

Interactive comment on “Glacier changes in the Pascua-Lama region, Chilean Andes (29° S): recent mass-balance and 50-year surface-area variations” by A. Rabatel et al.

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Received and published: 26 July 2011

Mauri Pelto comment: 2317-12: Need to include the percent coverage of penitents on the four glaciers from Figure 3. Authors reply: A new figure has been created. This figure, named Figure 3A and B, present a map of the four glaciers (see response to Referee #1), where the coverage of penitents has been represented. Penitents almost cover 100% of the glacierets surface, where the surface is not debris covered. On the Guanaco Glacier, the coverage of penitents varies from one year to another, but each year, parts of the glacier where wind blows strongly remain free of penitents.

Mauri Pelto comment: 2317-23: The penitents height ablation comparison should be

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included as a figure. A separate paper on the surface energy balance (SEB) is likely forthcoming, but this still is a key observation even without the full energy balance explanation of formation. Authors reply: One sentence has been added to specify the measurements made on the penitents, in relation with the stakes measurements: “For the areas on the ice bodies surface where penitents can be found, several morphological parameters associated to penitents are measured, such as: the size of the blade (length and width), the distance between two blades and the distance between the hollow and the foot of the stake (Figure 4).” A simple scheme has also been added (Figure 4). “Figure 4: Simplified scheme showing the measurements realised on the penitents themselves and the ablation stakes located in an area with penitents.”

Mauri Pelto comment: 2318-7: Why fewer penitents on the Guanaco? Penitents preferentially develop in glacier regions where the SEB is not homogenized by wind, is there more of a persistent downslope or overall surface wind on Guanaco versus the glacierets? Authors reply: Yes, this is a part of the explanation. Another reason, mentioned in the text few sentences above, is that the surface of the glacierets is almost completely covered by dust deposition from the unglaciated surroundings, which is not the case for the biggest ice bodies for which dust deposit mainly concerned glacier edges. However, fewer has been replaced by smaller, because penitents can be observed in the lower part of Guanaco Glacier, but they almost never exceed few tens of cm high, unlike on the glacierets where they can reach several meters high. Consequently, the text has been modified as follow: “Unlike the glacierets, we observed smaller penitents (about a few tens of cm high) on Guanaco Glacier and some parts of the surface are not covered by penitents. It is particularly the case at the level of the AWS; where high speed wind (annual average of 6.4 m s⁻¹) may eliminate penitents production; in good agreement with results obtained by Bergeron et al. (2006).”

Mauri Pelto comment: 2314-23: Diurnal fusion? Authors reply: It has been replaced by: “daytime melting”

Mauri Pelto comment: Table 1: Indicates 32 stakes emplaced on the four key ice bodies

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in Figure 3. Nowhere is there a map showing their distribution on any of the ice bodies. Authors reply: A new figure has been created. This figure, named Figure 3A and B, present a map of the four ice bodies where the stake distribution has been represented (see answer to Referee #1).

Mauri Pelto comment: 2316-3: There is no indication of the seasonal cycle or the variability of accumulation from stake to stake. If winter balance is to be shown to be the key variable, then a key focus must be the details on how much snow accumulates and where and how long it tends to persist. At what point in the ablation season is the snowcover lost during low accumulation years. Authors reply: On the new map (figure 3A), ablation and accumulation values for Guanaco Glacier are presented for two consecutive and contrasted years (see the map in the answer to Referee #1).

Mauri Pelto comment: 2316-6: It is noted that the Guanaco tends to either be fully snow covered or mostly bare at the end of the ablation season. What is the accumulation difference and distribution near the beginning of the ablation season. This should be discussed in terms of AAR. Of more importance is the accumulation for the various years of high AAR and low AAR. Authors reply: The ice bodies of Pascua-Lama region are more likely "reservoir glaciers". Positive mass balance are associated with years of extremely positive winter mass balance (very high precipitations) associated with El Nino conditions. Most of the years, they experiment a negative mass balance, and as mentioned in the text, or the snowpack disappear completely, or only patches of snow remain at the end of the ablation season. During the measurement period, we did not find any pluriannual firn, and the first results of the Guanaco ice core analysis (ice core retrieved in late 2008) seems to show that the ice exposed at the surface of Guanaco is older than one century (Ginot, pers. Com.)!

Mauri Pelto comment: 2316-11: Given that normal concepts of ELA ablation season and accumulation zone do not apply, it is even more important to report directly in a map figure their distribution on Guanaco at least in 2006 versus a low Bw year. Authors reply: On the new map (figure 3A), ablation and accumulation values for Guanaco

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Glacier are presented for two consecutive and contrasted years (see the map in the answer to Referee #1).

Mauri Pelto comment: 2318-18: It would be quite useful to have detailed follow up to Figure 1 mapping the marginal changes for Guanaco, Toro 1, and Toro 2 possibly. This is typical in any remote sensing analysis of glacier change (Andreasson et al., 2008; <http://www.thecryosphere.net/2/131/2008/tc-2-131-2008.pdf>). Authors reply: It has been done in a new map (Figure 9 in the new version) showing glacier contour evolution since 1955 for Guanaco, Toro 1 & 2 and Esperanza glaciers. "Figure 9: Contour changes for Guanaco Glacier and Esperanza, Toro 1 and 2 glacierets over the 1955-2007 period."

Mauri Pelto comment: 2319-13: PDO needs a reference for categorization of the current phase being negative. This is not what the creators (JISAO) of this index identify. They note cool period from 1998-2002, warm period from 2003-2008 and a cool period since that makes it impossible to assign a phase change at this point. (<http://cse.washington.edu/cig/pnwc/aboutpdo.shtml>) Authors reply: Every thing about PDO has been removed from the discussion.

