Tokyo Climate Center, Japan Meteorological Agency

TCC News

No. 27 Winter 2012

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Global Average Surface Temperature for 2011

The annual anomaly of the global average surface temperature for 2011 was the 12th highest on record at +0.07°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 the state of the climate. In its role as one of the world's leading climate centers, the Japan Meteorological Agency (JMA) calculates monthly, seasonal and annual global mean surface temperatures (i.e., combined averages of near-surface air temperatures over land and sea surface temperatures), thereby helping to raise public awareness of global warming development.

The annual global average surface temperature anomaly for 2011 was +0.07°C, with the 1981 – 2010 average as a baseline. This ranks as the 12th 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 the high latitudes of the Northern Hemisphere, while cool sea surface temperature anomalies were seen in central to eastern parts of the equatorial Pacific Ocean (Figure 2). The average temperature over land areas alone was the ninth highest on record.

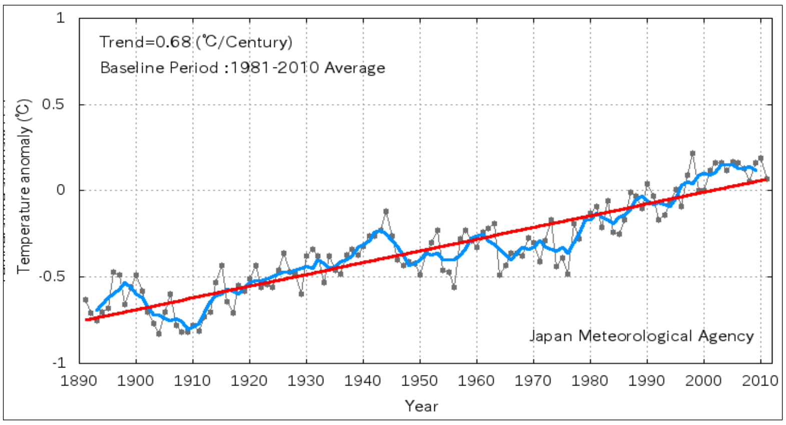


Figure 1 Long-term change in surface temperature anomalies averaged worldwide
The black line with dots indicates yearly anomalies of surface temperature. The blue line indicates the five-year running mean, and the red line shows the long-term linear trend. Anomalies are represented as deviations from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

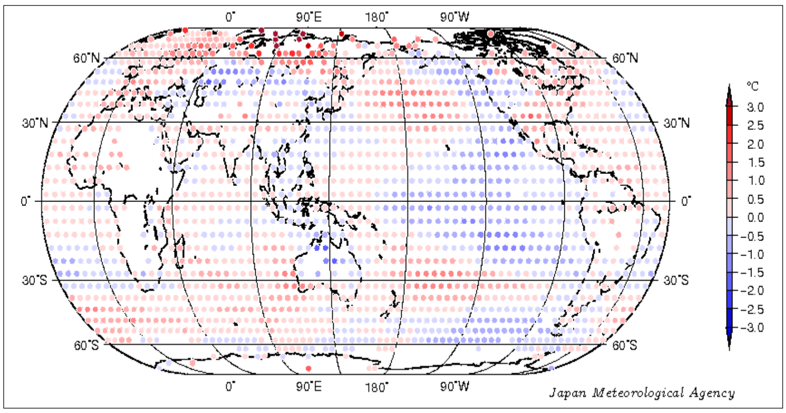


Figure 2 Annual mean temperature anomalies in 2011
The red and blue dots indicate temperature anomalies from the baseline period (1981 – 2010) averaged in 5° x 5° grid boxes.

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 13 warmest years on record have all been in the past 15 years. The recent high annual temperatures are considered to be a result of positive radiative forcing due to an increase in anthropogenic greenhouse gas concentrations since the Industrial Revolution in conjunction with decadal natural fluctuations inherent in the earth's climate system. On a shorter year-to-year time scale, the La Niña conditions prevalent in the equatorial Pacific very likely contributed to the lowering of the 2011 global temperature as compared to that of the previous year.

