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Tenth Session of
South Asian Climate Outlook Forum (SASCOF-10)
Thimphu, Bhutan, 24-26 April 2017

**Consensus forecast for the 2017 Southwest Monsoon
Season (June – September) Rainfall over south Asia**

Summary

Normal rainfall is most likely during the 2017 southwest monsoon season (June – September) over much of South Asia. More specifically:

- Below-normal rainfall is most likely over broad areas of north-western, central and south-eastern parts of South Asia.
- Above-normal rainfall is most likely over broad areas of eastern and the south-western parts of the region.
- Normal rainfall is most likely over the remaining areas.

This consensus outlook for the 2017 southwest monsoon rainfall over South Asia has been developed through an expert assessment of the prevailing global climate conditions and forecasts from different climate models from the participating National Meteorological Services (NMSs) and from around the world. The weak La Nina conditions that prevailed over the Pacific during the latter part of the last year (2016) weakened and turned to neutral ENSO conditions in January 2017. Currently, warm neutral ENSO conditions are prevailing. There is strong consensus among experts that neutral ENSO conditions are likely to continue through the spring season and weak El Nino conditions are likely to develop in the second half of this year. However, it is recognized that there is uncertainty about the development and timing of El Nino conditions. There is also uncertainty about the impact of development of weak El Niño conditions on the southwest monsoon season rainfall over the region. Other regional and global factors that may affect the region were also considered in arriving at this consensus outlook.

For more information and further updates on the southwest monsoon outlook on national scale, the respective NMSs may be consulted.

Introduction:

The climate outlook for the 2017 southwest monsoon season (June to September) was finalized during the tenth session of the South Asian Climate Outlook Forum (SASCOF-10), held at Thimphu, Bhutan during 24–26 April 2017 attended by experts from the South Asian countries. The 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) conditions over the Indian Ocean, winter and spring Northern Hemisphere snow cover etc. The key features of these conditions are as follows:

ENSO Conditions over the Pacific Ocean

The El Niño/Southern Oscillation is one of the global scale climate phenomena that have a significant influence on the year-to-year variability of the monsoon over South Asia. The weak La Nina conditions over the equatorial Pacific prevailed during the second half the last year weakened to neutral ENSO level in the early part of 2017. At present warm neutral ENSO conditions are prevailing. Recent changes in atmospheric conditions over the Pacific reflect the border line La Nina to neutral ENSO conditions. Latest forecasts indicate neutral ENSO conditions are likely to continue through middle of the monsoon season. Weak El Niño conditions are likely to develop in the second half of this year.

Conditions over the Indian Ocean

In addition to ENSO conditions over the Pacific, other factors such as Indian Ocean surface temperatures have some influence on the South Asian southwest monsoon. At present, close to normal SSTs are prevailing in the equatorial and north Indian Ocean. In the subtropical south Indian Ocean, negative SST anomalies are prevailing over eastern part and positive SST anomalies are prevailing over western part. As a result, currently neutral Indian Ocean Dipole (IOD) conditions are prevailing. The recent forecasts from coupled models suggest the development of positive IOD conditions in the latter part of the monsoon season and continue to early part of the post monsoon season.

Snow Cover over the Northern Hemisphere[#]

The snow-covered area over northern hemisphere (NH) was above normal during December 2016 & Jan 2017 and close to normal in the recent two months (February & March 2017). Snow-covered area over Eurasia was above normal from December 2016 to February 2017 and was close to normal in March 2017. NH snow cover during winter and spring has a general negative relationship with the subsequent Asian summer monsoon. ([#]Data source: Rutgers University global snow cover (link: <http://climate.rutgers.edu/snowcover/>)

Consensus Outlook for the 2017 Southwest Monsoon Rainfall over South Asia:

A consensus outlook for the 2017 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 and the current SASCOF sessions, and experimental as well as operational long-range forecasts based on statistical and dynamical models generated by WMO Global Producing Centers (GPCs) of long range forecasting, Regional Climate Centers (RCCs) and other climate research centers of the world.

There is strong consensus among the experts that the prevailing neutral ENSO conditions in the equatorial Pacific will develop into weak El Niño conditions during the second half of this year. However, uncertainty in the timing and intensity of the event was recognized. Analyses of historical observations indicate that developing El Niño though has a general negative impact on the monsoon rainfall over the region, there is no one to one association between El Niño and below-normal rainfall. Particularly during positive IOD years, impact of El Niño on the monsoon rainfall over the region was found to be significantly weakened. Therefore, it was recognized that there is some uncertainty in the impact of the developing weak El Niño conditions on the 2017 southwest monsoon over the region. It is also important to note that developing El Niño or positive IOD conditions are not the only factors that determine the performance of the Southwest monsoon over the region. Other relevant climate drivers such as the state of the tropical Atlantic temperatures, Eurasian land heating, intra-seasonal variability during the monsoon season are also important. The net impact of all these parameters determines the state of the monsoon over the region.

