



ICOS SWEDEN Operational Plan 2021

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Swedish
Research Council

ICOS Sweden Operational Plan 2021

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The ICOS Sweden Board endorsed this Operational Plan on 2020-11-02. The plan is complemented by other documents from ICOS Sweden, including the Strategic Plan (2021-2024) and the Annual Report (2020).

ICOS Sweden Operational Plan 2021

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1. Introduction to ICOS Sweden

ICOS - Integrated Carbon Observation System - is a European research infrastructure for quantifying and understanding the greenhouse gas balance of the European continent and of adjacent regions. The infrastructure is built up as a collaboration of nationally operated measurement stations in, at present, 14 European countries. ICOS Sweden is the Swedish contribution to this European effort. An ERIC (European Research Infrastructure Consortium) 'ICOS ERIC' has been established as a legal entity for ICOS data release as well as the coordination and integration of the whole research and measurement infrastructure, ICOS Research Infrastructure (RI), that includes the national networks, the measurement station assemblies and the central facilities (Fig. 1).

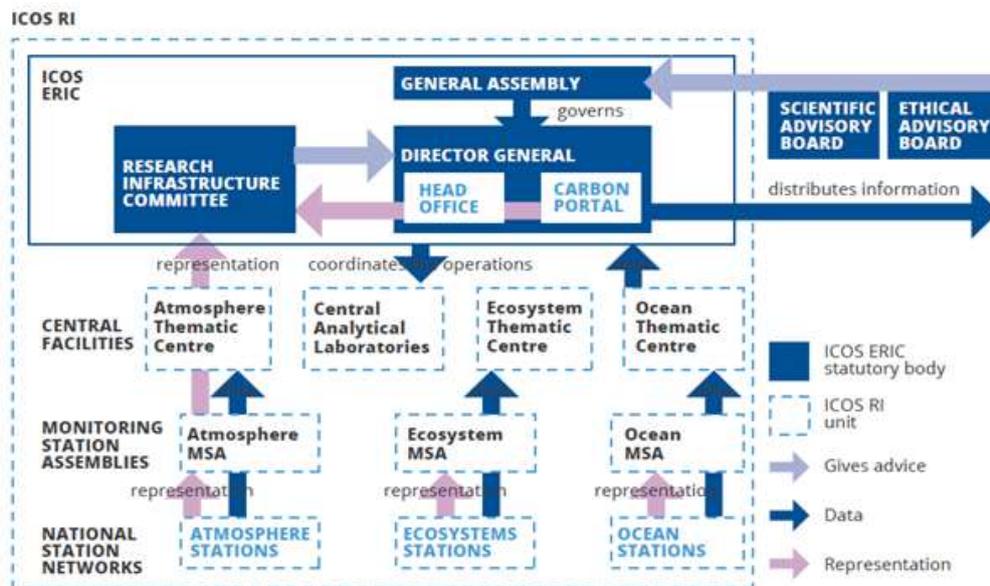


Figure 1. Outline of the ICOS RI organization. Sweden is a member of ICOS ERIC and ICOS Sweden is the Swedish node.

High-precision, standardized observations of the exchange of greenhouse gases and heat between the Earth's surface and its atmosphere form an essential basis for understanding not only our planet's present climate, but also past and future developments. It has also become clear that these studies must be secured beyond the lifetime of a typical research project. The aim of ICOS is therefore to construct, equip, and operate a network of standardized, long-term, high precision integrated monitoring stations for atmospheric greenhouse gas concentrations and fluxes. At the moment ICOS Research Infrastructure has more than 100 stations in 14 European countries. The current ICOS Atmosphere and Ecosystem Networks include more than 30 atmospheric and around 70 ecosystem stations located across Europe. The ICOS Ocean Network covers the North Atlantic and European marginal seas. The Ocean Observation System will consist of more than 20 facilities: Voluntary Observatory Ships, so called Ships of Opportunity (SOOP), fixed stations and research vessels.

ICOS Sweden is fully integrated with and plays an important role in the pan-European ICOS (ICOS RI). ICOS Sweden has been providing data, and that help to compile information on greenhouse gas exchange of typical northern ecosystems to the research community as well as Swedish stakeholders. ICOS Sweden will furthermore provide test sites for national inventory systems and sites and databases for advanced research.

Stations with ICOS RI are separated into 3 different classifications:

- Class 1 station: ICOS Ecosystem or Atmosphere Station with a complete equipment setup for measuring the full set of ICOS core variables.
- Class 2 station: ICOS Ecosystem or Atmosphere Station with a complete equipment setup for measuring ICOS core variables. Less variables are measured compared to the Class 1 station and ancillary data are determined less frequently.
- Associated station: The network of ecosystem sites in ICOS is enlarged with a set of Associated stations where the requirements in terms of variables collected and standards to follow are different from the Class 1 and Class 2 ICOS stations. Differently from Class 1 and Class 2 stations, already calculated fluxes and processed data at the final time resolution must be submitted (unless ICOS protocols are applied – see Ecosystem Thematic Center (ETC) services section).

2. Status of ICOS Sweden

Station certification

ICOS Sweden became, for most of the measurement systems, fully operational during 2014. In 2016, the station certification process procedures and the criteria for the different types of stations were specified by ICOS RI. In spring 2018, all three atmospheric stations (Svartberget, Norunda, Hyltemossa) were certified as Class 1 ICOS RI Atmosphere stations. Measurements and calibrations following the Atmosphere Thematic Centre's (ATC's) and the Central Calibration Facility's (CAL's) schedules are ongoing; data is transferred automatically to the ATC each night. The flask sampling system is operable at all sites. The last release by the ATC of finally calibrated and quality controlled data products (Level 2 data) including data from ICOS Sweden stations was in summer 2020 and included data until May 2020. These data as well as near real time data (Level 1 data) from the atmospheric stations are now available for users via access through the Carbon Portal¹.

