LONG-TERM CHANGES AND INFLUENCES OF CLIMATE VARIABILITY ON RAINFALL EXTREMES OF DIFFERENT DURATIONS

by

Wilord Metellus

A Thesis Submitted to the Faculty of

The College of Engineering and Computer Science

In Partial Fulfillment of the Requirements for the Degree of

Master of Science

Florida Atlantic University

Boca Raton, Florida

December 2016

LONG-TERM CHANGES AND INFLUENCES OF CLIMATE

VARIABILITY ON RAINFALL EXTREMES OF DIFFERENT DURATIONS

by

Wilord Metellus

This thesis was prepared under the direction of the candidate's thesis advisor, Dr. Ramesh Teegavarapu, Department of Civil, Environmental and Geomatics Engineering, and has been approved by the members of his supervisory committee. It was submitted to the faculty of the College of Engineering and Computer Science and was accepted in partial fulfillment of the requirements for the degree of Master of Science.

SUPERVISORY COMMITTEE:

Ramesh Teegavarapu, Ph.D., P.E.
Thesis Advisor

Evangelos I. Kaisar, Ph.D.

Yan Yong, Ph.D.
Chair, Department of Civil, Environmental and Geomatics Engineering

Panagiotis D. Scarlatos, Ph.D.

Mohammad Dyas, Ph.D.
Dean, College of Engineering and Computer Science

Deborah Floyd, Ed.D.
Dean, Graduate College

December 6, 2016
Date

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to the committee members for their guidance; and special thanks to my advisor, Dr. Ramesh Teegavarapu, for all his support, persistence, patience and encouragement during the course of this study. I also appreciate the support and contribution that my former supervisor, Francis Lewis, provided during the writing of this manuscript; my family and I will be forever grateful for your assistance. Lastly yet importantly, I would wholeheartedly like to thank all those who challenged or encouraged me to reach for my highest potential.

ABSTRACT

Author:	Wilord Metellus
Title:	Influences of Climate variability on Rainfall Extremes of Different Durations
Institution:	Florida Atlantic University
Thesis Advisor:	Dr. Ramesh Teegavarapu
Degree:	Master of Science
Year:	2016

The concept of Intensity Duration Frequency (IDF) relationship curve presents crucial design contribution for several decades under the assumption of a stationary climate, the frequency and intensity of extreme rainfall nonetheless seemingly increase worldwide. Based on the research conducted in recent years, the greatest increases are likely to occur in short-duration storms lasting less than a day, potentially leading to an increase in the magnitude and frequency of flash floods. The trend analysis of the precipitation influencing the climate variability and extreme rainfall in the state of Florida is conducted in this study. Since these local changes are potentially or directly related to the surrounding oceanic-atmospheric oscillations, the following oscillations are analyzed or highlighted in this study: Atlantic Multi-Decadal Oscillation (AMO), El Niño Southern Oscillation (ENSO), and Pacific Decadal Oscillations (PDO).

Collected throughout the state of Florida, the precipitation data from rainfall gages are grouped and analyzed based on type of duration such as short-term duration or minute, in hourly and in daily period. To assess statistical associations based on the ranks of the data, the non-parametric tests Kendall's tau and Spearman's rho correlation coefficient are used to determine the orientation of the trend and ultimately utilize the testing results to determine the statistical significance of the analyzed data. The outcome of the latter confirms with confidence whether there is an increasing or decreasing trend in precipitation depth in the State of Florida. The main emphasis is on the influence of rainfall extremes of short-term duration over a period of about 50 years. Results from both Spearman and Mann-Kendall tests show that the greatest percentage of increase occurs during the short rainfall duration period. The result highlights a tendency of increasing trends in three different regions, two of which are more into the central and peninsula region of Florida and one in the continental region. Given its topography and the nature of its water surface such as the everglades and the Lake Okeechobee, Florida experience a wide range of weather patterns resulting in frequent flooding during wet season and drought in the dry season.

DEDICATION

This manuscript is dedicated to my whole friends and family, particularly to my late mother and my beloved father, Perilia and Onelien Francois, who shaped my beliefs and carried me upon their shoulders to see and savor what they would never comprehend. The remarkable support and courtesy that my dear wife, Jourdine Celin-Metellus, along with my two wonderful children, Meagan D. Metellus and Wilord F. J. Metellus (Jayden), afforded me during this journey enhanced my faith into believing that we have done well to endure any troubles. - Phil 4:14

LONG-TERM CHANGES AND INFLUENCES OF CLIMATE VARIABILITY ON RAINFALL EXTREMES OF DIFFERENT DURATIONS

List of Tables

List of Figures

List of Acronyms

AMO	Atlantic Multidecedal Oscillation
AOML	Atlantic Oceanographic and Meteorological Laboratory
COADS	Comprehensive Ocean-Atmosphere Data Set
ENSO	El Niño-Southern Oscillation
ESRL	Earth System Research Laboratory
FDEP	Florida Department of Environmental Protection
GIS	Geographical Information System
IDF	Intensity Duration Frequency
IDWM	Inverse Distance Weighting Method
MEI	Multivariate ENSO Index
NAO	North Atlantic Oscillation
NASA	National Aeronautics and Spacial Administration
NASA GISS	NASA Goddard Institute for Space Studies
NCDC	National Climatic Data Center
NCEP	National Centers for Environmental Prediction
NEB	Northeast Brazil
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resources Conservation System
NWFWMD	Northwest Florida Water Management District

NWS	National Weather Service
ONI	Oceanic Niño Index
PDO	Pacific Decadal Oscillations
SFWMD	South Florida Water Management District
SJRWMD	St. Johns River Water Management District
SOI	Southern Oscillation Index
SRWMD	Suwannee River Water Management District
SST	Sea Surface Temperature
SWFWMD	Southwest Florida Water Management District
WMO	World Meteorological Organization

1. INTRODUCTION

1.1 Background and Scope

The concept of Intensity Duration Frequency (IDF) relationship curve presents crucial design information for several decades under the assumption of a stationary climate. The increase of design of new developments in urban areas, of stormwater systems and flooding concerns bring forth the necessity for distinctive precipitation-frequency duration data. Out of all the potential threats posed by climatic variability and change, those associated with water resources are the most consequential for both society and the environment (Lins et al., 2010). Nowadays, short-duration data becomes a scarce for new developments such as communities offering residences and shopping center parking lots with short time of concentration. In accordance with the National Oceanic and Atmospheric Administration (NOAA), the data used for short-duration rainfall analysis in this study are the largest annual precipitation for 15-, 30- and 45-minute durations. Changes in temperatures undoubtedly alter the precipitation cycles (Scafeta, 2010) and because of the direct relation of precipitation-frequency with human design, it is desirable to investigate the variation in the rainfall intensity-frequency routine. Understanding changes in the distribution, quantity and quality of, and demand for water in response to climate variability and change is essential to planning for and adapting to future climatic conditions (Lins et al., 2010).

1.2 Study Domain

This study investigates the change and variability in precipitation extreme for a period of over 100 years in the State of Florida, the study domain. Florida lies between the latitudes of 24° 27′ N to 31° 00' N and the longitudes of 80° 02′ W to 87° 38′ W. Bordering Alabama to the northwest and Georgia to the north, most of the state is located on a peninsula bounded on the east by the Atlantic Ocean, on the west by the Gulf of Mexico, and the Straits of Florida also called the New Bahama Channel and the Gulf of Florida, connect the Gulf of Mexico with the Atlantic Ocean and separate Florida from Cuba (Hanna, 2003). Located between the latitudes of 24° 27′ N to 31° 00' N and the longitudes of 80° 02′ W to 87° 38′ W, Florida shares its Stateline boundary with the states of Alabama and Georgia.

Britton Hill, located just south of the Alabama border, at 105 meters (345 feet) above the mean sea level it is the highest point in Florida and the lowest highpoint in any U.S. state (Johnson, 2008). Much of the state south of Orlando is low-lying and fairly leveled; however, some places, such as Clearwater, feature vistas that rise 15 – 30 m (50 to 100 feet) above the water. Much of Florida, including many populated areas such as Miami that are located on the coast, has an elevation of less than 3.7 meters (12 feet). Miami and other parts of south Florida are the most vulnerable regions in the world to rising sea levels associated with climate change (Hanna, 2003).

Through the five water management districts shown in Figure 1, the Florida Department of Environmental Protection (FDEP) is actively involved in the management of the water resources in the state of Florida (Harper and Baker, 2007) - South Florida Water Management District (SFWMD), St. Johns River Water Management District

(SJRWMD), Southwest Florida Water Management District (SWFWMD), Suwannee River Water Management District (SRWMD), and Northwest Florida Water Management District (NWFWMD).

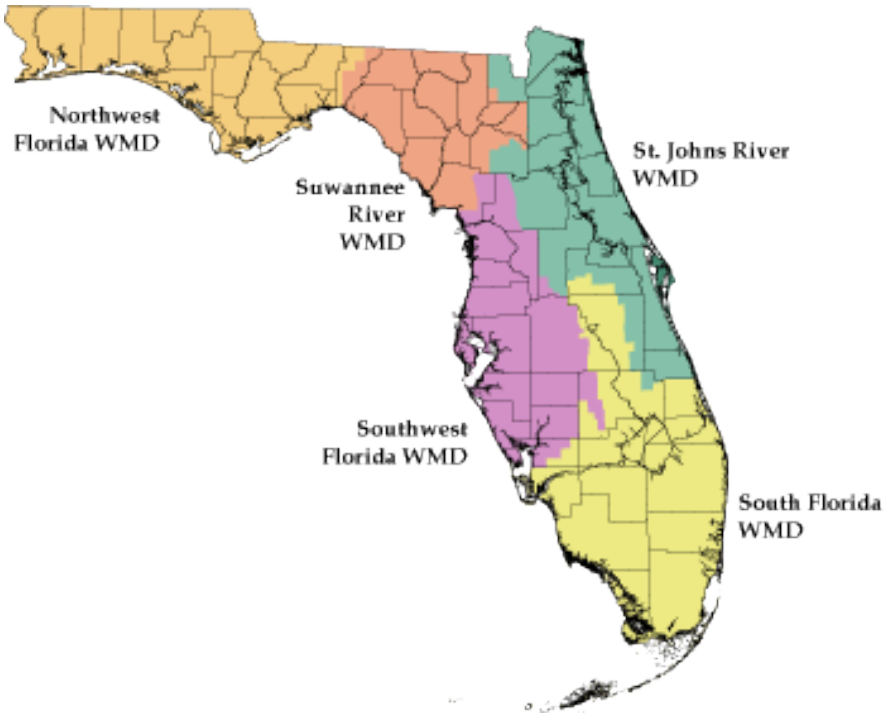


Figure 1 Florida Water Management District Map (FDEP, 2014)

1.3 Influences of Oscillations

Through teleconnection, the effects of the various oscillations can be felt worldwide. A teleconnection is a strong statistical relationship between weather in different parts of the globe. Pressure, circulation, and temperature anomalies occur thousands of kilometers away from each other, yet they are related; one such example of a teleconnection is the link between sea surface temperature (SST) and weather in other parts of the globe. (Bobsein, 2015). Understanding the effects and nature of various oscillations will help communities and land and resource managers understand local and regional implications, anticipate effects, and prepare for changes (USGS, 2007).

1.3.1 Climate Oscillations

This study mainly focuses on the influences of two oceanic-atmospheric modes of variability: The Atlantic Multidecadal Oscillation (AMO) and El Niño-Southern Oscillation (ENSO). Generally, the climate oscillations occur in two phases: a warm also known as positive phases and a cool phase or negative phase; however, during El Niño-Southern Oscillation, though it is a single climate phenomenon, there are three phases: El Niño phase also known as the warm phase, La Niña phase or the cool phase, and the ENSO-neutral phase that refers to the period that coincides with the transition between El Niño and La Niña events (NOAA, 2016).

1.3.2 Telecommunication Influencing Florida

Two major oscillations influence the weather conditions in Florida: AMO and ENSO. The Atlantic Multidecadal Oscillation (AMO) is a multi-decadal oscillation that affects the sea surface temperature of the Atlantic Ocean based on different climate patterns and identifiable characteristics on multi-decadal timescales. AMO oscillation between the warm and the cool phases may last 20 to 40 years at a time and a difference of about 1.5°C between extremes (Gittinger, 2015). According to Atlantic Oceanographic and Meteorological Laboratory (AOLM), recent research suggests that the AMO is related to the past occurrence of major droughts in the Midwest and the Southwest. When the AMO is in its warm phase, these droughts tend to be more frequent and/or severe (Vice-versa for negative AMO). Two of the most severe droughts of the 20th century occurred during the positive AMO between 1925 and 1965: The Dustbowl of the 1930s and the 1950s drought. Florida and the Pacific Northwest tend to be the opposite thus

warm AMO stimulates more rainfall (NOAA, 2005). Another oscillation that influences weather conditions in Florida is El Niño Southern Oscillation (ENSO).

ENSO oscillation between El Niño and La Niña phases contains 2 to 4 years cycle and a difference of about 4°C between extremes (Gittinger, 2015). In NOAA operational definitions for El Niño and La Niña, El Niño is characterized by a positive Oceanic Niño index (ONI) greater than or equal to +0.5°C whereas La Niña is characterized by a negative ONI less than or equal to -0.5°C. By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-months seasons (NOAA, 2016).

1.4 Problem Statement

The extent and bulk of climate research in the state of Florida have grown rapidly with the increase of design of new developments in urban areas, the necessity to design effective stormwater management systems, and the need to address its flooding concerns. Given its location, orientation, and unique climate, Florida is vulnerable to tropical storms and hurricanes, which can cause floods, and pose danger to the residents of the densely populated coastal areas (Pierce 2015). Bordering Alabama and Georgia to the north, most of the state is located on a peninsula bounded by the Atlantic Ocean on the east, the Gulf of Mexico on the west, and by the Straits of Florida, connect the Gulf of Mexico with the Atlantic Ocean and separate Florida from Cuba (Hanna, 2003). The impact of the oscillations varies in different regions of Florida; therefore, detailed spatial analysis of precipitation extremes and characteristics is needed to determine whether certain areas are more susceptible to flood or drought conditions under different phases of the oscillations (Pierce, 2015).

1.5 Main Objectives

Two main tasks are performed in this study: trend analysis of the precipitation in the last 100 years, and the variation in two different phases (El Niño and La Niña). This thesis analyzes the influences of climate variability on rainfall extremes of different durations in Florida. Precipitation extremes of minute, hour, and day precipitation depth are analyzed during a period of about 100 years. Two non-parametric tests, Mann-Kendall and Spearman's rho, are used to evaluate the statistical significance of the change in the rainfall precipitation depth of each rainfall gage dispersed throughout the State. The main objectives are:

- Collect and organize precipitation data from National Oceanic and Atmospheric (NOAA)
- Assess the changes in precipitation regime for potential increase or decrease rainfall for each period.
- Apply two non-parametric statistical tests to ascertain statistically significant changes in extremes precipitation during short-duration, hourly, and daily durations.
- Evaluate the changes recorded throughout the state to understand increasing or decreasing trend over the last century.
- Utilize spatial interpolation techniques, through GIS, to explore the characteristics between the phases of oscillations.
- Assess the influence of oscillations on precipitation variations.

1.6 Thesis Organization

The thesis is organized as follows:

Chapter 1 introduces the study domain and the influence of climate oscillations on the study domain. It also discusses the main objectives of the study and the necessity for distinctive precipitation-frequency duration data.

Chapter 2 discusses methods and results analysis of short-term duration rainfall design from similar studies. It also presents a literature review of the main oscillations (AMO, PDO, ENSO) that impact rainfall precipitation in the state of Florida.

Chapter 3 outlines the methodology used to evaluate the precipitation extreme and the non-parametric statistical tests to ascertain significant changes.

Chapter 4: The methodology highlights in the previous chapter is applied in this study for short-duration, hourly, and daily rainfall durations.

Chapter 5: The results of the thesis are analyzed and presented

Chapter 6: This chapter concludes the study along with contributions, identifies limitations associated with this study, and ultimately presents recommendations for further research.

2 LITERATURE REVIEW

2.1 Derivation of short-duration design rainfalls

Long period of recorded rainfall data is necessary to address the need of developing unbiased and effective design rainfalls. Historical daily rainfall data are largely accessible; however, short-duration rainfall data remain scarce (Haddad et al., 2013). To approach the stormwater management design challenges facing several urban applications, the design for short-duration rainfalls are crucial. This study analyzed a simplified approach to acquire design rainfalls of short-duration data from daily rainfall data and physio-climate characteristic classification.

2.2 Short-Duration-Rainfall Intensity Equations for Drainage Design

By using rainfalls intensity-duration equations that can be used for most locations in the United States (Hanson, 2012), in this analysis the author presents a valuable set of short-durations with return period and durations of 5-, 10-, 20-, 30-, and 60-min. The intensity of rainfall varies significantly with a storm and the geographic locations, and generally, the National Resources Conservation Service (NRCS) developed four 24-hour rainfall distributions (Distribution I, IA, II, III) to be used in different regions within the United States – with type IA as the least intense and type II the most intense short-duration rainfall (Pazwash, 2011) - and the author in this study is commended on developing a method that can generate rainfall intensity-duration equations throughout the country.

2.3 Future changes to the intensity and frequency of short-duration extreme rainfall

It is evident that the frequency and intensity of extreme rainfall is increasing worldwide. Based on the research conducted in recent years, short-duration storms are likely to increase considerably and they will potentially increase the amount and frequency of flash floods (Westra, et al. 2014). Noticeable long-term trends have been observed in precipitation magnitude in certain areas; these drifts generally exhibit large natural changes, and El Niño and changes in atmospheric circulation patterns such as the North Atlantic Oscillation have a substantial influence (Durkee et Al., 2007) on the short-duration rainfalls.

2.4 Influences of Decadal and Multidecadal Oscillation on Regional Precipitation Extremes and Characteristics

The precipitation in the state of Florida is influenced by three major teleconnections known as the North Atlantic Oscillation (NAO), the Atlantic Multidecadal Oscillation (AMO), and the Pacific Decadal Oscillation (PDO). Both the Atlantic Multidecadal Oscillation and the Pacific Decadal Oscillation are multi-decadal with intervals as long as 25 and 27 years respectively whereas the North Atlantic North Oscillation is a quasi-decadal oscillation containing short interval ranging from 2 to 4 years even though both cool and warm periods contain 21 years long intervals (Pierce 2013).

2.4.1 Sea surface temperature (SST)

The temperature of the water at the ocean surface has an important physical trait that varies predominantly with latitude; the warmest SST is generally located near the equator and the coldest in the Arctic and Antarctic areas. When the ocean absorbs more heat, SST will increase and the ocean circulation patterns that transport warm and cold water around the globe will change. Undoubtedly, the ocean continuously interacts with the atmosphere, and as a result, the sea surface temperature has profound influences on global climate. An increase in sea surface temperature unequivocally leads to an increase in the amount of atmospheric water vapor over the ocean. This water vapor feeds weather systems that produce precipitation, thus increasing the risk of heavy rain and snow. Moreover, the variation in SST can also shift storm tracks, potentially contributing to droughts in some areas (EPA, 2015).

The sea surface temperature increased over the 20th century and continues to rise. As shown in Figure 2, from 1910 through 2014, temperatures rose at an average rate of 0.13°F per decade (EPA, 2015).

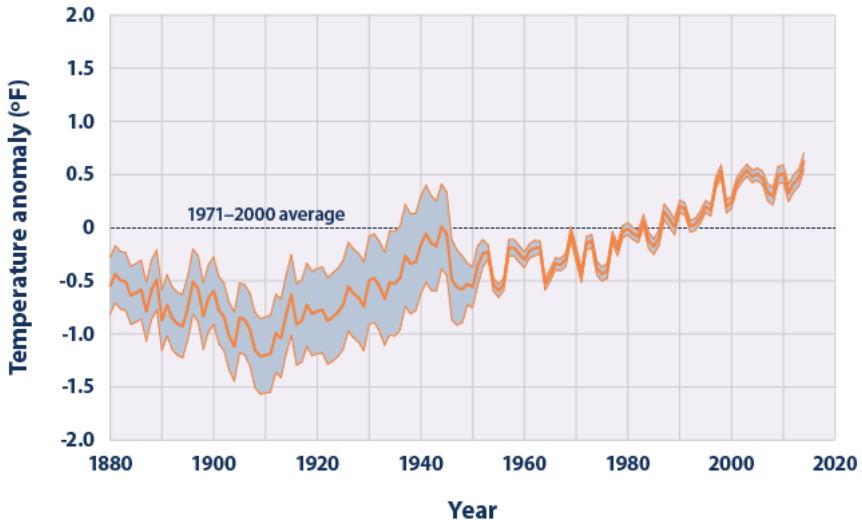


Figure 2 Average Global Sea Surface Temperatures, 1880 – 2014 (EPA, 2015)

Using the 1971 to 2000 average as a baseline, that graph depicts how the average surface temperature of the world's ocean has varied over the years and SST have been higher than any other time during the past three decades (EPA, 2015).

2.4.2 Atlantic Multidecadal Oscillation (AMO)

Several distinct rises and falls of the sea surface temperatures (SST) across the North Atlantic and its bounding continent in the late 1800's and the pattern is referred to as Atlantic Multidecadal Oscillation (AMO) (Henson, 2014). AMO is a natural phenomenon occuring mainly in the North Atlantic Ocean over a period of several decades. In a related study, Enfield (2001) demonstrates that the North Atlantic sea surface temperature for 1856 – 1999 contains a 65–80 year cycle of relatively small change of about 0.4^{0}c that occurs over several decades (Enfield et al., 2001). The geographical location where the SST anomalies are calculated is between the latitude of 75.0˚N and 0.0˚S and between the longitudes of 10.0˚E and 75.0˚W, (Pierce, 2013) as shown in Figure 3.

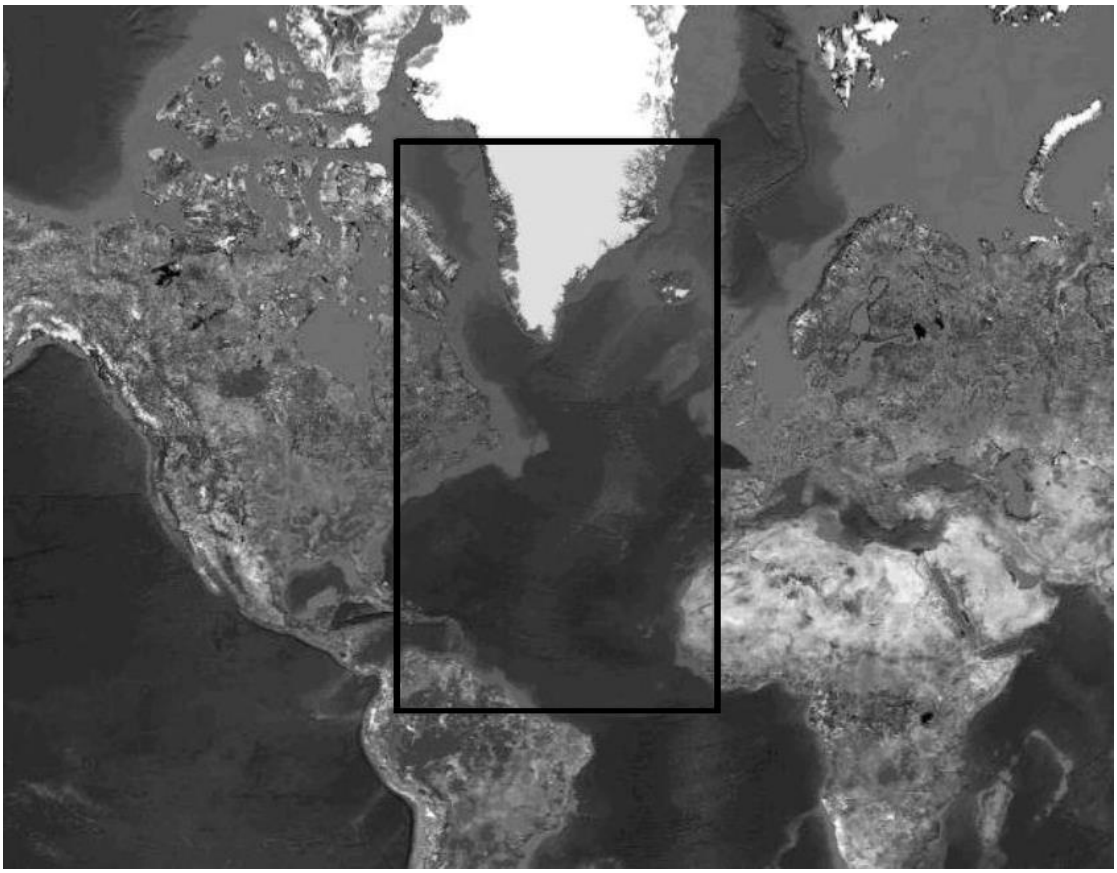


Figure 3 Plan View of AMO influence (Pierce, 2013)

AMO Trends

The Atlantic Multidecadal Oscillation impact is global in scope as it can alter weather patterns throughout the world. Though a positively correlated co-oscillation in parts of the North Pacific, AMO is most intense in the North Atlantic and it covers the entire basin (Trimble et al. 2001).

There are two phases associated with AMO and each phase peaking about 65-80 years. The positive phase is charactirized by SST values above normal temperature and the negative phase of AMO occurs when SST values are below the normal mean. There is considerable evidence of 65–80 year oscillation in temperature records for the North Atlantic and its bounding continents. Although this basin-wide pattern of sea surface

temperature anormalies is probably related to North Atlantic Oscillation (NAO) as well, it has become known as the impact of the Atlantic Multidecadal Oscillation (AMO). This periodicity has has been linked with rainfall patterns over the United States (Burroughs, 2009). The co-relation between the fluctuation of the SST and the change in precipitation has been studied by Enfield (2001) as he demonstrated that the change in AMO phases, positive versus negative phases, are directly related to the fluctuation of the rainfall precipitation in most of the United States and its bounding area. During AMO warming phases, most of the United States see less than normal rainfall, including Midwest droughts in the 1930s and 1950s. Between AMO cool and warm phases, Mississippi River outflow varies by 10% while the inflow to Lake Okeechobee, Florida varies by 40% (Enfield et al., 2001).

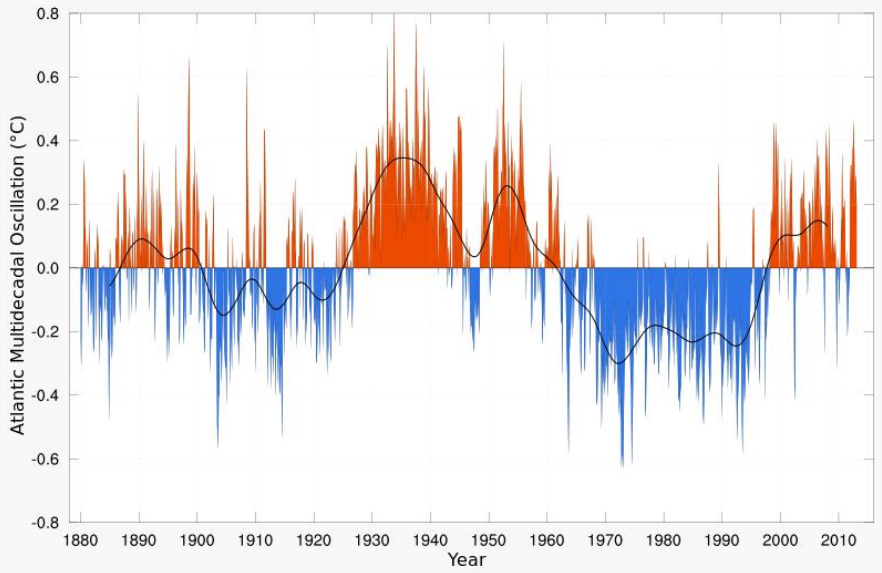


Figure 4 Monthly Temperature Values from 1880 to 2008 (Gittinnger 2015)

While observing some isolated years, the cool AMO phases occurred in the 1900s–1920s and 1960s–1990s, whereas the warm phases occurred in the 1930s–1950s and it is

currently approaching 20 years in current warm phase (Gittinger, 2015). These periods coincide with examples of untypical regional climate. For instance, the 1930s–1950s showed decrease in the Northeast Brazil (NEB) rainfall and the United States (US) river flows, while enhancing hurricane formation and rainfall precipitation in the Sahel region in Africa. Conversely, the 1960s–1980s was a period of high NEB rainfall and US river flows whereas Sahel rainfall and Atlantic hurricane formation were reduced (Knight et al., 2006).

2.4.3 El Niño -Southern Oscillation (ENSO)

The El Niño-Southern Oscillation (ENSO) is a naturally occurring phenomenon that involves changing ocean temperatures in the central and eastern equatorial Pacific, coupled with changes in the atmosphere (WMO, 2014). Out of all the oceans of the earth, the Pacific Ocean accounts for three-fifths of all water masses. This fact alone explains the Pacific's dominant influence over the continental masses– North America, Asia, Australia, and South America – that surround it, and over regions that are farther removed, such as the Caribbean basin, the islands of Indonesia, and even the Malayan Peninsula and the Indian subcontinent (Caviedes, 2001).

Unlike the phenomenon during AMO phases, the periodical change of the ENSO is irregular and it is caused by variations in sea surface temperature (SST) over the tropical eastern Pacific Ocean. Caviedes (2001) stated another important difference is that the widest part of the Pacific coincides roughly with the equator line, whereas the widest part of the Atlantic lies within the middle latitudes. Therefore, the Pacific Ocean possesses a much larger surface for collecting solar energy in equatorial latitudes, and passes much more humidity and heat into the atmosphere, than the other oceans. Even

though ENSO is a single climate phenomenon, it has three states, or phases that it can be in. The two opposite phases, “El Niño” and “La Niña,” require certain changes in both the ocean and the atmosphere because ENSO is a coupled climate phenomenon. “Neutral” is the middle state of the continuum (L’Heureux, 2014). Each phase or condition of the ENSO presents distinctive features.

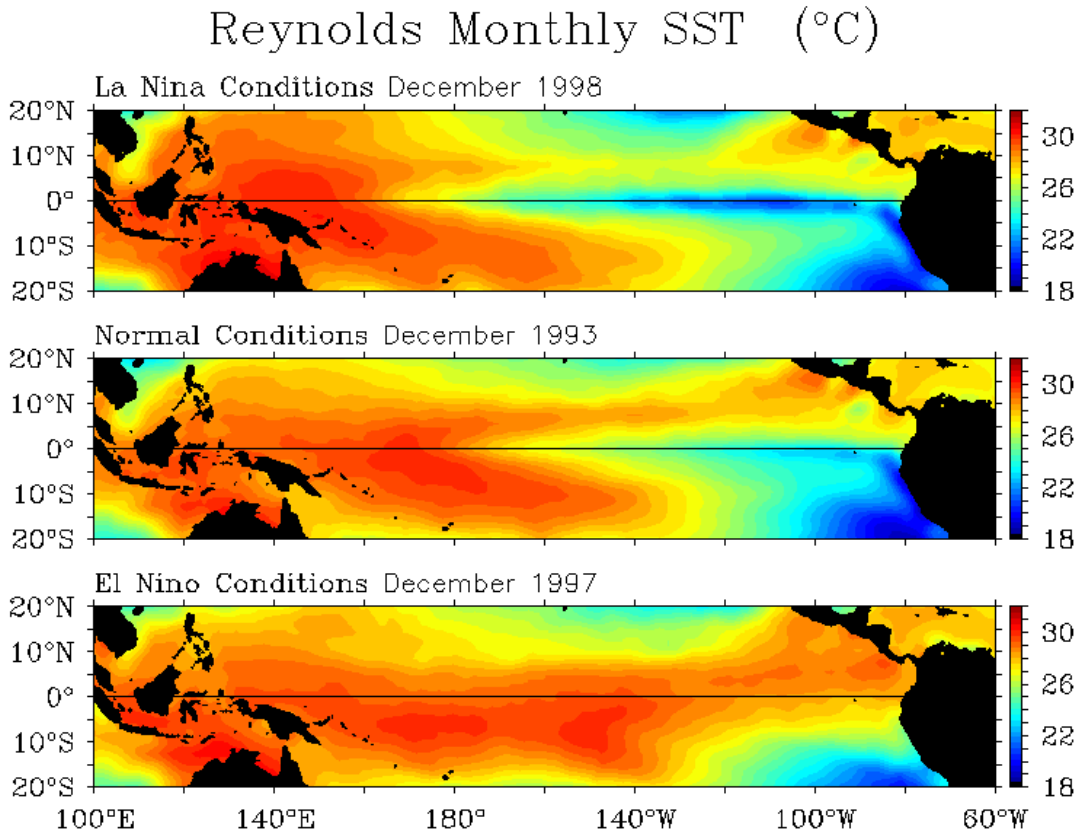


Figure 5 Reynolds Sea Surface Temperature Analyzing El Niño , normal, and La Niña conditions (NOAA, 2015)

Figure 5 is an excerpt of a real-time global sea surface temperature (SST) analysis that has been developed by Richard Reynolds from the National Climatic Data Center (NCDC); it depicts the three conditions of ENSO. Unusually warm ocean temperatures in the Equatorial Pacific Ocean characterize El Niño. In the warm phase, the temperature

patterns of the SST are downright plain and relatively uniform in the tropics where sunshine is most intense. Conversely, unusually cold temperatures of the ocean in the equatorial Pacific characterize La Niña. The cool phase is intriguing, and it remains commendably cool under intense sunlight while the temperature of the SST produces fascinating asymmetric patterns. Although the intensity of sunlight is independent of longitude and is perfectly symmetrical about the equator, she keeps the waters of the tropical Pacific colder in the east than the west and warmest in a band to the north of the equator (NOAA, 2015).

2.4.4 Oceanic Niño Index (ONI)

The Oceanic Niño Index (ONI) has become the de-facto standard that NOAA uses for identifying El Niño and La Niña events in the tropical Pacific. It is the running 3-months mean SST anomaly for the Niño 3.4 region (Null, 2016). The Niño 3.4 region is shown in Fig 6.

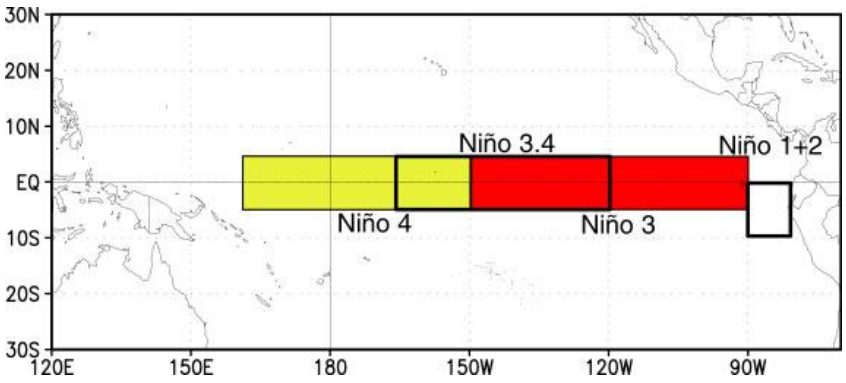


Figure 6 Niño 3.4 shown in the Tropical Pacific (NCEP, 2015)

El Niño or La Niña events are defined as 5 consecutives overlapping 3-month period at or above +0.5^{o} anomaly for warm (El Niño) events and at or below the -0.5^{o}

anomaly for cold (La Niña) events. The threshold is further broken down into Weak (with a 0.5 to 0.9 SST anomaly), Moderate (1.0 to 1.4 SST anomaly), Strong (1.5 to 1.9 SST anomaly, Very Strong (≥2.0) events (Null, 2016). The Oceanic Niño Index (ONI) for the period of 1950 to 2016 is shown in Fig 7.

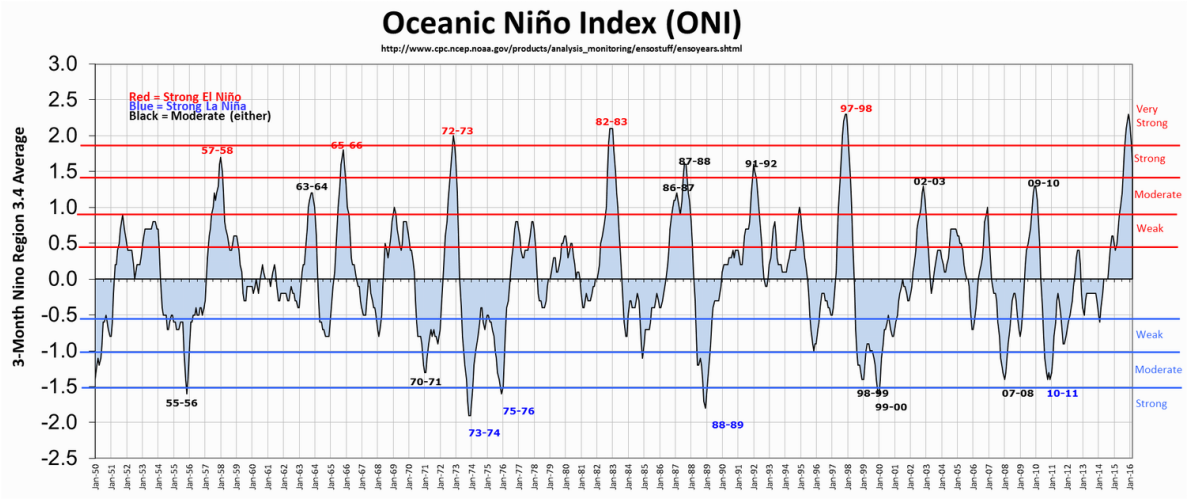


Figure 7 Oceanic Niño Index (NOAA, 2015)

The negative values of the ONI represent the cold phase (La Niña) whereas the positive ONI values represent the warm ENSO phase (El Niño).

2.4.5 Multivariate ENSO Index (MEI)

Considering its impact on the environment, El Niño (ENSO) is the most important coupled ocean-atmosphere phenomenon to cause global climate variability on seasonal to inter-annual time scales. Figure 8 reflects the monitoring ENSO data by basing the Multivariate ENSO Index (MEI) on six main observed variables over the tropical Pacific. The MEI is derived from tropical Pacific COADS (Comprehensive Ocean-Atmosphere Data Set) records and is a multivariate measure of the ENSO signal. The Multivariate

ENSO Index (MEI) was originally defined as the first seasonally varying principal component of six Ocean-Atmosphere (COADS) variable fields in the tropical Pacific basin. It provides for a more complete and flexible description of the ENSO phenomenon than single variable ENSO indices such as the Southern Oscillation Index (SOI) or Niño 3.4 SST (Walter and Trimlin, 1998, 2011).

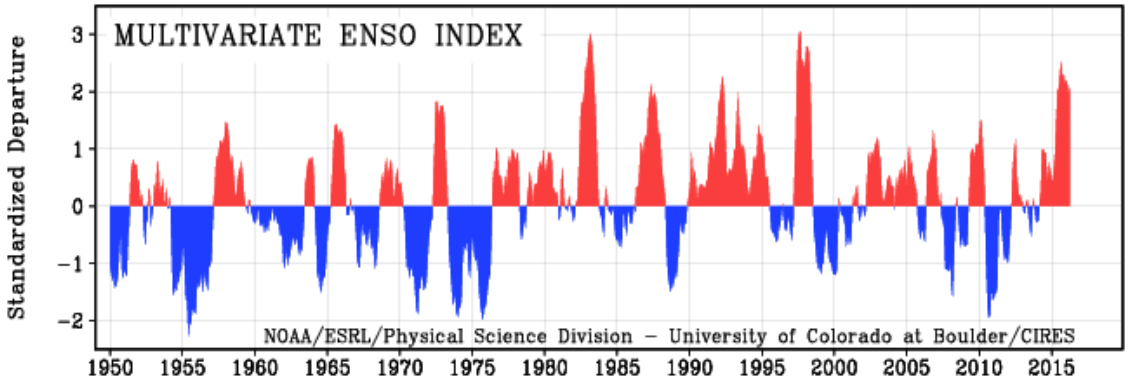


Figure 8 Multivariate ENSO Index (ESRL, 2015)

The negative MEI values represent the cold phase (La Niña) while the positive values represent the warm ENSO phase (El Niño).

3 METHODS OF ANALYSIS

This chapter presents the methodology developed for analysis of trends and the characteristics of precipitation extremes at various temporal durations. As shown in Figure 9, it also discusses the statistical significance differences between El Niño and La Niña.

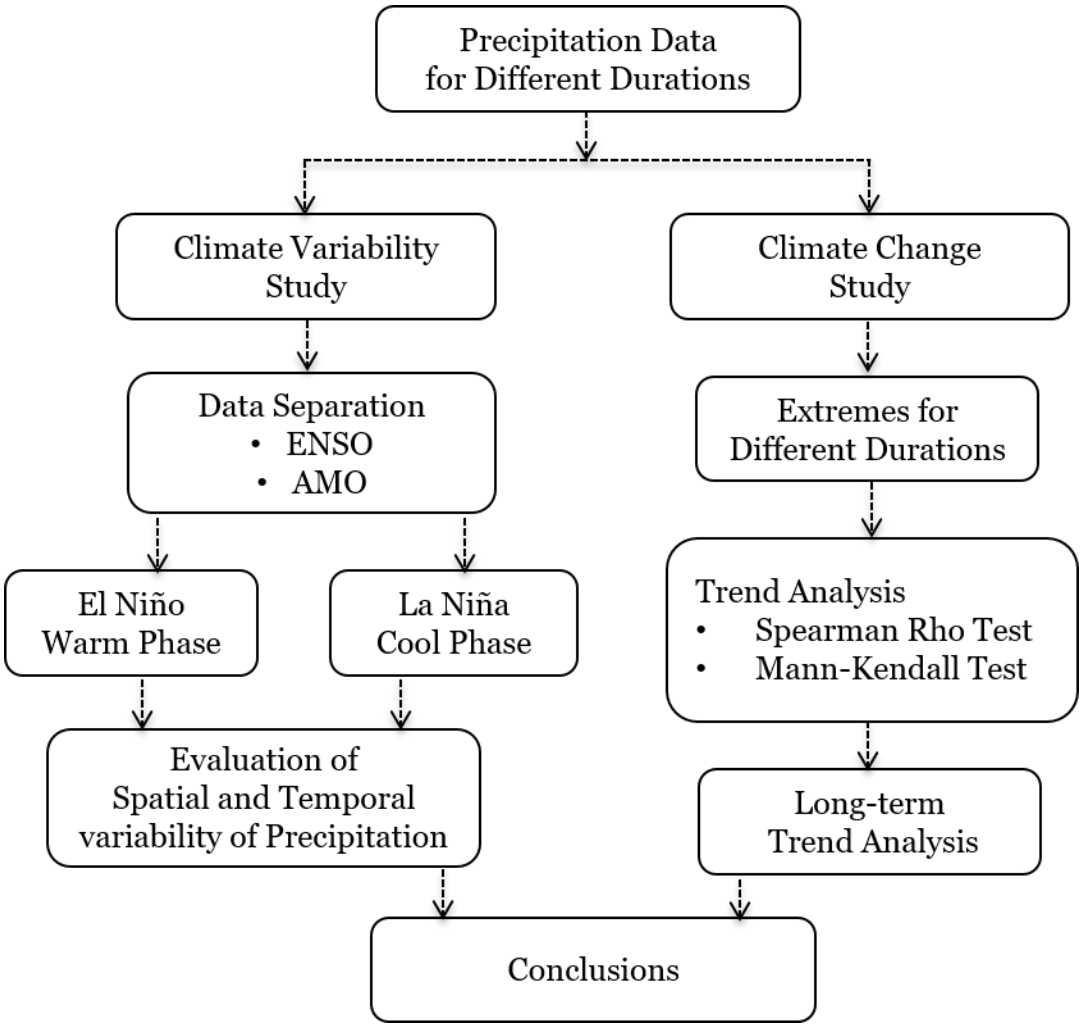


Figure 9 Methodologies for Evaluation of Rainfall Data

3.1 Evaluation of Precipitation Extremes

The precipitation data from rain gages dispersed throughout the state of Florida are collected for events duration of 15-minute, 30-minute, 45-minute, 1-hour, 2-hour, 3-hour, 6-hour, 12-hour, 1-day, 2-day, 3-day, 4-day, 7-day, 10-day, 20-day, 30-day, 45-day, and 60-day. The number of rain gage stations are grouped based on type of duration. The minute durations contain 73 stations, whereas the hour and day durations contain 112 and 242 stations, respectively. The historical precipitation data varies from station to station, yet it is independent of the time duration when the data is collected. The analysis of precipitation extremes is a distinct approach to evaluate raw precipitation data. Separating the data obtained from the National Oceanic and Atmospheric Administration (NOAA) to extract the precipitation extremes facilitates the utilization of various methods of analysis in this study. The methodology shown in Figure 9 can be applied in any case study region where there is a similar data.

The sections that follow will outline the non-parametric tests conducted in this study to analyze the correlation coefficient between the variables time and precipitation, the statistical methods to identify the orientation of the trends in the data, and finally the spatial analysis method to determine whether certain areas are prone to drought of flood conditions.

3.2 Correlation Coefficient

The data set collected is a bivariate data containing two types of random variables that can be analyzed and compared to find the correlated relationship between them. Time and rainfall precipitation constitute the two variables in the observed data. While exhibiting whether a relationship is positive or negative and the strength of the

relationship, statistic correlation is a powerful tool that provides very relevant information about the relationship between the variables. To identify whether there is a consistent behavior or no discernment patterns in increasing and in decreasing values, a correlation coefficient number that statically varies from -1.0 and +1.0 is used to represent the dependence of the two variables. In the following sections, Spearman's rho correlation coefficient (ρ) and Kendall's tau (τ) will be introduce as non-parametric correlation methods used in this study. Generally, ρ or $\tau > 0$ indicates positive correlation and ρ or $\tau < 0$ indicates negative correlation whereas, when the correlation coefficient returns ρ or $\tau = 0$, it is said that the variables are independent and not related. Since the numerical value ranges from +1.0 to -1.0, when a bivariate data set show an overall increase in numbers, it's called a positive correlation in which the dependent and the independent variables in a data set increase or decrease together and, therefore, counted as 1. Conversely, a negative correlation is registered when the correlation coefficient is or approach -1. Nonetheless, the covariance will be zero if there is no discernable pattern in the behavior of the two variables. The strength of the pattern is related to how tightly clustered the points are around the underlying form. The following words: near zero correlation, weak correlation, moderation positive correlation, strong positive correlation, moderate negative correlation, and strong negative correlation are the terms used to described the relative strength of the correlation between time and precipitation. Though relatively close, the choice of boundaries reflecting the correlation strength may vary from study to study; however, the following guidelines of correlation strengths found in Table 1 are used for this study:

Table 1 Correlation Strength Boundaries

Correlation Coefficient	Strength of Relationship
-1.0 to -0.5 or 1.0 to 0.5	Strong
-0.5 to -0.3 or 0.5 to 0.3	Moderate
-0.3 to -0.1 or 0.3 to 0.1	Weak
-0.1 to 0.1	None Very Weak

Generally, depending on the type of test used, the outcome is enumerated and illustrates the quantitative measure that reflects the correlated relationship between the random variables (Yue et al, 2002).

3.2.1 Spearman's Rho Correlation Coefficient Trend Test

Spearman's rho test is known as a nonparametric measure of statistical analysis used to test the association between two ranked variables. In this study, this test is used as a statistical method that assesses a possible linear association between the time and the precipitation data. The null hypothesis (H_o), which assumes that time series data are independent and identically distributed, indicates no trend over time; the alternate hypothesis (H_a) is that a trend exists and that data increase or decrease with i (Yue et al, 2002).

$H_o \rightarrow \rho = 0$ (3.1)

$H_a \rightarrow \rho \neq 0$ (3.2)

The test statistics R_{sp} and standardized statistic Z_{sp} are defined as

$$R_s = 1 - \frac{6\Sigma_{i=1}^{n} (D_i)^2}{n(n^2-1)} \quad (3.3)$$

$$Z_s = R_s \sqrt{\frac{n-2}{1-R_s^2}} \quad (3.4)$$

In these equations, R_s is the Spearman's Rank Correlation Coefficient, D_i is the rank of i^{th} observation, I is the chronological order number, n is the total length of the time series data, and Z_S is Student's t-distribution with (n − 2) degree of freedom. The positive values of Z_S represent an increasing trend across the hydrologic time series; negative values represent the decreasing trends. The critical value of t at a 5% significance level of Student's t-distribution table is defined as $(n-2,1-\alpha/2)$. If $|Z_S| > (n-2,1-\alpha/2)$, (H_O) is rejected and a significant trend exists in the hydrologic time series (Ahmad, et al, 2014).

Rank correlation is used quite extensively in this study and it is sought to determine the statistical significance of the analyzed data and ultimately utilize the testing results to determine whether there is an increasing or decreasing trend in precipitation depth.

3.2.2 Kendall Tau Correlation Coefficient

Kendall Tau is a rank-based non-parametric test; thus, outliers do not affect the result; this method was applied to the data in this study to detect statistical significance in the trends. In this test, the null hypothesis (H_o) was that there has been no trend in precipitation over time and the alternate hypothesis (H_a) was that there has been a trend (increasing or decreasing) over time (Ahmad et al., 2014).

Also known as Kendall's tau correlation coefficient, this test is similar to the Spearman's rho method. As a non-parametric hypothesis test, Kendall Tau conducts measurement of pair data. Kendall τ coefficient can be determine by using Equation 3.3

$$\tau = \frac{(\#\ of\ Concordant\ Pairs) - (\#\ of\ Discordant\ Pairs)}{\frac{1}{2}n(n-1)} \tag{3.7}$$

The denominator is the total pair combination, thus the coefficient must lie between -1 and +1. In the event that the two rankings are the same, the Kendall τ coefficient has a value of 1. When one ranking is the reverse of the other, the Kendall τ coefficient has a value of -1. The coefficient is expected to be nearly to zero when the two variables are independent (Prokhorov, 2001).

The mathematical equations for calculating Mann-Kendall Statistics S, (S) and standardized test statistics Z are as follows:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} sig(X_j - X_i), \tag{3.8}$$

$$\text{sig}\,(X_j - X_i) = \begin{cases} +1 & if\ (X_j - X_i) > 0 \\ 0 & if\ (X_j - X_i) = 0 \\ -1 & if\ (X_j - X_i) > 0, \end{cases} \tag{3.9}$$

In these equations, X_i and X_j refer to the time series observation in chronological order, i is the chronological order number, n is the length of the time series, t_p is the number of ties for p^{th} value, and q is the number of tied values.

$$\text{V (S)} = \frac{1}{18}\left[n(n-1)(2n+5) - \sum_{p=1}^{q} t_p\,(t_p-1)(2t_p+5)\right], \tag{3.10}$$

$$\text{Z} = \begin{cases} \frac{S-1}{\sqrt{VAR(S)}} & if\ S > 0 \\ 0 & if\ S = 0 \\ \frac{S+1}{\sqrt{VAR(S)}} & if\ S < 0 \end{cases} \tag{3.11}$$

Positive Z values indicate an upward trend in the hydrologic time series; negative Z values indicate a negative trend. If $|Z| > Z_{1-\alpha/2}$, (H_o) is rejected and a statistically significant trend exists in the hydrologic time series (Ahmad et al., 2014).

3.3 Spatial Analysis

3.3.1 Spatial Interpolation - Temperature

The global pattern of rainfall precipitation cycle is greatly influenced by the fluctuation of the ocean temperature. Generally, sea surface temperatures are predominant factors that affect the main phases of ENSO. The cooler phase of ENSO, La Niña occurs when the sea surface temperature in the ENSO region of the Pacific is cooler than the normal central and eastern equatorial temperatures. On the contrary, El Niño phase occurs when the temperatures in the ENSO region of the Pacific are warmer than normal average central and eastern equatorial temperatures. During the latter phase, the warmer surface waters oscillate, similarly to an agitated pool, across the Pacific Ocean causing variability in the climate pattern that ultimately affects the state of Florida.

