ICOS SWEDEN - user statistics 2019

ICOS National Network Sweden

Lunds Universitet · Göteborgs Universitet · Uppsala Universitet · SLU · Polarforskningssekretariatet · Vetenskapsrådet

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, March 21, 2016.

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.

ICOS Sweden stations are used as destination of excursions and field courses at different levels and attracted by this 271 scientific visitors during 2019.

Scientific users of the infrastructure are researchers using the data produced by the measurement stations to address their research question. The data downloads of near real time and final quality controlled data sets via the Carbon Portal have increased to >160000 during 2019, compared to 24 data requests by direct mail contact.

Scientific users of the ICOS Sweden infrastructure are also researchers coming to the stations adding installations or taking samples to answer their specific research question. During 2019, around 70 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

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

products. 3) Researchers synthesizing empirical data from different types of ecosystems and climatic regions in order to understand the processes regulating exchange of matter and energy between ecosystems and the climate system.

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.

Today, the ICOS Sweden community consists of more than 1400 scientists from at least 16 countries (since 2016), who participate in ICOS Sweden related work and operations. They design, build and operate ICOS stations and use and process ICOS data while integrating it into their own scientific research topics. The ICOS RI can thus be regarded as being **co-designed** by its users. 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. National users (71%) are hosted by all major research institutions of Sweden.

ICOS Sweden data and stations are also used in education at all levels from high school to research training. This and public information days follow the aim to increase the public awareness, interest, and knowledge of climate change issues. Large numbers of the general public (non-scientific users) have been and will be reached; for example, since 2016, more than 300 non-scientific users showed interest in the RI by e.g. visiting the sites. 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.

Table 1. Summary of the key numbers for the annual reporting of the infrastructure activities.

year	general key numbers	Site visitors and project Pis					Data Users				
	number of peer-reviewed publications	international		national			international		national		
		male	female	male	female	unknown	male	female	male	female	unknown
2016	44	140	129	337	270	0	49	33	18	7	60
2017	64	48	12	100	197	56	4	5	12	16	1186
2018	60	15	13	72	69	2	8	7	29	15	15781
2019	26	75	36	166	97	0	3	0	14	7	160302

Physical Users of the infrastructure

The motivation for users that come in person to the ICOS Sweden RI facilities is broad. It starts from the general public that is attracted by e.g. open-door days or programs for school children. ICOS Sweden facilities are also used for education at university level during excursions and field courses. Last but not least, 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.

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

The number of research projects at the stations increased by 63% compared to the previous years. Especially research projects which mainly use data products of the sites often include several stations of the network for their studies. The distribution of origin for national users during 2019 as far as known is shown in Fig. 1; the origin from international users was not registered during 2019.

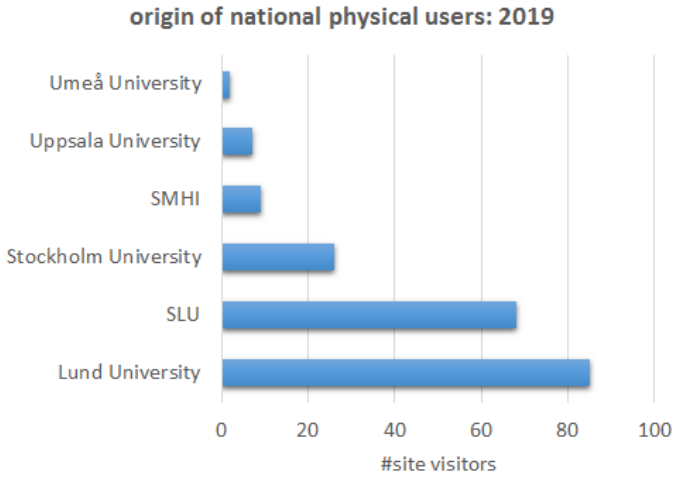

Fig. 1: Origin of national project PIs and visitors of the ICOS Sweden facilities in 2019 as far as known.

For the statistics on the number of physical users on subject area, only the research projects related to ICOS Sweden stations have been analyzed. During 2019, the background of the majority of the physical users was within Geo- and Environmental sciences (SCB code 105), but related also to SCB code 103 (atmospheric sciences, aerosol measurements) and Agricultural Science and Forestry (SCB code 401).

Users of the data produced by the infrastructure

Data produced at ICOS Sweden facilities is of interest for scientists nationally and internationally. During 2019, the amount of data requests from the ICOS Carbon portal, where all data are available under a Creative Commons Attribution 4.0 International License, as well as data requests from compiled data products like the NOAA Observation package (ObsPack) increased to more than 15800. 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 3). Statistics on gender distribution (Table 1) is purely based on data requests via the direct contact.

