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## Hydrometeorological and Glaciological Observations in the Koryto and Ushkovsky Glaciers, Kamchatka, 1996\*

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**Abstract :** In order to better understand the response of the glaciers in Kamchatka to a global climatic change, meteorological, hydrological and glaciological observations were carried out at Koryto Glacier in the Kronotsky Peninsula in July, 1996. We also made a preliminary shallow firn coring at an ice cap on the top of Ushkovsky Volcano, Kamchatka for the reconstruction of past climate over the region from July to August, 1996. The data taken in this expedition were reported.

**要旨 :** カムチャツカにおける氷河が如何に気候変化に応答しているかを調べる端緒として、クロノツキー半島のカレイタ氷河で気象、水文、氷河の観測を1996年7月に実施した。また、この地域の過去の気候変化を復元するための予察調査として、ウシュコフスキー火山山頂の氷冠で雪氷コア掘削を1996年7月から8月にかけて実施した。これらの調査で得られたデータを報告する。

**Key words :** meteorology, heat balance, water balance, mass balance, glacier, Kamchatka  
キーワード : 気象, 熱収支, 水収支, 質量収支, 氷河, カムチャツカ

## I. Introduction

It has been long waited for Japanese glaciologists to do research on glaciers in Kamchatka, for they are located just north of Hokkaido, where no glaciers exist and many snowpatch studies have been done by them. Kamchatka Peninsula is geographically close to Japan but it was felt far away because it has been closed to foreigners for a long time. It was opened just recently. In the summer of 1996, a group of the Institute of Low Temperature Science, Japan and an Uzbekistan glaciologist with a great help from Institute of Volcanology, Russian Academy of Sciences could carry out a meteorological, hydrological and glaciological research in Kamchatka.

Our main goal for the research is to understand the response of the glaciers to environmental change, such as global change and reconstruct the past climate by taking core samples from the glacier. The Kamchatka Peninsula is located as a part of the circum Okhotsk region. This region is very interesting because the Okhotsk Sea area is surrounded by Siberian high and Aleutian low, which balance would govern the climate of this area and the sea ice extent of the Sea of Okhotsk. The ocean is where southernmost sea ice can be formed in the Northern Hemisphere. The climate in Kamchatka must be immensely affected by activity of the Aleutian lows and the Siberian highs, as well as the sea ice extent in the Okhotsk Sea. Kamchatka glaciers' mass balance is also affected by those climatic conditions. Normally the glaciers' response to the climatic change is somewhat delayed or filtered, therefore, without knowing the basic processes of the accumulation and ablation of the glacier, it cannot be fully understood. Furthermore, the firn and ice in the glacier contain the past climatic signals. By coring the glacier ice and analyzing the ice samples, we might obtain the activity of Siberian high and Aleutian low as well as the sea ice extent of the Sea of Okhotsk.

In this report, the observations conducted on the Koryto Glacier in the Kronotsky Peninsula, and the ice cap on the Ushkovsky Volcano, Kamchatka in July and August, 1996, are summarized.

## II. Regional setting

The Koryto Glacier (Fig. 1) is one of the 32 glaciers reported in the Kronotsky Peninsula by Vinogradov (1968). Most of the glaciers in this region have clear appearance as compared with other glaciers in Kamchatka where the surface of glaciers are usually covered with debris or volcanic detritus. The glaciers in this region lay at the lowest altitudes among the Kamchatka glaciers, some of which flowing down to the altitude of 250 m. The Koryto Glacier is the

third largest glacier in this region, having the area of 8.9 km<sup>2</sup> and extending from 1200 m to 250 m a.s.l. toward northwest (Vinogradov, 1968). There is a relatively large accumulation area, while the glacier tongue in the ablation area is narrow. The surface of the glacier is free of debris, and lacks any icefall or intensive crevassed area (Fig. 3). The equilibrium line altitude was reported to be 780 m in the balance year of 1981/1982 (IAHS (ICSI)-UNEP-UNESCO, 1988).

Ushkovsky Volcano (56°12' N, 160° 38' E) is located in the central part of the Kamchatka Peninsula (Fig. 2). The area is characterized by a concentration of the highest volcanoes in Kamchatka, most of which exceed 3000 m in elevation. The Ushkovsky Volcano is 3900 m in elevation and the summit is characterized by a caldera of 4 km diameter. The caldera is covered by an ice cap which dips gently northward (Fig. 6). At the highest part of the caldera, there are two small craters, the smaller Herz crater and the larger Gorshkov crater, both of which are filled with ice. The diameters of the Herz and Gorshkov craters are 250 and 800 m, respectively. Part of the rim of the Herz crater is free from ice due to geothermal heating. The ice bodies in the two craters are constrained within each crater, while the ice cap in the caldera is drained by an outlet glacier, Bilchenok, to the north. The first glaciological work at the ice cap was conducted in 1984 which was followed by continuous observations during 1986-1988 by one of the authors (Y.M.). Based on the thermal features of a 13-m pit excavated at the center of the ice body within the Gorshkov crater, Murav'ev and Salamatin (1990) simulated the thickness of the ice body in the crater and suggested a thickness of between 38 and 87 m by inputting annual accumulation rates from 1.23 to 0.58 m/a water equivalent.

### III. Hydrometeorological data in the Koryto Glacier

In order to understand the basic processes for the mass balance of the Koryto Glacier, hydrometeorological observation was carried out from July 9 to July 19, 1996. Especially, attention was paid to the snowmelt processes and their discharge to the river. For this purpose, two meteorological stations and one hydrological station were set up : one is at an accumulation area, second at an ablation area and hydrological one at the river near the terminus of the glacier (Fig. 1).

The meteorological components measured at the ablation area (Fig. 5) are : net radiation (height from the ground :1 m), global radiation (1 m), air temperature (1.5 m), humidity (1.5 m), wind speed (3.5 m), wind direction (3.5 m), snow surface temperature (0.3 m) and precipitation (0.5 m) (Table 2). In Table 2, "Net" means the net radiation, "Glo" the global radiation, "Humid" the humidity, "WSpd" the wind speed, "WDir" the wind direction, "SurfT" the snow

surface temperature and “Preci” the precipitation. The time shown in Table 2 is the Kamchatka Standard Time which is 3 hours ahead of Japan Standard Time. Due to a logging error, net radiation and wind speed were not recorded until July 13, whereas the other elements were measured from July 9 to July 19.

The measurements at the accumulation area were the same as the ones at ablation area. Since the whole meteorological system was moved to a ridge of the glacier watershed for the year round operation, the data were taken until July 17.

The hydrological data were collected at the river about 100 m downstream from the terminus of the glacier. When we started the measurements, the most of the river were covered by seasonal snow, therefore, we were forced to install the hydrological station at a small snow-free part. We used a water level sensor, and for this reason the flow rate measurements were manually done several times in the period (Fig. 4) and Q-L curve was obtained. In Table 2, the calculated discharge (“Disch”) from the water level and the water temperature (“w.tem”) are shown.

#### **IV. Glaciological data in the Koryto Glacier and the Ushkovsky Ice Cap**

##### ***Koryto Glacier***

In the Koryto Glacier, both a temporal mass balance and a summer ablation were studied this year. In conjunction with these measurements, flow of the Koryto Glacier was observed simultaneously. The observation was conducted from July 8 to 20 in 1996.

Mass balance of the glacier was studied by measuring both the amount of seasonal snow and daily melting rates. Temporal mass balance of the glacier was estimated by drilling shallow firn cores down to the depth of previous summer layer which was clearly marked by a thin dirt layer or a dirt ice body. The coring was performed using the PICO lightweight coring auger (Koci and Kuivinen, 1984). The cutters of the auger were changed to a wider type manufactured by Geo Tecs Co. Ltd. The operation of drilling down to a depth of more than 10 m was supported by an original tripod system.

Five cores were obtained in the accumulation area of glacier. Temperature at any places of the cores was at the pressure melting point, thus, the glacier is considered to be temperate. Among the cores retrieved, wet density profiles for the Nos. 11 and 16 were tabulated in Tables 3 and 4.

Ablation of the glacier was measured by the stake method. The stakes were distributed spatially on 18 sites on the glacier (Fig. 1 ; Table 1). Changes of relative heights between the top of stakes and snow surfaces were recorded at least once a day (Table 5). The snow density

at the surface was approximately  $540 \text{ kg/m}^3$  and the ice was  $900 \text{ kg/m}^3$ , thus, it is possible to calculate the water equivalent values from Table 5 by multiplying the densities above.

Flow of the Koryto Glacier was measured along the two transections : the upper line crossing the No. 11 at an altitude of 785 m and the lower line crossing between the Nos. 5 and 6 at an altitude of 545 m (Fig. 1). The measurements were carried out on July 11 and July 17 from control points established on the left bank of the glacier. Survey poles were numbered in ascending order from the right to left banks of the glacier. The daily horizontal and vertical velocities are tabulated in Tables 7 (the upper line) and 8 (the lower line). The reason why the poles 1 and 2 in the upper line showed upglacial movement can be explained by the location of the poles which were installed at an upglacier-facing avalanche cone supplied from side valley.

### ***Ushkovsky Ice Cap***

The principal objective of the research on the Ushkovsky Ice Cap is the reconstruction of paleoclimate by using ice cores. We, therefore, concentrated our work on observations related to climatic interpretation of the core. Following our landing at the edge of the Herz crater by helicopter on July 24, 1996, we constructed a basecamp at the rim of the crater and remained until 4 th of August, conducting the research described below. The area of research activity was restricted to within the two craters. This is mainly because we can neglect an influence of horizontal flow of the ice cap which makes the interpretation of the core difficult.

During the 12 days at the Ushkovsky Volcano, we conducted ;

1. measurements of accumulation and ablation using the snow stake method ;
2. shallow firn core drilling and *in situ* physical analyses of the core ;
3. measurements of firn temperature in the drill hole ;
4. radio-echo soundings of the ice cap ;
5. construction of an Automated Weather Station (AWS).

In this report, we will describe the data of 1, 2 and 3 only.

The snow stakes were installed at 19 points along a transection crossing the two craters mentioned above (Fig. 2). The relative height from the top of the stake to the snow surface was measured once a day. We obtained data from only 8 points (Table 6) because frequent blizzards destroyed some of the stakes and made measurement impossible. Rime drops during the blizzard also made measurement difficult.

The shallow firn coring was performed at the center of Gorshkov crater (Fig. 7). It took three days for three persons to drill the firn core down to a depth of 27.66 m. The cores were then divided into pieces of approximately 10 cm length and used for density measurements (Table 9).

After the drilling, the borehole temperature profile was measured using eight platinum resistance sensors which were connected to a data logger recording the data every ten minutes with an accuracy of  $\pm 0.1$  °C. Each sensor was installed at the depths of measurement for at least one day, after which the snow temperatures were recorded (Table 10). The snow temperature profile measured at the same point in the beginning of July, 1986 (Murav'ev and Salamatin, 1990) is also tabulated.

