



Proceeding Paper

National Integration and Optimization of CAMS Products: The Eratosthenes Center of Excellence as National Coordinator for Atmospheric Monitoring in Cyprus [†]

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Abstract

The Copernicus Atmosphere Monitoring Service (CAMS) offers a broad portfolio of global and regional atmospheric products that support environmental monitoring, air quality assessment, health applications and climate policy. Under the CAMS National Collaboration Programme (NCP), the ERATOSTHENES Centre of Excellence (ECoE) serves as the national coordinator for Cyprus, working to bridge the gap between CAMS outputs and local end-user needs. This paper presents the strategy and implementation framework adopted by ECoE to facilitate CAMS uptake in Cyprus. Efforts focus on integrating CAMS data into national systems, developing tailored applications (e.g., UV forecasting, dust event alerts), building stakeholder capacity, and supporting regulatory reporting. Outcomes also include the deployment of the AirData Hub platform and initial steps toward institutionalizing CAMS-derived workflows in public health and environmental planning. The work highlights both the opportunities and technical challenges of customizing CAMS products for small-island contexts.

Keywords: Copernicus Atmosphere Monitoring Service (CAMS); National Collaboration Programme (NCP)



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1. Introduction

The Copernicus Programme is the European Union's flagship Earth Observation (EO) initiative, delivering freely accessible environmental data from space and in situ sensors. The Copernicus programme provides an unimaginable volume of data and information in various formats to European citizens (and not only), with the aim of improving their quality of life, completely free of charge and without restrictions. Among its six thematic services, the Copernicus Atmosphere Monitoring Service (CAMS) provides near-real-time, quality-assured information on air quality, greenhouse gases, solar radiation, and other atmospheric components. CAMS products support a wide array of applications, including public health, energy, environmental policy, and climate change mitigation [1].

Implemented by the European Centre for Medium-Range Weather Forecasts (ECMWF), CAMS provides global and regional data products that support critical sectors including public health, environmental management, renewable energy, and climate change mitigation. These products are publicly available, free of charge, and designed to foster broad uptake and societal benefit [1].

Although widely utilized across the EU and internationally, CAMS uptake in Cyprus has historically remained limited, particularly in terms of national integration into policy frameworks and operational systems. In response, the Eratosthenes Centre of Excellence (ECoE) has been contracted under the CAMS National Collaboration Programme (NCP) to serve as the national focal point for Cyprus. The goal is to bridge the so-called “last mile” by tailoring CAMS products to local contexts and embedding them into national infrastructures and decision-making processes.

Under this initiative, the ECoE collaborates with key public sector stakeholders such as the Department of Meteorology and the Air Quality Section of the Department of Labor Inspection. These efforts aim to enhance CAMS product visibility, accessibility, and usability for public administration, environmental monitoring, and public communication.

The Eratosthenes Centre of Excellence was established within the framework of the European Excelsior programme, coordinated by the Cyprus University of Technology and consists of a consortium in which the National Observatory of Athens, the German Aerospace Center (DLR), the German Institute for the Study of the Troposphere TROPOS, the Department of Electronic Services of the Deputy Ministry of Research, Innovation and Digital Policy and two other collaborating organizations, the Cypriot company Cyric and the Physical Meteorological Observatory (PMOD) in Switzerland which is also the World Radiation Centre.

The creation of the Eratosthenes Centre of Excellence is funded through the Excelsior programme with 15 million euros from the European Commission, another 15 million from the Cypriot Government and another 8 million from the Cyprus University of Technology. So far, additional funding of over 15 million euros has also been secured through funded research projects, service provision and other sources. The Centre is already five years old, currently has over 100 staff members, and has completed the procurement of over 6 million euros in equipment. Key components of this equipment are the Atmospheric Ground Observation Station, a National Infrastructure called CARO-GBS, which was installed and operates in Limassol, and the real-time satellite information receiving system called the Digital Acquisition System, which is now being installed at the premises of the Cyprus Telecommunications Authority.

The effort under this project aims to support the Copernicus Atmosphere Monitoring Service (CAMS) National Collaboration Programme in achieving optimal utilization of CAMS products at the national level and to facilitating Member States in incorporating CAMS data into their air quality information systems and addressing regulatory requirements. The primary objectives of this 18-month project aim at (a) stimulating the uptake of CAMS products for national reporting on air quality and greenhouse gas emissions; (b) enhancing communication and awareness at national, regional, and local levels regarding the benefits and applications of CAMS; and (c) collaborating with ECMWF and national authorities to ensure a seamless connection between Member States and CAMS, promoting the evolution and improvement of CAMS products based on user engagement and feedback.

