

**22<sup>nd</sup> Session of South Asian Climate Outlook Forum (SASCOF-22)  
and  
Climate Services User Forum (CSUF)  
26-28, April 2022 (Online)**

**Consensus Statement on the Seasonal Climate Outlook over South  
Asia for the 2022 Southwest Monsoon Season (June – September)**

### **Summary**

Normal to above normal rainfall is most likely during the 2022 southwest monsoon season (June – September) over most parts of the South Asia. Geographically, above-normal rainfall is most likely along the foot hills of Himalayas, many areas of northwestern and central parts of the region, and some areas of east and southern parts of the region. However, below normal rainfall is most likely over some areas of extreme north, northwest, and south, and southeastern parts of the region. The seasonal rainfall is most likely to be normal or of climatological probabilities over the remaining areas of the region.

During the season, above normal minimum temperatures are likely over many areas along foothills of Himalayas, northern, northwestern and northeastern parts of the South Asia. Below normal to normal minimum temperatures are most likely over most areas of central, southern and southeastern part of South Asia. The seasonal minimum temperatures have climatological probabilities over remaining parts of the region. The seasonal maximum temperatures are most likely to be normal to below normal over most parts of the region except over extreme northwest and some areas of northern and northeastern parts of the region. Maximum temperatures have climatological probabilities over remaining parts of the region.

This regional climate outlook for the 2022 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 22<sup>nd</sup> session of the South Asian Climate Outlook Forum (SASCOF-22) 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 September remained at same strength in March/April 2022. Based on the global climate model forecasts, there is strong consensus among experts that the La Niña 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 2022 southwest monsoon season (June to September) was finalized during the 22<sup>nd</sup> session of the South Asian Climate Outlook Forum (SASCOF-22) held during 26-28 April 2022 via video conferencing in the backdrop of the current 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 nine 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), Met Office (UKMO), International Research Institute for Climate and Society (IRI), Regional Integrated Multi-hazard Early-warning System (RIMES), Japan Meteorological Agency (JMA) , Lead Centre of LRFMME, 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. A neutral (cool) ENSO conditions were observed during May-July 2021. The (cool) ENSO conditions started strengthening during August and weak La Niña conditions were established by September 2021. Thereafter, the La Niña conditions kept strengthening to reach its maximum strength in December 2021. The La Niña conditions were slightly weakened in January and subsequently in February 2022, but slightly strengthened in March 2022. Currently, moderate La Niña conditions are prevailing over the Pacific. The latest global models forecast indicate that the La Niña conditions are likely to continue during the upcoming monsoon season.

### **IOD 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 the negative IOD conditions are likely to develop during the monsoon season.

