Tokyo Climate Center, Japan Meteorological Agency

TCC News

No.1 July 2005

Contents

Message from Editor

Head of TCC

The Japan Meteorological Agency (JMA) established the Tokyo Climate Center (TCC) in April 2002. TCC has been engaged in climate-related services for three years with the main purpose of assisting the climate monitoring and prediction services at National Meteorological and Hydrological Services (NMHSs) in Asia and Pacific regions. I am grateful to the NMHSs in the regions for their cooperation and contribution extended to TCC.

TCC has been operationally providing data and information that are useful for climate monitoring and prediction through the TCC website, and sponsored several international meetings including a training workshop for climate-related matters. TCC is planning to start providing tercile probabilistic forecasts and improved climate system monitoring and diagnostics based on the Japanese Re-Analysis project (JRA-25) dataset. I expect these improvements will make further contribution to the advancement of climate related activities in the regions.

This TCC Newsletter, newly published and to be issued four times a year, will include articles on significant climate disasters and events, forecaster's commentaries on seasonal outlooks, besides topics on the renewal and the usage of TCC products. I expect the newsletter will provide opportunities for timely exchange of views and information among the NMHSs on up-to-date techniques of climate monitoring and predictions as well as ongoing significant climate events. It will also deal with news and information on international climate activities, and progress of technical developments. Contribution to the newsletter from readers are always welcome.

I would hope the newsletter is of help to active communication among people engaged in climate matters, wishing further collaboration and advancement of climate services among Asia and Pacific nations.

Shingo Yamada
Head of Tokyo Climate Center

Ongoing Development Activities: COBE-SST

In March 2006, TCC will put a new historical sea surface temperature (SST) dataset, named COBE-SST, into operation for climate system monitoring, especially for El Niño monitoring. The COBE-SST is a part of the gridded datasets called COBE, Centennial in-situ Observation-Based Estimates of the variability of SSTs and marine meteorological variables (Ishii et al., 2005). The COBE consists of global objective analyses from the late 19th century to present, using historical observations from the International Comprehensive Ocean Atmosphere Data Set (ICOADS) and the Kobe Collection datasets. The COBE-SST provides a long-term homogeneous dataset with high spatial resolution (one-degree mesh), which is of great value for monitoring global climate change (see Figure 1).

Reference

Ishii M, A. Shoji, S. Sugimoto and T. Matsumoto, 2005: Objective Analyses of Sea-Surface Temperature and marine meteorological variables for the 20th Century using ICOADS and the Kobe Collection, Int. J. Climatol., 25, 865-879.

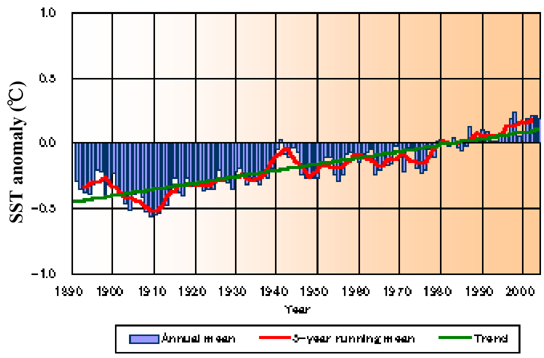

Figure 1 Annual mean SST Anomalies over the Globe from 1891-present, computed as departures from the 1971-2000 mean using COBE-SST

Experimental products for tercile probalistic forecast have become available from the TCC website.

1. Overview

TCC has been providing seasonal Numerical Weather Prediction (NWP) products based on the JMA ensemble prediction system through the website since September 2003. In June 2005, we started providing experimental products of the tercile probabilities of three-month mean 2m-temperature (T2m), equivalent to surface air temperature, and three-month accumulated precipitation, which are fundamental for the NMHSs to make probabilistic seasonal outlooks. In order to calibrate over-confident forecast estimated simply from each ensemble member's occurrence rate, a calibration method based on the Model Output Statistics (MOS) using the 18-year hindcast (1984-2001) data was developed, which made forecast significantly more reliable.

