Heavy snowfall in Japan on the Sea of Japan side and elsewhere in late 2021 and early 2022

1 February 2022
Tokyo Climate Center, Japan Meteorological Agency
https://ds.data.jma.go.jp/tcc/tcc

Summary

- From late December 2021 to early January 2022, a series of heavy snowfall events hit Japan on the Sea of Japan side and elsewhere, bringing unprecedented snowfall for this period in the Kinki region and other areas. For example, a 48-hour snowfall record of 78 cm was set at Hikone in Shiga Prefecture.
- These conditions are partly attributed to continuous cold air inflow over the country due to southward meandering of the polar front jet stream around Japan in association with a blocking high over western Siberia.

1. Climate

From late December 2021 onward, cold air from Siberia flowed into the vicinity of Japan in association with an intensified East Asian winter monsoon. This caused heavy snowfall on the Sea of Japan side from northern to western parts of the country and elsewhere (Figures 1-1, 1-2, 1-3, 1-4, 1-5, 1-6 and A1). New 48-hour snowfall records were set at five observation stations (Table 1-1).

Snowfall on the Sea of Japan side of the Kinki region in December was 504% of the normal, which was the second-highest for December after 2005 (640% of the normal) (Figure A1).

The average temperature during the period was also lower than normal nationwide.

2. Contributory factors

The primary factors contributing to these climate conditions are illustrated in Figure 2-1.

The heavy snowfall and low temperatures observed are partly attributed to southward meandering of the polar front jet stream (PFJ) around Japan, which resulted in continuous cold air flow over the region. The polar vortex in the troposphere, which is usually located over the Arctic region, was disrupted in association with this meandering and split into three parts. One split vortex moved southward to the north of Japan and brought masses of intensely cold polar air to the area. Cold air inflow from the Asian continent to the vicinity of western Japan around 26 December 2021 was particularly strong for December (Figure 2-2).

The southward meandering of the PFJ around Japan was likely influenced by a blocking

high over western Siberia and Rossby wave packet propagation from Europe. The subtropical jet stream during this period also meandered northward over the west of Japan and southward over eastern parts, creating favorable atmospheric circulation conditions for southward inflow of cold air over the country. Such meandering over Asia may be attributable to anomalous convective activity, which was suppressed over the Indian Ocean and enhanced over and around the Philippines in association with the prevailing La Niña event.

This analysis was performed in collaboration with the TCC Advisory Panel on Extreme Climatic Events (a JMA body staffed by prominent climatologists from the fields of academia and research).

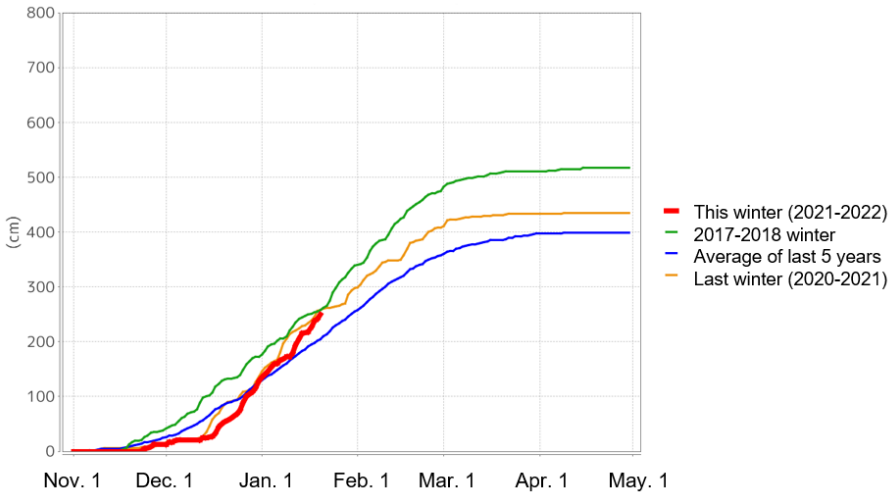

Figure 1-1. Average cumulative snowfall [cm] in regions designated under the Act on Special Countermeasures for Heavy Snowfall Areas (1 November 2021 – 20 January 2022)

