WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

GLOBAL SEASONAL CLIMATE UPDATE

TARGET SEASON: March-April-May 2024

Issued: 20 February 2024

Summary

During November 2023 – January 2024, the Pacific Niño sea-surface temperature (SST) index in the eastern Pacific (Niño 1+2) was above-normal but declined with respect to the previous months. The other three indices in the central Pacific were also above-normal. The observed SST conditions in the equatorial Pacific were characterized by an El Niño state. The observed Indian Ocean Dipole (IOD) was also above-normal. Both the North Tropical Atlantic (NTA) and South Tropical Atlantic (STA) SST index was above-normal and reflected widespread warmth in the tropical Atlantic north of the equator.

Observed sea-surface temperatures in the central tropical Pacific were characterized by El Niño state during November 2023 – January 2024. Above-normal sea-surface temperature anomalies in the Niño 3.4 and Niño 3 regions are predicted to decline during March-May 2024, however, moderate El Niño conditions are still forecast. Farther west in the Niño 4 region, the sea-surface temperature anomaly is also predicted to be above-normal. The strength of the Indian Ocean Dipole (IOD) index is predicted to return to near normal. In the equatorial Atlantic, SSTs are predicted to be above-normal in both the northern (NTA) and the southern (STA) areas during the season.

Consistent with the anticipated continuation but weakening of El Niño in the equatorial central and eastern Pacific, together with the prediction of above-normal sea-surface temperatures over much of the global oceans, there is widespread prediction of above-normal temperatures over almost all land areas. Positive temperature anomalies are expected over almost the entire Northern Hemisphere except in the far south-eastern part of North America. The largest increases in probabilities for above-normal temperatures are generally south of 45° N over Europe, Africa, and Asia, and south of 25° N over Central America. Over much of North America south of 40° N, except for the south-east, probabilities for above-normal temperature are weakly enhanced, while the probability of above-normal temperature north of 40° N were moderate to strong. In the Caribbean and Central America, the probabilities of above-normal temperatures are strongly increased, and this area extends to 30° S over South America. Extending further south, probabilities for above-normal temperatures are weakly increased. Over most of the land areas in the Southern Hemisphere, temperatures are predicted to experience above-normal temperature anomalies, as in the Northern Hemisphere. Thus, in Africa south of the equator, including Madagascar and the south-west Indian Ocean north of about 30° S, above-normal temperatures are predicted with high probabilities. Over Australia and New Zealand above-normal temperatures are predicted with moderate to high probability. Along 20° S in the Pacific Ocean, east of the Dateline, there is a narrow band of predicted normal-to-below normal temperatures that expands southwards in the far south-eastern Pacific.

Predictions for rainfall are similar to some of the canonical impacts of El Niño, which is expected to continue but weaken in March-May 2024. Above-normal rainfall is predicted over a narrow band along or just north of the equator from 150° E extending eastward to the southern region of Central America crossing into the southern Caribbean where it extends north-eastward towards southern Europe and probabilities for above-normal rainfall are strongly enhanced. Immediately to the south and along the equator between 65° W and 110° W enhanced probability for normal rainfall is predicted. Across most of the Pacific Ocean immediately to the north of the wet band and to about 30° N, rainfall is predicted to be below-normal. This northern band of predicted below-normal rainfall extends from southeast Asia to the western coast of Central America. Also starting from 150° E and immediately below the equator, a narrow band of probability for above-normal rainfall extends westward to the eastern coast of Africa where it turns south-eastward and reaches to 30° S and 90° E. In the Southern Hemisphere, the area of below-normal rainfall stretches across northern and western Australia, where to the west it extends into the Indian Ocean while to the east extends to 110° W and model consistency, over this region, is generally high. Also, in the southern hemisphere oceans along 45° S there is a band with probability of above-normal rainfall. Over most of Asia except for most of the Indian subcontinent and Arabian Peninsula, and in eastern Europe there is a weak enhancement in the probability for above-normal rainfall and model consistency is weak to moderate. The probability for below-normal rainfall is enhanced south of 10° S over Africa. and on the eastern side of the continent, where it extends into oceans and over to Madagascar. Enhancement in the probability for above-normal rainfall is also predicted over the northeastern region of North America extending into the western Greenland. Also, over North America, there is an elongated region for the probability of above-normal rainfall that extends from the southeastern tip of the continent all the way to the northwest.