Figure 2 shows a sample of the new products which are provided through the TCC website. The probabilities of the most likely category are shown by colors, i.e., red shows above normal, grey normal and blue below normal. The grids, where the Relative Operating Characteristic (ROC) area was smaller than 50% in the verification, remain blank. The forecasted probabilities of all categories at any grid point are shown with a click on the figure (Figure 3). Users may check the verification results of hindcast for the selected grid (and the surrounding eight grids). We hope the users make the best use of these probabilistic products, after checking these verification information.

2. Calibration method

The 18-year hindcast data were used to develop the MOS relationship. The ensemble mean T2m and precipitation were calculated as predictors. The corresponding observational data were the probabilities of occurrence in tercile determined from 18-year observations, derived from the ERA-40 for T2m and the Climate Prediction Center (CPC) Merged Analysis of Precipitation (Xie and Arkin, 1997) for precipitation. MOS model parameters were calculated for each of 2.5 x 2.5 deg. grids and for each month. The Ordered Probit Model[1)] technique was analyzed to the qualitative data with order. The maximum likelihood method was used for estimating the MOS model parameters.

3. Verification results

The verification was executed using the cross-validation method, that is, the MOS model parameters were calculated with the samples except the one to be validated. We checked the following verification scores: the ROC curve, the ROC area and the reliability diagrams, which are recommended in the WMO's Standard Verification System for Long-Range Forecast (SVSLRF[2)]). Figure 4 shows the percentage of grids at which the MOS estimation is proved more skilful than climatological one, i.e. the ROC area is larger than 50%. In the tropics (20N-20S : red curve), the MOS gives meaningful probability at about 80% of total grids. Figure 5 shows the reliability diagram for the grids where the ROC area is larger than 50%. It can be seen that the forecasted probabilities are fairly reliable in the probability range between 20% and 50%, and the Brier skill score shows that this method is significantly skilful at these grids.

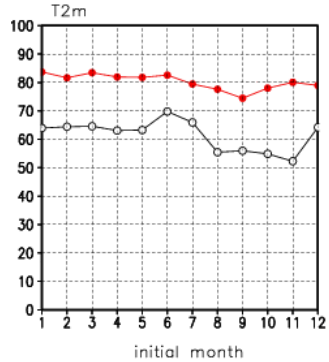

Figure 4 Ratio of above 50% ROC area regarding one-month lead tercile probabilistic forecast for three-month mean 2m-temperature. Red and black lines indicate the tropics (20S-20N) and the Northern Hemisphere (20N-90N), respectively.

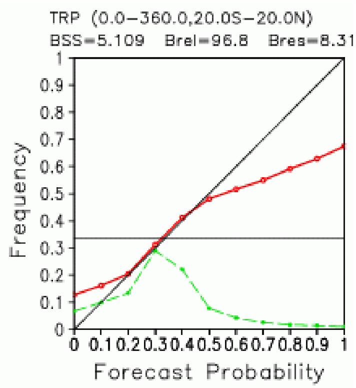

Figure 5 Reliability diagram (red) and forecast frequency (green) of above 50% ROC area regarding one-month lead tercile probabilistic forecast for three-month mean 2m-temperature in the tropics.

Reference

Xie P, P. A. Arkin, 1997: Global precipitation: a 17-year monthly analysis based on gauge observations, satellite estimates, and numerical model outputs. Bull. Amer. Meteor. Soc., 78, 2539-2558.

