ICOS SWEDEN Annual Report 2016

ICOS National Network Sweden

Lunds Universitet

Göteborgs Universitet

Stockholms universitet

SLU

Polarforskningssekretariatet
Swedish Polar Research Secretariat

Vetenskapsrådet

The Board of ICOS Sweden endorsed this Annual Report 2016 on 31 March 2017. The report is complemented by other documents from ICOS Sweden, including the Operational Plan for 2016, and the and Strategic plan 2016-2020.

Contents

Summary 1

1. Introduction to ICOS Sweden 2

2. Status of ICOS Sweden at the end of 2016 2

3. Building up and management of the measurement stations and systems 6

3.1 The measurement stations 7

3.1.1 Abisko-Stordalen ecosystem station 7

3.1.2 Degerö ecosystem station 8

3.1.3 Svartberget combined ecosystem and atmospheric station 8

3.1.4 Norunda combined ecosystem and atmospheric station 9

3.1.5 Östergarnsholm ocean station 10

3.1.6 Lanna ecosystem station 11

3.1.7 Hyltemossa combined ecosystem and atmospheric station 11

3.2 Development phase of the measurement stations and systems 12

3.2.1 Actions taken 2016 12

4. Building up and management of the ICOS Sweden organization 13

4.1 The ICOS Sweden Organization 13

4.1.1 The ICOS Sweden Board 14

4.1.2 The Scientific Advisory Committee (SAC) 14

4.1.3 Coordination Office (CO) 14

4.1.4 Consortium partners, partner Scientific Experts (SE) and Station Principal Investigators (SPIs) 14

4.1.5 Station Coordination Group (SCG) 15

4.1.6 Users' Groups 15

4.2 Development phase of the organization and its management 15

4.2.1 Actions taken 2016 16

5. Comments on economy and the deviation from the budget for 2016 16

6. Key numbers 18

Appendices I

Appendix 1: List of personnel during 2016 II

Appendix 2: List of measurement variables and instruments/systems IV

Appendix 3: List of abbreviations and acronyms VI

Summary

ICOS - Integrated Carbon Observation System - is a new European research infrastructure for quantifying and understanding the greenhouse gas balance of the European continent and of adjacent regions. The aim of ICOS is to construct, equip, and operate a network of standardized, long-term, high precision integrated monitoring stations for atmospheric greenhouse gas concentrations and fluxes. The infrastructure is built up as a collaboration of over 100 nationally operated measurement stations in eleven European countries. ICOS Sweden is the Swedish contribution to this European effort.

ICOS Sweden started its build up in mid-2010, funded by the Swedish Research Council and the ICOS Sweden consortium partners. ICOS Sweden operates, until the reporting date, ten measurement stations in total, of which six are ecosystem stations and three are atmospheric stations and one is an ocean station. The building up of the organization and management as well as of the measurement stations and systems is almost finalized. ICOS Sweden was, for most of the measurement systems, fully operational already in early 2016. During they year, we have been working on getting ICOS Sweden labelled and on adapting to the ICOS RI requirements. We have started submitting data from all our stations using the database structure from the Carbon Portal. This will include all ICOS Sweden data since start of the operational phase.

The decision from SRC on the application for the present funding period arrived on 17 December 2015 with a substantially reduced budget and a financing period of five years. Adaptation to the new budget and negotiations with the consortium partners took place in early 2016 and the new organization and funding period started in April. The long term strategy was renewed and the consortium agreement was revised. The main outreach activities during 2016 were focused on the annual workshop and the production of information material. The workshop 2016 took place in Abisko and focused on the effects of climatic changes in the subarctic - boreal intersection.

The key number follow up shows that there is an overall increasing trend of research interest within this topic with 182 scientific publications, whereof 40 peer-reviewed publications, where data from ICOS Sweden is used. 52 national and 17 international projects are ongoing at the sites. Number of data users in total is 288 and course participants visiting the sites slightly under 400.

1. Introduction to ICOS Sweden

ICOS - Integrated Carbon Observation System - is a new 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 over 100 nationally operated measurement stations in eleven 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.

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.

ICOS Sweden will be fully integrated with and play an important role in the pan-European ICOS (ICOS RI). ICOS Sweden will also provide data, and 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.

A description of ICOS RI status and progress can be found at the website http://www.ICOS-infrastructure.eu/. A list of ICOS Sweden personnel can be found in Appendix 1. In Appendix 2, the measurement variables and instruments/systems used in ICOS Sweden are listed. Appendix 3 contains a list of the acronyms and abbreviations mentioned in the report.

2. Status of ICOS Sweden at the end of 2016

The building up of the organization and management as well as of the measurement stations and systems is almost finalized. ICOS Sweden was, for most of the measurement systems, fully operational already in early 2016 and has, over the year, been working on adapting to the ICOS RI requirements. The buildup of the ICOS Sweden organization and its functions is finished except for the full implementation of the User's Group.

The installation and deployment of equipment and control systems at the ecosystem stations are finalized. The atmospheric systems are fully operational for most parts. The flask sampling systems are ordered and will be delivered in early 2017. The ocean station has installed power and some complementary instrumentation. All stations have entered the labelling process and we have started to deliver data from our stations to the central facilities. Figure 1 illustrates the development status of the ICOS Sweden measurement stations when it comes to delivery of data and information to the Central Facilities.

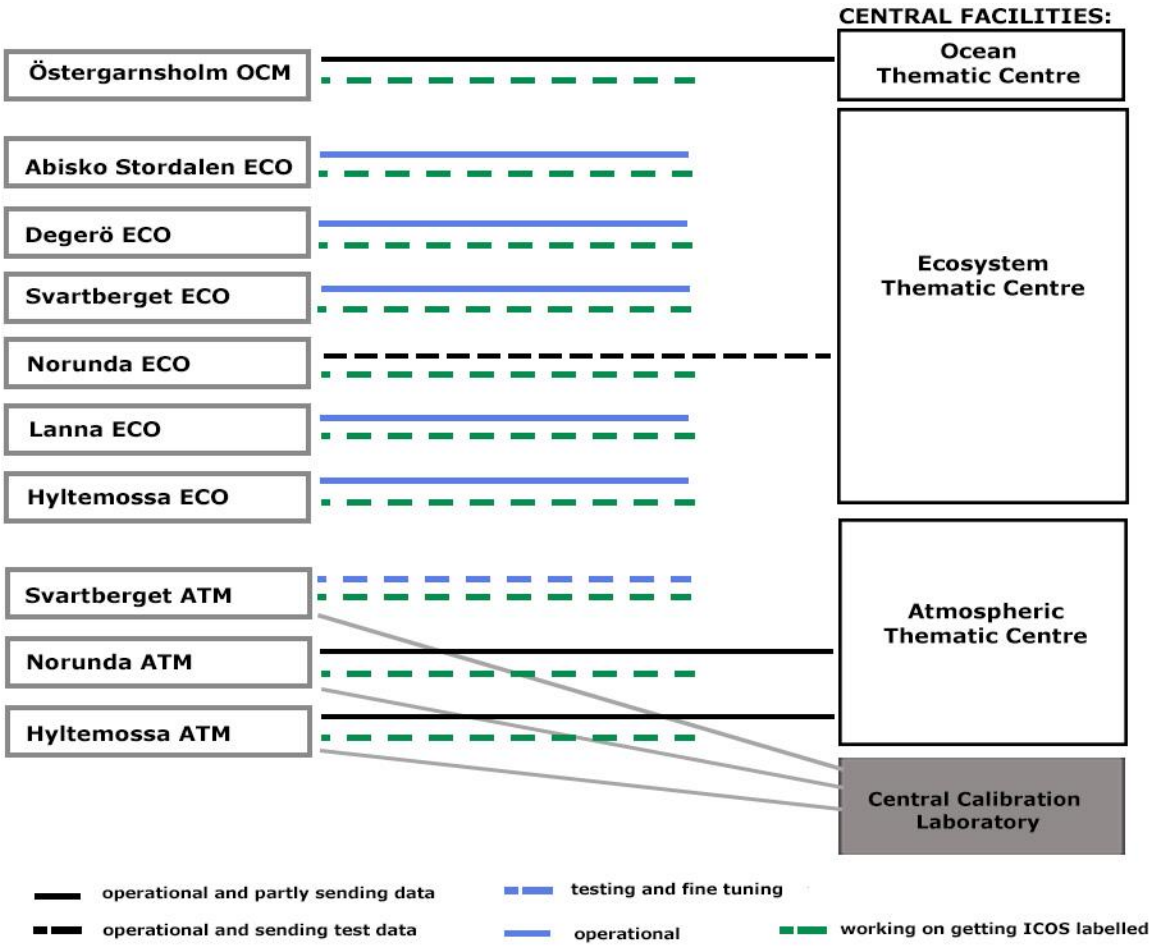

Figure 1. *The development status for the delivery of data and information to the Central Facilities from the ICOS Sweden measurement stations. Upper lines at all stations – development status for data delivery. Lower green lines – status on getting ICOS labelled.*

