

## ***Interactive comment on “Little Ice Age climate reconstruction from ensemble reanalysis of Alpine glacier fluctuations” by M. P. Lüthi***

**T. Johannesson (Referee)**

tj@vedur.is

Received and published: 26 November 2013

This is a very interesting paper that presents a powerful method for reconstructing temperature history from glacier length change records. The methodology both takes into account the "memory" of the glacier as represented by the response time of the glacier, as well as the lag caused by glacier dynamics between mass balance forcing / glacier volume and changes in glacier length. Particularly, interesting is the possibility to combine many glacier change records from the same area to derive a single temperature history that includes effects seen only in some of the glacier records.

Detailed comments:

page 5148, line 14: The last sentence in the abstract is perhaps a bit too strong. It,

C2538

furthermore, combines temperature and volcanic radiative cooling in one as if volcanic radiative cooling affects glaciers independent of temperature, whereas the meaning should be (see comment below) that volcanic radiative cooling mainly causes temperature variations that then lead to glacier fluctuations. How about something like "... are thus mainly explained by temperature variations that before the end of the 19th century appear to be driven by variations in volcanic forcing to a large extent" or something like that.

page 5154, lines 7-10: This sentence seems to imply that the methodology presented in the paper would lead to higher reconstructed temperatures for the present-time climate if glacier variation records were available for several more (future) decades. Since the glacier model represents the lag of the glacier response with respect to the climate forcing, this effect should be taken care off by the model to a first approximation at least. Clarify.

page 5157, line 18: Specify whether the  $7 \text{ W/m}^2$  refers to radiation impinging on the glacier surface that is partly reflected because of the albedo of the glacier surface or energy available for melting after albedo effects are taken into account.

page 5158, line 7-9: State more clearly that the ELA sensitivity given in table 2 is inconsistent with Ohmura's value by more than an order of magnitude ( $1 \text{ W/m}^2 \leftrightarrow 200 \text{ m}$ ; rather than  $7 \text{ W/m}^2 \leftrightarrow 100 \text{ m}$ ). The radiation variations on the right y-axis scale of figure 5b are ca.  $-0.5$  to  $+0.5 \text{ W/m}^2$  whereas the ELA variations are  $-100$  to  $100 \text{ m}$ , corresponding to temperature variations on the order of a degree  $^{\circ}\text{C}$ . This seem to indicate that the TS variations cannot directly be important cause of temperature or glacier length variations? Discuss more clearly.

page 5159, line 17-19: I am unsure what is meant by this sentence.

Page 5151, line 10: Delete "and per square meter" (inconsistent units)

page 5152, line 4: Should 283 values be 282 values?

C2539

page 5153, line 10: "data are"/"data are"?

page 5155, line 24: "closely follow" is a bit too strong, might perhaps be "bear some resemblance to"

page 5126, line 26: "differ from reality by the dynamical effects ..." might be "differ from reality because of the simplistic model dynamics, e.g. by the dynamical effects ..." (I don't think the small scale terminus topography is the only or main effect here)

page 5157, line 25: "only limited"/"limited"?

page 5159, line 15: "volcanic event"/"volcanic events"?

page 5160, line 27: "found ... in"/"inferred ... from"?

---

Interactive comment on The Cryosphere Discuss., 7, 5147, 2013.