

## ***Interactive comment on “Long-range atmospheric transport of volatile monocarboxylic acids with Asian dust over high mountain snow site, central Japan” by Tomoki Mochizuki et al.***

### **Anonymous Referee #2**

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This study correlates high levels of low molecular weight, monocarboxylic acids (LMW-MCA) with Asian dust in the Japanese snow pack. Since the primary sources of LMW-MCA are not associated with Asian dust events, the conclusion is the organic acids adsorb onto the dust particles during transport. This changes the surface chemistry of the dust particle and therefore its efficiency as ice nuclei in clouds. The study indicates that while organic acids adsorb on dust particles, coating of dust particles by sulfate or nitrate is not as efficient. The study further shows that the uptake of formic acid and acetic acid largely depended on the amount of Ca in the dust and therefore does not apply to all dust types. This is a good study and I recommend publication with minor corrections and revisions.

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I have concerns regarding the conclusion that coated dust particles make better ice nuclei and can therefore cause heavier snowfall. Many studies have shown that coating bare dust particles with organics can reduce the ice nucleating properties of bare mineral dust depending on the chemical composition the dust (Kulkarni et al 2014). Based on the complexity of ice nucleation properties of dust, the authors have not provided enough evidence to claim that these organic acid coated dust particles can alter the snowfall. This does not seem to be an important component of the study, but is an attempt for the authors to provide relevance context. It can be left out.

#### Minor Issues:

**Abstract:** Remove last line of the abstract as there is no evidence presented to support this statement.

**Page 2, line 1** When referring to urban, forest, marine, and Arctic samples are these air samples or water/snow samples?

**Page 2 line 20** This paragraph focuses on the importance of snow to the region and then discusses how changes in surface chemistry and hygroscopicity may improve ice nucleation of dust. See above comment. Previous studies have shown bare mineral dust to be very efficient IN and that coating may decrease ice nucleation properties, but increase water nucleation. This study provides no evidence either way and this section distracts from the point of the study.

**Page 3 line 10** “several dirty layers were recognized by visual observation due to the occurrence of Asian dusts.” This is an awkward statement. How was dust differentiated from a soot layer for example, or other industrial pollutants? How was the occurrence of Asian dust verified?

**Page 3 line 13** “In order to evaluate the homogeneity of snow samples within the same snow horizon with dust layer, ...” Not sure what is meant by this statement. Need clarification.

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Page 3 line 25 “The data of inorganic . . .” In addition to back trajectory and lidar data, were mineral, or crustal elemental fractions in the snow contaminants compared with reference material for the different Asian dust regions to verify dust from specific regions?

Page 3 line 30 Why and how was the pH of the samples adjusted to 8.5 to 9.0? If this is described in Kawamura and Kaplan 1984, then including it here just raises questions and isn’t informative. This is again stated on page 4 line 4 without explanation.

Page 7 line 25 “Although the alkalinity of snow pit samples can be affected. . .were slightly acidic.” Not sure what the relevance of this statement is. I think it is the use of “although” that is throwing me off.

Some, but not all grammatical clean-up

Abstract Line 17 remove “being” before consistent.

Page 1 line 30, comma after Kawamura citation.

Page 2, line 8 have a variety of sources (insert of)

Page 5 line 7 insert “the” before laser.

Page 7 line 9 change has to was before “involved”

Check uses of “although” and “however”, the authors use these two conjunctions are used a lot and not always appropriately.

Refs Kulkarni G., Sanders C., Zhang K., Liu X., and Zhao C., ‘Ice nucleation of bare and sulfuric acid-coated mineral dust particles and implication for cloud properties (2014) J. of Geophys. Res. DOI 10.1002/2014JD021567

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