WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

GLOBAL SEASONAL CLIMATE UPDATE

TARGET SEASON: December-January-February 2022-2023

Issued: 26 November 2022

Summary

During August-October 2022, 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 also negative. The North Tropical Atlantic (NTA) and the South Tropical Atlantic (STA) SST index were slightly positive.

For the December–February 2022- 2023 season, below-normal sea-surface temperature anomalies in the Niño 3.4 and Niño 3 regions, with values of approximately -0.7° C (Niño 3.4) and -0.7° C (Niño 3), are predicted and indicate a continuation of weak La Niña conditions.

Although a tendency towards a weak La Niña condition 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. The largest increase in probabilities for above-normal temperatures are along the Arctic coast of Asia, northern parts of central America, the eastern Maritime Continent, and New Zealand. There are also small areas of strong probabilities for above-normal temperature over the eastern part of South Asia, and over the eastern part of the Arabian Peninsula. There are enhanced probabilities for above-normal temperatures over most of Asia, Europe, Africa north of about 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 west coast of North America to east coast of Asia. Over eastern Australia and along parts of the south coast, below-normal temperatures are expected to have increased probabilities. Enhanced probabilities of below-normal temperatures are also indicated over in part of southern Africa, the northern and western coasts of South America, and north-western North America. Over much of the interior part of South America, normal temperatures are the most likely outcome.

Predictions for rainfall are similar to some of the canonical rainfall impacts of La Niña, which is predicted to continue in DJF 2022-2023. Probabilities for above-normal rainfall are enhanced over an area extending from north of Australia, primarily off the equator, into the Southwest Pacific to an area east of New Zealand, extending to about 130° W. There is an additional narrow band of high probabilities for above-normal rainfall stretching almost continuously across the entire Pacific at about 10° N, extending over northern South America and into Central Africa. This area is broader in the western and central Pacific, and in the central Pacific it extends northwards where it expands to cover much of the Arctic and northern and central North America. Much of south-eastern Southern Africa and a small part of south-eastern Australia also have increased probabilities of above-normal rainfall. A likelihood for anomalously dry area is predicted in the equatorial Pacific extending from north of Australia to the coast of South America, and extending southwards to the far southern part of South America. Probabilities for below-normal rainfall are high throughout this region north of about 25° S, although between about 160° and 100° W normal rainfall has the highest probability along the equator. Enhanced probabilities for below-normal precipitation are predicted over much of Eastern Africa, and over a small part of south-western Africa. Other areas with increased probabilities of below-normal rainfall are: South Asia along about 30° N extending into East Asia, the Indian subcontinent, the northern part of Central America and southern North America, south-eastern South America, and small parts of western and south-eastern Europe.

