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New approach to identify filled glacial lakes in high alpine environments

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Glacier retreat is one of the most visible consequences of temperature rise since LIA (little ice age) worldwide and in the European alps. The formation of new glacial lakes is observed as a new landscape feature in recently deglaciated high mountain areas and is well documented in the Austrian alps (264 new glacial lakes since LIA) and in other parts of the world. These lakes often originate from glacial depressions, formed by erosion through different glaciation cycles. Subglacial depressions may form into glacial lakes that represent sinks for sediment flux. Fluvial, glaciofluvial and gravitative sediment supply contributes to the sedimentation of these sinks during and after glaciation until the lake is completely filled up. Lifetime of glacial lakes and the timing of filled lakes is mostly unknown for high alpine environments due to lack of material available for dating (e.g. peat). Analysing of postglacial lake formation in high mountain areas by lake mapping fears to be incomplete by missing out filled up lakes that have disappeared from the landscape.

The aim of the study is to identify former glacial lakes, visible today as flat, fine-grained alluvions, using a GIS-based approach: the approach delineates flat areas in glacial environments of the LIA-extent in Austria. The method is based on the Surface Classification Model (SCM) developed previously by other authors and uses slope and roughness to detect flat areas. Second, a stream network, ranked by Strahler-order, indicates former glacier flow tracks and is used to identify potential confluence situations. We hypothesise that subglacial overdeepening occurs in confluence zones and that the overlap of stream junctions of higher Strahler-order streams with areas of low SCM values (i.e. flat areas with low surface roughness) are indicators of glacial depressions. As a result, the GIS-based approach shows 154 potential glacial depressions (Strahler order>3) within the LIA-extent of the Austrian alps, that indicates potential former glacial lakes.

We discuss the possibility to validate our modelling results with geophysical data. Appropriate methods may be ground-penetrating radar (GPR) or electrical resistivity methods, which are suitable to provide information on potential concave bedrock shape as indication for glacial depressions and typical lake grain size distribution (e.g. in varve layers). The aim is to develop an overall concept to integrate large-scale geomorphological data with point-wise geophysical measurements, that might be transferred to other areas covered with (former) glacial lakes.