WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

GLOBAL SEASONAL CLIMATE UPDATE

TARGET SEASON: September-October-November 2022

Issued: 26 August 2022

Summary

During May-July 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 and the negative value increased from the months of May to July. The North Tropical Atlantic (NTA) and the South Tropical Atlantic (STA) SST indices were slightly positive.

For the September-November 2022 season, below-normal sea-surface temperature anomalies in the Niño 3.4 and Niño 3 regions, with values of approximately -0.9º C (Niño 3.4) and -0.7º 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. The largest increase in probabilities for above-normal temperatures are over northern Asia, coastal regions of east Asia extending into Japan, and north-eastern and eastern parts of the Indian subcontinent. There are enhanced probabilities for above-normal temperatures over most of North and Central America and the northern parts of the Caribbean. The probabilities for above-normal temperatures are highest over the northern Caribbean, eastern North America, and an area over the western part of the continent. The probabilities for above-normal temperatures are increased over almost all of Europe. In the Southern Hemisphere, 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. The Indonesian Archipelago, northern Australia and many of the southwest Pacific islands lie within this band of above-normal temperatures. Over Australia, south of 20º S, below-normal temperatures are expected to have increased probabilities. Enhanced probabilities of above-normal temperatures are indicated over some far northern and north-western parts of mainland Africa. Elsewhere over Africa, except for a narrow band along 10º N and along the west coast of southern Africa where prediction is for below-normal temperature anomalies, the probabilities for above-normal temperature is slightly enhanced. Weak enhanced probabilities for above-normal temperatures are indicated over some parts of South America south of about 10º S with notable enhance in probabilities south of 30ºS. Over the northern and north-western parts of South America, there is a weak enhancement in the probability of normal or below-normal temperature.

Predictions for rainfall are similar to canonical rainfall impacts of La Niña which is predicted to continue in SON 2022. Probabilities for above-normal rainfall are enhanced over an area extending from the western Maritime continent over the Indonesian Archipelago, primarily south of the equator, and Australia into the Southwest Pacific to an area northeast of New Zealand, and reappearing again in the south-eastern South Pacific. Over the central Pacific there is an area of strongly increased probabilities for below-normal rainfall that straddles the equator. This anomalously dry area in the Pacific extends from about 150º E towards the southeast reaching as far as South America, Along the equator normal rainfall has the highest probability east of about 150º W. Enhanced probabilities for below-normal precipitation are predicted over much of Central and Eastern Africa, along the northern parts of the continent and in coastal areas of part of the Greater Horn. Much of Europe south of about 45º N also has increased probabilities for below-normal precipitation. Over the Indian subcontinent there are enhanced probabilities for above-normal rainfall. Probability for above-normal rainfall is also enhanced over southeast Asia and over far northern regions of Asia west of 150º E., The northern regions of South America are predicted to have above-normal rainfall while south of 20º S there is an increase in probability of below-normal rainfall. There are weak increases in probabilities for above-normal rainfall indicated in the northern regions of North America, and for below-normal over the southern parts of the mainland.

