Extreme Precipitation Analysis over New York Metropolitan Area

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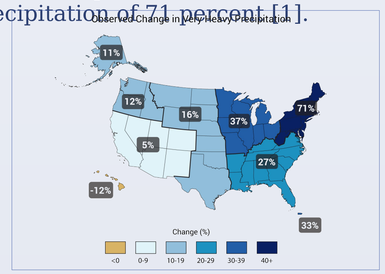
ABSTRACT

Our research project concentrates on the investigation of rainfall patterns within the New York Metropolitan area. In this regard, the rain gauge data from the National Climatic Data Center (NCDC) is employed to examine extreme and average precipitation of the study area as well as generate probability distributions of max/average rainfall intensities. Upon calculation and figuring out the average precipitation, we will create a graph, which will help find the pattern of our data. This is important because we can use the graph to predict future data precipitation within the region. The point precipitation data from rain gauges will be compared with radar data at the same locations and time.

INTRODUCTION

Every single year there is at least one extreme rainfall event within the Metropolitan Area. According to the Global Change website, the Northeast region of the U.S. which includes most of the Metropolitan Area has a heavy precipitation of 71 percent [1].

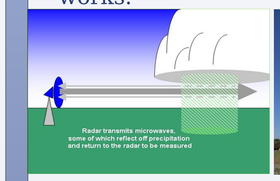


The results of the heavy precipitation can be seen through extreme rainfall events such as: Hurricane Irene in 2011, heavy rainfall that left Binghamton with 7.49 inches of rain on September 8, 2011 [2], as well as Hurricane Sandy which left part of the Metropolitan region with flooding, power outages and deep recovering. For our project, we collected data through the National Climatic Data Center website. We used rain gauge data, indicating the direct measurements of rainfall, and radar data which indicates measurements and sends waves. In addition, we used weather radar data which is a type of radar used to locate precipitation and calculate its motion.

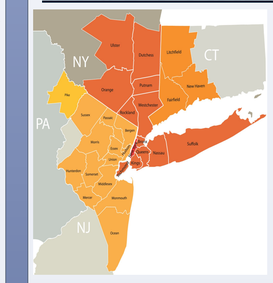
How Radar Works

Radar (Radio Detection And Ranging) emits beams (pulses) of microwave energy from a transmitter into the atmosphere. When these beams collide with objects in the atmosphere some of the energy bounces back towards the

This is an image of radar and how radar works.



STUDY AREA



The New York Metropolitan Area was selected as the study area which is approximately 30,000 Km^2 and compromises of a population of 23,484,252.

METHODS

We started our project by ordering hourly rainfall data through the National Climatic Data Center. Data were collected within the designated latitude of 39 N to 43 N and longitude of 76W to 68W resulting in a selection of about 3[illegible] stations.

We went on to select data that has records from 1948 to 2013. Once the data ordered were collected, we downloaded it from our email and transferred it to Microsoft Excel.

After transferring it to Excel, we made sure to check that all the stations were in place such as “New York Central Park Observation Towers”. Then we created a separate Excel file in order to separate the years and the date, so that the file would run smoothly with the Matlab cod[illegible]eated.

After creating the file, we used a Matlab code in order to develop annual means and maximums of each station from 1948 to 2013.

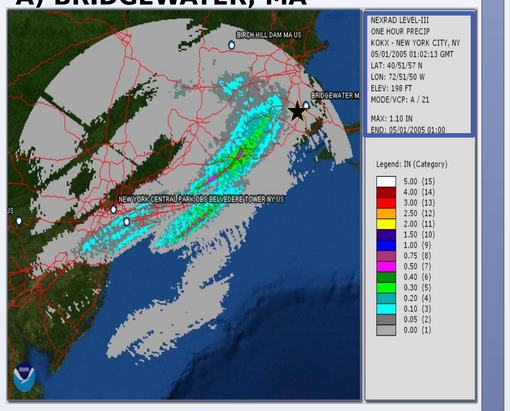
Upon receiving our mean and maximum from Matlab, we chose five significant stations which had 20 or more years of data. Then we transferred the results to Excel and eventually created a bar graph representing both maximum and average rainfall.

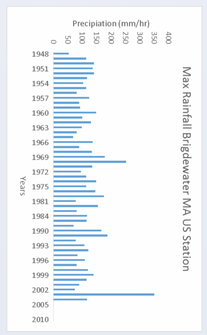
Site Name	Latitude	Longitude
Birch Hill Dam	42.63333	-72.1167
JFK	40.65	-73.7833
Bridgewater	42.63333	-72.1167
Central Park	40.78333	-73.9667
Allentown Lehigh Valley	40.65	-75.4333

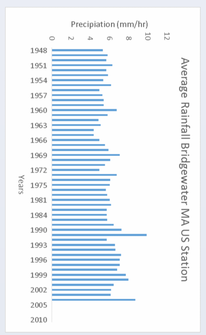
Then we used “NOAA Weather and Climate Toolkit” software to read the radar data. For each of those significant stations, that max rainfall date is selected and the precipitation map is generated.

