

Svalbard Integrated Arctic Earth Observing System

– the current state

27 December 2018

The Svalbard Integrated Arctic Earth Observing System (SIOS) is a collaborative effort to develop and maintain a regional observational system for long-term measurements in and around Svalbard, addressing Earth System Science (ESS) questions related to Global Change. The observing system and research facilities offered by SIOS build on the extensive observation capacity and diverse world-class research infrastructure provided by many institutions already established in Svalbard. This includes a substantial capability for utilising remote sensing resources to complement ground-based observations. From this solid foundation, SIOS envisions a significant contribution to the systematic development of new methods and observational design in Svalbard. This knowledge can advance other observational networks in the Arctic and elsewhere.

SIOS is aiming at more efficient use and better integration of the observing system based on a distributed data management system, an open access program that includes logistical support, as well as training and education activities. Working groups, task forces and other SIOS components pursue these aims in direct and structured dialogue with scientists, user groups, policy-makers and other porters of societal and scientific needs.

SIOS brings observations together into a coherent and integrated observational programme that will be sustained. Thus, SIOS offers unique opportunities for research and the acquisition of fundamental knowledge about global environmental change.

SIOS focuses on processes and their interactions between the different spheres, i.e. biosphere, geosphere, atmosphere, cryosphere, and hydrosphere. The core observational programme of SIOS provides the research community with systematic observations that are sustained over time, yet dynamic enough to be adapted as new methods appear or society poses new questions.

SIOS entered the operational phase in January 2018, after a three-year long interim phase (November 2014 – January 2018) and a four year long preparatory phase (October 2010 – November 2014)). Currently, the consortium consists of 25 institutions from 10 countries.

The goals, benefits, and duties of SIOS are summarised in appendix 1.

Integration and optimisation of the observation system

SIOS aims to set an example for how to systematically construct observational networks in the Arctic and how joint efforts provide added value to the user community. SIOS uses several means to achieve this goal. The working groups secure user commitment and impact on the process of improving the existing observing system; the data portal with its access to standardised data facilitates the integration between different research fields and nations; and the State of Environmental Science in Svalbard (SESS) report will be the ultimate tool for research-based guidance towards optimisation of the Svalbard Observing System for Earth System Science. The strategic overview, optimisation and integration of the observing system is handled at the science manager level. The final decisions are made by the General Assembly, after recommendations from the Board of Directors who in turn are guided by the Science Optimisation Advisory Group and other working groups (see figure 1).

State of Environmental Science in Svalbard (SESS) report

The main tangible product of SIOS is the annual State of Environmental Science in Svalbard (SESS) report. The first issue is due to be published on 14 January 2019. The report will summarise the state of current knowledge of key Earth System Science (ESS) parameters and analyse how these parameters influence one another. The SESS report will outline the work that has been done in the previous year within the SIOS cooperation to optimise the observing system and recommend research priorities for the following year(s).

The report will contain information about the long-term monitoring data that form the core of the observing system (“core data”). It will also cover new, innovative monitoring and research that has been carried out through the SIOS Access Programme. The focus will be on integrating datasets, encouraging new thinking about connections between measured parameters and pursuing quantitative links.

In addition to evaluating the state of current knowledge, the SESS report will outline the questions that remain unanswered and recommend ways to answer these questions. Solutions may include investing in new research infrastructure to collect new long-term data series or making changes to existing monitoring. This could mean adjusting the temporal or spatial resolution of measurements, or even changing the monitoring location to co-locate different types of measurements, such that datasets can be more easily combined.

This SESS report is the basis for developing the observing system.

