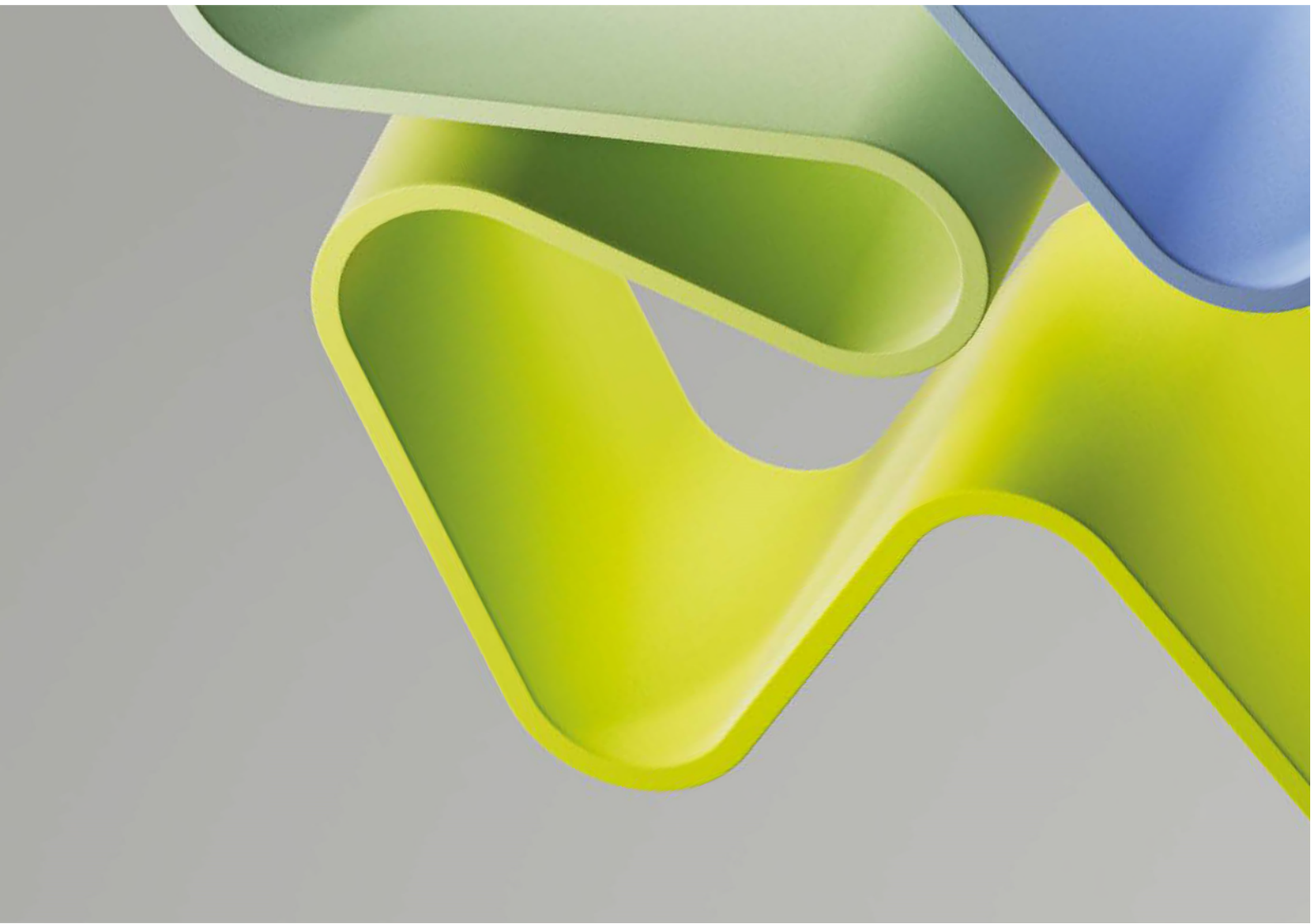
Forskningsrådet

Svalbard Integrated Arctic Earth Observing System (SIOS)

Evaluation of SIOS Knowledge Centre



Preface

In the contract between The University Centre in Svalbard and The Research Council of Norway regarding project number 322387 SIOS KC 2022 it was stipulated that SIOS-KC should be evaluated in 2023. Due to major internal changes in RCN the evaluation was delayed until 2024. Terms of reference for an evaluation were developed by the RCN, based on the stipulations in the contract, and an international panel of evaluators was formed.

The evaluation committee has collected information through interviews and document studies. The report describes SIOS-KC and SIOS in general, addresses selected issues, and provides SIOS-KC, and RCN, with several recommendations.

The Research Council of Norway wishes to thank the evaluation committee and the committee secretary for their insights and efforts.

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Summary

This evaluation of the Svalbard Integrated Arctic Earth Observing System Knowledge Centre (SIOS-KC) provides an assessment of the organization's effectiveness in coordinating Arctic research infrastructure in Svalbard. Established in 2018, SIOS addresses environmental and climate challenges in the Arctic through coordinating interdisciplinary research and data sharing among its 28 member institutions. This report evaluates the role of the SIOS Knowledge Centre (SIOS-KC) in advancing SIOS's mission, which focuses on optimizing observation systems, enhancing data management, and supporting international collaboration.

Using interviews, documentation, and KPIs, the evaluation highlights SIOS-KC's strengths across core services, including data management, remote sensing, logistics, access, training, and communications—all aimed at optimizing the Arctic observing system. Members report high satisfaction with these services. Key achievements include the annual State of Environmental Science in Svalbard (SESS) reports, which consolidate critical data and identify knowledge gaps. The SIOS Data Management System (SDMS) provides centralized access to research data, though metadata standardization remains challenging. Other valuable contributions include sustainable data collection via remote sensing and researcher training programs that build capacity.

Challenges identified in the evaluation include member engagement, coordination with other Svalbard institutions, and data standardization. Recommendations for SIOS-KC focus on expanding member engagement, addressing governance complexities, and improving outreach. Enhanced collaboration with institutions like the University Centre in Svalbard (UNIS) and the Svalbard Science Forum (SSF) is suggested to improve resource sharing and streamline logistics. Governance challenges—including dual international and national expectations and a "top-heavy" structure—call for role refinement to better align with SIOS's mission and member needs. Additionally, clearer communication about SIOS's services is recommended to retain current members and attract new ones, thus supporting long-term sustainability.

SIOS's financial stability remains dependent on funding from the Research Council of Norway, unless diversified funding sources are secured. In conclusion, while SIOS-KC delivers substantial value with limited resources, stronger collaboration with member institutions and streamlined governance would further enhance SIOS's impact and sustainability.

1 Introduction

1.1 Introduction to SIOS

The *Svalbard Integrated Arctic Earth Observing System (SIOS)* is an international observing system designed for long-term environmental measurements in and around the Svalbard archipelago. SIOS was established to address the growing need for coordinated, interdisciplinary approaches to studying the Arctic, a region experiencing rapid climate change at a rate three to four times faster than the global average. Addressing environmental and climate-related challenges requires an Earth system approach that no single institution or nation can tackle alone.

Officially established in 2018, SIOS coordinates research across disciplines, focusing on the interconnected aspects of Earth system science, including the ocean, atmosphere, biosphere, cryosphere, biogeochemistry, and geology. Its central hub, the *SIOS Knowledge Centre,* ensures collaboration and integration with the mission: to develop an efficient observing system, facilitate the sharing of technology, experience, and data, close knowledge gaps, and reduce the environmental footprint of research activities.

SIOS is comprised of 28 member institutions from 10 countries, with each member contributing expertise and resources to facilitate interdisciplinary research. The system emerged from an earlier initiative, *Svalbard Integrated Arctic Earth Observing System (SIAEOS),* which was included in the 2008 European Strategy Forum on Research Infrastructures (ESFRI) Roadmap. Although SIOS does not fully meet the criteria for ESFRI Landmark status, it is recognized in the ESFRI Landscape Analysis and participates in European infrastructure projects, including the ENVRI-FAIR community.