### **Snow Cover over the Northern Hemisphere**

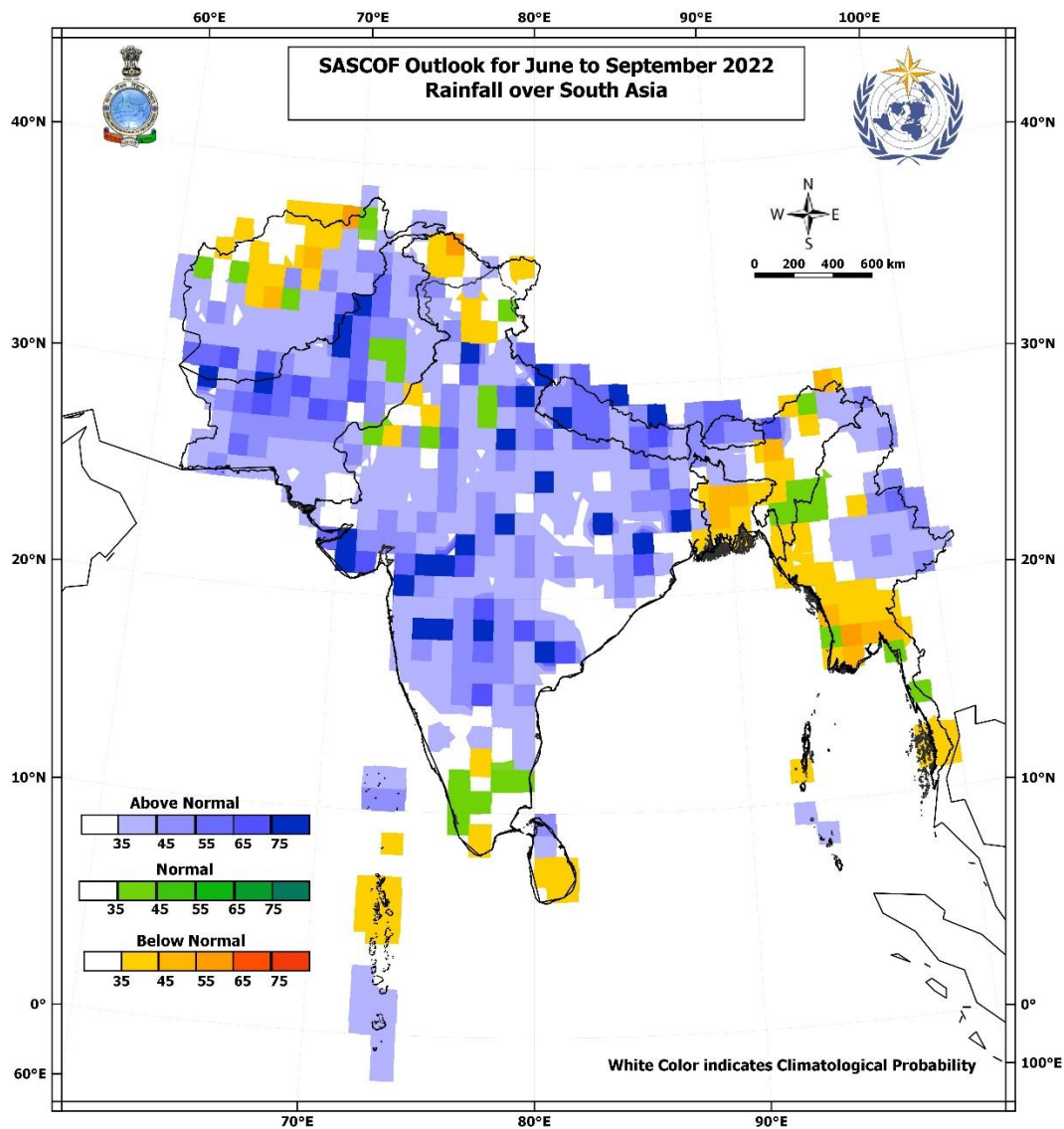
The snow-covered area over Northern Hemisphere as well as Eurasia was near normal (slightly towards positive side of the normal based on 1991-2020) during last few months (December 2021, January to March 2022). The northern hemisphere snow cover areas during February and March 2022 were 29<sup>th</sup> and 25<sup>th</sup> lowest ever during the respective months in the last 56 years. On the other hand, the Eurasian snow cover area 32<sup>th</sup> and 24<sup>th</sup> lowest ever during the respective months in the last 56 years. Winter and spring snow cover extent has a general inverse relationship with the subsequent Asian summer monsoon rainfall.

### **Regional Outlook for the 2022 Southwest Monsoon Rainfall over South Asia:**

A regional climate outlook for the 2022 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 La Nina conditions are likely to prevail over the equatorial Pacific 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 La Nina conditions are favourable for the normal to above normal southwest monsoon rainfall over most part of South Asia. However, it is important to note that ENSO conditions are 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

