Tokyo Climate Center, Japan Meteorological Agency

TCC News

Winter 2021

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The year 2020 tied with 2016 as the warmest since 1891

JMA analysis indicates that the annual anomaly of the global average surface temperature for 2020 (i.e., the combined average of near-surface air temperatures over land and sea-surface temperatures) was +0.45°C above the 1981 – 2010 average (+0.81°C above the 20th-century average), and tied with 2016 as the warmest since 1891 (Figure 1-1).

On a longer time scale, the annual global average surface temperature has risen at a rate of about 0.75°C per century. Global temperatures from 2014 to 2020 were the highest 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. Significant differences were seen between 2016 and 2020 in regard to oceanic conditions in the tropical Pacific. The strong El Niño event observed from 2014 to 2016 is thought to have increased global temperatures in 2016, while the tropical Pacific is considered to have exhibited ENSO-neutral or La Niña-like conditions throughout 2020.

High temperature deviations were particularly evident over wide areas of Europe, East Asia and Australia, and over the North Pacific and the Indian Ocean (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

(Goto Atsushi, Tokyo Climate Center)

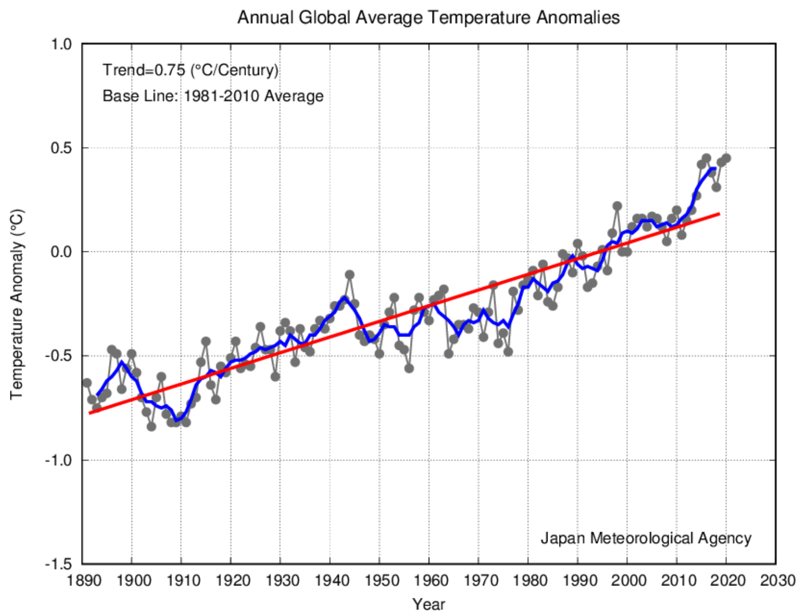

Figure 1-1 Long-term change in annual mean surface temperature anomalies over the globe

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.

