Tokyo Climate Center, Japan Meteorological Agency

TCC News

Winter 2023

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2022 global surface temperature 6th highest since 1891

JMA analysis indicates that the annual anomaly of the global average surface temperature for 2022 (i.e., the combined average of near-surface air temperatures over land and sea- surface temperatures) was +0.24°C above the 1991 – 2020 average, and was the sixth 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 +0.74°C per century. Global temperatures from 2014 to 2022 were all within the highest 10 on record, with nine of the ten warmest occurring during the last decade (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 particularly evident over wide areas of Europe to East Asia, in mid- and high-latitudes in the Northern Hemisphere (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://www.data.jma.go.jp/tcc/tcc/products/gwp/gwp.html

(TAMAKI Yuko, Tokyo Climate Center)

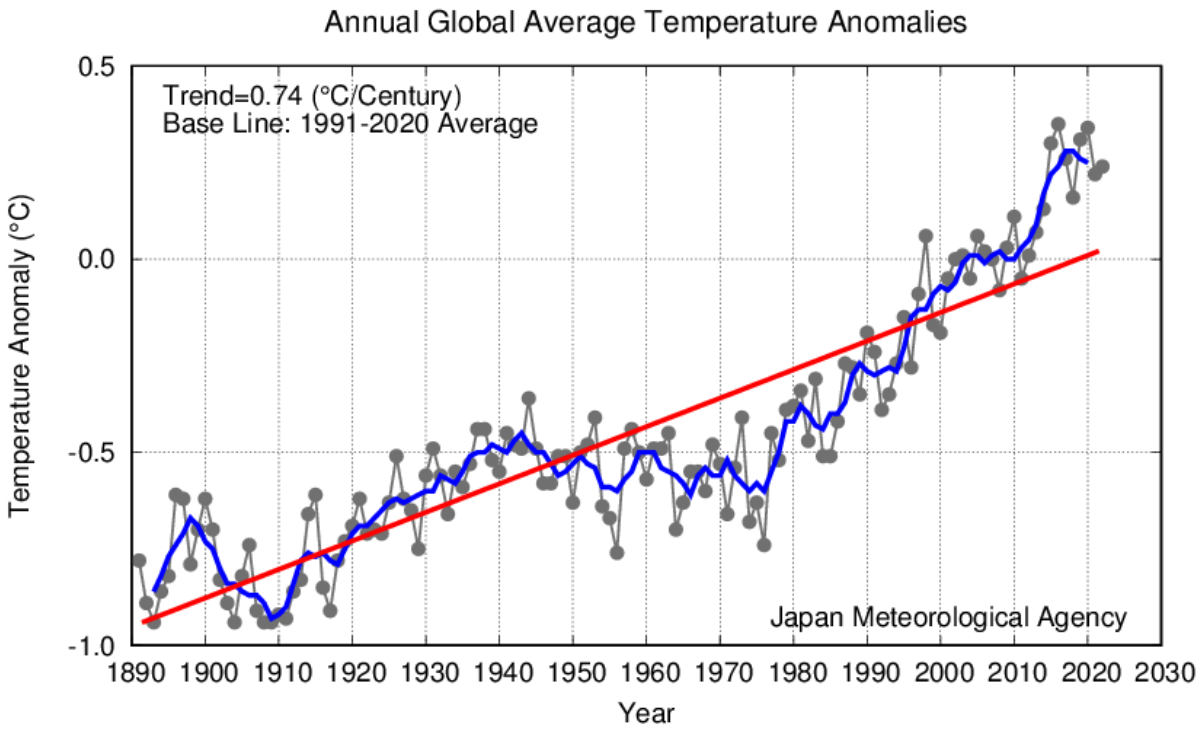

Figure 1-1 Long-term change in annual mean surface temperature anomalies over the globe

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.