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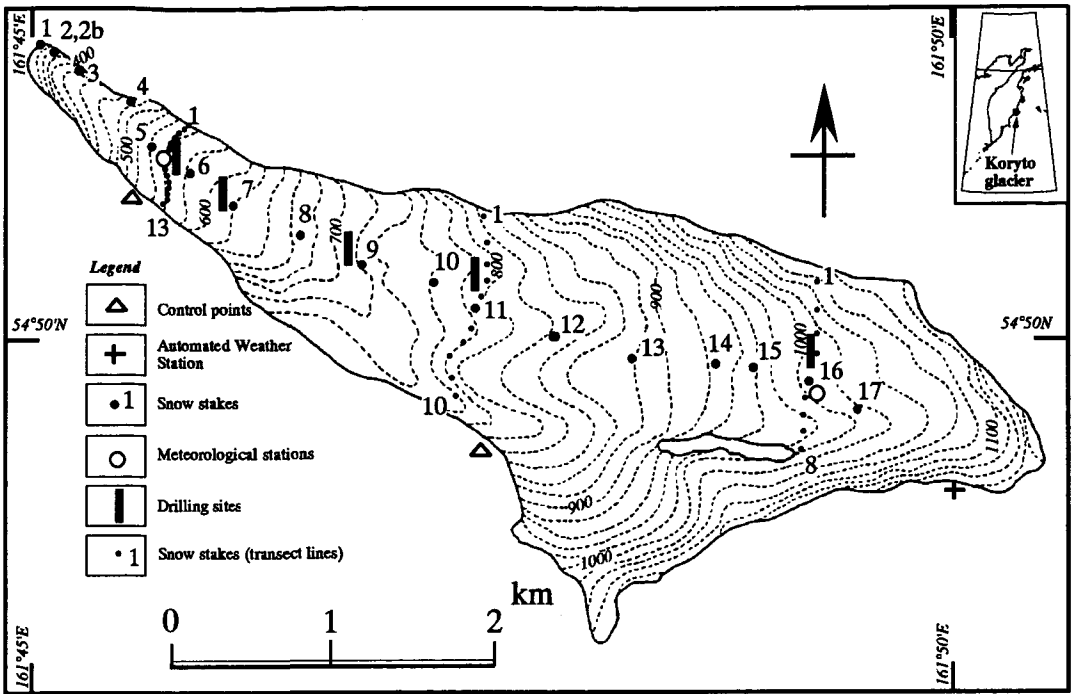


Fig. 1. Topographic map of the Koryto Glacier with various locations of the observations conducted in 1996.

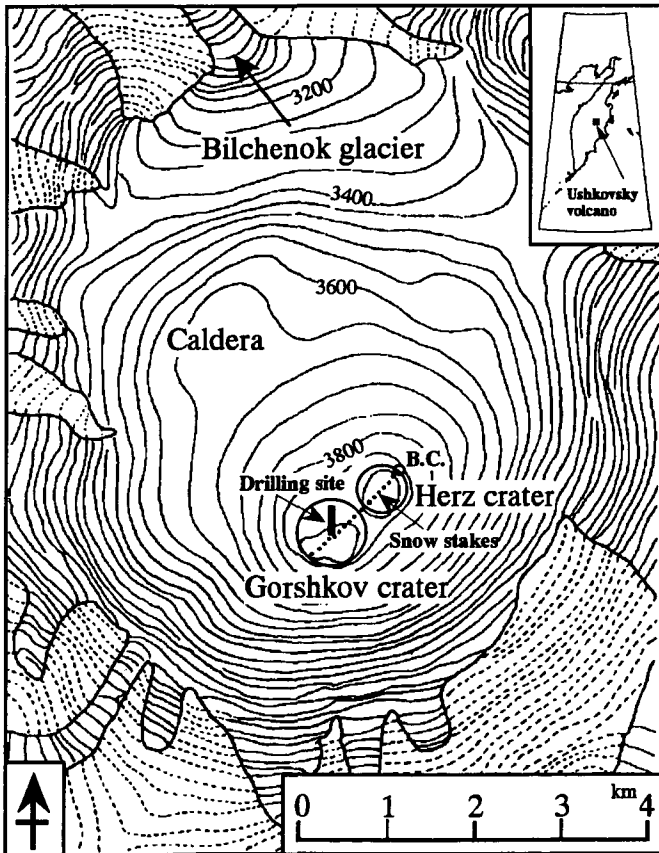
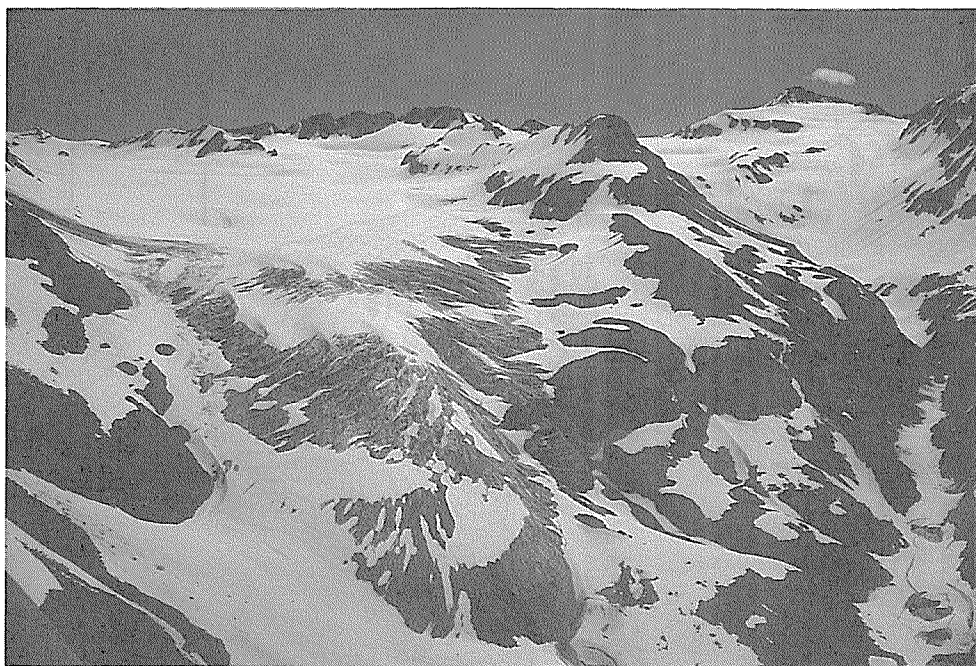


Fig. 2. Topographic map of the summit ice cap of the Ushkovsky Volcano. Solid and dotted contours (m) are for the glacier and bedrock, respectively.



**Fig. 3.** The Koryto Glacier seen from the north-west. Seasonal snow covers most of the glacier except the terminus in July 8, 1996.



**Fig. 4.** Hydrological observation at a stream drained from the terminus of the Koryto Glacier.



**Fig. 5.** Meteorological Station at the ablation area (No. 5 : 545 m a.s.l.) of the Koryto Glacier.



**Fig. 6.** The Ushkovsky Ice Cap seen from the north. The Gorshkov crater, where glaciological observation was conducted, is located at the highest part (3900 m a.s.l.) of the ice cap.



Fig. 7. Drilling site at the center of Gorshkov crater. The tripod was used for supporting the PICO lightweight coring auger. The background is the Kamchatka's highest active volcano, Klyuchevskoy (4750 m a.s.l.).

Table 1. Information of the observation sites on the Koryto Glacier. Meteorological stations are located at Stakes No. 5 (545 m a.s.l.) and No. 16 (1005 m a.s.l.).

Stake No.	Altitude (m)	Slope direction (°)	Slope angle(°)	Surface condition
1	320	337.5	15	Dirt ice
2	370	337.5	19	Dirt ice
2b	370	337.5	19	Snow
3	420	292.5	13	Dirt ice
4	480	315.0	10	Dirt snow
5	545	292.5	1	Snow
6	585	0.0	2	Snow
7	620	247.5	4	Snow
8	670	-	0	Snow
9	720	225.0	12	Snow
10	765	270.0	6	Snow
11	785	225.0	7	Snow
12	825	202.5	9	Snow
13	870	270.0	9	Snow
14	930	315.0	9	Snow
15	955	337.5	13	Snow
16	1005	-	0	Snow
17	1015	-	0	Snow

**Table 2.** Meteorological and hydrological data collected at the Koryto Glacier.

Place		Ablation Station								Accumulation Station								Hydro. St.	
Element	Unit	Net W/m <sup>2</sup>	Glo W/m <sup>2</sup>	AirT °C	Humid %	WSpd m/s	WDir o	SurfT °C	Preci mm	Net W/m <sup>2</sup>	Glo W/m <sup>2</sup>	AirT °C	Humid %	WSpd m/s	WDir o	SurfT °C	Preci mm	Disch m <sup>3</sup> /s	w. tem °C
July 9, 1997																			
KST																			
0:00:00																		5.4	0.2
1:00:00																		5.4	0.2
2:00:00																		5.5	0.2
3:00:00																		5.5	0.2
4:00:00																		5.6	0.2
5:00:00																		5.6	0.2
6:00:00																		5.6	0.2
7:00:00																		5.6	0.2
8:00:00																		5.7	0.2
9:00:00																		5.8	0.2
10:00:00																		5.9	0.2
11:00:00		110						188.4	0.0									5.9	0.2
12:00:00		222						121.1	0.0	0.0								5.9	0.2
13:00:00		176						127.2	0.0	0.0								5.9	0.2
14:00:00		210						120.9	0.0	0.0								6.0	0.2
15:00:00		150						130.3	0.0	0.0								6.0	0.2
16:00:00		126						127.9	0.0	0.0	72							6.0	0.2
17:00:00		100						127.7	0.0	0.0	146							5.9	0.2
18:00:00		64	6.1	79.9				120.5	0.0	0.0	100	5.1	88.3			0.0	0.0	5.9	0.2
19:00:00		42	5.5	80.7				131.4	0.0	0.0	64	5.0	87.6			0.0	0.0	5.9	0.2
20:00:00		14	5.0	83.8				142.1	0.0	0.0	26	5.0	86.5			0.0	0.0	5.9	0.2
21:00:00		0	4.9	86.6				115.9	0.0	0.0	4	4.5	98.4			0.0	0.0	5.9	0.2
22:00:00		0	5.4	89.4				97.3	0.0	0.0	0	4.5	99.4			0.0	0.0	5.8	0.2
23:00:00		0	5.4	93.8				242.2	0.0	0.0	0	4.5	99.7			0.0	0.0	5.8	0.2
Maximum			222	6.1	93.8			242.2	0.0	0.0	146	5.1	99.7			0.0	0.0	6.0	0.2
Minimum			0	4.9	79.9			97.3	0.0	0.0	0	4.5	86.5			0.0	0.0	5.4	0.2
Average			93	5.4	85.7			137.9	0.0	0.0	52	4.8	93.3			0.0	0.0	5.8	0.2
July 10, 1997																			
KST																			
0:00:00		0	5.4	95.9				274.2	0.0	0.0	0	4.1	99.7			0.0	0.0	5.9	0.2
1:00:00		0	5.6	96.6				322.6	0.0	0.0	0	4.1	99.8			0.0	0.0	5.9	0.2
2:00:00		0	5.7	97.8				290.6	0.0	0.0	0	3.9	100.0			0.0	0.5	6.0	0.2
3:00:00		0	5.2	97.9				263.4	0.0	0.5	0	3.9	99.9			0.0	1.0	6.0	0.2
4:00:00		0	4.9	98.0				91.5	0.0	1.5	0	3.9	100.0			0.0	2.0	5.9	0.2
5:00:00		4	4.9	97.9				271.8	0.0	1.0	10	4.0	100.0			0.0	2.5	6.0	0.2
6:00:00		16	5.2	98.1				308.9	0.0	1.0	28	3.9	100.0			0.0	4.5	5.9	0.2
7:00:00		46	5.0	98.0				263.4	0.0	1.0	70	3.8	100.0			0.0	4.0	5.9	0.2
8:00:00		52	5.0	98.1				157.0	0.0	1.0	124	3.8	100.0			0.0	2.0	6.0	0.2
9:00:00		40	5.4	98.0				306.0	0.0	0.0	112	4.0	99.9			0.0	0.0	6.0	0.2
10:00:00		40	5.5	98.4				241.3	0.0	0.5	126	4.1	99.9			0.0	0.0	6.1	0.2
11:00:00		60	5.0	98.1				79.8	0.0	0.0	184	4.2	100.0			0.0	0.0	6.1	0.2
12:00:00		138	4.5	98.3				132.0	0.0	0.0	350	4.1	99.9			0.0	0.0	6.1	0.2
13:00:00		224	4.1	98.1				132.9	0.0	0.0	412	4.9	99.9			0.0	0.0	6.1	0.2
14:00:00		292	5.2	98.2				126.7	0.0	0.0	652	5.3	99.2			0.0	0.0	6.2	0.2
15:00:00		432	5.5	98.4				105.8	0.0	0.0	536	5.6	97.0			0.0	0.0	6.2	0.3
16:00:00		362	5.7	94.0				109.7	0.0	0.0	442	5.7	96.7			0.0	0.0	6.2	0.3
17:00:00		388	6.9	85.9				124.3	0.0	0.0	402	5.4	93.3			0.0	0.0	6.2	0.2
18:00:00		368	5.6	87.1				129.7	0.0	0.0	450	5.5	90.7			0.0	0.0	6.3	0.3
19:00:00		218	5.3	82.3				145.0	0.0	0.0	278	6.2	89.1			0.0	0.0	6.4	0.2
20:00:00		86	4.8	81.0				127.0	0.0	0.0	104	5.6	87.6			0.0	0.0	6.5	0.2
21:00:00		14	6.4	77.2				123.4	0.0	0.0	20	6.2	82.4			0.0	0.0	6.5	0.2
22:00:00		0	5.5	79.0				125.3	0.0	0.0	0	5.0	90.8			0.0	0.0	6.5	0.2
23:00:00		0	6.0	78.7				120.5	0.0	0.0	0	4.5	90.4			0.0	0.0	6.5	0.2
Maximum			432	6.9	98.4			322.6	0.0	1.5	652	6.2	100.0			0.0	4.5	6.5	0.3
Minimum			0	4.1	77.2			79.8	0.0	0.0	0	3.8	82.4			0.0	0.0	5.9	0.2
Average			116	5.3	93.0			182.2	0.0	0.3	179	4.7	96.5			0.0	0.7	6.1	0.2

