Tokyo Climate Center, Japan Meteorological Agency

TCC News

Spring 2024

Table of Contents: TCC News No. 76

Pilot Launch of Seasonal Tropical Cyclone Forecast Products

In its role as a WMO Regional Climate Center, the Tokyo Climate Center (TCC) has started providing products for seasonal forecasting of tropical cyclones reaching tropical storm* intensity or higher for the western North Pacific to support WMO Members in the Asia/Pacific region. Registered users within National Meteorological and Hydrological Services (NMHSs) can access these products via the TCC website.

* Defined as a tropical cyclone with a maximum sustained wind speed of 34 knots or more and less than 48 knots.

The data consist of numerical outputs based on JMA’s seasonal ensemble prediction system. The following parameters are provided for the selected period and area:

- Number of Tropical Cyclones (Figure 1-1)
- Tropical Cyclone Frequency
- Accumulated Cyclone Energy

Forecasts are updated around the 20th of each month from May to August. For user convenience, 30-year (1991 – 2020) hindcast (i.e., retrospective forecast) verification results (Figure 1-2) are provided in addition to an algorithm description.

The products are currently in the pilot phase, and do not include TCC forecaster commentary. Access is exclusive to appropriately trained NMHS experts, and can be requested via the application page (linked to on the TCC website).

These products are intended to support NMHS in considering their seasonal forecasts. User feedback toward product improvement is welcomed.

(UESAWA Daisaku, Tokyo Climate Center)