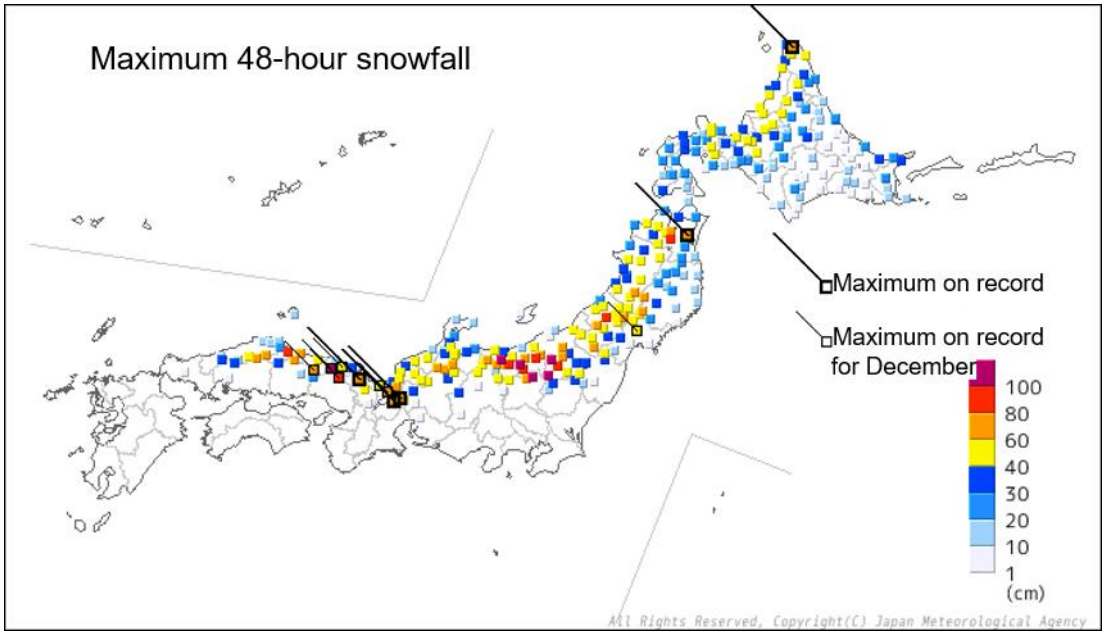

Figure 1-2. Maximum 48-hour snowfall [cm] for 25 December 2021 – 4 January 2022

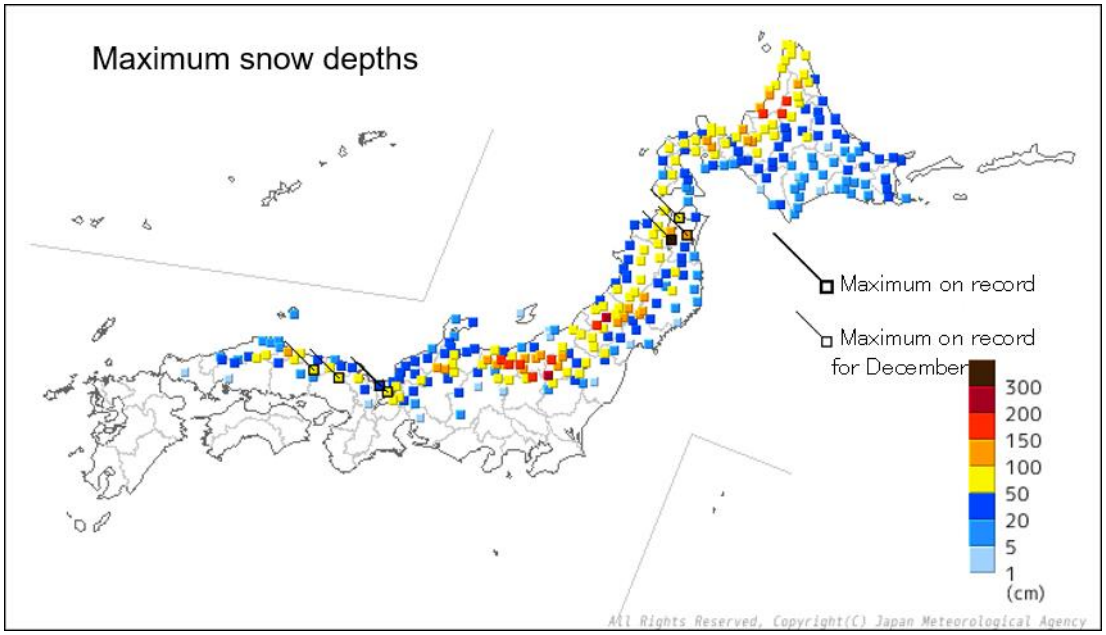

Figure 1-3. Maximum snow depths [cm] for 25 December 2021 – 4 January 2022

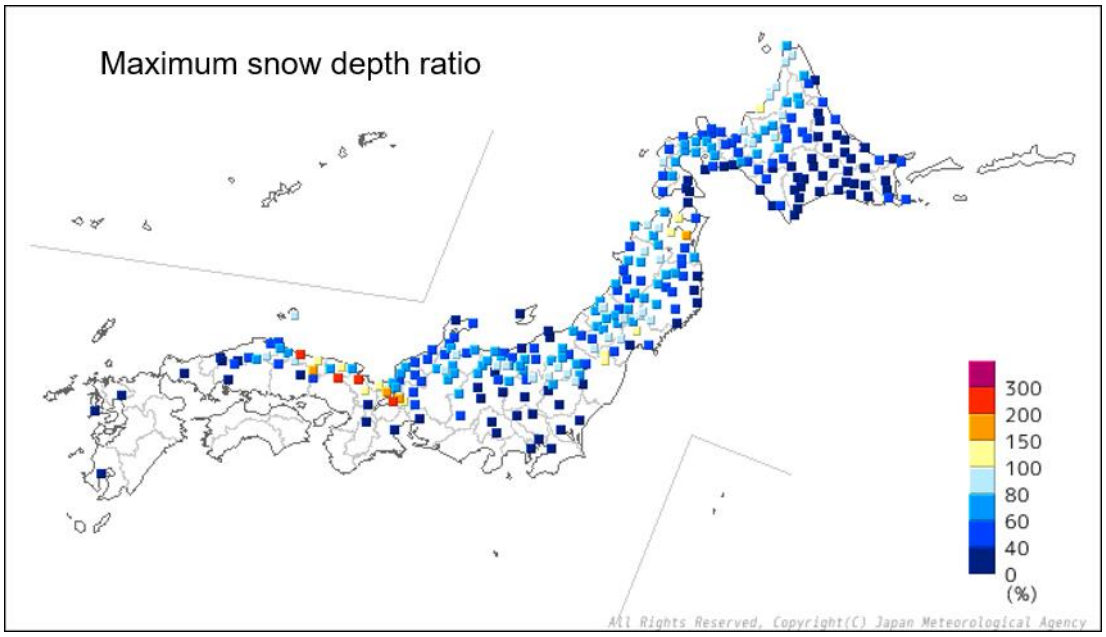

Figure 1-4. Ratio of maximum snow depth for 25 December 2021 – 4 January 2022 to the climatological normal of annual maximum snow depth [%]

The base period for the normal is 1991 – 2020.

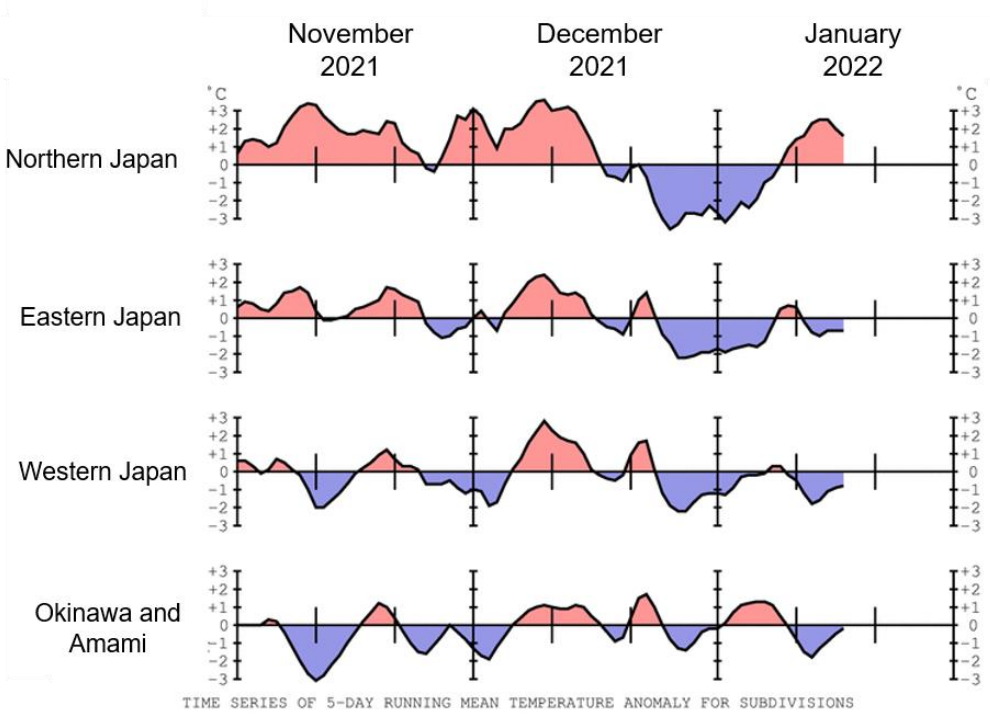

Figure 1-5. Time-series representations of 5-day running mean temperature anomalies [°C] for November 2021 – January 2022

The base period for the normal is 1991 – 2020.

