

Integrating Activities for Advanced Communities



D2.9 - Repository with selected climate data from INTERACT stations integrated in INTERACT GIS

Project No.871120– INTERACT

H2020-INFRAIA-2019-1

Start date of project: 2020/01/01

Duration: 48 months

Due date of deliverable: 2024/09/30

Actual Submission date: 2024/09/16

Lead partner for deliverable: AU

Author: Elmer Topp-Jørgensen

Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the Consortium (including the Commission Services)	
CO	Confidential, only for members of the Consortium (including the Commission Services)	

Table of Contents

Publishable Executive Summary	3
1. Development of the repository	4
1.1. Aims	4
1.2. Development of a framework for the repository	4
2. System description	5
Appendix 1. Station Display page in INTERACT GIS	8

Publishable Executive Summary

The development and integration of a repository for selected climate variables into INTERACT GIS was discussed among INTERACT station managers. Station managers recommended to focus on a few key variables (temperature and precipitation) and that this should preferably be built on an existing data mechanism that would allow for easy updates in the future. The system developed is based on downscaling of the Copernicus' Application Programming Interface (API) and a Python script that can collect new and updated data for existing and new INTERACT stations. Data is shown graphically for each station covering WMO climate normal from 1961-1990 and 1991-2020, on which data from individual years are shown for comparison with historic data. The update of data is made automatically and the system is thus continuously updated with new data.

1. Development of the repository

1.1. Aims

Research stations are critical for observing, understanding, and responding to Arctic changes. Task 2.3 of INTERACT III focuses on making station data and publications widely available to improve the services offered to the scientific community and enhance robust assessments of climate and ecosystem change. This task will contribute to the further development of INTERACT GIS, providing graphical display of selected climate data helping scientists to identify relevant stations for their research in combination with filtering functions embedded in the system.

Aims set out in the project description:

Task 2.3 "Making Station Data and Publications Widely Available" aims to ensure that all forms of data, both historic and near-real-time, from research stations are captured and made widely available. This task addresses objectives (i) and (iii) by contributing to INTERACT's Societal Challenges 3 and WP6.

Subtask 2.3.2 will provide open access to selected scientific data by establishing an INTERACT repository for key climate related parameters to be integrated in INTERACT GIS in cooperation with the Data Watch Guard (D2.9).

Aims formulated by station managers:

- Collect and store selected climate variables per station in the INTERACT GIS database.
- Utilize the WMO Climate Normal 30 years periods to illustrate climate change trends and extreme events at the stations (the periods are 1961-1990 and 1991-2020).
- Present visualizations to the users of INTERACT GIS, that gives insight in the recent four years climate at the stations and allows comparison with the WMO Climate Normal periods.

1.2. Development of a framework for the repository

Process

The content and functionalities of the repository were discussed among INTERACT station managers at INTERACT Station Managers' Forum meetings in an iterative process allowing station managers to comment on initial development ideas. Technical solutions and visualisations were made in a collaboration between technical experts at Aarhus University and INTERACT GIS system operator Umeå University.

Framework – recommendations from station managers

The iterative process led to clear recommendations from the INTERACT station managers, who suggested to focus on a few key variables (temperature and precipitation) to build a robust system that potentially could be expanded with more variables in the future. Station managers also recommended that system should be built on an existing data mechanism that would allow for easy updates in the future, reducing the need for manual transfer of data. This would ensure that data from all stations would be included and

prevent the need administrative resources for the task at the station level. Automatisation was recommended to ensure viability beyond the INTERACT project lifetime (end of 2024).

Station managers recommended that data was shown graphically for each station, reaching back as far as possible and with comparison of recent years against WMO climate normal.

2. System description

The INTERACT GIS database was extended with new tables to store the selected historical data – temperature and precipitation – for all INTERACT stations. Should new stations be added to the network, the system allows for easy integration of this climate variables repository element.

