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Author(s)	Lise Eder Murberg (NILU), Damien Boulanger (CNRS), Ute Karstens (ICOS), Alex Vermeulen (ICOS), Véronique RIFFAULT (IMT)
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## Introduction

The ATMO-ACCESS project is coming to an end. In this deliverable the final list of VA services contributing to the RI's catalogue of services is compiled from the outcome of VA activities. These activities include a Virtual Access Portal, a Homeless Data Portal, Footprint analysis and Time series analysis tools, a MOOC, tutorial videos, a serious game, and Cal/Val activities. The first four services were developed in "WP5: Developing and optimally integrating online data and computing services", the next three in "WP4: Developing and optimally integrating joint training services" and the Cal/Val activity, which was co-developed together with the stakeholders EUMETSAT and ESA as a joint effort between TNA and VA (WP9 and WP10).

Information on the development of training services can be found in D4.3 (<https://hal.science/hal-05206923v1>) for the first MOOC edition, and [D4.4 - Serious game, tutorial videos and second version of MOOC implemented and publicly available](#) for the Serious game, tutorial videos and second version of MOOC.

Technical descriptions of each service in operation from WP5 can be found in [D5.3 - Report describing data curation service](#), [D5.4 - The ATMO ACCESS Footprint service VRE](#), [D5.5 - Report describing Time series analysis VRE](#). An analysis of the cross-RI services is described in [D5.8 - Analysis of the cross-RI digital services](#), and the final data management plan in [D5.9 - Final Data Management Plan for data from TNA activities and recommendation for the future](#).

The long-term strategy can be found at [D10.3 - Report on long-term strategy of VA activities and the new services in ATMO-ACCESS, taking into account the tools developed in WP5 and their best usage for science, management and outreach](#), which highlights the long-term strategy of several of the services and includes recommendations for the services usage in terms of science, management and outreach.

Statistics on the use of several of the VA services can be found in [D10.1 - First report with feedback from users and statistics on use of the services](#), [D10.2 - Second report with feedback from users and statistics on use of the services](#) and D10.6 - Third report with feedback from users and statistics on the use of the service (in progress).

## List of VA services in ATMO-ACCESS

VA service	Link
<b>ATMO-ACCESS Virtual Access Portal</b>	<a href="https://www.atmo-access.eu/virtual-access/#/">https://www.atmo-access.eu/virtual-access/#/</a>
<b>Homeless data portal</b>	<a href="https://homeless-data-portal.nilu.no/">https://homeless-data-portal.nilu.no/</a>





<b>Footprint analysis tool for greenhouse gases, aerosols, reactive trace gases</b>	Greenhouse Gas Footprints	STILT creator: <a href="https://stilt.icos-cp.eu/worker/#">https://stilt.icos-cp.eu/worker/#</a>
		STILT viewer: <a href="https://stilt.icos-cp.eu/viewer/#">https://stilt.icos-cp.eu/viewer/#</a>
		FLEXPART request: <a href="https://www.icos-cp.eu/form/flexpart-footprint-request">https://www.icos-cp.eu/form/flexpart-footprint-request</a>
	Tropospheric vertical gradients	<a href="https://permalink.aeris-data.fr/atmo-access-footprint">https://permalink.aeris-data.fr/atmo-access-footprint</a>
	Aerosol distribution and source analysis	<a href="https://flexpart-request.nilu.no/">https://flexpart-request.nilu.no/</a>
<b>Time series analysis</b>		<a href="https://permalink.aeris-data.fr/atmo-access-timeseries">https://permalink.aeris-data.fr/atmo-access-timeseries</a>
<b>Massive open online course (MOOC)</b>	1 <sup>st</sup> edition	NA
	2 <sup>nd</sup> edition	<a href="https://www.atmo-access.eu/massive-open-online-course-mooc/">https://www.atmo-access.eu/massive-open-online-course-mooc/</a> OR <a href="https://www.fun-mooc.fr/fr/cours/atmospheric-research-infrastructures-sharing-the-future-of-our-a/">https://www.fun-mooc.fr/fr/cours/atmospheric-research-infrastructures-sharing-the-future-of-our-a/</a>
<b>Tutorial videos</b>	"Watch the ultimate guide for this MOOC"	<a href="https://www.youtube.com/watch?v=BKFPwgCiwBs">https://www.youtube.com/watch?v=BKFPwgCiwBs</a>
	"High resolution online quantification of trace metals in particulate matter using the Xact®"	<a href="https://www.atmo-access.eu/tutorial-videos/">https://www.atmo-access.eu/tutorial-videos/</a>



