ICOS SWEDEN - user statistics 2023

ICOS National Network Sweden

Lunds Universitet · Göteborgs Universitet · Uppsala Universitet · SLU · Polarforskningssekretariatet · SMHI · Swedish Research Council

Key numbers for the annual reporting of the infrastructure activities

"Special conditions for contributions to the national infrastructure - ICOS Sweden", The Swedish Research Council's (SRC's) Director General, April 06, 2020.

The Integrated Carbon Observation System Sweden, ICOS Sweden[1] is a part of the pan-European distributed research infrastructure ICOS[2] that promotes fundamental understanding of carbon cycle, greenhouse gas (GHG) budgets and perturbations and their underlying processes by providing consistent and persistent measurement data from *in situ* networks. The overall aim of ICOS Sweden is to produce harmonized, high-quality data on GHG exchanges, atmospheric concentrations and their defining state variables within typical Swedish ecosystems (both terrestrial and marine) and regions. These activities are critical to enable quantification of the Swedish GHG balance and the feed backs of these ecosystems to a changing climate. Swedish ICOS stations contribute data that are critical for a continental scale understanding of the GHG balance of Europe. This document contains a description of how infrastructure and its activities are organized in order to achieve these aims.

ICOS Sweden and its data products is an infrastructure which is open to everyone. As research infrastructure, it is meant to be used by scientists to address different research questions. By organizing open door events or preparing easy to understand teaching material, it can even reach out to the general public to arouse interest and enlarge knowledge on ecosystem related climate issues. Elaborated products will be available for all the interested social stakeholders such as citizens, decision makers and media.

Scientific users of the infrastructure are researchers using the data produced by the measurement stations to address their research question. More than 38500 datasets of near real time (level 1), final quality-controlled data sets (level 2), or elaborated products (level 3) have been downloaded via the Carbon Portal.

Scientific users of the ICOS Sweden infrastructure are also researchers coming to the stations for field experiments to answer their specific research question. During 2023, 369 unique research projects were active at the ICOS Sweden stations, many of them using several stations for their studies.

The users of ICOS infrastructure divide into two partially overlapping classes, data users and users of the physical station infrastructure. Again, the data and the sites will be available to all.

The academic users of ICOS data can be divided into three main groups. 1) Modelers working with both bottom-up and top-down type models from different disciplines, e.g., soil science, ecophysiology, biogeochemistry, hydrology, meteorology, climate science, atmospheric science. 2) Remote sensing (RS) community that is interested in ground truth data for validation of different RS products. 3) Researchers synthesizing empirical data from different types of ecosystems and climatic regions to understand the processes regulating exchange of matter and energy between ecosystems and the climate system.

[1] www.icos-sweden.se
[2] www.icos-ri.eu

Users taking advantage of the physical access to the measurement stations benefit from station infrastructure, including laboratory space, technical support, power supply, internet and other services, and high-quality auxiliary data provided by ICOS Sweden. These users perform on site research consisting of measurement programs that are in addition to the ongoing ICOS measurement program. They, in turn, benefit directly from the context of the long term ICOS measurements. The users use and process ICOS data while integrating it into their own scientific research topics. They publish scientific papers in high-impact journals, make presentations at international workshops and conferences, and develop novel measurement methods that may become operational within ICOS in future.

Table 1 comprises the summary of the key numbers since the start of the 2nd ICOS Sweden funding period 2016. The results are analyzed in more detail below. ICOS Sweden defined targets for the keynumbers in its most recent Strategic Plan. These are included in the last row of Table 1. The number of peer-reviewed publications increased and is now closer to the target than in 2022. Data usage by users from Sweden increased above the target number.