The outlook for southwest monsoon rainfall over South Asia is shown in Fig. 1. The figure illustrates the most likely tercile category¹ 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 synthesis of the available information and expert assessment. It was derived from an initial set of gridded objective forecasts and adjusted through expert assessment and consensus-building discussion of climate experts.

The outlook suggests that during the 2017 southwest monsoon season (June – September), normal rainfall is most likely over much of South Asia. More specifically, below-normal rainfall is most likely over broad areas of north-western, central and south-eastern parts of South Asia and above-normal rainfall is most likely over broad areas of eastern and the south-western parts of the region. Normal rainfall is most likely over the remaining areas.

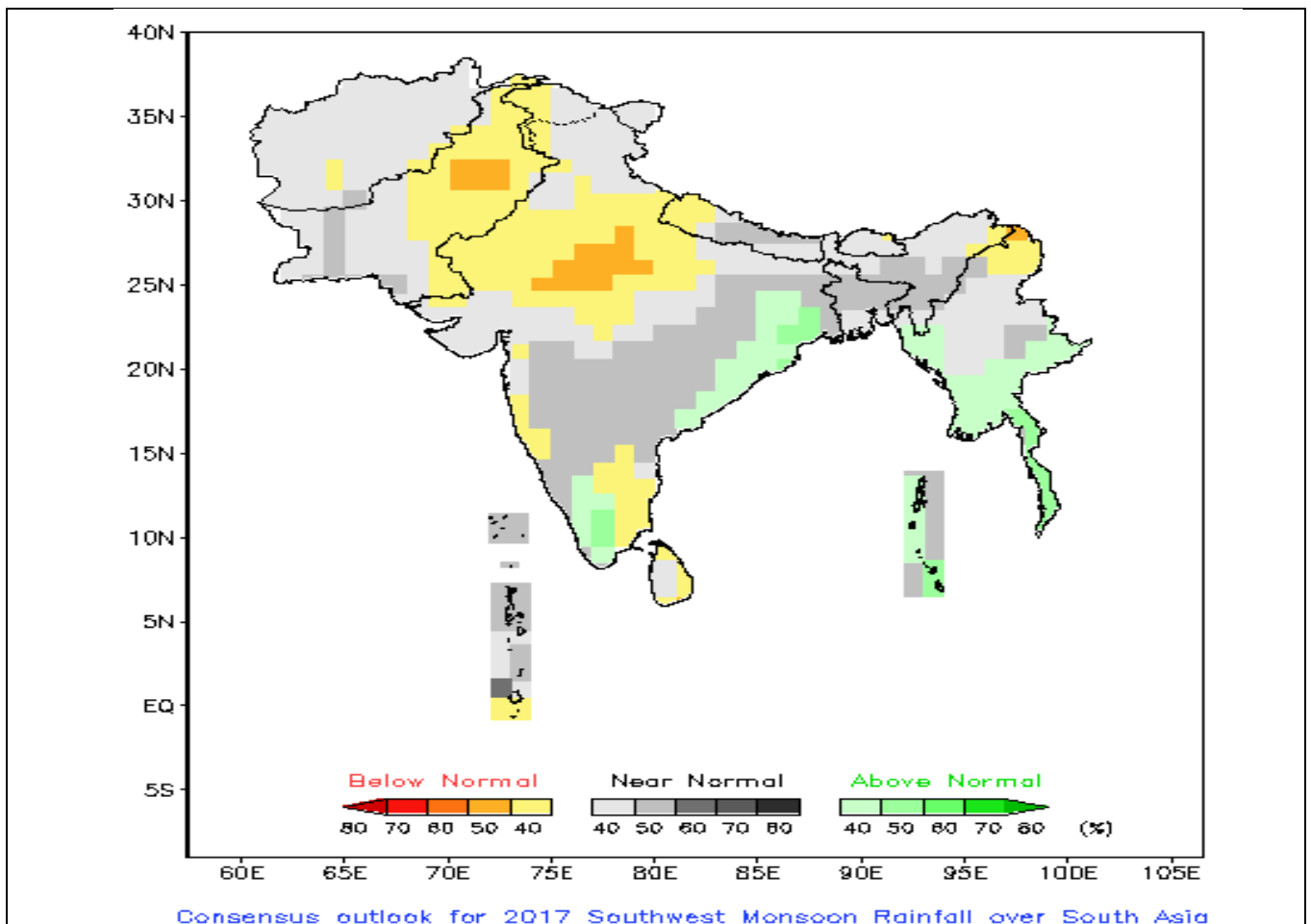


Fig.1. Probability of the most likely category for the 2017 Southwest Monsoon Rainfall over South Asia based on this consensus statement. The consensus-based probability forecast map was prepared based on model forecasts at global as well as national levels synthesized through subjective expert assessment.

