Monthly Highlights on the Climate System (June 2016)

Highlights in June 2016
- The monthly anomaly of the global average surface temperature was the highest since 1891.
- In the equatorial Pacific, remarkably positive SST anomalies were observed west of 160˚E, and negative SST anomalies were observed in the central and eastern parts.
- Convective activity was enhanced over India to the Bay of Bengal and the eastern part of the South Indian Ocean to the Maritime Continent, and suppressed over the equatorial western Indian Ocean and the western Pacific.
- The westerly jet stream was stronger than normal in its normal position over and around Japan.
- Monthly precipitation amounts were significantly above normal in north Japan and the Pacific side of western Japan. Monthly mean temperatures were significantly above normal in Okinawa/Amami.

Climate in Japan:

The Baiu-front fluctuated between Okinawa/Amami and the south coast of the mainland of Japan in the first half of the month. It was active in the last half of the month due to warm and wet southerly winds since the subtropical high was strong in the south of Japan. Monthly precipitation amounts were significantly above normal in the Pacific side of western Japan because the active Baiu-front stayed around there. Monthly precipitation amounts were significantly above normal in north Japan due to frequent passage of cyclones. On the other hand, monthly precipitation amounts were below normal, monthly sunshine durations were above normal and monthly mean temperatures were significantly above normal in Okinawa/Amami since the subtropical high had covered over Okinawa/Amami especially in the last half of the month.

World Climate:

The monthly anomaly of the global average surface temperature in June 2016 (i.e., the combined average of the near-surface air temperature over land and the SST) was +0.41°C (the warmest since 1891) (preliminary value) (Fig. 2). On a longer time scale, global average surface temperatures have risen at a rate of about 0.70°C per century in June (preliminary value).

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

- Monthly mean temperatures were extremely high from the Okinawa Islands of Japan to southern China.
- Monthly precipitation amounts were extremely high from Romania to northern France.
- Monthly precipitation amounts were extremely high in southeastern Australia.

Extratropics:

In the 500-hPa height field (Fig. 4), wave trains were seen over the area from the central Pacific to North America, with positive anomalies south of the Aleutian Islands and over western North America, and negative ones over the eastern Pacific and eastern North America. Early in the month, a blocking high developed over eastern Siberia and a trough was seen over northern Japan. The westerly jet stream was stronger than normal in its normal position over and around Japan (Fig. 5). The Pacific High was enhanced in the western part of its climatological extent and positive sea level pressure anomalies were seen over the area from central Siberia to the Sea of Okhotsk. In most of the troposphere, especially in the Northern Hemisphere mid- to high latitudes, zonal mean air temperatures were above normal.

Tropics:

Convective activity was enhanced over India to the Bay of Bengal and the eastern part of the South Indian Ocean to the Maritime Continent. It was suppressed over the Atlantic, the equatorial western Indian Ocean and the western Pacific (Fig. 6). The active phase of the Madden-Julian Oscillation (MJO) was propagating eastward over Africa to the Indian Ocean from early to mid- June and reached the Maritime Continent late in the month (Fig. 7). In the lower troposphere, anticyclonic circulation anomalies were seen over the northern part of the South China Sea to the seas south of Japan. In the upper troposphere, wave trains were dominant along the sub-tropical jet stream in the Northern Hemisphere (Fig. 8). The Southern Oscillation Index value was +0.9 (Fig. 10).

Oceanographic Conditions:

In the equatorial Pacific, remarkably positive SST anomalies were observed west of 160˚E, 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 -0.1˚C. In the North Pacific, remarkably positive SST anomalies were observed in almost the entire region except the central part. In the South Pacific, remarkably positive SST anomalies were observed from the eastern coast of Australia to near 35˚S, 160˚W, from west of Peru to near 5˚S, 150˚E, and from the western coast of Chile to near 45˚S, 125˚W. In the Indian Ocean, positive SST anomalies were observed in most of the tropical region east of 65˚E, and they were remarkable in the central and eastern parts of the southern tropical Indian Ocean. On the other hand, negative SST anomalies were observed near the eastern coast of Somalia. In the North Atlantic, remarkably positive SST anomalies were observed from the eastern coast of North America to near 30˚N, 40˚W.