Surface Air Temperature, MAM 2024 **Rainfall, MAM 2024**

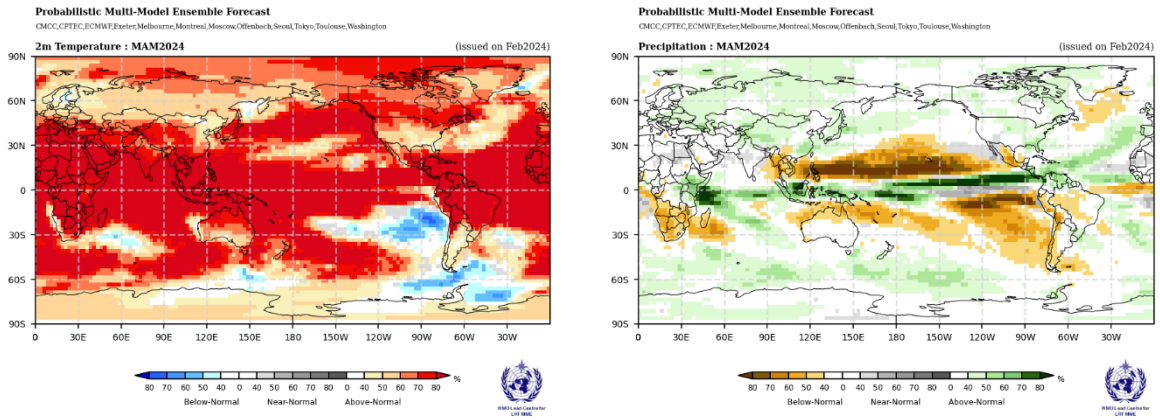


Figure 1. Probabilistic forecasts of surface air temperature and rainfall for the season March-May 2024. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal, and near-normal is depicted in blue, red, and grey shadings respectively for temperature, and orange, green and grey shadings respectively for rainfall. White areas indicate equal chances for all categories in both cases. The baseline period is 1993–2009.

1. Observations: November 2023 – January 2024

In the following sections, observed temperature and rainfall patterns for the previous season are discussed. For more detailed information about regional and local climate anomalies, the reader is referred to the concerned WMO Regional Climate Centres (RCCs) or RCC Networks, listed in Section 5.

1.1 Large-scale sea-surface temperature (SST) indices

During November 2023 – January 2024, the Pacific Niño sea-surface temperature (SST) index in the eastern Pacific (Niño 1+2) was above-normal but declined from its previous months. The other three indices in the central Pacific were also above-normal. The observed SST conditions in the equatorial Pacific were characterized by an El Niño state. The observed Indian Ocean Dipole (IOD) was also above-normal. Both the North Tropical Atlantic (NTA) and South Tropical Atlantic (STA) SST index was above-normal and reflected widespread warmth in the tropical Atlantic north of the equator.

Month	Niño 1+2	Niño 3	Niño 4	Niño 3.4	IOD	NTA	STA
November 2023	2.2	2.1	1.4	1.9	1.5	0.9	0.7
December 2023	1.4	2.1	1.4	2.0	1.2	1.0	1.2
January 2024	0.8	1.9	1.5	1.8	0.8	1.1	1.2
November 2023 - January 2024	1.5	2.0	1.4	1.9	1.2	1.0	1.0

Table 1. Large-scale oceanic indices (˚C). Anomalies are with respect to the 1991–2020 average. (*Source:* U.S. Climate Prediction Center)

1.2 Observed temperature

Over land, temperature anomalies for November 2023 – January 2024 were generally above-normal with small regions of below-normal temperatures interspersed in between (Figure 2, top). In the northern hemisphere, the largest positive land-temperature anomalies occurred over North America above 30° N, northeastern Africa extending into the Arabian Peninsula and Central Asia and arching northeast towards the Arctic regions of North Asia. In the southern hemisphere positive land-temperature anomalies generally occurred above north of 30° S in South America, South Africa, Australia, and New Zealand. A region of negative temperature anomaly was observed over northern Europe. Small patches of negative temperature anomalies were also observed over eastern Asia, along the west coast of South America, eastern Greenland, and a few isolated locations in Africa and Australia.

Over the oceans, in the equatorial Pacific extending from the Date Line all the way to the western coastal regions of South America and extending further north along the coast of Central America, above-normal temperature anomalies occurred. These temperature anomalies reflected El Niño conditions. In the extratropical southern Pacific Ocean between 60°-30° S and between 120°-60° W, below average temperatures were observed. Temperature anomalies in the Pacific Ocean north of the equator and in the southern Pacific along 45° S extending to 120° W were positive. In the eastern Indian Ocean, temperatures were near-normal while above-normal temperature dominated in the western Indian Ocean. The east-west temperature gradient was consistent with a positive phase of the Indian Ocean Dipole. Temperatures in the Gulf of Mexico, Caribbean and over almost the entire Atlantic Ocean between 30° S – 30° N, and Mediterranean were above-normal.

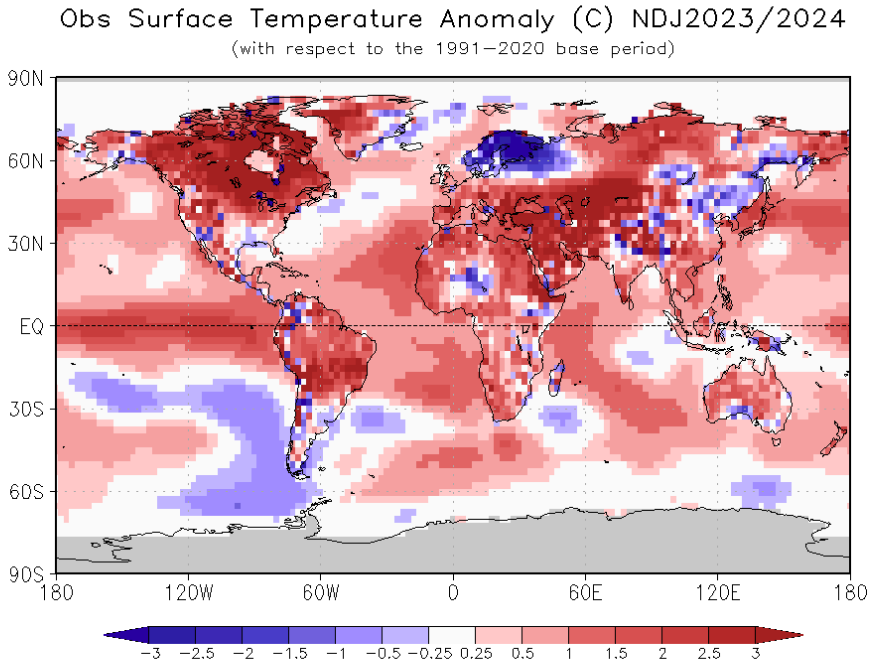
Over land, warm extremes (exceeding all seasonal mean temperatures observed during 1991–2020), occurred over the northernmost regions of North America, along 20° S in South America, the Arabian Peninsula extending into Central Asia. More extensive regions of warm extremes occurred over the oceans and included the Atlantic between 30° S – 30° N, in the western Indian Ocean, and the equatorial Pacific near the Date Line. No regions with cold extremes were observed.

