Swedish Infrastructure for Ecosystem Science (SITES)

Annual Report 2022

SITES

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1 Introduction

SITES (Swedish Infrastructure for Ecosystem Science) is a national infrastructure for terrestrial and limnological field research. SITES aims to promote high-quality research through long-term field measurements and experiments and by offering expertise that attracts both Swedish and international researchers to use the infrastructure. An additional and important goal is to make data openly available. The core of SITES consists of nine distributed research stations that represent all Swedish climate zones as well as a variety of different ecoregions (Figure 1). SITES research stations are: Abisko, Asa, Erken, Grimsö, Lönnstorp, Röbäcksdalen, Skogaryd, Svartberget and, during SITES I-II also Tarfala. Bolmen is an additional research station associated with SITES since 2018. The distributed nature of the infrastructure across Sweden and its diverse habitats and ecosystems offers research opportunities in many systems, including agricultural landscapes, forests, alpine landscapes, wetlands, lakes, and watercourses.

Furthermore, SITES helps to better understand the grand challenges faced by humanity on a global scale, such as climate change, biodiversity loss, and anthropogenic degradation to ecosystems. The infrastructure embraces the connectivity between landscape types and their individual elements, creating a research environment that allows scientists to view their study system in a broader context. To encourage these activities, SITES has established three Thematic Programs, SITES Water, SITES Spectral, and SITES AquaNet, that bind the stations together and enable the comparison of data and experiments from different climate zones and landscape elements. The Thematic Programs are led by experts in the respective research fields and coordinated by central support for data handling, streamlining the infrastructure activities, and connecting the SITES community with researchers.

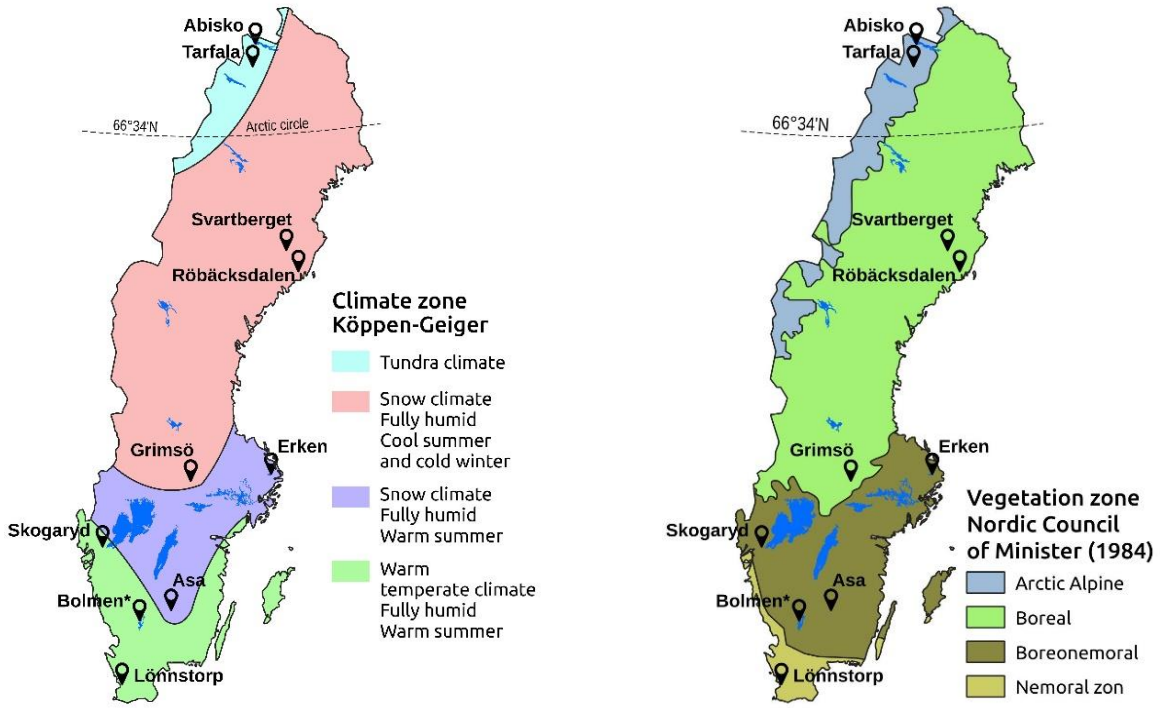

Figure 1. *SITES research stations are distributed across Sweden and encompass different ecosystems and climatic zones.*

The infrastructure is supported by the Swedish Research Council (VR) together with the organizations running the stations, i.e. the University of Gothenburg, the Polar Research Secretariat, the Swedish

University of Agricultural Sciences (coordinator), Stockholm University, and Uppsala University. In addition to the organizations listed SITES Spectral is coordinated via services offered by Lund University.

More information about the infrastructure and the contributing stations can be found on the SITES website: https://www.fieldsites.se/en-GB

The year 2022 marks the fifth and final year in the current five-year funding period from VR. The 2022 operations were characterized by further developing and consolidating the five priority areas identified in the 2017 application, in short: (1) to make data available on the SITES Data Portal, (2) to increase the number of users, (3) to make scientific products visible, (4) to increase coordination and exchange between stations, and (5) to increase international visibility and cooperation with other infrastructures and networks. The report below describes how this was achieved.

1.1 The effects of Covid-19

The consequences of the pandemic continue to affect society as a whole and have also impacted SITES activities during 2022 but to a lesser extent compared to 2021 and 2020. As restrictions were lifted in 2022, there were more opportunities for in person outreach activities and access to the stations. As such, SITES centrally organized in person activities to bring the community together, including a SITES Water and AquaNet workshop, data retreats and a SITES leadership meeting during the year. The number of training, development and outreach projects at the stations as well as research projects increased (compared to 2021 and 2020), with a notable increase in international projects, but still lags pre-pandemic levels.

1.2 SITES III – continued funding (2023-2028)

SITES has now been awarded continued funding for the grant period 2023-2028, under the VR call for research infrastructures of national interest. With the new funding, SITES can look forward to continuing operations during a third phase where SITES will continue to promote high-quality research across Sweden linked to the research stations. In the coming funding period, SITES is expected to develop and establish a model for coordinated infrastructure operation with ICOS (Integrated Carbon Observation System) and ACTRIS (The Aerosol, Clouds, and Trace Gases Research Infrastructure) and engage internationally within the eLTER (European Long-Term Ecosystem Research) network. The new funding will both secure long-term monitoring programs within the station network and enable the infrastructure to develop to meet the future needs of researchers and other stakeholders. In 2022, a major focus was on wrapping up SITES II and preparing for SITES III activities, this included discussions on streamlining the Thematic Programs and enhancing user engagement. Tarfala Station, and the associated Partner Organization, Stockholm University, have decided not to join SITES III and as such, discussions were held in 2022 on wrapping up Tarfala's formal engagement with SITES. Both parties are on good terms and hope to continue informal collaborations in the future.

2 SITES research stations

2.1 Numeric summary of station activities

National research infrastructures with support from VR, such as SITES, must report specific key figures for their activities. The definitions of the key figures were established by VR prior to the reporting for

the 2018 financial year and apply to scientific projects. The year 2022 marks the fifth year of reporting key figures in accordance with these definitions. In addition to VR's key figures, SITES reports its own key figures for competence-building projects. This category includes courses, workshops, conferences, and study visits. Taken together, these key figures provide a picture of the added value that the SITES stations provide for education, knowledge distribution, and research support to other sectors of society. The key figures are reported in Appendix 1.

Stations have different research profiles and the volume and breadth of operations vary, which strongly affects the key figures of the individual stations and makes cross-station comparison misleading. This annual report mainly summarizes total figures for the entire SITES infrastructure. However, individual key figures per station are reported to VR in an appended table. The year 2022 was again a special year due to the longevity of pandemic. Therefore, it is difficult to evaluate and interpret the key figures in comparison with years reported prior to the pandemic, i.e. 2018 and 2019. Nonetheless, an interesting comparison can be made between the development of the two years before and during the pandemic.

In 2022, a total of 518 scientific projects have received support from SITES. This is an increase compared to 2021 and 2020, 507 and 492 projects, respectively, and on par with 2019 pre-pandemic numbers of 515 projects. The total number of user days in 2022 also increased to 18,228, which is the most user days for a single year compared to all other years during the funding period (2021 was the next most user days with 16,938). Among the user days, 13% were remote access, which means that work was performed on-site by the station staff. This is comparable to most other years (14 % in 2018, 2019 and 2020). The number of projects on location in 2022 of 353 is a slight decrease from 2021 with 388 projects on location. However, the total number of user days on location increased to 15,853, compared to 13,534 user days in 2021, and is the most user days on location per year for the whole funding phase. There were a total of 33 multi-station projects and 37 Thematic Program projects in 2022, which is a small portion of total projects but a positive step towards the goal of increasing collaboration across stations.