Obtaining and visualising data

Ideally data should be harvested from stations climate data repository, but it was clear early in the process that not all stations share data in a way that would allow the development of such solution. In principle it can with some manual work be possible for stations to deliver their own locally logged climate data to the database at some point but working individually with each station was deemed as too uncertain, complex and time consuming an approach in this first version.

Instead, we chose to provide default data extracted from a Copernicus global climate product: ERA5 monthly averaged data on single levels from 1940 to present. This ensures that we have unified and quality assured data available for all stations in the system. When presented to station managers, the responses have been positive and confirmed that the data is representative for recent years climate and climate change at the stations. Likewise, the calculated WMO Climate Normal averages are based on the same Copernicus ERA 5 historic data specific to the station location.

Using Copernicus' Application Programming Interface (API), a Python script was developed to easily collect new and updated data for existing and new INTERACT stations. Data updates are automated monthly to ensure an up-to-date system allowing scientists to compare recent climate data against previous years and WMO climate normal reaching back to 1961.

The visualizations and functionality on the website, can be seen in the screenshots below (Figure 1 and 2, Appendix 1). Charts are made interactive and allow users to select preferred WMO climate normal and years to be displayed on the graphical element. It is possible to expand the graphical display for a more detailed view.

STATION FEATURES	
Opening year: 1995 Status: Open	
OPERATION	+
LOCATION	+
CLIMATE	+
LANDSCAPE AND ENVIRONMENT	+

FACILITIES	
HOUSING AND ACCOMODATION	+
LOGISTICS	+
STAFF AND SERVICES	+
FIELD EQUIPMENT	+
LABORATORY	+
COMMUNICATION AND IT	+
MEDICAL FACILITIES	+

STATION NAME AND OWNER

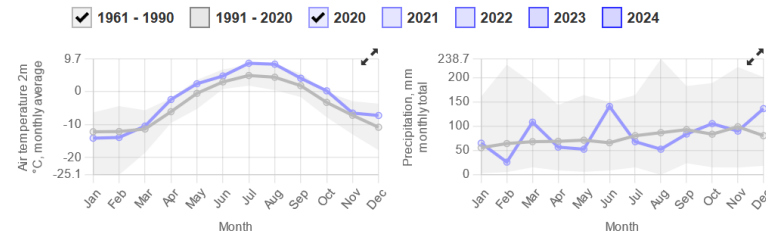
Greenland Institute of Natural Resources (GINR) is owned by the Government of Greenland.

LOCATION

The Greenland Institute of Natural Resources with its main buildings, laboratories, and living quarters is located in Nuuk, Greenland (64°11' N, 51°41' W). A research/field station is located in Kobbefjord (64°08' N, 51°23' W), c. 25 km southeast of Nuuk.

CLIMATE DATA

Grey colours are WMO Climate Normals including maximum and minimum values. Blue colours are individual years.



Climate data for the stations were extracted via Copernicus Climate Data Store, from the global gridded reanalysis product: ERA5 monthly averaged data on single levels from 1940 to present.

Description and source code: Roemer J.K. 2023. <https://doi.org/10.5281/zenodo.10214922>

Data Source: Hersbach et al. 2023. Copernicus Climate Change Service (C3S) Climate Data Store (CDS), <https://doi.org/10.24381/cds.t17050d7>

Figure 1. When viewing station details, in this case Greenland Institute of Natural Resources (GINR) in Nuuk, Climate Data is shown and the user can select which recent years to view and which WMO Climate Normal periods to compare to.

