Deliverable 4.4: First version of the CF implementation plans

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Comments	The CF implementation plans have been issued as a first version, and acknowledged by the Interim ACTRIS Council on their 9th meeting in Warsaw, 13-15 November 2019. Due to the parallel process for the validation of CF activities, a revision of the implementation plans is expected in 2020.

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1 Executive summary

ACTRIS includes eight Central Facilities (CFs): 6 Topical Centres (TCs), the Data Centre and the Head Office (HO), the latter comprising the Service and Access Management Unit (SAMU). Each Central Facility consists of several Units hosted by ACTRIS member countries by a responsible ACTRIS Research Performing Organisation (RPO). ACTRIS CFs are vital to ensure compliance with standard policies and procedures, to coordinate user access to state-of-the-art facilities, and to provide services required by the scientific community and other stakeholders. ACTRIS data are harmonised through standard quality control measures and are correctly archived and accessible to all users for the long term.

Figure 1 ACTRIS Central Facilities

The eight Central Facilities, operated by their respective hosting multinational consortia, were approved by the 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. After the selection process, the CF consortia have developed the implementation plans for the period 2020-2024. The implementation plans are summarized in this document, while the full documents of each Central Facility are available on the ACTRIS internal website.

Head Office (HO)

The ACTRIS ERIC Head Office (HO) shall be the central hub of ACTRIS coordinating the operations and enabling services for generating and disseminating knowledge, boosting technological development, creating human capital and employment for the benefit of the society, and tackling environmental challenges. HO shall promote and coordinate the provision of ACTRIS services, handle internal and external communication, operate the ERIC, and ensure the strategic development and sustainability of

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ACTRIS. HO shall operate from a user-oriented and service-based perspective, delivered consistently with quality, excellence, professionalism, and integrity.

The Head Office is organized in four Units. The **Service and Access Management Unit (SAMU)** is a single point of access for all ACTRIS users and support structure dedicated to optimize the access according to the ACTRIS user policy and strategy. The **ERIC Management Unit (EMU)** is responsible for the administration of the ERIC, giving the finance and legal support for the ACTRIS implementation and operation. The **Research Infrastructure Operations Unit (OPU)** is responsible for operative coordination and integration. It supports ACTRIS workflows and the integration of the different activities between the ACTRIS facilities (NF and CF), to guarantee a coherent operational system. The **Development and Relations Unit (DEVU)** enhances and maintains the strategic and technological development of ACTRIS, building external communications, relations and strategic partnerships.

All Units except SAMU will be fully operational in 2021. SAMU will gradually implement their operation support and services by 2025. During 2020-2025, the operation activities will ramp-up and the implementation activities will ramp-down fast, so that in 2023 the HO will be already at 80% of its full capacity.

Centre for Aerosol Remote Sensing (CARS)

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/polarized/lunar photometers.

CARS is organized in 8 Units which are grouped in 3 clusters, one cluster for each measurement technique covered by CARS. The **cluster for Aerosol High-power Lidars (AHL)** is operated in collaboration by the National Institute of R&D for Optoelectronics (Romania), Meteorological Institute of the Ludwig-Maximilians-University (Germany) and Consiglio Nazionale delle Ricerche – National Research Council of Italy (Italy). The **cluster for Automatic low-power Lidars and Ceilometers (ALC)** is operated in collaboration by Hohenpeissenberg Meteorological Observatory, Deutscher Wetterdienst (Germany) and Meteorological Institute of the Ludwig-Maximilians-University (Germany). The **cluster for Automatic Sun/sky/lunar Photometers (ASP)** is operated in collaboration by CNRS-Laboratoire d'Optique Atmospherique (France), University of Valladolid (Spain) and AEMET - Izaña Atmospheric Research Center (Spain).

The capacity at CARS was planned to cover maximum 52 aerosol remote sensing NFs (aerosol high-power aerosol lidars and automatic sun/sky/polarized/lunar photometers) and 29 cloud remote sensing NFs (automatic low-power lidars and ceilometers). CARS has reserved some capacity to provide virtual and remote services to about 9 aerosol high-power aerosol lidars, 34 automatic sun/sky/polarized/lunar photometers and 35 automatic low-power lidars and ceilometers.

All Units are currently operational, but more activities will be implemented gradually. During 2020-2025, the operation activities will ramp-up and the implementation activities will ramp-down fast, so that in

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2023 CARS will be already at 87% of its full capacity. Full capacity is planned for 2025. The presented time schedule assumes availability of the requested funds.

Centre for Aerosol In Situ Measurements (ECAC)

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 (NFs) for the physical and/or chemical in situ characterization of atmospheric aerosol particles as well as for particle sampling and subsequent laboratory analysis of these particles. ECAC will also offer measurement and data tools related to aerosol in situ measurements.

ECAC 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. **The chemical branch** also consists of three units, namely OGTAC CC (operated by TROPOS, Germany), EMC2 (operated by INFN, Italy), and ACMCC which is a cluster of three French Institutions (INERIS, CNRS and CEA). Subcontracting partner (ERLAP/JRC, Italy) is included under OGTAC CC.

The capacity at ECAC was planned to cover 70-90 aerosol in situ NFs. ECAC has reserved some capacity to provide services to non-ACTRIS users, in the range of 10%-30%, depending on the activity.

Three out of six units are already partly operational, and the other activities will be implemented gradually. During 2020-2025, the operation activities will ramp-up and the implementation activities will ramp-down, so that in 2023 ECAC will be already at 75% of its full capacity. Full capacity is planned for 2025. The presented time schedule assumes availability of the requested funds.

Centre for Cloud Remote Sensing (CCRES)

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 and turbulence profiling. CCRES will also provide support for automatic low power lidars and ceilometers used for cloud profiling purposes.

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. **The CNRS-FR (CCRES-FR) Unit** develops new-generation FMCW Doppler cloud radar technology and retrieval algorithms for cloud properties. CNRS-FR develops target-based calibration procedures for cloud radars, and reference equipment for on-site calibration at ACTRIS national facilities. **The TUD-NL (CCRES-NL) Unit** develops drone-aided radar calibration procedures (H2020 ACTRIS-2 programme). Using the multi-instrumented observatory at Cabauw measurement methodologies and retrieval algorithms have been developed for the determination of cloud properties. **The NCAS-UK (CCRES-UK) Unit** will serve as support to FR and NL units to develop new technical solutions. It has

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expertise concerning rain induced attenuation effects (including antenna/radome wetting) on Doppler Cloud Radars and their correction. It provides an S-band reference radar for evaluating corrections applied to particular models of cloud radar. **The UC-DE (CCRES-DE) Unit** has more than 20 years expertise concerning microwave radiometers, their operation, and full in-house characterization (calibration, quality control, retrieval development, data interpretation). They will handle the MWR activities in CCRES. **The FMI-FI (CCRES-FI) Unit** has more than 10 years expertise concerning Doppler Lidars, their deployment and operation, and characterization including quality control and retrieval algorithm development.

The capacity at CCRES was planned to cover maximum 30 cloud remote sensing NFs. CCRES has reserved some capacity to provide some of its services (e.g. remote service, training and opportunities for knowledge exchange) to about 20-40 users.

The operational activities will ramp-up starting 2020 up to the full operation in 2025. During 2020-2025, the operation activities will ramp-up and the implementation activities will ramp-down, so that in 2023 the most time-consuming services of CCRES will reach about 80% of full capacity. The presented time schedule assumes availability of the requested funds.

Centre for Cloud In Situ Measurements (CIS)

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 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, specialized 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).

CIS includes 4 units. Each unit is led by a unit head, who is employed at the respective hosting institutes together with the other unit personnel. The head of the **lead unit Centre of cloud ice nucleation (CCIce)** at Karlsruhe Institute of Technology (KIT) in Germany also represents the director of the CIS and forms the CIS Management Board (CIS-MaB) together with the other unit heads. The other units of the CIS are the **Centre for cloud particle properties (CCPar)**, located at The University of Manchester (U-Man) in the UK, the **Centre for cloud water chemistry (CCWaC)**, located at the Leibniz Institute for Tropospheric Research (TROPOS) in Germany, and the **Center for cloud ambient intercomparison (CCInt)**, located at the ZAMG Sonnblick Observatory in Austria. While this implementation plan is written for ACTRIS related activities only, unit laboratories, offices and existing instrumentation will be partly also used by other communities.

The capacity at CIS was planned to cover maximum 15 cloud in situ NFs.

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The operational activities will ramp-up starting 2020 up to the full operation in 2025. During 2020-2025, the operation activities will ramp-up and the implementation activities will ramp-down, so that in 2023 CIS will be already at 70% of its full capacity.

Centre for Reactive Trace Gases Remote Sensing (CREGARS)

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.

CREGARS is organized in 8 Units which are grouped in 3 clusters, one cluster for each measurement technique covered by CREGARS. The Units belonging to one cluster share responsibilities at the technical level for a particular technique. Within each cluster, the Units have specific tasks and share other tasks. In particular for the UVVIS cluster, as there are three types of UVVIS instruments compliant with ACTRIS requirements (MAXDOAS, PANDORA and SAOZ), each Unit has the responsibility for providing specific technical support/services for one type of instrument; the lead of the cluster will make sure that the activities of the three units are coordinated and that the ACTRIS UVVIS data from the three instrument types are harmonized. The fourth UVVIS Unit is essentially responsible for providing the support at the instruments intercomparison field site (Cabauw).

The capacity at CREGARS was planned to cover maximum 20 reactive trace gases remote sensing NFs (including chambers). CREGARS has reserved some capacity to provide services to about 20 users (FTIR, UVVIS, O3 DIAL)

CREGARS is already operational, however some activities will require adjustments and updates. In 2023 CREGARS will be already at 86% of its full capacity. The presented time schedule assumes availability of the requested funds.

Centre for Reactive Trace Gases In Situ Measurements (CiGas)

The key-mission of the CiGas is to offer current state operational support to ACTRIS National Facilities (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 gases and to develop towards future user needs utilising innovative methodologies.

CiGas operates and supports instrumentation and observations collected of the following atmospheric reactive trace gases: ➢ Non-Methane Hydrocarbons (NMHCs, typically over 40 compounds); ➢ Biogenic Volatile Organic Compounds (BVOCs) such as terpenes; ➢ Oxygenated VOCs (OVOCs) such as aldehydes, ketones, alcohols (methanol, formaldehyde, acetaldehyde, acetone…); ➢ Condensing vapours and direct aerosol precursors such as sulfuric acid and Highly Oxygenated Molecules (HOM; e.g. C10H14O9); ➢ Nitrogen Oxides (NOx) such as NO and NO2.

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With KIT as leading unit, the tasks are shared between six CiGas-units in order to combine complementary expertise. Some activities are duplicated between units to achieve metrological robustness and to provide sufficient capacity. CiGas is structured along specific compound classes by forming the clusters (1) anthropogenic/biogenic volatile organic compounds (ABVOCs), (2) oxygenated VOCs (OVOCs), (3) condensable vapours and (4) nitrogen oxides (NOx).

The capacity at CiGas was planned to cover maximum 48 reactive trace gases in situ NFs. CiGas has reserved some capacity to provide services to about 12 requests per year from academic and industry.

CiGas activities will be fully implemented in a time span of 5 years starting at 2020. During the implementation phase partial operation is possible starting with 50% operation in 2020 and ramping (10% annual increase) up to 100% operation at the end of 2025. In parallel, implementation activities are ramped down correspondingly. In 2023, CiGas will be at 80% of its full capacity. The presented time schedule assumes availability of the requested funds.

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2 Introduction

The CFs have been working on the Implementation plan according to the template and the guidance received from the IAC in June 2019. The first fully written drafts of the Implementation plans were received by 22 October 2019. The work has been intertwined with the first-round validation process, where the costs per activity in each CF in operational phase (2025) was requested. The Implementation plans will be further developed based on IAC feedback and the results of the Validation process.

The CFs Implementation Plan includes:

- General description of the Central Facility
- Implementation of governance
- Implementation of operations
    - Operation Support and services
    - Share of responsibilities between Units
    - Implementation timeline 2020-2024
    - Important milestones
    - Allocation of resources
- Risk management and contingency planning
- KPIs of the CF
- Catalogue of CF operational activities

This document presents the short summaries of each facility, the organigram, the partners, the list of activities, planned milestones, and risks and contingency plans. The full drafts of the CF specific implementation plans can be found in the following links:

- The full draft implementation plan of Centre for Aerosol Remote Sensing (CARS): https://www.actris.eu/LinkClick.aspx?fileticket=19TXPYTaQhg%3d&portalid=46
- The full draft implementation plan of Centre for Cloud Remote Sensing (CCRES): https://www.actris.eu/LinkClick.aspx?fileticket=E7VqAUb4MnY%3d&portalid=46
- The full draft implementation plan of Centre for Reactive Trace Gases Remote Sensing (CREGARS): https://www.actris.eu/LinkClick.aspx?fileticket=hF1NuFcQqVw%3d&portalid=46
- The full draft implementation plan of Centre for Reactive Trace Gases In Situ Measurements (CiGas): https://www.actris.eu/LinkClick.aspx?fileticket=hgM8ym8Udu4%3d&portalid=46
- The full draft implementation plan of Centre for Cloud In Situ Measurements (CIS): https://www.actris.eu/LinkClick.aspx?fileticket=MCFlivTfE5k%3d&portalid=46
- The full draft implementation plan of Centre for Aerosol In Situ Measurements (ECAC): https://www.actris.eu/LinkClick.aspx?fileticket=SzERBFQc_Ec%3d&portalid=46
- The full draft implementation plan of Head Office (HO): https://www.actris.eu/LinkClick.aspx?fileticket=OnIF-5HxXhk%3d&portalid=46
- The full draft implementation plan of Data Centre (DC): (Will be uploaded end of 2019)

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3 Implementation plan of the Head Office (HO)

The Head Office is responsible for coordinating and managing the multi-layered distributed research infrastructure and the success of the Head Office can be measured by its capacity to lead, organise, execute and manage the ACTRIS ERIC, ensure the smooth operations and service provision of ACTRIS, and to position ACTRIS in the national, European and global landscape. The focus areas of ACTRIS Head Office is steered by the long-term ACTRIS strategy. ACTRIS Head Office is comprised of four Units to meet the needs of the user communities and requirements and expectations set for European high-quality research infrastructures (ESFRI RIs). Each Head Office Unit is divided into tasks and activity categories to ensure the success and long-term sustainability of ACTRIS. Head Office is responsible for planning, improving and securing: 1) high-quality, transparent and easy-access services for promoting scientific excellence, 2) successful user strategy, 3) efficient governance and management (incl. human resources), 4) financial sustainability, 5) technological development and upgrading of the RI, 6) activities for innovation and socio-economic impacts, and 7) activities to reduce and manage risks. Figure 2 shows the different ACTRIS Head Office Units and the main tasks of the Units. Head Office Units can be described as follow:

1) **Service and Access Management Unit (SAMU)** is a single point of access for all ACTRIS users and support structure dedicated to optimize the access according to the ACTRIS user policy and strategy;
2) **ERIC Management Unit (EMU)** is responsible for the administration of the ERIC, giving the finance and legal support for the ACTRIS implementation and operation;
3) **Research Infrastructure Operations Unit (OPU)** is responsible for operative coordination and integration. It supports ACTRIS workflows and the integration of the different activities between the ACTRIS facilities (NF and CF), to guarantee a coherent operational system; and
4) **Development and Relations Unit (DEVU)** enhances and maintains the strategic and technological development of ACTRIS, building external communications, relations and strategic partnerships.

The Director General (DG) is the leader of the ACTRIS (research infrastructure) and legal representative of the ACTRIS ERIC. He/she represents equally all aspects of ACTRIS. DG is responsible for the implementation of the decisions made by the General Assembly, ensuring that the scientific and strategic development of ACTRIS meets the expectations on socio-economic impact, technology development and innovation.

