Tokyo Climate Center, Japan Meteorological Agency

TCC News

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Global surface temperature for 2018 the fourth highest since 1891

JMA analysis indicates that the annual anomaly of the global average surface temperature for 2018 (i.e., the combined average of the near-surface air temperature over land and the sea surface temperature) was +0.31°C above the 1981 – 2010 average. This was the fourth-warmest year on record, with 2015, 2016, 2017 and 2018 making up the top four in the 128-year period since 1891 (Figure 1). It is known that the global mean surface temperature tends to decrease after a La Niña event, and despite the event occurring from autumn 2017 to spring 2018, 2018 ranked just below 2016 (the warmest), 2015 (the second warmest) and 2017 (the third warmest).

On a longer time scale, the annual global average surface temperature has been rising at a rate of about 0.73°C per century. Twelve of the 13 warmest years on record since 1891 have occurred during this century (Table 1). 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.

In 2018, warm temperature deviations were particularly evident over wide areas of Europe, East Asia and the southwestern USA (Figure 2).

JMA monitors monthly, seasonal and annual average anomalies of global surface temperature. Those results are routinely updated on the following TCC website:

https://ds.data.jma.go.jp/tcc/tcc/products/gwp/gwp.html

(Shotaro Tanaka, Tokyo Climate Center)

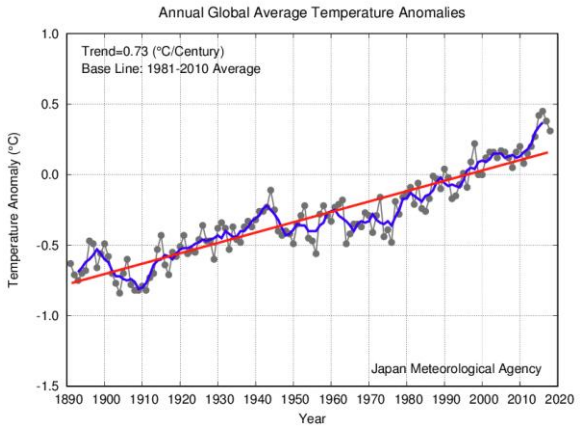

Figure 1 Long-term change in the annual anomalies of the global average surface temperature (1891 – 2018)
The black line with filled circles indicates anomalies of surface temperature in each year. The blue line indicates five-year running mean, and the red line indicates a long-term linear trend. Anomalies are represented as deviations from the 1981 – 2010 average.

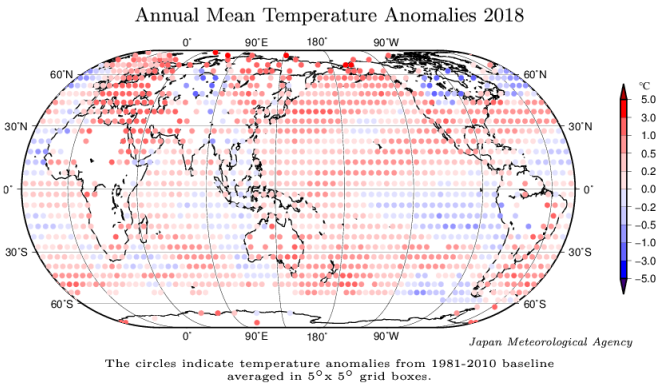

Figure 2 Annual mean temperature anomalies in 2018
The circles indicate anomalies of surface temperature averaged in 5° x 5° grid boxes. Anomalies are deviations from the 1981 – 2010 average.

Table 1 Ranking of annual global average temperatures

Rank	Year	Temperature Anomaly w.r.t. 1981 – 2010 average
1	2016	+0.45
2	2015	+0.42
3	2017	+0.38
4	**2018**	**+0.31**
5	2014	+0.27
6	1998	+0.22
7	2013	+0.20
	2010	+0.20
9	2005	+0.17
10	2009	+0.16
	2006	+0.16
	2003	+0.16
	2002	+0.16

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Highlights of the Global Climate in 2018

Annual mean temperatures were above normal in most parts of the world, and were very high from Alaska to northwestern Siberia, in the southern part of East Asia, from Micronesia to the central part of Southeast Asia, in the western part of South Asia, from Europe to the Middle East, in and around the southern part of Eastern Africa, from the western to the southeastern USA, from Central America to the eastern part of South America, and in Australia. Annual mean temperatures were below normal from eastern Canada to the northern USA, and were very low in and around the northeastern part of Central Asia (Figure 3).

