Tokyo Climate Center, Japan Meteorological Agency

TCC News

No. 31 Winter 2013

Contents

Page

Global Average Surface Temperatures for 2012

The annual anomaly of the global average surface temperature for 2012 was the eighth highest on record at +0.14°C above the 1981 – 2010 baseline.

Monitoring changes in temperature records on a decadal to centennial scale worldwide is of primary importance in ensuring scientifically sound diagnostics and understanding of the state of the climate. In its role as one of the world's leading climate centers, the Japan Meteorological Agency (JMA) provides global mean surface temperature data (i.e., combined averages of near-surface air temperatures over land and sea surface temperatures) on a monthly, seasonal and annual basis, thereby helping to raise public awareness of global warming development. The annual global average surface temperature anomaly for 2012 was +0.14°C with the 1981 – 2010 average as a baseline. This ranks as the eighth highest figure since 1891 – the earliest year of JMA's global temperature anomaly records (Figure 1, Table 1). Warm temperature anomalies were noticeable especially around North America, from western Russia through to the Mediterranean, and over the Indian Ocean and the central part of the North Pacific Ocean (Figure 2). The average temperature over land areas alone was the sixth highest on record.

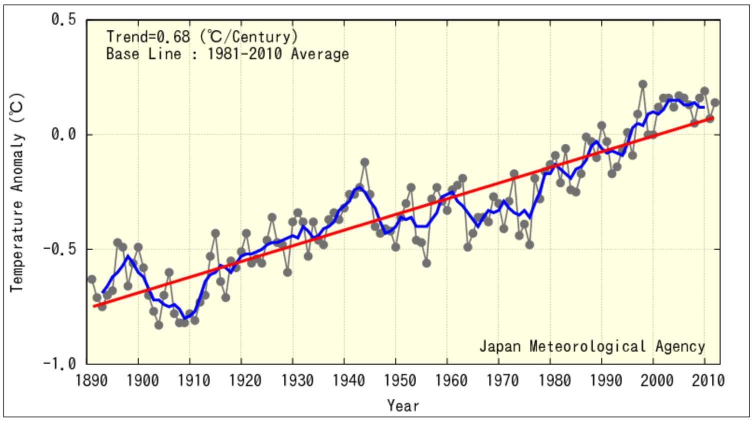


Figure 1 Long-term change in annual surface temperature anomalies averaged worldwide
The grey line with filled circles indicates yearly anomalies of surface temperature. The blue line indicates the five-year running mean, and the red line shows the long-term linear trend. Anomalies are represented as deviations from the 1981 – 2010 average.

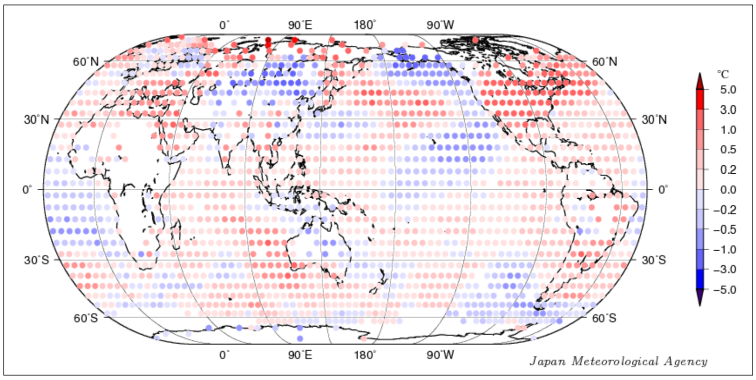


Figure 2 Annual mean temperature anomalies for 2012
The red and blue dots indicate temperature anomalies from the baseline period (1981 – 2010) averaged in 5° × 5° grid boxes.

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

As shown in Table 1, the 14 warmest years on record have all been in the past 16 years. The recent high annual temperatures are best explained as a consequence of disturbed energy balance between incoming solar radiation and outgoing infrared radiation. This disturbance is caused by the increase in anthropogenic greenhouse gas concentrations observed since the Industrial Revolution. The natural variability inherent in the earth's climate system is considered to contribute to temperature fluctuations on an annual-to-decadal scale.

