Monthly Highlights on the Climate System (December 2015)

Highlights in December 2015
- The monthly anomaly of the global average surface temperature was the warmest since 1891.
- El Niño event, which emerged in the Northern Hemisphere summer 2014, was in its mature stage during November and December 2015 (see *El Niño Outlook* updated on 12 January 2016).
- Convective activity was enhanced over the western to central equatorial Pacific, and was suppressed over the Philippines and the Maritime Continent.
- The jet stream shifted northward of its normal position over and around Japan.
- Monthly mean temperatures were significantly above normal all over Japan, and were the highest on record for December since 1946 in eastern Japan.

Climate in Japan:

The winter monsoon was weaker than normal and extremely warm days continued. Therefore, monthly mean temperatures were significantly above normal all over Japan and monthly total snowfall depths were significantly below normal on the Sea of Japan side. In addition, monthly precipitation amounts were above normal almost all over Japan, since low pressure systems passed around Japan many times. Monthly mean temperatures in eastern Japan and monthly precipitation amounts in the pacific side of western Japan were the highest on record for December since 1946, respectively.

World Climate:

The monthly anomaly of the global average surface temperature in December 2015 (i.e., the combined average of the near-surface air temperature over land and the SST) was +0.67˚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 0.74˚C per century in December (preliminary value).

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

- Monthly mean temperatures were extremely high in various places in the low latitudes.

- Monthly mean temperatures were extremely high and monthly precipitation amounts were extremely light from eastern Europe to the northwestern part of Northern Africa.

- Monthly mean temperatures were extremely high from southeastern Canada to the southern USA and monthly precipitation amounts were extremely heavy from the Midwest to the southern USA.

Extratropics:

In the 500-hPa height field (Fig.4), wave trains were observed over the area from North America to East Asia with positive anomalies over eastern North America, Europe and the area from northern East Asia to Japan and negative anomalies over the northern Atlantic and Western Siberia. The jet stream exhibited a meandering structure over the area from southern Eurasia to the seas east of Japan, with a northward shift over and around Japan (Fig. 5). In the lower troposphere, temperatures were above normal over the wide area of the Northern Hemisphere.

Tropics:

Convective activity was enhanced over the western to central equatorial Pacific, and was suppressed over the Philippines and the Maritime Continent (Fig. 6). The active phase of the Madden-Julian Oscillation (MJO) was seen propagating eastward from the Maritime Continent to the central Pacific from mid-December to late December (Fig. 7). In the lower troposphere, cyclonic circulation anomalies straddling the equator were seen over the western Indian Ocean and from the western to central Pacific. In the upper troposphere, anticyclonic circulation anomalies straddling the equator were seen over the Indian Ocean and from the central to eastern Pacific (Fig. 8). The Southern Oscillation Index value was -0.7 (Fig. 10).

Oceanographic Conditions:

Remarkably positive SST anomalies were observed from near the date line to the eastern part of the equatorial Pacific. The monthly mean SST anomaly in the NINO.3 region was +2.9˚C and the SST deviation from the latest sliding 30-year mean was +3.0˚C.

In the North Pacific, remarkably positive SST anomalies were observed from south of Alaska through the western coast of North America to central and eastern parts of the tropical region, and from the South China Sea to near 30˚N, 160˚E. In the South Pacific, remarkably positive SST anomalies were observed from near 45˚S, 145˚W to near 45˚S, 95˚W.

In the Indian Ocean, remarkably positive SST anomalies were observed in almost the entire region.

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

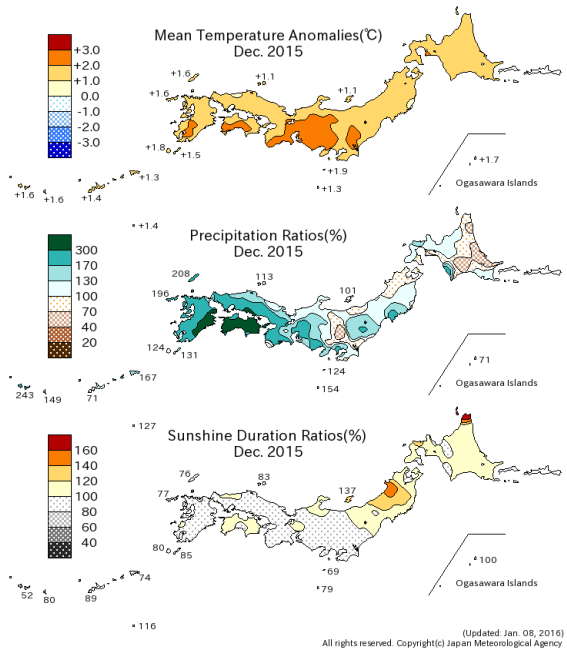

Fig. 1 Monthly climate anomaly / ratio over Japan (December 2015)
Top: temperature anomalies (degree C)
Middle: precipitation ratio (%)
Bottom: sunshine duration ratio (%)
Anomalies are defined as the deviations from the normal (1981-2010 average).