RESULTS

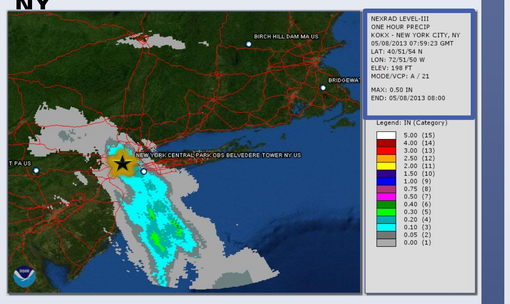
A) BRIDGEWATER, MA

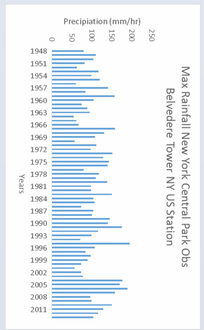


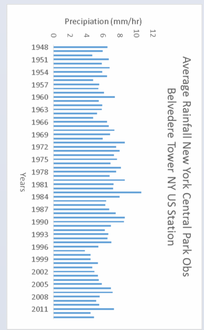




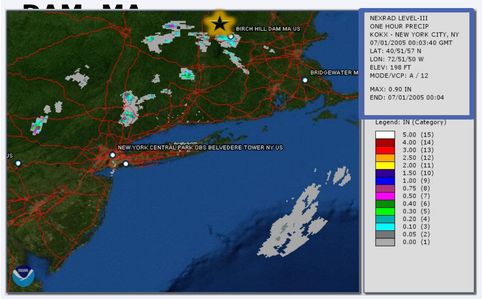
B) CENTRAL PARK, NY

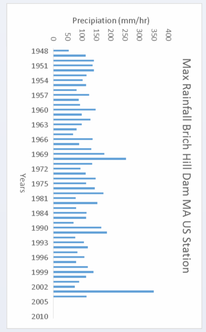


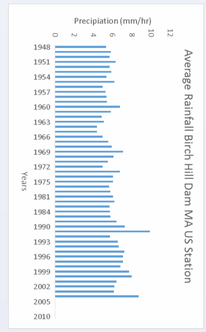




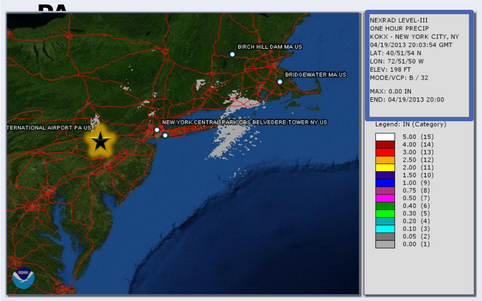
C) BIRCH HILL DAM, MA

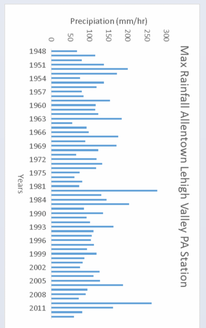


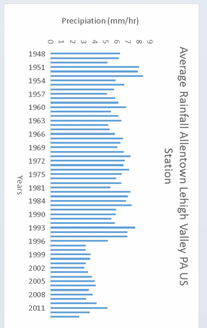




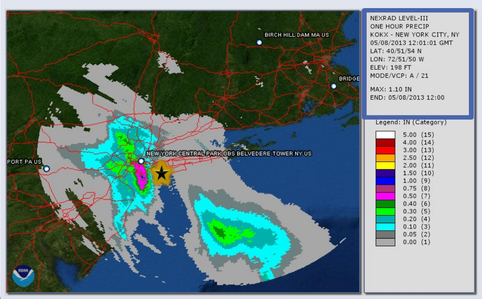
D) ALLENTOWN LEHIGH VALLEY PA

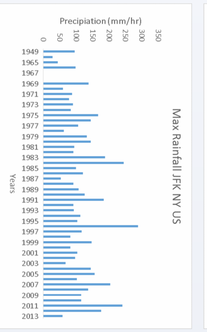


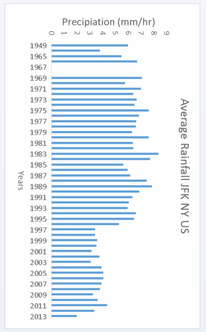




E) JFK, NY







A. The maximum rainfall for the Bridgewater station is around 50 to 350 mm,with an average rainfall of 4 to 8 mm per hour.
B. The maximum rainfall for the Central Park station is around 50 to 150 mm, with an average rainfall of 4 to 10 mm per hour.
C. The maximum rainfall for the Birch Hill Dam station is around 50 to 250 mm, with an average rainfall of 5 to 6 mm per hour.
D. The maximum rainfall for Allentown station is around 50 to 250 mm, with an average rainfall of 3 to 8 mm per hour.
E. The maximum rainfall for the JFK Station is around 25 to 250 mm, with an average rainfall of 2 to 7 mm per hour.

CONCLUSION

- All five stations have more than 20 years of data, however most of them are missing a couple of other years.
- For all five stations, the maximum rainfall fluctuates and there seem to be no consistent pattern.
- Looking at both the maximum and average rainfall graphs of all five stations, it shows that the precipitation varies. As a result, future rainfall events will also be fluctuate.
- Comparing rain gauge records with radar data shows that the storm has moved from the stations that we are looking at. It may be because of a difference in time zone (EDT & GMT). However, we have storms in the areas close to the stations with the value close to the rain gauge records, which can be considered as the validation of those records.
- I observed that the rainfall measurements from our radar data were slightly less than the rainfall measurements from our rain gauge data.

REFERENCES

[1] nca2014.globalchange.gov
[2] thinkprogress.org/climat

★ This star represents the location of the main station’s radar.

Acknowledgement

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- I’d like to thank my mentor Ali Hamidi for always be there when I had questions and taking his time to make sure I understood whatever I was doing. As well, Dr. Zahraei for helping our group every step of the way. Last but not least, Dr.Emiko, Dr. Shakila, and Dr. Khanbilvardi for making sure that my peers and I had a wonderful time this summer.

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