



SIOS Core Data

Documentation

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Revision history

Version	Date	Comment	Responsible
0.1	26.02.2019	Very First draft circulated to Core data Task Force	H. Lihavainen
0.2	8.3.2019	Comments from Task Force merged	H. Lihavainen
0.3	11.04.2019	Comments from Board of Directors	H. Lihavainen
0.4	20.02.2020	Comments after Core Data seminar during Polar Night Week 2020	D. Ignatiuk
0.5	6.04.2020	Final version	D. Ignatiuk
1.0	28.04.2020	Approved by Board of Directors	D. Ignatiuk

1. Background & motivation

Svalbard Integrated Arctic Earth Observing System (SIOS) is a regional observing system for long-term measurements in and around Svalbard addressing Earth System Science questions. SIOS integrates the existing distributed observational infrastructure in order to generate added value for all partners beyond what their individual capacities can provide. SIOS brings together observations in a coherent and integrated observational programme that will be sustained over a long period. Only in this way, the inherent coupling processes in this regional-scale Arctic system and its connections with the Earth System at large can be addressed in an adequate way.

One of the main products and services of SIOS are data useful to address identified key research questions in Earth System Science (ESS). The data can be the result of long-term monitoring programmes or ad-hoc activities and process studies. Integrated ESS studies should be the core activity of SIOS, with a focus on regionally relevant variables changing over timescales of years to decades.

SIOS core data need to be defined to optimise the resources contributed by the SIOS research community. The core observational programme of SIOS should provide the research community with systematic long-term observations, yet flexible enough to integrate upcoming new methods and research questions. The SIOS measurement programme and hence also core data is continuously monitored from this point of view and if necessary updated using the annual State of the Environmental Science in Svalbard (SESS) report, the SIOS infrastructure optimisation report and interaction with the modelling communities.

Svalbard is not representative of the whole Arctic, but its location at the crossroad between the high Arctic and lower-latitude regions, combined with its unique collection of a wide spectrum of instrumentation both on land and off-shore provide excellent opportunities to tackle major questions not easily addressed anywhere else. Among those are vertical and horizontal coupling processes both in the atmosphere and between the atmosphere, the ocean and the terrestrial compartments. As a starting point for ESS studies it is proposed that this and the various Earth spheres (atmosphere, hydrosphere, cryosphere, pedosphere) provide an underlying pattern for organising SIOS core monitoring measurements and complementary shorter term research.

The scientific themes that guide the observations and the optimisation of the observing system of SIOS are:

- State variables of importance for Global Environmental Change (GEC) diagnostics.
- Energy and mass exchange.
- Combined effects of human perturbations.
- Effects of GEC on organisms, populations, and ecosystems.

2. Types of SIOS data

Data products addressing the identified key research questions in Earth System Science (ESS) are the core product and service of SIOS. However, it has to be kept in mind that, due to the limited geographical extent of the SIOS region, Earth System Science (ESS) monitoring and observation activities have to be limited to regionally accessible and relevant variables which can be expected to change over timescales of years to decades. There is another aspect of data from the SIOS perspective: SIOS members have to follow the SIOS data policy, which follows the FAIR data principle closely. A central element of this data policy is that all data are open and free for all. SIOS data also include higher-order products ([level 3+](#)).

SIOS data are defined as all the ESS data available through the SIOS data management system (SDMS), including, e.g., solitary measurements and third-party data, see table 1. SIOS data should be accompanied by metadata. Where possible, some predefined measurement protocol (e.g. ACTRIS, GAW, etc.) should be included.

Table 1. Data definition in SIOS

Type of SIOS data	Policy	Category	Comment
Single field experiments.	Transparency (data are being collected).		SIOS data if available through SDMS
Historic data records, including long-term measurements, but discontinued.	Transparency (data exist). Submitted at owner's discretion.		SIOS data if available through SDMS
SIOS Access call, SESS report, and other higher-level data	Available after the project		SIOS data if available through SDMS
Long-term observations	Transparency (data exist). Submitted at owner's discretion.		SIOS data if available through SDMS
SIOS Core Data (SCD)	Transparency (data exist and is available on-line).	Core	Fulfils SIOS criteria of scientific requirements, data availability and >5 years collecting commitment
SIOS Core Data – Candidate (SCD-C)	Available on-line within one year	Core Candidate	Fulfils the same criteria as core data but data is not available on-line

3. SIOS Core Data requirements

The Science Optimisation Advisory Group (SOAG) with the Task Force for the core data have defined criteria that must be met for data to be qualified as SIOS Core Data (SCD). The criteria are based on standards of scientific excellence in the Earth Science System, in SIOS "legal" framework and SIOS Data Policy.

SIOS Core Data has to fulfil the following criteria:

1. Scientific requirements

The variable is critical to answer the key research questions as defined in SIOS infrastructure optimisation report, and further update in SESS reports. The requirement for temporal and spatial coverage varies between variables, and can also depend from the scientific question. This should be taken into account in the scientific requirement (optimisation). Connection with GCOS ECVs and other Essential variable schemes, as for example Essential Ocean Variables (EOVs), and marine Essential Biodiversity Variables (EBVs), can provide guidelines and criteria for selection and prioritization.

2. Data availability

SIOS core data should be available through SDMS. SIOS core data candidates should be available as soon as possible and at latest one year after data collection. Data must be described with rich metadata. Where possible, existing measurement and calibration protocols should be used, e.g. WIGOS, GAW, BSRN, ACTRIS and ICOS, to secure comparability. Instrument inter-comparisons are highly recommended. SIOS will work on promoting data protocol harmonisation, reinforce calibration chains, and sustain/facilitate intercomparison campaigns.

3. Members commitment

For SIOS core data, there should be a commitment from the providing institute to maintain the measurement for more than 5 years, and make the data available through SDMS. SIOS membership is based on a non-binding agreement. However, for members, there is a very strong requirement to sustain their credibility in the system.

In this SIOS "legal" framework, a letter indicating intentions of the member about data offered to SIOS, a period of validity of the offer, and at least tentative frequency of delivery (following rules fixed in criteria 2) could be well considered as a sort of "commitment".

4. SIOS Core Data

The first set of SIOS core data (Appendix 1) has been identified by The Science Optimisation Advisory Group (SOAG) in cooperation with the Research Infrastructure Coordination Committee (RICC) and additional scientific experts.

The selected variables are critical for characterising climate system and its changes, and these are taking advantage of the World Meteorological Organisation's Essential Climate Variables (ECV). These variables are also essential in answering the ESS science questions outlined in the SIOS Infrastructure Optimization Report.

SIOS Core Data are divided into 4 categories:

- SCD 1 ATMOSPHERE
- SCD 2 CRYOSPHERE
- SCD 3 TERRESTRIAL
- SCD 4 OCEANS

Most of the measurements are part of existing monitoring networks and thus follow defined measurement protocols with known measurement uncertainties.

The SIOS core data has been identified and characterised by the Essential Climate Variables (ECVs) defined by The Global Climate Observing System (GCOS), WMO standards and the Global Change Master Directory (GCMD) Keywords (Appendix 1).