



D4.2.2: Progress report on the acquisition of equipment that will be integrated in the facilities of CNR ISAC Bologna OU and harmonized with the network. [B8]



Deliverable number:	D4.2.2
Work package:	WP4 – Atmosphere
Intermediate Objective:	IO4.4
Deliverable type:	<input checked="" type="checkbox"/> Document, report
	<input type="checkbox"/> Websites, patent filings, videos, etc.
	<input type="checkbox"/> Other: please specify
Dissemination level:	<input checked="" type="checkbox"/> Public
	<input type="checkbox"/> Restricted
Estimated delivery (bimester):	B8
Actual delivery date:	29/02/2024
Author(s) (Partner-OU):	Ferdinando Pasqualini, Angela Marinoni, Luca Di Liberto, Laura Renzi, Serena Zaniboni (CNR-ISAC)
Reviewed by:	Lucia Mona, Gianluca Di Fiore (CNR-IMAA)
Note:	

IR0000032 – ITINERIS, Italian Integrated Environmental Research Infrastructures System - CUP B53C22002150006 (D.D. n. 130/2022)
 Funded by EU - Next Generation EU
 Mission 4 “Education and Research” - Component 2: “From research to business” -
 Investment 3.1: “Fund for the realization of an integrated system of research and innovation infrastructures”

Table of contents

1. INTRODUCTION.....	4
2. CNR ISAC ATMOSPHERIC OBSERVATORIES AND ROLE IN ATMOSPHERIC RIS.....	5
3. UPGRADE OF CNR-ISAC-BO GROUND BASED AND MOBILE OBSERVATORIES.....	5
4. PROCEDURES FOR THE PERSONNEL.....	6
5. EQUIPMENT PROCEDURES.....	6
6. CONCLUSIONS.....	10
ANNEX 1 – UPDATED LIST OF CNR-ISAC BO INSTRUMENTS.....	11
ANNEX 2 – FULL LIST OF CNR-ISAC BO INSTRUMENTS IN ACQUIRED WITHIN ITINERIS.....	13

Index of tables

Table 1: Procedures completed in 2023.	7
Table 2: Procedures published, for which the successful bidder has been identified in 2023.	7
Table 3: Procedures published, for which the bidder identification is in progress.	7
Table 4: Procedures that will published in 2024.	8

1. INTRODUCTION

This deliverable is prepared in the context of the ITINERIS project, within the Work Package 4 that deals with the integration of Research infrastructures working in the atmospheric domain through synergistic approaches and cross boundaries developments.

This deliverable reports the progress report on the acquisition of equipment that will be integrated in the facilities of CNR ISAC Bologna OU and harmonized with the network, in the frame of the Task 4.2. The main aim of Task 4.2 is the instrumental strengthening of the observational capacity of the Po Valley Observatories and of mobile exploratory platforms (AEROLAB), to reinforce the Italian contribution to the following Research Infrastructures: ACTRIS, EUFAR, ICOS. Concerning ACTRIS RI, we are extending the observations to the cloud in-situ and reactive gases remote sensing components and will extend the observational capabilities of mobile platforms. The historical observatory of Monte Cimone is mainly devoted to the in-situ components, while the remote sensing measurements have been more recently improved in the Po Valley sites (Bologna and San Pietro Capofiume). Regarding ICOS RI, we will assure a long-term commitment of GHG observations in the northern Italy by implementing new greenhouse gas (GHG) instrumentations. Moreover, we are extending the observational capacities to CO₂ and CH₄ isotopologues as well as to column-averaged abundances of the main GHGs.

The aim of the Deliverable is mainly linked to the scientific activities allowing the study of the impact of the atmospheric boundary layer height on aerosol and trace gases concentration in the lowermost levels (Activity 4.14). The in-situ observation upgrade concerns both near sea level and high-altitude sites. The AEROLAB mobile platform, that only has in-situ observations, will be equipped with remote sensing instruments, following the RI recommendations.

One of the main scientific goals is to couple and derive dependences among pollutants concentration in the main urban areas, related to AQ issues, and the ABL height. The development of new tools is foreseen making use of some previously collected database related to ACTRIS ("Monte Cimone with Po Valley facilities" observation node (CMN-PV)) and two RI-URBANS sites, Milano (CNR and Linate). Developed tools can be applied to the long-term continuous data set in the frame of ACTRIS RI. The tool can also become a prediction tool, in the context of 100% digital outcome of the ITINERIS project.

