

Metadata for a long-term climate series from the Russian meteorological station “Pyramiden” (1948-1957) at Svalbard

Short Communication

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Abstract

Soviet weather station "Pyramiden" was located in the same mining settlement on the northern shore of the Mimer bukta (Billefjorden, West Spitsbergen Island). Research station operated from 1948 to 1957, as a branch of Barentsburg research observatory (Grønfjorden, West Spitsbergen Island). It was the only station that held regular meteorological observations in the inland areas of the archipelago. Observational data (in the form of handwritten books and tables) are preserved in state fond of Arctic and Antarctic Research Institute (AARI, St. Petersburg, Russia). So far, these data have not been digitized and with their help not conducted any climate researches. Fruitful scientific collaboration between MET-Norway (Norwegian Meteorological Institute, Oslo) and AARI helped preserve these unique data to the polar scientific community. Now specialists-climatologists of both institutions complete joint climate researches that in the near future will be available to scientists, studying modern climate changes in the polar regions of the Earth.

Key words: Arctic, Svalbard, Pyramiden, regular meteorological observation

DOI: 10.5817/CPR2014-1-6

Introduction

Studies of climate change on Svalbard in the twentieth century are based on data records from Norwegian weather stations (Longyearbyen, Ny-Ålesund, Isfjord radio, Green Harbor) and a meteorological station in the Russian mining settlement Barentsburg. In the period 1948-1957 standard meteorological observations were also carried out in a mining settlement Pyramiden, located in the Billefjorden (north-eastern

Received May 15, 2014, *accepted* July 31, 2014.

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Acknowledgements: These study was supported by MET-Norway - AARI project “Analysis of long-term climate variability of West Svalbard based on time series from Russian and Norwegian weather stations” (2011-2012), The Russian Foundation for Basic Research, 2012-2014 (research project No.12-05-00780_a, No.14-04-10065) and AARI project No. 1.5.3.3 (2013-2015).

part of the Isfjorden). These observations are stored in the archives of the Arctic and Antarctic Research Institute (AARI) and have not been digitized and analyzed to date. Yet, it is the only long time series of instrumental and visual meteorological observations in one of the inner parts of Svalbard. During the same period, similar regular observations were made only at coastal stations of the archipelago (Barentsburg, Longyearbyen, Isfjorden radio).

In August 2011, a new Norwegian automatic weather station was installed at the historic site of the earlier meteorological station in Pyramiden in the framework of bilateral scientific cooperation between the AARI and the Norwegian Meteorological Institute (MET-Norway). Thus, meteorological observations, which had been interrupted in 1958, have now been resumed and continue these days.

Station location

The Hydro-Meteorological Station (HMS) in the Pyramiden settlement was established by an order of the Main Office of the Hydrometeorological Service of the USSR № 401 as of September 19, 1946. The official transmission of regular meteorological data was launched in January 1948.

The settlement is located on the northern shore of the Mimer bukta, on the southern slope of the Pyramiden Mountain (West Spitsbergen Island, Isfjorden, and Billefjorden). Station coordinates: 78° 39' N, 16° 23' E (Fig. 1).

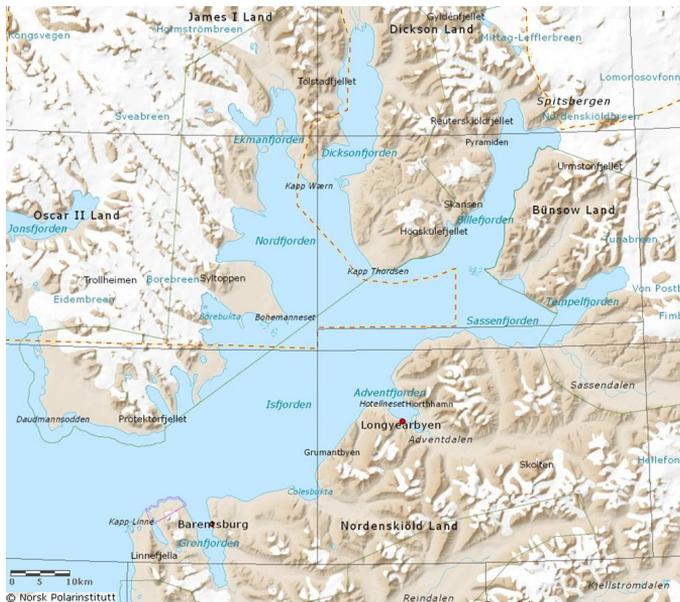


Fig. 1. Location of Pyramiden settlement in Billefjorden (*Source: <http://toposvalbard.npolar.no/>*).

