

Interactive comment on “Experimental evidence of the rear capture of aerosol particles by raindrops” by Pascal Lemaitre et al.

Anonymous Referee #1

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Scavenging of aerosols by raindrops has been a very important topic of atmospheric physics since the '80s. Recently it became actual again due to nuclear disasters. The major uncertainty of the efficiency of scavenging originates from the unknown collection/collision efficiencies between water drops and aerosol particles. Especially in the size range of raindrops the determination of this efficiency is difficult due to the wake capture caused by eddies behind the falling drops. The manuscript of Lemaitre et al. presents a possible experimental evidence for the wake capture, and provides parameterization to account for this effect. Nevertheless, this effect can also play a very important role in other atmospheric processes in which drop-particle collisions involved, such as contact freezing, for instance. In general the paper is clearly written and well organized, although I found the discussion of the novel parameterization and its relation to the experiments incomplete. The quality of the tables and figures is good. I really

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appreciate the error discussion in the Appendix. The paper can be recommended for publication in Atmospheric Chemistry and Physics. Nevertheless, I list some minor comments that can be taken into account for a revision before publication:

- p.1. line 31: “Aerosol particles are important components. . .” – please correct.
- p. 1. Line 33: “our” should be read instead of “out”
- p. 2. Line 34: You compare the results of your measurements against the model outcomes, but not the measurement itself. Please revise.
- p. 6., Fig. 2: Pressurized should be written instead of Pressurisez
- p. 7. Line 6: What does S_{goutte} stay for?
- p. 7. Eq. 4: Is this formula equivalent with the integration method of Müller et al. ? If no, how is it related to that? What is the accuracy of the size determination using Eq. 4?
- p. 7. Figure 4: The caption is actually wrong. The figure does not show the setting parameters, such as pressure, opening time, but the generated drop diameters using a predefined pressure and different opening times. Please revise the caption.
- p. 8. Line 2: The sentence should be reformulated.
- p. 8. Line 15: I believe the fall distance to reach terminal velocity was sufficient in the experiments, which could/should also been shown here by comparing the result with the theoretical calculations of Wang and Pruppacher (1977).
- p. 8. Line 17: How did you determine the axis ratio? Is it just the ratio of the vertical and horizontal dimensions of the drop? Do you see any canting of the drops, or are they perfectly horizontally aligned?
- p. 9: Line 18: APS; ELPI: online methods; filter: offline method. Can you compare their results?

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- p. 10. Figure 7: I think some labels and arrows are shifted in the Figure.
- p. 10. Line 9: How does argon help to minimize sedimentation? I think it would be useful to explain it in somewhat more detail.
- p. 11. Line 15: The sentence should be revised.
- p. 11. Line 24: What are the detection limits of the methods? I suggest to indicate these detection limits also in the figure?
- p. 12. Line 29: Within the 10 minutes measurement time the collected drops might evaporate. How do you deal with this water loss in the collector?
- p. 13. Figure 9: Where is the buffer volume? I suppose it is between the drop collector and the knife gate valve, right? It should be shown in the figure in this way.
- p. 13. Line 20: You claim that you measured the stability of the aerosol generator. What was the result of it? It is not indicated.
- p. 13. Eq 6. What do here $M_{g\ddot{t}te}$, and $[fluo]_{drop}$ stay for?
- p. 14. Eq. 7: What is H in the equation?
- p. 14. Line 3: Eq. 8 is just the ratio between Eq. 6 and 7; this should be noted again.
- p. 14. Line 8-9: The word “same” is unnecessarily often used.
- p. 14. Line 13: I believe you mean here the resolution of the instruments. It would therefore be worthwhile to give some specifications of them; such as detection limit (see one of my earlier comments), resolution, etc.
- p. 14. Table 1: The uncertainties of the measured quantities should be indicated.
- p. 14. Eq. 9: How do you determine the Cunningham factor for d_{ap} ? Is this an iteration method to calculate d_{ap} ?
- p. 14. Eq. 10: What is FG in the equation?

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- p. 15. Line 15: “x axis” is a very loose formulation.
- p. 15. Line 18: “model of reference in the environment” – again a loose formulation.
- p. 15. Line 24: I suggest here to consider the other physical processes involved in collision for different particle sizes, such as Brownian motion, thermophoresis, diffusio-phoresis, electroscavenging, etc. Good reference for that might be the paper of Ladino et al., ACP, pp. 9745 (2013), and the book of Pruppacher and Klett (2010).
- p. 17. Line 10: To be honest, I do not see the significant improvement. The difference between measurements and theory is still large. I suggest you to indicate a range of possible collection efficiencies as a shadowed area, for instance, in the Figure by calculating collection efficiencies corresponding to the smallest and largest aerosol particle at a given d_{ap} .
- p. 17. Line 18: I do not really get the point. Have you taken into account the rear capture or not? If not, is it possible to do that and modify the collection efficiency curve?
- p. 18. Line 4: I do not see the relevance of this figure, and its connection to the present experiments. Again, how do you account for the rear capture to calculate the collection efficiency?
- p. 20. Line 7: Please use dot instead of comma for the numbers.
- p. 21. Line 3: The dimension of the volume (and, consequently, its error) is meter cube, nor meter.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1085, 2017.

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