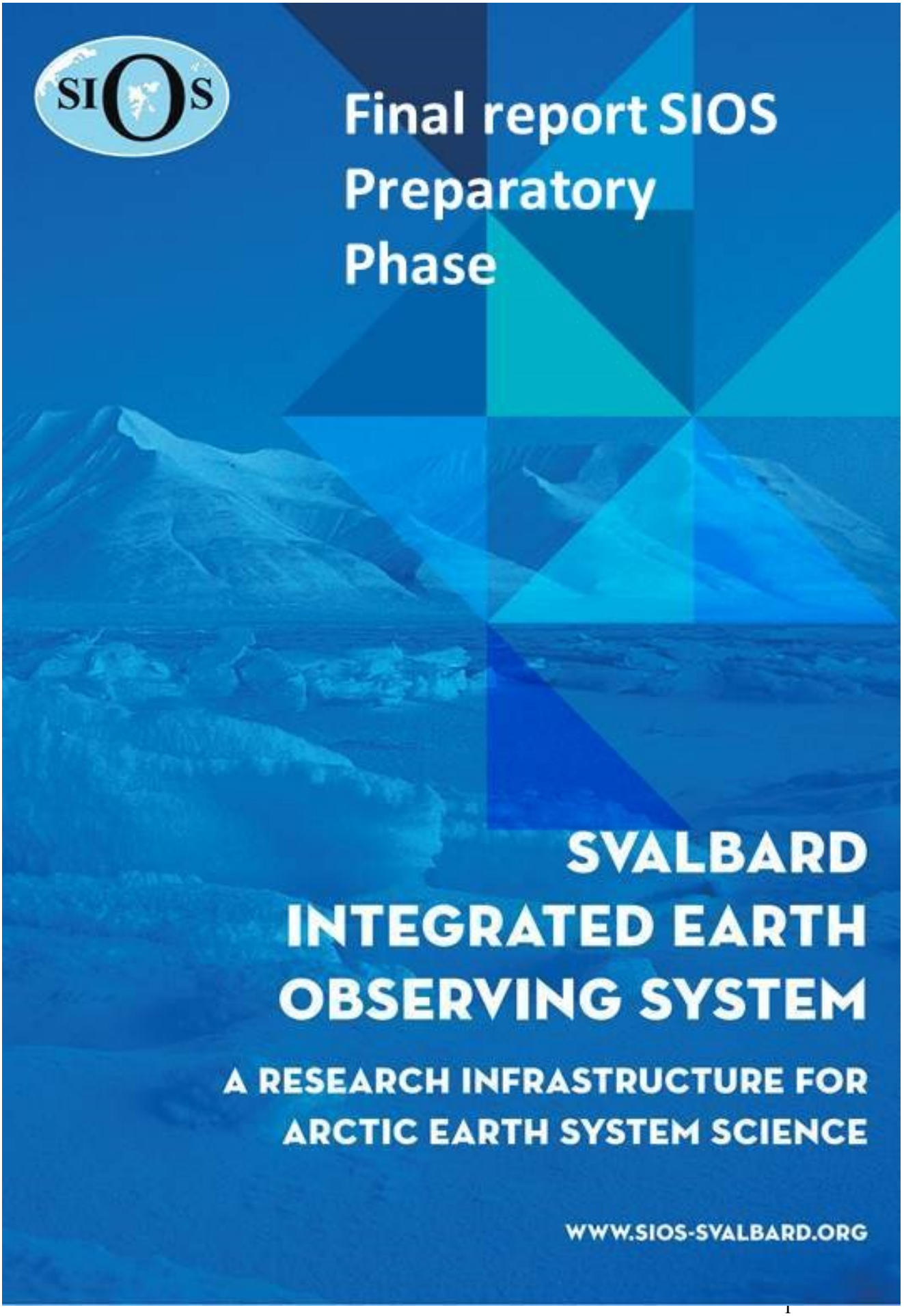
Final report SIOS
Preparatory
Phase
SVALBARD
INTEGRATED EARTH
OBSERVING SYSTEM
A RESEARCH INFRASTRUCTURE FOR
ARCTIC EARTH SYSTEM SCIENCE
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Building the Scientific, Technical, Financial, Legal and Organisational Case for the Svalbard Integrated Arctic Earth Observing System

SIOS - Preparatory Phase Project
European Commission Grant ID: 261747

FINAL REPORT

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Content

Summary: The scientific vision and main achievements

The Svalbard Integrated Arctic Earth Observing System (SIOS) will establish a regional observational system for long term measurements in and around Svalbard, addressing Earth System Science (ESS) questions related to Global Change. The upgraded observing system and research facilities offered by SIOS build on the extensive observation capacity and diverse world class research infrastructure provided by many nations 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 [1] a significant contribution to the systematic development of new methods and design for the implementation of observational networks in Arctic environments.

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 logistics support, as well as training and education activities. The SIOS preparatory phase work has also developed links to other European and international programs with Arctic components in order to optimise activities and share resources effectively.

Combined with joint strategic work and the establishment of meeting places and workshops, these various actions will create added value for the user community. This will be of importance not only for the individual institutions constituting the SIOS collaboration but also to the broader polar research community under the ESS domain.

As one of the large scale research infrastructure (RI) initiatives on the ESFRI roadmap (European Strategy Forum on Research Infrastructures), SIOS has, during a 4 year Preparatory Phase (PP) project (2010-2014), developed its scientific and technical case, including the elaboration of legal, organizational and financial plans for sustainable operation. In a compressed form, the main rules of procedures of the SIOS collaboration are reflected in the draft Statutes [2]. The SIOS PP project has involved 26 partner institutions based in 14 countries which have existing permanent or campaign based research and scientific infrastructure in Svalbard.

