ICOS RI Annual Report 2025

Approved 19 May 2026
ICOS/GA26/4

Contents

2025 Highlights of ICOS Research Infrastructure

ICOS 10 anniversary

The ICOS ERIC 10-year anniversary took place in Helsinki, Finland, on 25–27 November 2025. The week brought together scientists, technicians and other key staff from across the ICOS community, along with funders, collaborators and invited guests.

ICOS Curve

The ICOS Curve, a new interactive web service published on the eve of COP31 meeting, shows the dynamics and trends in CO_2 levels in the atmosphere above Europe. It calculates a monthly median CO_2 concentration for the previous month, and a growth rate for the most recent year. The application also allows you to compare CO_2 levels from stations in different places with European and global averages.

https://www.icos-cp.eu/impact/icos-curve

A new DG was selected, starting 1.1.2026

The General Assembly elected a new Director General, Hannele Korhonen (now Laine), at its meeting on 21 May 2025. She joined ICOS ERIC on 1 October 2025 and assumed the role of Director General on 1 January 2026.

KPI summary

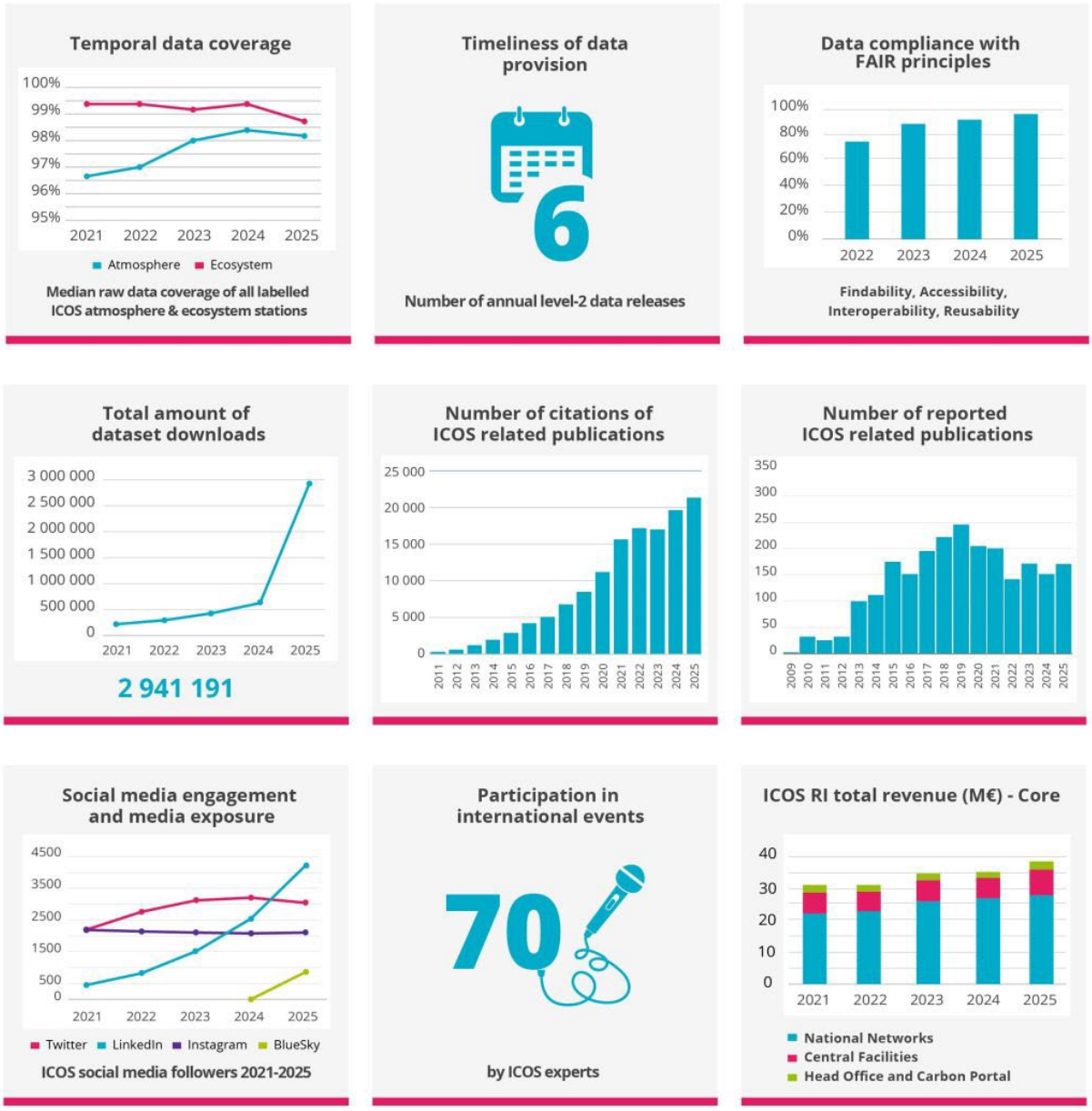


Figure 1 The essential ICOS Key Performance Indicators

Co-operation with other infrastructures

The most important co-operation between infrastructures happens on station level. The co-located stations are listed in Annex 2.

In 2025 the co-operation between the ICOS and ACTRIS Head Office teams has been more active than earlier. The highlight of the joint activities was the study circle of Horizon Europe. The idea of the study circle was to get to know Horizon Europe project management even better and to use the collective intelligence of ICOS, ACTRIS and eLTER colleagues. The material was based on a Horizon Europe Academy training that was held in Lisbon in March 2025. Each participant was given the chance to host a session giving a short 20-minute introduction to the topic and answering questions. Other participants studied the material independently and drafted 1-2 questions to the host and the group. In practice, questions and lively discussions went on in each session. The study group convened 9 times between August and December at the Head Office big meeting room and online.

In 2025, eLTER has made significant progress towards the ERIC status. The so-called step 1 application was very positively evaluated and approved by the European Commission in December 2025, which means that eLTER is likely to receive its ERIC plate in 2026. After the ICOS10 celebration, a Chinese delegation led by Professor Yu (Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences (IGSNRR-CAS) joined the visit organized with eLTER in Hyytiälä. Discussions confirmed the close collaboration between ICOS and eLTER on issues related to data protocols, standards, metadata… for the eLTER measurements related to carbon.

Director General and Head Office

Progress in the regular tasks

General Assembly coordination

Two ICOS General Assembly meetings took place in 2025. The autumn meeting took place in November in Helsinki as part of the ICOS10 celebrations, and the Info Day was opened to entire community. The spring meeting took place online in May.

RI Committee management

The RI Committee, formed by representatives from the Head Office, Carbon Portal, Central Facilities and Monitoring Station Assemblies, had a-three-day face to face meeting in Antwerpen, and a set of longer online meeting in in October. The RICOM also had monthly online-meetings.

Support for Scientific and Ethical Advisory Boards

The Scientific Advisory Board meeting with RICOM in November was held online and split over two days to accommodate all the various time zones from Finland to West coast USA. Three members came to the GA meeting in November and participated in some of the ICOS10 activities.

The Ethical Advisory Board has not had any emerging issues to solve during 2025. The new board had its kick-off meeting, elected Ondřej Hradil as chair, and one member participated in the ICOS10 activities.

Financial management of ICOS ERIC

The 2025 Annual Contributions of the member countries were paid before the Autumn General Assembly meeting. Accounts were audited before May meeting. Participation and coordination of

Horizon Europe projects added the load in administration, especially since EU Commission decided to audit ICOS EU project administration in September 2025.

The Financial Committee continues to collaborate with the Head Office on the financial management of ICOS ERIC, serving as an advisory and strategic working group that reports directly to the General Assembly. In 2025, the committee convened for two virtual meetings. The Autumn General Assembly selected 3 new members to the Financial Committee to replace two members that stepped down. The Financial Committee currently has five members.

Instrument register

No new instruments were bought 2025. ICOS ERIC still owns a PICARRO (in use onboard Tavastland, operated by IOW) and a MIRO (in use in ICOS Cities project).

Human resources management for ICOS ERIC

The Head Office continues to implement improvements, and to organise trainings based on the feedback received in Workplace Survey Autumn 2024. For instance, a First Aid training was held for all interested employees in December 2025. Heads of Units had coaching sessions with occupational psychologist Ellen Ek to refine their leadership skills.

ICOS ERIC Salary and Career Paths policy continues to guide career path progression and salary increases. An International Remote Work Policy, providing clear guidelines for employees wishing to work remotely from abroad for short periods of time, was finalised 2025.

The HO recruited a Head of Administration (Saija Korppi-Tommola) and a Communications Officer (Beatriz Abelenda, to work on EU projects) in August 2025 as well as a new Director General (Hannele Laine) who onboarded with retiring DG from October to December 2025. The total number of staff consistently averages around 20 on an annual basis.

The following personnel were employed by ICOS ERIC during the year 2025.

- Director General elect (Hannele Laine), started 1.10.25.
- Director of Carbon Portal (Alex Vermeulen), leading the Carbon Portal at Lund University. Deputy of the Director General during unforeseen absences.
- Head of Unit 'Operations' (Elena Saltikoff), coordination and development of the operations of the whole ICOS research infrastructure.
- Head of Unit 'Strategy & International Cooperation' (Emmanuel Salmon), coordination and development of the strategic and international cooperation of whole ICOS RI.
- Head of Unit 'Communications' (Katri Ahlgren) Responsibility for ICOS RI communication and outreach strategy, activities and ICOS brand and visual outlook.
- Head of Unit 'Administration' (Saija Korppi-Tommola) Responsibility for ICOS financial, HR and other administration, including project financial reporting and audit coordination.
- Operations Officer (Evi-Carita Riikonen), supporting the coordination of the operations, especially the RI Committee work, supporting the planning and reporting of the RI activities, operational development tasks and project management and impact analysis tasks.
- Science Officer (Janne-Markus Rintala), ICOS Science conference, contributing to projects and proposals especially related to ocean observations' technological and scientific research & development

- HR & Administration Officer (Inka Hellä), Human Resources and general administration and providing personal assistant duties for Director General.
- Senior Officer, Data Analyst, (Ville Kasurinen), HO contact for elaborated data products development, contributing to projects and proposals (ICOS Cities, KADI)
- Observation Network Officer (Maiju Tiiri), support with the coordination of the station network, ICOS Science Conference.
- Project Officer (Liisa Ikonen) contributes to participating and preparing for externally funded projects (ICOS Cities), and ICOS stakeholder analysis.
- Communications Officer (Charlotta Henry), tasks and responsibilities related ICOS RI internal as well as to ICOS RI external communications, and selected EU projects ICOS participates in (such as ICOS Cities).
- Communications Officer (Maria Luhtaniemi), communications tasks and responsibilities related ICOS RI internal as well as to ICOS RI external communications and to selected EU projects ICOS participates in (such as GEORGE and RItrainPlus).
- Communications Officer, (Karlina Ozolina), tasks and responsibilities related ICOS RI internal as well as to external communications and selected EU projects ICOS participated in (such as ENVRI-HUB-NEXT and KADI).
- Communications Assistant (Peter Taggart), communications tasks and responsibilities related ICOS RI internal as well as to external communications, and to selected EU projects ICOS participates in (such as NUBICOS).
- Service Designer (Mariana Salgado), contributes to EU projects ICOS participates in (IRISCC, ENVRINNOV).
- Controller; (Tommi Pesonen), travel and cost claims, assisting with the financial tasks.
- EU Project Assistant (Emilie Hachem), assisting with the tasks related Horizon2020 and Horizon Europe projects.
- KADI Project Manager (Theresia Bilola), tasks related to KADI project management.

Employed in 2025 (No longer with ICOS ERIC):

- Director General (Werner Kutsch). His contract ended 31.12.2025.
- Science Integration Officer (Sindu Parampil), facilitation of the initiatives of the ICOS academic community, contributing to projects and proposals, supporting the work of the ICOS Scientific Advisory Board, left 28.2.2025. SIO services have been outsourced from then on.
- Financial assistant (Leysan Karimova), assisting with the tasks related Horizon2020 and Horizon Europe projects. Contract ended 31.12.2025.

In 2025, of the 24 persons employed 15 of the employment contracts were until further notice and 9 were fixed term. Two employees worked part-time upon their own request at least part of the year.

Each ICOS employee had 2-4 confidential *development discussions* with their supervisor. In these events, employee and supervisor discuss tasks of the current year, performance and potential need of new skills. These skills can be achieved by independent learning, from colleagues or by participating in formal training. There is also space for feedback in both directions, and a discussion of motivation and well-being. Such discussions are a standard procedure in working life in Finland since 1970s. In many other countries, a similar event is called *performance review*, but in Finland tradition is to have more focus in being prepared for future tasks than in assessing the past performance.

Contract management.

Contracts were similar to previous years: IT support was bought from Atea, legal service from Fondia and the Audit company was KPMG, accounting company AZETS and recruitment partner Accountor.

Operational management of ICOS ERIC and RI

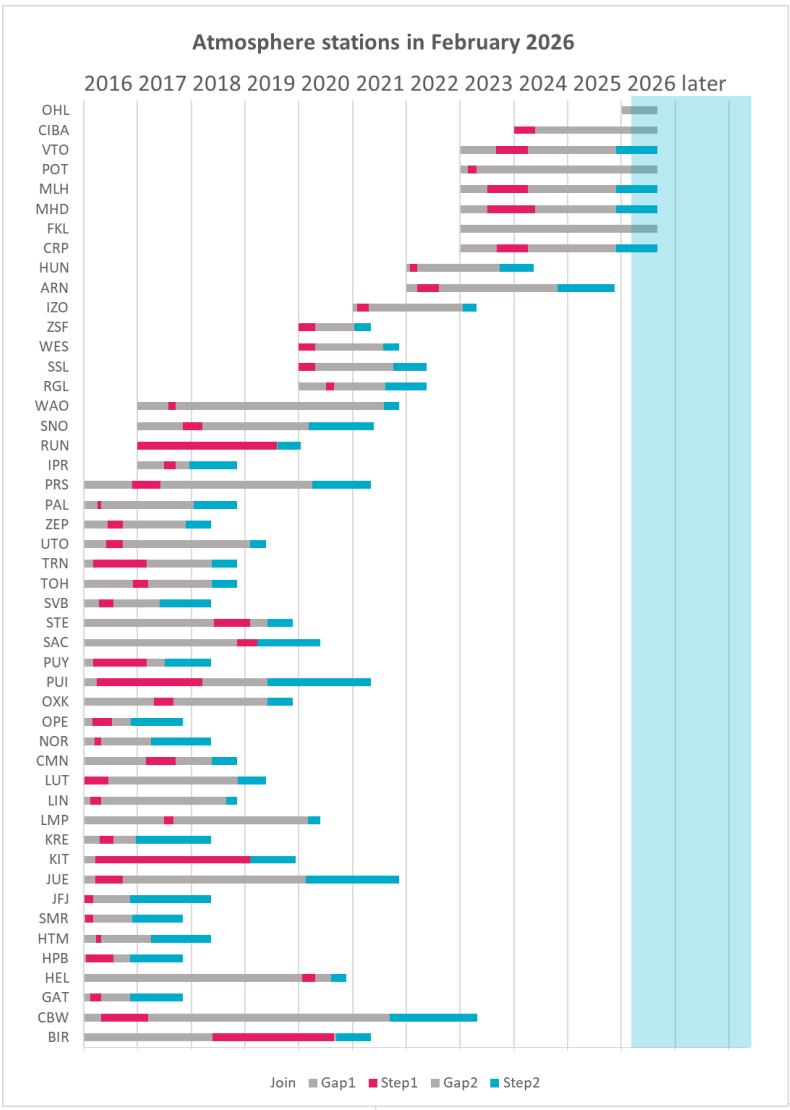
Several new PIs were introduced to ICOS activities. Online meetings were organized for all Focal Points of National Networks, and new Focal Points were invited to one-to-one meetings.
The members of Operations unit participated in the face-to-face meeting of "Super MSA" in context of ICOA10, as well as the online meetings of the MSAs.

A total of 8 stations received an official ICOS label in 2025. Of these stations one was an atmospheric station, five were ecosystem stations and two were ocean stations. Station contracts were prepared between the ICOS ERIC and the host organisations of labelled stations. Progress of the labelling is illustrated in Table 1 and figure 1, figure 2 and figure 3. The GA stakeholders have been encouraged to be in contact with stations, where progress is slow, and where appropriate even consider removing those stations from ICOS network.

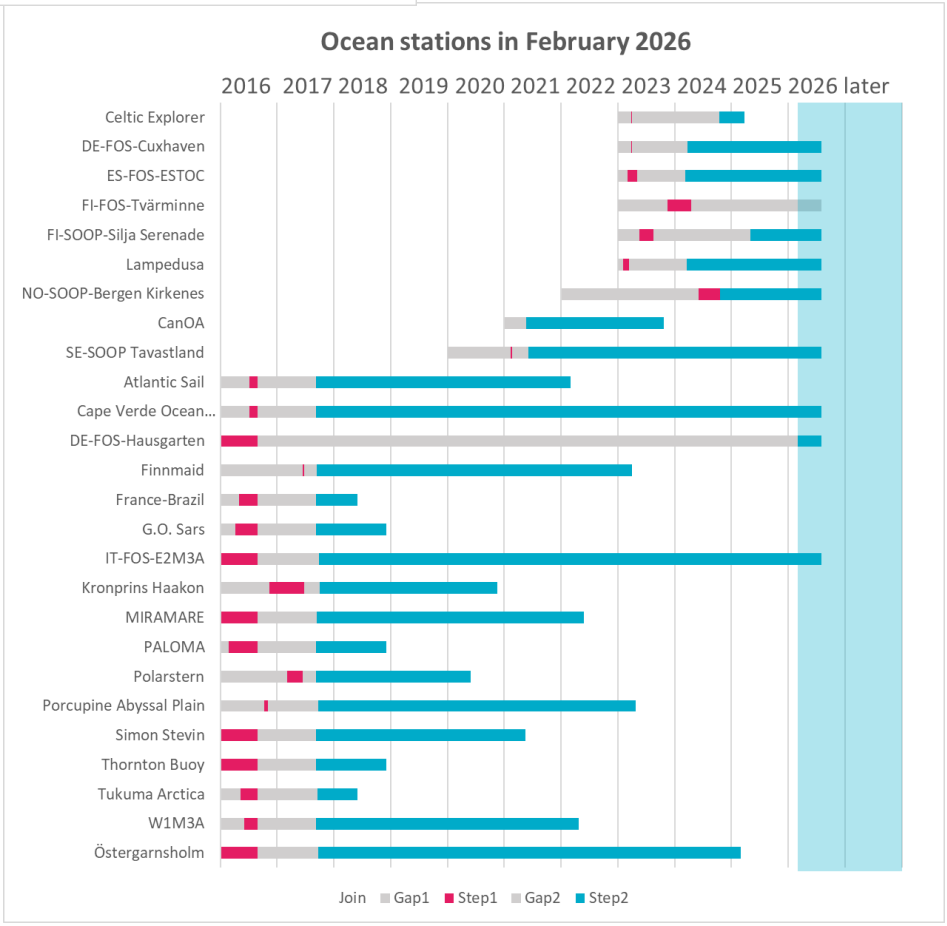
Status of the ICOS Station Labelling in February 2026

Member/ Observer countries	Stations total	Labelled stations total	Number and type of stations														% Labelled per country
			Ecosystem stations						Atmospheric stations				Ocean stations				
			C1	C1 labelled	C2	C2 labelled	Assoc.	Asso. labelled	C1	C1 labelled	C2	C2 labelled	C1	C1 labelled	C2	C2 labelled	
Belgium	12	9	1	1	4	4	3	0	0	0	2	1	2	2	0	0	75 %
Czech Rep.	4	4	1	1	1	1	1	1	1	1	0	0	0	0	0	0	100 %
Denmark	7	7	1	1	1	1	4	4	0	0	1	1	0	0	0	0	100 %
Finland	20	14	2	2	3	2	9	6	2	2	2	2	0	0	2	0	70 %
France	21	20	2	2	6	6	8	7	3	2	1	2	1	1	0	0	95 %
Germany	40	33	4	4	0	0	18	14	6	6	6	6	3	2	3	1	83 %
Greece	4	2	0	0	1	0	2	2	0	0	1	0	0	0	0	0	50 %
Hungary	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	100 %
Ireland	10	2	0	0	2	0	3	1	0	0	4	0	0	0	1	1	20 %
Italy	24	19	2	2	2	2	11	9	1	0	3	3	2	1	3	2	79 %
Netherlands	3	3	0	0	1	1	0	0	1	1	1	1	0	0	0	0	100 %
Norway	7	6	0	0	1	1	0	0	1	1	1	1	2	2	2	1	86 %
Spain	7	4	0	0	0	0	2	1	0	0	3	2	2	1	0	0	57 %
Sweden	12	11	0	0	6	6	1	1	3	3	0	0	1	0	1	1	92 %
Switzerland	3	3	1	1	0	0	1	1	1	1	0	0	0	0	0	0	100 %
UK	4	4	1	1	0	0	1	0	0	0	2	2	0	0	1	1	100 %
JRC	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	100 %
Total	180	143	15	15	28	24	64	47	19	17	29	23	13	9	13	7	
% Labelled per domain and class:			100 %		86 %		73 %		89 %		79 %		69 %		54 %		

Table 1. Labelled ICOS stations per country, domain and class by the end of February 2026. Note: One ocean station from Germany (DE-SOOP-Polarstern) was labelled as class 2 but has been changed to class 1.


Atmosphere stations in February 2026
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 later
OHL
CIBA
VTO
POT
MLH
MHD
FKL
CRP
HUN
ARN
IZO
ZSF
WES
SSL
RGL
WAO
SNO
RUN
IPR
PRS
PAL
ZEP
UTO
TRN
TOH
SVB
STE
SAC
PUY
PUI
OXK
OPE
NOR
CMN
LUT
LIN
LMP
KRE
KIT
JUE
JFJ
SMR
HTM
HPB
HEL
GAT
CBW
BIR
Join
Gap1
Step1
Gap2
Step2


Atmosphere
Step 1
Step 2


Ocean stations in February 2026
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 later
Celtic Explorer
DE-FOS-Cuxhaven
ES-FOS-ESTOC
FI-FOS-Tvärminne
FI-SOOP-Silja Serenade
Lampedusa
NO-SOOP-Bergen Kirkenes
CanOA
SE-SOOP Tavastland
Atlantic Sail
Cape Verde Ocean...
DE-FOS-Hausgarten
Finnmaid
France-Brazil
G.O. Sars
IT-FOS-E2M3A
Kronprins Haakon
MIRAMARE
PALOMA
Polarstern
Porcupine Abyssal Plain
Simon Stevin
Thornton Buoy
Tukuma Arctica
W1M3A
Östergarnsholm
Join
Gap1
Step1
Gap2
Step2


Ocean
Step 1
Step 2

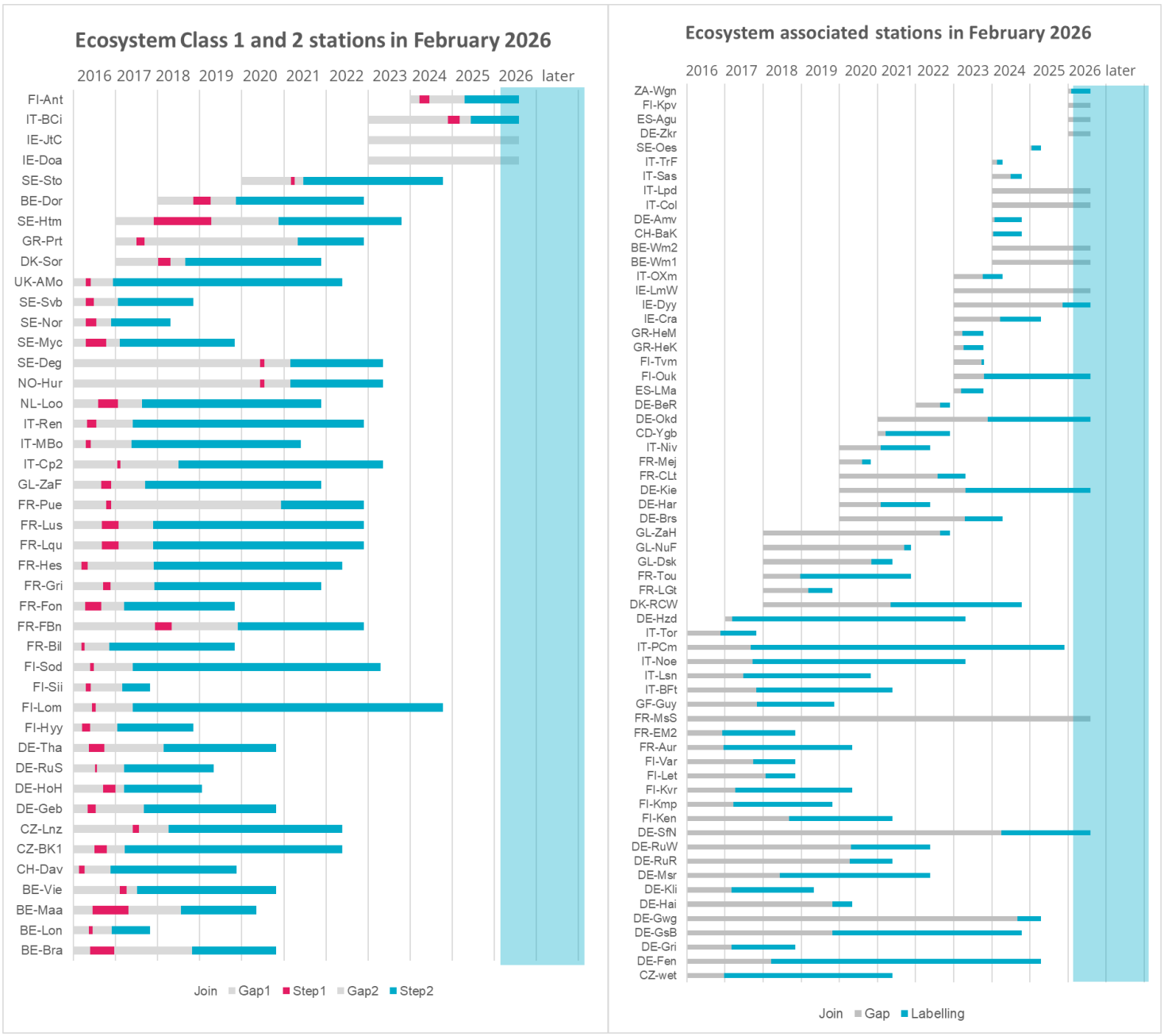


Figure 2-3. Progress of station labelling in each domain in February 2026.

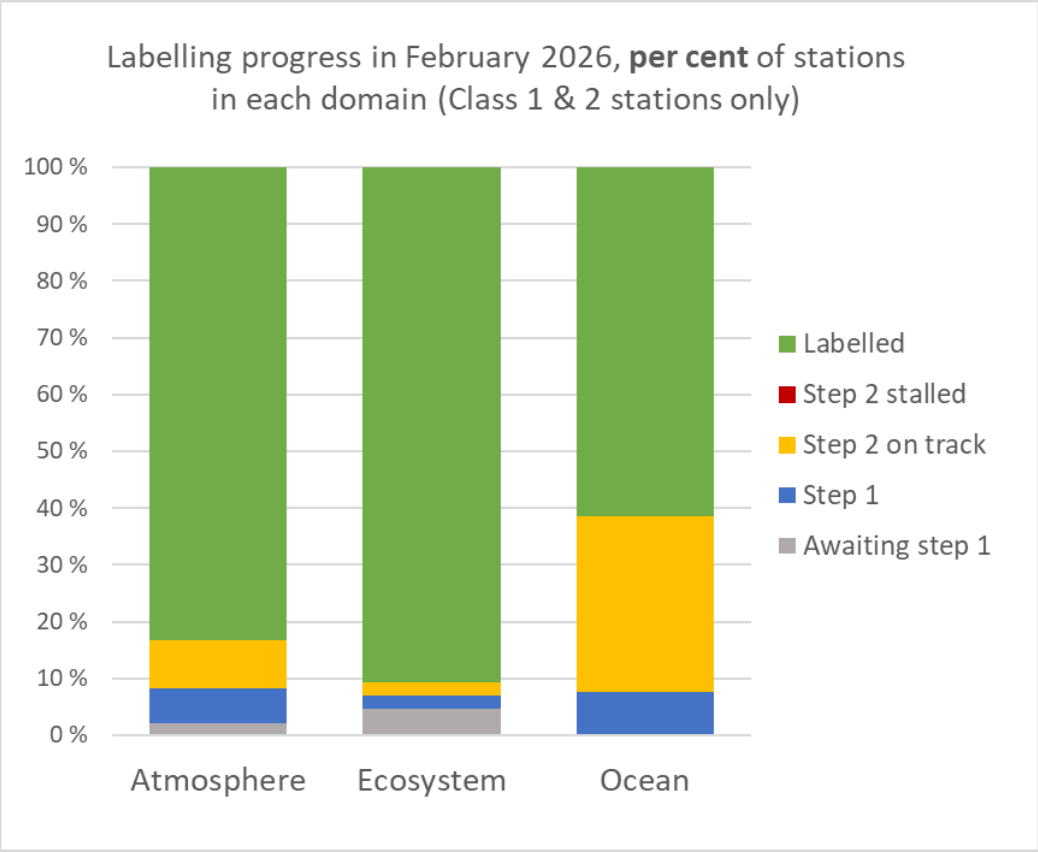


Figure 4. Labelling process, per cent of stations (Class 1 and class 2) in each labelling step by domain.

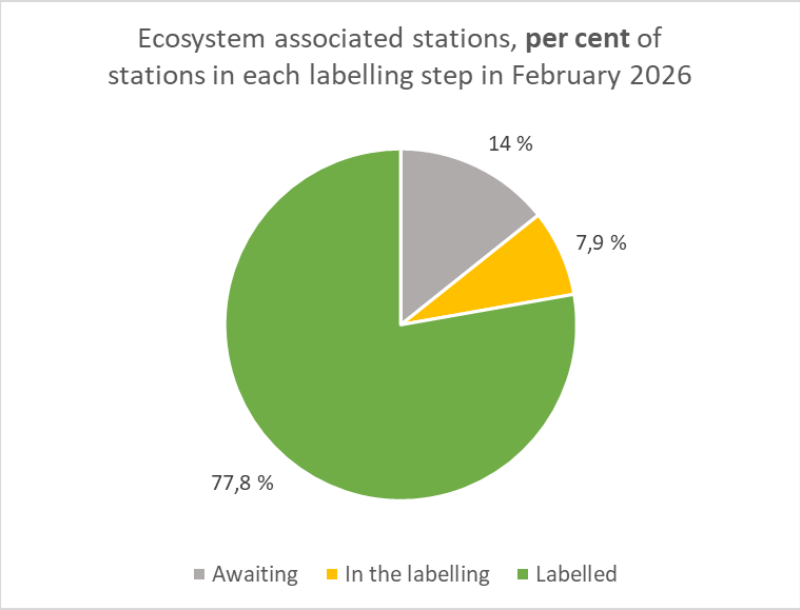


Figure 5. Labelling process of associated ecosystem stations in February 2026.

The station level progress of labelling can be followed from https://meta.icos-cp.eu/labeling/. Currently, 3 stations are with a status “Step 2 delayed” and no stations are in status “stalled”.

Support for ICOS-related science

One of major science facilitation activities ICOS focused on in 2025 was introducing ICOS data to new users in the modeling and remote sensing communities. Though ICOS data is well known to several groups, there are sections where we can continue to increase our presence. With this agenda, ICOS participated in two large, albeit different remote-sensing conferences: In May, ICOS participated in the GEO Global Forum and gave talks at ITINERIS booth. ICOS also participated in the ESA Living Planet Symposium (LPS) in Vienna, June 2025. The LPS is held every third year and is a premier scientific conference on Earth Observation. ICOS' mandate there was to explore the scope of in-situ GHG data for the remote sensing and satellite community in Europe and globally. ICOS had a booth and held lunch time talks on all 5 days highlighting the important role of in situ data as 'ground truth' in satellite calibration/validation (Cal/Val). In lieu of the 10-year anniversary of ICOS, a special Information Day was organised, where for the first time MSA members and CF staff attended, along with the GA delegates. The ICOS-10 Info Day was geared towards strengthening the ICOS community, while showcasing the excellent work done in ICOS - be it scientific, technological, administrative advances

Other conferences were on national level, see details in the reports of national networks. In addition, several project proposals were written, and Head Office provided letters of support describing the importance of nationally funded research projects for the entire GHG community.

The FLUXES Vol. 4 was aimed at providing a policy angle to the ICOS Cities project which ended in 2025, the dissemination activities as ongoing. Via FLUXES, ICOS is facilitating impact made of the research done by the ICOS Scientific community and making it visible for policymakers.

See also summary of ongoing projects at end of this report.

Communication and community integration

ICOS uses communications and outreach to considerably increase its impact to the society.

External communications and outreach

The ICOS Head Office continued to promote ICOS mission and its services to a wide range of stakeholders.

The fourth volume of ICOS's FLUXES, the European Greenhouse Gas Bulletin, was published in November 2025. The volume focused on urban measurements, showcasing the results of the recently finished ICOS Cities project to an audience consisting particularly of policymakers, policy advisors, and climate journalists. By the end of 2025, the volume had reached approx 2000 people. Same topics were also raised up in high-level meetings, and this will be continued during 2026. More about those in International Cooperation section of this report.

ICOS ERIC continued to produce videos about stations and central facilities. In 2025, the HO visited 3 stations in Ireland, producing videos, photos, articles etc. The footage from earlier station videos was used to produce a general ICOS promotion video. HO also made a promotional video of the Ocean Thematic Centre, in connection with GEORGE project's video production. That was published in 2026.

ICOS materials, website, media and social media

ICOS' external communication include production and dissemination of a wide range of engaging content across a variety of channels. ICOS HO published 64 (60) pieces of news on the website, and a monthly newsletter reaching 2109 (1976) readers. ICOS's followership in social media channel X was declining throughout the year, the engagement rates being in even steeper decline. ICOS's audience left the channel in large quantities following the changes in the channel's algorithm and nature. Anticipating leaving the channel, ICOS established a new account in Bluesky in late 2024 and left X in early 2026.

