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***Interactive comment on* “Black carbon concentrations and mixing state in the Finnish Arctic” by T. Raatikainen et al.**

Anonymous Referee #2

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This study provides valuable data in the Arctic ground site, however needs to address the followings:

Major: The introduction part I would suggest to shorten the part which explains the BC instrumentation, but more focusing the BC measurements in the Arctic ground sites.

About SP2- 1. Has the Aquadag calibration been applied to the ambient, i.e. different instrument response to Aquadag and ambient BC. 2. I would suggest to use an inverted Mie table to calculate the D_p/D_c using core refractive index $2.26+1.26i$ and coating $1.5+0i$ [Taylor et al., 2015; Liu et al., 2014]. 3. It is better to show a D_p and D_c size distribution for BC, and D_p size distribution for scattering particle to explicitly explain how you calculate the rBC number fraction.

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About the result analysis 1. To me, the D_p/D_c ranges 1.7-2.2, GMD 150nm-240nm; BC number fraction 0-0.5. All of these variations are significant. There must be very interesting stories there however have not been fully analysed and explained. 2. A general look of Fig. 3 is the BC mass is significantly lower in cloud than no cloud, does that mean a fraction of BC has been scavenged? Have you removed the data when snow precipitation? 3. About section 3.2.1, again when you have fully explained your own story, the comparison will be more interesting however at the moment the base is not solid. 4. There is no much point for section 3.2.2, as there will be no apparent diurnal trend for this remote site. 5. Could we show the clustered air mass types in Fig.3. 6. For section 3.4, I would suggest to calculate the MAC (absorption/mass) for different air masses, is rBC size or coating thickness affecting MAC?

Specific: Abstract “On the average, the number fraction of particles containing rBC was 0.24 and the average rBC core size in these particles was half of the total size (coated to core diameter ratio was 2.0). These numbers mean that the core was larger and had a significantly thicker coating than in typical particles closer to their source regions.”

State the number fraction of rBC is for what size range of particles –PM1? These numbers means core ‘larger’? It is not surprising the BC in this remote site is thickly coated, so does not mean too much if compared to ‘sources’. ‘Comparison of the measured rBC mass concentration with that of the optically detected equivalent black carbon (eBC) showed a factor of five difference, which could not be fully explained without assuming that a part of the absorbing material is non-refractory.’ – part of the absorbing material is non-refractory, what does that mean.

Taylor, J. W., Allan, J. D., Liu, D., Flynn, M., Weber, R., Zhang, X., Lefer, B. L., Grossberg, N., Flynn, J., and Coe, H.: Assessment of the sensitivity of core/shell parameters derived using the single-particle soot photometer to density and refractive index, *Atmos. Meas. Tech.*, 8, 1701–1718, doi:10.5194/amt-8-1701-2015, 2015.

Liu, D., Allan, J. D., Young, D. E., Coe, H., Beddows, D., Fleming, Z. L., Flynn, M. J.,

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Gallagher, M.W., Harrison, R. M., Lee, J., Prevot, A. S. H., Taylor, J.W., Yin, J., Williams, P. I., and Zotter, P.: Size distribution, mixing state and source apportionment of black carbon aerosol in London during wintertime, *Atmos. Chem. Phys.*, 14, 10061–10084, doi:10.5194/acp-14- 10061-2014, 2014.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 15, 15621, 2015.

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