Nuuk Ecological Research Operation

ClimateBasic

Manual

ASIAQ

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Contents

Foreword

The ClimateBasic monitoring program in Nuuk is part of Nuuk Ecological Research Operation (NERO).

The ClimateBasis monitoring program includes measuring, collection, quality control and communication of data, which describes the climate and hydrology in the low arctic ecosystem of Kobbefjord. The program runs two automatic climate stations (C1 and C2), two hydrometric stations (H1 and H2) and three diver stations (H3, H4, and H5). This manual describes in detail the monitoring sites and the measured parameters.

Asiaq - Greenland Survey is responsible for the operation of ClimateBasis.
The Danish Energy Agency finances the ClimateBasis monitoring program.

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1 Site Descriptions

This section describes the monitoring sites related to the ClimateBasic monitoring program. The climate monitoring program has been steadily developed since the first measurements in 2006 and by 2009 seven locations in Kobbefjord are included as monitoring sites for climate and hydrology, see Figure 1.1

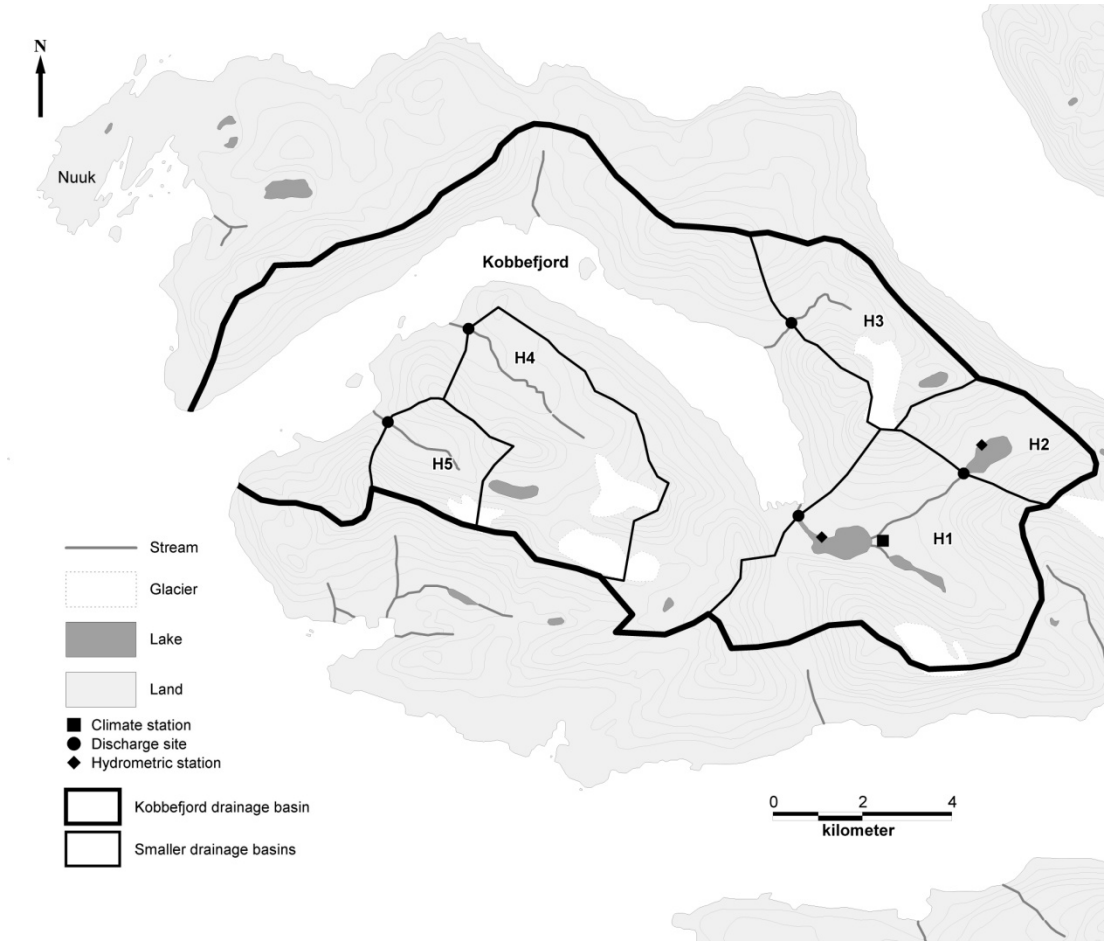

Figure 1.1 Map of ClimateBasic measuring sites in Kobbefjord.

Kobbefjord drainage basin consists of numerous smaller drainage basins. Two climate stations are located on the south-eastern shore of the lake Kangerluarsunnguup Tasia in drainage basin H1, which is the largest drainage basin in Kobbefjord. The hydrological monitoring consists of two permanent hydrometric stations located in drainage basin H1 and its sub-basin H2. These are measuring year round. Three smaller stations, called diver stations, are temporary stations located in rivulets at smaller drainage basins to Kobbefjord (H3-5). At these sites equipment is deployed each spring and collected late fall.

Table 1.1 displays the geographical location of ClimateBasic measuring sites. Due to variations in the local morphology it has not been possible to place all discharge measuring cross sections at the same location as the measuring stations.