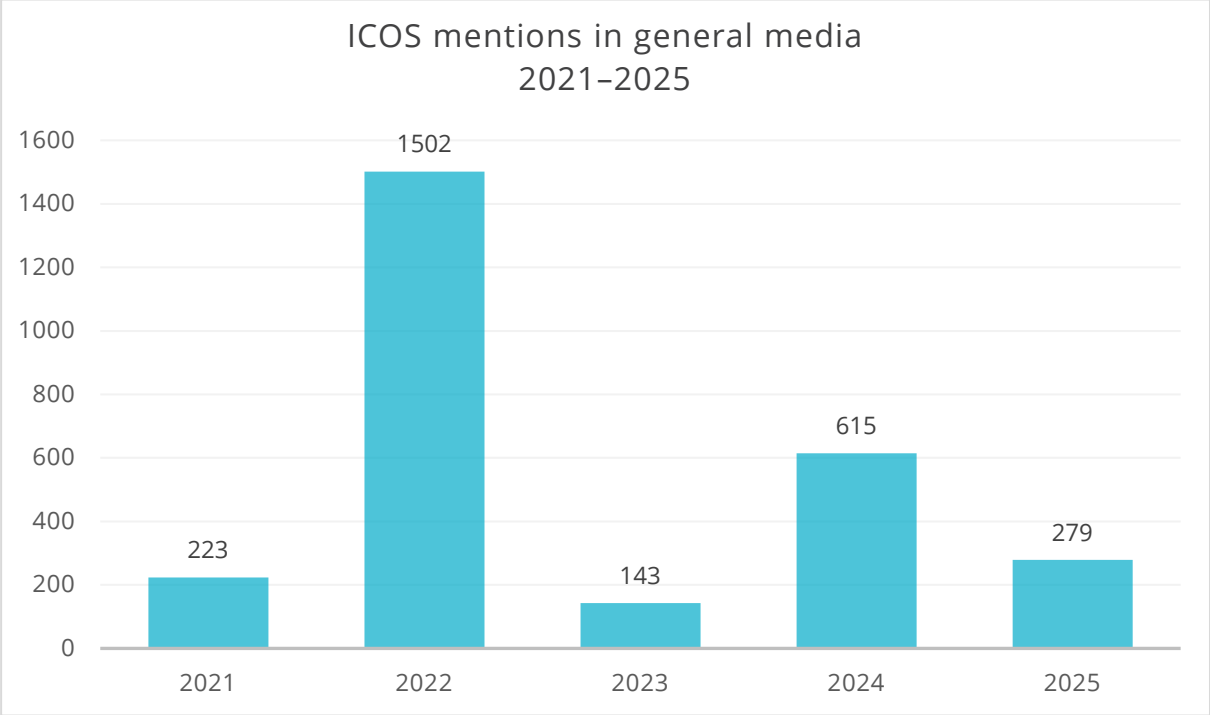


Figure 6: ICOS mentions in global online media 2021-2025. Year 2022 has exceptionally high number of media hits because of the high interest in North Stream gas leak that took place in late 2022.

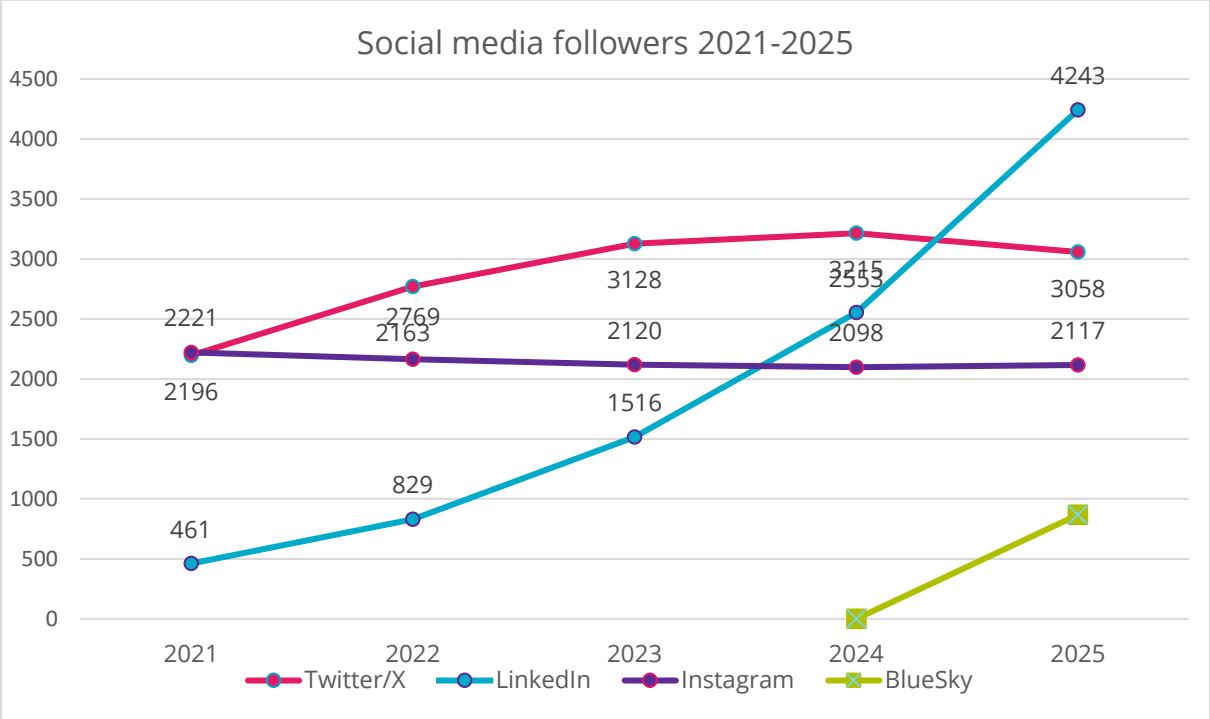


Figure 7. The number of followers in the most important ICOS social media channels. X (ex-Twitter) saw a decline in engagement 2025, as many ICOS's followers left the channel. However, this is not fully visible in the pink curve visualising the nr of followers, as many "froze" their accounts, keeping them in the channel but inactive. As a result, ICOS left X in early 2026, investing more into the new Bluesky and fast-growing LinkedIn. The use of LinkedIn in the world has grown considerably.

Community integration

Community integration refers to the participation of different parts of the RI into activities and the ability to improve activities and respond in an agile way to new opportunities or challenges.

Besides activities, communication is an important glue fitting the community together. To that end, the Head Office and Carbon Portal regularly support internal communication across the ICOS RI. HO continued to publish a community section connected to monthly newsletter, while the ICOS Carbon Portal maintained internal document management system and email-lists. The HO also continued the good cooperation with the RI Communications Network - consisting of National Network coordinators or Focal Points - in order to align messaging and to share information and best practises.

International Cooperation

No new country joined ICOS ERIC in 2025 but the work towards Portugal, Poland and Austria continued.

Portugal remains a highly strategic country as its geographical position, including its vast maritime domain, would significantly increase the coverage of the ICOS network. The main challenge faced is the lack of initiative of the local scientific communities, despite the efforts provided by the main contact of the Head Office. The link is constantly maintained but it is difficult to identify what could cause a breakthrough towards a Portuguese membership in ICOS ERIC.

One new target country has been Romania. The Horizon Europe 3e-CARE project, led by the Romanian National Institute for Optoelectronics (INOE) was submitted and validated in step 1 in 2025. It has led to intense discussions for the preparation of step 2 submitted in January 2026. It is expected that the development of an ICOS-compatible capacity in Romania, supported by ICOS ERIC as a core partner of the project, will encourage the Romanian authorities to join ICOS ERIC. ICOS has continued its activities as a member of the ENVRI Board, the newly established coordination body of the ENVRI Community. In the absence of a relevant cluster project, the year 2025 has not seen major developments in the common strategic activities of ENVRI.

In Africa, the activities in the Knowledge and Services from an African Observation and Data Infrastructure (KADI) project gave ICOS the opportunity to actively engage with many African stakeholders until the very last meeting of the project in Dar es Salaam (Tanzania) in August 2025. One key achievement, which was made possible by the active support of the ICOS ETC, was the compilation of Kenyan ecosystem data into the 2025 Fluxnet release.

The most recent activities of the Global Ecosystem Research Infrastructure (GERI), a consortium between ICOS and 5 other world-class RIs in Africa, Australia, China, Europe and the US, were presented at EGU25.

In 2025, ICOS decided not to attend COP30 in Belém (Brazil), but a key activity was featured there. The Head Office submitted a document to the Subsidiary Body for Scientific and Technological Advice (SBSTA) of UNFCCC to serve as “Further Resources for Plenary” at the Earth Info Day organized on November 10, 2025 at COP30. This document, entitled “ICOS Curve showing carbon dioxide concentrations and trends over Europe from 38 ICOS atmospheric stations in the northern hemisphere” is available on the website of the event: https://unfccc.int/event/earth-information-day-2025-mandated-event.

Green Team

ICOS ERIC Head Office personnel have reported their business travel and commuting emissions monthly since 2019. After the UNFCCC pledge of compensation by offsetting ended in 2023, new practices were developed that were still in place in 2025. The practices have been described in the ICOS ERIC Travel rules.

Slow travel: a supervisor can accept a longer travel time and reasonable additional travel costs if an employee selects a low-emission method such as the train or the bus.

Combining travel destinations: if an employee has several work-related journeys close to each other both time and location wise, they may choose to travel between the destinations instead of returning home in between.

It is encouraged to think more carefully if there is an actual need to travel – or could the same result be achieved by arranging a virtual meeting or by other method. At the same time, it is seen important to provide proper reasoning for travel – why or when to fly, and who should fly.

After the corona lock down, the Head Office business travel emissions dropped dramatically. After the lock down emissions have increased steadily but not yet reaching the 2019 level (<100 000 kg eCO2). A lot of reasoning was given why 2024 emissions were higher than 2023, such as growing number of staff, coordinating more projects and events in Australia and South Africa. In 2025 business travel emissions have decreased close to the 2022 level, to >40 000 kg eCO2, although there was no big change in number of staff or projects to be coordinated. However, the business travel destinations were closer, ICOS did not attend COP30 in Belém, Brazil, and even the GA meeting was held in Helsinki.

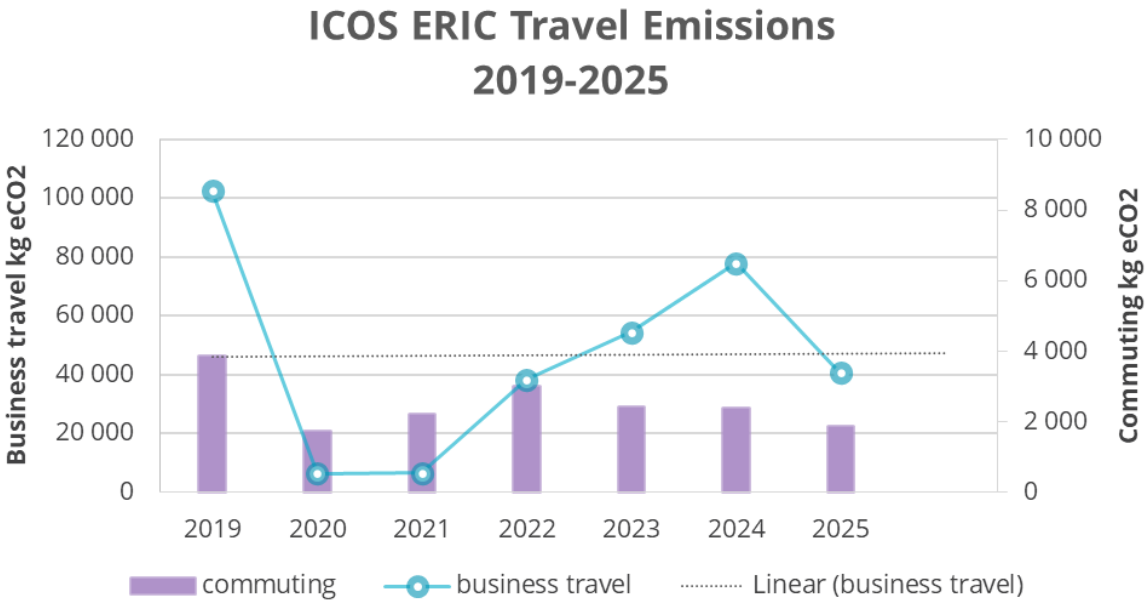


Figure 8. After COVID19 lockdown, business travel emissions increased steadily, but decreased again in 2025.

Carbon Portal

General

In the reporting year 2025 the operations at ICOS Carbon Portal were smooth and stable with all systems availability well above 99.9%. Despite a relatively large rotation in personnel of six persons, 4 (partial) parental leaves, and a large interruption due to a forced relocation of the offices over an 8-week period, we were able to secure the service provision in all aspects.

The 2025 plan of decreasing the relative workload from projects was only partially achieved mainly because of the above reasons. As the large projects ATMO ACCESS and ICOS Cities were ending by December 2025, significant workloads connected to the final deliverables of this project took a hit on the capacity. Therefore, spending on the core Carbon Portal budget ended up below the plan as priority was given to utilizing the project budgets.

The planned improvements by adding a data steward and a user support officer have proven to work very well. Carbon Portal is now increasingly used by external projects for trusted and FAIR publishing of ICOS related observations and data products. This also contributed to more requests to ICOS ERIC Carbon Portal to join consortia in Horizon Europe proposals.

The data steward was just in time to help to steer the ingestion of a multitude of different datatypes and data objects from the ICOS Cities into the ICOS Cities data portal. Despite being planned as protype demonstration City data portal the ICOS Cities Portal functions already as a TRL 9 operational product.

Increased attention to user support has resulted in more happy customers and quicker response to user requests for accounts, feedback and information.

The planned increase in capacity for the development of core back-end services did not come to full fruition in 2025 because of the already mentioned parental leaves in the development section of CP and unavoidable gaps capacity due to the long and careful process of filling the open positions. One new hire did not make it through the probation period so one developer position is still open.

In 2025 we started to deploy applications through more rapid development techniques using the Dokku platform, that allows to streamline the deployment of services directly by a ‘push’ from GitHub. The first example of this is the Curve application for atmosphere, that was launched at the ICOS10 event. A second example is an application to monitor the influence of nuclear reactor emissions of 14C on the 14CO2 signal received at ICOS stations, used by ATC and FCL to check which flask samples should be selected for analysis on 14CO2. More examples will follow in 2026 and onwards with ‘iconic’ explorative tools for ecosystem and ocean to illustrate the power of ICOS data, also for these domains.

Data Statistics

Data availability

In 2025 CP received in total 508 273 data objects (Table 1), of which 422 719 are considered ICOS data. Of these 217 930 came from the atmosphere domain, 198 862 from the ecosystem domain and 5 916 from the ocean domain. 11 ICOS data objects were of the mixed data theme, mainly CTE-HR data results. The biggest share of ICOS data is raw data (L0, 234 964), but also the daily growing NRT data files (L1, 186 227) form a considerable part of the total number of files. A total of 1 471 data objects were received as Level 2, final quality controlled, ICOS data. At the end of 2025, the Carbon Portal held in total more than 2.75 million data objects.

Total		508 273
ICOS data objects		422 719
	Atmosphere	217 930
	Ecosystem	198 862
	Ocean	5 916
	Mixed theme	11
	L0	234 964
	L1	186 227
	L2	1 471
	L3	57
Other data objects		85 554

Table 1 Statistics on number of data objects received in 2025.

Figures 1 and 2 show the percentage per month of raw data received for the individual stations of the ecosystem and atmosphere domain respectively. Clearly one can see that the number of stations sending data increases because of the growing number of labelled stations. For all years and over the whole period all stations show a data availability of better than 95%. Table 2 summarises the data per year and over the whole period for the two networks. No significant upward or downward trend can be seen over the period 2020-2024 which means the overall network behaves consistently and reliably, despite the growing number of stations that got labelled over the years.

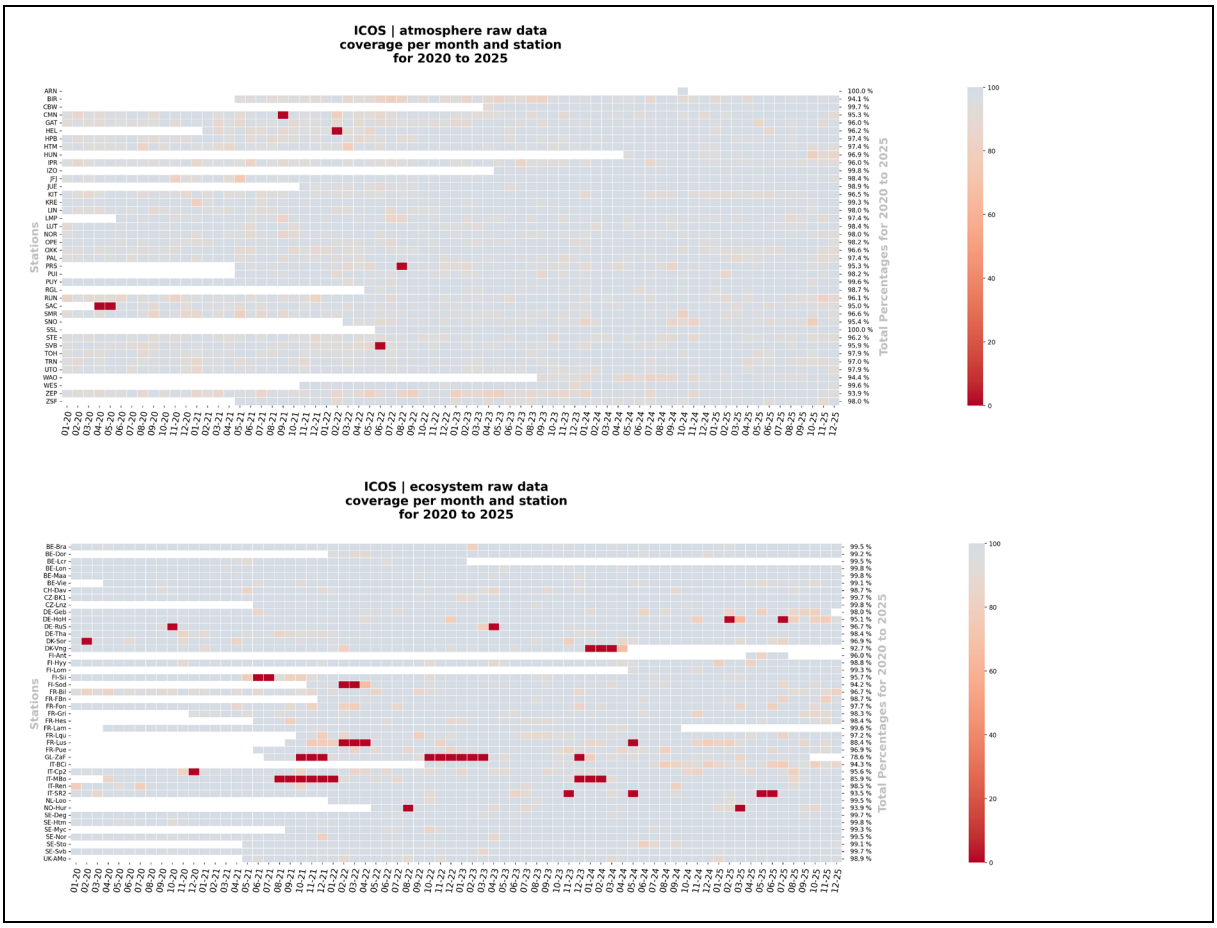


Figure 1 Top: Percentage of raw data coverage for Atmosphere stations for the period 2020-2025. Bottom: similar figure for the ecosystem domain

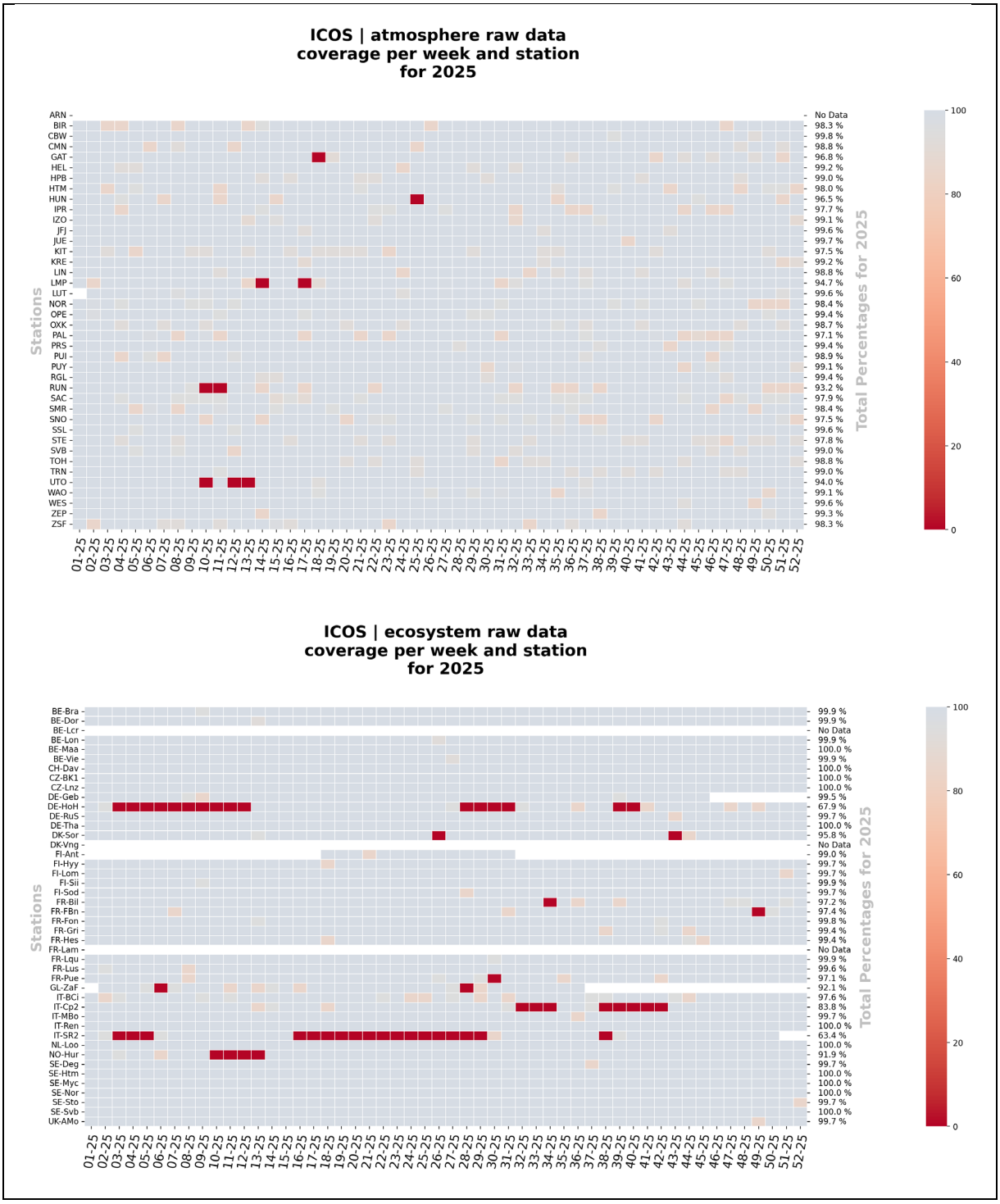


Figure 2 Top: Percentage of raw data coverage in 2025 for atmosphere stations. Bottom: same plot for the ecosystem domain.

Table 2 Percentage of raw data received for the domains of atmosphere and ecosystem for the years 2020 until 2025 and over the total period

Data coverage		2020	2021	2022	2023	2024	2025	2020-2025
Atmosphere	**Median**	96.0%	96.6%	97.0%	98.0%	98.4%	98.2%	97.6%
	Average	95.7%	96.6%	96.3%	97.6%	98.2%	97.9%	97.2%
Ecosystem	**Median**	99.7%	99.4%	99.4%	99.2%	99.4%	98.7%	99.3%
	Average	98.3%	98.0%	97.5%	98.3%	98.4%	97.0%	97.9%

Data releases

All domains delivered at least one release of level 2 final quality data. Ocean L2 release for 2024 was on 24 Feb 2025, Ecosystem L2 release 2025-1 on 5 May 2025 and Atmosphere L2 release 2025-1 on 1 July 2025. The end of growing season interim L2 dataset of Ecosystem data was released 24 Nov 2025.

The 2025 European Obspack data release product (GVeu v11) was prepared and released 12 September 2025. The first so-called FastTrack (FT-2025-1) quarterly release of ICOS Obspack data was published on 20 Jan 2025 and updated to FT-2025-2 on 31 March 2025 and FT-2025-3 on 2 October 2025. FastTrack releases are intermediate NRT releases (could be seen as data level 1.5) where the PIs performed manual quality control and flagging to the NRT data and ATC produced a minimal processing update.

Table 3 Release dates in 2025 of level 2 data for the three ICOS domains

Domain	Release	Date
Ocean	L2 2024-1	24 February 2025
Atmosphere	ICOS FT 2025-1	20 January 2025
	ICOS FT 2025-2	31 March 2025
	ICOS L2 2025-1	1 July 2025
	Obspack EU 2025	12 September 2025
	ICOS FT 2025-3	2 October 2025
Ecosystem	L2 2025-1	5 May 2025
	L2 2025-2	24 November 2025

Data usage by download count and user number

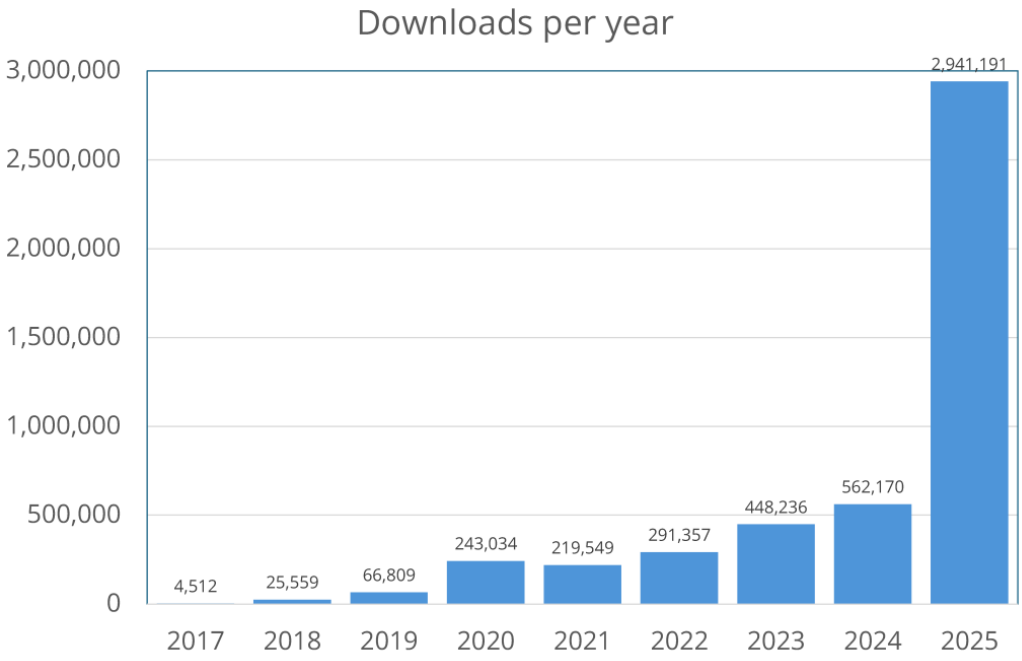


Figure 3. Total number of data downloads from Carbon Portal from 2017 to 2025. In 2025 the number of downloads of ICOS Level 1 and 2 data was: over 2.29 million. Total number of downloads was 2,9 million.

We can further zoom in on specific data uses and for example for the number of downloads we can clearly identify a spike in interest corresponding starting July 2025 with a second step up in October 2025 (Figure 5). Major part of the increase in the second half of 2025 can be traced to a large number

of IP addresses in the USA. We thus far suspect these downloads are coming from data centres performing data harvesting from the big AI providers Microsoft, Google, OpenAI and Anthropic.

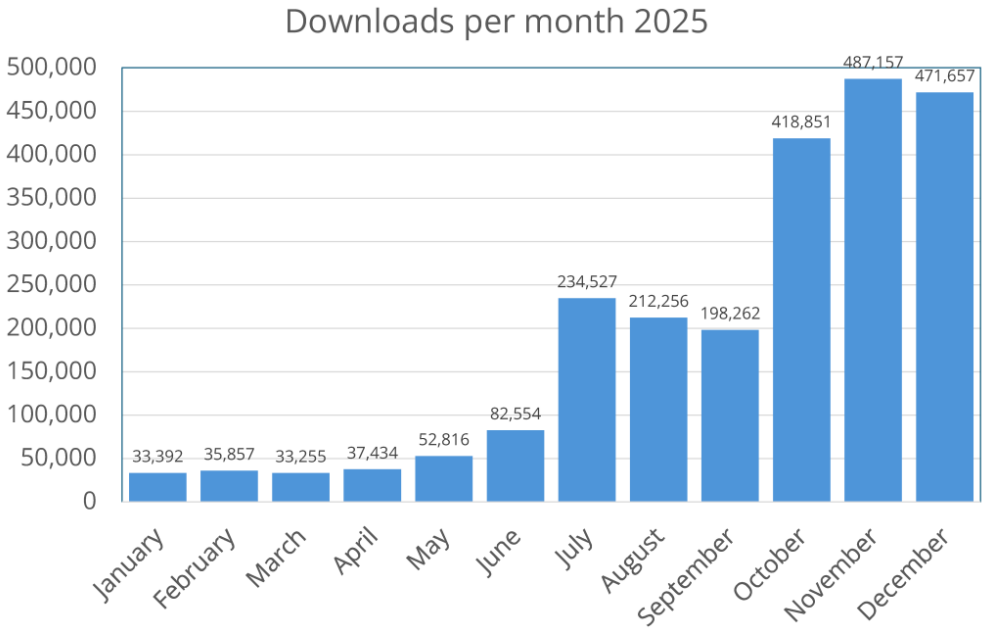


Figure 4. Monthly number of time series previews at Carbon Portal

Total amount of unique users of web pages and web services

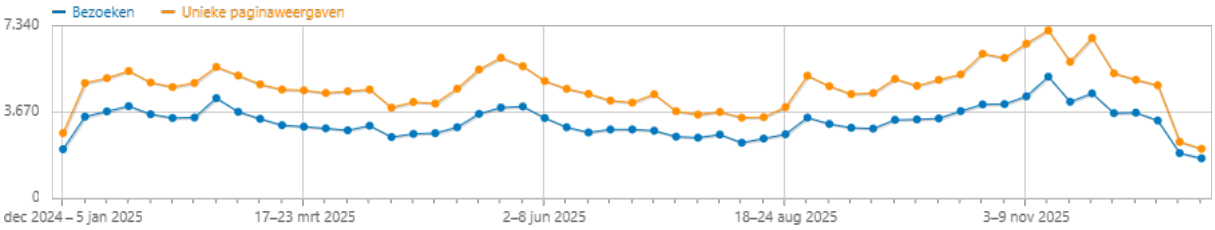


Figure 5 Number of unique users and pageviews per week over 2025 of the ICOS web site plus Carbon Portal. The total numbers of unique users over 2025 was over 170 310 users with 247 963 unique pageviews. We removed from the statistics a spike of more than 1 miilion bot visits in summer 2025.

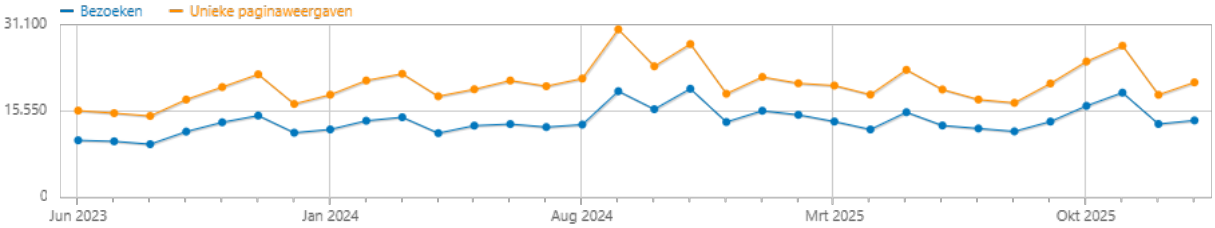


Figure 6 Number of unique users and pageviews per month in the period June 2023 until January 2026, showing a quite stable average of 15 000 users per month since 2023 with a clear peak in September 2022 (Nordstream pipeline blow-up event). Results before June 2023 are not shown here because of transfer of web statistics from Google Analytics to Matomo due to GDPR concerns.

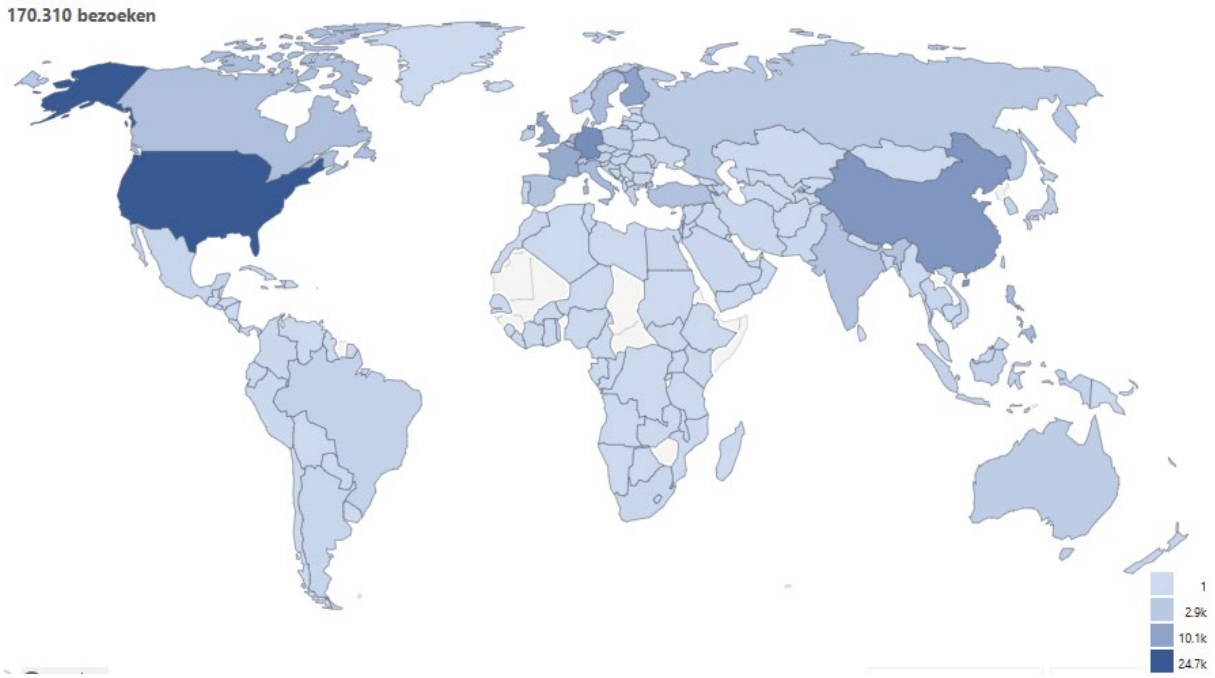


Figure 7 Number of visitors of the ICOS web sites per country for the year 2025.