¹Tercile categories have equal climatological probabilities, of 33.33% each.

Verification of consensus outlook statement of 2016:

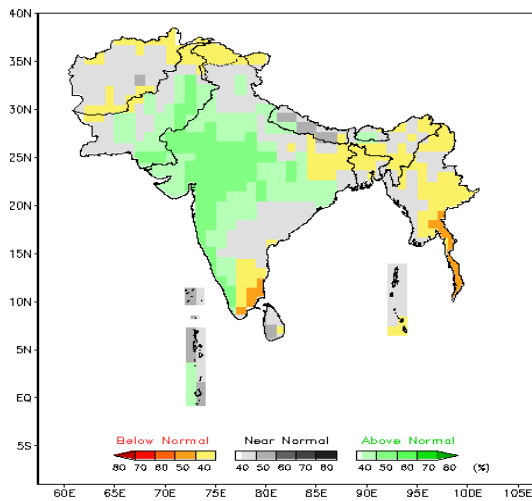


Fig.2 Consensus outlook map of SASCOP-8 for 2016 Southwest Monsoon Rainfall over South Asia.

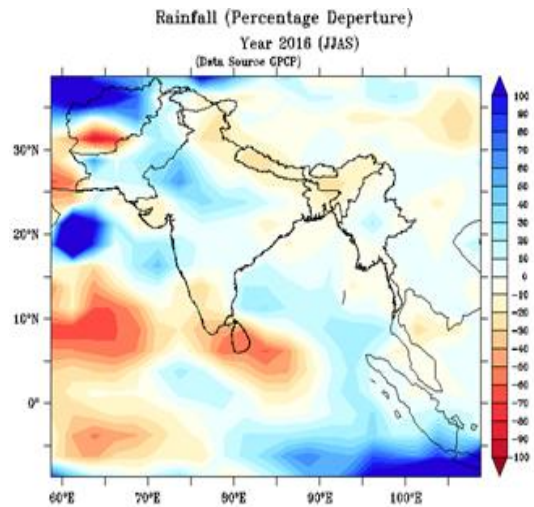


Fig.3 The observed rainfall anomaly (percentage departure) during the 2016 Southwest Monsoon Season over South Asia.

The consensus outlook map (Fig.2) for the southwest monsoon season (June to September) of 2016, developed in the eighth session of the South Asian Climate Outlook Forum (SASCOP-8) had indicated above-normal rainfall over South Asia as a whole during the 2016 southwest monsoon season (June – September). Region-wise, the forecast had indicated above-normal rainfall over broad areas of central and western South Asia, and below-normal rainfall over eastern parts of the region and the southeastern part of the peninsula. Normal rainfall predicted over the remaining areas.

The observed rainfall* (Fig.3) for the 2016 southwest monsoon season was normal over most parts of South Asia. However above normal rainfall was observed over some central and western parts of the region and below-normal rainfall over the southern and north and northeastern parts of the region. Thus the large scale spatial distribution of the observed rainfall was close to the forecasted rainfall pattern over the region.

(*Data source: <https://iridl.ldeo.columbia.edu/SOURCES/NASA/GPCP/V2p3/CDR/>)

Background of SASCOF

Climate predictions are of substantial benefit in many parts of the world in risk management and adaptation to the impacts of climate variability and change. It is 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 climatology 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 and its 4th session was held in 2013 at Kathmandu, Nepal. The fifth session of SASCOF was held in 2014 again at Pune, India. SASCOF-6 was held during 21–22 April last year (2015) in Dhaka, Bangladesh along with Climate Service User Forum (CSUF) for water sector. SASCOF-7, which was the first Forum that focused on the winter season, was held in Chennai, India during 14–15 Oct 2015, in conjunction with the first CSUF-Agriculture.

SASCOF-8 was held during 25-26 April 2016 in Colombo, Sri Lanka. CSUF-Water and CSUF-Health was organized in parallel sessions during 27-28 April. In addition, a joint CSUF session was held with SASCOF on 26 April 2016. SASCOF-8 was also preceded by a Capacity Building Training Workshop on Seasonal Prediction for the operational climate experts of the South Asian countries during 19-23 April 2016. SASCOF-9, which is the second session devoted exclusively for the Northeast monsoon season was held at Nay Pyi Taw, Myanmar, during 27-29th September 2016 in conjunction with the second CSUF-Agriculture.

