WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

GLOBAL SEASONAL CLIMATE UPDATE

TARGET SEASON: September-October-November 2021

Issued: 24 August 2021

Summary

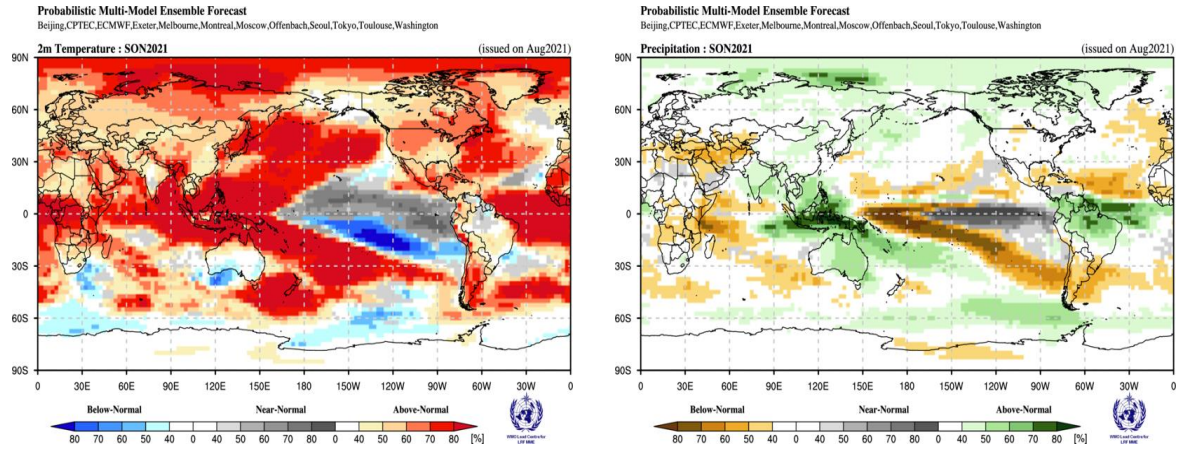
During May-July 2021, the four Pacific Niño sea-surface temperature (SST) indices in the central and eastern Pacific were near-normal The observed SST conditions were characterized by an ENSO-neutral state in the equatorial tropical Pacific. The Indian Ocean Dipole (IOD) over the observed period was negative. The North Tropical Atlantic (NTA) SST index was near-zero, and the South Tropical Atlantic (STA) SST index was positive and increased from May 2021 to July 2021, possibly indicating Atlantic Niño conditions.

Over the oceans, the south of the eastern Pacific below the equator, and the northern Atlantic had cooler or near normal temperatures. In the extratropical southern oceans near-to-below average temperatures generally prevailed. SSTs in the equatorial central Pacific indicated ENSO-neutral condition, with positive anomalies in the western equatorial Pacific and a tendency towards negative anomalies in the central and eastern Pacific.

Although a weak La Niña condition is predicted to return in the equatorial central and eastern Pacific, the widespread warmer global sea-surface temperature anomalies more generally are predicted to dominate the forecast of air temperatures for September-November 2021. Air temperature anomalies over land are expected to be strongest in the Northern Hemisphere. Positive temperature anomalies are expected over almost the whole northern hemisphere, with the only exception being the Indian subcontinent. The largest land air-temperature anomalies are expected over the central eastern part of North America, the far northern part of Asia and the Arctic. The models are most consistent in their predictions of an anomalously warm September-November 2021 over the said part of North America, and northern parts of Asia. Consistency for above-normal temperature is also high over Europe, northern Africa, central America, and far eastern Asia, although the predicted positive anomalies are not as high in these areas. In near-equatorial latitudes, positive temperature anomalies are predicted with high consistency in the Maritime subcontinent, and along the south coast of West Africa. In the Southern Hemisphere with the exception of most of Australia where temperature is predicted either to be near or slightly below normal, most of the land areas are predicted to have weak positive air temperature anomalies and model consistency is only weak to moderate. Other areas of below-normal temperatures are predicted only for areas in the vicinity of the expected weak La Niña in the central and eastern Pacific, and in small areas over the sea, including to the south of Madagascar, near the west coast of North America, and in a few areas along about 60°S.

