Monthly Highlights on the Climate System (October 2016)

Highlights in October 2016

- The monthly anomaly of the global average surface temperature was the third highest since 1891.
- It is considered that La Nina conditions are present in the equatorial Pacific (see *El Niño Outlook* updated on 10 November 2016).
- In the lower troposphere, anti-cyclonic circulation anomalies were seen over the wide area in the tropical North Pacific.
- A blocking high developed from the Scandinavian Peninsula to the Barents Sea.
- Monthly mean temperatures were significantly above normal in eastern and western Japan and Okinawa/Amami. On the other hand, monthly mean temperatures were below normal in northern Japan.

Climate in Japan:

Monthly mean temperatures were significantly above normal in eastern and western Japan and Okinawa/Amami due to warm southerly wind from the sub-tropical high which was stronger than normal in the south of Japan. Monthly precipitation amounts were above normal and monthly sunshine durations were significantly below normal in western Japan due to wet southerly wind.

On the other hand, monthly mean temperatures were below normal in northern Japan since severe cold surge of winter monsoon frequently came into northern Japan especially in the last ten days of the month. Monthly sunshine durations in northern Japan were significantly below normal on the side of Japan Sea and significantly above normal on the side of Pacific due to winter monsoon.

World Climate:

The monthly anomaly of the global average surface temperature in October 2016 (i.e., the combined average of the near-surface air temperature over land and the SST) was +0.29°C (the third warmest since 1891) (preliminary value) (Fig. 2). On a longer time scale, global average surface temperatures have risen at a rate of about 0.65°C per century in October (preliminary value).

Extreme climate events were as follows (Fig. 3).

- Monthly mean temperatures were extremely high from western Japan to the northern part of Southeast Asia.
- Monthly mean temperatures were extremely low in the southern part of Eastern Siberia and from the southern part of Central Siberia to the eastern part of Central Asia.
- Monthly mean temperatures were extremely high from the eastern USA to in and around Mexico, and monthly precipitation amounts were extremely low in the southern USA.

Extratropics:

In the 500-hPa height field (Fig. 4), wave trains were obviously seen over a wide area of the Northern Hemisphere. A blocking high developed from the Scandinavian Peninsula to the Barents Sea. Positive anomalies were observed also over Alaska. Negative anomalies were clearly seen from the mid-latitude bands of Eurasia to the Kamchatka Peninsula. The subtropical jet stream in the Northern Hemisphere was displaced northward of its normal position from Central Asia to Japan and stronger than normal in its normal position from the western to central Pacific (Fig. 5). The zonal mean subtropical jet streams were stronger than normal in both hemispheres, while zonal mean westerlies were weaker than normal near 60˚N. Zonal mean temperatures in the troposphere were above normal in all latitudes except near 50˚N and 40˚S and particularly warmer than normal over the Arctic region.

Tropics:

Convective activity was enhanced over the area from the eastern Indian Ocean to Indonesia, from the Bay of Bengal to the South China Sea and the latitude bands of 10˚N to 15˚N in the Pacific. It was suppressed over the western to central Indian Ocean and the equatorial Pacific (Fig. 6). The active phase of the Madden-Julian Oscillation (MJO) was seen over and around Indonesia in the first half of early October, and then became unclear (Fig. 7). In the lower troposphere, anti-cyclonic circulation anomalies were seen over the wide area in the tropical North Pacific. In the upper troposphere, anti-cyclonic circulation anomalies were seen over and around the East China Sea, from where wave trains extended into North America (Fig. 8). The Southern Oscillation Index value was -0.1 (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 -0.5˚C.

In the North Pacific, remarkably positive SST anomalies were observed from the northern part of the South China Sea to east of Japan, from near 25˚N, 155˚E to near 25˚N, 160˚W, from near the Aleutian Islands to the western coast of North America and from the western coast of Central America to near 10˚N, 170˚W. In the South Pacific, remarkably positive SST anomalies were observed from near the Solomon Islands to the western coast of Chile.