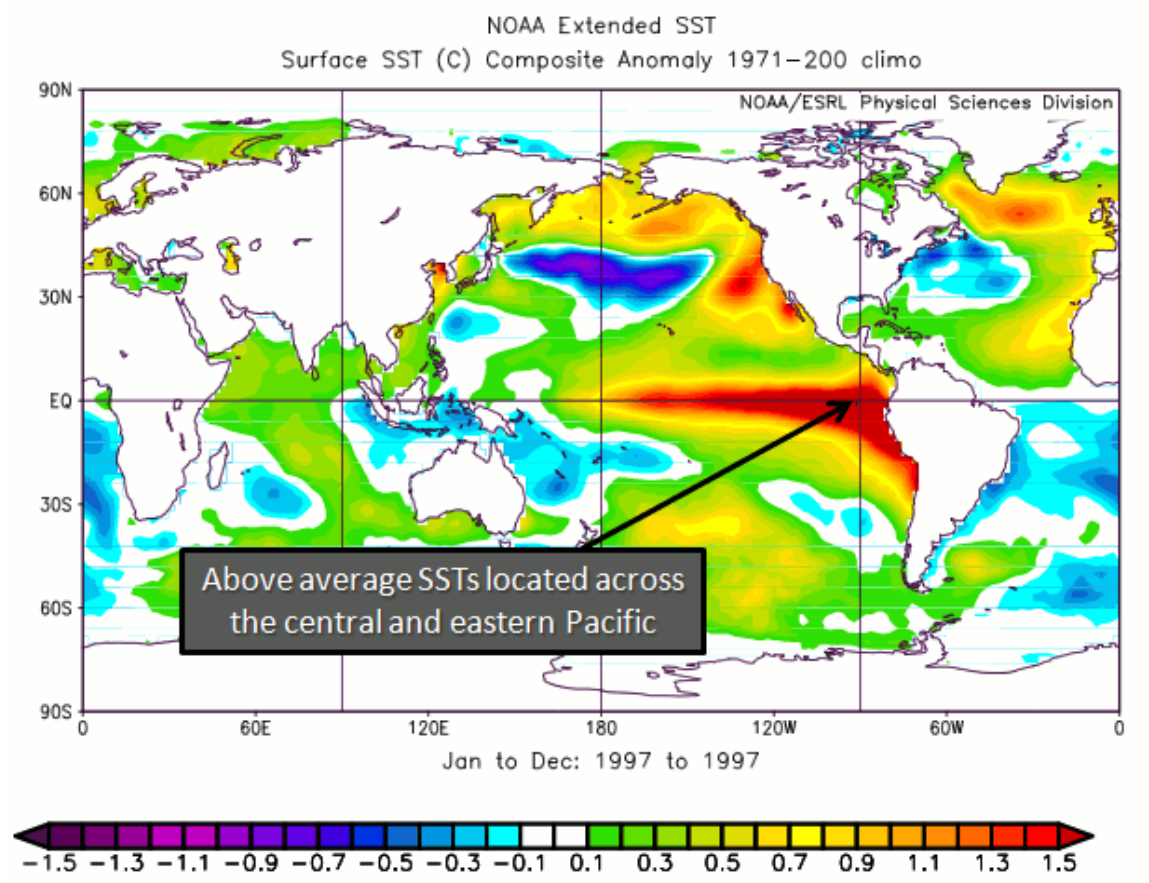


Figure 10 NOAA Extended Sea Surface Temperatures

3.3.2 Spatial Interpolation – Precipitation

Interpolation is a procedure used to generate new values within a range of a discrete set of known data points. Using this method, one can predict the cell values for locations that lack enough sample points. Geographic information system (GIS) and modeling techniques are becoming very relevant tools to generate effective and reliable spatial map. Considering that GIS is very much about spatial data and it provides the tools to analyze the data, after the mean value for each station is determined, ArcGIS is used to explore the spatial pattern between the data points for this study.

Geo-statistical interpolation or spatial interpolation techniques used in this study are the result of statistical data inputs; and spatial autocorrelation and the interrelation between the points contribute to the development of a spatial pattern or map of the precipitation depth in the state of Florida.

The spatial analysis will reveal a series of spatial variation of data points based on the warm (El Niño) or cold year (La Niña). As aforementioned, the maximum number of point sources collecting data is 242; however, for better appreciation of a study, environmental specialists often require spatial continuous data over an area of interest to make effective and sound decisions. Since the station of the rain gages are sparsely and unevenly distributed, the value of an attribute at any locations where no rain gages are available need to be estimated. In such cases, spatial interpolation provides the necessary tools to fulfill this task.

According to Webster and Oliver (2001), estimations of nearly all spatial interpolation methods can be represented as weighted averages of sampled data. They all share the same general estimation formula, as follows:

$$\hat{S}(x_0) = \sum_{i=1}^{n} \lambda_i s\,(x_i) \qquad (3.12)$$

Where $\hat{S}$ is the estimated value of an attribute at the point of interest x_0, S is the observed value at the sampled collected point x_i, λ_i is the weight assigned to the sampled point, and n represents the number of sampled points used for the estimation.

The trend analysis conducted in the previous methods is applicable to a data set consisting of either 73, 112, or 242 rain gages attempting to cover the State of Florida; however, to estimate rainfall precipitation at unmeasured locations, an

inverse distance weighting (IDW) Spatial Interpolation method is applied to interpolate results from each station and to project the results 2-dimensional in the Geographical Information System (GIS) ArcGIS, which is one of the most commonly used techniques for interpolation of scatter points. According to Qin (2015), inverse distance weighted methods are based on the assumption that the interpolation surface should be influenced most by the nearby points and less by the more distant points (Qin et Al., 2015).

4 CASE STUDY

4.1 Study Domain

This study will focus on evaluation of influences of climate variability on rainfall extremes in the state of Florida. Overseeing five water management districts, the Florida Department of Environmental Protection (FDEP) is actively involved in the management of the water resources in the state of Florida (Harper and Baker, 2007) - South Florida Water Management District (SFWMD), St. Johns River Water Management District (SJRWMD), Southwest Florida Water Management District (SWFWMD), Suwannee River Water Management District (SRWMD), and Northwest Florida Water Management District (NWFWMD).

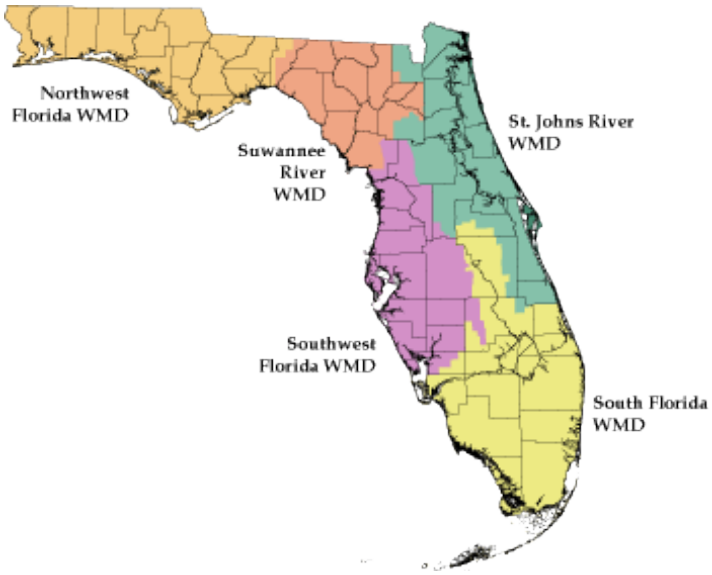


Figure 11 Map of Water Management Districts (FDEP, 2014)

Located in the southeastern region of the United States, Florida bordering Georgia to the north and Alabama to the northwest. Because no part of the state is far from the ocean, Florida's climate is directly impacted by irregular variation in winds and sea surface temperatures resulted from its surrounding oscillations. The predominant climate of the North of Lake Okeechobee or the central region of the state is humid subtropical whereas the southern portion has a true tropical climate. Though Florida's nickname is Sunshine State, severe weather is common from late spring until early autumn with frequent thunderstorms converging on the peninsula from both eastern and western coasts; consequently, Florida has the highest average precipitation of any state (Kindlmann et al. 2010). The Köppen-Geiger climate classification method provides more detailed categories on a global scale (Pierce, 2015).

4.2 Data Sets

This study encompasses geographic and frequency variation over relatively uncomplicated terrain. There are 242 rain gages stations distributed throughout the state. Considering that the state of Florida does not display much diversity of topographical regimes, this study requires no significant need for grouping of meteorological and topographical homogenous regions. The extreme precipitation data for durations of 15-minute, 30-minute, 45-minute, 1-hour, 2-hour, 3-hour, 6-hour, 12-hour, 1-day, 2-day, 3-day, 4-day, 7-day, 10-day, 20-day, 30-day, 45-day, and 60-day were collected from the National Oceanic and Atmospheric Administration (NOAA, 2015). These meteorological stations are spread throughout the state of Florida to facilitate temporal and spatial analysis of rainfall characteristics and precipitation extremes over a long period of time. Among the oldest stations collecting data in the state of Florida, precipitation extremes

recorded in the station located at the Tampa International Airport (27.9614000; -82.5403000) are dated from August 13, 1843 to March 12, 2010. Figure 12 shows the clustering representation of the distribution and the position of the 15-minute rain gages throughout Florida.

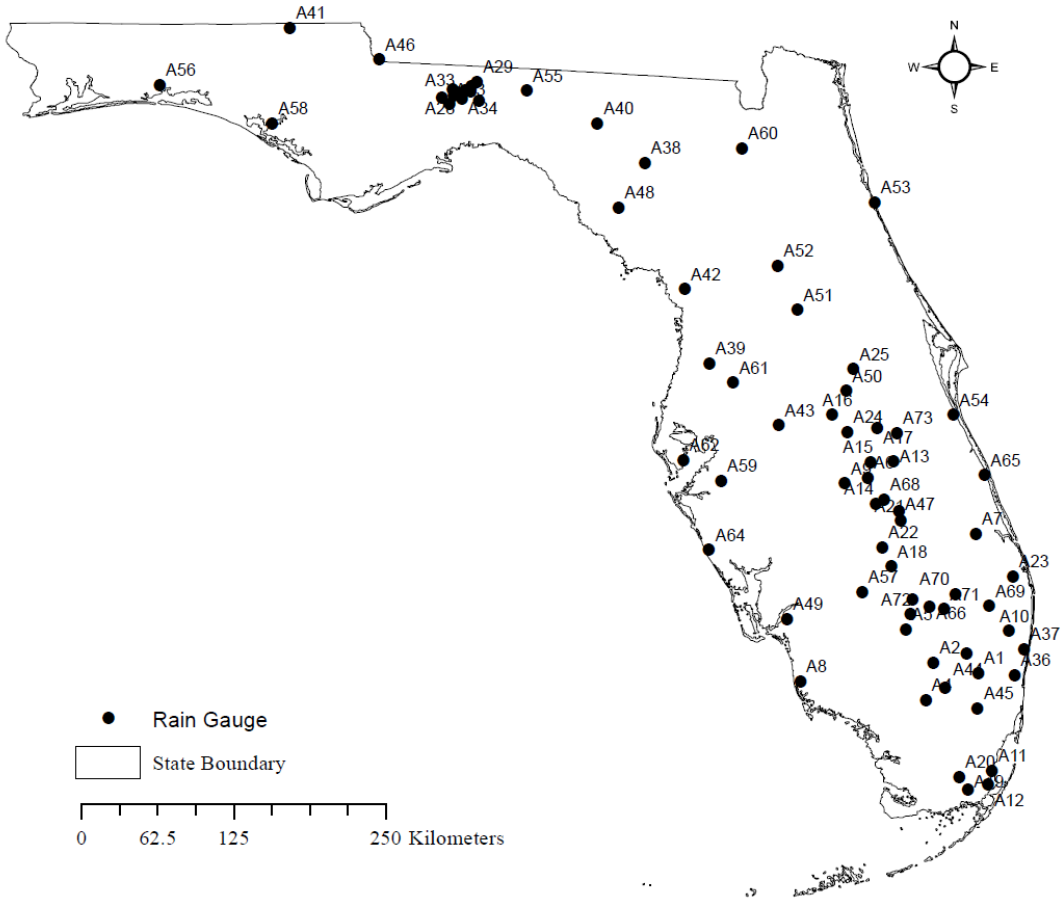


Figure 12 NOAA Rain Gage Used for this Study (15-minute duration)

4.3 Rainfall Data Collection

The aforementioned five water management districts monitor the rain gages available for this study. Generally, precipitation data are collected using either a collection well gage or a tipping bucket rain gage that uses electronic data loggers to record the rainfall in 0.01-inch increments every 15 minutes. In this study, for the sake of

simplification, the rain gage ID contain the letter A. B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q to identify the duration period of 15-minute, 30-minute, 45-minute, 1-hour, 2-hour, 3-hour, 6-hour, 12-hour, 1-day, 2-day, 3-day, 4-day, 7-day, 10-day, 20-day, 30-day, 45-day, and 60-day, respectively.

The number of rain gages for the durations of 15-minute, 30-minute, and 45-minute amount to 73 stations; 112 stations for durations of 1-hour, 2-hour, 3-hour, 6-hour, and 12-hour; and 242 stations for the duration of 1-day, 2-day, 3-day, 4-day, 7-day, 10-day, 20-day, 30-day, 45-day, and 60-day. Table 2a-2g shows the location of rain gage sites for 60-day period duration. Additional durations can be found in Appendix 7.

Table 2a. 60-Day Rain Gage Names and coordinates (Q1-Q34)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q1	3A-36+R	26.1915000	-80.4492000
Q2	3ANW+R	26.2665000	-80.7795000
Q3	3AS+R	26.0821000	-80.6915000
Q4	3ASW+R	25.9898000	-80.8362000
Q5	ALICO+R	26.5128000	-80.9819000
Q6	AVONPK+R	27.6317000	-81.2647000
Q7	BLUEG+R	27.2197000	-80.4650000
Q8	COLGOV+R	26.1297000	-81.7625000
Q9	LOTELA+R	27.5914000	-81.4353000
Q10	LXWS+R	26.4989000	-80.2222000
Q11	MRF122	25.4700000	-80.3464000
Q12	MRF123	25.3669000	-80.3764000
Q13	MRF155	27.7528000	-81.0772000
Q14	MRF187	27.4386000	-81.2064000
Q15	MRF191	27.7458000	-81.2453000
Q16	MRF205	28.0994000	-81.5286000
Q17	MRF23	28.0017000	-81.1936000
Q18	S131+R	26.9792000	-81.0900000
Q19	S18C-R	25.3306000	-80.5250000
Q20	S332-R	25.4217000	-80.5897000
Q21	S65DW+R	27.3142000	-81.0219000
Q22	S70+R	27.1186000	-81.1572000
Q23	SIRG+R	26.9072000	-80.1917000
Q24	SNIVLY+R	27.9717000	-81.4175000
Q25	TAFT+R	28.4361000	-81.3714000
Q26	HERRON STEEL SITE SILVER	30.4383000	-84.4111000
Q27	CHRISTIAN HERITAGE CHURCH	30.5053000	-84.3308000
Q28	LAKE JACKSON FACILITY	30.4833000	-84.2992000
Q29	TUCK PROPERTY N. CENTERV	30.5592000	-84.1500000
Q30	CITY WELL AT LIMOGES DR.	30.4844000	-84.1956000
Q31	LEON COUNTY LANDFIL US	30.4203000	-84.1347000
Q32	LAKE KANTURK OUTFALL AT CE	30.5272000	-84.1917000
Q33	SAN LUIS CITY PARK	30.4586000	-84.3211000
Q34	CHOWKEEBIN NENE NEAR MAGN	30.4331000	-84.2608000

Table 2b. 45-Day Rain Gage Names and coordinates (Q35-Q68)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q35	WEMBLEY WAY EASTGATE NEI	30.4931000	-84.2392000
Q36	S36-R	26.1734000	-80.1784000
Q37	BLACKMAN	30.9833000	-86.6500000
Q38	BOCA RATON	26.3675000	-80.1108000
Q39	BRANFORD	29.9625000	-82.9108000
Q40	BROOKSVILLE 7 SSW	28.4811000	-82.4353000
Q41	DOWLING PARK 1 W	30.2497000	-83.2594000
Q42	FT LAUDERDALE INTL AP	26.0719000	-80.1536000
Q43	GRACEVILLE 1 SW	30.9575000	-85.5331000
Q44	INGLIS 3 SW	29.0253000	-82.6158000
Q45	LAKELAND	28.0206000	-81.9219000
Q46	LIGNUMVITAE KEY	24.9027000	-80.6960000
Q47	MONTICELLO 10 SW	30.4406000	-83.9858000
Q48	NORTH NEW RVR CANAL 1	26.5667000	-80.7500000
Q49	NORTH NEW RVR CANAL 2	26.3336000	-80.5372000
Q50	PENNSUCO 5 WNW	25.9297000	-80.4539000
Q51	PORT MAYACA S L CANAL	26.9833000	-80.6167000
Q52	TRAIL GLADE RANGES	25.7647000	-80.4775000
Q53	WOODRUFF DAM	30.7219000	-84.8742000
Q54	MILES CITY	26.2483000	-81.2967000
Q55	OCHOPEE	25.9167000	-81.2833000
Q56	APALACHICOLA AP	29.7258000	-85.0206000
Q57	ARCADIA	27.2181000	-81.8739000
Q58	ARCHBOLD BIO STN	27.1819000	-81.3508000
Q59	AVON PARK 2	27.5944000	-81.5253000
Q60	BABSON PARK 1 ENE	27.8500000	-81.5167000
Q61	BARTOW	27.8986000	-81.8433000
Q62	BASINGER	27.3833000	-81.0333000
Q63	BELLE GLADE	26.6928000	-80.6711000
Q64	BIG CORKSCREW	26.3650000	-81.5478000
Q65	BLOUNTSTOWN 2 SE	30.4500000	-85.0500000
Q66	BRADENTON 5 ESE	27.4467000	-82.5014000
Q67	BRISTOL	30.4181000	-84.9861000
Q68	BROOKSVILLE CHIN HILL	28.6164000	-82.3658000

Table 2c. 45-Day Rain Gage Names and coordinates (Q69-Q102)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q69	BUSHNELL 2 E	28.6664000	-82.0894000
Q70	CANAL POINT USDA	26.8639000	-80.6256000
Q71	CARRABELLE 1 NNW	29.8667000	-84.6333000
Q72	CARYVILLE	30.7667000	-85.8167000
Q73	CEDAR KEY 1 WSW	29.1333000	-83.0500000
Q74	CHIPLEY	30.7836000	-85.4847000
Q75	BITHLO	28.5500000	-81.1000000
Q76	CLEARWATER	27.9667000	-82.7667000
Q77	CLERMONT 9 S	28.4553000	-81.7233000
Q78	COMPASS LAKE	30.6000000	-85.4000000
Q79	CORAL SPRINGS	26.2678000	-80.2750000
Q80	CRESCENT CITY	29.4292000	-81.5158000
Q81	CRESTVIEW BOB SKIES AP	30.7797000	-86.5225000
Q82	CROSS CITY 1 E	29.6333000	-83.1053000
Q83	DAYTONA BEACH	29.1894000	-81.0139000
Q84	DAYTONA BEACH INTL AP	29.1828000	-81.0483000
Q85	DE FUNIAK SPRINGS 1 E	30.7244000	-86.0939000
Q86	DELAND 1 SSE	29.0181000	-81.3106000
Q87	DESOTO CITY 8 SW	27.3697000	-81.5136000
Q88	DEVILS GARDEN	26.6033000	-81.1292000
Q89	DRY TORTUGAS	24.6281000	-82.8736000
Q90	EVERGLADES	25.8489000	-81.3897000
Q91	FEDERAL POINT	29.7550000	-81.5389000
Q92	FERNANDINA BEACH	30.6589000	-81.4636000
Q93	FLAMINGO RS	25.1422000	-80.9144000
Q94	FT DRUM 3 NW	27.5303000	-80.8167000
Q95	FT GREEN 12 WSW	27.5706000	-82.1378000
Q96	FT LAUDERDALE	26.1019000	-80.2011000
Q97	FT MYERS PAGE FLD AP	26.5850000	-81.8614000
Q98	FT PIERCE	27.4622000	-80.3539000
Q99	GAINESVILLE 3 WSW	29.6333000	-82.3667000
Q100	GAINESVILLE RGNL AP	29.6919000	-82.2756000
Q101	GLEN ST MARY 1 W	30.2717000	-82.1856000
Q102	HART LAKE	28.3833000	-81.1833000

Table 2d. 45-Day Rain Gage Names and coordinates (Q103-Q137)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q103	HASTINGS 4 NE	29.7517000	-81.4669000
Q104	HIALEAH	25.8175000	-80.2858000
Q105	HIGH SPRINGS	29.8286000	-82.5972000
Q106	HILLIARD	30.7000000	-81.9333000
Q107	HILLSBOROUGH RIVER SP	28.1428000	-82.2269000
Q108	HOMESTEAD EXP STN	25.5000000	-80.5000000
Q109	HYPOLUXO	26.5500000	-80.0500000
Q110	IMMOKALEE	26.4217000	-81.4100000
Q111	INDIAN LAKE ESTATES	27.8000000	-81.3333000
Q112	INVERNESS 3 SE	28.8031000	-82.3125000
Q113	ISLEWORTH	28.4833000	-81.5333000
Q114	JACKSONVILLE INTL AP	30.4950000	-81.6936000
Q115	JACKSONVILLE BEACH	30.2875000	-81.3928000
Q116	JASPER	30.5228000	-82.9447000
Q117	KEY WEST INTL AP	24.5550000	-81.7522000
Q118	KISSIMMEE 2	28.2764000	-81.4239000
Q119	LA BELLE	26.7458000	-81.4264000
Q120	LAKE ALFRED EXP STN	28.1042000	-81.7144000
Q121	LAKE CITY 2 E	30.1853000	-82.5942000
Q122	LAKE PLACID 2 SW	27.2833000	-81.3833000
Q123	LISBON	28.8728000	-81.7844000
Q124	LIVE OAK	30.2889000	-82.9650000
Q125	LOXAHATCHEE	26.6833000	-80.2667000
Q126	LYNNE	29.2003000	-81.9306000
Q127	MADISON	30.4517000	-83.4119000
Q128	MARIANNA SCH FOR BOYS	30.7667000	-85.2667000
Q129	MARINELAND	29.6700000	-81.2150000
Q130	MAYO	30.0564000	-83.1819000
Q131	MELBOURNE WFO	28.0958000	-80.6308000
Q132	MERRITT ISLAND	28.3500000	-80.7000000
Q133	MIAMI BEACH	25.8064000	-80.1336000
Q134	MIAMI INTL AP	25.7906000	-80.3164000
Q135	MIAMI WSO CITY	25.7167000	-80.2833000
Q136	MIAMI 12 SSW	25.6500000	-80.3000000
Q137	MILTON EXP STN	30.7794000	-87.1414000

Table 2e. 45-Day Rain Gage Names and coordinates (Q138-Q172)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q138	MONTICELLO 5 SE	30.4922000	-83.7833000
Q139	MOORE HAVEN LOCK 1	26.8400000	-81.0872000
Q140	MTN LAKE	27.9347000	-81.5928000
Q141	MT PLEASANT 2 W	30.6667000	-84.7000000
Q142	MYAKKA RIVER SP	30.6667000	-84.7000000
Q143	NAPLES	26.1686000	-81.7158000
Q144	NEW SMYRNA BEACH	29.0500000	-80.9500000
Q145	NICEVILLE	30.5316000	-86.4928000
Q146	OASIS RS	25.8581000	-81.0319000
Q147	OCALA	29.0803000	-82.0778000
Q148	OKEECHOBEE	27.1508000	-80.8653000
Q149	ORANGE CITY	28.9333000	-81.3000000
Q150	ORLANDO INTL AP	28.4339000	-81.3250000
Q151	ORLANDO WSO AP	28.5500000	-81.3333000
Q152	ORTONA LOCK 2	26.7897000	-81.3044000
Q153	PALATKA	29.6439000	-81.6606000
Q154	PANACEA 1 S	29.9989000	-84.4850000
Q155	PANAMA CITY 5 N	30.2492000	-85.6606000
Q156	PARRISH	27.6089000	-82.3478000
Q157	PENSACOLA RGNL AP	30.4781000	-87.1869000
Q158	PERRINE 4W	25.5819000	-80.4361000
Q159	PERRY	30.0986000	-83.5742000
Q160	PLANT CITY	28.0236000	-82.1422000
Q161	PUNTA GORDA 4 ESE	26.9164000	-81.9983000
Q162	QUINCY 3 SSW	30.6000000	-84.5500000
Q163	RAIFORD STATE PRISON	30.0678000	-82.1928000
Q164	ROYAL PALM RANGER STA	25.3867000	-80.5936000
Q165	ST AUGUSTINE LH	29.8875000	-81.2917000
Q166	SAINT LEO	28.3378000	-82.2600000
Q167	ST LUCIE NEW LOCK 1	27.1167000	-80.2833000
Q168	ST MARKS 5 SSE	30.1000000	-84.1667000
Q169	ST PETERSBURG	27.7631000	-82.6272000
Q170	SANFORD	28.8147000	-81.2778000
Q171	SARASOTA	27.3500000	-82.5333000
Q172	STARKE	29.9381000	-82.1164000

Table 2f. 45-Day Rain Gage Names and coordinates (Q173-Q207)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q173	STEINHATCHEE 6 ENE	29.7236000	-83.3061000
Q174	STUART	27.2000000	-80.1639000
Q175	TALLAHASSEE WSO AP	30.3931000	-84.3533000
Q176	TAMIAMI TRL 40 MI BEND	25.7608000	-80.8242000
Q177	TAMPA WSCMO AP	27.9614000	-82.5403000
Q178	TARPON SPGS SEWAGE PL	28.1586000	-82.7644000
Q179	TAVERNIER	25.0069000	-80.5211000
Q180	TITUSVILLE	28.6242000	-80.8158000
Q181	USHER TWR	29.4083000	-82.8186000
Q182	VENICE	27.1006000	-82.4364000
Q183	VENUS	27.1350000	-81.3303000
Q184	VERO BEACH 4SE	27.6528000	-80.4031000
Q185	WAUCHULA	27.5478000	-81.7994000
Q186	WAUSAU	30.6333000	-85.5833000
Q187	WEST PALM INTL AP	26.6847000	-80.0994000
Q188	WEWAHITCHKA	30.1192000	-85.2042000
Q189	WINTER HAVEN	28.0153000	-81.7331000
Q190	G56-R	26.3278000	-80.1308000
Q191	G57-R	26.2311000	-80.1242000
Q192	MIALCK+R	26.6819000	-80.8061000
Q193	MRF102	26.3689000	-80.1539000
Q194	MRF114	26.0603000	-80.2317000
Q195	MRF117	25.8269000	-80.3442000
Q196	MRF125C	26.7386000	-80.9344000
Q197	MRF133	26.7489000	-80.6836000
Q198	MRF137	26.8131000	-80.5636000
Q199	MRF138	26.7839000	-80.5253000
Q200	MRF159	27.4725000	-81.1439000
Q201	MRF18	28.1403000	-81.3519000
Q202	MRF183	26.7003000	-80.7161000
Q203	MRF198	26.7897000	-80.9617000
Q204	MRF206	26.6069000	-81.6497000
Q205	MRF212	26.4239000	-80.1222000
Q206	MRF213	26.4167000	-80.2039000
Q207	MRF220	26.6844000	-80.3675000

Table 2g. 45-Day Rain Gage Names and coordinates (Q208-Q242)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q208	MRF250	26.7125000	-81.6297000
Q209	MRF27	27.8031000	-81.1981000
Q210	MRF300	26.7281000	-80.8533000
Q211	MRF301	26.7150000	-80.0622000
Q212	MRF32	27.6600000	-81.1342000
Q213	MRF38	27.4014000	-81.1147000
Q214	MRF39	27.3733000	-80.4506000
Q215	MRF40	27.3325000	-80.4967000
Q216	MRF50	27.0653000	-80.9778000
Q217	MRF5005	26.4072000	-81.4164000
Q218	MRF5006	26.5956000	-81.3353000
Q219	MRF5010	26.1844000	-81.3464000
Q220	MRF5022	26.9244000	-81.3139000
Q221	MRF5029	27.6081000	-80.4314000
Q222	MRF5034	27.2903000	-80.8269000
Q223	MRF5053	27.4103000	-80.3369000
Q224	MRF54	26.9044000	-80.3039000
Q225	MRF57	26.8419000	-80.6022000
Q226	MRF60	26.8083000	-81.0467000
Q227	MRF63	26.7350000	-80.8953000
Q228	MRF65	26.7744000	-80.6175000
Q229	MRF73C	26.6650000	-80.7011000
Q230	MRF78	26.6189000	-80.1264000
Q231	MRF80	26.6244000	-80.9483000
Q232	MRF81	26.6122000	-80.2050000
Q233	MRF84	26.5208000	-80.1239000
Q234	MRF85	26.5283000	-80.1703000
Q235	S133-R	27.2061000	-80.8008000
Q236	S65E+R	27.2253000	-80.9625000
Q237	S-157	27.8304000	-80.5397000
Q238	S-164	28.3406000	-80.9333000
Q239	S-252D	27.6389000	-80.6789000
Q240	BLACK CK MIDDLEBURG	30.0602000	-81.8488000
Q241	LK JOANNA	28.8345000	-81.6460000
Q242	KENANSVILLE	27.9630000	-81.0500000

5 RESULTS AND ANALYSIS

5.1 Oceanic ENSO Index

This chapter will discuss the results of trend analysis of precipitation extremes for different durations and the temporal variation in El Niño and La Niña phases. Previous research in chapter 2 shows that the influence of decadal and multi-decadal oscillation influences global climate conditions. This study encompasses the analysis of the influence of the various oscillations on regional precipitation extremes at various temporal durations and the statistical significance of the outcome. Table 3 shows historical data for El Niño and La Niña events since 1950 based on Oceanic Niño Index. Both El Niño and La Niña contain some period of weak, moderate, and strong events; however, El Niño registered data classified as very strong events for the period of 1982 – 83, 1997 – 98, and 2015 – 16.

Table 3 Oceanic ENSO Index

El Niño				La Niña		
Weak	Moderate	Strong	Very Strong	Weak	Moderate	Strong
1951 – 52	1963 - 64	1057 - 58	1982 – 83	1950 - 51	1955 - 56	1973 - 74
1952 – 53	1986 - 87	1965 - 66	1997 – 98	1954 - 55	1970 - 71	1975 - 76
1953 – 54	1987 - 88	1972 - 73	2015 – 2016	1964 - 65	1998 - 99	1988 - 89
1958 – 59	1991 - 92			1967 - 68	1999 - 00	
1968 – 69	2002 - 03			1971 - 72	2007 - 08	
1969 - 70	2009 - 10			1974 - 75	2010 - 11	
1976 – 77				1983 - 84		
1977 - 78				1995 - 96		
1979 - 80				2000 - 01		
1994 – 95				2011 - 12		

5.2 Trends

The study of the variation in rainfall precipitation in the state of Florida was done using the different techniques discussed in chapter 3. The data available for trend analysis are grouped into three categories: short term duration period containing 15-, 30-, and 45-minute data; the hourly periods; and the daily period. This analysis consists of a sequence of mean precipitation depth taken at successive equally space points each year.

5.2.1 Long-term Trends (Tampa Intl' AP)

The time series analysis of trend precipitation extremes in rain gages similar to the station located at Tampa international Airport are analyzed to determine whether there is an upward, downward or no change in rainfall precipitation recorded in the last century. Tampa WSCOM AP (27.9614, -82.5403) is among the rain gages containing the longest recorded data in the state of Florida. Based on the data collected from NOAA, the original precipitation depth collected and recorded form this site is dated September 13, 1843 and the most recent precipitation depth available for this site is dated March 12, 2010. Table 4a and 4b reflect the precipitation extremes collected from 1843 to 2010 at the aforementioned site. Since NOAA published the collected data in English units, a conversion factor of 25.4 is used in this study to convert the data from inch to millimeter.

Table 4a Rainfall Precipitation Depth Recorded at Tampa WSCOM/AP

Day-Month		Year	Precipitation (mm)	Day-Month	Year	Precipitation (mm)
13-Sep		1843	66	8-Sep	1912	124
30-May		1844	84	3-Aug	1913	65
5-Jul		1845	73	24-Jan	1914	80
6-May		1846	107	2-Aug	1915	115
10-Sep		1847	65	15-Nov	1916	71
13-Feb		1850	65	16-Oct	1917	61
9-Jun		1852	84	26-Nov	1918	61
31-Dec		1853	72	8-Jun	1919	74
7-Jun		1854	122	10-Jul	1920	74
10-Jun		1855	89	25-Oct	1921	128
17-Nov		1857	70	27-Oct	1922	62
8-Apr		1882	59	3-May	1923	87
20-Aug		1891	75	23-May	1924	79
14-Jan		1892	67	15-Jul	1925	128
9-Aug		1893	66	29-Mar	1926	67
19-Sep		1894	111	19-Feb	1927	70
15-Oct		1895	71	21-Jun	1928	70
28-Jun		1896	110	20-Jul	1929	79
21-Sep		1897	112	28-Mar	1930	137
22-Aug		1898	100	10-Sep	1931	101
25-Jul		1899	107	5-Sep	1933	146
12-Jun		1900	65	13-Jun	1934	166
24-May		1901	65	4-Sep	1935	160
20-Feb		1902	99	4-Jul	1936	90
12-Sep		1903	95	10-Feb	1937	129
23-Jan		1904	82	22-Jun	1938	77
20-Jun		1905	89	12-Aug	1939	77
22-May		1906	67	14-Jun	1940	66
10-Dec		1907	96	29-Jun	1941	90
27-Aug		1908	50	15-Jul	1942	55
29-Jun		1909	108	25-Jun	1943	101
29-Jun		1910	89	19-Oct	1944	92
28-Nov		1911	60	23-Jun	1945	251

Table 4b Rainfall Precipitation Depth Recorded at Tampa WSCOM/AP

Day-Month	Year	Precipitation (mm)	Day-Month	Year	Precipitation (mm)
19-Jul	1946	118	8-May	1979	268
18-Sep	1947	91	14-Apr	1980	53
24-Jan	1948	55	8-Feb	1981	84
12-Aug	1949	120	8-Jul	1982	90
5-Sep	1950	105	30-May	1983	89
7-Apr	1951	88	25-May	1984	59
26-Mar	1952	57	3-Sep	1985	113
21-Mar	1953	84	26-Oct	1986	76
14-Nov	1954	89	30-Sep	1987	73
1-Jul	1955	72	16-Aug	1988	102
8-May	1956	48	19-Jun	1989	45
25-Jul	1957	137	14-Jul	1990	66
26-Feb	1958	68	13-Jul	1991	90
17-Jun	1959	84	28-Aug	1992	84
29-Jul	1960	275	9-Oct	1993	43
3-Feb	1961	67	29-Jul	1994	73
20-Sep	1962	98	24-Jun	1995	120
10-Nov	1963	96	1-Jan	1996	86
26-Jul	1964	93	26-Sep	1997	191
31-Jul	1965	59	7-Jul	1998	118
8-Jun	1966	75	18-Aug	1999	45
12-Aug	1967	116	15-Jul	2000	59
18-Oct	1968	58	14-Sep	2001	153
16-May	1969	74	9-Dec	2002	93
8-Aug	1970	63	25-Apr	2003	92
15-May	1971	99	7-Aug	2004	114
19-Aug	1972	79	29-Jun	2005	76
25-Mar	1973	72	3-Feb	2006	194
26-Jun	1974	125	31-Jul	2007	85
18-Jun	1975	72	21-Jun	2008	80
15-May	1976	93	1-Jul	2009	118
22-Aug	1977	43	12-Mar	2010	48
18-Feb	1978	49			

The distribution of mean annual rainfall of Tampa WSCOM AP is shown in Figure 14. As expected, Tampa WSCOM AP station is no different to reflect the gradual increase in precipitation depth in daily period during hurricane season timeframe, which begin in June to finish in November of every year. As a long-term trend, it is not uncommon to record annual rainfalls that vary between 50 and 150 millimeters.

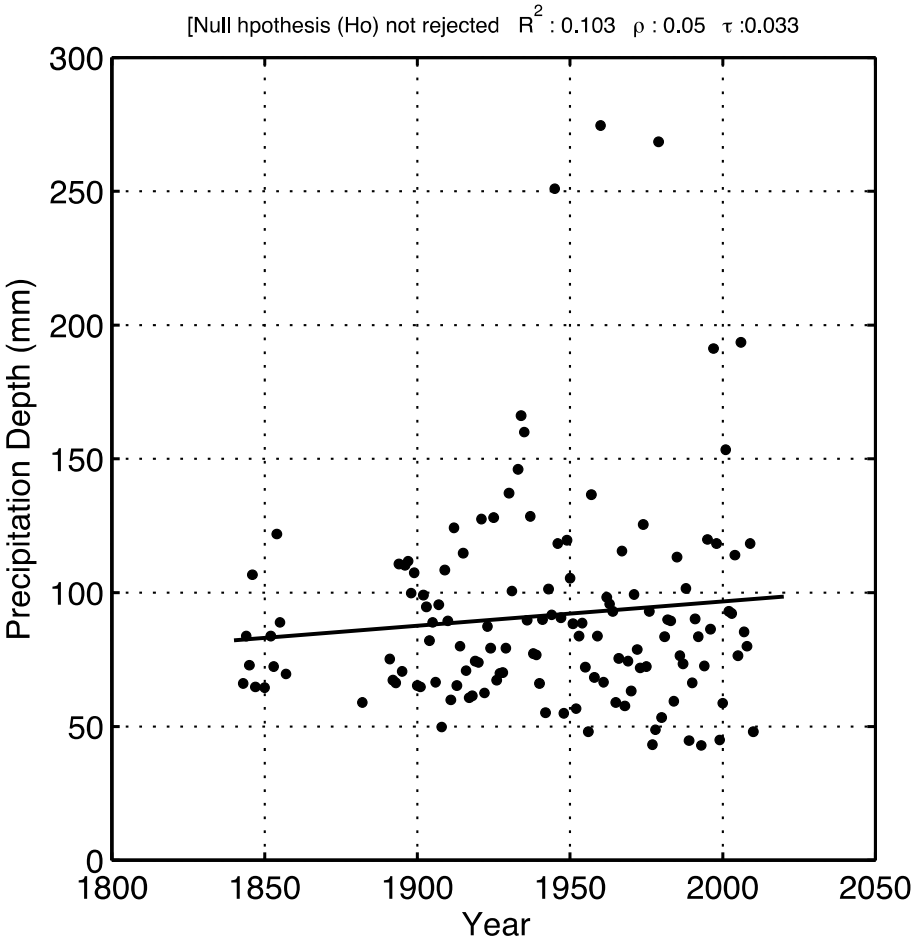


Figure 13 Mean Annual Rainfalls, Tampa WSCOM/AP

Several recorded precipitation extremes data are due to tropical storms or hurricanes. The three greatest precipitation extremes were recorded in 1945, 1960, and 1979.

Saffir-Simpson Hurricane Wind Scale/National Weather Service (SSHWS/NWS) classified the 1945 Outer Bank hurricane as a category-2 hurricane that was developed into the Gulf of Mexico and eventually turned northeast toward the Florida peninsula. After making landfall, that hurricane weakened to a tropical storm producing heavy rainfall over land. At the rain gage Tampa WSCOM AP a precipitation extreme of 251 millimeters (9.88 inches) was recorded on June 23, 1945. The occurrence of that rainfall over land contributed to the recovery from one of the worst recorded droughts in the state. The maximum rainfall of record 275 millimeters (10.81 inches) was logged in that station and it was a result of tropical storm Brenda that was developed in the northeastern Gulf of Mexico on July 29, 1960. The second highest precipitation extreme, 268 millimeters (10.57 inches), was recorded in that station on May 8, 1979. According to Stowers and Levasseur, the first six months of 1979 provided the Tampa Bay area with its share of anomalous weather patterns that not only confused and amazed professional meteorologists, but served the complacent pubic with notice that "it can happen here!" (Stowers et al.). Long-term precipitation trend at this site reveals that vast majority of the data points vary between 50 and 150 millimeters; thus the necessity to determine the statistical significance of this outcome.

5.2.2 Short-duration Precipitation Trend Analysis (S18C-R)

In this study, short-term duration analysis entails the analysis of data collected in less than a day. This analysis is important as it provides inputs as to whether there is a reasonable unwavering relationship that governs the intensity characteristics of this category.

Generally, recorded data for short-term duration rainfall from NOAA is available from 1950. The data are being collected in 47 stations throughout the state. As shown in Table 5 the first recorded data for station S18C-R (25.3306, -80.5250) located in the Everglades National Park near Homestead is dated 1968.

Table 5 Rainfall Precipitation Depth Recorded at S18C-R

Day-Month	Year	Precipitation (mm)	Day-Month	Year	Precipitation (mm)
19-Jun	1968	25	28-Sep	1990	9
5-Jun	1969	25	23-May	1991	28
5-Jul	1970	24	26-Jun	1992	45
2-Sep	1971	25	20-Jul	1993	15
12-Jul	1972	27	9-Oct	1994	21
23-Jun	1973	30	6-Oct	1995	18
1-Oct	1974	29	23-Jun	1996	13
2-Aug	1975	31	9-Jun	1997	56
11-Sep	1976	20	16-Sep	1998	39
8-May	1977	21	19-Jun	1999	43
30-Jun	1978	22	11-Sep	2000	26
28-May	1979	26	1-Aug	2001	27
31-Aug	1980	19	8-Aug	2002	30
18-Aug	1981	26	27-Mar	2003	23
25-Jun	1983	16	3-Jul	2004	21
29-May	1984	13	6-Aug	2005	22
3-Sep	1986	12	16-Sep	2006	39
25-Jun	1987	15	9-Sep	2007	41
15-Aug	1988	27	22-May	2008	38
22-May	1989	17			

The most rainfall data recorded in station S18C-R is 56 millimeters, on June 9, 1997. Consistently with other site locations of this category, that peak in precipitation extreme was not due to hurricane or any type of tropical storms. Because the longest short-duration precipitation extremes data available from NOAA is dated 1960, Figure 15

presents graphical representation figures of the precipitation depth and the year ranging from 1960 to 2010.

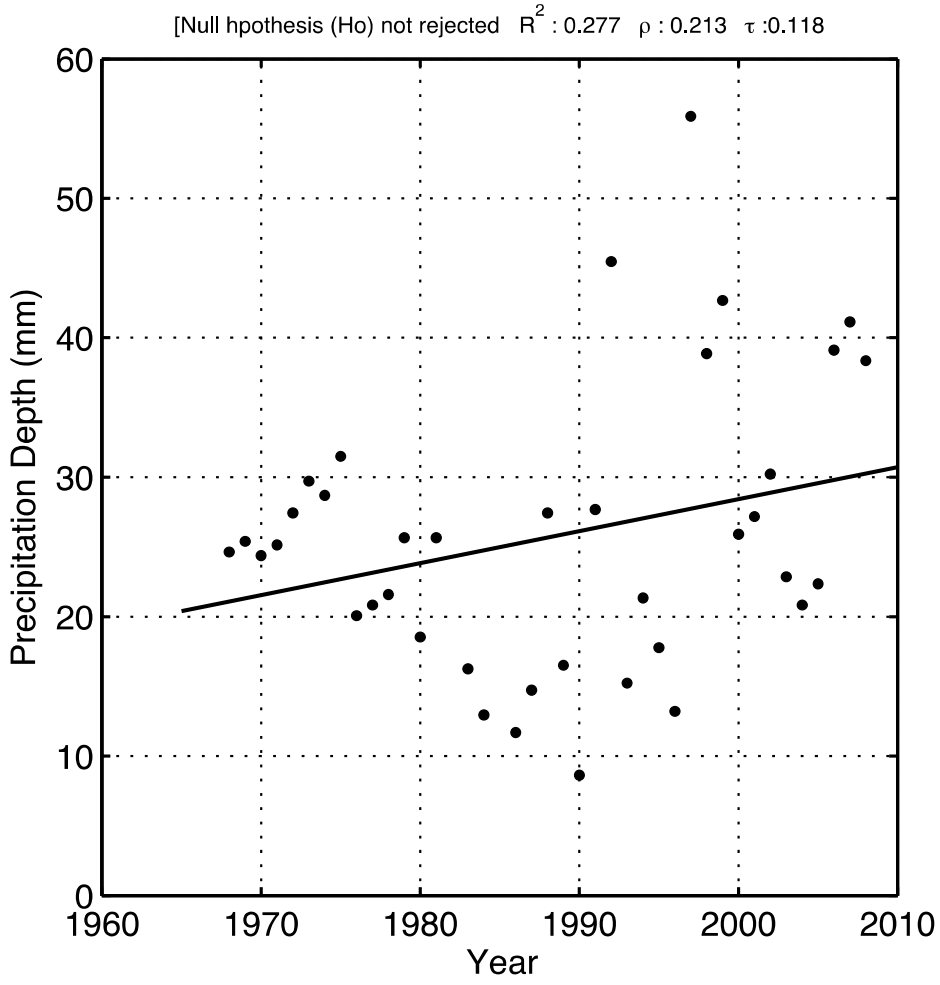


Figure 14 Mean Annual Rainfalls – Rain Gage S18C-R

Long-term precipitation trend at this site reveals that vast majority of the data maintain a variation between the range of 10 to 40 millimeters, which also a call for the necessity to determine the statistical significance of this outcome.

5.2.3 Variations in extremes in different phases

To understand the scattered plots, one needs to look at the overall pattern of the points, which constitutes the bulk representation of the form and orientation of the relationship between the variables. The larger values of the time also known as explanatory variables associated with large values of the precipitation or response variables are a reflection of positive change in the precipitation data, thus, as we move from left to right the precipitation data gradually increase. Conversely, when the larger values of the variable time are associated with smaller values of the response variables, it is said to be the reflection of negative change. The interpretation of the patterns heavily depends on variations and how tightly clustered the points are around the underlying form.

As stated in the previous chapter, the data are grouped in the following three categories: short-duration periods consisting of 15-minute, 30-minute, and 45-minute containing 72 rain gages or stations each; the hourly periods consisting 1-hour, 2-hour, 3-hour, 6-hour and 12-hour containing 112 stations each; and finally the daily periods consisting of 1-day, 2-day, 3-day, 7-day, 10-day, 20-day, 30-day, 45-day, and 60-day containing 242 stations each. Using the two non-parametric coefficient correlation methods discussed in chapter 3, an analysis is completed and returns a graph of each station for every duration period. Vast majority of the outcomes for both ρ and τ correspond to numerical values that fluctuate from very weak to moderate strength in the orientation of the data.

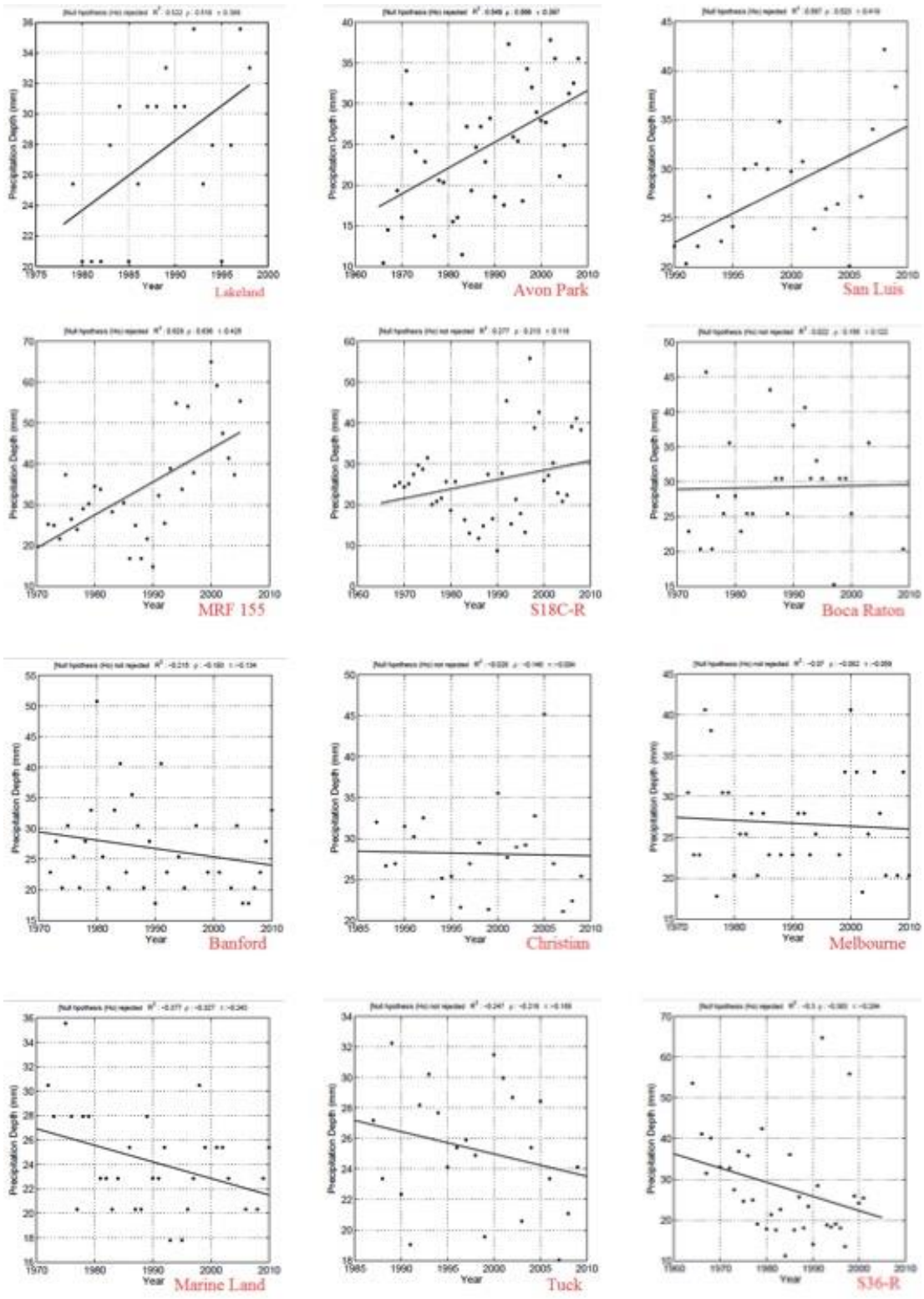


Figure 16a Trends in Short-durations Precipitation Depths at Different gages

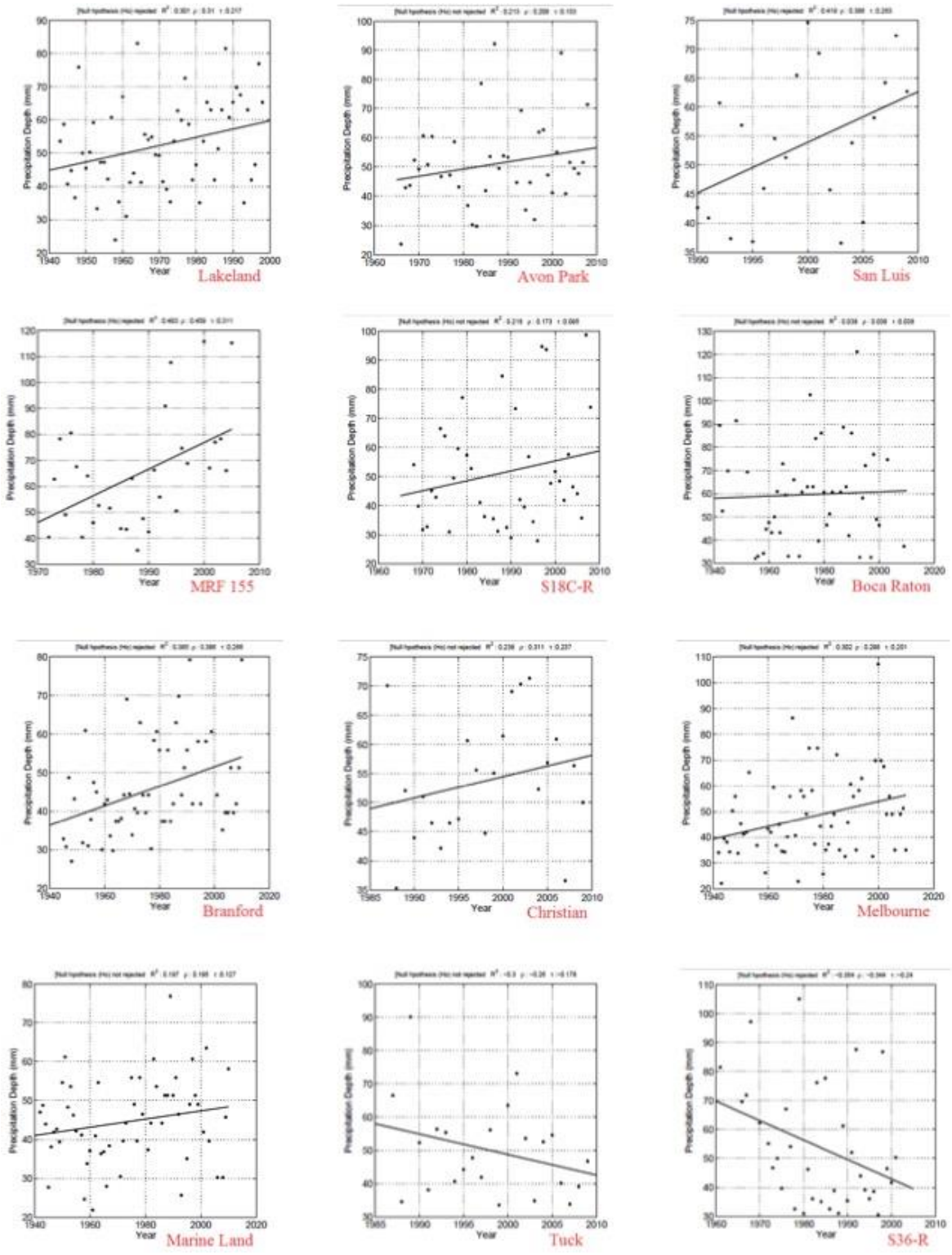


Figure 16b Trends in Hourly Precipitation Depths at Different gages

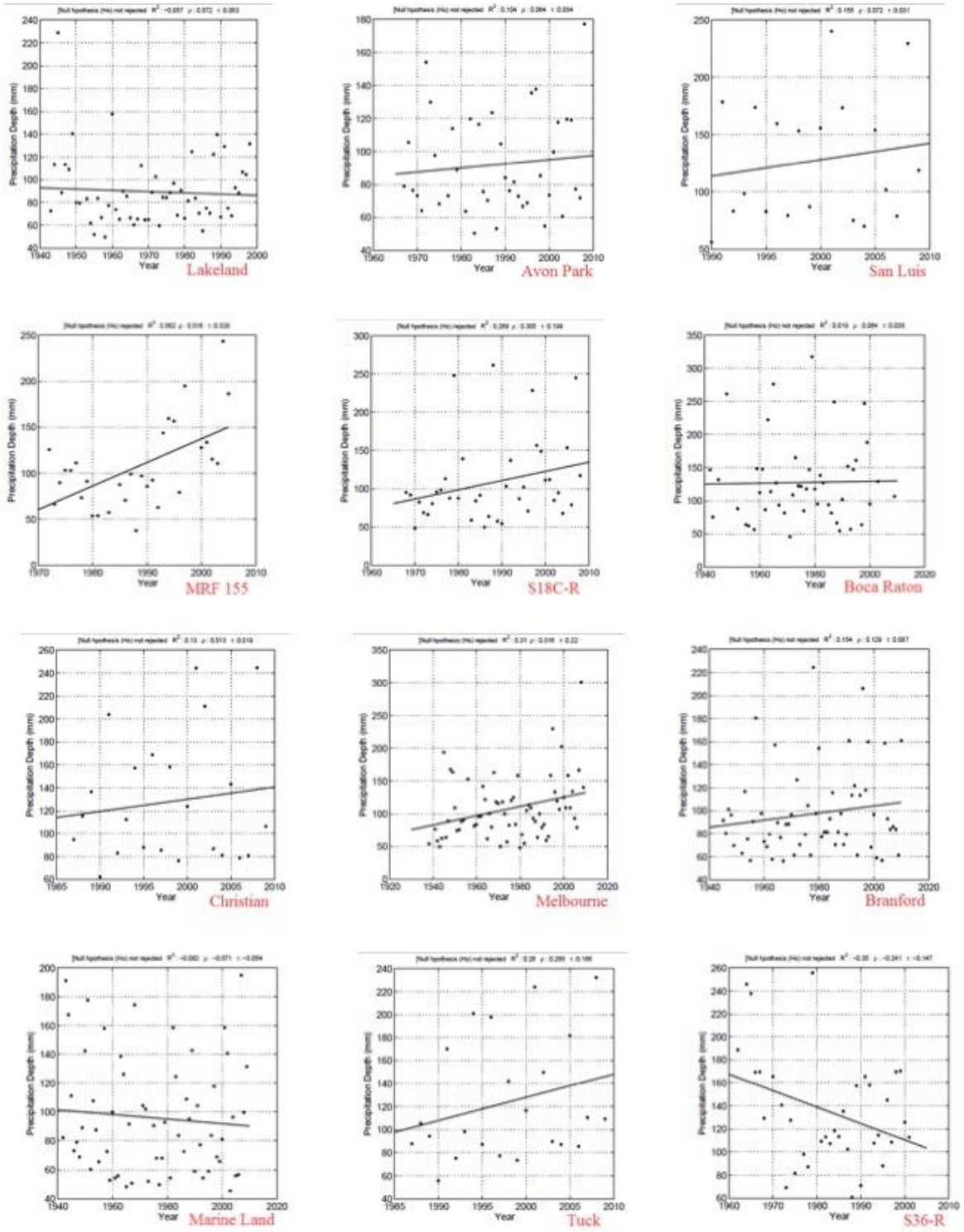


Figure 16c Trends in Daily Precipitation Depths at Different gages

The essential argument of using correlation coefficient methods in this study lie in the attempt to measure how well a linear model can describe the relationship between time and precipitation. To facilitate an overall view of the orientation of the precipitation data GIS automatically generates a superimposed line on the scattered points of each graph. The line superimposed on the scattered plot is useful for interpreting trends in the data in the following approaches:

- As you move from left to right, data set showing an upward trend reveals indication of some positive relationship between time and precipitation. As time increase, this approach anticipates an increase in precipitation.
- As you move from left to right, data set showing a downward trend reveals indication of some negative relationship between time and precipitation. As time increase, this approach anticipates a decrease in precipitation.
- When a data set show no consistent behavior or any discernment patterns in increasing or decreasing trend, one can assert that no relationship exists between time and precipitation.

