Data Paper
Ikumi Oyabu, Kenji Kawamura, Kyotaro Kitamura, Satoshi Sugawara, Shigeyuki Ishidoya, Taku Umezawa, Takuya Saito, Daisuke Goto, Ryo Fujita, Shinji Morimoto, Shuji Aoki, and Hideaki Motoyama. Firn air composition at the H128 and NDFN sites, Dronning Maud Land, East Antarctica. 2025, 9, p. 30–43. https://doi.org/10.20575/00000061.
(Received 10/30/2024; Accepted 2/12/2025)

---

1st submission
Editor Start Date: 10/31/2024
Editor Stop Date: 1/17/2025

Reviewer #1: (11/28/2024–12/18/2024)
Reviewer #2: (12/21/2024–1/14/2025)

Handling editor comments to the Author: Naohiko Hirasawa
Dear Dr. Oyabu and co-authors,

Two peer reviewers recognized the value of this data, and recommended publication of this paper in Polar Data Journal after some revision. I agree with them. Please read the reviewers' comments carefully and consider submitting a revised manuscript.

Sincerely,
Naohiko Hirasawa
NIPR

Reviewer #1: Kyohei Yamada
General comments:

Polar firn air is helpful for the recognition of past atmospheric compositions. The present study describes the first sampling of firn air at H128 with relatively high accumulation and NDFN with relatively low accumulation in January 2016 and January 2019, respectively. The authors explained the sampling system and procedure, presented the elemental and isotopic ratios measurement, and illustrated measured gas species profiles and density depth profiles.
The sampling methods and measurements are very well organized. However, there were a few points of concern in the section describing the meteorological conditions at the observation sites. While the analysis of air alone may suffice, accurately presenting the meteorological elements would make the observation sites helpful to understand.

Specific comments:
[L67] This dataset is described as being from locations where the accumulation is relatively high due to strong winds

and from locations where the winds are calm and the accumulation is low. However, Sec. 2 has no information on wind conditions. If the authors want to mention the difference in wind conditions at these observation sites, the authors should show the difference in wind speed.

[L75] Only the mean accumulation rate contains a yearly notation. Are the other elements (temperature, etc) on monthly means in January 2016 (H128) and 2019 (NDFN)? It needs to be clarified because it is written alongside the mean accumulation rate, which is a cumulative value over a certain period.

[L80] Since there is no AWS at NDFN, climate data from the nearby NDF is shown. It seems that it would be better to use the same period for both NDFN and NDF to compare accumulation. Is there no data available for the same period?

Minor comments:

[L44] The paragraph contains both "meters" and "m."

[L89] The abbreviation "NIPR" already appears in L86.

Reviewer #2: Anonymous

This extensive dataset of a variety of firn air compositions at two different sites of East Antarctica provides a valuable basis for better understanding of past atmospheric compositions, air entrapment processes in the firn, as well as age of gas in ice cores. All the dataset, figures, and manuscript are clearly written with no problem for their usage. I recommend the publication after a few corrections listed below.

*Dataset

"H128firnair_summary_data.xlsx" contains a personal note on the sheet "CO2, CH4, N2O, SF6". It seems there remains something to check for a calibration of CH4 data. This needs to be solved before the final publication.

*Manuscript

Line 11: "Tokyo 190-8518" is duplicated. Delete the first one.

Line 44: "at depths of approximately 10 to 15 meters from the bottom of the firn". Is this above or below 10–15 m from the bottom of firn?

Line 67: Delete spaces before and after the emdash (—).

Line 106: "metal bellows valves (SS-4H)" seems to be contradiction. Figure 2 shows that SS-8BG corresponds to bellows valves whereas SS-4H corresponds to manual valves. I guess this should be "metal manual valves (Swagelok, SS-4H)".

Line 119: "four metal valves" --> "four metal valves (MV4 to MV7)" for better accessibility when referring to Figure 2.