Table 1. Summary of the key numbers for the annual reporting of the infrastructure activities. Data downloads include all levels of data products (Level 0: raw data to level 3: elaborated products).

year	general key numbers	Project Pis		Number of site days	Data repository downloads	
	number of peer-reviewed publications	Inter-national	national	national	international	national
2016	44	17	52	-	--	--
2017	64	15	39	-	2	752
2018	60	28	26	-	3728	1397
2019	26	16	82	-	10483	2776
2020	87	13	76	-	50467	2296
2021	71	24	75	7928	44978	2111
2022	49	18	63	14819	52026	1752
2023	57	21	89	11264	45051	2822
target	>60	>15	>50	>5000	>40000	>2000

Physical Users of the infrastructure

The motivation for users that come in person to the ICOS Sweden RI facilities is broad. ICOS Sweden facilities are used for education at university level during excursions and field courses. National and international scientists use ICOS Sweden stations for their own research project related field work. Table 2 includes the updated numbers for each group of physical users. The number of visitors/users from the general public have not been registered for 2023. However, there were several events targeted to the general public, e.g. open doors at Hyltemossa Research station at the Worlds Environmental Day and in connection to the district championship in orienteering. Several activities were targeted to schools, e.g. SciFest Science Festival in Uppsala, launch of the webside “ICOS resurs för skolor” as result of the ICOS-MINT project, presentation at information days of the partner

universities. Furthermore, pupils get the possibility to spend a day at selected ICOS stations as part of their interships.

Table 2. User numbers for project PIs, Scientific visitors (site visitors through field courses and excursions) and General public visitors (general public and school children).

year	Project PIs		Scientific visitors		General public visitors
	male	female	male	female	not divided by gender
2016	50	19	355	277	245
2017	40	14	166	227	21
2018	42	12	72	67	32
2019	63	25	163	94	14
2020	49	35	129	64	10
2021	40	30	134	92	10
2022	68	35	407	208	128
2023	78	38	323	245	n/a

While the total number of academic projects slightly increased, the number of scientific visitors is lower compared to earlier years. Note, that the number of research projects purely using data are not part of this statistic. Even if researchers are asked to inform the station PIs about the usage of data the number is highly unsure due to the open data policy following. As in previous years, projects at the sites were mostly related to the respective host of the station used for the research (Fig. 1a). Other Swedish Universities which are not part of the ICOS consortium represent only a small share of the projects as PIs. However, they are involved as project partners (Fig. 1b).

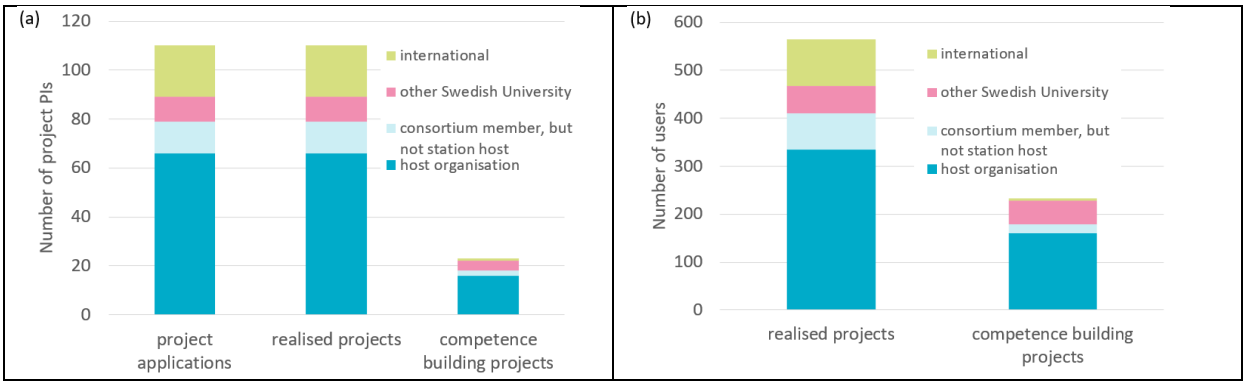

Fig. 1: Number of (a) academic projects and (b) academic users divided into their respective academic residence. Host organisations refers to the host of the respective station.

Users of the data produced by the infrastructure

Data produced at ICOS Sweden facilities is of interest for scientists nationally and internationally. During 2023, the number of data requests from the ICOS Carbon portal, where all data are available under a Creative Commons Attribution 4.0 International License was 38532. Whether the decrease is due to a different way of receiving this information or due to a real decrease in data requests is unclear. No personal data is gathered from users downloading data via the Carbon Portal, however, the country of origin is derived from the users IP number (Fig 2). As before, no statistics on gender distribution was evaluated for 2023.