Surface Air Temperature, SON 2022 **Precipitation, SON 2022**

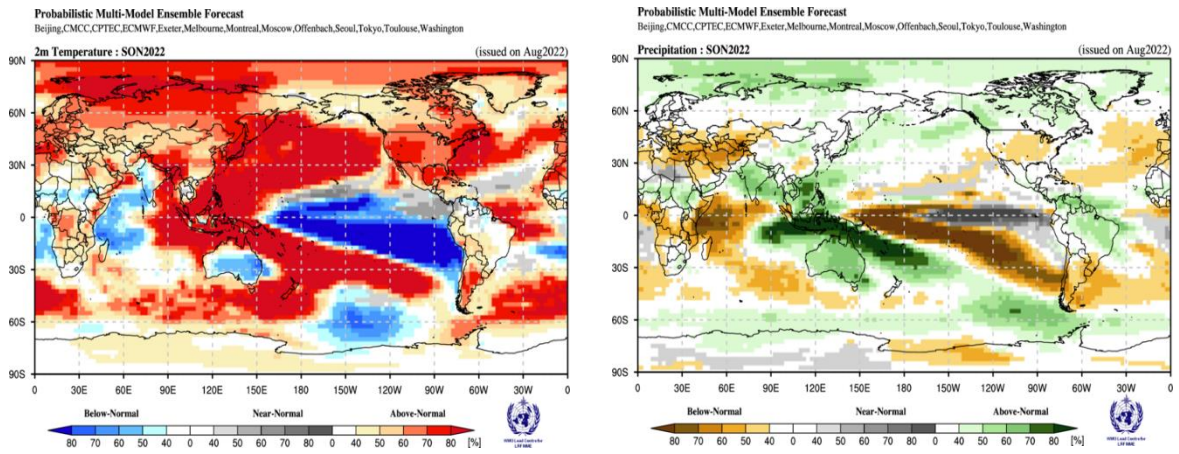


Figure 1. Probabilistic forecasts of surface air temperature and precipitation for the season September-October 2022. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in blue, red 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: May-July (MJJ) 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 May-July 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 and the negative value increased from the months of May to July. 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
May 2022	-1.4	-0.9	-0.9	-1.1	-0.6	0.3	0.1
June 2022	-1.4	-0.6	-0.6	-0.7	-0.7	0.4	0.5
July 2022	-1.2	-0.4	-0.9	-0.6	-1.1	0.3	0.2
May-July 2022	-1.3	-0.6	-0.8	-0.8	-0.8	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 May-July 2022 (Figure 2, top), and in general, above-normal temperatures were prevalent over the global land areas. The strongest positive land-temperature anomalies occurred over western and southern Europe, northern and eastern Asia, the southern US, and the northern parts of central America. Positive temperature anomalies also occurred over New Zealand, over much of South America north of 30° S, and parts of Africa that included the eastern half, western and north-western regions. Although less extensive, there were also regions with below-normal temperature anomalies including the eastern half of Australia, central west Asia and eastern Europe, south of 30° S in South America, southern regions of Central America, northwest South America, Madagascar, Greenland, isolated regions in northwest North America, parts of southern Asia from the Arabian Peninsula to the east coast of SE Asia. and a few patches over Africa.

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 extratropical North Pacific, eastern Indian Ocean, equatorial Atlantic, and in the southern Pacific along 30° S, were generally positive. A notable region having the largest positive ocean-temperature anomaly was observed in the northwest Pacific.

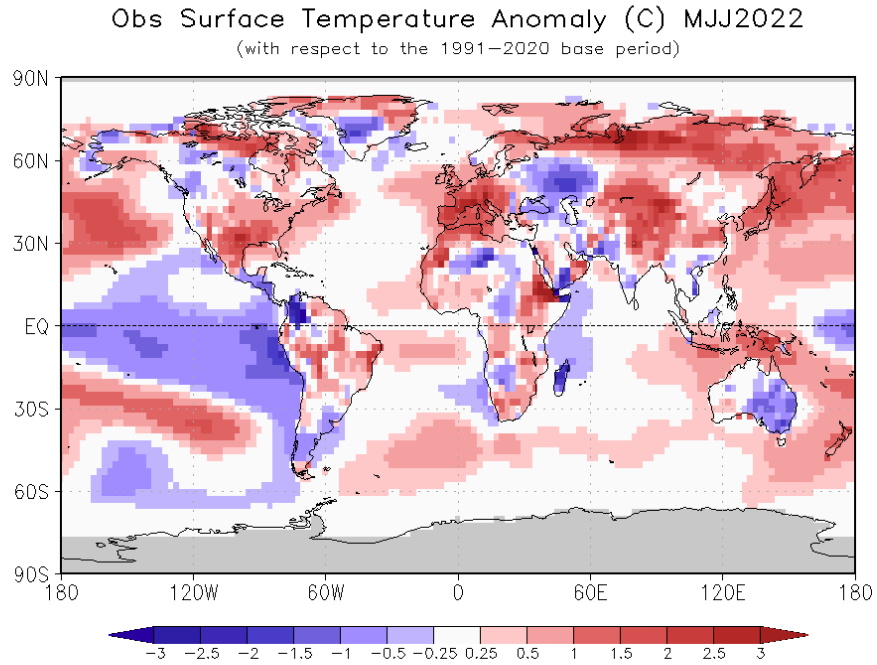
Consistent with the seasonal mean anomalies, warm temperature categories dominated (Figure 2, bottom panel). Warm extremes (exceeding all seasonal mean temperatures observed during 1991–2020), however, only occurred over a few patchy areas that included western and southern Europe, and New Zealand. Some oceanic regions also had warm extremes, notably the extratropical Pacific around 30° N, a band of SSTs starting in the western Pacific extending south-eastward towards the South American coast. Cold extremes in ocean temperature occurred south of the equator in the eastern Pacific. Few isolated regions of cold extremes were observed over the southern regions of Central America, northwest South America, Madagascar, and south-eastern Australia. No widespread extreme cold temperature was found over land areas.

