



Supplement of

Snow depth distributions on sea ice of different ages and thicknesses from regional field campaigns

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S1 The distributions of SND and SIT

The snow depth (SND) and sea ice thickness (SIT) distributions of each transect over the study areas are given in Fig. S1 - S3.

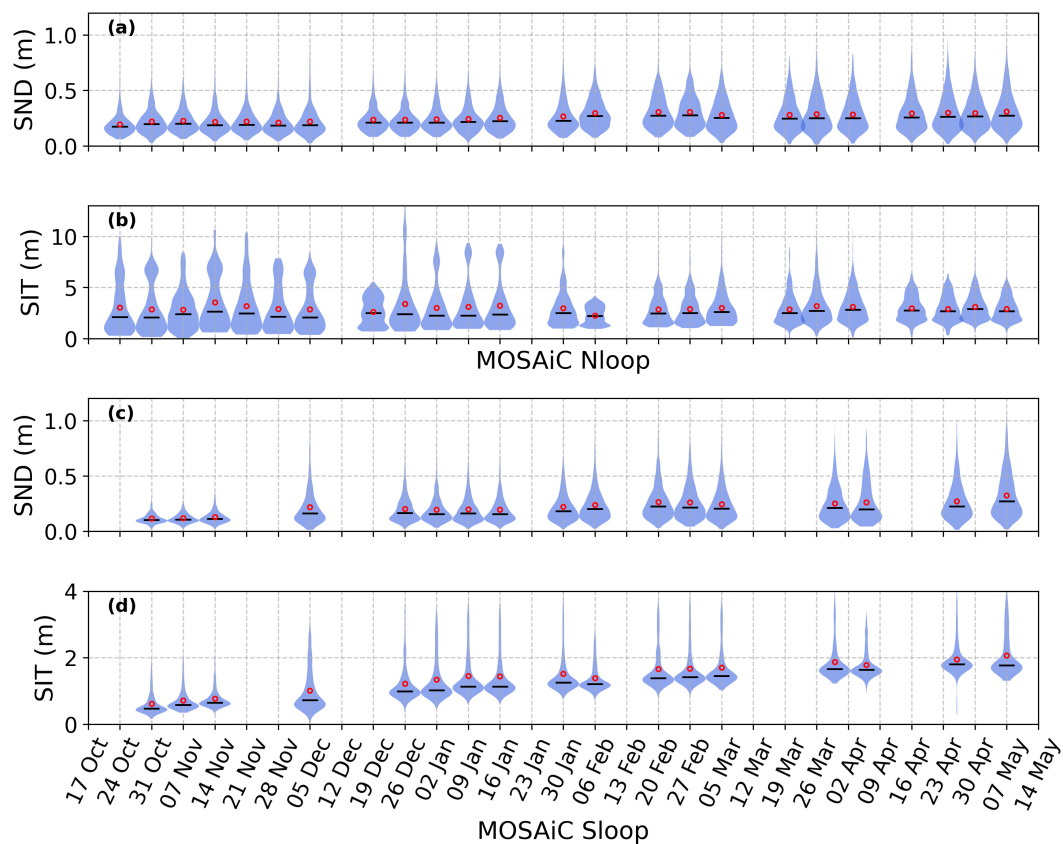


Figure S1. Violin plots of snow depth (SND) and sea ice thickness (SIT) for each transect from (a-b) MOSAiC northern loop (Nloop) and (c-d) MOSAiC southern loop (Sloop). The red dot and black line represent the mean and median values, respectively.

