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Summer weather conditions in 2005 and 2016 on the western and eastern coasts of south Spitsbergen

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Abstract: The climate of the Svalbard archipelago changes with geographical location (latitude and longitude) and is mostly dependent on oceanic and atmospheric circulation, altitude, topography and surface type. The aim of the study was to assess the variability of summer weather conditions on the western and eastern coasts of south Spitsbergen and to see it in connection with atmospheric circulation. The study focused on comparison between sub-daily data from field station measurements carried out during two research expeditions to the eastern coast of south Spitsbergen in the summer seasons of 2005 and 2016 and from the Polish Polar Station Hornsund, located on the western coast. Atmospheric circulation conditions were described by the subjective calendar of circulation types for Spitsbergen. The results confirmed that atmospheric circulation plays the most important role in shaping weather conditions, however local factors, especially the topography, modify the general weather pattern. The western coast of south Spitsbergen proved to be more humid and, consequently, more cloudy and foggy, whereas the eastern coast was characterized by more sunshine, less humidity and more frequent calm air situations. These differences are first and foremost a result of the direction of air-mass advection rather than of the type of pressure system.

Key words: Arctic, Svalbard, weather variability, air temperature, atmospheric circulation.

Introduction

Spitsbergen is the largest island of the Svalbard archipelago in the Norwegian Arctic (Fig. 1). Scientific exploration of Spitsbergen began during the 19th century. The first geographical discoveries and meteorological measurements were made by sealers and trappers, and later by numerous research expeditions initially undertaken by Norwegians (Hoel 1929). The first Polish scientific expedition to Spitsbergen took place in 1934, and in 1957 the Polish Polar

Station at Hornsund in south-western Spitsbergen was established. Since 1978, the station has been operating year-round and systematic synoptic meteorological observations at WMO standards have been made (Marsz and Styszyńska 2013). Climatological studies in this area focus mainly on weather and climate variability (*e.g.* Głowicki 1985; Sobolewski and Krzyścin 2006; Łupikasza 2009), climate characteristics (*e.g.* Baranowski 1968; Pereyma 1983; Kierzkowski 1996), spatial variability of meteorological elements (*e.g.* Gluza *et al.* 2004; Maciejowski and Michniewski 2007), weather conditions during particular seasons (*e.g.* Pietroń and Ziemiański 1985; Pociask-Karteczka and Ziaja 1990; Przybylak *et al.* 2006), the links between atmospheric circulation and weather (*e.g.* Niedźwiedź and Ustrnul 1988; Przybylak 1992a; Niedźwiedź 2013) and also the links between weather and glacier ablation processes (Migała *et al.* 2006, 2008).

The most important factors affecting the climate of Spitsbergen are atmospheric circulation, prevailing winds and local air circulation (katabatic and foehn winds, inversions), sea currents, sea-ice, topography, surface type and its albedo (*e.g.* Niedźwiedź 1993; Førland *et al.* 2011; Hisdal 1998).

The general atmospheric circulation in this region is controlled by the Icelandic Low and the high pressure over Greenland (Przybylak 1992a,b; Hisdal 1998). The island is an area of frequent confrontation of mild air masses, originating from the North Atlantic, and cold air-masses, formed over Arctic ice-fields, which result in large variations in weather throughout the year (Hisdal 1998; Niedźwiedź 2006). Heat is transported to Spitsbergen by both air-mass advection and ocean currents (Hisdal 1998). There are two ocean currents that significantly influence the climate of western and eastern sides of the island – the West Spitsbergen Current, which transports relatively warm Atlantic waters northwards and the East Spitsbergen Current transporting cold Arctic waters southwards (Loeng 1991; Walczowski and Piechura 2011; Ziaja 2011).

The topography of the island influences the weather and climate on both regional and local scale, modifying airflow, local wind speed and directions (*e.g.* Przybylak *et al.* 2006; Migała *et al.* 2008). Orographic clouds such as foehn banks, banner clouds, wave clouds, hat clouds, crest clouds, and slope clouds are often observed (Matuszko and Soroka 2013).

These factors result in a relatively mild climate along the western coast of Spitsbergen. Most of its area is unglaciated and covered with continuous Arctic tundra, which enabled sustenance of animals and permanent human settlements. Eastern parts of the island are significantly colder and mostly glaciated. Its vegetation is very sparse. This has led to a virtual nonappearance of herbivores and complete absence of human settlements (Ziaja 2011). Reaching the eastern coast of Spitsbergen is very difficult both overland (across mountain ranges and glaciers) and from the sea (because of the pack-ice). Owing to its remote location, scientific expeditions to this part of the island are rare and as a consequence its environment (including climatic conditions) has not been studied in much detail.

