Deliverable 4.3: Revised CF implementation plans

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Contents

Purpose of the document

This document presents the key aspects included in the revised implementation plans of the ACTRIS Central Facilities. The revised Implementation plans stay at the base of the Catalogue of Services, revised Cost Book, and 5-years financial plan. The revision was made in order to implement the recommendations of the Interim ACTRIS Council following the process of the validation of Central Facility activities.

The CF revised Implementation plans in extenso are available from the ACTRIS Intranet (see Section *0* in this document).

List of acronyms

ACTRIS – Aerosol, Clouds and Trace Gases Research Infrastructure

ACTRIS-IMP – ACTRIS Implementation Project

ACTRIS-PPP – ACTRIS Preparatory Phase Project

IAC - Interim ACTRIS Council

DG - Director General

NF – National Facility

CF – Central Facility

HO – Head Office

DC – Data Centre

TC – Topical Centre

ECAC/CAIS – Centre for Aerosol In-Situ Measurements

CARS – Centre for Aerosol Remote Sensing

CIS – Centre for Cloud In-Situ Measurements

CCRES – Centre for Cloud Remote Sensing

CiGas – Centre for Reactive Trace Gases In-Situ Measurements

CREGARS – Centre for Reactive Trace Gases Remote Sensing

RI – Research Infrastructure

ERIC - European Research Infrastructure Consortium

DMP - Data Management Plan

FAIR - Findable, Accessible, Interoperable and Reusable

KPI – Key Performance Indicators

QA – Quality Assurance

QC – Quality Control

SOP – Standard Operation Procedure

WMO – World Meteorological Organisation

GAW – Global Atmosphere Watch

EMEP - European Monitoring and Evaluation Programme

NDACC - Network for the Detection of Atmospheric Composition Change

PGN – Pandora Global Network

AERONET – Aerosol Robotic NETwork

EARLINET – European Aerosol Research Lidar NETwork

List of Central Facility Host Institutions

FMI - Finnish Meteorological Institute, Finland

UHEL - University of Helsinki, Finland

CNR - Consiglio Nazionale delle Ricerche, Italy

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

ULG - University of Liege, Belgium

NILU - Norwegian Institute for Air Research, Norway

CNRS - Centre National de la Recherche Scientifique, France

BSC - Barcelona Supercomputing Center, Spain

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

LMU - Ludwig Maximilian University of Munich, Germany

CNR-IMAA - Consiglio Nazionale delle Ricerche - Institute of Methodologies for Environmental Analysis, Italy

DWD - Deutscher Wetterdienst, Germany

UVA - University of Valladolid, Spain

AEMET - State Meteorological Agency, Spain

UVSQ - Versailles Saint-Quentin-en-Yvelines University, France

TUD – Delft University of Technology, Netherlands

KNMI - Royal Netherlands Meteorological Institute, Netherlands

UKRI - UK Research and Innovation, UK

UCol - University of Cologne – UC, Germany

U. Bremen - University of Bremen, Germany

MUI - Medical University Innsbruck, Austria

CNRS-LATMOS - Centre National de Recherche Scientifique (CNRS)/ Laboratoire Atmosphère, Milieux, Observations Spatiales, France

INERIS - Institut national de l'environnement industriel et des risques, France

INFN - Istituto Nazionale di Fisica Nucleare, Italy

TROPOS - Leibniz-Institut für Troposphärenforschung, Germany

ICPF - Institute of Chemical Process Fundamentals of the CAS, Czech Republic

KIT - Karlsruhe Institute of Technology, Germany

U-Man - The University of Manchester, UK

ZAMG - Zentralanstalt für Meteorologie und Geodynamik, Austria

FZJ - Forschungszentrum Jülich GmbH, Institute for Energy and Climate Research, IEK-8: Troposphere, Germany

IMT/LD - Institution Mines Telecom Lille Douai (IMT/LD), Energy & Environment research, Germany

Empa - The Laboratory for Air Pollution/Environmental Technology, Switzerland

Introduction

ACTRIS is constructed around large and unique atmospheric research facilities, the National Facilities (NFs), located in Europe and beyond, that serve for the acquisition of reliable, accurate, and high-quality data to document the 4-D distribution and variability of aerosol, clouds and trace gases in the natural atmosphere (Observational Facilities), and for understanding the complex interactions and processes driving this variability in the natural or controlled atmospheres (Exploratory Facilities). ACTRIS integrates, harmonises, and distributes datasets, activities, and services through its eight Central Facilities (CFs). Central Facilities are essential to ensure compliance of the measurements with standard operation procedures and data analysis, to coordinate user access to state-of-the-art data and facilities, and to provide tailored services to the scientific community and other stakeholders.

The Central Facilities (CFs) comprise of six **Topical Centres** (TCs), the **Data Centre** (DC) and the **Head Office** (HO). Each CF is jointly operated as a consortium of two or more Units around Europe. The CFs

are fundamental for ensuring that ACTRIS procedures and policies are respected and maintained. The production of harmonised, reliable, and documented observational data within ACTRIS relies on appropriate CFs that ensure compliance with the standard ACTRIS operating procedures and/or quality protocols across the entire network. Together, the CFs ensure that all ACTRIS data are produced, treated and quality-controlled according to defined procedures, properly archived for long-term access and usage, and accessible in a timely manner to all users. CFs also provide the appropriate level of training and education, both within and outside the Research Infrastructure (RI), as well as deliver tailored services for specific users - the scientific community, space agencies, Copernicus and the private sector, and others.

CFs are responsible for the definition of ACTRIS data standards including quality requirements, standard operating procedures, format and nature of delivery (near real-time or consolidated), flagging and selected of value-added products and provision. CFs also provide support to the NFs by technical assistance made both remote and on-site. In addition, CFs are responsible for training operators and users of ACTRIS.

ACTRIS Head Office (HO) develops and promotes the long-term sustainability of ACTRIS in all its aspects. The HO coordinates, develops, monitors, and integrates the RI operations as well as facilitates the work of ACTRIS governance and executive bodies. The HO provides and operates the ACTRIS single access point, Service and Access Management Unit (SAMU) that connects all users with the ACTRIS services and access providers (e.g. ACTRIS CFs and selected NFs). The HO provides information on ACTRIS and ACTRIS services, facilitates membership, and enhances new participations, and strengthens the international collaboration, research and training opportunities for all users.

ACTRIS Data Centre (DC) provides the management of ACTRIS data and value-added products, including long-term archiving and access to data, tools for data production, visualisation, evaluation, and analysis. ACTRIS data means data from observational NFs and exploratory NFs complying with the procedures established within ACTRIS. The DC is responsible for the data curation, which is the activity that stores, manages and ensures access to all data sets produced within the infrastructure. This includes quality control, data citation service, attribution, and versioning control of data. Accordingly, the DC offers operational support to the National Facilities and provides services to all users of ACTRIS data.

Topical Centres (TCs) 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) ensuring training and transfer of knowledge to ACTRIS operators and users, and 4) improvements of measurement methodologies for aerosol, clouds, and reactive trace gases. Six TCs are required 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) measurement techniques -

- Centre for Aerosol In-Situ Measurements (ECAC/CAIS);
- Centre for Aerosol Remote Sensing (CARS);
- Centre for Cloud In-Situ Measurements (CIS);
- Centre for Cloud Remote Sensing (CCRES);
- Centre for Reactive Trace Gases In-Situ Measurements (CiGas);

- Centre for Reactive Trace Gases Remote Sensing (CREGARS).

The eight Central Facilities, operated by their 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. During the ACTRIS-PPP project (2017 – 2019) the Central Facilities have developed their concepts as well as the first version of their implementation plans, which were subject to an extended validation process and further to the approval of the IAC. As a follow-up, the CFs were requested to revise the implementation plans according to the recommendation of the Interim ACTRIS Council and the validation committee.

Subject of the revision

The CF implementation plans initially developed during ACTRIS-PPP were revised during Summer 2020 at the request of the IAC and as a follow up of the validation process. Main revisions refer to:

- Adjustment of the timelines according to the general timeline of the RI (as known in Summer 2020)
- Adjustments of the necessary capacity according to the validated number of potential ACTRIS National Facilities
- Harmonization of the Topical Centres activities
- Addition of the Catalogue of CF operational activities

General description of the Central Facilities

ACTRIS Central Facilities have their own internal goals and mission, depending on the role within ACTRIS. The CFs are organised in different clusters and units. Table 1 includes a description of the CFs and the units that compose it and the host institutions.