1.2 Observed rainfall

For November 2023 – January 2024, the rainfall anomalies in the equatorial Pacific reflected a spatial pattern consistent with El Niño conditions with a narrow band of above-normal anomalies extending throughout the eastern Pacific just north of the equator and a broader region extending to 150° E near the Date Line (Figure 3, top panel). To the north of this equatorial band of above-normal rainfall anomalies, starting near the Date Line a band of below-normal rainfall anomalies extended eastward towards Central America. Towards the west, extending to the Maritime Continent and northwestward into the Philippines and South China Sea, negative rainfall anomalies were observed. South of the equator, also starting near the Date Line, a band of above-normal rainfall anomalies extended south-eastward to 120°W and was flanked by below-normal rainfall on both sides. Associated with the positive phase of the Indian Ocean Dipole, below-normal rainfall anomalies dominated the eastern half of the Indian ocean while positive anomalies dominated in the western Indian Ocean that arched north- and south westward into the northern and southern Indian Ocean respectively. Negative rainfall anomalies occurred in the north equatorial Atlantic with positive rainfall anomalies over the Gulf of Mexico and western Caribbean. Coastal regions of northwestern Australia were dominated by below-normal rainfall anomalies.

Over land, negative rainfall anomalies dominated South America north of 25° S, northeastern regions of North America, southeastern Greenland, coastal regions in the vicinity of the Mediterranean Sea, western regions of Central Africa, and Madagascar. Positive rainfall anomalies were observed over equatorial Africa, western and eastern Europe, southern Indian subcontinent, southeast Asia, southeastern Australia, northern and southeastern regions of North America extending into western Caribbean, and South America between 25° – 45° S.

Patchy regions of dry extremes (drier than all seasonal mean rainfall observed during 1991-2020) occurred over parts of southeastern Greenland, and western regions of Central Africa. Similarly, a few patchy regions of wet extremes were observed in the northern part of North America, and eastern Europe. In general, regions with coherent wet and dry extremes were absent.



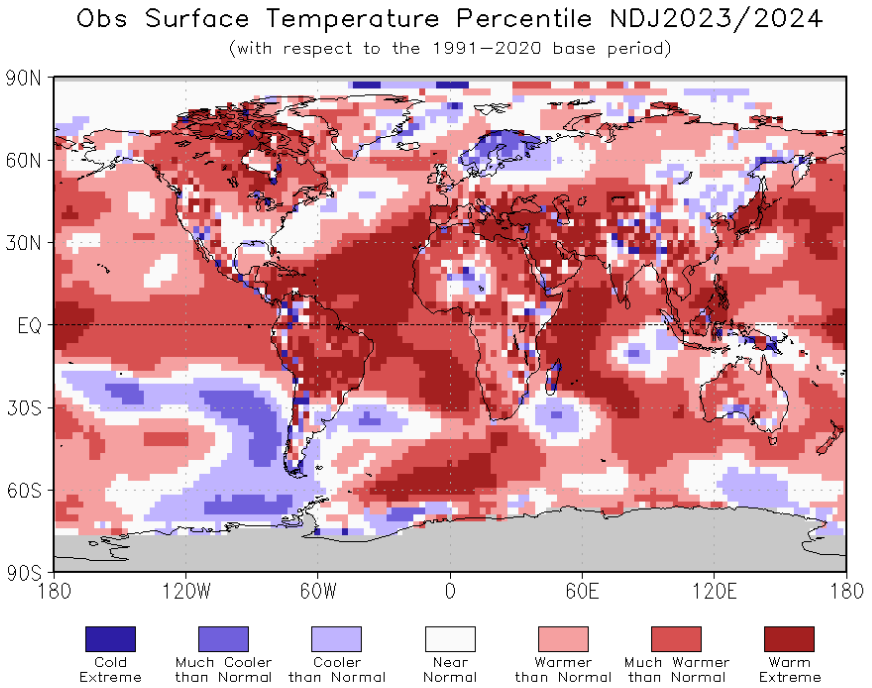
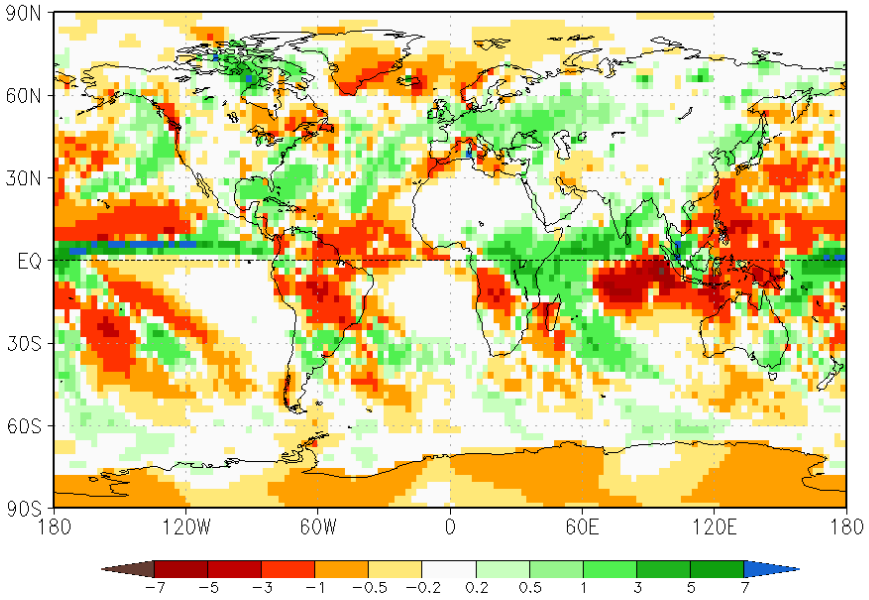