Extremely high summer temperatures were frequently observed in the Northern Hemisphere (Figure 5), with record highs observed in Europe, East Asia and the southwestern USA. Seasonal mean temperatures for summer (June to August) were the highest on record for this season in eastern Japan, Korea, China and the southwestern USA.

Annual precipitation amounts were above normal from Mongolia to northern China, from the eastern to the central part of Central Asia, from the northwestern part of the Middle East to the eastern part of Northern Africa, from southern Europe to the northwestern part of Northern Africa, and from the northeastern to the southern USA. Annual precipitation amounts were below normal in the western part of Central Asia, from the northwestern part of South Asia to the southern part of the Middle East, and in southeastern Australia (Figure 4).

In Europe, contrasting incidences of extreme high and low precipitation were frequently observed in southern and central parts, respectively (Figure 5).

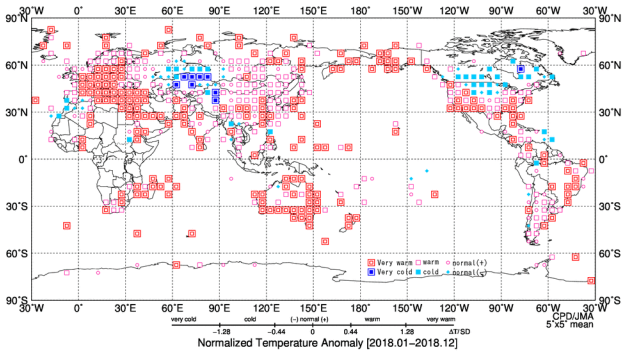

Figure 3 Normalized annual mean temperature anomalies for 2018
Categories are defined by the annual mean temperature anomaly against the normal divided by its standard deviation and averaged in 5° × 5° grid boxes. The thresholds of each category are −1.28, −0.44, 0, +0.44 and +1.28. The normal values 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.

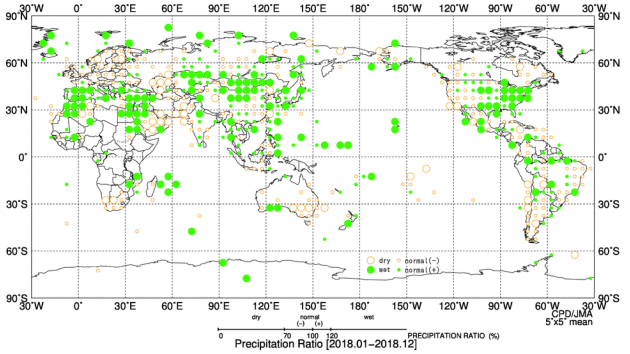

Figure 4 Annual total precipitation ratios for 2018
Categories are defined by the annual precipitation ratio to the normal averaged in 5° × 5° grid boxes. The thresholds of each category are 70, 100 and 120%. Land areas without graphics represent regions for which the observation data sample is insufficient or normal data are unavailable.

Major extreme climatic events and weather-related disasters occurring in 2018 are listed below (also see Figure 5).

