



ICOS SWEDEN - user statistics 2018

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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 Sweden¹ is a part of the pan-European distributed research infrastructure ICOS² 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 feedbacks 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 is fully integrated and plays an important role in the pan-European ICOS (ICOS RI). ICOS Sweden provides 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. The ICOS Sweden activities have been organized in five modules: module 1: organization and leadership, modules 2 to 4 for the Ecosystem, Atmosphere and Ocean stations and module 5 for the Technical and scientific expertise and support.

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 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, participate in international workshops and conferences, and

¹ www.icos-sweden.se

² www.icos-ri.eu

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 gymnasia 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 number of peer-reviewed publications | Site visitors and project Pis | | | | | Data Users | | | | |
|-------------|---|-------------------------------|--------|----------|--------|---------|---------------|--------|----------|--------|---------|
| | | international | | national | | unknown | international | | national | | unknown |
| | | male | female | male | female | | male | female | male | female | |
| 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 |

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 not divided by gender |
|-------------|-------------|--------|---------------------|--------|--|
| | male | female | male | female | |
| 2016 | 50 | 19 | 355 | 277 | 245 |
| 2017 | 40 | 14 | 166 | 227 | 21 |
| 2018 | 42 | 12 | 72 | 67 | 32 |

Since there were no larger international conferences during 2018, the share of international physical users is only 7%, the majority (144 counted users) of physical users had a national background, for approx. 20% of the users, it is not known whether their site visit was motivated nationally or internationally. Figures 1 and 2 show the distribution of origin for national (Fig. 1) and international (Fig. 2) users during 2018 as far as known.

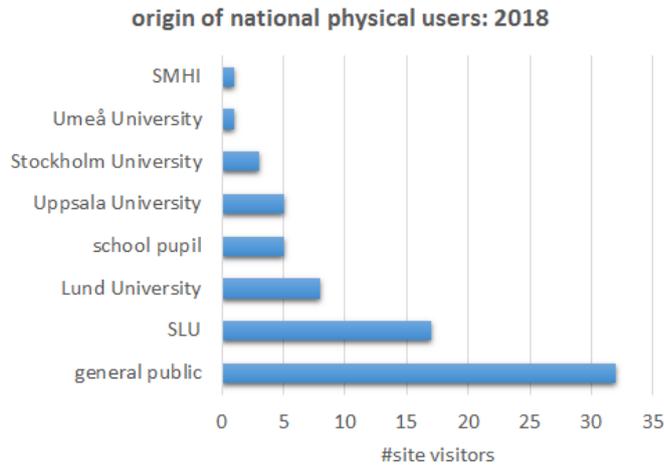


Fig. 1: Origin of national visitors of the ICOS Sweden facilities in 2018.

origin of international physical users: 2018

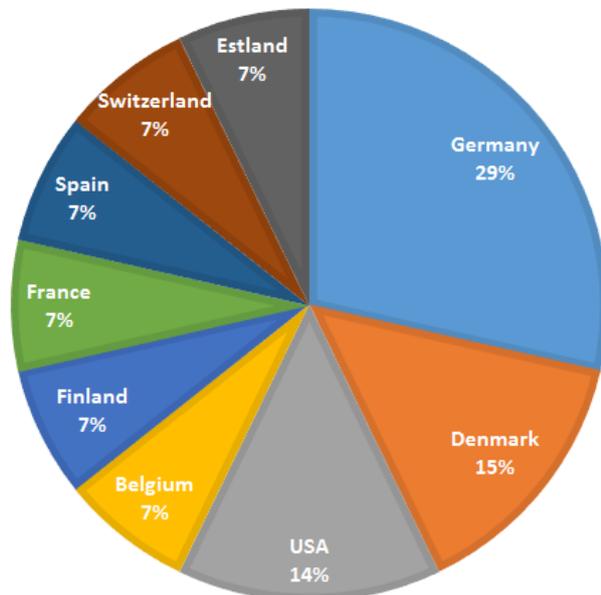


Fig. 2: Origin of international visitors of the ICOS Sweden facilities in 2018.