Figure 2. Observed November 2023 – January 2024 near-surface temperature anomalies relative to 1991–2020 (top). The *Cooler than Normal, Near Normal, and Warmer than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile of the 1991–2020 distribution, respectively. Regions with anomalies in the lowest and highest decile (or 10%) of the distribution are marked as *Much Cooler than Normal* and *Much Warmer than Normal*, respectively. The *Cold Extreme* and *Warm Extreme* shadings indicate that the anomalies exceeded the coldest and warmest temperature values of the 1991–2020 period for the season. Grey shading indicates areas where observational analysis was not available. (*Source:* U.S. Climate Prediction Center).

Obs Precipitation Anomaly (mm/day) NDJ2023/2024

(with respect to the 1991–2020 base period)



Obs Precipitation Percentile NDJ2023/2024

(with respect to the 1991–2020 base period)

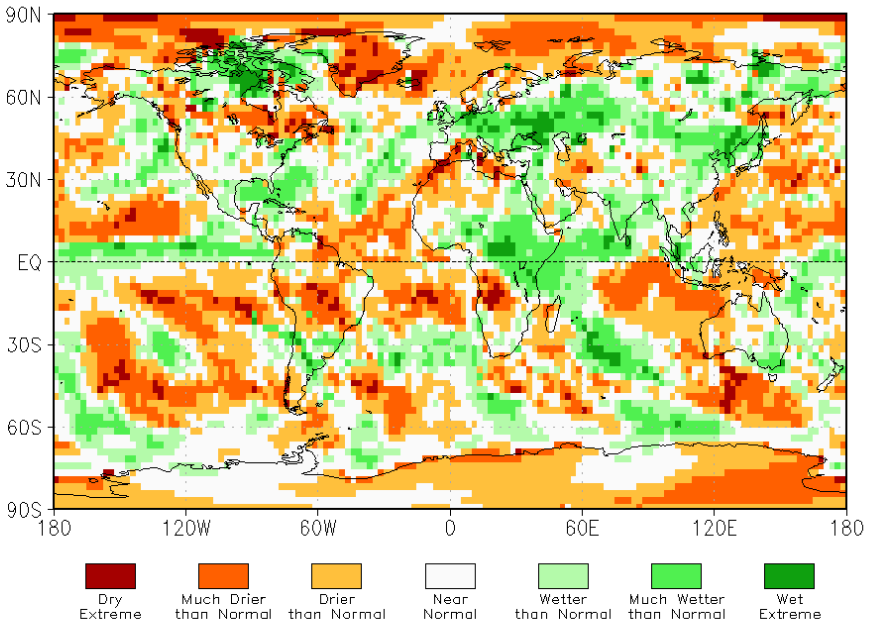


Figure 3. Observed rainfall anomalies for November 2023 – January 2024, relative to 1991–2020 base period (top). The *Drier than Normal, Near Normal and Wetter than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile of the 1991–2020 distribution, respectively. Regions with anomalies in the lowest and highest decile (or 10%) of the distribution are marked as *Much Drier than Normal* and *Much Wetter than Normal*, respectively. The *Dry Extreme* and *Wet Extreme* shadings indicate that the anomalies exceeded the driest and wettest values of the 1991–2020 period for the season.
(*Source:* U.S. Climate Prediction Center).

