Tokyo Climate Center, Japan Meteorological Agency

TCC News

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Contents

Global Temperature in 2010

The annual anomaly of the global average surface temperature in 2010 was the second highest on record at 0.34°C above normal.

Monitoring temperature records across the globe is essential in understanding, mitigating and adapting to the changing climate of Planet Earth. As one of the world's leading climate centers, the Japan Meteorological Agency (JMA) calculates the global mean surface temperature (i.e., the combined average of near-surface air temperatures over land and sea surface temperatures) on a monthly and an annual basis, thereby helping to raise public awareness of the ongoing development of global warming.

The annual anomaly of the global average surface temperature last year was +0.34°C against the 1971 – 2000 average, which was the second-highest figure (after 1998) since 1891 – the earliest year of JMA's global temperature anomaly records (Figure 1, Table 1). Warm temperature deviations were noticeable around the world, not least in the Indian Ocean and the Atlantic Ocean, with some exceptions in parts of Central Asia (Figure 2). The average temperature over terrestrial surfaces was the third highest on record.

On a longer time scale, the annual global average surface temperature has been rising at a rate of about 0.68°C per century.

It can be presumed that the high temperatures seen in recent years have been influenced by natural climatic variability (which fluctuates in cycles with durations ranging from several years to several decades) as well as by longer-

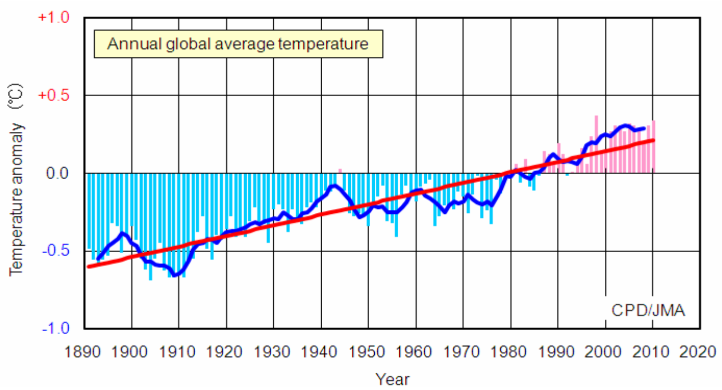

Figure 1 Long-term change in surface temperature anomalies averaged over the globe
The light-blue and pink bars indicate anomalies of surface temperature for each year. The blue line indicates the five-year running mean, and the straight red line shows the long-term linear trend. Anomalies are calculated as deviations from the normal (i.e., the 1971 – 2000 average).

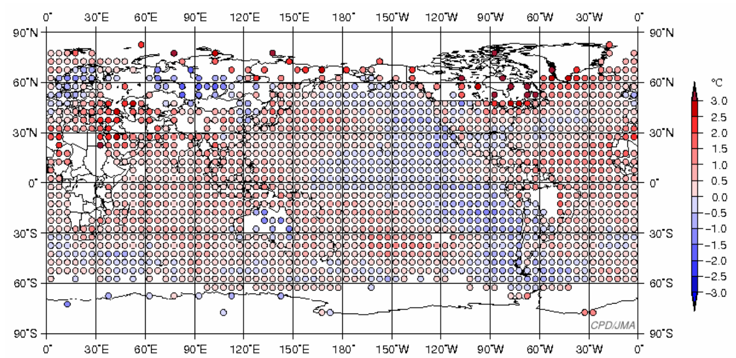

Figure 2 Annual mean temperature anomalies in 2010
The filled circles indicate temperature anomalies from the climatological normal (i.e. the 1971 – 2000 average) averaged in 5° x 5° grid boxes.

term global warming stemming from increased atmospheric concentration of anthropogenic greenhouse gases, including CO_2. In addition to these factors, the warm conditions experienced in 2010 can also be attributed to an El Niño event that lasted from summer 2009 to spring 2010.

Global average temperatures are monitored on an operational basis by multiple climate centers (the National Climate Data Center (USA), the Goddard Institute for Space Studies (USA), the Met Office Hadley Centre (UK) and JMA). On a monthly basis, these centers calculate the global temperature independently of each other in terms of analytical approaches and computation procedures. Despite this methodological divergence, the results they produce indicate similar patterns of month-to-month and year-to-year variability, and more importantly, an almost-identical long-term warming trend (Figure 3). The four records all show that our planet has become almost 0.8°C warmer than it was at the beginning of the 20th century.

