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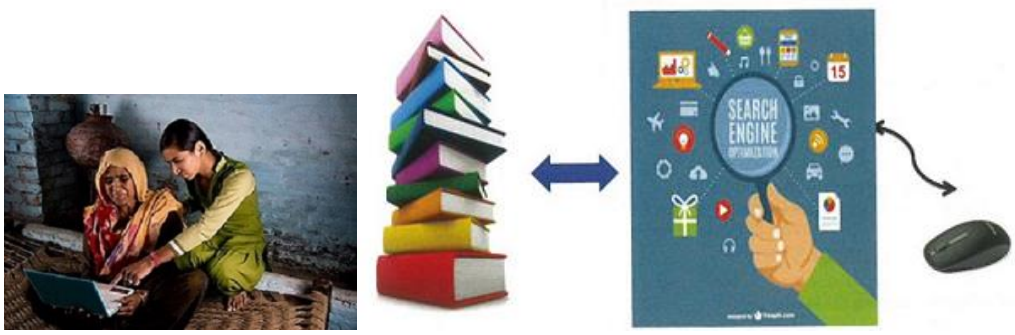
SPECIAL ISSUE

Region	Period	Forecast (% of LPA)			Actual Rainfall (% of LPA)
		15th April	31th May	1st August	
All India	June to September	96 ± 5	96 ± 4		110
Northwest India	June to September		94 ± 8		98
Central India	June to September		100 ± 8		129
Northeast India	June to September		91 ± 8		88
South Peninsula	June to September		97 ± 8		116
All India	July		95 ± 9		105
All India	August		99 ± 9		115
All India	August to September			100± 8	130

Verification of the operational Long-Range Forecast for 2019 SW monsoon rainfall



Finest Online Learning Platform

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Bulletin of IMSP

OCTOBER - DECEMBER 2019, Vol. 18, No. 10-12

Contents:

Performance of the Long-Range Forecasts for the 2019 Southwest Monsoon

O. P. Sreejith [1,2], Pai, D. S.[1], Arti Bandgar[1], Divya Surendren[1] and Madhuri M.[1]

[1]Climate Research and Services, India Meteorological Department (IMD), Pune.

[2]E-mail: **sreejith.op@gmail.com**

India Meteorological Department (IMD) issues various operational forecasts for the southwest monsoon rainfall and date of monsoon onset over Kerala. These forecasts are prepared using models based on the latest statistical techniques with useful skill (Pai et al. 2011, Pai and Rajeevan 2009, Rajeevan et al. 2007) and dynamical model using Monsoon Mission Climate Forecast System (MMCFS) developed by Indian Institute of Tropical Meteorology (IITM).

The first stage long range forecast issued on 15th April consisted of only forecast for season (June-September) rainfall over the country as a whole. In the second stage (31st May), along with the update for the April forecast, forecast for season rainfall over the four broad geographical regions (northwest India, central India, south Peninsula and northeast India) and that for monthly rainfall over the country as a whole for July and August were issued. In the 3rd stage (1st August), the forecast for the rainfall during the second half of the monsoon season over the country as a whole was issued. While preparing, the operational forecasts, the experimental and operational forecasts from various research institutions from India and abroad were also taken into account. In addition to the long-range forecasts issued for rainfall, an operational forecast for the date of monsoon onset over Kerala was issued on 15th May. Additionally, monthly and seasonal rainfall forecasts for the country as whole with different lag periods was issued using the Monsoon Mission global climate forecasting system (MMCFS). The latest version of the high resolution (horizontal resolution of approximately 38km (T382)). The global monthly and season forecasts for rainfall and temperature prepared using MMCFS are updated 15th of every month is now available through IMD, Pune website (www.imdpune.gov.in).

A brief description of IMD's operational statistical and experimental dynamical forecasting systems is discussed here along with the verification of the forecasts generated by these forecasting systems. In addition, the experimental forecasts for the southwest monsoon season rainfall over the country from various national and international research institutes obtained by IMD as guidance before issuing operational forecasts have also been discussed.

Based on an indigenously developed statistical model, it was predicted on 18th May 2019 that monsoon will set in over Kerala on 6th June with a model error of ±4 days. The actual monsoon onset over Kerala was also 8th June and therefore the forecast was accurate and within the error limit. The operational forecasts for the seasonal rainfalls over two broad geographical regions (Northwest India and Northeast India) and that for July rainfall over the country as a whole were within the forecast limit and correct. Also, the forecasts for the rainfall over the country as whole during the season and second half of the monsoon season and forecast for the Central India and South Peninsula were underestimate to the actual rainfall and were not correct.

The verification of long-range forecast issued for the southwest monsoon is given in **Table-1**.