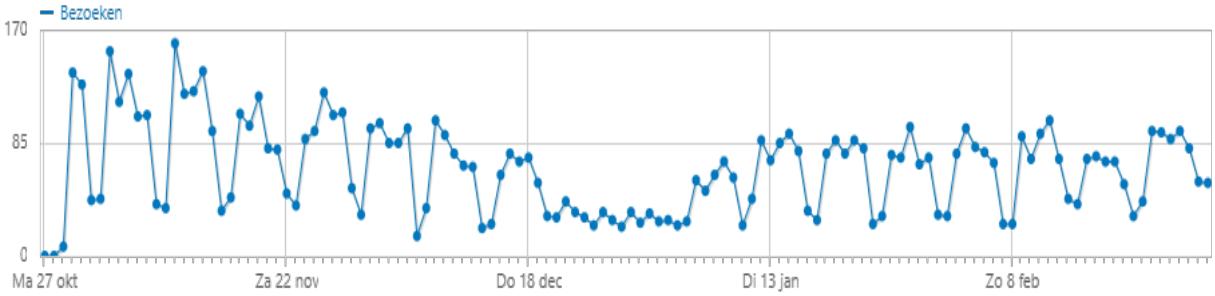


Figure 8 Number of visitors of ICOS Curve, starting from the launch in October 2025. During weekdays and outside holidays Curve receives a decent and fairly constant 85 views per day.

Impact

Impact through articles and citations

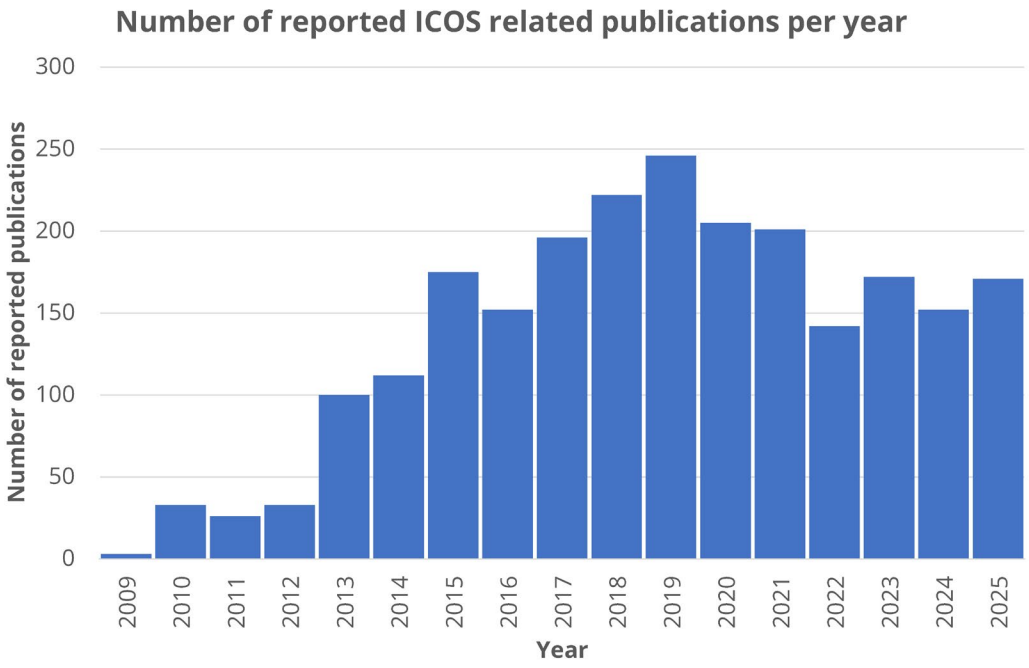


*Figure 9a Number of ICOS related **publications** per year as reported by the community via national Focal Points. Reporting publications has a lag of a few months to more than a year due to the review process, so that next year the numbers for 2025 and even 2024 and 2023 can still increase.*

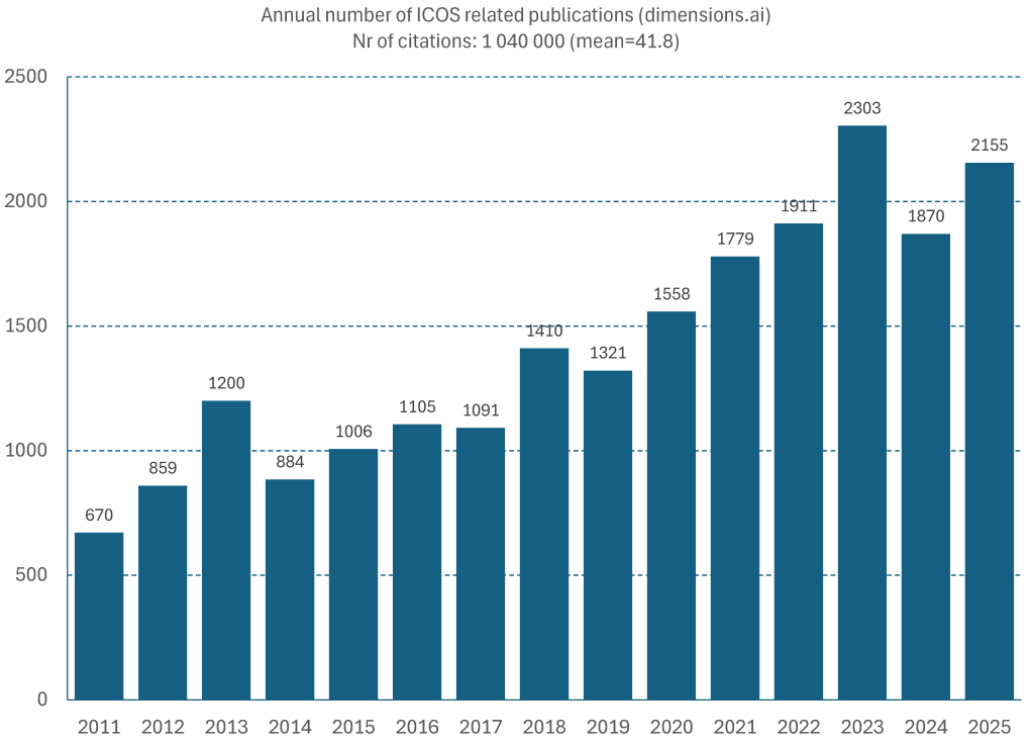


*Figure 9b Number of ICOS related **publications** per year extracted through dimensions.ai. Reporting publications has a lag of a few months to more than a year due to the review process, so that next year the numbers for 2025 and some other more recent years can still increase.*

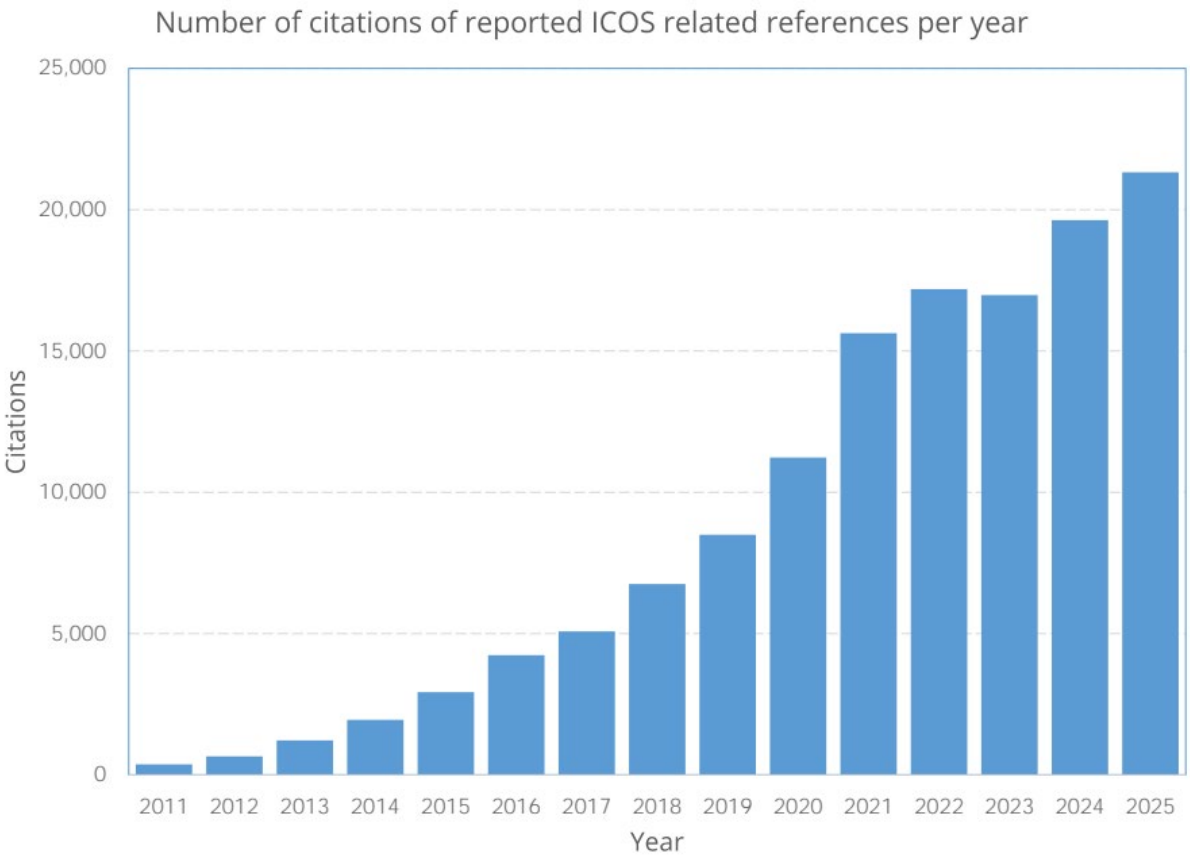


*Figure 10 Number of **citations** to the reported ICOS related publications per year (based on analysis of articles reported by national networks, ie, fig 9a.). In the Dimensions ai. analysis, each article has in average of 42 citations.* The total number of citations of reported references is 138 635, corresponding to an average of 63 citations per reference.

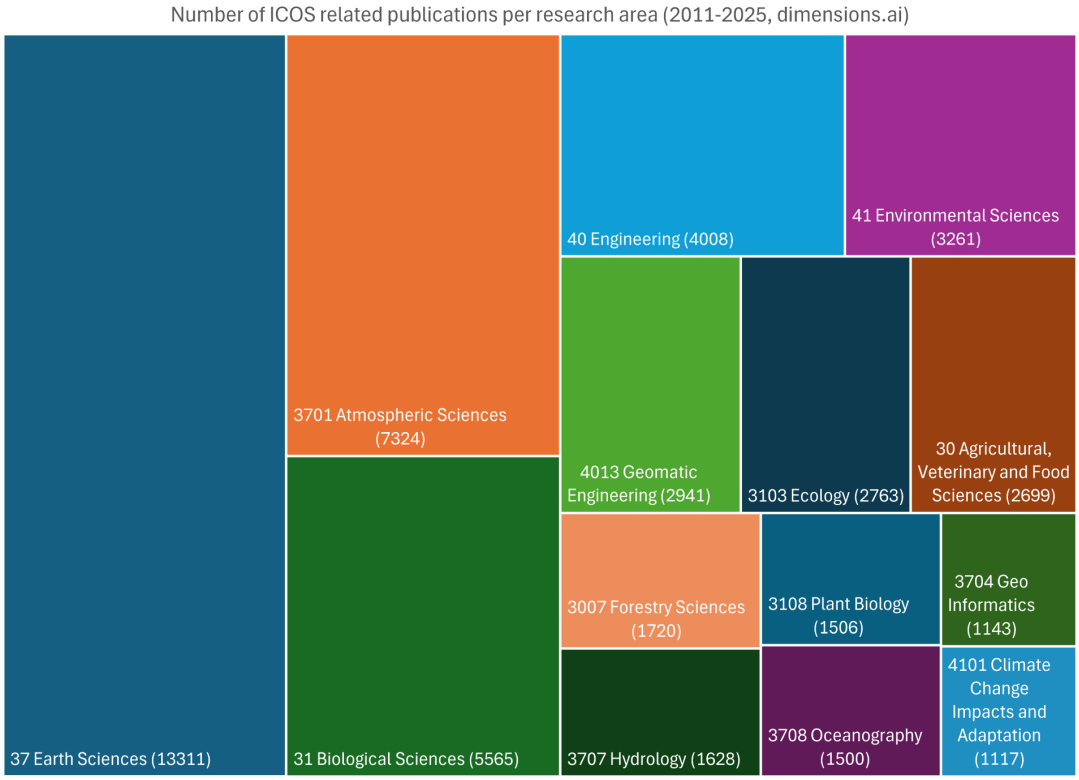


Figure 11. Categories of ICOS publications and number of publications per category over the period 2010-2025 (extracted through dimensions.ai). The six largest categories of ICOS publications were Earth Sciences, Atmospheric Sciences, Biological Sciences, Engineering, Ecology, Environmental Sciences and Geomatic Engineering.

Two methods have been used to estimate the scientific articles related to ICOS. Firstly, the national networks and central facilities are asked to list published papers in their area. The definition of ICOS-related articles has been discussed in RICOM 2017-2019 and it is stated on the website*. ICOS related publications are publications that used ICOS data or knowledge based on ICOS data or is based on science that is relevant for ICOS and to which persons from the large ICOS community have contributed.*

Number of these papers has been increasing steadily. An additional peak can be seen in 2017-2020, when, as encouraged by ESFRI evaluation board, extra effort was made to identify papers published outside of ICOS members countries (which are not under responsibility of any national network to report, but still emphasis the global value of ICOS Data).

The second method is using an artificial intelligence tool *Dimensions.ai*. When using prompt ICOS, FLUXNET, SOCAT, ObsPack it returns ten times as many hits than the manual method. The ratio is apparently constant over years, so the trend has same shape.

As ICOS does not yet have an agreed policy for use of AI tools, we publish here both numbers.

Science and integration

Jupyter notebooks

The Jupyter Notebook services at CP continued to be a popular service for scientists and students to explore ICOS data and products on our public service exploredata.icos-cp.eu or to work on their own scientific analyses and code development in collaboration with colleagues on our collaborative Jupyter Hub, which currently has more than 300 registered users.

In particular the advanced options of the collaborative Jupyter Hub are actively used in several EU projects (e.g. Avengers, Paris, ICOS-Cities) but also in smaller project groups (with a total of more than 50 project groups). These advanced options are sharing notebooks and data between users in collaborative projects including associated disk space on the ICOS Fileshare, allow upload of own data for analysis together with ICOS data, and provide permanent storage of notebooks and data. These Jupyter services are regularly updated to provide users with a versatile Python (also R, Julia) programming environment and are continuously expanded in close consultation with our users to support their scientific analysis and interpretation of ICOS data and products.

The public exploredata service has been upgraded to enable support for reproducible FAIR Jupyter notebooks in the future. For each of these notebooks, not only the source code and software dependencies are stored and assigned a DOI, but the computing environment in which each notebook was developed is also archived and can be reactivated on-demand on exploredata.

The ICOS-specific python libraries for an easy and user-friendly access to ICOS data and metadata as well as to results of the STILT footprint tool have been continuously updated to reflect the developments in the data portal. Improved performance of the access to the core data and metadata services of the data portal is provided by the new icoscp_core library that now forms the foundation of the existing user-friendly icoscp python library but can also be used stand-alone by more proficient scientific programmers. All example notebooks that CP provides to showcase the data access were adapted to the icoscp_core functionalities.

The development of Jupyter notebook-based tools has been continued throughout 2025. A tool to characterize and cluster European cities with respect to key aspects relevant for CO_2 monitoring and

modelling strategies was developed as part of a scientific study and mentioned already last year. The scientific paper describing this development has now been accepted and published. The respective Jupyter notebook is available to users for further analysis as a reproducible notebook with a DOI on the updated exploredata service.

Data products and scientific services, CURVE as a first of many new products

An interactive user interface for graphical representations of key ICOS datasets, such as those presented in the annual FLUXES publication, was implemented using a Platform-as-a-Service (PaaS) solution. PaaS enables easy prototyping of services, e.g. based on code developed by users on the Jupyter Hub.

The first of this line of quick prototype development and rapid developed products is the CURVE app at https://curve.icos-ri.eu/. The app uses live CO_2, CH_4 and N_2O observation data from the ICOS Atmosphere network, focusing on Europe. The user can select one or more stations and visualize the change in the median of filtered concentration of the greenhouse gases as measured by these stations over time, together with the change in the monthly aggregated data over the whole system network of the 38 Northern Hemisphere stations. Data is updated daily using ICOS's Near Real Time data, together with the calculation of monthly medians of the filtered data.

This way ICOS can provide updated growth rates on a daily basis where this before was only possible once per year with a latency of 9 months. The figure below also shows the global average background concentrations, as updated monthly with a latency of (currently 3 months) by NOAA from its collaborative global network. Global data shows the same underlying global trend in the greenhouse gases, as these all are long-lived gases. However, the variability in the global data is lower, especially with regards to seasonal variation, as this global network is located at remote background sites, reducing the influence of sources and sinks due to distance.

For scientists, to discover the influences of sources and sinks on a finer scale in space and time, a denser and more local network, like ICOS' network, is necessary. Despite the higher variability, an unprecedented accuracy and precision of the observations is needed, as small biases (smaller than 0.1 ppm on CO_2 levels of >420 ppm) will lead to erroneous estimates of sources and sinks. ICOS is the first large operational greenhouse gas observational network that achieves these demanding measurements at scale at the recommended WMO GAW compatibility goals.

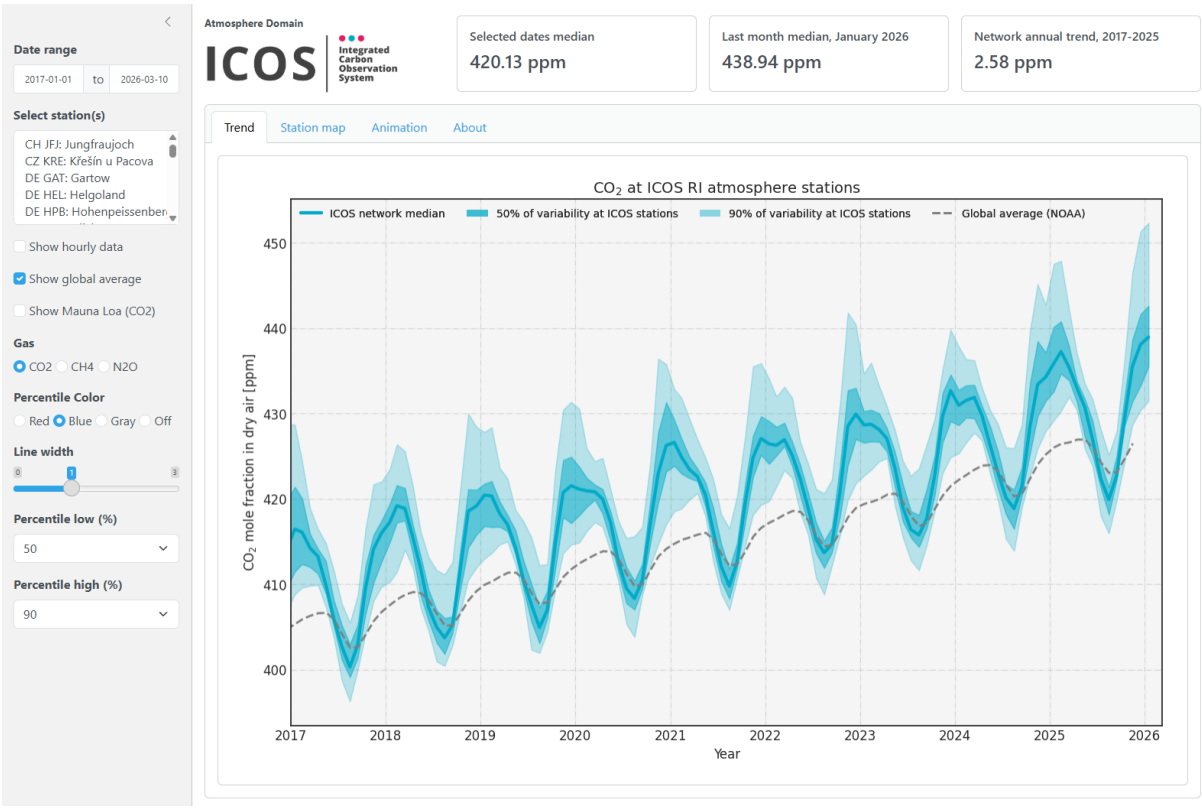


Figure 12. Screenshot of the ICOS CURVE application, that is now prominently shown on the ICOS homepage.

Data curation and publication

Upload and curation of elaborated products and project-based measurement data, including DOI minting, has seen an increasing demand in the last years and is since November 2024 handled by our data steward.

A semi-automated workflow for recurring datasets has been established and is now operational for ICOS atmosphere releases and Fast Track products, that are released in the form of European Obspack releases and automatically passed on to the WMO World Data Center for Greenhouse Gases. Examples are the latest FastTrack release at https://doi.org/10.18160/Z5HK-WJGY (357 individual time series) and the Level 2 final quality controlled release in 2025 at https://doi.org/10.18160/ERAF-JSPW (478 individual timeseries).

On request of our users, we now also provide Obspack like products for non-ICOS data, i.e. for APO/ O_2/N_2 and $^{14}CO_2$ historical datasets.

FLUXCOM-X, an extensive dataset of global, high resolution estimates of CO_2 net ecosystem exchange (NEE), gross primary productivity (GPP) as well as evapotranspiration (ET) and transpiration (ETT), generated by combining in-situ eddy covariance measurements of terrestrial land-atmosphere fluxes with e.g. satellite data through machine learning models, is disseminated through CP in several temporal and spatial resolutions to ease data handling for common use cases and has become the most downloaded external product in 2024 and 2025 (https://doi.org/10.18160/5NZG-JMJE).

The High-Resolution, near real-time CO_2 fluxes over Europe from the Carbon Tracker Europe system (CTE-HR) (https://doi.org/10.18160/20Z1-AYJ2) are extended on a monthly basis with a delay of 2-3 months depending on the availability of the input data. The CTE-HR system offers results from a dynamic anthropogenic emission model, net ecosystem productivity (NEP) calculated by SiB4, updated in 2025, as well as fire emissions and ocean fluxes at high spatial and temporal resolution.

Other products for use in atmospheric transport models and inversions, which have been available at CP for many years, continue to be regularly updated by Carbon Portal in only partly automated data pipelines, as these updates require many complex stapes and manual quality control. These include regional biosphere model results (VPRM and LPJ-GUESS), anthropogenic CO_2 emissions, and radon exhalation from soils, all with high spatial and temporal resolution. Anthropogenic CH_4 emissions, consistently derived using the same approach and input datasets as CO_2 emissions, are now also available. Meanwhile, LPJ-GUESS simulations of natural CH_4 fluxes remain in an experimental phase and will undergo further evaluation before publication.

The harmonized dataset of global CO_2 flux fields from the atmospheric inversion model systems that participated in the Global Carbon Budget 2025 (https://doi.org/10.18160/VZ3B-GHYQ) is like for GCB 2024 again disseminated through CP, allowing users to inspect the individual results in more detail. The annual update includes results from 14 different inversion systems.

CP assisted in the collection of historic and current, non-ICOS atmospheric O_2/N_2, isotopic, CH_4 and N_2O data, for example as data publications from the EU projects AVENGERS, PARIS, IM^{4}CA and EYE-CLIMA.

The STILT footprint tool and the tool for computing daily updated forecasts of back-trajectories are frequently used by scientists. The number of STILT simulations for ICOS and other existing atmospheric stations as well as for hypothetical station locations is steadily increasing. All input data for footprint calculations and emission data are annually updated.

FLEXPART model simulations to estimate the influence of radiocarbon emitted from nuclear facilities are now implemented as an operational service to the ICOS CRL and ATC to support sampling strategies for $^{14}CO_2$ (radiocarbon) and to directly inform the flask sampling devices at the ICOS stations whether or not to preserve samples depending on the prognosed amount of contamination of the radiocarbon content due to emissions from nuclear facilities. An interactive service has been developed and deployed as Dokku web service that allows operators at stations and FCL and ATC to follow the selection process for flask samples on the basis of excluding potential influence of nuclear reactors using the FLEXPART simulations.

Data portal

Improvements in functions and usability

We added the possibility to filter for keywords on the data portal. This feature required an important amount of work on our search index because it is possible to add keywords to several metadata elements like data types, projects, and individual datasets, which made this a complex task to implement and at the same time keep the portal search response snappy.

The image preview navigation was made easier by adding better controls and support for keyboard navigation (see this dataset for example).

We added some metadata elements (like various data formats, schema.org's isAccessibleForFree, URI prefixes for mid- and low-cost sensor stations (implemented for city networks), SKOS mapping properties (relatedMatch, narrowMatch, broadMatch) to better describe the data we host and updated the data portal to present this information. We also changed our data upload interface to support geo-coverage metadata. Other usability improvements were made to make it easier for people uploading data to provide all the relevant metadata.

We used to replicate our data to the B2SAFE trusted repository hosted by CSC in Finland, and unfortunately, they decided to discontinue this service. We worked with IT4I in the Czech Republic, also part of the EUDAT CDI consortium, to move our data from B2SAFE to their services, and updated the

data portal to replicate new data uploads. Besides a few short interruptions the new B2SAFE service works satisfactorily.

We set up a Fair Data Point instance as part of the ENVRI-HUB project to present in one place data from the several ENVRIs participating in the project. The work is still ongoing to help other research infrastructures map their metadata.

On the server infrastructure side, we started to set up more powerful monitoring tools (mainly Zabbix) to make sure that our services are available, fast, and work without issues, and eventual issues get detected and reported to the operations team without delay. The improved log monitoring and analysis tools will enable us to identify places where and which improvements are still needed.

FAIRness improvements

F.A.I.R. is a fairly recently minted concept (Wilkinson et al., 2016; see also https://www.go-fair.org/fair-principles/fairification-process/), that has been formulated as principles, without making reference to specific implementations, although it is stated that using the approach (as applied in Carbon Portal) of using Linked Open Data (LOD) and semantic web technology comes quite natural to build FAIR data systems. Measuring compliance to the FAIR principles is not straightforward, as the concept is purposely defined loosely, but there is a clear need to be able to track progress and compare different systems on the way to achieving more FAIR data systems.

In the projects ENVRI-Hub NEXT and IRISCC (for more details on these projects please see the project sections later in this report) we follow up on the recently finished ENVRIFAIR and EOSC-Future to further work on the interoperability of our data services with the other European environmental research infrastructures and common data and service catalogues using FAIR principles.

An interesting and advanced way of 'scoring' FAIRness has been developed by the FAIRsFAIR project (https://www.fairsfair.eu/) using the F-UJI tool (https://www.f-uji.net/), that provides a numerical score from 0 to 100% on how FAIR a certain data set is provided, the score is based on the FAIRsFAIR Data Object Assessment Metrics. In Figure 15 the F-UJI score is shown for an ICOS Level 2 data object. The resulting score early 2024 is 91%, which is graded as Advanced level. In a study performed by the European Commission (2022), where the same tool was used to evaluate FAIRness, ICOS Carbon Portal ranked 8th on the 26 tested repositories (see Figure 9). This result was achieved in 2020 with a score of 65%, now CP would rank 1st with the score of 96%.

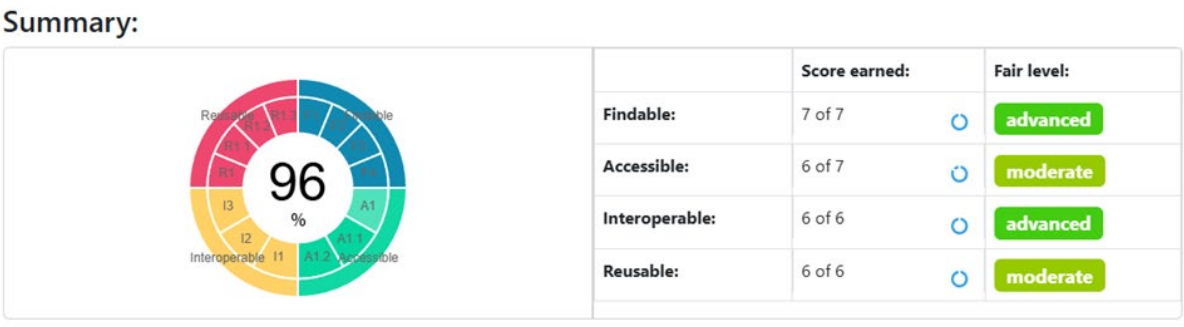


Figure 13 F-UJI score for the FAIRness score of an ICOS Level 2 data product for the atmosphere domain at the end of 2025, an increase of 4% compared to the score end of 2024

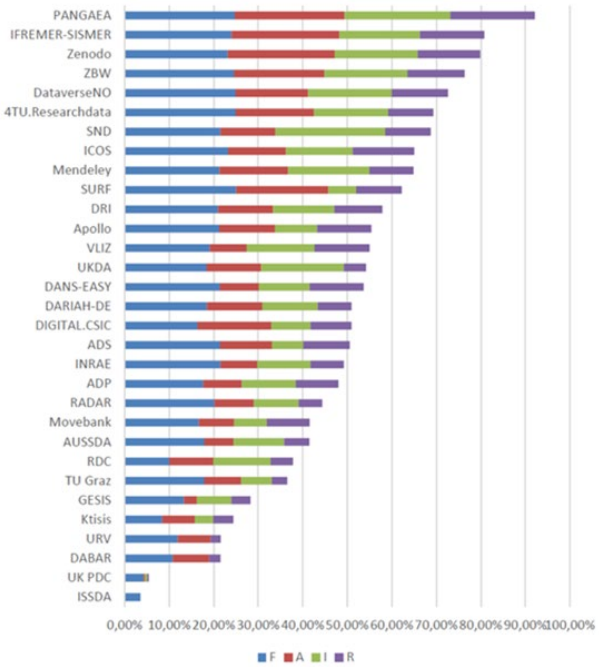


Figure 15 Comparison of the FAIRness scores of 31 data repositories using the F-UJI tool according to European Commission (2022), the comparison was performed in 2020.

During 2025, the CP initiated activities serving to enhance the descriptions of dataset variables in the CP metadata system by adding links to trusted community-provided external semantic resources such as controlled vocabularies, thesauri and keyword stores. Examples of the types of "qualified references" that can be added to variable definitions include SKOS standard relations like exact/close match, and narrower/broader concept. In addition, we started the work to create machine-actionable definitions of the concepts underlying the ICOS value type definitions, following the ontology-based model proposed by the RDA I-ADOPT working group.

In the context of the ENVRI-Hub NEXT project, we have set up a preliminary implementation of a FAIR Data Point (FDP) with the objective to use it as a catalogue of metadata about datasets from research infrastructures (RIs) that are contributing to the project. The FDP will provide a central access point to metadata from several RIs, including ICOS, expressed using a common vocabulary (the Data Catalog Vocabulary; DCAT). Following the requirements of the project, the metadata describing the datasets will also include a list of essential climate variables (ECVs) that are included in each dataset, and the ECVs will be expressed using the I-Adopt vocabulary, allowing for more fine-grained querying of datasets based on the characteristics of the variables they contain.

Data science

Through the engagement of Carbon Portal staff, ICOS is involved in various initiatives that seek to develop research data management (RDM) concepts and associated technologies that can support and sustain Open Science and FAIRness – both for human and "machines". In part this work is carried out in the framework of European research and infrastructure development projects, like ENVRI-Hub NEXT, where the CP has contributed to discussions and scientific use cases that both identify gaps in understanding and interoperability, and then develop technological ICOS solutions to these issues. Of special interest has been investigating how ICOS can streamline the use of persistent identifiers (PIDs) and semantic resource such as controlled vocabularies.

In parallel to these efforts, ICOS is also represented in working and interest groups of international initiatives like the Research Data Alliance (RDA), FORCE11, CODATA and the EOSC Association's Opportunity Area 1 Expert Group on Persistent Identifiers. In these fora, we have

contributed to discussions and other activities (surveys, recommendations) with insights from a "research infrastructure as service provider" perspective.

RDA:

- FAIR DO Fabric IG: M. Hellström (appointed co-chair in August 2022) is a contributing member, coordinating activities on FDO-related training and awareness-raising.
- InteroperAble Descriptions of Observable Property Terminology (I-ADOPT) WG: M. Hellström monitors developments, as this group is now in maintenance mode.
- FAIR Mappings WG: M. Hellström participates in group discussions and is working on an ICOS CP use case
- Coordinating Earth, Space, and Environmental Science Data Preservation and Scholarly Publication Processes WG: M. Hellström is an active member of the group, contributing to the analysis of an interview-based study of attitudes and practices by repositories and publishers. U. Karstens and H. Lankreijer together with M. Hellström represented the CP in one such interview.

FORCE11:

- FORCE11 Data usage typologies WG: M. Hellström actively participated in the work towards achieving a machine-actionable schema for classifying research data usage

CODATA:

- CODATA Research Data Management Terminology (RDMT) WG: M. Hellström contributed to thye 2025 update of the machine-actionable CODATA RDM TerminologyTraining on Open Science, RDM and FAIR

Education and training

ICOS Summer School 2025

ICOS has organised previously seven Summer Schools on the theme of measurements of greenhouse gases and their interpretation, initially under the flag of the ESF TTorch programme, the InGOS project and finally after implementation of the ICOS Research Infrastructure as ICOS Summer Schools. These schools are organised every other year and mostly at the Helsinki University forest station Hyytiälä. Envisaged participants are normally PhD, Postdoc, master students and technicians and scientists from the ICOS community.