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 each other in terms of quality control policies, analytical approaches and other computational procedures. Despite this methodological divergence, the results they produce indicate 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° 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 15 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	2007	+0.13
9	2004	+0.12
10	2001	+0.12
11	1997	+0.09
12	***2011***	***+0.07***
13	2008	+0.05
14	1990	+0.04
15	1995	+0.01

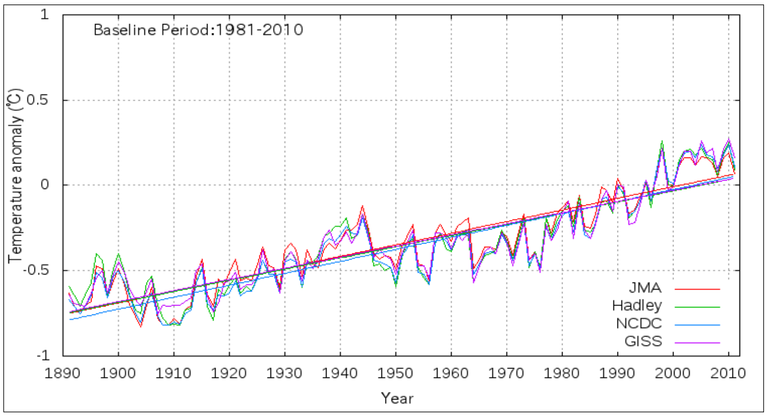


Figure 3 Global surface temperature records from four independent climate centers
Despite slight differences in the ranges of annual fluctuation, the four sets of records from JMA, Hadley Centre, NCDC and GISS show remarkably similar long-term rising trends. Annual anomalies are all adjusted to the 1981 – 2010 baseline period for convenience of comparison.

Highlights of the Global Climate in 2011

Annual mean temperatures were above normal from Siberia to western Europe and from eastern North America to northern Central America, while they were below normal from Mongolia to Central Asia, around the Indochina Peninsula, in western North America, and in northern Australia (Figure 4). Extremely high temperatures were frequently observed around the southern USA, while extremely low temperatures were frequently observed in northern Australia.

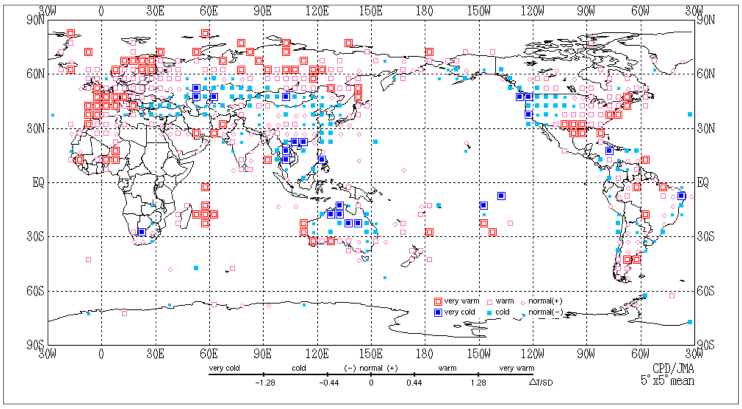


Figure 4 Annual mean temperature anomalies for 2011
Categories are defined by the annual mean temperature anomaly against the normal divided by its standard deviation and averaged in 5° × 5° grid boxes. The thresholds for each category are -1.28, -0.44, 0, +0.44 and +1.28. The normal values and standard 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 the Philippines to the Indochina Peninsula, around southern Pakistan, around the northeastern USA, in northern South America, and in Australia, while they were below normal in southern China, in Saudi Arabia, in Europe, from the southern USA to northern Mexico, and in central Polynesia (Figure 5). Extremely heavy precipitation amounts were frequently observed around the northeastern USA, while extremely light precipitation amounts were often seen in Europe, from the southern USA to northern Mexico, and in central Polynesia. The major extreme climatic events and weather-related disasters of 2011 are listed below (also see Figure 6).

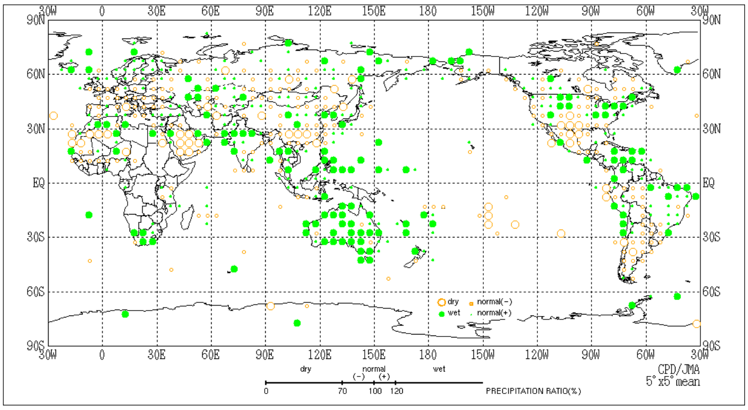


Figure 5 Annual total precipitation ratios for 2011
Categories are defined by the ratio of annual precipitation to the normal averaged in 5° × 5° grid boxes. The thresholds for each category are 70%, 100% and 120%. Land areas without graphics represent regions for which the sample size of observation data is insufficient or normal data are unavailable.

