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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Multiday haze in the East Asia: Transport and chemical aging of hygroscopic particles" *by* Yong Bin Lim et al.

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This manuscript presents some valuable data and a number of interesting ideas. However, due to some technical issues and an overall lack of cohesion of the different parts of the paper, I don't believe it is publishable in the current form.

The authors made ambient observations of atmospheric chemistry/air quality during a haze episode in South Korea in 2014, which is representative of a situation where poor air quality in Seoul is due to a combination of air pollution coming from China + local emissions and chemical processing. Measurements were made at a remote site upstream of Seoul, and in Seoul. It is not clear to me what the relationship between the ambient measurement data presented in this manuscript and the data from Seo et al. ACP (2017) from the same group is - the data presented here seem to be a subset of that study. This is very important and should be made more clear in the manuscript.

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Discussion paper

Although this was not discussed in the manuscript, the calculated aerosol pH at Deokjeok Island presented in Figure 5 (pH 8.9 and pH 9) is very concerning. According to the SI, aerosol pH was calculated using E-AIM. Typical aerosol pH is generally between ~0 and 5, so, based on the literature and my experience with aerosol thermodynamic models, I believe there was probably an error in the calculation. The authors need to discuss and defend this result if they believe it is correct. Aqueous chemistry calculations are very sensitive to aerosol pH, and if there was an error in the calculation of aerosol pH it's likely that there was also an error in aerosol liquid water calculations - another critical parameter for this study. The authors should compare their results to results from ISORROPIA, AIOMFAC, or another model, and refer to the current literature regarding pH of Asian haze aerosol (e.g. Chi et al, J. Met. Res. 32 (1) 14-25 2018; Guo et al., Sci. Rep, 7 (1) 12109 (2017)).

Based on the ambient observations, the authors hypothesize that the particles coming in to Seoul from upwind are hygroscopic and undergo multiphase chemical processing. This is an interesting hypothesis but the basis for this hypothesis is not well-articulated, and it is not apparent to me when looking at Figures 4 and 5. They then performed some ambitious chamber studies of photochemistry of aqueous aerosols containing glyoxal, H2O2, and other inorganic components. The connection between the ambient data and these chamber studies is really not clear. How are the experimental conditions connected to the ambient observations? Why use glyoxal? Why H2O2 and not, say, O3, which may be participating in some chemistry based on Figure 3? What happens to aerosol containing these species when they are dried in a diffusion drier then rehumidified, and are these representative of the local aerosol? The lab study raises more questions than it answers, and I think it should be analyzed more carefully and presented as its own manuscript rather than being framed as having direct relevance to the field data.

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