The dynamical seasonal forecasts from Monsoon Mission CFS for the season rainfall over the country as a whole based on both April and May initial conditions were underestimated to the actual situation by about 16% and 13% of LPA respectively and not within the forecast range. The experimental forecasts from most of the other Indian sources as well as from the international climate centers indicated below normal to normal rainfall.

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Rajeevan M, Pai DS, Anil Kumar R, and Lal B, 2007, New statistical models for long-range forecasting of southwest monsoon rainfall over India, Climate Dynamics, V28, pp813-828.

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Table-1: Verification of the operational Long-Range Forecast for 2019 SW monsoon rainfall.

Online Learning: Paradigm Shift in Education

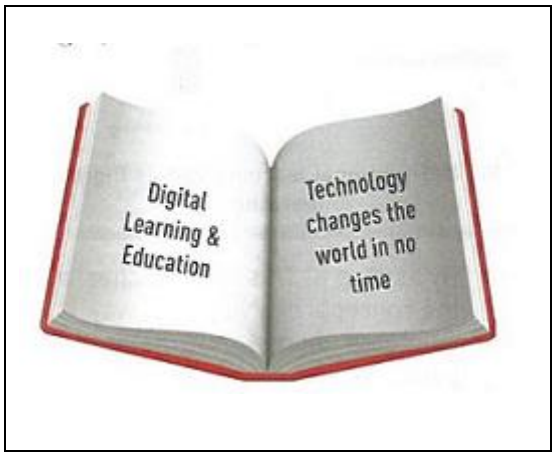
Manoj Kumar Tandon[1, 2, 3, 4]

[1]Scientist (Retired), Indian Institute of Tropical Meteorology, Pune.
[2]Visiting Faculty, Savitribai Phule Pune University, Pune
[3]7/12, White House Society, Yerwada, Pune.
[4]E-mail: mkbtandon@gmail.com

Since the dawn of civilisation to the information technology enriched present day era, learning has always been an important activity in any human's life. Learning enabled humans to make their lives better day-by-day. In India, learning started with sacred centre having name '**Gurukul**' which then shifted to names like '**School**', '**Ashram**' and '**University**'. For centuries and eras education has been associated with printed textbooks and classrooms. With fixed curriculum, timings, location and a well streamlined way of teaching, it catered to generations of learners and improved human civilisation. As the time passed, the methods and technology used for making learning process better also evolved. In today's technology driven digital era, learning is no more chalk, duster and blackboard based classroom learning. All over the world educationists, philanthropists and policy makers are finding new ways, means and mechanisms to make learning easily possible for one and all irrespective of their age, location and availability.

Online learning is changing rapidly the traditional conventional landscape of learning in India creating increased learner power and changing the learning face of both **urban and rural India**. Replacing traditional conventional modes and means of learning, online learning is fast emerging as the new frontier enabling any time learning for everyone at their own space and in the domain of their own interest. Online learning is the next generation of learning. Trend of online learning has been around for a while in recent times. Gone are the days of paper, chalk, dusters and blackboards as they have now been replaced by

electronic instructions which fortify both learning and knowledge. Online learning heralds a paradigm shift in learning. Online learning is the new generation of learning. In simplest words, information and communication technology (ICT) enabled learning is described as 'Online Learning'.



Now-a-days, one can get solutions to one's diverse range of problems which are a few clicks away on any good online learning platform. Online learning is the combination of following different learning strategies.

(1) **Flipped Learning**: Flipped learning is a learning technique in which instructions move from group learning space to individual learning space. It is a type of blended learning. In it one learning content is online to the learner outside the classroom.

(2) **E-learning**: E-learning is learning utilising electronic technologies with the help of internet for learning outside the traditional conventional classroom learning. These days E-learning is the most widely known technique that uses Wikipedia, blog page and any pursuing material like ppt, pdf documents to supply initial data to the learners. E-learning enables subject and domain consultants and experts to the cluster type of educators and learners on the classroom learning to resolve queries and doubts of learners.

(3) **Blended Learning**: It is somewhat a mixture of traditional learning and online learning. Some portion of this kind of learning is done as E-learning and other part as traditional conventional classroom learning.

(4) **Personalised Learning**: It is not a wide spread term. It refers to a learning technique which is done personally by an individual learner according to learner's needs. Learning contents may vary from individual to individual.

(5) **Individual Learning**: In this learning technique, teaching strategy is made with respect to every learner's weaknesses and strengths.

(6) **Differentiated Learning**: This technique deals with the learning situation when learners of different interests, different learning profiles and different readiness come along and e-tutor have to plan teaching strategy according to every learner of the group.

(7) **Gamification and Badging Learning**: In this learning technique, learning is accomplished with the help of games. It helps in engaging learners in learning activity.

(8) **Micro Learning**: These are short term learning techniques. It generally includes different short term online courses which normally last for one hour.

