Sustaining permafrost observations: priorities and needs of the Global Terrestrial Network for Permafrost (GTN-P)

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The Global Terrestrial Network for Permafrost (GTN-P) is the primary international programme concerned with sustained long-term monitoring of permafrost. GTN-P was developed in the 1990s by the International Permafrost Association (IPA) under the Global Terrestrial Observing System (GTOS) as part of the Global Climate Observing System (GCOS). The two major components of GTN-P (Essential Climate Variables) are: (a) long-term monitoring of the thermal state of permafrost in an extensive borehole network, the **Thermal State of Permafrost - TSP**; and (b) monitoring of the **Active-layer thickness - ALT**. Long-term monitoring of permafrost generates essential baseline information for the assessment of climate change impacts in polar and high mountain regions.

GTN-P data are used in process understanding, to develop and validate numerical models, and to develop scenarios of permafrost evolution over time. GTN-P data have high socio-economical relevance to the populations living in permafrost areas and beyond, through the provision of key information for land management and planning decisions including those related to resource development and development of strategies to adapt to climate change in permafrost areas. GTN-P data are routinely used by national, circumpolar and international assessments of climate change such as IPCC AR6, SWIPA, BAMS State of the Climate, Arctic Report Card and others (Romanovsky et al. 2019; Noetzli et al., 2019). The GTN-P community recently published an assessment of permafrost trends since the last IPY (Biskaborn et al., 2019).

GTN-P has established a robust governance structure which includes a Steering Committee, Advisory Board, a Secretariat, and National and Young National Correspondents (Streletskiy et al., 2017). The SC reviews the activities of the network, sets the directions for the future and leads the initiative for new activities in the network. SC is reviewed and audited regularly by the Advisory Board. The GTN-P Secretariat, hosted by the Alfred Wegener Institute (AWI, Germany) coordinates the network activities. The Arctic Portal (AP, Iceland), maintains a data management system (gtnp.arcticportal.org) and coordinates data management and dissemination.

The GTN-P Data Management System (DMS, gtnpdatabase.org) supports automatic data submission, standardization, quality control, processing, and data access. Presently 1350 TSP boreholes with metadata, 485 with complete time series and 250 active layer sites with metadata and 102 with continuous annual time series are registered in the DMS. There is a clear need for improved geographic coverage of the observational network in order to assess changes in permafrost system at global scales. However, GTN-P data acquisition operates on a largely voluntary basis with partial funding through private, national and internationally-sponsored programmes. **Sustaining and improving observational coverage requires dedicated long-term funding both on national and international level.**

GTN-P presently coordinates a network of 38 NCs and 17 Young NCs representing 26 partner countries. The active engagement of national correspondents is assured through their participation in GTN-P meetings and workshops corresponding with major permafrost conferences. **However there is no funding presently available to ensure active** continued involvement **and participation of NCs.**

While the GTN-P network is delivering products that are more and more widely used, **its capacity to secure long-term funding to sustain network activities and coordination has not evolved to meet research and societal needs and still largely relies on the voluntary contribution of individuals and short-term funded national research projects**. At the same time expectations of monitoring, reporting, development and maintaining of standardized geospatial datasets in commonly used formats require a continuing effort for data management. **The growing need for the permanent secretariat and data management personnel is essential in order to maintain the operational capacity of the network.**

To coordinate the day-to-day operations of GTN-P and to ensure its operability in the future, a dedicated entity should be created in a government or academic institution. The entity should be funded to ensure the provision of at least **one position for the coordination** of the network (the GTN-P Secretariat) and **one position for the related data management**.

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