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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The single-particle mixing state and cloud scavenging of black carbon at a high-altitude mountain site in southern China" *by* Guohua Zhang et al.

Anonymous Referee #2

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This paper presents aerosol particle mixing state measurements and analysis of black carbon containing cloud drop residuals obtained during a 10 day campaign from a ground station at a remote mountain site located in southern China. Cloud droplet residual particles were sampled with a ground based CVI operating behind a compact wind tunnel and analyzed with a SP-AMS, SMPS, and an aethalometer. Drivers for activation, including residual composition and particle size, are investigated. Results are compared with concurrent cloud-free and interstitial aerosol particle sampling

General comments:

This paper seems to be portrayed as an in-depth study on particle mixing state and

the influence of mixing state and anthropogenic activities on CCN activity; however, it may be more accurately described as an individual case study, looking at three cloud events in a single location. Care should be taken not to over-emphasize the implications of these results to all aspects of cloud activation processes. Support qualitative statements throughout the paper with quantitative results.

Specific comments:

Line 23-24: Other references have looked at the mixing state of BC particles in China. (e.g., Cheng et al. 2006; Wang et al., 2014). You have also referenced mixing state measurements by Huang et al. (2011) in Figure S7. You also reference another report of scavenging of BC particles made in China (Lines 70-72; Zhou et al., 2009)

Line 25-26: Please clarify or quantify the use of 'same extent'. Are you saying that the number fraction of particles containing black carbon is the same between 'cloud RES', 'cloud INT', and 'cloud free'?

Line 27-28: This statement seems to contradict the previous (Line 25-26).

Line 46: A number of studies have previously reported black carbon measurements in the free troposphere (e.g., Schwarz et al., 2013; Pusechel et al., 1992; Pósfai et al., 1999; Babu et al., 2011; Liu et al., 2010)

Line 48: Please expand on the usability of these results in modeling studies.

Line 50: Change 'residues' to 'residuals' for consistency.

Line 55: Fresh soot particles are generally very hydrophobic and generate organic layers over time, decreasing their hydrophobicity. Per your reference: "While freshly emitted soot is extremely hydrophobic, oxidation during aging causes soot to become more hydrophilic." (Zuberi et al., 2005)

Line 60-61: This seems to contradict your statement in the abstract that "...measured BC-containing particles... were activated into cloud droplets to the same extent as all

the measured particles"

Line 72: Change 'residues' to 'residuals' for consistency.

Line 74: Change 'would be altered' to 'could be altered'.

Line 90: Change 'residues' to 'residuals' for consistency.

Line 112-116: What is the average boundary layer height compared to the surrounding ground altitude for this region? How frequently is this site sampling free tropospheric air?

Line 115: Change 'isolated' to 'distant' (indicate that it is not near any anthropogenic sources).

Line 120: What is the particle size transmission efficiency for this wind tunnel set up? Are larger droplets transmitted through the tunnel with the same efficiency as smaller droplets?

Line 121: What is the wind tunnel velocity used for the ground based setup? Was it $\sim$80 m/s? You've reported an enhancement factor of 5.25 (Line 138), which would require a free stream velocity of $\sim$80 m/s at 15 LPM sample flow in the BMI CVI.

Line 127: Change "...particles that are capable of acting as CCN" to "...particles that were CCN"

Line 127-128: Please clarify what you mean by "A testing before measurements demonstrates that the influence of background aerosols on the collection of cloud droplets could be negligible..."

Line 133-136: Please provide further information on the GCVI measurement capabilities (visibility and rainfall detection). How are these measured by the instrument?

Line 137-139: Please change the following: "The enhancement factor (EF) for the particles collected by the GCVI is 5.25 (Shingler et al., 2012)" to indicate that the en-

hancement factor (EF) for the particles collected by the GCVI is calculated as EF = Atip*Vair/qsample, where this results in an EF for your setup of 5.25 using your wind tunnel velocity and your sample flow rate.

Line 140-149: Please provide uncertainties and detection limits for your instrument measurements or references for where this information can be found (state that this information is in the supporting information if necessary). Please provide total size range and bin resolution information for the SMPS instruments.

Line 143: Change 'scan' to 'scanning'.

Line 163: What MAC values were used to convert to EBC concentrations?

Line 213: Change 'approximate' to 'approximately'.

Line 216-218: This is a single event (Cloud II) and more sampling should be conducted to support this claim.

Line 225-227: Do these percentages indicate the number of total particles that had detectable amounts of these individual components?

Line 247-261: There are many qualitative statements in this section that would benefit from supporting quantitative results (e.g., "...the enhancement was more obvious..", "...particles have been broadly observed...", "An abundance of BC-coated materials...", etc..)

Line 259-260: Please explain this sentence, or link it to the previous study.

Line 370: Was LWC measured during this study?

Figure captions: Refrain from including discussion and references in the figure captions (keep this in the text body).

Figure 1: Report units on the y-axis.

Figure 4: What were the counts normalized to?

References

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