Tokyo Climate Center, Japan Meteorological Agency

TCC News

No. 43 Winter 2016

Contents

State of the Global Warming for 2015
~The year 2015 was the warmest year since 1891~

(1) Global Surface Temperature in 2015

The annual anomaly of the global average surface temperature for 2015 (i.e., the combined average of the near-surface air temperature over land and the SST) was +0.42 °C above the 1981–2010 average (+0.78 °C above the 20th century average), making it the highest since 1891. The top five warmest years are now: 2015 (+0.42°C), 2014 (+0.27°C), 1998 (+0.22°C), 2013 and 2010 (+0.20°C). On a longer time scale, global average surface temperatures have risen at a rate of about +0.71°C per century since 1891 (Figure 1).

In 2015, the monthly average air temperatures for January, March, May, June, July, August, September, October, November and December, and the seasonal average air temperatures for the boreal spring, summer and autumn were also the highest recorded since 1891.

(continued overleaf)

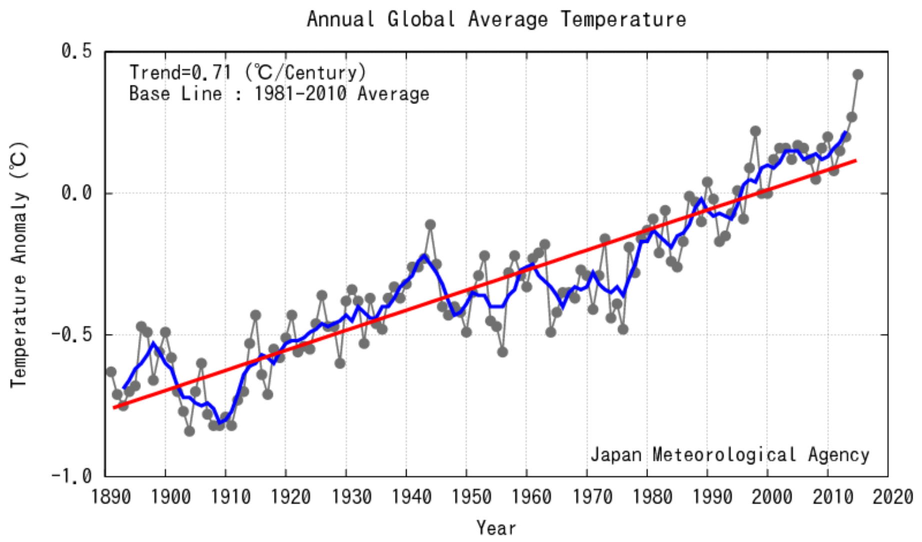

Figure 1 Long-term change in annual mean surface temperature anomalies over the globe
The black line with filled circles indicates anomalies of surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are represented as deviations from the 1981-2010 average.

Warm temperature deviations are especially seen over wide area of Eurasia, the Indian Ocean, and the North and Eastern Tropical Pacific (Figure 2).

Nine of the 10 warmest years on record since 1891 have occurred during this century. The recent high temperatures are thought to be affected by the global warming trend due to increase in anthropogenic greenhouse gas concentrations including carbon dioxide. Moreover the global averaged surface temperature is affected by inter-annual to decadal natural fluctuations intrinsic to the earth's climate, and the highest temperature for 2015 is thought to be due to El Niño event which has continued since the boreal summer 2014.

JMA monitors monthly, seasonal and annual average anomalies of global surface temperature. Those results are routinely updated on the following TCC website:
http://ds.data.jma.go.jp/tcc/tcc/products/gwp/temp/ann_wld.html

(Koji Ishihara, Climate Prediction Division)

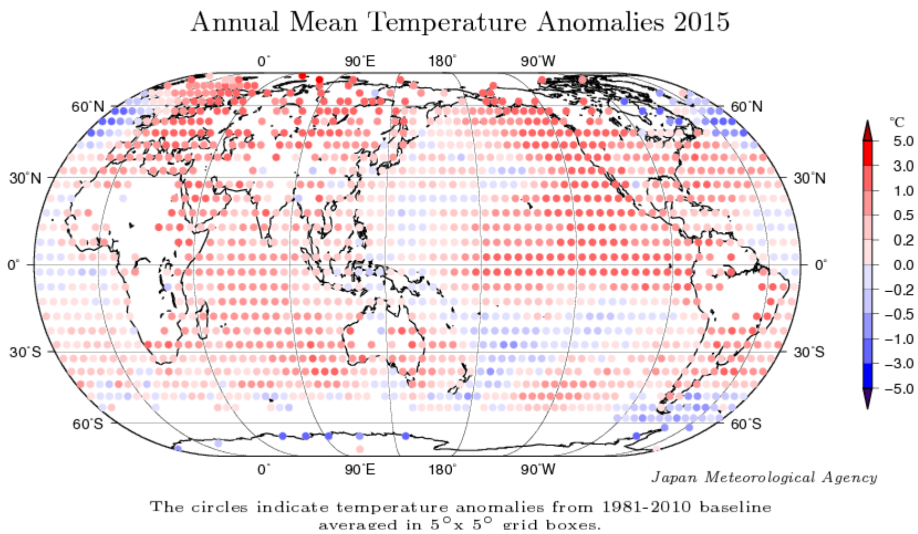

Figure 2 Annual mean temperature anomalies in 2015
The circles indicate anomalies of surface temperature averaged in 5° x 5° grid boxes. Anomalies are deviations from the 1981-2010 average.

(2) Ocean Heat Content in 2015

Oceans have a significant impact on the global climate because they cover about 70% of the earth's surface and have high heat capacity. According to the Intergovernmental Panel on Climate Change Fifth Assessment report (IPCC, 2013), more than 60% of the net energy increase in the climate system from 1971 to 2010 is stored in the upper ocean (0 – 700 m), and about 30% is stored below 700 m. Oceanic warming results in sea level rises due to thermal expansion, and impacts marine ecosystems.