The 8th ICOS Summer School took place between 5 and 25 of May 2025, again at Hyytiälä field station, for the first time using the completely renovated facilities. Main organizer was Alex Vermeulen, director of ICOS ERIC Carbon Portal. Local host was Professor Timo Vesala from Helsinki University (FI), with assistance from PhD candidate Ellinoora Ekman. The summer school was partly financed with contributions from NUBICOS, INAR, EYE-CLIMA and Vaisala.

The school handled almost all relevant aspects of Carbon Cycle and Climate Science in the context of global climate change, organized as lectures and practical exercises. One session of in total a full day was oriented on hands on experience with (global) transport models in modelling greenhouse gas concentrations and optimisation of surface/atmosphere fluxes from observations through Bayesian inversion. In total two excursions were organized, one to the ICOS greenhouse gas tall tower and flux station at Hyytiälä station, and one to the Siikaneva wetland side close to Hyytiälä.

58 applications were received and 35 candidates were selected. The candidates came from 10 different countries; 17 were male and 17 female, one did not identify gender.

Summer school 2025 **Program** Version: 28/04/2025

Challenges in measurement and modelling of Greenhouse Gases

	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu
Time	05/May/25	06/May/25	07/May/25	08/May/25	09/May/25	10/May/25	11/May/25	12/May/25	13/May/25	14/May/25	15/May/25
07:00-08:00		Breakfast						Breakfast			
8:30		Welcome	Field trip	Lecture	Practical	Practical		Lecture	Field trip	Lecture	
		Practical	08:00! Field trip SMEAR II T. Vesala	Ocean observations - I. Skjelvan	Life/work balance and diversity in science - Ana & Claire	Transport modelling - W. Peters, I. Luijkx	Free	Ecosystem modelling - A. Bastos	08:15 Wetland field trip - T. Vesala	Methane and nitrous oxide budget - Sander Houweling	
		Short elevator pitch of students									08:30 Bus transport to Helsinki
9:45		coffee break		coffee break				coffee break			
10:15		Lecture	Lecture	Lecture	Lecture	Lecture		Lecture	Field trip	Lecture	
		The climate system I - M. Heimann	ICOS General Intro - A. Vermeulen	Isotopes, tracers, 14CO2 - S. Hammer	Micromet. flux measurements - I.Mammarella	Data Assimilation - W. Peters		Urban fluxes - L. Järvi	Wetland field trip - T. Vesala	Climate communication and advocay - B. Verheggen	
11:30		Lunch									
13:00		Lecture	Lecture	Lecture	Lecture	Practical	Practical	Lecture	Lecture	Practical	
		Climate system II/Carbon Cycle I - M. Heimann	Measurement instrument principles I - C. Gerbig	Chamber flux measurements - C. Treat	Transport modelling - M. Krol	Data Assimilation - W. Peters, I. Luijkx	Poster session I	Satellites, FTIRs - S. Houweling	Tropical emissions - L. Merbold	Group presentations	
14:30		coffee/tea break									
15:00		Lecture	Lecture	Lecture	Practical	Practical	Practical	Lecture	Practical	Practical	
	14:30 Helsinki train station; 15:00 Helsinki Airport. Bus transport from Helsinki	Carbon Cycle II - M. Heimann /	Measurement instrument principles II - C. Gerbig	Wetland emissions - C. Treat	Transport modelling - W. Peters, I. Luijkx	Data Assimilation - W. Peters, I. Luijkx	Poster session II	Policy and bottom up inventories - W. Winiwarter	Group work	Wrap-up, evaluation	
16:00		Intro group work - A. Vermeulen	Data management - A. Vermeulen	O2/N2 applications - I. Luijkx				Q&A Climate and Carbon Cycle - Martin			
16:45											
17:15		Dinner								Dinner / Party	
19:00		Talk on "sauna as culture and physics"	Walk through Periferia Art Exhibition	Watching film "Compartment Number 6"	evening program	evening program	evening program	Talk "Treebound - Puuhunsidotut"	evening program		
	Dinner										

Figure 13 Overview of the ICOS Summer School 2025 program.

The participants were asked to score the Summer School in a short survey, that was similar to surveys held after the previous 7 ICOS Summer Schools. 31 out of 35 participants (91%) filled in the survey.

On a scale of 1-10, the average score is 9.1 with a standard deviation of 1.3, so this means the teachers did an excellent job according to the students! Previous summer schools scored around 8.5.

The highest score was given to the overall quality of the networking opportunities (9.9), followed by peer learning interactions (9.7) and the lowest (but still very high) score of 8.4 for the fit of content with expectations for the modelling exercises (with a large standard deviation of almost 2). Overall quality of the lectures was highly appreciated with a score of 9.3.

Figure 14 Portrait of students and teachers at the 8th ICOS Summer School

Other education and training

ICOS Carbon Portal hosted interactive Jupyter notebooks on its Jupyter Hub for the ICOS Summer School 2025 and several external courses, like a series of Ocean Carbon Practicals (J. Shuttler, University of Exeter), a course on atmospheric data and modelling at the Heidelberg Physics Graduate Days (I.Luijkx, Wageningen University), each with 40 or more users.

CPD participated to the ITINERIS training session for 30 atmospheric and ecosystem scientists, held 28-30 January at CNR in Potenza, Italy, demonstrating the use of ICOS data using the ICOS Jupyter hub together with ESA, C3S and CAMS.

Management

2025 was a turbulent year that provided many challenges related to the merger of the hosting department INES at Lund University into MGeo (Department of Earth and Environmental Sciences) and relocation of the different parts of the merged department. This caused for example a period of 8 weeks with no access to the offices, an internal moving process, and a substantial reduction in available office space and quality of the spaces for Carbon Portal. December 23 2025 we also had to learn that the new department will charge a 10% increased overhead in 2026 and further, which will reduce the available budget of the core work with about 1.2 million SEK (about 110 k€) each year. A discussion is ongoing with Lund University management on compensation for the increased overheads and a range of other suggested improvements.

Also, within a few months 6 persons gave notice, with reasons partly related to the situation at the department, and the lack of flexible career perspective in the university function categories and descriptions. Together with the in itself happy situation of four (partially overlapping) paternal leaves this meant a large hit for the capacity to keep core and projects going in most of 2025 while we were filling the open positions and compensate for the parental leaves.

However, thanks to the large commitment and professionalism of CP staff all core tasks were kept up with the required reliability and quality without loss in service availability. The reduced amount of realised FTE however led to an under-exhaustion of the core budget, as the available budget from two large projects ending in 2025 and associated work was given priority. The unplanned additional reserves built up during 2025 will be used in the coming two years to support development of new services and upgrade the server configuration to prepare for serving more AI services, some of the current servers are already 7 to 10 years old.

A well appreciated one day retreat was organised in the autumn to discuss with the team on new directions, the cooperation in the team, the recent challenges and their mitigation, the goals of ICOS and the role of CP in that and to perform some team building.

Human resources

Our system architect and development lead left in February but remained part-time connected to CP to allow for a smooth transition and was available for knowledge exchange and advice until August. Jonathan Thiry took over his position as lead developer and system architect.

Our user support officer Andrew Debevec was promoted to frontend developer, while keeping a few tasks for user support.

Angeliki Adamaki as project assistant was followed up by Nertila Gojani in a position as project coordinator

Our operations engineer André Bjärby was followed up by Robert Grabowski.

Ida Storm's position as scientific programmer was filled in by Yi Wang.

A new back-end developer to fill the position of Jonathan Thiry was hired but did not complete the probation period, leaving that position open thus far.

International cooperation at the Carbon Portal

Global Greenhouse Gas Watch

The WMO initiative Global Greenhouse Gas Watch (hereafter G3W) aims at providing global products of monthly net fluxes of CO_2, CH_4, and N_2O with 1x1 degree resolution, aiming to reduce uncertainties and increasing the reliability of the GHGs monitoring systems.

Figure 14 Implementation planning chart for G3W, next year or 2028 the pre-operational phase is planned to start and a fully operational system is planned to be in place by 2031/2023

CPD was selected to advise WMO in two of the three task teams that will guide the further development of the G3W: Task Team on Networks and Task Team on Data. Both task Teams and the previous advisory committee on G3W have two-monthly meetings and organise 1-2 face to face meetings or workshops per year, usually to be held in Geneva. CPD is also member of the Expert team on Atmospheric Composition Data Management of WMO. In 2025 this committee started to design the relevant elements for atmospheric observations data for the new WMO metadata standard called WMDR2 that forms an essential element of the updated version of the WMO Information System called WIS2.

CPD and/or CP staff attended all MSA meetings from the different domains and provided update presentations from the Carbon Portal relevant to the different communities.

WMO Scientific Advisory Group for Greenhouse Gases

2024 was the last year of the 8-year term for CPD as chair of the WMO Scientific Advisory group for Greenhouse Gases. Starting 2025 CPD represents ICOS as ex-officio member in this committee. CPD was co-editor of the WMO bulletin for Greenhouse Gases 2025, that as always received a lot of attention in the worldwide press. CPD is part of the organizing committee of the 26th WMO GGMT meeting in Cape town, South Africa in September 2026.

Atmosphere Thematic Centre

Highlights

- "Direct" flux measurements by eddy covariance at the tops of ICOS Atmosphere towers. 2024 AMT Outstanding Publication Award.

  Herig Coimbra, P. H., Loubet, B., Laurent, O., Bignotti, L., Lozano, M., and Ramonet, M.: Eddy covariance with slow-response greenhouse gas analysers on tall towers: bridging atmospheric and ecosystem greenhouse gas networks, Atmos. Meas. Tech., 17, 6625–6645, https://doi.org/10.5194/amt-17-6625-2024, 2024.

- Publication of the first L1 Fast Track release with CO2 isotopes (delta13C_co2 and delta18O_co2) flask data.

Task 1. General management

ATC Data Processing unit and Mlab meet on a weekly basis; ATC as a whole on a monthly basis.

ATC Director attended all RICOM meetings and ICOS GAs and performed the required reporting. ATC is also largely involved in the MSA Atmosphere that take place twice a year.

Task 2. Data management / production

Task 2.1 Level 0 data transfer

New instrument registrations took place and new data transfers have started.

Maintenance

- IT maintenance of the network data. Manage multiple instrument movements on different sites as well as change of processing parameters.
- The new interpolation of the water vapor correction factors has been applied to 27 couples station/instrument with 132 couples having timeseries over 3 years.
- Preparation for a processing program library update (Java libraries).
- GHG pre-processing program parametrization moved to the database.

Developments

- Evolutions for the preparation and generation of data releases (L2 and Fast Track) including information added automatically to the Carbon Portal landing pages.
- Evolution on the flask data releases, addition of the CO2 isotopes (delta13C_co2 and delta18O_co2).
- Evolution on the gas radon chain with the preparation and publication of a L2 data release.
- Evolution of the new processing chain for EM27 instruments to be able to generate a NRT data flow.
- In progress: evolutions of the chain processing the CAL flask sampler requests Implementation of strategies to take the modeled Nuclear Contamination into account.
- The “reprocessing” section of the weekly GHG data reports for the PIs have been added to the ATC website.

- Major updates of the graphical applications with a migration to new libraries. Addition of a few new features.

A new icos-ssh server has been installed, more powerful and with more storage.

Task 2.2 NRT data production

44 stations are connected to ATC, sending their data and processed in NRT mode. This represents 28294 (nearly equal to 2024) raw archive files (~209Go) processed for an availability rate of ~0.99 stations which transmit their data over the complete 2025 year.

Task 2.3 NRT data visualization and distribution.

NRT data visualisation can be accessed on ICOS ATC website [https://icos-atc.lsce.ipsl.fr/dp], through the page of the NRT data products generated at ICOS ATC, and/or, depending on the product, directly on the panel board of the concerned station (accessible via its trigram code).

In 2025, 4197 products files (only with .png, .html and .rds) of graphical NRT Data Products are produced daily from NRT measurements (total volume of 1.51Go and freely available on the ATC website for station monitoring and diagnosis.

Those Data Products are for PIs to verify the status of their stations. In total, for the year 2025, nearly ~ 95047 users have interacted with ATC's website, for ~ 1 223 852 page views. These statistics have increased significantly compared to 2024, due to a change in the audience tracking software solution, and ATC should definitely implement bot filtering.

Task 2.4 Level 2 data production.

The new Level 2 (2025-1 release final quality controlled) data from the atmospheric network has been released on July 2025 by the ICOS Atmosphere Thematic Centre. 2025-1 release containing data from the atmospheric network of ICOS Research Infrastructure for 39 stations and atmospheric composition at all available vertical levels at stations Birkenes, Cabauw, Gartow, Hegyhátsál, Helgoland, Hohenpeißenberg, Hyltemossa, Ispra, Izaña, Jungfraujoch, Jülich, Karlsruhe, Křešín u Pacova, La Réunion, Lampedusa, Lindenberg, Lutjewad, Monte Cimone, Norunda, OPE, Ochsenkopf, Pallas, Plateau Rosa, Puijo, Puy de Dôme, La Réunion, Ridge Hill, Saclay, SMEAR-II Hyytiälä, Station Nord, Schauinsland, Steinkimmen, Svartberget, Torfhaus, Trainou, Utö - Baltic Sea, Westerland, Weybourne, Zeppelin Observatory and Zugspitze. This collection contains the final quality controlled hourly averaged data for the mole fractions of CO2, CH4, N2O, CO and meteorological observations measured at the relevant vertical levels of the measurements stations; 14C in CO2 in two-weekly integrated samples (17 stations); and analysed flask data for CO2, CH4, CO, N2O, SF6, H2 and 14C (17 stations), for the period September 2015-1 April 2025. All stations follow the ICOS Atmospheric Station specification V2.0 (https://doi.org/10.18160/GK28-2188) and are certified as ICOS atmospheric stations Class I or II. Data processing has been performed as described in Hazan et al., 2016 (doi:10.5194/amt-9-4719-2016).

An update of the official release of the European Obspack project compiling atmospheric CO_2, CH_4 and N_2O from ICOS an non-ICOS European stations for the period 1972-2025 has been issued. This data package contains high accuracy CO_2/CH_4/N_2O dry air mole fractions from ICOS and non-ICOS European observatories, collected by the ICOS Atmosphere Thematic Centre (ATC) and provided by the station contributors. The package is part of the Globalview EU data product, released in 2025 and is intended for use in carbon cycle inverse modeling, model evaluation, and satellite validation studies.

Atmospheric Greenhouse Gas Mole Fractions of CO2, CH4 and N2O collected in Europe, covering the period 1972-2025 for CO2, 1984-2025 for CH4, and 1994-2025 for N2O, including final quality-controlled Level 2 ICOS data, release L2-2025.1. During the most recent period, a selected set of stations, after

being labelled as ICOS stations, follow the ICOS Atmospheric Station specification V1.3. All concentrations are calibrated to the WMO X2019 CO2 mole fraction scale in µmole/mole (ppm), WMO X2004A CH4 mole fraction scale in nmole/mole (ppb) and WMO X2006A N2O mole fraction scale in nmole/mole (ppb) - https://doi.org/10.18160/yrbf-fjnb

Publication of ICOS Atmosphere Release 2025-1 of Level 2 Activity Concentrations of Radon-222 data. https://meta.icos-cp.eu/collections/rCL4Cn7HNtl0sPAVMb62fdGn

Task 3. Network coordination, training and development

Task 3.1 Perform instrument testing

In 2025, ATC has acquired a large-volume environmental chamber (T, P, and RH) to optimize temperature and pressure sensitivity testing. This climate chamber allows for the simultaneous testing of multiple instruments (e.g., 6 Picarro analysers). It also enables testing of sensitivity to the rate of temperature change. The chamber was commissioned at the end of 2025.

ATC MLab has fulfilled its commitments by performing all the instrument testing required for the station labelling or quality check after repair. It includes leakage rate, instrument precision, linearity and drift, short term and long-term repeatability, sensitivity to inlet pressure, atmospheric pressure and temperature, H_2O correction. ATC MLab has provided a test report and a certificate of compliance to all the instruments tested.

Moreover ATC MLab has performed technology watch activities with new analyser testing. For instance, ATC has tested the new version of the LICOR N_2O analyser (Near-IR spectrometer), LI-8820, as potential cheaper (than the Mid-IR spectrometer) option to measure N_2O in ICOS. The lower performance specifications require the implementation of an appropriate QA/QC strategy, particularly with regard to calibration and the correction of variability. ATC continued to test the ability of the Picarro PI5310/G5310 N_2O/CO analyser to measure the $^{13}CO_2$ in order to potentially improve the N_2O measurement performance (crosstalk) and consider CO_2 isotopic ratio measurement by combining a PI5310 with a CO_2 analyser (G2301 or G2401) Picarro which measure $^{12}CO_2$ (performance assessment in progress at Mlab). After installing a Picarro upgraded mode for the $^{13}CO_2$ (more time spent on the species compared to the default mode), which led to a doubling of the $^{13}CO_2$ performances, we combined a G53 with a G24 analyser and compared them to a Picarro isotopic instrument -G2201-i). This study is still ongoing but shows promising results.

ATC is also still working on performance testing and characterization of several mid and low-mid cost sensors for CO2 and CH4 like MirSense MultiSense photoacoustic sensor, Senseair HPP and K96, Vaisala GMP343, Figaro CH4 Metal Oxide sensor, Alpha Sense CO sensor, Axetris LGD CH4, Cubic CH4, ABB HoverGuard… This prospective work takes place for new domain of application (mobile measurement, dense low-cost sensor network for urban area or industrial site…).

In the framework of Pedro Coimbra's PhD, ATC has worked with INRAE (ETC) to study the feasibility and relevance of "direct" flux measurements by eddy covariance at the tops of ICOS Atmosphere towers, utilizing the slow response GHG spectrometers already in place. The setup, which consists solely of adding a 3D anemometer next to the air intake at the top of the tower, was evaluated at the Saclay site. This study, which was awarded by AMT (2024 AMT Outstanding Publication Award), has demonstrated how an affordable setup upgrade of a typical tall tower site from the ICOS Atmosphere Network can increase the number of ICOS flux towers, with a multi species approach in a diverse and complex landscape (due to the large footprint), and improve the understanding and quantification of the potential impact of local fluxes on the measured concentration of the Atmosphere stations.

Task 3.2 Perform atmospheric station audit

ICOS Mobile Laboratory is one of the subunits of the ICOS RI Atmosphere Thematic Centre (ATC). It is physically located in the Finnish Meteorological Institute and mainly funded by the Ministry of Transport and Communication in Finland. The main task is to conduct quality control (QC) by parallel greenhouse gas measurements at ICOS atmosphere stations (AS). Aim is to improve measurement compatibility and development of quality assurance (QA) of the ICOS AS network that ensures credibility of the measurements. The instrumentation of the Mobile Laboratory includes three greenhouse gas analysers: Picarro G2401 (CO_2, CH_4, CO), Picarro G5310 (CO & N_2O) and Ecotech FTIR (CO_2, CH_4, CO, N_2O).

During the year 2025, the Mobile Laboratory performed three audit visits. The continental class 1 station Trainou (TRN) in the northwestern part of France, was audited at the beginning of the year. Then the coastal class 2 station Utö (UTO) in Finland was hosting the Mobile Laboratory in spring/early summer and finally the montain class 2 station Zugspitze (ZUG) in Germany was audited in autumn.

The audit report of the class 2 station Westerland (WES, Germany), audited in summer 2024, was finalised during the year 2024.

As a part of QC procedures of the Mobile Laboratory, it monitors calibration scales between ICOS CAL and Mobile Laboratory, using travelling cylinders prepared by WMO/GAW Central Calibration Laboratory. In 2025, the ATC website was updated with information about the Mobile Laboratory and its audit procedures. Also, it is taking part in every other meeting held at ATC in France since end of 2025 to ensure the best cooperation between the two entities.

Task 3.3 Perform training activities for ICOS atmospheric measurements

ATC has organized one in-person training. The attendees of this training were Pis/Staff from Switzerland, Denmark, Belgium, Finland and Italy. It lasted over 3.5 days.

All the initial training requested for new ICOS incomers and step 2 labelling have been provided by ATC.

ATC will continue to offer standard training at ATC in order to answer the demand of new incomers and also to deal with the technical staff turnover. These standard trainings can be online and face-to-face meeting at LSCE (more suitable for experimental practical work).

Task 3.4 Station Labelling

The ATC workplan, reports and associated budgets were provided to ICOS HO. Labelling of 1 new ICOS Atmosphere stations in 2025: El Arenosillo. Also, one station (Finokalia) has gone through step 1 and four (all the Irish stations) have begun Step 2.

Task 4. Projects and international cooperation

ATC was involved in 2025 in the following EU projects: ENVRI-FAIR, IsoMet (finishing in 2025), MetHIR (beginning in 2025), Atmo-Access, PAUL/ICOS cities finishing.

Task 5. Other activities

Webobs is a web application for monitoring and managing atmospheric measurement stations, developed at ATC. It provides support to station managers of the ICOS network and other networks to assist them in the maintenance of their stations.

A major upgrade of the WebObs platform is currently underway, both technically and visually. This includes migrating from Symfony 5 to Symfony 7 and upgrading to PHP 8.4.

On the front end, the interface is being redesigned using an open-source theme based on Bootstrap 5, along with modern tools such as Stimulus and Webpack Encore.

The objective is to provide a smoother, more intuitive, modern, and clean visual experience, while ensuring the platform remains robust and sustainable in the long term.

Ecosystem Thematic Centre

Highlights

- New FLUXNET initiative
- Level2 and Level2 Interim routinely processed and shared
- Increased international visibility in CalVal activities

Task 1. General management

Task 1.1 Management and provision of the ETC and the related It- and data management

ETC participated in the spring and fall GAs presenting the results obtained and the situation of the activities, to the Scientific Advisory Board meeting of and the Evaluation process meetings. ETC participated in the RICom meetings and teleconferences. A series of meetings have been organized in order to develop solutions for the specific financial situation of the ETC, including the preparation of different scenarios. Meetings have been both internal (with the stakeholders of the three countries) and external, with the HO and GA representatives.

Task 1.2 Reporting

The activity and financial plan for 2026 and the report of the 2024 activities (including the financial report) have been prepared and submitted to the DG and HO using the agreed template and guidelines approved by the GA.

Task 2. Data Management / Data production

The data collection continued in a systematic and robust way, including new stations and involving both ETC and Carbon Portal. All the labelled stations and the stations under the labelling procedure submitted data and metadata. Vegetation samples and soil samples have been shipped by 37 and 3 stations respectively to the ETC labs in France for analysis. Six soil sampling sets were sent to sites that had been sampling this year.

Level2 data have been produced and distributed through the CP, including the Interim version released after the growing season. Near Real Time data production and release continued operationally and the data release covers the period from the last Level2 release to the current day.

Subtask 2.1: Raw data collection and transfer, including their metadata.

The raw data flow from the station to the Carbon portal continued regularly under the supervision of the ETC. The metadata needed to interpret and then accept the files submitted are transferred regularly to the Carbon Portal in a machine-to-machine procedure. Also, ancillary raw data from DHP and ceptometer files have been regularly submitted to the ETC portal and transferred to the Carbon Portal where they are archived and assigned a PID. There have been 1091 vegetation samples shipped to the ETC (they were 671 in 2018, 934 in 2019, 989 in 2020 and 1242 in 2021, 1322 in 2022, 1218 in 2023, 1202 in 2024) for the analysis and all the samples have already been analysed and imported into the

database. In addition, 344 soil samples have been shipped for analysis in 2025 and are under processing. The soil samples are stored in the long-term facility for a total of 28 sites.

Subtask 2.2: From raw data to Level 1 data

Near Real Time data are produced every day and transferred to the Carbon Portal. The processing is scheduled every morning at 7 AM, after the check of raw data completeness and coherence with the metadata (that generates alert messages to the Station Teams for rapid intervention), produces several results that are uploaded to the Carbon portal. The NRT data also include the auxiliary data provided by the eddy covariance sensors that can be important for the early detection of issues with the different sensors. The NRT results are cumulative, with the addition of 48 half hours every day, and they start the day after the release of the Level2 data.

Subtask 2.3: Level 2 data production.

The Level 2 data production and upload to the Carbon portal happened twice in the year. The first release of the official Level2 is performed by the end of April and covers until the end of December of the previous year. The second processing period has been defined at the end of the growing season for both the continuous (fluxes and meteorological) and ancillary data. The product, named Level2 Interim, deprecates the official Level2 released in spring, and it is deprecated by the new official Level2 released the year after in spring.

A new footprint product has been designed, implemented and tested. This will be a major update in the ICOS data products and ICOS will be the first network providing these data. The code for the new product generation has been published in the ICOS ETC GitHub and the operational release is expected in 2026.

Task 3. Network coordination, training, and network / RI development

Subtask 3.1: Support and training for a correct implementation of the ICOS protocols.

The sensors listed in the ETC with a unique identifier arrived at 404 models (in 2024 they were 384). Continuous support has been provided to the stations' teams to optimize the data and metadata submission. Feedback time on specific requests is generally less than 36 hours and commonly within 24 hours.

Subtask 3.2 Evaluation, optimization, evolution and development of the methods used to measure the ICOS Ecosystem variables are crucial to ensure data quality and consistency.

The large effort to create a FAIR vocabulary for the sensors used in the ecosystem stations has been continued, using the VocBench system and in collaboration with Lifewatch Italy. This is expected to have a large impact on the FAIRness of the data and cross-RIs relations.

The largest effort has been on the review and finalization of the metadata system for all the management and disturbance data and information. This is expected to have a very important impact on the data users, in particular for all the activities related to Carbon Farming practices. The new system, developed together by the three ETC units with the support of external experts, is currently in the validation phase and will be used and implemented in 2026, with a dedicated person working in the French ETC team.

In the context of technological innovation the ETC started the evaluation on a periodic use of Terrestrial Laser Scanning to retrieve additional information on canopy structure which is very valuable for earth system modellers. In addition, this would lead to improved estimations of aboveground biomass estimation, needed to reduce uncertainty in the carbon balance of ICOS forest stations. Several ICOS stations have been included in a measurement campaign and in 2026 will start developing a centralised data processing of the points clouds.

Subtask 3.3 Station Labelling

The activities on the labelling continued in 2025 with stations that entered the process and stations proposed for labelling. In particular:

- Two stations started the labelling procedure (IE-Dyy and SE-Oes), and both completed the Step1
- Two Class2 stations started the Step 2 (FI-And and IE-JtC)
- Five Associated stations completed the labelling in 2025 (DE-Fen, DE-Gwg, IE-Cra, IT-PCm, SE-Oes)
- Currently there are 2 Class1 and Class2 stations entered before 2024 that did not start yet the labelling: IE-Doa and GR-Prt.
- Unfortunately one Class1 labelled station quit ICOS in 2025 (FR-Lam)

Subtask 3.4 Support on ecosystem data interpretation and use

The ETC has invested in the visualisation of the ancillary data products, creating graphical overviews of the data in the Level 2 archives. These visualisation tools will be made operational in the ICOS Carbon Portal in 2026. Basic support by email to specific questions about the ICOS products coming from users inside and outside the ICOS Community was also provided.

Task 4. Projects and international cooperation

A very large and impactful initiative has been carried out in 2025, in collaboration with the European Fluxes Database. Agreement with other networks for a common access system to updated eddy covariance data in the context of FLUXNET has been reached and implemented. ICOS CP is hosting data from Europe and from other continents where equivalent organizations are not yet ready (China, Japan, Korea, Africa). The ICOS ETC ensured that all the ICOS stations are included, with clear reference to ICOS and with legacy data to provide long time series.

The organization of the update system, where dataset from the ICOS sites will be automatically increased with the new data, has been started to be operational in 2026. The collaboration with the European Database ensured, for this first round, the processing of non-ICOS stations following the same ICOS procedures. The analysis of possible future solutions to ensure stability has been started.

To improve international cooperation with the EO cal/val community, the ICOS Ecosystem network and ETC activities have been presented at several relevant meetings like ESA Living Planet Symposium and ESA Land Product Validation Workshop with the aim to increase the use of ICOS Ecosystem data products for calibration and validation of Remote Sensing products.

Task 5. Other activities

ICOS ETC continued gathering pre-ICOS soil sampling information and computed soil carbon stock differences at BE-Lon, FR-Gri, and FR-Fon. A selection of sites were used to make organic matter quality analysis (RockEval and NIRS methods) and provide information on the organic matter degradability. They will be analysed in 2026.

Ocean Thematic Centre

Task 1. General management

Task 1.1: Management and provision of the OTC capacity and related IT- and data management

Task 1.2 Reporting

The OTC continues to meet on a weekly basis wherever possible to discuss a range of issues ranging from operational delivery of services through to contributions to ICOS strategy. In 2025 we hosted Hannele Laine during the summer on her 'round Europe tour' and in addition a large number of OTC personnel were present at the ICOS 10 celebrations including Ute Schuster (gave keynote OTC presentation), Jørund Strømsøe (OTC administrator in Bergen). The major management task of the year was onboading Lucía Gutiérrez-Loza into her new role as the OTC training and station support coordinator (see detailed report below). In addition, the Exeter lead position transferred from Andrew Watson to Ute Schuster and we invested considerable time in understanding and initiating the process by which VLIZ can formally join the OTC following the transfer of data management activity to VLIZ at the start of 2025. In addition we submitted a revised grant proposal to the Norwegian research council to cover ICOS operations in Norway in 2028 and 2029, the final 2 years of ICOS phase 3. Two MSA meetings were organised during the year. The first was online in spring and allowed all stations to provide relevant station updates. The second was at the ICOS 10 celebrations in Helsinki.

Task 2. Data management / Data production

Task 2.1 Data availability and quality

At the start of 2025 data operations moved from UiB to VLIZ alongside the Data lead Steve Jones. Hannelore Theetaert (VLIZ) joined Steve Jones and Ingunn Skjelvan on a part-time basis to assist in labelling and the full data handling/support pipeline. The data activity also includes a small component at NOC focussed on task 2.7.

The data pipeline itself remains stable and reliable. We continue to support stations in setting up their own data processing procedures to integrate with ICOS as effectively as possible. The ERDDAP server set up in 2024 is operating well, and is in regular use by one project that we are aware of. We are also in discussion to use this platform with the UK based stations for them to mirror ICOS data into their national data centre in line with their legal requirements.

Discussions have started on the development of data KPIs for OTC data, allowing more effective monitoring of the amount, quality and timeliness of data being produced by the network.

Task 2.2 Maintain metadata records

The annual SOCAT release cycle at the end of each year provides the obvious point for OTC to ensure that its stations' metadata is up to date. We are aware that there should be a more frequent programme in place to receive metadata updates, and discussions have started both within OTC and with some station PIs to establish how this might work best. Our integration into global metadata networks (see Task 2.7) means that this will become a greater priority.

Task 2.3 Raw (Level 0) data transfer

All Level 0 data uploaded to QuinCe as the basis for data reduction and quality control are automatically submitted to the Carbon Portal for archiving.

Task 2.4: Ingest and Process Near Real Time (Level 1) data delivered to the OTC from stations

Ingestion of Near Real Time data continues for all stations with the capability.

Task 2.5: Produce and transmit of publication quality (Level 2) data

L2 data from labelled stations continue to be processed and published at the ICOS data portal. We are also receiving backdated data whose processing has been delayed for various reasons. Three stations have had issues with their own data pipelines and have not submitted data to OTC in 2025. These issues are being actively pursued for resolution in early 2026.

Task 2.6: Software development and maintenance

There is one new sensor in the network, and one existing sensor that provides data through its new pathway, both of which require significant development work for integration into the QuinCe software and the data pipeline. We are working closely with the manufacturers to establish the correct protocols for these data streams. Beyond this, bug fixes and other basic maintenance are being performed.

Task 2.7: Metadata standards with ICOS

ICOS OTC has been an active participant in the ongoing efforts to harmonise metadata across multiple ocean observation networks with the goal of full interoperability between them. As the results of these discussions have crystallised we have designed new metadata structures for the ICOS Carbon Portal to ensure that we meet these new standards and also have the flexibility to make adjustments as the standards are implemented and reviewed. ICOS Carbon Portal has provided a new staging server where OTC can implement test versions of these new structures as they are finalised during the next months.

One aim of the international efforts in metadata standardisation is compatibility with WMO's WIGOS standards, which is something that ICOS itself is also considering. Close discussions have started and will be maintained to ensure that the two efforts are complementary.

Deliverable 2: Summary of data submissions and quality submitted to the Carbon Portal as part of the main report.

Summary of published L2 observations from labelled ICOS stations for 2025 (including pre-2025 data submitted during 2025):

Station	**Observations**
BE-FOS-Thornton Buoy	1,272
BE-SOOP-Simon Stevin	217,029
DE-SOOP-Atlantic Sail	*Data submission issue*
DE-SOOP-Finnmaid	324,181
DE-SOOP-Polarstern	*Data submission issue*
ES-SOOP-CanOA	16,382
FR-SOOP-France-Brazil	*Station not operating*
IE-SOOP-Celtic Explorer	*Data submission issue*
IT-FOS-E2M3A	*Station not operating*

IT-FOS-MIRAMARE	*Station not operating*
IT-FOS-PALOMA	25,824
IT-FOS-W1M3A	5
NO-SOOP-G O Sars	148,334
NO-SOOP-Kronprins Haakon	12,371
NO-SOOP-Sea-Cargo Express	208,081
NO-SOOP-Tukuma Arctica	118,518
SE-MFT-Östergarnsholm	1,931
UK-FOS-PAP	2,702

DE-SOOP-Atlantic Sail, DE-SOOP-Polarstern and IE-SOOP-Celtic Explorer have had issues with their data pipeline that prevented them from submitting data to ICOS in 2025. OTC is working closely with these stations to resolve the issues.

FR-SOOP-France-Brazil is having its equipment transferred to a new ship, so has not been collecting data in 2025. IT-FOS-E2M3A and IT-FOS-MIRAMARE and IT-FOS-W1M3A have had technical issues with their installations and collected very limited or no data.

Task 3. Network coordination, training and development

Task 3.1 Training to optimize and standardize performance of the network.

Tobias Steinhoff returned to GEOMAR at the end of 2024. A recruitment activity during spring 2025 lead to the appointment of Lucía Gutiérrez-Loza to lead this area in summer 2025. Lucia worked in the Ostergarnsholm station for her PhD work and is an expert in eddy covariance estimates of air sea CO2 fluxes. Our standard practice is to organise an in person event each fall but due to the ICOS 10 event we were unable to do this. A summary of activity in 2025 is as follows .

