



Technical and Scientific Description

Approved by the Interim ACTRIS Council in its 15th meeting

1 March 2021

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1 Executive summary

The Aerosol, Clouds and Trace Gases Research Infrastructure (ACTRIS) is an atmospheric Research Infrastructure (RI) that coordinates activities for documenting concentrations, understanding processes and quantifying impacts of short-lived atmospheric constituents on Earth's climate, air quality, human health and ecosystems. ACTRIS offers a unique portfolio of services used by a large community of scientists to conduct top-level research related to aerosol, clouds and reactive trace gases.

ACTRIS is constructed around large and comprehensive atmospheric research facilities, distributed across Europe and beyond, which serve for the acquisition of reliable high-quality data to document the distribution and variability of aerosol, clouds and reactive trace gases in the Earth's atmosphere. Some ACTRIS atmospheric research facilities also serve to investigate processes that control the life cycle of these short-lived atmospheric constituents under ambient and controlled laboratory conditions. ACTRIS produces and disseminates quality controlled and harmonized data from both long-term observations and shorter-term, process-oriented experiments. ACTRIS data provision follows FAIR (Findable, Accessible, Interoperable, Re-usable) principles. ACTRIS offers open access to a large portfolio of services, including training activities, physical and remote access to world-class research facilities, and tailored services, for the scientific community and other stakeholders in the public and private sectors.

ACTRIS ERIC (European Research Infrastructure Consortium) is the legal entity of ACTRIS, which coordinates and facilitates the establishment and operation of ACTRIS. As a complex distributed pan-European research infrastructure with many countries and institutions involved, ACTRIS is perfectly suited for adopting the ERIC regulation as a legal entity. Thanks to several years of joint efforts in the design and preparatory phase, ACTRIS entered a five-year implementation phase in 2020 and will commence the operational phase in 2025.

ACTRIS is a large RI with substantial financial volume. Considerable investments have been made by the participating countries during the design, preparatory and implementation phases, amounting to more than 700 M€, of which a large part is investment for upgrading the existing national facilities or building new ones. The estimated total implementation costs of the pan-European operations in ACTRIS (Head Office, Data Centre, Topical Centres) over 5 years is approximately 100 M€, and, from 2025 onwards, the estimated annual operation costs are approximately 16 M€. ACTRIS will create positive socio-economic effects directly from the development, maintenance and operation of ACTRIS, but also through the use of services by the wider research communities. ACTRIS is engaged in a multitude of collaborations with the private sector boosting European innovation potential into industrial production applications that are expected to grow with the international air pollution monitoring market. The use of ACTRIS by societal actors (including local authorities, environmental protection agencies, ministries, international organizations, weather services) is key for optimizing their environmental strategies and improving their decision-making processes.

ACTRIS is crucial for supporting scientific advances in the field of atmospheric research, extending from the fundamental understanding of atmospheric physical and chemical processes to improving the predictive capability of simulation models from local to global scales. ACTRIS contributes to reducing uncertainties in the life cycle of short-lived constituents, and to quantifying their potential impacts on climate, air quality and ecosystems, and on how climate-ecosystem feedback loops may change atmospheric composition in the future. ACTRIS enables the development of the required level of

understanding on the sources and fates of the air pollutants that negatively affect human health. ACTRIS observations are an essential contribution of Europe to international observing networks and a key component complementing Earth Observations from space, providing unique ground-truthing of remote sensing information collected by current and future satellite missions.

ACTRIS is fundamentally at the heart of grand challenges facing society: climate change and human health. Establishing ACTRIS as a sustainable RI will enable the expansion of the capacity to provide the science-based information necessary to face grand societal challenges.

2 Scientific relevance

The atmosphere is a highly complex system involving countless chemical and physical processes. The ability to predict the future behaviour of the atmosphere over all time scales from hours to decades brings great benefits to society and the economy. Examples span from short-term hazardous weather and pollution alerts, including early-warning systems, to the long-term evaluation of climate change and policy effectiveness. Reliable predictions and support for environmental policies require a sound understanding of the processes that are used in air quality and climate models underpinned by reliable observations. Without an observation system, based on state of the art research facilities producing high-quality data to constrain predictive models, the reliability of forecast of the atmosphere cannot be ascertained.

Because of their short residence times in the atmosphere, ranging from seconds to a few weeks, short-lived atmospheric constituents are highly variable in space and time. Their concentrations as well as physical and chemical properties largely affect:

- The Earth's radiation balance through absorption, scattering and indirect cloud-related processes, a major source of uncertainty in future-climate predictions;
- Air quality and public health, through long-term and short-term exposure to pollutants by deteriorating lung and heart functions and causing respiratory infections and heart diseases;
- Extreme weather events, by contributing to a changing energy balance at the ground and in the atmospheric column.

Emissions of pollutants change the atmospheric composition and contribute to climate change. Vice versa, climate change influences atmospheric composition through a series of feedback processes including changes in temperature, dynamics, the hydrological cycle, atmospheric stability, emissions of biogenic compounds and temperature-dependent transformation processes in the troposphere. However, the level of scientific understanding of the climate drivers, interactions and impacts is still very low.

Despite significant reduction in emissions of pollutants, atmospheric pollution is still a major cause of premature mortality in Europe with a significant fraction of the European urban population exposed to pollutant levels exceeding the current recommendations of the World Health Organization (WHO). Reducing the emissions of particles and reactive gases is needed to further improve air quality and contribute to tackling climate change, which is why Europe must continue to regulate emissions of short-lived atmospheric pollutants under the Long Range Trans-boundary Air Pollution (LRTAP) protocol of the Geneva Convention and the EU directive on national emissions ceilings. There is a clear need to provide high quality 4-dimensional (4-D) observations of the European atmosphere, develop reliable modelling tools to evaluate the effectiveness of public policies and to provide accurate predictions of future climate.

ACTRIS provides high-quality observations of aerosol, clouds and reactive trace gases, which constitute the basis for improving air quality, monitoring climate trends, establishing early-warning services on atmospheric hazards and enabling new knowledge about atmospheric processes. ACTRIS is unique in its architecture and disciplinary coverage within atmospheric and climate science. A robust and sustainable system producing high-quality data is also a crucial element for their use in forecast models including those of the Copernicus programme (Copernicus Atmosphere and Copernicus Climate, CAMS, C3S) and for the development of innovative services related to, e.g., human health and atmospheric hazards.

ACTRIS provides data from long-term observations of the atmosphere and specific experiments in controlled and natural environments to address the complex interactions between aerosol, clouds and reactive trace gases. Essentially, ACTRIS activities focus on:

- The chemical and physical properties of aerosol particles near the Earth surface, aerosol extinction and backscattering profiles throughout the troposphere and the lower stratosphere and integrated columnar aerosol properties;
- The concentrations of specific reactive trace gases and their oxidation products near the Earth surface and throughout the troposphere and lower stratosphere;
- The physical and chemical properties of cloud droplets and ice crystals and their dynamical evolution in natural clouds
- The processes by which aerosol, clouds and trace gases interact and thus impact air quality, precipitation, extreme weather, atmospheric hazards and climate change.

ACTRIS data and data products resulting from the integration of expertise will facilitate and enhance scientific exchange with user communities working on Earth system models, satellite retrievals, and analysis and forecast systems. ACTRIS will be the European research infrastructure for short-lived atmospheric constituents guiding the development for atmospheric observations.

2.1 ACTRIS Vision

ACTRIS is the fundamental European Research Infrastructure for short-lived atmospheric constituents increasing the excellence in Earth system observation and research, and providing information and knowledge for developing sustainable solutions to societal needs.

2.2 ACTRIS Mission

ACTRIS shall establish, operate, and develop a pan-European distributed research infrastructure for short-lived atmospheric constituents. ACTRIS shall provide effective access for a wide user community to its resources and services, in order to facilitate high-quality Earth system research.

2.3 Objectives of ACTRIS

The primary goal of ACTRIS is to produce high-quality integrated datasets in the area of atmospheric sciences and to provide services, including access to instrumented platforms, tailored for scientific and technological usage. The main objectives are:

- To provide information on the 4D-composition and variability and of the physical, optical and chemical properties of short-lived atmospheric constituents, from the surface throughout the troposphere to the stratosphere, with the required level of precision, coherence and integration;
- To provide information and understanding on the atmospheric processes driving the formation, transformation and removal of short-lived atmospheric constituents;
- To provide coordinated open physical and remote access to ACTRIS facilities for effective scientific, technological and innovative use of ACTRIS tools and services for a wide range of users, including the private sector;
- To provide efficient open access to ACTRIS data and services and the means to effectively use ACTRIS products;
- To ensure and raise the quality of data and use of up-to-date technology used in the RI and the quality of services offered to the community of users, involving partners from the private sector; and
- To promote training of operators and users and enhance the links between research, education and innovation in the field of atmospheric science.

3 Structure of ACTRIS

The core components of ACTRIS are the **Central Facilities (CFs)** and the **National Facilities (NFs)** as shown in Figure 1. ACTRIS Central Facilities perform ACTRIS operations at the European level and consist of six **Topical Centres (TCs)**, the **Data Centre (DC)** and the **Head Office (HO)**. ACTRIS National Facilities are **Observational Platforms** and **Exploratory Platforms** operated nationally.

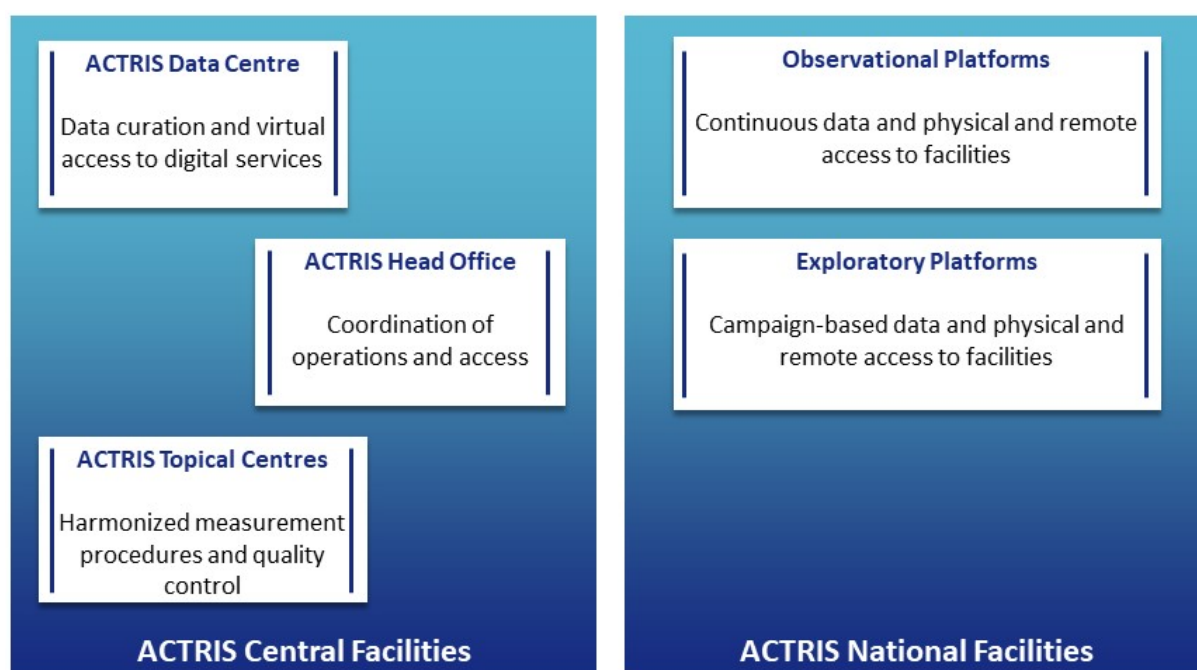


Figure 1. The core components of ACTRIS: National and Central Facilities

3.1 Central Facilities

The Central Facilities are fundamental for ensuring that ACTRIS procedures and policies are respected and maintained. Each CF is jointly operated as a consortium of several Units in two or more countries.