(1) Warm: from western Alaska to the eastern part of Eastern Siberia (January – April, September – October)
(2) Warm: from the northwestern part of Eastern Siberia to the northwestern part of Central Siberia (June, August, October)
(3) Cold: from southwestern Mongolia to northwestern China (January, September, December)
(4) Wet: in and around central Mongolia (January, July – September)
(5) Warm: from northern Japan to northwestern China (March – August)
(6) Heavy Rain: from eastern to western Japan (June – July)
(7) Warm: from northwestern Micronesia to the northwestern part of Southeast Asia (February, May, July – August, October – December)
(8) Dust Storm and Thunderstorm: northern India (May)
(9) Heavy Rain: India (June – September)
(10) Warm: from the southern part of Central Asia to the southeastern part of South Asia (January, March, May – June, August, November)
(11) Warm: in and around the Middle East (February – March, May – June, September)
(12) Warm: the northern Scandinavian Peninsula (May, July, November)
(13) Dry: in and around central Europe (February, May – November)
(14) Warm: from central to southern Europe (January, April – October, December)
(15) Wet: from southern Europe to the northwestern part of Northern Africa (January – June, August – October)
(16) Warm: from the western part of Western Africa to the northwestern part of Middle Africa (June, August – September, November)
(17) Heavy Rain: Nigeria (July – September)
(18) Heavy Rain and Tropical Storm: from the northern to central part of Eastern Africa (March – May)
(19) Warm: from Mauritius to northwestern South Africa (June, August – September, December)
(20) Wet: from the northeastern to southern USA (February, May, August – December)
(21) Warm: from the southern part of North America to the central part of Central America (February, May – September)
(22) Wildfire: the western USA (July – September, November)
(23) Warm: northeastern Brazil (June, August – September)
(24) Drought: in and around northern Argentina (January – March)
(25) Warm: from northern to central Argentina (February, April, September)
(26) Warm: from eastern to southern Australia (January, March – April, July, October – December)
(27) Drought: southeastern Australia (January – September)

(Kenji Kamiguchi, Tokyo Climate Center)

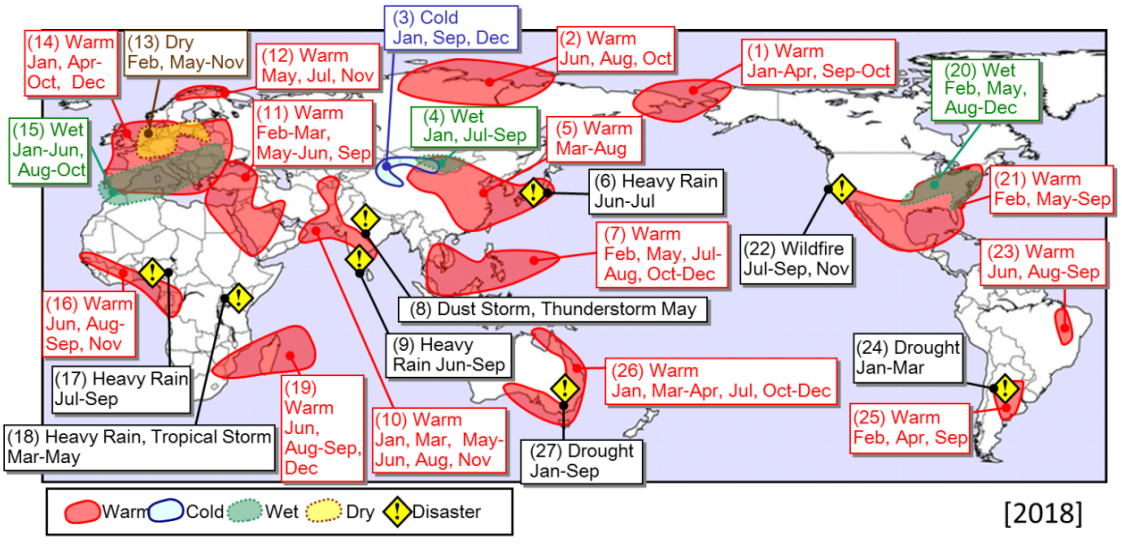

Figure 5 Major extreme climate events and weather-related disasters across the world in 2018
Schematic representation of major extreme climate events and weather-related disasters occurring during the year

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Summary of Japan's Climatic Characteristics for 2018

1. Annual characteristics

Japan's climatic characteristics for 2018 can be summarized as follows:

- The country experienced cold winter conditions (December 2017 – February 2018), and heavy snowfall was observed on the Sea of Japan side of eastern Japan.
- Markedly high temperatures persisted from spring to summer in eastern and western Japan.
- Record precipitation was observed in July around western Japan.
- Two typhoons (Jebi (T1821) and Trami (T1824)) made landfall on the country, causing wind storms and storm surges nationwide.