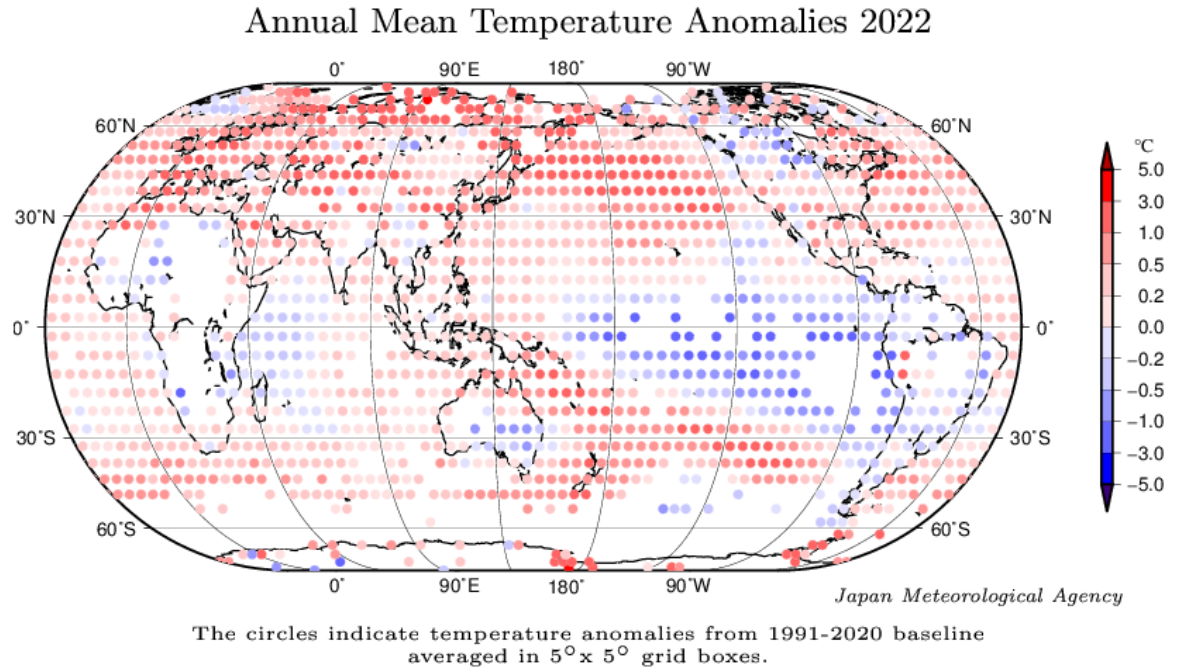

Figure 1-2 Annual mean temperature anomalies

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	2016	+0.35
2	2020	+0.34
3	2019	+0.31
4	2015	+0.30
5	2017	+0.26
6	**2022**	**+0.24**
7	2021	+0.22
8	2018	+0.16
9	2014	+0.13
10	2010	+0.11

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Highlights of the Global Climate in 2022

Annual mean temperatures were above normal mainly in the mid-latitudes, and very high from East Asia to Central Asia, from northwestern Europe to the northern part of Northern Africa, and from northern Australia to New Zealand (Figure 2-1). Annual mean temperatures were the highest on record in the UK, Germany, France, Spain, and New Zealand.

Extremely high temperatures were frequently observed in China, from central Europe to the northern part of Northern Africa, and from northern Australia to New Zealand (Figure 2-3 and map for details).

Annual precipitation amounts were above normal from the Nansei Islands of Japan to Southeast Asia, from northwestern India to southern Pakistan, and from southeastern Australia to New Zealand, and below normal from southern Europe to the northwestern part of Northern Africa, and in the western part of South America (Figure 2-2).

Extremely high precipitation amounts were observed frequently from the southern part of East Asia to Southeast Asia, and in southeastern Australia. Extremely light precipitation amounts were frequently observed from central Europe to the northwestern part of Northern Africa and in the central part of South America (Figure2-3 and map for details).

Major extreme climatic events and weather–related disasters occurring in 2022 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 2022 on the TCC website.