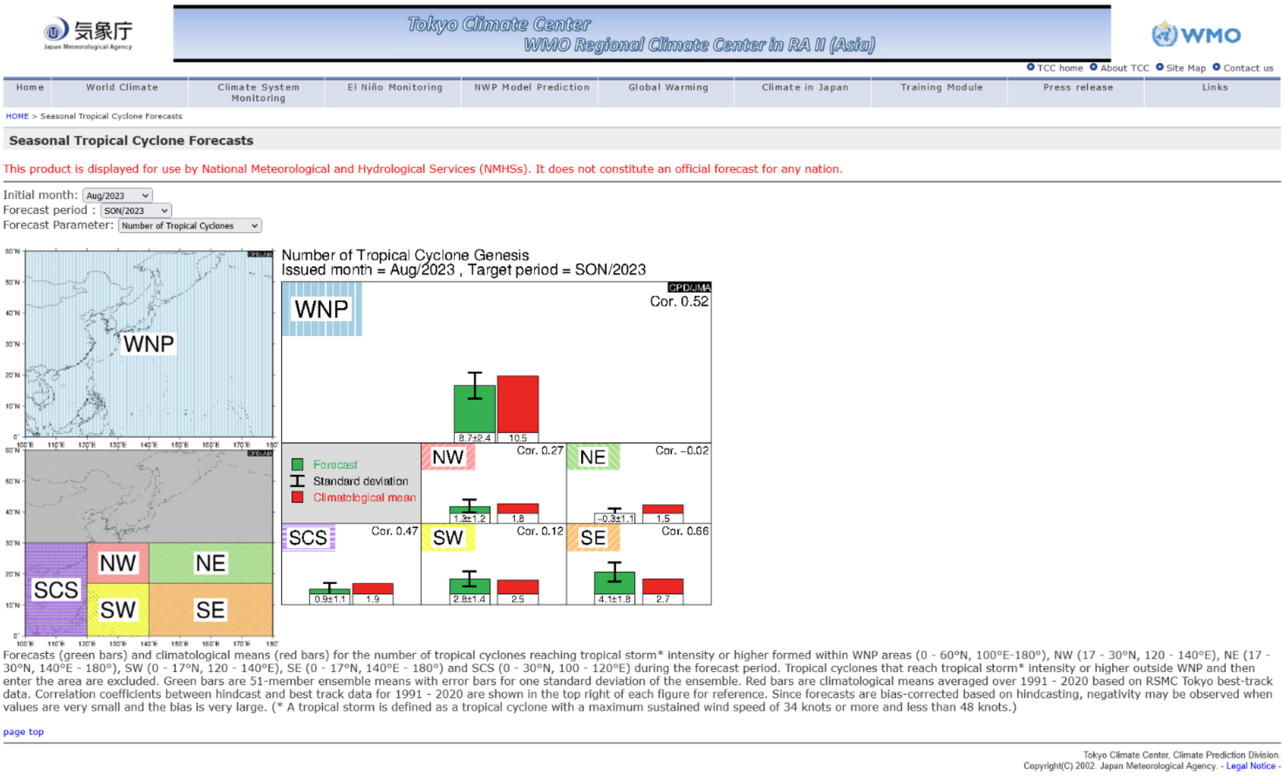


Figure 1-1 Seasonal forecast of tropical cyclone numbers

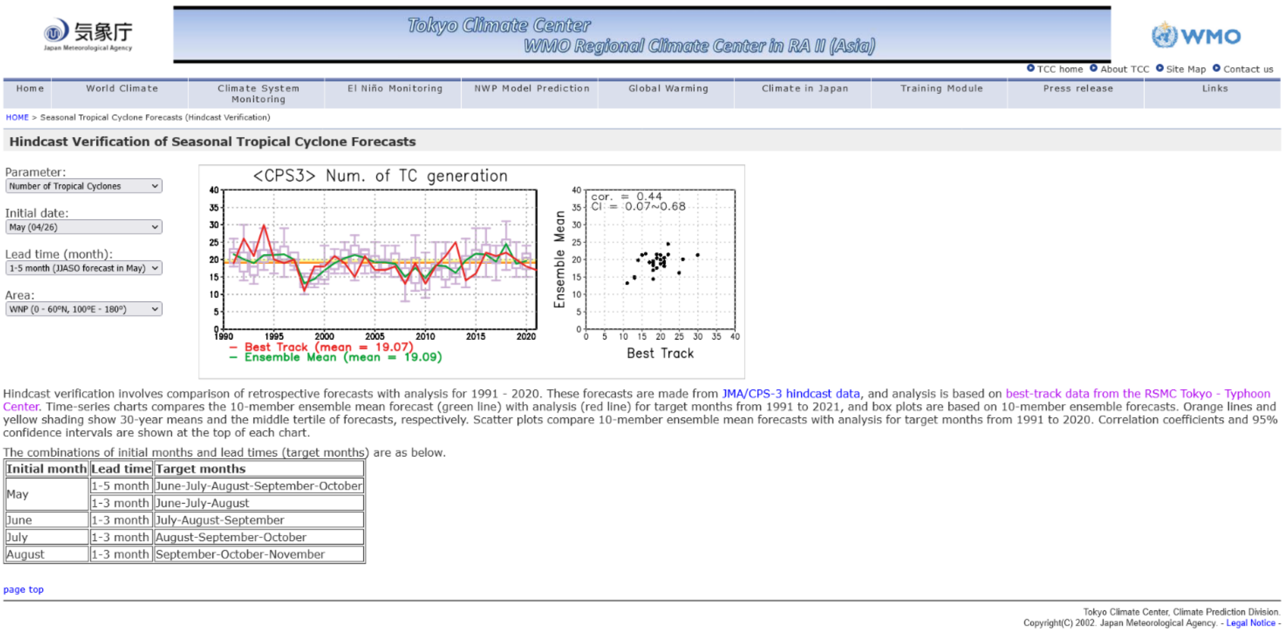


Figure 1-2 30-year (1991 – 2020) hindcast verification of seasonal forecasts for tropical cyclone numbers

[<<Table of contents](#) [<Top of this article](#)

JMA's Seasonal Numerical Ensemble Prediction for Boreal Summer 2024

This report outlines JMA's dynamical seasonal ensemble prediction for boreal summer 2024 (June – August, referred to as JJA), which was used as a basis for JMA's operational three-month outlook issued on 21 May 2024. The outlook is based on the seasonal ensemble prediction system of the Coupled Atmosphere-ocean General Circulation Model (CGCM).

Summary: Based on JMA's seasonal ensemble prediction system, it is more likely that La Niña conditions will develop by boreal autumn (60%) than ENSO-neutral conditions will continue (40%). In association with above-normal sea surface temperatures (SSTs) in the Indian Ocean, enhanced convection is expected from the western Indian Ocean to the Bay of Bengal. In the lower troposphere, anti-cyclonic circulation anomalies straddling the equator are expected from the eastern Indian Ocean to the western Pacific.

1. Sea surface temperatures

Figure 2-1 shows predicted SSTs (contours) and related anomalies (shading) for JJA. Negative anomalies are expected from the eastern to the central equatorial Pacific. Subsurface cold anomalies observed in these areas are expected to propagate eastward and reduce SSTs in the eastern part in boreal summer; however, there are large uncertainties regarding the degree to which this will affect NINO.3 SSTs. JMA's seasonal ensemble prediction system indicates that NINO.3 SSTs will fall below normal in boreal summer. In conclusion, it is more likely that La Niña conditions will develop by boreal autumn (60%) than ENSO-neutral conditions will continue (40%). In the western tropical Pacific, positive anomalies are expected in boreal summer. In the tropical Indian Ocean, positive anomalies in central and western parts and negative anomalies in eastern parts are expected in boreal summer.

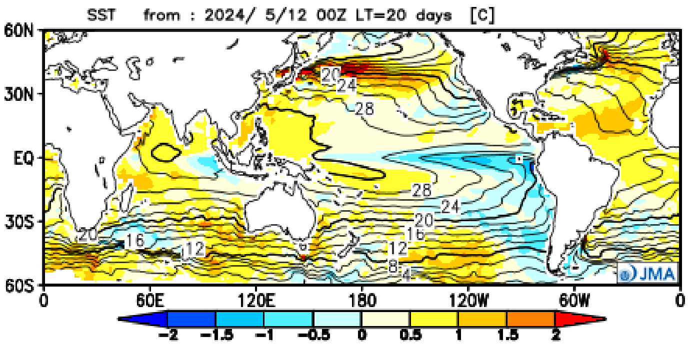


Figure 2-1 Predicted SSTs (contours) and SST anomalies (shading) for June–August 2024 (ensemble mean of 51 members)

2. Prediction for the tropics and sub-tropics

Figure 2-2 (a) shows predicted precipitation (contours) and related anomalies (shading) for JJA. Above-normal precipitation is expected from the western Indian Ocean to the Bay of Bengal and near the Maritime Continent, and below-normal precipitation is expected over the equatorial eastern Indian Ocean, the equatorial Pacific and around the Philippines.

Figure 2-2 (b) shows predicted velocity potential (contours) and related anomalies (shading) in the upper troposphere for JJA. In association with the precipitation anomalies described above, negative (i.e., large-scale divergent) anomalies are expected from the Atlantic to the central Indian Ocean, while positive (large-scale convergence) anomalies are expected over the Pacific.

Figure 2-2 (c) shows predicted stream functions (contours) and related anomalies (shading) in the upper troposphere for JJA. Anti-cyclonic circulation anomalies (i.e., positive in the Northern Hemisphere) straddling the equator are expected from the eastern tropical Pacific to the Atlantic. Cyclonic circulation anomalies are expected over Eurasia, implying a potential southward shift of the subtropical jet.

Figure 2-2 (d) shows predicted stream functions (contours) and related anomalies (shading) in the lower troposphere for JJA. Anti-cyclonic circulation anomalies straddling the equator are expected from the eastern Indian Ocean to the western Pacific.

