WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

GLOBAL SEASONAL CLIMATE UPDATE

TARGET SEASON: March-April-May 2023

Issued: 26 February 2023

Summary

During November 2022 – January 2023, all four Pacific Niño sea-surface temperature (SST) indices in the central and eastern Pacific were below-normal. The observed SST conditions in the equatorial Pacific were characterized by a weak La Niña state. The Indian Ocean Dipole (IOD) over the observed period was near zero. The North Tropical Atlantic (NTA) SST index was near zero while the South Tropical Atlantic (STA) SST index was slightly positive.

Near-normal sea-surface temperature anomalies in the Niño 3.4 and Niño 3 regions are predicted during the March-May (MAM) 2023 season indicating a return to the near-normal ENSO conditions. The IOD is also predicted to be near-normal in MAM 2023. In the equatorial Atlantic, SSTs are predicted to be near-normal in both the northern (NTA) and the southern (STA) areas during the season.

Although a tendency towards a return to near-normal ENSO conditions is predicted for the equatorial central and eastern Pacific, warmer-than-average sea-surface temperatures are generally predicted over other oceanic regions and contribute to widespread prediction of above-normal temperatures over land areas. Positive temperature anomalies are expected over most of the land areas in the Northern Hemisphere except for north-western North America and southeast Asia. The largest increase in probabilities for above-normal temperatures are along the northern parts of central America, south-eastern North America, the Caribbean, eastern Maritime Continent, New Zealand, and islands off the coast of northern east Asia. There are also small areas of strong probabilities for above-normal temperature over the eastern part of South Asia, and southern Europe. There are enhanced probabilities for above-normal temperatures over most of Asia, Europe, Africa north of 15° S, southern South America, and southern and eastern North America. However, over most land areas, the probabilities for above-normal temperature are only weakly or moderately increased. Strongly enhanced probabilities for above-normal temperatures are predicted in a band from north of Australia, extending to the south-eastern South Pacific, and in an arc extending over New Zealand to the vicinity of Tasmania. Many of the southwest Pacific islands lie within this band of above-normal temperatures. From the Maritime Continent east of 120° E, this area with the likelihood of above-normal temperature also extends into the central North Pacific, and at about 40° N stretches almost continuously from the west coast of North America to the east coast of Asia. Near-normal temperatures are expected over eastern coastal regions of Australia, and northeast South America.

Predictions for rainfall are similar to some of the canonical rainfall impacts of La Niña, although ENSO neutral conditions are predicted for MAM 2022-2023. Probabilities for above-normal rainfall are enhanced over an area extending from north of Australia, primarily below the equator, into the Southwest Pacific to an area east of New Zealand, extending to about 120° W. There is an additional narrow band of high probabilities for above-normal rainfall stretching continuously across the Pacific to about 150°W. The likelihood of above-normal rainfall is enhanced over north Asia and northern regions of the Indonesian Archipelago. Much of southern Africa and north-eastern South America extending into the Atlantic below the equator have increased probabilities of above-normal rainfall. A likelihood for anomalously dry is predicted over an area in the equatorial Pacific from the date line to 150° E and extending south of the equator to 100° W. Enhanced probabilities for below-normal rainfall are predicted over the entire Indian Ocean, and in the equatorial western Atlantic extending into the Gulf of Mexico to southwestern North America and into the eastern Pacific adjacent to Central America. The likelihood of near-normal rainfall is enhanced in the equatorial Pacific east of the dateline and in the eastern Atlantic off the coast of western Africa.

