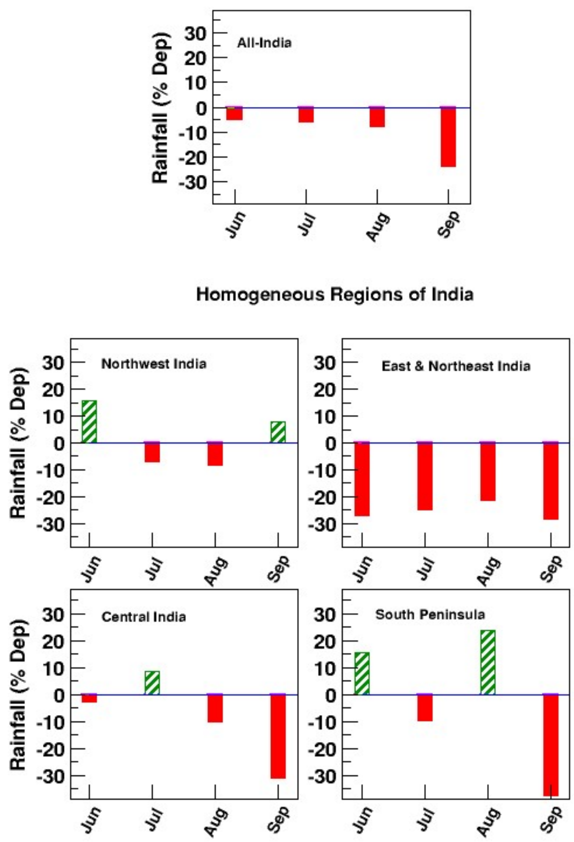
Bulletin of IMSP   BIMSP

November 2018

Vol. 17,4 2018



Monthly rainfall distribution of summer monsoon 2018 for India as whole and homogeneous regions of India

India Meteorological Society

Pune Chapter 2018-2020

The Indian meteorological Society was established in 1956 and was registered on 26 May 1972 under the societies Registration act of 1860 as amended by Punjab Amendment Act 1957 applicable to Delhi. Registration No. of the society is 5403. The society's headquarter is located at Delhi and its local chapters are functional at various places.

The Society is a non-profit making organization and none of its income or assets accrues to the benefit of its members.

Objective of the Society

1. Advancement of Meteorological and allied sciences in all their aspects
2. Dissemination of the knowledge of such sciences both among the scientific workers and among the public and
3. Promotion of application of Meteorology and allied sciences to various constructive human activities

Any person who is interested in aims of the society is eligible to become a member.

The annual subscription of membership is Rs. 500/- for scientists from India. Admission fee is Rs. 50/-.

"Bulletin of IMSP" is published monthly. Correspondence and contributions to the bulletin may be sent to **pune ims@rediffmail.com**. The manuscript should be typed at 1.5 space using Times New Roman font size 12. The author's name should be typed on the line below the title, the affiliation and email ID should follow on next line.

Bulletin of IMSP

November 2018, Vol 17, 4

Contents

1) Revadekar J.V. and S.K. Patwardhan: Characteristic features of Indian summer monsoon rainfall during 2018 4

2) J. R. Kulkarni: wind energy 18

3) Tandon M. K:. Fifth Generation Computer Systems 25

4) Research Highlight:

Rajput Abhay S D: Ozone pollution causing agricultural losses in India 33

Characteristic features of Indian summer monsoon rainfall during 2018

J.V. Revadekar and S.K. Patwardhan
Indian Institute of Tropical Meteorology, Pashan,
Pune – 411008

Abstract

Large part of India receives more than 80% of annual rainfall during the four summer months of June, July, August and September (JJAS). Though it is well-known for its regularity which occurs every year, it shows large spatial and temporal variability. Therefore, attempt has been made to provide a comprehensive analysis of spatio-temporal distribution of rainfall over India during summer monsoon season of 2018.

1. Introduction

The most important characteristics of the Indian climate is the occurrence of monsoon. The summer monsoon (June – September), which dominates most parts of the country, is the main source of water for India which contributes 80% of the annual rainfall.. The summer monsoon, though well-known for its regularity and dependability on the seasonal scale, the rainfall associated with it does show significant variation on different spatial and temporal scales. Much of the cultural, economic, and agricultural life centres around the Indian summer monsoon season (Webster et al., 1998; Gadgil and Gadgil, 2006; Gadgil and Kumar, 2006). Indian summer monsoon is influenced by several local geographic factors such as topography and small-scale atmospheric processes that affects spatial patterns. The nature of this monsoonal precipitation varies from region to region, and many studies reveal that complex land–atmosphere interactions have a significant impact on the monsoonal characteristics (Medina et al., 2010; Asharaf et al., 2012). Parthasarathy et al., (1993) analysed the sub-divisional monsoon rainfall series of India and also grouped them into homogeneous macro-regional units with similar rainfall characteristics to study variability of Indian summer monsoon rainfall.

The rainfall during monsoon months is not uniform and there are times when excess/deficit rainfall occurs and thus termed as the active/break phases of summer monsoon. Intraseasonal variability is widely studied by various researchers using various data sets (Goswami et al., 1998; 2006a,b; Kripalani et al.., 2004; Kulkarni et al., 2006; Rajeevan et al., 2006, 2010; Rajeevan and Bhate, 2008).

It is important to understand spatial and temporal variations of rainfall which have variability on timescales ranging from hours (diurnal) through intraseasonal (weeks), to seasonal, interannual, and longer periods (Rahaman et al., 2009) Therefore, a major theme of this paper is the monthly evolution of spatial patterns over a summer monsoon season during 2018. In addition to the spatial patterns, we also study temporal patterns and clustering of the spatial locations.

2. Spatial Variability

Month to month fluctuations of Indian summer monsoon rainfall is possibly more important to the local population, agricultural output and economic growth (Turner and Slingo, 2009).

2.1 June

Monsoon set over Kerala on 29th May, and covered the entire country on 29th June which is sixteen days earlier than normal. Rainfall activity over the country during the month was normal. Out of 36 meteorological subdivisions, 4 received large excess rainfall, 7 received excess rainfalls, 15 received normal rainfall, 8 subdivisions received deficient rainfall and remaining 2 subdivisions received large deficient rainfall (Fig. 1). Out of four homogeneous regions of India northwest India (15.9%) and south peninsula (15.7%) received excess rainfall, central India received (-2.7%) normal rainfall and East and Northeast India received (-26.9) deficient rainfall in June. Country as a whole, India received -5.0% departure rainfall of its long term mean in June.

2.2 July

During the month of July , rainfall activity over the country as a whole was normal. Out of 36 meteorological subdivisions, 2 received excess rainfall, 24 received normal rainfall, 9 subdivisions received deficient rainfall and one subdivision received large deficient rainfall. (Fig.2). Country as a whole, India received -5.8% departure rainfall of its long term mean in July. Cumulative rainfall from 1st June to 31st July was excess over one sub division, normal over 28 and deficient over 7 meteorological sub divisions.

2.3 August

In August, out of 36 meteorological subdivisions, 1 received large excess rainfall, 5 received excess rainfall, 14 received normal rainfall and 16 received deficient rainfall (Fig. 3). Cumulative rainfall from 1st June to 31st August over the country as a whole was normal during this period. Kerala received about one and half times of its respective normal rainfall. During the period, out of 36 meteorological subdivisions, 1 received excess rainfall, 27 received normal rainfall and the remaining 8 subdivisions received deficient rainfall. Country as a whole, India received -7.6% departure rainfall of its long term mean in the month of August. Kerala experienced one of the worst flood situations during first half of August of this year due to frequent heavy rain spells.

2.4 September

In the month of September, summer monsoon rainfall was large deficit (-23.6%). During this period out of 36 meteorological subdivisions, 7 received excess rainfall, 6 received normal rainfall and the remaining 23 subdivisions received deficient rainfall (Fig 4). Out of four homogeneous regions of India, only northwest India received above normal rainfall of 7.7%. Rest of the homogeneous regions East and Northeast India (-28.4%); central India (-30.9%) and South Peninsula (-37.5%) received large deficient rainfall.

2.5 Seasonal Rainfall

Seasonal (rainfall from 1st June to 30th September for the country as a whole was -9.4% of its LPA. During this period out of 36 meteorological subdivisions, only one subdivision Kerala received excess rainfall. 23 received normal rainfall and the remaining 12 subdivisions received deficient rainfall (Fig 5). Table 1 shows anomalies in seasonal rainfall for various homogeneous regions of India. All four homogeneous regions received below normal rainfall, large deficit region is East and Northeast India which received -24.4%.

Table 1. Anomalies in monsoon seasonal rainfall (% departure) for various homogeneous regions of India.