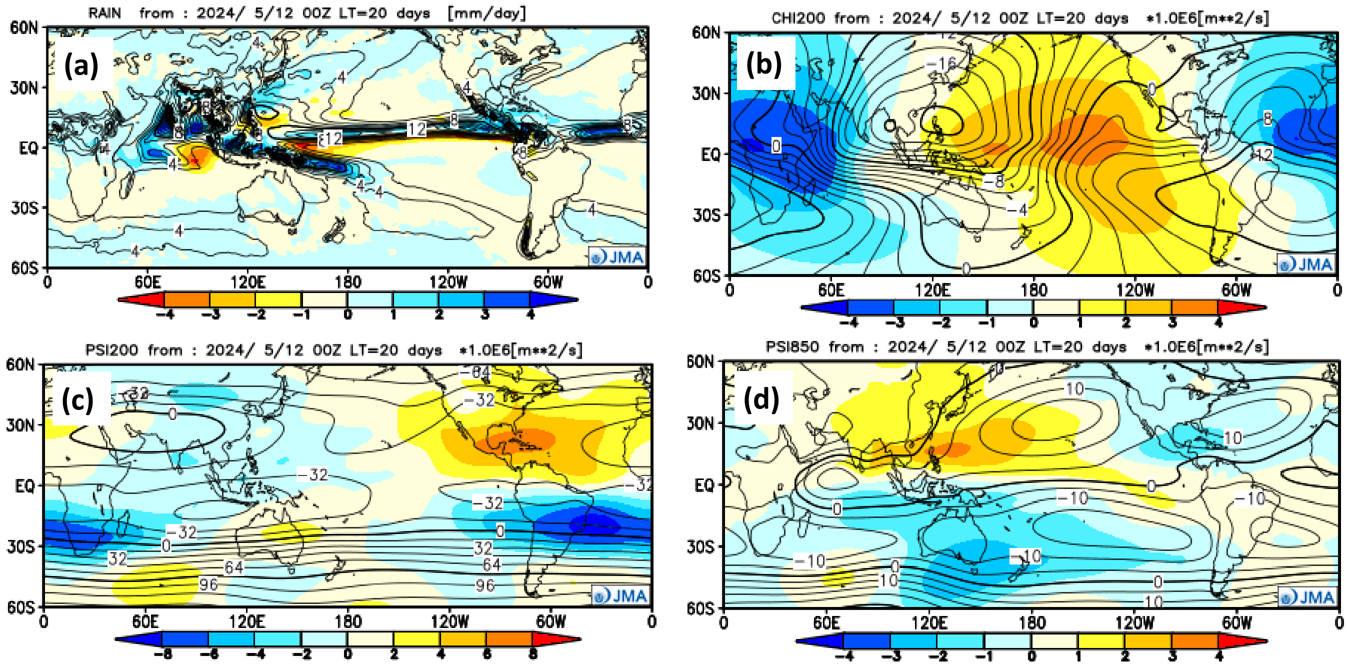


Figure 2-2 Predicted atmospheric fields over 60°N-60°S for June–August 2024 (ensemble mean of 51 members)
(a) Precipitation (contours) and anomaly (shading). The contour interval is 2 mm/day. (b) Velocity potential at 200-hPa (contours) and anomaly (shading). The contour interval is 2×10^6 m^2/s. (c) Stream function at 200-hPa (contours) and anomaly (shading). The contour interval is 16×10^6 m^2/s. (d) Stream function at 850-hPa (contours) and anomaly (shading). The contour interval is 5×10^6 m^2/s.

3. Prediction for the mid- and high- latitudes of the Northern Hemisphere

Figure 2-3 (a) shows predicted 500-hPa geopotential heights (contours) and related anomalies (shading) for JJA. Anomalies are expected to be positive over wide areas of the Northern Hemisphere and relatively small over mid-latitude Eurasia in association with southward shifting of the subtropical jet.

Figure 2-3 (b) shows predicted sea level pressure (contours) and related anomalies (shading) for JJA. Positive anomalies are expected over the subtropical western North Pacific in association with westward extension of the North Pacific Subtropical High. Negative anomalies are expected over the mid-latitudes from East Asia to the North Pacific.

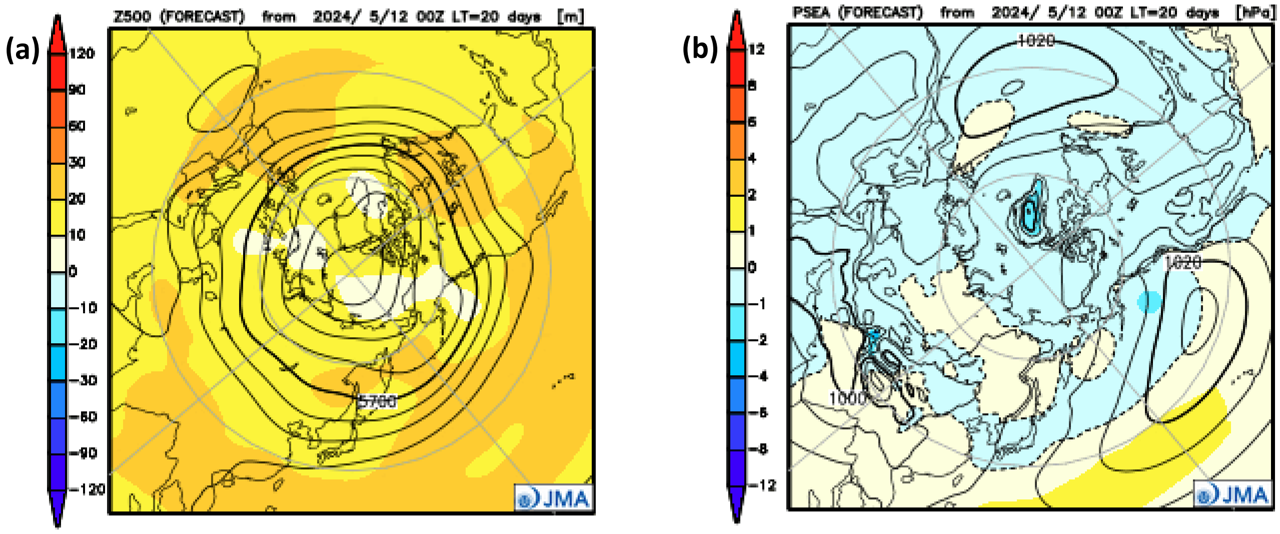


Figure 2-3 Predicted atmospheric fields over 20°N-90°N for June–August 2024 (ensemble mean of 51 members)
(a) Geopotential height at 500-hPa (contours) and anomaly (shading). The contour interval is 60 m. (b) Sea level pressure (contours) and anomaly (shading). The contour interval is 4 hPa.

Note: JMA operates a seasonal Ensemble Prediction System (EPS) using the Coupled atmosphere-ocean General Circulation Model (CGCM) to make seasonal predictions beyond a one-month time range. The EPS produces perturbed initial conditions by means of a combination of the initial perturbation method and the lagged average forecasting (LAF) method. Prediction is made using 51 members from the latest 17 initial dates (3 members are used every day). Details of the prediction system and verification maps based on 30-year hindcast experiments (1991–2020) are available at https://ds.data.jma.go.jp/tcc/tcc/products/model/.

(NAKAMIGAWA Hiroshi, Tokyo Climate Center)

<<Table of contents <Top of this article

Summary of the 2023/2024 Asian Winter Monsoon

This report summarizes the characteristics of the surface climate and atmospheric/oceanographic conditions related to the Asian winter monsoon for 2023/2024.