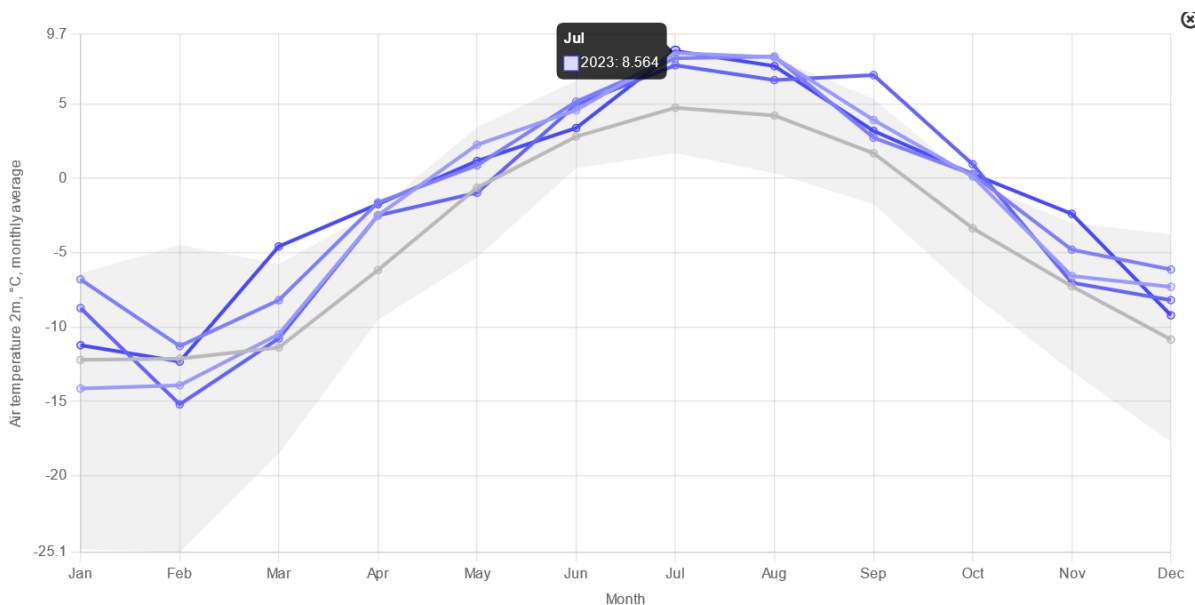


Figure 2. The graphs can be extended to full screen view to allow for closer inspection. In this case we see that recent years monthly average temperatures at GINR (except the short and cold winters) are several degrees above the WMO Climate Normal average for 1961-1990. Users can hover a point in the graph to get the exact value shown.

The acquisition and processing / preparation of climate data from Copernicus is described in detail in the resources below:

Description and source code: Roemer J.K. 2023. <https://doi.org/10.5281/zenodo.10214922>

Data Source: Hersbach *et al.* 2023. Copernicus Climate Change Service (C3S) Climate Data Store (CDS), <https://doi.org/10.24381/cds.f17050d7>

See the linked github repository <https://zenodo.org/doi/10.5281/zenodo.10214962> for how data was fetched from Copernicus Climate Data Store, prepared and plotted. The github repository also contains CSVs with source data for the plots.

Example of station display page can be seen here: <https://interact-gis.org/Home/Station/1>

Future opportunities

This repository represents significant progress in our ability to capture, store, and make available climate data across the diverse range of INTERACT stations, providing valuable insights into climate trends and extreme events in the Arctic region.

Continued collaboration with station managers can help refine the tool in INTERACT GIS and ensure they meet the practical needs of the research stations and visiting scientists. This could include:

- Develop harvest functionality from station repositories to allow display of ground observed data.
- Add additional variables
- Integrate local variability and increase temporal scale

Appendix 1. Station Display page in INTERACT GIS

Explore stations and their science

[LOGIN](#) | [SIGN UP](#)

ABISKO SCIENTIFIC RESEARCH STATION

[Apply for access](#)

ADDRESS

Abisko Scientific Research Station
 Veienkapsens Väg 36
 SE 961 07 Abisko
 Sweden

STATION MANAGER

Magnus Augner
 E-mail: magnus.augner@polar.se

CONTACT STATION

Phone: +46 (0) 980400 21
 E-mail: ans@polar.se
www.polar.se/abisko

[Social media](#)

