Tokyo Climate Center, Japan Meteorological Agency

# TCC News

No. 7 January 2007

## Contents



## Global Temperature 2006: Third Warmest since 1891

**The global surface temperature anomaly of 2006 was +0.31°C above normal, the third highest on record since 1891.**

Japan Meteorological Agency (JMA) monitors the global warming using surface temperature combined not only over land but also over the ocean (also see the article in the "TCC News" No.3). The annual anomaly of global average surface temperature during 2006 was +0.31 °C above normal (1971-2000 average) and was the third highest next only to 1998 and 2005 same as 2003 and 2002 since 1891. The annual mean temperature over the globe has increased at a rate of 0.67 °C per 100 years (Figure 1). Focusing on after the middle of 1980s, the annual-mean temperatures were above normal for most of the years and, especially, those in last 10 years (1997 to 2006) ranked within the 11th warmest since 1891. The annual-mean temperature has 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. For more information, please refer to http://okdk.kishou.go.jp/products/gwp/temp/ann_wld.html.

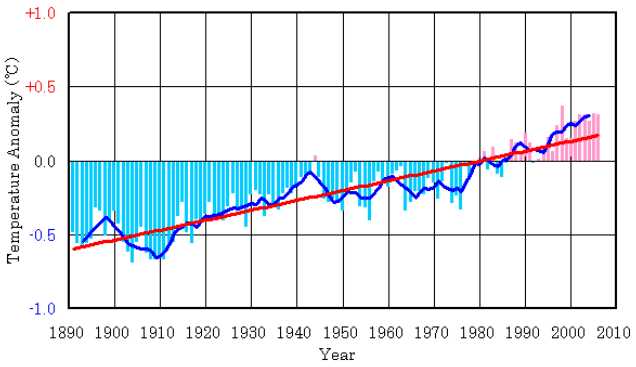


**Figure 1 Annual anomalies of global average surface temperature from 1891 to 2006**

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

(*Hiroko Morooka, Climate Prediction Division*)

## Highlights of Global Climate for 2006

**Annual mean temperatures were above normal in most of the world. Annual precipitation amounts were below normal in southeastern Australia and extremely light precipitations were observed frequently since June 2006. 23 named tropical cyclones formed in the western North Pacific in 2006 (the 1971-2000 average: 26.7).**

### 1. Annual mean climate

Annual mean temperatures were above normal in most of the world, except southern Siberia and the coastal areas of Australia, and especially high in western Europe, eastern North America and from China to the Middle East (Figure 2). Annual precipitation amounts were above normal in eastern and western Siberia, southeastern Africa, northwestern Australia, around India and around the eastern Caribbean Sea, while they were below normal in southern Europe, southeastern Australia, over the eastern Indian Ocean and from Mongolia to northern China (Figure 3).

### 2. Significant climatic events

Significant climatic events and weather disasters in 2006 are summarized below (Figure 4). Information of the numbers of fatalities is based on the reports of the press and EM-DAT: The OFDA/CRED International Disaster Database (http://www.em-dat.net).

**(1) Tropical cyclones in China (May to August)**

Typhoons "Chanchu", "Kaemi", "Prapiroon", "Saomai" and a tropical storm "Bilis" approached to or made landfall on the southeastern part of China between May and August. It was reported that the total number of fatalities caused by them reached 1,400 in China.

**(2) Heavy rains from Japan to the Korean Peninsula (July)**

In July, heavy rains related to the active Bai-u/Changma front caused 30 and 46 fatalities in Japan and Republic of Korea, respectively.

**(3) Heavy rain and tropical cyclones in the Philippines (February, May, September to November)**

In February, a heavy rain caused a large-scale landslide that led to more than 1000 fatalities in southern Leyte Island (for details: http://okdk.kishou.go.jp/news/tccnews04.pdf). Typhoons "Chanchu", "Xangsane", "Cimaron" and "Durian" approached or passed the Philippines in May and September to November. It was reported that the total number of fatalities caused by typhoons reached 1,000.