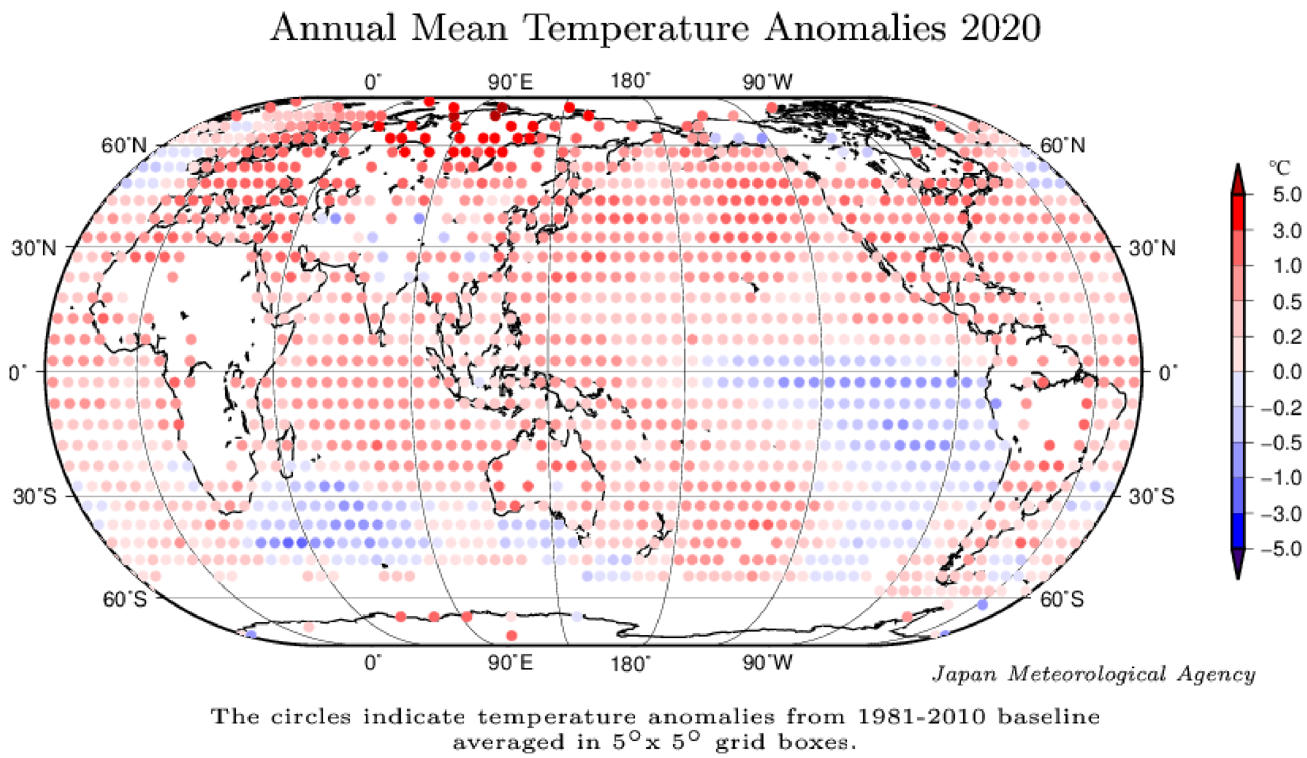

Figure 1-2 Annual mean temperature anomalies in 2020

The circles indicate anomalies of surface temperature averaged in 5° x 5° grid boxes. Anomalies are represented as deviations from the 1981 – 2010 average.

Table 1-1 Ranking of annual global average temperatures

Rank	Year	Temperature Anomaly w.r.t. 1981 – 2010 average
1	2020	+0.45
	2016	+0.45
3	2019	+0.43
4	2015	+0.42
5	2017	+0.38
6	2018	+0.31
7	2014	+0.27
8	1998	+0.22
9	2013	+0.20
	2010	+0.20

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Highlights of the Global Climate in 2020

Annual mean temperatures were above normal in most parts of the world, and were very high in Siberia, from the eastern part of East Asia to Southeast Asia, in and around Europe, in and around Madagascar, from the southern part of North America to South America, and in Australia (Figure 2-1).

Extremely high temperatures were frequently observed over periods of nine months or more in and around Siberia, from the eastern part of East Asia to Southeast Asia, from northern Europe to the central Middle East, from the southern part of North America to the central part of South America, and from northern to southeastern Australia. NHMSs in many countries reported record-high monthly, seasonal and annual mean temperatures for various periods. Extremely low temperatures were observed in and around the southern part of Central Asia (Figure 2-3).

Annual precipitation amounts were above normal from Western Siberia to the eastern part of East Asia, in the southern part of Southeast Asia, from the southern part of Central Asia to South Asia, from northern to western Europe, in Western Africa, from the eastern part of North America to Caribbean countries, in the eastern part of South America, and from central to southeastern Australia. Annual precipitation amounts were below normal from the southern part of Central Asia to the central part of East Asia, from the central to western part of Northern Africa, from the western USA to central Mexico, and in the southern part of South America. (Figure 2-2).

Extremely high precipitation amounts were frequently observed over periods of five months or more from central Mongolia to the Korean Peninsula, from western to southern Europe, and from the eastern to southeastern USA. Extremely low precipitation amounts were frequently observed over periods of five months or more from eastern to southwestern Europe and from northern Argentina to southern Brazil (Figure 2-3).

Major extreme climatic events and weather-related disasters occurring in 2020 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 2020 on the TCC website.

Table 2-1 List of major extreme climatic events and weather–related disasters across the world in 2020

	Type	Period	Area
(1)	Warm	January-November	In and around Siberia
(2)	Wet	February, August-September, November	From central Mongolia to the Korean Peninsula
(3)	Heavy Rain	July	From eastern to western Japan
(4)	Heavy Rain	June-August	China
(5)	Warm	January-September	From the eastern part of East Asia to Southeast Asia
(6)	Heavy Rain and Typhoon	October-November	From the Philippines to the Indochina Peninsula
(7)	Heavy Rain	June-October	In and around South Asia
(8)	Warm	January-February, August, December	From southern India to Sri Lanka
(9)	Cold	September-December	In and around the southern part of Central Asia

(10)	Warm	January-March, June, August-December	From northern Europe to the central Middle East
(11)	Wet	February-March, June, August, October, December	From western to southern Europe
(12)	Warm	February, April-May, July, September, November	From western Europe to the western part of Northern Africa
(13)	Dry	January, April-May, July, November	From eastern to southwestern Europe
(14)	Heavy Rain	June-September	Western Yemen, Sudan, Niger
(15)	Wet	July-September	From the central to western part of Western Africa
(16)	Warm	January-February, April-June, November-December	From the western part of Western Africa to the western part of Middle Africa
(17)	Heavy Rain	April-May	In and around the central part of Eastern Africa
(18)	Warm	February-March, October	In and around northern Madagascar
(19)	Wet	February, May-August, November	From the eastern to southeastern USA
(20)	Wildfire	August-September	The western USA
(21)	Warm	January-December	From the southern part of North America to the central part of South America
(22)	Hurricane	August, November	From the southern USA to Central America
(23)	Dry	February-March, May, September-November	From northern Argentina to southern Brazil
(24)	Warm	January, March-April, August	In and around southeastern Micronesia
(25)	Warm	January-April, June-November	From northern to southeastern Australia
(26)	Warm	April, June-July, September	Western Australia