Note: Dataset of the Japanese Reanalysis for Three Quarters of a century (JRA-3Q) (Kosaka et al. 2024) and MGDSST (Kurihara et al. 2006) were used to analyze atmospheric circulation and sea surface temperature (SST). NOAA Climate Prediction Center (CPC) Blended Outgoing Longwave Radiation (OLR) data provided by the U.S. NOAA Physical Sciences Laboratory (PSL) from their web site at https://psl.noaa.gov/data/gridded/data.cpc_blended_olr-2.5deg.html was used to infer tropical convective activity. The base period for the normal is 1991 to 2020. The term "anomaly" as used in this report refers to deviation from the normal.

1. Surface climate conditions

In winter 2023/2024, three-month (DJF) mean temperatures were well above normal over a wide area from Japan to Southeast Asia and below normal from Eastern Siberia to northern East Asia (Figure 3-1 (a)). This indicates that the East Asian Winter Monsoon (EAWM) was generally weaker than normal from eastern to southern East Asia.

However, notable monthly temperature variations were also observed. While warm anomalies were seen over most of East Asia in January, cold anomalies in December and February are suggestive of cold spells (Figures 3-1 (b) and (d)). Winter precipitation amounts were above normal in most parts of mid-latitude Eurasia (Figure 3-2).

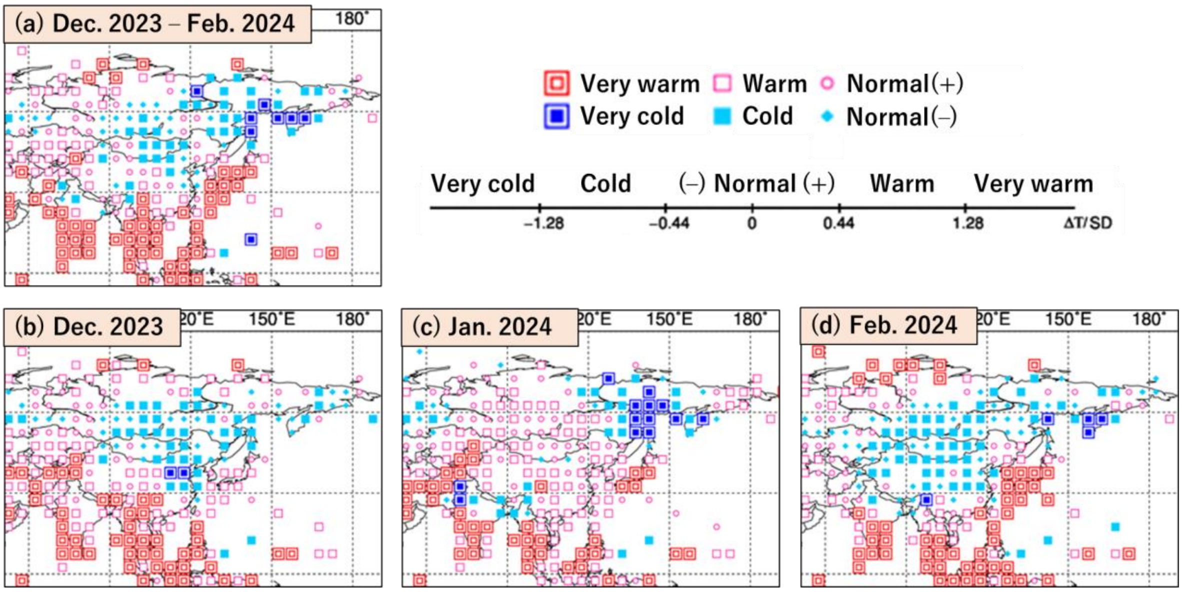


Figure 3-1 Temperature anomalies for (a) December 2023 to February 2024, (b) December 2024, (c) January 2024 and (d) February 2024

Categories are defined by the three-month/monthly 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. Standard deviations were calculated from 1991 – 2020 statistics. Areas over land without graphical marks are those where observation data are insufficient or where normal data are unavailable.

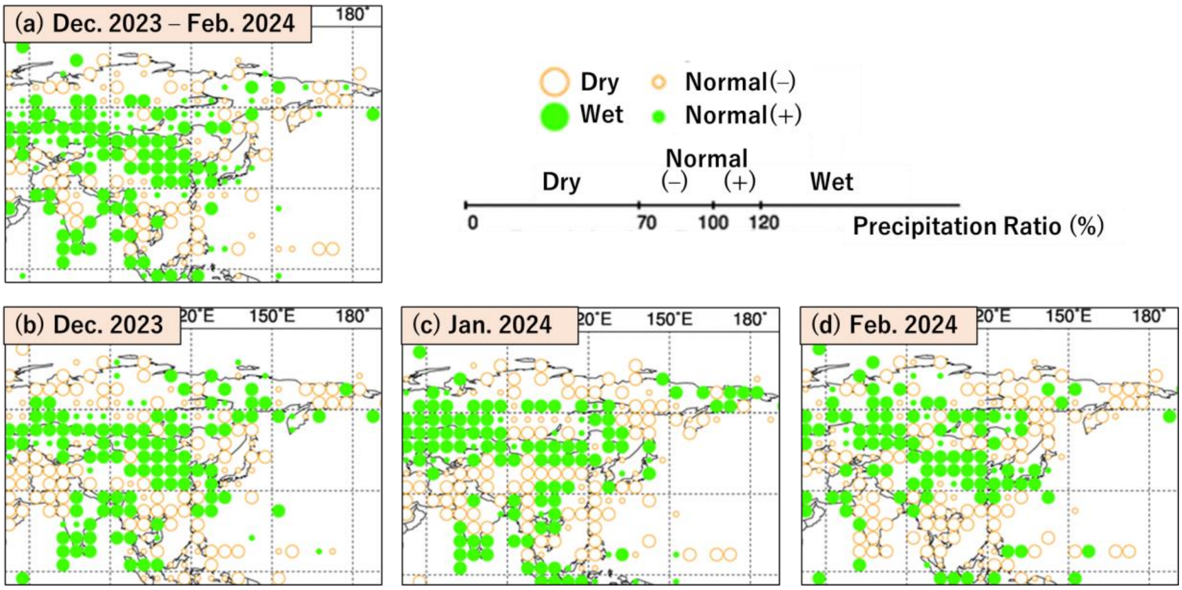


Figure 3-2 Precipitation ratio for (a) December 2023 to February 2024, (b) December 2023, (c) January 2024 and (d) February 2024

Categories are defined by the three-month/monthly precipitation ratio against the normal and averaged in 5° × 5° grid boxes. The thresholds of each category are 70, 100 and 120%. Areas over land without graphical marks are those where observation data are insufficient or where normal data are unavailable.

