The Cryosphere Discuss., 7, C1949–C1951, 2013
www.the-cryosphere-discuss.net/7/C1949/2013/

The Cryosphere Discussions
Open Access

Interactive comment on "Probabilistic estimation of glacier volume and glacier bed topography: the Andean glacier Huayna West" *by* V. Moya Quiroga et al.

Anonymous Referee #1

Received and published: 3 October 2013

For the Andean glacier Huayna West, authors calculate a total of 34 solutions of glacier volume and perform statistical analysis to identify the most probable solution. Authors demonstrate that the different solutions of ice volume are best explained by a lognormal probability distribution function. At 90% confidence level, they find that this glacier holds $0.0275 \pm 0.0052\,\mathrm{km}^3$ of ice. Due to the lack of measured ice volume, it is difficult to judge whether these estimates are reasonable and, hence, the employed statistical analysis is useful. Based on the methodological rigor, I personally believe that the probabilistic approach may be very useful to fine-tune the global estimate of ice volume in the best statistical way possible. The presented research itself, however, has some major issues (a few of these are fundamental flaws) that have to be addressed properly before

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

it could be considered for final publication. Several minor (but important) and editorial comments are provided in a supplementary material.

Major Comments

First, the majority of solutions (of glacier volume) are based on the volume-area (V-A) scaling methods. These methods are constructed based on V-A pairs of several glaciers, and are therefore intended for estimating ice volume of glacier ensembles. Studies suggest that error tends to increase while applying for a small sample of glaciers (see, e.g., a recent *TCD* paper by Farinotti and Huss, 2013). Unfortunately, the present study attempts to apply these methods for a single glacier!!! Further, authors skip to discuss why different methods propose different scaling relations (i.e., c and γ values): some methods are based on real glacier data, while some on synthetic data to provide conceptual explanation about, for example, how transient states of glacier affect the scaling-law relations. The point is that not all of the employed V-A models may be suitable for glacier Huayna West – given its geometric and climatic settings.

Second, it is not clear to me the primary objective of this research: whether it is to highlight the usefulness of probabilistic approach, or to simply approximate the present-day ice volume of glacier Huayna West. If it is the first one, the choice of glacier is not quite right for this study. In order to test the usefulness of the employed probabilistic approach, we should have a prior knowledge about the glacier ice volume (via, e.g., GPR survey). If the key idea of this research is to estimate the glacier ice volume, perhaps you should choose some other methods (e.g., Farinotti and others, *J. Glaciol.*, 2009) that are more reliable (for a single glacier application) than V-A scaling method.

Third, on top of these fundamental problems, the manuscript suffers from poor writing. (See the annotated manuscript attached as a supplementary material. Note that my annotations do not necessarily point out all errors.)

"Introduction" contains some info that are irrelevant in the present context; for example, what does the "relation between the subglacial processes and volcanic activities (p.

TCD
7, C1949–C1951, 2013

3934, l. 18-19)" have to do with estimation of glacier volume (primarily based on V-A scaling)? Next, the last paragraph on p. 3933 is too puzzling to differentiate among the various methods of volume estimation.

In "Methodology", it is not clear, for example, how many flowlines are considered to compute the ice thickness distribution following GlabTop approach. It is worth showing a map of the glacier and number of ice flowlines on it. If only central flowline is considered, then the corresponding calculations must overstate the actual ice volume. Next, Equations 2 and 4 chosen to define τ are not consistent in that they do not cover the situation when ΔH exceeds 1.6 km. There are several other inconsistencies. I recommend splitting this section into a few and rewriting it in a more logical manner.

"Results and discussion" is poorly written; the first and second last paragraphs do not look good. Authors should discuss about whether (and in what circumstances) the employed probabilistic approach may be useful for other glacier applications.

"Conclusions" should stress the fact that: (i) not in all applications the same probability distribution function (i.e., lognormal) best describes the several volume solutions; and (ii) the resemblance of any model solution to "most probable" solution is only coincidental, hence the corresponding model should not be misjudged as the best V-A scaling model.

"Figures" have very poor resolution. I recommend re-plotting them.

Please also note the supplement to this comment:
http://www.the-cryosphere-discuss.net/7/C1949/2013/tcd-7-C1949-2013-supplement.pdf

---

Interactive comment on The Cryosphere Discuss., 7, 3931, 2013.