

DIVERSITY OF GROUND TEMPERATURES ON THE KAFFIØYRA PLAIN (NW SPITSBERGEN) IN THE SUMMER PERIOD (1975-2009)

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The ground thermal conditions in Spitsbergen are shaped by a variety of factors, including the inflow of solar energy, the advection of air masses, atmospheric precipitation, the albedo, the extent of surface vegetation, snow cover, and the earth's inclination in relation to solar exposure. Furthermore they are also dependant on the thermal properties and moisture level of the ground itself, as well as the depth of the permafrost.

Research into ground temperatures on the Kaffiøyra Plain (NW Spitsbergen, Fig. 1) was conducted over 17 summer seasons (with "summer" here being taken as July 21st to August 31st) in the years 1975, 1977-80, 1982, 1985, 1989, 1997, 1998, 2000, 2005-09. The study was conducted as part of the Toruń Polar Expedition organized by the Institute of Geography at the Nicholas Copernicus University in Toruń. Among the studies investigating ground temperature in Kaffiøyra are Wójcik & Marciniak (1987) and Wójcik, Marciniak & Przybylak (1988). During all the research periods measurements were always taken in the same locations and the same measurement techniques were used. Ground temperatures were measured using mercury thermometers placed at depths of 5, 10, 20 and 50 cm. An additional measurement of ground temperature was taken at a depth of 1 cm was taken using a regular thermometer. Thermometer readings were taken 1⁰⁰, 7⁰⁰, 13⁰⁰ and 19⁰⁰ local mean time (LMT) (UTC + 1 hour). Measurement sites were selected with reference to three ecotopes: a sandy beach, the flat frontal-lateral summit moraine of the Aavatsmark Glacier, and the tundra (Fig. 1).

- ◆ the beach site (B) is located on the flat shoreline away from the range of influence of the Greenland Sea. The ground here is mostly sand and gravel and the surface layer is dry and free of vegetation.

- ◆ the moraine site (M) is situated on the flat frontal-lateral summit moraine of the Aavatsmark Glacier composed of sandy clay, gravel, mud, and sand. About 20% of the moraine has vegetation cover.

- ◆ the tundra site (T) is situated on the cone of the glacial outwash (sandur) emerging from the moraine of the Aavatsmark Glacier. The cone is largely made up of sand / gravel deposits with large quantities of rock scree. Around 70% of the surface is covered with tundra vegetation. There is a high level of moisture content in the ground at this site.

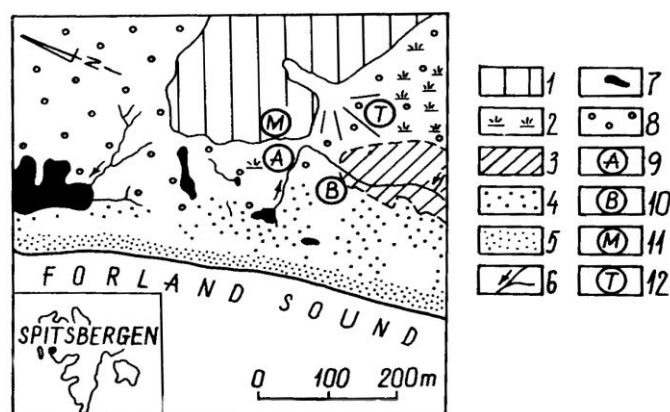


Fig. 1. A morphological sketch of the area of the Nicolaus Copernicus University Research Station and the location of the measurement sites. Key: 1- moraine, 2- tundra, 3- area subject to occasional flooding during high tides, 4- storm ridges, 5- beach area subject to occasional flooding during high tides, 6- currents, 7- lake, 8- glacial outwash (sandur), 9- research station, 10, 11, 12- ground temperature measurement sites: Beach (B), Moraine (M), Tundra (T).

The smallest differences between the readings for the different ecotypes are those recorded at 1⁰⁰ LMT, while the greatest are observed in the afternoon. In the surface ground layer (1-20 cm) at 1⁰⁰ LMT at all sites there appears an inverse pattern between measurements, which diminishes away from the surface. At 7⁰⁰ LMT the pattern begins to appear more normal, and becomes most clearly defined at 13⁰⁰ LMT. At 19⁰⁰ LMT a normal course develops in the isotherms, moving towards inversion. At the deeper ground layer (20-50 cm) there is a normal course throughout the day.

Long-term analysis of the ground temperature data confirms that the coolest site at all depths (1-50 cm) is the measurement point on the sandy beach; the tundra is warmer, and the warmest is the moraine site. The ground temperature in Kaffiøyra, similar to most meteorological elements, is subject to considerable variability from year to year. In the period analysed a rising ground temperature trend was noted during the summer seasons, e.g. at the beach site (50 cm) where an increase of 0.98°C/10 years was recorded.

References:

- Wójcik G., Marciniak K., 1987, Ground temperature of main ecotopes of Kaffiøyra, Spitsbergen, summer 1978; *Polish Polar Research*, 8 (1): 25-46.
- Wójcik G., Marciniak K., Przybylak R., 1988, Time and spatial variation of temperature of active layer in summer on the Kaffiøyra Plain (NW Spitsbergen), *V International Conference on Permafrost, Proceedings volume 1*, Trondheim, Norway: 499-504.