2. Potential evolution of the state of the climate over the next three months (March-May 2024)

2.1 Large-scale SST-based indices, March-May 2024

Month	Nino 1+2	Nino 3	Nino 4	Nino3.4	IOD	NTA	STA
March 2024	0.6±0.3	1.4±0.2	1.2±0.2	1.5±0.2	0.0±0.2	1.5±0.1	1.1±0.1
April 2024	0.0±0.6	0.9±0.3	0.9±0.2	1.1±0.3	0.1±0.1	1.4±0.1	0.9±0.1
May 2024	0.0±0.8	0.4±0.5	0.7±0.2	0.5±0.4	0.3±0.2	1.3±0.1	0.7±0.1
March-May 2024	0.2±0.5	1.1±0.4	1.1±0.2	1.3±0.3	0.0±0.2	1.4±0.1	1.0±0.1

Table 2: Multi-model forecasts for oceanic indices (°C), with standard deviation. Values are the equal-member-weighting average of those derived, using each GPC model's own hindcast climate mean, from the GPCs supplying SST forecasts (GPC Beijing, CMCC, ECMWF, Exeter, Melbourne, Montreal, Offenbach, Seoul, Tokyo, Toulouse, Washington). The standard deviation is calculated on all ensemble members. The latitude/longitude bounds of the regions are given in the supplementary information section.

Observed sea-surface temperatures in the central tropical Pacific were characterized by El Niño state during November 2023 – January 2024. Above-normal sea-surface temperature anomalies in the Niño 3.4 and Niño 3 regions are predicted to decline during March-May 2024, however, moderate El Niño conditions are still forecast. Farther west in the Niño 4 region, the sea-surface temperature anomaly is also predicted to be above-normal. The strength of the Indian Ocean Dipole (IOD) index is predicted to return to near normal. In the equatorial Atlantic, SSTs are predicted to be above-normal in both the northern (NTA) and the southern (STA) areas during the season.

2.2 Predicted temperature, March-May 2024

For information on the construction of the multi-model forecast maps, refer to the supplementary information section. (Note: Maps indicating forecast consistency among GPC models are available in the supplementary information[1]).

[1] File with supplementary information can be downloaded from https://ftp.cpc.ncep.noaa.gov/mingyue/GSCUWMO/Forecasts/GSCU_MAM2024_supplementary_info_LC-LRFMME.docx

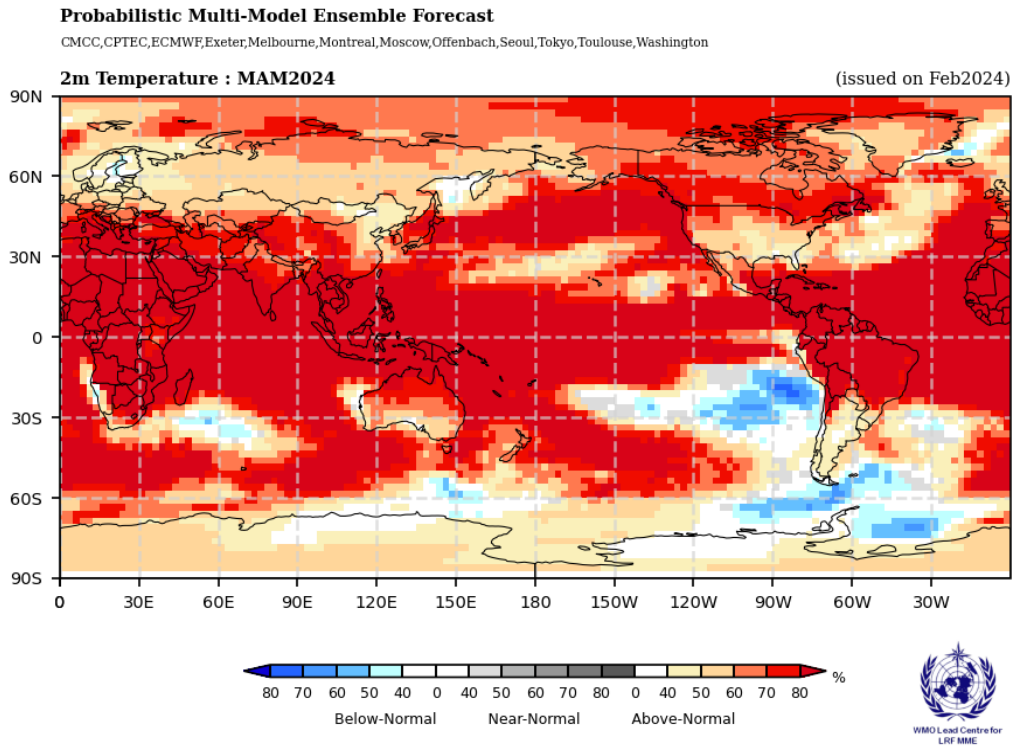


Figure 4. Probabilistic forecasts of surface air temperature for March-May 2024. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal, and near-normal is depicted in blue, red, and grey shadings, respectively. White areas indicate equal chances for all categories in both cases. The baseline period is 1993–2009. Figure is generated by The WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble.

