LIQUIDICE

Deliverable 1.1
Data catalogue of in-situ observations

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LIQUIDICE: LinkIng and QUantifying the Impacts of climate change on inlanD ICE, snow cover, and permafrost on water resources and society in vulnerable regions.

Funding programme: Horizon Europe **Project Start Date:** 01.02.2025

Grant Agreement No.: 101184962 **Duration:** 48 months

Document information	
Work Package	1 - Observations of inland ice, snow, permafrost and catchment discharge
Deliverable No.	1.1
Deliverable title	Data catalogue of in-situ observations
Dissemination level	☒ PU - Public ☐ SEN - Sensitive
Lead Beneficiary	USil
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Due date	31.01.2026

Document history		
Version	1.0	
Version Date	28.01.2026	
Status	☒ Draft	05.01.2026
	☒WP leader approved	19.01.2026
	☒Coordinator approved	21.01.2026
	☒Executive Board / SST approved	28.01.2026

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Executive summary

This report pertains to the Deliverable D1.1: Data catalogue of in-situ observations, as described in ANNEX 1, part A (p. 32) of the EC/REA Grant Agreement for project number 101184962, "LIQUIDICE". Work Package 1 of the LIQUIDICE project is led by GEUS with the support of USil, IG PAS, UMP, CNR, UiO, USil, NORCE, UGOT, SIOS-KC, IISC and IITB. Other beneficiaries are also asked to contribute to the deliverable by reaching out to key people and organisations in each of their own countries.

The goal of the catalogue is to collect the information about published, available online and unpublished datasets of the in-situ observations. The five specific glacial regions were identified as super study sites covering regions with diverse climatic characteristics and vulnerability to global warming (Chapter 4):

- Italian Alps study sites: Monte Rosa glacier system and the Lys and Évançon glacier catchment.
- Norway study sites: Jostedalsbreen glacier system and Nigardsbreen glacier catchment.
- Greenland study sites: Ilulissat and Kangerlussuaq ice sheet catchments.
- Svalbard study sites: the Austre Brøggerbreen and Werenskioldbreen glacier catchments and the Fuglebekken catchment.
- Indian Himalayan Region (IHR) - Ladakh Region and the Stok glacier and Chenab, Alaknanda and Teesta Basin.

A systematic method of cataloguing data was adopted using the Essential Climate Variables (Global Climate Observing System GCOS), Global Change Master Directory (GCMD) Keywords, and World Glacier Monitoring Service standards (Chapter 1).

Datasets are divided into five categories (Chapter 2): surface mass balance, snow cover, meteorological data, catchment discharge, and subsurface state, for which key project variables were identified during discussions within project partners.

The catalogue includes 210 datasets from all the sites. Most data are available for the Svalbard study site, comprising 132 datasets in total (62%). For the remaining study sites, the number of datasets is distributed proportionally. However, there are regions where no observations are available for a given category. The largest and longest datasets concern meteorology and glacier mass balance data. Analysis revealed that 73% of the mapped data is currently not accessible in open repositories.

The most common licenses for shared files are Creative Commons licenses (CC-BY 3.0, 4.0). The .csv file format is predominant, but for certain data types (e.g., meteorological or glaciological), the NetCDF format is also commonly used.

The catalogue has been supplemented with the characteristics of the repositories in which the data is stored. This is intended to aid in the future selection of data repositories that most fully meet FAIR data requirements and hold certificates such as the CoreTrustSeal.

Based on the created catalogue, further work will be carried out, including:

- Harmonisation and updating of surface point mass balance measurements from the Greenland ice sheet and glaciers, and ice caps in all five regions considered;
- Post-processing and harmonisation of available meteorological in-situ data from on or near-ice weather stations operated by the consortium partners in the regions studied;
- Homogenisation and cataloguing of available spatially distributed and point measurements of snow depth and cover from the unglaciated parts of the catchments across the regions studied, gathered from validated snow high-frequency radar surveys, automated in-situ instruments and manual observations.

Particular attention will be focused on catalogued data that is not currently available in open repositories.

The full catalogue is available in the Zenodo repository: 10.5281/zenodo.18376367

1. Earth System Models (ESMs) data with respect to FAIRness and priorities

Earth system models (ESMs) are comprehensive numerical frameworks that simulate the coupled dynamics of the Earth system by integrating interactions among physical components such as the atmosphere, oceans, land surface, and sea ice with climate-relevant chemical and biological processes. In recent years, ESMs have become indispensable for quantifying the impact of anthropogenic influences on the climate system and for projecting future climate trajectories under various emission scenarios (Lauer et al., 2025).

FAIR (Findable, Accessible, Interoperable, and Reusable) data principles are critically important for the development, evaluation, and application of Earth system models (ESMs). ESMs rely on large, heterogeneous datasets originating from observations, reanalyses, and model outputs, often produced by diverse institutions and disciplines. Adherence to FAIR principles ensures that these data can be efficiently discovered, accessed, and integrated across modelling frameworks, thereby enhancing model transparency, reproducibility, and comparability. Interoperable and well-documented datasets facilitate consistent coupling between model components, enabling systematic model evaluation and intercomparison efforts. Moreover, reusable data with standardised metadata and clear provenance support long-term model improvement and enable robust assessments of climate variability and change, ultimately strengthening the scientific basis for climate projections and decision-making.

The use of internationally recognised standards and controlled vocabularies is essential for ensuring consistency, interoperability, and scientific rigour in climate and Earth system research. Frameworks such as the Global Climate Observing System (GCOS) provide authoritative definitions of essential climate variables, promoting harmonised observations and facilitating the integration of datasets across regions and platforms. An Essential Climate Variable (ECV) is a physical, chemical or biological variable or a group of linked variables that critically contributes to the characterisation of Earth's climate. GCOS currently specifies 55 ECVs. ECV datasets provide

the empirical evidence needed to understand and predict the evolution of climate, to guide mitigation and adaptation measures, to assess risks and enable attribution of climate events to their underlying causes, and to underpin climate services. They are required to support the work of the IPCC (https://gcos.wmo.int/site/global-climate-observing-system-gcos/essential-climate-variables/about-essential-climate-variables). The Global Change Master Directory (GCMD) further supports data discoverability and interoperability through standardised keywords and metadata structures, enabling efficient data sharing and reuse within the Earth science community. The GCMD Keywords are a hierarchical set of controlled Earth Science vocabularies that help ensure Earth science data, services, and variables are described in a consistent and comprehensive manner, allowing for the precise searching of metadata and the subsequent retrieval of data, services, and variables. Initiated over twenty years ago, GCMD Keywords are periodically analysed for relevancy and will continue to be refined and expanded in response to user needs (https://www.earthdata.nasa.gov/data/tools/gcmd-keyword-viewer). Similarly, the Glossary of Glacier Mass Balance and Related Terms (Cogley et al., 2011) establishes precise and consistent terminology, reducing ambiguity and enhancing comparability among glaciological studies. Collectively, the adoption of such standards underpins reproducible research, improves the reliability of model evaluation and intercomparison, and strengthens the integration of observational data into Earth system models.

2. Selected variables for ESMs

Datasets are divided into five categories (Chapter 2): Surface mass balance, Snow cover, Meteorological data, Catchment discharge, and Subsurface state, for which key project variables were identified during discussions within WP1 and modified during information collection.

2.1. Surface mass balance

List of the crucial variables and their references to Essential Climate Variables (Global Climate Observing System (GCOS)) and to Global Change Master Directory (GCMD) Keywords:

Variable	GCOS hierarchical structure Domain/Subdomain /Observed Variables	GCMD hierarchical structure Term/ Variable_Level_1/Variable_Level_2
GLACIER MASS BALANCE	TERRESTRIAL/CRYOSPHERE/GLACIER MASS CHANGE	GLACIERS/ICE SHEETS/GLACIER MASS BALANCE/ICE SHEET MASS BALANCE/

Glossary of Glacier Mass Balance and Related Terms (Cogley et al., 2011):

Variable	Symbol in Cogley et al., 2011
annual balance at a point	ba
annual accumulation at a point	ca
annual ablation at a point	aa
glacier-wide annual surface mass balance	Ba
glacier-wide summer surface mass balance	Bs
glacier-wide winter surface mass balance	Bw

2.2. Snow cover

List of the crucial variables and their references to Essential Climate Variables (Global Climate Observing System (GCOS)) and to Global Change Master Directory (GCMD) Keywords:

Variable	GCOS hierarchical structure Domain/Subdomain /Observed Variables	GCMD hierarchical structure Term/Variable_Level_1/Variable_Level_2
snow depth	land/cryosphere/snow depth	snow/ice/snow depth/
snow water equivalent	land/cryosphere/snow water equivalent	snow/ice/snow water equivalent/

snow cover area	not defined	not defined

2.3. Meteorological data

List of the crucial variables and their references to Essential Climate Variables (Global Climate Observing System (GCOS)) and to Global Change Master Directory (GCMD) Keywords:

Variable	GCOS hierarchical structure Domain/Subdomain/Observed Variables	GCMD hierarchical structure Term/Variable_Level_1/Variable_Level_2
wind speed	atmosphere/surface/surface wind speed	atmospheric winds/surface winds/wind speed
wind direction	atmosphere/surface/surface wind direction	atmospheric winds/surface winds/wind direction
air temperature	atmosphere/surface/temperature (near surface)	atmospheric temperature/surface temperature/air temperature
net radiation	atmosphere/surface/energy and temperature	atmospheric radiation/net radiation /
upwelling shortwave radiation	atmosphere/surface/surface radiation budget	atmospheric radiation/shortwave radiation /
downwelling shortwave radiation	atmosphere/surface/surface radiation budget	downwelling shortwave radiation
downwelling longwave radiation	atmosphere/surface/surface radiation budget	atmospheric radiation/longwave radiation /
upwelling longwave radiation	atmosphere/surface/surface radiation budget	atmospheric radiation/longwave radiation /
albedo	land/biology/energy	earth science/cryosphere/snow/ice /albedo
24 hour precipitation amount	atmosphere/surface/estimates of liquid and solid precipitation	precipitation/precipitation amount/24 hour precipitation amount
humidity	atmosphere/surface/water vapour (relative humidity - surface)	atmospheric water vapor/water vapor indicators/humidity

2.4. Catchment discharge

List of the crucial variables and their references to Essential Climate Variables (Global Climate Observing System (GCOS)) and to Global Change Master Directory (GCMD) Keywords:

Variable	GCOS hierarchical structure Domain/Subdomain /Observed Variables	GCMD hierarchical structure Term/Variable_Level_1/Variable_Level_2
average flow	land/hydrology/hydrosphere/river discharge	terrestrial hydrosphere/surface water/ surface water processes/ measurements discharge(flow) /average flow
total runoff	land/hydrology/hydrosphere/river discharge	terrestrial hydrosphere/ surface water/ surface water processes/ measurements runoff /total runoff
water level	land/hydrology/hydrosphere/water state	terrestrial hydrosphere/surface water/surface water/ measurements water depth/level
water temperature	land/hydrology/hydrosphere/water quality	terrestrial hydrosphere/surface water/water temperature/
water conductivity	land/hydrology/hydrosphere/water quality	not defined