Surface Air Temperature, DJF 2022-2023 **Precipitation, DJF 2022-2023**

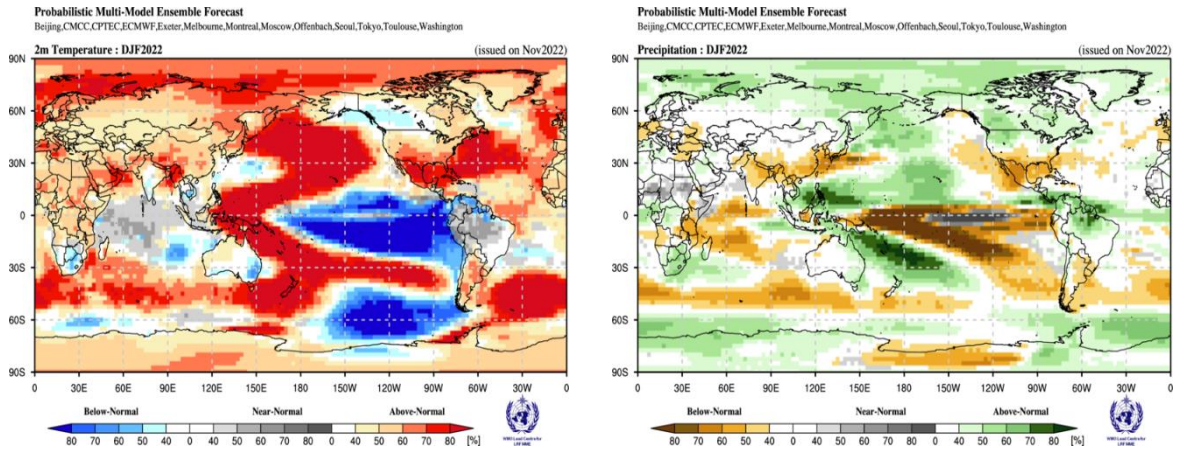


Figure 1. Probabilistic forecasts of surface air temperature and precipitation for the season December-February 2022-2023. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in blue, 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: August-October (ASO) 2022

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 August-October 2022, 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 also negative. The North Tropical Atlantic (NTA) and the South Tropical Atlantic (STA) SST index were slightly positive.

Month	Niño 1+2	Niño 3	Niño 4	Niño 3.4	IOD	NTA	STA
August 2022	-0.6	-0.5	-0.9	-1.0	-1.2	0.4	0.2
September 2022	-1.1	-0.8	-1.0	-0.9	-1.1	0.4	0.3
October 2022	-1.8	-0.9	-1.1	-0.9	-1.0	0.3	0.4
August-October 2022	-1.2	-0.8	-1.0	-0.9	-1.1	0.3	0.3

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 across the globe continued their general tendency of warmer-than-normal conditions for the season of August-October 2022 (Figure 2, top), and in general, above-normal temperatures were prevalent over the global land areas, particularly in the northern hemisphere. The strongest positive land-temperature anomalies occurred over North America above 30° N, western Europe, and northern regions of Asia. Positive temperature anomalies also occurred over New Zealand, over much of South America north of 20° S, parts of Africa that included the southern, western, and north-western regions, eastern Europe, Central Asia, eastern regions of Eastern Asia, and Greenland. Although less extensive, there were also regions with below-normal temperature anomalies including the southern half of Australia, north-western region of South Asia, coastal regions of Central Africa, north-western South America, a west-east band along 25° S in South America, northern and southern Central America, and the southeast region of North America.

Over the oceans, the eastern Pacific south of the equator had below-normal temperatures. In the extratropical southern Pacific Ocean along 60° S near-to below average temperatures generally prevailed. 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 and the Atlantic north of 30° N, eastern Indian Ocean, equatorial Atlantic, and in the southern Pacific along 30° S were generally positive. A band of positive SST anomalies also extended from the Maritime continent to the southern coast of South America. A notable region having the largest positive ocean-temperature anomaly was observed in the northwest Pacific.

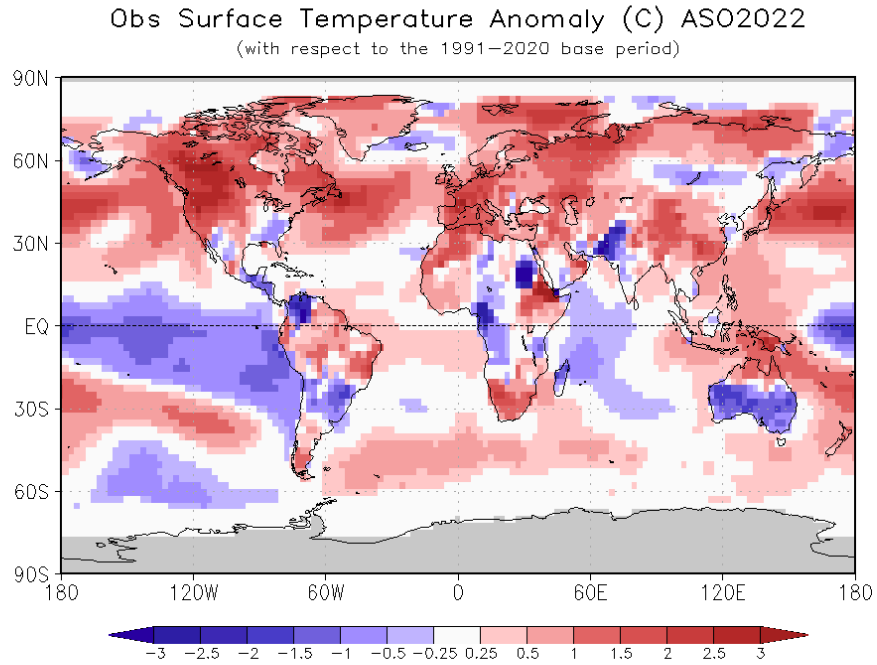
Consistent with the seasonal mean anomalies, warm temperature categories dominated (Figure 2, bottom panel). Warm extremes (exceeding all seasonal mean temperatures observed during 1991–2020), occurred between 30°-60° N over western North America, a few patchy areas that included western and southern Europe, north-western Africa, and northern New Zealand. Some oceanic regions also had warm extremes, notably the extratropical Pacific along 45° N, a band of SSTs starting in the western Pacific extending south-eastward towards the South American coast, and between 30°-60° N in the western Atlantic. Cold extremes in ocean temperature occurred south of the equator in the eastern Pacific. Few isolated regions of cold extremes were observed over the coastal regions of Central Africa, southern region of Central America, northwest South America, and northern Madagascar.