Organizationally, SIOS operates through two distinct yet closely related entities. *SIOS Svalbard AS*, a limited liability company fully owned by the *University Centre in Svalbard (UNIS AS)*, functions as the secretariat and administrative arm of SIOS. The second entity, the *SIOS Consortium*, is a partnership formed through a non-binding Memorandum of Understanding (MoU). The Consortium is governed by a General Assembly, a Board of Directors, and a director who manages both the Consortium and SIOS Svalbard AS. The SIOS Consortium itself is not a legal entity, but SIOS Svalbard AS serves as the legal framework for contracts and operations. Within this report, the term “SIOS” refers to the SIOS Consortium and its collective activities, while “SIOS Svalbard AS” is referenced by its full name when specified. SIOS Svalbard AS also has a General Assembly and a Board of Directors, but those bodies are of little relevance to this report.

SIOS’s central coordinating body, the *SIOS Knowledge Centre (SIOS-KC)* provides several services to both members and non-members. These include providing training, logistical support, data management, remote sensing services, and dissemination of SIOS research findings. Moreover, the SIOS-KC facilitates effective communication and collaboration between the various members, users and stakeholders, including researchers, institutions, and research infrastructure providers. This coordination supports SIOS’s broader mission of generating high-quality, open-access data, crucial for understanding the environmental changes in the Arctic.

In addition to coordinating research activities, SIOS-KC runs five working groups: Science Optimization Advisory Group, Research Infrastructure Coordination Committee, Remote Sensing Working Group, Data Management System Working Group, and Information Advisory Group. These groups, composed of members from various institutions, contribute to research coordination, data management, and the optimization of research infrastructure. Key events organized by SIOS-KC include the Polar Night Week, which features the release of the State of Environmental Science in Svalbard (SESS) report. Additionally, SIOS-KC organizes smaller calls for proposals to support collaborative projects known as the access program.

1.2 Purpose of the Evaluation

This evaluation aims to assess the effectiveness of SIOS-KC in meeting its strategic goals, particularly regarding research infrastructure coordination in Svalbard. It focuses on evaluating the extent to which SIOS fulfills its mission and the specific role of SIOS-KC in achieving these outcomes. This is *not* an evaluation of the scientific research supported by SIOS, but rather an assessment of its operational and strategic contributions.

The evaluation findings will provide advice for SIOS and SIOS-KC's future directions. This analysis is intended for SIOS-KC, its funders, the SIOS governance, and SIOS member institutions. It offers informed recommendations for future priorities and developmental strategies, both near- and long-term, for enhancing SIOS’s role in the Svalbard research infrastructure.

Key evaluation objectives include examining SIOS's facilitation of scientific collaboration, data sharing, and international research contributions. The evaluation assesses SIOS-KC’s management and operational efficiency, as well as its impact on the broader research environment in or related to Svalbard. Insights from this process will inform strategic decisions supporting the ongoing development of SIOS.

1.3 Methodology

This evaluation employs a mixed-methods approach, combining qualitative and quantitative data collection. Core methods include:

- *Interviews*: Conducted online and in person with key personnel and key actors, including representatives from research institutions, infrastructure providers, and other Arctic research stakeholders. These interviews, including a site visit to Longyearbyen, provided insights into SIOS’s operational dynamics and perceived effectiveness.
- *Reports and Documentation:* A comprehensive review of relevant reports and official documents related to SIOS’s operations, objectives, and outcomes complements the interview data to provide a well-rounded assessment of SIOS’s effectiveness. Documentation and SIOS website information was reviewed as of August 2024.

2 Current progress of SIOS-KC

2.1 SIOS services

SIOS-KC's core activities revolve around its six primary services, all of which are interconnected through the central service, “Optimization of the Observing System.” This evolution and optimization are guided by tools such as the SIOS science wheel and the State of the Environmental Science in Svalbard (SESS) reports. To follow the progress of the SIOS services a number of key performance indicators (KPI) have been identified. KPIs are useful tools, however, it is difficult to find updates of the KPIs in the annual reports.

Recommendation: Utilize the KPIs as a powerful tool to map progress. An annual reporting of KPIs related to the development of SIOS is needed for members to evaluate the effectiveness of SIOS-KC and the SIOS Consortium in shaping, developing, and expanding the long-term monitoring and data availability in Svalbard.

2.1.1 Optimization of the observing system

This service aims to enhance the observing system while reducing the environmental impact of research. Key tools include the annual SESS report, infrastructure optimization reports, and the SIOS science wheel. The SESS reports serve as a cornerstone for synthesizing current knowledge and fostering collaboration among researchers. They highlight knowledge gaps, recommend research priorities, and guide the sustainable development of the Arctic observing system. The identified knowledge gaps and recommendations described in the SESS reports are used to update the optimization reports.

This service is led by the SIOS Director in collaboration with the Science Optimization Advisory Group (SOAG), which advises SIOS concerning scientific and societal relevance and the overall strategical goals of the Observing System. SOAG’s role includes advising on:

- Development of SIOS’s science case.
- Prioritizing proposed services and initiatives based on relevance, feasibility, and practicality.
- Reviewing proposals for scientific quality.

This service plays a critical role in sustaining and advancing SIOS, and its supporting structures, and we believe the tools are robust. There is a strong link to the SIOS core data program, since the work in the SESS reports is based on data from SIOS. However, the visibility of these tools—particularly the SESS reports—remains limited in the wider scientific community, which may reduce their impact.

Recommendation: It is important that SIOS-KC provides an annual, updated roadmap based on the recommendations from the SESS reports. The implementation of these recommendations should be agreed upon together in form of a roadmap for improvement.

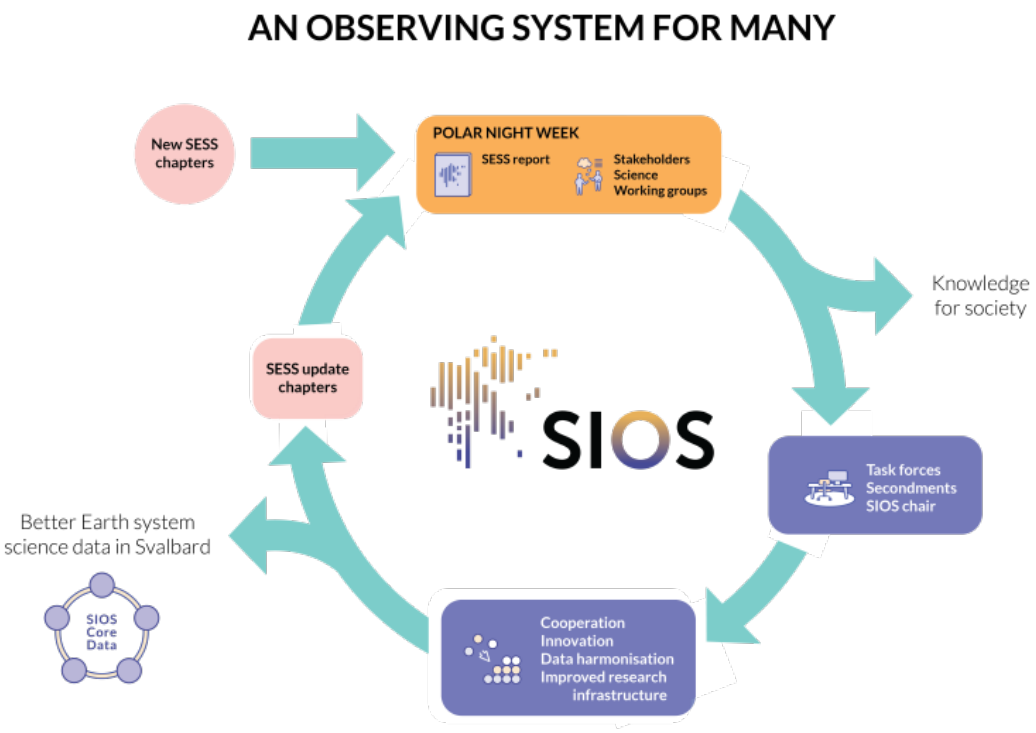

Figure 1: *Concept of the SIOS science wheel to develop an observing system for many uses and users. SIOS, i.e. the SIOS member institutions, the working groups, and the SIOS Knowledge Centre are the internal forces that move the SIOS wheel forward with the aim to provide better Earth system science data in Svalbard and thus serve the societal needs related to climate change, pollution and bio-diversity loss. The different aspects of the Earth System and the means to improve the observing system are the preoccupation of many work units, incl. task forces, secondments, and expert residents as the SIOS chair. With the principles of cooperation, innovation and data harmonization the SIOS community produces relevant long-term data series, the SIOS core data, and improved research infrastructure as basis for new research projects and capacity building. The State of Environmental Science in Svalbard (SESS) report allows research groups from member institutions to identify observational gaps and provide recommendations on how to close those (bottom-up process). The SIOS collaboration culminates in annual gatherings, the Polar Night Weeks. There, the SESS report is released and stakeholders, researchers, and SIOS working groups meet to discuss and finalize consortium activity plans for the following year. The plans are aligned with strategical aspects by the General Assembly (top-down process), allowing the wheel to roll on. [SIOS website]*