**(4) Cold waves in Europe (December 2005 to January 2006)**

In December 2005 and January 2006, extremely low temperatures were observed repeatedly in Europe. In Russia and eastern Europe, it was reported that cold waves brought 1,000 or more fatalities.

**(5) Heat waves in Europe (June to July)**

Heat waves in June and July brought more than 1,900 fatalities around central Europe. According to the weather services in UK, Netherland and Germany, July 2006 was the warmest month on record in those countries.

**(6) Heavy rains in eastern Africa (August to November)**

In eastern African countries, heavy rains occurred frequently between August and November and caused fatalities and damage. Especially, in Ethiopia, it was reported that more than 800 fatalities in August.

**(7) Heat waves in US (July to August)**

Western and northeastern US suffered from heat waves in July and August, respectively. It was reported that the heat waves led to more than 180 deaths in US.

**(8) Drought in Australia (since June)**

Extremely light precipitation was often observed around southeastern Australia since June. It was reported that due to severe drought, the amount of wheat harvest of 2006 was expected to be below 40 percent of 2005 in Australia.

(*Ayako Takeuchi, Climate Prediction Division*)

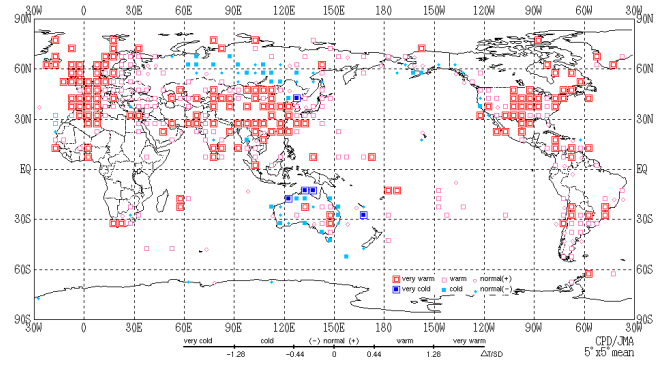

**Figure 2 Annual mean temperature anomaly in 2006**
Categories are defined by normalized annual temperature anomaly from normal (1971-2000 average).

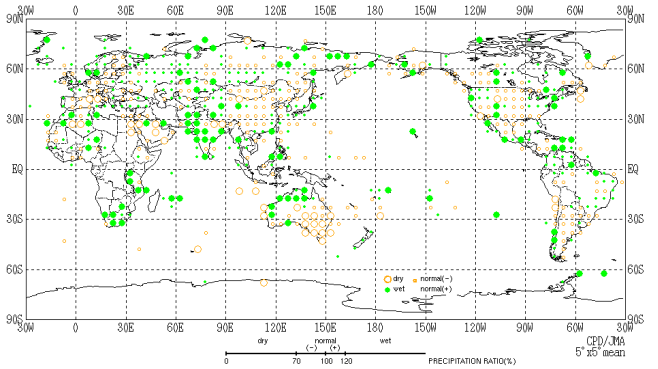

**Figure 3 Annual total precipitation ratio in 2006**
Categories are defined by annual precipitation ratio to normal (1971-2000 average).

