

## ***Interactive comment on “Measuring and modeling the hygroscopic growth of two humic substances in mixed aerosol particles of atmospheric relevance” by I. R. Zamora and M. Z. Jacobson***

**Anonymous Referee #1**

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The work presents a systematic study, and parameterisation of, water activity measurements for mixed systems of humic-like substances, diacids and sugars. It then extends the work to include an inorganic fraction. Modeling these systems using the ZSR equation they found it started to break down for multicomponent mixtures. I recommend that this work is published in ACP, provided that the following comments are addressed:-

- In section 2.1 you say the solutions were stirred until homogenous. Was all the material going into solution or was some of it just suspended?
- pg 1-57 ln4 you mention that due to the low solubility of succinic acid, a wide range

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of mass fractions wasn't explored. Why didn't you use malonic or glutaric acid instead as your category 2 compound? They are far more soluble (odd-even effect).

- Can you remake figure 2 with water activity on the y-axis rather than water vapour pressure, its quite hard to follow any trends with temperature as they are masked by the Clasius-Clayperon relation (VP increasing exponentially with temp)

- When comparing these bulk results with those from particle based measurements (HTDMA, EDB) are there any corrections which need to be made to make them comparable (is a surface tension needed?).

- With the multicomponet mixtures you state that interactions may explain the differences in hygroscopic growth. Have you tried modelling this? AIOMFAC (<http://www.aiomfac.caltech.edu/>) and E-AIM(<http://www.aim.env.uea.ac.uk/aim/aim.php>) have tools for modelling solute and solvent activities. I strongly suggest you at least look at these tools as they could provide a lot of insight into what is happening in the multicomponent mixtures. You may need to use some of the assumptions about humic substances Svenningsson has made (pg 1059 ln20 )

- In your conclusions you recommend studies of chamber extract to represent HULIS due to the widely varying hygroscopic behavior depend on the humic substance origin. This would be suitable for HTDMA and EDB but I don't think it would work for bulk studies (such as this one). Could the authors suggest a well defined compound or mixture of compounds that would better represent HULIS for bulk experiments? If not could they perhaps add a short discussion at the end (or even here in the comments) of the necessary properties a bulk HULIS substitute should have.

- Would you suggest we abandon humic and fulvic acids or do you think they still have a role to play as proxies for HULIS.