International Journal of Research in Engineering and Applied Sciences(IJREAS)
Available online at http://euroasiapub.org/journals.php
Vol. 7 Issue 6 , June-2017, pp. 335~340
ISSN (O): 2249-3905, ISSN(P): 2349-6525 | Impact Factor: 7.196

PREDICTION OF MONSOON RAIN FOR THE YEAR 2017 FOR MARATHAWADA INDIA

ANAND M. SHARAN
PROFESSOR
MECHANICAL ENGINEERING DEPARTMENT
FACULTY OF ENGINEERING, MEMORIAL UNIVERSITY OF NEWFOUNDLAND, ST. JOHN'S, NEWFOUNDLAND, CANADA A1B 3X5

ABSTRACT

In this work the rainfall in Marathawada has been calculated based on rainfall data of last 32 years going back to 1985.The calculations have been performed using two methods - Time Series method and Fast Fourier Transform (FFT) method. The results of these two methods are averaged for better reliability.

The rainfall data is also analyzed in the frequency domain to identify the causes which significantly contribute to the rainfall.

KEYWORDS: Monsoon rain prediction**,** Annual rainfall**,** Rainfall frequency spectrum, Flood control, Hydro-power generation

1 MONSOON RAINS AND THEIR EFFECTS ON AGRICULTURE, WATER AVAILIBILITY IN CITIES AND RURAL AREAS, AND HYDR-POWER GENERATION

In India about 75 to 90% of the annual rainfall takes place in Monsoon season. Since the country has widely different topography and forest distribution, the amounts of rain vary over wide ranges. This rain water is used to fill tanks, ponds, wells and other reservoirs or one can use this water for irrigation through canals. The rain water then flows into the rivers back to the ocean. The water in rivers and reservoirs also charge the underground water table. Many canals are constructed to transfer water to distant lands for agriculture and water supply to municipalities. In north India, a part of water supply comes from melting of glaciers into various rivers.

The farmers of Marathawada have historically suffered from the problem of undependability of rain in crop planting and consequent crop failure. Irrigation using pumps is not as simple because of higher energy costs such as that of Diesel fuel used in pumps

Another factor which is playing havoc in the rainfall is the global warming which has introduced increased uncertainty in preparing for planting crops. This planting period is very sensitive and critical. Crop failure brings extreme hardships to the farmers of Marathawad, and neighboring areas such as Telangana, and Vidarbha; some farmers even even commit suicide due to despair [1-8]

Vidarbha, Telangana, and Marathawada lie in the Central and Southern India as shown in Fig. 1 where their location is away from both the Western Ghats and the Eastern Ghats from where the

monsoon approaches the Indian subcontinent. It rains heavily between the Ghats and the sea but these Ghats act as a barrier for smooth rainfall transition between the coast and inland. There is a steep gradient in rainfall between the coasts and these three areas. To the south of Vidarbha is the Telangana region and on the southwest is the Marathwada region, and all of these regions suffer from droughts from time to time.

The lack of rain causes immense hardships to people in day to day life. Many have to purchase water for drinking and other needs [9, 10}. This also affects hydropower generation [11]. Similarly, such rainfall shortages can affect recharging of groundwater table [12].

From above one can understand that lack of rain can cause immense harm in any country but when it comes to countries with low per capita income - it brings disaster as the options get limited to solve individual's problems.

It is therefore very advantageous if one can have an idea of coming year's rainfall amount. This will help in planning of sowing of the crop in agriculture or storing water in dams etc. Similarly one can plan for relief supplies for drought affected areas. In case of excess rains one can prepare for flood.

In view of above this research is carried out to achieve better accuracy in obtaining the results in advance – about 8 months ahead of time so that one can make appropriate plans. In India, the Indian Meteorological Department (IMD) makes such predictions and there have been others who have carried out research in this field [13-15].