The three forest Ecosystem stations Hyltemossa, Norunda and Svartberget achieved the ICOS RI label as Class 2 Ecosystem station. The mire site Degerö was certified by the ICOS RI general Assembly in November 2019. Measurements (manual for ancillary vegetation data and automatic data sampling) are ongoing following the instructions of the Ecosystem Thematic Centre (ETC), which are based on the elaborated protocols for Ecosystem station measurements² and data is automatically transferred to the ETC via the Carbon Portal each night. The ETC released Level 2 data including data from the ICOS Sweden forest stations until the end of 2019 in summer 2020. These data products are now available through the Carbon Portal.

- Östergarnsholm is expected to become certified by ICOS RI in autumn 2020.
- Abisko-Stordalen started with the labeling process but put the final steps on hold until the start of the coming funding period.
- The new stations, the Ecosystem Station Mycklemossen and the SOOP M/S Tavastland, have entered the first step of the certification process in 2020.

The status of all measurement stations in October 2020 is summarized in Fig. 2.

¹ <https://data.icos-cp.eu/portal>

² www.international-agrophysics.org/infopage/articles/y/2018/pub/1/issue/4

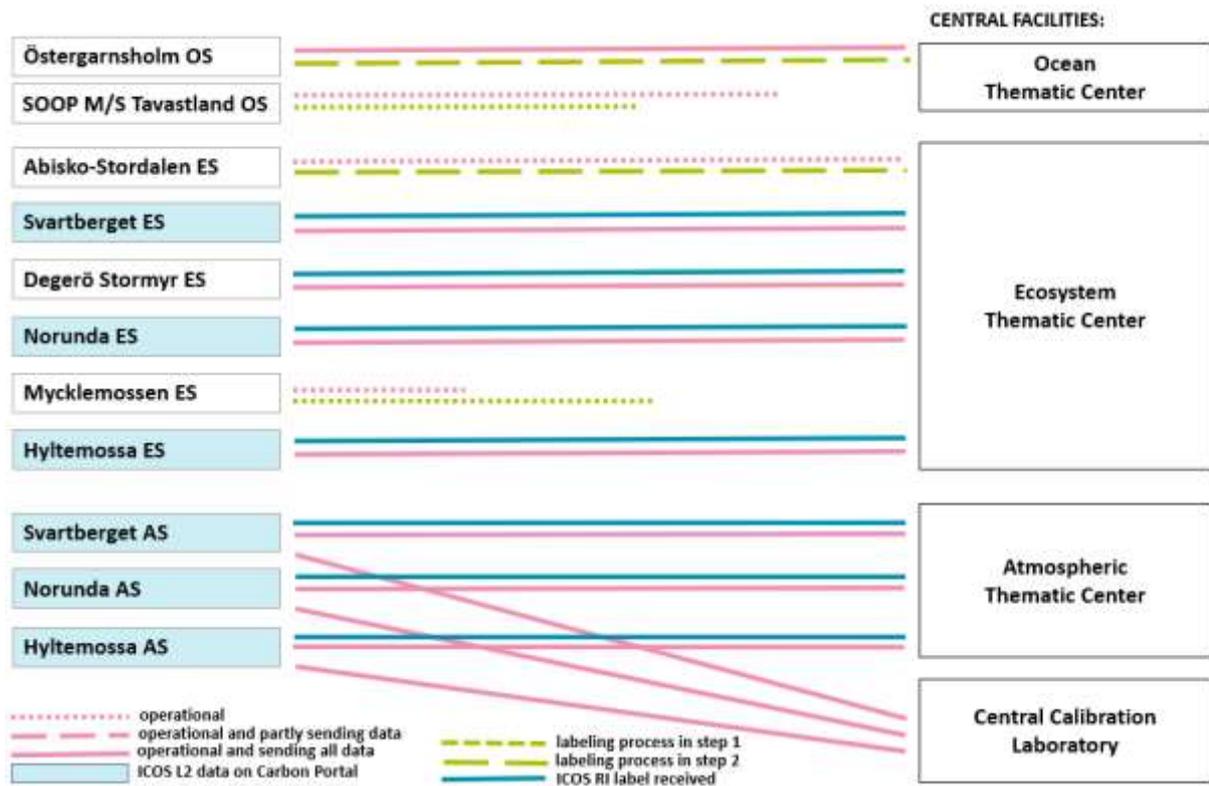


Figure 2. The development status for the delivery of data and information from the ICOS Sweden measurement stations to the ICOS Central Facilities (October 2020). Black lines – development status for data delivery. Colored lines – status ICOS labeling. AS – Atmosphere station, ES – Ecosystem station, OS – Ocean station.

ICOS Sweden data

Most data from the ICOS Sweden ecosystem network (start 2014, resp. 2015) has been available and searchable as ICOS Sweden data on the ICOS ERIC Carbon Portal. ICOS Sweden is continuously working on updating the files in the repository. The exact status of the data is summarized in Figure 3. Furthermore, ICOS Sweden contributed to the data collections for the analyses of the Drought 2018 and the Warm Winter 2019/20, resp. consequences of the shutdown due to the covid-19 pandemic. Data from these initiatives is (Drought 2018), resp. will be (Winter 2019/20-Covid19) available through the ICOS ERIC Carbon Portal.

Ecosystem station ICOS Sweden data (on Carbon Portal)

	Fluxes (annual files)	Meteo variables (annual files)	Gas and temperature profile variables (annual files)	Eco variables (annual files)	Metadata on instruments and variables
SE-Htm	2015-2020	2015-2020	2015-2020	2015-2020	On landing page at CP (variables and heights), resp on icos-sweden.se
SE-Lnn	2014-2017	Monthly until Aug 2017	--		
SE-Nor	2014-2018	Monthly: 2014+15, annual:2016-2019		Monthly 2014-2017	
SE-Deg	2014-2019	2014-2019	--	2014-2019	On landing page at CP (variables and heights), resp on icos-sweden.se
SE-Svb	2014-2020 (not: 2017)	2014-2019	2014-2020 (not: 2018)	2014-2019	On landing page at CP (variables and heights), resp on icos-sweden.se
SE-Sto	2016-2018	--	--	2014-2019	

Figure 3. Status of ICOS Sweden data products on the Carbon Portal on 2020-10-13.

