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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Particulate matter, air quality and climate: lessons learned and future needs" *by* S. Fuzzi et al.

Anonymous Referee #1

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Fuzzi et al. reviews impacts of particulate matter on climate, air quality and public health. This paper is a comprehensive review written by 21 experts in the field and it is a great contribution to the community. I would be very happy to recommend publication in ACP. I do not have much to criticize, but I found some sections carry only a few references (there are several paragraphs even without references). Moreover, some sections contain many of old references published before 2010 and only a few of recent papers, and thus, I feel some sections are not fully up-to-date. The authors may check very recent papers and see whether there are any of important aspects discussed particularly in the past few years. I have some specific comments that the authors should consider as below. Obviously I am not an expert for all the topics discussed in this paper, and I hope the other referee can point out aspects that I did not cover.

Abstract: I found that the current abstract is kept rather general and does not fully represents what are all reviewed. I would suggest extending abstract; please try to make it clear and specify key features of lessons learned and future needs.

P530, L10: There are some recent works regarding chemical transformation of allergenic proteins that I would suggest including here: Gruijthuijsen, et al. Int. Arch. Allergy Immunol. 2006, 141, 265; Shiraiwa et al. Nature Chem. 2011, 3, 291; Reinmuth-Selzle, K J. Proteome Res. 2014, 13, 1570.

P534, L6: I would suggest including Crounse et al. 2013 (J. Phys. Chem. Lett. 2013, 4, 3513), which proposed autoxidation, a key reaction for ELVOC formation.

P534, L20: Amazon, particularly in rainy season, is also close to pristine conditions. I would suggest including description of some measurement results conducted in Amazon. The importance of pre-industrial aerosols can be also emphasized in this section (e.g., Carslaw et al., Nature, 2013).

P540: HOA may not be fully equivalent to POA. HOA connects to chemical composition, whereas POA refers to an emission process. For example, dimers have low oxidation state and may be categorized as HOA, but dimers are certainly generated in secondary processes. It is often assumed in the AMS-PMF community that HOA corresponds to POA and OOA to SOA, but I would say this is still not fully elucidated. Please include some discussion or at least mention this issue.

P545, L13: Please spell out PN (particle number?).

P558, L13: This paragraph carries no references. There are many works done and please include several of those here.

P560, L26: For importance of particle-phase pathways for formation of low volatility compounds, please include some more recent references on dimer (e.g., Ziemann & Atkinson, Chem. Soc. Rev. 2012, 41, 6582; Shiraiwa et al. PNAS 2013, 110, 11746.) and organic salt formation (e.g., Yli-Juuti, T. Atmos. Chem. Phys. 2013, 13, 12507.).

P562, L14: Why suddenly health effects here? You could omit this sentence, or you need to add more descriptions of health effects.

Figure 12: This figure is not easy to understand. What is y-axis? Does it imply only dust, sea salt and PBAP undergo coagulation and removed via deposition? Coagulation should be relevant for ultrafine particles. This figure should be revised for easier understanding and better presentation.

P563, L10: For vapor wall loss, please also include Matsunaga & Ziemann (Aerosol Sci. Technol., 44, 881, 2010) and Loza et al. (Environ. Sci. Technol., 44, 5074, 2010). Particle wall loss is also an important issue for deriving SOA yields in chamber experiments. Please include a sentence with proper references.

P563, L15: This whole paragraph is again without any references. Please include any appropriate particularly for values for O:C ratio.

P565: Recently it has been found that organic aerosols can adopt an amorphous semisolid state depending on temperature and relative humidity (e.g., Virtanen et al., Nature, 2010; Koop et al., PCCP, 2011). It challenges traditional view of gas-particle interactions including gas uptake, chemical aging, SOA formation, aging and partitioning and CCN/IN activation. This is a hot topic in the aerosol chemistry community and many studies have been conducted in the past few years. I would suggest including more discussion on this aspect.

P566, L7: For organosulfate, I suggest including Iinuma, Y, Environ. Sci. Technol. 2007, 41, 6678.

P566: Dry deposition of particulate matter is reviewed extensively. Wet deposition is also as important or even more important as dry deposition for certain conditions. I would suggest that wet deposition of particulate matter should be also reviewed.

Section 2.4: This big section cites only a few papers published after 2010. Are there not much progress made in this field after 2011?

P571, L12: Lelieveld, J et al. (Atmos. Chem. Phys. 2013, 13, 7023) and Giannadaki et al. (Atmos. Chem. Phys., 14, 957, 2014) could be included here for estimation of premature mortality due to air pollution and dust, respectively.

P578, L20: Naphthalene SOA exhibits redox activity (McWhinney et al., Atmos. Chem. Phys., 13, 9731, 2013). You could also check some other studies using DTT assay to examine oxidative potential of PM.

P581, L12: In addition to formation mechanisms, formation kinetics would be also necessary.

P583: I would suggest mentioning about hazardous air pollutants (HAPs) and toxic air contaminants (TACs) (e.g., Finlayson-Pitts and Pitts, Chemistry of the upper and lower atmosphere, Academic Press, 2000).

P584, L24: You need several references here. Otherwise you cannot write “these studies”.

Figure 28: Is it known why there are peaks for both nitrate and sulfate around 2003?

P597, L12: Recent studies have shown that glassy SOA can nucleate ice. It is worth mentioning this aspect (e.g., Wang et al., J. Geophys. Res. 117, D16209, 2012; Schill et al., Environ. Sci. Technol., 48, 1675, 2014; Berkemeier et al. Atmos. Chem. Phys., 14, 12513, 2014).

P602, L8: Please include reference here.

P602, L9: Jacobson, 2001 is not a lab study. Please include lab works here (ex. Schnaiter et al., JGR, 2005; Zhang et al., PNAS, 2008).

P602-603: Refractive index of BC is still uncertain and that of BrC are highly uncertain, which directly affect the assessment of their radiative forcing. This may be worth mentioning.

P616: Would it be possible that ocean acidification affects biological activity in the sea

surface microlayer that eventually affects emission of sea spray aerosols and biogenic precursors?

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 521, 2015.