OTC pCO_2 station verification system*.* This was built and tested in 2024. The initial tests of the system in April 2024 resulted in the labelling of the Östergarnsholm station in 2025. The system was tested again in the summer of 2025 onboard of the R/V Gaia Blue as part of ITINERIS' EYES cruise. The campaign served to test the business model, and the outcomes were used to outline the terms of use of the system within the ICOS community. A full programme is set up for the early part of 2026 and we anticipate taking the system to the MSA meeting in 2026 in Venice for demonstration to the whole group so that they can begin to integrate it into their planning.

Workshop*:* In October 2025, OTC participated in the GEORGE Technical Forum II in VLIZ. The training covered sensors for marine carbonate system observations. The station verification system, developed in 2024, was one of the systems covered during the training event. Supporting material was prepared in advance of the training forum. The material is in continuous development and is intended to provide support to the stations regarding the installation and use of the station verification system.

An in-person MSA was also organised in Helsinki as part of the ICOS 10-year celebration events. Topics discussed during this in-person session included status and updates of stations labelling, bottlenecks for ocean stations, the station verification system, and technology needs, among other.

Reporting *on pCO2 intercomparison:* The results of the intercomparison are published and openly available:

Steinhoff, T., Gkritzalis, T., Jones, S., Macovei, V. A., Neill, C., Schuster, U., ... & Wanninkhof, R. (2025). The ICOS OTC pCO2 instrument intercomparison. Limnology and Oceanography: Methods, 23(12), 924-948.

Ongoing training in QuinCe: Steve Jones, Ingunn Skjelvan and Hannelore Theetaert provide user support for the QuinCe software. New users are given one-on-one initial training on a request basis.

Task 3.2 Station support

Most ICOS ocean stations use one of two technologies to measure surface ocean CO2 levels, systems directly calibrated using gas standards or membrane-based systems which rely on pre- and post-deployment calibrations. In ICOS OTC we provide support to both communities. We work closely with the ICOS Calibration Laboratory (CAL Lab) to ensure the supply of standard gases to the stations that require them; during 2025, 53 gas standard bottles where prepared and provided to ICOS ocean stations. Due to reduced capacity, no station visits were carried out in 2025 as stated in the workplan.

Deliverable 3: Report on network training and station support activities within main report (annually).

Task 3.3. Labelling

In 2025, the ICOS ocean network encompassed 28 stations, of which 13 were of the category FOS (Fixed Ocean Stations) and 15 were SOOP (Ship Of Opportunity). In 2025, the IE-SOOP Celtic Explorer and the SE-FOS Östergarnsholm were labelled as Class 2 stations. This means that 17 of the 28 stations are labelled. The labelling is a continuous activity where we help the stations achieving data of highest possible quality, give advices regarding instruments and installation, and help trouble shooting when things don't work as they should. The labelling scheme for the oceanic stations is being revisited motivated by the outcome of the inter-comparison experiment in 2021. The process is ongoing and no conclusion is drawn yet.

Deliverable 4: station labelling reports (continuous, summary in annual report)

Task 3.4: New technology and new platforms

New developments in sensor and platform technologies for ocean carbon observations have been presented to the ICOS-MSA and wider European carbon observing community during several events including the Wepal Quasimeme Ocean Acidification workshop (March 2025) and the ICOS MSA in Helsinki (November, 2026). The GEORGE technical forum II (October 2025) on sensors and samplers for ocean carbon observations was aimed specifically for the ICOS ocean stations and the wider European ocean observing community and offered theoretical and hands-on training on these new cutting edge technologies. Progress in carbon observing technology development has been further supported by securing further funding in 2025 by the UK's Future Marine Research Infrastructure Programme, project MaSCOt.

Task 4. Projects and international cooperation

Deliverable 5 International collaboration and standardization are key activities to increase ICOS's visibility and ensure cross-RIs data interoperability. The OTC organizes continuous exchange with other similar RIs globally and participates in national and international projects that strengthen ICOS's role in the scientific community. This task will ensure a proper flow of information, development, results and connections between the research projects and the ICOS OTC activities.

In 2025 we undertook work in the following areas

1. Delivering relevant parts of EU grants awarded in 2022 as follows

- Ocean Improved Carbon Understanding (ICU). This 15MEu OTC lead grant involves a significant work element lead by OTC host institutions Exeter and NORCE focused on using ICOS (and other) data to evaluate the current state of the Ocean C Cycle. Currently our major focus is on reconciling uptake estimated from surface observations like those from ICOS with estimates from interior accumulation (Exeter, NORCE)
- GEORGE, Large (10MEu) technology grant lead by ICOS head office in collaboration with EMSO and Argo aimed at supporting the transition to autonomous observing. Our major focus is on evaluating the strengths and weaknessses of differnt methodologies for estimating air sea CO2 flux and training (NORCE), alsongside a significant component of technological development (NOC)
- KADI, Capacity building grant lead by ICOS head office aimed at supporting the development of a GHG observing system in Southern Africa with significant ocean element This concluded this year but left a valuable legacy in terms of a coherent plan to establish an ocean observing system in coastal African states.
- EuroGOSHIP. EU Infrastructure development grant aimed at supporting network of sections that make inter alia observations of vertical ocean CO2 profiles. This concluded in 2025 and we plan a submission of phase 2 in Summer 2026.

2. To deliver a further 4 EU grants awarded in 2023

- AMRIT (NORCE): This proposal 'All Marine Research Infrastructures together' proposes a variety of actions to strengthen OTC operations including instrument tagging and training in the operation of the ultimate project objective: a technical support centre for European marine observing.
- Aquarius: This proposal addresses transnational access in the marine research infrastructures and contains a small OTC data component
- LandSeaLot. This contains resources to work with Jerico and Danubius around observing systems in the near shore zone with a focus on exploring the possibility of using isotopes to track the sources of CO2 flux to the atmosphere. During 2025 NORCE participated in 2 research expeditions to the Gulf of Bothnia to use isotope measurements to address this issue.
- NUBICOS: This is an ICOS Head Office coordinated grant with elements around improving the ICOS labelling system and supporting the Quince software package used by ICOS stations.

3. To deliver a grant awarded in 2024 'TRICUSO'.

This is an expansion of a grant lead by two MSA members which was unsuccessful. It links together multiple RIS and partner institutions with a strong technological innovation focus to fully understand how European institutions can integrate effort together to support Southern Ocean CArbon cycle observing within the framework of the G3W. t

4. Supporting or lead proposals in any areas identified by as being key expansion areas, or where ICOS is identified as a key contributor

In 2025 we successfully lead a grant JOHN that aims to bring together ICOS expertise with other key groups to understand what the key steps needed to deliver an integrated observing system in support of the G3W and Global C budget. JOHN will kickoff in September 2026 and run for four years.

Task 5. Other activities

- We had a substantial presence at the UNOC and One Ocean Science conference
- Sanders continues to serve as the EC G7FSOI delegate for the ocean carbon workstream
- Sanders continues to serve as the JPI Oceans lead on the Ocean Carbon Capacities programme
- Sanders continues to serve on the Observing Task team within the G3W

Central Radiocarbon Laboratory (CRL)

Task 1. General management

This task covers the activities listed below and includes risk management in accordance with the host institution's guidelines, RICOM activities following the RICOM Rules of Procedure, general communication and dissemination of ICOS science, participation in GA Info Days, meetings with the SAB, and other organisational duties related to coordinating CRL activities.

Task 1.1 Management and provision of general Central Radiocarbon Laboratory capacity and related data management at the CRL

CRL services and the capacity for sample analysis were fully provided in 2025.

In 2025, the new automated flask extraction and graphitisation system ALF-newAGE (ALF = Air Loading Facility; newAGE = new Automated Graphitisation Equipment) was delivered by ETH Zurich. Both components are prototype systems developed within the CORSO project specifically for the requirements of the ICOS CRL. During 2025, the ALF-newAGE system was installed and extensively tested at the CRL. A primary focus of the commissioning phase was to ensure that the new graphitisation system and the existing CRL graphitisation line do not cause systematic offsets. For this purpose, in total 399 quality-control samples were analysed on the new system. The comparison revealed a systematic difference of approximately 0.71 ‰ ± 0.16 ‰ in $\Delta^{14}C$. Further investigation showed that this offset originated from contamination in the primary standard CO_2 used in the ALF-newAGE system. After replacing the primary standard material, both graphitisation systems agreed within 0.23 ± 0.15 ‰. Achieving this agreement is a necessary step before integrating the ALF-newAGE system into the routine processing of ICOS CRL samples. Due to the issues described above, the commissioning of the system took longer than initially planned. During the extensive comparison and testing phase, several technical issues with the newAGE prototype system were identified and addressed. These included problems with the Peltier cooling units, the graphitisation furnaces, and the CO_2 trapping system, as well as a high compressed-air consumption, which required the installation of an upgraded compressed-air supply in the CRL laboratory. All identified issues were subsequently resolved, but they also contributed to the delay in commissioning the new system.

In parallel, development began on an automated preparation line for extracting CO_2 from NaOH absorption solutions used in integrated $^{14}CO_2$ sampling. The purpose of this system is to automatically acidify and extract CO_2 from NaOH samples using an autosampler, then transfer the purified CO_2 directly to the newAGE graphitisation system. In 2025, the design, hardware development, and control software programming were completed, and initial test extractions were carried out. Ultimately, this automated preparation line aims to replace the traditional manual preparation of integrated samples and facilitate their routine processing on the newAGE graphitisation system.

Deliverable 1: Provision of the Central Radiocarbon Laboratory capacity and the local database.

Deliverable has been fulfilled.

Person-months spent on Task 1.1: 14.4 PM

Task 1.2 Reporting

The general report, including the financial and activity report for 2024, was submitted to the HO in April 2025. The budget and work plan for 2026 were prepared and submitted in October 2025 (Deliverable 2). CRL activity updates were presented during the General Assemblies in May and October 2025 as well as in online meetings with the SAB.

Deliverable 2: CRL general report. The report includes the Annual Activity Report and the financial report, the Annual Work Plan and the Annual Budget for the following year and 5-years Financial Plan. It is based on templates provided by the HO and submitted to the General Assembly and RI Committee.

Deliverable has been fulfilled.

Person-months spent on Task 1.2: 2.8 PM

Task 2. Data management/production

Task 2.1 Radiocarbon analysis of up to 1000 two-weekly integrated CO_2 samples per year from the ICOS RI atmospheric station network

In 2025, 18 atmospheric ICOS Class 1 stations and two ICOS Class 2 stations, Izana and Schauinsland, along with the ICOS CRL pilot station, provided integrated CO_2 samples to the ICOS CRL. Sampling at Mace Head remained interrupted in 2025 following the collapse of the sampling mast.

A total of 365 European samples were analysed using low-level counting. In addition, 16 integrated samples from ICOS stations were analysed by accelerator mass spectrometry (AMS). Furthermore, 29 non-European integrated $14CO_2$ samples from the polar stations Neumayer (Antarctica) and Alert (Arctic), as well as from ATTO (Amazon Tall Tower Observatory), were analysed. Measurements from these global background stations support comparisons between different international 14C monitoring networks.

Deliverable 3: Continuous reporting of preliminary integrated $^{14}CO_2$ analysis L1 data for all atmospheric class-1 stations

Deliverable 4: 1 Revision of L1 integrated $^{14}CO_2$ analysis data to L2 for each atmospheric data release

Both deliverables have been fulfilled.

Person-months spent on Task 2.1: 16.7 PM

Task 2.2 Radiocarbon analysis of CO_2 from up to 1000 flask samples per year

In 2025, a total of 1,299 ICOS flask samples were analysed, compared to 1,087 in the previous year. In addition, 95 flask samples from the ICOS candidate station BIK (Poland) were processed and analysed.

According to the 2025 CRL work plan, the additional flask analyses associated with the CORSO project were expected to be completed in 2025. However, these analyses continued during 2025 under the CAMS2-26 project. The costs associated with these additional CORSO/CAMS2-26 samples are covered by the respective projects. In contrast to the EU-funded CORSO project, the CAMS2-26 analyses are processed through the CRL budget and therefore appear as part of the laboratory expenditures in the financial report.

Within the PAUL project, an additional 393 flask samples were processed and analysed for $^{14}CO_2$. The PAUL project fully covered the costs for the technical personnel involved in sample preparation as well as the AMS analysis costs.

Within the Horizon Europe project NUBICOS, the CRL analysed 34 additional flask samples collected at the Mace Head supersite. The analytical costs for these samples were fully covered by the NUBICOS project.

In total, 1,821 flask samples were processed at the CRL in 2025.

Deliverable 5: Continuous reporting of flask sample $^{14}CO_2$ analysis L1 data for all atmospheric class-1 stations

Deliverable 6: Revision of L1 flask sample $^{14}CO_2$ analysis data to L2 data for each atmospheric data release

Both deliverables have been fulfilled.

Person-months spent on Task 2.2: 11.9 PM (+16 PM funded by projects)

Task 3. Network coordination, training and development

Task 3.1: Interaction with station PIs

CRL scientists participated in the ICOS Atmosphere MSA meetings in April and October 2025. The $^{14}CO_2$ results from the integrated and flask sampling were presented to the MSA participants. The CRL and the stations regularly exchange emails regarding sample supplies, spare parts, and other issues. The regular transfer of samples between the stations and the CRL is functioning smoothly.

In 2025, the CRL continued to execute a flask sampling selection strategy to minimise the risk of nuclear $^{14}CO_2$ contributions for CAMS2-26-related ICOS stations. The network-wide adoption of this strategy is still pending, while CRL, CP, and ATC are working on its automated implementation.

Deliverable 7: Meeting and continuous interaction with station PIs. Annual meeting and ongoing exchange with station PIs to discuss CRL-related issues (together with MSA)

Deliverable 8: Supporting PIs in the $^{14}CO_2$ flask sample selection.

Both deliverables have been fulfilled.

Person-months spent on Task 3.1: 3.8 PM

Task 3.2 Production of integrated CO_2 samplers

In 2025, the Italian national network requested one integrated CO_2 sampler. The sampler is intended as a backup unit rather than for deployment at a specific station.

Deliverable 9: $14CO_2$ integrated sampler production (up to six samplers per year for new ICOS class-1 atmospheric stations).

Deliverable has been fulfilled.

Person-months spent on Task 3.2: 1.0 PM

Task 3.3: Operation of the ICOS Pilot station, development and evaluation of $ffCO_2$ monitoring strategies

In 2025, the CRL operated the ICOS CRL pilot station, including:

- continuous in-situ measurements with ICOS-compliant CRDS and FTIR analysers
- continuous in-situ NO and NO_2 measurements

- semi-continuous in-situ ^{222}Rn measurements
- integrated CO_2 sampling for $^{14}CO_2$ analysis

Deliverable 10 was completed through continuous operation, the transmission of in-situ GHG data to the ATC, and the submission of the $^{14}CO_2$ results to the CAL-FCL database. No additional flasks were sampled at the ICOS-CRL pilot station in 2025.

Scientific results obtained at the CRL pilot station were published in 2025 in Atmospheric Chemistry and Physics (https://acp.copernicus.org/articles/25/18373/2025/). The study evaluates the use of atmospheric tracers to estimate fossil-fuel CO_2 signals and documents the methodological framework developed at the CRL pilot station.

Apart from the continuous operation of the instrumentation and the routine sampling activities described above, no further technical or methodological developments were carried out at the CRL pilot station in 2025.

***Deliverable 10**:* Operation of the CRL pilot station. Continuous operation of ICOS standard instrumentation at the CRL pilot station and provision of in-situ and flask data to the ATC.

Deliverable has been fulfilled.

Person-months spent on Task 3.3: 4.5 PM

Task 4. Projects and international cooperation

The CRL participated in the PAUL project coordinated by ICOS ERIC and contributed to WP3. The project was completed in 2025, during which the CRL analysed 393 $^{14}CO_2$ samples for PAUL. The project covered the costs for flask analyses, consumables, and a dedicated part-time technician at the CRL.

The EU Horizon project CORSO (CO2MVS Research on Supplementary Observations), coordinated by ECMWF, was completed in 2025. The project provided resources and additional workforce to analyse ICOS flask samples from ten western European ICOS class-1 stations for $^{14}CO_2$ collected in 2024. After the completion of CORSO, the related analysis activities are being continued under the CAMS2-26 project.

The CRL participates in the Horizon Europe project NUBICOS (2024–2027), which establishes a global flask sampling "super site" at Mace Head (Ireland) together with ICOS partners at the University of Galway. The site enables co-located atmospheric $^{14}CO_2$ sampling by the four major laboratories monitoring the global $^{14}CO_2$ background (NOAA/INSTAAR, Scripps/UCI, GNS and ICOS). Within this framework, the CRL participated in the international intercomparison of atmospheric $^{14}CO_2$ measurements at the Mace Head supersite. By the end of 2025, the CRL had analysed 34 flask samples from Mace Head. Preliminary comparisons with the partner laboratories show good agreement with Scripps and GNS, with mean deviations below 0.8 ‰, while the deviations relative to NOAA are larger, at approximately 2 ‰. The analysis of the second pure CO_2 intercomparison (ICP) samples had already been completed in 2024. The publication of the ICP results has been postponed and is now planned for 2026.

For the ATTO+ project (Amazon Tall Tower Observatory, coordinated by MPI-BGC and funded by the German BMBF), the CRL analysed 11 integrated samples in 2025. The ATTO+ project pays €250 per sample plus overhead costs. All results will be available to ICOS RI.

Deliverable 11: Report on Projects and International and extra-ICOS collaborations. It reports, in the context of the Annual activities report, the activities performed and the results obtained from the participation in research projects and other collaboration activities.

Deliverable has been fulfilled.

Person-months spent on Task 4: 0.0 PM (9.25 PM are funded and accounted for in the individual projects)

Task 5. Other activities

Max Gachivsky, in collaboration with MPI-BGC in Jena, completed his work on fossil fuel CO_2 ($ffCO_2$) modelling at the European scale using the CarboScope TM3/STILT inversion system. The results of this PhD work were published in 2025 (doi:10.11588/heidok.00037507).

The study first evaluated for which regions in Europe the current ICOS $^{14}CO_2$ observations provide sufficient information to constrain fossil fuel CO_2 emissions. The analysis showed that the observational coverage is currently only sufficient for central-western Europe (CWE), while other European regions remain weakly constrained. Consequently, an expansion of the European $^{14}CO_2$ monitoring network will be necessary if additional regions are to benefit from the ICOS observations. The study then used the available ICOS $^{14}CO_2$ observations to evaluate and constrain fossil fuel CO_2 emissions in central-western Europe. The analysis shows that the inclusion of $^{14}CO_2$ observations significantly reduces biases in prior emission estimates. For the region of central-western Europe, the $^{14}CO_2$ observations reduce the bias in prior $ffCO_2$ emissions by approximately 60 % when using integrated samples and by about 70 % when using flask samples.

However, the analysis also demonstrates that the absolute magnitude of the $^{14}CO_2$-based $ffCO_2$ estimates remains sensitive to the assumed European $^{14}CO_2$ background value. A systematic bias of 0.5 ‰ in the background corresponds to a change of approximately 4 % in the inferred total $ffCO_2$ emissions for central-western Europe. This result highlights the importance of improving the observational coverage of the European $^{14}CO_2$ background. At present, the background determination relies largely on observations from Mace Head, indicating that additional background sites or sampling strategies will be required in the future.

The study also evaluated the use of CO-based $ffCO_2$ estimates derived from ^{14}C-calibrated CO enhancements. At the scale of the European ICOS network, this approach proved not to be robust, as the uncertainties associated with determining the CO background are too large. Consequently, CO-based $ffCO_2$ estimates are currently not suitable for continental-scale emission estimates within the ICOS network.

These results are documented in Max Gachivsky's PhD thesis, including recommendations for an improved $^{14}CO_2$ sampling strategy.

Person-months spent on Task 5: 7 PM

Flask and Calibration Laboratory (FCL)

Task 1. General management

Task 1.1 Management and provision of Flask and Calibration Laboratory capacity and related IT- and data management at of FCL

FCL services and the capacity for sample analysis and data management were provided in 2025. The capacity was partly reduced due to reduced staff number following the death of one team member (scientific programmer) and parental leave of two other FCL members. A new scientific programmer could be hired in November. Routine maintenance of the laboratory technical infrastructure was performed but a failure of the UPS system end of September resulted in a laboratory blackout causing some minor damage. The purchasing process for the intended replacement of the server at FCL has been started in 2025 but will be transacted in 2026.

Task 1.2 Reporting

The general report, which encompassed the financial and activity report for 2024, was submitted to the Head Office in February 2024. The budget and work plan for 2026 were provided in September 2025 (Deliverable 2). FCL activity updates were presented to the SAB.

Task 2. Data management / production

Task 2.1: Trace gas analysis

There have been 2811 flask samples from the 17 ICOS class 1 stations with active flask sampling programme that have been analysed (Deliverable 3), an additional 428 flasks for QC purpose. The Flask data transfer to the ATC included data provision for Fast Track Releases in January, April and October. Trace gas data from flask samples including their respective uncertainty estimates were provided for the ICOS Atmosphere 2025 data release in June 2025.

Task 2.2: Analysis of supplement parameters (CO2 stable isotopes and O2/N2 ratios)

All station air flask samples mentioned in Task 1 have been analysed for CO2 stable isotopes and O2/N2 ratios (Deliverable 4) and those measurement results have likewise been part of the annual and the Fast Track releases of ICOS Atmosphere data.

Task 2.3: Support to maintain ICOS network flasks fit for purpose

All flasks purchased by ICOS stations first received a standardised specification check at FCL before being pre-conditioned for usage. All flasks were reconditioned before being sent to the ICOS stations. Following sample pressure loss the respective flasks underwent a sensitive leak test and were repaired where necessary. This also applies to a large set of new flasks purchased with MPG funds for global sampling activities (see Task 4).

Task 2.4: Production of real air high pressure standard gases within specified composition ranges for the ICOS continuous-core parameters.

In 2025, 90 new standard gases have been filled for ICOS atmosphere monitoring and QC activities, 32 standards for ocean observations.

Task 2.5: Calibration and re-calibration of above-mentioned standard gases every third year relative to the current WMO calibration scales at any one time.

154 high pressure standard gases have been calibrated and recalibrated for atmospheric stations, 44 for Thematic Centers and 56 for ocean monitoring activities.

A data revision of the CO2 calibration has been conducted based on revised assignments of FCL standard gases. This update included additional information from a re-calibration done by the WMO Central Calibration Laboratory in 2024 and addressed small systematic biases arising from differences in the CO2 isotopologue composition of standard gases that are composed of modified real air relative to true atmospheric air. All previous calibration results were re-transferred to the ATC and have been used to reprocess the atmospheric CO2 measurement data.

Task 3. Network coordination, training and development

Task 3.1 Interaction with station PIs

FCL scientists participated in the ICOS Atmosphere MSA meetings in May and November. The FCL and the station PIs routinely interact concerning standard gas requests, flask shipments, and flask sampler questions. The regular transfer of samples between the stations and the FCL is going smoothly.

Task 3.2 Organisation of and participation in international QC activities to link ICOS to other global networks

The ongoing QC programme for flask analysis has been continued. Three sets of "sausage" flasks were prepared, distributed to the participating international partner laboratories, and analysed. New high pressure cylinder samples for the round robin programme ("MENI") were prepared, calibrated and forwarded to the involved partner laboratories. The respective measurement results of those two exercises are submitted to a NOAA-GML ftp site and plotted using their ICP2 software tool. Results of all QA/QC activities have been compiled and evaluated in the updated annual QC Report (https://doi.org/10.18160/V2NS-9WXH). Co-located collection of flask samples at the Mace Head supersite started in February 2025 for ICOS, NOAA, and SIO flasks as part of the NUBICOS project with data likewise being submitted to the NOAA-GML ICP site.

Task 3.3: Flask sampler support, development and implementation of new flask sampler capabilities for additional applications needed to enable upcoming flask sampling strategies

Support was provided to field stations in their operation of the flask sampling programme by remote and on-site support. A new flask sampler was delivered to Mace Head in its function of an ICOS supersite for flask intercomparison with other global greenhouse gas observation networks.

The flask sampler software was further developed to allow among others functional checks that have been made possible with the most recent flask sampler design upgrade. A successive hardware upgrade to bring flask samplers that are operational at ICOS class 1 stations on that design level shall be supported by the CAMS-2 project, which has been granted in 2025.

Task 4. Projects and international cooperation

PAUL / ICOS Cities project: The Relaxed Eddy Accumulation system was returned from Munich after successful completion of the project campaign. For its contributions to tasks 3.1 and 3.4 FCL analysed 255 samples in 2025.

CORSO: The participation of the CAL-CRL in the CORSO project has been supported by covering the additional flask logistics and analysis of additional 106 samples.

NUBICOS: A flask sampler for the NUBICOS comparison activities at the Irish Mace Head ICOS station was commissioned and staff of ICOS Ireland trained in its handling. Arrangements for the sampling were discussed with the international partners. The comparison activity started in February 2025 and 43 ICOS samples were collected. After optimisations in the planning of sampling events and in the alignment of sample collection times the comparison data in the second half of 2025 yielded a very satisfactory agreement in several tracers' mole fraction results between ICOS and NOAA. CO2 offsets have remained more noisy than expected which may indicate that the interim set-up of seperated air intake positions at the Mace Head station building might impact these results. A relocation of the intake lines to a common position at a new mast is foreseen for early 2026.

IM4CA: Administrative shortfalls have delayed the procurement of an isotope ratio mass spectrometer to set up an analytical system for the analysis of methane stable isotopes in 2025. The tender process is to be conducted in early 2026. An additional flask sampler has been manufactured to be used by an IM4CA project partner.

Global cooperation: The General Assembly has acknowledged the need to strengthen the redundance of global greenhouse gas observations. It has encouraged starting ICOS air sampling activities at global background stations initially based on external funding. Investment funding was raised from the Max Planck society in October 2025 allowing to procure material needed for such an activity. Funding will include also some financial contribution to operational costs up to 2030. A number of 1000 flasks dedicated to this activity was purchased and 15 manually operated flask samplers are being built. Discussions with colleagues from NOAA have started end of 2025 to explore at which sites collection of ICOS will be possible.

Task 5. Other activities

Monitoring Station Assemblies

All MSAs across the three domains

In 2025, for the first time, a cross-domain MSA meeting ("SuperMSA") was held, face to face, in the framework of the ICOS 10th anniversary meeting in Helsinki. The meeting was held on the morning of Wednesday, November 26 from 09:00 to 12:00 and attracted 192 registered participants. Topics included the role of ICOS in applied greenhouse gas research and monitoring worldwide, joint efforts between the three domains at their natural topical intersections and passing on best-practice examples between the three domains.

On the afternoon of the same day, all three MSA communities had individual meetings contributing to their respective annual meeting program (see below).

In addition to the MSA meeting itself, chairs and volunteers from all 3 MSA communities contributed to the planning and program of the Helsinki meeting, in particular to Info Day, e.g. through presentations and as panellists in a panel discussion.

Ocean MSA

In continuity with previous years, eight one-hour monthly online short meetings (named "MSA Café") were organized to facilitate continuous dialogue within the community and with the OTC, allowing regular updates and feedback exchange. They also helped to identify the most relevant topics for discussion at the online and in-person meeting.

The Ocean MSA community held an online spring meeting on 15–16 March, with participation from all stations. Each station presented its ongoing activities, challenges faced, and future perspectives. Various topics were discussed, including updates from the OTC, data updates, SOCAT, WMO matters, station labelling, future project developments, and potential KPIs for ocean stations.

The annual in-person meeting, usually held in autumn, took place this year within the framework of the ICOS 10th Anniversary Meeting, on the afternoon of 26 November. It was attended by 34 participants, both onsite and online. The meeting focused on technological developments, training needs (ongoing and future), and activities to be developed within upcoming projects, particularly in the context of international initiatives such as SOCONET and G3W.

Ecosystem MSA

Due to the abovementioned SuperMSA, the ecosystem MSA community had two face-to-face meetings in 2025 instead of the usual combination of one face-to-face meeting (spring in recent years) and a series of online meetings (autumn).

The spring meeting was held in Madrid from Tuesday, March 25 to Thursday, March 27 in rooms of the Spanish National Research Council (CSIC). Our hosts were Pilar Martin and her team (CSIC) and Arnaud Carrara (Mediterranean Center for Environmental Studies CEAM), who co-operate the ICOS site Majadas de Tiétar (ES-LMa). Tuesday was a full-day excursion to the site and places nearby with explanations about the Dehesa ecosystem. Wednesday and Thursday morning saw presentations and discussions by PIs, ETC and Head Office about monitoring practices, upcoming new instructions, possible project calls and scientific questions as well as a group exercise for ICOS communications.

The autumn meeting was held on the afternoon of Wednesday November 26 in Helsinki in the framework of the ICOS 19th anniversary event (see above), from 13:00 to approximately 17:30. It had 58 participants and contained contributions by PIs, ETC and CP about both, practical questions on continuing the monitoring activities and scientific questions like e.g. latest discussion on the magnitude of the land sink, as well as a project planning breakout meeting.

During this meeting and continuing via email afterwards, the new ecosystem MSA chairs were elected at the end of the 2-year term of Natalia Kowalska and Alexander Graf, both of which were looking for successors. Holger Lange (NO-Hur) was elected for the term 2026-2027; after another volunteer could not maintain his offer due to organisational reasons, Alexander Graf will remain chair in 2026. Our goal is, by finding a new volunteer starting 2027, to arrive at a similar practice as the other two domains, which swap their two chairs not at the same time but consecutively to improve continuity.

Atmosphere MSA

The spring face to face meeting was held in Offenbach, Germany at DWD on May 26-28, 2025. Apart from the updates from HO, central facilities, working groups and EU projects, we again had some nice additional contributions. These included two contributions from DWD about ITMS and ICON, as well as studies investigating nuclear $^{14}CO2$ discharges, the use of radon to improve CH_4 emission estimates, the influence of stratosphere to troposphere transport on the CO_2 and CH_4 measurements at Monte Cimone, measurements of halocarbons using the ICOS flask sampler and the impact of aging inlet

tubing on CO_2 (which was a topic during the MSA in autumn as well). Further, we had summarizing discussions for the data review groups and reporting on the European Obspack dataset, as well as actions required to get ICOS data ready in time for the annual level 2 atmospheric data release by ATC. Additionally to the annual (fully quality controlled) data release we now have a fast track data release every three months which includes manual PI quality control flags.

The autumn MSA meeting was held jointly with the other two domains as part of the Super MSA on November 26th in Helsinki, with 47 registered attendees from the atmospheric domain. Dagmar Kubistin stood down as MSA chair after serving in this role since 2024, and before that as co-chair since 2022. Arnoud Frumau was elected as the new MSA chair (having previously been vice chair since 2024), and Joe Pitt was elected as co-chair. Following a presentation by Bert Scheeren on the impact of aging inlet tubing on CO_2 measurements at the Lutjewad station, a new working group was established to investigate this issue.

National Networks

Belgium

No changes

Czech Republic

Highlights

ICOS CZ and its hosting institute Global Change Research Institute of the Czech Academy of Sciences (CzechGlobe) from 15 to 17 September 2025 organised its third international scientific conference Quo Vaditis in Velké Karlovice in Czechia. As suggested by the conference title, **"Quo vaditis Agriculture, Forestry and Landscape? 40 Years of Climate Change Research in the Czech Republic,"** the event was held to mark the 40th anniversary of the Experimental Ecological Station Bílý Kříž (ICOS ecosystem site) in the Beskydy Mountains. As in previous years, the multidisciplinary conference focused on the impacts of climate change and on strategies for mitigation and adaptation at different scales and across various disciplines, ranging from molecular processes to the landscape level, and from ecophysiology to socio-economics.

The presented papers addressed key topics such as carbon dynamics, greenhouse gas fluxes, adaptation strategies, and tools enhancing the mitigation functions of ecosystems, as well as current impacts of climate change at regional and global scales, including estimates based on projected climate scenarios. Presentations also covered ecosystem adaptive capacity, socio-economic scenarios, and sustainable transformational strategies.

The opening keynote lecture was delivered by the CzechGlobe director Prof. Marek, who summarised the history and major milestones of climate change research in the Czech Republic, including the establishment of the experimental station at Bílý Kříž. His presentation was followed by several other speakers whose papers focused on research results obtained at the Bílý Kříž site.

A bilateral project in the framework of the Swiss-Czech Cooperation Programme was awarded to two ICOS national networks: ICOS Czech Republic and ICOS Switzerland. The project implementation is planned for the period 2026–2028 . The INETFLUX (Innovative technologies cross scales to disentangle carbon dioxide and evapotranspiration fluxes of forests) project brings together CzechGlobe and two Swiss research institutions (ETH Zürich and WSL) which all are part of ICOS.

ICOS CZ research infrastructure that is part of national RI CzeCOS that is solely hosted and operated by Global Change Research Institute of the Czech Academy of Sciences (CzechGlobe) participated in autumn 2025 at **International peer-review assessment of large research infrastructures of the Czech Republic for period 2027 – 2034** that is organised by the Ministry of Education, Youth and Sports. The evaluation results will be published during the year 2026 and this key assessment for keeping funding of RI ICOS CZ.

Changes in station network

- No change
- All Czech stations are labelled since 16th GA May 2022 session.

Co-operation with other RIS

ICOS CZ host institute research infrastructure is also part of: ESFRI ACTRIS, DANUBIUS-RI, AnaEE ERIC and eLTER RI and it is founding member of EUFAR AISBL and these interlinks are used for interdisciplinary research.

Collocation stations:

- Křešín u Pacova atmospheric station (ICOS/ACTRIS).
- Bílý Kříž ecosystem station (ICOS/AnaEE/eLTER)
- Trebon wetland station (ICOS/eLTER)
- Lanžhot ecosystem station (ICOS/DANUBIUS-RI)

ICOS CZ participate in IRISCC (https://www.iriscc.eu/) project where is among others Bílý Kříž collocated ICOS site participating in TNA IRISCC call and other project activities.

Denmark

Highlights

The only atmospheric station DK-Sno, received a new Picarro high precision GHG analyser and installed it after being checked by ICOS-ATC.

The Team of the Class 1 beech forest ecosystem station (DK-Sor) received a grant to purchase a new soil chamber system for CO2 and CH4. We are looking forward to year 30 of continuous CO2 flux observations.

We are happy to start collaboration with two Finish universities with on a large Danish research project that will use the Danish ICOS stations and other Danish EC stations as backbones for field measurements on biological particle generation and non-CO2 climate effects. The number of EC stations in Denmark so far not yet associated with ICOS is growing.

