Tokyo Climate Center, Japan Meteorological Agency

TCC News

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Contents

Highlights of Global Climate for 2005

Annual mean temperatures were above normal in most of the world, and global mean surface temperature reached the second highest record since 1880. In the 2005 Atlantic hurricane season, 27 named storms (previous records: 21) were observed.

1. Annual mean climate

Global mean surface temperature in 2005 was the second highest since 1880 (for the details: http://okdk.kishou.go.jp/news/topics_20060202.html). Annual mean temperatures were above normal in most of the world, except western Mongolia and western Australia, especially high in Siberia to northern Europe, eastern China to South Asia, and most of Australia (Figure 1). Annually total precipitation amounts were above normal in northern Siberia, southern Central Siberia to the central Arabian Peninsula, the coast of China to southern India, southeastern Europe, the west coast of Africa, central Canada, southwestern USA, and around the Caribbean Sea, while they were below normal in eastern Mongolia to northern China, southwestern Europe to northwestern Africa, Peru, and Australia (Figure 2).

2. Significant climatic events

Significant climate events and damage in 2005 are summarized below (Figure 3).

(1) Heavy rain and typhoons in East Asia (May to October)

According to Tokyo Typhoon Center of JMA, 23 named tropical cyclones formed in the western North Pacific in 2005, and the number of the cyclones was less than the 1971-2000 average of 26.7. In early September, the typhoon "Nabi" hit Japan, causing severe damage such as 26 deaths and bringing record-breaking heavy precipitation of 1,321 mm for three days (4-6 September) in Nango Village in western Japan, which was 2.9 times as much as its normal monthly rainfall for September. There were 11 tropical cyclones causing damage to East Asia or the Indochina Peninsula. It was reported that the annually total number of fatalities caused by natural disasters related to heavy rain in China reached 1800.

(2) Heat waves in India and Pakistan (June)

Northern India to Pakistan experienced extremely hot conditions in June. Monthly mean daily maximum temperature of 44.1°C, which is more than 4 °C above normal, was observed in Allahabad in June. These conditions caused a number of deaths of heat stroke over the regions.

(3) Heavy rain in western India (June to July)

From June to July, precipitation was significantly heavy in central and western India. On 27 July, a record-breaking rainfall of 944 mm was observed at Mumbai, India, which caused devastating damage such as over 1,000 deaths.

(4) Drought in Spain and Portugal (January to September)

Extremely light precipitation was observed in Spain and Portugal. The total precipitation in Madrid from January to September was 82mm, which was only 29% of the normal. It was reported that these drought conditions brought massive forest fires in Portugal, crop failure and reduced hydroelectric power supplies in Spain.

(5) Hurricanes in USA and Central America (July to November)

The 2005 Atlantic hurricane season set several records, according to National Hurricane Center/NOAA, USA. There were 27 named storms (previous records: 21) and 14 hurricanes (previous records: 12) formed in the Atlantic Ocean. Extremely heavy precipitation was observed around the Caribbean Sea. It was reported that some hurricanes brought severe damage and fatalities to USA and Central America; especially Hurricane 'Katrina' led to more than 1300 deaths along the central Gulf Coast in USA.

(6) Cold wave and heavy snow in East Asia and Europe (December)

In December, extremely low temperatures were observed from southern Central Siberia to Japan and southwestern Europe due to persistent cold-air flow from the Arctic. Record-breaking heavy snows were also observed in the Japan Sea Side of Japan, including the record of maximum snow depth in December of 58 cm in Akita. In Japan, more than 80 persons died due to the heavy snow. In northeastern China, Korea and many areas of Europe, it was also reported that heavy snow disrupted transportation such as airplanes and trains.

