ATMO ACCESS
Access to Atmospheric Research Facilities

Analysis of long-term strategy of training and TNA related to the three access modalities

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1. Introduction

Transnational access (TNA) has been used within several European projects related to atmospheric research (e.g. ACTRIS, EUROCHAMP) to facilitate measurement campaigns, promote knowledge exchange, and support the education of early-career scientists across Europe. An integral aspect of these TNAs has been the training component, especially for young scientists. Historically, TNA was closely associated with physical access, for example, whereby instruments from different institutes were installed in a specific location, enabling scientists related to the respective instruments to learn from each other and establish personal connections. Physical access to training schools has also been a popular feature of past TNAs.

This report summarizes the activities performed in WP 4 of ATMO-ACCESS. First, it provides an overview of the status of training related to TNA at the beginning of ATMO-ACCESS, before the start of the project. Then the context of European research is considered. The report then summarizes the exercises and pilots related to training and the different access modes (physical, remote, hybrid, and virtual) related to the measurement and analysis of air quality and greenhouse gases. In-depth analysis of these activities is available in the respective delivery reports.

2. Reports on existing training components in transnational access

When the ATMO-ACCESS project and its training component in WP4 were devised, reducing the environmental footprint related to these trainings, which were mostly performed through physical access, was a very strong motivation for developing TNAs in a more sustainable way. However, during the recent Covid-19 pandemic, new remote access tools (such as Zoom, Webex, and MS Teams) became popular within the research community with no extra efforts. The landscape at the beginning of the project was analyzed by producing two reports on TNA for training activities: first, TNA and training related to physical access (D4.1: Report on existing training schemes in the atmospheric domain related to physical access); and second, TNA and training related to remote access (D4.2 Report on existing training schemes in the atmospheric domain related to remote access). These reports discussed the existing and future amounts of training related to physical and remote access (Figure 1). Before the pandemic, physical training dominated the TNAs in atmospheric sciences, related to access to research infrastructures (RI) and training schools. A large increase in numbers related to remote access was observed due to the Covid pandemic situation. Thus, training schools and specific training at central facilities, which would otherwise have been performed through physical access, have been executed remotely.

With all the new remote access tools available after the pandemic, it was concluded that the atmospheric community must critically evaluate whether the level of physical training related to TNA should return to pre-pandemic levels. Additionally, the potential of hybrid mode for all types of TNA within the atmospheric community should be explored.

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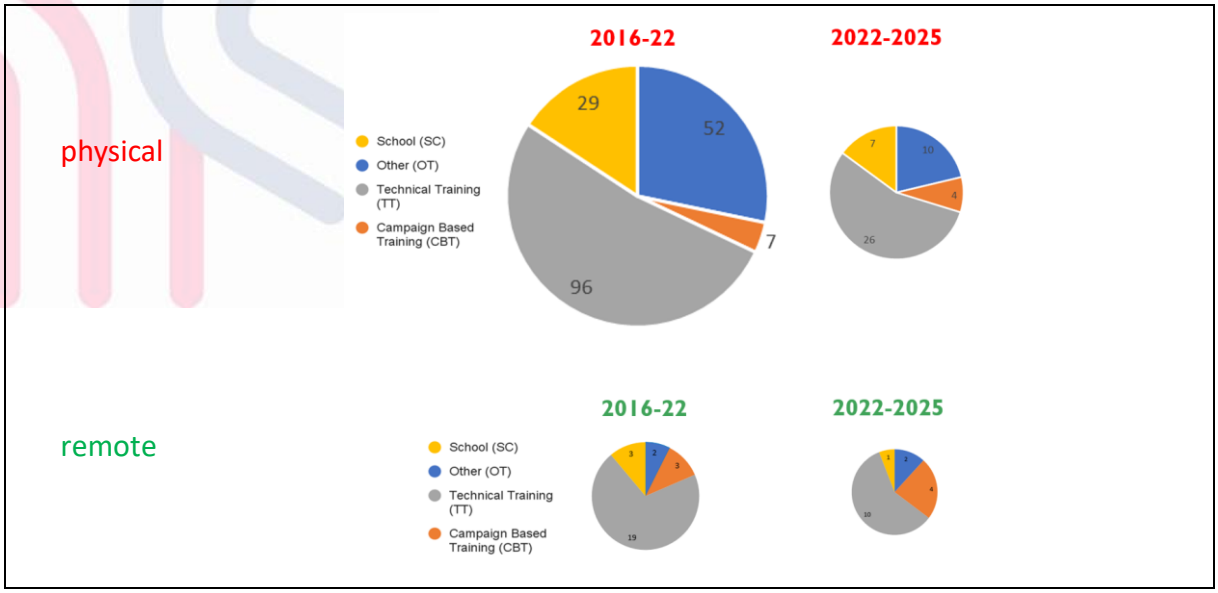

