Milestone 19: Report on existing access practices at participating EU and US Research Infrastructures

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Purpose

The purpose of the present document is to collect information about the current practices, management and organization for access by users to services provided by the atmospheric research facilities within the European Research Infrastructure ACTRIS (Aerosols, Clouds and Trace Gases Research Infrastructure) and by key observation networks in the United States (US): the Department of Energy ARM (Atmospheric Radiation Measurement) user facility, NOAA-FAN (Federated Aerosol Network), MPL-Net, and ASCENT (The Atmospheric Science and Chemistry mEasurement NeTwork). The outcome will allow the assessment of the differences and commonalities and allow developing strategies towards joint initiatives and harmonization of the access practices on a global scale.

Introduction

The goal of CARGO-ACT is to deliver a clear roadmap for sustainable cooperation between key European and US organizations to provide the best services for accessing and using climate- and air quality information. Particularly the research community, including weather, climate, and air quality monitoring and modelling, as well as space agencies, seek global integration of ground-based observations to complement satellite Earth Observation, essential for calibrating and validating satellite data. CARGO-ACT will address integrating diverse ground-based networks and engaging the relevant stakeholders to ensure cooperation. This includes not only data services but also access to measurement facilities, reference instruments, and laboratories.

The main objectives of CARGO-ACT are to build sustainable collaborations and create effective decision-making processes with the key partners in the US. It aims to show stakeholders and the global research community the advantages of aligning systems and standards for better cooperation. CARGO-ACT also seeks to set up ways to provide international access to distributed research facilities and develop a plan to scale up toward a global, integrated research infrastructure for studying aerosols, clouds, and trace gases.

Access context and framework

Efficient and high-quality user access to data and services provided by the atmospheric research infrastructures (RI) is crucial to improve our understanding of the complex atmospheric interactions and processes. The state-of-the-art facilities in Europe and the United States (US) provide the essential tools and data to observe long-term and to study the critical role the atmosphere plays in regulating climate, weather, and air pollution. Access is vital to scientific progress as it provides essential information and knowledge to develop science-driven responses to the environmental challenges that societies are facing. As atmospheric phenomena do not adhere to national borders, international initiatives to tackle global challenges and investigate global atmospheric trends are indispensable.

Despite the common goals of supporting scientific research and addressing global atmospheric challenges, the access practices differ between Europe and the US:

- **In Europe,** access to facilities, services and data is particularly funded by the infrastructure programme of the European Commission (EC), and is often organized within large, multi-national frameworks such as European Research Infrastructure Consortiums (ERIC). In Europe, a strategic body, the European Strategy Forum on Research Infrastructures (ESFRI), is mandated by the EC to support a coherent and strategy-led approach with respect to the European RIs. ESFRI establishes (and updates regularly) the European Roadmap for RIs. The EC infrastructure programme for funding of access is closely aligned with the ESFRI process. Emphasis is placed on open sciences and the promotion of efficient access to scientific resources and data. The EC particularly supports the transnational access scheme, by facilitating access by users, particularly from European Member and Associated states, to access facilities and data regardless of their location. International access is encouraged but limited. Access is granted through competitive calls, where users apply for use of services based on their scientific merit and collaboration potential. The aim is to support open science principles and to make data widely available for access and use. In Europe, several research infrastructures offer access to services in the atmospheric domain. IAGOS[1] and ICOS ERIC[2] essentially provide access to data and digital services that are widely and openly accessible. ACTRIS ERIC, additionally to the provision of data and digital services, furthermore offers access to research, technological, innovation and training services that involve an application and selection procedure for the users.

- **In the US**, access is typically coordinated by several national agencies and governmental organisations such as the Atmospheric Radiation Measurement network (ARM) of the Department of Energy (DoE), the National Oceanic and Atmospheric Administration (NOAA), the access programmes to the facilities of the National Aeronautics and Space Administration (NASA), or other measurement networks, e.g., those funded by the infrastructure programme of the National Science Foundation (NSF), such as the new network ASCENT (Atmospheric Science and Chemistry mEasurement NeTwork), which is currently being established and developed. Each of these agencies and organizations manage their own facilities and data repositories, and they also often collaborate through specific projects or research grants. Access to atmospheric facilities and data is organized by each of these agencies. International collaboration is encouraged. A strong emphasis is placed on open data access.

3.1 European and US infrastructures and networks

For this document, we address the access practices of the atmospheric infrastructures and networks listed below.

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[1] IAGOS (In-service Aircraft for a Global Observing System) is a European Research Infrastructure for global observations of atmospheric composition from commercial aircraft: https://www.iagos.org/

[2] ICOS ERIC (Integrated Carbon Observation System) is a European-wide greenhouse gas research infrastructure that produces standardised data on greenhouse gas concentrations in the atmosphere, as well as on carbon fluxes between the atmosphere, the earth and oceans: https://www.icos-cp.eu/

In Europe:

- **ACTRIS ERIC** - Aerosols, Clouds and Trace Gases Research Infrastructure is a RI for observing and monitoring short-lived atmospheric constituents (more than 150 variables). ACTRIS is operated by a consortium of European countries and research institutions through an ERIC framework, with national institutions managing the atmospheric research facilities in 17 different European countries. These National Facilities comprise 86 observational platforms (figure 1a) and additionally 37 exploratory platforms (atmospheric simulation chambers and mobile platforms).

In the US:

- **DoE-ARM** – The Atmospheric Radiation Measurement program is a user facility managed by the US Department of Energy, operating a global network of ground-based observatories and supporting aerial platforms to study cloud formation, aerosols, and their interactions with Earth's climate system. The ARM network has three fixed ground-based sites and three mobile facilities (figure 1b), listed as follows:
  - Southern Great Plains (SGP) – centered near Lamont, Oklahoma, US;
  - North Slope of Alaska (NSA) – centered at Utqiaġvik (formerly Barrow), Alaska, US;
  - Eastern North Atlantic (ENA) – located on Graciosa Island, Azores, Portugal;
  - Three ARM Mobile Facilities (AMF) - designed to operate in any environment. Two of the mobile facilities are typically deployed for a year at a time and have operated since 2005 and 2010. The third mobile facility is intended for longer term deployments (approximately 5-8 years) and has operated since 2013.

- **NOAA NFAN** – NOAA operates the National Federated Aerosol Network (NFAN) which is an international network with approximately 30 observational facilities worldwide for monitoring aerosol concentrations and properties (figure 1c). Key stations include the four NOAA baseline observatories: Barrow-Alaska, Mauna Loa-Hawaii, American Samoa, South Pole. Other observational facilities and sampling sites are located across the US, Canada, Europe, and Asia. NFAN is coordinated by NOAA's Global Monitoring Laboratory (GML), although as a federated network, individual sites implement their own physical access policies - the access described in this document is just for the NOAA operated sites. NFAN is a subset of the World Meteorological (WMO) Global Atmosphere Watch (GAW) and implements the recommended procedures for GAW facilities.

