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The Cryosphere Discussions

Interactive comment on "Glacier changes and climate trends derived from multiple sources in the data scarce Cordillera Vilcanota region, Southern Peruvian Andes" *by* N. Salzmann et al.

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Salzmann et al (2012) provide a useful inventory of glacier change and accompanying climate conditions in the Cordillera Vilcanota, Peru. This paper will be a valuable contribution with greater attention to areal extent change, sublimation change and evaluation of climate changes beyond using linear fits. More attention in the abstract and paper is required on the findings of glacier areal extent changes and the relation to other nearby Andean regions. Additional analysis of the changes in the sublimation-ablation ratio is needed for the observed climate trends. In terms of climate analysis the linear analysis for the whole period will not yield the best results if the changes that really impacted the

glacier occurred shortly before 1985. This would suggest looking at means for more than one period and trying non-linear fits.

1) One of the most robust findings of the paper is the change in areal extent of the glaciers from 1985-2006. The results must be presented in a clearer fashion. Additionally it is not worthwhile to compare the results to the Alps. Two recent references need to be consulted to assess the similarity in response of the glaciers and the consistency of the changes in climate conditions. Rabatel et al (2011) note a 29% reduction in glacier extent in the Huasco, Chile region from 1955-2007. Baraer et al (2012) note a 0.81% per year reduction in glacier extent in the Cordillera Blanca, Peru from 1990-2009. Both of these rates are supportive of the changes observed in Cordillera Vilcanota and that these changes are regional in nature. Baraer et al (2012) have a very useful Figure 6, it would be important to determine if the Vilcanota glaciers plotted in somewhat of the same way yielded a similar response pattern.

2) The change in specific humidity and maximum air temperature are the two most prominent climate trends identified by the authors. Higher specific humidity would reduce the diurnal range and should feature the greatest changes for the maximum air temperature, as observed. The role of the changes in maximum temperature and sublimation need further exploration. During the dry season sublimation is favored by low specific humidity and a positive downward water vapor gradient. The sublimation-ablation ratio is a key element for the mass balance of these glaciers. A change in this ratio will have substantial impacts on mass balance. Sublimation requires more energy than ablation and thus the more favorable the conditions for sublimation the more positive the mass balance. Given this, how do the observed trends impact the favorability of dry season sublimation. Is this a key issue in mass balance losses?

3) As noted in the paper glacier change before 1985 is limited, this suggests that the change in climate that has led to the retreat of these small glaciers with quick response times, occurred not long before 1985. Why use linear regression for the whole period, and not look to contrast the pre 1985 period to the post 1985 period or even for non-

linear fits. The different trends for the different periods could then be noted in Tables 3-7.

Minor corrections: Abstract need to add quantities on glacier areal extent changes

389-3: Use Andes references for water resources.

391-2 Rio Vilcanota feeds Laguna Sibinacocha needs to be pointed out.

393-8: Skip first sentence in section

395-12: Any references on how significant debris cover is?

395-18: The most widely used and tested scaling method is. . ...

395-25: The volume portion of the paper is the less important than the area or the climate. It is derived mostly from the area data. Why not also determine volume from the simple Bahr et al (1997) method for comparison.

398-25: replace mid-1980's to mid-1990's with 1985-1996.

399-1: 1996-2006 % area loss need to be specified directly.

399-3: The 14% and 33% need to be explained better or discarded.

401-7: It is of no value to compare results to the Alps, and appears lazy instead of using other Andean studies of areal extent change.

Table 3-5 can be combined

Table 6 and 7 can be combined

Baraer, M., Mark, B., McKenzie, J. Condom, T., Bury, J., Huh, K., Portocarrero, C., Gomez, J. and S. Rathay.: Glacier recession and water resources in Peru's Cordillera Blanca, Annals of Glaciology, 58(207) 134-150, 2012.

Rabatel, A., H. Castebrunet, V. Favier, L. Nicholson, and C. Kinnard (2011), Glacier changes in the Pascua-Lama region, Chilean Andes (29Â° S): recent mass-balance

and 50-year surface-area variations, The Cryosphere, 5 1029-1041, 2011.

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