(9) **Electronic Textbooks Based Learning**: Electronic textbooks are the books that an E-learner can read in digital form with the help of some digital device like Smartphone, laptop and tablet etc. Electronic textbooks are also known as digital books and E-books. The concept of digitalisation in text books have reformed the conventional education sector to greater extent and offers various books at low and affordable cost and update them in new versions without printing them on papers. Many countries in the world have made digital books compulsory at college and school levels of education. All textbooks in South Korea were digitalised in the year 2015.

(10) **Social Learning**: Now a days, there are many online digital learning tools with the help of which an online learner can network, interact, collaborate and exchange different ideas with other online learners in an online learning process.

(11) **KPI Based Learning**: In this learning technique, learning is done by sending or receiving data through integrated application that links controls with Key Performance Indicator (KPI).

(12) **Mobile Learning**: This technique is popularly known as M-Learning. It is integration of hardware, software and mobile technology. It not only includes Smartphone as a device but also other devices like laptops, desktops and tablets.

In an online learning scenario, knowledge is available everywhere and at all times. One should however not misuse online knowledge and technology but should use them wisely and properly to create a more knowledgeable, progressive and empowered society. Online learning is a win-win proposition for learners, tutors and institutions. Online learning is of great importance as it focuses on technology innovation and trend setting initiatives in primary, middle, college, university and mass education. Online learning is gaining popularity in India. Online learning is a mechanism through which you can learn from wherever you are and whenever and whatever you want to learn. Online learning has three crucial participants viz. (1) Digital Device, (2) Internet Connection and (3) Learner**.** Internet connection is the most central part of any

online learning configuration. Internet and Communication Technology enabled online learning has ushered in new paradigm shift in traditional learning. Online learning is enabling learners, especially in the remote and rural areas, in learning new technologies and quality education without making their physical presence in classroom. Following table showcases perceptions of different learning parameters in traditional versus online learning environments.

Online Versus Conventional Learning		
Parameter	**Online Learning**	**Conventional Learning**
Personalised Contents	Learning contents can be personalised based on learner's preferences.	Learning contents cannot be personalised.
Flexible Time	Learning at any time based on learner's conviences.	Learners have to make themselves available at specific time.
Structure of Information.	Information is organised for cross reference with tools good presentation views.	Information is available but it can be time consuming for search and reference and its presentation format is quite rigid.
Learner's Involvement	Increased involvement of learners. They have to read, search, re-read and take intermediate learning tests.	Trainers have a bigger responsibility in scheduling the learning process, executing learning and ensuring what the learners got is what they were supposed to learn.
Training Room	Physical presence of learner is not required.	Trainers and learners have to be collocated.

Online learning shall have an enduring and beneficial impact on traditional conventional education systems at school, college and university levels. Online learning in today's technology driven era is inevitable and must be proactively embraced by both "Tutors" and "Learners". Following table showcases how the educational contents, models and support technology associated with online learning has evolved with time.

Evolution of Online Learning Environment.	
Online Learning Models	**Contents and Support Technology**
First Generation **(1980s)** Learning Centred on materials.	**(1)** Contents in paper format. **(2)** Digital content reproducing books.

	(3) Audio Conferencing. **(4)** Video Conferencing. **(5)** Instructional Software.
Second Generation **(1990s & Early 2000s)** Learning Centred on virtual classrooms.	**(1)** Virtual Learning Environment. **(2)** Video Streaming. **(3)** Online materials. **(4)** Access to resources on Internet. **(5)** Beginning of Interactivity**:** e-mail forum.
Third Generation **(Late 2000s)** Learning Centred on flexibility and participation.	**(1)** Specialised Online Contents. **(2)** Reflection**:** e-platform and blogs. **(3)** Very Interactive Technologies. **(4)** Online Learning Communities. **(5)** Mobile Learning (M-Learning).

One of the biggest online learning platforms is **"Youtube"** which was launched by Google on 14th February 2005. Youtube is an American video sharing website headquartered in San Bruno, California (USA). Youtube was jointly cofounded by **Chad Hurtly** - Native of America, **Steve Chen** - Native of Taiwan and **Jawed Karim** - Native of (East) Germany. On Youtube, an online learner can find a video for learning anything starting from 'How to write a FORTRAN program' to 'How to play Guitar' and a lot more. Youtube is the most popular and largely accepted form of online learning tool. Youtube contains any kind of content whether it is academic or not. Youtube helps in development of different online learning forms like flipped classroom and blended learning. Any tutor can upload his/her own online learning video on the Youtube and any online learner can download online learning video of his/her choice from the Youtube. Everyday lots of learning videos are uploaded on the Youtube and watched. Following are some details about the vastness and utility of Youtube videos.

(1) Around 100 million Youtube videos are watched per day.

(2) Around 65,000 videos are uploaded on Youtube each day.

(3) Around 60% of all Youtube videos are watched online every day.