The Total Carbon Column Observing Network (TCCON) is a network of ground-based Fourier Transform Spectrometers (FTIR) recording direct solar spectra in the near-infrared spectral region, over the whole planet. The international Network for the Detection of Atmospheric Composition Change (NDACC) is composed of more than 70 globally distributed, ground-based, remote-sensing research stations with more than 160 currently active instruments. The CNR-ISAC-BO OU will acquire a Fourier transform infrared FTIR NDACC-TCCON compliant instrument, filling the gap of lacking GHG measurements in the Po Valley. These kinds of observations are missing, more generically, in a vast area covering the Central and Northern part of the Italian peninsula. The instrument will record direct solar spectra in the near-infrared spectral region and will allow the retrieval of accurate and precise column-averaged abundance of the most important atmospheric GHGs.

The document is structured in five different chapters. Annexes and references are reported at the end of the document.

2. CNR ISAC ATMOSPHERIC OBSERVATORIES AND ROLE IN ATMOSPHERIC RIS

The "Monte Cimone with Po Valley facilities" observation node" (CMN-PV) is an integrated site that provides a three-dimensional characterization of one of the most critical hot spots in Europe for climate and air quality. The CMN-PV Node includes the CNR observatory of Monte Cimone (2165 m s.l.m.), the unique global GAW-WMO station in Italy, the urban site of Bologna located within the CNR campus, and the rural site of San Pietro Capofiume. At these observatories, observations of polluting and climate-altering atmospheric compounds are performed since 20 years, also in collaboration with other Italian and international Institutions.

Since 2006, the CNR-ISAC Bologna Unit has been involved in European projects for the integration of atmospheric observations (aerosols, gases and clouds) into networks distributed throughout Europe. This integration contributes to a reliable and sustainable operational service in support of air quality policies, long-range transport of pollutants and climate change. The institute also has a decadal experience in the synergic use of remote sensing and in situ measurements of aerosol, gases and clouds. Moreover, the CNR-ISAC Bologna Unit is in charge for the operations of the ICOS atmospheric class-2 site CMN-IT. Within the European ICOS atmospheric network, this site represents a valuable location to monitor the net carbon fluxes occurring within the PBL of the northern Italy.

Within EU projects, in particular ACTRIS-2 and ATMO-ACCESS, the CMN-PV station has been selected among the sites that provide transnational access, offering high technical and scientific skills and advanced instrumentation, using "state-of-the-art" instruments for field campaigns and instrumental prototypes testing.

Moreover, a mobile laboratory (AEROLAB, a mobile platform compliant to ACTRIS requirements) is available at ISAC to characterize the aerosol optical and physical properties, in different locations, especially on the Italian territory, in order to integrate the permanent observatories time series. Its observational capabilities were used in several field campaigns across the Country addressing aerosol related problems.

The list of current available instruments is included in the *Error! Reference source not found.*. The upgrade foreseen or ongoing within ITINERIS is listed in ANNEX 2.

3. UPGRADE OF CNR-ISAC-BO GROUND BASED AND MOBILE OBSERVATORIES

The main needs for the observatories' maintenance are linked both to human capital and technical infrastructure.

Human capital

Human resources are the key factor for the long-term sustainability of the RIs. A lot of efforts have been dedicated to the scouting and selection of suitable personnel. From May 2023 to January 2024, 13 units of personnel have been hired for the ITINERIS activities; we wish a possible integration with permanent position of a non-negligible fraction of the enrolled personnel.

Technical infrastructure

The sustainability of the observations is linked to a good state and continuous maintenance of instrumentation and technical installations (electricity, LAN connection, ...) at the observatories (fixed and mobile). There is the need to implement the observatories, with electrical and network connections, UPS, gas inlet and aerosol inlet compliant with the recent standard operating procedures

defined in the ACTRIS network. Moreover, the FTIR RS instrument for vertical profiling of atmospheric gases needs a new building for an adequate deployment.