2.1.2 SIOS Data Management Service

The SIOS Data Management System (SDMS) is a key component supporting the SESS reports and optimization service. It functions as a virtual data center, offering unified access to datasets relevant to Earth System Science in Svalbard. Datasets, along with their associated metadata, are managed by several geographically distributed data centers. Each data center has its own set of Data Management Facilities for the ingestion of new data (and associated metadata), ongoing data maintenance, and curation. SIOS does not directly store data; instead, it harvests and aggregates metadata from partner data centers, providing researchers with access through the SDMS. This

approach allows SIOS to provide access to vast amounts of legacy data while remaining agnostic to the idiosyncracies of each data supplier.

To ensure data consistency, SIOS encourages its partners to adhere to specific metadata standards, although compliance remains a challenge. When it comes to providing SIOS services on top of the data, there are stricter requirements for SIOS Core Data, which must conform to specified formats such as CF-netCDF and Darwin Core Archive (DwCA). These formats store metadata directly within the data files, which is convenient for processing and ensuring metadata availability. However, transforming existing data into SIOS Core Data requires the creation of new files, resulting in file duplication and increased storage needs. The mechanisms for handling SIOS Core Data and other datasets differ, and no clear evolutionary path exists from legacy data to Science Core Data.

Currently, there is no common level of interoperability at the data level for SIOS legacy datasets. The primary focus has been on achieving interoperability at the discovery metadata level [from Data Management Plan, page 5]. The approach to data management presents challenges, as SIOS lacks enforcement power and depends on voluntary adherence by its members. The hope is that researchers and their institutions will recognize the benefits of common solutions and standards. Although the number of participating data centers following the recommendations is growing, the total number remains insufficient, and losing any of these centers would pose a significant risk. The question remains: are the benefits of adhering to the recommendations strong enough?

The distinction between SIOS Core Data and other datasets mirrors the broader discussion of SIOS's identity—whether it is a network of research-performing organizations (RPOs) or a true research infrastructure (RI). In terms of data management, the answer is both.

The challenges with data management extend beyond the lack of enforcement mechanisms. SIOS's diverse membership includes institutions with varying histories, legacy data, and different cultures and practices, which are not easily changed. Some members have commitments to other cooperative efforts, making adaptation to SIOS standards challenging. These challenges are inherent in a multidisciplinary setting like SIOS. Scientifically, the benefits of combining data across disciplines are significant and vital to the goals of SIOS but achieving data interoperability is demanding. SIOS is not working with these issues alone, and is, for example, engaged in the European ENVRI-FAIR project. Realistic ambitions, patience, and a stepwise approach are necessary to overcome these challenges.

SIOS-KC does not only support the observation level of the management of research data, but also aims at supporting the use of research data through their training service (e.g. Workshops on AI and data management). This has important implications for the solutions chosen.

Finally, the SDMS is important to the work reported in the SESS reports and to the development of SIOS. The data and the software tools are the basis for the analysis of the environmental state reported in the SESS reports. Currently, dissemination of these important activities, reports and the metadata portal are highlighted primarily at Polar Night Week.

Recommendation: If SIOS is supposed to be a consistent research infrastructure, it may be beneficial that data is standardized, necessitating a standardization unit with decision-making power. Alternatively, if SIOS operates as a network of cooperating infrastructures, it may be more beneficial

to accept the differences and slowly improve interoperability of data through development of appropriate mechanisms. SIOS needs to take conscious and realistic decisions on which direction to develop data management services.

Recommendation: To reduce project risk, SIOS should continue to have a stepwise approach to these issues and define suitable goals and KPIs to follow up the efforts.

Recommendation: SIOS-KC should make concerted efforts to lift issues and decisions regarding data management up to a strategic level and to ensure that these issues and decisions are owned by the General Assembly of SIOS.

Recommendation: SDMS and the outcomes of SESS reports should be communicated and presented outside of Polar Night Week. It is suggested to make presentations at a number of key international events (e.g. Arctic Frontiers, Arctic Science Summit Week and Arctic Circle) each year a strategic priority.

2.1.3 SIOS Remote Sensing Service

The SIOS remote sensing service is a single point of contact for those using spaceborne, airborne, terrestrial and submarine remote sensing data for ESS research in Svalbard. Therefore, it serves as a connection between users and the European Space Agency (ESA) and member institutions generating data. Remote sensing allows us to collect data over large areas and at different scales and resolutions for use in a variety of applications.

One of SIOS's aims is to reduce the environmental footprint of scientific data collection in Svalbard. To achieve this mission, SIOS supports and coordinates the usage of uncrewed aerial vehicles (UAVs) and aircraft platforms to acquire aerial imagery and hyperspectral data for the Svalbard research community to support scientific projects.

The service has been successful, as indicated by its use in the SESS reports and supported by the Remote Sensing Working Group and remote sensing training workshops. Additionally, under the pandemic, the Remote Sensing Working Group along with the SIOS-KC adapted quickly to the challenges of limited fieldwork by increasing accessibility to remote sensing data.

Recommendation: SIOS-KC should continue to support the Remote Sensing Working Group, and its engaged members to ensure remote sensing data remains available to all parties doing research in Svalbard.

2.1.4 SIOS Logistical Services

SIOS aims to increase logistical cooperation and reduce the administrative burden on researchers by providing information, sharing offers of support and negotiating special offers for SIOS members.

Logistic Services

SIOS-KC facilitates logistic help to institutions and researchers wanting to work in Svalbard. SIOS-KC has gathered diverse information on fieldwork related issues, including where to find guidelines for research permits and safety issues, an overview on ongoing cruises and available vessels, and links to other logistics providers.

This service has some overlap with the offerings of Svalbard Science Forum (SSF; see also section 2.2.6), which also provides information about research infrastructure and activities in Svalbard. The SSF facilitates coordination, collaboration and data sharing between researchers to avoid unnecessary duplication and encourage a smaller environmental footprint of research in Svalbard.

Recommendation: To develop a closer collaboration between SIOS-KC and SSF as this could help streamline resources, identify complementary areas, and minimize redundancy. (Also addressed in 2.2.6.)

Access Services

The SIOS Access Program coordinates access to a range of research infrastructure in Svalbard, making it available to both national and international researchers. SIOS-KC oversees the program in collaboration with the Research Infrastructure Coordination Committee, and so far, the program has provided logistic and financial support to 40 projects with high satisfaction among users.

Despite these achievements, there are fewer applications than desired. The access program is currently not a very strong part of the SIOS science wheel. However, members have communicated that this is a very important part of the work in SIOS, helping young scientists afford and conduct fieldwork, connect researchers for collaboration, and potentially recruit new member organizations to the SIOS Consortium.

Recommendation: The access program should be integrated as a stronger part of the SIOS science wheel.

Recommendation: Use more targeted outreach/marketing efforts that could increase awareness and application rates. The calls can also be announced for a longer period and if possible be promoted at the big science conferences to reach out to many scientists. A survey to identify what the potential users need could also help improve the number of applications.