3. Suggested activities during 2021

At the stations, fulfilling the commitments to ICOS RI is of highest priority.

During the coming year, the aim is to continue with the certification process for the remaining stations and if possible (e.g. Abisko-Stordalen) receive the ICOS label. This will also include to start, resp. to continue delivering data to ICOS RI in the ICOS operational mode. We will continue to provide ICOS Sweden Ecosystem station data as near real time data through the ICOS ERIC Carbon Portal. Adaptions of this near real time data to final ICOS data products will be done after publication of the Level 2 ICOS data.

According to the research plan of the ICOS Sweden proposal for 2021 to 2024, University of Gothenburg (UGOT) will decrease their ICOS activities at Lanna and instead introduce the mire Mycklemossen, at the SITES station Skogaryd, as an ICOS class 2 site. UGOT will continue to upgrade Mycklemossen to a full ICOS site. ICOS Sweden also aims to include measurements conducted by SMHI on board the SOOP M/S Tavastland, covering the Baltic Sea including the Gulf of Bothnia twice every week as Class 1 Ocean station. This will fill a gap in the existing observation network. Both stations will continue the certification process to get the stations actively contributing to ICOS RI as soon as possible.

The main emphasis of outreach activities in 2021 will again be on attracting scientific users to ICOS Sweden data and facilities. Main goal will be to show the usability of ICOS data for scientific questions. Among other options, this will be done by actively contributing to joint efforts by the ICOS community regarding current research questions. But also, by actively follow and contribute to the developments in larger European wide scientific monitoring proposals and projects (e.g. European Green Deal, Copernicus CoCO2). Collaboration with other research infrastructures will be extended and deepened to enlarge synthesis effects of sites. As in previous years, the deep involvement in education from school to higher education levels will continue as well as information to stakeholders and the general public.

3.1 Summary of activities

Below the activities are listed divided into 1) measurement stations, systems and data, 2) management of the organization, and 3) collaboration and outreach activities. Acronyms are explained in Appendix 4.

Measurements stations, systems and data:

- At the atmospheric stations, which all have received the ICOS label in spring 2018, the station teams will continue with the necessary tasks, defined in the ICOS RI protocols for atmospheric stations. These tasks include e.g. regular system tests (Fig. 4).
- The ecosystem stations that will have received the ICOS RI label by the end of 2019, will follow the strict schedule to fulfill all tasks defined in the ICOS RI protocols and instructions for ecosystem stations (Fig. 5). These tasks include above all regular vegetation sampling and the acquisition of hemispherical pictures for calculating green area index.
- The ocean station (Östergarnsholm) that will be certified by ICOS RI soon, will follow the schedule to fulfill all tasks defined in the ICOS RI protocols for ocean stations (Fig. 6). Furthermore, the station team will continue the discussion on the implementation of the land-based flux measurements into ICOS RI.
- The two new stations (Mycklemossen and SOOP M/S Tavastland) will go on in the labeling process during 2020.
- Connected to the tasks for stations that have been labeled or that are in the preparation to become labeled, ICOS Sweden will continue the automatic data delivery of data from the atmospheric stations to Atmospheric Thematic Centre (ATC), from Östergarnsholm to Ocean Thematic Centre (OTC) and from Hyltemossa, Norunda, Degerö and Svartberget to the Ecosystem Thematic Center (ETC).
- Also connected to the tasks, ICOS Sweden will continue the already upstarted manual data delivery of ancillary data from all ecosystem stations to the ETC.
- We will continue to follow up the sampling strategy for the automatic flask sampler at the central facilities.
- We will continue following the development and updates of ICOS ETC instructions for all type of measurements, continuous automatic as well as manual, and we will continue working on adapting our routines and make sure that they fulfill the ICOS requirements. The forest ecosystem stations will take part in an investigation by ETC aimed at the comparison of different methods to derive the Green Area Index (hemispherical photographs and measurements of below canopy photosynthetically active radiation).
- The staff will continue to participate in training on site routines and working practices as well as on the standardized measurement protocols and recommended data practices, arranged by ICOS RI and/or ICOS Sweden. The staff will also continue to follow up on health and security checks necessary for their working environment.
- The compilation of descriptions of all non-ICOS research activities that are ongoing inside the domains will be updated continuously and we will continue to provide service and support to projects at the stations if time allows.

- ICOS Sweden had taken over the management of a small research aircraft for GHG measurements in 2018. With start of the new funding period, ICOS Sweden no longer takes on the management and sponsorship of the aircraft's mandatory operating costs.
- The ICOS Sweden personnel will participate in workshops and other types of meetings organized by the ICOS RI Head Office and Thematic Centers if funding is available. The Station PIs will also participate in the ICOS RI Measurement Station Assembly meetings.
- Monitoring of the measurements and service, maintenance and update of systems as well as follow up of safety and rules at the stations will be continuously ongoing.
- ICOS Sweden data, which is not available from the ICOS ERIC Carbon Portal (CP) will be made available upon request. We will continue to upload ICOS Sweden ecosystem data for download from the Carbon Portal. Once, reliable Level 2 ICOS ecosystem data products are available through the CP, we will update the ICOS Sweden products to avoid different time series.