Monthly and annual temperature anomaly datasets for 5° x 5° grid boxes are available for download at http://ds.data.jma.go.jp/tcc/tcc/products/gwp/temp/map/download.html.

(Yoshinori Oikawa, Climate Prediction Division)

Table 1 Top ten annual global temperatures
(Shown as anomalies relative to the 1971-2000 base period)

Rank	Year	Temperature Anomaly
1	1998	+0.37
2	***2010***	***+0.34***
3	2005	+0.32
4	2009	+0.31
	2006	+0.31
	2003	+0.31
	2002	+0.31
8	2007	+0.28
9	2004	+0.27
	2001	+0.27

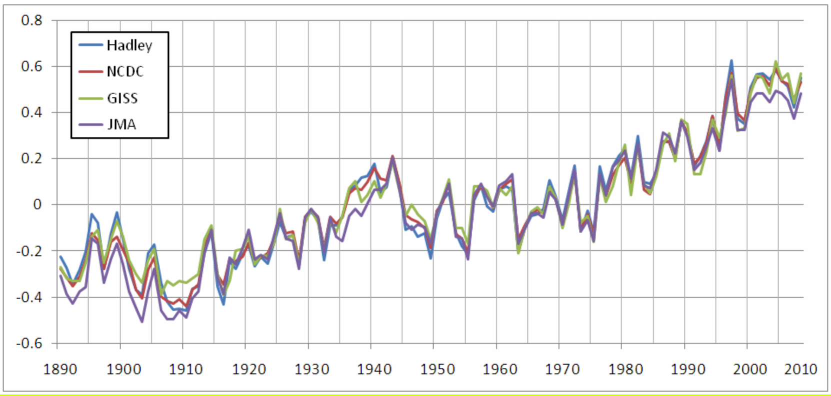

Figure 3 Global surface temperature records from four independent climate centers
Albeit small differences in ranges of annual fluctuation, the four records show long-term rising trends remarkably close to each other. (Note: Anomalies are adjusted to the base period of 1951 – 1980, for the sake of convenience of comparison.)

Highlights of the Global Climate in 2010

Annual mean temperatures were above normal in most areas of the world except in the areas of western to central Siberia, Europe and Australia (Figure 4). Extremely high temperatures were frequently observed around low latitudes between 30°S and 30°N, around western Russia, and around eastern North America, while extremely low temperatures were observed in Europe from January to February and from November to December and around the southeastern USA from February to March and in December.

Annual precipitation amounts were above normal in Indonesia, around Pakistan, in eastern Europe, in western Africa, in the northwestern USA, around the Caribbean Sea and in Australia, while they were below normal in southwestern South America (Figure 5). Extremely heavy precipitation amounts were frequently observed in northeastern China, around southern Indonesia and around the Caribbean Sea, while extremely light precipitation amounts were often seen in southwestern South America.

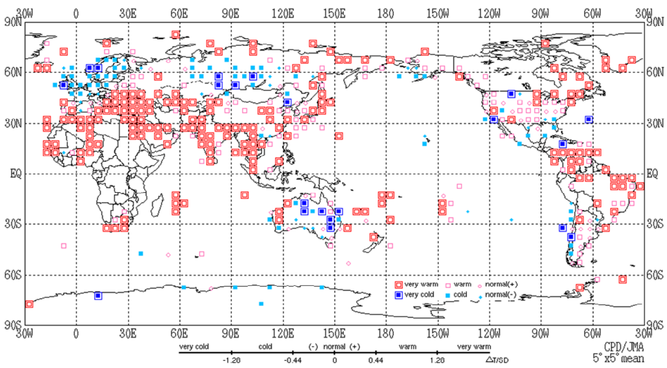

Figure 4 Annual mean temperature anomalies for 2010
Categories are defined by the annual mean temperature anomaly against the normal divided by its standard deviation and averaged in 5° × 5° grid boxes. The thresholds of each category are -1.28, -0.44, 0, +0.44 and +1.28. The normal values and standard deviations are calculated from 1971 – 2000 statistics. Land areas without graphics represent regions for which the sample size of observation data is insufficient or normal data are unavailable.