Surface Air Temperature, MAM 2023 **Precipitation, MAM 2023**

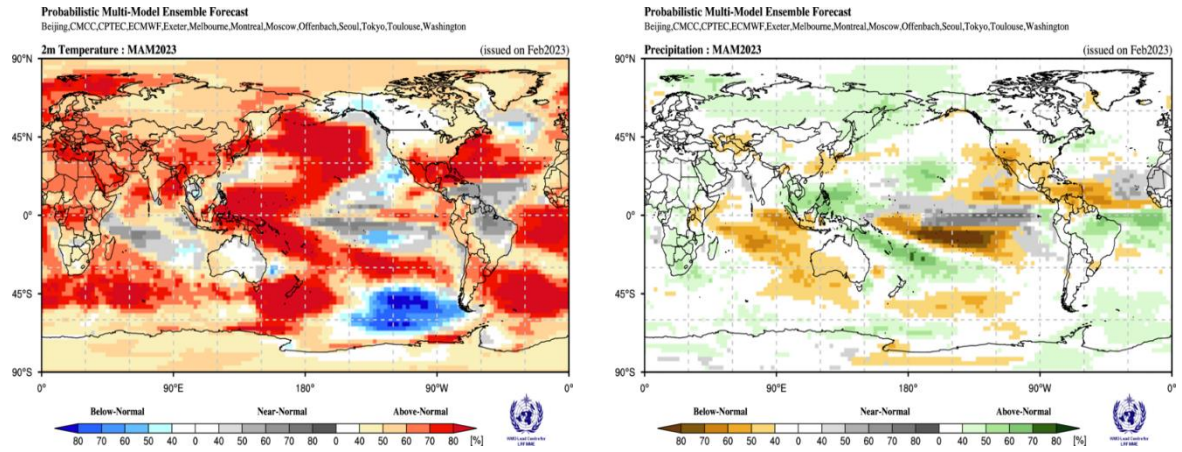


Figure 1. Probabilistic forecasts of surface air temperature and precipitation for the season March-May 2023. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal, and near-normal is depicted in blue, red, and grey shadings respectively for temperature, and orange, green and grey shadings respectively for precipitation. White areas indicate equal chances for all categories in both cases. The baseline period is 1993–2009.

1. Observations: November 2022 – January 2023

In the following sections, observed temperature and precipitation 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 2022 – January 2023, all four Pacific Niño sea-surface temperature (SST) indices in the central and eastern Pacific were below-normal. The observed SST conditions in the equatorial Pacific were characterized by a weak La Niña state. The Indian Ocean Dipole (IOD) over the observed period was near zero. The North Tropical Atlantic (NTA) SST index was near zero while the South Tropical Atlantic (STA) SST index was slightly positive.

Month	Niño 1+2	Niño 3	Niño 4	Niño 3.4	IOD	NTA	STA
November 2022	-1.4	-0.9	-0.9	-0.9	-0.6	-0.1	0.5
December 2022	-0.3	-0.8	-0.7	-0.8	-0.1	0.0	0.5
January 2022	-0.2	-0.5	-0.6	-0.7	0.1	-0.1	0.7
November 2022 – January 2023	-0.6	-0.7	-0.7	-0.8	-0.2	-0.1	0.6

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 areas, temperature anomalies for November 2022 – January 2023 were a mix of above- and below-normal conditions (Figure 2, top). In the northern hemisphere, positive land-temperature anomalies occurred over northern and eastern North America, Greenland, Europe, northern Africa extending into the coastal regions of western Africa and the Greater Horn of Africa, the Arabian Peninsula, and eastern Asia. Negative temperature anomalies were observed over western North America between 30º-60º N, northern Asia extending into central Asia, and interior regions of Africa south of 20ºN. In the southern hemisphere, positive temperature anomalies occurred over New Zealand, over much of South America south of 15º S, and southernmost parts of Africa. Negative temperature anomalies were observed over Australia, north-western and eastern regions of South America, western coastal regions of Africa between the equator and 30º S, and Madagascar.

Over the oceans, the eastern Pacific south of the equator had below-normal temperatures. In the extratropical southern Pacific Ocean along 60º S and between 180º-60º W below average temperatures were observed. SSTs in the equatorial central Pacific indicated a weak La Niña, with positive anomalies in the western equatorial Pacific and negative anomalies in the central and eastern Pacific - a pattern that indicates enhanced zonal SST gradients across the equatorial Pacific. SST anomalies in the Pacific north of 30º N and in the southern Pacific along 30º S were positive. A band of positive SST anomalies also extended from the Maritime continent towards the southern coast of South America. A notable region having the largest positive ocean-temperature anomaly was observed in the northwest Pacific. SSTs in the Indian Ocean were near average. SSTs in the western Caribbean and off the eastern coast of North America extending into the Atlantic Ocean were above-normal. Positive SST anomalies also extended from the coastal regions of Africa above the equator into the Mediterranean and northward along the coastal regions of Europe.