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 2018, the background of the majority (83%) of the physical users was within Geo- and Environmental sciences (SCB code 105). Physical users related to atmospheric sciences (aerosol measurements) accounted for roughly 10% at ICOS Sweden sites during 2018 (SCB code 103). The remaining 7% can be found in Agricultural Science and Forestry (SCB code 401).

Due to the co-location of the Svartberget/Degerö sites in the Krycklan area, hydrological motivated projects were dominating in previous years; however, during 2018 the share of carbon budget related research projects increased significantly. The spectrum of science questions investigated at the marine station (module 3) is broad. It attracts scientists from atmospheric physics and atmospheric chemistry as well as scientists with marine research questions.

Users of the data produced by the infrastructure

Data produced at ICOS Sweden facilities is of interest for scientists nationally and internationally. During 2018, 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 for the whole period since end 2017 to today (2019-02-13, Fig 3).

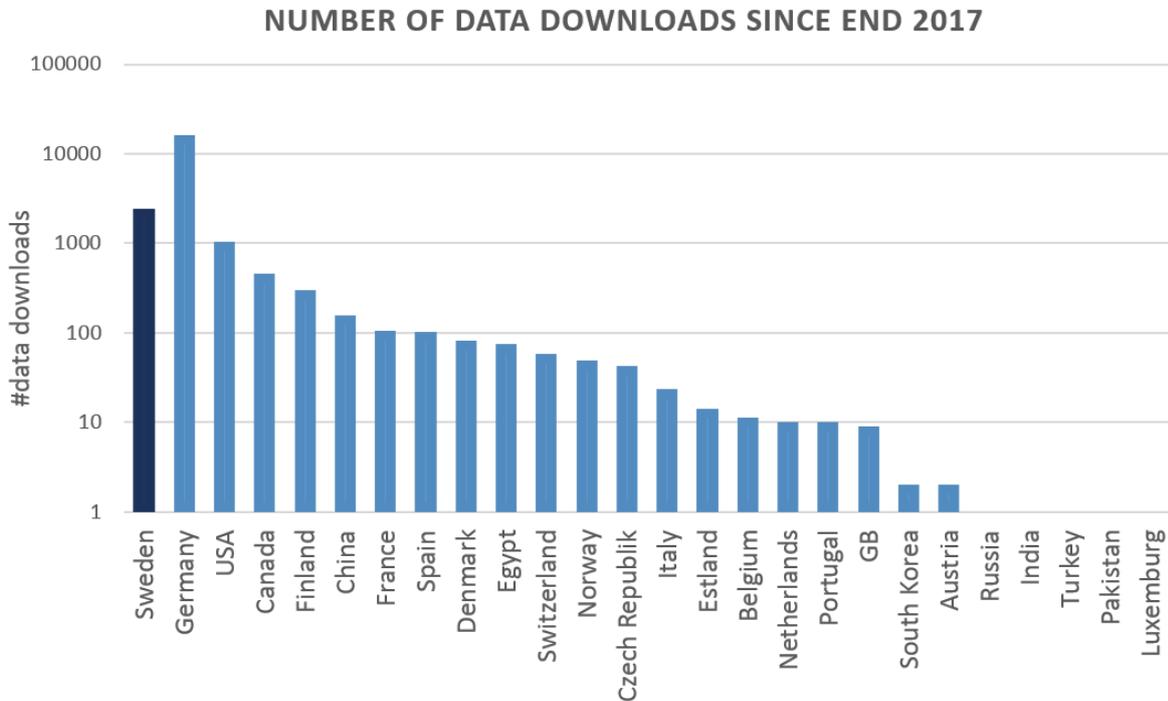


Fig. 3: Origin of international data users of the ICOS Sweden data products since 2017 (level 1 to 3); data downloads from the ICOS Carbon Portal.