Line 124: I found 20 sampling depths for NIPR samples in the dataset "H128firnair_summary_data.xlsx" whereas it is written as 19 in the text. Perhaps samples at 5.5 m above the surface were not counted? The sampling procedure at

5.5 m would be needed if that's different from other depths.

Line 144: "a IRMS" --> "an IRMS"

Line 247–248, Ref. 1: Missing page numbers and DOI is duplicated.

Line 346, Ref. 27: Missing "Arctic Data archive System (ADS), Japan". Also, the year should be 2023 according to the website linked.

Line 349, Ref. 28: Delete "p." at the end.

---

Authors Response:

We are grateful to the editor for handling our manuscript and the reviewers for their thorough reviews and attention to detail. Our responses and changes for the revision are explained below. Reviewer comments are provided in black, and our replies are highlighted in blue.

We have updated the datasheets by modifying the previously submitted versions. For the H128 dataset, we incorporated the CO2, CH4, N2O, and SF6 data obtained from the NIES flasks, corrected the AIST data for δ18Oatm and δAr/N2 values based on updates to the correction coefficients (Ishidoya et al., 2024, https://doi.org/10.5194/egusphere-2024-654), and added the analysis dates (H128firnair_summary_data_V1-2.xlsx). For the NDFN dataset, we also included the analysis dates (NDFNfirnair_summary_data_v1-1.xlsx). Please review these updates alongside the revised manuscript.

Response to reviewer #1:

General comments:

Polar firn air is helpful for the recognition of past atmospheric compositions. The present study describes the first sampling of firn air at H128 with relatively high accumulation and NDFN with relatively low accumulation in January 2016 and January 2019, respectively. The authors explained the sampling system and procedure, presented the elemental and isotopic ratios measurement, and illustrated measured gas species profiles and density depth profiles. The sampling methods and measurements are very well organized. However, there were a few points of concern in the section describing the meteorological conditions at the observation sites. While the analysis of air alone may suffice, accurately presenting the meteorological elements would make the observation sites helpful to understand.

Specific comments:

[L67] This dataset is described as being from locations where the accumulation is relatively high due to strong winds and from locations where the winds are calm and the accumulation is low. However, Sec. 2 has no information on wind conditions. If the authors want to mention the difference in wind conditions at these observation sites, the authors should show the difference in wind speed.

We added annual mean wind speeds at H128 and NDF in Section 2.

[L75] Only the mean accumulation rate contains a yearly notation. Are the other elements (temperature, etc) on monthly means in January 2016 (H128) and 2019 (NDFN)? It needs to be clarified because it is written alongside the mean accumulation rate, which is a cumulative value over a certain period.

To clarify the meteorological conditions at the observation sites, we added the observation months and periods in Section 2. After reviewing the AWS values, some numbers were slightly adjusted.

[L80] Since there is no AWS at NDFN, climate data from the nearby NDF is shown. It seems that it would be better to use the same period for both NDFN and NDF to compare accumulation. Is there no data available for the same period?

There is no accumulation rate data for the same period. Accumulation rates at NDF and NDFN were calculated based on the depths of the Pinatubo eruption signal (1992) from the snow pit surfaces and the densities up to those depths. Since the observation years differ between NDF and NDFN, and annual layers cannot be counted at either site, only the mean accumulation rate from the snow surface (observation year) to the Pinatubo eruption could be determined.

Minor comments:

[L44] The paragraph contains both "meters" and "m."

"meters" on line 44 has been changed to "m" for consistency, as "m" was used throughout the rest of the text.

[L89] The abbreviation "NIPR" already appears in L86.

Line 86 has been rewritten to spell out "NIPR," and line 89 has been revised to use its abbreviation.

Response to reviewer #2:

This extensive dataset of a variety of firn air compositions at two different sites of East Antarctica provides a valuable basis for better understanding of past atmospheric compositions, air entrapment processes in the firn, as well as age of gas in ice cores. All the dataset, figures, and manuscript are clearly written with no problem for their usage. I recommend the publication after a few corrections listed below.