1.2 Observed precipitation

For May-July 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 the western and south-western Indian Ocean, and in the north-western Pacific. Positive precipitation anomalies occurred in the oceanic regions in the vicinity of the Indonesian Archipelago, eastern Indian Ocean, and Coral Sea.

Over land, negative precipitation anomalies were observed over southern Greenland, the western half of Europe, southern regions of 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, southeast Asia, the Indonesian Archipelago, and north-eastern regions of South America. Over much of western and central Asia 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 in central Africa, north-western parts of the Indian sub-continent, northeast Asia, and New Zealand. Regions. Dry extremes were located in the Hudson Bay, the Greater Horn of Africa, and parts of southern Europe.



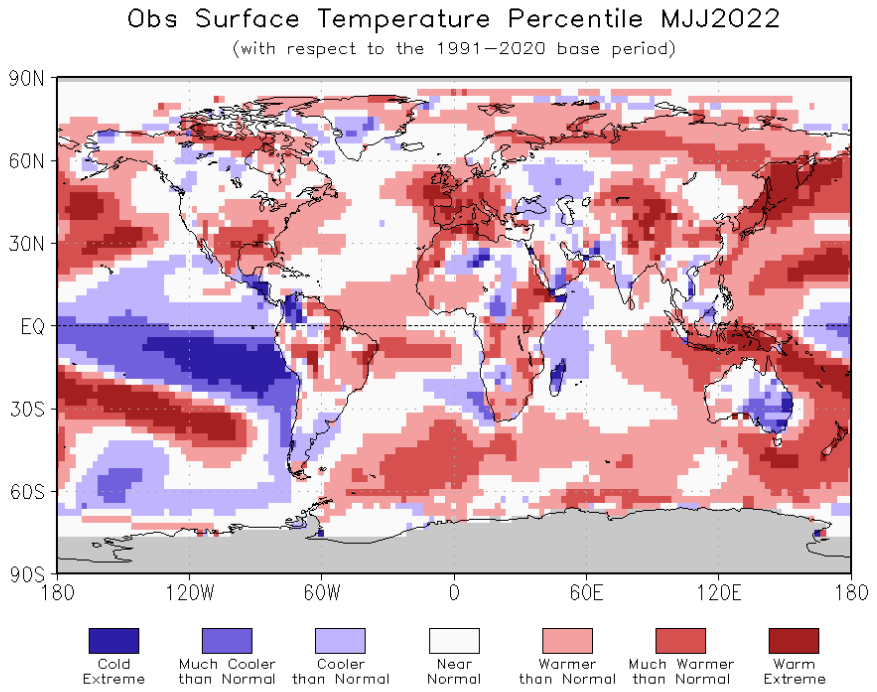
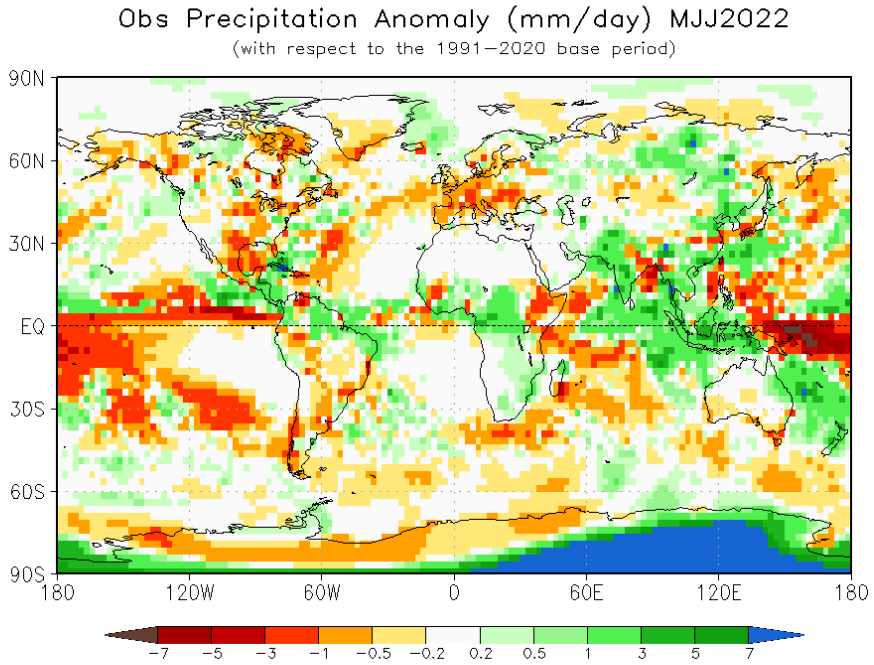


