2. LOCATION OF THE POLISH POLAR STATION AT HORNSUND

The Polish Polar Station is situated in the SW part of Spitsbergen Island, a part of the larger archipelago also named Spitsbergen earlier, but lately 'Svalbard'. Under the same name, there is also the Svalbard administrative unit of Kingdom of Norway, in which are included, besides Svalbard Archipelago, Björnöya (Bear's Island) and Hopen (Fig. 2.1.A). Spitsbergen (named earlier West Spitsbergen; Vest Spitsbergen in Norwegian) is the largest island of this archipelago, with an area of 37 673 km². From the west Spitsbergen is surrounded by the open water of the Greenland Sea, from the east by bodies of water belonging to the Barents Sea (Storfjord, Hinlopen and others), from the north – waters of the Arctic Ocean (Fig. 2.1.B).

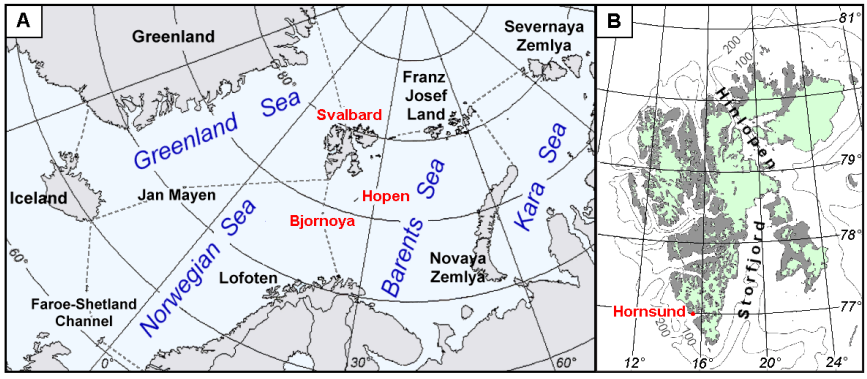

Fig. 2.1. Location of Svalbard and adjacent bodies of water (A) and Hornsund on Spitsbergen (B). Dashed lines – borders of sea, green colour – glaciated areas, isobaths 100 and 200 m are marked.

The southernmost part of Spitsbergen, the mountainous (~400–1431 m a.s.l) and strongly glaciated Sörkappland, is separated from the other parts of the island by a large entrenchment, consisting of Hornsund Fjord cutting deeply into the island from the west, and Hambergbukta in the east. Wedel Jarlsberg Land and Torell Land north of this Hornsund – Hambergbukta corridor are also high ground (~400–850 m a.s.l.), mountainous and strongly glaciated (Fig. 2.2).

The Polish Polar Station at Hornsund is located on the northern shore of Hornsund Fjord, around 4 km east of its mouth[1]. Geographical coordinates of the station are 77°00'N, 15°33'E (Fig. 2.2). The width of Hornsund at its mouth is considerable, ~ 14.5 km. Closer to the station the fjord narrows slightly to around 10 km. In this situation the mountainous relief along the southern shore

[1] A straight line connecting Cape Palffyodden (on the south) with Worcester Point (on the north) is considered the border between Hornsund and the Greenland Sea. The distance provided here is from the station to Worcester Point.

of Hornsund does not influence inflow of air masses towards the station from the W-SW. Inflow of air masses from other directions may be disturbed – smaller from S and E, bigger when there is flow from the north. While the distance from the station to the Greenland Sea is relatively short, it is around 42–45 km in a straight line from the Barents Sea coast. Air flow from Storfjorden to the station must pass over differing elevations - firstly via the Hambergbukta trough with its changing width, next, the Horn Glacier (Hornbreen; ca 250 m a.s.l.), and finally the interior parts of Hornsund Fjord – Brepollen and narrowings in the eastern and central parts of the fjord.