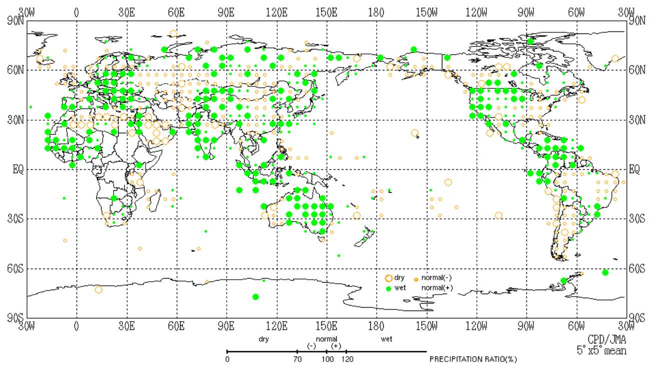

Figure 5 Annual total precipitation amount ratios for 2010
Categories are defined by the annual precipitation ratio to the normal averaged in 5° × 5° grid boxes. The thresholds of each category are 70%, 100% and 120%. Land areas without graphics represent regions for which the sample size of observation data is insufficient or normal data are unavailable.

The major extreme climatic events and weather-related disasters of 2010 are listed below (also see Figure 6):

(1) Low temperatures around western Siberia (Jan. – Feb., Dec.)
(2) Low temperatures around Mongolia (Feb. – Apr., Dec.)
(3) High temperatures around Japan (Jun. – Sep.)
(4) Torrential rains in central China (Aug.)
(5) Typhoons and heavy precipitation amounts from western Japan to Thailand (Oct.)
(6) High temperatures in Southeast Asia (all year round)
(7) Heavy precipitation around southern Indonesia (Jul. – Oct.)
(8) Heavy precipitation around Pakistan (Jun. – Sep.)
(9) Low temperatures in Europe (Jan. – Feb., Nov. – Dec.)
(10) High temperatures and light precipitation around western Russia (Jun. – Aug.)
(11) High temperatures from the Middle East to western Africa (all year round)
(12) High temperatures around Madagascar (all year round)
(13) High temperatures around eastern North America (all year round)
(14) Low temperatures around the southeastern USA (Feb. – Mar., Dec.)
(15) Heavy precipitation around the Caribbean Sea (Jun. – Dec.)
(16) High temperatures in northern South America (Jan. – Nov.)
(17) Low temperatures in southern South America (May, Jul. – Aug., Dec.)
(18) Heavy precipitation in eastern Australia (Dec.)

(Takafumi Umeda, Climate Prediction Division)

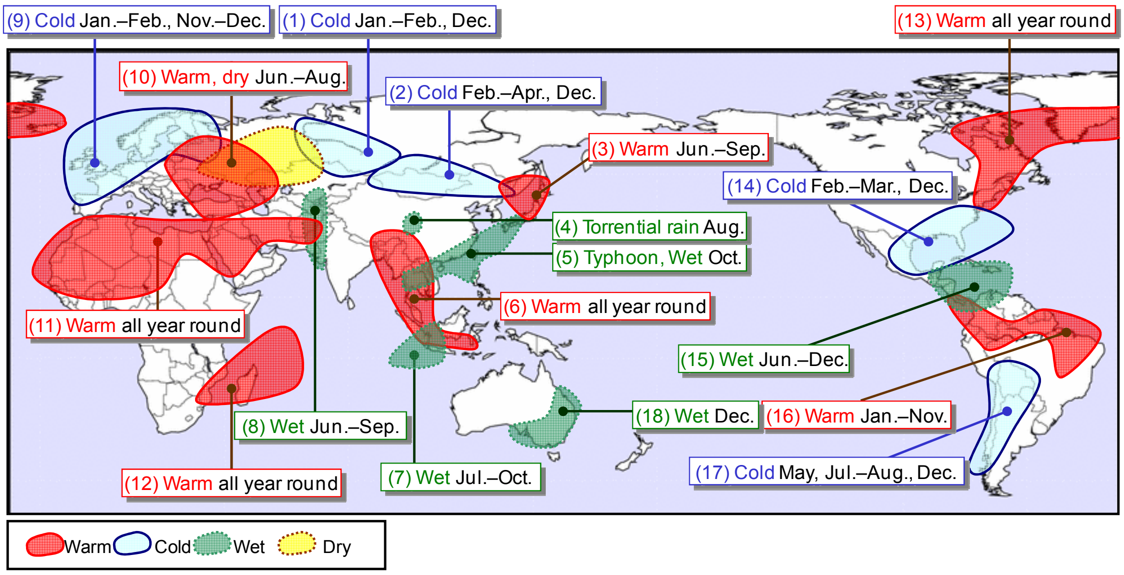

Figure 6 Major extreme climate events and weather-related disasters across the world in 2010
Schematic indication of major extreme climate events and weather-related disasters that occurred during the year

Summary of Japan's Climate in 2010

- **Above-normal annual mean temperatures nationwide**
- **Above-normal annual precipitation except on the Sea of Japan side of western Japan**
- **Very large intraseasonal temperature variations in winter and spring**
- **Hottest summer in more than 100 years**
- **Severe late-summer heat in the first half of September**

(1) Average surface temperature, precipitation and sunshine duration (Figure 7)

Annual mean temperatures were above normal nationwide, and the average surface temperature over Japan (averaged over 17 observatories confirmed as being relatively unaffected by urbanization) in 2010 was 0.86°C above normal (based on the 1971 – 2000 average), which was the fourth highest since 1898.

