

Northern Hemisphere Continental Snow Cover Extent: 2023 Update

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Annual snow cover extent (SCE) over Northern Hemisphere (NH) lands averaged 24.3 million km² in 2023. This was 0.8 million km² (3.2%) below the full period-of-record (November 1966–December 2023) mean, marking the seventh-least-extensive cover on record. Monthly SCE in 2023 ranged from a maximum of 47.1 million km² in January to a minimum of 2.9 million km² in August.

NH SCE in January and March ranked in the lower tercile of the 57-year record (1.8% and 2.8% below normal, respectively), while February (−0.9%) and April (−0.7%) were in the middle. North America (NA) had more extensive snow cover compared to normal than Eurasia (EUR) during each of these four months. In particular, NA had its fourth-most-extensive SCE in March (+7.6%) and its 16th most extensive in April (+4.8%). Thereafter, melt quickly occurred across NA, with May having its least-extensive SCE of the satellite era (−19.5%). Both continents contributed to June having the sixth-least SCE across the NH (−35.6%).

Across the NH, September and October began the new snow season with SCE in the middle tercile (−1.0% and +0.9%, respectively). SCE was above normal for both continents in November (+3.6%). While SCE remained above normal over EUR in December (+2.1%), SCE in NA declined to its third least extensive for the month (−10.8%), contributing to the seventh-least-extensive SCE overall for the NH (−2.8%). The contiguous United States' (US) SCE (not shown) was close to normal at the beginning of 2023, then became well above normal in March (+45.6%; fourth most extensive) and April (+62.3%, seventh most extensive). In May, the US SCE was below average (−17.6%) while Canadian SCE (not shown) was the lowest on record (−30.7%). Autumn snow cover began early over the US and was the 11th most extensive on record for October (+68.6%), but for the remainder of the year, US SCE was below normal, with December having the sixth-least-extensive SCE on record (−43.4%).

SCE is calculated at the Rutgers Global Snow Lab (GSL) from daily SCE maps produced by meteorologists at the US National Ice Center, who rely primarily on visible satellite imagery to construct the maps (Estilow et al. 2015). Maps depicting daily, weekly, and monthly conditions, anomalies, and climatologies may be viewed at the GSL website (<https://snowcover.org>).

Reference

Estilow, T. W., A.H. Young, and D.A. Robinson (2015) A long-term Northern Hemisphere snow cover extent data record for climate studies and monitoring. *Earth Syst. Sci. Data*, 7, 137–142, doi:10.5194/essd-7-137-2015.

