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Global Temperature 2007: Warmest over land since 1880

The global land surface temperature in 2007 was the highest on record since 1880, while the global average surface temperature in 2007 was the sixth highest since records began in 1891.

The annual anomaly of the global average surface temperature (i.e. the combined land-ocean temperature) during 2007 was 0.28°C above normal (based on the 1971–2000 average), and was the sixth highest since 1891. Annual mean temperatures were above normal in most land areas of the world. The greatest warming was found especially in high latitude regions of the Northern Hemisphere (Figure 1). The global land surface temperature anomaly in 2007 was 0.66°C above normal, and was the highest on record since 1880.

The annual mean temperature over the globe has been increasing at a rate of 0.67°C per 100 years (Figure 2). Focusing on the period after the mid-1980s, annual mean temperatures were above normal for most years and in particular, those in the last seven years (from 2001 to 2007) rank within the eighth warmest since 1891.

The annual mean temperature over the globe has varied along different time scales ranging from a few years to several decades, and its increasing trend is likely due to human activities, particularly the emission of greenhouse gases. For more information, please refer to http://ds.data.jma.go.jp/tcc/tcc/products/gwp/temp/ann_wld.html.

(Hiroko Morooka, Climate Prediction Division)

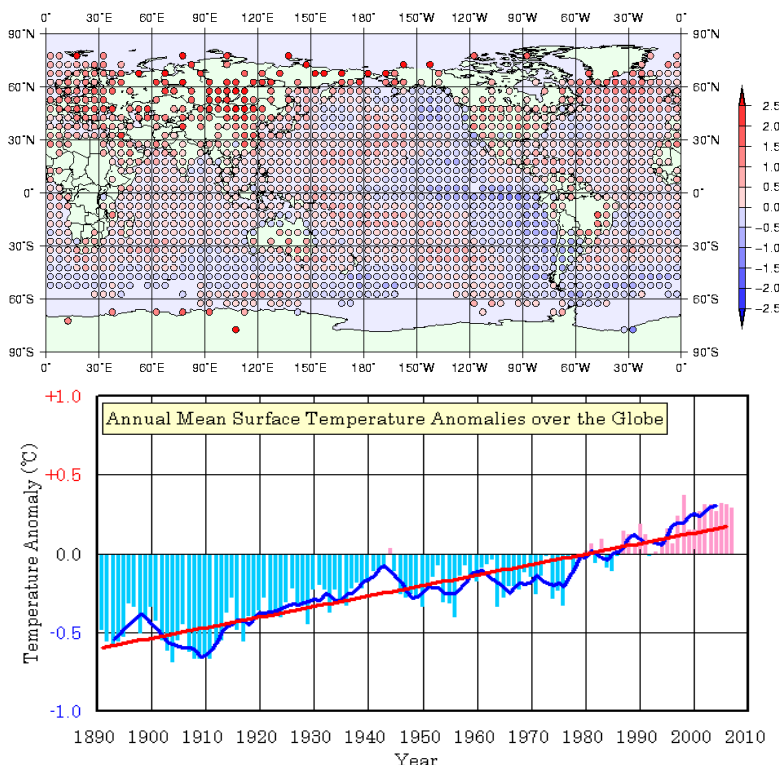


Figure 1
Annual mean temperature anomalies in 2007
The circles indicate temperature anomalies from the climatological normal (i.e. the 1971–2000 average) averaged in 5° x 5° grid boxes.

