Trend Analysis of Seasonal Rainfall in Southern West Bengal by Sen's Innovative Trend Analysis.

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Water Resources and Hydraulic Engineering

Submitted by

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I hereby declare that this thesis contains literature survey and original research work by the undersigned candidate, as part of my **Master of Engineering** in **Water Resources and Hydraulic Engineering** in the Faculty Council of Interdisciplinary Studies, Law & Management, Jadavpur University during academic session 2020-2022.

All information in this document have been obtained and presented in accordance with academic rules and ethical conduct.

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ABSTRACT

This study is formulated to access the trend pattern and behaviour of rainfall during Winter Season (Jan – Feb), Pre-Monsoon Season (March – May), Monsoon Season (June – September) and Post Monsoon Season (October – December) by Sen's Innovative Trend Analysis Methodology.

India's Economy is heavily dependent on agriculture. India ranks second worldwide in farm outputs. As per 2018 agriculture employed more than 50% of the Indian workforce and contributed 17-18 % to country's GDP.

It is very essential to have the knowledge of spatial and temporal distribution of rainfall for a variety of applications in Hydrology and Water Resources Management. Therefore, a study area in the southern region of West Bengal is selected and daily rainfall gridded data has been collected from Indian Meteorological Department. The daily data is sorted and arranged for every grid in each district (South 24 PGS, North 24 PGS, Purba Medinipur, Pashchim Medinipur, Jhargram, Bankura, Howrah, Hooghly, Purba Bardhaman, Pashchim Bardhaman, Birbhum, Murshidabad, Naida, Purulia) for monthly data and further arranged for seasonal data. Analysis for every grid point in each district has been carried out individually by Sen's Innovative Trend Analysis Method showing ITA plot for each grid and calculating statistical parameters, Slope and significance test for all four meteorological seasons. Output of the analysis is thoroughly discussed for each district in chapter 5, which when summarized gives the idea that for the past century, there is significant negative trend during Winter Season and Pre-Monsoon Season and significant positive trend during Monsoon Season and Post Monsoon Season. Negative trend during Winter Season and Pre-Monsoon Season indicates that there has been a gradual decrease in overall rainfall in these seasons and may continue to have a reduction in the amount of overall rainfall in those seasons, which further may introduce to lesser water availability and Drought like situations. Also, the positive trend on the other hand shows gradual increase in rainfall during Monsoon Season and Post Monsoon Season which further indicates increase in runoff of the catchment over the past century that may lead to flooding scenarios in the Southern West Bengal Region.

LIST OF ABBREVIATION

Acronyms	Elaboration
SP	South 24 Parganas
NP	North 24 Parganas
Pb_M	Purba Medinipur
Ps_M	Pashchim Medinipur
Jh	Jhargram
Bk	Bankura
Hw	Howrah
Hg	Hooghly
Pb_B	Purba Bardhaman
Ps_B	Pashchim Bardhaman
Br	Birbhum
Msh	Murshidabad
Na	Nadia
Pr	Purulia
ITA	Innovative Trend Analysis
IPCC	Intergovernmental Panel on Climate Change
IMD	Indian Meteorological Department

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Chapter 1

INTRODUCTION

1.1 Precipitation and its Importance:

Meteorologically, It may be defined as the product resulting from the condensation of water vapour that falls on the earth under the action of gravity from the clouds. The main forms of precipitation are rain, snow, hail, drizzle, sleet, ice pellets, hail and graupel. Rain and snow are the major forms of precipitation that contribute to the water resources particularly the freshwater resources of the earth. According to the statistical reports, approximately 505,000 km^3 of water falls as precipitation every year. It is an important part of the hydrological cycle of the earth and thereby is necessary for maintaining balance in the Earth. It is an essential part of the water cycle of the Earth. Thus, it is necessary for maintaining the natural balance. It is a major source of fresh water on Earth. Precipitation such as rainfall and its distribution forms a leading feature of the climate. It is necessary for regulating the global energy flow i.e. the movement of heat. The precipitation is one of the primary forms and components of water resources and the most critical water source for production and living. Affected by climate variability and anthropogenic activities, the river runoff of many rivers, seasonal and annual precipitation worldwide has undergone significant changes, seriously threatening the state of regional water resources.

1.2 Effect of Precipitation on Agriculture:

Precipitation, especially rain, has a dramatic effect on agriculture. All plants need at least some water to survive, therefore rain (being the most effective means of watering) is important to agriculture. While a regular rain pattern is usually vital to healthy plants, too much or too little rainfall can be harmful, even devastating to crops. Drought can kill crops and increase erosion, while overly wet weather can cause harmful fungus growth. Plants need varying amounts of rainfall to survive. For example, certain cacti require small amounts of water, while tropical plants may need up to hundreds of inches of rain per year to survive.

In areas with wet and dry seasons, soil nutrients diminish and erosion increases during the wet season. Animals have adaptation and survival strategies for the wetter regime. The previous dry season leads to food shortages into the wet season, as the crops have yet to mature. Developing countries have noted that their populations show seasonal weight fluctuations due to food shortages seen before the first harvest, which occurs late in the wet season.