2.1.5 SIOS Training Services

The SIOS Training Service aims to provide researchers with the necessary skills to make the best use of the SIOS research infrastructure and observing system. Based on requests by the SIOS community and training needs identified by the working groups, SIOS currently offers training courses on data management (for SESS report authors), standard rifle training, and remote sensing applications.

Several of the courses are recorded and can be found on the homepage, which is very useful for externals users. Currently there is very little collaboration between UNIS and SIOS-KC regarding the training service.

Recommendation: Increase the advertisement of the recorded training courses to increase knowledge on SIOS.

Recommendation: Explore mutual benefits between UNIS and SIOS-KC when developing future training services.

2.1.6 SIOS Communication Service

The SIOS Communication Service disseminates information about SIOS-KC's activities, Observing System developments, and other member institution initiatives. It manages the SIOS web portal, which averages 5,000 unique users monthly, and maintains a presence on social media (Instagram, Facebook, LinkedIn, YouTube and X). This service also produces outreach materials for conferences and networking events.

A key component of this service is the development of the annual SESS reports, a highly ambitious effort led by SIOS-KC. We would like to commend this ambition and so far, success. However, additional resources may be needed to maintain the scope and quality of the SESS reports.

Recommendation: Ensure proper resource allocation so that SESS reports can continue to be supported.

Recommendation: Member institutions are encouraged to actively promote SIOS, including key guiding outputs like SESS, to increase awareness and support.

2.1.7 Conclusion on SIOS services

SIOS provides a comprehensive suite of services designed to optimize Earth System Science research in Svalbard, emphasizing sustainability, collaboration, and knowledge sharing. Central to these efforts is the Optimization of the Observing System, guided by tools like the SESS reports and the SIOS science wheel to identify and address knowledge gaps. Additional services, including data management, remote sensing, logistics & access, training and communication, enable SIOS members to conduct higher-quality, more collaborative, and less invasive research.

To ensure effectiveness, annual reporting of KPIs and a roadmap for optimization are essential to track progress toward SIOS goals. The services provided by SIOS-KC are widely regarded as high-quality and relevant, supporting the mission of SIOS. However, their success relies on active use and prioritization by the members, who ultimately define the importance of these services in achieving their research objectives.

2.2 The effectiveness of the organization and governance of SIOS

It is fair to say that SIOS has a complex governance structure. While SIOS Svalbard AS is the legal entity that holds formal power and responsibility, it does not oversee the daily operations of SIOS. Instead, governance primarily occurs through the SIOS Consortium, comprising 28 members across 10 countries, with the General Assembly (GA) as its ultimate decision-making body. The existence of two parallel governance structures has several implications for the effective management of SIOS and SIOS-KC, particularly on supervision and steering of SIOS-KC activities and prioritization of diverse tasks. Moreover, SIOS operates at the international and national level creating an extra layer on the organizational structure. This arrangement also reflects SIOS's history as an ESFRI research infrastructure, influencing the current organizational setup and roles within the governance structure. Below, we address specific facets of governance effectiveness in greater detail.

2.2.1 Network vs. Research Infrastructure

The governance and operational organization of SIOS raises an important existential question: is SIOS a network of research-performing organizations (RPOs) or a true research infrastructure (RI) with its own legal entity, commonly set objectives, annually planned and reported tasks, responsibilities, and budget, as well as country-level binding commitments with (normally) 5-year financial plans?

From an organizational perspective, there are signs that SIOS operates more like a network than an RI, e.g.:

- *RPOs as Members:* SIOS Consortium members are primarily research-performing organizations, not representatives of country-level interests.
- *Financial Contributions:* Annual membership fees in cash, paid by RPOs, are relatively low (membership fees in cash of 100 KNOK per RPO) and form a small share of the annual budget.
- *Working Groups as Key Activity:* Member participation mainly occurs within working groups, where members appoint representatives as needed. Members' activities and resource allocations to the working groups are voluntary based and contributions are reported as in-kind afterwards (complicating resource allocations and prioritization of activities/contributions).
- *Non-binding Memorandum of Understanding (MoU):* The SIOS Consortium MoU clarifies that the Consortium does not establish legally binding obligations for members, nor does it incorporate mechanisms for dispute resolution in the event that financial or other contributions are not maintained. Membership relies on the voluntary engagement of each member.

Thus, while SIOS offers research infrastructure services like shared access to members' research infrastructure and data coordination, there are no contractual obligations or responsibilities to do so. The non-binding nature of the agreement directly impacts how SIOS-KC can operate within this framework. It seems that at the international level, SIOS-KC's role is primarily to facilitate the work of

the Working Groups and the governance bodies (GA and BoD) rather than to establish and operate common research infrastructure with joint RI services.

Considering only the Norwegian level, SIOS resembles more of an operational research infrastructure. The nature of the funding received annually from RCN to the SIOS-KC (through SIOS Svalbard AS) is more equivalent to traditional Head Office funding, with the requirement of operational Head Office tasks, roles, and expectations. Additionally, the investment-oriented SIOS InfraNOR project (Infrastructure development of the Norwegian node, RCN call of 2016, having its investment phase 2018–2023, its operational phase ending in 2025) aims to set up an integrated observation system to offer RI services.

The duality of expectations and commitments at the international and national levels creates an identity challenge for SIOS and SIOS-KC.

Recommendation: SIOS should carefully analyze and discuss what strategic objectives are realistic to achieve at both the international and national levels and to accept that the ambitions at these two levels may vary. The governance structure should then be adopted to fit these ambitions.

2.2.2 Top-heavy governance structure – GA, BoD and Director

The SIOS Consortium's governance structure, which includes a General Assembly (GA), Board of Directors (BoD), and Director, appears relatively "top-heavy" for an organization of its size and funding level. Many European research infrastructures with similar missions (ERICs, for example) have simpler governance structures. One option could be for the SIOS Consortium to be governed by the General Assembly and managed by the Director. The chair of the GA could assume responsibilities similar to those currently held by the BoD Chair. Both the Chair of the GA (of the Consortium) and the Chair of the General Assembly of SIOS Svalbard AS could support and guide the SIOS Director in their management tasks.

Recommendation: Evaluate the necessity of maintaining all the governance bodies: General Assembly, Board of Directors, and Director for the SIOS Consortium. It could be argued that the same level of supervision and quality of oversight can be achieved with a more efficient organizational structure.

2.2.3 Members of the SIOS Consortium and Voting Rights

In several interviews, the voting rights of the General Assembly (GA) were mentioned as an issue. According to the statutes of the SIOS Consortium, the GA voting rights are as follows:

> *Article 8: General Assembly*
> *8.1 The General Assembly is the ultimate authority of SIOS and consists of the Members, who have voting rights, and Observers, without voting rights. Each Member has one (1) vote. Members from the same country have one vote together and shall inform the General Assembly who casts that vote. For decisions requiring unanimous votes all members have one vote. The General*

Assembly may limit the size of the Members´ and the Observers´ delegations to the General Assembly.

The GA voting rights ensure that Norwegian institutions cannot dominate the GA, but they are also an example of how the SIOS Consortium retains elements from its ESFRI phase, reflecting a compromise between RPO representation and country representation. Most ESFRI research infrastructures have a legal entity with country representations, rights, and obligations. Presumably, the SIOS Consortium sought similar country-level representation for SIOS. However, country-level representation requires the presence of a delegate with mandated power (often appointed by the ministry in charge of RIs) in the GA. The country of origin of the RPO does not confer mandated power or country representation in the decision-making body. Additionally, country representation is often connected to funding. Following this logic, RCN, being the main funder of SIOS, should have membership in the SIOS GA or the SIOS Consortium should be recognized as a forum for RPOs interested in collaborating on research infrastructure-related topics in and around Svalbard.

Recommendation: It would be advisable to evaluate the statutes of the SIOS Consortium and discuss among members whether changes should be made to reflect the existing composition of members.