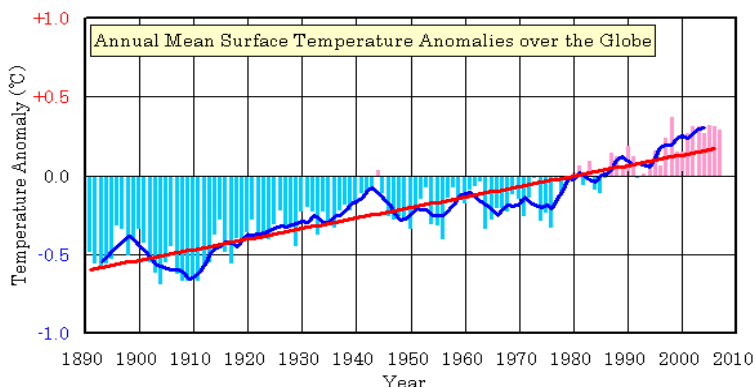


Figure 2
Annual anomalies in global average surface temperature from 1891 to 2007
The bars indicate anomalies from the climatological normal (i.e. the 1971–2000 average). The blue line indicates the five-year running mean, and the red line indicates the long-term linear trend.

Highlights of Global Climate for 2007

Annual mean temperatures were above normal in most areas of the world except South America (Figure 3). Extremely high temperatures were frequently observed in East Asia, eastern Siberia and Europe.

Annual precipitation amounts were above normal from Siberia to northern Europe and in Southeast Asia, while they were below normal around the Mediterranean Sea and in northeastern China, the USA and southern Australia (Figure 4). Extremely heavy precipitation amounts were frequently observed from Siberia to northern Europe and in Southeast Asia, while extremely light precipitation amounts were frequently observed in northeastern China, southern Europe and from southern Australia to New Zealand.

Major extreme events and weather-related disasters in 2007 are as listed below (Figure 5):

- (1) High temperature in eastern Siberia (Apr.–May and Aug.–Nov.)
- (2) Torrential rain in eastern China (Jun.–Jul.)
- (3) Tropical cyclone and torrential rain from the Korean Peninsula to China (Aug.)

- (4) Drought in southern China (Sep.–Nov.)
- (5) Heavy precipitation amounts in Pakistan (Feb.–Mar.)
- (6) Tropical cyclone and torrential rain in western Asia (Jun.)
- (7) Monsoonal torrential rains in India, Nepal and Bangladesh (Jun.–Aug.)
- (8) Cyclone in Bangladesh (Nov.)
- (9) High temperature in northern and western Europe (Apr.)
- (10) High temperature in southeastern Europe (May–Aug.)
- (11) Torrential rain over tropical Africa (Jul.–Sep.)
- (12) Cold wave in the USA (Jan.–Feb.)
- (13) Drought in the eastern and western USA (Year-long)
- (14) Drought in northeastern Brazil (Year-long)
- (15) Low temperature around Argentina (May–Aug.)
- (16) Drought in southern Australia (Jul.–Oct.)

(Hidehiko Isobe, Climate Prediction Division)

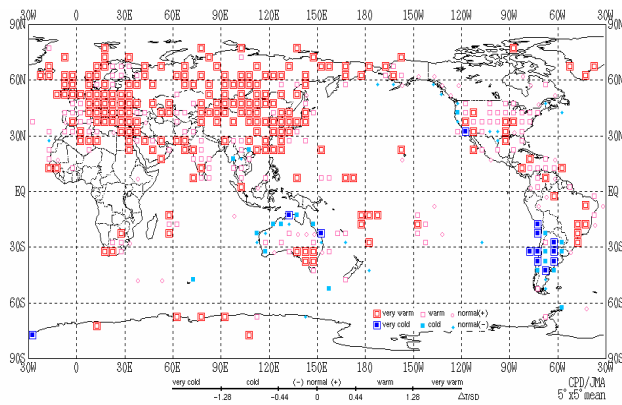


Figure 3 Annual mean temperature anomalies in 2007

Categories are defined by the annual mean temperature anomaly against the normal (based on the 1971–2000 average) divided by its standard deviation and averaged in $5^\circ \times 5^\circ$ grid boxes. The thresholds of the categories are -1.28σ , -0.44σ , 0 , $+0.44\sigma$ and $+1.28\sigma$, as shown in the legend. The normal values and standard deviations are calculated from 1971–2000 statistics. Land areas without marks represent regions for which observation data are insufficient or normal data are unavailable.

