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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Primary sources of $PM_{2.5}$ organic aerosol in an industrial Mediterranean city, Marseille" *by* I. El Haddad et al.

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First we want to thank Dr. Stefania Gilardoni for raising these relevant comments and questions.

We agree with the reviewer that the paper does need some modifications to improve its readability. In the corrected manuscript, we have taken into account the minor comments and heavily reorganized the paper structure in order to meet the suggestions of the reviewer. Now, the manuscript includes 4 sections: Introduction, Methods, CMB setup, Results and discussions.

Below are our responses on the main questions raised by the reviewer.

Contribution of spores:

In our opinion, estimating the contribution of primary biogenic organic aerosol (PBOA) remains, at present, eminently complex, as there are great many different primary biogenic sources and emitting processes and data at emission points are really scarce.

In our case, we have estimated using CMB modeling that vegetative detritus and plant wax contributions is relatively significant (2% of OC). By contrast, the concentrations of other PBOA components, mainly sugar polyols (arabitol and mannitol) that derive from spore emissions, are relatively low. In our opinion, this observation can be explained by two reasons.

First, it is reported that sugar composition in the aerosol displays high seasonal variability depending on their production and utilization by the ecosystem (Medeiros et al., 2006). In particular, polyols are expected to be more prevalent during bloom periods in the spring. So, during the field campaign that we conducted in summer time, the biological activity might be diminished, which may explain the relatively low concentrations of polyols observed here.

Second, it was also reported that polyols are predominant in the coarse mode (PM10-PM2.5) (Kourtchev et al., 2009). Here, we have measured their concentrations in the fine mode (PM2.5), which may explain the low levels that we have found comparing to those reported in other studies (Yttri et al., 2007;Kourtchev et al., 2009).

Discrepancies between total fossil TC and CMB fossil TC:

CMB fossil TC represents only the fossil TC that is emitted by primary sources. Hence, the difference between CMB fossil TC and total fossil TC measured by 14C, can be theoretically assigned to fossil secondary organic carbon (SOCf). Nonetheless, in practice, the estimation of the latter fraction (SOCf) is subjected to many uncertainties (marker decay, variability of source profiles ...) that are discussed thoroughly in the companion paper. As pointed out by the reviewer, the use of an incorrect conversion factor to calculate the fraction of non-fossil carbon can also lead to some uncertainties in the estimation of SOCf fraction and can affect the comparison between total fossil

TC and CMB fossil TC. This factor is dependent on the age of the emitting plants, as biomass photosynthesized 30, 20, 10, and 0 years before the FORMES study in 2008 would have a factor of 1.35, 1.18, 1.11, and 1.05, respectively (Levin et al., 2010). Here, we have selected an average value of 1.1 usually used in source apportionment studies using 14C data (Bench, 2004;Ding et al., 2008). More clarifications regarding this issue are added in the corrected manuscript.

The second remark pointed out by the reviewer regarding the comparison between total fossil TC and CMB fossil TC is that the discrepancies between the two values look larger when the concentrations of PAH and metals are higher. This observation can be explained by the particular meteorology of Marseille. The high concentrations of PAH and metals are encountered when the site was directly downwind of industrial area during land and sea breeze episodes, mainly on 30 June 2008 and 05 July 2008 (Fig. 4 and 7). These particular episodes are associated as well with high photochemical activity that appears to foster the formation of SOCf, which increases the discrepancies between total fossil TC and CMB fossil TC.

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