Table 1 List of ACTRIS CFs and their Units, Host institutions and brief descriptions. The Head Office Host institutions in brackets refer to the institutions hosting the Units before ACTRIS ERIC is founded.

Central Facility	Units	Host Institutions	Description
Head Office (HO)	ERIC Management Unit (EMU)	ACTRIS ERIC (FMI, UHEL)	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
	Research Infrastructure Operations Unit (OPU)	ACTRIS ERIC (FMI, UHEL)	
	Development and Relations Unit (DEVU)	ACTRIS ERIC (FMI, UHEL)	

Central Facility	Units	Host Institutions	Description
	Service and Access Management Unit (SAMU)	ACTRIS ERIC (CNR)	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. The HO coordinates the RI at the European level, in close cooperation with the national ACTRIS consortia, the NFs, and the other CFs.
Data Centre (DC)	Data Discovery, Virtual Access and Services unit *(DVAS)*	NILU, CNRS, CNR, FMI, BSC	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 provides 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 type of data.
	Aerosol remote sensing data centre unit *(ARES)*	CNR, CNRS	
	Trace gases remote sensing data centre unit *(GRES)*	CNRS	
	Cloud remote sensing data centre unit *(CLU)*	FMI	
	Atmospheric simulation chamber data centre unit *(ASC)*	CNRS	
	In situ data centre unit (In-Situ)	NILU	
Centre for Aerosol Remote Sensing (CARS)	Aerosol High-power Lidar unit @ INOE (AHL-INOE)	INOE	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.
	Aerosol High-power Lidar unit @ LMU (AHL-LMU)	LMU	
	Aerosol High-power Lidar unit @ CNR (AHL-CNR)	CNR-IMAA	
	Automatic low-power Lidar & Ceilometer unit @ DWD (ALC-DWD)	DWD	

Central Facility	Units	Host Institutions	Description
	Automatic low-power Lidar & Ceilometer unit @ LMU (ALC-LMU)	LMU	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.
	Automatic Sun/sky/lunar Photometer unit @ CNRS (ASP-CNRS)	CNRS	
	Automatic Sun/sky/lunar Photometer unit @ UVA (ASP-UVA)	UVA	
	Automatic Sun/sky/lunar Photometer unit @ AEMET (ASP-AEMET)	AEMET	
Centre for Cloud Remote Sensing (CCRES)	Cloud remote sensing unit France (CCRES-FR)	CNRS, UVSQ, EP	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 to 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. The CCRES consortium is built on five Central Facility Units. All five partners have been involved for many years in operating multi-instrumented atmospheric observatories that include cloud remote sensing instruments.
	Cloud remote sensing unit Netherlands (CCRES-NL)	DUT, KNMI	
	Cloud remote sensing unit UK (CCRES-UK)	UKRI	
	Cloud remote sensing unit Germany (CCRES-DE)	UCol	
	Cloud remote sensing unit Finland (CCRES-FI)	FMI	
Centre for Reactive Trace Gases Remote Sensing (CREGARS)	Fourier Transform Infrared spectrometer unit Belgium (FTIR-BE)	BIRA-IASB, ULG	The mission of the Centre for Reactive Trace Gases Remote Sensing (CREGARS) is to offer operational support to ACTRIS National Facilities operating FTIR (Fourier-Transform Infrared), UVVIS (UV-visible) spectrometers or Ozone Dial (Differential Absorption) LIDARS. 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
	Fourier Transform Infrared spectrometer unit Germany (FTIR-DE)	U. Bremen	
	UV-visible differential absorption spectrometer unit Belgium (UVVIS-BE)	BIRA-IASB	
	UV-visible differential absorption spectrometer unit	MUI	

Central Facility	Units	Host Institutions	Description
	Austria (UVVIS-AT)		Trace Gases Remote Sensing (RTGRS) community. 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.
	UV-visible differential absorption spectrometer unit France (UVVIS-FR)	CNRS, LATMOS	
	UV-visible differential absorption spectrometer unit Netherland (UVVIS-NL)	KNM	
	O3 differential absorption lidar unit France (O3DIAL-FR)	ATMOS-CNRS	
Centre for Aerosol In Situ Measurements (ECAC/CAIS)	ACMCC	CEA, CNRS, INERIS	The European Center 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 (NFs) for the physical and/or chemical in situ characterisation of atmospheric aerosol particles as well as for particle sampling and subsequent laboratory analysis of these particles. ECAC/CAIS will also offer measurement and data tools related to aerosol in situ measurements.
Additionally, ECAC/CAIS will offer specialised services, CAIS-related variables, to ACTRIS users of various types - academia, business, industry, and public services.
ECAC/CAIS is divided thematically into two branches – one dealing with physical aerosol properties and the other 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.
	CCC	UHEL	
	EMC2	INFN	
	OGTAC-CC	TROPOS, JRC	
	PACC	ICPF	
	WCCAP	TROPOS	
Centre for Cloud In Situ Measureme	Center for cloud ice nucleation (CCIce)	KIT	The key-mission of the Centre for Cloud In Situ Measurements (CIS) is to offer operational support to ACTRIS National Facilities (NFs) operating instrumentation for continuous long-term measurements of cloud occurrence, cloud

Central Facility	Units	Host Institutions	Description
Centre for Reactive Trace Gases In Situ Measurements (CiGas)	Center for cloud particle properties (CCPar)	U-Man	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. 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).
	Center for cloud water chemistry (CCWaC)	TROPOS	
	European Center for Cloud ambient Intercomparison (ECCINT)	ZAMG - SBO	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.
	VOC unit @ FZJ (CiGas-FZJV)	FZJ	The key-mission of the Centre for Reactive Trace Gases In Situ Measurements (CiGas) is to offer current state-of-the-art operational support to ACTRIS NFs, operational and exploratory platforms, which are operating instrumentation for continuous long-term measurements of volatile organic compounds (VOCs), condensable vapours and nitrogen oxides (NOx) in the atmosphere. That 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.
	NOx unit @ FZJ (CiGas-FZJN)	FZJ	
	VOC/NOx unit @ IMT (CiGas-IMT)	IMT/LD	
	Condensing vapours unit @ UHEL (CiGas-UHEL)	UHEL	CiGas operates and supports instrumentation and

Central Facility	Units	Host Institutions	Description
	VOC/NOx unit @ DWD (CiGas-DWD)	DWD	observations collected from the following atmospheric reactive trace gases - (1) Non-Methane Hydrocarbons (NMHCs, typically over 40 compounds subclassified into anthropogenic and biogenic),
	VOC unit @ Empa (CiGas-Empa)	Empa	(2) Oxygenated VOCs (OVOCs), such as aldehydes, ketones, alcohols (e.g. methanol, formaldehyde, acetaldehyde, acetone…), (3) Condensing vapours and direct aerosol precursors such as sulfuric acid and Highly Oxygenated Molecules (HOM; e.g. $C_{10}H_{14}O_9$), and (4) Nitrogen Oxides (NOx), such as NO and NO2. 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.

The detailed roles and share of responsibilities between the Unit are described in the individual CF revised Implementation plans (see Section 0).

Activities

The main goal of the activities proposed by the different CFs is the construction and upgrading of the CFs, setting-up the user access and services provision system, as well finalizing the implementation of the Data Centre where ACTRIS data and products will follow the FAIR principles and offer data that are findable, accessible, interoperable, and reusable (FAIR). Furthermore, the CFs will work on the governance and management tasks, and in increasing the connection with new users and member countries, further develop strategies within ACTRIS and for international collaboration and partnerships, and in the integration of ACTRIS at different strategic levels (national, European, and international). Overall, the target of the ACTRIS Implementation Phase is to ensure ACTRIS long-term operations and sustainability.