Annual precipitation amounts were above normal except on the Sea of Japan side of western Japan. Annual sunshine durations were significantly below normal in northern Japan and Okinawa/Amami.

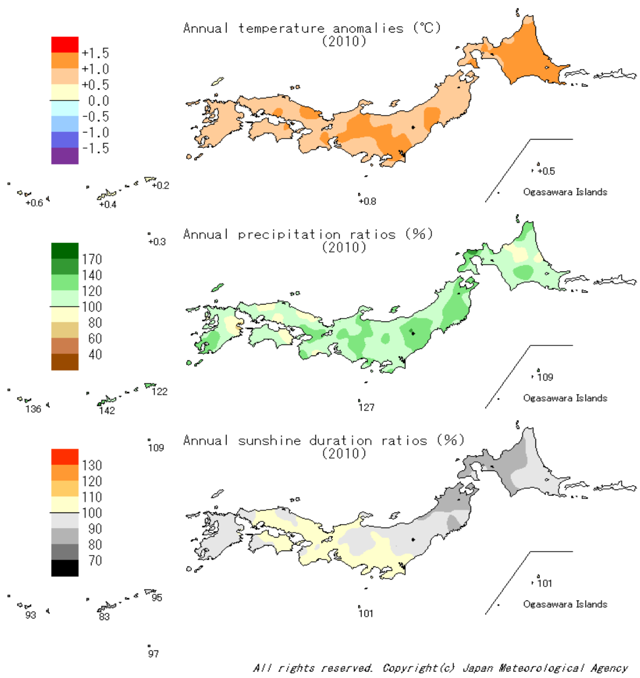

Figure 7 Annual climate anomalies/ratios over Japan in 2010

(2) Seasonal features (Figure 8)

(a) Winter (December 2009 – February 2010)

Although seasonal mean temperatures were above normal nationwide, intraseasonal temperature variations were large. Due to cold spells, many parts on the Sea of Japan side were hit by heavy snowfall in the middle of December, the first half of January and the first ten days of February. In early February, heavy snowfall hit Niigata on the Sea of Japan side of eastern Japan with a maximum snow depth of 81 cm, which was the highest on record since winter 1984/85.

(b) Spring (March – May 2010)

Intraseasonal temperature variations were very large nationwide. In the first and second ten-day periods of March and in the first ten days of May, temperatures were significantly above normal nationwide due to warm-air advection from the south. However, in the last ten days of March, the latter half of April and the last ten days of May, temperatures were below normal nationwide due to cold spells. Since cyclones and fronts frequently passed near mainland Japan, seasonal precipitation amounts were significantly above normal in northern, eastern and western parts of the country, and seasonal sunshine durations were significantly below normal in northern Japan and on the Sea of Japan side in eastern and western parts of the country.

(c) Summer (June – August 2010)

Japan experienced its hottest summer in more than 100 years, and the seasonal mean temperature was the highest on record since 1898. In particular, August was so hot that 77 out of 154 observatories in Japan recorded new record-high monthly mean temperatures. Seasonal precipitation amounts were significantly above normal on the Sea of Japan side of northern Japan due to the influence of fronts.

(d) Autumn (September – November 2010)

Seasonal mean temperatures were above normal nationwide, and significantly above normal in northern Japan. Due to severe late-summer heat in the first half of September, 46 out of 154 stations recorded new highs for the number of extremely hot days (i.e., those with a maximum daily temperature of 35°C or more) in September. Seasonal precipitation amounts were significantly above normal in Okinawa/Amami.