In the Indian Ocean, remarkably positive SST anomalies were observed south of Java.

In the North Atlantic, remarkably positive SST anomalies were observed from the eastern coast of North America to near 30˚N, 40˚W and remarkably negative SST anomalies were observed from near 40˚N, 40˚W to near 60˚N, 20˚W.

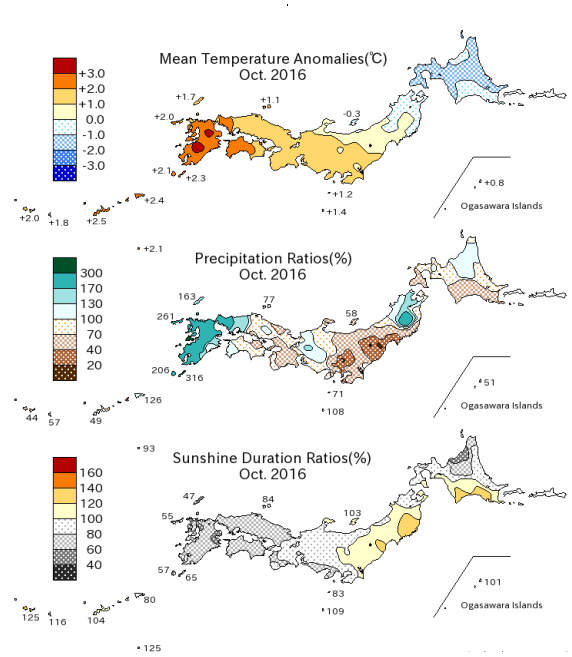

Fig. 1 Monthly climate anomaly / ratio over Japan (October 2016)
Top: temperature anomalies (degree C)
Middle: precipitation ratio (%)
Bottom: sunshine duration ratio (%)
Anomalies are defined as the deviations from the normal (1981-2010 average).

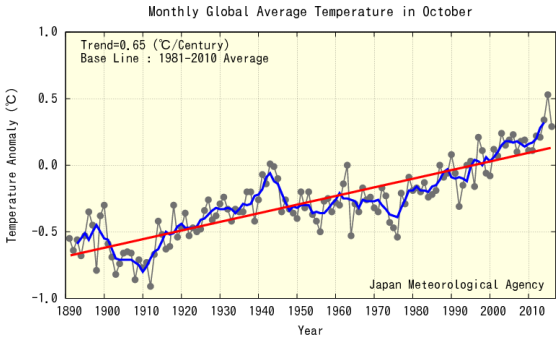

Fig. 2 Long-term change in monthly anomalies of global average surface temperature in October
The thin black line indicates anomalies of the surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are deviations from the 1981-2010 average.