Table 2-1 Major extreme climatic events and weather-related disasters worldwide in 2022

	Type	Period	Area
(1)	Warm and Dry	June-September (for Warm), September (for Dry)	From eastern to northwestern China
(2)	Tropical Storm	April, October	The Philippines
(3)	Warm	March-May	From western China to Pakistan
(4)	Cold and Wet	June-August (for Cold), July-August (for Wet)	In and around Pakistan
(5)	Warm and Dry	May-December (for Warm), January, May-August, October-December (for Dry)	From central Europe to the northwestern part of Northern Africa
(6)	Cyclone and Tropical Strom	January-March	From Madagascar to Malawi
(7)	Heavy Rain	April	The southeastern part of South Africa
(8)	Hurricane	September-October	From the southeastern to eastern USA
(9)	Heavy Rain	January-February, May	From northeastern to southeastern Brazil
(10)	Warm	March-November	From northern Australia to northern New Zealand
(11)	Wet	January, March-May, July-November	Southeastern Australia

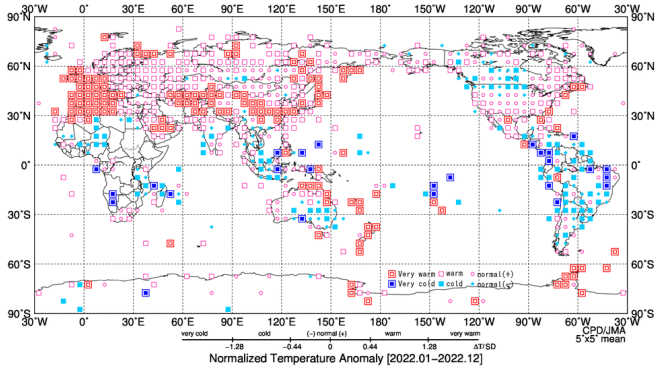

Figure 2-1 Normalized annual mean temperature anomalies for 2022

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.

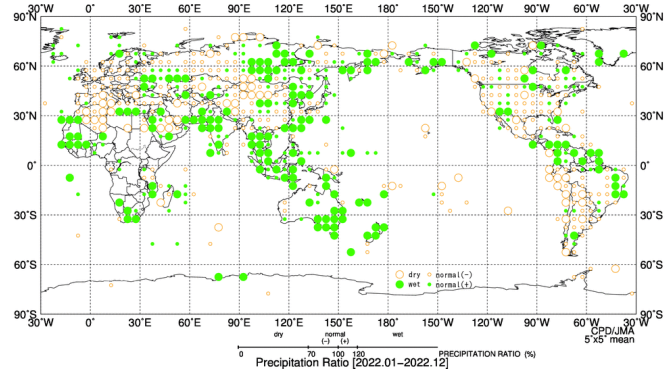

Figure 2-2 Annual total precipitation ratios for 2022

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.