1.3 Climate Change and its effect on Water Resources:

Information on the temporal and spatial distribution of rainfall is important for a variety of applications in hydrology and water resources management (Campling et al. 2001). Associated with global warming, changing rainfall patterns and their impact on surface water resources are important climatic problems facing society presently (Maragatham 2011).

Climate change affects regional water resources. Water resources are an essential foundation for society's sustainable development, the economy, and the ecological environment. As a unique geographic component, the mountain area is the birthplace of most rivers in arid regions. Almost all rivers originate in the mountainous regions. South Asia's water resources are mainly recharged by rainfall, melting ice and snow in the mountainous areas, making them more sensitive to climate change. Human activities have led to global environmental changes. Due to population growth and disproportional spatial distribution, developing industries, agricultural expansion, and increased urban construction, there is increased pressure on water and other natural resources because the anthropogenic demand for water is growing. Increase in emission greenhouse gases over the past few decades, has led the climate of the Earth to experience severe warming. This, in turn, is leading to extreme rainfall events of higher magnitude and frequency in recent times (IPCC, 2007 and IPCC, 2012; Rajeevan et al., 2008; Xu et al., 2015; Cavanaugh et al., 2015; Dong et al., 2017).

1.4 Climate Change in India and around the Globe:

India has many reasons to be concerned about climate change. Its large population depends upon climate-sensitive sectors such as agriculture and Forestry for its livelihood. By the mid-century, annual average river runoff and water availability are projected to increase by 10-40% at high latitudes and in some wet tropical areas and decrease by 10-30% over some dry regions at mid-latitudes and in the dry tropics, some of which are presently water-stressed areas.
Its impact on Indian monsoon can be observed as the number of dry days is increasing and the number of wet days has been decreasing. (Rani and Sreekesh, 2018; Yaduvanshi and Ranade, 2017; Mal et al., 2018).
Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases (very high confidence). Large-scale area average precipitation changes are more difficult to quantify than temperature changes because of the higher spatial variability of precipitation and because of data homogeneity problems, which are more difficult to overcome. A global assessment of data since 1970 has shown it is likely that anthropogenic warming has had a discernible influence on many physical and biological systems.

Evaluation of evidence on observed changes related to climate change is made difficult because the observed responses of systems and sectors are influenced by many other factors. In the Indian context, key factors that need to be borne in mind are:

- The impact of climatic change is likely to be most adversely felt in regions which presently use a high proportion of available water.
- Water supply systems, which are resilient under the current climate during adverse weather conditions, will be more able to meet changed climate conditions.
- Water resources whose physical properties are well under stood and whose exploitation is based on this understanding will be capable of being reorganized most rapidly to accommodate new conditions.
- One should avoid making unattainable demands on climate and hydrological modelers.

The effect of climate change is not limited to extreme climatic events like extreme temperatures, floods, and droughts across the globe. It has also affected the ecosystem processes, worldwide glacier recession, rising sea-level, changes of river regimes, erosion of soil, reduction of agricultural yield, food security, level of income, education, health facilities, etc. (Mal et al., 2018). Many researchers have drawn that climate change has effects on the glaciers leading to the formation of numerous high-altitude lakes in the Himalaya presenting the great threat to the low-lying areas (Bolch et al., 2012; Allen et al., 2002; Quincey et al., 2005; Huggel et al., 2002; Worn et al., 2013; Sattar et al., 2019a; Sattar et al., 2019b). Moreover, adverse effects of climate change is also evident in agriculture (Milanova et al., 2018; Schick et al., 2018), food security (Beer, 2017), vegetation (Zolotov et al., 2018), microclimate (Parveen and Sreekesh, 2018; Rani and Sreekesh, 2018; Sorokin and Mondello, 2018; Degórska and Degórski, 2018), sea-level rise (IPCC, 2012; Sorokin and Mondello, 2018), coastal flooding (Chen et al., 2017), river sedimentation (Ahmad and Das 2018), wildfires (IPCC, 2012), and flash floods (Christensen and Christensen, 2003). In addition, due to climate change, the human population is experiencing a huge loss of infrastructure, economy and natural environment (UNISDR, 2015a, b; Singh 2006; IPCC, 2012; Mukwada and Manatsa 2017). Studies reveal that developing countries are highly vulnerable to extreme events (Singh, 2001; UNISDR, 2015a, b; Yaduvanshi et al., 2015). Also, anthropogenic warming can cause the extreme rainfall events to increase primarily (O’gorman and Schneider, 2009; Sugiyama et al. 2010; Coumou and Rahmstorf, 2012; Mishra et al. 2012; IPCC 2007; Allan et al., 2014). The phenomena of atmospheric warming and higher moisture holding capability (Trenberth et al., 2005) is resulting an increase in the frequency and intensity of extreme rainfall events (Allen et al., 2002; Trenberth et al., 2003; Hennessy et al., 1997; Gordon et al., 1992; Meehl et al., 2000; Semenov et al., 2002;

Increasing temperatures tend to increase evaporation which leads to more precipitation. Precipitation has generally increased over land north of 30°N from 1900 to 2005 but has declined over the tropics since the 1970s. Globally there has been no statistically significant overall trend in precipitation over the past century, although trends have varied widely by region and over time.