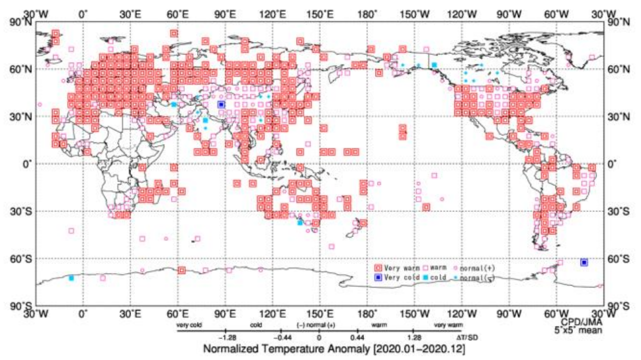

Figure 2-1 Normalized annual mean temperature anomalies for 2020

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 observation data sample is insufficient or normal data are unavailable.

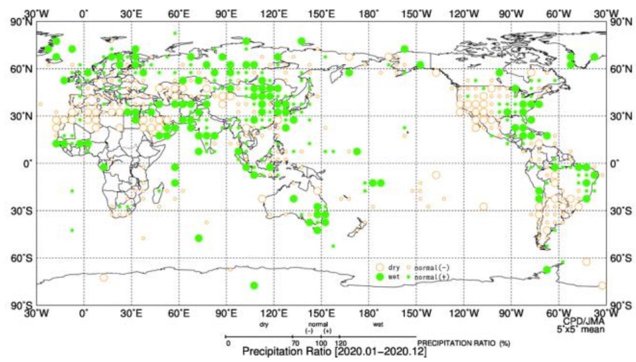

Figure 2-2 Annual total precipitation ratios for 2020

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.

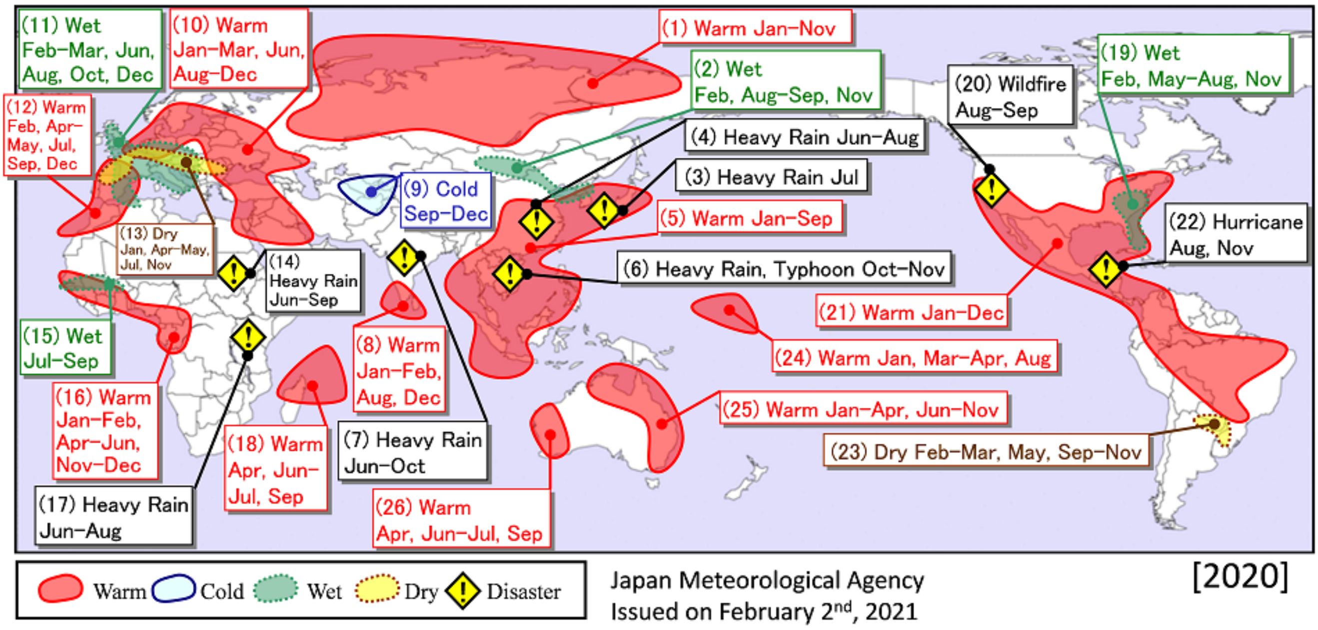

Figure 2-3 Major extreme climate events and weather-related disasters occurring around the world in 2020

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

(Adachi Noriyuki, Tokyo Climate Center)

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Summary of Japan’s Climatic Characteristics for 2020

Annual characteristics

Japan’s climatic characteristics for 2020 can be summarized as follows:

- High temperatures persisted nationwide, with annual means significantly above normal in all regions. The mean for eastern Japan was the highest since 1946, at 1.2°C above normal.