Przybylak *et al*. (2014) investigated spatial distribution of air temperature in Svalbard during their 1-year measurement campaign. For this purpose they launched a network of 30 measuring points across the whole archipelago, however, excluding eastern Spitsbergen. They found that the greatest spatial decreasing rate of temperature in Svalbard throughout the whole year was in the southwest–northeast direction (Przybylak *et al*. 2014). Significant differences in summer weather conditions between different stations and measuring points located in western and central Spitsbergen were found by Pociask-Karteczka and Ziaja (1990), Przybylak (1992b), Gluza *et al*. (2004), Przybylak *et al*. (2006) and Migała *et al*. (2008), among others. The only research study which demonstrated West–East weather differences in Spitsbergen and was based on in-situ data was conducted by Maciejowski and Michniewski (2007). In all of these studies, the authors strongly emphasized that the influence of local factors (especially topography, distance from the sea and surface type) on spatial weather and climate variability in Spitsbergen is decisive.

The Arctic is considered to be a region of intensified warming, as air temperature rise during the past few decades has been about twice as fast as in lower latitudes (Miller *et al*. 2010; Walsh *et al*. 2011). Nordli *et al*. (2014) analyzed composite air temperature series from Svalbard Airport (central Spitsbergen) spanning from 1898 to 2012 and identified positive and statistically significant trends for the entire period and for all seasons. Similar results were obtained by Gjelten *et al*. (2016) who examined air temperature tendencies along the coast and fjords of western Spitsbergen. Przybylak *et al*. (2016), who compared monthly temperatures in Svalbard in the period of 1865–1920 and the present day (2001–2010 and 1981–2010), revealed that the eastern part of the archipelago was characterized by the greatest temperature increase that was observed in all seasons. The explanation for this lies probably in the greatest historical-to-present sea-ice area decrease in the eastern marine part of the archipelago comparing to the western one (Przybylak *et al*. 2016). These observations are in accordance with the findings of Ziaja *et al*. (2009) and Ziaja (2012), who noted that environmental and landscape changes observed since the beginning of the 20th century in south Spitsbergen are much more intense and visible on the eastern coast than on the western. As Førland *et al*. (2011) showed, climate projections for the Svalbard region indicate a future warming (up to the year 2100) three times faster than observed during the last 100 years. The most intensive temperature increase is projected for the eastern part of the archipelago, where the sea-ice extent will be most radically reduced (Førland *et al*. 2011).

Since there are virtually no research studies concerning weather variability in eastern Spitsbergen, and at the same time this area is expected to experience considerable climatic and environmental changes, the monitoring of its weather and climate is of great importance. The aim of this study is to assess the variability of summer weather conditions on the western and eastern coasts of south Spitsbergen, and to relate the observed variability to atmospheric circulation, using data from the 2005 and 2016 summer seasons.

Data and methods

Two research expeditions to south-east Spitsbergen were undertaken by a team from the Institute of Geography and Spatial Management of the Jagiellonian University in Krakow in the summer seasons of 2005 and 2016. Weather conditions were observed during two periods from the 7th to the 21st of August, 2005 and from the 26th July to the 21st of August, 2016. During both expeditions, meteorological measurements were performed in the same location (φ=76°58'46"N, λ=17°16'28"E, Fig. 1) on a ridge of ice-covered lateral moraine of the Hambergbreen glacier at the foot of Tvillingtoppen summit, 20 m from the sea and 47 m a.s.l. The field station was situated on a slightly inclined (3–6°) convex slope with northeastern exposure, limited by the mountain massif to the West, and by a high and steep cliff dropping to the Barents Sea

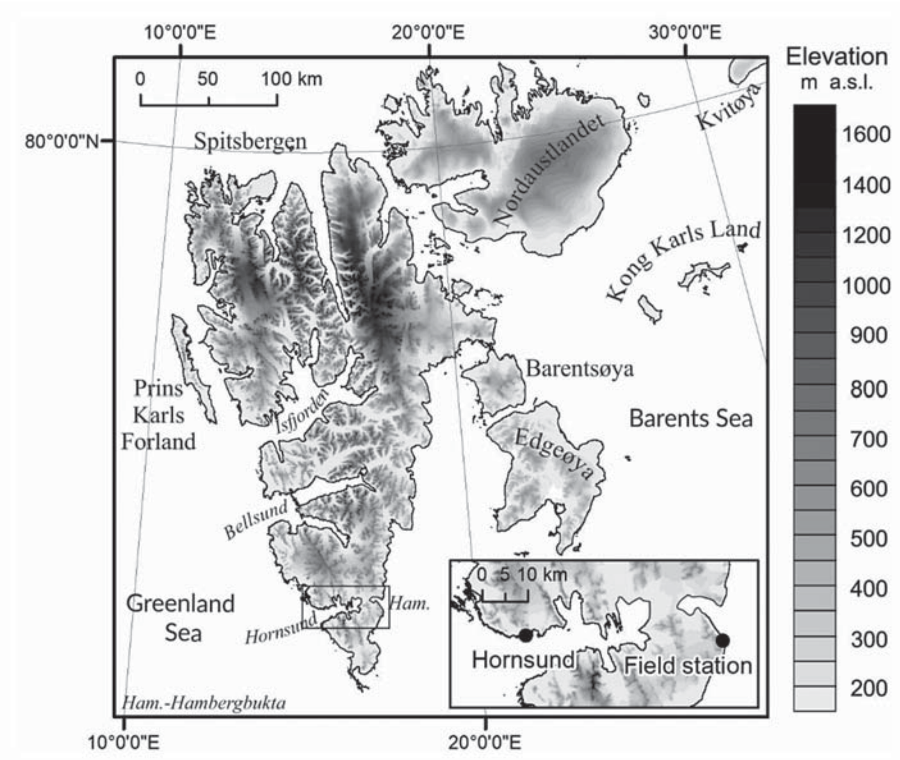

Fig. 1. The study area with locations of weather stations in the inset.