HO leadership ensures the strong coordination and management of ACTRIS. *HO Director* will work in close collaboration with ACTRIS Director General as all the other Central Facility leaders. HO Director will be in charge of the tasks and activities identified to Head Office, particularly ensuring the management of ACTRIS organization, ACTRIS ERIC as well as the operational RI functions and service provision.

3.1 Mission of the Central Facility

The ACTRIS ERIC Head Office (HO) shall be the central hub of ACTRIS coordinating the operations and enabling services for generating and disseminating knowledge, boosting technological development, creating human capital and employment for the benefit of the society, and tackling environmental

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challenges. HO shall promote and coordinate the provision of ACTRIS services, handle internal and external communication, operate the ERIC, and ensure the strategic development and sustainability of ACTRIS. HO shall operate from a user-oriented and service-based perspective, which shall be delivered consistently with quality, excellence, professionalism, and integrity.

3.2 Head Office Organigram

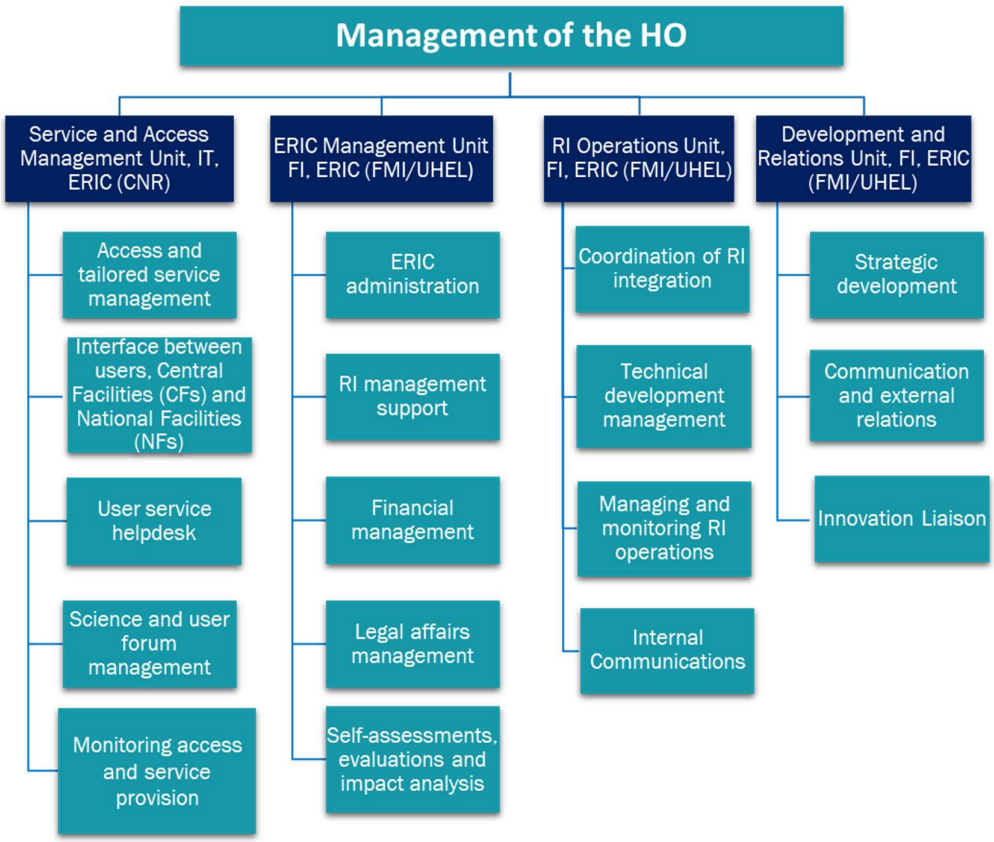

Figure 2 ACTRIS Head Office organigram showing the main tasks of different units

3.3 Partners

Leading Unit	**Host Institution of the Leading Unit**	**Name of the CF leader**	**Contact of the CF leader**
Leadership *Interim Director* *Head Office leader*	 FMI (FI) UHEL (FI)	 Sanna Sorvari Sundet Eija Juurola	 sanna.sorvari@fmi.fi eija.juurola@helsinki.fi
Unit	**Host Institution**	**Name of the Unit Head**	**Contact of the U*nit Head***

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Service and Access Management Unit (SAMU)	*CNR (IT)*	To be nominated for ACTRIS ERIC, in interim phase the responsible person is Rosa Maria Petracca Altieri, CNR,	rosa.petracca@imaa.cnr.it
ERIC Management Unit (EMU)	*FMI-UHEL (FI)*	To be nominated for ACTRIS ERIC, in interim phase the responsible persons are Anna Salonen, FMI and Mikhail Paramonov, FMI	anna.salonen@fmi.fi Mikhail.paramonov@fmi.fi
RI Operations Unit (OPU)	*FMI-UHEL (FI)*	To be nominated for ACTRIS ERIC, in interim phase the responsible person is Eija Juurola, UHEL	eija.juurola@helsinki.fi
Development and Relations Unit (DEVU)	*FMI-UHEL (FI)*	To be nominated for ACTRIS ERIC, in interim phase the responsible person is Giulia Saponaro, FMI, and Sanna Sorvari Sundet, FMI	giulia.saponaro@fmi.fi sanna.sorvari@fmi.fi

3.4 Implementation timeline 2020-2024

No.	Activity	2019	2020	2021	2022	2023	2024
	Implementation Activities						
1	Physical set up of Finland HO		100				
2	Physical set up of Italy HO	50	50				
3	Preparation of the Access Management Plan	70	30				
4	Analysis of the User needs	50	50				
5	Development of the Catalogue of Services	50	50	50			
6	Implementation of the Access Management Platform	40	40	30	30		

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No.	Activity	2019	2020	2021	2022	2023	2024
7	Implementation of the Science and User Forum	50	50				
8	Management & Communication of the SAMU		100				
9	Building and developing ACTRIS strategy		80	20			
10	Strategic development of ACTRIS operations and services		100				
11	Implementation of ERIC organisation		100				
12	Establishment of a cloud-based management tools for coordinating the work of the ERIC		100				
13	Registration of ACTRIS ERIC according to the Finnish legal system		100				
14	Organisation of the IAC/General Assembly meetings		100				
15	Establishment of the governance bodies		100				
16	Development of the ACTRIS annual clock of managerial processes		100				
17	Development of the document management system		100				
18	Implementation of bank accounts		100				
19	Procurement of auditing company		100				
20	Steering of the process on finalisation of the financial contributions		100				
21	Development of the user-friendly systems for the CFs for the financial report		100				
22	Contract negotiations with the CFs, and later with the NFs		100				
23	Development of the risk registry		100				
24	Development of the self-assessment system and the KPIs		100				
25	Planning of the next validation rounds and the evaluation at the end of the implementation phase of ACTRIS		100				
26	Development of the framework for the regular socio-economic impact analysis of ACTRIS		100				

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No.	Activity	2019	2020	2021	2022	2023	2024
27	Steering the establishment of the National Facility Assemblies, facilitate their organisation		100				
28	Building RI management structures, workflows, internal decision-making processes		100				
29	Development of the cloud-based process management system for the RI coordination		100				
30	Start the facilitation of National Facility labelling process		100				
31	Develop an ACTRIS Innovation strategy		100				
32	Develop the working modes within ACTRIS and communication methods related to raising awareness of ACTRIS and building relationships with research and industry		100				
33	Study and develop an ACTRIS technology transfer model		100				
34	Building and developing ACTRIS strategy		100				
35	Strategic development of ACTRIS operations and services		100				
	Operation Activities						
1	Leadership and management of HO			100	100	100	100
2	Management and Communication of the SAMU			100	100	100	100
3	Management of the OPU			100	100	100	100
4	Management of the EMU			100	100	100	100
5	Management of the DEVU			100	100	100	100
6	Access and tailored service management				50	60	70
7	Interface between users, CFs and NFs			50	50	60	70
8	User service helpdesk			50	50	60	70
9	Management of the Science and User Forum			50	50	60	70
10	Collection of the access metrics			50	50	60	70
11	Collection of the user feedback and processing (input to OPU, DEVU, EMU, CFs and NFs)			50	50	60	70

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No.	Activity	2019	2020	2021	2022	2023	2024
12	Access KPIs & service provision activity report			50	50	60	70
13	Review and Update of the AMP					50	
14	Update of the User needs analysis				50		50
15	Update of the Catalogue of Services					50	
16	Test, upgrade and maintenance of the Access Management Platform					50	70
17	Access document pack management			50	50	50	80
18	Access Eligibility check			50	50	50	80
19	Coordination of the access feasibility check by TCs			50	50	50	80
20	Establishment of the selection panels			50	50	50	80
21	Coordination of the Evaluation by the selection panels			50	50	50	80
22	Management of ACTRIS ERIC			100	100	100	100
23	RI management support			100	100	100	100
24	Financial management			100	100	100	100
25	Legal affairs management			100	100	100	100
26	Self-assessments, evaluations and impact analysis			100	100	100	100
27	Coordination of RI integration			100	100	100	100
28	Technological development management			100	100	100	100
29	Managing and monitoring RI performance			100	100	100	100
30	Measuring ACTRIS socio-economic impacts			100	100	100	100
31	Monitoring the NF labelling process			100	100	100	100
32	Management of well-integrated RI operations			100	100	100	100
33	Optimizing RI operational work flows			100	100	100	100
34	Maintaining RI operational work flows			100	100	100	100
35	Internal communication			100	100	100	100
36	Strategic development			100	100	100	100
37	Communication and external relations			100	100	100	100

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No.	Activity	2019	2020	2021	2022	2023	2024
38	Innovation liaison			100	100	100	100

3.5 Important Milestones

Note: Milestones are an ongoing process and will be evolved in the next versions.

Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
Implementation activities				
Validation of services; plan for the implementation phase established		Strategic development of ACTRIS operations and services	2020	This milestone is dependent on the completion of the works of the Validation Task Group and the Validation Advisory Group
Prioritisation of service provision (1st set of services)		Strategic development of ACTRIS operations and services		This milestone depends on the decisions of the IAC based on the work of the VAG and the VTG
User needs analysed	Document detailing the user needs as resulting from the analysis performed	Analysis of User needs	2020	
ACTRIS User strategy finalised	Document detailing the user strategy as refined to pave the way for ACTRIS future developments.	Analysis of User needs	2020	
1st release of the Catalogue of services	Online application providing a searchable initial list of the ACTRIS services available for users., including detailed descriptions and information on logistic and support services	Development of the Catalogue of Services	2021	
ACTRIS Access and Service Management Plan	Plan detailing internal processes for the access to ACTRIS Facilities and the provision of services	Preparation of the Access Management Plan	2021	

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
Beta version of the Access Management Platform	Early version of the platform available with most of the major features, released for testing and feedback	Implementation of the Access Management Platform	2022	
User access services tested	Beta version of the access management platform is tested and outcomes are used for improvements /upgrade	Test, upgrade and maintenance of the Access Management Platform	2024	
ACTRIS Science and User Forum	Online tool for fostering interactions and collaboration between ACTRIS and different user communities	Implementation of the Science and User Forum	2020	
ACTRIS User support system	User support services and feedback collection and processing are designed and in place	Preparation of the Access Management Plan	2021	
ACTRIS User service helpdesk	Web based application integrated in the access platform for users to get information and assistance.	User service helpdesk	2020	
CF agreements approved	to have the CFs engaged to ACTRIS is an important step to start with the implementation of ACTRIS and the operation support to the NFs	Development of coordinated RI operations	2021	
NF agreements approved	The labelling of ACTRIS CFs is needed the able to provide data to the users	- Establishment of the NFs labelling process - Monitoring the NF labelling process	2024	
Increase in the number of ACTRIS memberships	The involvement of countries to ACTRIS is needed to secure resources for the	Development of coordinated RI operations	2022	

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
	ACTRIS implementation and operation phases			
ACTRIS communication strategy	Excellent communication and outreach activities are essential to achieve ACTRIS goals	Coordination of ACTRIS communication and dissemination	2024	
Outreach materials ready for different user groups and stakeholders	The success of the full exploitation and dissemination of results relies on the well-managed and well-performed engagement and communication activities with the ACTRIS users and other target groups	- Coordination of ACTRIS communication and dissemination - Building and developing ACTRIS strategy	2023	
Operation activities				
The ERIC countries assure Long-term financial commitment	To secure long term financial support is essential to guarantee ACTRIS long term operations	- Administration of ERIC organisation - Development of coordinated RI operations - Building and developing ACTRIS strategy - Financial management - Legal aspects - Management of well-integrated RI operations	2024	
Financial plan updated	To keep the financial plan update is important for ACTRIS development.	- Financial management - Development of coordinated RI operations - Building and developing ACTRIS strategy - Administration of ERIC organisation	2022	

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
National ACTRIS consortia and ACTRIS ERIC communications tools ready	To keep the communication and interaction between the different national ACTRIS consortia facilitate the coordination of the activities and the follow-up of the processes on each country	- Administration of ERIC organisation - Development of coordinated RI operations		
Performance monitoring	To follow up ACTRIS performance is important to make a technical and financial decision depends on the needs or to increase ACTRIS promotion for specific users.	- Administration of ERIC organisation - Development of coordinated RI operations - Administration of ERIC organisation	2021	
Response to external assessment	External assessment will give detailed feedback from the users for ACTRIS to address and compare the services provided and the users benefit and to plan further services and activities.	- Design of the Science and User Forum - Implementation of the Science and User Forum - Development of ACTRIS downstream services - Management of ACTRIS downstream services - Maintaining external relations - Update of the User needs analysis - User service helpdesk - Monitoring access and service provision		
Business plan updated	The business plan is the roadmap of ACTRIS; it provides directions ACTRIS implementation and operation. it will evolve	- Administration of ERIC organisation - Development of coordinated RI operations	2024	

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
	depending on the ACTRIS community and user needs			
Community engagement activities	ACTRIS shall keep permanent promotion of its activities and services to attract new stakeholders	- Building and developing ACTRIS strategy - Coordination of ACTRIS communication and dissemination - Management of well-integrated RI operations		
New European events and activities arranged	ACTRIS permanent promotion shall be an important part of ACTRIS activities. It will benefit the ACTRIS capacity to reach to stakeholder and users at the European level.	- Coordination of ACTRIS communication and dissemination - Building and developing ACTRIS strategy		
Participation in global and regional collaboration and partnerships	To promote ACTRIS activities globally will help ACTRIS to reach new scientific communities that can benefit from ACTRIS products and services	- Building and developing ACTRIS strategy - Coordination of ACTRIS communication and dissemination		
New opportunities for collaboration and liaisons	ACTRIS community can collaborate in different projects and programs with their expertise. Permanent promotion of ACTRIS capacity is an essential activity to enhance ACTRIS	- Building and developing ACTRIS strategy - Coordination of ACTRIS communication and dissemination		
Positioning and collaborating in the RI landscape	ACTRIS is a strategic player within the RI landscape. ACTRIS shall promote the different activities to win visibility inside the RI landscape.	- Building and developing ACTRIS strategy - Coordination of ACTRIS communication and dissemination		

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3.6 Risk management and contingency planning

Description of Risk	Likelihood (high/medium/low)	Potential Impact (high/medium/low)	Mitigation/Risk reduction/Planned response (accept, avoid, reduce, or share the risk)
Service development and provision			
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.
Users are not aware of the ACTRIS services, too few requests for access to ACTRIS Facilities via SAMU	Low	High	Formulate a clear user strategy during the PPP in consultation with the experts and user communities. The awareness with efficient dissemination and promotion activities.
Governance and coordinated management			
Not enough countries as members of the ACTRIS ERIC	Medium	High	Present a clear ACTRIS concept and activity plan to the countries delegates. Ensure the high quality and timely management and implementation activities. Promote ACTRIS with the different stakeholders in each country.
Legal entity not established in 2021	High	Medium	Efficiently deliver the PPP outcomes. 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 and NF agreements concluded	Medium	High	Define a clear plan for negotiation and signing the agreements with the RPOs hosting CFs units and NFs.
National ACTRIS consortia and national stakeholders are not interactive with ACTRIS ERIC	Low	Medium	Program NF assembly and national consortia events with ACTRIS ERIC to keep the communication flow.
Underestimation of the expertise and human resources to build ACTRIS	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.

