Data
Models
Inventories

PARIS

Process Attribution of Regional Emissions

GA 101081430, RIA

OM observations from Dublin uploaded to public archives

Deliverable D7.1	
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Horizon Europe Cluster 5: Climate, energy and mobility
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Table of content

1. Changes with respect to the DoA (Description of the Action)

N/A

2. Dissemination and uptake

The dissemination of D7.1 involves the archiving of the validated OM observation dataset from Dublin in 2023 in the EBAS database (https://ebas.nilu.no), where it is fully accessible to the public. This ensures broad dissemination of the OM data, allowing stakeholders and the broader scientific community to access and utilize the dataset for various research purposes. The public availability of the dataset through EBAS facilitates uptake by providing a centralized platform for accessing atmospheric aerosol composition data from Dublin, thereby promoting transparency, collaboration, and informed decision-making in environmental protection.

3. Short Summary of results

The continuous observations of organic matter (OM) in atmospheric submicron aerosol (PM_1) were conducted in Dublin throughout 2023 using a sophisticated Aerosol Chemical Speciation Monitor (Q-ACSM), with a high time resolution of 15 minutes. Regular calibration of the instrument was performed according to standard protocols to ensure data quality. Subsequently, the data underwent thorough processing using standard software, followed by meticulous quality assurance and quality control (QA/QC) procedures applied to the entire dataset. Additionally, intercomparisons were conducted with observations from collocated instruments and a nearby EPA station, resulting in excellent agreement.

Overall, coverage of validated data after rigorous QA/QC procedures reached 95% throughout the year. The validated OM dataset and associated metadata has been documented in standardized NAS format files and has been submitted to EBAS database following standard submission procedures, enabling full public access through the EBAS website.

4. Evidence of accomplishment

The validated OM data from Dublin in 2023 has been submitted to the EBAS database, where the public is fully accessible to by specifying the country (Ireland), station, and component (organic_mass) on the EBAS website (https://ebas-data.nilu.no/), as shown by the screenshot below (Fig. 1).

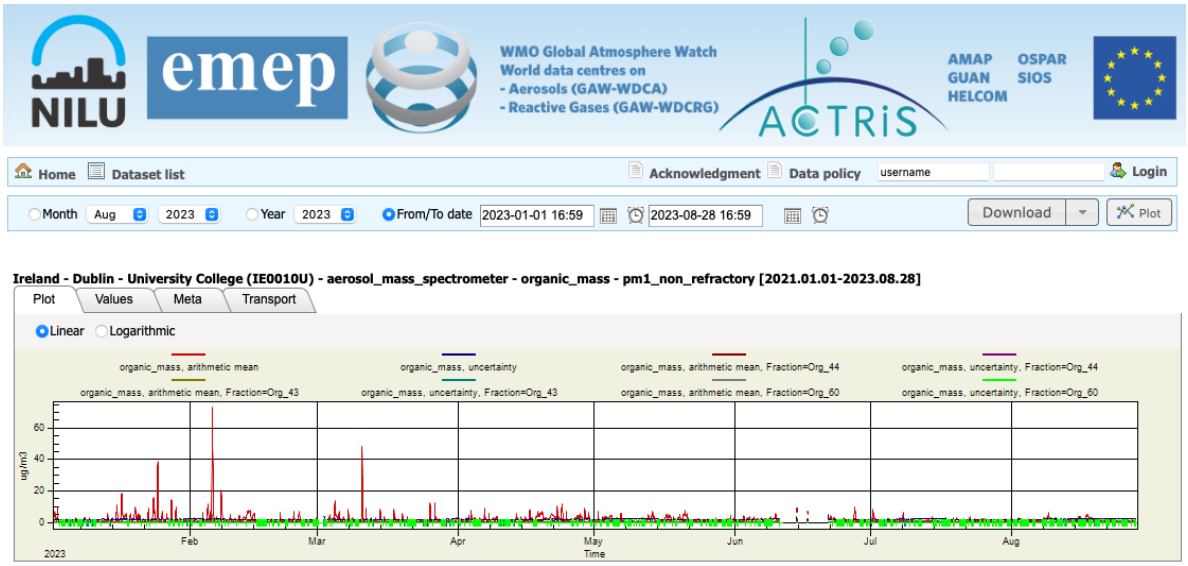

Fig. 1: Screenshots showing uploaded OM data on EBAS website.

4.1 Introduction | Background of the deliverable

Atmospheric aerosol particles, also known as particulate matter or PM, play a central role in two of the most significant threats to human well-being: air pollution, which causes millions of premature deaths annually, and climate change (Pope and Dockery, 2012; Lelieveld et al., 2015). Numerous studies have indicated that current PM levels observed in European cities exceed the guidelines recommended by the World Health Organization (Decesari et al., 2017; Ravina et al., 2019). Developing cost-effective mitigation strategies necessitates a deeper understanding of the chemical composition and sources of PM responsible for air pollution, as well as their corresponding temporal variability, such as seasonal and diurnal fluctuations.