Although negative SST anomalies associated with the expected La Niña conditions are weak, because of an enhanced east-west SST gradient, together with prediction for the negative phase of the IOD, typical rainfall anomalies associated with La Niña are still predicted. There are increased chances of unusually dry conditions near and west of the dateline, in parts of the South Pacific and anomalously wet conditions to the west and south-west Pacific that are canonical impacts of a La Niña. Along the equator across most of the central and eastern Pacific Ocean, probabilities are highest for near-normal rainfall. Over the Caribbean there is a moderate to strong indication of below-normal rainfall, and an east-west band of above-normal rainfall immediately to the south and just to the north of the equator. Increased chances of below-normal precipitation are also indicated over many parts of South America south of 30°S with above-normal rainfall anomalies to its north. Over much of the Mediterranean extending into the Arabian Peninsula and central Asia, and over the southern parts of central and eastern Africa higher probabilities for below-normal rainfall are also predicted. Areas of weakly increased probabilities for above-normal rainfall include some scattered locations in high latitudes of the northern hemisphere, Indian subcontinent, and Australia.

Surface Air Temperature, SON 2021 **Precipitation, SON 2021**



During May-July 2021, the four Pacific Niño sea-surface temperature (SST) indices in the central and eastern Pacific were near-normal The observed SST conditions were characterized by an ENSO neutral state in the equatorial tropical Pacific. The Indian Ocean Dipole (IOD) over the observed period was negative. The North Tropical Atlantic (NTA) SST index was near-zero, and the South Tropical Atlantic (STA) SST index was positive and increased from May 2021 to July 2021, possibly indicating emerging Atlantic Niño conditions.

Figure 1. Probabilistic forecasts of surface air temperature and precipitation for the season September-November 2021. 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 2021

In the following sections, observed temperature and precipitation patterns for the period May-July 2021 are briefly described. 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

Month	Niño 1+2	Niño 3	Niño 4	Niño 3.4	IOD	NTA	STA
May 2021	-0.7	-0.4	-0.1	-0.3	-0.3	-0.4	0.5
June 2020	0.1	-0.2	-0.1	-0.2	-0.5	-0.1	0.6
July 2021	0.5	-0.1	-0.2	-0.3	-0.5	-0.1	0.9
May-July 2021	0.0	-0.2	-0.2	-0.3	-0.4	-0.2	0.7

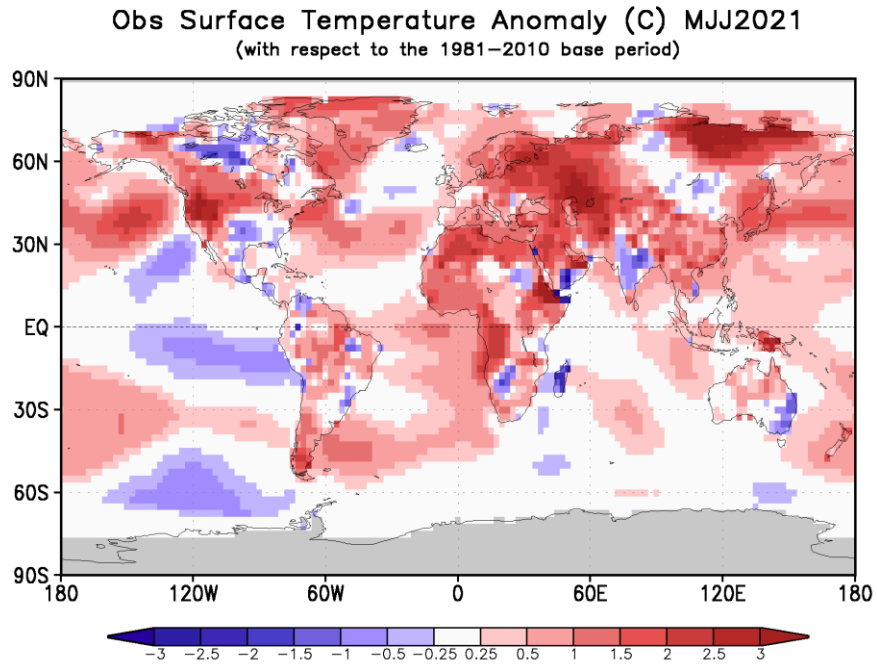
Table 1. Large-scale oceanic indices (°C). Anomalies are with respect to the 1981–2010 average. (*Source:* U.S. Climate Prediction Center)

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 2021 (Figure 2, top), and in general, above-normal temperatures dominated the global land areas. The most strongly positive land-temperature anomalies occurred over central Asia, eastern Europe, northeast Asia, northwest and central Africa, and western North America. Positive temperature anomalies also occurred over much of South America, Greenland, and the rest of Africa. May-July 2021 also had some regions with below-normal temperature anomalies including the Indian subcontinent, and south-eastern and far northern regions of North America.

