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Repeated electrical resistivity tomography measurements of permafrost in the mountains of southern Norway

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Since melting of ground ice takes place over a range of temperatures below 0 °C, parts of the extra energy from warming of the near-surface ground is used by phase changes within the permafrost, and ground temperatures are in this case less sensitive to changes in ground surface temperatures. When permafrost thaws and ice disappears completely, a greater part of the energy is hence available for increasing the ground temperature. This means that borehole temperatures are not sufficient to fully understand the ground thermal response to a change in the mean ground surface temperature, especially in ice-rich permafrost where latent heat effects dominate the ground thermal regime at temperatures close to 0 °C. Hence, repeated geophysical measurements indicating changes in ground ice conditions are valuable additional information.
Through the research project CRYOLINK ("Permafrost and seasonal frost in southern Norway") several shallow boreholes have been drilled in the mountains of southern Norway, and a monitoring program to measure air and ground temperatures was started. Future air temperature scenarios indicate a warming of 2.5-3.5 °C by 2100 in the region, so the observed recent warming and degradation of mountain permafrost will presumably continue. Here we present the first results of repeated electrical resistivity tomography measurements from some of the borehole locations. In addition to time-lapse tomographies of specific resistivities, we compare the apparent resistivities with the measured borehole temperatures and laboratory-measured temperature-resistivity relations of borehole samples.