

Winter intensive measurement campaign at Măgurele, Romania

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Introduction

A measurement campaign has been conducted at Romanian Atmospheric 3D Observatory (RADO, Magurele, southwest of Bucharest, Romania) between 1 Dec 2017 and 26 Feb 2018 as a part of the EMEP/ACTRIS/COLOSSAL intense measurement period (IMP) across Europe.

The campaign was focused on measuring the carbonaceous aerosols, which represent 70% of the total PM₁. The aim of the IMP was to separate the equivalent black carbon into the contribution from fossil fuel and wood burning.

Methodology

Characterisation of the aerosol features for the winter season was performed using collocated instruments: Aerosol Chemical Speciation Monitor (Q-ACSM), Aethalometer AE-33, Aerodynamic Particle Sizer 3321 (APS), optical particle sizer GRIMM EDM 180 (GRIMM-OPC) and filter measurements for deriving sugars and EC/OC concentration.

Additional data for meteorological parameters (temperature, wind speed, wind direction, relative humidity, solar radiation) and gases concentration (NO, NO₂, NO_x, O₃, SO₂, CO) were also measured.

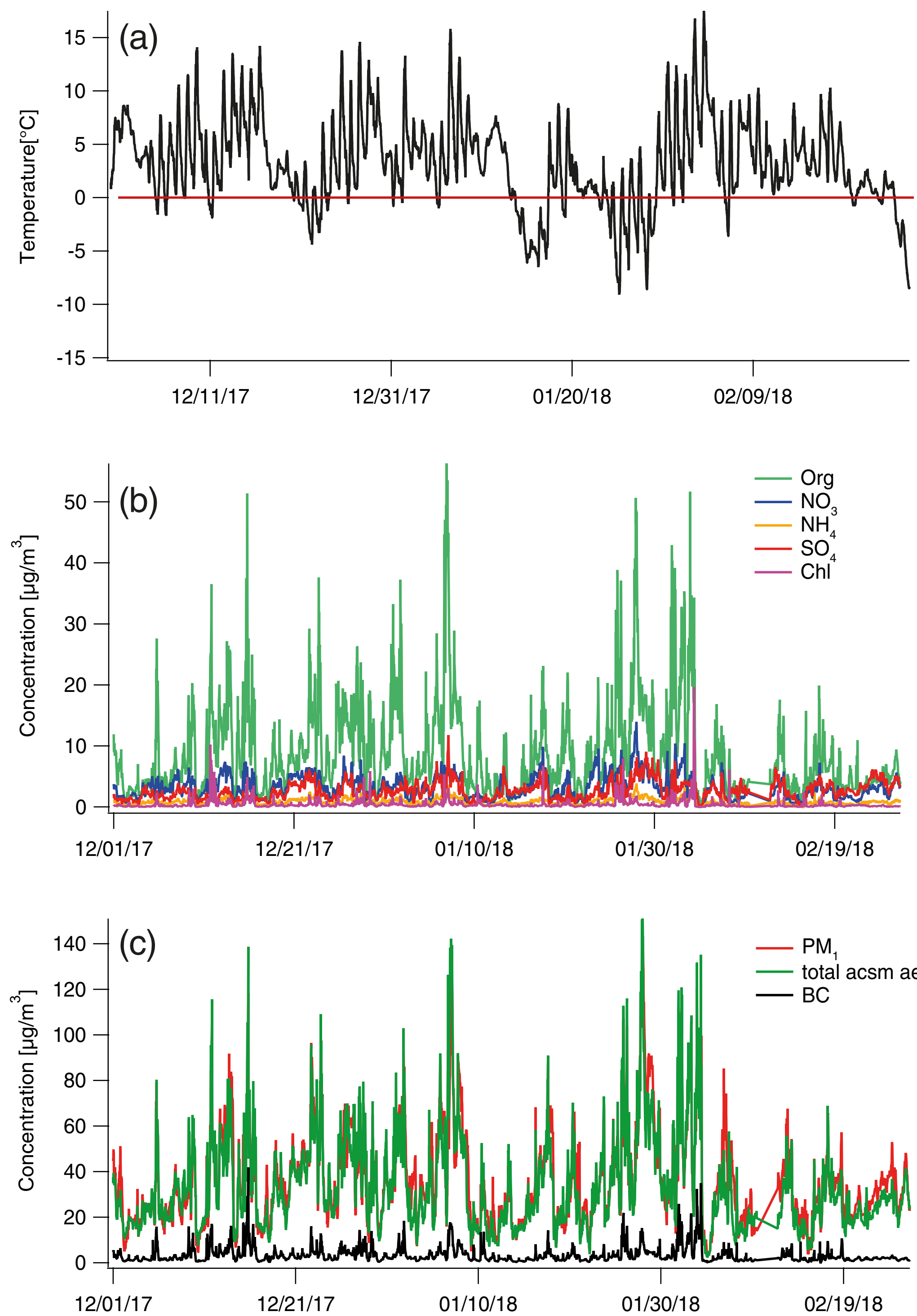


Figure 1. Time series for the period 1 Dec 2017–28 Feb 2018 for: (a) temperature; (b) nonrefractory PM₁ components, and (c) PM₁ and BC concentrations.

Results

The campaign period was specific for a warm winter, with a positive average temperature: 2.7 °C. The negative temperatures represented only 22.5% of the total recorded measurements (Figure 1a).

The particle sizer instruments highlighted the presence of submicronic particles. The average concentration of total PM₁ was 36 µg/m³, representing 95% of the total PM_{2.5} and 80% of the total PM₁₀.

The measurement period was characterized by high loadings of **organic aerosol, representing 55%** of the total non-refractory PM₁, while the inorganic aerosols were divided into: **nitrate 20%, sulphate 17%, ammonium 5%, and chloride 3%** (Figure 1b).

A good agreement between **PM₁** (Figure 1c) derived from GRIMM-OPC and the **PM₁ derived from Q-ACSM and black carbon (BC)** was found (a slope of 0.93 and an R² of 0.88).

The **BC concentration** was splitted into contribution from fossil fuel and wood burning using the absorption at 470 and 950 nm wavelengths and specific Ångström exponents (for fossil fuel 1 and 2 for wood burning). The BC_{wb} represented 60%.