Station Name	Short Name	Asiaq Station Number	Latitude	Longitude
Kobbefjord Hydro 1	H1	650	N64°07'59.2"	W51°22'50.8"
Kobbefjord Hydro 1	H1 cross section	650	N64°08'04.4"	W51°22'53.2"
Kobbefjord Qagssinguaq	H2	651	N64°09'23.6"	W51°18'42.2"
Kobbefjord Qagssinguaq	H2 cross section	651	N64°08'55.2"	W51°19'03.4"
Kobbefjord Climate 1 and 2	C1 and C2	652 and 653	N64°07'59.9"	W51°20'35.7"
Kobbefjord Oriartorfik	H3	654	N64°10'18.7"	W51°24'23.8"
Kobbefjord Oriartorfik	H3 cross section	654	N64°10'13.4"	W51°24'26.2"
Kobbefjord Teqqinngalip	H4	655	N64°09'31.0"	W51°32'54.2"
Kobbefjord Kingigtorssuaq	H5	656	N64°08'19.4"	W51°34'46.2"

Table 1.1 Positions of ClimateBasic measuring sites. Positions are measured with a handheld gps.

1.1 The Climate Monitoring Stations C1 and C2

Two identical climate stations, C1 and C2, are placed in the same microclimatic environment in the central valley of drainage basin H1, which is orientated east-west. The stations are surrounded by high mountains. The highest mountains in the area are NE of the stations and is 1389 m high. The mountain south of the station is 1157 m high and NNW of the stations the mountain is 1010 m high. On all three mountains glaciers are present on the slopes heading north.
The equipment measuring the different parameters are mounted on a 10 m mast, two 2 m masts and a precipitation gauge, see, Figure 1.2. All masts were erected around May 14th 2007. Relative uniform terrain surrounds the 10 m masts which are placed approximately 40 m above mean sea level. The radiation parameters are placed on the separate 2 m masts. The vegetation underneath the radiation masts is a mixture of salix and empetrum and is 0-20 cm high.
Physical changes to the station such as changes in the data logger program, replacements and calibration of sensors will be reported once a year in a separate report.

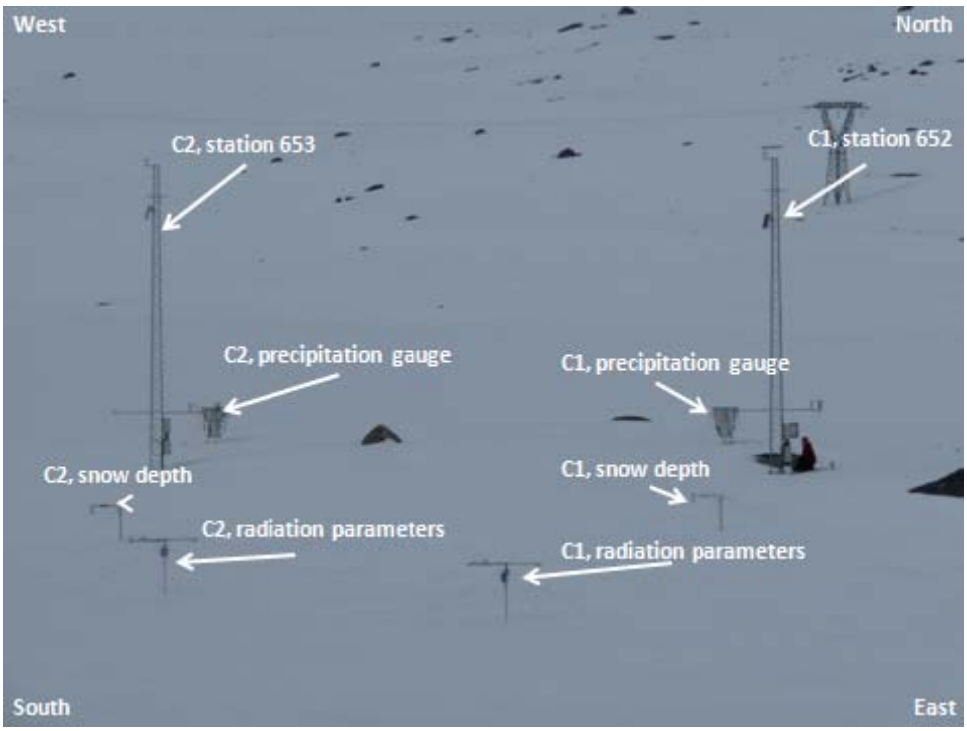

Figure 1.2 An overview of the double climate station C1 and C2.

1.2 Hydrometric Station H1

The hydrometric station H1 is located on the northern shore of the lake Kangerluarsunnguup Tasia close to the outlet of the lake and approximately 800 m from the fjord 30 m above mean sea level. The station was established May 15th 2007, but measurements have been carried out since June 2006 by the use of divers (see section 1.4). The water level in the lake is measured relative to a reference point on land. The reference point is given a height in a relative height system. The drainage area covers 31 km^2 which includes sub-basin H2. Discharge measurements are made at two cross sections, primary depending on ice conditions; see Figure 1.3 and Figure 1.4.