The climate outlook for the 2017 southwest monsoon season (June to September) (December) was prepared during the tenth session of the South Asian Climate Outlook Forum SASCOF-10 was held at Thimphu, Bhutan SASCOF-10 was hosted by the National Center for Hydrology and Meteorology (NCHM), Royal Government of Bhutan, with the technical co-ordination by India Meteorological Department (IMD). SASCOF-10 was preceded by a Capacity Building Training Workshop (Pre SASCOF) as a part of the 9th International Training Workshop on Climate Variability and Prediction (9ITWCVP), organized by NOAA-USAID-WMO and IITM, and hosted by IITM from 13-21 April 2017 in Pune, India.

World Meteorological Organization (WMO) co-sponsored the SASCOF-10 under a project funded by the Department of the Environment, Government of Canada, for the implementation of the Global Framework for Climate Services (GFCS). These events also form part of the activities of Regional Climate Centre (RCC) Pune, India, recommended for formal designation as WMO RCC.

The SASCOF-10 (24–26 April 2017) session was attended by participants from six of the eight South Asian countries, namely, Bhutan, India, Maldives, Myanmar, Nepal, Pakistan, and Sri Lanka. The session was also attended by experts from IMD, Indian Institute of Tropical Meteorology (IITM), WMO, Japan Meteorological Agency (JMA), National Centers for Environmental Prediction (NCEP), USA, and Regional Integrated Multi-hazard Early-warning System (RIMES). In addition, experts from various user sectors of Bhutan such as government, health, media, agriculture, and water resources took active part in the deliberations for assessing the available forecast information and for finalizing the consensus outlook for the southwest monsoon rainfall over South Asia. For preparing the consensus forecasts, the forecast products from various centers such as IMD, IITM, NCEP, Météo France, Met Office, UK, European Centre for Medium Weather Forecasting (ECMWF), Canadian Meteorological Centre (CMC), Bureau of Meteorology, Australia, IRI, JMA, Korea Meteorological Administration (KMA), China Meteorological Administration (CMA), Bureau of Meteorology, Australia, WMO’s Lead Centre for Long Range Forecasting - Multi-Model Ensemble (WMO LC-LRFMME), Japan Agency for Marine-Earth Science and Technology (JAMSTEC), and APEC Climate Center, APCC were also considered.

The long-term historical patterns of the southwest monsoon rainfall over South Asia (Fig.4), characterized by remarkable spatial variability, provide the general reference points at the respective locations for the rainfall anomalies indicated in the outlook.

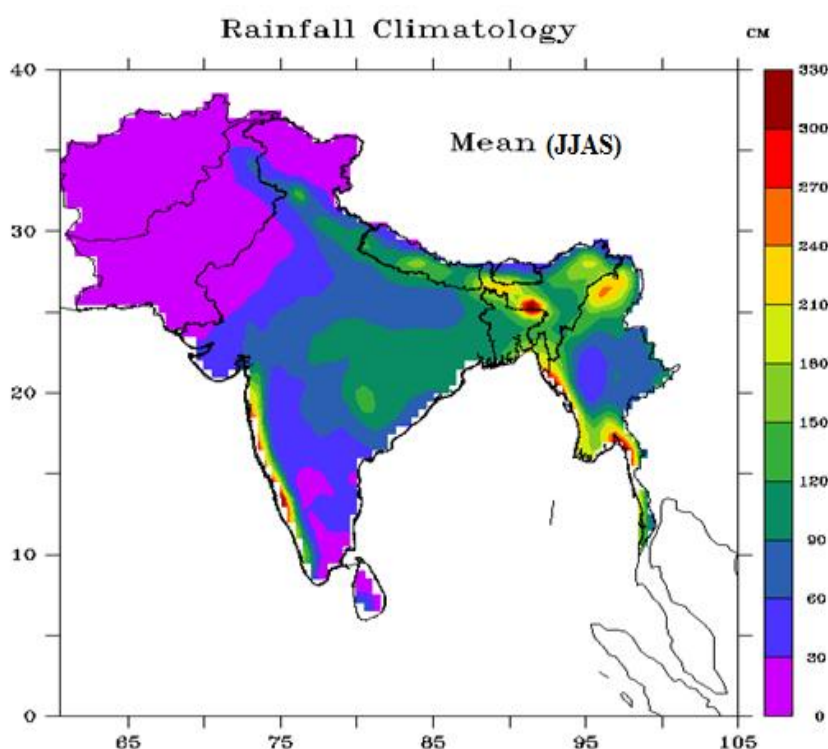


Fig.4. Rainfall Climatology for the period 1951–2007 over South Asia
 (Source: APHRODITE’s Water Resources Home page:
<http://www.chikyu.ac.jp/precip/english/index.html>)