Monthly Highlights on the Climate System (December 2016)

Highlights in December 2016
- The monthly anomaly of the global average surface temperature was the second highest since 1891.
- La Niña event is coming close to its end (see *El Niño Outlook* updated on 11 January 2017).
- Convective activity was enhanced over the area from the eastern part of the Bay of Bengal to the southern Indochina Peninsula, from Indonesia to the Philippines and the latitude bands of 10°N to 15°N in the central Pacific.
- The zonal mean westerly jet streams were stronger than normal north of their normal position in both hemispheres.
- In and to the south of eastern Japan, monthly mean temperatures were significantly above normal due to weak winter monsoon.

Climate in Japan:

Since developing low pressures occasionally passed through Japan, monthly precipitation amounts were significantly above normal in the Pacific side of eastern Japan and in western Japan. In northern Japan, while monthly mean temperatures were near normal, the variation of temperature was large. In and to the south of eastern Japan, monthly mean temperatures were significantly above normal due to weak winter monsoon. In particular, monthly mean temperatures were the highest on record for December since 1946 in Okinawa/Amami. In Hokkaido region, though monthly snowfall amounts were near normal, some places occasionally experienced heavy snow. In other regions, monthly snowfall amounts were below normal, since cold air outbreaks were weak.

World Climate:

The monthly anomaly of the global average surface temperature in December 2016 (i.e., the combined average of the near-surface air temperature over land and the SST) was +0.34°C (2nd warmest since 1891) (preliminary value) (Fig. 2). On a longer time scale, global average surface temperatures have risen at a rate of about 0.75°C per century in December (preliminary value).

Extreme climate events were as follows (Fig. 3).
- Monthly mean temperatures were extremely high from Okinawa region of Japan to southeastern China and from Mongolia to southern Pakistan.
- Monthly mean temperatures were extremely low in and around Turkey.
- Monthly precipitation amounts were extremely low from southeastern Europe to Ireland.

Extratropics:

In the 500-hPa height field (Fig.4), wave trains were dominant from the central Pacific to North America and from the Atlantic to Eurasia. Pronounced positive anomalies were seen over the northeastern part of the North Pacific and over Europe. Pronounced negative anomalies were seen over the area from Western Russia to Western Siberia. The westerly jet stream over Eurasia was stronger than normal north of its normal position (Fig. 5). The zonal mean westerly jet streams were stronger than normal north of their normal position in both hemispheres. Zonal mean temperatures in the troposphere were generally above normal, especially in the lower latitude.

Tropics:

Convective activity was enhanced over the area from the eastern part of the Bay of Bengal to the southern Indochina Peninsula, from Indonesia to the Philippines and the latitude bands of 10°N to 15°N in the central Pacific. It was suppressed over the western to central Indian Ocean and the wide area of the equatorial Pacific (Fig. 6). The active phase of the Madden-Julian Oscillation (MJO) was unclear through the month (Fig. 7). In the lower troposphere, the northward extension of the sub-tropical high was stronger than normal in the North Pacific. Anti-cyclonic circulation anomalies were clearly seen over the seas southeast to east of Japan. In the upper troposphere, anti-cyclonic circulation anomalies were seen over southern Eurasia (Fig. 8). The Southern Oscillation Index value was +0.3 (Fig. 10).

Oceanographic Conditions:

In the equatorial Pacific, remarkably positive SST anomalies were observed in the western part, and negative SST anomalies were observed in the central and eastern parts. The monthly mean SST anomaly and the SST deviation from the latest sliding 30-year mean in the NINO.3 region were both -0.4˚C.
In the North Pacific, remarkably positive SST anomalies were observed from the South China Sea to near 30˚N, 150˚W, from near the Aleutian Islands to the western coast of Canada and from the western coast of Central America to near 25˚N, 130˚W, and remarkably negative SST anomalies were observed from the southern part of the Sea of Okhotsk to near 40˚N, 135˚W. In the South Pacific, remarkably positive SST anomalies were observed from the western coast of Chile to near 10˚S, 170˚E. In the Indian Ocean, remarkably positive SST anomalies were observed south of Sumatera, near the eastern coast of Somalia and from near 30˚S, 50˚E to near 30˚S, 100˚E, and remarkably negative SST anomalies were observed near 20˚S, 95˚E. In the North Atlantic, remarkably positive SST anomalies were widely observed centering the western part.