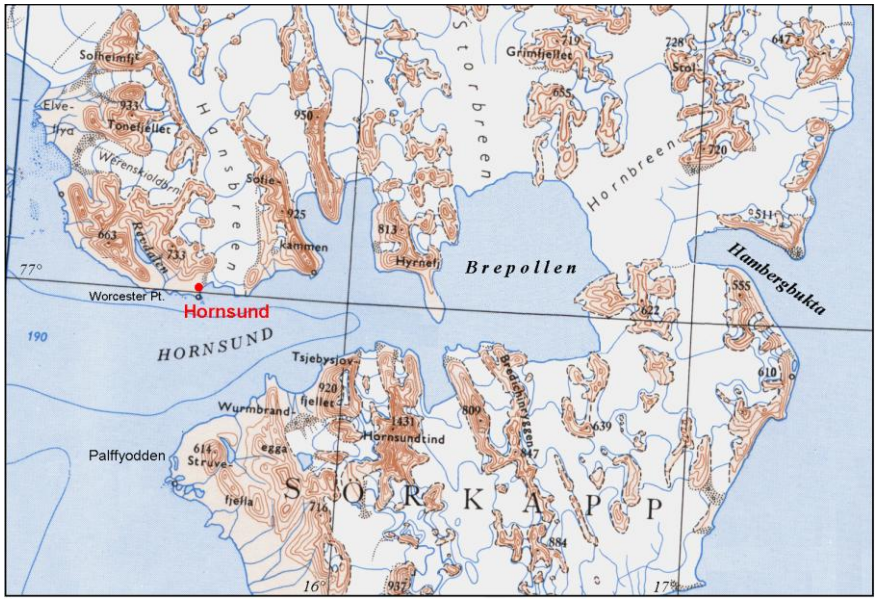

Fig. 2.2. Surroundings of Hornsund Fjord and location of the Polish Polar Station (on the basis of the Norsk Polarinstitutt map 1: 500 000, 1979; changed).

Buildings of the Polish Polar Station at Hornsund are situated on an uplifted aggradational marine terrace descending slightly to the south (Fig. 2.3, photos 1 and 2). The width of the terrace around the station is 650 to 800 m. To the SE the terrace widens to form Wilczek Cape (Wilczekodden) facing into waters of Hornsund Fjord. East of Wilczek Cape the coastline of Hornsund recedes towards the north, forming White Bear Bay (Isbjörnhamna) incised for around 1.3 km into the northern shore of the fjord[2].

The Hans Glacier (Hansbreen) discharges into Isbjörnhamna, where it terminates in an ice cliff 20–40 m high. The distance between front of the Hans Glacier and the station buildings is around two km. When the fjord is free of sea ice numerous growlers and fragmental ice break off of the cliff of Hans Glacier and are transported by tidal currents to Isbjörnhamna and the open waters of Hornsund Fjord. There is especially high calving of glacier ice in the summer; quite frequently the surface of western Isbjörnhamna being largely to entirely covered with glacier ice debris.

[2] The length of Isbjörnhamna chord is 2650 m.