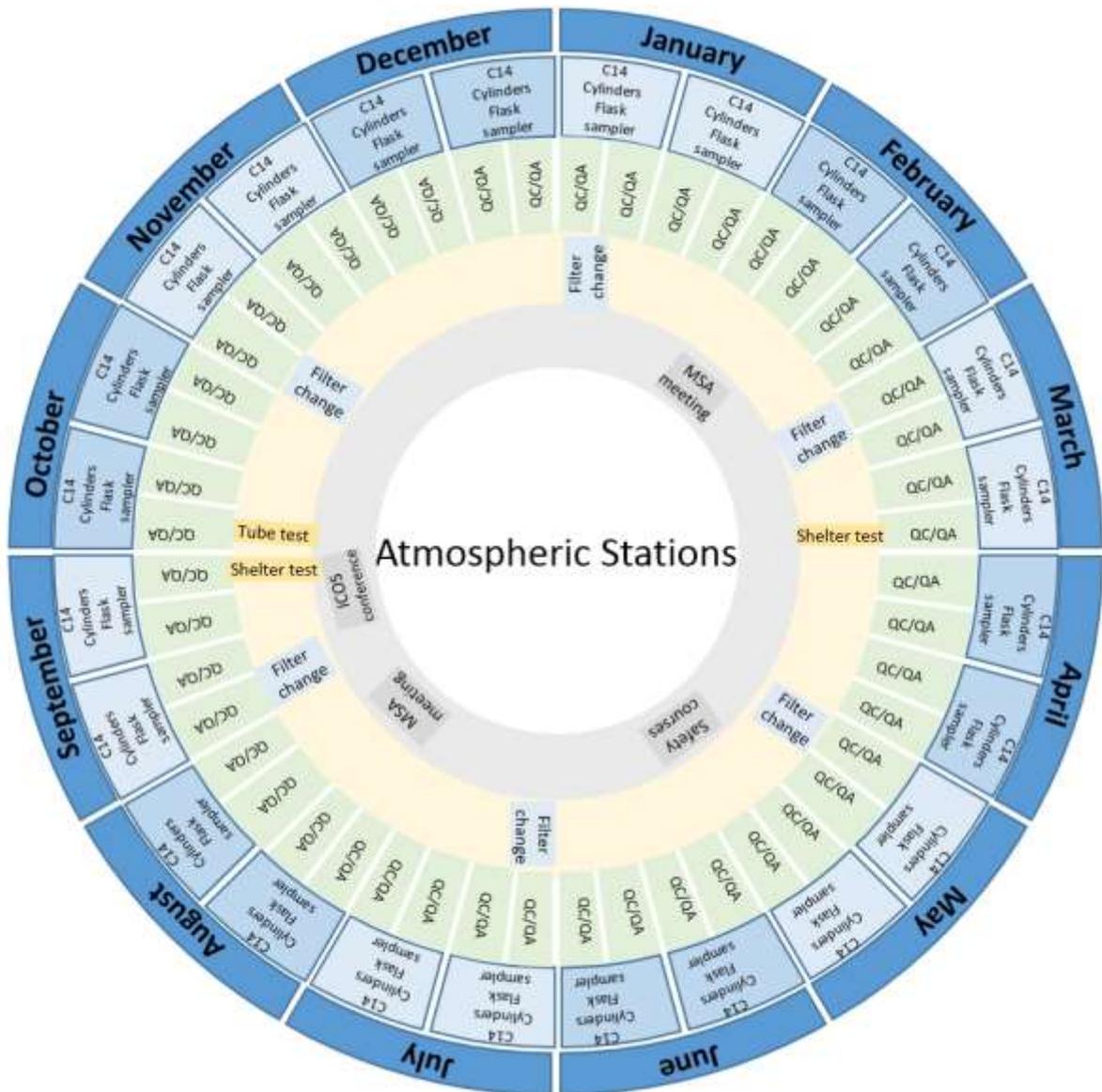


Figure 4: Tasks at the Atmospheric stations within ICOS RI/ICOS Sweden

Collaborations and outreach activities:

- ICOS Sweden will continue disseminating information and support education efforts through seminars, courses, field visits, media contacts, and through the ICOS Sweden homepage.
- ICOS Sweden will continue to adjust the possibilities for visiting scientists and field visits following the Swedish Government's and Public Health Authority's recommendations regarding measures to reduce the spread of the coronavirus (Covid-19).
- ICOS Sweden will continue to take initiatives on deepening the collaboration between ICOS Sweden and other Nordic infrastructures such as SITES, ACTRIS or NordSpec.
- We will continue to encourage applications from ICOS-external researchers aiming at setting up new projects at the stations.
- We will support and encourage scientists and stakeholders to make use of data measured at the ICOS Sweden stations.
- We will also continue to support ongoing activities at the sites.
- ICOS Sweden will take part in the Nordic ICOS Symposium organized by ICOS Finland in cooperation with the ICOS national networks in Sweden, Norway, and Denmark in autumn 2021.

4. Budget for 2021

The budget (tab. 1) is set up to meet the planned operations during 2021 is based on the budget adapted to the reduced funding and the agreement between partners that was also accepted by the research council. The difference is positive for all partners as costs increase over the years while incomes are evenly distributed over the years. The negative difference for Lund University is due to that the investments after the clear cut at Norunda Ecosystem Station are planned to occur in late 2021. Some of these investments may be delayed to 2022.

Table 1: Budget for ICOS Sweden 2021. Abbreviations: LU – Lund, SLU – Swedish University of Agricultural Sciences, University, GU – Gothenburg University, UU – Uppsala University, PFS – The Swedish Polar Research Secretariat, SMHI – The Swedish Meteorological and Hydrological Institute.

	LU	SLU	GU	UU	Polar	SMHI	Total
Incomes							
SRC	3 681	2 771	859	1 271	1 085	334	10 000
Co-funding	5 496	3 602	867	1 357	1 307	682	13 310
Total	9 177	6 372	1 726	2 628	2 392	1 015	23 310
Expences							
Salaries	3 590	2 967	592	705	925	377	9 156
Consumables	2 556	1 697	547	1 132	893	311	7 136
OH	1 611	1 022	274	653	378	282	4 220
Investments	1 969	492	139	53	139	38	2 830
Total	9 725	6 178	1 552	2 543	2 336	1 008	23 342
Difference	-548	194	174	85	56	8	-32

Appendix 1. The ICOS RI Organization

ICOS is a pan-European research infrastructure founded in 2008, which provides data on greenhouse gas concentrations. ICOS RI is part of the European environmental Research Infrastructure landscape. ICOS RI organization is founded in two pillars: research and measurement infrastructure and ICOS ERIC, a legal entity for ICOS data release, coordination, and integration of the whole system.