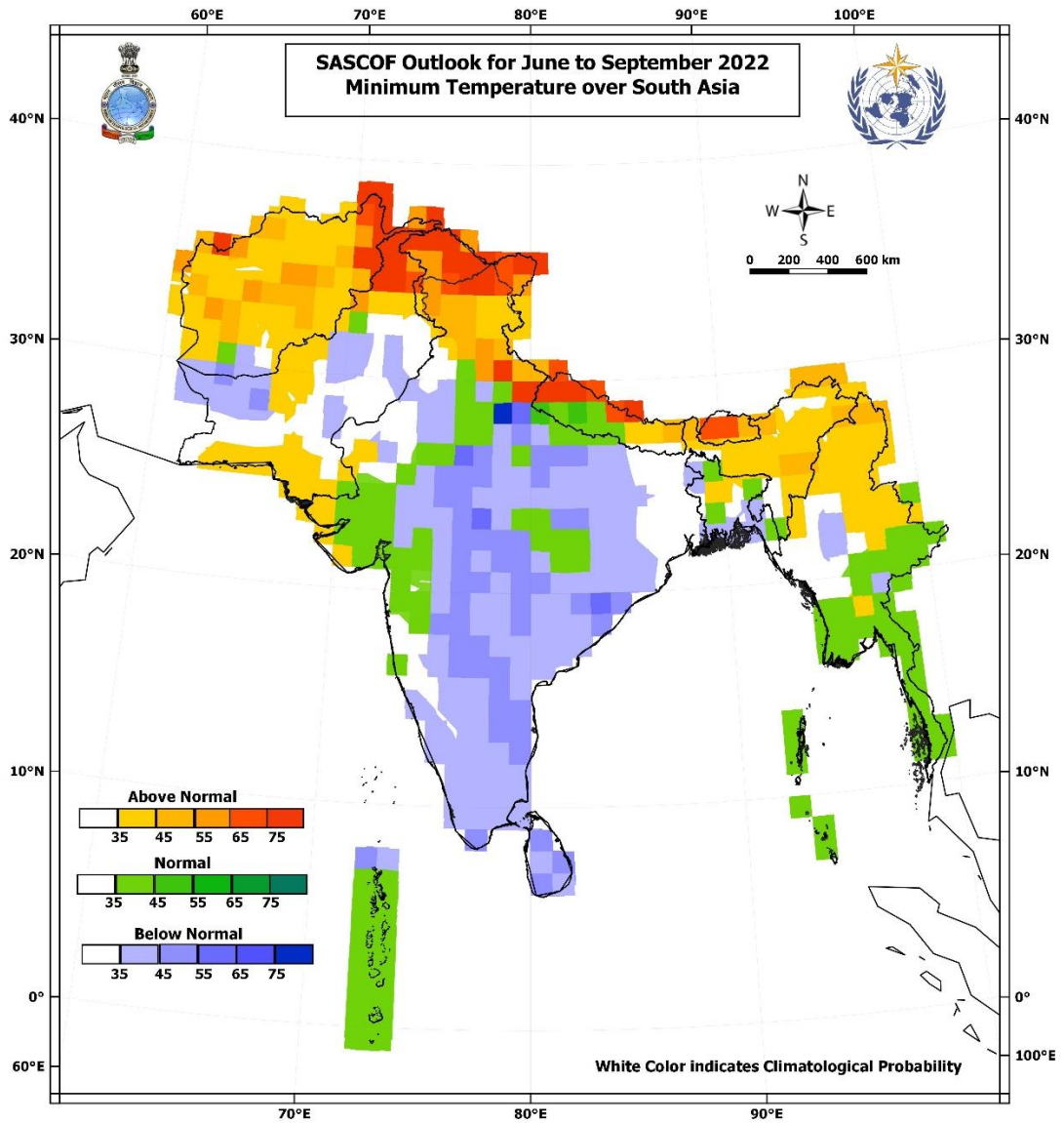
these parameters needs to be considered to determine the expected state of the monsoon over the region which are implicitly considered by the dynamical climate models that underpin the present outlook.