- **ASCENT** – The Atmospheric Science and Chemistry mEasurement NeTwork is a new comprehensive, high-time-resolution, long-term research and measurement network in the U.S. dedicated for the characterization of aerosol chemical composition and physical properties. ASCENT is funded through the National Science Foundation's (NSF) Mid-Scale Research Infrastructure program and is managed by the US Environmental Protection Agency. ASCENT collaborates with various US research organisations. ASCENT representatives contribute to CARGO-ACT but are not beneficiaries of the

CARGO-ACT (www.cargo-act.eu) is supported by the European Commission under the Horizon Europe (HORIZON) – Strengthening the international dimension of ESFRI and/or ERIC research infrastructures, HORIZON-INFRA-2023-DEV-01-07, Grant Agreement #: 101132093

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project. ASCENT leverages existing networks such as NEON[3], IMPROVE[4], NCore[5], PAMS[6], CASTNET[7], etc. and involves 12 ground-based sites across the US, including rural, remote, background, and urban sites (figure 1d). The sites, indicated as follows, are all equipped with the same suite of advanced aerosol instrumentation for real-time measurements of fine aerosol chemical composition and properties:

- o Delta Junction, Cheeka Peak/Makah, Pico Rivera, Rubidoux, Joshua Tree, Yellowstone, La Casa, Houston, Lawrenceville, Queens College, South DeKalb, Look Rook
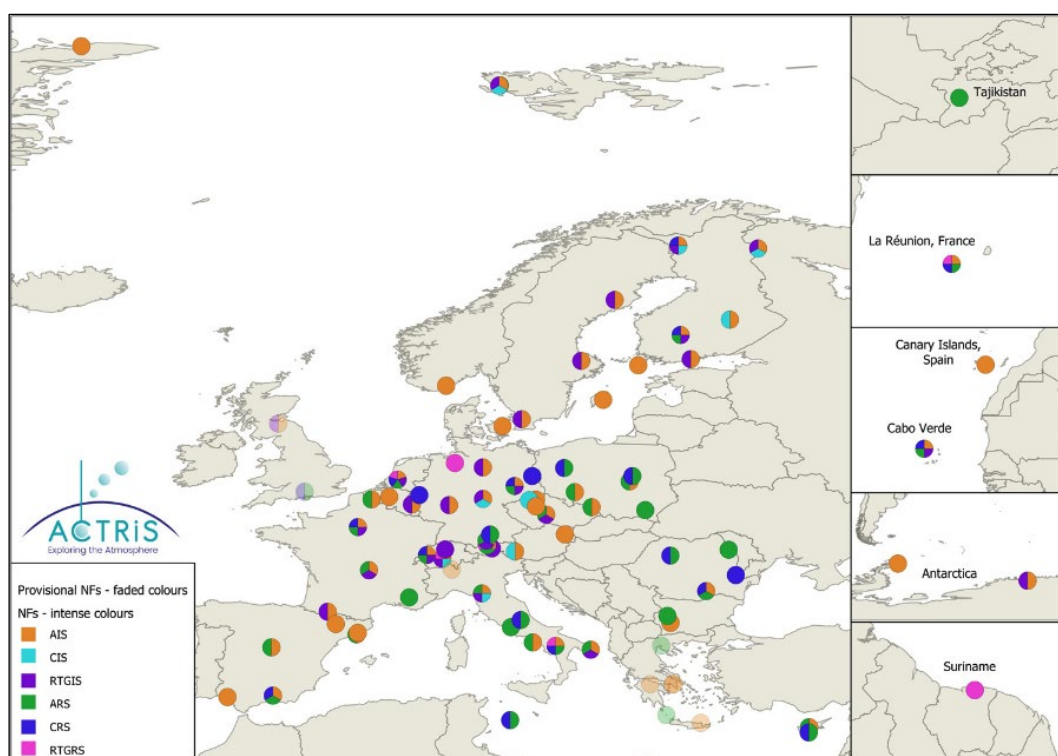

Figure 1a. Geographical distribution of ACTRIS observational platforms (Laj et al., 2024).

[3] National Ecological Observatory Network (NEON): https://www.neonscience.org/

[4] Interagency Monitoring of Protected Visual Environments (IMPROVE): https://vista.cira.colostate.edu/Improve/

[5] NCore Monitoring Network (NCore): https://www.epa.gov/amtic/ncore-monitoring-network

[6] Photochemical Assessment Monitoring Stations (PAMS): https://www.epa.gov/amtic/photochemical-assessment-monitoring-stations-pams

[7] Clean Air Status and Trends Network (CASTNET): https://www.epa.gov/castnet
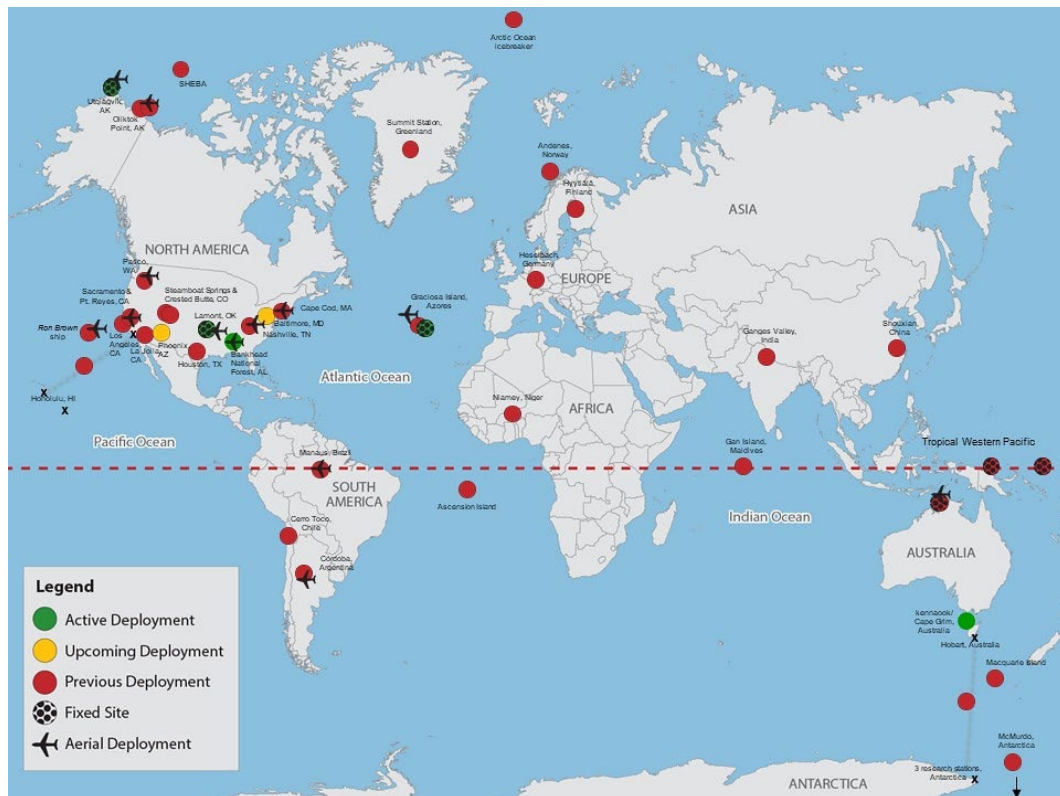
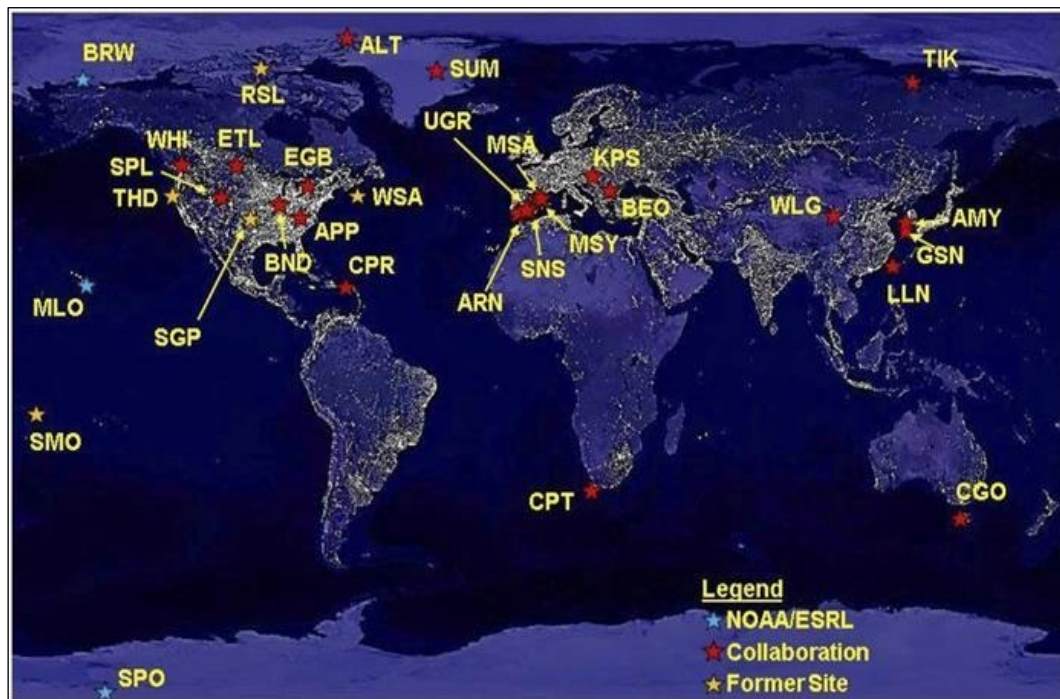Figure 1b. Location of ARM observatories (https://www.arm.gov/capabilities/observatories/).