(Akira Ito and Shuhei Maeda, Climate Prediction Division)

Probability Forecasts:

http://okdk.kishou.go.jp/products/model/probfcst/4mE/index.html

1) Ordered Probit Model:

http://okdk.kishou.go.jp/products/model/probfcst/4mE/doc/probit.html

2) SVSLRF:

http://www.wmo.ch/web/www/DPS/LRF/LRF-verification-systems.html

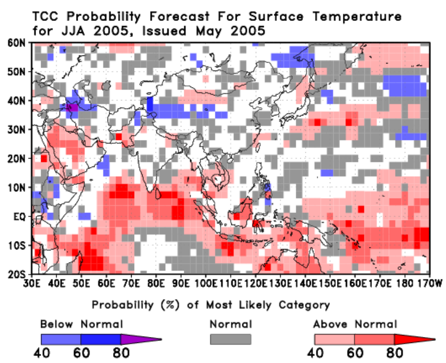

Figure 2 Probabilistic forecast products of the most likely category for 2m-temperature.

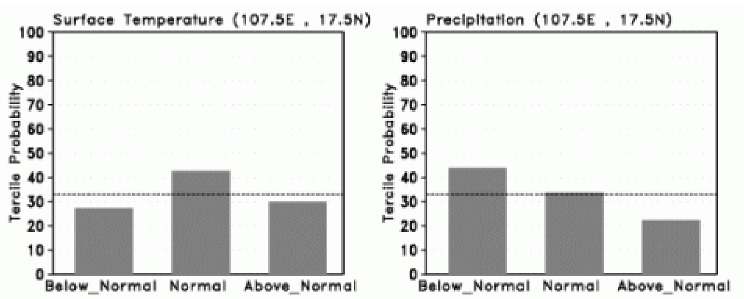

Figure 3 Tercile probabilistic forecast products for 2m-temperature (left) and precipitation (right) at a specific grid point.

Release of the "Global Warming Projection" volume 6

In March 2005, JMA published the "Global Warming Projection" volume 6. It contains detailed projections of the climate change around Japan in the end of the 21st century (Figure 6) with JMA's Regional Climate Model, whose horizontal resolution is about 20km (RCM20). Boundary conditions of RCM20 are made from the projections improved with JMA's CGCM, which are described in the "Global Warming Projection" volume 5. The increase rate of CO_2 is based on the Special Report on Emissions Scenarios (SRES) A2 provided by the Intergovernmental Panel on Climate Change (IPCC) in 2000.

The main results of the projections are as follows:

- The annual mean surface temperatures around Japan are projected to increase 2-3℃ in general, and about 4℃ in a part of Hokkaido.
- The annual precipitation is projected to increase in almost all parts of Japan, and the rate of increase is 20% at a maximum.
- The precipitation in July is projected to increase in most of the central and western parts of Japan, and also the frequency of heavy rainfall and the number of rainy days.

(Hiroko Morooka, Climate Prediction Division)

Global Warming Projection volume 5:
http://okdk.kishou.go.jp/products/gwp/gwp5/e_index.html
Global Warming Projection volume 6:
http://okdk.kishou.go.jp/products/gwp/gwp6/index.html

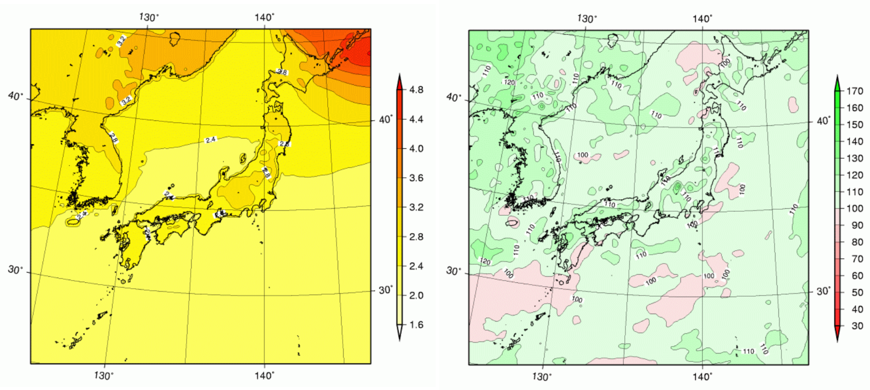

Figure 6 Change of annual mean temperature (unit: ℃, left) and annual precipitation (unit: %, right) for years of 2081 to 2100 relative to the period from 1981 to 2000.

