

Data Paper

Keiichiro Hara, Kazuo Osada, Masanori Yabuki, Masahiko Hayashi, Masataka Shiobara, Naohiko Hirasawa, and

Takashi Yamanouchi. Long-term monitoring of condensation nuclei concentrations at Syowa Station, Antarctic.

Polar Data Journal. 2023, 7, p. 13–23. <https://doi.org/10.20575/00000045>.

(Received 4/8/2022; Accepted 11/8/2022)

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1st submission

Editor Start Date: 4/8/2022

Editor Stop Date: 6/14/2022

Reviewer #1 (4/21/2022–6/10/2022)

Reviewer #2 (4/27/2022–6/14/2022)

Editor comments to the Author: Ryu Uemura

Thank you for submitting to PDJ. Please revise based on the reviewers' comments below. My editorial comments are below.

1. L.48: Please provide more precise latitude and longitude.
2. L.60: through > throughout
3. L.64: from April 1997 to January 2004
4. L.69: CPC 3010 > Please add manufacturer's name.
5. L.107: also screened
6. L.125: differences in
7. L.128: high correlations between the two instruments were??
8. L.128: between daily mean
9. Figure 2: CN measurement at Syowa Station, Antarctica
10. Figure3: @ > at

Reviewer #1: Anonymous

General Comments:

The long-term datasets for CN number concentrations in the Antarctic atmosphere are highly valuable. However, since this manuscript is submitted to a data journal, the authors should provide more detailed information on their

measurements and data. As an example, the information on the definition of "number concentration" is not provided; therefore, it is hard for the users to use the CN data presented here for comparison with those measured at other locations. If the CN number concentrations are not corrected to the values at a standard temperature and pressure (STP) condition (e.g., 0 degree C and 1 atm), the authors would need to provide the corrected CN data, as well as the actual measurement data (see also Comment 1). If the authors can answer the following comments appropriately, I would like to suggest publication in Polar Data Journal. In addition, this manuscript should be edited for English grammar and usage before considering publication.

Specific Comments:

1. Dataset: Please clarify the definition of "number concentrations" used for this dataset. If the CPC number concentrations presented here were obtained based on the volume of sample air at ambient air or room temperature and pressure conditions, please explain this point in the main text. In addition, since the volume of sample air would change depending on temperature and pressure, it would also be necessary to provide the CN number concentrations corrected to the values at a standard temperature and pressure (STP) condition (e.g., 0 degree C and 1 atm). This information is very important to quantify and compare the CN data with those measured at other locations in the world.
2. Abstract: More clear explanations would be necessary in the abstract. For example, the authors would need to explain the periods of measurements of the CN data with diameters larger than 10 nm and 7 nm, respectively.
3. Lines 42-43: This sentence may not be appropriate. I think new particle formation is also categorized as aerosol enhancement. On the other hand, I think that it is difficult to elucidate aerosol volatility based solely on CN data. I would suggest that this sentence should be written as follows (or something like this):  
  
"Earlier studies have used CN data to evaluate their long-term trends and the occurrence of enhanced aerosol events such as new particle formation and Antarctic haze phenomenon".
4. Line 48: The information on the coordinates of Syowa Station is too rough. Please provide more detailed coordinates of the latitude, longitude, and elevation.
5. Lines 64-87: I think that the explanations regarding CN measurements should be provided in Section "3. Methods" and not in this section.
6. Lines 68-69: Please provide the information on the manufacture and model of CPCs and then define their name like "CPC-3010" and "CPC-3783".
7. Lines 69-70: Please explain accurately how long the CPC-3010 and CPC-3783 have been operated. Because this is a technical paper employing the hourly mean datasets, the authors should provide a more detailed information on when (time/date) each instrument started and retired.
8. Lines 80-83: What is the flow rate (not flow speed) used for this inlet? In addition, the authors would need to explain

about expected particle losses in this inlet system.

