



South Asian Climate Outlook Forum (SASCOF): A Mechanism for Preparing Consensus Climate Forecast Outlook for South Asia

**SAARC DMC Training Workshop on
Seasonal Climate Forecasting for South Asia
Ahmedabad, India, 6–8 December, 2017**

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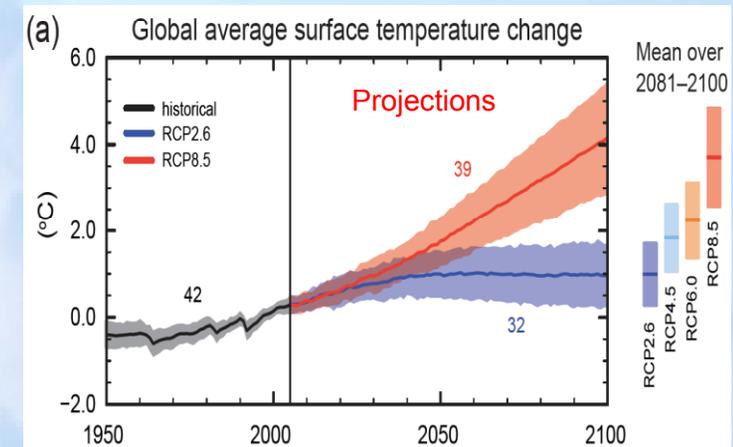
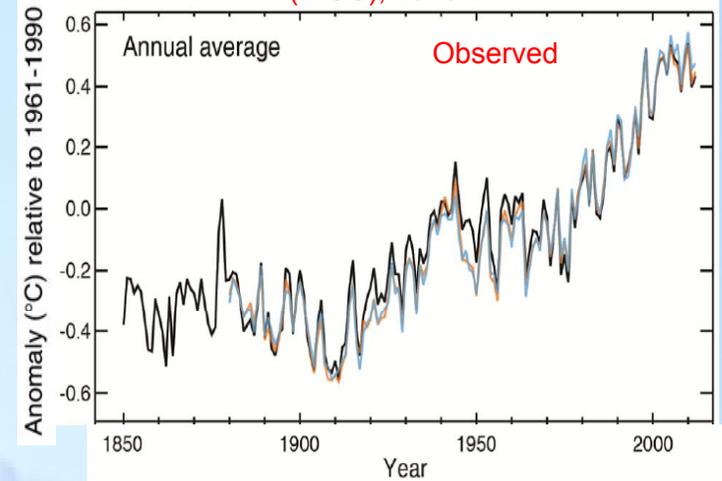
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Introduction

- ❖ In South Asia, as in the rest of the world, adapting to climate change is a complex challenge.
- ❖ The impacts of climate variability and change on natural, social and economic systems are becoming increasingly evident.
- ❖ Accurate and reliable weather and climate information are essential for assessing and managing the impact of climate change, and for planning adaptation measures.
- ❖ Such information provide the basis for global, regional and local climate models, as well as for climate adaptation strategies.

Inter Governmental Panel on Climate Change (IPCC), 2013



Introduction

- Rapid advances have been made in the understanding and predicting the climate system
- Therefore, now it is possible to provide climate products and services through optimized use of existing climate related data and monitoring products, sector specific climate products and the production of reliable predictions for time scales ranging from seasons to decades and longer time scales.
- Regional Climate Outlook Forums (RCOFs) are one of the vehicles for developing user-driven products and services and communicating those to users at regional and national scale.



Regional Climate Outlook Forum (RCOF)?

- A RCOF is a platform that brings together climate experts and sector representatives from countries **in a climatologically homogenous region** to provide consensus based climate prediction and information, with input from global and regional producing centres and National Meteorological and Hydrological Services, with the aim of gaining substantial socio-economic benefits in climate sensitive sectors.
- RCOFs strengthen regional networking of the climate service providers and user-sector representatives. Participating countries recognize the potential of climate prediction and seasonal forecasting as a powerful development tool to help populations and decision-makers face the challenges posed by climatic variability and change. One of the important components of RCOFs is development of existing capacities of NMHSs in seasonal forecasting and communication of climate information to user community.



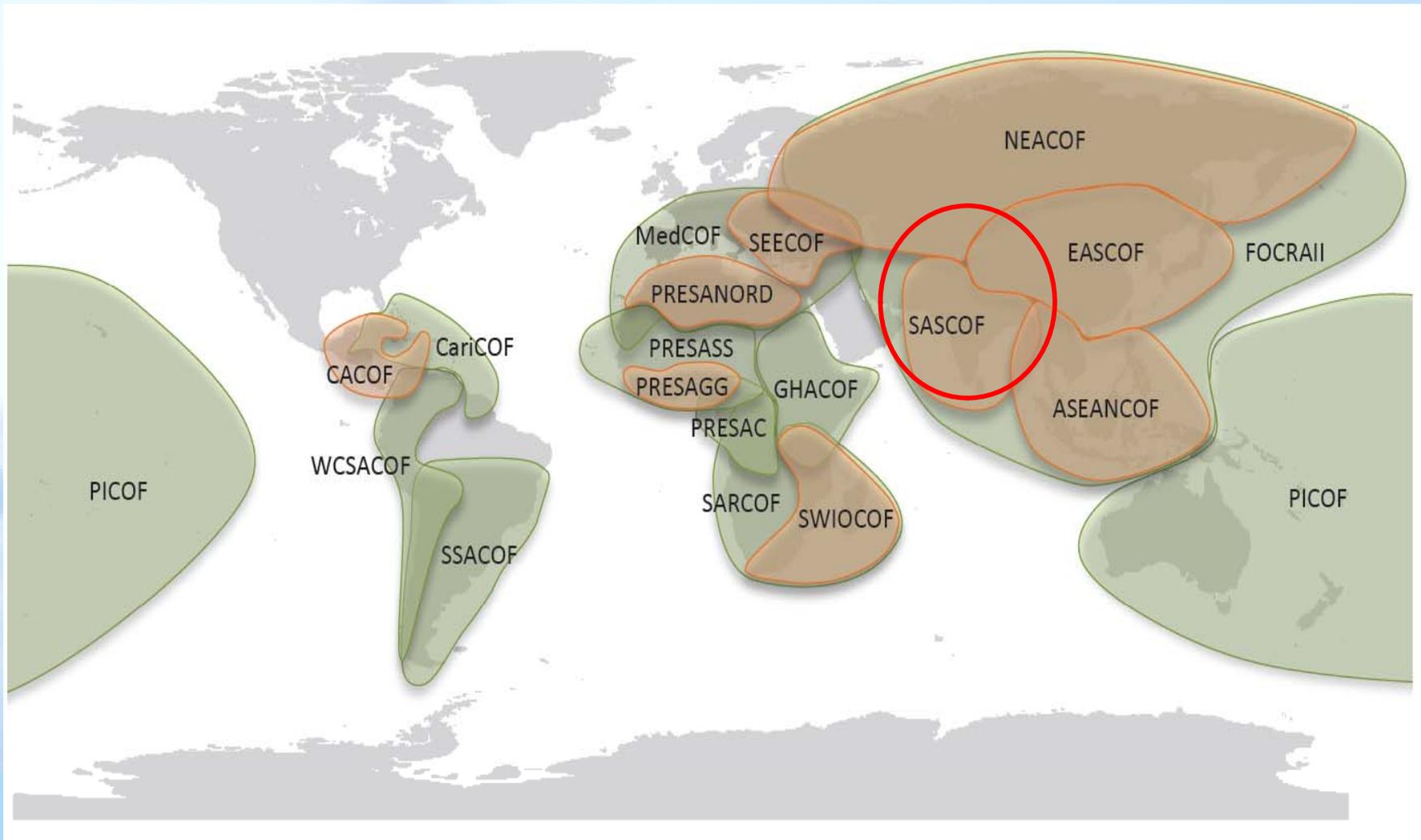
RCOF: Global Status

- The World Meteorological Organization (WMO), a specialized agency of the United Nations for weather, climate, and water, enables scientific understanding of climate variability and change through dedicated observations of the climate system; improvements in the analysis, monitoring and prediction and the development of climate applications and services; capacity building in the application of meteorological and hydrological data, dissemination of information in support of climate risk management and scientific research and assessments.
- Regional Climate Outlook Forum (RCOF) was initiated In late 1990s under the WMO Climate Information and Prediction Services (CLIPS) project in collaboration with National Meteorological and Hydrological Services (NMHSs), regional institutions and other international organizations. RCOF was first established in 1996 at a Meeting in Victoria Falls, Zimbabwe. It gained momentum as a regional response to the major 1997–1998 El Niño event, since then RCOF concept was spread worldwide.
- Currently there are 19 forums operational around the world, as of 2016.