Improvements in JMA's El Niño Forecast Model

In June 2005, JMA's El Niño forecast system, which provides Region B SST anomaly predictions for JMA's "El Niño Outlook", was improved to reduce its positive predictive bias. An example of the prediction of the SST deviation for Region B with the new system is shown in the Figure 7.

(1) Change in the analysis used for oceanic initial conditions

Previously, we used the analysis of Ocean Data Assimilation System (ODAS) with a lag of 35 days as oceanic initial conditions for CGCM, considering a delay in data acquisition. However, in recent years, much more data have become available on real-time basis owing to the development of new observation system, such as Argo profiling floats. Hence, we decided to use the analysis of ODAS with a lag of five days. This change reduced the forecast lead time by about one month.

(2) Change in the ensemble forecasting system

We adopted the ensemble forecasting system based on the Lagged Average Forecasting (LAF) method. Previously, we used six ensemble members, calculated twice a month. Now, we use 12 ensemble members, calculated six times per month (five-day interval). This change reduced the lead time of one-month forecast from 35-120 days to 5-60 days.

(3) Change in the bias correction method

The model's systematic bias depends upon both the predicted season and the lead time. Previously, we used the MOS relationship based on the hindcasts from 1988 to 2000. Now, the SST deviation for Region B is corrected by removing the model's mean error over the whole hindcast period from 1988 to 2003.

(Goro Yamanaka, Climate Prediction Division)

El Niño Outlook:
http://okdk.kishou.go.jp/products/elnino/outlook.html

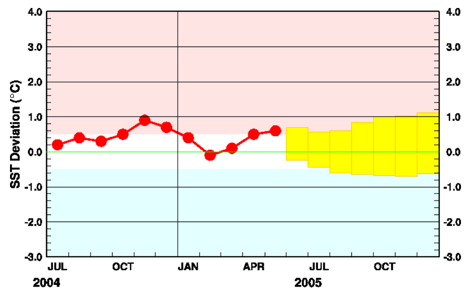

Figure 7 Outlook of the SST deviation for Region B (Niño.3) by the El Niño forecast model

This figure indicates a time series of the monthly SST deviations for Region B (4°N-4°S, 150°W-90°W). Thick lines with closed circles show the observed SST deviation and boxes show the predicted one for the next six months by the El Niño forecast model. Each box denotes the range where the SST deviation will be included with the probability of 70%.

Ongoing Development Activities: JRA-25 Project

JMA and CRIEPI (Central Research Institute of Electric Power Industry) have been conducting a new global long-term atmospheric reanalysis project. This cooperative research project named the Japanese 25-year ReAnalysis (JRA-25) Project is now on the final stage of the five-year project period. TCC is planning to provide TCC users with new historical dataset for climate system monitoring in March 2006 developed with this analysis system. The features of the products will appear in the next issue.

JRA-25 website:
http://www.jreap.org/indexe.html

Operation of a New Geostationary Meteorological Satellite, MTSAT-1R

The Multi-functional Transport Satellite (MTSAT-1R), the successor to Geostationary Meteorological Satellite-5 (GMS-5), was successfully launched on 26 February 2005 and started its operation on 28 June 2005.

MTSAT-1R is a three-axis body-stabilized spacecraft having two main missions, i.e. meteorological and aeronautical missions. The meteorological function of MTSAT-1R is improved in comparison with GMS-5. MTSAT-1R deploys a new imager with a wavelength 3.7μm (IR4) in addition to the conventional four channels (VIS, IR1, IR2 and IR3). The quantization of the infrared channels is improved from 8 bits to 10 bits, and that of the visible channel from 6 bits to 10 bits. Spectral channel bandwidths for the MTSAT-1R's imager are listed in the Table 1.