ICOS Research Infrastructure (Fig. 4) is coordinated and integrated by the ICOS European Research Infrastructure Consortium (ERIC). ICOS is one of 13 currently existing ERICs. The legal entity of ICOS European Research Infrastructure Consortium (ERIC) has held a Landmark status in the European Strategy Forum on Research Infrastructures (ESFRI) Roadmap since March 2016. The ESFRI Roadmap identifies new Research Infrastructures (RI) of pan-European interest corresponding to the long-term needs of the European research communities, covering all scientific areas, regardless of possible location.

ICOS Research Infrastructure receives funding from Member and Observer countries through annual membership contributions, and through host contributions towards specific facilities in ICOS RI. The station networks are funded by different national agencies.

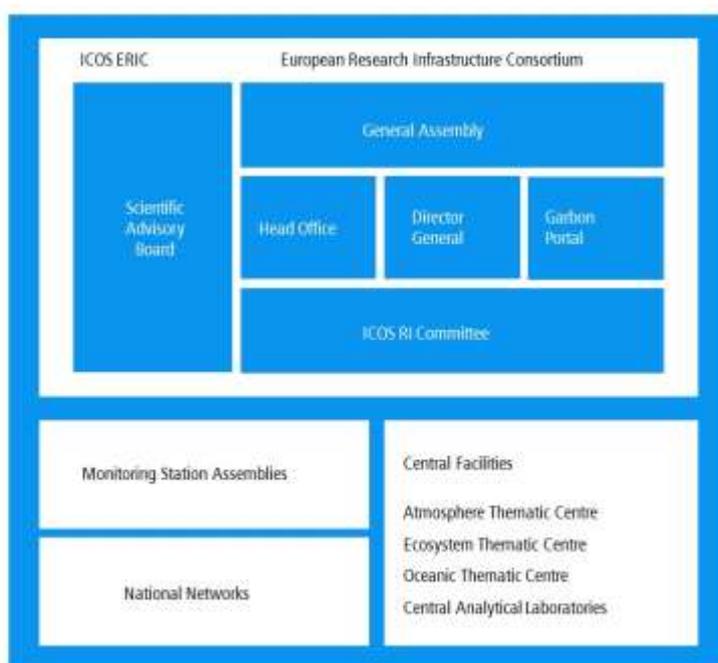


Figure 7. ICOS RI structure

ICOS National Networks form the backbone of ICOS RI

ICOS RI has more than 100 measurement stations in twelve European countries. These stations measure greenhouse gas concentrations in the atmosphere and fluxes over the terrestrial and marine

ecosystems. The ICOS stations are run and funded by national funding agencies, institutes, and universities, demonstrating an impressive joint effort to enable climate change research.

At the moment, ICOS Research Infrastructure includes more than 100 stations in 14 European countries. The current ICOS Atmosphere and Ecosystem Networks include more than 30 atmospheric and around 70 ecosystem stations located across Europe. The ICOS Ocean Network covers the North Atlantic and European marginal seas. The Ocean Observation System will consist of more than 20 facilities: Voluntary Observatory Ships, fixed stations and research vessels.

Monitoring Station Assemblies

Monitoring Station Assemblies (MSAs) for the Atmosphere, Ecosystem and Ocean Station Networks consist of Station Principal Investigators (PIs) of the ICOS National Networks. The MSAs monitor, develop and improve the scientific and technical basis of the ICOS RI. The MSAs usually meet twice a year and they work closely with the ICOS Central Facilities.

ICOS Central Facilities coordinate the data from Station Networks

Measurements on the greenhouse gases concentrations in each atmospheric, ecosystem and ocean station within the ICOS Station Network is transferred to and centralized in the ICOS Atmosphere, Ecosystem and Ocean Thematic Centers (ATC, ETC and OTC), which are coordinated by the ICOS Central Facilities (CFs). The CFs and the ICOS Central Analytical Laboratories (also coordinated by the CFs), ensure that highly standardized and coordinated data is maintained and respected. The CFs ensure that all data are treated and quality controlled with the same algorithms and properly archived for the long term.

ICOS ERIC coordinates ICOS RI

ICOS RI is coordinated by the legal entity of ICOS ERIC (European Research Infrastructure Consortium). ICOS ERIC was established by the decision of the European Commission on 23 November 2015, with the statutory seat in Finland. The principal task of ICOS ERIC is to coordinate the operations of ICOS RI, distribute information from ICOS RI to user communities and to provide integrated data and analysis from greenhouse gas observation systems.

ICOS Eric Head Office

ICOS ERIC Head Office, located in Helsinki, Finland, manages the legal entity of ICOS ERIC. The Head Office promotes network extension to new countries in cooperation with the ICOS Central Facilities and Focal Points of the ICOS National Networks. ICOS ERIC Head Office supports the scientific and technological developments in ICOS RI and facilitates the outreach, training, and mobility of participants.

General Assembly

The General Assembly is the governing and decision-making body of ICOS ERIC. It is composed of representatives of the Member and Observer countries of ICOS ERIC. Jean-Marie Flaud from the French Ministry of Higher Education, Research and Innovation is the current Chair of the ICOS ERIC General Assembly.

Director General

The Director General, appointed by the General Assembly, is the legal representative of ICOS ERIC. The Director General carries out the day-to-day management of ICOS ERIC and is responsible for the implementation of the decisions by the General Assembly, as well as overseeing and coordinating the activities of ICOS RI. Werner Kutsch is the current Director General of ICOS ERIC.