- In winter 2019/20 (December – February), temperatures were high nationwide in association with limited advection of cold air from Siberia to Japan (winter monsoon) relating to weak winter-type pressure distribution (high to the west and low to the east). Seasonal mean temperatures for eastern and western Japan were the highest since winter 1946/47. Snowfall amounts were relatively low nationwide, with those on the Sea of Japan side of northern and eastern Japan being the lowest since winter 1961/62.

- In July, ongoing heavy rain affected eastern and western areas of Japan in association with the stagnation of an active Baiu front over mainland Japan. Monthly precipitation on the Sea of Japan side of eastern Japan and in western Japan were the highest recorded, and monthly sunshine durations were the lowest recorded in eastern and western Japan. The rainy season ended later than usual in most regions, with Okinawa being a notable exception.

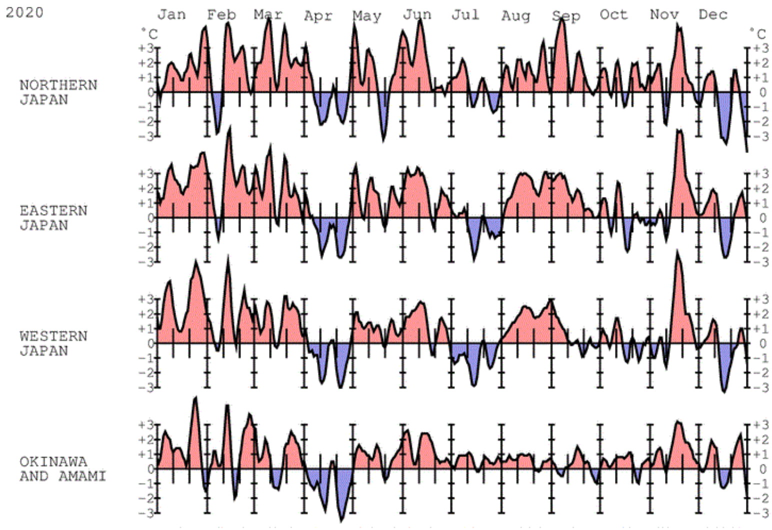

Figure 3-1 Time-series representation of five-day running mean temperature anomalies for subdivisions (January – December 2020) The normal is the 1981 – 2010 average.

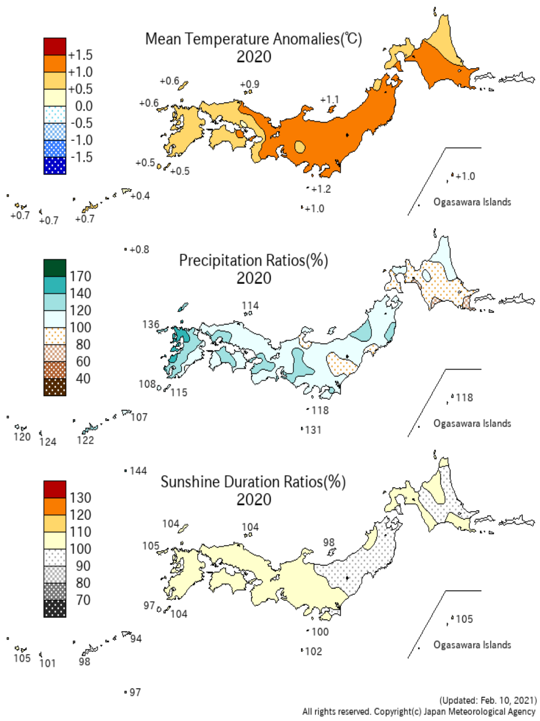

Figure 3-2 Annual climate anomalies/ratios for Japan in 2020

Seasonal characteristics

(a) Winter (December 2019 – February 2020)

Mild winter conditions were observed nationwide due to a weaker-than-normal winter monsoon. Seasonal mean temperatures in eastern and western Japan were the highest since 1946/47, and seasonal snowfall amounts on the Sea of Japan side of northern and eastern Japan were the lowest since 1961/62.

(b) Spring (March – May)

Sunny conditions persisted in and around western Japan from March to April due to frequent high-pressure system coverage. Seasonal sunshine durations were significantly above normal on the Pacific side of eastern Japan and in western Japan. Warm air flowed northward over the country in March and May. Seasonal mean temperatures in northern Japan were significantly above normal.

(c) Summer (June – August)

In July, areas over western to northeastern Japan experienced record-heavy rain and record-low sunshine durations in association with active Baiu-front stagnation in mainland Japan. As a result, seasonal precipitation amounts in eastern and western Japan were significantly above normal. Seasonal precipitation in Okinawa/Amami was also significantly above normal due to an active Baiu front and extra-tropical cyclones, while warm air covered the country in June and August. Monthly mean temperatures for June and August were the highest since 1946 in eastern Japan and the joint-highest since 1946 in western Japan.

(d) Autumn (September – November)

In early September, the large and very strong Typhoon Haishen (T2010) caused extensive damage over areas from Kyushu to Amami, with heavy precipitation and strong winds. Seasonal mean temperatures in northern Japan were significantly above normal due to southerly warm air flow. Seasonal mean temperatures in Okinawa/Amami were also significantly above normal due to warm-air coverage.