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Over-dependence on key individuals	High	Medium	Ensure the engagement on ACTRIS goals and strategic issues. 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.
Underestimation of real implementation costs	Medium	High	Update and revise the business plan regularly. Revise the cost assessment and the funding model. Analyse expenditures, actively seek for cost efficiency in e.g. procurements and operations RI-wide and with other env. RIs.
Community Engagement and Attracting New Members			
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.
Countries do not have strong and well-organised 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.
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 start-up companies.
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.

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4 Implementation plan of the Data Centre (DC)

Data Centre will provide its implementation plan by the end of 2019.

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5 Implementation plan of the Centre for Aerosol Remote Sensing (CARS)

CARS is organized 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. CARS Units will be linked by a Consortium Agreement.

The coordination and management of CARS is ensured by CARS Management Board, consisting of a Director and eight members (one Unit Head for each candidate Unit). The Unit Heads coordinate and represent their Unit in the CARS Management Board. They elect, according to the rules defined in the CARS consortium agreement, the CARS Director, who is coordinating and representing the CF in all ACTRIS boards and actions. The Management Board also nominates the deputy Director out of the 8 Unit Heads. The responsibilities of the Unit Heads, of the Director and of the deputy Director will be detailed in the CARS Consortium Agreement and in the CARS Internal rules of procedures.

5.1 Mission of the Central Facility

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/polarized/lunar photometer. Additionally, the Centre for Aerosol Remote Sensing offers specialized services for the above instruments and related ACTRIS variables, to ACTRIS users of various types: academia, business, industry and public services.

5.2 CARS Organigram

	CARS							
	AHL cluster			ALC cluster		ASP cluster		
	AHL-INOE	AHL-LMU	AHL-CNR	ALC-DWD	ALC-LMU	ASP-CNRS	ASP-UVA	ASP-AEMET
ACTIVITIES AT THE LEVEL OF THE CF								
Management of CARS	Lead					Contribution		
Management of the Units	Lead	Lead	Lead	Lead	Lead	Lead	Lead	Lead
Training	Contribution	Contribution	Contribution	Contribution	Contribution	Contribution	Contribution	Contribution
Dissemination	Contribution	Contribution	Contribution	Contribution	Contribution	Contribution	Contribution	Contribution
Development of new retrieval algorithms for exploiting instruments	Contribution	Contribution	Contribution	Contribution	Contribution	Lead	Contribution	Contribution
ACTIVITIES AT THE LEVEL OF CLUSTER UNITS								
Interlinks with other CFs			Lead	Contribution	Lead	Lead	Contribution	Contribution
Consultancy	Share of requests			Share of requests		Share of requests		
QA/QC guidelines	Lead	Contribution	Contribution	Contribution	Lead	Contribution	Contribution	Lead
QA/QC tools	Lead	Contribution	Contribution		Lead	Contribution	Lead	Contribution
QA/QC support		Lead				Lead	Contribution	Contribution
Calibration of instruments	Share of requests			Share of requests		Share of requests		
Evaluation of NF performances, incl. labeling	Share of requests			Share of requests		Share of requests		
Measurements traceability	Contribution	Lead	Contribution	Contribution	Lead	Contribution	Contribution	Lead
Support to increase the duty cycle of instruments						Shared requests		
Development and testing of new measurement instruments and procedures	Contribution	Contribution	Lead			Contribution	Contribution	Lead
Development of data evaluation procedures and plausibility tests	Contribution	Contribution	Lead	Contribution	Lead	Contribution	Lead	Contribution
Standardization	Contribution	Lead	Contribution	Lead	Contribution	Lead	Contribution	Contribution

Figure 3 CARS organigram: AHL cluster in blue, ALC cluster in red, ASP cluster in green; leading role for each activity is marked in dark shades

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5.3 Partners

Leading Unit	Host Institution of the Leading Unit	Name of the CF leader	Contact of the CF leader
AHL-INOE	National Institute of R&D for Optoelectronics	Doina Nicolae	nnicol@inoe.ro
Unit	**Host Institution**	**Name of the Unit Head**	**Contact of the Unit Head**
AHL-INOE	National Institute of R&D for Optoelectronics	Livio Belegante	livio@inoe.ro
AHL-LMU	Meteorological Institute of the Ludwig-Maximilians-University	Volker Freudenthaler	volker.freudenthaler@lmu.de
AHL-CNR	Consiglio Nazionale delle Ricerche – National Research Council of Italy	Aldo Amodeo	aldo.amodeo@imaa.cnr.it
ALC-DWD	Hohenpeissenberg Meteorological Observatory, Deutscher Wetterdienst	Ina Mattis	Ina.Mattis@dwd.de
ALC-LMU	Meteorological Institute of the Ludwig-Maximilians-University	Matthias Wiegner	m.wiegner@lmu.de
ASP-CNRS	CNRS-Laboratoire d'Optique Atmospherique	Philippe Goloub	philippe.goloub@univ-lille.fr
ASP-UVA	University of Valladolid	Carlos Toledano	toledano@goa.uva.es
ASP-AEMET	AEMET - Izaña Atmospheric Research Center	Natalia Prats	npratsp@aemet.es

5.4 Implementation timeline 2020-2024

CARS already has the main infrastructure in place and part of the necessary human resources. There are several upgrades to be made to the infrastructure, ending in 2022. There is also additional staff to be employed, however the financial resources for this are not yet secured. Some of the activities have an implementation component, before reaching the operational status, mostly referring to establishment of the workflows, development of procedures and guidelines, development of tools, etc. The implementation ends latest in 2023, when all operation support and services are ready to be offered, however not at full capacity. This means that the service is in place, but for a limited number of NFs and users. The reason is twofold: a) the number of NFs and users is not maximum (e.g. because the labelling of NFs can only start after the ERIC signature, and it will spread over several years); b) CARS is not yet ready to operate at full capacity (e.g. the newly employed personnel is not sufficiently trained to take over complex tasks). Some of the activities, although reaching the operational status, also consider regular

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updates of the developments (e.g. update of the software tools is considered even after starting the routine operation support).

The following activities will not be fully operational in 2024, mostly because of external factors (e.g. full capacity of the CFs to which CARS is interlinked, enrolment of the NFs in the program, availability of the necessary resources for operating at full capacity)

- Interlinks with other CFs – full capacity in 2025
- Evaluation of NF performances, incl. labelling – full capacity in 2025
- Measurements traceability – full capacity in 2025
- Support to increase the duty cycle of instruments – full capacity in 2025
- Development of data evaluation procedures and plausibility tests – full capacity in 2025
- Development of new retrieval algorithms for exploiting instruments synergies – full capacity in 2025

No.	Activity	2020	2021	2022	2023	2024
Implementation activities						
3	Interlinks with other CFs	88%	100%			
7	QA/QC tools	63%	100%			
9	Calibration of instruments	25%	50%	75%	100%	
11	Measurements traceability	100%				
Operation activities						
1	Management of CARS	50%	50%	100%	100%	100%
2	Management of the Units	50%	50%	100%	100%	100%
3	Interlinks with other CFs		67%	81%	88%	94%
4	Training	50%	83%	100%	100%	100%
5	Consultancy	100%	100%	100%	100%	100%
6	QA/QC guidelines	88%	100%			
7	QA/QC tools	100%	100%	100%	100%	100%
8	QA/QC support	100%	100%	100%	100%	100%
9	Calibration of instruments	75%	75%	79%	89%	100%
10	Evaluation of NF performances, incl. labelling		25%	36%	46%	57%
11	Measurements traceability	63%	63%	67%	79%	92%
12	Support to increase the duty cycle of instruments		20%	40%	60%	80%
13	Development and testing of new measurement instruments and procedures	100%	100%	100%	100%	100%
14	Development of data evaluation procedures and plausibility tests		20%	40%	60%	80%
15	Development of new retrieval algorithms for exploiting instruments synergies		20%	40%	60%	80%
16	Standardization	100%	100%	100%	100%	100%

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17	Dissemination	50%	50%	100%	100%	100%

5.5 Important Milestones

Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
Implementation activities				
ERIC signature	Final commitment of the countries to support ACTRIS	All implementation and operation activities	2021	The list of NFs participating impacts the business plan and the implementation plans of the CF
Establishment of the DC	Timeline for setting up the ARES and CLU Units at the DC	Interlinks with other CFs	2021	Impacts the establishment of the workflows between CARS and DC
Establishment of CCRS	Timeline for setting up CCRS		2021	Impacts the establishment of the workflows between CARS and CCRS
Establishment of the Head Office (including SAMU operations)	Timeline for setting up SAMU		2021	Impacts the establishment of the workflows between CARS and SAMU
Operation activities				
Availability of financial resources for personnel, travel, equipment and space	Start of the cash flow from the funding agencies and ERIC	All operation activities	2022	Without financial support, none of the operational activities can start
Signature of the CARS Consortium Agreement	Final agreement between CARS Units on the duties, workflows, processes and risk sharing	Management of CARS	2020	It formalizes the agreement between Units
Setup of the webpage and forum	The gate to CARS documentation, announcements		2021	Opens CARS to the public

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
	and information exchanges			
Employment of an expert manager at LMU	Needed expertise at LMU-AHL and LMU-ALC	Management of the Units	2021	
Development of the service provision program	A plan for service provision: what? who? how much? when?	Interlinks with other CFs	2021	Impacts on SAMU operations, and the workflows with SAMU; it is needed in order to organize, in an efficient manner, the service provision to NFs.
Development of the training program	A plan for trainig: what? who? how much? when?	Training	2021	Impacts the training activities for NFs and users, and consequently all activities dedicated to QA/QC of the measurements
Development of the operation support program	A plan for operation support provision: what? who? how much? when?	QA/QC guidelines	2021	Impacts the main operations of CARS; it is needed in order to organize, in an efficient manner, the operation support to NFs.
		QA/QC tools		
		QA/QC support		
		Calibration of instruments		
		Evaluation of NF performances, incl. labelling		
		Measurements traceability		
		Support to increase the duty cycle of instruments		
First step of the NF labelling started	Launch of the labeling process, with all detailed	QA/QC guidelines	2021	Impacts the workload at the CARS Units; brings important information for the follow-up
		QA/QC tools		
		QA/QC support		

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
	processes fully established	Calibration of instruments		operation support (quantity, frequency, priority).
		Evaluation of NF performances, incl. labeling		
		Measurements traceability		
		Support to increase the duty cycle of instruments		
Availability of the fixed reference AHL at AHL-INOE	The delivery, testing and final put into operation of the reference AHL at AHL-INOE	Calibration of instruments	2020	This instrument will be highly performant and will have all necessary channels for direct comparison of AHLs (any configuration)
Availability of mobile reference AHL-CNR	Optimization of the already existing mobile reference AHL-CNR.		2020	This instrument is highly performant and able for direct comparison (also on site) of AHLs, even if it is not equipped with all the channels like the new mobile reference AHL-CNR, but only with 3+2+1 multiwavelength aerosol Raman lidar measurements. It will be used in the meanwhile.
Availability of the new mobile reference AHL-CNR	Delivery, installation, testing and final put into operation of the mobile reference AHL at AHL-CNR		2022	This instrument will have performances much higher than the already existing one and will have all necessary channels for direct on site comparison of AHLs.
Complete setup of the optical	The upgrade of the existing optical laboratory		2022	The upgraded laboratory will allow to accommodate additional tests (than in ACTRIS-IA projects) for the

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
laboratory at AHL-INOE	(purchase of new equipment, setup of measurement chains, testing) and final put into operation of the optical laboratory at AHL-INOE			optical components, and to quantify with better accuracy the correction factors.
Complete setup of the optical laboratory at AHL-CNR	Delivery of all the components, assembling and installation, followed by set-up, testing and final put into operation of the optical laboratory at AHL-CNR		2022	Laboratory for test and calibration of optical components (laser, interferential filters, mirrors, optics, polarizing beam splitters, etc.) usually used in lidar systems of ACTRIS.
Upgrade of the mobile reference AHL at AHL-LMU	Upgrade of the mobile reference AHL at AHL-LMU		2022	Upgrade to additional 1064 nm depolarisation capacity for direct intercomparisons.
Availability of the modular lidar at AHL-CNR	Delivery, installation, testing and final put into operation testing and final put into operation of the modular lidar at AHL-CNR		2022	The facility will have a modular structure in order to easily set-up and test new lidar measurement configurations that can also run simultaneously: aerosol fluorescence; tropospheric aerosol optical properties; temperature with rotational Raman from troposphere to stratosphere; liquid water content; HSRL (High Spectral Resolution Lidar) configuration.

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
Availability of the fixed reference AHL-CNR	Delivery, installation testing and final put into operation of the fixed reference AHL at AHL-CNR		2022	This instrument will be highly will have all necessary channels for direct on site comparison (at AHL-CNR site) of AHLs and for h24/7days systematic measurements. It will be equipped to perform 3+2+3 multiwavelength aerosol Raman lidar measurements and water vapor mixing ratio.

5.6 Risk management and contingency planning

Due to the complexity of the processes and multiple interlinkages of processes needed to run ACTRIS during the Implementation Phase, it is crucial to have a well-developed risk management strategy and carefully planned risk management and monitoring actions. The risk policy and the risk management strategy are developed at the RI level. The risk management plan and the contingency measures are developed and monitored at different levels, including at the CF level.

CARS will actively participate in the risk management and sustainable development and implementation of ACTRIS. The consortium agreement between the Units will define the risk management plan and responsibilities. CARS-MB will follow up on the internal risk management plan, and will report to the HO on the critical issues.

Considering all uncertainties related to the ACTRIS dimension, timeline of the other CFs, financial commitment of the countries, evolution of the technology, etc., as well as the ambition of ACTRIS to be at the forefront of the research in the field, CARS is facing certain risks in the 2020-2024 period. The risks can be organisational, operational, financial and technical, with various probabilities of occurrence and different level of impact on the CF implementation and operation. Following the principles stated in the ACTRIS Risk Policy, CARS has identified the following risk exposure matrix, to be continuously updated. Contingency measures, as foreseen now, are reported in the same table.

Description of Risk	Likelihood (high/medium/low)	Potential Impact (high/medium/low)	Mitigation/Risk reduction/Planned response (accept, avoid, reduce, or share the risk)
Organisational risks			

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ACTRIS ERIC not established in 2021	High	Medium	Re-visit the implementation plan. Re-schedule non-critical activities
Institutions contributing to CARS do not conclude the Consortium Agreement	Low	High	Involve ACTRIS coordination in the negotiation process. Re-visit the implementation plan. Continue the basic operations at the contributing institutions
SAMU is not operational in 2021	Low	Medium	Focus on provision of operation support
ACTRIS DC is not operational in 2021	Low	Medium	Delay the interlinks with the DC
CCRS is not operational in 2021	Low	Medium	Delay the interlinks with CCRS
Disfunctionalities in the management of CARS	Medium	High	Increase the interaction of the CARS-MB members (e.g. meetings). Involve ACTRIS coordination in mediating the discussions of the CARS-MB.
Disfunctionalities in the management of the Units	Low	Medium	Involve CARS-MB in mediating the discussions at the Unit level. Inform the HO and the RPO concerned.
Operational risks			
CARS does not have enough capacity to provide the required operation support to NFs and the services to the users	Low	Medium	Re-vist the ramp-up process with clear RI support schedule and plan for gathering the capacity. Identify additional capacity outside the planned Units
The number of NFs to be supported by CARS is lower than expected	Medium	Medium	Re-direct the remaining capacity to provision of services to the users
The requests from the users to access CARS services is lower than expected	Medium	Low	Re-direct the remaining capacity to provision of complementary operation support to NFs. Increase the communication with the users. Increase the publicity
Underestimation of the expertise and human resources needed	Medium	High	Increase the percentage of involvement of the existing staff. Develop specialized training programs. Staff exchanges.
Over-dependence on key individuals	High	Medium	Create and maintain a supportive and attractive working environment. Monitor the well-being of staff. Train new HR capacity and decrease dependence on single persons. Adopt good documentation and archiving system.
Financial risks			
Insufficient resources for building the necessary infrastructure	Low	High	Re-visit the implementation plan. Re-distribute the work between Units.