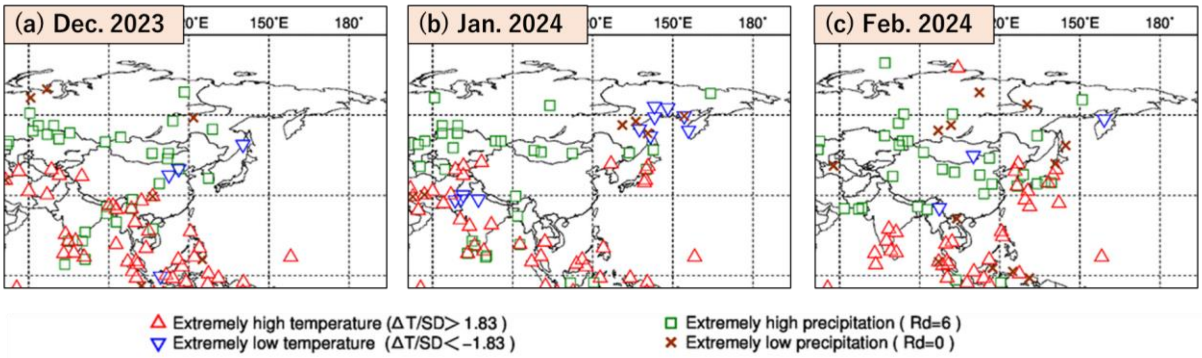


Figure 3-3 Extreme climate stations for (a) December 2023, (b) January 2024 and (c) February 2024

ΔT, SD and Rd indicate temperature anomaly, standard deviation and quintile, respectively.

Figure 3-3 plots stations where extreme climatic conditions were observed between December 2023 and February 2024. Extremely high temperatures were recorded from southwestern China to Southeast Asia in December (Figure 3-3 (a)) and from Japan to Southeast Asia in February (Figure 3-3 (c)). Extremely low temperatures were observed in the southern part of Eastern Siberia in January (Figure 3-3 (b)), and extremely high precipitation amounts were seen in mid-latitude areas from Central to East Asia from December to February (Figure 3-3).

2. Characteristic atmospheric circulation and oceanographic conditions

This section presents characteristics of atmospheric circulation and oceanographic conditions averaged in winter 2023/2024.

2.1 Conditions in the tropics

Figure 3-4 shows three-month mean sea surface temperature (SST) anomalies and anomalous convective activity for winter 2023/2024. Although SST anomalies were generally positive in tropical regions from the Indian Ocean to the Pacific, a tripolar pattern was observed with remarkably warm anomalies from the central to the eastern equatorial Pacific and the tropical western Indian Ocean, and relatively weak warm anomalies around the Maritime Continent (Figure 3-4 (a)). This tripolar SST anomaly pattern is associated with mature El Niño conditions and is a remnant of the positive Indian Ocean Dipole (IOD) event observed in the preceding summer – autumn period. Convective activity inferred from OLR was enhanced in the central equatorial Pacific and the western tropical Indian Ocean, and suppressed over and around the Maritime Continent (Figure 3-4 (b)), corresponding to the aforementioned tripolar SST anomaly pattern. In the upper troposphere, large-scale divergence anomalies were dominant around the equatorial date line in the Pacific and in the tropical western Indian Ocean, and large-scale convergence anomalies were seen over and around the Maritime Continent (Figure 3-4 (b)).

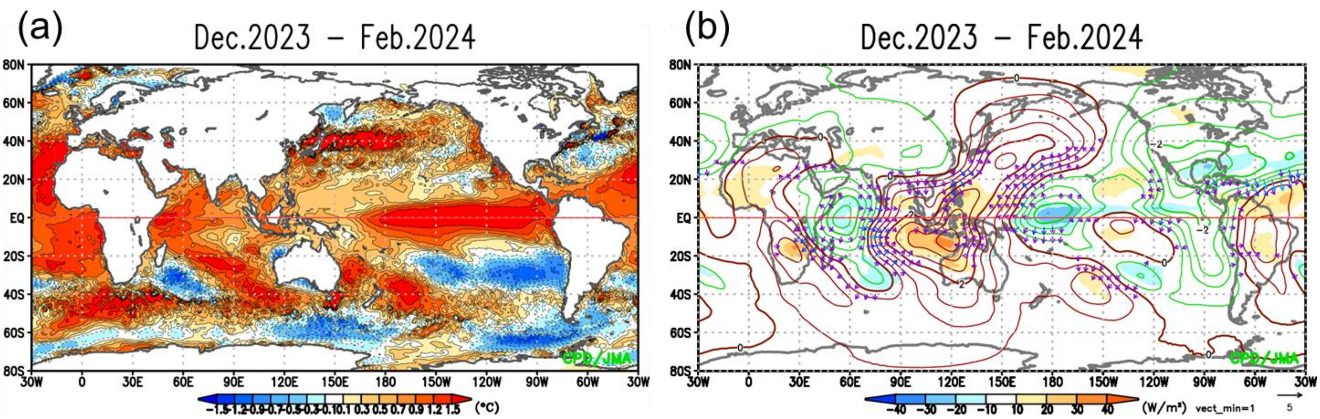


Figure 3-4 Three-month mean (a) SST anomalies and (b) anomalous convective activity in winter 2023/2024

The shadings in (a) and (b) show the SST anomalies [°C] and OLR anomalies [W/m^2]. The contours and vectors in (b) indicate 200-hPa velocity potential anomalies at intervals of 0.5 × 10^6 m^2/s and divergent wind anomalies, respectively. Negative (cold color) and positive (warm color) OLR anomalies show enhanced and suppressed convective activity compared to the normal, respectively.

Figure 3-5 shows three-month mean 200 and 850-hPa stream function anomalies for winter 2023/2024. In the upper troposphere, a wave train of anomalies was seen from western Europe to Japan via southern Eurasia, with anti-cyclonic circulation anomalies in the northwestern Indian Ocean/over Japan and cyclonic anomalies over southern China (Figure 3-5 (a)). Those over Japan corresponded to a northward meandering of the subtropical jet stream (STJ), which was conducive to a weaker-than-normal EAWM (Figure 3-1 (a)). These wavy anomalies are indicative of Rossby wave propagation along the STJ over Eurasia, which was partly induced by cumulus convection anomalies from the tropical Indian Ocean to the Pacific (Figure 3-4 (b)), as evidenced by a numerical experiment (not shown) using a linear baroclinic model (Watanabe and Kimoto 2000, 2001). In the central tropical Pacific, anti-cyclonic circulation anomalies straddling the equator were seen in response to enhanced cumulus convection in the central equatorial Pacific (Figure 3-5 (a)). In the lower troposphere, anti-circulation anomalies straddling the equator were seen in the area from the central Indian Ocean to the Maritime Continent (Figure 3-5 (b)).

