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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Physical state of 2-methylbutane-1,2,3,4-tetraol in pure and internally mixed aerosols" *by* Jörn Lessmeier et al.

Anonymous Referee #3

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Review of "Physical state of 2-methylbutane-1,2,3,4-tetraol in pure and internally mixed aerosols" by Lessmeier et al.

In this paper the authors 1) synthesized 2-methylbutane-1,2,3,4-tetraol, 2) measured the glass transition temperature of the tetraol, 3) determined a phase diagram for water/tetraol mixtures over the whole tropospheric temperature and RH range, 4) investigated water diffusion in the tetraol, and 5) measured the glass transition temperatures of mixtures of the tetraol with 3-methylbutante-1,2,3-tricarboxylic acid. This combined information was used to argue that isoprene-derived SOA will be a liquid in the lower troposphere and at high RH values, but a semisolid or even glassy state in the upper troposphere. The results have important implications for the growth and reactivity of atmospheric secondary organic aerosols. The paper combines first-rate physical chem-

istry and important atmospheric insight, and hence I strongly support this manuscript for publication in ACP. Due to the high quality of the manuscript, I have very few comments. Below are a few comments I have that the authors may want to consider before publication. Since I am not an expert on synthesis, I do not have any comments on the synthesis part of the manuscript.

Minor comments:

1) Page 5, line 3. Can the authors confirm that there was no loss of material after the DSC sample pans were sealed? In other words, did the seal prevent evaporation or water uptake? I assume this can be checked from repeated DSC measurements.

2) Figure 5. The shell of the second sphere from the left looks aqua, not light green. Should the shell be light green to be consistent with the figure caption?

3) Figure 7a. Should the annotation on the arrow be changed to "diffusion into the material (without further uptake)" or "diffusion into the particles (without further uptake)"?

4) From the water uptake experiments (e.g. Figure 7) would it be possible to extract a diffusion coefficient. This is, obviously, beyond the scope of the current paper, but I am interested in the authors' response.

5) Page 20, line 10 and Page 21, line 19-21. Can the authors comment on how the kgt they determined compares with the kgt assumed in the recent modelling study by Shiraiwa et al. 2017. Shiraiwa, M., Li, Y., Tsimpidi, A. P., Karydis, V. A., Berkemeier, T., Pandis, S. N., Lelieveld, J., Koop, T., and Poschl, U.: Global distribution of particle phase state in atmospheric secondary organic aerosols, Nature Communications, 8, 10.1038/ncomms15002, 2017.

6) Supplement, Page 4, line 13. Delete "we".

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