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The Cryosphere Discussions

Interactive comment on "Assessing high altitude glacier volume change and remaining thickness using cost-efficient scientific techniques: the case of Nevado Coropuna (Peru)" *by* P. Peduzzi et al.

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Peduzzi et. al., (2009) examine the thickness and volume changes of Coropuna Glacier, Peru since 1955. The key data sets are field acquisition of ice thickness, which is used as a basis to construct and test a model of ice thickness. The second key data set is development of DEM's at various times to assess ice surface elevation change and volume change. The ice thickness data set is a verifiable data set and is of greater value. This data set should more thoroughly explained and presented. The DEM's produced have considerable quality issues evident in Figure 8 that indicate the lack of quality of the results. How can these errors be reduced for future resampling

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and DEM construction is a key question that should be addressed? I look forward to seeing more results from the vice thickness field measurements and model and comments on potential application to other glaciers of this type in the Andes. The following are some specific suggestions highlighting the aforementioned.

836-17: How many depth targets were acquired along the profiles? What was the typical spacing of the sampling locations? How many of the locations yielded high quality basal returns? Given the value of the thickness data set I encourage the authors spend more time exploring the nature of this data set.

837-3: DEM's provide surface elevations and through differencing, volume change, not ice thickness.

837-29: Why does pixel subtraction lead to such poor results, is it due to horizontal geolocation issues? Any reference besides Racoviteanu et al., (2007) on this topic? Was the quality of the geo-referencing process tested using field GPS check points similar to Andreassen et al., (2008). If so what is the error?

839-20: Reference for statement on the theory of formation of glaciers.

840-25: Reference for statement on the established theory.

841: First paragraph should be in section 3.2.1.

Figure 1: Are the GPS coordinates shown for the ice thickness and GPS profiles? If so use a key to distinguish the various profiles, the points already have different colors.

Figure 3: More discussion of this figure would be appropriate. A second figure along another profile away from the crater, possibly at lower elevation and on a steeper slope would be instructive. This would further illustrate the value and accuracy of the ice thickness measurements.

Figure 5: What is the x-axis, what profile or transect is this? The fit is very good, again a second profile in a different setting would be useful. This could be combined with an-

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other similar to figure 3 showing the modeled and measured ice thickness on the radar image. The accuracy of the model for ice thickness would be further verified. A basic statistic on the correlation between measured and modeled ice thickness is needed. Figure 7: Where along these transects are control points where the ice thickness was measured, mark with a dot or an x in the figure.

Figure 8: Why the 1955-1997 comparison instead of 1955-2002? This diagram needs considerable analysis that is lacking. There are many points where significant thinning, more than 15 m are adjacent, within a few 10's of meters, to areas of thickening of more than 10 m. This is not a realistic result given the nature of the ice thickness profiles shown. Why is this occurring? There is considerable thinning near the yellow line, what does this line indicate? Why is the thinning here? This does seem to be the area with the most continuous response and data. Why and does this make this section a more accurate measure of surface change? There is considerable thickening near the margin on the west side and south side, is this realistic given the terminal position changes of the glacier. This would be a basic test of the validity of the DEM observed changes near the periphery. Thinning near the yellow line upslope of the thickening areas near the terminus does not fit the normal pattern of volume loss for a glacier. All of these examples point to the lack of value of the resultant DEM for real volume assessment. This does not mean the methods as described are not the best available. Instead it should focus attention on the need to better identify the degree of inaccuracy and the cause, so that future DEM's for Coropuna Glacier can be improved.

Interactive comment on The Cryosphere Discuss., 3, 831, 2009.