Figure 1c. Map of NFAN observatories (Andrews et al., 2019).
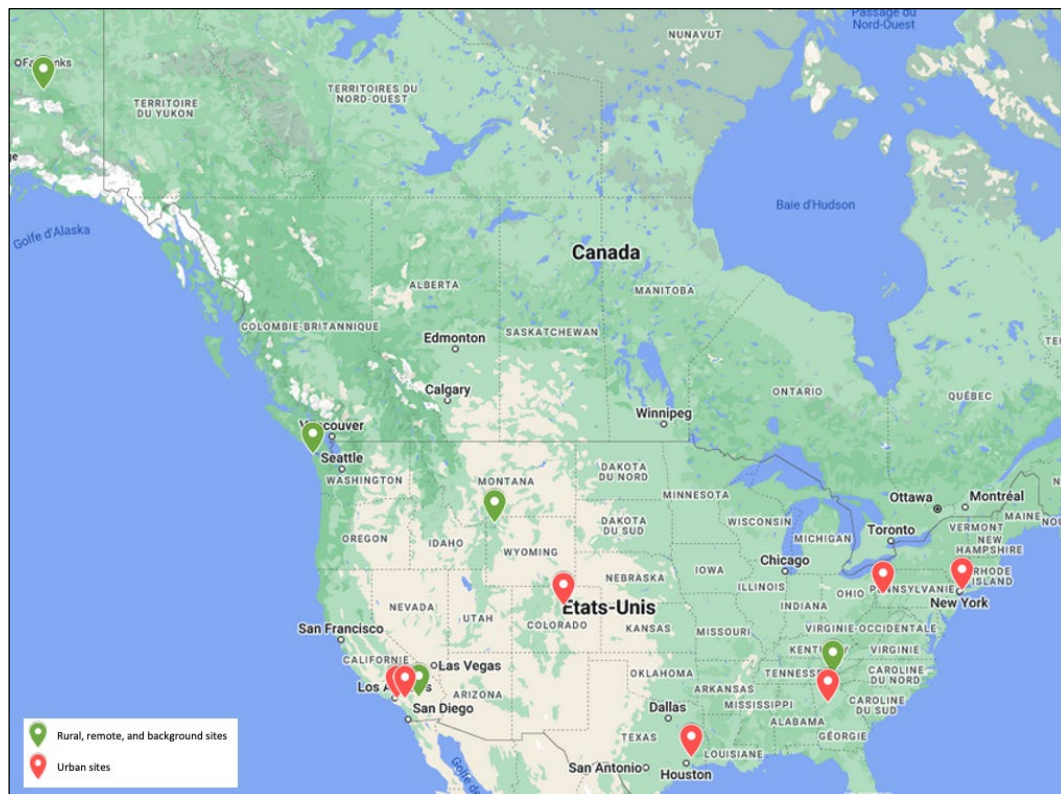
Figure 1d. Geographical overview of ASCNET facilities in the US
(https://ascent.research.gatech.edu/measurement-sites)

Some additional access information is expected to be gathered in the near future from other national and global networks, listed below. They mostly focus on access to data provision services. The information is expected to be collected during CARGO-ACT and will be included in a working version of the document, once available. This concerns the following networks:

● **GAW** (Global Atmosphere Watch) – GAW is a programme under the World Meteorological Organisation (WMO) comprising surface stations operating surface in situ and remote sensing observations of aerosol and trace gas properties, but also atmospheric deposition (figure 2a). This includes topic-specific World Data Centres (WDCs) of which several coincide with ACTRIS Data Centre units. Some GAW sites are also ACTRIS National Facilities, and all NFAN sites are GAW sites.

● **GALION** – The GAW Aerosol Lidar Observation Network is a network of ground-based lidar systems[8] operating under the umbrella of the WMO GAW programme to provide comprehensive global

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[8] Contributing GAW networks are, e.g., TCCON (Total Carbon Column Observing Network US/EU), IMPROVE (Interagency Monitoring of Protected Visual Environments /US), AD-NET[9] (Asian Dust and Aerosol Lidar Observation Network /Asia), EARLINET[10] (European Aerosol Research Lidar Network /EU), LALINET[11] (Latin America Lidar Network /Latin America), NADP (National Atmospheric Deposition Program /US), IDAF (IGAC Debits Africa /EU), MPLNET (NASA Micro-Pulse Lidar Network /US), CASTNET (Clean Air Status and Trends Network /US), IAGOS (In-service Aircraft for a Global Observing System /EU), ICOS ERIC (Integrated Carbon Observation System European Research Infrastructure Consortium /EU), EANET (Acid Deposition Monitoring Network in East Asia /East Asia).

profiling of atmospheric aerosols and clouds. GALION networks comprise MPLNET and NDACC (see below), as well as the following networks AD-NET[9], EARLINET[10], and LALINET[11] (which are not further addressed in this document being outside the scope of the current activity):

- o **MPLNET** – NASA's Micropulse Lidar network operates ground-based lidar systems to continuously monitor the aerosol and cloud vertical structure, and boundary layer heights. The >20 sites are distributed globally in the US, South America, Europe and Asia (figure 2b). MPLNET contributes to GALION.

