WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

GLOBAL SEASONAL CLIMATE UPDATE

TARGET SEASON: December-January-February 2020-2021

Issued: 26 November 2020

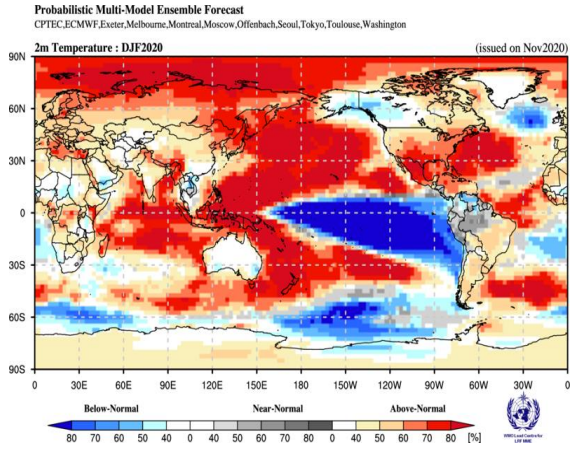
Summary

Observed sea surface temperatures (SSTs) in the central topical Pacific were in a La Niña condition during August-October 2020 with enhancement in below-normal SSTs from earlier seasons. The Indian Ocean Dipole (IOD) remained in a near-neutral condition and is predicted to continue being neutral. The SST in the Niño 3.4 and Niño 3 regions, both of which are often used to characterize ENSO conditions, are predicted to decrease further from approximately -1.0 °C during the August-October 2020 season to -1.5 (in Niño 3.4) and -1.25 (in Niño 3) during December-February 2020-2021, and hence, are expected to be in a moderate to strong La Niña condition.

Apart from a large area of the tropical eastern Pacific Ocean, sea-surface temperatures over most of the Pacific and Indian oceans are expected to be above-average for December 2020 - February 2021. Sea surface temperatures in the tropical Atlantic Ocean are also expected to be normal to above-normal, whereas the Southern Ocean and central North Atlantic Ocean are expected to be colder than average. The expected impacts on air temperatures over land are strongest in the maritime continent and over the southern half of North America, where temperatures are most likely to be above-normal. Above-normal temperatures are also likely over much of the northern high latitudes (except in the vicinity of Greenland and over north-western North America). In the Northern Hemisphere, other areas where above-normal temperatures are most likely include east Asia north of about 30 °N, much of south Asia, Europe and North Africa. Below-normal temperatures are predicted for South-east Asia, the southern part of the Arabian Peninsula, much of inland West Africa. The northern part of South America and southern part of Central America are predicted to have normal to below-normal temperatures. In the Southern Hemisphere, there is more uncertainty about the expected air temperatures, although there is a higher chance that the southern, central and eastern parts of South America will be above-normal. Central Africa and along about 15°S are also predicted to be above-normal, but elsewhere in Africa south of the equator and over Australia there is no clear signal.

The expected La Niña conditions are reflected in the rainfall forecasts for December 2020 - February 2021, which indicate many of the typical (canonical) La Niña impacts. These canonical impacts include increased chances of unusually wet conditions over much of the maritime continent, Australia, northwestern North America, and northern South America, plus unusually dry conditions over parts of the Greater Horn of Africa, sub-tropical latitudes of North America, and some parts of southeastern South America. Probabilities for below-normal rainfall are also increased over much of southern Europe, North Africa, and extending through Asia along about 30 °N. Central Africa is also predicted to be below-normal. There are increased probabilities of above-normal rainfall (possibly as snow) over much of the Northern Hemisphere north of about 45 °N. There is weak agreement about the impacts on rainfall over southern Africa and much of South America.

Surface Air Temperature, DJF 2020-2021



Precipitation, DJF 2020-2021

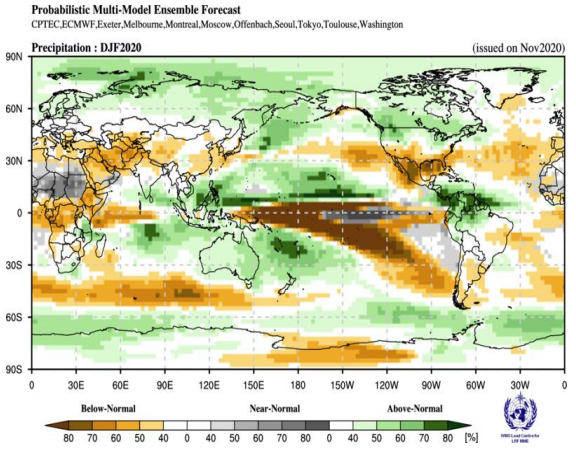


Figure 1. Probabilistic forecasts of surface air temperature and precipitation for the season December-February 2020-2021. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in blue, 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: August-October 2020