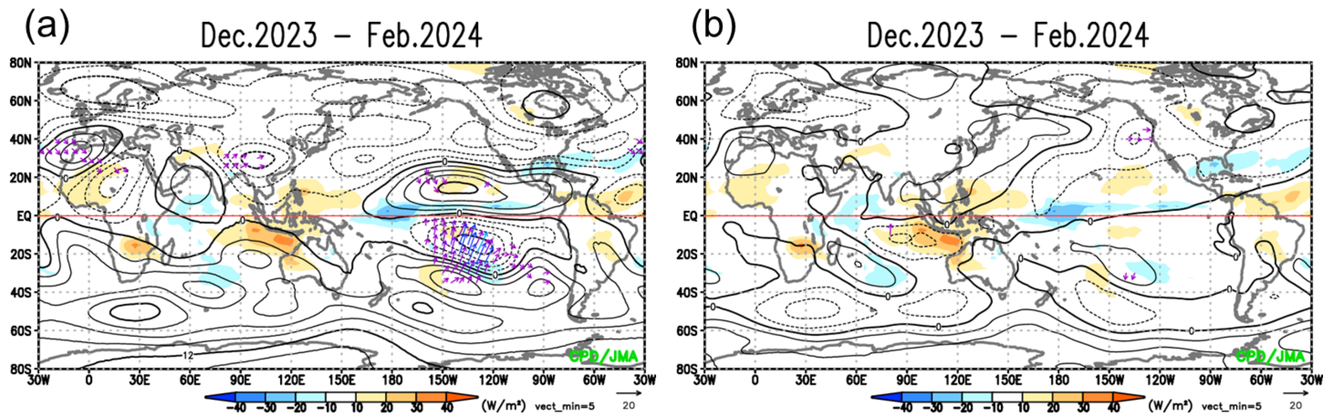


Figure 3-5 Three-month mean (a) 200-hPa and (b) 850-hPa stream function anomalies in winter 2023/2024

The contours indicate stream function anomalies at intervals of (a) 3 × 10^6 m^2/s and (b) 1.5 × 10^6 m^2/s, and the shadings show OLR anomalies [W/m^2]. The vectors denote horizontal component of wave activity flux [m^2/s^2] defined by Takaya and Nakamura (2001).

2.2 Conditions in the extratropics

Figure 3-6 shows three-month mean 500-hPa height, sea level pressure and 850-hPa temperature for winter 2023/2024 in the Northern Hemisphere. In the 500-hPa height field (Figure 3-6 (a)), the tropospheric polar vortex (typically located over the Arctic region) split in association with positive anomalies over the Arctic region and negative anomalies over Europe and the area from Eastern Siberia to Alaska. Significantly positive anomalies were also seen from Japan to the south of the Aleutian Islands. These conditions correspond to a clear polar front jet stream(PFJ) stretching from Eurasia to the north of Japan, which generally hindered southward flow of cold air masses to East Asia and led to a weaker-than-normal EAWM (Figure 3-1 (a)). In the sea pressure level (SLP) field, the Siberian High was stronger than normal in its northeastern part. The Aleutian Low was stronger than normal in its northeastern part and weaker than normal in its southwestern part (Figure 3-6 (b)). Lower-level temperatures were above normal in and around Japan (Figure 3-6 (c)) in association with the positive 500-hPa height and SLP anomalies described above.

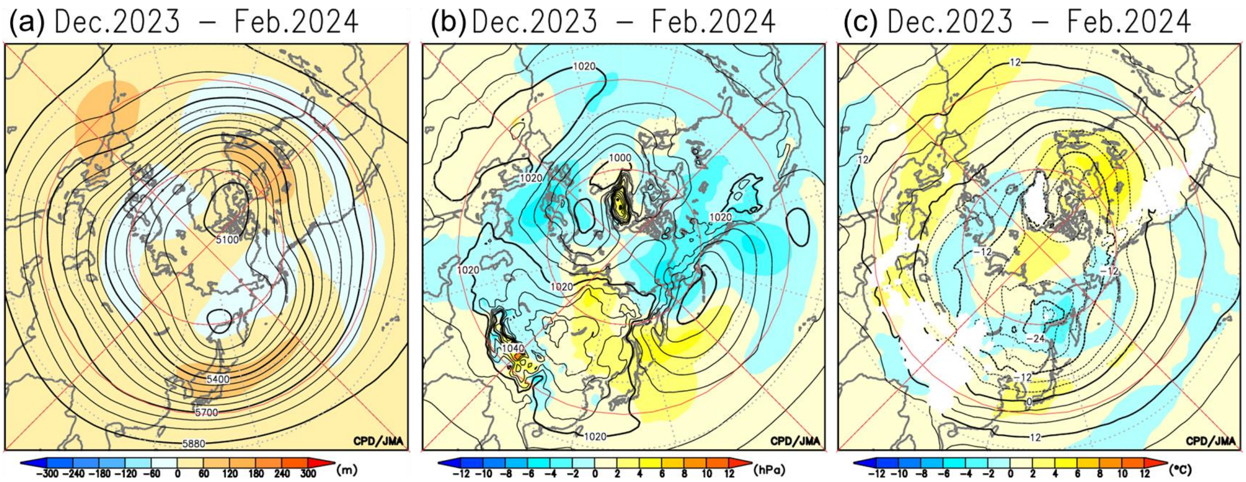


Figure 3-6 Three-month mean (a) 500-hPa height, (b) sea level pressure, and (c) 850-hPa temperature in winter 2023/2024

The contour intervals are (a) 60 m, (b) 4 hPa, and (c) 4 °C. The shading denotes related anomalies.

2.3 Intra-seasonal variations

Another notable characteristic of the EAWM in 2023/2024 was large intra-seasonal temperature variations, as partially manifested in monthly temperature anomalies (Figure 3-1). Several cold spells hit East Asia during the winter. For example, in the second half of December, the PFJ over Eurasia exhibited a large meandering structure, reinforcing an upper-level trough over East Asia (Figure 3-7 (a)). This temporarily brought intense cold air masses from Siberia to a wide area of East Asia (Figure 3-7 (b)). Figure 3-7 (c) indicates that the STJ over southern Eurasia exhibited an undulating structure with a southward meander over East Asia, which also facilitated the southward flow of cold air to the region. Conversely, extremely warm conditions were observed in association with wavy STJ and PFJ conditions over Eurasia as per those seen during the cold spell (Figures 3-7 (a) – (c)), except with a generally reversed geographical phase (Figures 3-7 (d) – (f)).

