



**Nineteenth Session of
South Asian Climate Outlook Forum (SASCOF-19) &
Climate Services Users Forum
Online Session, 26-28 April 2021**

**Consensus Statement on the Seasonal Climate Outlook over South
Asia for the 2021 Southwest Monsoon Season (June – September)**

Summary

Normal to above normal rainfall is most likely during the 2021 southwest monsoon season (June – September) over most parts of South Asia. Geographically, above-normal rainfall is most likely over some areas of the North West, along the foothills of Himalayas and North East parts of the region, and many areas of central part of the region. However, the seasonal rainfall is most likely to be below normal over many areas over extreme northwest, north East and some areas over north-eastern parts of the region. The seasonal rainfall is most likely to be normal or of climatological probabilities over the remaining areas.

During the season, minimum temperatures are likely to be above normal over most areas of west, northwest, north and north eastern parts of the South Asia. The minimum temperatures are most likely to be below normal over east-central and south western areas of the region. The seasonal minimum temperatures are likely to be normal or of climatological probabilities over remaining parts of the region. The maximum temperatures are likely to be below normal over most of the central parts of South Asia. The maximum temperatures are likely to be above normal over northwest and northern areas of northeast of the region. Maximum temperatures are likely to normal or of climatological probabilities over remaining parts of the region

This regional climate outlook for the 2021 southwest monsoon season over South Asia has been collaboratively developed by all nine National Meteorological and Hydrological Services (NMHSs) of South Asia with the support from international experts at the nineteenth session of the South Asian Climate Outlook Forum (SASCOF-19) conducted online. The process involved an expert assessment of the prevailing global climate conditions and forecasts from different climate models from around the world. The moderate La Niña conditions that prevailed over the Pacific since July 2020 have weakened to borderline La Niña to ENSO neutral conditions in the month of April 2021. Based on the global climate model forecasts, there is strong consensus among experts that the ENSO neutral conditions are likely to prevail during the southwest monsoon season. It is recognized that the global climate model predictions prior to and during the spring season generally have noticeable uncertainty due to spring barrier in the seasonal predictability. It is also recognized that other regional and global factors as well as the intra-seasonal features of the region can also affect the seasonal climate patterns over the region.

For more information and further updates on the southwest monsoon outlook on national scale, the respective National Meteorological and Hydrological Services (NMHSs) may be consulted.

Introduction:

The climate outlook for the 2021 southwest monsoon season (June to September) was finalized during the nineteenth session of the South Asian Climate Outlook Forum (SASCOF-19) held during 26-28 April 2021 via video conferencing in the backdrop of the current extraordinary circumstances of Covid-19 pandemic prevailing in the world since early 2020. The session was attended by experts representing the National Meteorological and Hydrological Services (NMHSs) of eight South Asian countries as well as those representing several global and regional climate agencies including World Meteorological Organization (WMO), WMO Regional Climate Centre (RCC) Pune, Indian Institute of Tropical Meteorology (IITM), International CLIVAR Monsoon Project Office (ICMPO), Met Office (UKMO), International Research Institute for Climate and Society (IRI), Regional Integrated Multi-hazard Early-warning System (RIMES), Japan Meteorological Agency (JMA), WMO Lead Centre for Long Range Forecasts Multi-Model Ensemble (LC-LRFMME), Korea Meteorological Administration (KMA) etc. The online forum deliberated on various observed and emerging climatic features that influence the performance of the southwest monsoon, such as the El Niño-Southern Oscillation (ENSO) conditions over the equatorial Pacific, Indian Ocean Dipole (IOD), winter and spring Northern Hemisphere (NH) snow cover and land surface temperature anomalies. The key features of these conditions are as follows:

ENSO Conditions over the Pacific Ocean

The ENSO is one of the global scale climate phenomena that have significant influence on the year-to-year variability of the monsoon over South Asia. La Niña conditions (colder than normal SSTs over the equatorial Pacific) were developed during second part of the previous year, which peaked in November. However, La Niña conditions over the equatorial Pacific started weakening in the early part of 2021 and conditions are now moving towards ENSO neutral conditions. Subsurface temperatures over the equatorial Pacific have substantially warmed and atmospheric patterns reflect neutral ENSO conditions. The latest global model forecasts indicate further warming trends and ENSO neutral conditions are likely to prevail during the upcoming monsoon season.