Regional Climate Outlook Forums All Over the World

In different regions of the world, the RCOFs have evolved in different ways, based on specific needs and capabilities and tailored to meet the local conditions. Meanwhile, in all regions they constitute reliable and authentic sources of high-quality climate information, developed through a cooperative endeavour and on a sustainable basis.



Establishment of SASCOF

- ❖ In Asia, China has been coordinating a RCOF called '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 a sub-regional scale. 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 RCOF for south Asia known as 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 summer monsoon climate.



South Asian Climate Outlook Forum (SASCOF): Beginning & Objectives

- ❖ In a meeting convened by WMO, the Directors General of the National Meteorological and Hydrological Services (NMHSs) in South Asia and Permanent Representatives (PRs) of the respective countries with WMO, at the Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy, on 6 August 2009, the PRs of south Asian nations with the WMO had unanimously agreed to establish a South Asian Climate Outlook Forum (SASCOF), to be implemented from 2010 onwards. The main objectives of SASCOF are the following.
- ❖ *To review the progress made in understanding and long range prediction of summer monsoon both regionally and globally;*
- ❖ *To make available detailed information on climate variability in South Asia for dissemination along with the seasonal outlook;*
- ❖ *To provide a platform for the stakeholders of SASCOF to share and exchange experience and knowledge on summer monsoon and its prediction;*
- ❖ *To initiate capacity building/human resource development activities for the South Asian region, particularly in seasonal prediction;*
- ❖ *To build collaboration and partnerships among the members of SASCOF for mutual benefit;*
- ❖ *To identify needs of user sectors through a dialog among different groups.*



SASCOF Background

Target Region: South Asia (9 countries)

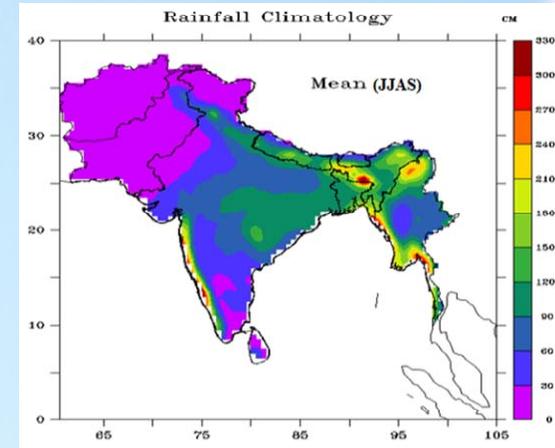
Co-ordinating Institution: India Meteorological Department (IMD)

Target Seasons: SW Monsoon (JJAS), NE Monsoon (OND), winter (DJF)

Parameters: Rainfall for all seasons. Temperature for OND and DJF

Major forcings on the regional climate: ENSO, IOD, Winter and spring Eurasian Snow Cover, Northern Hemisphere surface air temperature during spring season, sea surface temperature patterns over Atlantic Ocean, mid latitude flow pattern north of Asia etc.

Potential applications of seasonal outlooks: Agriculture (selection crops, crop yield forecast), Disaster preparedness and risk reduction (impact of floods and droughts), Public health (disease outbreaks like Malaria, cholera etc.), Energy sector (expected energy demand scenarios), water management (reservoir) etc.



Rainfall Climatology for the period 1951–2007 over South Asia.

(Data Source: APHRODITE's Water Resources Home page:

<http://www.chikyu.ac.jp/precip/english/index.html>)

RCOF frequency: Physical sessions in April for SW Monsoon & in September for NE Monsoon. online session in November for winter season (December to February):

Sources of funding: Financial support for conducting SASCOF activities mainly come from WMO through its various funding agencies like The United States Agency for International Development (USAID), Department of the Environment, Government of Canada etc. Participation of the experts from IMD and IITM, Pune is funded by the respective institutions.

S. No.	Country	Main rainfall periods
1	Afghanistan	Winter (DJF), Spring (MAM)
2	Bangladesh	Pre-monsoon (MAM), summer Monsoon (JJAS)
3	Bhutan	Winter (DJF), JJAS (summer monsoon)
4	India	Winter (JF) for north India, pre-monsoon for south peninsula and northeast India (MAM), SW Monsoon (JJAS) for most parts of the country and post monsoon (OND) for south Peninsula.
5	Maldives	May to October
6	Myanmar	Pre-monsoon (AM), Summer monsoon (JJAS), post monsoon (ON).
7	Nepal	Winter (DJF), JJAS (summer monsoon)
8	Pakistan	Winter (DJF), JAS (summer monsoon)
9	Sri Lanka	First inter-monsoon (MA), SW Monsoon (MJJAS), second inter-monsoon (ON)



The SASCOF Process (1/2)

-Main forum meeting is generally held for 2-3 days. Experts from south Asian countries and other regional and international climate centers participate

-The consensus outlook is reached based on the prevailing large scale global climatic patterns (like ENSO, IOD, Snow Cover etc.) and seasonal forecasts for the relevant season from both statistical and dynamical models. At least 50% of the forecast information is derived from various dynamical models.

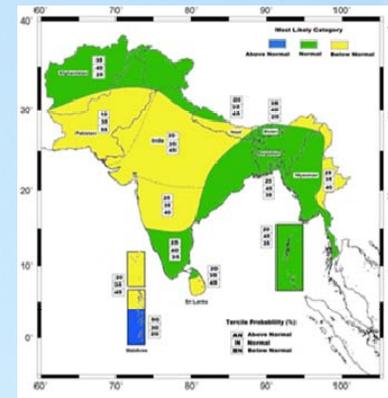
-Predictand data used in the statistical models are Grid point (GPCP) data from IRI data library & station data brought by the participating NMSs. Predictor data used are observed data (SST, precipitation, mslp, wind etc.) and model simulations (mainly NCEP CFS).

-Representatives from NMSs uses CPT to recalibrate the predictor data, assesses the skills of the methodology, and generate forecasts for the respective country.

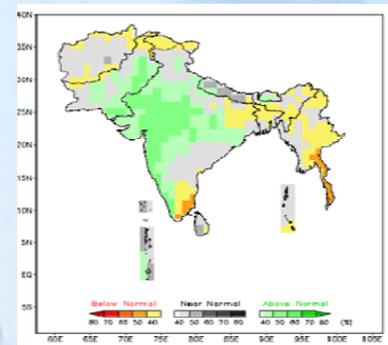
-Forecast information derived from the participating NMSs of the region based on the exiting forecasting system, WMO GPCLRFs and RCCs, and other climate research centers like IRI, IITM, APEC Climate Center etc. is also used.

-During 2011-2015, the probability forecast map depicted areas of most likely tercile categories (below normal, normal and above normal using yellow, green and blue colour shades) over the region, as well as the probabilities for each tercile categories over broad areas of same colour shade. From 2016 onwards the probability forecast map depicted 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 synthesis of the available information and expert assessment. It was derived from an initial set of gridded objective forecasts and modified through a consensus building discussion of climate

Consensus forecast for JJAS 2015



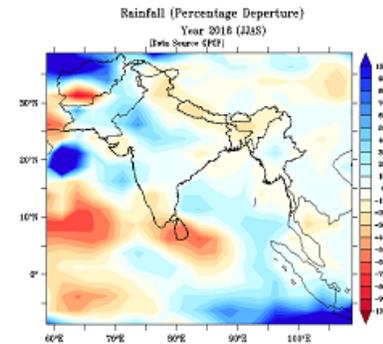
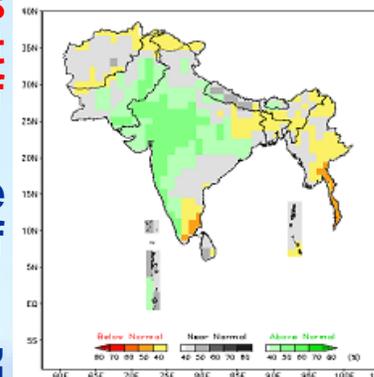
Consensus forecast for JJAS 2016



The SASCOF Process (2/2): NCOFs & RCC, Pune

- ❖ The components of the SASCOF consensus statement are; **Summary of the statement, Introduction, Current status and the forecast outlook of the large global climate anomalies like ENSO, IOD, snow cover over NH etc.,. Consensus forecast outlook along with a probability forecast map & a climatology map, and the verification of consensus forecast issued for the previous year.**
- ❖ The practice of including the verification part in the consensus forecast was started from 7th session of the SASCOF held in Colombo, Sri Lanka.
- ❖ Once the regional consensus forecast is issued, most of the NMHSs of the region conduct National Climate Outlook Forums (NCOFs) in the country as well as sub-country scales in local languages.