The activities for ICOS Sweden during 2016 are related to milestones (Table 1) in order to identify actions needed and to reveal the progress of the infrastructure. Compared to what was planned in the Operational plan for 2016, the following milestones have not been reached:

- Some of the instrument installations at the ecosystem and atmospheric stations are still not finalized due to delay of the decisions at the ICOS RI level.
- The measurement protocols are still not completely finalized at ICOS RI level and thus the routines at the sites are not fully adapted.
- The startup of the User's group has been postponed.
- Our stations have not yet become ICOS labelled stations but are in the labelling process.

Table 1. *ICOS Sweden milestones for the building up and management of the research infrastructure. Dotted lines mark the years when the milestone is active. The pink color shows start year and the blue color identifies the year when the milestone is finalized. In-between years are marked with yellow color. Table continues on the next page.*

				PHASE	2010	2011	2012	2013	2014	2015	2016
1.				**Initiation phase**							
	1.1.			***Building up of ICOS Sweden organization:***	====	========	========	========	========	========	========
		1.1.1.		*Establishing the ICOS Sweden management structure*	-----	----------	----------	----------	----------	----------	----------
			1.1.1.1.	Establishing the Coordination Office	-----						
			1.1.1.2.	Appointing the Board		----------					
			1.1.1.3.	Establishing the ICOS Sweden consortium and verifying the measurement stations	-----	----------					
			1.1.1.4.	Establishing the Station Coordination Group		----------					
			1.1.1.5.	Appointing the SAC			----------				
			1.1.1.6	Establishing the User Group				----------	----------	----------	----------
			1.1.1.7.	Establishing links to ICOS RI	-----	----------	----------	----------	----------		
		1.1.2.		*Development of the strategy and planning*	-----	----------	----------				
			1.1.2.1.	Strategic plan development and formalizing the operational plans	-----	----------	----------				
		1.1.3.		*Formalizing the reporting and dissemination*	-----	----------	----------				
			1.1.3.1.	Formalizing the annual reporting incl key numbers and economic outcomes		----------	----------				
			1.1.3.2.	Creating an outreach strategy	-----	----------					
	1.2.			***Building up of the field sites and measurement systems:***	====	========	========	========	========	========	========
		1.2.1.		*Building masts and labs*	-----	----------	----------	----------	----------		
		1.2.2.		*Employing staff and appointing Station Pis*	-----	----------	----------	----------	----------		
		1.2.3.		*Installing the instrumentation at the sites: ecosystem, atmospheric and ocean measurement systems*	-----	----------	----------	----------	----------	----------	----------
		1.2.4.		*Forming the routines at the measurement stations*	-----	----------	----------	----------	----------	----------	----------
			1.2.4.1.	Routines for the measurements and measurement protocols						----------	----------
			1.2.4.2.	Safety and rules at the stations	-----	----------	----------	----------	----------	----------	----------
			1.2.4.3.	Routines for access to stations and identification of the ICOS domain			----------	----------	----------	----------	----------
2.				**Testing phase**							
	2.1.			***Follow up of measurement routines and fine tuning***				========	========	========	========
		2.1.1.		*Ecosystem measurement data*				----------	----------	----------	----------
		2.1.2.		*Atmospheric measurement data*					----------	----------	----------
		2.1.3.		*Ocean measurement data*						----------	----------
	2.2.			***Startup sending data to the thematic centres***						----------	----------
		2.2.1.		*Ecosystem measurement data*						----------	----------
		2.2.2.		*Atmospheric measurement data*						----------	----------
		2.2.3.		*Ocean measurement data*						----------	----------
	2.3.			***Becoming ICOS labelled stations***							========
		2.3.1.		*Ecosystem sites*							----------
		2.3.2.		*Atmospheric sites*							----------
		2.3.3.		*Ocean sites*							----------

Table 1 (continued). *ICOS Sweden milestones. Continued from previous page.*

				PHASE	2010	2011	2012	2013	2014	2015	2016
3.				**Operational phase**							
	3.1.			***Management of the organisation***		========	========	========	========	========	========
		3.1.1.		*Reoccuring revision of the strategy and planning*				----------	----------	----------	----------
			3.1.1.1.	Production and revision of steering documents		----------	----------	----------	----------	----------	----------
			3.1.1.2.	Board revision and endorsements		----------	----------	----------	----------	----------	----------
			3.1.1.3.	SAC supevision and advice				----------	----------	----------	----------
		3.1.2.		*Evaluation and reporting*			----------	----------	----------	----------	----------
			3.1.2.1.	Biannual follow up of key numbers					----------	----------	----------
			3.1.2.2.	Annual reporting			----------	----------	----------	----------	----------
			3.1.2.3.	SRC evaluations and renewed applications			----------			----------	
		3.1.3.		*Conduction of outreach activities and dissemination*			----------	----------	----------	----------	----------
			3.1.3.1.	Annual workshop				----------	----------	----------	----------
			3.1.3.2.	Seminars, homepage, media activities		----------	----------	----------	----------	----------	----------
			3.1.3.3.	External courses and field visits		----------	----------	----------	----------	----------	----------
			3.1.3.4.	User group interaction							----------
			3.1.3.5.	Dissemination - reports and papers							
		3.1.4.		*Consortium agreement revision and renewal*			----------		----------		----------
		3.1.5.		*Cooperation activities*			----------	----------	----------	----------	----------
			3.1.5.1.	ICOS RI MSA meetings, workshops and conferences					----------	----------	----------
			3.1.5.2.	Cooperation with other projects			----------	----------	----------	----------	----------
		3.1.6.		*SCG management meetings*		----------	----------	----------	----------	----------	----------
	3.2.			***Management of sites, systems and measurements***		========	========	========	========	========	========
		3.2.1.		*Monitoring measurements at the sites*					----------	----------	----------
		3.2.2.		*Service, maintenance and update of systems*					----------	----------	----------
		3.2.3.		*Revision of work routines and protocols*						----------	----------
		3.2.4.		*Follow up of safety and rules at the stations*						----------	----------
		3.2.5.		*Storing and long-time archiving of data and metadata*							----------
		3.2.6.		*Delivery of data to CFs including quality verification*							
		3.2.7.		*Staff education and development*		----------	----------	----------	----------	----------	----------
			3.2.7.1.	*Staff participation in external and internal courses*		----------	----------	----------	----------	----------	----------
			3.2.7.2.	*Staff internal information and knowledge exchange*		----------	----------	----------	----------	----------	----------
		3.2.8.		*Service to ancillary project and data users*					----------	----------	----------

3. Building up and management of the measurement stations and systems

ICOS Sweden operates, until the reporting date, ten measurement stations in total, of which six are ecosystem stations and three are atmospheric stations and one is an ocean station (Fig. 2). The three atmospheric stations are co-located with three of the ecosystem stations.

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, Stockholm University, 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 Investigator (SPI) in the Station Coordination Group (SCG) of ICOS Sweden and in the ICOS RI Measurement Station Assembly (MSA) (see Chap. 4.1).