2. Seasonal characteristics

(a) Winter (December 2017 – February 2018)

Japan experienced cold winter conditions caused by the frequent flow of strong masses of cold air over the country. The seasonal mean temperature in western Japan was 1.2°C below the normal, making it the lowest in 32 years. Due to the influx of developed snow clouds, frequent heavy snowfall on the Sea of Japan side of the country affected transportation. In the Fukui Prefecture region of eastern Japan, snow accumulation amounted to 147 cm, which was the highest in 37 years. In addition, heavy snowfall occasionally hit the Pacific side of northern and eastern Japan due to the effects of developed low-pressure systems.

(b) Spring (March – May)

A covering of warm air over the country made seasonal mean temperatures significantly above normal nationwide. The temperature in eastern Japan was 2.0°C above normal, making it the highest since 1946. From eastern Japan to Okinawa/Amami, sunny conditions tended to prevail due to frequent coverage by migrating high-pressure systems. Conversely, heavy precipitation was occasionally observed from northern to western parts of Japan due to moist air flow associated with low-pressure systems passing around the country.

(c) Summer (June – August)

In early July, record precipitation was observed around western Japan. Major damage from landslides and floods occurred in association with the Baiu front remaining over Japan's mainland and huge amounts of moist air flowing into the region.

From mid-July onward the Pacific and Tibetan Highs expanded toward Japan, bringing a significantly earlier-than-normal end to the rainy season and extremely hot conditions to eastern and western parts of the country. On 23 July, a national-record daily maximum temperature of 41.1°C was recorded in the Kumagaya area of eastern Japan. The seasonal mean temperature in eastern Japan was 1.7°C above normal, making it the highest since 1946.

Seasonal precipitation amounts on the Sea of Japan side of northern Japan were significantly above normal due to an active rain front. Those on the Pacific side of western Japan and in Okinawa/Amami were also significantly above normal (the highest since 1946 in Okinawa/Amami) due to heavy rainfall brought by typhoons and the active Baiu front.

(d) Autumn (September – November)

Seasonal mean temperatures in northern and eastern Japan were above normal as high-pressure systems expanded to the east of the country, and the likelihood of effects from cold-air masses from high latitudes was reduced. Seasonal precipitation amounts were above normal in eastern/western Japan and Okinawa/Amami due to an active rain front and typhoons. In early September, the intense Typhoon Jebi (T1821) made landfall on western Japan and moved northward. In addition, Typhoon Trami (T1824) made landfall on western Japan after approaching Okinawa and moved over eastern/northern parts of the country in late September. These two typhoons brought wind storms, heavy precipitation, storm surges and high waves nationwide.

(Hiroshi Ohno, Tokyo Climate Center)

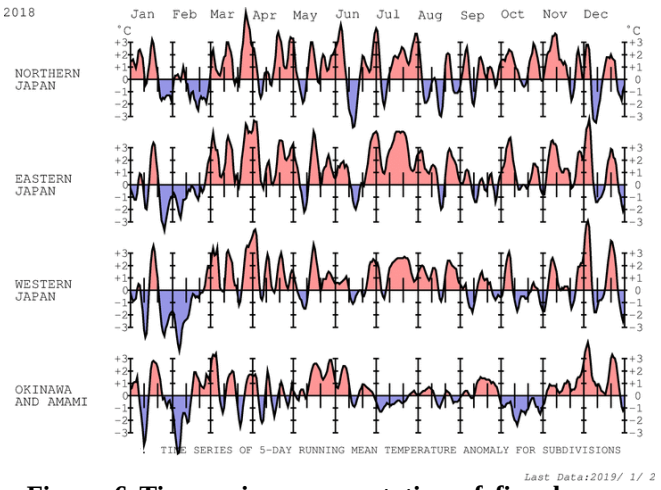

Figure 6 Time-series representation of five-day running mean temperature anomalies for subdivisions (January – December 2018)

The normal is the 1981 – 2010 average.