to the East. The measurements included air temperature and humidity (Väisäla electronic thermo-hygrometer, extreme-temperature thermometers), wind speed and direction (manually operated cup anemometer), and cloudiness. All the devices used were placed at the standard height of 2 m a.g.l. Measurements were obtained three times a day at 6:00, 12:00 and 18:00 UTC.

In order to compare weather conditions between the western and eastern parts of south Spitsbergen, analogous measurements from the Polish Polar Station Hornsund located at Isbjørnhamna bay in the Hornsund fjord were analyzed (meteorological observatory registered as WMO 01003, Norway). The Hornsund station is situated on a marine terrace, at 10 m a.s.l. and 300 m from the sea (φ=77°00'N, λ=15°33'E, Fig. 1). Aforementioned data were obtained from the meteorological bulletin published monthly by the Polish Academy of Sciences (*www.hornsund.igf.edu.pl*) and Spanish database Ogimet (*www.ogimet.com*). In order to ensure the comparability of the data, the wind speed at Hornsund (anemometer placed at the height of 10 m a.g.l.) was reduced to 2 m a.g.l. using a power low assumption (Peterson and Hennessey 1978).

To describe the atmospheric circulation conditions during the study periods, the subjective calendar of circulation types for the territory of Spitsbergen by Niedźwiedź (2016, available: *http://klimat.wnoz.us.edu.pl/#!/glowna*, extended by its author) was used. Niedźwiedź distinguished 21 circulation types, taking into account the baric field (a – anticyclonic, c – cyclonic) and direction of air masses advection: 10 cyclonic (*e.g.* Nc – North, NEc – North-East, Cc – center of cyclone, Bc – cyclonic through), 10 anticyclonic (*e.g.* Sa – South, SEa – South-East, Ca – central anticyclone situation, Ka – anticyclonic ridge) and the type x (unclassified). Additionally, surface and pressure levels charts for particular days were analyzed (*www.wetterzentrale.de*).

Background information for both weather and circulation conditions over the area of Svalbard were obtained from the ERA-Interim dataset for the period of 1981–2015 (Dee *et al.* 2011, available: *http://apps.ecmwf.int*). The circulation conditions and their impact on the current weather were estimated using empirical orthogonal function analysis (EOF).

Overview of summer weather conditions in south Spitsbergen

A set of EOF modes was performed to identify dominant spatial patterns of sea level pressure over Svalbard in summer (July-August). Three modes were seen to explain more than 75% of total variance (Fig. 2). The spatial variability of pressure anomalies in the first mode (EOF 1) brings cyclonic southeastern advection (Fig. 3). The second mode (EOF 2) exhibits the largest pressure variability, positive anomalies and the transport of air masses from the eastern sector, whereas the third pattern (EOF 3) produces only negative anomalies (down to -1.5 hPa) and brings

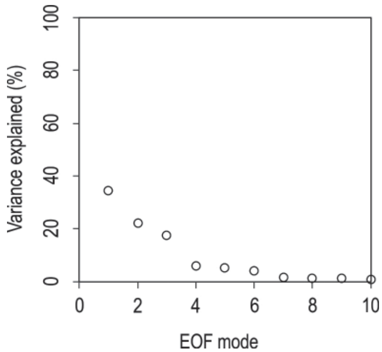

Fig. 2. Amount of variance explained by EOF modes 1–10, summer (July–August) 1981–2015.