Global average temperatures are monitored on an operational basis by multiple climate centers (the Met Office Hadley Centre (UK), the National Climate Data Center (USA), the Goddard Institute for Space Studies (USA) and JMA). On a monthly basis, these centers calculate the global temperature independently of one another in terms of data quality control policies, analytical approaches and other computational procedures. Despite this methodological divergence, the results they produce indicate remarkably similar levels of month-to-month and year-to-year variability, and more importantly, an almost-identical long-term warming trend (Figure 3). The four sets of records all show that the 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° × 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 16 annual global average temperatures since 1891

(Relative to the 1981 – 2010 baseline period)

Rank	Year	Temperature anomaly
1	1998	+0.22
2	2010	+0.19
3	2005	+0.17
4	2009	+0.16
	2006	+0.16
	2003	+0.16
	2002	+0.16
8	**2012**	**+0.14**
9	2007	+0.13
10	2004	+0.12
	2001	+0.12
12	1997	+0.09
13	2011	+0.07
14	2008	+0.05
15	1990	+0.04
16	1995	+0.01

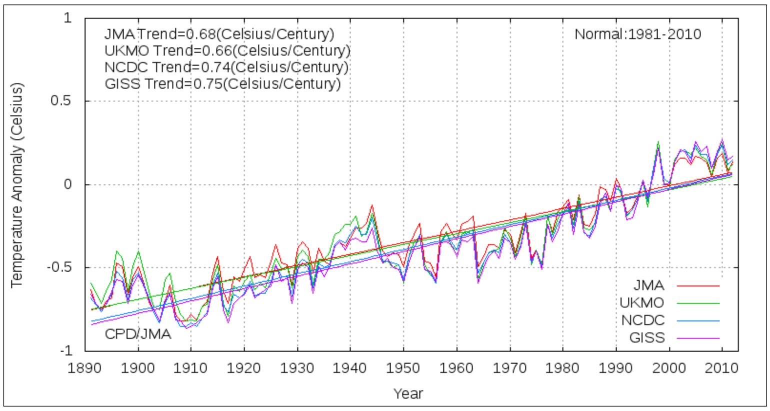


Figure 3 Global surface temperature records from four independent climate centers

Despite slight differences in the ranges of annual fluctuation, the four sets of records from JMA, Hadley Centre, NCDC and GISS show remarkably similar long-term rising trends. Annual anomalies are all adjusted to the 1981 – 2010 baseline period for convenience of comparison.

Highlights of the Global Climate for 2012

Annual mean temperatures were above normal in northern Siberia, southeastern Europe, the Middle East, the USA, central South America and southwestern Australia, and were below normal from northeastern China to eastern Kazakhstan and around Alaska (Figure 4). Extremely high temperatures were frequently observed in western Russia, southeastern Europe, the Arabian Peninsula, eastern to central parts of the USA and western Australia, and extremely low temperatures were frequently observed from northern China to Kazakhstan and in Alaska.

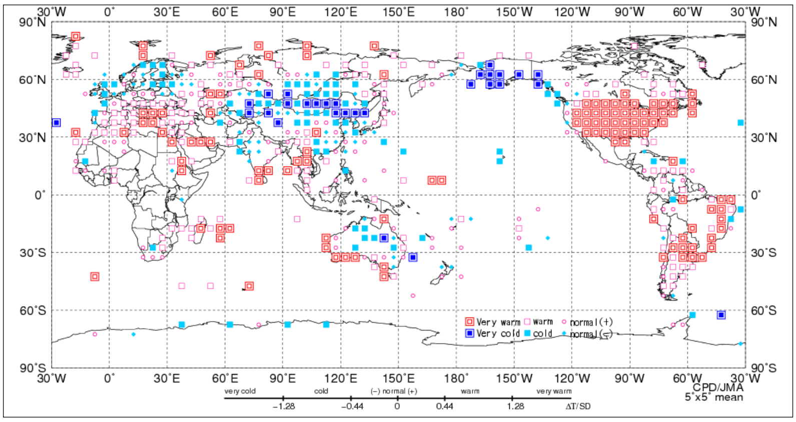


Figure 4 Annual mean temperature anomalies for 2012

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 1981 – 2010 statistics. Land areas without graphics represent regions for which the sample size of observation data is insufficient or normal data are unavailable.

Annual precipitation amounts were above normal from eastern Siberia to northern China, around the East China Sea and in Pakistan, northern Europe, western Africa and eastern Australia, and were below normal over the Arabian Peninsula, northwestern Africa, central to southern parts of the USA, northeastern Brazil and central Australia (Figure 5). Extremely heavy precipitation amounts were frequently observed in eastern Australia, and extremely light precipitation amounts were frequently observed in southern Europe, the central USA and northeastern Brazil.

