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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "A global model-measurement evaluation of particle light scattering coefficients at elevated relative humidity" *by* María A. Burgos et al.

Anonymous Referee #1

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This study evaluates the model simulations of aerosol scattering enhancement factor using in situ measurements. Model evaluation of the hygroscopic growth of aerosols is a valuable contribution to modeling community. The authors clearly described the methods and results, but my impression is that this manuscript reads like a technical report, rather than a scientific paper. The temporal collocation and the definition of dry RH are the two major discussion points, but I think they are mostly technical issues, rather than scientific findings. The authors show the hygroscopic growth of aerosols in models is highly uncertain and varies across models. I think what is more important is to explain why there is large spread across models, and how the results of this study could help future improvement of modeling aerosol optical properties. Without

sufficient explanations and scientific insights, I don't think this manuscript is suitable to be published at ACP that emphasizes scientific significance. I have the following comments that should be addressed.

1. The most important parameter that determines the f(RH) is the hygroscopic growth factor used in models, but the authors did not explain the differences across models. Table 2 only lists the factor for sea salt, but not other species. The hygroscopic factors of organic carbon, for example, have large uncertainties (Duplissy et al., 2011). What is the hygroscopic factor of OC used in these models? Same for other species. I'd suggest the authors explicitly compare hygroscopic growth factors for each species in each model, which may also help explain the differences across models.

2. The light scattering coefficients used in models are not discussed either.

3. As the authors mentioned, f(RH) largely depends on the aerosol size distribution, mixing state and aerosol composition. Model disagreements in f(RH) should also be attributed to these differences, but the authors did not explain how model differs in in size distribution and aerosol composition, and how this leads to differences in f(RH). For aerosol size distribution, the authors should explain how the size distribution is parameterized in model (e.g. log normal distribution? Modal radius?). For aerosol composition, a simple test would be to compare the aerosol chemical composition across models. I think this manuscript will be valuable contribution to if the authors could explain why the models differ, beyond the two technical issues.

4. The authors mention the mixing state of aerosols may partially explain the narrower range of GEOS-family models, but I don't understand the reasonings for this. The light extinction should decrease when changing from external to internal mixing because the aerosol size becomes larger while the number concentration decreases (Curci et al., 2015). I'd suggest the authors conduct further analysis on this, and provide more convincing explanations.

5. The hysteresis effect of aerosols is an important factor for modeling hygroscopic

growth, but it is not addressed in the manuscript. Few models consider the hysteresis effect, which could partially lead to model-measurement disagreement. The authors briefly mentioned this in the supplement, but I think this should be an important issue to discuss.

6. Line 15 of Page 13: Why is there seasonality of aerosol hygroscopicity in some sites? Is it due to seasonal variation of aerosol composition?

7. Figure 2: I'd suggest include the number of data pairs in the figures.

8. Figure 3: The seasonal variation in hardly seen. I think you could change the y axis limit to a smaller range?

References: Duplissy, J, P F DeCarlo, J Dommen, M R Alfarra, A Metzger, I Barmpadimos, A S H Prevot, et al. 2011. "Relating Hygroscopicity and Composition of Organic Aerosol Particulate Matter." Atmospheric Chemistry and Physics 11 (3), 1155–65. doi:10.5194/acp-11-1155-2011.

Curci, G, C Hogrefe, R Bianconi, U Im, A Balzarini, R Baró, D Brunner, et al. 2015. "Uncertainties of Simulated Aerosol Optical Properties Induced by Assumptions on Aerosol Physical and Chemical Properties: an AQMEII-2 Perspective." Atmospheric Environment 115 (c). 541–52. doi:10.1016/j.atmosenv.2014.09.009.

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