ENSO neutral conditions are generally associated with normal southwest monsoon over the region. However, in a few cases other regional factors such as Indian Ocean conditions may play a more dominant role in influencing monsoon performance.

Conditions over the Indian Ocean

In addition to ENSO conditions over the Pacific, other factors such as Indian Ocean SSTs also have influence on the South Asian southwest monsoon. A positive (negative) IOD is associated with a stronger (weaker) than normal monsoon over the region. At present, neutral Indian Ocean Dipole (IOD) conditions are prevailing over the Indian Ocean. The recent forecasts from coupled global models suggest that these neutral IOD conditions are likely to continue during the monsoon season. However, few climate models indicate development of weak negative IOD conditions during the monsoon season.

Snow Cover over the Northern Hemisphere

The snow-covered area over Northern Hemisphere as well as Eurasia was below normal during last few months (December 2020, January and March 2021). The Northern Hemisphere snow cover areas during February and March 2021 were 33rd and 11th lowest ever during the respective months in the last 55 years. On the other hand, the Eurasian snow cover area was 13th lowest ever during the respective months in the last 55 years. Winter and spring snow cover extent has a general inverse relationship with the subsequent Asian summer monsoon rainfall.

Regional Outlook for the 2021 Southwest Monsoon Rainfall over South Asia:

A regional climate outlook for the 2021 Southwest monsoon season rainfall over South Asia was prepared based on the expert assessment of prevailing large-scale global climate indicators mentioned above, experimental models developed during capacity-building workshops conducted for the South Asian countries in association with the previous SASCOF sessions, and experimental as well as operational long-range forecasts based on statistical and dynamical models generated by the NMHSs in the region and various other operational and research climate centres of the world.

There is a strong consensus among the experts that border line La Niña to ENSO neutral conditions are prevailing over the equatorial Pacific and that neutral ENSO conditions are likely to prevail during the southwest monsoon season. Further, it is well-known that ENSO predictions at this time of the year generally have substantial uncertainty due to the so-called spring barrier in seasonal predictability. It is also recognized that in general neutral ENSO conditions are favourable for the normal southwest monsoon rainfall over most part of South Asia. However, it is important to note that ENSO status is not the only factor that determines the performance of Southwest monsoon over the region. Other relevant climate drivers such as the state of the Indian Ocean Dipole, tropical Atlantic sea surface temperatures, Eurasian land heating etc. are also important. The relative impact of all these parameters needs to be considered to determine the expected state of the monsoon over the region which are implicitly considered by the dynamical climate models that underpin the present outlook.