The present method has yielded more accurate results in the past as compared to predictions by others. Similarly, this present method helps in planning of hydro-electric power generation where generation companies can plan ahead. This method's results can be used in planning for dangers of flood. This is because dams have been built on rivers and their tributaries and if there is heavy rain over the catchment area then water from all the dams need to be released from time to time to avoid over-flooding in the dams. The simultaneous release of water from many dams causes flood in areas downstream.

Since predicting amount of rainfall is a complex problem the idea here is to come up with improved models in order to accurately predict quantity of rain as close as the actual rain but within a reasonable tolerance. The global warming has added to the complexity of the problem since the rain pattern has become quite erratic. . It is expected from the researchers to go on improving their models so that the predictions are as close to the actual rainfall values. Such predictions need to be done year after year..

2 ANALYSIS OF HISTORICAL DATA AND PREDICTIONS

One can see the results for months of June to September in Figs 2 to 5 respectively and that of the total values (sum of all these four values) in Fig. 6.

In Fig. 2 we see that the Fast Fourier Transform (FFT) model exactly reproduces the rainfall history since 1985. Here, we also see that the regression analysis (Time Series method) results

show an increasing trend overall. The predictions for 2017 for June by both methods are not very far apart. To predict for 2017 Monsoon season, the prediction is based on the average of these two values which have been arrived at independently. The summary of results is given in Table 1. The details about these two methods can be seen in [16,17].

Fig. 3 shows the rainfall for the month of July. Even here, the FFT method yields very accurate mapping of the actual rainfall. It shows increasing trend in rainfall. In the recent past, the rainfalls have been excessively low. They show wide fluctuations from year to year.

In Fig. 4 we see that the mapping by the FFT method is quite close. However, the two methods arrive at results which are quite apart. The trend is also increasing. We also see that the results of the FFT method quite accurately matches with the actual values.

The rainfall history for September and prediction for this month are shown in Fig. 5. Here, the two methods differ more what than they did in the previous month. Here, the FFT method's values are not as close to the actual rainfall values. The trend is increasing even here.

In Fig. 6, the actual rainfall values of different months were added up as total rain. The results were obtained as before. Again here, the FFT method results almost reproduce the actual rainfall values. The predicted results by two methods are quite far apart.

Fig. 7 is a plot of amplitudes versus frequency numbers. Here, we see that frequency numbers 4,7,10, and 14 have their amplitudes higher than 6 centimeters. All of the amplitudes have been calculated using the Fourier series. This figure shows that higher frequencies are quite significant and they results in rapid variation of rainfall quantity from one year to another.

3. CONCLUSIONS

In this work, at first a brief review of the rainfall in India was carried out. It was seen that lack of rain affects many different aspects of one's life such as droughts, famine, flooding or irrigation including hydro power generation. It was discussed that Marathawada has undergone vast shortages of water supply just last year

Based on this work one can conclude the following:

1. The historical rain data showed that Marathawada has had slight increasing trend in rainfall (Time Series method).

2. The FFT method quite accurately maps the actual rainfall data in most cases even though the rain pattern is quite complicated.