SIOS is establishing itself as a distributed research infrastructure with a new centre of coordination providing access to a world class integrated regional observational system for long term measurements. This will be achieved under the joint framework of the SIOS Knowledge Centre. In order to provide the necessary tools for facilitating excellent research and contribute to the enhancement of our knowledge about climate and environmental changes in the region, the main assets of SIOS will be the:

- ***coordinated observation capacity*** guided by a joint strategy and development plan
- ***joint services set up under the Knowledge Centre*** to provide better and open access to the research facilities and observations, data and logistics
- ***activity program aiming at scientific integration*** under the Knowledge Centre, providing better knowledge management, training and meeting places for scientists and students

It is intended that SIOS will forge international links with other observational infrastructures across the Arctic to share data and best practice, leading to a pan-Arctic observational structure that will facilitate more effective regional modelling and understanding of the role of the Arctic in the Earth System.

1. SIOS - A State-of-the-art Arctic Earth Observing System

1.1 Introduction to the concepts and results

SIOS builds on the extensive research installations and observation capacity already in place by many international research institutions in Svalbard. A joint framework is to be set up to provide an integrated regional observing system for long term measurements. The integration will establish a dynamic core observation program in the ESS domain, with gradual upgrade of instrumentation, platforms and facilities made accessible to the scientific users in a coherent and quality assured way under the direction of the SIOS Knowledge Centre. The development of a coherent and dynamic joint observation strategy is fundamental to achieve true integration of the individual RIs.

The SIOS observation program focuses on the changes that occur at the interfaces between different spheres (e.g. ocean-atmosphere, ocean-biology, atmosphere-biology). SIOS will prioritize measurements of variables whose interactions are believed to be significant in Svalbard e.g. measurements that are assumed to be able to elucidate important processes acting on annual to decadal time-scales. The SIOS RI Optimization Report [3] presents priorities for systematic and sustained observations, based on the needs identified by the SIOS research community. Regular revisions of this RI development plan will be performed under the auspices of the SIOS Knowledge Centre.

The SIOS Knowledge Centre is the coordinating unit of the distributed SIOS research infrastructure, managing its daily operation and services offered to the research community. The Knowledge Centre is the main connector between the users of SIOS and the capabilities it provides, implementing the joint policies agreed by the SIOS partners. It will provide a venue to enable research, build capacity and inform society. By building on existing networks, infrastructures and services the scope and scale of the Knowledge Centre will be unique by providing coordination and integration between scientific fields, access and use of research infrastructure and data/datasets to the observational platforms in Svalbard and the surroundings [4].

The SIOS Services and activity program provided by the Knowledge Centre to the user community operating in and around Svalbard shall ensure:

- Open access to research infrastructure and observational capacities [5]
- Effective data management, based on open access to metadata and datasets [6]
- Use of remote sensing data and validation of such using on-site observations [7]
- Logistics coordination with access to equipment, workshops, labs, safety courses and information about research sailing routes and fieldwork operations [8]
- Tailored training and courses for better use of the research infrastructure [9]
- Scientific integration and optimisation of the observing system by organising scientific workshops, developing strategies for infrastructure development and use, sharing

knowledge in the field by effective and informative outreach to scientists and the public [10]

The Governance structure and legal form of SIOS has been elaborated and discussed during the full period of the SIOS PP project [11]. SIOS will be a membership based organization with a legally non-binding Memorandum of Understanding (MoU) establishing and regulating the cooperation between the partners [12]. The parties of the MoU will accept the Statutes [2] and the membership fees for running the Knowledge Centre and its services, and the legal form will be a Norwegian limited company (AS). Such a legally non-binding collaboration, signed by the existing research infrastructure organizations already in place in Svalbard, is regarded as the most flexible and simple solution for SIOS. It represents a light structure of added value and reflects the situation that the membership and financial contribution to the SIOS Knowledge Centre for most partners will be channelled through the existing structures owned and operated by polar research institutions.

A Financial Strategy proposing flexible membership contributions that fits the overall spending on research and RI of each partner institution in Svalbard is proposed [13]. A three level membership contribution scheme, ranging from 50-300 k€/year, is proposed for SIOS, of which up to 1/3 of the membership contribution can be in-kind. The allocation to a specific level of contribution will be based on an Equal Relative Share (ERS) model assuring that the membership fees are being related to the overall activity program of each partner.

The SIOS Research Infrastructure (RI) with the observing system and supporting facilities such as national research stations, vessels, existing databases and instruments, will continue to be owned and operated by each individual partner of SIOS as before. The resources will be made available to SIOS and accessible through the Knowledge Centre. Operational relations between the SIOS activity program and the partner facilities will be organized through the Research Infrastructure Coordination Committee (RICC). In addition to the RICC, the governing bodies will be General Assembly (GA), Board of Directors (BD) and Scientific Advisory Board (SAB). The Knowledge Centre will have an Executive Director and staff to support and facilitate the access, logistics, data management and other SIOS activities [14].

1.2 Developing a new data management system for Arctic data

The distributed SIOS Data Management System (SDMS) is the functionality enabling component of the SIOS Knowledge Centre. It supports submission, discovery, access, use and preservation of SIOS relevant data sets. The SDMS is based on existing research infrastructure owned and operated by SIOS partners as well as other organizations, research projects or programs. It is an effective, easily accessible data management system encompassing both space-based and ground-based data. The system covers a wide range of Earth System disciplines, and is compatible with, and makes use of, existing data handling systems in the thematic fields covered by SIOS.

A key output of SIOS is scientific data. Although many good state-of-the-art data management systems are developed already, SIOS users need a distributed data management system that combines data from a plethora of different instruments measuring a variety of parameters that helps us describe system Earth. The data management system will entail data from satellites, in-situ measurements of the atmosphere, land and ocean, continuously recorded data and data resulting from campaigns of varying length. SIOS is making these data searchable and accessible to the users in an interoperable way and will support the following functionality [15]:

- Data submission through well-developed documentation, best practices, interfaces and tools.
- Data discovery through human and machine interfaces, focusing initially on index metadata harvested from contributing data centres.
- Online access to data sets, utilizing internationally accepted access mechanisms.
- Data use by standardised documentation of data sets allowing users to access and understand data retrieved.
- Data transformation services, including sub-setting (by variable, geographical area or time), and re-projecting (changing the map projection) to ease scientific use of the data sets collected.
- Long term preservation of data sets through mandated data archives.