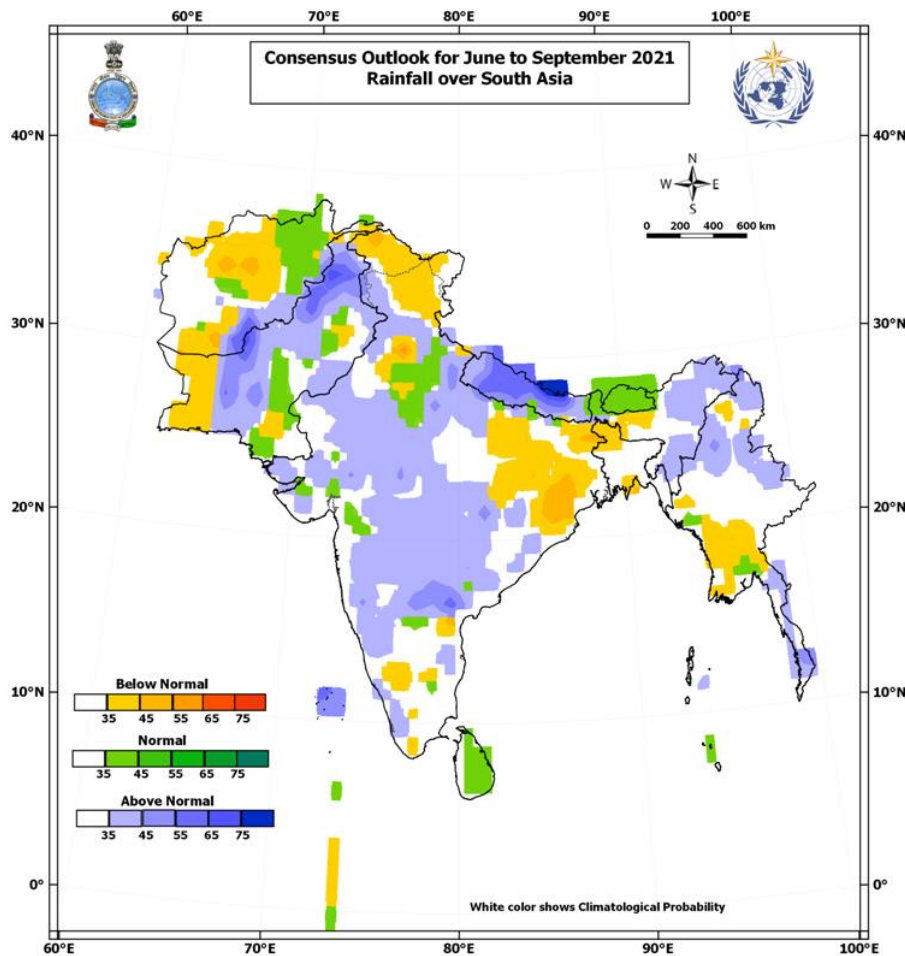


Fig.1a. Probability of the most likely tercile category for the 2021 southwest monsoon rainfall over South Asia. White areas within the land regions indicate tercile categories of equal climatological probabilities of 33.33% each.

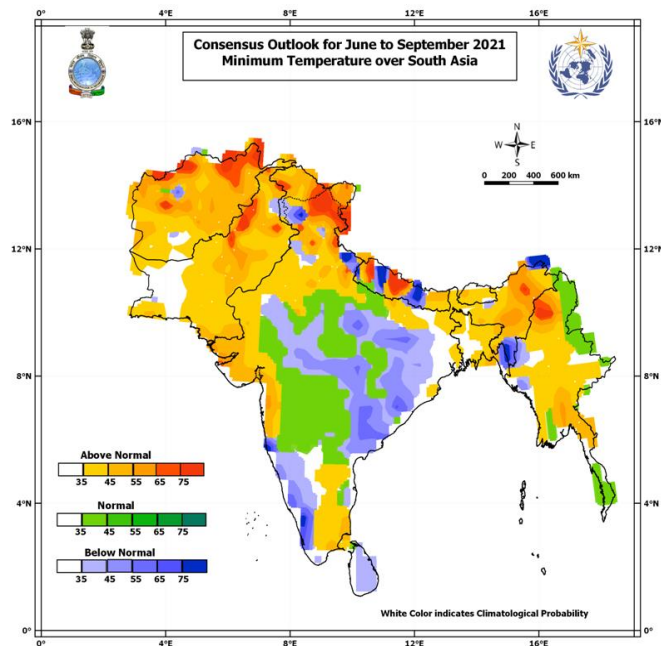


Fig.1b. Probability of the most likely tercile category for the 2021 southwest monsoon season (June to September 2021) Minimum Temperature and over South Asia. White areas within the land regions indicate tercile categories of equal climatological probabilities of 33.33% each.

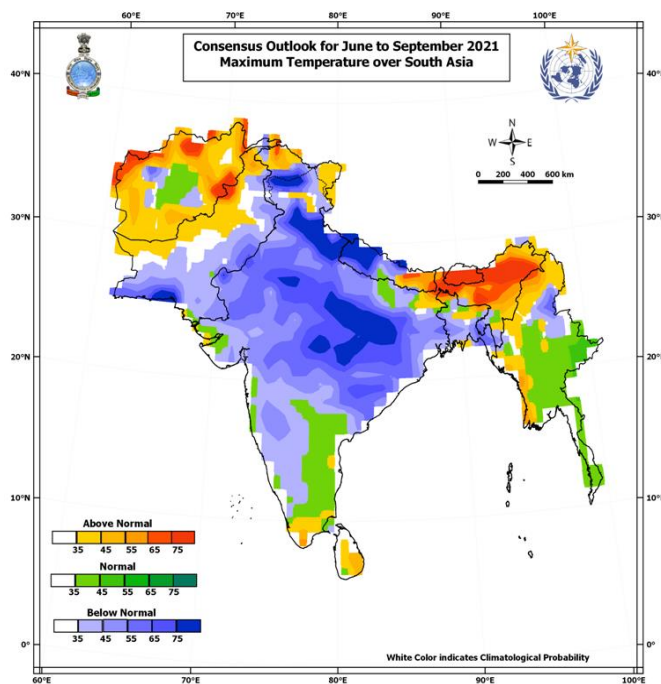


Fig.1c. Probability of the most likely tercile category for the 2021 southwest monsoon season (June to September 2021) Maximum Temperature and over South Asia. White areas within the land regions indicate tercile categories of equal climatological probabilities of 33.33% each.

