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15-years of permafrost monitoring on Janssonhaugen, Svalbard; new insights into permafrost response and sensitivity to climate change

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The Arctic land areas have experienced greater warming over the last three decades than elsewhere in the world. In Europe the Svalbard archipelago (located in the North Atlantic sector of the Arctic Ocean from 74° to 81°N and 10° to 35°E) have experienced the greatest temperature change during this period. At Svalbard airport the mean annual air temperature has increased by approximately 4 °C since 1980. Air temperatures on Svalbard are highly sensitive to the coupled sea ice-ocean-atmosphere system and recent studies suggest that the shrinkage in Arctic sea-ice cover is the most important factor for the record high temperatures.

Continuous temperature series from two instrumented permafrost boreholes (102 m and 15 m deep) on Janssonhaugen, Svalbard, provide main data for the present analysis. The boreholes are located 23 km from Svalbard Airport and were established in 1998 within the EU-funded PACE project and are designed for long-term temperature monitoring.

In this study we examine the impact of the recent atmospheric warming on the permafrost in Svalbard. Trends and variability in permafrost temperatures at different depths are compared to trends in air temperature and ground surface temperatures. Although Janssonhaugen is representative for exposed sites where snow cover typically is thin or absent, the altered effect of a thin snow cover on subsurface thermal regime has not been analysed in detail so far. The effect of variability in snow cover on ground temperatures is studied and quantified by combined use of snow cover modeling, 1-D transient heat flow modeling and advanced time-series analyses. The study gives new insights into permafrost response and sensitivity to climate change, including effects of more frequent anomalous weather events.