Over the oceans, the south of the eastern Pacific below the equator, and the northern Atlantic had cooler or near normal temperatures. In the extratropical southern oceans near-to-below average temperatures generally prevailed. SSTs in the equatorial central Pacific indicated ENSO-neutral condition, with positive anomalies in the western equatorial Pacific and a tendency towards negative anomalies in the central and eastern Pacific - a pattern that indicates enhanced zonal SST gradients across the equatorial Pacific. SST anomalies throughout the extratropical North Pacific and central Atlantic along 30ºN were generally positive. A notable region having the largest observed warm ocean-temperature anomaly was in the northeast Pacific.

Consistent with the seasonal mean anomalies, warm extremes dominated (Figure 2, bottom panel). Warm extremes (exceeding all seasonal mean temperatures observed during 1981–2010) occurred over western North America, central and western Africa, and regions of central Asia. No significant widespread extreme cold temperature was found over land areas. Some oceanic regions also had warm extremes, notably extratropical northeast Pacific and north-western Atlantic off the eastern coast of North America.



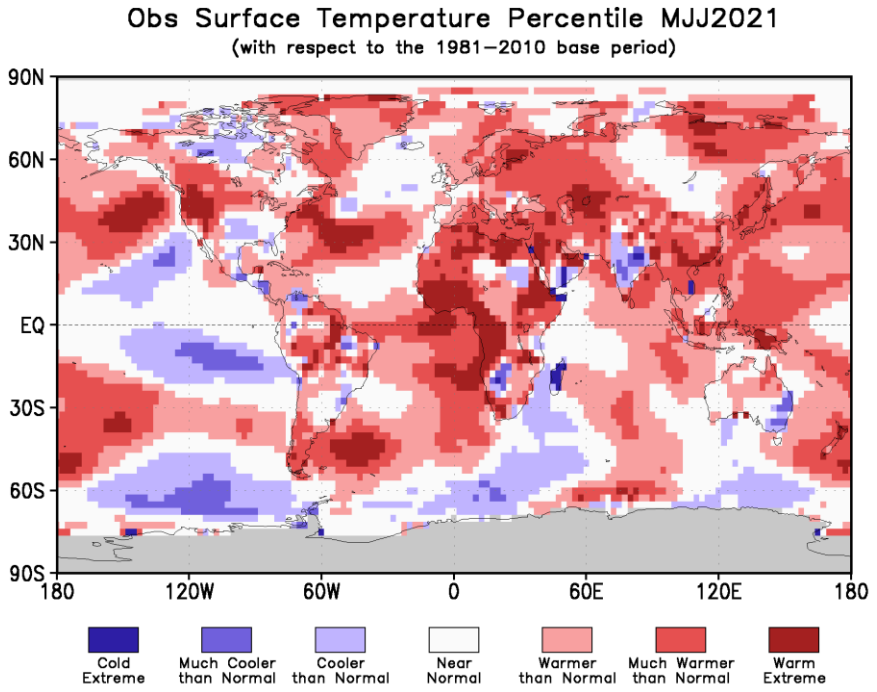
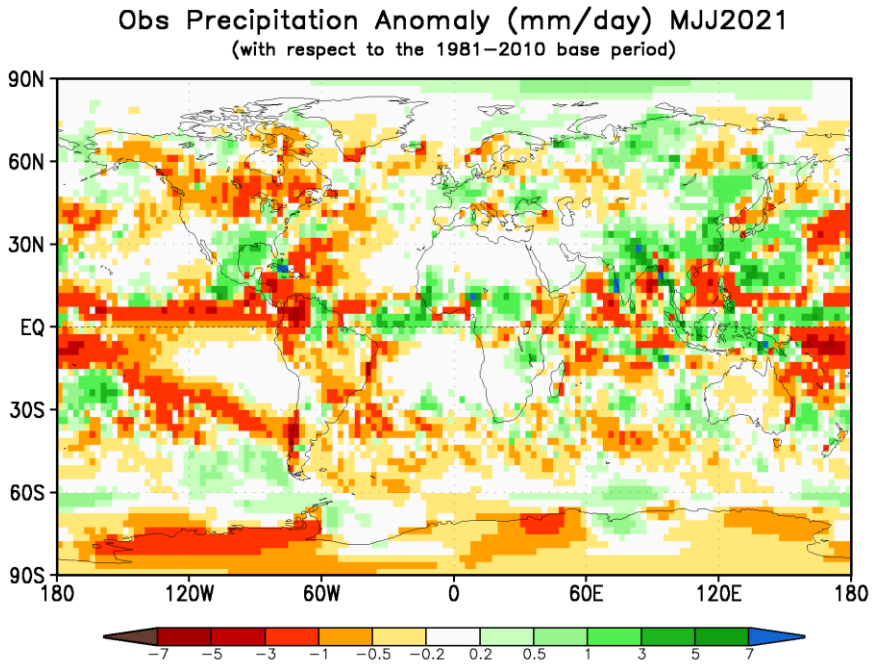