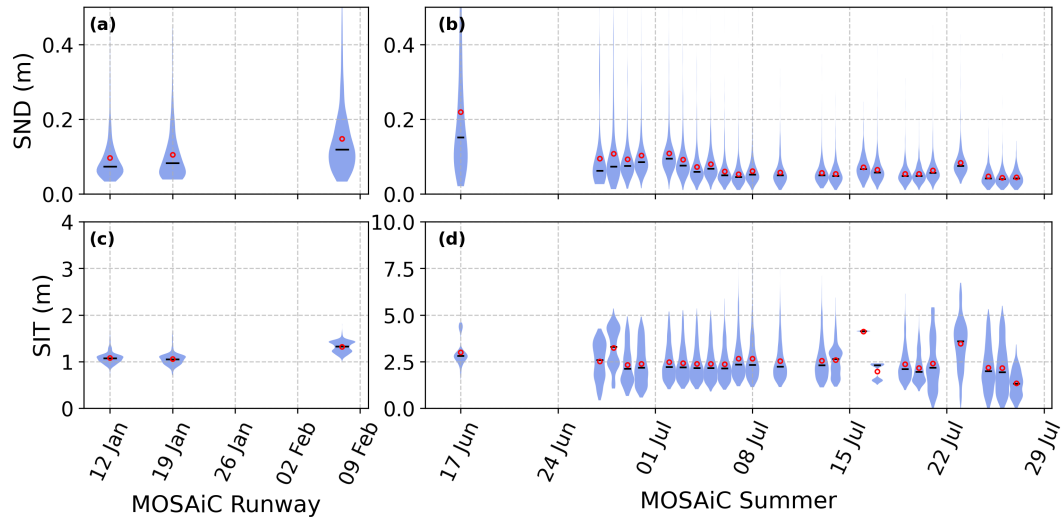


Figure S2. Violin plots of snow depth (SND) and sea ice thickness (SIT) for each transect from (a, c) MOSAiC Runway and (b, d) MOSAiC Summer. The red dot and black line represent the mean and median values, respectively.

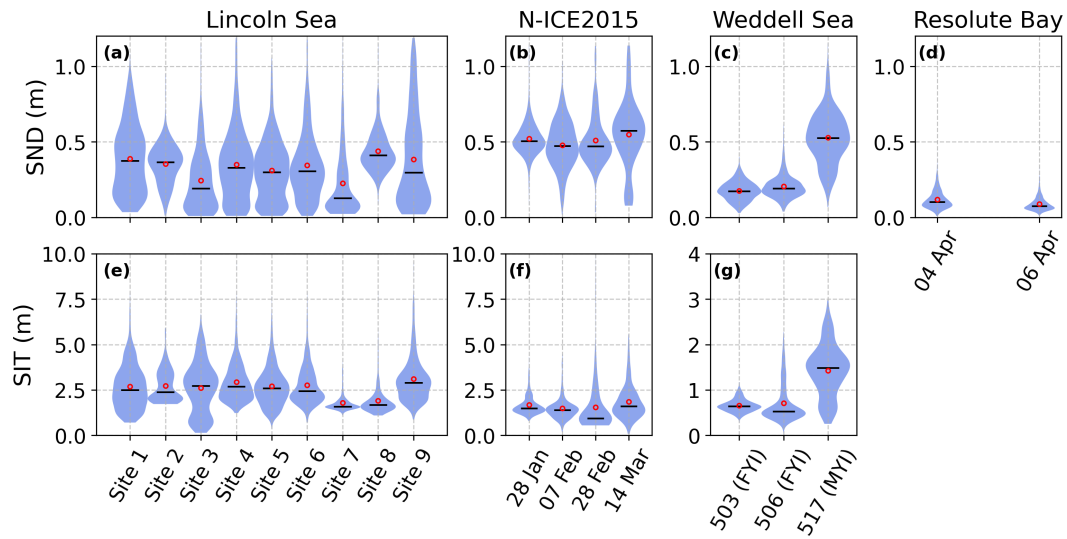


Figure S3. Violin plots of snow depth (SND) and sea ice thickness (SIT) for each transect from (a, e) Lincoln Sea, (b, f) N-ICE2015, (c, g) Weddell Sea, and (d) Resolute Bay. Note that there was no EM measurements of SIT over Resolute Bay. The red dot and black line represent the mean and median values, respectively.

