

## ***Interactive comment on “Glacier contribution to streamflow in two headwaters of the Huasco River, Dry Andes of Chile” by S. Gascoin et al.***

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Reply to M. Pelto

1) 2383-5: ablation stakes

The information requested by M. Pelto is indeed important and will be provided by Rabatel et al. (2011, same issue), along with a more detailed description of the mass-balance measurements methodology. In particular two maps have been added to this paper (Fig. 1 and Fig. 2, already available in 'Authors reply to referee #1 comments', by A. Rabatel, 26 Jul 2011). These maps indicate the location of ablation stakes on Guanaco glacier and glacierets Toro 1, Toro 2 and Esperanza. In addition Fig. 1 gives ablation and accumulation values for the Guanaco Glacier for two consecutive and

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contrasted years. We have added to the paragraph L5 2383 “This was illustrated in the case of the Guanaco glacier by Rabatel et al. (2011), where no ablation dependence with altitude is apparent for two contrasted years.”

We may clarify here that for the mass-balance analysis we conducted in this paper, the uniform ablation assumption is mathematically not required, as we only used spatial averages of ablation or accumulation measurements at the glacier scale. The same methodology could be applied to a typical alpine glacier with separated ablation-accumulation zones; the only difference is that in the Pascua-Lama context, the specific fluxes are meaningful at the glacier scale (e.g. the specific melting rate).

2) 2381-10: lysimeter measurements

We investigated the climate data available but unfortunately we did not find any apparent empirical relationship between air temperature or humidity and sublimation rates. The sublimation / melting ratios reported here may result from the combination of a number of meteorological variables (temperature, humidity, wind, radiations) thus we are not able to relate sublimation to one or two climate variables. That is why we did not find relevant here to indicate some climate data.

3) 2375-5: identify the human activity as mining.

We changed as suggested

4) 2378-26: “implied” refers to what?

We changed the text: “The initial excavation project involved the transport of glacial ice (...).”

5) 2380-8: “In most alpine glaciers settings, glacier runoff reduces minimum melt season streamflow causing a reduction in the relative variation of monthly discharge. This is indicated to not be the case here in the Andes. The particular mechanism should be explained briefly here.”

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We presume that M. Pelto meant: “in most alpine glaciers settings, glacier runoff increases minimum melt season streamflow” (and not “reduces”?). The mean annual regimes presented in Fig. 2 give actually a good example of the effect of percentage glacier cover on the intra-annual runoff variation, as it is observed in mid-latitudes glacierized catchments (e.g. Wallis, 2005). Intra-annual runoff variation increases consistently with percentage glacier cover along the Estrecho River at NE4, NE2A, NE5 gages and similarly in the Potrerillo catchment (VIT3 and TO6A gages)

6) 2382-7: Fusion, is not a typical term.

All instances of the term “fusion” in the text were removed and replaced by melting

7) 2382-16: add in a figure indicating stake locations on specific glaciers. Include a figure or table of the observed ablation from these same stakes. It is crucial to identify the variability of ablation from stake to stake.

Stake location and ablation values are now included in Rabatel et al. (2011).

8) 2383-6: Just because there is not a typical ablation and accumulation area does not suggest that they are uniform. If the previous comment is addressed, then the ablation variation will already be presented. It is also critical to indicate at least on a specific date or two that accumulation variation is relatively uniform. Since the mass balance has been examined there should be some measure of this.

The accumulation measurements for each stake were also indicated by Rabatel et al. (2011) for two contrasting years on Guanaco glacier.

9) 2387-14: Other months do not have this diurnal variation?

Manual runoff measurements at the glaciers snout are only available during the summer months January and February. As an indication, at NE5 gage, which is the first automatic station found downstream (glacier cover is 11% of catchment area), 47% of the annual runoff occurs between this two months. We can assume that a similar diurnal relative variation occurs during other months of the melting season such as

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December or March, but the magnitude of the daily runoff peak may be lower.

10) 2388-13: Why are these estimated, instead of reported measured values?

As indicated in Section 4.4., the measured hourly melting rates were interpolated over the day to obtain a rough estimation of the daily melting rates for each glacier. We modified the text and added a reference to this section to make it clearer.

11) 2392-5: This is a key point. If there is any data collected to date that can shed light on the amount of refreezing report it.

Unfortunately, there are no field observations to further address this issue. A possible approach could be the comparison of the runoff measurements with the melting rates computed using an energy balance model, provided that such model could deal with penitents growth.

12) Table 3: Is there any climate information such as temperature or humidity to accompany the lysimeter measurement periods?

See reply to comment 1)

13) Figure: A picture of Guanaco would be invaluable particularly if it could be annotated to indicate the stake locations and any other measurement sites.

An Ikonos image of Guanaco glacier with stake locations is not presented in Rabatel et al. (2011).

## References

Rabatel, A., 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., *The Cryosphere Discuss.*, 4, C1850–C1863, 2011

Wallis, I., *Hydrology of Glacierized Basins*, *Encyclopedia of Hydrological Sciences*, Wiley, 2005.

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