9. Line 84: What do you mean by "and 11.2 mm (0.44 inch)"?
10. Lines 86-87: What is the range of expected RH values at typical room conditions?
11. Lines 115-119: Please explain the details for the data files and their formats according to the Submission Guidelines of this journal.
12. Figure 1: Please specify the position of the north in Figure 1b, and then adjust the angle of Figure 1a in order to indicate the same direction as Figure 1b. In addition, please explain how the authors could indicate the direction of "prevailing wind". If it is based on previous work (Sato and Hirasawa, 2007?), please indicate the reference in the figure legend.
13. Figure 3: It seems that there is a strange mismatch of the daily CPC-3783 data at a certain level throughout the entire period ( $\sim 8 \times 10^2 \text{ cm}^{-3}$  in 2015 to  $\sim 4 \times 10^3 \text{ cm}^{-3}$  in 2021). Why did this mismatch happen?
14. Figure 4: It is hard to see the difference of the lines. Please use different colors or different types of lines (e.g., dashed, dotted). It is also not clear what the equation presented at the bottom of each figure means.
15. Dataset: I could check the daily datasets, but could not find the hourly datasets (the folders for both the hourly "3010" and "3783" data seemed to be empty). The hourly data should be uploaded appropriately.

Reviewer #2: Anonymous

This manuscript describes a long-term record of condensation nuclei concentration collected at Showa station in Antarctica. The period actually covers almost a quarter of a century, dating back as far as 1997. Considering the harsh environment, remoteness, and severity to maintain logistical support to ensure such continuous measurement, the value of the data set presented is unequivocal. It would make a huge asset to the polar atmospheric science, and encouraged to be made available to wider community. I therefore recommend the manuscript to be published after minor corrections. As a descriptive paper, some more technical details on the measurement setup, especially on the inlet design and flow splitters, will further enhance the soundness of the paper.

Overall comment:

There is no description about the inlet outside of the observatory. I expect the weather conditions can be very harsh At times for example during blizzards. Is there any heating to prevent icing and clogging? Any shielding to prevent large hydrometeors from entering the new inlet tower? In any case, is there any difference in the penetration efficiency of particles of certain size range depending on the wind speed? I totally understand the difficulty to setup a perfectly designed inlet and flow splitting systems in Antarctica already back in 1997, so what I'm only suggesting is to be as descriptive as possible and preferably provide measurement (or estimates) on the particle loss associated with different

inlet and tubing combinations as a whole. For example, there is an overlap of periods in 2004-2005 seasons for both buildings in Figure 2. Do you have any data to show direct comparison of the inlet and tubing systems with the same CPC?

Minor comments:

1. Lines 34-35: too many 'from's in one sentence. The sentence should rather be "... supplied and derived in the Antarctic troposphere through (1) secondary aerosol..., (2) primary...and (3) long-range transport...".
2. Line 38: ...low latitudes17-20.
3. Line 42: ...such as King Sejong10, 11.
4. Line 48: 'conducted' instead of 'taken'?
5. Lines 67-68: "Also, CN concentrations have been measured using a condensation particle counter (CPC) as part of aerosol monitoring at Syowa Station, Antarctica since April 1997." This sentence should come before the description of the clean air observatory (currently found in Lines 65-67).
6. Line 77: what is the composition of the "polymer" tube exactly? Any influence of electrostatic force on the particle loss?
7. Line 85: What does it mean by "and 11.2 mm (0.44 inch)"? which tubing?
8. Line 87: How dry is "lower relative humidity (i.e., dry condition)"? Please specify the range.

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Authors Response:

Authors appreciate greatly for your helpful comments to improve our manuscript. Corrected descriptions were marked by yellow highlights in the revised manuscript based on comments from the Editor, Reviewer #1 and #2. Our reply on the editor's and reviewer's comments (in red) is as follows.

Response to Editor;

1. L.48: Please provide more precise latitude and longitude.

We provide more precise latitude and longitude (69.005°S, 39.591°E)

2. L.60: through > throughout

Changed to "throughout"

3. L.64: from April 1997 to January 2004

Changed to "from May 1997 to January 2004."

4. L.69: CPC 3010 > Please add manufacturer's name.

Name of the manufacturer (TSI Inc.) was added into the text.

