

## ***Interactive comment on “Identification of glacial melt water runoff in a karstic environment and its implication for present and future water availability” by D. Finger et al.***

### **Anonymous Referee #3**

Received and published: 19 April 2013

Summary and general recommendation: Finger et al. have studied a glacier-karst system in the Swiss Alps and have used different methods to estimate the possible impact of climate-change induced glacier retreat on karst groundwater resources. This is an interesting and relevant study. The paper is suitable for publication following moderate changes, mainly concerning the use of terminology (sometimes incorrect) and missing information on some figures (that look good but are not really comprehensible). Also some scientific aspects need to be improved, e.g. concerning the limitations and transferability of the results.

Specific and general comments: 2745, line 6: The term “souterrain” is inappropriate.

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Do you mean underlying or underground? Anyway, the word can be deleted without losing any information. In fact, the entire sentence is not logical. Yes, glacier retreat is an important issue for water resources. Yes, karst aquifers are relevant. However, it is not clear why glacier-karst systems require particular attention. Either delete this statement or find a better justification why your test site / study are relevant.

In fact, most Swiss / alpine glaciers are not located on karst but on crystalline rock. Maybe you could indicate somewhere the proportion of glacier on karst and on other rock types?

24-25: I would also mention drinking water (small quantity, but very important) and irrigation (= irrigated agriculture). Not sure if snow production makes much sense here.

2746: You cite 2 papers by Vivian Gremaud et al. who have studied the directly adjacent and very similar glacier-karst system of Tsanfleuron. You should refer again to these papers in your discussion or conclusions and compare your results with their results. Not all results are presented in the published 2 papers. There is more in Vivian's PhD thesis, including an estimation of future water availability under conditions of glacier retreat. A third paper by Zeng, Gremaud et al. (2012) quantifies the efficiency of this glacier-karst system as a CO<sub>2</sub> sink under global warming.

Another reviewer has also observed that the literature review is incomplete and has agreed some relevant references. I agree, particularly concerning the pioneer work done by Chris Smart in the Canadian Rockies. However, I would not cite too much gray literature (old conference proceedings) but focus on papers in international journals and books – there is enough!

2748, line 3: Completely snow-free: Very important observation! This means that there is NO accumulation, i.e. the glacier is not only retreating but disappearing. Say this! Similar situation at Tsanfleuron, reported by Gremaud et al.

Line 8: 1-1,5 %: Are you sure? I don't have better numbers, but it seems to me that

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many Swiss glaciers are much, much larger, so I would suppose a smaller number. Please check!

2749, line 5: Urgonian = Schrattekalk (mention the name of this very famous limestone formation that hosts the two largest caves in the Alps)

14: The term “land use” is inappropriate here, because much of the area is not used!

2751, line 20-22: Correct in principle, but not as simple in this case, because folds and faults can create reservoir structures and phreatic conditions above the level of the springs.

2753, line 16: The injection quantities are crazily huge – Gremaud et al. used about 10-100 times smaller quantities in the Tsanfleuron area.

2757, line 23: The maximum concentration are enormous! Uranin concentrations are 20 times above the limit of visibility. At some place, you should mention that your injection quantities were extremely overdosed, otherwise you give a bad example for future tracer tests.

I prefer  $\mu\text{g/L}$  over  $\text{mg/m}^3$ , but that’s a question of taste.

2758, line 7: “amount of tracer passing” => use the term (tracer) recovery (%)

Discussion: Bette compare your findings with results from the literature, e.g. concerning flow velocities of subglacial, englacial and supraglacial melt waters. In fact, these important glaciological terms are not used in the entire paper. You should really read and cite more glacier (and karst) literature and use the relevant terms and concepts in your paper.

Table 3: Amount of tracer => recovery (%)! See comment above.

Table 4: Table heading makes no or little sense. Do you mean: Comparison of tracer recoveries and flow velocities obtained from the three tracer tests?

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Figure 1: A scale bar in figure b would be useful.

Figure 2: There should be a legend explaining the stratigraphy!

Figure 3: The figure looks amazing, but in fact, it is incomprehensible: No vertical scale, no horizontal scale, no orientation, the relation between geology and topography is unclear: does the figure shows surface geology (outcrops) or the internal geological structure or a bit of both? Inacceptable in the present form (although it looks good). Must be improved.

Figure 5 and 6: Such graphs are called (tracer) breakthrough curves! In general, you should use the correct terms from the glacier, karst and tracer literature.

Figure 7: Similar problem as figure 3: What is the relation between the colorful parts of this figure and the non-colored part in the upper left corner?

General comment: The limitations of your study should be addressed more clearly! Your results are (hopefully) true for your test site and for the neighboring test site studied by Gremaud et al. However, the transferability to other areas is very limited, even within the Alps: There are very few glacierised karst systems in the Alps, and very different general trends can be expected for non-glacierised areas and for areas including large glaciers (that will not disappear so quickly).

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 2743, 2013.

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