

Interactive comment on “A thermodynamic description for the hygroscopic growth of atmospheric aerosol particles” by Dimitri Castarède and Erik S. Thomson

Anonymous Referee #1

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In this study, the formation of a brine layer was proposed to extend the present Koehler theory aiming at predicting the pre-deliquescence water uptake of aerosol particles. The new equation was then used to fit experimental data of NaCl in literature. Using the fitted parameters, the new equation can well reproduce the pre-condensation below the deliquescence point. This study revealed a long-time neglected problem and provided one explanation for the pre-deliquescence water uptake. I believe that this study will bring new insights and trigger more discussions in the community. Thus I would recommend its publication in ACP if my following questions can be adequately addressed.

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Comments:

(1) Precondensation threshold

In the fit, the authors “excluded the data that preclude a full monolayer of water (≈ 0.3 nm)”. Are you suggesting the monolayer sets a threshold for precondensation, below which the precondensation doesn't occur? Or this is only to optimize the fitting parameters? I'd like to see more clear a structure of precondensation. Thus I would suggest to optimize e.g., extending the scale of Fig. 4 to lower RH ($RH < 50$), and consider using log-scale of $(gf-1)$ in the y axis. Figure 5 is a nice illustration but the visibility of the precondensation (core of this study) is not good.

(2) Non-prompt vs prompt

There has been discussions about the differences between the two experimental dataset used here (Haemeri et al and Biskos et al). Biskos et al. suggested a prompt deliquescence while non-prompt deliquescence was reported in Haemeri et al. That is Biskos found the gf of pre-deliquesced well below 1.2 while Haemeri showed gf up to ~ 1.4 -1.6 before deliquescence. According to the proposed theory, is such high gf possible from a precondensation?

(3) Prediction

I am thinking how the proposed method can be used to predict the precondensation. Now it seems that you have three adjustable parameters to fit the data, so how many experimental data do you need for a reliable fitting. As shown in Table 1, each size has its own fitting parameters. I am wondering if it is possible to have a universal parameter set that is applicable to all sizes. If so, the applicability of this method will be largely increased.

Technical suggestions:

In Fig. 4, the lines represent the equilibrium RH for each gf based on modified Koehler equation. Since the experimental data shows the equilibrium gf rather than the equi-

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librium RH, I would suggest plotting the same parameters (equilibrium gf) to avoid confusion.

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