It is virtually certain that globally integrated upper ocean (0 – 700 m) heat content (OHC) rose between 1950 and 2015 at a rate of 2.17 × 10^{22} J per decade as a long-term trend with interannual variations (statistically significant at a confidence level of 99%). Oceans exhibited marked warming from the mid-1990s to the early 2000s. Although the slope became moderate, OHC continues to increase significantly since then. A rise of 0.023°C per decade in the globally averaged upper ocean (0 – 700 m) temperature accompanied the OHC increase.

These long-term trends can be attributed to global warming caused by increased concentrations of anthropogenic greenhouse gases such as CO_2 as well as natural variability.

(Moeko Kitamoto, Marine Division)

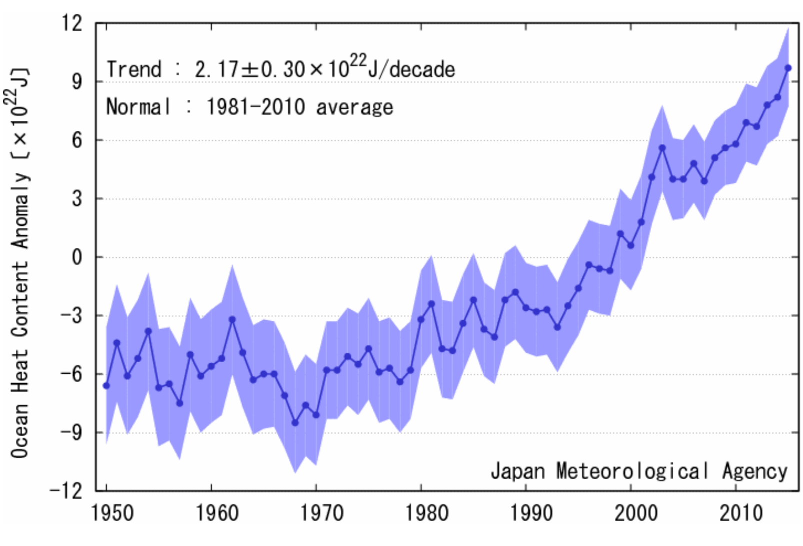

Figure 3 Time series representation of the globally integrated upper (0 – 700 m) ocean heat content anomaly
The 1981 – 2010 average is used as the normal. The solid line with dots shows the annual mean for the global integrals of upper (0 – 700 m) ocean heat content anomalies. The shaded area indicates a 95% confidence level.

Highlights of the Global Climate in 2015

Annual mean temperatures were above normal in many parts of the world, and were below normal in eastern Canada and on the coast of Antarctica (Figure 4). Extremely high temperatures were frequently observed in some parts of Siberia, on the western coast of North America and in various places in the low latitudes.

Annual precipitation amounts were above normal from western Japan to southeastern China, in northern China, from the western part of Central Siberia to northern India, in northern Europe, in and around the southern USA, on the coast from Ecuador to northern Chile, in and around Paraguay and in northern Australia. The amounts were below normal from central to western Indonesia, on the southern Arabian Peninsula, in South Africa, around the southern Caribbean Sea, in eastern Brazil and in northeastern Australia (Figure 5). Extremely heavy precipitation amounts were frequently observed from the southern USA to central Mexico, in and around Paraguay, and extremely light precipitation amounts were frequently observed in and around western Indonesia and in the northern part of South America.

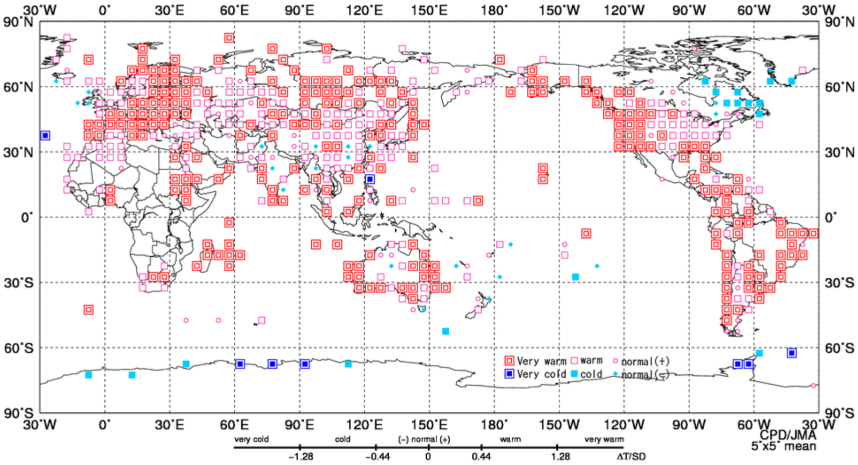

Figure 4 Annual mean temperature anomalies for 2015

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 observational data is insufficient or normal data are unavailable.

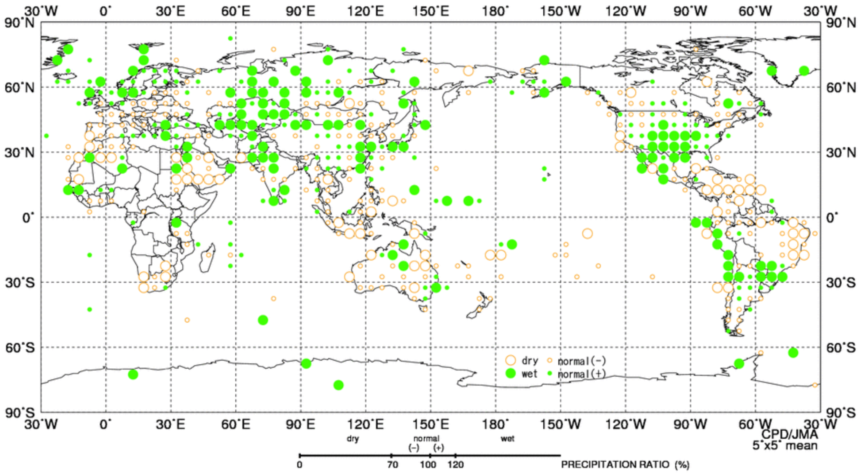

Figure 5 Annual total precipitation amount ratios for 2015

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%. The normal values and standard deviations are calculated from 1981-2010 statistics. Land areas without graphics represent regions for which the sample size of observational data is insufficient or normal data are unavailable.