	"A step-by-step tutorial video for the time series analysis in ATMO-ACCESS"	
	"VolcPlume Portal tutorial video"	
<b>Serious game "What's going on in the air?"</b>		<a href="https://www.atmo-access.eu/serious-game-whats-going-on-in-the-air/">https://www.atmo-access.eu/serious-game-whats-going-on-in-the-air/</a>
<b>Cal/Val</b>	ESA EarthCARE Cloud and Aerosol products	NA (report written for ESA)
	EUMETSAT Aerosol products	NA (report written for EUMETSAT)
	EUMETSAT Cloud products	NA (report written for EUMETSAT)

## ATMO-ACCESS Virtual Access Portal

The ATMO-ACCESS Virtual Access (VA) Portal serves as the central entry point to all online services developed within the project. After logging in, required for usage statistics and feedback collection, users can access tools for data curation of homebased data, trajectory and footprint analysis (including RI-specific tools for ICOS, IAGOS, and ACTRIS), time series analysis, MOOC, tutorial videos and a serious game.



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Home Contacts Documentation ATMO-CONNECT  
PROJECT ACCESS FACILITIES EVENTS & OUTREACH NEW CALLS ALERT!

# Virtual Access Portal

Use Edit\_Murberg   [GIVE FEEDBACK](#)



## ATMO-ACCESS Virtual Access Portal

This portal provides you with access to the new online services developed in the ATMO-ACCESS project. This includes access to:

- **Homeless data portal:**  
A portal for submission of measurement data from research projects, not associated to any long-term projects/networks nor sustainable data centres.
- **Footprint analysis tool for greenhouse gases, aerosols, reactive trace gases:**  
Model tools for interpretation of measurement data both measured at the ground and from aircrafts. You can request model runs to produce data products (e.g. footprint, source contributions) for your decided locations, or search and use the already produced products.
- **Time series analysis:**  
Identify, utilize and combine data more effectively across RIs and data repositories, including data coverage, collocation of data and visualisation of data.
- **Massive open online course (MOOC)**  
Online course 'Atmospheric Research Infrastructures: Sharing the future of our atmosphere'.
- **Serious game**  
Game 'What's going on in the air?'
- **Tutorial videos**  
Explore Cutting-Edge Tools in Atmospheric Science through the ATMO-ACCESS tutorial series! These tutorials will enhance your understanding and use of the following advanced atmospheric research tools.



Data curation of homeless data



Trajectory and footprint analysis



Tools for analysing time series



Online training services

Figure 1: Screenshot of the Virtual Access Portal after login. The portal links to the Homeless Data Portal, Footprint analysis and trajectory tools, Time Series Analysis and Online training services such as MOOC, Serious Game and Tutorial videos. There is a feedback button and a QR code for easy access to the page when used in presentations.

## Homeless data portal

The Homeless Data Portal is a dedicated data curation service designed to ensure long-term storage, quality control, and visibility of atmospheric measurement data that would otherwise remain outside research infrastructure (RI) workflows. Such “homeless data” typically originate from short-term research campaigns, projects, or TransNational Access (TNA) activities that are not connected to existing sustainable data centres. Through the portal, scientists can request support for curation and archiving, while RI experts provide training, curation tools, quality checks, and integration into long-term FAIR-compliant databases. Each curated dataset is assigned a Persistent Identifier (DOI), enabling proper citation and long-term discoverability.

By routing user requests seamlessly to the relevant RI, the portal strengthens cross-community data sharing while remaining tailored to RI-specific practices. The service supports both data custodians, by ensuring recognition, visibility, and accountability, and the wider research







community, by making valuable datasets accessible, reusable, and well-documented for future scientific use.

## ATMO-ACCESS Homeless Data Portal

The Homeless data portal is a portal for data curation of atmospheric measurement data. The portal is set up to serve scientists producing atmospheric measurements and time series resulting from research campaigns and TNA activities that are normally not included into any data management and data curation system and activity. These data sets are "homeless data", not associated with any long-term projects nor sustainable data centers. The goal of the portal is to make more data available to the end-user, as well as providing benefits for data collectors in terms of usage tracking and access to RI (Research Infrastructure) specific tools for curation and data access.

All request for data curation and archiving services will be handled by a relevant research infrastructure. You will be contacted by e-mail after your request.



To keep them free for you, ATMO-ACCESS deeply values feedback from users. We hope you will spend a few minutes on this feedback schema to feed our requested usage monitoring. Your opinions and feedback will help the ATMO-ACCESS team to understand what we're doing well and where we need to get better. The feedback will be used by the VA management and the development team, in strategic decision and project coordination.