Head Office

The first activities of the Implementation Phase of the ACTRIS HO Units include:

- The setup of the HO management system, including the physical implementation of office premises and office supplies, the establishment of cloud-based management tools to coordinate the work of the ERIC, IT services, as well as other service contracts. Importantly, these managerial tools include, for example, bank accounts, accounting and payroll system, HR processes, insurances, tools for personnel management, The Interim HO supports the recruitment of the Director General (DG) and other core personnel, following the decision of the IAC; and takes care of the ACTRIS ERIC contractual agreements and any other legal aspect of the ERIC (Responsible Unit: EMU);
- The establishment of the user access and services provision system, with specific tools (PASS, User HELP desk, User Access Forum, database of the evaluators, etc …) and internal procedures to manage, follow and monitor all the steps of the access process. Developing the Catalogue of Services in collaboration and in support of the National and Central Facilities proving services. Define and implement the *ACTRIS Access management Plan based on the ACTRIS access policy*. (Responsible Unit: SAMU);
- Building the RI management structures, workflows, internal decision-making processes. Facilitation of the NFs labelling process; Definition of workflows for RI operations; Coordination of the implementation of the whole RI as well as coordination of the contract negotiations with the CFs and the NFs. ERIC Step 2 preparatory work (Responsible Unit: OPU)
- Strategy development, setting up the communication and outreach strategy and related tools, advocating ACTRIS in international fora (Responsible Unit: DEVU)

Most of the SAMU, OPU and DEVU tasks are implemented in coordination with other CFs. This approach facilitates seamless service release during the Implementation Phase until the CFs are operational in 2025. ACTRIS HO's activities can be divided into the following categories:

Activity	Objectives
Activity 1 - Leadership and Management of the HO	Manage the HO units and support the DG in the representation of ACTRIS in the different meetings and arenas.
Activity 2 - Access and tailored service management	Enable extensive, easy and satisfactory access of users to ACTRIS services, managing the Catalogue of Services, organising and governing the review process and interacting on both sides with Users and Central/National Facilities.
Activity 3 - Users engagement and support	Engage, support and earn trust and awareness of users via the Science and User Access Forum and the User service helpdesk.
Activity 4 - ERIC management	Efficient and resource wise management of the ACTRIS ERIC functions, including administrative tasks, human resource management, financial and legal activities.
Activity 5 - RI management support	Seamless coordination and management of the RI operations to build a strong, unified ACTRIS and reach the set goals for high-quality atmospheric research infrastructure.

Activity	Objectives
Activity 6 – Communication	Effective and smooth internal and external communications, ensuring the internal synergies within ACTRIS and external visibility and impact.
Activity 7 - Liaison and external relations	Strong and influential position of ACTRIS internationally, fruitful cooperation with external partners for the benefit of ACTRIS users.
Activity 8 - New scientific and technological developments support	Building and maintaining ACTRIS as a world-class science and innovation platform through the definition and the implementation of the RI's innovation strategy plan.
Activity 9 - Monitoring and self-assessment	Timely and comprehensive monitoring and evaluation of the overall performance of ACTRIS, ACTRIS ERIC and Central Facilities, and successful participation in external evaluations.

Data Centre

ACTRIS data and products should be **f**indable, **a**ccessible, **i**nteroperable and **r**eusable (**FAIR**), and the data centre works towards fulfilling the FAIR principles. To achieve this, all data will follow the ACTRIS data lifecycle and the data centre will, in particular, provide:

- Persistent identifiers (DOI)
- Cataloguing and harvesting
- Data discovery (including data preview)
- Provenance information
- Quality control
- Public distribution according to ACTRIS Data policy
- Data usage statistics
- Long-term preservation

The ACTRIS data workflow and data lifecycle is described in the ACTRIS Data Management Plan (DMP). The ACTRIS DMP is based on a template from the Digital Curation   Centre that ensures that the DMP complies with the FAIR principles, is structured as recommended, and answers the questions raised in the "Open Research Data Pilot In Horizon 2020". The ACTRIS DMP serves   as the work plan for the data centre in operation and under implementation and describes the internal links between the Data Centre units, and to National Facilities and Topical Centre.

The Data Centre offer access to data (both human and machine interface), data products (Level 3 data) and tools and tailored services as support for campaigns.

For the NFs, the ACTRIS Data Centre will provide operation support in form of procedures, tools and data production, data quality assurance, data quality control, and data curation. It includes support for the data resulting from measurement techniques as described by the Topical Centres.

Activity	Objectives
Activity 1 - Data archive services	Long-term sustainable archive/repository for ACTRIS data and metadata produced by the observational and exploratory NFs, including operational Real-Real-Time (RRT) and Near-Real-Time (NRT) data flow.
Activity 2 - Data curation, production and tools for national facilities	Quality controlled level 1 and level 2 data and the associated metadata, including uncertainty estimates.
Activity 3 - Campaign service	Quality controlled data and metadata complying with ACTRIS standards when possible, campaign dashboard with day-to-day charts and report display and access to tools to facilitate decision and sharing of information within campaign.
Activity 4 - Data attribution and traceability	Identification of all ACTRIS data products ensuring attribution and traceability, linking all ACTRIS data products to their production and QA history.
Activity 5 - Support & Training (O51-O52, S36)	Knowledge transfer, training events, courses, documentation, tutorials, guidance and helpdesk for scientists, data producers and operators.
Activity 6 - Find and Access data	User access to ACTRIS level 0 to level 3 data.
Activity 7 - Data curation, production and tool service for integrated data (S8-S27)	ACTRIS Level 3 data products and tools.
Activity 8 - User community support and services (S32-S35)	ACTRIS harmonised data on global level through common procedures and good practice on data management, tools and quality control services.
Activity 9 - Workflow with other Central Facilities	Flow of information and data between DC and TCs; collection of information and data from TCs, common workflows and reports.
Activity 10 - Management of the Data Centre and the units	Well-managed and active data centre.

Topical Centres

TCs have defined a common set of activities emerging from the diverse approaches in the first versions of the Implementation Plans. The new set of activities reflects the joint purpose of ACTRIS, although each of the TCs has defined their objectives depending on needs and TC maturity. The present activity list is the synthesis of intensively discussing needs and recommendations resulting from the validation process, and as a result of the harmonization efforts (see *MS4.2 Recommendations for harmonisation of procedures and tools across the ACTRIS domains*).

Activity 1 - Management and Coordination - Ensure the internal management of the TC; enable coordination with other ACTRIS CFs and bodies.

TC	Specific tasks listed by the TC
ECAC/CAIS	• Building-up internal management structure of ECAC/CAIS and individual ECAC/CAIS units • Implementing the interactions between the CFs and with the NFs • Implementing reporting of activities, finances and work plan • Defining KPIs • Participation in different ACTRIS bodies • ACTRIS community building • Contribution to ACTRIS and ECAC/CAIS web page development
CARS	• Management of CARS • Internal management of the CARS Units • Implementation and operation of the workflows with the HO and other TC • Participation in ACTRIS bodies • Community building
CIS	• Overall management of CIS • Internal management of CIS units • Participation and representation in different ACTRIS bodies • Interactions between the CFs • Organization and reporting of activities and work plans • Reporting of finances • Monitoring and reporting of KPIs • Management of human resources • Controlling of costs, billing • ACTRIS community building, ACTRIS internal network activities • Website: setup and updates
CCRES	• Internal management of CCRES • Internal Management of CCRES Units • Interactions between the CFs • Web development (or outreach, interlinkages) • Reporting of activities and finances and work plans • Monitoring KPIs • Participation in different ACTRIS bodies • Cloud Remote Sensing community building
CiGas	• Internal management of CiGas • Internal management of CiGas units • Legal agreements • Monitoring KPIs • Building and maintaining the website • Reporting of finances and activities • Establish scientific meetings • ACTRIS community building, ACTRIS internal network activities

TC	Specific tasks listed by the TC
	• Participation in ACTRIS bodies
CREGARS	• Management of CREGARS for the implementation of the CF
	• Management of CREGARS for the operation of the CF
	• Management of the Units for the implementation of operation support and services
	• Management of the Units for the provision of operation support and services
	• Supervising the workflows with HO and other TC
	• Management of the Unit clusters

Activity 2 - Links with Associated Communities - Facilitate collaboration with scientific communities outside ACTRIS; promote ACTRIS standards, techniques and methodologies.