Major extreme climatic events and weather-related disasters occurring in 2015 are listed below (also see Figure 6).

(1) High temperatures in the southern part of Central Siberia (January – February, July – August)
(2) Torrential rain in southern China (May, July, August)
(3) High temperatures in and around the northern Indochina Peninsula (May – June, September, November)
(4) High temperatures (June – July, September – December) and light precipitation (July, September – November) in and around western Indonesia
(5) Torrential rain in Myanmar (June – August)
(6) Heatwave (May) and torrential rain (June – September, November – December) in India
(7) High temperatures in India (July – December)
(8) Heatwave (June) and torrential rain (July – September) in Pakistan
(9) Avalanches, floods and landslides in Afghanistan (February – April)
(10) High temperatures in and around the northern part of Western Siberia (April – June)
(11) High temperatures around the Red Sea (March, July – October)
(12) High temperatures in and around Mauritius (June – December)
(13) Floods in the southern part of Eastern Africa (January)
(14) High temperatures in and around the western USA (January – March, June – October)
(15) Drought in California (all year round)
(16) Heavy precipitation from the southern USA to central Mexico (February – May, October)
(17) High temperatures from the southeastern USA to southeastern Mexico (March – April, July, November – December)
(18) Landslide in southern Guatemala (October)
(19) High temperatures (May – December) and light precipitation (May – September) in the northern part of South America
(20) High temperatures in eastern and northwestern Brazil (September – December)
(21) Heavy precipitation in and around Paraguay (May, July, November – December)
(22) High temperatures in northern Chile (April – May, September)
(23) High temperatures in western Australia (September – November)

(Ayako Takeuchi, Tokyo Climate Center)

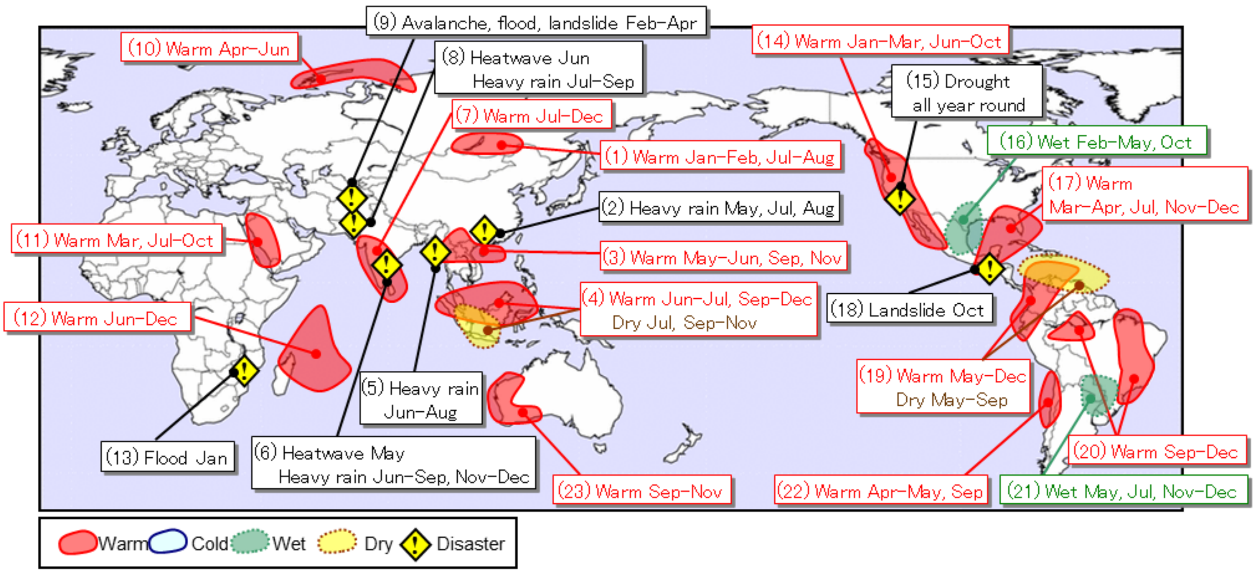

Figure 6 Major extreme climate events and weather-related disasters across the world in 2015
Major extreme climate events and weather-related disasters that occurred during the year are indicated schematically.

Summary of Japan’s Climatic Characteristics for 2015

- **Annual mean temperatures were above normal all over Japan. However, western Japan experienced its second consecutive cool summer.**
- **Annual precipitation amounts were above normal in eastern and western Japan and significantly above normal on the Pacific side of western Japan. Unprecedentedly heavy rain was recorded in the Kanto and Tohoku regions in September.**
- **Annual sunshine durations were above normal in northern Japan and on the Sea of Japan side of eastern Japan, and were below normal in western Japan.**

