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# Towards a robust method for estimation of volume changes of Mountain glaciers from ICESat data

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Worldwide estimation of recent glacier volume changes is still a challenge that can only be faced by an instrument mounted on a revisiting satellite platform. NASA's ICESat (Ice Cloud and Elevation Satellite) mission was primarily dedicated for mass balance studies of the continental ice sheets of Greenland and Antarctica. ICESat's Geoscience Laser Altimeter System (GLAS) provides accurate elevation estimates derived from the two way travel time of the emitted laser pulse. ICESat offers unlike radar altimeters conveniently small footprints ($\sim$72 m) with a spacing of 170 m along the nadir track. The date were acquired during 19 campaigns where each campaign provides under favorable conditions one flyover. The intersections of the track with glacier areas are random but it provides adequate data coverage for major mountain ranges. Estimation of height changes of mountain glaciers crossed by repeated ICESat tracks is hindered by rough topography, distances between repeated tracks (up to 3000 m), effects of saturation and often low accuracy of the available digital elevation models. Accuracy and limitations of two methods were compared: statistical approach where the differences of ICESat heights to a reference DEM are averaged and analytical approach in which only almost spatially identical tracks are analyzed. In both approaches accumulation and ablation areas were treated separately. As a test bed Aletsch Glacier in Swiss Alps with plenty of auxiliary datasets such as DEMs, topographic maps, climate data etc. was used. The ICESat data is well spaced over the glacier area and includes both accumulation and ablation areas plus glacier terminus. Preliminary results show a good agreement between both the approaches.