2.2.4 The balance between the efforts of the members and the working groups, and the resources spent by the Knowledge Centre

Currently, working groups play a central role in SIOS activities, actively supporting SIOS-KC initiatives while receiving administrative and logistical support from SIOS-KC staff. Most interactions occur virtually, with an annual in-person gathering, Working Group Days, which has been effective in fostering collaboration. Feedback from the 2023 event indicates active involvement, strong researcher-staff rapport, and significant participation from early-career researchers.

Given the importance of working groups in supporting SIOS, it may be beneficial to ensure consistent and active participation across all member organizations, particularly in groups that align closely with their scientific goals. This could mean setting a minimum level of participation for members in relevant working groups. For instance, participation in the Remote Sensing working group has been higher than in the Research Infrastructure Coordination Committee (RICC), which could indicate areas for greater member engagement.

Recommendation: If the members decide that the goal of SIOS is to be a true RI, consider making participation in relevant working groups mandatory for members to ensure alignment with Consortium goals. SIOS-KC and working group chairs should also strive to maintain a manageable workload across groups to encourage consistent engagement.

2.2.5 SIOS's Relationship with Other Svalbard Institutions

SIOS operates within a unique and somewhat crowded institutional landscape in Svalbard, where several organizations share overlapping goals related to research, environmental protection, and logistical support. While these institutions each have distinct missions and operational mandates, their scopes intersect significantly, creating potential for both productive collaboration and redundancy.

Key Institutions in Svalbard's Research and Environmental Landscape include:

- *The Governor's Office (Environmental Protection):* The Governor's Office enforces the Svalbard Environmental Protection Act and oversees 22 protected areas. This role includes granting permits for field research, with applications managed through the Research in Svalbard (RIS) database. Although their mission is primarily regulatory, the Governor's Office has a vested interest in scientific data that could inform environmental policy and protection efforts. Currently, however, it lacks a systematic channel for accessing research results, limiting its ability to use scientific insights in regulatory actions.
- *Svalbard Science Forum (SSF):* SSF, managed by the Research Council of Norway (RCN), serves as a central coordination and support platform for research in Svalbard. It provides the RIS database, coordinates funding for Svalbard-focused research, and organizes the biennial Svalbard Science Conference. As a forum comprising eight major actors (e.g., RCN, SIOS, UNIS, NPI, etc.), SSF facilitates collaboration and directs researchers to appropriate infrastructure, permissions, and funding opportunities.
- *University Centre in Svalbard (UNIS):* UNIS is a specialized academic institution offering Arctic education and research programs. Its strategic goals align with SIOS's data-sharing mission, though the relationship is largely limited to individual project coordination rather than institutional partnerships. UNIS benefits from SIOS's data management resources, such as the SIOS Data Management System (SDMS), though it does not integrate SIOS's training initiatives into its academic programming.
- *Ny-Ålesund Science Managers Committee (NySMAC):* NySMAC is a forum for cooperation and coordination among researchers and research activities in Ny-Ålesund. The committee was established in 1994 and includes representatives from all parties with major vested interests in Ny-Ålesund. Several SIOS members are also members of NySMAC, and SIOS is an observer to NySMAC. NySMAC provides advice and comments on research projects, research planning and coordination, research infrastructure development, and environmental protection, and promotes collaboration, mutual understanding and friendship. As a major initiative to promote international collaboration, NySMAC contributed to the development of the four Ny-Ålesund flagship programs [https://nyalesundresearch.no/nysmac/].

The interactions between SIOS and other Svalbard-based institutions show potential but lack coordination, structured collaboration, and shared strategic goals. Each entity supports similar overarching objectives—enhancing research quality, data sharing, and environmental protection—but operates in relative isolation. Adding to this confusion, SIOS members (RPOs) *own* Svalbard infrastructure, such as NPI and UNIS who both provide logistic equipment and support, while SIOS also offers small scale help with logistics.

Recommendation: SIOS-KC should establish formal, periodic meetings with SSF and the Governor's Office to synchronize objectives, streamline data-sharing processes, and discuss mutual needs and expectations. These regular meetings could promote a more cohesive research landscape and improve the Governor's access to research findings.

Recommendation: SIOS-KC and UNIS should consider joint training programs or workshops to align research and educational efforts. This could help train researchers in using shared data and infrastructure and foster a new generation of scientists familiar with SIOS's resources.

2.2.6 Conclusion on Governance

SIOS's governance structure has evolved to meet a unique combination of international, national, and network-oriented requirements, reflecting its history as an ESFRI infrastructure. However, this complex structure has also introduced challenges, particularly in aligning responsibilities, member engagement, and operational efficiency. Refining SIOS's identity and revisiting its governance setup to better support its dual role—as an international network and national infrastructure—will help in clarifying expectations and focusing resources where they are most impactful.

2.3 The effectiveness of the SIOS-KC

2.3.1 SIOS-KC operational effectiveness

The SIOS-KC is at the core of SIOS (see section 1.1), running daily operations through its dedicated staff. Established with the long-term support of the RCN, SIOS-KC has effectively built a competent and permanent "project office" since its inception in 2018, aligning closely with the intent of RCN funding. This evaluation underscores that, despite operating with a very small team, the KC has succeeded in fulfilling its primary objectives. Key achievements include its contributions to the annual SESS reports, successful coordination of Access calls, and quick adaptation to challenges such as the COVID-19 pandemic, during which the KC increased accessibility to remote sensing data in response to limited fieldwork opportunities. Members consistently expressed satisfaction with the Knowledge Centre's efficiency, and most noted that SIOS's absence would be a considerable loss. They did, however, have varying suggestions regarding where SIOS-KC should devote the most time and resources.

Still, the General Assembly, as the ultimate authority of SIOS, holds the responsibility for providing overall direction and supervision, including setting the priorities for SIOS-KC to ensure alignment with the consortium's objectives. Interviews with KC staff and Consortium members confirmed that, while adjustments in information flow and organizational structure could be beneficial, the KC is generally effective, and roles are well-aligned with SIOS's objectives.

Recommendation: With a more active and communicative GA, the SIOS-KC could become even more efficient and well-advised in their priorities.

2.3.2 SIOS-KC staff recruitment

The timeline for average residency on Svalbard is typically limited to a few years. While SIOS has recruited a highly qualified staff, changes in Norwegian Svalbard Policy are perceived as less welcoming, making relocation to Svalbard less attractive to potential international workers. A notable example is the change in voting rights to Longyearbyen council. SIOS-KC's staff turnover, which is heightened by Svalbard's residency difficulties and remote location, has not impaired operations significantly. The challenge lies in documenting knowledge and responsibilities to ease transitions for future staff, which could enhance KC's continuity. Implementing an "annual wheel" with role-specific task lists and their annual deadlines would enable new KC staff to integrate more effectively and support organizational continuity. Clear task descriptions for each KC role, beyond what is currently available, would facilitate onboarding and improve efficiency.

Recommendation: SIOS-KC should formalize documentation of roles and tasks to streamline transitions, especially for new staff, ensuring consistent and efficient operations.

2.4 International collaboration and member recruitment

2.4.1 SIOS current and potential future members

SIOS functions as a consortium comprising both international and national research institutions, research funding agencies, and those operating research infrastructure or providing data relevant to the Svalbard region. Members of SIOS own their research infrastructure and datasets and give access voluntarily through the collaboration. The cooperation is based upon a non-binding MoU and its statutes.

During the preparatory phase project of SIOS, there were 25 partners from 14 countries. Currently, the consortium includes 28 member institutions from 10 countries. Some preparatory phase partners, including key Arctic players from countries such as France, China, the United Kingdom, and the Czech Republic, have opted not to sign the MoU and join the operational phase of SIOS. The reasons for this reluctance include internal management hurdles, along with concerns about SIOS being incompatible with respect to their own research priorities. The non-member countries have varying reasons for their reluctance to join the Consortium, though interviews suggested that SIOS appears "too Norwegian for internationals and too international for Norwegian institutions." Additionally, some institutions feel that since the SIOS data portal is freely accessible to everyone and access calls are open to all, there is less incentive to become formal members of the consortium.

