



Institute of
Atmospheric Pollution
Research
National Research Council of Italy

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Assessment of PM Exposure at intra-urban scale in preparation of MAIA mission (APEMAIA)

WP1101 – Management

DEL003 – Management – Final Report

Contract n. 2023-39-HH.0

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PROJECT NAME	Assessment of PM Exposure at intra-urban scale in preparation of MAIA mission (APEMAIA)	CONTRACTOR	National Research Council – Institute of Atmospheric Pollution Research
PROJECT MANAGER	Maria Adamo (CNR-ITIAM)	DATE SUBMITTED	N/A
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EXECUTIVE SUMMARY

This document provides the final management report for the APEMAIA project, implemented under WP1101 – Management. It consolidates the management and coordination activities carried out over the project lifetime, summarises the main achievements, documents the principal challenges encountered and the mitigation actions adopted, and provides an overview of the financial management information available at project closure. It also identifies the main lessons learned and the actions supporting the sustainability and future exploitation of the project results.

Project management was based on the coordination of CNR-IIA, the University of Bari Interateneo Physics Department (DIF), and ARPA Puglia, with responsibilities distributed across the technical activities and monitored through periodic coordination, shared documentation, task tracking, and technical exchanges. The management approach supported the integration of heterogeneous Earth Observation, atmospheric, meteorological, urban and population datasets and the development of the project's modelling, exposure-assessment and dissemination components.

Despite challenges related to data availability and harmonisation, computational requirements, coordination of heterogeneous activities, and the management of procurement and financial procedures, the consortium completed the main technical and management activities and delivered the project outputs to ASI. The WebGIS platform was implemented and configured as a dissemination infrastructure and the software components were organised in reproducible, containerised workflows. The final exploitation and dissemination activities are documented in DEL006.

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1. AIM OF THE DOCUMENT

The aim of this final Management Report is to provide a consolidated account of how the APEMAIA project was managed from its start to its closure. The report focuses on coordination, monitoring of activities and deliverables, interaction among partners, management of technical dependencies, stakeholder coordination, risk and challenge management, and financial monitoring.

Unlike the periodic progress reports, this final report focuses on the activities actually carried out and the results achieved at project closure. It therefore replaces prospective management statements with a retrospective assessment of the management process, including the main lessons learned and recommendations for future initiatives.

1.1. Applicable and reference documents

This document incorporates, by dated or undated references, provisions from other documents. These references are cited at appropriate places in the text, and they are listed hereafter. For undated references, the latest edition of the publication referred applies.

In case of conflict between two or more applicable documents, the higher document will prevail.

1.2. Applicable documents

[AD 1] ASI Contract No. 2023-39-HH.0

[AD 2] subcontract CNR-IIA and DIF Prot. CNR-IIA n. 0276290 del 21/09/2023

[AD 3] subcontract CNR-IIA and ARPA Prot. CNR-IIA n. 0273735 del 19/09/2023

[AD 4] APEMAIA DEL004 – User Requirement Document -USD

[AD 5] APEMAIA DEL007 – Dissemination and Exploitation Results



1.3. Acronyms and abbreviations

Table 1-1 provides the acronym list.

Table 1-1: Acronyms and abbreviations

Acronym	Description
APEMAIA	Assessment of PM Exposure at intra-urban scale in preparation of MAIA mission
ARPA Puglia	Apulian Regional Agency for Environmental Protection
ASI	Agenzia Spaziale Italiana
CNR-IIA	Consiglio Nazionale delle Ricerche – Istituto sull’Inquinamento Atmosferico
CTM	Chemical Transport Model
EIRENE RI	Environmental Exposure Assessment Research Infrastructure
GEO	Group on Earth Observations
GPS	Global Positioning System
IGARSS	International Geoscience and Remote Sensing Symposium
NBS	Nature Based Solutions
US	User segment
WebGIS	Web Geographic Information System
WP	Work Package

2. PROJECT MANAGEMENT AND COORDINATION

2.1. Coordination structure and responsibilities

CNR-IIA (now CNR-ITIAM) acted as project coordinator and was responsible for overall scientific and technical coordination, monitoring of activities and interfaces, and interaction with ASI. DIF and ARPA Puglia were involved in the activities assigned to their respective areas of responsibility. Roles and responsibilities were mapped to the technical modules and work packages, allowing activities to be coordinated across the consortium.