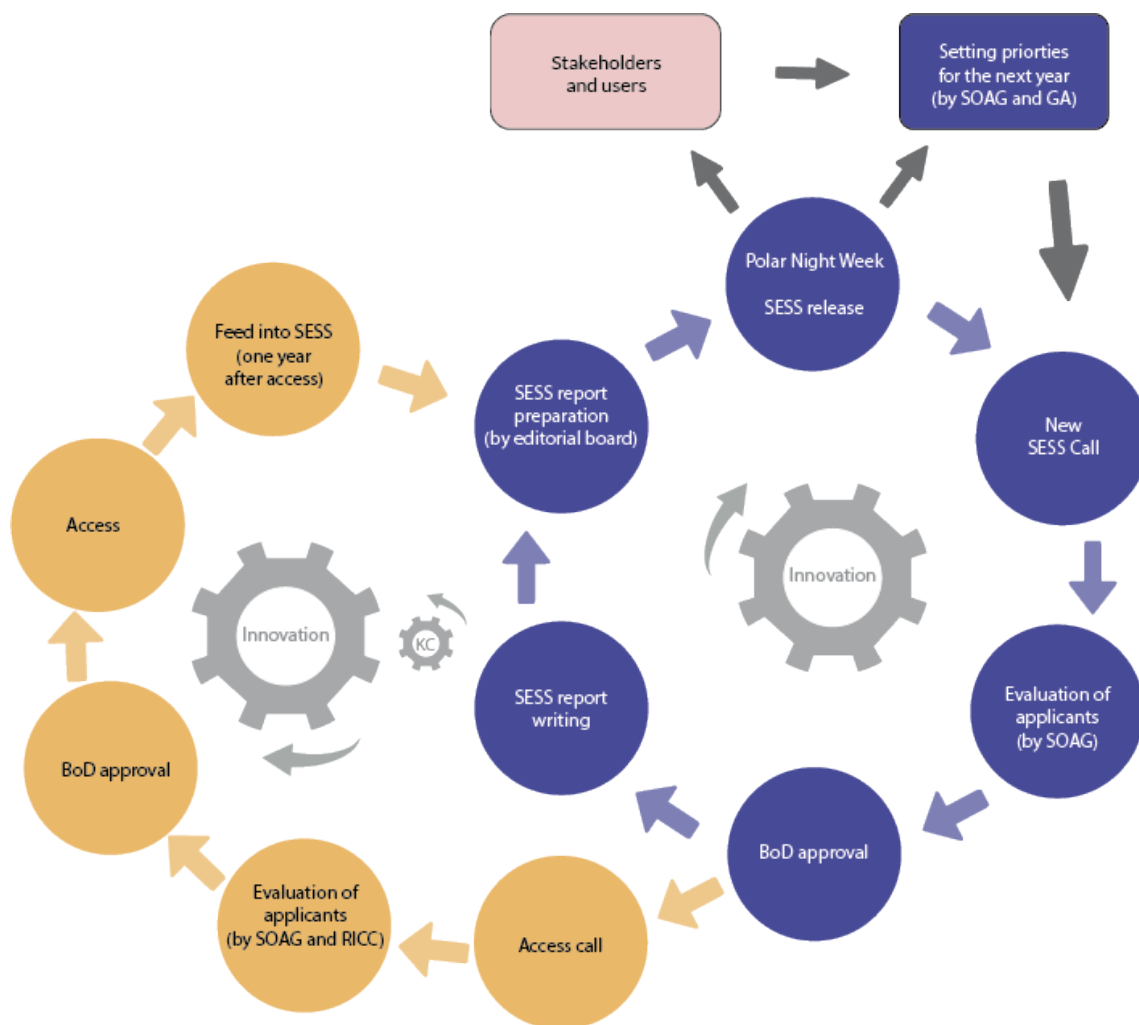


Figure 1 Concept of the SIOS Science Wheel, showing the development of the State of Environmental Science in Svalbard report and the Access Programme. Innovation is central in both processes in order to improve the Observing System. The teeth of the cogwheels that drive SIOS forwards are the working groups and task forces deployed by the governing bodies of SIOS. The Knowledge Centre ensures the continuous development. The annual meeting, SIOS Polar Night Week, brings the SIOS community together for science seminars, meetings and the SESS report release.

SESS = State of Environmental Science in Svalbard report; SOAG = Science Optimisation Advisory Group; GA = General Assembly; BoD = Board of Directors; RICC = Research Infrastructure Coordination Committee; KC = Knowledge Centre.

The SIOS call for input to each SESS report will be based on the recommendations of the previous year's report. As such it is important for those wishing to conduct research under the SIOS banner to contribute to the report so that their research priorities may be included as recommendations for the following year.

The SIOS Knowledge Centre

The SIOS Knowledge Centre (SIOS-KC) is the central hub of SIOS. It is located in the Svalbard Science Centre in Longyearbyen and offers coordinated services for the international research community. The SIOS-KC is funded by the Research Council of Norway. It has currently six staff members and has recently been strengthened with the addition of a coordinator for space-related activities, funded by the Norwegian Space Centre.

SIOS-KC has established several working groups and committees in order to support the services offered to the SIOS community. These working groups and committees consist of representatives of the member institutions and carry out tasks given by the General Assembly or the Board of Directors. They also suggest the work programme for the different services.

Currently established working groups are the Science Optimisation Advisory Group (SOAG), the Research Infrastructure Coordination Committee (RICC), the SIOS Data Management System Working group (SDMS WG), the Remote Sensing Working group (RSWG), and the Information Advisory Group (IAG).

SIOS-KC has established a number of services that are available to the SIOS community:

SIOS Data Management Service

The SIOS Data Management Service is integrating information from SIOS partner data repositories into a common virtual data centre, allowing SIOS users to search for and access data regardless of where they are archived. Providers and users have to commit to the SIOS data policy. The current focus is on discovery through standardised metadata, and retrieval, visualisation & transformation of data. Ultimately, the Data Management Service works towards integration of datasets which requires a high level of interoperability at the data level.