The number of unique users involved in scientific projects that have used any SITES station was 1,063 in 2022, which is the second most unique users for a single year during the funding phase (the most was in 2019 with 1, 210 unique users) and the most for pandemic years (post 2020). The total number of unique SITES users from training development and outreach programs was 3,166 and is slightly less compared to the pre-pandemic period (4,964 in 2019 and 3,998 in 2018) but an increase compared to 2020 and 2021, 553 and 1,881, respectively. This was also true for the total training development and outreach projects carried out at SITES stations amounting to 140 in 2022, which is more than the 122 training development and outreach projects combined for 2021 and 2020. These projects corresponded to 5,958 user days, which is comparable to the combined user days in 2020 and 2021, but still only half the user days reported for 2018 of 11,726. Skill-building projects were strongly affected by the pandemic as various restrictions made it difficult or impossible to travel to the stations in 2020 and 2021 but given that covid restrictions were reduced in 2022, there has been a significant increase in these activities at the station but they still are not back to the pre-pandemic state.

SITES is a national infrastructure open to all researchers and offers access to the infrastructure according to the equal conditions principle. SITES is also actively working through outreach and distribution of information to be diverse, inclusive, and equitable. In 2022, project leaders for reported scientific projects were from 72 different universities, including 11 Swedish universities and 5 domestic research institutes/organizations, in addition to 56 international academic affiliations. These project leaders represent 22 countries (compared to 18 in 2021, 19 in 2020 and 17 in 2019).

2.1.1 Gender distribution

Gender equality is one aspect of SITES ambition to be diverse, inclusive, and equitable. During the five-year funding phase SITES has collected gender information on project users and starting this year, in accordance with VR Gender Equality Plan, SITES has also reported gender and position distribution among employees for the first time.

Of scientific project leaders*, the percentage of female project leaders has stayed roughly the same in the past three years, but increased slightly to 38% in 2022 compared to 36% in 2021. Among other participants, 46% were female and 54% were male, which is an increase in female participants up from 35% in 2021. About a quarter of project leaders are junior in their career (11% female and 13% male). Another quarter (25%) are senior career female project leaders (an increase from 18% in 2020) and is similar to pre-pandemic numbers, which is a positive sign considering that the pandemic has had a disproportionally negative impact on female scientists (Viglione, 2020). However, the percentage of senior female project leaders still lags behind senior male project leaders (46% male) and thus SITES should continue to take proactive steps to attract projects led by female PIs and make SITES increasingly attractive as a resource for this user group.

Since this is the first year SITES has collected information on gender and position distribution among SITES station employees, no comparison between years can be made. Rather the statistics reported here are to give an indication of the current status of the gender and position distribution within the network. Of the total 107 staff that worked at SITES stations in 2022, 47 were female and 60 were male, of which females accounted for 37% of the total hours worked and males 63%. Females tended to hold Research Assistant and Lab Technician positions, whereas males tend to hold Research Engineer and Technician positions, with both genders evenly holding Field Technician positions. Within the Secretariat in 2022, there were three females and four males, of which females accounted for 41% of the total time and males 59%. Within the SITES Operational Leadership Group, there are four females and eight male Station Managers and one female and two male Thematic Program leads, thus females make up a third of the group.

*Please note that the percentages do not always add up to 100% due to a number of project leaders whose gender or career stage was not reported.

Viglione G. Are women publishing less during the pandemic? Here's what the data say. Nature. 2020 May 1;581(7809):365-7.

2.2 Research and development work at each station

A total of 186 peer-reviewed articles were published in scientific journals in 2022 (comparisons: 238 (2021), 232 (2020), 204 (2019)). The number of publications were slightly lower than previous years and could be an effect of the pandemic, i.e. since field visits were restricted early during the pandemic there was more focus on publications in 2020 and 2021. In 2022, restrictions at the stations were lifted and researchers had to split their time between publishing and field work again.

Published articles were divided into research fields based on SCB´s standard for the Swedish division of research topics (Table 1). Earth and related Environmental Sciences (37.6%), Biological Sciences (24.7%), and Agricultural Science (14.0%) were the largest subject areas, but research conducted at the SITES Stations covers a much wider range of research areas (see Table 1). Of note, a few articles published by Grimsö Wildlife Research Station were categorized as Health Sciences (2.1%) as they investigated the link between wildlife and the covid virus. Svartberget (51), Abisko (49) and Grimsö (45) accounted for a large share of the total number of publications. The section below highlights research activities conducted at SITES Stations during 2022.

Table 1: *Distribution of SITES publications 2022 within various research subjects based on SCB´s standard for the Swedish division of research topics.*

Research topic	Percent
1 Natural Sciences	66.1%
102 Computer and Informationn Sciences	1.1%
105 Earth and Related Environmental Sciences	37.6%
106 Biological Sciences	24.7%
107 Other Natural Sciences	2.7%
2 Engineering and Technology	9.7%
207 Environmental Engineering	9.7%
3 Medical and Health Sciences	2.1%
303 Health Sciences	2.1%
4 Agricultural and Veterinary Sciences	22.1%
401 Agriculture, Forestry, and Fisheries	8.1%
405 Other Agricultural Science	14.0%

There were many activities at the station in 2022 and below is just a snapshot of a few of them.

In **Abisko**, the station had a feeling of returning to pre-pandemic conditions, with a fast-paced field season that brought many international projects back to the station. The summer of 2022 was one of the busiest summers in the history of the research station, with the station constantly at full capacity, June through September. Researchers were affiliated with institutions spanning more than 12 countries and 3 continents, making the research at Abisko in 2022 international and interdisciplinary. In addition to continuous measurements, the summer monitoring work included lake chamber flux measurements and the development and installation of an improved system for measuring stream gas concentrations as part of SITES Water. Of note in 2022, Abisko celebrated over 100 years of meteorological measurements at the station.

At **Tarfala**, the snow accumulation and melt combined with heavy rains made for challenging sampling conditions at the station. Erosion was substantial, including a landslide on the western valley flank, and a completely changed riverbed. However, despite the difficult conditions the station staff successfully continued monitoring during a winter and summer campaign to the extent possible. The station ran as usual in 2022, after two years of reduced activities.

The extensive lake monitoring at **Erken** continued throughout 2022 including a unique time series on ice cover, which began in 1940, and is now published on the SITES Data Portal. A multidisciplinary collaborative study at Lake Erken (Newcastle University, UK and Uppsala University, Sweden),

exploring surfactant control of air-water gas exchange, coupled to total surfactant measurements in the surface microlayer and subsurface water with direct gas transfer velocity estimates for CO_2 by eddy covariance was completed in 2022. The resulting data set will enable the first-ever assessment of gas exchange across the surface of a freshwater body, as impacted by varying amounts of total surfactant and indices of the organic composition of the total surfactant pool.

Röbäcksdalen continues to not only be an important northern agricultural station but also is making its mark as an urban station. A collaboration agreement between SLU and Umeå municipality was signed in 2022, which specifically highlights Röbäcksdalen in the section about Umeå as a sustainable city. The station is located within the city and is a good focal point for the city's work around ecosystem services and biodiversity. During 2022, Röbäcksdalen had an organization change at SLU; the field station, which houses the majority of the SITES activities, is now part of the Department of Crop Production Science, while the dairy farm is part of the animal infrastructure at the Faculty of Veterinary Medicine and Animal Science.

The agricultural research at **Lönnstorp** station continues to expand with new facilities and infrastructure initiated in 2022. One such example, is the process to convert 10 ha of farmland to an organic experimental fields near Campus Alnarp. The Landscape Architecture, Horticulture and Crop Production Science (LTV) faculty, together with SITES Lönnstorp, have also started the process of establishing two irrigation facilities for agricultural and horticultural research. One of the irrigation facilities will be located at SITES Lönnstorp research station and the other one will be located at the new organic field described above. The DiverIMPACTS project ended in the spring of 2022, however, within this project two organic crop rotations were established and SITES Lönnstorp has decided to continue the crop rotations and add them to the SITES infrastructure since their continuation will generate interesting and important agricultural data.

