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ITINERIS

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LIST OF RECURRING ACRONYMS

API	Application Programming Interface
ASIT	IT and Telecommunications Services Area
AWS	Automatic Weather Station
BAS	Library of the Scientific Area
CeTrA	Center for Trace Analysis
DAIS	Department of Environmental Sciences, Informatics and Statistics
DB	Database
DSMN	Department of Molecular Sciences and Nanosystems
ISP-CNR	Institute of Polar Sciences of the Italian National Research Council
LCS	Low-cost sensors
LMS	Laboratory Management System
MRG	Col Margherita Atmospheric Observatory
OPC	Optical Particle Counter
OU	Operating Unit
RD	Remote Desktop
RI	Research Infrastructure
RM	Remote Machine
SBA	Library System of the Atheneum
UNIVE	Ca' Foscari University of Venice
VM	Virtual Machine
VPN	Virtual Private Network
WP	Work Package

1. RATIONALE

This Deliverable (D4.10.3) provides a comprehensive update on the development and structural harmonisation of the CeTrA Research Infrastructure, as part of the activities foreseen in ITINERIS Work Package (WP) 4. It follows the trajectory outlined in the two previous deliverables, D4.10.1 and D4.10.2, which respectively addressed the initial planning phase and the early-to-intermediate stage of implementation.

Compared to D4.10.2, the current document confirms the near-final operational state of the infrastructure, with most of the planned scientific resources now acquired, installed, and integrated. Minor variations from the original roadmap are acknowledged, including a small number of cancelled, revised or newly introduced upgrades. The consolidation of instrumental, digital, and organisational components has enabled a high level of functionality across CeTrA's core domains: analytical laboratories, the Col Margherita high-altitude observatory, and IT infrastructure for remote access and data integration.

The structure of the report reflects this tripartite articulation. Section 2 presents the updated catalogue of experimental services, including their classification, associated instrumentation, and the types of expertise and access supported. Section 3 is dedicated to the integrated digital ecosystem, describing the current state and progressive implementation of the web access portal, the laboratory management system, and the institutional data repository. Section 4 focuses on the Col Margherita Atmospheric Observatory, outlining the status of infrastructure reconstruction, plans for instrumentation deployment, and the development of the data pipeline connecting the observatory to CeTrA's central systems.

While the project is still ongoing, and several implementation steps - such as the online launch of the new web portal and the full operational deployment of the renewed Col Margherita high altitude atmospheric observatory - are scheduled for completion in the coming months, this report already provides a first consolidated view of CeTrA's performance. Preliminary metrics are included where available, particularly in relation to system usage, user engagement, and the uptake of data and laboratory services. These indicators offer an initial perspective on the infrastructure's capacity to support environmental research and its alignment with the strategic objectives of ITINERIS.

2. CeTrA EXPERIMENTAL SERVICES

This section provides an updated overview of the CeTrA Research Infrastructure, with particular focus on the portfolio of experimental services and scientific equipment currently accessible to users. Building upon the framework outlined in the previous report (D4.10.2), the present update confirms the consolidation of the infrastructure's functional organisation and highlights key developments concerning instrumentation, service provision, and digital integration. Attention is given to the classification of services across thematic domains, the operational configuration of the laboratory system, and the progressive structuring of access and traceability mechanisms. These elements collectively support CeTrA's role within the ITINERIS network and underpin the infrastructure's strategic alignment with national and international research priorities in the environmental field.

2.1. IMPROVED SCIENTIFIC RESOURCES AT CeTrA

The strengthening of CeTrA's scientific infrastructure represents one of the core axes of Activity 4.10, pursued through a progressive implementation process initiated in deliverable D4.10.1, consolidated in D4.10.2, and now documented in its substantially final state through the present report.
The initial roadmap outlined in D4.10.1 identified critical gaps and needs across three main intervention areas:

- enhancement of analytical capabilities at CeTrA laboratories;
- empowerment and digitalization of the Col Margherita Observatory (MRG);
- reinforcement of IT and software infrastructure for integrated data handling and remote operability.

As of D4.10.2 (B10), a substantial portion of the planned acquisitions had already been finalized or were in advanced testing phases. In the present deliverable, with minimal variations, the implementation process is confirmed as complete. The vast majority of originally planned resources are acquired, installed, and operational. With respect to the first version of the development plan (see Deliverable 4.10.1, Table 1 and associated description), a limited number of originally planned upgrades were either cancelled, reconfigured, or consolidated during implementation. Notably:

- The digital upgrade of the clean room pressure and temperature control system was cancelled due to excessive administrative complexity and the need to prioritize more strategic interventions.
- The Low-Cost Multisensors Monitoring Station, originally designed to enhance mobile and citizen-science monitoring capacity, was removed from the acquisition plan in favour of more robust, interoperable solutions better aligned with the research goals of the Atmosphere research domain.
- The fibre optics installation at MRG, originally foreseen in the ITINERIS plan and rescheduled to summer 2024 (as noted in D4.10.2), has been further postponed. It was ultimately excluded from the ITINERIS funding stream due to the procedural complexity associated with infrastructural works, not assimilable as pure instrumentation. However, the intervention has not been cancelled: it has been transferred to other funding lines managed independently by CNR, with implementation planned during 2025. This deferral is not expected to significantly

impact the final operational deployment of the observatory. For further details on the activities at MRG, see Section 4 of the present Deliverable.

- Some elements originally listed as separate items - such as the network apparatus for equipment connectivity and backup systems - were not eliminated, but rather consolidated into unified acquisition procedures under the broader server and digital infrastructure development strategy, to ensure administrative coherence and resource optimization.
- Additional technical adjustments were made across various components, including reallocation of licenses, upgrades to newer software versions, and refinements in configuration to match evolving system requirements.

Importantly, the reallocation of resources and adjustment of the procurement schedule generated cost savings, which were strategically reinvested in the acquisition of additional high-relevance instrumentation. These acquisitions, not originally foreseen in the ITINERIS plan, directly enhance CeTrA's capability in the atmospheric domain. Specifically, the new instruments include a high-flow cascade impactor, a low-volume sequential aerosol sampler, a high-precision microbalance, and a Scanning Mobility Particle Sizer (SMPS) - all of which contribute to expanding the infrastructure's analytical throughput and specialization.
All procedures foreseen in the implementation plan - as revised and finalized over the course of the project - have been successfully completed. Table 1 reports the updated list of encoded instruments acquired for CeTrA as part of ITINERIS, for direct comparison with Table 1 from Deliverable 4.10.1. The complete updated list of instrumentation available at CeTrA, including pre-existing resources (some of which were improved thanks to ITINETIS, namely in terms of software resources), new instrumentation acquired through ITINERIS and also external instrumentation that has been incorporated in CeTrA (namely, the Cavity Ring Spectroscopy system), is reported in the Annex I of the present document. Their description as reported in the Annex is also part of the information displayed in the new web portal of CeTrA (scheduled for release soon, see Section 3.1). All planned instrumentation has been procured, delivered, tested, and either already reported or scheduled for reporting. The equipment is fully operational, with the sole exception of instruments designated for the Col Margherita Observatory, which despite being technically operational will be installed at their final destination site MRG during 2025, once infrastructure and regulatory conditions are completed. For more information, refer to Section 4 of the present Deliverable.

Table 1 Updated list of encoded instruments acquired for CeTrA as part of ITINERIS.

Item #	Description	Status
1	Server infrastructure with adequate redundant storage and component dedicated to MRG + laptops and PCs + backup system	Purchase completed, under implementation
2	Network apparatus for equipment and systems connectivity	Purchase completed, operational
3	Scientific instrumentation update for connectivity	Re-distributed across other instrument-specific upgrades
4	Laboratory Management System (LMS) license	Purchase completed, operational
5	Data repository license	Purchase completed, operational
6	Booking and access system and remote connection system license	Booking/access system integrated in item #4
7	Backup system	Integrated in item #1
8	Optical Particle Counter	Purchase completed, operational
9	Aethalometer	Purchase completed, operational
10	Ion Chromatography with AS-AP thermostatic autosampler and Mass Spectrometer	Purchase completed, operational
11	High volume sequential sampler of atmospheric aerosols	Purchase completed, operational
12	Mercury analyzer	Purchase completed, operational
13	Automatic Weather Station (AWS) + meteorological tower + ancillary instrumentation	Purchase completed, operational
14	O_3, CO and NO_x online analyzers + power line + data transfer	Purchase completed, operational
15	Radio/Wi-Fi communication module + router + Switch Ethernet + Touchscreen, updated as an integrated industrial PC	Purchase completed, operational
16	Observatory-dedicated data transfer-storage platform (harmonized with CeTrA platform)	Integrated in items #1, 15
17	Software: LabView 2 licences + training + perpetual license extension	Purchase completed, operational
18	Vehicle for field monitoring campaigns ~~equipped with sensing station consisting of (PM, O_3, CO, NO_x, methane, meteo, solar panel, LoRA, battery, CPU)~~ + pc	Purchase completed, operational (sensors provided by external funding)
19	~~Infrastructure: upgrade and digitalization of temperature/pressure control system for clean room laboratories~~	Eliminated, reinvested
20	Instrument-specific big data elaboration package for UPLC-HRMS and dedicated PC	Purchase completed, operational
21	~~Database access license: (UPLC-) HRMS fragmentation spectra library~~	Eliminated due to inadequacy upon testing, reinvested
22	Origin Pro software (16 group licenses)	Purchase completed (reduced to 14 licenses), operational

Table 1 *Continuation.*

23	Chromeleon software (upgrade for ICS5000 IC and ALTIS MS instrumentation)	Purchase completed, operational
24	MassHunter software + autosampler (upgrade for GC-MS instrumentation)	Purchase completed, operational
25	F-search software (upgrade for PyGC-MS instrumentation)	Purchase completed, operational
26	Thermo Nicolet software (upgrade for FTIR instrumentation)	Purchase completed, operational
27	ICSD, PDF-4+ and PDF-4/organics database access license	Purchase completed, operational
28	Zeiss ZEN Core software (upgrade for (FE-SEM instrumentation)	Purchase completed, operational
29	HREM + JEMS software (upgrade for (S)TEM instrumentation)	Purchase completed, operational
30	~~Instrument: low-cost (multi)sensors monitoring station for air quality (PM-SO_2-NO_2-meteo-T-RH-noise), cloud storage and open data visualization platform~~	Eliminated, reinvested
34	NIR VIS Spectrometer + software+ laptop	New, purchase completed, operational
35	High-precision microbalance	New, purchase completed, operational
36	High-flow cascade impactor	New, purchase completed, operational
37	Low-volume aerosol sampler	New, purchase completed, operational
38	Scanning Mobility Particle Sizer (SMPS)	New, purchase completed, operational

2.2. HUMAN RESOURCES

Four units of fixed-term personnel were acquired for the project ITINERIS as a specific empowerment of the know-how and operativity of the technical offices:

- specialized RI manager, technologist D3 fixed term (30 months)
- specialized lab. technician D1 for MRG management/operativity, fixed term (30 months)
- N.2 specialized IT application technicians D1, fixed term (15 months)

As of the current reporting period, these positions are under evaluation for possible continuation in future operational frameworks, and there is a clear institutional intention to retain and consolidate these roles where feasible. This objective is, however, hindered by recent changes in national University infrastructure funding policies. Despite these limitations, CeTrA - thanks to its expanded capabilities and strategic role within ITINERIS - has received growing institutional recognition at Ca' Foscari University, which is actively working to ensure its long-term sustainability as a core research asset.
In addition to the recruitment of new personnel, permanent staff members of CeTrA have actively participated in inter-work package training activities organized within ITINERIS (Activity 3.6). The attendants were strategically selected from different internal units to promote the institutionalization of technical and procedural know-how across the infrastructure. The training courses focused on key thematic areas such as access management to research infrastructures, operation of virtual laboratories, FAIR data principles, and technical competence development. The participations are listed in the following.

- Activity 3.6 - Training current RIs staff and user communities; WP2 - Atmosphere; Title: Access to Research Infrastructures: process and modalities; 23-25 October 2024; Attendant: Alessandro Bonetto (alessandro.bonetto@Unive.it), Role: Technical-scientific coordinator for the supervision and maintenance of complex or large-scale equipment.
- Activity 3.6 - Training current RIs staff and user communities; WP8 - Virtual Research Environments and Cross-disciplinary Activities; Title: VRE operating mode – basic; 09-12 December 2024; Attendant: Marco Gavagnin (marco.gavagning@Unive.it), Role: IT Technician / Applications Division / New Software Deployment Management.
- Activity 3.6 - Training current RIs staff and user communities; WP2 - Atmosphere; Title/1: FAIR Awareness, 27-29 November 2024; Title/2: FAIR Assessment via FAIR Implementation Profiles, 10-20-23-29-30 January 2025; Attendant: Linda Spinazzè (linda.spinazze@Unive.it), Role: SBA representative for the Ca' Foscari University Data Repository.
- Activity 3.6 - Training current RIs staff and user communities; WP8 - Virtual Research Environments and Cross-disciplinary Activities; Title: Safety in the field work related to Ris (towers climbing and hiking principles); 4-7 March 2025; Attendant: Matteo Feltracco (matteo.feltracco@Unive.it), Role: Researcher, chemical characterization of particulate matter (PM), member of the Col Margherita Observatory management team.
- Activity 3.8 - Training object development for all target categories, including future generations of Earth stewards; WP3 - ITINERIS Training Programme; Title: Podcast

and video for science communication; 31 March – 4 April 2025; Attendant: Warren R.L. Cairns (warrenraymondlee.cairns@cnr.it), Role: Researcher, mercury atmospheric chemistry, Col Margherita Observatory management groups, CNR-ISP Communication group.

2.3. CATALOGUE OF EXPERIMENTAL SERVICES

In continuity with the framework introduced in the deliverable D4.10.2, the catalogue of experimental services developed by CeTrA has maintained its original structure and content, with only minor revisions and refinements introduced during the current reporting period. These changes involved technical specifications and detailed descriptions of selected services, without altering their scientific scope or functional framework. The updated version of the catalogue has been formally approved, both in terms of its structural organization and individual service entries and reflects the instrumental upgrades and workflow enhancements carried out under the ITINERIS project. The updated list of services is reported in the Annex II at the end of the present document.
The catalogue has not yet been made publicly available, as the updated version of the CeTrA internal portal is still under development and not yet published online (see Section 3.1), but this task is foreseen for completion not later than May 2025.
In the meantime, in March 2025, a first subset of services was communicated to the WP3 – Access – of ITINERIS to start the integration within the new ITINERIS HUB portal. This initial package includes services related to the Area of environmental analytical chemistry (EAC-01 to EAC-12), selected for their alignment with cross-infrastructure access priorities and their potential for broader interoperability. Pending interactions and feedback with WP3, and prior to the online release of the new CeTrA portal, to ensure maximum harmonisation between the two portals in the management of access to scientific services, the internal CeTrA team will assess further integrations of the list of services that can be migrated to the ITINERIS Hub.
Further minor updates are expected before the end of the project, particularly concerning some of the newly acquired instruments for which the service delivery framework is still being refined. A representative example are the OPC, Aethalometer, Mercury analyser and SMPS, which are currently part of the instrumentation assigned to MRG, but could also define independent services. The options under consideration include defining a new, dedicated service, or integrating the instrument within the scope of existing service definitions, depending on technical and operational compatibility.

2.4. ACCESS

During the current reporting period, the access policy framework previously outlined (Deliverable 4.10.2) has been consolidated and operationalized. The classification of access types, the definition of access procedures, and the collaborative management of access rights across institutions - particularly between CNR and Ca' Foscari University - have been confirmed as structural pillars of CeTrA's operational model. All the specifications concerning access modalities reported therein will be published in the new Web Portal of CeTrA currently under construction (see Section 3.1). Further cooperative work to improve the organizational structure of the accesses is going to be carried out by the end of the project thanks to the know-how acquired by the internal staff (see section 2.2) and in collaboration with the WP3 - Access - to guarantee harmonization with the ITINERIS Hub.

The main advancement since Deliverable 4.10.2 concerns the formalisation of procedures and regulatory instruments to support access governance. Dedicated documentation is being developed and uploaded to the Laboratory Management System (LMS) progressively, in parallel with the virtualisation of new infrastructural and instrumental resources. These documents serve as binding reference frameworks for users, ensuring alignment between physical access and digital traceability.
As practical examples (non-exhaustive), to be considered as follow-ups of the procedural documents mentioned in the Deliverable 4.10.2 (i.e. Clean Room Inorganics – Users Protocol [Annex 1] and OriginPro VM access procedure [Annex 2]), this deliverable includes the newly developed internal Regulation for the use of the vehicle dedicated to monitoring campaigns in the field – mobile laboratory (Annex 3), the Procedure for managing reagent storage via the LMS (Annex 4) and the Procedure for booking the Clean Room - INorganics via the LMS platform (Annex 5); which all laboratory users are required to follow. Specifically, the regulation for the use of the mobile laboratory was approved by departmental council decree on 16 September 2024 and includes 9 staff members currently authorised to drive the vehicle.

3. CeTrA Integrated Digital Platform

The present Section updates and expands upon the developments previously reported in Section 3 of D4.10.2. It not only documents the advancement of key activities, but - where applicable - also provides initial quantitative evidence on how the implemented systems are being used. In particular, the Web Access Portal (3.1) has progressed from a validated architectural proposal to an active implementation phase, with structured content, integration with institutional tools, and a plan for tracking user interactions. The Digital Laboratory Management System (3.2) confirms and refines the structure introduced in D4.10.2, offering updated data on user accounts, operational groups, and shared resources, thereby outlining how the platform is currently supporting internal workflows. The Data Repository (3.3) builds on the Dataverse framework previously established, reporting on the activation of DOI workflows, internal use of draft datasets and drafting of the FAIR implementation profile (FIP). These sections lay the groundwork for systematic monitoring of platform usage, both in the remaining phases of the ITINERIS project (through November 2025) and beyond, supporting long-term sustainability and continuous performance improvement of the infrastructure.

3.1. Web Access Portal

Following the drafting of deliverable D4.10.2, activities related to the CeTrA Web Access Portal have made significant progress from both a design and operational standpoint. In particular, the architectural scheme of the new portal - already outlined in the previous version of the document - has been formally approved and is now in the implementation phase. The general layout of the Web Portal and its main navigation structure are summarized in Figure 1, which provides a simplified schematic overview of the main sections and their respective submenus. This structure retains the same logic presented in Figure 2 of Deliverable D4.10.2, with only minor adjustments: the “Applications” section has been renamed “Services,” the “Case studies” section is now labelled “Publications,” and some hyperlinks have been updated. The proposed model, based on a modular and interoperable structure, has been recognised as consistent with the needs of the ITINERIS

project and with the criteria of traceability, transparency, and access that characterise research infrastructures.

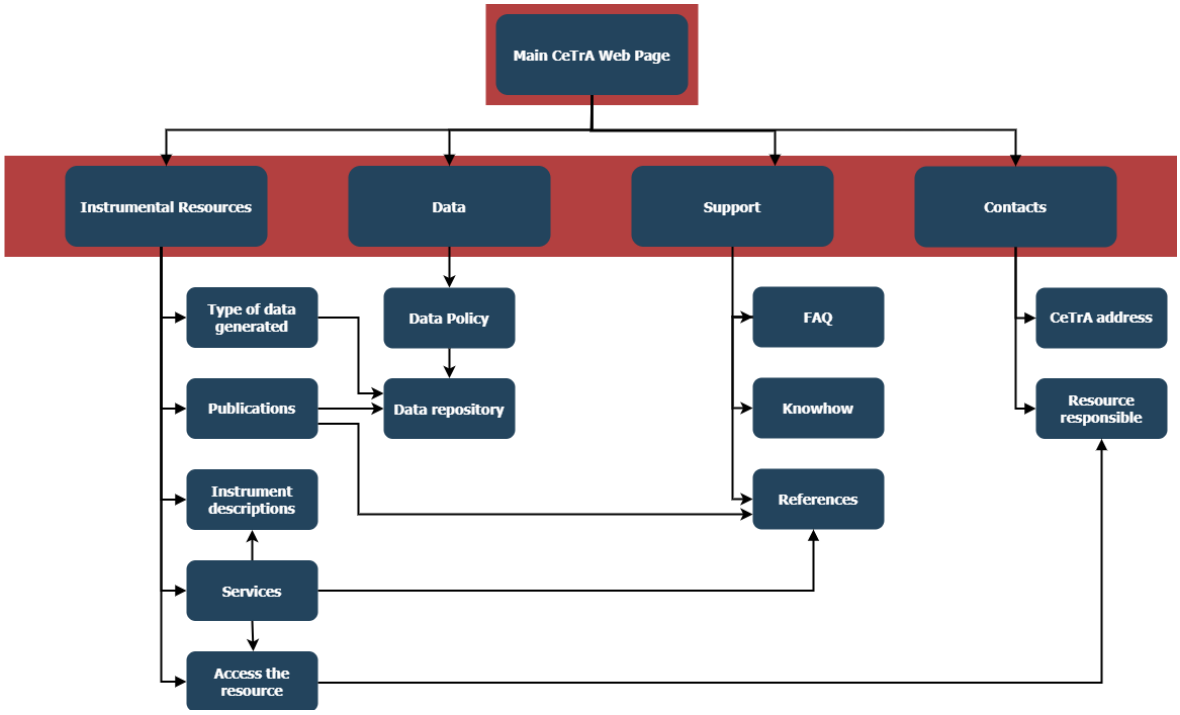

Figure 1 Overview of the updated website as the CeTrA HUB. Arrows represent hyperlinks between different site pages.

The creation of the new website is currently underway, with the direct involvement of the CeTrA unit in coordination with the University's ICT team and the scientific communication representatives. Development activities are following what was previously defined during the design phase: maintaining the communicative simplicity of the original site while systematically integrating information on the experimental services offered, access procedures, technical references, and the connection with digital tools (LMS, Data Repository) already operational within the infrastructure. The online publication of the new web access portal is foreseen for completion not later than May 2025.

Particular attention is being paid, during this implementation phase, to ensuring structural and informational consistency between the services presented on the portal and their corresponding metadata, which represent their digital counterpart within the existing document and management systems. The objective is to ensure functional symmetry between the web-based representation of services and their actual configuration in the underlying systems, providing a seamless user experience and content traceability that is technically robust and aligned with the FAIR principles.

Additional efforts are being made to ensure dynamic integration between the CeTrA portal and the newly created Data-Centric Environmental Studies Centre (DESC) of the Department of Environmental Sciences, Informatics and Statistics of Ca' Foscari University, which will serve as a unified access point for cross-cutting requests regarding services, support, and information. This connection will allow users to access contact forms and centralised support functions directly from the CeTrA site, ensuring consistency in the user experience and coordinated management of information flows.

In parallel, a technical strategy is under development to enable dynamic linking between datasets relevant to CeTrA - deposited in the University's institutional Data Repository - and the corresponding pages of CeTrA's web portal. The aim is to allow users to access the most updated dataset content directly from the CeTrA site through automatic synchronisation and indexing mechanisms. This development will further strengthen the integration between the portal's informational and operational components, positioning the Data Repository not only as an institutional archive but also as a dynamic source of scientific content.
Work is also ongoing to define the content structure and continuous update mechanisms of the portal, ensuring that it can serve as a dynamic and regularly updated access point for the target scientific community. Although the online version is not yet public, the implementation process is well advanced and represents one of CeTrA's strategic lines for enhancing its visibility and the effectiveness of the services offered.
To support future use of the portal, a monitoring plan has been defined to separately track two types of user interactions. On one hand, data will be collected on visits and engagement with the portal's secondary pages, to assess the level of information exploration. On the other hand, direct contacts submitted via the portal will be monitored, paying particular attention to the number, origin, and profile of users interested in services or instruments, as well as their distribution with respect to the contacts associated with each operational module.

3.2. Digital Laboratory Management System

This section presents an updated overview of the LMS, building upon the structural configuration outlined in D4.10.2. While the previous deliverable focused primarily on the definition of the system's architecture and its early-stage deployment, the current section provides a more detailed and data-driven account of its operational use. It includes quantitative information on active users, group composition, resource categories, and the internal distribution of responsibilities between institutional partners. The updates highlight how the platform is now routinely adopted for coordinating access to laboratories, instrumentation, storage units and analytical samples, in compliance with the plan outlined in the Deliverable 4.10.2. It also outlines the emerging patterns of usage across different functional modules and prepares the ground for future monitoring of laboratory performance and resource traceability within CeTrA. The following sections describe the usage status of individual modules of the LMS.