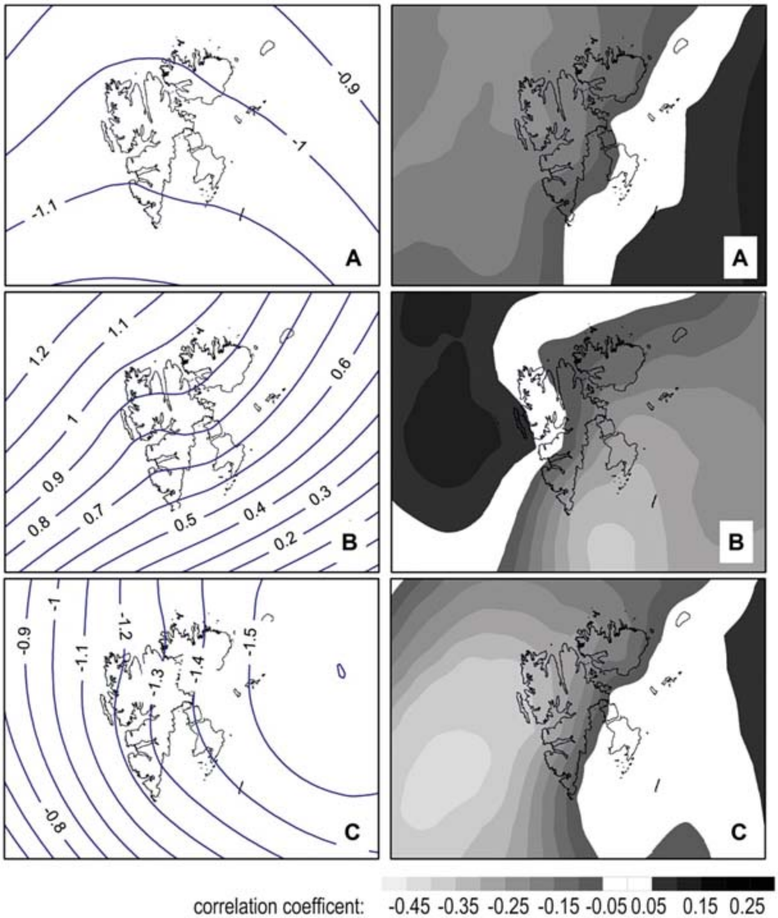

Fig. 3. Spatial patterns of pressure anomalies (hPa) in summer (July–August) for three leading EOF modes (1981–2015) (left panel) and correlation coefficient between leading EOF mode and air temperature (right panel): **A** – EOF 1, **B** – EOF 2 and **C** – EOF 3.

cyclonic northern, northwestern or western air mass advection (Fig. 3). This is confirmed by circulation types, among which advection from the southern sector (SW, SE) and West (W) are the most frequent in July, and in August advection from the East (E), South-East (SE) and North (N) dominate (Table 1). Nevertheless, according to Niedźwiedź's catalogue (Niedźwiedź 2016) non-advective anticyclonic ridge (Ka) and cyclonic trough (Bc) are also important during summer (Table 1). Intense SE advection (EOF 1) results in higher air temperature values especially in eastern Svalbard (for most of the area of Spitsbergen, correlation between the leading EOF mode and air temperature is negative) while the second circulation mode (EOF 2) is followed by lower temperatures in eastern and southeastern Spitsbergen (Fig. 3). Northern advection (EOF 3) brings cold air masses and a temperature decrease especially in the western part of the island (Fig. 3).

The frequency of non-advective circulation types (Table 1) results in low wind speed and calm conditions (8–10% of days). Foehn winds are among the most characteristic phenomena in Spitsbergen. On the western coast of the island, they occur during the Ec or SEc circulation types, and on the eastern coast during advection of air masses from the western sector (Kalicki 1985; Ziaja 1985; Maciejowski and Michniewski 2007; Migała *et al*. 2008).

Contrasts in air temperature between the western and eastern sides of Spitsbergen are especially visible during winter, when temperature is significantly influenced by the ocean currents. In summer, these contrasts are less noticeable due to the balancing effect of solar radiation (Hisdal 1998; Walczowski and Piechura 2011; Styszyńska 2013). However, spatial variability of temperature is still considerable due to the influence of the aforementioned local factors (Araźny *et al*. 2010; Kejna *et al*. 2010). At Hornsund, the mean monthly temperature

Table 1

Frequency of occurrence (%) of anticyclonic (a) and cyclonic (c) types of circulation over Spitsbergen (1981–2015) based on Niedźwiedź (2016).

Month	anticyclonic (a)										
	Na	NEa	Ea	SEa	Sa	SWa	Wa	NWa	Ca	Ka	total
July	1.8	3.0	3.7	5.2	1.5	5.1	3.6	1.9	1.8	15.1	42.7
August	3.7	2.8	5.3	4.8	3.1	3.1	2.9	1.2	2.6	16.1	45.6
Month	cyclonic (c)										
	Nc	NEc	Ec	SEc	Sc	SWc	Wc	NWc	Cc	Bc	total
July	6.3	3.2	5.3	4.8	3.9	6.5	6.3	5.1	3.4	8.9	53.7
August	5.9	4.1	4.7	6.8	4.4	5.4	4.6	4.9	3.6	6.8	51.2

Frequency of type "x" (unclassified) in July – 3.6%, in August 3.2%.

is 4.4°C in July and 4.1°C in August (1979-2009). It is characterized by small year-to-year variability which increases further inland (Marsz 2013a).

Summer is the most humid season with the annual maximum of relative humidity, the most overcast sky and the highest frequency of fog occurrence, intensified also by relatively warm air flowing over snow- or ice-covered surface or cool water surface and very low wind speed (Pietroń 1987; Hisdal 1998; Marsz 2013c). At Hornsund, summer mean relative humidity is 86% (the annual mean is 79%; 1979–2009 averages) but it gradually decreases when moving inland (Przybylak *et al*. 2006; Marsz 2013b).

During most of the year, the relation between relative humidity and air temperature is positive, indicating that thermohygrometric conditions are determined mainly by advection. July and August are the only months when this relation changes its sign to negative. This reflects that radiation is the dominant factor for thermohygrometric conditions in summer (Hisdal 1998; Marsz 2013b). As studies by Araźny *et al*. (2010) and Marsz (2013c) reveal, the relative humidity pattern at Hornsund is also influenced by foehn winds, and their impact may be larger in other locations in south Spitsbergen (Kejna *et al*. 2010).

