Tokyo Climate Center, Japan Meteorological Agency

TCC News

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Contents

Global Temperature in 2008

The annual anomaly of the global average surface temperature in 2008 was +0.20ºC – the tenth highest since records began in 1891.

The Japan Meteorological Agency (JMA) monitors global warming by analyzing surface temperature over land and oceans. The annual anomaly of the global average surface temperature in 2008 was 0.20°C±0.13°C above normal (based on the 1971 – 2000 average). The year 2008 ranks the tenth highest since 1891, although the anomaly was the lowest since 2001 due in particular to the La Niña event that occurred from spring 2007 to spring 2008.

On a longer time scale, global average surface temperatures have been increasing at a rate of 0.67°C per century (Figure 1), and surface temperatures have been above normal for most of the last two decades. High-latitude regions of the Northern Hemisphere have continued to experience warmer-than-normal conditions over the last several years (Figure 2).

Annual surface temperatures have varied along different time scales ranging from a few years to several decades. The increasing trend is very likely due to human activity – 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.

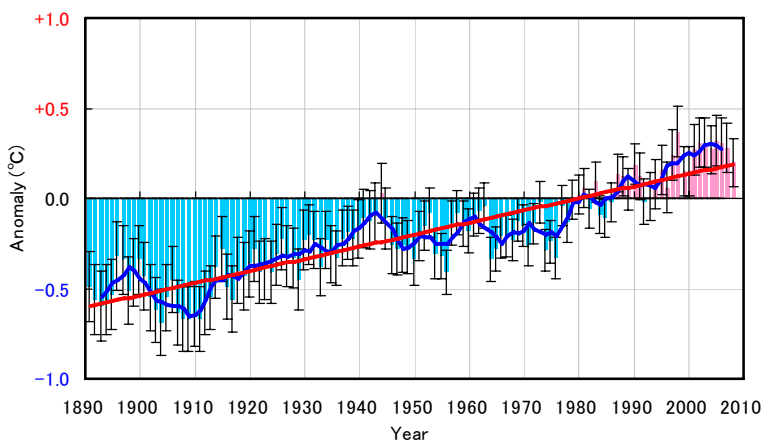*(Toshiyuki Kitajima, Climate Prediction Division)*

Figure 1 Annual anomalies in global average surface temperature from 1891 to 2008
The bars indicate the annual anomaly of the global average surface temperature and 90% confidence intervals for each year. The blue line indicates five-year running mean, and the red line shows the long-term linear trend.
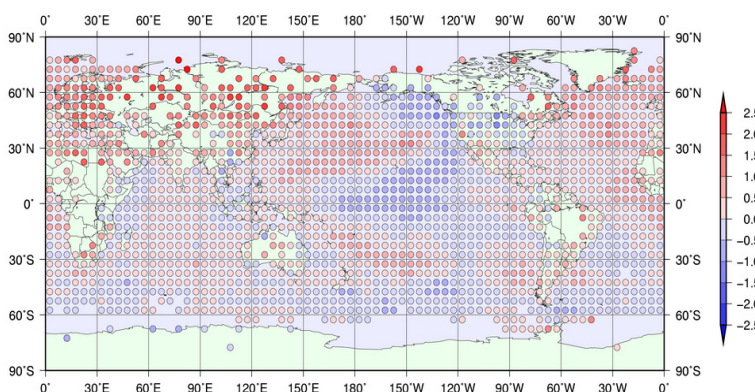

Figure 2 Annual anomalies of surface temperatures in 2008
The circles indicate temperature anomalies from the climatological normal (i.e., the 1971 – 2000 average) averaged in 5° x 5° grid boxes.

Highlight of the Global Climate for 2008

Annual mean temperatures were above normal in most areas of the world except Alaska, the northern USA and Australia (Figure 3). Extremely high temperatures were frequently observed across wide areas from eastern Siberia to northern Africa, while extremely low temperatures were recorded from China to central Asia from January to February. Extremely low temperatures were also frequently seen in eastern Australia until August.