*Dataset

"H128firnair_summary_data.xlsx" contains a personal note on the sheet "CO2, CH4, N2O, SF6". It seems there remains something to check for a calibration of CH4 data. This needs to be solved before the final publication.

Thank you for pointing this out. We discovered additional H128 data from NIES flasks that were missed in the original dataset. These data have now been added to "H128firnair_summary_data_V1-2.xlsx" after resolving the calibration issue. As the number of data points has increased, we revised the last paragraph in Section 3 (Line 163 in the revised manuscript with track changes) to: *"...in some NIES flasks from the H128 site were also measured at TU (a total of 13 sampling depths).* Revisions have also been made to Figure 3.

*Manuscript

Line 11: "Tokyo 190-8518" is duplicated. Delete the first one.

Deleted.

Line 44: "at depths of approximately 10 to 15 meters from the bottom of the firn". Is this above or below 10-15 m from the bottom of firn?

We have corrected as follows.

*".... at depths of approximately 10 to 15 m above the bottom of the firn."*

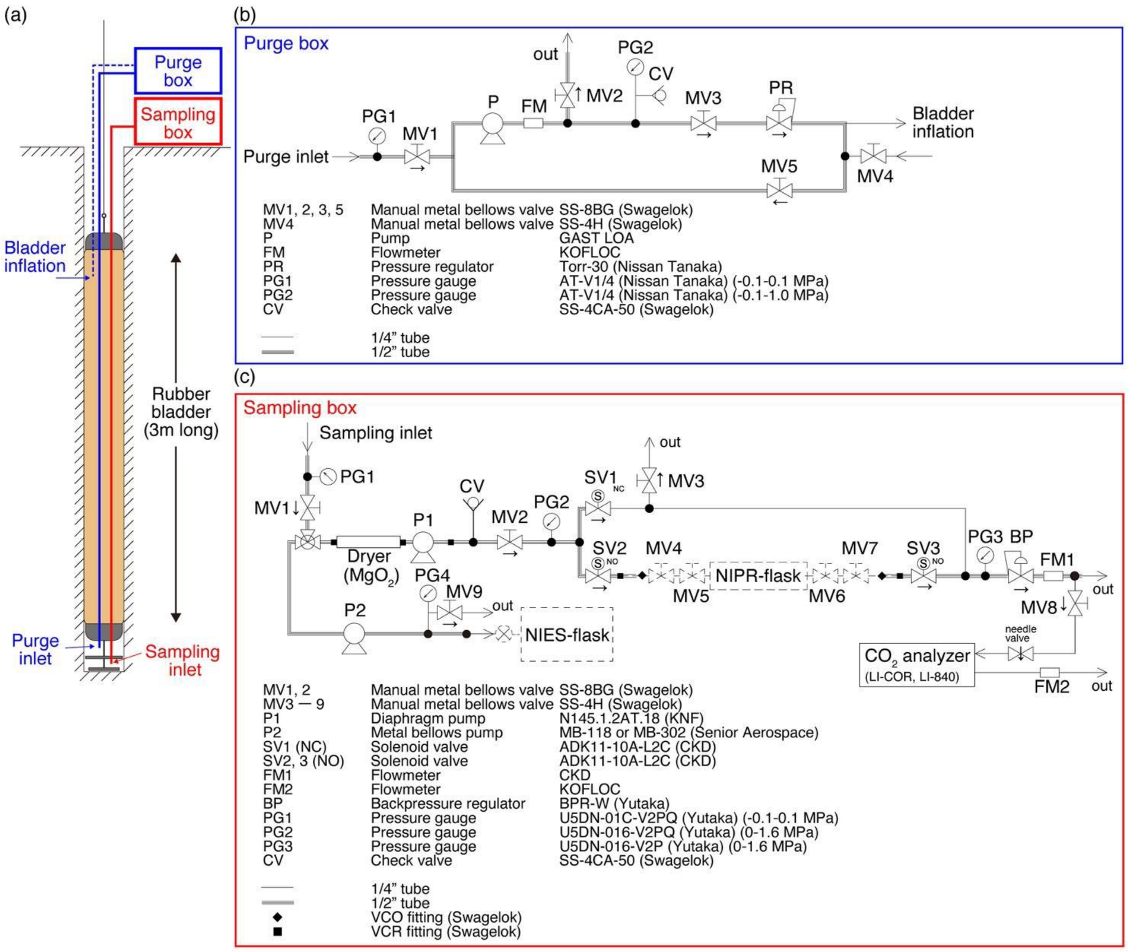
Line 67: Delete spaces before and after the emdash (—).

