WEEKLY SCIENCE

ISSN: 2321-7871
IMPACT FACTOR : 4.4162(UIF)
VOLUME - 5 | ISSUE - 15 | 12 OCTOBER - 2017

CLIMATE CHANGE AND RAINFALL VARIABILITY WITHIN IN GREATER HYDERABAD - A GEOSPATIAL TECHNOLOGICAL APPROACH

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ABSTRACT

Geospatial technologies like GIS, Remote Sensing and Global Positions Systems are essential tools in analyzing climate data and combating climate change. This Geospatial technologies helpsin climate monitoring and modeling. Geospatial technologies not only provide visual proof of the extreme weather conditions, but it also links all kinds of physical, biological and socioeconomic data. Geospatial technologies also helpful to simulate the socio-economic vulnerability of climate change. According to IPCC (Internal Governmental Panel on Climate Change) climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity

climate change also includes natural climate variability. The anthropogenic cause for climate change is mostly an outcome of human activity in urban areas. Cities are extremely vulnerable to climate change impacts as they generate no less than 40% of global Green House Gas (GHG) emissions.

Hyderabad is one of the mega cities of India. The city lies at 17°.36' N latitude and 78°.47' E longitude. Hyderabad city is experiencing more rain fall in less number of days . In this paper an attempted is made to analyze climate change trend of Greater Hyderabad with special reference to rainfall (i.e. from 1951- 2013) using SPSS. The intra-urban variability of rainfall within Grater Hyderabad is also done for the year 2013using GIS.

KEYWORDS- *Climate Change, Rainfall.*

1. INTRODUCTION

Monsoon seasons of the India is greatly effected due climate change and global warming(Kripalani, 2003).The changing pattern of the Monsoon seasons in India not only effect the agriculture productivity but also the life of the urban poor and urban infrastructure.The anthropogenic cause for climate change is mostly an outcome of human activity in urban areas(Sue Grimmond, 2007).Geospatial technologies like GIS, Remote Sensing and Global Positions Systems are essential tools in analyzing climate data and combating climate change. This Geospatial technologies helpsin climate monitoring and modeling. Geospatial technologies not only provide visual proof of the extreme weather conditions, but it also links all kinds of physical, biological and socioeconomic data. Geospatial technologies also helpful to simulate the socio-economic vulnerability of extreme weather events. Cities are extremely vulnerable to climate change impacts as they generate no less than 40% of global Green House Gas (GHG) emissions.

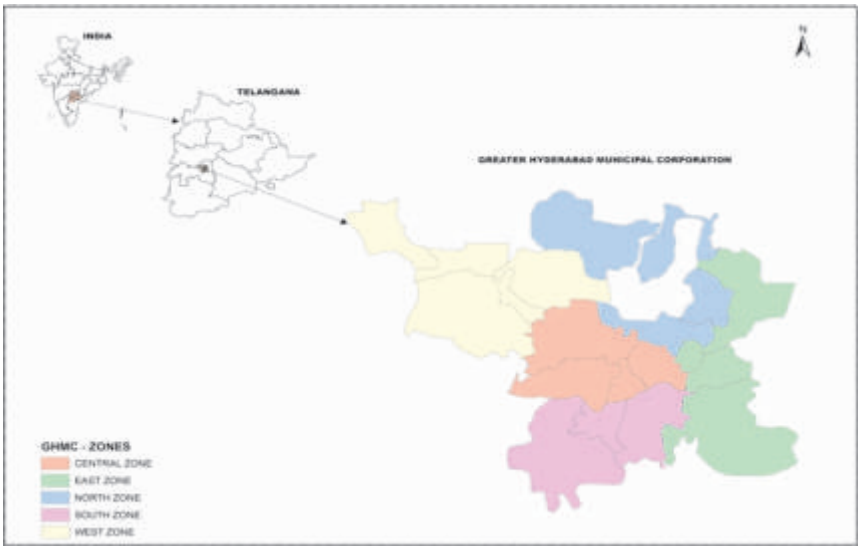
Hyderabad is one of the mega cities of India. The city lies at 17°.36' N latitude and 78°.47' E longitude. A gradual shift in local climate pattern in Hyderabad city experiencing its heaviest rainfall in recent years.In this paper an attempted is made to

analyze climate change trend of Greater Hyderabad with special reference to rainfall (i.e. from 1951- 2013) using SPSS. The intra-urban variability of rainfall within Grater Hyderabad is also done for the year 2013using GIS.