Annual precipitation amounts were above normal from Siberia to northern Europe, from Central America to northern South America and in Southeast Asia, while they were below normal in the Middle East and Australia (Figure 4). Extremely heavy precipitation amounts were frequently observed from Siberia to northern Europe, from Central America to northern South America and in Southeast Asia, while extremely light precipitation amounts were observed frequently in the Mediterranean area, northern Argentina and southern Australia.

Major extreme events and weather-related disasters in 2008 are as listed below (Figure 5):

(1) Low temperatures from China to central Asia (Jan. – Feb.)

(2) High temperatures from southeastern Siberia to northern Africa (Mar. – Nov.)

(3) Torrential rains in southern China (May – Jun.)

(4) Typhoons and torrential rains from southern China to the Philippines and in Vietnam (Jun. – Nov.)

(5) Heavy precipitation from Malaysia to eastern Indonesia (year-long)

(6) Cyclone in Myanmar (May)

(7) Torrential rains around northern India (Jun. – Sep.)

(8) Torrential rains around western Ukraine (Jul.)

(9) Heavy precipitation in northwestern Europe (Jun. – Aug.)

(10) Heavy precipitation around the western Mediterranean (July, Sep. – Nov.)

(11) Torrential rains in Yemen (Oct.)

(12) Cyclone in Madagascar (Feb.)

(13) High temperatures in southeastern Africa (Aug. – Dec.)

(14) High temperatures around Greenland (Jun. – Dec.)

(15) Heavy precipitation in the northeastern and central USA (Feb. – Mar., May – Jun., Sep.)

(16) Hurricanes from the southern USA to the Caribbean (Aug. – Sep.)

(17) Forest fires in California, USA (Oct.)

(18) Heavy precipitation from southern Central America to northern South America (year-long)

(19) Low temperatures in eastern Australia (Mar. – May, Aug.)

(20) Light precipitation in southern Australia (year-long)
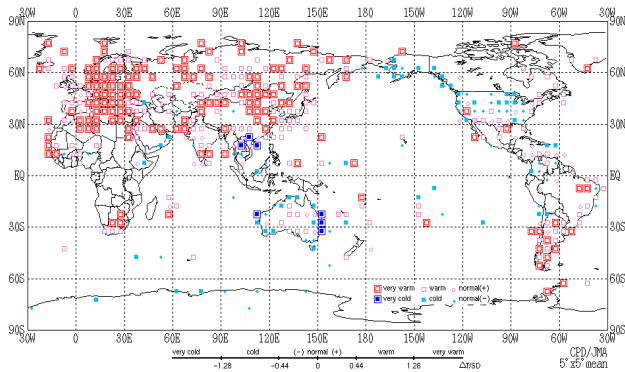
(Hidehiko Isobe, Climate Prediction Division)

Figure 3 Annual mean temperature anomalies for 2008
Categories are defined by the annual mean temperature anomaly against the normal divided by its standard deviation and averaged in 5° x 5° grid boxes. The thresholds of the categories are -1.28σ, -0.44σ, 0, +0.44σ and +1.28σ, as shown in the legend. The normal values and standard deviations are calculated from 1971 – 2000 statistics. Land areas without marks represent regions where observation data are insufficient or normal data are unavailable.
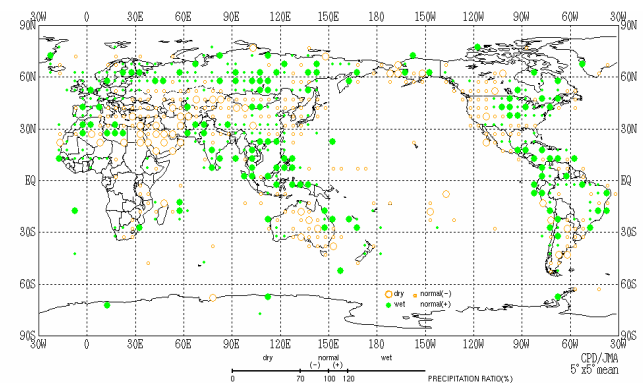