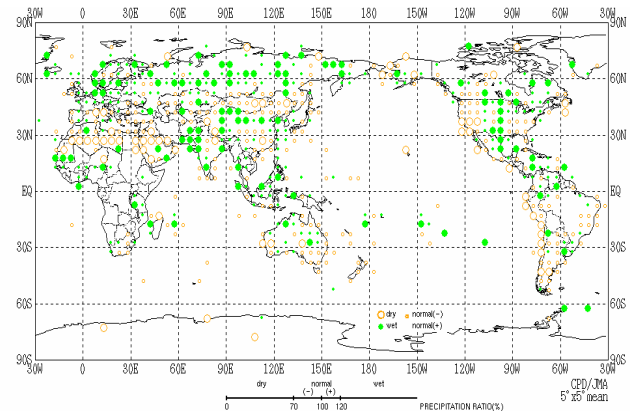


Figure 4 Annual total precipitation amount ratios in 2007

Categories are defined by the annual precipitation ratio to the normal (based on the 1971–2000 average) averaged in $5^\circ \times 5^\circ$ grid boxes. The thresholds of the categories are 70%, 100% and 120% as shown in the legend. Land areas without marks represent regions for which observation data are insufficient or normal data are unavailable.

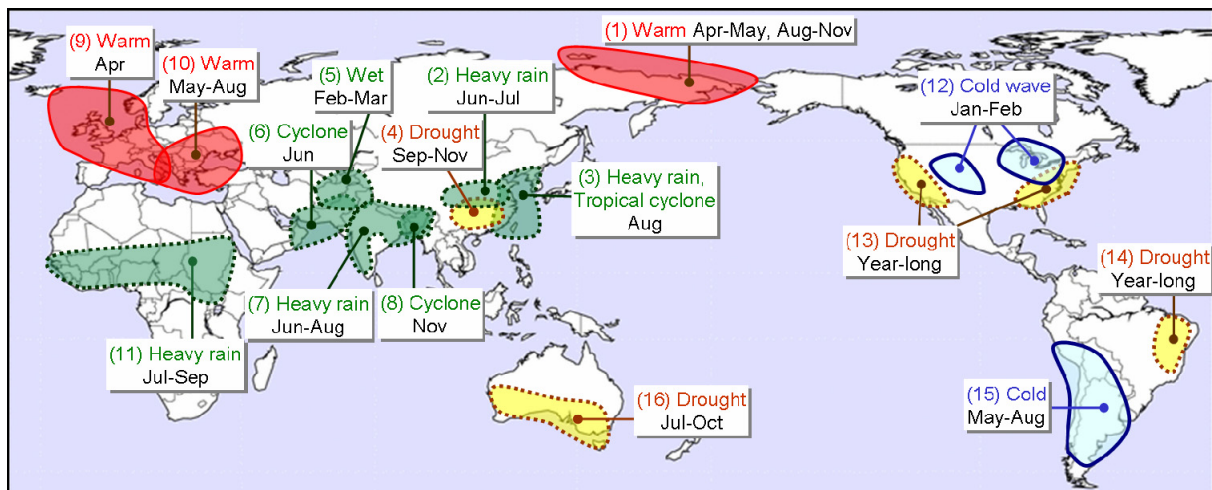


Figure 5 Extreme events and weather-related disasters in 2007

Major extreme climatic events and weather-related disasters in 2007 are indicated schematically.