Management of the technical workflow was supported by the assignment of clear responsibilities for individual modules, shared technical specifications, input/output formats, testing datasets and operational guidelines. These elements were circulated through collaborative platforms and reviewed during periodic coordination meetings.

2.2. Monitoring of activities and deliverables

Project progress was monitored through periodic coordination meetings, shared task lists, document exchange and technical reviews. Interfaces among data acquisition, AOD processing, PM estimation, exposure assessment and dissemination activities were followed throughout the project. Deadlines and format requirements were monitored during periodic reviews, while technical issues were addressed through direct exchanges and dedicated support.

This management approach supported the integration of activities performed by the three partners and facilitated the consolidation of results into the project deliverables. The final reporting process also included the delivery of the project outputs to ASI through the established reporting framework.

2.3. Technical workflow coordination

The project adopted a modular processing architecture covering data preprocessing and integration, AOD improvement, WRF output ingestion, database building, PM estimation and Machine Learning, and exposure assessment. From a management perspective, the modular structure facilitated the allocation of responsibilities, the definition of technical interfaces and the parallel implementation of activities.

- Standardised 300 × 300 m grids were established for the Areas of Interest and used as a common spatial reference.
- Satellite, meteorological, atmospheric, urban and ancillary datasets were spatially and temporally harmonised to support the subsequent modelling activities.
- Processing environments and software modules were organised using version-controlled and containerised environments.
- Technical coordination included validation activities and interaction with ARPA Puglia for the use and interpretation of ground-based and modelling data.
- Regular exchanges supported the integration of the outputs generated by the different partners.

2.4. Infrastructure and execution framework

Processing activities were executed using the ReCaS-Bari cloud infrastructure and the HTCondor high-throughput job scheduler. Conda-managed Linux environments were used to organise the main processing environments, including SNAP, Google Earth Engine and Machine Learning workflows. The software modules were maintained under version control and organised for reproducible execution.

The use of shared environments, testing datasets, common input/output specifications and version-controlled modules reduced interface problems and facilitated the integration of the different technical components. This infrastructure also provided the basis for the open-source implementation activities associated with WP3102.

2.5. Stakeholder coordination

Stakeholder interaction was carried out in relation to the main user segments identified for APEMAIA: space agencies and scientific communities, local and regional authorities and technical users, and civil society/general users. Technical exchanges with ARPA Puglia and participation in scientific and institutional events provided opportunities to discuss user needs and the applicability of the project outputs.

The requirements identified through previous projects, expert interaction and regulatory considerations included higher-resolution intra-urban PM information, population-weighted exposure indicators, and accessible use of EO-derived information. These requirements informed the development of the modelling and dissemination components.

3. MANAGEMENT-RELATED ACHIEVEMENTS

The management activities supported the completion and integration of the main project components. The following achievements are particularly relevant from a management perspective:

Area	Achievement
Coordination of partners	Responsibilities and technical interfaces were defined across CNR-IIA, DIF and ARPA Puglia, with regular coordination and monitoring of interdependent activities.
Integration of heterogeneous activities	Data acquisition, atmospheric modelling, Machine Learning, exposure assessment and dissemination activities were coordinated within a common workflow.
Monitoring and reporting	Project activities and deliverables were monitored through periodic reviews, shared documentation with sharepoint and coordination exchanges, supporting the consolidation of the final outputs.
Technical infrastructure	The ReCaS-Bari/HTCondor environment and containerised software structure supported the execution and integration of the computational workflows.
Dissemination infrastructure	The WebGIS was implemented and configured as a platform ready to support public dissemination of project products, while the project outputs were delivered to ASI through the reporting framework.
Scientific and institutional interaction	Project results were disseminated through conferences, workshops and interactions with scientific and institutional stakeholders, as documented in DEL007.