Figure 4 Annual total precipitation amount ratios for 2008
Categories are defined by annual precipitation ratio to the normal averaged in 5° × 5° grid boxes. The thresholds of the category are 70%, 100% and 120%, as shown in the legend. Land areas without marks represent regions where observation data are insufficient or normal data are unavailable.
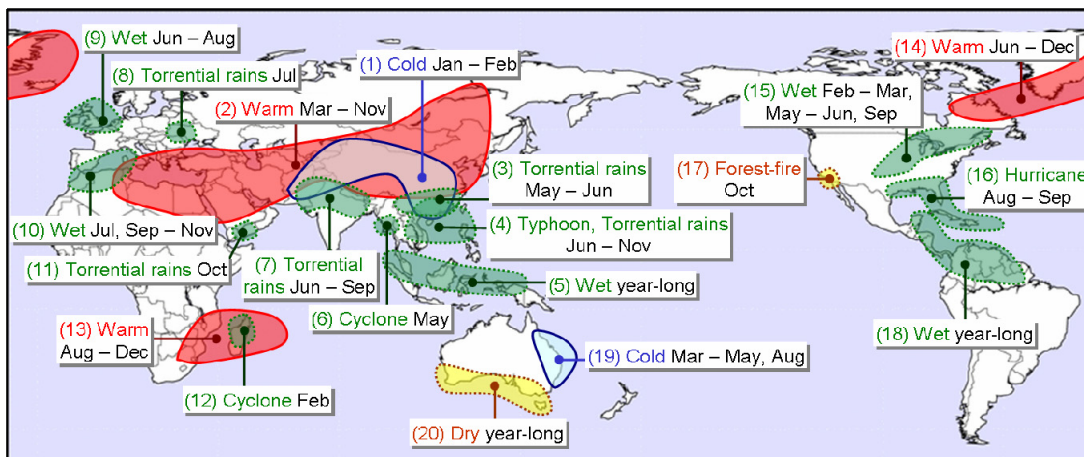

Figure 5 Extreme events and weather-related disasters in 2008
Major extreme climatic events and weather-related disasters occurring during the year are indicated schematically.

Summary of Japan's Climate in 2008

- **Above-normal annual mean temperature nationwide**
- **Light annual precipitation in northern Japan and on the Sea of Japan side of eastern Japan**
- **Light snowfall amounts on the Sea of Japan side**
- **Repeated localized torrential rainfall in summer**
- **Hot and dry weather in eastern and western Japan in July and August**
- **Below-normal incidence of typhoon formation and approach, and no typhoon landfall**

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

The annual anomaly of the average surface temperature over Japan (averaged over 17 observatories confirmed as being relatively unaffected by urbanization) in 2008 was 0.46°C above normal (i.e., the 1971 – 2000 average), and was the eleventh highest since 1898. Area-averaged annual mean temperature anomalies were +0.6°C in northern and eastern Japan, +0.5°C in western Japan and +0.4°C in Okinawa/Amami. Annual precipitation amounts were near normal nationwide except in northern Japan and on the Sea of Japan side of eastern Japan, where they were significantly below normal. Annual sunshine durations were below normal on the Pacific side of northern Japan, above normal on the Sea of Japan side of eastern Japan, and near normal on the Sea of Japan side of northern Japan, on the Pacific side of eastern Japan, in western Japan and in Okinawa/Amami.

(2) Seasonal climate features (Figure 7)

North-westerly winter monsoon patterns rarely appeared with cyclones and anticyclones periodically passing near Japan in the first half of winter, bringing warm and cloudy weather. In contrast, north-westerly monsoon patterns were significant in February, bringing unusually cold weather. As a result, seasonal mean temperatures were near normal in northern, eastern and western Japan. Storms repeatedly passed the Japanese archipelago in mid-to-late February, resulting in frequent bouts of rain and snow. However, seasonal snowfall amounts were below normal on the Sea of Japan side because of significantly below-normal snowfall in December and January.