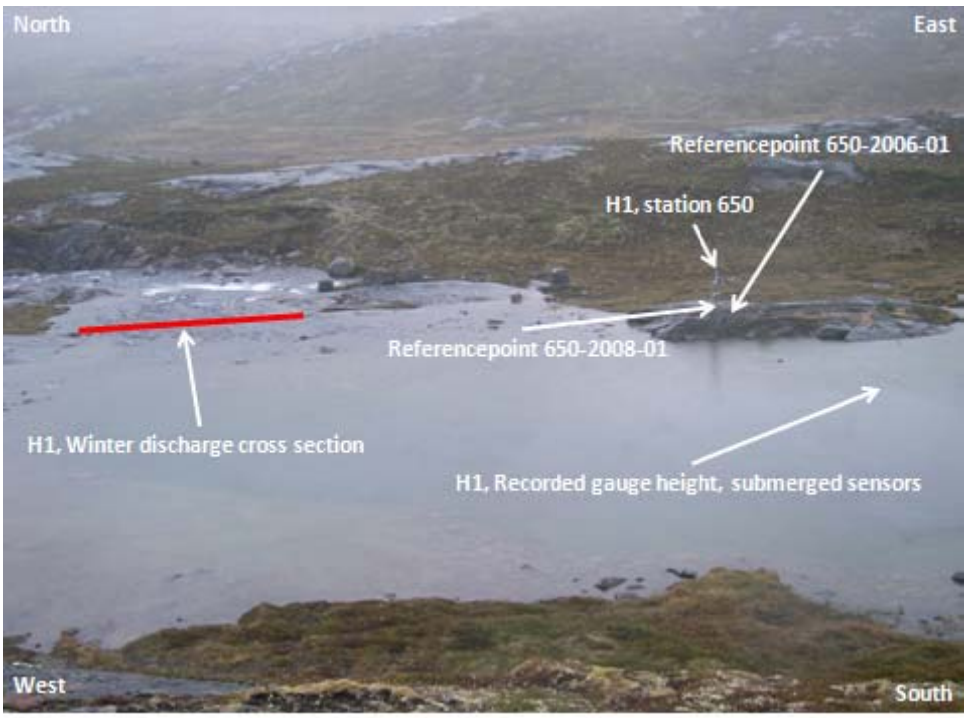

Figure 1.3 H1 at the outlet of Kangerluarsunnguup Tasia

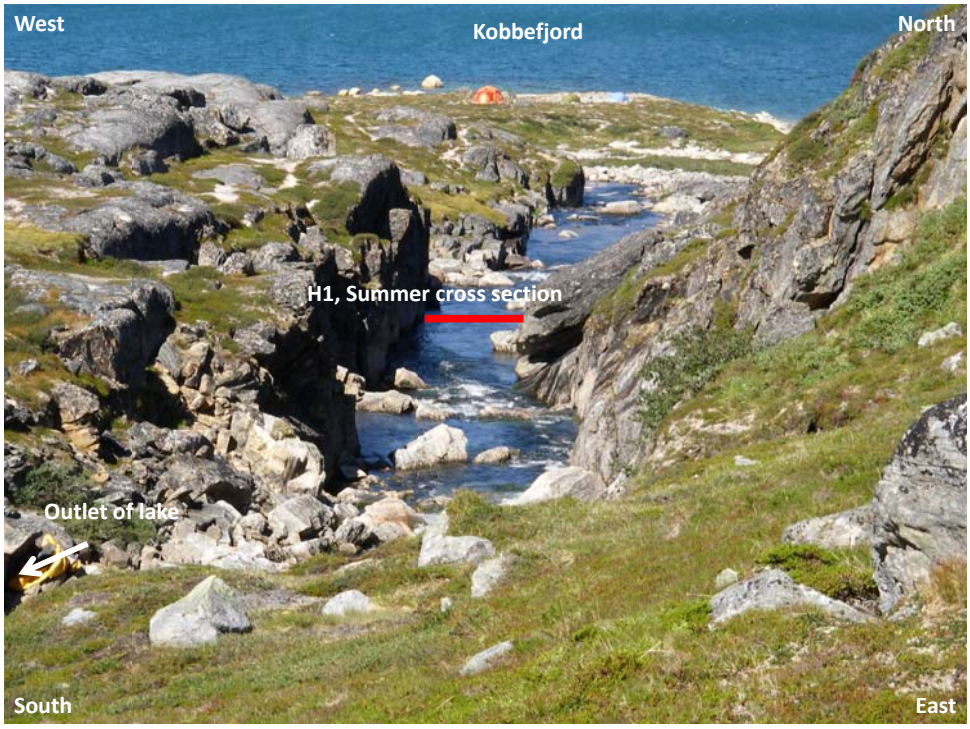

Figure 1.4 H1 summer cross section approximately 100 m downstream from the outlet.

1.3 Hydrometric Station H2

The hydrometric station H2 is located on the north-western shore of the lake Qagssinguaq about 1 km from the outlet of the lake approximately 210 m above

mean sea level. The station was established May 7th 2007. The recorded water level in the lake is measured relative to a reference point on land. The reference point is given a height in a relative height system. The drainage area covers 7 km^2 and is a sub-basin of H1. Discharge measurements have so far been made at a preliminary site by the outlet of the lake; see Figure 1.5 and Figure 1.6

