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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Size-resolved observations of refractory black carbon particles in cloud droplets at a marine boundary layer site" *by* J. C. Schroder et al.

Anonymous Referee #3

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This MS gives data collected at two out of three cloud events during a field campaign at Mt. Soledad, California. It contains a wealth of data on scavenging of rBC, which could, however, benefit from a more detailed analysis. The authors are very clear about problems experienced during sampling. Actually, the problems that occurred are the usual ones in field studies but are seldom mentioned.

The data are valuable, but the study needs more work and more discussions of implicit and explicit assumptions, as well as a clearer description of the measurement set-up and the measurements themselves. I'll go though the points in the order they appear in the text

Abstract:

The abstract mentions the total inlet and the CVI (lines 4 and 5), but it is unclear from the abstract alone that the CVI actually is the residual inlet. Giving percentages of cloud droplets sampled by the CVI without mentioning briefly how total droplet concentrations were obtained is rather confusing. The main results given in the abstract, which are also major results of the study, refer to coating thicknesses of rBC cores of different diameters. The point of coating thickness and core size is one of the most critical ones of the whole study and needs further discussion and investigation (see below)

could the fact that small rBC cores were found to have thick coatings and large cores thin coatings be an artefact of the upper size cut of the SP2 (220 nm) as larger particles (core+shell) could not be detected?

section 2.2 inlets:

Figure 1 is insufficient in its present form. It doesn't show how the droplet residuals were moved to the different instruments - were the particles passed into a sampling manifold where the instruments sampled in parallel or was there a common sampling line with the instruments connected sequentially? Where was the FM-100? As percentages of droplets are given: what was the spatial distance between the aerosol inlet(s) and the FM-100? How about the homogeniety of the cloud? Patchiness could give a huge effect if the total droplet concentrations and CVI droplet concentrations were not measured at the same spot (and even then patchiness can give problems)

section 2.4 refractory black carbon mass measurements / Section 2.5 coating thickness:

how accurate is the calibration with Aquadaq soot? How reliable is the lower cut size of 70 nm? SP2's have their problems, and more discussion of the accuracy of the data is needed. Same for the measurements of the coating thickness. Why could only 50% of the particles be fitted with the LEO procedure? Please give reasons. This could be

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a severe limitation of the results of the study

section 2.6

which condensation particle counters exactly were used with the SEMS and SMPS?

section 2.9 cloud properties

this section is much too short. How was the FM-100 operated? Positioning with regard to wind direction? Operation principle (just a short description), calibration, accuracy etc.? This is crucial for the comparison with the CVI, especially as the droplet sizes seem to be quite small (and the LWC of cloud 2 very low)

section 3.3.1

if there is evidence of bimodality in the BulkAero_tot distributions, why perform the size distribution fit only with a single mode lognormal distribution?

section 3.3.2 / 3.5

last par. of 3.3.2: most rBC cores are rather near the lower cut size of the SP2. The comparison of the rBC_res and the rBC_tot shows that the droplets contain larger rBC cores than the unactivated aerosol, and that the coating thickness (section 3.5) of larger cores are thinner than those of smaller cores. As the coating thickness could only be determined for the residual inlet, and as the SP2 there had actually a very narrow size range (70 - 220 nm), the result that large particles have thin coatings and small particles have thick ones could be an artefact of the upper cut size of the SP2?

If the particles have core-shell structure, of course they are internally mixed, but maybe this should be explicitly stated. Internal mixture can already have occurred in the aerosol entrained into the cloud, and new droplet activation of these particles, as well as through collision of unactivated particles with droplets. Any way to estimate this?

section 3.7 / Conclusions There seems to be an impicit assumption that all activated particles have to have diameters > 100nm - why? Do you have meteorology based

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estimates of the supersaturation history in the clouds (apart from the calculations with kappa-Koehler theory)?

please discuss why are there no large rBC cores with thick coatings? Is this caused by the failure of the LEO fitting procedure? If it is, then this point has to be discussed in depth. The main results are the sizes and coating thicknesses of rBC incorporated in cloud droplets, and if there are severe limitations to the analysis procedure, the limitations have to be stated at every mention of the results. If it is due to the upper cut size of the SP2, then it should also be stated explicitly

very minor points:

section 3.7.1 Crosier (2007) is missing from the list of references

section 3.7.3 better use molecular mass instead of molecular weight - it really is a mass and not a weight, even though "weight" is often used.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 11447, 2014.