PROMICE | GC-NET

Programme for Monitoring of the Greenland Ice Sheet

Readme: PROMICE and GC-Net automatic weather station data

Data available at http://www.promice.dk. Contact: info@promice.dk.

Terms of use

If the data are presented or used to support results of any kind, please inform a member of the PROMICE team at GEUS, and:

- Include the acknowledgement: "*Data from the Programme for Monitoring of the Greenland Ice Sheet (PROMICE) are provided by the Geological Survey of Denmark and Greenland (GEUS) at http://www.promice.dk. They include sites financially supported by the Glaciobasis programme as part of Greenland Ecosystem Monitoring (https://g-e-m.dk/), maintained by GEUS (ZAK, LYN) and by Asiaq Greenland Survey (NUK_K). The WEG stations are paid for and maintained by the University of Graz.*"
- Include a reference to the peer-reviewed article presenting PROMICE weather station data:

  Fausto, R. S., van As, D., Mankoff, K. D., Vandecrux, B., Citterio, M., Ahlstrøm, A. P., Andersen, S. B., Colgan, W., Karlsson, N. B., Kjeldsen, K. K., Korsgaard, N. J., Larsen, S. H., Nielsen, S., Pedersen, A. Ø., Shields, C. L., Solgaard, A. M., and Box, J. E.: Programme for Monitoring of the Greenland Ice Sheet (PROMICE) automatic weather station data, Earth Syst. Sci. Data, 13, 3819–3845, https://doi.org/10.5194/essd-13-3819-2021, 2021.

  as well as the citation to the data itself:

  How, P., Abermann, J., Ahlstrøm, A.P., Andersen, S.B., Box, J.E., Citterio, M., Colgan, W.T., Fausto, R., Karlsson, N.B., Jakobsen, J., Langley, K., Larsen, S.H., Mankoff, K.D., Pedersen, A.Ø., Rutishauser, A., Shields, C.L., Solgaard, A.M., van As, D., Vandecrux, B., Wright, P.J., 2022, "PROMICE and GC-Net automated weather station data in Greenland", https://doi.org/10.22008/FK2/IW73UU, GEUS Dataverse

If the data are crucial to the main conclusions of a manuscript or presentation of any kind, please include a member of the PROMICE team at GEUS in the author list.

The data are not to be passed on to a third party. PROMICE data can be obtained through http://www.promice.dk by anyone and at no charge. The data are to be used for the purpose as stated by the individual making the data request. For new studies, please make a new data request for the benefit of PROMICE user statistics. GEUS and its employees are not liable for the quality of the data.

To raise issues regarding our processing, please add an issue here: https://github.com/GEUS-Glaciology-and-Climate/pypromice/issues

To raise issues regarding our data, please add an issue here: https://github.com/GEUS-Glaciology-and-Climate/PROMICE-AWS-data-issues

Variables in hourly, daily and/or monthly data files

Variables with "_l" are only available at the two-boom stations. For details on calculated/corrected variables, please refer to the pypromice package documentation at https://github.com/GEUS-Glaciology-and-Climate/pypromice