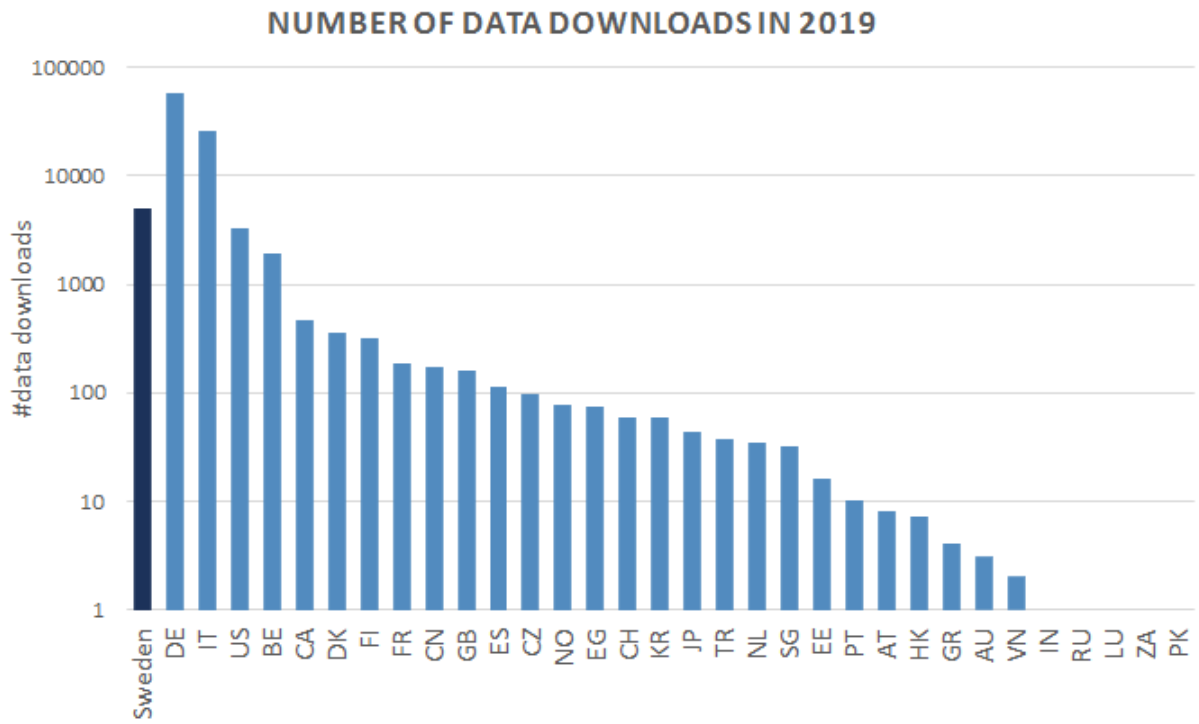

Fig. 3: Origin of international data users of the ICOS Sweden data products in 2019 (level 0 to 3); data downloads from the ICOS Carbon Portal.

The data flow from the stations through the ICOS Thematic Centres and to the Carbon portal been fully established for the Atmosphere Thematic Centre. The data flow from the stations to the Ecosystem Thematic Centre has been fully established for the labelled Ecosystem stations. During 2019, data from 2014 onwards has been made available in the FLUXNET data format at the Carbon Portal; the gap-filling has been done by the Ecosystem Thematic Centre based on PI calculated fluxes; the FLUXNET data format was often requested by users in the past. Data products which are not part of the published datasets at the Carbon Portal can be received through direct contact with the station Scientific Principle Investigators or the ICOS Sweden data manager.

77% of the data requests via direct contact came from Swedish institutions. Data products from ICOS Sweden stations are also used for educational purposes at undergraduate and graduate level, reaching out to a number of students in environmental sciences, forestry and physical geography.

Citation statistics for peer-reviewed publications related ICOS Sweden stations

The full list of peer-reviewed scientific publications published in 2019 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 2015 (Table 3). The full publication list of included papers is available on www.icos-sweden.se.

Table 3. Citation statistics on publications related to ICOS Sweden stations and ICOS Sweden activities (2020-02-26). The full publication list of included papers is available on www.icos-sweden.se.

	Since 2015
Total number of publications	256
Citations	4904

h-index	35
I10-index	141

Appendix A – List of peer-reviewed scientific publications that the infrastructure has contributed to with data, pure infrastructure or technical support: 2019