Verification of the consensus forecast map for 2016 JJAS Season



- As the SASCOF consensus forecast process does not cover all the seasons, Regional Climate Center (RCC) Pune issues forecast outlook for the rainfall and temperature for the next two three month moving seasons (i.e., for next four months period) over the region, The outlook is updated every month. The forecast outlook is prepared based on the high resolution climate forecasting system (CFS) model. RCC, Pune also provides forecast anomaly maps of rainfall and temperature over the region for the next 9 months and the anomaly maps are for monthly and 3 month moving seasons. RCC, Pune also provides latest status of the ENSO and IOD and its forecasts for next 9 months and issues ENSO and IOD bulletin updated every month.



Capacity Development Activities

- Capacity Development workshop as a part of main forum meeting was introduced in response to recommendation of the SASCOF-1, Pune, India in April, 2010.
- Conducted every year prior to Forums for summer monsoon.
- However, the last capacity development workshop was conducted as a part of the 9ITWCVP
- The main subject of the capacity development workshop has been seasonal prediction.
- The aims of the workshop are (i) Provide an updated overview on current research on the seasonal prediction (ii) provide dedicated lessons and opportunity to develop simple empirical prediction schemes for the nation-wide or homogeneous region-wide rainfall through hand on computer sessions and (iii) training to prepare country based seasonal forecast outlook.

Capacity Development Workshops Conducted Associated with SASCOF

Place	Duration	Topic
Pune, India	8-12 April, 2011	Seasonal Prediction of SW Monsoon
Pune, India	16-18 April, 2012	Seasonal Prediction of SW Monsoon
Kathmandu, Nepal	15-17 April, 2013	Seasonal Prediction of SW Monsoon
Pune, India	14-21 April, 2014	Seasonal Prediction of SW Monsoon
Dhaka, Bangladesh	19-20 April, 2015	Seasonal Prediction of SW Monsoon
Colombo, Sri Lanka	19-23 April, 2016	Seasonal Prediction of SW Monsoon
Pune, India (as a part of 9 th International Training Workshop on Climate Variability and Prediction (9ITWCVP))	13-21 April, 2017	Climate Variability & Prediction

Issues faced:

- No continuity in the training as new participants each year.
- Some participants lack required background in the subject
- Lack of good quality gridded climate data



SASCOF Training workshops

Associated with SASCOFs forum meetings, Training workshops on seasonal prediction are also conducted. Centre designs and conducts the training workshops as per the regional requirement. Support of international experts is also used. The participating climate experts from the NMHS of the region are trained in using, interpreting and downscaling global seasonal prediction products and developing a consensus outlook.



SASCOF-6



SASCOF-5



SASCOF-4



User Involvement

- To provide a platform for interaction with users of climate services and promote the use of RCOF products, the Forum invites representatives of the user community from climate sensitive user sectors, include Agriculture and food security, health, energy, water resources, disaster risk reduction and response, media etc.
- Some of the main forum meetings were also followed by a joint meeting of climate experts, and practitioners & decision-makers from these user sectors and stake holders from the region.
- These joint meetings review various issues related to the use of climate information to sector specific applications, sharing the experiences and lessons learned from the applications of previous SASCOF products etc.
- The meeting also encourage sector experts to develop detailed sector specific risk information including warnings based on the SASCOF products, and communicate to decision-makers and the public.
- Special outreach sessions involving media experts are also conducted to develop effective communication strategies.

User Forum Conducted Associated with the SASCOF

Place & Period	Session of the SASCOF	User Forums Conducted
Pune, India 23 - 25 April 2014	SASCOF-5	1 st User Forum for the Water Sector (CSUF-Water)
Dhaka, Bangladesh 21-22 April 2015	SASCOF-6	2 nd CSUF-Water
Chennai, India 14-15 Oct 2015	SASCOF-7	1 st CSUF-Agriculture
Colombo, Sri Lanka. 27-28 April 2016	SASCOF-8	3 rd CSUF-Water and 1 st CSUF-Health
Nay Pyi Taw, Myanmar 27-29 September 2016	SASCOF-9	second CSUF-Agriculture



SWOT Analysis

Strengths	Weaknesses
<ul style="list-style-type: none">• Countries of the region with nearly similar climatic characteristic and large agrarian community have nearly similar requirements of seasonal and sub-seasonal forecast outlook.• NMHSs of the region have long experience in providing weather services and have started extending climate services.• Significant improvement in the understanding and predictability of the climate variability (particularly that of the monsoons, which are the most dominating climate feature) of the region due to long global and regional research efforts.	<ul style="list-style-type: none">• Climate services activity is new area for some countries and there is lack of general awareness about the existing of such services.• Limited infrastructure and expertise (particularly in respect of seasonal prediction, which either absent or require further development) in some countries for extending the climate services.• Non availability of long period, high resolution, and quality data bases & Lack of coordination with end users
Opportunities	Threats
<ul style="list-style-type: none">• Keen interest from the NMHS and user sectors is an opportunity to develop sustainable SASCOF services.• Success in providing reasonably correct climate forecast outlook in previous years (like deficient southwest monsoon rainfall over the region during 2014 & 2015) has given confidence in our ability to provide forecasting information/ climate services about extreme events.• Opportunities to develop sector specific SASCOF products.	<ul style="list-style-type: none">• The NMSs have technical skills often unfamiliar to users.• Legal responsibility issues often unclear when weather/climate information is disseminated.• Entry of private companies in the met. Services.



Way Forward

Based on the discussions among the climate experts, experts from user sectors and other participants of the main forum and user forum meetings of SASCOF during the last 8 years (2010-2017), following points are important for further acceptability and usability of the SASCOF products.

- ❖ Development of high resolution and quality data bases over the region for better climate monitoring as well as bias correction and verification of climate forecasts.
- ❖ Make the process of preparing the consensus forecast map from various forecast inputs to be objective as much as possible.
- ❖ Skill map of such objective methods available for improving confidence in using the consensus forecast products
- ❖ Standard tools for verification of consensus forecasts
- ❖ Mechanism to update the consensus forecast regularly (say every month). An expert team of focal points from each NMHS lead by RCC can generate the forecast.
- ❖ The seasonal forecast to be supplemented by sub-seasonal/monthly climate forecasts.
- ❖ Conduct capacity training workshops on other topics such as the construction of long time series of gridded climate data over the region, extended range prediction, climate applications and climate impact assessment
- ❖ Increased interaction with the user community and generation of tailored climate products for the users.
- ❖ Specialised capacity building workshops for user community.