Figure 2. Observed May-July 2021 near-surface temperature anomalies relative to 1981–2010 (top). The *Cooler than Normal, Near Normal, and Warmer than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile of the 1981–2010 distribution, 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 1981–2010 period for the season. Grey shading indicates areas where observational analysis was not available. (*Source:* U.S. Climate Prediction Center).



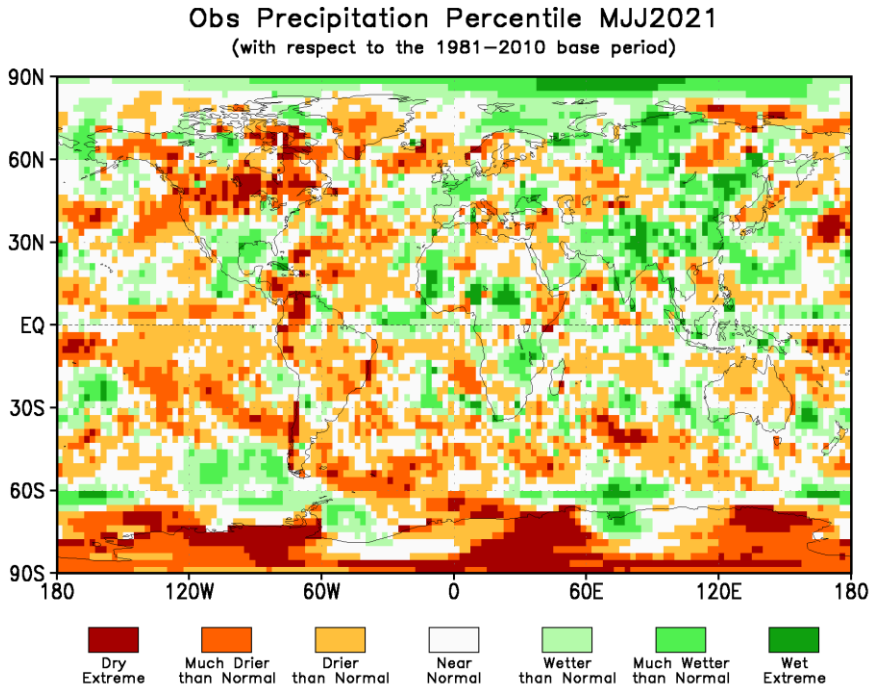


Figure 3. Observed precipitation anomalies for May-July 2021, relative to 1981–2010 base period (top). The *Drier than Normal*, *Near Normal and Wetter than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile of the 1981–2010 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 1981–2010 period for the season.
(*Source:* U.S. Climate Prediction Center).

1.3 Observed precipitation

For May-July 2021, the largest negative precipitation anomalies were in the equatorial Pacific near the date-line extending into the western Pacific with a narrower equatorial band extending into the eastern Pacific, and a band extending into the southern Pacific towards South America (Fig. 3, top panel). Below-normal precipitation anomalies also occurred in the northwest Atlantic above 15ºN, northern regions of North America, and over almost the entirety of South America and Australia. West of the negative anomalies in the equatorial western Pacific, positive precipitation anomalies extended into the Indonesian Archipelago. Positive precipitation anomalies also occurred over the Indian subcontinent extending into eastern Asia, and southwestern regions of North America.

Except over a small region in northeast North America where precipitation was extremely dry, no large-scale systematic regions with dry or wet extremes (precipitation below or above all seasonal totals observed during 1981-2010) over land occurred.