July 11, 1997																		
Place	Ablation Station							Accumulation Station							Hydro. St.			
	Element	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Disch
Unit	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	m <sup>3</sup> /s	°C
KST																		
0:00:00		0	5.7	78.4			136.5	0.0	0.0	0	4.4	82.7			0.0	0.0	6.6	0.2
1:00:00		0	5.5	78.9			127.3	0.0	0.0	0	3.3	86.8			0.0	0.0	6.7	0.1
2:00:00		0	5.8	76.7			125.5	0.0	0.0	0	3.2	84.1			0.0	0.0	6.7	0.2
3:00:00		0	7.0	74.6			147.0	0.0	0.0	0	4.3	84.9			0.0	0.0	6.8	0.2
4:00:00		2	8.1	76.8			92.3	0.0	0.0	4	4.5	85.7			0.0	0.0	6.9	0.2
5:00:00		14	8.5	74.7			158.3	0.0	0.0	20	5.2	90.8			0.0	0.0	6.9	0.2
6:00:00		32	8.8	72.9			140.1	0.0	0.0	42	5.6	87.3			0.0	0.0	6.9	0.2
7:00:00		74	8.8	73.8			61.0	0.0	0.0	86	4.5	87.9			0.0	0.0	6.9	0.2
8:00:00		110	6.3	73.4			129.0	0.0	0.0	168	6.0	78.1			0.0	0.0	6.9	0.2
9:00:00		182	8.0	71.4			130.3	0.0	0.0	260	6.5	71.8			0.0	0.0	6.9	0.2
10:00:00		260	6.4	73.4			126.6	0.0	0.0	358	7.2	73.7			0.0	0.0	6.9	0.2
11:00:00		278	6.8	75.4			130.5	0.0	0.0	378	7.2	78.1			0.0	0.0	6.8	0.2
12:00:00		250	8.6	72.3			131.4	0.0	0.0	396	7.1	77.9			0.0	0.0	6.8	0.3
13:00:00		208	9.1	72.6			141.0	0.0	0.0	468	6.9	82.7			0.0	0.0	6.9	0.1
14:00:00		260	9.4	73.6			225.6	0.0	0.0	894	6.5	87.6			0.0	0.0	6.9	0.2
15:00:00		264	9.3	75.7			84.7	0.0	0.0	806	6.4	85.0			0.0	0.0	6.9	0.2
16:00:00		504	7.8	74.7			96.7	0.0	0.0	818	6.3	83.9			0.0	0.0	6.9	0.3
17:00:00		496	7.4	71.8			122.0	0.0	0.0	588	5.9	85.3			0.0	0.0	6.9	0.3
18:00:00		346	7.8	68.7			134.6	0.0	0.0	418	6.5	78.6			0.0	0.0	6.9	0.3
19:00:00		198	6.7	73.0			143.8	0.0	0.0	250	6.2	80.8			0.0	0.0	6.9	0.3
20:00:00		80	7.9	72.7			133.9	0.0	0.0	104	5.6	76.4			0.0	0.0	6.8	0.2
21:00:00		10	6.2	75.9			118.7	0.0	0.0	14	6.3	74.1			0.0	0.0	6.7	0.2
22:00:00		0	7.5	68.7			124.0	0.0	0.0	0	4.6	79.3			0.0	0.0	6.6	0.2
23:00:00		0	7.1	70.3			112.8	0.0	0.0	0	5.2	80.3			0.0	0.0	6.5	0.2
Maximum		504	9.4	78.9			225.6	0.0	0.0	894	7.2	90.8			0.0	0.0	6.9	0.3
Minimum		0	5.5	68.7			61.0	0.0	0.0	0	3.2	71.8			0.0	0.0	6.5	0.1
Average		149	7.5	73.8			128.1	0.0	0.0	253	5.6	81.8			0.0	0.0	6.8	0.2

July 12, 1997																		
Place	Ablation Station							Accumulation Station							Hydro. St.			
	Element	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Disch
Unit	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	m <sup>3</sup> /s	°C
KST																		
0:00:00		0	8.0	66.8			140.7	0.0	0.0	0	3.8	86.1			0.0	0.0	6.5	0.2
1:00:00		0	7.9	70.8			132.6	0.0	0.0	0	4.1	86.0			0.0	0.0	6.4	0.2
2:00:00		0	7.2	67.3			155.7	0.0	0.0	0	4.0	87.4			0.0	0.0	6.4	0.2
3:00:00		0	7.0	69.2			128.2	0.0	0.0	0	3.8	84.8			0.0	0.0	6.5	0.2
4:00:00		2	6.1	71.2			138.5	0.0	0.0	2	4.6	82.6			0.0	0.0	6.5	0.2
5:00:00		18	8.1	72.3			68.8	0.0	0.0	24	5.2	76.4			0.0	0.0	6.6	0.2
6:00:00		48	7.6	69.2			154.7	0.0	0.0	102	5.6	76.8			0.0	0.0	6.6	0.2
7:00:00		182	7.1	72.4			136.6	0.0	0.0	234	4.9	79.6			0.0	0.0	6.5	0.2
8:00:00		382	6.4	73.3			138.7	0.0	0.0	400	5.0	78.6			0.0	0.0	6.5	0.2
9:00:00		516	7.6	68.2			124.7	0.0	0.0	538	5.2	76.0			0.0	0.0	6.5	0.2
10:00:00		654	10.3	63.1			150.5	0.0	0.0	712	6.5	69.9			0.0	0.0	6.5	0.3
11:00:00		732	9.2	63.5			126.6	0.0	0.0	800	6.1	73.9			0.0	0.0	6.6	0.3
12:00:00		774	9.4	63.0			136.5	0.0	0.0	852	6.3	68.9			0.0	0.0	6.7	0.3
13:00:00		744	8.0	65.3			121.0	0.0	0.0	846	6.5	70.8			0.0	0.0	6.7	0.3
14:00:00		788	9.3	62.9			142.9	0.0	0.0	822	6.8	68.6			0.0	0.0	6.8	0.3
15:00:00		674	9.9	60.7			137.2	0.0	0.0	652	6.4	71.1			0.0	0.5	6.8	0.3
16:00:00		536	7.3	67.4			133.2	0.0	0.0	594	6.7	70.7			0.0	0.0	6.8	0.3
17:00:00		494	7.8	65.7			115.3	0.0	0.0	532	5.8	70.6			0.0	0.0	6.8	0.3
18:00:00		276	7.8	68.2			118.2	0.0	0.0	322	8.3	65.8			0.0	0.0	6.8	0.3
19:00:00		172	6.9	67.7			115.5	0.0	0.0	194	8.2	65.0			0.0	0.0	6.8	0.3
20:00:00		70	7.2	67.8			122.8	0.0	0.0	86	7.9	67.8			0.0	0.0	6.7	0.3
21:00:00		8	7.4	69.2			115.0	0.0	0.0	10	8.7	62.0			0.0	0.0	6.5	0.2
22:00:00		0	7.6	68.4			124.6	0.0	0.0	0	9.0	65.1			0.0	0.0	6.4	0.2
23:00:00		0	7.5	69.3			129.5	0.0	0.0	0	9.1	67.6			0.0	0.0	6.5	0.2
Maximum		788	10.3	73.3			155.7	0.0	0.0	852	9.1	87.4			0.0	0.5	6.8	0.3
Minimum		0	6.1	60.7			68.8	0.0	0.0	0	3.8	62.0			0.0	0.0	6.4	0.2
Average		295	7.9	67.6			129.5	0.0	0.0	322	6.2	73.8			0.0	0.0	6.6	0.2

