change, debris cover change, snowline altitude change and terminus change have the potential to provide a data set of enough breadth for valuable interpretation. The paper at present does not realize that potential. I come away with more questions than answers. Some key references are not cited for comparison, for example Bajracharya and Mool (2009). Key assessments are not explored, for example, the highest rate of thinning being in the transition from clean ice to debris cover (Bolch et al, 2011). A key parameter needs

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to be better defined that these glaciers are the highest in altitude, is this based on mean, median or top elevation? Most comments below can be addressed with simply a better presentation. There is also an opportunity to greatly strengthen the SLA record without too much additional effort, at present this data set is not robust.

5391-121: Reword "We have decided to contribute to the international debate on glacier changes in the Himalaya by focusing our attention" to This contribution examines glacier changes on the south side of Mount Everest as part of an effort to better define glacier changes in the Himalaya.

5393-12: Many, is vague-quantify this. Bajracharya and Mool (2009), indicate there are 278 glaciers in the Dudh Khosi with 40 accounting for most of the area and all of these being valley-type.

5393-2: This period also coincides with maximum ablation low on the glacier.

5396-10: lateral and frontal moraines often are not in contact with retreating glacier. How was this dealt with? Were surface streams issuing from beneath glacier used?

5396-22: Was the SLA only identified on glaciers or along non-glaciated terrain as well?

5397-4: Switch time to season.

5400-9: generally continuous and constant.

5401-13: area loss instead of shrinkage, be careful using shrinkage in place of surface area loss, particularly in figure captions.

5403-21: Debris cover increases during periods of high ablation as more englacially stored debris is exposed. Bolch et al (2008: 2010) note the increase in debris cover and loss of clean ice area during the same period as a result.

5404-18-25: Confusing presentation need to present results in a table.

TCD
7, C2721–C2726, 2013

5404-28: This is expected given the lag in response time and that downwasting leads to more volume loss then retreat or area loss.

5405-4: Remove if this contention is not better supported.

5405-27 and 5406-5: Compare to Bajracharya and Mool (2009), also to Ren et al (2006). The terminus rates reported by these papers even for the same periods and same glaciers do not match those in the supplement. Why not? Bajracharya and Mool (2009) Table 1 can be compared to the supplement, and for glaciers like Ama Dablam, Imja, Khumbu etc, the retreat rates are generally lower in Thakuri et al (2013). The supplement itself is poorly presented, unreadable without effort. This is the key data, it must be well displayed, not microscopic. Ren et al (2006) is in the references but not in paper.

5406-20: These are a few of the available studies looking at different glacier over various time periods. Expressing this in text alone and without citing more extensive surveys is not valuable.

5407-16: indisputable not appropriate; highly likely okay.

5407-12: Bolch et al (2008) noted the highest downwasting near the transition between clean and debris covered glacier surface. This elevation is then important and should be mentioned. Bolch et al (2011) noted that .."most glaciers show maximum lowering in their mid-ablation zones, with a negligible change near their termini", during the 1970-2007period. Do your results confirm this? Does this not reveal importance of debris cover?

5408-6: Should refer to the local mass balances for recent years from Wagnon et al (2013).

5408-17: Changes in area and terminus position can be accurately assessed from individual satellite images every few years as both respond to long term trends. SLA varies daily and annually. Hence we can have only low confidence in the few scattered

TCD
7, C2721–C2726, 2013

observations. It is okay that it is not the definitive ELA, just need more dates for validation note annual observations from Mernild et al (2013) and Pelto et al (2013). There is good imagery every year back to 2000 that can identify the SLA. The SLA need not be determined on all glaciers in all years just choose a couple that have a reasonable elevation gradient such as Ngojumba, Imja and Langmuche and use these for validation. Below are dates when I found suitable Landsat images.

Year Julian Date: 2000 288 304: 2001 290: 2002 295: 2003 312: 2004 299 317: 2005 301 317: 2006 320 336: 2007 291 323: 2008 294 342: 2009 296 312: 2010 295 315: 2011 286 302:

5408-21: This paragraph on temperature can be greatly shortened and some data put into tabular form. Since this paper does not present new climate data, the topic deserves less coverage.

5409-19: Poor long sentence. If the temperature increases in summer this raises the threshold for rain-snow transition during the summer monsoon. This is important because, for summer accumulation type glacier's, peak ablation and peak accumulation happen during the same period.

5411-23: The termini of smaller glaciers are indicated as retreating less as a percentage, is this at all related to the lower terminus elevation of large glaciers?

5412-5: Does the higher area losses of small glaciers suggest it is the lowest elevation accumulation zones most impacted by climate change?

5412-23: The larger glaciers have both a higher accumulation zones and lower elevation termini, cannot just stipulate they are at the highest elevation.

5413-9: Again this statement is too simply made that the higher altitude glaciers are impacted differently than lower altitude glaciers. What is the altitude that you go by? The larger glaciers in the Khumbu have both high accumulation zones and low terminus elevations. They are being impacted, but is it the same process as for smaller glaciers?

TCD
7, C2721–C2726, 2013

5413-11: Have they been preserved more than other areas? This case cannot be made that the Everest glaciers are responding less without very careful review of glacier change from the Himachal Pradesh to Sikkim. I am not suggesting this be attempted here. For example Basnett et al (2013) noted a 3.3 % area loss of Sikkim glaciers from 1990-2010.

More tables are needed. The figures are quite good.

Bajracharya, S. R. and Mool, P. K.: Glaciers, glacial lakes and glacial lake outburst floods in the Mount Everest region, Nepal, Ann. Glaciol., 50, 81–86, 2009.

Basnett, S. Kulkarni, A., and Bolch, T.: The influence of debris cover and glacial lakes on the recession of glaciers in Sikkim Himalaya, India. Journal of Glaciology, 59 (218), doi: 10.3189/2013JoG12J184, 2013.

Bolch, T., Pieczonka, T., and Benn, D. I.: Multi-decadal mass loss of glaciers in the Everest area (Nepal Himalaya) derived from stereo imagery, The Cryosphere, 5, 349–358, doi:10.5194/tc- 5-349-2011, 2011.

Mernild, S., Pelto, M., Malmros, J., Yde, J., Knudsen, N.,and Hanna, E.,2013. Identification of snow ablation rate, ELA, AAR and net mass balance using transient snowline variations on two Arctic glaciers, J. Glaciol., 59, 649–659, doi:10.3189/2013JoG12J221.

Pelto, M., Kavanaugh, J., and McNeil, C., 2013. Juneau Icefield Mass Balance Program 1946–2011. Earth Syst. Sci. Data, 5, 319-330, doi:10.5194/essd-5-319-2013.

Ren, J., Jing, Z., Pu, J., and Qin, X.: Glacier variations and climate change in the central Himalaya over the past few decades, Ann. Glaciol., 43, 218–222, 2006.

Wagnon, P., Vincent, C., Arnaud, Y., Berthier, E., Vuillermoz, E., Gruber, S., Ménégoz, M., Gilbert, A., Dumont, M., Shea, J. M., Stumm, D., and Pokhrel, B. K.: Seasonal and annual mass balances of Mera and Pokalde glaciers (Nepal Himalaya) since 2007, The Cryosphere, 7, 1769-1786, doi:10.5194/tc-7-1769-2013, 2013.

Interactive comment on The Cryosphere Discuss., 7, 5389, 2013.