(*Hiroshi Nakamigawa, Climate Prediction Division*)

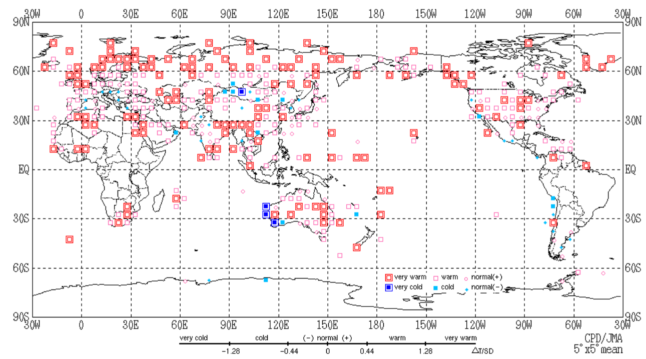

Figure 1 Annual mean temperature anomaly in 2005

Categories are defined by annual mean of normalized monthly temperature anomaly against normal (1971-2000 average)

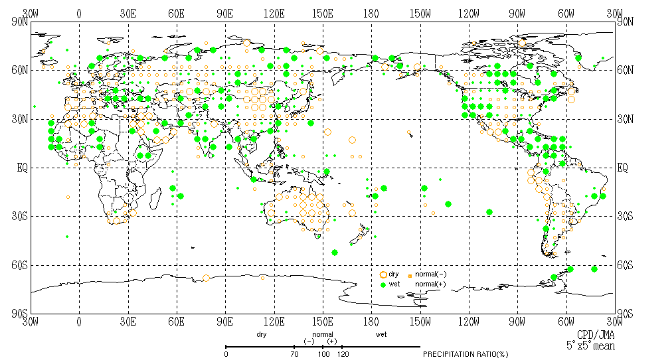

Figure 2 Annual total precipitation ratio in 2005

Categories are defined by annual precipitation ratio to normal (1971-2000 average)

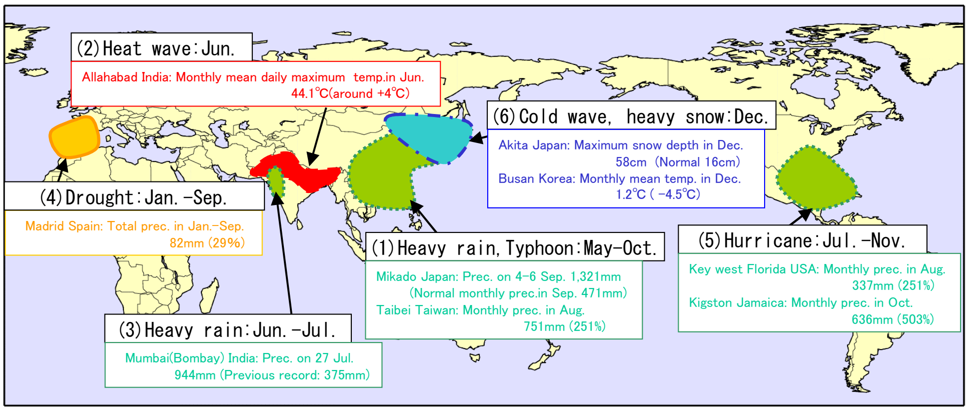

Figure 3 Significant climate events and damage in 2005

Climate Summary in Japan for 2005

The annual mean temperatures were near normal in most of Japan except for Western Japan. Partly in the Pacific side of Western and Eastern Japan, the rainfall amounts were less than normal through the spring and summer, resulting in serious shortages of water supply in summer. The Arctic cold air flowed out into Japan and persisted through December, which resulted in record-low monthly temperatures and record-high snow depths at a number of observatories.

1. Annual mean climate (Figure 4)

The annual mean temperatures were near normal in most of Japan except for Western Japan, where they were above normal. The annual precipitation amounts were below normal except for the Japan Sea side of Northern and Eastern Japan and Nansei Islands. They were significantly below normal in Tokai, Kinki and Shikoku districts, where five observatories in total recorded the lowest annual precipitation amounts. The annual sunshine durations were below normal in the Japan Sea side of Northern and Eastern Japan and in Nansei Islands, and above normal in the Pacific side of Eastern and Western Japan.