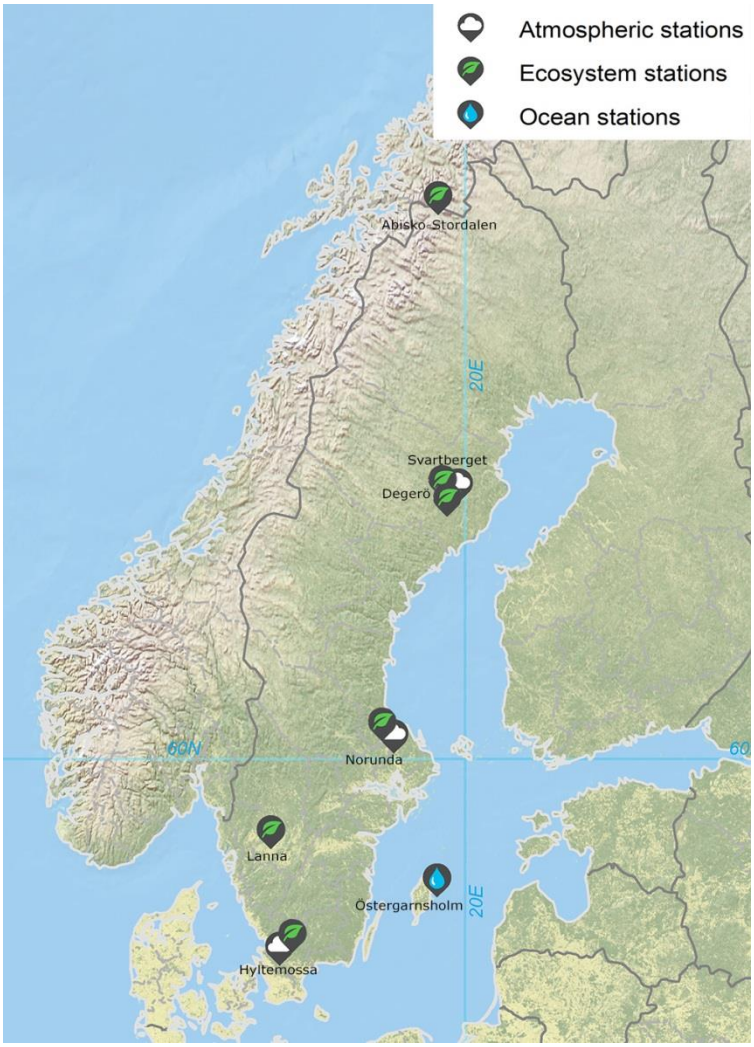

***Figure 2**. Location of the ICOS Sweden measurement stations.*

With the goal of optimization of resource usage, common collaborations between ICOS Sweden and other (infrastructure) projects have been started up. These are:

ACTRIS – a European Research Infrastructure for the observation of aerosols, clouds, and trace gases. Measurements at Hyltemossa and Norunda will replace measurements at Vavihill, resp. Aspvreten.

SITES – a nationally co-ordinated infrastructure for terrestrial and limnological field research. Abisko-Stordalen and Svartberget are located within the area of the SITES field research stations Abisko and Svartberget.

NordSpec – an infrastructure for collecting spectral data for ecosystem monitoring. The spectral measurements are conducted year-round using robust equipment in order to capture seasonal signals from vegetation. ICOS Sweden sites included in the network are Hyltemossa, Norunda, Degerö and Abisko-Stordalen.

NCoE DEFROST - Gathered internationally recognized experts with the goal of understanding how changes in the cryosphere caused by climate change influence the ecosystem/geosphere processes, which directly affect climate. ICOS Sweden site included in the Research Initiative was Abisko-Stordalen. DEFROST ended in 2016.

3.1 The measurement stations

Below, the measurement stations are described, followed by a summarized description of the progress during 2016 and a list of actions taken during this time. Personnel employed at the stations are listed in Appendix 1.

3.1.1 Abisko-Stordalen ecosystem station

The Stordalen subarctic wetland, consists of a fen/palsa/lake complex. The site is a protected natural wetland (unmanaged) which for the last 30 years has served as study area for a large number of national and international researchers as well as a favorite location for field courses and students. The location in Stordalen is well suited for studies of climate change effects in the Arctic and sub-Arctic region because a mean annual temperature of 0°C in the Abisko region makes the permafrost and associated ecosystems highly responsive to any changes in temperatures. Being the northernmost of all ICOS ecosystem stations, it represents an extreme site both within ICOS and Europe.

The station is operated by the Swedish Polar Research Secretariat at the Abisko Scientific Research Station, station PIs are Thomas Friborg and Patrick Crill. The station has been operational since spring 2013.

Especially during summer season, a large number of researchers are using Stordalen for field experiments, and ICOS has provided data and logistic assistance to four national and five international projects in the past year. Courses and excursions have visited the site during longer or shorter periods in 2016. As in previous years, groups from local gymnasiums as well as Umeå and Lund Universities visited the site. In late summer 2016, Abisko hosted the 4th annual ICOS Sweden Workshop meeting at Abisko Research station with visits to Stordalen.

The vegetation period, measured as the time of net CO_2 uptake is short at the station and lasted from doy 150 to doy 250 (Fig. 3).

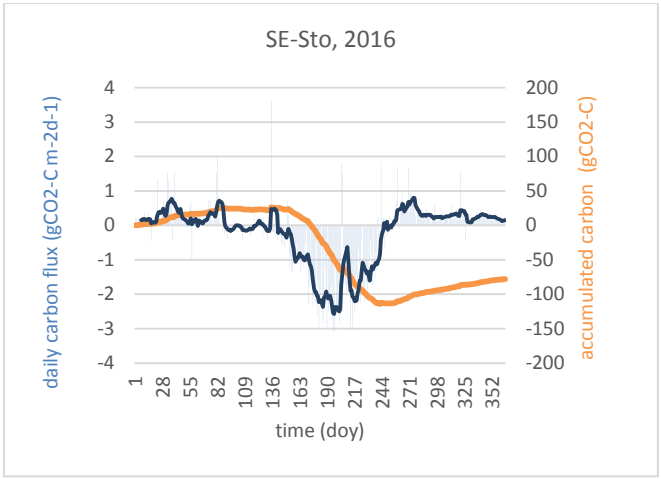

Figure 3. *Daily totals and annual cumulated sum of net CO_2 exchange at Abisko-Stordalen in 2016.*

3.1.2 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. The site is located in a cold temperate humid climate. The station is run by the Swedish University of Agricultural Sciences in their role as a consortium partner of ICOS Sweden. The station is operated by SLU, Umeå; station PI is Mats Nilsson.

There is a constant interest from researchers all over the world in data from Degerö resulting in numerous scientific publications. Each year, since the beginning of CO2 flux measurements in 2001, Degerö Stormyr has been a sink for carbon dioxide, taking up between 70 and 110 gCO_2-C per year (Fig. 4)

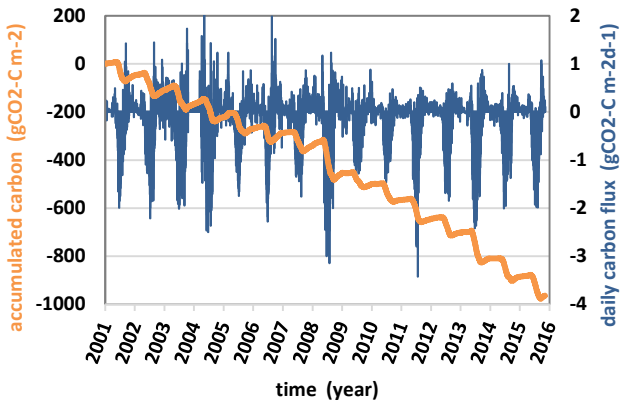

Figure 4. *Accumulated carbon dioxide and daily net CO_2 exchange at Degerö Stormyr.*

3.1.3 Svartberget combined ecosystem and atmospheric station

ICOS-Svartberget is located in the Svartberget Experimental Forest, Vindeln. It is run by SLU, Umeå; station PI is Mikaell Ottosson Löfvenius. The experimental forest covers 1076 hectares of boreal forest land and governs a manifold of research activities since 1923. A reference monitoring program of climate and water is active since 1980. ICOS-Svartberget site is situated on a moraine slope covered mainly by Scots pine (60%) and Norway spruce (40%), in the center of a

well-investigated sub-catchment with long-term hydrological measurement. The sub-catchment is part of the larger Krycklan catchment area. A wide range of ancillary data is available at ICOS-Svartberget and invites to collaborative research in field.

