Tokyo Climate Center, Japan Meteorological Agency

TCC News

Winter 2024

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Global temperature for 2023 was the highest since 1891

JMA analysis indicates that the annual anomaly of the global average surface temperature for 2023 (i.e., the combined average of the near-surface air temperatures over land and the sea- surface temperatures) was +0.54°C above the 1991 – 2020 average, and was the warmest on record since 1891 (Figure 1-1).

On a longer time scale, the annual global average surface temperature has risen at a rate of about +0.76°C per century, and 2014 to 2023 were among the warmest decade since 1891 (Table 1-1). These recent high temperatures are thought to be affected by the global warming due to increase in anthropogenic greenhouse gas concentrations including carbon dioxide. In addition, the global averaged surface temperature is affected by inter-annual to decadal natural fluctuations intrinsic to the earth's climate.

High temperature deviations were observed in most parts of the world (Figure 1-2).

JMA monitors monthly, seasonal and annual average anomalies of global surface temperature, with results routinely updated on the TCC website at https://ds.data.jma.go.jp/tcc/tcc/products/gwp/gwp.html

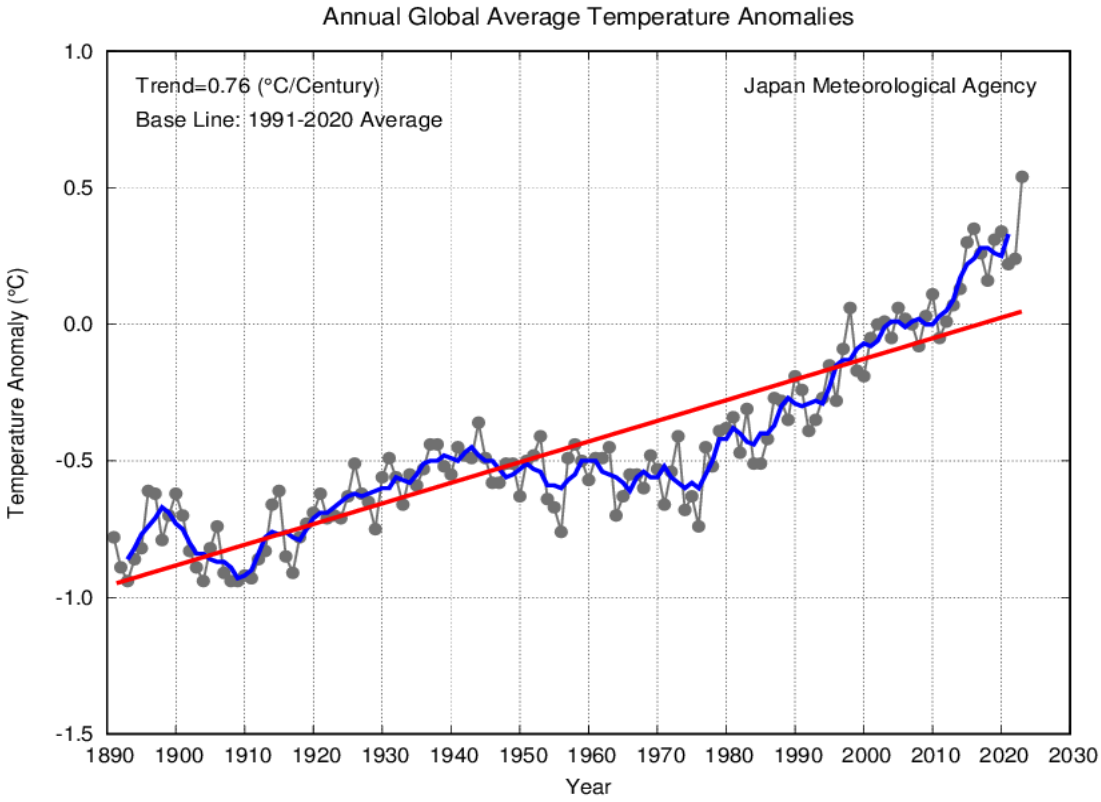

Figure 1-1 Long-term change in annual mean surface temperature anomalies over the globe

Anomalies are derived from the 1991 – 2020 average baseline. The thin black line indicates surface temperature anomalies for each year, while the blue and red lines indicate the related five-year running mean and the long-term linear trend, respectively.