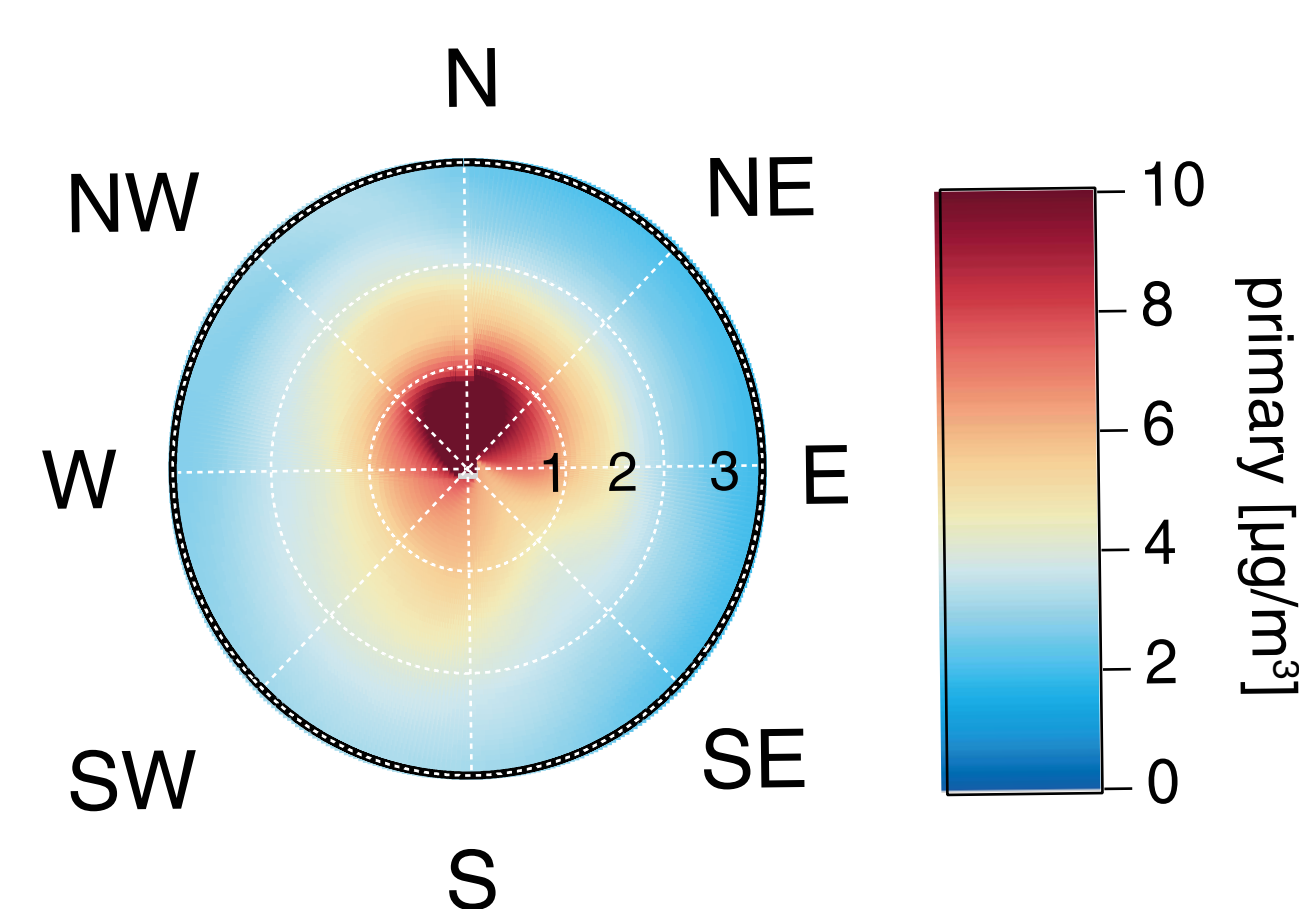


Figure 2. Source estimation for primary aerosol

The percentage of the derived factors is: 20% HOA, 20% BBOA, 33% OOA, and 27% OOA2-BBOA.

The source estimation for primary and secondary aerosols are illustrated in Figure 3 and 4, respectively.

The organic aerosol was apportioned in four factors (Figure 2): **HOA (a = 0.1)**, **OOA** and two types of biomass burning organic aerosols: **BBOA** and **OOA2-BBOA (a = 0.3)**.