In the following sections, observed temperature and precipitation patterns for the period May-July 2020 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

During August-September 2020, the four Niño sea surface temperature (SST) indices in the central and eastern Pacific were negative, with larger negative values in the eastern Pacific. The SST conditions generally characterized a La Niña condition in the equatorial tropical Pacific. The Indian Ocean Dipole (IOD) over the period was near zero. The North Tropical Atlantic (NTA) SST index was positive and the South Tropical Atlantic (STA) SST index was near zero.

Month	Niño 1+2	Niño 3	Niño 4	Niño 3.4	IOD	NTA	STA
August 2020	-0.95	-0.57	-0.21	-0.64	-0.06	0.45	0.25
September 2020	-0.86	-1.27	-0.41	-0.95	-0.22	0.25	-0.14
October 2020	-1.16	-1.3	-0.77	-1.35	0.14	0.31	-0.13
August - October 2020	-0.99	-1.05	-0.46	-0.98	-0.05	0.34	-0.01

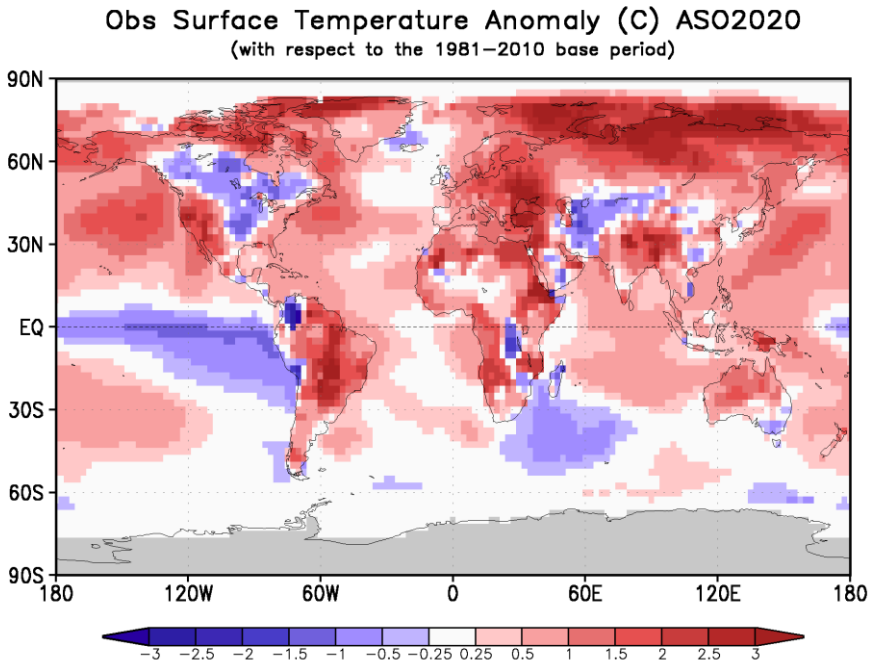
Table 1. Large-scale oceanic indices (°C). Anomalies are with respect to the 1981–2010 average. (*Source:* U.S. Climate Prediction Center)

1.2 Observed temperature

Over land, temperature anomalies across the globe continued their trend of warmer-than-normal conditions for the season of August-October 2020 (Figure 2, top), and in general, above-normal temperatures dominated the globe. The most strongly positive land temperature anomalies occurred over northern Asia, equatorial and central South America, northernmost and southwest regions of North America, southeastern Europe and the Greater Horn of Africa. Exceptions to positive land anomalies were negative temperature anomalies over the northeast regions of North America and central Asia.

Over the oceans, the eastern equatorial Pacific and southwest Indian Ocean (off the southeast coast of southern Africa) had cooler-than-normal temperatures. In the extratropical southern oceans near-average temperatures generally prevailed. SSTs in the equatorial central Pacific indicated a La Niña condition, with positive anomalies in the western equatorial Pacific and negative anomalies in central and eastern Pacific; a pattern that indicates enhanced zonal SST gradients across the equatorial Pacific. SST anomalies throughout the extratropical North Pacific and equatorial Atlantic Ocean 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 the northernmost parts of Asia, equatorial and central South America, southeast Europe, southwestern North America and western coastal and Greater Horn regions of Africa. No significant extreme cold temperature was found over land areas. Some oceanic regions also had warm extremes, notably the equatorial central and eastern Indian Ocean and Arabian sea, a north-south band in the western Pacific and extratropical northeast Pacific.



