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Periglacial process research for improved understanding of climate change in periglacial environments

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Periglacial landscapes extend widely outside the glaciated areas and the areas underlain by permafrost and with seasonal frost. Yet recently significant attention has in cryosphere research, related to periglacial geomorphology, been given to a direct climate permafrost relationship. The focus is on the permafrost thermal state including the thickness of the active layer, and often simplifying how these two key conditions are directly climatically controlled. There has been less focus on the understanding and quantification of the different periglacial processes, which largely control the consequences of changing climatic conditions on the permafrost and on seasonal frost all over the periglacial environments.

It is the complex relationship between climate, micro-climate and local geomorphological, geological and ecological conditions, which controls periglacial processes. In several cases local erosion or deposition will affect the rates of landform change significantly more than any climate change. Thus detailed periglacial process studies will sophisticate the predictions of how periglacial landscapes can be expected to respond to climatic changes, and be built into Earth System Modelling. Particularly combining direct field observations and measurements with remote sensing and geochronological studies of periglacial landforms, enables a significantly improved understanding of periglacial process rates.

An overview of the state of research in key periglacial processes are given focusing on ice-wedges and solifluction landforms, and seasonal ground thermal dynamics, all with examples from the high Arctic in Svalbard. Thermal contraction cracking and its seasonal meteorological control is presented, and potential thermal erosion of ice-wedges leading to development of thermokarst is discussed. Local and meteorological controls on solifluction rates are presented and their climatic control indicated. Seasonal ground thermal processes and their dependence on local vegetation and snow conditions as affecting active layer depths and top permafrost thermal regimes are discussed. An overview of other important periglacial processes such as weathering, rock glacier, pingo and palsa dynamics and their climatic and/or local condition controls are given. Finally an overall discussion on how periglacial processes can affect rock slope stability in periglacial environments close to the permafrost boundary is introduced, with an example from northern Norway.