Summary of Japan's Climate in 2007

- Fourth highest annual temperature on record, and light annual precipitation nationwide
- Warmest winter on record since 1946/47 and light snowfall amounts on the Sea of Japan side
- Sporadic cold spells and significantly light precipitation in western Japan in spring
- Remarkably delayed onset and end of rainy season
- New national record high temperature of 40.9°C marked on 16 August.
- Record-high autumn temperature with the lightest precipitation in western Japan
- Near-normal incidence of typhoon formation, approach, and landfall

(1) Annual temperature, precipitation and sunshine duration (Figure 6)

The annual mean temperature of Japan was 0.85°C above normal, and was the fourth highest on record since 1898. The annual mean temperature was averaged for 17 selected stations that are considered to be relatively unaffected by urbanization. Regional mean temperature anomalies were +0.7°C in northern Japan and +0.9°C in eastern Japan, both of which were above normal. The anomalies were +1.1°C in western Japan and +0.6°C in Okinawa/Amami, both of which tied the second highest on record since 1946. Annual precipitation amounts were below normal nationwide. Some parts of Western Japan experienced drought due to light precipitation from spring to June as well as in autumn. Annual sunshine durations were above normal in western Japan and on the Pacific side of eastern Japan, near normal in northern Japan and on the Sea of Japan side of eastern Japan, and below normal in Okinawa/Amami.

(2) Seasonal climate features (Figure 7)

Winter monsoon patterns appeared less frequently, and warmer-than-normal days were dominant nationwide. Eastern and western Japan experienced the warmest winter on record since 1946/47 when area-averaged temperature records began, and winter snowfall amounts in most regions on the Sea of Japan side were the smallest on record since 1961/62. Winter precipitation amounts from the San-in to the Hokuriku Districts were also significantly below normal. On the other hand, a rainstorm caused by a rapidly developing low passing along the Pacific side in the first ten days of January brought serious damage to northern and eastern Japan, where winter precipitation amounts were above normal.

In spring, fluctuations in temperature were large, and monthly mean temperatures in April were below normal nationwide except in western Japan. A frontal zone tended to shift southward from its normal position, and migratory highs frequently covered western Japan and the Pacific side of eastern Japan. These synoptic situations resulted in significantly below-normal seasonal precipitation. Meanwhile, Okinawa/Amami experienced a below-normal seasonal sunshine duration because the frontal zone stayed near the area. In April and May, unstable atmospheric conditions due to inflows of upper cold air frequently brought severe weather such as thunderstorms, gusts and hailstorms.

The Pacific high was weaker than normal around Japan in June and July, but was much stronger in August. The onset of the Bai-u (Japan's rainy season) was later than normal, and water shortages occurred in some areas of western Japan due to migratory anticyclones. The Bai-u front tended to stay near the mainland of Japan through July, which brought cool, rainy weather. Monthly precipitation amounts in July were above normal due to the active Bai-u front enhanced by Typhoon 0704 (MAN-YI). The end of Bai-u was later than normal in most regions of Japan. However, a Pacific high widely covered Japan in August, bringing hot, dry days on the Pacific side. On 16 August, a new national record maximum temperature of 40.9°C was marked concurrently at Kumagaya, Saitama Prefecture and Tajimi, Gifu Prefecture.

In the first half of autumn, the Pacific high was stronger than normal around Japan, and hot, fine days were dominant mainly in eastern and western Japan. Although seasonal precipitation amounts were above normal in eastern Japan and Okinawa/Amami due to tropical cyclones, light precipitation continued through autumn in western Japan and on the Sea of Japan side of eastern Japan, which resulted in further water shortages in some areas of western Japan. In the latter half of autumn, temperatures fluctuated significantly throughout Japan, and in the latter half of November strong cold spells caused record-breaking monthly snowfall amounts at some stations in mountainous areas.

In December, winter monsoon patterns rarely appeared, and cyclones and upper troughs brought rainy or cloudy weather nationwide. Monthly mean temperatures were above normal except in northern Japan, and snowfall amounts were remarkably below normal on the Sea of Japan side.