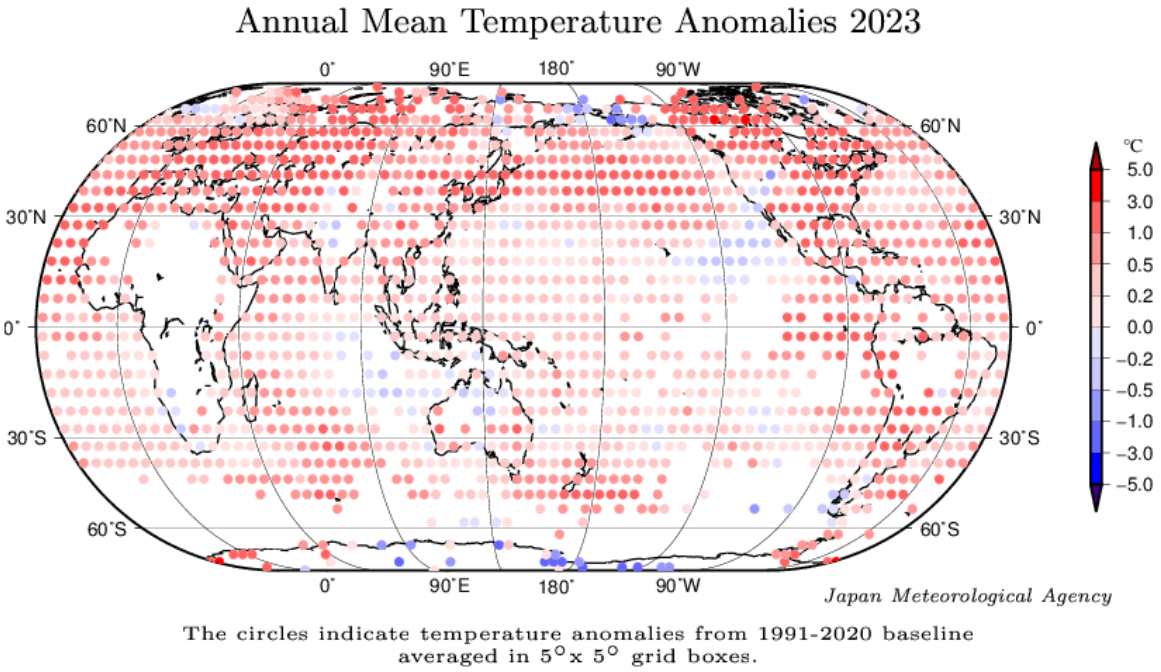

Figure 1-2 Annual mean temperature anomalies

The circles indicate anomalies of surface temperature averaged in 5° x 5° grid boxes. The annual mean global temperature anomaly is determined by averaging the anomalies, derived from the 1991 – 2020 average baseline, of all grid boxes weighted with the grid box area.

Table 1-1 Ranking of annual global average temperatures

Rank	Year	Temperature Anomaly w.r.t. 1991 – 2020 average
1	**2023**	**+0.54**
2	2016	+0.35
3	2020	+0.34
4	2019	+0.31
5	2015	+0.30
6	2017	+0.26
7	2022	+0.24
8	2021	+0.22
9	2018	+0.16
10	2014	+0.13

(TAMAKI Yuko, Tokyo Climate Center)

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Highlights of the Global Climate in 2023

Annual mean temperatures were above normal in most parts of the world, and very high from East Asia to Southeast Asia, from Central Asia to the northern part of Northern Africa, in northern North America, from eastern to southern North America, and in central South America (Figure 2-1).

Extremely high temperatures were frequently observed in eastern East Asia, from southern China to northeastern Australia, in southern India, in southern Central Asia, in the Arabian Peninsula, from eastern Europe to northwestern Northern Africa, in and around northern Madagascar, in northern North America, and from southern North America to central South America (Figure 2-3 and map for details).

Annual precipitation amounts were above normal from northwestern Central Asia to the Arabian Peninsula and from central to western Europe, and below normal in southwestern Central Asia and from southwestern Europe to western Northern Africa (Figure 2-2).

Extremely high precipitation amounts were frequently observed in western Russia and central Europe. Extremely low precipitation amounts were frequently observed from southern China to the Indochina Peninsula, in the northern part of Northern Africa, and from eastern to central Canada (Figure 2-3 and map for details).

Major extreme climatic events and weather–related disasters occurring in 2023 are listed below (Table 2-1, see also Figure 2-3). Further details are provided in the Annual Report on Global Extreme Climate Events in 2023 on

the TCC website.