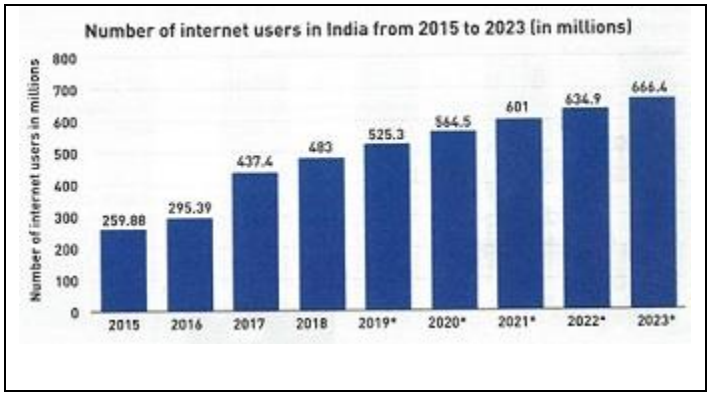
(4) Youtube sees 72 hours of newly uploaded videos every minute.

Online learning is an education that takes place over the Internet. It is often referred as E-learning, digital learning among many other names. Online learning is one kind of '**Distance Learning**' – an '**Umbrella Term**' for any learning that takes place across distance and not in a traditional classroom. In

online learning, learner's educational tool is accessible from Internet. Online learning tools are a staple of blended learning environment. Online learning is a powerful and quite effective tool in the hands of a common person with which person can change the world if the acquired knowledge is used wisely and properly.

Finest Online Learning Platform

In 1990, English computer scientist Tim Berners Lee developed World Wide Web (WWW). World Wide Web (WWW) was developed to enable scientists and researchers to share information and their research works. Development of World Wide Web was just the beginning of the online learning era. A dramatic change that technology has enabled is that today we can learn by ourselves. Tim Berners-Lee was knighted in 2004 by the Queen Elizabeth II of England for his services to the global development of Internet. Some online learning tools are (1) **BYJU's**, (2) **Google^{+} Communities**, (3) **DropBox**, (4) **Youtube Channels**, (5) **iTunesU**, (6) **Evernote**, (7) **Cloud Based Word Processors**, (8) **Pocket** and (9) **Zotero**. Online learning came within the reach of general public in around 1995. Since 1995, there has been a steady increase in the number of Internet users. With the rapid increase in the number of Internet users, online learning increased exponentially.



Online learning opens a complete new dimension of learning, as it provides equal opportunities of learning for each and every learner who is connected to the Internet. Online learning is the bridge between the Educator (Tutor) and the learner. Online learning has redesigned world's learning landscape. The 21st century classrooms are using '**Smart Boards**' and pods of '**Smart Desks**' as alternative to '**Ckalkboards**'. Online learning is not the next big thing; it is now the big thing. There is incredible and mysterious potential for online technology in and beyond classroom, but it is vital to rethink how learning is organised if we are to reap the rewards. **Nobel laureate Albert Einstein** had stated "**Once you stop learning, you start dying**". Education is the instrument by which we align our tomorrow with our yesterday and today. Education is an instrument by which we use the present to distil the wisdom of past so as to prepare ourselves for future. In technology enriched today's times where more tasks are taken up by other intelligences, the role of human mind needs to change. Education should lead and not follow. Education should equip us for the future and not keep us chained to the past. Education must be the domain of greatest creativity and not the slave of habit. Education can't be afraid of change if it has to help usher in tomorrow. We should however remember that technology, in the technology enriched present era, will never be able to replace great teachers but technology in the hands of great teachers can be transformational. Online learning embodies a shift from '**Classroom Learning**' to '**Screen Learning**'. Success of online learning and its widespread adoption and acceptance by both learners and educators shall herald the migration of education from **traditional Gurukul to the technology-based e-Kul**.

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On the Back to Back Monsoon floods over Kerala during 2018 and 2019: Twins but not Identical

Abhilash. S[1,3], Vijayakumar. P, Athira. A. U, Sreenath. A. V, A. K. Sahai[2], and K. Mohankumar [1]

[1]Department of Atmospheric Sciences, Cochin University of Science and Technology
[2]Indian Institute of Tropical Meteorology, Pune
[3]E-mail: abhimets@gmail.com