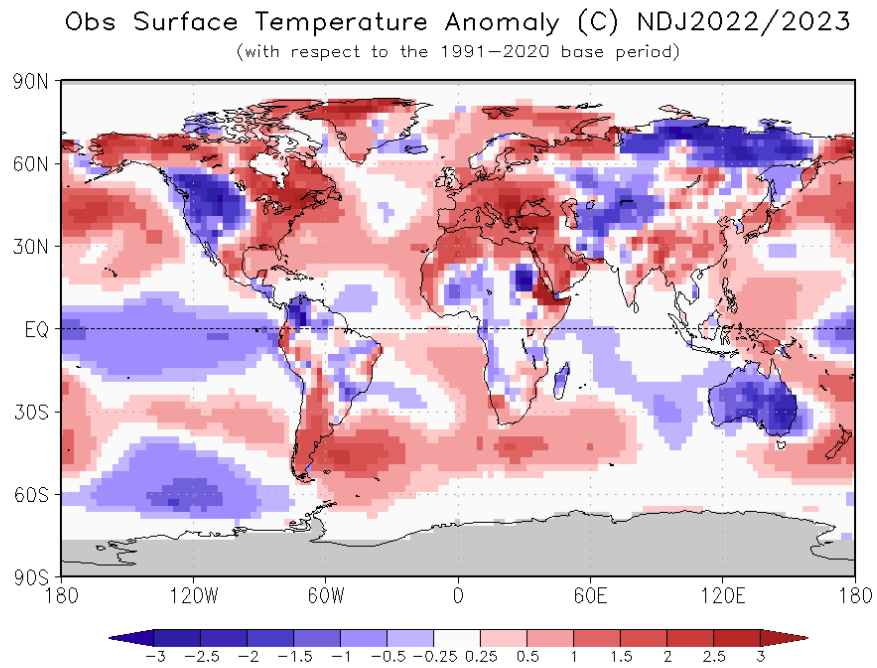
Warm extremes (exceeding all seasonal mean temperatures observed during 1991–2020), occurred south of 30ºS in South America, part of the Greater Horn of Africa, and in a few patchy regions in the southern parts of eastern Europe. Some oceanic regions also had warm extremes, notably the extratropical Pacific along 45º N, a band of SSTs from the western Pacific extending to the dateline, and between 30º-60º S in the western parts of the southern Atlantic. A region of cold extreme was observed over the coastal regions of eastern Australia.

1.2 Observed precipitation

For November 2022 – January 2023, the largest negative precipitation anomalies were in the equatorial Pacific near the dateline extending into the western Pacific with a narrow equatorial band extending into the eastern Pacific extending northward around 120º W, and another band extending into the southern Pacific towards the southern tip of South America (Fig. 3, top panel). Below-normal precipitation anomalies also occurred in the Indian Ocean west of 80º E, eastern Atlantic between 10º-40º N, north-western Atlantic, and in the north-eastern Pacific. Positive precipitation anomalies occurred in the oceanic regions in the vicinity of the Indonesian Archipelago, eastern Indian Ocean, and Coral Sea. Starting from the equatorial western Pacific, a band of positive precipitation anomalies extended southeastward into the South Pacific. A zonal band of negative rainfall anomalies stretched along 45ºS.

Over land, negative precipitation anomalies were observed over southern Greenland, northern Central America, the Caribbean, coastal regions of northwest North America, western Australia, and southern New Zealand. Over South America, northwest to southeast oriented bands of negative (on the southern flank) and positive rainfall (on the northern flank) anomalies extended from the equator to 45ºS. Positive rainfall anomalies occurred over equatorial Africa and extended into the south of the continent, and over the Indonesian Archipelago, central Australia, and northern New Zealand. Over much of northern and central Asia, and northern Africa no large-scale systematic departures in precipitation anomalies of either sign were observed.

Small regions of wet extremes (exceeding all seasonal mean rainfall observed during 1991-2020) were observed over the coastal regions of eastern South America, and northern New Zealand. Dry extremes were located in southern New Zealand.