We are in year two of a tall tower GHG eddy covariance observation in a Copenhagen suburb (Gladsaxe). The PI, Dr. Kostas Kissas, became Danish focal point for ICOS regarding urban observations.

All three Danish universities worked on involving young scientists which is supposed to lead to a gradual future shift in station PIs.

Changes in station network

All stations are running well. There are no changes.

Co-operation with other RIs

None reported.

Finland

Highlights

Both ICOS Ecosystem Class 1 and 2 -sites in Northern Finland, Sodankylä forest (FI-Sod) and Lompolojänkkä mire (FI-Lom) conducted their first ever ICOS soil sampling campaign in June and August, respectively.

Changes in station network

- Welgegund (ZA-Wgn) station in South Africa joined ICOS as an ecosystem associate station where aerosol and GHG measurements have been ongoing by FMI and UHel already since 2010. It represents grazed grassland savannah and is currently going through the labelling process. This is the first ICOS Finland station located outside of Finland.
- Kilpisjärvi (FI-Kpv) station in Finnish Lapland, run by UHel, joined ICOS as an ecosystem associate station. It represents mountain tundra ecosystem and is run with off-grid electricity, making it quite challenging to maintain the measurements over the long (>8 months) winter.

Co-operation with other RIS

The Finnish umbrella for four European RI's (ICOS, ACTRIS, AnaEE and eLTER), INAR RI Ecosystem board, has met three times in 2025 to discuss the common funding application and other coordination topics. There are several co-located sites between ICOS and eLTER, and now when eLTER is being constructed, coordination is needed.

The same INAR umbrella organized a Finnish research infrastructure science meeting in April 7-10, 2025, in Vuokatti, Sotkamo. There were about 100 participants discussing research themes with links to ICOS. ICOS Finland had a poster there.

Finnish ICOS, ACTRIS and eLTER scientists gathered together with several other researchers in annual ACCC (Atmospheric and climate competence center, a Flagship programme of the Research Council of Finland) science conference in Helsinki in November 10-12, 2025.

France

Highlights

- AMT (Atm. Meas. Tech.) **Outstanding Publication Award in 2025** for the paper: Eddy covariance with slow-response greenhouse gas analysers on tall towers: bridging atmospheric and ecosystem greenhouse gas networks Pedro Henrique Herig Coimbra, Benjamin Loubet, Olivier Laurent, Laura Bignotti, Mathis Lozano, and Michel Ramonet; Atmos. Meas. Tech., 17, 6625–6645, https://doi.org/10.5194/amt-17-6625-2024, 2024
- Extension of ICOS ATC applications (ATCQC, Webobs, data products) to total column measurements EM27
- SACLAY station: background definition to track the evolution of the Parisian urban dome for ICOS and ACTRIS (J. Doc and L. Bouillon thesis)
- Encouraging intercomparison of a membrane-based sensor with the showerhead equilibrator on the French SOOP line (Macovei et al., 2025).
- Seasonal Ocean CO_2 sinks evidenced near the Brazilian coast (10°S) from observations of the French SOOP line.

Changes in station network

- Ecosystem station Lamasquere closed

Co-operation with other RIS

- Colocated measurements at two urban sites in Paris (Romainville and Meudon) as part of ICOS-Cities
- Collaboration with ACTRIS-France and IAGOS-France in OBS4CLIM : NH3 measurements, overseas monitoring stations (Amsterdam I., Lamto, Chacaltaya), Atmo-Box, CO2/CH4 sensor for airborne applications
- Benjamin Loubet participating in the Scientific Steering Comity of the ANAEE ERIC science conference 2026.

Germany

Highlights

- Symposium "Fluxes anytime and anywhere: Current developments in measuring and modelling land-atmopshere exchange processes" due to Dennis Baldocchi's visit at University of Göttingen; including field visit at DE-Hai
- Contribution to three highly ranked publications addressing the fate of methane from the Nord Stream pipeline rupture, one in Nature (Harris et al.2025), two in Nature communications (Mohrman et al. 2025, Reum et al., 2025). Data from DE-SOOP Finnmaid played a crucial role for the quantification of the fraction of methane that remained in the water column, and its subsequent propagation in the water column.
- Finalization of the sensor-test facility on board DE-SOOP Finnmaid in connection to the EU Horizon Europe project GEORGE (operational since November)
- Keynote of Gregor Rehder (IOW) at Opening of Baltic Sea Science Conference on Nord Stream Blowout Event
- AWI-Polarstern: unique pCO2 data from the far south of the Weddell Sea where hardly any data are known: off Filchner-Rönne Ice Shelf
- Reference paper for Saxonian ICOS ecosystem sites finally published: https://doi.org/10.1016/j.agrformet.2025.110533

Changes in station network

Stations that completed labelling in GA meetings in 2025:

- Associated Ecosystem Station Fendt (DE-Fen)
    - Responsible institution: Karlsruhe Institute of Technology; Station PI: Hans Peter Schmid.
- Associated Ecosystem Station Graswang (DE-Gwg)
    - Responsible institution: Karlsruhe Institute of Technology; Station PI: Hans Peter Schmid.

New station added:

- Zarnekow station – Associated ecosystem site, peatland
    - Responsible Institution: Helmholtz Centre for Geosciences GFZ; Station PI: Torsten Sachs

Co-operation with other RIS

- DFG Research Unit, "Aquatic Methane Cycling in the Anthropocene (AMCA)", Coordinator: Frank Keppler, Heidelberg University (proposal was accepted in the first stage, we are now preparing the full proposal. Here DE-Amv is a key site)
- ReKIS (Regionales Klima-Informationssystem in Mitteldeutschland) includes regular updates of evapotranspiration and CO_2 sink at the Saxonian ICOS ecosystem sites: https://rekis.hydro.tu-dresden.de/wissen/sachsen-w/treibhausgase/treibhausgase/
- UFZ Leipzig joined the multi-site leaf water potential campaign initiated by the GfOe and coordinated by TU Dresden, repeated leaf water potential measurements and use of flux and met data
- HEREON is involved in the Wadden Sea-Rhine-Elbe LandSeaLot Integration Lab with DELTARES

- Integrated view and assessment of data from ICOS and BGC-Argo is in progress in the framework of the EU Horizon Europe project GEORGE; first results will be presented at the Ocean Science Meeting in Glasgow in February 2026.
- Within the EU-funded project GEORGE, GEOMAR is working together with Euro-ARGO and EMSO to improve marine carbon (and related parameters) observations. GEOMAR is involved in a task to include underway CO_2 measurement quality control in the online quality processing online tool QuinCe that was developed by ICOS OTC to process pCO_2 data.
- Cooperation with ACRI-ST and Ground-Based Observations for Validation (GBOV) of Copernicus Global Land Products - exchange of measurements and analysis results
- Cooperation with University of Leicester within the Advanced Surface Temperature Radiometer Network (ASTeRN) for the validation of land surface temperature measurements
- Cooperation with the global network for automated vegetation structure monitoring StrucNet
- VODnet (GNSS-T Vertical Optical Depth), led by GFZ
- https://deadtrees.earth/
- https://3dtrees.earth/

Greece

The Pertouli station broke down, causing damage to the instruments and infrastructure. As a result, data collection has been halted until repairs are completed.

Co-operation with other RIS

- AERONET (https://aeronet.gsfc.nasa.gov)
- Urbisphere (https://urbisphere.eu/campaign_berlin.html)
- ACTRIS (https://www.actris.eu)
- CLMS-Cities (https://clms-cities.eu/)

Hungary

No changes to report

Ireland

Highlights

- The ICOS Ireland network was officially launched in December, an ICOS science meeting was also held, incoming ICOS Director General Hannele Laine spoke at this event
- Two ICOS Ireland stations were labelled at the May General Assembly in 2025
    - Ecosystem - Clara Raised Bog (Associated)
    - Ocean - RV Celtic Explorer (Class 2)

Changes in station network

- Clara Raised Bog is now a labelled associate ecosystem station

- RV Celtic Explorer is now a labelled class 2 ocean station

Italy

Highlights

In November 2025, ICOS Italy participated in the ICOS10 celebration in Helsinki with a significant group of people, enhancing personal and scientific connections.

Furthermore, in December, a video about the Capodimonte station was finalized and uploaded on the new ICOS Italy YouTube channel. The station has also completed the labelling process.

Ecosystem domain

Throughout the year, the station of Castelporziano (IT-CP2) has been visited by relevant personalities, such as King Charles III of England and Sergio Mattarella, President of the Italian Republic.

The expertise gained at IT-CP2 supported a research period in Finland (Hyytiälä, FI-Hyy), where a PhD candidate, Roberto Corsanici, characterised ozone fluxes of a Scots pine forest in relation to abiotic drivers (meteorological parameters) and reactive biogenic VOC emissions influencing ozone exchange. Castelporziano has also been used as a test site for novel sap flow measurement technologies to compare with Eddy Flux data.

Atmospheric domain

The observation in Monte Cimone (IT-CMN) site clearly captured the atmospheric signal of the wildfire events that affected North America in May–June 2025. Evidence of the plume's impact on the atmospheric composition was the focus of two news articles published by the Carbon Portal and CNR.

Ocean domain

Near real time data transmission to the carbon portal has been implemented at the PALOMA station. ICOS-OTC officially collaborated in the Italian "ITINERIS-EYES" cruise (8–30 July 2025) on board RV *Gaia Blu*. Under the coordination of C. Cantoni, PI of the PALOMA station, the ICOS "station verification system" was borrowed and installed next to the ship's newly acquired sea-surface pCO_2 sensor. The experiment enabled the acquisition of high-quality pCO_2 data for the Mediterranean — still relatively scarce — and allowed evaluation of the performance of the *Gaia Blu* system under challenging summer conditions. C. Cantoni actively contributed to ICOS-RI as co-chair of the Marine ICOS Station Assembly (MSA). In this role, she co-organized the Joint MSA at ICOS10 event, one online MSA meeting, and nine short monthly MSA meetings.

Changes in station network

The Capodimonte (IT-PCm) station completed the labelling process.

The construction of Costa dei Trabocchi site (IT-UdA), a new atmospheric station that will soon be part of the network, is advancing.

Co-operation with other RIS

Numerous upgrades in different stations were carried out within the framework of the ITINERIS (Italian Integrated Environmental Research Infrastructures System) project. In both Torgnon stations (IT-Tor and IT-TrF), CMCC personnel participated in the European Union's Next Generation EU programme under Mission 4 "Education and Research", Component 2 "From research to business", supported by the NUBICOS Horizon Europe project.

Monte Cimone station was included in the H2020 ATMO ACCESS project in conjunction with ACTRIS-RI. Throughout the project (April 2021 – September 2025), CMN-IT hosted six experiments by external users through the Trans-National Access, totalling 160 user working days.

Potenza site is included in ATMO ACCESS and IRISCC projects as part of CIAO facility hosting ICOS and ACTRIS RI observations and additional instruments, and providing TNA physical and remote access.

Paloma station carries on the collaboration with DANUBIUS within the framework of the LandSeaLot project. In the Northern Adriatic coastal area, data collected at the riverine DANUBIUS station at the mouth of the Isonzo river, are being analysed in comparison with data from the PALOMA ICOS station, improve the understanding of lateral carbon fluxes and the role of estuarine areas in the global carbon budget.

Netherlands

Changes in station network

- NL-Loo: added O3 concentration and flux measurements.
- NL-CBW: Large maintenance at CBW tower reduced entrance availability. Due to added valveboxes in the tower at all heights to divert flow we were able to continue measurements most of the time. G5310 broke down in September 2025 after CBW power failures. New purchase PI5310 arrived from ICOS-ATC testing November 2025 and was implemented end November. Although Picarro Linux software has still bugs it is running in specs from half December.

Co-operation with other RIS

The ICOS Netherlands activities are part of the Dutch Ruisdael Observatory.nl infrastructure, in which we collaborate with ACTRIS Netherlands. Proposal for Dutch national FTO consortium (granted, started in January 2025), which includes and upgrades parts of the Ruisdael Observatory infrastructure, but also connects to GHG related RI's that work on land and water. Purchases of new equipment started with several tenders.

NL-Loo: LTER-LIFE+ (NL): participated in several workshops, gave a tour at the site.

Norway

Highlights

In 2025, the Norwegian Environment Agency awarded NILU the contract to continue the national monitoring programme for greenhouse gases in Norway and Svalbard for 2026–2031. This secures continued ICOS-compliant atmospheric measurements at Zeppelin Observatory and Birkenes, ensuring operational and financial stability for the Norwegian ICOS atmosphere component.

Annual NEE budgets now cover four full calendar years at the Hurdal terrestrial station; the carbon sink strength rebounded to the highest so far in 2025 after 3 years of decline. Phenocam analysis showed a strong annual greenness cycle despite dominance of evergreen trees.

Data from NO-SOOP G.O. Sars were delivered to the ICOS Carbon Portal and SOCAT from 10 cruises in 2025. NO-SOOP Bergen–Kirkenes line progressed toward labelling with stable measurements despite minor biofouling-related downtime.

Annual inversion products for 2024 were delayed due to staffing and data availability but are scheduled for release in early 2026. Initial methane inversion tests indicate improved agreement between updated bottom-up fluxes and optimized inversion results.

Changes in station network

Major upgrades on NO-SOOP Tukuma Arctica included installation of a new seawater intake and replacement of the CO_2 analyser with LiCOR 7815, reducing operational risk and improving data reliability.

Co-operation with other RIS

All marine stations participate in SOCONET (Surface Ocean CO_2 Network) and GOA-ON (Global Ocean Acidification Observing Network). Contributions to Global Carbon Project assessments. Integration / modelling activities areicos Nordic

linked to WMO Global Greenhouse Gas Watch (G3W) initiatives.

NO-Hur is one of the demonstration sites of the EU Horizon project "Monitoring, Reporting, and Verification of Soil Organic Carbon and Greenhouse Gas Balance" (MRV4SOC, https://mrv4soc.eu/, 2023-2026) and is feeding the data obtained into that project with a focus on carbon farming. The site at Hurdal is also contributing to the EU Horizon project CLIMB-FOREST (https://www.climbforest.eu/, 2022-2027) where the biophysical implications of forest management will be investigated and site-level runs of an Earth System Model (LPJ-GUESS) will be performed.

The Norwegian atmospheric sites Zeppelin (ICOS class 1) and Birkenes (ICOS class 2) are both part of the ACTRIS network. In addition, the Zeppelin Observatory is a key station in many research infrastructures including the European Monitoring and Evaluation Programme (EMEP); the Arctic Monitoring and Assessment Programme (AMAP); the Global Atmosphere Watch (GAW); and the Advanced Global Atmospheric Gases Experiment (AGAGE) network.

Spain

Highlights

During 2025, ICOS-Spain made significant progress in the labelling process of the six stations in the network. The El Arenosillo atmospheric station completed its labelling in November 2025, being classified as Class 2 and joining the other three fully labelled stations (CanOA, Izaña and Majadas de Tiétar).

The ESTOC oceanic station is in the final stages of labelling. The OTC is currently waiting to receive the data stored by the pCO_2 sensor, which will be sent after the next on-site maintenance, scheduled for April 2026. On the other hand, the CIBA Atmospheric Station, which joined ICOS at the end of 2024, is currently at the first stage of the procedure. The instrument setup is fully configured, and the station's Picarro analyser is at the ATC for testing.

Efforts were also made during 2025 to extend the spatial coverage of ICOS-Spain by including new stations. Contact was established with a new ecosystem station, Aguamarga, which will join the national network in 2026.

Changes in station network

CanOA Oceanic Station

- No major changes in 2025.

CIBA Atmospheric Station

- In July 2025, a preliminary test of the instrument setup was performed using a working tank filled at Izaña Observatory.
- In October 2025, the Picarro analyser was sent to LSCE for testing in the context of the ATC labelling process.

El Arenosillo Atmospheric Station

- In February, the STT tank was sent to the CAL in Jena (Germany).
- In October 2025, the shelter test was performed.
- In November, the STT tank was replaced.
- In November, changes were carried out to the measurement routine (STT every 12 hours instead of every 7 hours) and to the calibration procedure, with shorter cycles. These changes were suggested by the ATC.
- On 26 November, the labelling of the El Arenosillo station as a Class 2 atmospheric station was approved at the ICOS General Assembly.
- In December, staff climbed the tower, inspected the seven sampling lines, and replaced the protective devices on the tubes (funnels to prevent rain entry and screens to avoid insects).

ESTOC Oceanic Station

- In March 2025, ESTOC completed the annual maintenance operations, including the full renewal of its fixed-platform observing system. On 12 March 2025, a new mooring was deployed, restoring the surface package with calibrated sensors for sea surface temperature, salinity, dissolved oxygen, pCO_2, pH, and meteorological variables.
- On 15 March 2025, the 2024–2025 mooring was recovered, allowing the replacement and verification of the surface and atmospheric instruments.

Izaña Atmospheric Station

- The STT tank was replaced twice (first on 13 January and then on 22 July).
- The STWT tank was replaced twice (first on 21 January and then on 5 August).
- In March 2025, a backup Picarro analyser for the station was tested at LSCE. The instrument is scheduled to return in early 2026.

Majadas de Tiétar Ecosystem Station

- No major changes in 2025.

Co-operation with other RIS

CIBA station is part of the following research networks:

- ACTRIS (Aerosol, Clouds and Trace gases Research InfraStructure).
- COCCON (Collaborative Carbon Column Observing Network)
- AERONET (AErosol RObotic NETwork).
- EPROFILE (EUMENET Vertical Profile Observation)
- ICENET (Iberian Ceilometer Network)
- GOA-SCAN (GOA Sky Camera Network)

El Arenosillo station is part of the following research networks:

- ACTRIS (Aerosol, Clouds and Trace gases Research InfraStructure)
- WMO-GAW (Global Atmospheric Watch).
- AERONET (AErosol RObotic NETwork).
- MPLNET (Micropulse Lidar NETwork).

- COCCON (Collaborative Carbon Column Observing Network)
- WRC (World Radiation Center)
- WDCA (World Data Center of Aerosols).
- NOAA-ESARL Collaborative Aerosol Network

Izaña Observatory is part of the following research networks:

- ACTRIS (Aerosol, Clouds and Trace gases Research InfraStructure).
- GCOS (Global Climate Observing System)
- WMO-GAW (Global Atmospheric Watch)
- NDACC (Network for Detection of Atmospheric Composition Change)
- TCCON (Total Carbon Column Observing Network)
- COCCON (Collaborative Carbon Column Observing Network)
- BSRN (Baseline Surface Radiation Network)
- AERONET (AErosol RObotic NETwork)
- MPLNET (Micropulse Lidar NETwork)
- E-GVAP (EUMETNET EIG GNSS water vapour programme)
- PANDORA-PANDONIA

The QUIMA group of the ULPGC is one of the working groups of the GEORGE project. The GEORGE project brings together 28 leading partners from academia and industry, including three research infrastructures: EMSO-ERIC, Euro-Argo-ERIC and ICOS-ERIC. Together, these three ERICs cover the full extent of European marine waters, from the coasts to the open ocean and from the seafloor to the interior and the ocean surface. The project is coordinated by ICOS-ERIC and EMSO-ERIC.

PLOCAN plays a central role within the EMSO Research Infrastructure as the operator of the EMSO-Canarias regional facility, which hosts the long-term open-ocean observatory at ESTOC. Through this role, PLOCAN ensures the sustained operation, maintenance, and data stewardship of a multi-parameter ocean observing system that contributes essential records of physical, biogeochemical, and air-sea exchange processes to the wider EMSO network.

Majadas de Tiétar station is part of the Spanish ICP Forests network, which is integrated into eLTER (integrated European Long-Term Ecosystem, critical zone and socio-ecological Research).

Sweden

Highlights

The operations of the Integrated Carbon Observation System (ICOS) in Sweden had reached a number of significant milestones in 2025 (10 years of the dedicated atmosphere and ecosystem observatory Hyltemossa, 30 years of the Norunda research station, 30 years of the Östergarnsholm observatory, 15 years of the Swedish ICOS national network pioneering measurements and data towards the ICOS mission). These milestones were celebrated in a workshop in Lund, uniting employees and users of the RI as well as national stakeholders.

In 2025, 76 peer-reviewed publications and 18 doctoral theses using data from Swedish ICOS sites were published (full list available on www.icos-sweden.se/publications). At least 89 national and international unique research projects took advantage of the infrastructure by using data and/or using the stations for own measurements (list of projects on www.icos-sweden.se/research); many projects used several

Swedish stations for their research. In total, 214 male and 183 female scientists related to research projects using the stations physically and course participants (undergraduate and graduate education) visited the stations.

Changes in station network

- Östergarnsholm split into one Class 2 Ocean station (FOS) and one Associated Ecosystem station. Both received the ICOS label in May 2025.

Co-operation with other RIS

The national networks ICOS Sweden, ACTRIS Sweden and the national infrastructure SITES collaborate for better science and efficient operation of the field stations.

Switzerland

Highlights

Maarten Lupker (SERI), the ICOS-CH delegate in the ICOS GA, was elected as the new GA chair for a two-year term (November 2025).

ICOS RI published the ICOS curve for CO_2 concentrations, a new interactive web service, which also includes data of the ICOS-CH station Jungfraujoch (CH-JFJ, November 2025).

26 years of flux data from the ICOS-CH station Davos (CH-Dav) have been published and show that the carbon sink of a Norway spruce forest is far from certain in the future (Krebs et al. 2025; October 2025).

Climate change is causing trees to bud earlier in spring. Nevertheless, some tree species in Switzerland are growing less over time, including the spruce trees at the ICOS-CH station Davos (CH-Dav). This has consequences for carbon storage and forestry in the future, as shown by the long-term EC data. (Bose et al. 2025; July 2025).

A new web application was developed that allows station operators and users to screen recently acquired, yet unpublished atmospheric CO_2, CH_4, CO, N_2O, and O_3 measurements as well as to verify the quality of already published data. ICOS data were used as an ideal dataset for validation because both level 1 and level 2 data were available (GAW-QC; Brugnara et al. 2025, October 2025).

ICOS researchers were strongly involved in the preparation of the WMO Measurement Guidelines for Observations of CO_2, CH_4 and N_2O at Global Atmosphere Watch Stations (WMO, 2025; October 2025).

Martin Steinbacher (Station PI of the ICOS-CH station Jungfraujoch, CH-JFJ) was elected as president of the Swiss Commission for Atmospheric Chemistry and Physics (ACP) by the Strategic Board of the Swiss Academy of Sciences (SCNAT).

Nina Buchmann (PI and National Contact Point of ICOS-CH) was elected as member of the Swiss GAW/GCOS Scientific Steering Committee (SSC), Bern; and as member of the Scientific Advisory and Ethical Board of the Global Change Research Institute CAS in CZ, linked to CZ Globe and ICOS-CZ.

The ICOS-CH station Basel Klingelbergstrasse (CH-BaK) celebrated the ICOS label and 20 years of continuous operation with an event that gathered several ICOS-CH members and scientists that worked with this station over the last 20 years (April 2025).

ICOS-CH members from University of Basel and Empa were strongly involved in the ICOS Cities project which ended in December 2025.

Changes in station network

No changes.

Co-operation with other RIs

Davos station is part of the international networks eLTER, ICP forest level 2 and FLUXNET. The site also participates in the CLEANFOREST and the NextGenCarbon project. COST Action and. Davos is part of the national networks Swiss FluxNet (Swiss network of active eddy covariance flux sites), Long-term Forest Ecosystem Research (LWF), National Air Pollution Monitoring Network (NABEL), the biological drought and growth indicator network (TreeNet).

Jungfraujoch station is part of the National Air Pollution Monitoring Network (NABEL), CLIMGAS, SwissMetNet, Permafrost Monitoring Switzerland (PERMOS), Swiss Glacier Monitoring Network (GLAMOS), GAW Swiss Alpine Climate Radiation Monitoring program (SACRaM). Jungfraujoch is one of 10 National Facilities set to join ACTRIS once station labelling commences.

Basel station is part of the national network Swiss FluxNet (Swiss network of active eddy covariance flux sites) and FLUXNET.

United Kingdom

Highlights

Ridge Hill and Weybourne continue to be involved with the UK GEMMA programme (https://www.npl.co.uk/campaigns/greenhouse-gas-emissions-measurement-modelling).

New instrumentation installed at Ridge Hill to measure hydrocarbons and halogenated greenhouse gases as part of the UK DECC network (https://www.bristol.ac.uk/chemistry/research/acrg/current/decc.html).

New instrumentation installed at Ridge Hill to measure atmospheric N_2O and CO.

Research cruise to the PAP-SO ocean station in June 2025 (JC278) for maintenance of the UK-FOS-PAP, for process studies and for collection of validation samples.

The site was a technology demonstrator site for the Horizon Europe funded project GEORGE in 2025, with deployment of novel platforms and sensors at the site for comparison with the UK-FOS-PAP data.

Four years' worth of PAP-SO carbon data have been submitted to SOCAT as has the JC278 underway CO2 data (also findable via CDIAC).

Changes in station network

No changes to the UK station network

Co-operation with other RIS

In June 2025, in cooperation with EMSO and Argo RIs as part of the Horizon Europe funded GEORGE project, novel sensors for ocean carbonate measurements were deployed at the PAP-SO site. They will remain there until the next site visit in May/June 2026.

Annex 1: Contribution to KPI tables

Use of ICOS data in educational tools and activities

Member	Type: Thesis, class, …	Topic	Place / university	Notes
OTC	ICOS Summer school	Ocean observations	Hyytiälä, 5-15 May 2025	Organised by University of Helsinki and ICOS CP, encompassed all ICOS domains
BE	Climate Changes		ULiège (Gembloux)	
BE	Site visit, Brasschaat	BSc Bio engineering - Applied practicum	UAntwerp	
BE	Site visit, Dorinne		ULiège (Gembloux)	
BE	Practical sessions master course	Vegetation Modelling, model evaluation with CDYgb data	UGhent	
BE	Exchanges EcosystemsAtmosphere		ULiège (Gembloux)	
BE	Nature based Solution for Climate Change		ULiège (Gembloux)	
BE	Applied Marine Ecology Module	Carbon Cycling in Applied marine Ecology Module	Ghent University	
BE	Biogeochemical Cycles		Biogeochemical cycles in the ocean, polar ocean and sea ice	ULiège
BE	G. Hac (Master thesis)		Continuous Wavelet Transform Analysis of Mesoscale Motions Contribution to Scalar Transport at the ICOS Sites of Lonzée and Vielsalm.	ULiège - Gembloux
BE	S.Radelet (Master thesis)		Modélisation de l'impact de pratiquesagroécologiques sur les réservoirs de carbone du sol et les flux	ULiège (Gembloux)

			de CO2 pour une culture sur le site de Lonzée	
BE	G. Meuleneir (Master thesis)	De	Ontwikkelen van een lespakket rond klimaatwetenschap	UAntwerp
CZ	PHD thesis	Exploring the Dynamics of Forest Ecosystems: Integrating Spectral Data and Machine Learning	CZ-Lnz and Štítná / Masaryk University, Brno, Czechia	Completed by Marian Švik
CZ	Master thesis	Výukový materiál pro exkurzi na Atmosférickou stanici Křešín u Pacova (Didactic material for excursion to Atmospheric station Křešín u Pacova)	CZ – Atmospheric station Křešín	Completed by Daniel Lhotský (The didactic material has been verified during excursion with nearby lower secondary school. The material was then adjusted based on students' answers and interview with a teacher that was on the excursion to the atmospheric station.
CZ - Manuel Acosta	Field excursion - ERASMUS Students	Ecophysiology at the ecosystem level	CZ-Lnz / Mendel University	A total group of 12 student from different nationalities (Europe and Asia)
CZ - Natalia Kowalska, Marian Pavelka	Field Excursion 16.05.2025 - students	Visiting floodplain forest	CZ-Lnz, /University of Zagreb, Faculty of Forestry and Wood Technology	A total group of 38 people.
CZ - Jiří Dušek	Field excursion, EcoSocMan (Faculty of Science, University of South in České Budějovice)	Carbon exchange and meteorological parameters measured in wetland ecosystem	CZ-wet - Trebon wetland station	A total group of 22 student from different nationalities

CZ - Marian Pavelka	7 excursions at ESs (Bílý Kříž and Lanžhot)	Throughout the year	ICOS ESs (Bílý Kříž and Lanžhot)	In total about 200 participants
DK	MSc.	Paula Dawn Sachsenmaier (2025) The role of vegetation for the greenhouse gas exchange in a Danish suburb	DTU	ICOS urban flux network
DK	BSc.	Freja Cecilie Heister Jensen (2025) Digital repeat photography for annual variations in phenology of forest floor vegetation in a temperate Beech forest	DTU	ICOS / LTER
DK	MSc.	Marie-Therese_Guidje (2025) Assessing the industry's role in greenhouse gas emissions using eddy covariance measurements A case study in Gladsaxe	DTU	ICOS urban flux network
DK	MSc course	12145 Terrestrial Ecology for Engineers	DTU	5ECTS, field campaign at DK-Sor
DK	BSc course	25105 Ecology	DTU	5 ECTS, excursion to DK-Sor
DK	MSc course	Ecosystems, Climate and Climate change	KU	7,5 ECTS
DK	MSc course	Surface hydrology	KU	7,5 ECTS
FI	PhD thesis by Henriikka Vekuri	Reliable carbon balance estimates using eddy covariance – improved gap-filling methods and uncertainty quantification	University of Helsinki /Finnish Met. Institute	ICOS DK focal point Andreas Ibrom was opponent

FI	PhD thesis by Toprak Aslan	Towards improved understanding of carbon exchange dynamics in managed boreal forests	University of Helsinki	
FI	PhD thesis by Martti Honkanen	The air-sea exchange of CO2 at Utö Island in the Baltic Sea	University of Helsinki /Finnish Met. Institute	
FI	PhD thesis by Maria Tenkanen	High Northern latitude methane emissions estimated with an atmospheric inversion model	University of Helsinki /Finnish Met. Institute	
FI	PhD thesis by K. Jentzsch	Understanding methane fluxes in boreal peatlands – Contributions of spatial, temporal, and methodological variability	University of Potsdam	
FI	MSc thesis by Alina Markelova	Carbonyl sulfide flux in river Kitinen	University of Helsinki	
FI	MSc thesis by Santeri Satalahti	Evolution of Turbulent Heat Fluxes and Energy Balance over a Clear-Cut Forest	University of Helsinki	
FI	MSc thesis by Milla Karlsson	Non-growing season CO2 and energy fluxes from a subarctic ecosystem	University of Helsinki	
FI	MSc thesis by S. Croos	A Longitudinal Study of CO_2 Fluxes in Helsinki 2006 to 2023	University of Helsinki	
FI	MSc thesis by K. Merruntaus	Kasvillisuuden ositteiden ja pienmuotojen vaikutus boreaalisen suon respiraatioon	Univ. of Eastern Finland	

FI	Eddy Covariance Intensive course, April, 2025	Ivan Mammarella, Alex Buzacott	Course at University of Helsinki, held in Malaysia (LiWeFor EU project)	ca. 30 participants
FI	Lecture in a course Forest ecosystem biogeochemistry	Annalea Lohila	Lecture for university students: IPCC AR6 and forests. Univ. of Helsinki	ca. 50 participants
FI	Terrestrial Water, Carbon and Nitrogen Cycles, October-December, 2025	Timo Vesala	Univ. Helsinki	ca. 10 participants
FR	PhD Thesis	Approche atmosphérique multi-composés pour la caractérisation des sources d'émissions de CO_2 et de polluants en région parisienne	Université Paris-Saclay	Laura Bouillon
FR	PhD Thesis	Estimation des émissions de CO_2 dans l'aire urbaine de Paris à partir de mesures de colonnes totales	Université Paris-Saclay	Josselin Doc
FR	Practical work (Master 1)	Greenhouse Gases	Université de Versailles Saint Quentin en Yvelines	11 students, 6 hours, using CO_2 Sensors.
FR	Training Field Class (Master 1)	Atmosphere and Climate	Université de Versailles Saint Quentin en Yvelines	One week, 16 students, Work at LSCE ATC and TRN station.
FR	Teaching	Carbon Cycle (3rd year of engineer cursus)	Ecole Centrale Supelec	20 students, 3h
FR	Educational tool	Building of an air column mock-up illustrating the atmospheric column and associated instrumentations and means used to monitor it (ground	LSCE	Use for educational and communication activities

		observatories, mobile equipment such as boats, cars, UAV), planes, airCore, Satellite….		
FR	Practical course (Master 2)	Forest carbon cycle and climate change at the FR-Pue forest station	Université de Montpellier	Field visit (20 students)
FR	Teaching material	Forests and the carbon cycle (PEPR FairCarboN teaching material for master students, in French)	PEPR FairCarboN	40 slides freely available for teaching purposes
FR	PhD Thesis	Evaluation of the hydraulic activation of stomata impact on water fluxes based on ICOS datasets	Université Paris-Saclay, CSC	Shuaishuai Deng
FR	Practical course using FR-Gri dataset (Master 2)	Climate Lande Use Master (CLUES)	Université Paris-Saclay	12 students
FR	Practical course using FR-Gri dataset (Master 1)	ERM AgroParisTech master	Université Paris-Saclay	15 students
FR	Practical course using FR-Gri dataset (Master 1)	Biogeosciences Master 1	Eiffel University Marne-La-Vallée	20 students
FR	Master thesis	Trends and interannual variability of air-sea CO_2 flux in the tropical Atlantic	UFPE, Brazil	Herbert Rafael Barbosa de Souza
DE	PhD	About “Influence of Vegetation Fire Emissions on Atmospheric Methane at Two European ICOS”	Scuola Universitaria Superiore IUSS Pavia	To be submitted in 2026
DE	GAWTEC Kurs GHG, 31.01.2025		visit HPB station,	10 participants
DE	Seminar	Atmosphärische Klimagase: Vom	Cusanuswerk	~ 50 participants

		Messnetzwerk zur Spurenstoffbilanz		
DE	Seminar	The research infrastructures for greenhouse gases ICOS atmosphere	Itineris	~ 30 participants
DE	MSc	CO2, CH4 and N2O Fluxes of a Drained Peatland: Comparison of Eddy Covariance and Soil Chamber Measurements and Analysis of Potential Drivers	University of Münster	
DE	Lecture class	Angewandte Meteorologie und Klimaschutz	TU Dresden	
DE	Summer school	Short course: Flux Measurement Fundamentals (A technical short course with focus on the use of micrometeorological methods to obtain and analyze fluxes of momentum, heat and gases by eddy-covariance)	TU Dresden	10.-13.6.2025 (23 participants)
DE	University Course "Klima und Standort"	Field trip to DE-Tha station	TU Dresden	
DE	University Course "Urban Climate Lab" (B.Sc. / M.Sc.)	Data from DE-BeR used for analysis of carbon dioxide sources and sinks in urban environments	Technische Universität Berlin	20 students
DE	University Course "Urban Atmosphere" (M.Sc.)	Data from DE-BeR used for study of atmospheric processes and carbon dioxide fluxes in urban environments	Technische Universität Berlin	20 students