Each region of the world is going to have changes in precipitation due to their unique conditions. Eastern portions of North and South America, northern Europe, and northern and central Asia have become wetter. The Sahel, the Mediterranean, southern Africa and parts of southern Asia have become drier. There has been an increase in the number of heavy precipitation events over many areas during the past century, as well as an increase since the 1970s in the prevalence of droughts—especially in the tropics and subtropics. Changes in precipitation and evaporation over the oceans are suggested by the decreased salinity of mid- and high-latitude waters (implying more precipitation), along with increased salinity in lower latitudes (implying less precipitation, more evaporation, or both). Over the contiguous United States, total annual precipitation increased at an average rate of 6.1% per century since 1900, with the greatest increases within the East North Central climate region (11.6% per century) and the South (11.1%). Hawaii was the only region to show a decrease (−9.25%).

Chapter 2

Objective of the Thesis:

Since global climate change is influencing the characteristics of extreme rainfall events especially in urban areas of developing countries it is imperative to understand this phenomenon using a longer time series of in-situ measured rainfall data. Therefore, the main objective of the present study is

- To collect the daily Rainfall Gridded data over the study area, arrange and sort the Grid points to their respective Districts.

- To calculate the Monthly Rainfall from the daily Rainfall data.

- To calculate the Seasonal Rainfall (**Winter** - January to February, **Pre-Monsoon** – March to May, **Monsoon** – June to September and **Post Monsoon** – October to December) from the monthly Rainfall data.

- To calculate the Slope of Innovative Trend Curve for each grid in every district.

- To understand the nature of trend of seasonal rainfall in the Southern West Bengal Region for the past century (1901–2014), by Sen's Innovative Trend Analysis Method as well as to predict a future trend of seasonal precipitation over the region.

Study Area:

West Bengal is a state in the eastern region of India along the Bay of Bengal. With over 91 million inhabitants, it is the Fourth Most Populous State and the thirteenth-largest state by area in India. Covering an area of 88,752 km^2 (34,267 sq. mi), it is also the eighth-most populous country subdivision of the world. Part of the Bengal region of the Indian subcontinent, it borders Bangladesh in the east, and Nepal and Bhutan in the north. It also borders the Indian states of Odisha, Jharkhand, Bihar, Sikkim and Assam. The state capital is Kolkata, the third-largest metropolis, and seventh largest city by population in India. West Bengal includes the Darjeeling Himalayan hill region, the Ganges delta, the Rarh region, the coastal Sundarbans and the Bay of Bengal.

West Bengal is on the eastern bottleneck of India, stretching from the Himalayas in the north to the Bay of Bengal in the south. The Darjeeling Himalayan hill region in the northern extreme of the state is a part of the eastern Himalayas Mountain range. In this region is Sandakfu, which, at 3,636 m (11,929 ft), is the highest peak in the state. The narrow Terai region separates the hills from the North Bengal plains, which in turn transitions into the Ganges delta towards the south. The Rarh region intervenes between the Ganges delta in the east and the western plateau and high lands. A small coastal region is in the extreme south, while the Sundarbans mangrove forests form a geographical landmark at the Ganges delta.

West Bengal's climate varies from tropical savanna in the southern portions to humid subtropical in the north. The main seasons are summer, the rainy season, a short autumn and winter. While the summer in the delta region is noted for excessive humidity, the western highlands experience a dry summer like northern India. The highest daytime temperatures range from 38 °C (100 °F) to 45 °C (113 °F). At night, a cool southerly breeze carries moisture from the Bay of Bengal. In early summer, brief squalls and thunderstorms known as *Kalbaisakhi*, or Nor 'westers, often occur. West Bengal receives the Bay of Bengal branch of the Indian Ocean monsoon that moves in a southeast to northwest direction. Monsoons bring rain to the whole state from June to September. Heavy rainfall of above 250 centimetres (98 in) is observed in the Darjeeling, Jalpaiguri, and Cooch Behar district. During the arrival of the monsoons, low pressure in the Bay of Bengal region often leads to the formation of storms in the coastal areas. Winter (December–January) is mild over the plains with average minimum temperatures of 15 °C (59 °F). A cold and dry northern wind blows in the winter, substantially lowering the humidity level. The Darjeeling Himalayan Hill region experiences a harsh winter, with occasional snowfall.

In this thesis, we will be discussing mainly about the Southern Region of West Bengal, which includes 15 districts mentioned in the Fig 2.1

Burdwan division	Presidency division	Medinipur division	Malda division
• Hooghly district • Purba Bardhaman district • Paschim Bardhaman district • Birbhum district	• Howrah district • Kolkata district • Nadia district • North 24 Parganas district • South 24 Parganas district	• Purba Medinipur district • Paschim Medinipur district • Jhargram district • Purulia district • Bankura district	• Murshidabad district