Consistent with the anticipated continuation but weakening of El Niño in the equatorial central and eastern Pacific, together with the prediction of above-normal sea-surface temperatures over much of the global oceans, there is widespread prediction of above-normal temperatures over almost all land areas. Positive temperature anomalies are expected over almost the entire Northern Hemisphere except in the far south-eastern part of North America. The largest increases in probabilities for above-normal temperatures are generally south of 45° N over Europe, Africa, and Asia, and south of 25° N over Central America. Over much of North America south of 40° N, except for the south-east, probabilities for above-normal temperature are weakly enhanced, while the probability of above-normal temperature north of 40° N were moderate to strong. In the Caribbean and Central America, the probabilities of above-normal temperatures are strongly increased, and this area extends to 30° S over South America. Extending further south, probabilities for above-normal temperatures are weakly increased. Over most of the land areas in the Southern Hemisphere, temperatures are predicted to experience above-normal temperature anomalies, as in the Northern Hemisphere. Thus, in Africa south of the equator, including Madagascar and the south-west Indian Ocean north of about 30° S, above-normal temperatures are predicted with high probabilities. Over Australia and New Zealand above-normal temperatures are predicted with moderate to high probability. Along 20° S in the Pacific Ocean, east of the Dateline, there is a narrow band of predicted normal-to-below normal temperatures that expands southwards in the far south-eastern Pacific.

RA I (Africa): Enhanced probabilities of above-normal temperatures are indicated over all of mainland Africa and Madagascar. The probability increases are strong everywhere. Model consistency is strong over North, West, Central, southern Africa, and over Madagascar. The only region where model consistency is moderate is over equatorial East Africa extending into the Greater Horn of Africa.

RA II (Asia): Enhanced probabilities for above-normal temperatures are indicated over all of mainland Asia, with higher probabilities south of 45º N and the model consistency is very high. North of this region, enhancement in the probability for above-normal temperatures is weaker to 60º N, beyond which it increases again to moderately high probability values and the model consistency is high. The weakest enhancement in probability of above-normal temperatures is in a small region over East Asia, and around the Sea of Okhotsk, where model consistency is also low.

RA III (South America): Strongly enhanced probabilities for above-normal temperatures are indicated over South America north of about 30º S. Model consistency is very high over this region. Further south, there is a weak increase in the probability for above-normal temperatures and the model consistency is only weak to moderate. Over a small region along 45º S there is no clear indication for a signal.

RA IV (North America, Central America, and the Caribbean): There are enhanced probabilities for above-normal temperatures over most of North America, with the exception of the south-east mainland where there is no clear signal. The probabilities for above-normal temperatures are strong over Central America and the Caribbean south of 25º N, moderate to strong north of Hudson Bay and along an east-west band around 50º N. These above normal probabilities are weak over the rest of the continent. The probability for above-normal temperatures is also strong along much of the Pacific coast, extending into the North Pacific Ocean.

RA V (Southwest Pacific): Strongly enhanced probabilities for above-normal temperatures are predicted between equator and 15º N throughout the region and the model consistency is high. In the southern hemisphere, strongly enhanced probability for above-normal temperature is also predicted north of 15º S and the model consistency is high. Starting from the northeastern coast of Australia, a band of strong probability for above-normal temperature extends southeastward, and the model consistency is high. Probability for above-normal temperature is strongly enhanced over the northern regions of Australia while over the southernmost regions, there is only a moderate increase. Regions of moderate increase in the probability for above-normal temperatures also include New Zealand and waters adjacent to the western coast of Australia. Over the south-eastern Pacific off the west coast of South America there is an area of weak to moderately enhanced probabilities of below-normal temperature, with a weak band extending along 25º S to the Date Line. Model consistency is high in this anomalously cold area only in small areas in the south-eastern Pacific.

RA VI (Europe): The probabilities for above-normal temperatures are weakly increased over Europe with highest probabilities over the Mediterranean. The model-to-model consistency is also weak almost everywhere.