Table 2-1 Major extreme climatic events and weather-related disasters worldwide in 2023

	Type	Period	Area
(1)	Warm	March, June-October	In and around eastern East Asia
(2)	Warm	April-December	Southeast Asia
(3)	Warm	June-August	From eastern China to southern Central Asia
(4)	Wet	March-July	From central India to Pakistan
(5)	Warm	July-December	From Turkey to the Arabian Peninsula
(6)	Wet	August, October-December	Central Europe
(7)	Warm	March, June-December	From central Europe to Western Africa
(8)	Dry	February-April	From Spain to northern Algeria
(9)	Heavy Rain	September	Libya
(10)	Heavy Rain	March-May, October-December	From Somalia to Cameroon
(11)	Cyclone	February-March	From Madagascar to Malawi
(12)	Warm	January, May-December	From northern to central North America
(13)	Warm	May-December	From southern North America to central South America
(14)	Wildfire	August	The state of Hawaii, USA
(15)	Warm	March, June-September	From northern to southeastern Australia

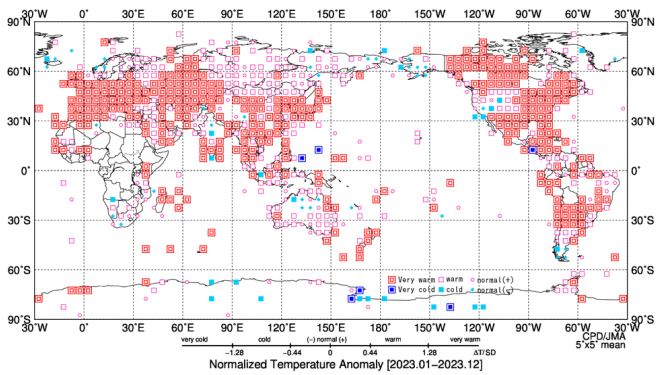

Figure 2-1 Normalized annual mean temperature anomalies for 2023

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 1991 – 2020 statistics. Land areas without graphics represent regions for which the observation data sample is insufficient or normal data are unavailable.

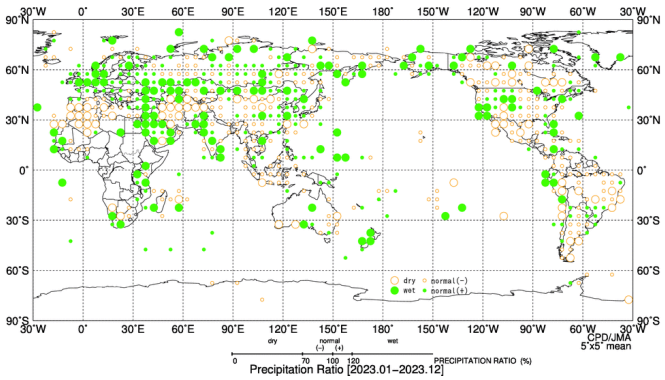

Figure 2-2 Annual total precipitation ratios for 2023

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 observation data sample is insufficient or normal data are unavailable.