- Bechthold, M., De Lannoy, G.J.M., Nilsson, M.B. *et al.*, 2019: PEAT-CLSM: A Specific Treatment of Peatland Hydrology in the NASA Catchment Land Surface Model. *Journal of Advances in Modelling Earth Systems*, doi.org/10.1029/2018MS001574
- Campeau, A., K. Bishop, N. Amvrosiadi, N. *et al.*, 2019: Current forest carbon fixation fuels stream CO_2 emissions. *Nat Commun* 10, 1876 (2019) doi:10.1038/s41467-019-09922-3
- Campbell, J. & Laudon, H., 2019: Carbon response to changing winter conditions in northern regions: Current understanding and emerging research needs,*Environmental Reviews*. http://dx.doi.org/10.1139/er-2018-0097
- Chi, J., M.B. Nilsson, N. Kljun, J. Wallermann, J.E.S. Fransson, H. Laudon, T. Lundmark, M. Peichl, 2019: The carbon balance of a managed boreal landscape measured from a tall tower in northern Sweden. *Agruic. Forest Meteorol.*, 274: 29-41. https://doi.org/10.1016/j.agrformet.2019.04.010
- Friedlingstein, P., Jones, M.W., O′Sullivan, M. *et al.*, 2019: Global Carbon Budget 2019. *Earth System Science Data*, 11, 1783-1838, DOI: 10.5194/essd-11-1783-2019.
- Koebsch, F., O. Sonnentag, J. Järveoja *et al.*, 2019: Refining the role of phenology in regulating gross ecosystem productivity across European peatlands. *Global Change Biology* (in press)
- Kozii, N., K. Haahti, T. Pantana, J. Chi, E.M. Hasselquist, H. Laudon, S. Launiainen, R. Oren, M. Peichl, J. Wallermann, N.J. Hasselquist, 2019: Partitioning the forest water balance within a boreal catchment using sapflux, eddy covariance and process-based model. Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2019-541, in review.
- Knox, S.H., Jackson, R.B., Poulter, B. *et al.*, 2019: FLUXNET-CH_4 Synthesis Activity: Objectives, Observations, and Future Directions. *Bulletin of the American Meteorological Society*, https://doi.org/10.1175/BAMS-D-18-0268.1
- Lagergren, F., A.M. Jönsson, H. Linderson, A. Lindroth, 2019: Time shift between net and gross CO_2 uptake and growth derived from tree rings in pine and spruce. *Trees*, 3(1), 4; DOI: 10.1007/s00468-019-01814-9
- Langvall, O. & Ottosson Löfvenius, 2019: M. Long-term standardized forest phenology in Sweden: a climate change indicator. *Int J Biometeorol*, doi:10.1007/s00484-019-01817-8
- Leufen, L.H. & Schädler, G., 2019: Calculating the turbulent fluxes in the atmospheric surface layer with neural networks. *Geosci. Model Dev.*: 12, 2033-2047. https://doi.org/10.5194/gmd-12-2033-2019
- Lupon, A. et al., 2019: Groundwater inflows control patterns and sources of greenhouse gas emissions from streams. *Limnology and Oceanography*. https://doi.org/10.1002/lno.11134
- Martinez, M.A., Woodcroft, B.J., Espinoza, J.C.I. *et al.*, 2019: Discovery and ecogenomic context of a global Caldiserica-related phylum active in thawing permafrost, Candidatus Cryosericota phylum nov., Ca. Cryosericia class nov., Ca. Cryosericales ord. nov., Ca. Cryosericaceae fam. nov., comprising the four species Cryosericum septentrionale gen. nov. sp. nov., Ca. C. hinesii sp. nov., Ca. C. odellii sp. nov., Ca. C. terrychapinii sp. nov. *Systematic and applied microbiology* 42, 54-66.
- Nielsen, C.S., N.J. Hasselquist, M.B. Nilsson, M. Öquist, J. Järveoja & M. Peichl, 2019: A novel approach for high-frequency in-situ quantification of methane oxidation in peatlands. *Soil Syst.*, 3(1), 4; DOI:10.3390/soilsystems3010004
- Nilsson, E., A. Rutgersson, A. Dingwell *et al.*, 2019: Characterization of wave energy potential for the Baltic Sea with focus on the Swedish Exclusive Economic Zone. *Energies* 12(5):793. DOI: 10.3390/en12050793
- Nijp, , J.J., Metselaar, K., Limpens, J. *et al.*, 2019: High-resolution peat volume change in a northern peatland: Spatial variability, main drivers, and impact on ecohydrology. *Ecohydrology*, doi.org/10.1002/eco.2114
- Pelotola, O., Vesala, T., Gao, Y. *et al.*, 2019: Monthly gridded data product of northern wetland methane emissions based on upscaling eddy covariance observations. *Earth Syst. Sci. Data*, 11, 1263-1289, https://doi.org/10.5194/essd-11-1263-2019
- Pisso, I., Sollum, E., Grythe, H. *et al.*, 2019: The Lagrangian particle dispersion model FLEXPART version 10.3. *Geosci. Model Dev. Discuss.*, doi.org/10.5194/gmd-2018-333

- Svensson, N., H. Bergström, A. Rutgersson, E. Sahlée, 2018: Modification of the Baltic sea wind field by land-sea interaction. *Wind energy* 2019:1-16. https://doi.org/10.1002/we.2320