[Feedback form](#)

### Data Archiving and Curation



Apply for data curation and archiving services through the atmospheric RIs

[Access Services](#)

### Data Access



Search ATMO-ACCESS related data from TNA and campaign activities

[Search Data](#)

### General Support



Send a request if you have questions regarding the data in ATMO-ACCESS

[Get Support](#)

Figure 2: Screenshot of the Homeless Data Portal. The page includes a workflow chart, the feedback form and links to pages for data archiving and curation requests, data access and FAQ and support.



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## Footprint analysis tool for greenhouse gases, aerosols, reactive trace gases

The ATMO-ACCESS Footprint Service provides emission sensitivity footprints for user-defined locations, together with modelled aerosol and trace gas distributions and source attribution analyses. The available services depend on the components and observation platforms the user selects, ensuring that the outputs best reflect the specific conditions of their study. We provide tools to preview and download a variety of requested footprint data products.

### Greenhouse Gas Footprints

The ICOS Footprint Analysis Service for greenhouse gases provides a comprehensive platform for analyzing and visualizing greenhouse gas concentrations and their source footprints at ground-based stations across Europe. The service includes the STILT Results Viewer, which enables users to access and explore footprint data stored in the repository. Users can visualize the footprints as animations, paired with modeled CO<sub>2</sub> or CH<sub>4</sub> concentrations and contributions from various source categories. For ICOS stations and some selected European stations, measured concentrations are also available, allowing for direct comparisons with model outputs. Results can be packaged and downloaded directly for the selected station and period. Results are available for CO<sub>2</sub> and CH<sub>4</sub>.