Out of consideration for convenience and consistency, the 12 stations shown in Figure 16a-16c are randomly selected out of the 242 stations analyzed in this study. As shown in the superimposed lines, some stations clearly depict apparent increasing or decreasing trend while others present more of a challenge to visualize the orientation of the trend. Since the same stations are being considered for all three categories, comparative analysis and the characteristics of the stations are eminent. The upward or downward trend shown

in stations such as San Luis or S36-R is consistent for all categories, whereas vast majority of stations such as Tuck present both upward and downward trend at different category.

5.2.4 Mann-Kendall vs. Spearman Trend Analysis

The statistical trend analysis methods Spearman and Mann-Kendall tests are conducted to confirm whether one can assert with certainty that any increase or any decrease in a set of data is statistically significant, otherwise there is no trend in the data. Though the analyses were conducted separately, both Spearman and Mann-Kendall tests yield similar results. As shown in Table 6a-6h, in several cases the null hypothesis (H_o) is not rejected, which implies that the upward trend of rainfall data does not reach the threshold level of probability set forth, thus these stations are NOT statistically significant. While the time series data are independent and identically distributed, the null hypothesis (H_o) not being rejected is an indication that there is no trend in these stations over time.

Table 6a 60-day Mann-Kendall vs. Spearman Trend Analysis

ID	P-value	Hypothesis (Spearman)	Spearman's ρ	Kendall's τ	P-value	Hypothesis (Mann-Kendall)	Hypothesis (RunsTest)
R1	0.815	H_o	0.036	0.026	0.807	H_o	H_o
R2	0.358	H_o	0.180	0.095	0.489	H_o	H_o
R3	0.520	H_o	0.116	0.083	0.505	H_o	H_o
R4	0.704	H_o	0.075	0.080	0.567	H_o	H_o
R5	0.665	H_o	-0.077	-0.052	0.678	H_o	H_o
R6	0.801	H_o	0.042	0.026	0.828	H_o	H_o
R7	0.903	H_o	0.024	0.025	0.866	H_o	H_o
R8	0.109	H_o	0.322	0.228	0.108	H_o	H_o
R9	0.222	H_o	-0.218	-0.123	0.321	H_o	H_o
R10	0.954	H_o	-0.009	-0.018	0.868	H_o	H_o
R11	0.104	H_o	0.284	0.209	0.085	H_o	H_o
R12	0.006	H_a	0.433	0.317	0.005	H_a	H_o
R13	0.000	H_a	0.624	0.448	0.001	H_a	H_a
R14	0.766	H_o	-0.057	0.005	0.986	H_o	H_o
R15	0.203	H_o	0.282	0.203	0.195	H_o	H_o
R16	0.451	H_o	-0.136	-0.082	0.515	H_o	H_o
R17	0.567	H_o	-0.106	-0.110	0.395	H_o	H_a
R18	0.284	H_o	-0.198	-0.118	0.359	H_o	H_o
R19	0.033	H_a	0.339	0.214	0.053	H_o	H_o
R20	0.544	H_o	-0.124	-0.108	0.454	H_o	H_o
R21	0.819	H_o	-0.036	-0.017	0.879	H_o	H_o
R22	0.962	H_o	-0.008	-0.008	0.948	H_o	H_o
R23	0.222	H_o	0.258	0.159	0.286	H_o	H_o
R24	0.868	H_o	0.030	0.015	0.914	H_o	H_o
R25	0.004	H_a	0.507	0.359	0.005	H_a	H_o
R26	0.809	H_o	0.053	0.055	0.712	H_o	H_a
R27	0.894	H_o	-0.030	-0.004	1.000	H_o	H_o
R28	0.771	H_o	0.027	0.020	0.612	H_o	H_o
R29	0.582	H_o	0.121	0.087	0.597	H_o	H_o
R30	0.624	H_o	0.108	0.083	0.597	H_o	H_o
R31	0.745	H_o	-0.075	-0.067	0.672	H_o	H_o
R32	1.000	H_o	0.000	-0.011	0.974	H_o	H_o

Table 6b 60-day Mann-Kendall vs. Spearman Trend Analysis

ID	P-value	Hypothesis (Spearman)	Spearman's ρ	Kendall's τ	P-value	Hypothesis (Mann-Kendall)	Hypothesis (RunsTest)
R33	0.457	H_o	-0.181	-0.099	0.576	H_o	H_o
R34	0.555	H_o	0.140	0.126	0.456	H_o	H_o
R35	0.777	H_o	0.068	0.074	0.673	H_o	H_o
R36	0.907	H_o	0.019	0.034	0.762	H_o	H_o
R37	0.021	H_a	0.438	0.312	0.021	H_a	H_o
R38	0.390	H_o	0.127	0.105	0.298	H_o	H_o
R39	0.864	H_o	-0.022	-0.018	0.842	H_o	H_o
R40	0.065	H_o	-0.172	-0.111	0.077	H_o	H_o
R41	0.738	H_o	-0.048	-0.025	0.795	H_o	H_o
R42	0.960	H_o	-0.005	-0.001	0.998	H_o	H_o
R43	0.574	H_o	0.084	0.061	0.545	H_o	H_o
R44	0.252	H_o	0.144	0.099	0.248	H_o	H_o
R45	0.461	H_o	0.101	0.069	0.463	H_o	H_o
R46	0.733	H_o	-0.064	-0.052	0.696	H_o	H_o
R47	0.474	H_o	-0.077	-0.053	0.462	H_o	H_o
R48	0.207	H_o	0.156	0.091	0.277	H_o	H_o
R49	0.207	H_o	0.156	0.091	0.277	H_o	H_o
R50	0.005	H_a	-0.401	-0.256	0.010	H_a	H_o
R51	0.009	H_a	-0.333	-0.254	0.004	H_a	H_a
R52	0.702	H_o	0.054	0.035	0.717	H_o	H_o
R53	0.169	H_o	0.216	0.177	0.102	H_o	H_o
R54	0.097	H_o	0.373	0.324	0.043	H_a	H_o
R55	0.143	H_o	0.315	0.217	0.154	H_o	H_o
R56	0.152	H_o	-0.148	-0.097	0.164	H_o	H_o
R57	0.815	H_o	-0.024	-0.011	0.880	H_o	H_o
R58	0.387	H_o	0.137	0.092	0.392	H_o	H_a
R59	0.787	H_o	0.027	0.023	0.725	H_o	H_o
R60	0.923	H_o	0.015	0.017	0.879	H_o	H_o
R61	0.098	H_o	-0.152	-0.098	0.116	H_o	H_o
R62	0.242	H_o	-0.203	-0.150	0.211	H_o	H_o
R63	0.554	H_o	-0.065	-0.044	0.554	H_o	H_o
R64	0.696	H_o	-0.057	-0.058	0.564	H_o	H_o

Table 6c 60-day Mann-Kendall vs. Spearman Trend Analysis

ID	P-value	Hypothesis (Spearman)	Spearman's ρ	Kendall's τ	P-value	Hypothesis (Mann-Kendall)	Hypothesis (RunsTest)
R65	0.759	H_o	-0.040	-0.024	0.784	H_o	H_o
R66	0.440	H_o	0.079	0.052	0.454	H_o	H_o
R67	0.319	H_o	0.141	0.093	0.340	H_o	H_o
R68	0.065	H_o	-0.172	-0.111	0.077	H_o	H_o
R69	0.566	H_o	-0.077	-0.056	0.537	H_o	H_o
R70	0.191	H_o	-0.172	-0.114	0.205	H_o	H_o
R71	0.300	H_o	0.126	0.080	0.330	H_o	H_o
R72	0.934	H_o	-0.010	-0.006	0.942	H_o	H_o
R73	0.393	H_o	0.107	0.082	0.336	H_o	H_o
R74	0.364	H_o	0.113	0.077	0.360	H_o	H_o
R75	0.430	H_o	-0.136	-0.097	0.406	H_o	H_o
R76	0.252	H_o	-0.190	-0.152	0.183	H_o	H_o
R77	0.544	H_o	0.079	0.042	0.636	H_o	H_o
R78	0.142	H_o	0.257	0.186	0.123	H_o	H_o
R79	0.460	H_o	0.122	0.078	0.490	H_o	H_o
R80	0.466	H_o	-0.089	-0.055	0.511	H_o	H_o
R81	0.951	H_o	-0.009	-0.006	0.960	H_o	H_o
R82	0.786	H_o	0.037	0.025	0.788	H_o	H_o
R83	0.544	H_o	-0.073	-0.047	0.556	H_o	H_o
R84	0.544	H_o	-0.073	-0.047	0.556	H_o	H_o
R85	0.386	H_o	-0.087	-0.053	0.433	H_o	H_o
R86	0.524	H_o	0.065	0.049	0.480	H_o	H_a
R87	0.699	H_o	-0.048	-0.026	0.762	H_o	H_o
R88	0.419	H_o	0.112	0.075	0.429	H_o	H_o
R89	0.780	H_o	0.054	0.030	0.837	H_o	H_o
R90	0.921	H_o	-0.011	-0.007	0.931	H_o	H_o
R91	0.621	H_o	-0.046	-0.029	0.643	H_o	H_o
R92	0.370	H_o	0.087	0.061	0.347	H_o	H_o
R93	0.499	H_o	-0.093	-0.064	0.495	H_o	H_o
R94	0.189	H_o	0.193	0.129	0.197	H_o	H_o
R95	0.035	H_a	0.272	0.188	0.034	H_a	H_o
R96	0.450	H_o	0.079	0.061	0.385	H_o	H_o

Table 6d 60-day Mann-Kendall vs. Spearman Trend Analysis

ID	P-value	Hypothesis (Spearman)	Spearman's ρ	Kendall's τ	P-value	Hypothesis (Mann-Kendall)	Hypothesis (RunsTest)
R97	0.045	H_a	0.190	0.128	0.046	H_a	H_a
R98	0.685	H_o	-0.039	-0.025	0.708	H_o	H_o
R99	0.014	H_a	-0.257	-0.174	0.978	H_o	H_o
R100	0.495	H_o	-0.086	-0.058	0.493	H_o	H_o
R101	0.702	H_o	-0.041	-0.042	0.556	H_o	H_o
R102	0.604	H_o	-0.089	-0.052	0.663	H_o	H_o
R103	0.303	H_o	0.182	0.132	0.286	H_o	H_o
R104	0.210	H_o	0.150	0.098	0.230	H_o	H_o
R105	0.461	H_o	-0.093	-0.062	0.469	H_o	H_o
R106	0.657	H_o	-0.074	-0.053	0.651	H_o	H_o
R107	0.478	H_o	-0.099	-0.065	0.495	H_o	H_o
R108	0.955	H_o	-0.006	-0.010	0.897	H_o	H_o
R109	0.129	H_o	-0.196	-0.127	0.149	H_o	H_o
R110	0.767	H_o	-0.045	-0.015	0.887	H_o	H_o
R111	0.019	H_a	-0.353	-0.262	0.012	H_a	H_o
R112	0.965	H_o	-0.004	-0.005	0.945	H_o	H_o
R113	0.254	H_o	0.141	0.085	0.312	H_o	H_o
R114	0.886	H_o	-0.012	-0.009	0.367	H_o	H_o
R115	0.330	H_o	0.082	0.050	0.375	H_o	H_o
R116	0.778	H_o	0.031	0.024	0.753	H_o	H_o
R117	0.535	H_o	0.051	0.036	0.515	H_o	H_o
R118	0.668	H_o	-0.041	-0.028	0.670	H_o	H_o
R119	0.506	H_o	0.081	0.058	0.481	H_o	H_o
R120	0.712	H_o	-0.044	-0.025	0.755	H_o	H_o
R121	0.400	H_o	0.078	0.054	0.385	H_o	H_o
R122	0.637	H_o	0.084	0.055	0.657	H_o	H_o
R123	0.872	H_o	0.020	0.023	0.788	H_o	H_o
R124	0.318	H_o	-0.128	-0.079	0.361	H_o	H_o
R125	0.489	H_o	-0.106	-0.072	0.487	H_o	H_o
R126	0.653	H_o	-0.055	-0.032	0.702	H_o	H_o
R127	0.591	H_o	-0.054	-0.040	0.551	H_o	H_o
R128	1.000	H_o	0.000	0.006	0.958	H_o	H_o

Table 6e 60-day Mann-Kendall vs. Spearman Trend Analysis

ID	P-value	Hypothesis (Spearman)	Spearman's ρ	Kendall's τ	P-value	Hypothesis (Mann-Kendall)	Hypothesis (RunsTest)
R129	0.097	H_o	-0.215	-0.144	0.102	H_o	H_a
R130	0.050	H_a	0.254	0.180	0.044	H_a	H_o
R131	0.399	H_o	0.105	0.066	0.436	H_o	H_o
R132	0.209	H_o	0.169	0.124	0.175	H_o	H_o
R133	0.004	H_a	-0.304	-0.196	0.005	H_a	H_o
R134	0.590	H_o	0.064	0.049	0.538	H_o	H_o
R135	0.016	H_a	-0.254	-0.175	0.015	H_a	H_o
R136	0.560	H_o	-0.080	-0.052	0.577	H_o	H_o
R137	0.320	H_o	0.133	0.081	0.369	H_o	H_o
R138	0.474	H_o	-0.077	-0.053	0.462	H_o	H_o
R139	0.514	H_o	-0.070	-0.041	0.568	H_o	H_o
R140	0.261	H_o	-0.121	-0.079	0.278	H_o	H_o
R141	0.955	H_o	-0.008	-0.005	0.950	H_o	H_o
R142	0.287	H_o	0.135	0.097	0.261	H_o	H_o
R143	0.805	H_o	0.032	0.030	0.728	H_o	H_o
R144	0.846	H_o	0.025	0.015	0.861	H_o	H_o
R145	0.159	H_o	0.159	0.107	0.164	H_o	H_o
R146	0.437	H_o	0.144	0.097	0.455	H_o	H_o
R147	0.182	H_o	-0.125	-0.081	0.199	H_o	H_o
R148	0.469	H_o	0.097	0.084	0.358	H_o	H_o
R149	0.912	H_o	-0.015	-0.014	0.883	H_o	H_o
R150	0.886	H_o	-0.015	-0.007	0.927	H_o	H_o
R151	0.886	H_o	-0.015	-0.007	0.927	H_o	H_o
R152	0.013	H_a	0.297	0.211	0.011	H_a	H_o
R153	0.293	H_o	-0.128	-0.086	0.296	H_o	H_o
R154	0.074	H_o	-0.255	-0.164	0.093	H_o	H_o
R155	0.478	H_o	0.078	0.059	0.432	H_o	H_o
R156	0.407	H_o	-0.107	-0.081	0.356	H_o	H_o
R157	0.055	H_o	0.171	0.114	0.060	H_o	H_o
R158	0.729	H_o	0.063	0.042	0.745	H_o	H_o
R159	0.090	H_o	-0.203	-0.138	0.088	H_o	H_o
R160	0.822	H_o	-0.022	-0.013	0.848	H_o	H_o

Table 6f 60-day Mann-Kendall vs. Spearman Trend Analysis

ID	P-value	Hypothesis (Spearman)	Spearman's ρ	Kendall's τ	P-value	Hypothesis (Mann-Kendall)	Hypothesis (RunsTest)
R161	0.742	H_o	0.035	0.026	0.719	H_o	H_o
R162	0.822	H_o	-0.024	-0.012	0.862	H_o	H_o
R163	0.080	H_o	-0.200	-0.147	0.057	H_o	H_a
R164	0.668	H_o	0.057	0.028	0.763	H_o	H_o
R165	0.496	H_o	-0.066	-0.049	0.434	H_o	H_o
R166	0.171	H_o	-0.129	-0.081	0.198	H_o	H_o
R167	0.695	H_o	0.056	0.045	0.642	H_o	H_o
R168	0.264	H_o	0.179	0.134	0.221	H_o	H_o
R169	0.729	H_o	-0.036	-0.029	0.678	H_o	H_o
R170	0.656	H_o	0.058	0.044	0.627	H_o	H_o
R171	0.936	H_o	-0.012	-0.016	0.880	H_o	H_o
R172	0.229	H_o	-0.218	-0.153	0.224	H_o	H_o
R173	0.349	H_o	0.152	0.131	0.239	H_o	H_o
R174	0.715	H_o	-0.045	-0.026	0.756	H_o	H_o
R175	0.042	H_a	0.191	0.124	0.052	H_o	H_o
R176	0.341	H_o	-0.124	-0.078	0.380	H_o	H_o
R177	0.089	H_o	-0.148	-0.098	0.096	H_o	H_o
R178	0.876	H_o	0.015	0.013	0.836	H_o	H_o
R179	0.615	H_o	0.064	0.050	0.560	H_o	H_o
R180	0.845	H_o	0.020	0.010	0.886	H_o	H_o
R181	0.612	H_o	-0.072	-0.038	0.699	H_o	H_o
R182	0.048	H_a	0.241	0.167	0.045	H_a	H_o
R183	0.837	H_o	-0.027	-0.021	0.813	H_o	H_o
R184	0.972	H_o	0.004	0.001	0.996	H_o	H_o
R185	0.761	H_o	-0.036	-0.028	0.721	H_o	H_o
R186	0.628	H_o	-0.059	-0.041	0.616	H_o	H_o
R187	0.177	H_o	-0.168	-0.103	0.226	H_o	H_o
R188	0.038	H_a	-0.280	-0.193	0.038	H_a	H_o
R189	0.724	H_o	-0.045	-0.030	0.730	H_o	H_o
R190	0.295	H_o	-0.166	-0.114	0.293	H_o	H_o
R191	0.492	H_o	-0.085	-0.064	0.436	H_o	H_o
R192	0.000	H_a	-0.426	-0.296	0.000	H_a	H_o

Table 6g 60-day Mann-Kendall vs. Spearman Trend Analysis

ID	P-value	Hypothesis (Spearman)	Spearman's ρ	Kendall's τ	P-value	Hypothesis (Mann-Kendall)	Hypothesis (Runs Test)
R193	0.782	H_o	-0.039	-0.039	0.682	H_o	H_o
R194	0.802	H_o	0.038	0.029	0.783	H_o	H_o
R195	0.294	H_o	0.192	0.119	0.347	H_o	H_o
R196	0.049	H_a	-0.225	-0.159	0.041	H_a	H_o
R197	0.042	H_a	-0.250	-0.172	0.040	H_a	H_o
R198	0.337	H_o	-0.137	-0.096	0.322	H_o	H_o
R199	0.491	H_o	-0.099	-0.049	0.609	H_o	H_o
R200	0.089	H_o	-0.288	-0.204	0.084	H_o	H_o
R201	0.424	H_o	0.128	0.088	0.425	H_o	H_o
R202	0.052	H_o	-0.250	-0.182	0.039	H_a	H_a
R203	0.020	H_a	-0.264	-0.172	0.026	H_a	H_o
R204	0.491	H_o	-0.109	-0.074	0.495	H_o	H_o
R205	0.024	H_a	0.386	0.253	0.037	H_a	H_o
R206	0.657	H_o	-0.062	-0.044	0.651	H_o	H_o
R207	0.173	H_o	-0.209	-0.158	0.134	H_o	H_o
R208	0.033	H_a	0.334	0.232	0.035	H_a	H_o
R209	0.549	H_o	0.081	0.058	0.527	H_o	H_o
R210	0.195	H_o	-0.164	-0.123	0.152	H_o	H_o
R211	0.865	H_o	0.023	0.016	0.862	H_o	H_o
R212	0.041	H_a	0.313	0.195	0.067	H_o	H_o
R213	0.925	H_o	-0.013	-0.016	0.865	H_o	H_o
R214	0.621	H_o	-0.083	-0.078	0.497	H_o	H_o
R215	0.063	H_o	0.323	0.205	0.091	H_o	H_o
R216	0.457	H_o	-0.126	-0.075	0.522	H_o	H_o
R217	0.774	H_o	-0.047	-0.045	0.692	H_o	H_o
R218	0.447	H_o	0.130	0.095	0.422	H_o	H_o
R219	0.423	H_o	0.125	0.073	0.496	H_o	H_o
R220	0.590	H_o	-0.082	-0.063	0.551	H_o	H_o
R221	0.586	H_o	-0.091	-0.063	0.589	H_o	H_o
R222	0.966	H_o	-0.006	-0.013	0.888	H_o	H_o
R223	0.616	H_o	-0.084	-0.046	0.706	H_o	H_o
R224	0.013	H_a	0.353	0.254	0.010	H_a	H_o

Table 6h 60-day Mann-Kendall vs. Spearman Trend Analysis

ID	P-value	Hypothesis (Spearman)	Spearman's ρ	Kendall's τ	P-value	Hypothesis (Mann-Kendall)	Hypothesis (RunsTest)
R225	0.853	H_o	-0.027	-0.017	0.865	H_o	H_o
R226	0.318	H_o	-0.152	-0.112	0.278	H_o	H_a
R227	0.188	H_o	-0.167	-0.101	0.240	H_o	H_o
R228	0.062	H_o	-0.212	-0.153	0.048	H_a	H_o
R229	0.000	H_a	-0.422	-0.292	0.000	H_a	H_o
R230	0.115	H_o	-0.219	-0.137	0.151	H_o	H_o
R231	0.020	H_a	-0.364	-0.256	0.019	H_a	H_o
R232	0.151	H_o	-0.204	-0.133	0.172	H_o	H_o
R233	0.928	H_o	-0.013	-0.006	0.957	H_o	H_o
R234	0.609	H_o	0.072	0.046	0.629	H_o	H_o
R235	0.511	H_o	-0.082	-0.054	0.521	H_o	H_o
R236	0.025	H_a	-0.279	-0.179	0.036	H_a	H_o
R237	0.294	H_o	0.177	0.123	0.289	H_o	H_o
R238	0.308	H_o	0.189	0.157	0.221	H_o	H_o
R239	0.892	H_o	0.016	0.005	0.948	H_o	H_o
R240	0.842	H_o	0.033	0.001	1.000	H_o	H_o
R241	0.221	H_o	-0.134	-0.090	0.225	H_o	H_o
R242	0.725	H_o	0.045	0.041	0.644	H_o	H_o

The presence of the alternate hypothesis (H_a) at some stations indicate that a trend exists and that data increase or decrease with time at these locations.

Figure 17 shows the Florida map and the rain gage locations for a typical daily category. The outcome of the statistical analysis performed in the indicated locations is represented in three different marks. While some rain gages display dark circle revealing that the trend at these stations are statistical significantly increasing, others display gray circle revealing that the trend at these stations statistical significantly decreasing. Most of the stations display a hollow circle, which reveals no change in these stations over time.

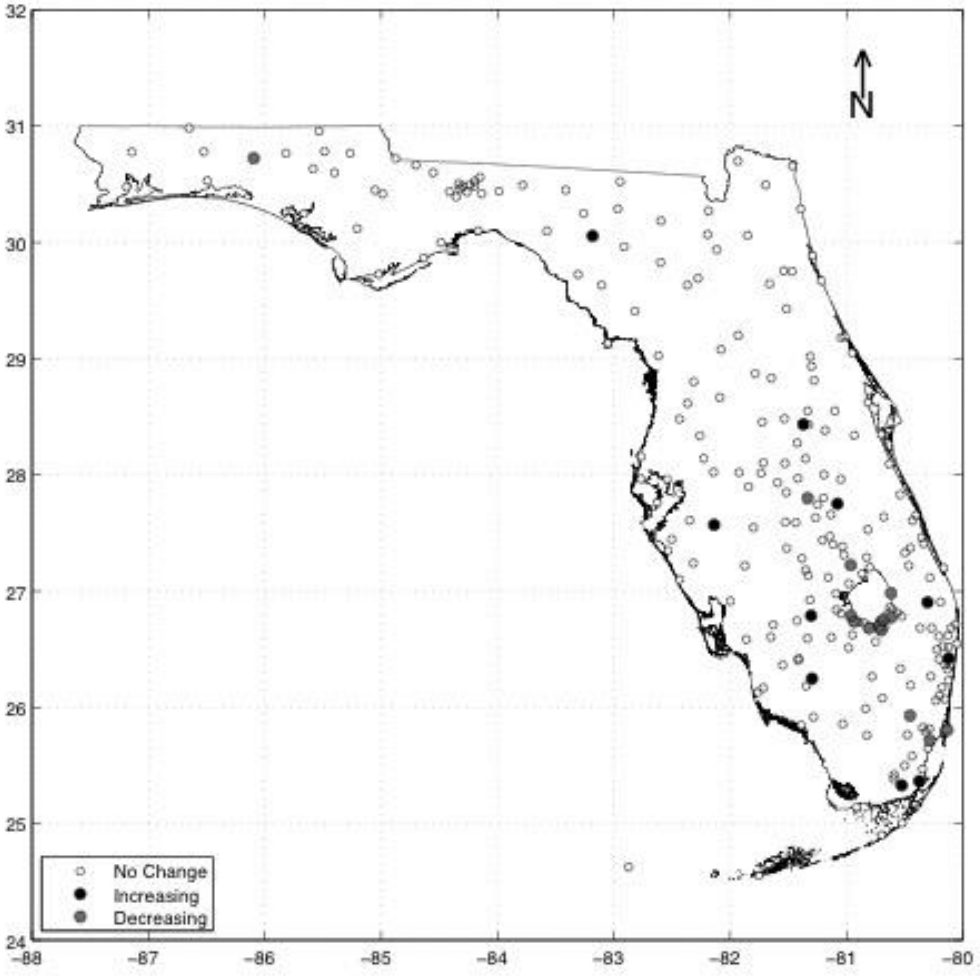


Figure 17 Statistical Trend Analysis of the Trend in Florida Rain Gages

5.3 Spearman Analysis

For the sake of the readability of the illustrations in this study, maps showing the outcome of the short-duration, hourly, and daily statistical trend analysis results using Spearman test method are shown in Figure 18a-18d. All 3 categories periods follow

relatively similar patterns having stations with statistical significant increase near the coastal areas and the lake Okeechobee.

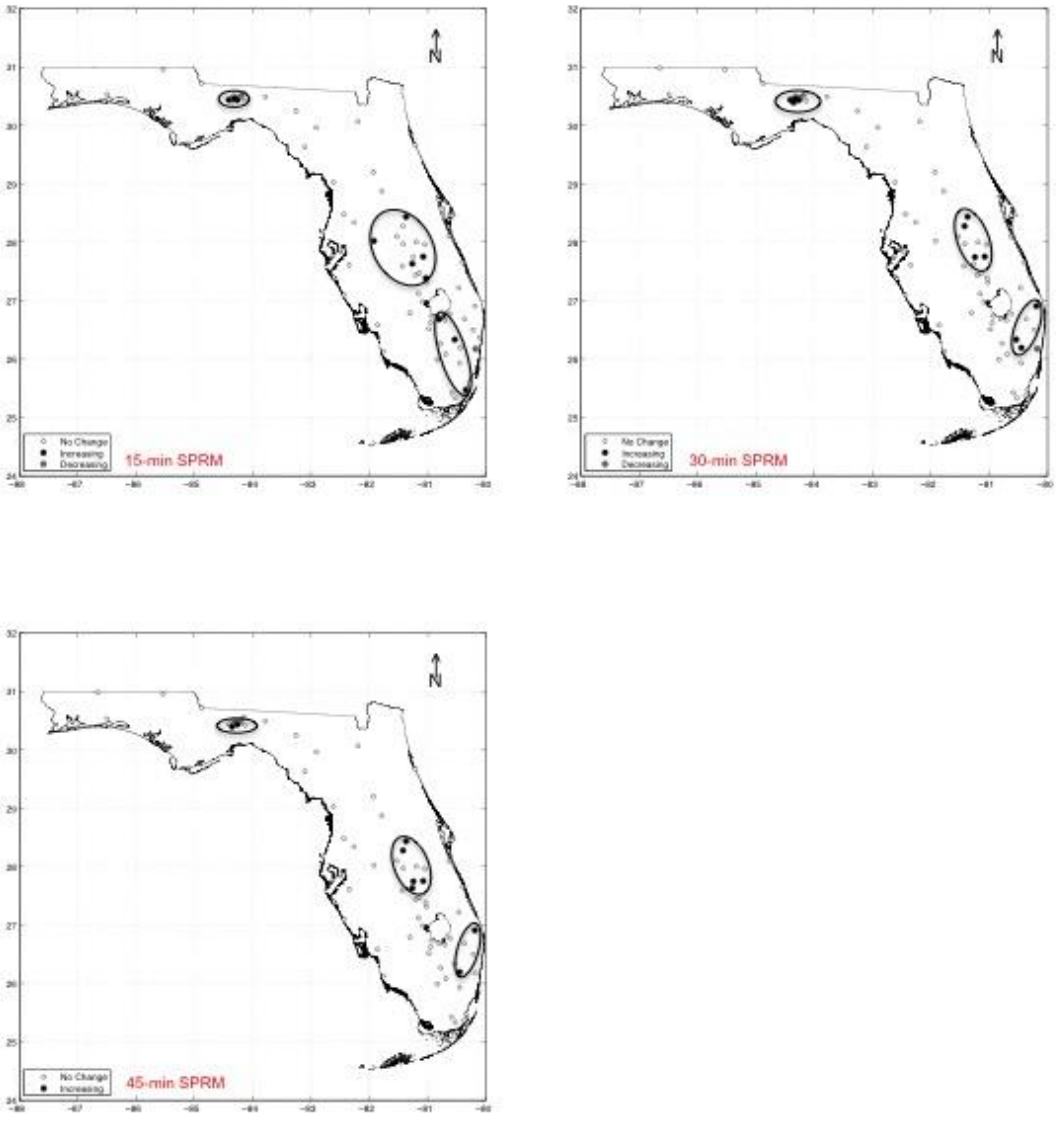


Figure 18a Short-durations Trend Analysis - Spearman Rho

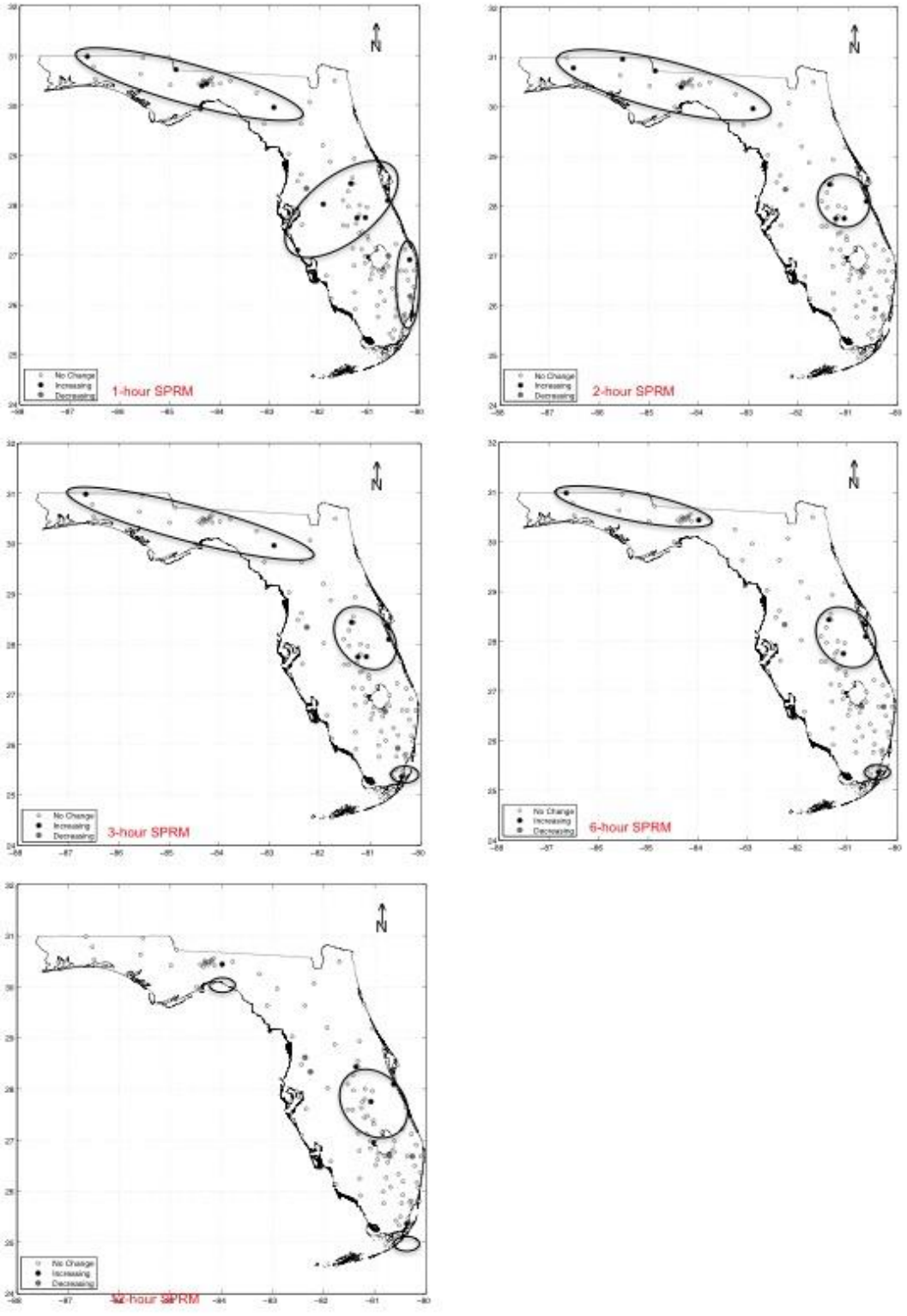


Figure 18b Hourly Duration Trend Analysis - Spearman Rho

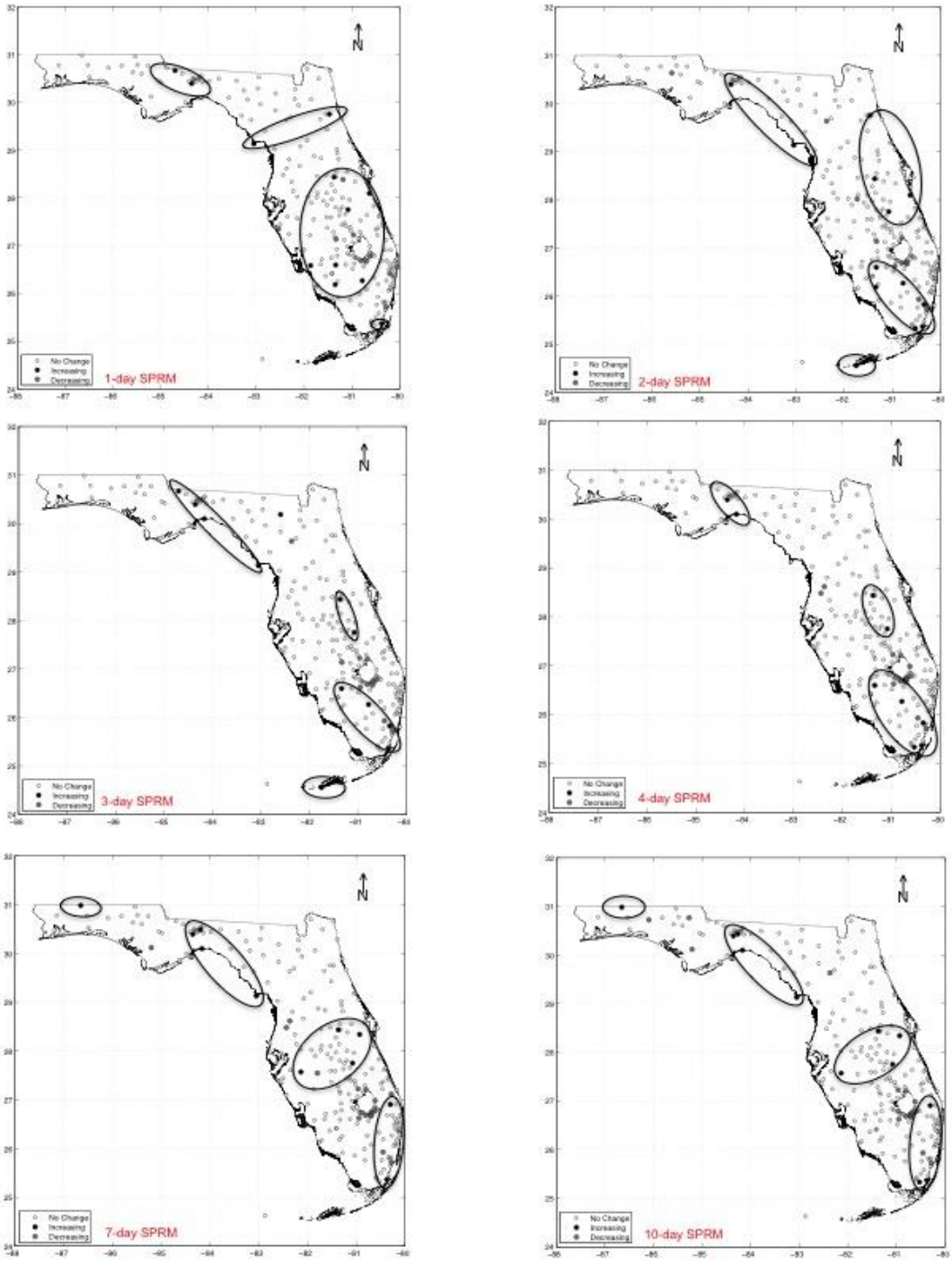


Figure 18c Daily Durations Trend Analysis (1- to 10-day) - Spearman Rho

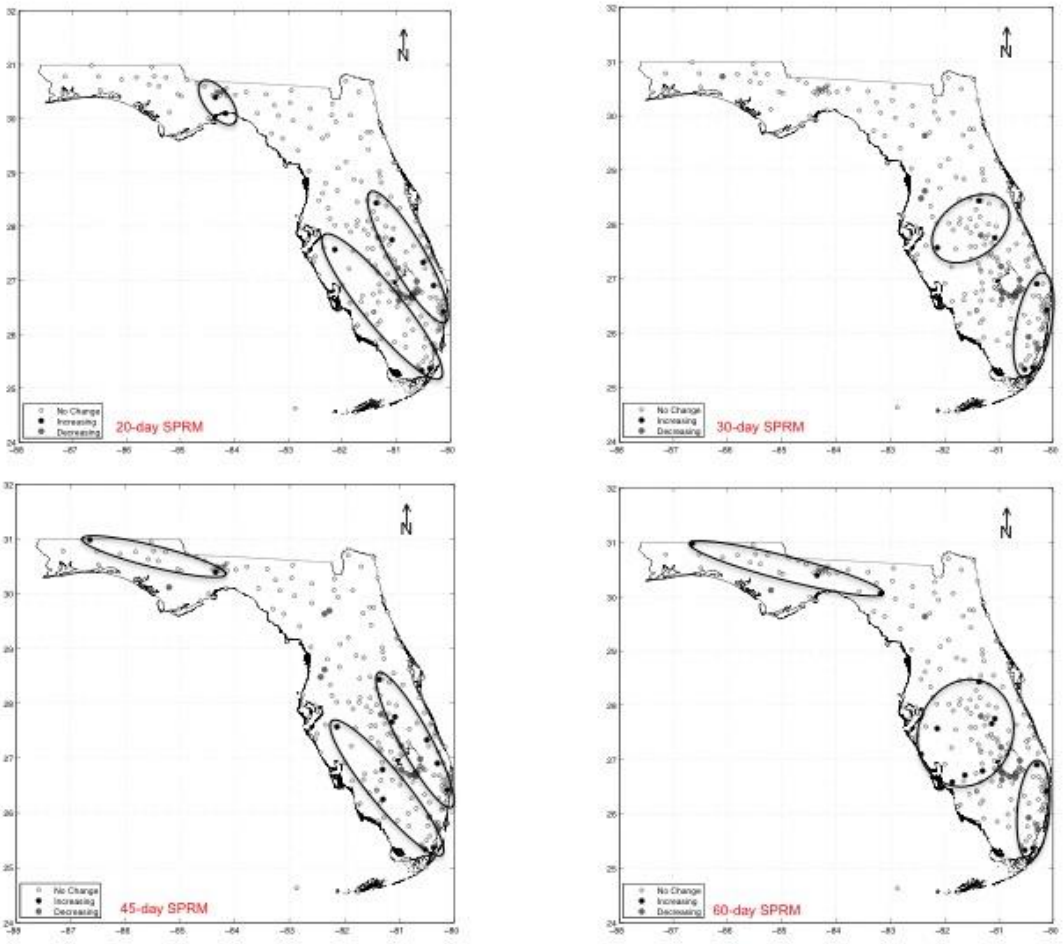


Figure 18d Daily Durations Trend Analysis (20- to 60-day) - Spearman Rho

Out of 73 short-duration period stations, 15% of rain gages recorded a statistical significant increase whereas about 84% of the data display no change in precipitation extremes in the past 50 years. For the hourly duration, which contains 112 stations, there is an increase in precipitation extremes of 8% while 90% of the data show no changes in the past 100 years. As daily durations data set are collected in 242 stations, the average of increase in precipitation extremes in the past 100 years amount to 5% whereas about 81% of the data display no changes.

Table 7 Trend Analysis Results - Spearman rho

Duration	RG	SS	PI	I %	DI	D %	N %
15-minute	73	12	11	15.1%	1	1.4%	83.6%
30-minute	73	12	11	15.1%	1	1.4%	83.6%
45-minute	73	9	9	12.3%	0	0.0%	87.7%
1-hour	112	16	13	11.6%	3	2.7%	85.7%
2-hour	112	12	9	8.0%	3	2.7%	89.3%
3-hour	112	10	7	6.3%	3	2.7%	91.1%
6-hour	112	9	6	5.4%	3	2.7%	92.0%
12-hour	112	9	5	4.5%	4	3.6%	92.0%
1-day	242	24	13	5.4%	11	4.5%	90.1%
2-day	242	26	13	5.4%	13	5.4%	89.3%
3-day	242	23	12	5.0%	11	4.5%	90.5%
4-day	242	22	9	3.7%	13	5.4%	90.9%
7-day	242	29	11	4.5%	18	7.4%	88.0%
10-day	242	29	12	5.0%	17	7.0%	88.0%
20-day	242	23	10	4.1%	13	5.4%	90.5%
30-day	242	25	7	2.9%	18	7.4%	89.7%
45-day	242	29	13	5.4%	16	6.6%	88.0%
60-day	242	29	15	6.2%	14	5.8%	88.0%

RG – Rain Gages SS – Statistical Significant Rain Gages

PI – Precipitation Increase I % - Percentage of Precipitation Increase

PD – Precipitation Decrease D % - Percentage of Precipitation Decrease

N % - Percentage No change

As shown in Table 7, the greatest percentage of increase occurs during the short rainfall duration period.

5.4 Mann-Kendall Analysis

Trend analysis using Mann-Kendall test also provides indication of whether a statistical trend really exists in the data set. Moreover, the graphs shown in Figure 17a-d display a layout of statistically significant increased stations of the Mann-Kendall test that yields an outcome virtually similar to Spearman test.

