Note

Meteorological Observations 1997 at the Arctic Station, Qeqertarsuaq (69°15'N), Central West Greenland

Niels Nielsen, Ole Humlum & Birger Ulf Hansen

Abstract

An automatic meteorological station has been operating at the Arctic Station (69°15'N, 53°31'W) in West Greenland since 1990. This paper summarizes meteorological parameters during 1997, including snow and sea ice cover, ground temperatures and active layer development, and presents comments on the local permafrost thickness.

Keywords

Climate, arctic, permafrost, active layer, snow cover, sea ice cover, Greenland, Disko.

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Outline of the Meteorological Year 1997

The mean annual air temperature (MAAT) at the Arctic Station 1997 was -3.3°C (Table 1), which is somewhat higher than the average since the station was established in late 1990 (Nielsen et al., 1995). The MAAT at the station is -4.9°C for the whole period 1991–1997. According to official meteorological data 1961–1990 the MAAT at Qeqertarsuaq is -3.9°C. The higher MAAT 1997 is primarily the result of higher winter temperatures, while summer temperatures were close to normal. The lowest 1997 air temperature (-29.4°C) occurred on 8 March, while the highest air temperature (14.8°C) was registered on 21 June. The warmest period, however, was in early and mid-June, while the remaining part of the summer was cooler (Fig.1). A maximum solar radiation of 902 W/m^2 was registered in early June, within the above warm period.

The mean annual wind speed was 3.9 m/s, with a maximum of 17.6 m/s (daily mean), which occurred in mid-March in connection with a foehn situation with easterly winds. During December the 12th a peak of 26.6 m/sec occurred fron the east. In general, however, the wind speed was comparatively low during the winter and somewhat higher during the summer and autumn (Fig.1). Easterly winds due to air masses flowing off the Greenland Ice Sheet to the east prevailed during periods of the winter and autumn, while southwesterly winds were more frequent during the summer.

The annual total liquid precipitation was 374 mm, which is high compared to the mean annual total precipitation (including snow) of 477 mm w.e. (ASIQ 1997). This high annual total is mainly derived from a wet August, culminating with no less than 118 mm rain on 11 August and 47 mm on 12 August in the morning – 165 mm in 1½ day. This corresponds to about 5 mm per hour with a maximum peak of 7 mm in 30 minutes. This represents a quite unusual event in this part of Greenland. The amount of precipitation in the form of snow during the winter is not

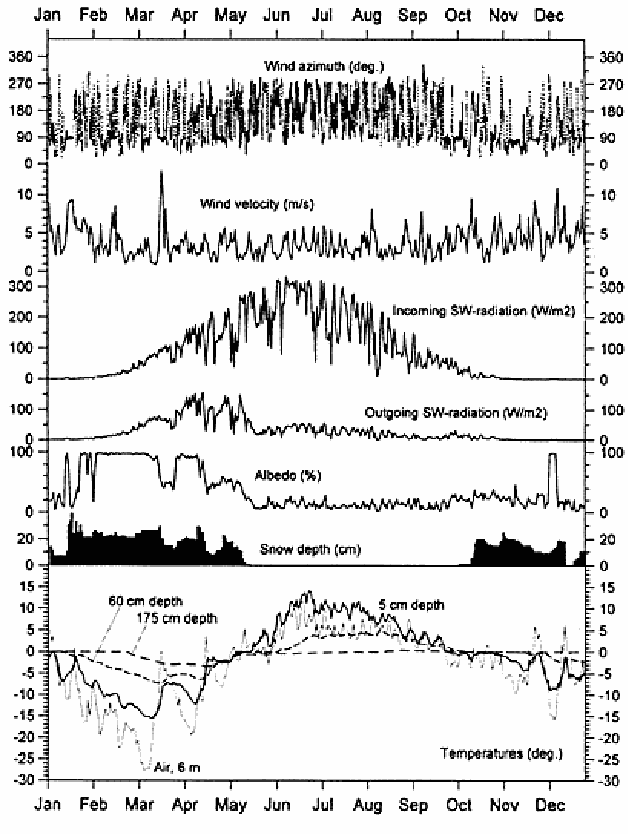

Figure 1: Diagrams showing various mean daily meteorological parameters and ground temperatures at the Arctic Station 1997. The snow cover thickness was measured daily.