2. Potential evolution of the state of the climate over the next three months (September-November 2021)

2.1 Large-scale SST-based indices, September-November 2021

Month	Nino 1+2	Nino 3	Nino 4	Nino3.4	IOD	NTA	STA
September 2021	0.1±0.4	-0.3±0.3	-0.3±0.1	-0.4±0.22	-0.7±0.2	0.2±0.1	0.2±0.1
October 2021	-0.1±0.3	-0.4±0.3	-0.4±0.2	-0.5±0.3	-0.7±0.3	0.2±0.1	0.1±0.1
November 2021	-0.2±0.3	-0.5±0.3	-0.4±0.2	-0.6±0.3	-0.5±0.3	0.2±0.1	0.1±0.1
September - November 2021	-0.1±0.3	-0.4±0.3	-0.4±0.2	-0.5±0.3	-0.6±0.3	0.2±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 CPTEC, ECMWF, Exeter, Melbourne, Montreal, Moscow, 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 the ENSO Neutral condition during May-June 2021. The below-normal sea-surface temperature anomalies in the Niño 3.4 and Niño 3 regions with values of approximately -0.5ºC (Niño 3.4) and -0.4 (Niño 3) are predicted during the September-November 2021 season, and indicate a small increase in negative anomalies. Farther west in the Niño 4 region, the sea-surface temperature anomaly is also predicted to be negative, with a value of about -0.4°C. The SON 2021 prediction, therefore, indicates a return to weak La Niña conditions in the central tropical Pacific. The IOD is predicted to be below-normal over the three months SON 2021. In the equatorial Atlantic, SSTs are predicted to be near-normal in both the northern (NTA) and the southern (STA) areas during the season. For STA, this indicates a decline from the above-normal to near-normal conditions.

2.2 Predicted temperature, September-November 2021

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_SON2021_supplementary_info_LC-LRFMME.docx