Figure 2. Observed May-July 2022 near-surface temperature anomalies relative to 1991–2020 (top). The *Cooler than Normal, Near Normal, and Warmer than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile of the 1991–2020 distribution,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



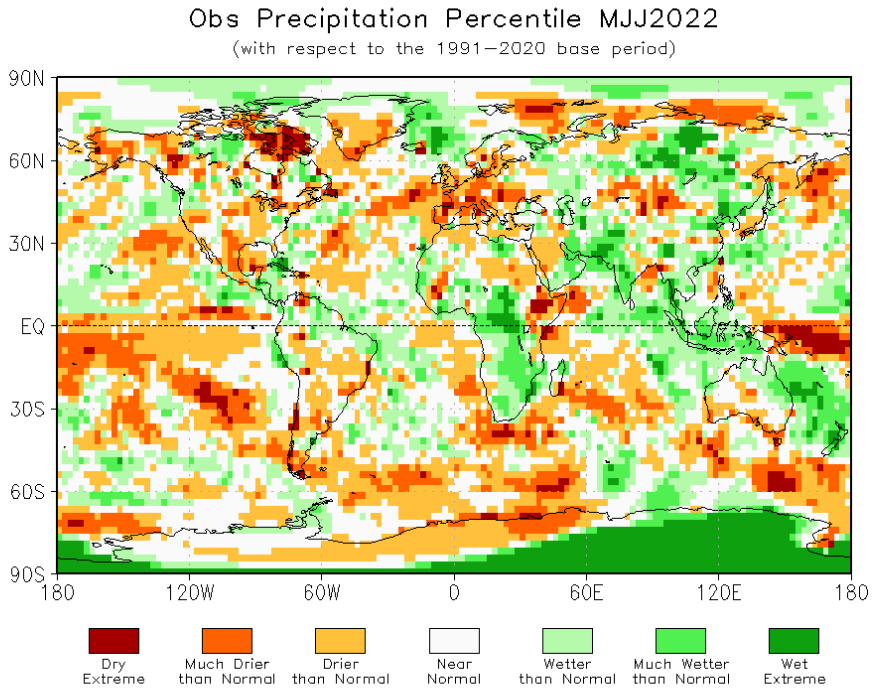


Figure 3. Observed precipitation anomalies for May-July 2022, relative to 1991–2020 base period (top). The *Drier than Normal*, *Near Normal and Wetter than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile of the 1991–2020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