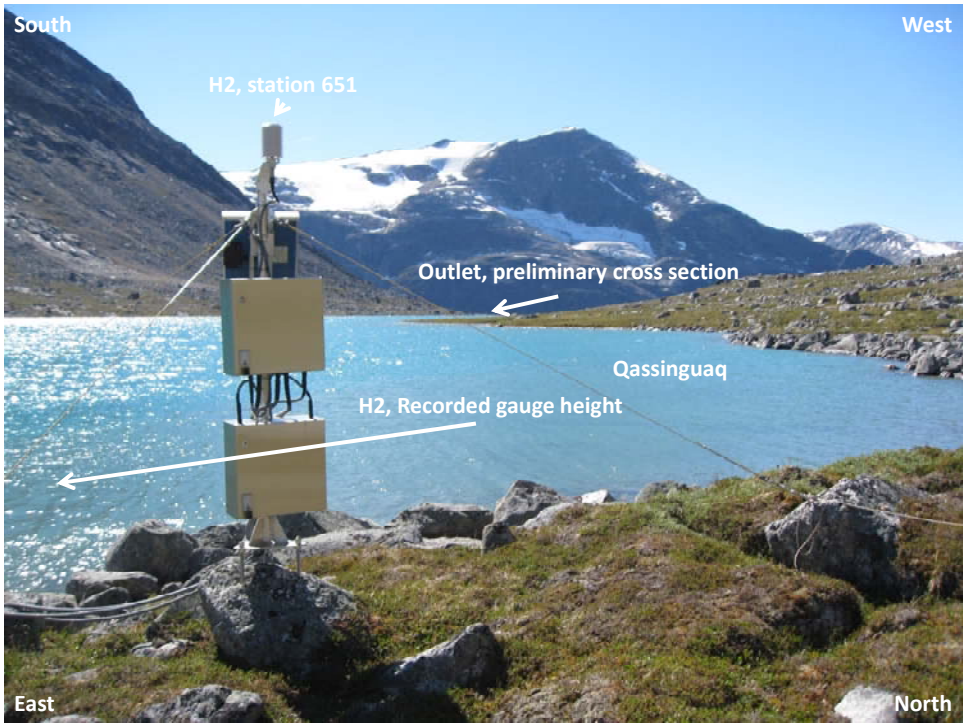

Figure 1.5 H2 at Qagssinguaq 210 m above sea level.

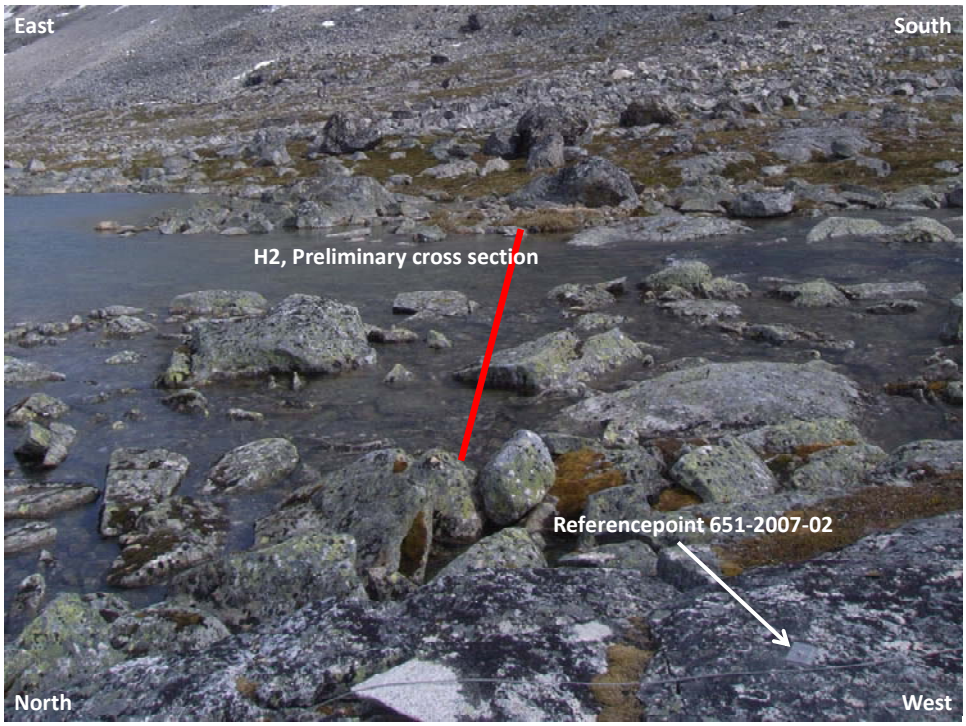

Figure 1.6 H2 preliminary cross section by the outlet of the lake.

1.4 Description of a Diver Station

A diver station consists of two divers placed in the water and one barodiver placed on land. A diver/barodiver is an independent unit containing a pressure transducer and a temperature sensor as well as a data logger, watch and power supply. The diver records absolute pressure i.e. the pressure due to both water and atmosphere. To obtain the water level the atmospheric pressure measured by the barodiver is subtracted from the diver data.
The divers are placed in a pvc pipe. The water level in the rivulet is measured relative to a reference point on land. The reference point is given a height in a relative height system.

1.4.1 Diver Station H3

The diver station H3 is located in a rivulet draining the northern part of Kobbefjord; see Figure 1.1. The divers are placed approximately 1100 m from the fjord, 100 m above sea level. The drainage area covers 10 km^2. Discharge measurements are made approximately 100 m downstream of the divers; see Figure 1.7 and Figure 1.8. The divers are every year deployed in spring and collected in fall before the water freezes. The measurements at H3 started in 2007.