1.2 Observed precipitation

For August-October 2022, the largest negative precipitation anomalies were in the equatorial Pacific near the date-line extending into the western Pacific with a narrow equatorial band extending into the eastern Pacific, and another band extending into the southern Pacific towards South America (Fig. 3, top panel). Below-normal precipitation anomalies also occurred in parts of south-western Indian Ocean, western and north-western Atlantic, and in the north-western Pacific. Positive precipitation anomalies occurred in the oceanic regions in the vicinity of the Indonesian Archipelago, eastern Indian Ocean, Coral Sea, and in the southern Pacific east of Australia.

Over land, negative precipitation anomalies were observed over southern Greenland, between 30°-60° N in North America, northern Central America, and eastern Africa in the vicinity of the Greater Horn of Africa, and north of the Bag of Bengal. Over South America, in general, negative rainfall anomalies occurred below the equator. Positive precipitation anomalies occurred over eastern parts of central Africa, the Indian subcontinent, northeast and southeast Asia, the Indonesian Archipelago, southeast Australia, and northern New Zealand. Over much of western and central Asia, and northern or southern Africa no large-scale systematic departures in precipitation anomalies of either sign was observed.

Small regions of wet extremes (exceeding all seasonal mean rainfall observed during 1991-2020) were observed over southeast Australia, the Indian subcontinent, and northeast Asia. Dry extremes were located in the Hudson Bay and patches of north-eastern North America, and over southern Greenland.