Section 2 outlines the methodology used to assess user needs and technical fit. Section 3 highlights the implementation of applications and systems, and Section 4 concludes with key outcomes and lessons learned.

2. Methodology

The methodological approach of the CAMS National Collaboration Programme (NCP) in Cyprus is designed to localize and optimize the use of CAMS products for national needs. The work is structured into interconnected activities that ensure not only technical integration but also strong stakeholder involvement and public awareness.

2.1. Stakeholder Engagement and Needs Assessment

An early priority of the project was to conduct a situational assessment and stakeholder needs analysis. Meetings and consultations were held with key national authorities and institutions including Department of Environment, Department of Meteorology, Department of Labor Inspection (Air Quality Branch), Ministry of Health, Department of Forests, Department of Agriculture, Cyprus Agricultural Payments Organisation and Town Planning and Housing Department. This activity ensured that the CAMS product portfolio was mapped against actual operational needs and data requirements. The engagement process followed a co-design philosophy to ensure relevance, usability, and alignment with policy mandates [2].

2.2. Integration of CAMS Products

Based on the results of the needs analysis, CAMS global and regional products were selected for incorporation into national workflows. These include: [3,4].

(i) Near-real-time air quality forecasts (from CAMS global and regional systems), (ii) Reanalysis datasets for air quality assessments (e.g., CAMS EAC4), (iii) UV Index forecasts, based on CAMS radiation and aerosol optical depth products, (iv) Dust and PM data from the CAMS regional ensemble and CHIMERE/EMEP models, and (v) Scenario and source-receptor tools (e.g., SHERPA) to support emission policy decisions.

CAMS data were integrated into the AirData Hub platform, a centralized public portal developed by ECoE for atmospheric data services in Cyprus. The data are visualized using dynamic dashboards, time series, and risk alerts, accessible to both authorities and the public.

2.3. Communication and Outreach

A comprehensive communication strategy is a key pillar of Cyprus' CAMS NCP implementation. Recognizing the diverse audience of potential users—from public authorities to educators and the public—the ECoE has prioritized tailored outreach efforts. These include multilingual digital content, such as educational infographics, video explainers, and interactive web modules, designed to increase the visibility and accessibility of CAMS products. Social media channels and thematic campaigns (e.g., #CAMsforCleanAir) have been leveraged to boost public engagement, while collaborations with ministries (Health, Education, and Environment) help integrate atmospheric data into official communication workflows. Regular workshops, stakeholder meetings, and targeted newsletters further enhance user awareness and help bridge knowledge gaps around CAMS product applications in policy, health, and climate.

2.4. Application Development

Informed by stakeholder consultations, the ECoE has developed a series of CAMS-integrated applications tailored to national needs. A key output is the UV Index Forecasting Platform, which combines CAMS global radiation and aerosol products with ground-based UV observations, delivering improved localized forecasts and risk messaging for the public, schools, and health institutions. Additionally, ECoE co-developed a Dust Data Cube in collaboration with the Department of Meteorology, designed to support aviation meteorology by enabling high-resolution spatiotemporal analysis and trajectory tracking of Saharan dust intrusions over Cyprus. Finally, the team-initiated pilot applications of the SHERPA tool to conduct urban air quality scenario assessments in Nicosia and Limassol, enabling data-driven evaluations of mitigation measures in line with national and EU air quality objectives.

3. Project Implementation

In response to the technical specifications, our proposed technical solution revolves around seamlessly integrating CAMS global and European-scale products into official national environmental information systems. The strategy encompasses the evaluation and adaptation of CAMS products always ensuring that these are aligned with European and international policies, including, but not limited to, the National Emissions Ceiling Directive (setting the limits on the total emissions of certain air pollutants by Member States [5]), air quality monitoring strategies, like the Green Deal (which encompasses a long list of policy initiatives aimed at putting Europe on track to reach net-zero emissions, and a pollution-free environment, by 2050 [6]), and the Paris Agreement (legally binding international treaty on climate change the main goal of which is to limit global warming to well below 2 °C, preferably to 1.5 °C, compared to pre-industrial levels [7]).

The strategy will be followed for the integration and adaptation founded on a comprehensive understanding of CAMS global and European-scale products. We will establish a seamless connection between these products and official national environmental information systems. This involves developing custom modules, if necessary, to ensure full integration with CAMS. Our team will conduct in-depth assessments to identify potential gaps and align CAMS products with specific national requirements.

For the implementation of the project, the following procedures are adopted.