- o **NDACC** – Network for the Detection of Atmospheric Composition Change is a global network of more than 70 ground-based, remote-sensing stations facilities for monitoring and understanding changes in atmospheric composition such as Greenhouse gases, aerosols, ozone and other trace gases (figure 2c). NDACC is a major contributor to GAW and a key component of the GAW IGACO[12] initiative.

- **AERONET** - Aerosol Robotic Network is a global observation system for monitoring aerosol optical properties using ground-based sun photometers. AERONET is coordinated by NASA (with European contributions via PHOTONS[13]/ACTRIS) and comprises more than 600 continuously operating sites distributed across the world (figure 2d).

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[9] AD-NET is the East Asian lidar network component of GALION and is not further detailed in this document (focusing on European and US networks: https://www-lidar.nies.go.jp/AD-Net/.

[10] EARLINET is the European aerosol Lidar network within GALION of which the majority of stations are currently part of ACTRIS: https://www.earlinet.org.

[11] LALINET is the Latin America Lidar network within GALION which is not further detailed in this document: http://lalinet.org/.

[12] Integrated Global Atmospheric Chemistry Observation (IGACO): https://igaco-o3.fmi.fi/

[13] Photometry for Operational Processing of Satellite Normalization (PHOTONS): https://www-loa.univ-lille1.fr/photons

Figure 2a. Map of GAW Global stations
(https://www.arm.gov/capabilities/observatories/).
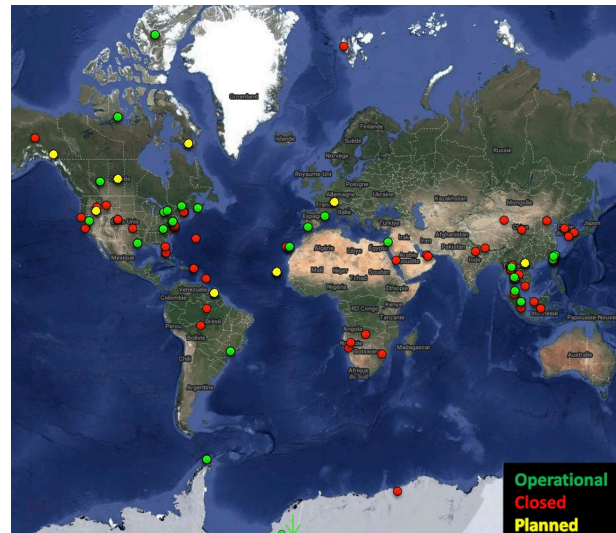
Figure 2b. Map of MPLNET sites
(https://mplnet.gsfc.nasa.gov/operations/sites.cgi?i).

Figure 2c. Geographical overview of NDACC
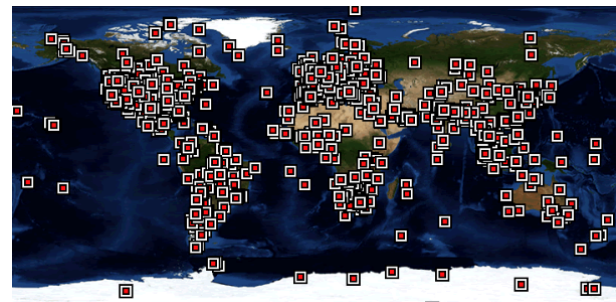measurement stations
(https://ndacc.larc.nasa.gov/).

Figure 2d. Map of available level 2.0 data from
AERONET Aerosol Robotic Network stations
(https://aeronet.gsfc.nasa.gov/new_web/aerosols.html).

3.2 Access vocabulary and definitions

Access to research facilities often involves specific terminology that is essential for understanding. Some of the key vocabulary terms are listed in section 6.

Access practices to atmospheric facilities in Europe and the US

The different access practices and modalities of the European and US networks, including ACTRIS, ARM, NFAN, GAW, and ASCENT are summarized in concise manner in Table 1 below. The different elements described include policy and guiding documents, type of facilities, type of access, catalogue of services, access types, user types and origin. Furthermore, information is provided distinctly for data services (accessible virtually/remotely) and other services (accessible physically, remotely, and/or in a hybrid way). The focus on data services includes the type of data services, the data catalogue, how data is accessed and access mode, FAIR data, the management and tools, users support provided, and licenses applied. For other services, addressed are the access point (if centralized) and management system, the available support tools, the publication, format and duration of the calls for access, the application, review and selection process, the organization and duration of the access, the type of user support provided, the access reporting and monitoring and user duties, and overall documents used in the process. Moreover, financial aspects are discussed such as typical units of access, user fees, and financial support to user mobility.

Table 1. Access modalities at atmospheric research facilities in Europe and the US.

RI/ Network / Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
Policies and guiding documents	- ACTRIS data policy - ACTRIS access and service policy - ACTRIS user policy - ACTRIS Data Management Plan - ACTRIS Access Management Plan	- ARM Data Guidelines - Data sharing policy - DOI guidance - User registration policy - Field Campaign Guidelines	- NFAN sites are encouraged to submit data to WDCA (EBAS[14]) - For NOAA-operated NFAN sites data is required to be completely open - Physical access to NOAA-operated NFAN sites is through a cooperative agreement with the GML Observatories group - Physical access to NFAN partner sites is through agreements with	- Individual data policies for GAW branches on aerosol in situ, trace gases, deposition, and aerosol remote sensing	- ASCENT SOP - Data policy - DOI

[14] EBAS (European Monitoring and Evaluation Database for Atmospheric Composition) is a database infrastructure operated by NILU: https://ebas.nilu.no/

RI/ Network Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
			individual sites (e.g., MoU[15], IAA[16], SLA[17], CRADA[18], CA[19])		
Type of facilities	- Observational platforms - Atmospheric simulation chambers - Mobile platforms - Laboratories, - Topical Centres - Data Centre	- Observatories - Aerial facility (tethered balloon, uncrewed aerial system, and piloted aircraft (new piloted aircraft under development) - Mobile facilities - Data center, modeling, and high performance computing	- Observatories - NOAA/GML also has other facilities (modeling, airplane, mobile...), here the focus is on in-situ aerosol related only	- Observational platforms at surface, in situ and remote sensing	- Ground-based measurement sites (12) in rural, urban, and remote sites
Type of services	Data services Research services Technological services Innovation services Training services Tailored services	ARM Observatories Instruments Campaigns Data services, modeling, high-performance computing Trainings, workshops, and user services	Observatories Instruments Training and workshops Data services	Data services Calibration services	Data services Intensive field campaigns (if additional funding is available)
Catalogue of services	https://www.actris.eu/catalogue-of-services	https://www.arm.gov/capabilities/		None	n/a