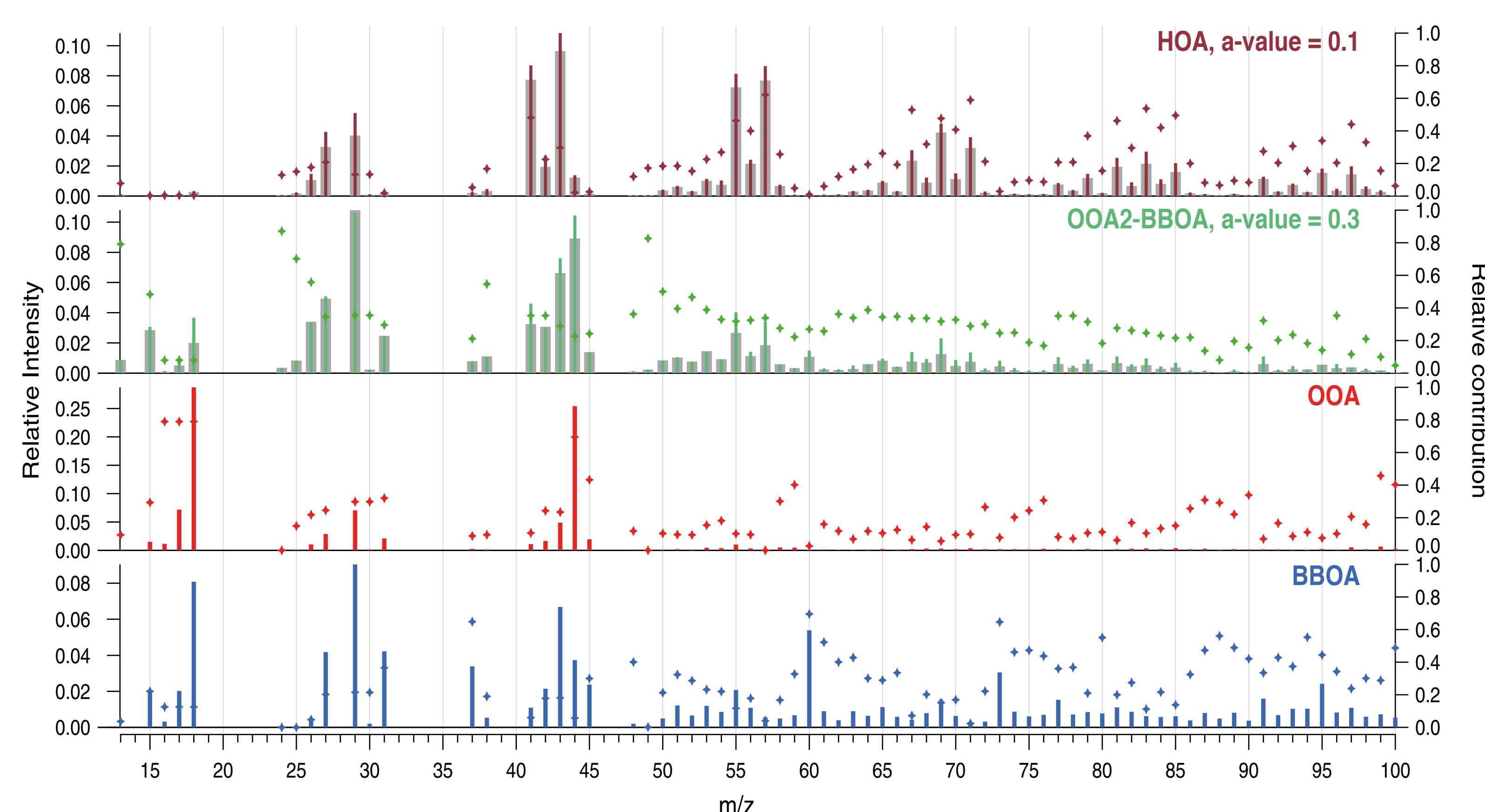


Figure 2. Mass spectra for organic factors.

