Metadata for the permafrost longterm observatory at Samoylov station, Lena River Delta, Russia

Julia Boike, William L Cable, Dimitry Yu Bolshiyanov, Niko Bornemann, Mikhail N Grigoriev, Inge Grünberg, Frederieke Miesner

Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research

October 10, 2022

Credit

Institution: The permafrost long-term observatory on Samoylov Island was installed in 1998 and is maintained since then by the Alfred-Wegener-Institute, Permafrost research section

Site responsible: Julia Boike (julia.boike@awi.de)

Data scientists: Main contact for questions regarding the data:
Frederieke Miesner (frederieke.miesner@awi.de), Inge Grünberg (inge.gruenberg@awi.de)

Publication: This dataset from 2020 is a continuation of a data record, which was published in *Boike et al., 2019*. If you use this dataset, please also cite the publication:
Boike, J., Nitzbon, J., Anders, K., Grigoriev, M., Bolshiyanov, D., Langer, M., Lange, S., Bornemann, N., Morgenstern, A., Schreiber, P., Wille, C., Chadburn, S., Gouttevin, I., Burke, E., and Kutzbach, L.: A 16-year record (2002–2017) of permafrost, active-layer, and meteorological conditions at the Samoylov Island Arctic permafrost research site, Lena River delta, northern Siberia: an opportunity to validate remote-sensing data and land surface, snow, and permafrost models, Earth Syst. Sci. Data, 11, 261-299, https://doi.org/10.5194/essd-11-261-2019 , 2019.

Please cite both, data and publication!

Accessibility

The data from previous (and following) years are published in the following 2 collections. Meteorological, soil, and thaw depth (CALM) data of all single years can be found within the respective collection in “Datasets listed in this publication series” and “Datasets listed in this bundled publication” for 2002–2018 and 2019–recent, respectively.

Data 2002–2018: Boike, Julia; Nitzbon, Jan; Anders, Katharina; Grigoriev, Mikhail N; Bolshiyanov, Dimitry Yu; Langer, Moritz; Lange, Stephan; Bornemann, Niko; Morgenstern, Anne; Schreiber, Peter; Wille, Christian; Chadburn, Sarah; Gouttevin, Isabelle; Kutzbach, Lars (2019): Measurements in soil and air at Samoylov Station (2002-2018), version 201908. Alfred Wegener Institute - Research Unit Potsdam, PANGAEA, https://doi.org/10.1594/PANGAEA.905236

Data 2019–recent: Boike, Julia; Cable, William L; Bolshiyanov, Dimitry Yu; Bornemann, Niko; Grigoriev, Mikhail N; Grünberg, Inge; Miesner, Frederieke (2022): Continuous measurements in soil and air at the permafrost long-term observatory at Samoylov Station (2002 et seq). Alfred Wegener Institute - Research Unit Potsdam, PANGAEA, https://doi.org/10.1594/PANGAEA.947032

We strongly advice to read *Boike et al., 2019* before using the data as it contains all information to understand the data. If you have any questions, please ask Frederieke Miesner (frederieke.miesner@awi.de) or Inge Grünberg (inge.gruenberg@awi.de)! If your work is heavily based on our data, we are happy to discuss about a collaboration.

Prior to 2002 data from an older installation at the same site can be found in the following data set and publication. Instructions on how to combine these earlier data with the new installation starting 2002 are given later below.

Data 1989–2011: Boike, Julia; Kattenstroth, Britta; Abramova, Katya; Bornemann, Niko; Chetverova, Antonina; Fedorova, Irina V; Fröb, Katrin; Grigoriev, Mikhail N; Grüber, Maren; Kutzbach, Lars; Langer, Moritz; Minke, Merten; Muster, Sina; Piel, Konstanze; Pfeiffer, Eva-Maria; Stoof, Günter; Westermann, Sebastian; Wischnewski, Karoline; Wille, Christian; Hubberten, Hans-Wolfgang (2013): Baseline characteristics of climate, permafrost, and land cover from Samoylov Island, Lena River Delta, Siberia. PANGAEA, https://doi.org/10.1594/PANGAEA.806233

Publication: Boike, J., Kattenstroth, B., Abramova, K., Bornemann, N., Chetverova, A., Fedorova, I., Fröb, K., Grigoriev, M., Grüber, M., Kutzbach, L., Langer, M., Minke, M., Muster, S., Piel, K., Pfeiffer, E.-M., Stoof, G., Westermann, S., Wischnewski, K., Wille, C., and Hubberten, H.-W.: Baseline characteristics of climate, permafrost and land cover from a new permafrost observatory in the Lena River Delta, Siberia (1998–2011), Biogeosciences, 10, 2105–2128, https://doi.org/10.5194/bg-10-2105-2013, 2013.

