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The Cryosphere Discussions

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

Anonymous Referee #2

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The paper presents hydrological and glaciological data from two headwaters in dry Andes of Chile. The main available data are:

- water level of five streams between 2620 and 3978 m a.s.l. since 2002 with automatic measurements, the area of these catchments are between 5.7 and 128.6 km2,

- several discharge measurements at the snouts of four glaciers between 4726 and 4970 m a.s.l.

- Annual data of ablation and accumulation of glaciers for six glaciers over the period 2003-2008, their area lying between 1.26 106 and 4.60 104 m2.

- Twelve experiments carried on during 1 to 12 days on lysemeters filled with snow or ice for estimation of the sublimation. These experiments were carried on between 2008 and 2010.

The aim of the study is to assess the effect of the projected glacier disappearance on river

discharge. Hence, the contribution of glacier melting and of snow melting (from glacier and from unglacierized area) to discharge are estimated, and also the amount of sublimation is discussed.

This paper addresses relevant scientific and social questions within the scope of the journal. It is an important contribution for the dry Andes where hydrological data of catchments including glaciers are still lacking when the question on the future of water resources and modification of hydrological regime in these regions are obviously important.

However, in several level the quality of the paper and probably of the contribution overall could be enhance. Indeed, in several clue points of the estimations the assumptions are not clear or not clearly presented. The text below presents several points that could be reworked or reworded.

As a conclusion, the reviewer recommends that the authors enhance the scientific and presentation quality before publication of a paper that can be an important contribution for water resources the dry Andes. Abstract Five glaciers in the text when six are cited including Toro 1 and Toro 2. Last sentence: give quantitative results rather than just “revealing large differences”.

p. 2376; l. 8 : Escobar et al. 1995 : not found in references. p. 20 to 27 : high value of sublimations are cited in %, it would be interesting in mm/year.

p. 2377, l. 5 : precise what is different in the seasonal variability between Tropical and Dry Andes (different and interesting for the purpose of the present work).

l. 10 : “the mean annual discharge measured “ => the mean annual discharged is estimated (computed) not measured.

l. 11 : “We also present direct measurements of meltwater discharge” => direct measurements can be done in terms of length, time, weight ... not in terms of m3/s (that result of computation – transformation of direct measurements) and moreover it is not clear how direct measurements of meltwater discharge could be carried on. That could be possible if it was clear how to make the difference between meltwater and other contribution to the discharge.

l. 25 : precipitation occurs almost exclusively as snowfall : what is the argumentation for that (see for example paper from Lhote et al, 2005, HSJ). And precise the months of summer time

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and Bolivian winter.

p. 2379, l. 19 : what is recorded is the water level. Precisions on possible errors of the discharge estimation based on these measurements would be useful.

l. 21 : “assumed to be a direct measure of the glacier meltwater discharge” => precise what can be not taken into account, groundflow below the glacier ? see for example paper from Favier et al. on a glacier in Ecuador.

In general, in the section 3.2 Data of Hydrology, considerations on data and on interpretation of data are combined before the presentation of Methods in section 4. It would be clearer to limit in section 3 the presentation of data.

p. 2381 l. 1 : give an example of the variation of the actual area of a glacier now and five years before.

l. 5-9 : even if the data of accumulation and ablation are presented in Rabatel et al. (2010) some more informations should be recalled here : are the data collected over the whole area of the glacier ? once a year ?....

l. 11-15 : measurements of sublimation by twelve experiments on lysimeters are not convincing : no precipitation during the experiment ? effect of the lysimeter ?

l. 16 : precisions needed on how these experiments from lysimeters give information on sublimation + melting rates

l. 24 : hydrological year in general begin from the lower monthly discharge (not melt season)

p. 2382, l. 7 => precise the area considered for te equation F=Ab-S (the whole glacier, cf area in table 1 ?) How S vary from one experiment to another ? Table 3 give “Ablation fraction “ and not sublimation. That is not clear. And how data from lysimeters are used (applied) on an overall glacier (and why? – whith which assumptions ?).

l. 23 : ablation rates inversely proportional to glacier size : papers from Francou et al. on the disappearance of Chacaltaya glacier in Bolivia could be cited.

p. 2383, l. 21 : precisions needed on how absolute sublimation rates are estimated from lysimeter experiments.

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p. 2388, l. 22-23 : justify why the evaporation is assumed negligible (when sublimation is not). See for example, paper from Favier etl. On groundwater from glacier that take into account estimation of evaporation.

p. 2389, l. 25 : “hydrological system is not in equilibrium with climate". A discussion would be welcome in the section 1. 2. Or 3. On the elevation of the equilibrium line of glaciers in the area (from generic studies as for example Condom et al. over the Andes). It sounds that presently the glacier in these dry Andes are not in equilibrium with present climactic conditions. And thus, the equilibrium line can be over the altitude of the summit of the glaciers . . . (?)

Table 1. precise the period (2002 – 2008 ?) and check area and glacier cover, especially between Toro and Potrerillo. On figure 1 (Map) The Area of the Potrerillo catchment (VIT-3) sounds larger than the one of Toro (when in table 1 it is the contrary).

Table 2. precise number of stakes and period of measurements and range of altitudes of the stakes

Table 3. Precise how the ablation fraction (last column) is computed.

Figure 2. Would be interesting to have the mean value of monthly precipitation (max in June – August when the max monthly discharges are in January – February (exact ?).

Figure 5. a) precise the number of glaciers under consideration : 74 ? b) indicate the nampe of the glaciers, which is the one with more than 1.8 10 6 m2 ? no one of such area is listed in table 2.

Interactive comment on The Cryosphere Discuss., 4, 2373, 2010.