Figure 1: Status of historical and future physical and remote trainings related to TNA at the beginning of ATMO-ACCESS in 2021

3. Pilot TNAs for the three access modes, including hybrid

Figure 2 summarizes the three access modes (physical, remote, virtual) and illustrates the pilot test cases discussed in this report. These cases are related either to campaign-based training or broader training schools.

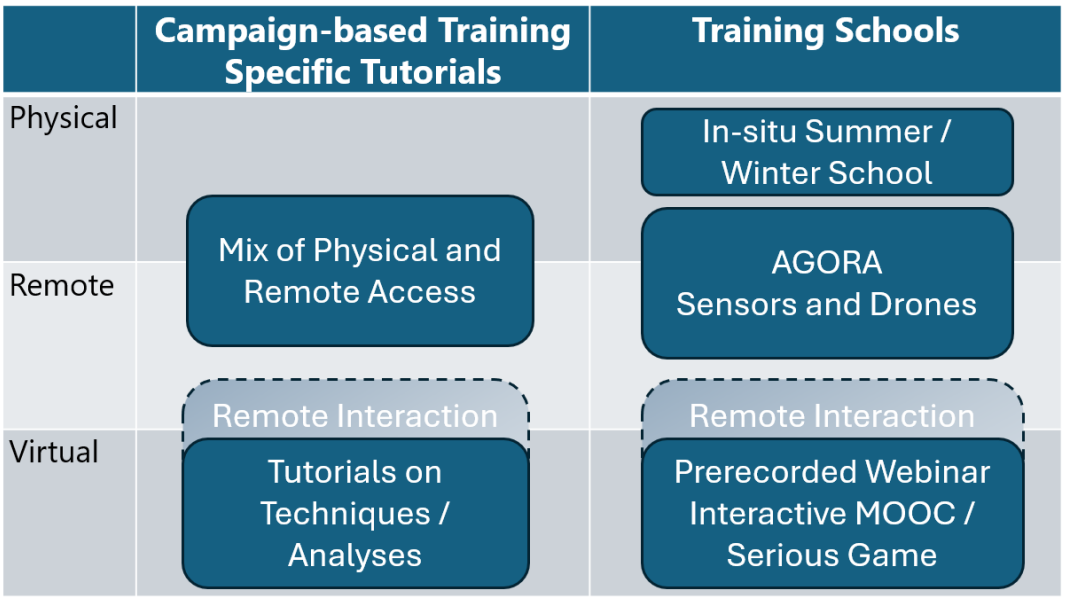

Figure 2: Individual trainings performed in ATMO-ACCESS during TNA-related campaigns and training schools. TNA-related trainings can be performed in physical, remote or virtual modes, as well as hybrid modes. Additionally, the potential of extending the value of virtual training through remote interaction is shown, as suggested in D.4.5 (Report on the long-term strategy of training and TNA related to the three access modalities).

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3.1. Campaign-based training (CBT)

In campaign-based training, trainees participate in campaigns at observation sites (national facilities) or exploratory platforms (mobile platforms or atmospheric simulation chambers). Training at central facilities is also discussed under CBT.

3.1.1 Training related to TNA at observation sites, mobile platforms and chambers

TNA at observation sites, mobile platforms and chambers offered a wide variety of possibilities for training, from hands-on instrument training and software and data management knowledge transfer. The user groups are typically students or early-career scientists. This training type was performed in the frame of the TNA WP (WP9) however the WP dedicated to training (WP4) tracked those TNAs, provided support in finding reviewers for those applications and helped design specific application forms.