→ **Topical Centres** support the operation of NFs and are responsible for 1) defining procedures and tools for quality assurance and quality control of ACTRIS measurements and data, 2) performing quality assurance and quality control of ACTRIS instruments and measurements, 3) NF labelling and evaluation of NF performance, 4) links with associated scientific communities, 5) ensuring training and transfer of knowledge to ACTRIS operators and users, and 6) improving measurement methodologies for aerosol, clouds and reactive trace gases. Six TCs are set up to respond to the scientific and technical needs of ACTRIS, each with a particular focus on either remote sensing (from the ground) or in-situ (near-surface) measurements. The TCs are:

- Centre for Aerosol Remote Sensing;
- Centre for Aerosol In-Situ Measurements;
- Centre for Cloud Remote Sensing;
- Centre for Cloud In-Situ Measurements;
- Centre for Reactive Trace Gases Remote Sensing;
- Centre for Reactive Trace Gases In-Situ Measurements.

→ **ACTRIS Data Centre** is the one stop shop for all ACTRIS data. It provides management and organisation of ACTRIS data and value-added products, including long-term archiving and access to data, tools for data production, visualization, evaluation and analysis. ACTRIS data is quality controlled from ACTRIS NFs, including both Observational and Exploratory Platforms, complying with the procedures established within ACTRIS. DC is responsible for the data curation activity that stores, manages and ensures access to all data sets produced within the infrastructure. This includes quality control, data citation service, attribution and version control of data. Accordingly, DC offers operation support to NFs and provides services to all users of ACTRIS data.

→ **ACTRIS Head Office** develops and promotes the long-term sustainability of ACTRIS in all its aspects. HO coordinates, develops, monitors and integrates the RI operations together with facilitating the work of ACTRIS governance and executive bodies. HO includes the Service and Management Unit (SAMU), which connects all users with ACTRIS services and access providers (e.g. ACTRIS CFs and NFs). HO provides outreach and information on ACTRIS and ACTRIS services, facilitates membership, and strengthens international collaboration, providing research and training opportunities for all users.

The eight Central Facilities, operated by the respective hosting multinational consortia, were approved by the Interim ACTRIS Council (IAC) in December 2018 after an independent selection process taking into consideration their capacity, expertise and commitment for implementing the required operation support and services. Each Central Facility consists of several Units hosted by ACTRIS Research Performing Organisations (RPOs) in different countries. Detailed information about the Units and hosting RPOs within each CF is presented in Annex 2. CFs participate in ACTRIS management and provide operation support to NFs as well as services to the users according to the ACTRIS Access and Service Policy.

3.2 National Facilities

The **National Facilities** consist of Observational and Exploratory Platforms, developed, managed and operated by national RPOs. **Observational Platforms** are fixed, ground-based stations located within Europe and at selected global sites. They acquire reliable high-quality data on the variability of aerosol, clouds and trace gases and their complex interactions by applying standardized remote-sensing and in-situ measurement techniques. **Exploratory Platforms** comprise atmospheric simulation chambers, laboratories and mobile platforms. They perform dedicated experiments and provide quality-controlled data on atmospheric compounds, processes, events or regions of relevance by following common standards. Exploratory Platforms and selected Observational Platforms also provide physical and remote access to users, which is centrally managed via SAMU, following the ACTRIS Access and Service Policy.

ACTRIS NFs apply a strict quality assurance / quality control (QA/QC) strategy. TCs and DC provide support to NFs and supervise the quality-assurance measures from instrumental setup to data delivery. Data are transferred to DC in compliance with the procedures, formats and timelines described in the ACTRIS Data Management Plan and the respective technical documentation. All data from NFs are published following the ACTRIS Data Policy and the FAIR principles.

Depending on the national strategy and the success in the labelling process, 80 Observational Platforms are foreseen. In addition, ACTRIS members and observers plan to operate 33 Exploratory Platforms, of which 17 are mobile platforms and 16 are atmospheric simulation chambers and laboratory platforms. The number and type of NFs planned to be provided by each country are presented in Table 1. The National Facility labelling process will start immediately after the establishment of ACTRIS ERIC. The principles for the selection and the process for labelling of NFs have been approved by the Interim ACTRIS Council in 2018.

Table 1. Foreseen number of National Facilities in each ACTRIS member and observer country.

Country	Expected Number of National Facilities			Total NF number
	Observational Platforms	Mobile Platforms	Atmospheric Simulation Chambers and Laboratories	
Austria	3			3
Belgium	4*	1		5
Bulgaria	2			2
Cyprus	2	1		3
Czech Republic	4			4
Finland	8	5	2	15
France	6*		2	8
Germany	14	5	5	24

Greece	5	1	1	7
Italy	7	2	1	10
The Netherlands	1			1
Norway	4			4
Poland	6	1		7
Romania	4	1	1	6
Spain	7		1	8
Switzerland	2*		1	3
UK	2		2	4
JRC**	1			1
Total	80	17	16	113

* There is one site co-operated by Belgium and France and one co-operated by Belgium and Switzerland counted in all countries, but only once in the total numbers.

**The European Commission Joint Research Centre (JRC) is listed separately, as it is not affiliated to any individual country.

Figure 2a shows the distribution of **Observational Platforms** that are foreseen for the operational phase in 2025, according to the plans of the 17 Members and Observers represented in the Interim ACTRIS Council. The platforms are located in diverse climatic regimes across the European continent and at key sites in the tropics, subtropics and polar regions. The sites located outside Europe are operated by European RPOs, often together with local partner institutions. Each Observational Platform contributes to at least one of the six ACTRIS observation types (remote sensing or in-situ measurement of aerosol, clouds or trace gases). Most sites have a long-term heritage, are part of national observatories and contribute to European and international networks such as EMEP, AERONET, EARLINET, Cloudnet, NDACC or GAW. During the implementation of ACTRIS, substantial upgrades of existing measurement sites are planned at national level, and several new platforms will be established to close observational gaps. Several sites will be co-located with other environmental infrastructures such as ICOS, SIOS, ANaEE or eLTER.

The **Exploratory Platforms** shown in figure 2b are split into 3 categories: 1) atmospheric simulation chambers that perform dedicated experiments under controlled conditions, 2) laboratories offering unique sets of instruments for the characterization of aerosol, clouds and trace gases in ambient conditions, and 3) mobile platforms comprising land-based, shipborne and airborne facilities, such as instrumented tethered balloons and unmanned aerial vehicles, for the investigation of various processes under specific meteorological, climatic or topographic conditions in selected environments and ecosystems not covered by the observational sites.

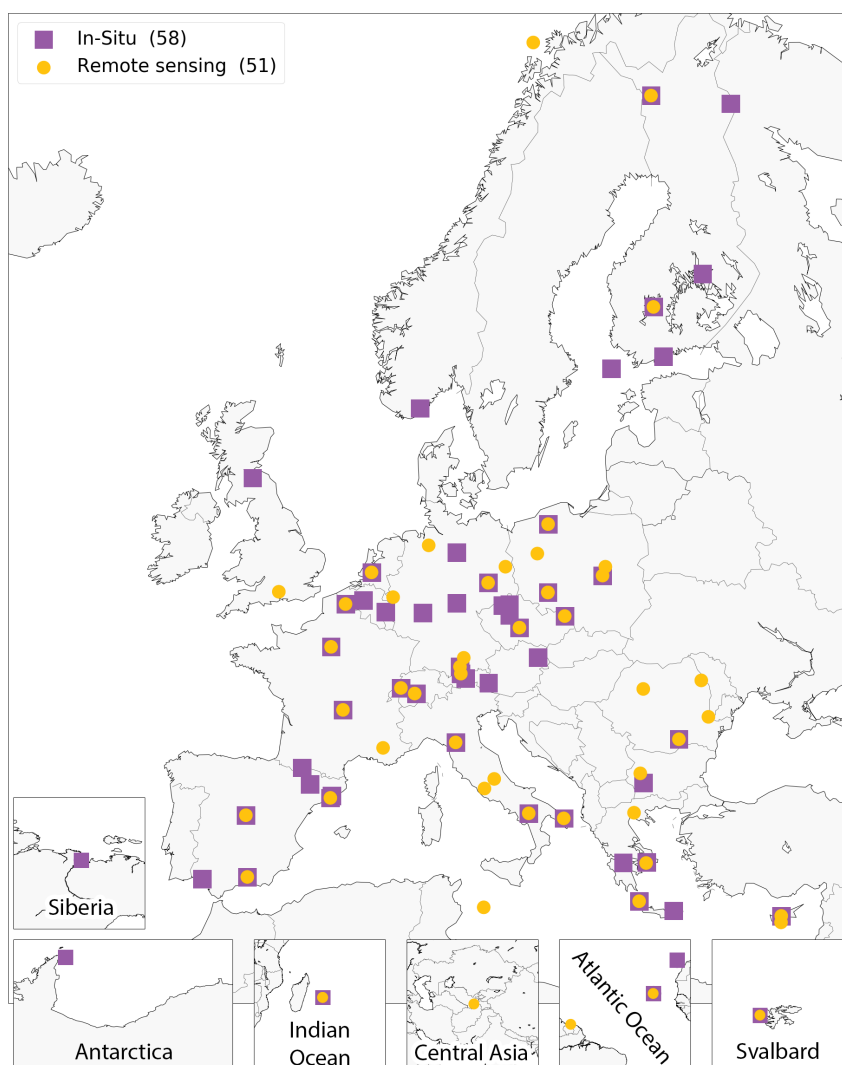


Figure 2a. Location of Observational Platforms proposed to ACTRIS by the participating countries. The colours indicate National Facilities performing either in-situ observations near the Earth surface (purple) or remote-sensing observations throughout the troposphere up to the stratosphere (yellow) or a combination of both (purple and yellow).

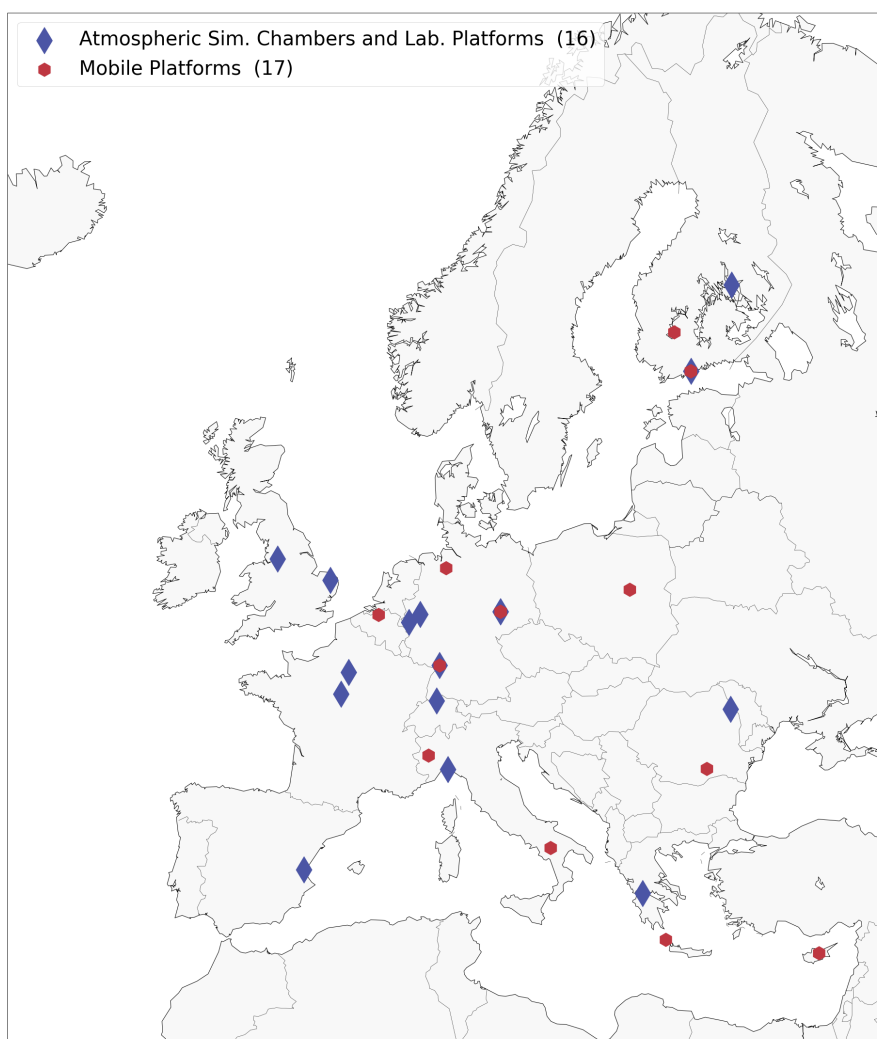


Figure 2b. Location of exploratory Platforms proposed to ACTRIS by the participating countries. The colours whether the platform is an atmospheric simulation chamber or laboratory facility (blue) or a mobile platform (red). The mobile platforms are marked at the location of their host institute.