ICOS RI Committee

The ICOS Research Infrastructure Committee (ICOS RI Committee) is a key advisory body in ICOS RI that supports the Director General in all matters relevant to the coordination and management of ICOS RI. ICOS RI Committee consists of representatives from the Head Office, Carbon Portal, each ICOS Central Facility and each Monitoring Station Assembly. The Director General chairs the committee.

Scientific Advisory Board monitors the scientific quality of ICOS RI

The ICOS Scientific Advisory Board (SAB) monitors the scientific quality of ICOS RI, gives feedback on and makes recommendations for the development of ICOS RI activities, and advises ICOS ERIC with the objective of achieving the scientific goals of ICOS RI. It also provides programmatic support by commenting on the overall science plans and directions, and analyses the output of ICOS RI.

Carbon Portal – the home for ICOS Data Products in ICOS RI

The ICOS Carbon Portal, an operative unit of ICOS ERIC, offers free access to ICOS RI data on greenhouse gases observations from the ICOS Station Networks, as well as easily accessible and understandable science and education products. The system design for the Carbon Portal management, databases, web services, and elaborated products is carried out by the system architect in a dialogue with both internal and external scientists. Dedicated researchers from all over the world will contribute to the elaborated products catalogue.

Appendix 2: The ICOS Sweden Organization

The ICOS Sweden management consists of a Steering Committee, a Scientific Advisory Committee, and a management group and has been operational since the beginning of the funding period 2016 to 2020. The management group is led by the Coordinating Director and includes the Science Director, the Station PIs and the Scientific Experts. During 2016, a Scientific and Technical Station Support Module as well as a Communication Officer have been added to the Coordination office. The support module is a resource for the stations and the costs for the module are shared between the partners. Updates to this structure may be possible as consequence of the Lund University investigation on the future of the ICOS Sweden structure (Fig. 5). Below, the different bodies and their duties are described according to their role until the end of 2020.

The ICOS Sweden Steering Committee

The present ICOS Sweden Board members are appointed until the end of 2020, where after the Lund University Vice-Chancellor will appoint new members selected in agreement with the Swedish Research Council and the Consortium Partners. The present members are Hannele Hakola, (Chair; Finnish Meteorological Institute), Matthias Lundblad (SLU Uppsala), Lars Tranvik (Uppsala University), Marko Scholze (Lund University), and Anke Thoss (Swedish Meteorological and Hydrological Institute). The Steering Committee is responsible for overall strategic and financial monitoring and shall promote development, operation, and management. The Steering Committee has also to decide on the focus and objectives for the collaboration between the different partner organizations that constitute ICOS Sweden. The Steering Committee meets the Scientific Advisory Committee (SAC) annually to discuss strategic issues.

The Scientific Advisory Committee (SAC)

The members of the Scientific Advisory Board are Inez Fung (University of California, Berkeley, USA), Yiqi Luo (Northern Arizona University, Flagstaff, USA), Monique Leclerc (University of Georgia, Georgia, USA) and Peter Rayner (University of Melbourne, Australia). The SAC contributes with scientific advice, establishes external links, and acts as ambassadors in general. SAC participates in the annual workshop and, in conjunction to the workshop, meets the Board to discuss strategic issues.

Coordination Office (CO)

The ICOS Sweden Coordination Office is hosted by Lund University. It consists of a Coordinating Director (Maj-Lena Linderson), a Science Director (Janne Rinne), a scientific secretary (Jutta Holst) and the personnel of the scientific and technical expertise module. This module includes two part time personnel (Meelis Mölder and Jutta Holst). The Coordinating Director decides on all day-to-day scientific, technical, and administrative issues of the research infrastructure. The Coordinating Director also serves as Sweden's national Focal Point to ICOS RI. The Science Director promotes external collaborations and research activities and assists the Coordinating Director in scientific and strategic planning. The CO supervises the activities at the stations and acts as an intermediary between the Board and the rest of the organization. The CO assists the Board in organizing meetings, taking minutes and compiling documents for progress follow up, revisions, and endorsements. Furthermore, the CO coordinates the renewal of applications and agreements as well as the internal communication and common information and outreach activities. The scientific and technical support module delivers

support on instrumentation and computer systems, and on data storage and delivery. The modules are resources for the stations and the costs are shared between the partners.

Consortium partners, Station Principal Investigators (SPIs) and scientific experts (SEs)

A Station Principal Investigator (SPI) is appointed for each of the operative ICOS Sweden stations. Responsibilities, tasks, and duties for the SPIs include organizing and managing the activities at their respective measurement station and to be responsible for the data quality checks in conjunction to the data submission to the Thematic Centers. The SPIs participate in the ICOS RI MSAs as representatives of ICOS Sweden and are part of a Station Coordination Group (SCG). The SPIs also promote outreach activities specific for their site e.g. courses and field visits. Each partner also provides ICOS Sweden with a scientific expert (SE) that act as a contact person between the respective partner and the CO. These experts participate in Management Team meetings in order to be well acquainted with the activities of ICOS Sweden, contribute to application writing, scientific meetings, and to other matters of strategic importance for development of the infrastructure. A partner may appoint the SPI of the measurement station to be its SE. The list of SPIs includes Mats B. Nilsson (Degerö), Matthias Peichl (Svartberget ES), Paul Smith (Svartberget AS), Anna Rutgersson (Östergarnsholm), Anna Willstrand Wranne (SOOP Tavastland), Meelis Mölder (Norunda), Per Weslien (Mycklemossen), Michal Heliasz (Hyltemossa), and Janne Rinne (Abisko-Stordalen). In October 2020, the SPIs are presently the same persons as the SEs, except for at Gothenburg University (Mycklemossen) for which Leif Klemedtsson is the SE and for Lund University (Norunda and Hyltemossa) for which Janne Rinne and Natascha Kljun act as SEs.