The outlook for the southwest monsoon rainfall and Temperature (Minimum and Maximum) for the season (June to September) as a whole over South Asia is shown

in Fig. 1a-c. The Figure illustrates grid wise most likely tercile category as well as its probability for each of the 1° latitude x 1° longitude spatial grid boxes over the region. The box-wise tercile probabilities were derived by a synthesis of the available information and expert assessment. It was derived from an initial set of gridded objective forecasts and was iterated through collaborative assessment to synthesize predictive signals coming from reliable multiple sources.

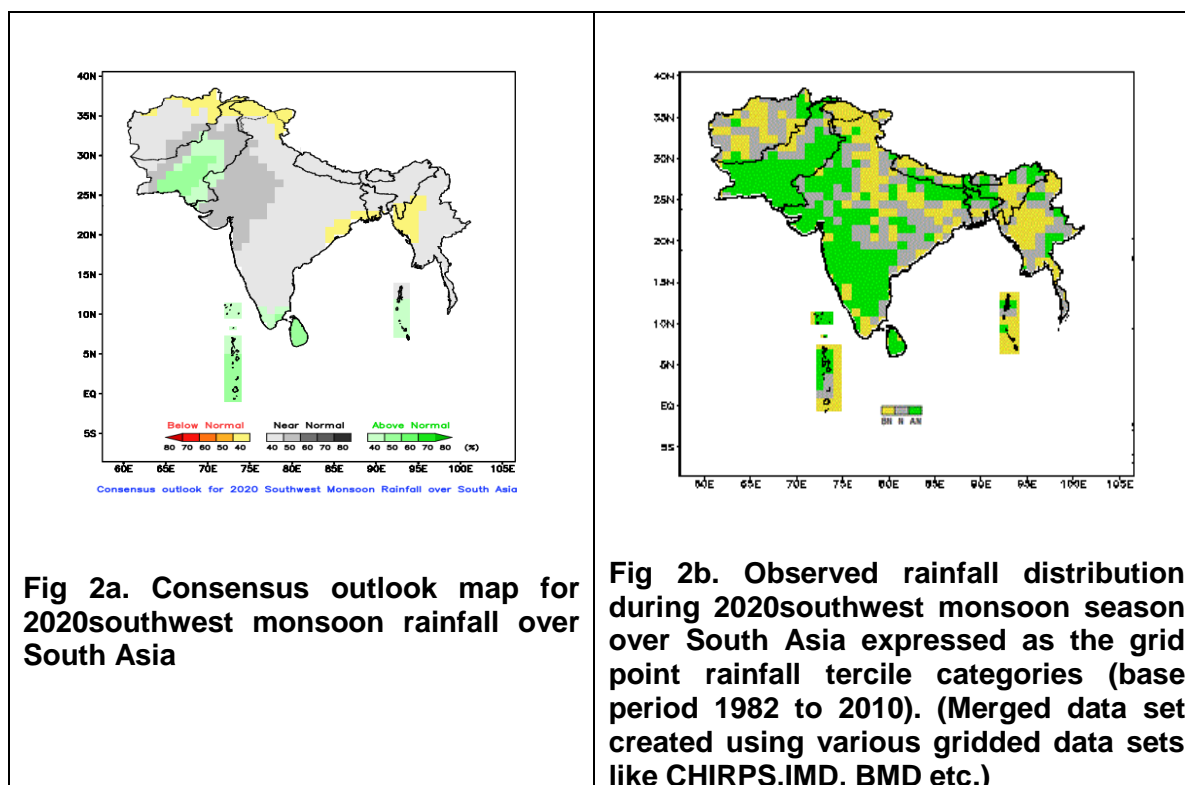
The outlook suggests that the rainfall for the season as a whole is most likely to be normal to above normal during the 2021 southwest monsoon season (June – September) over most parts of South Asia (Fig.1a). Above-normal rainfall is most likely over some areas of the North West, along the foothills of Himalayas and North East parts of the region, and many areas of central part of the region. However, the seasonal rainfall is most likely to be below normal over many areas over extreme northwest, north East and some areas over north-eastern parts of the region. The seasonal rainfall is most likely to be normal or of climatological probabilities over the remaining areas.