In general, it seems that the international networking that SIOS-KC facilitates is more attractive to smaller nations and especially non-Arctic states whereas larger polar nations are less dependent on this opportunity. The Board of Directors of SIOS Consortium includes participants from many countries which allows smaller or non-Arctic states to contribute to shape the future direction of research activities on Svalbard.

Out of the 28 current members, 18 are based in Norway, and many joined through the InfraNOR project (see 2.2.1). However, once these projects end, these institutions are no longer required to remain members of the SIOS Consortium, which could result in a substantial decrease in membership.

SIOS-KC has identified one KPI to evaluate “enhancing collaboration” which is related to the current and future number of members of SIOS. This is mentioned in the annual report under Membership but not explicitly as a KPI result.

Recommendation: For both international and national partners, it is extremely important that SIOS and SIOS-KC can communicate “what’s in it for you” to ensure that the current SIOS members experience the benefits of SIOS and want to stay in the network as well as enable new members (both national as well as international) to join.

2.4.2 SIOS members’ contributions to working groups

SIOS members constitute the foundation of the five SIOS working groups:

1. Remote Sensing Working Group
2. Data Management Working Group
3. Science Optimization Advisory Group
4. Research Infrastructure Coordination Committee
5. International Advisory Group

These working groups are made up of nominated individuals from member institutions and conduct important tasks. For example, many of the services, including the data management service, remote sensing service, training services, etc. are supported by the working groups. Some highly successful working group activities include the Research Infrastructure Coordination Committee and its Access Program along with SIOS safety training services. The Access calls were particularly important for many members, as they enable more widespread use of their research infrastructure. Meanwhile, the safety workshop is frequently cited as an invaluable contribution by the members, given its relevance to all those involved in Arctic research.

Still, only around half of the nominated working group members participate actively and attend the working groups’ meetings. Participation varies in the different working groups and for different SIOS member institutions. For example, the Remote Sensing Working Group benefits from high levels of engagement from many members, while other groups experience lower participation. The number of members engaged in the different working groups can be seen as an indicator of the interest and importance of the working group in the view of the members. However, the lack of full participation can also be partly attributed to the funding model, which is based on membership fees. Some institutions rely on external funding (not governmental support) to participate in SIOS, limiting their ability to contribute to the working groups effectively. Additionally, in some cases, tasks within the working groups have been carried over from year to year without much progress, which risks diluting the focus and impact of the groups.

Recommendation: To enhance the effectiveness and active member participation within the working groups, it is essential to implement suggestions made within the groups and focus on completing tasks. One potential solution is to divide the working group tasks into long-term services and fixed-term tasks, and follow-up to ensure tasks are completed and objectives are met.

2.4.3 SIOS-KC international collaboration

SIOS-KC is acknowledged for its extensive international networking and collaboration. Being located at the “edge of the world” makes networking even more critical to ensuring that SIOS can play a prominent role on the international stage. Collaborations with the Board of European Environmental Research Infrastructures (BEERI), participation in ENVRI-Hub NEXT, and the Sustained Arctic Observing Network (SAON) are highlighted as particularly important for maintaining SIOS’s relevance and contributing to global Arctic research initiatives. Additionally, SIOS’s involvement in the 4th International Conference on Arctic Research Planning (ICARP IV) leading towards the International Polar Year (IPY) 2032 positions it to help identify key research questions for the next decade, addressing critical interdisciplinary challenges in the Arctic.

SIOS is also a partner in several large EU projects, such as Arctic Passion and POLARIN. These projects provide valuable opportunities for networking, increasing visibility, and enhancing SIOS’s services, as most institutions involved in Arctic research and monitoring are also partners in these initiatives. Participation in EU projects is a vital avenue for advancing collaboration and promoting SIOS's contributions to the international research community.

SIOS-KC evaluates its international collaboration through a KPI related to the number of international initiatives, working groups, panels, and external projects it participates in. Therefore, this KPI is very relevant to assess the development of international collaboration in SIOS, and yet it is not clearly presented in the annual reports.

Recommendation: Include a section on Key Performance Indicators as an Annex in the Annual Reports to follow up the progress in the identified KPIs. This will also be useful for furthering the development and optimization of SIOS.

Recommendation: SIOS-KC has done an excellent job fostering international collaboration, and it is recommended that SIOS-KC continues to strengthen these efforts to maintain its significant impact on Arctic research networks and initiatives.

2.4.4 Conclusion on International collaboration and recruitment

SIOS has built a valuable platform for international and national research institutions, with particular appeal to some smaller or non-Arctic nations seeking access to Svalbard’s research resources. To retain current members and attract new ones, SIOS must better communicate specific benefits of membership, particularly those not available through open access. The effectiveness of SIOS’s working groups is currently limited by inconsistent member engagement. Implementing targeted, time-bound tasks within working groups could improve focus and progress. SIOS-KC's active international

partnerships and involvement in global initiatives strengthen its international relevance, and tracking these efforts via KPIs in annual reports would enhance accountability and help guide future growth.

2.5 Long-term sustainability of SIOS

The long-term sustainability of SIOS and its Knowledge Centre (SIOS-KC) is central to this evaluation, as it directly impacts SIOS's utility for stakeholders. This evaluation addresses three intersecting aspects:

- *Resource Allocation and Future Adjustments:* Analyzing current resource distribution to identify areas where future prioritization might enhance sustainability.
- *SIOS's ability to attract and retain members:* Assessing SIOS's ability to effectively communicate SIOS member benefits and encourage institutional commitment.
- *SIOS-KC's Role in Fostering Collaboration, Data Sharing, and Research Impact:* Assessing how well SIOS has promoted research collaboration, data accessibility, and meaningful scientific contributions, with emphasis on the operational effectiveness of SIOS-KC.

These focal points offer insights into SIOS's sustainability at organizational, operational, and member-engagement levels, aiming to foster dialogue on future priorities rather than prescribing specific funding adjustments.

2.5.1 Financial Sustainability and "Money Flow" within SIOS

The financial foundation of the Svalbard Integrated Arctic Earth Observing System (SIOS) and its Knowledge Centre (SIOS-KC) relies primarily on dedicated funding from the Research Council of Norway (RCN), with funding based on a commitment in the Government's budget proposal (Prop. 1 S, Kunnskapsdepartementet, 2024-2025, page 202). This funding serves as the operational backbone of the Consortium (see section 2.2).

The annual income for the operations of SIOS-KC is approximately 15 MNOK, with the majority funded by the RCN (ca. 12 MNOK/year). Additional funding sources include the Norwegian Space Centre (ca. 0.5 MNOK/year) and external research projects (such as EU-funded projects), contributing around 2 MNOK annually.

RCN funding enables SIOS-KC to meet operational goals, including core expenses, service provision, and project deliverables, with budget planning and annual reporting that has met RCN's expectations. This funding underpins critical initiatives such as the Access Program, remote sensing services, and collaborative research infrastructure.

In addition, the SIOS consortium contributes approximately 8 MNOK/year, comprised of 2.8 MNOK membership fees (in cash) and 4–5 MNOK in reported in-kind contributions from member institutions, the latter being substantially less than what is budgeted for. The SIOS "money flow" is further detailed in Figure 2.