Since the data flow from the stations to the ICOS Thematic Centres and to the Carbon portal has not yet been fully established for all Thematic Centres, data from ICOS Sweden stations are available as ICOS Sweden data through the Carbon Portal but also through direct contact with the station Scientific Principle Investigators or the ICOS Sweden data manager. Statistics on gender distribution (Table 1) as well as origin of data users (Fig. 4 and 5) is purely based on data requests via the direct contact.

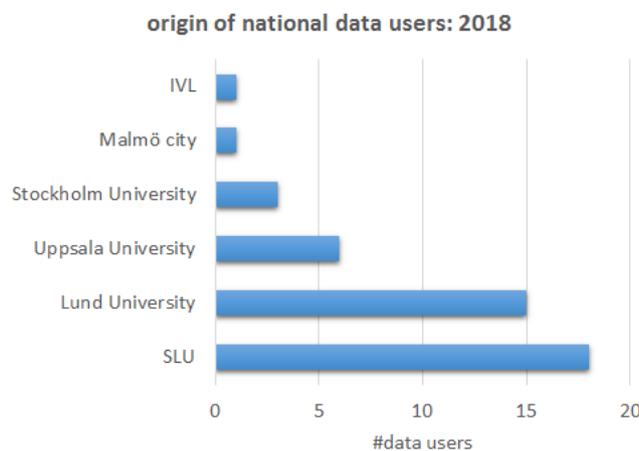


Fig. 4: Origin of national data users of the ICOS Sweden data products in 2018; data requests via direct contact.

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. In 2018, ICOS Sweden contributed with data products from ICOS Sweden stations to the “Weather and Climate” module of the National Resource Centre for Physics Education which is aimed at being a resource for teachers from preschool to upper secondary school (high school).

origin of international data users: 2018

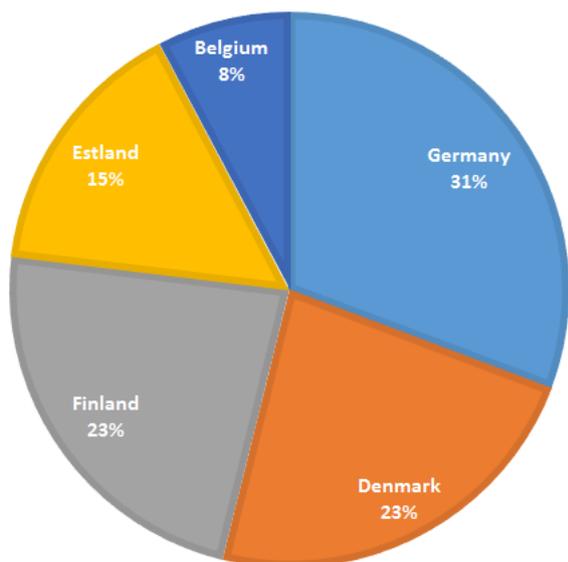


Fig. 5: Origin of international data users of the ICOS Sweden data products in 2018; data requests via direct contact.

Citation statistics for peer-reviewed publications related ICOS Sweden stations

The full list of peer-reviewed scientific publications published in 2018 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 2014 (Table 3).

Table 3. Citation statistics on publications related to ICOS Sweden stations (2019-02-13).

| | Since 2014 |
|-------------------------------------|------------|
| Total number of publications | 242 |
| Citations | 3010 |
| h-index | 27 |
| I10-index | 90 |

Appendix A – List of peer-reviewed scientific publications that the infrastructure has contributed to: 2018