Consensus outlook on minimum temperatures for June to September 2021 season suggests that minimum temperatures are likely to be above normal over most areas of west, northwest, north and north eastern parts of the South Asia. The minimum temperatures are most likely to be below normal over east-central and south western areas of the region. The seasonal minimum temperatures are likely to be normal or of climatological probabilities over remaining parts of the region.

Consensus outlook on maximum temperatures for June to September 2021 season suggests that the maximum temperatures are likely to be below normal over most of the central parts of South Asia. The maximum temperatures are likely to be above normal over northwest and northern areas of northeast of the region. Maximum temperatures are likely to normal or of climatological probabilities over remaining parts of the region

As the rainfall and Temperature during the southwest monsoon season depicts strong intra-seasonal variability, it is advised to watch the extended range forecasts along with updated seasonal forecasts for better decision making. The extended range forecasts for rainfall, temperature, cyclone genesis, MJO etc. over the region can be obtained from RCC, Pune website (<http://rcc.imdpune.gov.in/exrange.html>). These forecasts are updated every week.

Verification of rainfall outlook for JJAS2020 issued by SASCOF-16



The outlook for the 2020 southwest monsoon season (June to September) showed in Fig.2a suggested normal rainfall over most parts of South Asia. However, above normal rainfall was forecasted over the southern part and some areas of north-western parts of the South Asia. Below-normal rainfall was forecasted for over land areas around north Bay of Bengal and northern most parts of South Asia. Normal rainfall was forecasted for the remaining areas of the region.

Fig.2b shows the observed rainfall distribution during the 2020 southwest monsoon season expressed in terms of tercile categories. It is seen that normal to above normal rainfall was experienced over most parts of the region. The above normal rainfall observed over the north-western parts of South Asia and some parts of southern region matched very well with forecast. The below normal rainfall observed over some areas around north Bay of Bengal and northern most parts of South Asia also matched with the forecast. However, there were differences between the observed and forecasted rainfall patterns over the areas along foothills of Himalayas, some parts of extreme north-western region and central part of the region where normal rainfall was forecasted.

Background of SASCOF

Climate predictions are of substantial benefit to many parts of the world in risk management and adaptation to the impacts of climate variability and change, and it is considered useful for countries having common climatological characteristics to come together and collaboratively assess the available prediction information to develop consensus outlooks. Recognizing this, regional climate outlook forums (RCOFs) were conceived with an overarching responsibility to produce and disseminate a joint assessment of the state of the regional climate for the upcoming season. Built into the RCOF process is a regional networking of the climate service providers and user sector representatives. In Asia, China has been coordinating the 'Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II' (FOCRA II) since 2005, covering the entire Asian continent.

Asia is a large continent with large differences in the climatological settings on sub-regional scales. Therefore, WMO's Regional Association II (Asia) recommended sub-regional RCOFs devoted to specific needs of groups of countries having similar climatic characteristics. Implementation of the South Asian Climate Outlook Forum (SASCOF) in 2010 is a step in that direction with specific focus on the climate information needs of nations affected by the Asian southwest monsoon climate. The first three sessions of the SASCOF were held at Pune, India (during April) and its 4th session was held in April 2013 at Kathmandu, Nepal. SASCOF-5 (April 2014) was again held in Pune, India.

SASCOF-6 (April 2015) was held in Dhaka, Bangladesh along with Climate Service User Forum (CSUF) for water sector. SASCOF-7 (October 2015), which was the first forum that focused on the winter season, was held in Chennai, India in conjunction with the first CSUF-Agriculture. SASCOF-8 (April 2016) was held in Colombo, Sri Lanka along with CSUF Water and CSUF-Health in parallel sessions. SASCOF-8 was also preceded by a capacity building training workshop on seasonal prediction for the operational climate experts of the South Asian countries. SASCOF-9 (September 2016) was held in Nay Pyi Taw, Myanmar in September 2016, in conjunction with the second CSUF-Agriculture. SASCOF-10 was held in Thimphu, Bhutan (April 2017) and SASCOF-11 was held in Male, Maldives (September 2017).

