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Optimization of the geodetic mass balance by a geostatistical analisys of the surface elevation change

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In order to understand the effects of climate on glaciers, precise estimates of ice volume change over several decades are necessary. This information can be determined using the geodetic method. This technique is generally applied following two approaches. On the one hand, sequential DEM differencing allows the surface-elevation changes to be measured over the entire glacier, however it is a time-consuming method. On the other hand, the surface-elevation profiling approach is a fastest alternative, but the spatial variability of the surface-elevation changes may be not thoroughly captured. In this paper we present a new approach relying on a sampling network densification strategy to optimize the surface-elevation change quantification on the glaciers. We consider three glaciers over different periods: Antisana 15α (1997 – 2009), Saint-Sorlin (2003 – 2014) and Olivares Alfa (2013-2017). Based on a geostatistical analysis of the spatial dependence of the elevation difference, we conclude that $\sim$2000 sampling points are enough for the geodetic mass balance estimation. This amount of sampling points enables the spatial variability of the glacier-wide elevation changes to be accurately captured, making it unnecessary to have a complete coverage of the glacier surface for geodetic mass balance computation.