3. The complicated and fast changing rainfall pattern arises due to the presence of higher frequencies.

4. The total rain will be in the normal range within 19% deviation from the mean of the 32 year rainfall history

4. REFERENCES

1 Telangana's Shocking Statistics: 350 Farmer Suicides in Five Months, http://www.ndtv.com/article/south/telangana-s-shocking-statistics-350-farmer-suicides-in-five-months-616371
2 How Telangana Farmer's Suicide Has Changed the World of His Daughter. http://www.ndtv.com/article/south/how-telangana-farmer-s-suicide-has-changed-the-world-of-his-daughter-572462
3 Telangana Government Feels the Heat After Farmers' Suicide, http://www.khaleejtimes.com/kt-article-display1.asp?xfile=data/international/2014/November/international_November605.xml&section=international
4 Farmer's Suicide in Vidarbha : Everybody's Concern , http://medind.nic.in/jaw/t09/i2/jawt09i2piii.pdf
5 Farmers' Suicides in the Vidarbha Region of Maharashtra, India a Qualitative Exploration of Their Causes, http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3291283/
6 Four more Maharashtra farmers commit suicide, http://www.thehindu.com/news/national/four-more-maharashtra-farmers-commit-suicide/article6655587.ec
7 Three Farmers Commit Suicide in Draught-Hit Marathwada Region, http://zeenews.india.com/news/maharashtra/three-farmers-commit-suicide-in-draught-hit-marathwada-region_1508366.html
8 Farmer Suicides Rise in Vidarbha, Marathwada Regions, http://www.livemint.com/Politics/3E31tn7aYlT47QJizq8hWP/Farmer-suicides-rise-in-Vidarbha-Marathwada-regions.html
9 Tamil Nadu Gears up to Tackle Worst Water Shortage in Over 140 Years, http://www.thehindubusinessline.com/news/national/tamil-nadu-gears-up-to-tackle-worst-water-shortage-in-over-140-years/article9595958.ece
10 In Times of Drought: Overuse of Water Behind India's Dry Days , http://www.hindustantimes.com/india/in-times-of-drought-overuse-of-water-behind-india-s-dry-days/story-YiWENI7Cld92qrm0A0uM5L.html
11. The Thirst for Power: Hydroelectricity in a Water Crisis World, http://www.brinknews.com/the-thirst-for-power-hydroelectricity-in-a-water-crisis-world/
12. Groundwater Recharge, https://en.wikipedia.org/wiki/Groundwater_recharge
13 Rainfall Projections, http://www.imdpune.gov.in/endofseasonreport2013.pdf
14 Delsole, T. and Shukla, J., Geophys. Res. Lett., 2012 http://dx.doi.org/10.1029/2012GL051279.
15 Gadgil, S and Srinivasan J. "Monsoon prediction: are dynamical models getting better than statistical models?", J Current Science VOL. 103, NO. 3, 10 August 2012
16 Excel - Time Series Forecasting, http://www.youtube.com/watch?v=gHdYEZA50KE
17 Frequency Domain Using Excel, http://online.sfsu.edu/jtai/downloads/ENGR%20302/Excel.FFT.pdf

TABLE 1: RAIN FORECAST IN CENTIMETERS FOR MARATHAWADA DURING 2017 MONSOON MONTHS

METHOD	YEAR	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL	COMMENTS
TIME SERIES	2017	19.564	27.105	25.631	23.633	95.934	
FAST FOURIER TRANSFORM (FFT)	2017	12.688	17.062	8.659	13.861	52.270	
PREDICTION-AVERAGE OF TIME SERIES AND FFT METHODS	2017	16.126	22.084	17.145	18.747	74.102	NORMAL BUT ABOVE AVERAGE
AVERAGE OF 32 YARS		13.579	19.647	18.310	17.374	68.911	