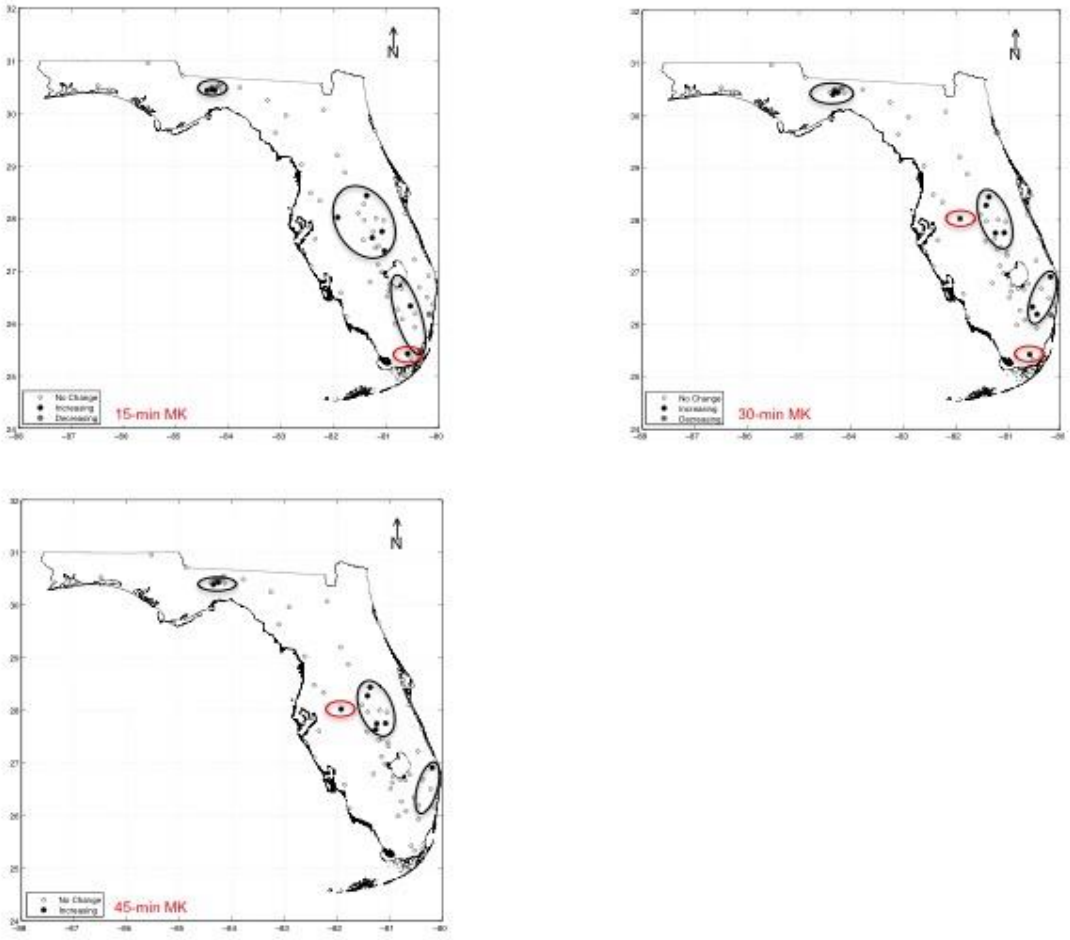


Figure 15a Short-durations Trend Analysis - Mann-Kendall

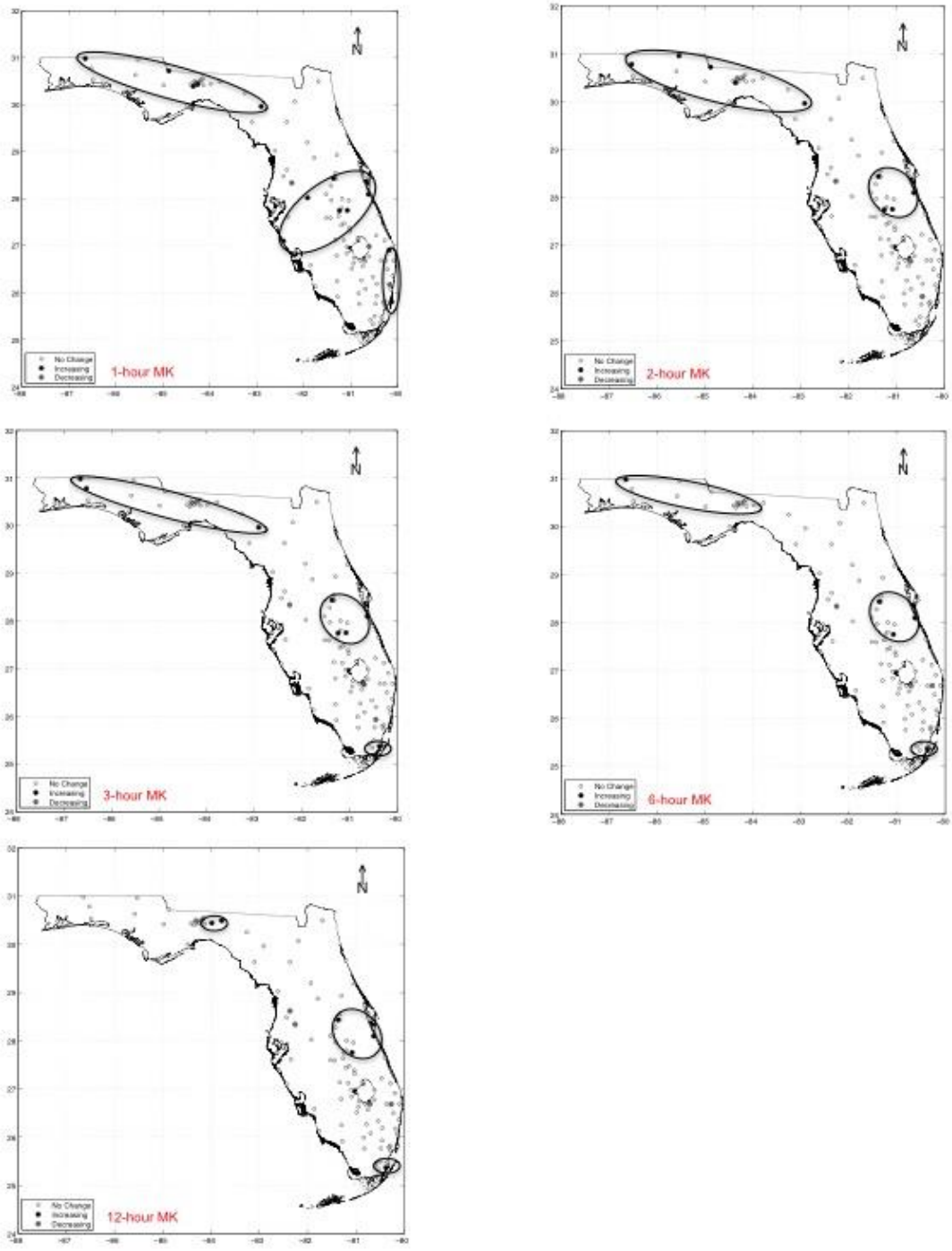


Figure 18b Hourly Durations Trend Analysis - Mann-Kendall

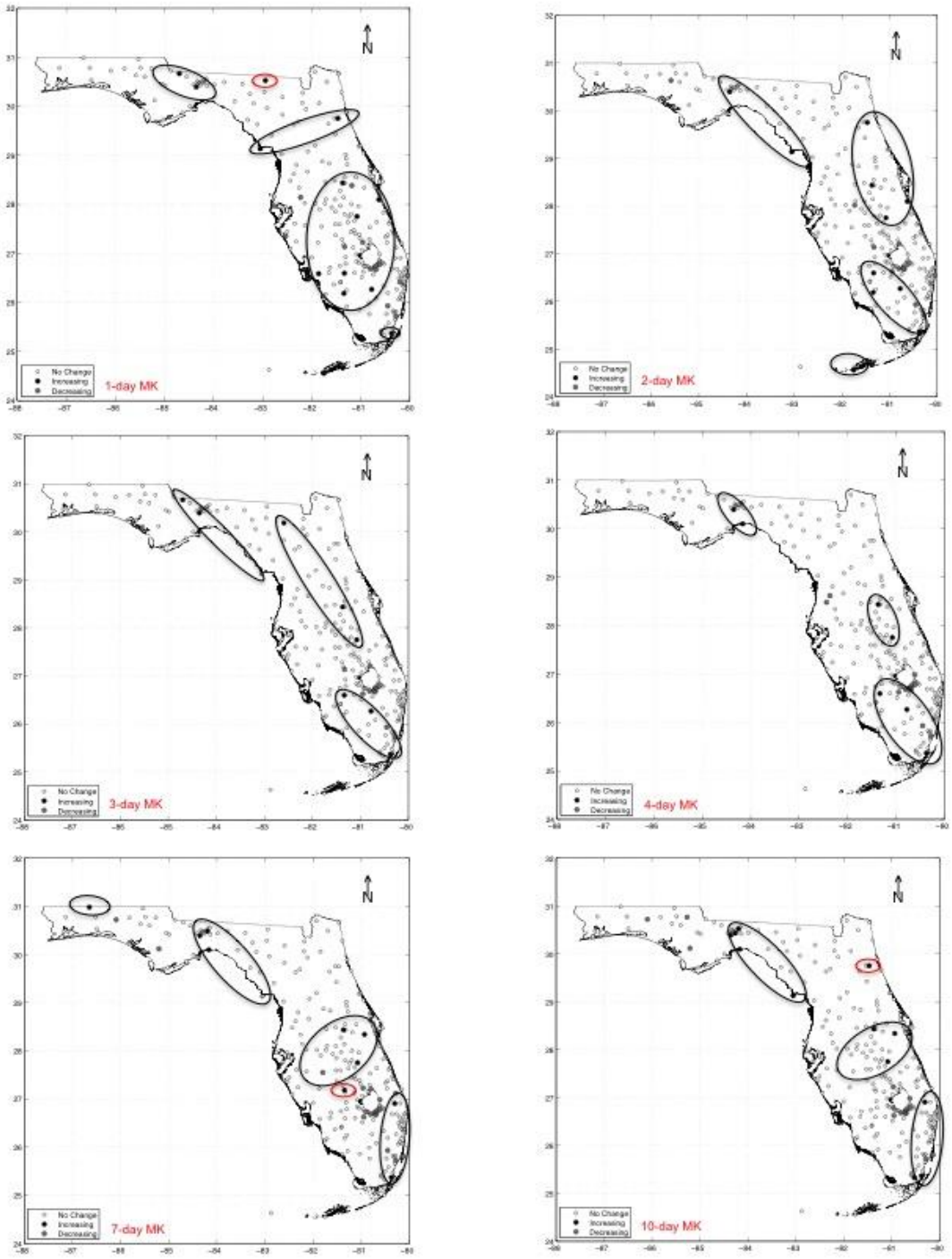


Figure 18c Daily Durations Trend Analysis (1- to 10-day) - Mann-Kendall

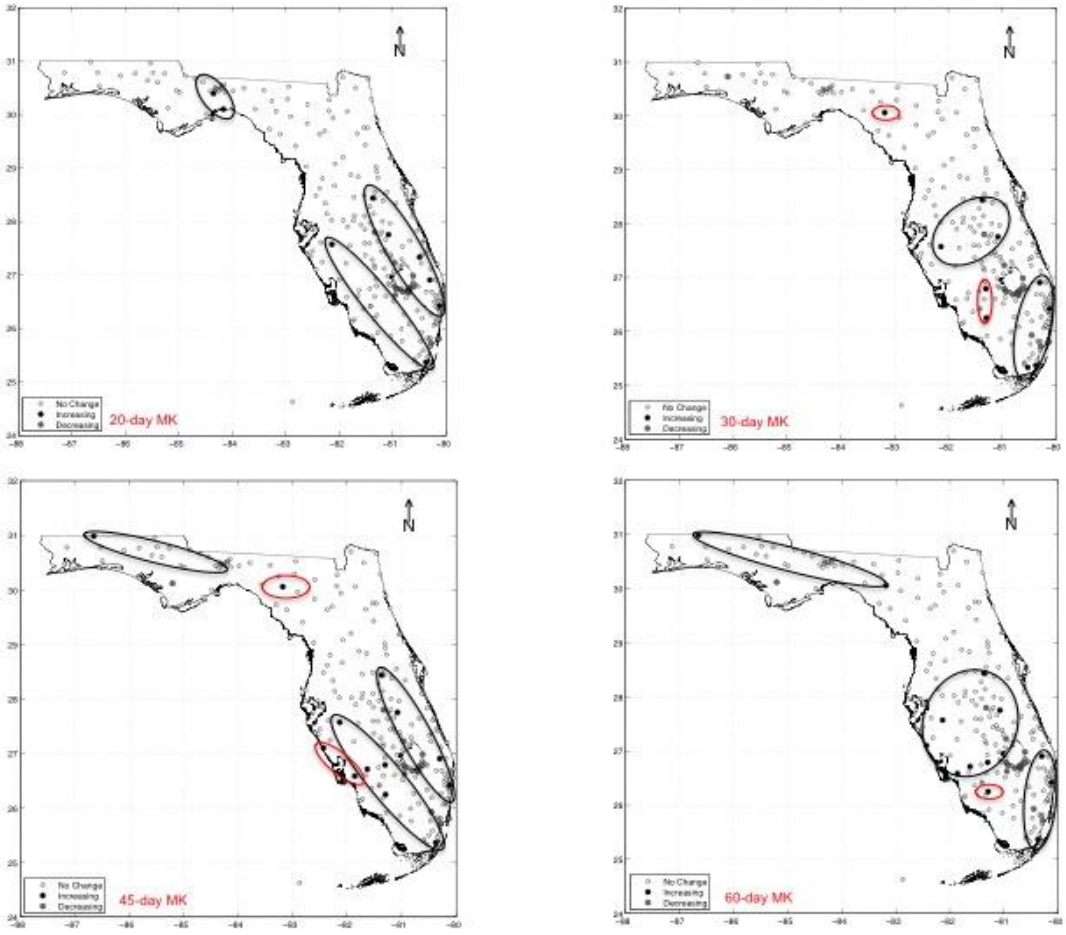


Figure 18d Daily Durations Trend Analysis (20- to 60day) - Mann-Kendall

Table 8 shows that the percentage increase in precipitation depth in the trend analysis from Mann-Kendall is virtually identical to Spearman Rho.

Table 8 Trend Analysis Results - Mann-Kendall Test

	RG	SS	PI	I %	DI	D %	N %
15-minute	73	12	11	15.1%	1	1.4%	83.6%
30-minute	73	14	12	16.4%	2	2.7%	80.8%
45-minute	73	9	9	12.3%	0	0.0%	87.7%
1-hour	112	16	13	11.6%	3	2.7%	85.7%
2-hour	112	12	9	8.0%	3	2.7%	89.3%
3-hour	112	12	8	7.1%	4	3.6%	89.3%
6-hour	112	8	5	4.5%	3	2.7%	92.9%
12-hour	112	10	6	5.4%	4	3.6%	91.1%
1-day	242	28	14	5.8%	14	5.8%	88.4%
2-day	242	24	11	4.5%	13	5.4%	90.1%
3-day	242	18	8	3.3%	10	4.1%	92.6%
4-day	242	18	7	2.9%	11	4.5%	92.6%
7-day	242	27	10	4.1%	17	7.0%	88.8%
10-day	242	26	12	5.0%	14	5.8%	89.3%
20-day	242	23	9	3.7%	14	5.8%	90.5%
30-day	242	24	10	4.1%	14	5.8%	90.1%
45-day	242	28	13	5.4%	15	6.2%	88.4%
60-day	242	28	13	5.4%	15	6.2%	88.4%

RG – Rain Gages

SS – Statistical Significant Rain Gages

PI – Precipitation Increase

I % - Percentage of Precipitation Increase

PD – Precipitation Decrease

D % - Percentage of Precipitation Decrease

N % - Percentage No change

5.5 Variation of Extremes

In the following section, the study is narrowed down to track both short and long-term durations pertaining to stations that are common in every rain event at all durations. Since all the stations found in the short-durations are also included in the hourly and daily

durations, the result analysis shown in Table 8 reflects the outcome of those unique 73 rain gages.

Table 9 Trend Analysis in 73 unique rain gage – Spearman's rho

Duration	SS	PI	I %	DI	D %	N %
15-minute	12	11	15.1%	1	1.4%	83.6%
30-minute	12	11	15.1%	1	1.4%	83.6%
45-minute	9	9	12.3%	0	0.00%	87.7%
1-hour	13	11	15.1%	2	2.7%	82.2%
2-hour	11	8	11.0%	3	4.1%	84.9%
3-hour	9	6	8.2%	3	4.1%	87.7%
6-hour	5	4	5.5%	1	1.4%	93.2%
12-hour	5	4	5.5%	1	1.4%	93.2%
1-day	10	7	9.6%	3	4.1%	86.3%
2-day	11	7	9.6%	4	5.5%	84.9%
3-day	10	5	6.9%	5	6.9%	86.3%
4-day	12	6	8.2%	6	8.2%	83.6%
7-day	12	5	6.9%	7	9.6%	83.6%
10-day	11	6	8.2%	5	6.9%	84.9%
20-day	10	5	6.9%	5	6.9%	86.3%
30-day	11	4	5.5%	7	9.6%	84.9%
45-day	10	6	8.2%	4	5.5%	86.3%
60-day	13	8	11.0%	5	6.9%	82.2%

After consistently used the same stations to track those 73 stations from 15-minute to 60-day durations, this analysis yields an enhanced result. While the extreme precipitations of the short-durations in the last 100 years are significantly increasing at 15%, the hourly periods reveal a slight increase that varies from 5.5% to 15.1 and the daily periods, from 5.5% to 11.0%. This analysis yields an important outcome very relevant to underground water resources. Though the short-duration rainfalls are slightly going up, the decrease trend in long-term duration rainfall is more pronounced in this section of the study. While a downward trend in long-term duration rainfall may not have

implications on stormwater management, it can be a cause for major concerns since we greatly depend on aquifer storage for water supply.

Usually these two tests coincide very well but at times Mann-Kendal analysis depicts a station or two added to the Spearman analysis outcome; however, in most cases, other station becomes hollowed, which offset the change in the percentage increase. Table 9 presents the Mann-Kendall result for this section.

Table 10 Trend Analysis in 73 unique rain gage – Mann-Kendall

Duration	SS	PI	I %	DI	D %	N %
15-minute	12	11	15.1%	1	1.4%	83.6%
30-minute	14	12	16.4%	2	2.7%	80.8%
45-minute	9	9	12.3%	0	0.0%	87.7%
1-hour	13	11	15.1%	2	2.7%	82.2%
2-hour	11	8	1106%	3	4.1%	84.9%
3-hour	10	6	8.2%	4	5.5%	86.3%
6-hour	5	4	5.5%	1	1.4%	93.2%
12-hour	6	5	6.9%	1	1.4%	91.8%
1-day	11	7	9.6%	4	5.5%	84.9%
2-day	11	6	8.2%	5	6.9%	84.9%
3-day	10	5	6.9%	5	6.9%	86.3%
4-day	11	5	6.9%	6	8.2%	84.9%
7-day	11	5	6.9%	6	8.2%	84.9%
10-day	11	7	9.6%	4	5.5%	84.9%
20-day	9	4	5.5%	5	6.9%	87.7%
30-day	10	5	6.9%	5	6.9%	86.3%
45-day	11	6	8.2%	5	6.9%	84.9%
60-day	12	6	8.2%	6	8.2%	83.6%

5.6 Temporal Occurrences of Extremes

The second aspect of this study is the variation of extreme precipitation in two different phases. To perform this task, the available data is separated into two temporal windows to determine spatial variation based on El Niño years and La Niña years. The

first temporal window is associated with warm phase and the other with cool phase. The entire data is separated as such to obtain the mean values for each year. A mean value is calculated for every station to validate a mean El Niño value for the year, and for all La Niña year, we also obtain a mean value for each station. For each rain event, once we find the mean values for all the station, we can interpolate the values for the cool year and all the values for the warm years. In comparing El Niño years versus La Niña years, the ultimate goal is to generate a graph reflecting the spatial interpolation of all the cold and warm mean values shown Table10a-10g.

Table 11a 60-day ENSO Means values

ID	El Niño (mm)	La Niña (mm)	Latitude	Longitude
R1	484.72	462.32	26.1915	-80.4492
R2	515.98	508.58	26.2665	-80.7795
R3	474.47	518.02	26.0821	-80.6915
R4	538.54	474.35	25.9898	-80.8362
R5	505.57	446.94	26.5128	-80.9819
R6	490.02	503.08	27.6317	-81.2647
R7	441.20	446.17	27.2197	-80.4650
R8	463.47	458.29	26.1297	-81.7625
R9	562.14	518.06	27.5914	-81.4353
R10	490.53	497.08	26.4989	-80.2222
R11	462.06	457.20	25.4700	-80.3464
R12	451.30	478.89	25.3669	-80.3764
R13	505.40	541.64	27.7528	-81.0772
R14	649.29	517.65	27.4386	-81.2064
R15	670.69	526.80	27.7458	-81.2453
R16	453.06	482.77	28.0994	-81.5286
R17	470.00	484.89	28.0017	-81.1936
R18	478.54	466.20	26.9792	-81.0900
R19	543.33	519.28	25.3306	-80.5250
R20	666.56	586.41	25.4217	-80.5897
R21	407.39	430.07	27.3142	-81.0219
R22	463.98	424.03	27.1186	-81.1572
R23	603.00	488.85	26.9072	-80.1917
R24	431.58	492.42	27.9717	-81.4175
R25	418.16	392.47	28.4361	-81.3714
R26	463.04	466.67	30.4383	-84.4111
R27	438.59	533.23	30.5053	-84.3308
R28	455.69	451.14	30.4833	-84.2992
R29	382.78	434.88	30.5592	-84.1500
R30	406.78	469.18	30.4844	-84.1956
R31	534.54	458.89	30.4203	-84.1347
R32	322.16	501.70	30.5272	-84.1917
R33	527.90	508.25	30.4586	-84.3211
R34	574.80	501.50	30.4331	-84.2608
R35	450.85	519.48	30.4931	-84.2392

Table 11b 60-day ENSO Means values

ID	El Niño (mm)	La Niña (mm)	Latitude	Longitude
R36	523.04	564.30	26.1734	-80.1784
R37	490.87	404.75	30.9833	-86.6500
R38	517.04	578.00	26.3675	-80.1108
R39	478.20	433.64	29.9625	-82.9108
R40	555.08	542.88	28.4811	-82.4353
R41	469.12	440.07	30.2497	-83.2594
R42	492.22	457.01	26.0719	-80.1536
R43	466.68	438.75	30.9575	-85.5331
R44	526.43	478.12	29.0253	-82.6158
R45	485.25	487.70	28.0206	-81.9219
R46	396.22	451.49	24.9027	-80.6960
R47	448.04	482.56	30.4406	-83.9858
R48	509.57	538.81	26.5667	-80.7500
R49	509.57	538.81	26.3336	-80.5372
R50	594.04	531.09	25.9297	-80.4539
R51	465.42	413.08	26.9833	-80.6167
R52	520.90	479.87	25.7647	-80.4775
R53	380.24	469.69	30.7219	-84.8742
R54	368.81	612.60	26.2483	-81.2967
R55	555.40	610.06	25.9167	-81.2833
R56	536.40	529.80	29.7258	-85.0206
R57	534.39	553.43	27.2181	-81.8739
R58	563.54	519.49	27.1819	-81.3508
R59	530.04	525.99	27.5944	-81.5253
R60	502.97	534.19	27.8500	-81.5167
R61	495.99	514.45	27.8986	-81.8433
R62	488.22	500.22	27.3833	-81.0333
R63	554.00	503.82	26.6928	-80.6711
R64	595.93	551.14	26.3650	-81.5478
R65	457.06	490.66	30.4500	-85.0500
R66	584.87	550.70	27.4467	-82.5014
R67	450.63	457.92	30.4181	-84.9861
R68	555.08	542.88	28.6164	-82.3658
R69	523.54	467.74	28.6664	-82.0894
R70	506.51	484.24	26.8639	-80.6256

Table 11c 60-day ENSO Means values

ID	El Niño (mm)	La Niña (mm)	Latitude	Longitude
R71	517.82	482.96	29.8667	-84.6333
R72	457.41	449.02	30.7667	-85.8167
R73	495.27	413.59	29.1333	-83.0500
R74	462.06	462.99	30.7836	-85.4847
R75	537.87	444.28	28.5500	-81.1000
R76	533.15	490.66	27.9667	-82.7667
R77	472.32	502.52	28.4553	-81.7233
R78	458.51	537.31	30.6000	-85.4000
R79	535.14	512.83	26.2678	-80.2750
R80	483.39	470.18	29.4292	-81.5158
R81	525.27	506.61	30.7797	-86.5225
R82	586.80	516.23	29.6333	-83.1053
R83	411.37	466.84	29.1894	-81.0139
R84	411.37	466.84	29.1828	-81.0483
R85	606.43	503.52	30.7244	-86.0939
R86	520.99	513.67	29.0181	-81.3106
R87	473.44	545.64	27.3697	-81.5136
R88	565.11	559.20	26.6033	-81.1292
R89	395.08	354.19	24.6281	-82.8736
R90	512.12	567.62	25.8489	-81.3897
R91	474.13	471.01	29.7550	-81.5389
R92	448.14	472.80	30.6589	-81.4636
R93	526.21	532.38	25.1422	-80.9144
R94	539.13	508.25	27.5303	-80.8167
R95	546.19	560.90	27.5706	-82.1378
R96	565.14	578.27	26.1019	-80.2011
R97	548.33	570.01	26.5850	-81.8614
R98	487.97	458.18	27.4622	-80.3539
R99	499.71	462.01	29.6333	-82.3667
R100	455.60	456.60	29.6919	-82.2756
R101	513.28	467.87	30.2717	-82.1856
R102	491.13	449.51	28.3833	-81.1833
R103	461.37	499.98	29.7517	-81.4669
R104	609.57	633.04	25.8175	-80.2858
R105	507.10	444.69	29.8286	-82.5972

Table 11d 60-day ENSO Means values

ID	El Niño (mm)	La Niña(mm)	Latitude	Longitude
R106	458.81	456.40	30.7000	-81.9333
R107	531.79	524.51	28.1428	-82.2269
R108	561.81	614.47	25.5000	-80.5000
R109	606.06	472.06	26.5500	-80.0500
R110	516.29	500.49	26.4217	-81.4100
R111	529.68	485.56	27.8000	-81.3333
R112	546.97	516.69	28.8031	-82.3125
R113	494.37	478.58	28.4833	-81.5333
R114	485.74	459.05	30.4950	-81.6936
R115	496.40	441.29	30.2875	-81.3928
R116	486.60	460.69	30.5228	-82.9447
R117	393.48	411.66	24.5550	-81.7522
R118	467.20	457.13	28.2764	-81.4239
R119	520.89	543.65	26.7458	-81.4264
R120	432.37	488.85	28.1042	-81.7144
R121	468.85	441.25	30.1853	-82.5942
R122	442.47	469.69	27.2833	-81.3833
R123	434.06	434.56	28.8728	-81.7844
R124	489.17	461.41	30.2889	-82.9650
R125	557.74	599.14	26.6833	-80.2667
R126	472.01	467.00	29.2003	-81.9306
R127	438.92	438.72	30.4517	-83.4119
R128	439.76	478.83	30.7667	-85.2667
R129	412.03	452.41	29.6700	-81.2150
R130	532.09	446.89	30.0564	-83.1819
R131	467.27	433.78	28.0958	-80.6308
R132	462.49	507.42	28.3500	-80.7000
R133	458.08	552.25	25.8064	-80.1336
R134	557.94	623.14	25.7906	-80.3164
R135	458.84	553.14	25.7167	-80.2833
R136	489.66	593.32	25.6500	-80.3000
R137	547.32	517.22	30.7794	-87.1414
R138	448.04	482.56	30.4922	-83.7833
R139	514.80	518.58	26.8400	-81.0872
R140	494.12	478.66	27.9347	-81.5928

Table 11e 60-day ENSO Means values

ID	El Niño (mm)	La Niña (mm)	Latitude	Longitude
R141	406.05	425.32	30.6667	-84.7000
R142	613.47	566.22	30.6667	-84.7000
R143	545.80	578.51	26.1686	-81.7158
R144	536.68	465.33	29.0500	-80.9500
R145	562.62	539.90	30.5316	-86.4928
R146	634.85	590.33	25.8581	-81.0319
R147	502.64	463.20	29.0803	-82.0778
R148	451.34	393.80	27.1508	-80.8653
R149	485.17	465.91	28.9333	-81.3000
R150	464.33	508.87	28.4339	-81.3250
R151	464.33	508.87	28.5500	-81.3333
R152	486.68	545.07	26.7897	-81.3044
R153	454.73	509.32	29.6439	-81.6606
R154	465.25	573.55	29.9989	-84.4850
R155	506.73	508.87	30.2492	-85.6606
R156	527.78	508.38	27.6089	-82.3478
R157	543.24	516.69	30.4781	-87.1869
R158	608.11	625.19	25.5819	-80.4361
R159	565.88	526.27	30.0986	-83.5742
R160	528.43	539.79	28.0236	-82.1422
R161	532.71	513.19	26.9164	-81.9983
R162	435.61	481.85	30.6000	-84.5500
R163	453.83	429.77	30.0678	-82.1928
R164	570.76	585.01	25.3867	-80.5936
R165	558.67	507.86	29.8875	-81.2917
R166	527.68	531.50	28.3378	-82.2600
R167	502.43	492.06	27.1167	-80.2833
R168	432.27	539.53	30.1000	-84.1667
R169	565.31	508.42	27.7631	-82.6272
R170	481.78	495.19	28.8147	-81.2778
R171	529.70	471.01	27.3500	-82.5333
R172	479.49	451.15	29.9381	-82.1164
R173	570.03	572.47	29.7236	-83.3061
R174	486.19	461.26	27.2000	-80.1639
R175	526.24	499.07	30.3931	-84.3533

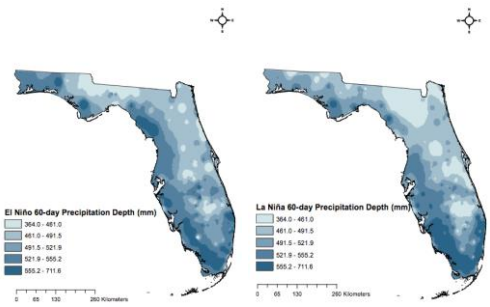
Table 11f 60-day ENSO Means values

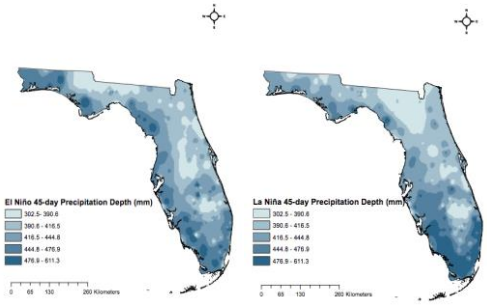
ID	El Niño (mm)	La Niña (mm)	Latitude	Longitude
R176	562.39	561.49	25.7608	-80.8242
R177	474.61	495.88	27.9614	-82.5403
R178	552.77	528.19	28.1586	-82.7644
R179	461.23	523.68	25.0069	-80.5211
R180	542.39	501.66	28.6242	-80.8158
R181	641.83	518.78	29.4083	-82.8186
R182	458.43	443.79	27.1006	-82.4364
R183	460.64	512.63	27.1350	-81.3303
R184	522.52	475.43	27.6528	-80.4031
R185	525.97	532.62	27.5478	-81.7994
R186	463.95	482.93	30.6333	-85.5833
R187	540.68	581.17	26.6847	-80.0994
R188	639.06	584.67	30.1192	-85.2042
R189	454.90	457.00	28.0153	-81.7331
R190	510.48	600.56	26.3278	-80.1308
R191	528.66	578.95	26.2311	-80.1242
R192	508.46	448.70	26.6819	-80.8061
R193	543.45	608.24	26.3689	-80.1539
R194	573.69	619.09	26.0603	-80.2317
R195	576.04	603.56	25.8269	-80.3442
R196	492.82	468.09	26.7386	-80.9344
R197	547.16	533.55	26.7489	-80.6836
R198	532.20	471.68	26.8131	-80.5636
R199	493.98	504.17	26.7839	-80.5253
R200	478.71	397.03	27.4725	-81.1439
R201	460.40	427.25	28.1403	-81.3519
R202	464.93	435.69	26.7003	-80.7161
R203	458.60	479.55	26.7897	-80.9617
R204	555.80	554.39	26.6069	-81.6497
R205	680.31	544.29	26.4239	-80.1222
R206	586.74	580.68	26.4167	-80.2039
R207	532.67	525.39	26.6844	-80.3675
R208	590.13	576.71	26.7125	-81.6297
R209	506.79	510.27	27.8031	-81.1981

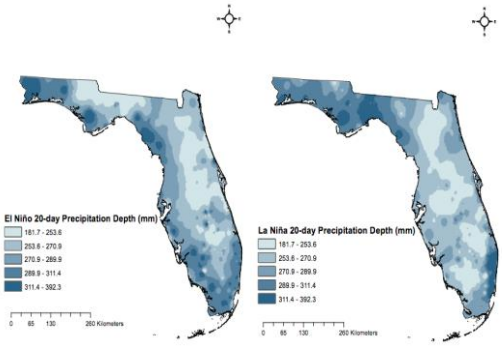
Table 11g 60-day ENSO Means values

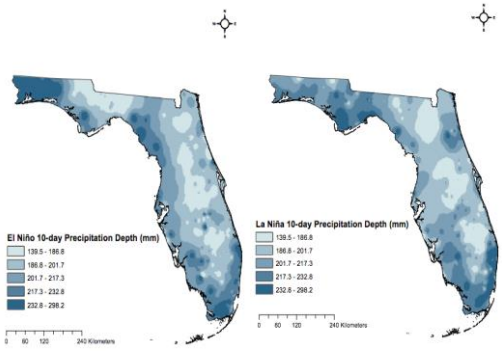
ID	El Niño (mm)	La Niña (mm)	Latitude	Longitude
R211	571.02	533.63	26.7150	-80.0622
R212	473.86	523.29	27.6600	-81.1342
R213	469.79	478.67	27.4014	-81.1147
R214	475.21	532.86	27.3733	-80.4506
R215	502.96	469.94	27.3325	-80.4967
R216	370.46	390.07	27.0653	-80.9778
R217	649.35	602.37	26.4072	-81.4164
R218	545.72	562.89	26.5956	-81.3353
R219	712.80	593.42	26.1844	-81.3464
R220	563.42	567.18	26.9244	-81.3139
R221	521.38	534.13	27.6081	-80.4314
R222	536.84	495.83	27.2903	-80.8269
R223	509.10	456.21	27.4103	-80.3369
R224	587.78	604.75	26.9044	-80.3039
R225	476.15	460.23	26.8419	-80.6022
R226	477.29	468.66	26.8083	-81.0467
R227	502.09	470.80	26.7350	-80.8953
R228	529.93	498.67	26.7744	-80.6175
R229	513.81	464.58	26.6650	-80.7011
R230	496.29	578.44	26.6189	-80.1264
R231	537.79	487.06	26.6244	-80.9483
R232	559.18	615.44	26.6122	-80.2050
R233	551.56	593.23	26.5208	-80.1239
R234	550.06	554.29	26.5283	-80.1703
R235	399.95	360.73	27.2061	-80.8008
R236	467.96	451.85	27.2253	-80.9625
R237	474.85	380.78	27.8304	-80.5397
R238	399.22	426.57	28.3406	-80.9333
R239	555.84	523.22	27.6389	-80.6789
R240	433.58	500.15	30.0602	-81.8488
R241	480.55	420.20	28.8345	-81.6460
R242	529.00	446.99	27.9630	-81.0500

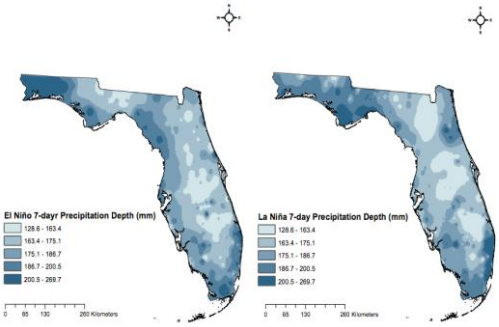
Using GIS, a set of sample points in the maps representing changes in various precipitation depths are generated to mark the continuity and the variability of observed data throughout the state. The morphology and characteristics of these changes facilitate the interpretation of each outcome. For the sake of the readability of the illustrations in this study, maps showing the interpolated results using IDW method are shown below.

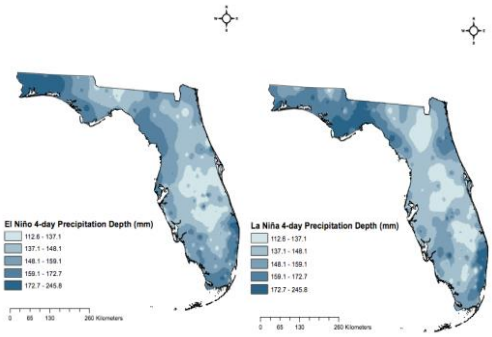


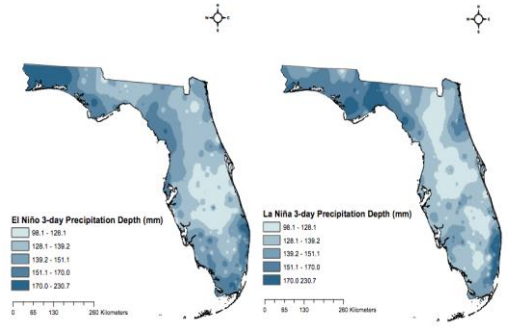


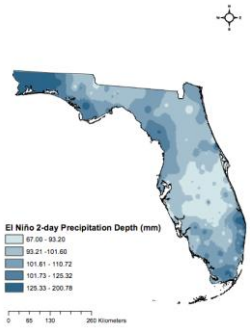


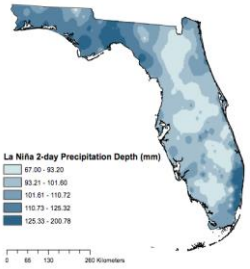


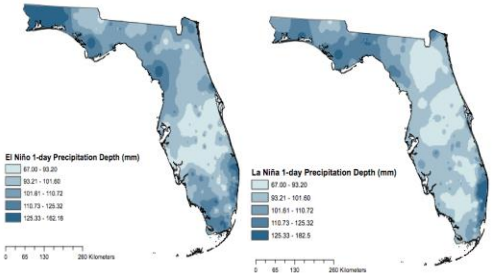


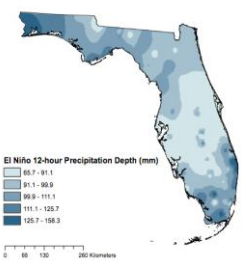


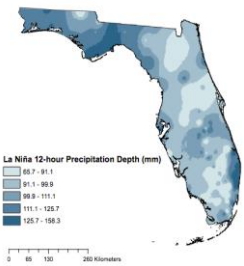


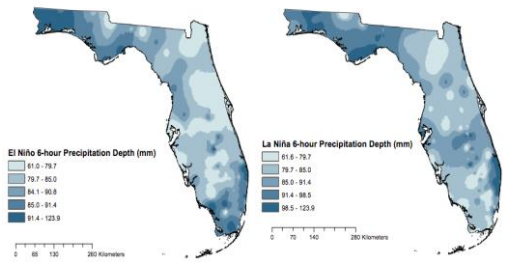


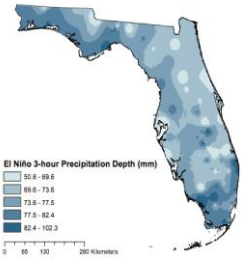


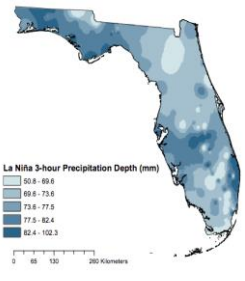


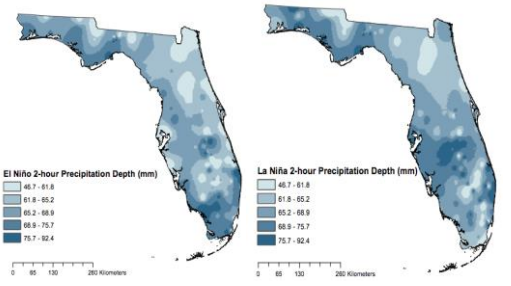


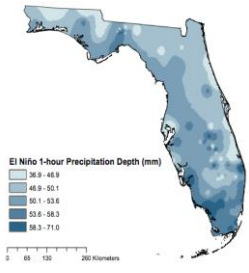


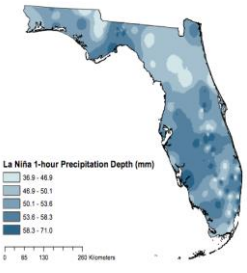












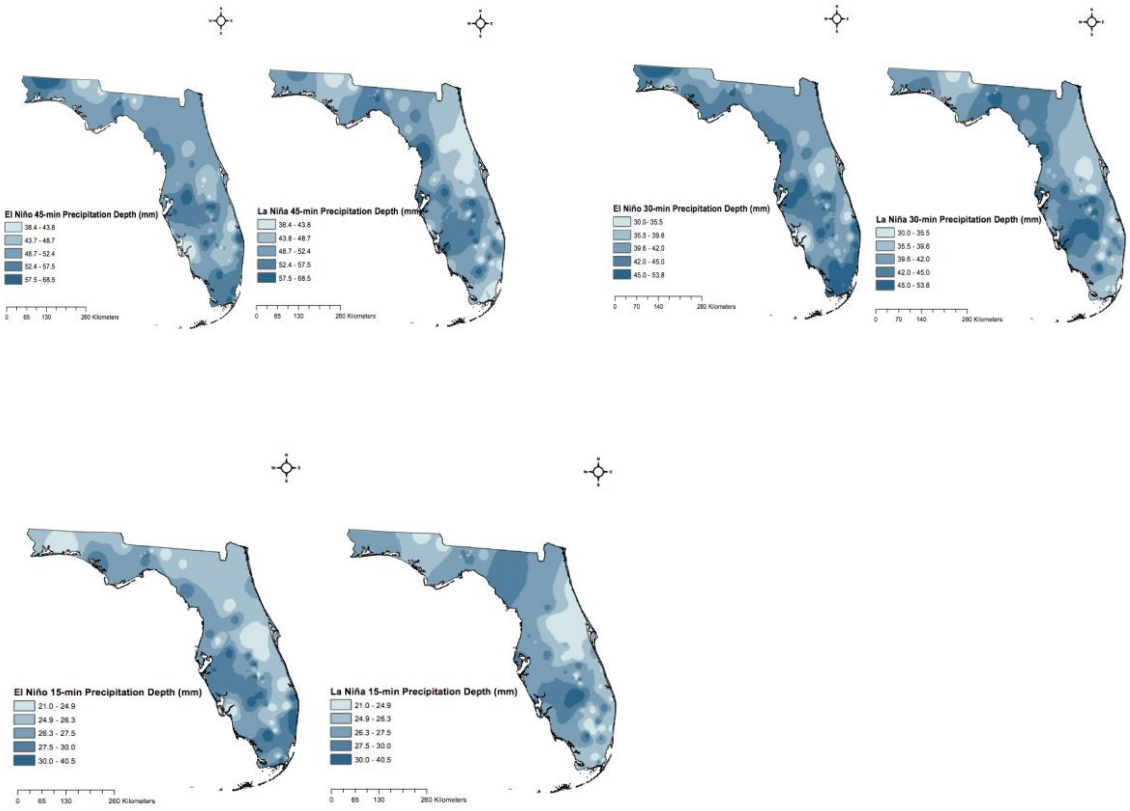


Figure 19 Spatial Variation Between Warm and Cool Phases

This analysis revealed a series of spatial variation of data points that can be classified as either warm (El Niño) or cold year (La Niña). As aforementioned, the maximum number of point sources collecting data is 242. Since the station of the rain gages are sparsely and unevenly distributed, the value of an attribute at any locations where no rain gages are available need to be estimated. In such cases, spatial interpolation provides the necessary tools to fulfill this task.

Given the topography of the state, several factors including localized and convective storm events, large surface water such as the Everglades and the Lake Okeechobee seems to influence long-term short-duration of extreme rainfalls in Florida.

6 CONCLUSIONS

El Niño-Southern Oscillation (ENSO) cycle describes the variations in temperature between the ocean and the atmosphere in the Pacific Ocean. Because of its vastness and its ability to change the global atmospheric circulation, it is known as one of the most important climate phenomena on Earth to influence temperature and precipitation across the globe. This cycle encompasses two opposite and complex weather patterns, El Niño and La Niña, that emerge from fluctuations of ocean temperatures in the Pacific Ocean. Generally, El Niño events occur more frequently than La Niña. While some prolonged events can possibly last for years, a typical episode of El Niño or La Niña usually last 9 to 12 months. The frequency at which El Niño and La Niña occur can be somewhat irregular, their events nonetheless occur on average every two to seven years. Two major oscillations influence the weather conditions in Florida: AMO and ENSO. Unlike ENSO, AMO is a multi-decadal oscillation with intervals that last as long as 25 to 27 years that affects the sea surface temperature of the Atlantic Ocean.

6.1 Contribution of this study

This thesis exhibits a series of rainfall precipitation study along with statistical trend analysis to confirm the orientation of rainfall extremes of different durations and their characteristics in the State of Florida. Using a collection of well gages or tipping bucket rain gage that uses electronic data loggers to record the rainfall, NOAA provided the data with duration periods of 15-minute, 30-minute, 45-minute, 1-hour, 2-hour, 3-hour, 6-

hour, 12-hour, 1-day, 2-day, 3-day, 4-day, 7-day, 10-day, 20-day, 30-day, 45-day, and 60-day. Using non-parametric tests, Spearman's rho and Kendall's tau, the data is ranked and evaluated to determine the correlation coefficient relationships between the variables time and precipitation depth. Examining the correlation coefficients reveals some data with large and small positive correlation, and large and small negative correlation. In most graphs, the scattered points provide modest positive and negative correlation with little or no evidence of a systematic relationship between the variables and, therefore, difficult to determine any positive or negative relationship between time and precipitation depth. To identify whether there is a consistent behavior or no discernment patterns in increasing and in decreasing values, statistical trend analysis methods, Spearman and Mann-Kendall tests, is conducted to confirm whether one can assert with certainty that any increase/decrease in a set of data is statistically significant or there is no change in the trends of the data. Both Spearman and Mann-Kendall tests yield similar results. Out of 73 short-duration period stations 15% of rain gages recorded a statistical significant increase whereas about 84% of the data display no change in precipitation extremes in the past 50 years. For the hourly duration, which contains 112 stations, there is an increase in precipitation extremes of 8% while 90% of the data show no changes in the past 100 years. As daily durations data set are collected in 242 stations, the average of increase in precipitation extremes in the past 100 years amount to 5% whereas about 81% of the data display no changes.

It is obvious that the complex weather patterns of ENSO, and that the warm and cool phases of AMO affect rainfall precipitation in Florida. While it is unclear whether long-term extremes of short-duration rainfalls are heavily impacted by tropical storms

and hurricanes, precipitation in longer durations seems consistent with passages of storms and hurricanes landfalls in Florida.

Spatial interpolation is used in this study to understand the spatial variation of precipitation extremes in the two phases of oscillation. The spatial analysis reveals a series of spatial variation of data points based on El Niño or La Niña year. In the spatial variation, the areas of greater influences are more pronounced and possibly more susceptible to flood or droughts. The ability to create spatial patterns or maps from sample data makes interpolation very powerful and useful for this study. The method of analysis described in this study can also be applied in other states or local entities where similar data are available to understand the influences of climate variability on precipitation extremes of different durations, which can be great resources to address flooding concerns, the necessity to design effective stormwater management systems, and water resource management issues.

6.2 Limitations of the Study

The genesis of the long-term precipitation data available from NOAA extends as far as 1843, about 173 years of rainfall data collected throughout the state of Florida. Research conducted in previous studies highlighted that short-duration storms are likely to increase considerably; though the short-durations periods analyzed in this study shown a statistical significant increase, the original rain gage is only dated 1968, which yields just about 50 years of short-duration data. Thus, the main limitation of this research lies in the fact that not enough short-duration data is available to conduct longer-term analysis. Florida is generally affected by continental climate contouring the northern section of the state to the borderline of Georgia and Alabama, and by peninsula climate

impacting the rest of the state. Since the continental climate hovering over most of the nation is influenced by several other oscillations, this research may be seen as being constrained by AMO and ENSO, which are the only oscillations evaluated in this study.

We are seeing a tendency of increasing trends in three different regions two of which are more into the central and peninsula region of Florida and one in the continental region. Considering the topography and the nature of its water surface such as the everglades and the Lake Okeechobee, Florida experience a wide range of weather patterns resulting in frequent flooding during wet season and drought in the dry season.

I only perform the research for Florida at stations that are not spatially consistent and uniform. Varying stations for different durations presents serious limitation for this study. For instance, short-duration data are collected in 72 stations while there are 242 stations for every daily-duration, thus, one cannot fully appreciate the general idea reflecting the analysis from a lower to a higher duration.

6.3 Recommendations for Future Research

This research encompasses an extensive research on short and long-term duration of precipitation data by evaluating their trend analysis, and the temporal variations between the warm and cool phases. While NOAA Digital Coast provides 58 tools that communities use to predict storm surges due to sea level rise and to manage their coastal resources, there is no known tool available to predict storms due to rainfall and trends in extreme precipitation. An exhaustive precipitation data of both short and long-term period is available for analysis and evaluation, but I only evaluate the trends and their differences. Further analysis is recommended to evaluate all characteristics of the changes for the short-durations.

One of the main relevancies of this study entails addressing the scarcity of short-duration precipitation data that is assumed to be stationary in the past couple decades. While long-term precipitation data has been active collecting data for well over 100 years, besides the limitation of using various stations for different durations, the original short-duration data available for this study simply involves the last 50 years. Additional study encompassing long-term short-duration data collected at uniformed and common stations will complement and enhance this study.

Finally, since the evaluation method of analysis of this study is applicable to other places where precipitation data are available, further analysis is recommended to expand the study domain well beyond the borderline of the state of Florida and, therefore, conduct similar study nationwide.

7 APPENDICES

Appendix A. Rain Gage Names and Geographic Coordinates

Appendix B. Rain Gage Location: Short Durations, Hourly, and Daily Period

Appendix C. Statistical Trend Analysis Figures – Spearman Rho vs. Mann-Kendall (SPRM vs. MK)

Appendix A. Rain Gage Names and Geographic Coordinates

Table 12: Location of the 15-minute Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
A1	3A-36+R	26.1915000	-80.4492000
A2	3ANW+R	26.2665000	-80.7795000
A3	3AS+R	26.0821000	-80.6915000
A4	3ASW+R	25.9898000	-80.8362000
A5	ALICO+R	26.5128000	-80.9819000
A6	AVONPK+R	27.6317000	-81.2647000
A7	BLUEG+R	27.2197000	-80.4650000
A8	COLGOV+R	26.1297000	-81.7625000
A9	LOTELA+R	27.5914000	-81.4353000
A10	LXWS+R	26.4989000	-80.2222000
A11	MRF122	25.4700000	-80.3464000
A12	MRF123	25.3669000	-80.3764000
A13	MRF155	27.7528000	-81.0772000
A14	MRF187	27.4386000	-81.2064000
A15	MRF191	27.7458000	-81.2453000
A16	MRF205	28.0994000	-81.5286000
A17	MRF23	28.0017000	-81.1936000
A18	S131+R	26.9792000	-81.0900000
A19	S18C-R	25.3306000	-80.5250000
A20	S332-R	25.4217000	-80.5897000
A21	S65DW+R	27.3142000	-81.0219000
A22	S70+R	27.1186000	-81.1572000
A23	SIRG+R	26.9072000	-80.1917000
A24	SNIVLY+R	27.9717000	-81.4175000
A25	TAFT+R	28.4361000	-81.3714000
A26	Herron Steel Site Silver	30.4383000	-84.4111000
A27	Christian Heritage Church	30.5053000	-84.3308000
A28	Lake Jackson Facility	30.4833000	-84.2992000
A29	Tuck Property N. Centerv	30.5592000	-84.1500000
A30	City Well At Limoges Dr.	30.4844000	-84.1956000
A31	Leon County Landfill Us	30.4203000	-84.1347000
A32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
A33	San Luis City Park	30.4586000	-84.3211000
A34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
A35	Wembley Way Eastgate Nei	30.4931000	-84.2392000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
A36	S36-R	26.1734000	-80.1784000
A37	Boca Raton	26.3675000	-80.1108000
A38	Branford	29.9625000	-82.9108000
A39	Brooksville 7 Ssw	28.4811000	-82.4353000
A40	Dowling Park 1 W	30.2497000	-83.2594000
A41	Graceville 1 Sw	30.9575000	-85.5331000
A42	Inglis 3 E	29.0253000	-82.6158000
A43	Lakeland	28.0206000	-81.9219000
A44	North New Rvr Canal 2	26.3336000	-80.5372000
A45	Pennsuco 5 Wnw	25.9297000	-80.4539000
A46	Woodruff Dam	30.7219000	-84.8742000
A47	Basinger	27.3833000	-81.0333000
A48	Cross City 1 E	29.6333000	-83.1053000
A49	Ft Myers Page Fld Ap	26.5850000	-81.8614000
A50	Kissimmee 2	28.2764000	-81.4239000
A51	Lisbon	28.8728000	-81.7844000
A52	Lynne	29.2003000	-81.9306000
A53	Marineland	29.6700000	-81.2150000
A54	Melbourne Wfo	28.0958000	-80.6308000
A55	Monticello 5 Se	30.4922000	-83.7833000
A56	Niceville	30.5316000	-86.4928000
A57	Ortona Lock 2	26.7897000	-81.3044000
A58	Panama City 5 N	30.2492000	-85.6606000
A59	Parrish	27.6089000	-82.3478000
A60	Raiford State Prison	30.0678000	-82.1928000
A61	Saint Leo	28.3378000	-82.2600000
A62	St Petersburg	27.7631000	-82.6272000
A63	Tallahassee Wso Ap	30.3931000	-84.3533000
A64	Venice	27.1006000	-82.4364000
A65	Vero Beach 4se	27.6528000	-80.4031000
A66	Mialck+R	26.6819000	-80.8061000
A67	MRF125C	26.7386000	-80.9344000
A68	MRF159	27.4725000	-81.1439000
A69	MRF220	26.6844000	-80.3675000
A70	MRF65	26.7744000	-80.6175000
A71	MRF73C	26.6650000	-80.7011000
A72	MRF80	26.6244000	-80.9483000
A73	Kenansville	27.9630000	-81.0500000

Table 13: Location Of The 30-minute Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
B1	3A-36+R	26.1915000	-80.4492000
B2	3ANW+R	26.2665000	-80.7795000
B3	3AS+R	26.0821000	-80.6915000
B4	3ASW+R	25.9898000	-80.8362000
B5	ALICO+R	26.5128000	-80.9819000
B6	AVONPK+R	27.6317000	-81.2647000
B7	BLUEG+R	27.2197000	-80.4650000
B8	COLGOV+R	26.1297000	-81.7625000
B9	LOTELA+R	27.5914000	-81.4353000
B10	LXWS+R	26.4989000	-80.2222000
B11	MRF122	25.4700000	-80.3464000
B12	MRF123	25.3669000	-80.3764000
B13	MRF155	27.7528000	-81.0772000
B14	MRF187	27.4386000	-81.2064000
B15	MRF191	27.7458000	-81.2453000
B16	MRF205	28.0994000	-81.5286000
B17	MRF23	28.0017000	-81.1936000
B18	S131+R	26.9792000	-81.0900000
B19	S18C-R	25.3306000	-80.5250000
B20	S332-R	25.4217000	-80.5897000
B21	S65DW+R	27.3142000	-81.0219000
B22	S70+R	27.1186000	-81.1572000
B23	SIRG+R	26.9072000	-80.1917000
B24	SNIVLY+R	27.9717000	-81.4175000
B25	TAFT+R	28.4361000	-81.3714000
B26	Herron Steel Site Silver	30.4383000	-84.4111000
B27	Christian Heritage Church	30.5053000	-84.3308000
B28	Lake Jackson Facility	30.4833000	-84.2992000
B29	Tuck Property N. Centerv	30.5592000	-84.1500000
B30	City Well At Limoges Dr.	30.4844000	-84.1956000
B31	Leon County Landfill	30.4203000	-84.1347000
B32	Lake Kanturk Outfall At Fe	30.5272000	-84.1917000
B33	San Luis City Park	30.4586000	-84.3211000
B34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
B35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
B36	S36-R	26.1734000	-80.1784000
B37	Blackman	30.9833000	-86.6500000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
B38	Branford	29.9625000	-82.9108000
B39	Brooksville 7 Ssw	28.4811000	-82.4353000
B40	Dowling Park	30.2497000	-83.2594000
B41	Graceville 1 Sw	30.9575000	-85.5331000
B42	Inglis 3 E	29.0253000	-82.6158000
B43	Lakeland	28.0206000	-81.9219000
B44	North New Rvr Canal 2	26.3336000	-80.5372000
B45	Pennsuco 5 Wnw	25.9297000	-80.4539000
B46	Woodruff Dam	30.7219000	-84.8742000
B47	Basinger	27.3833000	-81.0333000
B48	Cross City 1 E	29.6333000	-83.1053000
B49	Ft Myers Page Fld Ap	26.5850000	-81.8614000
B50	Kissimmee 2	28.2764000	-81.4239000
B51	Lisbon	28.8728000	-81.7844000
B52	Lynne	29.2003000	-81.9306000
B53	Marineland	29.6700000	-81.2150000
B54	Melbourne Wfo	28.0958000	-80.6308000
B55	Monticello 5 Se	30.4922000	-83.7833000
B56	Niceville	30.5316000	-86.4928000
B57	Ortona Lock 2	26.7897000	-81.3044000
B58	Panama City 5 N	30.2492000	-85.6606000
B59	Parrish	27.6089000	-82.3478000
B60	Raiford State Prison	30.0678000	-82.1928000
B61	Saint Leo	28.3378000	-82.2600000
B62	St Petersburg	27.7631000	-82.6272000
B63	Tallahassee Wso Ap	30.3931000	-84.3533000
B64	Venice	27.1006000	-82.4364000
B65	Vero Beach 4se	27.6528000	-80.4031000
B66	Mialck+R	26.6819000	-80.8061000
B67	MRF125C	26.7386000	-80.9344000
B68	MRF159	27.4725000	-81.1439000
B69	MRF220	26.6844000	-80.3675000
B70	MRF65	26.7744000	-80.6175000
B71	MRF73C	26.6650000	-80.7011000
B72	MRF80	26.6244000	-80.9483000
B73	Kenansville	27.9630000	-81.0500000