Region	**Seasonal % Departure**
Country as a whole	-9.4
Northwest India	-1.9
East and Northeast India	-24.4
Central India	-6.6
South Peninsula	-1.6

3. Temporal Variability

3.1 Daily rainfall

A very important feature of Indian monsoon is the existence of "active spells" and "break spells". Prolonged active/break episodes as an integral part of sub-seasonal variability can potentially change water availability and soil moisture availability within a season and influence crop yield (Krishna kumar et al., 2004; Gadgil and Rupa Kumar, 2006; Prasanna, 2014; Preethi and Revadekar, 2014). Farmers and water managers are keenly interested in the subseasonal variations of rainfall. In reality, the seasonal mean monsoon rainfall is the sum of contributions from vigorous sub-seasonal oscillations (i.e., active and break spells) (Goswami, 2012). Thus it is important to explore the occurrence of such spells. These active and break days are identified, for the whole Indian landmass, by comparing the daily aggregate rainfall against normal rainfall of that day. Above and below normal spells for India as a whole in daily rainfall during 1st June to 30th September 2018 are shown in Figure 6. 3-day running average of daily rainfall indicates a below normal spell from 23rd July to 10th August followed by above normal epoch of nearly one month. Above normal rainfall spells coincide with passage of synoptic scale systems like low pressure area, depressions and cyclonic storms (commonly known as low pressure systems, LPS). However cumulative rainfall is consistently below normal throughout August and September (Figure 7).

3.2 Monthly Rainfall

Figure 8 shows monthly rainfall anomalies (% departures) for India as a whole and for four homogeneous regions of India. It indicates negative anomalies for all the four monsoon months, for India as a whole and for East & Northeast India, which contribute towards seasonal total percentage departure -9.4% and -24.4% respectively. For country as a whole rainfall was 95% of LPA in June, 94% of LPA in July, 92% of LPA in August and 76% of LPA in September. For south peninsular region, though June and August show positive departure higher than 10%, its seasonal rainfall is below normal due to less rainfall during July and September.

4. Summary

Southwest monsoon set over Kerala on 29th May, 3 days ahead of its normal date. It progressed rapidly and covered the entire country in one month (on 28th June) well ahead of its normal schedule. The seasonal rainfall for 2018 was less than its long period average for a country as a whole as well as its four homogeneous regions. Country as a whole received less rainfall than its LPA during all the four monsoon months. During season 10 monsoon low pressure systems formed including 1 cyclone, 1 Deep Depression, 4 Depressions, 2 well marked low pressure areas and 2 low pressure areas. Above normal rainfall spells coincide with passage of these systems. East and Northeast region (northwest India) experienced below (above) normal l rainfall during all the four months of the season. Monsoon withdrawal commenced from west Rajasthan on 29th September. The southwest monsoon withdrew from the entire country, Bay of Bengal and the Arabian Sea on 21st October 2018, with a delay of 6 days.

Acknowledgements

The authors are thankful to Director, IITM, Pune, for providing the necessary facilities to pursue this study. The authors are grateful to Dr. R. Krishnan, Head, CCCR, IITM, Pune, for kind encouragements. Thanks are also due to Dr. J.R. Kulkarni for kind encouragements and suggestions. Authors are also grateful to India Meteorological Department (IMD) (source : www.imdpune.gov.in) for necessary data used in the present study.

References

Asharaf S, A Dobler, and B Ahrens, 2012. Soil moisture–precipitation feedback processes in the Indian summer monsoon season. *J. Hydrometeor.*, 13, 1461–1474

Gadgil S and S Gadgil, 2006. The Indian monsoon, GDP and agriculture *Econ. Pol. Wkly*. XLI 4887–95

Gadgil S, Rupa Kumar K, 2006. The Asian monsoon, agriculture and economy. In: The Asian monsoon. *Springer Praxis Books, Springer, Berlin*, pp 651–683.

Goswami BN, Ajayamohan RS, Suresh Kumar G, 1998. Intraseasonal oscillations and interannual variability of surface wind over the Indian monsoon region. *Proc Indian Acad Sci (Earth Planet Sci)* 107, 4–64

Goswami BN, Venugopal V, Sengupta D, Madhusoodan MS, Xavier PK, 2006a. Increasing trends of extreme rain events over India in a warming environment. *Science,* 314. 1442–1445

Goswami BN, Wu G, Yasunari T, 2006b. The annual cycle. Intraseasonal oscillations and road block to seasonal predictability of the Asian summer monsoon. *J Clim,* 19, 5078–5099

Goswami, BN, 2012. South Asian monsoon. In W. K.-M. Lau & D. E. Waliser (Eds.), South Asian monsoon, Berlin: Springer, pp. 21–72.

Kripalani RH, Kulkarni A, Sabade SS, Revadekar JV, Patwardhan SK, Kulkarni JR, 2004. Intra-seasonal oscillations during monsoon 2002 and 2003. *Curr Sci,* 87, 325–331.

Krishna Kumar K, Rupa Kumar K, Ashrit R, Deshpande NR, Hansen JW, 2004. Climate impacts on Indian agriculture. *Int J Climatol,* 24, 1375–1393.

Kulkarni A, Sabade SS, Kripalani RH, 2006. Intra-seasonal Vagaries of the Indian Summer Monsoon Rainfall. *Indian Institute of Tropical Meteorology,* RR114.

Medina, S., R. A. Houze, A. Kumar, and D. Niyogi, 2010. Summer monsoon convection in the Himalayan region: Terrain and land cover effects. *Quart. J. Roy. Meteor. Soc.*, 136, 593–616

Parthasarathy B, K Rupa Kumar and AA Munot, 1993. Homogeneous Indian monsoon rainfall : variability and prediction. Proc. Indian Acad. Sci (Earth Planet Sci) 102, 1, 121-155.

Prasanna V, 2014. Impact of monsoon rainfall on the total food-grains yield over India. J Earth Sys Sci 123, 5, 1129–1145

Preethi B, Revadekar JV, 2012. Kharif food grain yield and daily summer monsoon precipitation over India. *Int J Climatol.*

Rahman SH, Debasis Sengupta and M Ravichandran, 2009. Variability of Indian summer monsoon rainfall in daily data from gauge and satellite, *Geophys. Res.,* 114, D17113, doi:10.1029/2008JD011694

Rajeevan M, Bhate J, Kale JD, Lal B, 2006. High resolution daily gridded rainfall data for the Indian region: analysis of break and active monsoon spells. *Curr Sci,* 91, 296–306

Rajeevan M, Gadgil S, Bhate J, 2010. Active and break spell of Indian summer monsoon. *J Earth Sys Sci* 119, 3, 229–247.

Rajeevan M, Bhate J, 2008. A high resolution daily gridded precipitation dataset (1971–2005) for mesoscale meteorological studies. *Curr Sci,* 96, 558–562

Turner AG, Slingo JM, 2009. Sub seasonal extremes of precipitation and active-break cycles of the Indian summer monsoon in a climate change scenario. *Q J R Meteorol Soc* 135, 549–567

Webster PJ, Magafia VO, Palmer TN, Shukla J, Tomas RA, Yanai M, and Yasunari T, 1998. Monsoons: Processes, predictability and the prospectus for prediction. *Journal of Geophysical Research*, 103, 14,451–14,510

