



Tarfala Research Station (TRS) is located at 1135 m asl in the Kebnekaise Mountains, northern Sweden, and is run by Stockholm University. TRS welcomes scientists from all disciplines to conduct research in a unique arctic-alpine environment.

Annual report for Tarfala Research Station 2023

Chair of the board: Regina Lindborg

Director: Nina Kirchner

Operative station manager: Annika Granebeck

Tarfala Research Station (TRS) is located at 1135 m asl in the Kebnekaise Mountains, in northern Sweden, and is hosted by the Department of Physical Geography (NG) at Stockholm University (SU). Inaugurated in 1961, TRS has supported and conducted research in the fields of glaciology and geomorphology since. Mass balance investigations on Storglaciären started in 1946 and continue today, rendering one of the World's longest and most detailed continuous glacier mass balance records. Over the years, TRS has broadened its scope and now also focuses on ecosystems, biodiversity, hydrology, meteorology, climatology, archaeology and human geography to name but a few. TRS is open during two field seasons (spring-winter and summer), and welcomes scientists from all disciplines to conduct research in this unique arctic-alpine environment.

Start of the year

In the beginning of the year, TRS received a small grant from the Bolin Centre for Climate Research to create a continuous time series for discharge from the Tarfala catchment. A research assistant was employed in early 2023 to localize and digitize raw data over time, and to prepare it for coherent publication in the Bolin Centre Database.

In February TRS was represented at the 26th Alpine Glaciology Meeting in Zurich, Switzerland with both a talk and presentation. TRS presented possibilities for field work as well as currently running research and long-term observational programs, and introduced the new TRS master student grant.

During the spring, long-term financing of TRS was a re-occurring topic at the board meetings. If long-term financing of TRS is not secured, strategies and goals for TRS might need to be adapted since TRS is in need of bigger investments, both with regards to buildings and research infrastructures. The importance of increasing and deepening the research interest for the station across Stockholm University was also continuously discussed.

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Spring-winter at TRS

On March 20, the station started the spring-winter season. Field work went well and winter mass balance was surveyed for the four reference glaciers Mårmaglaciären, Riukojetna, Rabots glacier and Storglaciären. Maintenance of the timelapse camera at Lake Tarfala was also carried out and data from the permafrost hole was retrieved. Field work in the spring-winter season remains however challenging due to avalanche risks. To reach the station, staff and guests must pass Darfalsvaggi, an area that is classified as very demanding avalanche terrain. Travels in such terrain can only be done when avalanche warnings for the area are low. This puts a strain on the possibility for guest to visit the station, and regrettably some guests who originally had booked a visit had to cancel it due to too high avalanche risk. The spring-winter field season was ended on April 15, after all scheduled tasks to be performed at and around TRS had been successfully completed.



Research engineer Barnett on his way to Storglaciären to work with the mass balance program. Photo by Granebeck.

Summer at TRS

The summer season started on June 27, with regular duties such as glacier safety training, first aid exercises and practicing emergency routines, as well as station and equipment inspection, maintenance and general logistics. Each year, field assistants and kitchen staffs complement the permanent staff and support a wide range of TRS projects and data collection programs. This year, the staff pool was complemented by a station assistant as well.

With support from the communication project that TRS received funding for from Formas in 2022, TRS hosted Open House days for the general public continuously during the summer, this year in collaborating with the Swedish Tourist Association (STF). An outbreak of stomach sickness at Kebnekaise and northern Kungsleden, due to a Calicivirus, regrettably forced cancellation of one of the Open House

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days. TRS also hosted two popular science courses for mountain leaders. The courses were much appreciated and got fully booked within hours upon opening the registration.

In August, the station was more or less fully booked with different student groups from Stockholm University, Lund University and Technische Universität Berlin, to name a few. Smaller research group from KTH and Gustavus Adolphus College as well as a group from the Swedish Armed Forces also used TRS's facilities during the summer.



Participants in the Mountain leader course, learning about the automated weather station at Storglaciären. Photo by Linda Åkerberg.

Current research and long-term observation program

Collection of summer mass balance data for all four reference glaciers was completed as of September 2. All glaciers had a negative average mass balance for the year 2022/2023. While a negative average mass balance usually implies a somewhat positive mass balance in the accumulation area and more pronounced negative mass balance in the ablation area, neither Riukojetna nor Rabots glaciär had any accumulation area left this year. This means that these glaciers have lost their regions where they previously gained some mass. Whether this is the beginning of a trend that continues into the future remains to be seen.