Users

The registration and access procedures for the LMS platform (eLabJournal) have been previously detailed in Deliverable D4.10.2. In brief, all users must hold or obtain a UNIVE institutional account, which serves as the access key to the platform. Once registered, access rights are granted by the System Administrator based on role-specific permissions within the organizational structure. The LMS allows differentiated access levels depending on the user's affiliation (DAIS, DSMN, ISP-CNR or external) and assigned responsibilities, ensuring secure and role-based use of all modules.
Currently, the platform includes 66 active accounts: 49 affiliated with UniVe and 17 with ISP-CNR. Additionally, 5 accounts that had been active during the past year have since been deactivated following the conclusion of their users' collaboration with the infrastructure. This turnover reflects the normal dynamics of a user community, with the arrival of new collaborators and the deactivation of accounts no longer in use. These figures align with the overall trend in account activation since the platform's launch, as illustrated in the related

chart (Figure 2), showing the evolution of accounts spanning the three phases of beta-testing, implementation to the restricted team of key users and the final opening to all users.

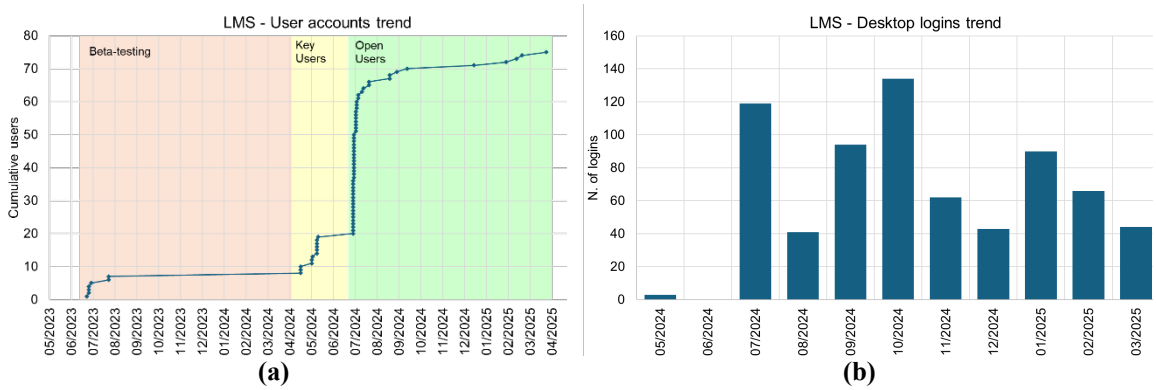

Figure 2 Trend of the number of user accounts activated in the LMS of CeTrA (a) and logins from desktop app (b).

Groups

Within the LMS, user activities are organized into "Groups," which represent either physical laboratories, research teams, or hybrid units such as clean rooms. Each Group is managed by a designated Administrator and is associated with specific Projects. Groups define access to equipment, storage units, protocols, and data, enabling modular and scalable management of CeTrA's distributed resources.

The platform currently includes 17 active groups divided into various functional categories. Of these, 11 are physical laboratories (identified by the "Laboratory -" prefix), which form the operational backbone of the infrastructure. There are also 2 system groups (Bio-ITech Admin and Ca' Foscari LMS Admins) for technical monitoring and management, 1 cross-cutting project group (Bioanalysis Research Line), 1 virtual laboratory (Compound Discoverer Software), 1 group dedicated to the atmospheric samples bank (Samples Bank), and 1 group for reagent storage (Storage Units Delta). The detailed list of activated Groups is reported in Table 2.

In total, these groups comprise 270 active memberships. However, this number does not reflect distinct users, as many users belong to multiple Groups. With 66 active accounts, each user is associated with an average of approximately 4 Groups. Most memberships are concentrated in the physical laboratories, which host 192 active members, while the remaining 78 are distributed among the other categories: system groups (6), project group (5), virtual laboratory (4), reagent storage (55), and sample bank (8).

As with the user accounts, the management of the groups - particularly the physical laboratories - reflects a mixed institutional composition. Of the 11 physical laboratories, 2 are managed by ISP-CNR and 9 by UNIVE. Management is defined as operational responsibility for the spaces and activities conducted within them, held by CNR-appointed personnel or the respective research leads at UNIVE. Beyond the physical labs, ISP-CNR is also responsible for managing the virtual lab and the atmospheric sample bank, underscoring its integrated role in CeTrA's overall operations.

Table 2 Groups currently activated as modules of CeTrA's digital LMS.

LMS Groups	Activated members	Managing Institution
Bio-ITech Admin	1	UniVe
Bioanalysis Research Line	5	UniVe
Ca' Foscari LMS admins	5	UniVe
Compound Discoverer Software	5	ISP-CNR
Laboratory - Clean Room INorganics	39	UniVe
Laboratory - Clean Room Organics	33	UniVe
Laboratory - Cold Lab (Delta R3)	5	UniVe
Laboratory - Delta R4	6	UniVe
Laboratory - Ecology	2	UniVe
Laboratory - Epsilon GC-MS / FTIR	27	ISP-CNR
Laboratory - Epsilon Preparation	34	ISP-CNR
Laboratory - LC & GC R1B	18	UniVe
Laboratory - LC R2	14	UniVe
Laboratory - LC/Bioanalytical preparation	12	UniVe
Laboratory Epsilon Facilities	3	UniVe
Samples bank atmosphere	8	ISP-CNR
Storage units Delta	55	UniVe

Units

The Units module compiles the list of physical and instrumental resources linked to the platform's groups. These units are categorized into three main types. The Equipment category (28 items) includes technical instruments that can be booked through the system. For each unit, users can upload technical documentation, usage protocols, and operational notes, as well as schedule maintenance or other support activities. The Laboratory category (6 items) comprises physical spaces - such as laboratories or operational rooms - that are also made bookable to coordinate logistics. The system allows users to associate access protocols and additional materials related to safety and physical space management, supporting the structured sharing and traceability of activities. The Storage category (12 items) includes environments and structures for storage, such as technical cabinets or preservation chambers. These are primarily used for inventory functions, enabling structured organization and updating of their contents. Notably, the mobile version of the app allows for real-time updates when contents are modified, facilitating day-to-day operational management. The detailed list of activated Units is reported in Table 3.

The units are unevenly distributed across groups: some labs host numerous resources, such as the Epsilon Preparation Laboratory (10 units), the Epsilon GC-MS / FTIR Laboratory (7), and the Clean Room Organics (6). Storage Units Delta also contains multiple storage resources. This structure enables centralized yet flexible management, integrating physical and digital assets into a single operational interface.
The system thus serves as a key tool for achieving high levels of organization and efficiency in the management of internal access and resources, while ensuring traceability of analytical activities - particularly the physical traceability of samples and materials.
It should be noted that, as of now, the instruments intended for MRG are not yet included in the system, as the station's physical infrastructure is still being finalized. Once operational, the station will be integrated into the system through the creation of a new dedicated group, with similar modules for instrument and space booking, particularly for planning monitoring campaigns.

Table 3 Units currently virtualized in CeTrA's digital LMS.

Unit	Type	Group	Unit	Type	Group
Compound Discoverer Software	Equipment	Compound Discoverer Software	Lyophilizer	Equipment	Laboratory - Epsilon Preparation
Clean Room INorganics Facility	Laboratory	Laboratory - Clean Room INorganics	Turbovap II	Equipment	Laboratory - Epsilon Preparation
Mercury analyser	Equipment	Laboratory - Clean Room INorganics	Mortar grinder Retsch RM200	Equipment	Laboratory - Epsilon Preparation
Clean Room Organics 19A "Clean"	Laboratory	Laboratory - Clean Room Organics	Glass cabinet Epsilon Preparation	Equipment	Laboratory - Epsilon Preparation
Clean Room Organics 19B "Dirty"	Laboratory	Laboratory - Clean Room Organics	Ultrasonic Bath Falc	Equipment	Laboratory - Epsilon Preparation
Wardrobe	Storage	Laboratory - Clean Room Organics	LC-Orbitrap 120	Equipment	Laboratory - LC & GC R1B
Room 2 Shelf	Storage	Laboratory - Clean Room Organics	ICS5000-MSQ	Equipment	Laboratory - LC & GC R1B
19B Left fume hood cabinet	Equipment	Laboratory - Clean Room Organics	GC MS/MS	Equipment	Laboratory - LC & GC R1B
19B Right fume hood cabinet	Equipment	Laboratory - Clean Room Organics	UHPLC/IC-ALTIS	Equipment	Laboratory - LC R2
Lab refrigerator ecology	Storage	Laboratory - Ecology	IC-ISQ	Equipment	Laboratory - LC R2
Reagent shelf ecology	Storage	Laboratory - Ecology	HPLC-API	Equipment	Laboratory - LC R2
Instrumental Lab - Epsilon	Laboratory	Laboratory - Epsilon GC-MS / FTIR	FLC-ALTIS	Equipment	Laboratory - LC R2
Pyrolysis GC-MS	Equipment	Laboratory - Epsilon GC-MS / FTIR	ICS-2100	Equipment	Laboratory - LC R2
Microbalance Sartorius CUBIS	Equipment	Laboratory - Epsilon GC-MS / FTIR	Autoclave	Equipment	Laboratory - LC/Bioanalytical preparation
MicroFTIR iN10	Equipment	Laboratory - Epsilon GC-MS / FTIR	Laminar flow bench	Equipment	Laboratory - LC/Bioanalytical preparation
RaptIR	Equipment	Laboratory - Epsilon GC-MS / FTIR	Freezer -80 °C	Storage	Laboratory Epsilon Facilities
GC-MS 1 Autosampler 150	Equipment	Laboratory - Epsilon GC-MS / FTIR	Dosson samples depot	Storage	Samples bank atmosphere
GC-MS 2 Cryotrap	Equipment	Laboratory - Epsilon GC-MS / FTIR	Cold room -1	Storage	Samples bank atmosphere
Accelerated Solvent Extractor	Equipment	Laboratory - Epsilon Preparation	Freezer -1 Gambaro	Storage	Samples bank atmosphere
Centrifugal Evaporator Genevac	Equipment	Laboratory - Epsilon Preparation	Organic solvents Delta basement	Storage	Storage units Delta
Laminar flow hood	Equipment	Laboratory - Epsilon Preparation	Acids storage Delta -1	Storage	Storage units Delta
Solvents Epsilon Preparation	Laboratory	Laboratory - Epsilon Preparation	Bases storage Delta -1	Storage	Storage units Delta
Acids Epsilon Preparation	Laboratory	Laboratory - Epsilon Preparation	Oxidizing storage Delta -1	Storage	Storage units Delta

Samples

The "Samples" section represents the current archive of the atmospheric sample bank within the infrastructure. Samples are indeed intended as sets and are divided into two main categories: "Chemicals" and "Atmosphere." The "Chemicals" category, which is the largest with 186 items, includes analytical standards, reagents, and reference materials used to support experimental activities. The remaining 64 samples fall under the "Atmosphere" category and consist of environmental sample sets, i.e., groups of samples collected or processed in a coordinated manner. Typically, each sample set corresponds to a specific field campaign. These sets include quartz filters of various formats, cascade Andersen filters, PM10 backup supports, PUF media, which are commonly used for collecting atmospheric particulate matter and volatile or semi-volatile organic compounds, in addition to liquid extracts from atmospheric aerosols. Table 4 summarises the various types of samples stored in the bank, including the number of sets and the total number of individual samples per type as of the date of this deliverable. As shown in the table, the bank currently includes nearly 3,500 samples related to the atmosphere compartment. Each sample set is accompanied by all metadata associated with the relevant sampling campaign, as illustrated by way of example on the right-hand side of the screen in Figure 3.

Table 4 Sample sets currently virtualized in CeTrA's digital LMS.

Sample type	N. Sample sets	N. Samples
Chemicals	186	>500
Samples bank atmosphere	62	3480
Liquid extracts	11	1301
Filters 150 mm quartz	1	182
Filters 47 mm quartz	6	1233
Filters Andersen cascade	19	449
PM10 - back-up Andersen	4	157
PUF	5	55
TSP	5	54
Other Samples	11	49

Within the classification outlined above, the sample bank includes aerosols from various sources, including Antarctica, the Arctic, the MRG station and other Alpine sites, the Gruvebadet station (Svalbard Islands), and urban sampling areas. In addition, the LMS manages samples related to other matrices, in particular ice, snow, and sediments, originating from different locations. An overview of the virtualised sample bank and its organisation is shown in the Figure 3.
The sample bank includes both materials currently being processed within ongoing projects involving the infrastructure and residues from past analytical and research activities. These older materials may be made available for new collaboration proposals. To this end, the infrastructure is evaluating the possibility of making the archive visible for storage purposes, to facilitate potential sharing with other operational units - especially considering the evolution of the ITINERIS network, which envisions shared use not only of instrumental resources but also of samples stored at various sites.

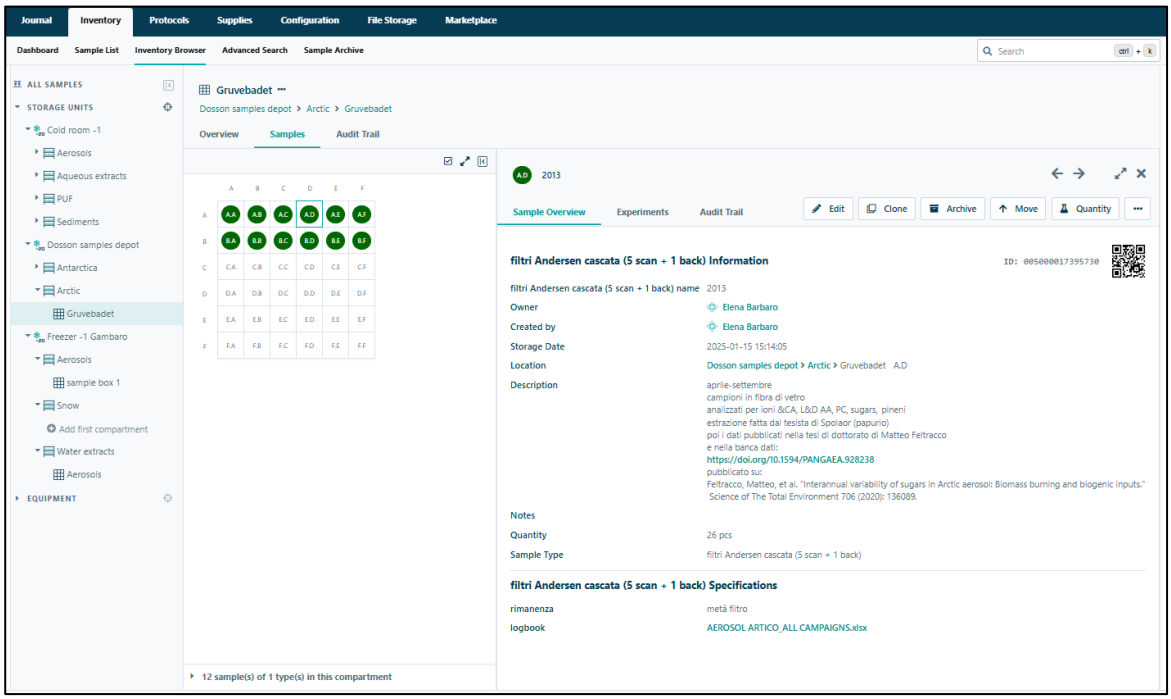

Figure 3 Representative snapshot of the Samples bank, with focus on atmosphere-related sets, virtualized in CeTrA's LMS.

As already mentioned in Section 2.4, for each new resource virtualised in the LMS, one or more usage procedures/protocols are currently being implemented. These are intended to facilitate the onboarding of new users to the system and to ensure the traceability and monitorability of samples and all activities carried out within the CeTrA research infrastructure. This includes the above-mentioned Procedure for managing reagent storage via the LMS (Annex 4) and the Procedure for booking the Clean Room - INorganics via the LMS platform (Annex 5). Annexes 4 and 5 are custom procedural documents currently developed by the CeTrA team to provide simplified guidance for users on specific functionalities of the LMS platform. Additional similar guides will be produced in the future as needed. Beyond these internal documents, all basic and advanced functionalities of the LMS are comprehensively described in the official user manual provided by the commercial LMS vendor, which is made available to all users directly within the platform.

3.3. Data Repository and Data Management policy

During the current reporting period, activities related to the CeTrA Data Repository have focused on consolidating the organizational architecture and refining procedural aspects concerning roles and authorizations. The system, based on the Dataverse platform and already structured into institutional sub-units, has maintained its functional framework and proven suitable for managing, publishing, and tracking datasets generated by experimental activities. The registration, authorization and access procedures for the Data Repository have been previously described in Deliverable D4.10.2. In summary, access to the Data Repository requires a UniVe institutional account and is regulated through a role-based permission system. Researchers may request the creation of a dedicated Dataverse via an online form, subject to approval by their department delegate. Once approved, they can manage datasets, assign user roles, and publish data upon metadata validation by the

institutional data curation team. Visualization and download are publicly available for published datasets, while access to unpublished or restricted data may require explicit authorization. Detailed operational guidelines for the use of the repository - including metadata standards, publication workflow, and license options - are available through the Open Science section of the Ca' Foscari University Library System (SBA) and are also accessible directly within the Data Repository platform interface.

Since the previous Deliverable, a major effort has been dedicated to the operational implementation of DOI registration. In the previous deliverable, the automatic reservation of DOIs at the draft dataset stage was still being finalized, and the institutional role in dataset creation had not been fully defined. In this phase, the flows for DOI assignment and publication have been clarified, ensuring alignment with metadata policies and the repository's hierarchical structure, thus enabling a more systematic and traceable application of persistent identifiers.

Currently, the number of users who have actively requested the creation of project-specific sub-dataverses or who have independently uploaded new datasets remains limited. However, this trend was anticipated, given that the systemic adoption of a research data repository is inherently a long-term process. It is nonetheless noteworthy that several users have begun to engage with the system by establishing dedicated sub-dataverses. These are generally associated with research projects rather than individual laboratories. Many of these project sub-dataverses are being used to upload datasets in draft form, without immediate publication. This is made possible by the repository's ability to act also as an internal data sharing environment in its early stages, allowing for the deposit of project deliverables or pre-publication versions of research outputs. These datasets are often intended for internal exchange among collaborators and project partners, with formal publication planned at a later stage - for example, as supplementary data to scientific articles once those articles become publicly available. As a result, a significant volume of content is already being managed in draft mode, though not yet visible to the public. It should also be noted that not all the datasets currently deposited under CeTrA fall strictly within the thematic scope of WP4 "Atmosphere" of the ITINERIS project. Some, while hosted within CeTrA's structure, are primarily relevant to environmental research in a broader sense, or to related domains such as health and sustainability. Examples include the dataverses Integrated Systemic Detection of Pollutants in the Human Body (INSYDE-HU), Drug combinations for rewriting trajectories of renal pathologies in type II diabetes (DC-ren), Ecological Transition and Remotization of Work (TER), and Botany and Plant Ecology. These illustrate how CeTrA is also serving as a platform for interdisciplinary research data management. The possibility of progressively exposing such and other datasets within the ITINERIS portal is under evaluation at the OU UniVe-DAIS. This would be achieved through enhancements to the metadata tagging system in the UniVe Data Repository, enabling automatic recognition and classification of datasets as ITINERIS-relevant, even when not originally structured for that purpose. A the moment of the current deliverable, the data from the ITINERIS project, published on the UniVe data repository (datarepository.unive.it) , have been made accessible for harvesting via server-side API to ITINERIS HUB (hub.itineris.cnr.it). The latter automatically checks (once a day), collects and publishes the Header and DOI reference, generating a direct link to the datasets. This harvesting method prevents duplicate content and ensures continuous updates on any versioning of the published datasets.

From an interoperability standpoint, the design and implementation of the CeTrA Data Repository follows a modular logic that enables scalable integration of heterogeneous

datasets produced across the infrastructure. The repository is structured to ensure long-term preservation, traceability, and accessibility of data through robust metadata management and role-based access policies. In line with the commitments of the ITINERIS project and the principles outlined in the national funding program (PNRR – M4C2 Investment 3.1), the CeTrA Data Repository and its associated digital resources are conceived to remain fully operational and maintained for a minimum duration of ten years following the end of the project. This long-term sustainability is ensured by institutional endorsement, dedicated administrative structures, and integration within the broader UNIVE digital ecosystem. The Data Repository will also maintain full interoperability with other research infrastructures through standard APIs and will support its active connection to the ITINERIS Hub, allowing CeTrA to contribute to, and benefit from, data exchange and harmonization processes within the ITINERIS framework.Meanwhile, the refinement of governance and procedural frameworks continues. Internal workflows for metadata validation, authorization management, and publication guidance have been further formalized. Interdepartmental meetings, coordinated by the Data Repository working group, remain an essential space for aligning the repository's institutional modules with the operational needs of the research communities involved.
Looking forward, the growth of the repository is expected to benefit from the synergies with the recently launched DESC at the DAIS Department, already mentioned in the Section 3.1. concerning the web portal of CeTrA. This initiative is designed to strengthen the integration of data, research, and digital infrastructures within the environmental sciences and will provide long-term support for CeTrA's data management strategy, also beyond the ITINERIS framework.

To support testing and structural validation of the platform, a set of demonstration datasets has already been uploaded and verified. The internal organization based on sub-dataverses has been preserved, with CeTrA structured as an operational node under the broader DAIS institutional hierarchy. This arrangement anticipates full integration with the ITINERIS Hub and consolidates CeTrA's role in institutional research data governance. In continuity with the principles outlined in the previous deliverable, CeTrA has further strengthened its commitment to FAIR data management. While the FAIR principles were already acknowledged as a reference framework for the organisation and accessibility of data generated by CeTrA resources, the current phase marks a concrete step forward: a preliminary draft of the FAIR Implementation Profile (FIP) specific to CeTrA has been prepared (Annex 6). This internal working document outlines the practices currently adopted in relation to metadata quality, data accessibility, licensing, and interoperability. In the coming months, CeTrA will collaborate with the relevant ITINERIS WP to refine this profile, with the goal of contributing to the updated mapping of FAIR adoption strategies across the involved research infrastructures, and to allow direct comparison with the reference standards and practices defined at the HUB level.

3.4. Scientific Activities

Although the UniVe-DAIS OU and the IR CeTrA are not formally responsible for scientific activities - neither vertical nor horizontal - within the ITINERIS project, beyond the harmonisation of the infrastructure within the ITINERIS network, research activities at CeTrA have continued to develop substantially. These developments have involved both topics closely related to the atmospheric domain and other areas directly or indirectly

connected to the broader field of environmental research. As an indication of the scientific output most directly supported by the infrastructural enhancements enabled by ITINERIS, the following list includes peer-reviewed publications (transmitted to the coordination of WP4) that explicitly acknowledge the project in their acknowledgements section:

- Feltracco, M. et al. The disinfection by-products are in the air: Aerosol measurements in the urban area of Venice. Atmos. Environ. 2024, 120224. https://doi.org/10.1016/j.atmosenv.2023.120224;
- Barbaro, E. et al. Chemical characterization of atmospheric aerosols at a high-altitude mountain site: a study of source apportionment. Atmos. Chem. Phys. 2024, 24, 2821. https://doi.org/10.5194/acp-24-2821-2024;
- Rosso, A. et al. Quantification and Chemical Characterization of Plastic Additives and Small Microplastics (<100 μm) in Highway Road Dust. Toxics 2023, 11, 936. https://doi.org/10.3390/toxics11110936;
- Gregoris, E. et al. Microplastics analysis: can we carry out a polymeric characterisation of atmospheric aerosol using direct inlet Py-GC/MS? J. Anal. Appl. Pyrolysis 2023, 105903. https://doi.org/10.1016/j.jaap.2023.105903;
- Feltracco, M. et al. Insights into size-segregated distribution of benzothiazoles in indoor aerosol from office environments. Environ. Sci.: Atmos. 2024, 4, 571. https://doi.org/10.1039/D4EA00031E;
- Crozzolin, L. et al. Stabilizing cubic γ-Ga_2O_3:Cr^{3+} spinel nanocrystals by size confinement into mesoporous silica nanoreactor channels. J. Mater. Chem. C 2024,12, 10929. https://doi.org/10.1039/D4TC01386G;
- Barbaro, E. et al. First evidence of benzothiazoles in arctic aerosols: Seasonal trend and sources attribution. Sci. Total Environ. 2024, 177722. https://doi.org/10.1016/j.scitotenv.2024.177722;
- Becce, D. et al. Wind Tunnel Evaluation of Plant Protection Products Drift Using an Integrated Chemical–Physical Approach. Atmosphere 2024, 15, 656. https://doi.org/10.3390/atmos15060656;
- Alterio, F. et al. Stress responses in blood donors: Oral fluid hormone dynamics and implications for donor support. Steroids 2025, 109604. https://doi.org/10.1016/j.steroids.2025.109604;
- Ulgelmo B. et al. Haloacetic Acids as Contaminants of Emerging Concern in Arctic Aerosol. ACS ES&T Air 2025, https://pubs.acs.org/doi/10.1021/acsestair.4c00318.