S2 MOSAiC time-series transects

To enable effective time-series analysis of PDF fitting performance, we selected repeated measurements collected along the same transects from the MOSAiC dataset. The transects used in this study are listed in Table S1.

Table S1. The dates of the selected transects for the MOSAiC northern loop (Nloop), southern loop (Sloop), Runway, and Summer transects.

MOSAiC Nloop	MOSAiC Sloop	MOSAiC Runway	MOSAiC Summer
7 Nov 2019	31 Oct 2019	12 Jan 2020	29 Jun 2020
14 Nov 2019	7 Nov 2019	19 Jan 2020	30 Jun 2020
21 Nov 2019	14 Nov 2019	7 Feb 2020	2 Jul 2020
28 Nov 2019	5 Dec 2019		3 Jul 2020
5 Dec 2019	26 Dec 2019		4 Jul 2020
19 Dec 2019	2 Jan 2020		5 Jul 2020
26 Dec 2019	9 Jan 2020		6 Jul 2020
2 Jan 2020	16 Jan 2020		7 Jul 2020
9 Jan 2020	30 Jan 2020		8 Jul 2020
16 Jan 2020	6 Feb 2020		10 Jul 2020
30 Jan 2020	20 Feb 2020		13 Jul 2020
6 Feb 2020	27 Feb 2020		14 Jul 2020
20 Feb 2020	5 Mar 2020		16 Jul 2020
27 Feb 2020	30 Mar 2020		17 Jul 2020
5 Mar 2020	26 Apr 2020		19 Jul 2020
20 Mar 2020			20 Jul 2020
26 Mar 2020			21 Jul 2020
3 Apr 2020			25 Jul 2020
16 Apr 2020			26 Jul 2020
24 Apr 2020			
30 Apr 2020			
7 May 2020			

S3 PDF fitting performances

Observed SND histograms and fitted PDFs (skew, gamma, log-normal, and normal) for selected transects are shown in Fig. S4.