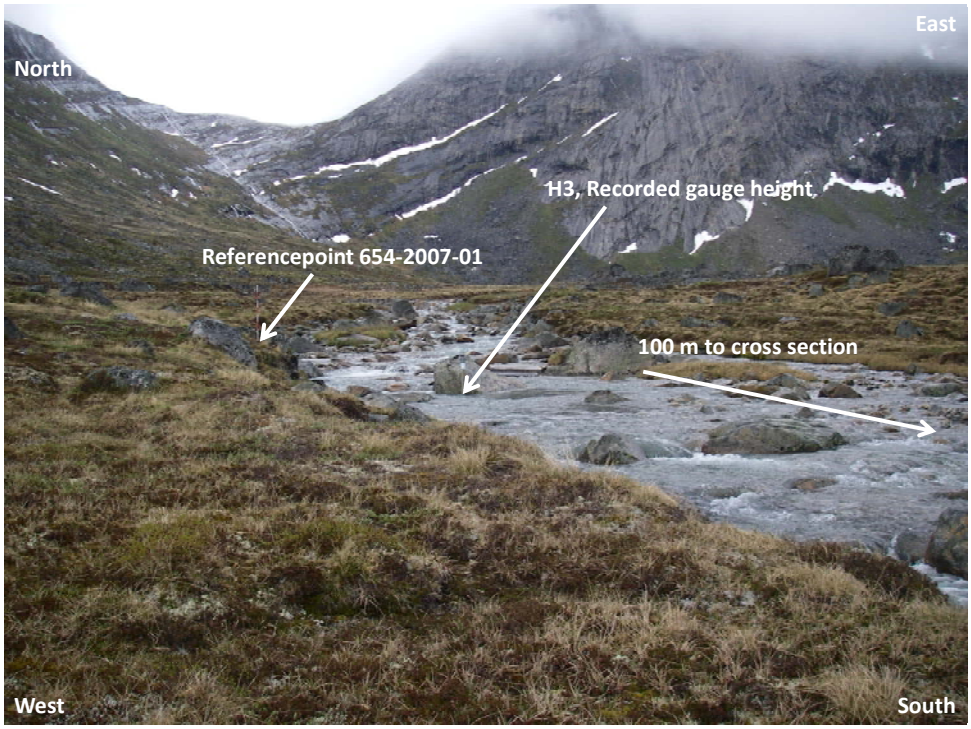

Figure 1.7 H3 at Oriartorfik 100 m above sea level.

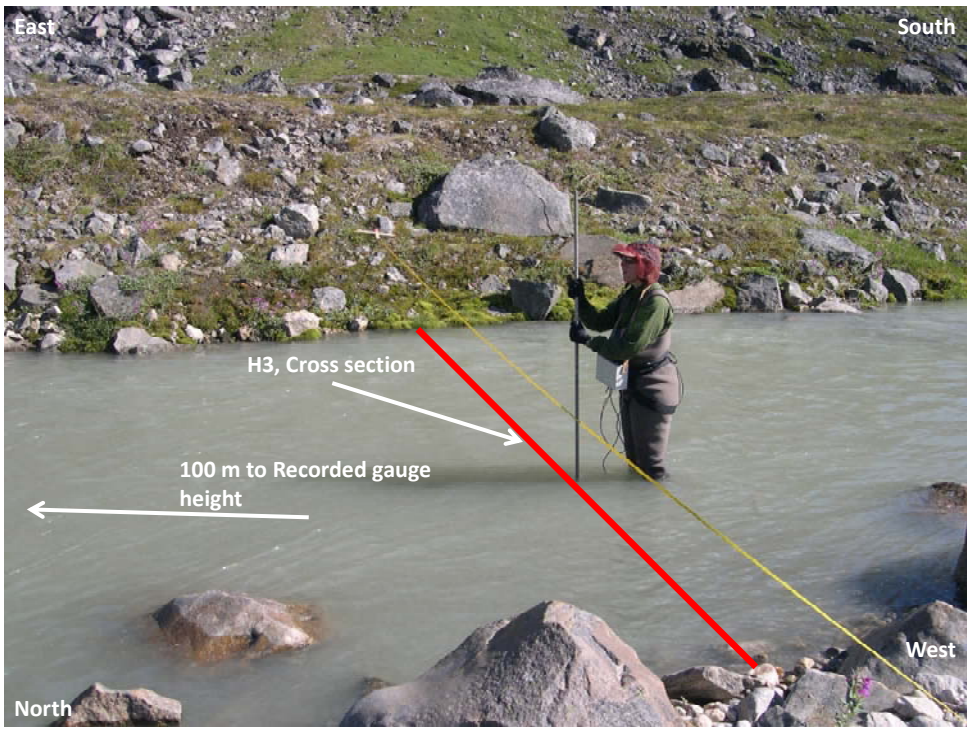

Figure 1.8 H3 cross section approximately 100 m downstream from the measuring site.

1.4.2 Diver Station H4

The diver station H4 is located in a rivulet draining the southern part of Kobbefjord; see Figure 1.1. The divers are placed approximately 600 m from the fjord, 30 m above sea level. The drainage area covers 17 km^2. Discharge measurements are made approximately 20 m downstream of the divers; see Figure 1.9 and Figure 1.10. The divers are every year deployed in spring and collected in fall before the water freezes. The measurements at H4 started in 2007.