Organic matter (OM) contributes a substantial portion of ambient PM in the atmosphere, constituting 20–90% of the submicron PM (PM_1) mass (Jimenez et al., 2009; Zhang et al., 2011). Moreover, atmospheric OM contains thousands of organic molecules, which have been reported to be more toxic than inorganic aerosol, e.g., sulfate and nitrate (Wu et al., 2022) and can have distinct effects on radiative forcing, thus, Climate. Therefore, a comprehensive understanding of OM sources, properties, and formation processes is crucial in addressing PM-related environmental challenges. OM can be directly emitted into the atmosphere by sources such as biomass and fossil fuel burning, cooking, etc., or formed through the atmospheric oxidation of gaseous volatile organic compounds (VOCs). However, the characterization of OM is always challenging, and it remains as the least characterized PM species so far due to its chemical complexity arising from diverse sources and formation pathways, leading to significant uncertainties that complicate assessments of the impacts on human health and climate change.

In recent decades, the Aerodyne aerosol mass spectrometers (AMS) (Allan et al., 2003) and aerosol chemical speciation monitor (ACSM) (Ng et al., 2011) have been widely employed to quantify atmospheric OM with high time resolution, enabling near real-time sampling of bulk OM mass spectrum on a routine basis at urban air quality (AQ) monitoring

stations. AMS and ACSM not only provide bulk OM mass concentration but also resolve OM originating from different sources and/or atmospheric processes when combined with source apportionment methods such as Positive matrix factorization (PMF) (Ulbrich et al., 2009), offering valuable information of the sources and fates of atmospheric OM. However, regulatory AQ monitoring networks in Europe primarily focus on bulk PM mass monitoring and lack routine measurement of even basic chemical composition, let alone the chemically complex OM. Without information on chemical composition and the ability to unravel the dominant sources, effective emissions reduction strategies may be akin to a shot-in-the-dark. In addressing these challenges, the urban background AQ monitoring station in Dublin, Ireland's capital city, has been equipped with the Quadrupole Aerosol Chemical Speciation Monitor (Q-ACSM) and various collocated instruments. Previous work at the Dublin AQ site on OM source attribution has demonstrated effective methods for distinguishing OM sources (Lin et al., 2018; Lin et al., 2019; Via et al., 2022). This project aims to further develop OM source apportionment methods and apply them to Dublin and other European countries. Additionally, it is imperative to openly share the observation dataset to promote transparency, informed decision-making, public awareness and scientific collaboration.

The deliverable presented in this report aims to archive the OM observation dataset from Dublin in 2023 in the EBAS database, facilitating open access for the broader scientific community and the general public.

4.2 Scope of the deliverable

1. **Data collection:** Gather online observation data of non-refractory components in submicron aerosols (PM_1), including organic matters (OM) and other species like sulfate, nitrate, ammonium and chloride, using advanced quadrupole aerosol chemical speciation monitor (Q-ACSM) with high time resolution (15-min intervals). Ensure the instrument is well-maintained and undergoes regular calibrations. Include relevant parameters such as instrument settings and meteorological conditions.
2. **Data processing and quality control**: Process the raw data collected by Q-ACSM (in.itx format) using standard processing software. Evaluate data quality and filter out any anomalies or bad data points. Implement quality control procedures to ensure data reliability and integrity. Document methodologies and criteria used for data validation and quality assurance.
3. **Data documentation**: Prepare comprehensive documentation describing the observation data using standard EBAS submission files. Include details such as data sources, sampling station and period, sampling protocols, instrumentation, calibration parameters, correction factors, units, time resolution, uncertainty, contact information of the data owner, and relevant background information about the observation data.
4. **Data formatting and standardization**: Format the observation data into standardized NAS files using the EBAS submission tool for public archiving on the EBAS database. Include metadata records providing essential information about the observation data, such as data description, temporal resolution and coverage, PM species measured, units, etc. Adhere to metadata standards and guidelines of EBAS atmospheric measurement data to facilitate data discovery and interoperability of the OM observation.

5. **Data submission to EBAS database**: Submit the standardized observation data NAS files to the EBAS database following submission procedures and requirements. Confirm successful data submission after manual quality assurance and quality control procedures are completed by the EBAS team.
6. **Accessibility and data sharing:** Ensure that the submitted OM observation data is fully accessible to the public, including stakeholders and the broader scientific community, through the EBAS website (https://ebas-data.nilu.no). To access the PM observation data, navigate to the EBAS website, select **Ireland** as the country, choose either **Dublin-University College** (for data from January to August 2023) or **Dublin-Trinity's Botanic Gardens** (for data after August 2023) as the station, select **organic_mass** as the component, and list the dataset. Then OM observations can be downloaded or visualize for the defined time period.

4.3 Content of the deliverable

Data description: The dataset comprises continuous observations of non-refractory species in PM, encompassing Organic Matter (OM) and inorganic species such as sulfate, nitrate, ammonium, and chloride (Fig. 2). These measurements were conducted throughout the year 2023 in Dublin, utilizing the Quadrupole Aerosol Chemical Speciation Monitor (Q-ACSM). The instrument underwent calibration following standard protocols, and the collected data were processed using established standard software based on Igor Pro. Thorough quality assurance and quality control (QA/QC) procedures have been performed to the dataset to ensure reliability and accuracy.