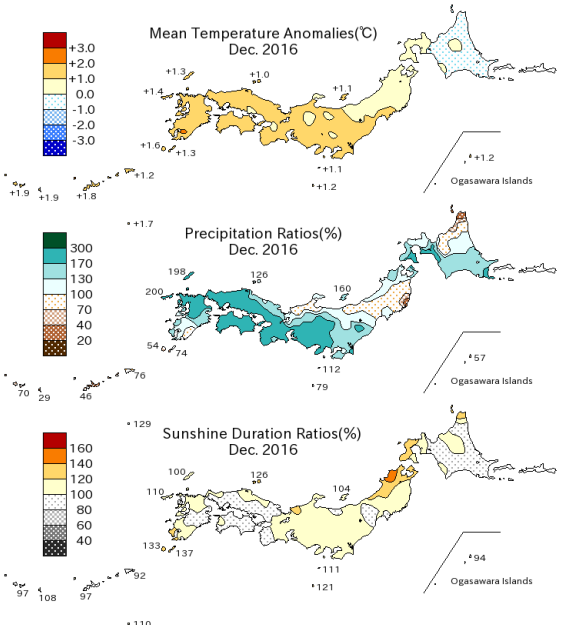

Fig. 1 Monthly climate anomaly / ratio over Japan (December 2016)

Top: temperature anomalies (degree C)
Middle: precipitation ratio (%)
Bottom: sunshine duration ratio (%)
Anomalies are defined as the deviations from the normal (1981-2010 average).

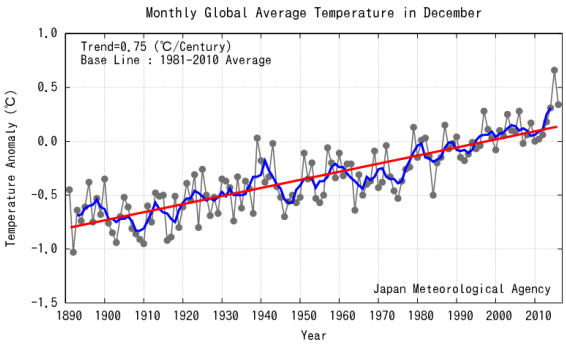

Fig. 2 Long-term change in monthly anomalies of global average surface temperature in December

The thin black line indicates anomalies of the surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are deviations from the 1981-2010 average.