(Shunji Takahashi, Climate Prediction Division)

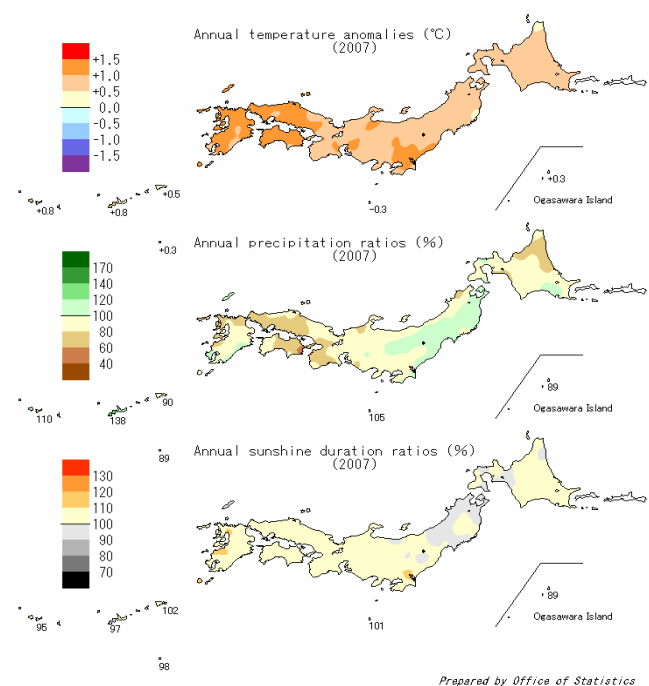


Figure 6 Annual climate anomalies/ratios over Japan in 2007

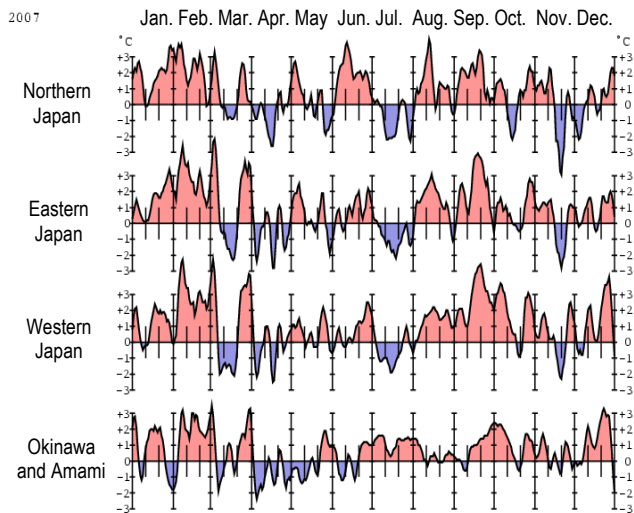
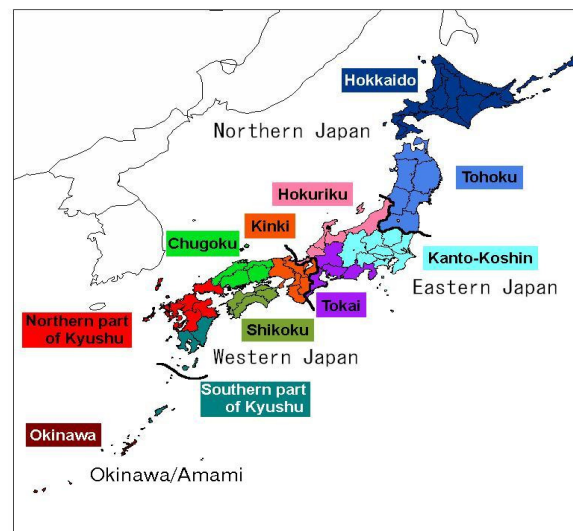


Figure 7 Time series of five-day running mean temperature anomalies for subdivisions. The normal is the 1971–2000 average.



Geographical subdivisions of Japan

TCC's Activity Report for 2007

The Tokyo Climate Center (TCC) of the Japan Meteorological Agency (JMA) has prepared the *Activity Report of the Tokyo Climate Center for 2007*, covering climate-related activities made by TCC in 2007 and its action plans for 2008.