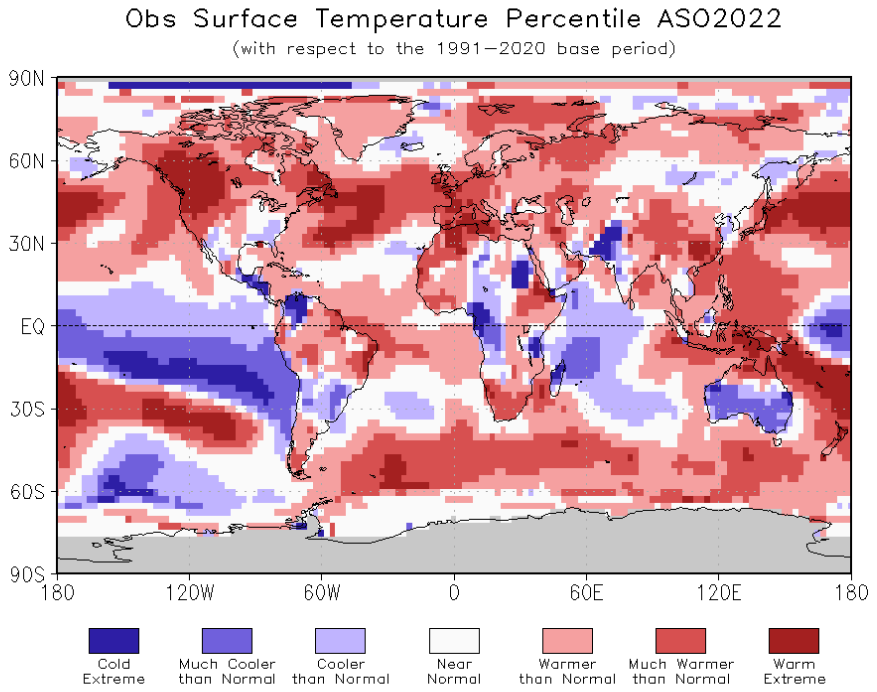
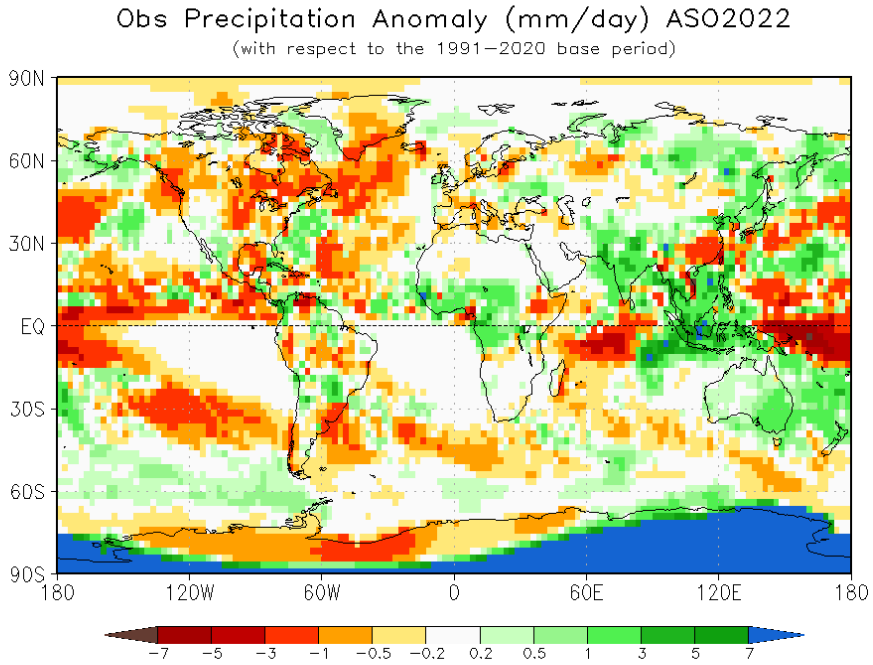


Figure 2. Observed August-October 2022 near-surface temperature anomalies relative to 1991–2020 (top). The *Cooler than Normal, Near Normal, and Warmer than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile of the 1991–2020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



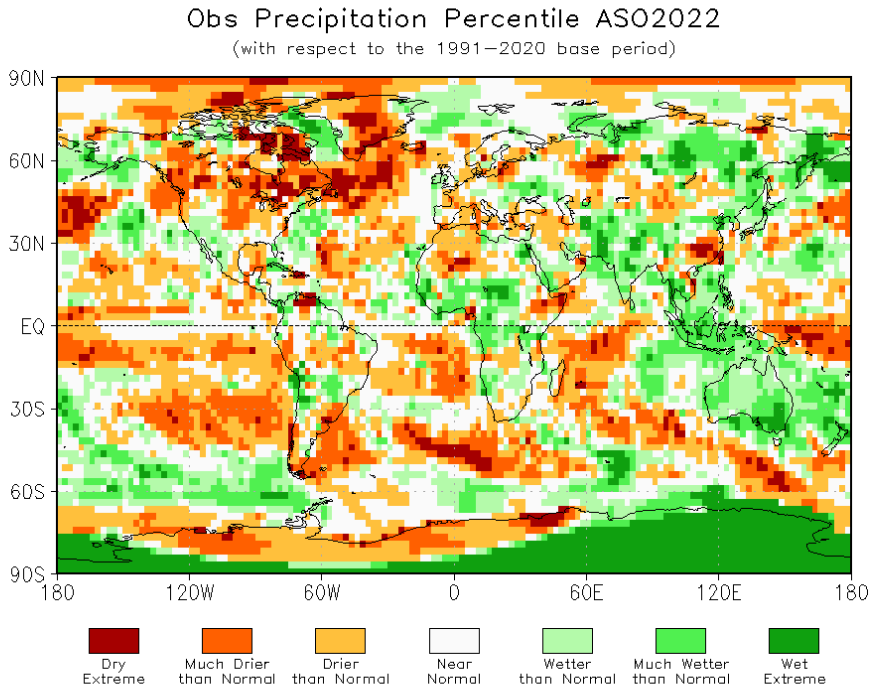


Figure 3. Observed precipitation anomalies for August-October 2022, relative to 1991–2020 base period (top). The *Drier than Normal*, *Near Normal and Wetter than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile of the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

