Highly Resolved Spatiotemporal variability of Carbonaceous Aerosols from Wood-burning in a Mountainous Area

Kristina Glojek[1], Griša Močnik[2], Honey Alas[3], Andrea Patricia Cuesta Mosquera[3], Luka Drinovec[2], Asta Gregorič[4], Matej Ogrin[1], Kay Weinhold[3], Irena Ježek[4], Thomas Müller[3], Martin Rigler[4], Maja Remškar[2], Dominik van Pinxteren[3], Martina Ristorini[5], Maik Merkel[3], Miha Markelj[6] and Alfred Wiedensholer[3]

[1]Department of Geography, Faculty of Arts, University of Ljubljana, Aškerčeva c. 2, 1000 Ljubljana, Slovenia
[2] Condensed Matter Physics, Jozef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia
[3] Leibniz Institute for Tropospheric Research, Permoserstr. 15, 04318, Leipzig, Germany
[4] Aerosol d.o.o., Kamniška 39 A, 1000 Ljubljana, Slovenia
[5]Department of Chemistry, Sapienza University of Rome, Viale Regina Elena 291, Rome, Italy
[6]Milan Vidmar Electric Power Research Institute, Hajdrihova 2, 1000 Ljubljana, Slovenia

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Contact: kristina.glojek@ff.uni-lj.si

Introduction

Studies (Largeron & Staquet, 2016; and the reference therein) showed that in populated mountainous regions air pollution can be a serious problem, especially in the cold part of the year. In order to adequately capture and understand rapidly changing atmospheric processes and consequently the dynamics of local air pollution in areas with complex terrain, high resolution temporal and spatial data are needed. Our aim is to measure the spatiotemporal variability of carbonaceous aerosols in a hilly rural area during ground temperature inversion episodes and during mixed atmosphere using mobile measurements.

Methods

Aerosol measurements were performed in the model region Retje (Slovenia), a populated woody karst hollow with frequent ground temperature inversions and residential wood combustion as the main energy source. To determine the spatial variability of the equivalent black carbon (eBC) in the selected hilly, rural area simultaneous mobile measurements were performed using two instrumented backpacks (AE51, MA200, OPSS 3330, temperature sensor) (Alas et al., 2018). Measurements were performed along 6 km long fixed route, with a 10 and 20 min stay on top of the hill and in the village, to compare with the reference instruments in the fixed stations (AE-33, TROPOS and TSI MPSS). Mobile measurements were performed in winter 2017/18 (December, January), three times a day (in the morning, at noon, and in the evening). The regression slope between two AE51 microaethalometers was 0.96. Fixed instruments showed good agreement with the mobile instruments during inter-comparison periods.

Conclusions

The pollutant concentrations in the studied area are decisively influenced by the intensity of local wood burning emissions and by unfavourable meteorological conditions, which prevent effective dispersion and dilution of pollutants during temperature inversions. The median value of eBC concentrations for the whole relief depression during temperature inversion episodes was 3.2 µg/m^3 and 0.8 µg/m^3 in periods with mixed atmosphere. The highest eBC concentrations were in the evenings, during temperature inversions. The median of eBC concentrations between 17:00 and 19:00 CET for the whole relief depression was 6.8 µg/m^3.

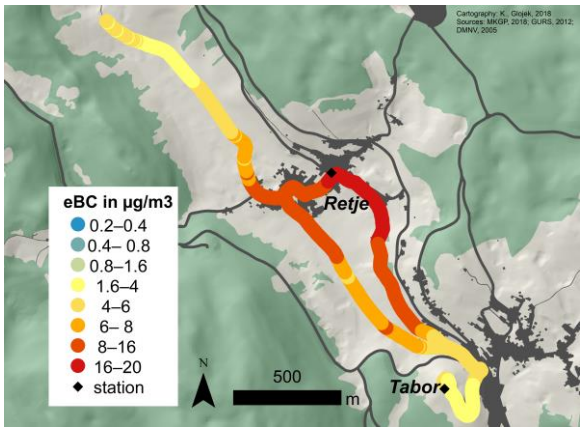

Figure 1. Evening eBC concentrations during temperature inversion periods.

In the village Retje the median of eBC concentrations was much higher (14–20 µg/m^3) than on the top of the hill Tabor (2–5 µg/m^3), where the air starts to drain out of the hollow.

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