Table 14: Location of the 45-minute Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
C1	3A-36+R	26.1915000	-80.4492000
C2	3ANW+R	26.2665000	-80.7795000
C3	3AS+R	26.0821000	-80.6915000
C4	3ASW+R	25.9898000	-80.8362000
C5	ALICO+R	26.5128000	-80.9819000
C6	AVONPK+R	27.6317000	-81.2647000
C7	BLUEG+R	27.2197000	-80.4650000
C8	COLGOV+R	26.1297000	-81.7625000
C9	LOTELA+R	27.5914000	-81.4353000
C10	LXWS+R	26.4989000	-80.2222000
C11	MRF122	25.4700000	-80.3464000
C12	MRF123	25.3669000	-80.3764000
C13	MRF155	27.7528000	-81.0772000
C14	MRF187	27.4386000	-81.2064000
C15	MRF191	27.7458000	-81.2453000
C16	MRF205	28.0994000	-81.5286000
C17	MRF23	28.0017000	-81.1936000
C18	S131+R	26.9792000	-81.0900000
C19	S18C-R	25.3306000	-80.5250000
C20	S332-R	25.4217000	-80.5897000
C21	S65DW+R	27.3142000	-81.0219000
C22	S70+R	27.1186000	-81.1572000
C23	SIRG+R	26.9072000	-80.1917000
C24	SNIVLY+R	27.9717000	-81.4175000
C25	TAFT+R	28.4361000	-81.3714000
C26	Herron Steel Site Silver	30.4383000	-84.4111000
C27	Christian Heritage Church	30.5053000	-84.3308000
C28	Lake Jackson Facility	30.4833000	-84.2992000
C29	Tuck Property N. Centerv	30.5592000	-84.1500000
C30	City Well At Limoges Dr.	30.4844000	-84.1956000
C31	Leon County Landfill	30.4203000	-84.1347000
C32	Lake Kanturk Outfall At Fe	30.5272000	-84.1917000
C33	San Luis City Park	30.4586000	-84.3211000
C34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
C35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
C36	S36-R	26.1734000	-80.1784000
C37	Blackman	30.9833000	-86.6500000
C38	Branford	29.9625000	-82.9108000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
C39	Brooksville 7 Ssw	28.4811000	-82.4353000
C40	Dowling Park	30.2497000	-83.2594000
C41	Graceville 1 Sw	30.9575000	-85.5331000
C42	Inglis 3 E	29.0253000	-82.6158000
C43	Lakeland	28.0206000	-81.9219000
C44	North New Rvr Canal 2	26.3336000	-80.5372000
C45	Pennsuco 5 Wnw	25.9297000	-80.4539000
C46	Woodruff Dam	30.7219000	-84.8742000
C47	Basinger	27.3833000	-81.0333000
C48	Cross City 1 E	29.6333000	-83.1053000
C49	Ft Myers Page Fld Ap	26.5850000	-81.8614000
C50	Kissimmee 2	28.2764000	-81.4239000
C51	Lisbon	28.8728000	-81.7844000
C52	Lynne	29.2003000	-81.9306000
C53	Marineland	29.6700000	-81.2150000
C54	Melbourne Wfo	28.0958000	-80.6308000
C55	Monticello 5 Se	30.4922000	-83.7833000
C56	Niceville	30.5316000	-86.4928000
C57	Ortona Lock 2	26.7897000	-81.3044000
C58	Panama City 5 N	30.2492000	-85.6606000
C59	Parrish	27.6089000	-82.3478000
C60	Raiford State Prison	30.0678000	-82.1928000
C61	Saint Leo	28.3378000	-82.2600000
C62	St Petersburg	27.7631000	-82.6272000
C63	Tallahassee Wso Ap	30.3931000	-84.3533000
C64	Venice	27.1006000	-82.4364000
C65	Vero Beach 4se	27.6528000	-80.4031000
C66	Mialck+R	26.6819000	-80.8061000
C67	MRF125C	26.7386000	-80.9344000
C68	MRF159	27.4725000	-81.1439000
C69	MRF220	26.6844000	-80.3675000
C70	MRF65	26.7744000	-80.6175000
C71	MRF73C	26.6650000	-80.7011000
C72	MRF80	26.6244000	-80.9483000
C73	Kenansville	27.9630000	-81.0500000

Table 15: Location of the 1-hour Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
D1	3A-36+R	26.1915000	-80.4492000
D2	3ANW+R	26.2665000	-80.7795000
D3	3AS+R	26.0821000	-80.6915000
D4	3ASW+R	25.9898000	-80.8362000
D5	ALICO+R	26.5128000	-80.9819000
D6	AVONPK+R	27.6317000	-81.2647000
D7	BLUEG+R	27.2197000	-80.4650000
D8	COLGOV+R	26.1297000	-81.7625000
D9	LOTELA+R	27.5914000	-81.4353000
D10	LXWS+R	26.4989000	-80.2222000
D11	MRF122	25.4700000	-80.3464000
D12	MRF123	25.3669000	-80.3764000
D13	MRF155	27.7528000	-81.0772000
D14	MRF187	27.4386000	-81.2064000
D15	MRF191	27.7458000	-81.2453000
D16	MRF205	28.0994000	-81.5286000
D17	MRF23	28.0017000	-81.1936000
D18	S131+R	26.9792000	-81.0900000
D19	S18C-R	25.3306000	-80.5250000
D20	S332-R	25.4217000	-80.5897000
D21	S65DW+R	27.3142000	-81.0219000
D22	S70+R	27.1186000	-81.1572000
D23	Sirg+R	26.9072000	-80.1917000
D24	Snivly+R	27.9717000	-81.4175000
D25	Taft+R	28.4361000	-81.3714000
D26	Herron Steel Site Silver	30.4383000	-84.4111000
D27	Christian Heritage Church	30.5053000	-84.3308000
D28	Lake Jackson Facility	30.4833000	-84.2992000
D29	Tuck Property N. Centerv	30.5592000	-84.1500000
D30	City Well At Limoges Dr.	30.4844000	-84.1956000
D31	Leon County Landfill	30.4203000	-84.1347000
D32	Lake Kanturk Outfall At Fe	30.5272000	-84.1917000
D33	San Luis City Park	30.4586000	-84.3211000
D34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
D35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
D36	S36-R	26.1734000	-80.1784000
D37	Blackman	30.9833000	-86.6500000
D38	Boca Raton	26.3675000	-80.1108000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
D39	Branford	29.9625000	-82.9108000
D40	Brooksville 7 Ssw	28.4811000	-82.4353000
D41	Dowling Park	30.2497000	-83.2594000
D42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
D43	Graceville 1 Sw	30.9575000	-85.5331000
D44	Inglis 3 E	29.0253000	-82.6158000
D45	Lakeland	28.0206000	-81.9219000
D46	Lignumvitae Key	24.9027000	-80.6960000
D47	Monticello 10 Sw	30.4406000	-83.9858000
D48	North New Rvr Canal 1	26.5667000	-80.7500000
D49	North New Rvr Canal 2	26.3336000	-80.5372000
D50	Pennsuco 5 Wnw	25.9297000	-80.4539000
D51	Port Mayaca S L	26.9833000	-80.6167000
D52	Trail Glade Ranges	25.7647000	-80.4775000
D53	Woodruff Dam	30.7219000	-84.8742000
D54	Miles City	26.2483000	-81.2967000
D55	Ochopee	25.9167000	-81.2833000
D56	Apalachicola Ap	29.7258000	-85.0206000
D57	Avon Park 2 W	27.5944000	-81.5253000
D58	Basinger	27.3833000	-81.0333000
D59	Bristol	30.4181000	-84.9861000
D60	Brooksville Chin Hill	28.6164000	-82.3658000
D61	Crestview Bob Sikes Ap	30.7797000	-86.5225000
D62	Cross City 1 E	29.6333000	-83.1053000
D63	Daytona Beach Intl Ap	29.1828000	-81.0483000
D64	Ft Myers Page Fld Ap	26.5850000	-81.8614000
D65	Gainesville 3 Wsw	29.6333000	-82.3667000
D66	Hialeah	25.8175000	-80.2858000
D67	Homestead Exp Stn	25.5000000	-80.5000000
D68	Jacksonville Intl Ap	30.4950000	-81.6936000
D69	Key West Intl Ap	24.5550000	-81.7522000
D70	Kissimmee 2	28.2764000	-81.4239000
D71	Lisbon	28.8728000	-81.7844000
D72	Loxahatchee	26.6833000	-80.2667000
D73	Lynne	29.2003000	-81.9306000
D74	Marineland	29.6700000	-81.2150000
D75	Melbourne Wfo	28.0958000	-80.6308000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
D76	Miami Beach	25.8064000	-80.1336000
D77	Miami Intl Ap	25.7906000	-80.3164000
D78	Miami Wso City	25.7167000	-80.2833000
D76	Miami Beach	25.8064000	-80.1336000
D77	Miami Intl Ap	25.7906000	-80.3164000
D78	Miami Wso City	25.7167000	-80.2833000
D79	Monticello 5 Se	30.4922000	-83.7833000
D80	Moore Haven Lock 1	26.8400000	-81.0872000
D81	Niceville	30.5316000	-86.4928000
D82	Okeechobee	27.1508000	-80.8653000
D83	Orange City	28.9333000	-81.3000000
D84	Orlando Intl Ap	28.4339000	-81.3250000
D85	Orlando Wso Ap	28.5500000	-81.3333000
D86	Ortona Lock 2	26.7897000	-81.3044000
D87	Panacea 1 S	29.9989000	-84.4850000
D88	Panama City 5 N	30.2492000	-85.6606000
D89	Parrish	27.6089000	-82.3478000
D90	Pensacola Rgnl Ap	30.4781000	-87.1869000
D91	Raiford State Prison	30.0678000	-82.1928000
D92	Saint Leo	28.3378000	-82.2600000
D93	St Lucie New Lock 1	27.1167000	-80.2833000
D94	St Petersburg	27.7631000	-82.6272000
D95	Tallahassee Wso Ap	30.3931000	-84.3533000
D96	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
D97	Tampa Wscmo Ap	27.9614000	-82.5403000
D98	Venice	27.1006000	-82.4364000
D99	Venus	27.1350000	-81.3303000
D100	Vero Beach 4se	27.6528000	-80.4031000
D101	Wausau	30.6333000	-85.5833000
D102	West Palm Bch Intl Ap	26.6847000	-80.0994000
D103	Mialck+R	26.6819000	-80.8061000
D104	Mrf125c	26.7386000	-80.9344000
D105	Mrf159	27.4725000	-81.1439000
D106	Mrf183	26.7003000	-80.7161000
D107	Mrf220	26.6844000	-80.3675000
D108	Mrf27	27.8031000	-81.1981000
D109	Mrf65	26.7744000	-80.6175000
D110	Mrf73c	26.6650000	-80.7011000
D111	Mrf80	26.6244000	-80.9483000
D112	Kenansville	27.9630000	-81.0500000

Table 16: Location of the 2-hour Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
E1	3A-36+R	26.1915000	-80.4492000
E2	3ANW+R	26.2665000	-80.7795000
E3	3AS+R	26.0821000	-80.6915000
E4	3ASW+R	25.9898000	-80.8362000
E5	ALICO+R	26.5128000	-80.9819000
E6	AVONPK+R	27.6317000	-81.2647000
E7	BLUEG+R	27.2197000	-80.4650000
E8	COLGOV+R	26.1297000	-81.7625000
E9	LOTELA+R	27.5914000	-81.4353000
E10	LXWS+R	26.4989000	-80.2222000
E11	MRF122	25.4700000	-80.3464000
E12	MRF123	25.3669000	-80.3764000
E13	MRF155	27.7528000	-81.0772000
E14	MRF187	27.4386000	-81.2064000
E15	MRF191	27.7458000	-81.2453000
E16	MRF205	28.0994000	-81.5286000
E17	MRF23	28.0017000	-81.1936000
E18	S131+R	26.9792000	-81.0900000
E19	S18C-R	25.3306000	-80.5250000
E20	S332-R	25.4217000	-80.5897000
E21	S65DW+R	27.3142000	-81.0219000
E22	S70+R	27.1186000	-81.1572000
E23	SIRG+R	26.9072000	-80.1917000
E24	SNIVLY+R	27.9717000	-81.4175000
E25	TAFT+R	28.4361000	-81.3714000
E26	Herron Steel Site Silver	30.4383000	-84.4111000
E27	Christian Heritage Church	30.5053000	-84.3308000
E28	Lake Jackson Facility	30.4833000	-84.2992000
E29	TUCK PROPERTY N. CENTERV	30.5592000	-84.1500000
E30	City Well At Limoges	30.4844000	-84.1956000
E31	Leon County Landfill	30.4203000	-84.1347000
E32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
E33	San Luis City Park	30.4586000	-84.3211000
E34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
E35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
E36	S36-R	26.1734000	-80.1784000
E37	Blackman	30.9833000	-86.6500000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
E38	Boca Raton	26.3675000	-80.1108000
E39	Branford	29.9625000	-82.9108000
E40	Brooksville 7 Ssw	28.4811000	-82.4353000
E41	Dowling Park 1 W	30.2497000	-83.2594000
E42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
E43	Graceville 1 Sw	30.9575000	-85.5331000
E44	Inglis 3 E	29.0253000	-82.6158000
E45	Lakeland	28.0206000	-81.9219000
E46	Lignumvitae Key	24.9027000	-80.6960000
E47	Monticello 10 Sw	30.4406000	-83.9858000
E48	North New Rvr Canal 1	26.5667000	-80.7500000
E49	North New Rvr Canal 2	26.3336000	-80.5372000
E50	Pennsuco 5 Wnw	25.9297000	-80.4539000
E51	Port Mayaca S L Canal	26.9833000	-80.6167000
E52	Trail Grade Ranges	25.7647000	-80.4775000
E53	Woodruff Dam	30.7219000	-84.8742000
E54	Miles City	26.2483000	-81.2967000
E55	Ochopee	25.9167000	-81.2833000
E56	Apalachicola Ap	29.7258000	-85.0206000
E57	Avon Park 2 W	27.5944000	-81.5253000
E58	Basinger	27.3833000	-81.0333000
E59	Bristol	30.4181000	-84.9861000
E60	Brooksville Chin Hill Ap	28.6164000	-82.3658000
E61	Crestview Bob Sikes Ap	30.7797000	-86.5225000
E62	Cross City 1 E	29.6333000	-83.1053000
E63	Daytona Beach Intl Ap	29.1828000	-81.0483000
E64	Ft Myers Page Fld Ap	26.5850000	-81.8614000
E65	Gainesville 3 Wsw	29.6333000	-82.3667000
E66	Hialeah	25.8175000	-80.2858000
E67	Homestead Exp Stn	25.5000000	-80.5000000
E68	Jacksonville Intl Ap	30.4950000	-81.6936000
E69	Key West Intl Airport	24.5550000	-81.7522000
E70	Kissimmee 2	28.2764000	-81.4239000
E71	Lisbon	28.8728000	-81.7844000
E72	Loxahatchee	26.6833000	-80.2667000
E73	Lynne	29.2003000	-81.9306000
E74	Marineland	29.6700000	-81.2150000
E75	Melbourne Wfo	28.0958000	-80.6308000
E76	Miami Beach	25.8064000	-80.1336000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
E77	Miami Intl Ap	25.7906000	-80.3164000
E78	Miami Wso City	25.7167000	-80.2833000
E79	Monticello 5 Se	30.4922000	-83.7833000
E80	Moore Haven Lock 1	26.8400000	-81.0872000
E81	Niceville	30.5316000	-86.4928000
E82	Okeechobee	27.1508000	-80.8653000
E83	Orange City	28.9333000	-81.3000000
E84	Orlando Intl Ap	28.4339000	-81.3250000
E85	Orlando Wso Ap	28.5500000	-81.3333000
E86	Ortona Lock 2	26.7897000	-81.3044000
E87	Panacea 1 S	29.9989000	-84.4850000
E88	Panama City 5 N	30.2492000	-85.6606000
E89	Parrish	27.6089000	-82.3478000
E90	Pensacola Rgnl Ap	30.4781000	-87.1869000
E91	Raiford State Prison	30.0678000	-82.1928000
E92	Saint Leo	28.3378000	-82.2600000
E93	St Lucie New Lock 1	27.1167000	-80.2833000
E94	St Petersburg	27.7631000	-82.6272000
E95	Tallahassee Wso Ap	30.3931000	-84.3533000
E96	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
E97	Tampa Wscmo Ap	27.9614000	-82.5403000
E98	Venice	27.1006000	-82.4364000
E99	Venus	27.1350000	-81.3303000
E100	Vero Beach	27.6528000	-80.4031000
E101	Wausau	30.6333000	-85.5833000
E102	West Palm Bch Intl Ap	26.6847000	-80.0994000
E103	Mialck+R	26.6819000	-80.8061000
E104	MRF125C	26.7386000	-80.9344000
E105	MRF159	27.4725000	-81.1439000
E106	MRF183	26.7003000	-80.7161000
E107	MRF220	26.6844000	-80.3675000
E108	MRF27	27.8031000	-81.1981000
E109	MRF65	26.7744000	-80.6175000
E110	MRF73C	26.6650000	-80.7011000
E111	MRF80	26.6244000	-80.9483000
E112	Kenansville	27.9630000	-81.0500000

Table 17: Location of the 3-hour Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
F1	3A-36+R	26.1915000	-80.4492000
F2	3ANW+R	26.2665000	-80.7795000
F3	3AS+R	26.0821000	-80.6915000
F4	3ASW+R	25.9898000	-80.8362000
F5	ALICO+R	26.5128000	-80.9819000
F6	AVONPK+R	27.6317000	-81.2647000
F7	BLUEG+R	27.2197000	-80.4650000
F8	COLGOV+R	26.1297000	-81.7625000
F9	LOTELA+R	27.5914000	-81.4353000
F10	LXWS+R	26.4989000	-80.2222000
F11	MRF122	25.4700000	-80.3464000
F12	MRF123	25.3669000	-80.3764000
F13	MRF155	27.7528000	-81.0772000
F14	MRF187	27.4386000	-81.2064000
F15	MRF191	27.7458000	-81.2453000
F16	MRF205	28.0994000	-81.5286000
F17	MRF23	28.0017000	-81.1936000
F18	S131+R	26.9792000	-81.0900000
F19	S18C-R	25.3306000	-80.5250000
F20	S332-R	25.4217000	-80.5897000
F21	S65DW+R	27.3142000	-81.0219000
F22	S70+R	27.1186000	-81.1572000
F23	SIRG+R	26.9072000	-80.1917000
F24	SNIVLY+R	27.9717000	-81.4175000
F25	TAFT+R	28.4361000	-81.3714000
F26	Herron Steel Site Silver	30.4383000	-84.4111000
F27	Christian Heritage Church	30.5053000	-84.3308000
F28	Lake Jackson Facility	30.4833000	-84.2992000
F29	Tuck Property N. Centerv	30.5592000	-84.1500000
F30	City Well At Limoges	30.4844000	-84.1956000
F31	Leon County Landfill Us	30.4203000	-84.1347000
F32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
F33	San Luis City Park	30.4586000	-84.3211000
F34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
F35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
F36	S36-R	26.1734000	-80.1784000
F37	Blackman	30.9833000	-86.6500000
F38	Boca Raton	26.3675000	-80.1108000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
F39	Branford	29.9625000	-82.9108000
F40	Brooksville 7 Ssw	28.4811000	-82.4353000
F41	Dowling Park 1 W	30.2497000	-83.2594000
F42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
F43	Graceville 1 Sw	30.9575000	-85.5331000
F44	Inglis 3 E	29.0253000	-82.6158000
F45	Lakeland	28.0206000	-81.9219000
F46	Lignumvitae Key	24.9027000	-80.6960000
F47	Monticello 10 Sw	30.4406000	-83.9858000
F48	North New Rvr Canal 1	26.5667000	-80.7500000
F49	North New Rvr Canal 2	26.3336000	-80.5372000
F50	Pennsuco 5 Wnw	25.9297000	-80.4539000
F51	Port Mayaca S L Canal	26.9833000	-80.6167000
F52	Trail Grade Ranges	25.7647000	-80.4775000
F53	Woodruff Dam	30.7219000	-84.8742000
F54	Miles City	26.2483000	-81.2967000
F55	Ochopee	25.9167000	-81.2833000
F56	Apalachicola Ap	29.7258000	-85.0206000
F57	Avon Park 2 W	27.5944000	-81.5253000
F58	Basinger	27.3833000	-81.0333000
F59	Bristol	30.4181000	-84.9861000
F60	Brooksville Chin Hill Ap	28.6164000	-82.3658000
F61	Crestview Bob Sikes Ap	30.7797000	-86.5225000
F62	Cross City 1 E	29.6333000	-83.1053000
F63	Daytona Beach Intl Ap	29.1828000	-81.0483000
F64	Ft Myers Page Fld Ap	26.5850000	-81.8614000
F65	Gainesville 3 Wsw	29.6333000	-82.3667000
F66	Hialeah	25.8175000	-80.2858000
F67	Homestead Exp Stn	25.5000000	-80.5000000
F68	Jacksonville Intl Ap	30.4950000	-81.6936000
F69	Key West Intl Airport	24.5550000	-81.7522000
F70	Kissimmee 2	28.2764000	-81.4239000
F71	Lisbon	28.8728000	-81.7844000
F72	Loxahatchee	26.6833000	-80.2667000
F73	Lynne	29.2003000	-81.9306000
F74	Marineland	29.6700000	-81.2150000
F75	Melbourne Wfo	28.0958000	-80.6308000
F76	Miami Beach	25.8064000	-80.1336000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
F77	Miami Intl Ap	25.7906000	-80.3164000
F78	Miami Wso City	25.7167000	-80.2833000
F79	Monticello 5 Se	30.4922000	-83.7833000
F80	Moore Haven Lock 1	26.8400000	-81.0872000
F81	Niceville	30.5316000	-86.4928000
F82	Okeechobee	27.1508000	-80.8653000
F83	Orange City	28.9333000	-81.3000000
F84	Orlando Intl Ap	28.4339000	-81.3250000
F85	Orlando Wso Ap	28.5500000	-81.3333000
F86	Ortona Lock 2	26.7897000	-81.3044000
F87	Panacea 1 S	29.9989000	-84.4850000
F88	Panama City 5 N	30.2492000	-85.6606000
F89	Parrish	27.6089000	-82.3478000
F90	Pensacola Rgnl Ap	30.4781000	-87.1869000
F91	Raiford State Prison	30.0678000	-82.1928000
F92	Saint Leo	28.3378000	-82.2600000
F93	St Lucie New Lock 1	27.1167000	-80.2833000
F94	St Petersburg	27.7631000	-82.6272000
F95	Tallahassee Wso Ap	30.3931000	-84.3533000
F96	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
F97	Tampa Wscmo Ap	27.9614000	-82.5403000
F98	Venice	27.1006000	-82.4364000
F99	Venus	27.1350000	-81.3303000
F100	Vero Beach	27.6528000	-80.4031000
F101	Wausau	30.6333000	-85.5833000
F102	West Palm Bch Intl Ap	26.6847000	-80.0994000
F103	Mialck+R	26.6819000	-80.8061000
F104	MRF125C	26.7386000	-80.9344000
F105	MRF159	27.4725000	-81.1439000
F106	MRF183	26.7003000	-80.7161000
F107	MRF220	26.6844000	-80.3675000
F108	MRF27	27.8031000	-81.1981000
F109	MRF65	26.7744000	-80.6175000
F110	MRF73C	26.6650000	-80.7011000
F111	MRF80	26.6244000	-80.9483000
F112	Kenansville	27.963|0000	-81.0500000

Table 18: Location of the 6-hour Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
G1	3A-36+R	26.1915000	-80.4492000
G2	3ANW+R	26.2665000	-80.7795000
G3	3AS+R	26.0821000	-80.6915000
G4	3ASW+R	25.9898000	-80.8362000
G5	Alico+R	26.5128000	-80.9819000
G6	Avonpk+R	27.6317000	-81.2647000
G7	Blueg+R	27.2197000	-80.4650000
G8	Colgov+R	26.1297000	-81.7625000
G9	Lotela+R	27.5914000	-81.4353000
G10	Lxws+R	26.4989000	-80.2222000
G11	MRF122	25.4700000	-80.3464000
G12	MRF123	25.3669000	-80.3764000
G13	MRF155	27.7528000	-81.0772000
G14	MRF187	27.4386000	-81.2064000
G15	MRF191	27.7458000	-81.2453000
G16	MRF205	28.0994000	-81.5286000
G17	MRF23	28.0017000	-81.1936000
G18	S131+R	26.9792000	-81.0900000
G19	S18C-R	25.3306000	-80.5250000
G20	S332-R	25.4217000	-80.5897000
G21	S65DW+R	27.3142000	-81.0219000
G22	S70+R	27.1186000	-81.1572000
G23	Sirg+R	26.9072000	-80.1917000
G24	Snivly+R	27.9717000	-81.4175000
G25	Taft+R	28.4361000	-81.3714000
G26	Herron Steel Site Silver	30.4383000	-84.4111000
G27	Christian Heritage Church	30.5053000	-84.3308000
G28	Lake Jackson Facility	30.4833000	-84.2992000
G29	Tuck Property N. Century	30.5592000	-84.1500000
G30	City Well At Limoges Dr.	30.4844000	-84.1956000
G31	Leon County Landfill Us	30.4203000	-84.1347000
G32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
G33	San Luis City Park	30.4586000	-84.3211000
G34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
G35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
G36	S36-R	26.1734000	-80.1784000
G37	Blackman	30.9833000	-86.6500000
G38	Boca Raton	26.3675000	-80.1108000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
G39	Branford	29.9625000	-82.9108000
G40	Brooksville	28.4811000	-82.4353000
G41	Dowling Park	30.2497000	-83.2594000
G42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
G43	Graceville 1 Sw	30.9575000	-85.5331000
G44	Inglis 3 E	29.0253000	-82.6158000
G45	Lakeland	28.0206000	-81.9219000
G46	Lignumvitae Key	24.9027000	-80.6960000
G47	Monticello 10 Sw	30.4406000	-83.9858000
G48	North New Rvr Canal 1	26.5667000	-80.7500000
G49	North New Rvr Canal 2	26.3336000	-80.5372000
G50	Pennsuco S Wnw	25.9297000	-80.4539000
G51	Port Mayaca S L Canal	26.9833000	-80.6167000
G52	Trail Glade Ranges	25.7647000	-80.4775000
G53	Woodruff Dam	30.7219000	-84.8742000
G54	Miles City	26.2483000	-81.2967000
G55	Ochopee	25.9167000	-81.2833000
G56	Apalachicola Ap	29.7258000	-85.0206000
G57	Avon Park 2 W	27.5944000	-81.5253000
G58	Basinger	27.3833000	-81.0333000
G59	Bristol	30.4181000	-84.9861000
G60	Brooksville Chin Hill	28.6164000	-82.3658000
G61	Crestview Bob Sikes Ap	30.7797000	-86.5225000
G62	Cross City 1 E	29.6333000	-83.1053000
G63	Daytona Beach Intl Ap	29.1828000	-81.0483000
G64	Ft Myers Page Fld Ap	26.5850000	-81.8614000
G65	Gainesville 3 Wsw	29.6333000	-82.3667000
G66	Hialeah	25.8175000	-80.2858000
G67	Homestead Exp Stn	25.5000000	-80.5000000
G68	Jacksonville Intl Ap	30.4950000	-81.6936000
G69	Key West Intl Ap	24.5550000	-81.7522000
G70	Kissimmee 2	28.2764000	-81.4239000
G71	Lisbon	28.8728000	-81.7844000
G72	Loxahatchee	26.6833000	-80.2667000
G73	Lynne	29.2003000	-81.9306000
G74	Marineland	29.6700000	-81.2150000
G75	Melbourne Wfo	28.0958000	-80.6308000
G76	Miami Beach	25.8064000	-80.1336000
G77	Miami Intl Ap	25.7906000	-80.3164000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
G78	Miami Wso City	25.7167000	-80.2833000
G79	Monticello 5 Se	30.4922000	-83.7833000
G80	Moore Haven Lock 1	26.8400000	-81.0872000
G81	Niceville	30.5316000	-86.4928000
G82	Okeechobee	27.1508000	-80.8653000
G83	Orange City	28.9333000	-81.3000000
G84	Orlando Intl Ap	28.4339000	-81.3250000
G85	Orlando Wso Ap	28.5500000	-81.3333000
G86	Ortona Lock 2	26.7897000	-81.3044000
G87	Panacea 1 S	29.9989000	-84.4850000
G88	Panama City 5 N	30.2492000	-85.6606000
G89	Parrish	27.6089000	-82.3478000
G90	Pensacola Rgnl Ap	30.4781000	-87.1869000
G91	Raiford State Prison	30.0678000	-82.1928000
G92	Saint Leo	28.3378000	-82.2600000
G93	St Lucie New Lock 1	27.1167000	-80.2833000
G94	St PETERSBURG FL	27.7631000	-82.6272000
G95	Tallahassee Wso Ap Fl	30.3931000	-84.3533000
G96	Tamiami Trl 40 Mi Bend Fl	25.7608000	-80.8242000
G97	Tampa Wscmo Ap Fl	27.9614000	-82.5403000
G98	Venice	27.1006000	-82.4364000
G99	Venus	27.1350000	-81.3303000
G100	Vero Beach 4se Fl	27.6528000	-80.4031000
G101	Wausau	30.6333000	-85.5833000
G102	West Palm Bch Intl Ap	26.6847000	-80.0994000
G103	Mialck+R	26.6819000	-80.8061000
G104	Mrf125c	26.7386000	-80.9344000
G105	Mrf159	27.4725000	-81.1439000
G106	Mrf183	26.7003000	-80.7161000
G107	Mrf220	26.6844000	-80.3675000
G108	Mrf27	27.8031000	-81.1981000
G109	Mrf65	26.7744000	-80.6175000
G110	Mrf73c	26.6650000	-80.7011000
G111	Mrf80	26.6244000	-80.9483000
G112	Kenansville	27.9630000	-81.0500000
G113	Tallahassee Wso Ap	30.3931000	-84.3533000
G114	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
G115	Tampa Wscmo Ap	27.9614000	-82.5403000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
G116	Tarpon Spgs Sewage Pl	28.1586000	-82.7644000
G117	Tavernier	25.0069000	-80.5211000
G118	Titusville	28.6242000	-80.8158000
G119	Usher Twr	29.4083000	-82.8186000
G120	Venice	27.1006000	-82.4364000
G121	Venus	27.1350000	-81.3303000
G122	Vero Beach 4 Se	27.6528000	-80.4031000
G123	Wauchula	27.5478000	-81.7994000
G124	Wausau	30.6333000	-85.5833000
G125	West Palm Bch Intl Ap	26.6847000	-80.0994000
G126	Wewahitchka	30.1192000	-85.2042000
G127	Winter Haven	28.0153000	-81.7331000
G128	G56-R	26.3278000	-80.1308000
G129	G57-R	26.2311000	-80.1242000
G130	MIALCK+R	26.6819000	-80.8061000
G131	MRF102	26.3689000	-80.1539000
G132	MRF114	26.0603000	-80.2317000
G133	MRF117	25.8269000	-80.3442000
G134	MRF125C	26.7386000	-80.9344000
G135	MRF133	26.7489000	-80.6836000
G136	MRF137	26.8131000	-80.5636000
G137	MRF138	26.7839000	-80.5253000
G138	MRF159	27.4725000	-81.1439000
G139	MRF18	28.1403000	-81.3519000
G140	MRF183	26.7003000	-80.7161000
G141	MRF198	26.7897000	-80.9617000
G142	MRF206	26.6069000	-81.6497000
G143	MRF212	26.4239000	-80.1222000
G144	MRF213	26.4167000	-80.2039000
G145	MRF220	26.6844000	-80.3675000
G146	MRF250	26.7125000	-81.6297000
G147	MRF27	27.8031000	-81.1981000
G148	MRF300	26.7281000	-80.8533000
G149	MRF301	26.715000	-80.0622000
G150	MRF32	27.66000	-81.1342000
G151	MRF38	27.4014000	-81.1147000
G152	MRF39	27.3733000	-80.4506000
G153	MRF40	27.3325000	-80.4967000
G154	MRF50	27.0653000	-80.9778000
G155	MRF5005	26.4072000	-81.4164000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
G156	MRF5006	26.5956000	-81.3353000
G157	MRF5010	26.1844000	-81.3464000
G158	MRF5022	26.9244000	-81.3139000
G159	MRF5029	27.6081000	-80.4314000
G160	MRF5034	27.2903000	-80.8269000
G161	MRF5053	27.4103000	-80.3369000
G162	MRF54	26.9044000	-80.3039000
G163	MRF57	26.8419000	-80.6022000
G164	MRF60	26.8083000	-81.0467000
G165	MRF63	26.7350000	-80.8953000
G166	MRF65	26.7744000	-80.6175000
G167	MRF73C	26.6650000	-80.7011000
G168	MRF78	26.6189000	-80.1264000
G169	MRF80	26.6244000	-80.9483000
G170	MRF81	26.6122000	-80.205000
G171	MRF84	26.5208000	-80.1239000
G172	MRF85	26.5283000	-80.1703000
G173	S133-R	27.2061000	-80.8008000
G174	S65E+R	27.2253000	-80.9625000
G175	S-157	27.8304000	-80.5397000
G176	S-164	28.3406000	-80.9333000
G177	S-252D	27.6389000	-80.6789000
G178	Black Ck	30.0602000	-81.8488000
G179	Lk Joanna	28.8345000	-81.6460000
G180	Kenansville	27.9630000	-81.0500000

Table 19: Location of the 12-hour Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
H1	3A-36+R	26.1915000	-80.4492000
H2	3ANW+R	26.2665000	-80.7795000
H3	3AS+R	26.0821000	-80.6915000
H4	3ASW+R	25.9898000	-80.8362000
H5	Alico+R	26.5128000	-80.9819000
H6	Avonpk+R	27.6317000	-81.2647000
H7	Blueg+R	27.2197000	-80.4650000
H8	Colgov+R	26.1297000	-81.7625000
H9	Lotela+R	27.5914000	-81.4353000
H10	LXWS+R	26.4989000	-80.2222000
H11	MRF122	25.4700000	-80.3464000
H12	MRF123	25.3669000	-80.3764000
H13	MRF155	27.7528000	-81.0772000
H14	MRF187	27.4386000	-81.2064000
H15	MRF191	27.7458000	-81.2453000
H16	MRF205	28.0994000	-81.5286000
H17	MRF23	28.0017000	-81.1936000
H18	S131+R	26.9792000	-81.0900000
H19	S18C-R	25.3306000	-80.5250000
H20	S332-R	25.4217000	-80.5897000
H21	S65DW+R	27.3142000	-81.0219000
H22	S70+R	27.1186000	-81.1572000
H23	Sirg+R	26.9072000	-80.1917000
H24	Snivly+R	27.9717000	-81.4175000
H25	Taft+R	28.4361000	-81.3714000
H26	Herron Steel Site Silver	30.4383000	-84.4111000
H27	Christian Heritage Church	30.5053000	-84.3308000
H28	Lake Jackson Facility	30.4833000	-84.2992000
H29	Tuck Property N. Centerv	30.5592000	-84.1500000
H30	City Well At Limoges Dr.	30.4844000	-84.1956000
H31	Leon County Landfill Us	30.4203000	-84.1347000
H32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
H33	San Luis City Park	30.4586000	-84.3211000
H34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
H35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
H36	S36-R	26.1734000	-80.1784000
H37	Blackman	30.9833000	-86.6500000
H38	Boca Raton	26.3675000	-80.1108000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
H39	Branford	29.9625000	-82.9108000
H40	Brooksville 7 Ssw	28.4811000	-82.4353000
H41	Dowling Park 1 W	30.2497000	-83.2594000
H42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
H43	Graceville 1 Sw	30.9575000	-85.5331000
H44	Inglis 3 E	29.0253000	-82.6158000
H45	Lakeland	28.0206000	-81.9219000
H46	Lignumvitae Key	24.9027000	-80.6960000
H47	Monticello 10 Sw	30.4406000	-83.9858000
H48	North New Rvr Canal 1	26.5667000	-80.7500000
H49	North New Rvr Canal 2	26.3336000	-80.5372000
H50	Pennsuco 5 Wnw	25.9297000	-80.4539000
H51	Mayaca S L Canal	26.9833000	-80.6167000
H52	Trail Glade Ranges	25.7647000	-80.4775000
H53	Woodruff Dam	30.7219000	-84.8742000
H54	Miles City	26.2483000	-81.2967000
H55	Ochopee	25.9167000	-81.2833000
H56	Apalachicola Ap	29.7258000	-85.0206000
H57	Avon Park 2 W	27.5944000	-81.5253000
H58	Basinger	27.3833000	-81.0333000
H59	Bristol	30.4181000	-84.9861000
H60	Brooksville Chin Hill	28.6164000	-82.3658000
H61	Crestview Bob Sikes Ap	30.7797000	-86.5225000
H62	Cross City 1 E	29.6333000	-83.1053000
H63	Daytona Beach Intl Ap	29.1828000	-81.0483000
H64	Ft Myers Page Fld Ap	26.5850000	-81.8614000
H65	Gainesville 3 Wsw	29.6333000	-82.3667000
H66	Hialeah	25.8175000	-80.2858000
H67	Homestead Exp Stn	25.5000000	-80.5000000
H68	Jacksonville Intl Ap	30.4950000	-81.6936000
H69	Key West Intl Airport	24.5550000	-81.7522000
H70	Kissimmee 2	28.2764000	-81.4239000
H71	Lisbon	28.8728000	-81.7844000
H72	Loxahatchee	26.6833000	-80.2667000
H73	Lynne	29.2003000	-81.9306000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
H74	Marineland	29.67000000	-81.21500000
H75	Melbourne Wfo	28.09580000	-80.63080000
H76	Miami Beach	28.8064000	-80.1336000
H77	Miami Intl Ap	25.7906000	-80.3164000
H78	Miami Wso City	25.7167000	-80.2833000
H79	Monticello 5 Se	30.4922000	-83.7833000
H80	Moore Haven Lock 1	26.8400000	-81.0872000
H81	Niceville	30.5316000	-86.4928000
H82	Okeechobee	27.1508000	-80.8653000
H83	Orange City	28.9333000	-81.3000000
H84	Orlando Intl Ap	28.4339000	-81.3250000
H85	Orlando Wso Ap	28.5500000	-81.3333000
H86	Ortona Lock 2	26.7897000	-81.3044000
H87	Panacea 1 S	29.9989000	-84.4850000
H88	Panama City 5 N	30.2492000	-85.6606000
H89	Parrish	27.6089000	-82.3478000
H90	Pensacola Rgnl Ap	30.4781000	-87.1869000
H91	Raiford State Prison	30.0678000	-82.1928000
H92	Saint Leo	28.3378000	-82.2600000
H93	St Lucie New Lock 1	27.1167000	-80.2833000
H94	St Petersburg	27.7631000	-82.6272000
H95	Tallahassee Wso Ap	30.3931000	-84.3533000
H96	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
H97	Tampa Wscmo Ap	27.9614000	-82.5403000
H98	Venice	27.1006000	-82.4364000
H99	Venus	27.1350000	-81.3303000
H100	Vero Beach 4se	27.6528000	-80.4031000
H101	Wausau	30.6333000	-85.5833000
H102	West Palm Bch Intl Ap	26.6847000	-80.0994000
H103	Mialck+R	26.6819000	-80.8061000
H104	MRF125C	26.7386000	-80.9344000
H105	MRF159	27.4725000	-81.1439000
H106	MRF183	26.7003000	-80.7161000
H107	MRF220	26.6844000	-80.3675000
H108	MRF27	27.8031000	-81.1981000
H109	MRF65	26.7744000	-80.6175000
H110	MRF73C	26.6650000	-80.7011000
H111	MRF80	26.6244000	-80.9483000
H112	Kenansville	27.9630000	-81.0500000

Table 20: Location of the 1-day Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
I1	3A-36+R	26.1915000	-80.4492000
I2	3ANW+R	26.2665000	-80.7795000
I3	3AS+R	26.0821000	-80.6915000
I4	3ASW+R	25.9898000	-80.8362000
I5	ALICO+R	26.5128000	-80.9819000
I6	AVONPK+R	27.6317000	-81.2647000
I7	BLUEG+R	27.2197000	-80.4650000
I8	COLGOV+R	26.1297000	-81.7625000
I9	LOTELA+R	27.5914000	-81.4353000
I10	LXWS+R	26.4989000	-80.2222000
I11	MRF122	25.4700000	-80.3464000
I12	MRF123	25.3669000	-80.3764000
I13	MRF155	27.7528000	-81.0772000
I14	MRF187	27.4386000	-81.2064000
I15	MRF191	27.7458000	-81.2453000
I16	MRF205	28.0994000	-81.5286000
I17	MRF23	28.0017000	-81.1936000
I18	S131+R	26.9792000	-81.0900000
I19	S18C-R	25.3306000	-80.5250000
I20	S332-R	25.4217000	-80.5897000
I21	S65DW+R	27.3142000	-81.0219000
I22	S70+R	27.1186000	-81.1572000
I23	SIRG+R	26.9072000	-80.1917000
I24	SNIVLY+R	27.9717000	-81.4175000
I25	TAFT+R	28.4361000	-81.3714000
I26	Herron Steel Site Silver	30.4383000	-84.4111000
I27	Christian Heritage Church	30.5053000	-84.3308000
I28	Lake Jackson Facility	30.4833000	-84.2992000
I29	Tuck Property N. Centerv	30.5592000	-84.1500000
I30	City Well At Limoges Dr.	30.4844000	-84.1956000
I31	Leon County Landfill Us	30.4203000	-84.1347000
I32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
I33	San Luis City Park	30.4586000	-84.3211000
I34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
I35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
I36	S36-R	26.1734000	-80.1784000
I37	Blackman	30.9833000	-86.6500000
I38	Boca Raton	26.3675000	-80.1108000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
I39	Branford	29.9625000	-82.9108000
I40	Brooksville	28.4811000	-82.4353000
I41	Dowling Park	30.2497000	-83.2594000
I42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
I43	Graceville 1 Sw	30.9575000	-85.5331000
I44	Inglis 3 E	29.0253000	-82.6158000
I45	Lakeland	28.0206000	-81.9219000
I46	Lignumvitae Key	24.9027000	-80.6960000
I47	Monticello 10 Sw	30.4406000	-83.9858000
I48	North New Rvr Canal 1	26.5667000	-80.7500000
I49	North New Rvr Canal 2	26.3336000	-80.5372000
I50	Pennsuco 5 Wnw	25.9297000	-80.4539000
I51	Port Mayaca S L Canal	26.9833000	-80.6167000
I52	Trail Glade Ranges	25.7647000	-80.4775000
I53	Woodruff Dam	30.7219000	-84.8742000
I54	Miles City	26.2483000	-81.2967000
I55	Ochopee	25.9167000	-81.2833000
I56	Apalachicola Ap	29.7258000	-85.0206000
I57	Arcadia	27.2181000	-81.8739000
I58	Archbold Bio Stn	27.1819000	-81.3508000
I59	Avon Park 2 W	27.5944000	-81.5253000
I60	Babson Park 1 Ene	27.8500000	-81.5167000
I61	Bartow	27.8986000	-81.8433000
I62	Basinger	27.3833000	-81.0333000
I63	Belle Glade	26.6928000	-80.6711000
I64	Big Corkscrew	26.3650000	-81.5478000
I65	Blountstown 2 Se	30.4500000	-85.0500000
I66	Bradenton 5 Ese	27.4467000	-82.5014000
I67	Bristol	30.4181000	-84.9861000
I68	Brooksville Chin Hill	28.6164000	-82.3658000
I69	Bushnell 2 E	28.6664000	-82.0894000
I70	Canal Point Usda	26.8639000	-80.6256000
I71	Carrabelle 1 Nnw	29.8667000	-84.6333000
I72	Caryville	30.7667000	-85.8167000
I73	Cedar Key 1 Wsw	29.1333000	-83.0500000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
I74	Chipley	30.7836000	-85.4847000
I75	Bithlo	28.5500000	-81.1000000
I76	Clearwater	27.9667000	-82.7667000
I77	Clermont 9 S	28.4553000	-81.7233000
I78	Compass Lake	30.6000000	-85.4000000
I79	Coral Springs	26.2678000	-80.2750000
I80	Crescent City	29.4292000	-81.5158000
I81	Crestview Bob Sikes Ap	30.7797000	-86.5225000
I82	Cross City 1 E	29.6333000	-83.1053000
I83	Daytona Beach	29.1894000	-81.0139000
I84	Daytona Beach Intl Ap	29.1828000	-81.0483000
I85	De Funiak Springs 1 E	30.7244000	-86.0939000
I86	Deland 1 Sse	29.0181000	-81.3106000
I87	Desoto City 8 Sw	27.3697000	-81.5136000
I88	Devils Garden	26.6033000	-81.1292000
I89	Dry Tortugas	24.6281000	-82.8736000
I90	Everglades	25.8489000	-81.3897000
I91	Federal Point	29.7550000	-81.5389000
I92	Fernandina Beach	30.6589000	-81.4636000
I93	Flamingo Rs	25.1422000	-80.9144000
I94	Ft Drum 3 Nw	27.5303000	-80.8167000
I95	Ft Green 12 Sww	27.5706000	-82.1378000
I96	Ft Lauderdale	26.1019000	-80.2011000
I97	Ft Myers Page Fld Ap	26.5850000	-81.8614000
I98	Ft Pierce	27.4622000	-80.3539000
I99	Gainesville 3 Wsw	29.6333000	-82.3667000
I100	Gainesville Rgnl Ap	29.6919000	-82.2756000
I101	Glen St Mary 1 W	30.2717000	-82.1856000
I102	Hart Lake	28.3833000	-81.1833000
I103	Hastings 4ne	29.7517000	-81.4669000
I104	Hialeah	25.8175000	-80.2858000
I105	High Springs	29.8286000	-82.5972000
I106	Hilliard	30.7000000	-81.9333000
I107	Hillsborough River Sp	28.1428000	-82.2269000
I108	Homestead Exp Stn	25.5000000	-80.5000000
I109	Hypoluxo	26.5500000	-80.0500000
I110	Immokalee	26.4217000	-81.4100000
I111	Indian Lake Estates	27.8000000	-81.3333000

Rain Gage ID	Rain Gage Name	LATITUDE	LONGITUDE
I112	Inverness 3 Se	28.8031000	-82.3125000
I113	Isleworth	28.4833000	-81.5333000
I114	Jacksonville Intl Ap	30.4950000	-81.6936000
I115	Jacksonville Beach	30.2875000	-81.3928000
I116	Jasper	30.5228000	-82.9447000
I117	Key West Intl Ap	24.5550000	-81.7522000
I118	Kissimmee 2	28.2764000	-81.4239000
I119	La Belle	26.7458000	-81.4264000
I120	Lake Alfred Exp Stn	28.1042000	-81.7144000
I121	Lake City 2 E	30.1853000	-82.5942000
I122	Lake Placid 2 Sw	27.2833000	-81.3833000
I123	Lisbon	28.8728000	-81.7844000
I124	Live Oak	30.2889000	-82.9650000
I125	Loxahatchee	26.6833000	-80.2667000
I126	Lynne	29.2003000	-81.9306000
I127	Madison	30.4517000	-83.4119000
I128	Marianna Sch For Boys	30.7667000	-85.2667000
I129	Marineland	29.6700000	-81.2150000
I130	Mayo	30.0564000	-83.1819000
I131	Melbourne Wfo	28.0958000	-80.6308000
I132	Merritt Island	28.3500000	-80.7000000
I133	Miami Beach	25.8064000	-80.1336000
I134	Miami Intl Ap	25.7906000	-80.3164000
I135	Miami Wso City	25.7167000	-80.2833000
I136	Miami 12 Ssw	25.6500000	-80.3000000
I137	Milton Exp Stn	30.7794000	-87.1414000
I138	Monticello 5 Se	30.4922000	-83.7833000
I139	Moore Haven Lock 1	26.8400000	-81.0872000
I140	Mtn Lake	27.9347000	-81.5928000
I141	Mt Pleasant 2 W	30.6667000	-84.7000000
I142	Myakka River Sp	27.2417000	-82.3161000
I143	Naples	26.1686000	-81.7158000
I144	New Smyrna Beach	29.0500000	-80.9500000
I145	Niceville	30.5316000	-86.4928000
I146	Oasis Rs	25.8581000	-81.0319000
I147	Ocala	29.0803000	-82.0778000
I148	Okeechobee	27.1508000	-80.8653000
I149	Orange City	28.9333000	-81.3000000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
I150	Orlando Intl Ap	28.4339000	-81.3250000
I151	Orlando Wso Ap	28.5500000	-81.3333000
I152	Ortona Lock 2	26.7897000	-81.3044000
I150	Orlando Intl Ap	28.4339000	-81.3250000
I151	Orlando Wso Ap	28.5500000	-81.3333000
I152	Ortona Lock 2	26.7897000	-81.3044000
I147	Ocala	29.0803000	-82.0778000
I148	Okeechobee	27.1508000	-80.8653000
I149	Orange City	28.9333000	-81.3000000
I150	Orlando Intl Ap	28.4339000	-81.3250000
I151	Orlando Wso Ap	28.5500000	-81.3333000
I152	Ortona Lock 2	26.7897000	-81.3044000
I153	Palatka	29.6439000	-81.6606000
I154	Panacea 1 S	29.9989000	-84.4850000
I155	Panama City 5 N	30.2492000	-85.6606000
I156	Parrish	27.6089000	-82.3478000
I157	Pensacola Rgnl Ap	30.4781000	-87.1869000
I158	Perrine 4w	25.5819000	-80.4361000
I159	Perry	30.0986000	-83.5742000
I160	Plant City	28.0236000	-82.1422000
I161	Punta Gorda 4 Ese	26.9164000	-81.9983000
I162	Quincy 3 Ssw	30.6000000	-84.5500000
I163	Raiford State Prison	30.0678000	-82.1928000
I164	Royal Palm Ranger Sta	25.3867000	-80.5936000
I165	St Augustine Lh	29.8875000	-81.2917000
I166	Saint Leo	28.3378000	-82.2600000
I167	St Lucie New Lock 1	27.1167000	-80.2833000
I168	St Marks 5 Sse	30.1000000	-84.1667000
I169	St Petersburg	27.7631000	-82.6272000
I170	Sanford	28.8147000	-81.2778000
I171	Sarasota	27.3500000	-82.5333000
I172	Starke	29.9381000	-82.1164000
I173	Steinhatchee 6 Ene	29.7236000	-83.3061000
I174	Stuart	27.2000000	-80.1639000
I175	Tallahassee Wso Ap	30.3931000	-84.3533000
I176	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
I177	Tampa Wscmo Ap	27.9614000	-82.5403000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
I178	TARPON SPGS SEWAGE PL	28.1586000	-82.7644000
I179	TAVERNIER	25.0069000	-80.5211000
I180	TITUSVILLE	28.6242000	-80.8158000
I181	USHER TWR	29.4083000	-82.8186000
I182	VENICE	27.1006000	-82.4364000
I183	VENUS	27.1350000	-81.3303000
I184	VERO BEACH 4 SE	27.6528000	-80.4031000
I185	WAUCHULA	27.5478000	-81.7994000
I186	WAUSAU	30.6333000	-85.5833000
I187	WEST PALM BCH INTL AP	26.6847000	-80.0994000
I188	WEWAHITCHKA	30.1192000	-85.2042000
I189	WINTER HAVEN	28.0153000	-81.7331000
I190	G56-R	26.3278000	-80.1308000
I191	G57-R	26.2311000	-80.1242000
I192	MIALCK+R	26.6819000	-80.8061000
I193	MRF102	26.3689000	-80.1539000
I194	MRF114	26.0603000	-80.2317000
I195	MRF117	25.8269000	-80.3442000
I196	MRF125C	26.7386000	-80.9344000
I197	MRF133	26.7489000	-80.6836000
I198	MRF137	26.8131000	-80.5636000
I199	MRF138	26.7839000	-80.5253000
I200	MRF159	27.4725000	-81.1439000
I201	MRF18	28.1403000	-81.3519000
I202	MRF183	26.7003000	-80.7161000
I203	MRF198	26.7897000	-80.9617000
I204	MRF206	26.6069000	-81.6497000
I205	MRF212	26.4239000	-80.1222000
I206	MRF213	26.4167000	-80.2039000
I207	MRF220	26.6844000	-80.3675000
I208	MRF250	26.7125000	-81.6297000
I209	MRF27	27.8031000	-81.1981000
I210	MRF300	26.7281000	-80.8533000
I211	MRF301	26.7150000	-80.0622000
I212	MRF32	27.6600000	-81.1342000
I213	MRF38	27.4014000	-81.1147000
I214	MRF39	27.3733000	-80.4506000
I215	MRF40	27.3325000	-80.4967000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
I216	MRF50	27.0653000	-80.9778000
I217	MRF5005	26.4072000	-81.4164000
I218	MRF5006	26.5956000	-81.3353000
I219	MRF5010	26.1844000	-81.3464000
I220	MRF5022	26.9244000	-81.3139000
I221	MRF5029	27.6081000	-80.4314000
I222	MRF5034	27.2903000	-80.8269000
I223	MRF5053	27.4103000	-80.3369000
I224	MRF54	26.9044000	-80.3039000
I225	MRF57	26.8419000	-80.6022000
I226	MRF60	26.8083000	-81.0467000
I227	MRF63	26.7350000	-80.8953000
I228	MRF65	26.7744000	-80.6175000
I229	MRF73C	26.6650000	-80.7011000
I230	MRF78	26.6189000	-80.1264000
I231	MRF80	26.6244000	-80.9483000
I232	MRF81	26.6122000	-80.2050000
I233	MRF84	26.5208000	-80.1239000
I234	MRF85	26.5283000	-80.1703000
I235	S133-R	27.2061000	-80.8008000
I236	S65E+R	27.2253000	-80.9625000
I237	S-157	27.8304000	-80.5397000
I238	S-164	28.3406000	-80.9333000
I239	S-252D	27.6389000	-80.6789000
I240	Black Ck	30.0602000	-81.8488000
I241	Lk Joanna	28.8345000	-81.6460000
I242	Kenansville	27.9630000	-81.0500000