In ATMO-ACCESS, campaign-based TNA was often performed in hybrid mode, as a mix of physical and remote access. Scientists were usually only on-site for the installation and deinstallation of instruments, and sometimes the instruments were shipped to the sites without scientists, with local researchers taking care of the instruments on-site. On one side, this was very cost-efficient in terms of the number of days spent on site, and, if travel was not included, was also ecologically beneficial. However, this approach poses a challenge in terms of training, as less time was spent on site, and it was practically impossible to receive on-the-job training and establish personal networks for future scientific collaboration.

3.1.2 Training related to TNA at Central Laboratories

TNA-related training at the Central Laboratories followed the same purpose as the campaign-based training. Here, scientists took advantage of instruments being shipped to the Central Laboratories (e.g. for recalibration) and received physical training in instruments and data handling. In terms of efficiency, it was recommended to combine several TNAs with training at the Central Laboratories or to perform training remotely. Related to this, also virtual training was developed related to Central Laboratories (see section 3.2.3)

3.2 Training Schools

Training schools are a very common, well-established way for training young scientists. There are several long-term training schools in atmospheric sciences (such as the Hyytiäla summer and winter schools), where both trainers and trainees are physically present. Within ATMO-ACCESS, we have tested new forms in which some trainers participated remotely or two independent training workshops were connected remotely, so that training beneficial for both parties could be shared. An important innovation in trainings schools related to atmospheric sciences was introduced with a MOOC (Massive Open Online Course) on Research Infrastructures connected to ATMO-ACCESS. Along with a webinar on cross-RI training, these trainings were used as pilots to test the virtual TNA.

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3.2.1 Physical Winter / Summer Schools

Physical training schools are a traditional method of training young scientists in measurement and sampling techniques, data analysis and scientific writing. During the COVID-19 pandemic, this form of training was not possible and was partly replaced by remote formats. After the restrictions ended, physical training schools resumed. While the added-value of physical interactions is clear, the environmental impact of travel to the site is a concern in view of environmental sustainability.

3.2.2 Hybrid Schools (combined physical and remote TNA)

The hybrid format was tested with two different approaches. First, the AGORA (Andalusian Global ObseRvatory of the Atmosphere) training school covered the characterization of atmospheric aerosols using in-situ and remote sensing techniques and second a hybrid workshop on sensors and drones commonly organized by EMPA (Switzerland) and the Cyprus Institute (Cyprus).

In AGORA, the training on Characterization of atmospheric aerosol using in situ and remote sensing technique lasted 3 weeks. After an initial remote interaction between students, the students moved to the AGORA observatory, where they followed the main part of the course, including lectures taught in person or remotely by the lecturers, and developed practical activities working with the observatory's instrumentation. The final phase of the summer school was conducted remotely again. The students principally approved of this format. In its first edition in Spring 2023, it gathered 21 students from 12 countries (including Spain, EU, US and Latin America). Further information can be found at that link: https://www.atmo-access.eu/agora-aerosol-training-course-characterization-of-atmospheric-aerosol-using-in-situ-and-remote-sensing-techniques/ and some pictures of the training are available in Figure 3 below.

From the feedback gathered from participants, this hybrid training had several advantages. It provided opportunities to interact with excellent researchers from around the world, and the face-to-face lectures and hands-on activities were well-received. The research projects and combination of in-situ and remote sensing aspects of the aerosol topic were also highlighted. The participants said that some virtual lectures could be improved, and time constraints led to exhaustion (also thinking of having lectures in different time zones). More time dedicated to physical interactions for research projects would be beneficial.

The first edition of AGORA has been repeated already once in 2024 and will be rerun in a bi-annual mode.

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Figure 3: Overview of the AGORA Training organized in June 2023 (hands on training on the left and lecture on the right).

Secondly, a hybrid workshop on sensors and drones was organized in November 2024. It combined training on sensors for measuring atmospheric trace gases in Switzerland with a workshop on using drones to measure these compounds in Cyprus. In this case, almost all the trainers participated remotely, and the lectures that covered common ground for both topics were shared (see Figure 4). Additionally, hands-on work was performed independently at both sites. More than 20 participants from 17 different countries including non-EU countries such as Lebanon, India, Pakistan, Turkey, Nigeria and Brazil attended the trainings. Some students were supported by ATMO-ACCESS TNA programme. This format proved to be a successful approach for linking the two communities in a very straightforward way. In this way, participants had the unique chance to learn more from the two schools and their specificities. The feedback gathered was very positive notably with regards to the interactions linked to the physical training and the interconnection between the two classes.