The Meteorological Satellite Center of JMA has been developing and improving operational products of MTSAT. Cloud Motion Winds (CMWs) and Water Vapor Motion Winds (WVMWs) will be derived from successive images in 15-minute intervals. The additional IR4 channel is expected to be useful for the detection of low-level cloud in nighttime. It will also bring substantial improvements in Satellite Cloud Grid Information Data (SCGID) and SST calculation. SST will be calculated more accurately with the infrared channels data of 10 bits. The Aerosol Optical Thickness (AOT), which has been used for monitoring dust aerosol originated in Asian Continent, will be calculated more accurately with the visible channel data of 10 bits.

(Nozomu Ohkawara, Meteorological Satellite Center)

MTSAT-1R website:
http://www.jma.go.jp/JMA_HP/jma/jma-eng/satellite/index.html

Table 1 Spectral Channel Bandwidths

Channel	Spectral band (μm)
Visible (VIS)	0.55 - 0.90
Infrared 1 (IR1)	10.3 - 11.3
Infrared 2 (IR2)	11.5 - 12.5
Infrared 3 (IR3)	6.5 - 7.0
Infrared 4 (IR4)	3.5 - 4.0

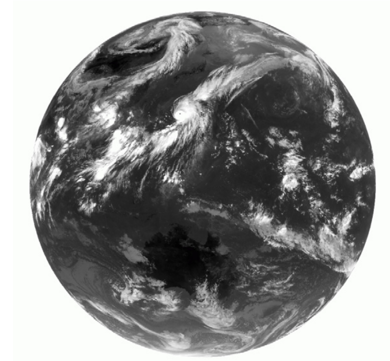

Figure 8 Test Imagery from MTSAT-1R

Coming Soon: Climate Change Monitoring Report 2004

JMA has issued a series of "Climate Change Monitoring Reports" annually since 1996. The Reports cover the achievement of our comprehensive activities in the field of climate ranging from observation, monitoring, analysis and projection to research and development.

The latest issue, "Climate Change Monitoring Report 2004", which covers climatic conditions of Japan and the world for the year 2004 and recent trends of greenhouse gases concentrations and the ozone layer depletion, is going to appear in August 2005 on the TCC website.

Among the wide-range subjects, the following are particularly highlighted in this 2004 issue:

- The global mean of the surface temperatures in 2004 was the fourth highest since 1880 only to 1998, 2002 and 2003.
- The mean surface temperature in Japan during 2004 was the second highest only to 1990 since 1889.
- During 2004, ten tropical cyclones made landfall in Japan, breaking the previous record of six.
- The annual mean sea levels at six out of 13 tide gauge stations on the coast of Japan were the highest in 2004 since 1970.
- Concentration of atmospheric carbon dioxide (CO_2) has been continuously increasing through the instrumental observed period. The annual mean concentration of CO_2 in 2004 was larger by 1.7 ppm than that in 2003 at all of the three observatories in Japan.
- The ozone depletion over the Antarctic in 2004 was not so severe as in 2003 when the record-size ozone hole was observed.

(Hiroko Morooka, Climate Prediction Division)

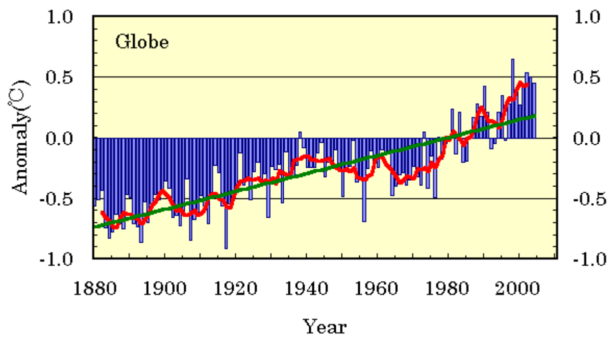

Figure 9 Annual (land only) global surface temperature anomalies from 1880 to 2004
Anomalies are deviations from normal (1971-2000 average). The blue bars indicate anomalies of annual mean surface temperature. The red lines indicate their 5-year running mean, and the green lines indicate the long-term linear trends.

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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(Chief Editor: Shingo Yamada)

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