

Processing and management of mountain permafrost data

Jeannette Noetzli WSL Institute for Snow and Avalanche Research SLF, Davos

Cécile Pellet Department of Geosciences, University of Fribourg

Sound assessments of climate-related permafrost changes require reliable and comparable data measured at representative sites over decades. Careful standardization and maintenance of field installations are crucial to reduce data gaps and subsequent data processing efforts. However, the production of high-quality permafrost time series does not end with the raw data being collected in the field. It crucially includes secure storage, quality control, data cleaning and gap-filling and, finally, the derivation of secondary products such as aggregations, warming rates or creep velocities. The 10th GCOS monitoring principle states that data management systems (DMS) that facilitate access, use and interpretation of data should be included as essential elements of climate monitoring systems.

Best practices for post data-acquisition tasks for permafrost data are hardly available. In part, guidelines for meteorological data can be applied for the processing or quality control of permafrost (temperature) data. However, permafrost data have to be treated with different statistical and gap-filling procedures, e.g., due to the time lag and dampening with depth or during phase change. We present the DMS of the Swiss Permafrost Monitoring Network PERMOS, which developed from an inhomogeneous archive of data files to a DMS, in which different types of permafrost time series (i.e., temperature and meteorological data, electrical resistivities, survey points) are stored and processed, and which has been continuously adapted and extended to meet the objectives of GCOS (storage, access, traceability related to raw data, processing, quality control and analyses). For each observation element, database structure and processing routines were developed to derive different levels of data and secondary products, as well as metadata on data manipulations and information on sites, methods or individual surveys.

Developing an NWT Permafrost Database

Ashley Rudy	Northwest Territories Geological Survey, Government of Northwest Territories, Yellowknife, NWT
Niels Weiss	NWT Geological Survey
Kumari Karunaratne	NWT Geological Survey
Steve Kokelj	Northwest Territories Geological Survey, Government of Northwest Territories, Yellowknife, NWT

Territorial governments are among the largest generators of permafrost information in Canada, and the capacity and infrastructure to support data stewardship and analysis are critical to applied permafrost projects. Across the NWT, various groups and agencies collect permafrost data at a significant expense and for a wide range of purposes, however, there is no standard reporting protocol or repository in the NWT for these data. With an increasing interest in understanding permafrost landscape change, and designing and maintaining resilient northern infrastructure, we need to improve how the information generated is transferred and mobilized. A need was identified to develop an NWT Permafrost Database to improve the organization and accessibility of the data, contribute positively to project planning, and environmental and regulatory monitoring, and create a culture of data sharing. The NWT Permafrost Database includes a legacy of permafrost data collected through partnerships with academic and government institutions, and industry. Through this project 537 ground temperature datasets and 194 geotechnical projects which represent more than 4700 boreholes have been recovered, which is just the tip of the iceberg for what exists in the NWT. A number of these sites are co-managed by academic and federal collaborators. The NTGS recognizes that interoperability between existing and future databases will be critical for the future of Canadian permafrost data management. The development of the NWT Permafrost Database has successfully supported northern governance, scientific leadership and coordination amongst government departments and indigenous organizations. This presentation will highlight the importance of discoverability and accessibility to permafrost data, the value it provides to support infrastructure planning, maintenance, and, adaptation and innovation in permafrost regions where infrastructure is the most vulnerable to the effects of climate change. It is also critical to support R&D projects, assess future trajectories, and in turn to ensure a repository for new data and research results.

International database of geoelectrical surveys on permafrost: a new IPA Action group

Coline Mollaret	University of Fribourg
Mohammad Farzamian	University of Lisbon, Portugal
Rebecca Gugerli	University of Fribourg
Christian Hauck	University of Fribourg
Teddi Herring	University of Ottawa, Canada
Christin Hilbich	University of Fribourg
Andreas Hördt	TU Braunschweig
Christof Kneisel	University of Wuerzburg
Cécile Pellet	Department of Geosciences, University of Fribourg
Riccardo Scandroglio	Chair of Landslide Research, Technical University of Munich, Germany
Sebastian Uhlemann	Lawrence Berkeley National Laboratory
Daniel Draebing	University of Bayreuth, Chair of Geomorphology, Bayreuth, Germany

Our new IPA action group (2021-2022) has a main objective of bringing together the international community interested in geoelectrical measurements on permafrost and laying the foundations for an operational International Database of Geoelectrical Surveys on Permafrost (IDGSP). We aim to initiate a database for geoelectrical data and develop guidelines for survey repetition and data processing. We promote and support the repetition of existing legacy geoelectrical measurements to yield the resistivity evolution over time and so detect temperature and ground ice/water changes in response to climate changes. Further aims include raising awareness of the value of geophysical data within the permafrost community and coordinating towards their integration into the Global Terrestrial Network for Permafrost (GTN-P).

International monitoring activities within the GTN-P currently include point-scale measurements of permafrost temperature and active layer thickness (Biskaborn et al. 2019). Geophysical, and especially geoelectrical measurements, have been used for permafrost detection and monitoring for more than 50 years, and are comparatively more cost-effective, faster, non-invasive, and spatially more representative than boreholes. Geoelectrical methods are currently used by countless research groups, government agencies and industries worldwide to investigate permafrost state. Repetition of old measurements happens seldom, even if it would allow to quantify permafrost degradation on a long-term scale. Exchange of data and expertise exists, but is limited or usually done bilaterally. Neither complete information about the existence of geophysical surveys on permafrost nor the data itself is available on a global scale. Given the potential gain for identifying permafrost evidence and for characterizing its changes around the world, there is a strong need for coordinated efforts regarding the exchange of data, metadata, guidelines, and expertise. Eventually, this database will enable monitoring and deciphering the effects of climate change on permafrost environments worldwide.

Biskaborn et al. 2019. Permafrost is warming at a global scale. *Nat Commun* 10, 264 (2019).
<https://doi.org/10.1038/s41467-018-08240-4>.