Figures

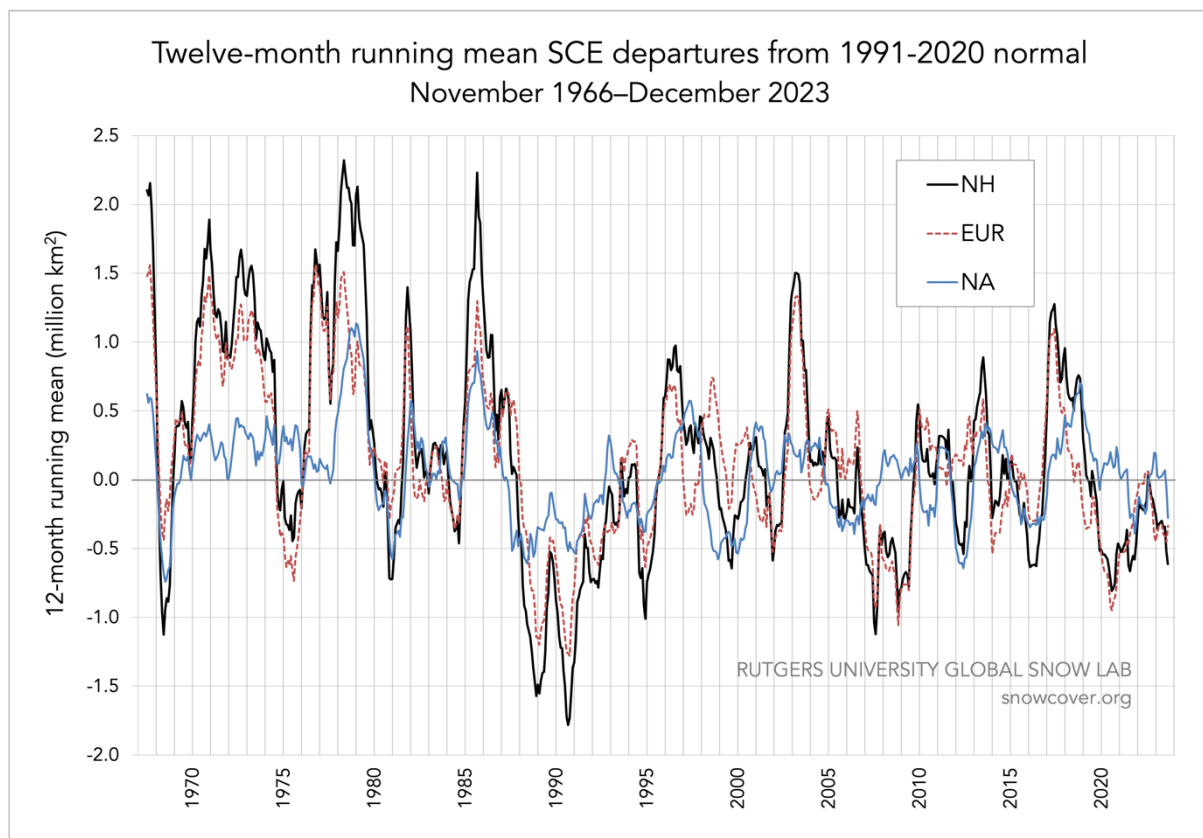


Figure 1. Twelve-month running anomalies of monthly SCE over NH lands as a whole and EUR and NA separately plotted on the 7th month using values from November 1966 to December 2023. Anomalies are calculated from NOAA snow maps. Mean NH SCE is 25.1 million km² for the full period of record. Monthly means for the period of record are used for 9 missing months during 1968, 1969, and 1971 to create a continuous series of running means. Missing months fall between June and October.