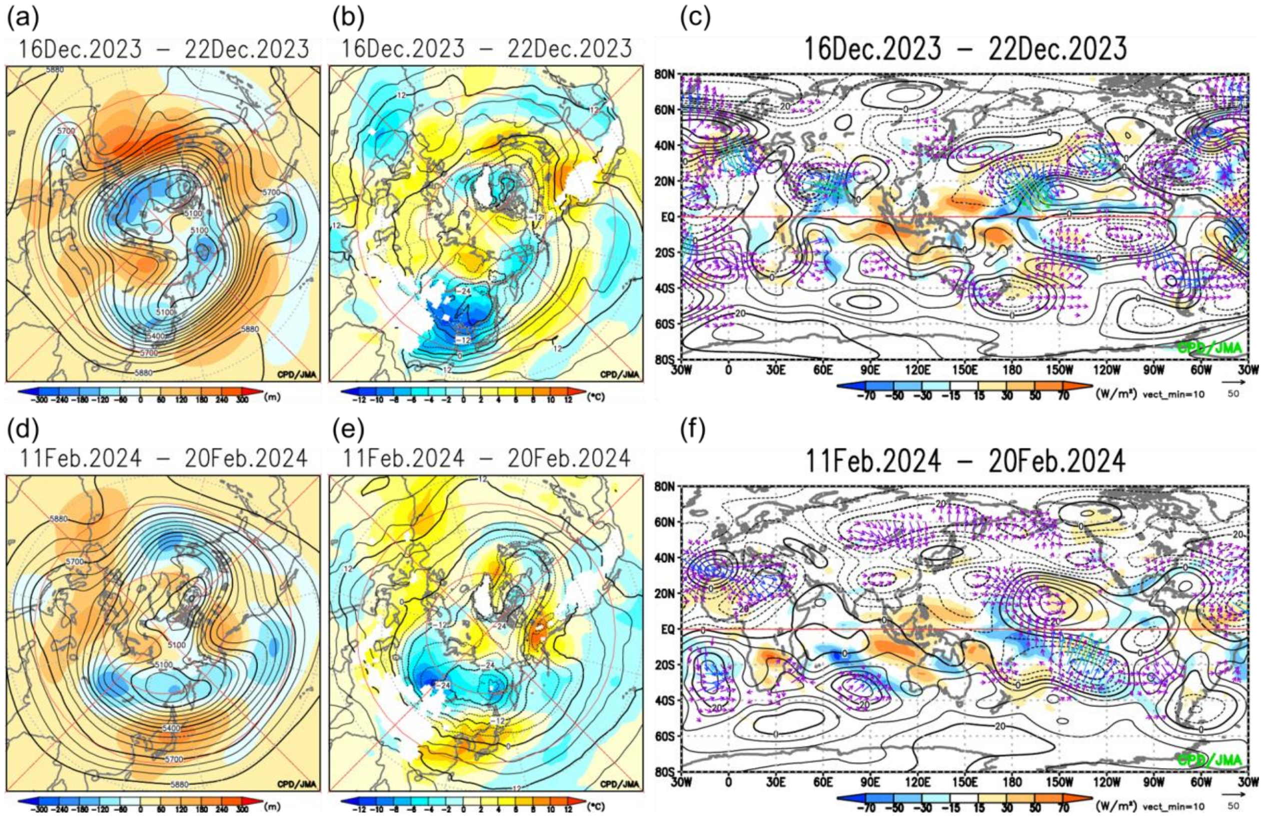


Figure 3-7 (a, d) 500-hPa height and (b, e) 850-hPa temperature, and (c, f) 200-hPa stream function anomalies averaged (a-c) from 16th to 22nd December 2023 and (d-f) 11th to 20th February 2024.

(a, d) and (b, e): The contour intervals are (a, d) 60 m and (b, e) 4 °C. The shading denotes related anomalies. (c, f): The contours indicate stream function anomalies at intervals of 3 × 10^6 m^2/s, and the shadings show OLR anomalies [W/m^2]. The vectors denote horizontal component of wave activity flux [m^2/s^2] defined by Takaya and Nakamura (2001).

(SATO Hirotaka, Tokyo Climate Center)

References

Kurihara, Y., T. Sakurai, and T. Kuragano, 2006: Global daily sea surface temperature analysis using data from satellite microwave radiometer, satellite infrared radiometer and in-situ observations. *Weather Service Bulletin*, **73**, Special issue, s1-s18 (in Japanese).

Kosaka, Y., S. Kobayashi, Y. Harada, C. Kobayashi, H. Naoe, K. Yoshimoto, M. Harada, N. Goto, J. Chiba, K. Miyaoka, R. Sekiguchi, M. Deushi, H. Kamahori, T. Nakaegawa; T. Y. Tanaka, T. Tokuhiro, Y. Sato, Y. Matsushita, and K. Onogi, 2024: The JRA-3Q reanalysis. *J. Meteor. Soc. Japan*, **102**, 49-109. https://doi.org/10.2151/jmsj.2024-004

Takaya, K., and H. Nakamura, 2001: A formulation of a phase-independent wave-activity flux for stationary and migratory quasigeostrophic eddies on a zonally varying basic flow, *J. Atom. Sci.*, **58**, 608–627.

Watanabe, M., and M. Kimoto, 2000: Atmospheric-ocean thermal coupling in the North Atlantic: A positive feedback. *Quart. J. Roy. Meteor. Soc.*, **126**, 3343–3369.

Watanabe, M., and M. Kimoto, 2001: Corrigendum. *Quart. J. Roy. Meteor. Soc.*, **127**, 733–734.

<<Table of contents <Top of this article

TCC and WMC Tokyo co-contributions to Regional Climate Outlook Forums in Asia

WMO Regional Climate Outlook Forums (RCOFs) bring together national, regional and international climate experts on an operational basis to produce regional climate outlooks based on inputs from participating NMHSs, regional institutions, Regional Climate Centres (RCCs) and global producers of climate predictions. By providing a platform for countries with similar climatological characteristics to discuss related matters, these forums ensure consistency in terms of access to and interpretation of climate information. In spring 2024, TCC experts participated in the following two RCOFs in Asia.

