

## ***Interactive comment on “Cloud droplet activity changes of soot aerosol upon smog chamber ageing” by C. Wittbom et al.***

**Anonymous Referee #1**

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The paper deals with the temporal change in CCN activity of soot particle during ageing. These chamber studies were done on two different soot types: diesel exhaust soot and soot particles generated with a flame soot generator (spiked with SOA precursors). Both soot types were aged in the chamber under UV-radiation. The soot particle properties were investigated with a CCNc, an Aerosol Particle Mass Analyser and a Soot Particle Aerosol Mass Spectrometer. They observed a clear increase in hygroscopicity of the soot particles due to ageing which they attribute to different aspects of the increasing SOA mass fraction on the particles.

General comments: There is a huge amount of interesting data and results in this paper and it surely suits publication in ACP, but I suggest restructuring of some parts before publication. For my taste I was to often send back and forth between the 12  
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figures, the supplement and other (companion?) papers for essential explanations, which made the manuscript hard to read for me. The paper is very explicit in some sections (e.g. 5.1 to 5.4), but in other parts, like the introduction of ADCHAM, which appears to be rather important for the discussion of the results, the information is too weak.

Specific comments:

Introduction:

I think the introduction in general should be straightened and strengthened, e.g. p8855, l22 to p8856, l7 the paragraph on SOA and VOC in soot particles is rather brief. Is IVOC from the abstract a standing term, would it be useful to explain it here? The paragraph on soot in the Arctic seems somehow misplaced between organic on soot and a very brief introduction to Köhler theory, which only lists chamber experiments of organics (repeated in the next paragraph), but not the hygroscopicity of soot in general. On p8857, l4 to l9, why do you introduce the kappa from Rissler (2006), which you don't use it later on? There should also be more literature available on kappa of soot than Tritscher et al., 2011, maybe even some ambient data to compare with. Why is shape and morphology important when dealing with soot particles?

Section 3.2:

Why do you have to model the gas-phase chemistry? Is it to gain knowledge on the partitioning of organic material between particulate and gas phase? This section comes out of the blue and to me the benefit is not clear from the rather short explanation given here? What stands ADCHAM for? How is it applied to you data here? I assume this is in detail explained in the supplement, but this section needs some more explaining sentences or the position within the manuscript should be reconsidered.

p 8864, line 6, What is DEP2 (Table 2 and the whole experiment was not introduced yet)?

Section 4.1 and Fig.1: Please use same instrument labelling in the text, figure and figure caption (e.g. DMA-TD-APM vs. DMA-APM?).

#### Section 5

page 8869, l7: What is the carbon oxidation state? Was it introduced yet?

page 8870, l1: How can CCN measurements support the size of the primary particle diameter?

page 8872, l8-11: You state here and already in the abstract, that a change in the activation properties can be attributed to one of the 4 factors you name. To me it became not clear if the 4 factors are common knowledge (if some, please cite the important papers) or the factors are the outcome of your investigation.

page 8874, l18: Is IVOC a standing term? Please give a clear definition or citation which definition you apply?

#### Section 6:

You state: "Change in hygroscopicity and morphology of the ageing soot particles will affect the deposition of the particles in the human respiratory tract, according to previous studies." Please give a fitting citation for the previous studies.

#### Technical notes:

page 8852, line 26: APM, abbreviation not introduced yet

page 8853, line 11+23: What stands "RFari" or "ERFari" in the IPCC citation for?

p8858,l24: Write better: (input values listed in table 1)

page 8859, line 18: In the formula of ammonium sulfate a 4 is missing.

p8868, l25: Analytik?

Table2: Please explain abbreviations, like dpp, sc(#52) or sc(#53).

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