



## **Ability of the volumetric mass balance method to detect a bias in the glaciological one on a long time series**

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The net mass balance of Sarennes Glacier (Massif des Grandes Rousses, French Alps) has been measured since 1949 by the glaciological method in which balances are sampled monthly on 5 sites and extrapolated to the whole glacier surfaces. The cumulated mass balance obtained this way is very sensitive to systematic errors that can accumulate linearly with the number,  $N$ , of measurement years, whereas random ones rise with  $\sqrt{N}$ . The volumetric balance method in which altitudinal changes are calculated from photogrammetric restitution of aerial photographs is an independent method whose errors are not time dependent. It has been applied on Sarennes glacier on the period 1952-2003. This yields to -32.3 meter of water equivalent (m w.e) whereas the glaciological mass balance provides -35.1 m w.e.. Such a 9% discrepancy is discussed with a detailed error analysis. The ability of detecting biases in the field measurement method with the volumetric one is evaluated in term of first and second type errors. The number and location of measurement sites required to include all of the natural spatial variability of the mass balance is inferred through a variance analysis.