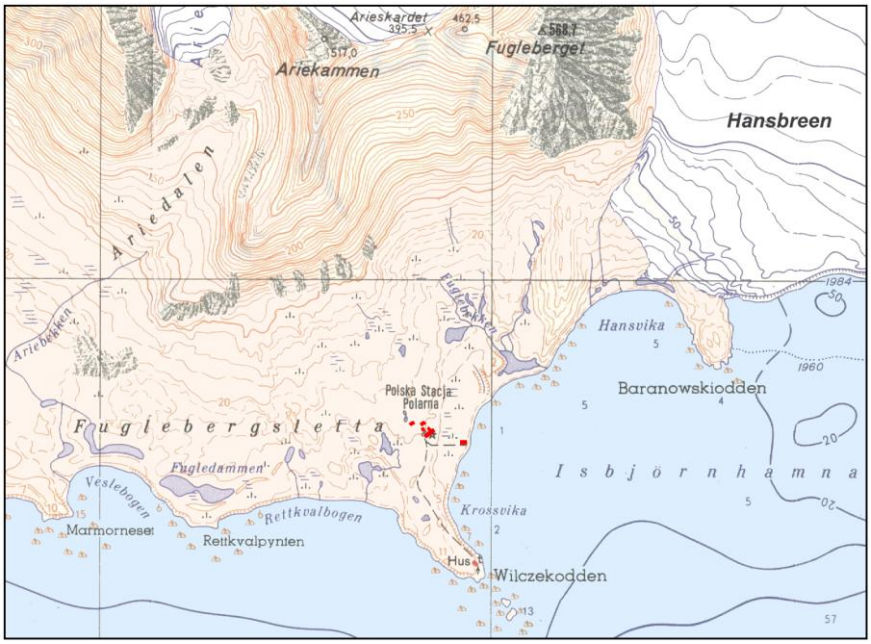

Fig. 2.3. The local surroundings of the Polish Polar Station at Hornsund
(extract from the topographic map 1: 25 000, IGP PAS).

The marine terrace shore along Hornsund Fjord is difficult of access, having not so high but steep cliffs in many places with numerous large rocks, reefs and islets in front of them. There is much more favourable access to the station from the sea on the eastern side, from Isbjörnhamna. Here the coast is depositional with well developed gravel beaches in places. The terrace on which the station buildings are situated is sheltered from the north by high and steep slopes of the Ariekammen – Fugleberget massif, rising to 517 m a.s.l. (Ariekammen) and 569 m a.s.l. (Fugleberget).

The surface of the marine terrace in the station region is broken up by small, ice-scoured bedrock hillocks, with marine sediment flats between them and local congelifluction sediments. In depressions there are small, permanent or ephemeral, shallow pools, fed mainly by meltwaters and thawing permafrost. Snow fields exist up to the second half of summer in shaded depressions, melting out at the end of summer/ beginning of fall. If the warm season is cooler, portions of some of them may survive to the next cold season. Ground ice permafrost is developed in the sediments of the marine terrace; the depth of active layer may reach 1.8–1.9 m at the end of the summer.

The meteorological station is located ~70–200 m W–WNW of the main station building and around 300 m from the Isbjörnhamna shore, on an even surface with abundant tundra vegetation (dry low shrub – lichen tundra). The elevation of the ground is around 10 m a.s.l. The meteorological plot has been located in this precise place since 1978 (photo 2.3). The height of anemometer above the ground is 10 m (photo 2.4). The barometer is 11 m above the mean sea level.

The Hornsund station works in the synoptic recording regime of the Norwegian meteorological net. Twenty-four-hour measurements with standard and automatic instruments as well as visual observations are made there. In the beginning, self-recording instruments were used for continuous

Photo 2.1. Polish Polar Station and surroundings – view from a helicopter (photo: archive IGP PAS).

Photo 2.2. Polish Polar Station viewed from Isbjörnhamna (photo T. Palmowski).

measurements. Since 1 January 2001, most of the measurements have been done with an automatic station recording to a Vaisala QLC-50 data logger. The anemometer mast and sensors of this system are situated 150 m SW of the station building. In July 2009, an automatic meteorological station was installed in the Polish Polar Station by employees of the Norwegian Meteorological Institute (NMI), and also certified by this team. This new measuring system was emplaced because of the need to obtain current (every hour) access to information on standard meteorological parameters for weather forecasting by NMI (Sikora *et al.* 2010). The sensors of the new system have been installed close to the Vaisala QLC-50 system sensors (photo 2.4). At present for the

measurements of temperature and air humidity, a Vaisala HMP 45D sensor recording at 60 seconds intervals is used. Direction and wind velocity are measured every second with an ultrasound two-axis anemometer, WindObserver™ II, produced by Gill Instruments. This anemometer allows for measurements of wind speed in the range from zero to 65 $m \cdot s^{-1}$. Measurement of atmospheric pressure is done every 60 seconds with a Vaisala PTB200A sensor. Results of measurements are automatically sent to NMI in Oslo every 60 minutes.