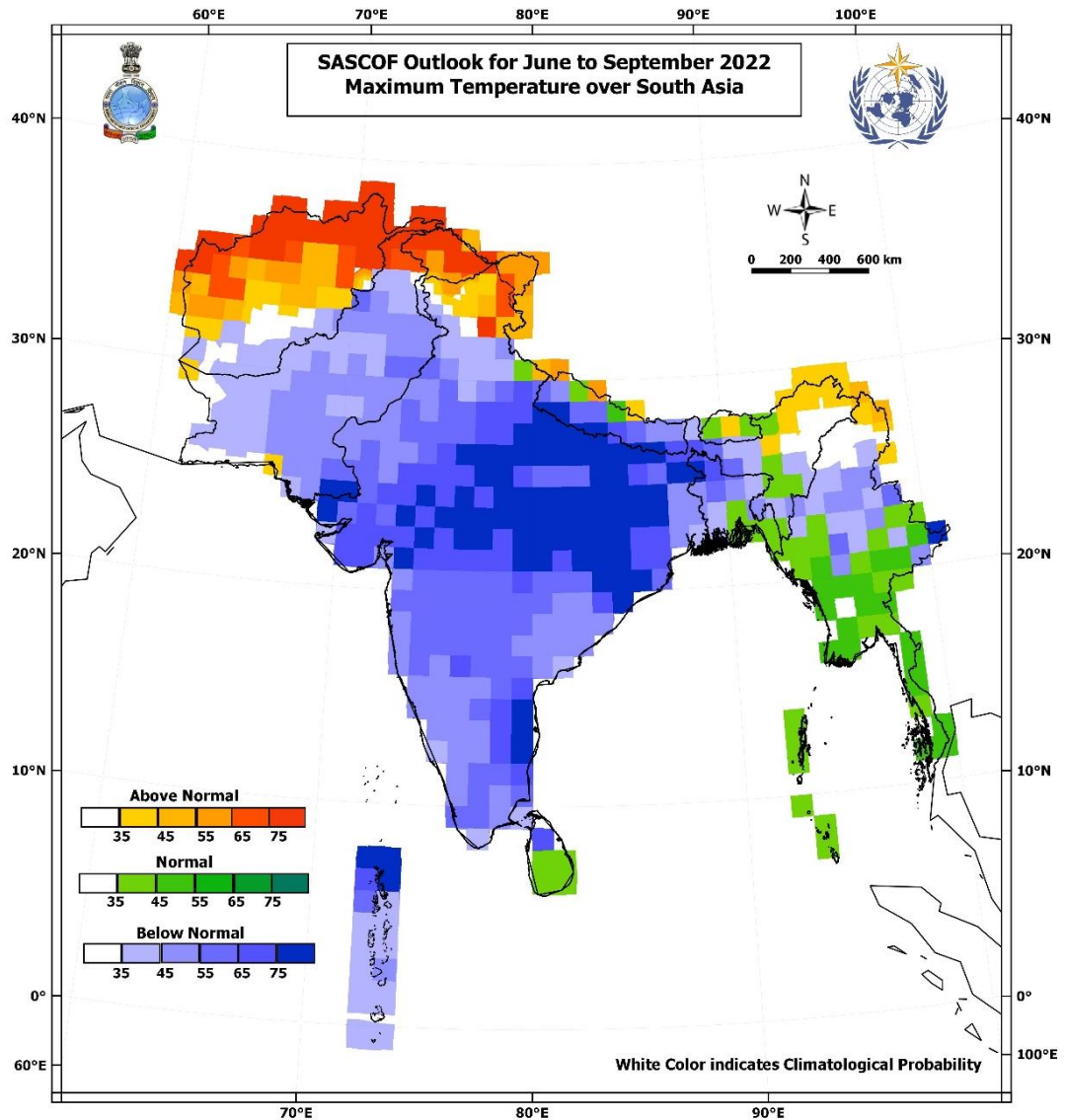
**Fig.1a.** Probability of the most likely category for the 2022 southwest monsoon rainfall over South Asia.

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<sup>1</sup>Tercile categories have equal climatological probabilities, of 33.33% each.



**Fig.1b.** Consensus outlook for the monsoon season (June to September 2022) Minimum Temperature and over South Asia.



**Fig.1c.** Consensus outlook for the monsoon season (June to September 2022) Maximum Temperature and over South Asia.

The outlook for the southwest monsoon rainfall and Temperature (Minimum & 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<sup>1</sup> 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.

