Atmospheric
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Discussions

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comment

Interactive comment on "Contrasting Local and Long-Range Transported Warm Ice-Nucleating Particles During an Atmospheric River in Coastal California, USA" by Andrew C. Martin et al.

Anonymous Referee #1

Received and published: 29 August 2018

General Comments:

The manuscript discussed warm ice-nucleating particles during an atmospheric river in a California coast area. The study exemplified a comprehensive investigation of an important research topic: sources of ice nucleating particles that could initiate freezing at -10°C or warmer temperatures. This research deployed parallel sampling at two nearby sites that are only separated by 35 km but are destined to experience different ice nuclei sources at certain conditions. The study employed an automated ice spectrometer and multiple meteorological instruments carried by balloon soundings, as well as remote sensing techniques. Therefore, it contains valuable data and anal-

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Discussion paper

ysis that deserve to be published for the public's interests. The study also carried out complementary modelling and statistical analysis while observation data is unavailable, constituting a complete effort of comprehensive investigation. The results of the study presented some good proposals on future study of marine INPs. The manuscript is presented in a way that the authors pose logically relevant questions for the readers and then cope with these questions one after one till satisfaction. Although the organization of the manuscript is different from a normal research article, the logic can be well understood and should be acceptable. However, there are still some issues to be fixed for the manuscript to become publishable.

Specific Comments:

1, Marine-sourced particles are determined to be insignificant as warm INPs based on precipitation samples from these two sites during this AR. Aerosol particle concentration over ocean at cloud level is usually much lower than over land, but that doesn't prevent marine clouds contain more warm ice nuclei than terrestrial clouds because IN/CN ratio can be as low as 1 in 10e6 if marine aerosol are more efficient in ice nucleation. Since previous researches have reported the capability of marine sourced particles to serve as warm INPs, the authors should then eliminate the possibility of experimental artifacts (including sampling and AIS testing) that might potentially exclude marine particles. It would be very interesting to know if there is signature of marine-sourced particles in the precipitation samples from one or both sites. For the conclusions of this article to be solid, the most important artifact or mechanism to preclude is that marine particles didn't survive AIS analysis for samples from both sites. Does rainfall intensity have any impacts on INP concentration measured from precipitation samples?

2, Some statistical analysis in the article doesn't seem to be convincing. For example, in the last paragraph of section4.8, a linear regression is still discussed when R square is lower than 0.01. In this case, maybe there is no relationship to seek.

3, The summary section seems to be slightly lengthy and could be presented in a more

concise manner. It is understandable that the authors intend to present a summarized study in a logically sound manner. However, some of the detailed analysis could be taken from the summary section without influencing the integrity of the manuscript.

4, There are some typos and imperfection of abbreviations or acronyms, as well as room for grammar improvement. All these will be presented in technical corrections.

Technical corrections:

1, In abstract, ice nucleating particles are abbreviated as "INP", while it is abbreviated as "INPs" in the introduction section and other parts of the article. To be consistent within the article and with other published research articles in this topic, it is preferred to use "INPs". To use it as a general term, the authors should still be able to use "ice nucleating particle" or "INP" without further defining it.

2, There are a series of occurrences that the paper mentioned section 3a, 3b,3c, 3d, 4d, 4e, 4f etc., which the paper is constructed as sections 3.1, 3.2, 3.3, etc. These mismatches should be fixed completely using "find and replace" function of the document editing software.

3, There are some word choice discrepancy throughout the manuscript. For example, "timeseries" and "time series" are used interchangeably. It would be preferred to be consistent in one manuscript. Most of the articles used "MSL" for altitude, while there are two occasions of using "AGL", i.e., line 15 in section 4.1, and title 7. Authors should examine if these two usages are correct and if they can be expressed as "MSL" accordingly.

4, Comments about quality of Figure 1: In figure title, along-slope direction wind should be symbolized as "â" instead of "û", which is for upslope wind. In Fig. 1a, the circle and square marks are too large compared with the marks in Fig. 2a. It would be less confusing if the unit "m" was assigned to colorbar title instead of the subfigure title, since there is already a unit (arc-sec.). In Fig. 1b, the colorbar seems to contain one

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single color in one small square, unlike the gradual change color scale in Fig. 1a. Therefore, the number should be aligned with the middle of the small square instead of the edge. Readers have to match "17" to "ocean" to determine that the numbers in the colorbar correspond to the colors above the numbers. It seems that the white/clear color in the bottom of colorbar is not used in the map and could be deleted. In that case, it would be unequivocal even if numbers sit at the bottom of each square.

5, In Figure 3, CFSR is not used or defined in the article elsewhere, it should be defined. Also, authors should be clear about what the star marks in the plot mean. In the figure 3 title, there are two usage of semicolon after "as in a", which could be replaced by comma.

6, In Figure 4, "acuum. precip." is used in the figure title while "cum. precip." is used in the ordinate (Y-axis) title of 4a. It is preferable to be consistent.

7, In Figure 7, the "X" and "O" marks are mentioned in the title but invisible in the figure. As mentioned in the second comment of technical corrections, it also contains section 3a but no such section can be found in the article. It should be changed to section 3.1 if that is what it means.

8, In Figure 9, the title confused ordinate with abscissa. Precipitation chance is abscissa (X axis) while reflectivity is ordinate (Y axis). Abscissa was also mistaken as ordinate in Figure 2 title. Actually only BBY seems to land on X-axis, so it is better to mention neither ordinate nor abscissa for Figure 2.

9, Throughout the manuscript, figures are referred inconsistently. Majority of the cases are referred to as Fig. X (where X is a number or number plus letter), while some are figure X, (e.g. "Figure 7" in Page 12 line 31 and "figure 7" in Page 12 line 34; Fig 4a in Page 16 Line 17). There examples are not exhaustive.

The following corrections are suggestions on grammar improvement and vocabulary selection.

Page 1 line 7: "Precipitation was collected at two sites, one coastal and one inland, that are separated by less than 35 km" –> "Precipitation samples were collected at two sites, one coastal and one inland, which are separated by about 35 km".

Page 1 line 13: "...warm INP are observed..." –> "...warm INPs were observed...". It seems the abstract uses past tense for other similar expressions.

Page 2 line 4: "including in the US state of California" –>"including the US state of California"

Page 2 line 19: "bacterium" –>"bacteria", unless there is a reason to explain why "virus" was used as plural but bacterium was used as singular.

Page 4 line 11: "raingauge" –> "rain gauge", refer to line 22 on the same page

Page 4 line 28: " at irregular interval"–>"at irregular intervals"

Page 5 line 24: "..to be bio-INP" –>"...as bio-INP"

Page 5 line 29-30: "A short definition of each and identification methodology using study datasets is to follow" –> A short definition for each of them and/or their identification methodology are to follow"

Page 6 line 19: "along-slope"–>"Along-slope"

Page 6 line 25-30: MBL and TBL seem to be defined awkwardly. Can they be better defined even though the current definitions are unambiguous?

Page 10 line 9: "The remainder of this study will focus on AR2" –> "The remainder of this paper will focus on AR2".

Page 31-34, Table 1 and Table 2 don't have a dot at the end of their titles while Table 3 and Table 4 have.