DE	Field training for students	Introduction *about FerryBox measurements (temperature, salinity, pH, turbidity), as well as carbonate system measurements (pCO2)*	HEREON	*Students from University of Hamburg and University of Oldenburg*
DE	University practical course "Eddy-Covariance"	Used DE-Brs data for their analyses	Institute of Geoecology, TU Braunschweig	Approx. 15 – 20 students from TU Brauschweig and LUH Hannover
DE	Class	'Bioclimatology', 'Ecosystem-Atmosphere Processes', 'Experimental Bioclimatology', 'Global Change', 'Klima- und Bodenschutz', 'Chemistry/Physics', 'Physik für Forstwissenschaftler'	Bioclimatology, University of Göttingen	Usage and discussion of data in the lectures and seminars (Alexander Knohl, Christian Markwitz, Anne Klosterhalfen)
DE	Master thesis	Johanna Kitzhofer: Bedeutung der Krautschicht für den Kohlenstoffhaushalt eines Kalkbuchenwaldes am Beispiel des Bärlauchs (Allium ursinum L.)	Bioclimatology, University of Göttingen	Supervisor: Anne Klosterhalfen
DE	Master thesis	Florian Wilms: Seasonal dynamics in leaf hydraulic and thermal traits in European beech and European ash and their relation to meteorological parameters	Bioclimatology, University of Göttingen	Supervisor: Anne Klosterhalfen

DE	University Course "Land-atmosphere interactions" (M.Sc.)	Used data from ICOS sites for student projects, Field trip to DE-Har station.	University of Freiburg	15 students work with EC-data
DE	University Course "Bioclimatology" (B.Sc.)	Field trip to DE-Har station and used data to illustrate basic principles.	University of Freiburg	40 students
DE	University Course "Atmosphere and Hydrosphere" (B.Sc.)	Used data from DE-Har to illustrate basic role of land surface in climate system.	University of Freiburg	280 students work with EC-data
DE	M.Sc. Thesis	Bridging the Gap between ecosystem water and carbon fluxes	University of Freiburg	Used data from ICOS Station DE-Har
DE	University Course "Tree and Forest Ecophysiology"	Field trip to DE-Har station and ecophysiological measurements		
DE	Class	WASCAL lecture on Chemical oceanography (A. Körtzinger)	Universidade Tecnica do Atlantico, Mindelo, Cabo Verde	
DE	Summer School	GOOD-OARS Summer School (T. Steinhoff)	CEMACS, Penang, Malaysia	
GR	Internship, Principles and Applications of Satellite Remote Sensing	*Development of Gap Filling Methods and Study of Carbon Dioxide Emissions for the City of Heraklion*	Foundation for Research and Technology – Hellas/ University of Crete – Department of Physics	GR
HU	class	Sampling, sample preparation and analytical tests: Introduction to ICOS stations and some of the data	University of Debrecen, Faculty of Science and Technology	
IE	Class (SS Botany, Environmental Sciences, Environmental	Plant Environment Interactions	Trinity College Dublin	

	Sciences and Engineering)			
IE	Class (JS Botany, Environmental Sciences)	Global Environmental Change	Trinity College Dublin	
IE	Thesis (MSc Taught)	Drivers of evapotranspiration fluxes from raised bog ecosystems	Trinity College Dublin	
IE	Lecture class MSc (AgriFood Sustainability & Technology (MScAST))	Emission verification	University of Galway	
IT	PhD thesis	Ecophysiological esponses to Abiotic Stresses in a Mediterranean Forest	University of Tuscia	
IT	PhD thesis	Ecophysiological esponses to Abiotic Stresses in a Mediterranean Forest	University of Tuscia	
IT	PhD thesis	Carbon fluxes in the mountains	University of Tuscia/ARPA Valle d'Aosta	Started in 2024, ending in 2027
IT	PhD thesis	ICOS POT atmospheric station and integration with ACTRIS and satellite observations	CNR-IMAA Tito Scalo/Università degli Studi della Basilicata, Italy	In progress. PhD thesis completion expected in August 2026
IT	PhD Thesis	Multiscale analysis of carbon, water, and energy fluxes: integrating Eddy Covariance measurements with data-driven modeling to decouple ecosystem cycle components.	University of Sassari (UNISS), University School for Advanced Studies (IUSS Pavia)	
IT	PhD thesis	IA Applications for Modeling GHG and	University of Naples Federico II	

		reactive gas emissions from agricultural ecosystems		
IT	Lecture classes	Carbon fluxes and climate change mitigation	Secondary schools in Aosta Valley	
IT	Lecture class	Carbon cycle and climate	University of Roma Tre	Lesson, three hours
IT	Lecture class	Carbon cycle related activities at Lampedusa	University of Roma Tre	Lesson, two hours
IT	Lecture class	Course: Can Science Save the Earth?	University of Naples Federico II	Lessons, 7.5 hours
IT	Lecture class	CO2 absorption by the ocean and the acidification process	International Centre for Theoretical Physics, Trieste, Italy	Advanced master in sustainable Blue Growth
IT	Lecture class	ITINERIS 1.17 - Atmospheric standardized observations: Methods and maintenance in observatories – In-Situ	Via Rocca, 2, 41029 Sestola, MO and GAW/WMO Global station of Monte Cimone	
IT	Poster	Synergies between ACTRIS and ICOS: combination of aerosol and GHS's first campaign measurements for the characterization of atmospheric composition at CIAO observatory in Tito, Potenza, Southern Italy	EAC Lecce, Italy	
IT	Poster	Isotopic Analysis of $\delta^{13}C$-CH_4 from a tall tower at the CIAO atmospheric observatory: Insights into Isotopic Variability	EAC Lecce, Italy	

		and the Impact of Small Fires		
IT	Poster	Eddy Covariance (EC) towers measure ecosystem-atmosphere fluxes but often face challenges when landscapes are heterogeneous. This study explores how modeling dynamic flux footprints and incorporating 20 m Sentinel-2 data can enhance the understanding of high-frequency Gross Primary Production (GPP) variability.	MPI- BGI, Jena; Germany	
IT	Poster	Footprint Modeling		ELLIS Summer School 2025, Jena; Germany
IT	Oral Presentation	Footprint Modeling	MPI- BGI, Jena; Germany	
IT	Oral Presentation	Footprint Modeling		MPI-BGI, Jena; Germany
IT	Oral Presentation	Footprint Modeling		CMCC Annual Meeting, Salerno; Italy
IT	Oral Presentation	Application of a physically informed neural network for the recovery of vertical greenhouse gas profiles in the Mediterranean Basin	SPIE Madrid, Spain	Winner of the "Best Student Paper Award"
ES	PhD thesis	To investigate carbon monoxide (CO) and methane	Spain / INTA. University of Huelva (institution where the thesis was defended).	ICOS data from El Arenosillo were used in

		(CH_4) at the El Arenosillo region.		this thesis. Successfully defended in September 2025 in the University of Huelva (Spain).
ES	Master's thesis	Comparison of methane observations and simulations using the STILT model.	Spain / INTA. University of Huelva (institution where was defended).	The Master's thesis was carried out to study methane observations and simulations using the STILT model, focusing on the contributions to methane in an Atlantic coastal region, and was defended at the University of Huelva (Spain) in December 2025.
ES	Master's thesis	Study of carbon dioxide in the surroundings of Doñana Natural Park (Huelva).	Spain / INTA. University of Huelva (institution where was defended).	The Master's thesis, titled "Study of CO_2 Concentrations in the Natural Environment of Doñana," in which data from the El Arenosillo station were used, was defended at the University of Huelva (Spain) in June 2025.

SE	PhD thesis	Bizjak-Johansson, T. 2025. Some aspects on boreal forest microbiotas and nitrogen.	SLU Umeå, SE	
SE	PhD thesis	Chen, Z. 2025. A Study on Process-based Modeling of Monoterpene Emission from Terrestrial Ecosystem	Hokkaido University, Japan	
SE	PhD thesis	Cronin, D.R. 2025. Unraveling permafrost peatland microbial dynamics across temporal and spatial scales.	Ohio State University, USA	
SE	PhD thesis	Dubois, K. 2025. On Coastal Hazards in the Baltic Sea	Uppsala University, SE	
SE	PhD thesis	De Gruyter, J. 2025. The soil microbial community as a whole: compositional changes in soil bacterial and eukaryotic communities through time and in times of perturbations	University of Antwerp, BE	
SE	PhD thesis	Freire Zapata, V.E. 2025. Soil Microbial Adaptations to Climate Disturbance: Integrated Multi-Omics Insights from Permafrost and Arid Ecosystems.	University of Arizona, USA	
SE	PhD thesis	Gachkivskyi, M. 2025. Assessing fossil CO_2 emissions in	Heidelberg University, GER	

		Europe: how reliably do ICOS $^{14}CO_2$ and CO observations constrain atmospheric inversions?		
SE	PhD thesis	Gómez-Ortiz, C. 2025. Top-Down Methods for Estimating the European Carbon Budget: Towards Independent Monitoring and Verification of Carbon Emissions	Lund University, SE	
SE	PhD thesis	Hermanns, F. 2025. Improving Hyperspectral Monitoring of Ecosystem Functioning with Novel Latent Variable Transformations	Humboldt-University Berlin, GER	
SE	PhD thesis	Leistner, T. 2025. Modelling and Linking Radar Backscatter and Stem Water Content in a Boreal Forest.	Chalmers University, SE	
SE	PhD thesis	Li, X. 2025. Improving crop yield prediction in Sweden using satellite remote sensing and the ecosystem model LPJ-GUESS	Lund University, SE	
SE	PhD thesis	Logan, M.N. 2025. Unraveling Biogeochemical Cycling of Carbon, Sulfur and Nitrogen With High Resolution Mass Spectrometry:	Colorado State University, USA	

		From California Vineyards to Thawing Permafrost in Sweden		
SE	PhD thesis	Müller, M. 2025. Mapping Vegetation Dynamics Under Drought Stress: Integrating Satellite, Meteorological, and Terrestrial Geospatial Data	Lund University, SE	
SE	PhD thesis	Noumonvi, K. D 2025. Methane emissions from high latitude peatlands : controls of their spatio-temporal dynamics across a mire complex	SLU Umeå, SE	
SE	PhD thesis	Petersen, R. 2025. Emission of biogenic volatile organic compounds from intact & clearcut boreal forest: Multi-year observations of BVOC fluxes at a Swedish boreal forest and the ecosystem-scale BVOC impacts of clearcut forestry	Lund University, SE	
SE	PhD thesis	Smeds, S. 2025. Peat properties and mercury methylation in drained and restored boreal peatlands	SLU Umeå, SE	
SE	PhD thesis	Tenkanen, M. 2025. Methane emissions at high northern	University of Helsinki, FIN	

		latitudes estimated by an atmospheric inversion model.		
SE	PhD thesis	Vettikkat, L. 2025. Ecosystem-scale Emissions of Biogenic and Agricultural Aerosol Precursors Into the Boreal Atmoshphere.	University of Eastern Finland, FIN	
SE	MSc thesis	DeFelice, H. 2025. Impacts of Permafrost Thaw and Methane Cycling in a Northern Peatland.	MSc College of Science at Rochester Institute of Technology, Rochster, New York, USA.	
SE	MSc thesis	Hirth, L. 2025. Seasonal carbon flux variations in temperate forests in southern Sweden.	Lund University, SE	
SE	MSc thesis	Soil organic carbon distribution across climatic and topographic gradients in sub-Arctic northern Sweden.	Umeå University, SE	
SE	MSc thesis	Liljeberg, C. 2025. Impact of clearcutting on forest carbon fluxes.	Lund University, SE	
SE	MSc thesis	Pikas, Y. 2025. Snowmelt Modeling and Energy Balance Characterization of a Boreal Snowpack: Comparing an Open and a Forested Site.	SLU Umeå, SE	
SE	MSc thesis	Päffgen, E. 2025. A turbulence based description of the	University of Bonn, GER	

		air-sea gas transfer in the Baltic Sea.		
SE	MSc thesis	Staudt, X. 2025. A Comparative Analysis of the Forest-Atmosphere Carbon Dioxide Exchange of European Scots Pine Ecosystems.	University of Innsbruck, AUT	
SE	BSc course	Geovetenskap - planeten jorden	Uppsala University	Course given twice per year, using data
SE	MSc course	Soil biology and biogeochemical cycles	SLU Uppsala, SE	Field visit as part of the course
SE	MSc course	Environmental field studies	Stockholm University, SE	Field visit as part of the course
SE	BSc course	Atmosphärens klimat och fysik	Uppsala University, SE	Field visit as part of the course
SE	BSc course	Course within the Forestry program	Linnéuniversitetet, SE	Field visit as part of the course
SE	BSc course	Norra Sveriges skogar och landskap	SLU Umeå, SE	Field visit as part of the course
SE	MSc course	forest ecology	SLU Umeå, SE	Field visit as part of the course
SE	MSc course	Remote sensing course	SLU Umeå, SE	Field visit as part of the course
SE	MSc course	Arctic Ecosystems	Umeå University, SE	Field visit as part of the course
SE	MSc course	GHG and Biochemistry	Lund University, SE	Field visit as part of the course
SE	MSc course	Environmental Monitoring Modelling and Reconstruction	Northumbria University, Newcastle, UK	Field visit as part of the course

SE	MSc course	Alpine and Polar Ecology at the University of Gothenburg	Gothenburg University, SE	Field visit as part of the course
SE	MSc course	Trädekofysilogi	Linnéuniversitetet, SE	Field visit as part of the course
SE	Teacher training	Klimat och Väder	Lund University, SE	Field visit as part of the course
SE	Various levels	Various courses	Different places	ICOS data is implemented in graphs, exercises etc used in teaching
CH	Lecture to station operators	Lectures on the greenhouse effect, the carbon cycle, GHG observation requirements, station setup, and QA/QC for long-term observations	Global Atmosphere Watch training and Education Centre	January 2025
CH	Lecture to station operators	Lectures on the greenhouse effect, the carbon cycle, GHG observation requirements, station setup, and QA/QC for long-term observations	Global Atmosphere Watch training and Education Centre	January 2025
CH	Bachelor course	Globaler Klimawandel: Ein Überblick mit Fallstudien	University of Basel	Spring Semester 2025
CH	Bachelor course	Wie misst man CO_2 in der Atmosphäre?	Lucerne University of Teacher Education	Spring and fall semester 2025
CH	PhD thesis, Luana Krebs	Understanding of greenhouse gas dynamics of CO_2, CH_4 and N_2O using a multi-scale approach in a	ETH Zurich	June 2025

		subalpine spruce forest.		
CH	Knowledge transfer to station operators	Laboratory visit of delegates from Costa Rica, Libya, and the Dominican Republic	Empa Duebendorf	July 2025
CH	Knowledge transfer to scientists	Laboratory visit and trip to Jungfraujoch of researchers from Zhejiang University of Technology	Empa Duebendorf, Jungfraujoch	August 2025
CH	Master course	Biogeochemistry and Sustainable Management	ETH Zurich	Fall semester 2025
CH	Bachelor course	Luft als Resource	University of Applied Sciences ZHAW, Winterthur	Fall semester 2025
CH	Bachelor course	Luftfremdstoffe und Luftqualität	University of Applied Sciences ZHAW, Wädenswil	Fall semester 2025
CH	Webinar to station operators	Carbon monoxide in the atmosphere	Global Atmosphere Watch training and Education Centre Webinar	November 2025
CH	BSc thesis, Maxine Jahn	Conclusions on the Carbon Budget Using Atmospheric $^{14}CO_2$ Measurements	University of Bern	
CH	BSc thesis, Filip Zürcher	Analysis of CO_2 and $\delta O_2/N_2$ measurements at Jungfraujoch	University of Bern	
CH	MSc thesis, Flavia Bindschedler	Investigating Stratospheric Intrusions at Jungfraujoch by Using Clumped CO_2 Isotopes	University of Bern	
CH	Knowledge transfer to scientists	Laboratory visit and trip to Jungfraujoch of researchers from	Empa Duebendorf, Jungfraujoch	August 2025

		Zhejiang University of Technology		
CH	Master course	Biogeochemistry and Sustainable Management	ETH Zurich	Fall semester 2025
CH	Bachelor course	Luft als Resource	University of Applied Sciences ZHAW, Winterthur	Fall semester 2025
CH	Bachelor course	Luftfremdstoffe und Luftqualität	University of Applied Sciences ZHAW, Wädenswil	Fall semester 2025
CH	Webinar to station operators	Carbon monoxide in the atmosphere	Global Atmosphere Watch training and Education Centre Webinar	November 2025
CH	BSc thesis, Maxine Jahn	Conclusions on the Carbon Budget Using Atmospheric $^{14}CO_2$ Measurements	University of Bern	
CH	BSc thesis, Filip Zürcher	Analysis of CO_2 and $\delta O_2/N_2$ measurements at Jungfraujoch	University of Bern	
CAL	PhD	Assessing fossil CO2 emissions in Europe How reliably do ICOS 14CO2 and CO observations constrain atmospheric inversions?	Heidelberg University	Author: Gachkivskyi, Maksym
CAL	Master	Using NOx as fossil fuel CO2 proxy at the ICOS CRL pilot station: challenges and benefits	Heidelberg University	Author: Hannes Juchem
CAL	Master	Improving Capabilities of 14CO2-Based Fossil Fuel CO2	Heidelberg University	Author: Timo Knaack
CAL	Bachelor	Fraktionierung und	Heidelberg University	Author: Max Missoni

		Transfereffizienz von CO2 auf Zeolith im new AGE-ALF System		
CAL	Master Seminar Environmental Physics - Summer term 2025	Climate System Dynamics: From Natural Variability to Human-Induced Change	Heidelberg University	Tutor: S Hammer, S Preunkert
CAL	Master Seminar Environmental Physics - Winter term 2025/2	Physics of the Earth System: Processes, Interactions and Change	Heidelberg University	Tutor: S Hammer, S Preunkert
ETC	Master course	Monitoring Terrestrial Carbon Cycle in Viterbo	Viterbo	Papale
ETC	Bachelor course	Global Carbon Cycle in Antwerp	Antwerp	Gielen

List of Main ICOS National Network Meetings

Member	**Meeting / Seminar**	**Date or frequency**	**Place or online**	**Nr. of participants**
BE	ICOS Wallonia annual meeting	2 October 2025	Gembloux	11
BE	Consortium day ICOS Belgium	10 March 2025	Antwerp	35
CZ	CzechGlobe Working Meetings and Seminars	Several times a month	Brno CzechGlobe seat and ICOS CZ sites	5-10
CZ	Subgroup data reviews	Every 6 months	online	11
CZ	All-stations data review	Every 6 months	online	60
DK	ICOS Denmark Steering group meeting	Two to three times per year	both	6

FI	ICOS Finland annual meeting	4.-5.2.2025	Helsinki	ca. 50
FI	ICOS Finland board	March 2025	Remote meeting	12
FI	ICOS Finland board	October 2025	Remote meeting	12
FR	Meeting CNES & ICOS French monitoring network	Annual	LSCE	10
FR	ESFRI – French roadmap	May 2025	online	20
FR	COPIL ICOS-France	Semestrial	Remote	15
FR	GCIF	Trimestrial	Remote	6
FR	French Ecosystem flux tower monthly meeting	Monthly	Remote	15
DE	ICOS Germany Annual Meeting	02.-04.12.2025	AWI – Alfred-Wegener-Institut, Bremerhaven	28 (+18 online)
DE	Atmosphere MSA	26-28 May 2025	DWD Offenbach	participants 38 (+10 online)
DE	Meeting of the ICOS Germany field and technical teams	08-09-10-2025	FZJ – Forschungszentrum Jülich, Jülich	14
IE	ICOS Ireland National Meeting	10:30 – 12:30, 15th January 2025	Online	IE
IE	ICOS Ireland National Meeting	10:30 – 15:30, 12th May 2025	Dublin, Ireland	IE

IE	ICOS Ireland National Meeting	10:30 – 15:30, 6th November 2025	Dublin, Ireland	IE
IE	ICOS Ireland Meeting with DG Elect	15:00 – 17:00, 1st December 2025	Dublin, Ireland	IE
IT	ICOS Italy JRU	06/05/2025	online	25
IT	ICOS Italy JRU	21/11/2025	online	30
NL	ICOS Netherlands national assembly	1/yr	Utrecht	15
NL	Ruisdael Science Day	19 September 2025	Utrecht	60
NO	ICOS Norway national network meeting	18.11.2025-19.11.2025	Bergen	20
ES	ICOS-Spain coordination meeting, including the Spanish participants in ICOS Cities.	04/02/2025 03/11/2025	Online	12 13
ES	Technical visit of CIBA staff to El Arenosillo station for consultation on ICOS protocols.	19/05/2025 and 20/05/2025	El Arenosillo Station, Huelva, Spain	3
ES	Technical visit of Izaña staff to CIBA station for preliminary testing of the CIBA instrument setup.	15/07/2025 and 16/07/2025	CIBA Station, Valladolid, Spain	5
ES	Meeting to discuss funding awarded for 2025-2026 under a national competitive grant (*Redes de Investigación 2024*).	21/11/2025	Online	10
ES	ICOS-Spain coordination meeting, including the Spanish participants in ICOS Cities.	04/02/2025 03/11/2025	Online	12 13

SE	Research engineer meeting	monthly	Online (1 in person)	between 5 and 14
SE	ICOS SE meeting	Every 2 to 3 months	online	Between 10 and 20
SE	ICOS SE steering committee meetings	Mar, Sep, Nov	online	9
SE	ICOS SE Scientific Advisory Board meeting	Jun	online	5
CH	ICOS-CH excursion to Jungfraujoch station	17 March 2025	Jungfraujoch, Switzerland	13
CH	ICOS Davos Spring Meeting	30 April 2025, annually	Birmensdorf, Switzerland	9
CH	HFSJG (Jungfraujoch) User Meeting	16 May 2025, annually	Bern, Switzerland	20
CH	ICOS-CH Annual Meeting	9 September 2025, annually	Birmensdorf, Switzerland	26

List of Main Events Organised or Co-organised by ICOS National Network

Member	**Event**	**Time**	**Place**	**Nr. of partici pants**
BE	ICOS BE Science conference	12 November 2025	Ghent	100
CZ	International Conference Quo vaditis agriculture, forestry and society under Global Change? 40 years of Climate Changev Research in the Czech Republic. https://quovaditis.eu/ (including book of conference abstracts)	15 – 17 September 2025	Velké Karlovice in the Beskid Mountains (Czech Republic).	70
DK	EGU GA 2025: BG 8.8 "From Long-Term Flux Observation and Ecosystem Research Networks to Individual Applications - Benefits to Science and Society"	30 Apr, 14:00–15:45	Vienna	300
DK	Nordic ICOS Symposium	24.11.2025	Helsinki	100
FI	ICOS Nordic meeting	11.11.2025	Helsinki	ca. 70
FI	ACCC-FASN conference	10.-12.11. 2025	Helsinki	ca. 200

FI	Event *CO-CARBON: Recent findings on urban carbon cycle and sinks*, 4th ACCC Impact week	24.2.2025	Helsinki	50
FI	ICOS 10 yr anniversary visitors at Tvärminne Zoological Station	27.-28.11.2025	Tvärminne Zoological Station	50
FI	HIKET seminar on GHG Inventory & Inversion	12	Helsinki	40
FR	Press Conference: Science meets city Paris	November	Paris (AirParif)	40
DE	EGU General Assembly, Session BG3.36 on ”Carbon and nitrogen cycling and trace gas exchange in agricultural ecosystems”	02.05.2025	Vienna, Austria	~50
DE	ICOS-10	Nov 2025	Helsinki	Co-orginised by MSA chair Atmosphere
DE	EGU General Assembly, Session BG3.7 on “Novel methods for bridging understanding of carbon, nitrogen, and water fluxes from leaf to continental scales”	01.05.2025	Vienna, Austria	~50
DE	Excursion of DMG members to DE-Tha	03.09.2025	Tharandt	15
DE	EGU General Assembly, Session AS2.3 on ”Air-Land Interaction”	30.04.2025	Vienna, Austria	~100
DE	FUTURO Co-Design Workshop	24.-26.11.2025	Saly, Senegal	~70
DE	FUTURO/MeerWissen Side Event (UNOC3)	10..06.2025	Nice, France	~50
IE	GCOS Symposium	30th April – 1st May 2025	Dublin, Ireland	
IE	ICOS Ireland Launch Event	09:30 – 17:00, 2nd December 2025	Dublin, Ireland	<100
IE	Flux Tower Workshop	09:30 – 14:00, 3rd December 2025	Dublin, Ireland	<40

IE	European Carbon Farming Summit Pre event	15:00 – 17:30, 3rd March 2025	Dublin, Ireland	<40
IT	ITINERIS Training course "Atmospheric standardized observations: Methods and maintenance in observatories – In-Situ"	19-21 May 2025	Sestola, Mt. Cimone	25
IT	Preparation of the Residential week RiViVe "Rethinking the biodiversity of the living" with trainers" to organise scientific and technical content at the ICOS Collelongo site	21-25/05/2025	Collelongo	12
IT	Residential week RiViVe "Rethinking the biodiversity of the living" – with presentation and visit to the ICOS Collelongo site	13-18/10/2025	Collelongo	35
NO/FI/SE/DK	ICOS Nordic Workship	24.11.2025	Helsinki	100
ES	Presentation of the CIBA station at an institutional press conference: https://www.youtube.com/watch?v=lPiSVqm5d6I	December 2025	Palacio de Santa Cruz, University of Valladolid	15
SE	ICOS Sweden anniversary workshop	2025-05-15	Lund	60
SE	5th Nordic ICOS Symposium	2025-11-24	Helsinki	Ca. 60
SE	FerryBox workshop at Swedish Research Vessel Infrastructure for Marine Research (SWERVE) at RV Svea and RV Skagerrak	2025-11-06+07	Gothenburg, Sweden	Ca 30
CH	Swiss Geoscience Meeting – Session 20 "Atmospheric Composition and Biosphere-Atmosphere Interactions. 12 talks and 10 posters	06 December 2025	Bern, Switzerland	25
CH	Swiss Geoscience Meeting – Session 21 "Urban environments and climate change", 18 contributions	06 December 2025	Bern, Switzerland	30
CH	Beat the Heat Conference 2025	28 August 2025	Basel, Switzerland	100
UK	WEPAL-QUASIMEME Workshop on Quality Assurance for Inorganic Carbon Measurements in context of Ocean Acidification Monitoring and Marine CO2 Removal Technologies	18-20 March 2025	National Oceanography Centre, Southampton, UK	60
OTC	IOCCP meeting in Bergen (IOCCP is the GOOS Biogeochemistry Panel).		Bergen, Norway	15

List of Main Events Attended by ICOS Consortium

Note: Some national networks have reported e.g. trainings, internal events and project meetings. Those have been excluded from this from calculation of the KPI and indicated here with grey background.

Member(s)	Event	Month	Place
IT	ITINERIS Training "Atmospheric Composition Data Exploitation"	January	CNR-IMAA Tito Scalo, Italy
CH	NABEL-Tagung: Trends und Herausforderungen in der Luftreinhaltung	January	Duebendorf, Switzerland
IT	ICOS ATC Training	January	LSCE Saclay, France
NO	Ocean Acidification programme meeting (Norwegian Environment Agency)	January	Norway
NO	Ocean Acidification at the coast and in fjords (FHF)	January	Norway
IT	Datalogger programming and sensors connection – basic course	January	online
UK	METS RCN	January	
BE	8th European Conference of Tropical Ecology	February	Amsterdam, the Netherlands
DE	Workshop JPI Oceans Joint Action Ocean Carbon Capacities	February	Brussels, Belgium
CAL	Invited Talk: Kimmel Centre, Weizmann Institute of Science	February	Rehovot, Isreal / remote
CAL	Invited Talk: $14CO_2$ as a Tool for Monitoring Carbon Cycle Changes	February	Zurich, Switzerland
IT	ITINERIS Training "Use of Stable Isotopes in environmental investigations"	March	CNR-IRET Montelibretti, Italy
BE	European Carbon Farming Summit	March	Dublin, Ireland
CH	Empa NPL GHG Engagement	March	Duebendorf, Switzerland
DE	Kohlenstofftagung	March	Göttingen, Germany
FI	CLEHE RC Seminar Days	March	Kuopio, Finland
BE, CZ, NL	ICOS MSA: face-to-face spring meeting	March	Madrid, Spain
IT	Conference "Closing the early warning gap together" (World Meteorological Day 2025)	March	Milan, Italy
DE, IT	Wepal-Quasimeme Workshop on Quality Assurance for inorganic carbon system measurements in context of ocean acidification monitoring	March	Southampton, UK
CH	Swiss Global Change Day	April	Bern, Switzerland
CH	Colloquium of the Institute Atmosphere, Climate and Earth Observation, University of Bern	April	Bern, Switzerland
DE	Oceanops, 13th Session of the "Ships Observation Team (SOT)"	April	Brest, France

CAL, DE, CH, GR	IG3IS Urban Greenhouse Gas Conference and Stakeholder Summit 2025	April	Geneva, Switzerland
FI	ACCC Impact week 2025	April	Helsinki, Finland
CH	Virtual Alpine Observatory 2025 Symposium	April	Kaprun, Austria
FI	INAR Research Infrastructures scientific meeting	April	Sotkamo, Finland
many	EGU General Assembly 2025	April	Vienna, Austria
IT	ITINERIS training "Atmospheric standardized observations: Methods and maintenance in observatories – In-Situ"	May	CNR-ISAC of Bologna/ Monte Cimone Atmospheric Station, Italy
ES	ACTRIS-Spain Workshop	May	Granada, Spain
CAL, NL, CH	8th ICOS Summer school	May	Hyytiälä, Finland
CAL	ICOS Cities project Annual Meeting	May	Munich, Germany
CZ, NL	ICOS atmosphere MSA: face-to-face spring meeting	May	Offenbach, Germany
IT	TNA at CESAR observatory	May	Utrecht, the Netherlands
CH	Symposium "The Status of the Swiss Carbon Cycle"	May	Zurich, Switzerland
GR	CitiesMissionConference2025	May	Vilnius, Lithuania
CH	Anniversary workshop – 40 years Sanasilva and 30 years LWF	June	Birmensdorf, Switzerland
IE, HO	UNFCCC Paris Agreement Meetings	June	Bonn, Germany and Belem Brazil
IT	Datalogger programming and sensors connection – advanced course	June	CNR Montelibretti
BE	Forum du Bassin de Congo de l'Eau	June	Kinshasa
DE, OTC	One Ocean Science Congress	June	Nice, France
DE	3rd United Nations Ocean Conference	June	Nice, France
BE	Consortium meeting MRV4SOC	June	Oslo, Norway
SE	IUFRO	June	Stockholm, SE
FI, IT, CH	eLTER science conference	June	Tampere, Finland
BE, IE, HO	ESA Living Planet symposium	June	Vienna, Austria
GR, HO	Research and Innovation (R&I) Days 2025	June	Brussels, Belgium
CH	Zijing Forum of Global Change Science at Tsinghua University	July	Beijing, China
CZ	FLUXNET Conference	July	Brisbane, Australia
IT	ITINERIS Training "Atmospheric remote sensing observation: labs maintenance and methods"	July	CNR-IMAA Tito Scalo, Italy
CH	Hainan Blue Carbon Forum 2025	July	Hainan, China
IT	TNA in El Arenosillo observatory	July	Mazagón, Spain
IT	Field experimental observation with Drone of canopy NDVI, leaf photosynthesis, and canopy temperature	July	Naples, Italy

BE	61st Annual Meeting of the Association for Tropical Biology and Conservation	July	Oaxaca, Mexico
DE, CH	12th International Conference on Urban Climate (ICUC)	July	Rotterdam, The Netherlands
FI	12th INTECOL Wetlands Conference	July	Tartu, Estonia
IT	iNEST – Young Researchers workshop: Advancing in understanding the Gulf of Trieste coastal dynamics through interdisciplinary research	July	Trieste, Italy
CH	Seminar at Northwest A&F University	July	Xi'an, China
GR	ICUC12	July	Rotterdam, Netherlands
CH	Beat the Heat Conference	August	Basel, Switzerland
IT	European Aerosol Conference	August	Lecce, Italy
OTC	IRVO Meeting (International research Vessel operators).	September	Bergen, Norway
DE	Forstwissenschaftliche Tagung 2025	September	Freiburg, Germany
DE	ITMS – Integriertes Treibhausgas-Monitoring System	September	Heidelberg, Germany
BE	ATTO workshop 2025	September	INPA in Manaus
IT	National Conference of the ITINERIS project (ITalian Integrated Network of Environmental Research Infrastructure System)	September	Roma, Italy
CH	3rd International scientific conference "Quo Vaditis, Agriculture, Forestry and Landscape?"	September	Velké Karlovice, Czech Republic
CH	2nd International Conference on Chemical Weather and Chemical Climate	October	Ben Guerir, Morocco
OTC	IOCCP annual Meeting	October	Bergen, Norway
BE	Ecosystems in a changing world conference	October	Brussels, Belgium
BE	Belgian Economic Mission, Seminar and meetings	October	California US
BE	ESA S2LPV meeting	October	Frascati
CAL, CH, OTC	Global greenhouse Gas Watch (G3W) Network Design Workshop	October	Geneva, Switzerland
DK	Symposium "Fluxes Anytime and Anywhere" in honor of Dennis Baldocchi	October	Göttingen, Germany
IT	Autumn school "Analysis of atmosphere-surface interactions and feedbacks"	October	Hyytiälä, Finland
SE	International Conference on Harmful Algae	October	Punta Arenas, Chile
IT	AIRES - il centro dell'atmosfera del Monte Cimone	October	Rome, Italy
GR	EuroGEO - European contribution to GEO (EGW25)	October	The Hague, Netherlands