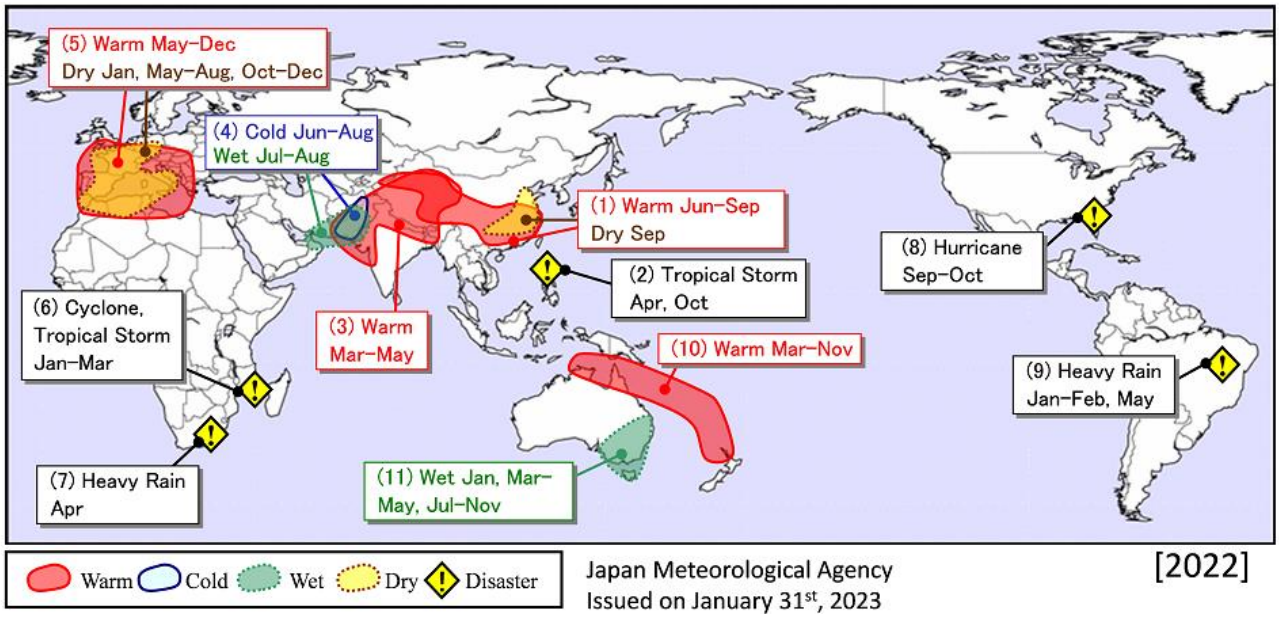

Figure 2-3 Major extreme climate events and weather–related disasters worldwide in 2022

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 2022

Annual characteristics

Japan's climatic characteristics for the year 2022 can be summarized as follows:

- Temperatures were above normal from spring to autumn except for a few short spells of cooler-than-normal conditions, resulting in annual temperatures above normal nationwide and significantly above normal in northern Japan.
- In winter 2021/22, an active northwest monsoon brought cold conditions in areas from eastern to western Japan and heavy snowfall on the Sea of Japan side of these regions.
- In August, unseasonably wet and cloudy conditions were observed in areas from northern to eastern Japan. There were no official dates for the withdrawal of the Baiu early-summer rainy season for parts of Japan due to unusually prolonged periods of rain.

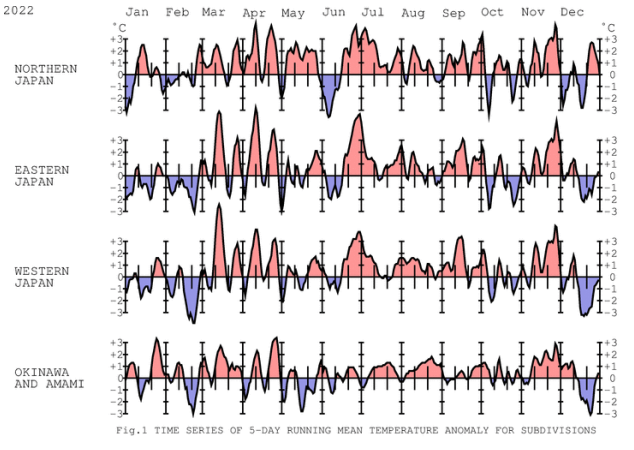

Figure 3-1 Time series representation of 5-day running mean temperature anomalies for the 4 subdivisions (Jan.-Dec. 2022)

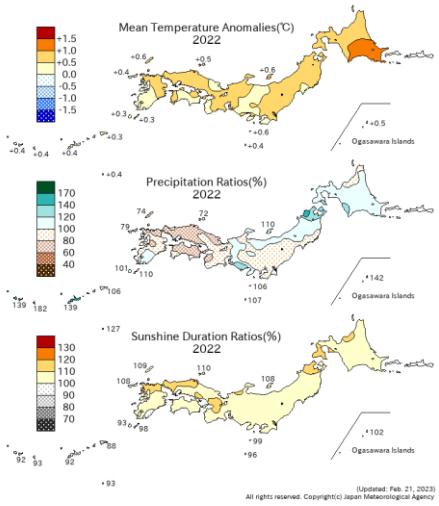

Figure 3-2 Annual climate anomalies/rations for Japan in 2022

The climatological normal period is 1991-2020.

Seasonal characteristics

(a) Winter (December 2021-February 2022)

The northwest monsoon began to intensify in late December and continued to be active almost through the rest of winter. This led to seasonal mean temperatures below normal in eastern to western Japan and record breaking snowfall in parts of the Sea of Japan sides of these regions. In northern Japan, seasonal snowfall amount was above normal in relation to the strong northwest monsoon and repeated passage of extratropical cyclones in its proximity.