Photo 2.3. Meteorological site in August 2001 (photo A. Styszyńska).

Photo 2.4. Meteorological mast with sensors in August 2010 (photo M. Sadecki).

Until July 2009, measurements of the amounts of atmospheric precipitation were done with a Hellmann D-200 pluviometer with an inlet situated 1 m above the ground. Measurements were done at 00, 06, 12 and 18 GMT. Since July 2009, a Geonor T-200B automatic pluviometer with antiwind shield has been used. This pluviometer measures precipitation every 2 minutes, with an accuracy of 0.1 mm. To judge the conformity and homogeneity of the data obtained with the old and new measuring systems both systems work simultaneously at present. The distance between two pluviometers is around 3–4 m (photo. 2.5). A temperature sensor is also connected to the Geonor T-200B pluviometer enabling measurements of minimum ground temperature. Every six hours measurement of ground temperature is done with a traditional thermometer for comparison.

Photo 2.5. Geonor T-200B pluviometer– left and Campbell Stokes sunshine recorder – right
(photo W.E. Krawczyk)

Measurement data are completed with visual observations. These are: total cloudiness, type of clouds at different levels, the height of cloud base, length of horizontal visibility. Type, timing and intensity of atmospheric phenomena occurrence are also assessed.

Besides the standard meteorological observations made for NMI at the station there are some special measurements and observations, depending on the program of each expedition, e.g. heat balance at different types of tundra (Angiel 1992, 1994, 1996), pollution of air and precipitation (Bryś 2002, Krawczyk *et al.* 2002, Krawczyk and Skręt 2005, Rozwadowska *et al.* 2008), ozone concentrations in the atmosphere etc. Some of these measurements are connected with international projects, e.g. measurements of aerosols within projects AERONET–NASA (2004–2008; Rozwadowska *et al.* 2010) or ASTAR (spring of 2004 and 2007).

At Hornsund measurements of sunshine duration are made with classic Campbell-Stokes heliographs (photo 2.5) and, since the spring of 2004, with a Kipp&Zonen CSD1 duration sensor that records with one minute resolution (Sobolewski and Krzyścin 2006). At the Polish Polar Station measurements of the intensity of solar radiation (see Chapter 8), long wave radiation and albedo of the surface and ultraviolet radiation UV-A and UV-B (Krzyścin and Sobolewski 2001, Sobolewski and Krzyścin 2006) are made with a CNR-1 NET-radiometer (Kipp&Zonen) on a temporary basis.

The state of the ground and formation, height and type of snow cover undergo systematic assessment. Since 2003, year-long observations of ice phenomena on the waters of Hornsund Fjord have been made (Styszyńska and Buchert 2005). These are combined with daily measurements of sea water temperature at the shore of Isbjörnhamna (Styszyńska and Rozwadowska 2008, Styszyńska 2009).

Since 1978 measurements of ground temperature have been made at the Polish Polar Station. The set of standard mercury elbow-shaped thermometers was installed at that time in the meteorological plot at the depths of 5, 10, 20 and 50 cm. In 1980 this set was completed with additional winding thermometers for measurements of ground temperature at the depths of 80 and 100 cm (Miętus and Filipiak 2001a). Measurements of ground temperature at shallower layers were made three times a day (at 6, 12, 18 GMT), measurement with winding thermometers – once a day (at 12 GMT). During the measurement programme the site was moved few meters but the geological setting and humidity conditions are the same at both places. There is a thin (few centimetres thick) soil layer with a poorly developed humus horizon covering a layer of sand and gravel with numerous stones and rock debris and layer of packed loam beneath (Miętus and Filipiak 2001b). An automatic measuring station was added in 2001 close to the point of ground temperature measurements. From this moment measurements of ground temperature at depths 5, 10, 20 and 50 cm are done not only with mercury thermometers but also with the resistivity sensors of a Vaisala system. Measurement at the depth of 100 cm is still done by the traditional method – with winding thermometer.