Atmospheric circulation and weather conditions during summer seasons 2005 and 2016

Research expeditions of 2005 and 2016 happened in the periods of significantly different weather conditions. The summer of 2005 was mostly under the influence of cyclonic circulation with air mass advection from northern and eastern sectors (Fig. 4) and non-advective conditions (anticyclonic ridge – Ka – was observed during 14.5% of all summer days). Anticyclonic advective types were distinctly less frequent. The circulation patterns brought negative temperature anomalies on the western coast of Spitsbergen whereas the interior as well as the eastern coast were characterized by slightly warmer conditions (Fig. 5B). In contrast, July and August in 2016 were dominated mainly by cyclonic weather with advection from the western sector (Fig. 4) and cyclonic through – Bc – with different directions of air flow and frontal system in the axis of through (16% of all days). An anticyclonic ridge (Ka) was also observed (10% of days). Thermal conditions were more uniform over the whole archipelago in the summer of 2016, compared to the summer of 2005, with temperatures *ca*. 2.0°C higher than the long-term means from 1981–2015 (Fig. 5A and 5C).

In both summer periods, circulation conditions resulted in significant weather differences between the western and eastern coast of south Spitsbergen. Weather conditions were additionally modified by local factors, especially during the days accompanied by non-advective circulation patterns.

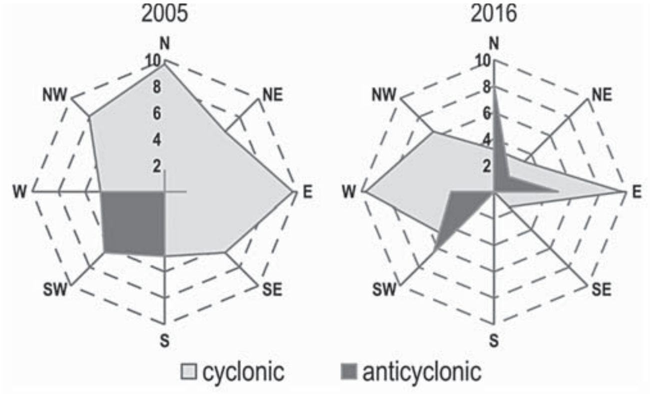

Fig. 4. The frequency (%) of advective circulation types in Spitsbergen in selected summer (July–August) periods 2005 and 2016 (based on Niedźwiedź 2016).

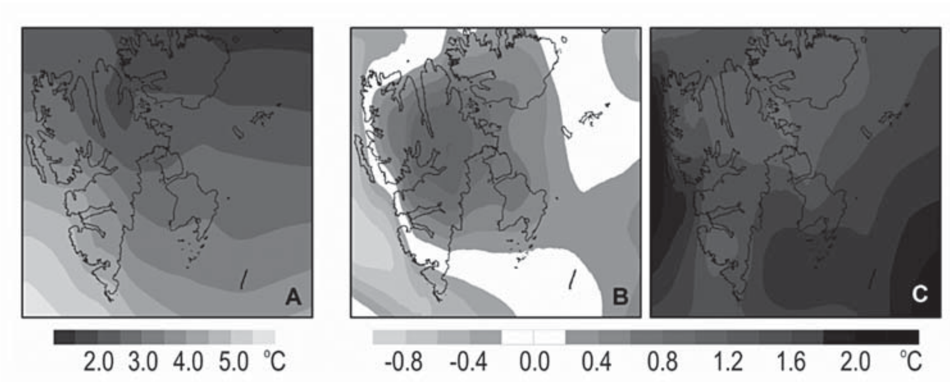

Fig. 5. Summer (July–August) air temperature in Svalbard archipelago: (**A**) mean of the period 1981–2015, (**B**) temperature anomalies in 2005 with a respect to 1981–2015 and (**C**) temperature anomalies in 2016 with a respect to 1981–2015.

Summer season 2005. — The observations and measurements were conducted between the 7th and 21st of August, 2005. The observation period began with non-advective conditions controlled by an anticyclonic ridge (Ka), which moved eastward starting from the northern Atlantic Ocean and ending over the Barents Sea. This brought almost stable weather conditions over the whole area of south Spitsbergen (07.08–12.08; Fig. 6). The only differences in wind directions between the western and eastern coasts were forced by topography. Southwestern humid and relatively warm airflow resulted in the increase in cloud cover and fog occurrence followed by a decrease in air temperature windward (Hornsund) on 09.08. Then eastern airflow (13.08–16.08), which was associated with a low-pressure system over the northern Atlantic Ocean (Ec), was accompanied by high wind speed with an average of 8 ms^{-1} in both locations, but with observations as high as 14 ms^{-1} at the field station (Fig. 6). Eastern advection brought more humid air masses that resulted in higher relative humidity and more cloudy sky at the field station. Temperatures at the Hornsund station were about 2.0°C warmer than at the field station. This was associated with foehn effects observed on the western coast of south Spitsbergen when a low-pressure center on the southern side of the archipelago moved westward (Ec). The last part of the observation period was controlled by low pressure systems originating in North Atlantic and rapidly moving eastward (18.08–21.08). Wind speeds and directions at the western and eastern coasts of the island were diverse due to dynamic circulation conditions (Fig. 6). When the cyclonic center was found over Spitsbergen (Cc), wind speed in both locations increased. Western and southwestern advection (Wc and SWc) in the last two days brought moderate winds and caused cloudiness and a temperature decrease at Hornsund. On the eastern side of the island, foehn effects were observed at the same time when a deep low-pressure system developed over the southern Greenland (Maciejowski and Michniewski 2007). It was clearly demonstrated by a sudden drop of relative humidity at the field station (Fig. 6).

