Atmos. Meas. Tech. Discuss., 7, C127–C129, 2014
www.atmos-meas-tech-discuss.net/7/C127/2014/

Atmospheric Measurement Techniques Discussions

Interactive comment on "An experiment to measure raindrop collection efficiencies: influence of rear capture" *by* A. Quérel et al.

Anonymous Referee #1

Received and published: 6 March 2014

This paper describes an experimental study on efficiencies with which raindrops are collecting aerosol particles. The subject of the paper is of great interest to the atmospheric physics community. An experimental setup built at the IRSN offers proper conditions for experimental studies of raindrops up to a few mm in diameter. Collection efficiencies were measured for aerosol particles in the sub-micron range, and were compared to other experimental data and theoretical results. In general the paper is clearly written, well organized and scientifically sounds. The quality of the figures is good. The paper can be recommended for publication in Atmospheric Measurement Techniques. Nevertheless, the measurement techniques should be discussed in more detail. Further, I list some comments and questions that can be taken into account for a revision before publication:

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1. There are no references in the first two paragraphs, however, it would be desirable to support those introductory summaries. Furthermore, what are the “radioactive releases from a nuclear accident”? Are they of particulate matter? From the point of view of the paper it should be clarified.

2. p. 512, line 3: Inertia is not a phenomenon.

3. I have some reservations about the reliability of the experiments. First, it is not described how the sizes of the drops were determined, and how the uncertainties given in Table 1 were calculated. The drop generator is stated to be able to generate monodispersedly distributed drops, but without giving any uncertainty. In Section 2.3 the shadowgraphy technique is mentioned; it is how the drop sizes were determined? If the drops are oscillating, it can lead to some uncertainties in the size determination. This theory regarding the incorrect size determination can probably supported by the shifted mode and the one-side skewness of the axis ratio distribution shown in Figure 3. Furthermore, how had been the terminal velocities determined? Why are the measurement errors so high (+/- 1 m/s)? If one calculates the drop sizes from the drop velocities in Table 1, they found to be between 1.44 and 2.6 mm (for the 2 mm diameter drops), and 2.1 to 3.58 mm for the 2.6 mm drops. Thus, the size uncertainty is very high. Please comment and clarify it by giving also some experimental details.

4. Another comment on the experimental setup: The height of the fall shaft is enough for experiments with drops of 2 mm diameter. But it seems to be a little bit too short for the 2.6 mm drops. (see Andsager et al, J. Atmos. Sci., 1999)

5. p. 516, Eq. 2: It is not given, what v(air) in the equation means. I cannot follow the comment right after the equation, namely that the setup is able to simulate raindrops of diameters up to 2.7 mm. Please clarify.

6. Section 2.4.: It is not clear here why the fluorescence properties of the particles are important. Later it will be obvious: because of the applied spectroscopy technique. It would be desirable to mention this here.

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7. p. 518, line 3: I suppose the ratio of the c-s is considered equal to 1 and not equal to Eq. 1.

8. p. 518, Eq. 4: What are the Cs here mean?

9. In Section 2.5 C is used for the concentration, earlier for the slip correction factor. It is a little bit confusing for the reader.

10. Section 4, Fig. 6: How were the error bars calculated?

11. p. 521, line 7: I cannot understand the sentence. Next sentence: What does "difference" mean? Is it larger or smaller?

12. p. 521: The Slinn model is mentioned and the experiments are compared to it. It would be therefore good if the model would shortly be introduced in the paper. The Slinn model is stated to be developed for spherical drops. Is it possible to modify it for flattened drops?

13. p. 521, line 15: What does "relaxation time of the particle" mean?

14. Figure 7 is not introduced in the text.

15. Figure 8: Why theoretical curves for so small diameters are shown? They are also very far from the measured data points.

16. p. 523, line 18: The authors claim that they observed that the collection is driven by the inertial impaction without any contribution of phoretic forces. Is it not something which can be characterized by the Péclet number by chance?

17. p. 524, line 1: "raindrops at a given size collect aerosol particles at a given size" does not sound good.

18. In general, the English of the manuscript should be revised, and the typos should be corrected.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 509, 2014.