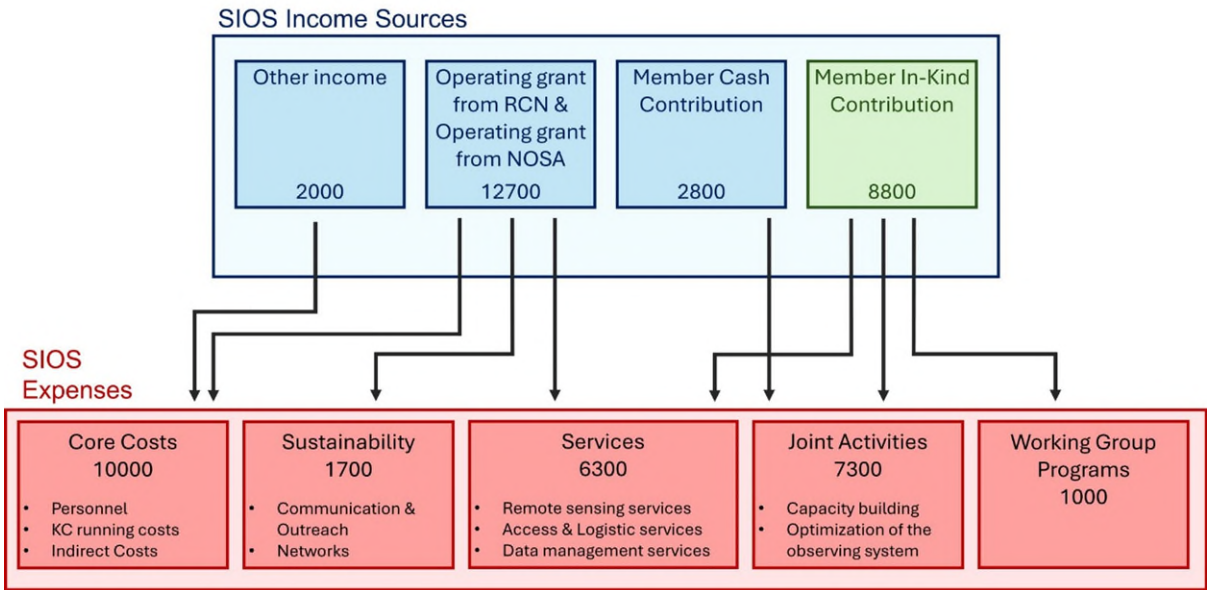

Figure 2. *SIOS income sources and expenses, exemplified by the 2023 budget. Amounts are listed in kNOK. Abbreviations represent the Research council of Norway (RCN) and the Norwegian Space Agency (NOSA).*

Resource Distribution within SIOS and the Role of In-Kind Contributions

SIOS's membership fees primarily fund core joint activities, such as capacity building and observing system optimization, while in-kind contributions are essential to support the working group programs and service provision. Notably, service provision is a shared funding responsibility, with SIOS-KC covering half of the funding and the other half expected to come from in-kind contributions by SIOS members.

However, in-kind contributions vary widely across institutions. Larger institutions tend to contribute more substantially, while smaller institutions may struggle to match this level. This variability presents a challenge when trying to maintain balanced participation across the consortium. Developing a more equitable structure that recognizes varying in-kind capacities could help build a stronger and more balanced membership foundation.

A significant challenge also arises from the retrospective nature of in-kind reporting. Currently, contributions are reported at the end of each fiscal year, relying on member confirmation of SIOS-KC's estimated in-kind activity. This often results in lower-than-anticipated contributions, limiting effective budget planning and strategic resource allocation. The unpredictable reporting structure weakens operational cohesion, as essential services depend on consistent partner contributions.

To strengthen the financial sustainability of SIOS, it is crucial that the substantial commitment from RCN in funding SIOS-KC's operations is reciprocated by active participation and engagement from SIOS members.

Recommendation: Increase transparency on RCN contributions and the benefits derived by consortium members to foster greater alignment.

Recommendation: The current retrospective in-kind reporting should be restructured to allow more reliable, predictable integration into SIOS operations. Encouraging partners to actively document and plan in-kind contributions upfront would enhance financial planning and service delivery.

Recommendation: To maximize the impact of services that rely on both SIOS-KC funding and in-kind contributions, a collaborative budget planning process could better align funding streams. This approach would enhance service reliability and potentially increase partner engagement by clearly linking their contributions to specific outcomes. Beyond services, other central activities such as joint projects could benefit from a more unified funding approach.

2.5.2 External Funding as a Foundation for Long-term Sustainability

The sustainability of the current funding setup is precarious if RCN funding were reduced. Without the RCN's contribution, the Knowledge Centre and SIOS would struggle. This reliance underlines the need for continued RCN commitment or the exploration of diversified funding models. This ongoing reliance presents both an opportunity and a challenge: while RCN funding enables a strong foundational structure, the long-term success of SIOS is still dependent upon continued engagement from all members.

In addition to the core RCN funding, securing external funding from sources such as EU research projects plays a crucial role in strengthening SIOS's financial foundation. These projects not only provide essential additional resources but also enhance SIOS's visibility and create valuable networking opportunities within the global research community. Furthermore, external funding offers the flexibility to support targeted initiatives, and specific research needs that extend beyond the scope of core activities, allowing SIOS to respond more swiftly to emerging challenges and opportunities. By participating in EU projects, SIOS can not only secure financial support but also increase its appeal to potential new members.

Recommendation: Long-term sustainability of SIOS is dependent upon RCN funding, meaning the RCN should ensure continuous financial support for SIOS and SIOS-KC if this activity is to continue.

Recommendation: Exploring options such as supporting EU research proposals for members could enhance SIOS's ability to attract project-based funding and demonstrate the consortium's value in research coordination.

2.5.3 The SIOS Membership and Institutional Commitment

SIOS currently functions as a network of member institutions with varying levels of participation (see section 2.4.1). While most members recognize the benefits of SIOS's physical and data infrastructure along with networking opportunities, engagement levels are inconsistent. This disparity in commitment poses a significant challenge to the long-term sustainability of SIOS.

Membership engagement was identified as a recurring issue in numerous interviews. A more active and consistent contribution from member institutions is essential to ensure the collective success of

SIOS and to achieve its long-term objectives. Strengthening institutional commitment will be a critical factor in securing the network's future sustainability and relevance in the evolving landscape of Arctic research.

A model often employed by ESFRI Research Infrastructures to ensure the long-term sustainability of core operations is the host contribution-based approach. This model provides a reliable mechanism for securing consistent funding and commitment from participating institutions.

Recommendation: All members should recognize their responsibility to actively engage with SIOS and contribute meaningfully to its operations. A more proactive approach to participation will be essential to the long-term success of the consortium.

Recommendation: To strengthen member engagement and support SIOS's sustainability, certain member institutions could take on the responsibility of hosting core SIOS activities, such as the Logistic Center or Access Services.

2.5.4 SIOS Attractiveness and Outreach for engaging members

To ensure long-term sustainability, SIOS needs to recruit new member institutions while retaining current members. Insights from interviews suggest that SIOS's primary method of retaining and recruiting members is through offering an attractive, clearly communicated value proposition. However, Norwegian institutions may perceive limited benefits in formal membership, given their existing access to Svalbard research resources. Establishing a clear member benefits structure and targeted outreach could help SIOS more effectively communicate its unique advantages, especially to Norwegian institutions.

A theme present in interviews was that some institutions didn't realize fully what SIOS membership could offer. This suggests that improved communication and outreach of SIOS services is necessary. With limited resources, SIOS's outreach efforts could benefit from expanding the information officer's role or adding additional support to prioritize in-person outreach, which has proven successful in enhancing institutional engagement. Furthermore, SIOS's digital presence could be optimized: while its web portal garners significant traffic, members have reported difficulties in locating important information. Enhanced website navigation and a targeted social media and communications strategy could improve advertisement of SIOS updates on logistics, available resources, and opportunities.

Recommendation: Increasing outreach resources could allow SIOS to strengthen its ties with current members while attracting potential new institutions. Improving digital communication channels would also support the availability and visibility of SIOS's resources and initiatives.

Recommendation: To bolster member commitment, SIOS should emphasize unique membership benefits beyond data access, such as prioritized collaboration.

2.5.5 Conclusion on Long-term Sustainability

The long-term sustainability of SIOS depends on a balance of financial stability, effective member engagement, and operational efficiency. SIOS's current reliance on substantial funding from the RCN has supported its foundational infrastructure and enabled the SIOS-KC to deliver high-quality services. However, long term success depends on member commitment and engagement. To enhance sustainability, SIOS should enhance member commitment by clarifying membership benefits, improve predictability of in-kind contributions, and improve onboarding documentation to maintain continuity amidst staffing changes. Additionally, expanding outreach and communication efforts will help attract and retain members, ensuring SIOS's ongoing relevance and impact in Arctic research.