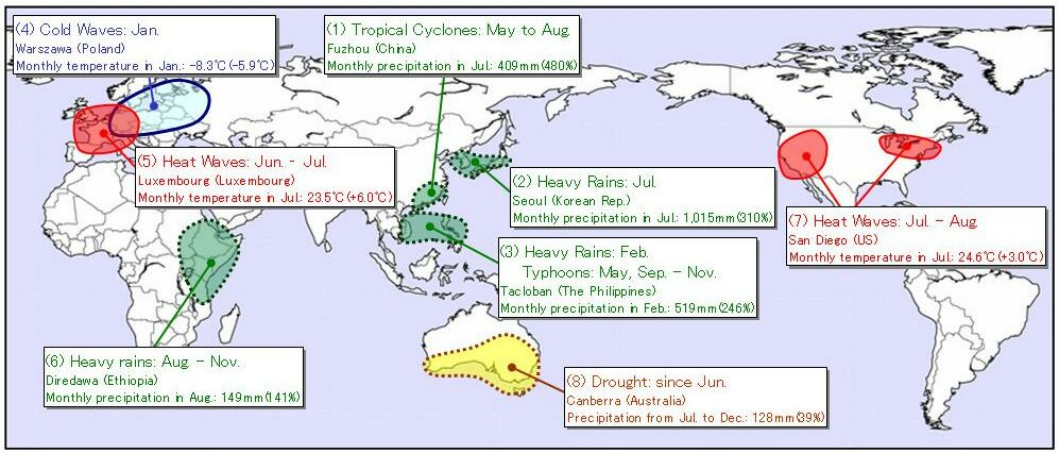


**Figure 4 Significant climatic events and damage in 2006**
Numerals in parentheses in the figure correspond to the respective event numbers in the section "2. Significant climatic events" of this article.

## Climate Summary in Japan for 2006

**The annual mean temperature was above normal over whole Japan. From December 2005 to January 2006, strong winter monsoon persisted, bringing record snowfalls and causing serious damage on the Japan Sea side. In July, active Bai-u front, located over Japan, brought extremely heavy rainfall and led to serious disasters in western and eastern Japan.**

**(1) Annual mean temperature, precipitation and sunshine duration (Figure 5)**

The annual mean temperature was above normal in all regions. From January to July 2006, warm and cold days were alternately experienced at intervals of about 10 days, and warmer-than-normal days were dominant in the rest of the year. The annual precipitation amounts were above normal in all regions except for the Japan Sea side area of

Eastern Japan and Nansei Islands where they were normal. The annual sunshine durations were below normal in all regions and they were remarkably below normal in the Pacific side of Northern and Eastern Japan.

**(2) Seasonal climatic features (Figure 6)**

Through December 2005 and the former half of January 2006, strong winter monsoon pattern continuously appeared and brought record snowfalls in the Japan Sea side areas. Although warm and cold days alternately appeared in the latter half of winter, the deepest snow-depth was recorded at 23 of 339 stations observing snow-depth. These record snowfalls brought serious damage to the society and it was named "The Heavy Snowfall in the winter 2005/06" by JMA.

In spring, the fluctuation of temperature was large and spring mean temperature was near-normal in most regions of Japan. Cold vortices and fronts tended to be active in April and May, respectively, and these brought unusually low sunshine duration in most regions of Japan.

The onsets of Bai-u, rainy season of Japan, were near-normal or later-than-normal in most regions of Japan. Bai-u front was more active than its normal and heavy rainfalls occurred nationwide. The remarkably heavy rainfall, named "The Heavy Rainfall in July 2006" by JMA, continued from 15th to 24th July and serious disasters were experienced nationwide. The ends of Bai-u were later than their normal in most regions, resulting in that summer sunshine duration was nationwide below normal. On the other hand, hot days were dominant due to Pacific high covering Japan in August and summer mean temperature was above normal in all regions.

In autumn, fine and warm days were dominant nationwide due to migratory highs tending to cover and cold air flow rarely occurring. Autumn mean temperature was above normal, and the western and eastern parts of Japan experienced record-breaking warm October. The fronts, usually causing autumn rainy spells, were also inactive, resulting in above-normal nationwide sunshine duration and remarkably little rainfall in the western and south-western parts. On the contrary, several developed lows brought heavy rainfalls in the northern and eastern parts leading to deluges in a short period, and tornados frequently occurred in November due to unstable atmospheric condition formed by low-level advection of wetter and warmer air. The tornado attacking Saroma town, Hokkaido district, killed nine residents.

Warm days were also dominant in December due to weaker-than-normal winter monsoon, and the snowfall amount in the Japan Sea side was below normal.