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[15] Memorandum of Understanding (MoU) – formal agreement, legally non-binding

[16] Inter-Agency Agreement (IAA) – binding agreement, involves government agencies

[17] Service Level Agreement (SLA) – formal agreement involving a service provider and a client

[18] Cooperative Research and Development Agreement (CRADA) – formal, binding agreement often used in US partnerships for research-sharing between research facility and private industry while protecting intellectual property

[19] Consortium Agreement (CA) – formal, binding agreement commonly used between partners in collaborative research projects involving multiple organisations

RI/ Network / Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
Access types	1) Free and open: virtual access 2) Competitive access: physical, remote, hybrid access (transnational access)	1) Free and open with ARM provided support 2) Proposal based access: physical, remote, research, and computing 3) Proprietary access (data not made publicly available; this is rare)	1) Free and open: virtual access 2) Cost recovery: required for physical access to NOAA's observatories 3) Other: non-NOAA sites set their own policies for physical access.	Data services: free and open, calibration services: free as long as resources available	Free and open access to all ASCENT data will be implemented (currently only available upon demand)
User types	All - mostly from academia and public and private institutions, public services, but also business + industries, non-profit research organisations, national + regional authorities, private citizens	All - universities, industry, research organizations, Govt, DOE Labs, non-profit, and foreign entities	Mostly from academia, but some government agencies and international collaborators	All, mostly academia and public institutions	All, academia, government, industry, public
User origin	Worldwide, EU-funded access is predominantly (80%) granted towards European users	Worldwide, users from 33 countries (in 2023)	Primarily US, but some international	Worldwide, national and institutional funding	Worldwide
Open and free access to data and digital services					
Type of data services	ACTRIS level 0-1-2-3 data (including L1-2 legacy data) Metadata NRT data Data curation Link to satellite	ARM data – instrument data (a and b-level) Value added products (c-level) Field campaign data, and PI contributed data	NFAN data of all flavors (NRT, Level 0-1-2) are submitted to WDCA[20] (EBAS)	Curation services for in situ aerosol, trace gas, and deposition, as well as aerosol remote sensing data in dedicated	High time-resolution of aerosol chemical composition and physical properties using ACSM (non-refractory

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[20] The GAW World Data Centre for Aerosols (WDCA) is hosted by the EBAS database: https://www.gaw-wdca.org/

RI/ Network Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
	data and to data of other global networks (NDACC, AERONET, etc.) Archiving of campaign and TNA data Documentation Data provenance, attribution, traceability Digital tools for processing of tailored data for analysis and research Footprint analysis tool Time services analysis, software	External data – customized external data such as ECMWF, NOAA weather data, and satellite data from NASA Access to external data via links ARM metadata using ISO 19115, JSON-LD, Schema.org Data access service via – ftp, ARMLive API service, Globus, THREDDS, and Jupyter notebook Data workbench enables customized ecosystem for data, computing and software access		topic data centres Level of traceability offered varies between data centres	aerosols), Xact (trace metals) Aethalometer (balck7bron carbon), SMPS (aerosol NSD and concentration) Level 0 (raw data), L1 (NRT with automated QA/QC), L2 (annual, validated data at hourly resolution), L3 (valued added data products)
Data catalogue	- https://dc.actris.nilu.no/search	- https://adc.arm.gov/discovery	- All NFAN data at EBAS: https://ebas.nilu.no - NOAA-owned data also at: https://gml.noaa.gov/aftp/aerosol/	- https://ebas-data.nilu.no/, https://gaw.kishou.go.jp - https://galion.world/search/	- https://ascent.research.gatech.edu/database
Data access	- Central access via web entry point	- Access via data discovery, ARMLive API	- Access via WDCA (EBAS) - NOAA data is	Depends on data repository of GAW WDC[22] (World	- Under development, provided on

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RI/ Network Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
		- Data flows from various observatories, data processing and operations happen in a centralized ecosystem	also available from NCEI[21] (but impossible to find there!) - Data flows from NFAN sites, data processing happens in a centralized location	Data Centres): - WDCA - WDCGG - WDCRG - WDCPC - WDC-RSAT - WRDC - WOUDC Centralised search portal (https://gawsis.meteoswiss.ch/GAWSIS/index.html#/), otherwise decentral	demand - Data flow from each site to a central database
Access mode	- Free and fully open to all users without authentication with username and passwords (except to specific data services or by certain DC units)	- Free and open access to all users with user registration, user name and password	- free and fully open to all users without authentication	- Depends on data repository, mostly open, one repository requires login (WDCGG).	- free and fully open
FAIR data	- ACTRIS adheres to FAIR data principles	- ARM adheres to FAIR, certified by US Public Reusable Research (PuRe) Data, and CoreTrustSeal Certified	- NOAA/GML is working on their FAIRness. NFAN has filled out a FAIR implementation profile	- Varies between data centres. WDCA and WDCRG, hosted in same infrastructure as ACTRIS In Situ, are adhering to FAIR data principles.	- ASCENT will adhere to FAIR data principles
Management	Handled by the individual ACTRIS	Data access and data tools	Data are collected,	Handled by individual GAW	Data tools developed by

chemistry), WDC-RSAT-World Data Centre for Remote Sensing of the Atmosphere (https://wdc.dlr.de), WRDC-World Radiation Data Centre (https://community.wmo.int/en/world-radiation-data-centre), WOUDC-World Ozone and Ultraviolet Radiation Data Centre (https://community.wmo.int/en/world-ozone-and-ultraviolet-radiation-data-centre).

[21] The National Centres for Environmental Information (NCEI) provide access to environmental data, products, and services: https://www.ncei.noaa.gov/

RI/ Network / Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
and tools	data centre unit: - In-Situ (In situ data centre unit for all aerosol, cloud and trace gas in situ data) - ARES (Aerosol remote sensing data centre unit) - CLU (Cloud remote sensing data centre unit) - GRES (Trace gases remote sensing data centre unit) - ASC (Atmospheric simulation chamber data centre unit) - DVAS (Data Discovery, Virtual Access and Services unit)	managed by ARM Data Services, which includes: - Site Data Systems - Data Quality Office - Ingest Development - Value Added Product (VAP) development - ARM Data Center, and Computing cluster	processed, QCd and archived to WDCA using NOAA-developed software, but QC is responsibility of individual site	WDCs	ASCENT database team, central automated QA/QC process for NRT data, finalized hourly data processed by individual sites
User support	Training, help desk	Help desk, webinars and training	NOAA/GML aerosol group provides support for data and instrument related aspects	Training, help desk	SOP and database teams
Licences applied	- CC BY 4.0 for L0-1-2-3 data, legacy L2 data, metadata - AGPL 3.0 (software) - CC0 (ACTRIS vocabulary)	- CC BY 4.0	- CC BY 4.0 (WDCA) - CC0 1.0 (NOAA/GML)	- mostly no licence - WDCA and WDCRG use CC BY 4.0.	AGPL-3.0-or-later (codes)
Competitive access to other services (e.g., via physical / remote / hybrid access)					
Centralised access point	Unique entry point for users, centralised management process to all	Centralized management process for access to all ARM	Access management is managed by site operators (NOAA/GML for		

