MEASUREMENTS OF BLACK CARBON – SPATIAL AND TEMPORAL HETEROGENIETY IN CENTRAL EUROPEAN BASINS

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Introduction

Aerosolized black carbon (BC) is a primary product of incomplete combustion of fossil and biomass fuel. It is present in the atmosphere in the form of particulate matter with a large optical absorption across the visible light spectrum. Black carbon is a good indicator of primary emissions and is thus a good indicator of the efficiency of abatement strategies. It is an air pollutant which contributes to climate change, while its inhalation is related to undesirable health outcomes.
Monitoring of BC by aerosol absorption using Aethalometer allows highly time-resolved source apportionment (Sandradewi et al 2008), while the results of chemical filter analyses can be used to apply the macro-tracer model (Kistler et al 2013), both for the determination of wood burning and traffic to particulate air pollution.
Several measurement campaigns were performed in three European cities of different sizes: Klagenfurt, Maribor and Ljubljana in order to study source specific spatial and temporal heterogeneity of BC. Different source apportionment methods for BC and carbonaceous matter were compared. Additionally, influence of meteorological parameters on temporal evolution of BC was studied.

Results

Measurements in Klagenfurt and Maribor lasted three consecutive winters, while several measurement campaigns were performed in the city of Ljubljana. All three cities are situated in basins (Fig. 1) and experience frequent severe pollution episodes in winter.
Results from all measurement campaigns show significant difference of spatial and temporal heterogeneity of BC apportioned to different sources. Wood smoke is spatially homogeneous on a regional scale, showing generally constant city to background ratio through the day. On the other hand, traffic contributes locally, which is observed as increased BC concentrations in the city centre with respect to the background location. Average measured BC values, as well as contribution of different sources are summarized in Table 1.
Measurements in Ljubljana, which were performed in order to assess efficiency of abatement measures, revealed a significant decrease of traffic related black carbon after closure of the city centre for vehicular traffic.
Diurnal pattern of BC concentration is governed by fluctuation of sources, as well as meteorological processes, such as mixing in the planetary boundary layer, wind speed and direction, and precipitation.

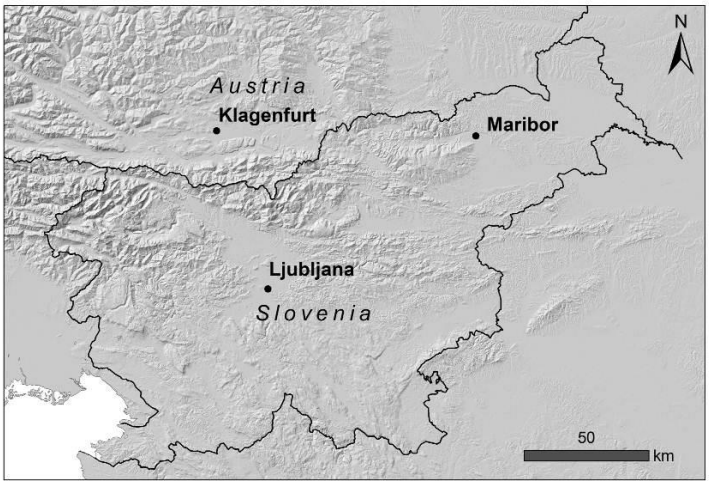

Figure 1. Measurement locations.

Table 1. Winter average values of total black carbon concentration (*BC*), contribution of traffic (BC_{ff}) and contribution of wood burning (BC_{wb}) measured in Ljubljana, Maribor and Klagenfurt.

		µg/m^3			**%**	
		BC	***BC*$_{ff}$**	***BC*$_{wb}$**	***BC*$_{ff}$**	***BC*$_{wb}$**
Ljubljana	city centre	4.8	3.7	1.1	77	23
	background	3.5	2.6	0.9	74	26
Maribor	city centre	5.3	4.0	1.3	76	24
	background	2.5	1.3	1.2	51	49
Klagenfurt	city centre	7.6	6.5	1.1	85	15
	background	4.9	3.3	1.7	66	34

Conclusion

Significant difference of spatial and temporal heterogeneity of BC apportioned to traffic and wood burning provides important information, which should be taken into account in the process of local and regional air pollution control. Wood smoke plays an important role in PM air pollution, especially considering the total concentration of carbonaceous matter. Socio-economic factors play an important role in the selection of energy source used for domestic heating, making wood one of the most affordable fuels, which is also the reason for increasing domestic wood burning in urban areas.

References

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