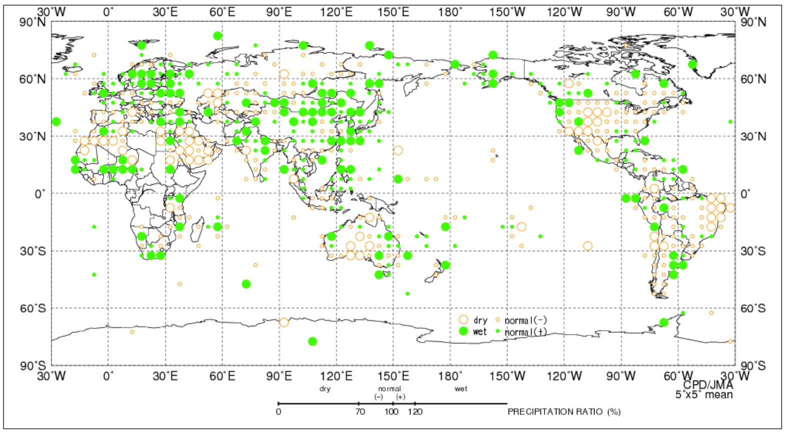


Figure 5 Annual total precipitation amount ratios for 2012
Categories are defined by the annual precipitation ratio to the normal averaged in 5° × 5° grid boxes. The thresholds of each category are 70%, 100% and 120%. Land areas without graphics represent regions for which the sample size of observation data is insufficient or normal data are unavailable.

Major extreme climatic events and weather-related disasters occurring in 2012 are listed below (also see Figure 6).

(1) Typhoon in the Philippines (December)
(2) Heavy precipitation in Pakistan (September)
(3) Low temperatures from northern East Asia to northwestern Africa (January – February, December)
(4) High temperatures from western Kazakhstan to western Russia (April – May, October)
(5) Heavy precipitation around the United Kingdom (April, June, December)
(6) High temperatures (June – November) and light precipitation (June, August, December) from around the Mediterranean Sea to the Arabian Peninsula
(7) High temperatures (March – July) and light precipitation (May – September, November) from eastern to central parts of the USA
(8) Hurricane in the eastern USA and Caribbean countries (October)
(9) Low temperatures in Alaska (January, March)
(10) Light precipitation in northeastern Brazil (March – April)
(11) Heavy precipitation in eastern Australia (March)
(12) High temperatures in western Australia (October, December)

(Kazuyoshi Yoshimatsu, Climate Prediction Division)

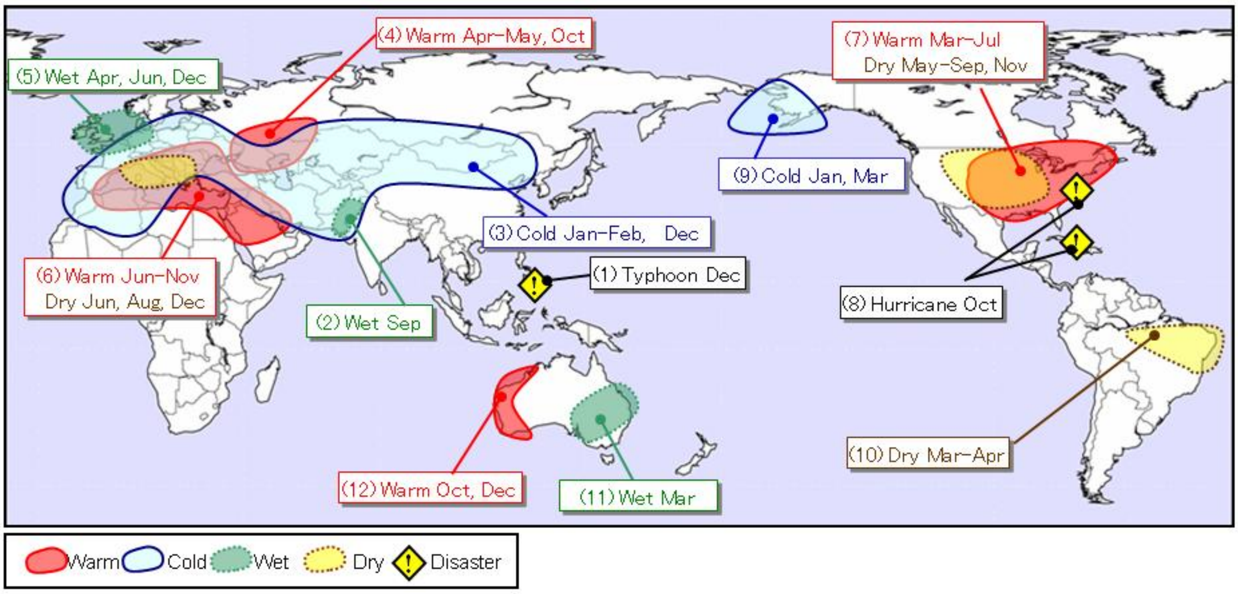


Figure 6 Major extreme climate events and weather-related disasters across the world in 2012
Major extreme climate events and weather-related disasters that occurred during the year are indicated schematically.