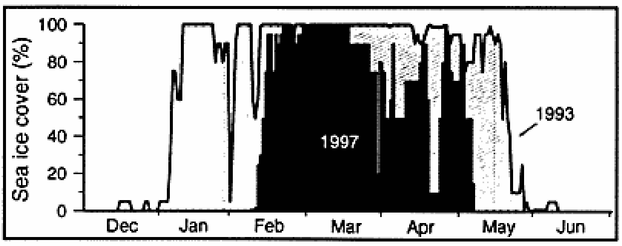

Figure 2: Daily sea ice cover observations estimated from the Arctic Station in 1993 (a 'normal' winter) and in 1997. Notice the drop in sea ice coverage in March and April and the simultaneous peaks of the air temperature, Fig. 1, (foehn-events).

measured. The winter 1996–97 the snow cover had a typical thickness of about 20 cm and lasted until mid May. The subsequent winter 1997–98 the snow cover was established in early October, and had a typical thickness of 15-20 cm throughout November and December.

The winter 1997 was exceptional concerning the sea ice occurrence. M/S Porsild, the research vessel of the Arctic Station, was ice bounded in the Qeqertarsuaq harbour only about 3 months in contrast to normally 5–6 months, Fig. 2.

The mean annual ground temperature at 5 cm depth was -0.8°C, which is 2.5°C above the MAAT. At 60 cm and 175 cm depth, the mean annual ground temperature was -0.5°C and -0.5°C, respectively. The maximum temperature registered at 175 cm depth was 0.5°C, and the active layer in 1997 at the station presumably was about 185 cm thick, which is close to normal for the measurement period 1991–97.

The date for initiation of thawing of the active layer, defined as the time in spring when the near-surface ground temperature (5 cm depth) became stable above 0°C, was on 19 May. The date where the maximum thawing depth was reached was on 29 August, inferred from the temperature at 175 cm depth. Initiation of autumn freezing, defined as the time from where the near-surface temperature (5 cm depth) was consistently below 0°C was on 29 September. Finally, the time for complete freezing of the active layer, defined as the time from which ground temperatures at all levels in the active layer again were below -1°C, was not reached before the end of 1997. All levels in the active layer demonstrate a zero curtain effect during autumn freeze-back, especially at 60 cm and 175 cm depth (Fig.1).

At Godhavn, the complete 1991–97 data series indicate that the initiation of the spring ground thaw usually is in early June, although in some years it may occur in May or even as early as in late April. In this respect 1997 represents a somewhat early initiation of ground thaw. The maximum thaw depth occurs more constantly in mid- or late-September, so again 1997 represents an early date for this parameter. Autumn freezing typically begins in late September or early October, which was also the case in 1997. The complete freezing of the active layer occurs, more variably, from late December to late January, and in this respect 1997 was normal.

No systematic mapping of permafrost or permafrost related terrain features have been carried out in this part of West Greenland. Weidick (1968) and Brown et al. (1997), however, both place Disko Island within the zone of continuous permafrost. Adopting a standard continental geothermal gradient of about 0.033°Cm^{-1} (Kappelmeyer and Haenel, 1974), and knowing that the mean ground temperature typically are a few degrees above the average air temperature as demonstrated above, the Qeqertarsuaq MAAT of -3.9°C (1961–1990) indicates a typical permafrost thickness of 40–80 m in southern Disko Island. These estimates are presumably somewhat conservative, as the Little Ice Age MAAT most likely was at least 2°C below modern values (Humlum, 1996), which would provide conditions for a somewhat thicker permafrost layer than is suggested by modern meteorological values.

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Table 1: Maximum-, minimum- and mean values for each month in 1997 of recorded climate parameters. -3.3°C is the highest mean annual temperature ever measured since the beginning of the observations at the Arctic Station. The total amount of fluid precipetation was also a record in this respect.