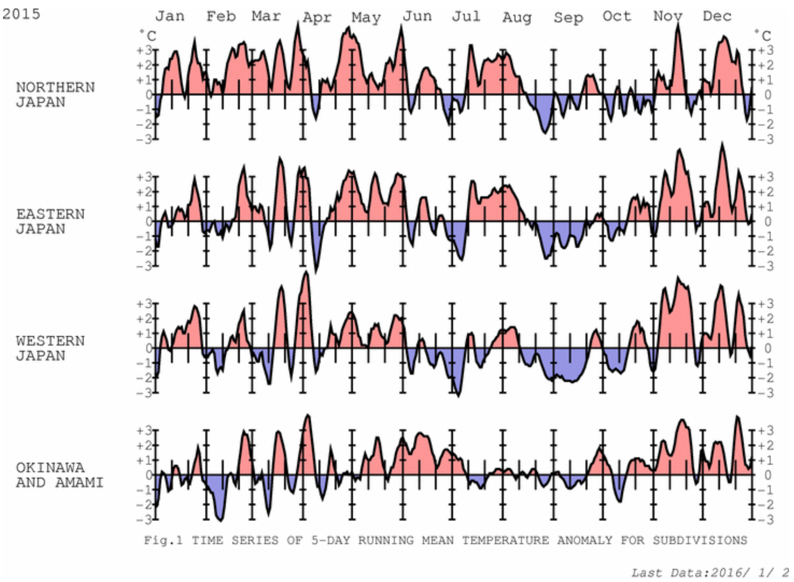

Figure 7 Time series of five-day running mean temperature anomalies for subdivisions (January – December 2015)
The normal is the 1981 – 2010 average.

(1) Annual characteristics

Annual mean temperatures were above normal in western Japan but below normal from summer to autumn, resulting in the region’s second consecutive cool summer.

In western Japan, annual sunshine durations were below normal and annual precipitation amounts were above normal, especially on the Pacific side. This was attributed to weak expansion of the north Pacific high and a frequently active front line in summer. On the Pacific side of eastern Japan, annual precipitation amounts were above normal and unprecedentedly heavy rain was recorded in September. Meanwhile, annual sunshine durations were above normal in northern Japan and on the Sea of Japan side of eastern Japan due to the frequent passage of migratory high pressure systems in late spring and mid-autumn.

(2) Seasonal characteristics

(a) Winter (December 2014 – February 2015)

Temperatures were below normal all over Japan in December 2014 but were subsequently above normal, especially in northern Japan.

Seasonal snowfall depths on the Sea of Japan side were below normal and significantly below normal in northern Japan. In association with low-pressure systems that tended to develop around northern Japan, snowfall depths in mountainous regions of northern and eastern Japan were above normal and severe blizzards occasionally hit the Hokkaido region.

(b) Spring (March – May)

Seasonal mean temperatures were above normal all over Japan in association with the frequent passage of low-pressure systems north of the country and frequent warm air flow from the south.

Seasonal sunshine durations were above normal in northern and eastern Japan in association with dominant migratory high-pressure systems. However, wet southerly winds caused lower levels of sunshine than usual on the Pacific side of eastern and western Japan from early-to-mid April.

(c) Summer (June – August)

In western Japan, seasonal precipitation amounts were above normal and seasonal sunshine durations were below normal, especially on the Pacific side, due to the significant influences of the Baiu front, typhoons and southerly wet flows.

In Okinawa/Amami, although seasonal precipitation amounts were above normal and seasonal sunshine durations were below normal, seasonal mean temperatures were significantly above normal due to unprecedentedly high temperatures in June.

In northern Japan, the North Pacific High strengthened and covered the region, driving temperatures significantly above normal from mid-July to early August and resulting in above-normal seasonal mean temperatures. On the Sea of Japan side of eastern Japan, seasonal precipitation amounts were significantly below normal due to the minimal influence of the Baiu front.

After mid-August, low temperatures and cloudy or rainy weather continued in association with fronts that tended to remain stationary around the mainland and the presence of the Okhotsk High, which caused wet and cool northeasterly flows on the Pacific side of northern and eastern Japan.

(d) Autumn (September – November)

Low temperatures and cloudy or rainy weather continued from mid-August into early September. Due to the approach of typhoons Kilo and Etau, the Kanto and Tohoku regions experienced unprecedentedly heavy rain that caused serious damage including major river overflows.

From mid-September to October, sunshine durations were significantly above normal due to dominant migratory high-pressure systems.

In association with the passage of low-pressure systems and flows of warm air from the south, temperatures were above normal all over Japan in November and sunshine durations were below normal, especially on the Pacific side and in western Japan.

In Okinawa/Amami, seasonal mean temperatures were significantly above normal, including unprecedentedly high temperatures in November, and seasonal precipitation amounts were significantly below normal in association with low impacts from low-pressure systems and typhoons (other than typhoon Dujuan).

(Masayuki Hirai, Climate Prediction Division)