1. TCC website and products

TCC launched a new website (<http://ds.data.jma.go.jp/tcc/tcc/index.html>) in March 2007. As one of the new services offered via the site, an online web-based interactive climate database called *ClimateView* was made available, enabling users to view and download data on monthly mean temperatures and monthly total precipitation derived from CLIMAT reports. *Monthly Highlights on Climate System*, focusing on monthly highlights of the climate, atmospheric circulation and oceanographic conditions, has been available on the website since April 2007.

The TCC website will be renewed in early 2008 with several new types of content including downscaled prediction products for one-month prediction in Southeast Asia. A new publication, *Annual Report on Climate System 2007* will be issued in early 2008, covering topics on extreme climate events around the world as well as a summary of the climate system in 2007.

2. JRA-25 and COBE-SST

A joint project between JMA and the Central Research Institute of Electric Power Industry on the long-term global atmospheric reanalysis known as *Japanese 25-year Reanalysis (JRA-25)* was completed in March 2006. The data assimilation system used in JRA-25 is operated as the JMA Climate Data Assimilation System (JCDAS). Both JRA-25 and JCDAS data (1979–present) are available through the JRA-25 official website (http://jra.kishou.go.jp/index_en.html).

3. Extended- and long-range EPS

JMA's one-month ensemble prediction system (EPS) was upgraded in March 2007, introducing new climatology of aerosol optical depth based on satellite observation and an improved cumulus convection scheme. For three-month and warm/cold season predictions, a new atmospheric model (GSM0703C) was introduced, consisting of a low-resolution version of the model used in the one-month prediction described above. The number of ensemble members increased from 31 to 51 and uncertainty in prescribed sea surface temperature (SST) was considered in addition to

uncertainty in the initial condition.

In 2008, new elements of GPV data (700 hPa temperature and its anomaly) will be added to one-month prediction, which will be available to registered NMHSs.

4. ODAS and El Niño prediction system

Since 1999, JMA's Meteorological Research Institute (MRI) has been developing a new Ocean Data Assimilation System (ODAS) named MOVE (Multivariate Ocean Variational Estimation) and an ocean prediction model named MRI.COM (MRI Community Ocean Model). A new ocean analysis system and a coupled ocean-atmosphere prediction model (JMA/MRI-CGCM) are scheduled to be put into operation in March 2008.

5. Global warming projection

JMA has implemented a projection of the atmospheric and oceanic climate around Japan toward the end of this century with a regional coupled ocean-atmosphere model developed in JMA/MRI and an improved version of the global coupled ocean-atmosphere model, named MRI-CGCM2.3.

Both the global and regional features of the projected climate and ocean currents will be published as *Global Warming Projection Volume 7* in March 2008.

6. RCC and GPC

TCC as well as the Beijing Climate Center (BCC) of the China Meteorological Administration (CMA) applied for Regional Climate Center (RCC) status at WMO RA II. At the Working Group on Climate-Related Matters for RA II (RA II WGCRM) held in Beijing in April 2007, the Group recommended to the President of RA II that both BCC and TCC be designated as RCCs. In June 2007, a website for the Regional Climate Center Network at RA II (<http://www.rcra2.org/detail/index.htm>) was established in close cooperation with BCC.

JMA was designated as one of the Global Producing Centers (GPC) for Long-Range Forecasts (LRF) for WMO at an extraordinary session of the WMO's Commission for Basic Systems (CBS) in 2006, and was approved as a GPC at the 59th session of the Executive Council of WMO held in May 2007.

7. Capacity building

JMA has conducted annual training courses in meteorol-

ogy for experts of National Meteorological and Hydrological Services (NMHSs) since 1973 as one of a number of courses provided by the Japan International Cooperation Agency (JICA). The training course in 2007 was held from September to December with emphasis on the operational use of numerical weather prediction, satellite meteorology and climate information. In a climate information session, staff members of the Climate Prediction Division gave lectures on climate system monitoring, long-range forecasting, El Niño outlook and global warming projection. In 2008, the training course will be renewed and its curriculum is now under consideration.