4. CHALLENGES ENCOUNTERED AND MITIGATION

Several challenges emerged during implementation. They mainly concerned data coverage and harmonisation, computational requirements, technical integration and administrative/financial management. The consortium addressed these issues through iterative technical work, coordination among partners, adaptation of processing workflows, and continued monitoring.

4.1. Data coverage and harmonisation

- Ground-truth data were limited in some areas, with spatial gaps affecting validation and model development.
- Seasonal variability introduced additional complexity in the assessment of model performance.
- Urban morphology, building footprints/heights and LiDAR coverage were not homogeneous across all Areas of Interest and therefore required case-specific adaptation.
- Some ancillary datasets, including WRF data for the Lazio region, were subject to external availability constraints.

These issues were mitigated through the harmonisation of the available datasets, adaptation of predictor-generation procedures to the characteristics of each Area of Interest, and coordination with the data providers and technical partners.

4.2. Technical and computational constraints

- The integration of multiple high-volume EO and ancillary datasets required substantial computational resources.
- RF and XGBoost processing on regional datasets generated high computational demand.
- Some delays occurred during the development and consolidation of the cloud-processing pipeline.
- Ground-data spatial gaps required additional checks and adaptations during validation.

The use of ReCaS-Bari, HTCondor, modular workflows and containerised environments helped manage computational requirements and allowed processing tasks to be distributed and monitored.

4.3. Stakeholder and organisational coordination

The diversity of user requirements required iterative exchanges and adjustments, particularly for the dissemination platform and the presentation of project outputs. Regular technical interactions and iterative review of requirements were used to keep the system aligned with the identified user needs.

Administrative and financial management also required additional coordination, particularly in relation to procurement procedures and the timing of expenditures. These aspects were monitored during project implementation and were incorporated into the final reporting process.



5. LESSONS LEARNED AND RECOMMENDATIONS

The management experience gained through APEMAIA highlighted several elements that are relevant for future projects combining Earth Observation, atmospheric modelling, Machine Learning and multi-partner data integration.

Lesson / area	Recommendation
Data availability	Ground-truth, meteorological and ancillary-data availability should be assessed at the beginning of the project for each Area of Interest, including spatial and temporal coverage and access conditions.
Common data standards	Common data formats, naming conventions, spatial references and quality-control procedures should be established as early as possible.
Computational planning	Computational requirements should be estimated during project planning, with adequate resources reserved for large-scale Machine Learning and multi-source processing.
Modular implementation	A modular workflow with clearly defined interfaces facilitates the distribution of responsibilities among partners and reduces integration risks.
Continuous stakeholder feedback	Regular feedback sessions are useful to identify changes in user requirements early and reduce the need for late redesigns.
Dissemination infrastructure	The dissemination platform should be developed early enough to allow sufficient time for final data preparation, metadata completion and population of the platform before project closure.
Financial and administrative monitoring	Procurement and expenditure timelines should be monitored continuously, with sufficient flexibility to address delays without affecting technical milestones.

6. FINANCIAL MANAGEMENT

The financial management of the project was carried out by the consortium partners in accordance with the approved budget and the applicable contractual and administrative requirements. Financial information was monitored as part of the project management activities and reported to ASI through the established reporting procedures.

CNR-IIA

Category	Allocated(€)	Spent(€)	Remaining(€)
Labour	62.426,27 € *	58.238,63 €	4.187,64 €
3.1 Raw Materials	10.400,00 €	- €	10.400,00 €
3.6 External major product	15.464,58 €	12.519,90 €	2.944,68 €
3.7 External services	36.416,93 €	- €	36.416,93 €
3.9 Travels	19.226,00 €	6.002,06 €	13.223,94 €
3.10 Miscellaneous	6.066,00 €*	1.335,00 €	4.731,00 €
Total	149.999,78 €	78.095,59 €	71.904,19 €

