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On the accuracy of estimating the potential sea level rise by scaling the area of mountain glaciers

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The results of different volume-area scaling methods were compared to measured volumes of 69 mountain glaciers. Since volume area scaling is a widely used tool for the development of future sea level rise and glacier runoff scenarios, two main research questions have been investigated:
i) How accurate is volume area scaling for glacier samples and specific glaciers?
ii) Does the relation between area and volume change in course of glacial recession?

The accuracy of volume area scaling was investigated for different sample of mountain glaciers. The differences between calculated and measured data were within the error bars of 10% for three scaling algorithms, but much more than that for four others. A larger sample including 69 previously published glacier volumes showed that an increase of the sample size does not necessarily decrease the differences between model results and measurements.
For specific glaciers, the modelled volumes differ more from the measured values than for the total sample.

The temporal stability of volume area scaling was analyzed from time series of glacier volumes calculated from known bedrock topography and historical glacier maps or moraines of the glacial maximum of the Little Ice Age (LIA). The results show that the recession of glaciers is not only changing the 'best fit' of volume area scaling parameters, but also comes along with disintegration of previously connected glaciers. Thus the term 'glacier area' has to be defined to use parameters developed for volume area scaling of a specific glacier state.

To develop a more general idea of the accuracy of scaling algorithms, especially for glaciers larger than $\sim$ 50 km^2, additional ice thickness measurements are needed. For already existing data, a reprocessing and homogenization to a present glacier state could help to reduce the uncertainty by using different glacier states for the development of scaling parameters.