In addition, training sessions are offered to research groups/communities to encourage and facilitate good data management right from the planning phase of a project.

SIOS Remote Sensing Service

The SIOS Remote Sensing Service is designed to offer researchers a single-point of contact for satellite information for Svalbard while drawing on the combined knowledge of the

network of SIOS partner institutions. The Remote Sensing Service coordinates commissioned data processing, advises researchers on their respective satellite needs, and provides tailored training on remote sensing. It facilitates and promotes the use of remote sensing products in the diverse parts of the SIOS science community.

SIOS Research Infrastructure Access and Logistics Service

The SIOS Access Programme facilitates access to the distributed research infrastructure owned and operated by SIOS members and made available to SIOS. The programme is coordinated by SIOS-KC in collaboration with the Research Infrastructure Coordination Committee (RICC) and offers access to scientific facilities and research instruments through regular strategic SIOS calls. Access is granted in accordance with the SIOS Access Policy. The access programme is supported by the logistics service, which also coordinates logistical support for all researchers employed at SIOS member institutions. The offered services include storage, freezer space, guest office and links with commercial service providers.

SIOS Training Service

The SIOS Training Service aims to provide researchers with necessary skills to make the best use of the SIOS research infrastructure and observing system. For this purpose, a portfolio of courses is currently being developed that can be tailored and offered to relevant groups within the SIOS community. The aim is to hold up to four workshops and trainings per year organised by member institutions with help of the SIOS-KC.

SIOS Communication Service

The SIOS Communication Service provides information about SIOS-KC activities, the Observing System developments, and SIOS-related activities within the member institutions. Currently, it focuses on the SIOS web portal www.sios-svalbard.org, Twitter communication and the production of information and outreach material for conferences, networking and other opportunities. The SIOS Communication Service is advised by the Information Advisory group (IAG).

Governance and organisational structure

SIOS is a distributed research infrastructure organised as a consortium. The consortium consists of the member institutions and its cooperation is based upon non-legally binding statutes and a MoU. It coordinates, develops and optimises research infrastructure owned by the member institutions. Research institutions and research funding agencies that own or operate research facilities in the Svalbard region or who provide research data relevant for the consortium may become members. SIOS is funded by the Research Council of Norway and by a combination of in-cash and in-kind contributions from the consortium members.

The General Assembly is the ultimate authority of SIOS, and consists of the consortium members. It is responsible for the overall direction and supervision of SIOS. The General Assembly appoints the Board of Directors and may establish advisory boards and committees.

The Chair of the Board of Directors is, by statute, an employee of a Norwegian member institution. The Board of Directors is responsible for the operation of SIOS in accordance with the directions and decisions given by the General Assembly.

The SIOS Director is appointed by the General Assembly on the proposal from the Board of Directors and carries out the day-to-day management of SIOS. The SIOS director is head of the SIOS Knowledge Centre and the SIOS administration. The SIOS director is also the director of the public limited company 'SIOS Svalbard AS', which was established 20 December 2016 to serve as the legal body of SIOS in its operational phase. The company is owned by the University Centre in Svalbard and is the vehicle for SIOS to enter into contracts necessary for running the consortium, e.g. employing staff for the Knowledge Centre.

On 26 January 2018, the start of the operational phase of SIOS was marked by 10 members of the interim phase signing the MoU accepting the SIOS statutes. Those are the founding members. In addition, two institutions became an observer. At the same time the General Assembly also accepted 13 new members. The statutes set out how the operational SIOS will function, and includes a preliminary budget for the first five years. This budget is based on contributions from the Norwegian host and from the consortium partners. The member contribution consists of two parts; an obligatory annual in-cash contribution of €10 000, and a contribution that may consist of in-kind or in-cash. The host contribution will cover the costs of running the SIOS-Knowledge Centre and contributes towards the consortium activity for

the first five years. The partner contributions will in full go towards the activities decided by the General Assembly.

Further information

The Consortium - <https://sios-svalbard.org/Consortium>

Management - <https://sios-svalbard.org/Management>

The Observing System - <https://sios-svalbard.org/ObservingSystem>

The Knowledge Centre - <https://sios-svalbard.org/KnowledgeCentre>

The Working Groups - <https://sios-svalbard.org/WorkingGroups>

SESS report - <https://sios-svalbard.org/SESSreport>

The Polar Night Week - <https://www.sios-svalbard.org/PolarNightWeek>

Documents (e.g. statutes, data policy and access policy) - <https://sios-svalbard.org/Documents>