FIG. 1 LOCATIONS OF MARATHAWADA. VIDARBHA. AND TELANGANA BETWEEN WESTERN AND EASTERN GHATS

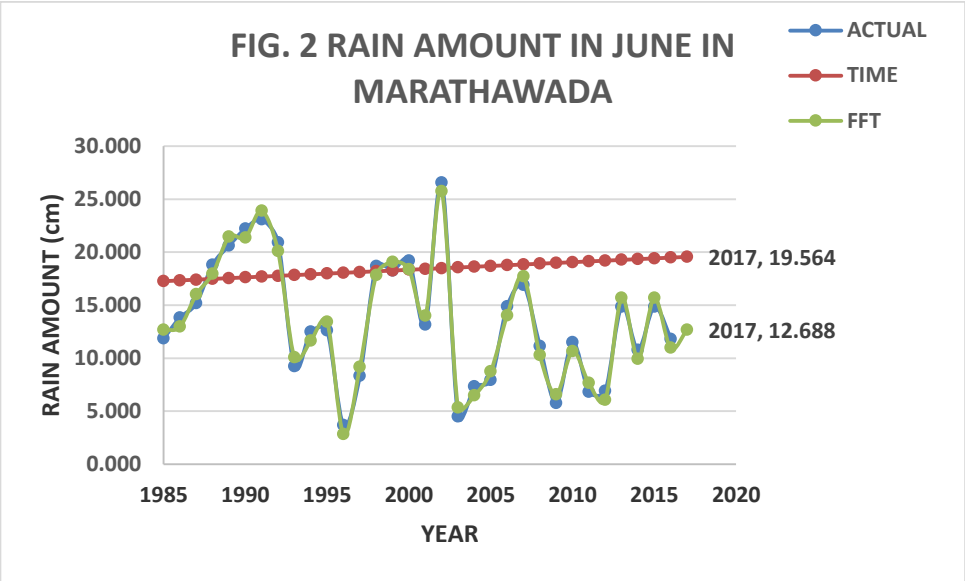
FIG. 2 RAIN AMOUNT IN JUNE IN MARATHAWADA
ACTUAL
TIME
FFT
RAIN AMOUNT (cm)
30.000
25.000
20.000
15.000
10.000
5.000
0.000
1985
1990
1995
2000
2005
2010
2015
2020
YEAR
2017, 19.564
2017, 12.688

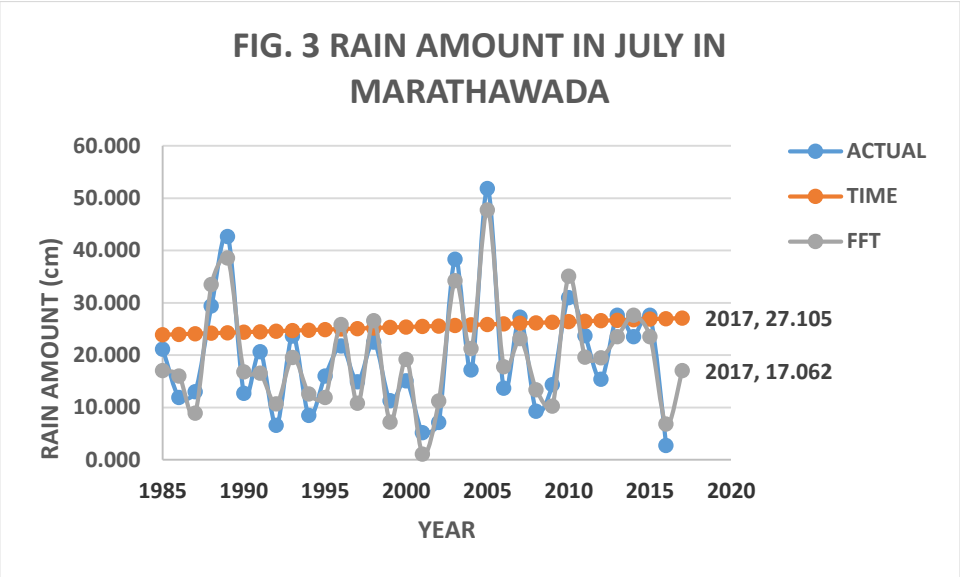
FIG. 3 RAIN AMOUNT IN JULY IN MARATHAWADA
ACTUAL
TIME
FFT
RAIN AMOUNT (cm)
60.000
50.000
40.000
30.000
20.000
10.000
0.000
1985
1990
1995
2000
2005
2010
2015
2020
YEAR
2017, 27.105
2017, 17.062