(1) Light precipitation in southeastern China (January – May)
(2) Flooding on the Indochina Peninsula (July – December)
(3) Tropical storm in the Philippines (December)
(4) Heavy precipitation in southern Pakistan (August – September)
(5) Light precipitation in Europe (March – May, September – November)
(6) Drought in eastern Africa (January – September)
(7) High temperatures from the Seychelles to Mauritius (April – December)
(8) Heavy precipitation around the northeastern USA (February – May, August – September)
(9) Tornados in southeastern and central parts of the USA (April – May)
(10) High temperatures around the southern USA (March – September)
(11) Light precipitation from the southern USA to northern Mexico (January – November)
(12) Torrential rains in southeastern Brazil (January)
(13) Light precipitation in central Polynesia (March – October)
(14) Low temperatures in northern Australia (January – June)

(Takafumi Umeda, Climate Prediction Division)

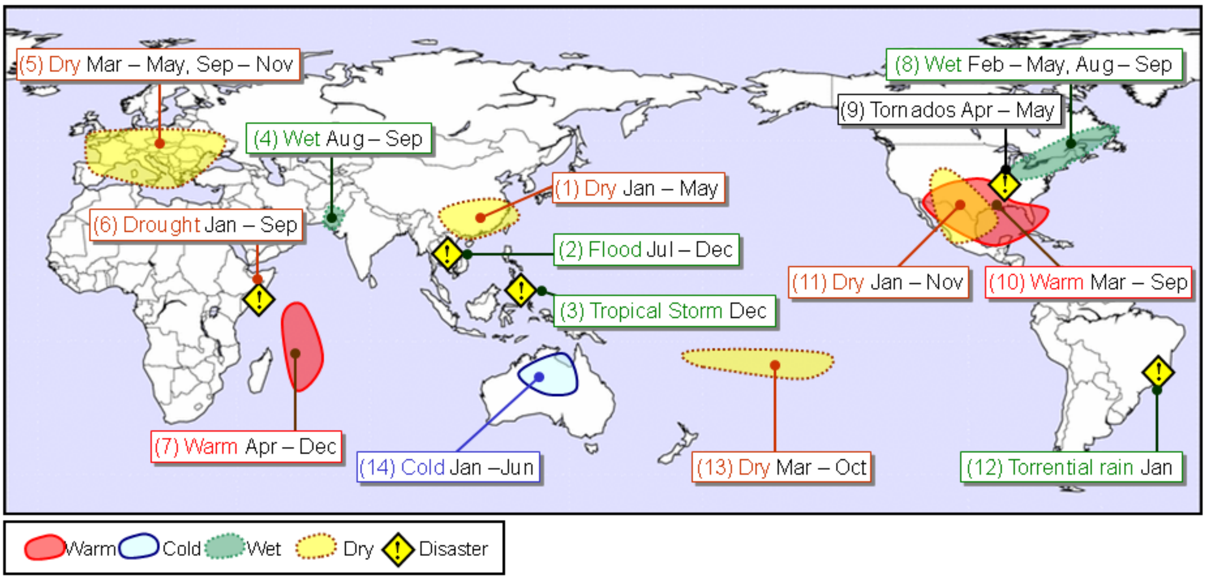


Figure 6 Major extreme climate events and weather-related disasters across the world in 2011
Schematic indication of major extreme climate events and weather-related disasters seen during the year

Summary of Japan's Climatic Characteristics for 2011

- Above-normal annual precipitation in western Japan and on the Sea of Japan side of northern and eastern Japan
- Below-normal annual sunshine durations in western Japan and Okinawa/Amami
- Below-normal temperatures nationwide in spring, and above-normal temperatures nationwide in summer and autumn
- Significantly earlier onset and end of the rainy season in many regions
- Record-breaking heavy rainfall in the prefectures of Niigata and Fukushima at the end of July
- Record-breaking heavy rainfall due to typhoons Talas and Roke in September

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

Temperatures tended to be below normal nationwide until May due to the effects of cold surges, and above normal from June through November. Annual mean temperatures were near normal except in Okinawa/Amami.

Annual precipitation amounts were above normal except in Okinawa/Amami and on the Pacific side of northern and eastern Japan. In particular, values were significantly above normal on the Sea of Japan side of northern Japan, which is subject to the effects of low-pressure areas and fronts.

Annual sunshine durations were above normal on the Pacific side of eastern Japan, below normal in western Japan and significantly below normal in Okinawa/Amami.