2.1 Large-scale SST-based indices, December-February (DJF) 2022-2023

Month	Nino 1+2	Nino 3	Nino 4	Nino3.4	IOD	NTA	STA
December 2022	-1.4±0.3	-1.1±0.3	-0.8±0.2	-1.0±0.3	-0.2±0.2	0.3±0.2	-0.3±0.1
January 2023	-1.0±0.4	-0.8±0.3	-0.5±0.3	-0.7±0.4	-0.1±0.1	0.3±0.2	-0.2±0.1
February 2023	-0.4±0.4	-0.4±0.4	-0.2±0.4	-0.4±0.4	0.0±0.2	0.2±0.2	-0.1±0.1
December – February 2022-2023	-0.9±0.5	-0.7±0.4	-0.5±0.4	-0.7±0.4	-0.1±0.2	0.3±0.2	-0.2±0.1

Table 2: Multi-model forecasts for oceanic indices (℃), 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 August-October 2022. Below-normal sea-surface temperature anomalies in the Niño 3.4 and Niño 3 regions with values of approximately -0.7° C (Niño 3.4) and -0.7° C (Niño 3) are predicted during the December-February 2022-2023 season indicating a continuation of weak La Niña conditions. Farther west in the Niño 4 region, the sea-surface temperature anomaly is also predicted to remain below normal, with a value of about -0.5° C. The prediction, therefore, indicates a continuation of weak La Niña conditions in the central tropical Pacific. The IOD is predicted to be near-normal or DJF 2022-2023. In the equatorial Atlantic, SSTs are also predicted to be near-normal in both the northern (NTA) and the southern (STA) areas during the season.

2.2 Predicted temperature, December-February (DJF) 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_DJF2022_supplementary_info_LC-LRFMME.docx