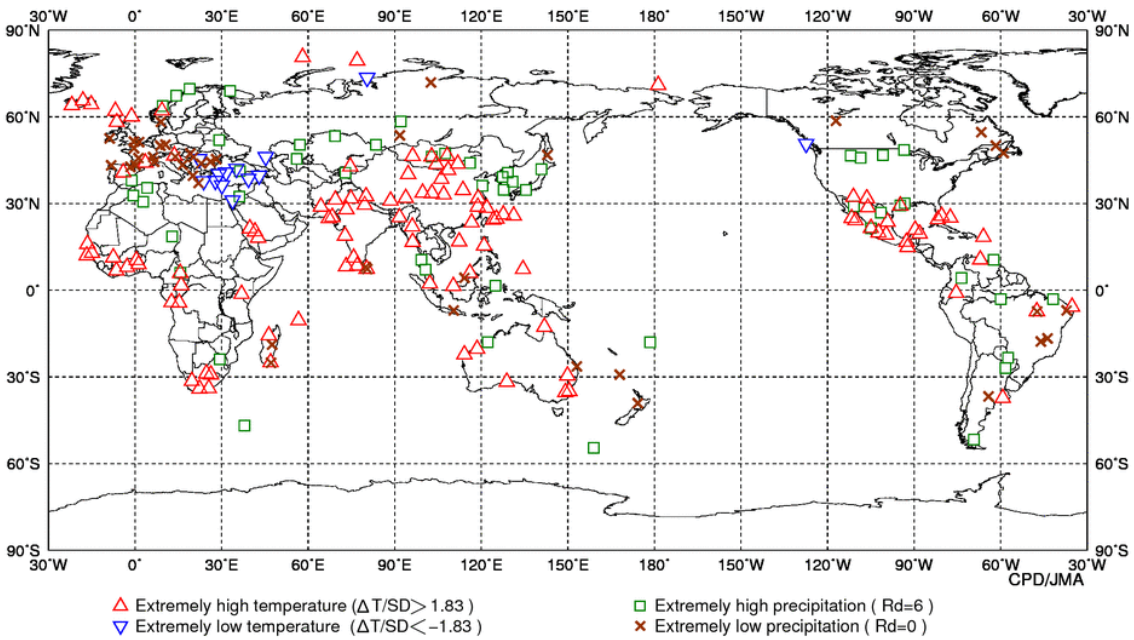

Fig. 3 Distribution of extreme climate events (December 2016)

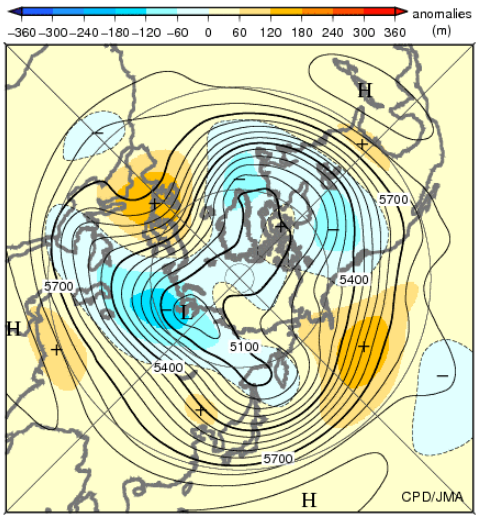

Fig. 4 Monthly mean 500-hPa height and anomaly in the Northern Hemisphere (December 2016)

The contours show heights at intervals of 60 m. The shading indicates height anomalies. The base period for the normal is 1981-2010.

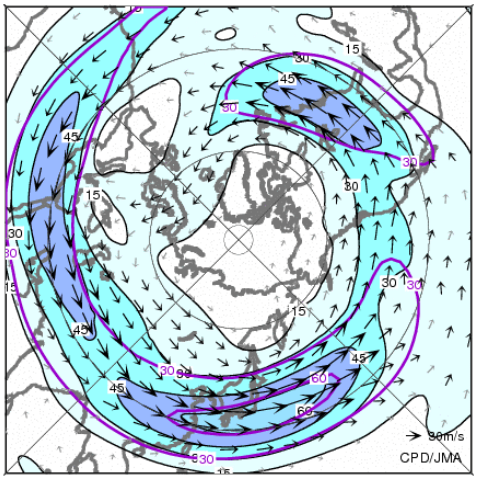

Fig. 5 Monthly mean 200-hPa wind speed and vectors in the Northern Hemisphere (December 2016)

The black lines show wind speeds at intervals of 15 m/s. The purple lines show normal wind speeds at intervals of 30 m/s. The base period for the normal is 1981-2010.