July 13, 1997

Place Element	Ablation Station								Accumulation Station								Hydro. St.	
	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Disch	w. tem
	Unit	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	m <sup>3</sup> /s
KST																		
0:00:00		0	7.4	71.6		131.2	0.0	0.0		0	8.1	68.8			0.0	0.0	6.5	0.2
1:00:00		0	6.8	70.7		121.1	0.0	0.0		0	8.1	66.0			0.0	0.0	6.6	0.2
2:00:00		0	7.2	72.3		137.3	0.0	0.0		0	7.8	73.6			0.0	0.0	6.6	0.2
3:00:00		0	6.5	71.8		116.4	0.0	0.0		0	5.9	79.0			0.0	0.0	6.6	0.2
4:00:00		0	7.3	70.8		121.6	0.0	0.0		0	7.6	66.5			0.0	0.0	6.6	0.2
5:00:00		20	6.3	76.3		123.8	0.0	0.0		26	6.6	70.6			0.0	0.0	6.5	0.2
6:00:00		56	5.6	77.3		129.3	0.0	0.0		72	7.0	75.8			0.0	0.0	6.5	0.2
7:00:00		134	5.7	78.0		128.4	0.0	0.0		136	7.8	76.6			0.0	0.0	6.6	0.2
8:00:00		192	6.8	76.4		126.6	0.0	0.0		208	7.5	77.5			0.0	0.0	6.6	0.2
9:00:00		408	6.5	78.6		131.3	0.0	0.0		422	7.4	76.0			0.0	0.0	6.6	0.2
10:00:00		452	6.3	80.9		129.2	0.0	0.0		508	7.7	77.5			0.0	0.0	6.6	0.3
11:00:00		622	5.8	81.3		122.4	0.0	0.0		620	7.9	78.6			0.0	0.0	6.6	0.3
12:00:00		762	5.0	84.3		131.5	0.0	0.0		860	7.8	79.8			0.0	0.0	6.7	0.3
13:00:00		794	5.5	83.3		127.8	0.0	0.0		1068	6.7	86.6			0.0	0.0	6.7	0.3
14:00:00		826	5.4	86.1		127.7	0.0	0.0		770	6.9	82.7			0.0	0.0	6.8	0.4
15:00:00		588	4.9	86.0		142.5	0.0	0.0		634	6.1	93.3			0.0	0.0	6.8	0.3
16:00:00		510	5.1	86.3		137.2	0.0	0.0		602	6.5	83.6			0.0	0.0	6.8	0.3
17:00:00		500	5.6	86.1		117.0	0.0	0.0		488	7.2	79.4			0.0	0.0	6.9	0.3
18:00:00		274	5.7	81.0		105.4	0.0	0.0		370	6.2	86.3			0.0	0.0	6.8	0.3
19:00:00		154	5.7	85.2	3.8	123.3	0.0	0.0		184	6.5	87.7			0.0	0.0	6.8	0.3
20:00:00	0.0	48	5.4	83.9	3.8	118.6	0.0	0.0		68	6.2	87.9	0.2	332.6	0.0	0.0	6.8	0.2
21:00:00	9.6	6	5.3	87.8	2.5	121.7	0.0	0.0		8	5.7	76.9	2.0	54.8	0.0	0.0	6.7	0.2
22:00:00	13.2	0	5.5	88.1	3.2	117.2	0.0	0.0		0	6.3	79.6	2.3	17.1	0.0	0.0	6.6	0.2
23:00:00	-1.2	0	4.0	86.8	3.0	136.8	0.0	0.0		0	5.3	92.4	1.3	74.1	0.0	0.0	6.6	0.2
Maximum	13.2	826	7.4	88.1	3.8	142.5	0.0	0.0		1068	8.1	93.3	2.3	332.6	0.0	0.0	6.9	0.4
Minimum	-1.2	0	4.0	70.7	2.5	105.4	0.0	0.0		0	5.3	66.0	0.2	17.1	0.0	0.0	6.5	0.2
Average	5.4	264	5.9	80.5	3.2	126.1	0.0	0.0		294	7.0	79.3	1.4	119.7	0.0	0.0	6.7	0.2

July 14, 1997

Place Element	Ablation Station								Accumulation Station								Hydro. St.	
	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Disch	w. tem
	Unit	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	m <sup>3</sup> /s
KST																		
0:00:00	-3.6	0	5.1	83.8	3.4	125.7	0.0	0.0		0	5.9	84.9	2.5	66.7	0.0	0.0	6.6	0.2
1:00:00	-28.8	0	4.3	88.1	3.4	106.5	0.0	0.0		0	5.5	87.4	2.3	41.2	0.0	0.0	6.5	0.2
2:00:00	-40.8	0	5.0	83.4	1.7	111.7	0.0	0.0		0	5.8	86.4	2.8	36.4	0.0	0.0	6.5	0.2
3:00:00	-12.0	0	4.8	88.2	1.4	162.5	0.0	0.0		0	5.4	90.1	2.6	25.4	0.0	0.0	6.5	0.2
4:00:00	6.0	0	4.5	88.6	0.9	304.6	0.0	0.0		0	5.3	95.2	1.1	1.2	0.0	0.0	6.5	0.2
5:00:00	13.2	12	4.7	91.3	1.7	138.3	0.0	0.0		12	4.9	98.0	3.0	55.1	0.0	0.0	6.5	0.2
6:00:00	27.6	32	4.4	92.3	3.1	134.7	0.0	0.0		60	4.8	99.8	2.9	10.1	0.0	0.0	6.5	0.2
7:00:00	34.8	74	3.0	95.5	3.1	112.2	0.0	0.0		162	4.7	99.8	3.1	52.7	0.0	0.0	6.5	0.2
8:00:00	50.4	126	2.9	97.8	2.3	107.9	0.0	0.0		286	4.5	99.2	2.8	60.8	0.0	0.0	6.6	0.2
9:00:00	70.8	212	4.0	98.0	2.2	118.9	0.0	0.0		442	4.1	98.3	2.8	52.1	0.0	0.0	6.5	0.2
10:00:00	104.4	292	4.2	96.1	2.0	108.8	0.0	0.0		574	4.7	96.6	2.3	33.8	0.0	0.0	6.5	0.2
11:00:00	129.6	338	4.8	92.4	1.8	113.5	0.0	0.0		560	5.2	94.1	1.8	258.2	0.0	0.0	6.6	0.3
12:00:00	118.8	260	5.5	87.3	1.1	72.5	0.0	0.0		468	4.9	96.0	1.6	257.0	0.0	0.0	6.6	0.3
13:00:00	88.8	242	6.4	89.8	1.7	348.1	0.0	0.0		492	4.9	96.3	1.5	211.4	0.0	0.0	6.5	0.3
14:00:00	91.2	254	5.9	90.9	1.1	37.1	0.0	0.0		514	2.6	93.8	1.5	187.1	0.0	0.0	6.5	0.3
15:00:00	97.2	210	6.9	88.0	1.3	94.0	0.0	0.0	118.5	470	5.5	96.8	1.3	36.4	0.0	0.0	6.6	0.3
16:00:00	87.6	184	6.7	88.8	1.5	34.6	0.0	0.0	82.8	348	5.0	96.9	2.0	67.0	0.0	0.0	6.6	0.3
17:00:00	80.4	136	6.5	89.1	1.5	88.7	0.0	0.0	70.2	278	4.8	97.8	1.1	295.5	0.0	0.0	6.5	0.2
18:00:00	69.6	112	5.9	89.6	1.8	111.1	0.0	0.0	57.5	192	4.8	99.1	1.4	13.3	0.0	0.0	6.5	0.2
19:00:00	62.4	74	6.5	87.6	1.6	102.5	0.0	0.0	41.4	114	4.6	99.5	1.2	59.7	0.0	0.0	6.4	0.2
20:00:00	42.0	24	6.6	85.3	1.4	207.9	0.0	0.0	31.1	46	4.5	99.9	1.2	333.6	0.0	0.0	6.4	0.2
21:00:00	27.6	2	5.3	87.9	1.4	88.2	0.0	0.0	15.0	6	4.2	100.0	1.6	62.0	0.0	0.0	6.3	0.2
22:00:00	21.6	0	5.2	89.1	1.6	166.8	0.0	0.0	6.9	0	3.7	100.0	0.8	133.1	0.0	0.0	6.3	0.2
23:00:00	21.6	0	4.4	89.8	1.9	87.0	0.0	0.0	4.6	0	3.7	100.0	0.6	201.5	0.0	0.0	6.3	0.2
Maximum	129.6	338	6.9	98.0	3.4	348.1	0.0	0.0	118.5	574	5.9	100.0	3.1	333.6	0.0	0.0	6.6	0.3
Minimum	-40.8	0	2.9	83.4	0.9	34.6	0.0	0.0	4.6	0	2.6	84.9	0.6	1.2	0.0	0.0	6.3	0.2
Average	48.4	108	5.1	89.9	1.9	128.5	0.0	0.0	47.5	209	4.8	96.1	1.9	106.3	0.0	0.0	6.5	0.2