## STILT results viewer

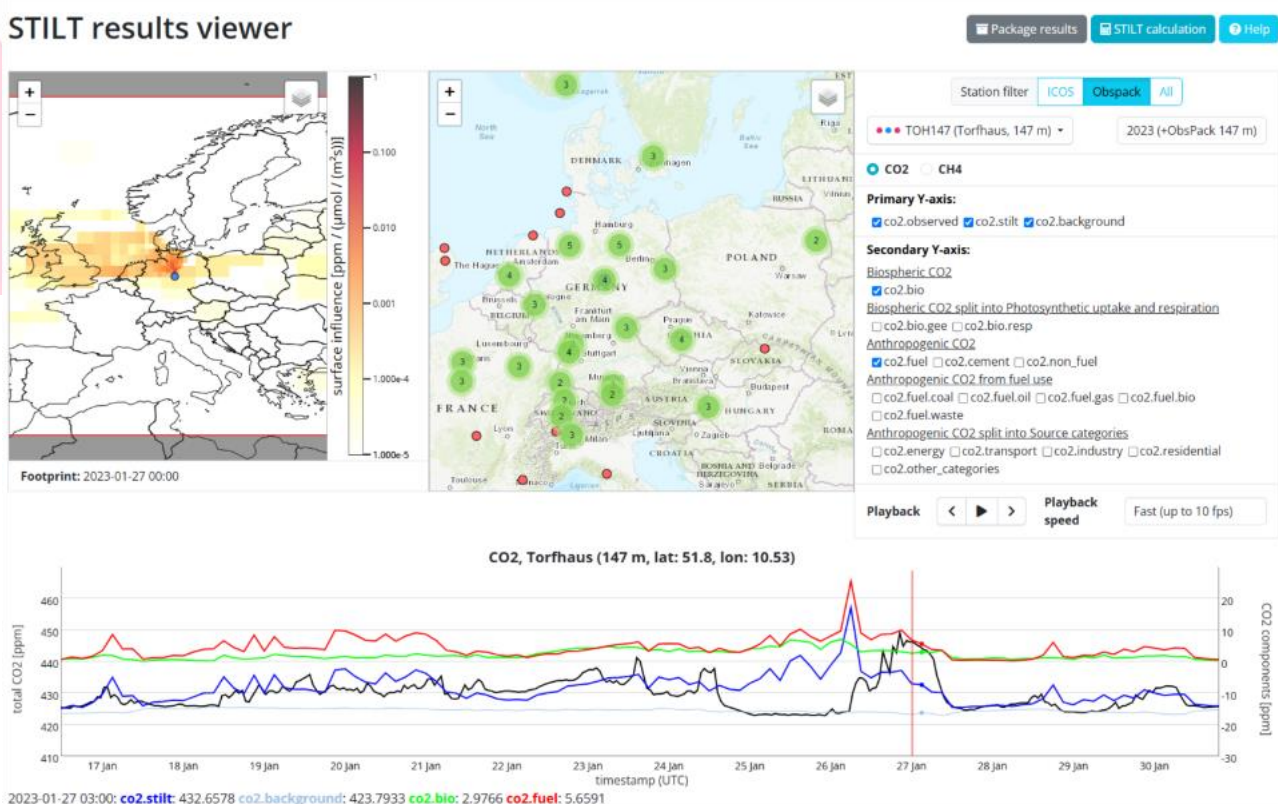


Figure 3: STILT viewer, here showing results available for stations for which Obspack observations exist. Selected is Torfhaus station for a measurement height of 147 m (above ground) and the year 2023. The user zoomed in to a period in January and can compare modelled and measured CO<sub>2</sub> values over the plot while at the same time the corresponding footprint is shown. Animations over time are also possible. Contributions from different source categories can be shown, next to measured and global background values.

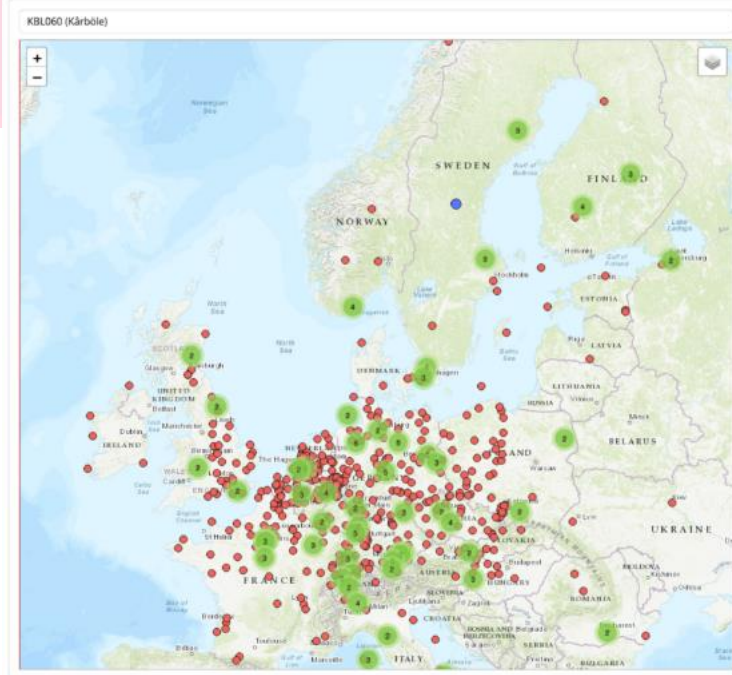
Additionally, the service offers a STILT Calculation Service, which allows users to initiate new STILT model runs for specific locations within the model domain. This feature requires users to input details such as station ID, name, and country, ensuring that the outputs are relevant and tailored to specific research needs. By supporting both pre-calculated and on-demand model results, the service provides flexibility for diverse research applications. The ICOS Footprint Analysis Service plays a crucial role in helping researchers understand greenhouse gas dynamics and source contributions, making it an essential tool for environmental science and monitoring.



## STILT calculation service Job starter

STILT viewer Help

### Existing STILT stations



### Start new STILT run

Site id (letter code + altitude)  
KBL060 [Load data](#)

Site name  
Kärböle

ICOS station id

Country code  
SE — Sweden

Latitude (decimal degree)  
61.94

Longitude (decimal degree)  
15.48

Altitude above ground (meters)  
60

Start date (YYYY-MM-DD)

End date (YYYY-MM-DD)

Start date missing: Stop date missing

[Submit STILT job](#)

### Submitted STILT jobs

[Show details](#)

