ATMO ACCESS
Access to Atmospheric Research Facilities

Activity report of the TNA to ATMO-ACCESS research infrastructures

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TNA title and acronym: Impact of Biomass Burning on Oxidative Potential of Fine and Coarse Particulate Matter: Düzce Case-PARTICLE

Facility/ies accessed: ATMOS-GR

This work has received funding from the European Union's Horizon 2020 research and innovation programme through the ATMO-ACCESS Integrating Activity under grant agreement No 101008004

Instructions

Please limit the report to max 3-5 pages, including tables and figures.
The report should be sent as pdf document and include the subheadings listed below. Please make sure to address any comments made by the reviewers (if applicable).

Is the information provided in the report confidential and should not be made available on the ACTRIS website?

☒ No, the information can be made public.

☐ Yes, the information should not be made public and access should be restricted to the TNA Team, the ATMO-ACCESS access providers, the reviewers concerned and the ATMO-ACCESS Strategic TNA Board.

Table of Contents

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1. Introduction and motivation of the TNA

Health studies have shown a strong association between exposure to particulate pollution and health risks,including premature death. Although particulate matter (PM) is one of the most well-known pollutants that causeadverse health impacts, aerosol toxicity metrics are currently emerging to better predict health risk factors. PM exposure results in oxidative stress (OS) in humans. OS is caused by an imbalance between antioxidant capabilityand the generation of reactive oxygen species (ROS) that is induced at the cellular level upon exposure to PM. Asa consequence, the term oxidative potential (OP) represents the ability of airborne pollutants to induce OS,through the production of redox active species that oxidize specific molecules (***Paraskevopoulou et al., 2022***). Düzce, a city located in the western Black Sea region of Türkiye, experiences frequent PM episodes, particularlyduring the winter season because of combustion for heating. According to the World Air Quality Report, Düzce isthe fifth most polluted city in Europe in terms of $PM_{2.5}$, with an annual average of 44.4 µg/m^3. Consequently, onewould expect that elevated $PM_{2.5}$ has a significant impact on air quality and human health. However, there hasbeen no research to determine the levels, sources, and health burden of PM-induced air pollution in the city. Recently, a field study was conducted in the corresponding city to identify the sources and health impacts of PM including coarse ($PM_{10-2.5}$) and fine ($PM_{2.5}$) fraction. The first results showed that the nighttime massconcentration was almost two times higher than the corresponding daytime average in both size fractions during winter, which could be attributed to the increased combustion activities for domestic heating, in addition to the decreased ambient temperature. Levoglucosan, a marker of biomass burning, in PM_{10} increases to 4 µg/m^3 on certain days, while the night time data is more than three times higher than day time data. This finding highlights the dominance of biomass burning in the city atmosphere. However, there are no published data on the impact ofaerosol-induced OP and the components of aerosols that cause OP in Düzce.

Although the Turkish Ministry of Environment, Urbanization, and Climate Change has set up approximately 400 air quality monitoring stations across Türkiye, chemically resolved data are not available to predict the impact of air pollution on human health. From the evidence available, Turkey emerges as a country with one of the highestrates of premature deaths due to air pollution in Europe. The Turkish-Greek bilateral cooperation established in this TNA will generate the first data on the extent of PM on human health by analyzing the OP of PM.

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Moreover, this TNA will help to identify the major sources affecting the chemical composition of PM by analyzing specific source markers such as brown carbon. These studies have significant implications regarding mitigation plans for air pollution control not only for Türkiye but also for the entire Eastern Mediterranean. Effective mitigation plans will also contribute to a decrease in atmospheric pollutants (for instance, black carbon) responsible for global warming, which is 15 % higher in the Mediterranean region than in the rest of the world. The results of this study will contribute to enhancing the cooperation among Turkish Greek partners. Knowledge will be transferred from Greek researchers to Turkish researchers, which helps to capacity building in Türkiye in the atmospheric chemistry field. The two partners will collaborate with new project ideas in the future.