TC	Specific tasks
ECAC/CAIS	"Links with associated communities" can be directly lived (operated), and there is no need for implementation tasks for ECAC/CAIS for this activity.
CARS	• Organization of events for the enlarged aerosol remote sensing community
	• Development of external relations
	• Dissemination of ACTRIS technical achievements
CIS	• Participation in expert groups
	• Dissemination of ACTRIS technical achievements
	• Exchange with external communities and networks
	• CIS community building workshops: conduct workshops and post-processing
	• Developing external relations: user dedicated outreach, user networking activities, stakeholder events
CCRES	• Dissemination of ACTRIS and CCRES technical achievements
	• Exchange of expertise with external communities within CCRES working groups
	• Organization of workshops
	• Participation of the TCs at different events (National and international level)
	• Developing external relations and links with other networks
CiGas	• CiGas participation on international networks.
	• Participation in expert groups
	• Establish regular workshops
	• Cooperation with international bodies e.g. Global Atmosphere Watch, National Metrological Institutes
	• Disseminate ACTRIS technical achievements
	• Exchange of expertise
CREGARS	• Annual workshops (web-based or physical meetings) for discussing and agreeing with the world-wide FTIR remote sensing community (ACTRIS beneficiaries and users) on the retrieval strategies and operation guidelines.
	• Annual workshops (web-based or physical meetings) for discussing with the UV-VIS community (ACTRIS beneficiaries and users) on the retrieval strategies and operation guidelines.
	• Workshops for discussion involving the whole O3 LIDAR community.

Activity 3 - Training and Consultancy - Transfer the necessary expertise to the candidate National Facilities, facilitating the fulfilment of the specific technical requirements; transfer the necessary expertise to the associated National Facilities, ensuring a correct implementation of specific procedures and tools; distribute ACTRIS knowledge to stakeholders, users and private companies.

TC	Specific tasks
ECAC/CAIS	• Building training courses for NF scientists and instrument operators • Generating intensive aerosol courses (physics and chemistry)
CARS	• Organization of CARS training events • Organization of CARS webinars • Consultancy to associated NFs • Consultancy to stakeholders, users and private companies
CIS	• Training of staff • Training of NF instrument operators and/or technicians • Consultancy for potential new observational sites • Consultancy to stakeholders, users and private companies
CCRES	• Training of CCRES staff • Training of NF instrument operators and technicians • Webinars • Consultancy for setting up observation sites • Consultancy to stakeholders, users and private companies
CiGas	• Training for NF instrument operators and/or technicians • Consultancy to users, stakeholders and private companies • Yearly data QA/QC workshops • Provision of online tools for data QA/QC
CREGARS	• Training of FTIR operators • Training of MAX-DOAS operators and scientists • Training of SAOZ operators and scientists • Training of ACTRIS Pandora operators and scientists • Training of O3DIAL operators

Activity 4 - Measurement and Data Procedures and Tools - Develop, update and implement at the associated National Facilities the specific quality assurance criteria, guidelines and procedures for calibrating and operating the instruments and processing the observation data; develop and implement at the associated National Facilities specific tools for controlling the quality of measurements; develop, update and implement central processing of observation data, as applicable.

TC	Specific tasks
ECAC/CAIS	• Generating SOPs • Implementing calibration methods • Generating Instrument guidelines

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TC	Specific tasks
	• Generating measurement guidelines • Generating data processing guidelines • Defining QA criteria • Generating QA tools • Implementing central processing components
CARS	• Documentation and revision of Quality Assurance criteria for the aerosol remote sensing measurement techniques • Documentation and revision of measurement procedures and guidelines (Standard Operation Procedures, instrument calibration, data processing for the aerosol remote sensing measurement techniques • Definition of data submission protocols and data formats • Development and update of Quality Assurance tools • Implementation of the Quality Assurance tools at the instrument observation sites
CIS	• SOPs: development and updates • Calibration methods: development and updates • Instrument and measurement guidelines: development and updates • Data workflow and processing guidelines: development, implementation and updates • QA criteria and documents: development and updates • QA tools: development, implementation and updates
CCRES	• SOPs • Calibration methods • Instrument guidelines • Measurement guidelines • Data processing guidelines • QA criteria • QA tools • Definition of target uncertainties of the instrument • Definition of target uncertainties in closure studies • Central processing components
CiGas	• Measurement guidelines and SOPs will be developed and updated • Defining QA criteria • Calibration methods: development and updates. • Development of QA/QC tools • Data processing guidelines
CREGARS	• Establishment of the workflows with the DC • Supervising the workflows with DC • Establishment of the workflows with the HO and other TC • Provision of measurement guidelines for ILS characterization • Provision and maintenance of retrieval software SFIT4 • Development of retrieval strategy for all ACTRIS FTIR target species (O3, HCHO, C2H6, NO2 and NH3)

TC	Specific tasks
	- Provision and maintenance of the retrieval strategy for all ACTRIS FTIR target species (O3, HCHO, C2H6, NO2 and NH3) - Development of control files and reference spectroscopic data for all ACTRIS FTIR target species - Development of QA/QC of instrument setup and measurements (operations) through verification of sample L1 data - Development of QA/QC of L2 FTIR, UVVIS and LIDAR products before submission to DC - Development of FTIR central processing L1 to L2 - Equip and prepare laboratories for use with UVVIS instruments - Maintain laboratories for use with UVVIS instruments - Characterization of LIDAR signals for instrumental set-ups. - Development of guidelines for N2O cell measurements - Update of SFIT4 integration in CF

Activity 5 - Measurement and Data Quality Monitoring - Monitor and support the quality control of the instruments, measurements and data; monitor and support the uncertainty estimates of the measurements and data.

TC	Specific tasks
ECAC/CAIS	- Implement quality control of the measurements - Implement quality control of the data - Generate housekeeping data real time analysis tool - Define instrument performance tests for site performance tests
CARS	- Implementation and execution of the operational workflows - Calibration of reference instruments - Traceability to standards - Calibration of field instruments - Instrument performance tests - Laboratory characterization of instruments and blocks - Support for instrument debugging - Support for increasing data availability - Quality control of the measurements - Quality control of the data
CIS	- Data Quality evaluation procedures and plausibility tests: development, use and updates - QC audits of NFs - Intercomparison campaigns - Instrument Performance test: Instrument calibration, Round Robin tests - Technical implementation of TC units - Technical maintenance and updates of TC units
CCRES	Housekeeping data real time analysis tool

TC	Specific tasks
	• Data evaluation procedures and plausibility tests • Quality control of the measurements • Quality control of the data • Workshops for reviewing the quality of the data • Intercomparison Campaigns • Instrument Performance test • Measurements traceability • Technical maintenance and updates of TC units
CiGas	• Establish scale transfer/calibration support • Develop intercomparison routines using target gases and parallel sampling • Intercomparison campaigns • Yearly data QA/QC workshops • Implement data QC checks using internally developed tools (e.g. @VOC@)
CREGARS	• QA/QC of L2 FTIR, UVVIS and LIDAR products before submission to Data Centre • Verification of the calibration cells against a calibrated N2O cell. • Hosting and participating in Intercalibration campaign at Cabauw. • Remote control of Pandora instruments ("Network operator tasks") • Field of view adjustment for an ACTRIS Pandora in the laboratory • Full wavelength calibration for one UVVIS unit at 3 temperatures in the laboratory • Radiometric calibration for a UVVIS unit in the laboratory • Analyse the laboratory measurements for one UVVIS unit and build instrument calibration file • Perform initial field tests for ACTRIS Pandora at Innsbruck • On-site calibration of Pandora using mobile reference Pandora instrument and field calibration tool • Remote calibration stability checks based on field data

Activity 6 - NF Labelling and Evaluation - Contribute to the selection of the candidate National Facilities; regularly evaluate the performances of the associated National Facilities.

