The Cryosphere
Discussions

EGU

Interactive comment on "Glacier change and glacial lake outburst flood risk in the Bolivian Andes" *by* Simon J. Cook et al.

Anonymous Referee #2

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General comments:

This paper fills a gap identified in the literature for an updated inventory of glacier mass changes and formation of potentially dangerous lakes in Bolivia. There are relatively few glaciers and a total glacier lake area of less than 10 km2 in Bolivia. Still, apparently there has not been a comprehensive and up-to-date accounting of glacier and lake changes for all ranges assessed here. This paper nicely provides a time trajectory of change over the most recent decades, when it has been widely recognized that change is occurring at unprecedented rates. The observations are therefore inherently valuable and should be published.

The paper is well-written and clear, and the methods of acquisition sound. However, the scientific merit of the data analyses is less obvious in terms of advancing process

understanding from the basic observations (i.e. this is clearly a reporting of important observations; what are the implications in terms of our understanding of dangerous lake formation?).

Specific comments:

Care should be taken in how related issues of water resources and vulnerability are included. It should be clarified that without measured values, the discussion of water supply and urban migration remains speculative. For example, what is the basis for estimating 15% of potable water to El Alto and La Paz come from glaciers (P1-28)? And is this water originating from a net loss of glacier mass, or is it simply from glacier fed streams? Without specifying, these general statements amount to speculative hyperbole. The authors should provide numbers, and references. Similarly, much of La Paz power comes from hydroelectrity? How much power generation is really vulnerable to being unreliable with low flows?

There is a sequence of steps taken to both automatically analyze the scenes, and also use human expertise to evaluate "dangerous lakes" vis-a-vis factors of risk and damage potential. Why not present this algorithm as a flow diagram? And why not provide relative scale/magnitude of danger? It is interesting to consider the area of lakes that meet the threshold of 'dangerous'. Why not present a graduated ranking of significance from least to most dangerous? The inventory of lakes seems to be numbered from smallest to largest volume/Qmax. But even that is not explicit in the text.

Error is equated to uncertainty, determined to be 10%. Is this rather high? This is based on an assumption of Gaussian distribution. I'm just unclear about how this relates to the reporting of areas.

I do like the inclusion of a kmz file for viewing the lakes. Simple and effective.

In assessing the lake formation related to glacier change, it seems that more analyses

of basic variables could be easily explored to substantiate some of the patterns that the authors observe, and help make more robust suggestions about processes. I think it most compelling to explore pattern of lake changes that might be anticipated given the valley morphology. For example, how do patterns of lake changes relate to topographic indices (e.g. hypsometry, lake elevation, distance from headwall)? What about relating lake changes to glacier forms? These seems straight forward derivatives of this impressive database that has been generated. Then, it would seem the authors might articulate more clear hypotheses to explain the lack of trend in ice-contact lake formation over time. How do these patterns compare to other regions?

It is not clear: were moraine-dammed lakes considered more dangerous or not? If there is no difference, why bother categorizing them as such? Explain.

I wonder why the lakes are numbered as they are (by size of Q max, starting from smallest?). Why not by region? Or keeping #1 as the largest (i.e. reflecting risk magnitude)?

Throughout this discussion, it is probably misleading to talk about "trend" with respect to the change in ice-contact lakes since there is not a significant tendency to the data.

Technical corrections:

P3 L5: what is meant by "first-pass assessment"? Is it spelled with dash or not (compare P4L23)?

P4L26 (and elsewhere): use colon before numbered list.

P5 L23 "Direct hydrological connection" to downstream infrastructure and communities

P5 L27: Lakes "sat" should be set

P8 L21: use 'glacierized' for currently glacier covered, as glaciated can refer to previously ice covered

P10 L27: "very variable" is awkward phrase; better to use "highly variable"

P11 L28: double periods.

P11, L32,33: remove the parentheses as this is a substantive point.

Map figures: the ESRI hillshade backdrop is okay, but they lack of any downstream features (population centers, roads) that are used in evaluating the 'dangerous' lake conditions.

Table 2: separate lake number and list by range. Could also abbreviate lake type to save space.