- Alekseychik, P., I. Mammarella, A. Lindroth *et al.*, 2018: Surface energy exchange in pristine and managed boreal peatlands. *Mires and peat*, 21, 14. 10.19189/MaP.2018.OMB.333
- Ameli, A.A. & J.R. Craig, 2018: Semi-analytical 3D solution for assessing radial collector well pumping impacts on groundwater-surface water interaction. *Hydrology Research*, 49, 17-26.
- von Buttlar, J., Zscheischler, J., Rammig *et al.*, 2018: Impacts of droughts and extreme-temperature events on gross primary production and ecosystem respiration: a systematic assessment across ecosystems and climate zones, *Biogeosciences*, 15, 1293-1318, <https://doi.org/10.5194/bg-15-1293-2018>.
- Campeau, A., K. Bishop, M.B. Nilsson *et al.*, 2018: Stable carbon isotopes reveal soil-stream DIC linkages in contrasting headwater catchments. *JGR-Biogeosciences*, 123(1):149-167, DOI:10.1002/2017JG004083
- Denfeld, B. A., Klaus, M., Laudon *et al.*, 2018: Carbon dioxide and methane dynamics in a small boreal lake during winter and spring melt events. *Journal of Geophysical Research: Biogeosciences*, 123, 2527-2540.
- Dengel S., A. Graf, T. Grünwald *et al.*, 2018: Standardized precipitation measurements within ICOS: rain, snowfall and snow depth: a review. *International Agrophysics*, 32:607-617
- Du Toit, A., 2018: Permafrost thawing and carbon metabolism. *Nature Reviews Microbiology* 16, 519
- Emerson, J.B., S. Roux, J.R. Brum *et al.*, 2018: Host-linked soil viral ecology along a permafrost thaw gradient. *Nature Microbiology* 3:870-880
- Faiola, C. L. , Buchholz, A., Kari, E. *et al.*, 2018: Terpene Composition Complexity Controls Secondary Organic Aerosol Yields from Scots Pine Volatile Emissions. *Scientific Reports*, 8, Article number: 3053
- Franz, D., M. Acosta, N. Altimir *et al.*, 2018: Towards long-term standardised carbon and greenhouse gas observations for monitoring Europe’s terrestrial ecosystems: a review. *International Agrophysics*, 32:439-455
- Gielen B., M. Acosta, N. Altimir *et al.*, 2018: Ancillary vegetation measurements at ICOS ecosystem stations. *International Agrophysics*, 32:645-664
- Gutiérrez-Loza, L., M.B. Wallin, Sahlée E., Nilsson E., Bange H.W., Kock A. and A. Rutgersson, 2018: Measurement of air-sea methane fluxes in the Baltic Sea using the eddy covariance method. *In revision*
- Hodgkins, S.B., C.J. Richardson, R. Dommain *et al.*, 2018: Tropical peatland carbon storage linked to global latitudinal trends in peat recalcitrance. *Nature Communications*, 9, 3640
- Hufkens K., F. Gianluca, E. Cremonese *et al.*, 2018: Assimilating phenology datasets automatically across ICOS ecosystem stations. *International Agrophysics*, 32:677-687
- Järveoja, J., M.B. Nilsson, M. Gažovič, P.M. Crill & M. Peichl, 2018: Partitioning of the net CO₂ exchange using an automated chamber system reveals plant phenology as key control of production and respiration fluxes in a boreal peatland. *Global Change Biology*, 24, 3436-3451
- Jocher, G., J. Marshall, M.B. Nilsson *et al.*, 2018: Impact of canopy decoupling and subcanopy advection on the annual carbon balance of a boreal Scots pine forest as derived from eddy covariance. *JGR-Biogeosciences*, 123(2):303-325, DOI:10.1002/2017JG003988
- Jurevics, A., Peichl, M., Egnell, G., 2018: Stand Volume Production in the Subsequent Stand during Three Decades Remains Unaffected by Slash and Stump Harvest in Nordic Forests. *Forests*, 9(12), 770; <https://doi.org/10.3390/f9120770>
- Kaisermann, A., J. Ogée, J. Sauze, S. Wohl, S.P. Jones, A. Gutierrez & L. Wingate, 2018: Disentangling the rates of carbonyl sulfide (COS) production and consumption and their dependency on soil properties across biomes and land use types. *Atmos. Chem. Phys.*, 18:9425-9440, DOI:10.5194/acp-18-9425-2018
- Kovalets, I., R. Avila, M. Mölder, S. Kovalets & A. Lindroth, 2018: Verification of a one-dimensional model of CO₂ atmospheric transport inside and above a forest canopy using observations at the Norunda research station. *Boundary-Layer Meteorol.*, 168(1):103-126, DOI:10.1007/s10546-018-0340-z
- Kuhn, M., E.J. Lundin, R. Giesler, M. Johansson & J. Karlsson, 2018: Emissions from thaw ponds largely offset the carbon sink of northern permafrost wetlands. *Scientific Reports*, 8, 9535
- Laudon, H. & R.A. Sponseller, 2018: How landscape organization and scale shape catchment hydrology and biogeochemistry: insights from a long-term catchment study. *Wiley Interdisciplinary Reviews: Water*, 5, e1265
- Ledesma, J.L.J., M.N. Futter, M. Blackburn *et al.*, 2018: Towards an improved conceptualization of riparian zones in boreal forest headwaters. *Ecosystems*, 21(2):297-315, DOI:10.1007/s10021-017-0149-5