1997	ARCTIC STATION, QEQERTARSUAQ - GODHAVN, GREENLAND											
	Wind Speed m/sec	Air temp °c	Rel. Humi %	Si W/m²	(Albedo)	Su W/m²	Precip mm H20 (days)	Snow depth cm (days)	Temp 0 cm °c	Temp 60 cm °c	Temp 175 cm °c	Temp 300 cm °c
January												
Max	21.5	8.9	100.0	35.2		48.0		60	-0.1	0.0	0.0	-2.0
Mean	5.7	-7.5	82.6	-2.8		6.5		19.5	-4.7	-0.8	0.0	-2.4
Min	0.0	-19.2	23.4	0.0		0.0			-9.0	-2.6	0.0	-3.1
Sum					(95.4)		1.9 (1)	(31)				
February												
Max	17.0	-8.6	100.0	238.8		215.3		26	-6.7	-2.6	0.0	-3.1
Mean	3.4	-17.0	88.1	17.3		17.0		22.3	-10.9	-4.0	-0.1	-3.9
Min	0.1	-25.5	27.1	0.0		0.0			13.9	-5.4	-1.1	-4.8
Sum					(98.5)		0.0 (0)	(28)				
March												
Max	25.4	3.5	100.0	444.4		430.6		29	-7.0	-5.3	-1.1	-4.8
Mean	3.7	-14.9	79.4	77.3		62.9		21.2	-11.7	-6.4	-2.4	-5.9
Min	0.1	-29.4	20.1	0.0		0.0			-15.9	-7.5	-3.1	-6.6
Sum							0.0 (0)	(31)				
April												
Max	14.9	6.7	100.0	679.8		583.8		29	-0.9	-2.1	-2.1	-5.7
Mean	3.3	-9.9	83.6	143.2		107.7		16.9	-6.5	-8.4	-8.2	-6.3
Min	0.0	-22.7	23.1	0.0		0.0			-12.8	-6.6	-3.5	-6.6
Sum					(75.2)		18.4 (6)	(30)				
May												
Max	14.6	10.3	100.0	777.7		478.8		18	11.3	0.0	-0.5	-2.8
Mean	3.1	-0.1	76.5	199.6		59.7		5.5	0.6	-0.3	-0.9	-4.4
Min	0.0	-5.5	21.1	0.0		0.0			-2.8	-2.1	-2.1	-5.7
Sum					(29.9)		6.9 (9)	(16)				
June												
Max	17.9	14.8	100.0	897.2		224.4		0	22.1	3.9	-0.3	0.7
Mean	3.3	7.1	58.6	269.3		39.2		0	10.1	1.7	-0.4	-1.3
Min	0.1	-0.8	24.9	0.0		0.0			0.8	0.0	-0.5	-2.8
Sum					(14.5)		5.2 (3)	(0)				
July												
Max	13.1	13.3	100.0	902.6		175.8		0	19.0	4.5	0.0	2.4
Mean	3.2	5.1	68.0	208.1		29.4		0	10.2	3.9	-0.2	1.7
Min	0.2	0.9	21.7	0.0		0.0			4.5	3.1	-0.3	0.7
Sum					(14.1)		25.1 (10)	(0)				
August												
Max	16.4	11.8	100.0	674.4		129.6		0	16.5	5.2	0.5	2.7
Mean	3.5	4.9	75.0	135.3		19.7		0	7.4	4.1	0.2	2.6
Min	0.1	-0.1	21.0	0.0		0.0			2.3	2.8	-0.1	2.4
Sum					(14.6)		206.4 (16)	(0)				
September												
Max	18.8	11.3	100.0	489.6		164.1		0	7.6	3.0	0.4	2.7
Mean	3.4	2.1	77.2	64.5		8.7		0	2.8	2.0	0.3	2.3
Min	0.0	-4.3	21.1	0.0		0.0			-0.2	0.9	0.3	1.8
Sum					(13.6)		70.2 (14)	(0)				
October												
Max	21.5	4.6	100.0	402.6		198.5		20	-0.1	0.9	0.3	1.8
Mean	4.5	-1.3	81.2	21.5		11.9		8.8	-0.5	0.2	0.1	0.9
Min	0.0	-6.1	21.1	0.0		0.0			-2.6	0.0	0.0	0.2
Sum					(55.2)		39.2 (13)	(24)				
November												
Max	23.5	7.3	100.0	65.9		64.9		25	-0.2	0.0	0.0	0.3
Mean	4.9	-3.7	80.4	1.9		1.4		16.5	-2.0	-0.1	0.0	-0.3
Min	0.4	-11.6	20.2	0.0		0.0			-4.6	-0.5	0.0	-0.9
Sum					(74.8)		0.8 (2)	(30)				
December												
Max	26.6	9.0	100.0	11.3		11.0		19	-0.7	-0.1	0.0	-0.9
Mean	5.0	-5.3	81.9	0.3		0.3		8.9	-5.9	1.7	0.0	-1.8
Min	0.1	-17.1	21.0	0.0		0.0			-9.3	-2.7	0.0	-2.7
Sum					(89.6)		0.0 (0)	(25)				
Year												
Max	26.6	14.8	100.0	902.6		583.8		60	22.1	5.2	0.5	2.7
Mean	3.9	-3.3	76.8	95.3		29.9		9.9	-0.8	-0.5	-0.5	-1.5
Min	0.0	-29.4	20.1	0.0		0.0			-15.9	-7.5	-3.5	-6.6
					(31.4)		374.3 (74)	(233)				

Note

A New Climate and Water-Balance Station on the Peninsula Skallingen, South West Jutland

Bent Hasholt, Ulf Pierre Thomas & Kirsten Simonsen

In March 1997 an automatic climate and water balance station was established on the peninsula Skallingen, 55°30'N, 8°15'E.

