Deliverable 6.4: Updated ACTRIS user strategy

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1. Purpose

The ACTRIS user strategy is an approach to engage and serve the needs of a large community of users from the scientific domain, the private sector, and the general public, and to provide them with high-quality, integrated data and services in the area of atmospheric sciences, including access to instrumented platforms, services tailored for scientific and technological usage, and training opportunities. The user strategy continuously evolves within a cyclic process for optimization and improvement to ensure alignment with the overall ACTRIS strategy. The purpose of this document is to provide an update of the user strategy in the context of the operational service provision within ACTRIS ERIC, established in 2023, with a focus on physical and remote/hybrid access. Particularly addressed is the evolution of the user needs and related requirements of the service design and service provision and access system as well as the challenges that are linked to this process. To be inclusive, statistical information on access provision in the perimeter of ACTRIS is documented, particularly since 2016 when ACTRIS has entered the ESFRI (European Strategy Forum on Research Infrastructures) Roadmap. Addressed is furthermore the sustainability of access which is considered vital to ensure a successful service provision and to guarantee a positive and satisfactory experience for all ACTRIS users.

2. ACTRIS User strategy

2.1 Context and status quo

2.1.1 Current ACTRIS user strategy

The ACTRIS user strategy defines the goals, priorities and plan of actions required for a provision of services to its users that effectively satisfy their needs and meet their expectations. The overall user strategy cycle comprises the following key elements (Figure 1a):

- **User attraction / acquisition →** for ensuring an effective communication and outreach strategy;
- **User understanding →** for providing knowledge of, and monitoring the user needs;
- **User experience →** for optimising the user interaction and achieving user satisfaction;
- **User-oriented services and processes →** for maintaining and developing the service portfolio and quality, and for exploring and developing new service concepts and components, while striving for a user-friendly and efficient access management system and process;
- **User feedback →** for ensuring continuous interaction with the users and assessing the quality of the service provision.

ACTRIS users originate from the academic, public, and private sector (Figure 1b). The users comprise scientists in atmospheric sciences (including experts from climate and national weather services, space agencies, national and regional air quality monitoring networks and environmental protection agencies), as well as professionals from business industries (e.g., instrument manufacturers, sensor industries) but

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also users from other fields: environmental sciences, energy, health & food, physical sciences & engineering, etc. The type of user communities is illustrated in Figure 1b and the benefits of accessing ACTRIS services are summarised in Table 1.

Figure 1a. ACTRIS user strategy cycle

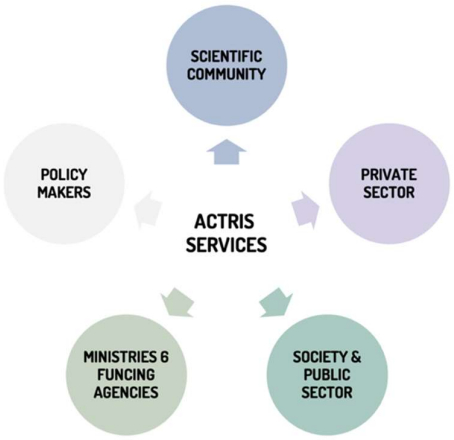

Figure 1b. ACTRIS user communities

Table 1: Benefits of ACTRIS services to its user communities

ACTRIS user communities	**Benefits**
Scientific community	Scientific excellence, international collaboration & visibility of research, open science – open data, cutting-edge research and breakthroughs, training and capacity building
Private sector	Innovation, new developments & novel technologies, R&D support, knowledge transfer, competitiveness
Policy makers	Support for policy-driven networks under EU directives and for decision-making on environmental issues, climate scenario predictions, information on extreme atmospheric events, linking national and EU strategies
Ministries and funding agencies	Structuring the research area, optimisation and use of resources, strategic investments and research programmesv
Society and public sector	Improved weather and climate predictions, enhanced awareness and information on air quality and climate change, environmental and social challenges, contribution to health impact analyses

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A set of eight recommendations on how to further optimise and implement the user strategy within ACTRIS has been proposed in the "Plan for enhanced user strategy with recommendations to ACTRIS facilities" (ACTRIS IMP Milestone MS36), and is summarised in Table 2. More detailed information on the user strategy cycle, the user communities and recommendations is also described in the same MS36.

Table 2. Recommendations for achieving a successful user strategy within ACTRIS

1. ACTRIS should persistently strive to reach different target audiences;
2. ACTRIS should maintain and foster a trusting and human relationship with the users ;
3. ACTRIS should monitor the evolving user needs and explore ways to meet the evolving user needs for novel and innovation services;
4. ACTRIS should keep and maintain current and historical documentation and statistics of access to its services;
5. ACTRIS should efficiently analyse and react on user feedback and make the information publicly available;
6. ACTRIS should regularly update the service catalogue to keep its users engaged and interested;
7. ACTRIS should strive for open access to its services, based on principles and modalities set out in the ACTRIS ERIC data policy and access and service policy, to increase scientific progress and impact;
8. ACTRIS should maintain a user-centric approach that prioritizes the needs of the users.

2.1.2 Implementing the user access and service provision system

Implementing a successful user strategy has been the overall objective in the implementation phase. Since 2020, ACTRIS has put significant efforts in developing an optimised and efficient access and service provision system. User access to ACTRIS services is conveniently centralised in a **single access point,** via the ACTRIS web portal (https://www.actris.eu). This ensures a harmonised and easy access to the various ACTRIS facilities and services, and also provides information about the ongoing calls and access opportunities in a centralised website location. The ACTRIS services provided by the ACTRIS National and Central Facilities, are diverse and include data services and digital tools, research, technological and innovation services, training services, and other tailored services (Figure 2).

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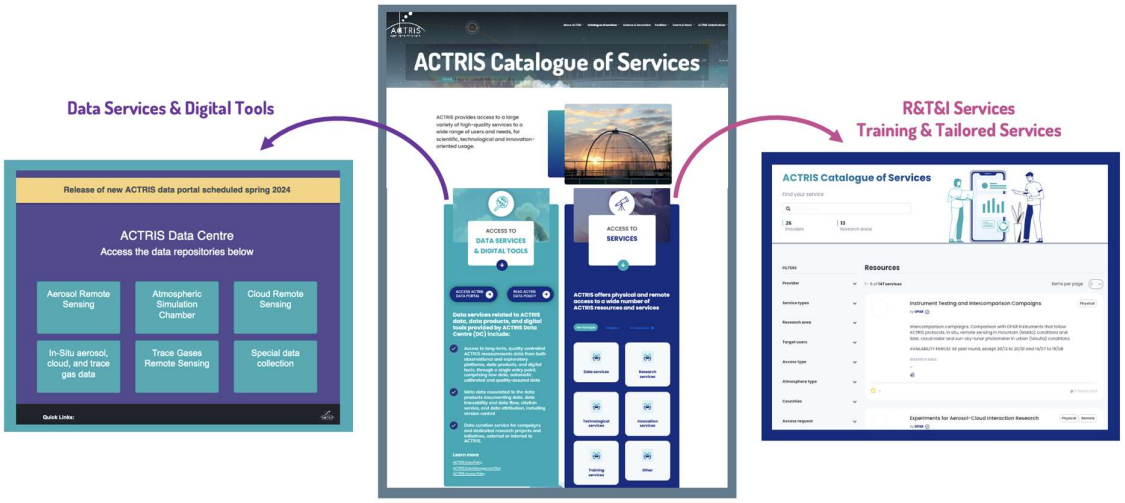

Figure 2: Illustration of access to ACTRIS services via its service catalogue on web portal (actris.eu) comprising both access to data services and digital tools via the ACTRIS Data Centre (shown on left-hand side) and access to research (R), technical (T), innovation (I), training and tailored services via the ACTRIS service and access management system (shown on right-hand side).

The centralised access of users via the ACTRIS webportal depends on the type of service:

- **Access of users to data services and digital tools is wide and free** and is guided by the ACTRIS data policy. Access to all ACTRIS data and data products is made through the ACTRIS Data Centre (DC) following the **FAIR** (findable, accessible, interoperatble and reusable) principles. The ACTRIS DC ensures the management and organisation of the ACTRIS data produced by the ACTRIS National Facilities, and includes long-term archiving, tools for data production, visualization, evaluation and analysis. These data services and digital tools are widely accessible by virtual access at all times and from worldwide locations via communication networks. Details about the services and the ACTRIS data lifecycle is described in the ACTRIS Data Management Plan (DMP).
- **Access of users to research/ technical/ innovation/ training/ tailored services offered by the ACTRIS facilities is managed by the Service and Management Unit (SAMU)** and is guided by the ACTRIS access policy. These services are available via physical, remote, or hybrid access. Access is competitive due to limited service provision capabilities and is therefore moderated. The access modalities and workflows including the overall access management, lifecycle, and key actors in the access process are described in detail in the ACTRIS Access Management Plan (AMP).

