

Interactive comment on “The impact of biomass burning and aqueous-phase processing on air quality: a multi-year source apportionment study in the Po Valley, Italy” by Marco Paglione et al.

Anonymous Referee #2

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Review of the MS titled “The impact of biomass burning and aqueous-phase processing on air quality: a multi-year source apportionment study in the Po Valley, Italy” by Marco Paglione et al. MS id no: acp-2019-274 Air pollution in urban regions has gained considerable attention in recent years due to its health and climate-effects. Povalley (Italy) is one such hotspot region, where ambient PM levels are exceeding to that of both WHO and European Air quality Directive. Large uncertainties of this PM related health and climate-effects are somewhat associated with sources and processes affecting the organic fraction, which is a major part of ambient PM here. Paglione et al. have studied the intense air pollution events at two different sites (Bologna: BO and San Pietro Capofiume: PSC) over Povalley using High-Resolution Aerosol Mass

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Spectroscopy (HR-AMS) with the specific aim of organic aerosol (OA) characterization and source apportionment over a period of four years (2011-2014). Overall, this is nice piece of study and worth publishing in ACP after addressing some of the below mentioned comments. I must say here that the uploaded text font of the ACP manuscript is too small read offline. I suggest authors to take care of this part when uploading the revision. Grey shades in figures should be in 'black' with increase in font size for all the figures. P2 L13: Is it 400 or 400,000 premature deaths?? P2 L20: replace 'proved' with 'established' P3 L16: Aerosol Chemical Monitor (ACSM)?? P9L25-29: I could not follow the logic of arguments here? Do authors mean HOA are embedded/occluded in water-soluble OA components at SPC, which are scavenged by the fog and left behind the HOA, thus increasing the fossil-based emission contribution to SPC?? Some additional explanation is needed here. From Table 1, it is apparent that OA contribute almost 50% at both sampling sites (BO and SPC). It is bit confusing to see some places OOA and other places as SOA. Please maintain consistency throughout the manuscript. In Table 2, I understand the reason of HOA share decrease between BO and SPC. But the BBOA component show more at BO site compared SPC during spring 2013 but also somewhat higher or comparable for other seasons too. Some explanation is need in the manuscript. P10 L8: Is it because of the differences in the ambient temperature and photochemical activity between winter and summer controls their abundance whether it is NH_4NO_3 in winter/fall vs. $(\text{NH}_4)_2\text{SO}_4$ in summer and, hence, their correlation with OOA component. Add some additional explanations here. P10 L10: Instead of calculating based on the overage, I recommend authors' to show the ratio of each fraction of OA between BO and SPC based on the box plots. This will give us a brief idea about the relative increment of emissions/formation processes contributing to observed compound classes of OA between both sites. P10 L13: Authors mentioned previously that in summer traffic is less at BO because of the shutdown of schools and public institutions, in which case, why the HOA fraction increased over BO compared to SPC in summer. In Table 3, why BBOA fraction is almost 6 fold higher at BO (urban) compared to the SPC (rural). This implies there exists a very strong local

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source of biomass combustion at BO compared to SPC, please clarify. Higher share of BBOA(%) over SPC in fall, why not is the case for winter or other seasons? P11 L6: Why focus only on these two factors? P11 L30-31: How this fraction of OOA_BB was estimated here? Figure 6 panel resolution and font sizes need to be improved? This figure is not readable at all offline. Grey shade text in panel d should be converted to black. P12 L19-20: These sentences are not clear, please rewrite. The slope line between triangles and circles seems to be zero (i.e., OOA_x_BB-aq) and those between triangles and squares (OOA_x_BB) is like between -0.5 and one. P12 L24: This is contradicting the above classification on L19-20. Please check. P12 L29: What are the input parameters to ISORROPIA-II, which mode is used, please provide. P13 L7: sentence should read like this, 'Dividing the individual OOA fractions with the total POA' In Figure 8, what is the OOA2, OOA3, OOA refers to, Please clarify. P13 L16: I can see m/z 29 signal but not 58 from figure 8 (left panel). Did I miss something here? P13 L21: mention those specific fragment ions here within parenthesis. In Figure 9, why there is no such presence of aq-SOA despite more sunlight and having precursors at both sites. Some explanations needed in the manuscript. Please provide line numbers continuously and also increase the font size of the text so that it will help us to properly evaluate the manuscript.

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