



## IPA Action Group Towards a Permafrost Thaw Subsidence Product within the GTN-P database

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### Background

One of the distinguishing features of permanently frozen ground in many Arctic regions is the presence of large volumes of ground ice. The observed and projected climate warming may result in changes of permafrost thermal and mechanical properties in the Arctic regions and subsidence of permafrost terrain in the subarctic regions. Because of high ground ice-content, the entire North American and Eurasian permafrost coastal and lowland regions can be considered as one of the most vulnerable in light of rapidly changing environmental conditions. The potential risks and increasing hazard exposure requires comprehensive monitoring with a specific attention to thaw subsidence.

Although permafrost and active layer thickness (ALT) monitoring are primarily based on field measurements, subsidence can be efficiently detected and monitored using remote sensing earth observation technologies. *In-situ* approaches comprise Global Navigation Satellite Systems and terrestrial laser scanning (LiDAR) applications. However, in the high north this equipment is available only for a limited number of sites. Consequently, until now, only local inventories of subsidence exist. Pioneering works in Alaska demonstrated that annual changes in the position of the ground surface result in different starting points for ALT measurements and that this effect might almost entirely superimpose ALT deepening, leading to pseudo-stable ALT's despite increasing thermal impacts from cumulated thawing degree days. Thus, since environmental changes are expected to exceed stability thresholds, this will also speed-up thaw subsidence. Thanks to increasing data availability, applications of radar interferometry are rapidly growing and promising for near-operational products. Integration of thaw subsidence into ALT monitoring (Fig. 1) should be seriously considered as it improves understanding of permafrost system reaction on climate change.

### Objectives and scope of the Action Group

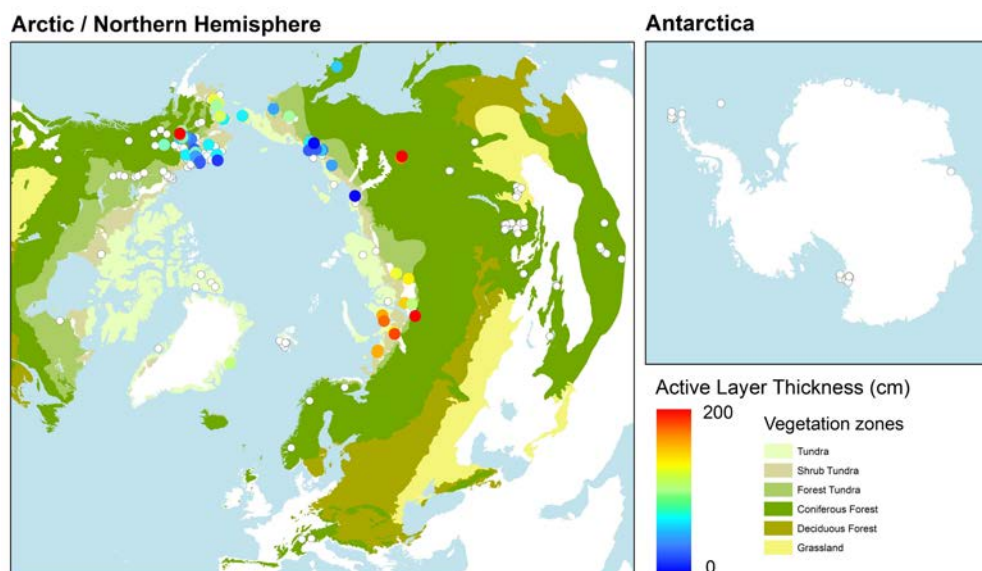
According to the IPA activities and objectives, the action group will:

- (1) initiate cooperative activities and work towards the development of new knowledge
- (2) bring together experts in permafrost thaw subsidence studies to share knowledge and to exchange experiences during international scientific meetings.

- (3) develop a scientific information product for the GTN-P database, compilation of reports, webinars, and tutorials for best practices to enable access to these materials.
- (4) encourage young scientists engineers to work in a research field that is directly related to permafrost by involving them during all stages of this activity.

The action group aims firstly at providing a forum for the exchange of experiences in ground-based monitoring, interferometric SAR, ground-based SAR, space and air-borne photogrammetry, close-range photogrammetry (structure from motion), and terrestrial and air-borne laser scanning. Secondly, potential super-sites for intercomparison will be discussed in order to evaluate and calibrate an envisioned standardized seasonal thaw subsidence product based on SAR interferometry. Thirdly, feasibility studies will be carried out for specific key sites where continuous ALT monitoring is carried out. The targeted product will be described in detail in online tutorials, enabling researchers to utilize these datasets for their field sites.

Finally, the action group aims on providing easy access to ready-to-use datasets for researchers in the fields of Arctic permafrost modeling, northern hydrology, biogeochemistry, periglacial geomorphology, and land and resource managers who need to recognize and prevent potential geohazards. The synergistic outcomes will add to the existing knowledge, literature, and data sources and provide a network on which new initiatives can build on. For outreach activities, such as interactive webinars, the action group will closely co-operate with the Association of Early Polar Career Scientist (APECS).



*Fig. 1: Circumpolar Active Layer Monitoring (CALM) sites showing available ALT data in 2016 (color points); initially the focus will be on arctic sites within the tundra vegetation zone*

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