



## **The role of artificial increase of accumulation within glacier skiing resorts. A feasibility study.**

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The amount of winter snow plays an important role in the ablation zone of a glacier by governing the onset of net ablation in spring. Beneath the investigation of ablation reduction measures (e.g. covering of the snow surface), the possibility of an artificial increase of accumulation was studied in the framework of the project 'Active Glacier Protection' from April 2004 to October 2006 in order to achieve a higher mass balance on a local scale. Using a degree-day approach, the additional mass of winter snow needed to eliminate ice ablation is calculated. The simple model is calibrated using air temperatures and melt rates measured within the glacier skiing resort Stubai during the ablation periods 2005 and 2006. The results indicate that 591 mm w.e. and 1157 mm w.e. of additional winter snow are required in order to achieve a zero net mass balance at the end of the respective hydrological years 2004/05 and 2005/06. In a next step, different technical methods are evaluated with respect to their potential in accomplishing the necessary mass gain. Selected approaches consider either the addition of new mass (artificial snowmaking, water injection) or the redistribution of existing one (snow management using snow-cats, optimized accumulation of snow drift). Data of respective field experiments shows that water injection and snow drift accumulation can hardly procure the desired mass gain. Similarly, artificial snowmaking is strongly constrained by water availability and the meteorological conditions, especially wet-bulb temperature, which is quantitatively investigated using measured meteorological parameters. On the other hand, the redistribution of snow using snow cats has demonstrated to be a practicable and efficient technique on a local scale. Furthermore, the overall assessment of the results gained during the project indicates that the combination of ablation reduction (covering) and accumulation increasing measures (snow

management strategies) allows a net mass gain even during strongly negative mass balance years for all slope expositions with a efficiency : cost ratio similar to artificial snowmaking.