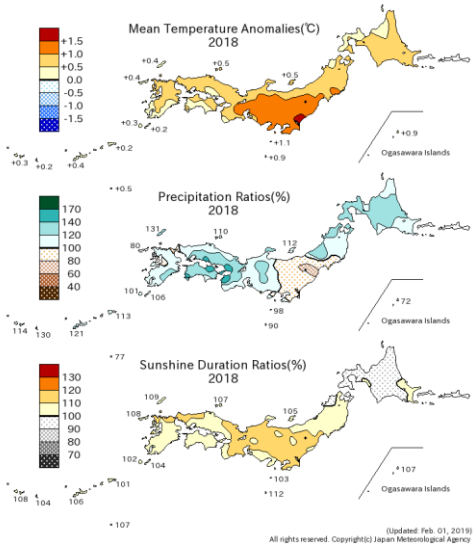

Figure 7 Annual climate anomalies/ratios for Japan in 2018

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TCC Activity Report for 2018

In 2018, 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, dispatching experts and hosting visitors.

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 Center (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).

From December 2017 to February 2018, a series of extreme cold spells hit Japan and its surrounding areas, and cold air consequently prevailed nationwide. Against this background, TCC issued a press release on primary factors causing the severe winter conditions affecting the nation. A total of three reports were issued in English and made available on the TCC website (https://ds.data.jma.go.jp/tcc/tcc/news/press_20180205.pdf, https://ds.data.jma.go.jp/tcc/tcc/news/press_20180223.pdf, https://ds.data.jma.go.jp/tcc/tcc/news/press_20180320.pdf).

In early July, Japan experienced significant rainfall particularly from western Japan to the Tokai region mainly (The Heavy Rain Event of July 2018), which caused widespread havoc nationwide. It was followed by heat wave that persisted over most of Japan in setting the highest temperature on record in late July. In this context, the Japan Meteorological Agency (with the help of the Tokyo Climate Center 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://ds.data.jma.go.jp/tcc/tcc/news/press_20180822.pdf) .

1.2 Questionnaire Survey regarding the Monthly Discussion on Seasonal Climate Outlook

TCC's Monthly Discussion on Seasonal Climate Outlook bulletin is mainly intended to assist NMHSs in the Asia-Pacific region in interpreting and assessing the World Meteorological Center Tokyo's products for three-month prediction and warm/cold season prediction and in understanding the current conditions of the climate system. As around four years have passed since the product's launch, TCC has conducted a questionnaire survey for improvement based on feedback from NMHS staff. Aggregate results will be made available once processing is complete for reflection toward enhancement of the bulletin.

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 a training seminar in each of its fiscal years (from April to March), and also held a seminar on one-month forecasts in November 2018. Details of the events are reported in TCC News No. 54.

2.2 Expert visits and other follow-up activities

TCC experts visited the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) in July, to hold a "TCC follow-up training seminar on Seasonal Forecasts and on the basic operation of TCC's Interactive Tool for Analysis of the Climate System (iTacs)". Discussions on future cooperation with PAGASA were also held (TCC News No. 53).

Other follow-up to previous TCC training seminars included hosting visiting experts at TCC and conducting teleconferences to provide technical support.

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 2018, TCC experts participated in the following RCOFs in Asia:

- Fourteenth session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II (FOCRA II-14) held in Nanning, China, from 24 to 26 April
- Twelfth session of the South Asian Climate Outlook Forum (SASCOF-12) held in Pune, India, from 18 to 20 April
- Thirteenth session of the South Asian Climate Outlook Forum (SASCOF-13) held in Colombo, Sri Lanka, from 26 to 28 September
- Sixth session of the East Asia winter Climate Outlook Forum (EASCOF-6) held in Seoul, the Republic of Korea, from 7 to 9 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.

A TCC expert also gave an online presentation of the Center's climate outlook at the 11th session of the ASEAN Climate Outlook Forum (ASEANCOF-11).

