

## GlaciArch: applying glaciological methods for gauging archaeological potential using GIS

Stephanie R. Rogers, University of Fribourg, [stephanie.rogers@unifr.ch](mailto:stephanie.rogers@unifr.ch)  
Mauro Fischer, University of Fribourg, [mauro.fischer@unifr.ch](mailto:mauro.fischer@unifr.ch)

Recent climate changes have led to an increase in the exposure of archaeological remains in frozen environments due to the melting of glaciers, ice patches, and permafrost on a global scale. In the majority of cases, the discovery of glacial archaeological remains has occurred due to chance. In order to avoid the risk of losing exceptional, often organic, cultural remains due to decomposition, systematic and predictive methodologies should be employed to locate areas of high archaeological potential. In this paper, we merge existing glaciological knowledge and methodologies with archaeological and historical information in GIS to gain a better understanding about how people interacted with frozen environments in the recent past, as well as to create a model to determine areas of high archaeological potential for the future based on glacier melting rates. First, glacier outlines from the years 1850, 1973, and 2010, as well as topographic properties such as slope and aspect, will be compared to archaeological and historical databases to validate the relationship between artifact discoveries and glacial extents over time. Next, a simple but robust, broad-scale hypsometric glacier recession model (Paul et al. 2007) will be employed along with several climate change scenarios for the Pennine Alps region. This approach is based on the relationship between current glacier extents and changes in the balanced-budget equilibrium line altitude ( $ELA_0$ ) and will be used to predict where glaciers will recede fastest. The results will specify locations in which archaeological investigations should be conducted first. Ground Penetrating Radar (GPR) data and the spatial distribution of modeled mass balance will then be used to calculate a high resolution glacier evolution model (Huss et al. 2008; Jouvet et al. 2009) at two control sites, the Theodule glacier and the Haut glacier d'Arolla, in order to check the accuracy of the regional model (Linsbauer et al. 2013). The results of archaeological and historical database investigations will increase understanding about the location and retrieval of artifacts in relation to glacier extents over time. The variations in glacier dynamics between sites makes it difficult to predict where archaeological remains might be located; however, we hope database investigation along with broad- and local-scale glacier modeling will provide insight into patterns of artifact location and retrieval to aid in archaeological prospection and investigation in the future.

### References

- Huss, M., D. Farinotti, A. Bauder, and M. Funk. 2008. "Modelling Runoff from Highly Glacierized Alpine Drainage Basins in a Changing Climate." *Hydrological Processes* 22: 3888–3902.
- Jouvet, G., M. Huss, H. Blatter, M. Picasso, and J. Rappaz. 2009. "Numerical Simulation of Rhonegletscher from 1874 to 2100." *Journal of Computational Physics* 228: 6426–6439.
- Linsbauer, A., F. Paul, H. Machguth, and W. Haeberli. 2013. "Comparing Three Different Methods to Model Scenarios of Future Glacier Change in the Swiss Alps." *Annals of Glaciology* 54: 241.
- Paul, F., M. Maisch, C. Rothenbühler, M. Hoelzle, and W. Haeberli. 2007. "Calculation and Visualisation of Future Glacier Extent in the Swiss Alps by Means of Hypsographic Modelling." *Global and Planetary Change* 55: 343–357.