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Detecting glacier-bed overdeepenings for glaciers in the Western Italian Alps using the GlabTop2 model: the test site of the Rutor Glacier, Aosta Valley

Cristina Viani (1), Horst Machguth (2), Christian Huggel (2), Luigi Perotti (1), and Marco Giardino (1)

(1) University of Torino, Department of Earth Sciences, Italy (cristina.viani@unito.it), (2) University of Zurich, Department of Geography, Switzerland

It is expected that the rapid retreat of glaciers, observed in the European Alps and other mountain regions of the world, will continue in the future. One of the most evident and relevant consequences of this phenomenon is the formation of new glacier lakes in recently deglaciated areas. During glacier retreat overdeepened parts of the glacier bed become exposed and, in some cases, filled with water.
It is important to understand where these new lakes can appear because of the associated potential risks (i.e. lake outburst and consequent flood) and opportunities (tourism, hydroelectricity, water reservoir, etc.) especially in densely populated areas such as the European Alps.

GlabTop2 (Glacier Bed Topography model version 2) allows to model glacier bed topography over large glaciated areas combining digital terrain information and slope-related estimates of glacier thickness. The model requires a minimum set of input data: glaciers outlines and a surface digital elevation model (DEM).
In this work we tested the model on the Rutor Glacier (8,1 km^2) located in the Aosta Valley. The glacier has a well-known history of a series of glacier lake outburst floods between 1430 AD and 1864 AD due to front fluctuations. After the last advance occurred during the 70s of the previous century, glacier shrinkage has been continuous and new lakes have formed in newly exposed overdeepenings.
We applied GlabTop2 to DEMs derived from historical data (topographic maps and aerial photos pair) representing conditions before the proglacial lake formation. The results obtained have been compared with the present situation and existing lakes. Successively we used the model also on present-day DEMs, which are of higher resolution than the historical derived ones, and compared the modeled bed topography with an existing bedrock map obtained by in-situ geophysical investigations (GPR surveys).
Preliminary results, obtained with the 1991 surface model, confirm the robustness of GlabTop2 in detecting the overdeepenings (6 were identified) and their location. Regarding their size, it seems to be influenced by the resolution of input data: the total overdeepended area covers about 1,3 km^2 in the case of 25m pixel size and about 0,6 km^2 in the 75m one.

Based on the results obtained with model application and verification at Rutor Glacier, GlapTop2 will be applied over larger areas of the Western Italian Alps (Piemonte and Aosta Valley) in order to assess locations of possible future lakes to facilitate identification of potentially hazardous conditions and dynamics.