Seasonal Highlights on the Climate System (December 2023 – February 2024)

Highlights (December 2023 – February 2024)

- Oceanic indicators suggest that ongoing El Niño conditions in the equatorial Pacific have already peaked and are now gradually weakening (see El Niño Outlook updated on 11 March 2024).
- Seasonal mean temperatures were significantly above normal nationwide. The seasonal anomaly of the average temperature over Japan was +1.27°C (the second highest for the season since 1898).
- The seasonal anomaly of the global average surface temperature was +0.68°C (the warmest for the season since 1891).
- Seasonal mean temperatures were extremely high from Honshu to Kyushu region of Japan, from Southeast Asia to the southwestern Indian Ocean, in the central Arabian Peninsula, from southeastern Europe to the eastern South Atlantic, from northern to eastern Canada, from northern to eastern South America, from central to southern South America, and from central Polynesia to eastern Australia.
- Convective activity was enhanced over the equatorial Pacific and over the western Indian Ocean, and suppressed from the eastern Indian Ocean to Indonesia.
- In the 500-hPa height field, the polar vortex in the Northern Hemisphere split with positive anomalies over the northern polar region and negative anomalies over Europe and from Eastern Siberia to Alaska. Wave trains were dominant over the Northern Hemisphere mid-latitudes with positive anomalies over northeastern North America, northwestern Northern Africa and from Japan to the east. Zonally-elongated negative anomalies over the mid-latitude western Hemisphere.
- The subtropical jet stream shifted southward from its normal position over eastern Eurasia. The polar-front jet stream was clear from Eurasia to the north of Japan. The westerly jet stream shifted southward from its normal position over North America.

Climate in Japan (Fig. S1):

- Seasonal temperatures were significantly above normal nationwide due to weaker-than-normal winter monsoon, and warm air inflow mainly in February. The seasonal anomaly of the average temperature over Japan was +1.27°C (the second highest for the season since 1898).
- Seasonal precipitation amounts were above normal on the Sea of Japan side of eastern Japan due to stronger influences of winter monsoon and low-pressure systems mainly in December, and on the Sea of Japan side and on the Pacific side of western Japan due to stronger influences of low-pressure systems and fronts in February. On the other hand, they were below normal in Okinawa/Amami due to weaker influences of low-pressure systems and fronts.
- Seasonal sunshine durations were above normal on the Sea of Japan side of northern/eastern Japan, on the Pacific side of northern Japan, and Okinawa/Amami, due to weaker-than-normal winter monsoon and so on.

World Climate (Fig. S2):

- Seasonal mean temperatures were extremely high from Honshu to Kyushu region of Japan, from Southeast Asia to the southwestern Indian Ocean, in the central Arabian Peninsula, from southeastern Europe to the eastern South Atlantic, from northern to eastern Canada, from northern to eastern South America, from central to southern South America, and from central Polynesia to eastern Australia.
- Seasonal precipitation amounts were extremely high in the Korean Peninsula, from southeastern Mongolia to northern China, from northern Central Asia to western Europe, and in southern Mexico.
- Seasonal precipitation amounts were extremely low in Italy, from southeastern Spain to northwestern Algeria, and in southern Brazil.

Oceanographic Conditions (Fig. S3)**:**

- In the equatorial Pacific, positive SST anomalies were observed in almost the entire region, with remarkably positive anomalies from the central to eastern parts.
- In the North Pacific, remarkably positive anomalies were observed from the western to central mid-latitudes.
- In the South Pacific, remarkably positive anomalies were observed over a wide area of tropical regions. In the subtropics, remarkably positive and negative anomalies were observed in the western and from the central to eastern parts, respectively.
- In the Indian Ocean, remarkably positive anomalies were observed in almost the entire region, with particularly large anomalies in the western part of the tropics.
- In the North Atlantic, remarkably positive anomalies were widely observed.