Summer season 2016. — The observations and measurements were conducted between the 26th of July and the 20th of August, 2016. Stable anticyclonic conditions at the beginning of the observation period (26.07–03.08) emphasized the role of the orographic barrier between the western and eastern coasts of south Spitsbergen. The eastern coast was windier, especially during northern advection. Moreover, the pressure field gave favorable conditions for foehn wind occurrence at the field station (Wa and Wc circulation types). The wind speed gradually increased to 19 ms^{-1} (over 22 ms^{-1} in gusts; not shown). Foehn effects intensified the temperature and humidity differences between the two stations. Higher moisture content and, in consequence, denser cloud cover and lower temperatures were recorded at Hornsund, while at the field station, clear weather was frequent, resulting in over 2.0°C higher air temperature and much lower relative humidity values (Fig. 7).

Cyclones developing over the North Atlantic and moving eastwards (4.08–14.08), like in 2005, brought a dynamic synoptic situation that gave highly variable wind speed and direction (Fig. 7). Because of orographic effects, wind speed at the field station was higher than at Hornsund, reaching a difference of 10 ms^{-1} in gusts (not shown). This cyclonic situation and advection of humid and cold air masses brought cloudy and foggy weather with drizzles at both stations followed by an air temperature decrease. The surrounding mountain peaks above 500 m a.s.l. were covered with fresh snow.

Southwestern air mass advection (SWc, SWa) resulted in similar mean wind speeds at both stations, however, wind directions were locally modified (15.08–20.08). At Hornsund, relative humidity, cloud cover and precipitation