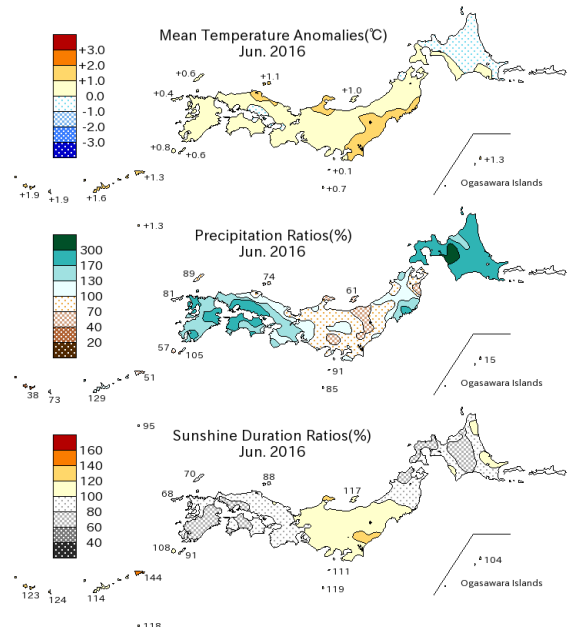

Fig. 1 Monthly climate anomaly / ratio over Japan (June 2016)
Top: temperature anomalies (degree C)
Middle: precipitation ratio (%)
Bottom: sunshine duration ratio (%)
Anomalies are defined as the deviations from the normal (1981-2010 average).

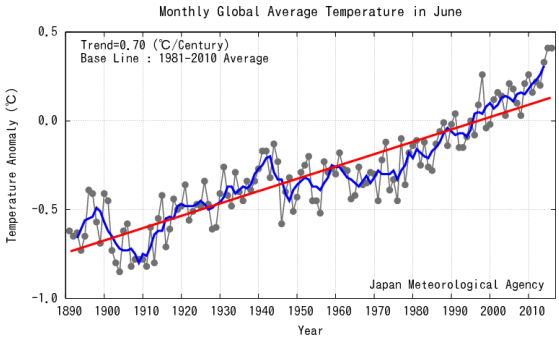

Fig. 2 Long-term change in monthly anomalies of global average surface temperature in June
The thin black line indicates anomalies of the surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are deviations from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