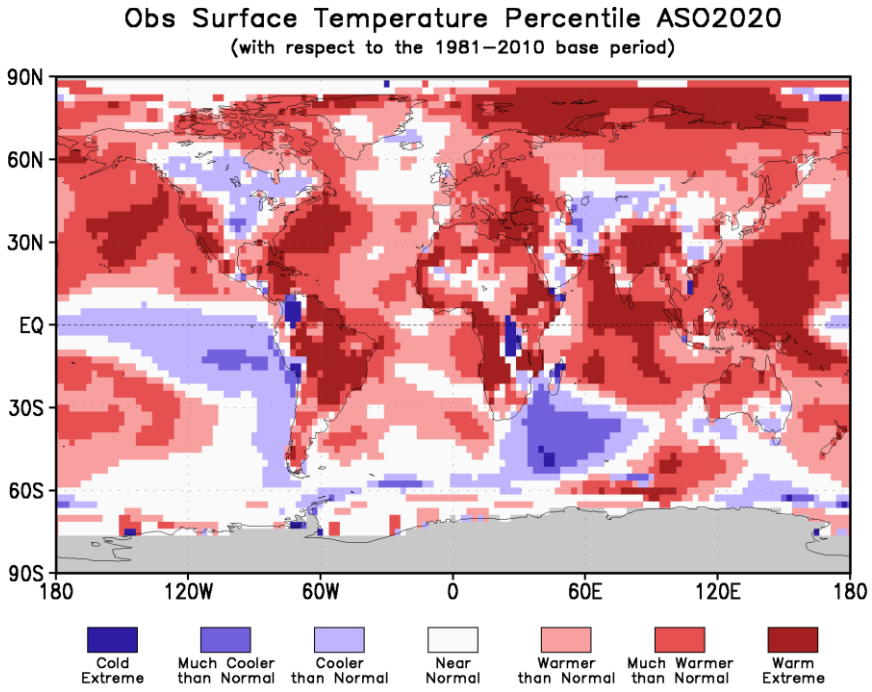
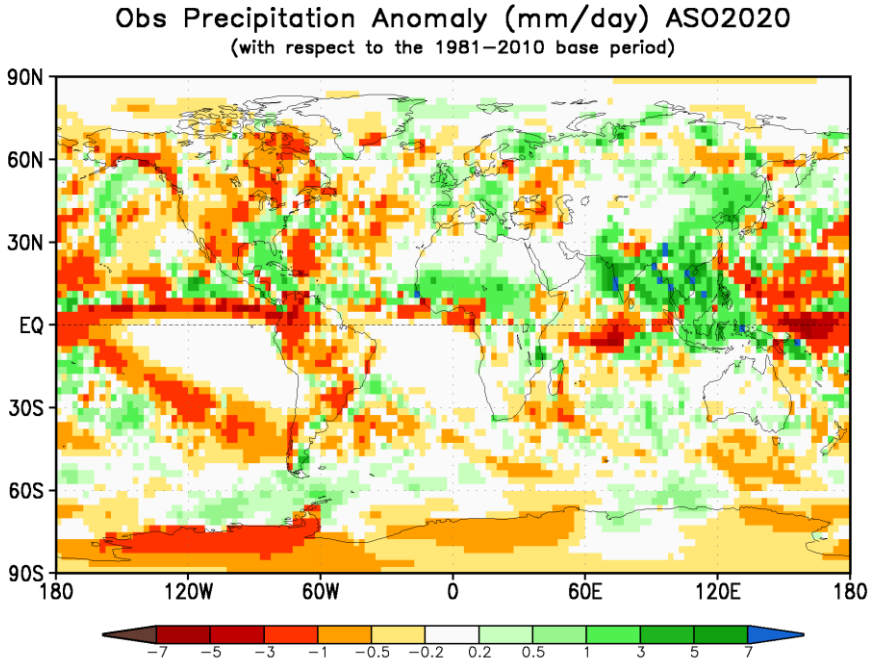


Figure 2. Observed August-October 2020 near-surface temperature anomalies relative to 1981–2010 (top). The *Cooler than Normal*, *Near Normal*, *and Warmer than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile of the 1981–2010 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).