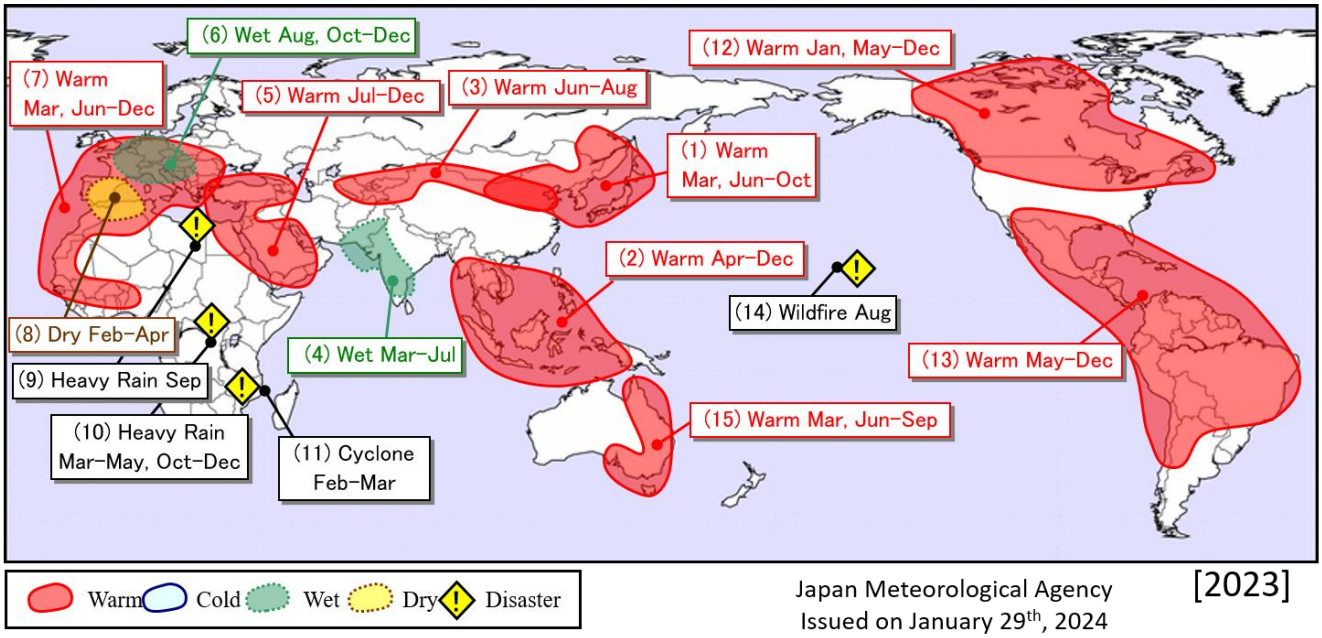

Figure 2-3 Major extreme climate events and weather–related disasters worldwide in 2023

Schematic representation of major extreme climate events and weather–related disasters occurring during the year.

(NAKAMURA Tetsu, OKUNAKA Yuka, Tokyo Climate Center)

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Summary of Japan's climatic characteristics for 2023

- Temperatures were above normal from spring to autumn except for a few short spells of below-normal conditions, resulting in the highest average nationwide annual mean since 1898 (Figure 3-1).
- Autumn sunshine durations were significantly above normal and precipitation was significantly below normal on the Pacific side of eastern and western Japan and in Okinawa/Amami, largely because the frequency of typhoons and other low-pressure systems affecting these regions was lower than normal. Sunshine durations on the Pacific side of western Japan were the highest and precipitation was the lowest for autumn (Figure 3-2).

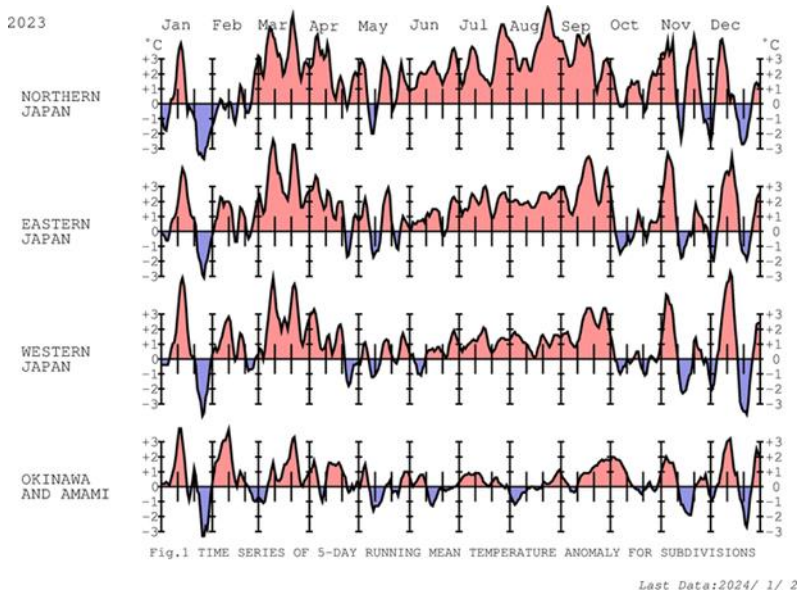

Figure 3-1 Time-series representations of five-day running mean temperatures (Jan. – Dec. 2023)