Although temperatures fluctuated widely in May, seasonal mean temperatures were above normal because warm weather was dominant in March and April. On the Pacific side of eastern and western Japan, precipitation amounts were above normal due to cyclones passing frequently near the Pacific coast of the main islands in April and May, while they were below normal on the Sea of Japan side of northern and eastern Japan because cyclones rarely passed over the north of the country.

In eastern and western Japan, cloudy or rainy weather was dominant due to active fronts in June, whereas hot and sunny weather was dominant in July and August due to a prevailing high-pressure system. On the other hand, in northern Japan, sunny weather was dominant in June, while cloudy or rainy days prevailed in July. Some areas of the mainland were sometimes hit by torrential rains and thunderstorms in August. In particular, at the end of August, some parts of eastern Japan experienced record-breaking heavy rainfall. In Okinawa/Amami, hot and sunny days were dominant throughout the season.

In autumn, fluctuations in temperature were wide in November, and hot or warm weather was dominant in September and October. As a result, seasonal mean temperatures were above normal nationwide. Sunny weather was dominant in northern Japan due to prevailing migratory anticyclones, and precipitation amounts were significantly below normal. In particular, the Pacific side of northern Japan experienced its lowest precipitation amounts since 1946 when area-averaged statistics first started. Meanwhile, typhoons struck Okinawa/Amami repeatedly, and precipitation amounts were significantly above normal.

In December, north-westerly winter monsoon patterns rarely appeared, and cyclones periodically passed over the Sea of Japan with warm air masses. Monthly mean temperatures were extremely above normal in northern and eastern Japan.

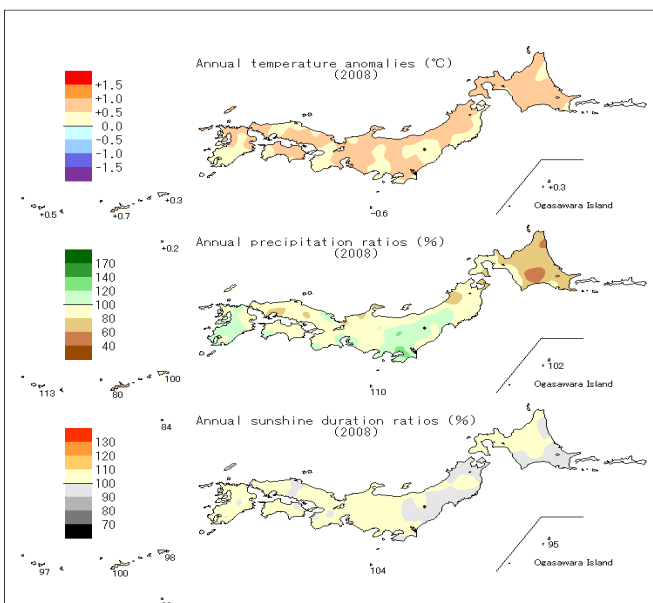*(Noriaki Watanabe, Climate Prediction Division)*

Figure 6 Annual climate anomalies/ratios over Japan in 2008
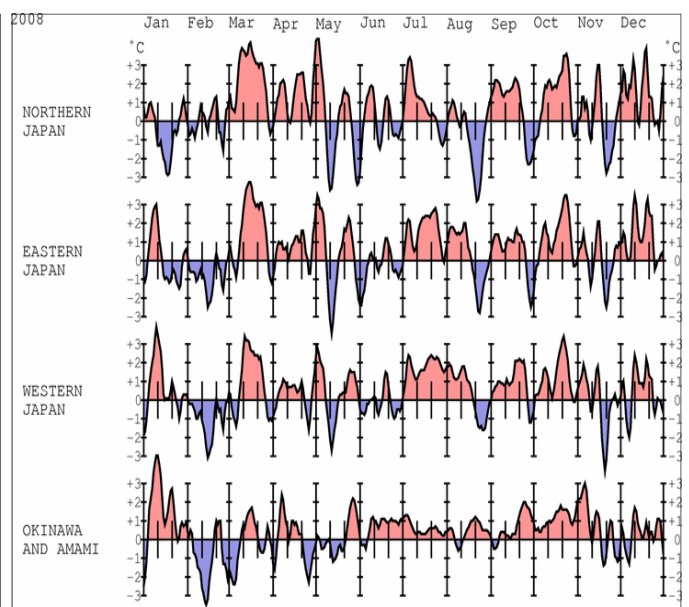