2. STUDY AREA

Hyderabad is one of the mega cities of India. The city lies at 17°.36' N latitude and 78°.47' E longitude (fig.1). April 2007 onwards Hyderabad became Greater Hyderabad Municipal Corporation. City is divided in to five zones (North, South, Central, East, and West) and covering an area of 650 sq.km (GHMC, 2013).

Fig 1



Source: Greater Hyderabad Municipal Corporation

3. MAIN OBJECTIVES

- To study the climate change pattern in Greater Hyderabad with special reference to long term trend of rainfall
- To study the spatial variability (i.e. intra-urban)of rainfall within Greater Hyderabad

3. DATABASE AND METHODOLOGY

The long trend of Climatic variable of rainfall is analyzed from the data obtained from Indian Meteorological Department (IMD) from 1951- 2013 (i.e. 63 years) . To asses the extreme rainfall year are assed based on SPSS analysis .The intra –urban variation of rainfall within the Greater Hyderabad is d done by data obtained from the Automatic Weather Stations (AWS) in the form of point data for the year 2013. Geospatial Technology tool GIS is used to bring out the micro variation in rainfall of Greater Hyderabad.

4. RESULTAND ANALYSIS

4.1 Long Term Trend of Rainfall

A long term analysis of rainfall is carried out for 63 years i.e. from 1951 – 2013. During the time period under consideration, highest rainfall was received during the year 1996 (1387 mm) and 1975 (1383mm) fig2. Lowest rainfall is recorded in the year 1972 which is to the tune of 515 mm. The range of precipitation received is 871 mm which is very much considerable. To analyze long-term extreme rainfall events / years mean and standard deviation values are used. The extreme high rainfall events are associated with $\bar{x} + 2\sigma$ .i.e. 1238.70 mm.

Table 1
STATISTICAL ANALYSIS OF LONG TERM TREND OF RAINFALL

Years	Range (mm)	Minimum (mm)	Maximum(mm)	Mean(mm)	Std. deviation
63	871	516	1387	818.82	209.946

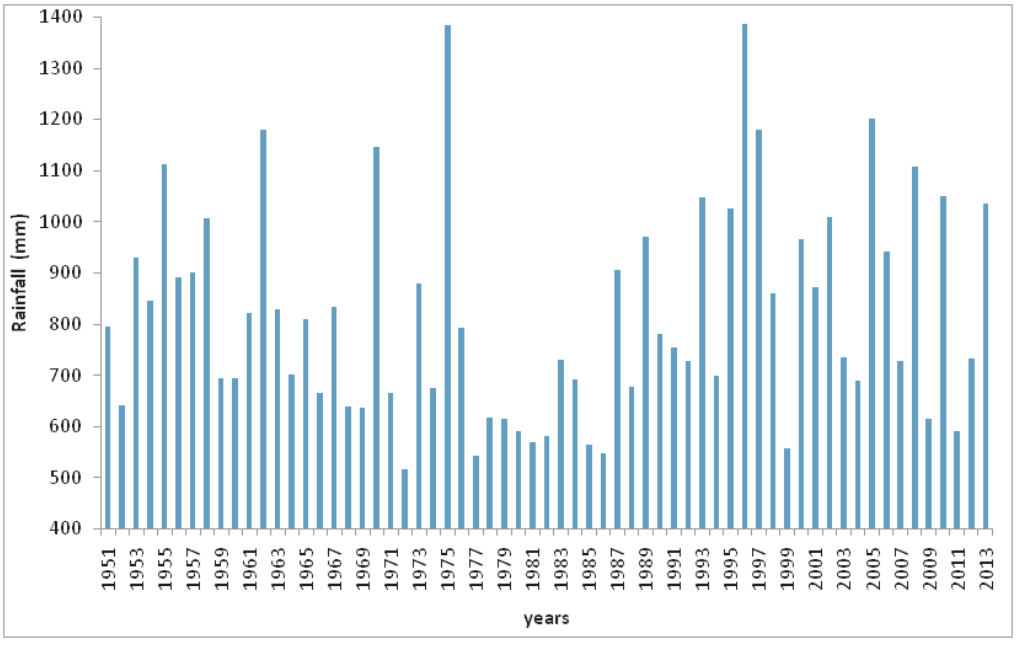
Source : Computed based on IMD data

Table 2
EXTREME RAINFALL YEARS

Years with Highest rainfall	Years with Lowest rainfall
1975 1996	1972 1995 1999

Source : Computed based on IMD data

Fig 2 :LONG TERM DISTRIBUTION OF RAINFALL



Source: Indian Meteorological Department (IMD)

The extreme rainfall years were 1975 and 1996 which received very high rainfall (table 2.). Extreme low rainfall years are associated with $\bar{x}$ - 1σ i.e. 606.8 mm. The years with extreme low rainfall were 1972, 1995, 1999 (table 2). The trend of rainfall has depicted lot of fluctuation (fig 2) . The period between 1980 to 2000 revealed the phase of low rainfall whereas the decade 1991-2000 is associated with phase of high rainfall .