During ACTRIS IMP, a user-friendly and **interactively accessible catalogue of services** has been implemented that allows cross-catalogue search options of available services with quick-search functions and filters. The catalogue of services particularly addresses the services related to physical/ remote/ hybrid access and requires updates on a regular basis in alignment with the AMP. Information of the user needs

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is continuously collected and will be considered within the service provision capabilities of the ACTRIS facilities. This access management and process related to the competitive access is based on the **newly developed online PASS system** (Platform for managing user access to ACTRIS ServiceS) to which the catalogue of services is directly linked. PASS allows to handle in automated manner the overall access process, including the application and evaluation process of the user request, and allows to interlink users, management team, service providers, and reviewers. The ACTRIS service and support system is completed by the « Science and User Access Forum », a digital platform for exchange of information, experiences, and needs among users, as well as a user helpdesk to provide centralised support to assist users in a timely manner with technical issues, questions, or problems related to the access process, services and/or facilities.

The user access and service provision has been extensively tested in the scope of the ACTRIS IMP transnational access (TNA) pilot activity. The TNA pilot was (intentionally) limited to 11 facilities of different types which were carefully selected in the preparations of the project: Central Facilities (both Topical Centres and DC units) and National Facilities. The access provision was organised and carried out under three different calls for access. This allowed ACTRIS to test, assess, and document the access workflows and functionalities in different steps. An emphasis was made to exchange directly with the main actors in the process (access providers, reviewers, management teams, and particularly the users), through a series of virtual meetings and in-depth discussions of the concept and efficiency, allowing to identify design issues and shortfalls with the aim of improving the overall access lifecycle. From the users, the information was gathered and analysed by means of systematic user feedback questionnaires following a physical or remote provision of services. The conclusions are summarised in the deliverables D7.1 and D7.2. An ideal testbed became available within the current ATMO-ACCESS project (H2020 Pilot for a new model of Integrated Activities, 2021-2025), where a large effort is being placed on providing transnational and virtual access to more than 50 different types of facilities[1] (observational platforms, exploratory platforms such as simulation chambers and mobile platforms, and Central Facilities) as part of a joint effort among the three research infrastructures in the atmospheric domain: ACTRIS, ICOS (Integrated Carbon Observations System), and IAGOS (In-service Aircraft for a Global Observing System). The project allows to apply, improve, and optimise the user access and service provision system that was developed and implemented during the ACTRIS IMP project, in particular since access is managed by the SAMU, making use of the PASS system.

[1] Types of facilities operated within ACTRIS:

- *Observational platforms* are fixed, ground-based facilities applying state-of-the-art measurement techniques to deliver long-term data following ACTRIS operation standards, and allow to perform experiments in ambient conditions.
- *Exploratory platforms* comprise atmospheric simulation chambers for dedicated experiments under controlled conditions or mobile platforms to deliver data and/or perform experiments based on common ACTRIS standards.
- *Central Facilities* are technological platforms responsible for the production of harmonized, reliable and documented data compliant with standard operating procedures and quality protocols.

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2.2 Evolution and challenges

With the ACTRIS IMP project ending, the ACTRIS user access and service provision system is now successfully implemented and fully operational. This is particularly important as ACTRIS was established in April 2023 as European Research Infrastructure Consortium (ACTRIS ERIC). Being legally recognized as an ERIC, ACTRIS has moved to mature and sustainable research infrastructure with a mission to provide effective access for a wide community of users. In alignment with the European Commissions' framework programmes, efforts are made by ACTRIS to offer services that allow users to conduct both **challenge-driven and curiosity-driven access** (more details can be found, e.g., in the Horizon Europe Work Programme 2023-2024)**.** Curiosity-driven research remains crucial, allowing users to pursue scientific exploration to advance frontier knowledge in the domains of expertise. ACTRIS supports curiosity-driven research by providing wide and efficient access to research and technological services, easily findable and accessible through the catalogue of services. Challenge-driven research is designed to tackle societal challenges (such as climate change, health, and clean energy). Challenge-driven access opportunities is often coupled with dedicated financial support (e.g., from the European Commission under Horizon Europe) towards distinct services that are more demanding. Related services are aimed at addressing major societal challengesand are more elaborate as they require more and more a wide sharing of information, knowledge and technologies beyond a single RI perimeter. A challenge-driven approach requires integrated and advanced services based on a cross-disciplinary approach. ACTRIS must always strive to put the user at the centre of its strategy and provide information and knowledge for developing sustainable solutions to societal needs. It is therefore continuously widening its portfolio to include complementary and interdisciplinary services.

The ACTRIS service provision ecosystem is evolving on a short- to mid-term time-scale. Therefore, the user strategy must take into account the results and recommendations from current and upcoming actions and other relevant aspects that are described and discussed in the following.

2.2.1 Ongoing and upcoming projects related to user and societal needs

ACTRIS facilities are participating in a number of ongoing and new cross-disciplinary projects aiming at developing new advanced services to meet the user and societals needs. These are listed below and shortly described:

- ***ATMO-ACCESS*** (Sustainable Access to Atmospheric Research Facilities, 2021-2025) develops recommendations for establishing a comprehensive and sustainable framework for access to distributed Research Infrastructures in the atmospheric domain to ensure integrated access to and optimised use of their services. It is testing and evaluating innovative modalities of access to facilities and complementary and more advanced services, including digital services, developed as part of a cross-RI effort of ACTRIS with ICOS and IAGOS.
- ***RI-URBANS*** (Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban & Industrial AreaS, 2021-2025) addresses the European Green Deal Challenges by demonstrating how service tools from atmospheric research infrastructures can be adapted

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and enhanced in air quality monitoring networks in an interoperable and sustainable way. It addresses the challenges and societal needs related to air quality in European cities and industrial, harbour, airport, and traffic hotspots and responds to the need to substantially reduce air pollution across the EU and to engage in a strategy to evaluate the health impacts of air pollution on citizens.

- ***IRISCC*** (*new*: 2024-2029, Integrated Research Infrastructure Services for Climate Change risks) will establish a service portfolio with transnational and virtual access provision to integrated RI services offered by the key European and national RIs. The access is provided to complementary and interdisciplinary cutting-edge services that will help to foster challenge-driven and interdisciplinary research on climate-change-related multi-hazard risks to support evidence-based policymaking, decision-making, and to improve Europe's resilience to climate change.
- ***CARGO-ACT*** (*new*: 2024-2027, Cooperation and AgReements enhancing Global interOperability for Aerosol, Cloud and Trace gas research infrastructures) will develop sustainable partnerships and decision-making processes with relevant partners from the USA by establishing the mechanisms for providing international access to distributed research infrastructures and converging interoperability and standards of interest to the global research community and stakeholders in the field of weather, climate, air quality monitoring and modelling.
- ***ENVRINNOV*** (*new*: 2024-2027, ENVironment Research infrastructures INNOVation Roadmap) will co-design, test, and validate a common Innovation Roadmap for the European Environmental and Earth System Research Infrastructures (ENVRI) community by analysing the services and ecosystem technological needs and gap of the ENVRIs, promoting the uptake of common strategies to enhance innovation across the ENVRI community network, and establish synergies and complementarities with relevant ecosystems.
- ***POLARIN*** (*new*: 2024-2030, POLAr Research Infrastructure Network) will gather the services provided by the international network of polar research infrastructures to address the scientific challenges of the polar regions. POLARIN will provide integrated, challenge-driven, and combined access to these infrastructures to facilitate interdisciplinary research on complex processes.

The involvement of ACTRIS in these projects is a response to the current user and societal needs, and will challenge the research infrastructure to develop suitable services and solutions. The ACTRIS user strategy will adapt to consider the recommendations resulting from all these projects.