Photo: Marek Szymocha

SIOS shall have a data policy approved by the General Assembly. The policy, which appears as an annex to the Statutes, shall be based on the principle of open access for any interested party to data, observations and scientific reports, free of charge. However, there will be some restrictions to the principle due to the need of confidentiality in certain cases i.e. when necessary for reasons of public security, protection of intellectual property rights, and protection of industrial information. Limitations to open access to data will be in accordance with general principles followed by the international scientific community [16].

The Remote Sensing Service will provide support for scientists working within Earth System Science (ESS) in the Svalbard region. It will be a new service made available through the SIOS Knowledge Centre [7, 17]. The service will enable a link to existing data repositories and provide easy access to earth observation data stored elsewhere, such as the NORMAP

project, the GEO portal and publicly available data through space agencies.

The reasoning for the service is threefold:

- To ensure that field work and other surface scientific investigations can be covered with the relevant information provided from space.
- To provide satellite owners with the best possible high arctic surface measurements for calibration and validation.
- To promote the integration of satellite data from different space platforms

1.3 Giving access to a unique network of Earth observing systems

The central objective of SIOS is to establish a world-class international Arctic observing platform with an Earth System Science (ESS) focus. The Knowledge Centre is intended to coordinate the organization and functioning of the platform. Building on an extensive gap analysis of existing RI and the needs for upgrade [18], the SIOS Research Infrastructure Optimisation plan [3] is an integrated observational framework for SIOS and a plan for optimisation of the research infrastructure, both existing and new, to address the vision. The partners of SIOS will be contributing to an integrated program of world class science measurements addressing important Earth System Science scale questions. The infrastructure development strategy organises the infrastructure into:

- Instruments observing vertical coupling of Earth System relevant parameters from the edge of space to the Earth's sub-surface.
- Instruments observing horizontal transport of further parameters across and around Svalbard.
- Instruments observing cryosphere/geosphere interactions and responses to climate change on Svalbard

A central component of SIOS will be to facilitate access to a coordinated international observational program utilising the full breadth of research infrastructure present on Svalbard to address ESS relevant issues [19]. The distributed infrastructure, belonging to the various SIOS members, will offer access opportunities to identified scientific facilities and research instruments through regular strategic SIOS calls. These will be organised by the Knowledge Centre, utilizing SIOS committees and external reviewers to facilitate an effective and transparent project review and assessment process. The committees contributing to the Access schemes will mainly be the Research Infrastructure Coordination Committee (RICC) and the Science Advisory Board (SAB). The committees will be involved in identifying research topics to be addressed, contribute to science assessment and identify appropriate stations and facilities for approved projects.

The SIOS Access Program builds on the instruments and research stations in Svalbard that belong to SIOS partners and produce data relevant to Earth System Science. It is proposed that up to 20 % of a station's capacity and infrastructure will be made available to the SIOS access schemes. SIOS access will be distinct from the access schemes already offered by individual national partner institutions as the SIOS scheme gives joint access to an integrated research infrastructure, rather than just a single installation. The national schemes will operate in parallel, providing additional opportunities for researchers to access Svalbard infrastructure. To help reduce the differences in use between stations and to encourage more interaction between researchers, within or between the settlements, all the approved access

projects will be encouraged to use more than one station or facility. This will enhance the use of infrastructure and add significant value for the scientific community. The SIOS Access Policy [19, 20] will assure:

- Open competition and selection of the applications for access according to criteria defined by the General Assembly. The application procedure shall ensure fair and transparent rules and a peer review process.
- SIOS members will contribute a proportion of their infrastructure's capacity to the Access Program, as well as providing an annual cash contribution and additional in-kind contribution to the program.
- SIOS may also seek third party funding for the Access Program, for example from EU transnational access funding schemes.
- Researchers that have been granted access to SIOS infrastructures must ensure that they have the necessary public permissions to operate in Svalbard, and must be registered in the Research in Svalbard (RIS) database.

SIOS will provide logistics based on existing services and as a response to current logistical needs [21, 22]. The logistical function within the SIOS Knowledge Centre will facilitate coordination and access to existing services in Svalbard. Logistical coordination for operations in the Svalbard region is already a year-round activity. Data collection has developed from seasonal field work to an all year operation. It is therefore necessary to provide relevant information of available logistics and requirements for full year activities in the field. It is also an objective for SIOS to coordinate logistics with the ambition to minimize the environmental impact.

A wide scope of information and real-time status of available logistical services and infrastructure will be provided through the SIOS Web Portal and displayed at the Knowledge Centre. This will include general information about planes/connections, ships, hotels/accommodation, research expeditions and updated logistics capabilities available at different locations. Such information will not only help to organize the fieldwork, but also improve the logistics coordination between SIOS partners. In the permanent research settlements of Ny-Ålesund, Hornsund and Barentsburg, provision of logistical services will follow those for existing infrastructure made available by owners/operators according to the SIOS Access Policy. SIOS partners established in Ny-Ålesund will deliver necessary logistical services when feasible.

The SIOS Knowledge Centre's main logistical services are:

- Provision of logistic advice to assist in the planning of SIOS projects/campaigns
- Contribution to internal evaluation of logistical feasibility and contact with main logistic providers in early phases of the planning
- Provision of logistical advice and information on relevant Svalbard regulations
- Facilitation of contact with existing services
- Contribution to contact with and support from logistic providers when planning/constructing budgets and during the activity
- Identification of overall logistical needs in SIOS projects (on an ongoing basis)
- Real-time, continuously updated logistical information in an overall presentation
- Safety courses for scientists participating in SIOS-labelled projects/campaigns

Photo: Halvard R. Pedersen

1.4 Challenges of international cooperation

SIOS seeks to build an integrated regional observational system for long term acquisition and proliferation of fundamental knowledge on global environmental change (GEC) [23, 24]. In a pan-arctic perspective, SIOS will develop and secure a robust communication with other bodies carrying out and funding research activities in the Arctic (observational as well as modelling) and actively promote a sustained Arctic observing network [25]. In the European research landscape, SIOS overlaps with several other environmental RI initiatives, and will therefore build close cooperation and coordination with other ESFRI projects with Arctic nodes, existing regional research networks in the European Arctic and pan-arctic initiatives. This involves interaction with the EC European Arctic Strategy [26] and the European Polar Board [27], close collaboration with other Arctic projects such as INTERACT [28], and ESFRI projects that include Arctic segments (e.g. EuroArgo, EMSO, ICOS) [29], reinforcing through coordinated activities the best and most effective coverage along the SIOS scientific domain. SIOS has contributed to the efforts of Environmental RIs to respond at the cluster strategy envisaged in the European Commission Horizon 2020 (H2020) work program (2015-2016) for Research Infrastructures. SIOS is already a partner in the ENVRI ^{PLUS} project proposal to the H2020 INFRADEV-4 2014/2015 call. SIOS is also represented in the Nordic RI-network "Research Infrastructure Network for Nordic Atmospheric and Earth", and is expected to be a relevant player along the whole H2020 and in Nordic infrastructure projects.