2. Scientific objectives

The primary objective of this TNA mission was to analyze the collected PM samples in terms of oxidative potential (OP) and water soluble brown carbon (BrC). In addition, the complimentary data including parameters such as sugars. EC/OC and major ions, was evaluated during this TNA mission to have an idea on the correlations among different parameters.

3. Reasons for choosing the Facility/ies

The ATMOS (GR) has state-of-the-art instruments for air quality monitoring. In addition, the Greek partner has well-equipped laboratories for conducting the analysis such as OP and BrC. Prof. Nicolaos Michalopoulos and his research group have many publications on the Eastern Mediterranean, including Greece, Cyprus and Türkiye. Consequently, they have experienced on the potential sources of air pollutants and their trans-boundary transport in the region. The transboundary nature of air pollution needs collaborative research and efforts between the neighboring countries. For these reasons, the ATMOS-GR facility was selected to conduct these activities.

4. Activities during the TNA (research, training, events, ...)

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The beneficiary was trained on atmospheric monitoring tools as well as analysis of the collected samples in Düzce (Türkiye) during this TNA mission. In addition, the preliminary assessment of data with the auxilary data including sugars, EC/OC and major ions were performed during this TNA.

5. Method and set-up of research

The samples collected during the wintertime were analyzed in terms of WS BrC and OP by following the methodologies described in ***Paraskevopoulou et al. (2023)*** and ***Paraskevopoulou et al. (2019)***, respectively

6. Preliminary project results and conclusions

The diurnal variation of fine and coarse PM mass concentration at the sampling site was depicted in Figure 1. The mean concentration value is depicted with the red star in the figure. Figure 1 indicates that mean PM levels are higher than 50 µg/m^3 at the site. Currently, there is no limit in Turkish Air Quality Monitoring and Evaluation Regulation for $PM_{2.5}$. The annual limit for PM_{10} is 40 µg/m^3. It is clear from Figure 1 that sum of mass concentration of fine and coarse PM is well above the annual limit set by the corresponding regulation. In addition, Figure 1 reveals that the levels both for $PM_{2.5}$ and $PM_{2.5\text{-}10}$ during the night-time is higher than the day-time values, which may be attributed to increased intensity of emissions and also lower mixinf height during night in the study area.

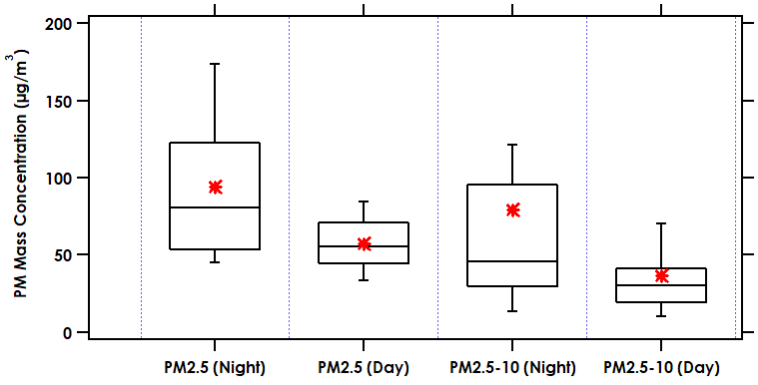

Figure 1. Diurnal variation of fine and coarse fraction of PM at the site

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OP as DTT_v activity measured in $PM_{2.5}$ samples collected day and night is depicted in Figure 2. Consisting with the trend observed for $PM_{2.5}$ diurnal variation, the higher median values were observed during the night as compared to day-time data, implying that night-time PM can induce more adverse health impacts on the citizens living in the city.