In addition, five pilot campaigns have been conducted in direct connection with the scientific activities of WP4 as part of ITINERIS:

- **Holtedalfonna Ice Core Drilling Campaign (Svalbard, March-April 2023)**
  Installation and test of one automatic weather station (AWS) and one O_3-CO_2-PM low-cost sensor (LCS) in harsh polar conditions on top of the Holtedalfonna glacier (1150 m) during the HDF2023 glaciological campaign. Meteorological observations were fundamental for supporting all the surface activities during the drilling operations. The AWS data was the first observational dataset produces specifically for testing CeTrA data repository. More details can be found in the project sheet - Annex 7.
- **Colle del Lys Field Campaign (Monte Rosa, October 2023)**
  Installation of AWS on top of the glacier for supporting the ice core drilling field operations (4150 m, Colle del Lys) and to test remote data transfer on mobile phone network. The campaign was as an explorative attempt to find a potential site for

permanent installation of an AWS in the Colle del Lys area. Even though the glaciological field campaign was a success, the AWS was able to transmit the meteorological data only on one occasion, because of intermittent mobile network. The data was however saved locally. More details can be found in the project sheet - Annex 8.

- **Colle Gnifetti Field Campaign (Monte Rosa, June 2024)**
  Installation of two AWS and two LCS for real-time aerosol monitoring at high altitude (4456 m, Colle Gnifetti) and valley level (1380 m, Alagna). The campaign aimed to acquire vertically resolved data on temperature and aerosol concentrations to study transport mechanisms and dilution processes in complex mountain environments. The campaign also served to field-test ITINERIS-acquired equipment under extreme conditions and to pilot data integration into the UniVe observatory-linked system database. More details can be found in the project sheet - Annex 9.
- **Sodankylä Field Campaign (Lapland-Finland, July–August 2024)**
  Conducted at the Finnish Meteorological Institute's Arctic Space Centre, the campaign focused on developing and validating new tools for isotopic characterization of atmospheric water vapour. Activities included $\delta^{18}O$ and δD analysis using Cavity Ring Down Spectroscopy, vertical sampling via balloons and drones, and assessment of AirCore sampling techniques. The campaign supported satellite calibration (e.g., Sentinel/ESA) and involved training and collaboration with FMI, UiB, and UniBern. More details can be found in the project sheet - Annex 10.
- **Valle d'Aosta Field Campaign (Western Alps, February 2025)**
  Organised in collaboration with ARPA Valle d'Aosta, CNR, University of Turin, and Ca' Foscari University, this campaign investigated the composition and vertical distribution of atmospheric aerosols across three altitudinal sites: Donnas (valley floor), Angelo Mosso Institute (2900 m), and Testa Grigia Observatory (3500 m). PM10 samplers and aethalometers were deployed to monitor optical and chemical aerosol properties. A long-term sampling programme was also launched at Plateau Rosa to assess seasonal trends and differentiate between local and long-range pollution sources, in connection with a Ca' Foscari PhD project. The completion of the campaign was published on ITINERIS website (https://itineris.cnr.it/news/cetra-2024-valle-daosta-campaign-successfully-completed/), X (https://x.com/ITINERIS_RI/status/1891818074942198056) and Bluesky (https://bsky.app/profile/itineris-ri.bsky.social/post/3lih76dbrnk2t).

Research activities at CeTrA continue through numerous national and international collaborations within ongoing or recently launched research projects. Among the partners involved, several institutions are actively collaborating with CeTrA and directly or indirectly benefiting from the services categorised under the area "Environmental Analytical Chemistry" (EAC-01 to EAC-13, as listed in Annex 2). The following list (non-exhaustive) includes such institutions and companies that have been identified as the first part of CeTrA's current user base and was shared with WP2 in March 2025 alongside the corresponding catalogue of services.

- A.I. Virtanen Institute for Molecular Sciences, University of Eastern Finland
- Agenzia Regionale per la Prevenzione e Protezione Ambientale – Veneto (ARPAV)
- Centre for Earth Observation Science, and Department of Environment and Geography, University of Manitoba
- Centre for Ice and Climate, Niels Bohr Institute, Copenhagen
- Competence Centre for Plant Health, Free University of Bozen-Bolzano

- Consejo Nacional de Investigaciones Científicas y Técnicas, Buenos Aires
- Department of Atmospheric Chemistry and Climate, Institute of Physical Chemistry Rocasolano, CSIC, Madrid
- Department of Biology, Ecology and Earth Sciences (DIBEST), University of Calabria
- Department of Chemical Sciences, University of Padova
- Department of Chemistry "Ugo Schiff", University of Florence
- Department of Chemistry, University of Bath
- Department of Comparative Biomedicine and Food Science, University of Padova
- Department of Earth Sciences, Montana State University, Bozeman
- Department of Ecologic and Biologic Science, University of Tuscia
- Department of Environmental Science, University of Milano-Bicocca
- Department of Geology, Cornell College
- Department of Geosciences, University of Padova
- Department of Neurosciences, University of Padova
- Department of Sciences, University of Roma Tre
- Direzione Prevenzione, Sicurezza Alimentare e Veterinaria Regione del Veneto
- ETH Zürich
- European Center for the Sustainable Impact of Nanotechnologies (ECSIN LAB), Mérieux NutriSciences Group
- École Polytechnique Fédérale de Lausanne (EPFL)
- Indian Institute of Tropical Meteorology, Pune
- Institute for Marine Biological Resources and Biotechnology (IRBIM-CNR)
- Institute of Atmospheric Pollution Research (IIA-CNR)
- Institute of Atmospheric Sciences and Climate (ISAC-CNR)
- Istituto per la Tecnologia delle Membrane (ITM-CNR)
- Laboratory for Observations and Measurements for the Environment and the Climate, ENEA
- Norwegian Polar Institute, Tromsø
- Quaternary Research Group, University of Innsbruck
- Società Estense Servizi Ambientali (S.E.S.A. S.p.A.)
- Thermo Fisher Scientific, Rodano
- U.S. Geological Survey, Geosciences and Environmental Change Science Center, Denver
- Universidade Federal do Tocantins, Brazil
- Water Research Institute (IRSA-CNR)

4. COL MARGHERITA ATMOSPHERIC OBSERVATORY

4.1. INTRODUCTION

As previously introduced in deliverables 4.10.1 and 4.10.2, the high-altitude Col Margherita Observatory (hereafter MRG) is a key CeTrA infrastructure for studying atmospheric pollutants and mesoscale-regional atmospheric circulation. It is located in a remote area of the Eastern Alps, northern Italy (46.37° N, 11.79° E, 2543 m). MRG has recently undergone extensive renovations, thanks to the collaboration between CeTrA-ITINERIS and CNR. In summary, while CNR was committed on the reconstruction of the observatory's physical structure (by replacing the old ISO 20' container with a new building), ITINERIS has:

- Significantly improved the IT infrastructure of the observatory,
- Upgraded the Automatic Weather Station (AWS),
- Enhanced MRG's atmospheric observation and analytical capabilities providing new gas and aerosol analysers and samplers.

As of the submission date of deliverable 4.10.3, while the construction of the new building has been completed (Figure 4b), works at MRG are still ongoing, specifically to install basic infrastructures such as the electrical system, the connection to the electrical grid and all the IT components (fibre-optic cable, networking devices, etc).

(a) **(b)**

Figure 4 The high-altitude Col Margherita Observatory. **(a)** The old observatory, built inside an ISO 20' container, and the automatic weather station as of late summer 2023 (picture from CeTrA website). **(b)** The new building under construction as of Nov. 2024. The old weather station is still visible in front of the construction site.

This section of the deliverable provides information on:

- the current status of construction work at MRG;
- the planned installation and configuration of the new ITINERIS instruments at MRG;
- the progress of testing new ITINERIS-instruments;
- a brief overview of the data pipeline from MRG to the CeTrA data centre and repository.

4.2. CURRENT STATUS OF CONSTRUCTION WORKS AT MRG

Filling the paperwork needed to start the construction work at MRG required roughly nine months (March - December 2024) but the green-light to delimitate the construction work area was already possible by the end of late summer 2024. Hence, the construction site was officially settled on 27 Aug on site by personnel from CeTrA (two ISP-CNR researchers, the ISP-CNR director and one UNIVE-DAIS technologist), personnel from construction companies (two engineers and the director of works), and the CNR RUP (*Responsabile Unico Procedimento*) connected remotely. As of now, the timeline to renew and make the observatory operative can be summarized as follows:

- Opening of construction site: 27 Aug. 2024
- Dismantling of the old observatory and start construction works of the new observatory: 15 Oct. 2024
- Completion of construction works (building): 10 Nov. 2024
- Expected installation of automatic weather station(s): Jun. 2025
- Expected installation of electrical system and IT infrastructure: Jul. - Aug. 2025

- Expected installation of data loggers, analysers (gasses and aerosol) and samplers (aerosol): Aug.-Sep. 2025
- Full operational capacity of the observatory expected by Oct. - Nov. 2025

The following pictures (Figure 5-7) report some important details and the key passages of the construction of the new building.

(a) **(b)**

Figure 5 Dismantling of the old observatory. **(a)** The old observatory, still enclosed by brick stone walls. **(b)** Complete removal of the stones and relocation of the ISO 20' container (visible on the right).

(a) **(b)**

Figure 6 Foundation and flooring setup of the new observatory. **(a)** Installation of the concrete flooring and the inspection pit for electrical grid and fiber-optic connections. **(b)** Trench excavation between the observatory and the cable car infrastructure for the installation of electrical and fiber-optic cables. A triple cable raceway was buried to house data and power lines separately, with an additional raceway reserved for maintenance or future installations.

(a) **(b)**

Figure 7 Final stages of the observatory construction. **(a)** Wooden framework and roof installation. Two of the three rooftop openings for atmospheric gas sampling are visible. A bent pipe for electrical and data raceway installation can be seen in the background. **(b)** Interior view at the completion of construction. One of the three inner sections of the roof openings is visible on the left.

4.3. PLANNED INSTALLATION AND CONFIGURATION OF ITINERIS INSTRUMENTATION AT MRG

The acquisition system of the MRG observatory has been described in detail in D4.10.2 (Section 3.4). In this section, we refer to "Instrument" as depicted in Figure 3-12 of D4.10.2, outlining the purpose of each instrument and its integration within the MRG instrumentation network. Following the schematic in D4.10.2, all instruments will interface with the "Industrial PC" for control, management and data retrieval. It is planned that, regardless of the communication interface and protocol used by each instrument, the data stream will be converted into MQTT packets, as further described in Section 4.4.

The instruments are categorized into three groups, corresponding to specific research areas within CeTrA:

A. Meteorological observations
B. Gas analysers
C. Aerosol measurements

A. Meteorological observations

The new observatory will be equipped with two Automatic Weather Stations (AWS). The first AWS will be installed in front of the observatory on a 5-meter pylon, while the second will be located a few hundred meters away, mounted on a custom 2-meter pole at the edge of the Col Margherita mountain ridge. Both AWS units are nearly identical, with the key difference being that the AWS on the ridge will be fully autonomous in terms of electrical power (Table 5).

Table 5 List of meteorological instruments and data logger of the AWS(s).

Instrument	Instrument model	Parameter
Thermohygrometer (active)	E+E e Thermistor ST-110-SS	Air temperature and relative humidity

Thermohygrometer (passive)	Hygrovue5-10	Air temperature and relative humidity
Wind-Cup anemometer	HD di Wind Monitor (alpine version)	Wind speed and direction
Wind-2D Ultrasonic anemometer	WINDSONIC4-1	Wind speed and direction
Barometer	BaroVUE10	Atmospheric pressure
IR Radiometer	SI-111-SS	Soil skin temperature
4-Components radiometer	NR01-05	Net radiation, solar radiation
Heated rain gauge	52202-10	Precipitation
Ultrasonic range sensor	SnowVue10-1	Snow height

Datalogger	**Acquisition rate**	**Communication**	**Protocol**
Campbell CR1000x (Internal 72 MB flash memory)	15 seconds	Toward Industrial PC via Ethernet, bridged over WiFi	MQTT (TCP-IP)

B. Gas analysers

Atmospheric trace gas concentrations will be measured using specialized analysers installed inside the observatory. These analysers will be connected to inlets on the building's rooftop via dedicated openings (see Figure 7A). The gas analysers will communicate directly with the Industrial PC through an Ethernet interface and are categorized into two sub-groups based on their physical installation. Each subgroup will be housed in a separate 19-inch rack (48 RU each), as detailed in Tables 6 and 7.

Table 6 Gas analysers in the *Reactive gas rack*.

Instrument	**Instrument model**	**Parameter**
NOx analyser	Horiba APNA-370	Mass concentration of NO and NO_2
CO analyser	Horiba APMA-370	Mass concentration of CO
Ozone analyser	Horiba APOA-370	Mass concentration of O_3

Logging	**Acquisition rate**	**Communication**	**Protocol**
Industrial PC and internal memory of the analyser	10 seconds	Ethernet cable	Custom raw TCP stream

Table 7 *Multipurpose rack* for gaseous Hg and shared with black carbon analyser. The same rack can be used to house other analysers for spot-campaign (32 RU available). Here only the gaseous Hg is reported.

Instrument	**Instrument model**	**Parameter**
Gaseous mercury analyser	Lumex RA-915AM	Mass concentration of Hg

Logging	Acquisition rate	Communication	Protocol
Industrial PC and internal memory of the analyser	10 seconds	Ethernet cable	Modbus/TCP

C. Aerosol

Aerosol measurements at MRG will be conducted using a continuous Optical Particle Counter (OPC), a black carbon analyser (aethalometer), and two high-volume particulate matter samplers. While the aethalometer and samplers will be installed inside the observatory, the OPC is planned to be mounted outside on the 5 m pylon used for the AWS. Both the OPC and aethalometer will continuously stream data to the Industrial PC, whereas the samplers, equipped with their own web server for remote control, will be accessible directly via VPN. Details are provided in Tables 8 to 10.

Table 8 Optical Particle Counter (OPC) installed on the 5 m meteorological pylon.

Instrument	Instrument model	Parameter
Multichannel optical particle counter	EDM 264 Grimm Xear Proc	Particle size distribution binned over 32 classes.

Logging	Acquisition rate	Communication	Protocol
Industrial PC and internal memory of the analyser	6 seconds	Ethernet cable	Custom raw TCP stream

Table 9 Aethalometer installed in the *Multipurpose rack*.

Instrument	Instrument model	Parameter
Aethalometer	AE33 Magee Scientific-Aerosol	Atmospheric black carbon concentration

Logging	Acquisition rate	Communication	Protocol
Industrial PC and internal memory of the analyser	10 seconds	RS-232 Serial interface	Custom ASCII serial stream

Table 10 Aerosol samplers.

Instrument	Instrument model
High Volume Aerosol Sampler	DHA-80 Digitel
Dual sequential aerosol sampler	Gemini Dadolab

Logging	Acquisition rate	Communication	Protocol
Log of instrumental status on internal memory	Selectable	Ethernet cable	HTTP/HTTPS

4.4. STATUS AND OVERVIEW OF THE DATA PIPELINE FROM MRG TO CETRA DATA CENTRE AND REPOSITORY

The OPC was one of the first ITINERIS instruments installed at the MRG observatory, becoming operational by the end of 2023. Atmospheric particulate matter data collected between 2023 and 2024 has been published in the CeTrA-UNIVE data repository (see Roman, 2025).
Regarding the connectivity of other MRG instruments, laboratory tests were conducted between late 2024 and early 2025. These tests included basic host-to-machine communication using Python scripts for TCP and serial protocols, as well as packet sniffing for the MQTT protocol. All tests were successful, confirming that every instrument can now communicate with the industrial PC, which will process and transmit the data to a remote database. The overall MRG data pipeline is summarized in Figure 8 and consists of four main steps reported in the following.

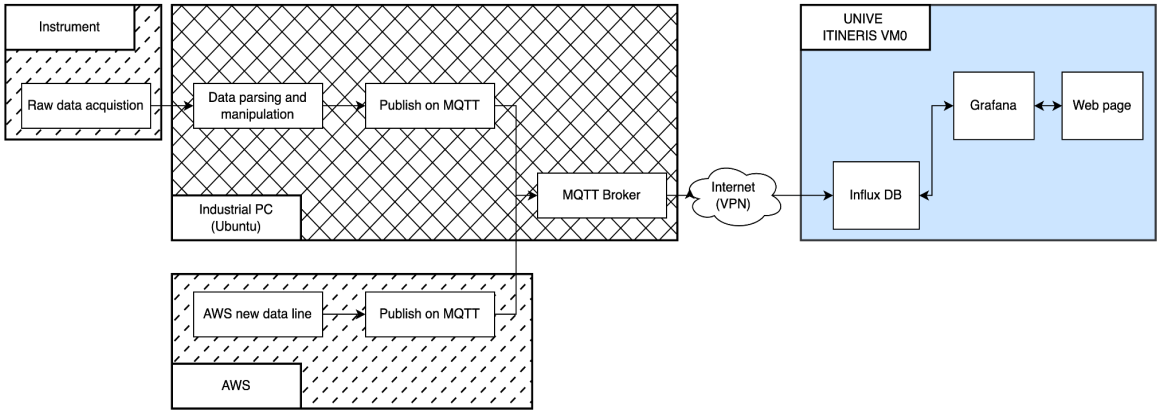

Figure 8 Schematic representation of the MRG data pipeline.

1. **Acquisition of data from Instruments** (excluding AWS). This step consists of two sub-steps:
    a. **Polling or Querying:** Instrumental data is retrieved using scheduled instructions (e.g., CRON + Python script).
    b. **Data Processing & Publishing:**
        i. The retrieved data is parsed, and a temporary data buffer is created, including a timestamp
        ii. The buffered data is then packed into an MQTT payload and published under an instrument-specific topic (e.g., "Gas/O3_analyzer" or "Aerosol/OPC").
2. **Acquisition of data from AWS**. The CR1000x datalogger has full MQTT capabilities, allowing data to be published directly onto the local network (e.g., under the topic CS/123456/xxxxx).
3. **MQTT Broker & Data Handling.**
    a. The MQTT broker manages messages from various MQTT publishers and ensures temporary data persistence (data persistence = TRUE). This guarantees that data is not lost in case of a connection failure between MRG and the remote virtual machine (UNIVE ITINERIS VM0).

4. **Database Integration & Web Visualization** *(Under Development)*.
   a. The MQTT broker is connected to an InfluxDB database via a third-party plugin (Telegraf) or by custom python scripts which will perform queries to the database (To Be Decided).
   b. At this stage, data is securely backed up on the ITINERIS VM and can be queried via the MRG website.
   c. Data display and download from the MRG website will be enabled through an integration of InfluxDB and Grafana. An example of the data visualization is shown in Figure 9.

Figure 9 Example of meteorological data display using Grafana (temporary instance on MRG website). The example was obtained with real data collected from MRG observatory with the old AWS.

It is important to note that the data pipeline does not include any data validation steps. Only basic averaging and aggregation functions are applied to the data. The CeTrA data curators will be responsible for validating and uploading the data to the CeTrA repository on an annual basis, following the same approach previously adopted for meteorological and aerosol observations[1,2].

[1] Eleonora Favaro; Matteo Feltracco; Elena Barbaro, 2025, "Meteorological Data from the Col Margherita High-Altitude Observatory (2023)", https://doi.org/10.71731/DATA_UNIVE/VS1VID, Datarepository UniVe, V1.

[2] Marco Roman, 2025, "Atmospheric Particulate Matter data from the Col Margherita High-Altitude Observatory (2023-2024)", https://doi.org/10.71731/DATA_UNIVE/J8DAJV, Datarepository UniVe, V1.

ANNEX 1 – INSTRUMENTATION AVAILABLE AT CETRA

Pre-existing instrumentation

Clean Laboratories

The facility includes two Clean Laboratories dedicated to the ultra-clean manipulation/preparation of samples for inorganic and organic analysis, respectively.
The inorganic clean laboratory is entirely made of plastic-coated materials designed for the low release of airborne particles, while the organic clean laboratory is entirely made of steel materials and components designed to minimize the release of organic substances and maximize the effectiveness of decontamination procedures. The inorganic clean laboratory consists of 4 rooms ISO 6 equipped with laminar flow benches (one is additionally equipped with an extractor hood and glove box for the preparation of atmospheric aerosols filters), 1 room ISO 5 equipped with laminar flow bench and 1 room ISO 4. The organic clean laboratory consists of 1 room ISO 7 for intermediate sample preparation, 2 rooms ISO 6 equipped with laminar flow benches, 1 room ISO 5 equipped with laminar flow bench and 1 room ISO 4.
All the clean rooms are at overpressure increasing as function of their class, equipped with ceiling installed HEPA filters for continuous filtering of the internal air and dedicated internal production systems of Milli-Q water (Elga LabWater).
Applications: contamination-free manipulation and processing of samples for trace and ultra-trace level analysis of inorganic or organic species.

Inductively coupled plasma - sector field mass spectrometer (ICP-SFMS)

The high-resolution mass spectrometer Element XR (Thermo Scientific) allows performing interference-free high-precision quantitative determination of elements and isotopic/elemental ratios in liquid samples down to the ultra-trace level.
Thanks to a combination of high-resolution mass filter and counting, analog and Faraday detection modes, the linear dynamic range of the detector extends from sub fg/g (ppq) to over 12 orders of magnitude in solution mode.
The instrument is equipped with a SC-4 autosampler (ESI) for continuous data acquisition and can be equipped with ARIS (ESI) or ARIDUS (Cetac) desolvating nebulizer systems for further reduction of solvent-based interferences such as oxides and hydrides.
Applications: quantitative multi-elemental and isotopic analysis at trace and ultra-trace levels in environmental samples, geological analysis, material sciences, conservation sciences, forensics, clinical samples, food and biological materials.

Inductively coupled plasma - quadrupole mass spectrometer (ICP-QMS)

The instrument iCAP-RQ (Thermo Scientific) is dedicated to the quantitative determination of trace elements and elemental ratios in liquid samples. The system is equipped with a Qcell technology assembly which can be run using He as collision gas and/or H2 as reaction gas to achieve reduction of spectral interferences. Additional accessories include an autosampler ASX-560 (Cetac) for high-throughput analysis, sample introduction kit for the analysis of HF mineralized samples and cone inserts for high sensitivity/robust/high matrix analysis. The instrument allows performing highly reproducible quantitative multi-elemental

determinations over 9 order of magnitude in concentration in a variety of sample matrices across the entire mass range.
Applications: quantitative multi-elemental analysis from major to low-trace levels in environmental samples, geological analysis, material sciences, conservation sciences, forensics, clinical samples, food and biological materials.

Inductively coupled plasma - optical emission spectrometer (ICP-OES)

The instrument iCAP 7400 (Thermo Scientific) is dedicated to the quantitative determination of major-to-trace elements and elemental ratios in liquid or (appropriately) dissolved samples. The system is equipped with high-efficiency light transmission system, radial or duo (radial + axial) plasma view configurations to suit a wide variety of sample types and elements of interest and a simultaneous wavelength acquisition system. Elemental concentrations can be determined with detection limits in the ppb or sub-ppb level with high instrumental precision and long-term signal stability even in complex matrices or at consistently high levels with minimized memory effects. Additional accessories include an autosampler ASX-560 (Cetac) for high-throughput analysis.
Applications: quantitative multi-elemental analysis from major to trace levels in environmental samples, geological analysis, material sciences, conservation sciences, forensics, clinical samples, food and biological materials.

Mercury analyser

The Mercur DUO plus (Analytik Jena) is an atomic absorption (AAS) and atomic fluorescence (AFS) spectrometer specifically designed and dedicated to the analysis of mercury in compliance with the standards EPA, EN and ISO. An integrated module with two gold collectors allows simple or cascade enrichment of mercury (according to EPA method 1631) to achieve determination limits from the low ppt to the ppq range with high method robustness, depending on the type of sample and configuration. Additional accessories include an autosampler AS-FD for high-throughput analysis.
Applications: determination of mercury in drinking and natural waters, wastewater, soil and sediments, rocks, ashes, biological fluids, food, beverages, quality control of materials.

Fourier-transform infrared spectroscopy (FT-IR) microscope

The instrument is an infrared microscope Nicolet iN10 (Thermo Scientific) integrating a high-resolution CCD optical camera and a FT-IR spectrometer and is designed to perform microanalysis with lateral resolution down to a 50-microns at room temperature or a few microns with liquid nitrogen cooling. The instrument is equipped with motorized stage, MicroTip ATR device for direct contact sampling and analysis of fine structures (down to 3 microns), motorized visible polarizer for visual inspection, MTC-A detector with spectral range 7800–650 cm-1 and the dedicated software package OMNIC Picta for spectral identification of pure compounds and mixtures. Acquisition can be performed in transmission, reflection, or ATR modes. Particles analysis can also be performed to extract species-specific distributions of morphological parameters (size, shape).
Applications: microspectroscopy, material identification, packaging and laminate, coating, active pharmaceutical ingredient mixture distribution mapping, identification of contaminants, microplastics identification and characterization.