July 15, 1997																			
Place	Ablation Station							Accumulation Station							Hydro. St.				
	Element	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Disch	w. tem
Unit	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	m <sup>3</sup> /s	°C	
KST																			
0:00:00	18.0	0	4.2	91.6	2.9	130.4	0.0	0.0	2.3	0	3.3	100.0	0.6	70.3	0.0	0.0	6.3	0.2	
1:00:00	16.8	0	4.2	89.9	2.8	100.9	0.0	0.0	2.3	0	2.8	100.0	0.6	100.9	0.0	0.0	6.3	0.2	
2:00:00	15.6	0	3.6	89.9	2.7	135.3	0.0	0.0	2.3	0	2.8	100.0	0.6	159.0	0.0	0.0	6.2	0.2	
3:00:00	14.4	0	3.4	91.8	2.5	117.3	0.0	0.0	-2.3	0	2.8	100.0	0.9	67.3	0.0	0.0	6.2	0.2	
4:00:00	14.4	0	2.9	90.3	2.3	121.0	0.0	0.0	0.0	2	2.8	100.0	2.1	51.9	0.0	0.0	6.3	0.2	
5:00:00	15.6	8	3.5	91.7	2.3	109.7	0.0	0.0	1.2	14	2.8	100.0	2.2	37.7	0.0	0.0	6.2	0.2	
6:00:00	20.4	32	3.5	92.2	2.1	120.1	0.0	0.0	8.1	54	2.9	100.0	3.3	25.3	0.0	0.0	6.1	0.2	
7:00:00	31.2	80	3.2	93.8	1.9	107.5	0.0	0.0	20.7	146	2.9	100.0	2.0	33.7	0.0	0.0	6.1	0.2	
8:00:00	54.0	164	3.3	92.2	2.1	114.0	0.0	0.0	39.1	252	2.8	100.0	2.5	237.1	0.0	0.0	6.1	0.2	
9:00:00	63.6	166	3.7	89.9	2.1	153.2	0.0	0.0	52.9	392	2.9	100.0	1.5	79.1	0.0	0.0	6.1	0.2	
10:00:00	79.2	210	3.2	88.4	3.0	129.4	0.0	0.0	105.8	546	3.5	100.0	1.3	350.4	0.0	0.0	6.1	0.2	
11:00:00	96.0	412	2.9	89.9	3.0	114.3	0.0	0.0	135.7	810	4.4	97.6	0.5	28.5	0.0	0.0	6.1	0.2	
12:00:00	195.6	480	3.4	88.0	2.8	132.3	0.0	0.0	209.3	824	3.4	98.0	1.5	116.5	0.0	0.0	6.1	0.3	
13:00:00	172.8	520	3.8	85.8	3.5	117.0	0.0	0.0	176.0	814	4.1	94.5	0.7	109.9	0.0	0.0	6.2	0.3	
14:00:00	260.4	652	3.8	85.1	3.8	109.0	0.0	0.0	230.0	812	3.4	96.2	1.3	324.0	0.0	0.0	6.2	0.3	
15:00:00	244.8	702	3.8	86.1	3.6	108.9	0.0	0.0	184.0	814	3.4	91.8	1.3	103.5	0.0	0.0	6.3	0.3	
16:00:00	216.0	598	4.1	82.7	3.5	139.1	0.0	0.0	156.4	686	5.0	78.4	1.1	348.9	0.0	0.0	6.4	0.3	
17:00:00	178.8	490	4.3	83.4	3.4	124.4	0.0	0.0	113.9	524	5.7	76.9	1.2	73.4	0.0	0.0	6.4	0.3	
18:00:00	105.6	332	4.4	81.2	2.1	133.2	0.0	0.0	71.3	362	6.1	69.6	1.6	37.0	0.0	0.0	6.4	0.3	
19:00:00	42.0	184	5.2	81.8	2.6	140.6	0.0	0.0	23.0	200	5.9	64.6	1.8	60.5	0.0	0.0	6.3	0.3	
20:00:00	-7.2	54	3.9	86.4	2.8	122.6	0.0	0.0	-16.1	66	5.2	77.6	1.7	70.3	0.0	0.0	6.2	0.2	
21:00:00	-39.6	8	4.5	83.5	2.2	128.9	0.0	0.0	-47.2	10	6.0	75.6	2.2	58.1	0.0	0.0	6.1	0.2	
22:00:00	-46.8	0	4.2	85.2	2.4	117.5	0.0	0.0	-54.1	0	5.1	82.8	2.6	23.1	0.0	0.0	6.1	0.2	
23:00:00	-50.4	0	4.7	81.6	1.5	70.6	0.0	0.0	-55.2	0	5.2	74.8	1.0	41.8	0.0	0.0	6.1	0.2	
Maximum	260.4	702	5.2	93.8	3.8	153.2	0.0	0.0	230.0	824	6.1	100.0	3.3	350.4	0.0	0.0	6.4	0.3	
Minimum	-50.4	0	2.9	81.2	1.5	70.6	0.0	0.0	-55.2	0	2.8	64.6	0.5	23.1	0.0	0.0	6.1	0.2	
Average	71.3	212	3.8	87.6	2.6	120.7	0.0	0.0	56.6	305	4.0	90.8	1.5	108.7	0.0	0.0	6.2	0.2	
July 16, 1997																			
Place	Ablation Station							Accumulation Station							Hydro. St.				
	Element	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Net	Glo	AirT	Humid	WSpd	WDir	SurfT	Preci	Disch	w. tem
Unit	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	W/m <sup>2</sup>	W/m <sup>2</sup>	°C	%	m/s	o	°C	mm	m <sup>3</sup> /s	°C	
KST																			
0:00:00	-20.4	0	3.7	89.8	2.8	133.6	0.0	0.0	-36.8	0	5.6	79.2	2.2	49.8	0.0	0.0	6.0	0.2	
1:00:00	12.0	0	4.1	82.9	0.6	122.4	0.0	0.0	10.4	0	4.9	82.1	1.3	262.5	0.0	0.0	6.0	0.2	
2:00:00	13.2	0	4.5	89.7	2.7	114.8	0.0	0.0	12.7	0	5.2	85.4	1.7	323.4	0.0	0.0	6.0	0.2	
3:00:00	21.6	0	4.3	83.4	2.5	123.7	0.0	0.0	12.7	0	4.2	91.7	0.9	335.7	0.0	0.0	6.0	0.2	
4:00:00	19.2	0	4.1	85.4	1.8	146.3	0.0	0.0	18.4	0	4.7	86.6	2.1	18.0	0.0	0.0	6.0	0.2	
5:00:00	15.6	8	4.1	89.3	2.6	135.1	0.0	1.0	15.0	8	4.7	94.3	1.0	211.6	0.0	0.0	6.0	0.2	
6:00:00	27.6	40	4.6	87.0	2.2	143.5	0.0	0.0	19.6	44	3.8	89.1	1.5	146.5	0.0	0.5	6.0	0.2	
7:00:00	36.0	88	4.8	85.7	2.7	112.9	0.0	0.0	34.5	98	5.5	85.6	1.4	111.7	0.0	0.0	6.0	0.2	
8:00:00	64.8	206	4.9	86.1	2.3	103.9	0.0	0.0	54.1	242	5.5	93.3	0.8	260.5	0.0	0.0	6.0	0.2	
9:00:00	121.2	332	5.1	85.7	2.9	151.4	0.0	0.0	93.2	396	5.7	89.8	1.2	308.3	0.0	0.0	6.0	0.3	
10:00:00	141.6	364	4.5	89.6	3.3	111.6	0.0	0.0	107.0	428	5.7	90.9	0.9	41.2	0.0	0.0	6.0	0.3	
11:00:00	154.8	554	4.3	87.6	3.6	138.3	0.0	0.0	107.0	496	4.8	86.7	0.9	93.6	0.0	0.0	6.1	0.3	
12:00:00	214.8	770	5.6	82.5	3.4	124.7	0.0	0.0	119.6	654	5.2	75.6	1.1	84.1	0.0	0.0	6.1	0.3	
13:00:00	294.0	912	5.9	76.6	2.9	125.7	0.0	0.0	205.9	946	7.0	66.9	1.1	38.1	0.0	0.0	6.2	0.3	
14:00:00	292.8	700	5.6	73.9	4.1	121.5	0.0	0.0	220.8	670	7.6	66.8	1.6	131.0	0.0	0.0	6.2	0.4	
15:00:00	202.8	452	5.1	77.1	4.2	110.0	0.0	0.0	161.0	540	5.2	75.5	1.4	151.2	0.0	0.0	6.2	0.3	
16:00:00	201.6	544	5.6	74.6	4.0	139.1	0.0	0.0	157.6	606	6.2	73.8	1.2	76.4	0.0	0.0	6.2	0.3	
17:00:00	170.4	262	6.6	72.8	3.4	131.7	0.0	0.0	138.0	384	6.6	70.8	2.3	23.2	0.0	0.0	6.2	0.3	
18:00:00	98.4	124	5.2	79.8	3.9	124.2	0.0	0.0	86.3	162	6.8	87.4	0.8	143.8	0.0	0.0	6.1	0.3	
19:00:00	62.4	50	4.8	81.8	3.2	129.8	0.0	0.0	57.5	74	4.4	94.6	1.2	111.0	0.0	0.0	6.1	0.3	
20:00:00	44.4	20	5.4	80.8	2.6	132.7	0.0	0.0	36.8	26	5.4	91.3	1.6	128.4	0.0	0.0	6.1	0.3	
21:00:00	28.8	4	5.4	84.6	2.5	127.5	0.0	0.0	26.5	4	4.4	99.1	0.8	72.0	0.0	0.0	6.0	0.2	
22:00:00	25.2	0	5.6	85.4	2.7	109.6	0.0	0.0	13.8	0	4.6	99.4	0.8	113.0	0.0	0.0	5.9	0.2	
23:00:00	30.0	0	5.3	88.3	3.5	130.2	0.0	0.0	2.3	0	4.2	100.0	1.5	112.7	0.0	0.0	5.9	0.2	
Maximum	294.0	912	6.6	89.8	4.2	151.4	0.0	1.0	220.8	946	7.6	100.0	2.3	335.7	0.0	0.5	6.2	0.4	
Minimum	-20.4	0	3.7	72.8	0.6	103.9	0.0	0.0	-36.8	0	3.8	66.8	0.8	18.0	0.0	0.0	5.9	0.2	
Average	94.7	226	5.0	83.4	2.9	126.8	0.0	0.0	69.7	241	5.3	85.7	1.3	139.5	0.0	0.0	6.1	0.3	





Table 3. Wet density profile of snow core retrieved from No. 11 at the Koryto Glacier.

Core No.	Sub No.	From (cm)	To (cm)	Length (cm)	Diameter (cm)	Weight (g)	Volume (cm <sup>3</sup> )	Density (kg/m <sup>3</sup> )
1	1	215.0	227.0	12.0	8.30	359.4	648.9	554
	2	227.0	249.0	22.0	8.14	597.4	1144.3	522
	3	249.0	267.5	18.5	7.65	517.0	849.9	608
	4	267.5	285.0	17.5	8.00	459.8	879.2	523
	5	285.0	300.5	15.5	7.87	418.0	753.6	555
2	1	300.5	320.5	20.0	7.96	471.7	994.8	474
	2	320.5	325.5	5.0	7.96	159.1	248.7	640
	3	325.5	335.5	10.0	7.96	279.9	497.4	563
	4	335.5	351.5	16.0	7.96	453.2	795.8	569
3	1	351.5	369.5	18.0	7.91	515.1	884.1	583
	2	369.5	389.5	20.0	8.04	569.5	1014.9	561
4	1	389.5	404.5	15.0	7.90	439.9	734.9	599
	2	404.5	412.0	7.5	7.88	302.6	365.6	828
5	1	412.0	429.5	17.5	8.12	489.7	905.8	541
	2	429.5	437.0	7.5	8.19	236.7	394.9	599
	3	437.0	451.0	14.0	8.19	374.7	737.2	508
6	1	451.0	469.0	18.0	8.06	537.4	917.9	585
	2	469.0	486.0	17.0	7.81	473.4	814.0	582
7	1	486.0	498.0	12.0	8.00	382.9	602.9	635
	2	498.0	517.5	19.5	8.16	569.1	1019.3	558
8	1	517.5	527.0	9.5	8.11	280.5	490.5	572
9	1	527.0	538.0	11.0	8.21	345.3	582.0	593
	2	538.0	551.0	13.0	8.22	370.0	689.5	537
10	1	551.0	563.0	12.0	7.89	357.7	586.4	610
	2	563.0	573.0	10.0	7.81	320.8	478.8	670
11	1	573.0	588.0	15.0	7.95	456.4	744.2	613
	2	588.0	603.5	15.5	8.11	476.2	800.3	595
	3	603.5	612.0	8.5	7.93	193.5	419.6	461
12	1	612.0	626.0	14.0	7.97	429.6	698.1	615
	2	626.0	635.5	9.5	8.16	279.2	496.6	562
13	1	635.5	650.5	15.0	8.11	473.4	774.5	611
	2	650.5	664.5	14.0	7.93	415.4	691.1	601
14	1	664.5	679.5	15.0	7.84	433.8	723.8	599
	2	679.5	694.5	15.0	7.88	463.2	731.2	634
	3	694.5	705.0	10.5	7.78	320.5	498.9	642
15	1	705.0	719.5	14.5	7.99	415.5	726.7	572
16	1	719.5	734.5	15.0	7.79	438.0	714.6	613
	2	734.5	749.5	15.0	7.76	483.8	709.1	682
	3	749.5	761.5	12.0	7.89	318.3	586.4	543
17	1	761.5	771.5	10.0	7.71	310.3	466.6	665
	2	771.5	783.0	11.5	7.47	331.9	503.7	659
18	1	783.0	798.0	15.0	7.79	419.0	714.6	586
	2	798.0	807.0	9.0	7.78	276.1	427.6	646
19	1	807.0	818.0	11.0	-	-	-	-
	2	818.0	829.0	11.0	6.62	312.2	378.4	825
20	1	829.0	832.5	3.5	7.01	121.5	135.0	900
21	1	832.5	837.5	5.0	-	-	-	-
	2	837.5	847.5	10.0	6.67	308.0	349.2	882

Core No.	Sub No.	From (cm)	To (cm)	Length (cm)	Diameter (cm)	Weight (g)	Volume (cm <sup>3</sup> )	Density (kg/m <sup>3</sup> )
	3	847.5	857.5	10.0	7.66	299.3	460.6	650
22	1	857.5	871.0	13.5	7.58	513.4	608.9	843
23	1	871.0	881.0	10.0	7.61	407.1	454.6	895
	2	881.0	893.5	12.5	7.61	477.1	568.3	840
24	1	893.5	903.5	10.0	7.56	408.4	448.7	910
	2	903.5	912.0	8.5	-	-	-	-
25	1	912.0	923.5	11.5	7.83	453.6	553.5	820
	2	923.5	931.0	7.5	7.75	307.5	353.6	870
26	1	931.0	941.0	10.0	7.66	390.5	460.6	848
	2	941.0	949.5	8.5	7.68	334.0	393.6	849
27	1	949.5	959.5	10.0	7.68	397.7	463.0	859
	2	959.5	966.5	7.0	7.69	280.4	325.0	863
28	1	966.5	976.5	10.0	7.76	405.4	472.7	858
	2	976.5	982.5	6.0	7.67	242.4	277.1	875
29	1	982.5	999.5	17.0	-	-	-	-
30	1	999.5	1016.5	17.0	7.65	693.9	781.0	888
31	1	1016.5	1028.5	12.0	7.64	484.5	549.8	881
	2	1028.5	1045.5	17.0	-	-	-	-
32	1	1045.5	1075.5	30.0	7.70	1211.0	1396.3	867
33	1	1075.5	1082.5	7.0	-	-	-	-
	2	1082.5	1108.5	26.0	7.74	1074.7	1222.7	879
34	1	1108.5	1135.0	26.5	7.78	1110.0	1259.1	882
35	1	1135.0	1160.5	25.5	7.74	1072.5	1199.2	894
36	1	1160.5	1179.0	18.5	7.74	747.5	870.0	859
37	1	1179.0	1198.5	19.5	-	-	-	-
38	1	1198.5	1209.5	11.0	7.78	467.0	522.7	894
	2	1209.5	1229.0	19.5	7.68	809.5	902.9	897
39	1	1229.0	1253.5	24.5	7.75	993.9	1155.2	860
40	1	1253.5	1288.5	35.0	7.69	1456.7	1624.8	897

Table 4. Wet density profile of snow core retrieved from No. 16 at the Koryto Glacier.