Fig. 2.1 Division & Districts of Southern WB

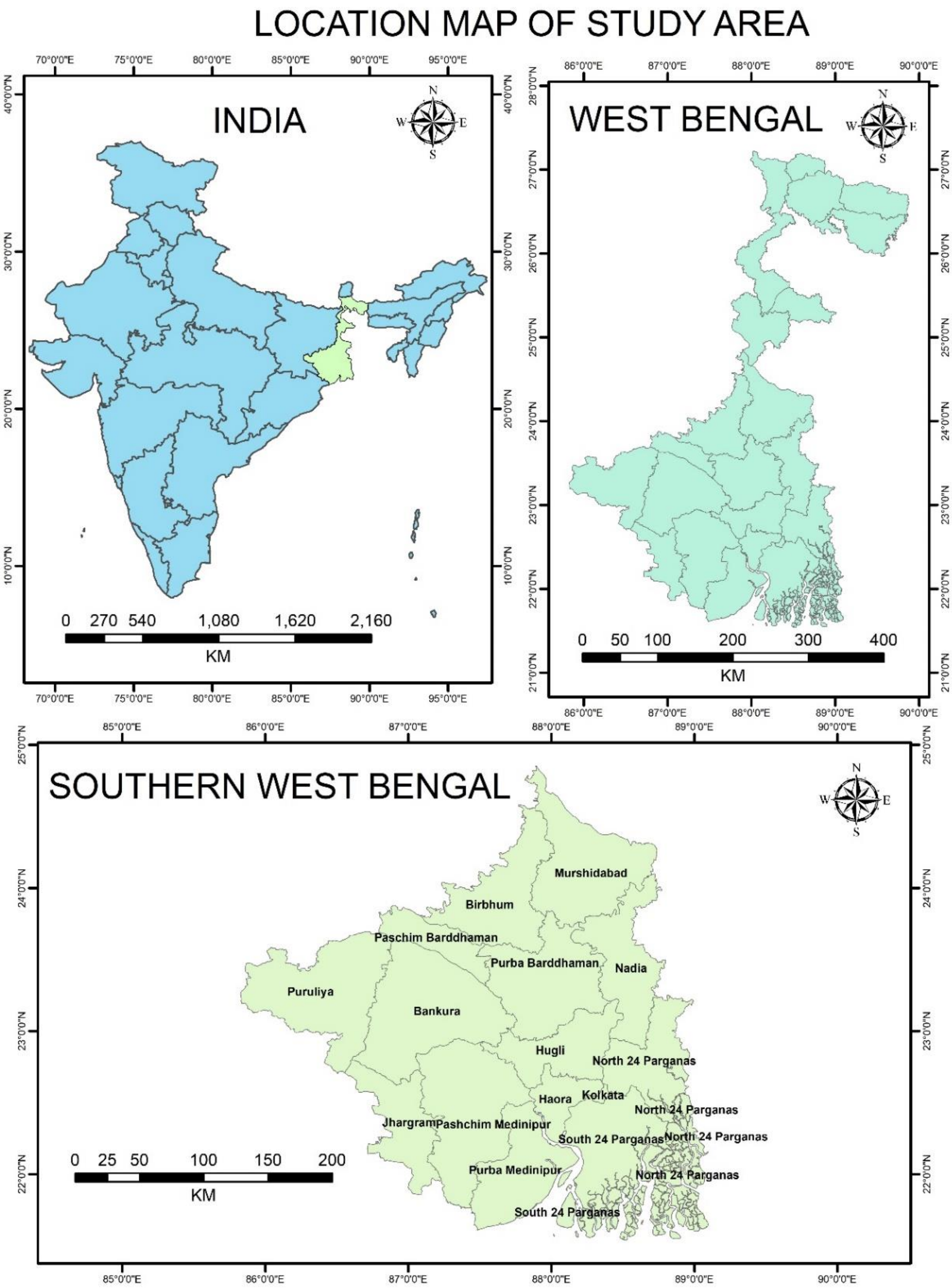


Fig. 2.2 Map of Study Area , India-West Bengal- Southern WB

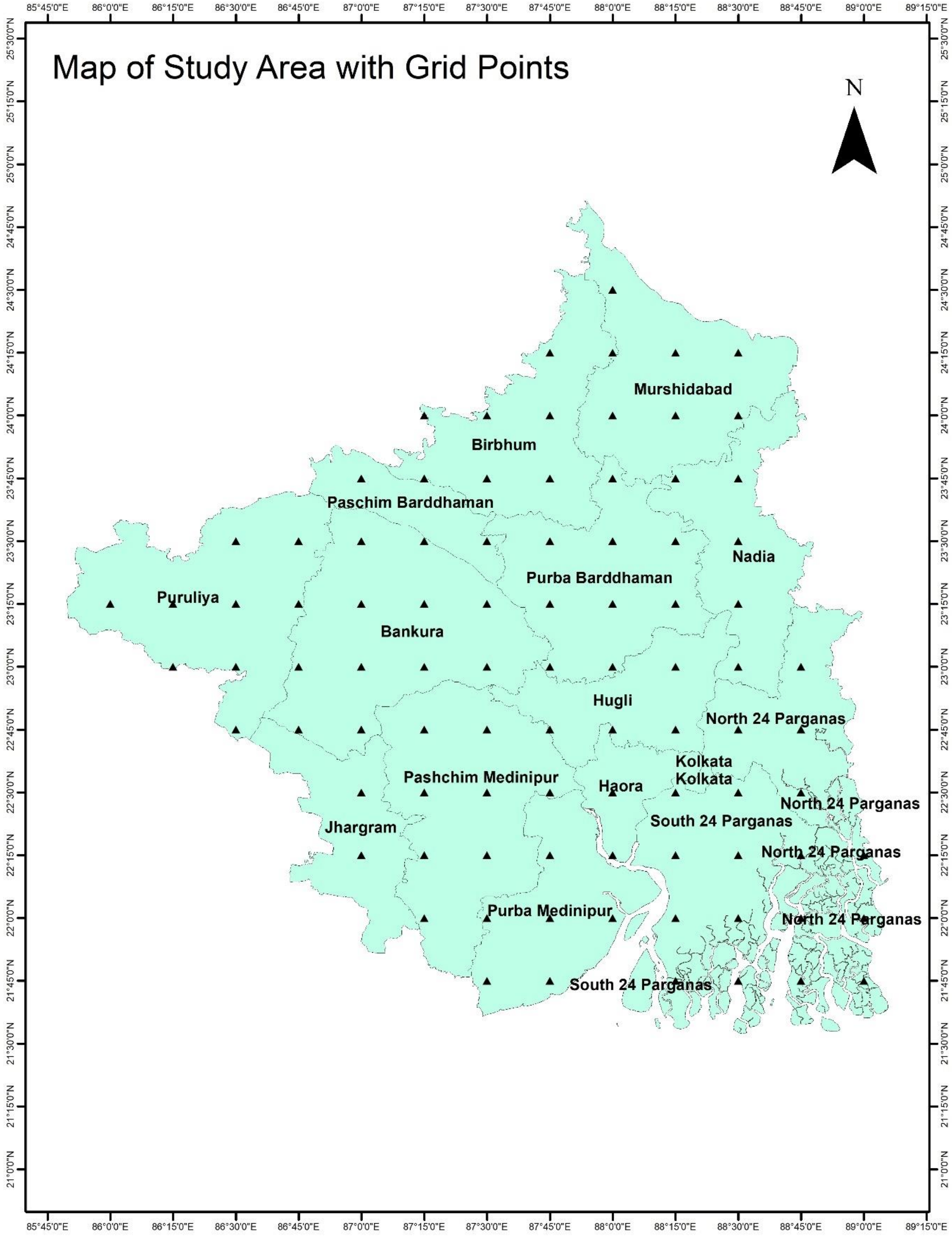


Fig. 2.3 Map of Southern WB with Grid Points

Chapter 3

Literature Review:

Chung and Ramanathan (2006) Sea surface temperatures (SSTs) in the equatorial Indian Ocean have warmed by about 0.6–0.8 K since the 1950s, accompanied by very little warming or even a slight cooling trend over the northern Indian Ocean (NIO). It is reported that this differential trend has resulted in a substantial weakening of the meridional SST gradient from the equatorial region to the South Asian coast during summer, to the extent that the gradient has nearly vanished recently. Based on simulations with the Community Climate Model Version 3 (CCM3), it is shown that the summertime weakening in the SST gradient weakens the monsoon circulation, resulting in less monsoon rainfall over India and excess rainfall in sub-Saharan Africa. The observed trend in SST is decomposed into a hypothetical uniform warming and a reduction in the meridional gradient. The uniform warming of the tropical Indian Ocean in the authors' simulations increases the Indian summer monsoon rainfall by 1–2 mm day^{-1}, which is opposed by a larger drying tendency due to the weakening of the SST gradient. The net effect is to decrease the Indian monsoon rainfall, while preventing the sub-Saharan region from becoming too dry.

P. Guhathakurta and M. Rajeevan (2008) They examined the New monthly, seasonal and annual rainfall time series of 36 meteorological subdivisions of India were constructed using the monthly rainfall data for the period 1901 – 2003 of fixed network of 1476 rain gauge stations. In the new network, on an average, there is one rain gauge station for every 3402 Sq. km area. The new rainfall series is temporally as well as spatially homogenous. Linear trend analysis was carried out to examine the long-term trends in rainfall over different subdivisions and monthly contribution of each of the monsoon months to annual rainfall. During the south-west monsoon season, three subdivisions viz. Jharkhand, Chhattisgarh, Kerala showed significant decreasing trend and eight subdivisions viz. Gangetic WB, West UP, Jammu and Kashmir, Konkan and Goa, Madhya Maharashtra subdivision, Rayalaseema, Coastal AP and North Interior Karnataka showed significant increasing trends. It has been found that the contribution of June, July and September rainfall to annual rainfall is decreasing for few subdivisions while contribution of August rainfall is increasing in few other subdivisions. EOF analysis is also done to know the spatial distribution of rainfall. The all India Monthly, seasonal and annual rainfall series constructed based on the 1476 stations are also reported.