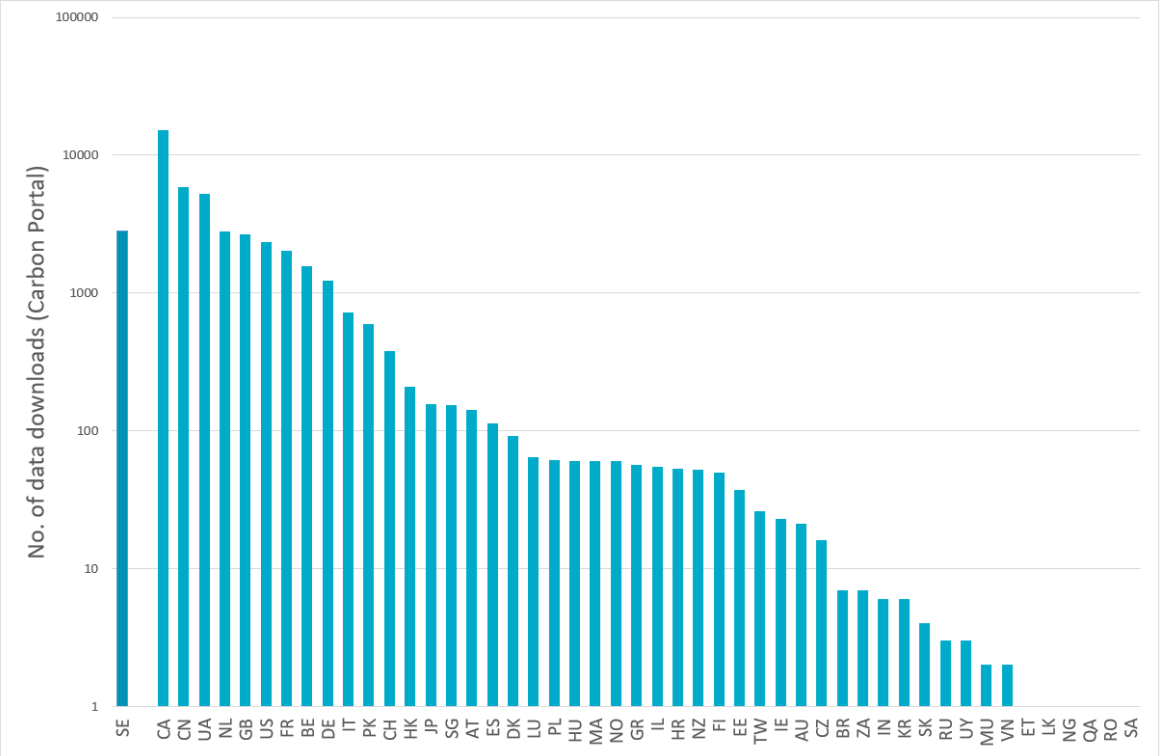

Fig. 2: Origin of international data users of the ICOS Sweden data products in 2023 (level 0 to 3); data downloads from the ICOS Carbon Portal.

Table 3. Downloads of data (Level 1 to 3) from the ICOS Carbon Portal since 2018 per station. The Ocean stations are not yet listed as data from the Swedish Ocean stations are not yet available from the Carbon Portal.

station/ year	Ecosystem Stations						Atmosphere Stations			Total
	SE-Sto	SE-Svb	SE-Deg	SE-Nor	SE-Lnn	SE-Htm	SVB	NOR	HTM	
2018	0	1046	25	560	124	1012	153	185	218	3 323
2019	5	2337	133	1381	451	1775	1294	1280	1901	10 557
2020	15	1071	378	613	289	838	1622	1618	1811	8 255
2021	249	899	378	580	167	657	2877	2902	3086	11 795
2022	538	1212	629	791	280	1023	4083	3791	3982	16 329
2023	470	876	679	626	137	695	11 574	11 602	11 873	38 532

The data flow from the stations through the ICOS Atmosphere Thematic Centre to the Carbon Portal been fully established. The data flow from the stations to the Ecosystem Thematic Centre has been fully established for the labelled Ecosystem stations (all but one ICOS Sweden station). Data requests directly to ICOS Sweden were often connected with detailed questions on how to use the data or where to find specific data products. Data downloads from stations from which official ICOS data releases are available on the Carbon Portal (labelled, resp. labelled before 2022) are higher than from the other stations (Table 3). In general, data downloads from the Atmosphere Stations are higher than from the Ecosystem stations. This can be explained by the structure of the data products (single variables in Atmosphere station data vs. collection of parameters in Ecosystem station data). Also the user behaviour is different for the different communities: whereas the Atmosphere station community often accesses the data by demand during model runs which results in multiple

downloads for multiple model runs, the typical Ecosystem station data user downloads a dataset and works offline with the data (single data download).