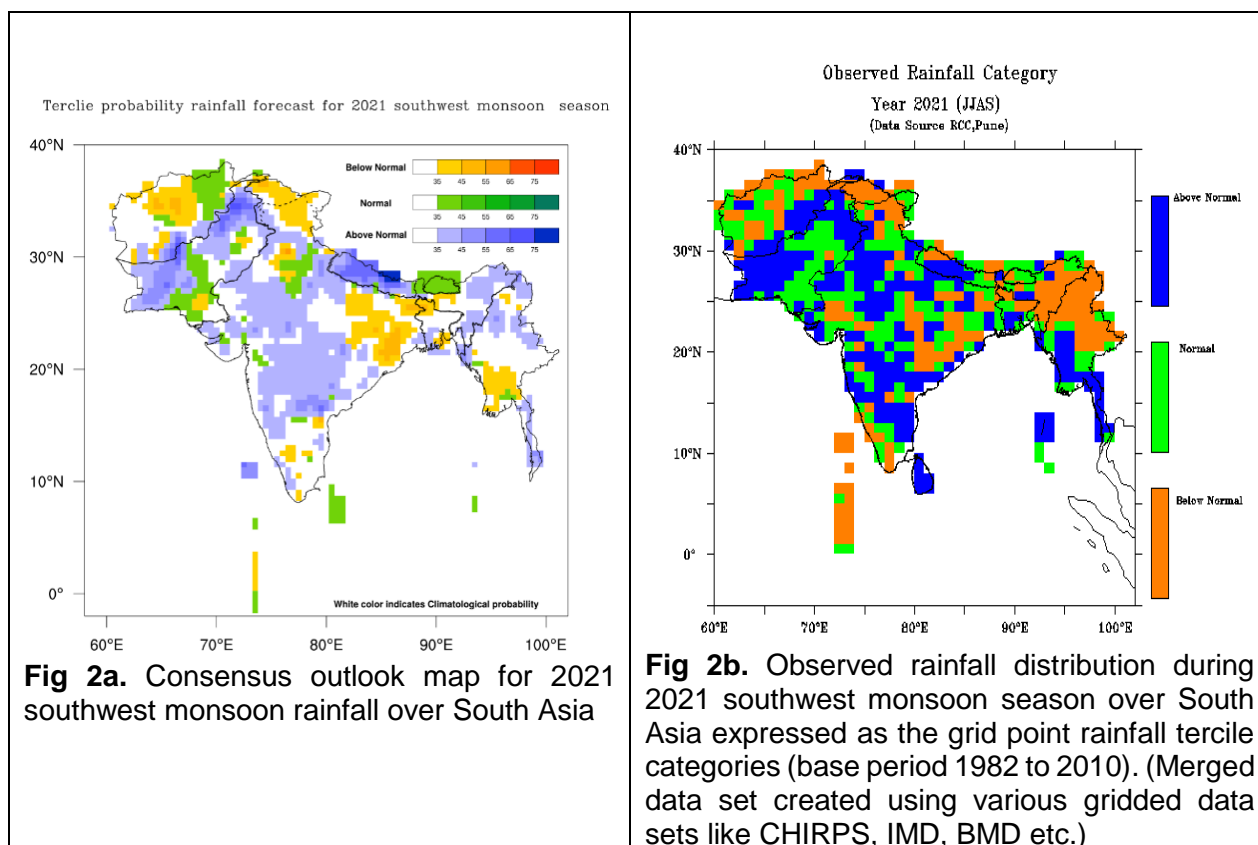
The outlook suggests that normal to above normal rainfall is most likely during the 2022 southwest monsoon season (June – September) over most parts of the South Asia. Geographically, above-normal rainfall is most likely along the foot hills of Himalayas, many areas of northwestern and central parts of the region, and some areas of, east, and southern parts of the region. However, below normal rainfall is most likely over some areas of extreme north, northwest, and south, and southeastern parts of the region. The seasonal rainfall is most likely to be normal or of climatological probabilities over the remaining areas of the region.

Consensus outlook on minimum temperatures for June to September 2022 season suggests during the season, above normal minimum temperatures are likely over many areas along foothills of Himalayas northern, northwestern and northeastern parts of the South Asia. Below normal to normal minimum temperatures are most likely over most areas of central, southern and southeastern part of South Asia.

Consensus outlook on maximum temperatures for June to September 2022 season suggests that the seasonal maximum temperatures are most likely to be normal to below normal over most parts of the region except over extreme northwest and some areas of northern and northeastern parts of the region. Maximum temperatures have 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 JJAS2021 issued by SASCOF-19



The outlook for the 2021 southwest monsoon season (June to September) showed in Fig.2a suggested above-normal rainfall over some areas of the northwest South Asia, along the foot hills of Himalayas and northeast parts of the region, and many areas of central part of the region. However, below normal was forecasted over many areas over extreme northwest, north and some areas over north-eastern parts of the region. Normal rainfall was forecasted for the remaining areas of the region.

Fig.2b shows the observed rainfall distribution during the 2021 southwest monsoon season expressed in terms of tercile categories. It was seen that above normal rainfall was observed over the parts of north-western and central South Asia and foothills of Himalaya matched well with forecast. The below normal rainfall observed over north, extreme northwest, and central-east parts of South Asia also matched well with the forecast. However, there were differences between the observed and forecasted rainfall patterns over the northeast regions of South Asia, where above 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 4<sup>th</sup> 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 Kathmandu, 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