The *Training Course on Interpretation of Climate Products and Climate Downscaling* was held at the Malaysian Meteorological Department (MMD) in October 2007. At the invitation of MMD, TCC's staff members attended the Training Course for lectures on various topics including

JMA's numerical/seasonal prediction models, ensemble prediction system and making guidance, statistical downscaling, access to GPV data and its application using R Language, and reanalysis data (JRA-25) and its application.

8. International conferences and workshops

JMA held the *International Workshop on Applications of Advanced Climate Information in the Asia-Pacific Region* from 20–22 February 2007 in Tokyo under the auspices of Japan's Ocean Policy Research Foundation. The *Third WCRP International Conference on Reanalysis* took place in January 2008 in Tokyo. An international training workshop and seasonal prediction meeting on East Asian winter monsoons is scheduled for autumn 2008 in Tokyo.

(Kumi Hayashi, Climate Prediction Division)

Third WCRP International Conference on Reanalysis

The Third International Conference on Reanalysis was held in Tokyo, Japan from 28 January to 1 February 2008 under the initiative of the World Climate Research Programme (WCRP), the Japan Meteorological Agency (JMA), the Central Research Institute of Electric Power Industry (CRIEPI) and the University of Tokyo. The Conference is also supported by the Group on Earth Observations (GEO) and the Global Climate Observing System (GCOS).

The Conference, attended by 260 participants from 21 countries worldwide, focused on the following aspects with 61 oral presentations (16 by invited speakers) and 73 poster presentations:

- Introduction of reanalyses
- Applications using reanalysis data
- Comparison and validation of characteristics of each reanalysis
- Data assimilation technique for reanalysis
- Strategy and international cooperation for future re-analysis

The five-day Conference considered not only global atmospheric reanalysis but also ocean and land reanalysis, mainly from the viewpoint of interaction with the atmosphere. At the end of the Conference, all the participants approved the Conference Statement appealing the importance and benefits of reanalysis data and relevant projects. The whole text of the Statement is available on the TCC

webpage at http://ds.data.jma.go.jp/tcc/tcc/library/3rac_Conference_Statement.pdf.

(Kazutoshi Onogi, Climate Prediction Division)



Dr. Tetsu Hiraki, Director-General of JMA, giving a welcome address at the opening session



Mr. Kazutoshi Onogi of JMA, giving an invited presentation on the Japanese Reanalysis, JRA-25



Panel Discussion chaired by Dr. Michael Manton, Monash University, Australia

Renewal of the TCC website

The Tokyo Climate Center (TCC) renewed homepage of its website to introduce new content.

One of the new introductions is probabilistic one-month forecast guidance for 7-day average surface temperatures and 14-day average precipitation in Southeast Asia as well as in Japan.

The URL of the website remains unchanged (<http://ds.data.jma.go.jp/tcc/tcc/index.html>).

(Kumi Hayashi, Climate Prediction Division)

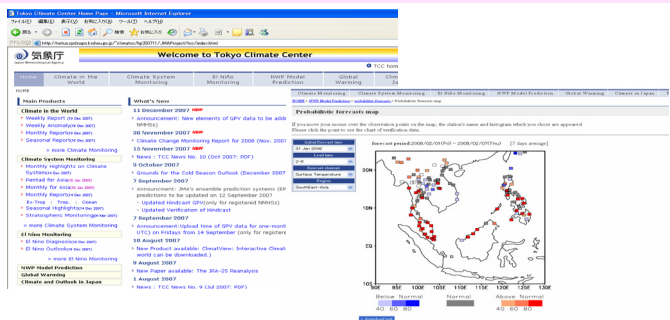


Image of renewed homepage and probabilistic one-month forecast for 7-day average surface temperature in Southeast Asia

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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