Pal et al. (2015) They estimate long-term trend in the amount of rainfall for Gangetic West Bengal (GWB) meteorological sub-division of India and each of the 13 districts under GWB separately. Monthly rain- fall time series data of 100 years (1901-2000) were analysed to measure monotonous trend of rainfall employing Sen's slope estimator. Statistical significance of the trend was determined using non-parametric Mann-Kendall test. An important result derived from the analysis was that the GWB sub-division and South 24 Parganas (S24P) district showed significant increasing trend (mm/year) of annual rainfall measuring 2.025 and 4.99 respectively. An inclining trend of monsoon precipitation, which was significant, found in four districts viz. Bankura, North 24 Parganas(N24P), S24P and West Midnapore along with GWB itself. A major finding of the study revealed that six districts and GWB had significant increasing trend in September rainfall with a maximum value of 1.324 mm/year in S24P district. Contribution of rainfall in October and post-monsoon season as well increased considerably in Kolkata and S24P districts while in December, similar trend was observed for Birbhum and Howrah districts. Murshidabad, S24P and East Midnapore districts experienced significant rising trend of precipitation in July, August and November respectively. On the contrary, Burdwan and Nadia districts, in the month of May and pre-monsoon season, had considerable declining trend of rainfall. Significant decreasing trend (mm/year) of precipitation, a concern for Nadia district, with magnitude of 0.127 and 0.293, was observed in the months of March and April respectively. Soumendu Chatterjee, Ansar Khan, Hashem Akbari, Yupeng Wang (2016) They investigate spatiotemporal monotonic trend and shift in concentration of monsoon precipitation across West Bengal, India, by analysing the time series of monthly precipitation from 18 weather stations during the period from 1901-2002. In dealing with, the in homogeneity in the precipitation series, RHtestsV4 software package is used to detect, and adjust for, multiple change points (shifts) that could exist in data series. Finally, the cumulative deviation test was applied at 5% significant level to check the homogeneity (presence of historic changes by cumulative deviations test). Afterward non-parametric Mann Kendal (MK) test and Theil-Sen estimator (TSE) was applied to detect of nature and slope of trends; and, Sequential Mann Kendall (SQMK) test was applied for detection of turning point and magnitude of change in trends. Prior to the application of statistical tests, the pre-whitening technique was used to eliminate the effect of auto correlation of precipitation data series. Four indices precipitation concentration index (PCI), precipitation concentration degree (PCD) and precipitation concentration period (PCP) and Fulcrum (Centre of gravity) were used to detect precipitation concentration and the spatial pattern in it. The application of the abovementioned procedures has shown very notable state wide monotonic trend for monsoon precipitation time series. Regional cluster analysis by SQMK found increasing precipitation in mountain and coastal regions in general except during the non- monsoon seasons. The results show that higher PCI values were mainly observed in South Bengal, whereas lower PCI values were mostly detected in North Bengal. The PCI values are noticeably larger in places where both monsoon total precipitation and span of rainy season are lower. The results of PCP reveal that precipitation in Gangetic Bengal mostly occurs in summer (monsoon season), and the rainy season arrives earlier in North Bengal than South Bengal, whereas the results of PCD also indicate that the precipitation in North Bengal was more dispersed within a year than that in South Bengal. The concentration characteristic of precipitation could be detected by fulcrum analysis, and significant concentration over most of West Bengal was obvious within July month band. Precipitation trend observed in west Bengal is compared with that in CI region and comparison of precipitation departure with Indian monsoon and Gangetic Bengal can be explained by forecasting ensemble.

PulakGuhathakurta and Jayashree Revadekar (2017) Long-term (1901–2010) district data have been used to examine the observed variability and trends in rainfall during the south-west monsoon season (June–September) and north-east monsoon season (October–December) over India. South-west monsoon rainfall averaged over the country as a whole does not show any significant long-term trend during the period 1901–2010, suggesting that south-west monsoon system is stable. However, there is a significant multi-decadal epochal variability over the country and the four homogenous regions over India. The recent decades from 1971 onwards are found to be drier than normal with the recent decade 2001–2010 being the driest. Rainfall during the month of July shows a decreasing trend over most parts of the central India. However, rainfall during June and August shows increasing trend over the central and south-western parts of the country. Significant decreasing trends are observed in the seasonal rainfall over three subdivisions, and significant increasing trends are observed over eight other subdivisions. The analysis of the north-east monsoon (October–December) rainfall over the five met subdivisions of Peninsular India reveals no significant long-term trend. However, the presence of decadal variability in north-east monsoon rainfall is clearly observed.

Yingying Yu et al. (2019) Climate is one of the most important factors in agricultural production and livelihood of the coastal zone of Bangladesh and the bay of West Bengal, India. They studied, nearly 40 years (1970 – 2017) of historical rainfall and temperature data from six weather stations located in the coastal zone were analysed to assess their keycharacteristics influencing crop growth and yield. The results revealed that the rainfall in the coastal zone varied both spatially and seasonally. The total annual rainfall generally increased from the west to east and from north to south, resulting in rainfall difference up to 1000 mm year-1. In addition to spatial variations, the rainfall varied seasonally, with the wettest 25% of days during the wet season contributing to more than 70% of the annual total precipitation. Heavy rainfall (> 40 mm day-1) was found to occur in the dry season (from December to February), including around the sowing time of Rabi crops, resulting in a risk of waterlogging. Daily temperature and rainfall were also investigated to detect linear trends over the 40-year period. Maximum temperature was found to have increased at five weather stations with an average rate of 0.04°C year-1 except at

Canning, West-Bengal showing that the coastal zone has been experiencing hotter and longer summers. The rainfall behaviour was more varied, although it exhibited a general increase in the recent decade.