4.2 Annual Rainfall and Annual Rainy Days within Greater Hyderabad

The Rainfall and rainfall data of 26 Automatic Weather Stations within Greater Hyderabad obtained as

shown in table 3. The highest amount of rainfall is recorded in Malkapur and followed by Srinagar Colony. The highest number of rainy days are associated with Jubilihills but it is not recorded the highest rainfall place in Hyderabad (table 3) . The annual rainfall in the study area varies between minimum of 456 mm and maximum of 1099mm .

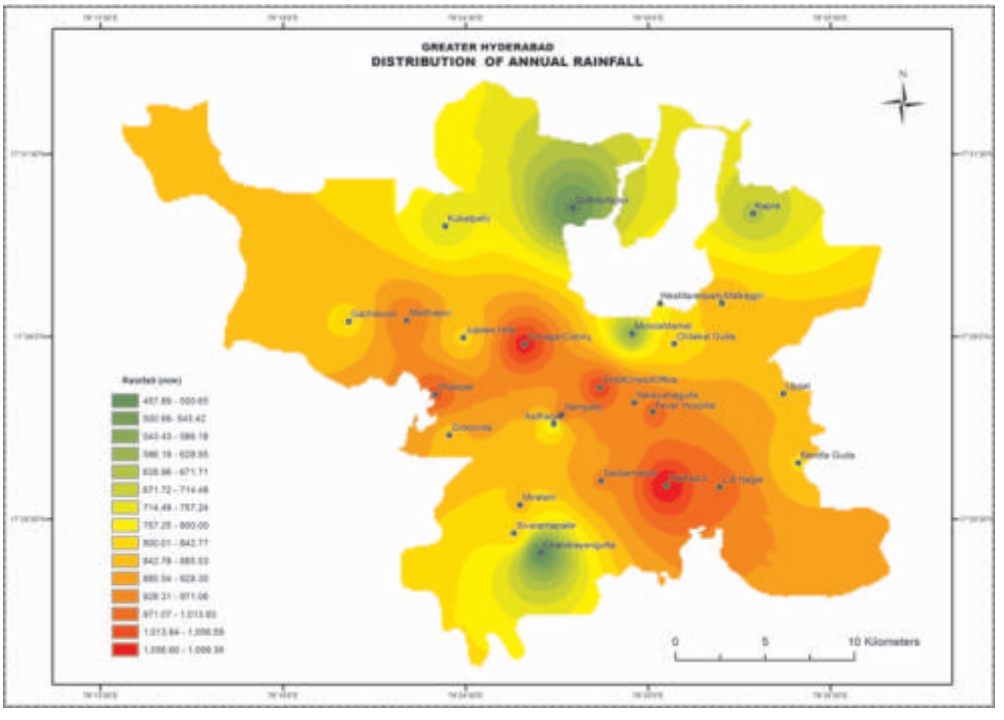
Table 3:Intra Urban – Annual Rainfall And Rainy Days Variability - 2013

Station Name	Rainfall (mm)	Rainy days	Intensity of rainfall / rainy day (mm)
Asifnagar	740.5	44.0	16.8
Bandlaguda	838.8	53	15.8
Chandrayangutta	456.8	32	14.2
Chilkalguda	816.8	48.0	17.0
Fever Hospital	989.8	62.0	15.9
GHMC Head office	1048.8	59.0	17.7
Golconda	871.3	62.0	14.0
Guchibowli	828.8	43.0	19.2
Jubilee Hills	831.8	68.0	12.2
Kapra	664.3	45.0	14.7
Kukatpally	724.8	55.0	13.1
L.B Nagar	985.8	65.0	15.1
Madhapur	970.8	51	19.0
Malkajgiri	880.8	53.0	16.6
Malkapur	1099.5	53.0	20.7
Miralam	852.8	54.0	15.7
Monda Market	599.3	39.0	10.7
Nampally	988.3	56	17.6
Narayanguda	949.8	58.0	16.3
Quthbullapur	489.5	48.0	10.1
Sardarmahal	932.8	53.0	17.6
Shaikpet	1023.0	55	18.6
Shivarampally	837.8	51.0	16.4
Srinagar colony	1076.3	61.0	17.6
Uppal	882.0	52.0	16.9
West Maredpally	799.6	56	14.2

Source: AWS data - 2013

The intra-urban variation in rainfall within the study area is 642mm which is very high compared to any standards. Malkapur in the south eastern part, recorded highest rainfall whereas Chandrayangutta in the south recorded minimum rainfall.The spatial distribution of rainfall in the city, reveals highly uneven distribution The locations which recorded low rainfall, are distributed in two major areas. One, in the northern part of Greater Hyderabad covering Kukatpally , Quthbullapur and Kapra (fig 3).They are mostly in the form of low rainfall islands. The second major low rainfall area, centers around Chandrayangutta. High rainfall area runs through the central part of the city and extends in a south- east to north- west direction in an elongated axis ,covering mostly the dense built up compact area.