Svartberget and Asa are both forest experimental parks where changes in vegetation, forest stands, and processes in soil, air, and water are studied in both basic and more practically oriented studies. At **Svartberget** there is an on-going manual harvest of trees in two field trials. The harvest has two aims; one aim is to transform the forest into what will eventually be a nice forest to stroll around in and the other is to move, as a first step, towards an example of continuous cover forestry (CCF). Hydrological restoration projects also continue at Svartberget, with a restoration case study related to beaver dams in Sweden, starting in 2022. The case study will have a before-after design, which includes the removal of 10 beaver dams located in the Vindeln Catchment including Krycklan (Svartberget).

In addition to the long-term forest monitoring at **Asa** station, along with Aneboda IM, the stations participated in a global soil biodiversity initiative (Soil BON) in 2022. The soil sampling is to have two paired sites, one nature conservation site (Aneboda IM) and one non-conservation site (Asa) and the samples need to be from a single habitat type, in this case, Norway Spruce. During spring 2022, water pressure sensors at the SITES water monitoring locations and the streams in the surrounding catchment areas were installed. This type of data has already been collected for many years in Asa, but these sensors are capable of sending the data directly to an online server which gives researchers immediate access to data from the office.

At **Skogaryd** station the long-term monitoring whole system approach continues with several projects. One such example is a new long-term forest management study initiated in 2022 on a 60-year-old Norway spruce (Picea abies) forest which is mature and ready for harvest. The study will evaluate the climate benefits of different management practices established during harvest 2022/23, (i) continuous

cover forestry with selection harvest based on target diameter cutting, (ii) clearcutting with subsequent replanting of saplings (rotation forestry), and (iii) extended rotation period, where the current 60-year-old forest will be allowed to continue growing undisturbed.

The research at **Grimsö** mainly concerns the ecology and management of wildlife (mammals and birds) and their relationship to forestry and agriculture as well as the interests of various societal actors. In addition to a large number of external research projects at the station, the annual collections of about 20 long-term data series is important. These are dominated by species abundance and distribution data, but also include phenology (plants and migratory bird species), habitat data, and weather data. In 2022, a SITES video was produced to showcase the "Survey Method for Hazel Grouse", the method is conducted as territorial mapping in part of the research area and includes the use of a whistle imitating the territorial song of a male hazel grouse.

2.3 Scientific courses and meetings

One of SITES strategic goals is for the increased scientific courses and meetings at the stations. This creates opportunities to show the participants what opportunities for research SITES offers and increases knowledge about the research that is currently conducted within the SITES infrastructure. It also promotes contacts and networking between researchers and station staff. The pandemic limited the number of courses and meetings that could be held on-site in 2020 and 2021, but in 2022 many activities were able to resume in person. Examples of such activities are as followed:

Symposium:

- The 19th Annual Krycklan Symposium took place at Svartberget with the focus on "The Next Generation for Water: Buffers, Maps and Peatland Management". There were about 100 people in attendance for the hybrid Symposium, with about 20 of those participating online.
- The Abisko research station hosted the annual Climate Impacts Research Centre (CIRC) Symposium, connected to Umeå University, with nearly 40 participants.

University Courses:

- A Greenhouse Gases and Biogeochemical Cycle course, arranged by Lund University, took place across multiple SITES stations. The course participants spent time at SITES Abisko station, ICOS site Hyltemossa and at SITES Lönnstorp station, where they built their own eddy covariance tower.
- An Arctic Ecosystems course, arranged by Umeå University, was conducted at Abisko station where students gained hands-on experience with ecological research. In 2022, the course had more than twice the number of participants as in previous years.
- A PhD course in Watershed Ecology and Biogeochemistry took place within the Krycklan catchment at Svartberget to addresses the foundational concepts and modern challenges within the broad field of watershed science.
- A Master's level Wildlife Biology course, hosted by the SLU Department of Ecology at Grimsö Wildlife Research Station, brought 16 students from 6 countries to the station for 2-months in 2022.

International activities:

- At Skogaryd station 50 high school students and their teachers from the Erasmus project "Global heat", tested several methods for studying ecosystem processes. The course was an international exchange between Sweden, Belgium, Italy and Austria.
- At Lönnstorp station, 20 students and researchers from Kiel University (Germany) visited and discussed several of the agricultural long-term experiments at the station.

2.4 Collaboration with the local community

One goal in SITES strategic plan is for the research performed at SITES stations to be used in the community and be communicated with the public outside of academia. One way to involve the community is for collaborators from outside of academia to be involved in projects conducted at the research stations. In 2022 there were 10 research projects and 66 training, development and outreach projects where the project leader was not associated with a University.

In addition to projects, stakeholders visit the STES stations, ranging from companies, county boards and government agencies in Sweden to international delegations. Excursions and courses arranged for stakeholders at the SITES stations focused on forestry, agricultural and wildlife, with several county boards making visits in 2022. A special collaboration agreement between SLU and Umeå municipality was signed this year, where the research station at Röbäcksdalen is specifically highlighted. On the international level, delegations from LUKE in Finalnd visited Röbäcksdalen to view and discuss the animal and field facilities. At Grimsö station, members from the Austrian Parliament and the embassy in Stockholm visited the wildlife station.

School visits of all ages, from preschool to high school, continue to be a highly engaging activity at the SITES stations, with a notable increase in the number of students, including internationally. Erken Laboratory hosted 1,595 students from 24 primary and high schools from around Uppsala and Stockholm counties for their Water Days program. During the visit, the students learn about how research in aquatic ecosystems is conducted and had the opportunity to learn about lake ecology and identify some key species found in the lakes.

2.4.1 SITES-related research in the media

Like previous years, several local, national, and international media organizations have featured SITES or the research conducted using data from the SITES infrastructure. This media attention increases the general knowledge about research and other activities conducted by SITES. Below are a few examples of stories that received media attention during the past year.

- AquaNet Paper Press release, "*Salta eller inte salta mot halka - en fråga om miljöpåverkan*"
- SVT Nyheter / Västerbotten, "*Se den rutiga skogen i Umeå – kommunen satsar på hyggesfri avverkning*"
- Sverige Radio, "*Ekologen Tomas Roslin skalar upp sökandet efter liv på jorden*"

2.5 Associated Stations

The **Bolmen** Research Station has been associated with SITES since 2018 through a collaboration agreement between SLU and Sydvatten. Bolmen's participation in SITES mainly applies to the Thematic Program SITES AquaNet, but the station is planning to participate to a wider extent in the infrastructure

in the future. In 2021, discussions began about the best approach for implementing the SITES Water program at Bolmen and during 2022 the implementation work has started with layer 1 and 2 alongside with manual profile measurements in 5 basins of Lake Bolmen once a month.

Together with Erken station, Bolmen also participated in AquaNet-Aquacosm plus TA experiment that ran for 5 weeks in the period from July 6th until August 12th. At Bolmen, scientists from Ireland, Spain, Czech Republic and Germany, participated, alongside with Swedish Scientists from Lund university.

Bolmen is part of the LifePlan project, and as most of the other SITES stations started in 2021. The project is looking at global biodiversity using a variety of different methods, including insect and spore traps, audio recordings, etc. Besides the international engagement, Bolmen also further developed collaborations on a regional scale.

There were three new projects during 2022, one study monitoring three inlets to Bolmen in regards to DOC/lake browning and ditches together with Halmstad university and Bolmen municipalities. The second one, a FORMAS financed Blue innovation project with Lagan water council, Bolmen Research station and Lund University as partners. The third project is the EU Interreg North Sea Region Blue transition project with 24 partners from 6 European countries, including the Swedish Geological Survey (SGU), Bolmen Research station/Sydvatten and Lund University. In both the latter projects the purpose is to develop a toolbox for mitigation and verification of methods that have been tested to be efficient for reducing the browning of lakes. It is expected that these measures are transferrable to many other lake systems since the problem is widespread in Sweden as wells as in other countries. The two last projects were granted in 2022 and will continue during 2023.

The station´s leadership regularly participates in the SITES communication activities and joins the monthly station manager forum as well as technician meetings. In 2022, the station continued to host the competence building project Think H2O!, which provided education to nearly 900 high school students over five weeks in September and October. The project highlights the value of water and increases young people's awareness, knowledge, and understanding of water-related issues and challenges. In the project, all young people and teachers have been informed about SITES and its activities. Think H2O! works for a lasting and long-term commitment by developing existing collaborations and involving new partners and experts on sustainability and water-related topics. Since the project started in 2014, almost 8,000 students and teachers have been educated at Think H2O!.