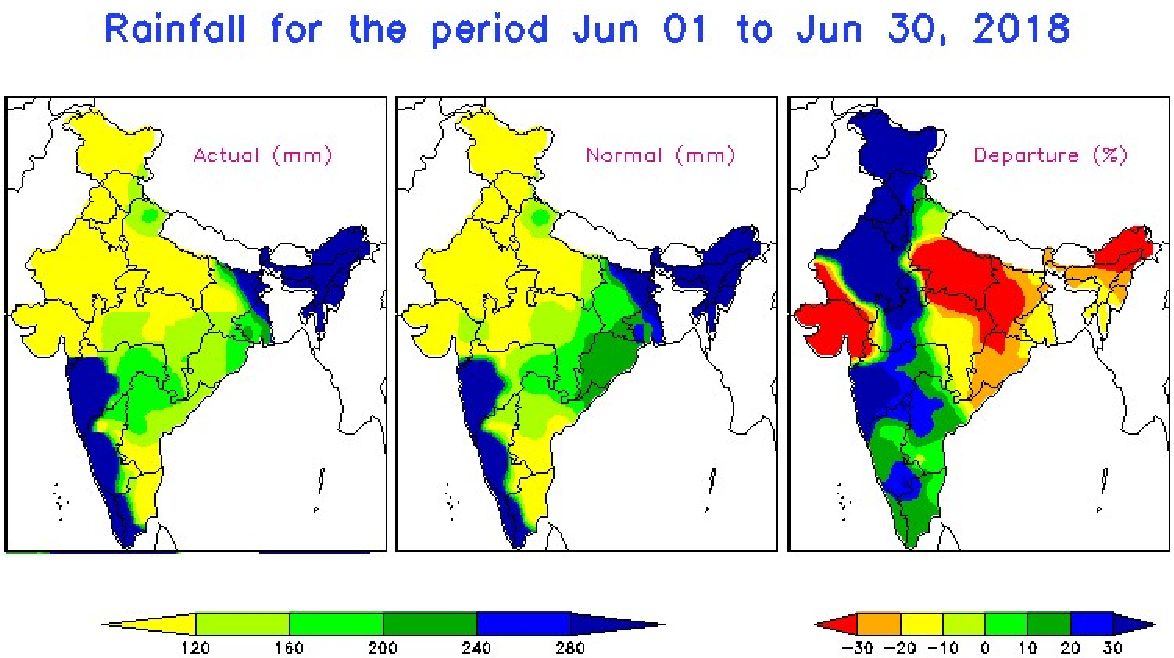


Figure 1 Spatial distribution of rainfall during June 2018

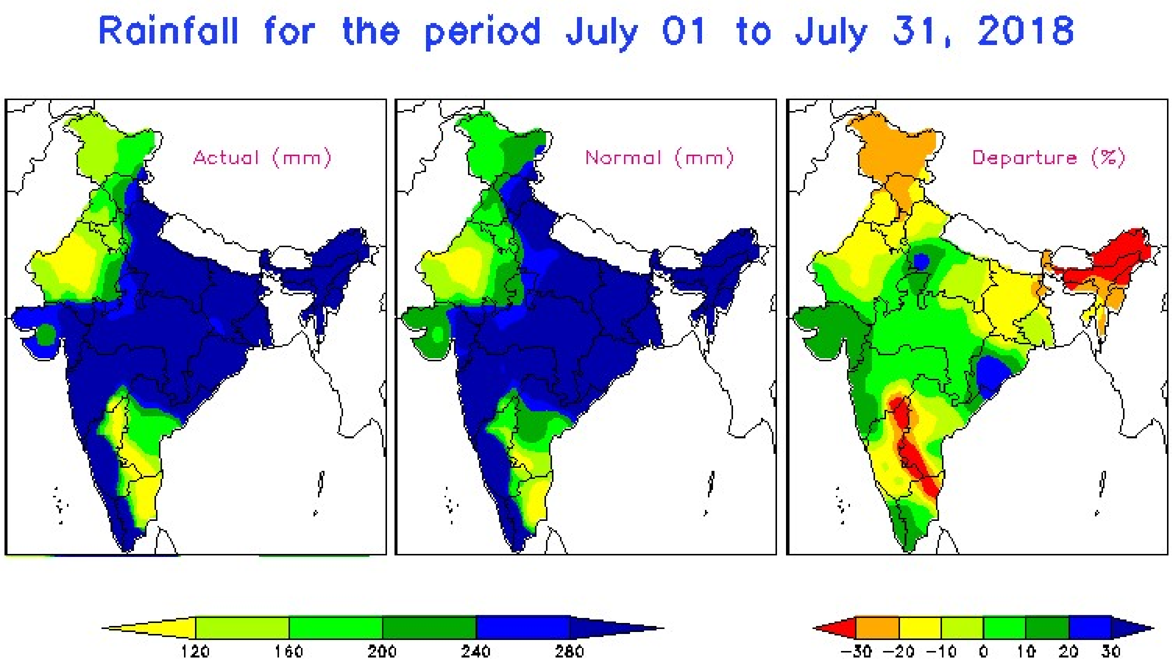


Figure 2. Spatial distribution of rainfall during July 2018

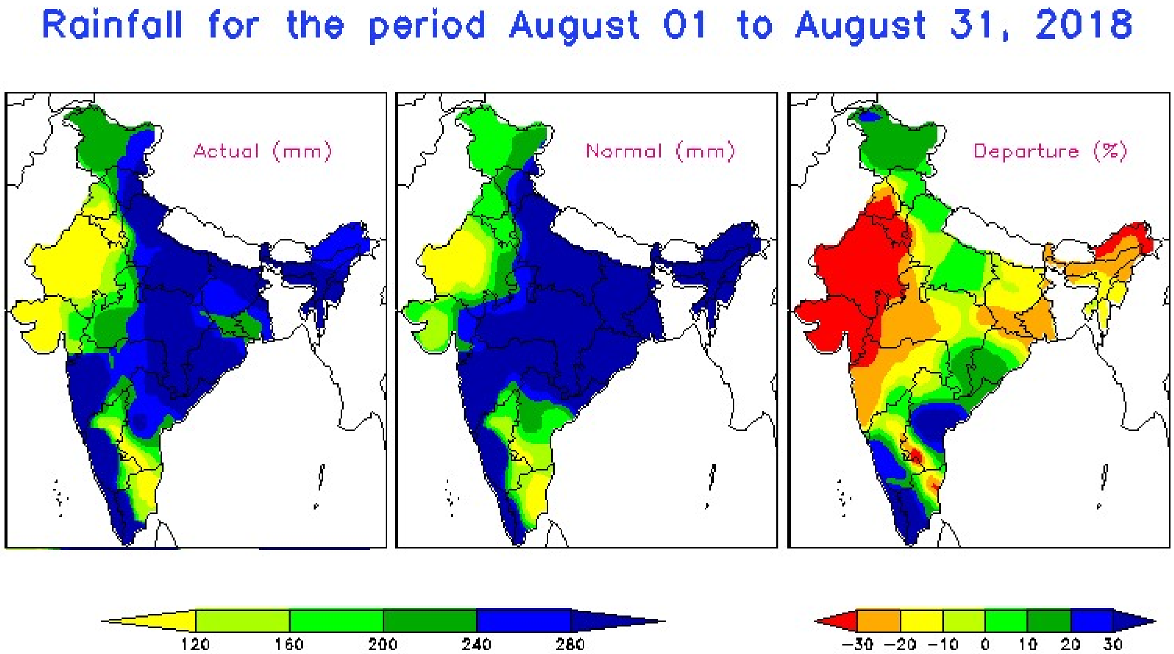


Figure 3. Spatial distribution of rainfall during August 2018

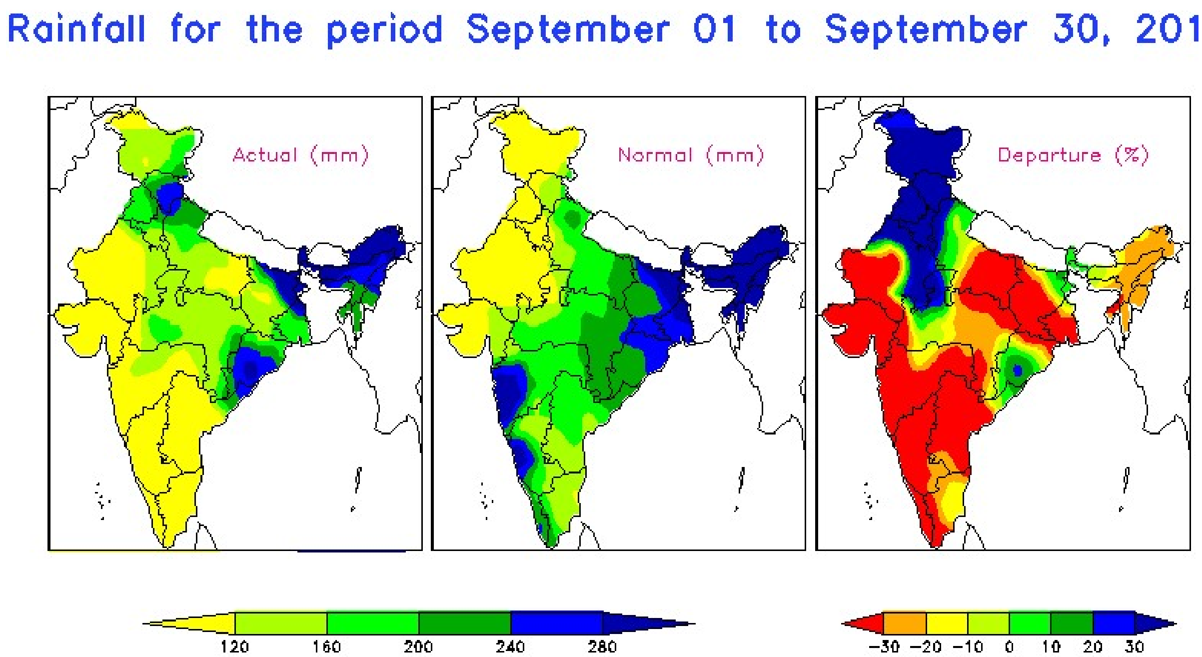


Figure 4. Spatial distribution of rainfall during September 2018