TC	Specific tasks
ECAC/CAIS	• Defining and implementing the labelling process in detail • Testing the labelling process • Evaluation of the initial applications
CARS	• Evaluation of the applications for the candidate NFs (aerosol remote sensing component) • Site audits • Regular evaluation of the NFs (aerosol remote sensing component)
CIS	• Develop guidelines for setting up specific NF types • Definition of milestones and performance checks during implementation and pre-operation of NFs

TC	Specific tasks
	• Support implementation and pre-operation of NFs • Evaluation of NF applications • Advice on improvements and adjustments during pre-operation of NFs • Reporting on milestones during implementation and pre-operation of NFs • Labelling verification through audits • Reporting of NF readiness • Assessment of technical performance for re-evaluations
CCRES	• Evaluation of the application • Labelling verification trough audits
CiGas	• Defining the NFs labelling process and criteria • Performing regular NF audits to check compliance with measurement guidelines and SOPs
CREGARS	• Labelling verification through audits • Evaluation of CREGARS NF application

Activity 7 - New Scientific and Technological Developments - Ensure the progress of science and technology in the field of the topical centre; preserve the state-of-the-art of ACTRIS in the field of the topical centre.

TC	Specific tasks
ECAC/CAIS	"New scientific and technological developments" can be directly started, and there is no need for implementation tasks for ECAC/CAIS here.
CARS	• Improvement of measurement techniques • Developing, assessing and implementing new techniques and measurement strategies (aerosol remote sensing) • Coordinating demonstrations and studies • Development of new retrieval algorithms • Metrology and standardization
CIS	• Assessment and implementation of new methods for SOP and best practices • Assessment and implementation of new technologies • Improvement of measurement techniques and strategies • Coordination of demonstrations and studies • Dissemination (scientific publications, other scientific communications)
CCRES	• Developing and accessing new techniques • Coordinating demonstrations and studies • Disseminating (scientific publications, other) • Improvement of measurement techniques • Prototype development • Prototype testing • Development of new measurement strategies • Development of new retrieval algorithms • Metrology and standardization (new methodologies)

TC	Specific tasks
	• Implementing new technologies • New methods for SOP and best practices
CiGas	• Developing, improving, and testing possible new instruments suitable for long-term monitoring within ACTRIS • Comparison of selected trace gases measured with the new techniques and state-of-the-art reference instruments. • Recommendations on implementing new measurement technologies
CREGARS	• Adaption of SFIT4 software to be used in CF

Detailed description of activities and tasks can be found in the individual CF revised Implementation plans (see Section 0).

Governance

Each ACTRIS Central Facility is organized as a consortium of Units with specific responsibilities. The Units are operated by one or more institutions, located in various countries, and linked by an internal Consortium Agreement. The management of each Central Facility is provided by its CF Management Board, where all Units belonging to the CF are represented. The Central Facility is represented in the ACTRIS bodies by the CF leader. The Management Board is the decision-making body of the CF. The CF Leader is the executive body. She/he has the overall responsibility for managing the activities decided by the Management Board and representing the CF in ACTRIS activities. The CF Leader reports to the Director General.
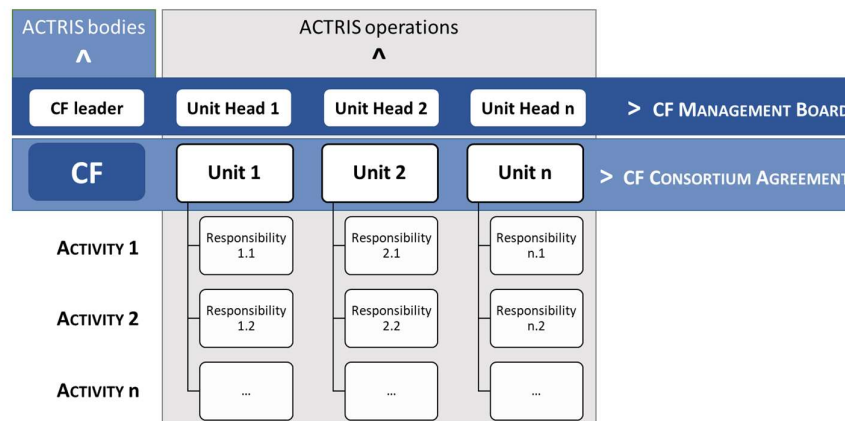
Figure 1 Schematics of a Central Facility structure

The CFs have a relevant role in the ACTRIS governance. The CFs Leaders (leaders of Head Office, Data Centre, and six Topical Centres) have a key role in the leadership and management of the distributed research infrastructure. CF leaders are responsible of the leading, managing, developing and implementing the activities of their Central Facility according to the agreed ACTRIS policies and rules. CF Leaders interact with the Central Facility Units and their staff, and the Director General. They are closely

linked with the scientific community of ACTRIS, contributing to the continuous development of the ACTRIS long-term strategy. Together with the Director General, they may officially represent ACTRIS in their field of expertise. They should also interact with the National Facilities and data users. Central Facility Leaders are members of the ACTRIS Research Infrastructure Committee and contribute to the development of ACTRIS as a unified, well-functioning research infrastructure.

For the Implementation Phase, the ACTRIS ERIC includes the functions of ACTRIS Head Office and part of the Data Centre, the TCs will be outside of the ACTRIS ERIC and the legal link to the ACTRIS ERIC will be with contractual agreements.

The specific internal structure of the Central Facilities is presented in *D4.2 Report on internal organization of CFs*. More details can be found in the individual CF revised Implementation plans (see section *0* Detailed revised Implementation plans*)*.

Timeline for implementation of the operations

The timeline for implementing the operations of the Central Facilities depends on the ERIC signature and consequently on the availability of financial support. ERIC Step 2 documents have been submitted, however the actual date of the ERIC signature, and therefore the moment when full financial support and formal agreements start, is not yet known. The timelines and milestone schedules proposed in the revised Implementation plans from august 2020 will need a revision once the ERIC is in place. The data presented below reflect the estimates made in august 2020.

Head Office
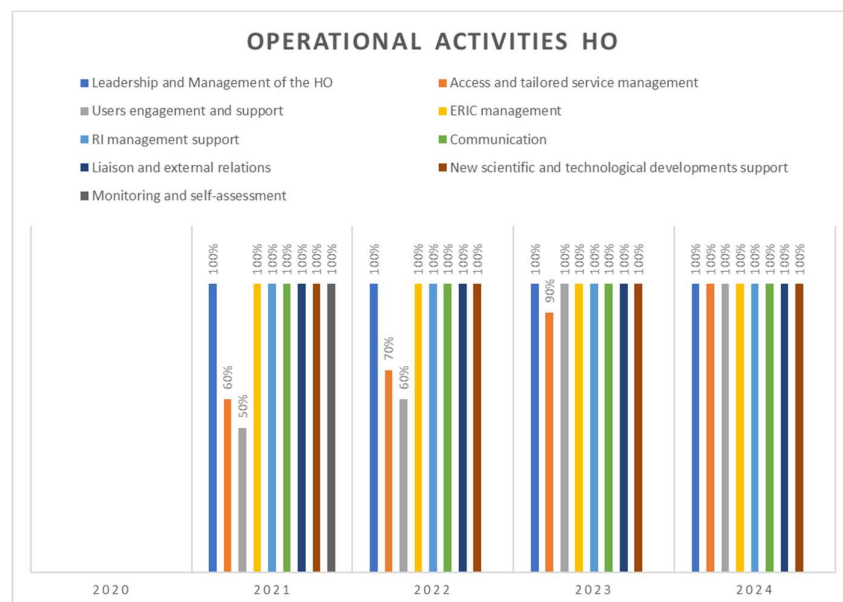
Figure 2 HO timeline for operational activities

Data Centre
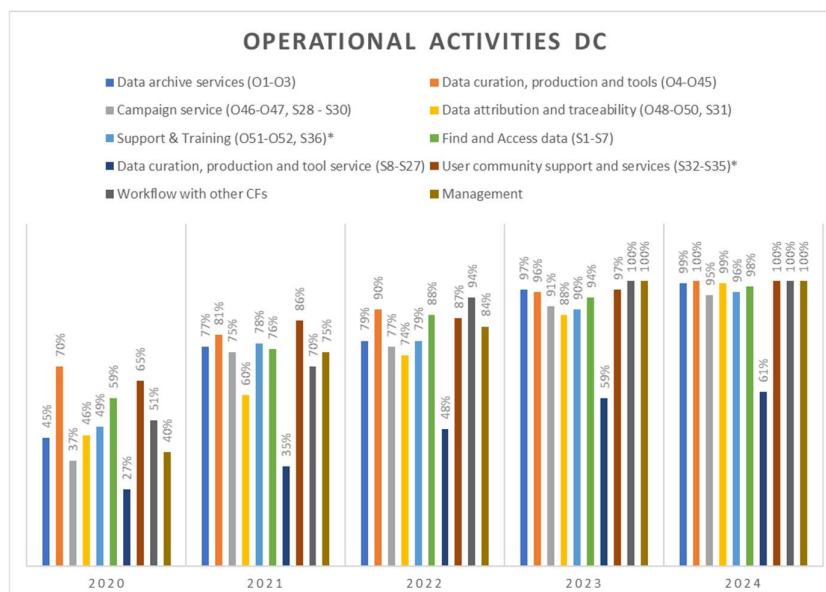
Figure 3 DC timeline for operational activities. The operation codes in the legend are explained in the full implementation plan (see section 9).