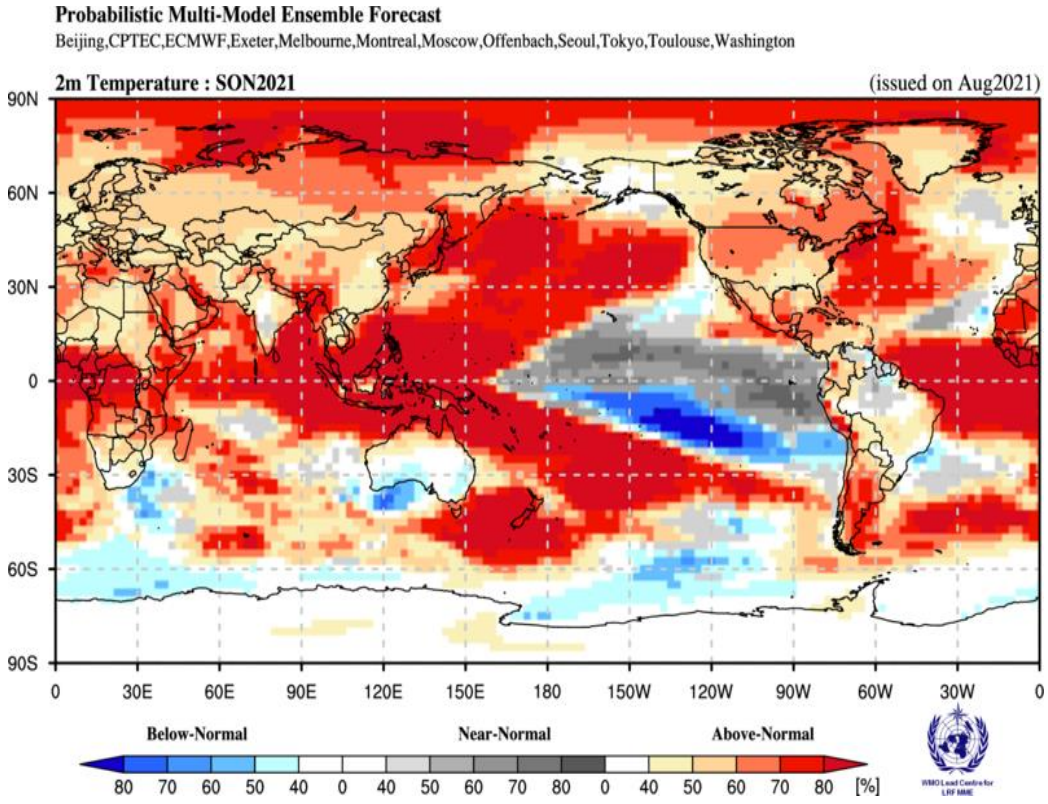


Figure 4. Probabilistic forecasts of surface air temperature for September-November 2021. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in blue, red and grey shadings respectively. 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 weak La Niña condition is predicted to return in the equatorial central and eastern Pacific, the widespread warmer global sea-surface temperature anomalies more generally are predicted to dominate the forecast of air temperatures for September-November 2021. Air-temperature anomalies over land are expected to be strongest in the Northern Hemisphere. Positive temperature anomalies are expected over almost the whole northern hemisphere, with the only exception being the Indian subcontinent. The largest land air-temperature anomalies are expected over the central eastern part of North America, the far northern part of Asia and the Arctic. The models are most consistent in their predictions of an anomalously warm September-November 2021 over the said part of North America, and northern parts of Asia. Consistency for above-normal temperature is also high over Europe, northern Africa, central America, and far eastern Asia, although the predicted positive anomalies are not as high in these areas. In near-equatorial latitudes, positive temperature anomalies are predicted with high consistency in the Maritime subcontinent, along the south coast of West Africa. In the Southern Hemisphere with the exception of most of Australia where temperature is predicted either to be near or slightly below normal, most of the land areas are predicted to have weak positive air temperature anomalies and model consistency is only weak to moderate. Other areas of below-normal temperatures are predicted only for areas in the vicinity of the expected weak La Niña in the central and eastern Pacific, and in small areas over the sea, including to the south of Madagascar, near the west coast of North America, and in a few areas along about 60°S.

RA I (Africa): Enhanced probabilities of above-normal temperatures are indicated over almost the entire mainland of Africa plus Madagascar. Probabilities are strongest in north-western Africa, and in near equatorial regions extending from the south coast of West Africa through to the Greater Horn of Africa. In southern and north-eastern Africa probabilities of above-normal temperatures are weaker than for most of the rest of the continent, but still increased, except over the southernmost region where there is no clear indication for a signal (and model consistency is also weak). Model-to-model consistency is moderate to high over the rest of the continent.

RA II (Asia): Enhanced probabilities for above-normal temperatures are indicated over the whole of Asia, except for the Indian subcontinent and parts of southeast Asia, where there is no clear indication for the temperature signal. The probabilities for above-normal temperatures are highest over the far eastern regions of east Asia, along about 90ºE in the eastern parts of the Himalayas, and north of 60ºN in northern Asia. Model-to-model consistency for these same regions is moderate to high.

RA III (South America): Enhanced probabilities for above-normal temperatures are indicated over the southern parts of South America and along the western coastal regions in a narrow band over the Andes. Probabilities for near-normal temperatures dominate over the north-central parts of the continent. The increases in probability are largest over the southernmost part of the continent, and along a narrow band over the Andes north of about 20ºS. The level of model consistency is moderate to strong and is particularly strong south of about 30 ºS. This same area experienced an unusually warm May-July 2021.

RA IV (North America, Central America and the Caribbean): There are enhanced probabilities for above-normal temperatures over almost the entire North America as well as over Central America and the Caribbean. The probabilities for above-normal temperatures are highest over much of the western and central regions of North America and over the northern part of the Caribbean and neighbouring areas of Central America. There is no clear indication for the temperature signal over the far north-western regions of North America, where model consistency is weak. Model-to-model consistency is generally high over the rest of the region.

RA V (Southwest Pacific): Strongly enhanced probabilities for above-normal temperatures are predicted in a band from north of Australia, extending to the central South Pacific, and along about 40ºS from New Zealand towards the eastern Pacific to about 120ºW. The Indonesian Archipelago 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, which coincides with the distribution of predicted negative sea-surface temperature anomalies associated with the expected La Niña conditions. Model-to-model consistency in this cold area is strong. Along the equator and east of the dateline, and to its north, probability for near-normal temperatures dominate. Over most of Australia, there is no indication for a clear signal except over the far northern region where the temperature is predicted to be above-normal and far southern regions where it is predicted to be below-normal with weak model-to-model consistency.

RA VI (Europe): The probabilities for above-normal temperatures are increased over most of Europe and are fairly uniform across the entire region. The model-to-model consistency is strongest in south-western and eastern Europe, and over northern Greenland.