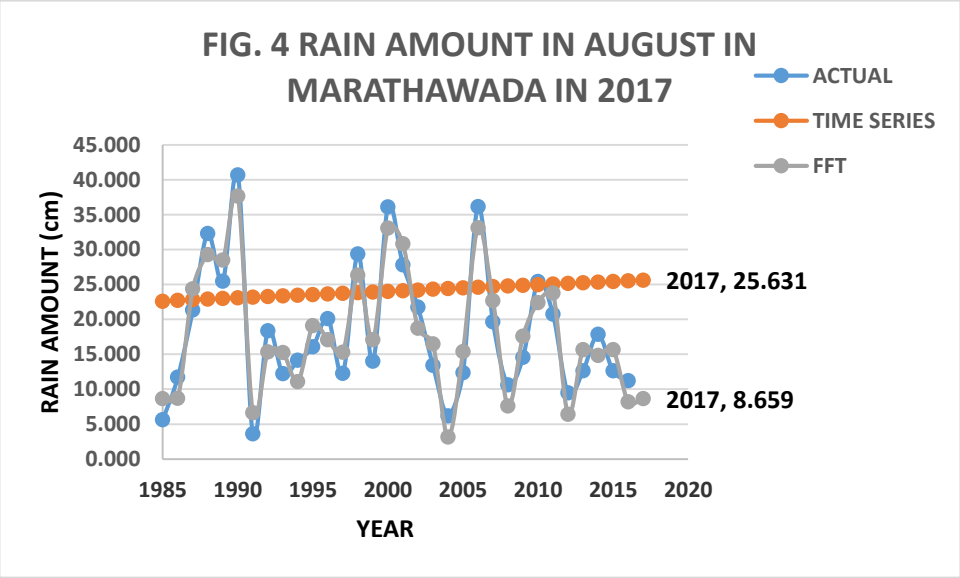
FIG. 4 RAIN AMOUNT IN AUGUST IN MARATHAWADA IN 2017
ACTUAL
TIME SERIES
FFT
RAIN AMOUNT (cm)
45.000
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
1985
1990
1995
2000
2005
2010
2015
2020
YEAR
2017, 25.631
2017, 8.659

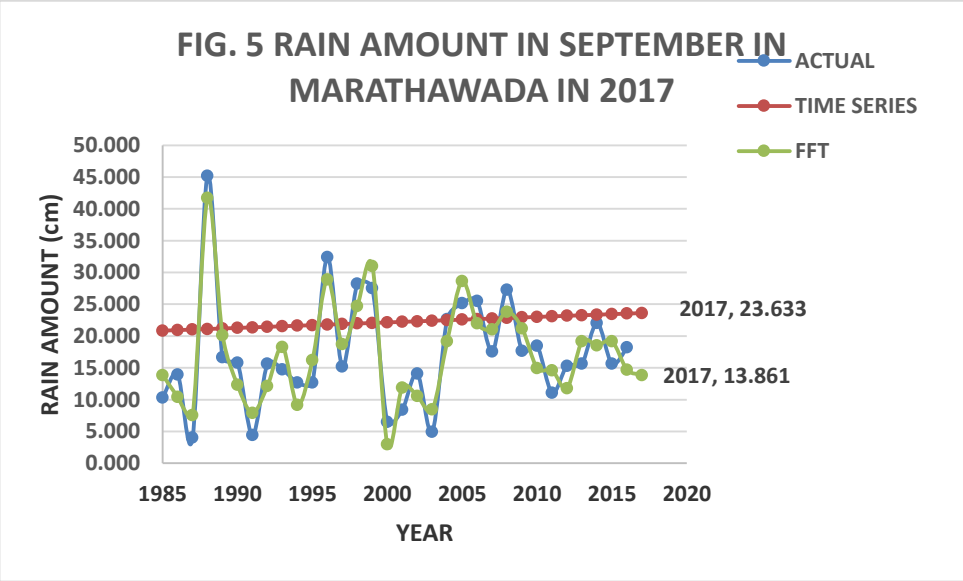
FIG. 5 RAIN AMOUNT IN SEPTEMBER IN MARATHAWADA IN 2017
ACTUAL
TIME SERIES
FFT
RAIN AMOUNT (cm)
50.000
45.000
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
1985
1990
1995
2000
2005
2010
2015
2020
YEAR
2017, 23.633
2017, 13.861