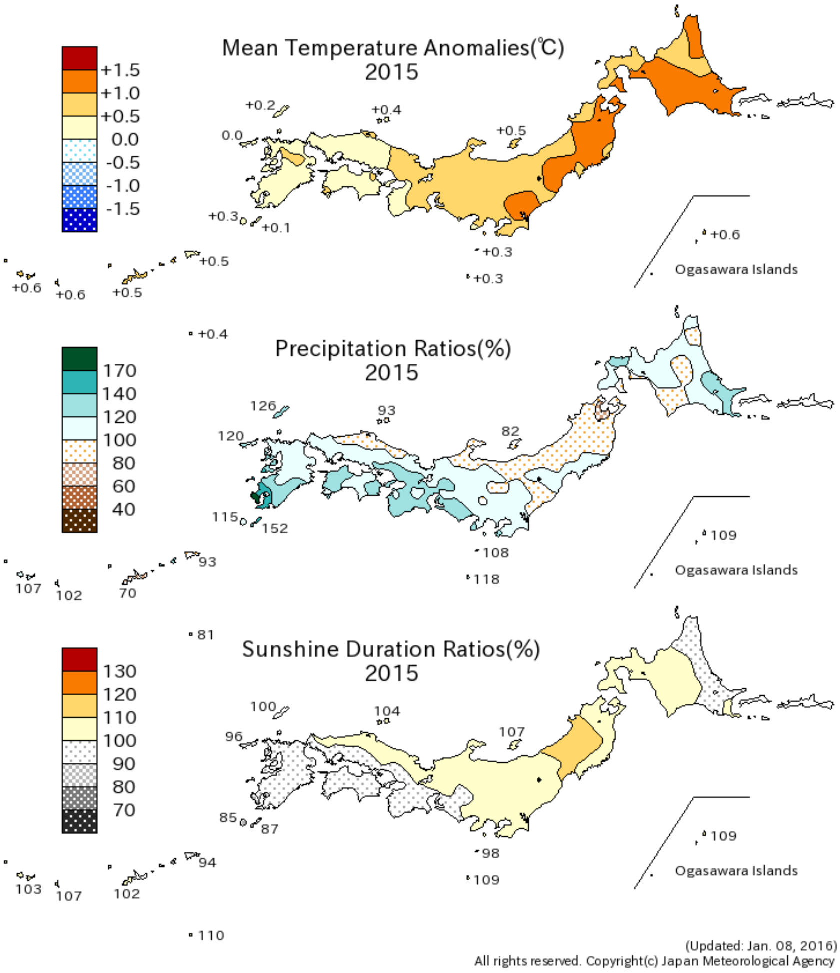

Figure 8 Annual climate anomaly/ratio for Japan in 2015

The JRA-55 Atlas

The JRA-55 Atlas – a comprehensive set of global climate maps based on the Japanese 55-year Reanalysis (JRA-55; Kobayashi et al. 2015) – is now available on JMA's website. This article provides an overview of its content.

JMA is one of limited weather centers to produce global atmospheric reanalysis data such as JRA-55, which was recently made freely available for climate research, climate monitoring. JRA-55 provides global atmospheric data from years as far back as 1958 with a horizontal resolution of TL319 (approximately 55 km). The data quality is significantly better than that of the Japanese 25-year Reanalysis (JRA-25), which contains notable biases, and its temporal consistency improves on that of previous reanalysis products.

JMA's JRA-55 Atlas is a comprehensive set of global climate maps intended to contribute to climate research and climate science through its superior characteristics. It consists of climatology maps (annual/seasonal/monthly) which calculated with 30-years average from 1981 to 2010 for a variety of meteorological variables ranging from basic metrics such as surface temperature to technical considerations for climate research, as well as time-series figures such as MJO-index or SOI-index after 1958.

The data in the JRA-55 Atlas are updated from those of the JRA-25 Atlas published in 2008, and the product also features enhanced content and an improved web interface.

Its major content is as follows:

1. Comprehensive global climate maps based on the present climatology (a 30-year mean covering the period from 1981 to 2010)
2. Data on more than 70 observable and non-observable climatic variables
3. A colorblind-safe color system based on the Brewer Color scheme (http://colorbrewer2.org/) in addition to standard rainbow colors and copy-friendly monochrome
4. Functionality for print-friendly PDF and CSV numerical data formats (limited variables)

JRA-55 is an atmospheric dataset with physical consistency. However, it should be noted that JRA-55 Atlas values are estimates based on numerical forecasting model output and observational data. Users requiring high precision should bear in mind that the figures and numerical data provided may have some degree of error. See the comprehensive report on JRA-55 (Kobayashi et al. 2015) for details of related characteristics and quality evaluations.

JRA-55 Atlas WEB;
http://ds.data.jma.go.jp/gmd/jra/atlas/en/index.html

(Kenji Kamiguchi,, Climate Prediction Division)

References:

Kobayashi, S., Y. Ota, Y. Harada, A. Ebita, M. Moriya, H. Onoda, K. Onogi, H. Kamahori, C. Kobayashi, H. Endo, K. Miyaoka, and K. Takahashi, 2015: The JRA-55 Reanalysis: General Specifications and Basic Characteristics. J. Meteor. Soc. Japan, 93, 5-48, doi:10.2151/jmsj.2015-001.

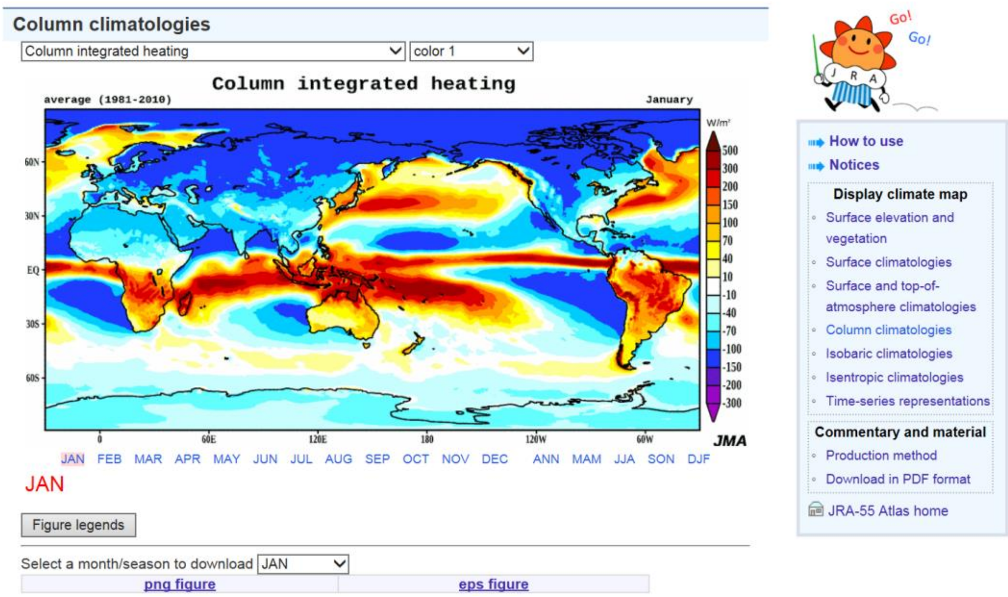

Figure 9 A display sample of JRA-55 Atlas (column integrated heating for January).