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2.2.2 Evolving user needs - new services, methods, parameters

The user strategy within ACTRIS is user-focused, building on the knowledge of the evolving user needs and experiences. Remaining at the state-of-the-art is crucial for ACTRIS by supporting continuous developments of new services and new variables. ACTRIS provides observations of short-lived climate forcers and other short-lived atmospheric components. ACTRIS currently produces and offers access to approximately 120 variables (35 aerosol, 65 trace gas and 20 cloud parameters), resulting from 58 methodologies. These data are harmonised, of high quality and precision, and follow the FAIR principles. The scientific community needs them to be able to address a number of scientific questions. E.g.: How do clouds, aerosols and trace gases affect the Earth's radiation balance and atmospheric chemistry? How do clouds respond to global warming? How do the concentration and distributions of aerosol and trace gases vary in space and time? What is the impact of climate feedback mechanisms on atmospheric composition and chemistry? (For details, see https://www.actris.eu/why-actris-needed). Continuous developments are crucial for several reasons:

- *Understanding complexity*: the Earth is an immensely complex system with interconnected variables. Continuous development of new methodologies helps scientists to better understand these intricate relationships. As our understanding deepens, new variables may emerge as crucial indicators or contributors to climate patterns.

- *Improving models*: atmospheric models constantly evolve to become more accurate and comprehensive. Introducing new parameters allows these models to better simulate real-world conditions, leading to more reliable predictions and assessments of the atmospheric processes.

- *Adapting to emerging challenges*: atmospheric science faces new challenges as our environment changes. New elements and discoveries highlight the needs for new factors that may become critical due to shifts in weather/climate, ecosystems, and/or human activities. Developing new services helps to adapt research to these emerging challenges.

- *Enhancing monitoring and analysis*: as technology advances, new instruments and methods become available, allowing scientists to measure and analyse previously unexplored aspects of the atmospheric system. These advancements may lead to identifying new variables that can offer valuable insights.

- *Addressing gaps in knowledge*: there are still gaps in our understanding of the atmospheric processes and interactions, and how certain elements contribute to climate change. Continuous developments can help fill these gaps, providing a more comprehensive picture of the complex processes involved.

- *Tailoring Solutions*: while our climate is constantly changing, different regions and ecosystems experience this change differently. Observations and services specific to certain regions or ecosystems may require more tailored solutions and adaptive strategies to mitigate the impacts related to climate change and air quality.

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The ACTRIS user strategy anticipates and supports the ongoing development of new services, methods, and climate-relevant parameters for refining our understanding of the atmospheric composition and processes and for enabling the design of effective strategies to address the challenges it entails.

2.2.3 Evolving user needs – cross-disciplinary services

ACTRIS continues to develop its service portfolio. Evolving user needs require sharing information and technologies across the scientific disciplines by engaging joint initiatives with other research infrastructures in the environmental domain and beyond. There are multiple benefits of cross-disciplinary services and access. Atmospheric processes and phenomena are inherently complex and interconnected with various scientific disciplines. Cross-disciplinary services are beneficial, as they bring together expertise from different fields (e.g., chemistry, physics, biology, ecology, geology, oceanography, health, etc.).

Cross-disciplinary collaboration enables a more **comprehensive understanding** of atmospheric processes, including weather patterns and extreme events, climate change, air quality, and their impacts on ecosystems and human health. Many atmospheric challenges require a **holistic approach** that considers multiple factors. For example, addressing air quality and pollution involves understanding not only of the atmospheric composition but also the chemistry of pollutants, their sources, and their effects on both the environment and human health. Cross-disciplinary services can facilitate integrated studies of such complex interactions. Solutions to atmospheric challenges also often involve **technological advancements and innovations**. Cross-disciplinary services foster collaboration between researchers and/or companies specialised in different technologies and methodologies, leading to the development of advanced instruments, models, and analytical tools for extended and improved data and products.

Policy decisions related to climate change mitigation, air quality regulations, disaster preparedness, etc. require reliable high-quality and long-term data. Cross-disciplinary services can provide policymakers with a more comprehensive understanding of the scientific data, enabling them to make informed decisions that have broader societal and environmental implications. As our understanding of atmospheric processes evolves, **new challenges emerge**. Cross-disciplinary approaches allow for flexibility in addressing emerging issues by combining expertise from various fields to tackle these challenges effectively. Cross-disciplinary services create opportunities for **education and training**. Students and researchers from different disciplines can learn from each other, fostering a new generation of scientists capable of addressing complex atmospheric issues.

The ACTRIS user strategy actively engages in cross-disciplinary services to provide the user communities a more holistic, nuanced, and effective way for understanding, mitigating, and adapting to environmental challenges by leveraging the strengths of joint services and data from diverse scientific disciplines.

ACTRIS fosters and maintains the cross-disciplinary approach through constant dialogue and efforts with other RIs, particularly through joint European projects. In the past decade, especially the RI cluster projects ENVRIplus (2015-2019, Environmental Research Infrastructures Providing Shared Solutions for Science

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and Society) and ENVRI-FAIR (2019-2022, Environmental Research Infrastructures building FAIR services accessible for society, innovation and research) have contributed to reinforce the cooperation and exchange among the environmental RIs towards open and multidisciplinary environmental science. Furthermore, cross-disciplinarity is particularly addressed in the IRISCC project which will start in 2024 (see 2.2.1). In the ongoing project ATMO-ACCESS, there is a current 6th call for transnational access that aims at offering multi-disciplinary services that intend to involve users and objectives that reach beyond the atmospheric domain (Figure 3).

Figure 3. Ongoing call announcement for multi-disciplinary access organised within the ATMO-ACCESS project to promote novel and unconventional use of the services offered by atmospheric facilities.

2.2.3 Evolving user needs – innovative access modalities

ACTRIS aims at developing innovative access modalities to adapt to evolving user expectations and needs. Particularly with the COVID-19 pandemic, the physical and remote access to services was significantly affected, and mobility of users was disrupted. As part of ACTRIS IMP TNA pilot, ACTRIS has advertised new access modalities for remote/hybrid access to optimise the use of the ACTRIS services. Before the pandemic, remote access had only been used to a limited extent, mostly for calibrations of instruments by the Central Facilities. Remote access has progressively become important, both within the ACTRIS IMP TNA pilots but also within the TNA activities organised by the ATMO-ACCESS project. Particularly the hybrid access, combining both physical and remote access, has become more and more attractive and requested (see section 2.3.5).

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Hybrid access can contribute to **increasing the services' utilisation rate** and offer the possibility for projects that last longer than those carried out via physical access only. For example, user teams physically visit a facility to mount and deploy their instruments, but it is the facility personnel that operate them for a defined period of time (often much longer than in the case of physical-only access), until they are dismounted again by the user group. This reduces the hands-on access of the user (or user group) but can extend the operation of the instruments and collection of the data. Hybrid access helps to **maximise the RI's usage and potential**. At the same time, hybrid access is more challenging for access providers, as it **requires additional personnel, resources and time**, as well as **specific scientific and technological expertise. (**Specific expertise and on-site support is particularly important as ACTRIS users often require tailored services via physical, remote, or hybrid access and not all requests can easily be carried out by the available facility personnel). **Remote/hybrid access is expected to have an impact on the cost for access**. Some facilities may more easily implement remote/hybrid access, but remote/hybrid access to the exploratory platforms (such as atmospheric simulation chambers and mobile platforms) is particularly challenging as physical presence of users facilitates the execution of the experiment where decisions and adjustments of the workplan are required in the course of the project. This process can not always and entirely be carried out by the facility staff only.

On the other hand, remote access may allow **users from around the world** to use the ACTRIS services without the constraints of geographical location, and thus offers more opportunities for cutting-edge services and expertise. This includes also access to mobile platform that offers different opportunities to users to access data services but also research, technical, innovation, and training and innovation services worldwide. The global accessibility to **remote training services** is of particular interest as it fosters collaboration and knowledge sharing. Similarly here, however, remote/hybrid training may also be more challenging for the service providers due to additional costs, capabilities and resources that are necessary.

Remote access can **significantly reduce costs and save time** for user teams who would otherwise need to travel to the facility. This efficiency is particularly beneficial for researchers having limited budgets or tight schedules. A challenge for ACTRIS is to **explore technological developments** to better implement remote/hybrid access mode in the future. Advancements in communication, virtual reality, and robotics allow for more sophisticated remote access capabilities, enabling users to interact with facility staff and instruments as if they were physically present. **Remote/hybrid access modalities provide resilience** by allowing research to continue even when physical access to facilities is restricted or difficult (for whatever reasons).