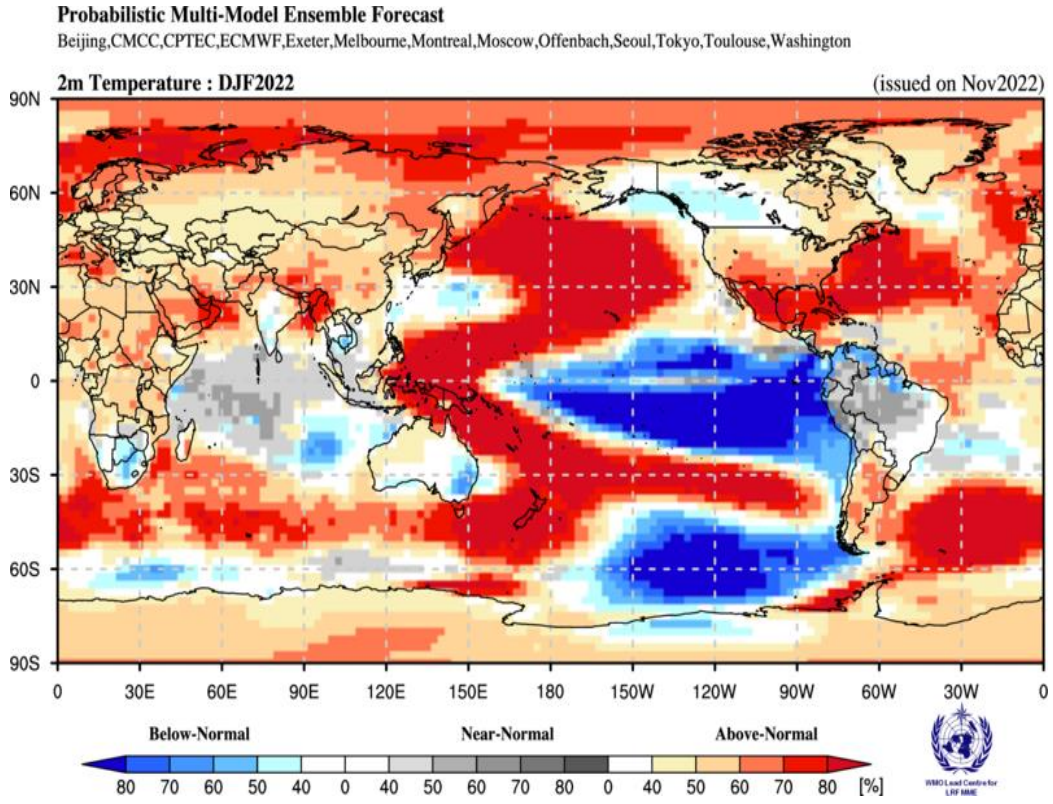


Figure 4. Probabilistic forecasts of surface air temperature for December-February 2022-2023. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in blue, red and grey shadings respectively. 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 weak La Niña condition 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. The largest increase in probabilities for above-normal temperatures are along the Arctic coast of Asia, northern parts of central America, the eastern Maritime Continent, and New Zealand. There are also small areas of strong probabilities for above-normal temperature over the eastern part of South Asia, and over the eastern part of the Arabian Peninsula. There are enhanced probabilities for above-normal temperatures over most of Asia, Europe, Africa north of about 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 west coast of North America to east coast of Asia. Over eastern Australia and along parts of the south coast, below-normal temperatures are expected to have increased probabilities. Enhanced probabilities of below-normal temperatures are also indicated over in part of southern Africa, the northern and western coasts of South America, and north-western North America. Over much of the interior part of South America, normal temperatures are the most likely outcome.

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

RA II (Asia): Enhanced probabilities for above-normal temperatures are indicated over almost all of Asia, except for parts of the Indian subcontinent and over the southeast where the forecast likelihood is for normal to below-normal temperatures. Despite the widespread predicted warmth, the probability increases are weak to moderate, and model consistency is strong only north of about 60° N and along a discontinuous band at about 30° N. The largest increases in probabilities for above-normal temperatures are along the Arctic coast, and along the Pacific coast north of central Japan. There are smaller areas of high probabilities for above-normal temperatures over the eastern Arabian Peninsula and in South Asia at about 90° E. Model consistency is high in all these areas.

RA III (South America): Weak enhanced probabilities for above-normal temperatures are indicated over South America south of about 30° S, except along the south and west coasts. Below-normal temperatures are predicted with moderate to high probability over the south and west coasts of almost the entire continent, as well as in many northern coastal areas. Model-to-model consistency is moderate to strong, but only along the immediate coastal strips. Over much of the northern parts of the continent there is a weak enhancement in the probability of 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 along the Atlantic coast of 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. For the southernmost parts of Central America and the eastern Caribbean there is no clear signal.

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 over the area. There is a sharp transition to an area of predicted below-normal temperature to the northeast, which coincides with the distribution of predicted negative sea-surface temperature anomalies associated with the prediction for La Niña conditions. Model-to-model consistency in this cold area is strong. Over Australia, there is a weak signal of below-normal temperatures in the east, and an even weaker signal of above-normal temperatures in the west.