As a regional observing system under the ESS domain, SIOS will provide a major contribution to the realization of a pan-Arctic Observing Network (SAON), as endorsed by the Arctic Council [25]. Coordination and cooperation with non-European nations is important, and the Russian, Japanese, Chinese and Korean research institutions in Svalbard are part of the SIOS collaboration. Of special importance to SIOS is the implementation of the

Transatlantic Research Alliance and SIOS will seek a close cooperation with relevant US and Canadian RI. Their regional contribution to a sustained Arctic observing system should also be secured under the SAON leadership. Close coordination with the RI and monitoring programs in Greenland will also be of high importance for SIOS [30].

Thanks to envisaged activities and continuous multi-level communication with all relevant actors, SIOS will contribute in several ways to the European Arctic Research strategy and to challenges related to international cooperation:

- **SIOS will have a significant contribution on reducing the fragmentation of the European research landscape.** The implementation of a common workspace for common discussions and decision-making, sharing facilities, exchanging information and data related to measurements and research activities, will bring positive effects inside as well as outside the context of SIOS.

- **SIOS will provide a natural catalyst and will be an attractive element of the European research landscape in the polar areas**. It will foster the development of new research, new cooperation constellations and new ways of integration of the European scientific community, but also will contribute to strengthen cooperation and joint activities with non-European countries and research institutions.

- **SIOS will offer a concrete way to increase magnitude and visibility of the investment made by each individual member institution.** The presence of a large multidisciplinary observational platform in an area in many ways crucial for the Arctic climate system, and the level of integration and cooperation among SIOS partners, will provide a business card of great importance not only to obtain more attention at national level but also to clearly shown the legitimate interest of the EU in the Arctic.

2. SIOS - A Research Infrastructure for Arctic Earth System Science

2.1 Introduction to the added value and main impacts of SIOS

SIOS will enhance the scientific environment in Svalbard by providing a core integrated measurement program. The special expertise and the activity program related to ***scientific and observational integration*** set up under the Knowledge Centre, will be one of the main assets of SIOS [4, 23, 24]. The task is challenging because of the historical legacies and different practices already present with the individual partners of SIOS. Additionally, SIOS involves a wide spectrum of scientific disciplines having developed individual solutions with respect to sampling strategies, data policy and management systems etc.

Globally relevant ESS questions are complex and require collective efforts to be solved. A systematic approach is essential in order to yield insights in a cost effective way. SIOS will

give access to an integrated observing system for all partners and thus ***supplies added value well beyond what their national investments would provide*** [3]. Svalbard is a region that is influenced by the surrounding areas but also influences its surroundings. ESS observations must be able to separate the regional influences from those from afar. This requires knowledge about the most important processes that influence the observations. By bringing many types of observations together and asking questions about how these are influenced by each other, we can gain new insights about the Svalbard regions role in the Earth system.

Improved use, better coordination and open access to the various observing systems, infrastructure and data (not otherwise accessible) will add value to all SIOS partners. The coordination of activities, organisation of scientific workshops and joint development of strategies for use and development of research infrastructure will be highly beneficial to scientists, but also to research funders. By joining forces and resources through SIOS, institutions will be able to create a first class research infrastructure in the Arctic. The added value for researchers includes:

- ***Enhanced and open access*** to research infrastructure and data
- ***Meeting place*** for scientific integration of the research infrastructure and workshops for the development of observation programs and research campaigns.
- ***Information*** about funding opportunities, transportation, logistical services and health, safety and environmental issues for fieldwork in Svalbard
- ***Arena for scientific discussions and strategy development*** on issues of relevance for Earth System Sciences.

The added value for research funders and decision makers include:

- ***Platform for integrated international cooperation, promoting excellence*** in research and enhancing access to state-of-the-art research infrastructure.
- Arena for tackling the high-priority research question that might lead to development of targeted ***joint calls for projects***.
- A ***web portal to knowledge and information*** about research infrastructure, their use/data/results and publications from research in Svalbard.
- ***Advice*** on ESS-related activities in Svalbard and latest scientific achievements.

2.2 SIOS Knowledge Centre – the place to go to for ESS on Svalbard

The SIOS Knowledge Centre will use the observations and knowledge to continuously develop the core program. It will provide an ***intellectual environment*** where sampling strategies and observational practices are developed with an ESS perspective, and will thus become a ***unique international meeting place*** for developing the science of long term environmental monitoring in Polar Regions [4]. The centre will continuously inform users and society about the accrued knowledge within its field of expertise.

An important capacity building activity at the Knowledge Centre will be to stimulate the development of new ***observational techniques and innovative methods*** that are clean, energy efficient and robust, in order to minimize the footprint of monitoring activities in the Arctic environments. Earth System studies, as the core element of SIOS, are depending on high

quality long term monitoring series. A key added value is to ensure the ***continuation of long term monitoring*** based on SIOS projects, by having the capacity to coordinate, organize and take responsibility for such series.