The ACTRIS user strategy actively embraces innovative access modalities (e.g., remote/ hybrid access), allowing to expand its outreach and attractiveness, to improve efficiency, foster collaboration, and adapt to the changing research landscape, while enhancing scientific progress and exploration.

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2.2.4 Evolving user communities and global outreach

Understanding the user communities and reaching out to them are crucial components of developing an effective user strategy. A user outreach relies on a consolidated communication strategy to promote attractivemenss and increase ficibility to reach out globally as well as to wider user communities. Advertisement of access opportunities and effective user interaction is the driver for successful user access and requires efficient communication tools and relevant communication channels, particularly outside Europe.

On a global scale, ACTRIS is engaged with key European and other international partners and contributes to a number of global networks. Many of these networks comprise several tens to hundreds globally distributed research facilities equipped with instruments that measure a number of ACTRIS parameters, with some of them being located in countries that are not members of ACTRIS ERIC. These networks include, among others, AERONET (Aerosol Robotic NETwork), CLOUDNET (Cloud Network), EARLINET (European Aerosol Research Lidar Network), EMEP (European Monitoring and Evaluation Programme), EMN (European Metrology Network for Climate and Ocean Observation), E-PROFILE (EUMETNET (European Meteorological Network) surface-based profile observations), MPLNET (Micro-Pulse Lidar Network), NDACC (Network for the Detection of Atmospheric Composition Change), PGN (Pandonia Global Network), WMO-GAW (Global Atmosphere Watch programme of the World Meteorological Organisation). The facilities located in countries that are members of ACTRIS ERIC receive operational support as ACTRIS National Facilities from the corresponding ACTRIS Central Facilities for quality assurance and control of their data, instrument calibrations, training, documentation and tools. The network facilities but also other scientific communities world-wide can request the same support via SAMU as users of the ACTRIS Central Facilities. The user community potentially served by ACTRIS is therefore large, given the associated scientific communities world-wide. The ACTRIS user strategy needs to account for these potential users while reinforcing the attractiveness of its services on a global scale.

Access opportunities in ACTRIS have always attracted users from outside Europe. Past service provision to 'international' users was mainly realised in the scope of transnational access projects (section 2.3.4) and was generally limited in quantity as access was provided with the help of European funding (the quantity of access must not exceed 20% of the total quantity of access to all users). Therefore, a strong potential for user demand on a global level exists and should be taken into account in the ACTRIS user strategy. Worth mentioning is the provision of training services to international users that are realised with a perspective to support capacity building within international networks e.g., LALINET (Latin America Lidar Nework) in South Amercia and AD-Net (Lidar observation network in East Asia). Furthermore, the deployment of mobile platforms worldwide provides opportunities to collect and access data measured outside Europe and/or to access ACTRIS services provided by mobile platforms at selected international locations where continuous measurements are not available. Remote and hybrid access modalities are expected to contribute to increased global outreach also, as they facilitate international users to benefit from ACTRIS services. Global outreach will therefore remain important and should be further developed.

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Historically, the majority of users have been originating from the academic field, with <10% of users coming from the private sector. Particular emphasis has been given within ACTRIS IMP to promote the access opportunities and services available towards the private sector for prototype testing, joint technology developments, and industrial applications. Nevertheless, access by this type of user has been limited, despite the specific actions addressed to this user community to increase the impact of innovation. The administrative burden and time delay associated with the TNA activities, as well as aspects related to proprietary research and confidentiality often hinder the use of the services by the private sector, despite their attractiveness. ACTRIS must make continuous efforts to promote its services to wide user communities, particularly the private sector and air quality networks.

2.3 A (rich) history of access

Knowledge about ACTRIS user communities has been built on extensive experience and interaction with users for more than two decades. Different EU framework programmes (FP) have enabled transnational access provision as part of the EU Research Infrastructures' programme. These integrating activities have been crucial for structuring the overall access provision and for developing the ACTRIS user strategy. This section will present the statistics with focus on the physical and remote/hybrid access provision for five projects listed below. Historical information from previous projects before that date - EUROCHAMP (FP6, 2004-2009), EUSAAR (FP6, 2006-2011) and EUROCHAMP-2 (FP7, 2009-2013) - are not included. The information presented for ATMO-ACCESS is only partial, as the project and associated access provision is still ongoing (including information for calls 1-4, the private sector call, a training pilot call and estimations for call 5).

- ACTRIS – Aerosols, Clouds, and Trace gases Research Infrastructure Network (FP7, 2011-2015), with TNA to 11 observational facilities and 1 central laboratory (composed of 3 different units). To distinguish this project, it is indicated as ACTRIS-1 throughout the document.
- ACTRIS-2 – Aerosols, Clouds, and Trace gases Research Infrastructure-2 (H2020, 2016-2019), with TNA to 18 observational facilities and 3 central laboratories (total of 8 different units).
- EUROCHAMP-2020 – Integration of European Simulation Chambers for Investigating Atmospheric Processes – Towards 2020 and beyond (H2020, 2016-2020), with TNA to 16 atmospheric simulation chambers and 4 central laboratories.
- ACTRIS IMP – ACTRIS Implementation project's TNA pilot activity within WP7 (H2020, 2020-2023), with TNA to 11 facilities including 4 observational platforms, 3 atmospheric simulation chambers, 1 mobile platform, 3 central laboratories.
- ATMO-ACCESS – Solutions for Sustainable Access to Atmospheric Research Facilities (H2020, 2021-2025), with TNA to 61 facilities including 29 observational platforms, 14 atmospheric simulation chambers, 5 mobile platforms, 13 central laboratories.

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2.3.1 User requests and success rate

ACTRIS entered the ESFRI Roadmap as project in 2016, in the same year of the start of the ACTRIS-2 project. Since then, 1463 user proposals (and 1848 proposals since ACTRIS-1 in 2011, respectively) have been submitted requesting access to the participating research facilities. The fraction of user projects evaluated and selected for acceptance is on average 88%, with a falling trend. For ACTRIS IMP and particularly ATMO-ACCESS the selection criteria were tightened with success rates of 79% and 76%, respectively. Success rates are critical to foster scientific excellence and maintain high standards. Competition helps to produce higher quality proposals with innovative ideas and significant potential impact. Resources are often limited and are therefore allocated to the most promising and impactful projects, which ensures that the best research proposals (particularly when unconventional or groundbreaking ideas are explored) receive support. ACTRIS has always aimed at maintaining an environment that encourages creativity and rewards excellence while ensuring fair opportunities to its user communities. The details on the number of user requests and success rates for each of the five projects are illustrated in Figure 4.

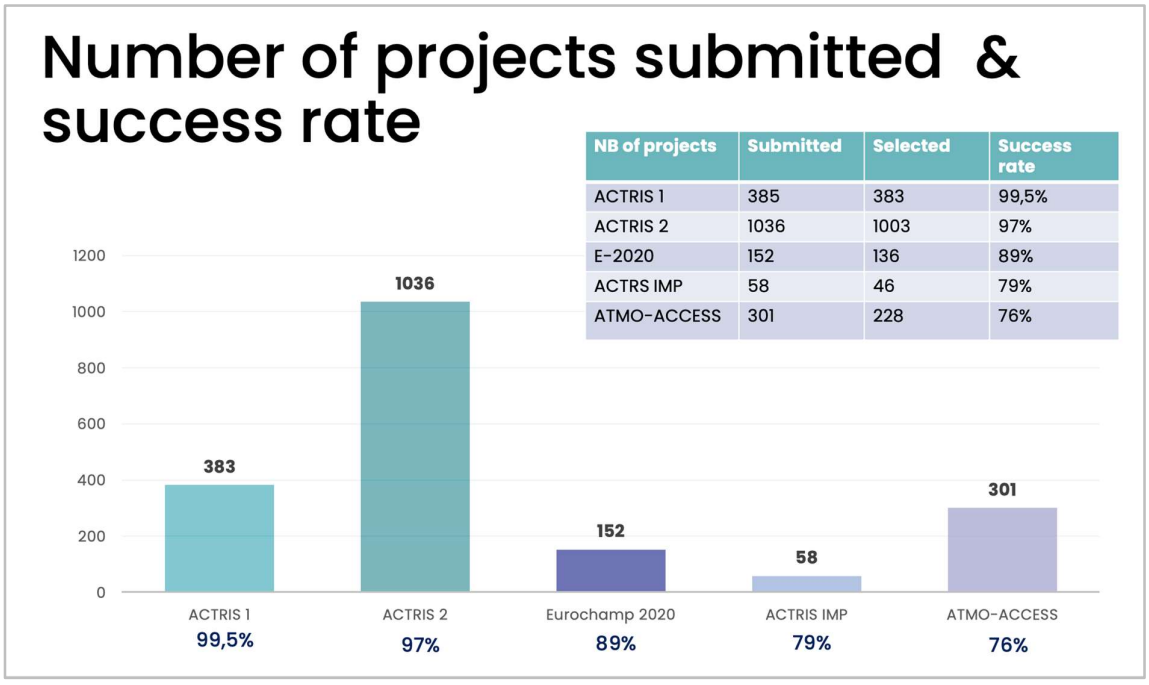

Figure 4: Number of user requests and success rate for each of the five projects ACTRIS-1, ACTRIS-2, EUROCHAMP-2020, ACTRIS IMP, and ATMO-ACCESS.