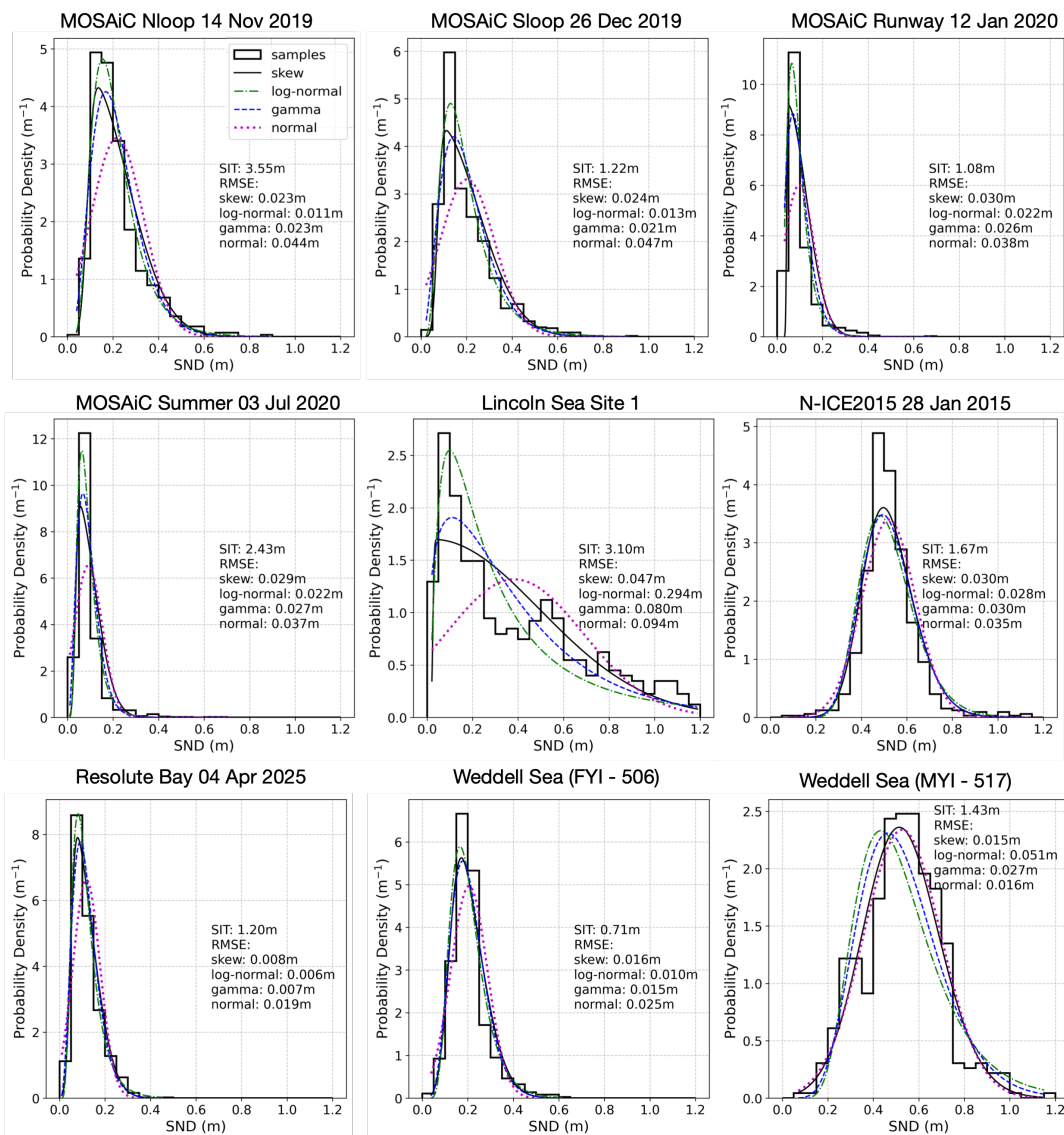


Figure S4. Display of the histograms and the fitted probability density functions (PDFs) over selected transects as examples. The histograms were generated with a bin width of 5 cm.

S4 Sea ice surface topography

The topography of the sea ice surface, represented by the total freeboard (the elevation of the snow-air interface relative to sea level), was measured using Airborne Laser Scanning (ALS) during MOSAic (Hutter et al., 2023). Here we present freeboard maps (Fig. S5g-j) for 25 December 2019 and 27 February 2020, co-located with SND and SIT measurements on 26 December 2019 and 27 February 2020, respectively.

The distributions of freeboard, SND, and SIT along the MOSAiC Nloop and Sloop transects are shown in Fig. S5a-f. For MOSAiC Nloop, the log-normal and skew distributions perform equally well on 26 December 2019, while the skew distribution provides the best fit on 27 February 2020 (see Fig. 8 in the article for goodness-of-fit details). For MOSAiC Sloop, the log-normal distribution performs best on 26 December 2019, whereas the best fit shifts to skew or gamma distributions on 27 February 2020.