2.5. Subsurface state

List of the crucial variables and their references to Essential Climate Variables (Global Climate Observing System (GCOS)) and to Global Change Master Directory (GCMD) Keywords:

Variable	GCOS hierarchical structure Domain/Subdomain /Observed Variables	GCMD hierarchical structure Term/Variable_Level_1/Variable_Level_2
methane	atmosphere/atmospheric composition/carbon cycle and other ghgs	atmospheric chemistry/carbon and hydrocarbon compounds/methane
permafrost temperature	land/cryosphere / thermal state of permafrost	frozen ground/permafrost/permafrost temperature
active layer	land/cryosphere / active layer thickness	frozen ground/active layer /
glacier thickness	not defined. change in thickness related to the product glacier elevation change of the variable land/cryosphere/change in glacier mass	cryosphere/glaciers/ice sheets/glacier thickness/ice sheet thickness
cold-to-temperate ice transition surface (cts) depth	not defined	not defined
ice sheet subsurface temperature	not defined	not defined

3. Description of the repositories

Name	Short name	URL	Registry of research data repository at re3data.org	Other certificates	PID used	Licenses	Repo-side verification	Data policy
World Glacier Monitoring Service	WGMS	https://wgms.ch/	Yes (r3d100010627)	CoreTrustSeal	Yes, DOI	Open access with citation requirement (per WGMS data pages) (wgms.ch)	Yes — uses standardised submissions templates and controlled formats (wgms.ch)	Yes — described in documentation/data order & submission pages
GEUS Dataverse	GEUS Dataverse	https://dataverse.geus.dk/	Yes (r3d100013987)	N/A (Dataverse standard)	Yes — DataCite DOIs for published datasets (Dataverse pattern)	Varies by dataset (publisher choice)	No central peer review — depends on submitter	Yes — Dataverse standard policy
Arctic Data Center	Arctic Data Center	https://arcticdata.io/catalog	Yes (r3d100011973)	CoreTrustSeal	Yes — DOIs for catalogue items	Varies per dataset	Yes — metadata & validation by Arctic Data Center	Yes — Data policy on site

PANGAEA	PANGAEA	https://www.pangaea.de/	Yes (r3d100010134)	CoreTrustSeal, WMO Information System, World Data System	Yes — DOIs for all datasets	Clear open licenses (CC)	Yes — curation and quality checks	Yes — data policy on site
SIOS Data Portal	SIOS	https://sios-svalbard.org/	No	N/A	Yes — DOIs via partners' data repositories	Varies by dataset, recommended CC-BY	Yes — data curation depends on partners' data repositories	Yes — data policy
Arktisk klima (MET Norway)	SE Klima	https://seklima.met.no/	No	N/A	Possibly internal PIDs	Varies	Likely only catalogue	Varies
NVE Sildre	Sildre/NVE	https://sildre.nve.no/	No	N/A	No global PIDs	Data terms on site	N/A	Yes — national data policy
Polish Polar DataBase	PPDB	https://ppdb.us.edu.pl/... https://polar.cenagis.edu.pl	Yes (r3d100014555)	N/A	Yes, PIDs and DOI	Clear open licenses (CC)	Depends on installation	N/A
MOSJ	MOSJ	https://mosj.no/en/...	No	N/A	No	Varies	Local indicator data	Local policy
GTN-G GlaThiDa	GlaThiDa	https://www.gtn-g.ch/glathida/	Yes, through WGMS	N/A	Yes, DOIs	Depends	Quality controlled	Yes
Presidi2 Regione VdA	Presidi2 VdA	https://presidi2.regione.vda.it/...	No	N/A	Local identifiers	Varies	No verification beyond portal	Yes

ThingsBoard Cloud	Thingsboard	https://thingsboard.cloud/login	N/A	N/A	No	N/A	Platform, not data repository	N/A
Zenodo	Zenodo	https://zenodo.org/	Yes (r3d100010468)	N/A	Yes, DOI	Varies. Common licenses include CC0 and various Creative Commons (CC) licenses.	Minimal central peer-review.	Yes
National Polar Data Center (NPDC) – NCPOR Data Portal	NCPOR Data Portal	https://data.ncpor.res.in/	No	No	No	Not explicitly stated; users are required to cite the National Polar Data Center and URL when using datasets, and datasets are "copyright © ESSO-NCPOR, Govt of India."	N/A	Yes

4. Data catalogue of in-situ observations

4.1 Italian Alps case of study: Monte Rosa glacier system and the Lys and Évançon glacier catchment

Surface mass balance

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Annual accumulation at a point	Lys Glacier	To be perform	approx 1900 to 2023	N/A	N/A	The accumulation rate can be recovered from the analysis of the LyS ice core collected in 2023 (to be performed) at annual or decadal resolution

Snow cover

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Snow depth	Garstelet and Istituto Mosso (close to Lys Glacier)	data upon request	2024 to present	N/A	N/A	The snow depth stations are inside and outside the LyS Basin and are easily accessible. The use of the data is currently under negotiation. These data are collected by the Laboratorio di Climatologia Alpina of the University of Turin
Snow depth	Lys catchment	https://presidi2.regione.vda.it/str_dataview_download#	2006 to present	.csv	CC-BY	These stations are located within the Lys catchment and at different altitudes
Snow water equivalent	Garstelet and Istituto Mosso (Lys Glacier)	data upon request	2024 to present	N/A	N/A	The SWE stations are the closest available to the LyS Basin and are easily accessible. The use of the data is currently under negotiation. These data are collected by the Laboratorio di Climatologia Alpina of the University of Turin

Meteorological data

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Air temperature	Lys catchment	https://presidi2.regione.vda.it/str_dataview_download#	2001 to present	.csv	CC-BY	These stations are located within the Lys catchment and at different altitudes. Daily data. Additional data are available from the HISTALP project (https://www.zamg.ac.at/histalp/) for the homogenization of meteorological stations within the catchment
24 hour precipitation amount	Lys catchment	https://presidi2.regione.vda.it/str_dataview_download#	2001 to present	.csv	CC-BY	These stations are located within the Lys catchment and at different altitudes. Daily data. Additional data are available from the HISTALP project (https://www.zamg.ac.at/histalp/) for the homogenization of meteorological stations within the catchment
Net radiation	Lys catchment	https://presidi2.regione.vda.it/str_dataview_download#	2006 to present	.csv	CC-BY	These stations are located within the Lys catchment and at different altitudes. Daily data

Wind speed	Lys catchment	https://presidi2.regione.vda.it/str_dataview_download#	2002 to present	.csv	CC-BY	These stations are located within the Lys catchment and at different altitudes. Hourly data
Wind direction	Lys catchment	https://presidi2.regione.vda.it/str_dataview_download#	2002 to present	.csv	CC-BY	These stations are located within the Lys catchment and at different altitudes. Hourly data
Albedo	Lys catchment	data upon request	2024 to present	N/A	N/A	The usage of the data is currently under negotiation
Wind direction	Lys catchment	data upon request	2024 to present	N/A	N/A	The usage of the data is currently under negotiation

Catchment discharge

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Total runoff	Lys catchment	https://presidi2.regione.vda.it/str_dataview_download#	2001 to present	.csv	CC-BY	Daily runoff at different altitudes along the Lys stream
Water level	Lys catchment	https://presidi2.regione.vda.it/str_dataview_download#	2001 to present	.csv	CC-BY	Daily water level at different altitudes along the Lys stream

Subsurface state

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Glacier thickness	Lys Glacier	data upon request (Fabrizio de Blasi)	data collected in 2023	.csv	N/A	Glacier thickness measurement collected in the accumulation area at the summit of the glacier both using mechanical drilling and radar measurements
Permafrost temperature	Lys Glacier	data upon request	N/A	N/A	N/A	Data under negotiation

4.2. Norway study site: Jostedalsbreen glacier system and Nigardsbreen glacier catchment

Surface mass balance

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Glacier-wide annual surface mass balance	Nigardsbreen	Fluctuations of Glaciers (FoG) Database. World Glacier Monitoring Service (WGMS), Zurich, Switzerland. https://doi.org/10.5904/wgms-fog-2025-02b	1961/62-2022/23	.csv, zipped	Open access under the requirement of correct citation	also available at NVE: https://glacier.nve.no/Glacier/viewer/CI/en/nve/ClimateIndicatorInfo/2297?name=Nigardsbreen
Glacier-wide summer surface mass balance	Nigardsbreen	Fluctuations of Glaciers (FoG) Database. World Glacier Monitoring Service (WGMS), Zurich, Switzerland. https://doi.org/10.5904/wgms-fog-2025-02b	1961/62-2022/23	.csv, zipped	Open access under the requirement of correct citation	also available at NVE: https://glacier.nve.no/Glacier/viewer/CI/en/nve/ClimateIndicatorInfo/2297?name=Nigardsbreen

Glacier-wide winter surface mass balance	Nigardsbreen	Fluctuations of Glaciers (FoG) Database. World Glacier Monitoring Service (WGMS), Zurich, Switzerland. https://doi.org/10.5904/wgms-fog-2025-02b	1961/62-2022/23	.csv, zipped	Open access under the requirement of correct citation	also available at NVE: https://glacier.nve.no/Glacier/viewer/CI/en/nve/ClimateIndicatorInfo/2297?name=Nigardsbreen

Snow cover

Variable	**Location**	**DOI, URL, Repository**	**Date (time series, single observations)**	**File format**	**License**	**Comments/description (different name of the variable in the dataset, references, restrictions, etc.)**
Snow depth	Jostedalen - Mjølversgrendi	https://seklima.met.no/days/surface_snow_thickness/custom_period/SN55430/nb/1962-01-01T00:00:00+01:00;2025-11-26T23:59:59+01:00	1962 - 2025	.csv	CC-BY 4.0	gap 2004-2020, but should be continuous, will request information
Snow water equivalent	61.18N,8.20E	N/A	Oct 2024-May 2025	N/A	N/A	Filefjell- distributed SWE measurement (fibreoptic technique)

Meteorological data

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Air temperature	Jostedalen - Mjølversgrendi	https://seklima.met.no/days/mean(air_temperature%20P1D)/custom_period/SN55430/nb/1962-01-01T00:00:00+01:00;2025-11-26T23:59:59+01:00	1962 - 2025	.csv	CC-BY 4.0	gap 2004-2020, but should be continuous, will request information
Wind speed	Jostedalen - Mjølversgrendi	https://seklima.met.no/days/mean(wind_speed%20P1D)/custom_period/SN55430/nb/1962-01-01T00:00:00+01:00;2025-11-26T23:59:59+01:00	1962 - 2004	.csv	CC-BY 4.0	
Humidity	Jostedalen - Mjølversgrendi	https://seklima.met.no/days/mean(relative_humidity%20P1D)/custom_period/SN55430/nb/1962-01-01T00:00:00+01:00;2025-11-26T23:59:59+01:00	1962 - 2025	.csv	CC-BY 4.0	gap 2004-2020, but should be continuous, will request information

24 hour precipitation amount	Jostedalen - Mjølversgrendi	https://seklima.met.no/days/sum(precipitation_amount%20P1D)/custom_period/SN55430/nb/1962-01-01T00:00:00+01:00;2025-11-26T23:59:59+01:00	1962 - 2025	.csv	CC-BY 4.0	gap 2004-2020, but should be continuous, will request information