3 SITES Thematic Programs

3.1 SITES Water

SITES Water builds a unique long-term, well-coordinated measurement program where hydrological, physical, chemical, and biological parameters within lakes and streams are measured. Based on this 'backbone' infrastructure SITES Water provides data and facilities to address a broad range of scientific questions relevant to the scientific community. There are several types of data collected within SITES Water divided into six layers.

- Layer 1: Background information
- Layer 2: Water balance

- Layer 3: Physical variables
- Layer 4: Chemical variables
- Layer 5: Biological variables
- Layer 6: GHG and C fluxes

All layers are split into base and advanced level, where base levels apply to all stations, and advanced levels apply to some stations and are usually a result of already ongoing programs and built on previous knowledge at the station.

3.1.1 Included stations

SITES Water includes seven of SITES stations: Abisko, Asa, Erken, Röbäcksdalen, Skogaryd, Svartberget and, during SITES II also Tarfala.

3.1.2 Activities in 2022

The monitoring program has been conducted according to plan. After two years of cancelled in-person technician meetings due to Covid-19, a three-day technician workshop, co-organized with SITES Aquanet, was held at Erken in March. The meeting was fruitful for summarizing activities in SITES II and for planning and identifying improvements for SITES III. Regular meeting activities were continued, with virtual monthly water technician meetings with all stations and weekly water leadership meetings with the central coordination team. The coordinating role of the program has been shared between Prof. Leif Klemedtsson and Associate Prof. Marcus Wallin during 2022 with the aim to secure a smooth transition to the new coordinator (Wallin) from 2023 and onwards.

The work during 2022 continued to heavily focus on implementing the SITES Data Portal structure at all stations for data types produced from SITES Water Layer 1 to 4. The eDNA material collected by the stations in Layer 5 has been processed and continued discussions occur on how to develop DNA data and metadata sharing capability for genomics data in the future. A major effort has been taken with data generated within the greenhouse gas (GHG) Layer 6 during autumn 2022. Lake methane (CH_4) flux data collected during SITES II have been compiled, processed and initially evaluated.

SITES Water has continued the work on the sediment data that were collected during 2020 and 2021 at four of the SITES lakes, Erssjön (Skogaryd), Feresjön (Asa), Erken (Erken) and Almbergasjön (Abisko). In cooperation with the Department of Limnology at Uppsala University, the collected long-cores have been analyzed during autumn 2022, and dried sediment samples have also been stored for further analysis. Together with previously analyzed short-cores and data from acoustic sediment mapping, SITES Water can now offer a comprehensive lake specific sediment data basis that can be used on its own or to give important context to other type of studies, for example gas flux measurements conducted in Layer 6. Discussions are ongoing for how to best make these data available on the SITES Data Portal.

SITES Water Stations with lakes have participated to various degrees in projects initiated by the Global Lake Ecological Observatory Network (GLEON), with particular efforts in 2022 made to the MixMet project focused on lake temperature profile data and continuous oxygen measurements.

A SITES Water introduction video was published on SITES YouTube channel during 2022. The video is also linked to the SITES webpage and can be used to inform about the program. Additional pre-

existing video material has been collected from other stations to complement the efforts and guarantee representation of all stations within SITES Water.

3.1.3 Plans for 2023

The monitoring program within SITES Water will be conducted as in previous years with the exception of Layer 6. Here the GHG flux chamber campaigns will be put on hold during 2023. This will allow the program to complete the data compilation and processing of data (for CO_2) collected during SITES II. Based on this data inventory, strategic decisions will be taken for how to proceed with the GHG flux chamber program within SITES Water from 2024 and onwards. Although GHG fluxes will not be measured in 2023, GHG concentrations in the lakes will still be measured, as part of the routine monitoring program and thus continuing monitoring of GHG in lakes. Making SITES Water monitoring data openly available on the SITES Data Portal will continue to be a high priority, now with a strong focus on the layer 5 and 6.

An annual technician meeting will be organized during 2023 (date and place to be decided). The plan is to co-organize the meeting with all three thematic programs (Water, Spectral, Aquatnet) as it is vital to develop competence for all the personnel at the stations working with these structures and data, and since many of the station staff are involved in multiple Thematic Programs. A special aim for this workshop will be to further address the Layer 6 GHG data and to identify alignments between the Thematic Programs to further strengthen the infrastructure and collaborations across stations.

3.2 SITES Spectral

3.2.1 Included stations and data management

SITES Spectral covers all SITES stations. Six stations (Asa, Lönnstorp, Röbäcksdalen, Skogaryd, Svartberget, and, in SITES II also Tarfala) participate fully in all activities, while the others participate in parts of the program. Measurements are made at the stations and are sent to SITES Spectral Thematic Centre (SSTC) in Lund for quality control and the development of quality-controlled data that can be used for further analyses. Data storage and backup are done in Lund and all generated products are accessible via the SITES Data Portal.

3.2.2 Activities in 2022

In 2022 SITES Spectral focused on further increasing the amount of collected and processed data, as well as on improving the data quality and metadata labeling. A lower number of drone flights were carried out in 2022, partly due to time constraint at the stations, but overall an adequate number of flights were performed.

Major tasks completed in 2022 include:

- SITES Spectral quality flagging system for all spectral sensors developed, documented, and made available on the SITES Data Portal.

- In 2022 a total of 11,024 images were collected from RGB sensor drone flights and 85,046 images from multispectral sensor drone flights made at the SITES stations.
- Data from all 56 RGB sensor drone flights have been processed into 3 data types (i.e., UAV Orthomosaics, Digital Elevation Models, and Point Clouds) and all uploaded.
- All multispectral sensor drone flights up until 2021 have been processed and are in the process of being uploaded to the SITES Data Portal.
- All PhenoCam data was processed during 2022 and uploaded data products until 2021 are on the SITES Data Portal.
- A visualization page for on-line sensor data was generated for station staff to check the status of the measurements. This was generated by ICOS Sweden and is hosted by an ICOS server.
- Fixed sensor datasets up to 2020 from all SITES Stations were processed. The processed data is in the quality flagging stage. Final editing and uploading of data will take place in 2023.
- Satellite data products for each station were produced in 2022.
- Interaction with stations was carried out via the data management meetings and individual meetings with stations.

3.2.3 Plans for 2023

The most important planned activities for SITES III, beginning in 2023 are:

- Continue development of satellite data products on vegetation phenology and productivity for all stations. Investigate the possibility to include abiotic variables (e.g. snow and ice).
- Continue full quality labeling of all data products. The work was initiated in 2021 but needs to be fine-tuned and tested, particularly for fixed sensor data.
- Documentation of all procedures, both for internal use and for generating product user manuals.
- Continue to develop automatic download of camera and fixed sensor data from stations.
- Continue discussions with ICOS Sweden on the inclusion of ICOS Hyltemossa and ICOS Norunda in SITES Spectral as an association to SITES.
- Purchase new drones and sensors for SITES III.
- Add phenocams to Bolmen and Erken.
- Collaborate with Asa to get a suitable mast installation for installing fixed sensors and phenocam.
- Discuss modifications of sensor locations to conform to other activities at the stations (e.g. phenological data sampling).

3.3 SITES AquaNet

3.3.1 Included stations

SITES AquaNet includes five stations; four SITES stations: Asa, Erken, Skogaryd, and Svartberget, as well as the SITES associated station, Bolmen.

3.3.2 Activities in 2022

In 2022 the primary focus of SITES AquaNet was the implementation of a coordinated experiment with the opportunity for transnational access (TA) within the EU project AQUACOSM-plus. The experiment investigated the effects of climate-driven variability in organic matter and nutrient run-off on lake communities. A TA call for that experiment was opened in December 2021 with a deadline in February 2022. There were enough applications to conduct the experiment at 2 lakes, Bolmen and Erken. The experiment brought together a team of 28 persons in total and involved 10 AQUACOSM-plus TA participants from Spain, Turkey, Ireland, Hungary and the Czech Republic, 6 participants from AQUACOSM-plus partners at IBG and Oldenburg University in Germany, and several participants from Uppsala University and Lund University. The experiment was started with a kick off workshop held at Erken and then the experiments at the two lakes were run in a fully synchronized way for 6 weeks.

During autumn, several meetings were organized to discuss plans for the experiments in 2023, As a result two TA AQUACOSM-plus calls were prepared and opened in November 2022 and January 2023, respectively. See section 3.3.3 for a description of the two calls.

Three publications from the GLEON Salinization experiment conducted in 2018, where Asa, Erken and Svartberget participated, were published in 2022 (DOI: https://doi.org/10.1002/lol2.10277 , DOI: https://doi.org/10.1073/pnas.2115033119, DOI: https://doi.org/10.1002/lol2.10239).