The station building was located in a wooden house in an open area on the eastern edge of the settlement, 800 m to the south from the Pyramiden Mountain (altitude 953 m above sea level) and 200 m from the coast line (Fig. 2). The meteorological site was located 30 meters to the south of the station building.

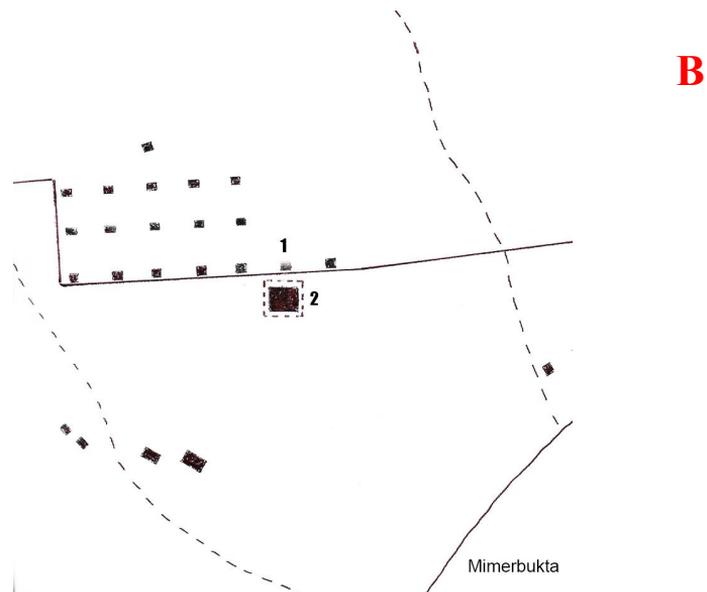


Fig. 2. Overview of “Finnish” houses /A/ and location of meteorological building and site /B/ (Source: archive of AARI) (1 – meteorological station; 2 – meteorological site).

Inside the station building there were three rooms and storage facilities with a total area of 63 m^2 (Fig. 3). One room (18 m^2) was office for the meteorological observer and two other rooms (total area of 26 m^2) were used as a living space for staff of the station (kitchen, bedroom, and canteen).

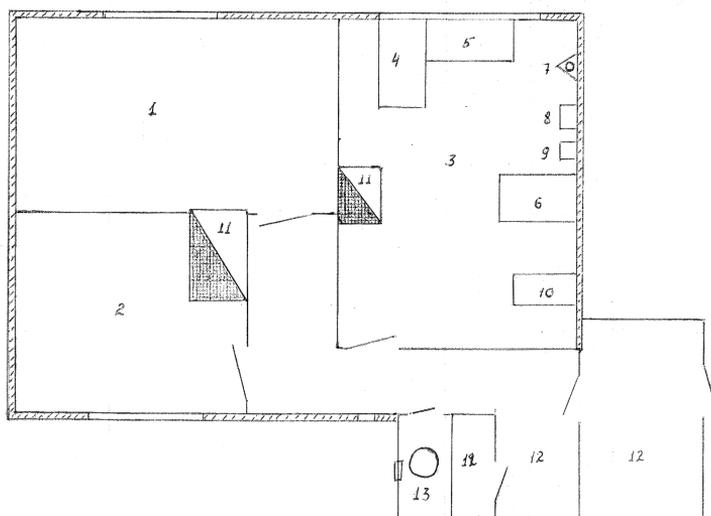


Fig. 3. Inside plan of meteorological building (*Source: AARI archive*)
(1, 2 – living rooms, 3 – working room; 4, 5, 6 – working table; 7 – barometer; 8 – barograph; 9 – barometer-aneroid; 10 – cupboard with instruments and spare parts; 11 – stove; 12 – storage facilities; 13 – toilet shower).

The soil at the meteorological site consisted of glacial deposits and is composed of a mixture of clay, sand, gravel, pebbles and stones. There was no vegetation at the measuring site. The height of site is 8.9 m above sea level (measured in 1948). The site is surrounded by a 1.5 m high wooden fence (“*lath fence*”), which was regularly dismantled in winter in order to preserve undisturbed characteristics of snow cover (maximum snow depth at the site was ca. 40 cm). On December 14, 1953 the wooden fence around the meteorological site was dismantled, and on February 12, 1954 the meteorological site was surrounded by a new metal wire fence.

Instruments and equipment

The following instruments and equipment were used for standard meteorological observations both inside the meteorological building (Fig. 3) and directly on the meteorological site:

- Mercury cup barometer (in a special wooden box on the wall of the room). The height of barometer was defined by leveling in October 1949. Elevation of the cup barometer was 13.2 m above sea level and 2 m above the floor. Precision of barometer was ± 0.3 hPa.
- Mechanical barograph and aneroid barometer were installed next to barometer (height - 1.55 m above the floor).