Topical Centres

Figure 4 ECAC/CAIS timeline for operational activities

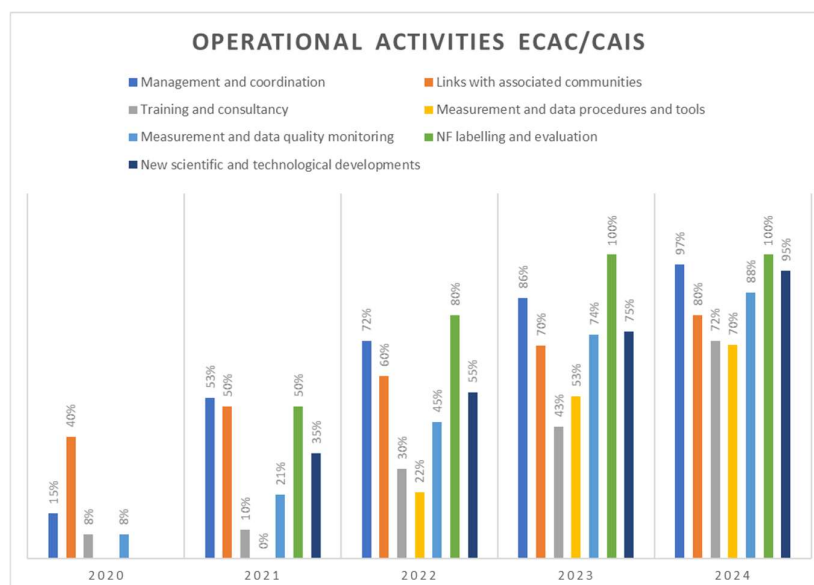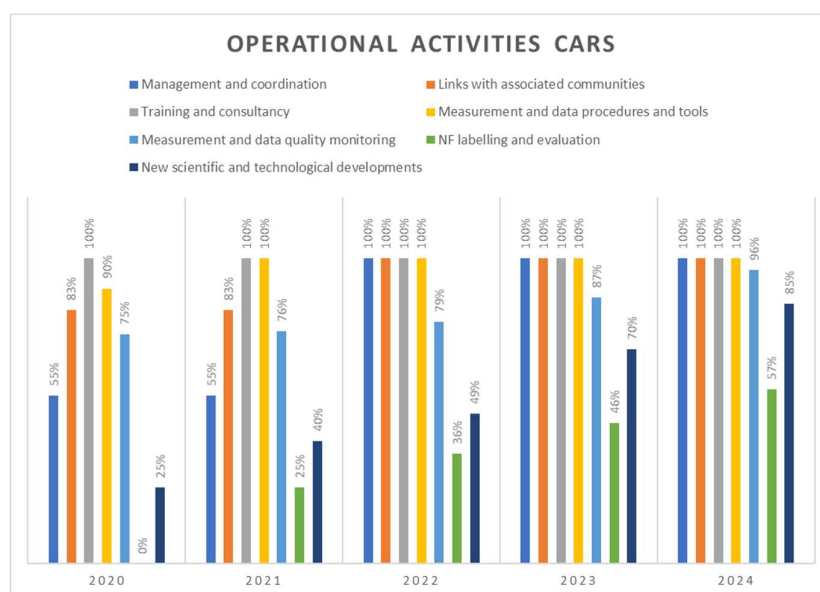*Figure 5 CARS timeline for operational activities*
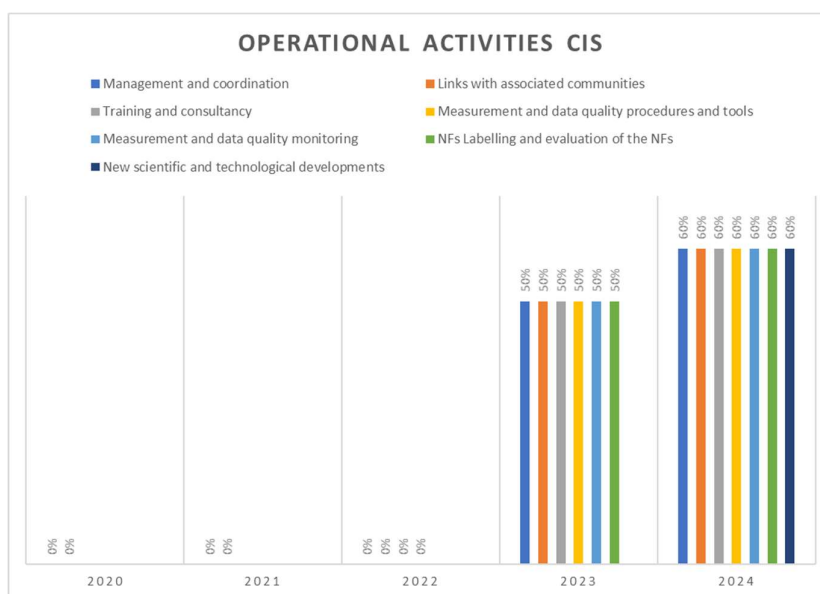