(Shuhei Maeda, Climate Prediction Division)

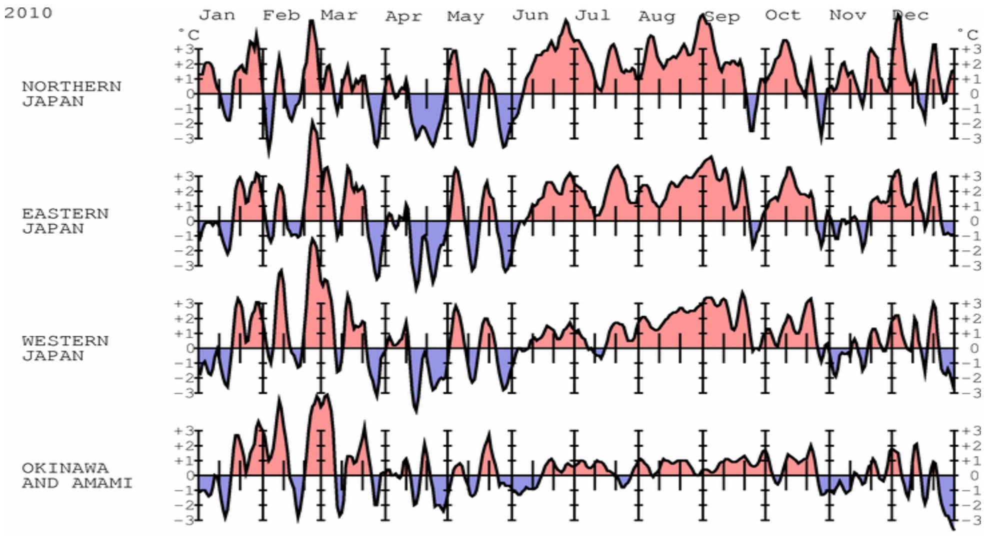

Figure 8 Time series of five-day running mean temperature anomalies for subdivisions
The normal is the 1971 – 2000 average.

Update of JMA's One-month Ensemble Prediction System

JMA will update its Ensemble Prediction System (EPS) for operational one-month forecasting on 4 March, 2011. The main updates are outlined below.

* Implementation of a new dynamical frame
  - Reduction of execution time
  (Application of reduced Gaussian Grids: reduction of the number of grid points used in the calculation of nonlinear terms – especially in the polar region – in order to save on execution time and computational resources)
  - Quadrupling of precision in evaluating the parameters for transformation between spectral and grid-point space
  - Refinement of other dynamical processes

* Update of the climatological aerosol total optical depth

* Minor change to land surface processes
  (Refinement of permeability in soil to improve soil wetness reproducibility in the snowmelt season)

As these updates involve only minor changes to the model physical processes, the impact on prediction fields is small, and the level of prediction skill is expected to be comparable to that of the current system. Meanwhile, hindcast experiments have been executed using the new system, and the target period will be extended from 1979 – 2004 to 1979 – 2009. In addition, plans are under way to execute an experiment for 2010 by this summer.

One-month prediction products are available on the TCC website at http://ds.data.jma.go.jp/tcc/tcc/products/model/index.html. GPV data files for operational forecasting and hindcasting are also available exclusively to registered NMHSs. To register, please contact TCC at tcc@climar.kishou.go.jp.

(Masayuki Hirai, Climate Prediction Division)

TCC Activity Report for 2010

The Tokyo Climate Center (TCC) of the Japan Meteorological Agency (JMA) has prepared the *Activity Report of the Tokyo Climate Center for 2010*, covering climate-related activities by TCC in 2010 and its plans for 2011.

1. New Content on the TCC Website

TCC operates a website that provides climate-related operational data and products as well as presentation materials used in meetings and training events (http://ds.data.jma.go.jp/tcc/tcc/index.htm).

The Center makes annual and monthly mean global average temperature data available through its website, and the provision of seasonal mean global average temperatures (i.e., for winter, spring, summer and autumn in the Northern Hemisphere) was commenced in September 2010.

A useful web-based tool for climate diagnosis referred to as ITACS (Interactive Tool for Analysis of the Climate System) enables users not only to monitor the current climate status but also to analyze the complex systems that lie behind climatic conditions. In July 2010, an ITACS tutorial was made available on the ITACS web page (http://jra.kishou.go.jp/itacs-info/tcc/itacsinfo.html). As of the end of 2010, a number of NMHSs in the Asia-Pacific region (Indonesia, Thailand, Sri Lanka, Laos, Mongolia, Bangladesh, Philippines, Viet Nam, Malaysia and China) were registered as ITACS users.