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Insufficient resources for supporting the operations	Medium	High	Re-visit the implementation plan. Prioritize crucial activities.
Limited and insufficient financial support from some of the countries involved in CARS	Medium	High	Re-distribute the work between Units. Increase the contributions from the RPOs.
Underestimation of real implementation costs	Medium	High	Update and revise the implementation costs regularly. Identify additional funding sources.
Underestimation of real operational costs	Low	High	Update and revise the operational costs regularly. Identify additional funding sources.
Technical risks			
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 towards properly equipped Units.
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 conclusive for allowing the calculation of the correction factors	Low	Medium	Develop new testing methods and 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 fulfil 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.

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6 Implementation plan of the Centre for Aerosol In Situ Measurements (ECAC)

The implementation plan is provided for the ACTRIS ECAC (CAIS) activities. All activities are directly linked to support of ACTRIS NFs, ACTRIS users and users outside of ACTRIS, but directly connected to ACTRIS activities. Some of the equipment may be also used for non-ACTRIS scientific activities such as research projects and this share is also mentioned in the implementation plan.

ECAC 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. The chemical branch also consists of three units, namely OGTAC CC (operated by TROPOS, Germany), EMC2 (operated by INFN, Italy), and ACMCC which is a cluster of three French Institutions (INERIS, CNRS and CEA). Subcontracting partner (JRC) is included under OGTAC CC (see a detailed organigram in the figure below). All the units will sign a Consortium Agreement.

ECAC will be managed by the ECAC board consisting of the Unit leaders and the ECAC director. The ECAC director is elected by the ECAC board as described in the Consortium Agreement for the given period of time. The ECAC director represents ECAC in the ACTRIS board and in all the related ACTRIS events. The unit leaders are responsible for the individual ECAC units towards ECAC and ACTRIS. All the rules and responsibilities will be described in the Consortium Agreement. During the ACTRIS implementation phase Prof. Alfred Wiedensohler will represent ECAC as a Director and Dr. Olivier Favez will act as his deputy.

6.1 Mission of the Central Facility

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 characterization of atmospheric aerosol particles as well as for particle sampling and subsequent laboratory analysis of these particles. ECAC will also offer measurement and data tools related to aerosol in situ measurements.

Additionally, ECAC will offer specialized services, CAIS-related variables, to ACTRIS users of various types: academia, business, industry, and public services.

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6.2 ECAC Organigram

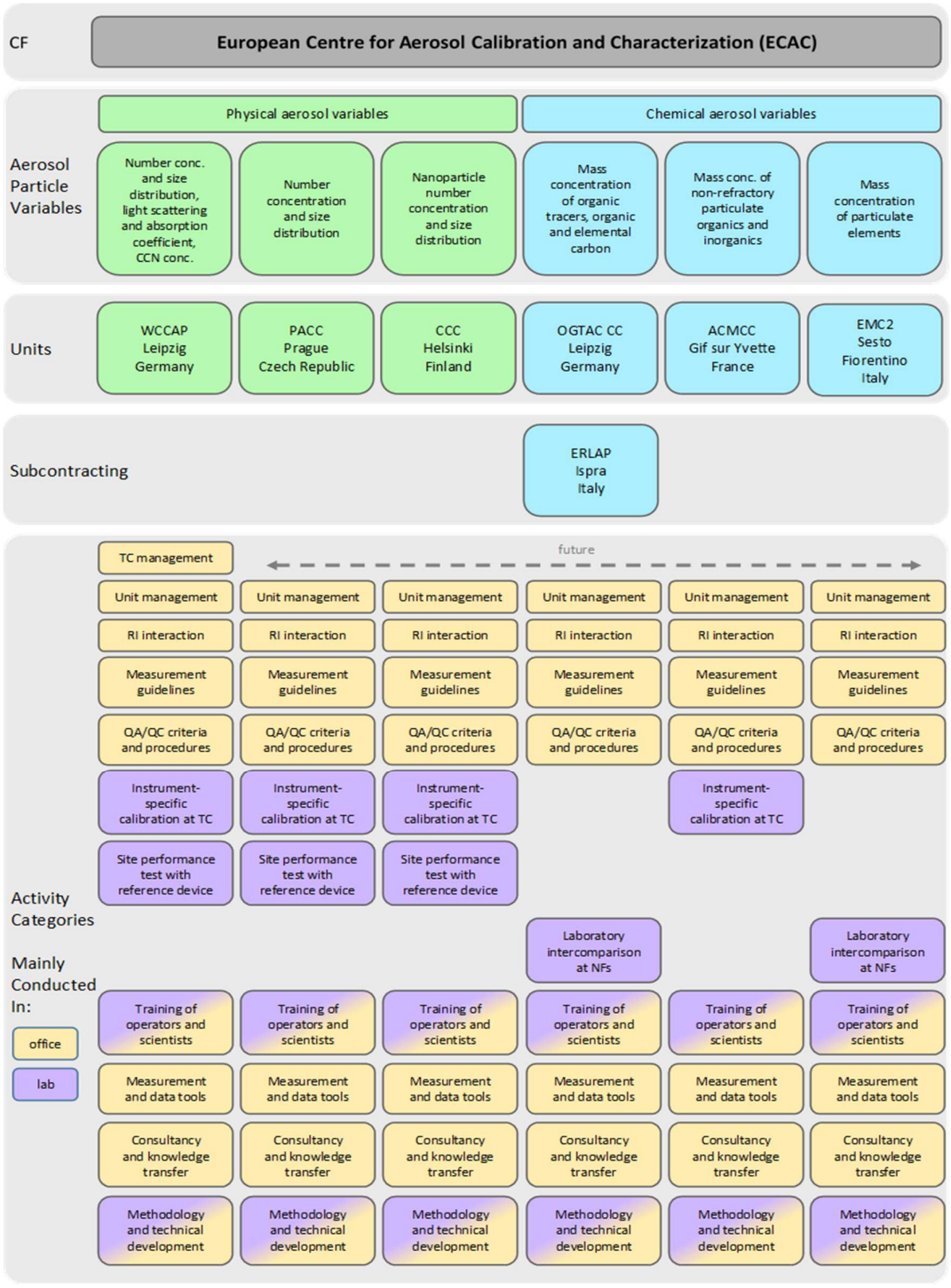

Figure 4 ECAC organigram showing the main tasks of different units

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6.3 Partners

Leading Unit	Host Institution of the Leading Unit	Name of the CF leader	Contact of the CF leader
WCCAP	TROPOS	Alfred Wiedensohler	ali@tropos.de
Unit	**Host Institution**	**Name of the Unit Head**	**Contact of the Unit *Head***
ACMCC	INERIS	Olivier Favez	olivier.favez@ineris.fr
CCC	INAR	Tuukka Petäjä	tuukka.petaja@helsinki.fi
PACC	ICPF	Jakub Ondracek	ondracek@icpf.cas.cz
EMC2	INFN	Massimo Chiari	chiari@fi.infn.it
OGTAC CC	TROPOS	Hartmut Herrmann	hartmut.herrmann@tropos.de

6.4 Implementation timeline 2020-2024

Nearly all operation activities will be fully operational by 2024. The activities not reaching 100% in 2024 represent either continuous processes which will be evolving during the whole project (e.g. Training of operators, Measurement and Data tools) or represent additional activities like Consultancy and knowledge transfer. Support and services will already be provided during the implementation phase by the Units that have been totally or partially operational during the former EU-funded projects ACTRIS and EUROCHAMP (WCCAP, ACMCC, OGTAC-CC). Implementation activities will pick up in 2020-2021, and fade out later on.

No.	Activity	2020	2021	2022	2023	2024
Implementation activities						
1	ECAC management	100%	100%	70%	50%	
2	ECAC unit management	100%	98%	70%	50%	40%
3	RI interaction - crucial	100%	100%	90%	70%	50%
4	RI interaction - necessary					
5	Measurement guidelines	100%	100%			
6	QA/QC criteria and procedures - crucial	75%	100%	75%	50%	
7	QA/QC criteria and procedures - necessary					
8	Instrument-specific calibration at TC - crucial	97%	100%	57%		
9	Site performance test with reference device					
10	Laboratory inter-comparison at NFs	30%	100%	100%	50%	
11	Training of operators and scientists - crucial	30%	100%	100%	30%	
12	Training of operators and scientists - added-value				100%	100%
13	Measurement and data tools	75%	100%	100%	25%	
14	Consultancy and knowledge transfer	100%		100%		

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No.	Activity	2020	2021	2022	2023	2024
Operation activities						
1	ECAC management		30%	60%	80%	100%
2	ECAC unit management		28%	56%	80%	97%
3	RI interaction - crucial	10%	50%	75%	95%	100%
4	RI interaction - necessary	30%	70%	85%	90%	95%
5	Measurement guidelines			70%	100%	100%
6	QA/QC criteria and procedures - crucial		25%	50%	75%	100%
7	QA/QC criteria and procedures - necessary				50%	75%
8	Instrument-specific calibration at TC - crucial		30%	60%	80%	100%
9	Site performance test with reference device		30%	60%	80%	100%
10	Laboratory inter-comparison at NFs		30%	50%	75%	100%
11	Training of operators and scientists - crucial			30%	50%	75%
12	Training of operators and scientists - added-value					50%
13	Measurement and data tools				25%	50%
14	Consultancy and knowledge transfer	35%	80%	85%	90%	95%
15	Methodology and technical development		35%	55%	75%	95%
16	AMS calibration - crucial		100%			100%
17	AMS calibration - added-value					100%

6.5 Important Milestones

Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
Implementation activities				
ECAC Consortium Agreement	Written agreement between all ECAC units	**ECAC management**	2020	
Establishing the ECAC Board	Select people being part of the board, how they are nominated, duration	**ECAC management**	2020	
Establishing a standard operation of ECAC	Define the workflow and the cooperation among Units of ECAC	**ECAC management**	2021	
Establishing the Units within ECAC	Define the internal structure and organization of individual Units	**ECAC unit management**	2020	

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
Hiring the new personnel	Launch job tender, interviews, selection process	**ECAC unit management**	2022	Depending on the Units
Establishing the standard communication with HO and DC	Define rules and requirements together with the HO and DC	**RI interaction – crucial**	2020	
Establishing the standard communication with NFs	Define rules and requirements together with the NFs	**RI interaction – crucial**	2020	
Initiating the labelling process	Define labelling criteria, proof the applications of NF	**RI interaction – crucial**	2021	
First ECAC technical meeting for potential NFs	Organize a technical meeting for potential NF operators	**RI interaction – necessary**	2020	
First ECAC workshop for NFs and users	Conduct first training workshops of potential NF operators	**RI interaction – necessary**	2021	Depending on the Units
First ECAC technical meeting with NF operators	Organize first technical meeting for operators from labelled NFs	**RI interaction – necessary**	2022	
Defining NF set-up guidelines and SOPs	Define guidelines and instrument SOPs for specifying requirements of an in situ aerosol NF	**Measurement guidelines**	2020	
Defining measurement guidelines for the observational platforms	Develop guidelines for measurements and data handling at NF observational platforms together with NF operators	**Measurement guidelines**	2020	
Defining measurement guidelines for the exploratory platforms	Develop guidelines for measurements and data handling at NF exploratory platforms together with NF operators	**Measurement guidelines**	2021	

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
QA criteria specification	Define QA criteria for each measurement/variable supported by CAIS/ECAC	**QA/QC criteria and procedures – crucial**	2020	
QC procedures specification	Define QC procedures reflecting the recent requirements regarding the type approval, instrument calibration, measurement process validation, operator training	**QA/QC criteria and procedures – crucial**	2020	
Defining online mass spectrometers measurement criteria	Develop MS dedicated measurement criteria for online mass spectrometer measurements	**QA/QC criteria and procedures – necessary**	2020	
Defining online mass spectrometers measurement procedures	Develop MS dedicated measurement procedures for online mass spectrometer measurements	**QA/QC criteria and procedures – necessary**	2020	
First round robin test with a MPSS performed	Perform first site performance tests with reference device serve for regular on-site instrument performance check	**Site performance test with reference device**	2021	
First aerosol physics course First aerosol chemistry course	Prepare first set of two joint lectures will be prepared covering aerosol physics and chemistry, respectively, that will be held by unit representatives at dedicated events (summer schools etc.)	**Training of operators and scientists - added-value**	2021	
Developing new measurement tool	Develop new ACTRIS variable specific analysis tools to monitor the	**Measurement and data tools**	2021	

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
Developing new data tool	instrumentation performance at NFs and facilitate the development of near-real time data products			
Defining list of consultancy services	Define all services available for all users, the frequency and make them open-access available	**Consultancy and knowledge transfer**	2020	
Operation activities				
Establishing the standard operation of individual new Units	Each new unit should establish their own standard operation workflow	**ECAC unit management**	2021	
Hiring the additional personnel	Launch job tender, interviews, selection process for new positions	**ECAC unit management**	2024	Depending on the Units
Performing the labelling process of new NFs	Perform labelling process for new NFs	**RI interaction – crucial**	2022	Depending on new NFs emerging
Regular ECAC technical meeting for existing NFs	Organize regular technical meeting for existing NF operators	**RI interaction – necessary**	2022	Regularly every year or as necessary
Regular ECAC workshop for NFs and users	Conduct regular training workshops of existing NF operators	**RI interaction – necessary**	2022	Depending on the Units
Regular ECAC technical meeting with NF operators	Organize regular technical meeting for operators from labelled NFs	**RI interaction – necessary**	2023	Regularly every year or as necessary
Updating SOPs	Update instruments SOPs for an in situ aerosol NF	**Measurement guidelines**	2022	Regularly every 2 years or as necessary
Updating measurement guidelines for the	Update guidelines for measurements and data handling at NF observational platforms	**Measurement guidelines**	2022	Regularly every 2 years or as necessary

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
observational platforms	together with NF operators			
Updating measurement guidelines for the exploratory platforms	Update guidelines for measurements and data handling at NF exploratory platforms together with NF operators	**Measurement guidelines**	2023	Regularly every 2 years or as necessary
QA criteria update	Update QA criteria for measurement/variable supported by CAIS/ECAC as needed	**QA/QC criteria and procedures – crucial**	2022	Regularly every 2 years or as necessary
QC procedures update	Update QA procedures reflecting the changes in requirements regarding the type approval, instrument calibration, measurement process validation, operator training	**QA/QC criteria and procedures – crucial**	2022	Regularly every 2 years or as necessary
Updating online mass spectrometers measurement criteria specification	Update dedicated measurement criteria for online mass spectrometer measurements	**QA/QC criteria and procedures – necessary**	2022	Regularly every 2 years or as necessary
Updating online mass spectrometers measurement procedures specification	Update dedicated measurement procedures for online mass spectrometer measurements	**QA/QC criteria and procedures – necessary**	2022	Regularly every 2 years or as necessary
Calibration workshops for various instrument types	Perform instrument-specific calibrations to evaluate and/or adjust the performance of the specific instruments from NFs on a regular basis	**Instrument-specific calibration at TC – crucial**	2020	Several times per year
Common open-access platform	Make results available on an open-access platform	**Instrument-specific**	2021	