2. Climatic features

(1) Temperature variation (Figure 5)

From January to May 2005, the Arctic Oscillation (AO) tended to be in its negative phase and occasionally caused cold air surges over Japan. Through January and February, winter monsoon patterns frequently strengthened with short intervals, causing large fluctuation of temperature. Snowfall amounts in the winter 2004/2005 were above normal in the Japan Sea side of Northern Japan and in the mountainous areas of Eastern Japan, and near normal in the other regions. In May, the Okhotsk high dominated and brought chilly weather to Northern Japan.

From June to November 2005, the AO tended to be in its positive phase and above-normal temperature dominated over Japan. The record-breaking monthly mean temperatures were observed at many stations in June, September and October.

(2) Partly drought condition in warm season

The onsets of the Baiu season were later than normal in most of the regions. The withdrawals of the Baiu season were earlier than normal except in Tohoku district, where it was significantly later than normal by about two weeks. In June, the Baiu front tended to be located off the southern coast of Japan and near Nansei Islands, where record-high monthly rainfalls were observed. The Baiu frontal zone shifted northward to the southern part of Japan in the end of June and occasionally caused heavy rainfalls in some areas. In some areas of Western Japan and the Pacific side of Eastern Japan, less-than-normal rainfall amounts were experienced during April to August, which resulted in serious shortages of water supply in summer. Although the situation was partly relieved by the heavy rainfalls due to Typhoon 0514 (Nabi), the condition of water shortage continued locally in the Pacific side of Japan till the end of 2005.

(3) Tropical cyclones affecting Japan

The number of Tropical Cyclones (TC) with maximum speed stronger than 17.2m/s formed in the western North Pacific in 2005 was 23, which was below normal (Normal:

26.7, range of near normal: 25-29). The number of the landfalls on the mainland Japan was three, which was near normal (Normal: 2.6). The number of TCs that came within the range of 300km from the mainland and islands of Japan was 12, which was also near normal (Normal: 10.8).

In early September, Typhoon 0514 (Nabi) landed on Kyushu and Hokkaido. Since it moved relatively slowly with its large stormy-wind area, record-breaking total rainfall amounts were observed at some stations in Western Japan, and caused severe damage including 26 deaths.

(4) Cold early winter

In the middle of November, the AO rapidly turned to the negative phase and the significantly negative phase persisted through December. Due to this, whole Japan was gripped by cold weather through the end of 2005, and lots of stations featured record-low monthly temperatures and record-high snow depths in December.

(*Shunji Takahashi, Climate Prediction Division*)