STATION FEATURES

Opening year: 1913
 Status: Open

- OPERATION** +
- LOCATION** +
- CLIMATE** +
- LANDSCAPE AND ENVIRONMENT** +

FACILITIES

- HOUSING AND ACCOMMODATION** +
- LOGISTICS** +
- STAFF AND SERVICES** +
- LABORATORY** +
- COMMUNICATION AND IT** +
- MEDICAL FACILITIES** +
- FIELD EQUIPMENT** +

SCIENCE

- SCIENTIFIC NETWORKS** +
- PROJECTS** +
- ACCESS PROGRAMMES** +

STATION NAME AND OWNER

The Abisko Scientific Research Station is run by the Swedish Polar Research Secretariat.

LOCATION

The station is located about 300 km north of the Arctic Circle and approximately 200 m a.s.l. on the south shore of Lake Torneträsk. The station is situated in a 40 hectare nature reserve bordering the Abisko National Park, which covers 70 km². The station is located in mountain birch forest and surrounded by mountains. The village of Abisko (year-round population approx. 150 people) is located nearby. The surrounding area offers a great variety in topography, geomorphology, geology, and climate, as well as flora and fauna. The highest mountain in the area reaches 1601 m a.s.l.

CLIMATE DATA

Grey column are WMO Climate Normals including maximum and minimum values. Blue column are individual years.

1901 - 1990

1901 - 2020

2020

2021

2022

2023

Climate data for the station were extracted via Copernicus Climate Data Store, from the global gridded reanalysis product: ERA5 monthly averaged data on single levels from 1960 to present.

Description and source code: Rowan J.K. 2023. <https://doi.org/10.21203/rs.3.rs-2921492>

Data Source: Hertzsch et al. 2023. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). <https://cds.clms.copernicus.org/dataset/10.21203/rs.3.rs-2921492>

BIODIVERSITY AND NATURAL ENVIRONMENT

The average annual air temperature is approximately 0°C. Annual precipitation along Lake Torneträsk varies greatly over an west-east gradient with 1000 mm in the west to 500 mm in the east. Mean annual air temperature and growing season length have exhibited an increasing trend over the last decade. Vegetation composition is varied, ranging from simple plant communities following retreating glaciers to complex mountain birch forest, heath and meadow tundra ecosystems. About 40% of the surrounding landscape is above the tree line. Ecosystems comprise mountain birch forest, lakes, rivers, streams, moors, wetlands, tundra heath, alpine meadow, high alpine environment, rocky outcrops, and glaciers. The area is underlain by sporadic permafrost, which is located primarily in mire areas. Fauna includes birds, fish, reindeer, moose, snowshoe hare, rodents, red fox, mink, otter, brown bear, wolverine, lynx, aquatic and terrestrial insects. The area is sparsely populated and land use is minimal, dominated by reindeer husbandry, hunting, fishing, tourism, and research.

HISTORY AND FACILITIES

The Abisko Scientific Research Station was established in 1913. The station can accommodate approx. 75 visitors. Accommodation is available in shared rooms in the main building (2-3 person rooms) and dorm style accommodation in separate buildings (2-4 person rooms). Fully equipped kitchens are available for visitors to prepare their own meals according to a self-catering principle. The station offers laboratory facilities, workshops, storage space (short-term storage only), a library, office space, a lecture theatre, classroom facilities, meeting rooms, and logistical support. The village of Abisko is located within a 15-minute walk from the research station, where you will find a well-equipped grocery store, gas station, and train station. Postal service is available at the research station and local grocery store. During tourist seasons (winter and summer), restaurants are available at tourist facilities.

Abisko Scientific Research Station also offers access to four off-grid, remote field huts in the surrounding area: two locations west of the station (Låvbjåkulle (alpine) and Kärkevaggi (glacial stream valley)) and two locations on the north shore of Lake Torneträsk (Jäppentjedde and Luoharjärvi).