2.3 Predicted precipitation, September-November 2021

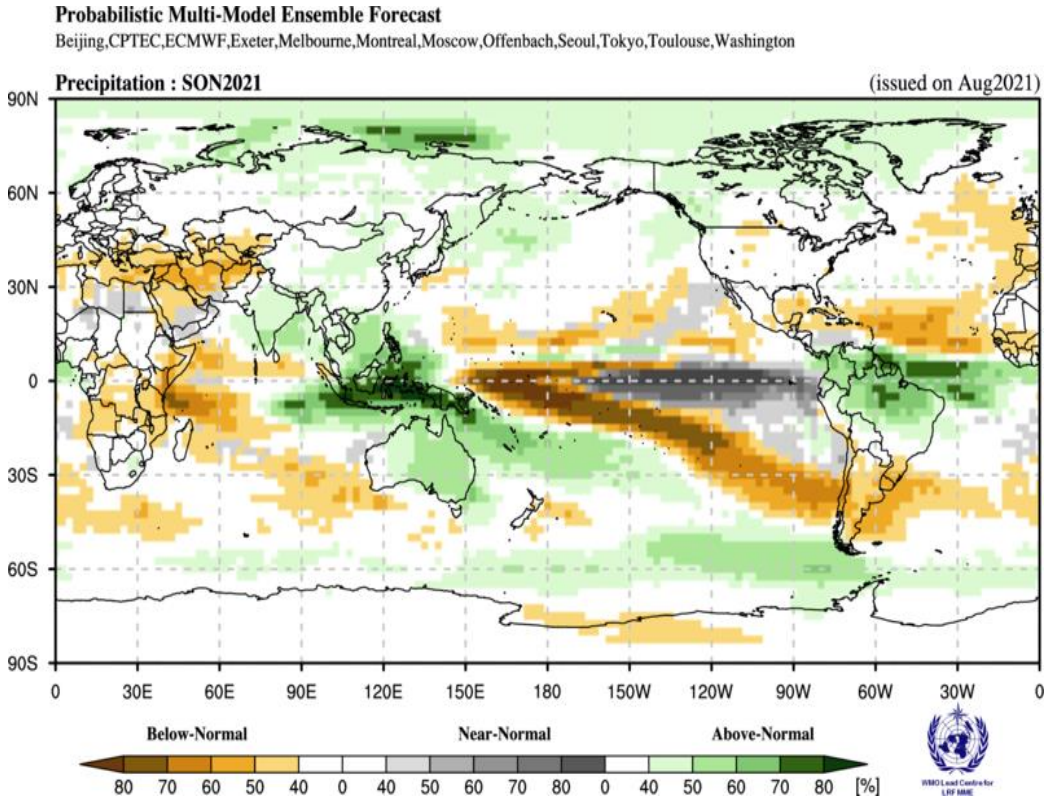


Figure 5. Probabilistic forecasts of precipitation for the season for September-November 2021. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in orange, green and grey shadings 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.

Although negative SST anomalies associated with the expected La Niña conditions are weak, because of an enhanced east-west SST gradient, typical rainfall anomalies associated with a La Niña are still predicted. There are increased chances of unusually dry conditions near and west of the dateline, in parts of the South Pacific and anomalously wet conditions to the west and south-west Pacific that are canonical impacts of a La Niña. Along the equator across most of the central and eastern Pacific Ocean, probabilities are highest for near-normal rainfall. Over the Caribbean there is a moderate to strong indication of below-normal rainfall, and an east-west band of above-normal rainfall immediately to the south and just to the north of the equator. Increased chances of below-normal precipitation are also indicated over many parts of South America south of 30ºS with above-normal rainfall anomalies to its north. Over much of the Mediterranean extending into the Arabian Peninsula and central Asia, and over the southern parts of central and eastern Africa higher probabilities for below-normal rainfall are also predicted. Areas of weakly increased probabilities for above-normal rainfall include some scattered locations in high latitudes of the northern hemisphere, Indian subcontinent, and Australia.

RA I (Africa): Enhanced probabilities for below-normal precipitation are predicted over much of the far eastern part of Africa, most notably near the equator, over parts of Central Africa below the equator, and over the far northern parts of North Africa. Model-to-model consistency is moderate to strong over most of these areas. Over much of Africa north of about 20ºN, the forecast indicates increased probabilities for near-normal rainfall, but most of these areas are desert. Over the rest of Africa, there is no clear indication for rainfall signal.