Catchment discharge

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Total runoff	Nigardsbrevatn	https://sildre.nve.no/station/76.5.0?76.5.0.1001_period=fullPeriod&76.5.0.1001_res=1440&76.5.0.1001_to=2025-11-26&76.5.0.1001_from=1998-06-04&76.5.0.1001_decimals=3	1998 - 2025	.csv	Norwegian License for Open Government Data (NLOD) which is compatible with CC Navngivelse 3.0 Norge (CC BY 3.0)	
Water level	Nigardsbrevatn	https://sildre.nve.no/station/76.5.0?76.5.0.1001_period=fullPeriod&76.5.0.1001_res=1440&76.5.0.1001_to=2025-11-	1998 - 2026	.csv	Norwegian License for Open Government Data (NLOD) which is compatible with CC	

		26&76.5.0.1001_from=1998-06-04&76.5.0.1001_decimals=3			Navngivelse 3.0 Norge (CC BY 3.0)	
Water temperature	Nigardsbrevatn	https://sildre.nve.no/station/76.5.0?76.5.0.1001_period=fullPeriod&76.5.0.1001_res=1440&76.5.0.1001_to=2025-11-26&76.5.0.1001_from=1998-06-04&76.5.0.1001_decimals=3	2014 - 2025	.csv	Norwegian License for Open Government Data (NLOD) which is compatible with CC Navngivelse 3.0 Norge (CC BY 3.0)	

Subsurface state

N/A

4.3. Greenland study sites: Ilulissat and Kangerlussuaq ice sheet catchments

Surface mass balance

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Annual balance at a point	Kangerlussuaq and Ilulissat	https://doi.org/10.18739/A2M61BR5M	1990-2025	.nc, .csv	CC-BY 4.0	Dataset is for entire Greenland. Catchments need to be clipped in postprocessing. Data has mixed temporal resolution: some observations are annual, some are seasonal, some are daily.
Annual ablation at a point	Kangerlussuaq and Ilulissat	https://doi.org/10.18739/A2M61BR5M	1990-2025	.nc, .csv	CC-BY 4.0	Dataset is for entire Greenland. Catchments need to be clipped in postprocessing. Data has mixed temporal resolution: some observations are annual, some are seasonal, some are daily.
Specific mass balance between dates	Kangerlussuaq and Ilulissat	https://doi.org/10.18739/A2M61BR5M	1990-2025	.nc, .csv	CC-BY 4.0	Dataset is for entire Greenland. Catchments need to be clipped in postprocessing. Data has mixed temporal resolution: some observations are annual, some are seasonal, some are daily.

Snow cover

NA

Meteorological data

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Wind speed	Kangerlussuaq (sites KAN_L, KAN_M, KAN_T, KAN_U) and Ilulissat (sites CP1, JAR, SWC)	https://doi.org/10.22008/FK2/IW73UU	KAN_L: 2008-25 KAN_M: 2008-25 KAN_T: 2024-25 KAN_U: 2009-25 CP1: 1995-2025 JAR: 1996-2025 SWC: 1990-2025	.nc and .csv	CC-BY 4.0	Variables referred to as wspd_u and wspd_l
Wind direction	Kangerlussuaq (sites KAN_L, KAN_M, KAN_T, KAN_U) and Ilulissat (sites CP1, JAR, SWC)	https://doi.org/10.22008/FK2/IW73UU	KAN_L: 2008-25 KAN_M: 2008-25 KAN_T: 2024-25 KAN_U: 2009-25 CP1: 1995-2025 JAR: 1996-2025 SWC: 1990-2025	.nc and .csv	CC-BY 4.0	Variables referred to as wdir_u and wdir_l

Air temperature	Kangerlussuaq (sites KAN_L, KAN_M, KAN_T, KAN_U) and Ilulissat (sites CP1, JAR, SWC)	https://doi.org/10.22008/FK2/IW73UU	KAN_L: 2008-25 KAN_M: 2008-25 KAN_T: 2024-25 KAN_U: 2009-25 CP1: 1995-2025 JAR: 1996-2025 SWC: 1990-2025	.nc and .csv	CC-BY 4.0	Variables referred to as t_u and t_l
Downwelling Shortwave Radiation	Kangerlussuaq (sites KAN_L, KAN_M, KAN_T, KAN_U) and Ilulissat (sites CP1, JAR, SWC)	https://doi.org/10.22008/FK2/IW73UU	KAN_L: 2008-25 KAN_M: 2008-25 KAN_T: 2024-25 KAN_U: 2009-25 CP1: 1995-2025 JAR: 1996-2025 SWC: 1990-2025	.nc and .csv	CC-BY 4.0	Variable referred to as usr_cor
Downwelling Shortwave Radiation	Kangerlussuaq (sites KAN_L, KAN_M, KAN_T, KAN_U) and Ilulissat (sites CP1, JAR, SWC)	https://doi.org/10.22008/FK2/IW73UU	KAN_L: 2008-25 KAN_M: 2008-25 KAN_T: 2024-25 KAN_U: 2009-25 CP1: 1995-2025 JAR: 1996-2025 SWC: 1990-2025	.nc and .csv	CC-BY 4.0	Variable referred to as dsr_cor
Downwelling Longwave Radiation	Kangerlussuaq (sites KAN_L, KAN_M, KAN_T, KAN_U) and Ilulissat (sites CP1, JAR, SWC)	https://doi.org/10.22008/FK2/IW73UU	KAN_L: 2008-25 KAN_M: 2008-25 KAN_T: 2024-25 KAN_U: 2009-25 CP1: 1995-2025 JAR: 1996-2025	.nc and .csv	CC-BY 4.0	Variable referred to as ulr

			SWC: 1990-2025			
Upwelling Longwave Radiation	Kangerlussuaq (sites KAN_L, KAN_M, KAN_T, KAN_U) and Ilulissat (sites CP1, JAR, SWC)	https://doi.org/10.22008/FK2/IW73UU	KAN_L: 2008-25 KAN_M: 2008-25 KAN_T: 2024-25 KAN_U: 2009-25 CP1: 1995-2025 JAR: 1996-2025 SWC: 1990-2025	.nc and .csv	CC-BY 4.0	Variable referred to as dlr
Albedo	Kangerlussuaq (sites KAN_L, KAN_M, KAN_T, KAN_U) and Ilulissat (sites CP1, JAR, SWC)	https://doi.org/10.22008/FK2/IW73UU	KAN_L: 2008-25 KAN_M: 2008-25 KAN_T: 2024-25 KAN_U: 2009-25 CP1: 1995-2025 JAR: 1996-2025 SWC: 1990-2025	.nc and .csv	CC-BY 4.0	
24 hour precipitation amount	Kangerlussuaq (sites KAN_L, KAN_M, KAN_T, KAN_U) and Ilulissat (sites CP1, JAR, SWC)	https://doi.org/10.22008/FK2/IW73UU	KAN_L: 2008-25 KAN_M: 2008-25 KAN_T: 2024-25 KAN_U: 2009-25 CP1: 1995-2025 JAR: 1996-2025 SWC: 1990-2025	.nc and .csv	CC-BY 4.0	Variables referred to as rainfall_cor_u and rainfall_cor_l

Humidity	Kangerlussuaq (sites KAN_L, KAN_M, KAN_T, KAN_U) and Ilulissat (sites CP1, JAR, SWC)	https://doi.org/10.22008/FK2/IW73UU	KAN_L: 2008-25 KAN_M: 2008-25 KAN_T: 2024-25 KAN_U: 2009-25 CP1: 1995-2025 JAR: 1996-2025 SWC: 1990-2025	.nc and .csv	CC-BY 4.0	Variables referred to as rh_u and rh_l

Catchment discharge

Variable	**Location**	**DOI, URL, Repository**	**Date (time series, single observations)**	**File format**	**License**	**Comments/description (different name of the variable in the dataset, references, restrictions, etc.)**
Average flow	Kangerlussuaq	https://doi.org/10.22008/FK2/XEHYCM	1949-2023	txt	CC0 1.0	From 2007 - ongoing monitoring. For the period 1976-2006, reconstruction was based on a nearby catchment. For the period 1949-1975, reconstruction was based on local air temperature
Total runoff	Kangerlussuaq	https://doi.org/10.22008/FK2/XEHYCM	1949-2023	txt	CC0 1.0	From 2007 - ongoing monitoring. For the period 1976-2006, reconstruction was based on a nearby catchment. For the period 1949-1975, reconstruction was based on local air temperature
Water level	Kangerlussuaq	https://doi.org/10.22008/FK2/XEHYCM	1949-2023	txt	CC0 1.0	From 2007 - ongoing monitoring. For the period 1976-2006, reconstruction was based on a nearby catchment. For the period 1949-1975, reconstruction was based on local air temperature

Subsurface state

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Subsurface temperatures	Kangerlussuaq, Ilulissat	https://doi.org/10.22008/FK2/IW73UU	1990-2025	.nc, .csv	CC BY 4.0	Hourly resolution
Subsurface temperatures	Kangerlussuaq, Ilulissat	https://doi.org/10.18739/A2M61BR5M	1990-2024	.nc, .csv	CC BY 4.0	Daily resolution, includes the source above plus many other data sources

4.4. Svalbard study sites: the Austre Brøggerbreen and Werenskioldbreen glacier catchments and the Fuglebekken catchment

Surface mass balance

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Glacier mass balance	Werenskiold breen	doi.org/10.5904/wgms-fog-2021-05	1999 - 2002, 2009 - 2023	.csv	Open access under the requirement of correct citation	References: Ignatiuk, Dariusz & Błaszczyk, Małgorzata & Budzik, Tomasz & Grabiec, Mariusz & Jania, Jacek & Kondracka, Marta & Laska, Michał & Małarzewski, Łukasz & Stachnik, Lukasz. (2022). A decade of glaciological and meteorological observations in the Arctic (Werenskioldbreen,