In order to achieve the main scientific goals of ITINERIS project, it is crucial to strengthen the observational capacity of the ISAC-BO observatories, in terms of data continuity and new variables to be measured. For these reasons, the OU ISAC-Bologna planned to purchase some instruments as backup in case of failure of the existing instrumental assets, such as aethalometers, nephelometer, SMPS, CRDS. Moreover, in order to achieve a deeper characterization and comprehension of processes affecting the air mass ageing we considered the need of new observation devoted to observing the aerosol, trace gases and cloud with both in-situ and remote sensing techniques. In particular, the unit of Bologna envisages the extension of observation capacity to cloud in-situ component, with a fog monitor, a Ice Nuclei analyser and a cloud sampler, to be installed at Monte Cimone. An SP-2 will give additional information on the black carbon mixing state and ageing processes affecting the air masses reaching Monte Cimone. Moreover, a deep implementation of AEROLAB mobile platform will be extended to the remote sensing component, in order to observe the atmospheric profiling over different environments on the Italian territory and apply the tools under development in the frame of 4.14 activity (impact of PBL on the in situ concentrations) in different areas over Italy.

4. PROCEDURES FOR THE PERSONNEL

Four positions for personnel with the profile of Technologist (III level CNR) have been hired on Activity 4.2. During 2023, the hiring procedures were all concluded: the calls have been published on December 27th 2022 with a deadline on January 26th 2023. An average of 12 applications for each call have been recorded. Evaluation committees have been nominated and selections were conducted during March following the CNR rules.

On May 15 2023 Ferdinando Pasqualini has been hired, and Laura Renzi on June 1st. Two positions were published again, because the winners did not accept the contract. The positions were published again in September and the two technologists were hired on December 15 2023 (Simonetta Montaguti) and January 8 2024 (Mattia Baglieri).

The Technologists will work in strict collaboration with the four researcher (III level) that were planned in the activity 4.14. These positions have also been published with the same competition procedure as the technologists and were hired on May 15 2023 (Alessandro Bracci, Paolo Pettinari, Nora Zannoni) and on July 24 (Marco Zanatta).

5. EQUIPMENT PROCEDURES

The Operating Unit of Bologna organized the purchase procedures at ISAC level, together with Lecce and Lamezia Terme Units. We planned 3 EU tender procedures, 3 derogation purchases for uniqueness, 20 procedures under threshold on the Italian market for public administration.

The following table (**Error! Reference source not found.**) reports the procedures completed in 2023.

Table 1: Procedures completed in 2023.

<i>INSTRUMENT DESCRIPTION</i>	<i>CPV code</i>	<i>Base price</i>	<i>PROCEDURE</i>	<i>Activity</i>	<i>Start of procedure</i>	<i>End of procedure</i>
Uninterruptible Power Supply	31680000-6	75.000€	AD	4.2	B3	B6
Solar Lunar sunphotometer	38340000-0	55.000€	AD	4.14	B3	B9
Platforms for data analysis	30230000-0	20.000€	Mepa RdO	4.2	B3	B7
Upgrade mobile lab for data acquisition, air conditioning and meteorological detection	38340000-0	10.000€	Mepa RdO	4.2	B3	B5

The following table (**Table 2**) reports the procedures published, for which the successful bidder has been identified in 2023.

Table 2: Procedures published, for which the successful bidder has been identified in 2023.

<i>INSTRUMENT DESCRIPTION</i>	<i>CPV code</i>	<i>Base price</i>	<i>PROCEDURE</i>	<i>Activity</i>	<i>Start of procedure</i>	<i>End of procedure</i>
Ceilometer	38340000-0	52.000€	AD	4.14	B3	B9
2 CPC (aerosol number concentration)	38340000-0	66.000€	AD	4.2	B3	B9

The following table (Error! Reference source not found.) reports the procedures published, for which the bidder identification is in progress.

Table 3: Procedures published, for which the bidder identification is in progress.

<i>INSTRUMENT DESCRIPTION</i>	<i>CPV code</i>	<i>Base price</i>	<i>PROCEDURE</i>	<i>Internal Organization for EU-Tenders</i>	<i>Activity</i>	<i>Start of procedure</i>	<i>End of procedure</i>
2 x nephelometers (aerosol scattering and back	38340000-0	64.000€	EU tender	EU-2-ISAC L1	4.2	B5	B11

scattering coefficient							
2 analyzers G2401 (CRDS CO, Co2, CH4) + 1 analyzer 13C (CRDS for 13C in CO2 and CH4)	38432100-3	430.000€	Unicity		4.14	B4	B11
Coupled system for cloud droplets and aerosol sampling	38340000-0	70.000€	AD		4.2	B6	B12
Calibration Unit for Volatile Organic Compounds	38340000-0	36.500€	AD		4.14	B6	B10

The following table (Error! Reference source not found.) reports the procedures that will be published in 2024.