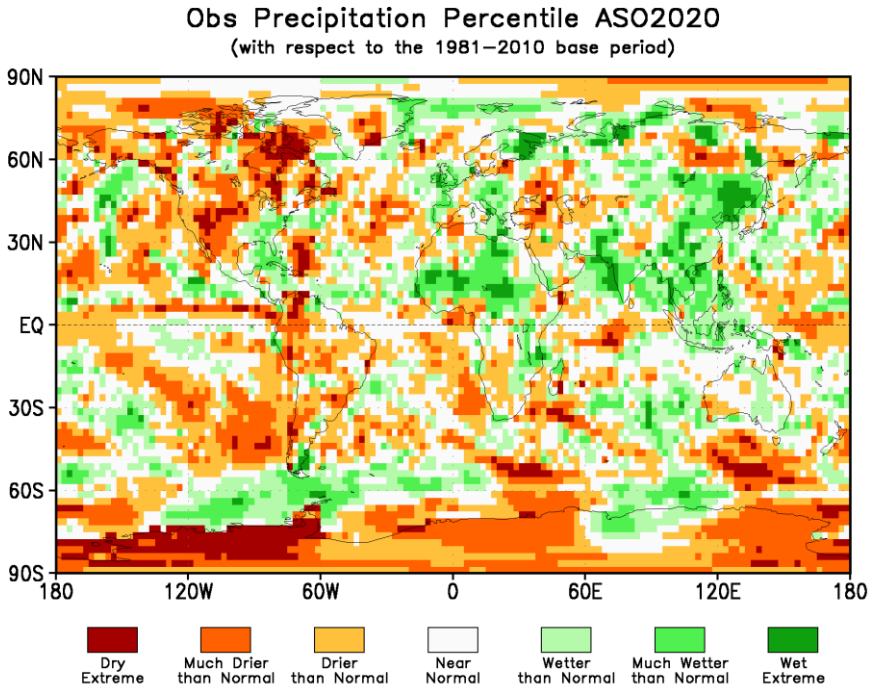


Figure 3. Observed precipitation anomalies for August-October 2020, relative to 1981–2010 base period (top). The *Drier than Normal*, *Near Normal and Wetter than Normal* shadings on the percentile map (bottom) indicate that seasonal mean anomalies were in the bottom, middle, and upper tercile of the 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 August-October 2020, the largest negative precipitation anomalies were in the equatorial Pacific near the date line extending into the western Pacific with a narrower band extending into the eastern Pacific and another band extending into the southern Pacific towards South America. West of these negative anomalies, positive precipitation anomalies stretched from the Indonesian Archipelago into the Bay of Bengal, Indian subcontinent and eastern Asia. Above-normal precipitation anomalies also occurred over most of western Europe, western Africa and southeast region of North America.

Below-normal precipitation anomalies generally dominated South America (with stronger values in the northwest), western and northeast North America and southeastern Europe. Below-normal precipitation occurred over the eastern regions of the Caribbean, Gulf of Guinea and the Greater Horn of Africa and equatorial western Indian Ocean. Bands of below-normal precipitation anomalies stretched across the extratropical southern oceans.

No large-scale systematic regions with dry or wet extremes (precipitation below or above all seasonal totals observed during 1981-2010) over land occurred, with the exception of a few isolated pockets of wet extremes that were observed over some different regions in western Africa and eastern Asia. An extreme dry region was observed in the far northeast region of North America.

2. Potential evolution of the state of the climate over the next three months (December-February 2020-2021)

2.1 Large-scale SST-based indices, December-February 2020-2021

Month	Nino 1+2	Nino 3	Nino 4	Nino3.4	IOD	NTA	STA
December 2020	-0.83±0.28	-1.45±0.31	-1.13±0.10	-1.60±0.27	-0.25±0.18	0.22±0.16	-0.21±0.10
January 2021	-0.75±0.37	-1.30±0.36	-1.18±0.15	-1.59±0.38	0.00±0.15	0.19±0.14	-0.27±0.10
February 2021	-0.55±0.42	-1.02±0.37	-1.00±0.16	-1.34±0.38	0.11±0.12	0.14±0.14	-0.23±0.14
December-February 2020-2021	-0.71±0.37	-1.26±0.38	-1.10±0.15	-1.51±0.36	-0.04±0.21	0.18±0.14	-0.24±0.11

Table 2: Multi-model forecasts for oceanic indices (℃), with standard deviation. Values are the equal-member-weighting average of those derived, using each GPC models 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 topical Pacific cooled to La Niña conditions during September – November 2020. The sea-surface temperature anomalies in the Niño 3.4 and Niño 3 regions are predicted to intensify to their strongest level sometime in late 2020, reaching values of approximately -1.5 during the December 2020 - February 2021 season. The strongest anomaly is expected in the Niño 3.4 region. Farther west in the Niño 4 region, the sea surface temperature is also predicted to decrease to a value of below -1.0 °C. The IOD is predicted to be close to zero when averaged over the three months December 2020 - January 2021. In the equatorial Atlantic, SSTs are predicted to be slightly above average in the north (NTA) and below average in the southern (STA) areas during the season.