- Leufen, L. H. & Schädler, G., 2018: Calculating the turbulent fluxes in the atmospheric surface layer with neural networks. *Geosci. Model Dev. Discuss.*, <https://doi.org/10.5194/gmd-2018-263>
- Lindroth, A., J. Holst, M. Heliasz *et al.*, 2018: Effects of low thinning on carbon dioxide fluxes in a mixed hemiboreal forest. *Agricultural and Forest Meteorology*, 262:59-70
- Loustau D., N. Altimir, M. Barbaste *et al.*, 2018: Sampling and collecting foliage elements for the determination of the foliar nutrients in ICOS ecosystem stations. *International Agrophysics*, 32:665-676
- Lundström, J., K. Öhman, H. Laudon, 2018: Comparing buffer zone alternatives in forest planning using a decision support system. *Scandinavian Journal of Forest*, 33, NO. 5, 493-501
<https://doi.org/10.1080/02827581.2018.1441900>
- Malhotra, A., T.R. Moore, J. Limpens & N.T. Roulet, 2018: Post-thaw variability in litter decomposition best explained by microtopography at an ice-rich permafrost peatland. *Arctic, Antarctic, and Alpine Research*, 50, e1415622
- Martinez, M.A., B.J. Woodcroft, J.C.I. Espinoza *et al.*, 2018: Discovery and ecogenomic context of a global Caldiserica-related phylum active in thawing permafrost, *Candidatus Cryoserica* phylum nov., *Ca. Cryoserica* class nov., *Ca. Cryosericales* ord. nov., *Ca. Cryosericeae* 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(1):54-66, DOI:10.1016/j.syapm.2018.12.003
- Menegat, A., P. Milberg, A.T.S. Nilsson, L. Andersson & G. Vico, 2018: Soil water potential and temperature sum during reproductive growth control seed dormancy in *Alopecurus myosuroides* Huds. *Ecol Evol.*, 8:7186-7194, DOI:10.1002/ece3.4249
- Meredith, L.K., K. Boye, C. Youngerman, M. Whelan, J. Ogée, J. Sauze & L. Wingate, 2018: Coupled biological and abiotic mechanisms driving carbonyl sulfide production in soils. *Soil Syst.* 2018, 2(3):37, DOI:10.3390/soilsystems2030037
- Mzobe, P., M. Berggren, P. Pilesjö, E. Lundin, D. Olefeldt, N.T. Roulet & A. Persson, 2018: Dissolved organic carbon in streams within a subarctic catchment analysed using a GIS/remote sensing approach. *PloS One*, 13(7):e0199608, DOI:10.1371/journal.pone.0199608
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- Nicolini, G., M. Aubinet, C. Feigenwinter *et al.*, 2018: Impact of CO₂ storage flux sampling uncertainty on net ecosystem exchange measured by eddy covariance. *Agricultural and Forest Meteorology*, 248:228-239
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- Nilsson, E., A. Rutgersson, A. Dingwell *et al.*, 2018: Characterization of wave energy potential for the Baltic Sea with focus on the Swedish Exclusive Economic Zone. *In revision.*
- Op de Beeck M., B. Gielen, L. Merbold *et al.*, 2018: Soil-meteorological measurements at ICOS monitoring stations in terrestrial ecosystems. *International Agrophysics*, 32:619-631
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