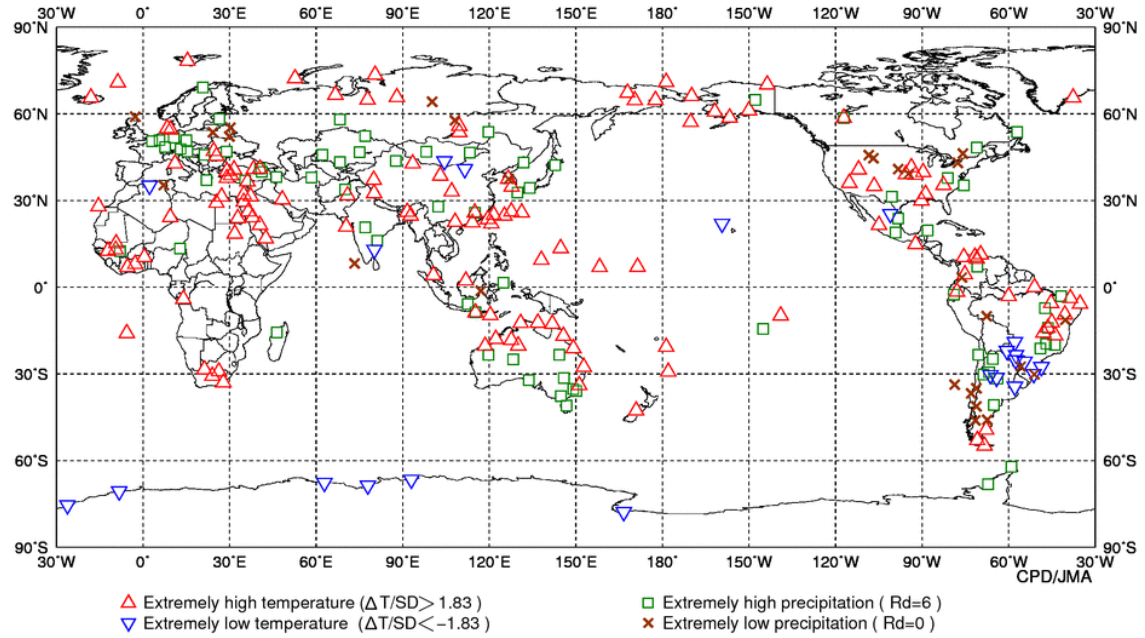

Fig. 3 Distribution of extreme climate events (June 2016)

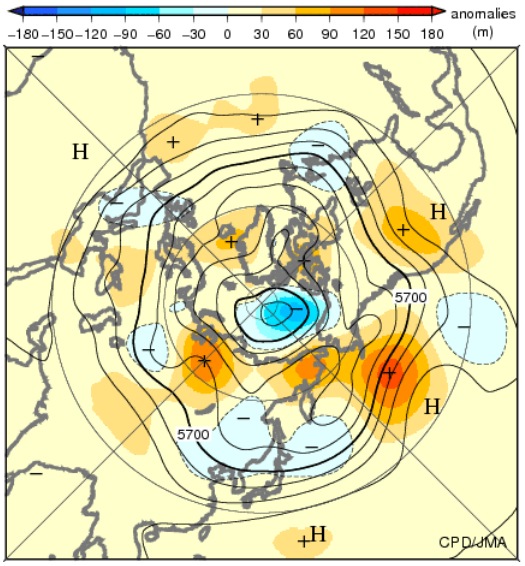

Fig. 4 Monthly mean 500-hPa height and anomaly in the Northern Hemisphere (June 2016)

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

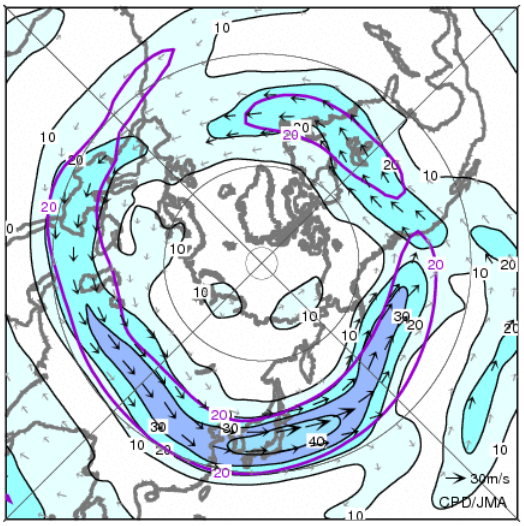

Fig. 5 Monthly mean 200-hPa wind speed and vectors in the Northern Hemisphere (June 2016)

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.