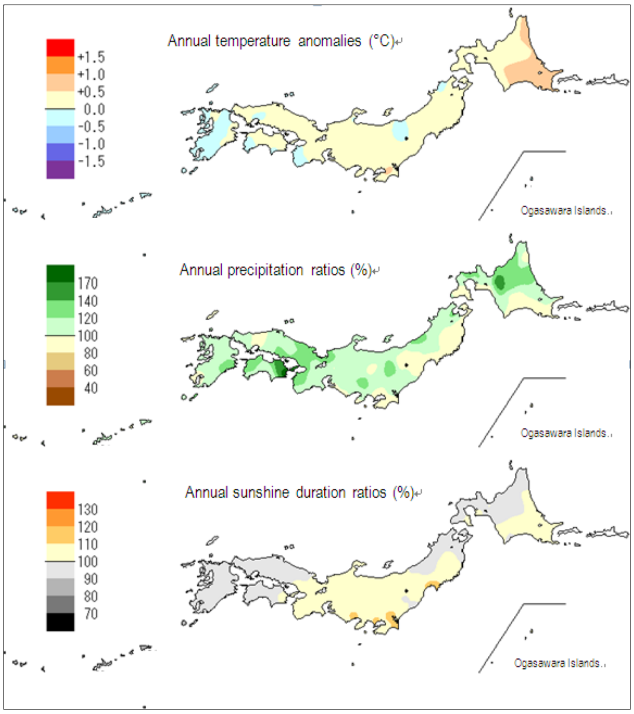


Figure 7 Annual climate anomalies/ratios for Japan in 2011

(2) Seasonal characteristics (Figure 8)

(a) Winter (December 2010 – February 2011)

Intraseasonal temperature variations were very large nationwide. From the end of December 2010 to the end of January 2011, temperatures were below normal nationwide, and snowfall amounts were above normal in all areas on the Sea of Japan side due to intermittent cold surges. Conversely, in the first half of December and the last half of February, temperatures were above normal nationwide due to the weak winter monsoon.

(b) Spring (March – May 2011)

Temperatures were below normal nationwide. In the first half of the season, values were significantly below normal in western Japan, while precipitation amounts were below normal and sunshine durations were above normal on the Pacific side due to the strong winter monsoon and anti-cyclones bringing cold air. In the second half of the season, temperatures were below normal in northern Japan due to the presence of cold vortexes.

(c) Summer (June – August 2011)

Although seasonal mean temperatures were above normal, intraseasonal temperature variations were very large nationwide. The onset and end of the rainy season were significantly earlier than normal in many regions. At the end of July, record-breaking heavy rainfall caused disaster conditions in the prefectures of Niigata and Fukushima.

(d) Autumn (September – November 2011)

As the westerly jet was shifted northward of its normal position, seasonal mean temperatures were above normal nationwide and significantly above normal in eastern and western Japan and Okinawa/Amami. Some typhoons and cyclones caused above-normal precipitation amounts nationwide. In September, record-breaking heavy rainfall brought by typhoons Talas and Roke caused disaster conditions in many areas.

(Koji Ishihara, Climate Prediction Division)