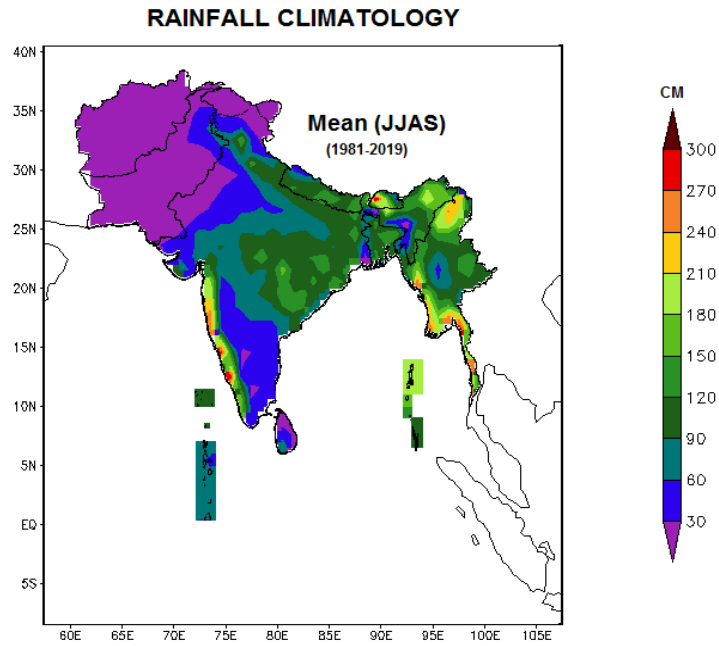
backdrop of the extraordinary circumstances of Covid-19 pandemic prevailing in the world. The session was jointly conducted by Bangladesh Meteorological Department (BMD), India Meteorological Department (IMD), World Meteorological Organization (WMO), Met Office, UK and Regional Integrated Multi-hazard Early-warning System (RIMES). SASCOF-16 session was also held on 8<sup>th</sup> 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 28<sup>th</sup> 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 28<sup>th</sup> 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 nineteenth session of the SASCOF (SASCOF-19) and Climate Service User Forum (CSUF) was held online during 26-28 April 2021, 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). The twentieth Session of South Asian Climate Outlook Forum (SASCOF-20) and Climate Services User Forum (CSUF) was held online during 27-30 September 2021. The 21<sup>st</sup> Session of South Asian Climate Outlook Forum (SASCOF-21) was held online on 25 November 2021.

The present and 22<sup>nd</sup> session of the SASCOF (SASCOF-22) 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).

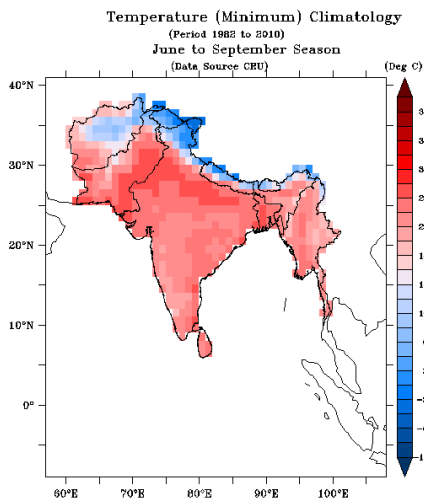
For preparing the consensus forecasts, the forecast products from various centres such as RCC Pune, JMA, CMA, WMO's Lead Centre for Long Range Forecasting –Multi-Model Ensemble (WMO LC-LRFMME), National Centre for Environmental Prediction (NCEP), USA, Météo France, Met Office UK, European Centre for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

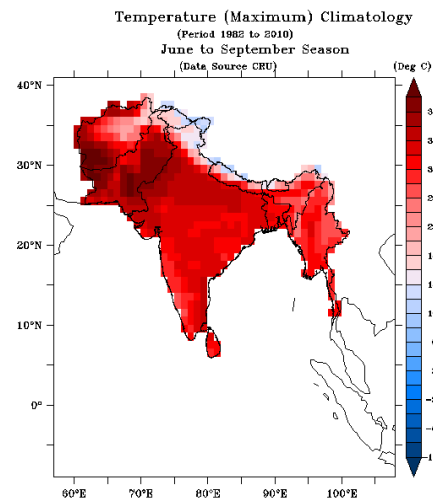
The long-term historical patterns of the Temperature (Minimum and Maximum) over South Asia during June to September (Fig.4 a & b), characterized by large spatial variability, provide the general reference points at the respective locations for the temperature anomalies indicated in the outlook.



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



**Fig.4 (a)** Minimum Temperature climatology for the period 1982-2010 for June to September Season over South Asia



**Fig.4 (b)** Maximum Temperature climatology for the period 1982-2010 for June to September Season over South Asia