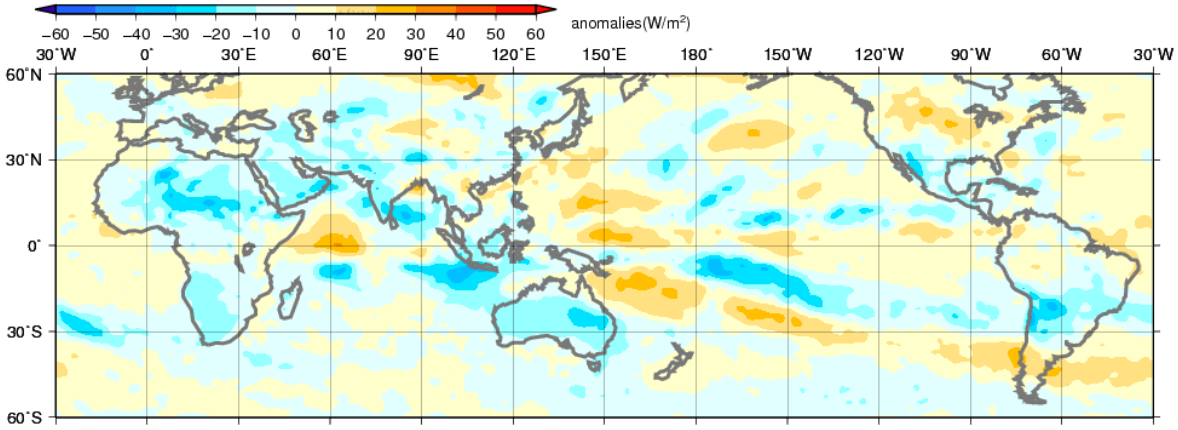

Fig. 6 Monthly mean Outgoing Longwave Radiation (OLR) anomaly (June 2016)

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

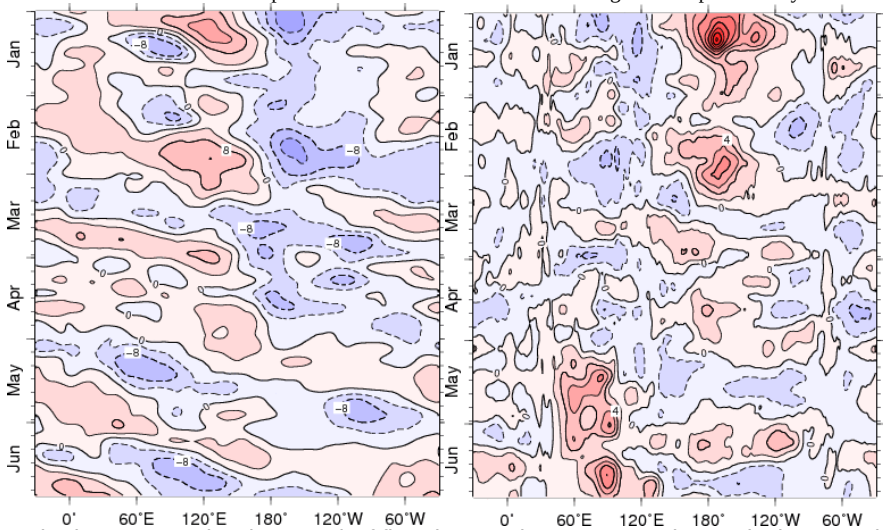

Fig. 7 Time-Longitude cross section (5°N-5°S) of five-day running mean 200-hPa velocity potential anomaly (left) and 850-hPa zonal wind anomaly (right) (January 2016 – June 2016)

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

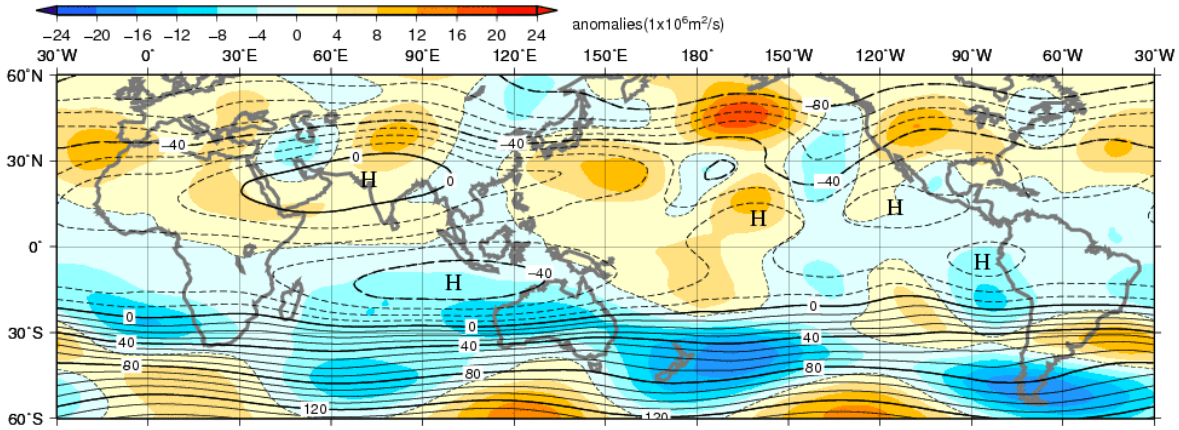

Fig. 8 Monthly mean 200-hPa stream function and anomaly (June 2016)