The Trilux sensor upgrade and recalibration was completed for the two remaining stations (Svartberget and Asa) and plans for purchasing spare sensors and parts and new instrumentation for the SITES III phase was initiated at the joint SITES Water/AquaNet workshop held at Erken in March 2022.

3.3.3 Plans for 2023

The main activity for 2023 are two AQUACOSM-plus TA experiments that are scheduled to be run in spring and summer. The first experiment will take place in spring, between the end of April to beginning of June, at Bolmen, Erken and Skogaryd, and will use the same set-up as for the experiment conducted in 2022. Thus, adding on a time (new season) and space (one additional station) component to the experiment conducted in 2022. The second experiment will take place in summer, between mid-June and end of July, at Asa and Svartberget. The experiment will investigate functional and compositional consequences of different salinity disturbance regimes on plankton communities.

4 Data handling

The SITES Data Portal has been in full operation since autumn 2019 and the number of openly available data sets and different data types has been continuously increasing ever since. As was the case last year,

the SITES Data Portal continues to be the main data repository in use for all participating research stations and in 2022 expanded in regards to additional Thematic Program and station specific data types available. In 2022 there were 4,479 individual data downloads from the SITES Data Portal (4,339 downloads from SITES stations and an additional 140 from the associated station Bolmen). To compare with previous years, an explanation is needed. The numbers of downloads reported in the Annual Report in 2021 were n=1,122 (2020) and n=4,728 (2021). However, we identified two bots that contributed to a significant number of reported data downloads on 2021. They were most likely only interested in indexing our content and should not be accounted as data downloads. When excluding these two individual IP addresses the data downloads per year are as followed: n=1,122 (2020), n=2,384 (2021) and n=4,479 (2022).

To provide a more robust solution for the reporting on the data user statistics, an IP address based statistic describing single user downloads will give more intel on the actual increase of the SITES Data user base. This solution automatically counteracts the bias of large data harvesters like the ones detected in 2022. With the increased value of virtual information theft and data mining the likelihood of more unrealistic numbers on the data download statistics will increase in the future. Whenever data miners are identified by the system development team, they are excluded from the reporting statistics. A two-pronged reporting by providing 1) Data downloads (Figure 2) and 2) Single user downloads (Figure 3), is planned to be included in Annual Reports for the SITES III phase.

The SITES Data Portal contains data sets from meteorological stations located at all SITES Stations, Thematic Program data from SITES Water, Spectral, and AquaNet, as well as station-specific data series. Continuous efforts are made to increase the usability of the data repository both for users of the data and data providers, i.e. the station staff and central data management. In line with this, staff at each station are trained to both make use of the e-infrastructure and provide support to additional users. Key components of the data management are communicated broadly internally, i.e. metadata assignments, data documentation with the overarching goal to follow the FAIR principles (Data that is Findable, Accessible, Interoperable, and Reusable). The ICOS team based at Lund University, who host the SITES Data Portal, support SITES with system development and advice, and training in data management. During 2022, station specific data workshops were held focusing on data quality control, metadata documentation and data uploads for meteorological and aquatic data types. These workshops contributed significantly to an increase in time series data from stations openly available on the SITES Data Portal.

Open access to the SITES Data Portal is found using the following link: https://data.fieldsites.se/portal/. The SITES Data Portal uses persistent identifiers (PIDs) to enable traceability of individual data sets. The download statistics from the SITES Data Portal can be tracked including filter options for country code, station, and time period using the following link: https://data.fieldsites.se/stats/. Download statistics from the data repository consider all existing data entries as seen in Figure 2.

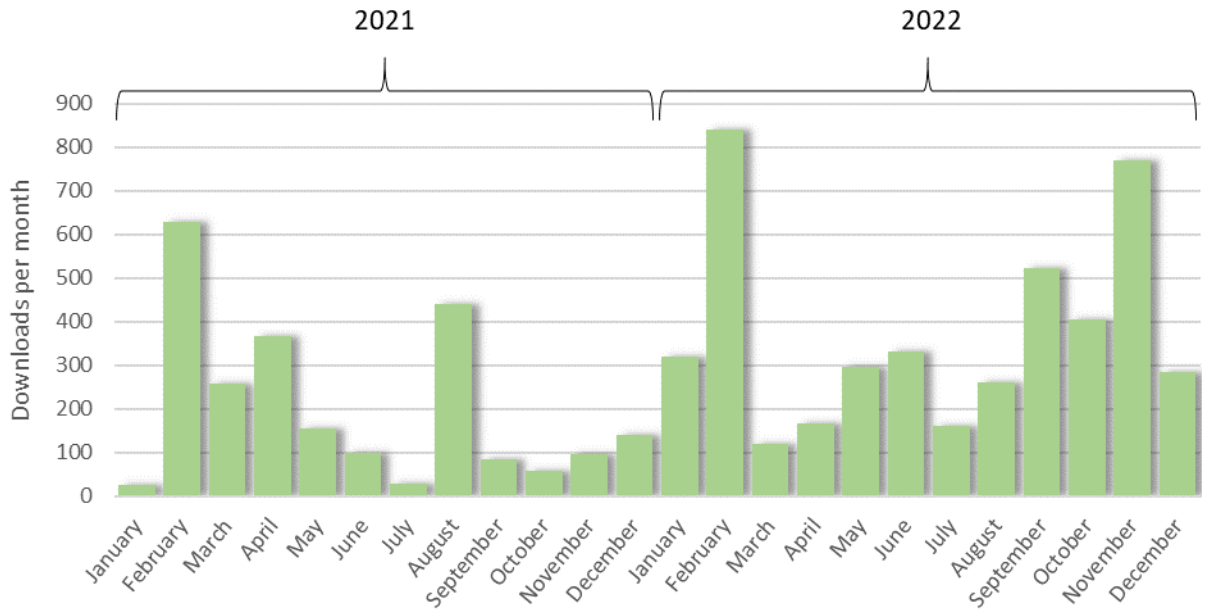

Figure 2: *Total number of downloads per month from the SITES Data Portal during the years 2021 (n=2,384) and 2022 (n=4,479).*

Further, Figure 3 provides the number of unique data users per month downloading data from the SITES Data Portal during the years 2021 (n=466) and 2022 (n=1,035).

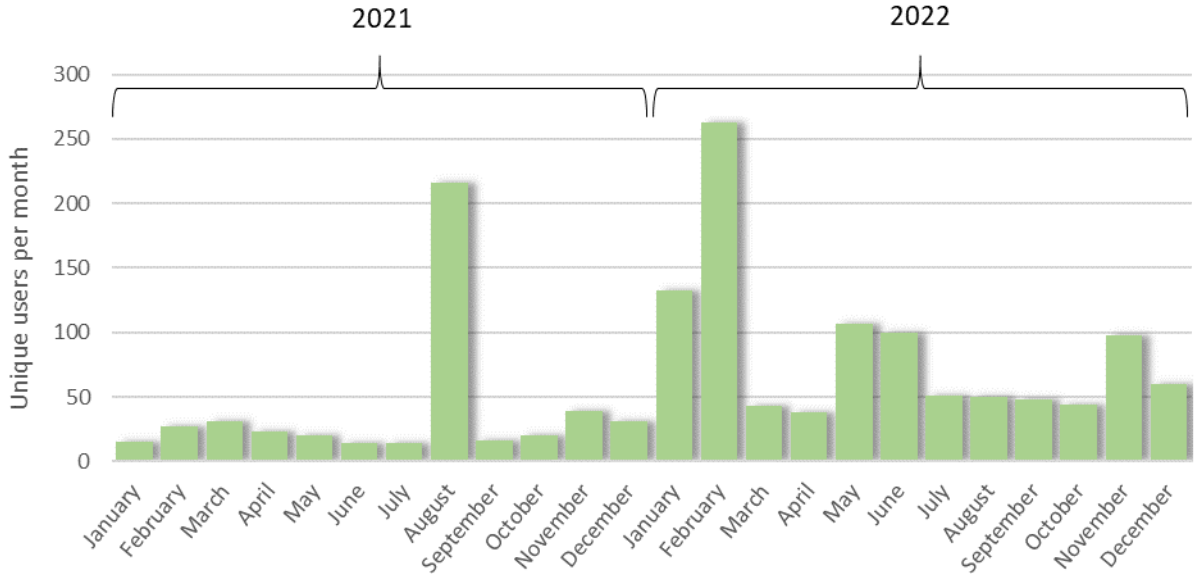

Figure 3: *Unique data users per month downloading data from the SITES Data Portal during the years 2021 (n=466) and 2022 (n=1,035).*

The highest number of individual data downloads occurred in February 2022 with a total of 840 single downloads. At the end of 2022, datasets had been downloaded from 27 different countries, which are distributed globally. Most of these datasets were downloaded from European countries with the highest number of downloads from Germany (n=1,621) followed by the United States (n=1,449) and Sweden (n=1,030).