SIOS shall not duplicate existing services but will coordinate existing facilities within SIOS, and collaborate with facilities serving the observational and modelling research community as well as policymakers. Scientific integration is necessary for better understanding of the environmental and climatic change in the Arctic. The aim is to develop a multidisciplinary international structure integrating multidisciplinary observations from Svalbard into a world-class Earth Observing System by:

- Strengthening links between SIOS partners
- Improving the observational network
- Joint strategy development

The added value for SIOS members will come clear by a proactive Knowledge Centre providing operational services, meeting places and facilities for scientific interaction between various scientific fields under the Earth system (e.g. atmosphere, hydrosphere, lithosphere, biosphere and heliosphere the processes within each and between them). The scientific integration facility will address ambitious science questions and attract excellent Arctic researchers, challenged to post clear defined goals that are realistic to be achieved with SIOS. A key added value is to provide a unique intellectual environment by bringing together ***international experts in focus groups*** to make a common advance on observational design and methods for ESS observations.

The SIOS Knowledge Centre will initiate and coordinate ***education and training*** of scientists and research technicians in polar research methods through dedicated field and laboratory courses. SIOS will offer specialized courses related to the infrastructure (and their data) being made available from SIOS partners in Svalbard. This will educate and stimulate scientists and research technicians in state of the art polar research methods and techniques. The use of the observational system and the data made accessible through the SIOS data management system in specific ESS training and education courses, will also have high impact.

2.3 Set of services enabling more state-of-the-art science

The SIOS Knowledge Centre will, as the core coordinating unit, provide the distributed data management system, access to the infrastructure, joint logistical support, and tailor-made training/education. Significant effort will be made to foster scientific discussions in order to jointly address the "big" scientific questions in an Earth system manner. Multidisciplinary approaches, sharing of data and infrastructure, as well as the involvement of the modelling community, will rapidly gain results of value both for the global, the regional and the local scientific community. Moreover, it is foreseen that the joint scientific work will ease and cohere the different national funding systems so that less money can be spent on duplication and more on the complimentary forefront research in this region.

It will be a goal in itself to develop SIOS to a state of the art infrastructure in Svalbard, but more than this it is necessary to put SIOS on the global map and stimulate to cooperation with other artic initiatives. Only in this way can SIOS pave the road for the Svalbard researchers and the global community with excellent research by cost effective approaches.

SIOS also aims at inviting researchers and technicians to discuss how field research can be performed in a more sustainable and greener way. New technology with less impact on the vulnerable nature must be taken into use, and new remotely operated instruments should be developed that can withstand the harsh climate conditions. The development of new solutions for continuous observations requires the involvement from different scientific fields and engineering cultures.

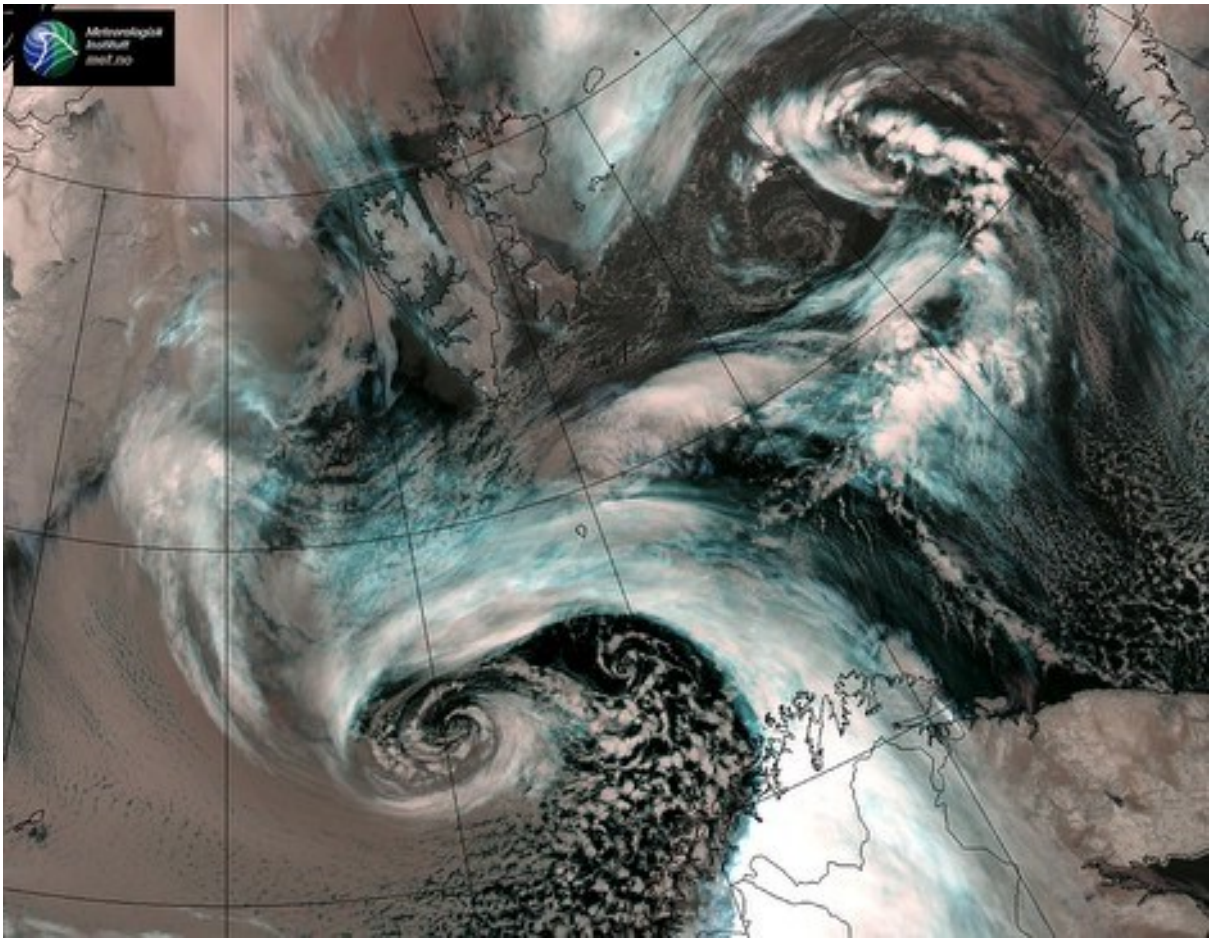


Photo: www.met.no

Important impacts of the SIOS Services:
Data sharing [6, 15, 16]***:*** The SIOS open access data policy and the ambitious data management system (SDMS) will be managed and maintained under the Knowledge Centre. This will also enable SIOS to establish itself as a major regional building block of SAON, as well as contributing effectively with an Arctic component to global datasets and GEOSS. Globally relevant Earth System Science (ESS) questions are complex and solving them requires collective efforts. By bringing together different types of observations and asking questions about how these are influenced by each other, new insights about the Svalbard region's role in the entire Earth system can be gained. Based on the principle of open data sharing, the SDMS will enable users to access all data sets and products offered by the partner institutions and external entities performing research and scientific work in Svalbard under a common framework.