The SASCOF-12 (April 2018) and associated training workshop on Climate Data Base Management and seasonal prediction were held in Pune, 2018. SASCOF-13 (September 2018) was held in Colombo, Sri Lanka. The SASCOF-14 and associated Pre-COF training workshop on seasonal prediction and CSUF was held in Katmandu, Nepal and hosted by Department of Hydrology and Meteorology (DHM). India Meteorological Department (IMD), World Meteorological Organization (WMO), Met Office, UK and Regional Integrated Multi-hazard Early-warning System (RIMES) co-sponsored the event held during 18-23 April, 2019. The SASCOF-15 and associated Pre-COF training workshop on seasonal prediction and CSUF was held in Thiruvananthapuram, India and hosted by India Meteorological Department (IMD). India Meteorological Department (IMD), World Meteorological Organization (WMO), Met Office, UK and Regional Integrated Multi-hazard Early-warning System (RIMES) co-sponsored the event held during 23-25 September 2019.

The sixteenth session of the SASCOF (SASCOF-16) & Climate Service User Forum (CSUF) was held during 20-22 April 2020 via video conferencing in the backdrop of the extraordinary circumstances of Covid-19 pandemic prevailing in the world. The session was jointly conducted by Bangladesh Meteorological Department (BMD), India Meteorological Department (IMD), World Meteorological Organization (WMO), Met Office, UK and Regional Integrated Multi-hazard Early-warning System (RIMES). SASCOF-16 session was also held on 8th June to issue update to the outlook issued in April.

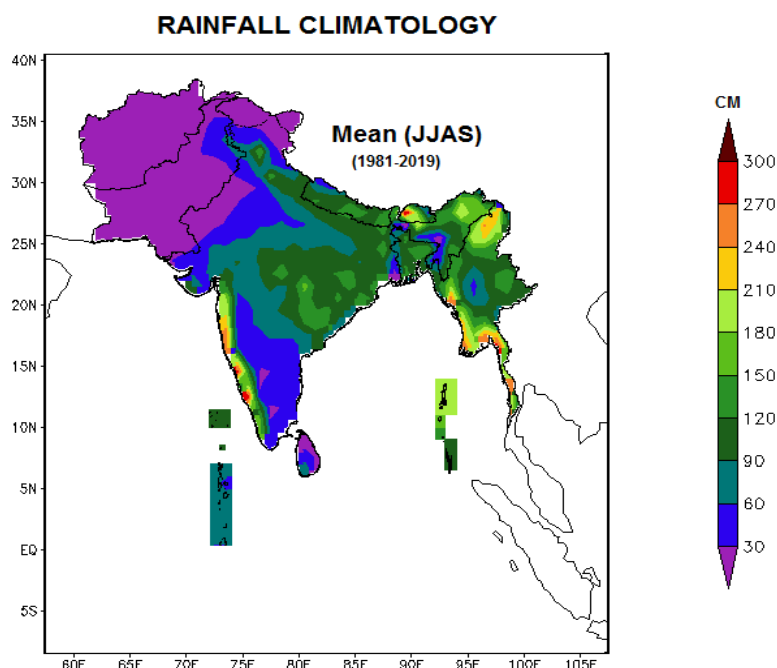
The seventeenth session of the SASCOF (SASCOF-17) & Climate Service User Forum (CSUF) was held during 23-24 and 28th September 2020 being held online due to continuing COVID-19 pandemic. The session was jointly conducted by India Meteorological Department (IMD), World Meteorological Organization (WMO), Met Office, UK and Regional Integrated Multi-hazard Early-warning System (RIMES).

The eighteenth session of the SASCOF (SASCOF-18) was held during 28th November 2020 being held online due to continuing COVID-19 pandemic. The session was jointly conducted by India Meteorological Department (IMD), World Meteorological Organization (WMO), Met Office, UK and Regional Integrated Multi-hazard Early-warning System (RIMES).