3.2 WMO international Workshop on Global Review of RCC Operations

In autumn 2018, TCC dispatched its RCC operations expert Akihiko Shimpo to the WMO International Workshop on Global Review of RCC Operations, held from 12 to 14 November 2018 in Pune, India. Mr. Shimpo attended the workshop and contributed to discussions on various aspects of RCC operations from regional and global-center viewpoints.

3.3 WMO RA II Working Group on Climate Services (WGCS)

In December, TCC head Yasushi Takatsuki and TCC expert Yasushi Mochizuki attended a meeting of the WMO RA II Working Group on Climate Services (WGCS) in Beijing, China, and engaged in discussions on the work of the WGCS with special focus on implementation of the Climate Services Information System (CSIS) on a regional level in RA II.

3.4 Other meetings

TCC expert Atsushi Minami attended the second WMO Workshop on Operational Climate Prediction held in Barcelona, Spain, from late May to early June. Mr. Minami presented TCC's various contributions in its mandated role as an RCC supporting the operational climate prediction work of NMHSs.

Mr. Takatsuki and Mr. Mochizuki attended the sixth session of the Management Committee of the Intergovernmental Board on Climate Services held in Rome, Italy, in October to contribute to the implementation and management of GFCS.

In March 2018, former TCC head Kiyotoshi Takahashi attended the Scoping Meeting on the Implementation of Third Pole Regional Climate Centre Network (TPRCC-N) in Geneva, Switzerland, to consider needs and capabilities relating to RCC operations in the Third Pole region. In December 2018, TCC head Yasushi Takatsuki attended an implementation planning meeting of the TPRCC-N in Beijing, China, to help develop a detailed implementation plan for the establishment of the network.

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 2018, TCC News No. 51 – 54 were issued and made available on the TCC website.

The Japan Meteorological Agency's annual Climate Change Monitoring Report 2017 is also available on the TCC website.

5. Staff changes

Kiyotoshi Takahashi, who served as the head of TCC in 2016, transferred to work as the director of the Narita Aviation Weather Service Center on 1st April 2018. He was succeeded by Yasushi Takatsuki, who previously worked on the coordination of activities regarding climate change and global warming.

6. Plans for 2019

- 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

A new web-based app designed to support the generation of one-month forecast guidance information will be launched in the first half of 2019. This handy resource was trialed at the previously reported training seminar in 2018, and the valuable feedback received from trainees was considered for further improvement ahead of its release. TCC also plans the imminent provision of new information and products based on the Standardized Precipitation Index (SPI) for better monitoring of droughts worldwide.

Further related efforts include investigation of teleconnection indices (e.g., the Arctic Oscillation Index) to enhance monitoring of atmospheric circulation with the use of the JRA-55 long-term reanalysis dataset. TCC plans to publish the investigation results and the indices on its website as soon as material is ready.

- 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.

(Yasushi Mochizuki, Tokyo Climate Center)

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TCC contributions to WMO RCC Review Workshop

The WMO International Workshop on Global Review of Regional Climate Centre (RCC) Operations was held from 12 to 14 November 2018 in Pune, India. Its purposes were to provide a platform for a review of operations, methodologies, products/services and institutional arrangements of all existing RCCs and RCC-networks, to identify related deficiencies and requirements, to propose ways for smooth future-oriented operations and sustainable development of RCCs, and to promote sustained uptake of relevant services and products by NMHSs. More than 30 experts from RCCs and other international organizations around the world attended, with one TCC expert contributing to discussions on aspects of RCC operations from the viewpoint of lessons learnt from TCC activities over the decade or so since its designation in 2009. The meeting materials are available on the website (http://www.wmo.int/pages/prog/wcp/wcasp/meetings/global_rcc_review_2018.php). The outcomes and recommendations of the event are expected to help RCCs and RCC-networks improve implementation in the field.

(Akihiko Shimpo, Tokyo Climate Center)

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You can also find the latest newsletter from Japan International Cooperation Agency (JICA).
JICA's World (January 2019)
https://www.jica.go.jp/english/publications/j-world/1901.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 "The New JICA Story 10 Years and Beyond Leading the world with trust".

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: Yasushi Takatsuki, Yasushi Mochizuki and Atsushi Minami)

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