3.3 Interactions between the ACTRIS components

The operability of ACTRIS builds on the clear roles and interactions between the different components. NFs produce data that are processed and stored in DC. TCs provide standardized operation procedures and quality control as operation support to NFs to assure data quality. HO coordinates the activities and provides user access to the data and services, including access to selected facilities. None of the components can operate alone, but the entire operation is based on interactions between the components.

The set-up of clear procedures, as well as continuous and effective management of the workflows between the components ensure the efficient operation of ACTRIS that will be monitored by internal performance indicators. The internal operation procedures define the administrative interactions between the ACTRIS components, whereas the ACTRIS Data Management Plan and the ACTRIS Access

Management Plan outline the tasks, responsibilities and interlinkages of NFs and CFs in the service provision.

For external users, procedures for accessing ACTRIS services will be facilitated through the single entry point at the ACTRIS web portal. Depending on the requested service, it is directly accessed (data and digital services) or provided with the mediation of the Head Office (physical or remote access to ACTRIS facilities) in cooperation with the facility in question.

4 ACTRIS ERIC

The ACTRIS European Research Infrastructure Consortium (ERIC) is the legal entity of ACTRIS. The main task of ACTRIS ERIC is to establish and operate a distributed research infrastructure. ACTRIS ERIC provides the coordination, integration, access and service provision, development, monitoring, and governance of ACTRIS, and is in charge of the strategic and financial development and the long-term operation and sustainability of ACTRIS. ACTRIS ERIC also coordinates and facilitates ACTRIS interactions with stakeholders, global and regional initiatives. ACTRIS ERIC activities are managed or facilitated by the ACTRIS Head Office.

The tasks of ACTRIS ERIC are described in Article two of the ACTRIS ERIC Statutes and are the following:

- Coordinate and monitor adequate provision of data from the National Facilities;
- Coordinate and monitor activities at the Central Facilities and their service development strategies;
- Ensure open and timely access to ACTRIS data and data products through the Data Centre;
- Operate a physical and remote access program to the Topical Centres, Data Centre and National Facilities;
- Any other activity to fulfil its objectives.

ACTRIS ERIC shall also carry out other activities, such as:

- promote ACTRIS to science communities, private sector and the general public;
- implement societal and technological developments related to the tasks of ACTRIS;
- develop joint activities with user groups including industry;
- promote knowledge transfer to industry and policy makers;
- harmonize the ACTRIS implementation with national priorities and strategies;
- promote the resources of ACTRIS for education and training purposes;
- collaborate and interoperate with other research infrastructures in related and complementary fields;
- foster training, outreach and international cooperation;
- participate as a funded or funding partner in scientific research activities relevant for its tasks; and
- any other related action necessary to achieve its aim.

The statutory seat of ACTRIS ERIC is located in Helsinki, Finland. ACTRIS ERIC includes all functions of ACTRIS Head Office and part of the Data Centre (ACTRIS DC management board). HO has four Units of which three are located in Finland (ERIC Management Unit, EMU; Research Infrastructure Operations Unit,

OPU; Development and Relations Unit, DEVU) and one (Service and Access Management Unit, SAMU) is located in Italy. The HO Management Board has representatives from all HO units. In addition, ACTRIS ERIC will start with the Head of Units of the Data Centre, located in Norway, Finland, Italy and France, also contributing part of their working time, minimum 10-15%, to ACTRIS ERIC in the implementation phase (2020-2024). During the implementation phase, it will be further studied whether ACTRIS ERIC should continue with this structure in the operational phase, if ACTRIS ERIC should start a process to appoint a DC Leader who would be a full-time employee of ACTRIS ERIC, or if the operational phase should start with a different/hybrid solution.

All other parts of the ACTRIS Central Facility and National Facility activities will be engaged with ACTRIS ERIC through agreements, described below. ACTRIS ERIC remains open to all Central Facilities being included in the legal entity if agreed by the ACTRIS ERIC members and permanent observers at the later stages of ACTRIS development.

4.1 ACTRIS ERIC linkages to the Central Facilities and the National Facilities

The cooperation agreement between ACTRIS ERIC and RPOs hosting the Central Facility units shall regulate the obligations and rights of RPOs and ERIC. Obligations of RPOs hosting Central Facility units include, but is not limited to, timely delivery of the agreed activities and services to the agreed level of quality; provision of the annual work plans and reports and financial plans and reports to ACTRIS ERIC; monitoring the activities of the Central Facility by use of Key Performance Indicators (KPIs); allocating resources to contribute and participate in CF-specific work of ACTRIS ERIC governance and management bodies; following the ACTRIS strategy and ACTRIS ERIC policies as well as internal rules; and implementing the decisions of the ACTRIS ERIC General Assembly (GA) relevant to the Central Facility. The obligations of ACTRIS ERIC include topics such as, but not limited to, collecting annual work plans and reports and financial plans and reports from each CF; allocating a budget according to the General Assembly decision and financial rules to each CF; providing information on national ACTRIS developments to CFs to enable the planning of work and resources; monitoring of KPIs from CFs; following the ethical issues and Intellectual Property Rights; and managing the access process and interaction with each NF and CF (labelling, capacity/feasibility check, organisation of calls, evaluation, selection, implementing the user access, reporting) for CF and NF services.

ACTRIS ERIC is liable only for those activities that are performed within ACTRIS ERIC. It is not liable for activities run by CFs that are linked by contractual agreements to ERIC.

In addition to the cooperation agreement between ACTRIS ERIC and CFs, RPOs hosting a Topical Centre or the Data Centre shall establish a consortium agreement among each other for defining the sharing of the CF operations, and the rights and obligations of each participating host organisation contributing to each CF.

The National Facilities are the backbone of ACTRIS as they are responsible for the data generation, scientific cooperation and improved process-understanding, and providing physical access for ACTRIS Users. National Facilities are operated and financed at the national level and are typically hosted by RPOs. National Facilities are linked to ACTRIS ERIC by agreements (between ACTRIS ERIC and hosting RPO(s), termed an ERIC – NF agreement). The ERIC – NF agreement defines the expected operations and services from the National Facilities as part of the Research Infrastructure. In particular, it defines the obligations and rights of the hosting RPO(s) and can include, but is not limited to, the following obligations: generation

of data according to ACTRIS standards, contributions to ACTRIS RI and, if relevant, provision of physical/remote access in accordance with ACTRIS standards and requirements and compliance with the ACTRIS Access and Service Policy and ACTRIS Data Policy that regulate the provision of access to ACTRIS services and data.

The ERIC - NF agreement will be signed at the end of the labelling process by the hosting RPO(s) and ACTRIS ERIC, after the official approval of the ACTRIS National Facility label. The commitment of the resources for long-term operation of each NF is given by RPOs in the initial step of the NF labelling process.

ERIC - NF agreements need to be approved and signed by all independent RPOs contributing to ACTRIS.

4.2 Financial linkage between ACTRIS ERIC and RPOs hosting CF and NF activities

Contribution principles for the funding regarding ACTRIS ERIC and ACTRIS CFs are defined in the ACTRIS ERIC statutes Annex 2.

As stated in the statutes, the resourcing of the ACTRIS National Facilities is organized nationally, and their funding shall not be considered as Host premium or membership contributions to ACTRIS ERIC or Host contributions to the Central Facilities that are not part of ACTRIS ERIC.

The countries hosting the Central Facility units shall be responsible for financing their construction, according to their national arrangements. The operations of the Central Facilities that are part of ACTRIS ERIC are partially funded through the Host premium contributions by the Host Countries and partially through the Membership contributions of ACTRIS ERIC members, permanent observers and observers, as described below. The operations of the Central Facilities that are not part of ACTRIS ERIC are partially funded through the Host contributions by the Central Facility Host Countries and partially by ACTRIS ERIC through reallocation of the Membership contributions.

The membership contributions will be collected from the members, permanent observers and observers according to the rules defined in the Internal Financial Rules as approved by the General Assembly. ACTRIS ERIC is responsible for allocating the agreed contributions to each Central Facility.

5 Governance and management

5.1 ACTRIS ERIC governance structure

ACTRIS ERIC governance is illustrated in figure 3 and includes the following components:

General Assembly

The General Assembly shall be the governing body of ACTRIS ERIC and shall be composed of delegates of the members, permanent observers and observers. Each member, permanent observer or observer shall be represented by up to two delegates. The General Assembly shall meet at least once a year and be responsible for the overall direction and supervision of ACTRIS ERIC.

The General Assembly decides, for example, on the RI strategic orientation and the functions and structure of ACTRIS. The General Assembly approves annual work plans, budget, accounts and activity reports of ACTRIS ERIC, and termination of activities or ACTRIS ERIC itself.

Advisory bodies to General Assembly

The General Assembly is supported by advisory bodies, such as a Scientific and Innovation Advisory Board (called the Scientific and Implementation Advisory Board during the Implementation Phase), an Ethical Advisory Board and a Financial Committee.

Director General

The Director General shall be appointed by the General Assembly according to a procedure adopted by the General Assembly. As listed in the ACTRIS ERIC Statutes, the Director General:

- shall be employed by ACTRIS ERIC.
- shall be the legal representative of ACTRIS ERIC.
- shall be responsible for the implementation of the decisions by the General Assembly and ensure the scientific and strategic development of ACTRIS meets the expectations on socio-economic impact, technology development and innovation.
- shall actively contribute to community building and fostering external relations and strategic partnerships as well as overseeing and coordinating ACTRIS activities.
- shall represent ACTRIS ERIC in any litigation.
- shall be selected for a term of five years and GA may renew the term once.

As the leader of the ACTRIS research infrastructure, the Director General represents all aspects of ACTRIS equally. The Director General oversees all research infrastructure activities, can delegate his/her tasks to other management bodies of ACTRIS and, if needed, can establish groups, boards and committees within ACTRIS ERIC to support his/her work and daily coordination tasks.