(Umeda Takafumi, Tokyo Climate Center)

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New Indian Ocean Dipole products

The Indian Ocean Dipole (IOD) is a major mode of interannual climate variability in the tropics, significantly affecting climate conditions on regional and global scales. New IOD products, including data related to monitoring and impacts on global climate/atmospheric circulation, are now available on the TCC website.

1. Indian Ocean Dipole Monitoring

IOD is characterized by sea surface temperature (SST) anomalies with opposite signs in the eastern and western tropical Indian Ocean. For related monitoring, TCC uses the dipole mode index (DMI) (Figure 4-1) based on SST differences between the western tropical Indian Ocean (the WIN area in Figure 4-2) and the southeastern tropical Indian Ocean (the EIN area in Figure 4-2). Further details on associated monitoring indices and related historical events are also provided, with monitoring index values available on the Download Indian Ocean Dipole Monitoring Indices page. These data are also provided on iTacs (the Interactive Tool for Analysis of the Climate System), which is a TCC web-based application for climate data analysis (Figure 4-3). These products are updated around the 10th of each month.

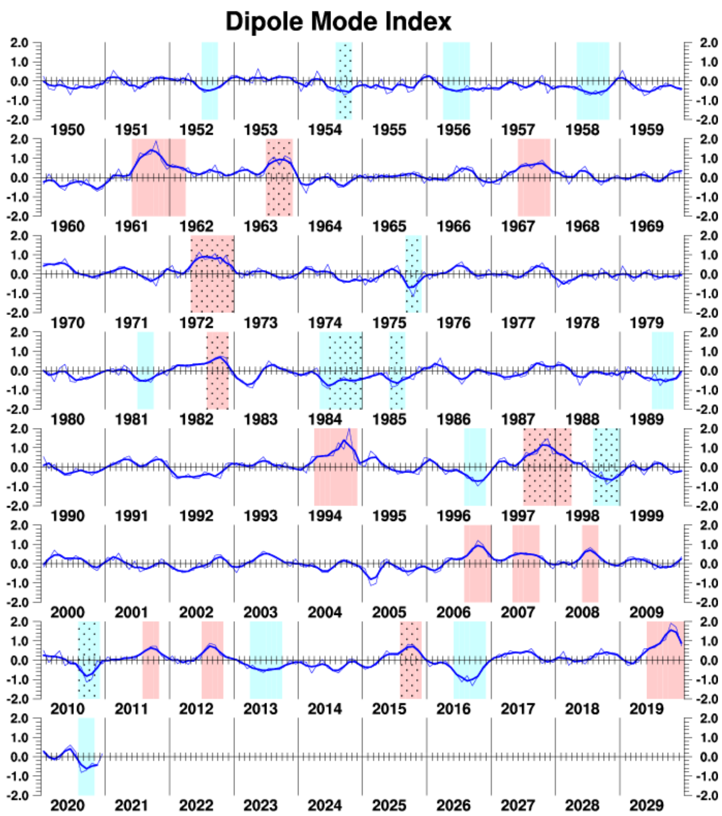

Figure 4-1 Dipole Mode Index (DMI) time-series representation

The thin and thick lines indicate monthly mean and three-month running mean DMI values, respectively, while red and blue shading denotes positive and negative IOD periods, respectively. Hatched areas indicate positive and negative IOD events in concurrence with El Niño and La Niña events, respectively.

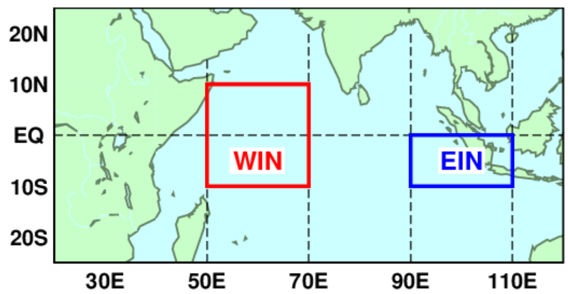

Figure 4-2 IOD monitoring indices

WIN: Area-averaged regional SSTs (10°S – 10°N, 50°E – 70°E)

EIN: Area-averaged regional SSTs (10°S – EQ, 90°E – 110°E]

DMI: Differences between WIN and EIN

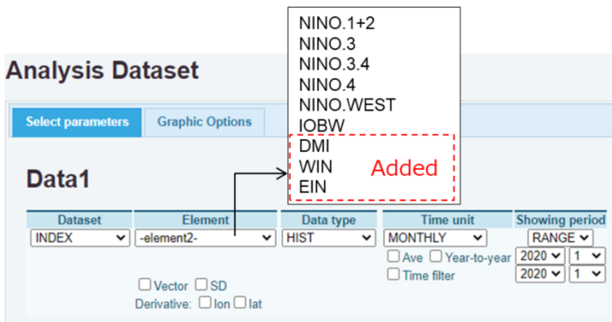

Figure 4-3 iTacs screen

IOD monitoring indices were added to the Index dataset on iTacs.

2. Global Climate Impacts

This page details anomaly characteristics observed in three-month-mean temperature and precipitation data for previous "pure" positive and negative IOD events (i.e., those with an absence of El Niño or La Niña conditions) with 5 x 5°-grid representation (Figure 4-4).