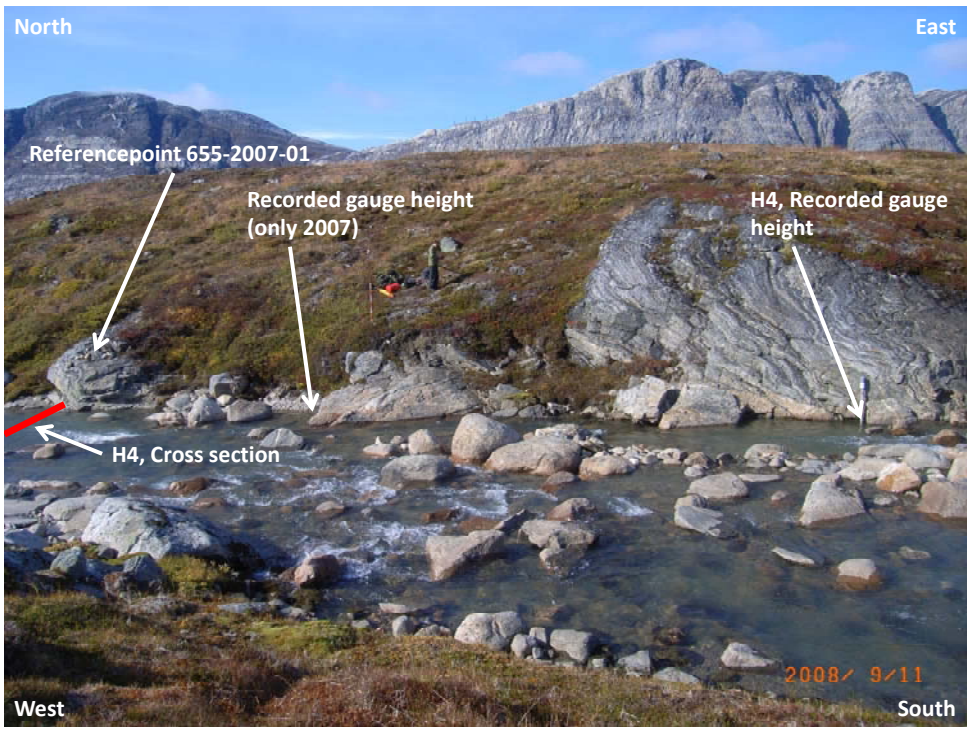

Figure 1.9 H4 at Teqqingalip.

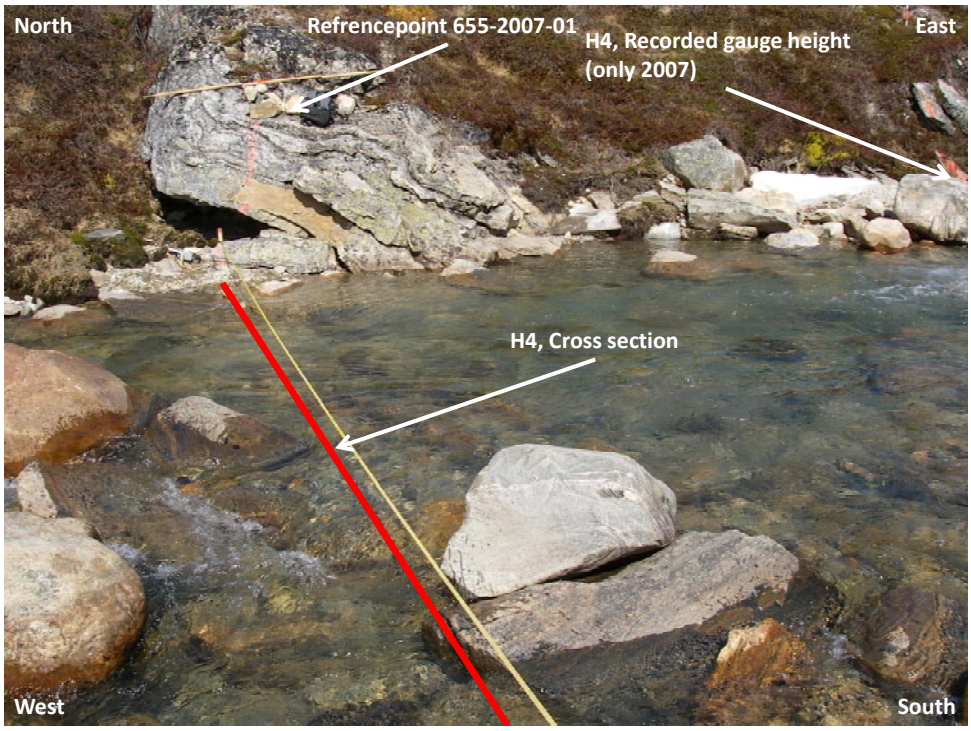

Figure 1.10 H4 cross section approximately 20 m downstream from the measuring site.

1.4.3 Diver Station H5

The diver station H5 is located in a rivulet draining the south-western part of Kobbefjord; see Figure 1.1. The divers are placed approximately 500 m from the fjord, 30 m above sea level. The drainage area covers 6 km^2. Discharge measurements are carried out at a river cross section just upstream of the diver location; see Figure 1.11. The divers are every year deployed in spring and collected in fall before the water freezes. The measurements at H5 started in 2008.