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
for calibration results		**calibration at TC – crucial**		
Calibration workshops for aerosol-MS commonly used at exploratory platforms	Workshop for online MS operated at exploratory platforms (AMS devices)	**Instrument-specific calibration at TC – added value**	2023	Every three years
Regular round robin test with a CPC performed	Site performance tests with reference device serve for regular on-site instrument performance check	**Site performance test with reference device**	2021	At least once per 3 years for every NF
Regular round robin test with a MPSS performed	Perform regular site performance tests with reference device serve for regular on-site instrument performance check	**Site performance test with reference device**	2022	At least once per 3 years for every NF
Inter-Laboratory Comparison performed	Inter-Laboratory-Comparisons (ILCs) are performed to frequently evaluate the performance and the level of QA/QC of the NFs	**Laboratory inter-comparison at NFs**	2020	Several times per year
Hands-on training workshop	Operators and scientists will be trained in workshops and hands-on training sessions at state-of-the-art instruments	**Training of operators and scientists – crucial**	2021	Regularly every year or as necessary
Regular aerosol physics course	Perform regular set of two joint lectures covering aerosol physics and chemistry, respectively, that will be held by unit representatives at dedicated events (summer schools etc.)	**Training of operators and scientists - added-value**	2022	Regularly every year or as necessary
Regular aerosol chemistry course				

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
Measurement tool update Data tool update	Update ACTRIS variable specific analysis tools to monitor the instrumentation performance at NFs and facilitate the development of near-real time data products	**Measurement and data tools**	2023	Regularly every 2 years or as necessary
Updating list of consultancy services	Update all services available for all users	**Consultancy and knowledge transfer**	2021	Regularly every year or as necessary
ECAC webpage update	Extend the ECAC webpage; include all units, launch the list of consultancies services etc.	**Consultancy and knowledge transfer**	2020	Regularly every year or as necessary
Testing newly developed instruments	Investigate the newly developed instruments being relevant for ACTRIS variables and NFs, prepare SOPs and QA/QC criteria and procedures and test their performance	**Methodology and technical development**	2022	Regularly every year or as necessary

6.6 Risk management and contingency planning

ECAC will be confronted with risks affecting financial, human and technical resources, that can be particularly critical during the Implementation Phase. These are mainly related to funding from the host institutions and corresponding National funds, securing suitable staff, and constructing the CF according to plans and standards. Risks and responses for minimizing their impacts are listed in the Table below.

ECAC does not perform activities that cannot be postponed by a couple of months. However, measures in place to prevent possible support and service disruptions, and/or minimize their effects include:

- The designation of a Deputy Director for ECAC, and Deputy Head for each Unit.
- The timely archiving of key documentation and data at a web page easily accessible to relevant stakeholders.

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- The redundancy of key instruments, preventive maintenance and fast access to corrective maintenance.

In case of emergency, the continuity of ECAC key operations is secured by:

- Transferring decision-making power to deputies
- Using secondary reference instruments and/or having primary reference instruments rapidly repaired.

Description of Risk	Likelihood (high/medium /low)	Potential Impact (high/med ium/low)	Mitigation/Risk reduction/Planned response (accept, avoid, reduce, or share the risk)
ECAC resources			
ECAC Units do not get as much funding as expected from the National funding sources	Medium	high	Unit redundancy for some of the key variables. Focus on crucial activities. Downscaling in support frequency and service provision.
ECAC Units lacks suitable staff for providing expected support and services	Low	high	Efficient HR management and training of staff. Have a clear, updated strategy for human resources.
CF Implementation			
ECAC consortium faces difficulties in setting up activities for internal support and service provision	Medium	High	Ensure support from the RPOs hosting ECAC units to have enough resources for the CF implementation.
ECAC does not have enough capacity to provide the required operational support to NFs	Low	Medium	Establish a well-planned ramp-up process building-up the capacity as needed.
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 Data Centre concept and data management plan.
Major breakdown of key instruments (e.g. Reference instruments	Medium	Low	Ensure redundancy of key instruments and optimized relationship with instrument manufacturers including preventive and corrective maintenance agreements.

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at CF, or travelling reference instruments).			
Service development and provision			
Users are not aware of the services provided by ECAC, and too few requests for access to ECAC Facilities	Low	High	Formulate a clear user strategy during the implementation phase in consultation with the experts and user communities. Increase awareness with efficient dissemination and promotion activities.
Governance and coordinated management			
Over-dependence on key individuals	High	Medium	Create and maintain a supportive and attractive working environment. Monitor the well-being of staff. 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 business plan regularly. Revise the cost assessment and the funding model. Analyse expenditures, actively seek for cost efficiency in, e.g. procurements and operations RI-wide and with other environmental RIs.
Delay in implementing ECAC with respect to planning	Low	High	Efficiently set up of the governance and get formal commitments from Units; solid and concrete implementation; monitoring progress.
Impact (innovation and socio-economic)			
ECAC impact on science and technology is not visible enough	Medium	Medium	Engage users to improve the attractiveness of ECAC for new science and technology opportunities.
Not enough interest from the private sector to co-develop new tools and/or instruments with ECAC	Medium	Low	Promote ECAC facilities for private sector users. Participate actively in technology and innovation events. Develop partnerships with start-up companies.

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7 Implementation plan of the Centre for Cloud Remote Sensing (CCRES)

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.

The CNRS-FR (CCRES-FR) Unit develops new-generation FMCW Doppler cloud radar technology and retrieval algorithms for cloud properties. CNRS-FR develops target-based calibration procedures for cloud radars, and reference equipment for on-site calibration at ACTRIS national facilities. The main activities of this unit will be:

- Coordination and management of the CCRES consortium
- Development of DCR calibration procedures
- Development of quality control package for DCRs
- Training of NF staff and users, organization of workshops
- Testing of new instruments
- Maintenance of the CCRES website

The TUD-NL (CCRES-NL) Unit develops drone-aided radar calibration procedures (H2020 ACTRIS-2 programme). Using the multi-instrumented observatory at Cabauw measurement methodologies and retrieval algorithms have been developed for the determination of cloud properties. Its main activities inside CCRES will be:

- Development of DCR calibration procedures
- Development of quality control package for DCRs
- Training of NF staff and users, organization of workshops
- Testing of new instruments

CNRS-FR and TUD-NL are both necessary to provide enough capacity to support all stations.

The NCAS-UK (CCRES-UK) Unit will serve as support to FR and NL units to develop new technical solutions. It has expertise concerning rain induced attenuation effects (including antenna/radome wetting) on Doppler Cloud Radars and their correction. It provides an S-band reference radar for evaluating corrections applied to particular models of cloud radar. In CCRES, NCAS-UK will be responsible for:

- Development/evaluation of DCR technical solutions, relating to
    - standard operating procedures
    - calibration
    - quality control
    - check-up tools.
- Training of NF staff and users

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The UC-DE (CCRES-DE) Unit has more than 20 years expertise concerning microwave radiometers, their operation, and full in-house characterization (calibration, quality control, retrieval development, data interpretation). They will handle the MWR activities in CCRES such as:

- Development of a data processing and quality control package for MWR
- Training for NF staff and users, calibration workshops
- Instrument calibration monitoring
- Testing of new instrument developments, calibration updates

The FMI-FI (CCRES-FI) Unit has more than 10 years expertise concerning Doppler Wind Lidars, their deployment and operation, and characterization including quality control and retrieval algorithm development. FMI-FI will be responsible for:

- Development of data processing and quality control package for DWL
- Training for NF staff and users

All 5 Units have over 20 years of experience in joint cloud remote sensing operations.

7.1 Mission of the Central Facility

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.

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7.2 CCRES Organigram

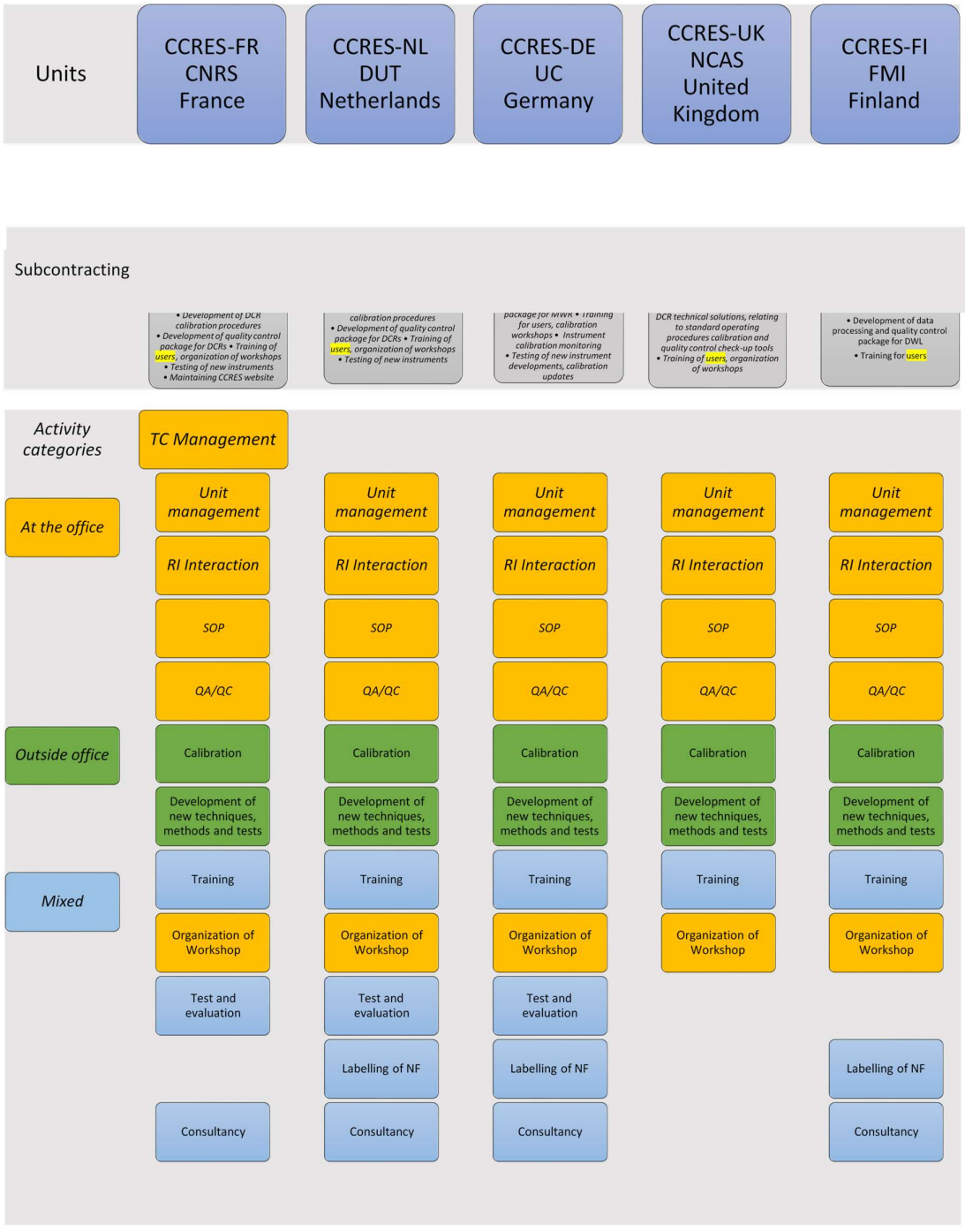

Figure 5 CCRES organigram showing the main tasks of different units

7.3 Partners

Leading Unit	Host Institution of the Leading Unit	Name of the CF leader	Contact of the CF leader
CCRES-FR	Centre National de la Recherche Scientifique – CNRS	Martial HAEFFELIN	martial.haeffelin@ipsl.fr
Unit	**Host Institution**	**Name of the Unit Head**	**Contact of the *Unit Head***
CCRES-NL	*Delft University of Technology – DUT*	*H.W.J. Russchenberg*	*h.w.j.russchenberg@tudelft.nl*
CCRES-DE	*University of Cologne – UC*	*Bernhard Pospichal*	*bernhard.pospichal@uni-koeln.de*
CCRES-UK	*National Centre for Atmospheric Science – NCAS*	*Christopher J. Walden*	*chris.walden@ncas.ac.uk*
CCRES-FI	*Finnish Meteorological Institute – FMI*	*Ewan J. O'Connor*	*ewan.oconnor@fmi.fi*

7.4 Implementation timeline 2020-2024

The CCRES implementation plan and schedule is designed to ensure that CCRES meets its support and service obligations in full by the end of year 5 of the implementation phase, ensuring full capacity during the operational phase.

During the implementation phase, the CCRES consortium will involve 10.8 FTE in total for the five units. During the operational phase (2025 and beyond), the CCRES consortium will involve 9 FTE in total for the five units.

During the implementation phase, both implementation and operational activities will take place. Out of the 10.8 FTE, 9 FTE will be dedicated to both implementation and operational activities, while 1.8 FTE will work ONLY on implementation activities throughout the implementation phase. In 2020, the 9 FTE will focus predominantly (50-80%) on implementation activities, with a more limited capacity on operational activities (20-50%). The capacity to cover operational activities and hence provide operational support and services, will be ramped up to reach nearly 100% in 2024. Hence in 2024, as the CCRES consortium will reach nearly 100% capacity to provide support and services (100% of the 9 FTE), 1.8 FTE will still be dedicated to implementation activities. This is necessary to consolidate the support and service activities to enter the operational phase in 2025.

Capacity of the CCRES consortium to perform operational activities during the implementation phase (2020-2024) shown as a fraction of the expected level of support and service to be provided in the operational phase						
No.	**Activity**	**2020**	**2021**	**2022**	**2023**	**2024**
		Capacity to perform operational activities				
1	Management and Units and HO interactions	50%	80%	100%	100%	100%

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Capacity of the CCRES consortium to perform operational activities during the implementation phase (2020-2024) shown as a fraction of the expected level of support and service to be provided in the operational phase						
No.	**Activity**	**2020**	**2021**	**2022**	**2023**	**2024**
2	Interlinks with other CFs and outside parties (e.g manufacturers)	50%	80%	100%	100%	100%
3	SoP	20%	40%	60%	80%	90%
4	QA&QC	20%	40%	60%	80%	90%
5	Calibration	20%	40%	60%	80%	90%
6	Development of new techniques, methods, procedures and tests	50%	80%	100%	100%	100%
7	Training	50%	80%	100%	100%	100%
8	Organization of workshops	100%	100%	100%	100%	100%
9	Test and evaluation	20%	40%	60%	80%	90%
10	Labelling of NF	20%	40%	60%	80%	90%
11	Consultancy	20%	40%	60%	80%	90%

lines highlighted in yellow indicate activities for which the ramp up is affected by the readiness of CCRES to provide support and by the readiness of ACTRIS NFs to implement CCRES services.