Verification of the Consensus Forecasts

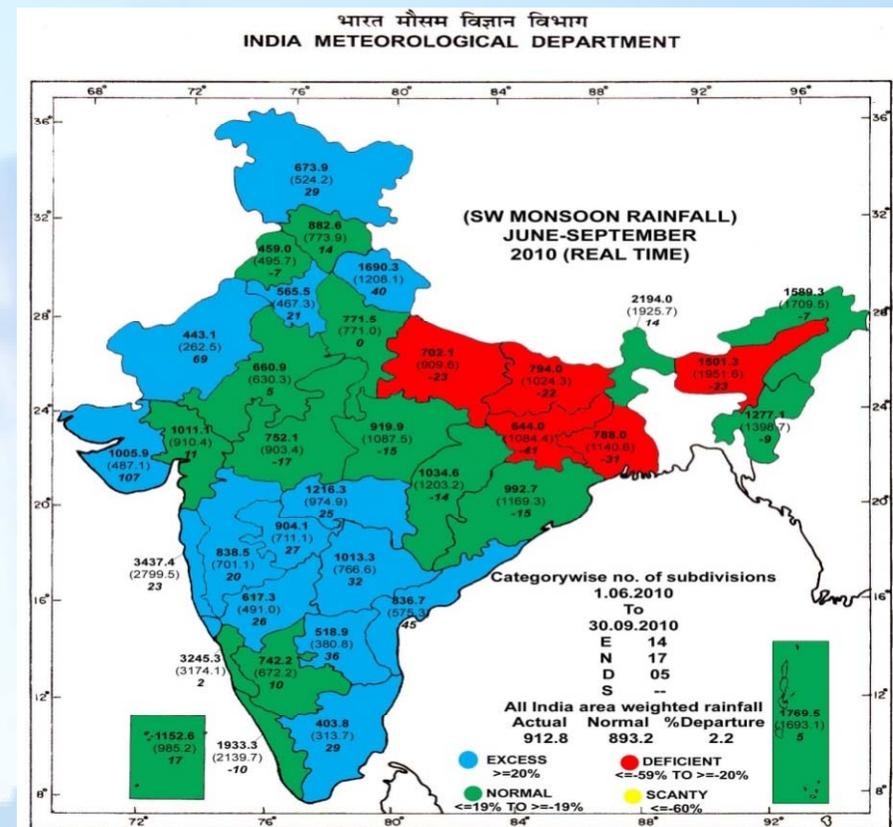
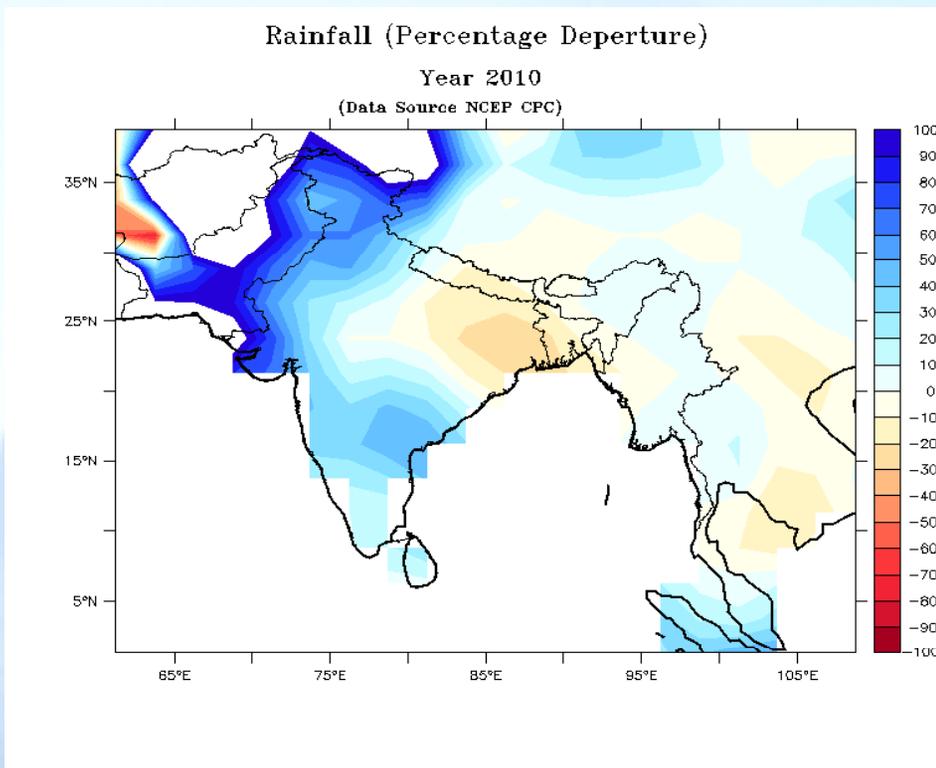
- ❖ The verification of the consensus forecast maps for seasonal rainfall issued during the last six years (2011-2016) is given in the next few slides. It can be seen that in most of the cases, the performance of the large scale rainfall anomaly over the region during the season was correctly indicated by the consensus forecasts.
- ❖ However, some differences were noticed in the forecast for the regional rainfall distribution.
- ❖ It may be mentioned that consensus forecasts were able to correctly indicate the below normal southwest monsoon season (June to September) rainfall over the region during the years 2014 & 2015 as well as the above normal northeast monsoon season (October to December) rainfall over the southern part of the region.



Verification of Forecast for South Asia - 2010

- ❖ Forecast: Based on the prevailing global climate indicators and forecasts from statistical and global dynamical models, rainfall over South Asia, in general, is likely to be within the normal range (No forecast map were produced).

GPCP PRECIPITATION ANOMALY: JJAS 2010



Arrived based on both Statistical and Dynamical Model Forecasts



14-Nov-19

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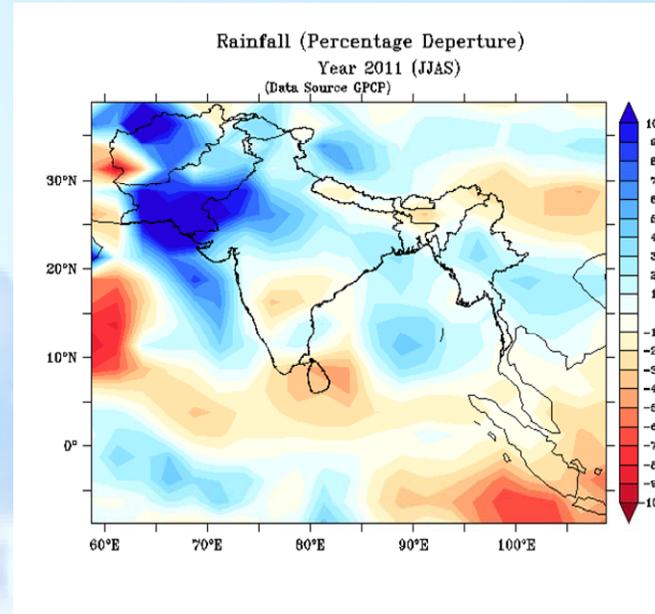
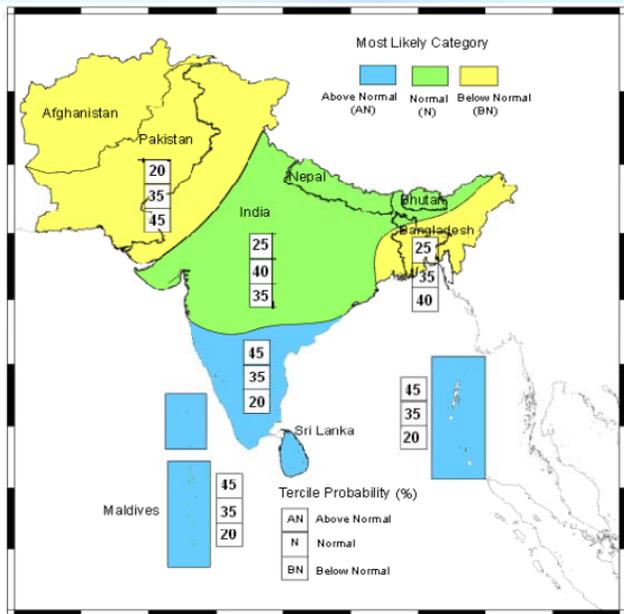


Verification of Forecast for South Asia - 2011

FCST

OBS

a) JJAS 2011



Forecast: Over South Asia, for the season as a whole, the large-scale summer monsoon rainfall would most likely be within the normal range. There is slightly enhanced likelihood for below normal rainfall conditions over the northwestern parts and some northeastern parts of South Asia. On the other hand, there is slightly enhanced likelihood of above normal rainfall over the southern parts of South Asia including the islands. Rainfall conditions close to the normal are more likely over the remaining parts of South Asia.