Renewed statistical products regarding the impacts of tropical SST variability on the global climate system

In January 2016, TCC has updated a part of its web pages that hosts investigation results on impacts of tropical sea surface temperature (SST) variability on the global climate and atmospheric circulation. The renewed products show statistical relationships between warmer/cooler SST events in the areas of NINO.3, NINO.WEST (i.e., El Niño/La Niña events) and the tropical Indian Ocean (IOBW) (Figure 10) and the global climate system. The analysis is based on surface observation data, the COBE-SST analysis dataset (Ishii et al., 2005) produced by JMA, JMA's latest reanalysis dataset (JRA-55; Kobayashi et al. 2015) and satellite observation data for outgoing longwave radiation (OLR). The period of the analysis was from 1958 through 2012 (55 years). See Global climate and Atmospheric Circulation for more details on data and methodology.

1. Global Climate

This page provides the schematic charts indicating typical anomaly patterns of surface temperature and precipitation for each season as seen in past warmer/cooler SST events. Figure 12 (next page) shows a schematic chart indicating the impacts of El Niño in boreal winter.

The page also provides anomaly patterns of three-month-mean temperature and precipitation fields centered on each calendar month for previous warmer/cooler SST events in each of the three tropical areas with 5° x 5°-grid representation (Figure 11).

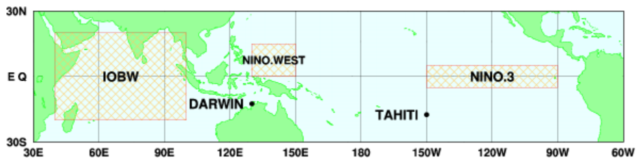

Figure 10 the regions for the SST monitoring indices

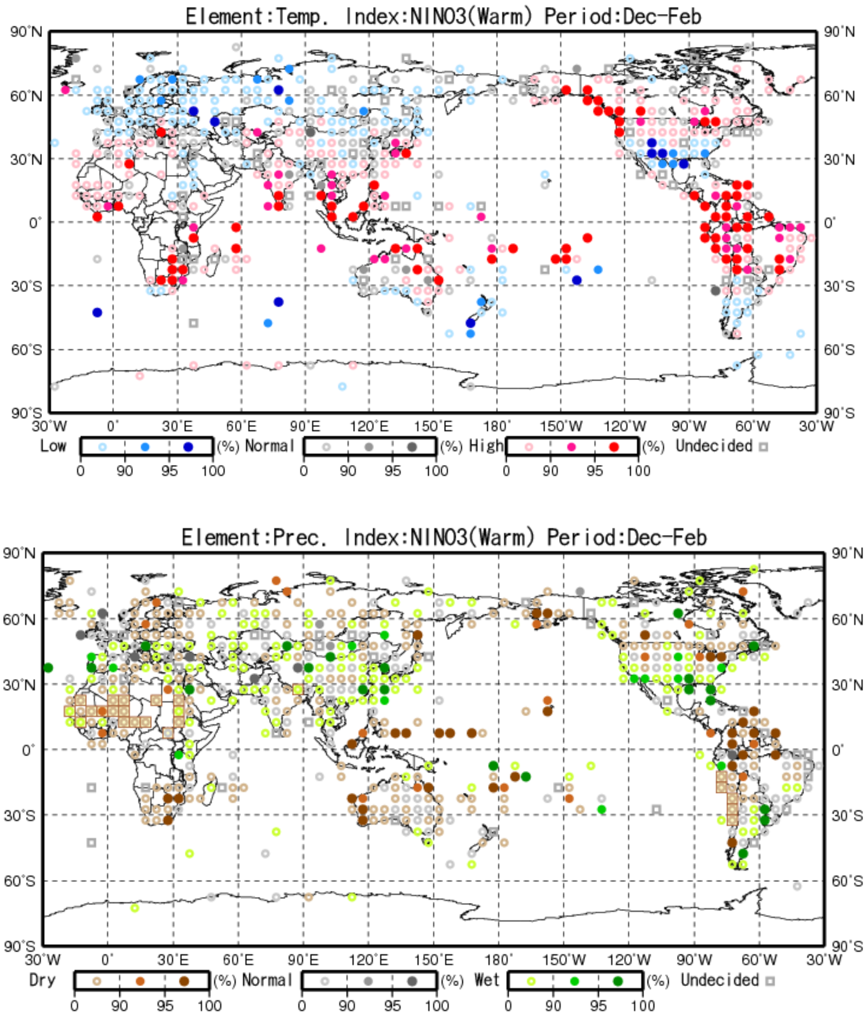

Figure 11 Temperatures (top) and precipitations (bottom) for December - February in El Niño events

The most frequent classes are shown with circles ("high," "normal" or "low" for temperature, and "wet," "normal" or "dry" for precipitation) and related statistical confidence levels (%) as indicated in the legends. "Undecided" as indicated by a gray square means that the most frequent class could not be isolated. Grid squares with a climatological probability of "dry" exceeding 33% are shown with a square in their background of the grid. No marks (circles or squares) are shown for a grid squares where insufficient data were available.

2. Atmospheric Circulation

This page provides the renewed statistical products regarding the relationship between warmer/cooler SST events and atmospheric circulation based on the Japanese 55-year reanalysis dataset (JRA-55) and satellite observation data. Also available are composite analysis charts of atmospheric circulation elements (such as OLR, 850-hPa and 200-hPa stream function anomalies) for past warmer/cooler SST events covering monthly and three-month mean periods (Figure 13).

The outlines of the seasonal characteristics for the composite analyses are also available.

