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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Measurements of cloud condensation nuclei activity and droplet activation kinetics of fresh unprocessed regional dust samples and minerals" *by* P. Kumar et al.

Anonymous Referee #1

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The paper presents measurements of the CCN activity of dust aerosol from field samples and individual minerals. The authors choose to examine unprocessed mineral dust aerosol, justifying this decision on the grounds that some dust does remain unprocessed in the atmosphere. The CCN activity of 12 samples are measured, including a mix of purchased samples of individual minerals and soil samples obtained from regions of dust production.

In addition, the ability of two activation theories to reproduce observed results is tested. FHH adsorption activation theory is found to be able to capture the relationship between particle diameter and critical supersaturation (Sc-Ddry), but Köhler theory (KT)

is found to capture the relationship only when a strong dependence of size was included. The finding that FHH is more suited to the description of the Sc-Ddry relationship that KT was also shown by the authors' previous papers, but this paper provides measurements to support the finding.

The paper is well written and the findings of interest to the ACP audience. My comments are all quite minor, once completed I think the paper is suitable for publication in ACP.

- The paper focuses on unprocessed mineral dust. Could the authors expand the discussion a little to postulate how the presence of hydrophillic material would affect the activation. Although dust can remain unprocessed in the atmosphere it is unlikely that pure dust particles will exist far from source. Would coagulation with e.g. soot block adsorption in some of the surface area? Can FHH and KT be combined in some way for mixed particles?
- The authors propose that one set of FHH parameters are suitable for all species considered, please place these values in context of other measurements of A_{FHH} and B_{FHH}, for example Kumar et al, GRL, 2009 Table 1, suggest that Arizona test dust has a $A_{FHH} = 0.27$ and $B_{FHH} = 0.79$, which is different to that proposed here. Is that all from the charge and shape corrections? Please clarify.
- Section 3.1.2: As the value of shape factor is unknown for the samples the authors use a range of non-sphericities to test the sensitivity of the derived Sc-Ddry relationship to non-sphericity. It is unclear to me how this range was used in the calculation (page 31051 around line 20).
- Section 3.1.1: Explain why the non-sphericity causes an increase in the activation diameter.
- Table 2: It would be interesting to also see the dependence of the calculated A_{FHH} and B_{FHH} on the assumed value of χ

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- Section 3.3: What is the significance of the retarded kinetics for cloud formation and properties?

Minor comments and typos

- Page 31040, line 24. Really? I would suggest that there are organic species less understood than dust.
- Page 31043, Line 25. Should read “even when it is well known” (or “even though“).
- Page 31047, Line 19. condensational growth
- Equation 1: Define k prime straight after equation 1 and define Hv and Seq (or at least point reader to the Appendix).
- Page 31050, Line 26. “somewhat higher compared to AR equal to”, please rephrase.
- Page 31051, Line 2. What are the techniques that give rise to different morphologies?
- Page 31054, Line 17. “KT aerosol” is an confusing expression here. Rephrase
- Page 31058, Line 23. aerosol at *the* same... determined for *the*...
- Page 31058, Line 23. the difference in outlet.. outlet? size?
- Page 31059, Line 14. consistent with *the* slower..
- Page 31060, Line 11. multiple charge corrections (not charging)

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 31039, 2010.