Kerala, located at the southwest tip of India witnessed disastrous floods during the monsoon seasons of two consecutive years 2018 and 2019. This paper provides a detailed analysis of this twin flood events using data from multiple sources and find out how they differ and remain non-identical on many accounts. In August 2018, the favourable conditions for active monsoon rainfall over India such as strong monsoon Low Level Jet (LLJ), monsoon depression formed over the Bay of Bengal near the monsoon trough and phase of Madden Julian Oscillation (MJO) was in favourable phases 4, 5, 6 during the flood period. However, this event is distinct with the less evaporation flux over the Central Arabian Sea and unusual meridional moisture transport from the South Equatorial Indian Ocean (SEIO) towards the Kerala coast. Thus, SEIO played as a vital moisture source of the event, and the intense meridional cross-equatorial wind stress and low-level wind from this region transported additional moisture to Kerala. Thus, together with the prevailing active rainfall condition, this additional moisture transport enhanced the total precipitable water along Kerala coast during August 2018. However, we report that the flood of 2019 in Kerala was resulted by a mesoscale cloudburst (MsCB) event, a very rare and never before happened phenomenon in the region. Rainfall exceeding 50 mm in two hours has been reported from many places between 8 and 22 UTC on 8th of August 2019. Satellite derived rainfall and cloud microphysical parameters reveal the uniqueness of 2019 MsCB event. Viewed as imprint of Global Climate Change, transformations of the cloud structure in the region and recurrence of intense rainfall of unprecedented scales are alarming and a major threat to the highly vulnerable Western Ghats ecosystems. Further the ability of coupled model, climate forecast system (CFS) in capturing the intensity at longer leads on the extended range is evaluated. Medium range forecast from Global forecast system (GFS) is also analysed during both events. Then model performance in capturing the dynamical and thermo-

dynamical fields have been compared with observations (presented in detail, in the paper).

The mixed-phase cloud processes in the monsoon environment

Thara Prabhakaran [1,2]

[1]Indian Institute of Tropical Meteorology, Pashan, Pune-411008
[2] E-mail: **thara@tropmet.res.in** ; **prabha.thara@gmail.com**

Monsoon is a very heterogeneous system with a multitude of complexities and has been investigated in detail from the large-scale aspects. The present talk (for Annual Monsoon Workshop-2019) will go the other way, in discussing the smaller scales from cloud and ice particles to the cloud and cloud system, focussing on the cloud process. The airborne observations of CAIPEEX started in 2009 and have finished 10 years; four phases of observational efforts. The inferences from CAIPEEX airborne observations and the high-resolution numerical simulations give a comprehensive idea of the mixed-phase cloud processes in monsoon clouds. The talk will summarize the findings so far.

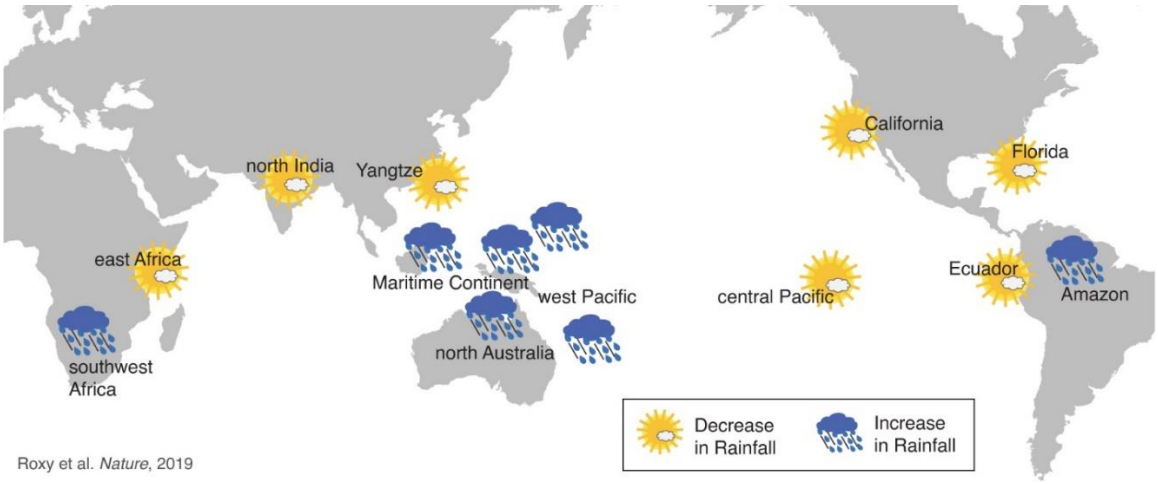
Indo-Pacific warming warps the MJO, changing global rainfall patterns

Roxy Mathew Koll [1,2] and Panini Dasgupta [1]

[1]Indian Institute of Tropical Meteorology, Pashan, Pune-411008

[2] E-mail: **roxy@tropmet.res.in**

The Indo-Pacific warm pool—the region of permanently warm sea surface temperatures in the tropics—has been expanding at an accelerated rate during the recent decades. The talk (for Annual Monsoon Workshop-2019) summarizes the impact of the warm pool expansion on the most prominent sub-seasonal weather system that travels some 20,000 km across the tropics—the Madden Julian Oscillation (MJO). While the total lifespan of MJO remains the same during 1981-2018, its phase duration has decreased over the Indian Ocean by 3–4 days and increased over the Indo-Pacific Maritime Continent by 5–6 days in the recent two decades. We find that the impact of these changes is not limited to the tropics, and has a bearing on some of the severe weather events across the globe. As a response to the changes in the MJO phase duration, an increase in mean rainfall is observed over most of the Maritime Continent including southeast Asia, and over northern Australia, west Pacific, Amazon basin and southwest Africa. A decline in rainfall is observed over the central Pacific, Ecuador and California, and a slight decrease in rainfall over the Yangtze basin in China, north India and Florida.