The main users of the SDMS are Earth system scientists. Since there are scarce data and information about the Svalbard region and the Arctic in general, both public administration and business/commercial actors will benefit from SIOS data services. The main benefits are:

- Better access to data, metadata and data products from the Svalbard region
- More efficient search for data
- Increased interoperability of data for cross-disciplinary research
- Faster and better coordination of the implementation of user needs
- Prevent doubling of work
- Facilitation of combined data products (in-situ and space-based data products etc).

Remote sensing [7, 17]**:** The Remote Sensing (RS) service will be implemented as an integral part of the SDMS. The RS service will utilize the existing infrastructures and capabilities for Earth observing data, harvest where data is available, with focus on facilitating access for SIOS research purposes. The benefits of the RS service are:

- Easy access to remote sensing data will represent an added value to scientists in the Earth system observation field, when combined with ground measurements.
- By using new technology and increase the use of remote sensing equipment, the environmental impact will be reduced.
- Researches will gain access to a large amount of satellite data from this region.
- The open data policy will increase the use of remote sensing data by making the access and interpretations accessible.
- New data products made available through the SIOS Knowledge Centre will add value to multidisciplinary research.
- SIOS can gain a leading role in providing quality controlled RS data for polar research, climate research and ultimately in ESS.
- Scientists working in the Svalbard region and satellite owners (calibration and validation measurements) will be the main users of the RS service.

The RI Development Strategy [3, 18]**:** Institutions from various countries will through cooperation be able to utilise and jointly acquire facilities not readily accessible as a single country. Researchers will gain access to larger, more diverse data sets than they would independently and have the opportunity to collaborate with researchers from other institutions. The infrastructure optimisation plan [3] aims to amend the original focus of observations from limited sites along the warmer west coast of the archipelago to a more widely distributed set of sites providing more realistic observations of key parameters in and around Svalbard. It also integrates all the diverse marine observations, and importantly, all the participating institutions sign up to a common set of measurements and sampling intervals. The commitment of instrumentation to long term observations within a common observational framework will generate more robust and valuable insights to environmental change. Working within SIOS will bring considerable added value to researchers, institutions and their respective national programs.

Access Policy [5, 19, 20]**:** SIOS shall have a policy for accessing the research infrastructure that the partner institutions bring together. The Access Policy shall be based on the principle of open access. Institutions will be able to access facilities of other SIOS partners which were previously not readily available to them. The benefits will be:

- Scientists will be able to meet and create new projects and networks, exchange ideas and plan future activities together as one international and cross-disciplinary team working towards common ESS relevant objectives.
- The users will gain access to larger, more diverse data sets from across the SIOS community than they could independently.
- The opportunity to collaborate with many other researchers will bring fresh

perspectives to the research.

- Closer interaction between researchers within and between different settlements will help to strengthen the connection and coordination between various research infrastructures.
- Through participation in the infrastructure development plan, the user investments will be made in a cost effective way to maximize the scientific outcome of the developing observational system.

Logistics coordination [8, 21, 22]**:** In all permanent research settlements, SIOS partner institutions are expected to provide logistical services according to the Access Policy. The main benefits of the logistics service of SIOS will be:

- Continuously updated information on how to get there (to Longyearbyen or elsewhere on Svalbard), what type of logistical equipment is needed for specific expeditions, where it is and the availability.
- Access to lab-space, workshops for maintenance and storage of equipment.
- Logistical equipment will be made available to those who receive open access to the distributed infrastructure according to the access programme of SIOS.
- Assistance in access to safety courses related to scientific activity in Svalbard.
- Assistance in legal issues related to research in the Svalbard region.

The general impact of the SIOS logistical service will be that better coordination and cooperation will prevent doubling of work and lessen the burden on a vulnerable environment. SIOS will provide logistical services that create more effective research, more relevant research and more value for money.

Photo: Ove Hermansen

2.4 The SIOS Implementation Phase

At the end of the 4 year Preparatory Phase (PP) project, the Norwegian Ministry of Education and Research announced a continuation of SIOS with officially kicking off an Interim Phase project for SIOS at the 4th Policy Board meeting in Oslo 20-21 November 2014 [31]. An Interim Project will start early 2015 and run until SIOS can be formally established, i.e. for a period of 2 to maximum 3 years. The project will be run by a Setup Team in Longyearbyen, led by the University Centre (UNIS) and the Norwegian Polar Institute (NP), with active involvement by the central Norwegian and international partner institutions contributing on the basis of Letters of Commitment (LOCs) [32]. All partner institutions are expected to contribute with access to their relevant permanent and campaign based infrastructure, in order to organise integration of the observing system in a practical and feasible manner.

The Interim Project shall focus on implementing core functions of the SIOS Knowledge Centre, emphasising the access to infrastructure and the observing system, the data management system and the web portal. The project builds on the Norwegian host bid for the implementation phase [33], the advice from the SIOS Preparatory Phase project [34], the advice from the external evaluation panel and the comments from the SIOS Policy Board. The tentative time plan aims at formal establishment of the SIOS consortium with signature of the (non-binding) MoU and formal establishment of a Norwegian Ltd Company by October 2016.