The e-infrastructure was marketed by highlighting specific data sets, data spanning multiple stations or significant progress on data management developments in the bi-monthly newsletter. The SITES Data Portal was also presented to the scientific community in webinars and meetings, e.g. “eLTER talks”. In addition, research publications were advertised using SITES data and acknowledging the use of the infrastructure and VR funding. The 2023 SITES calendar, has a data in focus theme, where each month a news item linking to the data on the SITES Data Portal will be posted, as a way to increase data knowledge within the SITES user base. The marketing efforts will continue in 2023 and throughout the next funding phase.

Further, the work on information exchange on data management practices continued between the SITES Secretariat, system developers and the eLTER data management team with the aim to align future metadata harvesting and data delivery services between the two infrastructures. A data management workshop was hosted by the SITES Secretariat at SLU in Uppsala focusing on different data handling approaches of SLU stations linked to eLTER Sweden, eLTER system developers from UKCEH and the SITES data management team. Furthermore, concrete system development steps were taken to expose the SITES data catalogue to the eLTER digital asset registry (eLTER DAR). A first SITES metadata catalogue representation on the eLTER DAR is planned to be published during 2023.

SITES continued the collaboration with the Swedish National Data Service (SND) throughout 2022 to ensure that data from the SITES Data Portal will be represented on a future SND research database catalog. Metadata sharing service with the INTERACT network for three of the SITES Stations (Abisko, Svartberget, and Tarfala) also continued during 2022. The stations listed have collaborative agreements with the INTERACT network and are required to offer a metadata sharing service on the virtual single entry point (https://dataportal.eu-interact.org/) for open access to monitoring data from all INTERACT stations. The SITES e-infrastructure was able to fulfill the requirements and tools were provided to the system developers to enable metadata harvesting from the SITES Data Portal and the respective stations. The engagement will continue throughout the next funding phase and will prepare SITES for involvement in similar metadata harvesting initiatives in the future, e.g. eLTER.

In addition, the development of INTERACT / SITES-GIS continued. The system is designed to be used by researchers applying for station access and tracks research activities and projects carried out at the stations. Several meetings were held throughout the year between the system administrators at Umeå University and the SITES Secretariat to adapt the project application form to standardize the data collection with the quantitative information needed to compile the Annual Report key figures. An updated project registration was published in spring 2022. There are plans to implement the full functionality of the tool at all SITES stations during 2023 for project registration and reporting.

Dedicated data retreats, where personnel from the Secretariat visited the SITES stations, occurred throughout 2022. The data retreats were focused efforts that massively increased the amount of data, in particular for SITES Water, published on the Data Portal. The regular weekly data meetings with the Secretariat, system developer and SITES Spectral Technician, continued in 2022. The Data Management group met three times during the year and produced the first SITES Data Management Plan, now available on the SITES Data Portal: https://meta.fieldsites.se/objects/U1I9w-9o5jJJ-REAGD87Uxjo.

5 Leadership and coordination

The SITES management function is briefly described below along with a brief account of how it has developed and changed over the year in response to the infrastructure needs.

5.1 SITES consortium

SITES is run jointly by SLU, the University of Gothenburg, Stockholm University, and Uppsala University, as well as the Swedish Polar Research Secretariat. The terms and conditions for the collaboration are defined in a Consortium Agreement with an added opportunity for the SITES partners to provide input on strategic matters (i.e., Business Plan, budget, associations, and agreements) during yearly meetings with the Partner Organization Advisory Board. This advisory group also advises on strategic plans, the decommissioning plan as well as the appointment of the Director and Steering Group. This model for engaging the SITES Partner Organizations ensures that the SITES operations are aligned with the strategic planning of the Partner Organizations and as such facilitates the long-term strategic joint development of the infrastructure together with the organizations that co-finance and support the work.

In 2022, the Partner Organization Advisory Board met three times on 03/02, 01/09, and 13/12. Representatives of the principals were Maria Knutson Wedel (Vice chancellor of SLU, chair of the meeting), Ingela Dahllöf (Vice Dean of the University of Gothenburg), Katarina Gårdfeldt (Director, Swedish Polar Research Secretariat), Anders Karlhede (Deputy Vice chancellor of Stockholm University) and Anna Qvarnström (Vice Dean of Uppsala University). From SITES, the Director Stefan Bertilsson, Deputy Director Blaize Denfeld and Steering Group Chair, Anna Gårdmark, along with Sofia Wretblad from SLU's management office participated. The main discussion of these meetings was on establishing the consortium agreement and conditions for the next funding period (2023-2028), which included the decision by Tarfala Station, and the associated Partner Organization, Stockholm University, to not join SITES III. The hiring process of SITES new Director (Kevin Bishop was selected) and representation in eLTER Interim Council were also major discussion points in 2022.

5.2 Steering Group

The SITES Steering Group is appointed by SLU with the charge and mandate to oversee and lead the activity of the infrastructure in line with the governing documents.

The current steering group has its mandate from 2021-03-01 to 2024-02-29 and consists of the following members:

- Johan Bergh, Linnaeus University
- Jan Bengtsson, SLU
- Anna Gårdmark, SLU (Chair)
- Anders Hedenström, Lund University (Vice Chair)
- Jan Karlsson, Umeå University
- Inger Kappel Schmidt, University of Copenhagen
- Hanna Silvenoinen, Norwegian Institute for Nature Research.

In 2022, the steering group met eight times (31/01, 14/03, 26/04, 01/06, 15/08, 20/09, 18/10, 06/12) as there were many important decisions taken in 2022, including the new SITES Director and reallocation of the SITES III budget (as discussed above). Similar to the previous years, all meetings have been conducted as virtual meetings due to the pandemic situation but it is the plan in 2023 to reinstate at least 1-2 in person meetings per year.

5.3 Scientific Advisory Board

Due to the increasing demand for large-scale infrastructure access and broad support across multiple stations, SITES has established a separate, independent Scientific Advisory Board (SAB) to assist with evaluation and prioritization. The SAB consists of 5 prominent scientists who were appointed by the Steering Group with their term starting January 2022:

- Mari Källersjö, Gothenburg Botanical Garden (Chair)
- Göran Ståhl, SLU
- Klaus Steenberg Larsen, University of Copenhagen
- Gerlinde de Deyn, Wageningen University & Research
- Kathleen Weathers, Cary Institute of Ecosystem Studies

The SAB provides strategic advice to the Steering Group on prioritization of infrastructure access and strategic development and will be maintained during the next project phase. The SAB had its first meeting in 2022 with plans to increase SAB engagement during the next funding phase. The SAB and the Steering Group should have one joint meeting per year, with additional meetings when called for. The appointment for the SAB is three years with possible reappointment for a second three-year period.

5.4 SITES Operational Leadership Group

The SITES Operational Leadership Group includes the nine SITES Station Managers, the SITES Thematic Program Leaders, the Director of the associated station Bolmen, and the SITES Secretariat.

The group has regularly occurring meetings that serve to distribute information and provide a platform for discussion and an important activity for communication between the SITES Secretariat and the field research stations. These meetings enable coordination, operational planning, and consensus building on common strategic goals within the infrastructure.

The group has met regularly during the year on ten occasions (i.e. every month except for the holiday periods in January and July), with all but one meeting being organized virtually. The SITES Operational Leadership Group had an in person meeting jointly at Lönnstorp and Bolmen in October. The main focus of the meeting was to reflect on the accomplishments of SITES II and plan for the operations during SITES III.

In 2022, there was a change in leadership at Asa research station, as Wilhelm Lönnqvist assumed responsibility for leading the operations, as Martin Ahlström stepped down from his position due to health issues. Leif Klemedtsson, retired as Skogyard Station Manager in 2021 but still maintained his role as the leader for the SITES Water Thematic Program during 2022. In 2023, Marcus Waillin will take on the role of SITES Water Thematic Program lead but already during 2022 was engaged a small percentage for a smooth knowledge transfer of the program.