Figure 6 CIS timeline for operational activities
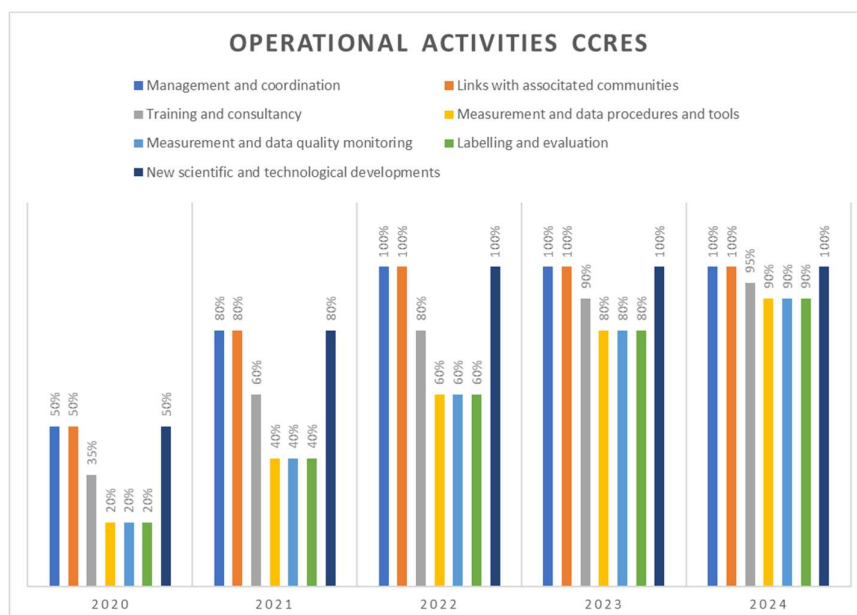
Figure 7 CCRES timeline for operational activities
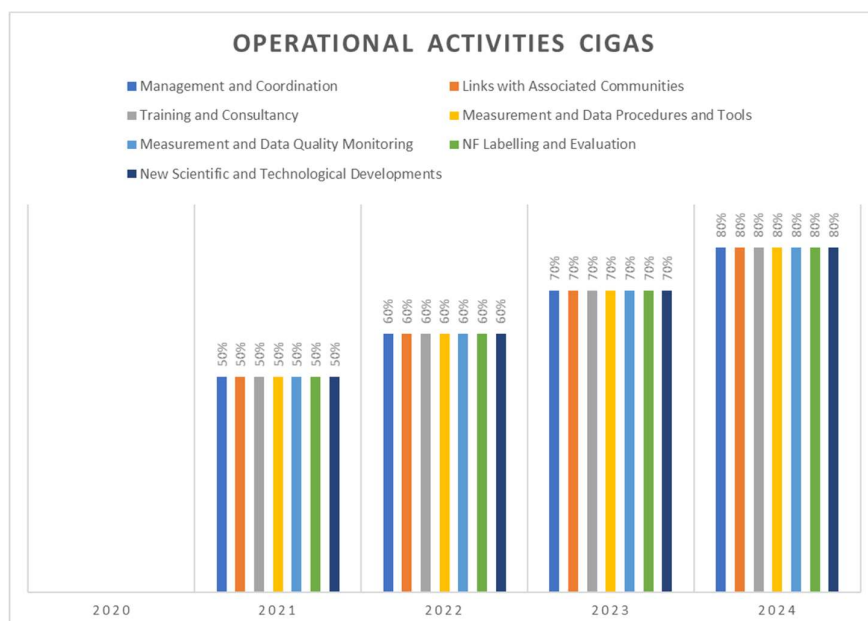
Figure 8 CiGas timeline for operational activities
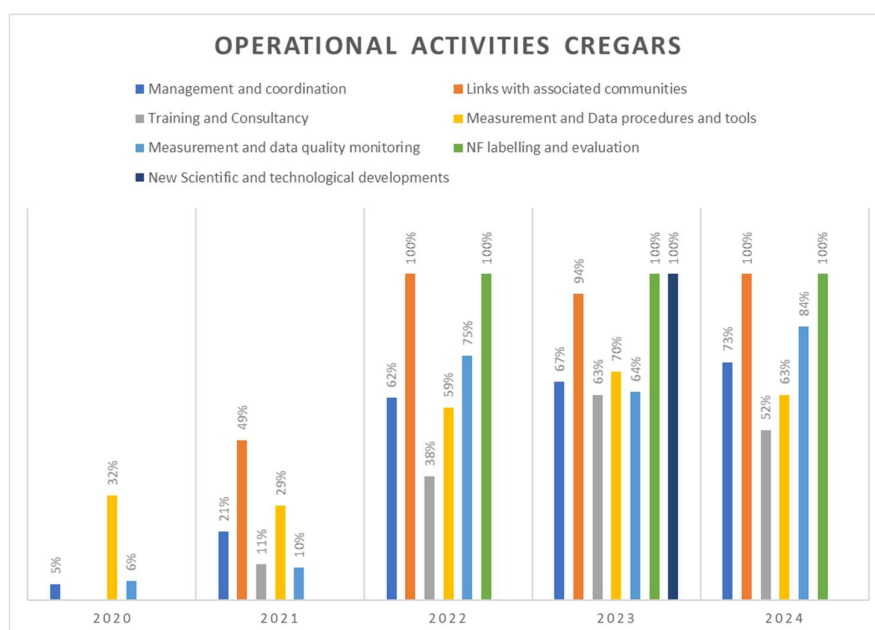
Figure 9 CREGARS timeline for operational activities

Key milestones

Key milestones during the implementation phase can be found in the individual CF revised Implementation plans (see section *0* Detailed revised Implementation plans*). A summary of the most important milestones is presented below.

Head Office

Milestone name	Estimated year of achievement
Establishment of ACTRIS ERIC	2021 (depends on Step2 process)
Launch of the ACTRIS Catalogue of services	2021 (+ updates)
Launch of the Access Management Platform	2021
Establishment of the ACTRIS Science and User Access Forum	2021
Launch of the ACTRIS User support system	2021
Launch of the ACTRIS User service helpdesk	2021
Performance monitoring	2021 (+ continuously)
Approval of the Financial plan	2022 (+ updates)
Approval of the Business plan	2022 (+ updates)
Approval of the CF agreements	2022
Approval of the NF agreements	2022 (+ continuously)
Launch of the ACTRIS ERIC communications tools	2022
Organization of Community engagement activities	2022 (+ continuously)

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Milestone name	Estimated year of achievement
Organization of New European events and activities	2022 (+ continuously)
Positioning and collaborating in the global landscape	2022 (+ continuously)

Data Centre

Milestone name	Estimated year of achievement
Mandate and task for DC management board	2020
Establishment of ACTRIS Data Expert team	2020
Mandate and task of ACTRIS Data Expert team	2020
Initial adjustments of workflows with TCs and NFs	2020
Revision of ACTRIS DMP	2020
Revised overview of level 3a,b,c data products with responsibilities included in DMP	2020
Establishment of DC management board	2020
Signature of the ACTRIS DC Consortium Agreement	2021
Define procedures for archiving level 0 data for all units described in the DMP	2021
Define procedures for archiving level 1 data for all units described in the DMP	2021
Access to information on ACTRIS DC training and support activities through the ACTRIS DC portal	2021
Procedures for access to level 0 data for all units described in the DMP	2021
Strategy and roadmap to revise ACTRIS data portal	2021
First version of campaign dashboard service available upon request through SAMU	2022
Centralised support website for providing relevant services for campaigns available from ACTRIS DC portal	2022
Data curation and archive of campaign data available	2023
New version of ACTRIS Data Portal launched for users	2023
Initial version of workflow tools for interactions between the Topical Centres, Data Centre and National Facilities in place - pilot	2023
Full workflow tools for interactions between the Topical Centres, Data Centre and National Facilities in place	2024

Topical Centres

Milestone name	Estimated year of achievement
Setup of the webpage and forum	2021
Employment of new personnel	2021-2022
Establishment of linkages with other CFs	2022

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Milestone name	Estimated year of achievement
Signature of the TC Consortium Agreement	2022
Development of the training program	2022-2023
Development of the operation support program	2022-2023
Development of the service provision program	2022-2023
Upgrade of the laboratories and equipment	2022-2025
First step of the NF labelling	2022-2025

Risks and mitigation

The whole ACTRIS community, especially National ACTRIS Consortia, CFs and NFs together with HO, is participating in the identification of risks and defining the impacts of each risk. For the implementation phase, ACTRIS is using risk categories that reflect the main activity categories and objectives of ACTRIS implementation. The risks are categorised in relation to 1) RI operations; 2) Services development and provision; 3) Governance and coordinated management; 4) Community and country engagement; 5) Collaboration and communication, and 6) ACTRIS impact.

Risks are dynamically updated and monitored through the ACTRIS Risk Register, which is a tool to support risk management. The Risk Register is based on the CFs internal analysis and the requirements from the hosting organisations. It keeps track of identified risks, current assessment of their likelihood and impact, besides who is responsible for taking action to minimise that exposure.

The main risks pointed out by the CFs are related with the possibility that the countries hosting CFs units do not sign the ERIC Step 2 or that the ERIC is not established in 2021, with the main mitigation plan the re-evaluation of the Implementation plans and re-scheduling of the critical activities.

Another concern is to secure the long-term funding. As a contingency plan the CFs are planning to work for the promotion of the ACTRIS activities to the stakeholders and to prioritise the critical activities to keep the CFs operational.

Regarding the technical work, the TCs are concerned about not having enough capacity to provide the required operation support and services provision. To avoid the risk, the TCs are planning to establish a well-planned ramp-up process with the RI support connected with the labelling processes.

The complete list of risks identified by the CFs can be found in the individual CF revised Implementation plans (see section *0* Detailed revised Implementation plans*).* General risks are taken into consideration for the ACTRIS Risk Registry and are presented in *MS2.6 Refined risk management plan*. In this deliverable we present the CF-specific technical risks only.