RI/ Network / Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
	ACTRIS facilities	facilities	NOAA-operated observatories), partners for their observatories)		
Management system	- a. Data services: ACTRIS data portal (virtual access) - b. Other services: Online Platform for managing user Access to ACTRIS ServiceS (PASS)	- a. Operational management using variety of tools developed by the ARM infrastructure staff - b. User management system - c. Metadata management - d. Data quality management - e. Platform to access data via data discovery, JupyterHub workbench	- a. Data services: Data and metadata quality management using NOAA-developed software - b. Other services: managed directly by GML staff for baseline sites	- No unified management system apart from overlap with ACTRIS and NFAN	- a. Data and metadata quality management using ASCENT-developed tools - b. Other services: n/a
Access support tools	Helpdesk, User forum	Helpdesk, real-time user feedback, connecting experts (instrument mentors, subject matter experts)	NOAA aerosol group - connecting experts (instrument and subject matter)		
Publication of calls	ACTRIS website, social media, newsletters, mailing lists, announcements at scientific events, etc.	ARM website, social media, newsletters, mailing lists, announcements on professional society websites, etc.	n/a	informal	n/a
Call format and duration	Varying, depending on available funding: - annual /biannual /triannual calls	Varying, depending on service requested and scale of request:	n/a	informal	n/a

RI/ Network / Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
	- thematic calls - in case of private sector access or fast track (crisis-driven), requests are possible continuously independent of the calls - In case of deadlines, calls are open for about 2 months	- annual calls - open calls - calls coordinated with another DOE facility - Services are typically not approved for more than a year at a time but the length varies significantly and can exceed a year			
Application	- Online user request via Platform for managing user access to ACTRIS ServiceS (PASS) - Application differs depending on type of service requested (research vs technological vs innovation vs training service) - Applications are possible if call is open	- Online user request through the ARM website - Campaign proposal form for access to field facilities - Request form for access to high-performance computing facilities	- Detailed cooperative project application form needed after validation of online cooperative project interest form through NOAA/GML's observatory group and cost recovery (just for access to NOAA-operated sites Barrow, Mauna Loa, American Samoa, Table Mountain) - Other NFAN observatories have their own access policy - South Pole and Summit have separate access policies (NSF controlled and provided by US air national guard)		n/a

RI/ Network / Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
Selection process and duration	- 3 steps: 1-eligibility check (SAMU, 2-feasibility check (access provider), 3-peer review - Duration of review and selection process is about 4-6 weeks	The process varies depending on the scale of the request: - Small-scale projects are reviewed by the ARM management team - Larger proposals go through a peer review process - The duration varies from about 1-2 months to approximately 8 months for the annual call for a full facility	- There is not really a selection process - if a group wanting access can come to agreement with NOAA/GML and meet cost-recovery requirements they get physical access to make the measurements they want to make. - Selection is just for access to NOAA-operated sites		n/a
Review panel	- Independent panel, in general 2-3 reviewers for each proposal, chosen ad hoc from reviewer pool	- The ARM management team reviews small-scale proposals - Intermediate proposals by an ad hoc panel - the largest scale (for a mobile facility or piloted aircraft) is reviewed by a rotating standing committee	- NOAA/GML observatory group and any potentially affected group already on-site (just for access to NOAA operated sites)	- at discretion of calibration centres	n/a
Evaluation and criteria	Done according to access modes: - Scientific excellence-driven (for research services), - Need-driven (for technical or	- The actual tracking of scoring and final decisions are handled by DOE, not by facility management - Proposals are evaluated for:	n/a	at discretion of calibration centres	n/a

RI/ Network / Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
	training services) - Market-driven (for innovation services) The criteria are well defined for each mode in the general evaluation guidelines	Scientific/technical merit, appropriateness (of the proposed method), Competency of personnel and adequacy of proposed resources, reasonableness of requested facility resources, relevance to DOE priorities			
Ranking and selection	- Depending on review score: A (excellent: A+, A, A-), B (good: B+, B, B-), C (average: C+, C, C-), D (poor), E (not eligible) - Selection depends on availability of funding: A and B proposals are generally accepted, C proposals are conditional, D and E proposals are rejected	- Excellent, Very Good, Good, Fair, Poor. - Selection by DOE is based on review score, alignment with DOE priorities, and logistical feasibility (including cost)	n/a	at discretion of calibration centres	n/a
Organisation of access and service provision	Directly organised between user and access provider	Directly organized between user and manager of the specific facility to be accessed	Directly organized with NOAA/GML observatory group and user (just for access to NOAA operated sites)		Directly organized between user and ASCENT PI and site PI
Type of user support	logistical, administrative, scientific, technical support,	Logistical, adminstrative, scientific, technical support,	logistical, administrative, technical support (just for NOAA		logistical, administrative, scientific, technical support

RI/ Network / Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
	training	training	operated sites)		
Access duration	Varies, one or several days or weeks, typically on the order of 1-2 weeks, in case of remote/hybrid access several weeks or months are possible	Varies with the duration of the activity	varies with activity		varies with activity
Access reporting documents	Confirmation of access document, service report (other: see user duties)	See "User duties"	Cooperative agreement with NOAA/GML observatories group (just for access to NOAA operated sites)		To be determined
User duties	- Acknowledge-ment statement - User feedback questionnaire - Scientific access report - Provision of data - Publication of results - Acknowledge-ments of contributors (infrastructure / facility + staff)	- Sign-off on ARM policies - Abstract describing activity - Submission of data products - Final report - Data and final report due within six months of the closing of the campaign			To be determined
Access monitoring tools	- KPIs, statistics, quantitative and qualitative access metrics tracked and provided	- Project management system based on the commercial software, ServiceNow, to track the review and implementation of projects and access to ARM facilities.			To be determined
Other	- Guidelines for	- Guidelines for	- Cooperative		

Modality Type \ RI/Network	ACTRIS	ARM	NFAN	GAW	ASCENT
documents used in access process	applicants - User statement of compliance (both linked to PASS) - General evaluation guidelines for reviewers - Terms of reference for reviewers - Users terms of reference (at facility)	applicants and awardees are provided: - on the ARM website (arm.gov) - Through the "Field Campaign Guidelines" document - Through safety documentation provided by facility managers provided to users before accessing a facility	agreement with NOAA/GML observatory group		
Financial and other aspects related to access					
User fees	- Possible, but waived for users when specific funding is available (e.g., via projects where facilities are reimbursed, based on calculated facility-dependent access costs), data and publications are mandatory, except for private sector users - Travel costs may be partially supported in case of EU TNA projects - Data access is free	- Users are responsible for their effort and travel, and usually for shipping expenses. - ARM pays for operational costs including facility modifications and staff time - so long as user data are to be made publicly available within six months of the end of the activity. - If that is not the case, then the activity is considered to be proprietary and the user is responsible for the full cost	- Cost-recovery fees applied to users - Users are responsible for their travel and effort and for paying cost-recovery fees		- Users are responsible for their effort and travel