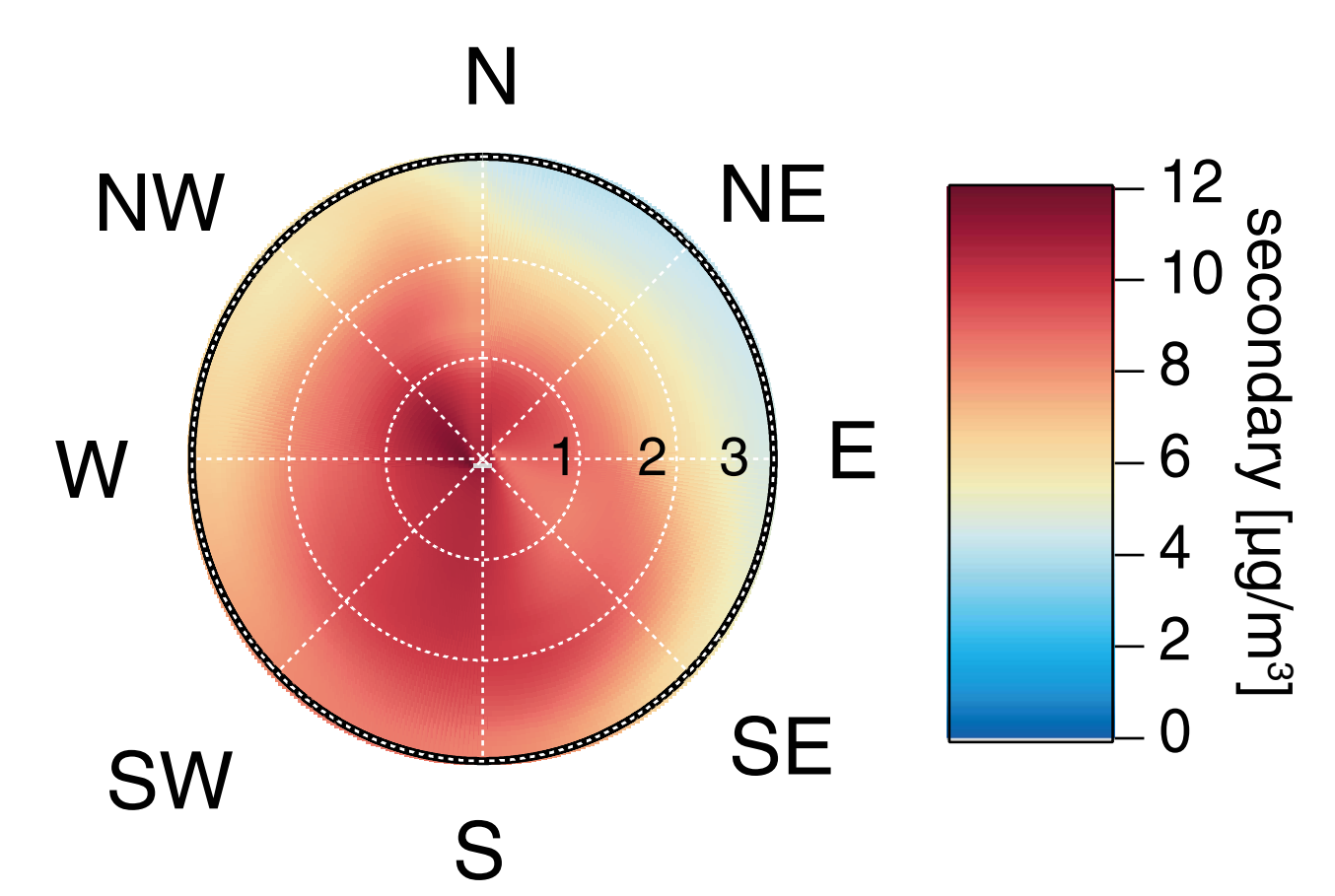


Figure 4. Source estimation for secondary aerosol

The factors have been validated with external tracers, the R² are as follows:
HOA vs. NO_x = 0.6
OOA vs. NO₃ = 0.66
OOA2-BBOA vs. BC_{wb} = 0.59
BBOA vs. BC_{wb} = 0.9
BBOA vs. levoglucosan = 0.96 (Figure 5).

Conclusions

The IMP in Romania was characterized by mainly positive temperatures. The sampled aerosols were in the fine mode, from which the organic aerosol represented 55%. The source apportionment of BC resulted in 60% contribution from wood-burning and 40% from fossil fuel.