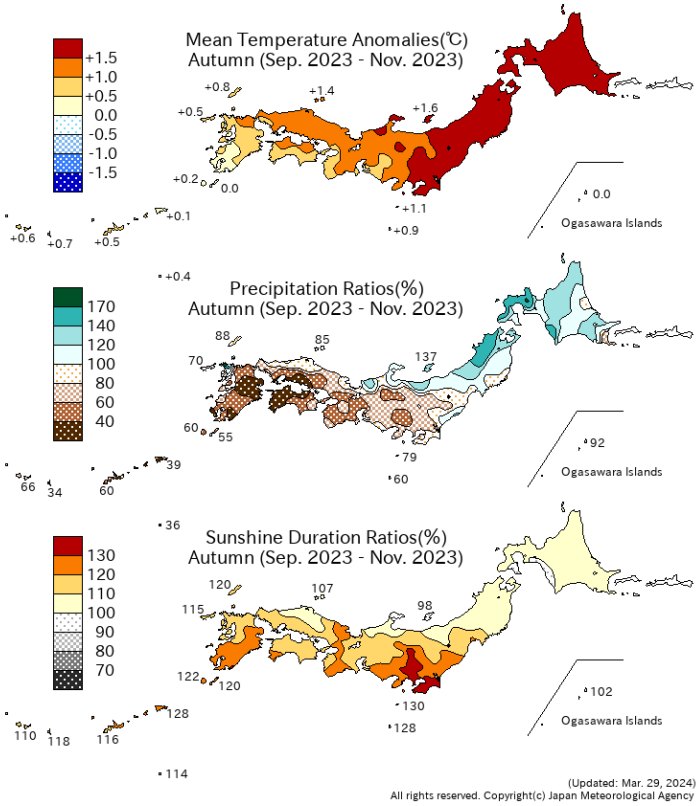

Figure 3-2 Annual climate anomalies/ratios for Japan in autumn 2023

Seasonal characteristics

(a) Winter (December 2022 – February 2023)

Periodic cold flowed in over Japan's main islands of Japan. More occasions of cold air affect caused below-normal seasonal temperatures specifically in northern Japan. Seasonal precipitation was above normal on

the Sea of Japan side of eastern Japan, where northwest monsoon conditions brought more rain and snow, and seasonal temperatures were above normal in Okinawa/Amami, which was often covered by warm-air masses.
High-pressure systems covered the area around western Japan more frequently than low-pressure systems and fronts, causing below-normal seasonal precipitation on the Pacific side of northern to western Japan and the Sea of Japan side of western Japan.

(b) Spring (March – May)

Warm-air masses frequently covered Japan during this period, causing the highest seasonal mean temperatures over Japan for spring since 1898 (anomaly: +1.59°C). Values were significantly above normal in northern to western Japan and above normal in Okinawa/Amami.
Seasonal sunshine durations were above normal nationwide due to frequent high-pressure system coverage, while low-pressure systems and fronts brought heavy rain to western Japan and the Sea of Japan side of Eastern Japan.

(c) Summer (June – August)

Coverage by warm-air and sub-tropical warm air inflows caused the highest nationwide average seasonal mean temperature since 1898 (anomaly: +1.76°C). Values in northern and eastern Japan were also the highest for summer since 1946, with values in western Japan tying with 2013, 2018 and 2022 for the same record.
High-pressure systems frequently covered northern and western Japan, while the June Baiu front and typhoons Khanun (T2306) and Lan (T2307) in August brought significantly above-normal seasonal precipitation to the Pacific side of eastern and western Japan and Okinawa/Amami. These also caused below-normal seasonal sunshine durations in Okinawa/Amami.

(d) Autumn (September – November)

Coverage by warm-air and caused a seasonal nationwide mean temperature anomaly of +1.39°C, which was the warmest for autumn since 1898. Seasonal mean temperatures in northern to western Japan were also significantly above normal, with those in northern and eastern Japan being the highest for autumn since 1946.
Seasonal precipitation was the highest for autumn since 1946 on the Sea of Japan side of northern Japan, as the region was significantly affected by low-pressure systems and cold air. Values were significantly below normal on the Pacific side of eastern and western Japan as well as in Okinawa/Amami due to a lower-than-normal frequency of low-pressure systems and typhoons. Seasonal precipitation was the lowest for autumn since 1946 on the Pacific side of western Japan.

Seasonal sunshine durations were significantly above normal on the Pacific side of eastern and western Japan, on the Sea of Japan side of western Japan and in Okinawa/Amami in association with frequent high-pressure system coverage. Values were the highest for autumn since 1946 on the Pacific side of eastern and western Japan and on the Sea of Japan side of western Japan.