2.3 Predicted rainfall, March-May 2024

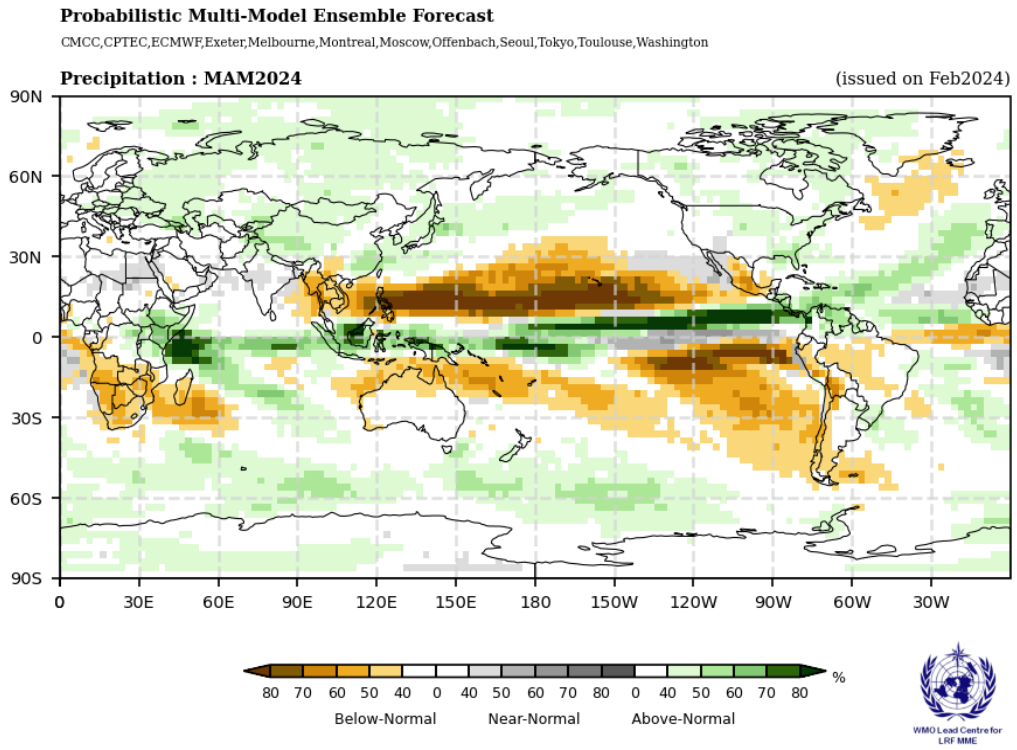


Figure 5. Probabilistic forecasts of rainfall for the season for March-May 2024. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal, and near-normal is depicted in orange, green and grey shadings, respectively. White areas indicate equal chances for all categories in both cases. The baseline period is 1993–2009. Figure is generated by The WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble.

Predictions for rainfall are similar to some of the canonical impacts of El Niño, which is expected to continue but weaken in March-May 2024. Above-normal rainfall is predicted over a narrow band along or just north of the equator from 150° E extending eastward to the southern region of Central America crossing into the southern Caribbean where it extends north-eastward towards southern Europe and probabilities for above-normal rainfall are strongly enhanced. Immediately to the south and along the equator between 65° W and 110° W enhanced probability for normal rainfall is predicted. Across most of the Pacific Ocean immediately to the north of the wet band and to about 30° N, rainfall is predicted to be below-normal. This northern band of predicted below-normal rainfall extends from southeast Asia to the western coast of Central America. Also starting from 150° E and immediately below the equator, a narrow band of probability for above-normal rainfall extends westward to the eastern coast of Africa where it turns south-eastward and reaches to 30° S and 90° E. In the Southern Hemisphere, the area of below-normal rainfall stretches across northern and western Australia, where to the west it extends into the Indian Ocean while to the east extends to 110° W and model consistency, over this region, is generally high. Also, in the southern hemisphere oceans along 45° S there is a band with probability of above-normal rainfall. Over most of Asia except for most of the Indian subcontinent and Arabian Peninsula, and in eastern Europe there is a weak enhancement in the probability for above-normal rainfall and model consistency is weak to moderate. The probability for below-normal rainfall is enhanced south of 10° S over Africa. and on the eastern side of the continent, where it extends into oceans and over to Madagascar. Enhancement in the probability for above-normal rainfall is also predicted over the northeastern region of North America extending into the western Greenland. Also, over North America, there is an elongated region for the probability of above-normal rainfall that extends from the southeastern tip of the continent all the way to the northwest.

RA I (Africa): Enhanced probabilities for above-normal rainfall are predicted in the southern regions of eastern Africa and the model consistency is weak to moderate. Over much of southern Africa there are increases in the probability of below-normal rainfall, with moderate to strong consistency. Around 20° S and on the eastern side of the continent, this area of below-normal probability extends over into the oceans to Madagascar. Over some regions of southern Sahara, the increased probability for normal rainfall largely is indicated and reflects the aridity of the area.

RA II (Asia): Over most of Asia except for most of the Indian subcontinent, Arabian Peninsula, interior regions of East Asia, and in the far northeast near the tip of the continent, there is a weak enhancement in the probability for above-normal rainfall and model consistency is weak to moderate. An enhancement in the probability for below-normal rainfall over southeast Asia and this region extends northwestward to the eastern parts of the Indian subcontinent. The model consistency over this region is moderate to high.

RA III (South America): South America north of 30º $ to the equator and along 60º W is predicted to be below-normal with weak enhancement in probability and the model consistency is low. Below-normal rainfall is also predicted along the west coast of South America south of the equator, extending across the southernmost part of the continent. Probabilities are moderately enhanced and model consistency is strong. There is an increase in probability for above-normal rainfall over a small region along the south-eastern coastal South America and model consistency is moderate. There are also weak indications of above-normal rainfall over north-western South America, and the model consistency is moderate.

RA IV (North America, Central America, and the Caribbean): There is an enhancement in the probabilities for below-normal rainfall in the northern regions of Central America while for the southern regions there is an enhancement in the probability of above-normal rainfall and model consistency is moderate to high. The area for an increase in the probability for above-normal rainfall extends into the southern Caribbean and the model consistency is high. Increases in probability of above-normal rainfall are also located in northeast North America, with strongest probabilities over the Hudson Bay, but with moderate model consistency. There is an elongated area of weak enhancement in the probability for above-normal rainfall that extends from the southeastern tip of the continent all the way to the northwest and the model consistency is generally moderate.

RA V (Southwest Pacific): Probabilities for above-normal rainfall are strongly enhanced over a narrow area extending along or immediately north of the equator from about 150º E to the coast of South America. Model consistency over this region is high. Immediately on and a few degrees south of the equator between about 165º W and 110º W, enhanced probability for normal rainfall is predicted. Across most of the Pacific Ocean immediately to the north of the wet band and to about 30º N, rainfall is predicted to be below-normal. Also starting from 150º E and immediately below the equator, a narrow band of probability for above-normal rainfall extends westward over the Maritime continent to the eastern regions of Indonesia and the model consistency is moderate to high. An area of below-normal rainfall stretches across northern and western Australia, where to the west it extends into the Indian Ocean while to the east extends to 110º W and model consistency generally is high. Approximately 20º S over Australia and over New Zealand there is no clear signal.