Mauri Pelto comment: 2308-22: Arid diagonal? Authors reply: This expression define one of the Earth's driest region. It is commonly used in papers dealing with glaciology, hydrology and climatology in this region. However, the wording has been changed to be more explicit and a reference was added: "the so-called "South America Arid Diagonal" (23-28°S, Schwerdtfeger, 1970)."

Interactive comment on The Cryosphere Discuss., 4, 2307, 2010.

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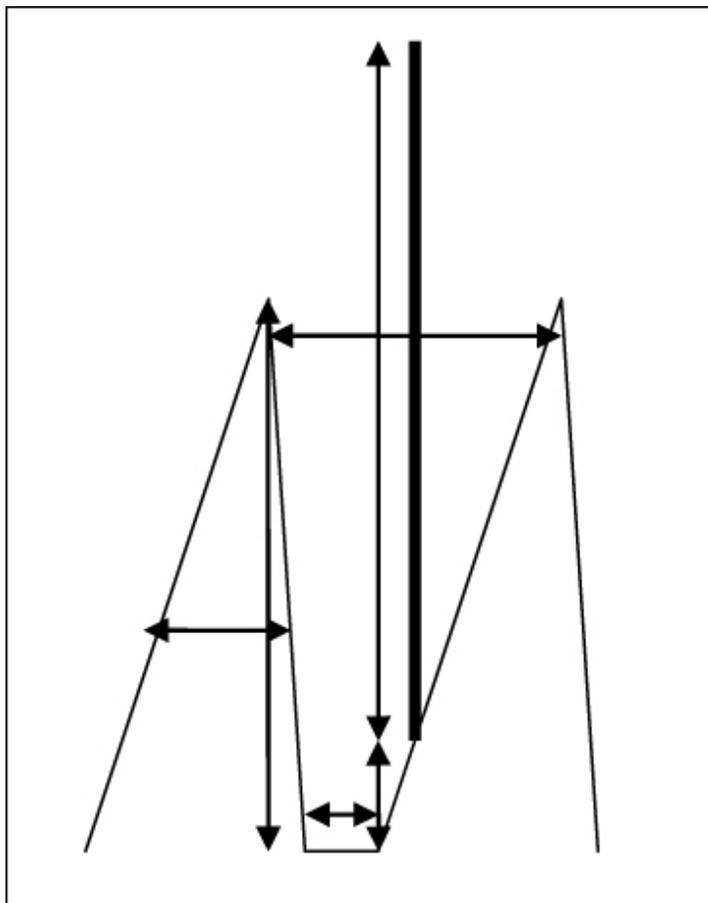


Fig. 1.

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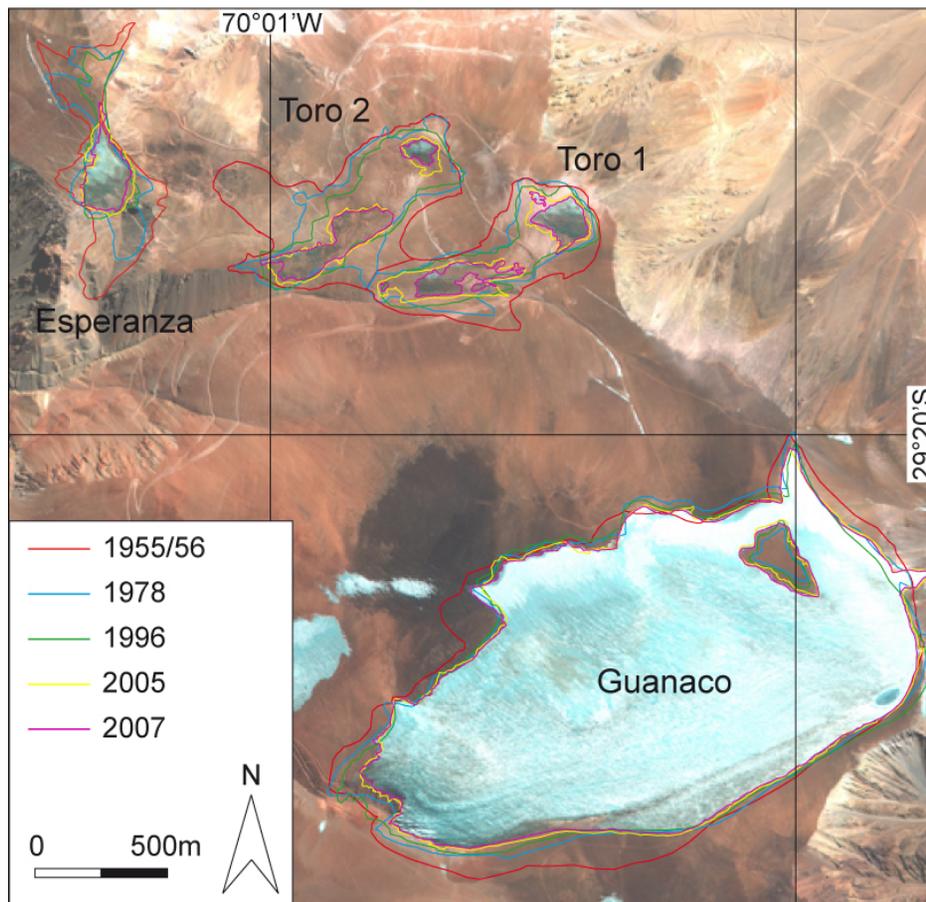
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