In conclusion, as SIOS moves toward a potential third period of dedicated RCN funding, it is crucial to prioritize discussions on long-term strategy and sustainability. This entails not only internal reflections within the SIOS-KC but also broader engagement with the international research community that benefits from SIOS. To achieve long-term success, SIOS-KC, in partnership with RCN and the SIOS General Assembly, should facilitate a collaborative dialogue with member institutions on sustainable pathways forward, motivated by shared goals and desires for the future.

While the Knowledge Centre can and should consider ways to make its services more attractive and responsive to both existing and potential members, achieving greater sustainability will ultimately depend on coordinated, member-level mobilization that reinforces the mutual benefits of participation in SIOS. This challenge requires groundwork beyond the SIOS-KC itself, as RCN, SIOS leadership, and member institutions will need to actively promote and engage in SIOS's collaborative mission.

3. Recommendations

3.1 Recommendations regarding SIOS services

Utilize the KPIs as a powerful tool to map progress. An annual reporting of KPIs related to the development of SIOS is needed for members to evaluate the effectiveness of SIOS-KC and the SIOS Consortium in shaping, developing, and expanding the long-term monitoring and data availability in Svalbard.

Optimization of the Observing System

- It is important that SIOS-KC provides an annual, updated roadmap based on the recommendations from the SESS reports. The implementation of these recommendations should be agreed upon together in form of a roadmap for improvement.

SIOS Data Management System

- If SIOS is supposed to be a consistent research infrastructure it may be beneficial that data is standardized, necessitating a standardization unit with decision-making power. Alternatively, if SIOS operates as a network of cooperating infrastructures, it may be more beneficial to accept the differences and slowly improve interoperability of data through development of appropriate mechanisms. SIOS needs to take conscious and realistic decisions on which direction to develop data management services.
- To reduce project risk, SIOS should continue to have a stepwise approach to these issues and define suitable goals and KPIs to follow up the efforts.
- SIOS-KC should make concerted efforts to lift issues and decisions regarding data management up to a strategic level and to ensure that these issues and decisions are owned by the General Assembly of SIOS.
- SDMS and the outcomes of SESS reports should be communicated and presented outside of Polar Night Week. It is suggested to make presenting at a number of key international events (e.g. Arctic Frontiers, Arctic Science Summit Week and Arctic Circle) each year a strategic priority.

SIOS Remote Sensing Services

- SIOS-KC should continue to support the Remote Sensing Working Group, and its engaged members to ensure remote sensing data remains available to all parties doing research in Svalbard.

SIOS Logistical Services

- To develop a closer collaboration between SIOS-KC and SSF as this could help streamline resources, identify complementary areas, and minimize redundancy.
- The access program should be integrated as a stronger part of the SIOS science wheel.

- Use more targeted outreach/marketing efforts that could increase awareness and application rates. The calls can also be announced for a longer period and if possible be promoted at the big science conferences to reach out to many scientists. A survey to identify what the potential users need could also help improve the number of applications.

SIOS Training Services

- Increase the advertisement of the recorded training courses to increase knowledge on SIOS.
- Explore mutual benefits between UNIS and SIOS-KC when developing future training services.

SIOS Communication Service

- Ensure proper resource allocation so that SESS reports can continue to be supported.
- Member institutions should be encouraged to actively promote SIOS, including key guiding outputs like SESS, to increase awareness and support.

3.2 Recommendations regarding SIOS governance

Network vs. Research infrastructure

- SIOS should carefully analyze and discuss what strategic objectives are realistic to achieve at both the international and national levels and to accept that the ambitions at these two levels may vary. The governance structure should then be adopted to fit these ambitions.

Top-Heavy Governance Structure

- Evaluate the necessity of maintaining all the governance bodies: General Assembly, Board of Directors, and Director for the SIOS Consortium. It could be argued that the same level of supervision and quality of oversight can be achieved with a more efficient organizational structure.

Members of the SIOS Consortium and Voting Rights

- It would be advisable to evaluate the statutes of the SIOS Consortium and discuss among members whether changes should be made to reflect the existing composition of members.

The balance between the efforts of the members and the working groups, and the resources spent by the Knowledge Centre

- If the members decide that the goal of SIOS is to be a true RI, consider making participation in relevant working groups mandatory for members to ensure alignment with Consortium

goals. SIOS-KC and working group chairs should also strive to maintain a manageable workload across groups to encourage consistent engagement.

SIOS's relationship with other Svalbard institutions

- SIOS-KC should establish formal, periodic meetings with SSF and the Governor's Office to synchronize objectives, streamline data-sharing processes, and discuss mutual needs and expectations. These regular meetings could promote a more cohesive research landscape and improve the Governor's access to research findings.
- SIOS-KC and UNIS should consider joint training programs or workshops to align research and educational efforts. This could help train researchers in using shared data and infrastructure and foster a new generation of scientists familiar with SIOS's resources.

3.3 Recommendations regarding SIOS-KC effectiveness

- With a more active and communicative GA, the SIOS-KC could become even more efficient and well-advised in their priorities.
- SIOS-KC should formalize documentation of roles and tasks to streamline transitions, especially for new staff, ensuring consistent and efficient operations.

3.4 Recommendations regarding international collaboration and recruitment

SIOS Current and Potential Future Members

- For both international and national partners, it is extremely important that SIOS and SIOS-KC can communicate "what's in it for you" to ensure that the current SIOS members experience the benefits of SIOS and want to stay in the network as well as enable new members (both national as well as international) to join.

SIOS Members' Contributions to Working Groups

- To enhance the effectiveness and active member participation within the working groups, it is essential to implement suggestions made within the groups and focus on completing tasks. One potential solution is to divide the working group tasks into long-term services and fixed-term tasks, and follow-up to ensure tasks are completed and objectives are met.

SIOS-KC International Collaboration

- Include a section on Key Performance Indicators as an Annex in the Annual Reports to follow up the progress in the identified KPIs. This will also be useful for furthering the development and optimization of SIOS.

- SIOS-KC has done an excellent job fostering international collaboration, and it is recommended that SIOS-KC continues to strengthen these efforts to maintain its significant impact on Arctic research networks and initiatives.

3.5 Recommendations regarding Long-term sustainability of SIOS

Financial Sustainability and “Money Flow” within SIOS

- Increase transparency on RCN contributions and the benefits derived by consortium members to foster greater alignment.
- The current retrospective in-kind reporting should be restructured to allow more reliable, predictable integration into SIOS operations. Encouraging partners to actively document and plan in-kind contributions upfront would enhance financial planning and service delivery.
- To maximize the impact of services that rely on both SIOS-KC funding and in-kind contributions, a collaborative budget planning process could better align funding streams. This approach would enhance service reliability and potentially increase partner engagement by clearly linking their contributions to specific outcomes. Beyond services, other central activities such as joint projects could benefit from a more unified funding approach.

External Funding as a Foundation for Long-term Sustainability

- Long-term sustainability of SIOS is dependent upon RCN funding, meaning the RCN should ensure continuous financial support for SIOS and SIOS-KC if this activity is to continue.
- Exploring options such as supporting EU research proposals for members could enhance SIOS’s ability to attract project-based funding and demonstrate the consortium's value in research coordination.

The SIOS Membership and Institutional Commitment

- All members should recognize their responsibility to actively engage with SIOS and contribute meaningfully to its operations. A more proactive approach to participation will be essential to the long-term success of the consortium.
- To strengthen member engagement and support SIOS’s sustainability, certain member institutions could take on the responsibility of hosting core SIOS activities, such as the Logistic Center or Access Services.

SIOS Attractiveness and Outreach for engaging members

- Increasing outreach resources could allow SIOS to strengthen its ties with current members while attracting potential new institutions. Improving digital communication channels would also support the availability and visibility of SIOS’s resources and initiatives.
- To bolster member commitment, SIOS should emphasize unique membership benefits beyond data access, such as prioritized collaboration.

Appendix I: Evaluation committee members

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