Source apportionment of oxidative potential of atmospheric particulate matter: method & application at 15 sites in France

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Introduction

Atmospheric ambient PM has already been shown to be linked to diverse health outcome such as asthma, cardiovascular disease and increase cancer risk. However, epidemiological studies focus only on PM mass despite the fact that the PM present a wide span of size, shape, chemical composition and so reactivity. The oxidative potential (OP) of PM has been proposed as a new proxy for air quality in order to better estimate the the population exposition since it integrates the different PM characteristic and is a closely linked to the inflammatory response of the body to the oxidative stress induced by PM, and so to different health outcomes. However, long time series of OP measurement are still poorly documented in the literature and no standardized assays has emerged. Moreover, very scars source apportionment of OP has been conducted yet.

Methods

In this study, we sampled aerosols one every third day at 15 different sites in France for 1 year. We measured OP thanks to 2 different assays (OP AA and OP DTT) together with a advanced chemical speciation (ions, EC/OC, metals, organics, etc) on the very same PM filters. Thanks to PM source apportionment through the use of PMF and an adapted multiple linear-regression (see Weber et al, 2018), we then expressed the intrinsic OP ($OP/\mu g_{PM}$) for each source. We also compare the similarity between the different PMF factor at each site (thanks to tools developed in the FAIRMODE group (Belis et al, 2018)) in order to assess the geochemical stability of the intrinsic OP of the factors at the regional level.

Results & conclusions

Both OP present clear seasonal pattern with high value during winter and relatively lower during summer. We also note that the 2 different OP assays do not present the same reactivity toward the sampled aerosols. Comparing to the PM mass source apportionment, we clearly observe a redistribution of the different sources contribution when considering the OP instead of the mass (see figure 1, example of Chamonix). We also show that the primary road traffic source has an intrinsic OP (OP/µg of PM) significantly higher than the other PM sources, notably when considering the AA assay. As a consequence, it demonstrates that depending on the metric we use (ie. mass or OP), the source contribution completely differ.

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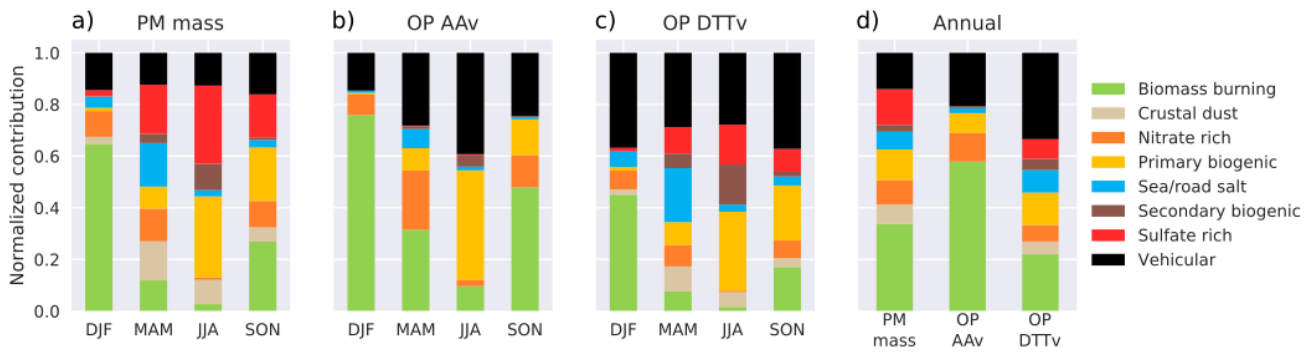

Figure 1: Source contribution to the mass of PM (**a**) and 2 different OP assays (**b** OP AA_v and **c** OP DTT_v), express as seasonal (**a**, **b** and **c**) and annual (**d**) normalized contribution.