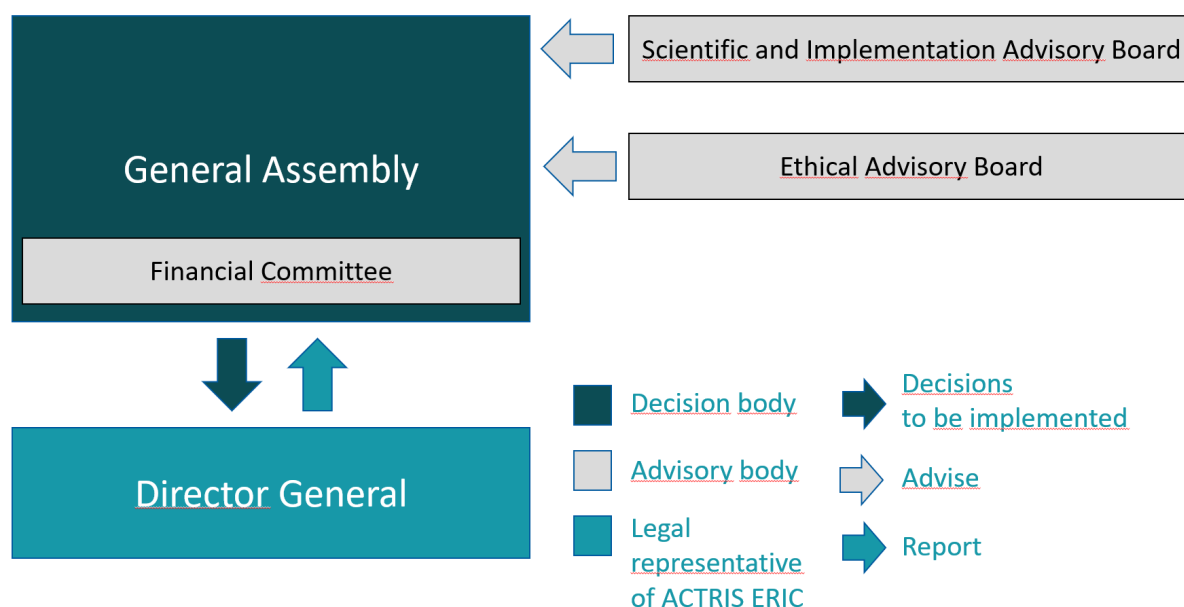


Figure 3. ACTRIS ERIC bodies and the main features of the ACTRIS governance structure.

5.2 ACTRIS management structure

As ACTRIS is a large and multi-layered research infrastructure, it needs clear internal rules and a management structure with clear managerial processes to operate ACTRIS efficiently and to support the

Director General. In addition, it is important to accommodate the needs and interests of involved RPOs and be flexible enough in developing efficient structures in bottom-up processes.

The ACTRIS management structure is illustrated in Figure 4 and includes the following components:

Central Facility leaders

The Central Facility Leaders (leaders of the Head Office, Data Centre, and the six Topical Centres) are responsible for leading, managing, developing and implementing the activities of their Central Facility according to the agreed ACTRIS policies and rules. Central Facility Leaders are members of the ACTRIS Research Infrastructure Committee (RI Committee) and contribute to the development of ACTRIS as a unified well-functioning research infrastructure. Central Facility Leaders interact with the Central Facility Units of their respective CFs and their staff, and within the RI Committee with the Director General. They also interact with the National Facilities and data users.

Central Facility Management Boards

Each Central Facility has an internal CF Management Board to support the implementation of CF tasks and the daily CF operation and management. Management Boards are chaired by the CF leader and include the Head of each CF Unit.

Research Infrastructure Committee

The Research Infrastructure Committee (RI Committee) is the highest level scientific and technical advisory body responsible for consistency, coherence, sustainability and development of ACTRIS. The RI Committee supports the Director General in the management of ACTRIS, particularly related to implementation and scientific and technical issues. The RI Committee develops strategic and scientific plans together with the Director General and HO, and strengthens the communication among the National Facilities (NFs) and Central Facilities (CFs). The RI Committee is convened by the Director General, and shall have representatives both from the Central Facilities and from National Facilities. The composition and the nomination processes are described in the internal rules.

Other bodies

In addition to the above-mentioned bodies, ACTRIS will have other advisory and support bodies, such as a National Facility Technical and Scientific Forum. The forum focuses on technical and operative matters and joint scientific activities to develop the RI, and ensures the connection between the scientific expertise and technological development. A Simulation Chamber Committee supports the operation of simulation chambers on matters related to procedures, quality, consistency and relevance. The feedback the advisory bodies is important for the RI development and sustainability.

National level bodies

All countries participating in ACTRIS have a substantial community involved in ACTRIS consisting of numerous RPOs that contribute to the ACTRIS operations in their countries. Therefore, well organized governing and managing structures are also needed at the national level. Most countries have their own national ACTRIS consortia with its internal management structure and often an appointed national ACTRIS coordinator. Furthermore, all ACTRIS Member and Observer countries have nominated a National Contact Person ensuring information flow between the European level ACTRIS activities and national activities.

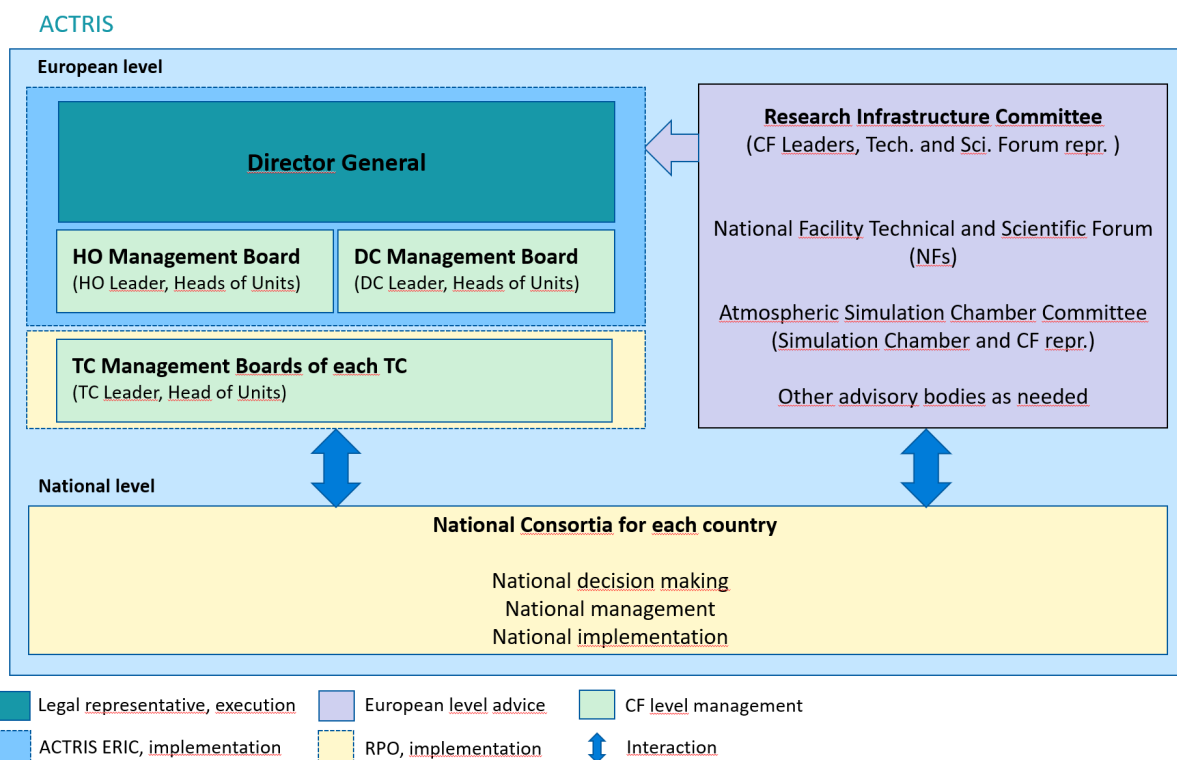


Figure 4. ACTRIS management structure.

6 ACTRIS services

ACTRIS offers access to a large variety of high-quality services to a wide range of users and needs, for scientific, technological and innovation-oriented usage.

Access opportunities are offered to researchers worldwide, although experience of access in the past shows that the European research community has benefited to a greater extent so far, with an average of 86% of access provided to EU researchers and 14% to non-EU scientists.

Access of users to ACTRIS services is provided physically, remotely or virtually (operation support offered to the ACTRIS National Facilities is excluded). The two main type of services are:

- (1) virtual access to data services – high quality, harmonized, and documented ACTRIS data and digital products originating from observational and exploratory platforms and provided via DC
- (2) Physical and remote access to services provided by ACTRIS DC, TCs and selected NFs

The services and access to them are elaborated below.

6.1 ACTRIS data, data products, and digital tools

Data services related to ACTRIS data, data products, and digital tools provided by ACTRIS Data Centre include:

- Access to quality controlled ACTRIS measurement data from both observational and exploratory platforms, data products, and digital tools, through a single entry point, comprising raw data, calibrated data and quality-assured data with corresponding uncertainties;

- Meta data associated with the data products documenting the data, data traceability and data flow, citation service, and data attribution, including version control; and
- Data curation service for campaigns and dedicated research projects and initiatives, external or internal to ACTRIS.

ACTRIS provides access to observation data covering a comprehensive set of variables, listed in Annex 1 next to the respective TC, together with combined higher-level data products that are listed next to the DC description. These also include data from simulation chamber experiments, comprising information on the full experiment data and the experimental conditions. Finally, additional data and data products are available on request. ACTRIS data are a European contribution to international networks such as GAW (GALION, SARGAN), NDACC, and AERONET.

6.2 Access to services of the ACTRIS Facilities

ACTRIS offers open and effective physical and remote access to a wide number of ACTRIS resources and services provided by CFs and NFs. Access to observational and exploratory platforms and to experimental facilities hosted by various TCs is key to promoting technological developments, state-of-the-art research projects, and supporting innovation. The specific services include:

- **Research service**; a centralized modality to access ACTRIS observational and experimental facilities equipped with state-of-the-art instrumentation and equipment for realisation of scientific experiments under ambient or controlled conditions;
- **Technical service**; a centralized modality to use ACTRIS facilities hosted by the various TCs for instrument-specific calibration, testing, and inter-comparison with a reference instrument;
- **Innovation service** dedicated to market-oriented applications and decision-making, targeting the use of ACTRIS facilities and knowledge by the private sector; and
- **Training service**; training of ACTRIS Users to use ACTRIS data and tools, targeted courses on atmospheric challenges, capacity building activities for related infrastructures etc.

6.3 ACTRIS access strategy

ACTRIS aims at providing efficient and effective access to the resources and services of ACTRIS for a broad community of users around the world to support excellent research, foster innovation and provide high-quality information for society to tackle societal challenges related to air quality, climate change and health. The guidelines and general principles for access and use of ACTRIS data and services are defined in the **ACTRIS Data Policy** and **ACTRIS Access and Service Policy**, and the management, detailed rules, procedures and workflows are described in the **ACTRIS Data Management Plan** and the **ACTRIS Access Management Plan**. ACTRIS has an open access policy available for all users. ACTRIS ERIC shall respect and comply with any European and national legislation as applicable regarding the protection of personal data and privacy, environmental science data as well as health and safety at work. The **Ethical Guidelines** to be approved by the ACTRIS ERIC General Assembly for ACTRIS shall be applied to the **ACTRIS Data and Access Policy**. ACTRIS follows all principles and guidelines set by the European charter for access to Research Infrastructures.

Virtual, Physical and Remote access to services of the Central Facilities and National Facilities is centrally coordinated by Head Office. **Virtual access** to ACTRIS data and digital services that can be simultaneously used by a large number of users is wide and free, and it is provided by DC through the ACTRIS website.

There is no selection of users, and the data provision follows the ACTRIS Data Policy and ACTRIS Data Management Plan.

The provision of **physical and remote access** is competitive as it depends on the facilities' capacity available for users, which is not unlimited and varies from site to site. Thus, a selection process has been established, following defined procedures and specific criteria. The access can be either excellence-driven, technical-need driven or market-driven. For each access mode, the selection is based on availability at the facility and relevant criteria evaluated by a panel of experts. The centralized management of access to the ACTRIS services is entrusted to the Service and Access Management Unit (SAMU) of ACTRIS HO. SAMU organizes, simplifies and automates as much as possible the central management of physical and remote access for the entire RI, guiding and controlling each step of the process (application, availability check, management, review and selection, approval, support to access and monitoring/reporting) and facilitating an optimized management of facility availability. Costs generated by the provision of services to users need to be covered, also with the possible contribution of the users accessing the services. Fees for access, to the extent found necessary, should contribute to the financial sustainability of the ACTRIS service provision.