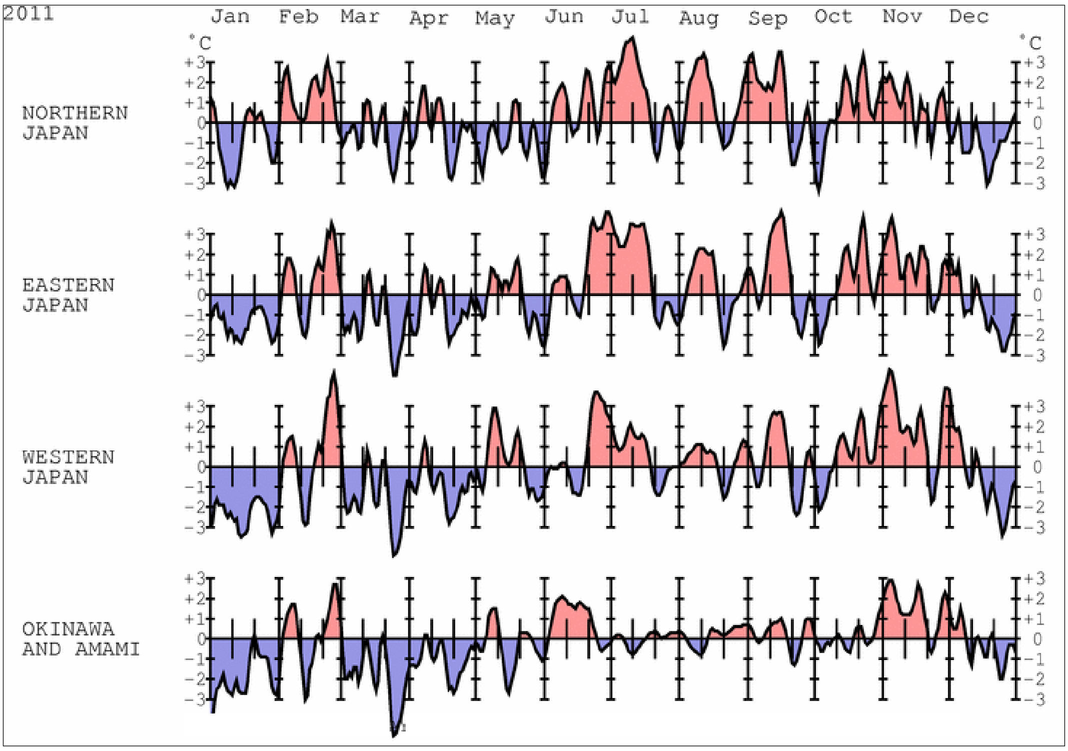


Figure 8 Time series of five-day running mean temperature anomalies for subdivisions (January – December 2011)
The normal is the 1981 – 2010 average.

Intercomparison and Calibration of Ozone Observation Instruments – a JMA RDCC activity for Asia

As ozone in the stratosphere absorbs much of the sun's biologically harmful ultraviolet radiation, it helps to protect life on earth and represents a major stratospheric heat source. In this context, ozone observation is important not only for assessing the status of stratospheric ozone depletion caused by ozone-depleting substances but also for monitoring the climate.

WMO's Global Atmosphere Watch (GAW) programme has established a system for the calibration of Dobson ozone spectrophotometers at individual monitoring stations (Figure 9) to support homogenous and accurate ozone observation. In its role as the Regional Dobson Calibration Centre (RDCC) for WMO Regional Association II (Asia), JMA maintains the Regional Standard Dobson spectrophotometer (RSD) through calibration against the World Standard Dobson spectrophotometer, calibrates Dobson spectrophotometers used in Asia and provides related training.

In September 2011, the two Dobson spectrophotometers used at Xianghe and Kunming in China were calibrated against the RSD instrument at JMA's Aerological Observatory in Tsukuba as part of RDCC activities. Errors of just over 1% in both instruments before calibration were reduced to less than 1% as a result of the intercomparison and calibration. Training in ozone observation and quality control of data collected was also provided to the participants.

A report on the results will be made available on the RDCC website at
http://ds.data.jma.go.jp/gmd/wcc/dobson/rdcc.html. (This link will be available from March 2012.)

(Masaki Adachi, Atmospheric Environment Division)

Figure 9 Calibration system of Dobson spectrophotometers

Scene of the intercomparison

TCC Activity Report for 2011

In 2011, 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 and dispatching experts.

1. Highlights in 2011

1.1 Assistance to NMHSs affected by heavy rainfall over the Indochina Peninsula

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

In 2011, heavy monsoon rains caused widespread flooding in Thailand and other areas of the Indochina Peninsula from late July to the end of the year. On 31 October 2011, TCC issued a report entitled "Heavy rainfall over the Indochina Peninsula for June – September 2011" to give a brief summary of the situation. The report was 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 No. 26)

1.2 Global Framework for Climate Services (GFCS)

Climate services are vital to manage climate risks and seize opportunities, but often do not reach communities most vulnerable to climate change. Together with its partners, WMO is currently working on the development of the Global Framework for Climate Services to better serve society's needs for accurate and timely climate information. Regional Climate Centres (RCCs) are expected to play a major role in the Climate Services Information System (CSIS) – one of five components of the Framework. As one of only two existing RCCs, TCC contributed to the effective and appropriate development of the system and the framework.

Staff from the Center gave a presentation on regional aspects of CSIS at the GFCS side-event during the 16th World Meteorological Congress in June 2011 (TCC News No. 25). TCC also participated in the development of the draft implementation plan for the GFCS as a contributor to the sections of CSIS and Capacity Development in the implementation plan.

1.3 Service as an operational DCPC within the WMO Information System

TCC was designated as one of the first Data Collection or Production Centres (DCPCs) of the WMO Information System (WIS) at the 16th World Meteorological Congress in June 2011. Along with seven other DCPCs operated by JMA, TCC started providing metadata catalogues for data discovery, access and retrieval (DAR) services as a new WIS service as of 1 August 2011. (TCC News No. 25)

1.4 New climatological normals for 1981 – 2010

JMA has developed new climatological normals using data for the period from 1981 to 2010, and started operationally using them on 18 May 2011. As these data are used in various products available on the TCC website, a number of products have been updated. (TCC News Nos. 24 and 25)

1.5 Update of JMA's One-month Ensemble Prediction System

JMA updated its Ensemble Prediction System (EPS) for operational one-month forecasting on 4 March 2011. The main changes included implementation of a new dynamical frame, an update to the climatological aerosol total optical depth, and minor adaptations to land surface processes (TCC News No. 23). In addition to the change in operational forecasts, hindcast experiments were also executed using the new system, and the target period will be extended to 1979 – 2010. The updated gridded data obtained from these experiments were made available in January 2011.