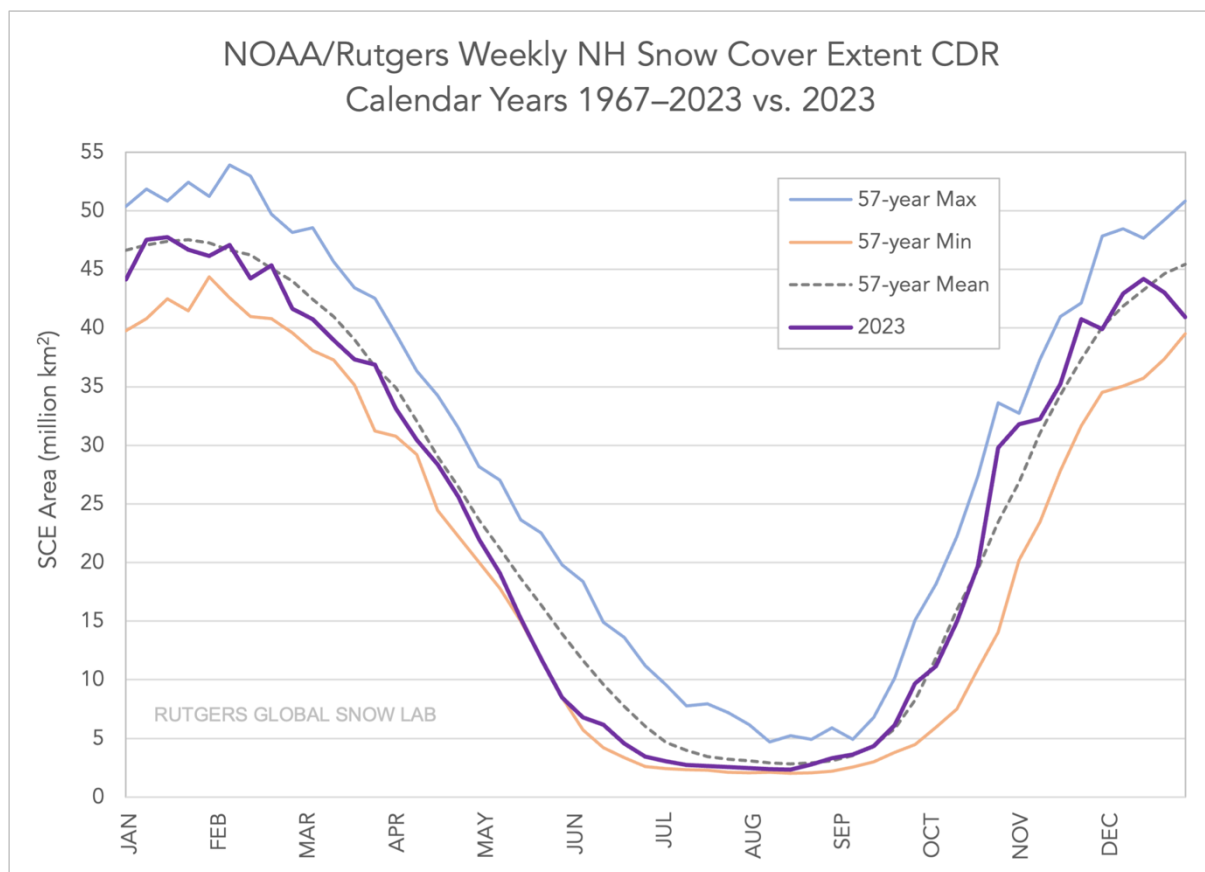


Figure 2. Weekly NH SCE for 2023 (purple) plotted with the mean (grey dashed line), maximum (blue), and minimum (orange) SCE for each week. Mean weekly SCE and extremes are calculated using the 57-year record from January 1967–December 2023. Weekly data granules represent SCE for each 7-day period ending on Monday.