7 ACTRIS user communities and added value

7.1 The value proposition for user communities

ACTRIS users originate from academia, public and private non-profit research organisations, other non-profit organisations, as well as from business, industry, national and regional authorities and public services, and private citizens, from ACTRIS members and observers and from countries outside ACTRIS, inside and outside Europe. ACTRIS has developed a specific value proposition for the core user communities to ensure that services are positioned around what users value and need.

ACTRIS value proposition for researchers

- Enhancement of research performance due to centralized access to high-quality data and specific services;
- Access to research platforms for conducting excellent research and creating new scientific knowledge; and
- Increased possibilities for international collaboration, large-scale research projects and training opportunities.

ACTRIS value proposition for the private sector

- Enhancement of R&D performance due to facilitated access to ACTRIS facilities, data and other specific services;
- Support for the development and standardization of novel technologies and products through participation in the European Centre for Normalization activities.

ACTRIS value proposition for policy makers

- Support for policy-driven networks established under EU-directives and UN-directives (local and European air-quality networks);
- Evaluation of environmental (air quality and climate) policies in relation to regulation strategies and emission abatement through direct evaluation of atmospheric trends at regional / European scale;
- Decision-making regarding environmental issues by provision of high-quality and long-term data for predicting climate scenarios from local and regional up to national and international level;
- Support to atmospheric hazard management and risk mitigation via the knowledge base of ACTRIS expert teams and monitoring of extreme atmospheric events.

ACTRIS value proposition for ministries and funding organisations

- Establishment of a unique research infrastructure for atmospheric sciences within Europe to improve efficiency of operation and coordination among the European research institutions avoiding the duplication and fragmentation of research efforts; and
- Providing better value for money via strong pan-European dimension and coordinated access to data and services; added value for research, innovation, and society through efficient use of the RI resources;
- Internationalization of the areas in which NFs are located, increasing their attractiveness being part of pan-European RI.

ACTRIS benefits to society (e.g. general public, national and international media)

- Improved weather, climate and air quality predictions resulting from ACTRIS;
- Enhanced awareness on the environmental challenges that society is facing, e.g., climate change and air quality issues; and
- Promotion of dialogue between researchers and society to translate scientific knowledge into practical applications.

ACTRIS benefits to Europe and to the international community

- Facilitating cutting edge science and excellence in European research;
- Contribution to further development of the European Research Area enhancing cross-border collaboration; and
- Provision of data and services as the European part of international networks.

7.2 ACTRIS user strategy

ACTRIS aims to place serving its users at the centre of ACTRIS operations and strategic development. The ACTRIS user strategy will guarantee that the value proposition offered to the identified user communities remains current and continues to fit user needs.

The strategy will support the continuous provision of value in terms of services, assistance, knowledge, know-how etc., which ACTRIS can offer to users in response to their needs, based on the technical capabilities of the Central Facilities and National Facilities and in line with the overall ACTRIS mission.

The user strategy consists of many perspectives that need to feed into an overall cohesive and consistent perspective. The strategic perspectives to be taken into account are:

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- Service development strategy: services developed in response to user needs, resulting from the user requirements analysis;
 - User engagement strategy: a strategy on how to establish a close relation between ACTRIS, its facilities and the users, and how to shape, nurture and maintain ongoing interactions between ACTRIS and the users, working co-operatively with the users so that they have a real influence over the services that are relevant for their research. It is about earning the trust of users;
 - User experience strategy: a strategy on how to ensure that the overall experience of ACTRIS (services, interactions, support, whatever) is positive, satisfactory, and not arduous for users; and
 - User acquisition strategy: a strategy on the selection and adoption of the suitable approach to get new users on board, mainly through communication, by defining messages and using various means to familiarise potential users with ACTRIS services and to use them for their excellent science.

8 Impact of ACTRIS

8.1 Socio-economic impact

ACTRIS constantly evaluates its impact on knowledge-building, societal contribution, on regional and national economies, capacity building and human capital development. According to the socio-economic assessment conducted in 2017, ACTRIS creates positive socio-economic effects through several impact pathways: direct impact on the ACTRIS community (RPOs, companies) involved in the development, maintenance and operation of ACTRIS; wider research communities (research groups, organisations and programs) utilizing the outcomes of ACTRIS; industry and societal actors (including local authorities, environmental protection agencies, companies, ministries, international organisations, weather services) using ACTRIS outcomes to optimize their services and environmental strategies and improve their decision-making processes.

ACTRIS facilitates the uptake of services by the private sector by offering a simplified identification of, and access to, resources located in Europe. During 2008-2016, organisations involved in ACTRIS signed contracts with approximately 100 private companies to develop, upgrade or use the research infrastructure. Partnerships with industry and more generally, the private sector, have generated funding to partners, and the innovative character of ACTRIS is manifested by the 19 patent applications filed in 2008-2016, 12 of which had already been granted by 2017. National ACTRIS activities had led to the creation of 12 start-ups and spin-offs by 2017. Furthermore, during 2008-2016, approximately 140 new methodologies, prototypes or designs were developed within the ACTRIS community, some in conjunction with National Metrology Institutes and adopted as Centre for European Normalization (CEN) standards. ACTRIS has proven a very efficient leverage for attracting national and international research funding. It is estimated that approximately 300 M€ has been raised for performing research using ACTRIS during 2008-2016 (approximately 27 M€ per year). During that period, for each 1 M€ already invested in the development, maintenance and upgrading- of the research infrastructure, another 0.92 M€ was acquired through research and development programs. The long-term sustainability of ACTRIS, together with the increased visibility of its Catalogue of Services will clearly augment the attractiveness of ACTRIS for partnership with both academics and the private sector.

8.2 ACTRIS impact on strengthening and improving the European Research Area

ACTRIS strengthens European research by several means identified in the European Research Area (ERA) 2020 scheme. ACTRIS creates a single borderless market for research and data in the field of atmospheric science, including borderless access to the best atmospheric research facilities in Europe to foster science, innovation and technology development. ACTRIS member and observer countries have joined together to pool their resources and to streamline their research funding into a single Research Infrastructure, enhancing the mobility of researchers, data, knowledge and innovation within Europe and beyond. More specifically (but not limited to):

- ACTRIS strengthens ERA action 2 (***Support Member States in the coordination and prioritization of national research and innovation funding***) by enabling the Member States to coordinate their research funding in the atmospheric field into a single Research Infrastructure instead of fragmented and overlapping efforts;
- ACTRIS strengthens ERA action 4 (***Support Member States that have lower performance in training their researchers to access and develop excellence and increase their number of highly cited publications by one-third over 5 years***) by making research data and access to research facilities available to all regardless of the investments in research in the country where the researcher originates. This also supports the research in the Member States where the investments available for, and performance in training of, researchers are lower. The common data standards are also likely to boost large-scale international collaboration in the atmospheric science community leading to more high-impact publications including participants from those countries with currently lower research performance;
- ACTRIS strengthens ERA action 6 (***Develop and test a networking framework in support of Europe's research and innovation ecosystems, building on existing capacities, to strengthen excellence and maximise the value of knowledge creation, circulation and use***) by organizing and pooling together the existing capacity and past investments made in the ACTRIS Member and Observer countries, maximizing the creation, circulation and use of data and new knowledge and strengthening excellence in science;
- ACTRIS strengthens ERA action 8 (***Deliver a toolbox of measures to support researchers' careers, through a mobility scheme, trainings and more, in order to make Europe more attractive for talent***) by creating a powerful tool for supporting researcher careers. Not only does ACTRIS make data and access available for all, but also creates strong hubs of scientific and technological excellence attracting researchers, provides staff exchange programs and organizes training activities for both staff and users;
- ACTRIS strengthens ERA action 10 (***Support the creation of world-class research infrastructures and establish an updated governance structure for research and technological infrastructures***) by creating a new world-class research infrastructure for short-lived atmospheric constituents – a field where such a coordinated effort did not exist before;
- ACTRIS strengthens ERA action 12 (***Develop concrete plans with Member States to promote gender equality, as well as diversity and inclusiveness, in science, research and innovation***) with gender equality being a central part of its human resources strategy. Gender balance has already been studied in the projects leading towards ACTRIS and has been found to be exceptionally well balanced in respect to other initiatives in the field of physics;

- ACTRIS strengthens ERA action 13 (*Organise citizen science campaigns and hackathons to engage citizens, especially young people, in science and innovation*) by not only dissemination of information but also by involving citizens in science projects, already demonstrated by several host institutions of ACTRIS facilities; and
- Finally, ACTRIS contributes to ERA action 14 (*Develop with Member States a new approach to set and implement strategic priorities for the European Research Area, through a Pact for Research and Innovation in Europe*) by creating knowledge that allows Member States to set and implement strategic priorities in their research and funding and enabling a more specified focus on research.

8.3 ACTRIS impact on scientific knowledge

ACTRIS creates excellent science in the field of atmospheric and Earth climate research. In the last 10 years, ACTRIS has resulted in more than 8 000 scientific papers and 100 book chapters. More than 900 Masters and PhD students performed part of their research, and more than 2 200 graduates received training, in ACTRIS facilities. Publications in international journals exceeded 3 600, approaching 410 annually. Within the frame of ACTRIS, new patents, methodologies, prototypes, and instrument designs have been developed to foster the development of new methods for air quality control and climate monitoring and to improve risk management assessments.

A significant fraction of ACTRIS scientific publications is directly connected to the work performed at NFs. Previously acquired ACTRIS-related data has already been used to evaluate global and regional emission inventories for key natural and anthropogenic species, to measure atmospheric concentration trends, to simulate different atmospheric conditions to better quantify processes from nanoscale to macro-scale, to provide regional air- quality, numerical weather prediction and climate models with the necessary information for assimilation or validation and testing, to complement observations from space for many different applications and to evaluate the effectiveness of public policies.

The establishment of ACTRIS as a research infrastructure consolidates its capacity to maintain high scientific standards by further developing the science services and facilitating access.

8.4 ACTRIS as a platform for innovation

Services offered by ACTRIS to support innovation are meant to foster knowledge transfer, which aims in the medium to long term to create both technological and societal breakthroughs and impact. Such services can include training on demand or tailored services targeting specific user groups; design and co-design of instrumentation, equipment or procedures, joint research activities and joint instrument testing.

During the Implementation Phase, ACTRIS continues to contribute to innovation, working on technology development, including promotion of cooperation with the private sector, policy makers and the public. The main tasks are:

- Identifying the development areas and services for private sector collaboration;
- Promoting co-development opportunities for technology development and new services;
- Promoting ACTRIS as an innovation platform;
- Enhancing the use of ACTRIS data products and digital tools for market-oriented applications and decision-making processes; and

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- Enhancing the use of ACTRIS Exploratory and Observational Platforms for market-oriented applications by providing access to the private sector.

During the implementation phase, ACTRIS will work to provide a sound platform and tools to stimulate a more open technology transfer approach within ACTRIS, for disseminating relevant research outputs on atmospheric science to the private sector and for enhancing the collaboration between NF and CF operators and the private sector.

8.5 ACTRIS supporting mobility

ACTRIS supports mobility and internationalization by attracting researchers to access world-class, high-quality facilities especially through the ACTRIS access program for Central Facilities and selected National Facilities. ACTRIS is distributed across almost 20 European countries and thus offers great opportunities for researchers and other user groups to access facilities across Europe and beyond. The ACTRIS access program will also be open to global user communities. Guidelines and sustainable management and funding of an effective access provision in ACTRIS will be defined in the implementation phase. The project will explore modalities of access establishing sustainable access procedures across the EU for distributed atmospheric RIs, involving national and international stakeholders.

ACTRIS encourages also National Facility staff to actively participate in staff exchange programs that support RI activities. Industry placement schemes can provide inspiring opportunities as part of staff exchanges at CFs and NFs. ACTRIS sites are attractive and easily accessible for research and technological development. In this way, ACTRIS can ensure cross-fertilisation and knowledge transfer concerning new technologies, best practices, and approaches. The staff exchange programs and industry replacement schemes will be further developed in the later stages of RI implementation.