Core No.	Sub No.	From (cm)	To (cm)	Length (cm)	Diameter (cm)	Weight (g)	Volume (cm <sup>3</sup> )	Density (kg/m <sup>3</sup> )
1	1	135.0	145.7	10.7	8.08	299.3	548.4	546
	2	145.7	166.2	20.5	7.85	583.2	991.7	588
	3	166.2	188.6	22.4	8.08	602.2	1148.0	525
	4	188.6	206.3	17.7	7.85	494.8	856.2	578
	5	206.3	225.5	19.2	7.91	469.4	943.0	498
2	1	225.5	245.5	20.0	7.82	484.0	960.1	504
	2	245.5	259.5	14.0	7.99	416.0	701.6	593
	3	259.5	275.5	16.0	7.67	502.8	738.9	680
3	1	275.5	290.5	15.0	7.87	476.8	729.3	654
	2	290.5	301.0	10.5	8.09	295.3	539.5	547
	3	301.0	322.5	21.5	7.84	578.6	1037.4	558
4	1	322.5	337.5	15.0	8.03	442.9	759.3	583
	2	337.5	352.5	15.0	7.77	424.2	710.9	597
	3	352.5	367.0	14.5	7.65	377.7	666.1	567
5	1	367.0	382.0	15.0	7.99	428.2	751.7	570
	2	382.0	399.5	17.5	7.86	498.7	848.7	588
6	1	399.5	411.3	11.8	7.88	323.3	575.2	562
	2	411.3	432.5	21.2	7.72	580.0	991.8	585
	3	432.5	434.5	2.0	7.69	75.6	92.8	814
7	1	434.5	449.5	15.0	8.03	438.6	759.3	578
	2	449.5	466.0	16.5	7.65	466.9	758.0	616
8	1	466.0	481.0	15.0	7.64	447.8	687.3	652
	2	481.0	496.5	15.5	7.23	439.6	636.0	691
9	1	496.5	511.5	15.0	8.08	419.7	768.7	546
	2	511.5	526.0	14.5	7.92	399.2	714.0	559
10	1	526.0	545.5	19.5	7.91	569.6	957.8	595
11	1	545.5	560.5	15.0	7.96	458.3	746.1	614
	2	560.5	580.0	19.5	7.97	565.9	972.3	582
12	1	580.0	595.0	15.0	7.84	458.1	723.8	633
	2	595.0	613.0	18.0	7.68	508.0	833.4	610
13	1	613.0	628.0	15.0	7.79	452.0	714.6	633
	2	628.0	647.5	19.5	7.65	569.2	895.8	635
14	1	647.5	662.5	15.0	8.02	451.2	757.4	596
	2	662.5	679.5	17.0	7.89	493.8	830.8	594
15	1	679.5	699.5	20.0	8.05	597.5	1017.4	587
16	1	699.5	714.5	15.0	7.88	441.7	731.2	604
	2	714.5	723.0	8.5	7.95	253.1	421.7	600
17	1	723.0	736.5	13.5	7.96	423.6	671.5	631
18	1	736.5	751.5	15.0	7.88	442.7	731.2	605
	2	751.5	766.5	15.0	7.95	462.9	744.2	622
	3	766.5	783.0	16.5	7.95	481.3	818.6	588
19	1	783.0	798.0	15.0	8.06	485.1	764.9	634
	2	798.0	802.0	4.0	8.06	171.9	204.0	843
	3	802.0	816.0	14.0	7.98	374.3	699.8	535
	4	816.0	834.0	18.0	7.78	573.7	855.3	671

Core No.	Sub No.	From (cm)	To (cm)	Length (cm)	Diameter (cm)	Weight (g)	Volume (cm <sup>3</sup> )	Density (kg/m <sup>3</sup> )
20	1	834.0	849.0	15.0	7.79	465.8	714.6	652
	2	849.0	862.0	13.0	7.75	404.9	612.9	661
21	1	862.0	877.0	15.0	7.99	454.1	751.7	604
	2	877.0	896.5	19.5	7.59	579.6	881.8	657
22	1	896.5	912.0	15.5	7.97	451.8	772.9	585
	2	912.0	917.0	5.0	8.19	182.4	263.3	693
23	1	917.0	932.0	15.0	7.59	492.7	678.3	726
	2	932.0	944.0	12.0	7.67	337.2	554.2	608
24	1	944.0	961.0	17.0	7.87	537.2	826.5	650
	2	961.0	978.0	17.0	7.79	496.2	809.8	613
25	1	978.0	993.0	15.0	7.84	472.2	723.8	652
	2	993.0	1006.0	13.0	7.97	369.4	648.2	570
26	1	1006.0	1025.0	19.0	8.03	519.6	961.7	540
27	1	1025.0	1040.0	15.0	7.91	430.7	736.7	585
	2	1040.0	1055.0	15.0	7.78	431.5	712.7	605
28	1	1055.0	1064.5	9.5	7.87	339.7	461.9	735
	2	1064.5	1082.0	17.5	7.75	520.3	825.1	631
29	1	1082.0	1099.0	17.0	7.88	477.6	828.6	576
30	1	1099.0	1117.0	18.0	7.67	510.9	831.3	615
	2	1117.0	1130.0	13.0	7.70	392.4	605.1	649
31	1	1130.0	1145.0	15.0	7.93	416.2	740.5	562
	2	1145.0	1164.0	19.0	7.99	548.8	952.2	576
32	1	1164.0	1179.5	15.5	8.00	459.9	778.7	591
	2	1179.5	1193.5	14.0	7.56	413.0	628.1	658
33	1	1193.5	1196.1	2.6	7.71	82.1	121.3	677
	2	1196.1	1208.1	12.0	7.50	442.3	529.9	835
	3	1208.1	1221.1	13.0	7.61	467.4	591.0	791
34	1	1221.1	1234.1	13.0	7.68	433.6	601.9	720
	2	1234.1	1247.6	13.5	7.73	396.5	633.2	626
35	1	1247.6	1263.6	16.0	7.42	508.8	691.5	736
	2	1263.6	1279.1	15.5	7.68	499.7	717.7	696
36	1	1279.1	1294.1	15.0	7.62	504.1	683.7	737
	2	1294.1	1299.6	5.5	7.68	149.8	254.7	588
37	1	1299.6	1310.1	10.5	7.53	288.1	467.4	616
38	1	1310.1	1325.1	15.0	7.70	483.3	698.1	692
	2	1325.1	1340.1	15.0	7.69	491.9	696.3	706
	3	1340.1	1355.1	15.0	7.60	443.8	680.1	653
39	1	1355.1	1366.1	11.0	7.53	359.7	489.6	735
	2	1366.1	1372.6	6.5	7.82	237.4	312.0	761
40	1	1372.6	1392.6	20.0	7.55	607.4	894.9	679
41	1	1392.6	1395.6	3.0	7.32	94.8	126.2	751
42	1	1395.6	1410.6	15.0	7.82	438.4	720.1	609
	2	1410.6	1423.6	13.0	7.85	396.1	628.9	630
	3	1423.6	1433.6	10.0	7.45	278.9	435.7	640
	4	1433.6	1449.6	16.0	7.53	477.3	712.2	670

Core No.	Sub No.	From (cm)	To (cm)	Length (cm)	Diameter (cm)	Weight (g)	Volume (cm <sup>3</sup> )	Density (kg/m <sup>3</sup> )
	5	1449.6	1453.6	4.0	7.53	160.7	178.0	903
43	1	1453.6	1471.6	18.0	7.63	566.0	822.6	688
44	1	1471.6	1485.1	13.5	7.80	557.6	644.8	865
	2	1485.1	1496.6	11.5	7.75	244.0	542.2	450
45	1	1496.6	1510.6	14.0	7.77	458.1	663.5	690
	2	1510.6	1525.1	14.5	7.59	494.5	655.7	754
46	1	1525.1	1535.6	10.5	7.66	407.6	483.6	843
	2	1535.6	1545.1	9.5	7.79	362.6	452.6	801
	3	1545.1	1557.1	12.0	7.73	386.4	562.9	686
47	1	1557.1	1572.1	15.0	7.56	566.6	673.0	842
	2	1572.1	1587.1	15.0	7.77	532.2	710.9	749
48	1	1587.1	1602.1	15.0	7.50	510.4	662.3	771
	2	1602.1	1618.1	16.0	7.45	478.1	697.1	686
49	1	1618.1	1633.1	15.0	7.70	536.3	698.1	768
	2	1633.1	1645.1	12.0	7.67	366.5	554.2	661
50	1	1645.1	1660.1	15.0	7.77	537.0	710.9	755
	2	1660.1	1674.1	14.0	7.74	435.1	658.4	661
51	1	1674.1	1689.1	15.0	7.80	509.5	716.4	711
	2	1689.1	1700.6	11.5	7.72	382.0	538.0	710
52	1	1700.6	1715.6	15.0	7.75	535.0	707.2	756
	2	1715.6	1728.6	13.0	7.66	416.6	598.8	696
53	1	1728.6	1743.6	15.0	7.90	537.7	734.9	732
	2	1743.6	1754.1	10.5	7.72	352.5	491.2	718
54	1	1754.1	1769.1	15.0	7.54	555.3	669.4	830
	2	1769.1	1785.1	16.0	7.72	563.3	748.6	753
55	1	1785.1	1791.1	6.0	-	-	-	-
	2	1791.1	1805.1	14.0	7.95	489.2	694.6	704
	3	1805.1	1821.1	16.0	7.85	498.8	774.0	644
56	1	1821.1	1839.1	18.0	7.84	584.8	868.5	673
57	1	1839.1	1854.1	15.0	7.72	597.4	701.8	851
	2	1854.1	1866.6	12.5	7.38	410.6	534.4	768
58	1	1866.6	1870.1	3.5	-	-	-	-
	2	1870.1	1884.1	14.0	7.86	481.6	679.0	709
59	1	1884.1	1899.1	15.0	7.69	552.3	696.3	793
	2	1899.1	1912.6	13.5	7.73	508.5	633.2	803
60	1	1912.6	1917.1	4.5	7.79	187.0	214.4	872
	2	1917.1	1929.6	12.5	7.65	447.8	574.3	780
	3	1929.6	1944.6	15.0	7.73	435.3	703.6	619
61	1	1944.6	1956.6	12.0	7.91	426.0	589.4	723
	2	1956.6	1967.1	10.5	7.90	459.9	514.4	894
62	1	1967.1	1977.6	10.5	7.78	379.9	498.9	761
	2	1977.6	1990.1	12.5	7.67	441.4	577.3	765
63	1	1990.1	2004.1	14.0	7.68	480.1	648.2	741
	2	2004.1	2018.1	14.0	7.65	498.4	643.2	775
64	1	2018.1	2031.1	13.0	7.91	481.7	638.5	754