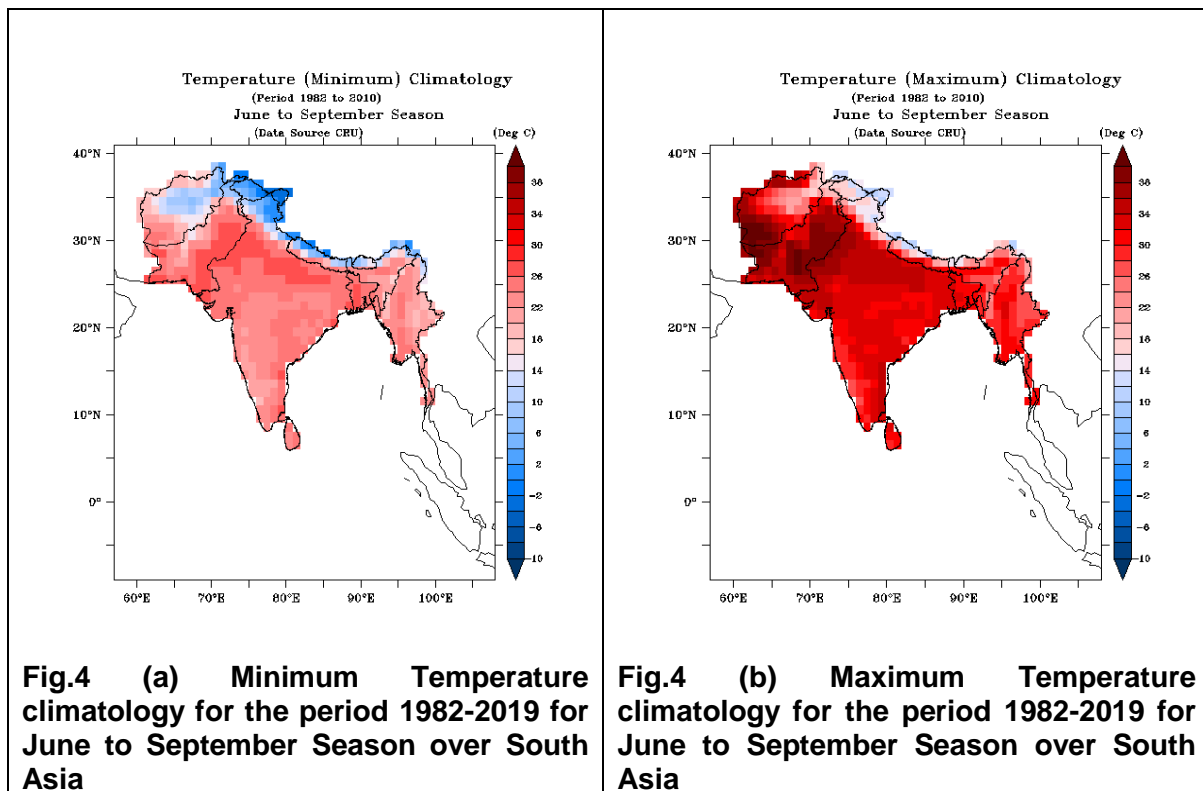
The present and nineteenth session of the SASCOF (SASCOF-19) and Climate Service User Forum (CSUF) is again being held online due to continuing COVID-19 pandemic. The session was jointly conducted by Meteorological Department (IMD), World Meteorological Organization (WMO), Met Office, UK and Regional Integrated Multi-hazard Early-warning System (RIMES).

For preparing the consensus forecasts, the forecast products from various centres such as RCC Pune, JMA, CMA, WMO's Lead Centre for Long Range Forecasting –Multi-Model Ensemble (WMO LC-LRFMME), National Centre for Environmental Prediction (NCEP), USA, Météo France, Met Office UK, European Centre for Medium Weather Forecasting (ECMWF), Canadian Meteorological Centre (CMC), Bureau of Meteorology (BoM), Australia, International Research Institute for Climate and Society (IRI), APCC, and CPTEC, Brazil etc. were also considered.

The long-term historical patterns of the southwest monsoon rainfall over South Asia (Fig.3), characterized by remarkable spatial variability, provide the general reference points at the respective locations for the rainfall anomalies indicated in the outlook.



**Fig.3 Rainfall climatology for the period 1981-2019 over South Asia
(Source: Merged rainfall data over South Asia of RCC, Pune)**



The long-term historical patterns of the Temperature (Minimum and Maximum) over South Asia during June to September (Fig.4 a & b), characterized by large spatial variability, provide the general reference points at the respective locations for the temperature anomalies indicated in the outlook.