

## ***Interactive comment on “Investigation of molar volume and surfactant characteristics of water-soluble organic compounds in biomass burning aerosol” by A. Asa-Awuku et al.***

**A. Asa-Awuku et al.**

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**Surface tension is a time dependent phenomenon (Slama et al JGR 2007). What value of the surface tension was used in the calculation (is it the one after an equilibration time?) and how relevant is it to cloud droplet growth? If it is indeed attained on cloud droplet activation times used here, what does it mean in terms of the dissolution kinetics and diffusion to the surface?**

According to Taraniuk et al (GRL, 2007) and the subsequent analysis of Asa-Awuku et al (JGR, in press), Humic-like substances diffuse fast enough to the surface layer of activated CCN so they are effectively in equilibrium with the bulk. This means that measurements of surface tension are appropriate for CCN activation. The value of

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surface tension we obtain is after allowing the drop to equilibrate for 30-100 seconds. This discussion has been included in the text.

**Recently, Wex et al (GRL 2007) used a similar approach for reaching CCN closure of HULIS containing aerosols. The authors should cite this paper and discuss the similarities and difference of the two approaches and their results. Discussion with respect to Petters MD (Tellus 2006) should also be included.**

Wex et. al. (2007) employ Köhler theory to solve for a parameter that combines the average molar volume and van't Hoff factor. KTA is also based on Köhler theory, but explicitly determines the average molar mass (volume) and surfactant characteristics of the water-soluble organic in the CCN; effects of inorganic salts, if existing, are deconvoluted from the CCN measurements. One needs to assume an effective van't Hoff factor, but additional measurements (such as those presented by Dinar et al.) can help constrain the "base value" and uncertainty in the parameter. Similar things can be said on the density used for molar mass estimations.

Petters suggest that application of Flory-Huggins theory (FH) is best for describing the impact of high molecular weight polymeric chains on water activity; thus a combination of FH with Köhler Theory is appropriate for predicting CCN activity. This implies that polymeric material exists in the water-soluble fraction of the aerosol, and that the organic material is essentially composed of a few monomers. It is unclear whether this is true for the WSOC considered in this study; an implementation of FH into KTA is certainly possible, but left for future work.

**P3591 L17: Add reference to Decesari et al, ES&T 2007, who carried out detailed functional group analysis of HULIS from various sources.**

Suggested References have been added.

**P3591 L27: add reference to surface tension measurements of HULIS by Kiss et al (J Atmos Chem 2005) and Salma et al (JGR 2007).**

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Suggested References have been added.

**P3592 L8: add references to Graber and Rudich, and various studies by Markus Kalberer and by Gyula Kiss who looked HULIS in various environments and the annual**

Suggested References have been added.

**P3604 L5: Explain the value used for density and relate to measurements by Dinar et al (ACP 6, 5213-5224, 2006) of higher densities measured for HULIS. If there is no better assumption, discuss possible errors on the conclusions that could result from this assumption**

Our hydrophobic sample is much like the extracted F5 sample of Dinar et al. with a density of  $1.5 \text{ g cm}^{-3}$ . We have accounted for this in our molar volume sensitivity analysis by varying density from  $1.4$  to  $1.6 \text{ g cm}^{-3}$ . A similar treatment is also followed for the van't Hoff factor. We have included this discussion and respective references in the revised text.

**P3604 L13: There is no indication in the data that the concentration exceeds the CMC. Explain the statement.**

The data indeed do not exceed the CMC; however, if the predicted WSOC concentration is applied to the Szyszkowski-Langmuir fit of our data, the surface tension becomes negative. This implies that (with some uncertainty of course) that the CMC is reached at the point of activation. This has been further clarified in the text.

**P3604 L25: Dinar et al (J. Geophys. Res., D112, doi:10.1029/2006JD007442, 2007. and .ACP, 6, 2465-2482, 2006) provide estimates to the amount of dissociation in the HULIS samples they studied. Discuss the assumptions for the van't Hoff factor used in this study in light of these observations and the possible error associated with this assumption.**

The uncertainty associated with a van't Hoff factor varying between 1 and 1.2 is now

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provided in the text.

**P3606, L8: the very last parameter should be indexed "j", not "i"**

Corrected

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 3589, 2007.

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