Variable name	*Units*	*Description*
time	yyyy-mm-dd HH:MM:SS	Time. Time stamp of hourly averages given for following hour
p_u	hPa	Air pressure (upper boom).
p_l	hPa	Air pressure (lower boom).
t_u	degrees Celsius	Air temperature (upper boom) at height z_boom_u
t_l	degrees Celsius	Air temperature (lower boom) at height z_boom_l
rh_u	%	Relative humidity (upper boom) at height z_boom_u
rh_u_cor	%	Relative humidity (upper boom) – corrected for saturation over ice in subfreezing conditions
qh_u	%	Specific humidity (upper boom). Calculated from rh_u_cor
rh_l	%	Relative humidity (lower boom) at height z_boom_l
rh_l_cor	%	Relative humidity (lower boom) - corrected for saturation over ice in subfreezing conditions
qh_l	g kg-1	Specific humidity (lower boom). Calculated from rh_l_cor
wspd_u	m s-1	Wind speed (upper boom) at height z_boom_u + 0.4 m
wspd_l	m s-1	Wind speed (lower boom) at height z_boom_l + 0.4 m
wdir_u	degrees	Wind from direction (upper boom) at height z_boom_u + 0.4 m
wdir_l	degrees	Wind from direction (lower boom) at height z_boom_l + 0.4 m
dsr	W m-2	Downwelling shortwave radiation at height z_boom_u + 0.1 m
dsr_cor	W m-2	Downwelling shortwave radiation – tilt-corrected from dsr
usr	W m-2	Upwelling shortwave radiation at height z_boom_u + 0.1 m
usr_cor	W m-2	Upwelling shortwave radiation – tilt-corrected calculated from usr
albedo	-	Albedo. Calculated from dsr_cor and usr_cor
dlr	W m-2	Downwelling longwave radiation at height z_boom_u + 0.1 m
ulr	W m-2	Upwelling longwave radiation at height z_boom_u + 0.1 m
cc	%	Cloud cover. Estimated from dlr and t_u
t_surf	degrees Celsius	Surface temperature. Calculated from ulr and dlr. Surface longwave emissivity is set to 0.97
dlhf_u	W m-2	Latent heat flux (upper boom). Calculated using gradients of wind speed and humidity between the surface and measurement height. Aerodynamic surface roughness for momentum is set to 0.001 m
dlhf_l	W m-2	Latent heat flux (lower boom). Calculated using gradients of wind speed and humidity between the surface and measurement height. Aerodynamic surface roughness for momentum is set to 0.001 m
dshf_u	W m-2	Sensible heat flux (upper boom). Calculated using gradients of wind speed and temperature between the surface and measurement height. Aerodynamic surface roughness for momentum is set to 0.001 m
dshf_l	W m-2	Sensible heat flux (lower boom). Calculated using gradients of wind speed and temperature between the surface and measurement height. Aerodynamic surface roughness for momentum is set to 0.001 m
z_boom_u	m	Upper boom height
z_boom_l	m	Lower boom height
precip_u	mm	Precipitation (upper boom) (cumulative liquid)
precip_u_cor	mm	Precipitation (upper boom) (cumulative liquid) – corrected

precip_l	mm	Precipitation (lower boom) (cumulative liquid)
precip_l_cor	mm	Precipitation (lower boom) (cumulative liquid) – corrected
t_i_1-11	degrees Celsius	Subsurface temperature from thermistor measurements 1 to 11. Note that the thermistor strings in the ablation area will melt out.
tilt_x	degrees	Tilt to east. Station may have rotated
tilt_y	degrees	Tilt to north. Station may have rotated
rot	degrees	Station rotation from true North. Station may have rotated
gps_lat	degrees north	Latitude
gps_lon	degrees east	Longitude
gps_alt	m	Altitude
gps_time	s	GPS time
gps_hdop	m	GPS horizontal dilution of precision (HDOP)
batt_v	V	Battery voltage
fan_dc_u	mA	Fan current (upper boom). Current drawn for ventilation of the temperature and humidity assembly. Normal values exceed 100 mA
fan_dc_l	mA	Fan current (lower boom). Current drawn for ventilation of the temperature and humidity assembly. Normal values exceed 100 mA
freq_vw	Hz	Frequency of vibrating wire in precipitation gauge
t_log	degrees Celsius	Logger temperature
t_rad	degrees Celsius	Radiation sensor temperature

For more information, please refer to the variables look-up table (variables.csv) provided with this data product.

Sensor list

Instruments in italic are only installed on PROMICE v2 stations. They are being replaced by v3 stations.