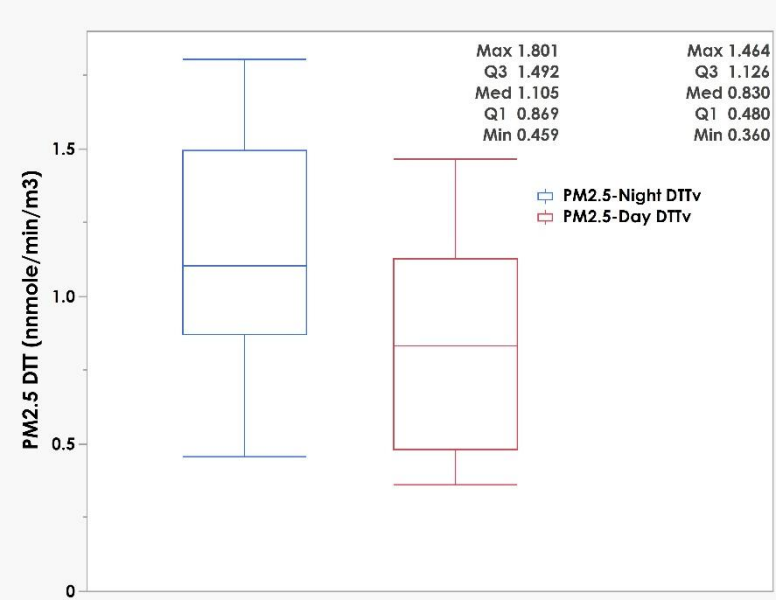

Figure 2. Diurnal variation of fine and coarse fraction of PM at the site

Diurnal variation of BrC in $PM_{2.5}$ samples is shown in Figure 3. The night-time data has significantly higher mean values as compared to day-time data, which is consistent with the diurnal trend observed for $PM_{2.5}$ mass concentration and OP.

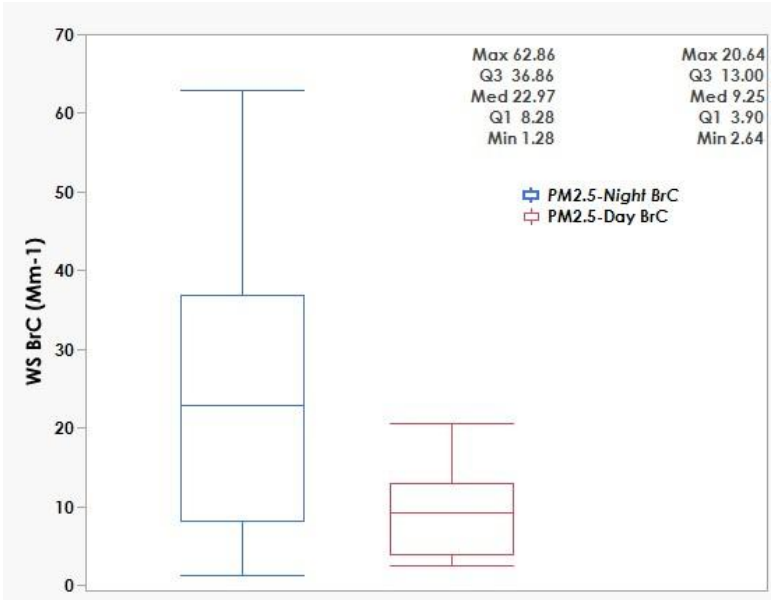

Figure 3. Diurnal variation of fine and coarse fraction of PM at the site

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7. Outcomes and future studies

A total of 240 samples were collected in the course of this study. Summer samples (N=60) have already been analysed in terms of OP, BrC and EC/OC. The analyzes of the remaining samples are still going on. Prof. Dr. Fatma Öztürk proposed a research project to the Turkish Scientific and Technological Research Council (TUBITAK) to take grant to support the ongoing chemical analyzes in Türkiye. A large dataset will be formed in the framework of this study, which help us to find the sources impacting the air quality and health impacts of poor air quality on the citizens living in the city. The experience gained on the analyzes of PM samples in terms of OP and BrC can be transferred to other field campaigns in Turkish side. In addition, this cooperation between Turkish and Greek researchers will help to solve common environmental problems across the borders.

8. Plans for publications

(in peer-reviewed journals, conference proceedings, etc. acknowledging the support by ATMO-ACCESS). Details, including the DOI, need to be provided as soon as available.

At least two papers in highly impacted journals in the atmospheric field and two oral presentations in the international conferences are expected from this study.

9. References

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