2.1 Large-scale SST-based indices, September-November (SON) 2022

Month	Nino 1+2	Nino 3	Nino 4	Nino3.4	IOD	NTA	STA
September 2022	-0.7±0.3	-0.7±0.3	-0.9±0.2	-0.8±0.3	-1.2±0.2	0.1±0.1	-0.1±0.1
October 2022	-0.7±0.3	-0.7±0.3	-0.9±0.2	-0.9±0.4	-1.2±0.2	0.1±0.1	-0.1±0.1
November 2022	-0.7±0.2	-0.7±0.4	-0.8±0.3	-0.9±0.4	-0.8±0.3	0.1±0.1	-0.1±0.1
September-November 2022	-0.7±0.3	-0.7±0.3	-0.9±0.3	-0.9±0.3	-1.1±0.3	0.1±0.1	-0.1±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 May-July 2022. Below-normal sea-surface temperature anomalies in the Niño 3.4 and Niño 3 regions with values of approximately -0.9° C (Niño 3.4) and -0.7° C (Niño 3) are predicted during the September-November 2022 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 -0.9° C. The SON 2022 prediction, therefore, indicates a continuation of weak La Niña conditions in the central tropical Pacific. The IOD is predicted to be negative over SON 2022. 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, September-November (SON) 2022

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_SON2022_supplementary_info_LC-LRFMME.docx

