# Transport and Transformation of Atmospheric Aerosol over Central Europe

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## Introduction

The trend in $PM_{10}$ concentrations in Europe has stagnated over the last two decades, showing only limited annual changes even though there are continuous reductions in PM emissions (European Environmental Agency Report 2020). Possible reasons could be linked to both the aging processes of the particles in the atmosphere and their long-range transport.

Therefore, better understanding the multiple origins of the atmospheric aerosols and their source apportionment at different places are necessary for the development of efficient mitigation strategies.


**Fig. 1: The three TRACE measurement stations measure online aerosol chemical composition and black carbon and are equipped with high volume quartz digitel samplers to measure $PM_{2.5}$**

The TRACE project will assess the transport and transformation of atmospheric aerosol across Central Europe with emphasis on anthropogenic sources (including coal and wood combustion) using offline and online measurement methods and state-of-the art modelling tools.

Measurements were performed during winter (1st February – 10th March) and summer (1st July – 20th August) periods in 2021 simultaneously at three sampling places (Melpitz, Kosetice and Frydlant) which form a triangle covering a key transition zone between the more polluted areas to identify and quantify the contribution of transported aerosol coming from Eastern Europe to the local air quality.

## Results

### Winter Campaign

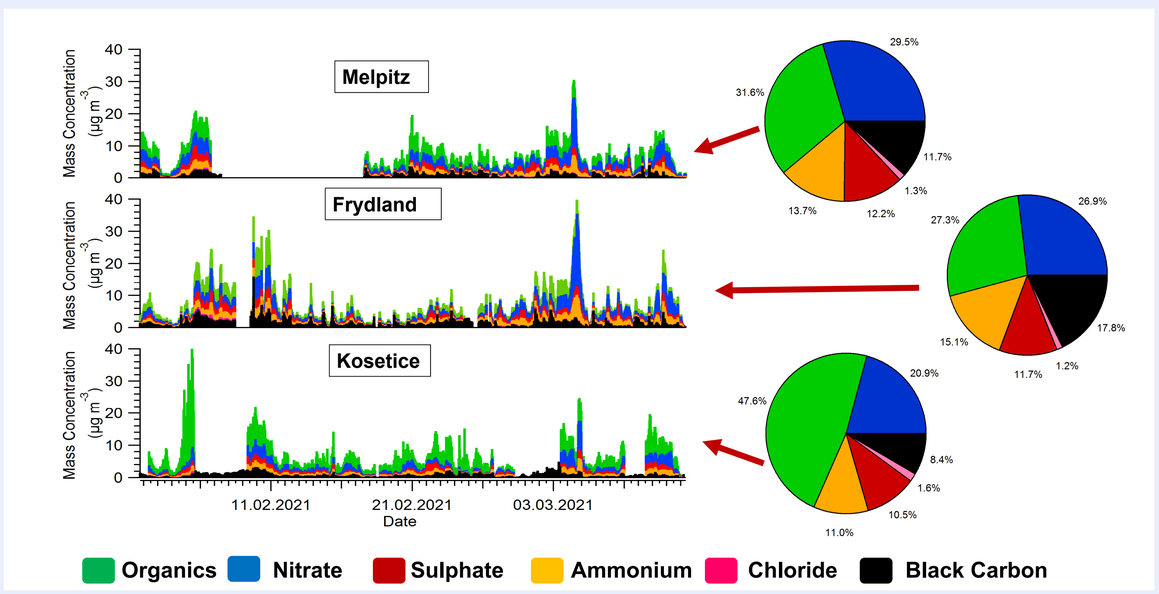


**Fig. 2: Inter Site Mass Fraction Comparison for Winter using AMS data**

### Summer Campaign

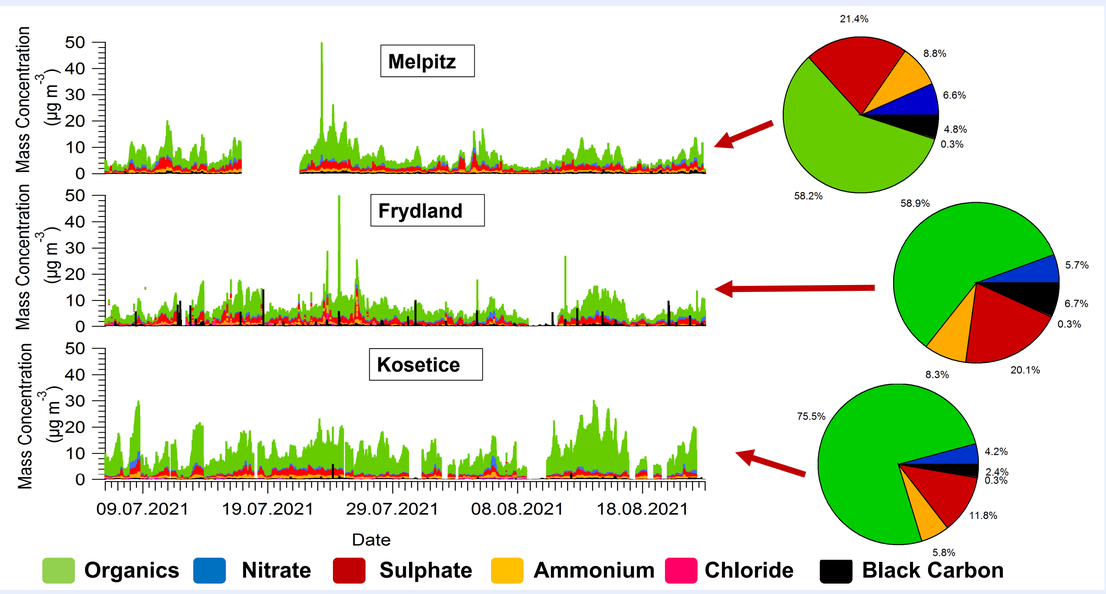


**Fig. 3: Inter Site Mass Fraction Comparison for Summer using AMS data**

Frydland station, located only 10 km from a coal power plant showed the highest fraction of Black Carbon in winter (17.8%) as well as in summer (6.7%) whereas Kosetice station showed the highest fraction of organics (47.6% in winter and 75.5% in summer).

