Data
Models
Inventories

PARIS

Process Attribution of Regional Emissions

GA 101081430, RIA

Complete calendar year of extended and quality-controlled F-gas data uploaded to the ICOS portal

M37			
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Horizon Europe Cluster 5: Climate, energy and mobility

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Table of content

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

While the report was delivered with delay, the relevant data were uploaded to the ICOS Carbon Portal on time for use in the associated inverse modelling tasks.

2. Dissemination and uptake

The data collected/produced as part of this milestone are relevant for the production of the Annex reports in WP2. As such they have been shared with the relevant project partners prior to the completion of the respective deliverables. Final data products are all available publicly on the ICOS Carbon Portal for use by other scientists and practitioners. They are embargoed in order to assure that AGAGE data are not distributed prior to the official data release.

3. Short Summary of results

Atmospheric observations of F-gas mole fractions from the site directly supported by the PARIS project (Hegyhátsál (Hungary), Taunus (Germany), Birkenes (Norway) and Capo Granitola (Italy) as well as the existing AGAGE data and the flask data from Cabauw (The Netherlands) have been compiled and submitted to the ICOS carbon portal (https://meta.icos-cp.eu/objects/uI-KaooRRgyJcWY_EM56UwI8).

All data have been critically quality controlled through common data review meetings.

4. Evidence of accomplishment

The data are available for download from the ICOS Carbon Portal under the following download link: (https://meta.icos-cp.eu/objects/uI-KaooRRgyJcWY_EM56UwI8, see Fig. 1)

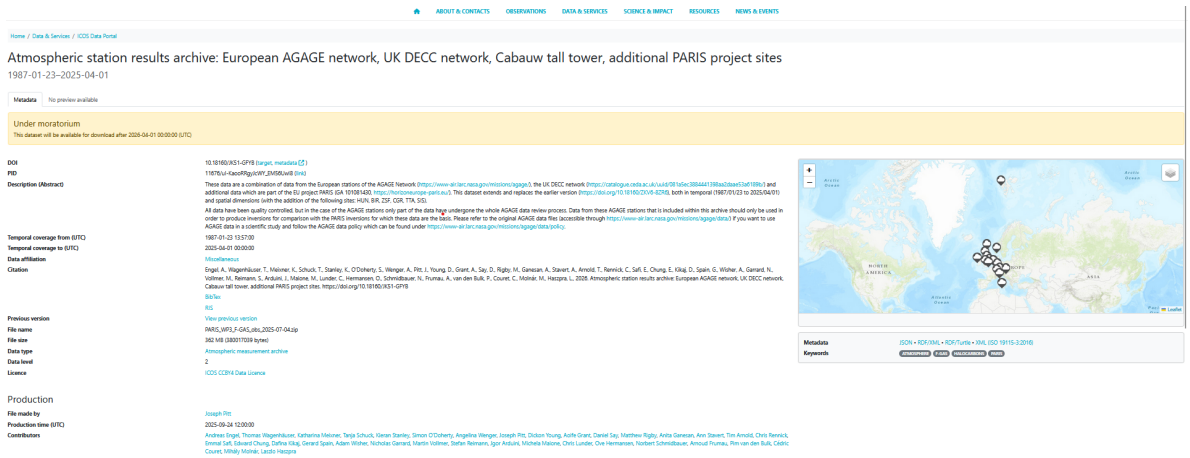

Fig. 1: Data landing page for F-gases uploaded to the ICOS Carbon Portal

4.1 Introduction | Background of the milestone

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_3, SF_6. Any reference to F-gases in this context refers to this list unless otherwise specified.

Despite their smaller emissions compared to major greenhouse gases like CO_2, CH_4, and N_2O, 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_2O. 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 caps 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, Hégyhátsal) and the flask measurements site at Cabauw (the Netherlands) whichh is continued under PARIS. Data from all these stations are included in this second data release from the PARIS project.

4.2 Scope of the milestone

This milestone forms the basis for the inverse modelling results and are in turn used in the draft Annexes provided to the national inventory teams for their 2026 reporting to the UNFCCC (D2.3).

4.3 Content of the deliverable | milestone

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_3, SF_6), 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 the corresponding deliverable report

4.4 Conclusion and possible impact

The availability of the data and the high quality is a prerequisite for the inversions and the top-down estimates of the emissions which are provided to the National inventory reporting teams.

4.5 References

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5. History of the document

Version	Author(s)	Date	Changes
1.0			