Singh et al. (2020) They examined the Spatio-temporal trends and variability of seasonal and annual rainfall for 36 districts of Maharashtra, India. For this purpose, 118 years (1901 to 2018) gridded rainfall data of India Meteorological Department (IMD) were analysed using Mann-Kendall (MK), modified Mann-Kendall (MMK), Sen's slope (SS), Spearman's rank correlation (SRC), simple linear regression (SLR), and innovative trend analysis (ITA). Auto-correlation coefficient was calculated at lag-1 and tested at 5% level of significance. Rainfall variability was examined using the coefficient of variation (CV). The analysis revealed significantly decreasing trends for winter and premonsoon rainfall in districts of Maharashtra. Monsoon, post-monsoon, and annual rainfall had both increasing and decreasing trends. Out of 185 time series analysed, ITA detected trends in 168 (90.8%) time series. All the trends detected by MK/MMK, SRC, and SLR were captured by ITA, along with trends in additional 103(55.6%) time series which were not captured by any of the aforesaid methods. Rainfall variability was very high in all the districts for winter, pre-monsoon, and post-monsoon seasons. The trends and variability analysis of rainfall in the state along with their maps would be useful for the local stakeholders for planning efficient use of water resources

Denzil et al Meghalaya is known to receive the most torrential rainfall in the world, but the region suffers from water shortage as soon as the rain recedes, and the dry season starts. Changes in rainfall patterns and distribution can have a profound impact on water availability in a watershed, and therefore, examining spatial and temporal variations in rainfall is essential. However, the long-term rainfall variations in Meghalaya are not well explored. In this study, we take up two important watersheds in Meghalaya, i.e. Umiam and Umtru watersheds, to study the spatial and temporal rainfall variations. Using the gridded rainfall data from the Indian Meteorological Department from 1901 to 2018, we show that annual, winter, pre-monsoon, and monsoon rainfall is decreasing, whereas the post-monsoon rainfall is increasing. We use the innovative trend analysis (ITA) method to identify the trends in low-, medium-, and high-intensity rainfall. We find that low- and medium-intensity rainfall is in decreasing trend while high-intensity rainfall is increasing across annual and seasonal time scales. Lastly, we cross-check the trends detected using the

innovative trend analysis method with a widely accepted Mann-Kendall (MK) test. We find that the results obtained by using the two methods generally concur; however, the ITA can detect non-monotonic trends in different rainfall intensities and is more sensitive to hidden patterns than the MK test.

Malik et al Under the climate change scenario, the identification of drought trends is primarily essential for the efficient utilization of water resources. In this paper, two methods, including traditional Mann-Kendall (MK) and graphical Şen-Innovative Trend (ŞIT), were utilized for Effective Drought Index (EDI) trend detection at 13 meteorological stations situated in the State of Uttarakhand, India. The EDI was computed for 54 years from 1962 to 2015 using monthly rainfall data at the study stations. The magnitude (mm/year) of the EDI was derived by Sen's-Slope Estimator (SSE) method. In total, 156 series of data were analyzed, and the results showed that the ŞIT method detected a significantly negative/positive trend in 71/60 time series, while the MK method detected a significantly negative/positive trend in 25/9 time series from January to December at the study stations. Magnitude (mm/year) varies from − 0.0275 to 0.0256 (January), − 0.0352 to 0.0343 (February), − 0.0312 to 0.0312 (March), − 0.0343 to 0.0276 (April), − 0.0359 to 0.0237 (May), − 0.0293 to 0.0205 (June), − 0.0234 to 0.0235 (July), − 0.0277 to 0.0405 (August), − 0.0297 to 0.0247 (September), − 0.0288 to 0.0227 (October), − 0.0290 to 0.0241 (November), and − 0.0298 to 0.0236 (December) over the study region. Additionally, the results indicated the supremacy of the ŞIT method by examining the unobserved trend that cannot be detected by the MK method over the study region in the EDI data series. In general, the EDI trend was found negative (decreasing) and positive (increasing), which suggested that more attention should be paid towards drought and wet (i.e., moderate, severe, extreme) at the study stations. The results of this research can be employed for water resource management and understanding the characteristics of climate variation over the study area.

Malik et al This study investigates the spatial and temporal patterns of trends on seasonal (pre-monsoon, monsoon, post-monsoon, and winter) and annual rainfall time series data (1966–2015) at 13 stations located in the central Himalayan region of the Uttarakhand State of India. The temporal trend was analyzed using recently proposed innovative trend analysis (ITA) method with significance test. The results of the ITA method were compared with the Mann-Kendall (MK) test at 5% significance level. The spatial variation of the trends in seasonal and annual rainfall series was interpolated using the Thiessen polygon (TP) method in ArcGIS 10.2 environment. The results of comparison revealed that the trend detected by MK test (significantly positive in 3-time series and significantly negative in 6-time series) can be effectively identified using ITA (significantly positive in 19-time series and significantly negative in 32-time series). The ITA method could detect some trends that cannot be observed by the MK test. According to the spatial distribution of MK-test, significantly increasing (decreasing) trends were observed in 1 (0), 1 (2), 0 (1), 1 (1), and 1 (1) polygons in pre-monsoon, monsoon, post-monsoon, winter, and annual rainfall data, while the ITA method detected significant trends in 3 (7), 6 (5), 1 (9), 4 (5), and 5 (6) polygons in the study region. The developed maps of spatial variability of rainfall trends may help the stakeholders and/or water resource managers to figure out the risk and vulnerability related to climate change in the study region.