(NATORI Hiroaki, Tokyo Climate Center)

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TCC Expert Visit to TMD

TCC arranges expert visits to National Meteorological and Hydrological Services (NMHSs) to support climate services and effective technological transfer.

As part of such efforts, two TCC experts visited the Thai Meteorological Department (TMD) from 6 to 8 December 2023 to provide training on the generation of Global Warming information based on the latest Intergovernmental Panel on Climate Change (IPCC) report and promote effective use of TCC's Interactive Tool for Analysis of the Climate System (iTacs). The visit was conducted as follow-up to the TCC Training Seminar of 2022 (see TCC News No. 71 and the TCC website for details), and also provided an opportunity for further collaboration between TMD and TCC.

The course was attended by around 15 TMD staff, who also engaged in practical exercises using field observation data from Thailand and Global Warming Projection data from JMA's Meteorological Research Institute. Basic iTacs operation was also highlighted via hands-on exercises, and individual groups of two or three subsequently analyzed previous extreme climate events occurring in Thailand using iTacs and made related presentations.

The visit provided good opportunities for attendees to learn about global warming and contributed to the potential for further collaboration. TCC will continue to arrange expert visits to NMHSs in Southeast Asia and elsewhere as necessary to assist with operational climate services.

Figure 4-1 Practical exercises

Figure 4-2 End of the seminar

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TCC Training Seminar on Seasonal Forecast

Since 2008, JMA's Tokyo Climate Center (TCC) has assisted National Meteorological and Hydrological Services (NMHSs) in improving their climate services. The Center's major activities in this regard involve providing basic climate data, products and tools through its website and assisting with capacity development in the Asia-Pacific region. Training seminars are held to support capacity development as part of TCC's role as an RCC in the WMO RA

II area, along with expert visits to NMHSs to promote effective technology transfer and discuss potential support for climate services.

In this context, the Center held a seasonal forecasting training seminar at JMA headquarters from 29 January to 2 February 2024, with in-person attendance for the first time in four years following COVID-19. The event was attended by 13 people from NMHSs in Bangladesh, Bhutan, Hong Kong (China), Indonesia, Lao People's Democratic Republic, Malaysia, Mongolia, Nepal, Pakistan, the Philippines, Sri Lanka, Thailand and Vietnam. Focus was placed on forecasting capacity via exercises using the Interactive Tool for Analysis of the Climate System (iTacs) and a beta version of a JMA three-month guidance tool. The course provided a reminder of climate system essentials via presentations and hands-on work using in-situ observation data from individual trainees for the guidance tool. The conclusion featured presentations from all participants on February – April prediction results in their own countries and fruitful discussions between staff and trainees.

Presentation content is available on the TCC website at
https://www.data.jma.go.jp/tcc/tcc/library/library2023.html.

Figure 5-1 Participants and Tokyo Climate Center staff

Figure 5-2 Practical exercises

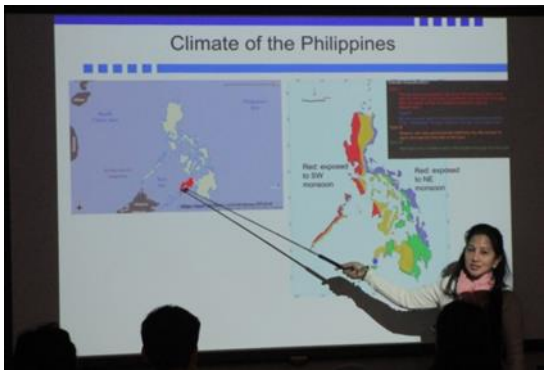

Figure 5-3 Presentation

(TAKAHASHI Kiyotoshi, Tokyo Climate Center)

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TCC Activity Report for 2023

In 2023, the Tokyo Climate Center (TCC) continued to support Asia-Pacific National Meteorological and Hydrological Services (NMHSs) by providing and enhancing data and products, as well as hosting the East Asian Seasonal Climate Outlook Forum (EASCOF), holding training seminars, publishing quarterly newsletters and participating in international meetings.

1. Enhancement of online data/products/tools

1.1 Special reports on extreme events

In a mandate role as a WMO Regional Climate Centre (RCC) in Regional Association II (RA II), TCC monitors world climate conditions with focus on Asia and its surrounding area. The Center issues reports on extreme climate events and summaries of the Asian summer/winter monsoon on its website (https://www.data.jma.go.jp/tcc/tcc/products/clisys/reports/index.html).