Table 21: Location of the 2-day Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
J1	3A-36+R	26.1915000	-80.4492000
J2	3ANW+R	26.2665000	-80.7795000
J3	3AS+R	26.0821000	-80.6915000
J4	3ASW+R	25.9898000	-80.8362000
J5	ALICO+R	26.5128000	-80.9819000
J6	AVONPK+R	27.6317000	-81.2647000
J7	BLUEG+R	27.2197000	-80.4650000
J8	COLGOV+R	26.1297000	-81.7625000
J9	LOTELA+R	27.5914000	-81.4353000
J10	LXWS+R	26.4989000	-80.2222000
J11	MRF122	25.4700000	-80.3464000
J12	MRF123	25.3669000	-80.3764000
J13	MRF155	27.7528000	-81.0772000
J14	MRF187	27.4386000	-81.2064000
J15	MRF191	27.7458000	-81.2453000
J16	MRF205	28.0994000	-81.5286000
J17	MRF23	28.0017000	-81.1936000
J18	S131+R	26.9792000	-81.0900000
J19	S18C-R	25.3306000	-80.5250000
J20	S332-R	25.4217000	-80.5897000
J21	S65DW+R	27.3142000	-81.0219000
J22	S70+R	27.1186000	-81.1572000
J23	Sirg+R	26.9072000	-80.1917000
J24	Snivly+R	27.9717000	-81.4175000
J25	Taft+R	28.4361000	-81.3714000
J26	Herron Steel Site Silver	30.4383000	-84.4111000
J27	Christian Heritage Church	30.5053000	-84.3308000
J28	Lake Jackson Facility	30.4833000	-84.2992000
J29	Tuck Property N. Century	30.5592000	-84.1500000
J30	City Well At Limoges Dr.	30.4844000	-84.1956000
J31	Leon County Landfill Us	30.4203000	-84.1347000
J32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
J33	San Luis City Park	30.4586000	-84.3211000
J34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
J35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
J36	S36-R	26.1734000	-80.1784000
J37	Blackman	30.9833000	-86.6500000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
J38	Boca Raton	26.3675000	-80.1108000
J39	Branford	29.9625000	-82.9108000
J40	Brooksville	28.4811000	-82.4353000
J41	Dowling Park	30.2497000	-83.2594000
J42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
J43	Graceville 1 Sw	30.9575000	-85.5331000
J44	Inglis 3 E	29.0253000	-82.6158000
J45	Lakeland	28.0206000	-81.9219000
J46	Lignumvitae Key	24.9027000	-80.6960000
J47	Monticello 10 Sw	30.4406000	-83.9858000
J48	North New Rvr Canal 1	26.5667000	-80.7500000
J49	North New Rvr Canal 2	26.3336000	-80.5372000
J50	Pennsuco S Wnw	25.9297000	-80.4539000
J51	Port Mayaca S L Canal	26.9833000	-80.6167000
J52	Trail Glade Ranges	25.7647000	-80.4775000
J53	Woodruff Dam	30.7219000	-84.8742000
J54	Miles City	26.2483000	-81.2967000
J55	Ochopee	25.9167000	-81.2833000
J56	Apalachicola Ap	29.7258000	-85.0206000
J57	Arcadia	27.2181000	-81.8739000
J58	Archbold Bio Stn	27.1819000	-81.3508000
J59	Avon Park 2 W	27.5944000	-81.5253000
J60	Babson Park 1 Ene	27.8500000	-81.5167000
J61	Bartow	27.8986000	-81.8433000
J62	Basinger	27.3833000	-81.0333000
J63	Belle Glade	26.6928000	-80.6711000
J64	Big Corkscrew	26.3650000	-81.5478000
J65	Blountstown 2 Se	30.4500000	-85.0500000
J66	Bradenton 5 Ese	27.4467000	-82.5014000
J67	Bristol	30.4181000	-84.9861000
J68	Brooksville Chin Hill	28.6164000	-82.3658000
J69	Bushnell 2 E	28.6664000	-82.0894000
J70	Canal Point Usda	26.8639000	-80.6256000
J71	Carrabelle 1 Nnw	29.8667000	-84.6333000
J72	Caryville	30.7667000	-85.8167000
J73	Cedar Key 1 Wsw	29.1333000	-83.0500000
J74	Chipley	30.7836000	-85.4847000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
J75	Bithlo	28.5500000	-81.1000000
J76	Clearwater	27.9667000	-82.7667000
J77	Clermont 9 S	28.4553000	-81.7233000
J78	Compass Lake	30.6000000	-85.4000000
J79	Coral Springs	26.2678000	-80.2750000
J80	Crescent City	29.4292000	-81.5158000
J81	Crestview Bob Sikes Ap	30.7797000	-86.5225000
J82	Cross City 1 E	29.6333000	-83.1053000
J83	Daytona Beach	29.1894000	-81.0139000
J84	Daytona Beach Intl Ap	29.1828000	-81.0483000
J85	De Funiak Springs 1 E	30.7244000	-86.0939000
J86	Deland 1 Sse	29.0181000	-81.3106000
J87	Desoto City 8 Sw	27.3697000	-81.5136000
J88	Devils Garden	26.6033000	-81.1292000
J89	Dry Tortugas	24.6281000	-82.8736000
J90	Everglades	25.8489000	-81.3897000
J91	Federal Point	29.7550000	-81.5389000
J92	Fernandina Beach	30.6589000	-81.4636000
J93	Flamingo Rs	25.1422000	-80.9144000
J94	Ft Drum 3 Nw	27.5303000	-80.8167000
J95	Ft Green 12 Wsw	27.5706000	-82.1378000
J96	Ft Lauderdale	26.1019000	-80.2011000
J97	Ft Myers Page Fld Ap	26.5850000	-81.8614000
J98	Ft Pierce	27.4622000	-80.3539000
J99	Gainesville 3 Wsw	29.6333000	-82.3667000
J100	Gainesville Rgnl Ap	29.6919000	-82.2756000
J101	Glen St Mary 1 W	30.2717000	-82.1856000
J102	Hart Lake	28.3833000	-81.1833000
J103	Hastings 4ne	29.7517000	-81.4669000
J104	Hialeah	25.8175000	-80.2858000
J105	High Springs	29.8286000	-82.5972000
J106	Hilliard	30.7000000	-81.9333000
J107	Hillsborough River Sp	28.1428000	-82.2269000
J108	Homestead Exp Stn	25.5000000	-80.5000000
J109	Hypoluxo	26.5500000	-80.0500000
J110	Immokalee	26.4217000	-81.4100000
J111	Indian Lake Estates	27.8000000	-81.3333000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
J112	Inverness 3 Se	28.8031000	-82.3125000
J113	Isleworth	28.4833000	-81.5333000
J114	Jacksonville Intl Ap	30.4950000	-81.6936000
J115	Jacksonville Beach	30.2875000	-81.3928000
J116	Jasper	30.5228000	-82.9447000
J117	Key West Intl Ap	24.5550000	-81.7522000
J118	Kissimmee 2	28.2764000	-81.4239000
J119	La Belle	26.7458000	-81.4264000
J120	Lake Alfred Exp Stn	28.1042000	-81.7144000
J121	Lake City 2 E	30.1853000	-82.5942000
J122	Lake Placid 2 Sw	27.2833000	-81.3833000
J123	Lisbon	28.8728000	-81.7844000
J124	Live Oak	30.2889000	-82.9650000
J125	Loxahatchee	26.6833000	-80.2667000
J126	Lynne	29.2003000	-81.9306000
J127	Madison	30.4517000	-83.4119000
J128	Marianna Sch For Boys	30.7667000	-85.2667000
J129	Marineland	29.6700000	-81.2150000
J130	Mayo	30.0564000	-83.1819000
J131	Melbourne Wfo	28.0958000	-80.6308000
J132	Merritt Island	28.3500000	-80.7000000
J133	Miami Beach	25.8064000	-80.1336000
J134	Miami Intl Ap	25.7906000	-80.3164000
J135	Miami Wso City	25.7167000	-80.2833000
J136	Miami 12 Ssw	25.6500000	-80.3000000
J137	Milton Exp Stn	30.7794000	-87.1414000
J138	Monticello 5 Se	30.4922000	-83.7833000
J139	Moore Haven Lock 1	26.8400000	-81.0872000
J140	Mtn Lake	27.9347000	-81.5928000
J141	Mt Pleasant 2 W	30.6667000	-84.7000000
J142	Myakka River Sp	27.2417000	-82.3161000
J143	Naples	26.1686000	-81.7158000
J144	New Smyrna Beach	29.0500000	-80.9500000
J145	Niceville	30.5316000	-86.4928000
J146	Oasis Rs	25.8581000	-81.0319000
J147	Ocala	29.0803000	-82.0778000
J148	Okeechobee	27.1508000	-80.8653000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
J149	Orange City	28.9333000	-81.3000000
J150	Orlando Intl Ap	28.4339000	-81.3250000
J151	Orlando Wso Ap	28.5500000	-81.3333000
J152	Ortona Lock 2	26.7897000	-81.3044000
J153	Palatka	29.6439000	-81.6606000
J154	Panacea 1 S	29.9989000	-84.4850000
J155	Panama City 5 N	30.2492000	-85.6606000
J156	Parrish	27.6089000	-82.3478000
J157	Pensacola Rgnl Ap	30.4781000	-87.1869000
J158	Perrine 4w	25.5819000	-80.4361000
J159	Perry	30.0986000	-83.5742000
J160	Plant City	28.0236000	-82.1422000
J161	Punta Gorda 4 Ese	26.9164000	-81.9983000
J162	Quincy 3 Ssw	30.6000000	-84.5500000
J163	Raiford State Prison	30.0678000	-82.1928000
J164	Royal Palm Ranger Sta	25.3867000	-80.5936000
J165	St Augustine Lh	29.8875000	-81.2917000
J166	Saint Leo	28.3378000	-82.2600000
J167	St Lucie New Lock 1	27.1167000	-80.2833000
J168	St Marks 5 Sse	30.1000000	-84.1667000
J169	St Petersburg	27.7631000	-82.6272000
J170	Sanford	28.8147000	-81.2778000
J171	Sarasota	27.3500000	-82.5333000
J172	Starke	29.9381000	-82.1164000
J173	Steinhatchee 6 Ene	29.7236000	-83.3061000
J174	Stuart	27.2000000	-80.1639000
J175	Tallahassee Wso Ap	30.3931000	-84.3533000
J176	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
J177	Tampa Wscmo Ap	27.9614000	-82.5403000
J178	Tarpon Spgs Sewage Pl	28.1586000	-82.7644000
J179	Tavernier	25.0069000	-80.5211000
J180	Titusville	28.6242000	-80.8158000
J181	Usher Twr	29.4083000	-82.8186000
J182	Venice	27.1006000	-82.4364000
J183	Venus	27.1350000	-81.3303000
J184	Vero Beach 4 Se	27.6528000	-80.4031000
J185	Wauchula	27.5478000	-81.7994000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
J186	WAUSAU	30.6333000	-85.5833000
J187	WEST PALM BCH INTL AP	26.6847000	-80.0994000
J188	WEWAHITCHKA	30.1192000	-85.2042000
J189	WINTER HAVEN	28.0153000	-81.7331000
J190	G56-R	26.3278000	-80.1308000
J191	G57-R	26.2311000	-80.1242000
J192	MIALCK+R	26.6819000	-80.8061000
J193	MRF102	26.3689000	-80.1539000
J194	MRF114	26.0603000	-80.2317000
J195	MRF117	25.8269000	-80.3442000
J196	MRF125C	26.7386000	-80.9344000
J197	MRF133	26.7489000	-80.6836000
J198	MRF137	26.8131000	-80.5636000
J199	MRF138	26.7839000	-80.5253000
J200	MRF159	27.4725000	-81.1439000
J201	MRF18	28.1403000	-81.3519000
J202	MRF183	26.7003000	-80.7161000
J203	MRF198	26.7897000	-80.9617000
J204	MRF206	26.6069000	-81.6497000
J205	MRF212	26.4239000	-80.1222000
J206	MRF213	26.4167000	-80.2039000
J207	MRF220	26.6844000	-80.3675000
J208	MRF250	26.7125000	-81.6297000
J209	MRF27	27.8031000	-81.1981000
J210	MRF300	26.7281000	-80.8533000
J211	MRF301	26.7150000	-80.0622000
J212	MRF32	27.6600000	-81.1342000
J213	MRF38	27.4014000	-81.1147000
J214	MRF39	27.3733000	-80.4506000
J215	MRF40	27.3325000	-80.4967000
J216	MRF50	27.0653000	-80.9778000
J217	MRF5005	26.4072000	-81.4164000
J218	MRF5006	26.5956000	-81.3353000
J219	MRF5010	26.1844000	-81.3464000
J220	MRF5022	26.9244000	-81.3139000
J221	MRF5029	27.6081000	-80.4314000
J222	MRF5034	27.2903000	-80.8269000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
J223	MRF5053	27.4103000	-80.3369000
J224	MRF54	26.9044000	-80.3039000
J225	MRF57	26.8419000	-80.6022000
J226	MRF60	26.8083000	-81.0467000
J227	MRF63	26.7350000	-80.8953000
J228	MRF65	26.7744000	-80.6175000
J229	MRF73C	26.6650000	-80.7011000
J230	MRF78	26.6189000	-80.1264000
J231	MRF80	26.6244000	-80.9483000
J232	MRF81	26.6122000	-80.2050000
J233	MRF84	26.5208000	-80.1239000
J234	MRF85	26.5283000	-80.1703000
J235	S133-R	27.2061000	-80.8008000
J236	S65E+R	27.2253000	-80.9625000
J237	S-157	27.8304000	-80.5397000
J238	S-164	28.3406000	-80.9333000
J239	S-252D	27.6389000	-80.6789000
J240	BLACK CK	30.0602000	-81.8488000
J241	Lk Joanna	28.8345000	-81.6460000
J242	Kenansville	27.9630000	-81.0500000

Table 22: Location of the 3-day Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
K1	3A-36+R	26.1915000	-80.4492000
K2	3ANW+R	26.2665000	-80.7795000
K3	3AS+R	26.0821000	-80.6915000
K4	3ASW+R	25.9898000	-80.8362000
K5	ALICO+R	26.5128000	-80.9819000
K6	AVONPK+R	27.6317000	-81.2647000
K7	BLUEG+R	27.2197000	-80.4650000
K8	COLGOV+R	26.1297000	-81.7625000
K9	LOTELA+R	27.5914000	-81.4353000
K10	LXWS+R	26.4989000	-80.2222000
K11	MRF122	25.4700000	-80.3464000
K12	MRF123	25.3669000	-80.3764000
K13	MRF155	27.7528000	-81.0772000
K14	MRF187	27.4386000	-81.2064000
K15	MRF191	27.7458000	-81.2453000
K16	MRF205	28.0994000	-81.5286000
K17	MRF23	28.0017000	-81.1936000
K18	S131+R	26.9792000	-81.0900000
K19	S18C-R	25.3306000	-80.5250000
K20	S332-R	25.4217000	-80.5897000
K21	S65DW+R	27.3142000	-81.0219000
K22	S70+R	27.1186000	-81.1572000
K23	Sirg+R	26.9072000	-80.1917000
K24	Snivly+R	27.9717000	-81.4175000
K25	Taft+R	28.4361000	-81.3714000
K26	Herron Steel Site Silver	30.4383000	-84.4111000
K27	Christian Heritage Church	30.5053000	-84.3308000
K28	Lake Jackson Facility	30.4833000	-84.2992000
K29	Tuck Property N. Centerv	30.5592000	-84.1500000
K30	City Well At Limoges Dr.	30.4844000	-84.1956000
K31	Leon County Landfill Us	30.4203000	-84.1347000
K32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
K33	San Luis City Park	30.4586000	-84.3211000
K34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
K35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
K36	S36-R	26.1734000	-80.1784000
K37	Blackman	30.9833000	-86.6500000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
K38	Boca Raton	26.3675000	-80.1108000
K39	Branford	29.9625000	-82.9108000
K40	Brooksville	28.4811000	-82.4353000
K41	Dowling Park	30.2497000	-83.2594000
K42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
K43	Graceville 1 Sw	30.9575000	-85.5331000
K44	Inglis 3 E	29.0253000	-82.6158000
K45	Lakeland	28.0206000	-81.9219000
K46	Lignumvitae Key	24.9027000	-80.6960000
K47	Monticello 10 Sw	30.4406000	-83.9858000
K48	North New Rvr Canal 1	26.5667000	-80.7500000
K49	North New Rvr Canal 2	26.3336000	-80.5372000
K50	Pennsuco 5 Wnw	25.9297000	-80.4539000
K51	Port Mayaca S L Canal	26.9833000	-80.6167000
K52	Trail Glade Ranges	25.7647000	-80.4775000
K53	Woodruff Dam	30.7219000	-84.8742000
K54	Miles City	26.2483000	-81.2967000
K55	Ochopee	25.9167000	-81.2833000
K56	Apalachicola Ap	29.7258000	-85.0206000
K57	Arcadia	27.2181000	-81.8739000
K58	Archbold Bio Stn	27.1819000	-81.3508000
K59	Avon Park 2 W	27.5944000	-81.5253000
K60	Babson Park 1 Ene	27.8500000	-81.5167000
K61	Bartow	27.8986000	-81.8433000
K62	Basinger	27.3833000	-81.0333000
K63	Belle Glade	26.6928000	-80.6711000
K64	Big Corkscrew	26.3650000	-81.5478000
K65	Blountstown 2 Se	30.4500000	-85.0500000
K66	Bradenton 5 Ese	27.4467000	-82.5014000
K67	Bristol	30.4181000	-84.9861000
K68	Brooksville Chin Hill	28.6164000	-82.3658000
K69	Bushnell 2 E	28.6664000	-82.0894000
K70	Canal Point Usda	26.8639000	-80.6256000
K71	Carrabelle 1 Nnw	29.8667000	-84.6333000
K72	Caryville	30.7667000	-85.8167000
K73	Cedar Key 1 Wsw	29.1333000	-83.0500000
K74	Chipley	30.7836000	-85.4847000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
K75	Bithlo	28.5500000	-81.1000000
K76	Clearwater	27.9667000	-82.7667000
K77	Clermont 9 S	28.4553000	-81.7233000
K78	Compass Lake	30.6000000	-85.4000000
K79	Coral Springs	26.2678000	-80.2750000
K80	Crescent City	29.4292000	-81.5158000
K81	Crestview Bob Sikes Ap	30.7797000	-86.5225000
K82	Cross City 1 E	29.6333000	-83.1053000
K83	Daytona Beach	29.1894000	-81.0139000
K84	Daytona Beach Intl Ap	29.1828000	-81.0483000
K85	De Funiak Springs 1 E	30.7244000	-86.0939000
K86	Deland 1 Sse	29.0181000	-81.3106000
K87	Desoto City 8 Sw	27.3697000	-81.5136000
K88	Devils Garden	26.6033000	-81.1292000
K89	Dry Tortugas	24.6281000	-82.8736000
K90	Everglades	25.8489000	-81.3897000
K91	Federal Point	29.7550000	-81.5389000
K92	Fernandina Beach	30.6589000	-81.4636000
K93	Flamingo Rs	25.1422000	-80.9144000
K94	Ft Drum 3 Nw	27.5303000	-80.8167000
K95	Ft Green 12 Sww	27.5706000	-82.1378000
K96	Ft Lauderdale	26.1019000	-80.2011000
K97	Ft Myers Page Fld Ap	26.5850000	-81.8614000
K98	Ft Pierce	27.4622000	-80.3539000
K99	Gainesville 3 Wsw	29.6333000	-82.3667000
K100	Gainesville Rgnl Ap	29.6919000	-82.2756000
K101	Glen St Mary 1 W	30.2717000	-82.1856000
K102	Hart Lake	28.3833000	-81.1833000
K103	Hastings 4ne	29.7517000	-81.4669000
K104	Hialeah	25.8175000	-80.2858000
K105	High Springs	29.8286000	-82.5972000
K106	Hilliard	30.7000000	-81.9333000
K107	Hillsborough River Sp	28.1428000	-82.2269000
K108	Homestead Exp Stn	25.5000000	-80.5000000
K109	Hypoluxo	26.5500000	-80.0500000
K110	Immokalee	26.4217000	-81.4100000
K111	Indian Lake Estates	27.8000000	-81.3333000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
K112	Inverness 3 Se	28.8031000	-82.3125000
K113	Isleworth	28.4833000	-81.5333000
K114	Jacksonville Intl Ap	30.4950000	-81.6936000
K115	Jacksonville Beach	30.2875000	-81.3928000
K116	Jasper	30.5228000	-82.9447000
K117	Key West Intl Ap	24.5550000	-81.7522000
K118	Kissimmee 2	28.2764000	-81.4239000
K119	La Belle	26.7458000	-81.4264000
K120	Lake Alfred Exp Stn	28.1042000	-81.7144000
K121	Lake City 2 E	30.1853000	-82.5942000
K122	Lake Placid 2 Sw	27.2833000	-81.3833000
K123	Lisbon	28.8728000	-81.7844000
K124	Live Oak	30.2889000	-82.9650000
K125	Loxahatchee	26.6833000	-80.2667000
K126	Lynne	29.2003000	-81.9306000
K127	Madison	30.4517000	-83.4119000
K128	Marianna Sch For Boys	30.7667000	-85.2667000
K129	Marineland	29.6700000	-81.2150000
K130	Mayo	30.0564000	-83.1819000
K131	Melbourne Wfo	28.0958000	-80.6308000
K132	Merritt Island	28.3500000	-80.7000000
K133	Miami Beach	25.8064000	-80.1336000
K134	Miami Intl Ap	25.7906000	-80.3164000
K135	Miami Wso City	25.7167000	-80.2833000
K136	Miami 12 Ssw	25.6500000	-80.3000000
K137	Milton Exp Stn	30.7794000	-87.1414000
K138	Monticello 5 Se	30.4922000	-83.7833000
K139	Moore Haven Lock 1	26.8400000	-81.0872000
K140	Mtn Lake	27.9347000	-81.5928000
K141	Mt Pleasant 2 W	30.6667000	-84.7000000
K142	Myakka River Sp	27.2417000	-82.3161000
K143	Naples	26.1686000	-81.7158000
K144	New Smyrna Beach	29.0500000	-80.9500000
K145	Niceville	30.5316000	-86.4928000
K146	Oasis Rs	25.8581000	-81.0319000
K147	Ocala	29.0803000	-82.0778000
K148	Okeechobee	27.1508000	-80.8653000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
K149	Orange City	28.9333000	-81.3000000
K150	Orlando Intl Ap	28.4339000	-81.3250000
K151	Orlando Wso Ap	28.5500000	-81.3333000
K152	Ortona Lock 2	26.7897000	-81.3044000
K153	Palatka	29.6439000	-81.6606000
K154	Panacea 1 S	29.9989000	-84.4850000
K155	Panama City 5 N	30.2492000	-85.6606000
K156	Parrish	27.6089000	-82.3478000
K157	Pensacola Rgnl Ap	30.4781000	-87.1869000
K158	Perrine 4w	25.5819000	-80.4361000
K159	Perry	30.0986000	-83.5742000
K160	Plant City	28.0236000	-82.1422000
K161	Punta Gorda 4 Ese	26.9164000	-81.9983000
K162	Quincy 3 Ssw	30.6000000	-84.5500000
K163	Raiford State Prison	30.0678000	-82.1928000
K164	Royal Palm Ranger Sta	25.3867000	-80.5936000
K165	St Augustine Lh	29.8875000	-81.2917000
K166	Saint Leo	28.3378000	-82.2600000
K167	St Lucie New Lock 1	27.1167000	-80.2833000
K168	St Marks 5 Sse	30.1000000	-84.1667000
K169	St Petersburg	27.7631000	-82.6272000
K170	Sanford	28.8147000	-81.2778000
K171	Sarasota	27.3500000	-82.5333000
K172	Starke	29.9381000	-82.1164000
K173	Steinhatchee 6 Ene	29.7236000	-83.3061000
K174	Stuart	27.2000000	-80.1639000
K175	Tallahassee Wso Ap	30.3931000	-84.3533000
K176	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
K177	Tampa Wscmo Ap	27.9614000	-82.5403000
K178	Tarpon Spgs Sewage Pl	28.1586000	-82.7644000
K179	Tavernier	25.0069000	-80.5211000
K180	Titusville	28.6242000	-80.8158000
K181	Usher Twr	29.4083000	-82.8186000
K182	Venice	27.1006000	-82.4364000
K183	Venus	27.1350000	-81.3303000
K184	Vero Beach 4 Se	27.6528000	-80.4031000
K185	Wauchula	27.5478000	-81.7994000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
K186	Wausau	30.6333000	-85.5833000
K187	West Palm Bch Intl Ap	26.6847000	-80.0994000
K188	Wewahitchka	30.1192000	-85.2042000
K189	Winter Haven	28.0153000	-81.7331000
K190	G56-R	26.3278000	-80.1308000
K191	G57-R	26.2311000	-80.1242000
K192	MIALCK+R	26.6819000	-80.8061000
K193	MRF102	26.3689000	-80.1539000
K194	MRF114	26.0603000	-80.2317000
K195	MRF117	25.8269000	-80.3442000
K196	MRF125C	26.7386000	-80.9344000
K197	MRF133	26.7489000	-80.6836000
K198	MRF137	26.8131000	-80.5636000
K199	MRF138	26.7839000	-80.5253000
K200	MRF159	27.4725000	-81.1439000
K201	MRF18	28.1403000	-81.3519000
K202	MRF183	26.7003000	-80.7161000
K203	MRF198	26.7897000	-80.9617000
K204	MRF206	26.6069000	-81.6497000
K205	MRF212	26.4239000	-80.1222000
K206	MRF213	26.4167000	-80.2039000
K207	MRF220	26.6844000	-80.3675000
K208	MRF250	26.7125000	-81.6297000
K209	MRF27	27.8031000	-81.1981000
K210	MRF300	26.7281000	-80.8533000
K211	MRF301	26.7150000	-80.0622000
K212	MRF32	27.6600000	-81.1342000
K213	MRF38	27.4014000	-81.1147000
K214	MRF39	27.3733000	-80.4506000
K215	MRF40	27.3325000	-80.4967000
K216	MRF50	27.0653000	-80.9778000
K217	MRF5005	26.4072000	-81.4164000
K218	MRF5006	26.5956000	-81.3353000
K219	MRF5010	26.1844000	-81.3464000
K220	MRF5022	26.9244000	-81.3139000
K221	MRF5029	27.6081000	-80.4314000
K222	MRF5034	27.2903000	-80.8269000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
K223	MRF5053	27.4103000	-80.3369000
K224	MRF54	26.9044000	-80.3039000
K225	MRF57	26.8419000	-80.6022000
K226	MRF60	26.8083000	-81.0467000
K227	MRF63	26.7350000	-80.8953000
K228	MRF65	26.7744000	-80.6175000
K229	MRF73C	26.6650000	-80.7011000
K230	MRF78	26.6189000	-80.1264000
K231	MRF80	26.6244000	-80.9483000
K232	MRF81	26.6122000	-80.2050000
K233	MRF84	26.5208000	-80.1239000
K234	MRF85	26.5283000	-80.1703000
K235	S133-R	27.2061000	-80.8008000
K236	S65E+R	27.2253000	-80.9625000
K237	S-157	27.8304000	-80.5397000
K238	S-164	28.3406000	-80.9333000
K239	S-252D	27.6389000	-80.6789000
K240	Black Ck Middleburg	30.0602000	-81.8488000
K241	Lk Joanna	28.8345000	-81.6460000
K242	Kenansville	27.9630000	-81.0500000

Table 23: Location of the 4-day Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
L1	3A-36+R	26.1915000	-80.4492000
L2	3ANW+R	26.2665000	-80.7795000
L3	3AS+R	26.0821000	-80.6915000
L4	3ASW+R	25.9898000	-80.8362000
L5	ALICO+R	26.5128000	-80.9819000
L6	AVONPK+R	27.6317000	-81.2647000
L7	LOTELA+R	27.5914000	-81.4353000
L8	LXWS+R	26.4989000	-80.2222000
L9	MRF122	25.4700000	-80.3464000
L10	MRF123	25.3669000	-80.3764000
L11	MRF155	27.7528000	-81.0772000
L12	MRF187	27.4386000	-81.2064000
L13	MRF191	27.7458000	-81.2453000
L14	MRF205	28.0994000	-81.5286000
L15	MRF23	28.0017000	-81.1936000
L16	S131+R	26.9792000	-81.0900000
L17	S18C-R	25.3306000	-80.5250000
L18	S332-R	25.4217000	-80.5897000
L19	S65DW+R	27.3142000	-81.0219000
L20	S70+R	27.1186000	-81.1572000
L21	Sirg+R	26.9072000	-80.1917000
L22	Snivly+R	27.9717000	-81.4175000
L23	Taft+R	28.4361000	-81.3714000
L24	Herron Steel Site Silver	30.4383000	-84.4111000
L25	Christian Heritage Church	30.5053000	-84.3308000
L26	Lake Jackson Facility	30.4833000	-84.2992000
L27	Tuck Property N. Century	30.5592000	-84.1500000
L28	City Well At Limoges Dr.	30.4844000	-84.1956000
L29	Leon County Landfill Us	30.4203000	-84.1347000
L30	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
L31	San Luis City Park	30.4586000	-84.3211000
L32	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
L33	Wembley Way Eastgate Nei	30.4931000	-84.2392000
L34	S36-R	26.1734000	-80.1784000
L35	Blackman	30.9833000	-86.6500000
L36	Boca Raton	26.3675000	-80.1108000
L37	Branford	29.9625000	-82.9108000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
L38	Brooksville	28.4811000	-82.4353000
L39	Dowling Park	30.2497000	-83.2594000
L40	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
L41	Graceville 1 Sw	30.9575000	-85.5331000
L42	Inglis 3 E	29.0253000	-82.6158000
L43	Lakeland	28.0206000	-81.9219000
L44	Lignumvitae Key	24.9027000	-80.6960000
L45	Monticello 10 Sw	30.4406000	-83.9858000
L46	North New Rvr Canal 1	26.5667000	-80.7500000
L47	North New Rvr Canal 2	26.3336000	-80.5372000
L48	Pennsuco S Wnw	25.9297000	-80.4539000
L49	Port Mayaca S L Canal	26.9833000	-80.6167000
L50	Trail Glade Ranges	25.7647000	-80.4775000
L51	Woodruff Dam	30.7219000	-84.8742000
L52	Miles City	26.2483000	-81.2967000
L53	Ochopee	25.9167000	-81.2833000
L54	Apalachicola Ap	29.7258000	-85.0206000
L55	Arcadia	27.2181000	-81.8739000
L56	Archbold Bio Stn	27.1819000	-81.3508000
L57	Avon Park 2 W	27.5944000	-81.5253000
L58	Babson Park 1 Ene	27.8500000	-81.5167000
L59	Bartow	27.8986000	-81.8433000
L60	Basinger	27.3833000	-81.0333000
L61	Belle Glade	26.6928000	-80.6711000
L62	Big Corkscrew	26.3650000	-81.5478000
L63	Blountstown 2 Se	30.4500000	-85.0500000
L64	Bradenton 5 Ese	27.4467000	-82.5014000
L65	Bristol	30.4181000	-84.9861000
L66	Brooksville Chin Hill	28.6164000	-82.3658000
L67	Bushnell 2 E	28.6664000	-82.0894000
L68	Canal Point Usda	26.8639000	-80.6256000
L69	Carrabelle 1 Nnw	29.8667000	-84.6333000
L70	Caryville	30.7667000	-85.8167000
L71	Cedar Key 1 Wsw	29.1333000	-83.0500000
L72	Chipley	30.7836000	-85.4847000
L73	Bithlo	28.5500000	-81.1000000
L74	Clearwater	27.9667000	-82.7667000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
L75	Clermont 9 S	28.4553000	-81.7233000
L76	Compass Lake	30.6000000	-85.4000000
L77	Coral Springs	26.2678000	-80.2750000
L78	Crescent City	29.4292000	-81.5158000
L79	Crestview Bob Sikes Ap	30.7797000	-86.5225000
L80	Cross City 1 E	29.6333000	-83.1053000
L81	Daytona Beach	29.1894000	-81.0139000
L82	Daytona Beach Intl Ap	29.1828000	-81.0483000
L83	De Funiak Springs 1 E	30.7244000	-86.0939000
L84	Deland 1 Sse	29.0181000	-81.3106000
L85	Desoto City 8 Sw	27.3697000	-81.5136000
L86	Devils Garden	26.6033000	-81.1292000
L87	Dry Tortugas	24.6281000	-82.8736000
L88	Everglades	25.8489000	-81.3897000
L89	Federal Point	29.7550000	-81.5389000
L90	Fernandina Beach	30.6589000	-81.4636000
L91	Flamingo Rs	25.1422000	-80.9144000
L92	Ft Drum 3 Nw	27.5303000	-80.8167000
L93	Ft Green 12 Wsw	27.5706000	-82.1378000
L94	Ft Lauderdale	26.1019000	-80.2011000
L95	Ft Myers Page Fld Ap	26.5850000	-81.8614000
L96	Ft Pierce	27.4622000	-80.3539000
L97	Gainesville 3 Wsw	29.6333000	-82.3667000
L98	Gainesville Rgnl Ap	29.6919000	-82.2756000
L99	Glen St Mary 1 W	30.2717000	-82.1856000
L100	Hart Lake	28.3833000	-81.1833000
L101	Hastings 4ne	29.7517000	-81.4669000
L102	Hialeah	25.8175000	-80.2858000
L103	High Springs	29.8286000	-82.5972000
L104	Hilliard	30.7000000	-81.9333000
L105	Hillsborough River Sp	28.1428000	-82.2269000
L106	Homestead Exp Stn	25.5000000	-80.5000000
L107	Hypoluxo	26.5500000	-80.0500000
L108	Immokalee	26.4217000	-81.4100000
L109	Indian Lake Estates	27.8000000	-81.3333000
L110	Inverness 3 Se	28.8031000	-82.3125000
L111	Isleworth	28.4833000	-81.5333000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
L112	Jacksonville Intl Ap	30.4950000	-81.6936000
L113	Jacksonville Beach	30.2875000	-81.3928000
L114	Jasper	30.5228000	-82.9447000
L115	Key West Intl Ap	24.5550000	-81.7522000
L116	Kissimmee 2	28.2764000	-81.4239000
L117	La Belle	26.7458000	-81.4264000
L118	Lake Alfred Exp Stn	28.1042000	-81.7144000
L119	Lake City 2 E	30.1853000	-82.5942000
L120	Lake Placid 2 Sw	27.2833000	-81.3833000
L121	Lisbon	28.8728000	-81.7844000
L122	Live Oak	30.2889000	-82.9650000
L123	Loxahatchee	26.6833000	-80.2667000
L124	Lynne	29.2003000	-81.9306000
L125	Madison	30.4517000	-83.4119000
L126	Marianna Sch For Boys	30.7667000	-85.2667000
L127	Mayo	30.0564000	-83.1819000
L128	Melbourne Wfo	28.0958000	-80.6308000
L129	Merritt Island	28.3500000	-80.7000000
L130	Miami Beach	25.8064000	-80.1336000
L131	Miami Intl Ap	25.7906000	-80.3164000
L132	Miami Wso City	25.7167000	-80.2833000
L133	Miami 12 Ssw	25.6500000	-80.3000000
L134	Milton Exp Stn	30.7794000	-87.1414000
L135	Monticello 5 Se	30.4922000	-83.7833000
L136	Moore Haven Lock 1	26.8400000	-81.0872000
L137	Mtn Lake	27.9347000	-81.5928000
L138	Mt Pleasant 2 W	30.6667000	-84.7000000
L139	Myakka River Sp	27.2417000	-82.3161000
L140	Naples	26.1686000	-81.7158000
L141	New Smyrna Beach	29.0500000	-80.9500000
L142	Niceville	30.5316000	-86.4928000
L143	Oasis Rs	25.8581000	-81.0319000
L144	Ocala	29.0803000	-82.0778000
L145	Okeechobee	27.1508000	-80.8653000
L146	Orange City	28.9333000	-81.3000000
L147	Orlando Intl Ap	28.4339000	-81.3250000
L148	Orlando Wso Ap	28.5500000	-81.3333000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
L149	Ortona Lock 2	26.7897000	-81.3044000
L150	Palatka	29.6439000	-81.6606000
L151	Panacea 1 S	29.9989000	-84.4850000
L152	Panama City 5 N	30.2492000	-85.6606000
L153	Parrish	27.6089000	-82.3478000
L154	Pensacola Rgnl Ap	30.4781000	-87.1869000
L155	Perrine 4w	25.5819000	-80.4361000
L156	Perry	30.0986000	-83.5742000
L157	Plant City	28.0236000	-82.1422000
L158	Punta Gorda 4 Ese	26.9164000	-81.9983000
L159	Quincy 3 Ssw	30.6000000	-84.5500000
L160	Raiford State Prison	30.0678000	-82.1928000
L161	Royal Palm Ranger Sta	25.3867000	-80.5936000
L162	St Augustine Lh	29.8875000	-81.2917000
L163	Saint Leo	28.3378000	-82.2600000
L164	St Lucie New Lock 1	27.1167000	-80.2833000
L165	St Marks 5 Sse	30.1000000	-84.1667000
L166	St Petersburg	27.7631000	-82.6272000
L167	Sanford	28.8147000	-81.2778000
L168	Sarasota	27.3500000	-82.5333000
L169	Starke	29.9381000	-82.1164000
L170	Steinhatchee 6 Ene	29.7236000	-83.3061000
L171	Stuart	27.2000000	-80.1639000
L172	Tallahassee Wso Ap	30.3931000	-84.3533000
L173	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
L174	Tampa Wscmo Ap	27.9614000	-82.5403000
L175	Tarpon Spgs Sewage Pl	28.1586000	-82.7644000
L176	Tavernier	25.0069000	-80.5211000
L177	Titusville	28.6242000	-80.8158000
L178	Usher Twr	29.4083000	-82.8186000
L179	Venice	27.1006000	-82.4364000
L180	Venus	27.1350000	-81.3303000
L181	Vero Beach 4 Se	27.6528000	-80.4031000
L182	Wauchula	27.5478000	-81.7994000
L183	Wausau	30.6333000	-85.5833000
L184	West Palm Bch Intl Ap	26.6847000	-80.0994000
L185	Wewahitchka	30.1192000	-85.2042000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
	WINTER		
L186	HAVEN	28.0153000	-81.7331000
L187	G56-R	26.3278000	-80.1308000
L188	G57-R	26.2311000	-80.1242000
L189	MIALCK+R	26.6819000	-80.8061000
L190	MRF102	26.3689000	-80.1539000
L191	MRF114	26.0603000	-80.2317000
L192	MRF117	25.8269000	-80.3442000
L193	MRF125C	26.7386000	-80.9344000
L194	MRF133	26.7489000	-80.6836000
L195	MRF137	26.8131000	-80.5636000
L196	MRF138	26.7839000	-80.5253000
L197	MRF159	27.4725000	-81.1439000
L198	MRF18	28.1403000	-81.3519000
L199	MRF183	26.7003000	-80.7161000
L200	MRF198	26.7897000	-80.9617000
L201	MRF206	26.6069000	-81.6497000
L202	MRF212	26.4239000	-80.1222000
L203	MRF213	26.4167000	-80.2039000
L204	MRF220	26.6844000	-80.3675000
L205	MRF250	26.7125000	-81.6297000
L206	MRF27	27.8031000	-81.1981000
L207	MRF300	26.7281000	-80.8533000
L208	MRF301	26.7150000	-80.0622000
L209	MRF32	27.6600000	-81.1342000
L210	MRF38	27.4014000	-81.1147000
L211	MRF39	27.3733000	-80.4506000
L212	MRF40	27.3325000	-80.4967000
L213	MRF50	27.0653000	-80.9778000
L214	MRF5005	26.4072000	-81.4164000
L215	MRF5006	26.5956000	-81.3353000
L216	MRF5010	26.1844000	-81.3464000
L217	MRF5022	26.9244000	-81.3139000
L218	MRF5029	27.6081000	-80.4314000
L219	MRF5034	27.2903000	-80.8269000
L220	MRF5053	27.4103000	-80.3369000
L221	MRF54	26.9044000	-80.3039000
L222	MRF57	26.8419000	-80.6022000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
L223	MRF60	26.8083000	-81.0467000
L224	MRF63	26.7350000	-80.8953000
L225	MRF65	26.7744000	-80.6175000
L226	MRF73C	26.6650000	-80.7011000
L227	MRF78	26.6189000	-80.1264000
L228	MRF80	26.6244000	-80.9483000
L229	MRF81	26.6122000	-80.2050000
L230	MRF84	26.5208000	-80.1239000
L231	MRF85	26.5283000	-80.1703000
L232	S133-R	27.2061000	-80.8008000
L233	S65E+R	27.2253000	-80.9625000
L234	S-157	27.8304000	-80.5397000
L235	S-164	28.3406000	-80.9333000
L236	S-252D	27.6389000	-80.6789000
L237	Black Ck	30.0602000	-81.8488000
L238	Lk Joanna	28.8345000	-81.6460000
L239	Kenansville	27.9630000	-81.0500000

Table 24: Location of the 7-dSay Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
M1	3A-36+R	26.1915000	-80.4492000
M2	3ANW+R	26.2665000	-80.7795000
M3	3AS+R	26.0821000	-80.6915000
M4	3ASW+R	25.9898000	-80.8362000
M5	Alico+R	26.5128000	-80.9819000
M6	Avonpk+R	27.6317000	-81.2647000
M7	Blueg+R	27.2197000	-80.4650000
M8	Colgov+R	26.1297000	-81.7625000
M9	Lotela+R	27.5914000	-81.4353000
M10	Lxws+R	26.4989000	-80.2222000
M11	MRF122	25.4700000	-80.3464000
M12	MRF123	25.3669000	-80.3764000
M13	MRF155	27.7528000	-81.0772000
M14	MRF187	27.4386000	-81.2064000
M15	MRF191	27.7458000	-81.2453000
M16	MRF205	28.0994000	-81.5286000
M17	MRF23	28.0017000	-81.1936000
M18	S131+R	26.9792000	-81.0900000
M19	S18C-R	25.3306000	-80.5250000
M20	S332-R	25.4217000	-80.5897000
M21	S65DW+R	27.3142000	-81.0219000
M22	S70+R	27.1186000	-81.1572000
M23	Sirg+R	26.9072000	-80.1917000
M24	Snivly+R	27.9717000	-81.4175000
M25	Taft+R	28.4361000	-81.3714000
M26	Herron Steel Site Silver	30.4383000	-84.4111000
M27	Christian Heritage Church	30.5053000	-84.3308000
M28	Lake Jackson Facility	30.4833000	-84.2992000
M29	Tuck Property N. Centerv	30.5592000	-84.1500000
M30	City Well At Limoges Dr.	30.4844000	-84.1956000
M31	Leon County Landfil Us	30.4203000	-84.1347000
M32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
M33	San Luis City Park	30.4586000	-84.3211000
M34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
M35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
M36	S36-R	26.1734000	-80.1784000
M37	Blackman	30.9833000	-86.6500000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
M38	Boca Raton	26.3675000	-80.1108000
M39	Branford	29.9625000	-82.9108000
M40	Brooksville 7 Ssw	28.4811000	-82.4353000
M41	Dowling Park 1 W	30.2497000	-83.2594000
M42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
M43	Graceville 1 Sw	30.9575000	-85.5331000
M44	Inglis 3 Sw	29.0253000	-82.6158000
M45	Lakeland	28.0206000	-81.9219000
M46	Lignumvitae Key	24.9027000	-80.6960000
M47	Monticello 10 Sw	30.4406000	-83.9858000
M48	North New Rvr Canal 1	26.5667000	-80.7500000
M49	North New Rvr Canal 2	26.3336000	-80.5372000
M50	Pennsuco 5 Wnw	25.9297000	-80.4539000
M51	Port Mayaca S L Canal	26.9833000	-80.6167000
M52	Trail Glade Ranges	25.7647000	-80.4775000
M53	Woodruff Dam	30.7219000	-84.8742000
M54	Miles City	26.2483000	-81.2967000
M55	Ochopee	25.9167000	-81.2833000
M56	Apalachicola Ap	29.7258000	-85.0206000
M57	Arcadia	27.2181000	-81.8739000
M58	Archbold Bio Stn	27.1819000	-81.3508000
M59	Avon Park 2	27.5944000	-81.5253000
M60	Babson Park 1 Ene	27.8500000	-81.5167000
M61	Bartow	27.8986000	-81.8433000
M62	Basinger	27.3833000	-81.0333000
M63	Belle Glade	26.6928000	-80.6711000
M64	Big Corkscrew	26.3650000	-81.5478000
M65	Blountstown 2 Se	30.4500000	-85.0500000
M66	Bradenton 5 Ese	27.4467000	-82.5014000
M67	Bristol	30.4181000	-84.9861000
M68	Brooksville Chin Hill	28.6164000	-82.3658000
M69	Bushnell 2 E	28.6664000	-82.0894000
M70	Canal Point Usda	26.8639000	-80.6256000
M71	Carrabelle 1 Nnw	29.8667000	-84.6333000
M72	Caryville	30.7667000	-85.8167000
M73	Cedar Key 1 Wsw	29.1333000	-83.0500000
M74	Chipley	30.7836000	-85.4847000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
M75	Bithlo	28.5500000	-81.1000000
M76	Clearwater	27.9667000	-82.7667000
M77	Clermont 9 S	28.4553000	-81.7233000
M78	Compass Lake	30.6000000	-85.4000000
M79	Coral Springs	26.2678000	-80.2750000
M80	Crescent City	29.4292000	-81.5158000
M81	Crestview Bob Skies Ap	30.7797000	-86.5225000
M82	Cross City 1 E	29.6333000	-83.1053000
M83	Daytona Beach	29.1894000	-81.0139000
M84	Daytona Beach Intl Ap	29.1828000	-81.0483000
M85	De Funiak Springs 1 E	30.7244000	-86.0939000
M86	Deland 1 Sse	29.0181000	-81.3106000
M87	Desoto City 8 Sw	27.3697000	-81.5136000
M88	Devils Garden	26.6033000	-81.1292000
M89	Dry Tortugas	24.6281000	-82.8736000
M90	Everglades	25.8489000	-81.3897000
M91	Federal Point	29.7550000	-81.5389000
M92	Fernandina Beach	30.6589000	-81.4636000
M93	Flamingo Rs	25.1422000	-80.9144000
M94	Ft Drum 3 Nw	27.5303000	-80.8167000
M95	Ft Green 12 Wsw	27.5706000	-82.1378000
M96	Ft Lauderdale	26.1019000	-80.2011000
M97	Ft Myers Page Fld Ap	26.5850000	-81.8614000
M98	Ft Pierce	27.4622000	-80.3539000
M99	Gainesville 3 Wsw	29.6333000	-82.3667000
M100	Gainesville Rgnl Ap	29.6919000	-82.2756000
M101	Glen St Mary 1 W	30.2717000	-82.1856000
M102	Hart Lake	28.3833000	-81.1833000
M103	Hastings 4 Ne	29.7517000	-81.4669000
M104	Hialeah	25.8175000	-80.2858000
M105	High Springs	29.8286000	-82.5972000
M106	Hilliard	30.7000000	-81.9333000
M107	Hillsborough River Sp	28.1428000	-82.2269000
M108	Homestead Exp Stn	25.5000000	-80.5000000
M109	Hypoluxo	26.5500000	-80.0500000
M110	Immokalee	26.4217000	-81.4100000
M111	Indian Lake Estates	27.8000000	-81.3333000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
M112	Inverness 3 Se	28.8031000	-82.3125000
M113	Isleworth	28.4833000	-81.5333000
M114	Jacksonville Intl Ap	30.4950000	-81.6936000
M115	Jacksonville Beach	30.2875000	-81.3928000
M116	Jasper	30.5228000	-82.9447000
M117	Key West Intl Ap	24.5550000	-81.7522000
M118	Kissimmee 2	28.2764000	-81.4239000
M119	La Belle	26.7458000	-81.4264000
M120	Lake Alfred Exp Stn	28.1042000	-81.7144000
M121	Lake City 2 E	30.1853000	-82.5942000
M122	Lake Placid 2 Sw	27.2833000	-81.3833000
M123	Lisbon	28.8728000	-81.7844000
M124	Live Oak	30.2889000	-82.9650000
M125	Loxahatchee	26.6833000	-80.2667000
M126	Lynne	29.2003000	-81.9306000
M127	Madison	30.4517000	-83.4119000
M128	Marianna Sch For Boys	30.7667000	-85.2667000
M129	Marineland	29.6700000	-81.2150000
M130	Mayo	30.0564000	-83.1819000
M131	Melbourne Wfo	28.0958000	-80.6308000
M132	Merritt Island	28.3500000	-80.7000000
M133	Miami Beach	25.8064000	-80.1336000
M134	Miami Intl Ap	25.7906000	-80.3164000
M135	Miami Wso City	25.7167000	-80.2833000
M136	Miami 12 Ssw	25.6500000	-80.3000000
M137	Milton Exp Stn	30.7794000	-87.1414000
M138	Monticello 5 Se	30.4922000	-83.7833000
M139	Moore Haven Lock 1	26.8400000	-81.0872000
M140	Mtn Lake	27.9347000	-81.5928000
M141	Mt Pleasant 2 W	30.6667000	-84.7000000
M142	Myakka River Sp	30.6667000	-84.7000000
M143	Naples	26.1686000	-81.7158000
M144	New Smyrna Beach	29.0500000	-80.9500000
M145	Niceville	30.5316000	-86.4928000
M146	Oasis Rs	25.8581000	-81.0319000
M147	Ocala	29.0803000	-82.0778000
M148	Okeechobee	27.1508000	-80.8653000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
M149	Orange City	28.9333000	-81.3000000
M150	Orlando Intl Ap	28.4339000	-81.3250000
M151	Orlando Wso Ap	28.5500000	-81.3333000
M152	Ortona Lock 2	26.7897000	-81.3044000
M153	Palatka	29.6439000	-81.6606000
M154	Panacea 1 S	29.9989000	-84.4850000
M155	Panama City 5 N	30.2492000	-85.6606000
M156	Parrish	27.6089000	-82.3478000
M157	Pensacola Rgnl Ap	30.4781000	-87.1869000
M158	Perrine 4w	25.5819000	-80.4361000
M159	Perry	30.0986000	-83.5742000
M160	Plant City	28.0236000	-82.1422000
M161	Punta Gorda 4 Ese	26.9164000	-81.9983000
M162	Quincy 3 Ssw	30.6000000	-84.5500000
M163	Raiford State Prison	30.0678000	-82.1928000
M164	Royal Palm Ranger Sta	25.3867000	-80.5936000
M165	St Augustine Lh	29.8875000	-81.2917000
M166	Saint Leo	28.3378000	-82.2600000
M167	St Lucie New Lock 1	27.1167000	-80.2833000
M168	St Marks 5 Sse	30.1000000	-84.1667000
M169	St Petersburg	27.7631000	-82.6272000
M170	Sanford	28.8147000	-81.2778000
M171	Sarasota	27.3500000	-82.5333000
M172	Starke	29.9381000	-82.1164000
M173	Steinhatchee 6 Ene	29.7236000	-83.3061000
M174	Stuart	27.2000000	-80.1639000
M175	Tallahassee Wso Ap	30.3931000	-84.3533000
M176	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
M177	Tampa Wscmo Ap	27.9614000	-82.5403000
M178	Tarpon Spgs Sewage Pl	28.1586000	-82.7644000
M179	Tavernier	25.0069000	-80.5211000
M180	Titusville	28.6242000	-80.8158000
M181	Usher Twr	29.4083000	-82.8186000
M182	Venice	27.1006000	-82.4364000
M183	Venus	27.1350000	-81.3303000
M184	Vero Beach 4se	27.6528000	-80.4031000
M185	Wauchula	27.5478000	-81.7994000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
M186	Wausau	30.6333000	-85.5833000
M187	West Palm Intl Ap	26.6847000	-80.0994000
M188	Wewahitchka	30.1192000	-85.2042000
M189	Winter Haven	28.0153000	-81.7331000
M190	G56-R	26.3278000	-80.1308000
M191	G57-R	26.2311000	-80.1242000
M192	MIALCK+R	26.6819000	-80.8061000
M193	MRF102	26.3689000	-80.1539000
M194	MRF114	26.0603000	-80.2317000
M195	MRF117	25.8269000	-80.3442000
M196	MRF125C	26.7386000	-80.9344000
M197	MRF133	26.7489000	-80.6836000
M198	MRF137	26.8131000	-80.5636000
M199	MRF138	26.7839000	-80.5253000
M200	MRF159	27.4725000	-81.1439000
M201	MRF18	28.1403000	-81.3519000
M202	MRF183	26.7003000	-80.7161000
M203	MRF198	26.7897000	-80.9617000
M204	MRF206	26.6069000	-81.6497000
M205	MRF212	26.4239000	-80.1222000
M206	MRF213	26.4167000	-80.2039000
M207	MRF220	26.6844000	-80.3675000
M208	MRF250	26.7125000	-81.6297000
M209	MRF27	27.8031000	-81.1981000
M210	MRF300	26.7281000	-80.8533000
M211	MRF301	26.7150000	-80.0622000
M212	MRF32	27.6600000	-81.1342000
M213	MRF38	27.4014000	-81.1147000
M214	MRF39	27.3733000	-80.4506000
M215	MRF40	27.3325000	-80.4967000
M216	MRF50	27.0653000	-80.9778000
M217	MRF5005	26.4072000	-81.4164000
M218	MRF5006	26.5956000	-81.3353000
M219	MRF5010	26.1844000	-81.3464000
M220	MRF5022	26.9244000	-81.3139000
M221	MRF5029	27.6081000	-80.4314000
M222	MRF5034	27.2903000	-80.8269000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
M223	MRF5053	27.4103000	-80.3369000
M224	MRF54	26.9044000	-80.3039000
M225	MRF57	26.8419000	-80.6022000
M226	MRF60	26.8083000	-81.0467000
M227	MRF63	26.7350000	-80.8953000
M228	MRF65	26.7744000	-80.6175000
M229	MRF73C	26.6650000	-80.7011000
M230	MRF78	26.6189000	-80.1264000
M231	MRF80	26.6244000	-80.9483000
M232	MRF81	26.6122000	-80.2050000
M233	MRF84	26.5208000	-80.1239000
M234	MRF85	26.5283000	-80.1703000
M235	S133-R	27.2061000	-80.8008000
M236	S65E+R	27.2253000	-80.9625000
M237	S-157	27.8304000	-80.5397000
M238	S-164	28.3406000	-80.9333000
M239	S-252D	27.6389000	-80.6789000
M240	Black Ck Middleburg	30.0602000	-81.8488000
M241	Lk Joanna	28.8345000	-81.6460000
M242	Kenansville	27.9630000	-81.0500000