Two standard meteorological louvered screens (for protection from direct sunlight and precipitation) were placed on the meteorological site. One of them was used for thermometers and hygrometers: “Asman psychrometer”, maximum, minimum and main

thermometers and two hygrometers - main and control). The bulbs of all thermometers in this screen were at a height of 2 m above the ground. The second screen was designed for mechanical recordings (daily thermograph, daily and weekly hygrographs).

The following thermometers were installed in the first screen:

- Mercury thermometers ("dry" and "wet bulb"). The range is from +44 to -32.8°C, corrections are for range from +40 to -30°C;
- Maximum thermometer (mercury), range: +57.5/ -27.5°C, corrections for range: +50/-20 °C;
- Minimum thermometer (spirit), range: +22.5/-54.5°C, corrections for range: +20/-50°C;

The main and control hygrometers were also in this screen.

The following instruments were set in the second screen (mechanic clock recorders):

- Daily thermograph; Daily hydrograph; Weekly hydrograph

During positive temperatures the relative humidity was measured simultaneously by the main hygrometer and by the wet/dry Asman psychrometer. During sub-zero temperatures the wet/dry psychrometer could not be used, and a conversion graph was used to adjust the hygrometer readings to be valid for the psychrometer.

The values of the relative humidity from the main hygrometer different from the humidity values calculated by the "Asman psychrometer" are typically on 10-15% different in the extreme ranges of the humidity (30-50 and 80-100%) during the winter period in the days of possible wetting. A conversion graph is created once throughout the spring-summer period.

In addition to the two screens, the following instruments were operated at the meteorological site of Pyramiden station:

- Wind vane "Wilde"

The height of the wind vane above the ground was changed several times: 1948 – 11 m, 1949 – 12.2 m, 1953 – 12 m, 1954 – 12.5 m. The wind vane was ca. 6-8 m higher than all nearest buildings and was located at least 25 m away from them.

- Rain gauge

On July 31, 1956 at 13^h 30^m (local time), a new rain gauge (model O-I or "Tretyakov" precipitation gauge) was installed replacing an old model of a rain gauge. The exact date for change from old to new rain gauge is a very important factor for correction of undercatch in the measured amounts of precipitation. The height of the upper edge of the bucket and the "Nifer"-wind shield around the gauge was 2 m above the ground. During strong winds the precipitation measurements may be influenced by blowing and drifting snow.

- Soil thermometer

Thermometer (mercury or spirit, depending on the time of year) was deployed on the surface of the soil (snow) in a special fenced area 3x4 m. In periods without snow,

but with frozen ground, the soil was crumbled before the thermometer was deployed 0,5 cm into the soil every 10th day.

- Snow depth

Three fixed sticks were used for measurements of the snow depth at the meteorological site.

- Visual observations

The number, type and height of clouds, horizontal visibility and atmospheric phenomena (snow, rain, fog, etc.) were visually observed on the meteorological site.

Methods of observations

Standard meteorological observations on the Pyramiden station were performed according to the "*Guidelines for Hydrometeorological stations and posts*" (Issue 3, Part I – "*Meteorological observations at stations*". *Hydrometeor. Publ. House. Leningrad, 1946*). This document sets out the basic principles of the organization and the methods for all kinds of measurements and observations performed on soviet meteorological stations.

The instrumental and visual meteorological observations were made four times per day, in the main climatic timeline on Pyramiden station, which were 0, 6, 12, 18 hours Greenwich Mean Time (GMT), corresponding to 1, 7, 13 and 19 o'clock solar (local) mean time (SMT). All observations were performed by three observers.

Determinations of the amount of precipitation in the rain gauge and the state of the soil surface were taken twice a day at 7 and 19 SMT.

The density of the snow on the meteorological site was determined before January 1 every 5 days, and after January 1, the last day of each 10 days period of the month.

Description of electronic archive of meteorological data

The following data of the main meteorological characteristics observed on Pyramiden station for the period 1948-1957 have been prepared:

- Surface air temperature (°C, 2 m level, mean daily, maximum and minimum values);
- Daily sum of precipitation (mm);
- Daily snow depth (cm);
- Wind velocity and direction (m/s, degree, 10 m, four times per day);
- Frequency of total and low clouds (tenth, four times per day).

A complete digital version of the meteorological data collected at the research station Pyramiden for the period 1948-1958, is located in state data funds of AARI (Saint-Petersburg, Russia) and at MET-Norway (Oslo, Norway).

Currently, a group of experts from Arctic and Antarctic Research Institute, Norwegian Meteorological Institute and Saint-Petersburg state University analyzes of seasonal and long-term variability of meteorological characteristics in the Pyramiden area to assess the climate conditions in the inland areas of West Svalbard.