Geomorphic sensitivity of the Arctic region: geohazards and infrastructure (INFRAHAZARD)

Deeper understanding of the impacts of current and future climate on Earth surface systems (ESSs) is fundamental for science and society. This is highly relevant in the Arctic, where geomorphic ESS processes control landscape dynamics and ecosystem processes. In addition to the nature, the Arctic is undergoing significant changes regarding urbanization, settlement patterns, and economic activities, creating challenges for planners, decision makers and engineers. Infrastructure forms the basis for regional economic growth and sustainable development in the Arctic. The increase in Arctic temperature may change physical properties of soil that can have drastic negative effects on infrastructure and land use.

The INFRAHAZARD consortium focuses on the modelling of the Arctic ESSs in a changing climate and production of geospatial data-based infrastructure risk assessments for decision making and land use planning. For the first time the sensitivities of ESSs and their relation to human activity is explored across the Arctic region. More precisely, the objectives are to: (i) investigate the environmental drivers of Arctic geomorphic processes across scales, (ii) forecast the geomorphic sensitivity of Arctic throughout the 21st Century, and (iii) identify threat spots and quantify the amount of Arctic infrastructure at risk in the face of climate warming. Our ground-breaking approach is to apply complementary research data and approaches to assess the impact of the climate change on the Arctic ESSs and infrastructure. The research is based on comprehensive geospatial and remote sensing based data at global, regional and local scales, and innovative modelling methodology.

So far, we have constructed a comprehensive circum-Arctic database on ESSs (e.g. ground temperature, active layer, and permafrost features), environmental conditions (e.g. climate and ground properties) and infrastructure (residential, transportation, and industry) at high (<1 km) resolution. Moreover, we have compiled field-based data on ESS processes (e.g. frost action) at local scale (more than 600 observation sites have been inventoried). Using the compiled data sets we have, for example, projected the ground thermal regime in current and future climates (e.g. using RCP4.5 and 8.5 scenarios) and modelled geomorphic features across scales. We have found that: (i) local environmental conditions control the current and future geomorphic process activity in high-latitude landscapes, (ii) the distribution of permafrost landforms can be modelled across the Arctic at high resolution, (iii) there will be substantial degradation of circum-Arctic permafrost by the middle of this century, and (iv) Arctic infrastructure is at high risk in the near future owing to thaw of ice-rich permafrost. Next, we focus on the publication of the results.

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