In the framework of WMO/GAW and Group on Earth Observations (GEO), operations outside Europe are expected to increase in regions where there is a current lack of observations. ACTRIS can provide knowledge transfer via recommendations for building and developing the capacity of researchers in the field of atmospheric science, contributing to the harmonisation of measurements at a global level. Promoting the establishment of mobility programs with third-party countries will contribute to educational and training activities.

ACTRIS is well linked to the global science community. High quality services attract international users. These, and the training programmes for researchers and technicians, will increase the mobility within and to Europe, and increase global connections for young researchers.

8.6 ACTRIS responding to societal needs

ACTRIS is at the heart of grand challenges facing society: climate change and human health. Data and data products provided by ACTRIS partners have already led to improved predictions for weather, climate and air-quality as well as enhancing awareness of the environmental challenges. The information provided by ACTRIS will contribute significantly to defining mitigation and adaptation strategies, and supporting international conventions and protocols. The ACTRIS community has been instrumental in delivering key information to civil aviation authorities during the Iceland volcanic eruption in 2010 and is regularly used to identify causes for high-level of particulate matter in European cities, and for early-warning of atmospheric hazards such as dust or forest fire episodes. Furthermore, the unique atmospheric probing capabilities in ACTRIS have provided support for decision making and risk management during many

atmospheric hazards related to fires, volcanic eruptions, severe pollution events, thus increasing societal resilience to hazards. Establishing ACTRIS as a sustainable RI will expand the capacity to provide the science-based information necessary to face grand societal challenges.

8.7 ACTRIS in the European and International landscapes

ACTRIS will enhance the role of the European Union in international organizations and multilateral fora in the field of atmospheric and climate sciences. ACTRIS is the European contribution to global networks through data and service provision. ACTRIS makes an essential contribution to different programs in WMO and GEO, strengthens the connection to the Global Climate Observing System (GCOS) on essential climate variables. ACTRIS contributes to Copernicus services by providing data products to CAMS for near-real time model validation. CAMS monitors air-quality in Europe and provides forecasts of air-quality for European cities. ACTRIS is of high added value in the European and international landscape, and is already recognized as such by many international organizations.

9 ACTRIS outreach strategy

The activities on outreach and external relations include all the strategic and technical tasks and means to communicate and promote services, relevance, added value and impact of ACTRIS externally to different user and stakeholder groups. The effectiveness of communication and outreach is measured via relevant Key Performance Indicators.

The development of ACTRIS relies on close connections to the ACTRIS science community and engaging new users. Thus, the continuous development of ACTRIS community engagement activities is an important part of the outreach strategy. The involvement of the scientific community and other users in non-ACTRIS countries is important, as it is the first step for new countries to join ACTRIS ERIC as members or observers.

The other important direction of collaboration and communication is the different stakeholder groups, such as academy, industry, UN organisations, space agencies, research centres, other RIs, international associations, metrology institutes, research programmes, Copernicus, GEO, observation and modelling networks etc. ACTRIS ERIC shall conclude cooperation agreements with key stakeholders, either to facilitate the production of services or to ensure that a specific service is provided, and that the role of ACTRIS is clearly established.

ACTRIS HO coordinates and supports ACTRIS communication and dissemination activities, including regular updating of the communication and outreach strategy, executing coordinated external RI communication actions, and the management of ACTRIS brand and visual outlook, using the most suitable means and tools to increase the awareness of ACTRIS at national, European and international level. This includes:

- Informing about ACTRIS activities, opportunities, and results via the ACTRIS web site, social media, newsletters, and press releases;
- Participation in meetings and fora;
- Facilitation of ACTRIS representation in relevant programmes and external bodies;
- Organisation of scientific workshops and conferences, including ACTRIS science conferences and technical development meetings;

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- Organisation of targeted community events and activities in non-ACTRIS countries to increase the awareness of ACTRIS;
 - Identifying of new user communities and building and maintaining the connection with them; and
 - Creation of different documents and presentations to promote ACTRIS activities.

10 Monitoring the performance, impact and risks

10.1 ACTRIS Key Performance and Impact Indicators

ACTRIS Head Office is responsible for organizing self-assessment and consultation, monitoring KPIs and risks, providing guidance on quality management to CFs and NFs, and employing benchmarking and best practices to support the planning and development of quality management of ACTRIS.

The performance of ACTRIS shall be evaluated annually against a set of KPIs. The list of KPIs is expected to evolve according to needs and practicality. The KPIs are categorized into three types:

- **Operational indicators** measure how well the RI operates. These include the number of labelled NFs, amount of data provided from NFs to DC, amount of operation support provided by TCs to NFs, training of NF operators and outreach events organized.
- **Service indicators** measure the amount of ACTRIS data and services offered and used and the broadness of the user base.
- **Organisational indicators** measure the administrative performance of ACTRIS ERIC as an organisation, including deviations from budget and activity plan, and work satisfaction of staff.

In addition to these, ACTRIS has a set of **Key Impact Indicators** for assessing the recognition, relevance and impact of ACTRIS.

The planned sets of KPIs are listed in the Annex 2. The KPIs reflect the activity plan for ACTRIS Implementation Phase 2020-2024. The KPIs will be constantly developed.

10.2 Risk management plan

The ACTRIS Risk Management Plan outlines the actions for identifying, quantifying, managing and monitoring threats and risks. The risk management of ACTRIS includes risk assessment, mitigation strategies for the risks identified, risk treatment when occurring, preparation of contingency plans, and communication and monitoring of the main risks. As a part of ACTRIS Risk management, ACTRIS has a set of Risk Management Principles as general guiding principles for operation and management. The Risk Management Principles are following:

- **Risk management principle 1:** The risks are considered in the regular management and decision-making procedure, and they are assessed and monitored regularly.
- **Risk management principle 2:** ACTRIS shall aim to mitigate the impact of the potential risks and prepare for contingencies.
- **Risk management principle 3:** The priority is set for high likelihood risks with serious impacts.

The entire ACTRIS community, especially National ACTRIS Consortia, CFs and NFs together with HO, participates in identifying risks and defining the impacts of each risk. Everyone in ACTRIS is responsible for preventing risks and reporting them to the Central Facility director, national ACTRIS Consortium

coordinator, HO or Director General. For the implementation phase, ACTRIS is using the following risk categories that reflect the main activity categories and objectives of ACTRIS implementation. The risks are categorized in relation to 1) RI operations; 2) Service development and provision; 3) Governance and coordinated management; 4) Community and country engagement; 5) Collaboration and communication; and 6) ACTRIS impact.

In addition to the general ACTRIS Risk Management Plan, each CF will prepare a detailed risk assessment related to the implementation of the specific CF, based on the CF internal activities and the requirements from the hosting organisations.

ACTRIS maintains a Risk Register, which is the basis for the ACTRIS Risk Management. The Risk Register identifies the potential risks for ACTRIS, and is updated regularly. The Risk Register keeps track of identified risks, current assessment of their likelihood and impact and the defined responsibilities. The outline of the ACTRIS Risk Register is provided in Annex 3.

ANNEX 1. List of ACTRIS Central Facilities and their Units.

ANNEX 1-Table 1. List of ACTRIS CFs and their Units, Host institutions and brief descriptions

Central Facility		Units	Host Institutions
Head Office (HO)	ACTRIS Head Office (HO) is in charge of the strategic development and planning of ACTRIS services for users to solve important scientific questions and in promoting technology development and innovations. HO also manages and oversees the future cooperation with RIs from other domains. HO manages the ACTRIS scientific and technological development project portfolio and ensures that these collaborations lead to benefits for ACTRIS users, such as developments in services and operations, in line with the ACTRIS strategy. HO shall coordinate and promote ACTRIS services, handle internal and external communication, operate the legal entity, and ensure the strategic development and sustainability of ACTRIS. HO coordinates the RI at the European level, in close cooperation with the national ACTRIS consortia, NFs, and other CFs.	OPU	ACTRIS ERIC (FMI, UHEL)
		DEVU	ACTRIS ERIC (FMI, UHEL)
		EMU	ACTRIS ERIC (FMI, UHEL)
		SAMU	ACTRIS ERIC (CNR)
Data Centre (DC)	ACTRIS Data Centre (DC) is responsible for handling the ACTRIS data. The primary role of ACTRIS DC is to compile, archive and provide access to well documented and traceable ACTRIS measurement data and data products, including digital tools for visualisations, data analysis and research. As a tool for science, the highest priorities for ACTRIS DC is to maintain and increase the availability of ACTRIS data and data products relevant to climate and air quality research for all interested users. All primary measurement data and produced data products are made available to the users via the ACTRIS data portal. ACTRIS DC will provide scientists and other user groups with free and open access to all ACTRIS data in accordance with the Access policy, and ACTRIS follows the open research data initiative of the Commission. ACTRIS DC provides access to all measurements, both quality-assured data and near-real-time data, archived in interoperable topical data repositories handling very diverse types of data.	DVAS	NILU, CNRS (and associated partners), CNR, FMI, BSC
		ARES	CNR, CNRS
		ASC	CNRS

<p>ACTRIS DC process and provides access to the ACTRIS variables listed below for each topical Centre. In addition to these ACTRIS variables, DC provides access to a set of combined higher-level data products elaborated from those variables. These are:</p> <p>ACTRIS level 3 data products:</p> <p>Column Water Vapour Content; Climatology products for ACTRIS in situ variables at ACTRIS National Facilities across Europe; Climatology products for ACTRIS aerosol profile and column variables at ACTRIS National Facilities across Europe; Climatology products for ACTRIS cloud profile and column variables at ACTRIS National Facilities across Europe; Single Scattering</p>	CLU	FMI
	GRES	CNRS

	<p>Albedo at ACTRIS National Facilities; Calculated particle light extinction coefficient; Integrated full-range particle number size distribution; Source apportionment of submicron organic aerosols in Europe; Volatile Organic Compounds (VOC) source attribution across Europe; Cloud occurrence at cloud in situ observational platforms; Aerosol columnar properties; ReOBS; Monthly averaged trace gases remote sensing climatologies; Satellite data – combined with ground based ACTRIS data</p> <p>ACTRIS data products involving regional and global models:</p> <p>Aerosol trend assessment; Gas trend assessment; Data Interpretation and Outlier Identification Tool; Model Evaluation Service; NWP Model Evaluation Service; Transport modelling products for assessment of source regions; Alert Service for National Facilities</p> <p>ACTRIS data products from simulation chambers</p> <p>Rate constants for gas-phase reactions; Rate constants for condensed phase reactions; Secondary organic aerosol yields; Photolysis frequencies; Quantum yields; Vapour pressures; Henry's constants; Mass extinction coefficients</p>	In-Situ	NILU
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Central Facility	Description	ACTRIS variables	Units	Host Institutions
		<ul style="list-style-type: none"> Attenuated backscatter profile 	AHL-INOE	INOE

Central Facility	Description	ACTRIS variables	Units	Host Institutions
Centre for Aerosol Remote Sensing (CARS)	<p>The mission of the Centre for Aerosol Remote Sensing (CARS) is to offer operation support to ACTRIS National Facilities operating aerosol remote sensing instrumentation: aerosol high-power aerosol lidars, automatic low power lidars and ceilometers, and automatic sun/sky/polarised/lunar photometer. Additionally, the Centre for Aerosol Remote Sensing offers specialised services for the above instruments and related ACTRIS variables, to ACTRIS users of various types: academia, business, industry and public services.</p> <p>CARS is organised in 8 Units which are grouped in 3 clusters, one cluster for each measurement technique covered by CARS. The Units belonging to one cluster share responsibilities at the technical level for a particular technique, while horizontal activities (management, training, dissemination) involve all Units. Within each cluster, the Units have specific tasks and share other tasks.</p>	<ul style="list-style-type: none"> • Volume depolarization profile • Particle backscatter coefficient profile • Particle extinction coefficient profile • Lidar ratio profile • Ångström exponent profile • Backscatter-related Ångström exponent profile • Particle depolarization ratio profile • Particle layer geometrical properties (height and thickness) • Particle layer optical properties (extinction, backscatter, lidar ratio, Ångström exponent, depolarization ratio, optical depth) • Column integrated extinction • Planetary boundary layer height 	AHL-LMU	LMU
			AHL-CNR	CNR
			ALC-DWD	DWD
			ALC-LMU	LMU
			ASP-CNRS	CNRS, ULille
			ASP-UVA	UVA
			ASP-AEMET	AEMET