High performance ion chromatograph - mass spectrometer (HPIC-MS)

The instrumentation consists of a high-performance ion chromatograph ICS-5000 Standard Bore and Microbore System (Dionex, Thermo Scientific) coupled to a single quadrupole mass spectrometer MSQ Plus (Thermo Scientific) and is dedicated to the quantitative determination of and water-soluble and ionic organic/inorganic compounds in liquid media. The chromatograph can operate up to 5000 psi to achieve high performance separation and is equipped with an eluent generator ICS 5000EG (Dionex, Thermo Scientific) configured with carbonate or hydroxide eluents for anions and metanesulfonic acid (MSA) for cations determination, suppressors ASRS 500 or CCES 300 (Thermo Scientific) to remove the salts form mobile phase before entering the MS source, and CD conductivity detector. The mass spectrometer is equipped with an electrospray source (ESI).
Applications: determination of inorganic ions and water-soluble and ionic organic compounds (e.g. sugars, organic acids) in water, sediment, soil, atmospheric aerosol, food and beverages, composite materials.

High performance liquid chromatograph - tandem mass spectrometer (HPLC-MS/MS)

The instrumentation consists of a 1100 series HPLC system (Agilent Technologies) coupled to an API 4000 triple quadrupole mass spectrometer (Applied Biosystems/MDS SCIEX) and is dedicated to the identification and quantitative determination of low abundance organic compounds in liquid media. The HPLC is equipped with a vacuum degasser, a binary HPLC pump system, an autosampler and a thermostatic column compartment. The mass spectrometer is equipped with a Turbo V source for flexible exchange between atmospheric pressure chemical ionization (APCI) source and Turbolon spray probe, capable of achieving maximized ionization efficiency and minimized chemical noise and instrumental drift.
Applications: identification and quantitative determination of low abundance organic compounds in clinical samples (e.g. pesticides/drug residues), forensic toxicology, environmental matrices, food and beverages, composite materials.

Ultra performance liquid chromatograph - high resolution mass spectrometer (UPLC-HRMS)

The instrument consists of an ultra-high performance liquid chromatograph (UPLC) Ultimate 3000 (Thermo Scientific) equipped with a nano pump and autosampler for high throughput, coupled to an LTQ Orbitrap XL mass spectrometer (Thermo Scientific). The ionization is obtained using a Nanospray Flex ion source (Thermo Scientific) equipped with a Picotip silica emitter. The MS/MS acquisition is downstream to a collision induced dissociation (CID) fragmentation and provides accurate mass measurement (<10 ppm) with high mass resolution (600,000) and sensitivity (low femtomole to high attomole). This instrument can carry out quantitative proteomics and metabolomics analyses over a wide dynamic range, including low-abundance peptides, and untargeted analysis of environmental and clinical samples with accurate identification of unexpected compounds.
Applications: proteomics, PTM characterization, metabolomics, untargeted analysis of compounds in complex liquid media.

Gas chromatograph - tandem mass spectrometer (GC-MS/MS)

The instrument consists of a GC Trace 1310 (Thermo Scientific) equipped with user-exchangeable instant connect injector and detector modules, coupled to a TSQ 9000 triple quadrupole MS/MS detection system. The ExtractraBrite ion source is fully removable without breaking the vacuum probe interlock (VPI) to achieve fast operationality and switching from electron ionization (EI) to chemical ionization (CI). For the highest level of sensitivity the Advanced Electron Ionization (AEI) source can be configured to reach instrument detection limits into the attogram range. The instrument is suited for quantitative targeted and untargeted analysis of volatile/semi-volatile compounds.
Applications: SPE samples, pesticides residuals, persistent organic pollutants in food and beverages, waters, clinical samples, forensic sciences.

Gas chromatograph – mass spectrometers (GC-MS)

Three GC-MS analysers are available at the Centre.
A single quadrupole 7890A-5975C GC-MS instrument (Agilent Technologies), equipped with a 150 vial positions autosampler (7693A, Agilent Technologies) and electron ionization source operated in positive mode. The instrument allows qualitative screening and quantitative determination of pesticides, lipids, persistent organic pollutants in environmental and biological matrices (aerosol, water, soil, sediment, biota).
A single quadrupole 7890A-5975C Cryo-GC-MS instrument (Agilent Technologies), equipped with a Unity2 (Markes International) thermal desorption and with a 15 vials autosampler (G4513A, Agilent Technologies). The instrument is suited for the analysis of volatile and semi-volatile organic compounds (VOCs and SVOCs) in environmental matrices (indoor and outdoor air quality), food, forensics, consumer and other application fields (flavours and fragrances).
A PyGC-MS instrument 6890-5973N (Agilent Technologies), equipped with a pyrolizer (CDS 5150). The instrument is suited for qualitative analysis of volatile (persistent organic pollutants, pesticides, etc.) and non-volatile compounds (paints, adhesives, plastics, synthetic fibres), in environmental, clinical, and forensic samples.
Applications: persistent organic pollutants in food and beverages, waters, clinical samples, forensic sciences, volatile species of interest in climate, environmental and food science.

Transmission electron microscope with scanning mode (S/TEM)

The instrument JEOL JEM-F200 is a 200 kV TEM with scanning capabilities (S/TEM) equipped with a range of imaging detectors including: bright-field (BF); high-angle annular dark-field (HAADF); secondary electrons (SE); back-scattered electrons (BSE). The electron source is a Cold Filed Emission Gun (CFEG) which provides:

- an electron beam energy spread ≤ 0.3 eV (FWHM) @ 200 kV;
- a brightness ≥ 8e8 A/cm2sr @ spot size = 0.7 nm;
- a probe current ≥ 2.5 nA @ spot size = 0.7 nm, in conjunction with the 4-lense illumination system.

The point resolution is ≤0.23 nm in conventional TEM mode and ≤0.16 nm in STEM mode, using the HAADF detector, with still the capability to tilt the sample up to angles ≥ 80°, which will allow the implementation of tomographic techniques in future.
The microscope is equipped with an energy dispersive X-ray spectrometry (EDS) detector with analytical resolution ≤ 133 eV @ 5.6 keV. The 100 mm2 active area assures a collection

angle ≥ 1 sr, which, also given the probe current values, allows fast acquisition of EDS spectra and X maps even at the high spatial resolution corresponding to small probe sizes. This instrument enables extended experiments for a wide variety of applications allowing morphological, structural, and chemical nanoscale investigations.
Applications: analysis of composition, morphology and size distributions in vacuum and VP mode; ceramics; metals; glass; aerosol particles; chemical (elemental) imaging.

Scanning electron microscope (SEM)

Field emission (FE) SEM Zeiss Σigma|VP equipped with a thermal field emission gun (Schottky emitter) source. The electron-optical column is a GEMINI design, and the instrument can work in variable-pressure (VP) mode, with pressures adjustable from 1 to 133 Pa, avoiding the need to coat non-conductive samples. The instrument is provided with a range of imaging detectors:

- conventional Everhart-Thornley detector for secondary electrons (SE), with high collection efficiency;
- 4-sector semiconductor detector for back-scattered electrons (BSE);
- high-resolution in lens detector for SE, which (together with the electron source and the column design) allows a nominal resolution down to 1.5 nm @ 15 kV.

The machine is also equipped with a Bruker Quantax 200, an energy dispersive X-ray spectrometry (EDS) system of the SDD type, with a 30 mm2 window which allows fast spectra and X maps acquisition; analytical resolution ≤127 eV @ 5.6 keV.
Applications: analysis of composition, morphology and size distributions in vacuum and VP mode; ceramics; metals; glass; aerosol, mineral and biological particles; chemical (elemental) imaging.

Atomic force microscope (AFM)

Dimension Icon (Bruker) is a tip-scanning AFM platform allowing nanoscale imaging. The analysis can be conducted in ambient and liquid environments. Depending on the requirements, three main modes with suitable probes are available: (i) contact mode, (ii) tapping mode and (iii) non-contact mode. In addition to the morphology of the samples, a wide variety of properties can be investigated. Nano-electrical properties of the materials with a spatial resolution of the order of 10 nm or less (depending on the AFM probe) can be investigated by means of conductive AFM (c-AFM) and Kelvin probe force microscopy (KPFM). The c-AFM allows to obtain topography and electrical conductivity maps of the samples by using a conductive tip. Nanomechanical analysis is also available (PeakForce-QNM®) by means of PeakForce Tapping® technology.
Applications: molecular engineering, surface chemistry, semiconductors and polymeric material science and cellular biology.

X-ray diffraction spectrometer (XRD)

The Empyrean Series 3 (Malvern Panalytical) is an X-ray platform for the structural analysis of powders, thin films, nanomaterials and solid materials in a single instrument. Standard wide angle X-ray scattering (WAXS) and ultra-small angle X-ray scattering (USAXS) modes are available for analysis in air and in liquid. The instrument is equipped with a point-like X-ray source, allowing to map samples with a spatial resolution of about 300 μm. In

addition, grazing-incidence GISAXS and GIWAXS geometries are also implemented for the analysis of films and nanostructures deposited/grown on different substrates.
Applications: characterization of crystalline materials, identification of fine-grained minerals, sample purity, textural measurements, thin films characterization.

Col Margherita Atmospheric Observatory

The high-altitude observatory of Col Margherita (MRG) is currently the only station in the Eastern Alps providing measurements of atmospheric pollutants and the main meteorological parameters. The station is located on the top of Col Margherita at 2543 m a.s.l. (46.36 ° N - 11.79 ° E) in the municipality of Falcade (Belluno), near the border between Veneto and Trentino Alto Adige, in the mountain scenery of the Belluno Dolomites (UNESCO World Heritage Site since 2009). The Col Margherita observatory is part of the GAW-WMO stations network as a "GAW Regional station" since December 2019.
The MRG station is equipped with the following technical systems and scientific instrumentation:
[this section will be updates as soon as the MRG station will be back operational]
Applications: air quality monitoring, meteorological monitoring, atmospheric pollutants, atmospheric aerosols.

New Instrumentation

Cavity Ring-Down Spectroscopy

The Cavity Ring-Down Spectroscopy (CRDS) L2140-i isotopic water analyzer provides high-precision measurements of $\delta^{18}O$, $\delta^{17}O$, and δD in water vapor. The instrument is equipped with autosampler (model A0325) and vaporizer (model A0211), enabling high precision measurements (<0.025‰ for $\delta^{18}O$) of the isotopic composition of water, although yielding good throughput (~20 samples per day). The volume of water required for a single sample analysis is small (~20 µl), although the minimum sample manageable by the autosampler is ~100 µl. The instrument runs in a wide range of humidity (specs. 1000 – 50000 ppm) and atmospheric pressure (40 to 133 kPa, absolute), therefore it can be natively used to measure the isotopic composition of atmospheric water vapor at sea level, on the ground, in high altitude mountains and in aircraft up to 6000m ASL.
Applications: stable water isotope analysis of freshwater, ice core, snow and water vapor. Paleoclimate (e.g. isotope thermometry), ecohydrology (e.g. quantification of evapotranspiration fluxes from soils and plants), hydrology (e.g. investigation of ground water recharge areas), forensics (e.g. analysis of water source region in food, prior separation), atmospheric physics (e.g. tracking air mass mixing).

Scanning Mobility Particle Sizer

The Scanning Mobility Particle Sizer (SMPS) 3938 spectrometer is a modular system for measuring particle size distributions in air. The system consists of an electrostatic classifier with a scanning mobility column (DMA) and a condensate particle counter (CPC). This allows the measurement of size distributions and numerical concentrations of particles from 1 nanometer to 1 micron in size with a size resolution of 64 channels per decade for a total of up to 167 channels (between 2.5 nm and 1 µm). The Aerosol Instrument Manager (AIM) software controls the operation of the SMPS 3938 spectrometer, allowing data to be

processed by number, size, mass, and volume, and data to be exported to other software applications.
The system is equipped with an atmospheric particulate sampling system.
Applications: atmospheric science; air quality monitoring; combustion research; nanoparticle characterization in environmental and engineered contexts; high-resolution measurement of submicron aerosol particle size distributions.

Ion chromatography – mass spectrometer (IC-MS)

Ion chromatography system ICS-6000 HPLC Dual Pump with AS-AP thermostatic autosampler coupled to ISQ-EC single quadrupole mass spectrometer (Thermo Scientific Dionex). Its Reagent-Free IC components, including RFIC-EG for automated eluent generation and self-regenerating suppression, offer enhanced convenience and efficiency. Using only deionized water, the system ensures precise eluent concentrations tailored to specific analytical requirements, contributing to superior accuracy for the detection and quantification of low-molecular-weight ions with limits of detection (LOD) in the single-digit-parts-per-billion (ppb) range. The system is dedicated to the targeted quantitative analysis of polar compounds in environmental matrices and is particularly well suited for the analysis of atmospheric aerosols collected in remote and alpine areas.
Applications: environmental water monitoring; analysis of inorganic anions (e.g., nitrate, nitrite, sulfate, chloride); detection of organic acids (e.g., formate, acetate, oxalate); trace determination of haloacetic acids in drinking water; characterization of ionic degradation products of pesticides; investigation of ionic species in atmospheric aerosols; analysis of industrial effluents and wastewater; source apportionment studies involving ionic tracers.

Vehicle for field monitoring campaigns

Vehicle configured and customized for use as a mobile laboratory unit (mobile environmental monitoring unit). The vehicle is a Ford Nuovo Custom (DFBF) Transit Van Trend 2.0 Ecoblue 136 HP A8, specifically selected and modified with a custom configuration to allow the transport and/or onboard installation of dedicated scientific instrumentation for environmental analysis. It is intended for potential deployment as a mobile laboratory (mobile unit for environmental monitoring). The van provides suitable volume, engine power, and all-wheel drive (4x4) capabilities to support the transport of materials and conduct environmental monitoring campaigns, including in remote or high-altitude areas.
Applications: transport of materials and execution of environmental monitoring campaigns.

Aethalometer

Aethalometer AE33 for online continuous measurement of airborne black carbon. The aerosol-laden air stream is drawn through a spot on a filter tape at a measured flow rate. The analysis of the black carbon is made following the two-spot technology: sensitive detectors measure the intensities of light transmitted through an un-exposed portion of the tape, acting as a reference; versus the collecting spot. The measured particles are divided by the inlet flow and the result is reported as concentration.
Additionally, the analysis is made at 7 optical wavelengths spanning the spectrum 370, 470, 520, 590, 660, 880 and 950 nm and with a time resolution to 1 second. The instrument is equipped with a touch screen controller, and it is remotely accessible.

Applications: real-time measurement of aerosol optical properties; quantification of aerosol climate direct effect via light absorption; monitoring of atmospheric black carbon concentrations; contribution to climate, air quality, and cryosphere impact assessments; spectral analysis of aerosol absorption to differentiate fossil fuel and biomass burning sources.

Optical Particle Counter

The optical particle counter (OPC) EDM 264 Eco pursues an automatic continuous analysis and integrates concentration reading and particle size distribution in 31 size classes between 0.25 and 35 µm, equidistant, with a simultaneous real-time determination of PM mass in 12 particle size fractions (inhalable, thoracic, and respirable fractions in accordance with EN 481; PTS, PM10, PM4, PM2.5, PM1, and PM coarse). The instrument is installed in a transportable outdoor cabinet. The spectrometer is completed with a GPS system; heated 50 cm probe with u-Sigma-2 input; T, P, and RH weather sensor; USB interface, Ethernet (TCP/IP); GRIMM 1179 software.
Applications: high-frequency measurement of atmospheric aerosol particle size distribution; estimation of aerosol climate impact; assessment of aerosol atmospheric lifetime; investigation of natural and anthropogenic aerosol sources; characterization of aerosol burden in mountain regions.

High-volume aerosol sampler

The High-volume aerosol sampler DHA-80 is a fully automatic systems to sample dust and aerosol particles for later assessment and analysis. The sampler operation range in standard execution is 100 to 1.000 liters per minute (6 to 60 m^3/h). The instrument has a magazine of 15 filters stretched in filter holders. They are automatically changed to the flow position at the pre-set time. The sampling can be programmed with starting time and duration but also for more complex applications using cycles for interrupted sampling or wind dependent sampling when the instrument is equipped with optional wind sensor. The field housing is suited for outdoor installation. It is easy to transport and because of a good sound insulation very quiet.
Applications: automatic collection of aerosol samples on quartz fiber filters, specifically designed for remote areas.

Low-volume aerosol sampler

The Gemini sequential sampler by DadoLab is a practical, portable and user-friendly aerosol sampler. It incorporates a multifunctional central unit (MPC) capable of managing sequential sampling across both single and dual channels. The sampler has a mass of approximately 35 kg, exclusive of the pump and the supporting stand. The Gemini in the dual-channel version can accommodate up to 42 white/exposed filters samples in total. The MPC unit is outfitted with contemporary communication interfaces, including USB, RFID, Bluetooth, and mobile network, thereby guaranteeing comprehensive data traceability. Additionally, the Gemini is designed with a forced internal air recirculation system, which assists in sustaining the ventilation tube and exposed samples at ambient room temperature.
Applications: automatic collection of aerosol samples on quartz fibre filters.

High-flow cascade impactor

The Model 131B High-Flow Cascade Impactor by TSI is designed for the sampling of low-concentration particles, such as in pristine environments, to collect a larger mass per stage compared to conventional other conventional impactors or to obtain samples in shorter sampling intervals. The impactor is available with 6 stages, covering an aerodynamic size range from 0.25 to 10 µm. Particles are deposited onto 75 mm substrates that can be analysed for mass, chemical analysis, or microscopy. The Model 131B is constructed from anodized aluminium to ensure lightness, durability, and nozzle dimensional stability. The main characteristics include: a sampling flow rate of 100 L/min, a sharp particle size cut-off characteristic, micro-orifice plates designed for low flow resistance and reduced particle bounce and re-entrainment, six impactor stages with nominal cut points ranging from 250 nm to 10 µm, in addition to a 90 mm final filter. The 75 mm impactor substrates are designed to deposit particles in four separate quadrants for easy substrate division. Additionally, the design of the instrument guarantees a low inter-stage losses.
Applications: atmospheric aerosol analysis for size distribution and composition in high mountain sites.

ANNEX 2 – CATALOGUE OF EXPERIMENTAL SERVICES

Area: environmental analytical chemistry (EAC)

Service EAC-01: quali-quantitative determination of (semi)volatile organic compounds (VOCs and SVOCs) in environmental matrices (waters, sediments, soils, atmospheric aerosols, snow/ice, speleothems, biota), food. **Specific analytes**: persistent organic pollutants (PAHs, PCBs, PBDE); biogenic tracers (fecal and plant sterols, linear alkanes, fatty acids, waxes); fragrances. **Technique**: gas chromatography - mass spectrometry (GC-MS) and gas chromatography-tandem mass spectrometry (GC-MS/MS). **Equipment**: GC 7890A - single quadrupole MS 5975C (Agilent Technologies) equipped with 150 slots autosampler (7693A ALS, Agilent Technologies) and EI source operated in positive mode; GC 7890A - single quadrupole MS 5975C (Agilent Technologies) equipped with Unity2 (Markes International) thermal desorption system, 16 slots autosampler (G4513A, Agilent Technologies) and EI source operated in positive mode; GC Trace 1310 (Thermo Scientific) - TSQ 9000 triple quadrupole MS/MS, equipped with user-exchangeable instant connect injector and detector modules, ExtractaBrite EI/AEI/CI ion source. **Supporting services**: field sampling, sample preparation (extraction, purification, preconcentration), data elaboration. **Contacts**: GC-MS elena.argiriadis@cnr.it (ISP-CNR Venice); GC-MS/MS vecchiato@Unive.it (DAIS-UNIVE). Service provided by joint collaboration between UNIVE-DAIS and ISP-CNR VE.

Service EAC-02: quali-quantitative determination of microplastics by polymer type in environmental matrices (waters, sediments, atmospheric aerosols, snow/ice, biota). **Specific analytes**: PE, PP, PS, ABS, PVC, PET, PC, PMMA, Nylon, etc. (matrix and objective -dependent). **Technique**: pyrolysis gas chromatography-mass spectrometry (py-GC/MS). **Equipment**: GC HP6890 - single quadrupole MS 5973N (Agilent Technologies) equipped with a CDS 5150 pyrolizer (CDS Analytical). **Supporting services**: field sampling, sample preparation (extraction, purification, preconcentration), data elaboration. **Contact**: elena.gregoris@cnr.it (ISP-CNR Venice). Service provided by ISP-CNR VE.

Service EAC-03: quali-quantitative determination of microplastics, microlitter, coatings and active pharmaceutical ingredients in environmental matrices (waters - stormwater, sediments, soils, atmospheric aerosols, snow/ice, biota). **Specific analytes**: PE, PP, PS, ABS, PVC, PET, PC, PMMA, Nylon, etc. (matrix and objective -dependent). **Technique**: fourier-transform infrared (FTIR) microspectroscopy. **Equipment**: Nicolet iN10 (Thermo Scientific), equipped with motorized stage, MicroTip ATR device for direct contact sampling and analysis of fine structures (down to 3 µm), motorized visible polarizer for visual inspection, MTC-A detector with spectral range 7800–650 cm^{-1}, acquisition in transmission, reflection or ATR modes. **Supporting services**: field sampling, sample preparation (extraction, filtration), data elaboration. **Contact**: fabiana.corami@cnr.it (ISP-CNR Venice). Service provided by ISP-CNR VE.

Service EAC-04: qualitative chemical characterization of polar organic compounds in environmental matrices (waters, sediments, soils, atmospheric aerosols, snow/ice, biota), food. **Specific analysis**: suspect screening analysis, untargeted analysis, metabolomic investigation, study of degradation products of contaminants (bisphenol

A, pesticides, PFAs). **Technique**: ultra-high performance liquid chromatography-high resolution mass spectrometry (UHPLC-HRMS). **Equipment**: Ultimate 3000 - Orbitrap XL (Thermo Scientific) equipped with Nanospray Flex ion source and Picotip silica emitter. **Supporting services**: field sampling, sample preparation (extraction, purification, preconcentration), data elaboration. **Contact**: roberta.zangrando@cnr.it (ISP-CNR Venice). Service provided by joint collaboration between UNIVE-DAIS and ISP-CNR VE.

Service EAC-05: quantitative determination of polar organic compounds in environmental matrices (waters, sediments, soils, atmospheric aerosols, snow/ice, biota), food, human biomonitoring. **Specific analytes:** emerging contaminants (haloacetic acids, polar anionic pesticides, benzothiazoles, bisphenols, organo-phosphates flame retardants), fire tracers (anhydrosugars, methoxy phenolic compounds), biogenic tracers (alcohol sugars, saccharides, L-D amino acids, α-pinene oxidation products). **Technique:** High performance ion chromatography - mass spectrometry (HPIC-MS); high performance liquid chromatography - tandem mass spectrometer (HPLC-MS/MS). **Equipment:** ICS-5000 Standard Bore and Microbore System (Dionex, Thermo Scientific) coupled to a single quadrupole MSQ Plus (Thermo Scientific); 1100 series HPLC system (Agilent Technologies) coupled to API 4000 triple quadrupole MS (Applied Biosystems/MDS SCIEX). **Supporting services:** field sampling, sample preparation (extraction, purification), data elaboration. **Contact**: matteo.feltracco@Unive.it (DAIS-UNIVE). Service provided by joint collaboration between UNIVE-DAIS and ISP-CNR VE.

Service EAC-06: high precision quantitative determination at ultra-trace levels of elements and isotopic/elemental ratios in environmental matrices (waters, sediments, soils, atmospheric aerosols, snow/ice, biota), food, human biomonitoring, innovative materials. **Technique:** inductively coupled plasma - sector field mass spectrometry (ICP-SFMS). **Equipment:** Element XR (Thermo Scientific) equipped with a SC-4 autosampler (ESI) for continuous data acquisition and ARIS (ESI) or ARIDUS (Cetac) desolvating nebulizer systems. **Supporting services:** field sampling, samples preparation (digestion, fractionation, preconcentration), data elaboration. **Contact**: giulio.cozzi@cnr.it (ISP-CNR Venice). Service provided by ISP-CNR VE.

Service EAC-07: quantitative multi-elemental analysis from major to low-trace levels in environmental matrices (waters, sediments, soils, atmospheric aerosols, snow/ice, biota), food, human biomonitoring, innovative materials. **Technique**: inductively coupled plasma - optical emission spectrometry (ICP-OES) and inductively coupled plasma - quadrupole mass spectrometry (ICP-QMS). **Equipment**: iCAP-RQ (Thermo Scientific) equipped with a Qcell technology assembly using He as collision gas and/or H_2 as reaction gas, autosampler ASX-560 (Cetac) for high-throughput analysis, sample introduction kit for the analysis of HF-digests and cone inserts for high sensitivity/robust/high matrix analysis; iCAP 7400 (Thermo Scientific) equipped with a high-efficiency light transmission system, radial or duo (radial + axial) acquisition mode, autosampler ASX-560 (Cetac) for high-throughput analysis. **Supporting services:** samples preparation (digestion, fractionation, preconcentration), data elaboration. **Contact**: cairns@Unive.it (ISP-CNR Venice), marco.roman@Unive.it (UNIVE-DAIS). Service provided by joint collaboration between UNIVE-DAIS and ISP-CNR VE.