The data can be retreived by a cellular phone and a modem. The station and selected data are described.

Keywords

Bent Hasholt, Ulf Pierre Thomas and Kirsten Simonsen: Skalling-Laboratoriet

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In 1931 when the late professor Niels Nielsen first visited the peninsula Skallingen, he discovered the unique landscape and the needs for new quantitative research in this environment.

He initiated the building of a new field laboratory, Skalling-Laboratoriet, situated near the old sea-rescue station in the centre of the peninsula. The laboratory was a base for an intensive research programme that soon covered the whole Danish Waddensea and related drainage basins. The old laboratory was destroyed during the war (1940–45), but a new one was built in 1949, just at the entrance to Skallingen. This new laboratory has since grown, partly because it is used as a base for field courses for students from the Institute of Geography, University of Copenhagen. Training in measurering of climate and water-balance parameters is part of the curriculum in physical geography. Therefore, several ad hoc measuring stations have been established over the years. Also for research purposes it has been necessary to establish short-term measurements of parameters that are not included in the ordinary measurement programmes of, e.g. DMI.

For a long time, it has therefore been a wish to establish and run a measuring station where the relevant climate, water-balance and hydrographic parameters are obtained for use both by scientists and students. Earlier stations have suffered from difficult access to and need for frequent change of batteries because of high power consumption. Data handling has also been tedious, because data was recorded on non-electronic media. The technological development has recently overcome these restrictions.

In November 1996 it was decided to establish a station on Skallingen, taking advantage of the new technological development. The way from decision to establishment is, however, not always straightforward, because Skallingen is a national conservancy area. No less than 4 different institutions have to be asked for a permit. The process is well under way, however, because of the time officially allowed for objections against the project, it has not been possible to finish all parts of the station in the saltmarsh area in 1997.

Location and instrumentation of the station:
Earlier stations have been located on a meadow near the recent field station and near the rescue station. Because of the shelter effect from the forest, the situation near the

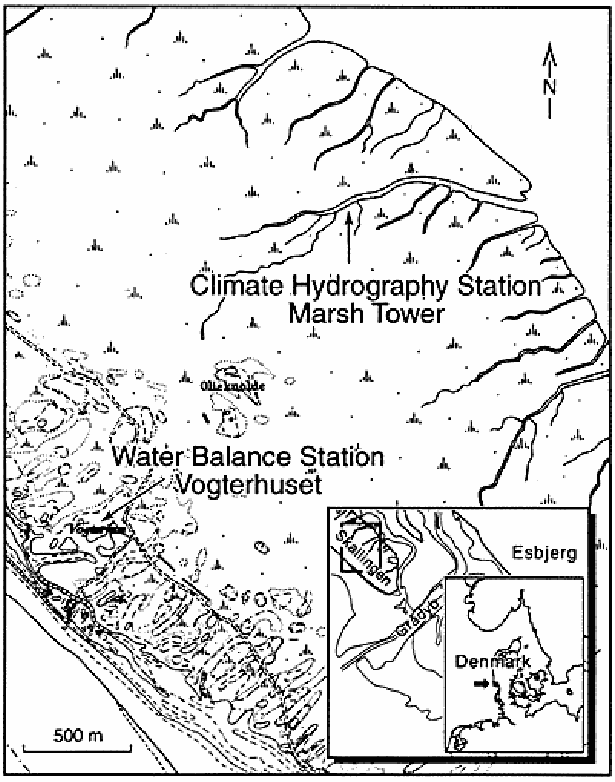
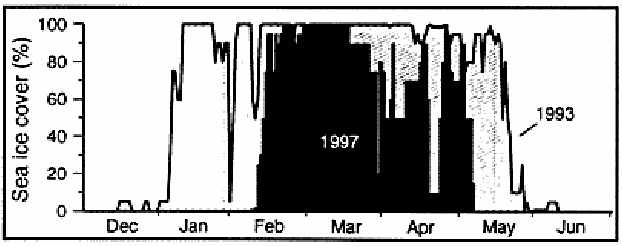


Figure 1: Location of stations.



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