5. L.107: also screened

Changed to “also screened”.

6. L.125: differences in

Changed to “differences in”.

7. L.128: high correlations between the two instruments were??

Description was changed to “high correlation between CN concentrations measured by CPC-3010 and those by CPC-3783”

8. L.128: between daily mean

This was not modified in the text, because high correlation was found both in daily-mean and daily-median as shown in Fig. 4.

9. Figure 2: CN measurement at Syowa Station, Antarctica

Label was modified to “CN measurement at Syowa Station, Antarctica”

10. Figure3: @ > at

As well as the reply above, changed to “at”.

Response to reviewer #1;

1. Dataset: Please clarify the definition of "number concentrations" used for this dataset. If the CPC number concentrations presented here were obtained based on the volume of sample air at ambient air or room temperature and pressure conditions, please explain this point in the main text. In addition, since the volume of sample air would change depending on temperature and pressure, it would also be necessary to provide the CN number concentrations corrected to the values at a standard temperature and pressure (STP) condition (e.g., 0 degree C and 1 atm). This information is very important to quantify and compare the CN data with those measured at other locations in the word.

In the revision, we provide CN concentrations under conditions of ambient air pressure and standard conditions and standard conditions (i.e., 0°C and 1013.25 hPa). Details were added into the section of “4. Data Records”.

2. Abstract: More clear explanations would be necessary in the abstract. For example, the authors would need to explain the periods of measurements of the CN data with diameters larger than 10 nm and 7 nm, respectively.

We added short explanation on the periods for the respective measurements of CN concentrations with diameters larger than 10 nm and 7 nm into the abstract.

3. Lines 42-43: This sentence may not be appropriate. I think new particle formation is also categorized as aerosol enhancement. On the other hand, I think that it is difficult to elucidate aerosol volatility based solely on CN data. I would suggest that this sentence should be written as follows (or something like this):

"Earlier studies have used CN data to evaluate their long-term trends and the occurrence of enhanced aerosol events

such as new particle formation and Antarctic haze phenomenon".

From the viewpoint of aerosol supply into the atmosphere, new particle formation can “enhance” aerosol concentrations. However, we want to show atmospheric aerosol conditions and phenomena. Thus, we modified the sentence as follows; Using CN data, earlier works have elucidated new particle formation<sup>21, 28</sup>, long term trends<sup>25</sup>, aerosol volatility<sup>7, 29</sup>, and Antarctic haze phenomena<sup>18, 30</sup>.

4. Line 48: The information on the coordinates of Syowa Station is too rough. Please provide more detailed coordinates of the latitude, longitude, and elevation.

More detail information was added into the text.

5. Lines 64-87: I think that the explanations regarding CN measurements should be provided in Section "3. Methods" and not in this section.

Section 2 shows “Location and Measurement”. Therefore, explanation about CN measurement remains in Section 2. Instead, the title of “Section 3” changed to “Data analysis” to avoid confusion.

6. Lines 68-69: Please provide the information on the manufacture and model of CPCs and then define their name like "CPC-3010" and "CPC-3783".

We added the models and the manufacture’s name into the text.

7. Lines 69-70: Please explain accurately how long the CPC-3010 and CPC-3783 have been operated. Because this is a technical paper employing the hourly mean datasets, the authors should provide a more detailed information on when (time/date) each instrument started and retired.

We added more detailed information on CPC operations in the text.

8. Lines 80-83: What is the flow rate (not flow speed) used for this inlet? In addition, the authors would need to explain about expected particle losses in this inlet system.

We added some explanations on particle losses in the inlet and tubes. Simultaneous CN measurements between outside and inside showed that the particle losses might be insignificant.

9. Line 84: What do you mean by "and 11.2 mm (0.44 inch)"?

This was an editorial error. Removed from the text.

10. Lines 86-87: What is the range of expected RH values at typical room conditions?

Because air temperature between ambient (outside) condition and inside of the observatory is larger than 20°C, CN concentrations were measured under the conditions with relative humidity less than 10 %. The range was added into the text.