The forest is about 110 years old with a mean height around 20 m. Some cleaning was done in 1962, otherwise the stand is undisturbed except for unavoidable influences by installation of research infrastructures and instrument. The ICOS ecosystem instrumentation was in place during 2013, most of the measurements started in June 2013.

With -162 gCO_2-C (Fig. 5), the annual CO_2 uptake at Svartberget was relatively small compared to previous year (2015: -202 gCO_2-C).

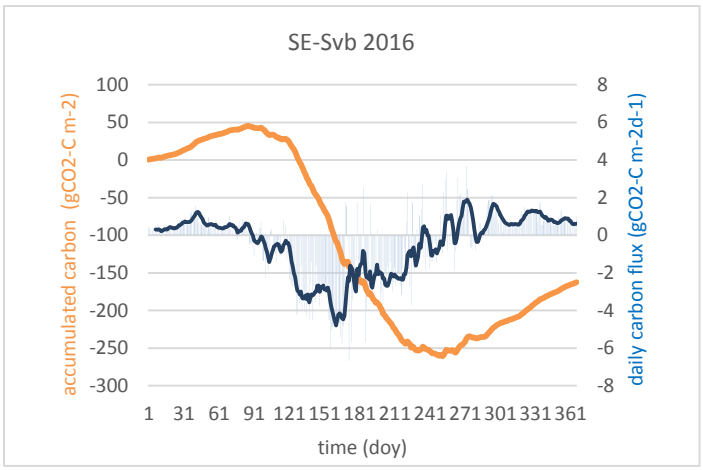

Figure 5. *Daily totals and annual cumulated sum of net CO_2 exchange at Svartberget in 2016.*

3.1.4 Norunda combined ecosystem and atmospheric station

The Norunda station is located in a mixed boreal pine/spruce forest, about 30 km north of Uppsala. The mean air temperature is 5.6°C and the mean annual precipitation sums up to 544 mm (data period 1961-1990, SMHI station Uppsala). Southwest is the prevailing wind direction. The station is operated by Lund University, as part of its commitments as a partner of ICOS Sweden; the Station PI is Meelis Mölder.

The station is the oldest flux site in Sweden, established in 1994. Parts of the forest are older than 110 years. In 2021, the area ca 500 m around the main tower will be turned into a clear cut. The ICOS Sweden equipment at the station is operational since 2013. Core measurements for the atmospheric system (GHG concentrations) are operational since 2015.

As in previous years, also in 2016, the Norunda forest was a source for CO_2 caused by high respiration rates (Fig.6).

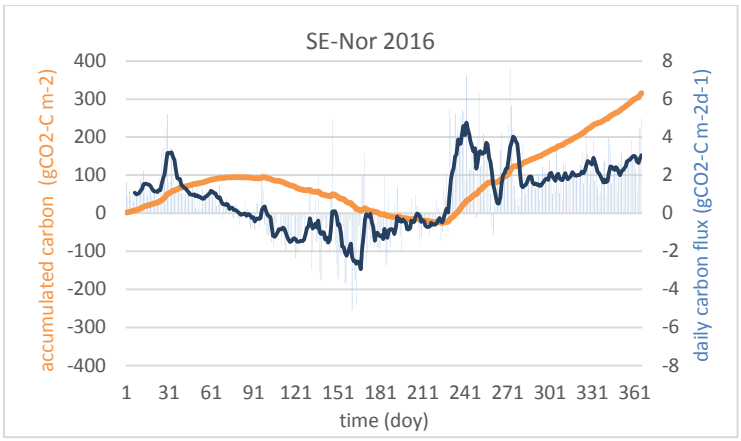

Figure 6. *Daily totals and annual cumulated sum of net CO_2 exchange at Norunda in 2016.*

3.1.5 Östergarnsholm ocean station

The Östergarnholm ocean station is located in the Baltic Sea, about 4 km east of Gotland. The measuring site at Östergarnsholm has been running since 1995 by Uppsala University, station PI is Anna Rutgersson. It is a land-based 30 m tower situated on the southern tip of a very small, flat island. In addition to the tower measurements several buoys in the water continuously measure temperature, pCO_2 salinity and oxygen.

The cold water in spring and summer gives dominantly stable atmospheric stratification during April to July. Despite low winter temperatures, the sea surrounding Östergarnsholm has ice free conditions throughout the year. Higher rates of cyclonic activity in winter result generally in higher wind speeds in winter than in summer.

The carbon cycle represented by the Östergarnsholm site shows a strong seasonal variation with marine carbon uptake from April to October, and emissions from November to March (Fig. 7).

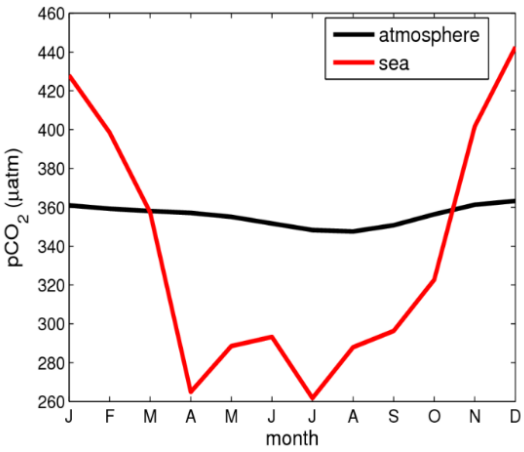

Figure 7. *Modelled monthly pCO_2 concentrations at Östergarnsholm in the atmosphere and the sea.*

3.1.6 Lanna ecosystem station

Lanna is the most northern agricultural sites within ICOS-Europe (58°20.43'N 13°6.14'E) operated by GU (station PI Per Weslien) and is located on the SLU research station which has been in operation since 1929. ICOS Lanna is thus operated in close cooperation with SLU. Part of this collaboration was the event "Lanna day", where research facilities at Lanna from SLU and ICOS Sweden were open for the general public. Approx. 100 people used the possibility to have a look at the installations and to get insight into climate research.

The station is set on clay soil and representative for the most dominate cereal production in Sweden. The 1961-1990 average annual precipitation at the site was 560 mm and annual temperature 6.1°C.

As agricultural site, N_2O plays an important role in the annual GHG budget. The measured flux is mostly influenced by fertilization (Fig. 8).

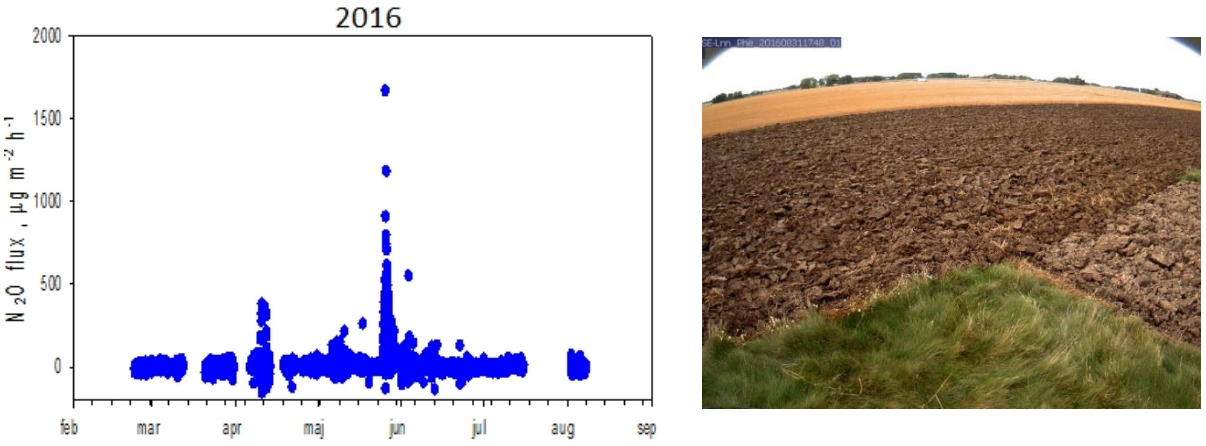

Figure 8. *Half-hourly N_2O flux at Lanna from February to August 2016*.

