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Organisation and analysis of temperature data measured within the Swiss Permafrost Monitoring Network (PERMOS)

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The Swiss permafrost monitoring network (PERMOS) has been running since 2000 and developed from a loose network of research sites towards an operational network with long-term funding and integration into national and international monitoring structures. The monitoring strategy follows a landform based approach to capture the interaction of subsurface thermal conditions with the atmosphere in a comprehensive picture of permafrost in the Swiss Alps and includes three observation elements: (1) ground temperatures in boreholes and at the surface around the drill site, (2) changes in unfrozen water content at the drill sites, and (3) permafrost creep velocities. They are observed in different landforms (e.g., rock walls, rock glaciers, scree slopes) because topography and site characteristics are decisive for different changes in subsurface thermal regimes.

Three of the ten monitoring principles formulated by the Global Climate Observing System (GCOS) for field measurement relate to the management and quality of data and metadata and state that data management systems are an essential element of climate monitoring systems. For these purposes a data management system is built up that (1) ensures comparability and quality of the data, (2) provides secure and long-term storage in a robust and flexible system with customised access for basic and advanced users and data exchange with data centres and (3) at the same time keeps the (time) effort needed to a minimum. To this end, a relational database was set up and processing protocols are developed for standardization relying on open source products. As of today, the PERMOS data base includes data from the three key observation elements as well as other available ancillary data from most of the Swiss permafrost research sites with time series of up to more than 20 years and more for temperature measurements. This finally builds the basis for comprehensive and joint analyses across sites and parameters within the SNF-funded project «The Evolution of Mountain Permafrost in Switzerland» (TEMPS).

In this contribution, we present the data management strategy within PERMOS and give an overview on the available data and results obtained in collaboration with TEMPS. We focus on temperature data and show results and comparisons from analyses across a large number of sites in different landforms. Generally, permafrost temperatures in the past decade are characterized by a maximum in 2003/2004, followed by a decrease and again increasingly warm conditions in the past 5–6 years. While trends in surface temperatures in the past decade are small, clearer trends can be seen at depth in many boreholes. Here, the general pattern of warming and cooling phases during the past 1–2 decades is rather persistent across all drill sites irrespective of local influences.