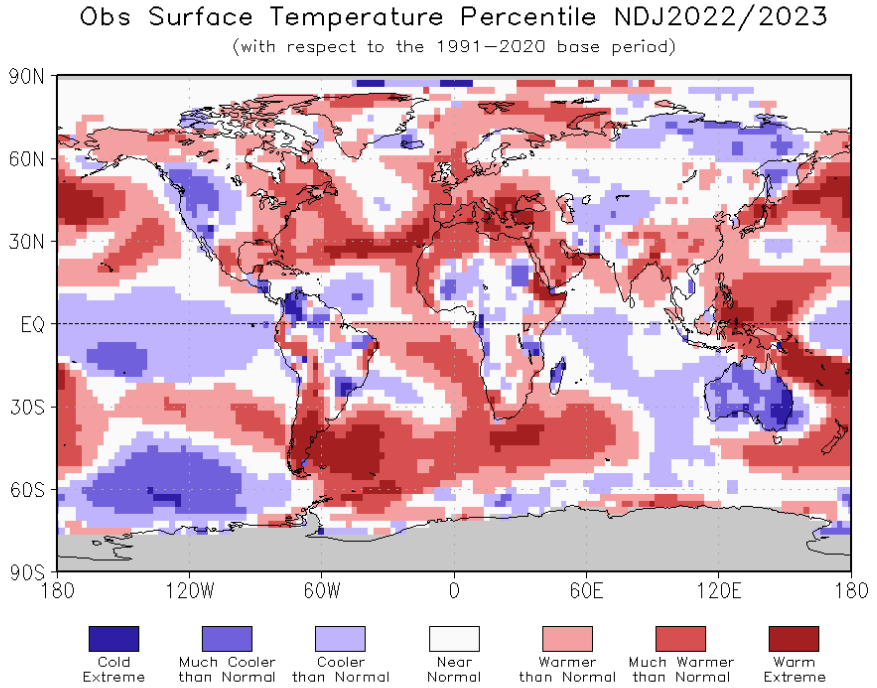
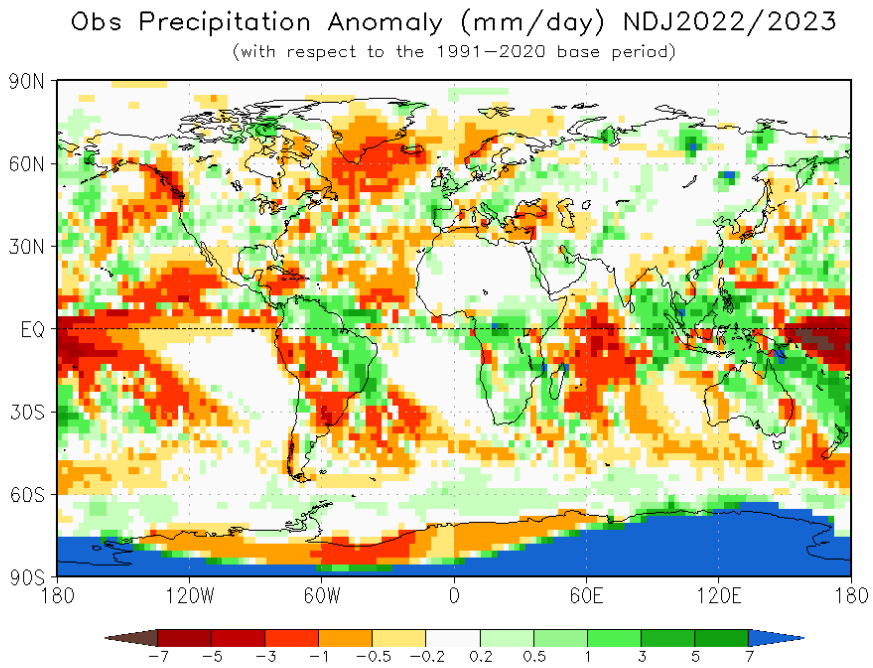


Figure 2. Observed November 2022 – January 2023 near-surface temperature anomalies relative to 1991–2020 (top). The *Cooler than Normal, Near Normal, and Warmer than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile of 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).



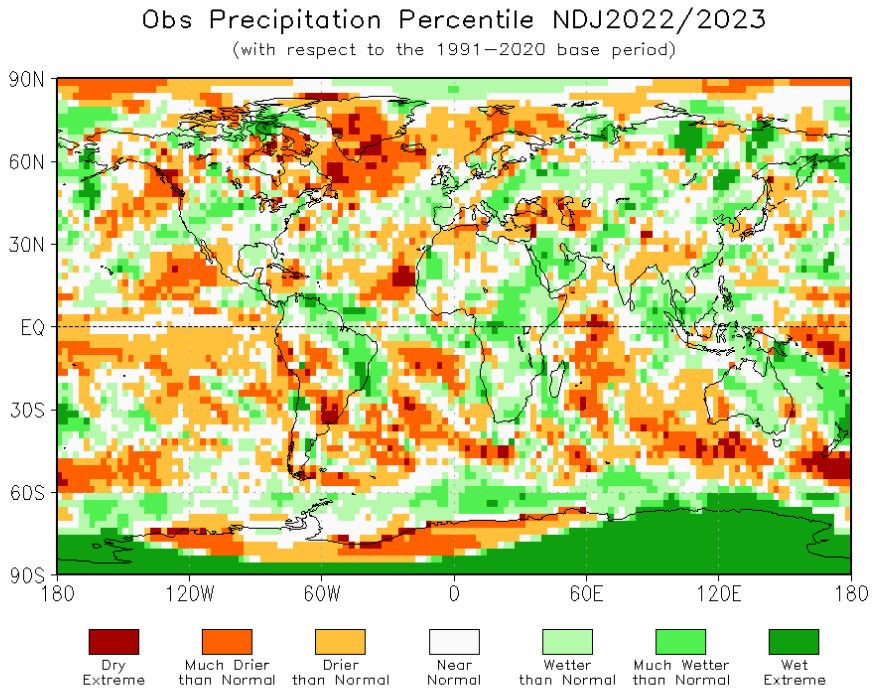


Figure 3. Observed precipitation anomalies for November 2022 – January 2023, relative to 1991–2020 base period (top). The *Drier than Normal, Near Normal and Wetter than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile 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 2023)