RI/ Network Modality Type	ACTRIS	ARM	NFAN	GAW	ASCENT
		impact of the activity			
Financial mobility support to users	Partial or fully when specific funding is available (e.g., EU INFRA-SERV projects)	No funding is provided to users - but anyone may access ARM services for free if they provide collected data back to the facility for public distribution	No funding provided to user		No funding provided to user, but can write collaborative proposals with users for relevant funding opportunities
Unit of access	Varying, e.g., Days, users working day, staff working time	Calendar duration	Varying		Varying

The RIs and networks in EU and the US involve mostly observational (ground-based) facilities and the data and added value data products provided by these. Some furthermore provide access to other types of technical or mobile platforms (ACTRIS, ARM), or aerial facilities (ARM, partly NOAA). The services include access to data, field campaigns, instrument access and training. ACTRIS and GAW also provide calibration services, and ARM capabilities provide access to modeling simulations and high-performance computing. For ACTRIS and ARM, these services are described in a distinct catalogue of services. Access to data and digital products is generally free and open (except to some specific data services requiring specific computing resources). Access to facilities and instruments requires additional resources and is, therefore, competitive and involves a competitive process, and also depends on the availability of funding.

The services are principally available to users worldwide, but are primarily used by European and US users, respectively. They comprise all user types, mostly coming from academia and research organisations, while users from private sector (industries) and public sector (spatial agencies, meteorological services, protection agencies) are sometimes involved but in considerably lower numbers.

Access to data is fully open and free for all and accessible centrally to data from the different measurement facilities. ACTRIS and ARM provide a specific data discovery and access portal. Data is available in different data levels depending on the level of data processing. The data level vocabulary differs slightly, with value added data products representing the highest level. ACTRIS, NFAN, and ASCENT also provide Near-Real-Time (NRT) data. Some data services require specific computing resources and require a request process (e.g. to modeling and computing services provided by ARM or specific analysis tools provided by ACTRIS) with a

minimum of user authentication. All RIs/networks adhere to FAIR data principles. The management and provision of access is handled by the individual RI/network concerned. The European data is all included within ACTRIS, with one central access for users, although the different types of data are managed by different data centre units. ARM, NOAA, GAW and ASCENT have their own process to manage the data collection, QA/QC, processing and user access. All use public and open licenses for data (mainly CC BY 4.0), ACTRIS and ASCENT use the general public license AGPL 3.0 for software and codes. All RIs/networks provide user support in form of training, helpdesk capacity, and/or specific webinars.

Access to other services made via physical, remote, or hybrid services are related to a different process compared to wide and free data access, as specific resources for the provision of access to these services are generally needed (e.g., staff time, consumables costs). In Europe, access is centralized through the central Service and Access management Unit (SAMU), connected to ACTRIS, and management via an online platform (PASS). In the US, it is also centralized for the ARM facilities using online forms, while for NFAN the access management is done by the facility operators. GAW has currently no unified management system (except for access to the European facilities that are part of ACTRIS. The access process to ASCENT is under development, being a network that has only been established very recently. Most information for access is, in each case, available via the RI/network's websites and user helpdesks or support groups are available to users.

ACTRIS and ARM have a communication strategy for the publication of the calls for access via their respective websites, social media, newsletters, mailing lists, and by other means, with varying call formats (annual, open calls or coordinated calls and depending on the service needs (and duration) and available funding to cover the costs for access provision. The specific application and review process slightly differs and is described as follows:

- For ACTRIS, and as long as funding is available, access is continuously open for private sector users as well as for urgent access requests in case of environmental emergencies; otherwise, the call duration is about 2 months. The application process is made online via the "PASS" platform that also allows the management of the entire review and selection process by SAMU. The requests are reviewed in several steps and involves a feasibility validation by the facility operator and an independent peer-review process, with a duration of 4-6 weeks for the overall review process. The evaluation criteria depend on the type of service requested and are well defined, the selection depends on the final score result. The access to the facility, once accepted, is directly organized between the user and the access provider and includes logistical, administrative, scientific and technical support as well as training where needed. The access duration can vary between one or several days up to several weeks (or months in case of remote/hybrid access). Post-access requirements include a confirmation of access document, a user statement, acceptance of facilities' terms of use, a scientific access report, a feedback questionnaire, and the provision of data and publication of results, with latter acknowledging the support of the Infrastructure / facility and staff involved. SAMU monitors the access activity and provides statistics, using key performance indicators (KPI) based on defined quantitate and qualitative access metrics. User access depends on the availability of funding for covering the variable fees (while operational costs are covered by the

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facilities), user fees are possible. The access costs required the definition of a unit of access which can vary as a function of facility and/or service type. Financial support to cover travel and subsistence costs of the users may be requested and can be covered when specific funding is available, e.g., through European infrastructure funding programmes.

- ARM has both frequent and open calls and the lead time to make access requests depends on the size of the experimental campaign (i.e., the costs incurred by the facility, as access costs are not recovered by the users and access to ARM facilities is free-of-charge provided that data collected during the campaign is made publicly available). Accordingly, the review process is more complex with increasing costs to the facility and duration of the review process. E.g., small campaigns (facility costs up to 25 k$) are reviewed monthly by an internal board and campaigns can start as soon as 30 days after approval, whereas campaigns with facility costs up to 100 k$ and 300 k$ are reviewed quarterly by ad hoc peers or semi-annually by ad hoc peers/ARM science board, and can start 60 or 90 days, respectively, after approval. Annual calls are published for use of the mobile facilities and aerial assets. These proposals receive an external peer review. All ARM campaigns are initiated through online user requests forms that are available via the ARM website. The access to the facility, once accepted, is directly organized between the user and the facility manager, and includes logistical, administrative, scientific and technical support as well as training where needed. The access duration is variable depending on the activity. Post-access user duties comprise sign-off on ARM policies, the submission of an abstract and, for larger campaigns, a final scientific report, and the submission of data and data products within six months of the closing of the campaign. The review and implementation of the ARM facility projects is monitored using a commercial software (ServiceNow). ARM covers the facilities' operational costs including facility modifications and staff time, proprietary research must fully be covered by the user. No funding is provided for user travel. Instrument shipment costs are usually the responsibility of the user but ARM may cover costs in situations where shipment by the user would be overly complex (esp. for international deployments).

- For NFAN (specifically for the NOAA-operated sites within NFAN) user requests, an online interest form is needed to initiate the cooperative research agreement process. It is evaluated for general feasibility and project appropriateness by the NOAA Global Monitoring Laboratory (GML). Once the initial review is approved, a comprehensive cooperative application form must be submitted and is reviewed by GML staff to determine the cost recovery fees (staff time needs etc.). After consensus is reached, a cooperative agreement will be established. International users requesting access to NOAA facilities furthermore must submit a foreign visitor request for prior approval. The access to the facility, once accepted, is directly organized between the user and the NOAA/GML observatory group, and includes logistical, administrative, and technical support. The access duration is variable depending on the activity. User access is made on cost recovery basis where the users of the facility pay a fee to cover the cost of their use (staff time, space, power, consumables, etc.). Users are furthermore responsible for covering their own travel costs.

