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Interactive comment on "Enhanced growth rate of atmospheric particles from sulfuric acid" *by* Dominik Stolzenburg et al.

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We also agree with the comments made by Chris Hogan and we would like to put some emphasis on possible issues in the theoretical part of this relevant study.

In the manuscript the Hamaker constant for sulfuric acid particles is calculated from experimental growth rates. However, the selected collision/coagulation rate model by Chan and Mozurkewich (2001) should be discussed in more detail as the estimated magnitude of the long-range interaction i.e. the Hamaker constant follows from it. The model has been used previously for collisions of molecules with atmospherical relevance in the free molecular regime (e.g. Kürten et al. 2014, doi:10.1073/pnas.1404853111; Lehtipalo et al. 2016, doi:10.1038/ncomms11594;

Kürten et al. 2018, doi:10.5194/acp-18-845-2018) even though the model is based on Brownian coagulation in a field of force (Sceats 1986, doi:10.1063/1.450636) which does not describe the correct transport physics of collisions of molecules in the gas phase (Ouyang et al. 2012, doi:10.1063/1.4742064).

In a very recent study, the rate enhancement in collision of two sulfuric acid molecules was estimated using atomistic trajectory simulations and theoretical approaches (Halonen et al. 2019, doi:10.5194/acp-19-13355-2019). In this particular case, the Sceats model is significantly overestimating (about 40%) the rate coefficient at 300 K in the free molecular regime. We are agreeing with Chris Hogan, who in his comment suggested that different approaches should be concidered along with the one by Chan and Mozurkewich. (Furthermore the study by Halonen et al. suggests that a simple Langevin-like model is performing better especially if the Keesom interaction is negligible).

Also, as it is often repeated in the manuscript, the claim that the enhancement is solely due to Debye-type permanent dipole-induced dipole interaction should be rationalized somewhere. For a single sulfuric acid molecule and a spherical particle containing a large number of molecules, neglecting the Keesom interactions is a good approximation, however for the interaction of a single molecule and a small cluster this may not be the case. And in any case, the London dispersion forces are always present.

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