Fig 3

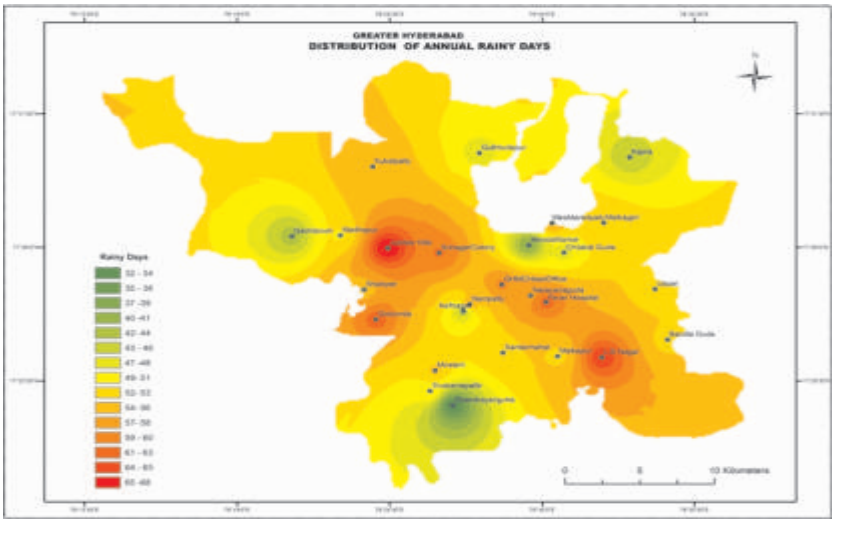


Source: Interpolated based on AWS data – 2013

It is core of the city with locations like Srinagar colony, GHMC Head office, Fever Hospital which receives higher rainfall. On the whole, it is seen that the central part of the city received higher rainfall than the peripheral locations.

Annual rainy days is presented in the table 3. The intra urban rainy days depicted a large variations. The lowest rainy days around 30-35 days per annum is mostly recorded in the peripheral locations like Gachibowli, Chandrayangutta and Kapra (fig 4). The core of the city also registered low rainy days around Mondamarket, Chilkalguda and Asifnagar. Higher rainy days are recorded in the western portion around Jubilee Hills, Srinagar colony, Golconda and in the south eastern part, it is concentrated around L.B.Nagar. Central part of the city also recorded more number of rainy days. Most of the parts of city recorded rainy days between 45 -55 days.

Fig 4



Source : Interpolated based on AWS data – 2013

The intra- urban spatial distribution analysis of rainfall and rainy days has highlighted that there are marked variations within the city. The table 3, shows the intensity of rainfalli.erainfall per rainy day .The intra urban intensity of rainfall has shown considerable intra urban variations. The intensity of rainfall varies between 12.3 mm per rainy day to 19.25 mm per rainy day.

The spatial pattern of intensity of rainfall revealed that, the peripheral locations like Kukatpally, Quthbullapur, Kapra, Chandrayangutta, Golconda have recorded low intensity of rainfall. There are locations in the western part, which recorded exceptionally high intensity of rainfall like Gachibowli, Shaikpet and Madhapur. These locations recorded intensity of rainfall between 18 to 19 mm per rainy day. The central part of the city registered high intensity of rainfall which varies between 15 to 17 mm / rainy day

5. CONCLUSION

The long term trend of rainfall revealed that, the period between 1980 to 2000 revealed the phase of low rainfall whereas the decade 1991-2000 is associated with phase of high rainfall. The intra-urban variability of annual rainfall within Hyderabad varies between minimum of 456 mm and maximum of 1099 mm . On the whole, it is seen that the central part of the city received higher rainfall than the peripheral locations.The spatial pattern of intensity of rainfall revealed that, the peripheral locations like Kukatpally, Quthbullapur, Kapra, Chandrayangutta, Golconda have recorded low intensity of rainfall. The analysis has clearly brought out the finer spatial variations of rainfall with the help of one of the Geospatial technological tool i.e. GIS.

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