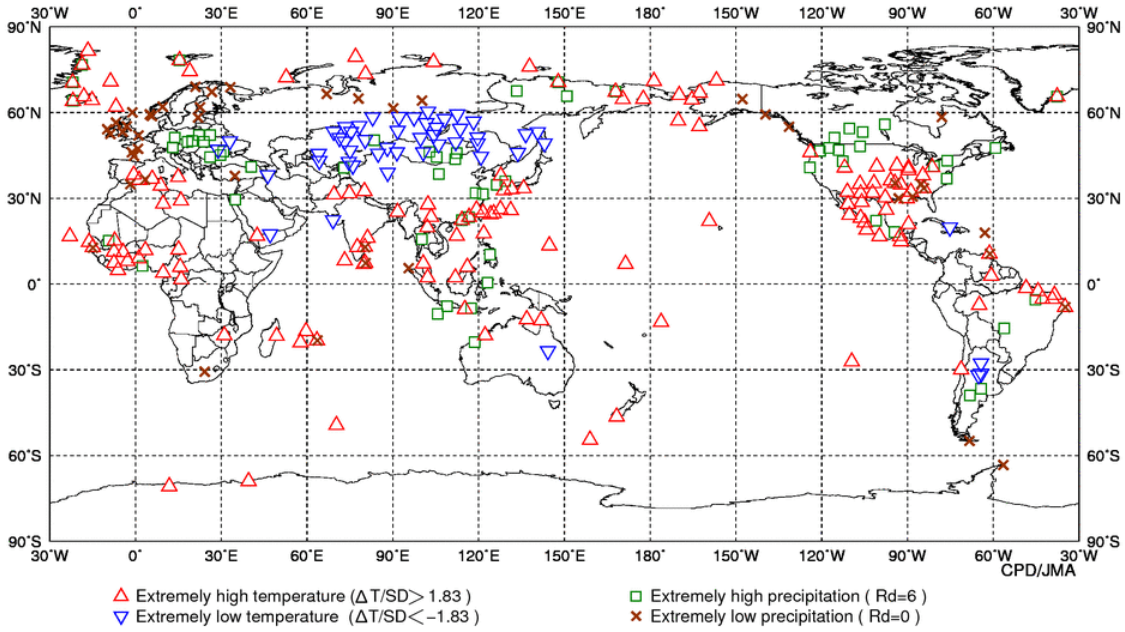

Fig. 3 Distribution of extreme climate events (October 2016)

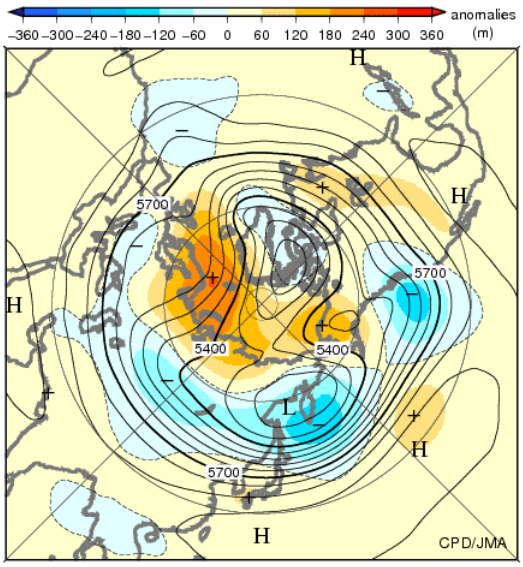

Fig. 4 Monthly mean 500-hPa height and anomaly in the Northern Hemisphere (October 2016)
The contours show heights at intervals of 60 m. The shading indicates height anomalies. The base period for the normal is 1981-2010.

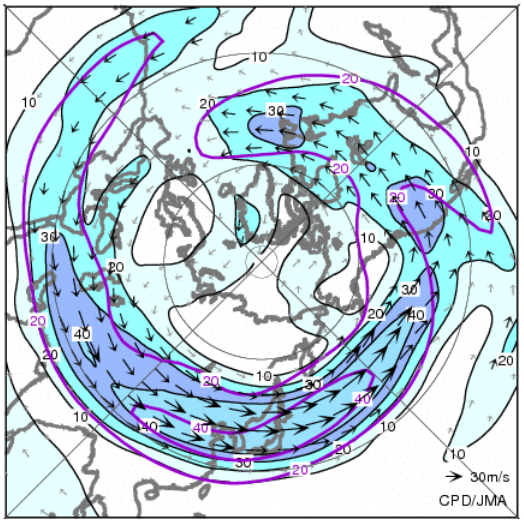

Fig. 5 Monthly mean 200-hPa wind speed and vectors in the Northern Hemisphere (October 2016)
The black lines show wind speeds at intervals of 10 m/s. The purple lines show normal wind speeds at intervals of 20 m/s. The base period for the normal is 1981-2010.