(*Shunji Takahashi, Climate Prediction Division*)

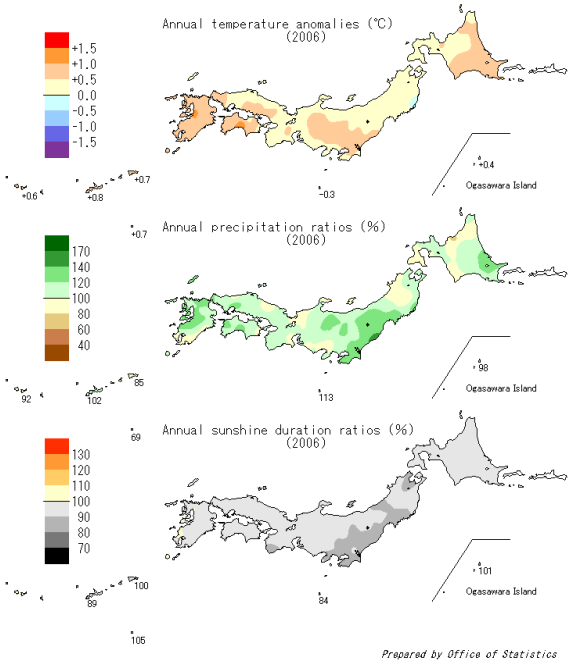


**Figure 5 Annual Climate Anomaly/Ratio over Japan**

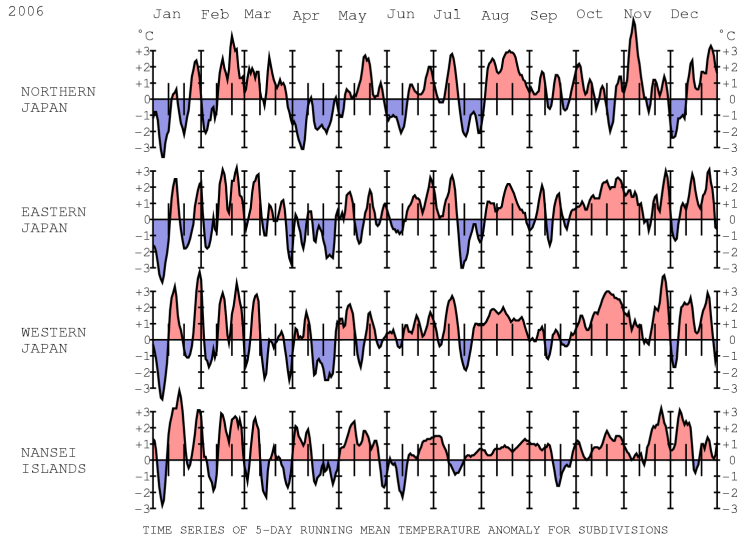


**Figure 6 Five-day Running Mean Temperature Anomalies for Regions**

## Start of "Monthly Highlights on Climate System"

'Monthly Highlights on Climate System' is going to be initiated in April 2007, succeeding 'Monthly Report on Climate System' which has been published since April 1987. It is to be issued as a monthly bulletin in the PDF format focusing on monthly highlights of climate, atmospheric circulation and oceanographic condition. The report guides detailed information of climate monitoring and analysis on the TCC website. Around the same time, the historic atmospheric circulation figures from 1979 and more useful climate diagnosis products are going to be provided on the TCC website. JMA also has a plan to start early 2008 to issue 'Annual Report on Climate System' (provisional title) which includes topics of the extreme climate events in the world as well as a summary of the world climate and climate system of the year.

(*Hiroshi Nakamigawa, Climate Prediction Division*)

# TCC's Research and Development Activity in 2006:
## downscaled probabilistic one-month prediction products for Southeast Asian countries —Major outcomes and future challenges—

**In order to support the NMHSs in issuing probabilistic forecast information that is suitable to be incorporated into decision-making processes, TCC has developed the downscaled probabilistic one-month prediction methods for Southeast Asian countries in cooperation with the FUJITSU FIP Corporation since 2004, and successfully finalized them in January 2007.**

### 1. Previous years' achievements

In FY 2004, it was indicated that there was a possibility of making appropriate probabilistic forecasts of Week-2 mean temperature and monthly accumulated precipitation, using JMA's operational one-month Ensemble Prediction System (EPS) outputs from March 2001 to February 2004. In FY 2005, a statistical downscaling technique was developed and verified mainly for 7-day and 28-day precipitation amounts using the high-quality and long-term daily surface climate database and the JRA-25 data. It was found that in general the multivariate regression using orographical predictor improved forecast skill, but the effect of the orographic predictor significantly differed from region to region and from season to season.