2.1 Large-scale SST-based indices, March–May 2023

Month	Nino 1+2	Nino 3	Nino 4	Nino3.4	IOD	NTA	STA
March 2023	0.3±0.2	0.1±0.1	-0.1±0.2	-0.1±0.1	0.2±0.1	0.1±0.1	0.1±0.1
April 2023	0.6±0.4	0.3±0.2	0.2±0.2	0.1±0.2	0.2±0.1	0.1±0.1	0.2±0.1
May 2023	1.0±0.5	0.7±0.3	0.3±0.2	0.4±0.3	0.0±0.1	0.2±0.1	0.3±0.1
March-May 2023	0.5±0.4	0.2±0.2	0.1±0.2	0.0±0.2	0.1±0.1	0.1±0.1	0.2±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 in a weak La Niña condition during November 2022 – January 2023. Near-normal sea-surface temperature anomalies in the Niño 3.4 and Niño 3 regions are predicted during the March-May (MAM) 2023 season indicating a return to near-normal ENSO conditions. Farther west in the Niño 4 region, the sea-surface temperature anomaly is also predicted to be near normal. The prediction, therefore, indicates a return to near-normal ENSO conditions in the central tropical Pacific. The IOD is also predicted to be near-normal in MAM 2023. In the equatorial Atlantic, SSTs are predicted to be near-normal in both the northern (NTA) and the southern (STA) areas during the season.

2.2 Predicted temperature, March-May 2022-2023

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_MAM2023_supplementary_info_LC-LRFMME.docx

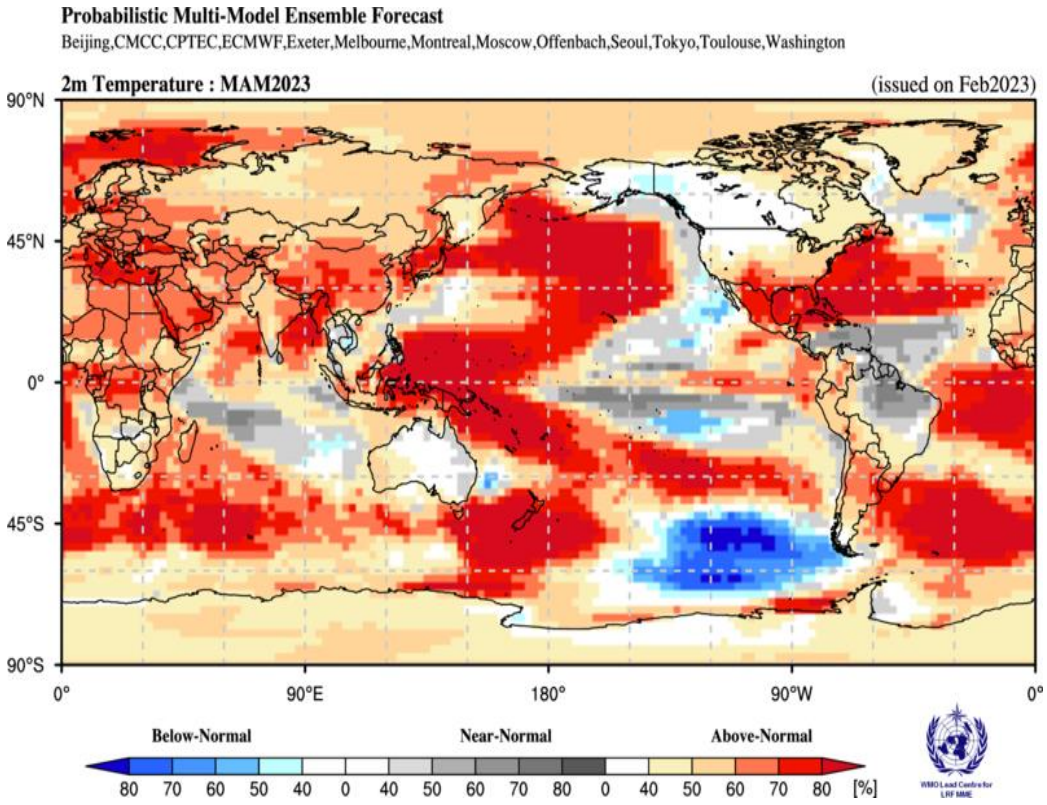


Figure 4. Probabilistic forecasts of surface air temperature for March – May 2023. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal, and near-normal is depicted in blue, red, and grey shadings, respectively. 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.