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Figure 4: Overview of the hybrid autumn schools organized November 2024 at EMPA and CyI: participants in Cyprus remotely connected to a presentation at EMPA.

3.2.3 Virtual Access

The global accessibility and continuous availability of virtual training tools are attractive means of knowledge transfer and strengthen the impact of the project beyond its end date and through global outreach. Here the different platforms where virtual access was provided are described.

3.2.3.1 Training videos

Three training videos have been created in relation to Central Laboratories: first, on the use of an X-act instrument for the online analysis of metals in aerosols (ACTRIS CAIS-ECAC); second, on the application of an online quality assessment tool for analyzing potential errors in VOC data (ACTRIS CiGAS); and third, on explaining the databases for atmospheric data (EBAS).
The corresponding videos are available through the following links:
https://www.youtube.com/watch?v=IcAF8oVRrro&ab_channel=ATMO-ACCESS
https://polybox.ethz.ch/index.php/s/uI9WdN81AluL7gO
https://www.youtube.com/watch?v=F18tegyCr-g

IMT (France) also produced two additional tutorials: one on the timeseries analysis service developed within ATMO-ACCESS; and the other on analyzing volcanic plumes through the VOLCPLUME platform which integrates various atmospheric data from in situ measurements, remote sensing and satellites (Figure 5) (https://www.atmo-access.eu/tutorial-videos/)

3.2.3.2 Pre-recorded webinars

Pre-recorded webinars are an excellent, low-level way to learn about a new field. Within the greenhouse gas community, ICOS offers an excellent series of webinars on various topics. Topics include training on ICOS atmospheric measurements and guidance on finding and using ICOS data through its web services. More information is available here:
https://www.icos-cp.eu/science-and-impact/education/recorded-workshops-and-webinars

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Within ATMO-ACCESS, the National Atmospheric Observatory Košetice (NAOK) in the Czech Republic provided an excellent multiday cross-RI webinar (featuring ACTRIS, ICOS, and EIRENE), with 16 lectures and 33 practical videos. It featured activities connected with research on atmospheric components (aerosol, trace gases and clouds, GHGs fluxes), environment pollutants (POPs), remote sensing applications and air quality in general. A special online format of the training workshop allowed the participants to manage each training day according to their learning pace and timing schedule. Moreover, practical videos showed all the details of daily routine work at the observatory. At the end of each training session, knowledge quizzes focused on specific topics to test the newly acquired skills of the participants. A total of 137 trainees from 39 countries (with India, Poland and Italy being the 3 countries with the most trainees) attended this event, which was distributed over the globe. This again demonstrates the impact of virtual training in engaging the international community. Most of the trainees were postgraduates. The course description is available at the following link: https://www.atmo-access.eu/atmospheric-and-environmental-research-infrastructure-online-training/

3.2.3.3 MOOC (massive open online course) and serious game

Within ATMO-ACCESS, IMT (France) was primarily responsible for the virtual training component, providing the following pilot virtual training sessions:

In the MOOC (massive open online course) titled "Atmospheric Research Infrastructures: Sharing the Future of Our Atmosphere", scientists addressed air pollution and climate change issues and explained the importance of atmospheric research and the workflow of ACTRIS, IAGOS and ICOS. The first edition took place from January to February 2025, with 811 learners enrolled and the second improved edition took place in May – June 2025, with 518 learners enrolled (Figure 6). The second and third important countries in terms of trainees after France were China and India for this second edition, demonstrating the attractiveness of this type of resource and its ability to enhance the influence and visibility of European RIs. Finally, in July 2025, a "serious game" titled "What's going on in the air?", was released. It covered aerosol properties via remote sensing. No statistics on the serious game were available at the time this report was written.