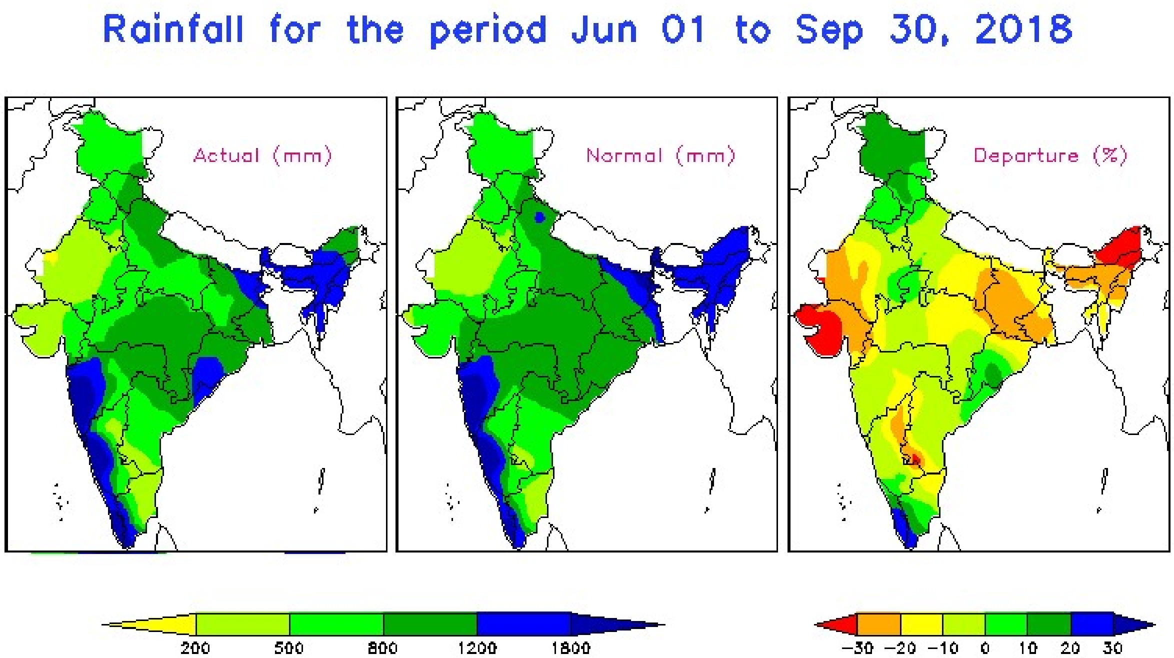


Figure 5. Spatial distribution of rainfall during summer monsoon season (JJAS) 2018

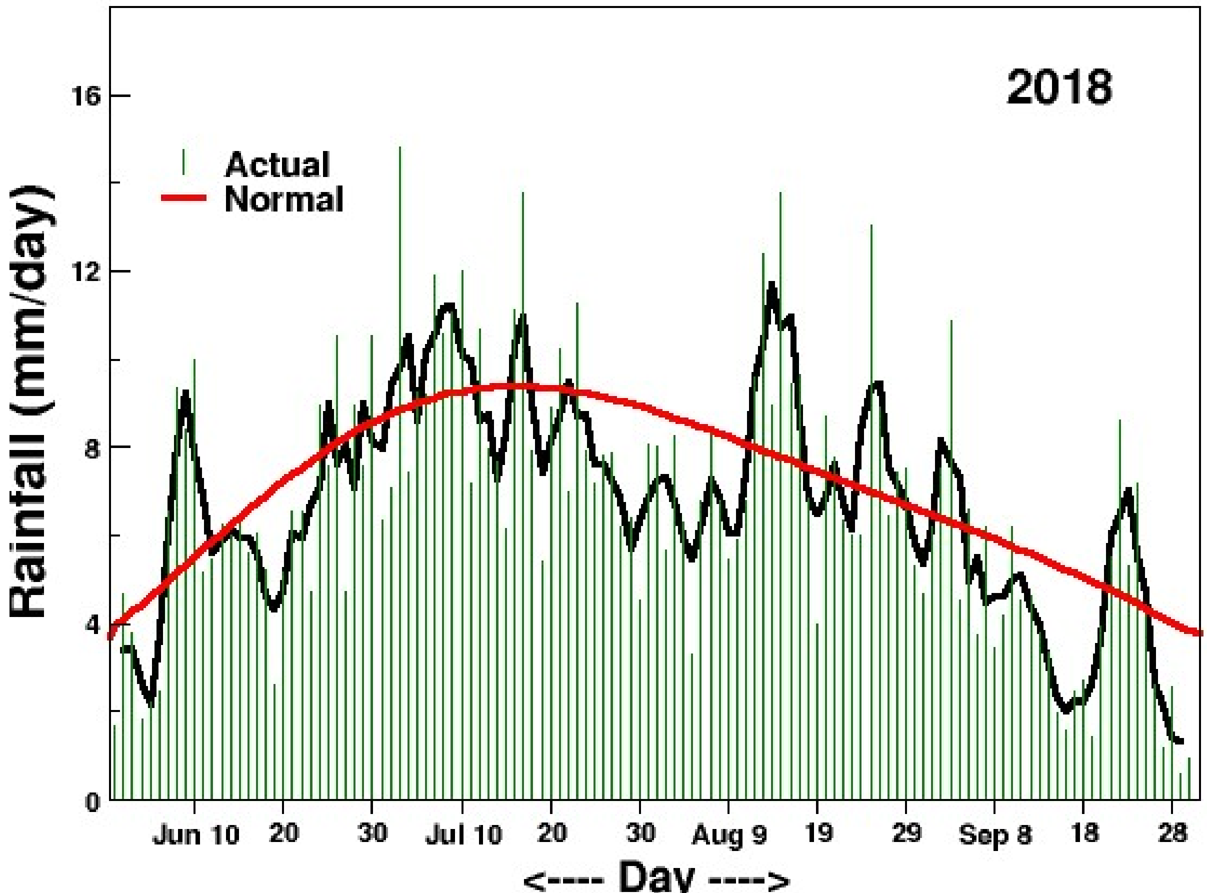


Figure 6. Daily rainfall distribution during summer monsoon (1st June to 30th September 2018). Thick black line show 3-day running average.

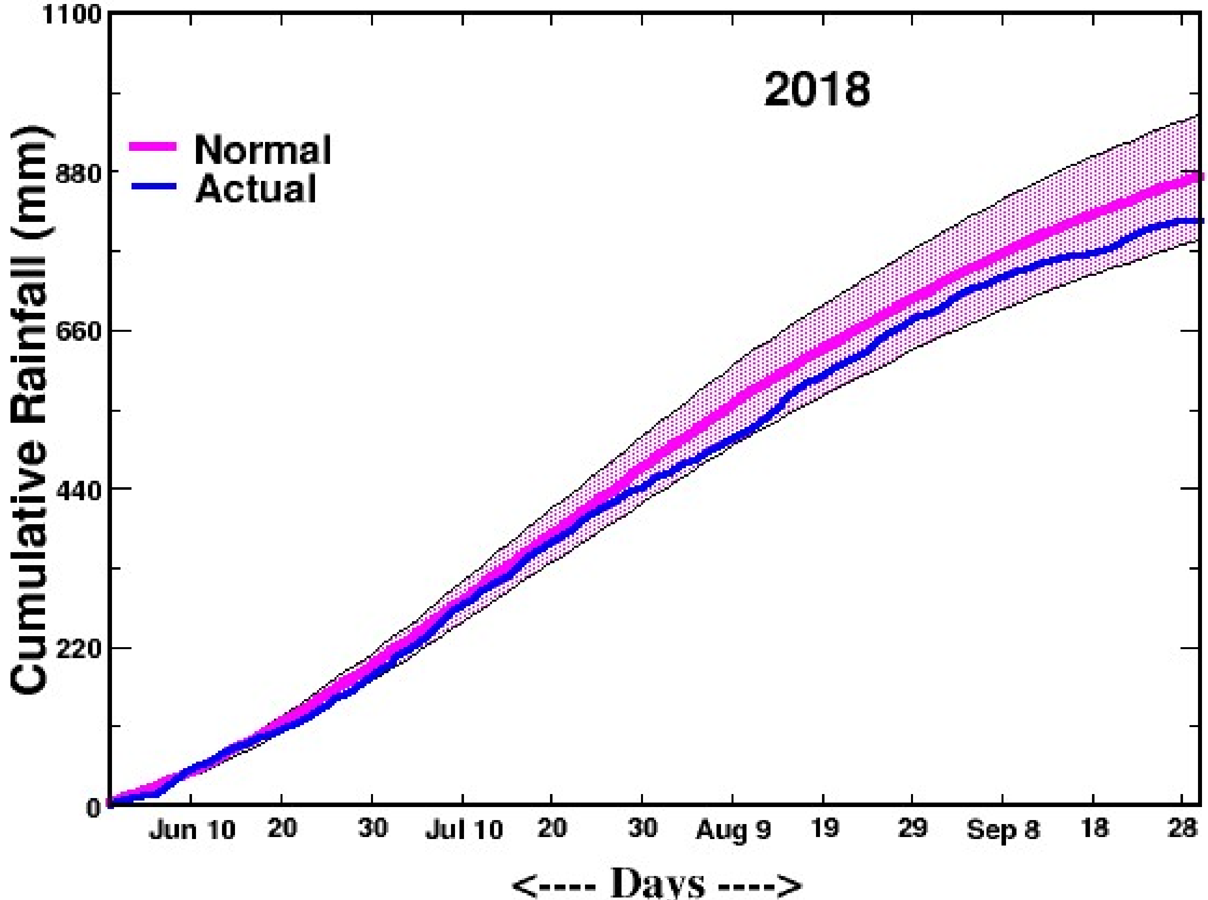


Figure 7. Daily cumulative rainfall during summer monsoon (1st June to 30th September 2018).