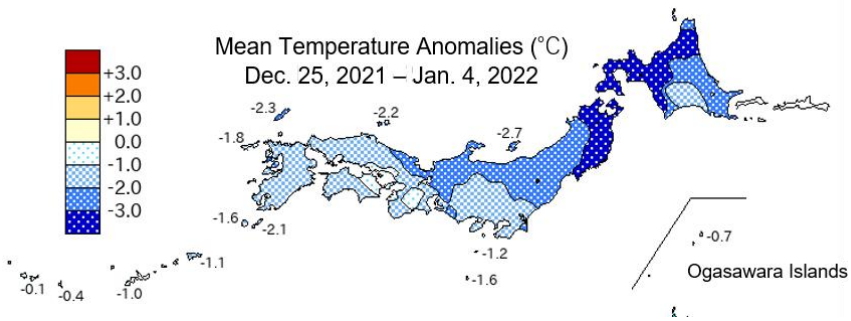

Figure 1-6. Distribution of mean temperature anomalies [°C] for 25 December 2021 – 4 January 2022

The base period for the normal is 1991 – 2020.

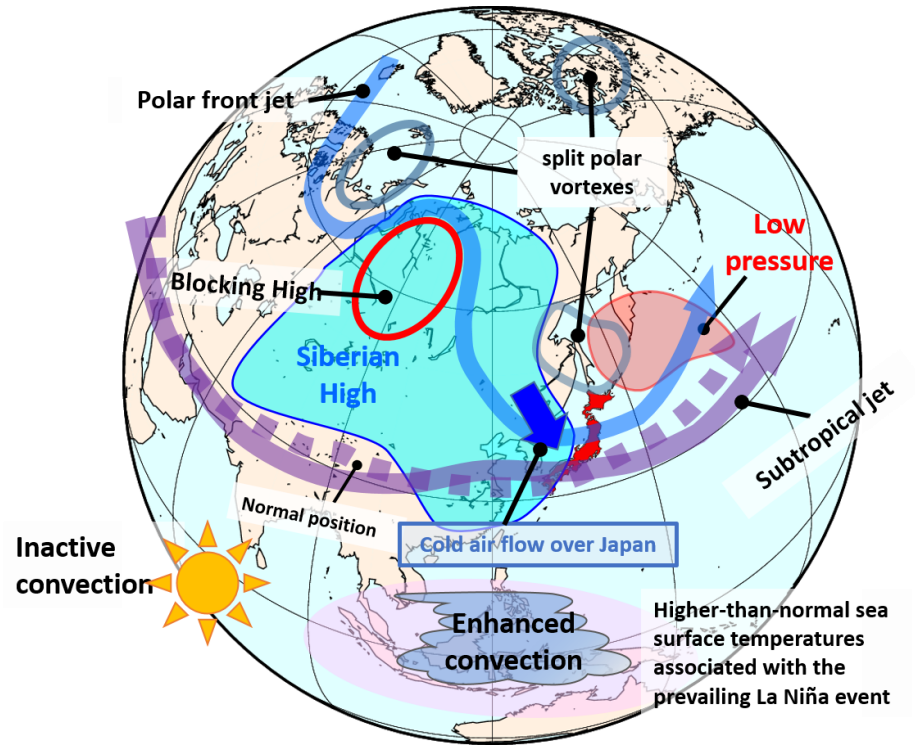

Figure 2-1. Characteristics of atmospheric circulation bringing heavy snowfall and low temperatures to Japan from late December 2021 to early January 2022

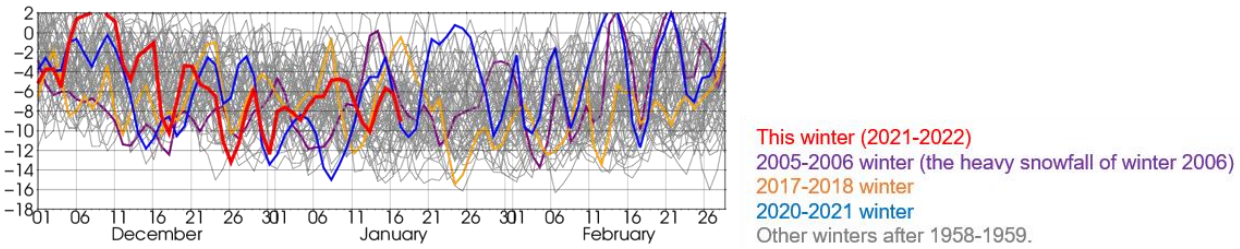

Figure 2-2. Time-series representation of 850 hPa temperature (approx. 1,500 m) over Japan (30 – 45°N, 125 – 145°E) from December 2021 onward

The temperature on 26th December was the ninth lowest for December since 1958.