The Management Team

In October 2020, the management Team is made up of the Station Principal Investigators (SPIs) and the scientific experts (SE), as representatives for their respective measurement station and consortium partner. The team coordinates the activities at the different sites, resolves various technical and practical issues, and is a forum for discussions on the management and development of the research infrastructure. The team has regular phone/internet meetings that are complemented by occasional site visits, when needed. They also contribute to applications and reporting, including the strategic development of ICOS Sweden, and act as intermediary between their respective partner and the CO.

Users' Group

In the early stage of the buildup of ICOS Sweden, the plan was to set up a Users' Group and a Stakeholder's group. The Users' Group should promote contacts with members of the scientific user community, who are tentatively interested in using research sites and measurement data of the national RI. The Stakeholders' Group aimed at promoting contact with representatives of authorities and organizations that are potentially interested in using the synthesized data products of ICOS RI. Because ICOS RI is not yet fully operational, and ICOS Sweden's activities are just starting, it was decided to join the two contact groups into one single user group open to stakeholders as well as site and data users.

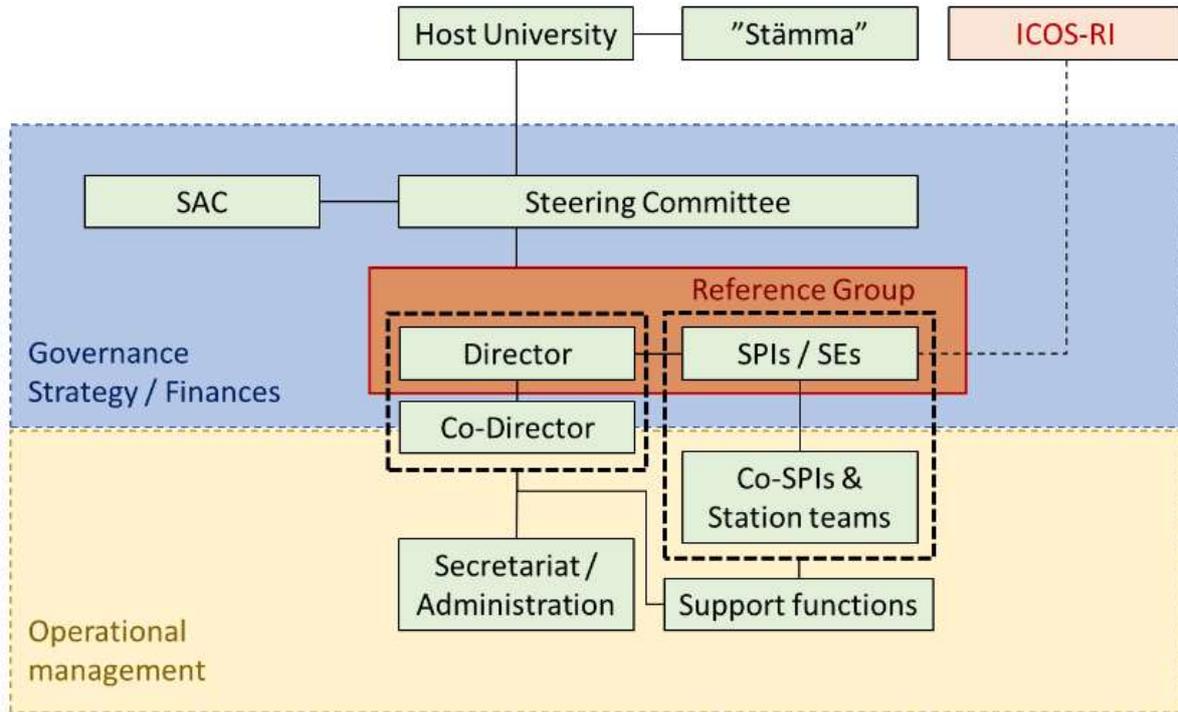


Figure 8. The proposed organizational structure of ICOS Sweden from 2021 onwards.

Appendix 3: The measurement stations

ICOS Sweden operates, up to the end of 2020, ten measurement stations in total, of which six are ecosystem stations and three are atmospheric stations and one is an ocean station (Fig. 6). The three atmospheric stations are co-located with three of the ecosystem stations. For the coming funding period, measurements onboard the SOOP M/S Tavastland, operated by SMHI, will be included as ICOS Sweden station.

The locations of the measurement stations have been chosen with the main aim to cover typical Swedish conditions, while at the same time considering a broader Nordic context as well as the European perspective. The stations are run by the consortium partners Lund University, University of Gothenburg, Swedish University of Agricultural Sciences, Uppsala University, Swedish Meteorological and Hydrological Institute, and The Swedish Polar Research Secretariat. Each partner has employer's liability for the personnel at its station(s) and is represented by a Station Principal Investigators (SPI) in the Management Team of ICOS Sweden and in the ICOS RI Measurement Station Assembly (MSA) (see App. 2).



Figure 9. Location of the ICOS Sweden measurement stations including the ICOS Ocean measurements onboard the SOOP M/S Tavastland.

Abisko-Stordalen ecosystem station

The Stordalen subarctic wetland, consisting of a fen/palsa/lake complex, is of large interest to many researchers and there are a number of ongoing activities there including flux measurements by different groups. The wetland area is located very close to the 0°C isotherm and represents a very dynamic part of the sub-arctic region. The station is operated by The Swedish Polar Research Secretariat at the Abisko Scientific research Station. Personnel resources will during 2021 correspond to 1.2 FTE involving the research engineers Niklas Rakos, Alexander Meire, Erik Lundin and Meelis Mölder (LU). Station PI will be Janne Rinne, Lund University.

Degerö ecosystem station

The Degerö station is situated on a minerogenic oligotrophic boreal mire covering 6.5 km² in the Kulbäcksliden research park at Vindeln Experimental Forests, located in a cold temperate humid climate. The station is run by Swedish University of Agricultural Sciences as part of their commitment as a partner of ICOS Sweden. Personnel resources correspond to 1.25 FTE involving the research engineer Giuseppe De Simon, Per Marklund, Pernilla Löfvenius and the Station PI Mats B. Nilsson.