Table 25: Location of the 10-day Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
N1	3A-36+R	26.1915000	-80.4492000
N2	3ANW+R	26.2665000	-80.7795000
N3	3AS+R	26.0821000	-80.6915000
N4	3ASW+R	25.9898000	-80.8362000
N5	Alico+R	26.5128000	-80.9819000
N6	Avonpk+R	27.6317000	-81.2647000
N7	Blueg+R	27.2197000	-80.4650000
N8	Colgov+R	26.1297000	-81.7625000
N9	Lotela+R	27.5914000	-81.4353000
N10	Lxws+R	26.4989000	-80.2222000
N11	MRF122	25.4700000	-80.3464000
N12	MRF123	25.3669000	-80.3764000
N13	MRF155	27.7528000	-81.0772000
N14	MRF187	27.4386000	-81.2064000
N15	MRF191	27.7458000	-81.2453000
N16	MRF205	28.0994000	-81.5286000
N17	MRF23	28.0017000	-81.1936000
N18	S131+R	26.9792000	-81.0900000
N19	S18C-R	25.3306000	-80.5250000
N20	S332-R	25.4217000	-80.5897000
N21	S65DW+R	27.3142000	-81.0219000
N22	S70+R	27.1186000	-81.1572000
N23	Sirg+R	26.9072000	-80.1917000
N24	Snivly+R	27.9717000	-81.4175000
N25	Taft+R	28.4361000	-81.3714000
N26	Herron Steel Site Silver	30.4383000	-84.4111000
N27	Christian Heritage Church	30.5053000	-84.3308000
N28	Lake Jackson Facility	30.4833000	-84.2992000
N29	Tuck Property N Centerv	30.5592000	-84.1500000
N30	City Well At Limoges Dr.	30.4844000	-84.1956000
N31	Leon County Landfill Us	30.4203000	-84.1347000
N32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
N33	San Luis City Park	30.4586000	-84.3211000
N34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
N35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
N36	S36-R	26.1734000	-80.1784000
N37	Blackman	30.9833000	-86.6500000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
N38	Boca Raton	26.3675000	-80.1108000
N39	Branford	29.9625000	-82.9108000
N40	Brooksville 7 Ssw	28.4811000	-82.4353000
N41	Dowling Park 1 W	30.2497000	-83.2594000
N42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
N43	Graceville 1 Sw	30.9575000	-85.5331000
N44	Inglis 3 E	29.0253000	-82.6158000
N45	Lakeland	28.0206000	-81.9219000
N46	Lignumvitae Key	24.9027000	-80.6960000
N47	Monticello 10 Sw	30.4406000	-83.9858000
N48	North New Rvr Canal 1	26.5667000	-80.7500000
N49	North New Rvr Canal 2	26.3336000	-80.5372000
N50	Pennsuco 5 Wnw	25.9297000	-80.4539000
N51	Port Mayaca S L Canal	26.9833000	-80.6167000
N52	Trail Glade Ranges	25.7647000	-80.4775000
N53	Woodruff Dam	30.7219000	-84.8742000
N54	Miles City	26.2483000	-81.2967000
N55	Ochopee	25.9167000	-81.2833000
N56	Apalachicola Ap	29.7258000	-85.0206000
N57	Arcadia	27.2181000	-81.8739000
N58	Archbold Bio Stn	27.1819000	-81.3508000
N59	Avon Park 2 W	27.5944000	-81.5253000
N60	Babson Park 1 Ene	27.8500000	-81.5167000
N61	Bartow	27.8986000	-81.8433000
N62	Basinger	27.3833000	-81.0333000
N63	Belle Glade	26.6928000	-80.6711000
N64	Big Corkscre	26.3650000	-81.5478000
N65	Blountstown 2 Se	30.4500000	-85.0500000
N66	Bradenton 5 Ese	27.4467000	-82.5014000
N67	Bristol	30.4181000	-84.9861000
N68	Brooksville Chin Hill	28.6164000	-82.3658000
N69	Bushnell 2 E	28.6664000	-82.0894000
N70	Canal Point Usda	26.8639000	-80.6256000
N71	Carrabelle 1 Nnw	29.8667000	-84.6333000
N72	Caryville	30.7667000	-85.8167000
N73	Cedar Key 1 Wsw	29.1333000	-83.0500000
N74	Chipley	30.7836000	-85.4847000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
N75	Bithlo	28.5500000	-81.1000000
N76	Clearwater	27.9667000	-82.7667000
N77	Clermont 9 S	28.4553000	-81.7233000
N78	Compass Lake	30.6000000	-85.4000000
N79	Coral Sprngs	26.2678000	-80.2750000
N80	Crescent City	29.4292000	-81.5158000
N81	Crestview Bob Sikes Ap	30.7797000	-86.5225000
N82	Cross City 1 E	29.6333000	-83.1053000
N83	Daytona Beach	29.1894000	-81.0139000
N84	Daytona Beach Intl Ap	29.1828000	-81.0483000
N85	De Funiak Springs 1 E	30.7244000	-86.0939000
N86	Deland 1 Sse	29.0181000	-81.3106000
N87	Desoto City 8 Sw	27.3697000	-81.5136000
N88	Devils Garden	26.6033000	-81.1292000
N89	Dry Tortugas	24.6281000	-82.8736000
N90	Everglades	25.8489000	-81.3897000
N91	Federal Point	29.7550000	-81.5389000
N92	Fernandina Beach	30.6589000	-81.4636000
N93	Flamingo Rs	25.1422000	-80.9144000
N94	Ft Drum 3 Nw	27.5303000	-80.8167000
N95	Ft Green 12 Wsw	27.5706000	-82.1378000
N96	Ft Lauderdale	26.1019000	-80.2011000
N97	Ft Myers Page Fld Ap	26.5850000	-81.8614000
N98	Ft Pierce	27.4622000	-80.3539000
N99	Gainesville 3 Wsw	29.6333000	-82.3667000
N100	Gainesville Rgnl Ap	29.6919000	-82.2756000
N101	Glen St Mary 1 W	30.2717000	-82.1856000
N102	Hart Lake	28.3833000	-81.1833000
N103	Hastings 4 Ne	29.7517000	-81.4669000
N104	Hialeah	25.8175000	-80.2858000
N105	High Springs	29.8286000	-82.5972000
N106	Hilliard	30.7000000	-81.9333000
N107	Hillsborough River Sp	28.1428000	-82.2269000
N108	Homestead Exp Stn	25.5000000	-80.5000000
N109	Hypoluxo	26.5500000	-80.0500000
N110	Immokalee	26.4217000	-81.4100000
N111	Indian Lake Estates	27.8000000	-81.3333000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
N112	Inverness 3 Se	28.8031000	-82.3125000
N113	Isleworth	28.4833000	-81.5333000
N114	Jacksonville Intl Ap	30.4950000	-81.6936000
N115	Jacksonville Beach	30.2875000	-81.3928000
N116	Jasper	30.5228000	-82.9447000
N117	Key West Intl Airport	24.5550000	-81.7522000
N118	Kissimmee 2	28.2764000	-81.4239000
N119	La Belle	26.7458000	-81.4264000
N120	Lake Alfred Exp Stn	28.1042000	-81.7144000
N121	Lake City 2 E	30.1853000	-82.5942000
N122	Lake Placid 2 Sw	27.2833000	-81.3833000
N123	Lisbon	28.8728000	-81.7844000
N124	Live Oak	30.2889000	-82.9650000
N125	Loxahatchee	26.6833000	-80.2667000
N126	Lynne	29.2003000	-81.9306000
N127	Madison	30.4517000	-83.4119000
N128	Marianna Sch For Boys	30.7667000	-85.2667000
N129	Marineland	29.6700000	-81.2150000
N130	Mayo	30.0564000	-83.1819000
N131	Melbourne Wfo	28.0958000	-80.6308000
N132	Merritt Island	28.3500000	-80.7000000
N133	Miami Beach	25.8064000	-80.1336000
N134	Miami Intl Ap	25.7906000	-80.3164000
N135	Miami Wso City	25.7167000	-80.2833000
N136	Miami 12 Ssw	25.6500000	-80.3000000
N137	Milton Exp Stn	30.7794000	-87.1414000
N138	Monticello 5 Se	30.4922000	-83.7833000
N139	Moore Haven Lock 1	26.8400000	-81.0872000
N140	Mtn Lake	27.9347000	-81.5928000
N141	Mt Pleasant 2 W	30.6667000	-84.7000000
N142	Myakka River Sp	27.2417000	-82.3161000
N143	Naples	26.1686000	-81.7158000
N144	New Smyrna Beach	29.0500000	-80.9500000
N145	Niceville	30.5316000	-86.4928000
N146	Oasis Rs	25.8581000	-81.0319000
N147	Ocala	29.0803000	-82.0778000
N148	Okeechobee	27.1508000	-80.8653000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
N149	Orange City	28.9333000	-81.3000000
N150	Orlando Intl Ap	28.4339000	-81.3250000
N151	Orlando Wso Ap	28.5500000	-81.3333000
N152	Ortona Lock 2	26.7897000	-81.3044000
N153	Palatka	29.6439000	-81.6606000
N154	Panacea 1 S	29.9989000	-84.4850000
N155	Panama City 5 N	30.2492000	-85.6606000
N156	Parrish	27.6089000	-82.3478000
N157	Pensacola Rgnl Ap	30.4781000	-87.1869000
N158	Perrine 4w	25.5819000	-80.4361000
N159	Perry	30.0986000	-83.5742000
N160	Plant City	28.0236000	-82.1422000
N161	Punta Gorda 4 Ese	26.9164000	-81.9983000
N162	Quincy 3 Ssw	30.6000000	-84.5500000
N163	Raiford State Prison	30.0678000	-82.1928000
N164	Royal Palm Ranger Sta	25.3867000	-80.5936000
N165	St Augustine Lh	29.8875000	-81.2917000
N166	Saint Leo	28.3378000	-82.2600000
N167	St Lucie New Lock 1	27.1167000	-80.2833000
N168	St Marks 5 Sse	30.1000000	-84.1667000
N169	St Petersburg	27.7631000	-82.6272000
N170	Sanford	28.8147000	-81.2778000
N171	Sarasota	27.3500000	-82.5333000
N172	Starke	29.9381000	-82.1164000
N173	Steinhatchee 6 Ene	29.7236000	-83.3061000
N174	Stuart	27.2000000	-80.1639000
N175	Tallahassee Wso Ap	30.3931000	-84.3533000
N176	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
N177	Tampa Wscmo Ap	27.9614000	-82.5403000
N178	Tarpon Spgs Sewage Pl	28.1586000	-82.7644000
N179	Tavernier	25.0069000	-80.5211000
N180	Titusville	28.6242000	-80.8158000
N181	Usher Twr	29.4083000	-82.8186000
N182	Venice	27.1006000	-82.4364000
N183	Venus	27.1350000	-81.3303000
N184	Vero Beach 4se	27.6528000	-80.4031000
N185	Wauchula	27.5478000	-81.7994000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
N186	WAUSAU	30.6333000	-85.5833000
N187	WEST PALM BCH INTL AP	26.6847000	-80.0994000
N188	WEWAHITCHKA	30.1192000	-85.2042000
N189	WINTER HAVEN	28.0153000	-81.7331000
N190	G56-R	26.3278000	-80.1308000
N191	G57-R	26.2311000	-80.1242000
N192	MIALCK+R	26.6819000	-80.8061000
N193	MRF102	26.3689000	-80.1539000
N194	MRF114	26.0603000	-80.2317000
N195	MRF117	25.8269000	-80.3442000
N196	MRF125C	26.7386000	-80.9344000
N197	MRF133	26.7489000	-80.6836000
N198	MRF137	26.8131000	-80.5636000
N199	MRF138	26.7839000	-80.5253000
N200	MRF159	27.4725000	-81.1439000
N201	MRF18	28.1403000	-81.3519000
N202	MRF183	26.7003000	-80.7161000
N203	MRF198	26.7897000	-80.9617000
N204	MRF206	26.6069000	-81.6497000
N205	MRF212	26.4239000	-80.1222000
N206	MRF213	26.4167000	-80.2039000
N207	MRF220	26.6844000	-80.3675000
N208	MRF250	26.7125000	-81.6297000
N209	MRF27	27.8031000	-81.1981000
N210	MRF300	26.7281000	-80.8533000
N211	MRF301	26.7150000	-80.0622000
N212	MRF32	27.6600000	-81.1342000
N213	MRF38	27.4014000	-81.1147000
N214	MRF39	27.3733000	-80.4506000
N215	MRF40	27.3325000	-80.4967000
N216	MRF50	27.0653000	-80.9778000
N217	MRF5005	26.4072000	-81.4164000
N218	MRF5006	26.5956000	-81.3353000
N219	MRF5010	26.1844000	-81.3464000
N220	MRF5022	26.9244000	-81.3139000
N221	MRF5029	27.6081000	-80.4314000
N222	MRF5034	27.2903000	-80.8269000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
N223	MRF5053	27.4103000	-80.3369000
N224	MRF54	26.9044000	-80.3039000
N225	MRF57	26.8419000	-80.6022000
N226	MRF60	26.8083000	-81.0467000
N227	MRF63	26.7350000	-80.8953000
N228	MRF65	26.7744000	-80.6175000
N229	MRF73C	26.6650000	-80.7011000
N230	MRF78	26.6189000	-80.1264000
N231	MRF80	26.6244000	-80.9483000
N232	MRF81	26.6122000	-80.2050000
N233	MRF84	26.5208000	-80.1239000
N234	MRF85	26.5283000	-80.1703000
N235	S133-R	27.2061000	-80.8008000
N236	S65E+R	27.2253000	-80.9625000
N237	S-157	27.8304000	-80.5397000
N238	S-164	28.3406000	-80.9333000
N239	S-252D	27.6389000	-80.6789000
N240	Black Ck Middleburg	30.0602000	-81.8488000
N241	Lk Joanna	28.8345000	-81.6460000
N242	Kenansville	27.9630000	-81.0500000

Table 26: Location of the 20-day Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
O1	3A-36+R	26.1915000	-80.4492000
O2	3ANW+R	26.2665000	-80.7795000
O3	3AS+R	26.0821000	-80.6915000
O4	3ASW+R	25.9898000	-80.8362000
O5	Alico+R	26.5128000	-80.9819000
O6	Avonpk+R	27.6317000	-81.2647000
O7	Blueg+R	27.2197000	-80.4650000
O8	Colgov+R	26.1297000	-81.7625000
O9	Lotela+R	27.5914000	-81.4353000
O10	Lxws+R	26.4989000	-80.2222000
O11	MRF122	25.4700000	-80.3464000
O12	MRF123	25.3669000	-80.3764000
O13	MRF155	27.7528000	-81.0772000
O14	MRF187	27.4386000	-81.2064000
O15	MRF191	27.7458000	-81.2453000
O16	MRF205	28.0994000	-81.5286000
O17	MRF23	28.0017000	-81.1936000
O18	S131+R	26.9792000	-81.0900000
O19	S18C-R	25.3306000	-80.5250000
O20	S332-R	25.4217000	-80.5897000
O21	S65DW+R	27.3142000	-81.0219000
O22	S70+R	27.1186000	-81.1572000
O23	Sirg+R	26.9072000	-80.1917000
O24	Snivly+R	27.9717000	-81.4175000
O25	Taft+R	28.4361000	-81.3714000
O26	Herron Steel Site Silver	30.4383000	-84.4111000
O27	Christian Heritage Church	30.5053000	-84.3308000
O28	Lake Jackson Facility	30.4833000	-84.2992000
O29	Tuck Property N. Centerv	30.5592000	-84.1500000
O30	City Well At Limoges Dr.	30.4844000	-84.1956000
O31	Leon County Landfil Us	30.4203000	-84.1347000
O32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
O33	San Luis City Park	30.4586000	-84.3211000
O34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
O35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
O36	S36-R	26.1734000	-80.1784000
O37	Blackman	30.9833000	-86.6500000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
O38	Boca Raton	26.3675000	-80.1108000
O39	Branford	29.9625000	-82.9108000
O40	Brooksville 7 Ssw	28.4811000	-82.4353000
O41	Dowling Park 1 W	30.2497000	-83.2594000
O42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
O43	Graceville 1 Sw	30.9575000	-85.5331000
O44	Inglis 3 Sw	29.0253000	-82.6158000
O45	Lakeland	28.0206000	-81.9219000
O46	Lignumvitae Key	24.9027000	-80.6960000
O47	Monticello 10 Sw	30.4406000	-83.9858000
O48	North New Rvr Canal 1	26.5667000	-80.7500000
O49	North New Rvr Canal 2	26.3336000	-80.5372000
O50	Pennsuco 5 Wnw	25.9297000	-80.4539000
O51	Port Mayaca S L Canal	26.9833000	-80.6167000
O52	Trail Glade Ranges	25.7647000	-80.4775000
O53	Woodruff Dam	30.7219000	-84.8742000
O54	Miles City	26.2483000	-81.2967000
O55	Ochopee	25.9167000	-81.2833000
O56	Apalachicola Ap	29.7258000	-85.0206000
O57	Arcadia	27.2181000	-81.8739000
O58	Archbold Bio Stn	27.1819000	-81.3508000
O59	Avon Park 2	27.5944000	-81.5253000
O60	Babson Park 1 Ene	27.8500000	-81.5167000
O61	Bartow	27.8986000	-81.8433000
O62	Basinger	27.3833000	-81.0333000
O63	Belle Glade	26.6928000	-80.6711000
O64	Big Corkscrew	26.3650000	-81.5478000
O65	Blountstown 2 Se	30.4500000	-85.0500000
O66	Bradenton 5 Ese	27.4467000	-82.5014000
O67	Bristol	30.4181000	-84.9861000
O68	Brooksville Chin Hill	28.6164000	-82.3658000
O69	Bushnell 2 E	28.6664000	-82.0894000
O70	Canal Point Usda	26.8639000	-80.6256000
O71	Carrabelle 1 Nnw	29.8667000	-84.6333000
O72	Caryville	30.7667000	-85.8167000
O73	Cedar Key 1 Wsw	29.1333000	-83.0500000
O74	Chipley	30.7836000	-85.4847000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
O75	Bithlo	28.5500000	-81.1000000
O76	Clearwater	27.9667000	-82.7667000
O77	Clermont 9 S	28.4553000	-81.7233000
O78	Compass Lake	30.6000000	-85.4000000
O79	Coral Springs	26.2678000	-80.2750000
O80	Crescent City	29.4292000	-81.5158000
O81	Crestview Bob Skies Ap	30.7797000	-86.5225000
O82	Cross City 1 E	29.6333000	-83.1053000
O83	Daytona Beach	29.1894000	-81.0139000
O84	Daytona Beach Intl Ap	29.1828000	-81.0483000
O85	De Funiak Springs 1 E	30.7244000	-86.0939000
O86	Deland 1 Sse	29.0181000	-81.3106000
O87	Desoto City 8 Sw	27.3697000	-81.5136000
O88	Devils Garden	26.6033000	-81.1292000
O89	Dry Tortugas	24.6281000	-82.8736000
O90	Everglades	25.8489000	-81.3897000
O91	Federal Point	29.7550000	-81.5389000
O92	Fernandina Beach	30.6589000	-81.4636000
O93	Flamingo Rs	25.1422000	-80.9144000
O94	Ft Drum 3 Nw	27.5303000	-80.8167000
O95	Ft Green 12 Wsw	27.5706000	-82.1378000
O96	Ft Lauderdale	26.1019000	-80.2011000
O97	Ft Myers Page Fld Ap	26.5850000	-81.8614000
O98	Ft Pierce	27.4622000	-80.3539000
O99	Gainesville 3 Wsw	29.6333000	-82.3667000
O100	Gainesville Rgnl Ap	29.6919000	-82.2756000
O101	Glen St Mary 1 W	30.2717000	-82.1856000
O102	Hart Lake	28.3833000	-81.1833000
O103	Hastings 4 Ne	29.7517000	-81.4669000
O104	Hialeah	25.8175000	-80.2858000
O105	High Springs	29.8286000	-82.5972000
O106	Hilliard	30.7000000	-81.9333000
O107	Hillsborough River Sp	28.1428000	-82.2269000
O108	Homestead Exp Stn	25.5000000	-80.5000000
O109	Hypoluxo	26.5500000	-80.0500000
O110	Immokalee	26.4217000	-81.4100000
O111	Indian Lake Estates	27.8000000	-81.3333000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
O112	Inverness 3 Se	28.8031000	-82.3125000
O113	Isleworth	28.4833000	-81.5333000
O114	Jacksonville Intl Ap	30.4950000	-81.6936000
O115	Jacksonville Beach	30.2875000	-81.3928000
O116	Jasper	30.5228000	-82.9447000
O117	Key West Intl Ap	24.5550000	-81.7522000
O118	Kissimmee 2	28.2764000	-81.4239000
O119	La Belle	26.7458000	-81.4264000
O120	Lake Alfred Exp Stn	28.1042000	-81.7144000
O121	Lake City 2 E	30.1853000	-82.5942000
O122	Lake Placid 2 Sw	27.2833000	-81.3833000
O123	Lisbon	28.8728000	-81.7844000
O124	Live Oak	30.2889000	-82.9650000
O125	Loxahatchee	26.6833000	-80.2667000
O126	Lynne	29.2003000	-81.9306000
O127	Madison	30.4517000	-83.4119000
O128	Marianna Sch For Boys	30.7667000	-85.2667000
O129	Marineland	29.6700000	-81.2150000
O130	Mayo	30.0564000	-83.1819000
O131	Melbourne Wfo	28.0958000	-80.6308000
O132	Merritt Island	28.3500000	-80.7000000
O133	Miami Beach	25.8064000	-80.1336000
O134	Miami Intl Ap	25.7906000	-80.3164000
O135	Miami Wso City	25.7167000	-80.2833000
O136	Miami 12 Ssw	25.6500000	-80.3000000
O137	Milton Exp Stn	30.7794000	-87.1414000
O138	Monticello 5 Se	30.4922000	-83.7833000
O139	Moore Haven Lock 1	26.8400000	-81.0872000
O140	Mtn Lake	27.9347000	-81.5928000
O141	Mt Pleasant 2 W	30.6667000	-84.7000000
O142	Myakka River Sp	30.6667000	-84.7000000
O143	Naples	26.1686000	-81.7158000
O144	New Smyrna Beach	29.0500000	-80.9500000
O145	Niceville	30.5316000	-86.4928000
O146	Oasis Rs	25.8581000	-81.0319000
O147	Ocala	29.0803000	-82.0778000
O148	Okeechobee	27.1508000	-80.8653000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
O149	Orange City	28.9333000	-81.3000000
O150	Orlando Intl Ap	28.4339000	-81.3250000
O151	Orlando Wso Ap	28.5500000	-81.3333000
O152	Ortona Lock 2	26.7897000	-81.3044000
O153	Palatka	29.6439000	-81.6606000
O154	Panacea 1 S	29.9989000	-84.4850000
O155	Panama City 5 N	30.2492000	-85.6606000
O156	Parrish	27.6089000	-82.3478000
O157	Pensacola Rgnl Ap	30.4781000	-87.1869000
O158	Perrine 4w	25.5819000	-80.4361000
O159	Perry	30.0986000	-83.5742000
O160	Plant City	28.0236000	-82.1422000
O161	Punta Gorda 4 Ese	26.9164000	-81.9983000
O162	Quincy 3 Ssw	30.6000000	-84.5500000
O163	Raiford State Prison	30.0678000	-82.1928000
O164	Royal Palm Ranger Sta	25.3867000	-80.5936000
O165	St Augustine Lh	29.8875000	-81.2917000
O166	Saint Leo	28.3378000	-82.2600000
O167	St Lucie New Lock 1	27.1167000	-80.2833000
O168	St Marks 5 Sse	30.1000000	-84.1667000
O169	St Petersburg	27.7631000	-82.6272000
O170	Sanford	28.8147000	-81.2778000
O171	Sarasota	27.3500000	-82.5333000
O172	Starke	29.9381000	-82.1164000
O173	Steinhatchee 6 Ene	29.7236000	-83.3061000
O174	Stuart	27.2000000	-80.1639000
O175	Tallahassee Wso Ap	30.3931000	-84.3533000
O176	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
O177	Tampa Wscmo Ap	27.9614000	-82.5403000
O178	Tarpon Spgs Sewage Pl	28.1586000	-82.7644000
O179	Tavernier	25.0069000	-80.5211000
O180	Titusville	28.6242000	-80.8158000
O181	Usher Twr	29.4083000	-82.8186000
O182	Venice	27.1006000	-82.4364000
O183	Venus	27.1350000	-81.3303000
O184	Vero Beach 4se	27.6528000	-80.4031000
O185	Wauchula	27.5478000	-81.7994000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
O186	Wausau	30.6333000	-85.5833000
O187	West Palm Intl Ap	26.6847000	-80.0994000
O188	Wewahitchka	30.1192000	-85.2042000
O189	Winter Haven	28.0153000	-81.7331000
O190	G56-R	26.3278000	-80.1308000
O191	G57-R	26.2311000	-80.1242000
O192	MIALCK+R	26.6819000	-80.8061000
O193	MRF102	26.3689000	-80.1539000
O194	MRF114	26.0603000	-80.2317000
O195	MRF117	25.8269000	-80.3442000
O196	MRF125C	26.7386000	-80.9344000
O197	MRF133	26.7489000	-80.6836000
O198	MRF137	26.8131000	-80.5636000
O199	MRF138	26.7839000	-80.5253000
O200	MRF159	27.4725000	-81.1439000
O201	MRF18	28.1403000	-81.3519000
O202	MRF183	26.7003000	-80.7161000
O203	MRF198	26.7897000	-80.9617000
O204	MRF206	26.6069000	-81.6497000
O205	MRF212	26.4239000	-80.1222000
O206	MRF213	26.4167000	-80.2039000
O207	MRF220	26.6844000	-80.3675000
O208	MRF250	26.7125000	-81.6297000
O209	MRF27	27.8031000	-81.1981000
O210	MRF300	26.7281000	-80.8533000
O211	MRF301	26.7150000	-80.0622000
O212	MRF32	27.6600000	-81.1342000
O213	MRF38	27.4014000	-81.1147000
O214	MRF39	27.3733000	-80.4506000
O215	MRF40	27.3325000	-80.4967000
O216	MRF50	27.0653000	-80.9778000
O217	MRF5005	26.4072000	-81.4164000
O218	MRF5006	26.5956000	-81.3353000
O219	MRF5010	26.1844000	-81.3464000
O220	MRF5022	26.9244000	-81.3139000
O221	MRF5029	27.6081000	-80.4314000
O222	MRF5034	27.2903000	-80.8269000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
O223	MRF5053	27.4103000	-80.3369000
O224	MRF54	26.9044000	-80.3039000
O225	MRF57	26.8419000	-80.6022000
O226	MRF60	26.8083000	-81.0467000
O227	MRF63	26.7350000	-80.8953000
O228	MRF65	26.7744000	-80.6175000
O229	MRF73C	26.6650000	-80.7011000
O230	MRF78	26.6189000	-80.1264000
O231	MRF80	26.6244000	-80.9483000
O232	MRF81	26.6122000	-80.2050000
O233	MRF84	26.5208000	-80.1239000
O234	MRF85	26.5283000	-80.1703000
O235	S133-R	27.2061000	-80.8008000
O236	S65E+R	27.2253000	-80.9625000
O237	S-157	27.8304000	-80.5397000
O238	S-164	28.3406000	-80.9333000
O239	S-252D	27.6389000	-80.6789000
O240	Black Ck Middleburg	30.0602000	-81.8488000
O241	Lk Joanna	28.8345000	-81.6460000
O242	Kenansville	27.9630000	-81.0500000

Table 27: Location of the 45-day Rain Gage Stations

Rain Gage ID	Rain Gage Name	Latitude	Longitude
P1	3A-36+R	26.1915000	-80.4492000
P2	3ANW+R	26.2665000	-80.7795000
P3	3AS+R	26.0821000	-80.6915000
P4	3ASW+R	25.9898000	-80.8362000
P5	ALICO+R	26.5128000	-80.9819000
P6	AVONPK+R	27.6317000	-81.2647000
P7	BLUEG+R	27.2197000	-80.4650000
P8	COLGOV+R	26.1297000	-81.7625000
P9	LOTELA+R	27.5914000	-81.4353000
P10	LXWS+R	26.4989000	-80.2222000
P11	MRF122	25.4700000	-80.3464000
P12	MRF123	25.3669000	-80.3764000
P13	MRF155	27.7528000	-81.0772000
P14	MRF187	27.4386000	-81.2064000
P15	MRF191	27.7458000	-81.2453000
P16	MRF205	28.0994000	-81.5286000
P17	MRF23	28.0017000	-81.1936000
P18	S131+R	26.9792000	-81.0900000
P19	S18C-R	25.3306000	-80.5250000
P20	S332-R	25.4217000	-80.5897000
P21	S65DW+R	27.3142000	-81.0219000
P22	S70+R	27.1186000	-81.1572000
P23	Sirg+R	26.9072000	-80.1917000
P24	Snivly+R	27.9717000	-81.4175000
P25	Taft+R	28.4361000	-81.3714000
P26	Herron Steel Site Silver	30.4383000	-84.4111000
P27	Christian Heritage Church	30.5053000	-84.3308000
P28	Lake Jackson Facility	30.4833000	-84.2992000
P29	Tuck Property N. Centerv	30.5592000	-84.1500000
P30	City Well At Limoges Dr.	30.4844000	-84.1956000
P31	Leon County Landfil Us	30.4203000	-84.1347000
P32	Lake Kanturk Outfall At Ce	30.5272000	-84.1917000
P33	San Luis City Park	30.4586000	-84.3211000
P34	Chowkeebin Nene Near Magn	30.4331000	-84.2608000
P35	Wembley Way Eastgate Nei	30.4931000	-84.2392000
P36	S36-R	26.1734000	-80.1784000
P37	Blackman	30.9833000	-86.6500000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
P38	Boca Raton	26.3675000	-80.1108000
P39	Branford	29.9625000	-82.9108000
P40	Brooksville 7 Ssw	28.4811000	-82.4353000
P41	Dowling Park 1 W	30.2497000	-83.2594000
P42	Ft Lauderdale Intl Ap	26.0719000	-80.1536000
P43	Graceville 1 Sw	30.9575000	-85.5331000
P44	Inglis 3 Sw	29.0253000	-82.6158000
P45	Lakeland	28.0206000	-81.9219000
P46	Lignumvitae Key	24.9027000	-80.6960000
P47	Monticello 10 Sw	30.4406000	-83.9858000
P48	North New Rvr Canal 1	26.5667000	-80.7500000
P49	North New Rvr Canal 2	26.3336000	-80.5372000
P50	Pennsuco 5 Wnw	25.9297000	-80.4539000
P51	Port Mayaca S L Canal	26.9833000	-80.6167000
P52	Trail Glade Ranges	25.7647000	-80.4775000
P53	Woodruff Dam	30.7219000	-84.8742000
P54	Miles City	26.2483000	-81.2967000
P55	Ochopee	25.9167000	-81.2833000
P56	Apalachicola Ap	29.7258000	-85.0206000
P57	Arcadia	27.2181000	-81.8739000
P58	Archbold Bio Stn	27.1819000	-81.3508000
P59	Avon Park 2	27.5944000	-81.5253000
P60	Babson Park 1 Ene	27.8500000	-81.5167000
P61	Bartow	27.8986000	-81.8433000
P62	Basinger	27.3833000	-81.0333000
P63	Belle Glade	26.6928000	-80.6711000
P64	Big Corkscrew	26.3650000	-81.5478000
P65	Blountstown 2 Se	30.4500000	-85.0500000
P66	Bradenton 5 Ese	27.4467000	-82.5014000
P67	Bristol	30.4181000	-84.9861000
P68	Brooksville Chin Hill	28.6164000	-82.3658000
P69	Bushnell 2 E	28.6664000	-82.0894000
P70	Canal Point Usda	26.8639000	-80.6256000
P71	Carrabelle 1 Nnw	29.8667000	-84.6333000
P72	Caryville	30.7667000	-85.8167000
P73	Cedar Key 1 Wsw	29.1333000	-83.0500000
P74	Chipley	30.7836000	-85.4847000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
P75	Bithlo	28.5500000	-81.1000000
P76	Clearwater	27.9667000	-82.7667000
P77	Clermont 9 S	28.4553000	-81.7233000
P78	Compass Lake	30.6000000	-85.4000000
P79	Coral Springs	26.2678000	-80.2750000
P80	Crescent City	29.4292000	-81.5158000
P81	Crestview Bob Skies Ap	30.7797000	-86.5225000
P82	Cross City 1 E	29.6333000	-83.1053000
P83	Daytona Beach	29.1894000	-81.0139000
P84	Daytona Beach Intl Ap	29.1828000	-81.0483000
P85	De Funiak Springs 1 E	30.7244000	-86.0939000
P86	Deland 1 Sse	29.0181000	-81.3106000
P87	Desoto City 8 Sw	27.3697000	-81.5136000
P88	Devils Garden	26.6033000	-81.1292000
P89	Dry Tortugas	24.6281000	-82.8736000
P90	Everglades	25.8489000	-81.3897000
P91	Federal Point	29.7550000	-81.5389000
P92	Fernandina Beach	30.6589000	-81.4636000
P93	Flamingo Rs	25.1422000	-80.9144000
P94	Ft Drum 3 Nw	27.5303000	-80.8167000
P95	Ft Green 12 Wsw	27.5706000	-82.1378000
P96	Ft Lauderdale	26.1019000	-80.2011000
P97	Ft Myers Page Fld Ap	26.5850000	-81.8614000
P98	Ft Pierce	27.4622000	-80.3539000
P99	Gainesville 3 Wsw	29.6333000	-82.3667000
P100	Gainesville Rgnl Ap	29.6919000	-82.2756000
P101	Glen St Mary 1 W	30.2717000	-82.1856000
P102	Hart Lake	28.3833000	-81.1833000
P103	Hastings 4 Ne	29.7517000	-81.4669000
P104	Hialeah	25.8175000	-80.2858000
P105	High Springs	29.8286000	-82.5972000
P106	Hilliard	30.7000000	-81.9333000
P107	Hillsborough River Sp	28.1428000	-82.2269000
P108	Homestead Exp Stn	25.5000000	-80.5000000
P109	Hypoluxo	26.5500000	-80.0500000
P110	Immokalee	26.4217000	-81.4100000
P111	Indian Lake Estates	27.8000000	-81.3333000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
P112	Inverness 3 Se	28.8031000	-82.3125000
P113	Isleworth	28.4833000	-81.5333000
P114	Jacksonville Intl Ap	30.4950000	-81.6936000
P115	Jacksonville Beach	30.2875000	-81.3928000
P116	Jasper	30.5228000	-82.9447000
P117	Key West Intl Ap	24.5550000	-81.7522000
P118	Kissimmee 2	28.2764000	-81.4239000
P119	La Belle	26.7458000	-81.4264000
P120	Lake Alfred Exp Stn	28.1042000	-81.7144000
P121	Lake City 2 E	30.1853000	-82.5942000
P122	Lake Placid 2 Sw	27.2833000	-81.3833000
P123	Lisbon	28.8728000	-81.7844000
P124	Live Oak	30.2889000	-82.9650000
P125	Loxahatchee	26.6833000	-80.2667000
P126	Lynne	29.2003000	-81.9306000
P127	Madison	30.4517000	-83.4119000
P128	Marianna Sch For Boys	30.7667000	-85.2667000
P129	Marineland	29.6700000	-81.2150000
P130	Mayo	30.0564000	-83.1819000
P131	Melbourne Wfo	28.0958000	-80.6308000
P132	Merritt Island	28.3500000	-80.7000000
P133	Miami Beach	25.8064000	-80.1336000
P134	Miami Intl Ap	25.7906000	-80.3164000
P135	Miami Wso City	25.7167000	-80.2833000
P136	Miami 12 Ssw	25.6500000	-80.3000000
P137	Milton Exp Stn	30.7794000	-87.1414000
P138	Monticello 5 Se	30.4922000	-83.7833000
P139	Moore Haven Lock 1	26.8400000	-81.0872000
P140	Mtn Lake	27.9347000	-81.5928000
P141	Mt Pleasant 2 W	30.6667000	-84.7000000
P142	Myakka River Sp	30.6667000	-84.7000000
P143	Naples	26.1686000	-81.7158000
P144	New Smyrna Beach	29.0500000	-80.9500000
P145	Niceville	30.5316000	-86.4928000
P146	Oasis Rs	25.8581000	-81.0319000
P147	Ocala	29.0803000	-82.0778000
P148	Okeechobee	27.1508000	-80.8653000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
P149	Orange City	28.9333000	-81.3000000
P150	Orlando Intl Ap	28.4339000	-81.3250000
P151	Orlando Wso Ap	28.5500000	-81.3333000
P152	Ortona Lock 2	26.7897000	-81.3044000
P153	Palatka	29.6439000	-81.6606000
P154	Panacea 1 S	29.9989000	-84.4850000
P155	Panama City 5 N	30.2492000	-85.6606000
P156	Parrish	27.6089000	-82.3478000
P157	Pensacola Rgnl Ap	30.4781000	-87.1869000
P158	Perrine 4w	25.5819000	-80.4361000
P159	Perry	30.0986000	-83.5742000
P160	Plant City	28.0236000	-82.1422000
P161	Punta Gorda 4 Ese	26.9164000	-81.9983000
P162	Quincy 3 Ssw	30.6000000	-84.5500000
P163	Raiford State Prison	30.0678000	-82.1928000
P164	Royal Palm Ranger Sta	25.3867000	-80.5936000
P165	St Augustine Lh	29.8875000	-81.2917000
P166	Saint Leo	28.3378000	-82.2600000
P167	St Lucie New Lock 1	27.1167000	-80.2833000
P168	St Marks 5 Sse	30.1000000	-84.1667000
P169	St Petersburg	27.7631000	-82.6272000
P170	Sanford	28.8147000	-81.2778000
P171	Sarasota	27.3500000	-82.5333000
P172	Starke	29.9381000	-82.1164000
P173	Steinhatchee 6 Ene	29.7236000	-83.3061000
P174	Stuart	27.2000000	-80.1639000
P175	Tallahassee Wso Ap	30.3931000	-84.3533000
P176	Tamiami Trl 40 Mi Bend	25.7608000	-80.8242000
P177	Tampa Wscmo Ap	27.9614000	-82.5403000
P178	Tarpon Spgs Sewage Pl	28.1586000	-82.7644000
P179	Tavernier	25.0069000	-80.5211000
P180	Titusville	28.6242000	-80.8158000
P181	Usher Twr	29.4083000	-82.8186000
P182	Venice	27.1006000	-82.4364000
P183	Venus	27.1350000	-81.3303000
P184	Vero Beach 4se	27.6528000	-80.4031000
P185	Wauchula	27.5478000	-81.7994000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
P186	Wausau	30.6333000	-85.5833000
P187	West Palm Intl Ap	26.6847000	-80.0994000
P188	Wewahitchka	30.1192000	-85.2042000
P189	Winter Haven	28.0153000	-81.7331000
P190	G56-R	26.3278000	-80.1308000
P191	G57-R	26.2311000	-80.1242000
P192	MIALCK+R	26.6819000	-80.8061000
P193	MRF102	26.3689000	-80.1539000
P194	MRF114	26.0603000	-80.2317000
P195	MRF117	25.8269000	-80.3442000
P196	MRF125C	26.7386000	-80.9344000
P197	MRF133	26.7489000	-80.6836000
P198	MRF137	26.8131000	-80.5636000
P199	MRF138	26.7839000	-80.5253000
P200	MRF159	27.4725000	-81.1439000
P201	MRF18	28.1403000	-81.3519000
P202	MRF183	26.7003000	-80.7161000
P203	MRF198	26.7897000	-80.9617000
P204	MRF206	26.6069000	-81.6497000
P205	MRF212	26.4239000	-80.1222000
P206	MRF213	26.4167000	-80.2039000
P207	MRF220	26.6844000	-80.3675000
P208	MRF250	26.7125000	-81.6297000
P209	MRF27	27.8031000	-81.1981000
P210	MRF300	26.7281000	-80.8533000
P211	MRF301	26.7150000	-80.0622000
P212	MRF32	27.6600000	-81.1342000
P213	MRF38	27.4014000	-81.1147000
P214	MRF39	27.3733000	-80.4506000
P215	MRF40	27.3325000	-80.4967000
P216	MRF50	27.0653000	-80.9778000
P217	MRF5005	26.4072000	-81.4164000
P218	MRF5006	26.5956000	-81.3353000
P219	MRF5010	26.1844000	-81.3464000
P220	MRF5022	26.9244000	-81.3139000
P221	MRF5029	27.6081000	-80.4314000
P222	MRF5034	27.2903000	-80.8269000

Rain Gage ID	Rain Gage Name	Latitude	Longitude
P223	MRF5053	27.4103000	-80.3369000
P224	MRF54	26.9044000	-80.3039000
P225	MRF57	26.8419000	-80.6022000
P226	MRF60	26.8083000	-81.0467000
P227	MRF63	26.7350000	-80.8953000
P228	MRF65	26.7744000	-80.6175000
P229	MRF73C	26.6650000	-80.7011000
P230	MRF78	26.6189000	-80.1264000
P231	MRF80	26.6244000	-80.9483000
P232	MRF81	26.6122000	-80.2050000
P233	MRF84	26.5208000	-80.1239000
P234	MRF85	26.5283000	-80.1703000
P235	S133-R	27.2061000	-80.8008000
P236	S65E+R	27.2253000	-80.9625000
P237	S-157	27.8304000	-80.5397000
P238	S-164	28.3406000	-80.9333000
P239	S-252D	27.6389000	-80.6789000
P240	Black Ck Middleburg	30.0602000	-81.8488000
P241	Lk Joanna	28.8345000	-81.6460000
P242	Kenansville	27.9630000	-81.0500000

Table 28a. 60-Day Rain Gage Names and coordinates (Q1-Q34)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q1	3A-36+R	26.1915000	-80.4492000
Q2	3ANW+R	26.2665000	-80.7795000
Q3	3AS+R	26.0821000	-80.6915000
Q4	3ASW+R	25.9898000	-80.8362000
Q5	ALICO+R	26.5128000	-80.9819000
Q6	AVONPK+R	27.6317000	-81.2647000
Q7	BLUEG+R	27.2197000	-80.4650000
Q8	COLGOV+R	26.1297000	-81.7625000
Q9	LOTELA+R	27.5914000	-81.4353000
Q10	LXWS+R	26.4989000	-80.2222000
Q11	MRF122	25.4700000	-80.3464000
Q12	MRF123	25.3669000	-80.3764000
Q13	MRF155	27.7528000	-81.0772000
Q14	MRF187	27.4386000	-81.2064000
Q15	MRF191	27.7458000	-81.2453000
Q16	MRF205	28.0994000	-81.5286000
Q17	MRF23	28.0017000	-81.1936000
Q18	S131+R	26.9792000	-81.0900000
Q19	S18C-R	25.3306000	-80.5250000
Q20	S332-R	25.4217000	-80.5897000
Q21	S65DW+R	27.3142000	-81.0219000
Q22	S70+R	27.1186000	-81.1572000
Q23	SIRG+R	26.9072000	-80.1917000
Q24	SNIVLY+R	27.9717000	-81.4175000
Q25	TAFT+R	28.4361000	-81.3714000
Q26	HERRON STEEL SITE SILVER	30.4383000	-84.4111000
Q27	CHRISTIAN HERITAGE CHURCH	30.5053000	-84.3308000
Q28	LAKE JACKSON FACILITY	30.4833000	-84.2992000
Q29	TUCK PROPERTY N. CENTERV	30.5592000	-84.1500000
Q30	CITY WELL AT LIMOGES DR.	30.4844000	-84.1956000
Q31	LEON COUNTY LANDFIL US	30.4203000	-84.1347000
Q32	LAKE KANTURK OUTFALL AT CE	30.5272000	-84.1917000
Q33	SAN LUIS CITY PARK	30.4586000	-84.3211000
Q34	CHOWKEEBIN NENE NEAR MAGN	30.4331000	-84.2608000

Table 28b. 60-Day Rain Gage Names and coordinates (Q35-Q68)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q35	WEMBLEY WAY EASTGATE NEI	30.4931000	-84.2392000
Q36	S36-R	26.1734000	-80.1784000
Q37	BLACKMAN	30.9833000	-86.6500000
Q38	BOCA RATON	26.3675000	-80.1108000
Q39	BRANFORD	29.9625000	-82.9108000
Q40	BROOKSVILLE 7 SSW	28.4811000	-82.4353000
Q41	DOWLING PARK 1 W	30.2497000	-83.2594000
Q42	FT LAUDERDALE INTL AP	26.0719000	-80.1536000
Q43	GRACEVILLE 1 SW	30.9575000	-85.5331000
Q44	INGLIS 3 SW	29.0253000	-82.6158000
Q45	LAKELAND	28.0206000	-81.9219000
Q46	LIGNUMVITAE KEY	24.9027000	-80.6960000
Q47	MONTICELLO 10 SW	30.4406000	-83.9858000
Q48	NORTH NEW RVR CANAL 1	26.5667000	-80.7500000
Q49	NORTH NEW RVR CANAL 2	26.3336000	-80.5372000
Q50	PENNSUCO 5 WNW	25.9297000	-80.4539000
Q51	PORT MAYACA S L CANAL	26.9833000	-80.6167000
Q52	TRAIL GLADE RANGES	25.7647000	-80.4775000
Q53	WOODRUFF DAM	30.7219000	-84.8742000
Q54	MILES CITY	26.2483000	-81.2967000
Q55	OCHOPEE	25.9167000	-81.2833000
Q56	APALACHICOLA AP	29.7258000	-85.0206000
Q57	ARCADIA	27.2181000	-81.8739000
Q58	ARCHBOLD BIO STN	27.1819000	-81.3508000
Q59	AVON PARK 2	27.5944000	-81.5253000
Q60	BABSON PARK 1 ENE	27.8500000	-81.5167000
Q61	BARTOW	27.8986000	-81.8433000
Q62	BASINGER	27.3833000	-81.0333000
Q63	BELLE GLADE	26.6928000	-80.6711000
Q64	BIG CORKSCREW	26.3650000	-81.5478000
Q65	BLOUNTSTOWN 2 SE	30.4500000	-85.0500000
Q66	BRADENTON 5 ESE	27.4467000	-82.5014000
Q67	BRISTOL	30.4181000	-84.9861000
Q68	BROOKSVILLE CHIN HILL	28.6164000	-82.3658000

Table 28c. 60-Day Rain Gage Names and coordinates (Q69-Q102)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q69	BUSHNELL 2 E	28.6664000	-82.0894000
Q70	CANAL POINT USDA	26.8639000	-80.6256000
Q71	CARRABELLE 1 NNW	29.8667000	-84.6333000
Q72	CARYVILLE	30.7667000	-85.8167000
Q73	CEDAR KEY 1 WSW	29.1333000	-83.0500000
Q74	CHIPLEY	30.7836000	-85.4847000
Q75	BITHLO	28.5500000	-81.1000000
Q76	CLEARWATER	27.9667000	-82.7667000
Q77	CLERMONT 9 S	28.4553000	-81.7233000
Q78	COMPASS LAKE	30.6000000	-85.4000000
Q79	CORAL SPRINGS	26.2678000	-80.2750000
Q80	CRESCENT CITY	29.4292000	-81.5158000
Q81	CRESTVIEW BOB SKIES AP	30.7797000	-86.5225000
Q82	CROSS CITY 1 E	29.6333000	-83.1053000
Q83	DAYTONA BEACH	29.1894000	-81.0139000
Q84	DAYTONA BEACH INTL AP	29.1828000	-81.0483000
Q85	DE FUNIAK SPRINGS 1 E	30.7244000	-86.0939000
Q86	DELAND 1 SSE	29.0181000	-81.3106000
Q87	DESOTO CITY 8 SW	27.3697000	-81.5136000
Q88	DEVILS GARDEN	26.6033000	-81.1292000
Q89	DRY TORTUGAS	24.6281000	-82.8736000
Q90	EVERGLADES	25.8489000	-81.3897000
Q91	FEDERAL POINT	29.7550000	-81.5389000
Q92	FERNANDINA BEACH	30.6589000	-81.4636000
Q93	FLAMINGO RS	25.1422000	-80.9144000
Q94	FT DRUM 3 NW	27.5303000	-80.8167000
Q95	FT GREEN 12 WSW	27.5706000	-82.1378000
Q96	FT LAUDERDALE	26.1019000	-80.2011000
Q97	FT MYERS PAGE FLD AP	26.5850000	-81.8614000
Q98	FT PIERCE	27.4622000	-80.3539000
Q99	GAINESVILLE 3 WSW	29.6333000	-82.3667000
Q100	GAINESVILLE RGNL AP	29.6919000	-82.2756000
Q101	GLEN ST MARY 1 W	30.2717000	-82.1856000
Q102	HART LAKE	28.3833000	-81.1833000

Table 28d. 60-Day Rain Gage Names and coordinates (Q103-Q137)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q103	HASTINGS 4 NE	29.7517000	-81.4669000
Q104	HIALEAH	25.8175000	-80.2858000
Q105	HIGH SPRINGS	29.8286000	-82.5972000
Q106	HILLIARD	30.7000000	-81.9333000
Q107	HILLSBOROUGH RIVER SP	28.1428000	-82.2269000
Q108	HOMESTEAD EXP STN	25.5000000	-80.5000000
Q109	HYPOLUXO	26.5500000	-80.0500000
Q110	IMMOKALEE	26.4217000	-81.4100000
Q111	INDIAN LAKE ESTATES	27.8000000	-81.3333000
Q112	INVERNESS 3 SE	28.8031000	-82.3125000
Q113	ISLEWORTH	28.4833000	-81.5333000
Q114	JACKSONVILLE INTL AP	30.4950000	-81.6936000
Q115	JACKSONVILLE BEACH	30.2875000	-81.3928000
Q116	JASPER	30.5228000	-82.9447000
Q117	KEY WEST INTL AP	24.5550000	-81.7522000
Q118	KISSIMMEE 2	28.2764000	-81.4239000
Q119	LA BELLE	26.7458000	-81.4264000
Q120	LAKE ALFRED EXP STN	28.1042000	-81.7144000
Q121	LAKE CITY 2 E	30.1853000	-82.5942000
Q122	LAKE PLACID 2 SW	27.2833000	-81.3833000
Q123	LISBON	28.8728000	-81.7844000
Q124	LIVE OAK	30.2889000	-82.9650000
Q125	LOXAHATCHEE	26.6833000	-80.2667000
Q126	LYNNE	29.2003000	-81.9306000
Q127	MADISON	30.4517000	-83.4119000
Q128	MARIANNA SCH FOR BOYS	30.7667000	-85.2667000
Q129	MARINELAND	29.6700000	-81.2150000
Q130	MAYO	30.0564000	-83.1819000
Q131	MELBOURNE WFO	28.0958000	-80.6308000
Q132	MERRITT ISLAND	28.3500000	-80.7000000
Q133	MIAMI BEACH	25.8064000	-80.1336000
Q134	MIAMI INTL AP	25.7906000	-80.3164000
Q135	MIAMI WSO CITY	25.7167000	-80.2833000
Q136	MIAMI 12 SSW	25.6500000	-80.3000000
Q137	MILTON EXP STN	30.7794000	-87.1414000

