Atmos. Chem. Phys. Discuss., 9, C12286–C12290, 2010
www.atmos-chem-phys-discuss.net/9/C12286/2010/

Atmospheric
Chemistry
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Discussions

Interactive comment on "Hygroscopic properties of Amazonian biomass burning and European background HULIS and investigation of their effects on surface tension with two models linking H-TDMA to CCNC data" *by* E. O. Fors et al.

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Received and published: 29 April 2010

Reply to anonymous referee no. 1.

The authors would like to thank the referee for good observations and for supplementing the list of references in the introduction!

P269228L18 The references have been included.

P26929L26 Referece has been included.

P26930L10 The following text has been added under “3. Extraction”: “After the extraction procedure, the samples were frozen until analysis.”

P26031 Yes, the extraction was identical. The following text has been added under “3. Extraction”: “The extraction procedure of the HULIS was identical for the SMOCC and K-puszta samples. For the K-Puszta samples, all fractions were saved and analysed. However, for the SMOCC samples, only the HULIS fraction was extracted, as there were at this point no plans of analysing the Extract and Effluent samples.”

P26935L13 The ion value used in this paper is the same is in Wex et al (2007). To clarify this, the line “which was first introduced by Wex et al. (2007)” has been added in the section “4.3.2 ion model”. The relation between kappa_R and ion is that they are identical in the physical meaning, namely the number of moles of soluble entities per m3. The difference is in the formulation of the Köhler equation and the fact that the ion method uses the iterative scheme to deduce a concentration dependent surface tension according to Szyskowski-Langmuir. The difference between Wex et al (2007) and the paper by Ziese et al (2007) is that Ziese as well as this paper uses an iterative approach, with a parameterized surface tension, to find a solution that fits both at sub- and supersaturation. In Wex et al. (2007), ion is deduced only from hygroscopic growth data using two assumptions: surface tension= 72 mN/m (water) and 50 nM/m (used as a a “lower limit” of pure HULIS). Using the lower limit value of ion, you are left with three (or four, depending on if you count omega*ny as one or two parameters) free parameters. They then made the assumption that the omega*ny should be between 1 and 1.5 and that s should be between 1.4 and 1.8 g/cm3. Now we are left with only the molecular weight, which in this case ended up between 290 and 560 g/mole. To summarize, making assumptions on both density and dissociation, it is possible to make a statement about the molecular weight. In the same way, it is possible to make an estimate on the degree of dissociation, but then assumptions must be made regarding the molecular weight and density. We feel that this reasoning includes too many unknown parameters, so we have chosen to focus on the surface tension effects.

P26927L20 We do not understand this comment.

P26939L1 It disappeared in the text formatting. We will make sure it is back for the final publication. However, it should read ion.

P26940L14 The following has been added to clarify: "This is possibly due to the aging process of the aerosol. During night the boundary layer collapses and the sampling is more dominated by fresh particles from smouldering. During daytime, the boundary layer height increases and aged particles are mixed down (Rissler et al., 2006). As has been recently shown recently by Jimenez et al. (2009), aged SOA tend to be more oxidized and more soluble than fresh SOA, which would support these results."

P26941L20-21 This is a good point. The growth factors have been recalculated according to their "minimum size" including the shrinking. This way the effect in taken into account as much as possible. We are not sure why some restructure and some not. It can be a question of the sample, but also of changes in nebulising conditions such as droplet size, solute concentration etc. Since the same H-TDMA was used for all samples, we assume that it is sample dependent. The following text has been added: "The reason for this behaviour is unknown. It cannot be determined whether this effect originates from different nebulising and drying conditions or if it is the sample properties that are different. The growth factors used in this work are recalculated so that the minimum growth factor equals 1, to avoid underestimating the solubility of the samples."

P26942L20 The references have been added.

P26946L6 The following has been added on P26946L10: "The two models investigated gave similar results, although slightly different approaches were done regarding the formulation of the Köhler equation. Both models have both advantages and disadvantages. For very low growth factors, the κ model tends to overestimate the critical supersaturation, due to the assumption included in the model that the dry volume can be neglected. In the ion model, the dry volume is included and therefore it works better for small growth factors (Fig 8). The ion model uses a concentration dependent parameterization of the surface tension, which means that the model gives a more consistent description of the particle solubility in different saturation regimes. In the κ model , the surface tension is adjusted retrospectively at the point of activation, making an estimation of the surface tension at activation slightly biased. On the other hand, the κ model can be used to predict the critical supersaturation using only H-TDMA data, which makes it more useful for e.g. CCN-prediction of atmospheric aerosols. It also includes a non-ideality which is included according to the model salt used. This means that if a proper model salt is used, the non-ideality of the particle can potentially be described in a better way than by the ion model."

P26946L25 This is a misprint. The text has been changed from "lower" to "higher"

Table 2 Unfortunately, it cannot be read from the paper what the growth factor was at 90% RH. There is a ion value in Figure 1, but the scale is too coarse to read a proper value from.

Table 3 The r2 value is the correlation coefficient between RH and kappa_R. However, since we also calculated the correlation significance independently of r2, we have now removed the r2 values to avoid confusion. The Table 3 text has been changed to the following for clarification: "kappa_R value statistics for RH values between 90 and 98%. The kappa_R presented are based on assuming that the non-ideality of the solute can be accounted for by a model salt. kappa_R values in parenthesis are values resulting from ideal behaviour or the droplet – assuming full dissociation. The significances of a correlation (linear increase of kappa_R as a function of RH) were calculated (95% CI) assuming ideal solutions. If correlations exist there is likely an increase in the effective number of soluble ions in the solution at increasing RH, thus, using kappa_R from Gf measurements at 90% will probably lead to an overestimation of sc."

Figure 6 The figure text has been changed to the following for clarification: "Measured critical supersaturations for the K-puszta samples. The lines represent the supersatu-

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ration ratios of three different arbitrary ideal compunds as a function of dry diameter, Dp., and are intended solely to guide the eye on the ideal dependence of sc on Dp. The sc values are calculated according to equation 4.”

References

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Rissler, J., Vestin, A. Swietlicki, E., Fisch, G., Zhou, J., Artaxo, P. and Andreae, M. O. : Size distribution and hygroscopic properties of aerosol particles from dry-season biomass burning in Amazonia, Atmospheric Chemistry and Physics, 6, 471-491, 2006.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 26925, 2009.