2.2 Predicted temperature, December-February 2020-2021

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]).

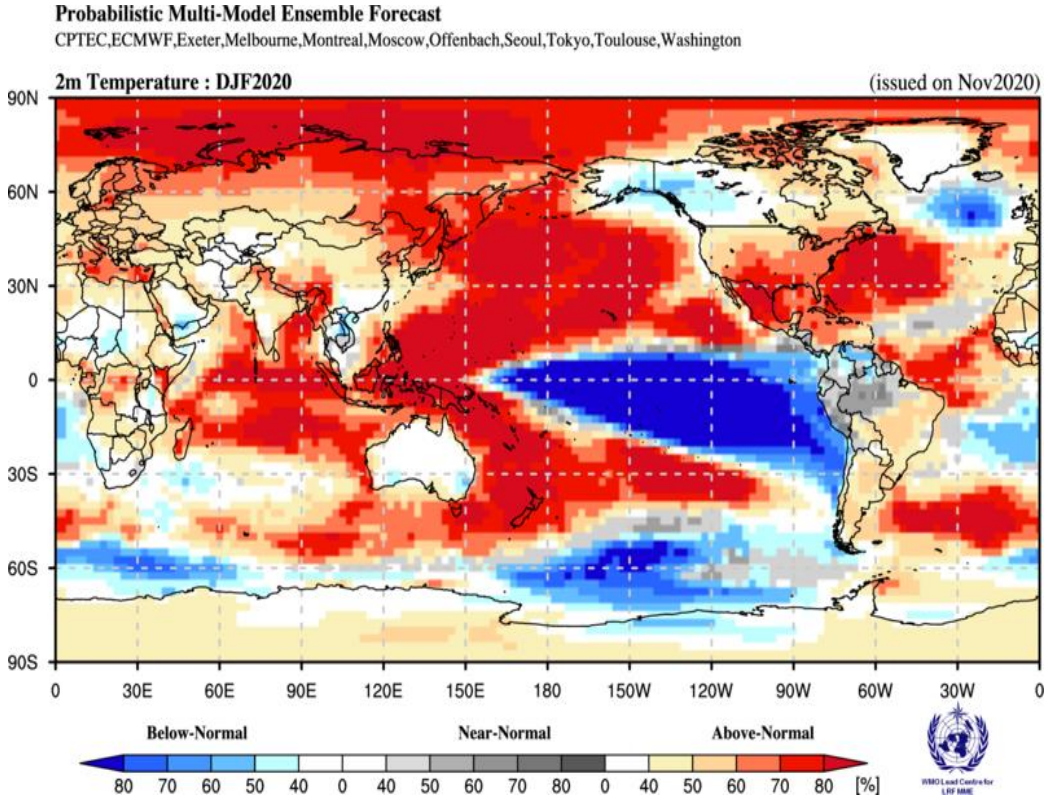


Figure 4. Probabilistic forecasts of surface air temperature for December-February 2020-2021. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in blue, red and grey shadings respectively. 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.

The impacts of the 2020/21 La Niña, and of the predicted global sea-surface temperature anomalies more generally, on air temperatures over land are expected to be strongest in the maritime continent and over the southern half of North America, where temperatures are most likely to be above-normal. Above-normal temperatures are also likely over much of the northern high latitudes (except in the vicinity of Greenland and over north-western North America). In the Northern Hemisphere, other areas where above-normal temperatures are most likely include east Asia north of about 30 °N, much of south Asia, Europe and North Africa. Below-normal temperatures are predicted for South-east Asia, the southern part of the Arabian Peninsula, much of inland West Africa. The northern part of South America and southern part of Central America are predicted to have normal to below-normal temperatures. In the Southern Hemisphere, there is more uncertainty about the expected air temperatures, although there is a higher chance that the southern, central and eastern parts of South America will be above-normal. Central Africa, and along about 15 °S, are also predicted to be above-normal, but elsewhere in Africa south of the equator and over Australia there is no clear signal.