APPENDIX 1

Goals of SIOS

- Enhance Svalbard as an Earth system science research platform
- Coordinate long-term monitoring
 - To enhance data availability
 - To increase the impact of the Svalbard monitoring in international processes
 - To enhance stakeholder influence on monitoring
 - To address grand challenges of Arctic environmental research
- Stimulate new research endeavours in Svalbard by providing a “core data” and infrastructure backdrop that is unprecedented in polar regions.
- Stimulate innovation in instruments, methods and measurement strategies to enhance monitoring in the Arctic (and as a spin-off probably elsewhere too).
- Work towards creating an environment where interactive experiment adjustment in the field will be made possible through real-time data services.
- Efficient use of infrastructure
- Stimulate inter-station cooperation and exchange in Svalbard
- Ensure transparency of research activities at all stations
- Enable an open access data policy in Svalbard with a database system

Benefits for SIOS members

- Prioritised access to SIOS infrastructure
- Prioritised services from SIOS and access to select real-time services
- Open access to data
- Increased cost efficiency and quality for monitoring and science
- Better overall usage of own research infrastructure
- Influence on the long-term development of monitoring and research infrastructure in Svalbard
- Influence what constitutes core data
- Influence the development of SIOS services
- Better coordination of funding applications improving chances of success
- Promotion of own institution and data through SESS report and SIOS outreach activities
- Right to use SIOS brand

Duties of members

- Commit to long-term monitoring efforts
- Participate in working groups, task forces, and SIOS governing bodies
- Support SIOS with cash and in-kind contributions as decided by the General Assembly
- Adhere to SIOS data and access policies
- Compulsory reporting to RiS¹

Duties, rights, and opportunities for non-members

- Adhere to Svalbard research data policies
- Compulsory reporting to RiS
- Open access to data
- SIOS services are offered when there is available capacity at full cost recovery
- Access to infrastructure is open but at owners' discretion and at full cost recovery
- Provide input to SESS reports to empower own future membership/participation

¹ Research in Svalbard (RiS) database (<https://www.researchinsvalbard.no>) containing information about research and monitoring projects in Svalbard and surrounding waters.

APPENDIX 2

Other achievements in 2017 and 2018

- Operational phase of SIOS established at the General Assembly 26 January 2018. Pilot call for proposals for analysis of existing data, resulting in 6 contributions to the first SESS report. These and three additional chapters comprise the first SESS report – to be released 15 January 2018 (read more: <https://sios-svalbard.org/SESSreport>)
- First SIOS access projects conducted fieldwork (read about the projects: <https://sios-svalbard.org/Access2018>). Second call for access opened and 10 projects accepted (see table 1 for successful projects).
- SIOS interim project proposal "SIOS – Infrastructure development of the Norwegian node (SIOS-InfraNor)" received funding from the Research Council of Norway in 2017. The project represents a substantial Norwegian contribution to strengthening the SIOS observing system development and has been started during 2018 (read more: <https://sios-svalbard.org/InfraNor>)
<https://www.unis.no/funding-secured-sios-infrastructure-development/>
- Contributions to and collaboration with several networks and initiatives, including ENVRIplus, Interact, INTAROS, and ICOS.
- Planning of the first SIOS Polar Night Week 14-18 January 2018 (<https://sios-svalbard.org/PolarNightWeek>)

Table 1: Accepted access projects in the 2018 call.

Project title	PI	Institution	Allocated funding (NOK)
GNSS TEC and Scintillation monitoring under the Cusp (GENIUS)	L Spogli	National Institute of Geophysics and Volcanology (Italy)	152 000
Snow, Weather, And Glacier Network for real-time observations (SWAGNet)	C Borstad	University Centre in Svalbard (Norway)	355 350
Dual-frequency satellite beacon receiver for ionospheric monitoring in Bjørnøya (TomoBear)	J Norberg	Finnish Meteorological Institute (Finland)	50 000
Energy Deposition in the Geomagnetic Cusp Alfvén Resonator (EDGAR)	S Hatch	University of Bergen (Norway)	66 000
Multi-scales study of plasma transportation around cusp region using joint-observations with GCI-Cusp Project (M-Scale of plasma transportation)	Y Wang	Shandong University at Weihai (China)	93 320
Black carbon measurements in the air and clouds at Zeppelin Observatory (AC/BC)	R Modini	Paul Scherrer Institute (Switzerland)	142 000
Validation of a satellite based Snow Cover Index for Svalbard (SvalSCE)	M A Killie	Norwegian Meteorological Institute (Norway)	200 000
Biogenic Aerosol, oceanic Primary production and Nucleation Events in the Arctic (BioAPNEA)	L Caiazzo	University of Florence (Italy)	213 000
Spatial VARIability: VALidation dataset on POPs concentrations in snow (SVal-POPs)	K Koziol	Gdansk University of Technology (Poland)	135 100
Firn aquifer observations on Lomonosovfonna Svalbard (Nbreem)	W van Pelt	Uppsala University (Sweden)	70 000