



Data  
Models  
Inventories

# PARIS

Process Attribution of Regional Emissions

GA 101081430, RIA

Full year of F-gas data, uploaded to ICOS portal  
- 1<sup>st</sup> round

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## D3.2, data embedded in D2.3

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Responsible scientist	A. Engel
Contributors	A. Wenger, S. O'Doherty, K. Stanley, UNIVBRIS, U.K C. Lunder, NILU, Norway J.Arduini, M. Maione, UNIURB, Italy A. Engel, K. Meixner, T. Wagenhäuser, GUF Germany
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**Horizon Europe Cluster 5: Climate, energy and mobility**

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## 1. Changes with respect to the DoA (Description of the Action)

With the 2<sup>nd</sup> amendment of the GA, this deliverable has been changed from “D3.2 - F-gas Annex to NIR for each F-gas focus country” to “D3.2 -Full year of F-gas data, uploaded to the ICOS portal – 1<sup>st</sup> round”. The due date was adjusted from month 22 to 28. The amendment was accepted in December 2025.

## 2. Dissemination and uptake

The PARIS data are publicly available through the ICOS carbon portal under [https://meta.icos-cp.eu/objects/ul-KaooRRgyJcWY\\_EM56UwI8](https://meta.icos-cp.eu/objects/ul-KaooRRgyJcWY_EM56UwI8).

They are, however, restricted in use by a data disclaimer, as they have not undergone the whole AGAGE data review process. PARIS data which are fully controlled are released in parallel through the AGAGE network and are currently (as of Jan 2026) available up to Dec. 2024.

## 3. Short Summary of results

As part of PARIS, a new MEDUSA measurement system was installed at Taunus Observatory in early February 2023, with continuous measurements commencing on February 5, 2023. To ensure that PARIS data is intercomparable with data from other programs such as ACTRIS, this additional PARIS data set is fully incorporated into the AGAGE network. This includes full quality control and provision of consistent absolute scales and ensures that the quality of the new measurements (instrument precision) is comparable to other AGAGE stations. As of early 2024 in addition new measurements have been started at Capo Granitola (Sicily, Italy, continuous), Birkenes (Norway, flask sampling) and Hégyhátsal (Hungary, flask sampling) and flaks sampling has been continued at Cabauw (The Netherlands).

The flask data from 2024 have been incorporated into the 2<sup>nd</sup> data release of PARIS on the ICOS carbon portal ([https://meta.icos-cp.eu/objects/ul-KaooRRgyJcWY\\_EM56UwI8](https://meta.icos-cp.eu/objects/ul-KaooRRgyJcWY_EM56UwI8)).

Data are being used in the inversions which are part of PARIS. All other data are from the existing AGAGE stations at Mace Head, Tacolneston, Zeppelin, Monte Cimone and Jungfraujoch, the latter station not being part of the PARIS project.

## 4. Evidence of accomplishment

### 4.1 Introduction | Background of the deliverable

Concerning the F-gases, the PARIS project has identified three major limitations in our understanding of F-gas fluxes across Europe, as outlined in our proposal: 1) the limited measurement network, 2) poor understanding of the spatial and temporal distribution of emissions and, 3) the wide variation in emission factors used by different countries in UNFCCC reporting. A prerequisite for improving the second and third aspect is the establishment of a robust observational network to address the first issue. PARIS has chosen to focus on the most important F-gas climate forcers in Europe for WP3, i.e. HFC-134a, -143a, -125, -32, -227ea, -365mfc, -152a, HFC-23, HFC-245fa, HFC-43-10mee, PFC-14, -116, -218, -318, NF<sub>3</sub>, SF<sub>6</sub>. Any reference to F-gases in this context refers to this list unless otherwise specified. Despite their smaller emissions compared to major greenhouse gases