Citation statistics for peer-reviewed publications related ICOS Sweden stations

The full list of peer-reviewed scientific publications published in 2023 that the ICOS Sweden infrastructure has contributed to through data measured at the stations or support of field research at the stations is included in Appendix A. Google scholar was used to compile the citations related to publications since 2019. The full publication list of included papers is available on www.icos-sweden.se. Theses on graduate and undergraduate level using data from ICOS Sweden stations are listed in Appendix B.

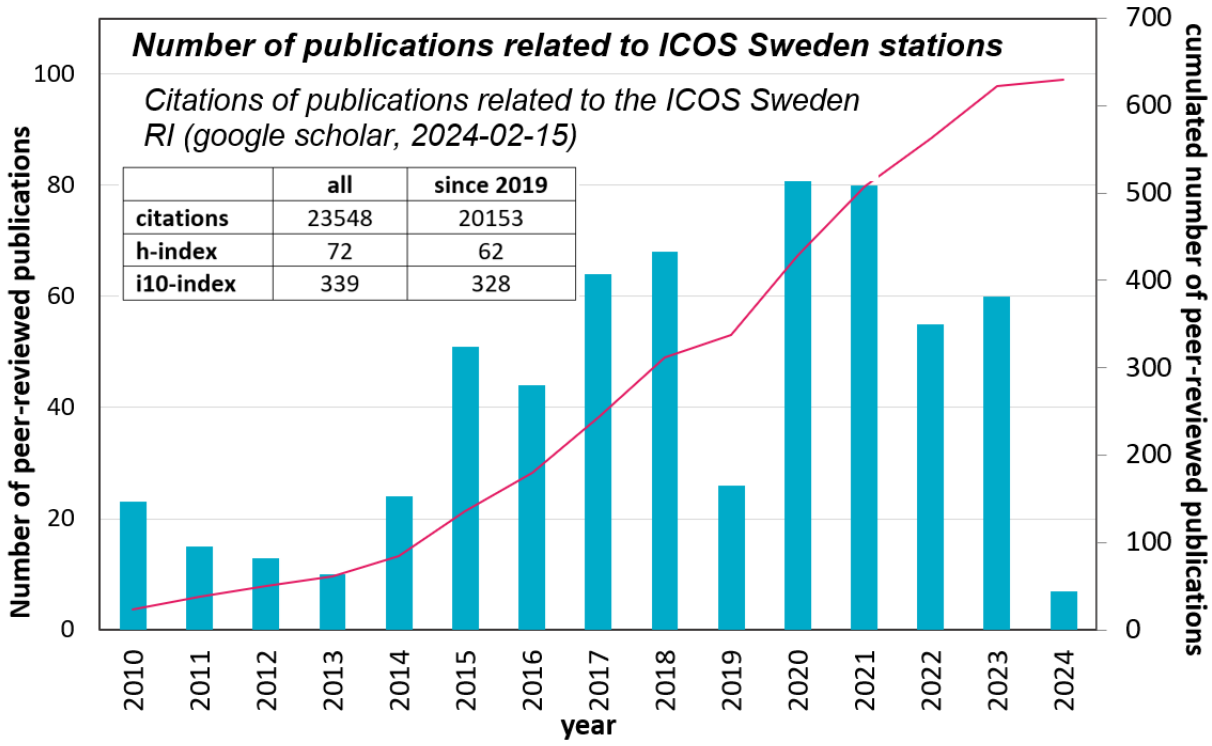

Figure 3. Number of publications and citation statistics (google citations, 2024-02-15) of publications related to ICOS Sweden stations and ICOS Sweden activities. The full publication list of included papers is available on www.icos-sweden.se.

Appendix A

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