Figure 7 Time series of five-day running mean temperature anomalies for subdivisions
The normal is the 1971 – 2000 average.

TCC Activity Report for 2008

The Tokyo Climate Center (TCC) of the Japan Meteorological Agency (JMA) has prepared the *Activity Report of the Tokyo Climate Center for 2008,* covering climate-related activities by TCC in 2008 and its plans for 2009.

1. TCC website and products

TCC updated its website (http://ds.data.jma.go.jp/tcc/tcc/index.html) in March 2008 with several new features including downscaled products for one-month prediction in Southeast Asia.

A new publication, *Annual Report on Climate System 2007* was issued in March 2008, covering topics on extreme climate events around the world and giving a summary of the climate system in 2007. Other publications, such as *Climate Change Present and Future* and *Climate Change Monitoring Report for 2007*, were also made available on the TCC website.

2. JRA-25 Atlas

The joint project between JMA and the Central Research Institute for Electric Power Industry on long-term global atmospheric reanalysis (called the *Japanese 25-year Reanalysis (JRA-25)*), was completed in March 2006. In March 2008, maps of annual, seasonal and monthly averaged climate fields for various meteorological variables from JRA-25 products have been made available in the JRA-25 Atlas at http://ds.data.jma.go.jp/gmd/jra/atlas/eng/atlas-tope.htm.

3. Extended- and long-range EPS

In January 2008, new elements of GPV data (700-hPa temperature and its anomaly) were added as one-month predictions, and have been made available to registered NMHSs.

4. ODAS and El Niño prediction system

The Meteorological Research Institute (MRI) of JMA 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) since 1999. The new ocean analysis system and the ocean-atmosphere coupled prediction system were put into operation in March 2008.

5. Global warming projection

JMA has implemented a projection of the atmospheric and oceanic climate around Japan for the end of the current century using a regional coupled ocean-atmosphere model developed by JMA/MRI and an improved version of the global ocean-atmosphere coupled model known as MRI-CGCM2.3.2. *Global Warming Projection Volume 7*, published in March 2008 includes the climate and ocean currents projected in and around Japan.

6. RCC

TCC and the Beijing Climate Center (BCC) of the China Meteorological Administration (CMA) were recommended for designation to Regional Climate Center (RCC) status in WMO RA II at the Working Group on Climate-Related Matters (WGCRM) meeting in Beijing in April 2007. In close cooperation with the BCC, the Regional Climate Center Network in RA II (http://www.rccra2.org/detail/index.htm) website went live in June 2007.

At another WGCRM meeting in Tokyo in August 2008, it was agreed that other candidates (India, Iran and Russian Federation) should be encouraged to participate in the RA II RCC Network on a pilot-mode working with BCC and TCC.

7. Capacity building

JMA has conducted training courses in meteorology for experts of National Meteorological and Hydrological Services (NMHSs) since 1973 on an annual basis as one of the training initiatives provided by the Japan International Cooperation Agency (JICA). The 2008 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.

At the request of the Malaysian Meteorological Department (MMD), JMA/TCC ran a hands-on training course on climate data communication and application for three weeks in July – August. Two officers from MMD's Climate Section participated in the course to learn the use of Linux machines and data processing for GRIB and GRIB2. Another four-week training course on climate forecasting and its application was conducted in September with the participation of another two officers from MMD to learn how to use seasonal forecasting models.