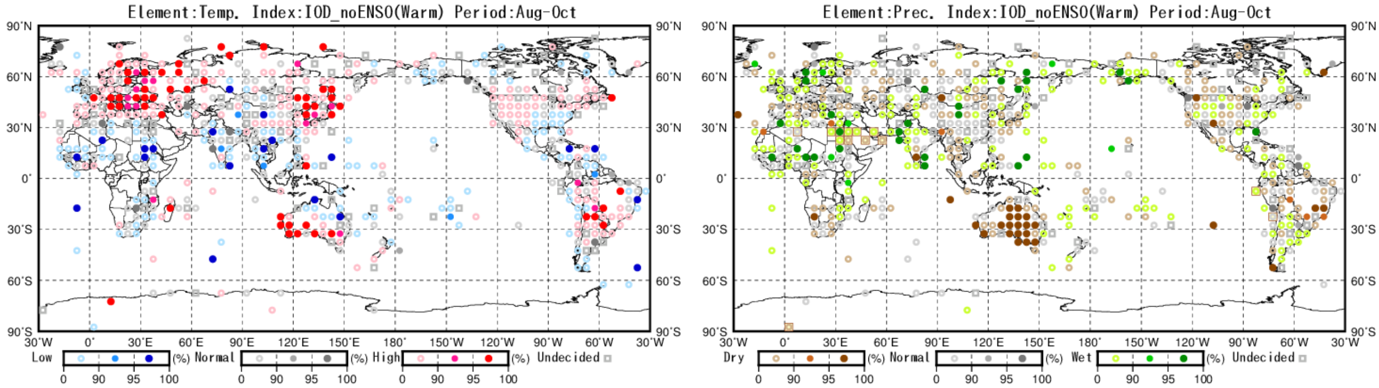

Figure 4-4 Temperatures (left) and precipitation (right) for August – October in positive phases of pure IOD events

The most frequent classes are represented by circles (high/normal/low for temperature, wet/normal/dry for precipitation) and related statistical confidence levels (%) as indicated in the legends. Grey squares indicate that the most frequent class could not be isolated. Grid squares with a dry climatological probability exceeding 33% are shown with a square in the grid background. No circles or squares are shown for grid squares with insufficient data.

3. Atmospheric Circulation Impacts

This page details the relationship between pure IOD events and atmospheric circulation based on the Japanese 55-year reanalysis dataset (JRA-55) and satellite observation data (Figure 4-5), along with information on the characteristics of mature IOD stages based on composite analysis.

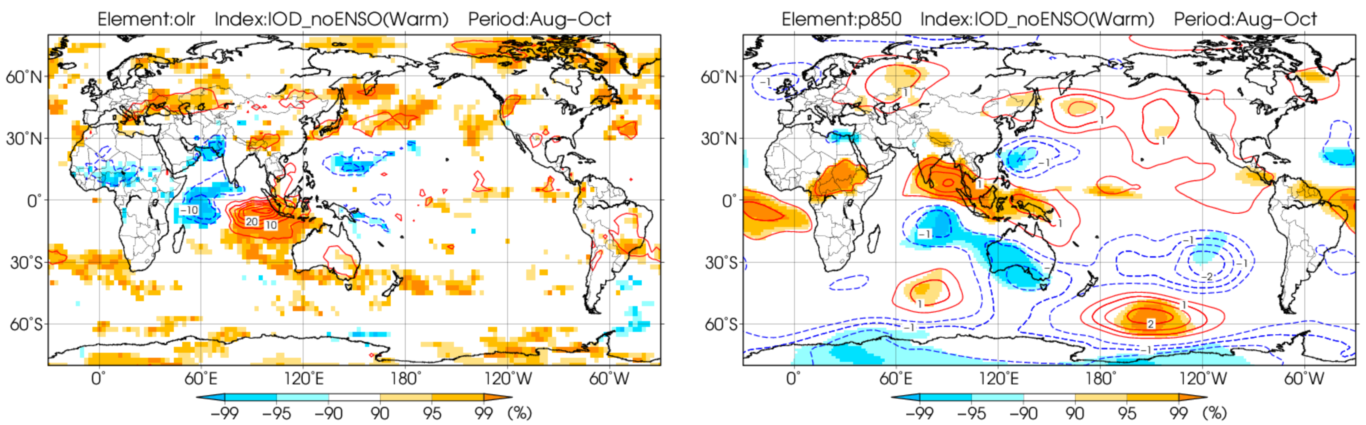

Figure 4-5 Outgoing longwave radiation (left) and 850-hPa stream function (right) composite anomalies for August – October in positive phases of pure IOD events

Contours show composite anomalies at intervals of 5 W/ m^2 (left) and $x10^6$ m^2/s (right). Shading indicates confidence levels. Data are based on satellite observation from 1979 to 2012 (left) and JRA-55 reanalysis from 1958 to 2012 (right).

(Sato Hirotaka, Tokyo Climate Center)

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TCC and WMC Tokyo co-contributions to ASEANCOF-15

The 15th ASEAN Climate Outlook Forum (ASEANCOF-15) was hosted online by the ASEAN Specialised Meteorological Centre of the Meteorological Service Singapore (MSS) on 23, 25 and 27 November 2020. Attendees discussed the climatic conditions of the upcoming winter monsoon season, which generally lasts from December to February.