						Svalbard). https://essd.copernicus.org/articles/14/2487/2022/essd-14-2487-2022.pdf
Annual balance at a point	Werenskiold breen	https://ppdb.us.edu.pl/geonetwork/srv/pol/catalog.search;jsessionid=99E530A297F42BE7442527E35670E5EF#/metadata/22ec7f15-4867-47c3-9e29-6494c81f953f , Polish Polar DataBase	2009 - 2020	.csv	CC BY-NC 3.0	as above
Annual accumulation at a point	Werenskiold breen	https://ppdb.us.edu.pl/geonetwork/srv/pol/catalog.search;jsessionid=99E530A297F42BE7442527E35670E5EF#/metadata/22ec7f15-4867-47c3-9e29-6494c81f953f , Polish Polar DataBase	2009 - 2020	.csv	CC BY-NC 3.0	as above
Annual ablation at a point	Werenskiold breen	https://ppdb.us.edu.pl/geonetwork/srv/pol/catalog.search;jsessionid=99E530A297F42BE7442527E35670E5EF#/metadata/22ec7f15-4867-47c3-9e29-6494c81f953f , Polish Polar DataBase	2009 - 2020	.csv	CC BY-NC 3.0	as above
Glacier-wide annual surface mass balance	Werenskiold breen	https://ppdb.us.edu.pl/geonetwork/srv/eng/catalog.search#/metadata/5465a634-1c65-456e-b190-c11d75fa094d	1999 - 2002, 2009 - 2018	.csv, .nc	CC BY-NC-SA 4.0	as above
Glacier-wide summer	Werenskiold breen	https://ppdb.us.edu.pl/geonetwork/srv/eng/catalog.search#/metadata/5465a634-	1999 - 2002, 2009 - 2018	.csv, .nc	C BY-NC-SA 4.0	as above

surface mass balance		1c65-456e-b190-c11d75fa094d, Polish Polar DataBase				
Glacier-wide winter surface mass balance	Werenskiold breen	https://ppdb.us.edu.pl/geonetwork/srv/eng/catalog.search#/metadata/5465a634-1c65-456e-b190-c11d75fa094d, Polish Polar DataBase	1999 - 2002, 2009 - 2018	.csv, .nc	C BY-NC-SA 4.0	as above
Glacier mass balance	Austre Broggerbreen	https://mosj.no/en/indikator/climate/land/mass-balance-for-glaciers-in-svalbard/	1968 to present	.csv	Open access	
Glacier-wide annual surface mass balance	Austre Broggerbreen	https://mosj.no/en/indikator/climate/land/mass-balance-for-glaciers-in-svalbard/	1968 to present	.csv	Open access	
Glacier-wide annual surface mass balance	Austre Broggerbreen	https://doi.org/10.5904/wgms-fog-2025-02b	1966/67 to present	.csv	Open access under the requirement of correct citation	
Glacier-wide summer surface mass balance	Austre Broggerbreen	https://doi.org/10.5904/wgms-fog-2025-02b	1966/67 to present	.csv	Open access under the requirement of correct citation	

Glacier-wide winter surface mass balance	Austre Broggerbreen	https://doi.org/10.5904/wgms-fog-2025-02b	1966/67 to present	.csv	Open access under the requirement of correct citation	
Annual balance at a point	Austre Broggerbreen	https://doi.org/10.5904/wgms-fog-2025-02b	2000 - 2009	.csv	Open access under the requirement of correct citation	between 11 and 13 pts per year
Annual accumulation at a point	Austre Broggerbreen	available on request federico.scoto@unive.it	2012 - 2025	.csv	Available on request	Summit accumulation point

Snow cover

Variable	**Location**	**DOI, URL, Repository**	**Date (time series, single observations)**	**File format**	**License**	**Comments/description (different name of the variable in the dataset, references, restrictions, etc.)**
Snow depth	Werenskiold breen	10.5281/zenodo.5792167	2009-2019	.csv	CC-BY 4.0	References: Ignatiuk, Dariusz & Błaszczyk, Małgorzata & Budzik, Tomasz & Grabiec, Mariusz & Jania, Jacek & Kondracka, Marta & Laska, Michał & Małarzewski, Łukasz & Stachnik, Lukasz. (2022). A decade of glaciological and meteorological observations in the Arctic (Werenskioldbreen, Svalbard).

						https://essd.copernicus.org/articles/14/2487/2022/essd-14-2487-2022.pdf
Snow water equivalent	Werenskiold breen	https://ppdb.us.edu.pl/geonetwork/srv/eng/catalog.search#/metadata/622ca04b-5403-4070-89d0-39702810f566	2009-2019	.csv	CC-BY 4.0	as above
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	2013.05.15	.rad, .rd3, .cor, RINEX	CC BY-NC-ND	Raw 800 MHz GPR data covering representative profiles of Werenskioldbreen (the entire altitude range), referring to previous studies. Survey conducted on the seasonal snow cover deposited on the glacier surface during the period of maximum accumulation. References: - Laska, M. S., Grabiec, M., Ignatiuk, D., & Budzik, T. S. (2017). Snow deposition patterns on southern Spitsbergen glaciers, Svalbard, in relation to recent meteorological conditions and local topography. Geografiska Annaler Series A-Physical Geography, 99, Article 3. https://doi.org/10.1080/04353676.2017.1327321
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	2014.05.20	.rad, .rd3, .cor, RINEX	N/A	Raw 800 MHz GPR data covering representative profiles of Werenskioldbreen (the entire altitude range), referring to previous studies. Survey conducted on the seasonal snow cover deposited on

						the glacier surface during the period of maximum accumulation
Snow depth	Werenskiold breen	Available on request: dariusz.ignatiuk@us.edu.pl	2015.04.07	.rad, .rd3, .cor, RINEX	N/A	Raw 800 MHz GPR data covering representative profiles of Werenskioldbreen (the entire altitude range), referring to previous studies. Survey conducted on the seasonal snow cover deposited on the glacier surface during the period of maximum accumulation
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	2015.05.15	.rad, .rd3, .cor, RINEX	N/A	Raw 800 MHz GPR data covering representative profiles of Werenskioldbreen (the entire altitude range), referring to previous studies. Survey conducted on the seasonal snow cover deposited on the glacier surface during the period of maximum accumulation
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	June - August 2012	.csv	N/A	Five measurement sessions covering snow depth and physical characteristics of the surface layer of the snow cover during the ablation season. Measurements were taken at 11 points corresponding to the ablation stake network at that time
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	May 2013	.csv	N/A	Fieldwork covering snow depth and physical characteristics of the surface layer of the snow cover during the maximum accumulation. Measurements were taken at 11 points corresponding to the ablation stake network at that time. Applied for GPR data validation. References: - Laska, M. S., Grabiec, M., Ignatiuk, D., & Budzik, T.

						S. (2017). Snow deposition patterns on southern Spitsbergen glaciers, Svalbard, in relation to recent meteorological conditions and local topography. Geografiska Annaler Series A-Physical Geography, 99, Article 3. https://doi.org/10.1080/04353676.2017.1327321
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	May 2014	.csv	N/A	Two measurement sessions covering snow depth and physical characteristics of the surface layer of the snow cover during the maximum accumulation. Measurements were taken at 11 points corresponding to the ablation stake network at that time. Applied for GPR data validation
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	May 2015	.csv	N/A	Fieldwork covering snow depth and physical characteristics of the surface layer of the snow cover during the maximum accumulation. Measurements were taken at 11 points corresponding to the ablation stake network at that time. Applied for GPR data validation
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	May-June 2015	.csv	N/A	Three measurement sessions covering snow depth and physical characteristics of the surface layer of the snow cover during the maximum accumulation. Measurements were taken at 11 points corresponding to the ablation stake network at that time. Applied for GPR data validation
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	May 2012	.csv	N/A	Two snow pits with detailed stratification of the seasonal snow cover

Snow water equivalent	Werenskiold breen	Available on request: michal.laska@us.edu.pl	May 2012	.csv	N/A	as above
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	May 2013	.csv	N/A	Two snow pits with detailed stratification of the seasonal snow cover (consintent with Fierz et al. 2009)
Snow water equivalent	Werenskiold breen	Available on request: michal.laska@us.edu.pl	May 2013	.csv	N/A	as above
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	May 2015	.csv	N/A	Two snow pits with detailed stratification of the seasonal snow cover (consistent with Fierz et al. 2009)
Snow water equivalent	Werenskiold breen	Available on request: michal.laska@us.edu.pl	May 2015	.csv	N/A	as above
Snow depth	Werenskiold breen	https://ppdb.us.edu.pl/geonetwork/srv/eng/catalog.search;jsessionid=6AFD004670A736603E754B227BCB11ED#/metadata/c8479c71-8ee1-40e8-991d-29c9f1e2f149	April 2015	.csv	N/A	Snow cores in vincinity of the ablation stakes. Applied for GPR data validation
Snow water equivalent	Werenskiold breen	https://ppdb.us.edu.pl/geonetwork/srv/eng/catalog.search;jsessionid=6AFD004670A736603E754B227BCB11ED#/metadata/c8479c7	April 2015	.csv	N/A	as above

		1-8ee1-40e8-991d-29c9f1e2f149				
Snow depth	Werenskiold breen	Available on request: michal.laska@us.edu.pl	April 2018	.csv	N/A	Snow cores in vicinity of the ablation stakes
Snow water equivalent	Werenskiold breen	Available on request: michal.laska@us.edu.pl	April 2018	.csv	N/A	as above
Snow depth	Werenskiold breen	Available on request: dariusz.ignatiuk@us.edu.pl	April 2022	.csv	N/A	Snow cores in vicinity of the ablation stakes
Snow water equivalent	Werenskiold breen	Available on request: dariusz.ignatiuk@us.edu.pl	April 2022	.csv	N/A	as above
Snow depth	Werenskiold breen	https://thingsboard.cloud/dashboard/ac31b1f0-cf98-11ed-a776-91b88e4188de?publicId=d7cda030-c246-11ed-9fed-91622243936c&state=W3siaWQiOiJkZWZhdWx0IiwicGFyYW1zIjp7fX0seyJpZCI6InNlbnNvckRldGFpbHMiLCJwYXJhbXMiOnsiZW50aXR5SWQiOnsiaWQiOiI4ZjRlYWJjMC1kNDYwLTExZWQtYjc0Ny0z	April 2024 to present	.csv	N/A	Air temperature at one hour resolution from upper parts of the ablation zone. Data derived from the ultrasonic SPICE sensor (with some datagaps)

		ZDIyODRlZmY0ZjliLCJlbnRpdHlUeXBlIjoiREVWSUNFInOsImVudGl0eU5hbWUiOiIzMDA0MzQwNjE1NTA4NTAiLCJlbnRpdHlMYWJlbCI6IlNQSUNFLTM1In19XQ%253D%253D				
Snow depth	Austre Broggerbreen	Available on request: andrea.spolaor@cnr.it (point) and jack.kohler@npolar.no (all glacier)	2012 to present	.csv	upon request	Snow depth at the summit of the glacier during the maximum accumulation period.
Snow water equivalent	Austre Broggerbreen	Available on request: andrea.spolaor@cnr.it (point) and jack.kohler@npolar.no (all glacier)	2012 to present	.csv	upon request	SWE at the summit of the glacier during the maximum accumulation period.
Snow depth	West Bayelva	Available on request: andrea.spolaor@cnr.it\ federico.scoto@unive.it	2020 to present	.csv	upon request	Snow depth automatic measurements in the coastal area. https://www.frontiersin.org/journals/earth-science/articles/10.3389/feart.2023.1123981/full
Snow cover area	Austre Broggerbreen	Available on request: roberto.salzano@cnr.it	2015 to present	NetCDF	upon request	