3.1. Evaluation of CAMS Products

In the implementation of our technical solution, we will employ advanced tools and state-of-the-art facilities to conduct a comprehensive evaluation of CAMS products. This evaluation strategy encompasses a multi-faceted approach, addressing various aspects, including:

- **Air Pollution Level Assessment:** Utilizing existing monitoring strategies and datasets, we will conduct a rigorous assessment of air pollution levels in accordance with regulatory standards. Integration of CAMS products into our analysis will be a pivotal component, enhancing the accuracy and comprehensiveness of our assessments.
- **Main Drivers Analysis:** Leveraging sophisticated modeling and data analytics techniques, we will delve into the primary drivers of air pollution episodes. This entails a detailed examination of transboundary influences, natural contributions, and the impact of diverse sources on air quality.
- **User Feedback Mechanisms:** To ensure the ongoing relevance and effectiveness of CAMS products, we will establish robust user feedback mechanisms. Actively engaging end-users, we will gather valuable insights, preferences, and critiques. This interactive feedback loop will facilitate continuous improvement and refinement of CAMS.
- **Additional Products Evaluation:** In addition to the core focus on air pollution assessment, we will extend our evaluation efforts to include other CAMS products. For instance, we will assess the UV-Index forecast and evaluate CAMS radiation in conjunction with the Cyprus Solar Network (CSN). This expanded scope ensures a holistic evaluation, providing insights into various atmospheric components and their implications.

By integrating these evaluation components, we aim to create a comprehensive understanding of the performance and impact of CAMS products. This approach not only ensures the reliability of air quality assessments but also contributes valuable insights for enhancing the overall suite of CAMS.

3.2. Enhancing Communication

Communication is paramount in ensuring the successful uptake of CAMS products. The technical solution includes a comprehensive communication strategy that involves:

- **Translation Services:** Adapting CAMS materials into national languages to enhance accessibility and understanding among diverse audiences.
- **Social Media Engagement:** Leveraging social media channels to disseminate information, updates, and engage with the public on air quality-related issues.
- **Press Relations:** Building relationships with traditional media to ensure rapid and accurate dissemination of climatic and environmental events, fostering a proactive approach to communication.
- **Events and Campaigns:** Organizing both online and physical events, campaigns, and partnerships to increase awareness at various levels. This includes developing engaging content such as web content, factsheets, videos, and animations.

3.3. Utilization of CAMS Products for Reporting

The technical solution incorporates a detailed strategy for utilizing CAMS products in reporting air quality data to the European Commission and the European Environment Agency. This involves:

- **Regulatory Compliance:** Ensuring that our reporting mechanisms align with EU Ambient Air Quality Directives (2008/50/EC) and other relevant regulatory frameworks.
- **Scenario Tools:** Utilizing CAMS air quality models to create interactive policy tools that showcase the impact of emission reductions on European air quality. CAMS regional models and tools like SHERPA are piloted for urban planning and emission scenario development.
- **Source-Receptor Tools:** Employing CAMS products to identify pollution sources during episodes, enhancing the accuracy and effectiveness of reporting.

3.4. Direct Use of CAMS Products for National Purposes

The technical solution adopted places a strong emphasis on directly using CAMS products for national purposes. This involves:

- **Product Utilization:** Leveraging CAMS portfolio, including satellite data, in situ data, and model output statistics, to address specific national or local activities.
- **High-Resolution Requirements:** Utilizing CAMS Model Output Statistics to meet local high-resolution requirements, refining forecasts and monitoring capabilities in specific locations defined in the EEA e-reporting database.

ERATOSTHENES Centre of Excellence (ECoE), as the National Focal Point of CAMS NCP, leads the effort to integrate CAMS products into national systems. This initiative aims to tailor CAMS data to Cyprus' specific geographical and climatic conditions, creating targeted applications, while through institution's participation at international research infrastructures (e.g., ACTRIS-ERIC) and its advanced equipment of the Cyprus Atmospheric Remote Sensing Observatory (CARO) in place it is expected to achieve the goals set. The strategy prioritizes incorporation of CAMS products with existing national air quality networks, stakeholder engagement, fostering collaboration with key national entities to ensure the developed tools satisfy regulatory and practical needs. The project also emphasizes capacity building to train local experts in the utilization and interpretation of CAMS products for enhanced decision-making.

Within the framework of the project, the AirData Hub (<https://airdatahub.eu/>) was built, aiming to support CAMS NCP in achieving optimal utilization of CAMS products at the national level (Figure 1).