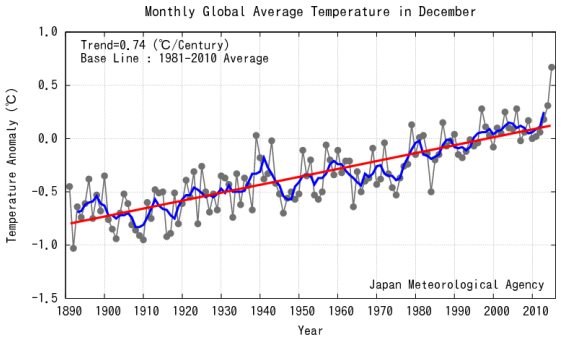

Fig. 2 Long-term change in monthly anomalies of global average surface temperature in December
The thin black line indicates anomalies of the surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are deviations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

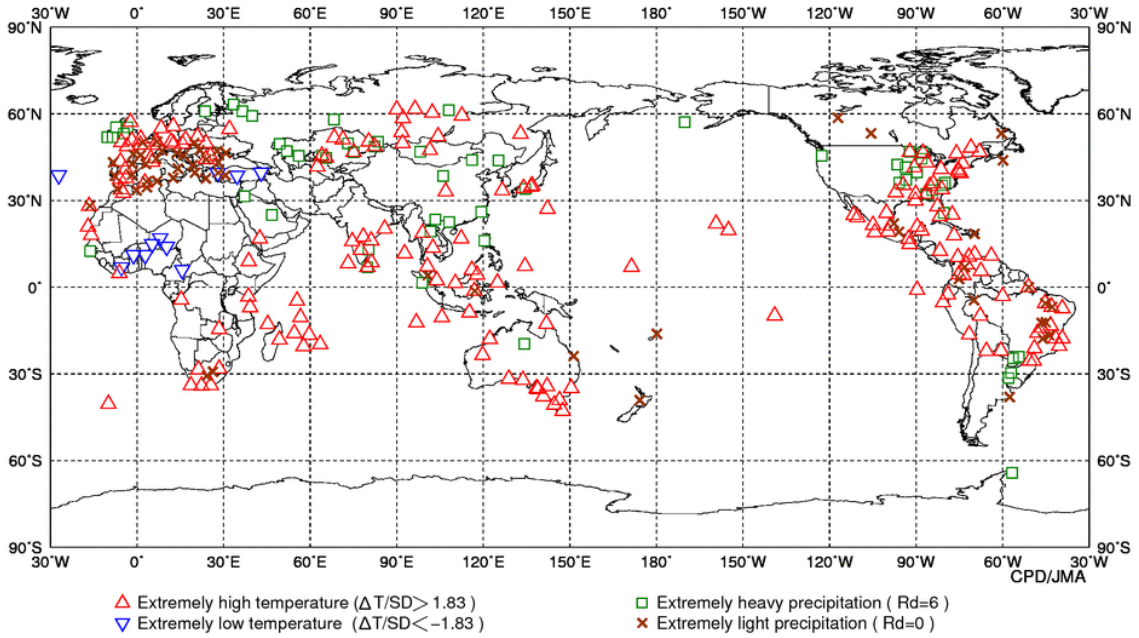

Fig. 3 Distribution of extreme climate events (December 2015)

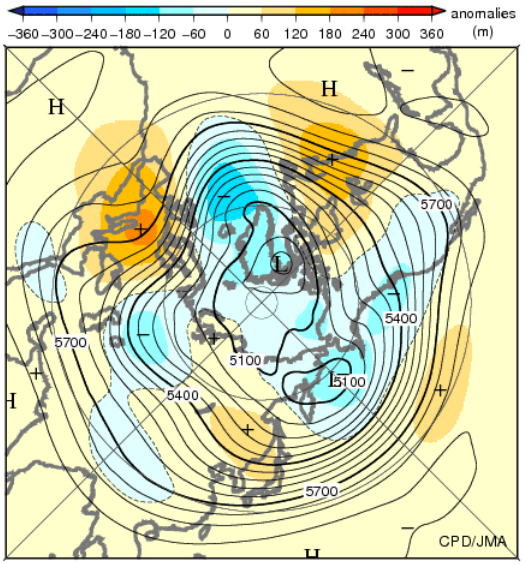

Fig. 4 Monthly mean 500-hPa height and anomaly in the Northern Hemisphere (December 2015)
The contours show heights at intervals of 60 m. The shading indicates height anomalies. The base period for the normal is 1981-2010.