Tropics:

- Convective activity was enhanced over the equatorial Pacific and over the western Indian Ocean, and suppressed from the eastern Indian Ocean to Indonesia (Fig. S4).
- In the upper troposphere, anti-cyclonic circulation anomalies straddling the equator were seen from the central to eastern parts of the tropical Pacific, and a wave train was seen along the subtropical jet stream, with anticyclonic circulation anomalies over the Mediterranean Sea, the Arabian Sea and from Japan to the east, and cyclonic circulation anomalies over the North Africa and China (Fig. S5).
- In the lower troposphere over the tropical area, anti-cyclonic circulation anomalies straddling the equator were seen from the eastern Indian Ocean to the Maritime Continent.
- In the sea level pressure field over the tropical area, positive anomalies were seen from the central Indian Ocean to the central Pacific, and negative anomalies were seen over the western Indian Ocean and over the eastern Pacific.

Extratropics:

- In the 500-hPa height field (Fig. S6), the polar vortex in the Northern Hemisphere split with positive anomalies over the northern polar region and negative anomalies over Europe and from Eastern Siberia to Alaska. Wave trains were dominant over the Northern Hemisphere mid-latitudes with positive anomalies over northeastern North America, northwestern Northern Africa and from Japan to the east. Zonally-elongated negative anomalies over the mid-latitude western Hemisphere.
- The subtropical jet stream shifted southward from its normal position over eastern Eurasia. The polar-front jet stream was clear from Eurasia to the north of Japan. The westerly jet stream shifted southward from its normal position over North America (Fig. S7).
- In the sea level pressure field (Fig. S8), positive anomalies were seen from Central Siberia to the seas east of Japan and negative anomalies were seen over Europe and from Alaska to North America. The Siberian High was stronger than normal in the northeastern part, and the Aleutian Low was stronger than normal in the northeastern part.
- Temperatures at 850-hPa were above normal over northern North America, from the southern North Atlantic to Central Asia and over Japan, and below normal over Eastern Siberia (Fig. S9).

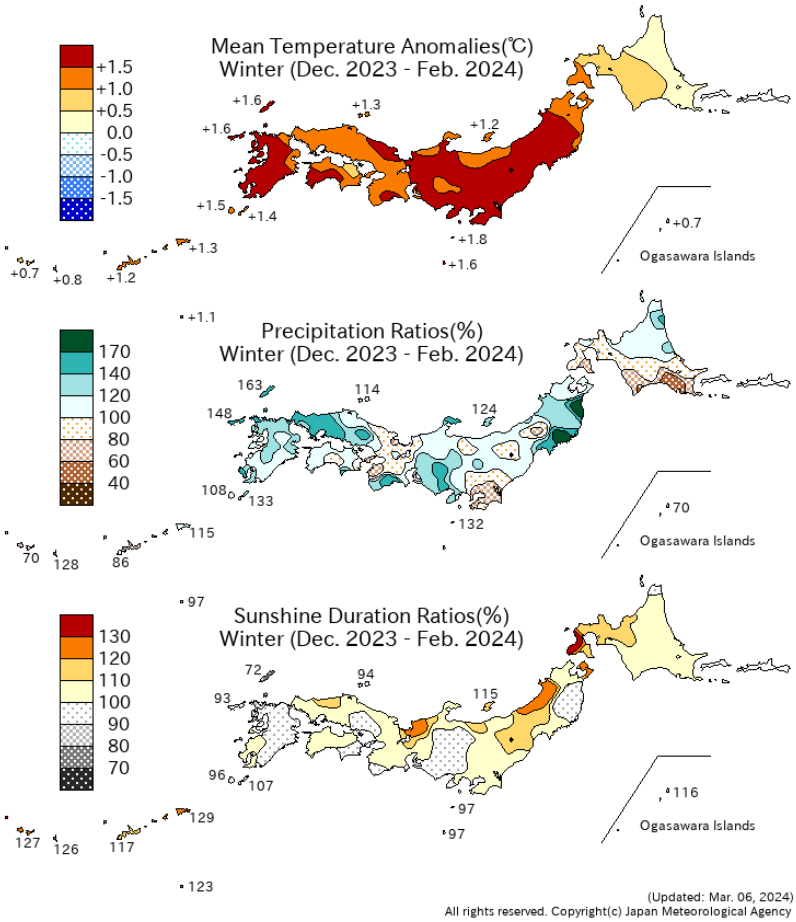

Fig. S1 Seasonal climate anomaly/ratio over Japan (December 2023 – February 2024)
Top: temperature anomalies (degree C)
Middle: precipitation ratio (%)
Bottom: sunshine duration ratio (%)
The base period for the normal is 1991-2020.