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

2.3 Predicted precipitation, December-February (DJF) 2022-2023

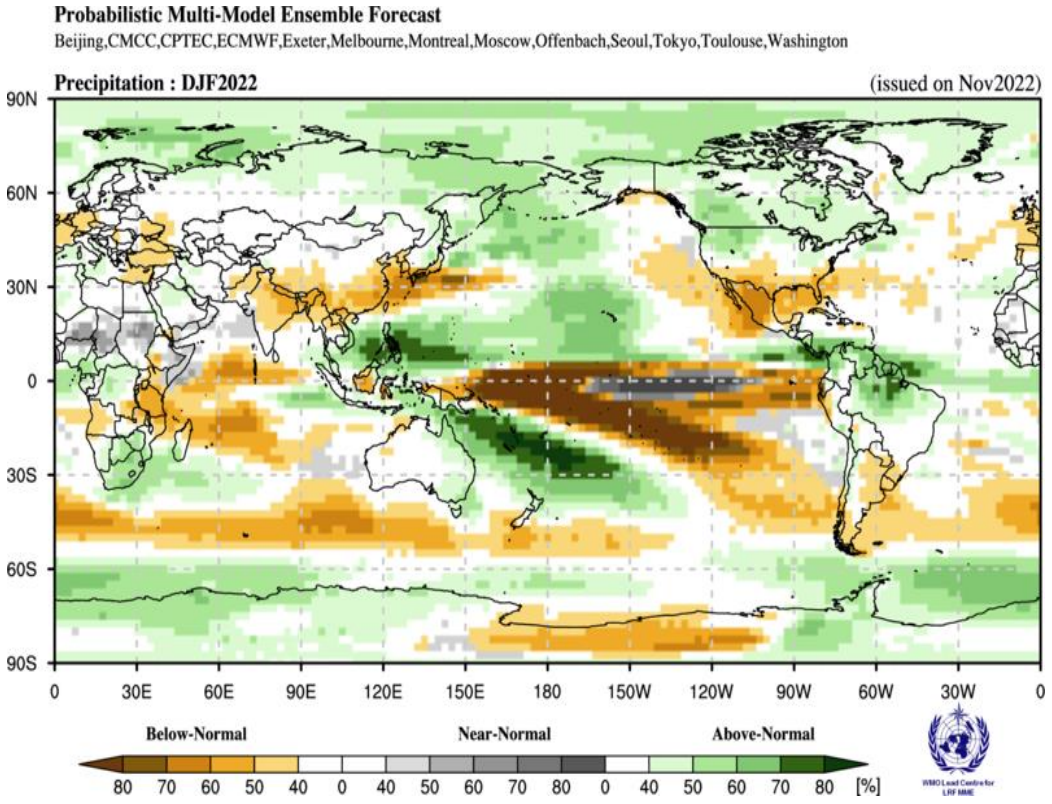


Figure 5. Probabilistic forecasts of precipitation for the season for December-February 2022-2023. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in orange, green and grey shadings 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, which is predicted to continue in DJF 2022-2023. Probabilities for above-normal rainfall are enhanced over an area extending from north of Australia, primarily off the equator, into the Southwest Pacific to an area east of New Zealand, extending to about 130° W. There is an additional narrow band of high probabilities for above-normal rainfall stretching almost continuously across the entire Pacific at about 10° N, extending over northern South America and into Central Africa. This area is broader in the western and central Pacific, and in the central Pacific it extends northwards where it expands to cover much of the Arctic and northern and central North America. Much of south-eastern Southern Africa and a small part of south-eastern Australia also have increased probabilities of above-normal rainfall. A likelihhod for anomalously dry area is predicted in the equatorial Pacific extending from north of Australia to the coast of South America, and extending southwards to the far southern part of South America. Probabilities for below-normal rainfall are high throughout this region north of about 25° S, although between about 160° and 100° W normal rainfall has the highest probability along the equator. Enhanced probabilities for below-normal precipitation are predicted over much of Eastern Africa, and over a small part of south-western Africa. Other areas with increased probabilities of below-normal rainfall are: South Asia along about 30° N extending into East Asia, the Indian subcontinent, the northern part of Central America and southern North America, south-eastern South America, and small parts of western and south-eastern Europe.

RA I (Africa): Enhanced probabilities for below-normal precipitation are predicted over much of Eastern Africa. This predicted dry area extends into the eastern Indian Ocean over the northern part of Madagascar to about 80° E. Model consistency is moderate. The area of predicted below-normal probabilities also extends to the west coast of the mainland, but consistency is weak. To the northwest of this dry area, over Central Africa and along the south coast of West Africa, probabilities for above-normal rainfall area increased, but model consistency is weak. There is greater consistency in predictions of above-normal rainfall over much of southern Africa, extending over the southern tip of Madagascar into the central South Indian Ocean. North of about 10° N over the mainland, probabilities for normal rainfall are increased, but much of these areas are desert and December – February is the dry season. In North Africa there are small patches of increased probabilities for above-normal rainfall.