(b) Spring (March-May)

Seasonal mean temperatures were above normal nationwide and significantly above normal in northern and western Japan, due to a continuation of warm air advection. Seasonal sunshine durations were significantly above normal for northern Japan and the Sea of Japan side of eastern Japan under dominant influences from anticyclones. Meanwhile in Okinawa/Amami, moist air inflow associated with the active Baiu front in May reduced sunshine duration and brought significantly above normal precipitation.

(c) Summer (June-August)

Seasonal mean temperatures were above normal nationwide and significantly above normal in eastern to western Japan and Okinawa/Amami. In western Japan in particular, the seasonal mean temperature was the highest on record since 1946 at +0.9°C above normal, tying with 2018 and 2013. Seasonal precipitation amount was significantly above normal in northern Japan in relation to repeated influences from extratropical cyclones and fronts. The official dates for the withdrawal of Baiu were unable to be determined for parts of northern and eastern Japan, due to prolonged rainy weather conditions.

(d) Autumn (September-November)

Warm air inflow in September and weak northwest monsoon in November resulted in seasonal mean temperatures significantly above normal nationwide. The delayed onset of northwest monsoon and influences from anticyclones led to significantly above normal seasonal sunshine durations in the Sea of Japan sides of northern, eastern and western Japan. In contrast, repeated influences of tropical cyclones and moist air inflow combined to bring significantly above normal seasonal precipitation amount and significantly below normal sunshine duration in Okinawa/Amami.

(OIKAWA Yoshitaka, NATORI Hiroaki, Tokyo Climate Center)

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TCC Training Seminar on Global Warming Projection Information

JMA's Tokyo Climate Center (TCC) has been assisting National Meteorological and Hydrological Services (NMHSs) in improving their climate services since 2008. The Center's two major activities in this regard involve providing basic climate data, products and tools to NMHSs through its website and assisting with capacity development at NMHSs in the Asia-Pacific region. TCC holds annual training seminars as part of capacity development activities in its role as an RCC in the WMO RA II area. In addition to running annual training seminars, TCC arranges expert visits to NMHSs to promote the effective transfer of technology and discuss possible support for climate services.

Same as last year, due to the COVID-19, TCC held the Training Seminar on Global Warming Projection Information on 9, 10, and 15 November 2022 virtually with the help of an online communication tool. The seminar was attended by 10 trainees and 13 observers from NMHSs in Bangladesh, Bhutan, Hong Kong (China), Indonesia, Malaysia, Mongolia, Nepal, the Philippines, Thailand and Viet Nam. The seminar focused on improving knowledge about Global Warming and its projection and on enhancing skills in detecting impacts by Global Warming and utilization of its model projection data using statistical trend detection methods. The course included lectures and practical exercises using in-situ observation data prepared by each trainee and Global Warming Projection data conducted by Meteorological Research Institute. At the end of the seminar, all participants gave presentations on the situation of long-term change in their own countries and engaged in fruitful discussions with lecturers and others present.

The content of the lectures is available on the TCC website at https://www.data.jma.go.jp/tcc/tcc/library/library2022.html.

A group photo of attendees and Tokyo Climate Center staff

The opening address by Mr. MORI Takashi, Director-General of the Atmosphere and Ocean Department (current Deputy Director-General for Disaster Mitigation) at the Japan Meteorological Agency (9 November, 2022)

Discussion and practical exercises at the seminar

(TAKAHASHI Kiyotoshi, Tokyo Climate Center)

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Visit to TCC by staff from the Meteorological, Climatological and Geophysical Agency of Indonesia (BMKG)

In its role as a World Meteorological Organization (WMO) Regional Climate Centre (RCC), TCC performs a variety of capacity development activities based on 1) annual training in Tokyo and 2) dispatch of experts to National Meteorological and Hydrological Services (NMHSs) to organize local training courses. TCC also hosts NMHS climate experts upon request.