As part of collaborative activities between TCC and the World Meteorological Centre (WMC) Tokyo, a representative of WMC Tokyo provided a winter monsoon season outlook based on JMA's dynamic seasonal ensemble prediction system with probabilistic information on atmospheric variability and evolution of conditions in the tropical Pacific and Indian Ocean areas. This information was provided to support the output of country-scale outlooks by National Meteorological and Hydrological Services (NMHSs) in the ASEAN region and to contribute to the summarization of a consensus outlook for Southeast Asia. The representative also provided information on useful data and charts available on the TCC website and the Copernicus Climate Change Service (C3S), in which forecasts provided by WMC Tokyo have been incorporated since October 2020. TCC and WMC Tokyo are committed to collaboration with operational climate communities to enhance progress in forecast skill and application of climate information toward the resolution of common issues and realizing a climate-resilient world.

(Tsuji Kazuaki, Tokyo Climate Center)

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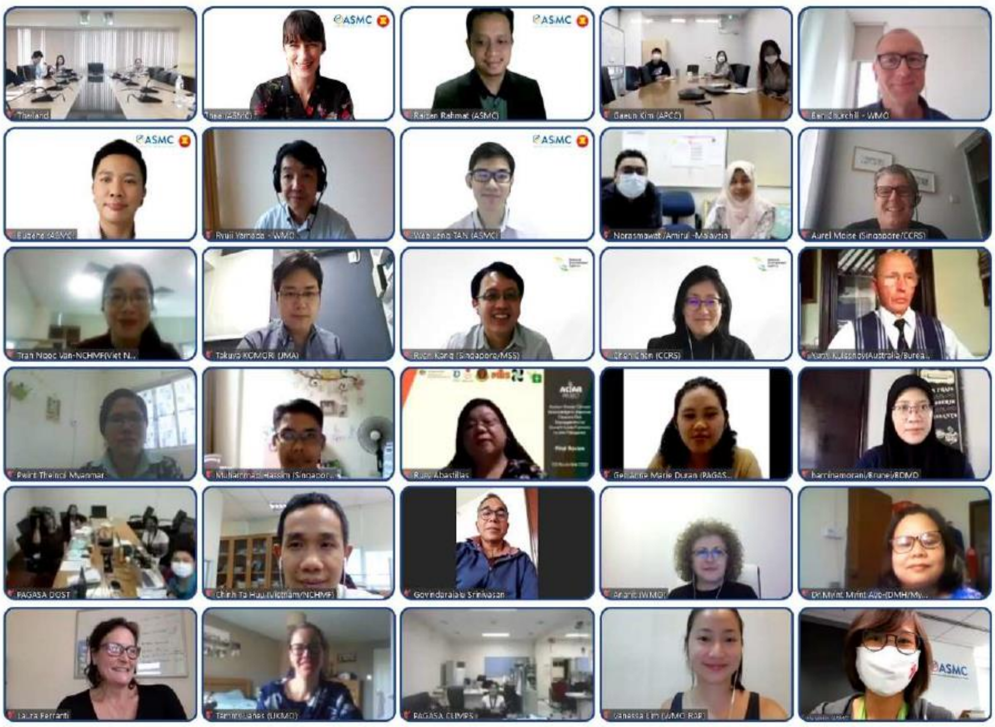

Figure 5-1 Participants in the ASEANCOF-15

TCC Activity Report for 2020

In 2020, 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, publishing quarterly newsletters and hosting/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://ds.data.jma.go.jp/tcc/tcc/products/clisys/reports/index.html).

Winter in Japan (December 2019 to February 2020) was the warmest since 1897/98, with significantly lower snowfall than usual. TCC issued a press release on primary factors causing these conditions, with two English-language reports provided on its website (https://ds.data.jma.go.jp/tcc/tcc/news/press_20200127.pdf, https://ds.data.jma.go.jp/tcc/tcc/news/press_20200501.pdf).

Stagnation of the active Meiyu-Baiu front over Japan brought record-heavy rainfall from western to northeastern parts of the country in July (officially titled the Heavy Rain Event of July 2020) along with record-low sunshine durations. In collaboration with the Tokyo Climate Center Advisory Panel on Extreme Climatic Events (see TCC News No. 28), the Japan Meteorological Agency (JMA) reported on primary atmospheric and oceanic conditions associated with these extremes (https://ds.data.jma.go.jp/tcc/tcc/news/press_20200916.pdf).

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

JMA upgraded its Global Ensemble Prediction System (Global EPS) for one month prediction on 24th March 2020. In addition to improved physical parameterization schemes in the forecast model, new relaxation method for its oceanic boundary condition was also implemented. Along with the Global EPS upgrade, JMA released higher-resolution global 1.25-degree grid data for one-month prediction in GRIB2 format, which involves spatial differencing and complex packing for reduced data volume. The data are provided to authenticated users on the TCC website at https://ds.data.jma.go.jp/tcc/tcc/gpv/index.html. The hindcast data are also provided to authenticated users in the same website.