TCC convened the Training Seminar on Climate Information and Forecasting at JMA Headquarters from 4 – 6 November 2008 with 13 invited participants from 12 countries and territories who were engaged in operational long-range forecasting at NMHSs in East and Southeast Asia. The participants learned how to use the data and products available on the TCC website for long-range forecasting.

8. International conference and workshop

JMA held a meeting of WGCRM for RA II of WMO at JMA in Tokyo from 7 – 8 August 2008. The meeting reviewed the implementation of climate-related activities in RA II, and an agreement was made to further develop cooperative relationships among members.

The Ninth Meeting for the Seasonal Prediction of the East Asian Winter Monsoon took place at JMA from 6 – 7 November 2008 with more than 30 participants from NMHSs in East and Southeast Asia. Attendees discussed the latest outlook for the 2008 – 2009 winter monsoon and exchanged information and knowledge about the East Asian Winter Monsoon System, El Niño/La Niña outlook, long-term trends and decadal variability/seasonal outlooks using statistical and dynamic forecast models.

9. Future plans

In the first quarter of 2009, TCC will publish a gridded dataset of annual and monthly mean temperature anomalies worldwide from 1891 onward on the TCC website. The data, which covers 5° x 5° grid boxes worldwide can be downloaded and displayed on a map. This resource will enable users to monitor and analyze climate change on a regional scale.

In the second quarter of 2009, TCC's newly developed software, *Interactive Tool for Analysis of the Climate System (ITACS),* will be made available on the TCC website, enabling registered NMHSs to display various kinds of maps with selected parameters and to make statistical

analysis.

In April 2009, the data format of one-month-forecast GPV products will be changed from GRIB1 to GRIB2. Daily GPV data for individual ensemble members will also be made available on the TCC website for the first time.

JMA is preparing for the upgrade of its seasonal forecast model scheduled for early 2010. The upgraded version will introduce a one-tier coupled system instead of the current two-tier system. It is expected that the forecast skill of the new model will be improved, particularly for precipitation over the tropics and the Asian monsoon/winter Australian winter monsoon.

In February 2009, JMA will update the El Niño prediction system, which consists of a global ocean data assimilation system and a coupled atmosphere-ocean global circulation model (CGCM).

TCC plans to hold a training seminar on the utilization of JRA-25 data for NMHSs in East and Southeast Asia in late 2009 or early 2010.

(Kumi Hayashi, Climate Prediction Division)

Upgrade of One-month-forecast GPV Products

JMA improved its one-month ensemble prediction system in March 2008 (please refer to TCC News No. 12 for details). Accordingly, GPV products for one-month forecasts will be upgraded in April 2009 with the change of data format from GRIB1 to GRIB2 and the provision of new products (daily GPV data for individual ensemble members and hindcast data).

The main upgrades to the GPV products are outlined below.

1. Change of data format (from GRIB1 to GRIB2)
   New data file in GRIB2 format will be available from April 2009. In connection, the following definitions will be changed.
   - Unit of rainfall amount (from [kg m^{-2} 7days^{-1}] will be changed to [kg m^{-2} day^{-1}]).
   - Method of calculating time-mean values: Time mean values will be made on the basis of 6-hourly data (at 00, 06, 12 and 18 UTC), as opposed to the current method that uses only values at 12 UTC.
   The provision of data files in GRIB1 format will cease in September 2009 after a six-month transition period.

2. Addition of daily GPV data for individual ensemble members
   TCC will newly provide daily GPV data for individual ensemble members in addition to currently available ensemble mean data.
   Ensemble size: 50
   Element: comparable to ensemble mean data
   Data format: GRIB2

3. Provision of hindcast data
   Daily GPV data for individual ensemble members will be made available.
   Target period: from 1979 to 2004 (the initial dates are the 10th, 20th and last day of every month)
   Ensemble size: 5
   Element: comparable to ensemble mean data
   Data format: GRIB2

Sample data sets are available at
   http://ds.data.jma.go.jp/tcc/tcc/gpv/model/1mE.Grib2/1mE_ens_grib2.html (ensemble statistics) and
   http://ds.data.jma.go.jp/tcc/tcc/gpv/model/1mE.Grib2/1mE_mem_grib2.html (forecasts by individual ensemble members).
   For the details, please refer to http://ds.data.jma.go.jp/tcc/tcc/gpv/model/1mE.Grib2/1mE_GPV_outline.html.