3.1.7 Hyltemossa combined ecosystem and atmospheric station

Hyltemossa is a combined ecosystem and atmospheric station located in Skåne, southern Sweden, operated by Lund University and station PI Michal Heliasz. The site is placed in a temperate, maritime climate with monthly average temperatures for January around 0°C and 20°C for July. Annual average temperature is around 8°C. Spring months are the driest while summer months are the wettest with total annual precipitation of around 800 mm.

The ICOS activities are centered on a 150 m tall tower. The site around the tower is dominated by Norway spruce (Picea abies) with a small fraction of birch trees (Betula sp.) and single occurrence of Scots pine (Pinus sylvestris). Understory vegetation is sparse. The forest floor is mainly covered by mosses.

The forest is owned and managed by Gustafsborg Säteri AB (www.gustafsborg.se). The management turnover rate is 50 years, with an estimated growth of 34 m within 100 years. After clear cut, the site was replanted in 1983 with 3300 trees per hectare. At the present time the forest stand is 19 m tall and holds around 190 m^3 per hectare (excluding branches, stumps and roots).

The ICOS site was established in 2014 and started high quality ecosystem measurements in January 2015 (Fig. 9).

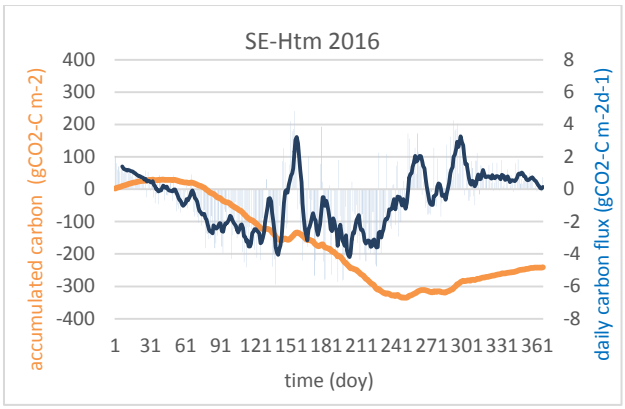

***Figure 9**. Daily totals and annual cumulated sum of net CO_2 exchange at Hyltemossa in 2016.*

3.2 Development phase of the measurement stations and systems

The buildup of measurement stations and systems was finalized at the end of 2015 and ICOS Sweden has, for most of the measurements systems, been fully operational since then.

During 2016, we have been working on getting ICOS labelled. The atmospheric stations have furthermore been working on the remaining installations and the testing and quality control of these. We have contributed to the revision of instructions that will be the base for the labelling process and are continuously adapting our routines and stations to these.

Delivery of test data from the Norunda ecosystem station to the ETC has been ongoing since 2015 and we have started submitting from all our stations using the database structure from the Carbon Portal. The aim is to provide easy access to non-ICOS labelled data from the ICOS Sweden infrastructure to potential users. This will include all ICOS Sweden data since start of the operational phase. Following the ICOS RI data provision rules, the continuous submission of ICOS labelled data may start after the labelling process has been finalized.

In 2015, we planned to invest in LIDARs (laser based distance measurements of boundary layer height) for the atmospheric sites. These LIDARs would enable expansion of the systems in order to suite other projects including aerosol measurements. Due to the reduced funding, the investment plan was discarded. In late 2016, the ATC requirement for boundary layer height measurement was further postponed. We however still found it valuable to have the possibility to serve possible station users and collaboration projects with instrumentation to measure BLH and cloud base, and still considered to invest in less costly ceilometers.

At the Ocean station, the new power system and some complementary instruments was installed and the water sampling program continued. There is a continuous dialogue with OTC of labelling of marine flux stations, but there is not yet any final agreement. All previous data for CO2, water temperature and salinity in the water (from 2005 to 2016) is being delivered to the SOCAT database with an ICOS label.

3.2.1 Actions taken 2016

Numbers within [] indicate milestones, as defined in Table 1.

- All stations entered step one of the labelling process that is the formal application and station construction phase and mainly concerns the registration and evaluation of the suitability of the station. Most of the stations entered step 2, a test period that shall facilitate the station compliance to the defined protocols for measurements, before the end of the year [2.3, 3.2.3]

- The wind sensors of the profile systems have been installed and the atmospheric installations of the gas concentration measurements were finalized and integrated with the 3-level profile concentration measurements at the three ATM sites. Quality control and the test phase is still ongoing at the Svartberget station. [1.2.3, 2.1.2]
- Because the recommendation from ICOS ATC on which type of instrument to be used has been postponed without date for decision, the LIDAR systems planned to be purchased and installed at the atmospheric sites was discarded. A possible solution is to instead install Ceilometers. Decision will be taken in early 2017. The automatic flask samplers are under production at MPG and are ordered. They will be delivered during early 2017. [1.2.3]
- We planned for the purchase of spare instruments as the budget for the new five-year period does not include any investments. This has started and will be finalized in early 2017. [1.2.3]
- At the Östergarnsholm station, the water sampling program was continued. A new power system was installed (solar, wind and generator) in November 2016. During summer, a new distrometer for precipitation measurements was also installed. [1.2.3]
- ETC has summarized the measurement protocol contents into so called instructions that will be the base for the evaluation of the stations in the labelling process. We have provided thorough input to these instructions. We have also started to adjust our procedures in order to fulfil the ICOS requirements. [1.2.4, 3.2.2]
- The staff has participated 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. [3.2.7]
- The ICOS Sweden personnel have participated in workshops and other types of meetings organized by the ICOS RI Head Office and Thematic Centers. The Station PIs have participated in the ICOS RI Measurement Station Assembly meetings. [3.2.7]
- The work on documenting the “ICOS domain” for all sites continued based on the footprint analysis. Routines for registration and agreement documents for non-ICOS research activities was further developed. [1.2.4]
- The compilation of descriptions of all non-ICOS research activities that are ongoing inside the domains have been continuously updated and we have provided service and support to projects at the stations. [1.2.4, 3.2.8]
- We have decided on system for data archiving, set up routines for archiving, and started implementing them. [3.2.5]
- Monitoring of the measurements and service, maintenance and update of systems as well as follow up of safety and rules at the stations have been continuously ongoing [3.2.1, 3.2.2, 3.2.4]
- Until the ICOS RI Carbon Portal is operational, we have continued to make data available upon request. We have started the delivery of data through the ICOS Carbon Portal. The aim is to deliver data from all stations from 2014 and on. Since 2014, continuous data from Norunda, with its metadata, has been submitted as an evaluation data set for ETC to standardize its procedures. [2.2.1, 3.2.8]

4. Building up and management of the ICOS Sweden organization

4.1 The ICOS Sweden Organization

During the last six years, the ICOS Sweden management structure has been built up and now consists of a Board and Scientific Advisory Committee, a Coordination Office and Director, the consortium partners and a Station Coordination group. Below, the different bodies and their

duties are described, followed by a summarized description of the progress up to the end of 2015 and a list of actions taken during the year.

4.1.1 The ICOS Sweden Board

The ICOS Sweden Board members are Sanna Sorvari (Chair; Finnish Meteorological Institute (FMI), Marianne Lilliesköld (Swedish Environmental Protection Agency), Joakim Langner (Swedish Meteorological and Hydrological Institute SMHI), Gunilla Svensson (Stockholm University) Benjamin Smith (Lund University), and Hans Winsa (Sveaskog). The Board is responsible for the overall strategic and financial monitoring and shall promote development, operation and management. The Board has also to decide on the focus and objectives for the collaboration between the different partner organizations that constitute ICOS Sweden. The Board meets the Scientific Advisory Committee (SAC) at the annual workshop to discuss strategic issues.

4.1.2 The Scientific Advisory Committee (SAC)

The members of the Scientific Advisory Board are Professor Beverly Law (Oregon State University, USA), Professor Monique Leclerc (University of Georgia, Georgia, USA), Professor Ernst-Detlef Schulze (Max Planck Institute for Biogeochemistry, Jena, Germany) and John Moncrieff (University of Edinburgh, Edinburgh, UK). John Moncrieff became a new member during 2015. 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.