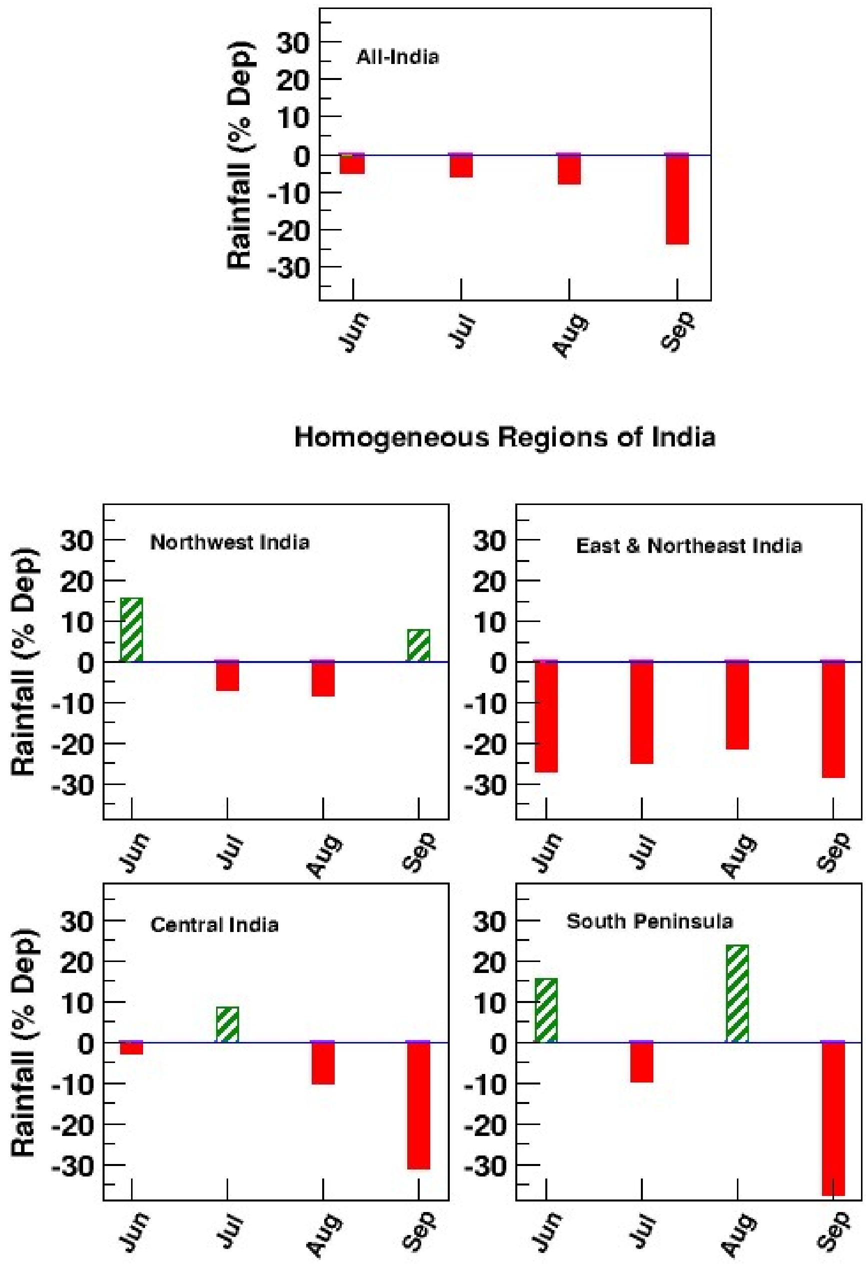


Figure 8. Monthly rainfall distribution of summer monsoon 2018 for India as a whole and Homogeneous regions of India.

Wind energy

J. R. Kulkarni
Vaintey, Rajyog Society, Pune

Abstract

In the present global warming conditions wind energy assumes an important place as it is a clean source of energy. The basics of wind energy and its potential in India have been discussed in the paper.

1. Introduction

Wind is movement of air in the atmosphere. Air flows from high pressure area to low pressure area due to pressure gradient force. Due to rotation of the Earth, the wind is deflected to the right of its direction in the northern hemisphere. This deflecting force is called Coriolis force. The speed of the wind is reduced due to frictional forces present at the surface of the Earth. The net wind speed and direction are governed by these three forces. As wind is associated with the motion, it has kinetic energy. When the kinetic energy of the wind is converted in to usable power, it is termed as "wind power". Wind turbines transform wind energy in to electricity which can be used for variety of purposes in the society.

Wind energy is one of the fastest growing sources of electricity generation in the world today. The increasing interest in the wind power is due to its benefits and special features over other sources. These special features are:

1. The wind power is environment friendly. The electricity generated is without any pollution.
2) It is sustainable**:** Winds blow continuously in the atmosphere. Therefore it is continuous inexhaustible source of energy.
3) The wind power is affordable due to technological development
4) Wind power is locally produced, so it helps for economic development of the local area.

2. Global wind system

Wind is a three dimensional vector quantity having direction and speed. The horizontal wind speed is much greater than vertical wind speed. The general circulation of the atmosphere is used to denote overall picture of the atmospheric motions. The tropical regions are in excess of heat and the mid-latitude and polar regions are in net deficient of heat. The wind systems are developed to transport excess heat in the tropical regions to the extra tropical regions. The air rises in the equatorial regions and moves towards the poles in both the hemispheres. The air after travelling to 30^0 latitude both north and south, sinks and returns to the equator in the lower tropospheric levels. This is termed as Hadley circulation. The low level winds in the tropics are in the north east direction and are termed as trade winds. The trade winds from both the hemispheres meet near the equator. This region is called Inter Tropical convergence zone (ITCZ). The surface winds are weaker at the ITCZ and the region is called as "Doldrums". Similarly the winds at 30^0 latitudes are weak. This region is termed as "Horse latitude”. The surface winds over Indian region are in southwest direction in the monsoon season and in the northeast direction in the winter season.

3. History of use of wind energy

The wind has been used as a energy source from ancient times. It has been used to drive the ships in the Nile River in 5000 B.C. During the period 200-100 B.C. wind energy was used to pump the water in China. During that era, wind energy was used for grinding grains in Persia and Middle East. It was introduced in Mediterranean and Europe in 11 century by traders. The wind energy was used to drive ships by Arab trades to visit India during 15- 18 century. There were large improvements in the wind energy machines by Duch people and millions of wind energy machines were in operations in 20 century in the world. In India wind measurements were described in Brihat Samhita by mathematician Varahamihira in 505-587 AD. With the advent of steam engines, the usage of wind energy machines reduced. However during climate change era, there is renewed interest in the usage of wind energy.

4. Wind measurements

As per meteorological convention, the wind direction is the direction from true north expressed in degrees from which winds come to the station. The wind direction is measured by wind vane. It consists of a pointer on one end and a flat plate on the other end. It is mounted on the vertical axis. Four rods are fixed at the bottom pointing four directions. The wind vane moves with the wind and the direction of the wind is shown by the position of the pointer with respect to fixed rods The wind speed is measured by cup anemometer. The wind vane and cup anemometer are installed at 10 m above the surface. The exposure of the wind instrument should be such that wind should flow unobstructed. The unobstructed area is defined as the area where the distance between the location of wind instruments and any obstruction is at least 10 times the height of the obstruction.

4.1 Beaufort scale

The Beaufort scale is an empirical method of denoting the wind speeds based on the conditions at sea and on land. The following table 1 gives Beaufort scale number, corresponding wind speeds and the sea and land conditions.

Table 1: Empirical method of denoting the wind speeds based on the conditions at sea and on land.