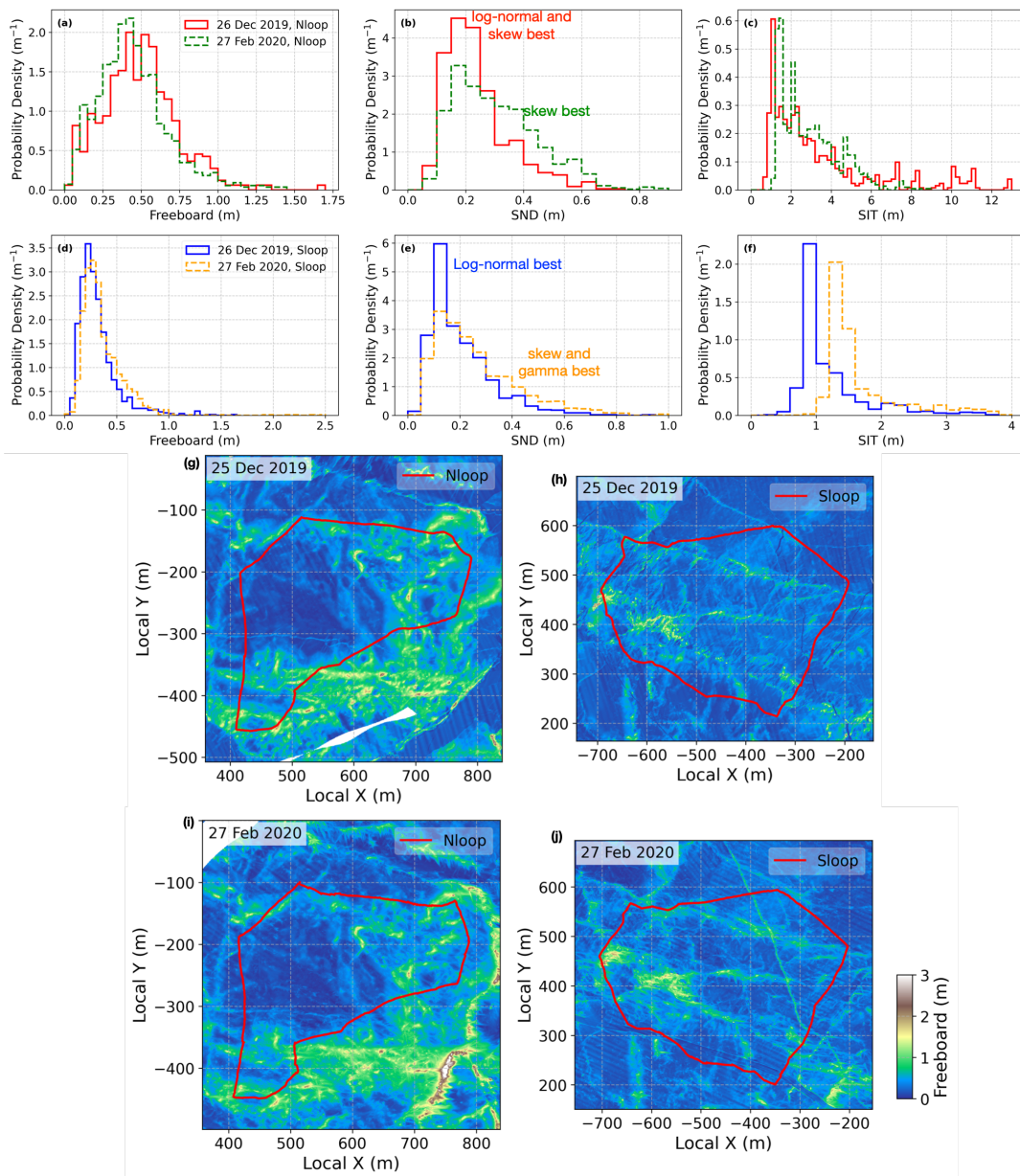


Figure S5. (a) and (d) Histograms for the freeboard along the transects measured by Airborne Laser Scanning (ALS) on 25 December 2019 and 27 February 2020, respectively. (b) and (e) Snow depth (SND) measured on 26 December 2019 and 27 February 2020, respectively. (c) and (f) Sea ice thickness (SIT) measured on 26 December 2019 and 27 February 2020, respectively. The freeboard and SND histograms were generated with a bin width of 5 cm, while the SIT histograms were generated with a bin width of 0.3 m. (g–j) ALS images of the sea ice topography (freeboard).

References

- Hutter, N., Hendricks, S., Jutila, A., Birnbaum, G., von Albedyll, L., Ricker, R., and Haas, C.: Merged grids of sea-ice or snow freeboard from helicopter-borne laser scanner during the MOSAiC expedition, version 1, <https://doi.org/10.1594/PANGAEA.950896>, 2023.