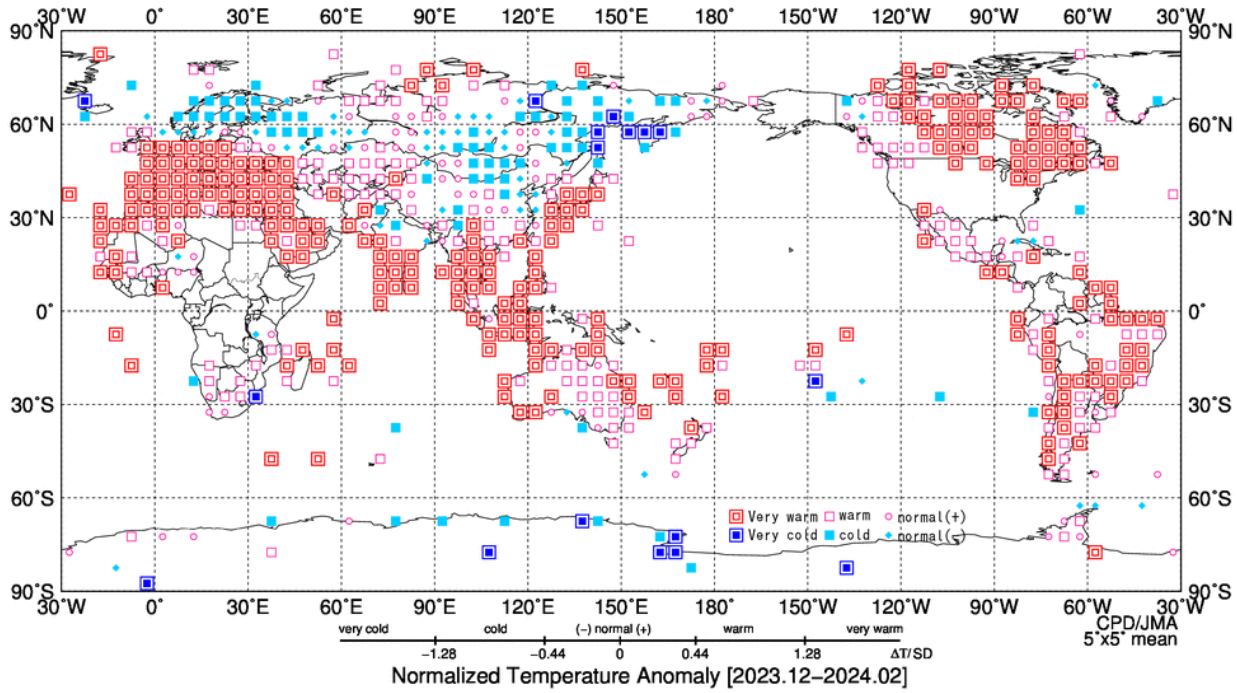

Fig. S2 Three-month mean temperature anomaly (normalized) category (December 2023 – February 2024)