Summary of Japan's Climatic Characteristics for 2012

- **Near-normal annual mean temperatures nationwide**
- **Significantly above-normal annual precipitation and significantly below-normal annual sunshine duration in Okinawa/Amami**
- **Below-normal winter temperatures in northern, eastern and western Japan, and the second-heaviest snowfall in the last 10 years on the Sea of Japan side of northern, eastern and western Japan**
- **Significantly above-normal summer precipitation on the Pacific side of western Japan and in Okinawa/Amami due to frequent heavy-rain events associated with the active Baiu front, typhoon passage and moist southerly flow**
- **Record-breaking heat wave in late summer in northern and eastern Japan**

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

Temperatures tended to be below normal in the cold season and above normal in the warm season nationwide. As a result, annual mean temperatures were near normal nationwide. Annual precipitation amounts were above normal in most parts of Japan, and were significantly above normal in western Japan and Okinawa/Amami in summer and in northern and eastern Japan in spring and autumn. Okinawa/Amami experienced significantly above-normal annual precipitation amounts and significantly below-normal annual sunshine durations.

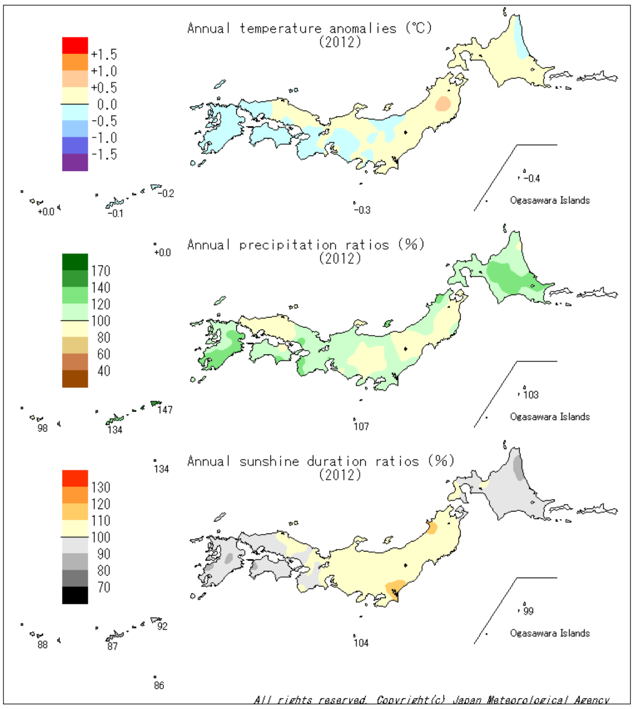


Figure 7 Annual climate anomalies/ratios for Japan in 2012

(2) Seasonal characteristics (Figure 8)

(a) Winter (December 2011 – February 2012)

The winter monsoon was stronger than normal throughout winter. Temperatures were below normal for these three consecutive months except in Okinawa/Amami. Heavy snowfall often hit the Sea of Japan side, resulting in the second-largest snow depth figure in the last 10 years. Seventeen stations reported record annual maximum snow depths, and Okinawa/Amami experienced the shortest winter sunshine durations since 1946.

(b) Spring (March – May 2012)

Westerly jet streams tended to meander over East Asia during spring. Upper cold air masses often moved southward to Japan and caused severe weather events such as storm winds, heavy rainfall and tornadoes.

(c) Summer (June – August 2012)

The Baiu front stayed around western Japan in the rainy season during the first half of summer. Convective activity along the Baiu front was often enhanced and caused heavy rainfall in western Japan. In the latter half of summer, the dominant North Pacific high covered the main islands and brought hot sunny days while Okinawa/Amami experienced wet and cloudy days due to frequent typhoon approaches and strong warm moist southerly flow around the western edge of the North Pacific high.

(d) Autumn (September – November 2012)

The North Pacific high continued to be dominant east of Japan, bringing hot and sunny days in northern and eastern Japan in September. This resulted in the highest monthly mean temperature in northern Japan (3.7°C above normal) since 1946. In the latter half of autumn, temperatures tended to be below normal nationwide.