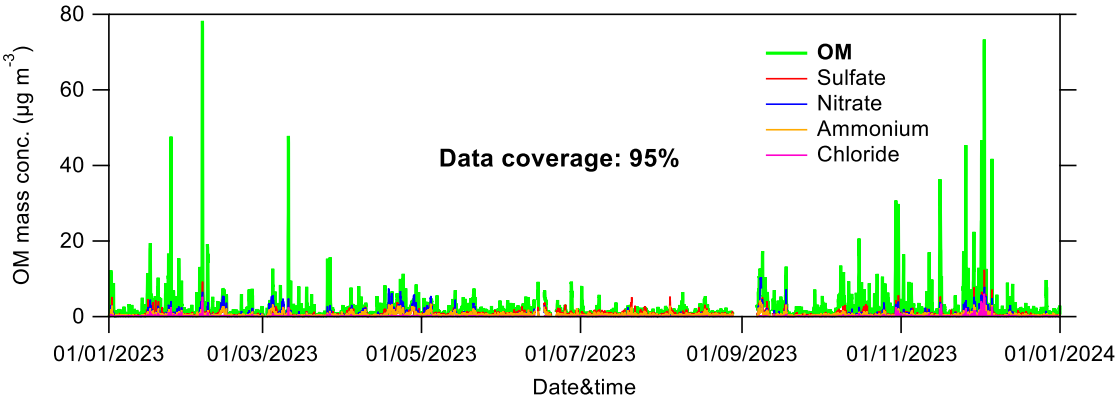

Fig. 2: Time series of the observed OM mass concentration and that of other non-refractory species including sulfate, nitrate, ammonium and chloride from Dublin in 2023, with the data coverage reached 95%.

Metadata: The dataset is accompanied by comprehensive metadata, detailing information such as the measurement units, station name (Dublin-University College for January to August 2023, or Dublin-Trinity's Botanic Gardens for September to December 2023) and type (urban background site), sampling protocol and period, instruments settings and calibration parameters, contact information of the submitters, and more.

Findability: The dataset can be accessed via the EBAS database. Users can locate the dataset by specifying the country (Ireland), station, and component (organic_mass) on the

EBAS website: https://ebas-data.nilu.no/. A link to the data base is available on the PARIS website https://horizoneurope-paris.eu/data/.

Accessibility: The dataset is publicly accessible through the EBAS database, ensuring that stakeholders and the broader scientific community can easily access and utilize the data for their research and applications.

Interoperability: The dataset is formatted into standardized NAS files using the EBAS submission tool, facilitating interoperability with other datasets and platforms. Metadata standards and guidelines for ACSM field measurements were followed to enhance interoperability and facilitate data discovery.

Reusability: The dataset includes not only bulk OM mass concentrations but also mass concentrations of specific OM m/zs (mass-to-charge ratios), applied CDCE values, and data uncertainty, providing a comprehensive view of the observed atmospheric composition. This ensures that the data are reusable for various research purposes and analyses.

4.4 Conclusion and possible impact

The online ambient observations of OM from Dublin provide detailed and valuable insights into the composition and concentration variations of organic aerosol in urban area. Analysis of the dataset reveals significant temporal variations in OM, reflecting its complex sources and formation processes. Continuous observation of OM enables the identification of key components and sources of OM, thus, contributes to ongoing efforts to assess the impacts of air pollution on public health and climate change and enhances our understanding of aerosol sources and associated environmental impacts. Importantly, the OM observation dataset supports efforts to identify sector-specific emissions contributing to organic aerosol formation, aiding in the development of targeted emission reduction strategies. Additionally, OM acts as a short-lived climate forcer, influencing regional and global climate patterns, thus, understanding the sources of OM is also crucial for accurately assessing their climate impacts. Moreover, the in-situ OM observation from Dublin in 2023 provides valuable field dataset to evaluate the agreement between field measurements and model simulations thus contributes to the modelling improvement.

The availability of the OM observation dataset enhances collaboration and knowledge exchange among consortium members, fostering interdisciplinary research and innovation and serving as a valuable resource for the project. The OM observation dataset complements the greenhouse gas (GHGs) emissions data analyzed in other work packages, contributing to efforts on accurately assessing climate change. The integration of OM observations with GHGs emissions data allows for a more comprehensive evaluation of the complex interactions between aerosols and climate. By sharing the dataset openly, the dataset facilitates broader scientific inquiry and exploration within the research community, researchers can leverage the data for diverse research applications. The OM observations dataset also aligns with the EU's objectives and priorities related to climate, environmental protection, public health, and sustainable development. The dataset supports EU initiatives aimed at improving air quality, reducing emissions, and mitigating the impacts of air pollution on human health and climate. By promoting openly data sharing and collaboration, the OM observation dataset can be utilized to inform evidence-based policies and strategies in relation to air quality and climate challenges at regional and global scales.

4.5 References

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5. History of the document

Version	Author(s)	Date	Changes
V 1.0	Lu Lei, Jurgita Ovadnevaite	10/05/2024	New document
	S. Walter	28/05/2024	Finalising document and submission