Inter-winter evolution of biomass burning contribution to PM_{10} in an Alpine valley based on aethalometer model

Julie Allard[1, 2], Florie Chevrier[1, 2], Irena Ježek[3], Griša Močnik[3, 4], Guillaume Brulfert[5], Jean-Luc Besombes[2] and Jean-Luc Jaffrezo[1]

[1]Université Grenoble-Alpes, CNRS, IGE, 38400 Saint-Martin-d'Hères, France
[2]Université Savoie Mont-Blanc, LCME, F-73000, Chambéry, France
[3]Aerosol d.o.o, 1000, Ljubljana Slovenia
[4]Jozef Stefan Institute, 1000, Ljubljana, Slovenia
[5]Atmo Auvergne-Rhône-Alpes, 73000, Chambéry, France

Keywords: biomass burning, aethalometer model, long-term monitoring, confounding factors
Contact: Julie.Allard@univ-grenoble-alpes.fr

The Arve valley (France) is an urbanized valley and frequently experiences winter pollution, which has led to the implementation of emission abatement measures. A pilot operation at national scale is operational since 2013 to reduce biomass burning emissions by subsidizing old wood-burning appliance replacement. In 6 years, nearly 30% (3252 appliances) of old devices estimated on the territory have been exchanged. To assess the impact on air quality, a system to monitor continuously biomass burning contribution to PM_{10} was deployed based on aethalometer model (Sandradewi *et al.*, 2008) for black carbon (BC_{wb}) and extended to PM_{10wb}. However, several factors confound the trend between winters, by complicating source apportionment and drastically influence concentrations levels. The most important factor is the meteorological phenomena of cold air pools. The aim of this study was to propose a methodological strategy to take into account factors that may lead to false conclusions.

Aethalometer AE33 and high volume samplers (DA-80) were installed at three sites in the valley, representing the different atmospheric areas (Figure 1): 115 24h-PM_{10} samples were collected on quartz filters, at each site between 11/2013 and 10/2014 and 52 samples per site for each following winter (01/11 to 31/03) until 2018. The quality of the aethalometer source apportionment is checked by comparing daily measurements with EC (EUSAAR2) and levoglucosan concentrations. Source contributions from PMF developed for this specific area (described in Weber *et al.*, 2018) agree with results of other source apportionment tools (radiocarbon, Bonvalot *et al.*, 2016, and PMF on AMS, Bertrand *et al.*, 2015). Daily concentrations are then analyzed according to homogeneous atmospheric conditions determined by an automatic classification method (Allard *et al.* 2018).

During the 4 winters (2013 to 2016), PM_{10} chemical composition did not vary significantly, making it possible to estimate PM_{10wb} from BC_{wb}. A decrease of winter PM_{10wb} concentrations was demonstrated at Passy when comparing days with homogeneous atmospheric conditions (Theil-Sen method, p-value < 0.001). For conditions without a temperature inversion, a 9 to 19% decrease of PM_{10wb} per winter is observed on the 3 sites. Winter measurements for 2017 and 2018 will consolidate these results.

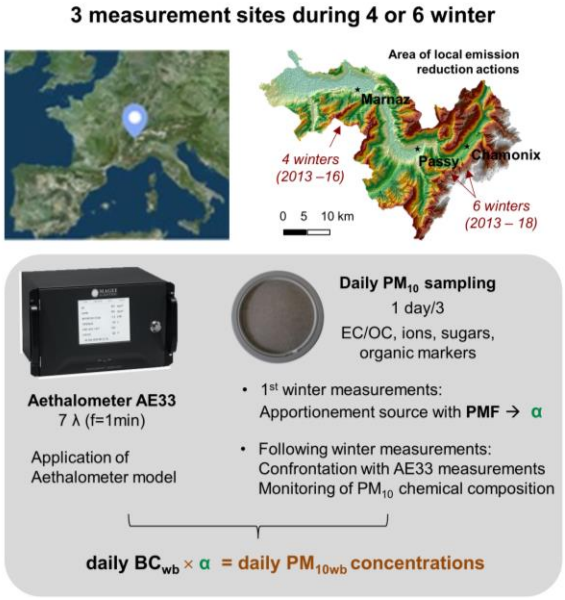

Figure 1. Schema of applied methodology to estimate continuous biomass burning contributions

This work was supported by the French Agency of Environment and Energy Management (ADEME) in program DECOMBIO (n°1362C0028).

Allard, J. *et al.* (2018) in *Proc. 11th Int. Conf. on Air Quality*, Barcelona, Spain.
Bertrand, A. *et al.* (2015) in *Proc. European Aerosol Conference*, Milano, Italy.
Bonvalot, L. *et al.* (2016) in *Atmos. Chem. Phys.* **16**, 13753-13772
Sandradewi, J. *et al.* (2008) in *Environ. Sci. Technol.* **42**, 3316-3323
Weber, S. *et al.* (2018) in *Atmos. Chem. Phys.* **18**, 9917-9629