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Atmospheric Chemistry and Physics
Discussions
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Interactive comment on "CCN activity of six pollenkitts and the influence of their surface activity" *by* Nønne L. Prisle et al.

Anonymous Referee #1

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Overview:

The authors well executed a well written study to assess the cloud-forming propensity and water uptake capacity of various species of pollenkitt, a viscous substance that encapsulates pollen particles, in both binary solution and ternary mixtures including ammonium sulfate (AS). By measuring the particle surface tension and critical point, and deriving hygroscopic parameter kappa (k), for these mixtures they conclude that the surface active nature of pollenkitt influences the condensation nuclei (CN) activity and the size-dependent k via both bulk-surface partitioning and surface tension depression. Their results indicate that the surface activity of pollenkitt result in heightened hygroscopicity and in some cases a salting out effect caused by the presence of AS in the ternary mixtures increases the bulk to surface partitioning. As briefly touched

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upon by the authors in the introduction, the prevalence of pollen(kitt) in proximity to real world cloud-forming meteorologies is uncertain. Even granting that submicron subpollen particles SSP are found at altitudes relevant for cloud formation, there is no reason to believe that the systems studied, pure pollentkitt and pollenkitt + AS (i.e. no bulk pollen grain material), would be present. Much of the studys motivation and contextualisation is predicated on cloud forming potential of the pollenkitt so it is unfortunate that the link to real world cloud formation remains tenuous, thereby diminishing the impact of the study.

Specific comments:

Dp,50 often referred to as a critical diameter throughout the study should be referred to as the dry activation diameter or similar. It is easy to confuse this with the critical point of the köhler curve, and the change will make terminology consistent with Moore et al. 2010.

It would be useful to see Figure 2 plotted against particle size, along with the köhler curves as predicted by the four models.

Page 2, line 28: Is the data available to quantify these high humidities? Or at least specify sub- or supersaturated?

Page 3, line 32: Ovadnevaite et al study better characterised as a coastal rather than oceanic location. Furthermore, the aerosol size distribution and chemical composition they studied is not representative of marine aerosol at large – I suggest removing “with potential global implications due to the relative significance of marine aerosol”. See Heintzenberg et al (2000), for example, for comparison.

Page 3, line 6: Around here I suggest adding the reference Lowe et al. (2016) – uses 4 surfactant models, very similar conceptually to those in this study, to model CCN spectra across a similar range of supersaturations.

Page 4, line 32: State that this is Dp,50

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Page 4, line 34: State somewhere the numerical values of all supersaturation bands.

Page 5, line 7: Is there some rationale for choosing this mass fraction? I guess to be a representative aerosol composition in a vegetation-rich region. I think it would be beneficial to add some motivating text. Furthermore, it would be have been nice to see how the results and conclusions might change subject to a varying mass fraction. I recommend including something to this effect in the revisions if possible.

Page 7, line 19: Is c_PK the total concentration for the bulk model and surface phase concentration in the partitioning model? If so, would be good to clarify here.

Page 8, section 2.5: state what you are assuming for surface tension for this procedure. If sigma=sigma_w then change in Eq. 1. Otherwise the reader doesn't get this information until page 12 line 19.

Page 8, line 12: Is this Dp,c the same as Dp,50? C.f. previous comments regarding activation and critical sizes.

Page 19, line 15: Do you mean Ragweed rather than poplar? The solid green curve for poplar is > k_AS for all sizes.

Technical comments:

Cloud activation is strange terminology. I suggest changing to condensation nuclei (CN) activation, or similar, throughout

Page 5, line 26: remove “(increasing d)”

Page 8, Eq. 4: Replace M_w and rho_w with partial molar volume as in Eq.1. Then no need to redefine. R also already defined under Eq.1

Page 9, line 11: section 3.2 ?

Page 11, line 5: change weight –> mass

Page 12, line 20: Define growth factor

Page 12, line 25: “high droplet total concentration”, a bit confusing replace with “high total pollenkitt concentrations” or similar (if that’s what you mean).

Page 12, line 28: nether -> neither

Figure 3: explain box whiskers in caption

References:

Heintzenberg, J., Covert, D., and Van Dingenen, R.: Size distribution and chemical composition of marine aerosols: a compilation and review, Tellus B, 52, 1104–1122, doi:10.1034/j.1600- 0889.2000.00136.x, 2000

Lowe, S., Partridge, D. G., Topping, D., and Stier, P.: Inverse modelling of Köhler theory – Part 1: A response surface analysis of CCN spectra with respect to surface-active organic species, Atmos. Chem. Phys., 16, 10941-10963, https://doi.org/10.5194/acp-16-10941-2016, 2016.

Moore, R. H., Nenes, A., and Medina, J.: Scanning Mobility CCN Analysis–A Method for Fast Measurements of Size-Resolved CCN Distributions and Activation Kinetics, Aerosol Science and Technology, 44, 861–871, https://doi.org/10.1080/02786826.2010.498715, 2010

Ovadnevaite, J., Zuend, A., Laaksonen, A., Sanchez, K. J., Roberts, G., Ceburnis, D., Decesari, S., Rinaldi, M., Hodas, N., Facchini, M. C., 15 Seinfeld, J. H., and O’ Dowd, C.: Surface tension prevails over solute effect in organic-influenced cloud droplet activation, Nature, 546, 637–641, 2017.

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