(Takafumi Umeda, Climate Prediction Division)

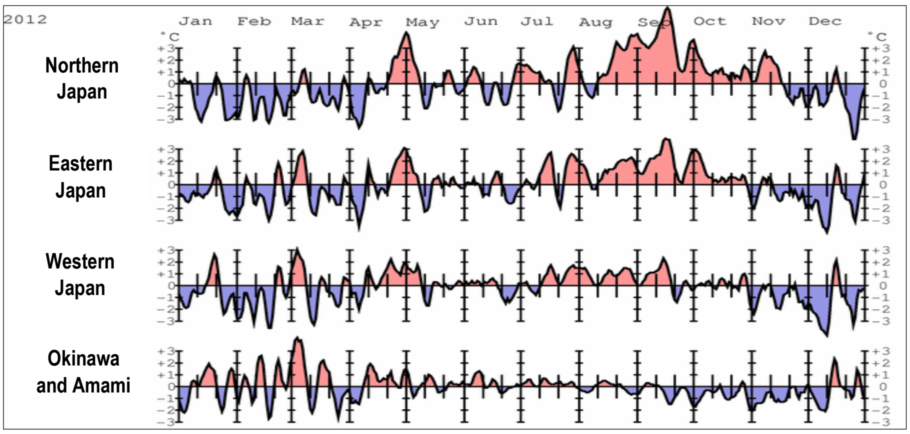


Figure 8 Time series of five-day running mean temperature anomalies for subdivisions (January – December 2012)
The normal is the 1981 – 2010 average.

TCC Activity Report for 2012

In 2012, the Tokyo Climate Center (TCC) continued to support the climate services of NMHSs in Asia-Pacific countries by providing and enhancing data and products, holding training seminars, sending experts and hosting visitors.

1. Highlights of 2012

1.1 Contribution to the development of the Global Framework for Climate Services (GFCS)

WMO works on the development of the Global Framework for Climate Services (GFCS) to better serve society's needs for accurate and timely climate information. In October 2012, an extraordinary session of the World Meteorological Congress approved the governance structure and implementation plan for the GFCS. TCC participated in discussions on the development of the draft implementation plan for the GFCS as a contributor to the sections of the Climate Services Information System (CSIS) and Capacity Development in the implementation plan. Regional Climate Centres (RCCs) are expected to play a major role in the CSIS – one of five components of the framework. In its role as an RCC, TCC plans to contribute to the effective and appropriate development of the system and the framework.

For successful and efficient implementation of the GFCS, it is important for NMHSs to share related good practices, especially in regard to the development and provision of user-oriented/targeted services. At the 15th session of the WMO Regional Association II (Asia) (Doha, Qatar, December 2012), it was agreed that TCC would lead a new GFCS-related pilot project under which it will establish a portal site to collect and share climate information provided by NMHSs and good practices on the application of climate information.

1.2 Issuance of special reports on extreme events

NMHSs are expected to actively contribute to climate risk management, and are tasked with issuing appropriate and timely information when extreme events occur. Against this background, TCC is committed to assisting NMHSs in fulfilling their roles.

In February and December 2012, the Eurasian Continent was hit by a marked cold wave. In response, TCC issued special reports entitled "Cold Wave over the Eurasian Continent" on 6 February and 28 December to briefly summarize the situation. These reports were also made available on the WMO website. The Center additionally provided NMHSs in the affected areas with extra commentary on the situation as well as information on how to prepare related figures using web-based tools available on the TCC website (TCC News Nos. 27 and 31).

2. Enhancement of data/products/tools on the TCC website

TCC strives to continuously enhance its services in the provision of data, products and tools.

In 2012, the following data and products were made available on the TCC website:

- 13 November: Animation maps (climate system monitoring)
- 26 December: Asian monsoon monitoring indices (climate system monitoring)
  Time-longitude cross sections (climate system monitoring)

The following upgrades were also made to products/services.

- 10 February: Increased number of forecast stations in line with a minor revision of the probabilistic forecast system (one-month probabilistic forecasts)
- 21 December: Addition of ensemble mean and standard deviation values for individual forecast stations (one-month probabilistic forecasts)
- 21 December: Addition of a new forecast station (Hong Kong Observatory) (one-month probabilistic forecasts)

Some of these new data/products were made available in response to requests by NMHSs, and are also expected to be useful to other parties. The Center will continue to accommodate requests from NMHSs wherever possible.

3. Capacity development

TCC holds annual training seminars as part of capacity-building activities related to its role as an RCC in the WMO RA II area. In addition to running annual training seminars, it arranges expert visits to and hosts visitors from NMHSs to support exchanges of views on climate services and the effective transfer of technology.