On 13 and 14 December 2022, six BMKG climate experts were hosted in Japan under a Japan International Cooperation Agency (JICA) project for capacity development under the Implementation of Climate Change Strategy to highlight the country's advanced approach toward climate change. The initiative was intended to reinforce capacity in climate information development based on essential expertise in climate analysis and wide-ranging related application via TCC training.

The course included presentations on global warming and IPCC's AR6 initiative, seasonal forecasting, risk management based on seasonal forecasts, a one-month guidance tool, interannual/decadal variability in tropical ocean conditions (e.g., El Niño Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD)), climate system diagnostics, and practical exercises in operation of the TCC interactive tool for analysis of the climate system (iTacs). In addition to TCC presentations, three BMKG experts highlighted evaluation of BMKG seasonal forecasts, forecast skill assessment in consideration of IOD index values and correlation of multivariable ENSO values, and monsoon and dipole mode values in rainfall variability.

This brief course provided valuable opportunities for BMKG attendees to learn more about the climate-related activities of TCC and TCC tool utilization, highlighted how BMKG works to advance climate services, and clarified requirements in relation to TCC services. The training is expected to contribute to the efficient and effective development of climate services, including issuance of appropriate information on climate change related to global warming in Indonesia.

(TAKAHASHI Kiyotoshi, Tokyo Climate Center)

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TCC Experts Visit to the Philippines

TCC provides online information and tools related to monitoring and analysis of the climate system, seasonal forecasts, global warming and other variables to National Meteorological and Hydrological Services (NMHS), and also supports capacity building for climate services and facilitates effective transfer of technical expertise on TCC products and tools.

As part of such efforts, two TCC experts visited the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) from 7 to 10 February 2023 to provide training on one-month forecasts and promote the effective use of TCC's web-based Interactive Tool for Analysis of the Climate System (iTacs). The visit was a follow-up to the 2021 TCC Training Seminar (see TCC News No. 67 and the TCC website for details).

With the attendance of PAGASA managers and 26 trainees from its headquarters and regional branches, the course began with practice on basic iTacs operation including an outline of climatological dynamics. Individual groups of 3 or 4 attendees subsequently analyzed previous extreme climate events occurring around the Philippines using iTacs and made related presentations. Focus was then placed on the expertise and techniques necessary to generate one-month probabilistic forecast products using TCC's One-month Guidance Tool, and attendees produced forecasts for their own regions with subsequent presentations on their achievements. TCC seminars characteristically involve such exercises and presentations to promote understanding of climatological dynamics, one-month forecasting techniques and usage of TCC tools.

The visit also provided valuable opportunities for TCC in terms of awareness regarding the latest status of PAGASA's climate services, and TCC staff engaged in fruitful discussions on future collaboration with PAGASA. TCC will continue to arrange expert visits to NMHSs in Southeast Asia and elsewhere as necessary to assist with operational climate services.

(HIRAI Masayuki and YAMAMOTO Kosuke, Tokyo Climate Center)

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TCC Activity Report for 2022

In 2022, the Tokyo Climate Center (TCC) continued to support the climate services of National Meteorological and Hydrological Services (NMHSs) in Asia-Pacific countries by providing and enhancing data and products, holding training seminars, publishing quarterly newsletters and participating in online international meetings.

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

1.1 Issuance of special reports on extreme events

In a mandate role as a WMO Regional Climate Centre (RCC) in Regional Association II (RAII), 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).

A series of heavy snowfall events hit Japan on the Sea of Japan side and elsewhere from late December 2021 to early January 2022, bringing unprecedented snowfall for this period in the Kinki region and other areas. TCC issued a press release on factors behind this snowfall and low temperatures around the country, and uploaded an English-language report on the findings to its website (https://www.data.jma.go.jp/tcc/tcc/news/press_20220201.pdf).

TCC also issued a press release summarizing heavy snowfall events over the whole winter (https://www.data.jma.go.jp/tcc/tcc/news/press_20220329.pdf).