[1] File with supplementary information can be downloaded from https://ftp.cpc.ncep.noaa.gov/mingyue/GSCUWMO/Forecasts/GSCU_DJF2020_supplementary_info_LC-LRFMME.docx

RA I (Africa): Enhanced probabilities of above-normal temperature are indicated over most of North Africa, extending along the coastal areas of West Africa, and into Central Africa. Above-normal temperatures are also predicted for much of the Greater Horn north of the equator, and for Southern Africa along about 15 ºS extending into the Indian Ocean over Madagascar. Most of these regions show moderate to high levels of model-to-model consistency. The regions with strongest probability for above-normal temperature are over Madagascar, and along the equator. There is a weaker tilt of the odds towards above-normal temperatures over western Southern Africa. Much of the southern Sahara, as well as small areas along the west coast of Southern Africa and in the southern part of the Greater Horn, are predicted to have increased probability of normal to below-normal temperature.

RA II (Asia): Strongly enhanced probabilities for above-normal temperature are indicated in the Arctic Circle over Asia, over the northeastern part of the continent, and over an eastern art of South Asia. Model-to-model consistency for most of these regions is high. The strongest tilt of odds for above-normal temperature is predicted over the northernmost regions of Asia where observed temperatures were above-normal during August – October 2020. There are weak probabilities of above-normal temperature over much of the rest of Asia, except over the Arabian Peninsula, and over southeastern Asia. In both these locations, there are areas with moderate to strong model-to-model consistency.

RA III (South America): Weakly enhanced probabilities for below-normal temperature are indicated over the far northern part of South America. Similarly, along the near-coastal western strip temperatures are predicted to be below-normal, consistent with the anomalously cold ocean conditions there. Over much of the rest of the northwestern third of the continent, temperatures are predicted to be normal. However, the level of model consistency for the inland areas is not high. Much of the rest of the continent (except for the southernmost tip) is predicted to experience above-normal temperatures, although model consistency is mostly weak to moderate.

RA IV (North America, Central America and the Caribbean): Enhanced probabilities for above-normal temperature are indicated over much of North America south of about 50 ºN, except for the southern part of the isthmus, and over the Caribbean. The strongest tilts in the odds for above-average temperatures are at about 30 ºN. Over all these areas model-to-model consistency is strong. Increased chances for above-normal temperature are also indicated for much of the northeastern part of North America (but not for Greenland), but the probabilities and level of model-to-model consistency are weaker than for areas further south. Predictions for the northwestern part of the continent indicate weakly enhanced probabilities for below-normal temperature. Model-to-model consistency is moderate-to-strong for this area. The southern part of Central America has an increased chance of normal temperature.

RA V (Southwest Pacific): Strongly enhanced probabilities for above-normal temperature are predicted in a band from north of Australia, extending to New Zealand, and along about 30 ºS towards the eastern Pacific. 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 closely represents the distribution of predicted negative sea-surface temperature anomalies associated with the anticipated La Niña conditions. Model-to-model consistency in this cold area is very strong. The predictions over the ocean areas broadly represent an intensification of the observed anomalies for August – October 2020. Over Australia, there is no consistency in the temperature predictions. A tilt of odds towards below-normal temperature is predicted over part of the immediate southern Australia coast, with weak to moderate model consistency, except for some coastal areas, where the temperature anomalies are expected to be consistent with the sea-surface temperature anomalies in the vicinity.

RA VI (Europe): The probabilities for above-normal temperature are increased over virtually all of Europe. The increased probabilities are strongest in northeastern Europe where model-to-model consistency is also very strong. There is also very strong model-to-model consistency over the eastern Mediterranean, and throughout mainland Europe consistency is strong. Over the far northwestern parts of Europe, including Greenland, there are increased probabilities of normal to below-normal temperature, but model-to-model consistency is mostly weak.

