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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud scavenging of abundant anthropogenic refractory particles at a mountain site in North China" *by* Lei Liu et al.

Anonymous Referee #1

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General Comments:

Overall, the article investigated cloud residual and interstitial particles and addressed the potential impact of aerosol particles on environment (including human health) and climate over one of China's heavily polluted regions. The study (or campaign) was carried out in a mountain site 1500 m a.g.l. by in-situ sampling followed by lab analysis employing TEM-EDS. The research gained some valuable data to unveil some of the chemical properties and mixing states of cloud residual and interstitial particles in a uniquely polluted area. The underlying logic is sound and the structure of the article is appropriate. The figures are clear and appropriate. However, there is room for grammar improvement and concept clarification.

Specific Comments:

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Discussion paper

Table 1: There is a gap in individual particle sampling between July 25 and July 29. Is this because of instrument down time or other reasons? If it is the former, it could be appropriately addressed in the manuscript. If it is due to other reasons, they need to be justified.

Line 16: The statement of "our knowledge about aerosol-cloud interaction in heavily polluted conditions is weak" is not convincing. It might be difficult to accurately describe or explain the aerosol-cloud interaction in polluted regions, as the pollution type could vary from region to region. However, scientific communities are aware of the possible pollution sources and how these sources could influence aerosol-cloud interaction. It's just a matter of how complicated the particles could be in terms of its chemical composition and how active it could serve as CCN. Nevertheless, the NCP could be a unique area for particle pollution and well deserve sufficient scientific investigations.

Line 20: Mixing state should only refer to aerosol or particle as an ensemble. When it comes to an individual particle, you can only describe it as a pure material or a mixture based on chemical composition. You can definitely describe the mixing state after investigating chemical composition of all the individual particles sampled. Therefore, I would express Line 20 as: . . .used to investigate size and chemical composition of individual cloud RES and INT particles, and study the mixing states of these particles.

For definition of aerosol/particles mixing state, please refer to

N. Riemer and M. West [2013], Quantifying aerosol mixing state with entropy and diversity measures, Atmos. Chem. Phys., 13, 11423-11439, DOI: 10.5194/acp-13-11423-2013

For how to use individual particle chemical composition to describe mixing state, please refer to

Deng, C., Brooks, S. D., Vidaurre, G., and Thornton, D. C. O.: Using Raman Microspectroscopy to Determine Chemical Composition and Mixing State of Airborne

Marine Aerosols over the Pacific Ocean, Aerosol Science and Technology, 48, 193-206, 10.1080/02786826.2013.867297, 2014.

Line 30 to 32, The readers have to understand the relationships built on three “from”s, there must be a better grammar expression for this segment. Additionally, the article needs to discuss more about biogeochemical cycle if it is to be emphasized in abstract. The article didn’t measure black carbon but discussed its potential impacts. The researches of this study need to define the relationship of black carbon and the TEM measured species, e.g., soot. The authors should justify the interchangeable use of black carbon and soot identified by TEM if this is the case.

Line 48: Is chemical composition of clouds important? Isn’t cloud droplet mainly composed of water in terms of mass? It is understandable that chemical composition of aerosol is important for cloud nucleating, not as important as particle size though according to Dusek et al., 2006. It seems that the authors of this manuscript mean chemical composition of cloud RES and INT particles here.

Line 58-59: The impact of Fe-bearing particles on oceans is undeniable but seems to beyond the discussion of this research. There is no measurement about how much Fe-particles are transported to ocean. Therefore, it seems to be not very relevant and insignificant to be mentioned.

Technical corrections:

Line 74: “Field observations are requested to . . .”, so, who has requested field observations? I think it would be more appropriate to say “ Field observations are needed to..”

Line 79: I would recommend changing “Many studies. . .” to “Numerous studies..” or “Several studies. . .”. “Many” sounds just vague and exaggerating.

Line 79 to Line 83: From “Many studies. . .” on, it would be better if these can be incorporated into one sentence.

Line 92: “Capture interactions” is questionable and sounds exaggerated.

Line 101: Similar to a previous comment about Line 79, there are two occurrence of “many”. First, it would be better to have some vocabulary variations. Second, “many” doesn’t sound academically accurate.

Line 124-125: Recommend changing to “ More detailed information about the setup of a modified sampler can be found in Li et al., 2011a.”

Line 142: Recommend changing to “. . .interstitial particles mostly distributed on the peripheral areas of TEM grid. . .”

Line 145: Recommend changing “separate” to “distinguish between”.

Line 146: Recommend changing “In a word, many previous” to “Generally, a number of previous”

Line 154: “(see the supplement)” to “(refer to the supplement)”

Line 191: Recommend changing from “such as steel mills and smelters.” to “such as production activities in steel mills and smelters.”

Line 233: “we can still identify them. . .” to “they can still be identified. . .”

Line 343 to Line 244: It can be challenged mathematically that 76% is 3.5 times higher 22%. Generally, it is preferred to express it as “76% is 2.5 times higher than 22%” or “76% 3.5 times of 22%”.

Line 259: “reveals” should be changed to “reveal”

Line 270: “the particle number” to “particle number”

Line 280 and Line 293: Better to rephrase the expression of “We believe”. It is too subjective to be overused in a scientific journal paper.

Line 285: It would be better to just use “black carbon” instead of “BC”, even though it has been defined earlier. “BC” has only been discussed in introduction section and

hasn't been discussed ever since. It won't take much more space though.

Line 309: "If they are" to "If they were". The verb is in the subjunctive.

Line 321: "is still a mystery in polluted air" to "is still unresolved"

Line 322: "should be further considered" to "should be further studied"

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