TARFALA RESEARCH STATION

Storglaciären AWS
Storglaciären Snow

January, 2018

METADATA REPORT

Contents

1 Station setup

1.1 History and aim

The *Storglaciären AWS* (Fig.1) was established 2012. It stands at approximately $1350\,\mathrm{m}$ a.s.l. on a relatively flat part of the ablation area of a valley glacier in the Northern Swedish mountains ($67.9030°$N, $18.5726°$E). To catch the meteorological factors and surface change throughout the glacier ablation season the aim has been to mount the station in late winter and dismantle it in early fall.

Figure. 1. The automatic weather station in late August, 2013. The photo is taken towards west.

In fall 2013 a simple station, *Storglaciären Snow* (Fig.2), consisting of the sonic ranger and a temperature and relative humidity probe was left after the dismantling of the *Storglaciären AWS*. The aim is to measure the distance to the surface throughout the year to increase the chance of catching essential snowfall and ablation outside of the manually monitored periods.

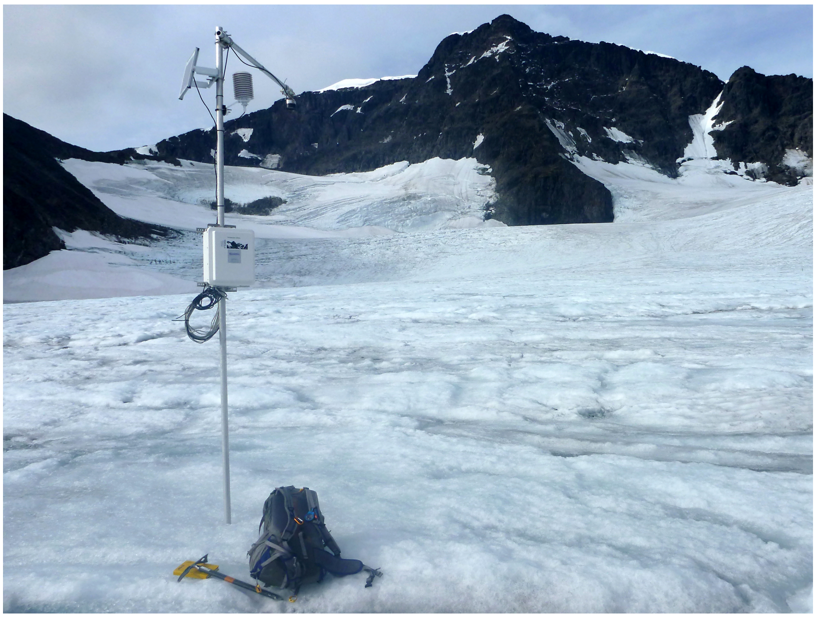

Figure. 2. The Automatic snow station in mid-September, 2013. The photo is taken towards south-west.

1.2 Instrumentation

The stations are entirely automatic powered by a 12 V *valve-regulated lead-acid battery* and a *solar panel*, the data is saved in a ***Campbell Scientific*** *data logger* and manually downloaded. The stations consists of the instrumentation listed in Table 1.

Table. 1. Instrumentation setup at Storglaciären AWS (above line) and Storglaciären Snow (below line).

Instrument	Active
CR1000, Data logger	Ablation season, 2013– ongoing
HC2S3, Temperature and Relative Humidity Probe (at approx 0.5 m)	Ablation season, 2013– ongoing
HC2S3, Temperature and Relative Humidity Probe (at approx 1 m)	Ablation season, 2013– ongoing
HC2S3, Temperature and Relative Humidity Probe (at approx 2 m)	Ablation season, 2013– ongoing
Hukseflux NR01 (SR01 Pyranometer)	Ablation season, 2013– ongoing
Hukseflux NR01 (IR01 Pyrgeometer)	Ablation season, 2013– ongoing
05103, Wind Monitor	Ablation season, 2013– ongoing
52202, Tipping Bucket Raingauge	Ablation season, 2013– ongoing
CR200X, Data logger	Year-round, Sep. 2013– ongoing
HC2S3, Temperature and Relative Humidity Probe	Year-round, Sep. 2013– ongoing
SR50A, Sonic Ranging Sensor	Year-round, Apr. 2013– ongoing

2 Data management

2.1 Data file description

The data is presented as files with *comma-separated values* (csv). One file has retained the log interval but with an automatic removal of distinctly unreliable values (section 2.3) and one file for each parameter with calculated hourly values. Table 2 describe the content of the files existing for SgAWS and table 3 translate the headers of the files.

Table. 2. Description of the content of the csv-files. The yyyy indicates the concern year(s).

File name (.csv)	Measurement	Time interval
SgAWS_yyyy	All parameters	10 or 15 min
SgSnow_yyyy	All parameters	10, 15 or 30 min
SgAWS_yyyy_Temp	Temperature	Hourly
SgAWS_yyyy_RH	Relative humidity	Hourly
SgAWS_yyyy_Rad	Radiation	Hourly
SgAWS_yyyy_Wind	Wind	Hourly
SgAWS_yyyy_Prec	Liquid precipitation	Hourly

2.2 Plot description

The cleaned data is presented as simple plots collected in the file *SgAWS_yyyy_plots*. A short description of the individual plots is found in table 4.