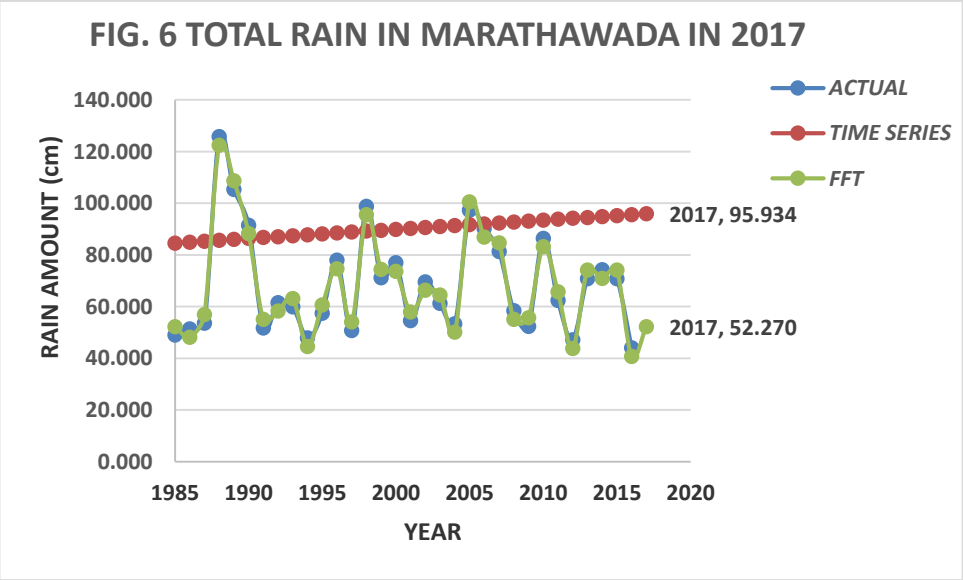
FIG. 6 TOTAL RAIN IN MARATHAWADA IN 2017
ACTUAL
TIME SERIES
FFT
RAIN AMOUNT (cm)
140.000
120.000
100.000
80.000
60.000
40.000
20.000
0.000
1985
1990
1995
2000
2005
2010
2015
2020
YEAR
2017, 95.934
2017, 52.270

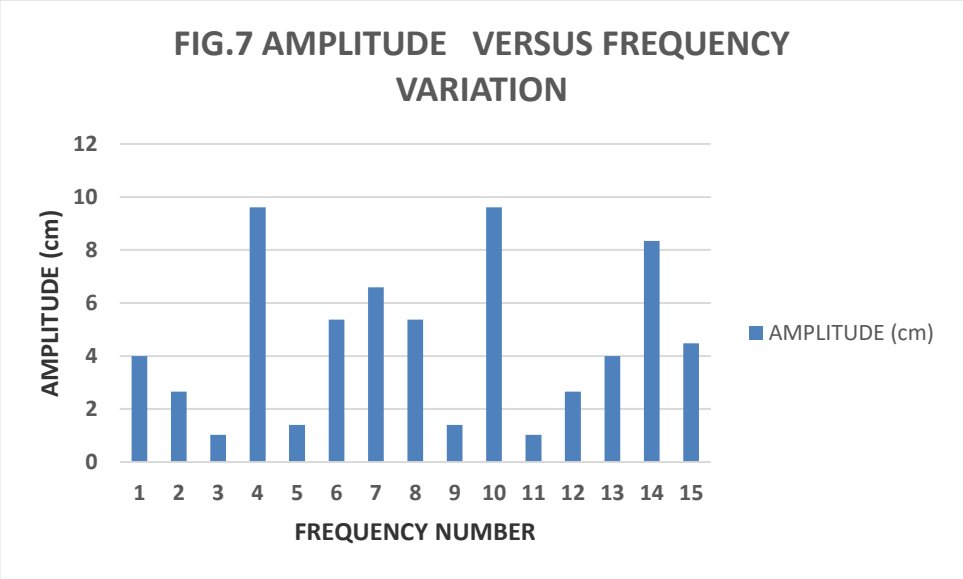
FIG.7 AMPLITUDE VERSUS FREQUENCY VARIATION
AMPLITUDE (cm)
12
10
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
FREQUENCY NUMBER
AMPLITUDE (cm)