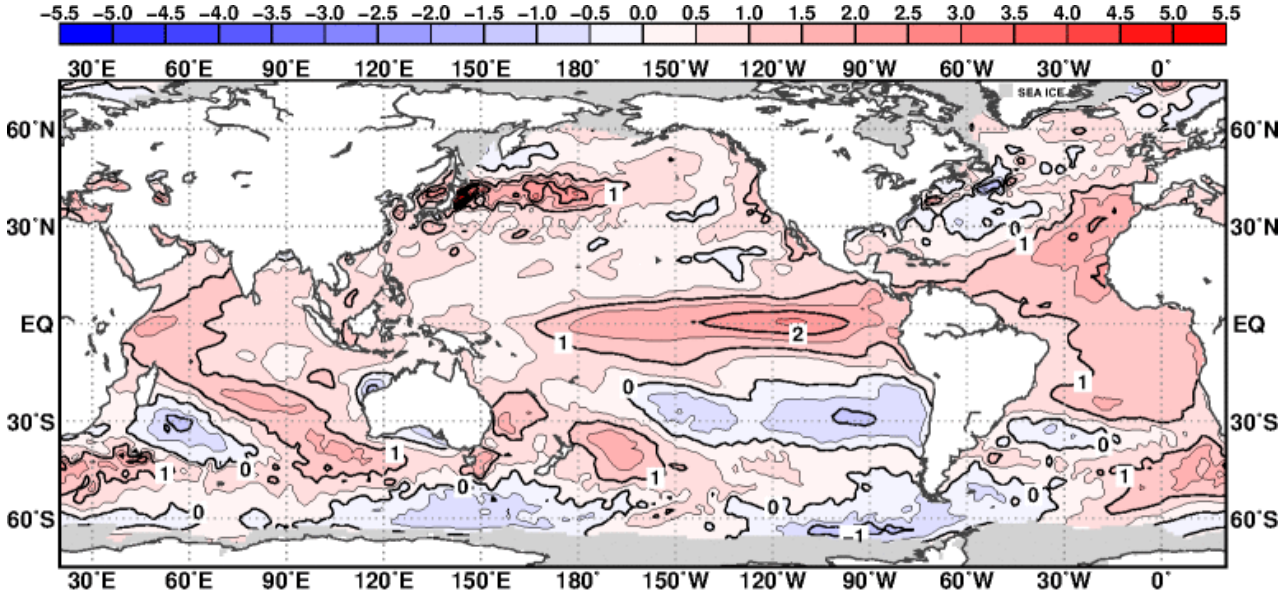

Fig. S3 Three-month mean sea surface temperature anomaly (December 2023 – February 2024)
The contour interval is 0.5 degree C. The base period for the normal is 1991-2020. Maximum coverage with sea ice is shaded in gray.

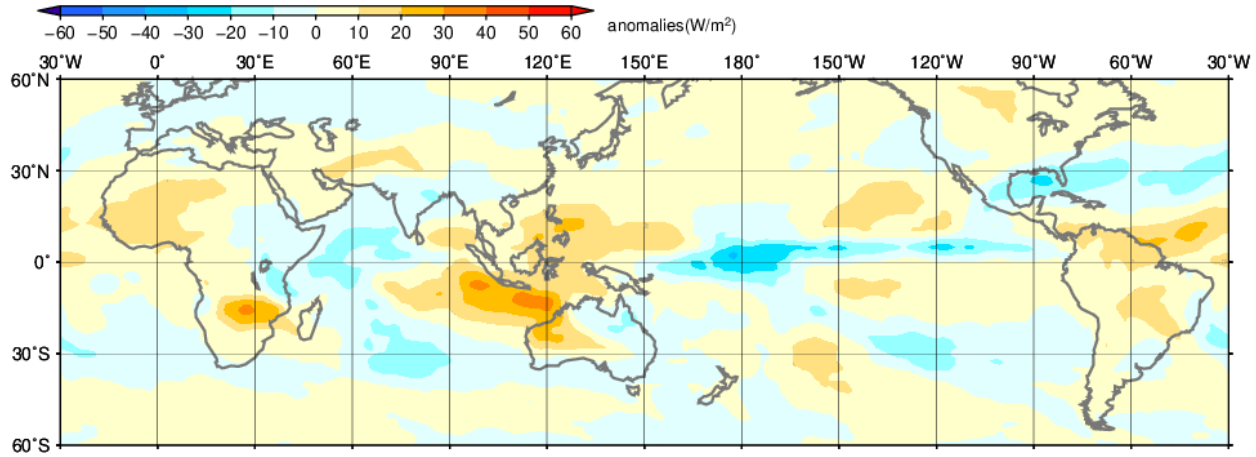

Fig. S4 Three-month mean Outgoing Longwave Radiation (OLR) anomaly (December 2023 – February 2024)
The shading interval is 10 W/m^2. The base period for the normal is 1991-2020. Original data (CPC Blended OLR) provided by NOAA.