Although a tendency towards a return to near-normal ENSO conditions is predicted for the equatorial central and eastern Pacific, warmer-than-average sea-surface temperatures are generally predicted over other oceanic regions and contribute to widespread prediction of above-normal temperatures over land areas. Positive temperature anomalies are expected over most of the land areas in the Northern Hemisphere except for north-western North America and southeast Asia. The largest increase in probabilities for above-normal temperatures are along the northern parts of central America, south-eastern North America, the Caribbean, and eastern Maritime Continent, New Zealand, and islands off the coast of northern east Asia. There are also small areas of strong probabilities for above-normal temperature over the eastern part of South Asia, and southern Europe. There are enhanced probabilities for above-normal temperatures over most of Asia, Europe, Africa north of 15° S, southern South America, and southern and eastern North America. However, over most land areas, the probabilities for above-normal temperature are only weakly or moderately increased. Strongly enhanced probabilities for above-normal temperatures are predicted in a band from north of Australia, extending to the south-eastern South Pacific, and in an arc extending over New Zealand to the vicinity of Tasmania. Many of the southwest Pacific islands lie within this band of above-normal temperatures. From the Maritime Continent east of 120° E, this area with the likelihood of above-normal temperature also extends into the central North Pacific, and at about 40° N stretches almost continuously from the west coast of North America to the east coast of Asia. Near-normal temperatures are expected over eastern coastal regions of Australia, and northeast South America.

RA I (Africa): Enhanced probabilities of above-normal temperatures are indicated over most of mainland Africa north of 15° S. The probability increases are weak to moderate, but model consistency is strong north of 10° N. Over southern Africa below 15°S, there is likelihood of near-normal and below-normal temperatures, but with weak model consistency, and the surrounding coastal areas in the east and south have increased probabilities for above-normal temperature, with moderate to high model consistency. There is an increased probability of above-normal temperatures, also with high model consistency, over Madagascar.

RA II (Asia): Enhanced probabilities for above-normal temperatures are indicated over almost all of Asia, except for parts of southeast Asia where likelihood of the forecast is for normal to below-normal temperatures. The strongest likelihood for above-normal temperature is indicated over the Arabian Peninsula, a band between 30°-45°N across central and eastern Asia, and eastern parts of the Indian subcontinent. Over these regions model consistency is strong. A weak likelihood for above-normal temperature is predicted over North Asia, and central and western regions of the Indian subcontinent, and the model consistency is weak to moderate.

RA III (South America): Weak enhanced probabilities for above-normal temperatures are indicated over South America south of about 30° S and stretch northward along the coastal regions in the west. Model consistency is low except for the region between 30°S-45°S where model consistency is high. Over much of the northern and north-eastern parts of the continent there is a weak enhancement in the probability of near-normal temperature and the model consistency is low.

RA IV (North America, Central America, and the Caribbean): There are enhanced probabilities for above-normal temperatures over most of Central America, the northern part of the Caribbean, the southern and eastern parts of North America as well as along the Arctic coast. The probabilities for above-normal temperatures are highest over northern Central America, the northern Caribbean, and in southeast North America. Model-to-model consistency is high over these areas. Over the north-eastern part of the continent, there is a weak signal of below-normal temperatures, and the model consistency is low. For the southern and the eastern Caribbean, the strongest probability is for near-normal temperatures, and model consistency is low.

RA V (Southwest Pacific): Strongly enhanced probabilities for above-normal temperatures are predicted in a band from north of Australia, extending to the south-eastern South Pacific, and in an arc extending over New Zealand to the vicinity of Tasmania. Many of the southwest Pacific islands lie within this band of above-normal temperatures, and model-to-model consistency is strong. There is a sharp transition to an area of predicted below- to near-normal temperature to the north of this band, which coincides with the distribution of predicted near-normal sea-surface temperature anomalies associated with the prediction for ENSO neutral condition. The model-to-model consistency over this area is low. Over Australia, there is a weak signal of near-normal temperatures in the west, and an even weaker signal of near-normal temperatures in the eastern coastal regions.

RA VI (Europe): The probabilities for above-normal temperatures are increased over all of Europe with stronger probabilities located in the west. The model-to-model consistency is moderate to high.