Abstract

Understanding permafrost processes and changes requires long-term observational datasets. This dataset is a continuation of the dataset available from the long-term observational site Samoylov, located in the Lena River Delta, Siberia (72.37 °N, 126.48 °E). The location is characterized by a cold, dry tundra climate with mean annual air temperature of –11.7 °C (using years with complete data between 1998 and 2017). The mean monthly temperatures over this period varied between 9.4 °C in the warmest month (July) and –31.7 °C in the coldest month (February). The average summer rainfall (June-October) was 145.2 mm. This dataset adds recent years to the observations of meteorological parameters, energy balance, and subsurface observations which have been recorded since 1998. The instrumentation, calibration, processing and data quality control is explained in Boike et al. (2019). The data provide observations of temporally variable parameters that mitigate energy fluxes between permafrost and atmosphere. The meteorological observations include snow depth, snow temperature, liquid precipitation, water level, air temperature, relative humidity, wind speed and direction, atmospheric pressure and radiation fluxes. The below ground sensors measure ground heat flux, active layer and permafrost temperature, soil volumetric water content, relative permittivity, and soil bulk electrical conductivity. Those variables were measured at various depths and beneath different microtopographic features (a polygon center, a rim, a slope, and a trough), representing landscape heterogeneity. The data also include observations of active layer depth twice per month in summer at 150 points on a regular grid. The observations are suitable for use in integrating, calibrating and testing permafrost as a component in Earth System Models. The resulting quality-controlled dataset is unique in the Arctic and serves as a baseline for future studies.

Measured Variables

The data is published in three parts. The first contains the meteorological observations, the second contains the soil and permafrost measurements and the third contains the active layer depth, measured on a grid that is part of the Circumpolar Active Layer Monitoring Program (CALM). An overview of all variables published as time series is presented in Table 1. Some variables have _center, _rim, _icewedge, and _slope as location index. This refers to the sensor location in the low-centered polygon landscape (see chapter 3.2 in Boike et al., 2019, and explanation for CALM classification below). The permafrost temperatures measured in the borehole in depths up to 26.75 m have the location identifier _borehole. Borehole temperatures are measured within a tube installed deeply in the permafrost. The topmost sensors (in particular Ts_borehole_0 and Ts_borehole_75 are affected by air/water circulation and should not be used. Active layer thaw depth (synonym: active layer thickness) is measured at 150 points at a CALM site. The grid points of the CALM site are classified according to micro-topographic characteristics: (1) ”center” refers to the depressed, typically wet, central region of the polygonal structures; (2) ”slope” refers to the transition zone between the centers and the rims; (3) ”rim_high” refers to polygon rims which are significantly elevated above the remaining terrain; (4) ”rim_flat” refers to shallower polygon rims between the centers; (5) ”crack” are measurement points within a frost crack which are typically located within the rims.

Table 1: Variables with column name and unit

Variable	Column original	Column pangaea	Unit
date / time[1]	UTC (in YYYY-MM-DD hh:mm)	Date/Time (in YYYY-MM-DDThh:mm:ss)	–
air/snow temperature	Tair_(height in cm)	TTT	°C
relative humidity	RH_(height in cm)	RH	%
atmospheric pressure	PA	PPPP	kPa
incoming shortwave radiation	SwIn	SWD	$W\,m^{-2}$
outgoing shortwave radiation	SwOut	SWU	$W\,m^{-2}$
incoming longwave radiation	LwIn	LWD	$W\,m^{-2}$
outgoing longwave radiation	LwOut	LWU	$W\,m^{-2}$
net radiation	RadNet	NET	$W\,m^{-2}$
wind speed	Vwind_(height in cm)	ff	$m\,s^{-1}$
wind speed maximum	Vwind_max_(height in cm)	ff max	$m\,s^{-1}$
wind speed minimum	Vwind_min_(height in cm)	ff min	$m\,s^{-1}$
wind direction	Dirwind_(height in cm)	dd	°
wind direction standard deviation	Dirwind_sd_(height in cm)	dd std dev	°
active layer thaw depth	Dal_(ID)	–	cm
precipitation (liquid)[2]	Prec	Precip	mm
snow depth	Dsn	Snow h	m
soil/permafrost temperature	Ts_(location[4])_(depth in cm)	–	°C
soil bulk electrical conductivity	Cond_(location)_(depth in cm)	–	$S\,m^{-1}$
relative permittivity[3]	E2_(location)_(depth in cm)	Permittivity rel	–
soil volumetric liquid water content	Vwc_(location)_(depth in cm)	–	$m^3\,m^{-3}$
ground heat flux	G_(location[4])_(depth in cm)	–	$W\,m^{-2}$
water level[5]	WL	–	m