Managing and Simulating Human-Natural Hydro-meteorological System

Subimal Ghosh [1,2]

[1]Professor, Department of Civil Engineering, Indian Institute of Technology Bombay

[2] E-mail : **subimal@civil.iitb.ac.in ; subimal.ghosh@gmail.com**

Hydrologic simulations have been carried out, with the portioning of water coming from atmosphere to land surface, in terms of precipitation, to Evapo-Transpiration (ET), infiltration and runoff. Such partitioning is affected by climatic conditions (Aridity Index, ratio to Potential ET to Precipitation) and river basin characteristics. This is considered in state-of-art Budyko framework, the simplest form of hydrologic modelling. Budyko framework also helps to understand the dominating attributes based on observed data. Such a framework works well for a natural system. The present-day hydrologic system is a human-natural system, where human interventions, resulting from changing climatic conditions, affect the basin characteristics. Increasing aridity results into increase in irrigation that in turn affects the hydrological processes. Climatic change may result into changing properties of vegetation, such as stomatal closure that leads to changing ET. Hence, aridity index and basin characteristics are no longer two independent factor and there is a need to consider such hydrologic system with an emphasis to each and every factor with their inter-linkages. The new generation land surface model incorporates dynamic vegetation, human intervention etc., however; still, the Budyko framework has its own importance in term of quick diagnosis of changing the hydrologic system.

Effect of drop size distribution on charging process inside thundercloud

S. D. Pawar [1,2]

[1]Indian Institute of Tropical Meteorology, Pashan, Pune-411008
[2] E-mail: pawar@tropmet.res.in

Many microphysical processes such as coalescence, breakup, evaporation, condensation, raindrop clustering, and mixing can influence, the evolution of the drop size distribution (DSD) inside thunderstorms. The information about shape of the DSD of raindrops can be very useful for understanding the microphysical processes that transform the cloud water droplets into rain drops and their growth mechanisms. Numerous studies have shown that the electric fields inside thundercloud and lightning discharges can influence the microphysical and dynamical properties of thundercloud. Laboratory studies have shown that the shape, growth, breakup, and evaporation characteristics of water drops are strongly influenced, if the drops are charged or they are falling through electric fields. Charge and electric field influence different microphysical processes like condensational or diffusional growth of water droplets, collision and coalescence process and evaporation, which in turn may influence the drop size distribution inside cloud and can thereby modulate the total precipitation at surface.

Many experimental studies have clearly shown that thunderclouds generally have positive dipole charge structure, i.e., positive charge in the upper part and negative charge below it. However, it is known for a long time that some thunderstorms can have inverted polarity charge structure than generally observed in the typical thunderstorms. Williams et al (2005) proposed that the inverted polarity charge structure in thunderstorms is a result of superlative liquid water content in the mixed phase region. Many studies have shown that higher cloud base heights are connected to inverted polarity thunderstorms. A possible physical basis for the association of higher cloud base height with inverted polarity is based on cloud droplet size theory. In laboratory experiments simulating the mixed phase conditions in thunderclouds, Avila and Pereyra (2000) have found a tendency for positive charging of the rimer with decreasing cloud droplet size.

Here, the effect of drop size distribution on charging process inside thundercloud and its physical basis has been discussed.

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Impact of monsoon 2019 on crop production in the country

R. Balasubramanian[1,3], Kripan Ghosh[1], K.K. Singh[2] and Gracy John[1]

[1]India Meteorological Department, Pune-5
[2] India Meteorological Department, New Delhi-3
[3]E-mail: rbala_india@yahoo.com

In India, around 55 percent of the total cultivated area is under rain dependent agriculture. Even though major production of crops depends on monsoon rainfall, every year the aberrations and erratic rainfall pattern affect the production and productivity of major crops to various extents across the country. Quantity and distribution of southwest monsoon rainfall plays very important role in Indian agriculture as more than 70% of agricultural area still depends on monsoon rainfall. The performance of monsoon (quantity and distribution) reflects in the crop production. The timely onset of monsoon leads to regular sowing of crops in the respective agroclimatic zones. Spatial and temporal variation of rainfall also plays important role which significantly affect the crop growth and ultimately production. Also, irregular monsoon activity such as late arrival, breaks, heavy rainfall etc. lead to droughts and floods bringing down agricultural productivity.