To complement the monthly meetings of the SITES Leadership Operational Group, Data Management meetings are conducted with participation from all stations and lead by the Secretariat and the Data Portal system developer. Additional technical meetings related to the Thematic Program leads, are also organized to enable further knowledge exchange and cross-station coordination between station staff.

5.5 Secretariat

The Secretariat is tasked to operationally lead the infrastructure and ensure that the SITES operations are conducted in accordance with the strategic goals and the Steering Group decisions. Like previous years, the function of the Secretariat is physically placed at the Department of Aquatic Sciences and Assessment (SLU, Uppsala) under the leadership of Director Stefan Bertilsson, also working as Professor at the same department. The Director position is 50% of a full-time position. Stefan Bertilsson has been SITES Director throughout most of the current funding phase and decided that 2022 would be his last year as Director. As such, the process for finding SITES new Director took place in 2022 under the Steering Group's leadership, with the decision to hire Kevin Bishop. Although his official role as SITES Director begins in 2023, already in 2022 he was engaged with SITES to allow for knowledge transfer.

The Director is assisted by a Secretariat consisting of a Deputy Director (100%), a Coordinator who leads the work with SITES Data Management (100%), a Communicator (20%), an Economist (25%), and an International Coordinator (10%) who also leads eLTER Sweden. In 2022, the Deputy Director was on parental leave for a portion of the year, and thus responsibilities within the Secretariat were supported with the addition of an Environmental Assessment Analyst during that time. In addition to the staff employed at SLU, the system development and maintenance of the SITES Data Portal, corresponding to 50% of a full-time position, is commissioned to the ICOS Carbon Portal hosted by Lund University. Additionally, the Steering Group approved strategic initiatives that included the temporary employment of two environmental analysis assistants who have contributed to the work with the geographical background description of the stations and data mobilization as well as greenhouse gas data processing for all SITES Water lakes. A main focus of the Communicator in 2022 was on the production of SITES video content.

6 Communication

SITES external communication and outreach activities and the opportunities offered to the research community is conducted both centrally at the Secretariat and at the stations.

The SITES website https://www.fieldsites.se/en-GB is the central information platform. The number of unique visitors to the website in 2022 (24,831 visitors) was on par with visitors to the website in the previous year (29,100 in 2021), which compared to earlier years is a major increase (6,939 in 2018, 8,017 in 2019, and 9,106 in 2020). News about SITES, the stations, and the Thematic Programs are regularly published on the website. Weekly news was posted on the website throughout 2022 and the number of items (48 in 2022) stayed consistent compared the previous year (49 in 2021 and 56 in 2020).

In 2022 five Newsletters were published and sent to a broad target group consisting of internal recipients, such as station staff, Station Managers and the leadership group, as well as externals, consisting of key researchers associated with SITES, colleagues at the Departments associated with the stations, and interested stakeholders. SITES offers an open subscription option to the newsletter as well as an easy option to unsubscribe from the send list. Each newsletter contains, among other things, status reports from the stations highlighting ongoing activities, interviews with staff working in SITES or at a station, a description of a dataset from the SITES Data Portal, and a list of new publications. In 2022, a new section was added to the Newsletter to highlight SITES promotional videos. The Mailchimp platform is used to send out the Newsletter and at the end of the year in 2022, the Newsletter had 160 subscribers.

SITES also uses several social media platforms to engage with a wide network of potential users. Centrally the social media platforms are mainly used to repost weekly news published on the SITES website, share and repost job advertisements within the scope of SITES, highlight news posts from SITES collaborators, i.e. individual researchers and research networks, and give real time updates about SITES activities, e.g. meeting or conference attendance. The main platforms used are Facebook (over 80 post) and Twitter (over 100 post) and to a lesser extent LinkedIn (mainly used for weekly news and job announcements). Twitter was started in the spring of 2021 and has showed the highest increase in popularity with nearly 500 subscribers by the end of 2022 from just over 200 subscribers at the end of 2021. SITES AquaNet and several stations, including Lönnstorp, Röbäcksdalen, Erken, Abisko and Tarfala, also use Twitter and/or Facebook as part of their science communication strategies.

In 2022, SITES YouTube channel was relaunched to make the videos from the 2021 video campaign publicly available, including an 1) Introduction to SITES Water, 2) Hyperspectral camera, 3) Research collaborations and 4) Drones to measure Methane. In 2022, additional video campaigns took place, resulting in three additional videos on the SITES YouTube channel, 1) Winter lake sampling at Erken, 2) Hazel Grouse survey method at Grimsö and 3) Introduction to the SITES Spectral. An agricultural focused video is planned for 2023, that will use the footage collected from Lönnstorp in 2022, in combination with a video campaign at Röbäcksdalen in 2023.

In order to communicate the opportunities offered by the infrastructure, SITES participates in meetings, conferences, and similar forums relevant to potential users of the infrastructure. Given that the pandemic restrictions continued into early 2022, the SITES Secretariat continued to virtually interacted with international networks and collaborative projects. However, SITES also had the possibility to participate in an in person eLTER meeting in Mallorca, Spain.

7 International collaborations

7.1 LTER Europe

In 2022, staff from SITES secretariat have continued their participation in the two Horizon 2020 projects eLTER PPP and eLTER PLUS, which are developing a European research infrastructure for ecosystem research and monitoring, based at field stations in LTER Europe. The governance body in the developing RI is the Interim Council, consisting of ministry representatives from all partner countries. In Sweden, this is delegated from the ministry to the Swedish Research Council with a further mandate to SITES and SLU. At first, Sweden was represented by former SLU Pro Vice-Chancellor Kevin Bishop. However, after Kevin Bishop was elected chair of the Interim Council, Sweden is now represented by the SLU Vice-Chancellor Maria Knutson Wedel and with Sofia Wretblad as deputy.

Within the two H2020 projects that aim to develop the RI, members of the SITES Secretariat have been given the tasks of e.g. developing structures and standards for data management and modeling, developing a Human Resources strategy, as well as establishing a strong forum for Site and Platform Coordinators across this emerging network of European LTER stations. This is an opportunity to develop our international network and ensure that Sweden is well aligned with developments taking place at the European level, a mission that is fully in line with SITES strategic plan. Based on already existing instrumentation, the Secretariat has also promoted the selection of some SITES stations as “Category 1 stations” (formerly called “Master Sites”) in the planned research infrastructure. However, the site categorization has just started and an upgrade to category 1 depends on available funding. All stations in SITES are members in LTER Sweden and thereby also in LTER Europe and receive

continuous information from the leaders of eLTER and are also invited to join the forum for station representatives, topical working groups, and other eLTER meetings, as well as invitations from the international LTER (ILTER) to participate in webinars, training activities and their biannual conferences.

7.2 AQUACOSM-plus

Through Uppsala University, SITES AquaNet participates with all its five AquaNet stations including the associated station Bolmen in the EU infrastructure project AQUACOSM-plus. AQUACOSM-plus aims to develop coordination and sharing of leading European mesocosm infrastructures and provides SITES with excellent opportunities for skills exchange and development as well as the opportunity for international researchers and students to participate in experiments conducted within SITES AquaNet. As part of this project, coordinated experiments with funding for transnational access took place in 2022 and will again occur in 2023. These experiments, run at the SITES AquaNet stations, provide ample opportunities for attracting new users, forging new collaborations, and highlighting the capabilities within SITES AquaNet. A strategic meeting between AQUAOSM and SITES took place towards the end of 2022 to discuss the possible future collaborations after the end of the AQUACOSM-plus project. SITES hopes that this fruitful collaboration continues in the future.

7.3 LIFEPLAN

LIFEPLAN is a larger international project funded by a European Research Council Synergy grant that aims to map biological diversity on a global level by a combination of spatial biodiversity inventories and long-term biodiversity time-series observations. SITES participates by hosting and operating sample collection programs at seven of the research stations and the associated station Bolmen. The project will provide a foundation for establishing and expanding future biodiversity research within SITES with links to similar measuring stations and time series from ecosystems around the world. The sampling campaign was continued in 2022 and all SITES stations, except for Tarfala, are participating and now delivering samples and automatically collected images and acoustic data to the project coordination.

7.4 ICOS-ACTRIS

SITES has a longstanding collaboration with ICOS. One aspect of this is the operation and development of the SITES Data Portal in collaboration with the ICOS Carbon Portal. Additionally, co-localization of the two infrastructures at several SITES stations include, for example, shared technology development in micrometeorology and shared installations (e.g. masts). Recently a third related infrastructure (ACTRIS; Aerosol, Clouds, and Trace Gases Research Infrastructure) was funded by VR with additional apparent synergies, co-localization, and collaborative opportunities. While contact has already been established between SITES-ICOS-ACTRIS in the form of strategic discussion meetings and a joint center of excellence research school application in 2022, efforts will be intensified in the coming years and are in line with conditions from VR to jointly developing a plan and vision for strengthened infrastructure collaboration and integration.