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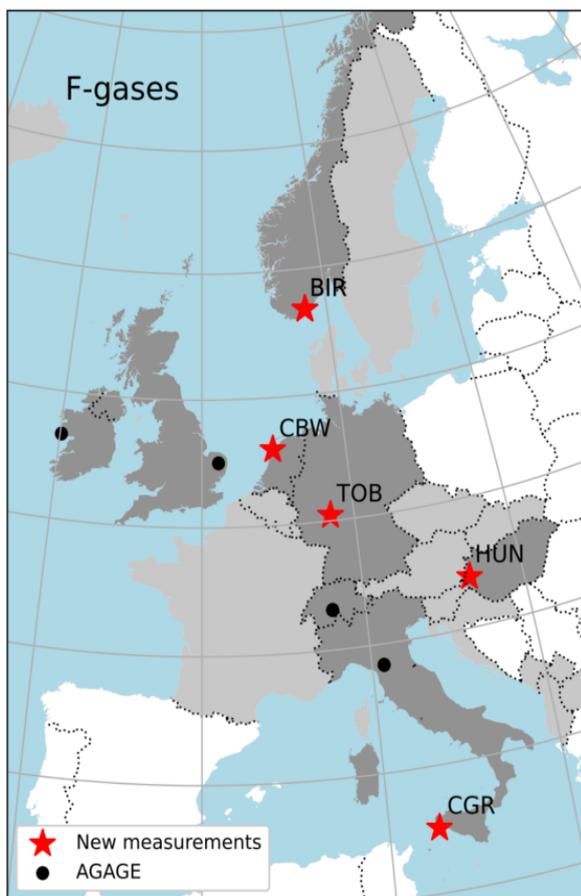
like CO<sub>2</sub>, Methane, and N<sub>2</sub>O, these F-gases contribute significantly to climate change due to their high global warming potentials. In fact, relative to 1750 conditions, halogenated greenhouse gases have had a greater impact on climate change than N<sub>2</sub>O. Nonetheless, the observational network for these gases remains sparse.

Because of their very low abundance compared to the major GHGs, measuring F-gases is challenging and requires sophisticated and expensive gas chromatograph mass-spectrometer (GC-MS) systems. The current measurement infrastructure in Europe, supported by the AGAGE network and related activities, includes GC-MS “Medusa” systems or similar instruments at key sites, enabling the measurement of major fluorinated gases approximately every two hours. Our capacity of F-gas measurements in Europe prior to the start of the PARIS project was high-frequency measurements from Mace Head (Ireland), Tacolneston (UK), Jungfraujoch (Switzerland), Zeppelin (Norway) and Monte Cimone (Italy), as well as low-frequency flask samples from Taunus (Germany). However, significant gaps remain in our sensitivity to European emissions.

In this project, Taunus (Germany) has been added as an in-situ station that is fully integrated into the AGAGE network, making 2-hourly measurements of approximately 50 F-gases using the AGAGE GC-MS system. This has been achieved by supporting the installation and running of a new AGAGE Medusa system, purchased in a recent capital grant. PARIS has also expanded new flask-sampling activities to Birkenes (Norway) and Hegyhátsál (Hungary), continued sampling at Cabauw (Netherlands) and established the new site Capo Granitola in southern Italy. All of these measurements are now established, and they are part of this second data release of F-gases from the PARIS project.

Measuring F-gases is critical as they are strong greenhouse gases, with emissions regulated under international treaties such as the Kigali Amendment to the Montreal protocol and under European legislation (F-gas regulation). The verification of bottom-up estimates can be achieved by implementing regional observations, but due to their low concentrations in the atmosphere, measurements are difficult and require high accuracy as expected changes are small. Continuous measurements by in-situ gas chromatography coupled with mass spectrometry provide the best opportunity to collect dense and high-quality data. However, this approach requires very expensive, specialized equipment and significant maintenance work to ensure high data quality. A particularly effective instrument is the MEDUSA system which is the standard used in the AGAGE (Advance Global Atmospheric Gas Experiment, <https://agage.mit.edu/>) network. A new MEDUSA system was installed at Taunus Observatory in Germany in early February 2023 and it has been providing high quality data since then. This data is being used e.g., in the inverse modelling work as part of PARIS. Figure 1 shows the observational network extended by PARIS, highlighting Taunus Observatory (TOB) as a new continuous station running the MEDUSA instrument. This data release includes measurements from the AGAGE stations Mace Head, Tacolneston, Zeppelin, Monte Cimone and Jungfraujoch, with the latter station not being a project partner as well as from the additional stations established within PARIS (Capo Granitola, Birkenes, Hégyhátsál) and the flask measurements site at Cabauw (the Netherlands) which is continued under PARIS. Data from all these stations are included in this second data release from the PARIS project.