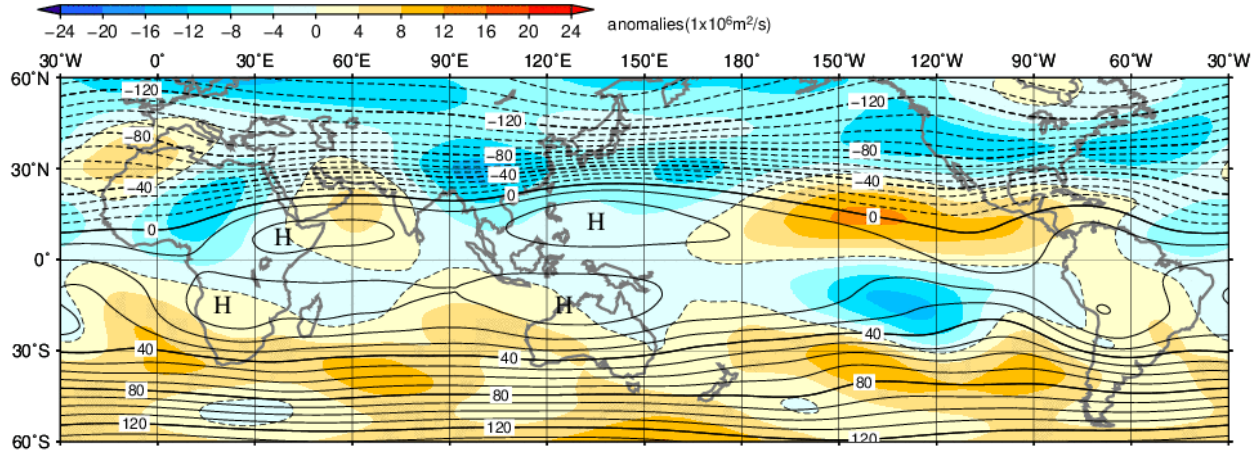

Fig. S5 Three-month mean 200-hPa stream function and anomaly (December 2023 – February 2024)
The contour interval is 10x10^6 m^2/s. The base period for the normal is 1991-2020.

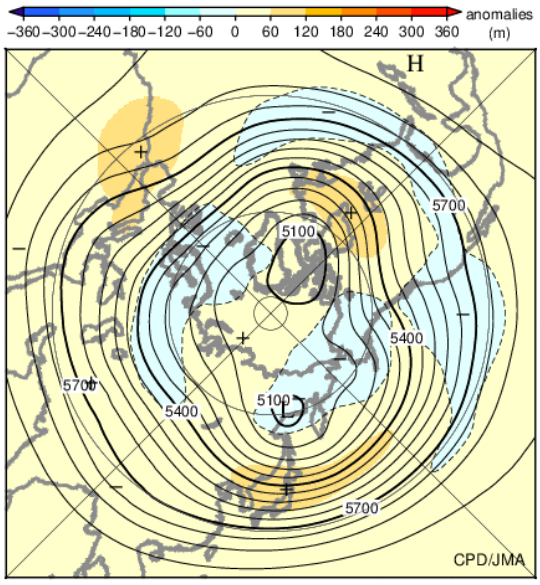

Fig. S6 Three-month mean 500-hPa height and anomaly in the Northern Hemisphere (December 2023 – February 2024)

The contours show 500-hPa height at intervals of 60 m. The shading indicates its anomalies. The base period for the normal is 1991-2020.