3.1 Training seminars

In 2012, the Training Seminar on Climate Analysis Information was held from 26 to 30 November at JMA Headquarters in Tokyo. The event was attended by 13 experts from NMHSs in Bangladesh, Hong Kong, Indonesia, Lao People's Democratic Republic (PDR), Malaysia, Mongolia, Myanmar, Nepal, the Philippines, Sri Lanka, Thailand and Viet Nam. Through lectures and exercises, the participants learned about climate system monitoring and how to prepare climate analysis information on extreme climate events. The presentations given by the lecturers are available on the TCC website (TCC News No. 31).

3.2 Expert visit

In March 2012, TCC sent experts to three Asian countries (Lao PDR, the Philippines and Viet Nam) for follow-up work relating to the TCC Training Seminar on One-month Forecast Products held in November 2011. The activities they led included practical exercises with the Interactive Tool for Analysis of the Climate System (ITACS) and the installation of a module for site-specific probabilistic guidance for one-month forecasting. The experts also led discussions and exchanged views with attendees on improving climate services and engaging in future collaboration (TCC News No. 29).

3.3 Visitors

In July 2012, TCC hosted four experts from Indonesia's Meteorological, Climatological and Geophysical Agency (BMKG) to assist them in developing a Climate Early Warning System. Center staff presented the details of work procedures for the operational climate warning system in Japan and JMA's Ensemble Prediction System (EPS) for seasonal forecasting, and then led exercises on the application of gridded EPS data. The visit also provided TCC staff with a good opportunity to learn about BMKG climate services, including those tailored to agriculture in Indonesia (TCC News No. 27).

4. International meetings

4.1 Regional Climate Outlook Forums

Regional Climate Centres are expected to actively contribute to discussions in Regional Climate Outlook Forums (RCOFs). In 2012, TCC experts participated in two RCOFs in Asia. These were the eighth session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II (FOCRA II) held in Beijing, China, from 5 to 7 April, and the third session of the South Asian Climate Outlook Forum (SASCOF-3) held in Pune, India, from 19 to 20 April. TCC attendees gave presentations on seasonal predictions based on JMA's numerical model and participated in discussions to produce consensus forecasts.

In addition to these RCOFs, TCC, in collaboration with the Beijing Climate Center (BCC) of the China Meteorological Administration, the Korea Meteorological Administration (KMA) and the National Agency for Meteorology, Hydrology and Environment Monitoring (NAMHEM) of Mongolia, held the Joint Meeting for the Seasonal Prediction of the East Asian Winter Monsoon. Its 13th session, hosted by KMA, took place in Seoul in the Republic of Korea from 6 to 8 November, and was attended by a TCC expert. As noted at the 15th session of the WMO Regional Association II (Asia), China, Japan, Korea and Mongolia have agreed to establish a new sub-RCOF (called the East Asia winter Climate Outlook Forum (EASCOF)) for the region dominated by the East Asian winter monsoon based on deliberations at the joint meeting, and the forum's first session will be held in autumn 2013. TCC will continue to collaborate with these countries for the effective organization of the EASCOF.

TCC was also able to contribute to RCOFs in Africa. These were the 15th RCOF for West Africa, Cameroon and Chad (PRESAO-15) (Ouagadougou, Burkina Faso, May) and the first RCOF for the South West Indian Ocean region (PRESAOI-1, Moroni, Comoros, June). In response to invitations addressed to TCC and the Global Producing Center for Long-range Forecasts (GPC) Tokyo, staff from both organizations collaboratively prepared and provided climate analysis and prediction information suitable for RCOFs, and these data were used as important input at the events.

4.2 Other meetings

Mr Ryuji Yamada, a TCC expert and a member of the WMO CCl Expert Team on Strategy for Capacity Building for Climate Services, took part in a teleconference of the team in June. Discussions mainly focused on job competency requirements for climatological personnel.

At the 15th session of the WMO Regional Association II (Asia) (Doha, Qatar, December), Mr Yamada was designated as co-coordinator of the Expert Group on Climate Services (EG-CS) within the RA II Working Group on Climate Services (WGCS). He plans to promote the GFCS and activities related to climate services, including the use of RCC products, in collaboration with the other co-coordinator, Dr Ghulam Rasul (Pakistan).

5. Publications

TCC has published its newsletter (TCC News) on a quarterly basis since 2005. The publication is intended to enhance communication and provide information to NMHSs and related communities about recent TCC developments, events and activities as well as details of the Center's reports on the state of the climate, monitoring results and outlooks. In 2012, TCC News Nos. 27 – 30 were issued and made available on the TCC website.

Other English-language publications related to the climate, such as Climate Change Monitoring Report 2011 and Annual Report on the Climate System 2011, were also made available on the TCC website.