For related enquiries, please contact TCC at tcc@climar.kishou.go.jp.

(Yukiko Naruse, Climate Prediction Division)

Improvement of JMA's El Niño Prediction System

In February 2009, JMA improved its El Niño prediction system, which consists of a global ocean data assimilation system and a coupled atmosphere-ocean global circulation model (CGCM). In March 2009, the creation of new *Model forecast of SST anomalies for Niño regions* products is scheduled, and these will be made available on the TCC website (http://ds.data.jma.go.jp/tcc/tcc/products/elnino/nino_fcst/indices/indexninofcst.html).

What's new
1. Improvement to the ensemble method (Figure 8)
   - Introduction of ensemble perturbations for oceans (five members with one initial date)
   - Change of ensemble member aggregation
   [Present] Lagged Average Forecasting (LAF) ensemble (one member with twelve initial dates)
   [New] Combination of perturbations and LAF ensemble (five members with six initial dates)
   The ensemble size will therefore increase from 12 to 30, and the lag period will be shortened from 55 to 25 days.

2. Update of statistics
   - Elaboration of statistics for the variational method of ocean data assimilation
   - Update of statistics for the CGCM, such as flux correction and bias correction of SSTs

Performance
   To examine the impacts of refining the ensemble method, the performances of the following two ensemble

methods were compared in a hindcast experiment (Figure 9):

LAF5: A 10-day LAF ensemble consisting of five members

PTB10: A combination of the 25-day LAF ensemble and perturbations consisting 10 members.

Four initial dates per year were set for the experiment (31 January, 1 May, 30 July and 28 October) for the period from spring 1996 to spring 2006 (10 years). The ensemble size of *PTB10* was larger than that of *LAF5*, and lag period for *PTB10* was shorter than that of *LAF5*. It can be estimated that the difference in performance of both methods

corresponds approximately to the improvement in forecast skills brought about by this update.

It is found that *PTB10* improves on the prediction SSTs over the western tropical Pacific and the Indian Ocean (Figure 10). This improvement can mainly be attributed to the increased ensemble size compared with the results of other methods in aggregating ensemble members (not shown). Perturbations used in the new ensemble method are important to increase ensemble size within a limited time.
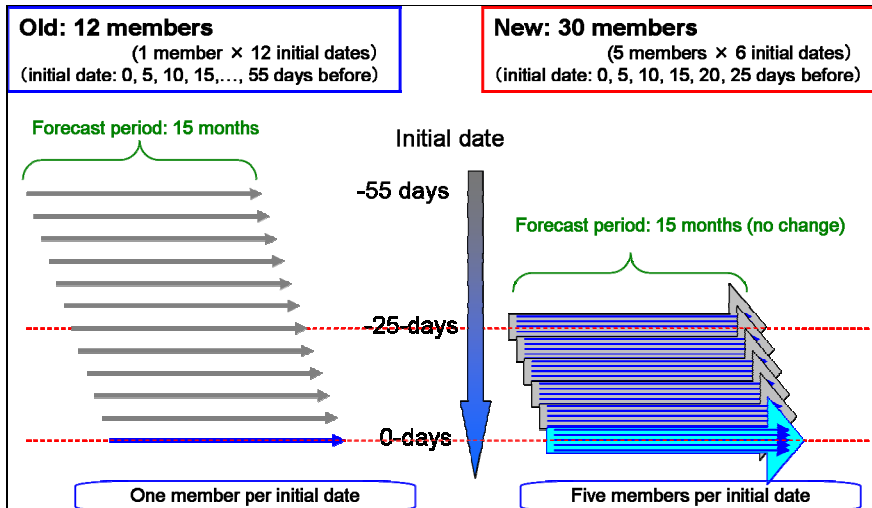
(Masayuki Hirai, Climate Prediction Division)