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TUTORIAL : VOLCPLUME

#HIGHLIGHT 1 July 202

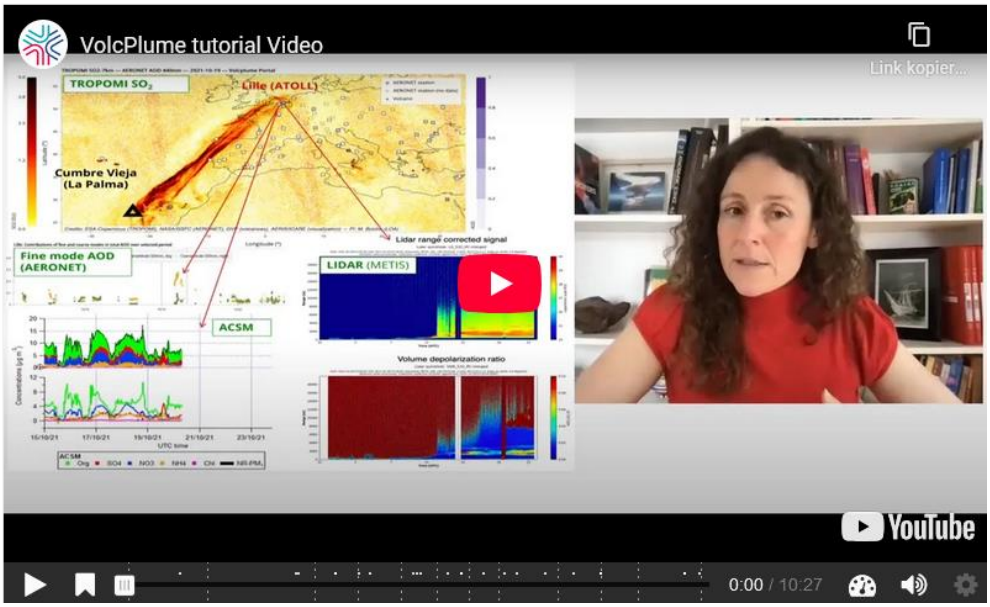

Figure 5: Start page of the tutorial video on volcanic plume detection.

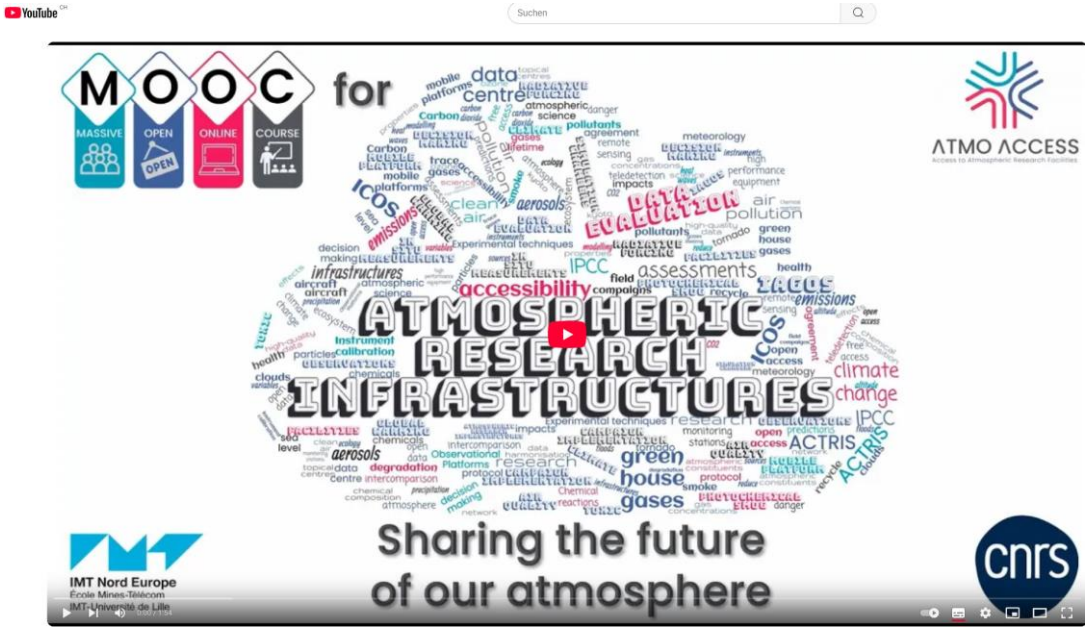

Figure 6: Start page of the MOOC on Atmospheric research Infrastructures

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