7.5 Other

In addition to the major infrastructure projects highlighted above, SITES collectively participated in several other international networks and projects or contributed with infrastructure to support international collaborative research efforts. SITES has for example partnered with the Global Lake

Ecological Observatory Network (GLEON) in several projects and during 2022 the SITES lake stations finalized the dissolved organic matter composition (DOM) sample delivery and in 2023 will compile data for this project. In addition, Erken supported several additional GLEON projects including, projects related to lake ice cover, chlorophyll and lake temperature gradients. SITES also continued its collaboration with INTERACT in 2022 via the SITES stations Abisko, Svartberget, and Tarfala engagement in the INTERACT transnational access and the SITES INTERACT GIS station search and application platform (details found in Section 4).

8 Financial reporting

The funding for SITES comes partly from an infrastructure grant awarded by the Swedish Research Council (21,448 kkr per year), and partly from equivalent or larger co-funding from the owners of the participating research stations in accordance with the funding decision. The budget distribution between the participating organizations and stations (Table 2) is defined in the ratified consortium agreement. The stations vary in their history, organization, and mission and therefore there are large differences in the relative contribution of SITES activities and capabilities to the total station operations ranging from 100% of the activities to including only certain parts of the station activities.

The financial report includes both the central coordination functions within the secretariat and the SITES activities at the individual stations for the year 2022. It is subject to audit by an external accredited auditor to fulfill the requirements for an auditor's certificate. The negative financial results for most of the stations and also for the infrastructure combined (Table 2) reflects an increased level of co-financing by the partners that is needed to maintain strategically important activities and programs at the SITES stations. The negative balance for the Secretariat was caused by increased investments in data support and other centrally covered services to the stations including GIS tasks, sediment analyses and technician time.

Table 2: *Financial reporting of grant funds and co-financing for SITES 2022.*

Financial report SITES 2022 (kkr)				
Station	**Cost**	**VR funding**	**Budget**	**Result**
Abisko	6 275	1 147	2 987	-3 288
Tarfala	4 135	913	2 377	-1 758
Svartberget[1]	11 551	3 810	8 651	-2 900
Röbäcksdalen	4 017	1 256	3 269	-748
Grimsö	1 822	808	2 105	283
Erken[1]	5 222	1 896	4 153	-1 069
Skogaryd[1]	6 336	2 681	5 710	-627
Asa	6 040	1 939	5 048	-992
Lönnstorp	3 013	998	2 599	-414
Total SITES Stations [*]	*48 411*	*15 449*	*36 897*	*-11 514*
Total SITES Secretariat [2,*]	*7 777*	*5 999*	*5 999*	*-1 778*
Total SITES Stations & Secretariat	*56 188*	*21 448*	*42 896*	*-13 292*

[*] *For the total costs rounding causes slight differences in sums.*

[1] *The costs for thematic program coordination and data management are included in the financial report as follows: Erken 489 kkr for SITES AquaNet, Skogaryd and Svartberget 792 kkr each for SITES Water.*

[2] *The secretariat budget also includes costs for coordination and data management for the thematic program SITES Spectral at a total cost of 1 386 kkr which is allocated to Lund University (not a consortium member).*

Appendix 1 – Key figures

Table A1: *Project data key numbers for SITES scientific projects for the whole funding period (2018-2022)*

Scientific projects	2022	2021	2020	2019	2018
Total number of projects	**518**	507	492	515	570
Home institution of the project [1]					
Host organization	**340**	324	328	298	284
Organization within the consortium	**34**	24	25	33	50
Other Swedish school	**61**	59	77	90	100
Public organization	**5**	2	4	3	0
Other organization (private association or commercial)	**8**	13	11	11	22
International organization	**70**	44	47	80	114
Thematic Program/Multiple Station Projects					
SITES Water	**25**	28	29	35	52
SITES AquaNet	**2**	2	6	9	8
SITES Spectral	**10**	12	15	2	3
Other projects that use multiple SITES stations	**33**	53	50	30	12
Type of access[2]					
Total number of days used	**18 228**	16 938	14 198	16 831	14 323
On location - number of projects	**353**	388	377	451	332
On location - number of user days	**15 853**	13 534	12 276	14 464	12 309
Remote access[3] - number of projects	**313**	241	195	158	237
Remote access[3] - number of user days	**2 375**	3 404	1 923	2 367	2 014
Data downloads – number of projects	**416**	348	379	289	302
Data downloads – number of downloaded datasets[4]	**4 339**	4 594	1 897	2 592	910

1 Home institution for the project is determined by that of the PI

2 A single project can have both days on location and remote access.

3 Remote access means that the researchers themselves were not on site and that the work was performed by station personnel
4 Reported for SITES stations, associated station Bolmen had 140 downloads, making a grand total of 4,449 downloads

Table A2: *User data key numbers for SITES Scientific projects in 2021, 2020, and 2019.*

Scientific projects	2022	2021	2020	2019	2018
Users[5]					
Total number of unique users	*1 063*	*979*	*1 051*	*1 210*	*1 032*
Number of unique project leaders	*319*	*304*	*295*	*335*	*313*
Number of other unique users[6]	*744*	*675*	*756*	*875*	*719*
Project leaders - split by gender and career stage					
Female - junior	*35*	*39*	*40*	*48*	*52*
Female - senior	*79*	*71*	*53*	*83*	*72*
Male - junior	*42*	*31*	*36*	*33*	*54*
Male - senior	*146*	*144*	*148*	*153*	*135*
Unspecified gender or career stage	*17*	*20*	*17*	*18*	*0*
Project leaders - home institute					
Host organization	*165*	*180*	*148*	*135*	*120*
Organization within the consortium	*35*	*24*	*21*	*31*	*27*
Other Swedish Universities and academic institutions	*53*	*52*	*68*	*75*	*65*
Public organization	*4*	*1*	*4*	*3*	*1*
Other organization (private association or commercial)	*6*	*9*	*10*	*10*	*12*
International organization	*63*	*65*	*44*	*81*	*88*
Other users - split by gender and career stage					
Female - junior	*182*	*83*	*99*	*129*	*121*
Female - senior	*103*	*97*	*120*	*178*	*116*
Male - junior	*126*	*105*	*101*	*127*	*161*
Male - senior	*207*	*225*	*292*	*314*	*315*
Unspecified gender or career stage	*128*	*171*	*144*	*127*	*60*
Other users - home institute					
Host organization	*150*	*206*	*254*	*179*	*152*
Organization within the consortium	*105*	*94*	*108*	*93*	*39*
Other Swedish Universities and academic institutions	*136*	*112*	*134*	*162*	*179*
Public organization	*28*	*8*	*17*	*5*	*7*
Other organization (private association or commercial)	*31*	*17*	*19*	*9*	*15*
International organization	*295*	*253*	*224*	*427*	*326*

5 Unique users are identified by station and summed across stations, meaning that the total number of SITES users and PIs will be slightly inflated if they are a part of projects at multiple stations.

6 Manual adjustments have been made within stations for users that were listed as both PIs and "other users". They have been counted just as Pis

Table A3: *Key numbers for SITES training, development and outreach projects from 2021, 2020, and 2019.*

Training, Development, & Outreach Projects	2022	2021	2020	2019	2018
Total number of projects	**140**	63	59	171	173
Home institution of the project [1]					
Host organization	**52**	20	30	66	52
Organization within the consortium	**2**	1	0	8	5
Other Swedish Universities and academic institutions	**9**	3	2	23	69
Public organization	**64**	36	21	58	9
Other organization (private association or commercial enterprise)	**3**	3	5	12	20
International organization	**10**	0	1	4	9
Type of access [2]					
Total number of unique users	**3 166**	1 881	553	4 964	3 998
Total number of days used	**5 958**	2 786	3 711	9 961	11 726
On location - number of projects	**124**	56	56	168	158
On location - number of user days	**5 952**	2 646	1 510	9 798	11 383
Remote access[3] - number of projects	**10**	12	19	14	17
Remote access[3] - number of user days	**8**	140	2 201	163	343

1 Home institution of the project is determined by that of the PI

2 A single project can have both days on location and remote access.

3 Remote access means that the researchers themselves were not on site and that the work was performed by station personnel