7.5 Important Milestones:

Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
Implementation activities				
(1) Implementing support activities to NFs	• Start Standard-operating-procedures, Data quality assurance and control, Data traceability, and instrument calibration activities in Year 1. Procedures will be reviewed on a yearly basis and updated accordingly. • Start In-house check-up tool activities in Year 2.	• SOP, QA/QC, Based on preliminary procedures and documentation • Require exchange with manufacturers. The update schedule will depend on the implementation of new developments by manufacturers	• Year 1 = 2020 • Year 2 = 2021	
(2) Support activities to users	Dedicated focused meetings	Workshop and Training	Twice per year	
(3) Community workshops involving ACTRIS Cloud	To communicate new developments, share performance summaries, and collect user feedback.	These workshops will include: - SOP - QA&QC	Organized on a yearly basis	

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
remote sensing NFs and DC		- Calibration - Development of new techniques, methods, procedures and tests		
(4) Training workshops	Training of operators and scientists	Based on Community Workshop	Organized on a yearly basis	
Operation activities				
(1) Remote support to ACTRIS NFs	Support that does not require physical access by NFs	Related to procedures and performance evaluation	Yearly basis	
(2) Support based on physical access	To ensure network-wide calibration and site evaluations	Reports from calibration activities, workshops, and consultancy	Yearly basis	
(3) Training and opportunities for knowledge sharing based on community workshops				

7.6 Risk management and contingency planning

To be added in the next version.

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8 Implementation plan of the Centre for Cloud In Situ Measurements (CIS)

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. The head of the lead unit Centre of cloud ice nucleation (CCIce) at Karlsruhe Institute of Technology (KIT) in Germany also represents the director of the CIS and forms the CIS Management Board (CIS-MaB) together with the other unit heads. The other units of the CIS are the Centre for cloud particle properties (CCPar), located at The University of Manchester (U-Man) in the UK, the Centre for cloud water chemistry (CCWaC), located at the Leibniz Institute for Tropospheric Research (TROPOS) in Germany, and the Center for cloud ambient intercomparison (CCInt), located at the ZAMG Sonnblick Observatory in Austria.

While this implementation plan is written for ACTRIS related activities only, unit laboratories, offices and existing instrumentation will be partly also used by other communities. The units of the Central Facility will solidify their obligations towards ACTRIS by developing a consortium agreement which will be signed by their host national Research Performing Organisations (RPOs).

8.1 Mission of the Central Facility

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 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, specialized 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).

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8.2 CIS Organigram

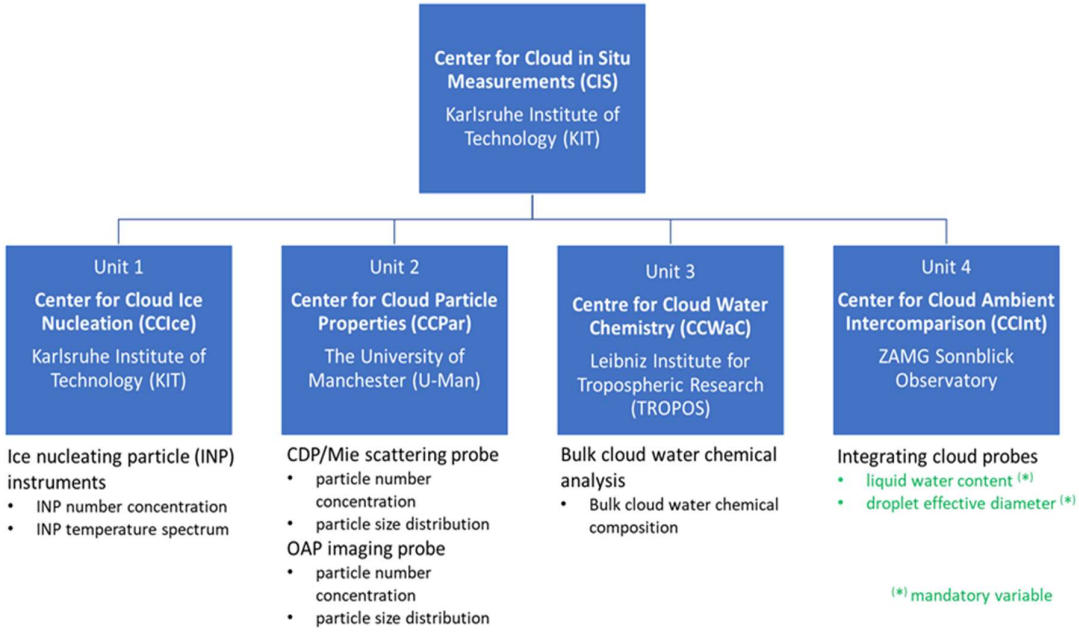

Figure 6 CIS organigram and supported instruments and variables. NF facility mandatory variables are coloured green.

8.3 Partners

Leading Unit	**Host Institution of the Leading Unit**	**Name of the CF leader**	**Contact of the CF leader**
1 CCIce	Karlsruhe Institute of Technology (KIT)	Kristina Höhler	kristina.hoehler@kit.edu
Unit	**Host Institution**	**Name of the Unit Head**	**Contact of the U*nit Head***
1 CCIce	Karlsruhe Institute of Technology (KIT)	Kristina Höhler	kristina.hoehler@kit.edu
2 CCPar	The University of Manchester (U-Man)	Tom Choularton	choularton@manchester.ac.uk
3 CCWaC	Leibniz Institute for Tropospheric Research (TROPOS)	Dominik van Pinxteren	dominik@tropos.de
4 CCInt	ZAMG Sonnblick Observatory	Elke Ludewig	elke.ludewig@zamg.ac.at

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8.4 Implementation timeline 2020-2024

The CIS and the CIS unit management is already working. From 2020 CIS starts to establish the NF network and the preparation of the units to service all the proposed activities like recruiting new personnel. The setup and establishment of the facilities will continue until the end of 2024. Hence, facility update and maintenance can start in 2025. From 2020 and 2021 the development of the QA criteria and SOPs is scheduled for 2 years. After that both are planned to re-evaluated every three years starting in 2025 and 2026, respectively. The development of the NF network and the establishment of the NF labelling starting in 2020 are the very first steps for the NF services. In 2021 first consultancies of NF candidates are planned. The NF labelling will start in 2022 followed by the first workshop and training in 2023 planned for each subsequent year. CCIce will offer a first INP measurement intercomparison already in 2020 and continue every second year. The intercomparison of water collectors will follow one year later. The intercomparison of cloud particle instruments will start in 2025, because the setup of these units and facilities will continue until 2024. The user activities will start in 2022 with the establishment of the user network and first user services will be serviced from 2024 on.

All units plan to recruit their new personnel until 2021. Afterwards the internal training of this personnel will start with a one year frequency. The outreach/PR activities have to start as soon as possible in 2020 with regular updates of our CIS website from 2022 on.

No.	Activity	2020	2021	2022	2023	2024
Implementation activities						
1	establish NF network					
2	establish user network					
3	develop workshop and training principles					
4	implement data workflow					
5	setup and establish facilities					
6	recruiting and training of new personnel					
7	develop QA criteria					
8	develop SOPs					
9	establish NF labelling					
10	develop and establish NF audit system					
11	establish CIS website					
Operation activities						
1	overall coordination with TC, HO, DC					
2	management of the CIS units					
3	NF networking activities					
4	review NF data workflow					

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No.	Activity	2020	2021	2022	2023	2024
5	consultancy for NF candidates					
6	facility maintenance and updates					
7	re-evaluation QA criteria					
8	re-evaluation SOPs					
9	NF audits					
10	training unit personnel					
11	NF workshops and training					
12	NF labelling					
13	intercomparison of INP instruments					
14	intercomparison of cloud particle instruments - chamber					
15	intercomparison of cloud particle instruments - ambient					
16	intercomparison of cloud water collectors					
17	calibration of INP instruments					
18	calibration of CDP Mie Scattering Cloud Probes					
19	calibration of OAP imaging cloud probes					
20	round-robin tests with reference cloud water samples					
21	user workshops and training					
22	user consultancy					
23	test of instrument prototypes					
24	user instrument calibration					
25	user networking activities					
26	update CIS website					
27	PR activities					

8.5 Important Milestones

Milestone name	short description	linked activity	Estimated year of achievement	Comments
Implementation activities				
NF network built-up	CIS NF community built up, documentation of CIS NFs and networking activities	establish NF network	2021	

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Milestone name	short description	linked activity	Estimated year of achievement	Comments
user network built-up	CIS user community built up, documentation of CIS users and networking activities	establish user network	2023	
defined workshop and training principles	training contents and timelines for CFs and users are documented	develop workshop and training principles	2022	
data workflow implementation	data workflow is defined and tested	implement data workflow	2022	
facilities built-up	facilities are ready to fulfil ACTRIS needs	setup and establish facilities	2024	strongly depending on national funding
100% staff	personnel is recruited and trained	recruiting and training of new personnel	2021	strongly depending on national funding
defined QA criteria	QA criteria are defined and documented	develop QA criteria	2021	
defined SOPs	SOPs are defined and documented	develop SOPs	2022	
defined NF labelling criteria	NF labelling criteria are defined and documented	establish NF labelling	2020	
defined NF audit procedures	NF audit procedures are defined and documented	develop and establish NF audit system	2023	
CIS website built-up	CIS website up and running	establish CIS website	2021	
Operation activities				
1st NF network workshop	1st of bi-annual workshop series was done	NF networking activities	2022	planned every two years
1st review of data workflow	documented re-evaluation of data workflow and possible adjustments	review NF data workflow	2024	planned every two years
1st review of QA criteria	documented re-evaluation of QA criteria and possible adjustments	re-evaluation QA criteria	2024	planned every three years
1st review of SOPs	documented re-evaluation of SOPs and possible adjustments	re-evaluation SOPs	2025	planned every three years
1st NF audit	documented first NF audit performed	NF audits	2024	

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Milestone name	short description	linked activity	Estimated year of achievement	Comments
1st NF workshop	documented first NF workshop performed	NF workshops and training	2023	
1st NF label	NF label is assigned	NF labelling	2022	
1st CCIce intercomparison	documentation of activity	intercomparison of INP instruments	2020	planned every two years
1st CCPar intercomparison	documentation of activity	intercomparison of cloud particle instruments - chamber	2025	will be operational 2025
1st CCInt intercomparison	documentation of activity	intercomparison of cloud particle instruments - ambient	2025	will be operational 2025
1st CCWac intercomparison	documentation of activity	intercomparison of cloud water collectors	2021	planned every two years
1st INP calibration	documentation of activity	calibration of INP instruments	2023	planned every two years
1st CDP calibration	documentation of activity	calibration of CDP Mie Scattering Cloud Probes	2023	planned each year
1st OAP calibration	documentation of activity	calibration of OAP imaging cloud probes	2024	planned each year
1st CCWac round-robin	documentation of activity	round-robin tests with reference cloud water samples	2023	planned every two years
1st user workshop	documentation of activity	user workshops and training	2025	planned every two years
1st instrument prototype tested	documentation of activity	test of instrument prototypes	2024	planned each year
1st user instrument calibrated	documentation of activity	user instrument calibration	2024	planned each year
1st user networking activity	documentation of activity	user networking activities	2024	planned every two years

8.6 Risk management and contingency planning

The highest uncertainty for the timeline and integrity of CIS implementation is the national funding constraints the units are facing. Recently, the German Federal Ministry of Education and Research selected ACTRIS-D, the German Consortium of the European Research Infrastructure for the observation of Aerosol, Clouds and Trace Gases (ACTRIS), for the National Roadmap for research infrastructures. Details about funding budget and timelines are not yet shared, which might influence a possible adoption

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of the implementation plan in future. In Austria and the UK, the political decision process on allocation of funding and the distribution of financial resources is still ongoing. However, in Austria we have a good exchange with the ministry being responsible for and expecting a final agreement by the end of 2019. The CIS-MaB will discuss any progressions of these processes and will try to adapt to possible funding constraints although this will imply prolonged implementation timelines and/or a reduction of the number of services.

As also the personnel resources depend on the political decisions on funding support, unit staff momentarily is facing a high amount of workload. As HR processes and training will take some time, a further delay in starting of hiring CIS related personnel will also imply a risk in not meeting deadlines and milestones.

Depending on the future correlation of UK and the EU, there is a risk of not being able to realize the CCPar unit as described. As the scientific exchange between all CIS units is vivid and established, we will in all scenarios try to keep the U-Man expertise available to the ACTRIS community. Part of the initiatives planned within CIS might be covered by CCInt or CCIce with some external support. Some of the commercial instruments used and serviced at CIS are manufactured by only one company (e.g. PINE chamber). Hence, further developments, availability on the market and needed firmware updates depend on the companies policy and strategy. In trying to be in close collaboration, we can plan for such cases and maybe find a solution with the manufactures.

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9 Implementation plan of the Centre for Reactive Trace Gases Remote Sensing (CREGARS)

CREGARS is organized in 8 Units which are grouped in 3 clusters, one cluster for each measurement technique covered by CREGARS. The Units belonging to one cluster share responsibilities at the technical level for a particular technique. Within each cluster, the Units have specific tasks and share other tasks. In particular for the UVVIS cluster, as there are three types of UVVIS instruments compliant with ACTRIS requirements (MAXDOAS, PANDORA and SAOZ), each Unit has the responsibility for providing specific technical support/services for one type of instrument; the lead of the cluster will make sure that the activities of the three units are coordinated and that the ACTRIS UVVIS data from the three instrument types are harmonized. The fourth UVVIS Unit is essentially responsible for providing the support at the instruments intercomparison field site (Cabauw).

The governance rules in CREGARS are not yet decided; they will be decided in the course of the implementation phase during a Management Board (MB) meeting including all Units Leads. We will probably agree on a Consortium Agreement.

9.1 Mission of the Central Facility

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 specialized 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.

9.2 CREGARS Organigram

	CREGARS							
	CREGARS-FTIR			CREGARS-UVVIS				CREGARS-O3DIAL
	CREGARS-FTIR-BE @BIRA-IASB	***CREGARS-FTIR-BE @ULiège***	***CREGARS-FTIR-DE @U.Bremen***	***CREGARS-UVVIS-BE @BIRA-IASB***	***CREGARS-UVVIS-AT @MUI***	***CREGARS-UVVIS-FR @CNRS***	***CREGARS-UVVIS-NL @KNMI***	***CREGARS-O3DIAL-FR @CNRS***
ACTIVITIES								
CREGARS management	Lead	Contribution	Contribution	Contribution	Contribution	Contribution	Contribution	Contribution
Cluster management	Lead	Contribution	Contribution	Lead	Contribution	Contribution	Contribution	Lead
Unit management	Lead	Lead	Lead	Lead	Lead	Lead	Lead	Lead
FTIR-Processing and QC/QA	Lead							
FTIR-Audit and Consultancy	Lead	Contribution	Contribution					
FTIR-Training			Lead					
FTIR-SOP	Lead	Contribution	Contribution					

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UVVIS-Processing and QC/QA				Lead	Contribution	Contribution		
UVVIS-Audit and Consultancy				Lead	Contribution	Contribution		
UVVIS-Training[1]				Contribution	Contribution	Lead		
UVVIS-SOP[2]				Lead	Contribution	Contribution		
UVVIS-Instrument calibration				Contribution	Lead	Contribution	Contribution	
O3DIAL-Audit and Consultancy								Lead
O3DIAL-SOP								Lead
O3DIAL-Quality insurance								Lead
CREGARS data verification & submission to Data Center	Lead							

Figure 7 CREGARS organigram showing the main tasks of different units

9.3 Partners

Leading Unit	**Host Institution of the Leading Unit**	**Name of the CF leader**	**Contact of the CF leader**
CREGARS-FTIR-BE	Royal Belgian Institute for Space Aeronomy (BIRA-IASB)	Martine De Mazière Deputy leader: Bart Dils	martine.demaziere@aeronomie.be; bart.dils@aeronomie.be
Unit	**Host Institution(s)**	**Name of the Unit Head**	**Contact of the Unit *Head***
CREGARS-FTIR-BE	Royal Belgian Institute for Space Aeronomy (BIRA-IASB) & University of Liège (ULiège), Belgium	Martine De Mazière Deputy leader: Bart Dils	martine.demaziere@aeronomie.be; bart.dils@aeronomie.be
CREGARS-FTIR-DE	University of Bremen (U.Bremen), Germany	Mathias Palm	mathias@iup.physik.uni-bremen.de
CREGARS-UVVIS-BE	Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Belgium	Michel Van Roozendael	CREGARS-UVVIS-BE
CREGARS-UVVIS-AT	Medical University Innsbruck (MUI), Austria	Axel Kreuter	axel.kreuter@imed.ac.at

[1] Each UVVIS will be 'leading' the training oart that is specific for the instruments type that it is responsible for, and the French unit at CNRS will be coordinating the activities in order to ensure that the minimum training that is applicable to all types of UVVIS instruments is provided in every training.

