Particulate matter variability sources in an open-plan office: comparison of two monitoring campaigns

R. Ouaret[1,2], A. Ionescu[1], V. Petrehus[3], Y. Candau[1] and O. Ramalho[2]

[1] Université Paris-Est, CERTES (EA 3481), UPEC, F-94010, Créteil, France
[2] Université Paris-Est, CSTB, Champs-sur-Marne, F-77447, France
[3]Department of Mathematics and Informatics, Technical University of Civil Engineering, Bucharest, Romania

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Presenting author email: rachid.ouaret@u-pec.fr, r.ouaret@gmail.com

This work focuses on the identification of the main sources of variability of particulate matter in a real indoor environment using blind source separation (BSS) methods. In order to study the potential of these methods in indoor source separation, different comparisons were performed: (*i*) using different BSS methods, applied on the same monitoring campaign database; (*ii*) using the same methods for two different campaigns; (*iii*) comparing indoor and outdoor results from the same measuring campaign.

The two monitoring campaigns were performed in the same open-plan office: the first one in 2012, during 6 months (from February to June) and the second one, during 3 months in 2015 (from January to April). The indoor air particulate matter was sampled hourly (in 2012) or every minute (in 2015), using an optical particle counter (Dust Monitor 1.108, Grimm), which provided the number of particles per liter, for fifteen size bins within a range of 0.3-20 µm. During the second campaign (in 2015), particulate matter was sampled also outdoors (on the roof of the same building), using the same protocol. Due to some measurement problems, only five size bins were selected for the 2012 monitoring campaign: 0.3-0.4 µm, 0.8-1 µm, 1.6-2 µm, 4-5 µm, 7.5-10 µm.

The different BSS methods employed for comparison were: NNMF (Non Negative Matrix Factorization), PMF (Positive Matrix Factorization), ICA (Independent Component Analysis), PCA (Principal Component Analysis). The mixing matrix, that is factorised, under different constraints, is obtained by using the fifteen time series in columns for the 2015 campaign and the five time series for the 2012 campaign. Each time series corresponds to a size bin.

The results of the estimated sources contributions provided by NNMF are illustrated in Figure 1 for the 2012 campaign and in Figure 2 for the 2015 campaign. Each curve can be interpreted as a source size bin variation. The three sources obtained for the 2012 campaign appear among those obtained for the 2015 campaign. A forth source can be found on the Figure 2, because the mixing matrix includes also particles of size bin greater than 10µm.

Some sources extracted by the different factorization methods are very similar; the same remark can be done for the sources obtained for the two campaigns. A similarity with outdoor sources shows the importance of the outdoor air transfer in the open plan office, especially for the fine particles.

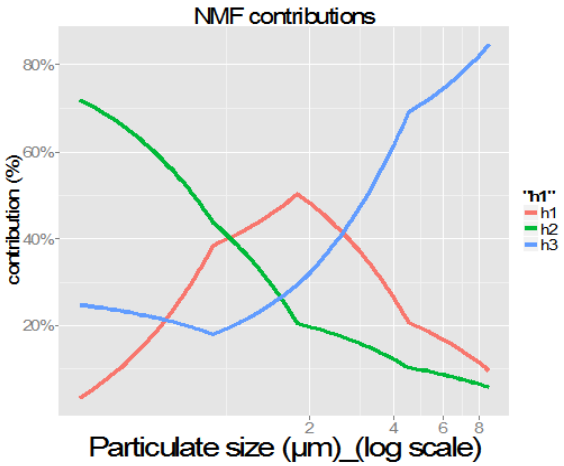

Figure 1. Relative source contributions in the open-plan office obtained using the NNMF method for the 2012 campaign, based on particles less than 10 µm.

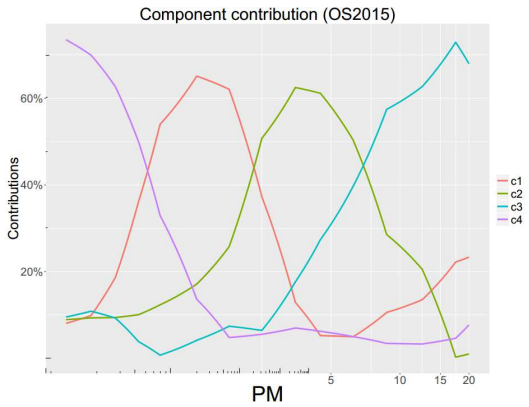

Figure 2. Relative source contributions in the open-plan office obtained using the NNMF method for the 2015 campaign, based on particles up to 20 µm.

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