### 2. Major achievements and findings in FY 2006

#### 2-1 Improvement of the statistical downscaling technique

14-day precipitations at stations in Southeast Asia were regressed with the 10-year extended-range ensemble hindcasts with 11 members. Then they were verified using cross-validation technique excluding samples year by year. New predictors, such as the MJO indices and the NINO.3 SST index, were considered on top of the orographic predictor. It was found the new predictors improve the prediction skill at many stations and seasons.

#### 2-2 Development of a prototype of probabilistic prediction products at stations

The probability density function estimation technique, which was validated in FY 2004, was applied to the downscaled prediction described in Section 2-1. Verification of the probabilistic prediction was done on a country-by-country basis. It was found to have significantly better skill than the climatological one, and to have high reliability, not only for above- or below-median probability, but also for exceeding upper-one-third probability.

#### 2-3 Technical transfer and collaborative development with MMD and TMD

An official of TCC had meetings with the Malaysian Meteorological Department (MMD) and the Thai Meteorological Department in January 2007. He introduced the method and the verification results of the downscaled probabilistic prediction products mentioned in Section 2-3 and provided them technical documents and some sample products. It was agreed that TCC and TMD/MMD would try to develop some application products collaboratively under the necessary technical assistance by TCC.

### 3. Remaining issues for the future

#### 3-1 Operational provision of the downscaled probabilistic prediction products

Now that the statistical downscaling technique and the probability density estimation method has proved to work well, it should be considered to produce real-time prediction products from the operational one-month EPS outputs and to disseminate them through the Internet to the NMHSs in Southeastern Asia regularly. It would be helpful for conducting near-real-time verification and for developing some applications out of them.

#### 3-2 Needs for web-based application tools

It was found in the meetings with MMD and TMD that they would like to develop the same kind of tailored products which meet specific users' needs by themselves. It is thought desirable to develop web-based tools which assist the NMHSs in developing their original prediction products by using their original observation data. Because TCC has both statistical tools and consistent historical analysis and prediction data, such as JRA-25/JCDAS, COBE-SST and hindcasts, it would help a lot if TCC could develop a web-based analysis and prediction tools in the future.

#### 3-3 Technical transfer of the statistical downscaling method

It was also revealed during the meeting with MMD and TMD, that basic knowledge on the statistical and probabilistic methods was lacked by many of the staff in NMHSs. It is quite important to carry out technical transfer and capacity building meeting the needs and backgrounds of each country, in order to promote better use of this kind of new prediction product.

(*Shingo Yamada, Climate Prediction Division*)

# TCC's Activities in 2006 and Action Plans in 2007

**TCC has formulated "Activity Report at Tokyo Climate Center in 2006", which contains climate-related activities conducted at JMA in 2006 and TCC's action plans in 2007. Here, main points of the report is introduced. The whole document will be available at the TCC website soon.**

### 1. TCC website and products

The TCC web server will be renewed in April 2007. In the second quarter of 2007, its website design will be renewed and the RA-II RCC Network homepage will be opened. It is planned to add some new monitoring, diagnosis and prediction products sequentially to the new website. For example, in the second quarter of 2007, the downscaled prediction products are planned to be experimentally provided through the TCC website.

### 2. JRA-25 and COBE-SST

The joint project between JMA and Central Research Institute for Electric Power Industry on the long-term global atmospheric reanalysis, called "Japanese 25-year Reanalysis (JRA-25)", was finalized in March 2006. After registration, JRA-25 data are available through the JRA-25 official website (http://jra.kishou.go.jp/index_en.html). The JMA Climate Data Assimilation System (JCDAS), inheriting

the data assimilation system used in the JRA-25, was implemented into operation. The Sea Surface Temperature (SST) analysis system was upgraded to the same one used in the centennial SST reanalysis (Ishii et. al., 2005), which is called COBE-SST.