[2] Each UVVIS will be 'leading' the SOP that are specific for the instruments type that it is responsible for, and the Belgian unit at BIRA will be coordinating the activities in order to ensre that the SOP are consistent for the different instrument types as much as possible.

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CREGARS-UVVIS-FR	Centre National de Recherche Scientifique (CNRS)/ Laboratoire Atmosphère, Milieux, Observations Spatiales (LATMOS), France	Andrea Pazmino	andrea.pazmino@latmos.ipsl.fr
CREGARS-UVVIS-NL	Royal Netherlands Meteorological Institute (KNMI), the Netherlands	Arnoud.Apituley	arnoud.apituley@knmi.nl
CREGARS-O3DIAL-FR	Centre National de Recherche Scientifique (CNRS)/ Laboratoire Atmosphère, Milieux, Observations Spatiales (LATMOS), France	Sophie Godin-Beekmann	sophie.godin-beekmann@latmos.ipsl.fr

9.4 Implementation timeline 2020-2024

No.	Activity	2020	2021	2022	2023	2024
Implementation activities						
1	CF Management	100%	100%	100%	100%	100%
2	Unit Management	100%	100%	100%	100%	100%
3	Cluster Management	100%	100%	100%	100%	
4	FTIR-Processing and QC/QA	100%	100%	100%	100%	100%
6	FTIR-Training	100%	100%			
7	FTIR-SOP	100%	100%	100%	100%	100%
8	UVVIS-Processing and QC/QA	100%	100%	100%		
11	UVVIS-SOP	100%	100%			
12	UVVIS-Instrument calibration	100%	100%	100%		
14	O3DIAL-SOP	100%	100%			
15	O3DIAL-Quality insurance	100%	100%			
16	CREGARS data verification & submission to Data Centre	100%	100%	100%		
Operation activities						
1	CF Management		100%	100%	100%	100%
2	Unit Management			100%	100%	100%
3	Cluster Management	100%	100%	100%	100%	100%
4	FTIR-Processing and QC/QA			100%	100%	100%
5	FTIR-Audit and consultancy	100%		100%	100%	100%
6	FTIR-Training		100%	100%	100%	100%
7	FTIR-SOP	100%	100%	100%	100%	100%
8	UVVIS-Processing and QC/QA		100%	100%	100%	100%
10	UVVIS-Training			100%	100%	100%
11	UVVIS-SOP			100%	100%	100%
12	UVVIS-Instrument calibration			100%	100%	100%
13	O3DIAL-Audit and consultancy		100%	100%	100%	100%
14	O3DIAL-SOP	100%	100%	100%	100%	100%
15	O3DIAL-Quality insurance		100%	100%	100%	100%

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No.	Activity	2020	2021	2022	2023	2024
16	CREGARS data verification & submission to Data Center			100%	100%	100%

9.5 Important Milestones

Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
Implementation activities				
M1.1 = M2.1 = M2.1	Signature of the CREGARS Consortium Agreement	CREGARS management; CREGARS Units management; CREGARS Units Cluster management	end 2020	
M1.2 = M2.2 = M3.2	Set-up of communication and documents exchange channels for CREGARS MB	CREGARS management; CREGARS Units management; CREGARS Units Cluster management	end 2021	
M3.3	Workshops for getting consensus within global NDACC FTIR community	CREGARS Units Cluster management	end 2021	
M4.1	FTIR central processing and QA/AC system fully operational	FTIR Processing and QC/QA	beginning 2024	
M5.1	set-up and expertise for FTIR cell calibrations fully operational	FTIR Audit and consultancy	end 2020	
M5.2	FTIR sites audit system fully operational	FTIR Audit and consultancy	end 2022	
M5.3	consultancy capability for new FTIR locations	FTIR Audit and consultancy	end 2024	
M6.1	readiness for providing guidelines and training for FTIR operators	FTIR training	end 2022	
M6.2	readiness for training for running SFIT4	FTIR training	End 2020	
M7.1	FTIR ILS characterization guidelines	FTIR SOP	end 2020	
M7.2	SFIT4 and related software and tools availability	FTIR SOP	end 2020	
M7.3	retrieval strategies, SFIT4 control files and spectroscopic linelists for HCHO, O_3, C_2H_6	FTIR SOP	end 2021	
M7.4	retrieval strategies, SFIT4 control files and spectroscopic linelists for NO_2 and NH_3	FTIR SOP	end 2024	

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Milestone name	Short description	Linked activity	Estimated year of achievement	Comments
M8.1	Central processing system fully ready for Pandora instruments	UVVIS-Processing and QC/QA	end 2020	
M8.2	Central processing system fully ready for SAOZ instruments	UVVIS-Processing and QC/QA	end 2021	
M8.3	Central processing system fully ready for MAXDOAS instruments	UVVIS-Processing and QC/QA	end 2022	
M10.1	readiness for training of UVVIS operators and data providers	UVVIS Audit and consultancy	end 2024	
M11.1	readiness for providing SOP for UVVIS instruments	UVVIS SOP	end 2022	
M12.1	ready for laboratory calibrations with a capacity for 21-28 UVVIS instruments per year	UVVIS instrument calibration	end 2022	
M12.2	ready for laboratory calibrations with a capacity for 30-40 UVVIS instruments per year	UVVIS instrument calibration	end 2024	
M12.3	readiness for performing site audits with certified travelling standard UVVIS instrument	UVVIS instrument calibration	end 2024	
M12.4	readiness of Cabauw site for hosting UVVIS instruments intercomparison campaigns	UVVIS instrument calibration	end 2022	
M13.1	readiness for providing recommendations and performing quality audits for 3 DIAL measurements	O3DIAL Audit and consultancy	end 2024	
M14.1	readiness for providing O3DIAL SOP	O3DIAL SOP	end 2024	
M15.1	readiness for providing QA of O3DIAL	O3DIAL Quality Assurance	end 2024	
M16.1	readiness of the system for GREGARS data verification & submission to Data Centre	GREGARS data verification & submission to Data Centre	end 2022	Dependent on ACTRIS DC/GRES readiness

9.6 Risk management and contingency planning

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Due to the complexity and multiple interlinkages of processes needed to run ACTRIS during the Implementation Phase, it is crucial to have a well-developed risk management strategy and to implement risk monitoring and management. The risk policy and the overall risk management strategy are developed at the RI level. The risk monitoring and management including the implementation of contingency measures must also be developed at the level of the CF.

CREGARS will actively participate in the risk management, sustainable development and implementation of ACTRIS. The consortium agreement between the Units must include a risk management plan and associated responsibilities. The actual status of risks will be discussed systematically during the Management Board meetings; the implementation of possible contingency measures will also be agreed during these meetings; both (risk status and contingency measures) will be reported to the HO.

Considering all uncertainties related to the ACTRIS dimension, the required interactions with GRES and the Data centre in general, the financial commitments of the countries, evolution of the technology and of the global environmental landscape, of the users community, etc., CREGARS is facing certain risks in the 2020-2024 period. The risks can be organisational, operational, financial and technical, with various probabilities of occurrence and different levels of impact on the CF implementation and operation. Following the principles stated in the ACTRIS Risk Policy, CREGARS has identified the following risk exposure matrix, to be continuously updated. Contingency measures, as foreseen now, are reported in the same table

Description of Risk	Likelihood (high/medium/low)	Potential Impact (high/medium/low)	Mitigation/Risk reduction/Planned response (accept, avoid, reduce, or share the risk)
Organisational risks			
ACTRIS ERIC not established in 2021	High	Medium	Re-visit the implementation plan. Re-schedule activities.
Institutions contributing to CREGARS do not conclude the Consortium Agreement	Low	High	Involve ACTRIS HO and IAC in the negotiation process. Re-visit the implementation plan. Continue the basic operations at the contributing institutions
SAMU is not operational in 2021	Low	Medium	Focus on provision of operation support; delay provision of services if the CF is facing capacity issues
ACTRIS DC is not operational in 2021	Low	Low	Rely on GRES if GRES would be more advanced. Disseminate and archive data through NDACC DHF if neither GRES nor the DC are operational.
Disfunctionalities in the management of CREGARS	Medium	Medium	The interaction between the different clusters are less important so the CREGARS management of the clusters is more critical and

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Description of Risk	Likelihood (high/medium/low)	Potential Impact (high/medium/low)	Mitigation/Risk reduction/Planned response (accept, avoid, reduce, or share the risk)
			the meetings among cluster units may be increased.
Disfunctionalities in the management of the Units Clusters	Medium	High	Fall back on coordination at CREGARS-MB level.
Disfunctionalities in the management of the Units	Medium	High	Replace Unit Lead and/or Unit staff that is deficient (action to be taken by other members of CREGARS MB).
Coordination and communication problems between CREGARS Units, and/or between CREGARS MB and ACTRIS HO, and/or between CREGARS and ACTRIS DC/GRES	Medium	High	Ensure affective communication channels, increase frequency of remote and/or face-2-face meetings
Operational risks			
CREGARS does not have enough capacity to provide the required operation support to NFs	Low	Medium	Re-visit the ramp-up process with clear RI support schedule and plan for gathering the capacity. Identify additional capacity outside the planned Units
CREGARS does not have enough capacity to provide the requested services to the users	Medium	Low	Reduce service level; Identify additional capacity in NDACC.
The number of NFs to be supported by CREGARS is lower than expected	Medium	Low	Re-direct the remaining capacity to provision of services to the users
The requests from the users to access CREGARS services is lower than expected	Medium	Low	Re-direct the remaining capacity to provision of complementary operation support to NFs. Increase the communication with the users. Increase the publicity. Re-orient some capacity to the preparation of the evolution of ACTRIS
Underestimation of the human resources needed; wrong evaluation of the	Medium	High	Increase the percentage of involvement of the existing staff. Develop specialized training programs. Staff exchanges.

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Description of Risk	Likelihood (high/medium/low)	Potential Impact (high/medium/low)	Mitigation/Risk reduction/Planned response (accept, avoid, reduce, or share the risk)
expertise and human resource profiles			
Over-dependence on key individuals	High	High	Create and maintain a supportive and attractive working environment. Monitor the well-being of staff. Train new HR capacity and decrease dependence on single persons. Adopt good documentation, communication and archiving systems.
Demotivation of staff involved in CREGARS administrative and non-technical tasks	Medium	High	Make sure that staff can maintain some attractive tasks in parallel, by sharing the CREGARS workload over more persons
Long-lasting absence of key staff	Medium	High	Ensure sharing of knowledge and expertise such that backup options exist
Financial risks			
Insufficient resources for building the necessary infrastructure	Low	High	Re-visit the implementation plan. Re-distribute the work between Units. Search for additional funding sources
Insufficient resources for supporting the operations	High	High	Re-visit the implementation plan. Prioritize crucial activities. Search for additional RPO contributions (staff involvement).
Limited and insufficient financial support from some of the countries involved in CREGARS	High	High	Re-distribute the work between Units. Increase the contributions from the RPOs. Reduce the CREGARS tasks while keeping only the essential tasks.
Underestimation of real implementation costs	Medium	High	Update and revise the implementation costs regularly. Identify additional funding sources. Reduce administrative burden. Reduce the CREGARS tasks while keeping only the essential tasks.
Underestimation of real operational costs	Low	High	Update and revise the operational costs regularly. Identify additional funding sources. Reduce administrative burden. Reduce the CREGARS tasks while keeping only the essential tasks.
Technical risks			

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Description of Risk	Likelihood (high/medium/low)	Potential Impact (high/medium/low)	Mitigation/Risk reduction/Planned response (accept, avoid, reduce, or share the risk)
Delays in the build-up of the necessary infrastructure (new equipment)	Low	Low	Use existing equipment, even if not at the state-of-the-art. Re-distribute work towards properly equipped Units. Re-schedule tasks that depend on it.
Software tools are incomplete, delayed, have bugs, …	Low	Medium	Additional IT support will be solicited (in the RPOs, in other CFs, in the Data Centre). 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 instruments, site audits, …	Medium	Low	Reschedule the related tasks, adapt their frequency, take lessons for future, adapt procedures
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 inline with beneficiaries expectations,

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10 Implementation plan of the Centre for Reactive Trace Gases In Situ Measurements (CiGas)

With KIT as leading unit, the tasks are shared between six CiGas-units in order to combine complementary expertise. The units provide specific parts of the intended activities as further detailed in Section 3.2. Some activities are duplicated between units to achieve metrological robustness and to provide sufficient capacity. The planned activities for implementation are 100% for ACTRIS. CiGas is structured along specific compound classes by forming the clusters (1) anthropogenic/biogenic volatile organic compounds (ABVOCs), (2) oxygenated VOCs (OVOCs), (3) condensable vapours and (4) nitrogen oxides (NOx). The overall organisational structure is displayed in the Figure below.

The CiGas office at the lead unit is coordinating the general workflow between the units, the Head Office (HO), the Service and Access Management Unit (SAMU), the Data Centre (DC), the NFs and the users. The CiGas director leads the management board consisting of the unit heads. The management board organises the compound cluster specific workflow coordinated by the cluster lead unit among the participating units e.g. for measurement guidance of ABVOC the units KIT, Empa, IMT and DWD contribute (units with a yellow colour share in the above Figure). The compound cluster leading units are experts in their field and will address the activities linked to the specific measurement techniques and data quality procedures.

The legal framework inside of CiGas will be set by a consortium agreement. CiGas will be entirely outside the ACTRIS ERIC and the legal link of CiGas to ACTRIS ERIC will be contractual. Details will be negotiated during the implementation phase.

10.1 Mission of the Central Facility

The key-mission of the CiGas is to offer current state operational support to ACTRIS National Facilities (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 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.

CiGas operates and supports instrumentation and observations collected of the following atmospheric reactive trace gases:

(1) Non-Methane Hydrocarbons (NMHCs, typically over 40 compounds),

(2) Biogenic Volatile Organic Compounds (BVOCs) such as terpenes,

(3) Oxygenated VOCs (OVOCs) such as aldehydes, ketones, alcohols (methanol, formaldehyde, acetaldehyde, acetone…),

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(4) Condensing vapours and direct aerosol precursors such as sulfuric acid and Highly Oxygenated Molecules (HOM; e.g. C10H14O9), and

(5) 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.