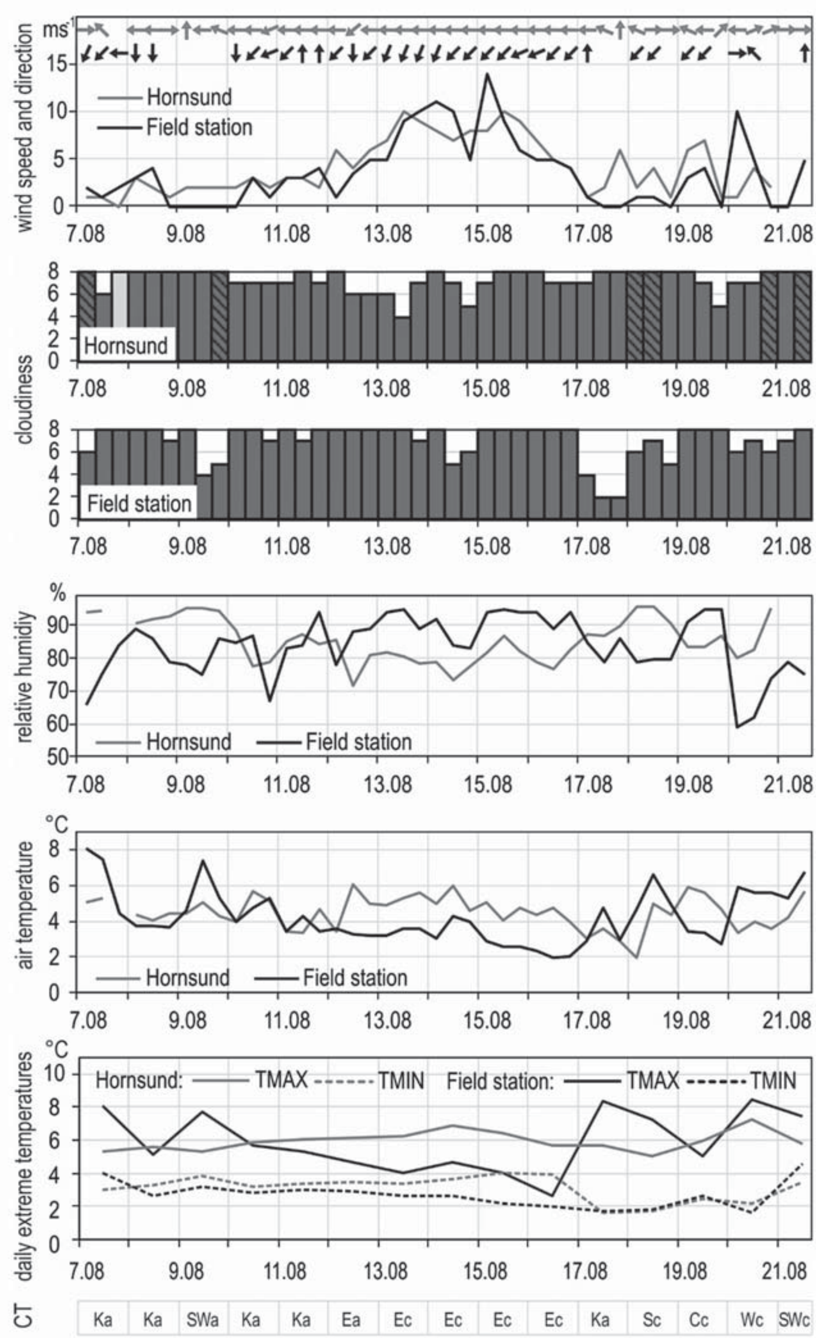

Fig. 6. Wind speed and direction, cloudiness (striped bars – fog, light grey bars – no data), relative humidity and air temperature at three observation times (6:00, 12:00, 18:00 UTC) and daily extreme temperatures at Hornsund and at the field station during 7.08–21.08 of 2005; CT – circulation types for Spitsbergen based on Niedźwiedź (2016).

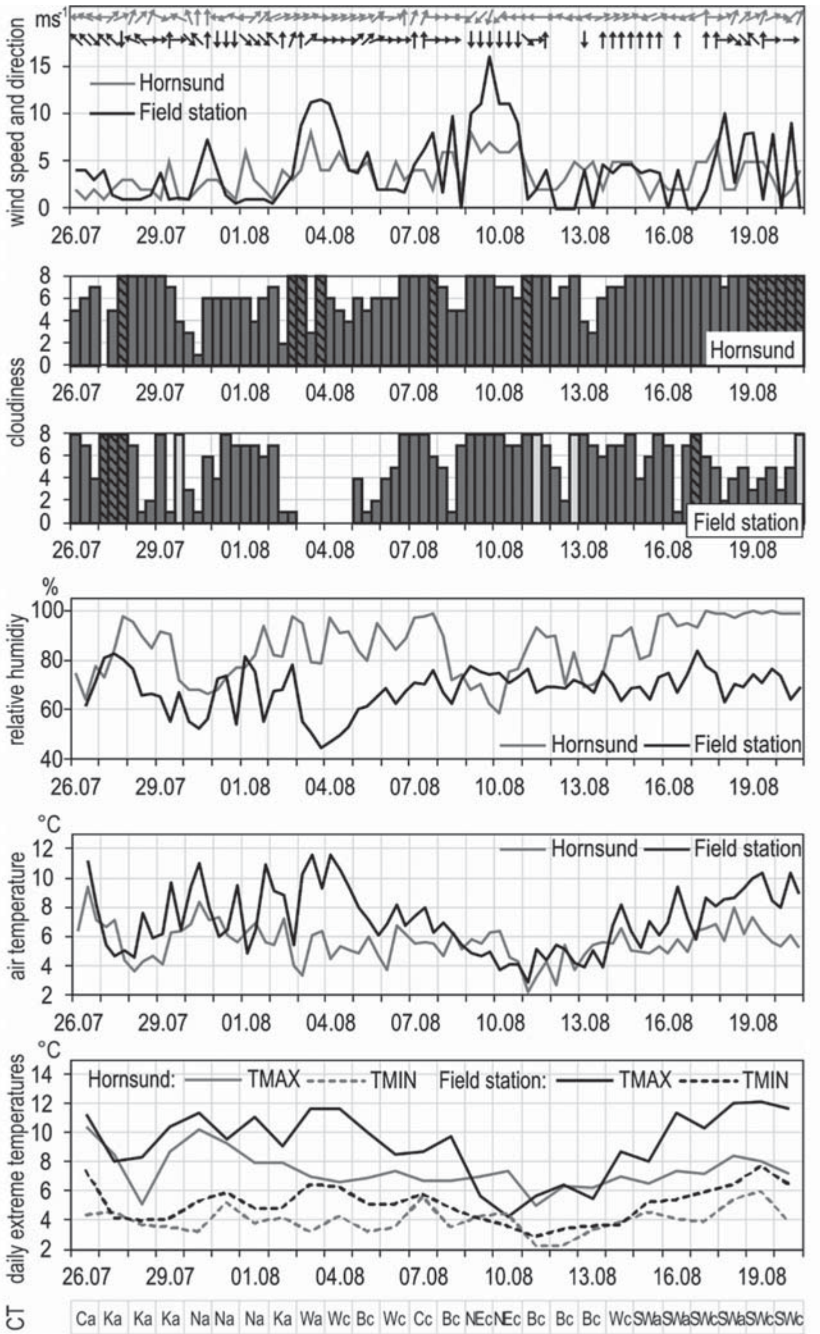

Fig. 7. Wind speed and direction, cloudiness (striped bars – fog, light grey bars – no data), relative humidity and air temperature at three observation times (6:00, 12:00, 18:00 UTC) and daily extreme temperatures at Hornsund and at the field station during 26.07–20.08 of 2016; CT – circulation types for Spitsbergen based on Niedźwiedź (2016).

daily totals as well as the temperature increased, and fog was observed several times. The leeward field station was sunnier and drier and therefore temperature changes were more pronounced (Fig. 7).

