Earth Surface
Dynamics
Discussions

Interactive comment on "Estimating the volume of Alpine glacial lakes" by S. J. Cook and D. J. Quincey

S. J. Cook and D. J. Quincey

s.j.cook@mmu.ac.uk

Interactive comment – Reply to Anonymous Reviewer 1 (ESurfD-3-C344-2015)

We thank Reviewer 1 for their review of our work. Most of the questions asked of the reviewer have been answered with the response "Yes", with no further action required. Questions 5, 13, 14, and 15 all require responses. Responses to reviewers are requested in the following format: (1) comments from Referees, (2) author's response, (3) author's changes in manuscript. We follow this structure for each of the questions outlined above.

Q5: (1) The reviewer asks us to clarify our statement in section 4.3 regarding our critique of empirical relationships that are based on regional datasets. The reviewer

notes the case of Himalayan glacial lakes that do appear to exhibit a regional trend. The reviewer asks us how we identified outliers in the dataset in section 3.1.

(2) The reviewer refers to p922 line 28 where we suggest that relationships used to estimate lake volumes based on collating information by region should not necessarily be expected to perform any better at predicting lake volume than relationships that are derived from a wide range of sites and regions. We use as evidence for this the example of lakes in the Southern Alps of New Zealand, which are in close proximity to one another, yet have different levels of volume predictability (under- and over-predicted) - our point being that lakes in this region must be unusually deep or shallow for their respective areas. Hence, it is unlikely that any regional trend exists here. The reviewer remarks that (1) we have made this statement without actually running the analysis by region, and (2) that the consistent under-prediction of Himalayan glacial lake volumes indicates that a regional relationship may perform better there. These are fair comments, and ultimately we have clarified our point in the revised manuscript taking into consideration these issues.

Taking the example of New Zealand (although also applicable to other regions), there are relatively few data points to test whether or not a regional relationship could out-perform existing empirical relationships (such as that of Huggel et al., 2002). Hence, we have made a suggestion that can be treated as a hypothesis to be tested in future work, i.e. that regional relationships will not necessarily out-perform existing empirical relationships. The case of New Zealand supports that point, but the case for the Himalaya indicates that there may be some merit in regional relationships, as highlighted by Reviewer 1. However, our key point remains: any relationship (general, regional, context-based or otherwise) should be applied judiciously. In reality, we suspect that there are regional controls on erosion, sediment transfer and deposition that ultimately lead to the development of lakes with potentially predictable characteristics. However, even within regions there can be significant differences in glacier character that lead to significant differences in lake depth, and hence volume. We believe that the point we

are making needs to be made in order to stimulate further work on this issue. We have clarified and elaborated on our point, incorporating the sensible comments of Reviewer 1.

Reviewer 1 also comments that we need to discuss how outliers have been identified (as alluded to on p916 Line 7). Frankly, in making this statement we have simply made a visual assessment – looking at Fig 1 there's a lot of scatter about the best fit line and the line representing Huggel et al.'s (2002) relationship. We have clarified this point, and have also removed reference to "significantly" because we did not undertake a statistical significance analysis here – we have replaced this with "greatly" and now refer specifically to the fact that outliers were determined visually from Fig. 1. A full error analysis is presented later in Table 3.

(3) We have clarified our point about the performance of regional relationships in section 4.3. We have clarified our assessment of outliers in section 3.1.

Q13: (1) Reviewer 1 recommends harmonizing lowercase lettering in figure 3 and caption. (2) Agreed. (3) We have changed all letters in the figure to lowercase.

Q14: (1) The reviewer notes some missing references, reference edits, and asks us to check all references. (2) Agreed. (3) We have added the missing reference by Richardson & Reynolds (2000) to the reference list, checked the inclusion of other cited references, and changed the Mool et al. references to ICIMOD. In doing this, we removed the reference to Haeberli (1983), which was not cited in the text.

Q15: (1) The reviewer recommends adding a "lake type" column to the Supplementary data table. (2) Good point. (3) We have done this in the Supplementary Tables 1 and 2.

Interactive comment on Earth Surf. Dynam. Discuss., 3, 909, 2015.