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Comment

## ***Interactive comment on “A data set of world-wide glacier length fluctuations” by P. W. Leclercq et al.***

### **Anonymous Referee #2**

Received and published: 9 December 2013

#### Review

The presented paper is a valuable contribution to our knowledge of past glacier changes, and it forms an impressive compilation of world-wide glacier length changes. As correctly stated by the authors, the world-wide glacier length records have a large potential for various interpretations regarding past climate and environmental changes. Although glacier length changes have to be interpreted with care – e.g., as they reflect indirect climate signals, as they may show non-climatic signals, and depend on internal glacier dynamics, etc. – they can provide a precious insight into our past climate, and they are often the only available information of glacier changes before the onset of other glacier observations (e.g., mass and thickness observations). The paper by Leclercq et al. demonstrates the potential of a global glacier length change dataset.

I can imagine that the compilation of this material and getting the information from a

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variety of different sources was time-consuming and required a lot of effort. This effort merits to be honored and the corresponding paper to be published. However there are several critical and fundamental points to be named. They must be addressed before publication:

1) As stated above, the compilation of the glacier length changes deserves to be recognized. But on the other hand, what is the novelty of the presented dataset? Is it simply a continuation of the dataset that has been started by Klok and Oerlemans (2004) and Oerlemans (2005), as stated on page 4777 in the paper? Or does it include some fundamental changes? An interesting point, for example, would be a detailed discussion of the quality of the different records (if this is possible at all?). Can you find differences depending on the methods that have been used for determining the length changes. Other interesting points, e.g. the dependence of the observed glacier changes on glacier geometry, glacier types etc. could be mentioned. They are discussed only shortly in the paper (chapter 3.2). The combination of the glacier length records with glacier parameters obtained from the World Glacier Inventory (WGI) and other sources is valuable in this respect.

2) Chapter 3.1 presents a global overview of the length changes. However it is not clear to me if this chapter shall also address global glacier fluctuations, i.e. if the overall aim is to give a picture of global glacier fluctuations (not length changes!), or if it is a global picture derived solely from the available glacier length records. These are two different objectives. The data quality and abundance of data points are reduced as further back in time we go, and interpretations of the length records therefore have to be done with great care. Figure 9 shows several artifacts related to this problem. I am wondering for example about the peaking uncertainties in several regions. I understand the jumps in the regional length changes curves, but I am wondering how I shall interpret the figure, e.g. if I am interested in the long-term glacier development in a particular region?

3) Chapter 3.2 brings an interesting discussion, but the discussion could be deepened. E.g., in the following Conclusions part, several new aspects, not discussed in Chapter

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3, are brought up. It is though not always evident where these conclusions, among some very interesting ones, come from. The discussion could be deepened, e.g. with a climatic interpretation of the records, with a regional differentiation. However I would consider this to be out of the initial scope of the paper (and would lead to another study).

On the other hand, you bring some fundamental conclusions, and I fully agree, also in line with reviewer 1, that more long-term glacier records from outside Europe and South America would highly be appreciated. Finally, it is very welcome that the dataset is available to the scientific community.

More comments:

Page 4776:

Line 2: write “indicators of past climate change”

Line 8: Shouldn't it read “1535” (record of Lower Grindelwald Glacier?)

Line 9: Why does the number of records decrease after 1962?

Line 12: You mention small fluctuations until the mid-19th century. Is this not an artifact due to the temporal resolution of the available records?

Line 15: You mention the behavior of calving glaciers. This is an interesting aspect, including the comparison with the non-calving glaciers. Given the limited number of records of calving glaciers, is it feasible to make the direct comparison? And: Are tidewater glaciers and glaciers calving in fresh water treated separately? Another point is also that many glaciers may become (or became) calving glaciers during (calving in lakes) during certain time periods.

Line 25: I wouldn't limit the discussion here on the sea-level issue alone, but include other more general consequences of glacier changes, and correspondingly give a broader list of suitable key references.

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Page 4777:

Line 7: “Biological evidence” sounds rather strange, what do you mean exactly?