SIOS builds on the extensive research installations and observation capacity already in place by many international research institutions in Svalbard. The following international partner institutions have committed to continue the SIOS collaboration and will contribute to the implementation of SIOS and the Interim Project, according to their LOCs and statements delivered in connection with the 4th Policy Board meeting [32]:

- **Alfred Wegener Institute (AWI, Germany)**
- **Consiglio Nazionale delle Recherche (CNR, Italy)**
- **Finish Meteorological Institute / Univ. of Helsinki (FIM/UH-Phys. Finland)**
- **Polar Research Institute of China (PRIC, China)**
- **British Antarctic Survey (BAS, UK)**
- **National Institute of Polar Research (NIPR, Japan)**
- **Institute Polaire Francais (IPEV, France)**
- **University of Stockholm (SU, Sweden)**
- **Institute of Geophysics, Polish Academy of Sciences (IGF-PAS, Poland)**
- It is expected that the SIOS partner institutions **Arctic, Antarctic Research Institute (AARI, Russia), Korea Polar Research Institute (KOPRI, Korea) and the Czech Centre for Polar Ecology(CPE, The Czech Republic)**, will be able to define their contribution at their earliest convenience.

3. References and contact details.

3.1 SIOS Website and partner institutes/facilities

❖ SIOS Website

- **The Norwegian Polar Institute (NP)**
  Svalbard Science Centre and Sverdrup Station, Ny-Ålesund, http://sverdrup.npolar.no/
- **The University Centre in Svalbard (UNIS)**
  Svalbard Science Centre, http://www.unis.no
- **Alfred Wegener Institute for Polar and Marine Research (AWI),**
  AWIPEV Station, Ny-Ålesund, http://www.awipev.eu/
- **French Polar Research Institute (IPEV)**
  AWIPEV Station, Ny-Ålesund, http://www.awipev.eu/
- **Institute of Geophysics - Polish Academy of Sciences (IGF-PAS)**
  Polish Polar Station in Hornsund, http://www.igf.edu.pl/home.php
- **National Research Council of Italy (CNR)**
  Dirigibile Italia Station, Ny-Ålesund, http://www.cnr.it
- **Arctic and Antarctic Research Institute of Roshydromet (AARI)**
  Russian Science Centre in Barentsburg, http://www.aari.nw.ru/
- **Norwegian Space Centre (NSC)**
  http://www.romsenter.no/
- **National Environmental Research Institute - Aarhus University, Denmark (AU-NERI)**
  Zackenberg Station and Station Nord in Greenland, http://www.au.dk/en/
- **Finnish Meteorological Institute (FMI), Finland**
  http://www.fmi.fi
- **University of Groningen (UoG), The Netherlands**
  Ny-Ålesund, http://www.arcticstation.nl/
- **Polar Research Institute of China (PRIC)**
  Yellow River Station, Ny-Ålesund, http://www.polar.gov.cn
- **Korea Polar Research Institute (KOPRI)**
  Ny-Ålesund, http://www.kopri.re.kr
- **Polar Geophysical Institute -Russian Academy of Sciences (PGI-RAS)**
  Russian Science Centre in Barentsburg, https://www.ras.ru/

- **Institute of Oceanology -Polish Academy of Sciences (IOPAS)**
  Polish Polar Station in Hornsund, http://www.iopan.gda.pl/
- **Stockholm University, Sweden (SU)**
  Zeppelin Station Ny-Ålesund, http://www.su.se
- **University of Bergen (UiB), Norway**
  http://www.uib.no
- **University of Tromsø (UiT), Norway**
  http://www.uit.no
- **Norwegian Meteorological Institute (met.no), Norway**
  http://www.met.no
- **Nansen Environmental and Remote Sensing Center (NERSC), Norway**
  http://www.nersc.no/
- **Institute of Marine Research (IMR), Norway**
  http://www.imr.no/
- **Norwegian Institute for Air Research (NILU), Norway**
  Zeppelin Station, Ny-Ålesund, http://www.nilu.no/
- **Andøya Rocket Range (ARR), Norway**
  http://www.rocketrange.no/
- **National Institute of Polar Research (NIPR), Japan**
  http://www.nipr.ac.jp/

3.2 Core Reports and Deliverables from the SIOS PP project:

[1] SIOS Vision
[2] D2.4 SIOS Draft Statutes
[3] D3.4 SIOS Optimization Report and RI development Strategy
[4] D8.3 SIOS Knowledge Center Concept and Implementation Plan
[5] D4.7 SIOS Access Service Implementation Plan
[6] D6.6 SIOS Data Management System Implementation Plan
[7] D7.8 SIOS Remote Sensing Service Implementation Plan
[8] D5.8 SIOS Logistics Service Implementation
[9] D8.5 SIOS Education and Training Program Implementation Plan
[10] D8.4 SIOS Interactive Web Portal Implementation Plan for Scientific Integration
[11] D2.1 SIOS Assessment of legal instruments
[12] D2.7 SIOS Draft Memorandum of Understanding (MoU)
[13] D3.2 SIOS Financial Strategy
[14] D2.2 SIOS Governance structure including observation platforms
[15] D6.4 SIOS Data Management System Design
[16] D6.1 SIOS Data Policy
[17] D7.7 SIOS Remote Sensing Strategy

[18] D3.1 SIOS Gap Analysis Synthesis Report
[19] D4.5 SIOS Access Policy
[20] D4.6 SIOS Access Financial Model
[21] D5.7 SIOS Logistics Policy
[22] D5.6 SIOS Logistics Service
[23] D8.2 SIOS Observational Integration plan
[24] D8.1 SIOS Scientific coordination and integration
[25] D9.7 SIOS SAON Task Proposal
[26] D9.2 SIOS in the European Arctic Strategy
[27] D9.3 SIOS MoU proposal with the European Polar Board
[28] D9.5 SIOS MoU with INTERACT
[29] D9.6 SIOS MoU with EMSO
[30] D9.4 SIOS Integration with Greenland Environmental Monitoring
[31] D3.5 SIOS Minutes from the 4th Policy Board meeting
[32] D3.7 SIOS Letter of Commitments to the Implementation Phase
[33] D2.6 SIOS Host Bid for the Implementation Phase
[34] D3.6 SIOS Minutes from the 5th General Assembly

3.3 Other SIOS Deliverables

Reports elaborated under the work packages on access (WP4), data (WP6), logistics (WP5) and remote sensing (WP7), forming the basis for decision making on SIOS:

[35] D4.1 Assessment of the Ny-Ålesund infrastructure projects
[36] D4.2 Questionnaire "Research infrastructure users' expectations
[37] D4.3 Assessment report of potential users' feedback
[38] D4.4 Report on access to research infrastructure platforms of non-EU partners
[39] D5.1 Energy and data connection strategies for the main land-based platforms
[40] D5.2 Cabling strategy for the Fram Strait marine and seafloor observatories
[41] D5.3 Research vessel inventory and sailing plan in Svalbard region 2011-2016
[42] D5.4 General transport assessment and future strategy
[43] D5.5 Common supplies and maintenance routines plan
[44] D6.2 SIOS Datasets – Relevant Existing Datasets & expected datasets
[45] D6.3 SIOS Data Management System – User Requirements Document
[46] D6.5 Integration with relevant data centres and archives
[47] D6.7 SIOS Data Utilisation Plan
[48] D6.8 Distributed SIOS Data Management System, pilot
[49] D7.1 Assessment of research areas with great EO support potential
[50] D7.2 Plans and analysis of SIOS needs for rocket campaigns
[51] D7.3 Prioritised satellite missions for SIOS research in the next decade
[52] D7.4 Cooperation agreements with owners of prioritised satellite missions
[53] D7.5 Validation capabilities and technology development requirements
[54] D7.6 Cooperation agreements with GMES and GEOSS

3.4 Minutes from General Assemblies and Policy Board meetings

- General Assembly 1, October 2010
- General Assembly 2, October 2011

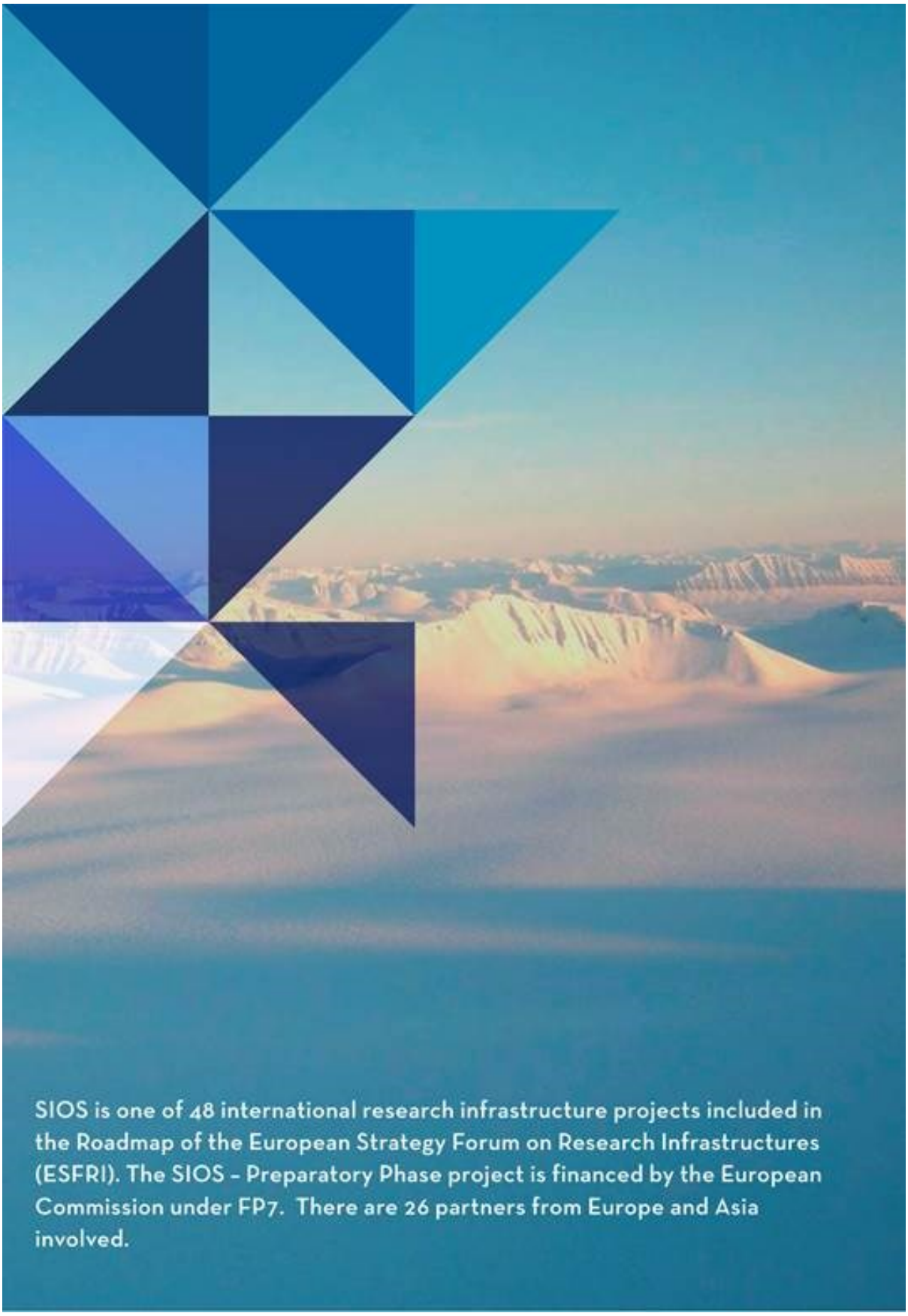
- General Assembly 3, December 2012
- General Assembly 4, October 2013
- General Assembly 5, September 2014
- Policy Board 1, February 2012
- Policy Board 2, October 2013
- Policy Board 3, May 2014
- Policy Board 4, November 2014

3.5 SIOS Outreach material

- Factsheets
- Posters

3.6 SIOS Preparatory Phase Contact Details

- Project Coordinator Jon Børre Ørbæk: jbo@rcn.no
  The Research Council of Norway
  Drammensveien 288, PO Box 564
  NO-1327 Lysaker, Norway
  Mobile: +4792086814


SIOS is one of 48 international research infrastructure projects included in the Roadmap of the European Strategy Forum on Research Infrastructures (ESFRI). The SIOS – Preparatory Phase project is financed by the European Commission under FP7. There are 26 partners from Europe and Asia involved.