**3. Extended- and long-range EPS**

The extended-range (one-month) Ensemble Prediction System (EPS) was separated from the medium-range EPS, and its ensemble size was increased from 26 to 50. The atmospheric global prediction model for the extended-range EPS was upgraded to the medium-resolution version (TL159L40) of the JMA Global Spectral Model for short-range forecasting (GSM0507). The long-range (three-month and warm/cold season) EPS was upgraded to the low-resolution version (TL95L40) of the JMA Global Spectral Model for short-range forecasting (GSM0502), and its ensemble size is planned to increase from 31 to 50 in 2007. In 2007, the extended- and long-range EPS is planned to be subsequently upgraded through improvements of physical processes in the model and introduction of new environmental data.

**4. ODAS and El Niño prediction system**

MRI (Meteorological Research Institute) of JMA has been developing a new Ocean Data Assimilation system, named MOVE (Multivariate Ocean Variational Estimation) system, and an ocean prediction model, named MRI.COM (MRI Community Ocean Model), since 1999. The new ocean analysis system and the ocean-atmosphere coupled prediction system are scheduled to be implemented into operation in March 2008.

**5. Global warming projection**

The projection of the atmospheric and oceanic climate around Japan for the end of this century is under calculation with a regional coupled ocean-atmosphere model developed in MRI/JMA and the improved version of the global ocean-atmosphere coupled model, named MRI-CGCM2.3. In March 2008, both global and regional features of the projected climate and ocean currents is planned to be published as the "Global Warming Projection Volume 7".

**6. RCC and GPC**

TCC has applied for the Regional Climate Centre (RCC) status in WMO RA-II with its implementation plan, which is available at the TCC website (http://okdk.kishou.go.jp/about/implementation_plan_2006.pdf). TCC has also applied for the Global Producing Centre (GPC) for Long-Range Forecast (LRF) with an activity report, which is available at the WMO website (ftp://www.wmo.int/Documents/SESSIONS/CBS.Ext(06)/English/pdf/d06-3(3)_en.pdf).

**7. Capacity building**

JMA has conducted a training course in meteorology for NMHSs' experts every year since 1973 as one of the training courses provided by the Japan International Cooperation Agency (JICA). The course in 2006 is focused on operational use of numerical weather prediction, satellite meteorology and climate information. In the climate information session, trainees were given lectures on climate system monitoring, long-range forecasting, El Niño outlook and global warming projection and were provided practices on displaying and analyzing the forecast and analysis data. In September to December 2007, this training course will be subsequently organized.

**8. International conference and workshop**

JMA is going to hold an international workshop on the "Applications of Advanced Climate Information in the Asia-Pacific Region" in 20-22 February 2007 in Tokyo, under the auspices of the Ocean Policy Research Foundation, Japan. The third WCRP international conference on reanalysis is planned to be held in January 2008 in Tokyo.

(*Shingo Yamada, Climate Prediction Division*)

## Update of JMA's Seasonal Ensemble Prediction System

JMA's extended- and long-range ensemble prediction systems (EPS) are scheduled to be upgraded in March and in the middle of 2007, respectively. Regarding the global atmospheric prediction model used in the extended-range EPS, main points to be changed are as follows:

i) Update of absorption coefficient of water vapor in the solar radiation scheme, including the continuum absorption effect,

ii) Introduction of the new climatology of aerosol optical depth based on satellite observation data compiled by the Atmospheric Environment Division, JMA, and

iii) Introduction of the improved cumulus convection scheme, including trigger function and raindrop re-evaporation.

It has been shown that this new model (GSM0703C) has smaller systematic error, especially in the lower tropospheric temperature around Japan. Along with this model change, the Breeding of Growing Modes (BGM) method, which is used for making perturbed initial condition, is going to be improved. The improved BGM method gives smaller initial perturbation than the current one in the tropics, and properly takes into account instability associated with the Madden Julian Oscillation (MJO); it is expected to improve the probabilistic forecasting skill of the MJO.

As for the upgrade of the long-range EPS, it is planned in the middle of 2007 that the low resolution version of the GSM0703C is introduced and the number of ensemble members is increased to 50 from 31. In the new EPS, uncertainty in prescribed SST will be considered in addition to uncertainty in the initial condition.

(*Shuhei Maeda, Climate Prediction Division*)

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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