11. Lines 115-119: Please explain the details for the data files and their formats according to the Submission Guidelines of this journal.

We added data fields/list in each file into the text in Section 4 (Data Records).

12. Figure 1: Please specify the position of the north in Figure 1b, and then adjust the angle of Figure 1a in order to

indicate the same direction as Figure 1b. In addition, please explain how the authors could indicate the direction of "prevailing wind". If it is based on previous work (Sato and Hirasawa, 2007?), please indicate the reference in the figure legend.

Direction of the north was added in Fig.1b. Orientation of Fig 1a was adjusted in the revised figure. Although direction of prevailing wind at Syowa is common knowledge, Sato and Hirasawa (2007) was cited in the figure caption.

13. Figure 3: It seems that there is a strange mismatch of the daily CPC-3783 data at a certain level throughout the entire period ( $\sim 8 \times 10^2 \text{ cm}^{-3}$  in 2015 to  $\sim 4 \times 10^3 \text{ cm}^{-3}$  in 2021). Why did this mismatch happen?

This was digital errors when the manuscript was converted to pdf file. The error was not observed in the original figure.

14. Figure 4: It is hard to see the difference of the lines. Please use different colors or different types of lines (e.g., dashed, dotted). It is also not clear what the equation presented at the bottom of each figure means.

The colors of the lines was changed. Equations of the correlations were shown in the text.

15. Dataset: I could check the daily datasets, but could not find the hourly datasets (the folders for both the hourly "3010" and "3783" data seemed to be empty). The hourly data should be uploaded appropriately.

After revision of the manuscript, we are going to upload all files in the sever. When you check the revised manuscript, the file will be uploaded.

Response to reviewer #2;

Overall comment:

There is no description about the inlet outside of the observatory. I expect the weather conditions can be very harsh At times for example during blizzards. Is there any heating to prevent icing and clogging?

As presented in Osada et al. (2006), air inlet was not heated in our measurements. Because Osada et al. (2006) was already cited in the text, more explanation was not added in the text.

I totally understand the difficulty to setup a perfectly designed inlet and flow splitting systems in Antarctica already back in 1997, so what I'm only suggesting is to be as descriptive as possible and preferably provide measurement (or estimates) on the particle loss associated with different inlet and tubing combinations as a whole.

Simultaneous CN measurements between the atmospheric observatory and the clean air observatory, and between outside (tethered balloon measurements) and inside of the clean air observatory indicated insignificant difference less than 2 %. This difference was approximately same as inter-comparison of CPC measurements for simultaneous measurements as stated in the Section 5. Therefore, the particle loss by the inlet and tubes might be insignificant in CN measurements in our measurements.

Minor comments:

1. Lines 34-35: too many 'from's in one sentence. The sentence should rather be "... supplied and derived in the Antarctic troposphere through (1) secondary aerosol..., (2) primary...and (3) long-range transport...".

The sentence changed to “~troposphere through (1) secondary aerosol formation including new particle formation from aerosol precursors emitted from oceanic bioactivity and snowpack chemistry,<sup>4-12</sup> (2) primary emissions of sea salt aerosols from sea-ice surface via snow erosion and ocean surface by bubble bursting,<sup>2, 13-16</sup> and (3) long-range transport from desert, anthropogenic combustion, and biomass burning in the middle latitudes and low latitudes<sup>17-20</sup>.”

2. Line 38: ...low latitudes<sup>17-20</sup>.

Corrected.

3. Line 42: ...such as King Sejong<sup>10, 11</sup>.

Corrected.

4. Line 48: 'conducted' instead of 'taken'?

Changed to “conducted”.

5. Lines 67-68: "Also, CN concentrations have been measured using a condensation particle counter (CPC) as part of aerosol monitoring at Syowa Station, Antarctica since April 1997." This sentence should come before the description of the clean air observatory (currently found in Lines 65-67).

The sentence was moved to the top of paragraph.

6. Line 77: what is the composition of the "polymer" tube exactly? Any influence of electrostatic force on the particle loss?

Specific model and manufacturer of the tube were added in the text. Although polymer tubes can induce generally particle loss, the simultaneous CN measurements indicated insignificant difference, as stated above.