4.1.3 Coordination Office (CO)

The ICOS Sweden Coordination Office is hosted by Lund University. CO consisted, in the end of 2016, of a Director (Maj-Lena Linderson), an Assistant Director (Janne Rinne) and a Communication Officer (Susanna Olsson). Furthermore, the CO includes the function for scientific and technical station support (Meelis Mölder, Jutta Holst and Björn Eriksson). The Director decides on all day-to-day scientific, technical, and administrative issues of the research infrastructure and is responsible for implementing the decisions of the Board. The Director also serves as Sweden's national Focal Point to ICOS RI. The Assistant Director promotes external collaborations and is active in initiating and promoting strategic research activities for the infrastructure and assists the Director in scientific and strategic planning. The overall tasks of the CO are to supervise 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 function for scientific and technical station support deliver support on instrumentation and computer systems, and on data storage and delivery. The support is a common resource for the stations and the costs are shared between the partners.

4.1.4 Consortium partners, partner Scientific Experts (SE) and Station Principal Investigators (SPIs)

A SPI has been appointed for each station. 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 the SCG. The SPIs also promote outreach activities specific for their site e.g. courses and field visits. The SPI has delegation for her/his work from the consortium partner responsible for the station. An SPI may also be Scientific Expert of the partner running the measurement station in question. The Scientific Experts act as a contact person between the respective partner and the Directors and are part of the SCG. The Scientific Expert promotes the research use of the

measurement stations and data at their respective partner organization and engages in how to make ICOS Sweden known and used within Sweden following the Strategic Plan. They contribute to application writings and to other matters of strategic importance for development of the infrastructure. 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. The list of SPIs includes Thomas Friborg and Patrick Crill (Abisko-Stordalen), Mats B. Nilsson (Degerö), Mikaell Ottosson Löfvenius (Svartberget), Meelis Mölder (Norunda), Anna Rutgersson (Östergarnsholm), Per Weslien (Lanna), and Michal Heliasz (Hyltemossa). SEs are Patrick Crill (SU), Mats B. Nilsson and Mikaell Ottosson Löfvenius (SLU), Anna Rutgersson (UU), Leif Klemedtsson (GU), and Janne Rinne (LU).

4.1.5 Station Coordination Group (SCG)

The Station Coordination Group is made up of the SPIs, the SEs, as representatives for their respective stations and consortium partner, the Data Manager and the Directors, and is headed by the ICOS Sweden Director. The group coordinates the activities at the different sites and resolves various technical and practical issues and is a forum for discussions on the management and development of the research infrastructure. The SCG has regular phone/internet meetings, which are complemented by occasional site visits, when needed.

4.1.6 Users' Groups

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. Guy Schurgers, University of Copenhagen is appointed as chair with the aim of leading the work with identifying and enrolling members to the group and further defining its objectives and work procedures. To start with, the enrollment will be concentrated on scientific users of the data and of the sites. The stakeholder community will be approached once ICOS Sweden is operational and there are data products to display to illustrate the usefulness of the data.

4.2 Development phase of the organization and its management

The decision from SRC on the application for the present funding period arrived on 17 December 2015 with a substantially reduced budget and a financing period of five years. Adaptation to the new budget and negotiations with the consortium partners took place in early 2016 and the new organization and funding period started in April. The long term strategy was renewed and the consortium agreement was revised. During the year, the former Director retired and the mandate for the Board ended, which lead to new appointments. Due to the difficult financial situation for the Abisko-Stordalen station, the organization has put a lot of effort into finding a possibility to continue with the station. The main outreach activities during 2016 were focused on the annual workshop and the production of information material. The work with enrolling members to the User's Group and to further define its objectives and work procedures has not yet started due to the intensive work on adapting to the new funding situation. This will be a task for the coming year.

4.2.1 Actions taken 2016

Numbers within [] indicate milestones, as defined in Table 1.

- The coordination office has participating in the development of new agreements with SRC and a revised consortium agreement. [3.1.1.]
- The agreements introduce some changes in the organization such as the host organization responsibilities and the Board delegation. We have adapted the organization accordingly.
- The Board delegation ends in the end of 2016 and some of the members were replaced. [3.1.2, 3.1.4]
- Polars involvement in ICOS Sweden and the Abisko-Stordalen station was at risk being excluded after 2016 due to budget restrictions. Extra funding from remaing assets from the first funding period were set off to support the station during 2017 to allow for some time and the CO has continuously worked on finding alternative solutions. [3.1.4, 3.1.5]
- The Board endorsed the annual reporting and operational plan. The Board and the SAC contributed to the revision of the strategic plan that was submitted to SRC as required in the funding agreement. [3.1.1,3.1.2]
- The work on establishing the User's Group was postponed till next year. [1.1.1, 3.1.3]
- We arranged monthly internal information meetings via internet as well as field visits to stations. We also arranged face-to-face SCG meetings. [3.1.6, 3.2.7]
- Anders Lindroth retired as Director of ICOS Sweden in November and Maj-Lena Linderson was appointed to new Director. The leadership will be divided into an operational and a scientific appointment with corresponding responsibilities. [3.1]
- ICOS Sweden has continued disseminating information and support education efforts though seminars, courses, field visits, media contacts, and through the ICOS Sweden homepage. [3.1.3]
- We have developed information material like folders, posters, a roll-up, t-shirts, calendars and station catalogues. [3.1.1, 3.1.3]
- We arranged the annual ICOS Sweden workshop in Abisko. The Advisory Committee and Board was invited and had a strategy meeting in connection to the workshop. [3.1.3]
- As a start of a collaboration between ICOS Sweden and other the other Nordic ICOS infrastructures, we have decided on a common workshop in 2017. We have also participated in the Research Infrastructure Network for Nordic Atmospheric and Earth System Science Nordic ENVRI. [3.1.5]
- ICOS Sweden has, through Carbon Portal contacts, collaborated with ENVRI+ and EUDAT regarding data management. [3.1.5]
- We have continued to encourage applications from ICOS-external researchers aiming at setting up new projects at the stations and to support already ongoing activities. [3.2.8]

5. Comments on economy and the deviation from the budget for 2016

A summary of the financial outcomes for 2016 for all sites and the common equipment investments are given in Table 2 below. It should be noted that this is a liquidity budget, using incomes and expenses and no depreciation costs, which means that the difference between the total incomes and total expenses represent the amounts available. The accumulated assets correspond to the accumulated amount available since 2010, following the contributions by SRC and the partners in the consortium agreement.

Table 2. *Financial outcomes 2016 for each partner and in total (kSEK). For acronyms, see Appendix 3.*

Incomes	**LU**	**SLU**	**GU**	**UU**	**Polar**	**SU**	**Total**
SRC funding Jan-March	1,220	642	270	350	343	0	2,825
SRC funding April-Dec	2,486	1,422	728	1,050	528	45	6,259
Other funding	374	214	109	0	79	7	783
Co-financing	4,694	3,330	1,252	1,387	1,430	210	12,303
Reseved for equipment	7,400	900					8,300
Total	**16,174**	**6,508**	**2,359**	**2,787**	**2,380**	**262**	**30,470**
Costs							
Salaries	4,226	2,269	762	1,310	892	121	9,580
Consumables	1,150	783	476	530	255	23	3,217
OH	1,646	1,073	337	810	401	89	4,356
Equipment and investments	3,007	150	133	0	0	0	3,290
Shared cost for support module	255	799	93	64	93	0	1,304
Total	**10,284**	**5,074**	**1,801**	**2,714**	**1,641**	**233**	**21,747**
Difference	**5,890**	**1,434**	**503**	**48**	**707**	**29**	**8,611**

The preliminary outcome for 2016 follows well the budgets for each partner except for the less than expected infrastructure investments. The delay is due to late decisions on the requirements by the Central Facilities in ICOS RI, and that the production of some of the items has been delayed (e.g. the flask sampler produced by MPG Jena). These were purchased in early 2017. The running costs for the stations were slightly lower than expected. This due to that the stations are not yet running as labelled stations with the corresponding duties and full costs that we estimated in early 2016.