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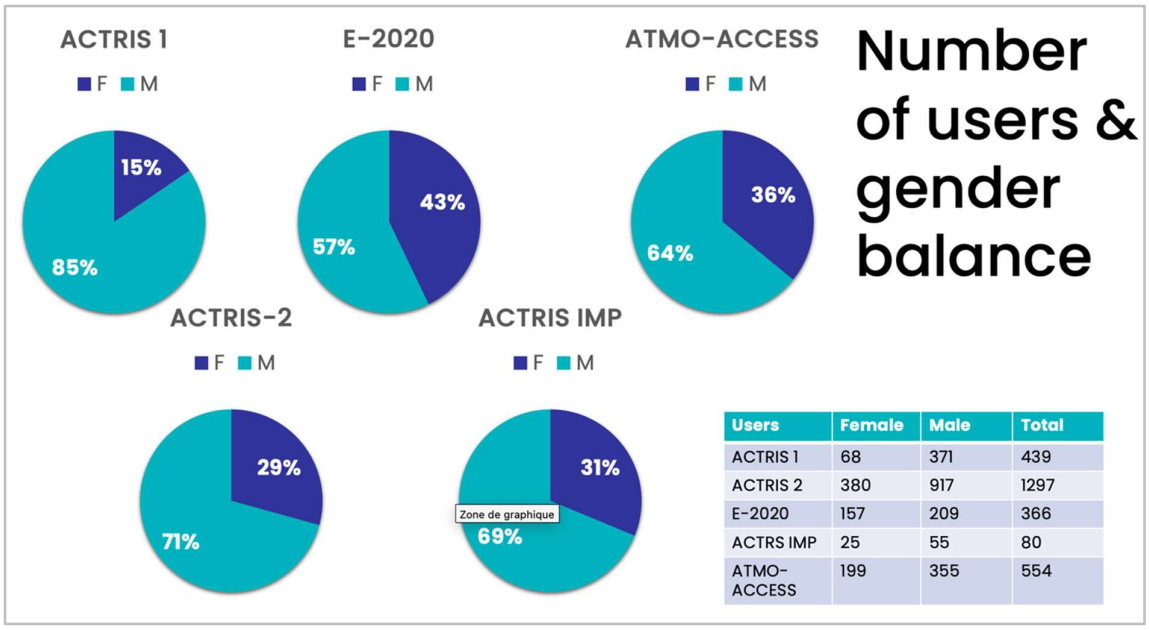
2.3.2 Number and type of users

Each of the user groups accepted usually comprises one and in most cases several users. The total number of users since ACTRIS-2 is 1858 (2297 since ACTRIS-1). The percentage of female users is on average 33% and varies between 15% and 43% (Figure 5). The user profile is illustrated in Figure 6. The majority of users are expert scientists, accounting for 57% on average (range between 51-68%). Early career scientists represent 34% of the users on average (range between 26-45%), and 9% of the users are technicians and engineers (range between 4-10%).



Users	Female	Male	Total
ACTRIS 1	68	371	439
ACTRIS 2	380	917	1297
E-2020	157	209	366
ACTRS IMP	25	55	80
ATMO-ACCESS	199	355	554

Figure 5: Number of users and gender balance of the users.

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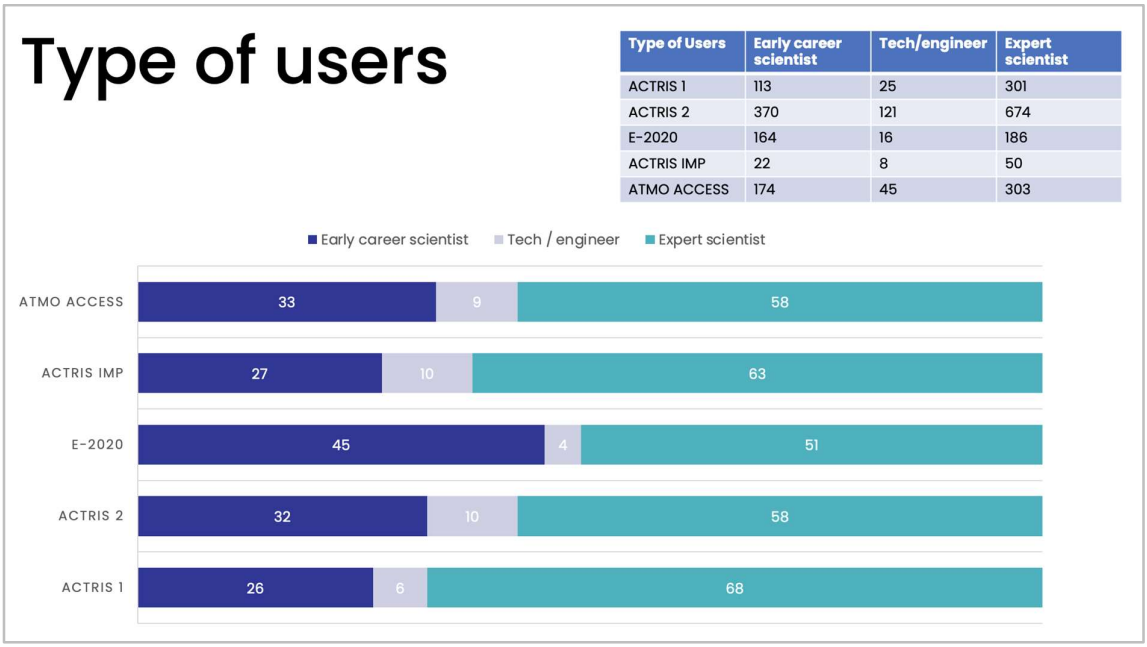

Type of Users	Early career scientist	Tech/engineer	Expert scientist
ACTRIS 1	113	25	301
ACTRIS 2	370	121	674
E-2020	164	16	186
ACTRIS IMP	22	8	50
ATMO ACCESS	174	45	303

Figure 6: User profile. The information in the table is given in absolute numbers while the graph indicates percentages.

2.3.3 User origin by sector

The majority of users originate from the public-academic sector, accounting for 95% of the total number of users, and with 5% of the users coming from the private sector. In ATMO-ACCESS more private sector users are involved, accounting for 11% of all users (Figure 7). In latter project, specific efforts were made to encourage participation from the private sector, e.g., via extensive communication actions, by offereing access to an unprecedent number (>60) of different types of facilities, and by enabling continuous access opportunities outside the access calls.