Instrument type	Manufacturer	Model	Accuracy (unit)
	Campbell Scientific	*CS100/Setra 278*	*±2.0 (hPa)*
Barometer	Lufft	WS401-UMB	±0.5 hPa (0...40°C)
	Rotronic	*MP100H-4-1-03-00-10DIN*	*±0.1 (K)*
Thermometer, aspirated	Lufft	WS401-UMB	±0.2°C (>-20°C), ±0.5°C (>-30°C)
	Rotronic	*HygroClip HC2 or HC2-S3*	*±0.8 % (RH)*
Hygrometer, aspirated	Lufft	WS401-UMB	±2%
Anemometer	R.M. Young	05103-5	±0.2 (m s−1) or 1%
Radiometer	Kipp & Zonen	CNR1 or CNR4	±10 (%)
Sonic ranger (x2)	Campbell Scientific	SR50A	±1 (cm) or ±0.4%
Pressure transducer	Ørum & Jensen in GEUS assembly	NT1400 or NT1700	±2.5 (cm)
Precipitation gauge	Lufft	WS401-UMB	±2 % (Res. 0.5 mm, Max. intensity 144 mm/h)
	GEUS	*RS PRO Termistor, 100 kΩ*	*±0.9 (%)*
Thermistor string	GeoPrecision	TNode	±0.1 (K)
Inclinometer	HL Planar in GEUS assembly	NS-25/E2	0.6 (%)
	Trimble/Tallysman	*SAF5270-G/TW4020*	2.5 (m) indicative
GPS antenna	Iridium		
Iridium modem	NAL Research	9602-LP	–

Iridium antenna	Campbell Scientific	30741	–
Batteries (4×28 A h)	Panasonic	LC-XC1228P	–
Solar panel	RS PRO	RS PRO 10 W	–

Measurement/transmission intervals

The AWSs measure all variables (except those by GPS) every 10 minutes and transmit hourly averages. In the processing, values are calculated from raw logger data. Data gaps are filled making use of transmitted data, where available.

Averages

- Daily averages are calculated from hourly averages.
- Monthly averages are calculated from daily averages.

Nota bene

- Unrealistic spikes have been removed from the data by setting upper and lower limits.
- The most recent values in the data files are calculated from transmitted data and will be updated after the next station visit, improving data quality and coverage.
- Automatic weather stations can topple in strong winds or get covered by winter-accumulated snow, in which cases data quality for most measured variables will be reduced. Erroneous data recorded after/during these events are always identified by the automatic processing routine but will be clearly identifiable for the data user.
- During maintenance visits (in spring or summer) the stations may be moved/leveled. Variables such as height of depth will undergo an easily recognizable shift.

Changes in Edition 2

- Shortwave radiation values no longer corrected if it requires albedo extrapolation towards the end of the time series.
- Tilt values only given when actually measured.

Changes in Edition 3

- Lower temperature limits set to -80 C, previously -60 C.
- Relative humidity values exceeding 100% now set to 100%.
- Column RelativeHumidity_wrtWater removed.
- Column SpecificHumidity included.
- Wind speed values of 0 m/s no longer replaced by -999.
- Wind speed no longer replaced by -999 for wind directions outside the 1-360 degree range.
- Estimates of the sensible and latent heat fluxes included.
- Pressure transducer depth limit set to 30 m, previously 50 m.
- Daily ablation now calculated after smoothing over 5 hourly values to reduce noise by random measurement error.
- Tilt values now smoothed over 7 values to reduce noise by random measurement error.
- Longwave emissivity of snow and ice changed from 1 to 0.97.
- Surface temperature values exceeding 0 °C now set to 0 °C.
- Latitude and longitude outputted in decimal degrees instead of degrees and decimal minutes.
- Hourly-average raw logger data shifted by one hour (minor bug fix).

Changes in Edition 4

- Workflow migrated from IDL/GDL to Python 3.8, in the pypromice toolbox.
- Two-boom processing incorporated.
- Precipitation correction added.
- Range thresholding values changes for various variables (see the pypromice variables.csv documentation).
- See the changelog file (AWS_changelog.txt) for sub-Edition changes