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Assessment of Late Holocene sediment volume and accumulation rates in valley floors of the Swiss Alps: The Hasli valley and Lütschine Fan delta case study

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The study of the accumulation rates and estimation of sediment volume can offer important information to the knowledge of fluvial dynamics in mountain areas. Sediment accumulation in mountain deltas and alluvial fans is predominantly characterized by variations in discharge and sediment supply. These variables are controlled by a wide range of internal and external factors such as flow regime, morphology, land use, climate variability, etc. This work will center on two basins located in the Bernese Swiss Alps, the upper Aare basin and the Lütschine basin.
Our study will focus on the sediment bodies of deltas located at the outlet of both basins. These bodies are the youngest fluvial deposits of the accumulation sequences of the valley fill, started in general terms after the retreat of the Lütschine and Aare glaciers at approximately 17 and 16 kyr. Both rivers flow into Lake Brienz and have glaciated areas in the higher lands.
The main purpose of this work is to estimate the sediment volume and accumulation rates during the last 3000 years. In addition, we will establish a comparison between the two basins and identify the major trends in sedimentation rates. This study also allows the identification of the anthropic influences in sediment dynamics.
We used a total of 15 boreholes and 5 cross sections to study the geometry of the sediment bodies in both deltas. The geochronology is based on 14C dating of organic sediments, peat and wood taken from these cores. For the estimation of the sediment volume we used a geostatistical modelization of the paleo surfaces and applied this calculation for 500-years time slices. This method allows us to obtain a model of sediment deposition of both deltas from 3000 yr cal BP to the present day surface.
In general, results show a decreasing trend of sedimentation rates during the last 3000 years. This decrease is mostly due to natural dynamics, particularly to the Holocene post glacial landscape adaptation and related changes of sediment production and storage. With regard to this time scale, we don't observe any considerable increase in the accumulation rates caused by human intervention. Only during the last 500 years we detect a moderate increase in sedimentation rates that breaks the downward trend of the 3000-years series. This final aggradation pulse can be explained by the expansion of land-use, as enhanced deforestation until the second half of the 19th century and the spread of alpine grassland. Even though both deltas share similar accumulation trends, the Lütschine fan delta was subjected to at least 800 years of anthropic hydrological management, whereas the Aare delta kept its natural configuration until the mid 18th century. This fact explains the different distribution of aggradation and progradation of the deltas during the last 1000 years. In the future we hope to improve our results by incorporating further bore sites in our model.