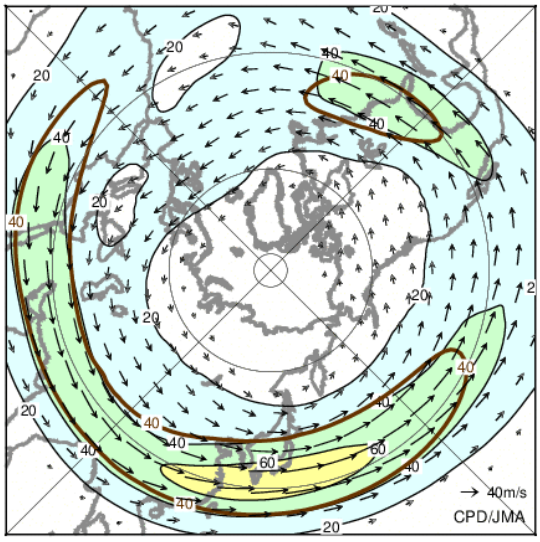

Fig. S7 Three-month mean 200-hPa wind speed and vectors in the Northern Hemisphere (December 2023 – February 2024)

The black lines show wind speed at intervals of 20 m/s. The brown lines show its normal at intervals of 40 m/s. The base period for the normal is 1991-2020.

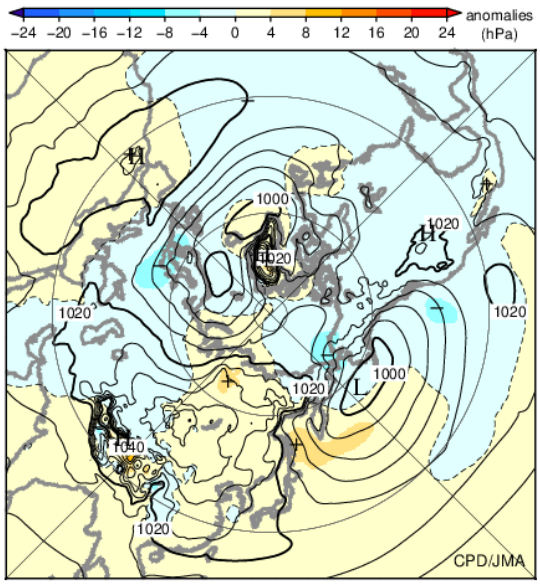

Fig. S8 Three-month mean sea level pressure and anomaly in the Northern Hemisphere (December 2023 – February 2024)

The contours show sea level pressure at intervals of 4 hPa. The shading indicates its anomalies. The base period for the normal is 1991-2020.

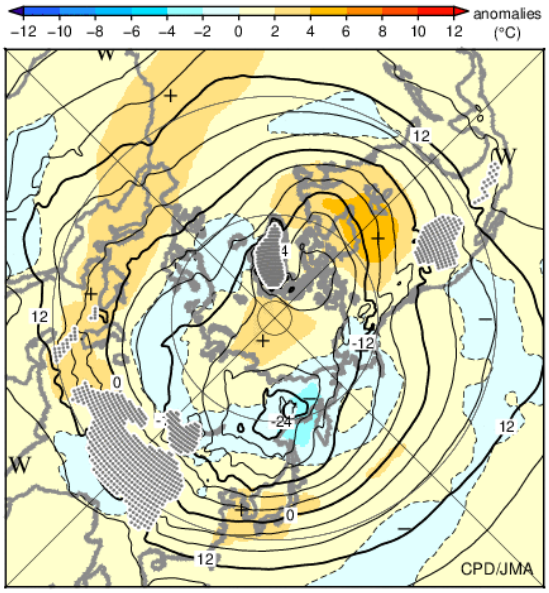

Fig. S9 Three-month mean 850-hPa temperature and anomaly in the Northern Hemisphere (December 2023 – February 2024)

The contours show 850-hPa temperature at intervals of 4 degree C. The shading indicates its anomalies. The base period for the normal is 1991-2020.

Detailed information on the climate system is available on the Tokyo Climate Center's website.
https://www.data.jma.go.jp/tcc/tcc/index.html
This report is prepared by the Tokyo Climate Center, Climate Prediction Division, Atmosphere and Ocean Department, Japan Meteorological Agency.