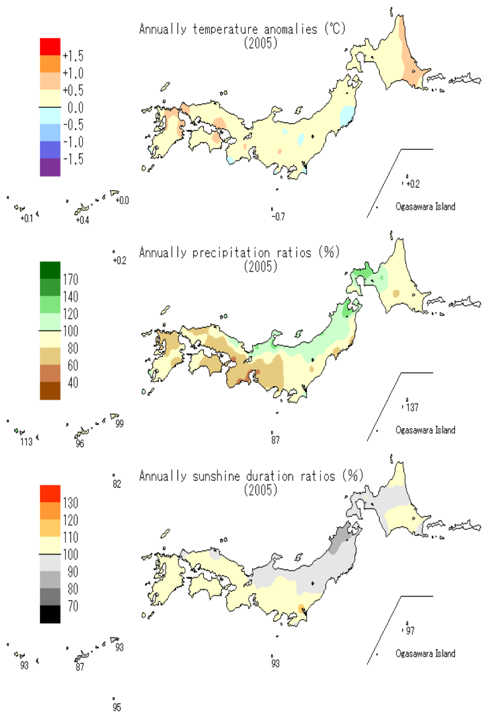

Figure 4 Annual Climate Anomaly/Ratio over Japan

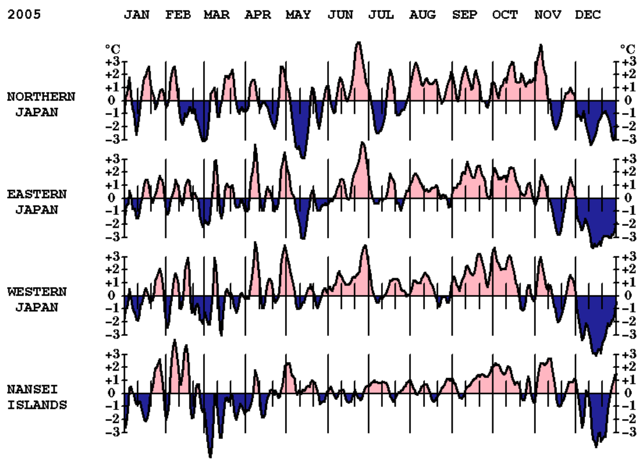

Figure 5 Five-day Running Mean Temperature Anomalies for Subdivisions

Global Temperature 2005: Second Warmest since 1891

The global surface temperature anomaly of 2005 was +0.32°C above normal, and the second highest on record since 1891. JMA started to monitor the global temperature combined over land and ocean at the beginning of 2006.

JMA monitors the global warming using data combined not only over land but also over the ocean, instead of the land-only data from the beginning of 2006. The oceanic part of the combined data is the JMA's original long-term sea surface temperature analysis data, called COBE-SST (also see the articles in the "TCC News" No.1 and this issue)

The annual anomaly of global average surface temperature during 2005 was +0.32°C above normal (1971-2000 average), and was the second highest next only to 1998 since 1891. The annual mean temperature over the globe has increased at a rate of 0.66°C per 100 years (Figure 6).

The annual-mean temperatures have varied in different time scales ranging from a few years to several decades. The increasing trend is likely due to human activities, particularly the emission of greenhouse gases.

It is planned for the products of the global temperature anomaly derived from the combined data to be routinely posted on the TCC website from April 2006.

The procedure for estimating the global temperature anomaly is as follows:

1) average monthly-mean temperature anomalies over land in each 5^{o} x 5^{o} grid box in the world;
2) average monthly-mean sea surface temperature anomalies in each 5^{o} x 5^{o} grid box in the world where at least one ship-observation exists;
3) average the anomaly in 1) and that in 2) according to the ratio of land to ocean for each grid box;
4) average the anomalies of all the grid boxes weighted with the area of the grid box; and
5) average monthly-mean global temperatures during the year.

(*Hiroko Morooka, Climate Prediction Division*)

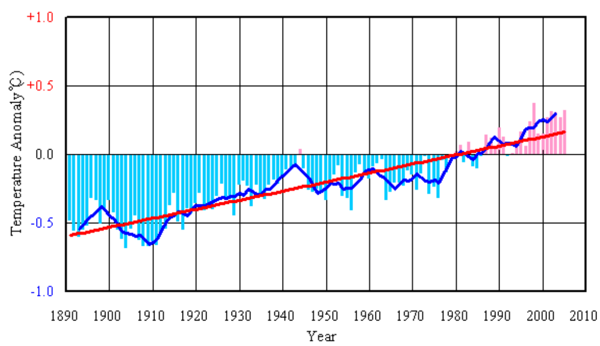

Figure 6 Annual anomalies of global average surface temperature from 1891 to 2005

The bars indicate anomalies from the climatological normal (1971-2000 average). The blue line shows five-year running mean anomalies and the red line indicates the long-term linear trend.

Upgrade of JMA's Global Data-Processing and Forecasting System in March 2006

The JMA's Global Data-Processing and Forecasting System is going to be upgraded in March 2006. In parallel with this upgrade, it is planned that the systems of JMA's climate analysis and ensemble prediction and relevant products provided through the TCC website (http://okdk.kishou.go.jp/) will be changed.