1.3 Release of Global Gridded Datasets for 6-month Forecasts

In response to received requests from NMHSs and other international centers, JMA began providing global 2.5-degree gridded datasets for 6-month forecasts every 5-days. The data are provided to authenticated users at https://ds.data.jma.go.jp/tcc/tcc/gpv/index.html.

1.4 Security of TCC interactive product pages (iTacs and JMA One-month Guidance Tool)

To ensure online security for interactive product pages, TCC began requiring secure website connections in November, thereby eliminating unencrypted communication with iTacs and JMA's One-month Guidance Tool. Users of these pages should change the website address from http to https as follows:

- iTacs (Interactive Tool for Analysis of the Climate System)
  https://extreme.kishou.go.jp/tool/itacs-tcc2015/
- JMA's One-month Guidance Tool
  https://extreme.kishou.go.jp/cgi-bin/simple_guidance/index.cgi

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's annual training seminar was not held in FY 2020 due to COVID-19 and related travel restrictions. The Center is considering the potential for running the seminar in FY 2021.

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 2020, TCC experts participated in the following RCOFs in Asia:

- Sixteenth session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II (FOCRA II-16) held online, on 7 May
- Sixteenth session of the South Asian Climate Outlook Forum (SASCOF-16) held online, from 20 to 22 April
- Seventeenth session of the South Asian Climate Outlook Forum (SASCOF-17) held online, from 23 to 28 September
- Eighth session of the East Asia winter Climate Outlook Forum (EASCOF-8) held online, on 5 November (Hosted by JMA; see 3.2 for details.)

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 the 15th session of the ASEAN Climate Outlook Forum (ASEANCOF-15) online to present TCC's climate outlook for the region.

3.2 EASCOF

The eighth EASCOF session (EASCOF-8) was hosted online by JMA on 5 November 2020 with the presence of more than 30 experts from China, Japan, Mongolia and the Republic of Korea and a special contribution by experts from the North Eurasia Climate Centre (NEACC). Attendees discussed recent phenomena related to seasonal prediction of the East Asian Winter Monsoon (EAWM) and reached a consensus on seasonal outlooks for the coming winter. A WMO representative outlined the organization's objective seasonal prediction strategy, and a UN ESCAP representative detailed the organization's proposal for impact-based forecasting based on seasonal climate prediction in the region. Forum materials used in the session are available via the EASCOF portal website (https://ds.data.jma.go.jp/tcc/tcc/library/EASCOF/index.html).

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 2020, TCC News No. 59 – 62 were issued and made available on the TCC website.

5 Personnel changes

Having served as TCC head since 2018, TAKATSUKI Yasushi took over as director of the Meteorological Research Institute on 1st April 2020. He was succeeded by FUJIKAWA Norihisa, who also serves as the director of JMA's Climate Prediction Division.

6 Plans for 2021

- **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**

From discussions with NMHSs (such as those held during the 2019 visit to Meteorological Service Singapore), TCC recognized the relevance of gathering information regarding the Indian Ocean Dipole (IOD) mode for improved climate forecasts. In response to demand, the Center planned to start providing new IOD information/products in January 2021.

Due to a change in calculation scheduling for the Global Ensemble Prediction System, the number of ensemble members for each base time (00 UTC on Tuesday and Wednesday) will be changed in gridded data files for one-month prediction. However, as the total number of ensemble members (50) will not change, the GPV format will remain the same. No significant modification for users' analysis commands is needed. The Extreme Forecast Index (EFI) and other TCC products will be slightly influenced by the ensemble member change, but usability will not be affected.

As per TCC News No. 60, the old low-resolution 2.5-degree grid data of the Global EPS for one-month prediction in GRIB2 format was provided as a temporary measure for the transition period. Since JMA will stop providing these data online at the end of March 2021, authenticated users should switch to the current

1.25-degree grid data.
https://ds.data.jma.go.jp/tcc/tcc/gpv/index.html

TCC also plans to change the normal period from the current 1981 – 2010 to 1991 – 2020 in a two-step process. From spring 2021 onward, TCC products (other than those of WMC Tokyo for long-range forecasting) will be based on the 1991 – 2020 normal period, and WMC Tokyo GPV products will follow in spring 2022. TCC will add notations to avoid confusion over any differing normal values during the transition period.

Further improvements are planned for spring 2022, including increased resolution for TCC's Global Ensemble Prediction System for operational one-month forecasting. Details will be provided in due course.

- **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. The format of these activities (i.e., online hosting or in-person attendance) will depend on the status of the COVID-19 pandemic.

(Wakamatsu Shunya, Tokyo Climate Center)

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You can also find the latest newsletter from Japan International Cooperation Agency (JICA).
JICA's World (January 2021)
https://www.jica.go.jp/english/publications/j-world/2101.html
JICA's World is the quarterly magazine published by JICA. It introduces various cooperation projects and partners along with the featured theme. The latest issue features "Revisiting Human Security in Today's Context: Security and Dignity for All".

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: Oikawa Yoshinori, Wakamatsu Shunya and Tsuji Kazuaki)

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TCC Website:
https://ds.data.jma.go.jp/tcc/tcc/index.html

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