Beaufort Number	Description	Wind speeds			Sea and land conditions
		Knots	Ms^{-1}	Kmh^{-1}	
0	calm	< 1	<0.515	<1.853	Calm, smoke rises vertically, sea like a mirror
1	Light air	1-3	0.5-1.5	1.8-5	Direction of smoke by smoke drift, but not by wind vanes, Ripples with appearance of scales without foam
2	Light breeze	4-6	1.6-3.3	6-11	Wind felt on face, leaves rustle, ordinary vanes moved by vanes, small wavelets still short but more pronounce, crest have glassy appearance but do not break
3	Gentle breeze	7-10	3.4-5.4	12-19	Leaves and twigs in constant motion, wind extends light flag, crests begin to break, foam of glassy appearance,
4	Moderate breeze	11-16	5.5-7.9	20-28	Raises dust and loose paper, small branches are moved, small waves becoming larger, fairly frequent white horses
5	Fresh breeze	17-21	8-10.7	29-38	Small trees in leaf begin to sway, crested wavelets formed on inland waters, wave height 2-3 m
6	Strong breeze	22-27	10.8-13.8	39-49	Large branches in motion, whistling heard in telegraph wires, umbrellas used with difficulty, wave height over sea 3-4 m, foam crests are more intensive
7	Near gale	28-33	13.9-17.1	50-61	Whole trees in motion, inconvenience felt in walking, sea heaps, 4-5 m wave height
8	Gale	34-40	17.2 20.7	62-74	Breaks twigs of the trees, wave height 5-7.5m
9	Strong gale	41-47	20.8 – 42.4	75-88	Slight structural damage occurs, Chimney pots and slates removed
10	Storm	48-55	24.5-28.4	89-104	Seldom experienced inland, trees uprooted, considerable structural damage occurs
11	Violent storm	56-63	28.5-32.6	103-117	Very rarely experience, accompanied by widespread damage,foam in great patches, surface of sea takes white appearance
12	Hurricane	64 and above	32.7 and above	118 and above	Devastation

5 **Wind Energy**

The wind power P due to wind of velocity V passing through area A is given by

$$P = \frac{1}{2}\rho A\,(V ** 3)$$

Where ρ is density of air. P is expressed in watts or kilowatts. With ρ is in kg m^{-3} and V in kmph, the power P per unit area ($kWhm^{-2}$) is

$$P = 0.00001073\,\rho\,(V ** 3)$$

Mani (1990,1992) has given mean monthly and annual energy content of the wind in $kWhm^{-2}$ for the 21 stations in India. The highest annual value of 3181 $kWhm^{-2}$ is observed at Muppandal. In Maharashtra, the stations Deogad, Malwan and Vijaydurg report the annual values of 920.2, 454.8 and 1584.2 $kWhm^{-2}$ respectively.

6) Wind mill or wind energy Generator (WEG)

The main components of a wind mill are:

1. Tower 2) Nacelle 3) Rotor 4) Gearbox 5) Generator 6)Braking System 7) Yaw System 8) Controllers 9) Sensors

   Figure 1 shows wind mill and its components (from Google)

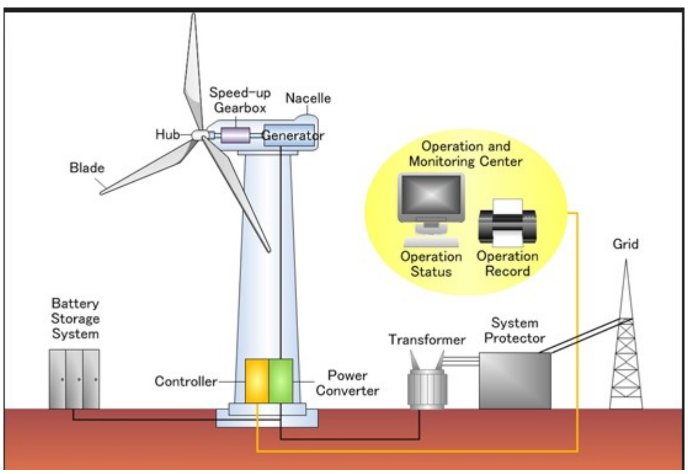


Figure 1: Typical wind mill and its components (Adopted from Google internet site)

7) Essential requirements for a wind farm-

An area where a number of wind electric generators are installed is known as a wind farm. The essential requirements for establishment of a wind farm for wind power generation are:

1. Existence of high wind the site
2. Availability of suitable land
3. Proper approach road to the site
4. Existence of nearby electricity grid

8) The main advantages of power generation from wind energy are-

1. The capital cost is comparable with conventional power plants. For a wind farm, the capital cost ranges between 4.5 crores to 6.85 crores per MW, depending up on the type of turbine, technology, size and location.
2. Construction time is less.
3. Fuel cost is zero.
4. Operational & Maintenance costs are very low.
5. Capacity addition can be in modular form.

9) The pollution saving from a WEG having an average output of 4,00,0.00 kWh per year has been estimated as:-

1. Sulphur - dioxide (SO_2): 2 to 3.2 tonnes
2. Nitrogen - oxide (NO) ; 1.2 to 2.4 tonnes
3. Suitable terrain and good soil condition
4. Carbon - dioxide (CO_2) : 300 to 500 tonnes
5. Particulates : 150 to 280 kg.

(Data taken from wikipedia)

10) Limitations

1. Wind machines must be located where strong, dependable winds are available most of the time.
2. Because winds do not blow strongly enough to produce power all the time, energy from wind machines is considered "intermittent," that is, it comes and goes. Therefore, electricity from wind machines must have a back-up supply from another source.
3. As wind power is "intermittent," utility companies can use it for only part of their total energy needs.
4. Wind towers and turbine blades are subject to damage from high winds and lighting. Rotating parts, which are located high off the ground can be difficult and expensive to repair.
5. Electricity produced by wind power sometimes fluctuates in voltage and power factor, which can cause difficulties in linking its power to a utility system.
6. The noise made by rotating wind machine blades can be annoying to nearby neighbours.

(source Wikipedia)

11) National Institute of Wind Energy (NIWE)

National institute of wind energy is an autonomous R&D institution established by the Ministry of New and Renewable Energy (MNRE), Government of India in 1999 to serve as a technical focal point of excellence to foster the development of wind energy in the country. NEWE estimated wind power potential in India using wind atlas and in situ wind measurements. The state wise wind energy potential as follows (from NIWE website)

States / UTs	Installable Potential(MW) at 50 m Level
Andaman & Nicobar	2
Andhra Pradesh	5394
Arunachal Pradesh*	201
Assam*	53
Chhattisgarh*	23
Gujarat	10609
Himachal Pradesh *	20
Jammu & Kashmir *	5311
Karnataka	8591
Kerala	790
Lakshadweep	16
Madhya Pradesh	920
Maharashtra	5439
Manipur*	7
Meghalaya *	44
Nagaland *	3
Orissa	910
Rajasthan	5005
Sikkim *	98
Tamil Nadu	5374
Uttarakhand *	161
Uttar Pradesh *	137
West Bengal*	22
Total	**49130**

* Wind potential has yet to be validated with measurements

12) Maharashtra Energy Development Energy (MEDA)

MEDA is working in the area of wind energy in Maharashtra. Its objectives are:

- Assistance to state and central govt to promote and develop new and renewable sources of energy and technologies and to promote and implement energy conservation.
- Working as State Nodal Agency in renewable energy sector and state designated agency in energy conservation sector
- Committed to explore the resources such as Wind, Bagasse Cogen, Hydro, Biomass, Geothermal, Wave which are clean and eco-friendly in nature (MEDA website)

MEDA established 221 wind measuring stations having mast height of 50 m, 35 stations with mast height of 80 m and 3 stations with height of 100 m. Total number of wind measuring stations in Maharashtra are 259. All the major manufacturers of wind turbines including Suzlon, Vestas, Gamesa, Regen, Leitner Shriram have presence in Maharashtra.

13) Wind power forecasting

In the nation-wide electricity grid, there has to be maintained balance between electricity generation and consumption. The electricity is generated by different sources like hydro electric, coal and nuclear. The generation of electricity by these sources is controllable and predictable. The wind power generation is a function of wind speed and is variable on all time scales. The electricity managers prepare estimate of electricity consumption for the country as a whole 24 hour in advance. Based on the estimated consumption, action is proposed for the generation of the electricity by all the sources. The most variable part in the budget of electricity generation is the wind power. Based on the forecasts of wind power, the other sources of the power generation are adjusted. Therefore forecasting of wind power, and hence the winds, assumes a significant importance in the electricity management of the country.

The wind forecasting is carried out using numerical models, statistical and empirical methods. The numerical prediction method (NWP) consists of using dynamical models such as WRF at high (3 km) resolution. The statistical method consists of auto regressive (AR), auto regressive moving average (ARMA), and auto regressive integrated moving average (ARIMA) models. Empirical method consists of use of Artificial Neural Networks (ANN). Now the attempt is using hybrid method in which ANN is used to tune NWP forecasts

14) Summary

There is a large potential of wind energy in India. The subject of wind forecasting has become an important topic in the field of meteorology. Hence a very focussed efforts are required in accurate wind prediction to mitigate county's power problem.