RA II (Asia): Over much of the Indian subcontinent, extending eastward through East Asia, southern Japan, and along 30º N into the central Pacific, there are enhanced probabilities for below-normal rainfall and model consistency is high. Probability for below-normal rainfall is also enhanced over the central Indian Ocean along the equator and immediately to the north. Probabilities for above-normal rainfall are increased over the far northern and north-eastern regions of Asia. Model consistency is moderate to high. There is a stronger increase in the probability for above-normal rainfall over the northern Maritime Continent. The Arabian Peninsula and much of Central Asia have no clear signal and there is little to no model consistency.

RA III (South America): Northern parts of South America are predicted to have above-normal rainfall (model-to-model consistency is mostly moderate to strong). In the south-east and far southern part of the continent there is an increase in probability of below-normal rainfall, but model consistency is moderate. There are stronger signals for below-normal rainfall along the west coast near the equator and south of about 40º S. Model consistency is strong in both these areas.

RA IV (North America, Central America, and the Caribbean): There are weak increases in probabilities for above-normal precipitation indicated in much of North America north of about 40º N (much of which is likely to fall as snow). Model consistency is generally moderate, but is strong in the far north-west, and in in the central western regions. Further south, across the southern most parts of North America, and the northern half of Central America, below-normal rainfall is indicated. Model consistency is moderate to strong but weakens over the northern Caribbean. The likelihood of above-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 130º W. The probabilities and model consistency are strongest between 150º E and 150º W. This area stretches over north-eastern Australia, and reappears in the south-east of the continent. There is an additional band of high probabilities for above-normal rainfall stretching from the east coast of Southeast Asia almost continuously across the entire Pacific at about 10º N. Model consistency is high over the Philippines. Between these two wet zones, probabilities for normal and below-normal rainfall are strongly enhanced. This anomalously dry area extends from about 150º E towards the southeast reaching as far as South America, and model consistency is high throughout. Along the equator, normal rainfall has the highest probability east of about 160º W. Immediately south of Australia and New Zealand, there is a band of increased probabilities for below-normal rainfall. Model consistency is moderate.

RA VI (Europe): Most of Europe has little to no signal, but there are weak indications of below-normal precipitation in parts of western Europe and in the south-east. Model consistency is moderate. There are weak indications of above-normal precipitation in some parts of the western and central Mediterranean, and in far northern parts of the continent. Model consistency is moderate to strong. There is no clear rainfall signal over central and eastern Europe.

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.

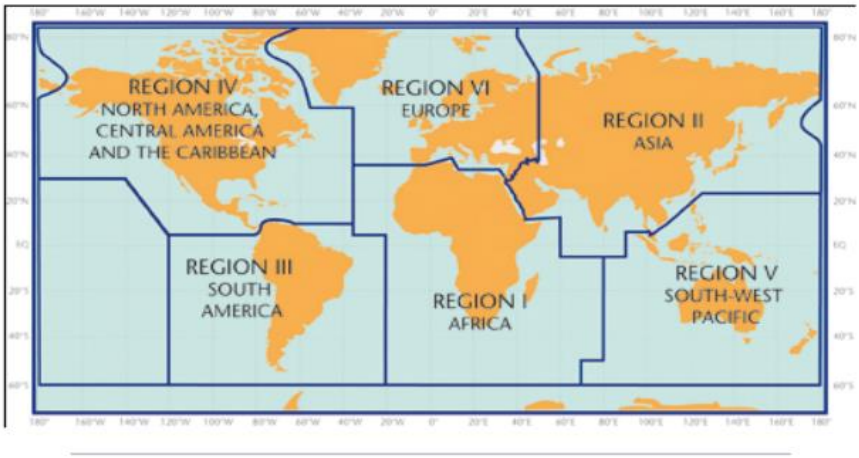
Figure 4 shows the spatial pattern of seasonal mean surface air temperature forecast probabilities. Probabilities are calculated for the average temperature for the season being in the highest third (above-normal or warm), middle third (normal) or lowest third (below-normal or cold) ranges of the baseline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