2.3 Predicted precipitation, March-May 2023

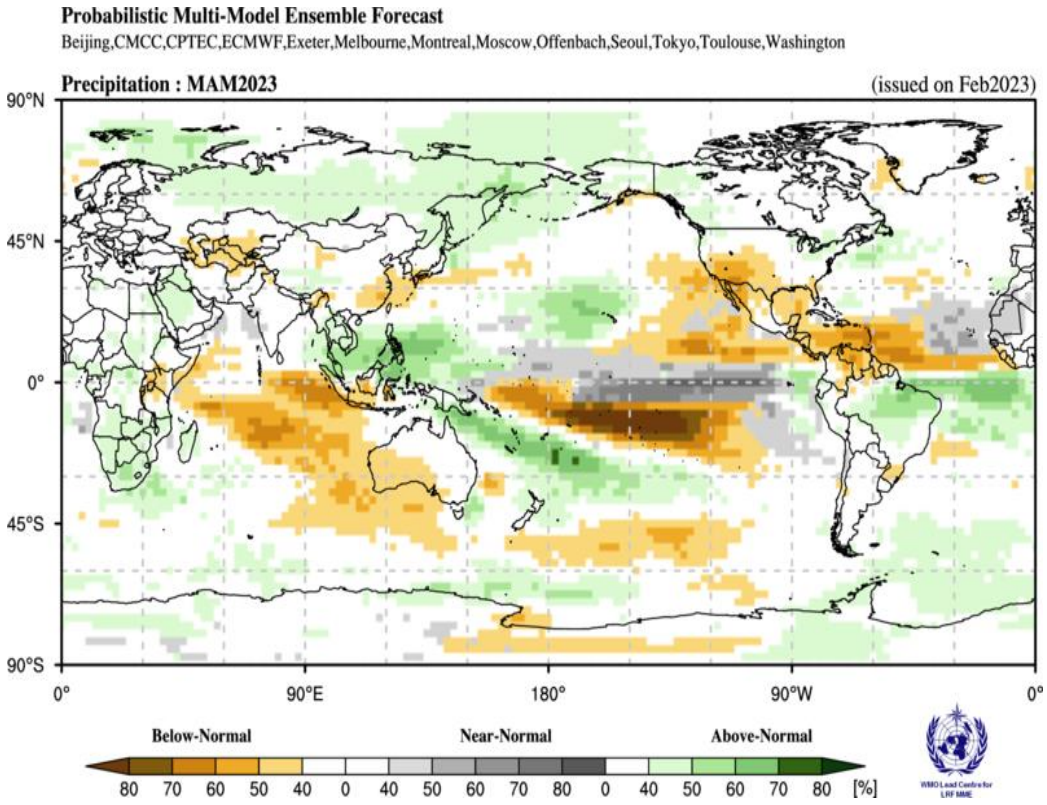


Figure 5. Probabilistic forecasts of precipitation for the season for March – May 2023. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal, and near-normal is depicted in orange, green and grey shadings, respectively. 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 rainfall impacts of La Niña, although ENSO neutral conditions are predicted for MAM 2022-2023.. Probabilities for above-normal rainfall are enhanced over an area extending from north of Australia, primarily below the equator, into the Southwest Pacific to an area east of New Zealand, extending to about 120º W. There is an additional narrow band of high probabilities for above-normal rainfall stretching continuously across the Pacific to about 150ºW. The likelihood of above-normal rainfall is enhanced over north Asia and northern regions of the Indonesian Archipelago. Much of southern Africa and north-eastern South America extending into the Atlantic below the equator have increased probabilities of above-normal rainfall. A likelihood for anomalously dry is predicted over an area in the equatorial Pacific from the date line to 150º E and extending south of the equator to 100º W. Enhanced probabilities for below-normal rainfall are predicted over the entire Indian Ocean, and in the equatorial western Atlantic extending into the Gulf of Mexico to southwestern North America and into the eastern Pacific adjacent to Central America. The likelihood of near-normal rainfall is enhanced in the equatorial Pacific east of the dateline and in the eastern Atlantic off the coast of western Africa.

RA I (Africa): Enhanced probabilities for below-normal precipitation are predicted over parts of eastern Africa. This predicted dry area extends into the western Indian Ocean north of Madagascar and extends southeastward towards Australia. Model consistency is moderate to strong. Over the rest of Africa there is weak enhancement in the likelihood for above-normal precipitation and the model consistency is low except over the southern regions where model consistency is moderate.

RA II (Asia): Over much of Asia north of 45º N there are enhanced probabilities for above-normal rainfall and model consistency is moderate. Probability for above-normal rainfall is also enhanced in southeast Asia and the Arabian Peninsula and model consistency is moderate to high. Some patchy regions of below-normal probability for rainfall are forecast over central Asia and coastal regions of eastern Asia and model consistency is moderate to low.