Figure 1. Screenshot of the AirData Hub, a national platform launched by ECoE to centralize and visualize CAMS products such as air quality forecasts, UV index, and particulate matter data. The platform is designed for public awareness, institutional use, and future data integration by multiple authorities.

As an example, through the dissemination of UVI forecasts, the public will be educated about the optimal durations for sun exposure and by harnessing climatological UV radiation data specific to Cyprus, relevant authorities will proactively institute measures aimed at mitigating the potential risks and adverse consequences associated with prolonged sun exposure (see Figure 2).

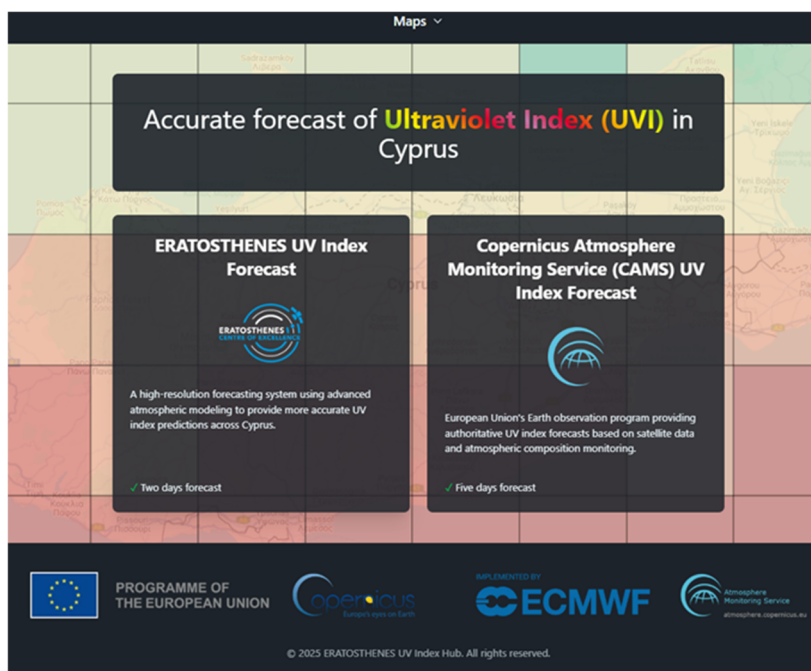


Figure 2. Interface from the CAMS-enhanced UV Index tool showing forecast values over Cyprus. The tool integrates CAMS radiation and aerosol data with ground observations to inform public health decisions and sun exposure guidelines.

3.5. Monitoring and Impact Assessment

To ensure the continuous improvement and effectiveness of our technical solution, we will implement:

- **Key Performance Indicators (KPIs):** Establishing KPIs to quantitatively measure the performance of the integrated CAMS products, ensuring alignment with project objectives and user requirements.
- **Feedback Loops:** Incorporating feedback loops that facilitate regular assessments and adjustments based on user input, technological advancements, and evolving air quality standards.
- **Regular Assessments:** Conducting periodic assessments to gauge the impact of CAMS products on national environmental information systems, reporting accuracy, and user satisfaction.

4. Concluding Remarks

The implementation of the CAMS National Collaboration Programme (NCP) in Cyprus, led by the ECoE, marks a significant milestone in the country's atmospheric monitoring capabilities [5–7]. Through this initiative, Cyprus has made concrete steps in translating Copernicus Atmosphere Monitoring Service (CAMS) products into actionable information tailored to national and local needs.

By engaging with stakeholders from environmental, meteorological, and public health sectors, the project has demonstrated the value of co-designing services such as the UV Index Forecasting Platform and the Dust Data Cube for aviation meteorology. These tools serve as practical applications of CAMS outputs, directly supporting public awareness, policy decisions, and operational workflows.

Despite initial challenges related to limited awareness and technical integration, Cyprus' efforts show that with appropriate institutional coordination, even small-island states can effectively localize and scale CAMS. A central takeaway is that the "last mile" of CAMS implementation hinges on national customization, feedback loops with end-users, and consistent engagement with EU-level developments.

The lessons learned from Cyprus are now being shared with other Member States, including Malta, supporting broader regional uptake of CAMS products. Looking ahead, opportunities remain in institutionalizing CAMS into long-term environmental reporting frameworks, enhancing the resolution of localized forecasts, and strengthening digital platforms such as the AirData Hub.

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Data Availability Statement: The CAMS data used in this study are openly available at <https://atmosphere.copernicus.eu/data> (accessed on 5 July 2025). The local radiation data presented in this study are not openly available for technical reasons but are available on request from the corresponding author.

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