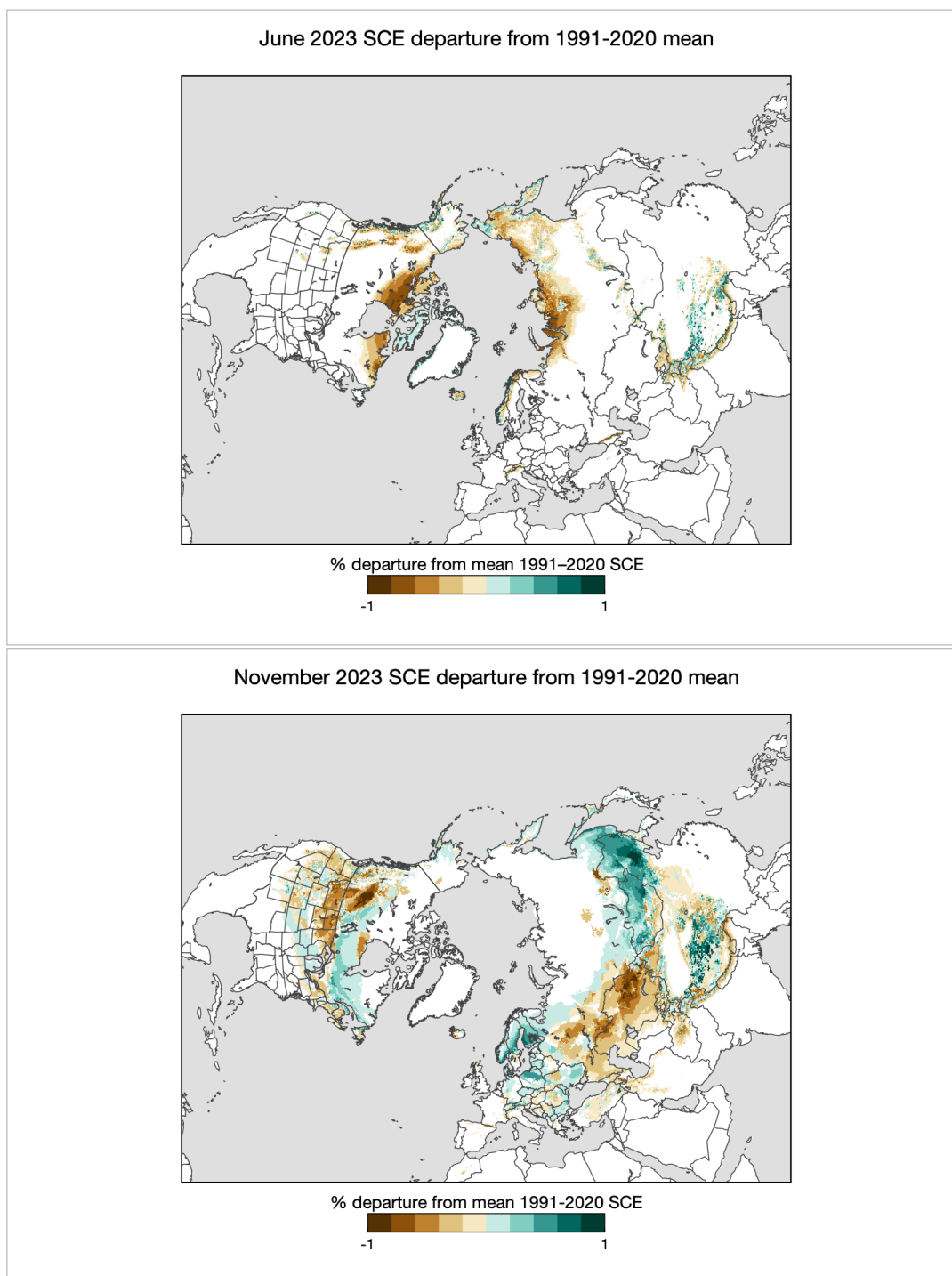


Figure 3. Monthly SCE departure maps showing June (top) and November (bottom). June exhibited the lowest SCE anomaly (-2.17 million km²) during 2023, while November was the highest above normal (+0.53 million km²). Mean monthly SCE calculated using the 30-year span from 1991–2020. Negative departures indicate less SCE than normal (brown) with positive departures (green) showing areas of SCE above the 30-year mean.

Table

	Yrs.	2023 NH Anomaly ($\times 10^6 \text{km}^2$)	NH Mean ($\times 10^6 \text{km}^2$)	NH Std. Dev.	2023 NH Rank	2023 Eurasia Rank	2023 NA Rank
Jan	57	-0.9	47.1	1.5	41 (17)	48 (10)	27 (31)
Feb	57	-0.4	45.9	1.8	32 (26)	37 (21)	24 (34)
Mar	57	-1.1	40.4	1.8	43 (15)	52 (6)	4 (54)
Apr	57	-0.2	30.5	1.6	28 (30)	43 (15)	16 (42)
May	57	-2.3	19.0	2.0	50 (8)	35 (23)	57 (1)
Jun	56	-3.3	9.3	2.5	50 (7)	46 (11)	53 (4)
Jul	54	-1.0	3.8	1.2	44 (11)	42 (13)	41 (14)
Aug	55	-0.4	2.9	0.7	39 (17)	39 (17)	29 (27)
Sep	55	-0.1	5.4	0.9	28 (28)	22 (34)	33 (23)
Oct	56	+0.2	18.6	2.6	25 (32)	24 (33)	28 (29)
Nov	58	+1.2	34.4	2.1	17 (42)	16 (43)	28 (31)
Dec	58	-1.2	43.7	1.8	48 (11)	18 (41)	56 (3)
Ann	54	-0.8	25.1	0.8	48 (7)	45 (10)	45 (10)

Table. Monthly and annual climatological information on NH, EUR, and NA SCE between November 1966 and December 2023. Included are the numbers of years with data used in the calculations, NH anomalies, NH means, NH standard deviations, and rankings. Areas are in millions of square kilometers. 1968, 1969, and 1971 have 1, 5, and 3 missing months respectively, thus are not included in the annual (Ann) calculations. NA includes Greenland. Ranks are from most to least extensive (least to most in parentheses).

Dataset used

Robinson, D.A., Estilow, T.W., and NOAA CDR Program, 2012: NOAA Climate Data Record (CDR) of Northern Hemisphere (NH) Snow Cover Extent (SCE), Version 1. NOAA National Centers for Environmental Information. doi:10.7289/V5N014G9.

- <https://snowcover.org>

Acknowledgement

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Summary bullet points

- Annual snow cover extent (SCE) over NH lands averaged 24.3 million km² in 2023. This is 0.6 million km² less than the 1991-2020 average and ranks as the 48th most extensive cover on record during the satellite era.
- SCE continues a general trend of early spring melt, particularly at higher latitudes, while fall and early winter SCE continues a recent decadal run of above normal conditions.