Finished computations
Site 'BUC030' (2022-01-01 - 2023-12-31)
Site 'KBL060' (2023-01-01 - 2023-12-31)
Site 'ARN010' (2017-01-01 - 2017-02-01)
Site 'TOH076' (2018-01-01 - 2023-12-31)
Site 'TOH110' (2018-01-01 - 2023-12-31)
Site 'TOH010' (2018-01-01 - 2023-12-31)
Site 'TOH147' (2018-01-01 - 2023-12-31)
Site 'LUT' (2006-12-06 - 2006-12-07)
Site 'LUT' (2025-01-22 - 2025-01-23)
Site 'LUT' (2025-01-22 - 2025-01-23)
Site 'HAU005' (2023-04-07 - 2023-06-27)
Site 'CMN760' (2018-01-01 - 2022-12-31)
Site 'CLU100' (2024-01-01 - 2024-12-31)
Site 'CLU100' (2023-01-01 - 2023-12-31)
Site 'CMN_test' (2023-06-01 - 2023-06-30)
Site 'CMN760' (2023-06-01 - 2023-06-30)
Site 'GRO200' (2023-05-08 - 2023-05-16)
Site 'LMT' (2006-01-12 - 2023-12-31)
Site 'STR' (2006-01-12 - 2023-12-31)
Site 'CZR' (2006-01-12 - 2023-12-31)
Site 'SMR127' (2018-07-03 - 2018-07-10)
Site 'SMR127' (2024-07-20 - 2024-07-22)
Site 'PDM' (2006-01-18 - 2006-08-24)
Site 'CGR' (2006-01-12 - 2013-12-31)
Site 'CGR' (2023-01-01 - 2023-12-31)
Site 'OST' (2020-01-01 - 2020-01-31)

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[Give us Feedback](#)



Legal mentions

This project has received funding from the European Union's Horizon 2020 research and innovation programme through the ATMO-ACCESS Integrating Activity under grant agreement No 101008004.  
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Figure 4: STILT calculation service to start on-demand calculations of new footprints for any known or new station.

The ICOS greenhouse gas footprint service also allows users to request a set of FLEXPART footprint calculations for one or more stations and specified time intervals through a simple web form. These requests are handled manually, and results are packaged according to the user preferences.



## Tropospheric vertical gradients

The IAGOS footprint analysis service combines the viewer of FLEXPART footprints and modelled SOFT-IO CO contributions and allows users to explore tropospheric vertical profiles of carbon monoxide mixing ratios (measured by IAGOS) in conjunction with source attribution data (calculated using the SOFT-IO model). The vertical profiles are from airports visited by commercial aircrafts equipped with IAGOS' instrumentation. The SOFT-IO model is based on the coupling of FLEXPART backward footprint (with the receptor points located along the profile) with emission inventory databases. The service provides a visualization of the above-mentioned data via a simple, attractive user interface.