Modernizing the glacier mass balance program

A central component of the ongoing modernization of the glacier mass balance program is to create repeated digital elevation models (DEM) with uncrewed aerial vehicles (drones). In the long run, this can replace the costly repeated stake measurements that are used today. This year, two DEMs were created for Storglaciären. Also, with funding from SU's section for Earth and Environmental Sciences, a novel

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cosmic ray sensor (a so-called Snow fox) was acquired. The Snow fox is a sensor that is used to derive density of a given snow mass, based on the amount of cosmic radiation that penetrates the snow mass under which the sensor is buried. The sensor is placed on the snow free glacier surface at the end of summer, and then revisited in winter when snow has accumulated above it thus the snow mass can be assessed. During winter 2023/2024, the Snow fox is tested at TRS, so that during spring-winter, comparisons can be made between density profiles from manual snow pit digging and data from the Snow fox.

Numerical modeling of Storglaciären was also initiated. A modern bedrock topography will be an indispensable component for the model setup, but the most recent dataset of the bedrock underneath Storglaciären is more than 30 years old. In late August, a new ice penetrating radar was therefore tested at Storglaciären with the aim to map the bedrock. The raw data looks promising and bedrock was reached and mapped in some of the deepest parts of the glacier. Testing will continue during winter 2023/2024, so that proper mapping can be conducted in 2024.

Tarfala Lake, hydrology and permafrost and Sydtoppen

Since 2016, lake water temperature is acquired continuously in the central deepest part of Lake Tarfala. Data from Lake Tarfala is considered an important contribution to advancing the understanding of how arctic alpine lakes respond to climate change. Understanding the lakes mixing processes is aided by time lapse camera data.



Discharge measurements at Lillsjön outlet. Photo by Granebeck.

Discharge measurements were also conducted approximately once per week at Tarfalabron, which provided an alternative assessment of mass loss from Storglaciären. In the future, it is desirable to measure discharge from Storglaciären closer to the glacier. To reach Tarfalabron, a rather time-consuming hike down the valley must be made and the measurements are somewhat dependent on favorable weather conditions.

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Relocating the discharge measurement site is a topic to be investigated during 2024.

The old but partially still functioning Permafrost and Climate in Europe (PACE)-borehole at Tarfala Ridge was maintained and data was retrieved from the loggers. However, since some sensors are not functioning properly, they need to be replaced.

Two automated weather stations (AWS) operated by TRS in Laevasvaggi and in Lihtti, were completely overhauled. They were equipped with new sensors (snow depths, soil temperature, in addition to the existing precipitation, air temperature, wind speed and direction and solar radiation sensors) and satellite modems to allow data transfer in real time. A time lapse camera was also added to the Lihtti AWS, sending pictures of vegetation and current weather three times per day. Lihtti and Laevasvaggi are important areas for the reindeer herds of the Girjas and Laevas Sami communities.

The annual measurement of the elevation of Kebnekaise Southern Peak was conducted on September 11. The measurement attracted (as usual) considerable media attention and this year SVT released a news piece on the result on September 13, in both "Morgonstudio" and "Aktuellt".

Accident and interim station manager

Granebeck had a serious accident and injured her lower left leg in the TRS surroundings on July 14. Kirchner coordinated the rescue mission from TRS, supporting the Mountain Rescue that was called to the accident site. The rescue operation benefitted from the detailed "in case of emergency" work process at TRS, that was developed in collaboration with the Mountain Rescue and certified mountain guides during 2021-22. Granebeck was on sick-leave until October and Johanna Dahlqvist, certified mountain leader, member of the Mountain Rescue, a ski patroller and arctic wilderness tourist guide, was employed from August 1-end of October as interim operative station manager.

Fall at Campus Frescati

At the end of the summer, Anders Karlhede, one of the strategic advisors of the president of Stockholm University, was tasked by the president to propose a relocation of TRS within Stockholm University, effective as of January 1, 2024. It is suggested that TRS becomes an independent unit within the Baltic Sea Centre, but final decisions are pending.

Due to the forthcoming re-location of TRS, the annual TRS Day was postponed and will take place during 2024, in cooperation with the new host.

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TRS publication list

A list of publications with relation to TRS is kept at www.su.se/tarfala-research-station/research/publications-connected-to-tarfala. At present, this list contains only publications until 2022. We work on updating the list with 2023 records, and appreciate if you let us know of any 2023 publications that you are aware of.

TRS 2023 in numbers	
Nights spent at TRS, of which approximately 50 % is by staff	1106 nights
Approved funding applications	6 pc, total 1,922 MSEK
Rejected funding applications	3 pc, total 4,9 MSEK
Research projects by visiting researchers	4 pc
University courses	5 pc
Field work visits for MSc thesis	2 pc
Popular science courses	2 pc
Open house days	4 pc
TRS representation on conferences/events/workshops	3 pc
Published datasets	8 pc, 2 pc under review
Articles by TRS staff (published and/or in review with minor revisions)	2 pc

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