2. Enhancement of data/products/tool on the TCC web site

TCC strives to continuously enhance its services in the provision of data, products and tools. In 2011, the following data and products were newly made available on the TCC website:

- 3 Mar.: Forecasting maps and circulation indices based on hindcast experiments using the updated One-month Ensemble Prediction System
- 25 Mar.: Pacific Decadal Oscillation (PDO) index
- 25 Jul.: Warm/Cold Season Probability Forecast and Verification (for registered NMHS users)
- 2 Sep.: Daily gridded data of One-month Forecasting (for registered NMHS users)
- 31 Oct.: Animation of the JMA One-month EPS (7-day running mean) as an experimental product

Upgrades were also made to products/services as detailed below.

- 6 Jan.: Enhancement of hindcast gridded data in accordance with the replacement of the One-month Forecasting Model in March 2011 (for registered NMHS users) (see Section 1.5)
- 3 Jun.: Verification of one-month probabilistic forecasts with a new hindcast
- 25 Jul.: Addition of a new element (Sea Surface Temperature) to the Three-month Probability Forecast
- 31 Oct.: Upgrade of the Interactive Tool for Analysis of the Climate System (ITACS) to Version 4

3. Capacity Development

3.1 Training Seminars

TCC holds an annual training seminar as part of capacity-building activities related to its role as an RCC in the WMO RA II area. As the seminar for fiscal 2010 took place in January 2011 (TCC News No. 23), two training sessions were held during the calendar year.

As the seminar for fiscal 2011, the Training Seminar on One-month Forecast Products was held from 7 to 9 November at JMA Headquarters in Tokyo. The event was attended by 13 experts from NMHSs in Bangladesh, Cambodia, Hong Kong, Indonesia, Lao People's Democratic Republic, Malaysia, Mongolia, Myanmar, Pakistan, the Philippines, Sri Lanka, Thailand and Viet Nam. Through lectures and exercises, the participants learned how to produce one-month forecasts using guidance and gridded model outputs. The presentations given by the lecturers are available on the TCC website. (TCC News No. 26)

3.2 Expert visit

TCC dispatches experts to NMHSs to support exchanges of views on climate services and the effective transfer of technology. In March 2011, two TCC experts visited the Meteorological, Climatological and Geophysical Agency (BMKG) in Indonesia. They outlined the latest status of JMA's seasonal forecasts and ITACS, and discussed effective reporting of CLIMAT with BMKG experts toward the improvement of climate services in Indonesia.

4. International meetings

4.1 Regional Climate Outlook Forums

In November, TCC hosted the Twelfth Joint Meeting for the Seasonal Prediction of the East Asian Winter Monsoon in Tokyo (TCC News No. 26). In addition to experts from the four regular participating countries (China, Japan, Mongolia and the Republic of Korea), participants in the TCC Training Seminar also attended, making the meeting even more fruitful. As the purposes and organization of the Joint Meeting are similar to those of Regional Climate Outlook Forums (RCOFs), the event is expected to be formally recognized as an RCOF in the future.

TCC is also involved in RCOFs in Asia. In 2011, experts from the Center participated in FOCRAII (Beijing, China, April) and SASCOF-2 (Pune, India, April), and gave presentations on TCC and JMA's forecasts.

4.2 Other meetings

In January 2011, a Japan Society for the Promotion of Science (JSPS) International Forum titled "Climatic Changes in Monsoon Asia (CCMA)" was held in Bangkok, Thailand, as part of the Strategic Program for Building an Asian Science and Technology Community – an initiative operated with funding support from the Special Coordination Funds for Promoting Science and Technology. The goals of the forum are to solve common challenges and build an exploratory research network encompassing Japan and Southeast Asian countries. A presentation on TCC activities was given at the forum to encourage enhanced collaboration between operational climate service providers and research communities.

A TCC expert is a member of the Expert Team on Regional Climate Centres (ET-RCC) under the Commission for Climatology (CCl), and participated in its session held in Offenbach, Germany, in October. The event's discussion topics included the establishment and operation of WMO RCCs, the standardization of RCC products and services, and coordination with other climate-related entities.

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 2011, TCC News Nos. 23 – 26 were issued and made available on the TCC website.

Other English-language publications related to the climate, such as Climate Change Monitoring Report 2010, were also made available on the TCC website.