(Hitomi Saito, Tokyo Climate Center)

References:

Ishii, M., A. Shouji, 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.

Kobayashi, S., Y. Ota, Y. Harada, A. Ebita, M. Moriya, H. Onoda, K. Onogi, H. Kamahori, C. Kobayashi, H. Endo, K. Miyaoka, and K. Takahashi, 2015: The JRA-55 Reanalysis: General Specifications and Basic Characteristics. J. Meteorol. Soc. Japan, 93(1), 5-48, doi:10.2151/jmsj.2015-001.

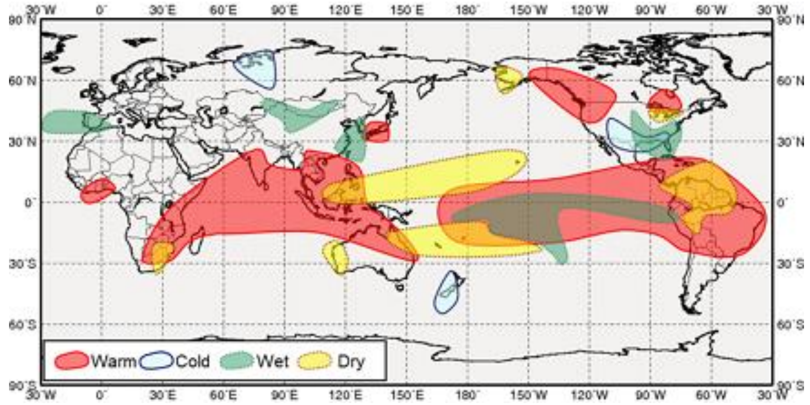

Figure 12 Schematic charts of the impacts of El Niño in boreal winter

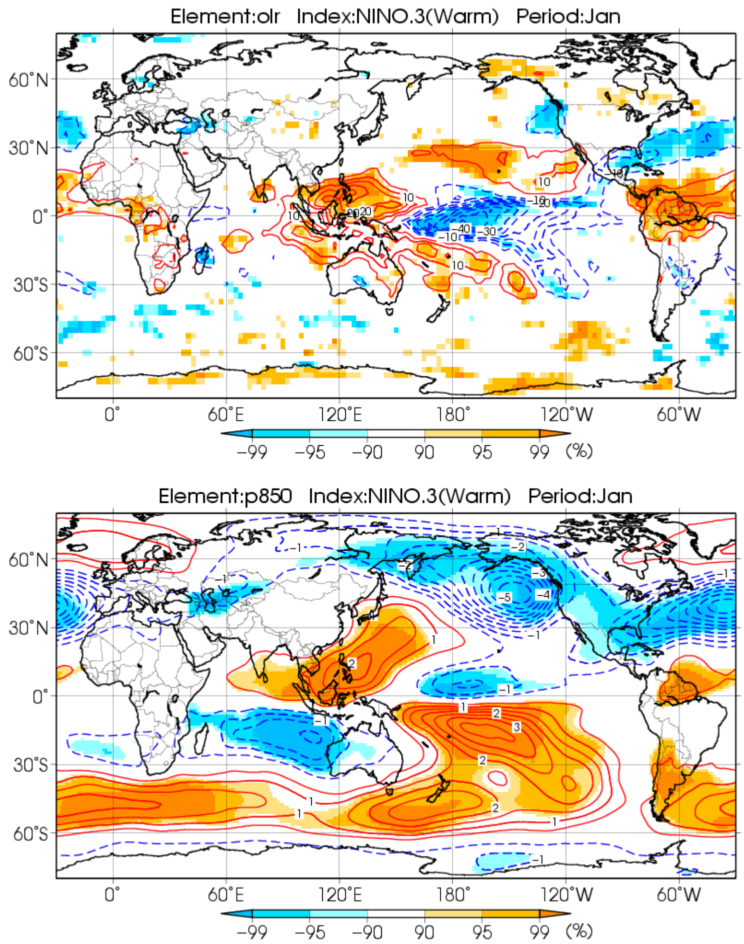

Figure 13 Monthly mean composite of (top) outgoing longwave radiation anomalies and (bottom) 850-hPa stream function anomalies in El Niño events (January)

Contours show composite anomalies at intervals of 5 W/m^2 and $0.5x10^6$ m^2/s. Shading indicates the confidence level. Satellite observation data covering 1979 – 2012 (top) and the JRA-55 reanalysis covering 1958 – 2012 (bottom) are used.

TCC Activity Report for 2015

In 2015, 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, dispatching experts and hosting visitors.

1. Highlights of 2015

1.1 Upgrade of JMA's Seasonal forecast model in June 2015

JMA introduced a new version of its Seasonal Ensemble Prediction System (JMA/MRI-CPS2) in June 2015. This seasonal ensemble prediction system (EPS) is used to produce three-month and warm/cold season predictions as well as El Niño monitoring and outlook work. Changes in the new system include enhanced resolution, improved physics in the model's atmospheric and oceanic components, and the introduction of an interactive sea ice model. The changes made improved predictive skill overall, among other things, ones for sea surface temperatures associated with El Niño-Southern Oscillation (ENSO), surface temperatures in the Northern Hemisphere and precipitation in the tropics. More detailed verification information is provided on the TCC website. In the new real-time operational suite, 51-member ensemble integration is carried out from consecutive initial dates with intervals of five days. An outline of the model's configuration and its operation is provided on the TCC website and in TCC News No. 40.