Service EAC-08: quantitative determination of mercury at trace-ultratrace levels in environmental matrices (waters, sediments, soils, atmospheric aerosols, snow/ice, biota); in-field real-time detection of mercury vapor in the air. **Technique**: cold-vapor atomic fluorescence spectroscopy (CV-AFS) and atomic absorption spectroscopy (AAS). **Equipment**: Mercur DUO Plus - Analytik Jena AG CV-AAS equipped with AS-FD autosampler for liquid matrices; high sensitivity mercury analyzer Lumex RA-915AM AAS (portable). **Supporting services**: field sampling (US-EPA 1669), sample preparation (US-EPA 1631 vers. E / UNI-EN 15853: 2010, treatment with BrCl, $NH_2OH \cdot HCl$, $SnCl_2$, digestion, preconcentration), data elaboration. **Contact**: warrenraymondlee.cairns@cnr.it (ISP-CNR Venice). Service provided by joint collaboration between UNIVE-DAIS and ISP-CNR VE. **User details**:

Service EAC-09: size distribution analysis of airborne submicron particles for the study of atmospheric aerosols transport dynamics, source apportionment, indoor air quality monitoring, nucleation/condensation studies, combustion and engine exhaust studies, inhalation toxicology studies, nanotechnology research and materials synthesis. **Technique:** Scanning Mobility Particle Sizer (SMPS) spectrometry. **Equipment:** TSI CEN SMPS 10-800 nm acquisition range with 384 total channels, equipped with soft X-rays neutralizer, CPC, PM2.5 and PM10 sampling head, compliant with TROPOS standards, ACTRIS recommendations and UNI CEN/TS 17434:2020. **Contact**: mauro.masiol@Unive.it (DAIS-UNIVE).

Service EAC-10: Customized vehicle for remote/itinerating sampling/measurement campaigns (waters, sediments, soils, atmospheric PM and volatile compounds). **Equipment:** customized 4x4 Ford Transit van equipped with weather station and atmospheric aerosol (PM10, PM2.5) sequential sampler (Tecora Skypost). **Supporting services:** the van can be equipped with other portable instruments (from CeTrA or third parties) or used to transport voluminous and fragile instruments and materials into the field. Consultancy on sampling campaign organization and logistics can also be provided. **Contact**: fabrizio.deblasi@cnr.it (ISP-CNR Venice). Service provided by joint collaboration between UNIVE-DAIS and ISP-CNR VE.

Service EAC-11: indoor/outdoor sampling of atmospheric dust, aerosols and gases; participation in environmental sampling and/or monitoring campaigns. **Equipment**: high volume sampler DIGITEL DHA80 (TSP, PM10, PM2.5, PM1) with 15 150 mm filters and 4 PUF filters; sequential PMx sampler GEMINI Dadolab aerosols sampler (TSP, PM10, PM1) on 47 mm filters; high-flow cascade impactor (TSI) with 6 stages in the 10, 2.5, 1.4, 0.77, 0.44 and 0.25 µm aerodynamic size range. **Supporting services:** filters/equipment decontamination and preparation. Consultancy on sampling campaign organization and logistics can also be provided. **Contact**: matteo.feltracco@Unive.it (DAIS-UNIVE). Service provided by joint collaboration between UNIVE-DAIS and ISP-CNR VE.

Service EAC-12: samples/materials decontamination, manipulation and pre-analytics in clean laboratories for trace organic and inorganic analysis; conduction of experiments in contamination-free controlled conditions. **Equipment:** Clean Room Inorganics (ISO 6 to ISO 4 laboratory environment constructed entirely of plastic-coated materials) and Clean Room Organics (ISO 7 to ISO 4 laboratory environment constructed entirely of steel materials), both overpressure, equipped with ceiling installed HEPA filters for continuous filtering of the internal air and dedicated internal

production systems of Milli-Q water (Elga LabWater). **Supporting services:** the clean laboratories can be adapted to host custom-made/third parties instrumental set-ups to conduct experiments in contamination-free controlled conditions. **Contact:** Inorganics Clean Laboratory marco.roman@Unive.it (DAIS-UNIVE); Organics Clean Laboratory matteo.feltracco@Unive.it (DAIS-UNIVE). Service provided by joint collaboration between UNIVE-DAIS and ISP-CNR VE.

Service EAC-13: monitoring/sampling campaigns at the high-altitude atmospheric observatory of MRG, with dedicated data sharing/integration. **Equipment:** Bulk deposimeter for Hg in atmospheric deposition (MercuryBulk, Bus100, Eigenbrodt), weather sensors (temperature and relative humidity of air, atmospheric pressure, wind direction and speed, snow height and soil temperature), PM10 sequential low volume particulate autosampler (Skypost, Tecora), Optical Particle Counter (OPC, XearPro) Incoming instrumentation: O_3, CO and NO_x analyzers (XearPro), Aethalometer AE33 (Magee Scientific), mercury analyser RA-915AM (Lumex), Scanning Mobility Particle Sizer (SMPS, TSI), aerosol particles samplers (DIGITEL DHA80 and GEMINI Dadolab). **Supporting services:** the observatory can be adapted to host custom-made/third parties instrumental set-ups to conduct experiments in high-altitude alpine environment conditions. Consultancy on sampling campaign organization and logistics can also be provided. **Contact:** fabrizio.deblasi@cnr.it and giulio.cozzi@cnr.it (ISP-CNR Venice).

Area: physico-chemical characterization of materials (PCCM)

Service PCCM-01: micro-to-nano scale analysis of composition, morphology and size distributions in vacuum and variable-pressure (VP) mode of materials (ceramics, metals, glass) and environmental samples (atmospheric aerosols, mineral and biological particles) for material sciences and environmental applications; chemical (elemental) imaging. Technique: scanning electron microscopy (SEM). Equipment: field emission (FE) SEM Zeiss Σigma VP equipped with a thermal field emission gun (Schottky emitter) source, pressures adjustable from 1 to 133 Pa (uncoated non-conductive specimens), equipped with multiple imaging detectors (with high collection efficiency Everhart-Thornley detector for SE; high-resolution in lens detector for SE at nominal resolution down to 1.5 nm @ 15 kV; 4-sector semiconductor detector for BSE; Bruker Quantax 200 EDS system of the SDD type for elemental analysis at resolution ≤127 eV @ 5.6 keV). Supporting services: sample preparation. **Contact**: michele.back@unive.it (DSMN-UNIVE).

Service PCCM-02: (sub)nano-scale analysis of composition, morphology and size distributions in vacuum and variable-pressure (VP) mode of materials (ceramics, metals, glass) and environmental samples (atmospheric aerosols, mineral and biological particles) for material sciences and environmental applications; chemical (elemental) imaging. **Technique**: Scanning transmission electron microscopy (S/TEM). **Equipment**: JEOL JEM-F200 (JEOL) 200 kV TEM with scanning capabilities equipped with Cold Field Emission Gun (CFEG) providing electron beam energy spread ≤ 0.3 eV (FWHM) @ 200 kV, brightness ≥ 88 A/cm2sr @ spot size = 0.7 nm, probe current ≥ 2.5 nA @ spot size = 0.7 nm, in conjunction with the 4-lense illumination system. The microscope is also equipped with EDS detector with analytical resolution ≤ 133 eV @ 5.6 keV **Supporting services:** sample preparation. **Contact** (provisional): cantonpa@Unive.it (DSMN-UNIVE).

Service PCCM-03: nano/atomic-scale topographic and surface chemistry (electrical conductivity) imaging analysis in ambient and liquid environments of materials (adsorbents, semiconductors, polymers, atmospheric aerosols, mineral and biological particles) for molecular engineering, material science, environmental applications and cellular biology. **Technique**: atomic force microscopy (AFM). **Equipment**: Dimension Icon (Bruker) AFM platform; analysis in contact, tapping and non-contact modes, equipped for conductive AFM (c-AFM), Kelvin probe force microscopy (KPFM) and nanomechanical analysis (PeakForce-QNM®) by means of PeakForce Tapping® technology. **Supporting services:** sample preparation. **Contact** (provisional): leonardo.puppulin@Unive.it (DSMN-UNIVE).

Service PCCM-04: characterization of crystalline phases, identification of fine-grained minerals, purity analysis, textural measurements and thin films and nanostructures characterization of/in materials (ceramics) and environmental samples (atmospheric aerosols, mineral particles) for material sciences and environmental applications; analysis in air and in liquid. **Technique**: X-ray diffraction spectrometry (XRD). **Equipment**: X-ray Empyrean Series 3 (Malvern Panalytical) platform equipped with a point-like X-ray source, standard wide angle X-ray scattering (WAXS) and ultra-small angle X-ray scattering (USAXS) modes, grazing-incidence GISAXS and GIWAXS geometries, spatial resolution ~300 μm. **Supporting services:** sample preparation. **Contact** (provisional): riellop@Unive.it (DSMN-UNIVE).

Area: information technology (IT)

Service IT-01: statistical data analysis and visualization, virtual machines access. **Software**: OriginPro (OriginLab). **Contact**: marco.roman@Unive.it (DAIS-UNIVE).

Service IT-02: untargeted and targeted analysis of complex mass spectrometry data, enabling identification, characterization, and annotation of unknown compounds in complex mixtures; remote access. **Software**: Compound Discoverer (Thermo Fisher Scientific). **Contact**: roberta.zangrando@cnr.it (ISP-CNR).

The virtual access to datasets, potentially associated to all of the individual experimental services from the catalogue, is a transversal service.

ANNEX 3 – REGOLAMENTO PER L'UTILIZZO DEL LABORATORIO MOBILE (ITA)

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REGOLAMENTO PER L'UTILIZZO DEL LABORATORIO MOBILE: VEICOLO FORD TRANSIT TARGA GV114ZM (PROGETTO ITINERIS_PNRR)

(approvato con delibera del Consiglio di Dipartimento del 16 settembre 2024)

Art. 1 - Oggetto
1. Il presente Regolamento disciplina l'utilizzo del laboratorio mobile (VEICOLO FORD TRANSIT TARGA GV114ZM) del Dipartimento di Scienze Ambientali, Informatica e Statistica
2. Il Dipartimento ha acquisito il laboratorio mobile con i fondi del progetto ITINERIS nei limiti prescritti da bando, il regolamento ne disciplina opportunamente l'utilizzo, ai sensi della normativa vigente.
3. Il Presidio del Laboratorio mobile è affidato al dott. Marco Roman referente scientifico del progetto Itineris.

Art. 2 - Utilizzo dell'auto
1.L'uso del laboratorio mobile è affidato in via prioritaria del gruppo di ricerca legato alle attività del progetto ITINERIS PNRR, di cui è referente il dott. Marco Roman, ed è inteso come un sostegno alle attività di ricerca del progetto fino alla sua conclusione.

2. L'uso del laboratorio mobile verrà esteso ad altre attività di supporto a progetti di Ricerca di altri gruppi del Dipartimento, per attività didattiche, solo al termine del progetto finanziato dal PNRR, previa ulteriore verifica e autorizzazione del Direttore.

3. L'uso del Laboratorio mobile è consentito solo al personale indicato con decreto del Direttore, in particolare:
Dott. Marco Roman, Prof. Andrea Gambaro, Dott. Matteo Feltracco, Dott. Marco Vecchiato, Dott.ssa Mara Bortolini, Dott.ssa Marta Radaelli, Dott. Daniele Zannoni, Prof. Mauro Masiol, Dott. Alessandro Bonetto.

4. La guida dell'automezzo è consentita previa autorizzazione alla Missione richiesta al Direttore tramite procedura on-line, con almeno 3 giorni lavorativi di anticipo rispetto alla data prevista per l'utilizzo.

5. Il trasporto di persone diverse da quelle indicate all'art. 2, c.3 deve essere indicato nel modulo denominato "Diario di bordo" sottoscritto da ciascun richiedente. Nel caso di personale afferente al Dipartimento, la richiesta di autorizzazione alla Missione dovrà essere preventivamente inviata al Direttore, con le stesse tempistiche del

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comma 4. E' consentita la presenza di sole tre persone a bordo, incluso il conducente.

6. Le missioni con l'utilizzo del Laboratorio mobile dipartimentale devono partire dalla sede del Dipartimento, senza nessuna eccezione.

7. Le chiavi dell'autoveicolo, unitamente al badge per l'accesso al parcheggio interrato dell'Edificio Epsilon, sono conservate presso la Segreteria del Dipartimento, terzo piano edificio Alfa, via Torino 155, Mestre ufficio amministrativo. L'autoveicolo Laboratorio mobile deve essere ritirato e riconsegnato presso il Dipartimento nella sede indicata in orario di apertura degli uffici Amministrativi.

8. Qualora gli impegni di servizio abbiano inizio prima delle ore 8.00 o termine oltre le ore 16:30, è possibile ritirare le chiavi il giorno precedente alla missione o consegnarle il giorno successivo, dandone esplicita indicazione nella procedura di richiesta missione.

Art. 3 – Doveri dei conducenti
1.Ogni conducente, nell'uso del mezzo Laboratorio mobile, è tenuto al rispetto delle norme del Codice della Strada, nonché alla massima diligenza e prudenza, fermo restando che eventuali sanzioni amministrative comminate per violazioni al Codice della Strada sono a carico del conducente stesso, ai sensi delle vigenti disposizioni di legge.

2. Ogni conducente è tenuto alla conoscenza del corretto utilizzo e funzionamento del mezzo Laboratorio mobile (fornito di cambio automatico), per cui si raccomanda al primo utilizzo di leggere il manuale d'istruzioni e le istruzioni scaricate dall'applicazione on line fornita all'acquisto.

3. I conducenti sono tenuti a compilare l'apposito "Diario di Bordo" di cui all'art. 4, dal quale devono risultare le informazioni ivi previste.

4. È onere di ciascun conducente, al momento della riconsegna del veicolo, assicurarsi che il veicolo sia in condizioni di buona pulizia, che abbia il serbatoio pieno di carburante (GASOLIO e ADBLUE), che siano spente tutte le luci e le apparecchiature elettriche ed elettroniche di bordo e che tutte le serrature siano chiuse. Le chiavi dell'automezzo dovranno essere riconsegnate nell'ufficio Amministrativo del Dipartimento, all'indirizzo, via Torino 155, Mestre, terzo piano edificio Alfa.

Art. 4 – Diario di bordo
1. Il diario di bordo è conservato all'interno dell'autoveicolo ed è composto dal foglio di viaggio, dal quale deve risultare:

- data e ora di ritiro e riconsegna delle chiavi
- motivo dell'utilizzo (attività in campo per ricerca)
- conducente e responsabile scientifico,

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- la/le località di destinazione (nel caso di destinazioni plurime è possibile indicare "destinazioni varie" nell'ambito di una certa area),
- chilometraggio iniziale e finale dell'autoveicolo,
- litri e spesa per il carburante,
- note (come dettagliato al c. 2)

2. Nel Diario di bordo devono inoltre essere segnalati, nel campo "Note":

- tutti i malfunzionamenti o altri vizi riscontrati nel veicolo
- eventuali segnalazioni riguardanti incidenti, furto, danneggiamenti, o altri casi particolari verificatisi durante il viaggio
- anomalie rispetto ad un corretto utilizzo del mezzo riscontrate al momento del ritiro (es. assenza del pieno di carburante) o della riconsegna (es. segnalazione dell'esigenza di pulizia straordinaria che sarà imputata sui fondi del responsabile scientifico)
- lo smarrimento, la sottrazione o la riscontrata mancanza anche di uno solo dei documenti, delle dotazioni, o dei dispositivi obbligatori di sicurezza.

3. Eventuali malfunzionamenti e/o segnalazioni riportati nel campo "Note" devono anche essere riferite ai referenti dell'automezzo tempestivamente e al massimo entro il giorno lavorativo successivo a quello di utilizzo del veicolo.

4. Il Diario di bordo deve essere compilato e firmato dal conducente utilizzatore. Al termine di ogni mese la documentazione relativa al mese stesso deve essere consegnata in Segreteria del Dipartimento, da parte di tutti gli utilizzatori.

Art. 5 - Divieti
1. È fatto assoluto divieto:

- di trasportare persone e/o materiali estranei all'Università che non siano in diretto rapporto con il lavoro da eseguire o con l'oggetto della missione e che non risultino nell'elenco indicato nella procedura di autorizzazione missione;
- di fare dell'automezzo un uso personale o, comunque, diverso da quello autorizzato;
- di farsi sostituire nella guida dell'automezzo da persona non autorizzata, salvo il caso di assoluta impossibilità dello stesso a proseguire nella guida;
- di fumare all'interno dell'automezzo;
- di abbandonare o lasciare parcheggiato il mezzo senza prendere le dovute cautele.

Art. 6 - Documentazione e dotazione a bordo dell'automezzo

1. L'automezzo deve avere a bordo la seguente documentazione e la sottoelencata dotazione:
a) carta di circolazione;
b) copia del certificato di assicurazione obbligatoria;
c) documentazione relativa all'autorizzazione per la circolazione in zona ZTL;
e) modulistica per rilevamento incidenti stradali;

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f) copia del presente Linee Guida;
i) documentazione dell'automezzo fornita dalla casa automobilistica;
j) documentazione per la richiesta di assistenza/soccorso stradale;
k) diario di bordo.

Art. 7 – Rifornimenti, manutenzioni e comportamento in caso di sinistro o guasti

1.I rifornimenti di carburante vengono effettuati dai conducenti indicati all'art.2 c.3 presso i distributori, ciascun conducente dovrà farsi rilasciare la relativa ricevuta (scontrino). La ricevuta (scontrino) del rifornimento deve essere allegata come spesa di missione e trasmessa all'ufficio Amministrazione del Dipartimento per il relativo rimborso sui fondi di ricerca dei docenti utilizzatori.

2. Gli incaricati della gestione (art.2 c.3) provvedono, ad attivare la manutenzione ordinaria e straordinaria, nonché i periodici controlli e sostituzioni di routine (olio, acqua, livello liquido freni, gomme, ecc…), presso la ditta convenzionata, ovvero presso il concessionario di acquisto del laboratorio mobile. Eventuali costi di manutenzione fuori convenzione verranno coperti da Fondi di Dipartimento, autorizzati dal Direttore.

3. In caso di sinistro, il conducente/incariato ha il dovere di presentare in maniera tempestiva la denuncia utilizzando la procedura consueta di Ateneo e avvisando tempestivamente la Segreteria Amministrativa , per attivare il rimborso da parte dell'Assicurazione.

Art. 8 – Sanzioni

1. Le sanzioni per le infrazioni al Codice della Strada, siano esse contestate sul posto o notificate successivamente, sono a carico del conducente/incaricato.

Art. 9 – Norme finali

1. Per quanto non espressamente previsto dal presente Regolamento, si fa rinvio alla normativa statale vigente in materia.

ANNEX 4 – PROCEDURA DI GESTIONE DEL DEPOSITO REAGENTI TRAMITE PIATTAFORMA LMS (ITA)

Procedura di gestione del deposito reagenti (solventi, acidi) Delta tramite piattaforma Laboratory Management System (ELN) eLabJournal

Regole generali:

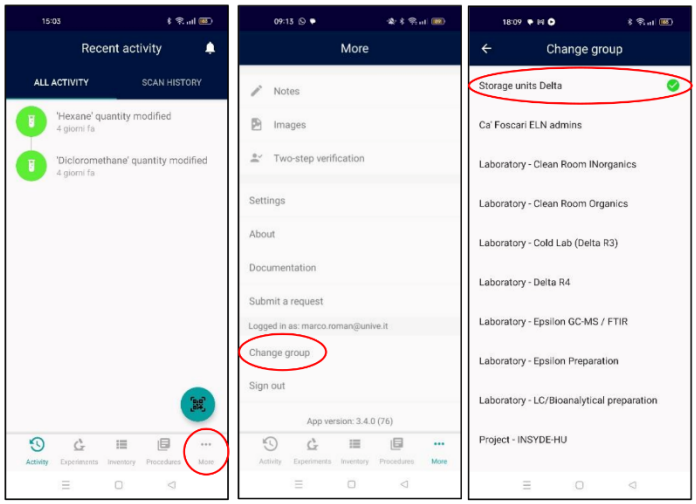
1. per accedere fisicamente al deposito è necessario: 1) essere dotati di badge apposito abilitato; 2) essere abilitati alla piattaforma eLabjournal; 3) essere almeno in coppia (l'accesso solitario non è consentito).
2. per accedere al deposito è necessario essere dotati di badge personale appositamente abilitato (Carlo Bragato, Marta Radaelli, Mara Bortolini, Marco Casula), o in alternativa richiedere temporaneamente per ciascun accesso uno dei badge abilitati ad uso comune disponibili presso Mara Bortolini (studio Delta 3° piano int. 8609) o Marco Roman (studio Delta 1° piano int. 7731). Al momento del ritiro del badge è obbligatorio compilare il registro accessi cartaceo disponibile in loco. Studenti e tirocinanti, pur se abilitati all'accesso, non sono abilitabili alla piattaforma; pertanto, il loro accesso al deposito è consentito solo se accompagnati da personale abilitato.
3. L'abilitazione alla piattaforma eLabjournal è possibile solo per utenti che dispongono di account personale unive. L'abilitazione alla piattaforma per un nuovo utente deve essere richiesta all'admin della stessa Marco Roman (marco.roman@unive.it) direttamente dal nuovo utente (se strutturato unive) oppure dal tutor/referente (se non strutturato unive).
4. È obbligatorio contrassegnare ogni nuova confezione di reagente stoccato con il nome di un utente titolare chiaramente visibile.
5. Una volta usciti dal deposito, è obbligatorio aggiornare l'inventario eLabjournal del deposito in base a quanto prelevato/stoccato seguendo la procedura di seguito descritta.

1. Aggiornamento dell'inventario su piattaforma eLabJournal

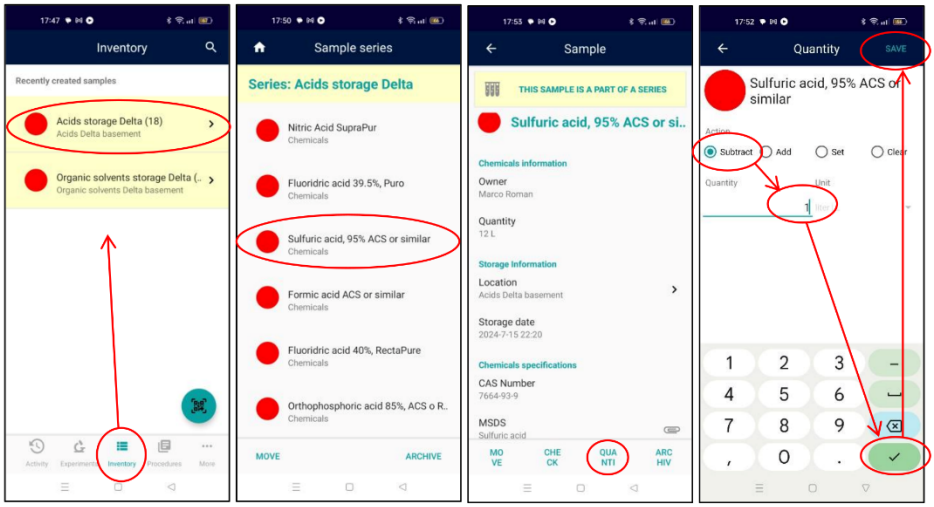
L'aggiornamento può essere effettuato da App mobile solo nei termini della variazione quantitativa di reagenti già stoccati, oppure da desktop/applicativo web per tutte le variazioni (es. inserimento nuovi reagenti) secondo le modalità seguenti. Le procedure di seguito descritte consentono di aggiornare l'inventario ma anche semplicemente di consultarlo senza apportare modifiche.

A) Da App mobile (solo consultazione e aggiornamento quantità)

- *Eventuale abilitazione al primo utilizzo. Scaricare (Google Play o Apple Store), installare ed avviare l'app eLabJournal. Effettuare il login: alla richiesta di inserimento credenziali scegliere il login istituzionale – Ca' Foscari. Al primo accesso l'app vi chiederà di collegarvi da desktop e da lì abilitare il dispositivo mobile: è sufficiente seguire la procedura guidata indicata dall'app stessa. Nel collegarvi da desktop, scegliete analogamente il login istituzionale e verrete reindirizzati alla pagina di login unive in cui potete inserire le credenziali dell'account unive già in vostro possesso. Questa operazione di abilitazione del dispositivo mobile non è più necessaria successivamente, a meno che non facciate intenzionalmente logout dall'app (allora va ripetuta). Inoltre, il logout cancella lo storico, pertanto si raccomanda semplicemente di chiudere l'app senza effettuare logout, in questo modo ogni volta che la riaprirete sarete già loggati.*
- Nella schermata principale "Recent activity" (i cui contenuti cambiano ad ogni attività effettuata), cliccare sull'inona con i tre puntini "More" in basso a destra. Nella schermata "More" cliccare su "Change group". Nella schermata "Change group" verificare che il Gruppo attivo (quello in alto con la spunta verde) sia "**Storage units Delta**"; se così non fosse attivarlo scegliendolo dall'elenco sottostante. L'app manterrà attivo l'ultimo gruppo scelto anche se chiusa, fin tanto che l'utente non attiva un gruppo diverso.