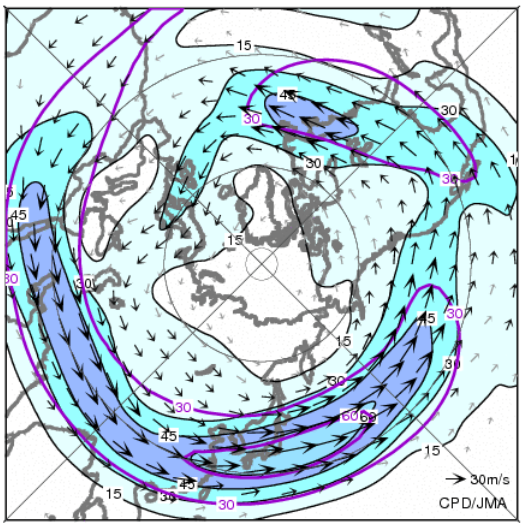

Fig. 5 Monthly mean 200-hPa wind speed and vectors in the Northern Hemisphere (December 2015)
The black lines show wind speeds at intervals of 15 m/s. The purple lines show normal wind speeds at intervals of 30 m/s. The base period for the normal is 1981-2010.

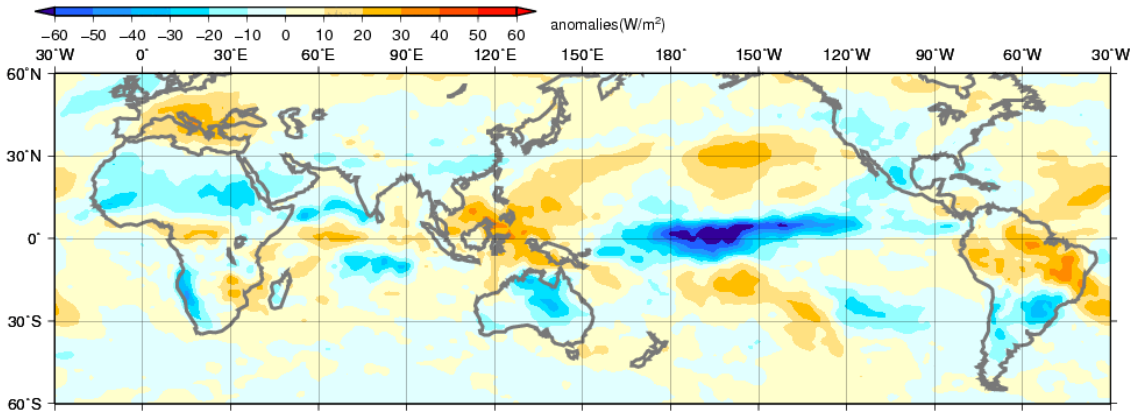

Fig. 6 Monthly mean Outgoing Longwave Radiation (OLR) anomaly (December 2015)
The contour interval is 10 W/m^2. The base period for the normal is 1981-2010. Original data provided by NOAA.

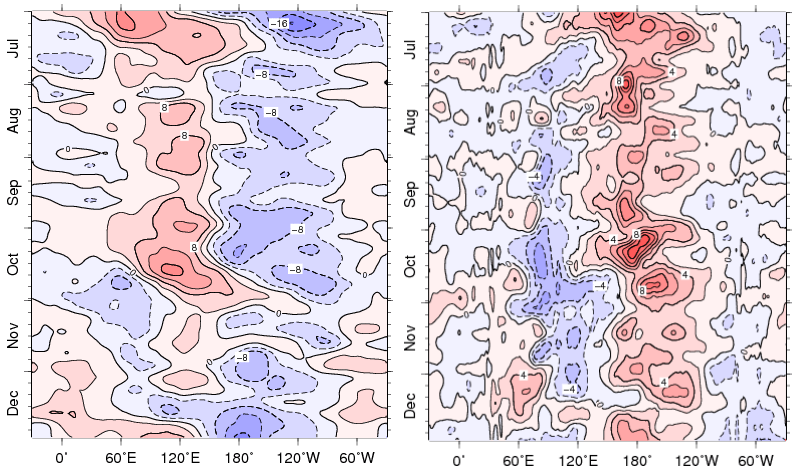

Fig. 7 Time-Longitude cross section (5°N-5°S) of five-day running mean 200-hPa velocity potential anomaly (left) and 850-hPa zonal wind anomaly (right) (July 2015 – December 2015)
The contour intervals are 4x10^6 m^2/s (left) and 2 m/s (right). The base period for the normal is 1981-2010.