Snow water equivalent	West Bayelva	Available on request: andrea.spolaor@cnr.it\ federico.scoto@unive.it	2020 to present	.csv	upon request	Snow water equivalent from automatic measurements in the coastal area. https://www.frontiersin.org/journals/earth-science/articles/10.3389/feart.2023.1123981/full
Snow depth	Fuglebergsletta	Available on request: michal.laska@us.edu.pl	April 2015	.rad, .rd3, .cor, RINEX		Raw 800 MHz GPR data of the snow depth and ice thickness along the coastline of Isbjornhamna
Snow depth	Fuglebekken catchment	Available on request: luks@igf.edu.pl data publication planned for Q3 2026	1983-2025	.csv	N/A	Daily manual measurementa at the Polish Polar Station Hornsund meteorological station site
Snow depth	Fuglebekken catchment	Available on request: luks@igf.edu.pl data publication planned for Q3 2026	2014-2025	.csv	N/A	Weekly manual measerment in 20 distributed points in the coastal part of the Fuglebekken catchment
Snow depth	Fuglebekken catchment	Available on request: luks@igf.edu.pl data publication planned for Q3 2026	2023-2025	.csv	N/A	Automatic measuremnets of the snow depth at 3 snow stations on the slop
Snow Water Equivalent	Fuglebekken catchment	Available on request: luks@igf.edu.pl data publication planned for Q3 2026	1983-2025	.csv	N/A	Every 5 days manual measurementa at the Polish Polar Station Hornsund meteorological station site
Snow Water Equivalent	Fuglebekken catchment	Available on request: luks@igf.edu.pl data publication planned for Q3 2026	2014-2025	.csv	N/A	Weekly manual measerment in 20 distributed points in the coastal part of the Fuglebekken catchment

Snow depth	Ny Ålesund	https://seklima.met.no/days/surface_snow_thickness/custom_period/SN99910/nb/2009-01-01T00:00:00+01:00;2025-11-26T23:59:59+01:00	2009-present	.csv	CC-BY 4.0	
Snow depth	Adventdalen	TBD	April 2025	.csv	CC-BY 4.0	Snow depth from field campaign in Adventdalen along stretches alligned with Icesat-2 transects

Meteorological data

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Air temperature	Hornsund	https://sios-svalbard.org/metsis/metadata/IG_PAS_SIOS_SCD_1_3_AIR_TEMPERATURE_PT1M	2018-	.nc	CC BY-NC-SA 4.0	minute time interval
Air temperature	Hornsund	https://doi.org/10.1594/PANGAEA.909073	1979-2018	.tab (tsv)	CC BY-NC-SA 4.0	maximum diurnal temperature; Wawrzyniak, T. and Osuch, M.: A 40-year High Arctic climatological dataset of the Polish Polar Station Hornsund (SW Spitsbergen, Svalbard), Earth Syst. Sci. Data, 12, 805–815, https://doi.org/10.5194/essd-12-805-2020, 2020
Air temperature	Hornsund	https://doi.org/10.1594/PANGAEA.909074	1979-2018	.tab (tsv)	CC BY-NC-SA 4.0	mean diurnal temperature; Wawrzyniak, T. and Osuch, M.: A 40-year High Arctic climatological dataset of the Polish Polar Station Hornsund (SW Spitsbergen, Svalbard), Earth Syst. Sci. Data, 12, 805–815, https://doi.org/10.5194/essd-12-805-2020, 2020

Air temperature	Hornsund	https://doi.org/10.1594/PANGAEA.909075	1979-2018	.tab (tsv)	CC BY-NC-SA 4.0	minimum diurnal temperature; Wawrzyniak, T. and Osuch, M.: A 40-year High Arctic climatological dataset of the Polish Polar Station Hornsund (SW Spitsbergen, Svalbard), Earth Syst. Sci. Data, 12, 805–815, https://doi.org/10.5194/essd-12-805-2020, 2020
24 hour precipitation amount	Hornsund	https://sios-svalbard.org/metsis/metadata/IG_PAS_SIOS_SCD_1_7_24_HOUR_PREC	2018-	.nc	CC BY-NC-SA 4.0	
24 hour precipitation amount	Hornsund	https://doi.org/10.1594/PANGAEA.909070	1979-2018	.tab (tsv)	CC BY-NC-SA 4.0	Wawrzyniak, T. and Osuch, M.: A 40-year High Arctic climatological dataset of the Polish Polar Station Hornsund (SW Spitsbergen, Svalbard), Earth Syst. Sci. Data, 12, 805–815, https://doi.org/10.5194/essd-12-805-2020, 2020
Humidity	Hornsund	https://sios-svalbard.org/metsis/metadata/IG_PAS_SIOS_SCD_1_8_HUMIDITY_PT1M	2018-	.nc	CC BY-NC-SA 4.0	minute time interval

Humidity	Hornsund	https://doi.org/10.1594/PANGAEA.909071	1983-2018	.tab (tsv)	CC BY-NC-SA 4.0	daily mean relative humidity; Wawrzyniak, T. and Osuch, M.: A 40-year High Arctic climatological dataset of the Polish Polar Station Hornsund (SW Spitsbergen, Svalbard), Earth Syst. Sci. Data, 12, 805–815, https://doi.org/10.5194/essd-12-805-2020, 2020
Wind speed	Hornsund	https://sios-svalbard.org/metsis/metadata/IG_PAS_SIOS_SCD_1_1_WIND_SPEED_PT1M	2018-	.nc	CC BY-NC-SA 4.0	minute time interval
Wind speed	Hornsund	https://doi.org/10.1594/PANGAEA.909078	1983-2018	.tab (tsv)	CC BY-NC-SA 4.0	daily mean wind speed; Wawrzyniak, T. and Osuch, M.: A 40-year High Arctic climatological dataset of the Polish Polar Station Hornsund (SW Spitsbergen, Svalbard), Earth Syst. Sci. Data, 12, 805–815, https://doi.org/10.5194/essd-12-805-2020, 2020
Wind direction	Hornsund	https://sios-svalbard.org/metsis/metadata/IG_PAS_SIOS_SCD_1_2_WIND_DIRECTION_PT1M	2018-	.nc	CC BY-NC-SA 4.0	minute time interval

Wind direction	Hornsund	https://doi.org/10.1594/PANGAEA.909077	1983-2018	.tab (tsv)	CC BY-NC-SA 4.0	daily mean wind direction; Wawrzyniak, T. and Osuch, M.: A 40-year High Arctic climatological dataset of the Polish Polar Station Hornsund (SW Spitsbergen, Svalbard), Earth Syst. Sci. Data, 12, 805–815, https://doi.org/10.5194/essd-12-805-2020, 2020
Net radiation	Hornsund	https://sios-svalbard.org/metsis/metadata/IG_PAS_SIOS_SCD_1_4_NET_RADIATION_PT1M	2017-	.nc	CC BY-NC-SA 4.0	minute time interval
Downwelling Shortwave Radiation	Hornsund	https://sios-svalbard.org/metsis/metadata/IG_PAS_SIOS_SCD_1_5_SHORTWAVE_RADIATION_PT1M	2017-	.nc	CC BY-NC-SA 4.0	minute time interval
Air temperature	Fuglebekken catchment	Available on request: luks@igf.edu.pl data publication planned for Q3 2026	2023-2025	.csv	N/A	Air temperature at 5 ponts in the vertical profile from the botto to the summit of the Fugleberget

Wind speed	West Bayelva	Available on request: andrea.spolaor@cnr.it\federico.scoto@unive.it	2020 to present	.csv	upon request	Wind speed at minute time resolution from the Gruvebadet Aerosol site. Additional data are also available at different altitudes from the Climate Change Tower upon request
Wind direction	West Bayelva	Available on request: andrea.spolaor@cnr.it\federico.scoto@unive.it	2020 to present	.csv	upon request	Wind direction at minute time resolution from the Gruvebadet Aerosol site. Additional data are also available at different altitudes from the Climate Change Tower upon request
Air temperature	West Bayelva	Available on request: andrea.spolaor@cnr.it\federico.scoto@unive.it	2020 to present	.csv	upon request	Air and snow Temperature at 10 minutes time resolution from the Gruvebadet Aerosol site. Additional data are also available at different altitudes and with a longer time series (from 2010) from the Climate Change Tower upon request
Upwelling Shortwave Radiation	West Bayelva	Available on request: andrea.spolaor@cnr.it\federico.scoto@unive.it	2020 to present	.csv	upon request	Net radiation at minute time resolution from the Gruvebadet Aerosol site. Additional data are also available at different altitudes from the Climate Change Tower upon request
Downwelling Shortwave Radiation	West Bayelva	Available on request: andrea.spolaor@cnr.it\federico.scoto@unive.it	2020 to present	.csv	upon request	Albedo at minute time resolution from the Gruvebadet Aerosol site. Additional data are also available at different altitudes from the Climate Change Tower upon request
Air temperature	Werenskiold breen	Available on request: michal.laska@us.edu.pl	April 2022 - April 2023	.csv	N/A	Air temperature at one hour resolution from upper parts of the ablation zone

Humidity	Werenskiold breen	Available on request: michal.laska@us.edu.pl	April 2022 - April 2023	.csv	N/A	Air temperature at one hour resolution from upper parts of the ablation zone
Albedo	Werenskiold breen	Available on request: michal.laska@us.edu.pl	June - August 2012	.csv	N/A	Point measurements of the snow abledo, performed at 11 points corresponding to the ablation stake network at that time, in during the progressive melting of the snow cover
Air temperature	Werenskiold breen	https://thingsboard.cloud/dashboard/ac31b1f0-cf98-11ed-a776-91b88e4188de?publicId=d7cda030-c246-11ed-9fed-91622243936c&state=W3siaWQiOiJkZWZhdWx0IiwicGFyYW1zIjp7fX0seyJpZCI6InNlbnNvckRldGFpbHMiLCJwYXJhbXMiOnsiZW50aXR5SWQiOnsiaWQiOiI4ZjRlYWJjMC1kNDYwLTExZWQtYjc0NyOzZDIyODRlZmY0ZjliLCJlbnRpdHlUeXBlIjoiREVWSUNFIn0sImVudGl0eU5hbWUiOiIzMDA0MzQwNjE1NTA4NTAiLCJlbnRpdHlMYWJlbCI6IlNQSUNFLTM1In19XQ%253D%253D	April 2024 to present	.csv	CC-BY 4.0	Air temperature at one hour resolution from upper parts of the ablation zone. Data derived from the ultrasonic SPICE sensor (with some datagaps)
Air temperature	Ny Ålesund	https://seklima.met.no/days/mean(air_temperature%20P1D)/custom_period/SN99910/nb/1974-01-01T00:00:00+01:00;2025-11-26T23:59:59+01:00	1974-present	.csv	CC-BY 4.0	

Wind speed	Ny Ålesund	https://seklima.met.no/days/mean(wind_speed%20P1D)/custom_period/SN99910/nb/1974-01-01T00:00:00+01:00;2025-11-26T23:59:59+01:00	1974-present	.csv	CC-BY 4.0	
24 hour precipitation amount	Ny Ålesund	https://seklima.met.no/days/sum(precipitation_amount%20P1D)/custom_period/SN99910/nb/1974-01-01T00:00:00+01:00;2025-11-26T23:59:59+01:00	1974-present	.csv	CC-BY 4.0	
Humidity	Ny Ålesund	https://seklima.met.no/days/mean(relative_humidity%20P1D)/custom_period/SN99910/nb/1974-01-01T00:00:00+01:00;2025-11-26T23:59:59+01:00	1974-present	.csv	CC-BY 4.0	
Wind Speed	Werenskiold breen	https://zenodo.org/records/6528321	2009-2020	NetCDF	CC-BY 4.0	There may be gaps in the data series. References: Ignatiuk, Dariusz & Błaszczyk, Małgorzata & Budzik, Tomasz & Grabiec, Mariusz & Jania, Jacek & Kondracka, Marta & Laska, Michał & Małarzewski, Łukasz & Stachnik, Lukasz. (2022). A decade of glaciological and meteorological observations in the Arctic (Werenskioldbreen, Svalbard). https://essd.copernicus.org/articles/14/2487/2022/essd-14-2487-2022.pdf