10.2 CiGas Organigram

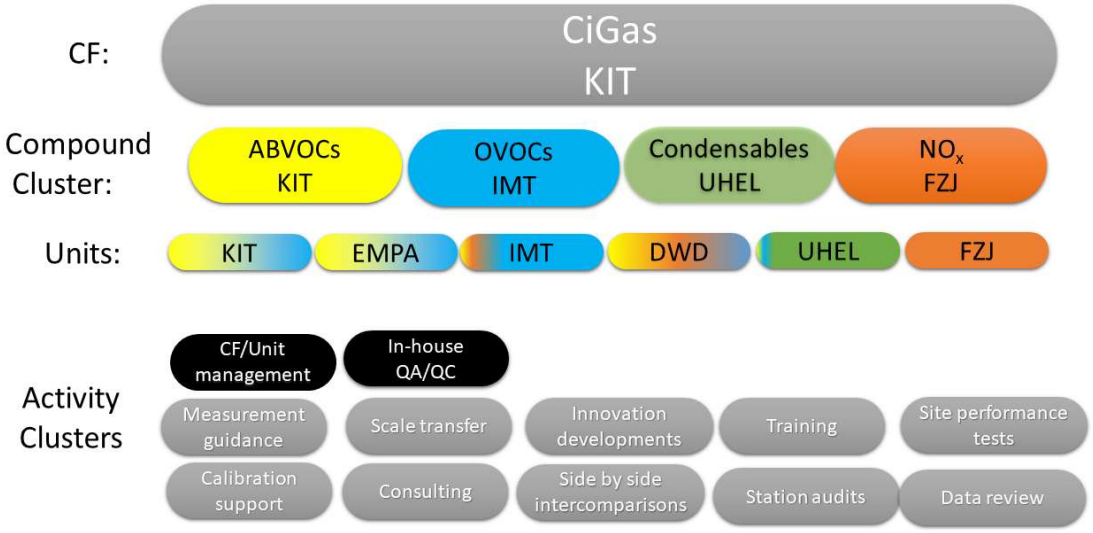

Figure 8 CiGas organigram showing the main tasks of different units

10.3 Partners

Leading Unit	Host Institution of the Leading Unit	Name of the CF leader	Contact of the CF leader
CiGas-KIT	Institute of Meteorology and Climate Research (IMK), Department of Atmospheric Environmental Research (IFU), Karlsruhe Institute of Technology	Rainer Steinbrecher	rainer.steinbrecher@kit.edu
Unit	**Host Institution**	**Name of the Unit Head**	**Contact of the Unit Head**
CiGas-FZJ	Institute of Energy and Climate Research, IEK8: Troposphere, Forschungszentrum Jülich GmbH	Robert Wegener	r.wegener@fz-juelich.de

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CiGas-IMT	Institution Mines Telecom Lille Douai (IMT/LD), Energy & Environment research, education and innovation centre	Stéphane Sauvage	stephane.sauvage@imt-lille-douai.fr
CiGas-UHEL	University of Helsinki – Institute for Atmospheric and Earth System Research	Tuija Jokinen	tuija.jokinen@helsinki.fi
CiGas-DWD	Hohenpeissenberg Meteorological Observatory, Deutscher Wetterdienst	Anja Claude	anja.claude@dwd.de
CiGas-Empa	The Laboratory for Air Pollution/Environmental Technology, Empa	Stefan Reimann	stefan.reimann@empa.ch

10.4 Implementation timeline 2020-2024

CiGas activities will be fully implemented in a time span of 5years starting at 2020. During the implementation phase partial operation is possible starting with 50% operation in 2020 and ramping (10% annual increase) up to 100% operation at the end of 2025. In parallel, implementation activities are ramped down correspondingly.

No.	Activity Cluster	2020	2021	2022	2023	2024
Implementation activities						
1	Measurement guidance	50%	-	30%	-	10%
2	Scale transfer	50%	40%	30%	20%	10%
3	Innovation developments (new instrument tests, QA/QC software developments for implementation)	50%	-	30%	-	10%
4	Training	50%	40%	30%	20%	10%
5	Calibration support	50%	40%	30%	20%	10%
6	Station performance comparison (round robin, parallel off-line sampling, on-site reference instruments)	50%	40%	30%	20%	10%
7	Central side-by-side comparisons	-	-	30%	-	10%
8	Station audits	50%	40%	30%	20%	10%
9	Data review (issue tracker, @VOC@, QA/QC workshops)	50%	40%	30%	20%	10%
10	Consultancy	50%	40%	30%	20%	10%
11	In-house QA/QC (key comparisons, ISO)	50%	40%		20%	10%
12	Management (interlinkages HO, SAMU, DC, NFs, Users, Units)	50%	40%	30%	20%	10%

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No.	Activity Cluster	2020	2021	2022	2023	2024
Operation activities						
1	Measurement guidance	50%	-	70%	-	90%
2	Scale transfer	50%	60%	70%	80%	90%
3	Innovation developments (new instrument tests, QA/QC software developments for implementation)	50%	60%	70%	80%	90%
4	Training	50%	60%	70%	80%	90%
5	Calibration support	50%	60%	70%	80%	90%
6	Station performance comparison (round robin, parallel off-line sampling, on-site reference instruments)	50%	60%	70%	80%	90%
7	Central side-by-side comparisons	-	-	70%	-	90%
8	Station audits	50%	60%	70%	80%	90%
9	Data review (issue tracker, @VOC@, QA/QC workshops)	50%	60%	70%	80%	90%
10	Consultancy	50%	60%	70%	80%	90%
11	In-house QA/QC (key comparisons, ISO)	50%	60%	-	80%	90%
12	Management (interlinkages HO, SAMU, DC, NFs, Users, Units)	50%	60%	70%	80%	90%

10.5 Important Milestones

Milestone name	Short description	Linked activity cluster	Estimated year of achievement	Comments
Measurement Guidelines NMHCs, NOx, update. Measurement Guidelines PTR-MS, first draft. Measurement Guidelines PTR-MS. Measurement Guidelines OVOCs, BVOCs, first draft. Measurement Guidelines OVOCs, BVOCs. Measurement Guidelines HCHO, first draft. Measurement Guidelines HCHO.	Standardised procedures for measurement, data evaluation, quality assurance, quality control, and data reporting of ACTRIS variables.	Measurement guidance	2020 2020 2021 2022 2023 2023 2024 2024	Revision as needed based on innovation developments

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Measurement Guidelines condensable vapours, first draft. Measurement Guidelines condensable vapours.			2025	
Scale available at NFs for ABVOC and NO. Scale available at NFs for OVOCs. Scale available at NFs for HCHO and NO_2. Scale available at NFs for condensable vapours.	Scale transfer to target gases with close to ambient air amount fractions by the responsible units for use at the NFs.	Scale transfer	2021 2022 2023 2024	For ABVOC and NO the scales are established at the Central Calibration Laboratories (CCLs) of GAW. For OVOC the scales will be established by the end of 2022, for HCHO and NO_2 by the end of 2023 and for selected condensable vapors by the end of 2024.
ACTRIS approved new technologies	New developments in measuring and analysing reactive trace gases in air including QA/QC procedures will be tracked and evaluated against reference methods.	Innovation developments (new instrument tests, QA/QC software developments for implementation)	2024	
Training available for NMHCs and NOx analysis. Training available for PTR-MS analysis. Training available for OVOCs and BVOCs. Training available for HCHO analysis Training available for condensable vapours analysis	In training centres with thematic training courses, the necessary expertise for operating an ACTRIS labelled station will be shared with the corresponding station staff.	Training	2021 2022 2023 2024 2024	
Working standard checks available for ABVOC and NO. Working standards checks available for OVOCs and BVOCs.	NFs send the working standards to the corresponding units for checking and possibly	Calibration support	2021 2023	

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Working standards checks available for HCHO and NO_2. Working standards checks available for condensable vapours.	assigning traceable amount fractions to ACTRIS variables		2024 2024	
Measurement performance monitoring available for ABVOC and NO. Measurement performance monitoring available for OVOCs and BVOCs. Measurement performance monitoring available for HCHO and NO_2. Measurement performance monitoring available for condensable vapours.	Analytical laboratories are asked to analyse target gas samples in the same way as they measure ambient air samples. Further, air samples are taken in parallel to routine sampling (parallel off-line sampling with canisters/adsorption tubes) and send to the organising unit for analysis. For HCHO, selected ABVOC and selected condensable vapours a reference instrument will be operated in parallel to the routine measurements.	Station performance comparison (round robin, parallel off-line sampling, on-site reference instruments)	2022 2024 2024 2024	
Analytical instrument compatibility test available for the compound clusters	NF's are invited to take their analytical and/or sampling equipment for comparison to the unit organising a side-by-side experiment	Central side-by-side comparisons	2024	
Audits are available for ABVOC and NO. Audits are available for OVOCs and BVOCs. Audits are available for HCHO and NO_2. Audits are available for condensable vapours.	Units are visiting NFs for conducting audits checking the operation and performance of the NF according to ACTRIS MGs and SOPs.	Station audits	2021 2023 2024 2024	

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Data review is available for ABVOC and NO. Data review is available for OVOCs and BVOCs. Data review is available for HCHO and NO_2. Data review is available for condensable vapours.	The submitted time series are checked in terms of correct flagging of calibrations and instrument malfunction, target gas measurements, outliers after time series analysis, following a standardised QA/QC protocol.	Data review (issue tracker, @VOC@, QA/QC workshops)	2020 2023 2024 2024	
Consultancy is available for ABVOC and NO. Consultancy is available for OVOCs and BVOCs. Consultancy is available for HCHO and NO_2. Consultancy is available for condensable vapours.	Interested parties are consulted in terms of applying for the ACTRIS label, implementing MGs and SOPs, data reporting, QA/QC measures, as well as for implementing ACTRIS approved new technologies.	Consultancy	2020 2023 2024 2024	
QA/QC controlled operation of units	The units aim at certifying as reference laboratory according ISO and aim at participating in key comparisons organised by the community NMI) assembled in the CCQM-GAWG of BIPM.	In-house QA/QC (key comparisons, ISO)	2024	
Functional CiGas management	The management board ensures operation support to the NFs according to the identified needs, agreed schedules, procedures, and available capacity at the units. It also coordinates the organisation of workshops,	Management (interlinkages HO, SAMU, DC, NFs, Users, Units)	2024	

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	interaction with users, the collection of user feedbacks, the website, social media accounts and contributes to the ACTRIS websites for visibility to the general public. It provides work plans and reports.			
Measurement Guidelines NMHCs, NOx, PTR-MS. Measurement Guidelines OVOCs, BVOCs. Measurement Guidelines HCHO. Measurement Guidelines condensable vapours.	Standardised procedures for measurement, data evaluation, quality assurance, quality control, and data reporting of ACTRIS variables.	Measurement guidance	2021 2023 2024 2025	Revision as needed based on innovation developments
Scale available at NFs for ABVOC and NO. Scale available at NFs for OVOCs and BVOCs. Scale available at NFs for HCHO and NO2. Scale available at NFs for condensable vapours.	Scale transfer to target gases with close to ambient air amount fractions by the responsible units for use at the NFs.	Scale transfer	2023 2024 2025 2025	For ABVOC and NO the scales are established at the Central Calibration Laboratories (CCLs) of GAW. For OVOC the scales will be established by the end of the year 2022, for HCHO and NO2 by the end of the year 2023 and for selected condensable vapors by the end of the year 2024. The achievement year depends on the development of the NFs.
ACTRIS approved new technologies	New developments in measuring and analysing reactive trace gases in air including QA/QC procedures will be tracked and	Innovation developments (new instrument tests, QA/QC software	2025	

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	evaluated against reference methods.	developments for implementation)		
Training available for NMHCs and NOx analysis. Training available for PTR-MS analysis. Training available for OVOCs and BVOCs. Training available for HCHO analysis Training available for condensable vapours analysis	In training centres with thematic training courses, the necessary expertise for operating an ACTRIS labelled station will be shared with the corresponding station staff.	Training	2022 2023 2024 2025 2025	
Working standard checks available for ABVOC and NO. Working standards checks available for OVOCs and BVOCs. Working standards checks available for HCHO and NO_2. Working standards checks available for condensable vapours.	NFs send the working standards to the corresponding units for checking and possibly assigning traceable amount fractions to ACTRIS variables	Calibration support	2023 2025 2025 2025	
Measurement performance monitoring available for ABVOC and NO. Measurement performance monitoring available for OVOCs and BVOCs. Measurement performance monitoring available for HCHO and NO_2. Measurement performance monitoring available for condensable vapours.	Analytical laboratories are asked to analyse target gas samples in the same way as they measure ambient air samples. Further, air samples are taken in parallel to routine sampling (parallel off-line sampling with canisters/adsorption tubes) and send to the organising unit for analysis. For HCHO, selected ABVOC and selected condensable vapours a reference instrument will be	Station performance comparison (round robin, parallel off-line sampling, on-site reference instruments)	2023 2025 2025 2025	

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	operated in parallel to the routine measurements.			
Analytical instrument compatibility test available for the compound clusters	NF's are invited to take their analytical and/or sampling equipment for comparison to the unit organising a side-by-side experiment	Central side-by-side comparisons	2025	
Audits are available for ABVOC and NO. Audits are available for OVOCs and BVOCs. Audits are available for HCHO and NO_2. Audits are available for condensable vapours.	Units are visiting NFs for conducting audits checking the operation and performance of the NF according to ACTRIS MGs and SOPs.	Station audits	2022 2024 2025 2025	
Data review is available for ABVOC and NO. Data review is available for OVOCs and BVOCs. Data review is available for HCHO and NO_2. Data review is available for condensable vapours.	The submitted time series are checked in terms of correct flagging of calibrations and instrument malfunction, target gas measurements, outliers after time series analysis, following a standardised QA/QC protocol.	Data review (issue tracker, @VOC@, QA/QC workshops)	2021 2024 2025 2025	
Consultancy is available for ABVOC and NO. Consultancy is available for OVOCs and BVOCs. Consultancy is available for HCHO and NO_2. Consultancy is available for condensable vapours.	Interested parties are consulted in terms of applying for the ACTRIS label, implementing MGs and SOPs, data reporting, QA/QC measures, as well as for implementing ACTRIS approved new technologies.	Consultancy	2021 2024 2025 2025	
QA/QC controlled operation of units	The units aim at certifying as reference laboratory	In-house QA/QC (key	2025	

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	according ISO and aim at participating in key comparisons organised by the community NMI) assembled in the CCQM-GAWG of BIPM.	comparisons, ISO)		
Functional CiGas management	The management board ensures operation support to the NFs according to the identified needs, agreed schedules, procedures, and available capacity at the units. It also coordinates the organisation of workshops, interaction with users, the collection of user feedbacks, the website, social media accounts and contributes to the ACTRIS websites for visibility to the general public. It provides work plans and reports.	Management (interlinkages HO, SAMU, DC, NFs, Users, Units)	2025	

10.6 Risk management and contingency planning

The presented activities and the time line for implementing CiGas assumes funding as proposed with different possibilities to raise the so far unsecured funds. The main risk is that the units do not achieve the funding level envisaged. In this case the management board of CiGas analyses the current situation during one of their regular meetings. According to the available funding for the different units, activities will be prioritised along the measurement techniques. New risks will be identified at the annual meetings between the TC and the NF. Adequate measures for their contingency will be addressed in an update of the risk management strategy. The presented risk analysis is rather tentative as major parts of the funding are unsecured. We may discuss two possibilities: (1) full funding and (2) reduced funding. Full funding will enable the units to proceed as planned. Reduced funding concepts will have to be carefully checked and all units have to re-evaluate their contributions to the CiGas consortium. In that case and given that all units stay in the consortium, the amount of support and services must be reduced proportionally to the budget cuts. However, it is not in our interest to speculate about the implications of severe reductions of our planned funding. The risk assessment is shown in the table below.

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Risk type	Risk	Likelihood	Impact	Contingency
Managerial	Lack of funding for unit(s) of CiGas	Medium	High	Searching support from other member countries, taking over tasks by the other units, if not possible reduction of services
Managerial	Required support/services cannot be fully provided by CiGas due to limited resources	Medium	High	Searching for higher support from stakeholders, projects, other member countries, or shift tasks to another Unit with higher resources. If not possible reduction of services.
Managerial	Conflicts with SAMU about the services to be provided	Low	Medium	Have clear regulation, allow CiGas to decide about the amount of services, financing of external users need clarification.
Managerial	Individual Units of CiGas do not perform sufficiently	Medium	Medium	Have clear regulation, improve communication, solve issues within CiGas, if not possible include HO+GA.
Technical	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.
Technical	Difficulties in generating reference standards at the required uncertainty	Low	High	Cooperation with a commercial supplier of standards.

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