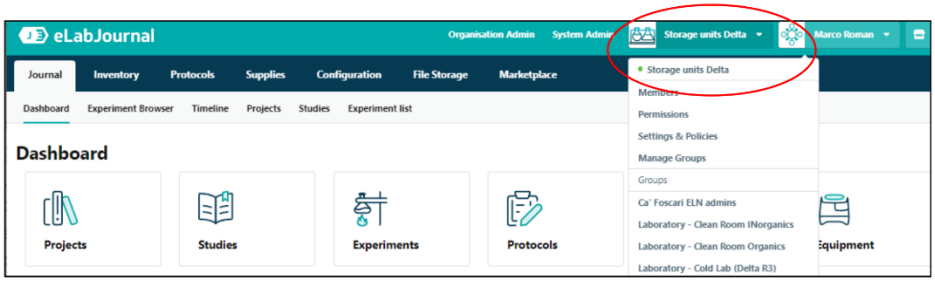


- (Tornati indietro) Nella schermata principale cliccare sull'icona "Inventory" in basso al centro. Se nella schermata non compare nulla sotto l'intestazione "Recently created samples" fare un refresh della schermata con uno swipe verso il basso al centro dello schermo. Cliccare sul deposito che si intende aggiornare: "Acids storage Delta" oppure "Organic solvents storage Delta", accedendo così alla lista di tutti i reagenti ivi stoccati (denominata "Series"). Scorrere la lista fino al reagente che si intende aggiornare, quindi cliccarne il nome così da accedere alla corrispondente scheda. Nella scheda è possibile visualizzare il responsabile del reagente (owner), la quantità (quantity), e scaricarne la scheda di sicurezza (MSDS). Per aggiornare la quantità cliccare sulla voce "QUANTI" in basso a destra. Nella nuova scheda: 1) cliccare sull'operazione che si intende effettuare, es. "Subtract" per scalare la quantità prelevata oppure "Add" per aggiungere una nuova quantità stoccata; 2) scrivere la quantità da aggiornare, es. 1L se è stata prelevata una bottiglia da 1L; accettare l'inserimento cliccando sul visto e infine sul "SAVE" per salvare la modifica. La variazione di quantitativo stoccato verrà aggiornata automaticamente. Ogni modifica e autore della modifica sono memorizzati a sistema.

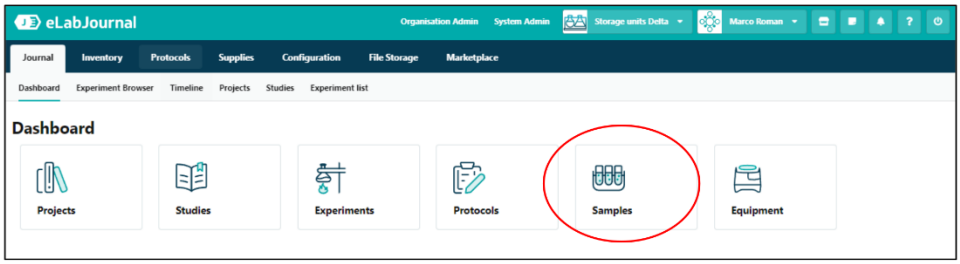


B) Da desktop/applicativo web (consultazione e tutti gli aggiornamenti)

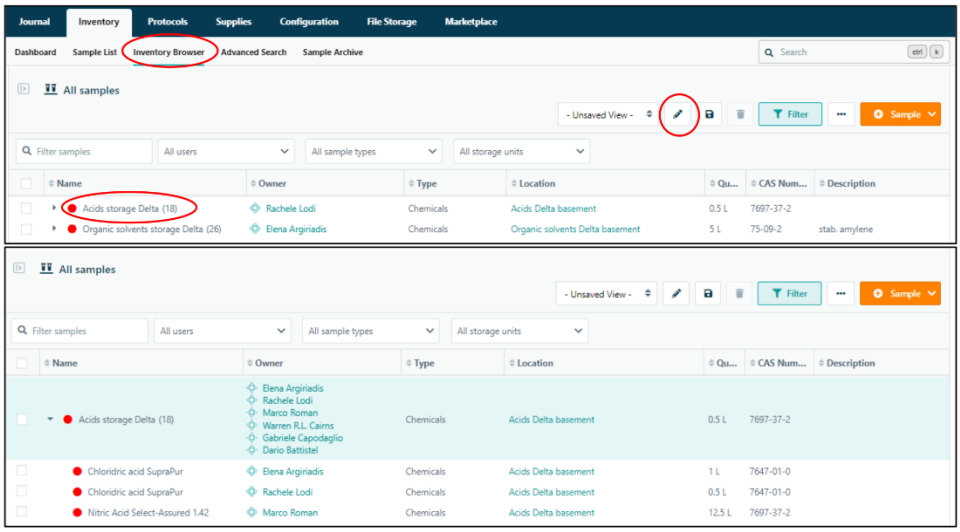
- Collegarsi all'applicativo: https://unive.elabjournal.com/ ed effettuare il login. Alla richiesta di inserimento credenziali scegliere il login istituzionale – Ca' Foscari, verrete reindirizzati alla pagina di login unive in cui potete inserire le credenziali dell'account unive già in vostro possesso.
- Nella schermata principale dell'applicativo, individuare il banner superiore azzurro chiaro e verificare che il Gruppo attivo sia "**Storage units Delta**". In caso contrario è possibile cambiare il Gruppo attivo cliccando sul pulsante e scegliendo dal menu a tendina. Ciascun utente è abilitato a una diversa lista e composizione dei Gruppi attivabili.



- Nella schermata principale (Dashboard) cliccare sul pulsante "Samples".

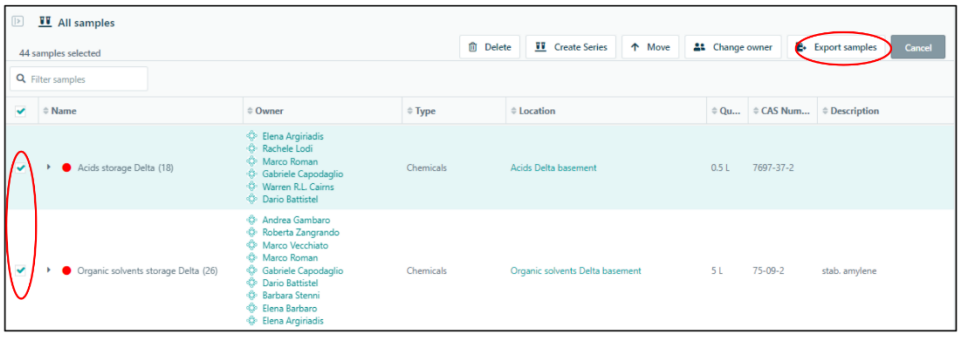


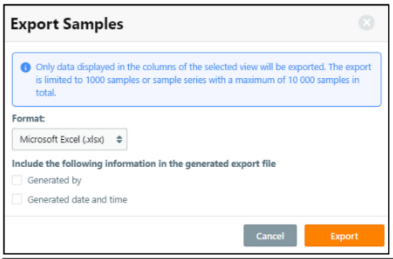
1. **Consultare ed esportare l'inventario**
   - Nella schermata "Inventory browser" è possibile cliccare sui singoli depositi, aprendo la lista dei reagenti ivi stoccati e visualizzandone i dettagli. È possibile modificare la lista dei dettagli visualizzati cliccando sul pulsante con la matita in alto a destra. È possibile anche effettuare una ricerca di reagenti specifici o filtrare le liste per utente.



La voce "owner" specifica chi sia titolare di ciascun set di reagenti (o di tutto il contenuto inventariato nel deposito alla riga corrispondente).

- Attivando il *tick* sui depositi o sui singoli reagenti di interesse è possibile esportare tutti i dati dell'inventario cliccando sul pulsante "Export samples"



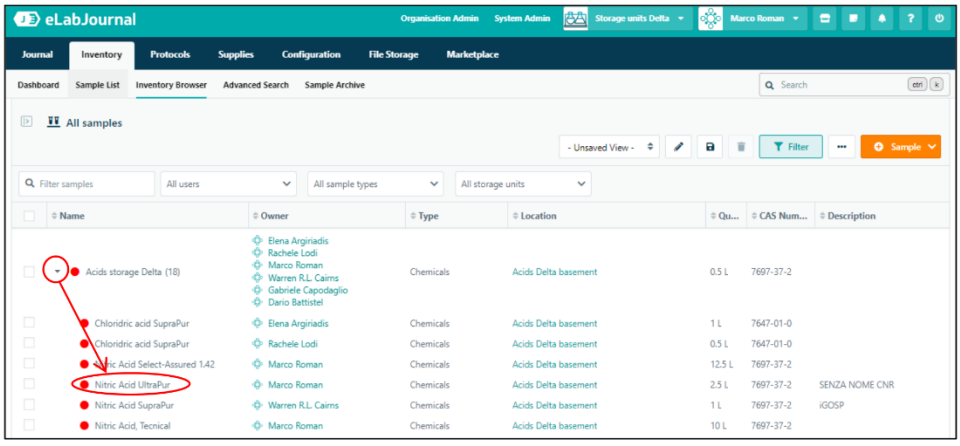


Nella scheda "Export Samples" selezionare il formato (es .xlsx), quindi cliccare "Export" e selezionare nome file e cartella di destinazione

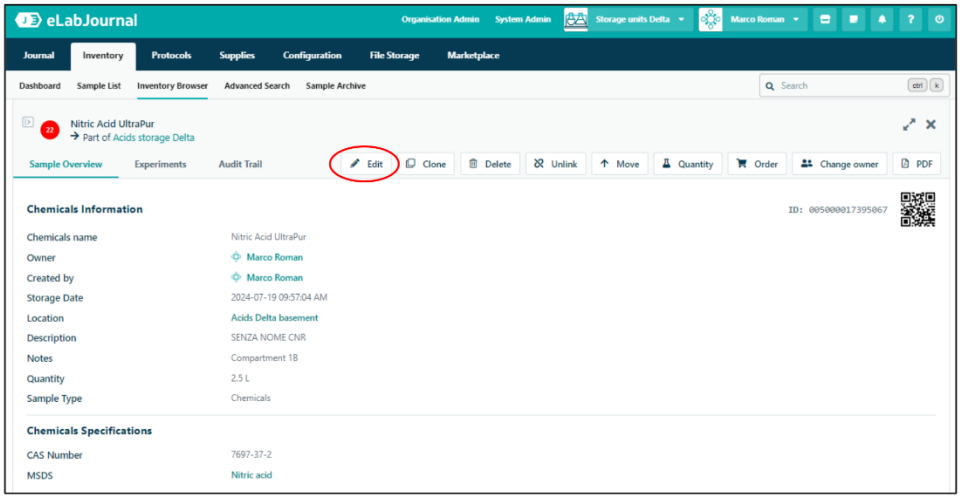
	A	B	C	D	E	F	G	H
1	Name	User	Sample type	Location	Quantity	Description	Note	CAS Number
2	Nitric Acid SupraPur	Rachele Lodi	Chemicals	Acids Delta basement	0.5 L		Compartment 1C	7697-37-2
3	Fluoridric acid 39.5%, Puro	Elena Argiriadis	Chemicals	Acids Delta basement	1 L			7664-39-3
4	Sulfuric acid, 95% ACS or similar	Marco Roman	Chemicals	Acids Delta basement	12 L			7664-93-9
5	Formic acid ACS or similar	Marco Roman	Chemicals	Acids Delta basement	1 L			64-18-6
6	Fluoridric acid 40%, RectaPure	Marco Roman	Chemicals	Acids Delta basement	5 L			7664-39-3
7	Orthophosphoric acid 85%, ACS o RPE o simile	Gabriele Capodaglio	Chemicals	Acids Delta basement	3 L			7664-38-2
8	Nitric Acid 60%, UltraPur	Gabriele Capodaglio	Chemicals	Acids Delta basement	2 L		Compartment 1B	7697-37-2
9	Nitric Acid 67-69%, Normatom	Marco Roman	Chemicals	Acids Delta basement	1 L		Compartment 1D	7697-37-2
10	Chloridric acid 36%, UltraPur	Gabriele Capodaglio	Chemicals	Acids Delta basement	16 L			7647-01-0
11	Chloridric acid SupraPur	Dario Battistel	Chemicals	Acids Delta basement	2.5 L			7647-01-0
12	Chloridric acid 34-37%, Normatom	Marco Roman	Chemicals	Acids Delta basement	3 L			7647-01-0
13	Nitric Acid SupraPur	Warren R.L. Cairns	Chemicals	Acids Delta basement	1 L	iGOSP	Compartment 1C	7697-37-2
14	Nitric Acid, Tecnical	Marco Roman	Chemicals	Acids Delta basement	10 L		Compartment 1C	7697-37-2
15	Nitric Acid SupraPur	Gabriele Capodaglio	Chemicals	Acids Delta basement	9 L		Compartment 1C	7697-37-2
16	Nitric Acid Select-Assured 1.42	Marco Roman	Chemicals	Acids Delta basement	12.5 L		Compartment 1D	7697-37-2
17	Nitric Acid UltraPur	Marco Roman	Chemicals	Acids Delta basement	2.5 L		Compartment 1B	7697-37-2
18	Chloridric acid SupraPur	Elena Argiriadis	Chemicals	Acids Delta basement	1 L			7647-01-0
19	Chloridric acid SupraPur	Rachele Lodi	Chemicals	Acids Delta basement	0.5 L			7647-01-0

2. Aggiornare un reagente esistente

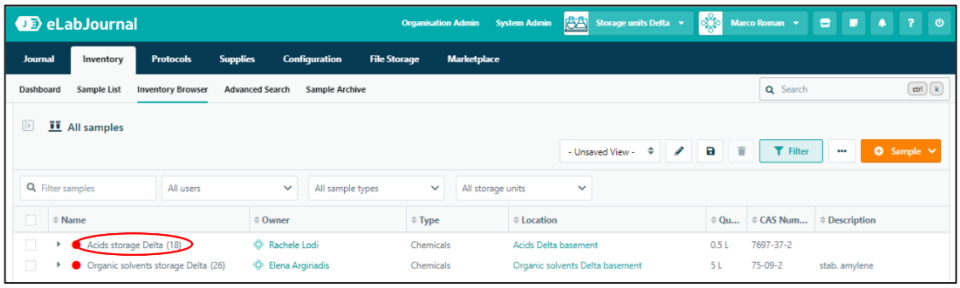
- Nella schermata "Inventory browser", cliccare sul deposito e quindi sul reagente che si intende aggiornare.



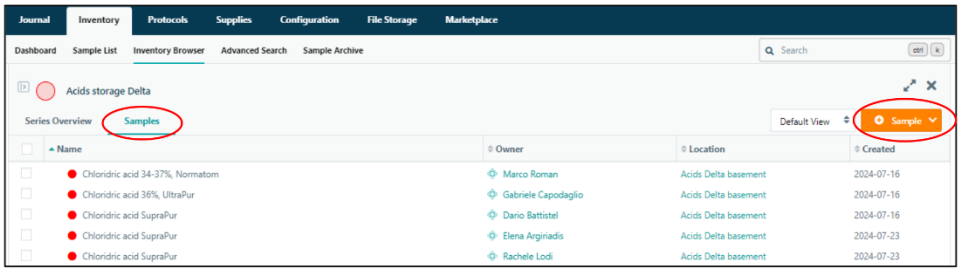
Nella scheda reagente è possibile visualizzare il responsabile del reagente (owner), la quantità (quantity), e scaricarne la scheda di sicurezza (MSDS). Per aggiornare la quantità e qualunque altra specifica cliccare sulla voce "Edit". Apportare le modifiche nei campi corrispondenti, quindi premere "Save and close" in alto a destra.



3. **Inserire un nuovo reagente**
   - Nella schermata "Inventory browser", cliccare sul deposito che si intende aggiornare.

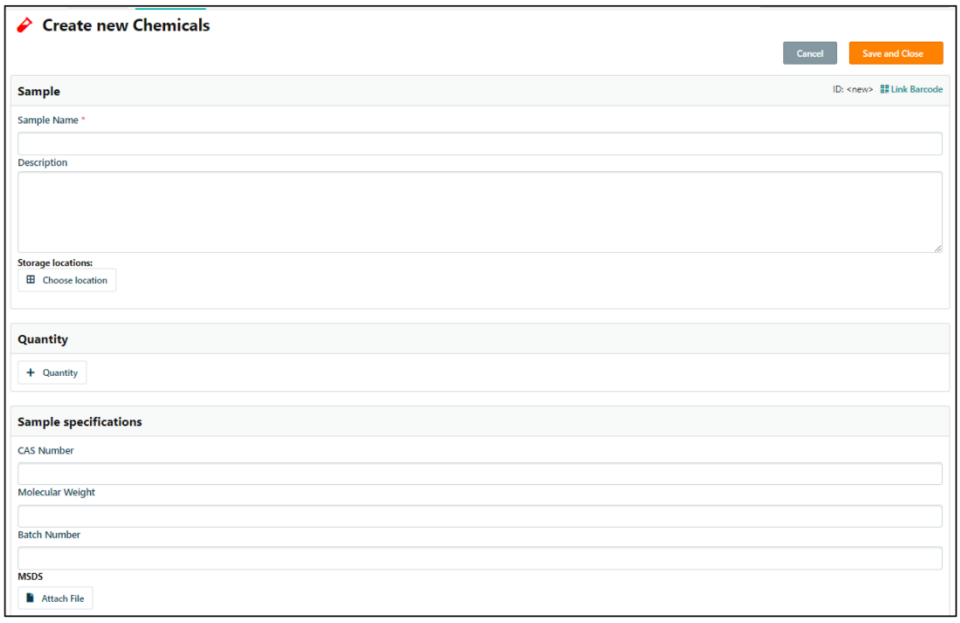


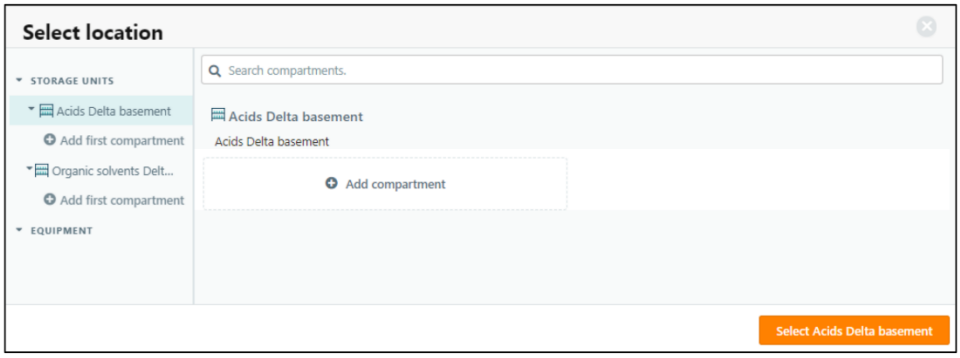
- Aprire la scheda "Samples", cliccare sul pulsante + Sample in alto a destra.



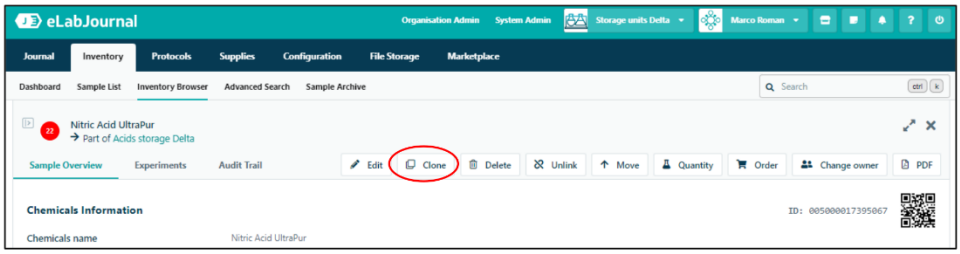
- Nella scheda di inserimento nuovo Chemical compilare tutti i campi, nello specifico obbligatoriamente:
  - Sample name (nome reagente e grado)
  - Storage location (selezionare il deposito corretto, quindi premere il pulsante arancione "Select […]"
  - Quantity (scegliere l'unità di misura e riportare il valore)
  - CAS number
  - MSDS (caricare il .pdf della scheda di sicurezza)

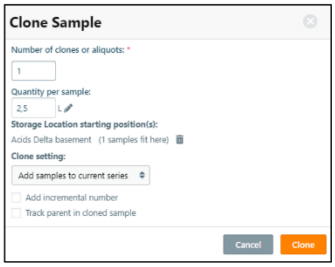
  Infine, cliccare "Save and Close".





- In alternativa, è possibile anche clonare e poi modificare un reagente già esistente selezionandolo nella schermata "Inventory browser", cliccando sul pulsante "Clone".





Nella scheda "Clone Sample" inserire numero di cloni, quantità, selezionare il deposito di destinazione, scegliere dal menu a tendina l'opzione "Add sample to current series" e deselezionare le opzioni sottostanti, quindi cliccare il pulsante "Clone".

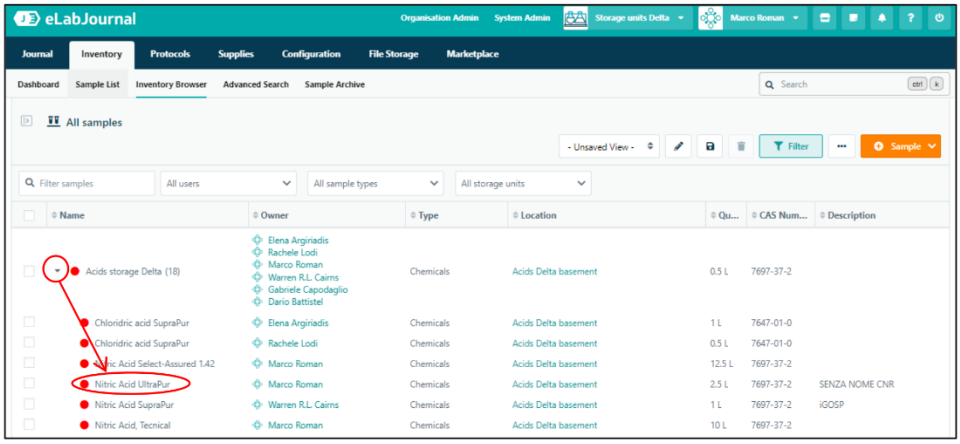
Sarà poi possibile modificare i dettagli del nuovo reagente operando nella scheda "Edit" come precedentemente descritto.

Il creatore di un reagente ne è automaticamente responsabile (owner). Solo gli utenti di livello "Administrator" possono modificare l'owner di un reagente preesistente.

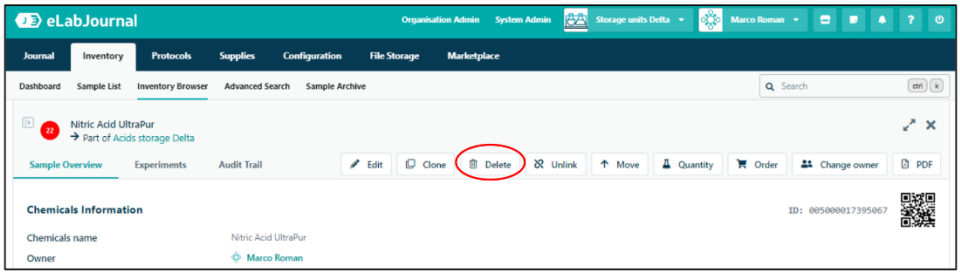
4. Eliminare un reagente

Solo l'owner e gli utenti di livello "Administrator" possono eliminare un reagente.

- Nella schermata "Inventory browser", cliccare sul deposito e quindi sul reagente che si intende eliminare.



- Nella scheda reagente cliccare “Delete”, quindi confermare l’eliminazione.