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**Figure 1: F-gas measurement sites.** Existing high-frequency measurement stations are shown as black dots (AGAGE and affiliated). New high-frequency measurements will be installed at Taunus (TOB). New flask sampling is proposed at the locations indicated by a red star, at Birkenes (BIR), Cabauw (CBW), Hegyhátsál (HUN) and Capo Granitola (CGR) in southern Italy (TBD), which is implemented as a continuous site. Countries shown in light grey are those where national emissions inferences are likely to be possible, and focus countries are shown in dark grey. PARIS focuses on the most important F-gas climate forcers in Europe (HFC-134a, -143a, -125, -32, -227ea, -365mfc, -152a, HFC-23, HFC-245fa, HFC-43-10mee, PFC-14, -116, -218, -318, NF<sub>3</sub>, SF<sub>6</sub>).

#### 4.2 Scope of the deliverable

The deliverable consists of the upload of all data including the additional new data from both continuous and flask measurements. Data are provided up to the end of 2024. These data are the basis for the derivation of emissions using top-down methods and are available for the inverse modelling, which will improve the top-down estimate of emissions, starting in the year 2023.

**Metadata:** These datasets are accompanied by comprehensive metadata, detailing information such as the measurement units, station name, and contact information of the data providers.

**Findability:** These datasets can be accessed via the ICOS Carbon Portal database. Users can locate the dataset by specifying the keywords F-Gas or PARIS

**Accessibility:** These datasets are publicly accessible through the ICOS Carbon Portal database, ensuring that stakeholders and the broader scientific community can easily access and utilize the data for their research and applications.

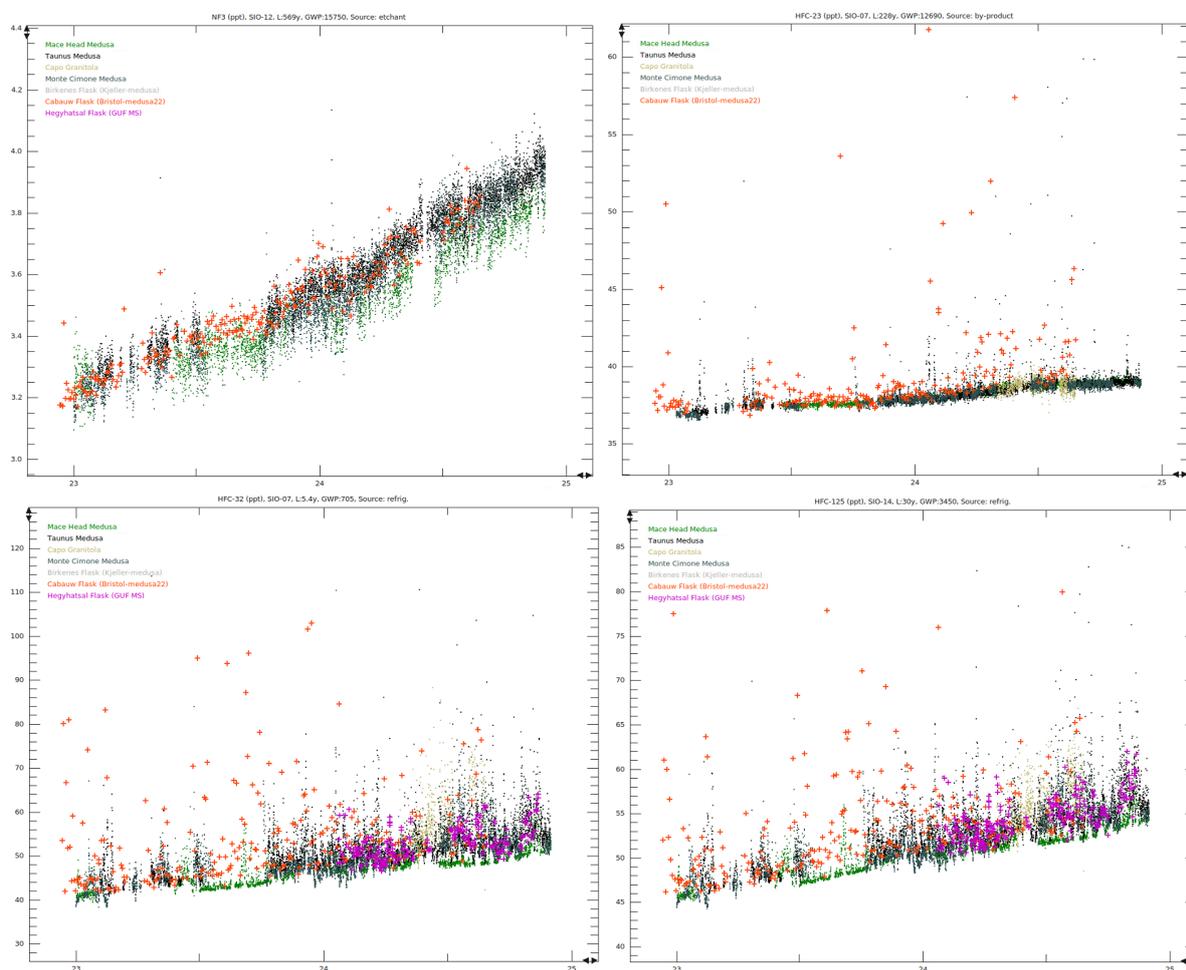
**Interoperability:** The dataset is formatted into standardized netCDF files which are easily computer readable.