Core No.	Sub No.	From (cm)	To (cm)	Length (cm)	Diameter (cm)	Weight (g)	Volume (cm <sup>3</sup> )	Density (kg/m <sup>3</sup> )
65	2	2031.1	2043.1	12.0	7.74	400.0	564.3	709
	1	2043.1	2053.1	10.0	7.62	406.4	455.8	892
66	2	2053.1	2066.1	13.0	7.70	382.7	605.1	633
	1	2066.1	2081.1	15.0	7.81	541.6	718.2	754
67	2	2081.1	2091.1	10.0	7.83	383.1	481.3	796
	3	2091.1	2103.6	12.5	7.64	399.1	572.8	697
	1	2103.6	2119.1	15.5	7.74	526.8	728.9	723
68	1	2119.1	2134.1	15.0	7.65	541.0	689.1	785
69	2	2134.1	2147.1	13.0	7.71	429.3	606.6	708
	1	2147.1	2159.1	12.0	7.66	436.8	552.7	790
70	2	2159.1	2171.6	12.5	7.70	394.1	581.8	677
	1	2171.6	2181.6	10.0	-	-	-	-
	2	2181.6	2196.1	14.5	7.79	460.6	690.7	667

**Table 5.** Changes in snow surface (cm in snow height) at the Koryto Glacier.

Stake No.	Change in snow surface from previous measurements (cm in height)													Total
	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul		
1	0.0	-6.0		-7.8	-13.4	-9.2	-6.8	-5.9	-9.3	-9.8	-2.7	-17.8	-88.7	
2	0.0	-9.7	-4.8	-9.2	-13.2	-9.5	-5.7	-6.3	-10.1	-11.8	-0.1	-17.7	-98.1	
2B	0.0	-10.2	-5.7	-10.5	-12.8	-10.3	-5.7	-6.1	-7.9	-11.3		-26.3	-106.8	
3	0.0	-7.8	-6.5	-7.0	-12.3	-11.7	999	-6.0	-10.0	-9.7	-4.2	-20.2	-	
4	0.0	-7.9	-4.8	-6.3	-10.2	-8.2	-4.6	-4.5	-6.7	-10.7	-4.6	-17.6	-86.1	
5	0.0	-7.7	-5.9	-6.1	-9.3	-9.3	-5.7	-4.3	-7.4	-10.1	-4.7	-20.0	-90.5	
6	0.0	-8.5	-7.5	-3.5	-9.4	-9.0			-17.1	-10.8	-3.4	-21.2	-90.4	
7	0.0	-6.2	-5.6	-3.8	-10.0	-7.4			-14.7	-8.7	-2.3	-16.5	-75.2	
8	0.0	-6.3		-8.5	-9.8	-7.2			999	-11.2		-24.1	-	
9		0.0		-10.1	-9.5	-8.0			-16.1	-11.4		-21.8	-76.9	
10		0.0			-18.2	-6.8			-14.7	-12.2		-20.1	-72.0	
11				0.0	-8.4	-7.0			-15.2	-13.0		-25.0	-68.6	
11A				0.0	-8.5	-8.3			-15.2	-12.7		-23.5	-68.2	
11B				0.0	-8.2	-8.0			-12.8	-12.0		-24.5	-65.5	
11C				0.0	-9.1	-8.7			-14.5	-10.9		-25.7	-68.9	
11D				0.0	-8.5	-7.6			-14.8	-11.9		-21.6	-64.4	
12		0.0			-19.3	-6.6			-15.5	-11.7		-21.2	-74.3	
13		0.0			-19.0	-7.7			-16.0	-10.1		-23.1	-75.9	
14		0.0			-17.7	-8.0			-16.7	-10.8		-20.0	-73.2	
15		0.0			-17.2	-7.1			-15.2	-11.5		-18.1	-69.1	
16		0.0			-15.8	-8.2			-15.3	-10.4		-14.2	-63.9	
17		0.0		-17.7			-19.3			-18.2		-16.9	-72.1	

\*The value of 999 means a break of measurement

**Table 6.** Changes in snow surface (cm in snow height) at the Ushkovsky Ice Cap.

Stake No.	Change in snow surface from previous measurements (cm in height)					Total
	25-Jul	27-Jul	29-Jul	1-Aug.	2-Aug.	
1	0	0.9	0.7	24.2	4.7	30.5
2	0	0.2	999	13.0	2.4	-
3	0	0.5	2.1	999	0.8	-
4	0	0.8	999	20.4	1.7	-
5	0	0.7	4.6	999	5.9	-
6	0	1.0	2.0	31.7	8.6	43.3
7	0	0.0	10.9	27.5	13.7	52.1
8	0	0.6	999	29.0	3.1	-
9	0	0.5	1.6	999	8.4	-
10	0	1.4	3.0	16.4	5.8	26.6
11	0	-0.7	4.3	23.9	10.0	37.5
12	0	-1.1	9.1	23.5	6.7	38.2
13	0	0.0	5.3	23.0	8.2	36.5
14	0	2.0	9.8	25.6	4.6	42.0
15	0	0.0	3.0	999	999	-
16	0	1.5	3.6	999	999	-
17	0	0.9	4.2	999	999	-
18	0	0.8	8.8	999	999	-
19	0	2.9	2.8	999	999	-

\*The value of 999 means a break of measurement

**Table 7.** Flow of the Koryto Glacier in the upper line. Positive and negative values of the vertical velocities denote the emergence and submergence velocities.

Survey Pole	Flow velocity (m/day)	
	Horizontal	Vertical
1	-0.04	0.04
2	-0.03	-0.04
3	0.10	-0.01
4	0.10	0.03
5	0.17	-0.07
6	0.16	-0.01
7	0.15	0.02
8	0.09	-0.01
9	0.09	-0.01
10	0.05	-0.02
11	0.04	-0.01

\* Poles Nos. 1 & 2 flowed upglacier

**Table 8.** Flow of the Koryto Glacier in the lower line. Positive and negative values of the vertical velocities denote the emergence and submergence velocities.

Survey Pole	Flow velocity (m/day)	
	Horizontal	Vertical
1	0.00	0.01
2	0.04	-0.02
3	0.08	-0.01
4	0.19	-0.01
5	0.21	-0.02
6	0.22	-0.02
7	0.22	-0.01
8	0.23	-0.01
9	0.22	-0.01
10	0.20	0.00
11	0.16	0.03
12	0.15	0.00
13	0.01	-0.02

Table 9. Density profile of snow core retrieved from the Ushkovsky Ice Cap.

Core No.	Sub No.	From (cm)	To (cm)	Length (cm)	Diameter (cm)	Weight (g)	Volume (cm <sup>3</sup> )	Density (kg/m <sup>3</sup> )
Pit	1	0.0	11.0	11.0				237
	2	11.0	17.0	6.0				237
	3	17.0	31.0	14.0				237
	4	31.0	32.0	1.0				900
	5	32.0	42.5	10.5				296
	6	42.5	86.0	43.5				466
	7	86.0	90.0	4.0				900
	8	90.0	160.0	70.0				313
	9	160.0	160.5	0.5				900
	10	160.5	180.0	19.5				381
	11	180.0	207.0	27.0				381
1	1	207.0	227.0	20.0	7.25	325.3	825	394
	2	227.0	242.0	15.0	7.17	269.0	605	444
	3	242.0	252.0	10.0	6.69	150.6	351	429
2	1	252.0	258.0	6.0	6.63	130.8	207	632
	2	258.0	264.0	6.0	7.18	135.0	243	556
	3	264.0	278.0	14.0	7.29	313.7	584	537
	4	278.0	288.0	10.0	7.46	233.5	437	534
	5	288.0	303.0	15.0	7.39	185.8	643	289
3	1	303.0	312.0	9.0	7.56	344.7	404	854
	2	312.0	328.0	16.0	7.66	423.0	737	574
4	1	328.0	338.5	10.5	7.46	334.9	459	730
	2	338.5	353.0	14.5	7.58	299.1	654	457
	3	353.0	368.0	15.0	7.82	343.9	720	478
	4	368.0	377.0	9.0	7.55	141.5	403	351
	5	377.0	385.0	8.0	7.11	94.2	317	297
5	1	385.0	395.0	10.0	7.53	242.2	445	544
	2	395.0	410.0	15.0	7.43	326.3	650	502
	3	410.0	425.0	15.0	7.47	284.8	657	433
	4	425.0	435.0	10.0	7.59	243.4	452	538
6	1	435.0	450.0	15.0	7.48	311.9	659	473
	2	450.0	465.0	15.0	7.55	338.9	671	505
	3	465.0	481.0	16.0	7.74	357.0	752	474
7	1	481.0	497.0	16.0	7.60	510.7	725	704
	2	497.0	511.0	14.0	7.50	314.6	618	509
	3	511.0	528.5	17.5	7.64	374.8	802	467
8	1	528.5	543.5	15.0	7.49	297.7	661	451
	2	543.5	557.0	13.5	7.53	322.4	601	537
	3	557.0	565.5	8.5	7.62	226.8	387	585
9	1	565.5	581.5	16.0	7.59	440.1	724	608
	2	581.5	599.5	18.0	7.55	349.7	805	434
10	1	599.5	614.5	15.0	7.53	274.4	668	411
	2	614.5	629.5	15.0	7.52	265.9	666	399
	3	629.5	644.5	15.0	7.62	323.4	684	473
	4	644.5	661.5	17.0	7.34	333.2	719	463

Core No.	Sub No.	From (cm)	To (cm)	Length (cm)	Diameter (cm)	Weight (g)	Volume (cm <sup>3</sup> )	Density (kg/m <sup>3</sup> )
11	1	661.5	670.5	9.0	7.79	241.3	429	563
	2	670.5	681.5	11.0	7.58	176.3	496	355
	3	681.5	697.5	16.0	7.20	254.5	651	391
12	1	697.5	709.5	12.0	7.65	411.9	551	747
	2	709.5	721.5	12.0	7.51	255.1	531	480
	3	721.5	734.0	12.5	7.41	257.4	539	478
13	1	734.0	745.0	11.0	7.41	215.4	474	454
	2	745.0	758.0	13.0	-	-	-	-
14	1	758.0	769.5	11.5	7.75	452.1	542	834
15	1	769.5	779.5	10.0	7.72	407.9	468	872
	2	779.5	797.5	18.0	7.41	329.0	776	424
	3	797.5	816.5	19.0	7.60	488.2	861	567
16	1	816.5	831.5	15.0	7.51	424.3	664	639
	2	831.5	842.0	10.5	7.68	231.5	486	476
17	1	842.0	857.0	15.0	7.66	396.4	691	574
	2	857.0	869.0	12.0	7.67	294.5	554	531
	3	869.0	881.0	12.0	7.87	302.5	583	518
18	1	881.0	896.0	15.0	7.68	403.5	695	581
	2	896.0	911.0	15.0	7.73	379.9	704	540
	3	911.0	918.5	7.5	7.71	178.3	350	509
19	1	918.5	933.5	15.0	7.75	354.5	707	501
	2	933.5	948.5	15.0	7.70	355.5	698	509
	3	948.5	962.0	13.5	7.69	300.5	627	479
20	1	962.0	976.5	14.5	7.71	356.1	677	526
	2	976.5	989.0	12.5	7.77	421.0	592	711
21	1	989.0	1000.0	11.0	7.70	298.4	512	583
	2	1000.0	1019.5	19.5	7.79	562.7	929	606
22	1	1019.5	1034.5	15.0	7.65	359.9	689	522
	2	1034.5	1051.5	17.0	7.71	541.9	793	683
23	1	1051.5	1066.5	15.0	7.75	398.8	707	564
	2	1066.5	1079.0	12.5	7.75	312.3	589	530
24	1	1079.0	1086.5	7.5	7.53	270.1	334	809
25	1	1086.5	1098.5	12.0	7.63	473.9	548	864
	2	1098.5	1109.5	11.0	-	-	-	-
	3	1109.5	1121.5	12.0	7.66	463.3	553	838
26	1	1121.5	1136.5	15.0	7.77	396.5	711	558
	2	1136.5	1151.5	15.0	7.59	390.6	678	576
	3	1151.5	1166.5	15.0	7.62	389.7	684	570
	4	1166.5	1180.5	14.0	7.61	335.8	636	528
27	1	1180.5	1194.0	13.5	7.59	352.9	611	578
	2	1194.0	1205.5	11.5	7.60	423.8	521	813
28	1	1205.5	1213.5	8.0	7.46	273.8	349	783
	2	1213.5	1228.5	15.0	7.52	405.6	666	609
	3	1228.5	1240.5	12.0	7.58	395.9	541	731
	4	1240.5	1252.0	11.5	7.58	327.5	519	631