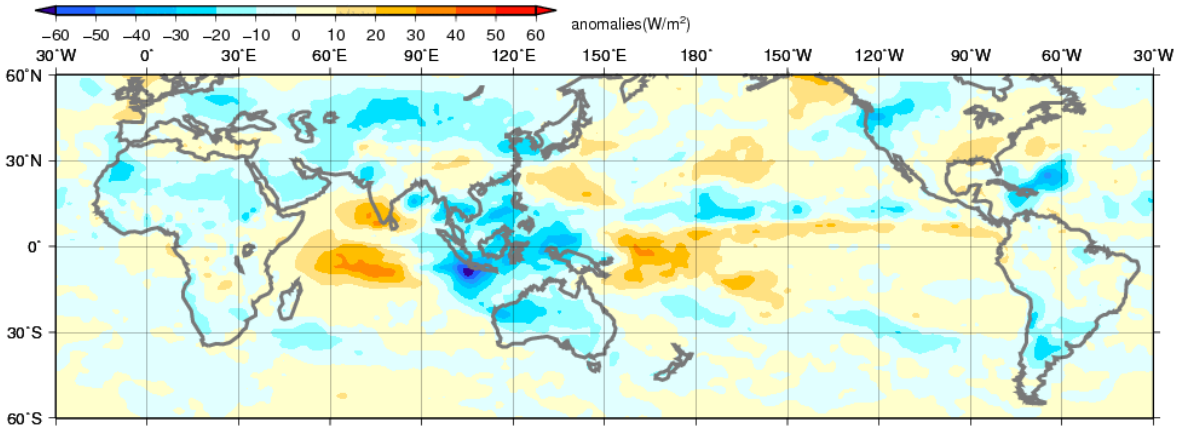

Fig. 6 Monthly mean Outgoing Longwave Radiation (OLR) anomaly (October 2016)
The contour interval is 10 W/m^2. The base period for the normal is 1981-2010. Original data provided by NOAA.

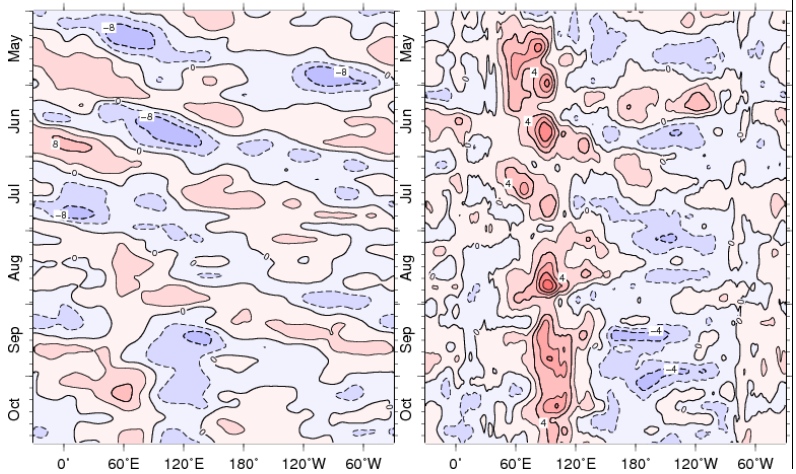

Fig. 7 Time-Longitude cross section (5°N-5°S) of five-day running mean 200-hPa velocity potential anomaly (left) and 850-hPa zonal wind anomaly (right) (May 2016 – October 2016)
The contour intervals are 4x10^6 m^2/s (left) and 2 m/s (right). The base period for the normal is 1981-2010.

