Atmos. Chem. Phys. Discuss., 10, C14585–C14587, 2011
www.atmos-chem-phys-discuss.net/10/C14585/2011/

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.

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Received and published: 17 March 2011

We thank Anonymous Referee #2 for the comments provided. Please find our responses as follows.

Reviewer: That is, with nonspeherical particles, what is the diameter used in the Kelvin term? I believe that a correct description is given in the book of Defay et al. (see also Romakkaniemi et al., 2001), however, the actual shape of the particles should then be known. Obviously, the particle will remain nonspherical still after adsorption of several water layers but tend to get more and more spherical with addition of each layer. What in general is the number of monolayers at

activation? What in general is the number of monolayers at activation?

Author: We thank the reviewer to directing us to Defay et al. (1966) and Romakkaniemi et al. (2001). Yes, we agree that the non-sphericity of the particle would need to be incorporated into the diameter used in the Kelvin term at the point of activation if only a few monolayers are adsorbed at activation. This has been shown by Eq. (7) of Romakkaniemi et al. (2001).

The number of water monolayers adsorbed at the wet activation diameter, θ_c, can be estimated as $\theta_c = \left(\frac{D_c - D_{se}}{2D_w}\right)$, where D_c is the critical wet diameter, D_{se} is the surface-area equivalent diameter, and D_w is the diameter of water molecule = 2.75Å. For all regional samples considered in our study, we find that at the point of activation, θ_c ranges from 100 - 500. Based on this, we can assume that at the point of activation, a non-spherical aerosol has sufficiently high mono-layers of water vapor such that the shape is spherical, and, the molar volume and gas-liquid surface tension of the adsorbed H_2O approaches that for the bulk water.

Reviewer: Does the adsorbed water affect the particle shape and in what way?

Author: In a related manuscript (Kumar et al., 2011, in preparation), we have found that the process of water vapor adsorption is reversible and does not affect the hydrophilicity of the mineral aerosol considerably. As particle hydrophilicity inherently depends on the shape of the particle, it can be concluded that for mineral aerosols typical of dust (e.g., calcite, kaolinite, illite, and quartz) water adsorption does not affect particle shape. An exception to this is montmorillonite swelling clay that has a different behavior to water adsorption /desorption due to presence of Ca^{2+} and Na^{+} ions that hydrate and can cause montmorillonite clay to swell up during adsorption. This may affect montmorillonite shape upon drying but is left for a future study.

Reviewer: How much are the FHH parameters' values affected by the nonsphericity?

Author: We have computed the sensitivity of FHH parameters to the shape factor and included the results in Table 2.

References:

Kumar, P., Sokolik, I. N., and Nenes, A.: Measurements of cloud condensation nuclei activity and droplet activation kinetics of wet processed regional dust samples and minerals, Atmos. Chem. Phys. Discuss., 2011, (manuscript in preparation).

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