Mapping and quantifying short-term evolution of proglacial areas

This project focuses on the dynamics of "proglacial areas", i.e. landscapes which only recently has been exposed from under the ice. We are going to study proglacial areas in SE Iceland, where most of the glaciers retreated seriously during the last century. Glaciers in Iceland are very dynamic, which gives us an ideal opportunity to watch how they evolve in response to changes in climatic conditions and intensification of geomorphological processes. The main aim of the project is to understand and quantify feedbacks between deglaciation and geomorphic activity on the foreland of receding temperate glaciers in SE Iceland over annual and intra-annual temporal scales.

From the scientific standpoint, the proglacial areas are essential, because they record information about the character of former glaciological processes. Correct deciphering of these processes allows for better interpretation of the reaction of ice masses to climate changes. From a more applied standpoint, the proglacial areas can be treated as "sediment storages". Such sediments can be relatively easy mobilised and transported downvalley – often very rapidly - threating human lives and infrastructure. Geomorphic dynamics in proglacial landscapes is controlled by the time passed since deglaciation, with modification by the local conditions, like topography or geology. Existing theoretical models of paraglacial activity take the form of a simplified curve, indicating when the landscape may become unstable. The critical issue is that they have not been tested and compared over detailed spatial and temporal scales. Moreover, the quantitative aspect of recent paraglacial activities related to deglaciation and climate changes remains largely unknown despite being of critical importance due to their potentially substantial impact on landscape dynamics and further implications for interpretation of geological records. To understand how rapidly the debris can be re-distributed, the theoretical paraglacial model needs to be constrained, while more specific models for different settings need to be developed.

We will employ field-based and remote sensing observations to quantify and compare the sensitivity of geomorphic response to climate change and the character of the ice masses. The project will investigate a range of mountain glaciers – from small valley glaciers to larger, more complex ice masses. We are going to use satellite images and very detailed (cm-scale) images captured with drones, which will enable us to assess the modifications of even subtle landforms.

The project will: (1) map recent (last ~ 15 years) changes in the landscape based on semi-annual high-resolution satellite images; (2) quantify the annual and intra-annual rates and volume of relief changes based on time-series of UAV surveys. The impact of this work will be to quantify the rates and magnitudes of geomorphic processes modifying proglacial areas such as drainage transformation, dead-ice melting, debris flow activities, and to assess preservation potential of landform assemblages important for the interpretation of specific glacial processes-form relationships. As such, the realisation of this project will lead to a quantified understanding of short-term evolution of proglacial areas, which will allow researchers to compile modern analogues for palaeoglaciological reconstructions and provide a basis for the prediction of future changes in the polar regions.