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

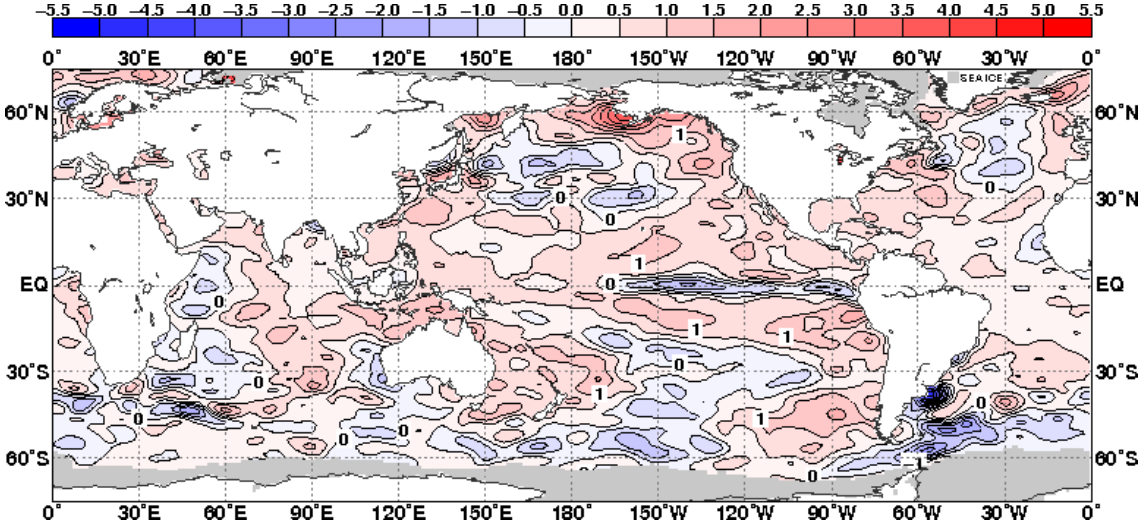

Fig. 9 Monthly mean sea surface temperature anomaly (June 2016)

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.

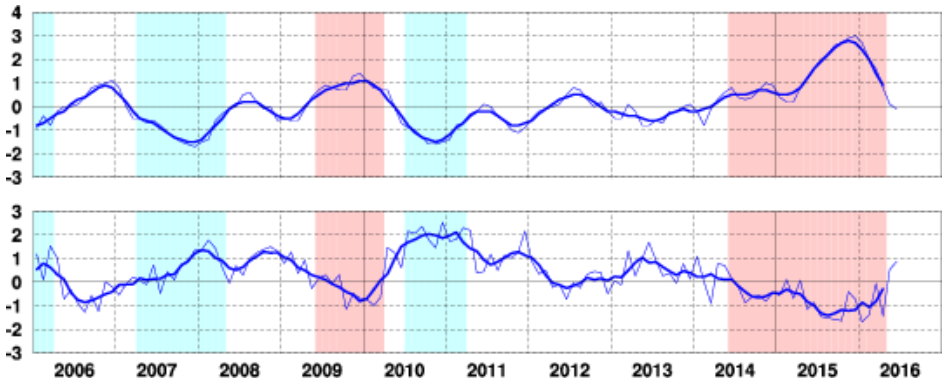

Fig. 10 Time series of monthly mean SST departure (degree C) from the reference value defined as the immediate past 30-year mean SST averaged over the NINO.3 region (upper). Time series of the Southern Oscillation Index with respect to the 1981-2010 base period (lower).

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.