Table 28e. 60-Day Rain Gage Names and coordinates (Q138-Q172)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q138	MONTICELLO 5 SE	30.4922000	-83.7833000
Q139	MOORE HAVEN LOCK 1	26.8400000	-81.0872000
Q140	MTN LAKE	27.9347000	-81.5928000
Q141	MT PLEASANT 2 W	30.6667000	-84.7000000
Q142	MYAKKA RIVER SP	30.6667000	-84.7000000
Q143	NAPLES	26.1686000	-81.7158000
Q144	NEW SMYRNA BEACH	29.0500000	-80.9500000
Q145	NICEVILLE	30.5316000	-86.4928000
Q146	OASIS RS	25.8581000	-81.0319000
Q147	OCALA	29.0803000	-82.0778000
Q148	OKEECHOBEE	27.1508000	-80.8653000
Q149	ORANGE CITY	28.9333000	-81.3000000
Q150	ORLANDO INTL AP	28.4339000	-81.3250000
Q151	ORLANDO WSO AP	28.5500000	-81.3333000
Q152	ORTONA LOCK 2	26.7897000	-81.3044000
Q153	PALATKA	29.6439000	-81.6606000
Q154	PANACEA 1 S	29.9989000	-84.4850000
Q155	PANAMA CITY 5 N	30.2492000	-85.6606000
Q156	PARRISH	27.6089000	-82.3478000
Q157	PENSACOLA RGNL AP	30.4781000	-87.1869000
Q158	PERRINE 4W	25.5819000	-80.4361000
Q159	PERRY	30.0986000	-83.5742000
Q160	PLANT CITY	28.0236000	-82.1422000
Q161	PUNTA GORDA 4 ESE	26.9164000	-81.9983000
Q162	QUINCY 3 SSW	30.6000000	-84.5500000
Q163	RAIFORD STATE PRISON	30.0678000	-82.1928000
Q164	ROYAL PALM RANGER STA	25.3867000	-80.5936000
Q165	ST AUGUSTINE LH	29.8875000	-81.2917000
Q166	SAINT LEO	28.3378000	-82.2600000
Q167	ST LUCIE NEW LOCK 1	27.1167000	-80.2833000
Q168	ST MARKS 5 SSE	30.1000000	-84.1667000
Q169	ST PETERSBURG	27.7631000	-82.6272000
Q170	SANFORD	28.8147000	-81.2778000
Q171	SARASOTA	27.3500000	-82.5333000
Q172	STARKE	29.9381000	-82.1164000

Table 28f. 60-Day Rain Gage Names and coordinates (Q173-Q207)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q173	STEINHATCHEE 6 ENE	29.7236000	-83.3061000
Q174	STUART	27.2000000	-80.1639000
Q175	TALLAHASSEE WSO AP	30.3931000	-84.3533000
Q176	TAMIAMI TRL 40 MI BEND	25.7608000	-80.8242000
Q177	TAMPA WSCMO AP	27.9614000	-82.5403000
Q178	TARPON SPGS SEWAGE PL	28.1586000	-82.7644000
Q179	TAVERNIER	25.0069000	-80.5211000
Q180	TITUSVILLE	28.6242000	-80.8158000
Q181	USHER TWR	29.4083000	-82.8186000
Q182	VENICE	27.1006000	-82.4364000
Q183	VENUS	27.1350000	-81.3303000
Q184	VERO BEACH 4SE	27.6528000	-80.4031000
Q185	WAUCHULA	27.5478000	-81.7994000
Q186	WAUSAU	30.6333000	-85.5833000
Q187	WEST PALM INTL AP	26.6847000	-80.0994000
Q188	WEWAHITCHKA	30.1192000	-85.2042000
Q189	WINTER HAVEN	28.0153000	-81.7331000
Q190	G56-R	26.3278000	-80.1308000
Q191	G57-R	26.2311000	-80.1242000
Q192	MIALCK+R	26.6819000	-80.8061000
Q193	MRF102	26.3689000	-80.1539000
Q194	MRF114	26.0603000	-80.2317000
Q195	MRF117	25.8269000	-80.3442000
Q196	MRF125C	26.7386000	-80.9344000
Q197	MRF133	26.7489000	-80.6836000
Q198	MRF137	26.8131000	-80.5636000
Q199	MRF138	26.7839000	-80.5253000
Q200	MRF159	27.4725000	-81.1439000
Q201	MRF18	28.1403000	-81.3519000
Q202	MRF183	26.7003000	-80.7161000
Q203	MRF198	26.7897000	-80.9617000
Q204	MRF206	26.6069000	-81.6497000
Q205	MRF212	26.4239000	-80.1222000
Q206	MRF213	26.4167000	-80.2039000
Q207	MRF220	26.6844000	-80.3675000

Table 28g. 60-Day Rain Gage Names and coordinates (Q208-Q242)

Rain Gage ID	Rain Gage Name	Latitude	Longitude
Q208	MRF250	26.7125000	-81.6297000
Q209	MRF27	27.8031000	-81.1981000
Q210	MRF300	26.7281000	-80.8533000
Q211	MRF301	26.7150000	-80.0622000
Q212	MRF32	27.6600000	-81.1342000
Q213	MRF38	27.4014000	-81.1147000
Q214	MRF39	27.3733000	-80.4506000
Q215	MRF40	27.3325000	-80.4967000
Q216	MRF50	27.0653000	-80.9778000
Q217	MRF5005	26.4072000	-81.4164000
Q218	MRF5006	26.5956000	-81.3353000
Q219	MRF5010	26.1844000	-81.3464000
Q220	MRF5022	26.9244000	-81.3139000
Q221	MRF5029	27.6081000	-80.4314000
Q222	MRF5034	27.2903000	-80.8269000
Q223	MRF5053	27.4103000	-80.3369000
Q224	MRF54	26.9044000	-80.3039000
Q225	MRF57	26.8419000	-80.6022000
Q226	MRF60	26.8083000	-81.0467000
Q227	MRF63	26.7350000	-80.8953000
Q228	MRF65	26.7744000	-80.6175000
Q229	MRF73C	26.6650000	-80.7011000
Q230	MRF78	26.6189000	-80.1264000
Q231	MRF80	26.6244000	-80.9483000
Q232	MRF81	26.6122000	-80.2050000
Q233	MRF84	26.5208000	-80.1239000
Q234	MRF85	26.5283000	-80.1703000
Q235	S133-R	27.2061000	-80.8008000
Q236	S65E+R	27.2253000	-80.9625000
Q237	S-157	27.8304000	-80.5397000
Q238	S-164	28.3406000	-80.9333000
Q239	S-252D	27.6389000	-80.6789000
Q240	BLACK CK MIDDLEBURG	30.0602000	-81.8488000
Q241	LK JOANNA	28.8345000	-81.6460000
Q242	KENANSVILLE	27.9630000	-81.0500000

Appendix B. Rain Gage Location: Short Durations, Hourly, and Daily Period

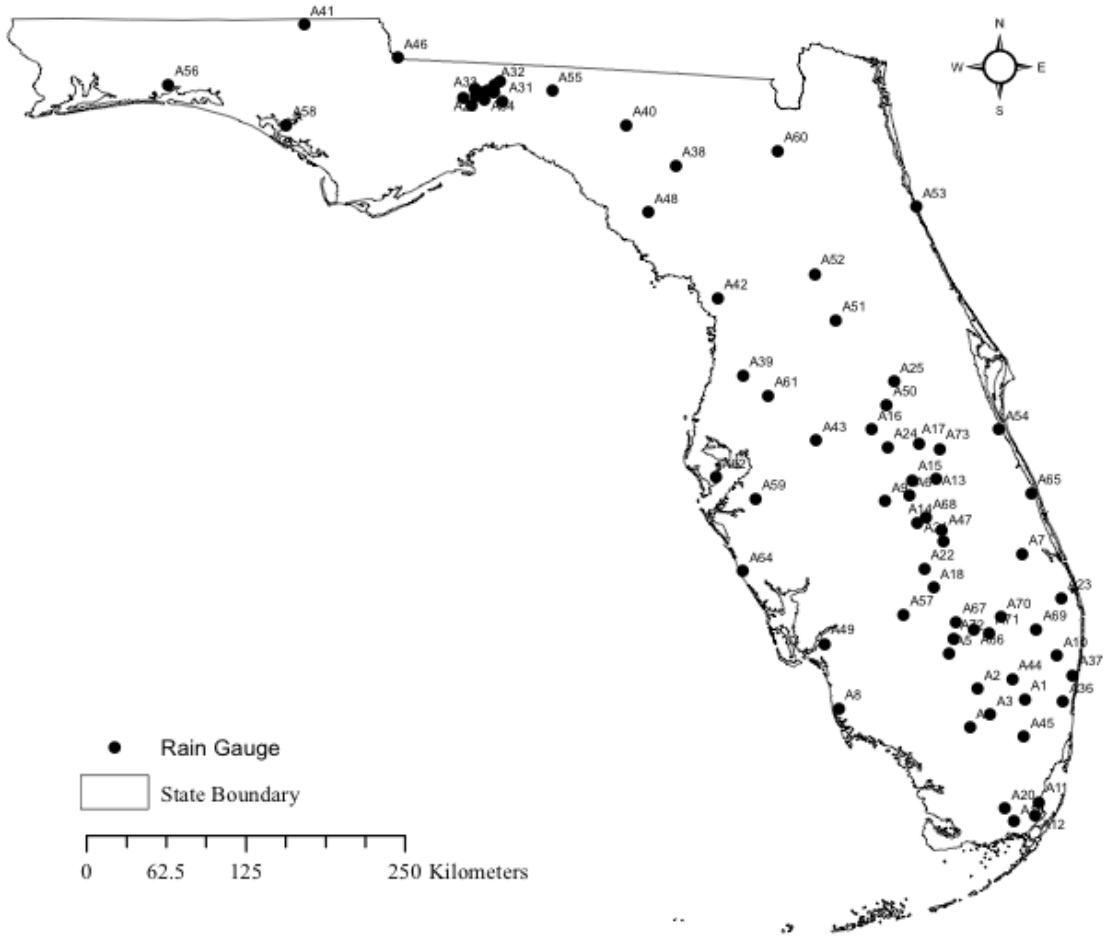


Figure 16 NOAA Rain Gage Used for 15-minute duration

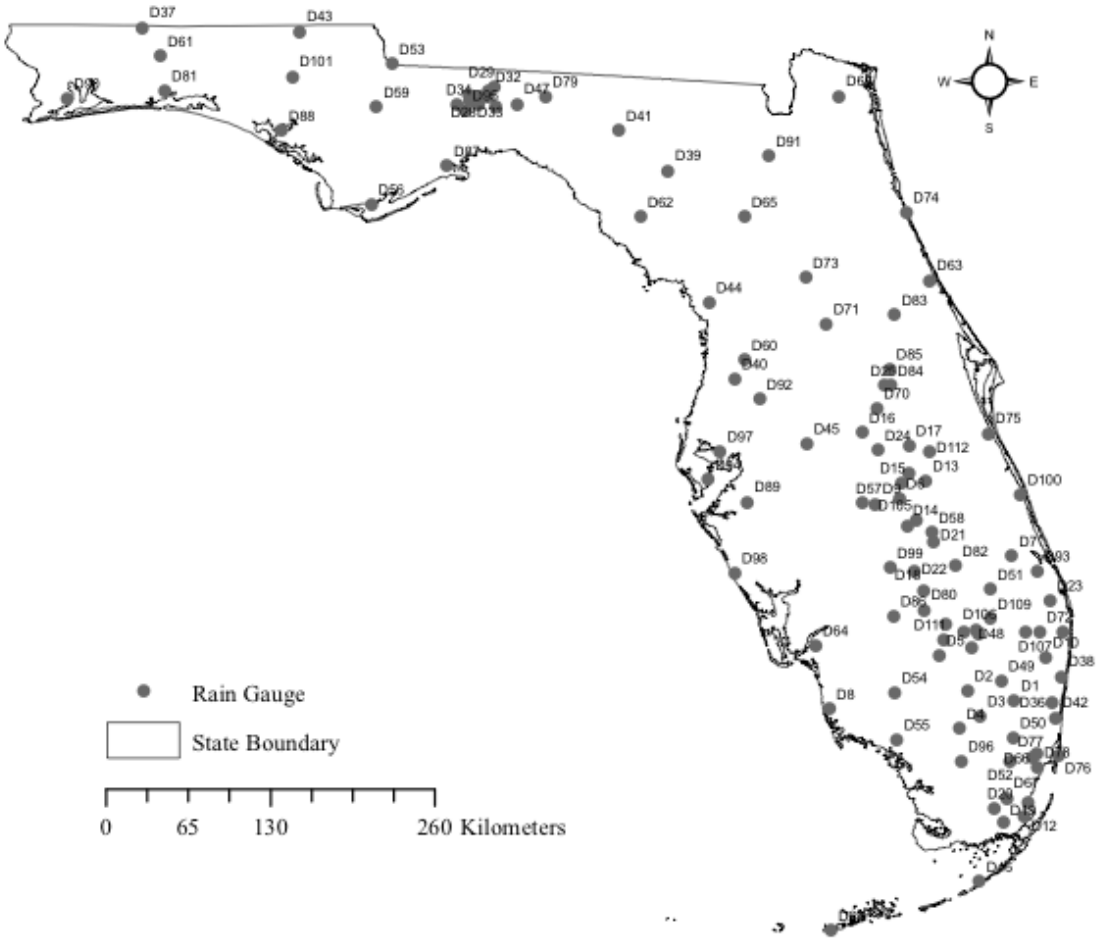


Figure 17 NOAA Rain Gage Used for 1-hour duration

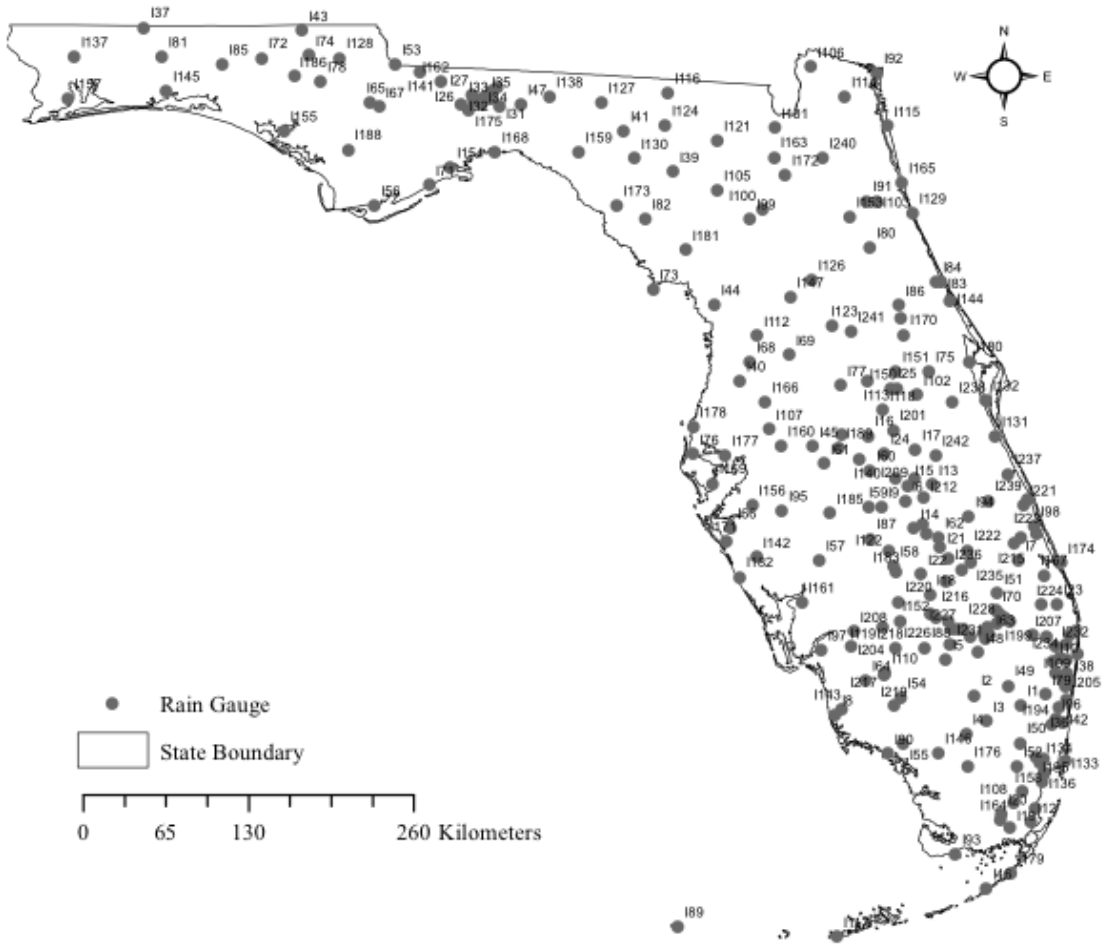


Figure 18 NOAA Rain Gage Used for 1-day duration

Appendix C. Statistical Trend Analysis Figures – Spearman Rho vs. Mann-Kendall (SPRM vs. MK)

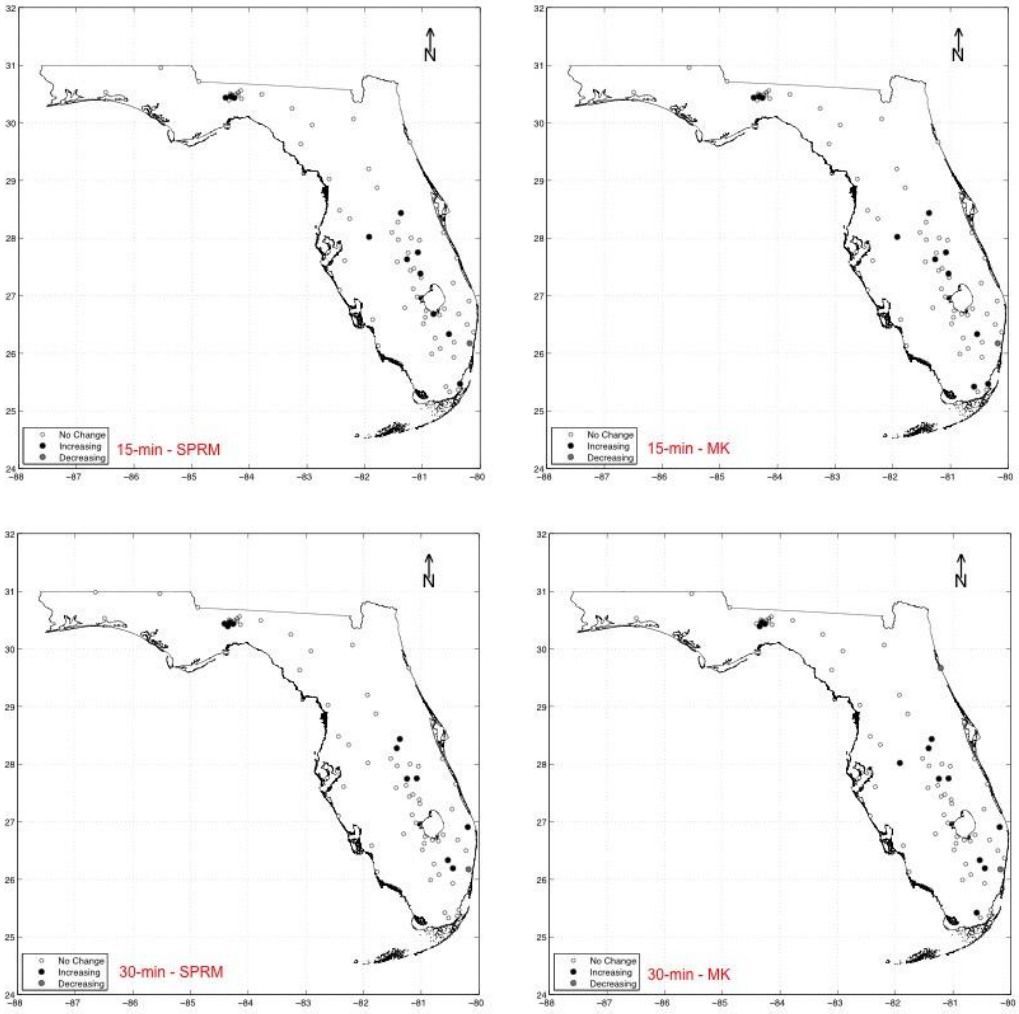


Figure 19. 15-min and 30-min Trend Analysis Figures - SPRM vs. MK

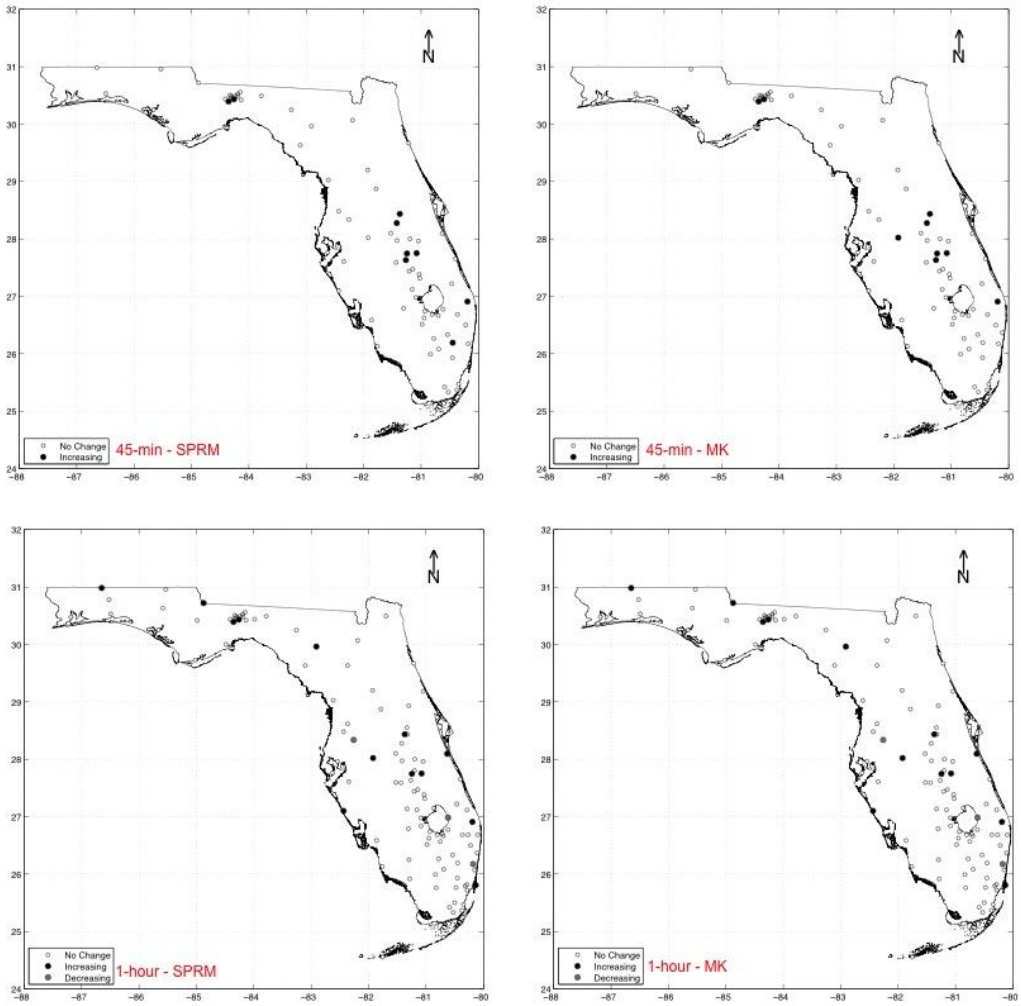


Figure 20. 45-min and 1-hour Trend Analysis Figures - SPRM vs. MK

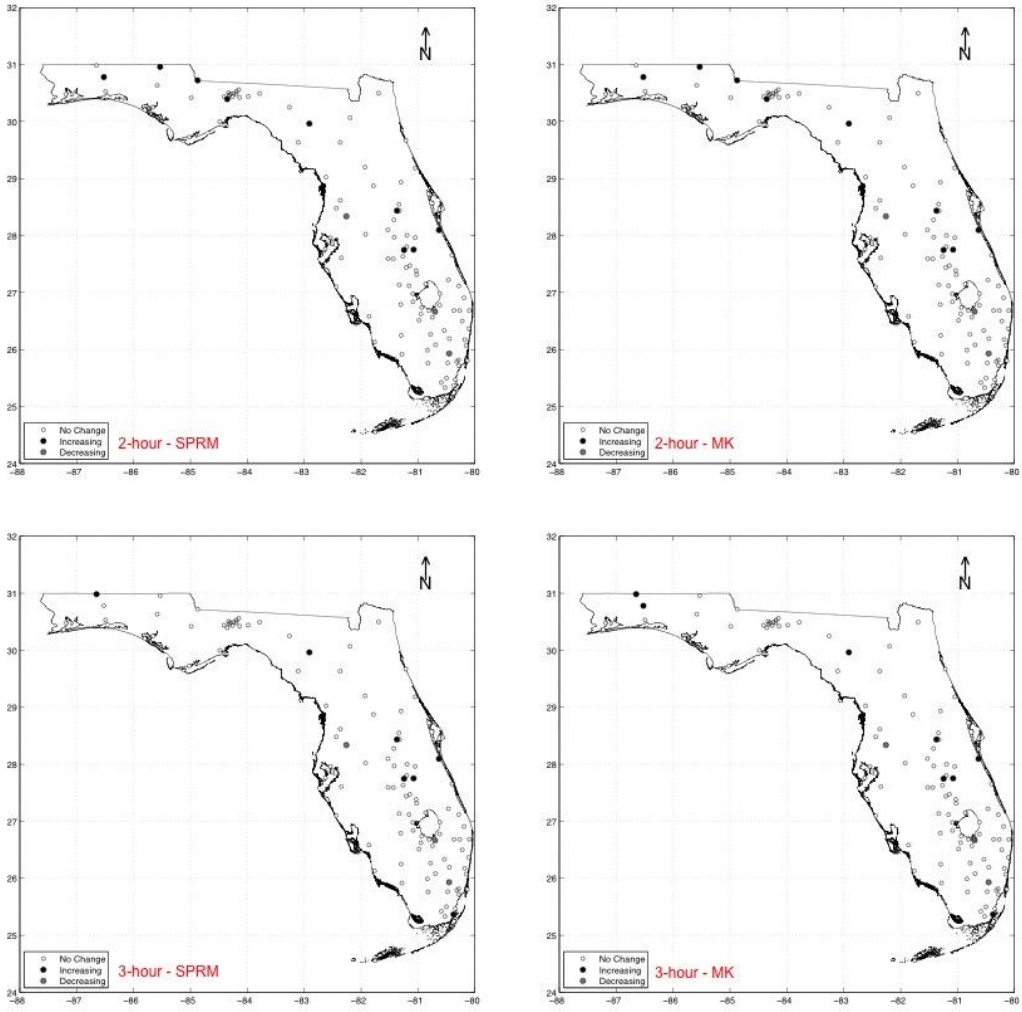


Figure 21. 2-hour and 3-hour Trend Analysis Figures - SPRM vs. MK

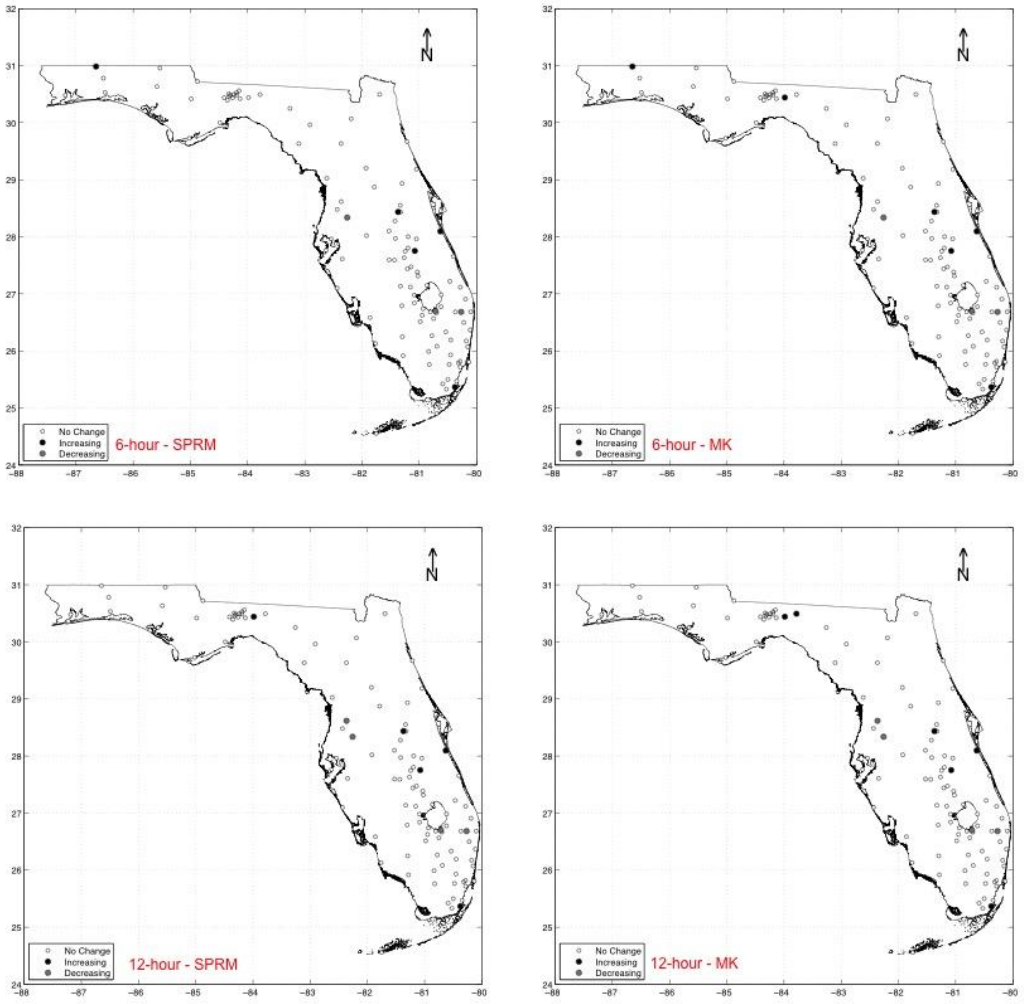


Figure 22. 6-hour and 12-hour Trend Analysis Figures - SPRM vs. MK

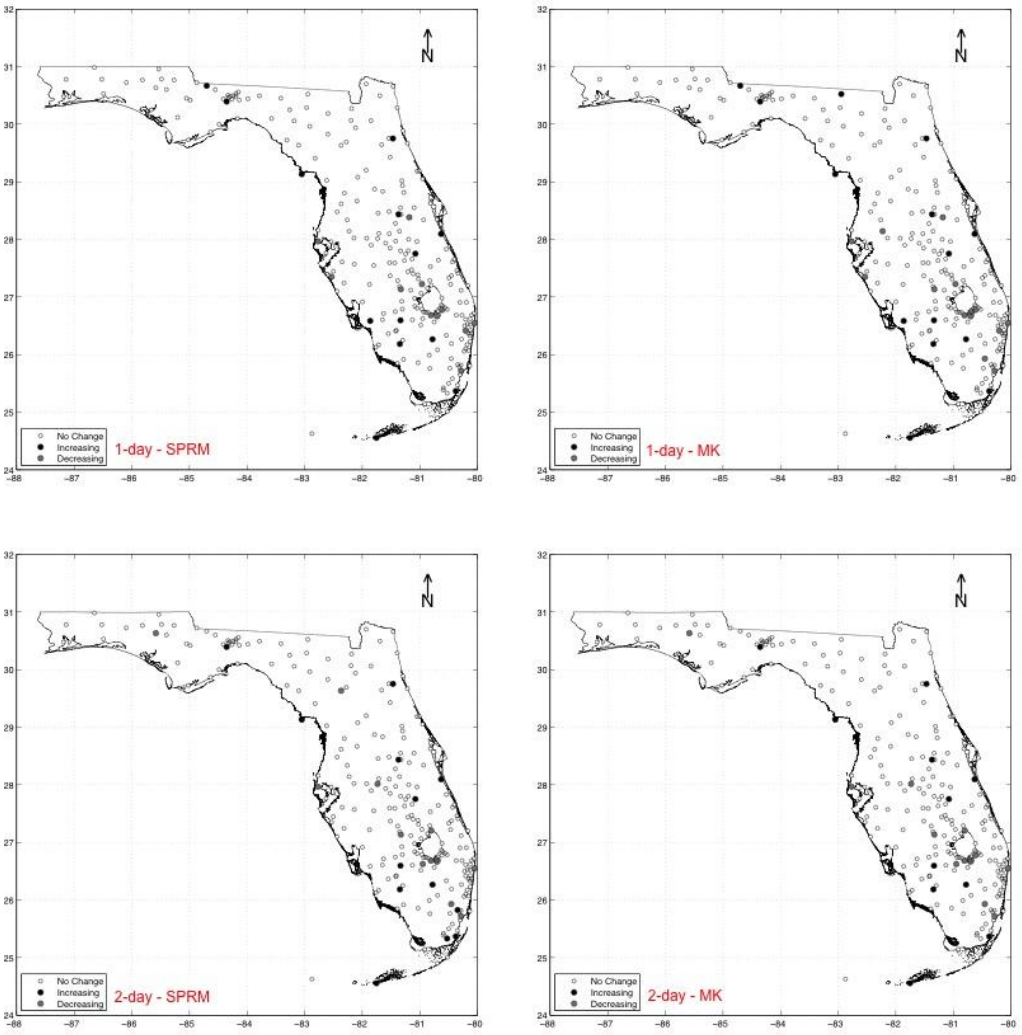


Figure 23. 1-day and 2-day Trend Analysis Figures - SPRM vs. MK

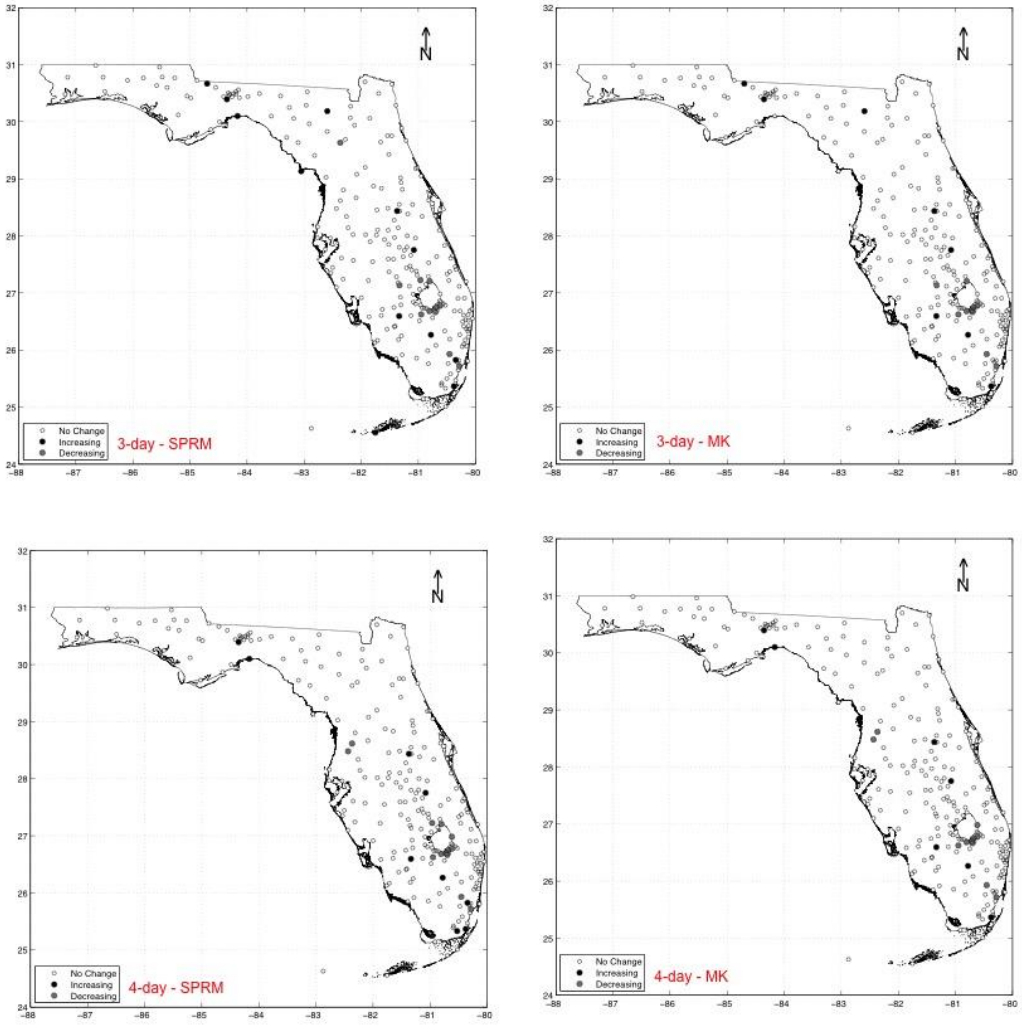


Figure 24. 3-day and 4-day Trend Analysis Figures - SPRM vs. MK

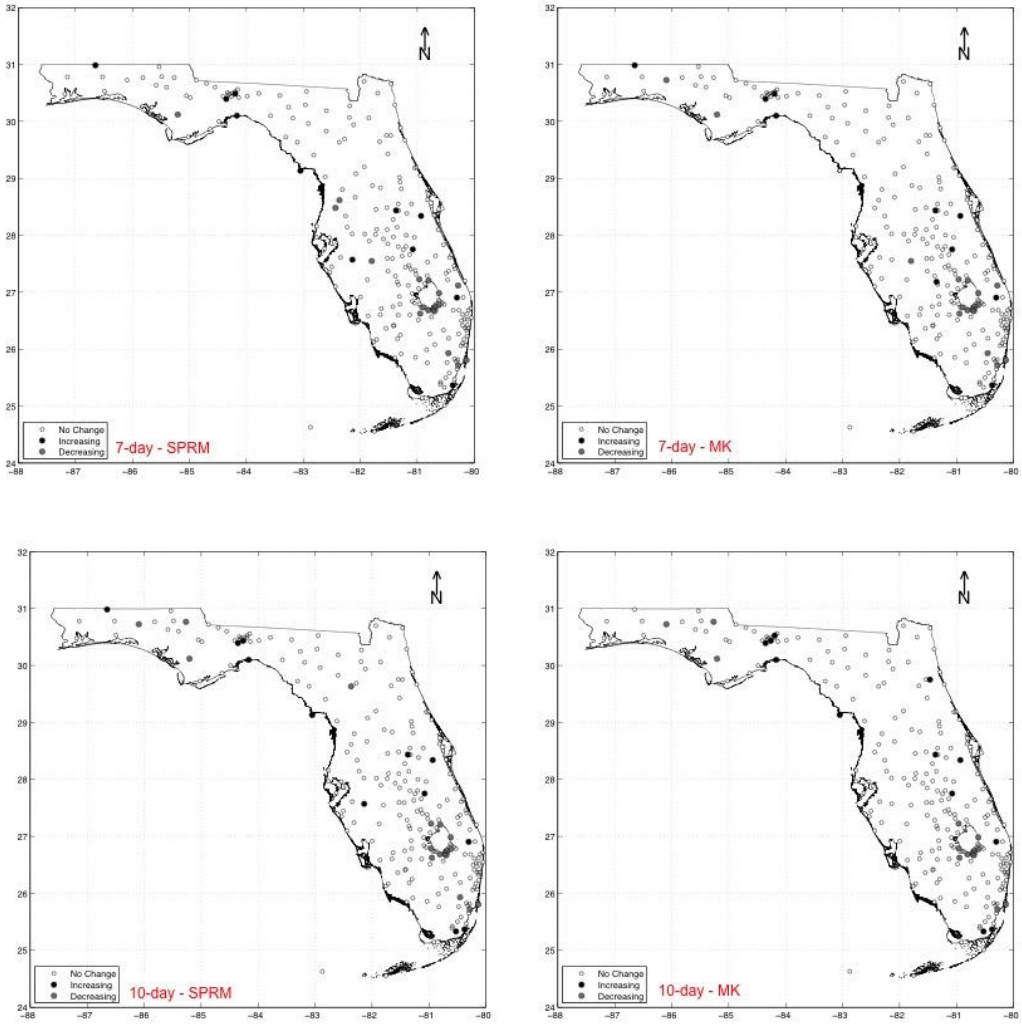


Figure 25. 7-day and 10-day Trend Analysis Figures - SPRM vs. MK

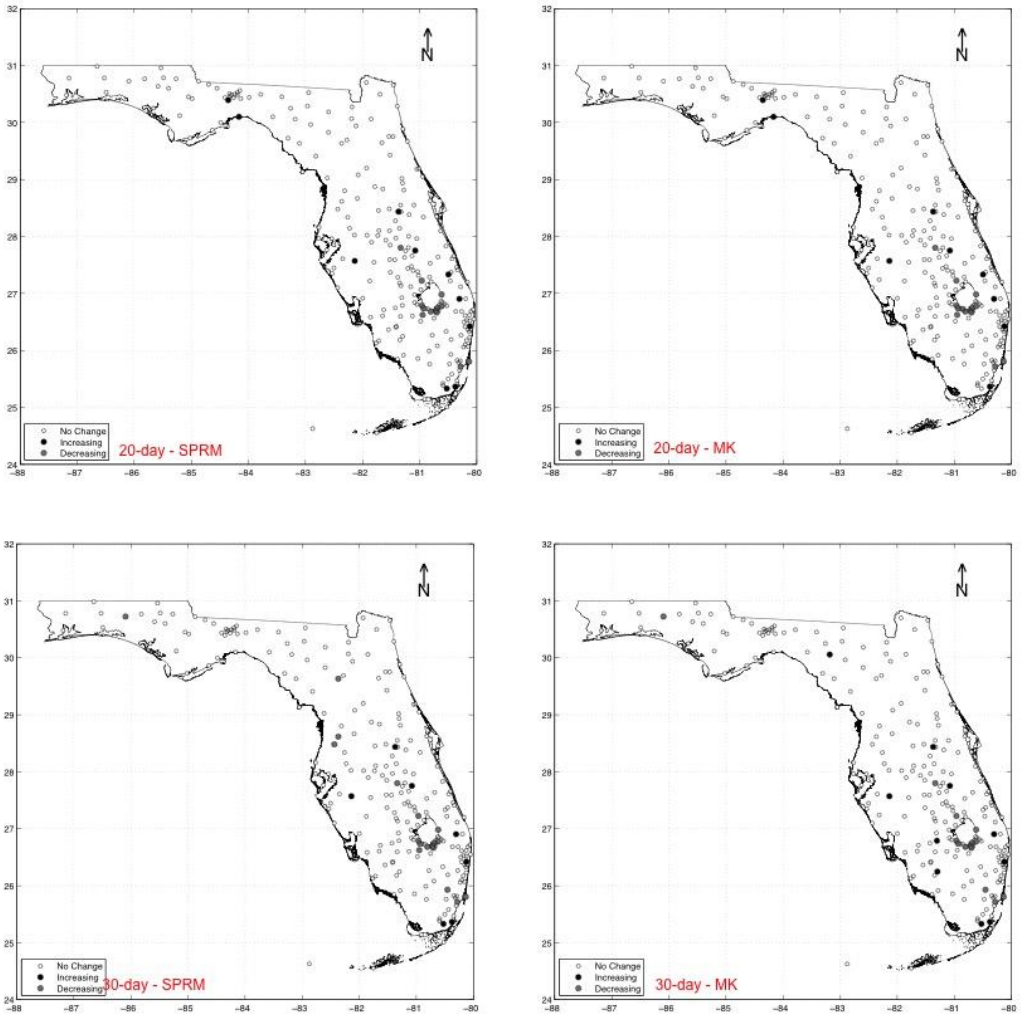


Figure 26. 20-day and 30-day Trend Analysis Figures - SPRM vs. MK

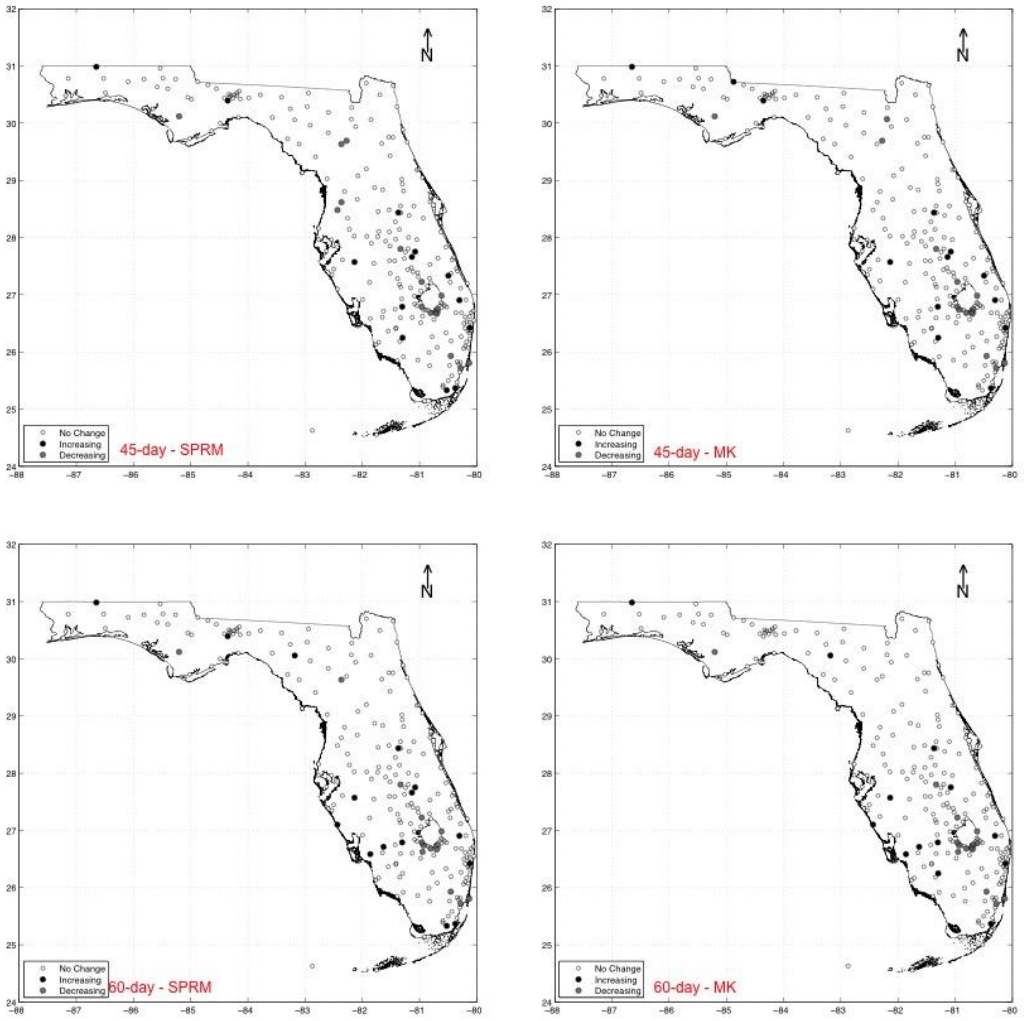


Figure 27. 45-day and 60-day Trend Analysis Figures - SPRM vs. MK

8 REFERENCES

Scafetta, N. "Empirical evidence for a celestial origin of the climate oscillations and its complications" (PDF). *Journal of Atmospheric and Solar-Terrestrial Physics* **72**: 951–970. May 2010.

Harper, Harvey H., and David M. Baker. "Evaluation of Current Stormwater Design Criteria Within the State of Florida." June 2007.

Haddad K, Rahman A. “Derivation of short-duration design rainfalls using daily rainfall statistics”. July 2, 2013.

Hanson, C. “Short-Duration-Rainfall Intensity Equations for Drainage Design”. *Journal of Irrigation and Drainage Engineering*, P219, April 10, 2012.

Pazwash, H. “Urban stormwater management”. P45. 2011.

McDonald, John H. “Handbook of Biology Statistic”. *Spearman Rank Correlation.* July 20, 2015.

Prokhorov, A.V. "Kendall coefficient of rank correlation", in Hazewinkel, Michiel,*Encyclopedia of Mathematics*, Springer, ISBN 978-1-55608-010-4. 2001

Abdi, H. "Kendall rank correlation" (PDF). In Salkind, N.J. *Encyclopedia of Measurement and Statistics.* 2007.

Durkee, J.D. , Frye, J.D., Fuhrmann, C.M., Lacke, M.C., Jeong, H.G.,Mote, T.L. "Effects of the North Atlantic Oscillation on precipitation-type frequency and distribution in the eastern United States." Department of Geography,Climatology Research Laboratory, University of Georgia, 2007.

Milla P. “Influences of Decadal and Multidecadal Oscillation on Regional Precipitation Extremes and Characteristics“. December 2013.

Westra, S; Fowler, HJ; Evans, JP; Alexander, LV; Berg, P; Johnson, F; Kendon, EJ; Lenderink, G; Roberts NM. “Future changes to the intensity and frequency of short-duration extreme rainfall”. “Reviews of Geophysics” September 2014. P222– P255.

H. B. Mann, “Nonparametric tests against trend,” Econometrica, vol. 13, pp. 245–259, 1945.

M. G. Kendall, *Rank Correlation Methods*, Griffin, London, UK, 1975. Hanna, A.J.. "Florida, Straits of." Dictionary of American History. 2003. Encyclopedia.com. 15 Nov. 201 <http://www.encyclopedia.com>.

Johnson, R. Florida, the Sunshine State *Welcome to America*. Retrieved October 16, 2008.

"Elevations and Distances in the United States". U.S Geological Survey. 29 April 2005. Retrieved 2006-11-03.

E. L. Lehmann, *Non-parametrics, Statistical Methods Based on Ranks*, Holden-Day, San Francisco, Calif, USA, 1975.

R.Sneyers,“On the statistical analysis of series of observations,” Technical Note 143, WMO no. 415, World Meteorological Organization, 1990.

S. Yue, P. Pilon, and G. Cavadias, “Power of the Mann-Kendall and Spearman’s rho tests for detecting monotonic trends in hydrological series,” *Journal of Hydrology*, vol. 259, no. 1–4, pp. 254–271, 2002.

I. Ahmad, Deshan Tang, Bakhtawar Wagan "Precipitation Trends over Time Using Mann-Kendall and Spearman's rho Tests in Swat River Basin, Pakistan" Received 14 October 2014.

E. R. Dahmen and M. J. Hall, *Screening of Hydrological Data: Tests for Stationarity and Relative Consistency*, Publication #49, ILRI, Wageningen, The Netherlands, 1990.

H. B. Mann, "Nonparametric tests against trend," *Econometrica*, vol. 13, pp. 245–259, 1945.

National Centers for Environmental Information (NCEI) - ttps://www.ncdc.noaa.gov/cdo-web/. 2015

Gittinger, M. *Impact of El Niño and AMO on Florida rainfall patterns and the NOAA 2014-2015 Dry Season Outlook.*. 2015.

Kerr, R. A., A North Atlantic climate pacemaker for the centuries, Science, 288 (5473), 1984-1986, 2000.

Enfield, D., Mestas-Nunez, A., & Trimble, P. (2001). The Atlantic Multidecadal Oscillation and its relation to rainfall and river flows in the continental U.S. Geophysical Research Letters, 28(10), 2077-2080.

Rurroughs, W. J. "Climate Change A Multidisciplinary Approach*";* Second Edition. Cambridge, UK: Cambridge University Press. P 71. 2009.

Henson, R. "The Thinking Person's Guide To Climate Change*"*. *American Meteorological Society*. Boston, MA:, 2014.

Koch-Rose, M.,Berry, L., Bloetscher, F., Hernández Hammer, N., Mitsova-Boneva, D., Restrepo, J., Root, T., Teegavarapu, R.,. "Florida Water Management and Adaptation in the Face of Climate Change." *Florida Climate Change Task Force*, 2011.

Jeff R. Knight, J.R., C. K. Folland, and A. A. "Scaife.Climate impacts of the Atlantic Multidecadal Oscillation". May 12, 2006.

Jan N. El Niño and La Niña Years and Intensities. *Based on Oceanic Niño Index (ONI).* Updated May 5, 2016.

L'Heureux, "EL Niño: Fizzle or Sizzle?" Michelle; August 13, 2014.

Wolter, K., and M. S. Timlin, 2011: "El Niño/Southern Oscillation behaviour since 1871 as diagnosed in an extended multivariate ENSO index". *Intl. J. Climatology*, **31**, 14pp., 1074-1087.

Climate Prediction Center/NCEP/NOAA (PDF). ENSO: Recent Evolution Current Status and Predictions.

Pavel Kindlmann, A.F.G. Dixon, J.P. Michaud. Aphid Biodiversity Under Environmental Change*: Patterns and Processes.* Dordrecht; New York: Springer, 2010.

Caviedes, César, and Inc Net Library. "El Niño in History: Storming Through the Age"*s*. Gainesville, FL: University Press of Florida, 2001.

Linsley, Ray K.; Kohler, Max A.; Paulhus, Joseph L.H. Hydrology for Engineers. McGraw-Hill, 1982.

Quin, Nianxiu; Wang, Junneng; Yang, Guishan; Chen, Xi; Liang, Haoyuan; Zhang, Jianbin. “Spatial and Temporal Variations of Extreme Precipitation and Temperature Events for the Southwest China in 1960-2009”. February 2015.

Stowers, D; Levasseur, Michael. “The Tampa Bay Storm of May, 1979.” November 1980.

Null, Jean; “EL Niño and La Niña Years and Intensities”. December 4, 2015.

Qin, Ning; Zhoa, Ning; Wang, Nibing; “Fast Dynamic Meshing Method Based on Delaynay Graph and Inverse Distance Weighting Average”. 2016.

Bobsein, Jenna; “Streamflow extremes and Climate Variability in Southeastern United States.” May 2015.

Wolter, K; Trimlin, M. S.: “El Niño/Southern Oscillation behavior sine 1871 as diagnosed in an extended multivariate ENSO index (MEI).” *Intl. J. Climatology.* 2011