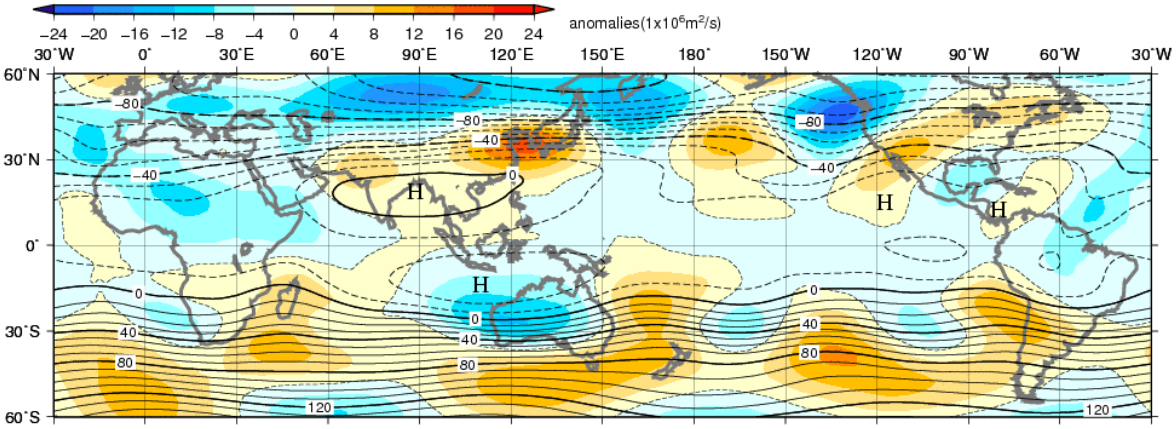

Fig. 8 Monthly mean 200-hPa stream function and anomaly (October 2016)

The contour interval is $10x10^6$ m^2/s. The base period for the normal is 1981-2010.

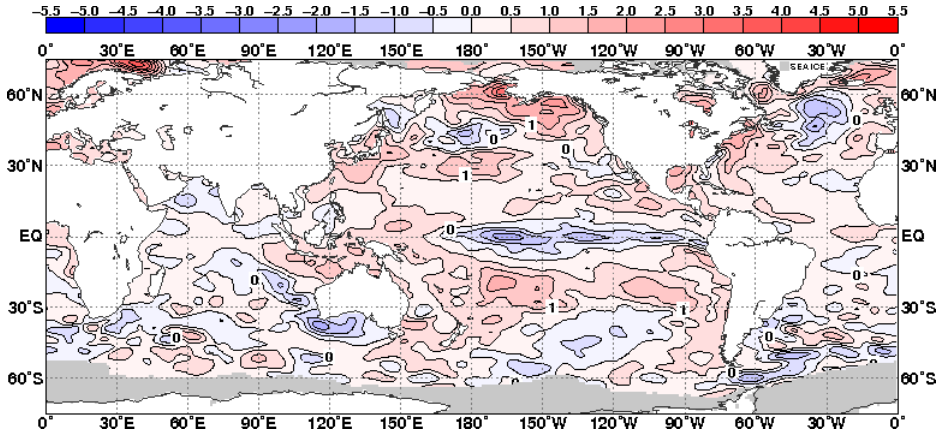

Fig. 9 Monthly mean sea surface temperature anomaly (October 2016)

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.

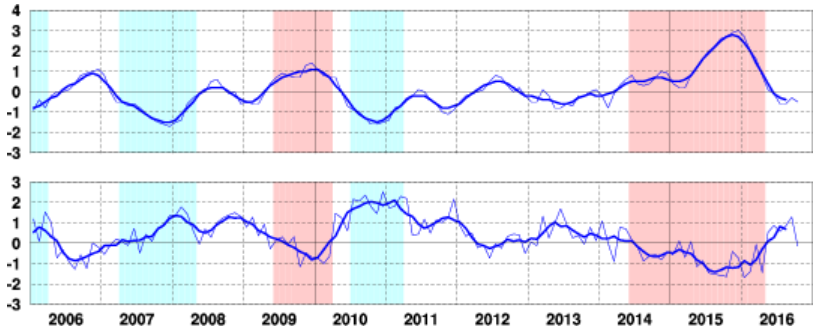

Fig. 10 Time series of monthly mean SST departure (degree C) from the reference value defined as the immediate past 30-year mean SST averaged over the NINO.3 region (upper). Time series of the Southern Oscillation Index with respect to the 1981-2010 base period (lower).

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.