6. Plans for 2013

With the development of the GFCS, the importance of international collaboration through RCCs is growing, and TCC plans to further strengthen its activities to lead RA II's contribution to the GFCS. In light of the important roles played by NMHSs in climate-related disaster risk management (one of the key sectors in the GFCS), TCC plans to enhance regional climate watch observation by more actively providing NMHSs with relevant information as necessary. As part of an RA II pilot project, TCC will collect climate information provided by NMHSs as well as details of good practices on the application of climate information in society, and will make these resources available on a portal site.

As per the recommendation adopted at the 15th session of the WMO Commission for Basic Systems (CBS) (Jakarta, Indonesia, September), which was supported by RA II at its 15th session (December), the Russian Federation's

North Eurasia Climate Centre (NEACC) will be formally designated as a new RCC in RA II at the 65th session of the WMO Executive Council (May 2013). TCC hopes to engage in efficient collaboration with the new RCC as an extension to its current work with China’s BCC. A couple of RA II RCC proponents are expected to enter their demonstration phase shortly, and TCC staff look forward to assisting them in their preparations.

In autumn 2013, TCC will hold its annual training seminar with a dozen invited experts. The Center will also continue to dispatch experts to NMHSs as necessary and host visitors from NMHSs upon request.

JMA is currently conducting the Japanese 55-year reanalysis project (JRA-55), which is scheduled for completion in fiscal 2013. The Agency plans to develop a high-resolution one-month forecast model, which will become operational in fiscal 2013. Data and products based on JRA-55 and the high-resolution forecast system will be made available to NMHSs through TCC in due course.

(Teruko Manabe, Tokyo Climate Center)

TCC Training Seminar on Climate Analysis Information

TCC held the Training Seminar on Climate Analysis Information from 26 to 30 November, 2012, at JMA Headquarters in Tokyo. The event was attended by 13 experts from 12 NMHSs in Bangladesh, Hong Kong, Indonesia, Lao People’s Democratic Republic, Malaysia, Mongolia, Myanmar, Nepal, the Philippines, Sri Lanka, Thailand and Viet Nam. The seminar focused on improving skills in climate system monitoring and in preparation for climate analysis information on extreme climate events, with teaching based on lectures and practical exercises using data and products available on the TCC website as well as a web-based application tool for climate analysis. At the end of the seminar, all participants gave presentations highlighting climate analysis information on past extreme climate events that occurred in their countries and engaged in fruitful discussions with lecturers and participants. The content of the lectures is available on the TCC website (http://ds.data.jma.go.jp/tcc/tcc/library/library2012.html).

(Teruko Manabe, Tokyo Climate Center)

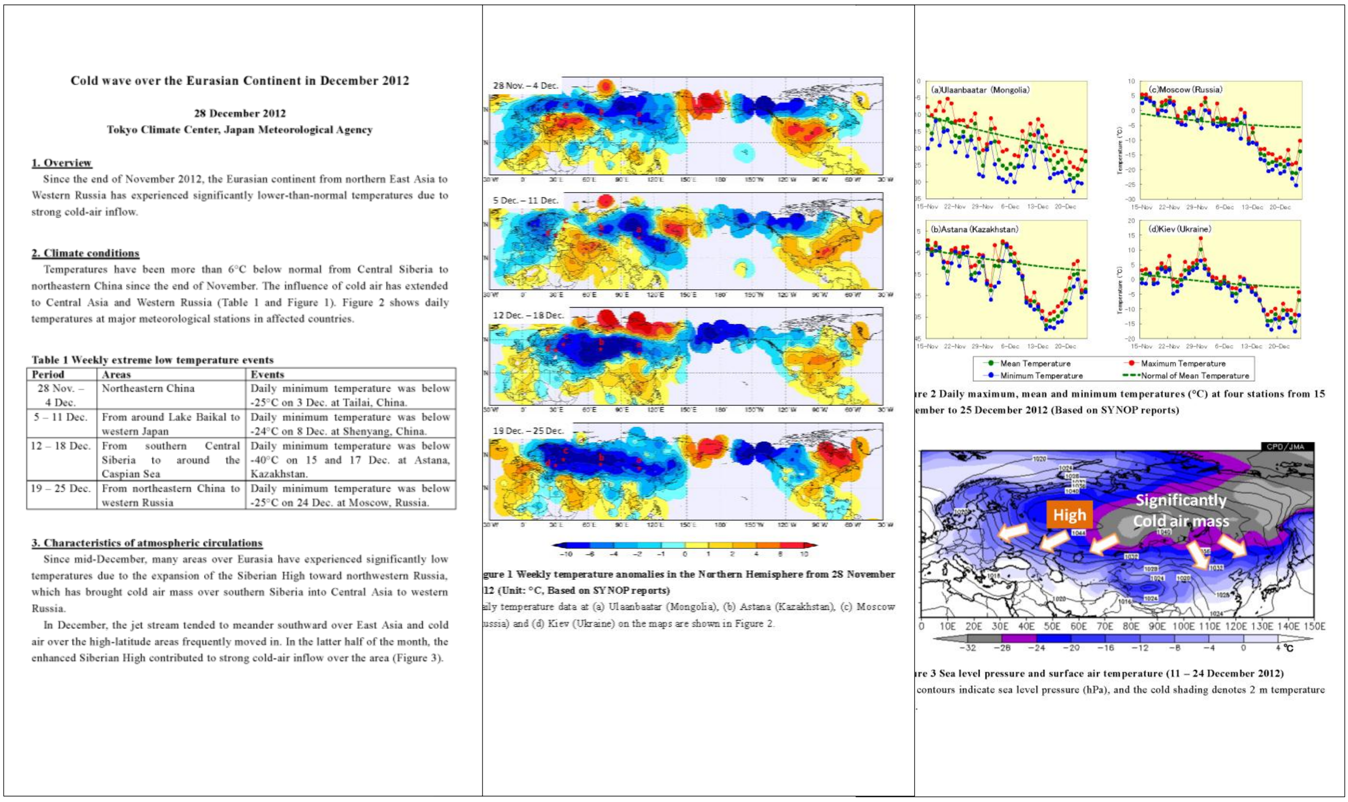
Issuance of a TCC Report on the Cold Wave over the Eurasian Continent