**Reusability:** The dataset is linked to the calibration scales employed by the AGAGE network, ensuring that absolute values are traceable and reusable.

D3.2 – Full year of F-gas data, uploaded to the ICOS portal – 1<sup>st</sup> round

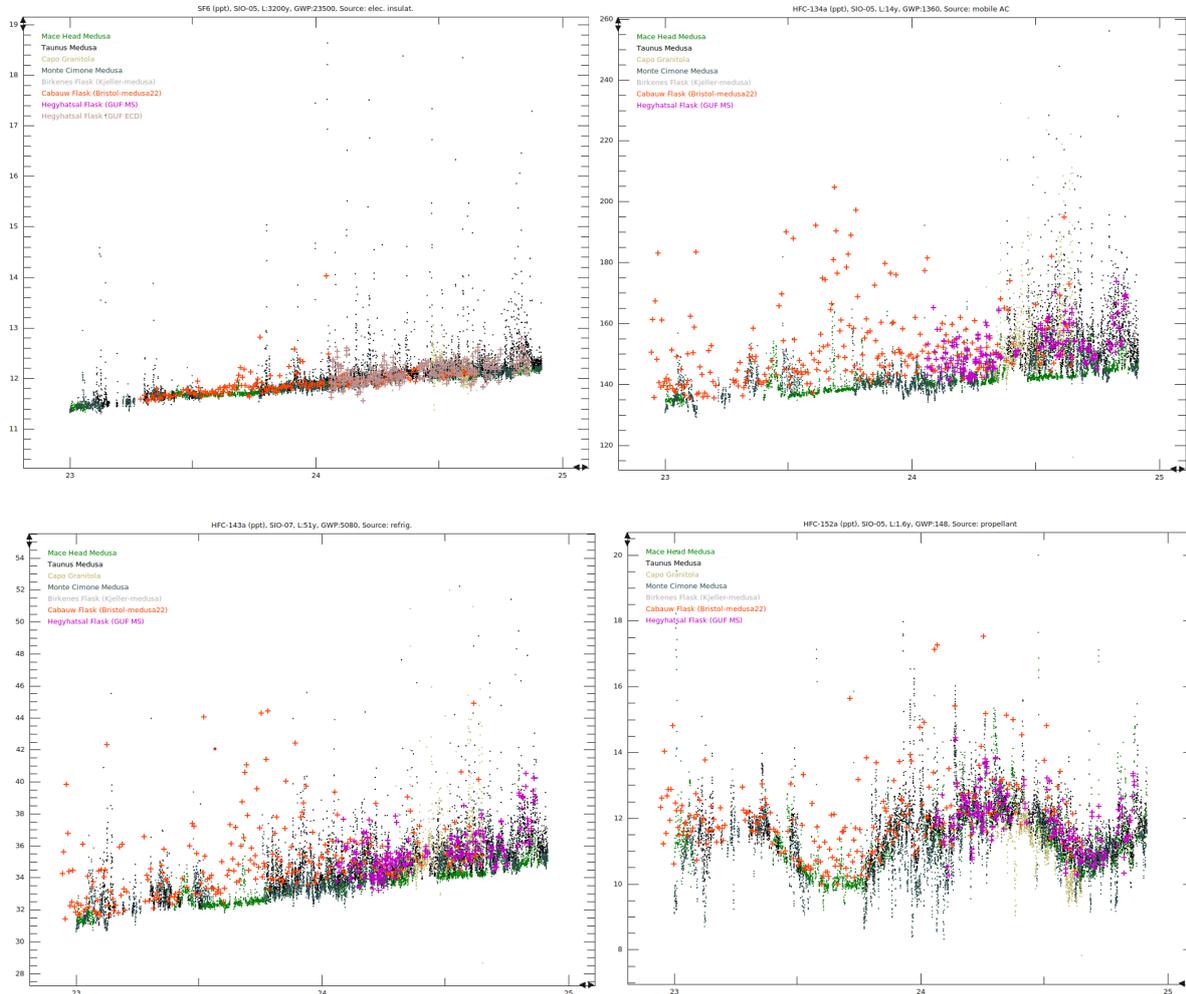
### 4.3 Content of the deliverable

PARIS focuses on the most important F-gas climate forcers in Europe (HFC-134a, -143a, -125, -32, -227ea, -365mfc, -152a, HFC-23, HFC-245fa, HFC-43-10mee, PFC-14, -116, -218, -318, NF<sub>3</sub>, SF<sub>6</sub>), all of which can be observed by the MEDUSA system run at the AGAGE stations. Within the frame of the PARIS project the measurements from the new AGAGE station at Taunus Observatory in Germany have been integrated into the network starting in 2023 in order to expand the observational network. In addition, measurements from the continuous site at Capo Granitola and from the flask stations at Birkenes, Cabauw and Hégyhátsal are now available starting in the year 2024. The measurements for a suite of target compounds are shown in Figures 2 and 3. Figure 4 shows a screenshot of the download page on the ICOS carbon portal.



**Figure 2:** Full two years of extended F-gas observations. Measurements of NF<sub>3</sub> and some major HFCs for the year 2023 at AGAGE stations linked to the PARIS project, including the new measurement at Taunus Observatory as well as measurements from the new continuous site at Capo Granitola and from the flask stations at Birkenes, Cabauw and Hégyhátsal.

D3.2 – Full year of F-gas data, uploaded to the ICOS portal – 1<sup>st</sup> round



**Figure 3:** Full year of extended F-gas observations. Measurements of SF<sub>6</sub> and some major HFCs for the year 2023 at AGAGE stations linked to the PARIS project, including the new measurement at Taunus Observatory as well as measurements from the new continuous site at Capo Granitola and from the flask stations at Birkenes, Cabauw and Hégyhátsal.

Especially for SF<sub>6</sub>, it is clearly visible that more pollution events with enhanced mixing ratios are observed at Taunus Observatory than at other stations. This shows that Taunus Observatory is a site which is well suited to derive atmospheric emissions. These enhancements have been linked to emissions from a factory in South-western Germany (Meixner et al., 2025).

