Understanding snow accumulation patterns in an highly glacierized alpine catchment

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The accurate estimation of snow distribution at the end of the accumulation period is important in glacierized surfaces, since it determines the timing of ice exposure and the corresponding occurrence of ice or snow melt. Moreover, glacier areas, which are earlier exposed, are obviously characterized by a higher mass loss compared to those exposed later. In this study, we investigate the spatial and inter-seasonal variability of observed snow accumulation patterns over the highly glacierized basin of Haut Glacier d' Arolla in the Swiss Alps during two accumulation seasons (2006-2007 and 2010-2011). We use a set of four digital elevation models (DEMs) generated by high resolution helicopter-borne light detection and ranging (LiDAR) data, which have been acquired in snow free conditions at the beginning of the accumulation period and before the start of the ablation season. Elevation differences between each subset of two DEMs provide an estimation of snow cover at the maximum of accumulation. These results are compared with a dense number of manual snow depth measurements available over the glacier at the date of the LiDAR surveys. In particular, we compare the snow depth empirical distributions and main statistical descriptors for the two seasons. We relate them to the main topographic attributes and the average meteorological forcing with the aim to understand if topographical controls have a stronger influence than the climatic forcing that determines the winter accumulation. The meteorological forcing is provided by two automatic weather stations available in the site and is used to reconstruct the winter climatic condition for both seasons.