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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Relating the hygroscopic properties of submicron aerosol to both gas- and particle-phase chemical composition in a boreal forest environment" *by* J. Hong et al.

Anonymous Referee #1

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General comments

The paper by Hong et al. titled "Relating the hygroscopic properties of submicron aerosol to both gas- and particle-phase chemical composition in a boreal forest environment" presents results from the 2013 PEGASOS study at the Hyttiala boreal forest site, in Finland. The paper reports measurements of the hygroscopicity of 15-145 nm particles, and the hygroscopic growth factor (HGF) f these particle classes was related to their chemical composition, in particular to sulfate to organic ratio and oxygen to carbon ratio (O:C) as measured by an HR-ToF-AMS. Despite many papers so far have addressed this topic using laboratory and ambient data, this work adds to the pool of

literature with some original and unique aspects that are worth noting. For example, the HGF is reported for different sized submicron particles (nucleation, Aiken and accumulation mode) and a composition derived HGF (obtained using the HR-ToF-AMS data) is also reported to perform a closure study. Different composition dependent parameterizations are tested out and compared. Finally, the possible effect of extremely low volatility organic molecules, ELVOC (as measured by nitrate ion chemical ionization mass spectrometry) on the hygroscopicity of nucleation mode particles is also addressed.

I consider this to be a valuable paper that presents results from an important field study and it is definitely appropriate for publication on ACP. The manuscript is well written and clear in all the various sections. The introduction puts the work into context of previous literature and the references are adequate and up to date. The experimental part is accurately described, the authors provide sufficient detail on the instruments used to characterized the aerosol properties, and provide accurate information regarding the calculations performed for the closure. The results are explained clearly and the paper is easy to understand. The amount of material provided is sufficient and clearly outlined. I have a very few comments and questions, and overall I believe that the paper can be published after minor changes.

Specific comments are listed below.

Specific comments

Page 15516, lines 4-5: when presenting the HR-ToF-AMS data, it would be good to add a brief statement on collection efficiency (CE) that I assume was applied for quantification. Did the author apply the standard CE = 0.5 ? Did they calculate their own CE ? Please clarify on this subject

Page 15520, lines 17-20: the authors make the correct observation that the larger discrepancy between measured and calculated HGF for the smallest particles sizes is likely due to the fact that the AMS doesn't collect efficiently particles smaller than

50-60 nm due the aerodynamic lens design and cut-off. Perhaps add a brief statement somewhere here to explain this to the non AMS expert reader; for example, you can re write as "...which is dominated by accumulation mode particles due to the cut-off of the standard aerodynamic lens for particles smaller than 80 nm (Williams et al., 2012)".

Page 15520, lines 22-25: the authors should also note that the data on the y-axis of Fig 5 have a positive offset. Is this also related to the fact that the constant HGF and / or the mixing rule assumptions might be inadequate or there is something else going on ? Later in the paper (page 15521, lines 10-14) when discussing the results of Figure 6, the authors show that the correlations improve when applying an O:C dependent HGF as presented in Massoli et al. (2010). Is the data offset in the y-axis also improving ? Based on the slope values, it seems to me that that is the case, and that the offset is reduced even further when the authors apply their own parameterization. Perhaps a little phrase to point this out would be a nice addition given that the slopes are not shown in Figure 6.

Figures 5,6,7: for extra clarity, the captions of these Figures should add that the dashed line is the 1:1 line, given that the slopes are not shown.

References Willians et al., Characterization of an aerodynamic lens for transmitting particles greater than 1 micrometer in diameter into the Aerodyne aerosol mass spectrometer, Atmos. Meas. Tech., 6, 3271–3280, 2013, doi:10.5194/amt-6-3271-2013.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 15511, 2015.