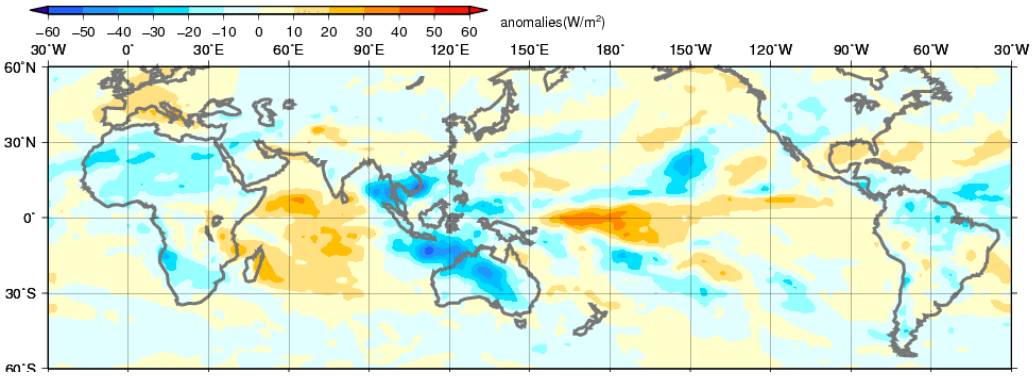

Fig. 6 Monthly mean Outgoing Longwave Radiation (OLR) anomaly (December 2016)

The contour interval is 10 W/m^2. The base period for the normal is 1981-2010. Original data provided by NOAA.

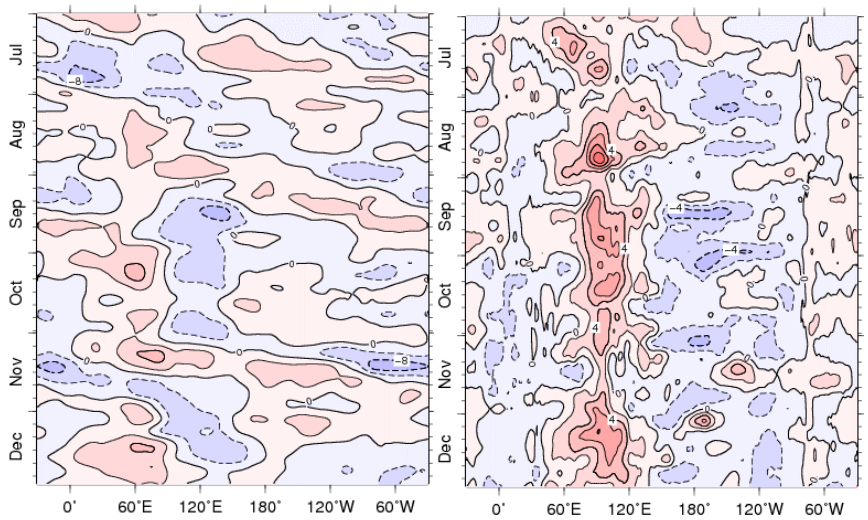

Fig. 7 Time-Longitude cross section (5°N-5°S) of five-day running mean 200-hPa velocity potential anomaly (left) and 850-hPa zonal wind anomaly (right) (July 2016 – December 2016)

The contour intervals are 4x10^6 m^2/s (left) and 2 m/s (right). The base period for the normal is 1981-2010.

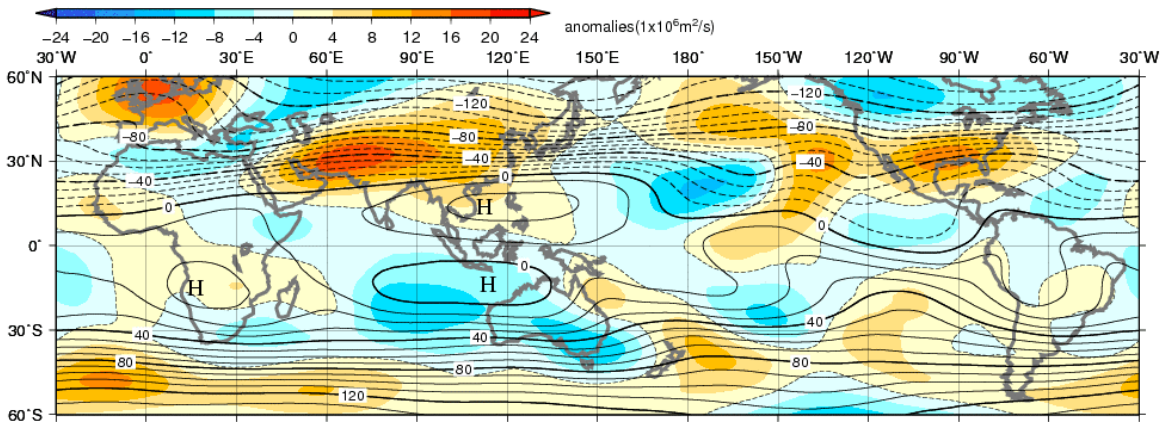

Fig. 8 Monthly mean 200-hPa stream function and anomaly (December 2016)

The contour interval is 10×10^6 m^2/s. The base period for the normal is 1981-2010.