[1] Time is provided in UTC, local time is UTC +9 hour.

[2] Precipitation is the total sum during one measurement interval (mm/30 min).

[3] In literature, ´, dielectric number, dielectric value, and relative permittivity are used synonymously.

[4] Location of the sensor (rim, center, slope, icewedge, borehole)

[5] In relation to the ground surface.

Quality flags

The data was carefully quality-controlled, as described in chapter 4 of Boike et al. (2019). For most applications, we advice to only use data with the flag 0 as these data points passed all quality tests. We assigned the flags based on the rules (Table 2) using automated scripts. Flags 3 (maintenance) and 6 (plausibility) were assigned manually. Flag 5 (gradient) was used in the datasets before 2019 since frequent spikes occurred. Since 2019, flag 5 has not been applied. If an air temperature sensor is covered by snow and thus does not measure ambient air temperature but snow temperature, flag 8 is applied.

Table 2: Quality flag scale

Flag	Meaning	Description
0	Good data	All quality tests passed
1	No data	Missing value
2	System error	System failure led to corrupted data, e.g., when the power supply broke down, sensors were removed from their proper location, sensors broke or the data logger saved error codes
3	Maintenance	Value influenced by the installation, calibration or cleaning of sensors or the programming of the data logger; information from field protocols of engineers
4	Physical & sensor limits	Value outside the physically possible or likely range or outside the sensor limits
5	Gradient	Value unlikely because of prolonged constant periods or high/low spikes; automated test within each single series using variable-specific parameters
6	Plausibility	Value unlikely in comparison with other series or for a given time of the year; flagged manually by engineers
7	Decreased accuracy	Value with decreased sensor accuracy, e.g. identified when freezing soil does not have a temperature of 0 °C
8	Snow covered	Sensor measured good data but in snow not in air (snow temperature instead of air temperature)

Level 2 time series 2002 to recent years

In earlier years, we provided a level 2 dataset (https://doi.org/10.1594/PANGAEA.905236). The level 2 data allows a combined analysis of the period 1998–2002 with the data of the newer station starting in 2002. To combine the data of different stations and extend the level 2 data to the recent year, we provide here again an overview of the naming conventions of the sensors in the different datasets (Table 3). The data has not been changed in any way (e.g. no interpolation or regression). The choice of sensors and depths from the two periods was based on the following criteria: 1) same surface type (center or rim) and 2) same sensor height.

Table 3: Soil temperatures and volumetric water content in the level 2 product; the columns show the variable names in the old and the more recent datasets as well as in the level 2 product.

Soil parameter			Meteorological parameter		
1998–2002	2009–recent	Level 2	1998–2002	2009–recent	Level 2
Ts_center_7	Ts_center_5	Ts_center_lv2_5	Tair_200	Tair_a_200	Tair_a_lv2_200
Ts_center_13	Ts_center_10	Ts_center_lv2_10	Tair_50	Tair_a_50	Tair_a_lv2_50
Ts_center_32	Ts_center_30	Ts_center_lv2_30	RH_200	RH_a_200	RH_a_lv2_200
Ts_center_42	Ts_center_40	Ts_center_lv2_40	RH_50	RH_a_50	RH_a_lv2_50
Ts_rim_9	Ts_rim_6	Ts_rim_lv2_6	Prec	Prec	Prec_lv2
Ts_rim_15	Ts_rim_16	Ts_rim_lv2_16	Vwind_300	Vwind_300	Vwind_lv2_300
Ts_rim_28	Ts_rim_27	Ts_rim_lv2_27	Dirwind_300	Dirwind_300	Dirwind_lv2_300
Ts_rim_37	Ts_rim_38	Ts_rim_lv2_38	RadNet	RadNet	RadNet_lv2
Ts_rim_47	Ts_rim_51	Ts_rim_lv2_51			