Air Temperature	Werenskiold breen	https://zenodo.org/records/6528321	2009-2020	NetCDF	CC-BY 4.0	As above
Upwelling Shortwave Radiation	Werenskiold breen	https://zenodo.org/records/6528321	2009-2020	NetCDF	CC-BY 4.0	As above
Downwelling Shortwave Radiation	Werenskiold breen	https://zenodo.org/records/6528321	2009-2020	NetCDF	CC-BY 4.0	As above
Upwelling Longwave Radiation	Werenskiold breen	https://zenodo.org/records/6528321	2009-2020	NetCDF	CC-BY 4.0	As above
Downwelling Longwave Radiation	Werenskiold breen	https://zenodo.org/records/6528321	2009-2020	NetCDF	CC-BY 4.0	As above

Humidity	Werenskiold breen	https://zenodo.org/records/6528321	2009-2020	NetCDF	CC-BY 4.0	As above
Wind Speed	Bayelva	https://doi.org/10.5194/essd-10-355-2018 ; https://doi.org/10.1594/PANGAEA.898683 ; https://doi.org/10.1594/PANGAEA.927403 ; https://doi.org/10.1594/PANGAEA.936272 ; https://doi.org/10.1594/PANGAEA.948950 ; https://doi.org/10.1594/PANGAEA.961672 ; https://doi.org/10.1594/PANGAEA.968498 ; https://doi.org/10.1594/PANGAEA.980876	1998-2024	.tab	1998-2017 CC-BY-3.0; 2018-2024 CC-BY-4.0	

Wind Direction	Bayelva	https://doi.org/10.5194/essd-10-355-2018 ; https://doi.org/10.1594/PANGAEA.898683 ; https://doi.org/10.1594/PANGAEA.927403 ; https://doi.org/10.1594/PANGAEA.936272 ; https://doi.org/10.1594/PANGAEA.948950 ; https://doi.org/10.1594/PANGAEA.961672 ; https://doi.org/10.1594/PANGAEA.968498 ; https://doi.org/10.1594/PANGAEA.980876	1998-2024	.tab	1998-2017 CC-BY-3.0; 2018-2024 CC-BY-4.0	

Air Temperature	Bayelva	https://doi.org/10.5194/essd-10-355-2018 ; https://doi.org/10.1594/PANGAEA.898683 ; https://doi.org/10.1594/PANGAEA.927403 ; https://doi.org/10.1594/PANGAEA.936272 ; https://doi.org/10.1594/PANGAEA.948950 ; https://doi.org/10.1594/PANGAEA.961672 ; https://doi.org/10.1594/PANGAEA.968498 ; https://doi.org/10.1594/PANGAEA.980876	1998-2024	.tab	1998-2017 CC-BY-3.0; 2018-2024 CC-BY-4.0	

Net Radiation	Bayelva	https://doi.org/10.5194/essd-10-355-2018 ; https://doi.org/10.1594/PANGAEA.898683 ; https://doi.org/10.1594/PANGAEA.927403 ; https://doi.org/10.1594/PANGAEA.936272 ; https://doi.org/10.1594/PANGAEA.948950 ; https://doi.org/10.1594/PANGAEA.961672 ; https://doi.org/10.1594/PANGAEA.968498 ; https://doi.org/10.1594/PANGAEA.980876	1998-2024	.tab	1998-2017 CC-BY-3.0; 2018-2024 CC-BY-4.0	

Humidity	Bayelva	https://doi.org/10.5194/essd-10-355-2018 ; https://doi.org/10.1594/PANGAEA.898683 ; https://doi.org/10.1594/PANGAEA.927403 ; https://doi.org/10.1594/PANGAEA.936272 ; https://doi.org/10.1594/PANGAEA.948950 ; https://doi.org/10.1594/PANGAEA.961672 ; https://doi.org/10.1594/PANGAEA.968498 ; https://doi.org/10.1594/PANGAEA.980876	1998-2024	.tab	1998-2017 CC-BY-3.0; 2018-2024 CC-BY-4.0	

Upwelling Shortwave Radiation	Bayelva	https://doi.org/10.5194/essd-10-355-2018 ; https://doi.org/10.1594/PANGAEA.898683 ; https://doi.org/10.1594/PANGAEA.927403 ; https://doi.org/10.1594/PANGAEA.936272 ; https://doi.org/10.1594/PANGAEA.948950 ; https://doi.org/10.1594/PANGAEA.961672 ; https://doi.org/10.1594/PANGAEA.968498 ; https://doi.org/10.1594/PANGAEA.980876	1998-2024	.tab	1998-2017 CC-BY-3.0; 2018-2024 CC-BY-4.0	

Downwelling Shortwave Radiation	Bayelva	https://doi.org/10.5194/essd-10-355-2018 ; https://doi.org/10.1594/PANGAEA.898683 ; https://doi.org/10.1594/PANGAEA.927403 ; https://doi.org/10.1594/PANGAEA.936272 ; https://doi.org/10.1594/PANGAEA.948950 ; https://doi.org/10.1594/PANGAEA.961672 ; https://doi.org/10.1594/PANGAEA.968498 ; https://doi.org/10.1594/PANGAEA.980876	1998-2024	.tab	1998-2017 CC-BY-3.0; 2018-2024 CC-BY-4.0	

Upwelling Longwave Radiation	Bayelva	https://doi.org/10.5194/essd-10-355-2018 ; https://doi.org/10.1594/PANGAEA.898683 ; https://doi.org/10.1594/PANGAEA.927403 ; https://doi.org/10.1594/PANGAEA.936272 ; https://doi.org/10.1594/PANGAEA.948950 ; https://doi.org/10.1594/PANGAEA.961672 ; https://doi.org/10.1594/PANGAEA.968498 ; https://doi.org/10.1594/PANGAEA.980876	1998-2024	.tab	1998-2017 CC-BY-3.0; 2018-2024 CC-BY-4.0	

Downwelling Longwave Radiation	Bayelva	https://doi.org/10.5194/essd-10-355-2018 ; https://doi.org/10.1594/PANGAEA.898683 ; https://doi.org/10.1594/PANGAEA.927403 ; https://doi.org/10.1594/PANGAEA.936272 ; https://doi.org/10.1594/PANGAEA.948950 ; https://doi.org/10.1594/PANGAEA.961672 ; https://doi.org/10.1594/PANGAEA.968498 ; https://doi.org/10.1594/PANGAEA.980876	1998-2024	.tab	1998-2017 CC-BY-3.0; 2018-2024 CC-BY-4.0	

Catchment discharge

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Total runoff	Bayelva	Upon request to Ilaria Banschi (ilaria.banesci@cnr.it)	N/A	N/A	N/A	
Total runoff	Bayelva	https://sildre.nve.no/station/400.1.0?params=1001,1000,1003&1001v1=1440&1000v0=144	1989 to present	.csv	Norwegian License for Open Government	gap 2019-2023 (new station, may have homogeneity break)

		0&1000v3=1440&1003v2=1440&1003v3=1440&1003v1=1440&17v1=1440&9104v1=1440&2v1=1440&9100v1=1440&1006v1=1440&4v1=1440&400.1.0_tab=1			Data (NLOD) which is compatible with CC Navngivelse 3.0 Norge (CC BY 3.0)	
Water level	Bayelva	https://sildre.nve.no/station/400.1.0?params=1001,1000,1003&1001v1=1440&1000v0=1440&1000v3=1440&1003v2=1440&1003v3=1440&1003v1=1440&17v1=1440&9104v1=1440&2v1=1440&9100v1=1440&1006v1=1440&4v1=1440&400.1.0_tab=1	1989 to present	.csv	Norwegian License for Open Government Data (NLOD) which is compatible with CC Navngivelse 3.0 Norge (CC BY 3.0)	gap 2019-2023 (new station, may have homogeneity break)
Water temperature	Bayelva	https://sildre.nve.no/station/400.1.0?params=1001,1000,1003&1001v1=1440&1000v0=1440&1000v3=1440&1003v2=1440&1003v3=1440&1003v1=1440&17v1=1440&9104v1=1440&2v1=1440&9100v1=1440&1006v1=1440&4v1=1440&400.1.0_tab=1	1991 topresent	.csv	Norwegian License for Open Government Data (NLOD) which is compatible with CC Navngivelse 3.0 Norge (CC BY 3.0)	gap 2019-2023 (new station, may have homogeneity break)

Total runoff	Werenskiold breen /Breelva	Available on request (publication planned for 2026): Elżbieta Łepkowska: elzbieta.majchrowska@us.edu.pl	1970s onwards (some gaps)	N/A	N/A	data available for 1970–1974, 1979–1980, 1983, 1985–1986, 1988, 1998, and 2007–2013, 2017, 2019–2020, 2023–2025 total runoff for 18 hydrologically active seasons are described at: https://ppdb.us.edu.pl/geonetwork/srv/pol/catalog.search#/metadata/e395aa85-8d7e-44bf-ab94-bfd8453a5add
Discharge	Fuglebekken	Available on request (publication planned for 2026) Marzena Osuch Marz@igf.edu.pl	2014 onwards	N/A	N/A	Data available for 2014-2025, measurements made with Nivus PCMF during hydrologically active seasons (mid June-mid September)
Water level	Fuglebekken	Available on request (publication planned for 2026) Marzena Osuch Marz@igf.edu.pl	2014 onwards	N/A	N/A	Data available for 2014-2025, measurements made with Nivus PCMF during hydrologically active seasons (mid June-mid September)

Streamwater temperature	Fuglebekken	Available on request (publication planned for 2026) Marzena Osuch Marz@igf.edu.pl	2014 onwards	N/A	N/A	Data available for 2014-2025, measurements made with Nivus PCMF during hydrologically active seasons (mid June-mid September)
Average flow	Werenskioldbreen /Breelva	Available on request (publication planned for 2026): Elżbieta Łepkowska: elzbieta.majchrowska@us.edu.pl	1970s onwards (some gaps)	N/A	N/A	data available for 1970–1974, 1979–1980, 1983, 1985–1986, 1988, 1998, and 2007–2013, 2017, 2019–2020, 2023–2025 avg. flow for 18 hydrologically active seasons are described at: https://ppdb.us.edu.pl/geonetwork/srv/pol/catalog.search#/metadata/e395aa85-8d7e-44bf-ab94-bfd8453a5add
Water level	Werenskioldbreen /Breelva	Available on request (publication planned for 2026): Elżbieta Łepkowska: elzbieta.majchrowska@us.edu.pl	2007- present (some gaps)	N/A	N/A	2007–2013, 2017, 2019–2020, 2023–2025 Water and air pressure at the hydrometric station of the Werenskioldbreen in 2019 and 2020 are available at: https://ppdb.us.edu.pl/geonetwork/srv/pol/catalog.search#/metadata/