2. Improvements to JMA's Ensemble Prediction System for Long-range Forecasting

JMA improved its ensemble prediction system for long-range forecasting in February 2010. The main updates were: (1) introduction of a coupled ocean-atmosphere general circulation model to replace the atmospheric general circulation model; (2) a change in ensemble techniques and EPS operation; and (3) provision of new grid point value products. In conjunction with these updates, relevant data and products (including monthly GPV data from individual ensemble members in addition to ensemble mean data and hindcast data) were also made available on the TCC web page (for registered NMHSs only). Please refer to TCC News No. 19 for details (http://ds.data.jma.go.jp/tcc/tcc/news/tccnews19.pdf).

3. Training Activities

JMA has conducted training courses in meteorology for experts from NMHSs since 1973 on an annual basis as one of the training initiatives provided by the Japan International Cooperation Agency (JICA). The 2010 course was held from September to December with an emphasis on the operational use of numerical weather prediction, satellite meteorology and climate information. In the climate information session, staff members from the Climate Prediction Division gave lectures on climate system monitoring, long-range forecasting, the El Niño outlook and global warming projection to four participants from Bhutan, Cambodia, Iran and Malaysia.

4. International Cooperation

In March 2010, a JMA expert visited the National Centre for Hydro-Meteorological Forecasting (NCHMF) of the Vietnamese National Hydro-Meteorological Service to discuss and exchange views for further improvement of the climate services provided by NCHMF and TCC.

In December 2010, at the request of the Indonesia Meteorological, Climatological and Geophysical Agency (BMKG), TCC hosted two experts from BMKG for three days. They learned about JMA's operational climate prediction and ocean wave models as well as their utilization.

TCC experts participated in a number of international meetings, including the sixth session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II (FOCRAII) held at the Beijing Climate Center in April, the first session of the South Asian Climate Outlook Forum (SASCOF) held in Pune, India in April, and the 11th Joint Meeting for the Seasonal Prediction of the East Asian Winter Monsoon in Seoul in November, organized by the Korea Meteorological Administration. These experts gave presentations on recent TCC activities, introduced the data and products available on the TCC website, and participated in discussions on the seasonal outlook for the coming season.

5. Future Plans

TCC will update its web page (http://ds.data.jma.go.jp/tcc/tcc/index.html) in March. The updated page will provide links to data and products in line with RCC mandatory functions ((1) operational activities for LRF, (2) operational activities for climate monitoring, (3) operational data services to support operational LRF and climate monitoring, and (4) training in the use of operational RCC products and services).

In February 2011, hindcast data for three-month and warm/cold season prediction (maps and charts) will be made available on the TCC website.

In March 2011, JMA will update its one-month forecasting model. Accordingly, relevant hindcast data will be made available on the TCC web page in advance (for registered NMHSs only).

As to improvements in JMA's ensemble prediction system for long-range forecasting, TCC will consider providing 1.25° x 1.25° grid GPV data for the Asian region in 2012.

In order to facilitate the utilization of seasonal forecast data, TCC will hold a training seminar on the application of seasonal forecast GPV data to seasonal forecast products in January. It will also hold another training seminar on seasonal prediction this autumn focusing on one-month forecasts.

(Kumi Hayashi,
Tokyo Climate Center, Climate Prediction Division)

TCC Training Seminar on Application of Seasonal Forecast GPV Data to Seasonal Forecast Products

TCC held the *Training Seminar on Application of Seasonal Forecast GPV Data to Seasonal Forecast Products* at JMA Headquarters in Tokyo from 18 to 21 January, 2011, as part of its capacity-building activities in its role as one of the Regional Climate Centers in WMO RA II. The purpose of the seminar was to assist NMHSs in enhancing their operational seasonal forecasting services. The event was attended by 19 representatives from 18 NMHSs engaged in operational long-range forecasting in the Asia-Pacific region (Bangladesh, Hong Kong, Indonesia, Kazakhstan, Laos, Malaysia, the Maldives, Mongolia, Myanmar, Nepal, Pakistan, the Philippines, Qatar, Singapore, Sri Lanka, Thailand, Uzbekistan and Viet Nam). The participants learned about the seasonal forecast GPV data available on the TCC website as well as their application to seasonal forecast products such as probabilistic seasonal forecasts.

After a series of lectures and practical exercises, individual participants gave presentations on the exercise results of statistical guidance for seasonal forecasting in each country. The seminar provided a good opportunity for the attendees to deepen their knowledge of GPV data utilization and application.

(Kumi Hayashi,
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Any comments or inquiries on this newsletter and/or the TCC website would be much appreciated. Please e-mail to: tcc@climar.kishou.go.jp

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