



## Measured rates of glacier shrinkage

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A new collection of repeated area measurements yields 685 and 271 measurements of areal change for single glaciers and glacierized regions respectively. Nearly all show shrinkage. Hardly any are accompanied by error estimates. Typical rates for glaciers during the past 50 years are  $-0.20\%$  to  $-0.40\% \text{ a}^{-1}$ . When weighted by initial area, however, the average rate is only  $-0.07\% \text{ a}^{-1}$  because the larger glaciers are shrinking more slowly. In the regional sample the area-weighted rate varies between  $-0.10\% \text{ a}^{-1}$  and  $-0.20\% \text{ a}^{-1}$ . Accelerated loss is evident beginning in the 1980s, but it is difficult to assess the evolution of the average shrinkage rate quantitatively. Further, in 32 regional samples containing information on the dependence of shrinkage rate on initial size, some regions (parts of High Mountain Asia, the Alps, the Queen Elizabeth Islands) exhibit strong dependence while others (notably in western North America) show little or none. Thus an important question remains open: to develop an estimate of the global average rate, it either will or will not be necessary to rely on the glacier size distributions of those regions without area-change measurements. Tentative estimates, relying on an enlarged version of the World Glacier Inventory which includes 125,000 glaciers, vary from  $2500 \text{ km}^2 \text{ a}^{-1}$  (size dependence as exhibited by the Alps and the Queen Elizabeth Islands) to as low as  $500\text{-}600 \text{ km}^2 \text{ a}^{-1}$  (no size dependence). Knowing the rate more accurately would be valuable both in modelling the future evolution of SG and in estimating their average mass balance at the present day, but the shrinkage rate represents an unsolved problem in both these contexts. In a third context, reduction of areal extent offers the most natural interpretation of “shrinkage” in the public mind, and here it is at least possible to offer plain-language interpretations of the tentative results described above: the world’s SG, which cover an extent roughly equivalent to that of France, have in the past 50 years lost an area equal to that

of Belgium (no size dependence) or possibly England (strong size dependence).