						9421eb09-4327-4c0c-b5f6-3e22bdf136e2

Subsurface state

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Glacier thickness	Werenskioldbreen	https://dx.doi.org/10.5904/wgms-glathida-2020-10 GlaThiDa 3.1.0	19800430	.csv	CC BY 4.0	Dowdeswell et al. 1984. Airborne radio echo sounding of sub-polar glaciers in Spitsbergen. Norsk Polarinstitutt. Skrifter 182. Dowdeswell et al. 1984. Radio echo-sounding of Spitsbergen glaciers. J. Glaciol., 30(104), 16-21. Welty et al. 2020. Worldwide version-controlled database of glacier thickness observations. Earth System Science Data 2020. DOI: https://doi.org/10.5194/essd-2020-87
Glacier thickness	Austre Broeggerbreen	https://dx.doi.org/10.5904/wg	1988	.csv	CC BY 4.0	(2 points, by ice drilling) Bjornsson et al. 1996, The thermal regime of sub-polar glaciers mapped by multi-

		ms-glathida-2020-10 GlaThiDa 3.1.0				frequency radio-echo sounding, Journal of Glaciology, 42(140), 23-32. Welty et al. 2020. Worldwide version-controlled database of glacier thickness observations. Earth System Science Data 2020. DOI: https://doi.org/10.5194/essd-2020-87
Glacier thickness	Austre Broeggerbreen	https://dx.doi.org/10.5904/wgms-glathida-2020-10 GlaThiDa 3.1.0	1990	.csv	CC BY 4.0	Bjornsson et al. 1996, The thermal regime of sub-polar glaciers mapped by multi-frequency radio-echo sounding, Journal of Glaciology, 42(140), 23-32. Welty et al. 2020. Worldwide version-controlled database of glacier thickness observations. Earth System Science Data 2020. DOI: https://doi.org/10.5194/essd-2020-87
Cold-to-temperate ice transition surface (cts) depth	Werenskioldbreen	Not available	April 1998	N/A	N/A	Pälli et al. 2003. Firn-ice zone features of four polythermal glaciers in Svalbard seen by ground-penetrating radar. Annals of Glaciology, 37(1), 298-304. Pälli et al. 2003. The drainage pattern of two polythermal glaciers: Hansbreen and Werenskioldbreen in Svalbard. Polar Research, 22(2), 355-371

Cold-to-temperate ice transition surface (cts) depth	Werenskioldbreen	https://ppdb.us.edu.pl/geonetwork/srv/pol/catalog.search#/metadata/a1105d69-5ed1-43ce-a546-6dcf6f907778	April 2008	.shp	N/A	Thermal structure of S Spitsbergen glaciers. Dataset contains vector data of thermal structure of glaciers derived from RES Raw (compare other records relating to 2008). Reference: Grabiec M. 2017: Stan i współczesne zmiany systemów lodowcowych południowego Spitsbergenu w świetle badań metodami radarowymi. Wydawnictwo Uniwersytetu Śląskiego, 328 s.
Glacier thickness	Werenskioldbreen	Available on request: mariusz.grabiec@us.edu.pl	14-15.04.2016	.rad, .rd3, .cor, RINEX	N/A	Raw 30 MHz GPR data covering the entire Werenskioldbreen enabling the distinction of glacier thickness, bed topography, and thermal structure
Cold-to-temperate ice transition surface (cts) depth	Werenskioldbreen	Available on request: mariusz.grabiec@us.edu.pl	14-15.04.2016	.rad, .rd3, .cor, RINEX	N/A	Raw 30 MHz GPR data covering the entire Werenskioldbreen enabling the distinction of glacier thickness, bed topography, and thermal structure

Glacier thickness	Werenskioldbreen	https://ppdb.us.edu.pl/geonetwork/srv/pol/catalog.search#/metadata/a1105d69-5ed1-43ce-a546-6dcf6f907778	April 2008	.shp	N/A	Glacier thickness as the supplementary information to the thermal structure of S Spitsbergen glaciers. Dataset contains vector data of thermal structure and glacie thickness of glaciers derived from RES. Reference: Grabiec M. 2017: Stan i współczesne zmiany systemów lodowcowych południowego Spitsbergenu w świetle badań metodami radarowymi. Wydawnictwo Uniwersytetu Śląskiego, 328 s.
Glacier thickness	Werenskioldbreen	Available on request: mariusz.grabiec@us.edu.pl	21-22.09.2007	.rad, .rd3, .cor	N/A	Raw 200 MHz GPR data covering the frontal zone of Werenskioldbreen and the forefield, enabling the distinction of glacier thickness, bed topography, and forefield structure including permafrost table and active layer depth. References: - Dobiński W., Grabiec M., Gądek B. 2011: Spatial relationship in interaction between glacier and permafrost in different mountainous environments of high and mid latitudes, based on GPR research. Geological Quarterly 55(4): 15-27.; - Grabiec M. 2017: Stan i współczesne zmiany systemów lodowcowych południowego Spitsbergenu w świetle badań metodami radarowymi. Wydawnictwo Uniwersytetu Śląskiego, 328 s.

Active layer	Werenskioldbreen	Available on request: mariusz.grabiec@us.edu.pl	21-22.09.2007	.rad, .rd3, .cor	N/A	Raw 200 MHz GPR data covering the frontal zone of Werenskioldbreen and the forefield, enabling the distinction of glacier thickness, bed topography, and forefield structure including permafrost table and active layer depth. Reference: Dobiński W., Grabiec M., Gądek B. 2011: Spatial relationship in interaction between glacier and permafrost in different mountainous environments of high and mid latitudes, based on GPR research. Geological Quarterly 55(4): 15-27
Glacier thickness	Werenskioldbreen	Available on request: mariusz.grabiec@us.edu.pl	19, 28, 29.04.2008	.rad, .rd3, .cor, RINEX	N/A	Raw 25 MHz GPR data covering the entire Werenskioldbreen (37 km), from which a DEM of the glacier bed was made and the thermal structure was highlighted (compare other records relating to 2008). References: - Navarro F.J., Martín-Español A., Lapazaran J.J., Grabiec M., Otero J., Vasilenko E., Puczko D. 2014. Ice volume estimates from ground-penetrating radar surveys, Wedel Jarlsberg Land glaciers, Svalbard. Arctic, Antarctic, and Alpine Research, 46(2):394-406. - LAPAZARAN J.J. , OTERO J. , MARTÍN-ESPAÑOL A. , NAVARRO F.J. 2016. On the errors involved in ice-thickness estimates I: ground-penetrating radar measurement errors. Journal of Glaciology, 62(236) - LAPAZARAN J.J. , OTERO J. , MARTÍN-ESPAÑOL A. , NAVARRO F.J. 2016. On the errors involved in ice-thickness estimates II: errors in digital elevation models of ice thickness. Journal of Glaciology,

						62(236) Grabiec M. 2017. Stan i współczesne zmiany systemów lodowcowych południowego Spitsbergenu w świetle badań metodami radarowymi. Wydawnictwo Uniwersytetu Śląskiego, 328 s.
Cold-to-temperate ice transition surface (cts) depth	Werenskioldbreen	Available on request: mariusz.grabiec@us.edu.pl	19, 28, 29.04.2008	.rad, .rd3, .cor, RINEX	N/A	Raw 25 MHz GPR data covering the entire Werenskioldbreen (37 km), from which a DEM of the glacier bed was made and the thermal structure was highlighted (compare other records relating to 2008)
Glacier thickness	Werenskioldbreen	Available on request: mariusz.grabiec@us.edu.pl	07.05.2011	.rad, .rd3, .cor, RINEX	N/A	Raw 100 MHz GPR data covering the frontal zone of Werenskioldbreen and the forefield, enabling the distinction of glacier thickness, bed topography, and forefield structure
Glacier thickness	Werenskioldbreen	Available on request: mariusz.grabiec@us.edu.pl	03.04.2024	.rad, .rd3, .cor	N/A	Raw 30 MHz RTA GPR data covering the entire Werenskioldbreen

Cold-to-temperate ice transition surface (cts) depth	Werenskioldbreen	Available on request: mariusz.grabiec@us.edu.pl	03.04.2024	.rad, .rd3, .cor	N/A	Raw 30 MHz RTA GPR data covering the entire Werenskioldbreen
Glacier thickness	Werenskioldbreen	Available on request: mariusz.grabiec@us.edu.pl	05.08.2021	.rad, .rd3, .cor	N/A	Raw 30 MHz RTA GPR data S part of the front
Cold-to-temperate ice transition surface (cts) depth	Werenskioldbreen	Available on request: mariusz.grabiec@us.edu.pl	05.08.2021	.rad, .rd3, .cor	N/A	Raw 30 MHz RTA GPR data S part of the front
Active layer	Fuglebergsletta	Available on request: marta.kondracka@us.edu.pl	30.08.2010	.txt	N/A	Raw ERT data, profile in the coastal zone, profile from the sea to the Fugleberget (between the Polish Polar Station and Hansbreen)
Active layer	Fuglebergsletta	Available on request: marta.kondracka@us.edu.pl	15.08.2012	.2dm	N/A	Raw ERT data profile in the coastal zone, profile between the Polish Polar Station and Wilczekodden

Active layer	Fuglebergsletta	Available on request: marta.kondracka@us.edu.pl	16.08.2012	.dat, .txt	N/A	Raw ERT data, profile on the slope of the Fuglebekken
Active layer	Fuglebergsletta	Available on request: marta.kondracka@us.edu.pl	18.08.2012	.2dm	N/A	Raw ERT data, slopes of the Fuglebekken
Active layer	Fuglebergsletta	Available on request: marta.kondracka@us.edu.pl	20.08.2017	.rad, .rd3, .cor	N/A	RAW 50 MHz, slopes of the Fuglebekken
Active layer	Fuglebergsletta	Available on request: marta.kondracka@us.edu.pl	30.08.2017	.rad, .rd3, .cor	N/A	RAW 200 MHz GPR data covering coastal zone near Polish Polar Station
Active layer	Hansbreen	Available on request: marta.kondracka@us.edu.pl	09.09.2017	.dat, txt	N/A	RAW ERT covering the front of the stagnant ice on the W part of the Hansbreen
Active layer	Hansbreen	Available on request: marta.kondracka@us.edu.pl	14.09.2017	.rad, .rd3, .cor	N/A	RAW 100 MHz GPR data covering the front of the stagnant ice on the W part of the Hansbreen

Active layer	Fuglebergsletta	Available on request: sorynski@igf.edu.pl	27.06.2024	.dat, .txt	N/A	Raw ERT data, profile from the Fugle river to the SW part of the Hansbreen (5m spacing, Dipole Dipole + Gradient XL)
Active layer	Fuglebergsletta	Available on request: sorynski@igf.edu.pl	18.06.2024	.dat, .txt	N/A	Raw ERT data, profile from the seashore to slope of Fugleberget - near Renifer borehole (5m spacing, Dipole Dipole + Gradient XL)
Active layer	Fuglebergsletta	Available on request: sorynski@igf.edu.pl	23.09.2024	.dat, .txt	N/A	Raw ERT data, profile from the seashore to slope of Fugleberget - near Renifer borehole (2m spacing, Dipole Dipole + Gradient XL)
Ground temperature from boreholes	Fuglebekken	Available on request: marz@igf.edu.pl		.csv		Ground temperature from 7 boreholes up to 20 m located in the Fuglebekken, measurements with 1 hour interval