6. Plans for 2012

With the development of the GFCS, improvement and expansion of NMHS climate services are expected. In this context, the importance of international cooperation through RCCs is growing, and TCC plans to further strengthen its activities in this area. As an RCC in the Asian region, the Center will expand its customized services for NMHSs in the area in 2012. Considering the important role of NMHSs in climate risk management, TCC will enhance regional climate watch by more actively providing NMHSs with relevant information as necessary. The following plans are also in place for the TCC website:

- Development of new products for Asian monsoon monitoring
- Provision of useful animations relating to climate system monitoring in Asia

TCC also plans to hold an annual training seminar in the autumn of 2012, and expert visits from TCC to NMHSs will be organized as necessary.

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)

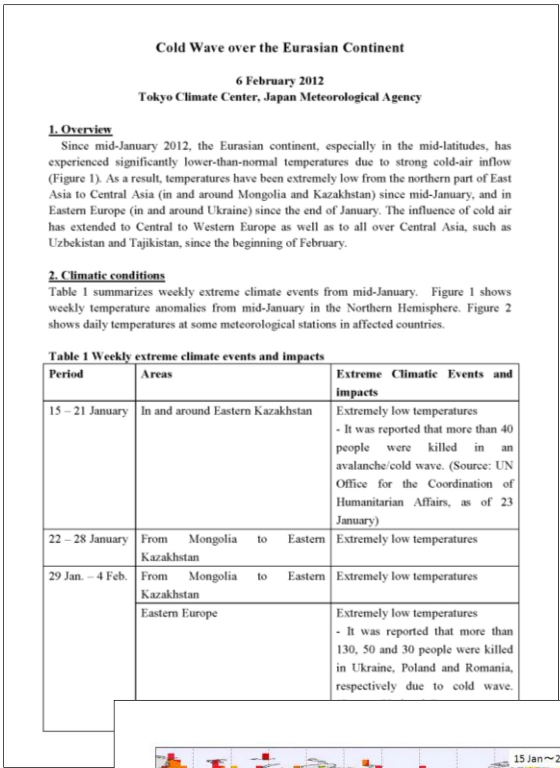
Issuance of a TCC Report on the Cold Wave over the Eurasian Continent

A recent cold wave has affected Europe and a wide area stretching from the northern part of East Asia to Central Asia.

In response, TCC issued a report entitled "Cold Wave over the Eurasian Continent" (http://ds.data.jma.go.jp/tcc/tcc/news/Cold_Wave_over_the_Eurasian_Continent.pdf) on 6 February 2012, to give a brief summary of the situation. The Center also provided NMHSs in the affected areas with supplementary commentary on the situation as well as information on how to prepare related figures using web-based tools available on the TCC website, such as ITACS (http://extreme.kishou.go.jp/tool/itacs-tcc2011/).

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

(Ryuji Yamada, Tokyo Climate Center)



Cold Wave over the Eurasian Continent

6 February 2012
Tokyo Climate Center, Japan Meteorological Agency

1. Overview

Since mid-January 2012, the Eurasian continent, especially in the mid-latitudes, has experienced significantly lower-than-normal temperatures due to strong cold-air inflow (Figure 1). As a result, temperatures have been extremely low from the northern part of East Asia to Central Asia (in and around Mongolia and Kazakhstan) since mid-January, and in Eastern Europe (in and around Ukraine) since the end of January. The influence of cold air has extended to Central to Western Europe as well as to all over Central Asia, such as Uzbekistan and Tajikistan, since the beginning of February.

2. Climatic conditions

Table 1 summarizes weekly extreme climate events from mid-January. Figure 1 shows weekly temperature anomalies from mid-January in the Northern Hemisphere. Figure 2 shows daily temperatures at some meteorological stations in affected countries.

Table 1 Weekly extreme climate events and impacts

Period	Areas	Extreme Climatic Events and impacts
15 – 21 January	In and around Eastern Kazakhstan	Extremely low temperatures - It was reported that more than 40 people were killed in an avalanche/cold wave. (Source: UN Office for the Coordination of Humanitarian Affairs, as of 23 January)
22 – 28 January	From Mongolia to Eastern Kazakhstan	Extremely low temperatures
29 Jan. – 4 Feb.	From Mongolia to Eastern Kazakhstan	Extremely low temperatures
	Eastern Europe	Extremely low temperatures - It was reported that more than 130, 50 and 30 people were killed in Ukraine, Poland and Romania, respectively due to cold wave.