During the 2023 Baiu season, enhanced frontal activity brought heavy rain over wide areas from western to northern parts of the country, accompanying stationary linear mesoscale convective systems elsewhere. From mid-July onward, record-high temperatures were observed in northern/eastern Japan and elsewhere. The average temperature for northern parts of the country in late July was the highest for the region since records began in 1946, and that for eastern Japan was the second highest for the region. The average temperature for the Sea of Japan side of eastern and western Japan in early August was also the highest ever. In this context, the Japan Meteorological Agency (JMA), with the help of the Advisory Panel on Extreme Climatic Events (see TCC News No. 28), investigated atmospheric and oceanic conditions considered to have contributed to such climate extremes and summarized related primary factors. A comprehensive report is available at https://www.data.jma.go.jp/tcc/data/news/press_20230928.pdf

1.2 Upgrade of JMA's Global Ensemble Prediction System for One-month Prediction

WMC/JMA upgraded its Global Ensemble Prediction System for One-month Prediction in March. The area relating to two-tier sea surface temperatures (SSTs) based on prediction using the Seasonal Ensemble Prediction System (Seasonal EPS) was expanded from tropical and subtropical oceans to the whole global ocean. Model topography will also be upgraded using high-quality Digital Elevation Model (DEM) data.

1.3 Commencement of JRA-3Q utilization in diagnosis products and iTacs

The fundamental dataset used in diagnosis products and iTacs was changed from JRA-55 to JRA-3Q (see as per TCC News No. 72).

2. Capacity development

TCC conducts 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.

2.1 Expert visits

In February, TCC experts visited the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) to provide follow-up training on one-month forecasts and basic operation of TCC's Interactive Tool for Analysis of the Climate System (iTacs; see TCC News No. 71).

In June, a TCC expert and a Global Producing Centre (GPC) Tokyo expert visited the Meteorological Service Singapore (MSS)/Centre for Climate Research Singapore (CCRS) to enhance collaboration between both parties (see TCC News No. 73).

In December, TCC experts visited the Thai Meteorological Department (TMD) to provide follow-up training on global warming and basic iTacs operation (see TCC News No. 75).

3. International meetings

3.1 Regional climate outlook forums

RCCs are expected to actively contribute to and lead profound discussions in Regional Climate Outlook Forums (RCOFs). In 2023, TCC hosted the 11th Session of the East Asia Winter Climate Outlook Forum (EASCOF-11), and TCC experts also participated in the following RCOFs in Asia together with GPC-Tokyo experts:

19th session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II (FOCRA II-19) in Nanning, China, from 8 to 10 May

25th session of the South Asian Climate Outlook Forum (SASCOF-25) online, from 27 to 29 April

26th session of the South Asian Climate Outlook Forum (SASCOF-26) online, from 26 September to 3 October

21st session of the ASEAN Climate Outlook Forum (ASEANCOF-21) online, from 17 to 23 November

11th session of the East Asia winter Climate Outlook Forum (EASCOF-11) with hosting at JMA headquarters, from 8 to 10 November (including a special session for introduction to objective seasonal forecast toward a consensus outlook)

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

In collaboration with TCC, a representative from the World Meteorological Centre Tokyo (WMC Tokyo) attended SASCOF-25, SASCOF-26 and ASEANCOF-21 online.

4. 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 2023, TCC News No. 71 - 74 were issued and made available on the TCC website.

5. Plans for 2024

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

RCCs are expected to play a major role in GFCS implementation. In this context, TCC plans to further strengthen its activities and lead RA II contributions to the framework. These efforts will include the provision of ongoing assistance to NMHSs for better climate services, as well as maintenance of a site for information sharing on climate services in RA II.

– Product/tool provision

TCC/JMA plans to start provision of online information on seasonal tropical cyclone forecasting for the western North Pacific around May/June.

TCC also plans to release a new experimental three-month forecast guidance tool online in addition to its one-month guidance tool.

– Capacity development

TCC will host a dozen experts at its annual training seminar in later FY 2024, and will continue to dispatch experts to NMHSs as necessary and host visitors from NMHSs upon request.

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JICA Magazine

https://jicamagazine.jica.go.jp/en/

"JICA Magazine" is a public relations magazine published by JICA. It introduces the current situation of developing countries around the world, the people who are active in the field, and the content of their activities.

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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