7. Line 85: What does it mean by "and 11.2 mm (0.44 inch)"? which tubing?

This was an editorial error. Removed from the text.

8. Line 87: How dry is "lower relative humidity (i.e., dry condition)"? Please specify the range.

Because air temperature between ambient (outside) and inside of the observatory is larger than 20°C, CN concentrations were measured under the conditions with relative humidity less than 10 %. The range was added into the text.

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2nd submission

Editor Start Date: 8/24/2022

Editor Stop Date: 9/29/2022

Reviewer #1 (9/5/2022–9/29/2022)



Editor comments to the Author: Ryu Uemura

Line 164: "8. Figures (optional)"> "7. Figures"

(i.e., Please remove "optional" and correct the number)

Reviewer #1: Anonymous

General comments:

I think that the authors have answered almost all my comments appropriately. If the authors can answer the following minor comments, I would like to suggest publication in Polar Data Journal.

Specific comments:

1. Dataset: I assume the data uploaded in the CPC/Daily/3783 folder should be composed of "Date, Amb\_Median, STD\_Median, Amb\_Mean, STD\_Mean", while the current data are "Date, Amb\_Median, Amb\_Median, Amb\_Mean, Amb\_Mean".
2. Dataset: Please check if the values in the dataset are indeed correct. For example, it seems that some Amb\_Mean values in the CPC/Daily/3783 folder show abnormally high values (e.g., 232113950.4 on 2014/2/18).
3. Line 49: "20 m" => "20 m above mean sea level"?
4. Lines 70-71: Please explain that UT means Universal Time (it is explained in Section 4, though).
5. Line 85: As I pointed out in my previous review comment, please explain the flow rate (in addition to flow speed) used for this inlet.
6. Line 164: "8. Figures (optional)" => "7. Figures (optional)"?

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Authors Response:

Authors appreciate greatly for your helpful comments to improve our manuscript. Corrected descriptions were marked by yellow highlights in the revised manuscript based on comments from the Editor, Reviewer #1. Our reply on the editor's and reviewer's comments (in red) is as follows.

Response to Editor;

Line 164: "8. Figures (optional)"> "7. Figures"

(i.e., Please remove "optional" and correct the number)

We corrected to "7. Figures"

Response to reviewer #1;

1. Dataset: I assume the data uploaded in the CPC/Daily/3783 folder should be composed of "Date, Amb\_Median, STD\_Median, Amb\_Mean, STD\_Mean", while the current data are "Date, Amb\_Median, Amb\_Median, Amb\_Mean, Amb\_Mean".

The wrong headers are corrected. This resulted from the bug in our program. Although most data were treated (corrected) before data upload, daily data of cpc-3783 were forgotten to be corrected.

2. Dataset: Please check if the values in the dataset are indeed correct. For example, it seems that some Amb\_Mean values in the CPC/Daily/3783 folder show abnormally high values (e.g., 232113950.4 on 2014/2/18).

Some data had error data (due to logging error). We checked all data and remove the errors from the published data.

3. Line 49: "20 m" => "20 m above mean sea level"?

Yes. We add "above mean sea level" into the text.

4. Lines 70-71: Please explain that UT means Universal Time (it is explained in Section 4, though).

Yes. We add the mention of UT in line 70-71 in the revised manuscript.

5. Line 85: As I pointed out in my previous review comment, please explain the flow rate (in addition to flow speed) used for this inlet.

Because we already show the inner diameter of tube and flow speed in the text, flow rate can be estimated to 870 L min<sup>-1</sup> at flow rate of 2 m s<sup>-1</sup>. Short explanation (information) was added into the text.

6. Line 164: "8. Figures (optional)" => "7. Figures (optional)"?

We corrected to "7. Figures"

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3rd submission

Editor Start Date: 11/8/2022

Editor Stop Date: 11/8/2022

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Editorial Office's note

Calculate checksum date: 11/10/2022

Algorithm:SHA256

Hash link: <http://id.nii.ac.jp/1434/00000045> > hash list