*Table. 3. Header translation of the csv-files. The header consists of a **parameter abbreviation** (first), a **statistical method** (last) and an additional number if several measurements of the same parameter exists (middle). All header components are separated by an underscore.*

Header component	Description	Unit
TIMESTAMP	Date and time (yyyy-mm-dd HH:MM)	
aT	Air temperature	°C
RH	Relative humidity	%
SW	Incoming short wave radiation	$\mathrm{W\,m^{-2}}$
SWrefl	Reflected short wave radiation	$\mathrm{W\,m^{-2}}$
LWin	Incoming long wave radiation	$\mathrm{W\,m^{-2}}$
LWout	Outgoing long wave radiation	$\mathrm{W\,m^{-2}}$
WS	Wind speed	$\mathrm{m\,s^{-1}}$
WD	Wind direction	°
Prec	Rainfall	mm
Dist	Distance to the surface	m
Tg	Ground temperature	°C
SD	Snow depth	m
mom	Sample	
avg	Average	
tot	Total	
std	Standard deviation	
max	Highest measured value	
min	Lowest measured value	

2.3 Changes made to the raw data set

Before compiling the csv-files a Matlab script is run to remove indisputable errors in the data. For manually removed data a specific year, see the *readme*-file in that year's folder. **Note that errors may still occur in the data set**.

2.3.1 General

Automatic removal of general errors in the data:

— Gaps in data are filled with Time stamp and *NaN*

— Values equal -6999 (an error output from the Campbell Sc. data logger) are replaced with *NaN*

2.3.2 Temperature

Automatic removal of errors in the temperature data:

— Values outside the temperature sensor range (-40–60 °C) are replaced with *NaN*

— Values with a *moving standard deviation* (5 values) greater than 1.0 are replaced with NaN

2.3.3 Relative humidity

Automatic removal of errors in the relative humidity data:

— Values outside the relative humidity sensor range (0–100 %) are replaced with *NaN*

— Values with a *moving standard deviation* (5 values) greater than 20 are replaced with *NaN*

Table. 4. Description of the plot contents. The title of each plot consist of a few descriptive words (generally the parameter), the station abbreviation and the year.

Title	Description
Air temperature	Air temperature over time at approx $0.5\,\mathrm{m}$ (**T**), $1\,\mathrm{m}$ (**T2**) and $2\,\mathrm{m}$ (**T3**) above the surface
Air temperature correlation	Correlation between sensors at different heights (see *Air temperature*)
Relative humidity	Relative humidity over time at approx $0.5\,\mathrm{m}$ (**RH**), $1\,\mathrm{m}$ (**RH2**) and $2\,\mathrm{m}$ (**RH3**) above the surface
Relative humidity correlation	Correlation between sensors at different heights (see *Relative humidity*)
Solar radiation	Incoming (**SW**) and reflected (**SWrefl**) short wave radiation over time
Long wave radiation	Incoming (**LW**) and outgoing (**LWo**) long wave radiation over time
Wind speed	Wind speed over time
Wind direction	Wind direction over time
Wind rose	The fraction of wind speed measurements with specific velocity and direction
Precipitation	Rainfall over time

2.3.4 Radiation

Automatic removal of errors in the radiation data:

— Values outside the short wave radiation sensor range (<2000 $\mathrm{W\,m^{-2}}$) are replaced with *NaN*

— Values outside the long wave radiation sensor range (<1000 $\mathrm{W\,m^{-2}}$) are replaced with *NaN*

— When reflected short wave radiation is greater than the incoming short wave radiation (usually due to snow accumulation on the up-facing sensor) the values of incoming short wave radiation are replaced with *NaN*

No additional calibration changes are done. Using values from *Swedish Meteorological and Hydrological Institute* shows that the differences between the sensors are well within the sensor error range (September, 2017).

2.3.5 Wind

Automatic removal of errors in the wind data:

— Values outside the wind speed sensor range (0–100 $\mathrm{m\,s^{-1}}$) are replaced with *NaN*

— Values outside the wind direction sensor range (0–360 $^\circ$ at wind speed $\geq$1.1 $\mathrm{m\,s^{-1}}$) are replaced with *NaN*

2.3.6 Precipitation

The precipitation data should be treated with caution. We suspect that the tipping bucket vibrates in high wind speeds. However, there is not always recorded high precipitation at high wind speeds and rain in high wind speeds are common. Therefore, pinpointing incorrect values is not possible. It is therefore likely that incorrect values exist in the data set.

No automatic removal of errors in the precipitation data.

2.3.7 Surface change

Automatic removal of errors in the surface change data:

— Values outside the sensor range (0.5–10 m) are replaced with *NaN*

— Values when the recorded *sonar signal quality* is too low or high are replaced with *NaN*

— Values that has no temperature to be corrected to (see paragraph on *Temperature correction*) are replaced with *NaN*

Temperature correction The *SR50A* sensor is sonic ranger measuring the distance to the ground. Since the air temperature affects the speed of sound the value read from the sensor needs to be corrected against air temperature (equation 1). To loose as little accumulation/ablation data as possible the temperature correction equation is set to firstly use the value read from *Storglaciären Snow*, secondly from *Storglaciären AWS* and thirdly from fitted temperature data calculated from the air temperature recorded at *Tarfala RS AWS* (TRSAWS). When using fitted temperature from TRSAWS we estimate an increase of a sensor error with up to $\pm 2\,\mathrm{cm}$.

$$DISTANCE = READING_{SR50A}\sqrt{\frac{T^{\circ}\,\mathrm{K}}{273.15}} \tag{1}$$