Table 4: Procedures that will published in 2024.

<i>INSTRUMENT DESCRIPTION</i>	<i>CPV code</i>	<i>Base price</i>	<i>PROCEDURE</i>	<i>Internal Organization for EU-Tenders</i>	<i>Activity</i>	<i>Start of procedure</i>	<i>End of procedure</i>
aethalometer for black carbon concentration, BB fraction	38340000-0	40.000€	EU tender	EU-1-ISAC L1	4.2	B3	B12
CASS (Total Carbon Content ("TC"), the Elemental Carbon content (EC), the Organic Carbon content (OC) and the Black Carbon content (BC) of suspended aerosol particles in near-Real Time)	38340000-0	75.000€	EU tender	EU-1-ISAC L1	4.2	B3	B12
SP-2 D (Refractory BC, mixing state)	38340000-0	360.000€	EU Tender	EU-1-ISAC L2	4.14	B3	B13

SMPS (aerosol size distribution 10-800 nm)	38340000-0	80.000€	EU tender	EU-1-ISAC L3	4.2	B3	B12
FTIR for GHG and RGs	38432100-3	550.000€	EU Tender	EU-1-ISAC L4	4.14	B4	B12
Lidar Raymetrics	38340000-0	328.000€	EU tender	EU-1-ISAC L5	4.14	B3	B12
Fog monitor, LWC, Reff, DROPLET SIZE DISTRIBUTION	38340000-0	135.000€	EU tender	EU-3-ISAC-L1	4.2	B7	B14
Doppler Cloud radar	38340000-0	278.000€	EU tender	EU-3-ISAC L3	4.14	B7	B14
The Portable Ice Nucleation Experiment (PINE)	38340000-0	335.000€	EU Tender	EU-3-ISAC-L4	4.2	B3	B12
observatories data storage	30230000-0	20.000€	Mepa RdO		4.2	B3	B10
Webcam for internal and external visual monitoring	30230000-0	7.050€	AD		4.2	B9	B13
Meteorological probes	38340000-0	10.000€	AD		4-2	B8	B11
Aerosol sampler	38340000-0	47.500€	AD		4.2	B3	B6
Container FTIR	45214630-5	60.000€	AD		4.2	B6	B14
Installation and Management kit for Observatories	38340000-0	60.000€	AD		4.14	B6	B12
Installation and Management kit on Mobile Platforms	38340000-0	40.000€	AD		4.14	B6	B12
Aerosol inlet	38340000-0	25.000€	AD		4.14	B6	B12
Works for structural adaptation of observatories	38340000-0	50.000€	AD		4.14	B6	B12
Container aerosol in situ	38340000-0	25.000€	AD		4.14	B6	B12
Construction works for FTIR observatory	38340000-0	25.000€	AD		4.14	B6	B12
Pneumatic system (two) for sampling on the mobile platforms (AEROLAB and VOYAGER)	38340000-0	60.000€	AD		4.14	B6	B12

6. CONCLUSIONS

Thanks to the upgrade made available through the ITINERIS project, the CNR-ISAC-BO OU will deeply implement the observational capacity of both ground based and mobile platforms. Part of the instrumental and technical upgrade is already installed and operative at the Italian facilities of CMN-PV (UPS, CPCs, ...) and AEROLAB (e.g. sunphotometer, mobile upgrade, CPC, ...). We plan to install all the new instrumentation as soon as the purchasing procedures are carried out before the end of project.

The infrastructural strengthening will improve the capacity to attract new users through the access programs of ITINERIS and the EU RIs (e.g. ATMO-ACCESS). Moreover, this will develop the conditions for harmonising standards, metadata and policies amongst the different RIs, that are very diverse and on different levels of maturity but face similar challenges in their operations in regard to FAIR compliance and Access management.