Monsoon 2019 has been one of the most unusual in recent decades. From June to September 2019, the country received the highest amount of monsoonal rain in the past 25 years. It has affected farmers, as monsoon season started during an unusually dry June, which led to water stress and drought reported in parts of central and south India. In spite of late onset of monsoon and large deficient rainfall during the month of June, the seasonal rainfall ended in above normal category in 2019. Monsoon rainfall during July, August and September was above its Long Period Average. Delayed onset and slow progress of southwest monsoon affected normal sowing and also growth and development of different *kharif* crops in some parts of the country.

Southwest monsoon set in over Kerala on 6th June 2019, one week later than its normal onset date, thereafter the progress was slow covering Gujarat and Madhya Pradesh from 28th June to 4th July and the entire country by 19th July. Sowing/transplanting of *kharif* crops started in Kerala and north-eastern states of the country as per the normal sowing window.

During Monsoon 2019, delayed onset of monsoon and dry spells during the month of July affected normal sowing of kharif crops in North Interior Karnataka, Telangana, Rayalaseema, Marathwada, West Vidarbha, Jharkhand and Manipur. Rainfall deficiency was observed during the months of June and July which improved to normal by the end of August due to improved rainfall situation. Farmers were advised to adopt the contingency measures in these states.

Heavy rain during first week of August caused floods and landslides in Malappuram, Kannur, Wayanad and Kozhikode districts in Kerala and affected on standing crops like Virippu rice, banana, pepper, cardamom, rubber, ginger and turmeric. The banks of Krishna River in Raichur and Yadgir districts in Karanataka experienced one of the worst floods in August first week and continued till third week of the month. Bajra and rice crops were affected. Floods during last week of July 2019 affected standing crops in Assam such as *sali* rice (nursery / transplanting), jute, vegetables, pulses (already sown) in Dhemaji, Sonitpur, Darrang, Nalbari, Barpeta, Chirang, Kokrajhar, Dubri, Goalpara, Kamrup, Kamrup (M), Morigoan,

Nagaon, Golaghat, Jorhat and Cachar districts. Heavy rainfall received during 8-18 August 2019 caused floods in Coastal Zone (South 24 Parganas and East Midnapore districts) of Gangetic West Bengal. Growth of transplanted aman rice was hampered due to high water level. Also, in the month of September, excess rainfall from 9 to 13 September, submerged aman rice fields at vegetative stage and caused waterlogging in betel vine and vegetable gardens. Continuous heavy rain for a period of 19 days (23 July to 10 August) created waterlogged condition in cashewnut orchards in Konkan. Floods during end of July to first week of August in Sangli, Kolhapur and Satara districts in Madhya Maharashtra damaged standing crops of rice, soybean, sugarcane, sorghum etc. Waterlogging for more than one week damaged sugarcane crop extensively in Kolhapur and Sangli districts. Heavy rains during August 15-20 caused floods in some districts in Himachal Pradesh and Uttarakhand affecting rice, maize, orchard crops and vegetable crops. Also during August 18- 20, floods were reported in more than 300 villages in Punjab affecting standing rice, cotton, vegetable crops etc. Flood conditions were reported in Mandsaur, Neemach, Morena, Sheopur, Sehore and Bhind districts of Madhya Pradesh during second week of September affecting Standing crops of Soybean, Black gram, maize.

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Suitable Agromet advisories, based on weather situations, have been issued under GKMS scheme to the farmers in different districts by the Agromet Field Units (AMFUs) through AIR, DD (Sahyadri), print (newspapers) and electronic media including SMS using mobile phone through Kisan Portal launched by Ministry of Agriculture, Govt of India and through private companies under Public Private Partnership (PPP) mode for crop management. Various agromet products have been generated to aid in framing agromet advisories by the Agromet Field Units (AMFUs). Alerts and warning along with agromet advisories have been sent to the farmers during heavy rainfall, flood and dry spell situation through SMS. During VAYU cyclone, 17.67 lakhs and during BULBUL-18.2. lakhs SMS sent to the farmers during 2019.

The production of most of the crops for the agricultural year 2019 has been estimated higher than their normal production. As per First Advance Estimates for 2019 (*kharif* only), total food grain production in the country is estimated at 140.57 million tonnes. The production during 2019 is higher by 8.44 million tonnes than the average food grain production of previous five years (2013-14 to 2017-18), *Kharif* rice is estimated at 100.35 million tonnes which is higher by 6.80 million tonnes than the five years' average production of 93.55 million tonnes, total *kharif* pulses production is estimated at 8.23 million tonnes, i.e. 1 million tonnes higher than the five years' average production of 7.23 million tonnes, total *kharif* oilseeds production is estimated 1.11 million tonnes higher during 2019-20 (total production 22.39 million tonnes) than the production during 2018-19 (21.28 million tonnes) and also the production of oilseeds during 2019-20 is also higher by 2.17 million tonnes than the average oilseeds production.