Central Facility	Description	ACTRIS variables	Units	Host Institutions
		<ul style="list-style-type: none"> • Spectral Downward Sky Radiances • Direct Sun/Moon Extinction Aerosol Optical Depth (column) • Aerosol columnar properties • Aerosol profile microphysical and optical properties 		
Centre for Cloud Remote Sensing (CCRES)	<p>The mission of the Centre for Cloud Remote Sensing (CCRES) is to offer operational support to ACTRIS National Facilities operating cloud remote sensing instrumentation, namely Doppler Cloud Radars (e.g. Ka, W-band), microwave radiometers for temperature and humidity profiling, and Doppler lidars for wind profiling. CCRES will also provide support for automatic low power lidars and ceilometers used for cloud profiling purposes.</p> <p>The CCRES consortium is built on 5 Central Facility Units. All 5 partners have been involved for many years in operating multi-instrumented atmospheric observatories that include cloud remote sensing instruments.</p>	<ul style="list-style-type: none"> • Cloud/aerosol target classification • Drizzle drop size distribution • Drizzle water content • Drizzle water flux • Ice water content • Liquid water content • Liquid water path • Temperature profile • Relative humidity profile • Integrated water vapour path 	CCRES-FR	CNRS, UVSQ, EP
			CCRES-NL	TUD, KNMI
			CCRES-UK	NCAS
			CCRES-DE	UCoI
			CCRES-FI	FMI
Centre for Reactive Trace	The mission of the Centre for Reactive Trace Gases Remote Sensing (CREGARS) is to offer operational	<ul style="list-style-type: none"> • Ozone vertical profile 	CREGARS-FTIR-BE, BIRA-IASB	BIRA-IASB

Central Facility	Description	ACTRIS variables	Units	Host Institutions
Gases Remote Sensing (CREGARS)	<p>support to ACTRIS National Facilities operating FTIR (Fourier-Transform Infrared), UVVIS (UV-visible) spectrometers or Ozone Dial (Differential Absorption) LIDARS.</p> <p>Additionally, CREGARS should offer specialised services similar to the support offered operationally to ACTRIS beneficiaries, for the above instruments and related ACTRIS variables, to ACTRIS users of various types (academia, research organisations, business, industry and public services) that are part of the global Reactive Trace Gases Remote Sensing (RTGRS) community.</p> <p>CREGARS is organised in 8 Units which are grouped in 3 clusters, one cluster for each measurement technique covered by CREGARS. The Units are belonging to one cluster share responsibilities at the technical level for a particular technique.</p>	<ul style="list-style-type: none"> • Ozone partial columns • Ozone column • Formaldehyde column • Formaldehyde lower tropospheric profile • NO2 column • NO2 partial column • NO2 lower tropospheric profile • NH3 column • C2H6 column 	CREGARS-FTIR-BE.ULg	ULiège
			CREGARS-FTIR-DE	U. Bremen
			CREGARS-UVVIS-BE	BIRA-IASB
			CREGARS-UVVIS-AT	MUI
			CREGARS-UVVIS-FR	CNRS, UVSQ
			CREGARS-UVVIS-NL	KNM
			CREGARS-O3DIAL-FR	CNRS, UVSQ
Centre for Aerosol In Situ Measurements (CAIS/ECAC)	<p>The European Centre for Aerosol Calibration and Characterization (ECAC) aims at acting as the ACTRIS Centre for Aerosol In Situ measurements (CAIS), whose mission of is to offer operation support to ACTRIS National Facilities for the physical and/or chemical in situ characterisation of atmospheric aerosol particles as well as for particle sampling and subsequent laboratory</p>	<ul style="list-style-type: none"> • Particle light scattering and backscattering coefficients • Particle number size distribution - mobility diameter 	ACMCC	CEA, CNRS, INERIS
			CCC	UHEL
			EMC2	INFN

Central Facility	Description	ACTRIS variables	Units	Host Institutions
	<p>analysis of these particles. ECAC will also offer measurement and data tools related to aerosol in situ measurements.</p> <p>Additionally, ECAC will offer specialised services, CAIS-related variables, to ACTRIS users of various types: academia, business, industry, and public services.</p> <p>ECAC is divided thematically into two branches – one dealing with physical aerosol properties and one with chemical composition of aerosol particles. The physical branch includes three units - WCCAP at TROPOS (Germany), PACC at ICPF (Czech Republic) and CCC at University of Helsinki (Finland) - where some of the activities overlap.</p>	<ul style="list-style-type: none"> • Particle number size distribution - optical and aerodynamic diameter • Particle light absorption coefficient and equivalent black carbon concentration • Particle number concentration • Nanoparticle number size distribution • Nanoparticle number concentration • Cloud condensation nuclei number concentration • Mass concentration of particulate organic and elemental carbon • Mass concentration of particulate organic tracers • Mass concentration of non-refractory particulate organics and inorganics • Mass concentration of particulate elements 	OGTACCC	TROPOS
			PACC	ICPF
			WCCAP	TROPOS

Central Facility	Description	ACTRIS variables	Units	Host Institutions
Centre for Cloud In Situ Measurements (CIS)	<p>The key mission of the Centre for Cloud In Situ Measurements (CIS) is to offer operational support to ACTRIS National Facilities operating instrumentation for continuous long-term measurements of cloud occurrence, cloud water content, and cloud droplet effective diameter at observational platforms, or for episodic measurements of cloud particle size distributions, chemical cloud water composition, and ice nucleating particles during dedicated laboratory and field campaigns. While the main activities focus on the ACTRIS community, specialised services are offered to users from academia, business, industry, and public services.</p> <p>The aim of CIS is to develop and adapt its procedures and performance to future needs continuously responding to new research and development projects, with a focus on the operation of existing instruments and methods, and the development and implementation of improved and new methods in cooperation with the NFs and other Topical Centres (TCs).</p> <p>CIS includes four units. Each unit is led by a unit head, who is employed at the respective hosting institutes together with the other unit personnel.</p>	<ul style="list-style-type: none"> • Liquid Water Content • Droplet effective diameter • Droplet number concentration • Droplet size distribution • Ice particle number concentration • Ice particle size distribution • Ice nucleating particle number concentration • Ice nucleating particle temperature spectrum • Bulk cloud water chemical composition 	CCIce	KIT
			CCPar	U-Man
			CCWaC	TROPOS
			CCInt	ZAMG (SBO)

Central Facility	Description	ACTRIS variables	Units	Host Institutions
Centre for Reactive Trace Gases In Situ Measurements (CiGas)	<p>The key-mission of CiGas is to offer current state-of-the-art operational support to ACTRIS National Facilities, operational and exploratory platforms, operating instrumentation for continuous long-term measurements of volatile organic compounds (VOCs), condensable vapours and nitrogen oxides (NO_x) in the atmosphere. This includes activities to guide research and service development in the field of reactive trace gases and to develop towards future user needs, utilising innovative methodologies. The operational support to ACTRIS NFs is supplemented by tailored services for users from the Global Atmospheric Watch Network (GAW) and other atmospheric observation networks, academia, business, industry, and public services depending on the respective resources.</p> <p>CiGas operates and supports instrumentation and observations collected from the following atmospheric reactive trace gases:</p> <p>(1) Non-Methane Hydrocarbons (NMHCs, typically over 40 compounds sub-classified into anthropogenic e.g. ethane, ethane, ethyne, propane, etc. and biogenic e.g. the terpenes α-pinene, limonene etc.),</p> <p>(2) Oxygenated VOCs (OVOCs), such as aldehydes, ketones, alcohols (e.g. methanol, formaldehyde, acetaldehyde, acetone etc.,</p>	<ul style="list-style-type: none"> • Non-methane hydrocarbons (NMHCs) • Oxygenated volatile organic compounds (OVOCs) • Terpenes • NO • NO₂ • Condensable vapours 	CiGas-FZJV	FZJV
			CiGas-FZJN	FZJN
			CiGas-IMT	IMT/LD
			CiGas-UHEL	UHEL
			CiGas-DWD	DWD
			CiGas-Empa	EMPA

Central Facility	Description	ACTRIS variables	Units	Host Institutions
	<p>(3) Condensing vapours and direct aerosol precursors such as sulfuric acid and Highly Oxygenated Molecules (HOM; e.g. C₁₀H₁₄O₉), and</p> <p>(4) Nitrogen Oxides (NO_x), such as NO and NO₂.</p> <p>The core activities of CiGas are to ensure sustainable and traceable, high-quality data and data products of in-situ measured atmospheric reactive trace gases with known uncertainty. These activities include development, testing and implementing advanced measurement technologies and data evaluation algorithms, and testing prototypes of gas analytical devices, and enhancing the competence of the operative personnel by training.</p>			

ANNEX 2: List of KPIs

ANNEX 2-Table 1. Planned set of Key Performance Indicators for ACTRIS.

Index	Comment	Type of data	Frequency
Operational Indicators			
Number and type of support activities offered to NFs at TCs	A measure of internal support for ACTRIS National Facilities	Numerical	Yearly
Number of data sets provided from NFs to DC	Number of data sets provided from the NFs on each category/variable	Numerical	Yearly
Number of ACTRIS NFs labelled	Measure of success in implementation. According to the labelling process and plan	Numerical	Yearly
Number of targeted training events offered by TC and DC to NF operators.	Measure of ACTRIS capacity building to support ACTRIS best practices.	Numerical	Yearly
Number and type of dissemination and outreach activities.	Measure of ACTRIS outreach activities and events organized.	Numerical	Yearly
Services Indicators			
Number of services (remote, virtual or physical access) provided to the users via SAMU	Measure of ACTRIS operations	Numerical	Yearly
Number of downloads from DC	Number of downloads of the different data products that ACTRIS have for short-lived atmospheric constituents, for each variable and NF	Numerical	Yearly
Number of new data products, digital tools and services available to the user communities	A measure of the capacity and competence for the service development.	Numerical	Every Second Year
Number of users served by physical and remote access to CFs and NFs	Measure of ACTRIS capacity to provide services to users and support mobility	Numerical	Yearly

Number of users from academic/research, public, private and other sectors	Measure of user diversity	Numerical	Yearly
Number of cross-organisation and cross-border exchange among personnel and users	Measure of mobility	Numerical	Yearly
Organisational Indicators			
Deviation from the annual ACTRIS ERIC budget	A measure of the planned and reported ACTRIS ERIC activities	Numerical	Yearly
Deviation from the annual ACTRIS Activity Plan (comparison of Activity plans and Annual reports)	A measure of the planned and reported RI operations	Semi-quantitative	Yearly
ACTRIS ERIC Staff satisfaction	Workplace questionnaire	Semi-quantitative	Every Second Year

ANNEX 2-Table 2. Planned set of Key Impact Indicators for ACTRIS.

Index	Comment	Type of data	Frequency
ACTRIS visibility	Measure of ACTRIS recognition and visibility among target groups	Semi-quantitative	Yearly
Number of ACTRIS-related publications by the scientific community	A large and diverse scientific community gets the benefit of ACTRIS services and products for scientific publications	Numerical	Yearly
Number of agreements concluded with critical partnerships (liaisons)	Measure of attractiveness of ACTRIS service.	Numerical	Every Second Year
ACTRIS data products used as reference for policy making in air quality and climate actions (e.g. EMEP, IPCC, UNFCCC).	A measure of the role of ACTRIS in the knowledge production chain (mobility of knowledge) on climate change and air quality related topics	Semi-quantitative	Every Second Year
Participation in international standardization and harmonization activities; i.e. ISO (International Organisation for Standardization), WMO and other international organisations (GEO, GCOS)	Indicates the ACTRIS activities and impact in the international level	Semi-quantitative	Every Second Year
ACTRIS collaboration with other research infrastructures in related and complementary fields	Measure of unique ACTRIS data and services at the European level	Semi-quantitative	Every Second Year

ANNEX 3: Preliminary ACTRIS Risk Register

ANNEX 3-Table 1. Preliminary ACTRIS Risk Register for implementation activities including mitigation plans.