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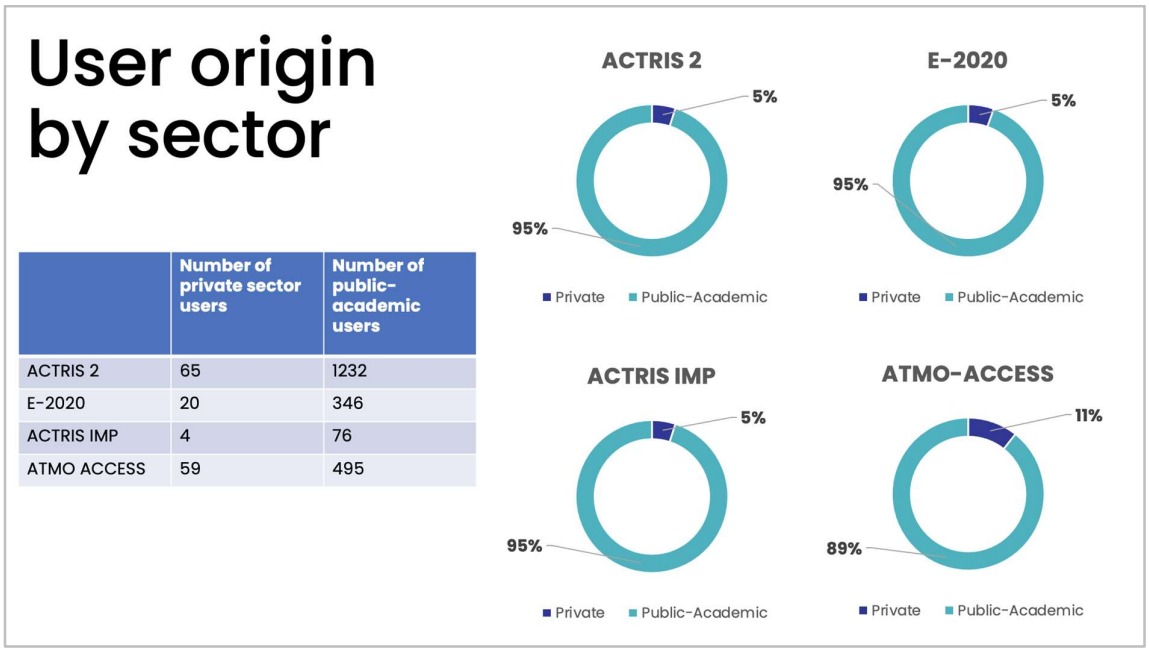

	Number of private sector users	Number of public-academic users
ACTRIS 2	65	1232
E-2020	20	346
ACTRIS IMP	4	76
ATMO ACCESS	59	495

Figure 7: User origin as a function of total number of users, differentiating between users coming from the public-academic vs the private sector.

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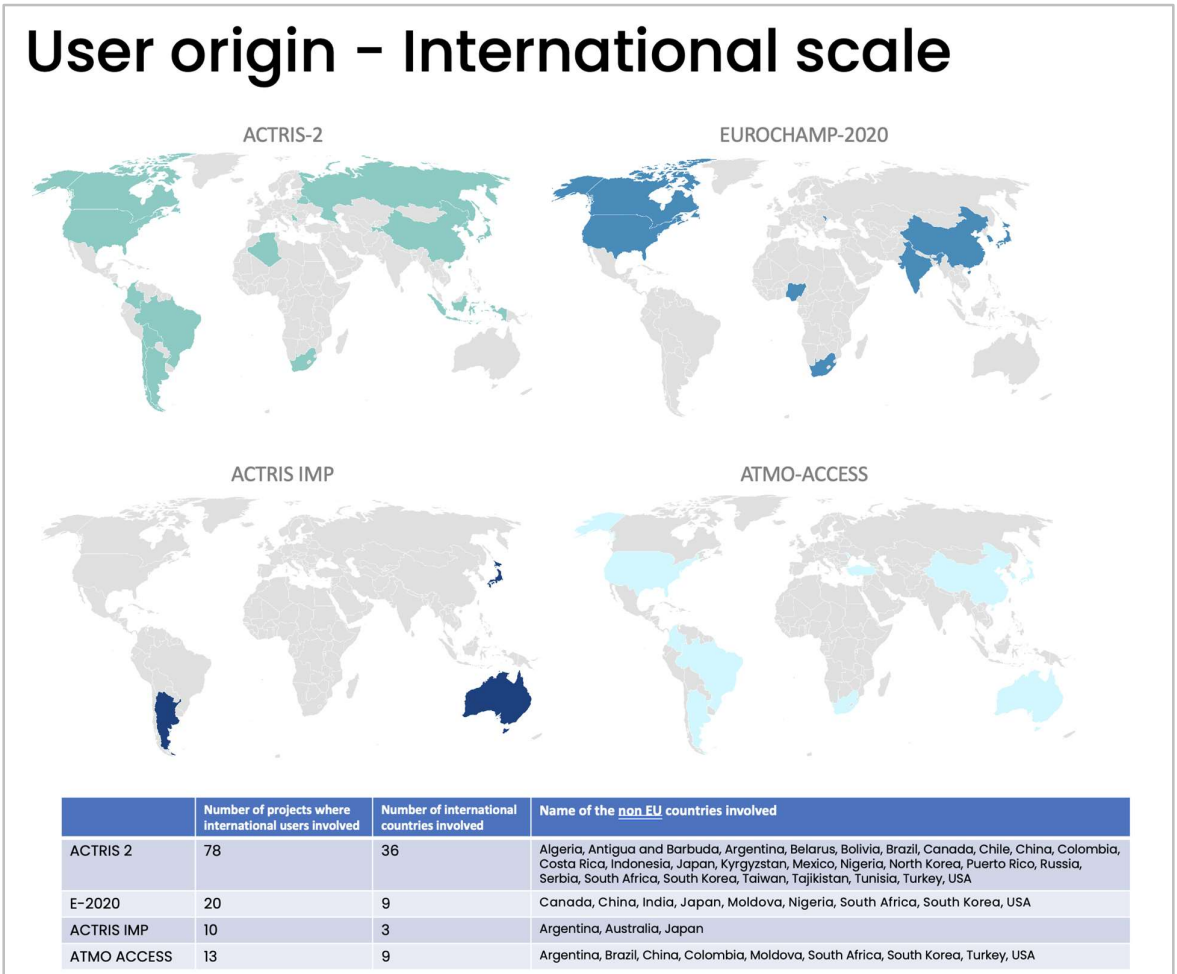
2.3.4 Geographical user origin

The transnational access programme enables global outreach and attracts users world-wide. Although the European Commission-funded TNA programmes are mostly aimed at providing access opportunities from users from within Europe (TNA rules stipulate that access to users outside Europe must be limited), about 127 projects so far have involved international users (users from countries other than European member, associated or candidate states), representing about 10% of the total projects. The geographical origin of these international users by country is indicated in Figure 8.



	Number of projects where international users involved	Number of international countries involved	Name of the non EU countries involved
ACTRIS 2	78	36	Algeria, Antigua and Barbuda, Argentina, Belarus, Bolivia, Brazil, Canada, Chile, China, Colombia, Costa Rica, Indonesia, Japan, Kyrgyzstan, Mexico, Nigeria, North Korea, Puerto Rico, Russia, Serbia, South Africa, South Korea, Taiwan, Tajikistan, Tunisia, Turkey, USA
E-2020	20	9	Canada, China, India, Japan, Moldova, Nigeria, South Africa, South Korea, USA
ACTRIS IMP	10	3	Argentina, Australia, Japan
ATMO ACCESS	13	9	Argentina, Brazil, China, Colombia, Moldova, South Africa, South Korea, Turkey, USA

Figure 8: Geographical user origin and involvement of international users in TNA projects. The map does not include users from European member, associated or candidate states which represent the majority of all users.

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2.3.5 Type of access and type of facilities accessed

The type of access with respect to physical, remote and hybrid access is indicated in Figure 9. The fraction of remote access is large in ACTRIS-1 and ACTRIS-2, accounting for 77% and 45%, respectively. Remote access mostly concerned use of a technological service for calibration of individual instruments, whereas the physical access is related to the use of a facility by a user team for research services (e.g., realisation of scientific experiments). Hybrid access was not documented before the pandemic, and has been used significantly in ACTRIS IMP (56%) and ATMO-ACCESS (43%). The combined remote and hybrid access accounts for the majority of access types in both projects, representing 78% in ACTRIS IMP and 59% in ATMO-ACCESS, calculated with respect to the number of projects.