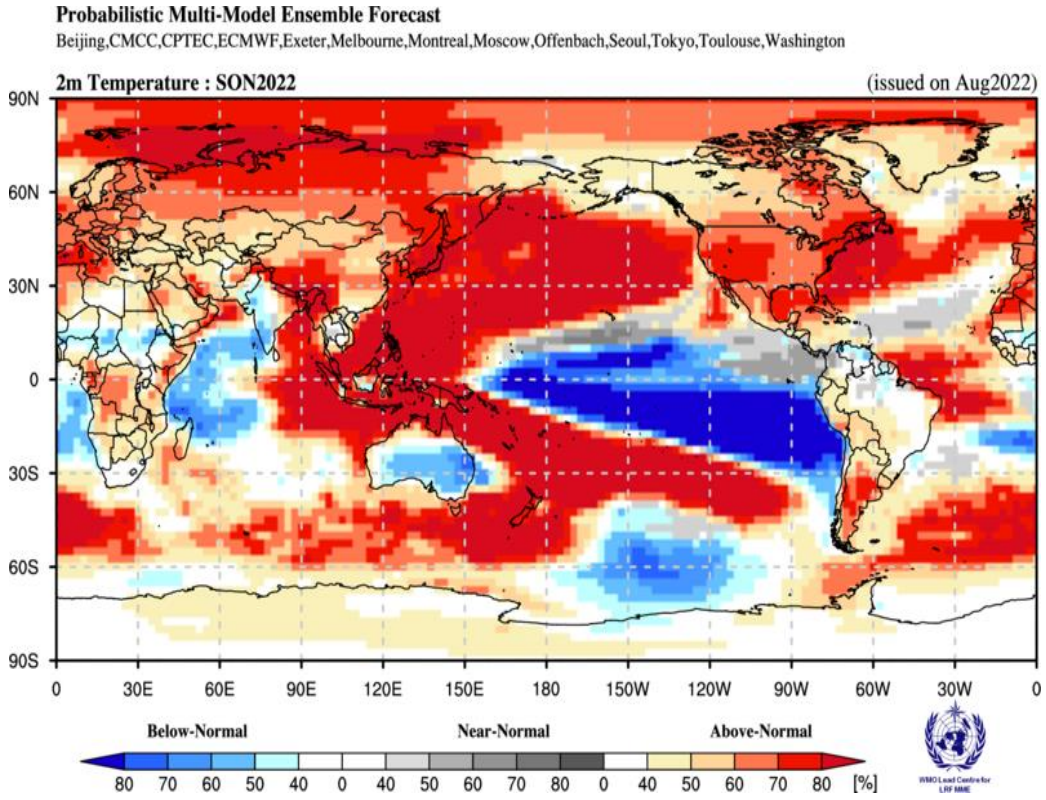


Figure 4. Probabilistic forecasts of surface air temperature for September-November 2022. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in blue, red and grey shadings respectively. 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. The largest increase in probabilities for above-normal temperatures are over northern Asia, coastal regions of east Asia extending into Japan, and north-eastern and eastern parts of the Indian subcontinent. There are enhanced probabilities for above-normal temperatures over most of North and Central America and the northern parts of the Caribbean. The probabilities for above-normal temperatures are highest over the northern Caribbean, eastern North America, and an area over the western part of the continent. The probabilities for above-normal temperatures are increased over almost all of Europe. In the Southern Hemisphere, 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. The Indonesian Archipelago, northern Australia and many of the southwest Pacific islands lie within this band of above-normal temperatures. Over Australia, south of 20° S, below-normal temperatures are expected to have increased probabilities. Enhanced probabilities of above-normal temperatures are indicated over some far northern and north-western parts of mainland Africa. Elsewhere over Africa, except for a narrow band along 10° N and along the west coast of southern Africa where prediction is for below-normal temperature anomalies, the probabilities for above-normal temperature is slightly enhanced. Weak enhanced probabilities for above-normal temperatures are indicated over some parts of South America south of about 10° S with notable enhance in probabilities south of 30°S. Over the northern and north-western parts of South America, there is a weak enhancement in the probability of normal or below-normal temperature.

RA I (Africa): Enhanced probabilities of above-normal temperatures are indicated over some far northern and north-western parts of mainland Africa, and the model consistency is moderate to high over these areas. Elsewhere over Africa, except for a narrow band along 10° N and along the west coast of southern Africa where prediction is for below-normal temperature anomalies, the probabilities for above-normal temperature are slightly enhanced. The southern region of Madagascar has increased probabilities of above-normal temperatures, but the signal is rather weak, and consistency is moderate. In the southernmost part of Africa there is no clear indication for a signal.

RA II (Asia): Enhanced probabilities for above-normal temperatures are indicated over most of Asia, except for parts of the Indian subcontinent where the forecast is for below-normal temperatures. The largest increase in probabilities for above-normal temperatures are over northern Asia, coastal regions of east Asia extending into Japan, and north-eastern and eastern parts of the Indian subcontinent. In all these regions model consistency is high. The prediction for probabilities for above-normal temperature are weakly enhanced over the Arabian Peninsula and Central Asia and the model consistency is low. There is no clear indication for signal over southeast Asia.

RA III (South America): Weak enhanced probabilities for above-normal temperatures are indicated over some parts of South America south of about 10° S. Model-to-model consistency, however, is strong only south of 30° S. Over northern and north-western parts of the continent there is a weak enhancement in the probability of normal or below-normal temperature and the model consistency is low. The prediction for normal to below-normal temperatures also extends along a narrow strip of western coastal regions throughout the continent. There is no clear signal over the north-eastern parts of South America.

RA IV (North America, Central America, and the Caribbean): There are enhanced probabilities for above-normal temperatures over most of North and Central America and the northern part of the Caribbean. The probabilities for above-normal temperatures are highest over the northern Caribbean, eastern North America, and an area over the western part of the continent. Model-to-model consistency is high over most areas east of about 120° W. Over Central America, the probability for above-normal temperature is largest over the northern regions and decreases towards the southern regions.

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. The Indonesian Archipelago, northern Australia and many of the southwest Pacific islands lie within this band of above-normal temperatures, and model-to-model consistency is strong over most of the area. There is a sharp transition to an area of predicted below-normal temperature to the northeast, but largely south of the equator, 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, south of 20° S, below-normal temperatures are expected to have increased probabilities and the model consistency is low.