West-to-east summer weather gradient

The present study, although based on short observation periods, confirmed significant W–E summer weather differences in south Spitsbergen. Maciejowski and Michniewski (2007) compared air temperature, relative humidity and wind speed variability during the summer of 2005 at the field station, based on the same data as used in this study, with that observed at the Baranowski Polar Station, located to the north-west of the Hornsund station. The differences between the two locations were even more evident than these presented for the field station and Hornsund. The results of Przybylak *et al*. (2016), who examined warm season air temperature variability in Svalbard from 1865 to 1920, showed that these W-E differences were seen also at the turn of the 19th and 20th centuries. The southeastern part of the archipelago was about 0.5–1.5°C cooler compared to the southwestern part in all months from May to September. A similar magnitude of W-E differences in Svalbard summer temperature was reported by Przybylak *et al*. (2014) based on a 1-year measurement campaign starting in August 2010 and ending in July 2011. Slightly different values were observed in the case of south Spitsbergen in this study. During the observation period in 2005, air temperature on its eastern coast was on the average 0.2°C lower than on the western coast. On the other hand, during the observation period in 2016, the eastern coast was on the average 1.6°C warmer than the western one. This discrepancy results from the specific weather conditions (foehn winds) which occurred during these periods. In order to definitely determine the magnitude of W-E weather differences, longer periods of measurements and observations are necessary.

The obtained results suggest that the main reasons of the W-E weather differences are the atmospheric circulation and local topography. It has already been confirmed that there is a clear relationship linking Spitsbergen summer season weather with atmospheric circulation. It has been particularly well documented for air temperature (*e.g*. Hanssen-Bauer and Førland 1998; Araźny *et al*. 2010; Gluza and Siwek 2012; Láska *et al*. 2012; Niedźwiedź 2013) and precipitation (*e.g*. Hanssen-Bauer and Førland 1998; Niedźwiedź 2002; Łupikasza 2013), and has also been shown for other meteorological elements. However, as proved by Przybylak (1992a,b) and later confirmed by Araźny *et al*. (2010), Gluza and Siwek (2012) and in this paper, different meteorological elements depend more on the direction of air mass advection than on the type of pressure system.

A large topography impact on general weather patterns in south Spitsbergen, and especially on airflow modification, has been clearly demonstrated. This is in accordance with the results of Pociask-Karteczka and Ziaja (1989), Migała *et al*. (2008), Kejna *et al*. (2010) and Láska *et al*. (2012) who documented the influence of topography on weather conditions in other locations in Spitsbergen, *e.g*. blocking effect of the mountains, drainage effect of the fjords.

As several studies indicate, the influence of sea currents, *i.e*. warm West Spitsbergen current and cold East Spitsbergen current, on the weather and climate is much more pronounced in winter than in other seasons (Hisdal 1998; Walczowski and Piechura 2011). Maslowski *et al*. (2004), who examined selected characteristics of the Barents Sea based on model simulations, showed that West and East Spitsbergen Currents are well represented in the summer sea surface temperature fields. In order to determine whether their influence on weather conditions is noticeable also in this season, more data than used in this study and longer observation periods are required.

Conclusions

In this paper, we have provided the results of meteorological measurements performed in the little-studied area of southeastern Spitsbergen during two research expeditions undertaken in the 2005 and 2016 summer seasons. Using the data from the field station and the Polish Polar Station Hornsund, we have examined the weather conditions differences between the western and eastern coasts of south Spitsbergen in relation to atmospheric circulation and local factors.

The study confirmed more humid and, consequently, more clouded and foggy weather conditions on the western coast of south Spitsbergen. The eastern coast was characterized by more sunshine, less humidity and more frequent calm air situations. The air temperature differences between these two locations were not so evident, this was probably a consequence of foehn effects in the studied time periods.

Our results confirm that the atmospheric circulation plays the most important role in shaping weather conditions in south Spitsbergen, however local factors, especially the topography, modify the general weather pattern.

The two observation periods belonged to unusual (to some extent) summers, when circulation and temperature anomalies were observed. Although the summer in 2005 was about 1.5°C cooler than the 2016 period and almost average compared to the 1981–2015 mean, it was influenced by both cyclonic and anticyclonic pressure systems with one third of days accompanied by non-advectional circulation pattern – anticyclonic wedge. The lack of air mass advection favored local weather factors causing W-E differences in wind speed, cloudiness and, in consequence, temperature. Dynamic circulation conditions during both periods, but especially in 2016, gave a W-E difference that was mainly a result of the direction of the air mass advection but significantly modified by orography, namely shadow effect and foehns. Western or southwestern air mass inflow affected mostly the western coast, bringing dry and warmer conditions to the leeward side in 2016. Eastern and northeastern circulation in 2005 gave lower temperatures on the eastern coast, however, the W-E differences were less pronounced under these conditions.

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