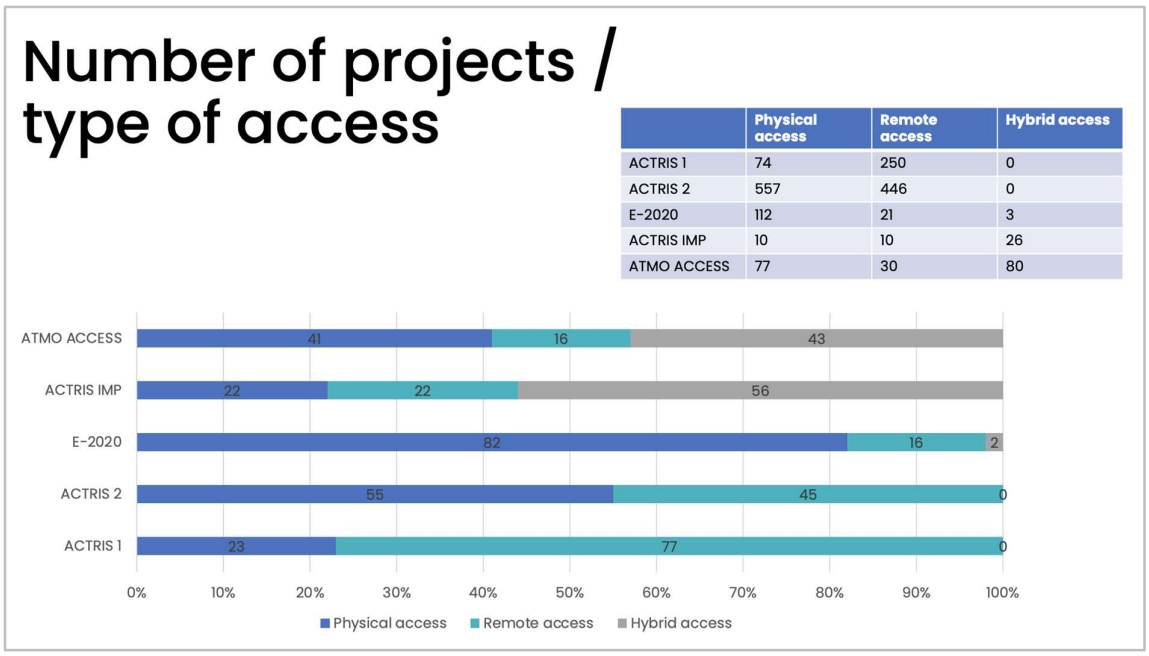

Figure 9: Access type as a function of number of user projects for ACTRIS-1, ACTRIS-2, EUROCHAMP-2020, ACTRIS IMP and ATMO-ACCESS. The type of access distinguishes physical, remote, and hybrid access. The table gives the absolute number of projects whereas the graph indicates percentages.

The type of facilities accessed are illustrated in Figure 10. The type of facilities comprise observation facilities, atmospheric simulation chambers, mobile platforms, and central laboratories. According to Figure 10, access during ACTRIS-2 and ACTRIS-IMP was predominately made to central laboratories (representing 75% and 65% of the projects). However, the numbers are biased by the fact that access to central facilities consisted of the calibration of a single instrument for which one single project was defined, whereas each project involving access to observational or exploratory facilities consisted of physical access visits of one or several users for several days. During EUROCHAMP-2020, the access was

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expectantly made to the simulation chambers and in ATMO-ACCESS more than half of the access has involves observational facilities.

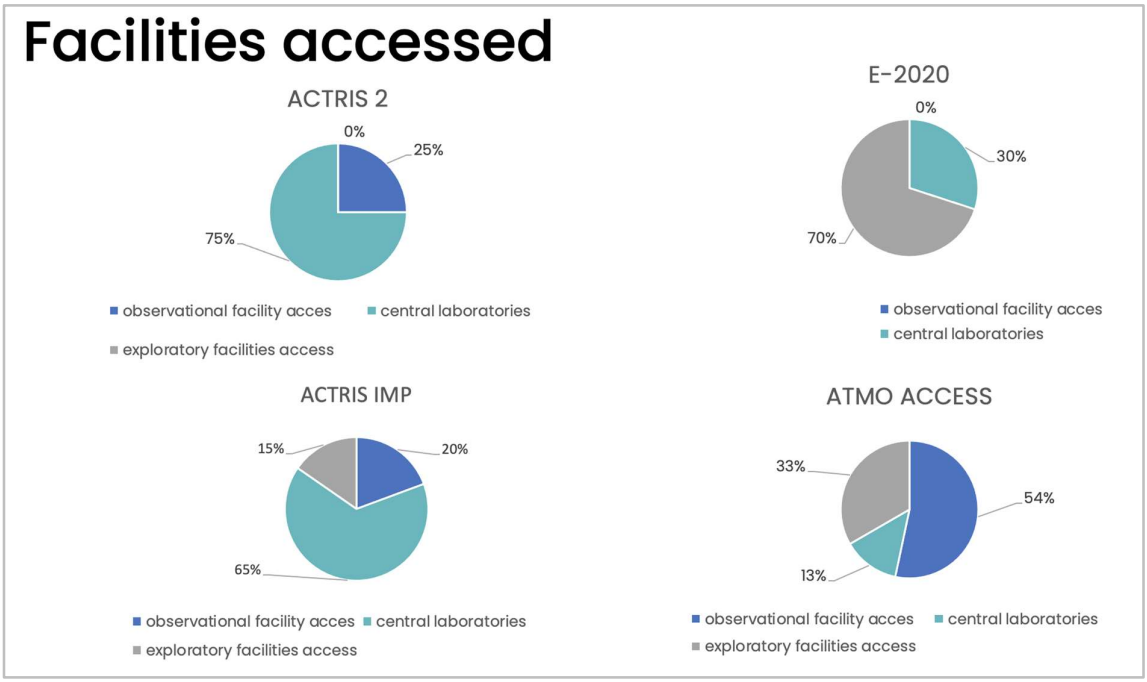

Figure 10. Type of facilities from which services were requested. Observational facilities comprise ground-based platforms, exploratory facilities include both atmospheric simulation chambers and mobile platforms, central laboratories indicate technical platforms (ACTRIS central facilities).

2.3.6 Quantity of access provided

The number of access units provided in each of the five projects is indicated in Figure 11. The quantity of access is not meant to be compared but to give an idea of the overall volume of access provided in these projects with each having a specific objective and distinct TNA budget. Access numbers can not easily be compared as different units of access are used within each individual project. The type of access units are:

- user working days (UWD), mostly used by observational platforms with 1 UWD being equivalent to one working day spent by one user at the facility to access the services,
- days (DAY), used mainly by atmospheric simulation chambers and some observational platforms, where 1 DAY corresponds to one working day spent at the facility to use its services, independent of the number of users,
- staff working day (SWD) which is equivalent to one labour day required by the facility staff person to provide the access to the services.

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- Additional other specific access units are used, e.g., one calibration relating to the calibration of one instrument at a facility, or data processing service as used by some data centre units.

Since ACTRIS-2, 7058 units of access (all types confounded) have been offered to the users, and 9522 units of access since ACTRIS-1. With ATMO-ACCESS still ongoing, this number is expected to increase significantly as many of the user projects are either ongoing or upcoming.

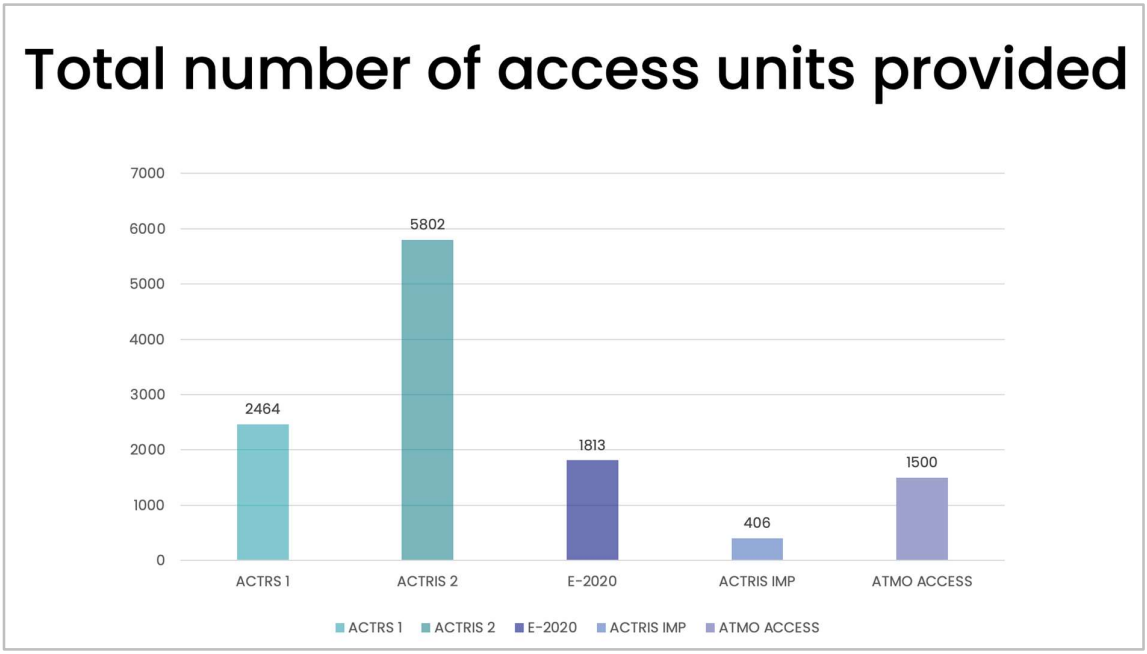

Figure 11: Total number of access units provided by each of the user projects. The units of access comprise different types of access units within each project.