Line 10: I can imagine that the compilation of the records was challenging. But what do you want to express with this sentence here? It could be interpreted that the dataset has some shortcomings that were not possible to be solved, due to the challenges. Therefore it is better to describe here these challenges more precisely.

Line 15: please indicate precisely what you want to analyze (i.e. what you will analyze in the following treatise).

Line 20: Delete “At present”

Line 24: I suggest to check the English phrasing.

Line 26: Not clear: is it the main goal to address centennial changes?

Page 4779:

Line 8: For Nigardsbreen, better give (or add) the following reference: Østrem, G.; Li-estøl, O. & Wold, B. 1976: Glaciological investigations at Nigardsbreen, Norway Norsk Geografisk Tidsskrift, 30, 187-209.

Lines 11-14: Very general and short description; please reveal more details.

Line 17/18: Important question: How do you determine these uncertainties??

Line 19: rather glacial deposits (after glacier erosion)

Line 24: What about surface exposure dating? (and radiocarbon dating?)

Line 29: Only if a tree-ring chronology is available!! (a lot of work. . .)

Page 4780:

Line 2: Can you give a reference for ecesis time?

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Line 13: Write “radio carbon”

Line 24: (see also comment above): How do you determine the uncertainty?? (in space and time)

Lines 28/19: I assume that with trees found in situ, the statements could be much more precise, no?

Page 4781:

Chapter 2.2: The main and general “challenge” here is how to handle records with only few data points available?

The paragraph starting in line 23 is not clear to me and I suggest rewriting it.

Line 25: The World Glacier Inventory has been updated in 2012 (see the NSIDC website).

Page 4782:

Lines 9/10: How does this judgment works?

Lines 15ff: This could be shortened: the classification of your regions is described rather detailed. Also, I suggest not to abbreviate “HMA”. In addition: Paragraph 2.3. is rather hard to read, check if it can be shortened.

Line 26: Only the southern Alps are part of southern Europe.

Line 29: I notice that above it is stated that data on glacier geometries are taken from the WGI, here you mention the RGI. (The results should be the same, no?)

Page 4784:

The paragraph lines 9-24 should be checked and rewritten in line with the 2012 update of the WGI (I assume it doesn't affect the results of the present study).

Chapter 2.4: It might be worthwhile to set subtitles for each region. Be careful that this

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chapter does not become too superficial, e.g. can you reveal more details or interesting regional features to be detected from the dataset?

Page 4786:

Lines 8-10: Is there an explanation for the high number of available records for the southern Andes and the low latitudes? And are those records as detailed as those available for Scandinavia or the Alps?

Line 14: This is not a very precise statement (“military maps from the 19th century”). Is there more information available?

Line 16 starting with “Also time...”: English phrasing?

Line 18: “North Asia has the smallest...”

Page 4787:

Chapter 3.1: The division into the different time windows may lead to arbitrary results, or can you exclude that the results are influenced by the varying (and partly very low) temporal resolution of the records?

Page 4788:

Line 9/10: The statement of smaller length changes until the mid-19th century needs to be explained. Again: can you exclude an artifact due to the temporal resolution of the available records? As documented by many studies cited in your article, there are impressive glacier advances (and retreats) during the Little Ice Age, e.g. as documented by historical evidence. On the other hand, some glacier records with dated moraines may solely consist of different maximum glacier front position, with no information on the glacier behavior in the time between those maxima. Here it is not possible to draw conclusions about the variability or the full range of past glacier length changes (past minimum glacier extents are always much more difficult to reconstruct).

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Line 15: The bed topography has a large influence on all glaciers, not only on tidewater glaciers.

Lines 21/22: Please explain this statement (should have been discussed in Section 3.1).

Page 4791:

Line 5ff: Important: The question here is how good the global glacier signal is reflected in the glacier length records. The following statement of a stronger glacier retreat in the first half of the 20th century is interesting, but I question whether this is in line with other records, and whether it is feasible to make such a conclusion. If yes, there is need for a better explanation and a more precise differentiation.

Line 14: How could this improvement be achieved? Any suggestions from the authors would be appreciated!

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Interactive comment on The Cryosphere Discuss., 7, 4775, 2013.

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