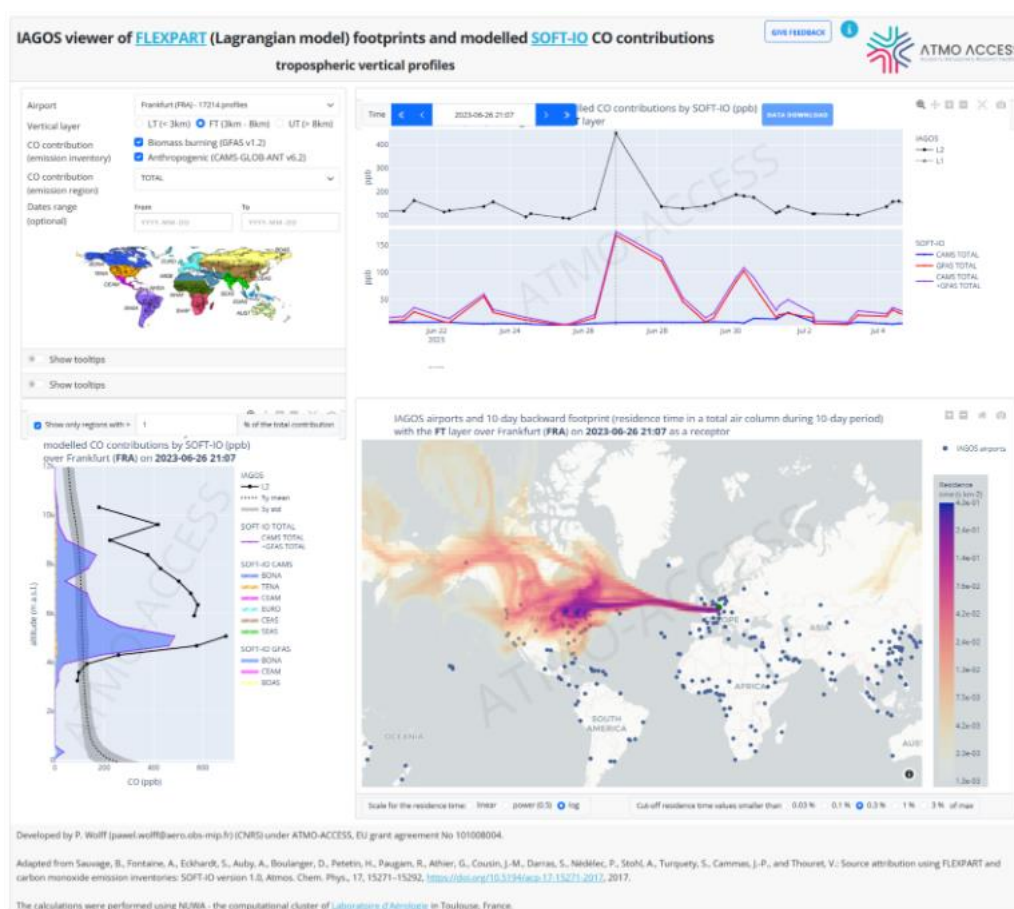


Figure 5: Screenshot of the IAGOS footprint viewer showing analysis of the 26 June 2023 event where wildfires from Eastern Canada caused elevated CO levels at the middle and upper troposphere detected by IAGOS and the SOFT-IO model above Frankfurt airport.

## Aerosol distribution and source analysis

The FLEXPART Aerosol Distribution and Source Analysis service provides advanced modelling tools to interpret ground-based aerosol and trace gas observations. Using the FLEXPART (FLEXible PARTicle dispersion) model, the service offers two modes of access: users can request customized model runs, by specifying location, timeframe, and product type, or directly explore



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pre-computed datasets through the online station map (<https://flexpart-request.nilu.no/data-access>) Products include air mass trajectories, footprint emission sensitivities, and sector-based source contributions, which are particularly valuable for analysing black carbon, dust, and microplastics.

The service supports both retrospective (up to 20 days backward, with long-term datasets from 2010 onwards) and near-real-time analyses, providing 3-hourly resolution footprints and 1-day forecasts. Tailored products are available for specific applications, including dust events, black carbon from defined sectors or campaigns, land-use change impacts, and microplastic measurements. These datasets are widely used in the research community, contributing to peer-reviewed publications and enabling advanced source attribution studies.



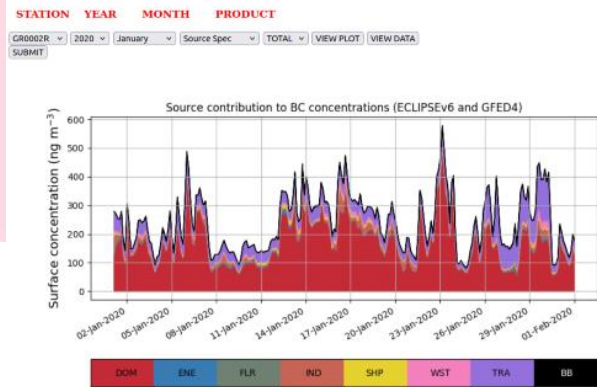






## FLEXPART products for BC measurements

For support and more information please submit a request here: <https://flexpart-request.nilu.no/support>



## FLEXPART products for BC measurements

For support and more information please submit a request here: <https://flexpart-request.nilu.no/support>

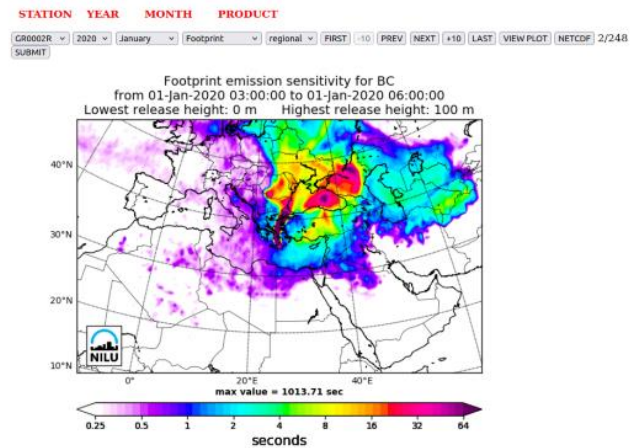


Figure 7: An example FLEXPART product, here for Black Carbon at station Finokalia (GR) for January 2020, showing calculated concentrations and contributions from the different source categories as well as footprint emission sensitivity at a 3 hour time interval.

## Time series analysis

The Time Series Analysis service provides users a tool to identify, use and combine data across RIs and data repositories. It aims at serving a large variety of users (students, academics, private or public organizations, NGOs, communities of projects, etc.) by providing a dedicated Virtual Research Environment (VRE) for facilitating their exploration of multiple in situ datasets with long time series of different variables. The service makes accessible the most commonly used basic metrics (e.g. means, percentiles) and statistical analysis (e.g. trends), as well as visualization tools to look at e.g. 2D or 3D scatter plots. The combination of different variables important for climate and air quality recorded by ACTRIS, IAGOS and ICOS allows users to explore relevant cross-cutting issues.