RA III (South America): Northwestern parts of South America are predicted to have increased probability for below-normal rainfall (model-to-model consistency is mostly moderate to strong). The probability for above-normal rainfall is enhanced over northeastern parts of South America. Over the southern regions of South America there is no clear signal.

RA IV (North America, Central America, and the Caribbean): There are weak increases in probabilities for above-normal precipitation indicated for north-western North America. Model consistency is low to moderate. Further south, across the southernmost parts of North America, enhanced probabilities for below-normal rainfall are indicated. Model consistency is moderate to strong. The likelihood of below-normal rainfall is enhanced over the southern part of Central America and the southernmost parts of the Caribbean. Model consistency is moderate to strong.

RA V (Southwest Pacific): Probabilities for above-normal rainfall are enhanced over an area extending from north of Australia, primarily off the equator, into the Southwest Pacific to over northern New Zealand and extending to about 120° W. The probabilities and model consistency are strongest between 150° E and 150° W. There is an additional band of high probabilities for above-normal rainfall stretching from the east coast of Southeast Asia almost continuously across the Pacific at about 10° N to about 150° W. Model consistency is high over the Philippines and farther east between the dateline and 150° W. Between these two wet zones, probabilities for normal and below-normal rainfall are strongly enhanced. This anomalously dry area extends from about 150° E towards the southeast reaching as far as 90° W, and model consistency is high. Along the equator, normal rainfall has the highest probability east of about 170° W. In the southwestern Australia and immediately south of Australia and New Zealand, there is a band of increased probabilities for below-normal rainfall. Model consistency is moderate to low.

RA VI (Europe): Most of Europe has little to no signal, but there are weak indications of enhanced probability above-normal precipitation in the northern parts of eastern Europe. Model consistency is moderate to low.

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.

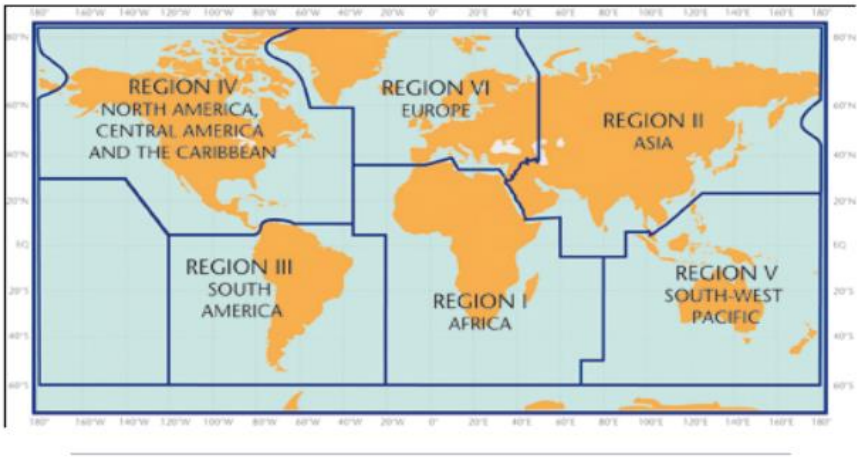
Figure 4 shows the spatial pattern of seasonal mean surface air temperature forecast probabilities. Probabilities are calculated for the average temperature for the season being in the highest third (above-normal or warm), middle third (normal) or lowest third (below-normal or cold) ranges of the baseline 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 precipitation 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

This Global Seasonal Climate Update was jointly developed by the WMO Infrastructure (INFCOM) and Services (SERCOM) Commissions with contributions from:

- WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (LC-LRFMME), Korea Meteorological Administration, NOAA National Centers for Environmental Prediction
- WMO Global Producing Centres for Long-Range Forecast (GPCs-LRF): GPC-Beijing (China Meteorological Administration), GPC-CPTEC (Center for Weather Forecast and Climate Studies, Brazil), GPC-ECMWF (European Center for Medium-Range Forecast), GPC-Exeter (UK Met Office),GPC- Melbourne (Bureau of Meteorology), GPC-Montreal (Meteorological Services of Canada), GPC-Moscow (Hydro meteorological Center of Russia), GPC-Offenbach Deutscher Wetterdienst), GPC-Pretoria (South African Weather Services), GPC-Seoul (Korea Meteorological Administration), GPC-Tokyo (Japan Meteorological Agency), GPC-Toulouse (Météo-France), GPC-Washington (National Centers for Environmental Prediction), GPC-CMCC (Centro Euro-Mediterraneo sui Cambiamenti Climatici).
- International Research Institute for Climate and Society (IRI)