3. Integrating sustainability into the user strategy

The ACTRIS user strategy supports an approach that places the needs and experiences of the users in the centre of its overall strategy. It emphasises the users' perspectives and requirements to create services and processes that are likely to be embraced and valued by the users, and to keep them engaged and interested. Although not addressed as part of the user strategy, financial considerations of user access and service provision play a critical role. The financial aspects are the backbone of a user strategy and provide the necessary framework for access.

Considerations of access funding directly impact the capability for service provision and user accessibility. The feasibility and sustainability are aspects that are particularly important in the case of distributed

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research infrastructures. The financial constraints and preferences of the users should be considered by offering flexible pricing models that are aligned with the ACTRIS user strategy.

To date, access provision has mostly relied on European Integrated Activities that have provided the financial framework to i) fund the provision of the services (access cost incurred by the facilities) and ii) (co-) fund the use of the services by the users (e.g., travel expenses, instrument transport etc.). With the establishment of ACTRIS ERIC and of an operational service provision system, the funding of user access to ACTRIS services has to move away from mostly project-based access funding and towards implementing an adequate framework of reliable and sustainable funding involving different types of funding sources.

A sustainable access funding strategy for ACTRIS involves developing a financial model that ensures physical and remote/hybrid access to its distributed services over the long term. Relying on a single funding source for access is insufficient and also risky. A sustainable strategy involves diversifying funding streams which may include national (and regional) funding, (national and European) project funding, ACTRIS ERIC funding (from membership contributions), and user fees (Figure 12).

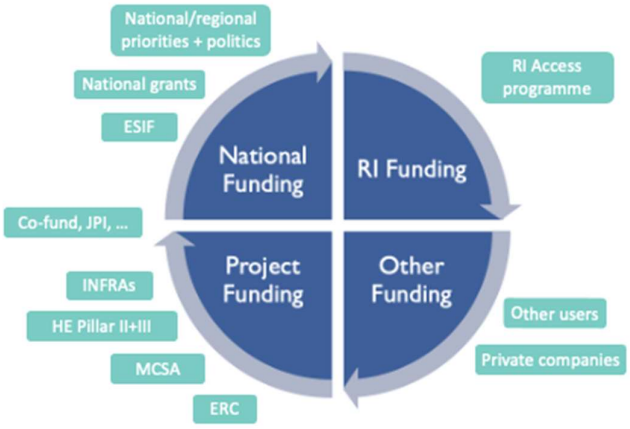

Figure 12. Illustration of synergistic potential funding sources expected to achieve sustainable access.

The different funding sources are complementary and should be embedded in the context of the national and European Roadmaps, e.g.:

- National/regional funding typically covers a (large) fraction of access costs for investments, operational/running costs, and the facility personnel etc.
- Project funding (INFRAs + others) may cover costs for provision of services (TNA-VA) and support the user mobility for the use of services within a given financial scope prescribed by the grant. Within ACTRIS, specific funding has allowed users to access the services for about two decades.
- RI funding within ACTRIS currently ensures the access of users to ACTRIS data and digital services. However, in order to sustain any physical and remote/hybrid access provision, a coordinated RI

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access programme with a dedicated ACTRIS ERIC budget line and resource allocation covered by the member countries may be indispensable.

- Other funding sources, e.g., user fees can help offset expenses related to operational access provision. Different pricing schemes for tailored use or specific users (private sector, non RI members, …) are being developed and should be considered.

The financial aspects will have to be integrated into a cohesive strategy for access. The ACTRIS strategy work on funding of user access was initiated during the ACTRIS preparatory phase, in 2018. Both the **ACTRIS Access and service policy** as well as the **ACTRIS Data policy** were approved by the ACTRIS Interim ACTRIS Council[2] (IAC) and ACTRIS ERIC General Assembly in 2018 and 2023, respectively. They define the guidelines and general principles for access of users to ACTRIS services, data and digital tools. The associated **access management plan** and **data management plan** have been developed and further updated during the ACTRIS IMP project, defining the management procedures and workflows related to the access provision and data lifecycle.

The financial model underlying the operations of ACTRIS for the provision of user access to the data services is funded by the ACTRIS ERIC member countries. The funding of physical and remote/hybrid user access is not included, and efforts are made towards establishing an access programme within ACTRIS. In parallel, the IAC has approved the **9 principles for physical and remote access** funding in November 2020:

1. **Strengthen the comprehensive scope of access** → ACTRIS should aim at developing an access funding framework that promotes broad access to a large variety of services.
2. **Open and fair access funding** → ACTRIS should aim at developing an access funding framework that supports open and fair access of users to ACTRIS services.
3. **Flexibility and attractiveness of access funding** → ACTRIS should aim at developing an access funding framework that supports flexible solutions and enhances attractiveness and incentives for all stakeholders involved.
4. **Sustainability of physical and remote access** → ACTRIS should develop a an access funding strategy that ensures the long-term sustainability of physical and remote access.
5. **Coherent access cost model** → ACTRIS should develop and access cost model based on an identification and estimation of the full costs of physical and remote access.
6. **Transparent access pricing scheme** → ACTRIS should develop an adequate access pricing scheme for user fees based on clear and transparent rules.
7. **Promote free-of-charge access of users** → ACTRIS should develop an access funding framework that promotes free-of-charge access for academic users to foster scientific and technological achievements driven by excellence.

[2] The Interim ACTRIS Council (IAC) is the highest decision-making body for ACTRIS as a research infrastructure prior to ACTRIS ERIC establishment, consisting of representatives nominated by the ministries or organisations mandated to act on the behalf of the country.

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8. **Benefits of access to ACTRIS Members and Observers** → The ACTRIS access funding scheme should consider the benefits of being an ACTRIS member or observer.
9. **Coordinated access programme** → ACTRIS should adopt a coordinated ACTRIS access programme that includes physical and remote access to enhance visibility, relevance and impact, and to stay competitive and create value perception for the users.

With the approval of the principles of access, considered as pertinent guiding principles, the IAC expressed their support and recognition of the need for developing a funding strategy that enables physical and remote/hybrid user access for ACTRIS. Further dedicated activities for developing a sustainable financial solution for access, including a user pricing scheme, is currently underway.

4. Conclusions

The ACTRIS user strategy, presented in this document and completed by the Plan for enhanced user strategy with recommendations to ACTRIS facilities (ACTRIS IMP MS36), lay the groundwork for a comprehensive approach of ACTRIS to enhance the experience of users and to respond to their needs, while ensuring alignment with the overall ACTRIS strategy to provide effective access for a wide user community to its resources and services in order to facilitate high-quality Earth system research. The user strategy focuses particularly on providing the best possible user experience for physical and remote/hybrid access by optimising ACTRIS' user engagement and creating a user-friendly environment. It further aims at providing a robust framework to guide the future actions in the ACTRIS operational phase, building on the historical user experiences and considering the evolving needs and constraints, including financial considerations. As ACTRIS moves forward, implementation and iteration of the user strategy will be important, involving regular assessments, feedback integration, and agile adjustments to ensure the relevance and effectiveness of the user approach, and to create satisfying, user-centred experiences that contribute to the success and impact of ACTRIS.

5. Reference documents

ACTRIS IMP MS36 – Plan for enhanced user strategy with recommendations to ACTRIS facilities

ACTRIS IMP D6.5 – ACTRIS Access and service management plan (document not yet ready at the time of submission, can be found at https://www.actris.eu/how-are-we-funded/actris-imp-documents)

ACTRIS IMP D6.6 – ACTRIS Access management Platform

ACTRIS IMP D7.1 – Recommendations for optimizing the access process and user interaction

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ACTRIS IMP D7.2 – Recommendations for implementing access to ACTRIS services (document not yet ready at the time of submission, can be found at https://www.actris.eu/how-are-we-funded/actris-imp-documents)

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