### D3.2 – Full year of F-gas data, uploaded to the ICOS portal – 1<sup>st</sup> round

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## Atmospheric station results archive: European AGAGE network, UK DECC network, Cabauw tall tower, additional PARIS project sites

1987-01-23–2025-04-01

Metadata No preview available

**Under moratorium**  
This dataset will be available for download after 2026-04-01 00:00:00 (UTC)

**DOI** 10.18160/KS1-GFYB (target, metadata) [↗](#)  
11676/ai-KaoorRgyjzWY\_EM56UwB (link)

**PID**

**Description (Abstract)** These data are a combination of data from the European stations of the AGAGE Network (<https://www-air.larc.nasa.gov/missions/agage/>), the UK DECC network (<https://catalogue.ceda.ac.uk/uuid/081a5ec3884441398aa2daae53a6189b>) and additional data which are part of the EU project PARIS (GA 101081430, <https://horizon.europa-paris.eu/>). This dataset extends and replaces the earlier version (<https://doi.org/10.18160/2XV6-8Z9S>), both in temporal (1987/01/23 to 2025/04/01) and spatial dimensions (with the addition of the following sites: HUN, BIR, ZSF, CGR, TTA, SIS). All data have been quality controlled, but in the case of the AGAGE stations only part of the data have undergone the whole AGAGE data review process. Data from these AGAGE stations that is included within this archive should only be used in order to produce inversions for comparison with the PARIS inversions for which these data are the basis. Please refer to the original AGAGE data files (accessible through <https://www-air.larc.nasa.gov/missions/agage/data/>) if you want to use AGAGE data in a scientific study and follow the AGAGE data policy which can be found under <https://www-air.larc.nasa.gov/missions/agage/data/policy>.