- For ASCENT, information about the application and review process will be provided at later stage, as

well as information about the access reporting and monitoring. The organization of the access is directly organized between the site manager and the user. The access duration is variable depending on the activity. Users are responsible for their effort and travel costs, but they may benefit from funding opportunities through collaborative proposals.

The documents used in the overall access process for ACTRIS, ARM, and NOAA NFAN and the links to them are listed in the reference section 7 of this document.

Conclusions and next steps

This document provides an overview of the current practices and modalities used by some of the key European and US RIs/networks to manage and organize the process of access of users to benefit from the services and data provided by the atmospheric research facilities. The collection of and exchange on these fundamental elements will serve as basis for a more in-depth analysis of the access practices to identify the commonalities and differences between the access schemes, which will be done in a next step. A possible alignment of the access practices will be explored, and necessary adjustments highlighted. The results will be reported in deliverable 5.1 (due in month 14) which will serve as basis for developing a future framework to enable joint international access initiatives.

Access glossary

Some of the key access vocabulary and definitions which are considered essential for understanding is listed the following (in alphabetical order):

Access: Access refers to the ability of a user to use the facilities, resources, and services offered by a research infrastructure.

Access mode: An access mode regulates the conditions for the selection of users and is based on the type of service requested. E.g., within ACTRIS, the following access modes apply: i) excellence-driven access is based on scientific excellence objectives, ii) need-driven aims to guarantee quality assurance and high instrument performance (technical needs) or to build capacity (training needs), iii) market-driven access refers to conditions of access requested by a private sector user.

Access provider: An access provider is the operator of a facility providing access of users to the services offered by this facility.

Competitive access: Competitive access refers to a process where the capacity for providing resources or services is limited and access of users is based on a selection procedure with defined selection criteria.

Cost recovery access: where users of a physical facility pay a fee that covers the cost of their use (space, power, technician time, etc.)

FAIR principles: Fair principles are guidelines aimed at making data Findable, Accessible, Interoperable, and Reusable. FAIR principles enhance the visibility, accessibility, and usability of research data by ensuring that it is easily discoverable, accessible, compatible with other data, and can be reused in different contexts. FAIR

principles promote effective data sharing and collaboration in the scientific community.

Free access: Free access refers to access that is available free-of-charge, not requiring any user fees or payment.

Hybrid access: Hybrid access combines multiple types of access resources and services, including virtual, physical and remote access. As hybrid access involves resources for which an infrastructure/facility/equipment/installation has limited capacity, a competitive selection of users similar to physical and remote access is required.

Open access: Open access refers to the practice of providing free, unrestricted access to research outputs, including articles, books, and datasets. Open access promotes greater dissemination of knowledge, enhances collaboration, and supports the principles of transparency and reproducibility in research.

Physical access: Physical access (PA) is "hands-on" access when users physically visit an infrastructure/facility/equipment/installation. The available services or resources are not unlimited, and a competitive, peer-reviewed process is required following a defined procedure with well-defined criteria and call conditions for the selection of users.

Remote access: Remote access (RA) is access to resources and services offered without users physically visiting the infrastructure/facility/equipment/installation. As for physical access, the services or resources are not unlimited, and a competitive, peer-reviewed process is required following a defined procedure with well-defined criteria and call conditions for the selection of users.

Research Infrastructure: A research infrastructure is a comprehensive system of facilities, resources, and services that supports scientific research and innovation across various disciplines. It includes physical facilities, equipment, computing centres and databases. Research infrastructures enable users to conduct high-quality studies and collaborations.

SAMU: The Service and Access Management Unit (SAMU) is an operational unit that is part of the ACTRIS Head Office facilitating the access of users to the ACTRIS services.

Service: A service refers to the various types of support, tools, and resources provided to users to facilitate their research activities. Services can comprise, for example, data services, research services, technological services, innovation services, training services, etc.

Topical Centre: A Topical Centre (TC) is a facility within ACTRIS that provides services and operation support for quality assurance (QA) and quality control (QC) of ACTRIS measurements and data (including training and knowledge transfer, calibration, QA/QC tools, and development of standard operation and evaluation procedures. Within ACTRIS, six TCs are set up to respond to the scientific and technical needs of ACTRIS, each with a particular focus on either remote sensing (from the ground) or in-situ (near-surface) measurements: Centre for Aerosol Remote Sensing (CARS), Centre for Aerosol In-Situ Measurements (CAIS), Centre for Cloud Remote Sensing (CCRES), Centre for Cloud In-Situ Measurements (CIS), Centre for Reactive Trace Gases Remote Sensing (CREGARS), and Centre for Reactive Trace Gases In-Situ Measurements (CIGAS).

Transnational access: Transnational access (TNA) refers to the provision of access to an infrastructure/facility/equipment/installation located in a different country than the one where the user is

based.

User: A user is a person, a team, or an institution making use of resources, services or data offered by an infrastructure/facility/equipment/installation.

Virtual access: Virtual access (VA) is free access to users provided by a facility or infrastructure through communication networks; an unlimited number of users can simultaneously use the available services or resources, and the users are not selected. Virtual access concerns, e.g., access to scientific data, digital tools and/or integrated online services.

Wide access: Wide access refers to the broad and unrestricted access of users to data, resources, or services.

References

ACTRIS Access Management Plan https://www.actris.eu/sites/default/files/inline-files/ACTRIS_ERIC_GA_approved_ACTRIS_Access_Management_Plan%20%281%29.pdf

ACTRIS Data Management Plan https://www.actris.eu/sites/default/files/inline-files/ACTRIS_ERIC_GA_approved_Data%20Management%20Plan.pdf

ACTRIS Data policy
https://www.actris.eu/sites/default/files/inline-files/ACTRIS_ERIC_GA_approved_ACTRIS_data_policy.pdf

ACTRIS Access and service policy
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ACTRIS User policy
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ARM DOI guidance
https://www.arm.gov/working-with-arm/acknowledging-arm/doi-guidance-for-datastreams

ARM Data guidelines
https://www.arm.gov/guidance/datause/generalguidelines

ARM Data sharing policy
https://www.arm.gov/guidance/datause/datasharing

ARM Field campaign guidelines
https://www.arm.gov/publications/programdocs/doe-sc-arm-14-032.pdf

ARM Guidelines for accessing data, sites, and field campaign services
https://www.arm.gov/working-with-arm/use-arm-facilities

ARM User registration policy
https://www.arm.gov/help/faqs

Laj, P., and Coauthors, 2024: Aerosol, Clouds and Trace Gases Research Infrastructure (ACTRIS): The European Research Infrastructure Supporting Atmospheric Science. *Bull. Amer. Meteor. Soc.,* **105**, E1098-E1136, https://doi.org/10.1175/BAMS-D-23-0064.1

NOAA GML Atmospheric baseline observatories cooperative project interest form
https://docs.google.com/forms/d/e/1FAIpQLSdHz1GG6AQAOpyYXTgHQKn73tbtRqa1AxDB5la_jcRLf3Tt8Q/viewform

NOAA GML Foreign national visitor request form
https://gml.noaa.gov/obop/documents/GMD_ForeignNationalRequest.pdf