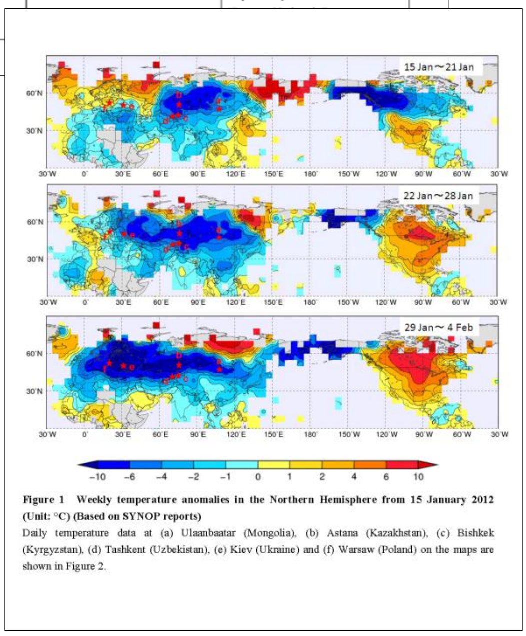


Figure 1 Weekly temperature anomalies in the Northern Hemisphere from 15 January 2012 (Unit: °C) (Based on SYNOP reports)
Daily temperature data at (a) Ulaanbaatar (Mongolia), (b) Astana (Kazakhstan), (c) Bishkek (Kyrgyzstan), (d) Tashkent (Uzbekistan), (e) Kiev (Ukraine) and (f) Warsaw (Poland) on the maps are shown in Figure 2.

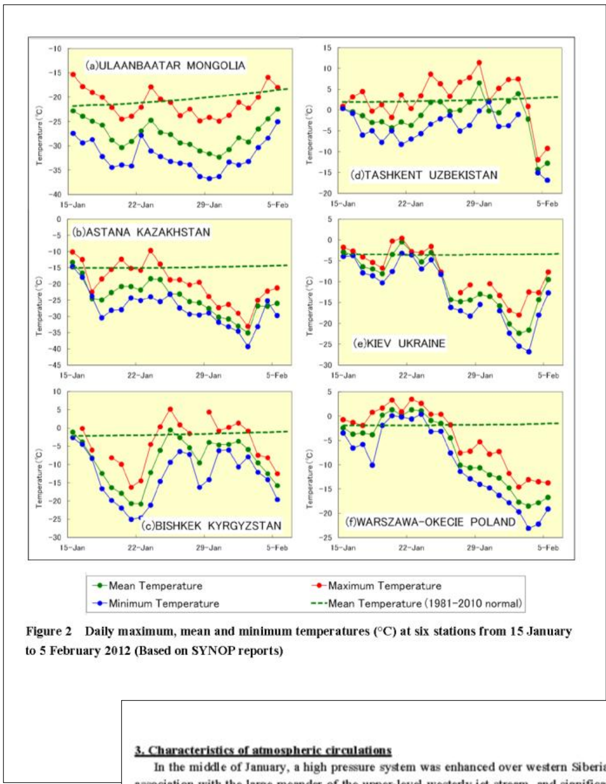
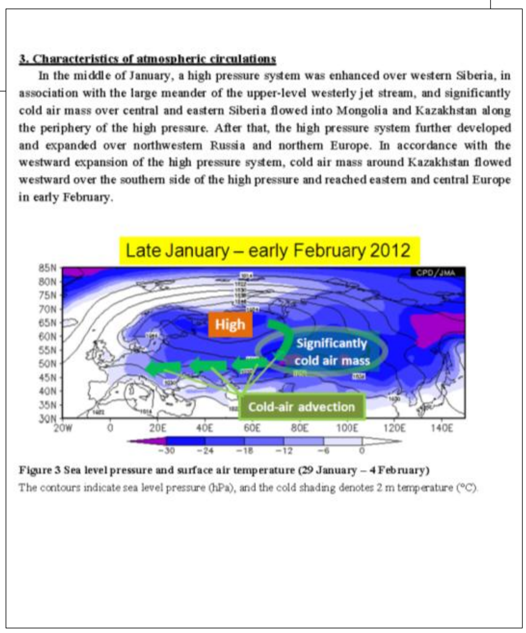


Figure 2 Daily maximum, mean and minimum temperatures (°C) at six stations from 15 January to 5 February 2012 (Based on SYNOP reports)



3. Characteristics of atmospheric circulations

In the middle of January, a high pressure system was enhanced over western Siberia, in association with the large meander of the upper-level westerly jet stream, and significantly cold air mass over central and eastern Siberia flowed into Mongolia and Kazakhstan along the periphery of the high pressure. After that, the high pressure system further developed and expanded over northwestern Russia and northern Europe. In accordance with the westward expansion of the high pressure system, cold air mass around Kazakhstan flowed westward over the southern side of the high pressure and reached eastern and central Europe in early February.

Figure 3 Sea level pressure and surface air temperature (29 January – 4 February)
The contours indicate sea level pressure (hPa), and the cold shading denotes 2 m temperature (°C).

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.
(Editors: Teruko Manabe, Ryuji Yamada and Kenji Yoshida)

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