Table 1.1 Record-high snowfall locations[1] 25 December 2021 – 4 January 2022

3-hour snowfall records

Prefecture	Location	Observation (cm)	Previous record (cm) (year)	Start of observation	Description
Aomori	Goshogawara (五所川原)	21	21 (1996)	1979	Joint record-high
Shiga	Maibara (米原)	16	16 (2018)	2001	Joint record-high

6-hour snowfall records

Prefecture	Location	Observation (cm)	Previous record (cm) (year)	Start of observation	Description
Hokkaido	Iwamizawa(岩見沢)	36	30 (2011)	1999	
Tottori	Chizu (智頭)	43	42 (2017)	1981	

12-hour snowfall records

Prefecture	Location	Observation (cm)	Previous record (cm) (year)	Start of observation	Description
Niigata	Tsugawa (津川)	54	53 (2003)	1980	
Shiga	Hikone (彦根)	37	36 (2017)	2001	
Hyogo	Wadayama (和田山)	43	43 (2020)	1981	Joint record-high

24-hour snowfall records

Prefecture	Location	Observation (cm)	Previous record (cm) (year)	Start of observation	Description
Shiga	Hikone (彦根)	68	44 (2012)	2001	
Hyogo	Wadayama (和田山)	71	64 (2000)	1981	

[1] https://www.data.jma.go.jp/obd/stats/data/mdrr/periodstat/index.htmll

Table 1.1 Record-high snowfall locations 25 December 2021 – 4 January 2022 (Continued)

48-hour snowfall records

Prefecture	Location	Observa-tion (cm)	Previous record (cm) (year)	Start of observa-tion	Description
Hokkaido	Koetoi (声問)	76	67 (2013)	2006	
Aomori	Noheji (野辺地)	66	54 (2010)	2008	
Shiga	Maibara (米原)	74	63 (2012)	2001	
Shiga	Hikone (彦根)	78	65 (2017)	2001	
Kyoto	Maizuru (舞鶴)	71	62 (2012)	2001	

72-hour snowfall records

Prefecture	Location	Observa-tion (cm)	Previous record (cm) (year)	Start of observa-tion	Description
Hokkaido	Koetoi (声問)	92	78 (2013)	2006	
Aomori	Noheji (野辺地)	85	57 (2021)	2008	
Shiga	Hikone (彦根)	79	66 (2017)	2001	
Kyoto	Maizuru (舞鶴)	71	67 (2005)	2001	

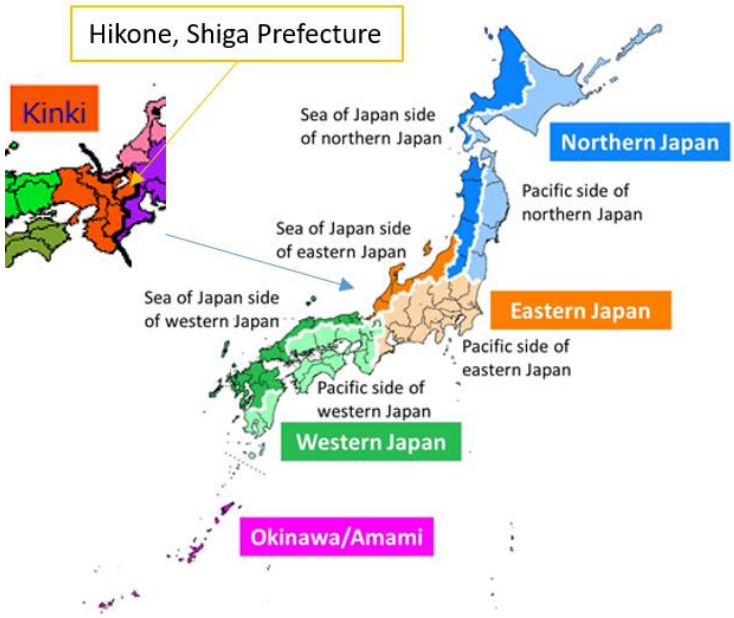

Figure A1. Climatological regions of Japan
JMA's seven regional divisions for climate monitoring and forecasting (the Sea of Japan and Pacific sides of northern, eastern and western Japan, and Okinawa/Amami)