References

Mani A, 1990 Wind Energy resource survey for India I, Allied Publications, Ltd, 1, 347

Mani A, 1992 Wind Energy Resource Survey of India II , Allied publishers Ltd, 1, 591

NIWE National Institute of Wind Energy, Ministry of New and Renewable Energy, Government of India, niwe.res.in

MEDA Maharashtra Energy Development Agency, Government of Maharashtra,www.mahaurja.com/meda

WMO 1961, WMO Technical Note No 175 Meteorological aspects of the utilization of the wind as an energy source, WMO No. 575, 1,80

Fifth Generation Computer Systems

Manoj Kumar Tandon[1, 2]
[1]Scientist (Retired), Indian Institute of Tropical Meteorology, Pune.
[2]Visiting Faculty,
Savitribai Phule Pune University, Pune.
Symbiosis International (Deemed University), Pune.

Computer fabrication technology has been advancing steadily ever since its advent around World War II. After the fabrication of first generation computers, lot of revolutions came in computer fabrication industry. Numerous advances came in computer fabrication technology that resulted into the evolution of computers of different generations viz. first, second, third, fourth and fifth generations. With the generation oriented evolution of computer fabrication technology, programming languages also had generation oriented development viz. first, second, third, fourth and fifth generations of computer programming languages. A generation language (GL) refers to any of the following.

(1) The first-generation languages, aka, 1GL, are the low level languages that are machine languages.

(2) The second-generation languages, aka, 2GL, are also low level languages that are assembly languages. They are sometimes used in kernels and hard ware drives and are more commonly used for video editing and video games.

(3) The third-generation languages, aka 3GL, are high level languages such as Fortran, C, C++, Java and Visual Basic.

(4) The fourth-generation languages, aka 4GL, are languages that consist of statements that are similar to statements of human languages like English. Fourth generation languages are commonly used in database programming and scripts. Some of the fourth-generation languages are Ruby, Perl, PHP, Python and SQL.

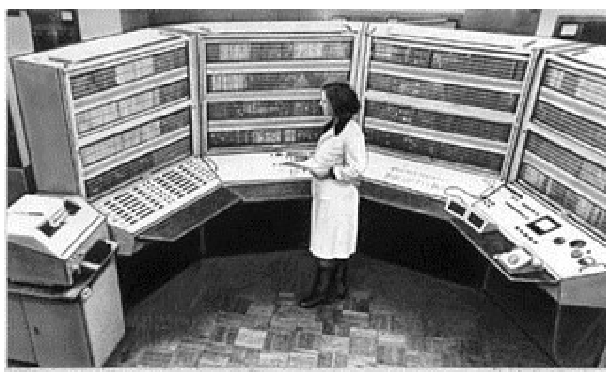
(5) The fifth-generation languages, aka 5GL, are programming languages that contain visual tools to help develop a program. Some of the fifth-generation languages are Mercury, Prolog and LISP. LISP is the foundation of the fifth generation computer systems. The fundamental concept of LISP is linked list. Linked list is also called list. Name ‘Prolog’ stands for ‘PROgramming in LOGic’ and ‘LISP’ stands for ‘LISt Processing’. A fifth generation language is a programming language based on problem solving using constraints to the given problem, rather than using an algorithm written by a programmer. Most constraint based and logic programming languages and some declarative languages are the fifth-generation languages.

Besides generation oriented classification, computer languages are also classified according to their level. Level of a computer programming language is of two kinds viz.

‘Low’ and ‘High’. Computer language is either a low level language or a high level language. Low level computer languages are sub-classified as ‘Low Level Machine Language’ or ‘Low Level Assembly Language’. Low level computer languages, viz. 1GL and 2GL, are associated with first and second generation computer systems. A low level computer programming language provides little or no abstraction from a computer’s instruction set architecture. Commands and functions in the low level language map closely to processor instructions. High level computer languages are associated with third, fourth and fifth generation computer systems. High level languages, viz. 3GL, 4GL and 5GL, came from 1950s onwards. Design of present day computers from the first to the fifth generation are based on digital technology and are therefore also called ‘Digital Computers’ unlike ‘Quantum Computers’ whose design is based on wave mechanics. In digital computer, bit is called digital bit because it is digitally represented by either 0 or 1 whereas in quantum computer, quantum bit (Qubit) has wave representation. Digital bit is also called ‘Classical Bit’. Both digital bit and quantum bit are considered analogous to a coin which has two sides viz. ‘Head’ and ‘Tail’. Some enterprising computer scientist has described the difference between digital bit and quantum bit by stating that “Digital bit is like a tossed coin after it has fallen on the ground whereas quantum bit is like a tossed coin while it is still spinning in the air”. Quantum computers are currently being used in some research laboratories and institutes in United States. Fifth generation computer systems, based on artificial intelligence are still in development stage, though there are some applications such as voice recognition that are being used today. The use of parallel processing and superconductors is helping to make artificial intelligence a reality. Fifth generation computer systems are the next stage of computer development. With the goal of creating computers capable of serving the foundation of an advanced information society, the development of the fifth generation computer system for knowledge information processing started. Following are some first to fourth generation of computer systems.

First Generation Computer System

Second Generation Computer System



Third Generation Computer System

Fourth Generation Computer System

Programming languages have been classified in programming language generations. Historically, this classification was used to indicate increasing power of programming styles. 'Computer Generation' is a term related to the evolution and adaptation of technology and computing. Fifth generation computer system project is currently being carried out in Japan. Artificial intelligence is the core of both design and functionality of a fifth generation computer system. Operational efficiency of any artificial intelligence based software is estimated in the units of LIPS where LIPS stands for 'Logical Inferences Per Second'. LIPS value is used as artificial intelligence classification criterion. Artificial intelligence is categorized into 'Strong Artificial Intelligence' and 'Weak Artificial Intelligence' depending upon the artificial intelligence criterion. Higher value of LIPS signifies strong artificial intelligence whereas lower value of LIPS signifies weak artificial intelligence. Sometimes weak artificial intelligence is also called 'Narrow Artificial Intelligence' and strong artificial intelligence is called 'General Artificial Intelligence'. Weak (narrow) artificial intelligence may outperform humans at whatever its specific task is, like solving equations whereas strong (general) artificial intelligence would outperform humans at nearly every cognitive task. Fifth generation computers are being built around the concept of logic programming. The goal of fifth generation computer system is to develop the device which could respond to natural language input and are capable of learning and self organization. Quantum computation and molecular and nanotechnology are used in the design of fifth generation computer system. Fifth generation computers will have the power of human intelligence and will be able to recognize images and graphs. Fifth generation computer systems will be able to use massive number of CPUs for faster processing speed. The most noticeable characteristic of fifth generation computers will be the ability to apply previously gained knowledge, draw conclusions and then execute a task. Fifth generation computers will, in short, simulate the human ability to think. Following table shows year wise evolution of computer technology underlying the fabrication of various generations of digital computer systems and the associated generation languages.

Generation	Period	Computer Technology	Language Category
First	1940 – 1956	Vacuum Tube Based	Machine Languages
Second	1956 – 1963	Transistor Based	Assembly Languages
Third	1963 – 1971	Integrated Circuit Based	Imperative Languages
Fourth	1971 – 2010	Microprocessor Based	Object Oriented Languages
Fifth	2010 – Beyond	Artificial Intelligence Based	Logic Languages

Besides being too sophisticated and complex devices, fifth generation computer systems have these advantages - Work faster than earlier generation computers, Development of true artificial intelligence and Advancement in superconductor technology. Artificial intelligence is a branch of computer science which explores the possibility of creating complex software capable of mimicking some of the abilities of human mind. The name "Artificial Intelligence" dates from the 1956 conference held at Dartmouth College, New Hampshire, where it was coined by the designer of LISP language John McCarthy. Artificial intelligence research is intended to illuminate some aspects of human intellectual ability and to recreate this in computer. The fifth generation languages Prolog and LISP are being extensively used in the exciting world of artificial intelligence. The main thrust of artificial intelligence research is now probably determined by the fifth generation computer systems project being carried out in Japan. Ultimate advances in artificial intelligence will depend largely upon two factors viz. the development of new computer architectures incorporating parallel processing and the creation of more sophisticated computer languages capable of exploiting the new possibilities of such enhanced computer systems and intelligent software. Combined with the continuing growth of programming languages and techniques, artificial intelligence will lead to greater insights into the nature of human mind. Knowledge engineering is used in representing knowledge in the fifth generation computer systems. Artificial intelligence theorists regard human mind as being equivalent to exotic software running on a particularly powerful biological computer. Fifth generation computers involving sophisticated artificial intelligence are intended to communicate in natural languages, like English, possess large knowledge data base together with an efficient inference engine and shall be able to derive new heuristics from their own experiences. Some of the applications of fifth generation computer systems are (1) Decision making robots, which can work with visual inputs and respond on their own, working without following any step by step instruction, (2) Word processor that could be controlled by means of speech recognition and (3) Programs that could translate documents from one language to another language. Parallel processing is also an intrinsic feature of the design of fifth generation computer system architecture. Besides artificial intelligence, parallelism is classified according to the granularity of parallelism as (1) 'Finely Grained Parallelism' and (2) 'Coarse Grained Parallelism'. Finely grained parallelism is tantamount to massively parallel topologies of processors. Finely grained parallelism is suitable for studies related to weather forecasting and climate science. Artificial intelligence based fifth generation computer systems having built-in parallelism support following kinds of computational configurations.