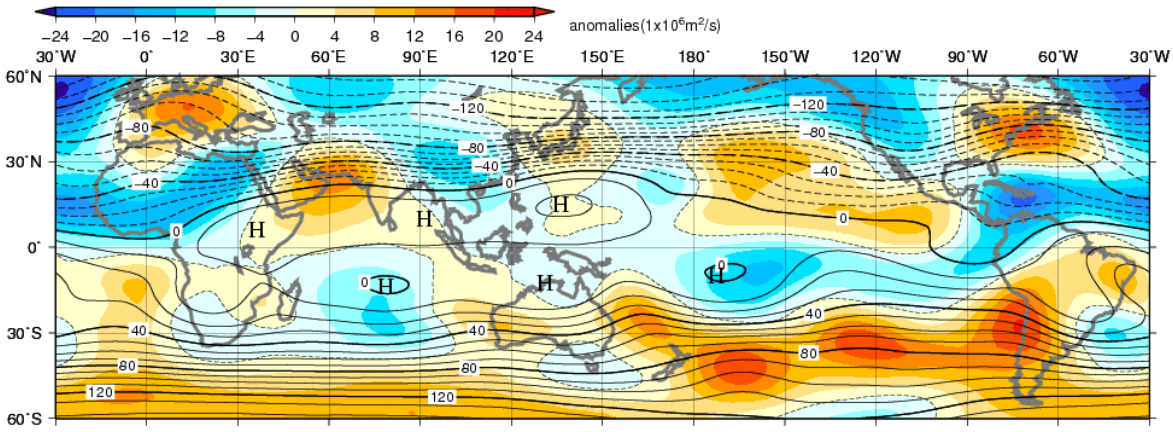

Fig. 8 Monthly mean 200-hPa stream function and anomaly (December 2015)

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

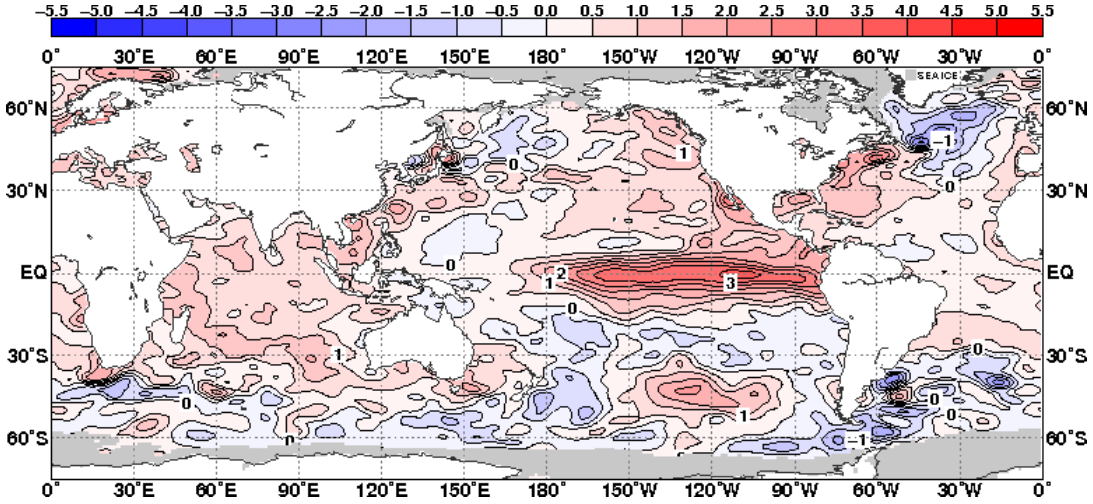

Fig. 9 Monthly mean sea surface temperature anomaly (December 2015)

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.

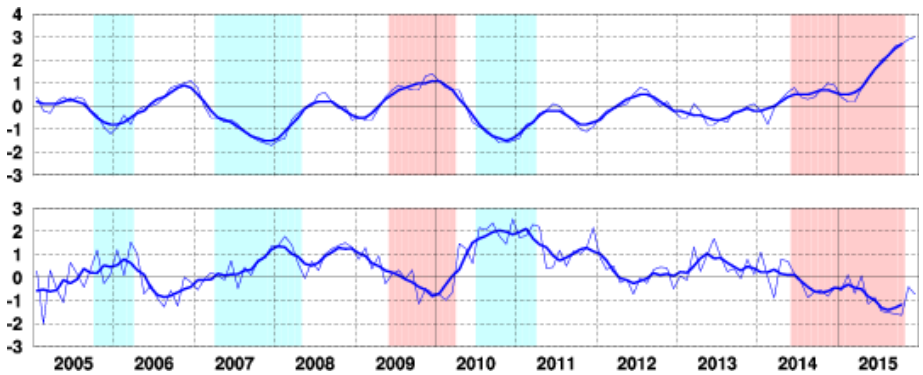

Fig. 10 Time series of monthly mean SST departure (degree C) from the reference value defined as the immediate past 30-year mean SST averaged over the NINO.3 region (upper). Time series of the Southern Oscillation Index with respect to the 1981-2010 base period (lower).

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.