RA VI (Europe): Most of Europe has weakly enhanced probabilities of above-normal rainfall signal and model consistency is also weak.

3. Latest updates for monitoring and prediction information

Each month, the latest updates for the real-time monitoring and seasonal mean predictions included in GSCU can be found at:

Monitoring:

https://ftp.cpc.ncep.noaa.gov/mingyue/GSCUWMO/

Predictions:

www.wmolc.org/board/downloadExt?fn=WMOLC_T2M.png

http://www.wmolc.org/board/downloadExt?fn=WMOLC_PREC.png

4. How to use the Global Seasonal Climate Update

The GSCU is intended as guidance for RCCs, Regional Climate Outlook Forums (RCOFs) and National Meteorological and Hydrological Services (NMHSs). It does not constitute an official forecast for any region or nation. Seasonal outlooks for any region or nation should be obtained from the relevant RCCs (see below for contact details) or NMHS.

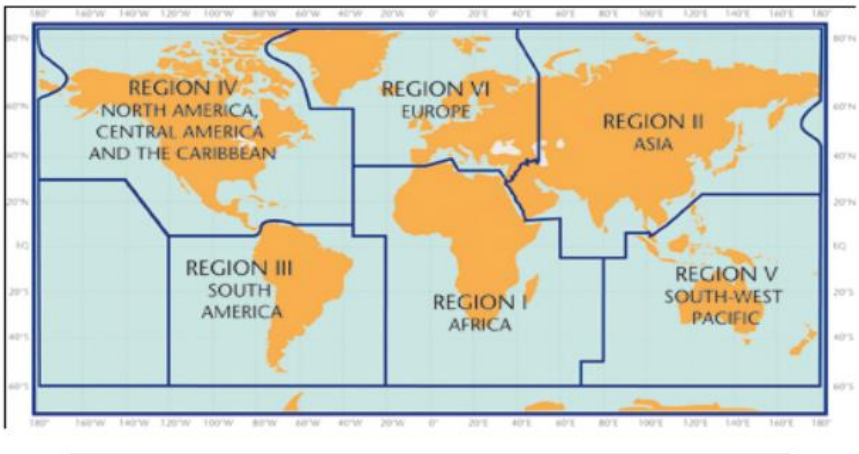
Figure 4 shows the spatial pattern of seasonal mean surface air temperature forecast probabilities. Probabilities are calculated for the average temperature for the season being in the highest third (above-normal or warm), middle third (normal) or lowest third (below-normal or cold) ranges of the baseline record (1993-2009) at each location. Colour code is indicated only for the category that has the highest probability of occurrence. For example, for regions highlighted in red, the most likely forecast category for seasonal mean surface air temperature to occur is warmer than normal. Similarly, the blue colour highlights regions where the seasonal mean surface air temperature forecast indicates the colder than normal category as most likely, while grey colour highlights regions where the seasonal mean temperature forecast indicates the near normal category as most likely. Deeper shades of respective colours highlight increasing probability for the seasonal mean temperature to be in the indicated category. White areas indicate equal chances for all categories.

A particular colour does not assure that the seasonal mean temperature is “certain” to be observed in the most likely forecast category that is shown, but rather its probability of being in that category. As a consequence, the observed seasonal mean temperatures have a non-negligible probability to be observed in a category different from the category indicated on the map as most likely. Users need to take the probabilistic nature of seasonal forecasts into account when making decisions. It should also be noted that the absolute values for the surface air temperature corresponding to the definitions of the above normal (warm), normal or below normal (cold) categories depend on the climatology (historical information) at the location, and therefore, is location dependent.

The interpretation of the probabilities for the rainfall forecast (Figure 5) is the same as that for the seasonal mean surface air temperature except that green and brown colours indicate whether the forecasted seasonal mean rainfall is most likely to be in the wet or dry category. As for surface temperature, grey colour highlights regions where the seasonal mean rainfall forecast indicates the near normal category as the most likely.

The skill of seasonal forecasts is substantially lower than that of weather timescales and skill may vary considerably with region and season. It is important to view the forecast maps together with the skill maps provided in the supplementary material.

For reference, the six WMO Regional Associations domains are depicted in the figure below.



5. Designated and developing WMO Regional Climate Centres and Regional Climate Centre Networks

- https://public.wmo.int/en/our-mandate/climate/regional-climate-centres

6. Resources

Sources for the graphics used in the GSCU:

- The WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (LC-LRFMME): http://www.wmolc.org
- WMO portal to the Global Producing Centres for Long-range Forecasts (GPCs-LRF): https://public.wmo.int/en/programmes/global-data-processing-and-forecasting-system/global-producing-centres-of-long-range-forecasts
- WMO portal for Regional Climate Outlook Forums https://public.wmo.int/en/our-mandate/climate/regional-climate-outlook-products
- International Research Institute for Climate and Society (IRI): https://iri.columbia.edu/
- NOAA Climate Prediction Centre (CPC): http://www.cpc.ncep.noaa.gov

7. Acknowledgements

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- WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (LC-LRFMME), Korea Meteorological Administration, NOAA National Centers for Environmental Prediction
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