6. Key numbers

ICOS Sweden has identified a list of key numbers that should be reported annually and used to evaluate the performance and usefulness of the infrastructure (Table 3). The key numbers are explained in the table or described in the following text. Targets for the key numbers have not yet been established.

Table 3. *Key numbers for evaluation of the ICOS Sweden infrastructure (updated 2017-03-27).*

Key No	Performance	Key number description
1.	85	Percentage of uptime of measurements for key variables such as fluxes and concentrations flagged with the highest quality.
2.	90	Percentage of uptime of backup meteorological variables to be used for gap filling.
3.	52	Number of national research projects at the different sites.
4.	17	Number of international research projects (projects with a foreign PI) at the different sites.
5.	Not compiled	Volume (amount of funding) of research projects.
6.	288	Number of users of ICOS Sweden data.
7.	Not applicable	Volume of data retrieval of ICOS data products (provided by ICOS Carbon Portal) from ICOS Sweden sites.
8.	40	Number of peer review publications (in preparation and/or published) where data from ICOS Sweden sites are used.
9.	Not applicable	Number of citations for all peer review publications where data from ICOS Sweden sites are used.
10.	182	Number of other scientific publications where data from ICOS Sweden are used.
11.	0	Number of popular science publications related to ICOS Sweden/non-scientific visitors to ICOS Sweden sites.
12.	86	Number of appearances in public media.
13.	8 / 361	Number of undergraduate courses and number of participants.
14.	1 / 18	Number of graduate courses and number of participants.
15.	27	Number of course days at the different sites.
16.	4	Number of undergraduate theses using data or sites.
17.	9	Number of graduate theses using data or sites.
18.	3	Number of meetings/conferences/workshops organized by ICOS Sweden.
19.	See text	No of stakeholders.
20.	See text	Impact on society and industry.

Number of non-scientific visitors to the sites: approx. 280

Key number 1 and 2, the percentages of uptime of measurements of key variables and backup meteorological variables are important measures connected to data accessibility and each key variable should be presented separately. These are illustrated in Figure 11.

Key number 7, volume of data retrieval of ICOS RI data products (provided by ICOS Carbon Portal) from ICOS Sweden sites, is not applicable this year as the Carbon Portal has not yet started delivering data.

Key number 9 and 10 concerns ICOS labelled data delivered through the Carbon Portal. As the portal has not yet started delivering data, the key numbers are not applicable yet. Figure 3 illustrates number of publications referring to ICOS related data that does is not ICOS labelled.

Key number 18 is an indicator of how well ICOS Sweden can interact with the wider scientific and stakeholder communities.

Key numbers 19 and 20 relates to the required reporting in the SRC agreement: "Infrastructure importance for direct societal interests" and "Infrastructure importance for trade and industry and commercial use". As ICOS Sweden has not fully entered the operational phase, this can only be described in general terms, without specification of actual number of users outside the scientific community.

Other issues required in the annual reporting according to the agreement with SRC that not included here: number of patents and scientific breakthroughs as they are not applicable for the infrastructure.

Some of the key numbers are not yet applicable as ICOS RI and ICOS Sweden has not fully entered the operational phase. However, the interest of users for the type of data produced at ICOS Sweden is illustrated by the number of academic users at the ICOS Sweden sites (Table 4) and by the number of publications referring to ICOS-related data from the sites (Figure 10). Interests of users have been research related to greenhouse gas (GHG) exchange, hydrological processes, and climate change.

Table 4. *Number of academic users of data, measured at sites within ICOS Sweden since 2005. Numbers include (i) data requests from sites that now belong to ICOS Sweden via the European Fluxes Database Cluster, (ii) projects which are in direct relation to ICOS and (iii) data requests addressed to ICOS Sweden directly.*

Year	Number of Data Users		
	international	national	total
2005	3	0	3
2006	19	0	19
2007	4	0	4
2008	14	9	23
2009	38	2	40
2010	45	6	51
2011	21	1	22
2012	36	2	38
2013	64	1	65
2014	51	17	68
2015	75	45	120
2016	211	77	288

As can be seen from table 4 and figure 10, there is an overall increasing trend of research interest within this topic.

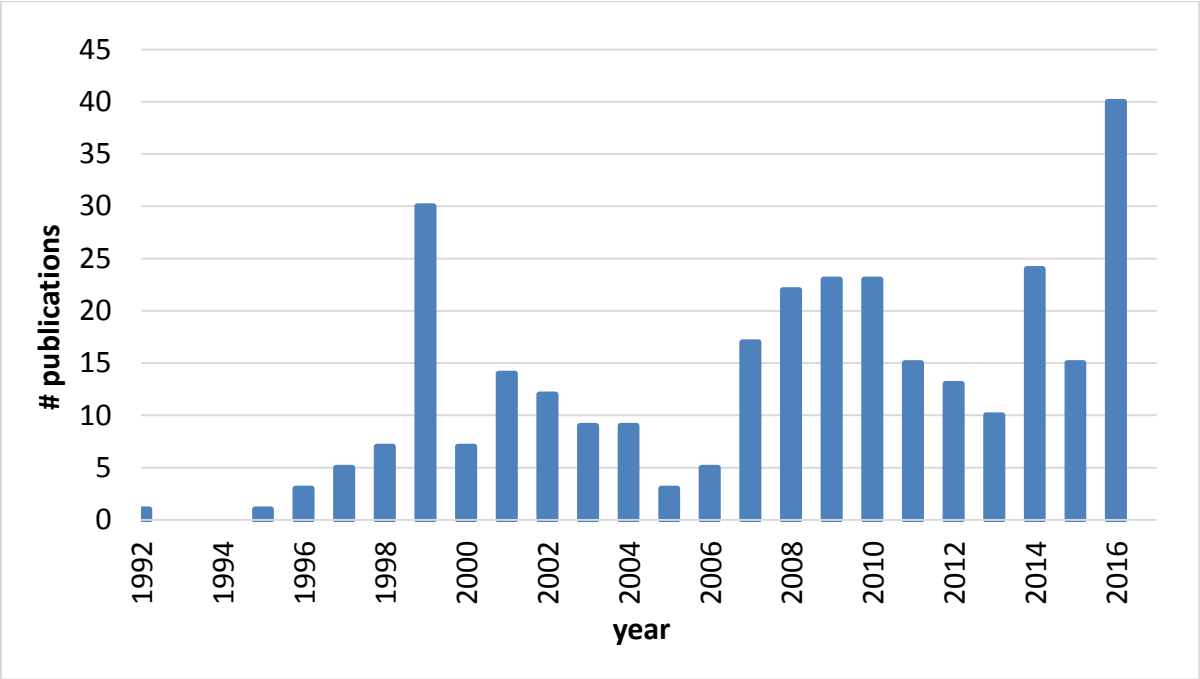

Figure 10. *Number of peer-reviewed and popular science publications referring to ICOS-related data measured at sites that now belong to ICOS Sweden.*

The uptime statistics for the backup systems for meteorological variables and the key variables have improved since the previous year (Figure 11). No statistics for the backup system can be provided for Östergarnsholm, as it is not foreseen to be installed at this site. The eddy covariance data coverage at the ecosystem sites where higher than 80% at all sites. Measurements for the atmospheric stations were running continuously and stable during 2016. Ongoing power supply problems caused an overall low data coverage at the ocean site Östergarnsholm. New power system has been installed to provide a more reliable power supply from late 2016 on.