2.3 Predicted precipitation, December-February 2020-2021

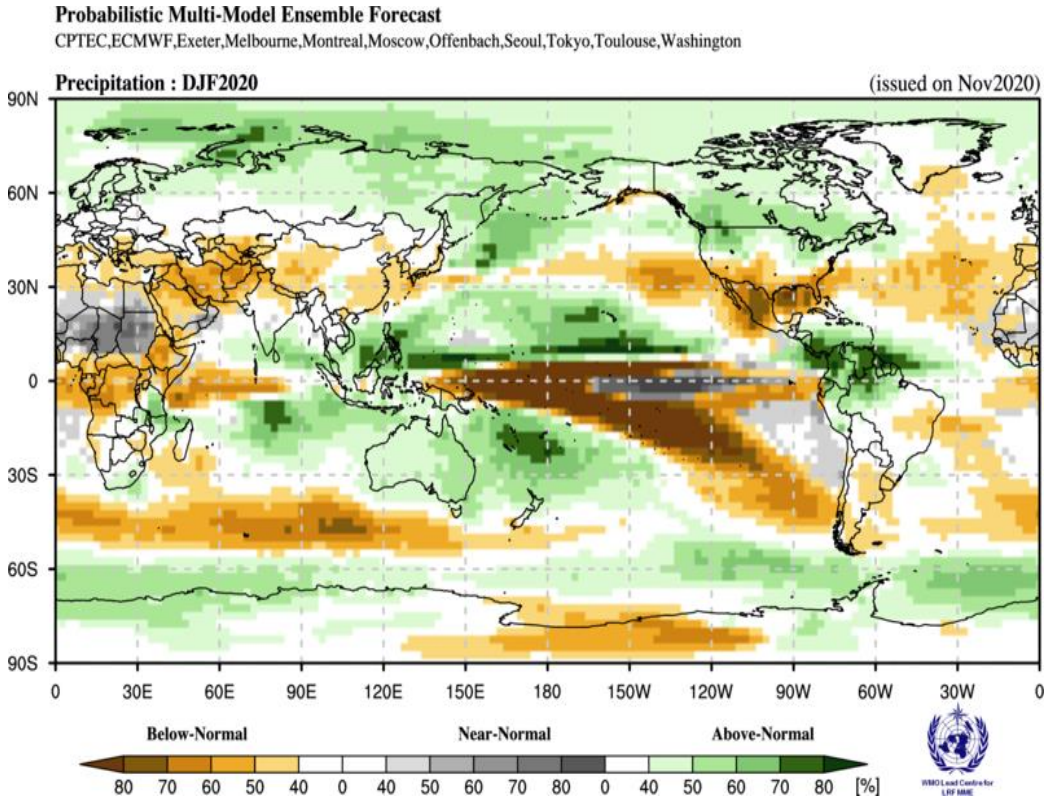


Figure 5. Probabilistic forecasts of precipitation for the season for December-February 2020-2021. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in orange, green and grey shadings 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.

Many of the predicted rainfall anomalies for December 2020 - February 2021 represent typical (canonical) La Niña impacts. These canonical impacts include increased chances of unusually wet conditions over much of the maritime continent, Australia, northwestern North America, and northern South America, plus unusually dry conditions over parts of the Greater Horn of Africa, sub-tropical latitudes of North America, and some parts of southeastern South America. Probabilities for below-normal rainfall are also increased over much of southern Europe, North Africa, and extending through Asia along about 30 °N. Central Africa is also predicted to be dry. There are increased probabilities of above-normal rainfall (and possibly as snow) over much of the Northern Hemisphere north of about 45 °N. There is weak signal in rainfall over southern Africa and much of South America.

RA I (Africa): Enhanced probabilities for below-normal precipitation are predicted over much of equatorial Africa, most of the Greater Horn north of the equator, Central Africa, and the Mediterranean coast. Model-to-model consistency is strongest in the Greater Horn. Over much of the rest of Africa north of the equator, the forecast indicates increased probabilities for normal rainfall, but most of these areas are desert and/or experiencing their dry season. The predicted area of below-normal rainfall extends along the west coast of Southern Africa. There is another predicted narrow band of below-normal rainfall extending from the southeastern part of the continent into the Indian Ocean to the south of Madagascar. Model-to-model consistency is moderate here. Immediately to the north of this band, over the far southern part of the Greater Horn and extending to the far northern part of Madagascar, is a small area of increased chances of above-normal rainfall. The model-to-model consistency for this area is strong. The far southern part of the continent is indicated to have weakly increased chances of above-normal rainfall, but the model-to-model consistency for this signal is reasonably strong.

RA II (Asia): There is a large area of enhanced probability for below-normal precipitation over much of southwestern Asia. This predicted dry band extends eastwards, with some breaks, along about 30 ºN immediately north of South Asia, and reappearing along the continent's east coast. The model-to-model consistency is particularly strong in the southwest of the continent, and off the east coast. In the far southeast, and at the southern tip of the Indian subcontinent, there are increased probabilities of above-normal rainfall. Model-to-model consistency increases towards the east along these latitudes. All along the Arctic coast probabilities for above-normal precipitation (possibly as snow) are indicated. Model-to-model consistency is strong, both for precipitation and temperature, indicating a relatively warm and wet winter. Most of the large remaining areas of the continent, including between about 45 and 60 ºN, shows no discernible forecast signal.