(1) Weak artificial intelligence based finely grained parallelism.

(2) Weak artificial intelligence based coarse grained parallelism.

(3) Strong artificial intelligence based finely grained parallelism.

(4) Strong artificial intelligence based coarse grained parallelism.

The term artificial intelligence is applied when a machine mimics cognitive functions that humans associate with other human minds such as 'learning' and 'problem solving'. Some people consider artificial intelligence to be a danger to humanity if it progresses unabatedly. Others believe that artificial intelligence, unlike previous revolutions; will create a risk of mass unemployment. Besides its use in the design and working of fifth generation computer systems, domain of artificial intelligence consists of (1) Machine Learning – deep learning, unsupervised learning, supervised learning, (2) Natural Language Processing – text generation, question answering, (3) Vision – image recognition, machine vision, (4) Expert Systems – adoptive learning, reasoning with uncertainty, (5) Speech – voice recognition, language translation, (6) Planning and Scheduling – automation and (7) Robotics. In twenty-first century, artificial intelligence techniques have experienced a resurgence following concurrent advances in computer power, large amounts of data and theoretical understanding. Today artificial intelligence techniques have become essential part of computer technology helping to solve many challenging problems of computer science. Artificial intelligence and machine learning are making great strides in twenty-first century. Everything we love about human civilization is a product of intelligence, so amplifying our human intelligence with artificial intelligence has the potential of helping human civilization flourish like never before – as long as we manage to keep the technology beneficial.

Research Highlights

Ozone pollution causing agricultural losses in India

Abhay SD Rajput, IITM, Pune

(Source: Ghude S.D., Jena C., Chate D.M., Beig G., Pfister G.G., Rajesh Kumar, Ramanathan V., Reductions in India's crop yield due to ozone, Geophysical Research Letters, online, August 2014, DOI:10.1002/2014GL060930, 1-7)

Recent scientific studies have shown that long-term exposure to high concentrations of ozone at the surface level can damage agricultural produce causing substantial loss in crop yield and quality. Developmental activities in the recent past have led to a rapid increase in the gases like nitrogen oxides (NOx), carbon monoxide (CO) and volatile organic compounds (VOCs) which act as precursors for ozone formation and hence, a rapid increase in the ozone levels in the atmosphere at the surface. Climate change is raising further concerns for increase in ozone levels. Studies show high concentrations of ozone gas at the surface level over the major agriculture regions in India, including the Indo-Gangetic Plains. Ozone concentration is further projected to increase in the future. This makes the Indian agriculture sector vulnerable and unfortunately, no air quality standards are available at present in India to protect agriculture from the ill-effects of ground-level ozone gas. Further, the quantum of losses incurred by the Indian agriculture sector is unknown.

This necessitates quantification of such losses in crop yield due to ozone and identification of interventions for mitigating such losses. Several studies have quantified such crop losses on global or regional scale by using high-resolution global chemistry transport models. But no such effort in the Indian context is known. Therefore, keeping this urgent need in view, a small team of scientists from the Indian Institute of Tropical Meteorology (IITM), Pune in collaboration with other scientists from the national Centre for Atmospheric Research, USA and the Scripps Institution of Oceanography, USA took the challenge to quantify ozone-induced crop losses and to identify the critical mitigation pathways to reduce such losses.

They wanted to study the damage caused by ozone gas to four main crops grown in India during the first decade of the 21st century and for this, they selected the year 2005 as a representative year for this period. The four crops selected for the study are: wheat, rice, cotton and soybean. Wheat and rice are the two main cereal crops which act as the staple food for the Indians. Cotton and soybean are the well known and grown commercial crops in India. Productivity of these crops varies significantly from state to state and region to region due to various factors like soil quality, season, irritation, microclimates, local resources, etc.

To estimate the crop losses due to ozone gas, the team led by IITM scientists used a regional chemistry transport model, latest multiple NOx emission inventories, and district-wise crop production data sets. The model selected here was WRF-Chem version 3.2.2 which was run with 27 vertical levels from the surface to a height where the atmospheric pressure is 50 hectopascal (hPa) to simulate hourly levels of ozone gas at the surface at a 0.5° spatial resolution for the year 2005. Six different NOx emission inventories developed by six different groups for the year 2005 were used. From among the various precursor gaes, NOx is shows highest sensitivity to ozone production. Hence, only NOx emission inventories are used here. The crop production data is taken from the Special Data Dissemination Standard, Directorate of Economics and Statistics (SDDS-DES), Ministry of Agriculture, Govt. of India. This crop data was converted into a grid format to match 0.5° resolution of WRF-Chem model.

The surface ozone concentrations were simulated by using the WRF-Chem model for six different NOx inventories one by one. Then, crop losses due to ozone for each case, and the estimated mean yield loss at 0.5° resolution for the four crops were calculated. Finally, average yield loss due to ozone exposure for each of the four crops was calculated. The losses for each crop due to ozone exposure were calculated by using AOT40 exposure metrics and its concentration response (CR) relationships on each grid. Here, AOT40 stands for 'Accumulated dose of ozone Over a Threshold of 40 parts per billion (ppb)' and is a measure of the potential risk to crops due to ozone exposure. It is the sum of the differences between the hourly concentration of ozone over 40 ppb. The CR relationship in this case refers to the change in effect on a crop caused by differing levels of exposure to ozone after a certain exposure time. These AOT40 based CR relationships are derived from a number of field experiments worldwide. After calculating production losses for each crop over each grid cell, values from all the grid cells were summed up for each crop. Then, the final estimates were derived from these values multiplied by domestic market prices for each crop during the year 2005.

The results from this study show that substantial areas under crop production in India suffer sufficient damage to vegetation and yield loss. On the national scale, the fractional losses during 2005 to cotton, wheat, soybean and rice are 5.3±3.1%, 5.0±1.2%, 2.7±1.9%, 2.1±0.9% respectively. This shows highest fraction loss to cotton. In terms of weight, the losses to wheat, rice, soybean and cotton are 3.5±0.8 million tons (Mt), 2.1±0.8 Mt, 0.23±0.16 Mt and 0.17±0.10 Mt respectively. Here, the maximum loss is to wheat followed by rice. The researchers say that if all these losses to these four crops due to ozone exposure are combined together, then it amounts to an estimated economic loss of 1.29±0.47 billion USD for the year 2005.

Such crop production losses and the economic damage for a country like India where a large population is living below poverty line are a matter of concern. The study suggests that the widespread ozone pollution is causing considerable loss to crop production and hence, is having an impact on food security in the country. The estimated losses of 5.6 Mt in wheat and rice production, if prevented, can sufficiently feed 94 million poor people living below poverty line in India.

The researchers admit that there may be considerable uncertainties in the estimated losses due to ozone. But these results provide important first hand information to policy makers to put controls on emissions of precursor gases leading to the formation of ozone so as to minimize ozone-induced crop production losses for ensuring food security in India.

(Source: Ghude S.D., Jena C., Chate D.M., Beig G., Pfister G.G., Rajesh Kumar, Ramanathan V., Reductions in India's crop yield due to ozone, Geophysical Research Letters, online, August 2014, DOI:10.1002/2014GL060930, 1-7)

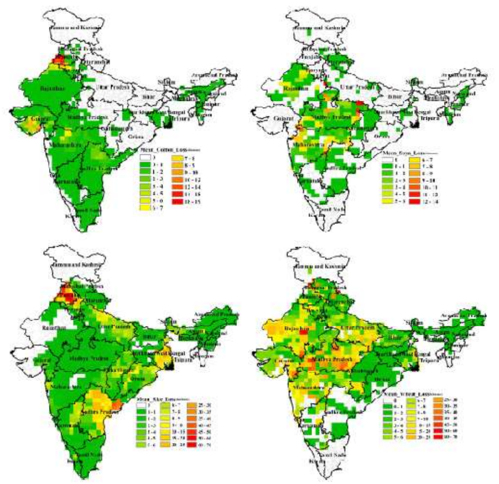


Fig. 2: Average ozone-induced crop production loss from AOT40 metrics for cotton, soybean, rice, and wheat during 2005. The production loss numbers are given in kilotons/grid cell.