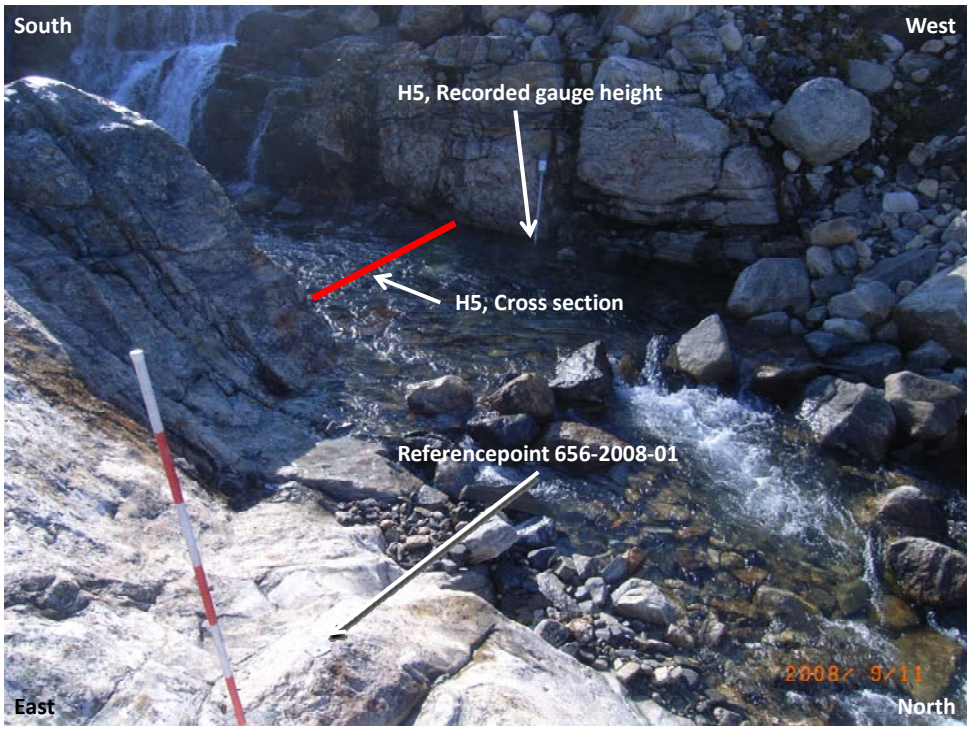

Figure 1.11 H5 at Kingigtorssuaq, both measuring site and cross section.

2 Measured Parameters

2.1 The Climate Stations, C1 and C2

At the climate stations, C1 and C2, 15 different parameters are measured. In Table 1.1 the parameter, sensor type, sensor height above terrain and specifications are seen with the aggregation method.

Parameter	Sensor Type	Sensor Height (m.a.t.)	Measuring Range	Sensitivity (resolution)	Accuracy	Data stored in the data logger [1]	
						Average/sum	Sample/max /min
Air Temperature	Vaisala HMP 45D	2 m	-40 – +60 °C	0.1 °C	+/- 0.4 °C	$[0;30]^{30\text{ min}}_{10\text{ sec}}$ Average	$[-]^{30\text{ min}}_{10\text{ sec}}$ max/min
Relative Humidity	Vaisala HMP 45D	2 m	0.8 – 100 %RH	0.1 %	+/- 3 %	$[0;30]^{30\text{ min}}_{10\text{ sec}}$ Average	
Air Pressure at Station	Campbell Scientific PTB101 B	1.5 m	600 – 1060 hPa	0.1 hPa	+/- 4 hPa	$[0;30]^{30\text{ min}}_{10\text{ sec}}$ Average	
Wind Speed	Met One 034B	10 m	0.4 – 49 m/s	0.1 m/s	+/- 0.12 m/s (>10.1 m/s 1.1%)	$[0;10]^{10\text{ min}}_{10\text{ sec}}$ Average	$[-]^{30\text{ min}}_{10\text{ sec}}$ max/min
Wind Speed	Theodor Friedrichs & Co 4034.0000	2 m	0.5 – 60 m/s	0.1 m/s	+/- 0.3 m/s	$[0;10]^{10\text{ min}}_{10\text{ sec}}$ Average	$[-]^{30\text{ min}}_{10\text{ sec}}$ max/min
Wind Direction	Met One 034B	10 m	0 – 360°	0.5°	+/- 4°	$[0;10]^{10\text{ min}}_{10\text{ sec}}$ Average	$[-]^{30\text{ min}}_{10\text{ sec}}$ at max wind
Short Wave Radiation, Incoming and Outgoing	CNR1	2 m	0 – 1000 W/m^2	0.6 – 2.7 W/m^2	+/- 10 % for daily sums	$[0;5]^{5\text{ min}}_{10\text{ sec}}$ Average	
Long Wave Radiation, Incoming and Outgoing	CNR1	2 m	+/-250 W/m^2	0.3 – 1.1 W/m^2	+/- 10 % for daily sums	$[0;5]^{5\text{ min}}_{10\text{ sec}}$ Average	
UltraViolet B Radiation	Solar Light & Co 501A	2 m	0 – 583 mW/m^2	< 0.583 mW/m^2	+/- 5 % for daily total	$[0;5]^{5\text{ min}}_{10\text{ sec}}$ Average	
Net Radiation	NR Lite	2 m	+/- 2000 W/m^2	0.7 W/m^2	+/- 10 %	$[0;5]^{5\text{ min}}_{10\text{ sec}}$ Average	
Photosynthetic Active Radiation	Kipp & Zonen PAR Lite	2 m	0 – 3700 µmol/(S*m^2)	1.2 – 1.8 µmol/(S*m^2)	+/- 10 %	$[0;5]^{5\text{ min}}_{10\text{ sec}}$ Average	
Relative Vegetation Index	Skye Inst. SKR110	2 m	<500 µmol/m^2/s	100 µmol/m^2/s	+/- 3 – 5 %	$[0;5]^{5\text{ min}}_{10\text{ sec}}$ Average	
Precipitation	Ott Pluvio	-	0 - 99.99 mm	0.05 mm/h		$[0;60]^{60\text{ min}}_{10\text{ sec}}$ Sum	$[-]^{x\text{ min}}_{10\text{ sec}}$ Sample
Snow Depth	Campbell Scientific SR 50	-	0.5 – 10 m	0.1 mm	+/- 1 cm or 0.4 %		$[0;179]^{180\text{ min}}_{-}$ Sample

Table 2.1 Parameter, senor type, sensor height above terrain, sensor specifications and aggregation method for the Climate Stations, C1 and C2.