Svartberget combined ecosystem and atmospheric station

The Svartberget site is located in a mixed boreal pine/spruce forest within the Vindeln Research Forests which are situated in Vindeln, 60 km west of Umeå in the Province of Västerbotten. The station is operated by Swedish University of Agricultural Sciences, a consortium partner of ICOS Sweden. Personnel resources correspond to 2.25 FTEs involving the research engineers Paul Smith, who also is PI for the atmosphere station, Pernilla Löfvenius, Giuseppe De Simon, and the ecosystem Station PI Matthias Peichl.

Norunda combined ecosystem and atmospheric station

Norunda is located in a mixed boreal pine/spruce forest about 30 km north of Uppsala. The station is the oldest flux site in Sweden, established in 1994, with an existing infrastructure in terms of tower, electricity, buildings etc. The station is operated by Lund University, being a partner in ICOS Sweden. Personnel resources correspond to 2.15 FTEs involving the research engineers Anders Båth and Irene Lehner, as well as the Station PI Meelis Mölder.

Östergarnsholm marine station

The site Östergarnsholm is located at the small very flat island Östergarnsholm situated 4 km east of Gotland in the Baltic Sea. The island is very flat and for selected wind sectors, well representing open sea, marine conditions. Measurements include air-sea flux of carbon dioxide, water vapor, surface friction, as well as CO₂, SST and oxygen in the water. The exchange of CO₂, H₂O and energy between the sea and the atmosphere is measured by an eddy covariance system, which is additional to the standard OTM station measurements. Both, water-based measurements and land-based ecosystem measurements will be processed by OTC. The site has been running since 1995 and will be included as an ICOS Sweden station in 1 January 2015. The station is run by Uppsala university and personnel resources involved in the station include research engineer Leonie Esters and the Station PI Anna Rutgersson. Hans Bergström, Erik Sahlée and Erik Nilsson are also involved in the station operational work.

Mycklemossen ecosystem station (planned to be fully included after 2020)

Skogaryd mire is situated in a part of the country with high levels of nitrogen deposition. Instruments have been installed on the Mycklemossen mire at Skogaryd to measure biogeochemical/physiological mire ecosystems in relation to global changes, process modelling, remote sensing, soil atmosphere, stream water chemistry and atmospheric exchanges. These measurements enable determination of the net ecosystem carbon balance, which is unique in mire ecosystems. The station is operated by University of Gothenburg, a partner in ICOS Sweden. In the current phase, the personnel resources are covered by the research infrastructure project SITES.

Hyltemossa combined ecosystem and atmospheric station

The Hyltemossa site is located in southernmost Sweden, in a young temperate spruce forest around 30 years old. The station is operated by Lund University, as part of its commitment as a partner of ICOS Sweden. Personnel resources correspond to 2.15 FTEs involving the research engineers Michal Heliasz, who is also the Station PI, and Tobias Biermann and Thomas Holst.

SOOP M/S Tavastland ocean station

SMHI and the Finnish Environmental Institute, SYKE, installed a ferrybox on the M/S Tavastland VOS in 2009. The ferrybox measures salinity, temperature, oxygen, chlorophyll fluorescence, phycocyanin fluorescence and CDOM-fluorescence. Furthermore, pCO₂ has been monitored. There are two automated water samplers that can be used to collect reference samples. M/S Tavastland transports mainly paper from Paper Mills near Kemi, in the very north of Finland, to Travemunde in Germany. This route back and forth takes about a week. The station PI is Anna Willstrand Wranne, who also runs the station as research engineer together with Kristin Andreasson.

Appendix 4: List of abbreviations and acronyms

ICOS RI (European level)

ATC – Atmospheric Thematic Center

AS – Atmosphere station

CAL – Central Analytical Laboratory

CF – Central facilities (ETC, ATC, OTC and CAL)

CP – Carbon Portal

ES – Ecosystem station

ETC – Ecosystem Thematic Center

ERIC – European Research Infrastructure Consortium

ESFRI - European Strategy Forum on Research Infrastructures

HO – Head office

ICOS RI – Integrated Carbon Observation System Research Infrastructure

ICOS PP – ICOS Planning Project (sometimes also Preparatory Phase)

ISIC – ICOS Stakeholder Interim Council

OS – Ocean station

OTC – Oceanic Thematic Center

SOOP – Ship of Opportunity

ICOS Sweden

CO – ICOS Sweden's Coordination Office

SAC – ICOS Sweden's Scientific Advisory Committee

SCG – ICOS Sweden's Station Coordination Group

SPI – ICOS Sweden Station Principal Investigator

ICOS Sweden partners

LU – Lund University

GU – Gothenburg University

SU – Stockholm University

SLU – Swedish University of Agricultural Sciences

PFS – The Swedish Polar Research Secretariat

Other infrastructures and organizations

ACTRIS - Aerosols, Clouds, and Trace gases Research Infrastructure network (<http://www.actris.net>)

ANAEE – Analysis and Experimentation on Ecosystems (www.anaee.com)

GMES - Global Monitoring for Environment and Security (now called Copernicus, <http://www.copernicus.eu>)

DEFROST – A Nordic Centre of Excellence with the aim to understand how climate change induced changes in the cryosphere influence the ecosystem/geosphere processes which directly affect climate (<http://www.ncoe-defrost.org>)

INTERACT – International Network for Research and Monitoring in the Arctic (<http://www.eu-interact.org>)

NORDFROST - A Nordic researcher network supporting the study of greenhouse gas and energy exchange in sub-arctic and arctic ecosystems (<http://www.nateko.lu.se/nordfrost>)

WCRP – World Climate Research Programme (<http://www.wcrp-climate.org>)

SITES – Swedish Infrastructure for Ecosystem Research (<http://www.fieldsites.se/>)

Other

CWG – contract working group

GHG – greenhouse gas

SMHI – Swedish Meteorological and Hydrological Institute

SRC – Swedish Research Council (in Swedish VR – Vetenskapsrådet)

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