7. ANNEX 1 – UPDATED LIST OF CNR-ISAC BO INSTRUMENTS

Monte Cimone

- Aethalometer Magee AE33: aerosol absorption coefficients, Black carbon, Brown Carbon, multiwavelength
- MAAP Thermo 5022 : aerosol absorption coefficients, Black carbon, scattering corrected
- Nephelometer, TSI 6735:
- Aurora 3000 Ecotech Aerosol light scattering coefficients, 3 w
- SMPS Tropos: Aerosol size-distribution (range: 10 - 800 nm)
- CPC-TSI 3772: Fine particles Number concentration
- Optical Particle Counter, GRIMM 1108: Aerosol size-distribution (range: 0.3 - 30 μm), PM10, PM2.5
- Aerodynamic Particle Sizer, TSI 3321: Aerosol size-distribution (range: 0.5 - 30 μm)
- CCN-200, Droplet Measurement Technique: CCN concentration at 6 super saturation degree
- NAIS (Neutral cluster and Air Ion Spectrometer): size distribution of neutral particles and +/- ions (range 0.8-40 nm)
- Picarro G2401 (CO₂, CH₄, CO, H₂O),
- Picarro G5310 (N₂O, CO, H₂O),
- Thermo 49i (O₃),
- Thermo 42i-TL (NO, NO₂),
- Teledyne T200UP (NO, NO₂),
- Thermo 43i-TLE (SO₂).
- ICOS Flask Sampler,
- ¹⁴C ICOS sampler,
- Calibratore Thermo 49i-PS,
- Diluitore Thermo 146i
- Celiometer Luft CHM15K.

Bologna

- Thermo 49i (O₃),
- Teledyne T200UP (NO, NO₂),
- DOAS "TROPOGAS",
- Calibratore Thermo 49i-PS,
- Diluitore Thermo 146i
- Q-ACSM for the online chemistry
- AE-33 for the equivalent black carbon concentration

San Pietro Capofiume

- DOAS “SkySpec-2D-210”
- MAAP Thermo 5022 : aerosol absorption coefficients, Black carbon, scattering corrected
- SMPS, custom built
- GRIMM EDM 164 Optical Particle Counter
- Advanced LiDAR Raimetrics LR 221-D300
- CIMEL 318 sunphotometer

Aerolab

- Aethalometer Magee AE33: aerosol absorption coefficients, Black carbon
- Nephelometer, Ecotech Aurora 3000: Aerosol light scattering coefficients
- SMPS Tropos: Aerosol size-distribution (range: 8 - 800 nm)
- Optical Particle Counter, GRIMM 11R: Aerosol size-distribution (range: 0.3 - 30 μm), PM10, PM2.5
- Aerodynamic Particle Sizer, TSI 3321: Aerosol size-distribution (range: 0.3 - 30 μm)
- CPC-TSI 3750: Fine particles Number concentration
- Wind lidar Metek HALO
- Thermo tei42i: NO, NO₂,NO_x
- Thermo tei450i: SO₂, H₂S

8. ANNEX 2 – FULL LIST OF CNR-ISAC BO INSTRUMENTS IN ACQUIRED WITHIN ITINERIS

1. The Portable Ice Nucleation Experiment (PINE)
2. Fog monitor, LWC, Reff, DROPLET SIZE DISTRIBUTION
3. SP-2 D (Refractory BC, mixing state)
4. Cloud sampler
5. aethalometer for black carbon concentration and BB fraction
6. CASS (Total Carbon Content (“TC”), the Elemental Carbon content (EC), the Organic Carbon content (OC) and the Black Carbon content (BC) of suspended aerosol particles in near-Real Time)
7. SMPS (aerosol size distribution 10-800 nm)
8. FTIR for GHG and RGs
9. Container for FTIR
10. 2 x Nefelometers (aerosol scattering and back scattering coefficient)
11. 2 x condensation particle counters (aerosol number concentration)
12. Ceilometer
13. Solar Lunar sunphotometer
14. Advanced Lidar Raymetrics
15. Doppler Cloud radar
16. UPS for mountain observatory
17. 2 greenhouses gases analyzers G2401 (Cavity Ring Down Spectrometers CO, CO₂, CH₄, H₂O) + 1 analyzer G2201-I (CRDS for ¹³C in CO₂ and CH₄)
18. Aerosol sampler
19. Meteorological probes
20. Data storage for ISAC BO observatories
21. Webcam for internal and external visualisation
22. Data analyses platforms
23. Upgrade mobile Platform Voyager III, for data acquisition of internal and external meteorological monitoring
24. Calibration system for organic volatile compounds
25. Installation and Management kit for Observatories
26. Installation and Management kit on Mobile Platforms
27. Aerosol inlet
28. Works for structural adaptation of observatories
29. Container for aerosol in situ measurements
30. Construction works for FTIR observatory

31. Pneumatic system (two) for sampling on the mobile platforms (AEROLAB and VOYAGER)