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FloodAlp! Frequency and intensity of extreme floods in the Alps through the Holocene

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Floods caused by extreme precipitation events represent one of the major natural hazards in the Alpine realm. New climate models point to the possibility that flood frequency and intensities increase as a result of the upcoming climate change. To quantify these predicted changes of extreme events, knowledge of their natural variability is required.
The FloodAlp! project aims to reconstruct the frequency and the intensities of Holocene flood events in the Alps by using lake sediments as natural geologic archives. Lake basins record such extreme events with characteristic sediment layers that contrast sharply with the regular background sediments. The high discharge values with large amounts of suspended particles trigger turbiditic underflows that focus the detrital particles in the deepest areas of the basins, so that several hundreds of such events can be identified in ideally suited lakes.

A total of sixteen lakes along a north-south transect covering a wide range in altitude is investigated in the project. Each targeted lake is first investigated by a high-resolution (3.5 kHz) reflection seismic survey, providing information on the sediment thickness, seismic stratigraphy, sediment distribution and ideal coring locations. After this first evaluation, long sediment cores (max. length 16 m) are taken in the deepest depression of the lake basin. Precondition for establishing the flood record is a good age model, which is accomplished by 14C and 137Cs/210Pb dating. Also crucial is the differentiation between background sedimentation and event layers as well as between mass-movement-related and flood-related event deposits. This characterisation of the sedimentary facies is achieved by chemical, physical and mineralogical analyses of the sediment.

Sediment records have been investigated in six of sixteen targeted lakes so far and the results show already the high potential of this approach. In every lake, over hundred flood-related turbidite deposits with a thickness from 0.1 to several tens of centimeters can be sharply distinguished from background sedimentation as well as from mass-movement deposits. To optimise the resolution of the flood records, we are analysing layers that are even thinner than one milimeter by using a scanning electron microscope (SEM) in combination with an energy dispersive x-ray analyses system (EDX). The results of sediment core analyses provide well-dated flood chronologies through the complete Holocene, which allow building up a flood-event inventory of the Alps. First comparisons of the flood records from the investigated lakes in the Northern Alps show that the approach produces patterns that can be correlated between the different lakes. The numerous periods of enhanced flood occurrence seem to show a dominant millennial-scale variation. Initial comparison with the records that are to date available from the Southern Alps indicate similar patterns but also show some periods of different flood activities, which might be related to changing atmospheric circulation patterns during the Holocene.