Core No.	Sub No.	From (cm)	To (cm)	Length (cm)	Diameter (cm)	Weight (g)	Volume (cm <sup>3</sup> )	Density (kg/m <sup>3</sup> )
29	1	1252.0	1268.0	16.0	7.58	486.1	722	674
	2	1268.0	1282.0	14.0	7.56	453.1	628	721
	3	1282.0	1295.0	13.0	7.66	506.8	599	846
	4	1295.0	1306.0	11.0	7.64	287.8	504	571
30	1	1306.0	1319.5	13.5	7.52	367.4	599	613
	2	1319.5	1331.0	11.5	7.58	418.3	519	806
	3	1331.0	1343.0	12.0	7.55	337.3	537	628
31	1	1343.0	1358.0	15.0	7.56	412.2	673	612
	2	1358.0	1373.0	15.0	7.60	492.8	680	725
	3	1373.0	1385.0	12.0	7.53	326.6	534	611
32	1	1385.0	1401.0	16.0	7.68	566.2	741	764
	2	1401.0	1413.0	12.0	7.65	340.7	551	618
	3	1413.0	1425.5	12.5	7.66	341.3	576	593
33	1	1425.5	1431.5	6.0	7.13	149.5	239	624
	2	1431.5	1447.5	16.0	7.21	323.1	653	495
	3	1447.5	1465.5	18.0	6.61	355.4	617	576
34	1	1465.5	1480.0	14.5	6.62	312.4	499	626
	2	1480.0	1493.5	13.5	6.55	283.0	455	622
35	1	1493.5	1508.5	15.0	7.02	285.2	580	491
	2	1508.5	1531.5	23.0	6.55	475.3	775	614
36	1	1531.5	1552.5	21.0	6.59	472.0	716	659
37	1	1552.5	1567.5	15.0	6.50	293.3	497	590
	2	1567.5	1582.5	15.0	6.69	309.7	527	588
	3	1582.5	1594.5	12.0	6.56	240.5	405	593
	4	1594.5	1606.5	12.0	6.67	220.3	419	526
38	1	1606.5	1619.5	13.0	7.63	377.3	594	635
	2	1619.5	1634.5	15.0	7.64	440.9	687	641
39	1	1634.5	1649.5	15.0	7.59	446.4	678	658
	2	1649.5	1661.5	12.0	7.61	348.6	546	639
	3	1661.5	1673.5	12.0	7.61	347.1	546	636
40	1	1673.5	1688.5	15.0	7.60	452.9	680	666
	2	1688.5	1703.5	15.0	7.62	448.7	684	656
	3	1703.5	1715.5	12.0	7.74	381.0	564	675
41	1	1715.5	1730.5	15.0	7.62	446.8	684	653
	2	1730.5	1742.5	12.0	7.66	378.0	553	684
	3	1742.5	1753.5	11.0	7.66	287.1	507	567
42	1	1753.5	1768.5	15.0	7.65	428.6	689	622
	2	1768.5	1780.5	12.0	7.66	344.3	553	623
	3	1780.5	1792.5	12.0	7.64	340.7	550	620
43	1	1792.5	1807.5	15.0	7.70	435.4	698	624
	2	1807.5	1819.5	12.0	7.75	355.5	566	628
	3	1819.5	1832.0	12.5	7.74	374.1	588	636
44	1	1832.0	1844.0	12.0	7.59	361.9	543	667
	2	1844.0	1854.0	10.0	7.62	319.6	456	701
	3	1854.0	1862.0	8.0	7.61	260.6	364	717

Core No.	Sub No.	From (cm)	To (cm)	Length (cm)	Diameter (cm)	Weight (g)	Volume (cm <sup>3</sup> )	Density (kg/m <sup>3</sup> )
45	1	1862.0	1877.0	15.0	7.60	496.5	680	730
	2	1877.0	1892.0	15.0	7.66	448.2	691	649
	3	1892.0	1905.0	13.0	7.67	375.8	600	626
46	1	1905.0	1917.0	12.0	7.64	370.5	550	674
	2	1917.0	1929.0	12.0	7.73	381.2	563	677
	3	1929.0	1943.0	14.0	7.68	413.7	648	638
47	1	1943.0	1958.0	15.0	7.64	444.0	687	646
	2	1958.0	1969.0	11.0	7.65	359.3	505	711
	3	1969.0	1981.0	12.0	7.68	376.4	556	677
48	1	1981.0	1996.0	15.0	7.62	451.8	684	661
	2	1996.0	2011.0	15.0	7.72	456.6	702	651
	3	2011.0	2018.5	7.5	7.75	234.9	354	664
49	1	2018.5	2033.5	15.0	7.75	439.9	707	622
	2	2033.5	2047.5	14.0	7.77	431.4	663	650
	3	2047.5	2059.0	11.5	7.75	326.6	542	602
50	1	2059.0	2071.0	12.0	7.72	362.1	561	645
	2	2071.0	2083.0	12.0	7.75	362.8	566	641
	3	2083.0	2096.0	13.0	7.75	383.2	613	625
51	1	2096.0	2104.5	8.5	7.35	195.5	360	542
	2	2104.5	2116.0	11.5	7.33	247.9	485	511
	3	2116.0	2126.0	10.0	7.69	301.3	464	649
	4	2126.0	2135.5	9.5	7.72	261.7	444	589
52	1	2135.5	2140.5	5.0	7.73	146.8	235	626
	2	2140.5	2150.0	9.5	7.77	275.4	450	612
	3	2150.0	2158.5	8.5	7.72	313.5	398	788
	4	2158.5	2173.5	15.0	7.78	423.3	713	594
53	1	2173.5	2183.5	10.0	7.76	282.9	473	598
	2	2183.5	2195.0	11.5	7.79	361.1	548	659
	3	2195.0	2202.5	7.5	7.71	247.8	350	708
	4	2202.5	2207.5	5.0	7.64	114.3	229	499
54	1	2207.5	2224.0	16.5	7.73	647.1	774	836
	2	2224.0	2237.0	13.0	7.75	366.7	613	598
	3	2237.0	2245.5	8.5	7.73	316.1	399	793
	4	2245.5	2256.5	11.0	7.70	309.7	512	605
55	1	2256.5	2265.5	9.0	7.72	285.5	421	678
	2	2265.5	2273.0	7.5	7.73	234.9	352	668
	3	2273.0	2279.5	6.5	7.71	194.7	303	642
	4	2279.5	2286.0	6.5	7.71	260.8	303	860
56	1	2286.0	2291.5	5.5	7.77	175.9	261	675
	2	2291.5	2301.0	9.5	7.73	398.1	446	893
	3	2301.0	2312.5	11.5	7.73	333.4	539	618
	4	2312.5	2319.0	6.5	7.80	215.5	310	694
	5	2319.0	2326.0	7.0	7.75	210.5	330	638
57	1	2326.0	2336.0	10.0	7.76	274.2	473	580
	2	2336.0	2346.0	10.0	7.74	303.4	470	645

Core No.	Sub No.	From (cm)	To (cm)	Length (cm)	Diameter (cm)	Weight (g)	Volume (cm <sup>3</sup> )	Density (kg/m <sup>3</sup> )
58	3	2346.0	2356.0	10.0	7.74	300.6	470	639
	4	2356.0	2363.5	7.5	7.75	210.0	354	594
	1	2363.5	2373.5	10.0	7.81	319.3	479	667
	2	2373.5	2383.5	10.0	7.77	305.7	474	645
	3	2383.5	2393.5	10.0	7.74	320.9	470	682
59	4	2393.5	2401.0	7.5	7.73	218.5	352	621
	1	2401.0	2411.0	10.0	7.78	295.0	475	621
	2	2411.0	2421.0	10.0	7.74	306.0	470	651
	3	2421.0	2431.0	10.0	7.74	378.6	470	805
60	4	2431.0	2438.0	7.0	7.77	198.9	332	600
	1	2438.0	2448.0	10.0	7.72	310.5	468	664
	2	2448.0	2458.0	10.0	7.73	293.0	469	625
	3	2458.0	2468.0	10.0	7.72	311.8	468	666
61	4	2468.0	2474.5	6.5	7.78	216.7	309	702
	1	2474.5	2484.5	10.0	7.75	339.5	471	720
	2	2484.5	2489.5	5.0	7.71	204.6	233	877
	3	2489.5	2501.5	12.0	7.70	393.3	559	704
62	4	2501.5	2509.0	7.5	7.71	229.7	350	656
	1	2509.0	2519.0	10.0	7.65	364.9	459	794
	2	2519.0	2529.0	10.0	7.72	356.2	468	761
	3	2529.0	2536.0	7.0	7.78	219.9	333	661
63	4	2536.0	2548.0	12.0	7.72	449.2	561	800
	1	2548.0	2558.0	10.0	7.74	276.0	470	587
	2	2558.0	2570.0	12.0	7.69	421.2	557	756
	3	2570.0	2577.0	7.0	7.73	220.3	328	671
64	4	2577.0	2584.5	7.5	7.71	258.7	350	739
	1	2584.5	2593.5	9.0	7.72	264.4	421	628
	2	2593.5	2601.5	8.0	7.72	262.6	374	702
	3	2601.5	2609.5	8.0	7.73	239.3	375	638
65	4	2609.5	2618.0	8.5	7.67	274.9	393	700
	1	2618.0	2626.0	8.0	-	-	-	-
	2	2626.0	2637.5	11.5	7.73	378.7	539	702
	3	2637.5	2646.0	8.5	7.75	258.0	401	644
66	4	2646.0	2657.0	11.0	7.78	352.7	523	675
	1	2657.0	2663.0	6.0	7.69	182.5	279	655
	2	2663.0	2671.0	8.0	7.71	298.2	373	799
	3	2671.0	2682.0	11.0	7.74	344.3	517	666
67	4	2682.0	2694.5	12.5	7.75	386.8	589	656
	1	2694.5	2703.5	9.0	7.70	301.3	419	719
	2	2703.5	2713.5	10.0	7.75	353.3	471	749
	3	2713.5	2722.5	9.0	7.74	288.5	423	682
68	4	2722.5	2734.5	12.0	7.76	469.7	567	828
	1	2734.5	2744.5	10.0	7.74	336.3	470	715
	2	2744.5	2754.5	10.0	7.76	322.3	473	682
	3	2754.5	2766.5	12.0	7.72	384.8	561	685

**Table 10.** Snow temperature profiles in the Ushkovsky Ice Cap both in 1996 and 1986.

Depth below surface (cm)	Snow Temperature (°C)	
	1996	1986
20	-7.1	
30		-3.6
60		-10.6
90		-13.0
120		-14.5
150		-14.0
180		-14.7
200	-9.7	
210		-14.0
240		-12.0
270		-14.5
300		-15.0
330		-17.0
360		-16.2
390		-18.0
400	-16.4	
420		-18.6
450		-18.2
480		-18.2
510		-18.0
600	-16.8	
710		-18.0
800	-16.6	
1000	-16.1	
1070		-16.5
1108		-16.4
1320		-16.0
2100	-15.0	