RA III (South America): Most of South America along and north of the equator are predicted to have above-normal rainfall (model-to-model consistency is mostly strong). Over a small part of northern South America, a weak tilt of the odds towards above-normal rainfall is predicted, with weak to moderate model consistency. The forecast in the northern area represents a continuation of above-normal observed there in May-July 2020, while the forecast in the southern location marks a reversal of the above-normal conditions observed in May-July 2020.

RA IV (North America, Central America and the Caribbean): An enhanced probability for below-normal precipitation is predicted for the south-central regions of North America, with moderate model consistency. With indications for above-normal precipitation, the forecasts for northern parts of the North America represent a marked contrast to the below-average rainfall observed during August – October 2020. In the southernmost part of North America, there is an increased chance of below-normal rainfall and the model consistency is strong. Further south over central America there are enhanced probabilities of above-normal precipitation, specifically in the southernmost parts. In each area, the model-to-model consistency is moderate to strong.

RA V (Southwest Pacific): Probabilities for above-normal rainfall are strongly enhanced over the off-shore islands of southeast Asia and in the Southwest Pacific in an area north of New Zealand. The model consistency is very strong in both areas. The southern part of the maritime subcontinent and Australia are also predicted to have above-normal rainfall, but probabilities of wet and the model-to-model consistency are weaker. In a narrow band along the equator in the maritime continent the rainfall signal is unclear, but east of about 130 ºE the equatorial zone is expected to be unusually dry. This dry area expands towards the southeast, but there is a small area corresponding approximately with the Niño 3 region where normal rainfall has the highest probability. South of about 40 ºS there is another band of increased probabilities for below-normal rainfall extending from the Indian Ocean to just beyond the dateline.

RA VI (Europe): Over Europe there is not much of a consistent signal in the predicted precipitation. North of about 60 ºN (except in the northwestern part of Europe) the probabilities for above-normal precipitation (possibly as snow) are weakly enhanced. Probabilities for below-normal precipitation are weakly enhanced in the Mediterranean region. In both areas, model-to-model consistency is weakly enhanced.

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:
https://www.wmolc.org/modules/data/plot/autograds4/download_PMME.php?filename=wmo/WMOLC_T2M.gif

https://www.wmolc.org/modules/data/plot/autograds4/download_PMME.php?filename=wmo/WMOLC_PREC.gif

4. How to use the Global Seasonal Climate Update

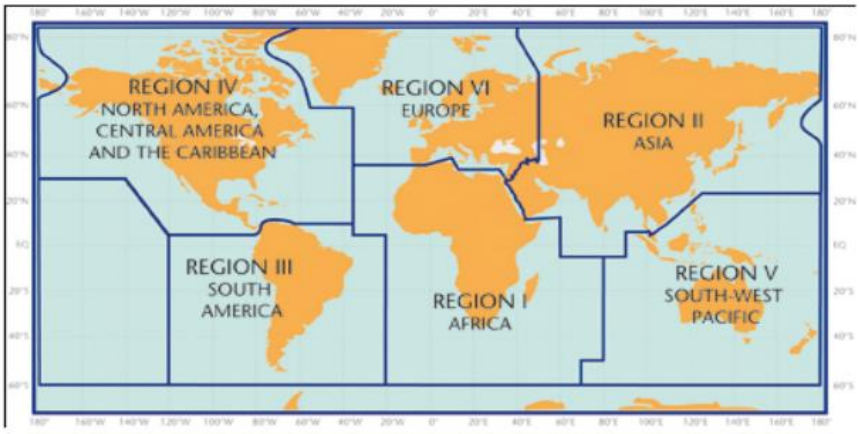
The GSCU is intended as guidance for RCCs, Regional Climate Outlook Forums (RCOFs) and National Meteorological and Hydrological Services (NMHSs). It does not constitute an official forecast for any region or nation. Seasonal outlooks for any region or nation should be obtained from the relevant RCCs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

- RA I: http://www.wmo.int/pages/prog/wcp/wcasp/RCC-Africa.html
- RA II: http://www.wmo.int/pages/prog/wcp/wcasp/RCC-Asia.html
- RA III: http://www.wmo.int/pages/prog/wcp/wcasp/RCC-SouthAmerica.html
- RA IV: http://www.wmo.int/pages/prog/wcp/wcasp/RCC-NorthAmerica.html
- RA V: http://www.wmo.int/pages/prog/wcp/wcasp/RCC-SouthwestPacific.html
- RA VI: http://www.wmo.int/pages/prog/wcp/wcasp/RCC-Europe.html

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 GSCU portal http://www.wmo.int/pages/prog/wcp/wcasp/LC-LRFMME/index.php
- WMO portal for Regional Climate Outlook Forums (RCOFs): 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 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)