Atmospheric Chemistry and Physics Discussions

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Comment on acp-2022-544

Anonymous Referee #2

Referee comment on "Size-dependent hygroscopicity of levoglucosan and D-glucose aerosol nanoparticles" by Ting Lei et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-544-RC2, 2022

The manuscript by Lei et al. reported the HTDMA data for levoglucosan and D-glucose particles for the size range of 6 ~ 100 nm. Both of these compounds are atmospherically important chemical species. The data for 100 nm particles agreed well with literature. In the case of levoglucosan particles, measurement of hygroscopicity for particles smaller than 15 nm was challenging due to evaporation. The issue was not observed for D-glucose. In the case of D-glucose particles, a significant size-dependence in hygroscopic growth was observed only for the high RH (RH > 80%) region. The data of the study will serve as a reference for future studies on hygroscopicity of atmospheric nanoparticles. The topic is obviously a part of the scope of the research community. The following points should be considered prior to the acceptance of the manuscript.

Major comments

The authors state that the UNIFAC model does not provide highly accurate results for organic compounds which contains many polar functional groups (e.g., the description starts from L354). However, the discussion is not well supported by references. Thus, it is difficult for a reader to evaluate the level of uncertainty. As D-glucose is an important chemical compound in various research areas, a numerous number of studies should have been conducted for investigating its interaction with water. It would be great if the authors could provide further detailed discussion using these references to support their argument.

The authors demonstrated that evaporation of levoglucosan inhibits accurate measurements of hygroscopicity for the nano-size range. However, it seems that the influence of evaporation is absent for the D-glucose data. It would be beneficial to describe the reason why the evaporation only occurred to levoglucosan. As the authors carefully quantified the residence time of particles in their HTDMA system, it could be possible to provide more quantitative information using the saturation vapor pressures of the two chemical species.

It is interesting that the authors only observed the size-dependence in growth factor of D-glucose for the range of RH > 80%. There seems to be no size dependences for the lower RH region. To the best of the reviewer's knowledge, it is not a well-known phenomenon. Do the authors have any potential hypothesis for explaining it? I believe that it will be beneficial for future studies if the author could add some ideas that can explain the observation to the manuscript.

Minor/editorial comments

There are numerous typos and grammatical issues with the manuscript. The reviewer suggests the authors to be careful about these points in revising the manuscript.

Abstract

The current abstract is a little bit long and redundant. It describes what the authors have done, but it does not tell the key conclusions of the manuscript well. I suggest the authors to revise it.

L60 ~ 63

Mochida and Kawamura (2004) are cited for three times for describing the atmospheric significance of levoglucosan and D-sucrose. However, the paper by Mochida and Kawamura (2004) focused on hygroscopicity measurement of levoglucosan and other important marker compounds for biomass burning. Other references that directly supports the corresponding descriptions need to be provided.

L61

I agree that levoglucosan and D-glucose are important chemical species for biomass burning particles. However, they would probably be one of the most polar chemical species among constituents of biomass burning particles. It is not clear to me if they can be considered as representative compounds for hygroscopicity.

L123-125

Generally, the issue of multiple charge particles is not a significant concern for small (diameter < 30 nm) particles. Could the authors make the corresponding description to be more detailed?

L169

The equation (2) looks like an equation for the ideal solution to me. Although the idea of ideal solution can occasionally be applied for the Kohler theory, the Kohler theory is not equivalent as the ideal solution. It would be better to change the name of the corresponding section.

L190

Are there any good references to support the idea that the partial molar volume of water does not change in solution? If it changes, how much it could change? How would it affect the interpretation of the data?

L235

I wonder what the author's definition of 'diluted aqueous droplet' is. 20 mol kg-1 is highly concentrated. Please clarify.

L237

Please indicate the saturation concentration of levoglucosan in water before mentioning about supersaturation.

L248 (and other places)

No deliquescence/efflorescence were observed in the study. It may not be appropriate to call the operation modes of the HTDMA as 'deliquescence/efflorescence modes' under this condition. Hydration/dehydration might be a better expression.

References

The reference list needs to be carefully checked. There are numerous issues. For instance, I do not believe that the names of the authors of the following paper accurately represented in the current version of the manuscript.

‘Chan, M. N. C. a. C. K.: Mass transfer effects in hygroscopic measurements of aerosol particles, Atmos. Chem. Phys., 5, 2703–2712,’