ANNEX 5 – PROCEDURA DI PRENOTAZIONE DELLA CLEAN ROOM INORGANICS TRAMITE PIATTAFORMA LMS (ITA)

Finanziato dall'Unione europea NextGenerationEU | Ministero dell'Università e della Ricerca | Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA | Università Ca'Foscari Venezia

Procedura di prenotazione della CR-IN tramite piattaforma Laboratory Management System (ELN) eLabJournal

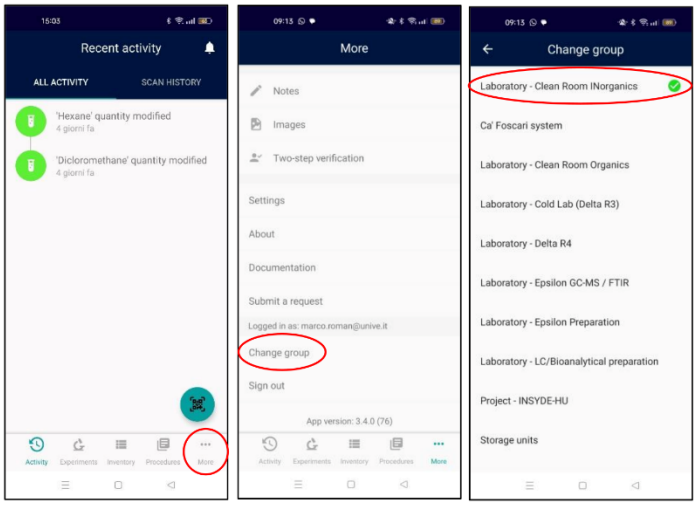
Regole generali:

- è obbligatorio prenotare la CR prima di ogni accesso.
- Solo gli utenti abilitati alla piattaforma eLabJournal possono effettuare una prenotazione.
- L'abilitazione alla piattaforma è possibile solo per utenti che dispongono di account personale unive.
- L'abilitazione alla piattaforma viene rilasciata dal RDRL contestualmente alla più generale autorizzazione all'accesso.
- Studenti e tirocinanti, pur se abilitati all'accesso, non sono abilitabili alla piattaforma; pertanto, le attività che sessioni in lavoro in CR che li riguardano devono essere necessariamente prenotate da un (qualunque) utente abilitato che se ne fa referente nell'occasione.

La prenotazione può essere effettuata sia da App mobile che da desktop/applicativo web secondo le modalità seguenti.

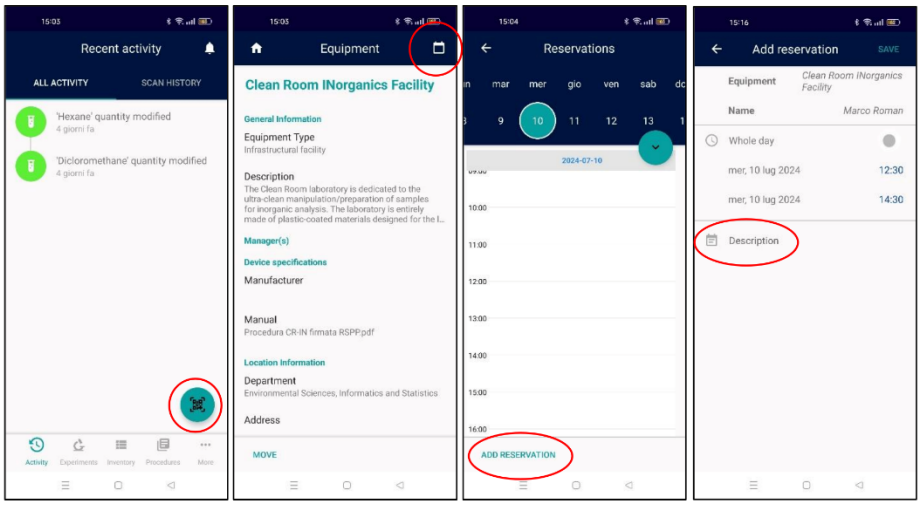
A) Da App mobile

- Scaricare (GPlay), installare ed avviare l'app eLabJournal. Effettuare il login: alla richiesta di inserimento credenziali scegliere il login istituzionale – Ca' Foscari. Al primo accesso l'app vi chiederà di collegarvi da desktop e da lì abilitare il dispositivo mobile: è sufficiente la procedura guidata indicata dall'app stessa. Nel collegarvi da desktop, scegliete analogamente il login istituzionale e verrete reindirizzati alla pagina di login unive in cui potete inserire le credenziali dell'account unive già in vostro possesso. Questa operazione di abilitazione del dispositivo mobile non è più necessaria successivamente, a meno che non facciate intenzionalmente logout dall'app (allora va ripetuta). Inoltre, il logout cancella lo storico, pertanto si raccomanda semplicemente di chiudere l'app senza effettuare logout, in questo modo ogni volta che la riaprirete sarete già loggati.
- Nella schermata principale "Recent activity" (i cui contenuti cambiano ad ogni attività effettuata), cliccare sull'icona con i tre puntini "More" in basso a destra. Nella schermata "More" cliccare su "Change group". Nella schermata "Change group" verificare che il Gruppo attivo (quello in alto con la spunta verde) sia "Laboratory – Celan Room INorganics"; se così non fosse attivarlo scegliendolo dall'elenco sottostante. L'app manterrà attivo l'ultimo gruppo scelto anche se chiusa, fin tanto che l'utente non attiva un gruppo diverso.



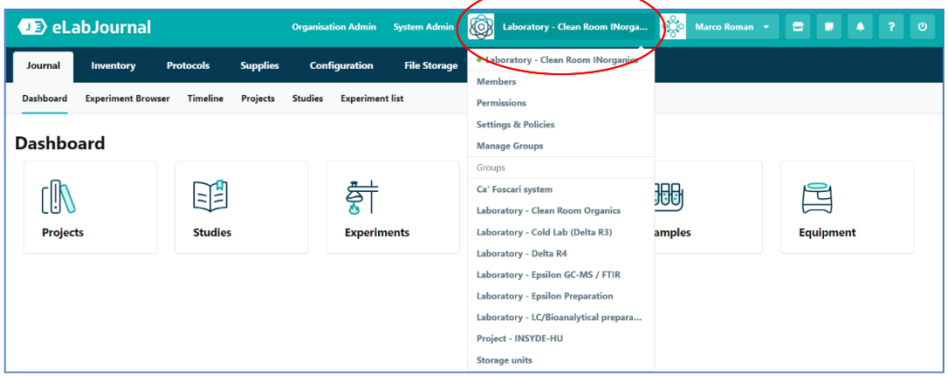
- (Tornati indietro) nella schermata principale "Recent activity", cliccare sul tool di scansione QRcode in basso a destra. Scansionare il QRcode "Booking CR" esposto sulla porta esterna della CR.

- Nella schermata di gestione della facility denominata "Equipment", cliccare sull'icona del calendario in alto a destra sul banner blu.
- Nella schermata del calendario "Reservations" è possibile effettuare la prenotazione cliccando sia su "Add reservation" in basso a destra, che direttamente sul calendario stesso.
- Nella schermata di prenotazione "Add reservation" è obbligatorio compilare il campo "Description" riportando:
    - i nominativi di tutti gli altri utenti (oltre al prenotante) che eventualmente parteciperanno alla stessa sessione, e in particolare degli studenti e tirocinanti, in quest'ultimo caso indicando se opereranno da soli. È in ogni caso possibile per utenti diversi prenotare in modo indipendente l'occupazione della CR in slot temporali sovrapposti.
    - In due parole, una descrizione dell'attività da svolgere
- Se sono già state effettuate prenotazioni via App in precedenza, sarà possibile accedere al calendario della CR anche dalla scheda "Scan History" della schermata principale dell'App.
- Le prenotazioni sono editabili e cancellabili operando sulle stesse schermate.

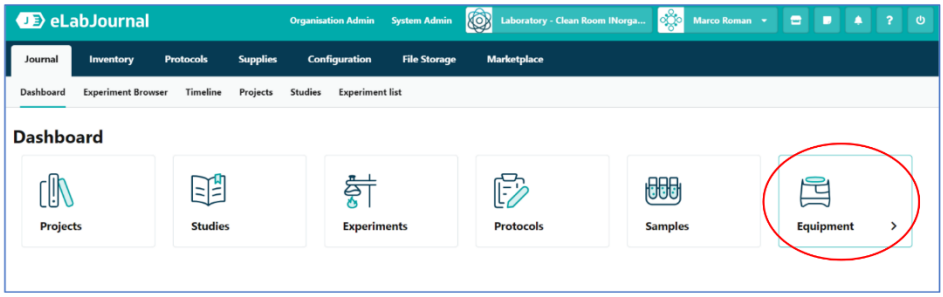


B) Da desktop/applicativo web

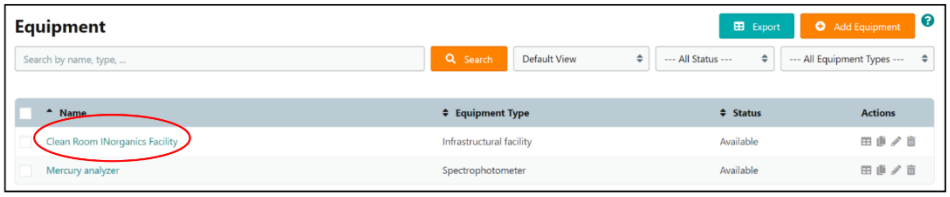
- Collegarsi all'applicativo: https://unive.elabjournal.com/ ed effettuare il login. Alla richiesta di inserimento credenziali scegliere il login istituzionale – Ca' Foscari, verrete reindirizzati alla pagina di login unive in cui potete inserire le credenziali dell'account unive già in vostro possesso.
- Nella schermata principale dell'applicativo, individuare il banner superiore azzurro chiaro e verificare che il Gruppo attivo sia "Laboratory – Clean Room INorganics ". In caso contrario è possibile cambiare il Gruppo attivo cliccando sul pulsante e scegliendo dal menu a tendina. Ciascun utente è abilitato a una diversa lista e composizione dei Gruppi attivabili.



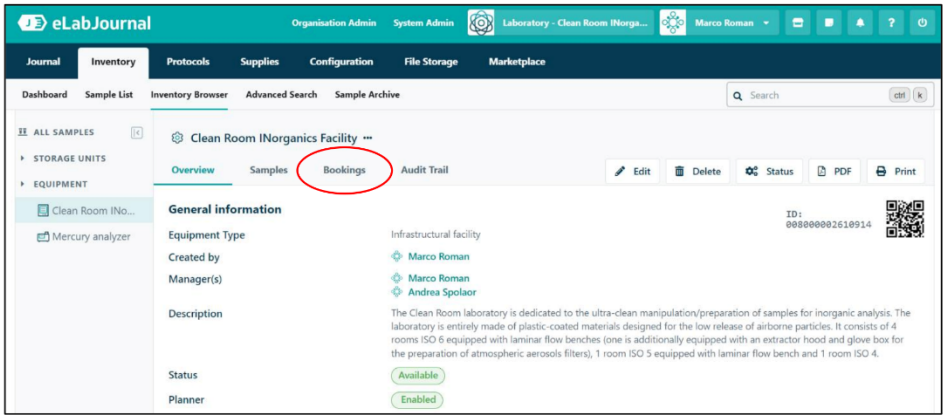
- Nella schermata principale (Dashboard) cliccare sul pulsante “Equipment”.

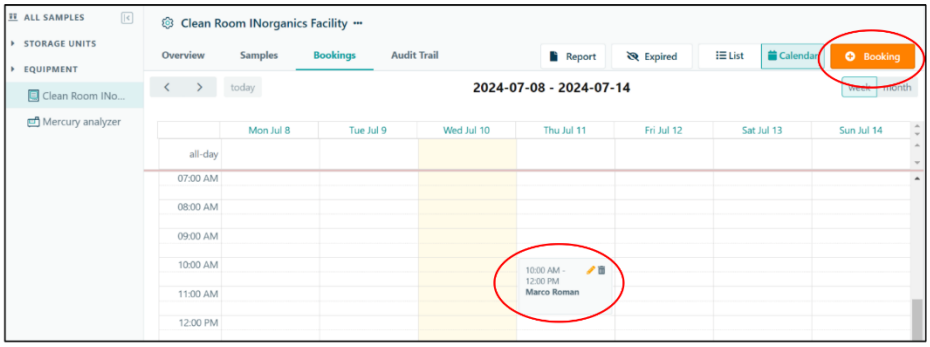


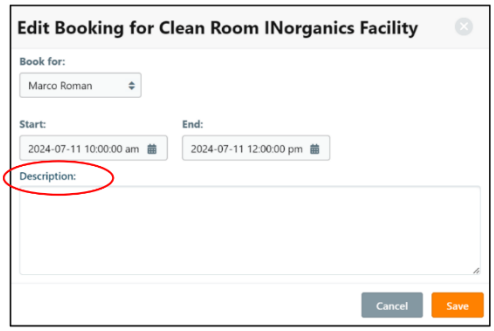
- Nella schermata successiva, cliccare sulla voce “Clean Room INorganics Facility”.



- Nella schermata successiva sono visualizzate le info sulla CR. Cliccando su “Bookings” si accede al calendario di prenotazione. È possibile effettuare la prenotazione cliccando sia su “Booking” in alto a destra, che direttamente sul calendario stesso.
- Nella schermata di prenotazione (attivabile anche cliccando sulla matita nello slot prenotato) è obbligatorio compilare il campo “Description” riportando:
    - i nominativi di tutti gli altri utenti (oltre al prenotante) che eventualmente parteciperanno alla stessa sessione, e in particolare degli studenti e tirocinanti, in quest’ultimo caso indicando se opereranno da soli. È in ogni caso possibile per utenti diversi prenotare in modo indipendente l’occupazione della CR in slot temporali sovrapposti.
    - In due parole, una descrizione dell’attività da svolgere
- Le prenotazioni sono editabili e cancellabili operando sulle stesse schermate.


eLabJournal
Organisation Admin
System Admin
Laboratory - Clean Room INorga...
Marco Roman
Journal
Inventory
Protocols
Supplies
Configuration
File Storage
Marketplace
Dashboard
Sample List
Inventory Browser
Advanced Search
Sample Archive
Search
ALL SAMPLES
STORAGE UNITS
EQUIPMENT
Clean Room INo...
Mercury analyzer
Clean Room INorganics Facility
Overview
Samples
Bookings
Audit Trail
Edit
Delete
Status
PDF
Print
General information
ID:
Equipment Type
Infrastructural facility
Created by
Marco Roman
Manager(s)
Marco Roman
Andrea Spolaor
Description
The Clean Room laboratory is dedicated to the ultra-clean manipulation/preparation of samples for inorganic analysis. The laboratory is entirely made of plastic-coated materials designed for the low release of airborne particles. It consists of 4 rooms ISO 6 equipped with laminar flow benches (one is additionally equipped with an extractor hood and glove box for the preparation of atmospheric aerosols filters), 1 room ISO 5 equipped with laminar flow bench and 1 room ISO 4.
Status
Available
Planner
Enabled


ALL SAMPLES
STORAGE UNITS
EQUIPMENT
Clean Room INo...
Mercury analyzer
Clean Room INorganics Facility
Overview
Samples
Bookings
Audit Trail
Report
Expired
List
Calendar
Booking
today
2024-07-08 - 2024-07-14
week
month
Mon Jul 8
Tue Jul 9
Wed Jul 10
Thu Jul 11
Fri Jul 12
Sat Jul 13
Sun Jul 14
all-day
07:00 AM
08:00 AM
09:00 AM
10:00 AM
11:00 AM
12:00 PM
10:00 AM - 12:00 PM
Marco Roman


Edit Booking for Clean Room INorganics Facility
Book for:
Marco Roman
Start:
2024-07-11 10:00:00 am
End:
2024-07-11 12:00:00 pm
Description:
Cancel
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ANNEX 6 – FAIR DATA IMPLEMENTATION PROFILE (FIP) MINI-QUESTIONNAIRE DRAFT

Community description	
Name of Community	Centre for Trace Analysis (CeTrA) - Environment Data Repository
Description of Community	A repository to store environmental data generated by the Centre for Trace Analysis (CeTrA)
Supporting Links	https://datarepository.unive.it/dataverse/cetra-environment
Research Domain	Main: Analytical Chemistry; other: Environmental Chemistry, Atmospheric Sciences
Data Steward	Internal
Date of FIP creation	- *tbd* -

	FAIR Enabling Resource (FER)	
Question	**Name**	**URI**
F1 MD	DataCite DOI Resolution Service	http://purl.org/np/RATn3tHBlRq3NMNC67hGGrwX4v18uhr7uaBwRT1krJEHs#DataCite_DOI_Resolution_Service
F1 D	DataCite DOI Resolution Service	http://purl.org/np/RATn3tHBlRq3NMNC67hGGrwX4v18uhr7uaBwRT1krJEHs#DataCite_DOI_Resolution_Service
F2	DC | Dublin Core	http://purl.org/np/RApwFvegOdPfNuKlF64wctAzaffAv3j_2kAU9y6kfBoy8#DCMI
F2	Schema.org	https://w3id.org/np/RAXKj086gOTnOBnbQShZlh7Stz6ahqaWRKxf3dMq6M2oM#Schema.org
F3	DataCite | DataCite Ontology	http://purl.org/np/RANGw57Qlx5BklwMWCP1srqv4KG1o1I8cvA2IRaHq_HDg#DataCite
F3	JSON LD	
F4 MD	The Dataverse Project	http://purl.org/np/RAyf2JdAuOzQR2Jzdz4HrrgjHJVHWCotJvFcmLihHvi3k#Dataverse
F4 D	The Dataverse Project	http://purl.org/np/RAyf2JdAuOzQR2Jzdz4HrrgjHJVHWCotJvFcmLihHvi3k#Dataverse
A1.1 MD	OAI-PMH Schema | Open Archives Initiative Protocol for Metadata Harvesting Schema	http://purl.org/np/RAnwFn9lcKK8S2tccnwPZJw-0_hF5N03BL-8BuchPHtvQ#OAI-PMH
A1.1 D	SWORD | Simple Web-service Offering Repository Deposit (SWORD) API (v2.0)	http://purl.org/np/RArO-JI6-z6G-wVk636iGn-Zz8_amE8-7RnqaSrBwM5mg#SWORD-API-v2.0
A1.2 MD	SWORD | Simple Web-service Offering Repository Deposit (SWORD) API (v2.0)	http://purl.org/np/RArO-JI6-z6G-wVk636iGn-Zz8_amE8-7RnqaSrBwM5mg#SWORD-API-v2.0
A1.2 D	HTTPS | Hypertext Transfer Protocol Secure	http://purl.org/np/RAF1ANn-BCFop0OBMOC7S8NtG0y_xYhRX4tAu37XZVCo0#HTTPS
A2	DataCite DOI Policy	http://purl.org/np/RA4rdLbzwrBDZzdvLVophtrDEQVvevvzou3dihHRZzH4o#datacite-doi-policy
I1 MD	eXtensible Markup Language (XML)	https://w3id.org/np/RAQLETXaxPTEvZdt7Cx761TwcHLzBKPF3J6bM5YCY2llY#XML
I1 D	JSON Schema | JavaScript Object Notation Schema	http://purl.org/np/RAlLCugRZltIBCt_KATatwxJrkdDfxC3EDbCHML172Bhl#JSON_Schema
I2 MD	GCMD Keywords | Global Change Master Directory Keywords	http://purl.org/np/RAhixhioRuOn3wpxcLB9oO2sIP98gkaMc5zEcimd9KH5Y#GCMD
I2 D	Paleoenvironmental Standard Terms	https://w3id.org/np/RA2xnez6J51G8LuPqJSbAZBD1IVr-V3TlIYNIqHWNBZQk#PaST
R1.1 MD	CC BY-NC-SA 4.0 | Attribution-NonCommercial-ShareAlike 4.0 International	http://purl.org/np/RAzULQmwy3wZ8laY-ZKZ3kXGmAihweBvKMU70RR638804#CC-BY-NC-SA-4.0
R1.2 MD	DataCite Metadata Scheme	http://purl.org/np/RAko0U2Q8boW-drM8t11DcbX6lxu2mcSQf-2BrM07geIQ#datacite_metadata_scheme
R1.2 D	DataCite Metadata Scheme	http://purl.org/np/RAko0U2Q8boW-drM8t11DcbX6lxu2mcSQf-2BrM07geIQ#datacite_metadata_scheme

	Replacement FER			
Question	**Usage**	**Name**	**URI**	**Considerations**
F1 MD	currently in use			
F1 D	currently in use			
F2	currently in use			
F2	currently in use			
F3	currently in use			The data repository also supports "OAI-PMH" and "Schema.org JSON LD metadata"
F3	currently in use			
F4 MD	currently in use			The data repository is based on the DataVerse Project; datarepository.unive.it
F4 D	currently in use			
A1.1 MD	currently in use			
A1.1 D	currently in use			
A1.2 MD	currently in use			
A1.2 D	currently in use			
A2	currently in use			
I1 MD	currently in use			
I1 D	currently in use			
I2 MD	currently in use			
I2 D	currently in use			
R1.1 MD	to be replaced	CC BY 4.0 | Attribution 4.0 International	http://purl.org/np/RAQ__sGdY_Qc7l1O_zmn4nr-pMBOxKU04Ur9s998rS6Fc#CC-BY-4.0	
R1.2 MD	currently in use			
R1.2 D	currently in use			

ANNEX 7 – HOLTEDALFONNA 2023 FIELD CAMPAIGN

Finanziato dall'Unione europea NextGenerationEU | Ministero dell'Università e della Ricerca | Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA | Università Ca'Foscari Venezia

Technical report

ITINERIS operations during the Holtedalfonna 2023 drilling campaign

05-06-2023

Daniele Zannoni

Introduction

An ice core drilling campaign was carried out from 4 to 19 April 2023 on top of the Holtedalfonna glacier, Svalbard (NO). During the drilling campaign (HDF2023) an automatic weather station (AWS) and a low-cost sensors (LCS) unit have been installed in the remote camp in the framework of the ITINERIS project. The aim of the test was to benchmark the AWS and LCS durability and usability in harsh environment. The results of the test are reported in this document while the full datasets are going to be integrated into the upcoming CeTrA repository.

Description of the instrumentation

The AWS tested is a commercial VantagePro2 (Davis Instruments), property of the Department of Environmental Sciences Informatics and Statistics (DAIS) of the Ca' Foscari University of Venice. The AWS is equipped with Temperature (T), Relative Humidity (RH), Pressure (P), Wind Speed (WS) and Wind Direction (WD) transducers. The AWS also includes a remote console unit which enable the user to continuously monitor and log the weather data. The data stored inside the console unit can be accessed by a USB cable using proprietary software (WeatherLink). The AWS and the console communicate via radio at 433 MHz. Weather data was saved with 1 minute resolution.
The LCS unit is a prototype built for the Marie Skłodowska-Curie project PIONEER which allows to simultaneously measure O_3, CO_2 and particulate matter (PM) concentration in air. The prototype is enclosed into an IP66 case which only requires 5V alimentation provided through a waterproof connector. The LCS unit communicates over WIFI to a recording device via MQTT. The recording device during the campaign was a common cellular phone running Android OS and a custom MQTT broker. LCS data was saved with 5 seconds resolution.
As part of the project, it was also possible to use an IRIDIUM GO! unit (Norwegian Polar Institue) for email communication and daily weather forecast updates.

Description of the site

The units under test have been installed in the remote camp on the top of the Holthedalfonna glacier (79.15 N, 13.38 E; 1150 m. a.s.l.), as shown in Figure 1. The AWS was installed on top of a 2m height aluminum pole fixed into the snow with ~10kg ballast while the recording console was placed into one of the kitchen/supply tents. It was important to keep the console at reasonable temperature (>5 °C) to avoid freezing and malfunction of the LCD screen. The LCS was installed close to the kitchen tent, where a small UPS was connected to grid power from a low power generator (LPG). The recording mobile phone was also placed into the kitchen tent and left unattended for most of the time. Details of the installation of the AWS and LCS are reported in Figure 2.a and Figure 2.b. The IRIDIUM antenna was installed nearby the kitchen tent as well.

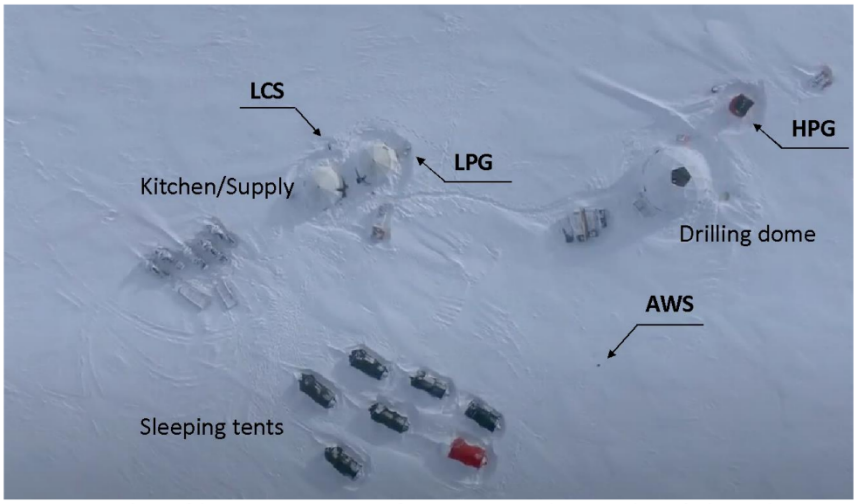

Figure 1: Aerial view of the remote camp. Position of instrumentation under tests and main facilities in the camp.