DIF

Category	Allocated(€)	Spent(€)	Remaining(€)
Labour	75.771,35 €	24.785,82 €	50.985,53 €
3.6 External major product	15.300,00 €	15.030,40 €	269,60 €
3.9 Travels	3.377,15 €	1.402,98 €	1.974,17 €
3.10 Miscellaneous	5.490,00 €	- €	5.490,00 €
Total	99.938,50 €	41.219,20 €	58.719,30 €

ARPA

Category	Allocated(€)	Spent(€)	Remaining(€)
Labour	46.720,16 €	44.163,79 €	2.556,37 €

3.6 External major product	3.279,36 €	3.279,36 €	- €
Total	49.999,52 €	47.443,15 €	2.556,37 €

General project overview of the amount financed

Category	Allocated(€)	Spent(€)	Remaining(€)
Labour	184.917,78 €	127.188,24 €	57.729,54 €
3.1 Raw Materials	10.400,00 €	- €	10.400,00 €
3.6 External major product	34.043,94 €	30.829,66 €	3.214,28 €
3.7 External services	36.416,93 €	- €	36.416,93 €
3.9 Travels	22.603,15 €	7.405,04 €	15.198,11 €
3.10 Miscellaneous	11.556,00 €	1.335,00 €	10.221,00 €
Total	299.937,80 €	166.757,94 €	133.179,86 €

General project overview of the In-kind Contribution

Category	Allocated(€)	Spent(€)	Remaining(€)
Labour	291.535,04 €	250.384,85 €	41.150,19 €
3.10 Miscellaneous	8.415,00 €	- €	8.415,00 €
Total	299.950,04 €	250.384,85 €	49.565,19 €

- **Budget Utilization:** 56% of financed allocated funds utilized, primarily for Labour and external major product. 83% of the planned in-kind contribution had been reported in the Labour cost category. The financial data reported refer to the situation as of 28 July 2025.

- **Final Costs**
Following the receipt of the first reimbursement after RA1, the financial implementation of the project was affected by a combination of administrative and procedural constraints, both at project and institutional level. To date, the PRIME beneficiary has not yet received the payment associated with RA2, while the documentation submitted following RA3 is still undergoing the formal approval process. These circumstances and CNR-ITIAM's internal

administrative and management constraints in the same period affected the availability and timing of the financial resources required to complete the remaining project purchases. Consequently, the combined effect of the timing of the project-related financial and approval procedures and the internal administrative constraints temporarily limited the capability of the whole consortium to complete the final procurement activities according to the originally planned schedule.

7. Conclusions

From a management perspective, APEMAIA was implemented through a coordinated multi-partner approach that enabled the integration of Earth Observation, atmospheric, meteorological, urban and population datasets and supported the development of the project's modelling, exposure-assessment and dissemination components.

The management framework based on defined responsibilities, periodic coordination, shared technical documentation, task monitoring and computational infrastructure supported the integration of the different activities. The main challenges concerned data availability and harmonisation, computational requirements, stakeholder requirements, and administrative and financial procedures. These were addressed through iterative technical adaptations and continuous coordination among the partners.

At project closure, the principal project outputs had been consolidated and delivered to ASI. The WebGIS had been implemented as a dissemination infrastructure and was ready for use, although the final project products were not populated on the platform during the project period. The software and workflow components were organised to facilitate reproducibility and future reuse.

8. POST-PROJECT SUSTAINABILITY AND FOLLOW-UP

The consortium identified several actions to support the continued use and exploitation of APEMAIA results after the formal project end:

- Maintain the APEMAIA WebGIS available for consultation for the period identified in the dissemination and exploitation framework.



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- Maintain the project software repositories and containerised modules under the applicable open-source arrangements to facilitate reuse.
- Continue scientific dissemination and publication of project results, including the preparation and submission of additional scientific papers.
- Continue exploitation of the project outputs in research activities concerning Earth Observation-based air-quality monitoring, population exposure, environmental health and urban Nature-Based Solutions.
- Maintain interaction with ASI and the MAIA scientific community and consider future opportunities for the application of APEMAIA methodologies and products.