Description of Risk	Likelihood (high/medium/low)	Potential Impact (high/medium/low)	Mitigation/Risk reduction/Planned response
RI operations			
CF consortia have difficulties in setting up CF activities for internal support and service provision	Medium	High	Ensure support from RPOs and countries hosting CF units to have enough resources for the CF implementation.
TCs do not have enough capacity to provide the required operational support to NFs	Low	Medium	Establish a well-planned ramp-up process with clear RI support schedule and plan for gathering the capacity.
Less than half of foreseen NFs are submitted for labelling process	Medium	High	Ensure support from RPOs operating NFs to have enough resources for upgrading and maintaining NF operations. Ensure that the cost of ERIC membership is not hindering NF.
Delay in labelling processes due to capacity issues at TC or others	Medium	High	HO must follow up TC implementation plans, and work in a coordinated manner with the TC leaders in the timelines and procedure to label NFs in different topics.
Inefficient data workflow due to the difficulties or delays in implementation of CFs and NFs	Low	High	Ensure the coherent development and implementation of the ACTRIS Data Centre according to the ACTRIS Data Centre concept and data management plan. Ensure proper RI operation management with all necessary ACTRIS components (HO, DC, TCs and NFs).
Service development and provision			
SAMU is not able to provide services to users due to the low level of TC	Low	High	Work together with TC units, NF operators, hosting RPOs and countries to ensure the

and NF commitments or capacity on the provision of access to external users				commitments for service provision. Communicate the benefits for NFs and TCs.
The user interface is not efficient enough to process all the data and service requests from the users	Low		High	Establish a long-term plan for SAMU and DC to be able to increase the capacity and resources if needed.
Users are not aware of ACTRIS services or the access procedures to ACTRIS Facilities via SAMU	Low		High	Formulate a clear user strategy during the implementation phase in consultation with the experts and user communities. The awareness with efficient dissemination and promotion activities.
Cost per service is too high resulting in too few requests	Medium		High	HO shall make market analysis to evaluate the cost of the different services that ACTRIS offers and will update the cost after two years of operation
Governance and coordinated management				
Not enough countries as Members of ACTRIS ERIC		Medium	High	Present a clear ACTRIS concept and activity plan to the country delegates. Ensure the high quality and timely management and implementation of activities. Promote ACTRIS for stakeholders in the countries and communicate the benefits of ACTRIS for countries. Reduce costs if needed by focusing on core services and extend later.
ACTRIS ERIC not established in 2021		High	Low/Medium	Feed high-quality support material for decision making of the Interim ACTRIS Council and national decision-making processes. Engage and support IAC for constructive development of ACTRIS ERIC and ACTRIS.
Not enough CF agreements concluded		Medium	High	Define a clear plan for negotiation and signing the agreements with RPOs hosting CF units and NFs.
Not enough agreements signed with NFs		Medium	High	Communicate the benefits of ACTRIS. Secure enough Members for ACTRIS ERIC. Integrate the process with CF contract agreement when RPO has both facilities; define a clear plan of negotiation for the rest of the RPOs
National ACTRIS consortia and national stakeholders	Low		Medium	Program NF assembly and national consortia events with ACTRIS ERIC to keep the communication flow.

are not interactive with
ACTRIS ERIC

Underestimation of the
expertise and human
resources to build ACTRIS
or not enough staff
provided by RPOs to work
on ACTRIS implementation

Medium High

Guarantee the allocation of necessary human
resources and available skills, efficient HR
management and realistic progress assessment
toward operation, training of staff. Communicate
the importance of good HR and management to
funders. Have a clear, updated strategy for human
resources.

Over-dependence on key
individuals

High High

Ensure the engagement on ACTRIS goals and
strategic issues. Communicate with RPOs on their
crucial role for providing good work conditions
and environment to ACTRIS staff. Create and
maintain a supportive and attractive working
environment. Monitor the well-being of staff.
Adopt a management plan feasible for the
complexity of the enterprise. Train new HR
capacity and decrease dependence on single
persons. Adopt good documentation and
archiving system. Have a clear, updated strategy
for human resources.

Underestimation of real
implementation costs

Medium High

Update and revise the implementation and
business plan regularly. Revise the cost
assessment. Analyse expenditures, actively seek
for cost efficiency in, e.g. procurements and
operations RI-wide and with other environmental
RIs.

Delay in implementing RI
within ten years from
starting on the Roadmap

Low High

Efficiently set up of the governance and get formal
commitments from countries for ACTRIS ERIC;
solid and concrete implementation plan written
for CF and NFs; monitoring.

Community and country engagement

Difficulties to engage
countries, disagreements
on the contribution
principles.

Medium High

Engage key countries and funders early in the
negotiations. Keep everyone informed. Prepare
(the decisive) meetings well with realistic financial
plans. Build up trust and transparency in the
working culture. National ACTRIS Consortia play
an important role at the national level

Countries do not have strong and well-organized ACTRIS science communities.	Low	Low	Establish open and well-communicated events for science communities. Support the establishment of National Consortia.
Collaboration and communication			
Not enough collaboration agreements concluded with key partnerships (liaisons)	Medium	Low	Participate actively in the international arena, i.e. seeking partnerships and creating concreted means for collaborations and identifying service provision.
Not enough visibility among targeted user groups. ACTRIS does not reach new user communities	Low	Medium	Establish communication tasks working on targeting outreach activities and create different tools and materials to the user groups and stakeholders and facilitate internal and external communications.
The relevance and impact of ACTRIS not sufficiently communicated and promoted	Medium	Medium	Update the ACTRIS science case in dialogue with the users. Ensure that users have a proper way to acknowledge ACTRIS by requesting the users to cite ACTRIS datasets within the text of the publication and include a reference to them in the reference list. References to the dataset shall be detailed enough so that the reader of the paper or document shall be able to obtain the datasets from ACTRIS.
Impact (innovation and socio-economic)			
Not enough interest from the private sector to co-develop new services with ACTRIS	Medium	Low	Promote ACTRIS platforms for private sector users. Participate actively in technology and innovation events. Develop partnerships with private companies in the ACTRIS framework.
ACTRIS does not have enough socio-economic impacts	Low	Medium	Verify and strengthen communication and dissemination strategy and activities. Guarantee the full exploitation of ACTRIS results. Formulate a clear scientific strategy and align it to the needs of the user communities. Ensure the needed resources and competence for promoting, analysing and communicating impacts.

ANNEX 4: List of acronyms

ACTRIS – Aerosol, Clouds and Trace Gases Research Infrastructure

ACTRIS IMP – ACTRIS Implementation Phase Project is a EU Horizon 2020 Coordination and Support Action (grant agreement No 871115). ACTRIS IMP started on 1 January 2020 for a period of 4 years.

AERONET – Aerosol Robotic Network

AnaEE – European research infrastructure on Analysis and Experimentation on Ecosystems

ASC – ACTRIS Atmospheric simulation chamber Data Centre Unit

ATMO-ACCESS –project (funded by the European Commission), where distributed atmospheric research facilities ACTRIS, ICOS and IAGOS will develop a pilot for a new model of Integrating Activities

CAIS – Centre for Aerosol In Situ Measurements

CAMS – Copernicus Atmosphere Monitoring Service

CARS – Centre for Aerosol Remote Sensing

CEN – European Committee for Standardization

CF – Central Facility

CCRES – Centre for Cloud Remote Sensing

CiGas – Centre for Reactive Trace Gases In Situ Measurements

CIS – Centre for Cloud In Situ Measurements

CLU – Cloud Remote Sensing Data Unit

CREGARS – Centre for Reactive Trace Gases Remote Sensing

C3S – Copernicus Climate Change Service

DC – Data Centre

DG – Director General

DEVU – Development and Relations Unit

EARLINET – European Aerosol Research Lidar Network

eLTER – Long-Term Ecosystem Research in Europe

EMEP – Co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe

EMU – ERIC Management Unit

ERA – European Research Area

ERIC – European Research Infrastructure Consortium

EU – European Union

FAIR – Findable, Accessible, Interoperable and Re-usable

GA – General Assembly

GAW – Global Atmosphere Watch

GALION – The GAW Aerosol Lidar Observation Network

GEO – Group on Earth Observations

GCOS – Global Climate Observing System

GEOSS – Global Earth Observation System of Systems

HO – Head Office

IAC – Interim ACTRIS Council

IAGOS – In-service Aircraft for a Global Observing System

ICOS – Integrated Carbon Observation System Research Infrastructure

IPCC – Intergovernmental Panel on Climate Change

ISO – International Organisation for Standardization

JRC – European Commission Joint Research Centre

LRTAP – Long Range Trans-boundary Air Pollution

KPI – Key Performing Indicator

NF – National Facility

NDACC – International Network for the Detection of Atmospheric Composition Change

OPU – Research Infrastructure Operations Unit

QA/QC – Quality Assurance/Quality Control

RI – Research Infrastructure

RPO – Research Performing Organisation

RR – Risk Register, which is the basis for the ACTRIS Risk Management

SAMU – Service and Management Unit

SARGAN – The GAW in-Situ AeRosol Network

SIOS – Svalbard Integrated Arctic Earth Observing System

TC – Topical Centre

UN – United Nations

UNFCCC – United Nations Framework Convention on Climate Change

WMO – World Meteorological Organisation

WMO/GAW – The Global Atmosphere Watch (GAW) programme of WMO

RPO acronyms in ANNEX 1

AEMET - Izãna Atmospheric Research Center, Spain

BIRA-IASB - Royal Belgian Institute for Space Aeronomy, Belgium

BSC - Barcelona Supercomputing Centre, Spain

CEA - French Alternative Energies and Atomic Energy Commission, France

CNR - Consiglio Nazionale delle Ricerche, Italy

CNRS - Centre National de la Recherche Scientifique, France

DWD - Deutscher Wetterdienst (DWD), Germany

EMPA - Swiss Federal Laboratories for Materials Science and Technology, Switzerland

EP - Ecole Polytechnique, France

FMI - Finnish Meteorological Institute, Finland

FZJN - Forschungszentrum Jülich GmbH - Nitrates, Germany

FZJV - Forschungszentrum Jülich GmbH - Volatiles, Germany

ICPF - Institute of Chemical Process Fundamentals, Czech Republic

IMT/LD - Institution Mines Telecom Lille Douai, France

INERIS - French National Institute for Industrial Environment and Risks, France

INFN - Istituto Nazionale di Fisica Nucleare, Italy

INOE - National Institute of Research and Development for Optoelectronics, Romania

JRC – Joint Research Centre, European Commission

KIT - Karlsruhe Institute of Technology, Germany

KNMI - Royal Netherlands Meteorological Institute, The Netherlands

LATMOS - Laboratoire Atmosphère, Milieux, Observations Spatiales, France

LMU - Ludwig-Maximilians-University, Germany

MUI - Medical University Innsbruck, Austria

NCAS - National Centre for Atmospheric Science, United Kingdom

NILU - Norsk Institutt for Luftforskning Stiftelse, Norway

SBO – Sonnblick Observatory, Austria

TROPOS - Leibniz Institute for Tropospheric Research, Germany

TUD - Delft University of Technology, The Netherlands

U.Bremen – University of Bremen, Germany

UCol - University of Cologne, Germany

UHEL - University of Helsinki, Finland

ULiège - University of Liège, Belgium

U-Man - The University of Manchester, United Kingdom

UVA - University of Valladolid (UVA), Spain

UVSQ - Université de Versailles Saint-Quentin-en-Yvelines

ZAMG - Central Institution for Meteorology and Geodynamics, Austria