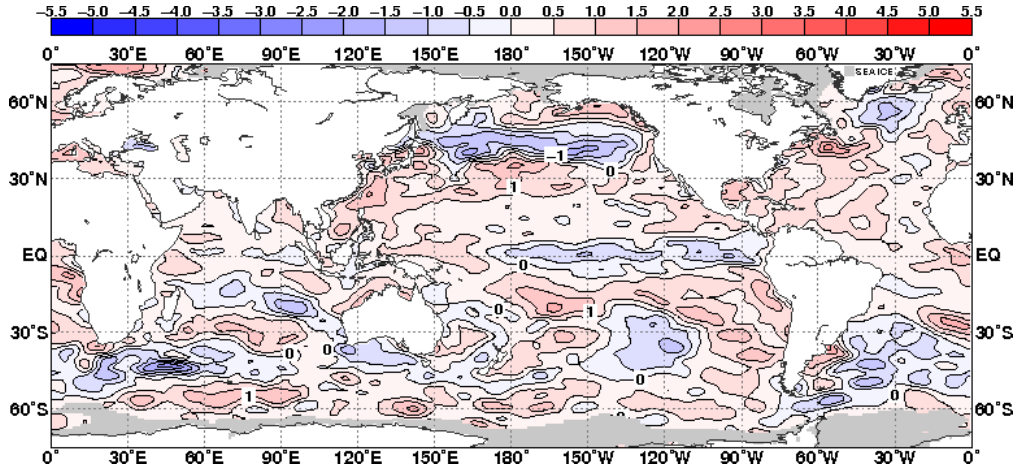

Fig. 9 Monthly mean sea surface temperature anomaly (December 2016)

The contour interval is 0.5 degree C. The base period for the normal is 1981-2010. Maximum coverage with sea ice is shaded in gray.

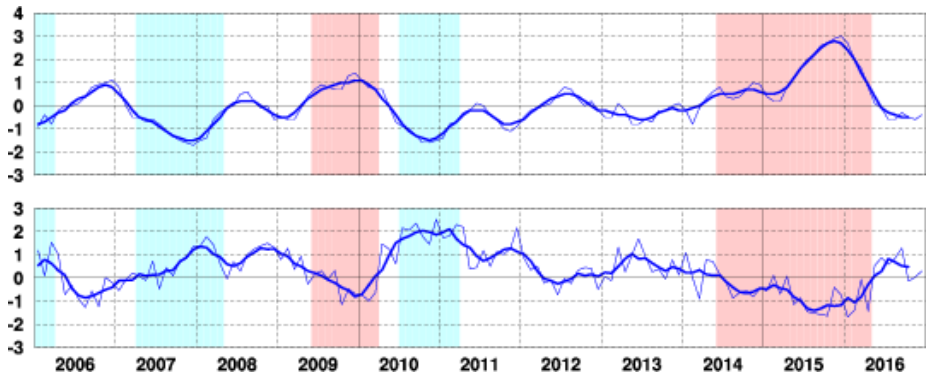

Fig. 10 Time series of monthly mean SST departure (degree C) from the reference value defined as the immediate past 30-year mean SST averaged over the NINO.3 region (upper). Time series of the Southern Oscillation Index with respect to the 1981-2010 base period (lower).

Thin blue lines represent monthly means and thick blue lines five-month running means. Periods of El Niño and La Niña events are shown as red-colored and blue-colored boxes, respectively.

Detailed information on the climate system is available on the Tokyo Climate Center's website.

http://ds.data.jma.go.jp/tcc/tcc/index.html

This report is prepared by the Climate Prediction Division, Global Environment and Marine Department, Japan Meteorological Agency.