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

2.3 Predicted precipitation, September-November (SON) 2022

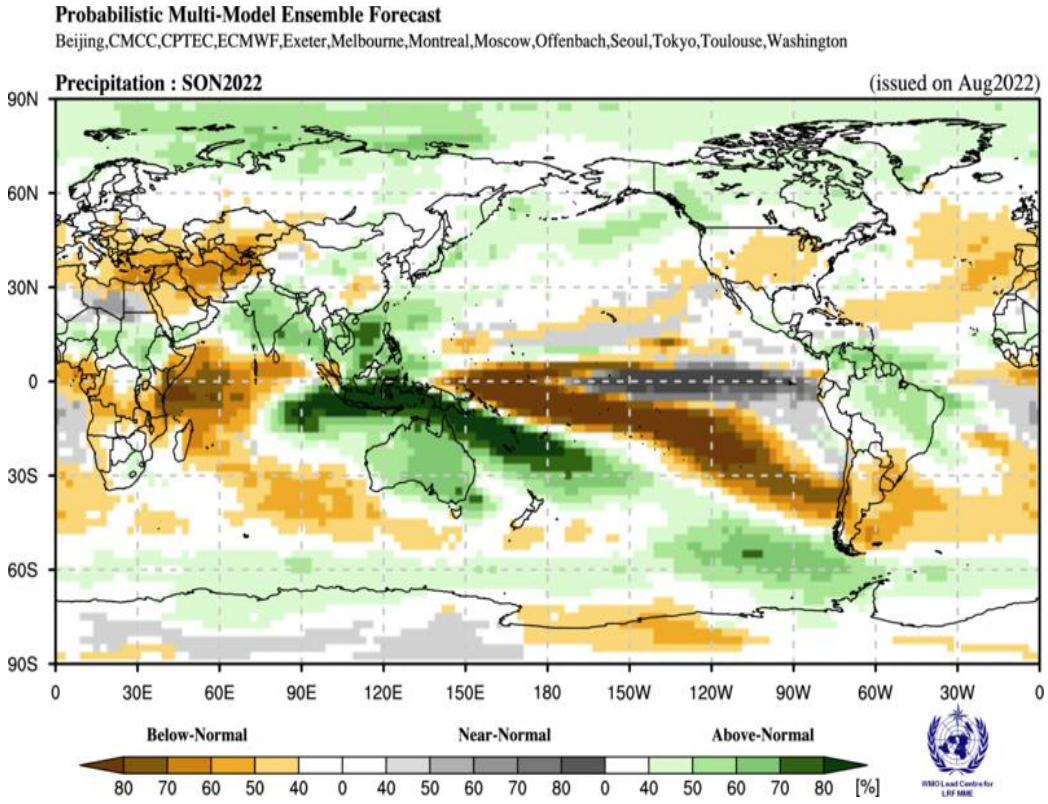


Figure 5. Probabilistic forecasts of precipitation for the season for September-November 2022. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in orange, green and grey shadings 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 canonical rainfall impacts of La Niña which is predicted to continue in SON 2022. Probabilities for above-normal rainfall are enhanced over an area extending from the western Maritime continent over the Indonesian Archipelago, primarily south of the equator, and Australia into the Southwest Pacific to an area northeast of New Zealand, and reappearing again in the south-eastern South Pacific. Over the central Pacific there is an area of strongly increased probabilities for below-normal rainfall that straddles the equator. This anomalously dry area in the Pacific extends from about 150° E towards the southeast reaching as far as South America, Along the equator normal rainfall has the highest probability east of about 150° W. Enhanced probabilities for below-normal precipitation are predicted over much of Central and Eastern Africa, along the northern parts of the continent and in coastal areas of part of the Greater Horn. Much of Europe south of about 45° N also has increased probabilities for below-normal precipitation. Over the Indian subcontinent there are enhanced probabilities for above-normal rainfall. Probability for above-normal rainfall is also enhanced over southeast Asia and over far northern regions of Asia west of 150° E., The northern regions of South America are predicted to have above-normal rainfall while south of 20° S there is an increase in probability of below-normal rainfall. There are weak increases in probabilities for above-normal rainfall indicated in the northern regions of North America, and for below-normal over the southern parts of the mainland.