Figure 8 Schema of showing the aggregation of ensemble members under the old (left) and new El Niño prediction system (right)
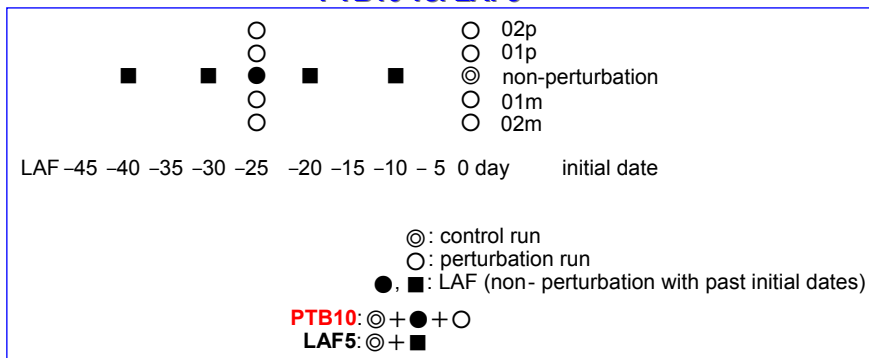

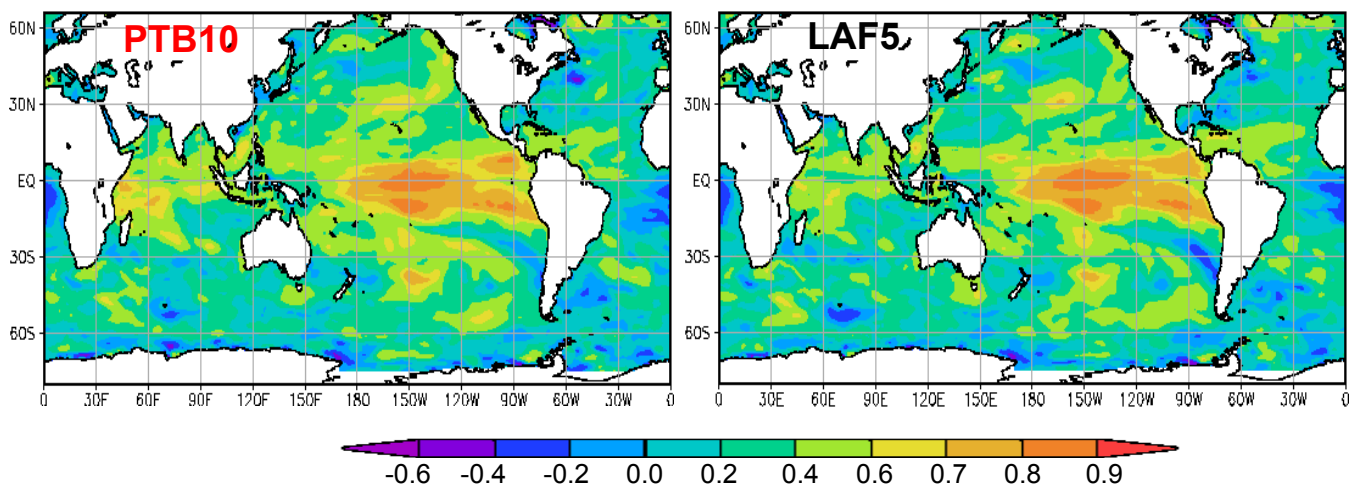**Figure 9 Schema of two ensemble methods (PTB10 and LAF5) in the hindcast experiment**

Figure 10 Anomaly correlation coefficient of the SST prediction by PTB10 (left) and LAF5 (right) Lead time is six months.