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Impact of resolution and radar penetration on glacier elevation changes computed from DEM differencing

J. Gardelle (1), E. Berthier (2), and Y. Arnaud (3)

(1) CNRS-Université Grenoble 1, LGGE, Grenoble, France (gardelle@lgge.obs.ujf-grenoble.fr), (2) CNRS, Université de Toulouse, LEGOS, Toulouse, France (etienne.berthier@legos.obs-mip.fr), (3) IRD-Université Grenoble 1, LTHE/LGGE, Grenoble, France (yves.arnaud@ird.fr)

Regional glacier mass balances can be measured by subtracting multi-temporal digital elevation models (DEMs). However, DEMs are often biased with altitude and it remains unclear whether the elevation differences observed on the ice-free terrain can be used to correct biases on ice-covered areas. We investigate such altitude-related biases using DEMs from three different sensors: SPOT-5, SRTM C-band and SRTM X-band. The bias due to different original DEM resolutions can be corrected using a relationship between curvature and elevation difference, calculated on ice-free terrain. The impact of C-band radar penetration into snow and ice can be evaluated for a specific region by comparing SRTM C-band and SRTM X-band DEMs. In our test area (Karakoram), the resolution-related bias has a minor influence on the region-wide elevation change. Conversely, not accounting for C-Band penetration would seriously biases the mean glacier mass balance.