CF	Technical risk	Likelihood (high/ medium/ low)	Potential Impact (high/ medium/ low)	Mitigation/ Risk reduction/ Planned response (accept, avoid, reduce, or share the risk)
HO	SAMU is not operational due to the low level of TC and NF commitments or capacity on the provision of access	Low	High	Work together with TC units, NF operators, hosting RPOs and countries to ensure the commitments for service provision. Communicate the benefits for NFs and TCs.
	The user's interface is not efficient enough to process all the data and service requests from the users	Low	High	Establish a long-term plan for the SAMU and DC to be able to increase the capacity and resources if needed.
DC	Data volume exceeds capacity	Low	Medium	This can occur if number of NFs exceed the expected capacity and scalability by a large margin. Scalability is considered during labelling process and prioritisation may be necessary
	Data storage system failure	Medium	Medium	Data archive can be lost through storage system failure, corruption or deletion (intended or inadvertent) or damage (intended or inadvertent). Implement multiple redundancy (data backup and offsite backup). Ensure adequate retention policy (avoid too many backups) for short-term and long-term. Test backup system and recovery. Requires disaster recovery planning. Aided by decentralised data centre
	Physical security	Low	Medium	See answer for data storage above
	Logical security	Medium	High	See answer for data storage above
	Environmental security (e.g. natural disaster)	Low	Medium	See answer for data storage above
	Data manipulation	Low	High	Identify all objects with persist identifier, together with checksum for consistency check
	Data permanence	Low	High	Long-term availability is critical for raw data (Level 0), not so critical for data that can be regenerated. Particular Level 1-3 version regeneration will

CF	Technical risk	Likelihood (high/ medium/ low)	Potential Impact (high/ medium/ low)	Mitigation/ Risk reduction/ Planned response (accept, avoid, reduce, or share the risk)
				depend on software version archiving. Use non-proprietary open formats for data, metadata and processing software used to generate them. Re-assess formats and software every 10 years and modify structures as necessary.
	GDPR issues	Medium	Low	Personal data inside files and accompanying metadata. Issue for long-term rather than short-term. ACTRIS-wide policy decision
	NF Data Processing queue at DC units	low	medium	Concise description of data submission procedures available to NFs e.g. in data management plan and online to reduce manual interactions with the NFs. Use tools to monitor status of data in processing queue, and the various steps at the DC unit, to identify, take action and reduce bottle neck in workflows. An elevated number of NFs could result in higher number of data submission than DC unit capacity is scaled for. A prioritization of processing can reduce this impact. Acceptance delays for some data.
ECAC/CAIS	Major breakdown of key instruments (e.g. fixed or mobile reference instruments).	Medium	Low	Ensure redundancy of key instruments and optimized relationship with instrument manufacturers including preventive and corrective maintenance agreements.
	Incompatible data structures and inefficient data flow due to the difficulties in ECAC implementation	Low	High	Ensure the coherent development of data structures and workflow in agreement with the ACTRIS DC concept and data management plan.
CARS	Software tools do not provide sufficient support for the complete QA/QC of the measurements	Medium	Medium	Operators will be trained to compensate for the weaknesses of the support software. The scientific community will be consulted to suggest solutions for improvement of the tools.
	Laboratory tests are not	Low	Medium	Develop new testing methods and

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CF	Technical risk	Likelihood (high/ medium/ low)	Potential Impact (high/ medium/ low)	Mitigation/ Risk reduction/ Planned response (accept, avoid, reduce, or share the risk)
	conclusive for allowing the calculation of the correction factors			procedures. Collaborate with other laboratories and/or the manufacturers.
	Direct comparisons with the reference instruments are not conclusive for allowing the identification of instrumental biases	Medium	Medium	Supplement by other kind of operation support, e.g. laboratory tests or expert visits. Re-schedule the direct comparison.
	Reference instruments are not sufficiently complex / performant to allow direct comparisons with a variety of field instruments	Low	Medium	Promote standardization of the ACTRIS instrumentation. Identify possibilities to invest in new, more complex reference instruments.
	QA tests, site audits, real time QA/QC are not efficient in ensuring the full QA/QC chain of the measurements	Low	High	Define strict QA criteria. Develop additional methods / procedures. Properly train the operators. Discuss with the ACTRIS DC procedures for flagging suspicious data products.
	New developments (instruments, algorithms, procedures, tools) do not fulfill the needs of the infrastructure	Medium	Medium	Discuss with the ACTRIS community, implement suggestions. Discuss with other experts in the field. Involve the private sector.
CIS	Delays in the build-up of the necessary infrastructure (new equipment)	Medium	Medium	Use existing equipment, even if not at the state-of-the-art. Re-distribute work between the Units. Re-schedule tasks.
	Delay in development of QA guidelines, documents and tools	Medium	Medium	Re-visit the implementation plan. Re-distribute the work between Units.
	Failure of key infrastructure	Low	High	Ensure availability of spare infrastructure to the extent possible
	QA/QC tests, software tools, site audits, real time QA/QC are not efficient in ensuring the full QA/QC chain of the data	Low	High	Define strict QA criteria. Develop additional methods / procedures. Properly train the operators.
CCRES	Lockdown of personnel due to	High	High	Have a continuity plan ready for the phases of lockdown, that implies a

CF	Technical risk	Likelihood (high/ medium/ low)	Potential Impact (high/ medium/ low)	Mitigation/ Risk reduction/ Planned response (accept, avoid, reduce, or share the risk)
	sanitary or other crisis			good understanding and use of the different online tools for internal communication and meetings (videoconferences and online workspace). Prioritise activities that are feasible without physical meetings and work on developing more online tools to create virtual synergies.
	Underestimation of the expertise needed to implement CCRES activities and difficulty of recruiting skilled personnel	Medium	High	Train new personnel using a good documentation and archiving system. Have a clear, updated strategy for human resources. Create and maintain a supportive and attractive working environment. Monitor the well-being of staff.
CiGas	Link to global scales of WMO/GAW for specific VOCs and NOx compounds not available	Low	High	Seek cooperation with National Metrological Institutes of the Gas Analysis Working Group of BIPM. If not possible CiGas provides own standard.
	Difficulties in generating reference standards at the required uncertainty	Low	High	Cooperation with a commercial supplier of standards.
CREGARS	Software tools are incomplete, delayed, have bugs, …	Low	Medium	Additional IT support will be solicited (in the RPOs, in other CFs, in the Data Center). It will be investigated whether tools from other CFs can be shared/adapted.
	Failure of key infrastructure (reference instrument, laboratory equipment, IT infrastructure, central data processing system, …)	Medium	High	Ensure availability of spare infrastructure to the extent possible (which will be impossible for expensive infrastructure); re-schedule CREGARS tasks dependent on that infrastructure.
	Development of SOP more tedious than expected	Medium	Medium	Solicit support from members from the RTGRS community (NDACC, PGN, …).
	Logistics issues with organisation of intercomparison campaigns, shipping of	Medium	Low	Reschedule the related tasks, adapt their frequency, take lessons for future, adapt procedures.

CF	Technical risk	Likelihood (high/ medium/ low)	Potential Impact (high/ medium/ low)	Mitigation/ Risk reduction/ Planned response (accept, avoid, reduce, or share the risk)
	instruments, site audits, …			
	New developments (instruments, algorithms, procedures, tools) do not fulfil the needs of the infrastructure	Low	Low	Discuss with the ACTRIS & RTGRS communities, implement suggestions. Discuss with other experts in the field. Involve the private sector.
	'Synchronisation' with global networks (NDACC, PGN, …) fails	Low	High	Improve communication between ACTRIS & RTGRS communities, adapt ACTRIS requirements to reach consensus with the global RTGRS communities.
	Training of NF operators and users fails	Low	Medium	Solicit feedback from beneficiaries & amend training concepts to get in line with beneficiaries' expectations.

Detailed revised Implementation plans

Apart from the topics summarized above, the CF revised implementation plans contain detailed information on operational support and services to be provided, resources to be allocated and Key Performance Indicators proposed.

CF revised Implementation plans can be accessed through the ACTRIS Intranet as follows:

- HO revised Implementation plan 2020-2024
- DC revised Implementation plan 2020-2024
- ECAC revised Implementation plan 2020-2024
- CARS revised Implementation plan 2020-2024
- CIS revised Implementation plan 2020-2024
- CCRES revised Implementation plan 2020-2024
- CiGas revised Implementation plan 2020-2024
- CREGARS revised Implementation plan 2020-2024