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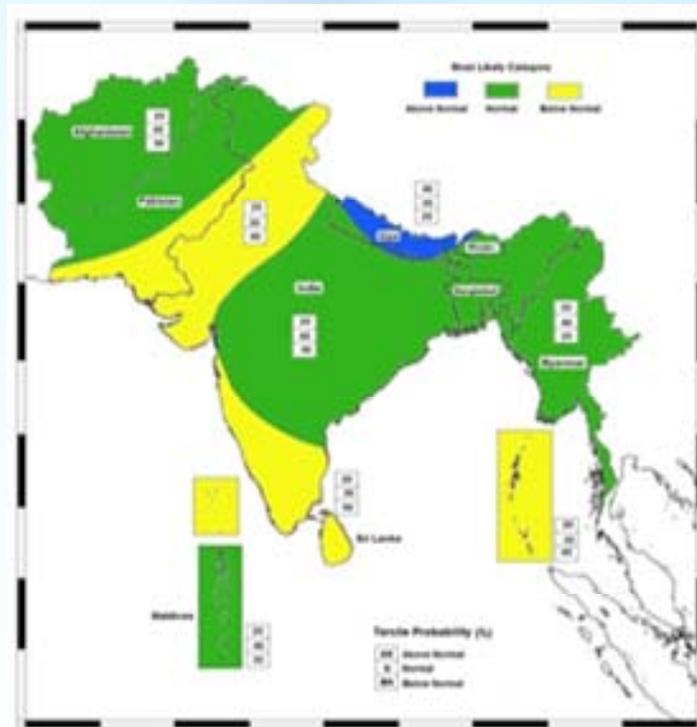
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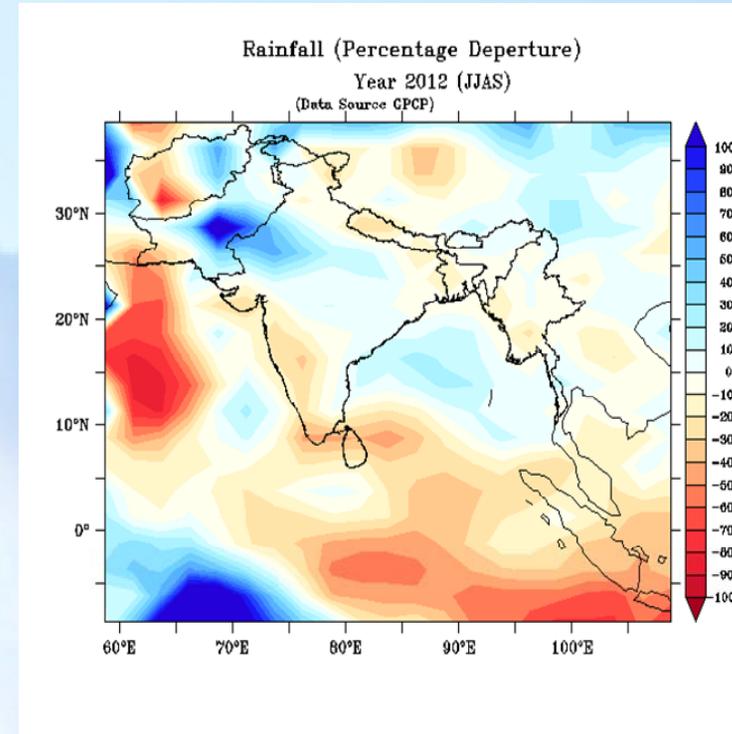
Verification of Forecast for South Asia - 2012

FCST

a) JJAS 2012



OBS



Forecast: Over South Asia and for the season as a whole, the large-scale summer monsoon (June to September) rainfall would most likely be normal. However, the expert assessment also noted a slight tendency for the South Asian summer monsoon rainfall to be below normal. There is slightly enhanced likelihood for below normal rainfall conditions over some broad areas of northwestern and southern parts of South Asia. Rainfall conditions close to the normal are more likely over the remaining parts of South Asia



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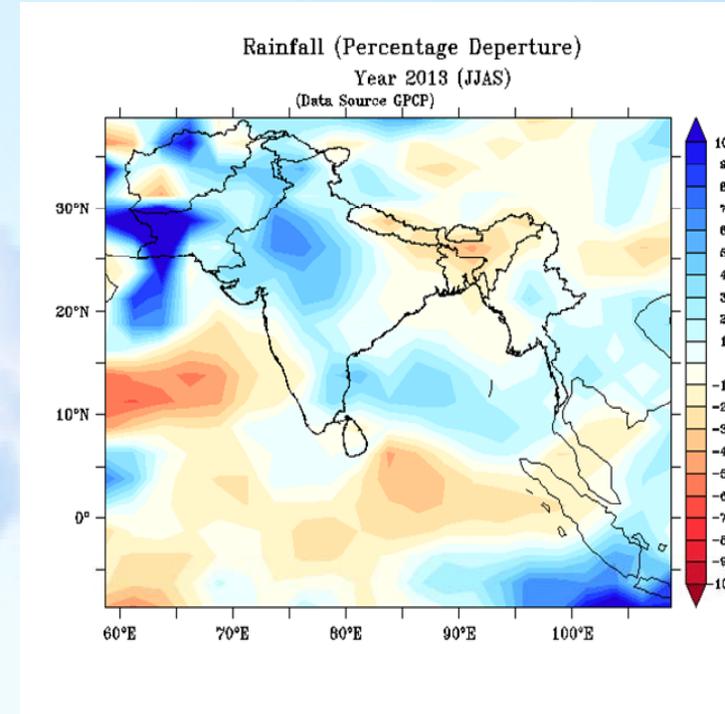
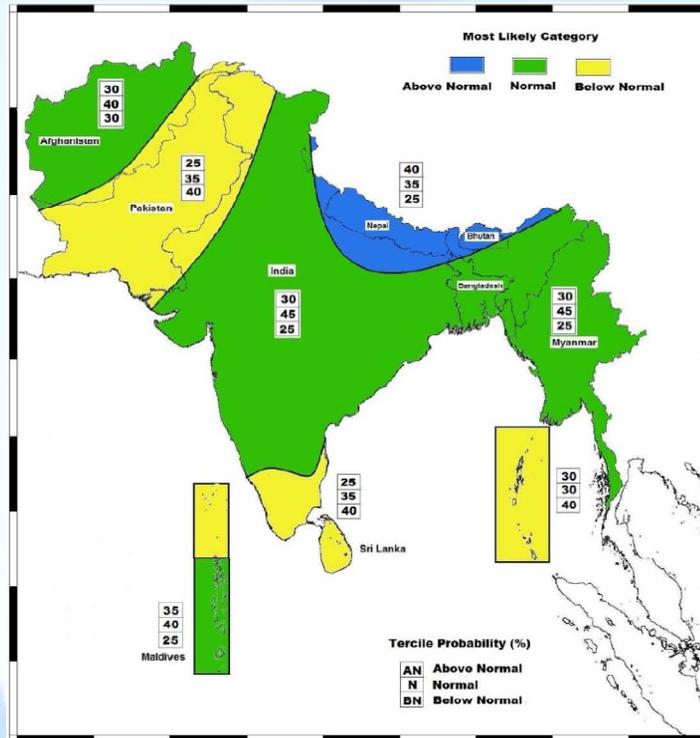


Verification of Forecast for South Asia – JJAS 2013

FCST

OBS

a) JJAS 2013



Forecast: The large-scale summer monsoon rainfall for South Asia and the season (June – September) as a whole will most likely be within the normal range with a slight tendency towards the higher side of the normal range.

In terms of spatial distribution of rainfall, the more likely scenario is for below normal rainfall over some areas of northwestern and southern parts of South Asia and for above normal rainfall over some areas along the Himalayan region. Rainfall conditions close to the long-period average are more likely over the remaining parts.