CZ, IE, NO	UNFCCC COP30, the United Nations Climate Change Conference and the Subsidiary Body Meetings	November	Belem, Brazil and online
BE	FLEX user workshop	November	Bonn, Germany
CAL	CORSO Final meeting	November	Bonn, Germany
FI	Tulanet Infrastructure Day 2025	November	Espoo, Finland
All	ICOS 10 year anniversary, Infor Day, GA and MSA meetings	November	Helsinki, Finland
NO	ICOS Nordic workshop – Status of ICOS Norway and atmosphere domain updates	November	Helsinki, Finland
ES	RESPIRE-CLIMATE Workshop	November	Madrid, Spain
CAL, CH	ICOS Germany meeting, ICOS-D Wissenschaftliche Versammlung 2025	December	Bremerhaven
DE, SE	International Ocean Colour Science Meeting	December	Darmstadt, Germany
CH	Annual Meeting of the British Ecological Society	December	Edinburgh, UK
IT	Annual Conference of the Bio-Agri-Food Department of the National Research Council of Italy	December	Milan, Italy
BE, ETC	American Geophysical Union (AGU)	December	New Orleans, USA
IT	Implementation of FAIR Principles for Marine Data at OGS	December	Trieste, Italy and Online
DK	ICOS Cities Final Meeting	December	Zurich, Switzerland
GR	UpClim: Presentation of the research on the study of climate and climate change by the Department of Geology at a special event	December	Thessaloniki, AUTH
IE	IPCC Plenary	February and November	Hangzhou, China and Lima, Peru

List of outreach events

Member	**Event**	**Person**	**Media**	**Note**
BE	VRT Journaal, january 2025, bosbranden LA	H. Verbeeck	National media, news report VRT nws	https://rtv.auxipress.be/ExternalVideo/Alert?id=mMquyo5hCzg%3D&lang=nl
BE	Keynote by Flemish reporter on	S. Vercruysse	Keynote for general audience	6/02 Keynote met Stijn Vercruysse over de toekomst van Afrika of is Afrika de toekomst? - In the yard

	DRC “Is er een toekomst voor Afrika of is Afrika de toekomst?”			
BE	Publication in National Geographic	F. Kimbesa	Publication	How the Congo became the world’s most critical rainforest | National Geographic
BE	Festival, p anel member	P. Boeckx	Festival for general public	Congo aan Zee: West-Vlaams wereldburgerfestival
BE	Launch of new research drone in BE-Brasschaat	I. Janssens	National media, news report VRT nws	26 April 2025 https://www.vrt.be/vrtnws/nl/2025/04/26/unieke-drone-vliegtdagelijk-over-bos-in-brasschaatom-gezondhei/
BE	Launch of new research drone in BE-Brasschaat	I. Janssens	Online and printed articles	HLN Het Nieuwsblad
BE	Book Launch 'Kan Congo de wereld redden' door John Vandaele	H. Verbeeck, J. Mande	Book Launch	
BE	Science battle at Nerdland-festival	S. Lamotte	Presentation science festival	at
BE	Interview on forest fires	H. Verbeeck	Radio interview	Radio 1 - Recordhoeveelheid bos verloren in 2024: "Vaak door mens aangestoken bosbranden"
BE	Site visit	B. Heinesch		20 July 2025 BE-Dor site presentation during the visit of the European Commissioner for Agriculture and Food, Christophe Hansen
BE	Interview in news paper	H. Verbeeck, J. Mande	De Morgen	https://www.demorgen.be/nieuw s/na-de-verwoestende-brandenin-frankrijk-het-fundamenteleprobleem-blijft-de-klimaatopwarming~b8b0f16a/
BE	Science Day	UAntwerp team	Science fair	23 November 2025

BE	Publication of UGent-CBCE website	P. Boeckx, M. Bauters, H. Verbeeck	Website	https://cbce.ugent.be/
BE	Visits by politicians, diplomatics, research (Belgian Ambassy, FAO et coordinator at UN, British ambassy, IECD (European institute of cooperation and development,	F. Kimbesa, H. Fundji, D. Ekili, J. Mbifo (Technician team Congoflux)	Site visits	
BE	Course middle school schools Kisangani. Building a Mini meteorological station		School course	
CZ	On-line article in the most popular Czech media server Seznam.cz: Lesy otáčí a vypouští víc CO2 než lidé? Tak to úplně není, ale změna se děje (Do forests rotate and emit more CO2 than humans? That's not entirely true, but change is happening)	Ladislav Šigut	Seznam.cz (https://www.seznamzpravy.cz/clanek/zahranicni-lesy-otaci-a-vypousti-vic-co2-nez-lide-tak-to-uplne-neni-ale-zmena-se-deje-293101)	Statements supported by the Czech Carbon Observation System (CzeCOS) ecosystem sites network that are part of ICOS
DK	Interview	A. Ibrom and K Pilegaard	Danish State Television	The development of the carbon sequestration at the DK-Sor site over the 29 years of measurements in relation to the changing climate during the period.
FI	Short presentation	Leena Järvi	COP30, Belem, Brazil	

	and participating on panel discussion on *Negative Emissions - How to remove carbon dioxide in urban areas*			
FI	Event *CO-CARBON: Recent findings on urban carbon cycle and sinks*	Leena Järvi, Minttu Havu	4th ACCC Impact week, Helsinki, Finland	
FI	Media interview "Mysteeripömpelit hämmentävät keskellä Helsinkiä – "Vihollisen vakoiluantureita?"	Leena Järvi	Ilta-Sanomat newspaper	https://www.is.fi/kotimaa/art-2000011237555.html
FI	Visit of a film crew ordered by the European Commission to create a movie on the infrastructure used by the station (ICOS). Film to be released in Feb. 2026.			
FI	Interview about global CH4 emissions, 24.11.2025	Tuula Aalto	MTV3 TV channel news	Link
FI	Students visiting Ränskälänkorpi EC flux site in a drained peatland forest, Southern Finland			
FI	World Wetlands Day event at Siikaneva hosted by Peat&Trees,	Eeva-Stiina Tuittila		

	2.2.2025, Siikaneva, Ruovesi			
FI	eLTER science conference excursion (meeting organized in Tampere) in Lettosuo ICOS flux site (FI-Let), about 35 visitors	Annalea Lohila		
FI	Webinar "What do we know about the climate effects of afforesting a cutover peatland"	Annalea Lohila	Webinar n Finnish for ca. 60 persons	
FI	Presentation "Layers, carbon balance and climate interactions of forests"	Annalea Lohila	Presentation in Forest Science day	
FR	Press conference	T.Lauvaux, M.Ramonet M. Delmotte L. Rivier		Une étude européenne confirme des progrès dans la lutte contre le changement climatique et la baisse des émissions de CO_2 à Paris Link Link Link Link
FR	Visit of international students (ATC & ICOS)	M. Delmotte	International physics Olympiads finals	About 30 students coming from all over the world for the international finals of the Physics Olympiads. Host Université Paris-Saclay (and CEA for the one-day visit).
FR	Visit for stakeholders and policymakers (FR-Pue)	JM Limousin	Regional TV	Escale en Occitanie du programme national de recherche PEPR FORESTT sur le thème « Vulnérabilité &

				préservation des forêts méditerranéennes » Link
FR	Online media in French : Video on the Guyaflux site measurements	Laetitia Brechet		Link
FR	News in the UPSaclay scoop it on pesticide volatilisation measured in FR-GRI	Benjamin Loubet		Link
DE	feature article "Gute Aussicht auf die Klimakrise“		Süddeutsche Zeitung	Link
DE	DWD new public engagement pavilion		Merkur	Link
DE	Zeitungsartikel zu SF6 Studie als Reaktion zu Veröffentlichung K. Meixner et. Al, 2025			Link
DE	Public Talk highlighting the contribution of ICOS and FLUXNET to climate-smart land use, focusing on the CO2-Albedo tradeoff (in German)	Alexander Graf	Series "Wissenschaft online" (Forschungszentrum Jülich), 2025-04-03 and Series "Essener Klimagespräche" (Deutsche Meteorologische Gesellschaft), 2025-12-09.	
DE	Akademie im Gespräch, "Was braucht unser Wald?", 26. March 2025, Göttingen	Alexander Knohl	podium discussion	

DE	Kinderuni, "Wälder in einer warmen Welt", 28. May 2025, University of Göttingen	Alexander Knohl, Anne Klosterhalfen et al.	lecture	Lecture for children about the impact of climate change on forest ecosystems
DE	Outreach Event, 21. June 2025 – 6. Nacht des Wissens, University of Göttingen	Alexander Knohl, Anne Klosterhalfen and entire Bioclimatology group	open house of University of Göttingen	presentation of a small eddy-covariance tower with live data stream and VR visit to DE-Hai flux site
DE	Lecture series "Wald im Wandel", "Wenn der Wald den Atem anhält: Klimaextreme und ihre Folgen", University of Göttingen, 04. November 2025, University of Göttingen	Alexander Knohl	public lecture series	
DE	Press release	S. Haberstroh, A. Christen	University of Freiburg	**Years of drought turn pine forest into source of CO_2** Link
GR	Radio Interview	Nektarios Chrysoulakis	Thema Kritis, radio	Greek microsatellites and the Sat4Gaia project.
GR	WEKEO #AtmosphereMonitoring	Konstantinos Politakos	Online Workshop	Evaluation of Modeled Heating CO_2 Emissions (MEHNDI - ECMWF) Using an Urban ICOS Eddy Covariance Flux Tower in the CoCO$_2$ Project
GR	TV interview	Nektarios Chrysoulakis	TV Creta	The CLMS-Cities Project
IE	ICOS Ireland website		EPA	ICOS - Ireland | Environmental Protection Agency
IE	ICOS Ireland brochures		EPA	
IE	ICOS Ireland videos		ICOS Explore	#ExploreICOS: Mace Head – Atmospheric supersite at the edge of Europe #ExploreICOS: Clara Raised Bog - Uncovering the science of Ireland's carbon stores

IT	Presentation at the EGU 2025	Terenzio Zenone, Carlo Calfapietra, Gabriele Guidolotti, Teresa Bertolini, Marco Ciolfi, Michele Mattioni, Negar Rezaei, and Emanuele Pallozzi		X1.120 EGU25-9741 Carbon and water fluxes in urban forest: improving human well - being for a more sustainable society
IT	Presentation at the 12th International Conference on Urban Climate. Rotterdam & online | 7–11 July 2025	Terenzio Zenone, Carlo Calfapietra, Teresa Bertolini		ICUC12-792 Carbon and water fluxes in urban forest: improving human well - being for a more sustainable society
IT	Newspaper article	Bruno Coletta	https://italia-informa.com/	Link
IT	News in web site		https://www.cnr.it/it/news/13598/incendi-in-canada-la-nube-di-inquinanti-raggiunge-l-italia-e-monte-cimone	Incendi in Canada: la nube di inquinanti raggiunge l'Italia e Monte Cimone
IT	National Television (RAI3)	Paolo Cristofanelli		"Presa Diretta" Link Link
IT	EGU General Assembly 2025, Vienna, Austria, 27 Apr–2 May 2025	Vivaldo., Ferraris, Baneschi, Baronetti, Giamberini, Provenzale, Raco, and Galvagno.	EGU25-13663, https://doi.org/10.5194/egusphere-egu25-13663	Title: CO2 Fluxes at high-altitude mountain ecosystems: a comparative study of two grasslands in the Aosta valley
IT	Students' visit (high school students from Croatia, Spain, and Lampedusa) to the	Damiano Sferlazzo	Lampedusa Integrated Observatory	Students within the Erasmus+ program

	Lampedusa Observatory			
IT	Scientific visit to Lampedusa station	Francesco D'Amico	Lampedusa Integrated Observatory	
IT	Scientific access to the infrastructure	Prof. J. L. Gomez Amo and two students, Univ. of Valencia, Spain	Lampedusa Integrated Observatory	
IT	Newspaper article	Martellucci et al.	Frontiers in Marine Science	https://doi.org/10.3389/fmars.2025.1633617
IT	Technical report	Organelli et al.	CNR Institutional Research Information System	https://hdl.handle.net/20.500.14243/555621
IT	Newspaper article	Steinhoff et al.	Limnology and Oceanography: Methods	**https://doi.org/10.1002/lom3.10727**
IT	Press release	Carolina Cantoni	CNR press release	Link
IT	Interview	Carolina Cantoni	Instagram	Link
IT	TV Program on atmospheric monitoring at the station at Plateau Rosa	Giulia Zazzeri	Mediaset	https://mediasetinfinity.mediaset.it/video/eplanet2025/monitoraggi-ad-alta-quota_F313663401013C02
IT	News on the institute website	CNR-IMAA	https://imaa.cnr.it/?p=3833&lang=it	Study visit: Il CNR IMAA incontra le Scuole. Lezioni Aperte. IX ediz.
IT	X post	ITINERIS X profile	https://x.com/ITINERIS_RI/status/1887093819620876366	Visit to the CIAO Observatory by the student attending the Atmospheric Composition Data Exploitation ITINERIS training
IT	Television program	Leonardo Montagnani	RAI3	Documentary "Materia Viva" with scenes from the ICOS IT-Ren site
IT	Video Capodimonte	Terenzio Zenone, Carlo Calfapietra, Gabriele Guidolotti, Teresa Bertolini,	YouTube	https://www.youtube.com/watch?v=wKWtJAnzOYc&t=2s

NO	Online article	Stephen Platt	NRK	Nye tall: Metan-utslippene etter Nord Stream var tidenes største www.nrk.no/klima/nye-tall_-metan-utslippene-etter-nord-stream-var-tidenes-storste-1.17210861
NO	Online article	Stephen Platt	Barents Observer	Record levels of greenhouse gases in the atmosphere. Actions needed now, Greenpeace says Link
NO	Online article	Stephen Platt	Energy and Climate	Metanutslipp på vei opp www.energiogklima.no/to-grader/ekspertintervju/metanutslipp-pa-vei-opp
NO	Radio interview	Stephen Platt	NRK	Nord Stream: Største enkeltutslepp av metan nokon gang
NO	Online article	Stephen Platt	NILU press release	Rekordhøye lystgassnivåer truer både klimamål og ozonlaget
ES	Public visits	Jose A. Adame	In person	Student visits to the El Arenosillo station were organised for groups from the University of Huelva, the International University of Andalusia, among others, as well as several high schools in Huelva, Seville, and Cádiz.
ES	Public visits	Pedro Rivas-Soriano and Sergio León	In person	Visit by students from the University of Manchester.
ES	Public visits	Izaña staff	In person	Visit to the Izaña Observatory by participants in the HARMONIA School “About the Clouds” (Action COST HARMONIA, International network for harmonization of atmospheric aerosol retrievals from ground-based photometers)
ES	Public visits	Carlos Torres, Pedro Rivas-Soriano, Ayoze Álvarez-Hernández	In person	Visit to the Izaña Observatory by participants in the 16th Implementation and Coordination GRUAN Meeting.
ES	Outreach public talk	Carlos Torres	In person and online	Outreach presentation given at “La Torre de las Nubes”, an event promoted by Teidelab to

				disseminate the science carried out in Teide National Park. Carlos Torres gave a talk on the history of the Izaña Observatory and its current activities. https://www.youtube.com/watch?v=U4oDdHdXtqc&t=6928s
ES	News item	Pedro Rivas-Soriano, Carlos Torres, Omaira García, Ayoze Álvarez-Hernández	Internet	Publication of a news item announcing the historic atmospheric CO_2 record measured at the Izaña Observatory in 2025. Link
SE	Newspaper article	Lindroth, T. Biermann	Tidningen Syre	Tio år med Parisavtalet – så blev facit
SE	Host news webpage	Vermeulen	Lund University	
SE	Online magazine	SE-Sto	Quanta magazine	The Ends of the Earth
SE	Host news webpage	SE-Sto	Polar Research Secretariat	Polarforskningssekretariatet: Nya instrument i Abisko-Stordalen stärker klimatforkningen
CH	Visit of University of Freiburg at Basel station	Christian Feigenwinter and Stavros Stagakis	Station visit, 13 January 2025	
CH	State Councillor visits Jungfraujoch station	HFSJG	Station visit, 28 February 2025	
CH	Visit of the Werner Siemens-Foundation at Jungfraujoch station	HFSJG	Station visit, 28 February 2025 and 15 December 2025	
CH	Visit of vice president of the ETH board at WSL (showing long-term monitoring infrastructure)	Sophia Etzold	Visit, 20 March 2025	Link
CH	A parliamentary delegation from	Eliza Harris and Silvio	Station visit, 7 March 2025	

	Sweden at Jungfraujoch station	Decurtins HFSJG		
CH	Visit of University of Padova students at Basel station	Roland Vogt and Stavros Stagakis	Station visit, 7 May 2025	
CH	Visit of MINT (STEM) students at WSL showing long-term monitoring research and work as ecologists)	Sophia Etzold	Visit, 20 October 2025	
CH	Visit of the ECOSENSE project group to the Basel station	Christian Feigenwinter, Armin Sigmund	Visit, 31 July 2025	
CH	Visit of foresters from Zurich Forest District 1 at WSL (showing long-term monitoring infrastructure)	Sophia Etzold und Roman Zweifel	Visit, 1 December 2025	
CH	Article in Forestry Magazine	Sophia Etzold, Roman Zweifel	Schweizerische Zeitschrift für Forstwesen	Etzold S et al. (2025) - 25 Jahre Wachstumsentwicklung in 19 Schweizer Wäldern unter zunehmender Trockenheit. Schweizerische Zeitschrift für Forstwesen, 176(2), 77-83. https://www.szf-jfs.ch/de/artikel/25-jahre-wachstumsentwicklung-in-19-schweizer-waeldern-unter-zunehmender-trockenheit?setBackToOverview=true&cHash=e449cbcec6885452c379f8227b1872ce
CH	Article in Forestry Magazine	Roman Zweifel, Buchmann Nina, Sophia Etzold	Schweizerische Zeitschrift für Forstwesen	Zweifel R et al. (2025) Wachstum und Trockenstress: physiologische Charakterisierung von Schweizer Waldbäumen. Schweizerische Zeitschrift für Forstwesen 176 (2): 99 – 105.

				https://www.szf-jfs.ch/de/artikel/wachstum-und-trockenstress-physiologische-charakterisierung-von-schweizer-waldbaeumen?setBackToOverview=true&cHash=e449cbcec6885452c379f8227b1872ce
CH	Book chapter		Haupt Verlag	Hightech im Bergwald. In: Huovinen et al. (2025): Wandern, wo andere forschen. Haupt Verlag, Bern, 306 pages. ISBN: 978-3-258-08405-3
CH	Interview	Lukas Emmenegger, Stavros Stagakis	SwissCore	Supporting cities on their NetZero journey https://www.swisscore.org/supporting-cities-on-their-netzero-path/
CH	Video		B1M, world's largest, most subscribed-to video channel for construction	Inside Europe's Most Remote Building, https://youtu.be/OVysOYeYbFw
CH	Report	ICOS-CH consortium involved in various chapters	https://www.meteoswiss.admin.ch/about-us/research-and-cooperation/programmes-gaw-ch-and-gcos-ch/gaw-ch-and-gcos-ch-reports.html	MeteoSwiss 2025. National Climate Observing System (GCOS Switzerland). Update 2025.
CH	Report	Stavros Stagakis	GAW Report No. 314	Turnbull et al. (2025): Integrated Global Greenhouse Gas Information System: Urban Emission Observation and Monitoring Good Research Practice Guidelines, https://doi.org/10.59327/WMO/GAW/314
CH	Report	Martin Steinbacher	GAW Report No. 318	Zellweger et al. (2025): Measurement Guidelines for the Observations of CO_2, CH_4 and N_2O at Global Atmosphere Watch Stations, https://library.wmo.int/idurl/4/69672

CH	Report	Lukas Emmenegger, Martin Steinbacher	GAW Report No. 319	Ganesan et al. (2025): Integrated Global Greenhouse Gas Information System Good Practice Guidance for Estimating National-scale Greenhouse Gas Emissions using Atmospheric Observations, https://library.wmo.int/idurl/4/69714
CH	Handbook/Report	Stavros Stagakis, Lukas Emmenegger	ICOS ERIC - Carbon Portal	Papale et al. (2025): Handbook of European Urban GHGs observations, https://doi.org/10.18160/WK4N-BGS6

Annex 2: Co-location of stations in 2025

Name	Domain	Class	Location	Member	Notes	eLTER	ACTRIS	Other
La Reunion	Atmosphere Station	2	FR	BE+FR		x	x	
Oud-Heverlee	Atmosphere Station	2	BE	BE	New station for 2026, **not reported for 2025**			
Brasschaat	Ecosystem Station	1	BE	BE	ICP Forests	x		x
Dorinne	Ecosystem Station	2	BE	BE				
Lonzee	Ecosystem Station	2	BE	BE		x		
Maasmechelen	Ecosystem Station	2	BE	BE	AnaEE	x		x
Vielsalm	Ecosystem Station	2	BE	BE		x	x	
Yangambi	Ecosystem Station	Associated	CD	BE				
BE-FOS-Thornton Buoy	Ocean Station	1	BE	BE	LifeWatch	x		x
BE-SOOP-Belgica	Ocean Station	1	BE	BE	Removed in 2026, **still reported for 2025**			
BE-SOOP-Simon-Stevin	Ocean Station	1	BE	BE	LifeWatch			x
Westmalle1	Ecosystem Station	Associated	BE	BE				
Westmalle2	Ecosystem Station	Associated	BE	BE				
Jungfraujoch	Atmosphere Station	1	CH	CH			x	x
Davos	Ecosystem Station	1	CH	CH		x		x
Basel Klingelbergstrasse	Ecosystem Station	Associated	CH	CH				
Křešín u Pacova	Atmosphere Station	1	CZ	CZ			x	
Lanzhot	Ecosystem Station	1	CZ	CZ	Danubius			x
Bily Kriz forest	Ecosystem Station	2	CZ	CZ	AnaEE	x		x
Trebon	Ecosystem Station	Associated	CZ	CZ		x		
Gartow	Atmosphere Station	1	DE	DE	WMO GAW contributing network			x
Hohenpeissenberg	Atmosphere Station	1	DE	DE	WMO GAW global station		x	x
Karlsruhe	Atmosphere Station	1	DE	DE	WMO GAW contributing network			x
Lindenberg	Atmosphere Station	1	DE	DE	WMO GAW contributing network		x	x
Ochsenkopf	Atmosphere Station	1	DE	DE	WMO GAW contributing network			x
Schauinsland	Atmosphere Station	1	DE	DE	WMO GAW			x
Steinkimmen	Atmosphere Station	1	DE	DE	WMO GAW contributing network			x
Helgoland	Atmosphere Station	2	DE	DE	WMO GAW contributing network			x
Jülich	Atmosphere Station	2	DE	DE	IAGOS, WMO GAW contributing network		x	x

Name	Domain	Class	Location	Member	Notes	eLTER	ACTRIS	Other
Torfhaus	Atmosphere Station	2	DE	DE	WMO GAW contributing network			x
Westerland	Atmosphere Station	2	DE	DE	WMO GAW			x
Zugspitze	Atmosphere Station	2	DE	DE	WMO GAW		x	x
Amtsvenn	Ecosystem Station	Associated	DE	DE				
Fendt	Ecosystem Station	Associated	DE	DE	TERENO			x
Gebesee	Ecosystem Station	1	DE	DE				
Hohes Holz	Ecosystem Station	1	DE	DE	TERENO	x		x
Selhausen Juelich	Ecosystem Station	1	DE	DE	TERENO	x		x
Tharandt	Ecosystem Station	1	DE	DE				
Berlin-Rothenburgstrasse	Ecosystem Station	Associated	DE	DE	PhenoCam Network			x
Braunschweig	Ecosystem Station	Associated	DE	DE				
Graswang	Ecosystem Station	Associated	DE	DE	TERENO			x
Grillenburg	Ecosystem Station	Associated	DE	DE				
Grosses Bruch	Ecosystem Station	Associated	DE	DE	TERENO	x		x
Hainich	Ecosystem Station	Associated	DE	DE		x		
Hartheim	Ecosystem Station	Associated	DE	DE	PhenoCam Network, PsiNet (https://psinetrcn.github.io)			x
Hetzdorf	Ecosystem Station	Associated	DE	DE				
Kienhorst	Ecosystem Station	Associated	DE	DE				
Klingenberg	Ecosystem Station	Associated	DE	DE				
Mooseurach	Ecosystem Station	Associated	DE	DE				
Oberklenkendorf	Ecosystem Station	Associated	DE	DE				
Rollesbroich	Ecosystem Station	Associated	DE	DE	TERENO	x		x
Schechenfilz Nord	Ecosystem Station	Associated	DE	DE				
Wustebach	Ecosystem Station	Associated	DE	DE	TERENO	x		x
Zarnekow	Ecosystem Station	Associated	DE	DE	New station for 2026, **not reported for 2025**			
Cuxhaven	Ocean Station	2	DE	DE	JERICO			x
DE-FOS-CVOO	Ocean Station	1	DE	DE				
DE-FOS-Hausgarten	Ocean Station	1	DE	DE		x		
DE-SOOP-Atlantic Sail	Ocean Station	1	DE	DE				

Name	Domain	Class	Location	Member	Notes	eLTER	ACTRIS	Other
DE-SOOP-Finnmaid	Ocean Station	1	DE	DE				
DE-SOOP-Polarstern	Ocean Station	1	DE	DE	MOSAiC, Antarctica InSync			x
Station Nord	Atmosphere Station	2	DK	DK			x	
Soroe	Ecosystem Station	1	DK	DK		x		
Zackenberg Fen	Ecosystem Station	2	GL	DK				
Disko	Ecosystem Station	Associated	GL	DK				
Nuuk Fen	Ecosystem Station	Associated	GL	DK				
Risoe	Ecosystem Station	Associated	DK	DK				
Zackenberg Gras	Ecosystem Station	Associated	GL	DK				
CIBA	Atmosphere Station	2	ES	ES			x	x
El Arenosillo	Atmosphere Station	2	ES	ES			x	x
Izana	Atmosphere Station	2	ES	ES			x	x
Majadas de Tiétar	Ecosystem Station	Associated	ES	ES		x		
Aguamarga	Ecosystem Station	Associated	ES	ES	New station for 2026, **not reported for 2025**			
CanOA VOS-line	Ocean Station	1	ES	ES				x
ESTOC	Ocean Station	1	ES	ES				
Hyytiälä	Atmosphere Station	1	FI	FI	AnaEE	x	x	x
Pallas	Atmosphere Station	1	FI	FI			x	x
Puijo	Atmosphere Station	2	FI	FI			x	
Utö - Baltic sea	Atmosphere Station	2	FI	FI	Jerico		x	x
Anttila	Ecosystem Station	2	FI	FI				
Oulanka	Ecosystem Station	Associated	FI	FI	AnaEE	x		
Hyytiälä	Ecosystem Station	1	FI	FI	AnaEE	x	x	x
Sodankyla	Ecosystem Station	1	FI	FI		x		
Lompolojankka	Ecosystem Station	2	FI	FI		x	x	
Siikaneva	Ecosystem Station	2	FI	FI		x		
Kenttarova	Ecosystem Station	Associated	FI	FI		x	x	
Kuivajarvi	Ecosystem Station	Associated	FI	FI		x		
Kumpula	Ecosystem Station	Associated	FI	FI				
Lettosuo	Ecosystem Station	Associated	FI	FI				
Tvärminne	Ecosystem Station	Associated	FI	FI	EMBRC	x		x

Name	Domain	Class	Location	Member	Notes	eLTER	ACTRIS	Other
Varrio	Ecosystem Station	Associated	FI	FI	AnaEE	x	x	x
Kilpisjarvi	Ecosystem Station	Associated	FI	FI	New station for 2026, **not reported for 2025**			
Welgegund	Ecosystem Station	Associated	ZA	FI	New station for 2026, **not reported for 2025**			
FI-SOOP-Silja Serenade	Ocean Station	2	FI	FI				
FI-FOS-Tvärminne	Ocean Station	2	FI	FI	EMBRC	x		x
Observatoire pérenne de l'environnement	Atmosphere Station	1	FR	FR	Station also known as Bure			
Saclay	Atmosphere Station	1	FR	FR				
Trainou	Atmosphere Station	1	FR	FR				
Puy de Dôme	Atmosphere Station	2	FR	FR			x	
Fontainebleau-Barbeau	Ecosystem Station	1	FR	FR				
Hesse	Ecosystem Station	1	FR	FR				
Bilos	Ecosystem Station	2	FR	FR				
Font-Blanche	Ecosystem Station	2	FR	FR	AnaEE			x
Grignon	Ecosystem Station	2	FR	FR				
Laqueuille	Ecosystem Station	2	FR	FR	AnaEE			x
Lusignan	Ecosystem Station	2	FR	FR	AnaEE			x
Puechabon	Ecosystem Station	2	FR	FR	AnaEE			x
Aurade	Ecosystem Station	Associated	FR	FR		x		
Col du Lautaret	Ecosystem Station	Associated	FR	FR	AnaEE	x		x
Estrees-Mons A28	Ecosystem Station	Associated	FR	FR				
Guyaflux	Ecosystem Station	Associated	GF	FR				
La Guette	Ecosystem Station	Associated	FR	FR				
Mejusseaume	Ecosystem Station	Associated	FR	FR				
Montiers sur Saulx	Ecosystem Station	Associated	FR	FR	AnaEE			x
Toulouse	Ecosystem Station	Associated	FR	FR			x	
FR-SOOP-France-Brazil	Ocean Station	1	FR	FR				
Ridge Hill tower	Atmosphere Station	2	GB	GB				
Weybourne Atmospheric Observatory	Atmosphere Station	2	GB	GB				

Name	Domain	Class	Location	Member	Notes	eLTER	ACTRIS	Other
Auchencorth Moss	Ecosystem Station	1	GB	GB				
UK-FOS-PAP	Ocean Station	1	GB	GB	EMSO			X
Finokalia	Atmosphere Station	2	GR	GR			x	
HECKOR - Heraklion Kornarou	Ecosystem Station	Associated	GR	GR				
HECMAS - Heraklion Mastabas	Ecosystem Station	Associated	GR	GR				
Pertouli	Ecosystem Station	2	GR	GR				
Hegyhátsál	Atmosphere Station	2	HU	HU	WMO GAW, NOAA			x
Carnsore Point	Atmosphere Station	2	IE	IE				
Mace Head	Atmosphere Station	2	IE	IE			x	
Malin Head	Atmosphere Station	2	IE	IE				
Valentia Island	Atmosphere Station	2	IE	IE				
Clara Raised Bog	Ecosystem Station	Associated	IE	IE				
Dooary	Ecosystem Station	2	IE	IE				
Leam West	Ecosystem Station	Associated	IE	IE				
Doory	Ecosystem Station	Associated	IE	IE				
Johnstown Castle	Ecosystem Station	2	IE	IE				
RV Celtic Explorer	Ocean Station	2	IE	IE				
Lampedusa	Atmosphere Station	2	IT	IT			x	
Monte Cimone	Atmosphere Station	2	IT	IT			x	
Potenza	Atmosphere Station	1	IT	IT				
Plateau Rosa	Atmosphere Station	2	IT	IT				
Borgo Cioffi	Ecosystem Station	1	IT	IT				
Castelporziano2	Ecosystem Station	1	IT	IT		x		
Monte Bondone	Ecosystem Station	2	IT	IT				
Renon	Ecosystem Station	2	IT	IT		x		
Arca di Noe - Le Prigionette	Ecosystem Station	Associated	IT	IT				
Bosco Fontana	Ecosystem Station	Associated	IT	IT		x		
Lison	Ecosystem Station	Associated	IT	IT				
Nivolet	Ecosystem Station	Associated	IT	IT		x		

Name	Domain	Class	Location	Member	Notes	eLTER	ACTRIS	Other
Osservatorio Ximeniano Firenze	Ecosystem Station	Associated	IT	IT				
Parco Urbano di Capodimonte	Ecosystem Station	Associated	IT	IT				
Torgnon	Ecosystem Station	Associated	IT	IT		x		
Torgnon-LD	Ecosystem Station	Associated	IT	IT		x		x
Collelongo	Ecosystem Station	Associated	IT	IT		x		
Lampedusa Ecosystem Observatory	Ecosystem Station	Associated	IT	IT				x
Sassari	Ecosystem Station	Associated	IT	IT				
IT-FOS-PALOMA	Ocean Station	1	IT	IT		x		
IT-FOS-E2M3A	Ocean Station	2	IT	IT				
Lampedusa	Ocean Station	2	IT	IT				
IT-FOS-Miramare	Ocean Station	2	IT	IT				
IT-FOS-W1M3A	Ocean Station	2	IT	IT	EMSO			x
Ispra	Atmosphere Station	2	IT	JRC				
San Rossore 2	Ecosystem Station	2	IT	JRC	Removed in 2026, **still reported for 2025**			
Cabauw	Atmosphere Station	1	NL	NL			x	
Lutjewad	Atmosphere Station	2	NL	NL			x	
Loobos	Ecosystem Station	2	NL	NL				
Zeppelin Observatory	Atmosphere Station	1	NO	NO	AGAGE, EMEP, AMAP,GAW, NOAA		x	
Birkenes Observatory	Atmosphere Station	2	NO	NO			x	
Hurdal	Ecosystem Station	2	NO	NO				
NO-SOOP-G.O.Sars	Ocean Station	1	NO	NO				
NO-SOOP-Tukuma Arctica	Ocean Station	1	NO	NO				
NO-SOOP Bergen-Kirkenes	Ocean Station	2	NO	NO				
NO-SOOP-Kronsprins Haakon	Ocean Station	2	NO	NO				

Name	Domain	Class	Location	Member	Notes	eLTER	ACTRIS	Other
NO-SOOP-Sea-Cargo Express	Ocean Station	2	NO	NO	Removed in 2026, **still reported for 2025**			
Hyltemossa	Atmosphere Station	1	SE	SE			x	
Norunda	Atmosphere Station	1	SE	SE			x	
Svartberget	Atmosphere Station	1	SE	SE			x	
Abisko-Stordalen Palsa Bog	Ecosystem Station	2	SE	SE	INTERACT	x		x
Degero	Ecosystem Station	2	SE	SE	INTERACT			x
Hyltemossa	Ecosystem Station	2	SE	SE	NordSpec			x
Mycklemossen	Ecosystem Station	2	SE	SE		x		
Norunda	Ecosystem Station	2	SE	SE	NordSpec			x
Svartberget	Ecosystem Station	2	SE	SE	INTERACT	x		x
SE-MFT-Östergarnsholm	Ocean Station	2	SE	SE			x	
Östergarnsholm	Ecosystem Station	Associated	SE	SE				
SE-SOOP Tavastland	Ocean Station	1	SE	SE				
					total	**48**	**41**	**64**

Total
153