## Time-series analysis

0. Information 1. Search datasets 2. Select datasets 3. Filter data 4. Data analysis

GIVE FEEDBACK



Exploratory analysis Trend analysis Multivariate analysis

Variables

☐ Select all / none

- ☒ co2\_ICOS\_1h\_Weybourne\_10.0 : CO2 (dry air mole fraction)
- ☒ co2\_ICOS\_1h\_Svartberget\_150.0 : CO2 (dry air mole fraction)
- ☒ co2\_ICOS\_1h\_Billsdale\_248.0 : CO2 (dry air mole fraction)
- ☒ O3\_IAGOS\_1D\_Roissy\_layer=PBL : Daily median of ozone mixing ratio
- ☒ H2O\_gas\_IAGOS\_1D\_Roissy\_layer=PBL : Daily median of water vapor volume mixing ratio
- ☒ RHL\_IAGOS\_1D\_Roissy\_layer=PBL : Daily median of relative humidity (Liquid Water)
- ☒ air\_temp\_IAGOS\_1D\_Roissy\_layer=PBL : Daily median of air temperature

Analysis method

☒ Mean and standard deviation

☐ Percentiles

☐ Moving average

Parameters

Aggregation period:

☐ day

☒ week

☐ month

☐ season

☐ year

Minimal sample size for period: 1

☒ Show standard deviation with ☒ fill ☐ error bars



Figure 8: In the final Data analysis step one can further explore the dataset, and show aggregated data by day, week, month, season and year, and perform a trend analysis as shown for CO2 below.

## Massive open online course (MOOC)

The MOOC *Atmospheric Research Infrastructures: Sharing the Future of Our Atmosphere* introduces learners to key atmospheric processes and the role of European Research Infrastructures (RIs) in tackling air pollution and climate change. The course is structured over two weeks, with interactive videos, quizzes, and supplementary resources designed to provide both foundational knowledge and insights into cutting-edge research facilities.

The first week focuses on atmospheric science fundamentals. Learners explore the links between air pollution and climate change, the role of aerosols and clouds, the impact of greenhouse gases, and the importance of infrastructures in monitoring these processes. Interactive quizzes and “To go further” materials help consolidate understanding and encourage critical thinking about scientific and policy challenges.

The second week shifts toward research infrastructures themselves. Dedicated modules present ACTRIS, IAGOS and ICOS. These modules highlight how coordinated European infrastructures generate high-quality data, support international collaboration, and contribute to policy-making and climate strategies. Interviews with scientists from each RI give learners a behind-the-scenes view of their work, motivations, and the broader impact of their research.





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In response to feedback from the first edition, the second edition improved accessibility and interactivity. Interviews and Q&A sections were embedded within the learning path, subtitles and navigation features were enhanced, and new exercises were introduced to foster engagement. A revised final graded quiz ensures fair evaluation, while a short “Ultimate Guide” tutorial video was added to help participants navigate the MOOC effectively. Learners also gained access to a new video on atmospheric simulation chambers (an area not fully covered in the pilot edition) along with links to additional virtual resources developed in ATMO-ACCESS.

Altogether, the MOOC combines interactive teaching, expert insights, and practical examples to give students, early-career researchers, and professionals a comprehensive introduction to atmospheric research infrastructures and their central role in understanding and addressing climate and air quality challenges.

## Tutorial videos

Three tutorial videos were developed and aimed at exploring innovative, sustainable training methods beyond traditional access, laying the groundwork for future digital training initiatives within the atmospheric research community. One additional tutorial was part of the second edition of the MOOC (described above) and provided guidance and useful tips for better engagement of the learners.







**High-resolution online quantification of trace metals in particulate matter using the Xact®**  
*Instructor & Presenter: Khanneh Wadinga Fomba*  
Explore the Xact instrument inside & outside  
Uncover its power with clear step-by-step guidance of its intuitive software



**TROPOS**  
Leibniz Institute for Tropospheric Research



**A Step-by-Step Tutorial Video for the Time Series Analysis in ATMO-ACCESS**  
*Presenter: Hannah Clark*  
Dive into the Time Series Analysis service  
Learn how to effectively access & analyse the RIS observational data



**Laero**  
Laboratoire d'Aérodynamique

**Coming soon**



**VolcPlume Portal tutorial video**  
*Instructor & Presenter: Marie Boichu*  
Unleash the power of the VolcPlume platform  
Detect & analyse volcanic plumes with clear instructions & a real-case study integrating satellite, ground-based remote sensing & in situ observations



**LOA**  
Laboratoire d'Observatoire Atmosphérique

Figure 9: Tutorial videos offered in ATMO-ACCESS.