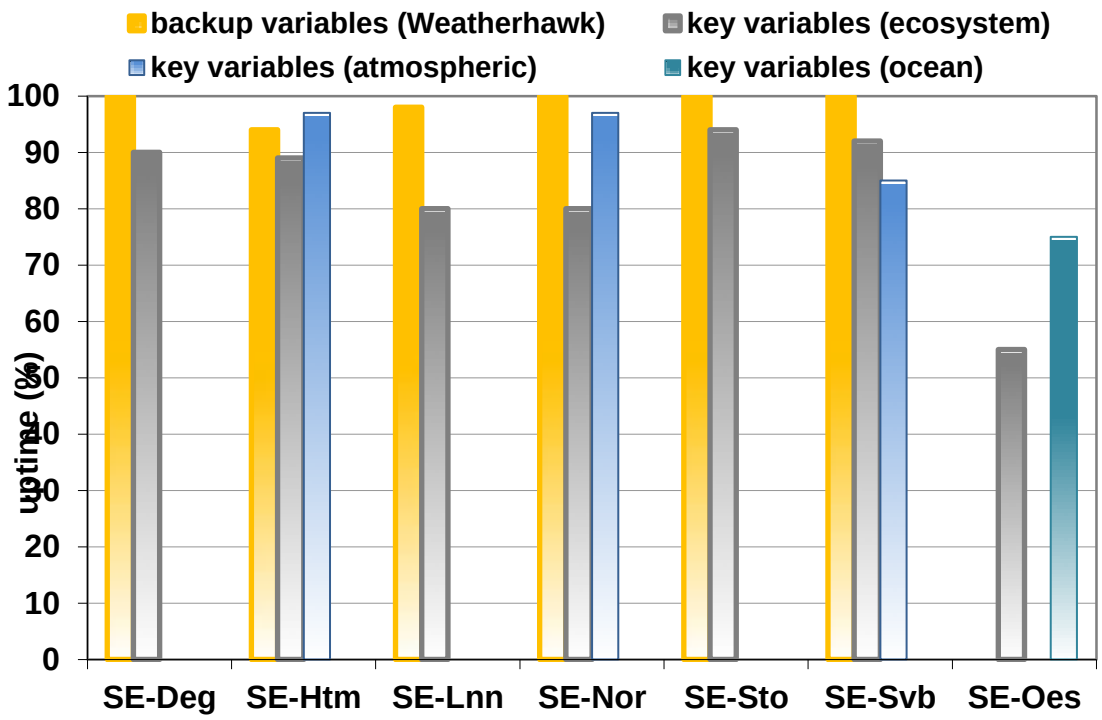

Figure 11. *Bar plot showing the percentage of days with high data quality (>80% data per day available) for backup meteorological variables and for key variables for the ecosystem, atmospheric and ocean stations. Key variable for the ecosystem stations are turbulent fluxes from the eddy covariance systems. Key variables for the atmospheric stations are concentrations of GHG at three levels, Key variables for the ocean station is pCO_2 (CO_2 concentration). Note: This figure was produced on 11 December. All stations in ICOS Sweden are shortened with the prefix SE. Deg is Degerö, Htm is Hyltemossa, Lnn is Lanna, Nor is Norunda, Sto is Abisko-Stordalen, Svb is Svartberget and Oes is Östergarnsholm.*

Appendices

Appendix 1: List of personnel during 2016

Total amount of FTEs: 13.3

Coordination Office:

Anders Lindroth, director, 50% (until November)
Maj-Lena Linderson, scientific coordinator, 60%, from November coordinating director, 60%
Janne Rinne, science director and SE (from November), 20%
Jutta Holst, scientific and technical station support, 50% until April, then 80%
Meelis Mölder, scientific and technical station support 25% until April, then 50%
Susanna Olsson, communication officer 25% until June then 50%
Björn Eriksson, scientific and technical station support, 20%

Measurement stations:

Abisko-Stordalen:

Per Marklund, research engineer, 100%
Niklas Rakos, research engineer, 50%
Thomas Friborg, station PI and SE, 20%
Patrick Crill, station PI and SE, 10%

Degerö and Svartberget:

Holger Tülp, research engineer, 100%
Eric Larmanou, research engineer, 100%
Pernilla Löfvenius, research engineer, 50%
Guiseppe de Simon, research engineer, 50%
Tomas Hörnlund, research engineer, 50%
Mikaell Ottosson Löfvenius, station PI and SE, 20 %
Mats Nilsson, station PI and SE, 10%

Norunda:

Irene Lehner, research engineer, 100%
Anders Båth, research engineer, 75%
Meelis Mölder, station PI, research engineer, 50%

Östergarnsholm:

Anna Rutgersson, station PI and SE, 35%
Marcus Wallin, research engineer, 50%
Erik Nilsson, research engineer, 45%
Hans Bergström, research engineer, 5%

Lanna:

Per Weslien, Station PI, research engineer, 75%
Bengt Liljeblad, research engineer, 25%
Leif Klemedtsson, SE, 35%

Hyltemossa:

Tobias Biermann, research engineer, 100%
Michal Heliasz, station PI, research engineer, 100%
Jutta Holst, research engineer, 20%

Appendix 2: List of measurement variables and instruments/systems

Ecosystem stations				
Continuous measurements		Forest	Wetland	Agriculture
Turbulent fluxes	CO_2	1	1	1
	H_2O	1	1	1
	CH_4	-	1	-
	N_2O	-	-	1
	Momentum	1	1	1
	Sensible heat	1	1	1
Radiative fluxes	Incoming short-wave	2	2	2
	Outgoing short-wave	1	1	1
	Incoming long-wave	1	1	1
	Outgoing long-wave	1	1	1
	Net Radiation	Combination of 4 components	Combination of 4 components	Combination of 4 components
	Incoming PAR	2	2	2
	Diffuse incoming PAR	1	1	1
	Outgoing PAR	1	1	1
	PAR below canopy	16	-	-
	Spectral reflectance	1	1	1
Soil fluxes	Soil heat flux	4	4	4
	Soil CO_2 efflux	6	-	-
State variables	Air temperature profile	14-15	5	5
	CO_2 profile	14-15	5	5
	CH_4 profile	0	0	0
	Relative humidity	1	1	1
	Wind speed/direction	Flux sonic, SE-Nor: 14	Flux sonic	Flux sonic
	Soil temperature profile	4x5	4x5	4x5
	Soil moisture profile	4x5	4x5	4x5
	Ground water level	1-4	4	-
	Ground height	-	1	-
	Snow depth	1	1	1
	Precipitation	1	1	1
	Tree trunk surface temperature	48	-	-
	Canopy IR temperature	1	1	1
	Backup meteorological station	1	1	1
Imaging	Above canopy phenological cam	1	1	1
	Below canopy phenological cam	1	0	0
Periodic measurements	Green area index	x	x	x
	Aboveground biomass	x	x	x
	Leaf chemical analysis	x	x	x
	Litterfall	x		
	C and N export/import	x		x

Atmospheric stations				
		Svartberget	Norunda	Hyltemossa
Continuous measurements	CO_2, CH_4, H_2O, CO	3	3	3
	Wind speed/direction	3	3	3
	PBL height	1	1	1
	Meteorological parameters	3	3	3
Periodic measurements	Sampling for radio carbon ^{14}C	1	1	1
	Flask sampling: SF_6, N_2O, O_2, N_2, C-14, Rn-222 + other isotopes	1	1	1

Ocean station		
Continuous measurements		Östergarnsholm
Turbulent fluxes	CO_2	1
	H_2O	1
	CH_4	-
	N_2O	-
	Momentum	1
	Sensible heat	1
Radiative fluxes	Incoming short-wave	2
Water measurements	Temperature profile	4
	Salinity profile	4
	Surface CO_2	1
	Surface Oxygen	1
State variables	Air temperature profile	5
	CO_2 profile	4
	H_2O profile	4
	Wind profile	5
	Relative humidity	1
	Precipitation	1
Periodic Water sampling	Nitrogen	x
	Phosphorous	x
	Silica	x

Appendix 3: List of abbreviations and acronyms

ICOS RI (European level)

ATC – Atmospheric Thematic Center
ATM – Atmospheric stations
CAL – Central Analytical Laboratory
CP – Carbon Portal
ECO –Ecosystem stations
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
OCM – Ocean stations
OTC – Oceanic Thematic Center

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
SE – ICOS Sweden Consortium Partner Scientific Expert

ICOS Sweden partners

LU – Lund University
GU – Gothenburg University
SU – Stockholm University
UU – Uppsala University
SLU – Swedish University of Agricultural Sciences
PFS - 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

NORA – The Marie Sklodowska Curie Initial Training Network ”Nitrous Oxide Research Alliance”

SMHI –Swedish Meteorological and Hydrological Institute

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