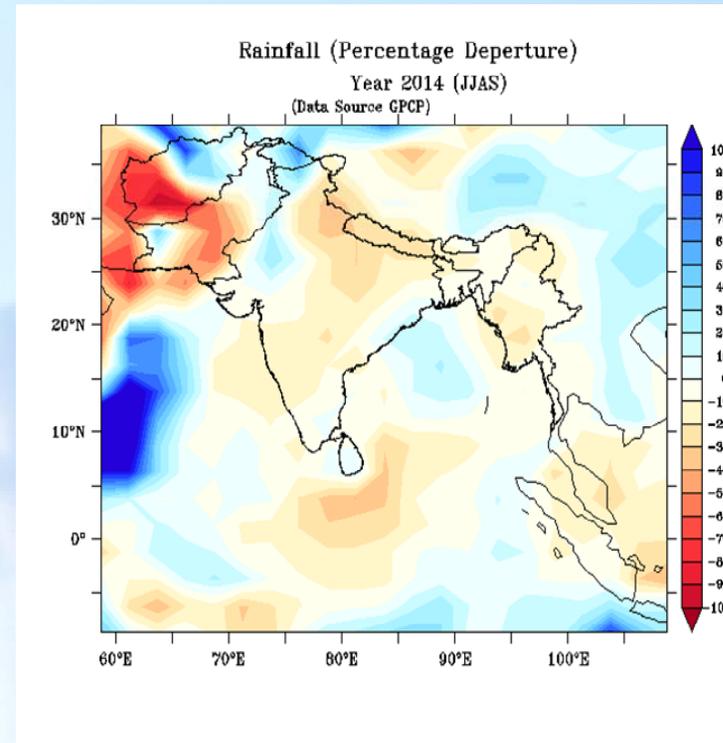
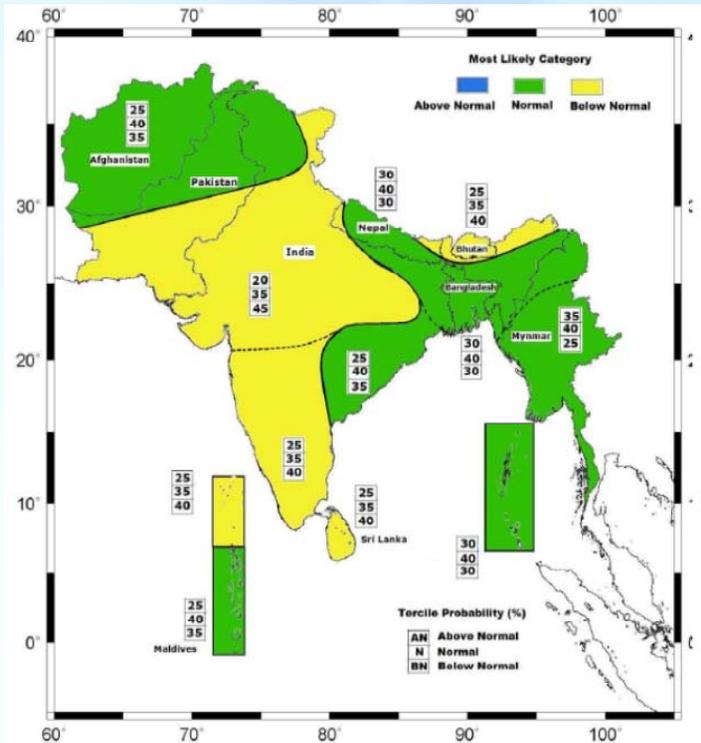
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Verification of Forecast for South Asia – JJAS 2014

a) JJAS 2014

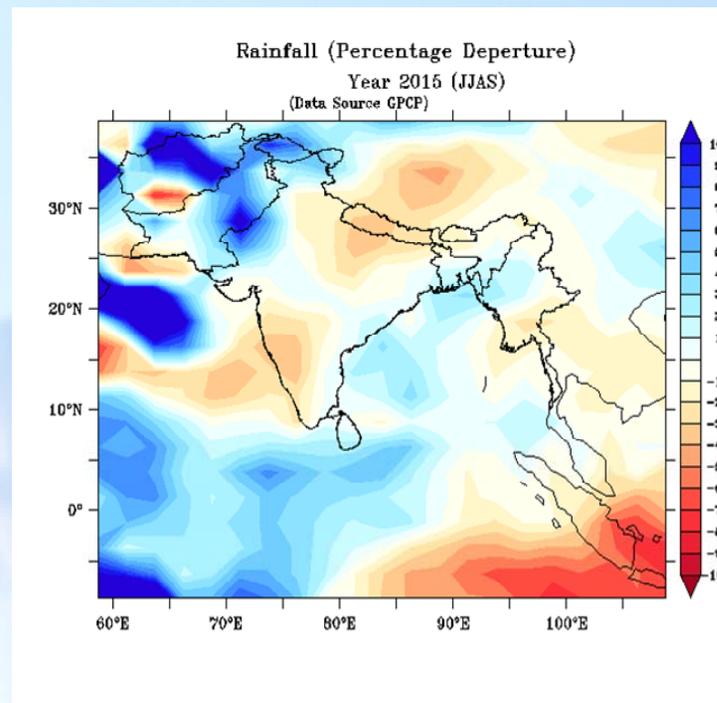
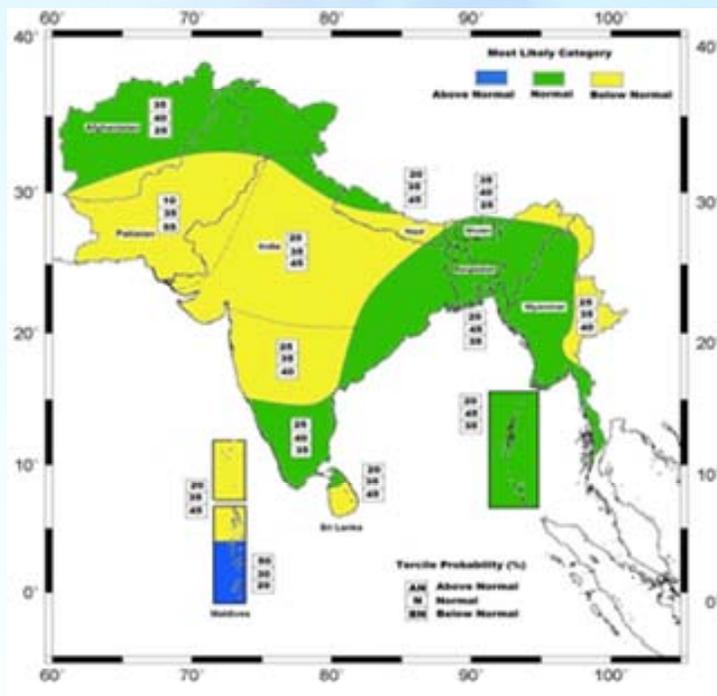


Below-normal to normal rainfall is most likely during the 2014 summer monsoon season (June – September) over south Asia as a whole. Below-normal rainfall is likely over broad areas of western, central and southwestern parts of South Asia and some areas in the northeastern-most parts of the region. Normal rainfall is likely over broad areas of northwestern and eastern parts and some island areas in the southernmost parts of the region.



Verification of 2015 SW monsoon consensus Forecast

a) JJAS 2015



The observed rainfall for the 2015 southwest monsoon season was below normal over most parts of the south Asia except over some northeastern parts of region suggesting below normal rainfall over the region as whole in general agreement with the consensus forecast. However, there were some differences in the spatial distributions of the observed and forecasted rainfall over the region.