**Temporal coverage from (UTC)** 1987-01-23 13:57:00  
**Temporal coverage to (UTC)** 2025-04-01 00:00:00

**Data affiliation** Miscellaneous

**Citation** Engel, A., Wagenhäuser, T., Meixner, K., Schuck, T., Stanley, K., O'Doherty, S., Wenger, A., Pitt, J., Young, D., Grant, A., Say, D., Rigby, M., Ganesan, A., Stavert, A., Arnold, T., Rennick, C., Safi, E., Chung, E., Kikaj, D., Spain, G., Wisner, A., Garrard, N., Vollmer, M., Reimann, S., Arduini, J., Maione, M., Lunder, C., Hermansen, O., Schmidbauer, N., Frumau, A., van den Bulk, P., Couret, C., Molnár, M., Haszpra, L., 2026. Atmospheric station results archive: European AGAGE network, UK DECC network, Cabauw tall tower, additional PARIS project sites. <https://doi.org/10.18160/KS1-GFYB>

**Bibtex**  
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**File name** PARIS\_WF3\_F-GAS\_obs\_2025-07-04.zip

**File size** 362 MB (380017039 bytes)

**Data type** Atmospheric measurement archive

**Data level** 2

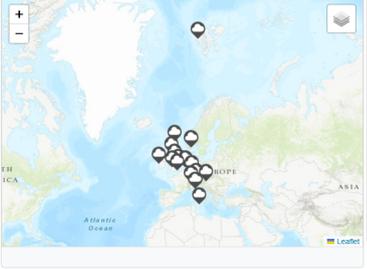
**Licence** ICOS CCBY4 Data Licence

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**File made by** Joseph Pitt

**Production time (UTC)** 2025-09-24 12:00:00

**Contributors** Andreas Engel, Thomas Wagenhäuser, Katharina Meixner, Tanja Schuck, Kieran Stanley, Simon O'Doherty, Angelina Wenger, Joseph Pitt, Dickon Young, Aoife Grant, Daniel Say, Matthew Rigby, Anita Ganesan, Ann Stavert, Tim Arnold, Chris Rennick, Emmal Safi, Edward Chung, Dafina Kikaj, Gerard Spain, Adam Wisner, Nicholas Garrard, Martin Vollmer, Stefan Reimann, Igor Arduini, Michela Maione, Chris Lunder, Ove Hermansen, Norbert Schmidbauer, Arnaud Frumau, Pim van den Bulk, Cédric Couret, Mihály Molnár, Leszlo Haszpra



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**Keywords** [ATMOSPHERE](#) • [F-GAS](#) • [HALOCARBONS](#) • [PARIS](#)

## 4.4 Conclusion and possible impact

The milestone has been reached. The new continuous Taunus observatory data are of very high quality comparable to other AGAGE sites and due to the location of Taunus Observatory close to possible emissions, it is well suited to identify ongoing emissions of F-gases in Europe. It is therefore a well suited extension of the European observational network. The additional flask data and the continuous data from Capo Granitola are processed and provided routinely now. The whole two years of data have undergone a critical data review and are submitted to the ICOS carbon portal.

## 4.5 References

Meixner, K., Wagenhäuser, T., Schuck, T. J., Alber, S., Manning, A. J., Redington, A. L., Stanley, K. M., O'Doherty, S., Young, D., Pitt, J., Wenger, A., Frumau, A., Stavert, A. R., Rennick, C., Vollmer, M. K., Maione, M., Arduini, J., Lunder, C. R., Couret, C., Jordan, A., Gutiérrez, X. G., Kubistin, D., Müller-Williams, J., Lindauer, M., Vojta, M., Stohl, A., and Engel, A.: Characterization of German SF<sub>6</sub> Emissions, ACS ES&T Air, 2, 2889-2899, 10.1021/acsestair.5c00234, 2025.

## 5. History of the document

Version	Author(s)	Date	Changes
1	Andreas Engel	30.01.2026	