1.2 Upgrade of the Interactive Tool for Analysis of Climate System (iTacs)

In November 2015, TCC launched version 5 of its web-based application software named "iTacs". iTacs stands for "Interactive Tool for Analysis of the Climate System," and was developed by JMA/TCC to assist National Meteorological and Hydrological Services (NMHSs). iTacs supports the creation of various types of charts to enable analysis of the characteristics and structure of climate systems, various types of charts and it is also equipped with a variety of statistical functions, such as linear regression and correlation coefficients, EOF, SVD and FFT. In iTacs ver. 5, 30-year re-forecast (hindcast) datasets covering the period from 1981 to 2010 are additionally implemented with JMA's one-month ensemble prediction system. iTacs ver. 5 also provides more efficient connections between client PCs and web servers via a revamped web interface. Please refer to TCC News No. 42 for more information on this upgrade.

1.3 Contribution to the Global Framework for Climate Services (GFCS)

WMO Regional Association II recognized at its fifteenth session (2012) that it is important to share good practices and lessons learned for the successful implementation of the GFCS and thus adopted a new Pilot Project on Information Sharing on Climate Services. TCC plays a leading role in the implementation of the Project. As part of related work, it launched a dedicated website (http://ds.data.jma.go.jp/tcc/pilot/) to share information on climate services provided by NMHSs and on their Framework-related activities on 31 March 2014. In summer 2015, TCC again invited NMHSs in RA II to take part in this pilot project via a questionnaire survey. The aims of this work were to update the website's content and enhance information highlighting the concrete examples and good practices of climate information usage. The updated information is available on the website.

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

TCC strives to continuously extend its services in the provision of data, products and tools. In 2015, the following data and products were made available on its website:

- June:
  Upgrade of JMA's Seasonal forecast model
- 13 November:
  Version upgrade of iTacs (Interactive Tool for Analysis of the Climate System)

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-development activities related to its role as an RCC in RA II. In addition to running annual training seminars, it also 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 seminar

TCC hold a training seminar in its each fiscal year from April to March. In 2015, TCC held a seminar in November, with one-month forecasts as the subject. Details of the event are reported in TCC News No.42.

3.2 Expert visits and other follow-up activities

TCC experts visited the Thai Meteorological Department (TMD) in March and the Department of Meteorology (DOM) of Sri Lanka in Colombo in June, to hold a follow-up seminar on the generation of climate change projection information by using one of the latest global warming projection data. The visits were planned as follow-up to the TCC training seminar held in January 2015, and also provided an opportunity for TMD and DOM to discuss future cooperation with TCC (TCC News No.40 and TCC News No.41).

Other follow-up activities to previous TCC training seminars included accepting expert visits at the TCC and conducting teleconferences to provide technical supports.

4. International meetings

4.1 Regional Climate Outlook Forums

RCCs are expected to actively contribute to discussions in Regional Climate Outlook Forums (RCOFs). In 2015, TCC experts participated in the following RCOFs in Asia:

- Sixth Fifth session of the South Asian Climate Outlook Forum (SASCOF-5) held in Dhaka, Bangladesh, from 21 to 22 April
- Eleventh session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II (FOCRA II) held in Beijing, China, from 11 to 13 May
- Third session of the East Asia winter Climate Outlook Forum (EASCOF) held in Seoul, Republic of Korea, from 3 to 5 November
- Fifth session of the ASEAN Climate Outlook Forum (ASEANCOF) held in Singapore from 18 to 19 November

TCC attendees gave presentations on seasonal predictions based on JMA's numerical model and participated in discussions toward the formulation of a consensus statement on regional forecasts.

4.2 Other meetings

In 2015, TCC head Dr Kazutoshi Onogi attended two meetings in Geneva, Switzerland to contribute to the implementation and management of GFCS. In April, he attended the meeting of the Task Team on Monitoring and Evaluation of implementation of the GFCS as a member of this task team, and in October took part in the third session of the Management Committee of the Intergovernmental Board on Climate Services in Geneva.

Mr Atsushi Goto, a TCC expert and member of the CCl/CBS Joint Expert Team on Regional Climate Centres (ET-RCCs), participated in the session, held in conjunction with the Task Team on Regional Climate Outlook Forums (TT-RCOFs) in Melbourne, Australia in September.

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 2015, TCC News Nos. 39 – 42 were issued and made available on the TCC website.

Other English-language publications related to the climate, such as Climate Change Monitoring Report 2014 and Annual Report on the Climate System 2014, were also published on the TCC website.

6. Staff changes

Ms. Teruko Manabe, who served as the Head of TCC for four years, moved to the Tokyo Regional Headquarters of the Japan Meteorological Agency on 1st April, to work as Director of the Disaster Mitigation Department there. She has been replaced with Kazutoshi Onogi (PhD) who has long contributed to the development of JMA's long-term reanalysis data and long-range forecast models.

7. Plans for 2016

- Contribution to the Global Framework for Climate Services (GFCS)

RCCs are expected to play a major role in the implementation of the GFCS. TCC plans to further strengthen its activities and lead RA II's contribution to the Framework. Such activities include the provision of further assistance to NMHSs for better climate services, as well as maintenance and updating of the portal site for the Pilot Project on Information Sharing on Climate Services.

- New/upgraded data, products and tool development

TCC plans to implement a major upgrade of its Seasonal Ensemble Prediction System for operational one-month forecasting by early 2017.

To leverage the JRA-55, long-term reanalysis dataset, investigation on teleconnection indices (e.g., the Arctic Oscillation Index) is being prepared to enhance monitoring of atmospheric circulation. TCC plans to publish the investigation results and the indices on its website in 2016. In addition to its work on the above-listed products and tool, TCC is making efforts to develop information/products based on the Standard Precipitation Index (SPI) towards better monitoring of droughts worldwide.

- Capacity development

In the last quarter of the year, TCC will hold its annual training seminar with a dozen invited experts as attendees. The Center will also continue to dispatch experts to NMHSs as necessary and host visitors from NMHSs upon request.

(Kazutoshi Onogi, Head, Tokyo Climate Center)

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: Kazutoshi Onogi, Atsushi Goto and Yasushi Mochizuki)

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