- The 28th summer session of the South Asian Climate Outlook Forum (SASCOF-28)
- The 20th session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II (FOCRA II)

1. SASCOF-28

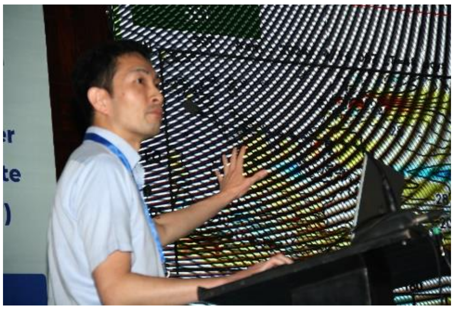
RCC Pune hosted the 28th summer session of the South Asian Climate Outlook Forum (SASCOF-28) and Climate Services User Forum (CSUF) from 29 April to 1 May 2024 in Pune, India.

South Asia is home to a quarter of the world's population but occupies only 3% of its land area, making it the most densely populated region anywhere. Its climate is largely dependent on the Southwest Monsoon. Approximately 70 – 80% of annual rainfall in most parts of the region occurs during the monsoon season (June – September), which has significant socio-economic effects on the region. The seasonal to inter-annual variability of monsoon rainfall, both in amount and distribution, often results in severe droughts or floods, with large-scale impacts on the agrarian sector in terms of production and food security. As there is a strong link between the effects of the summer monsoon and overall socio-economic conditions in South Asian countries, the region requires accurate, reliable and useful monsoon information and early warnings on related activity to support programs for sustainable economic growth.

As part of WMO World Meteorological Centre (WMC) and TCC joint activities (co-activities), JMA expert made the following two presentations. These presentations are expected to support the output of country-scale outlooks by National Meteorological and Hydrological Services (NMHSs) in the relevant regions.

- Summer monsoon season outlook based on JMA's operational seasonal ensemble prediction system (JMA/MRI-CPS3) with probabilistic information on oceanographic conditions from the Indian Ocean to the Pacific (El Niño southern oscillation, Indian Ocean Dipole, etc.) and associated atmospheric circulation patterns
- Recent joint activities involving WMC Tokyo and TCC roles, such as the launch of the Japanese Reanalysis for Three Quarters of a Century (JRA-3Q) and renewal of climate system monitoring products and statistical materials based on JRA-3Q.

SASCOF-28 issued a climate outlook for the 2024 summer monsoon season (June – September). The subsequent CSUF session focused on interfacing with users from the water, agriculture, disaster risk reduction and health sectors for interpretation and assessment of seasonal climate information and elucidation of specific needs toward the provision of further customized climate information.



At the SASCOF meeting

At the CSUF meeting

At the office of the Director General, India Meteorological Department

Group photo at the conference center

In front of the Indian Meteorological Department, Pune

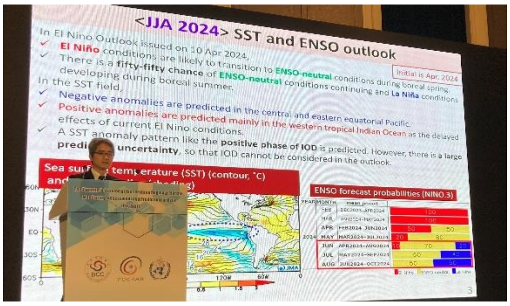
2. FOCRA II

The 20th Session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Asia (FOCRA II) was held from 9 to 11 May 2024 in Qingdao, Shandong, China. This landmark anniversary occasion drew more than 100 representatives from the WMO Secretariat and 24 countries and territories, including China, the United Kingdom, Japan and the Republic of Korea. Attendees shared recent research results and discussed climate service development, new technologies and applications such as AI, and climate projection and seasonal climate prediction.

JMA representatives gave three presentations on the following and led discussions in a chairing role:

- Recent WMC Tokyo/TCC activities, including updates to JMA's seasonal ensemble prediction system (JMA/MRI-CPS3), launch of the Japanese Reanalysis for Three Quarters of a Century (JRA-3Q), and a startup plan for JMA seasonal tropical cyclone forecast.
- Climate monitoring diagnosis results for winter 2023/24 based on discussions by JMA's Advisory Panel on Extreme Climate Events
- Seasonal outlook for summer over Japan, including probabilistic forecasts, based on oceanographic conditions from the Indian Ocean to the Pacific and associated atmospheric circulation patterns predicted by JMA/MRI-CPS3

FOCRA II issued a consensus outlook for summer climate conditions in the RA II region after discussions in the summary session. Broad agreement was reached on enhancing collaboration between RCCs and NMHSs toward the production of enhanced climate information for RA II.



Presentation at FOCRA II

Discussions at FOCRA II

Group photo and 20th anniversary cake, FOCRA II

(SASCOF-28: TAKEMURA Kazuto, FOCRA II: SUGIMOTO Hiroyuki and NAKAMURA Tetsu, Tokyo Climate Center)

<<Table of contents <Top of this article

TCC contributions to the Report on the States of the Climate in Asia 2023

WMO's State of the Climate in Asia 2023 report (published on 23rd April 2024) summarizes climatic conditions and extreme weather events observed in 2023 and associated socio-economic impacts in the Asian region (RA II). The report is intended for widespread reference in various fields relating to climate change.

At the 80th session of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP-80), an online side-event was chaired by Ben Churchill, director of WMO's Regional Office for Asia and the South-West Pacific, to launch the report. Representatives from WMO, ESCAP, UNDRR, IMD, JMA gave presentations, with JMA summarizing its contribution to the report together with IMD.

The contributions of National Meteorological and Hydrological Services (NMHSs) and WMO Regional Climate Centers (RCCs) were essential in compiling the report. TCC again made a significant contribution with its drafting of input on regional temperatures/extreme events in RA II and tropical cyclones over the western North Pacific Ocean and the South China Sea. Ongoing collaboration among Members and RCCs in RA II is expected to support future reporting in this field for the Asian region.

URL: https://library.wmo.int/records/item/68890-state-of-the-climate-in-asia-2023

(TAKAHASHI Kiyotoshi, Tokyo Climate Center)

[<<Table of contents](#) [<Top of this article](#)

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.
Please e-mail to tcc@met.kishou.go.jp.
(Editors: HARADA Masashi, TAKAHASHI Kiyotoshi)

Tokyo Climate Center, Japan Meteorological Agency
3-6-9 Toranomon, Minato City, Tokyo 105-8431, Japan

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

[<<Table of contents](#)