1 Data stored in the data logger is given as $[a;b]^d_c$, where 'd' is the interval between outputs written to the data logger, 'c' is the interval between scans of the sensor, 'a' and 'b' are minutes into the interval between output. Average values are found by averaging data values measured with interval c between 'a' and 'b'. Sample values are measured 'a' minutes into the interval between output.

2.2 The Hydrometric Stations, H1 and H2

At the Hydrometric Stations, H1 and H2, three and four parameters are measured respectively. In Table 2.2 and Table 2.3 the parameter, sensor type, sensor height above terrain and specifications are seen with the aggregation method for H1 and H2 can be seen.

Parameter	**Sensor Type**	**Sensor Height (m.a.t.)**	**Measuring Range**	**Sensitivity (resolution)**	**Accuracy**	**Data stored in the data logger [1]**	
						Average/sum	Sample/max /min
Air Temperature	Campbell 107-L	2 m	-35 – +50 °C	0.1 °C	+/- 0.4 °C	$[0;30]^{30\text{ min}}_{10\text{ sec}}$ Average	$[-]^{30\text{ min}}_{10\text{ sec}}$ max/min/sample
Water Level 1	Drück PTX1730		1.5 – 35 mH_2O	0.01 m	+/- 0.25%		$[-]^{60\text{ min}}_{10\text{ sec}}$ sample
Water Level 2	Drück PTX1730		1.5 – 35 mH_2O	0.01 m	+/- 0.25%		$[-]^{60\text{ min}}_{10\text{ sec}}$ sample
Water Temperature 1	Campbell 107-L		-35 – +50 °C	0.1 °C	+/- 0.4 °C		$[-]^{60\text{ min}}_{10\text{ sec}}$ sample
Water Temperature 2	Campbell 107-L		-35 – +50 °C	0.1 °C	+/- 0.4 °C		$[-]^{60\text{ min}}_{10\text{ sec}}$ sample

Table 2.2 Parameter, senor type, sensor height above terrain, sensor specifications and aggregations method for the Hydrometric Station H1.

Parameter	**Sensor Type**	**Sensor Height (m.a.t.)**	**Measuring Range**	**Sensitivity (resolution)**	**Accuracy**	**Data stored in the data logger [1]**	
						Average/sum	Sample/max /min
Air Temperature	Vaisala HMP 45D	2 m	-40 – +60 °C	0.1 °C	+/- 0.4 °C	$[0;30]^{30\text{ min}}_{10\text{ sec}}$ Average	$[-]^{30\text{ min}}_{10\text{ sec}}$ max/min/sample
Relative Humidity	Vaisala HMP 45D	2 m	0.8 – 100 %RH	0.1 %	+/- 3 %	$[0;30]^{30\text{ min}}_{10\text{ sec}}$ Average	$[-]^{30\text{ min}}_{10\text{ sec}}$ max/min/sample
Water Level 1	Drück PTX1730		1.5 – 35 mH_2O	0.01 m	+/- 0.25%		$[-]^{60\text{ min}}_{10\text{ sec}}$ sample
Water Level 2	Drück PTX1730		1.5 – 35 mH_2O	0.01 m	+/- 0.25%		$[-]^{60\text{ min}}_{10\text{ sec}}$ sample
Water Temperature 1	Campbell 107-L		-35 – +50 °C	0.1 °C	+/- 0.4 °C		$[-]^{60\text{ min}}_{10\text{ sec}}$ sample
Water Temperature 2	Campbell 107-L		-35 – +50 °C	0.1 °C	+/- 0.4 °C		$[-]^{60\text{ min}}_{10\text{ sec}}$ sample

Table 2.3 Parameter, senor type, sensor height above terrain, sensor specifications and aggregations method for the Hydrometric Station H2.

2.3 The Diver Stations, H3, H4 and H5

At the diver stations four different parameters are measured. In Table 2.4 parameter, senor type, sensor height above terrain, sensor specifications and aggregations method for H3, H4 and H5 can be seen.

Parameter	**Sensor Type**	**Sensor Height (m.a.t.)**	**Measuring Range**	**Sensitivity (resolution)**	**Accuracy**	**Data stored in the data logger [1]**	
						Average/sum	Sample/max/min
Air Temperature	Van Essen Inst. BaroDiver 11.11.55.01	~1 m	-20 - 80 °C	± 0.01 °C	± 0.1 °C		[–]15 min 15 min sample
Air Pressure	Van Essen Inst. BaroDiver 11.11.55.01	~1 m	0-1.5 mH_20	0.25 cmH_2O	± 0.5% cmH2O		[–]15 min 15 min sample
Water Level 1	Van Essen Inst. MiniDiver 11.11.01.04		0-10 mH_2O	0.4 cmH_2O	± 0.05% Full Scale		[–]15 min 15 min sample
Water Level 2	Van Essen Inst. MiniDiver 11.11.01.04		0-10 mH_2O	0.4 cmH_2O	± 0.05% Full Scale		[–]15 min 15 min sample
Water Temperature 1	Van Essen Inst. MiniDiver 11.11.01.04		± 0.05%	± 0.01 °C	± 0.1 °C		[–]15 min 15 min sample
Water Temperature 2	Van Essen Inst. MiniDiver 11.11.01.04		± 0.05%	± 0.01 °C	± 0.1 °C		[–]15 min 15 min sample

Table 2.4 Parameter, senor type, sensor height above terrain, sensor specifications and aggregations method for the diver stations H3, H4 and H5.

3 Communication of Data and Reports

Data from the stations are once a year delivered to the Nuuk Basic database and a description of the data can be seen in the NERO Annual Report.