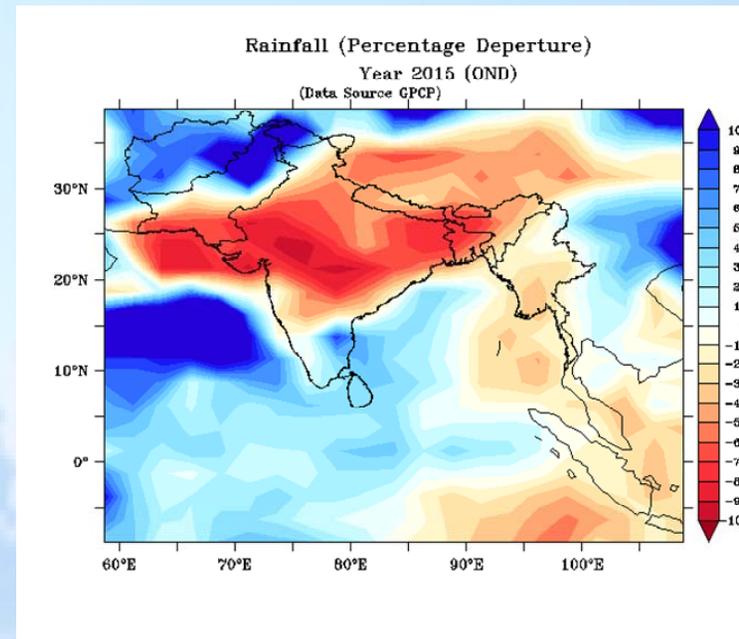
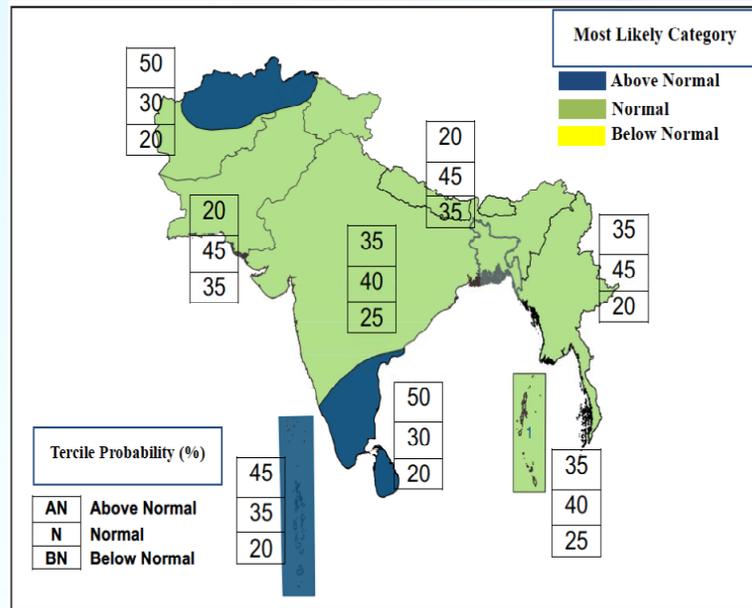
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Verification of 2015 NE monsoon consensus Forecast

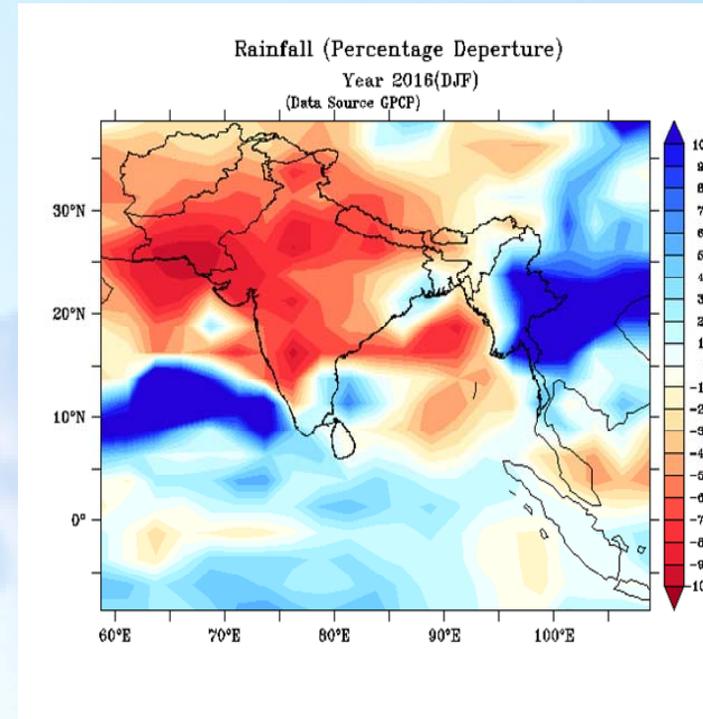
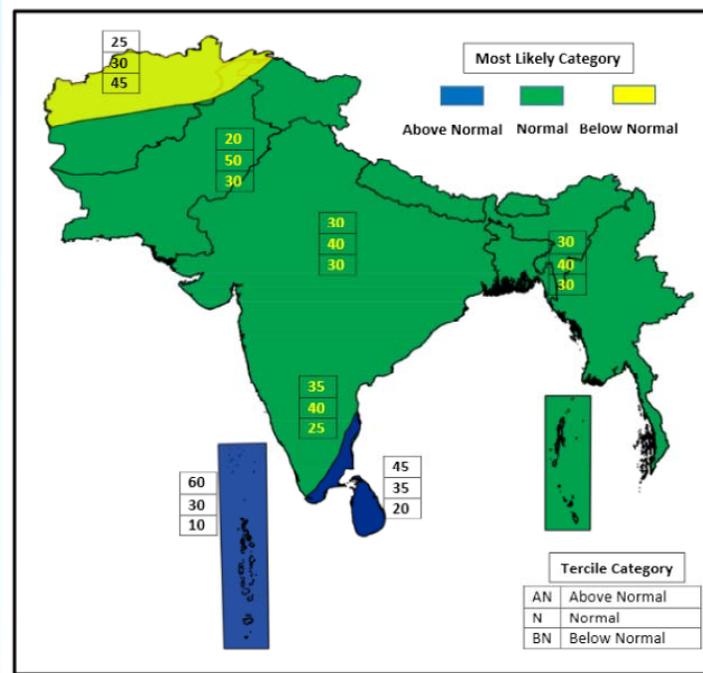
a) OND 2015



Normal to above normal rainfall is likely during the 2015 Northeast monsoon season (October–December) over southern parts of South Asia including southeast peninsular India, Sri Lanka and Maldives. Above normal rainfall is likely over northern most parts of the region. Other areas of the region that generally receive very little rain during the season are likely to receive normal rainfall. During the season, normal to above normal temperatures are likely, over most parts of the region.

Verification of DJF 2015-16 consensus Forecast

a) DJF 2015-16

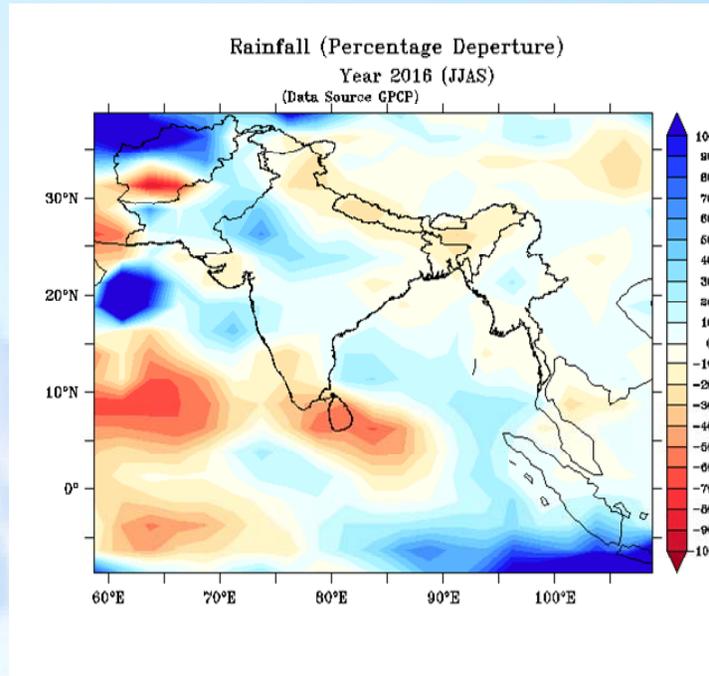
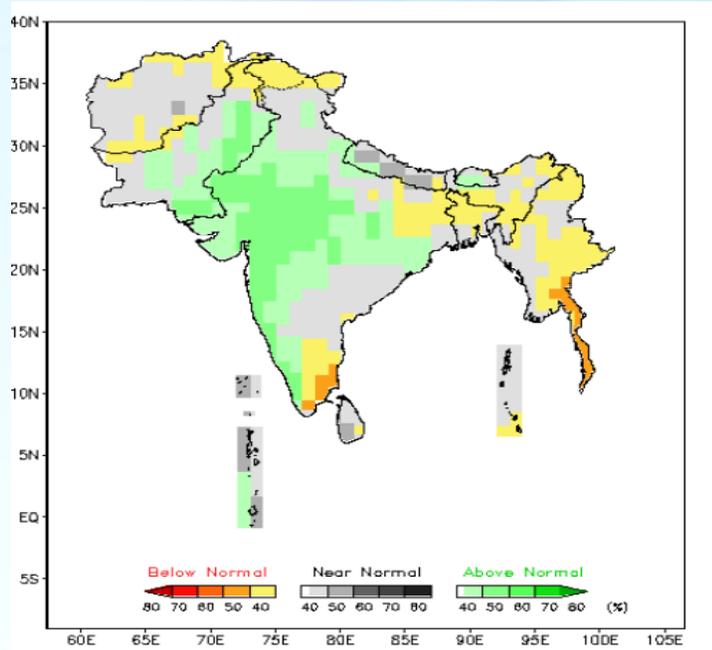


Above normal rainfall is likely during the Winter Season (December 2015 to February 2016) over southern parts of South Asia including Sri Lanka, Maldives and neighboring Lakshadweep Island region. Below normal precipitation is likely over the northernmost part of south Asia. Other areas of the region are likely to receive normal precipitation. During the season, normal to above normal temperatures are likely, over most parts of the region.