1. The JMA's Global Data-Processing and Forecasting System

The JMA's Global Data-Processing and Forecasting System is going to be upgraded in March 2006. The computing power of the new super-computer system is 27.5Tflops (theoretical value) faster by about 36-times than that of the old one. Total sizes of main memory and the massive data storage unit are 13.1TB and 2.0PB, respectively, and are larger by about 25-times than those of the old one.

2. Atmospheric Analysis System

The JMA Climate Data Assimilation System (called JCDAS), which is the same system as used in the Japanese 25-year Reanalysis Project (see the article in TCC News No.2), will be adopted as a new operational system on 1st March 2006, following the current OI-version of Climate Data Assimilation System. JCDAS provides real-time atmospheric and land surface analyses at a 6-hour interval (00, 06, 12, 18 UTC) which are consistent with the JRA-25 data. After completion of JRA-25 calculation in the end of March 2006, JMA's climatological normal of the atmosphere will be replaced with that based on the JRA-25 data.

3. Oceanic Analysis System

The global Sea Surface Temperature (SST) analysis system, which is the same as used in the COBE analysis (see the article in TCC News No.1), will be in operation from March 2006. Main differences from the current analysis system are the higher spatial resolution of one-degree mesh instead of two-degree one, and the improved quality control and inter/extrapolation procedure. The new global SST, called COBE-SST, will be utilized for the following purposes: El Niño monitoring, the initial condition for the El Niño prediction model, the boundary conditions for JMA's Ensemble Prediction System (EPS) and JCDAS, and monitoring of long-term global climate change.

At the same time, we are planning to modify the index of El Niño and La Niña. Main modification is to use a sliding 30-year average for the climatological reference instead of a fixed reference of the 1961-1990 average now in use. The details of the modification will be described on the "El Niño Monitoring and Outlook" page on the TCC website in March 2006.

4. Ensemble Prediction System (EPS)

The extended-range EPS for one-month outlook will be separated from the medium-range EPS for weekly weather forecast. In addition, the global atmospheric prediction model used in the EPS will be upgraded by adopting the same schemes as adopted in the short-range global NWP model in July 2005. The main changes are the introduction of a semi-Lagrangian scheme, the implementation of a new parameterization scheme for radiation process, and the utilization of the COBE-SST as oceanic boundary conditions. One of the merits of this separation is that we can optimize the initial perturbations for the extended-range prediction. The number of the ensemble members will be increased from 26 to 50, which is expected to help improve the probability distribution of the EPS. The prediction model for the seasonal (three-month and warm/cold season) outlooks will be upgraded at the same time. A full-fledged hindcast experiment is planned in 2006 by using the empowered supercomputer system described in the section 1. The hindcast data, along with the long-term reanalysis data (JRA-25), are expected to be useful to research on the predictability of the EPS and to develop application products derived from the EPS.

(*1 and 4: Shingo Yamada, 2: Hiroshi Koide, and 3: Tadashi Ando*)

A special Report on Extremely Cold Weather over Northeastern Asia in December 2005 prepared

In December 2005, it was extremely cold over northeastern Asia, and averaged temperature over Japan was the lowest since 1948. One of the reasons for the cold weather is significant meandering of the westerly jet influenced by the persistency of the negative phase of the Arctic Oscillation. Another reason was that the extremely active convection over the Bay of Bengal, the South China Sea and the Philippine Sea was strongly related to the cold weather. A stationary Rossby wave train along the strong Asian jet, which was excited by the active cumulus convection over those areas, caused the persistent and large-amplitude meandering of the jet, leading to the repetitive cold air outbreaks in and around Japan. But it remains to reveal the reason for the persistency of the active convection over the area, and it is necessary to examine whether the AO interacts with the stationary Rossby wave excited by the active convection.

The special report about the extremely cold weather and the active convection is available on the TCC website:
http://okdk.kishou.go.jp/news/topics_20060127.html

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Any comments or inquiries on this newsletter and/or the TCC website would be much appreciated. Please e-mail to the following address:
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