References

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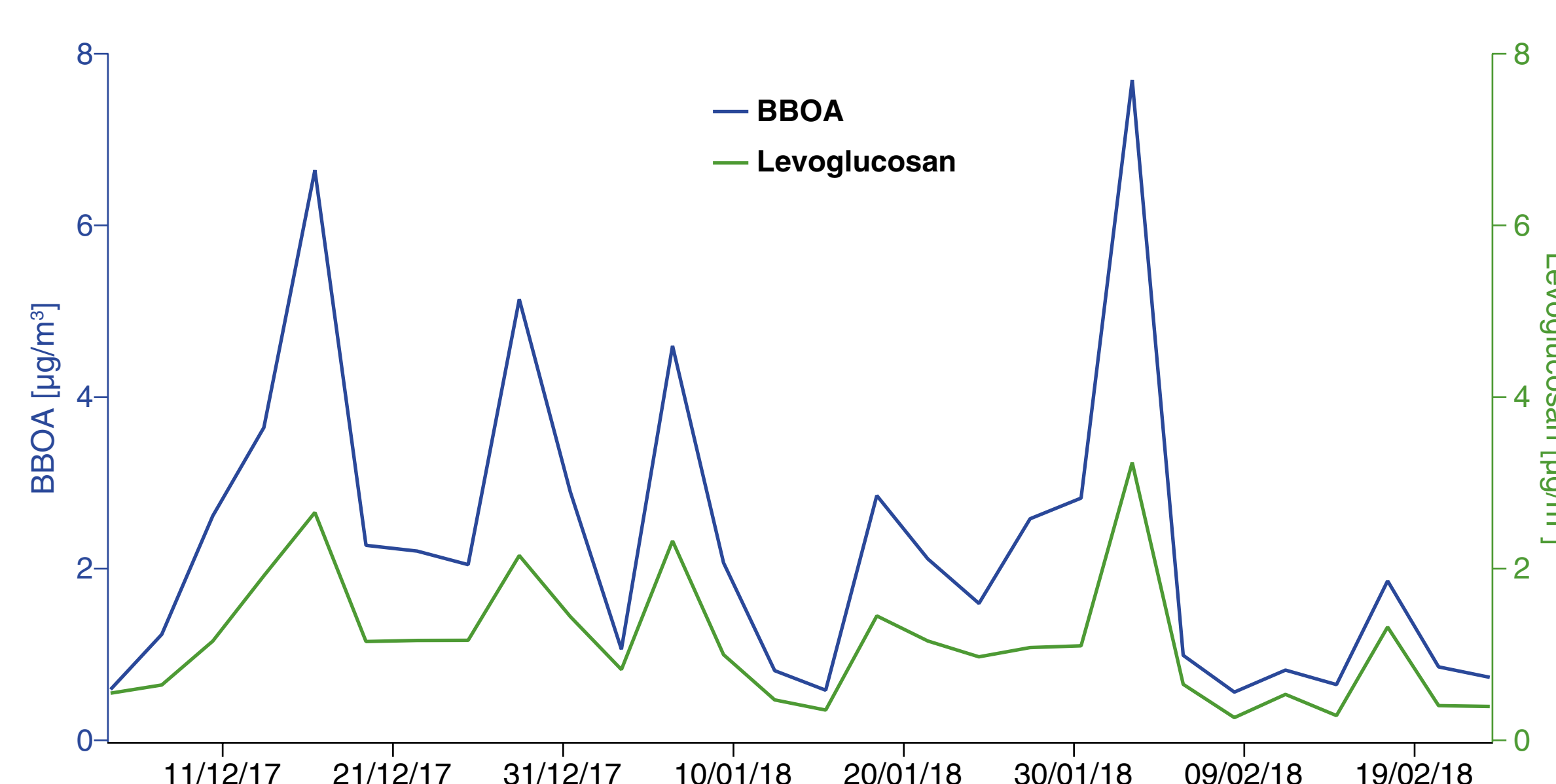


Figure 5. Time series of BBOA and levoglucosan.

Acknowledgements

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