From late June to early July 2022, record-high temperatures were observed in eastern and western parts of Japan. From mid-July to mid-August, many parts of the country experienced record-heavy rain. 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 on the website (https://www.data.jma.go.jp/tcc/tcc/news/press_20220914.pdf)

1.2 Upgrade of JMA's Seasonal Ensemble Prediction System

JMA's Seasonal Ensemble Prediction System was upgraded in February 2022 to improve sub-seasonal and seasonal forecasts, including operational three-month predictions, warm/cold season outlooks and El Niño outlooks. The latest system, JMA/MRICPS3 (the Japan Meteorological Agency/Meteorological Research Institute-Coupled Prediction System version 3), is an atmosphere/ocean/land/sea ice-coupled prediction system featuring a variety of changes in its initialization and the forecast model used.

1.3 Upgrade of the Global Ensemble Prediction System for One-month Prediction

JMA upgraded its Global EPS for one-month prediction on 17th March 2022. In this upgrade, the horizontal resolution of the model was enhanced and the 2-tier SST method was updated with using SSTs predicted by the new Seasonal EPS (JMA/MRI-CPS3) for the forecast longer than 6 days.

1.4 Update of Weekly Report on Global Extreme Climate Events

The weekly report on global extreme climate events was updated on June 29, 2022. In this update, JMA newly provides users with weekly data on weather stations recording extreme climate conditions in HTML and CSV format files and new distribution maps showing such stations. The conventional overview of extreme climate events and meteorological disasters in the world is also provided as before. The URL of the update page is https://www.data.jma.go.jp/tcc/tcc/products/climate/weekly/ .

2. 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.

2.1 Training seminar

TCC holds training seminars every fiscal year (April – March), with the November 2022 event covering Global Warming. The seminar was held online as it was in 2021 due to COVID-19. Details of the events are reported in TCC News No. 71.

2.2 Hosting of NHMS staff

In response to a request from BMKG (Indonesia) under an ongoing JICA project, TCC held a two-day seminar at JMA Headquarters on 13 and 14 December 2022 to promote climate-related expertise and experience with iTacs. Details are reported in TCC News No. 71.

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 2022, TCC experts participated in the following RCOFs in Asia:

- Eighteenth session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II (FOCRA II-18) held online, on 9 May
- Twenty-second session of the South Asian Climate Outlook Forum (SASCOF-22) held online, from 26 to 28 April
- Twenty-third session of the South Asian Climate Outlook Forum (SASCOF-23) held online, from 26-28 to 30 September
- Tenth session of the East Asia winter Climate Outlook Forum (EASCOF-10) held online, on 10 November
- Nineteenth session of the ASEAN Climate Outlook Forum (ASEANCOF-19) held online, from 21 to 25 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.

In collaboration with TCC, a representative from the World Meteorological Centre Tokyo (WMC Tokyo) attended SASCOF-22, SASCOF-23, and ASEANCOF-19 on line.

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 2022, TCC News No. 67 – 70 were issued and made available on the TCC website.

5. Plans for 2023

-Eleventh session of the East Asia winter Climate Outlook Forum (EASCOF-11)

TCC will host the EASCOF-11 in autumn 2023, with details to be announced in due course.

- 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 of the portal site for Information Sharing on Climate Services in RA II.

- New/upgraded data, products and tool development

Previously postponed enhancements of the new dataset are expected to take place in the first half of 2023. These include the utilization of JRA-3Q (the Japanese Reanalysis for Three-Quarters of a Century), COBE-SST2 (Centennial in situ Observation-based Estimates of the Variability of SST and Marine Meteorological Variables, version 2) and MOVE/MRI.COM-G3 (the Multivariate Ocean Variational Estimation/Meteorological Research Institute Community Ocean Model – Global version 3). These improvements will influence several products on the

TCC website, including the interactive iTacs tool, with details to be provided in due course.

- Capacity development

In the second half of Japan's fiscal 2023, TCC will host a dozen invited experts at its annual training seminar. The Center will also continue to dispatch experts to NMHSs as necessary and host visitors from NMHSs upon request.

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You can find the latest newsletter from the Japan International Cooperation Agency (JICA).

JICA Magazine

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

"JICA magazine" is a public relations magazine published by JICA. It introduces the current situations 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.
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