RA II (Asia): There are few indications of systematic shifts in probability of rainfall anywhere over Asia. There is enhanced probability for below-normal rainfall over the Arabian Peninsula and neighbouring region in central Asia and model consistency is moderate to strong. Regions with enhanced probability for above-normal rainfall include the Indian subcontinent, eastern and southeast Asia, and extreme northern parts of Asia with moderate consistency among models.

RA III (South America): Most of South America north of 15ºS is predicted to have above-normal rainfall (model-to-model consistency is mostly moderate to strong). South of 30ºS there is a small increase in probability of below-normal rainfall, but model consistency is strong.

RA IV (North America, Central America and the Caribbean): An enhanced probability for below-normal precipitation is predicted for much of the Caribbean and for Central America bordering the Gulf of Mexico and Caribbean Sea, with moderate model consistency. There are also indications for below-normal precipitation over western and central parts of North America and model-to-model consistency is weak to moderate. In the far north and north-western parts of North America, there are slightly increased chances of above-normal rainfall and model consistency is moderate.

RA V (Southwest Pacific): Probabilities for above-normal rainfall are enhanced over an area extending from equatorial parts of the Indonesian Archipelago into the Southwest Pacific to an area northeast of New Zealand. The model consistency strengthens towards the southeast of this band. Over the central Pacific there is an area of strongly increased probabilities for below-normal rainfall that is immediately south of the equator. This area extends from about 170ºE towards the southeast reaching as far as South America, but the probabilities weaken east of about 120ºW. Model-to-model consistency is strong throughout most of this region. Along the equator across most of the Pacific Ocean east of 170ºW, probabilities are highest for near-normal rainfall. Enhanced probabilities for above-normal rainfall are predicted for the entire Australian continent with larger values to the east, with moderate model consistency.

RA VI (Europe): Except over part of the far southern portion of Europe and the Mediterranean where probabilities for below-normal rainfall are weakly enhanced and model consistency is moderate, there is no clear indication for rainfall signal over 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

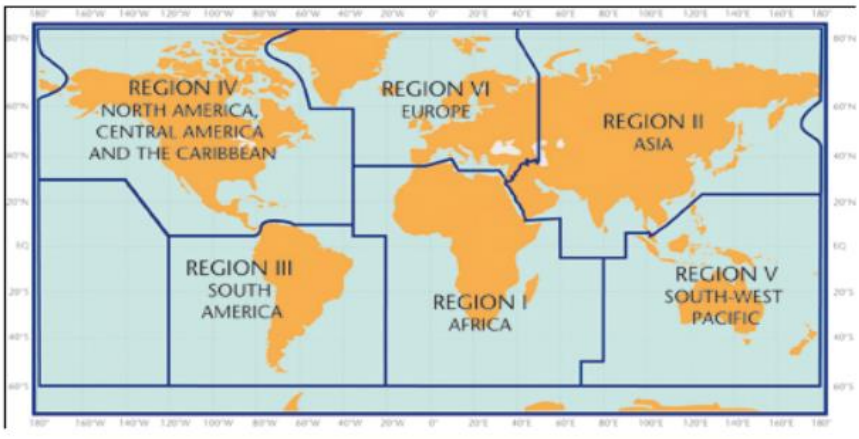
The GSCU is intended as guidance for RCCs, Regional Climate Outlook Forums (RCOFs) and National Meteorological and Hydrological Services (NMHSs). It does not constitute an official forecast for any region or nation. Seasonal outlooks for any region or nation should be obtained from the relevant RCCs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

Seasonal forecasts are probabilistic in nature. Although the text and figures used in the GSCU highlight the tercile categories that is predicted with the highest probability, it is important to recognize that the other tercile categories may also have substantial (though lower) probability.

The geographical areas occupied by the forecast signals should not be considered precise. Similarly, signals with small spatial extent may be unreliable.

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 appendices.

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): http://www.wmo.int/pages/prog/wcp/wcasp/clips/producers_forecasts.html
- 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): http://portal.iri.columbia.edu/portal/server.pt
- NOAA Climate Prediction Centre (CPC): http://www.cpc.ncep.noaa.gov

7. Acknowledgements

This Global Seasonal Climate Update was jointly developed by the WMO Commission for Climatology and Commission for Basic Systems 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)
- International Research Institute for Climate and Society (IRI)