From the end of November 2012, the Eurasian continent from northern East Asia to western Russia experienced significantly lower-than-normal temperatures due to strong cold-air inflow. Temperatures were more than 6°C below normal from Central Siberia to northeastern China. The influence of this cold air extended to Central Asia and western Russia.

In response, TCC issued a report entitled "Cold Wave over the Eurasian Continent in 2012" on 28 December 2012, to give a brief summary of the situation.

TCC remains committed to its efforts to assist NMHSs, and will continue its involvement in such activities in the future.

(Ryuji Yamada, Tokyo Climate Center)



Cold wave over the Eurasian Continent in December 2012

28 December 2012
Tokyo Climate Center, Japan Meteorological Agency

1. Overview

Since the end of November 2012, the Eurasian continent from northern East Asia to Western Russia has experienced significantly lower-than-normal temperatures due to strong cold-air inflow.

2. Climate conditions

Temperatures have been more than 6°C below normal from Central Siberia to northeastern China since the end of November. The influence of cold air has extended to Central Asia and Western Russia (Table 1 and Figure 1). Figure 2 shows daily temperatures at major meteorological stations in affected countries.

Table 1 Weekly extreme low temperature events

Period	Areas	Events
28 Nov. – 4 Dec.	Northeastern China	Daily minimum temperature was below -25°C on 3 Dec. at Tailai, China.
5 – 11 Dec.	From around Lake Baikal to western Japan	Daily minimum temperature was below -24°C on 8 Dec. at Shenyang, China.
12 – 18 Dec.	From southern Central Siberia to around the Caspian Sea	Daily minimum temperature was below -40°C on 15 and 17 Dec. at Astana, Kazakhstan.
19 – 25 Dec.	From northeastern China to western Russia	Daily minimum temperature was below -25°C on 24 Dec. at Moscow, Russia.

3. Characteristics of atmospheric circulations

Since mid-December, many areas over Eurasia have experienced significantly low temperatures due to the expansion of the Siberian High toward northwestern Russia, which has brought cold air mass over southern Siberia into Central Asia to western Russia.

In December, the jet stream tended to meander southward over East Asia and cold air over the high-latitude areas frequently moved in. In the latter half of the month, the enhanced Siberian High contributed to strong cold-air inflow over the area (Figure 3).

gure 1 Weekly temperature anomalies in the Northern Hemisphere from 28 November 12 (Unit: °C, Based on SYNOP reports)
aly temperature data at (a) Ulaanbaatar (Mongolia), (b) Astana (Kazakhstan), (c) Moscow ussia) and (d) Kiev (Ukraine) on the maps are shown in Figure 2.

ıre 2 Daily maximum, mean and minimum temperatures (°C) at four stations from 15 ember to 25 December 2012 (Based on SYNOP reports)

ıre 3 Sea level pressure and surface air temperature (11 – 24 December 2012)
contours indicate sea level pressure (hPa), and the cold shading denotes 2 m temperature

Any comments or inquiry on this newsletter and/or the TCC website would be much appreciated. Please e-mail to tcc@met.kishou.go.jp.
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