Deleted.

Line 106: "metal bellows valves (SS-4H)" seems to be contradiction. Figure 2 shows that SS-8BG corresponds to bellows valves whereas SS-4H corresponds to manual valves. I guess this should be "metal manual valves (Swagelok, SS-4H)".

We have revised the sentence and the legends in Fig. 2 (b) and Fig. 2 (c) as follows.

*"The sample flasks are cylindrical in shape, made of stainless steel, and equipped with two all-metal and bellows-sealed manual valves (SS-4H) at each end, with a volume of about 1 L (NIPR flasks)."*




Line 119: "four metal valves" --> "four metal valves (MV4 to MV7)" for better accessibility when referring to Figure 2.

Corrected as suggested.

Line 124: I found 20 sampling depths for NIPR samples in the dataset "H128firnair_summary_data.xlsx" whereas it is written as 19 in the text. Perhaps samples at 5.5 m above the surface were not counted? The sampling procedure at 5.5 m would be needed if that's different from other depths.

We corrected the sampling depths to 20 for the NIPR flasks at H128. Additionally, we included the sampling procedure at the surface (0 and 5.5 m at H128 and 1.0 and 1.5 m at NDFN), as follows.

*To compare with firn air compositions, ground-level air sampling was also conducted. At H128, air was sampled at 0 m and 5.5 m above ground, while at NDFN, sampling was performed at 1.0 m and 1.5 m above ground. At H128, the tube connected to the MV1 of the sampling box was attached to a 5.5 m-long bamboo stick to collect air. At NDFN, the bladder with stainless steel flanges was supported by bamboo sticks set up in an X shape, and air was collected using the same system as for firn air sampling. The valve operations for air collection were the same as those used for firn air sampling. At both sites, sampling was conducted approximately 50 m upwind from the firn air sampling locations.*

Line 144: "a IRMS" --> "an IRMS"

Corrected.

Line 247–248, Ref. 1: Missing page numbers and DOI is duplicated.

Corrected.

Line 346, Ref. 27: Missing "Arctic Data archive System (ADS), Japan". Also, the year should be 2023 according to the website linked.

Corrected.

Line 349, Ref. 28: Delete "p." at the end.

Deleted.

---

2nd submission

Editor Start Date: 1/30/2025

Editor Stop Date: 2/12/2025

Reviewer #1 (2/5/2025–2/12/2025)

Reviewer #2 (2/4/2025–2/5/2025)

Handling editor comments to the Author: Naohiko Hirasawa

Dear Authors,

Thank you very much for the revised manuscript and data submission. I have submitted a proposal to the Editorial Board for acceptance of this paper.

Naohiko Hirasawa

Reviewer #1: Kyohei Yamada

The revisions made to the manuscript have significantly improved its clarity and readability. Thank you for your efforts in addressing the previous comments.

Reviewer #2: Anonymous

The authors have appropriately addressed all the reviewer comments on both the manuscript and the dataset. I have reviewed the additional data and the revised Figure 3. I recommend it for publication as is.

---

Editorial Office's note

Calculate checksum date: 3/26/2025

Algorithm: SHA256

Hash link: http://id.nii.ac.jp/1434/00000061 > hash list