Consensus forecast of 2016 SW Monsoon Rainfall

a) JJAS 2016



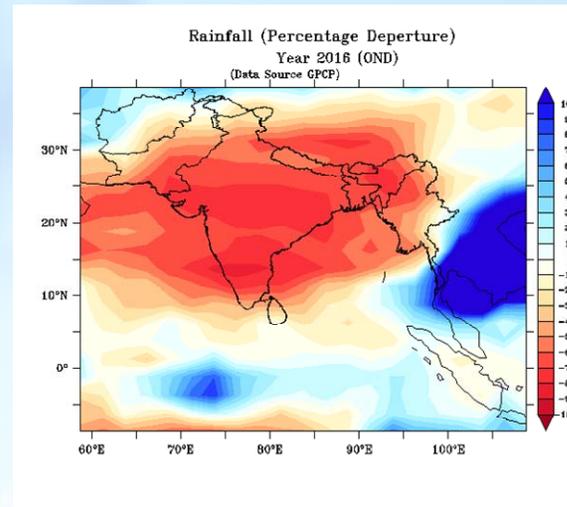
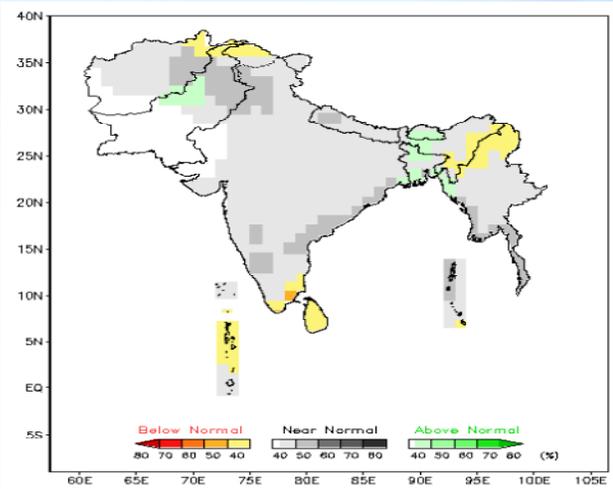
Above-normal rainfall is most likely during the 2016 southwest monsoon season (June – September) over much of South Asia. More specifically:

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



OND 2016 & DJF 2016-17

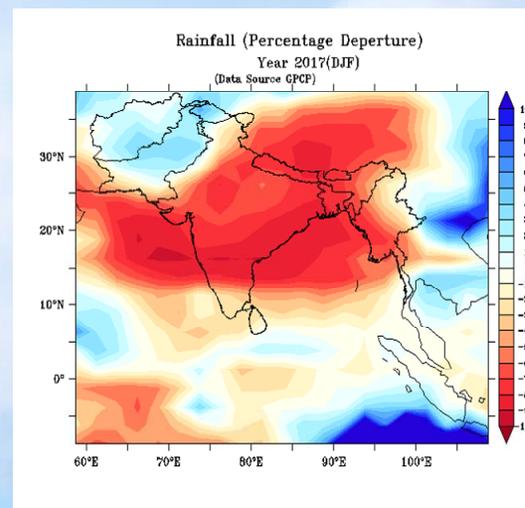
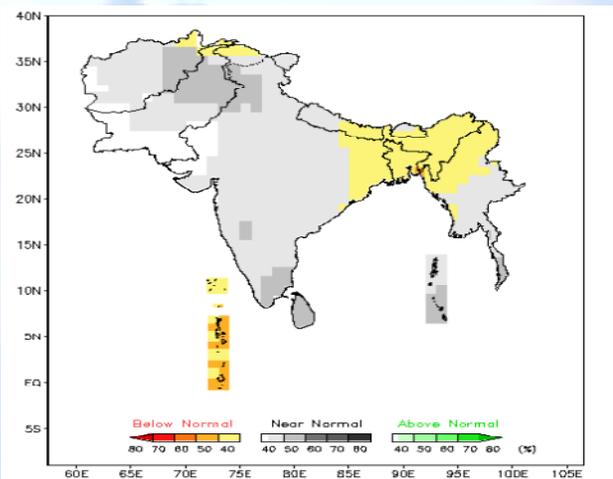
a) OND 2016



Normal rainfall is most likely over most parts of south Asia during the 2016 Northeast monsoon season (October – December). However, below normal rainfall is likely over some areas of southeast peninsular India, Sri Lanka and Maldives. Below normal rainfall is also likely over some areas of north and eastern parts of the region. Above normal rainfall is likely over western and northwestern parts of Pakistan and some northeastern parts of the region.

During the season, normal to slightly above normal temperatures are likely, over most parts of the region.

b) DJF 2016-17

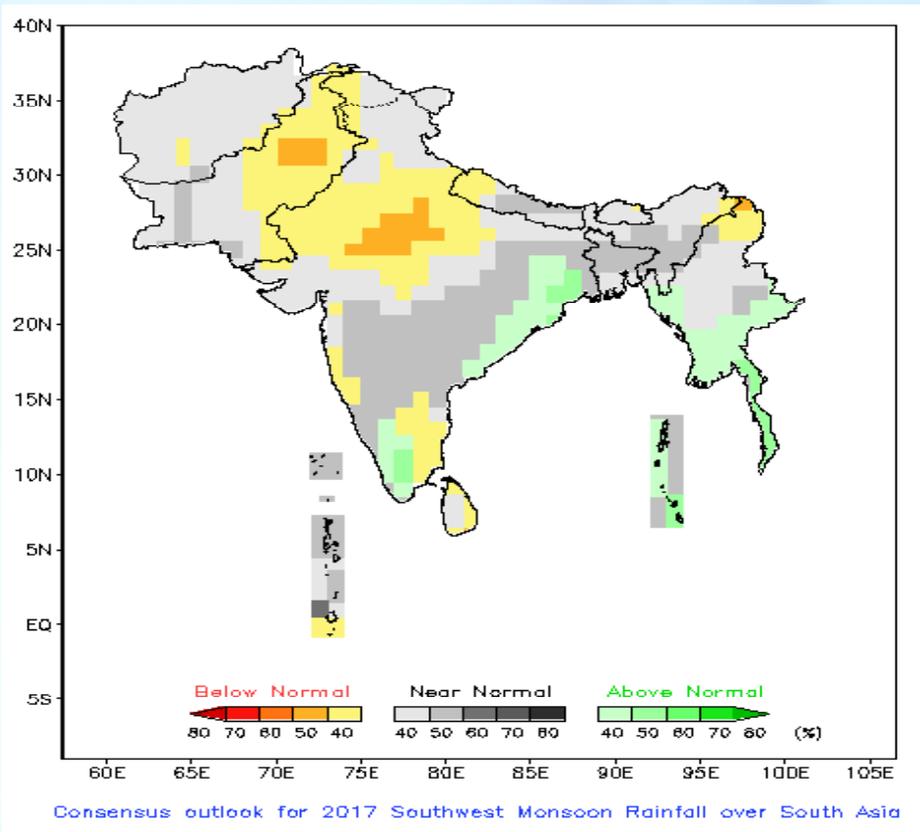


Below normal precipitation is likely during the Winter Season (December 2016 to February 2017) over northern most parts of the south Asia, Maldives & neighboring Lakshadweep, and northeastern parts of South Asia including northeast India, east Nepal, Bhutan, and northern parts of Myanmar. Normal precipitation is likely over the remaining parts of the region.

During the season, normal to above normal temperatures are likely, over most parts of the region.



Consensus Rainfall Probability Forecast



- 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.

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



14-Nov-19

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT





Thank you



11/14/2019

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29