IMD issued appropriate measures to farming community through the agromet advisories based on the medium range weather forecast as well as the extended range weather forecast in order to deal with the impact of adverse weather situation. These advisories have helped the farmers to undertake decisions on sowing of crops, supplementary irrigation, pest and disease control, contingent crop planning etc. in time which has resulted in improvement in agricultural situations under extreme weather conditions

Performance of Operational GFS/GEFS T1534 in Predicting Monsoon Rainfall and High Impact Weather Events during 2019

Medha Deshpande [1,2]

(on Behalf of IITM Short Range Prediction Team)

[1]Indian Institute of Tropical Meteorology, Pashan, Pune-411008
[2] E-mail: **medha_d@tropmet.res.in**

In view of the uncertainty in initial condition and model physics, there was a need for high resolution ensemble based forecast system for region specific probabilistic prediction of weather over India. Considering this along with the existing Global Forecast System deterministic model (GFS T1534), the high resolution (12 km approximately) ensemble forecast system GEFS (T1534) with 20 members is implemented and is in operation since June 2018 for the probabilistic prediction. The operational GEFS is valuable in the probabilistic prediction of extreme weather events like: Thunderstorm, Heavy Rain, Tropical Cyclones, Heat and Cold wave. Along with the performance of model for JJAS 2019, some of the events/cases of extreme weather will be discussed in the meeting (Annual Monsoon Workshop-2019). The prediction of wind gust, rainfall probability and cyclone Strike probability is significant in the flood management and issue of warning point of view. For the benefit of IMD forecasters, various model diagnostics and products like rainfall probability for all the blocks, EPSGRAM, SKEW T log P diagram, percentile-based forecast, Rain Probability forecast over River Basins, etc. have been developed and are available operationally.

IMSP News:

Special Lecture by Prof. Sulochana Gadgil on 23rd October 2019 at IITM Pune

Indian Meteorological Society Pune Chapter (**IMSP**) organized a **Special Lecture by Prof. Sulochana Gadgil** (renowned Monsoon Meteorologist & Professor, CAOS, IISc, Bengaluru) on **23rd September 2019** at Meghdoot Complex of IITM Pune. The title of her lecture was "**Summer Monsoon of 2019: How and Why?**". She highlighted various special features of SW Monsoon of 2019 and explained the scientific reasons of those in a very simple and popular manner, so that it can be understood not only by scientific experts but also by general audience. The lecture was attended by more than 250 persons and it was highly appreciated by the audience.

Prof. Sulochana Gadgil

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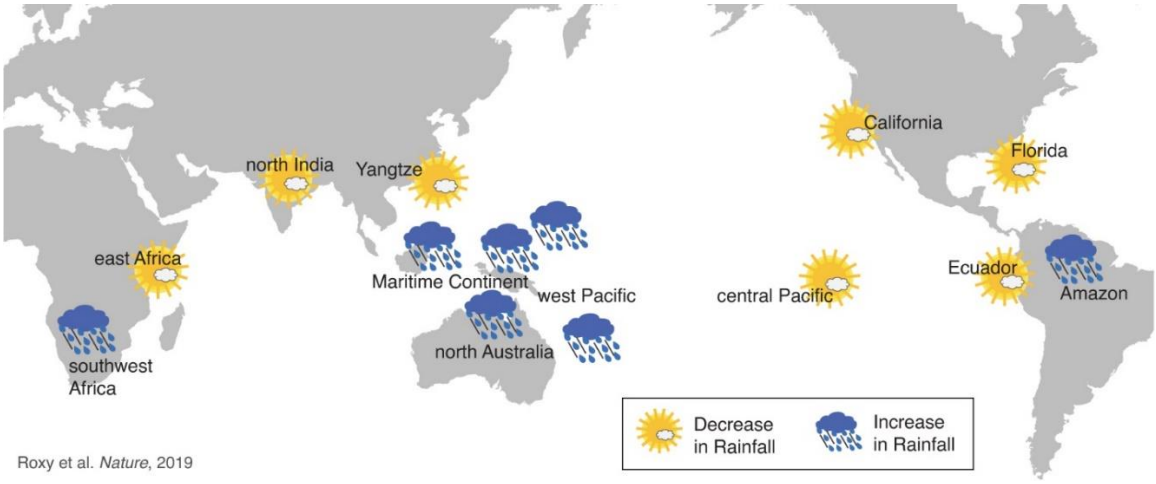

Indo-Pacific warming warps the MJO, changing global rainfall patterns

IMSP

Indian Meteorological Society,
Pune Chapter
(A Scientific Society registered under Govt. of India, New Delhi)

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