## Case Studies – Winter Campaign

### Nitrate Peak Event

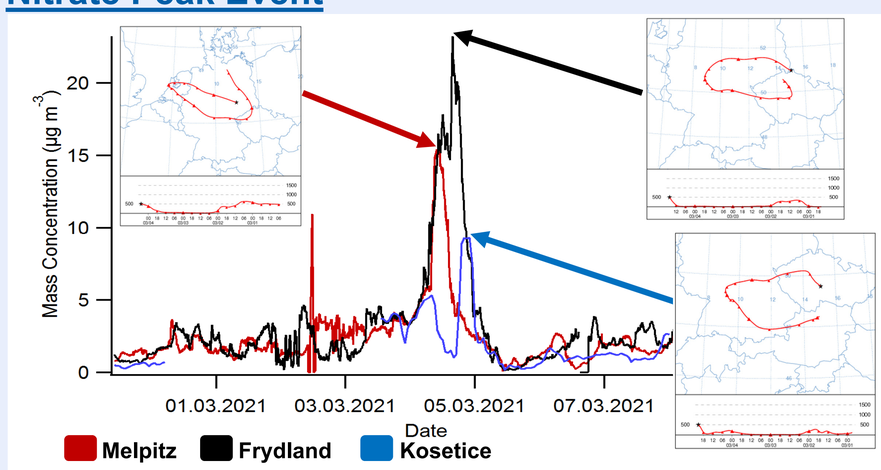


**Fig. 4: Nitrate mass concentration peaks and the subsequent trajectories calculated at a height of 500 m (NOAA-HYSPLIT 4, Draxler and Hess, 2004)**

Nitrate peaks were observed with a 6 hour time delay at the three sites indicating a western mass trajectory from Melpitz to Frydland and finally to Kosetice station.

### EC v/s eBC

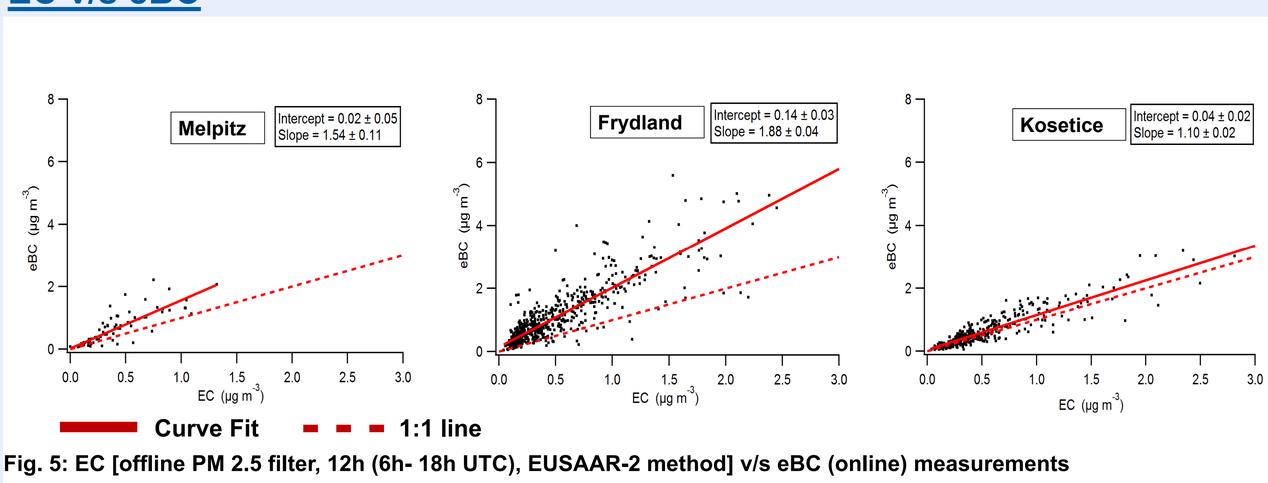


**Fig. 5: EC [offline PM 2.5 filter, 12h (6h- 18h UTC), EUSAAR-2 method] v/s eBC (online) measurements**

All stations exhibited different eBC/EC ratios in winter with Frydland showing the highest which maybe attributed to the influence of brown carbon attributed absorption and fresh soot emissions (Düsing et. al. 2021).

## Summary

1. Winter was marked by higher nitrate and sulphate mass concentrations compared to summer whereas summer was marked by relatively higher organics.
2. Frydland Station (located near the coal power plant) showed highest fraction of black carbon compared to other stations in both summer and winter.
3. The highest eBC/EC ratio was observed in Frydland which could be attributed to brown carbon related absorption.

## References

Trends in PM annual mean concentrations in Europe: European Environmental Agency Report, 2020

Düsing, S., et al., Measurement report: Comparison of airborne, in situ measured, lidar-based, and modeled aerosol optical properties in the central European background – identifying sources of deviations, Atmos. Chem. Phys., 21, 16745–16773, 2021.

Draxler, R., et al., NOAA technical memorandum : Description of the HYSPLIT_4 modeling system, ERL ARL-224, 2004.

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