RA I (Africa): Enhanced probabilities for below-normal precipitation are predicted over much of Central and Eastern Africa, extending along the south coast of West Africa and the west coast of southern Africa, along northern parts of the continent and in coastal areas of part of the Greater Horn, and the model consistency is moderate to high in all these regions. The Sahelian belt and the north-western half of the Greater Horn have increased chances of above-normal precipitation, but the signal is not strong, especially over the Sahel. Over southern Africa, there is no clear indication for rainfall signal.

RA II (Asia): Over the Indian subcontinent there are enhanced probabilities for above-normal rainfall and model consistency is moderate to high. Probability for above-normal rainfall is also enhanced over southeast Asia and model consistency is moderate. Probability for above-normal rainfall is increased over the far northern regions of Asia west of 150º E. There is an increase in the probability for below-normal rainfall over the Arabian Peninsula extending toward Central Asia and model consistency is moderate to strong.

RA III (South America): The northern regions of South America are predicted to have above-normal rainfall (model-to-model consistency is mostly moderate to strong). South of 20º S there is an increase in probability of below-normal rainfall, and model consistency is moderate to strong.

RA IV (North America, Central America, and the Caribbean): There are weak increases in probabilities for above-normal rainfall indicated in the northern regions of North America, and for below-normal over the southern parts of the mainland. Model consistency is moderate in both areas. The likelihood of above normal rainfall is enhanced over the southern part of Central America. Model consistency is only moderate. Over much of the Caribbean there is no clear signal except over the northeast where there is an increase in probability for below-normal rainfall.

RA V (Southwest Pacific): Probabilities for above-normal rainfall are enhanced over an area extending from the western Maritime continent over the Indonesian Archipelago, primarily south of the equator, and Australia into the Southwest Pacific to an area northeast of New Zealand, and reappearing again in the south-eastern South Pacific. The model consistency is high in much of the eastern section of this area. Probabilities are strongly enhanced along about 10º S and between 90º and 160º E. Over the central Pacific there is an area of strongly increased probabilities for below-normal rainfall that straddles the equator. 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 150º W.

RA VI (Europe): Much of Europe south of about 45º N has increased probabilities for below-normal precipitation and model consistency is moderate to strong. There is no clear rainfall signal over northern 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.

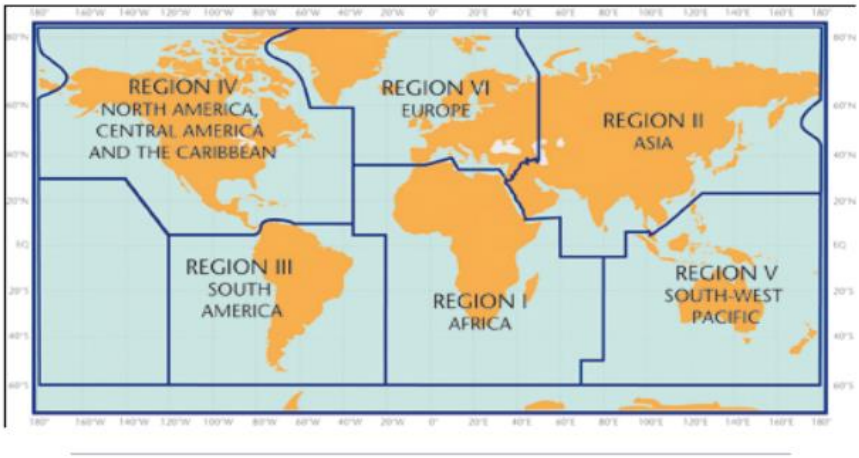
Figure 4 shows the spatial pattern of seasonal mean surface air temperature forecast probabilities. Probabilities are calculated for the average temperature for the season being in the highest third (above-normal or warm), middle third (normal) or lowest third (below-normal or cold) ranges of the baseline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