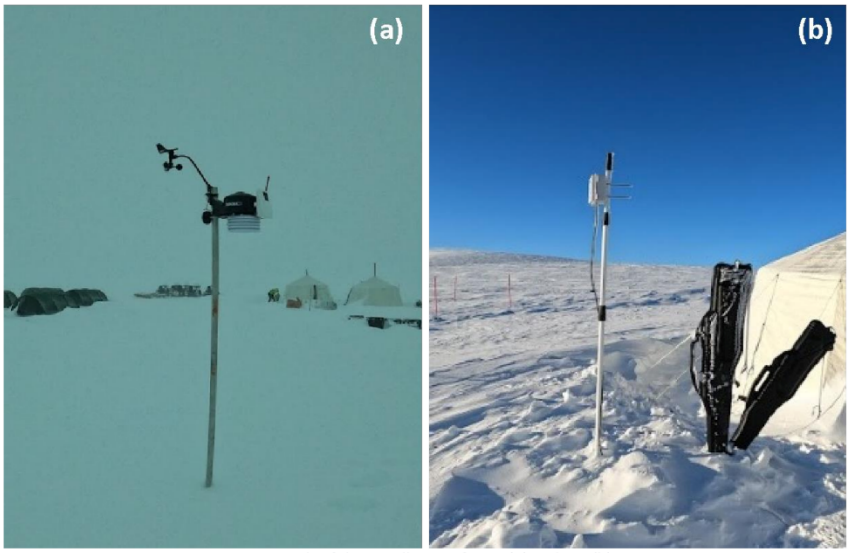

Figure 2: Details of the installation of AWS (a) and LCS (b) units.

Description of the activities

The field activities can be summarized as follows:

- 04 April, installation of the AWS and LCS units.
- 04 to 18 April recording of AWS data with manual collection from the console (~daily frequency)
- 04 to 13 April recording of LCS data with automatic backup of the data on mobile phone.
- 04 to 18 April daily update of the weather forecast via IRIDIUM and daily update of the weather conditions on top of HDF glacier to the base camp in Ny Ålesund.

- 19 April uninstall of the AWS and LCS units.

Results: AWS data

As shown in Figure 3, the AWS recorded successfully from 4 to 18 April with only limited data interruption on 8 and 10 April. Data gaps are consistent among all the variables observed and can be attributed to AWS or recording unit malfunctioning. Especially the recording unit inside the kitchen tent worked frequently below the working temperature and might be the main cause of missing data. It is also possible to observe frequent missing data in the Wind chill, WS and RH. Such missing data are very likely due to rime frost formation on the sensors, especially stopping the anemometer, as further discussed in the "Discussion and Conclusions" section. A brief summary of the information on the data collected with the AWS is reported in Table 1.

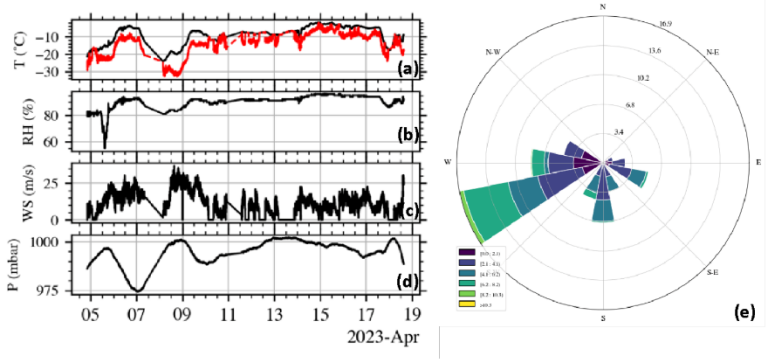

Figure 3:Meteorological observations collected with the AWS. (a) air temperature in black, Wind chill in red. (b) Relative humidity. (c) Wind speed. (d) Sea level-adjusted atmospheric pressure. (e) Wind direction reported as wind rose.

Table 1: Summary of the AWS data.

Parameter	
Deployment Duration	13 days and 18.7 hours
Number of Variables	6
Number of Data Points for Each var.	17755
Missing Data	18.9 hours (8 April) 15.8 hours (10 April)
Data Quality	High
Data Size	0.881 MB

Results: LCS data → Data need conversion/calibration

As shown in Figure 4, the data collected by the LCS station shows the same missing data of the AWS (8 and 10 April), with an extra missing data window between 11 and 14 April because of repeated LPG failure and electrical power loss. The O_3 and the PM sensors survived after the first data interruption (8 April) while the CO_2 sensor retrieved no meaningful data after 8 April 4:50 (UTC). The O_3 data shows scattered outliers, mostly concentrated on 9 April, when WS was in general high (> 15 m/s). The PM sensor shows good agreement among the concentrations of the three different aerodynamic particle sizes.

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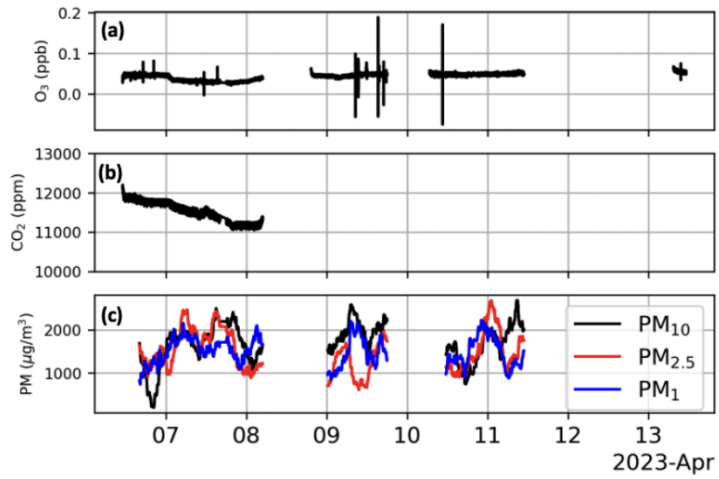

Figure 4: Data recorded by LCS station. (a) O_3, (b) CO_2, (c) PM with different aerodynamic diameters (moving average, 8 hours window).

Table 2: Summary of the LCS data.

Parameter	
Deployment Duration	13 days and 18.7 hours
Number of Variables	5
Number of Data Points for Each var.	68167 (O_3) 28826 (CO_2) 68162 (PM)
Missing Data	**O_3 and PM** 18.9 hours (8 April) 15.8 hours (10 April) 44.5 hours (11-12 April) **CO_2** Data loss after 8 April 4:50 (UTC)
Data Quality	Medium (O_3) Poor (CO_2) Medium (PM)
Data Size	22.5 MB

Discussion: reliability of the hardware

Both the AWS and the LCS station proved excellent reliability under the harsh condition of the field campaign. All the instruments worked very close to the manufacturer specification in terms of temperature and RH. However, one of the most critical factors affecting the reliability of the hardware was the nearly continuous high RH conditions coupled to high WS. This enhanced the rime frost formation on both units, as shown in Figure 5. The rime frost formation caused repeated failure in the anemometer. Investigation on the status of the anemometer was performed daily (with hoar removal by hand). For the LCS station, the rime formation and the high RH/low temperature conditions seems to have a large impact on the CO_2 sensor only, which stopped measuring ~48 hours after installation. The reason of the CO_2 sensor failure is not clear,

despite a visual inspection of the LCS station suggested clogging of the sensor because of the ice buildup. The O_3 and PM sensor might be more robust than the CO_2 sensor, since they showed similar ice buildup on the external inlets without measurement failure. Usually, the LCS station should be mounted with external inlets pointing downward, however, given the nearly constant wind direction it was decided to install it pointing SW. This way, the rime frost formation was limited on the enclosure face equipped with the sensor inlets.
A visual inspection of the internal components of the LCS station (Figure 5.c) proved the good quality of the enclosure sealing, since no snow/ice was found inside the box.

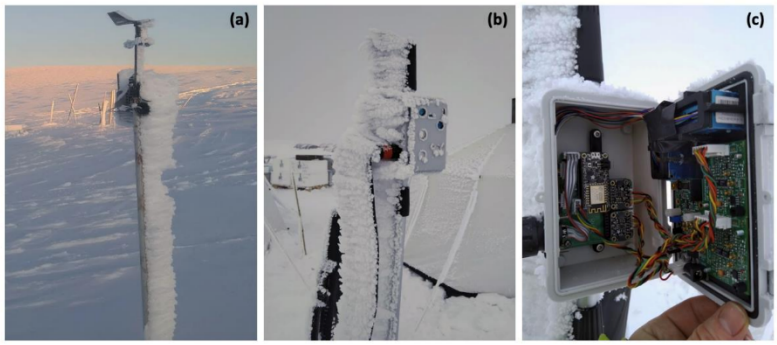

Figure 5: Equipment condition at the end of the campaign. (a) AWS. (b) LCS station. (c) Details of the inner components of LCS station.

In general, the big difference in reliability between AWS and LCS is the sensitivity to power outages. Indeed, both units are equipped with batteries (alkaline for AWS, lead acid for LCS) but the AWS showed better performances than LCS. It should be noted that the LCS is still a prototype, and a better power management/efficiency is expected in the following years.

Conclusions and perspectives

It is fair to say that the AWS produced good quality data with only small gaps for the full-time frame of the field campaign. On the other hand, the LCS provided medium quality data for O_3 and PM while very poor data quality for CO_2. It is also fair to say that the instruments under investigation was tested in harsh condition, very close to, and sometime above, the limits provided by manufactures. Especially the LCS survived for many days, still being a prototype.
The large size of the data is consistent with high frequency acquisition and might be sub-optimal for low-power low-bandwidth and long-term deployment. For long-term unattended deployment it is suggested to monitor and collect the data with hourly resolution, with an expected decrease of data size by ~2-3 orders of magnitude, as shown in Table 3.

Table 3: Measured and expected data stream. All values in kB/day.

	AWS	LCS
HDF2023 Campaign (measured)	880	3010
Long-term unattended deployment (expected)	1	4.1

It is expected to upload the AWS and LCS data collected during the HDF2023 field campaign on the CeTrA repository, which is currently under development.

ANNEX 8 – COLLE DEL LYS 2023 FIELD CAMPAIGN

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Preparatory document

Colle del Lys 2024 field campaign

Introduction and rationale

Weather data from mountain sites is extremely important because high-altitude areas can be considered reference sites of the free troposphere. Present weather data from glacier sites can also provide meaningful information for reconstruction of past climate signal archived in alpine ice cores because it can be used to calibrate the *isotope thermometer* for a specific ice core drilling site. *Colle del Lys,* within the Monte Rosa massif in the western Alps is a well-known site where several ice cores have been drilled since the '90s and where more snow-pits and drilling campaign are expected to be carried out in the future. An Automatic Weather Station (AWS) was installed near Colle del Lys for a limited time in the past. However, no AWS is currently recording any data in such area, despite the glaciological importance of the site.

A short-term ice core drilling campaign leaded by CNR-ISP will be performed from October 2nd to 26th at Colle del Lys (LYS2023). Given that CeTrA is co-managing the Col Margherita alpine observatory in the eastern alps and is currently re-enforcing its instrumental capabilities in the framework of the WP4 of the ITINERIS project, the LYS2023 field operations is a good opportunity to **extend the CeTrA-CNR-UNIVE observational capabilities in the western alps**. In this context a preliminary investigation of the site and a temporary installation of an AWS can provide meaningful data for the permanent installation of meteorological sensors and for supporting the CNR-ISP drilling team, as demonstrated for the Holthedalfonna campaign in Svalbard during March 2023 (HDF2023).

Proposed field activities

The activity proposed linked to ITINERIS during the LYS2023 campaign are:

1. Installation of AWS on top of the glacier for supporting the ice core drilling field operations. • Depending on the IRIDIUM bandwidth, it is expected to upload daily weather data to CeTrA server in Venice, where Col Margherita data is currently archived.
The HDF2023 field campaign highlighted the suitability of the Vantage Pro2 (Davis) AWS as a robust tool for acquisition of weather data in harsh polar environment. Main advantages of the Vantage Pro2 are the extremely compact and robust production and the extremely high energy efficiency-low power consumption. Therefore, a Vantage Pro2 will be used for temporary AWS installation and investigation of potential sites.

2. Investigation of a potential site for permanent installation of an AWS in the Colle del Lys area. • VHF-UHF transmission test with the nearby high-altitude mountain hut *Capanna Gnifetti* • Installation of the weather station mounting pole
Several meteorological sensors and dataloggers have been acquired within the ITINERIS project. Such equipment was meant to be used to update the instrumentation at the Col Margherita observatory and for installation of new observational locations in the alps. The sensors include air temperature, relative humidity, wind speed and direction, atmospheric pressure. Two dataloggers are available: a Campbell CR800 and CR1000x. However, LYS2023 operation is carried out collaborating with *Fondazione Montagna Sicura* (FMS), which is also interested in the AWS

installation and can provide additional equipment such as another datalogger, a battery/solar panel and transmitter.

Potential end users and data reusability

On the one hand, the weather data acquired during the campaign with the temporary AWS installation will be shared according to the FAIR principles on the data repository of CeTrA and can be used for scientific research. For instance, given the high altitude of the remote site at Colle del Lys (4150 m ASL), the short-term data will be representative of the free troposphere and can be used, together with data available on the valley floor to study boundary layer dynamics (see vertical pilot of ITINERIS 4.15, Atmospheric boundary layer height). On the other hand, the permanent installation of an AWS in the Colle del Lys region can provide meaningful data for the calibration of the isotope thermometer for future snow pits that are regularly performed in that area. Moreover, the permanent installation of the AWS in collaboration with FMS opens possibility to target a larger audience among general public for mountain safety purposes.

ANNEX 9 – COLLE GNIFETTI 2024 FIELD CAMPAIGN

Finanziato dall'Unione europea NextGenerationEU | Ministero dell'Università e della Ricerca | Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA | Università Ca'Foscari Venezia

Preparatory document

Colle Gnifetti 2024 field campaign

Introduction and rationale

Convection and vertical mixing in the low atmosphere are to large extent driven by the vertical air temperature gradient. As the latter affects the stability of the atmosphere, it is a key factor to consider for estimating the transport and dilution of pollutants. Still, the associations between vertical gradients of temperature and pollutants in the lower troposphere are challenging to get because they need observation sites at different elevations within a limited geographical distance. High elevation sites on mountains fulfill this requirement at the cost of addressing several logistical issues such as the lack of adequate power supply and harsh conditions, that can affect the instrumental reliability. In this project we will install two Automatic Weather Station (AWS) and two Low-Cost Sensors (LCS) for particulate matter analysis at the Mount Rosa massif, to get one full week of weather and particulate matter concentration data at two different altitudes. We will take advantage of the short-term ice core drilling campaign leaded by CNR-ISP that will be performed from June 12th to 30th at Colle Gnifetti (Gniff2024) to temporarily install one AWS and one LCS at the drilling site at 4456 m asl. A second AWS and LCS will be installed at the logistics headquarter in Alagna (Rifugio Sant'Antonio) at 1380 m asl.

The Gniff2024 field operations are not only a unique opportunity to test the reliability of the AWS and LCS equipment acquired with ITINERIS in harsh condition, but it will also enable CeTrA to obtain an interoperable dataset of high value , to be shared and used for pollution studies in mountain environment, for example for evaluating transport models of pollutants across topography complex areas. Eventually, the project can also be a pilot study to test the new data transfer system from LCS to the new database of UNIVE linked to the MRG atmospheric observatory in the eastern Alps.

Proposed field activities

The proposed activities linked to ITINERIS during the Gniff2024 campaign are basically two:

1. Installing one AWS on top of the glacier, for supporting the ice core drilling field operations, and one AWS at low altitude, nearby the head quarter. ○ The AWS will log the data internally. Data will be collected daily and uploaded manually on a dedicated repository.
The HDF2023 and LYS2023 field campaigns highlighted the suitability of the Vantage Pro2 (Davis) AWS as a robust tool for acquisition of weather data in harsh polar and high-altitude environments. Main advantages of the Vantage Pro2 are the extremely compact and robust production and the extremely high energy efficiency-low power consumption. Therefore, the Vantage Pro2 will be used for both sites.
2. Installation of one LCS on top of the glacier and one LCS at low altitude, nearby the base camp. ○ The LCS will stream the data continuously across the internet using MQTT protocol. Data will be sent to a database.
The particulate matter LCS (Pioneer MSCA, Federico Dallo) are equipped with a 2.4GHz WiFi module that enable the LCS to communicate over the internet. Internet connection on the top of Mount Rosa will be provided by an IoT internet connection (4G/LTE, Mobile Things) that is operational both in Italy and Switzerland. The internet connection in Alagna will be provided by Rifugio Sant'Antonio.

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The following Figures 1 and 2 schematize the expected configuration of the field installations at the top of Mount Rosa and in Alagna, respectively.

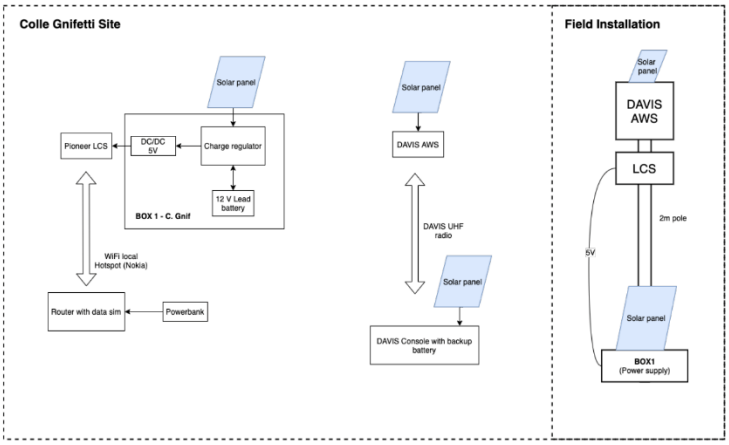

Figure 1: Sketch of Colle Gnifetti measurement setup.

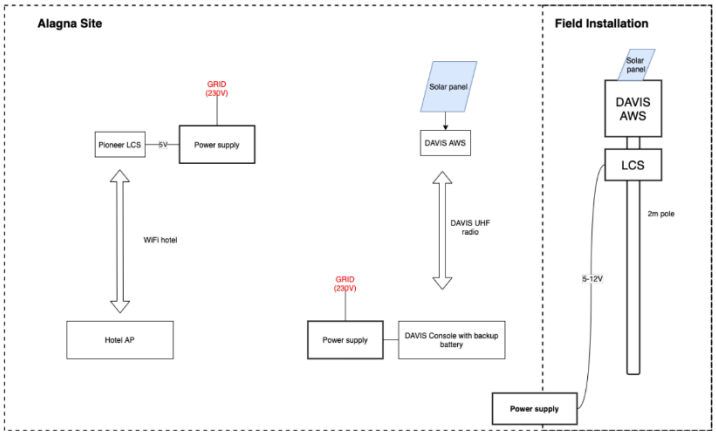

Figure 2: Sketch of measurement setup in Alagna

As shown in Figure 1 and 2, the two sites have very similar setup overall, but different designs of the power supply systems: the high-altitude site will include mostly/only solar panels, while power from the grid will be available in Alagna.

Potential end users and data reusability

The weather and particulate matter data acquired during the campaign will be made accessible to the ITINERIS network according to the FAIR principles through the CeTrA Dataverse, part of UNIVE Datarepository. Potential users of this specific dataset can be atmospheric and environmental scientists that need observational data to benchmark particulate transport models in mountain areas.

ANNEX 10 – SODANKYLA 2024 FIELD CAMPAIGN

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Preparatory document

Development of novel tools for the characterization of water vapor in the atmospheric boundary layer: Sodankyla field campaign and training

Introduction and rationale

This document outlines the second phase in developing a novel sampler designed to characterize the vertical and spatial variability of water vapor isotopic composition in the troposphere. The primary objective of this sampler is to provide robust measurements of water vapor isotopic composition, supporting weather studies and remote sensing validation. The remote sensing community, as emphasized at the ATMOS2024 international conference hosted by the European Space Agency (ESA), has prioritized satellite data validation for the Sentinel missions.

Following the proposal submitted on April 18, 2024 (Step 1), the team composed of members from the University of Venice (UNIVE) and the Geophysical Institute (GFI) of the University of Bergen (UiB) successfully designed the first prototype of a surface sampler. This prototype, used in conjunction with a vertical profiler, can provide a comprehensive snapshot of the spatial distribution of water vapor isotopic composition around the launch site (Figure 1.a).

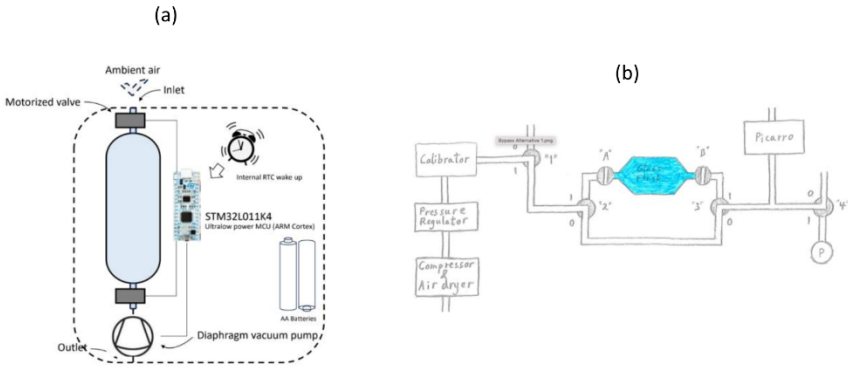

Figure 1: (a) Sketch of the surface sampler that uses the same flasks of the vertical profiler. **(b)** Sketch of the measurement setup for analyzing the water vapor isotopic composition inside one of the profiler and/or surface flask.

At the same time, the sampler designed to probe the vertical isotopic composition of the troposphere (the vertical profiler) was completed by the Finnish Meteorological Institute (FMI) and tested at the Geophysical Institute of the University of Bergen (GIF-UiB). Notably, both the vertical profiler and the surface sampler utilize the same type of sampling material and method, specifically employing glass flasks to sample atmospheric air and the water vapor contained therein. A sketch of the configuration used to measure the water vapor content in the flask is shown in Figure 2.b.

The primary objective of the fieldwork activity scheduled for July-August 2024 is to train participants in analyzing the water vapor content of flasks using the Picarro water vapor isotope analyzer. This will be achieved by participating in the upcoming field campaign of the ESA project "Water Vapour Isotopologue Flask Sampling for the Validation of Satellite Data" (WIFVOS), which will take place at the Arctic Space Centre of FMI in Sodankylä, Lapland, Finland. Additionally, the field campaign will provide an excellent opportunity for CeTrA personnel to acquire new knowledge about weather balloon launching for atmospheric studies and to practice other emerging techniques, such as the use of *AirCore* Atmospheric Sampling System[1].

Proposed activities for step 2 and expected results.

The following activities will be carried out by UNIVE personnel, in accordance with the field campaign design by FMI and the ITINERIS OBJ3 (Pilot service on Planetary Boundary Layer height):

1. Setup the measurement rack for flask analysis
The measurement rack will be set up in collaboration with a technician from GFI-UiB. This system is designed to provide highly reliable measurements of the water vapor isotopic composition inside the flask at both ambient and mid-tropospheric pressure. This setup phase will enable UNIVE personnel to independently set up the measurement rack for future field campaigns.
2. Analyze the $\delta^{18}O$ and δD isotopic composition of water vapor sampled with the vertical profiler
The UNIVE - UiB team will support the FMI campaign by analyzing the isotopic composition of the water vapor collected with the vertical profiler. FMI is expecting to use the same flask sampling system on weather balloons, to retrieve the full tropospheric profile, but also on drones, to retrieve the isotopic composition of water vapor in the lower troposphere.
3. Test the feasibility of Air Cores technique for water vapor analysis
AirCore is a sampling system developed at NOAA to obtain vertical profiles of greenhouse gasses (CO_2 and CH_4) concentration in the atmosphere. UNIVE and the University of Bern (UNIBERN) have already carried out successful independent testing of AirCore on synthetic water vapor profiles (unpublished data). This campaign will be an opportunity to collect real AirCore data and to compare it with the vertical profiler and with FTIR remote sensing, being Sodankyla a Reference Site of the Total Carbon Column Observing Network (TCCON).

It is worth noting that the participation of UNIVE CeTrA in this campaign will foster new connections with other institutions involved in the field of remote sensing, such as FMI, UNIBERN, and ESA in general.

[1] https://gml.noaa.gov/ccgg/aircore/