

## ***Interactive comment on “Glacier changes on Sierra Velluda massif, Chile (37° S): mountain glaciers of an intensively-used mid-latitude landscape” by A. Fernández et al.***

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Glacier changes on Sierra Velluda massif, Chile (37° S): mountain glaciers of an intensively-used midlatitude landscape by Fernandez et al.

The most valuable contribution of this paper is in reporting area changes of the 13 glaciers in this little studied region. By contrast, reported thickness changes are unconvincing. The reason, perhaps, is that horizontal coordinates can be determined more accurately than vertical coordinates, as is true with other methods such as terrestrial surveying.

The English is very much improved, although the writing could use some attention in  
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the second part of the text. In many places values are given to more significant figures than is warranted by the data.

Some points in my earlier comments were addressed in this draft, but others were not. Comments in the following are indicated by page and line (page,line).

GENERAL RESPONSE: We appreciate the re-revision. We made relevant changes and improved the English.

SPECIFIC COMMENTS (page, line)

(686,18) Do the authors mean that interannual changes in terminus position follow interannual changes in precipitation? Changes in thickness and therefore glacier mass will respond annually through surface mass balance processes to annual changes in climate variables, but terminus position and thus area will respond much more slowly.

AUTHORS' ANSWER: We eliminated that sentence.

(687,25) The paper should indicate whether Keller translated it to English or to Spanish.

AUTHORS' ANSWER: Included (2,29)

(688,5) "glaciated" should be "glacierized" See p 46 of Glossary of Glacier Mass Balance and related terms by Cogley et al. (2011) IHP-VII Technical Documents in Hydrology No. 86, IACS Contribution No. 2, UNESCO-IHP, Paris.

AUTHORS' ANSWER: Changed in all locations.

(689,11) Cubic convolution should be briefly described or a reference cited.

AUTHORS' ANSWER: Included: Lillesand and Kiefer, 1987 (4,5).

(690,25) Eqns (1,2) are still incomprehensible to me. Units of and are not stated, nor is the range of the summations or what assumptions are made about correlations between the various, between the various, or between the and the

AUTHORS' ANSWER: We refer you to the relevant papers that validate the approach:

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Ye et al. (2006), Williams et al. (1997), Hall et al. (2003) and Silverio and Jaquet (2005).

(691,23) The term "map algebra" persists and is undefined.

AUTHORS' ANSWER: A reference is included: Longley, 2001 (6,5)

(693,9) What 36.1% refers to is unclear.

AUTHORS' ANSWER: It refers to the first Principal Component. The writing was modified to make it clear, but that whole text was moved to the supplementary information file (2,5).

(693,15) Is IDW error meant ?

AUTHORS' ANSWER: IDW is less uncertain than TIN for the DEM comparison (text moved to the supplementary information file)

(695,11) The two values +7.8 and -9.9 are not identified.

AUTHORS' ANSWER: Their units are in meters. They are the only GPS points at similar altitudes as the analyzed glaciers. That is already clearly explained in the text (now in the supplementary information file).

(695,28) That is too many significant figures.

AUTHORS' ANSWER: We changed all numbers, except for rates, to only one decimal.

(697,22) See comment 712.

AUTHORS' ANSWER: We merged tables 4 and 5 but we did not have room for aspects. However, since the first draft the relevant aspects are already mentioned (Table 3).

(698,22) Giving the ratio of two small integers to three significant figures is excessive. Better than saying 76.9% would be to say 10 of 13.

AUTHORS' ANSWER: Changed in all locations.

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(699,22) There is negligible dependence of thickness change on altitude in Fig. 6. Moreover, increase of thinning with altitude is contrary to glacier behavior in other regions of the world.

AUTHORS' ANSWER: We included more explanation in the results (10,29-31) and the discussion (12,16-20) in terms of the possible relationship between the areas not considered for the comparison and the trend. However, we want to highlight that our "glacier-by-glacier" comparison data show that almost all glaciers thinned and half of them did so at significant rates.

(701,28) Say where the other 38% come from. This is an interesting statement, so giving the amounts from all sources should be included.

AUTHORS' ANSWER: We included more data and adjusted the numbers (12,2-4)

(702,25) Sensitivity to inter-annual climatic variability should be identified more precisely. Glacier thickness responds immediately and directly to changes in accumulation and ablation, but area and terminus position do not.

AUTHORS' ANSWER: We eliminate the sentence related to response and reaction time.

(703,6) "descent of 27m on the side" is unclear.

AUTHORS' ANSWER: This sentence was eliminated.

(710) Table 2 is totally incomprehensible, although the m values and km<sup>2</sup> values seem to be in constant ratio.

AUTHORS' ANSWER: Since the equation uses the image resolution for the RMSE calculation, a sort of ration can be expected. We reconfigured the table to make it clear.

(712) If the coordinates are given instead as degrees and hundredths, there would be room in Table 4 to give the aspect. For instance, 37.48 S, 71.43 W instead of 37°28'30"

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S, 71 25'31" W

AUTHORS' ANSWER: Refer to answer (692,22).

(713)  $|0.01| < |0.0001|$  is a mathematical contradiction.

AUTHORS' ANSWER: We reconfigured the table (now table 3) to make it clear.

(714) Appearance of Table 6 would be enhanced were the uncertainties 26.24 and 0.67 stated in the caption rather than being repeated in every line. It could also probably then be merged with another table.

AUTHORS' ANSWER: Changed. Table no merged, though.

(719) Show the 13 letters in Tables 4-6.

AUTHORS' ANSWER: Shown in new table 3 only.

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Interactive comment on The Cryosphere Discuss., 5, 685, 2011.