

The formation of glacial lakes in Austria since the Little Ice Age

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The global temperature rise in the 20th and 21st centuries led to massive deglaciation and the formation of numerous glacial lakes. Glacier lake development and lifetime are controlled by the complex interplay of climate and geological boundary conditions, geomorphological process activity and glacier dynamics. New lakes in formerly glaciated alpine areas significantly contribute to changing geomorphologic, hydrologic and ecologic conditions at high altitudes.

Here we present an inventory of lakes in the Austrian Alps. The inventory is a central part of the project FUTURELAKES that aims at understanding and modelling the development of glacier lakes in Austria. We intersect glacier lake locations with glacier inventory data to understand how deglaciation controls lake evolution. The timing of lake formation is reconstructed by comparing emerged lake area with vanished glacier area at five points in time from Little Ice Age (LIA) to 2014 – the longest time period covered by a glacier lake inventory. We discuss lake formation with respect to temperature records at high-alpine climate stations in the study area.

The lake inventory contains 1389 mapped lakes with a minimum size of 1000 m² covering an area of more than 17 km². Lakes are classified by the damming mechanisms: (a) glacial debris dammed (49.5%), (b) bedrock dammed (49%), (c) glacier ice dammed (0.4%), and (d) debris dammed (1.1%).

In Austria, 243 lakes above 1700 m have formed since LIA. Both the total number of glacial lakes and total lake area increased exponentially from LIA to 2014, while glacier area shrunk correspondingly. The number of new lakes per year grew from 0.6 (± 0.1 , LIA-1920) to 5.8 (2006-2014) and new lake area per year increased from 6,877 \pm 513 m² (LIA-1920) to 74,129 m² (2006-2014). This development can be linked to rising air temperatures in the Austrian Alps which show an accelerated increase since the 1980s.