

Dear Referee #1,

Thank you for your comments on our manuscript. Please find below your comments in blue and the authors' responses in black.

The manuscript by Bressi et al. analyzed one-year submicron aerosol data that was collected at a regional background site in Po Valley using an ACSM. The performance of the ACSM measurements was fully evaluated, and the variations in chemical composition and diurnal cycles were characterized. Further, positive matrix factorization with ME-2 algorithm was used to resolve potential organic aerosol factors with different sources and processes. While SOA was important throughout the year, an enhanced role of biomass burning aerosols during cold seasons was also observed. Atmospheric aerosols in Po Valley have been widely characterized at both urban and rural sites and the results in this study were overall consistent with previous conclusions. Although there are no new scientific findings compared to previous studies, this manuscript is still worth for publication by providing a general overview in aerosol variations and sources on an annual basis in Po Valley.

My major comment is the discussions on seasonal differences. In the text, the figures only showed the averages on annual basis (some seasonal averages in supplementary). I suggest the authors move the important seasonal information into the main text. This is also one of the uniqueness of this study. For example, show the diurnal cycles of NR-PM<sub>1</sub> species during four seasons in Figure 4.

The important seasonal information has been moved into the main text accordingly. Figure 4 has therefore been modified and now show the diurnal cycles of NR-PM<sub>1</sub> species during four seasons and on the annual scale. Figure S6 has been removed. Following referee #2 suggestions as well, the variations of NR-PM<sub>1</sub> chemical composition and OA factors' contributions as a function of total NR-PM<sub>1</sub> mass are also examined on the seasonal scales (Fig. S9 and Sect. S4).

Please also show the diurnal cycles of mass concentrations of OA factors in Figure 2, sometimes, it is misleading if only the diurnal cycles of mass fractions are shown.

Figure 2 has been modified accordingly and now show the diurnal cycles of mass concentrations of OA factors.

Fog events are frequent in Po Valley. I am surprised that the authors didn't discuss the fog impacts (scavenging and production) on aerosol variations, particularly in winter.

Fog events are indeed frequent in the Po Valley. We decided not to discuss this subject in the manuscript for two main reasons. First, our manuscript is focused on statistically significant variations (e.g. seasonal, daily) in order to suggest recommendations for PM abatement strategies. We thus decided not to comment specific pollution events (e.g. biomass burning, traffic or fog events). Second, previous studies have reported in detail the fog impacts on aerosol variations in the Po Valley (e.g. Gilardoni et al., 2014). We consider that additional innovative information on fog impacts on aerosol variations in the Po Valley cannot be given based on our datasets.

With one-year data, weekend effects might be explored for a better interpretation of sources.

We agree with the referee that weekend effects help better interpret sources. Weekend effects have been explored and are mentioned briefly in the manuscript, which reports that i) HOA contributions are higher during weekdays than weekends, which is characteristic of traffic emissions (l. 312) and ii) BBOA contributions are conversely higher during weekends than weekdays, consistent with residential heating emissions (l. 317).

A figure showing weekday/weekend contributions and concentrations of OA factors in each season has been added in the supplementary material (Fig. S6). Precisions have been added in the text as follows:

I. 308-310: “[HOA] relative contribution is characteristic of traffic emissions, exhibiting a peak in the morning, and higher contributions during weekdays than weekends (e.g. averages of 14 and 9%, respectively, in autumn, Fig. S6).”

I. 312-315: Regarding BBOA, “A distinct daily cycle with higher contributions during night-time than daytime is observed, in addition to higher contributions during weekends than weekdays (e.g. averages of 24 and 21%, respectively, in spring, Fig. S6), consistent with residential heating emissions.”

Line 394, “and previous observations (Putaud et al., 2013)” is not one of the reasons.

Modified accordingly:

“Higher levels were expected during cold months due to enhanced biomass burning emissions and lower boundary layer heights (BLH), as previously observed at the study site (Putaud et al., 2013).”

Line 449, typo, “C<sub>2</sub>H<sub>3</sub>O<sup>+</sup>”.

Modified accordingly, “C<sub>2</sub>H<sub>3</sub>O<sup>+</sup>”

## References

Gilardoni, S., Massoli, P., Giulianelli, L., Rinaldi, M., Paglione, M., Pollini, F., Lanconelli, C., Poluzzi, V., Carbone, S., Hillamo, R., Russell, L. M., Facchini, M. C. and Fuzzi, S.: Fog scavenging of organic and inorganic aerosol in the Po Valley, *Atmospheric Chem. Phys.*, 14(13), 6967–6981, doi:10.5194/acp-14-6967-2014, 2014.

Putaud, J.-P., Adam, M., Belis, C. A., Bergamaschi, P., Cancellinha, J., Cavalli, F., Cescatti, A., Daou, D., Dell’Acqua, A., Douglas, K., Duerr, M., Goded, I., Grassi, F., Gruening, C., Hjorth, J., Jensen, N. R., Lagler, F., Manca, G., Martins Dos Santos, S., Passarella, R., Pedroni, V., Rocha e Abreu, P., Roux, D., Scheeren, B., and Schembari, C.: JRC-Ispra Atmosphere-Biosphere-Climate Integrated monitoring Station (ABC-IS): 2011 report, JRC Technical Reports, Joint Research Centre, Ispra (Italy), available at: <http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/28242/1/lb-na-25753-en-n.pdf> (last access: 28 March 2014), 2013.