### “High resolution online quantification of trace metals in particulate matter using the Xact®”

This tutorial introduces the Xact® Ambient Continuous Multi-Metals Monitor 625i, used for real-time measurement of trace metals in particulate matter. It explains the importance and challenges of trace metal analysis, gives an overview of the instrument's internal and external components, and provides a step-by-step guide to its operation. A demonstration of the ADAPT software is included, and the video concludes with a discussion of the instrument's benefits and limitations for atmospheric research.

### “A step-by-step tutorial video for the time series analysis in ATMO-ACCESS”

In this tutorial, the Time Series Analysis service developed in ATMO-ACCESS is presented. The video walks users through accessing datasets from ACTRIS, IAGOS, and ICOS, and demonstrates exploratory, trend, and multivariate analyses. It also shows how to navigate the platform interface, select and filter datasets, and use interactive visualization tools. Designed for hands-on learning, the tutorial allows viewers to follow the full workflow step by step.

### “VolcPlume Portal tutorial video”

This tutorial introduces the existing VolcPlume web platform for studying volcanic gas and particle emissions. The video demonstrates how to access, visualize, and analyze data using a multi-source, multi-scale approach. A real-case study of the Cumbre Vieja eruption on La Palma is used to illustrate the platform's features and its integration of satellite, ground-based, and in

situ observations. The tutorial highlights the platform's practical applications for research and operational purposes in areas such as air quality, climate science, and aviation safety.

## Serious game “What’s going on in the air?”

The serious game is an interactive educational tool, free to use, available in English, and aimed at students, researchers, professionals, and anyone interested in air quality and climate. It teaches aerosol science and remote sensing through a role-play scenario at the ATOLL observatory in Lille, France. Two central characters support the learning journey. Mauna, a scientific expert, acts as a mentor who poses questions and encourages players to think critically about atmospheric processes. Max, an observatory's technical support staff member, provides practical guidance with explanations and hints about scientific instruments. Together, they create a dynamic and supportive environment.

The game progressively introduces key concepts through short, interactive exercises. Players begin with the basics of aerosols and gradually build knowledge of remote sensing principles and instrumentation, focusing on sun photometers and LIDAR. Throughout the game, players learn to identify aerosol types and origins using backtrajectory analysis, interpret atmospheric backscatter profiles from LIDAR, and combine LIDAR and sun photometer data to estimate aerosol mass concentration profiles. All theoretical knowledge provided during the game is conveniently compiled in a digital pad, accessible at any time through the interface.

## Satellite Calibration and Validation

Three pilot activities provided the satellite organisations ESA and EUMETSAT with reliable access to accurate ground-based measurements from ACTRIS for calibrating and validating the corresponding satellite measurements of aerosol and/or cloud.

The pilot activities were implemented by co-design with the respective satellite agency, with automated ACTRIS data production, access and provision for requested products being enhanced to enable service provision in “near real time” mode or faster. Implementation used both TNA and VA resources, TNA for calibration activities at the national facilities and the central facilities, and VA for implementation at the Data Centre. The pilots demonstrated the potential for operational use of products from the ACTRIS network.

## Conclusion

The deliverable “Final list of VA services contributing to the RI's catalogue of services” presents the complete set of Virtual Access (VA) services developed within ATMO-ACCESS. These services are designed to enhance data access, analysis, training, and outreach across European atmospheric Research Infrastructures (RIs).





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Access to Atmospheric Research Facilities

The document outlines the VA Portal as the central entry point, giving users access to multiple services: the Homeless Data Portal for curation and long-term storage of campaign-based or “homeless” datasets; the Footprint analysis tools (ICOS, IAGOS, ACTRIS) for greenhouse gases, aerosols, and reactive trace gases; and the Time Series Analysis service to explore cross-RI datasets with basic statistics and visualization tools.

In addition to data tools, the deliverable includes training services: a MOOC, several tutorial videos, and a serious game designed to engage and educate diverse audiences. Finally, the Cal/Val services enabled satellite product validation (ESA EarthCARE and EUMETSAT aerosol and cloud products). Together, these services expand the accessibility, discoverability, and usability of RI data, supporting both scientific research and outreach.