4.5. Indian Himalayan Region (IHR) - Ladakh Region and the Stok glacier and Chenab, Alaknanda and Teesta Basin

Surface mass balance

Variable	**Location**	**DOI, URL, Repository**	**Date (time series, single observations)**	**File format**	**License**	**Comments/description (different name of the variable in the dataset, references, restrictions, etc.)**

Glacier Mass Balance	Stok Glacier, Ladakh	https://github.com/arindan/Stok-Glacier-data-LICUIDICE-project	18 September 2025	csv	Restricted	The dataset is part of Arindan Mandal's postdoctoral work and therefore consider restricted. Please discuss with the authors
Annual balance at a point	Stok Glacier, Ladakh	upon request	2022 to present	N/A	N/A	Indian Institute of Science, Bangalore
Glacier-wide annual surface mass balance	Stok Glacier, Ladakh	upon request	2022 to present	N/A	N/A	Indian Institute of Science, Bangalore
Glacier Mass Balance	Chhota Shigri Glacier, Chandra Basin	https://doi.org/10.5194/tc-18-5653-2024	2003-2014	N/A	N/A	
Glacier Mass Balance	Gepan Gath	https://doi.org/10.1017/jog.2025.31	2014-2023	N/A	N/A	
Glacier Mass Balance	Samudra Tapu/Sutri Dhaka	https://doi.org/10.1017/aog.2024.46	2015-2022	N/A	N/A	

Glacier Mass Balance	Bara Sigri Glacier, Chandra Basin	http://dx.doi.org/10.2139/ssrn.5430176	1950-2022	N/A	N/A	

Snow cover

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Snow depth	Stok Glacier, Ladakh	https://github.com/arindan/Stok-Glacier-data-LICUIDICE-project	18 September 2025	csv	Restricted	The dataset is part of Arindan Mandal's postdoctoral work and therefore considered restricted. Please discuss with the authors
Snow depth	Bara Shigri	https://data.ncpor.res.in/newhtml/5	2017 - 2019	ASCII	N/A	
Snow depth	Gepang Gath glacial lake	https://data.ncpor.res.in/newhtml/5	2016 - 2017	ASCII	N/A	
Snow depth	Himansh	https://data.ncpor.res.in/newhtml/5	2015 - 2018	ASCII	N/A	
Snow depth	Sutri Dhaka	https://data.ncpor.res.in/newhtml/5	2017	ASCII	N/A	

Meteorological data

Variable	Location	DOI, URL, Repository	Date (time series, single observations)	File format	License	Comments/description (different name of the variable in the dataset, references, restrictions, etc.)
Air temperature	Leh, Ladakh	https://github.com/arindan/Stok-Glacier-data-LICUIDICE-project	1 Oct 2024 to 17 Sep 2025	.csv	Restricted	The dataset is part of Arindan Mandal's postdoctoral work and therefore considered restricted. Please discuss with the authors
Relative humidity	Leh, Ladakh	https://github.com/arindan/Stok-Glacier-data-LICUIDICE-project	1 Oct 2024 to 17 Sep 2025	.csv	Restricted	The dataset is part of Arindan Mandal's postdoctoral work and therefore considered restricted. Please discuss with the authors
Air Temperature	Ladakh valley region (6-7 sites)	upon request	2022 to present	N/A	N/A	
Wind Speed	Stok Glacier, Ladakh	upon request	2022 to present	N/A	N/A	
Wind Direction	Stok Glacier, Ladakh	upon request	2022 to present	N/A	N/A	

Net Radiation	Stok Glacier, Ladakh	upon request	2022 to present	N/A	N/A	
Humidity	Ladakh valley region (6-7 sites)	upon request	2022 - present	N/A	N/A	
Wind Speed	Trakarding Glacier	https://doi.org/10.1594/PANGAEA.931159	2016-2019	.csv	CC-BY 4.0	
Wind Direction	Trakarding Glacier	https://doi.org/10.1594/PANGAEA.931159	2016-2019	.csv	CC-BY 4.0	
Air Temperature	Trakarding Glacier	https://doi.org/10.1594/PANGAEA.931159	2016-2019	.csv	CC-BY 4.0	
Net Radiation	Trakarding Glacier	https://doi.org/10.1594/PANGAEA.931159	2016-2019	.csv	CC-BY 4.0	
Upwelling Shortwave Radiation	Trakarding Glacier	https://doi.org/10.1594/PANGAEA.931159	2016-2019	.csv	CC-BY 4.0	
Downwelling Shortwave Radiation	Trakarding Glacier	https://doi.org/10.1594/PANGAEA.931159	2016-2019	.csv	CC-BY 4.0	

Albedo	Trakarding Glacier	https://doi.org/10.1594/PANGAEA.931159	2016-2019	.csv	CC-BY 4.0	
24 Hour Precipitation Amount	Trakarding Glacier	https://doi.org/10.1594/PANGAEA.931159	2016-2019	.csv	CC-BY 4.0	
Humidity	Trakarding Glacier	https://doi.org/10.1594/PANGAEA.931159	2016-2019	.csv	CC-BY 4.0	
Air Temperature	HBC (Himansh Base camp) Sutri Dhaka Glacier, Chandra Basin	https://doi.org/10.1017/aog.2024.46	2015-2022	N/A	N/A	
Humidity	HBC (Himansh Base camp) Sutri Dhaka Glacier, Chandra Basin	https://doi.org/10.1017/aog.2024.46	2015-2022	N/A	N/A	
Downwelling Shortwave Radiation	HBC (Himansh Base camp) Sutri Dhaka Glacier, Chandra Basin	https://doi.org/10.1017/aog.2024.46	2015-2022	N/A	N/A	
Downwelling Longwave Radiation	HBC (Himansh Base camp) Sutri Dhaka Glacier, Chandra Basin	https://doi.org/10.1017/aog.2024.46	2015-2022	N/A	N/A	
Wind Speed	HBC (Himansh Base camp) Sutri Dhaka	https://doi.org/10.1017/aog.2024.46	2015-2022	N/A	N/A	

	Glacier, Chandra Basin					
24 Hour Precipitation Amount	HBC (Himansh Base camp) Sutri Dhaka Glacier, Chandra Basin	https://doi.org/10.1017/aog.2024.46	2015-2022	N/A	N/A	

Catchment discharge

Variable	**Location**	**DOI, URL, Repository**	**Date (time series, single observations)**	**File format**	**License**	**Comments/description (different name of the variable in the dataset, references, restrictions, etc.)**
Water Level	Ladakh Region and the Stok glacier and Chenab, Alaknanda and Teesta Basin.	http://indiariverflow.com	2021 to present	N/A	N/A	https://doi.org/10.1038/s41597-024-03923-8
Total Runoff	Ladakh Region and the Stok glacier and Chenab, Alaknanda and Teesta Basin.	https://indiawris.gov.in/wris/#/home, upon request	2000-present	N/A	N/A	

Subsurface state

N/A

5. Conclusions

Work on the Data Catalogue of In-Situ Observations has enabled the collection of information on most of the available archival data for selected study areas. The analysis revealed that 74% of 220 datasets are not available in an open repository or are only available upon request. This will allow us to take further steps to make archival data available in accordance with FAIR data principles.

The available datasets are extremely diverse in every respect. In ideal situations, after appropriate quality control, the measured dataset is saved in a file as a multi-year measurement series. Unfortunately, it often turns out that for a given observation station, several (or more) datasets exist, covering different time periods, with different metadata, and created by different people. Thanks to the work carried out within this project, efforts will be made to standardise and harmonise long-term observations.

It is worth noting that much of the shared data has a clearly defined license (usually Creative Commons), which facilitates the reusability of the data. File formats also generally adhere to FAIR data principles. Datasets vary significantly in quality and quantity across different areas, depending on the specific teams working in each area and the number of teams involved.

Italian Alps study sites: Monte Rosa glacier system and the Lys and Évançon glacier catchment

Sixteen datasets have been catalogued for the area, nearly half of which (7) concern meteorological data. The longest available datasets date back to 2001 (meteorological and catchment discharge data). Mass balance data are not available, but modelling has allowed reconstruction of the mass balance to approximately 1900. Fifty per cent of the datasets are available in open repositories, all under the CC-BY license and in .csv file format.

Norway study sites: Jostedalsbreen glacier system and Nigardsbreen glacier catchment

Twelve datasets have been catalogued for the area, 92% (11) of which are available in an open repository. All files are available under the CC-BY 4.0 license in .csv format. Meteorological, snow, and glaciological data demonstrate continuous measurement series dating back to 1962. Hydrological data have only been collected since 1998. Subsurface state observations are missing for this area.

Greenland study sites: Ilulissat and Kangerlussuaq ice sheet catchments

Eighteen datasets have been catalogued for the area, all available in an open repository. Most files are available under the CC-BY 4.0 license in .csv and NetCDF formats, excluding hydrological data, which are open in the Public Domain (CC0) in .txt format. Excluding hydrological data, which were modelled backwards to 1949, all other variables have a time series from 1990 to 2025. No data is available on snow cover.

Svalbard study sites: the Austre Brøggerbreen and Werenskioldbreen glacier catchments and the Fuglebekken catchment

In the Svalbard area, key observations are conducted in several locations, resulting in a large amount of collected data. 142 datasets have been catalogued, of which 43% (61) are available in open repositories. Data sharing is most successful for glacier mass balance (13 datasets out of 14 shared) and meteorological data (35/44). These data are primarily made available under CC-BY 3.0 and 4.0 licenses, with exceptions under CC-BY-NC-SA 4.0. Files are primarily made available in .csv and NetCDF formats. In the case of hydrological data, data in the open repository is available only for one area. A significant number of snow cover datasets are unpublished (30 of 35). However, the longest observation series is available online under the CC-BY 4.0 license in .csv format. For the Subsurface State, 39 datasets have been mapped, of which only 5 are available in open repositories.

Indian Himalayan Region (IHR) - Ladakh Region and the Stok glacier and Chenab, Alaknanda and Teesta Basin

Thirty-two datasets have been catalogued for the area, 75% (24) of which are available in the open repository. Much of the data is available through publications and their accompanying supplementary materials. With the exception of one series of Bara Sigri Glacier mass balance data (from 1950), the remaining data have been collected since the beginning of the 21st century.

The analysis, in addition to determining the amount of data available, allowed for a comprehensive overview of the in-situ observation system. The research teams gained an understanding of their monitoring systems' functioning and the ability to compare them with the research of other teams. It is clear that some areas lack monitoring of key variables, while in other areas, the data is plentiful but not organised and accessible.

Building on the established catalogue, subsequent activities will focus on the systematic consolidation and enhancement of key observational datasets. This includes the harmonisation and updating of surface point mass balance measurements from the Greenland Ice Sheet, as well as from glaciers and ice caps across all five regions considered. In addition, available in situ meteorological observations from weather stations located on or near ice-covered areas and operated by consortium partners will be post-processed and harmonised to ensure consistency and comparability. Furthermore, spatially distributed and point-based observations of snow depth and snow cover from unglaciated portions of the catchments will be homogenised and catalogued, drawing on validated high-frequency radar surveys, automated in situ instrumentation, and manual measurement campaigns. Emphasis will be placed on datasets identified in the catalogue that are not currently accessible through open data repositories, with the aim of improving their visibility, standardisation, and potential for reuse.

6. References

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