Maharana et al This work examines the changes in precipitation characteristics over the Indian region using the latest high- resolution CORDEX-CORE model simulations. Individual RCM (COSMO, RegCM4.7, and REMO) experiments, their ensembles, and all RCM ensembles are examined to evaluate their performance using various statistical metrics. It aims to provide a holistic idea for choosing better models for specific analysis (variability, climatology, temporal evolution, indices, etc.) of precipitation distribution over India. The COSMO model experiments show lesser mean bias and have a high correlation coefficient (>0.8) compared to REMO and RegCM4. Each RCM ensemble performs better than its members in representing the spatial patterns of precipitation. Interestingly, the RCM experiments downscaling the forcings from MPI_ESM GCMs and ERA-Interim outperforms other RCM experiments in the resent day period. The probability distribution function reflects that the mean frequency and the intensity of Precipitation are best represented in the RegCM4 ensemble. Further, most RCMs agree to a robust increase in low-intensity rainfall (>0.1–4 mm_day-1) in the future under the RCP8.5 scenario. The intra-seasonal variability in terms of active and break spells are best represented in the RegCM4 ensemble. There exists uncertainty in terms of projection of active phases, while all model experiments agree to the decrease in the break phases in the near future compared to the present day. The projected consecutive dry (wet) days and their spells will decrease (increase) over India. The heavy precipitation events are expected to increase (by 18–32 days) along with its contribution (by 14–48%) towards the total precipitation over entire India indicating a possible increase in flooding events in the future. The present-day ISM characteristics is well captured in the model ensemble compared to individual experiments. The model ensemble indicates towards a robust increase in low-intensity rainfall in the future. The very heavy precipitation events and its contribution towards total precipitation are increasing in the future.

Chapter 4

Methodology:

Trend Analysis: Trend analysis is a methodology used in research to gather and study data for prediction-making about future based on the analysis of observed and recorded data from past and ongoing trends. It is basically the process of looking at current trends in order to predict future ones and is considered a form of comparative analysis.

Purpose of trend analysis: A series of observations of a random variable (Rainfall, concentration, unit well yield, biologic diversity, etc.) have been collected over some period of time. We would like to determine if their values generally increase or decrease (getting "better" or "worse"). In statistical terms this is a determination of whether the probability distribution from which they arise has changed over time. We would also like to describe the amount or rate of that change, in terms of changes in some central value of the distribution such as a mean or median. Interest may be in data at one location, or all across the country.

The null hypothesis: H0 is that there is no trend. However, any given test brings with it a precise mathematical definition of what is meant by "no trend", including a set of background assumptions usually related to type of distribution and serial correlation. The outcome of the test is a "decision" -- either H0 is rejected or not rejected. Failing to reject H0 does not mean that it was "proven" that there is no trend. Rather, it is a statement that the evidence available is not sufficient to conclude that there is a trend.

Possible outcomes of a statistical test in context of trend analysis:

	True Situation	
Decision	No trend. H_0 true.	Trend exists. H_0 false.
Fail to reject H_0. "No trend"	Probability = $1-\alpha$	(Type II error) β
Reject H_0. "Trend"	(Type I error) significance level α	(Power) $1-\beta$

Fig. 4.1 Probabilities associated with possible outcomes of a trend

Different types of trend Detection Test for Hydrometeorological Time series are :

1) Sen's Innovative Trend Analysis (2012,2017)
2) Mann Kendall Test (MK) 1945
3) Sen's Slope Estimator (SS)
4) Modified Mann Kendall Test (mMK)
5) Simple Linear Regression Analysis (LRA)
6) Spearman's Rho Test

In this paper our focus is mainly on Sen's Innovative Trend Analysis Method.

The innovative trend analysis (ITA) proposed by Şen (2012) was also applied to detect the trends in rainfall time series. Unlike the most commonly used classical trend analysis methods like the M-K/mM-K and SS tests, the ITA method is free from the assumptions of serial autocorrelation, normality, and length of the records. The time series is divided into two equal parts in ITA from the first date to the end date. Both sub-series are arranged in ascending order. The first half of the series is placed on X-axis, and the second half is placed at the Y-axis of the Cartesian coordinate system. The 1:1 line on the coordinate system is considered as no-trend line which separates increasing and decreasing trends. If the scatter points fall above (below) 1:1 line, the time series exhibit a monotonic increasing (decreasing) trend. Otherwise, if the scatter points show non-monotonic trend (i.e., composition of different trends in the time series), the time series is classified into several clusters. The classification of hydro-meteorological data into "low", "medium" and "high" groups can be achieved by dividing the variation domain of the data into three intervals.

The straight-line trend slope (s) plotted by the ITA can be calculated according to the following expression (Şen, 2017a).

$$s = 2(\overline{y_2} - \overline{y_1})/n \quad (1)$$

where $\overline{y}1$and $\overline{y}2$ are the arithmetic averages of the first and second half of the dependent variable, and n is the numbers of data. Actually, the arithmetic averages of the two halves appear as "centroid point" falling on the data line.

For Example, in Fig. 4.2 Monsoon Rainfall at Grid 1 of South 24 PGS is taken as an application of this proposed method.

The substitution of the numerical values as n = 114 and the arithmetic averages as $\bar{y}_1$ = 1213 and $\bar{y}_2$ = 1351.8

into Eq. (1), yields s = 2 × (1351.8 - 1213)/114 = 2.435

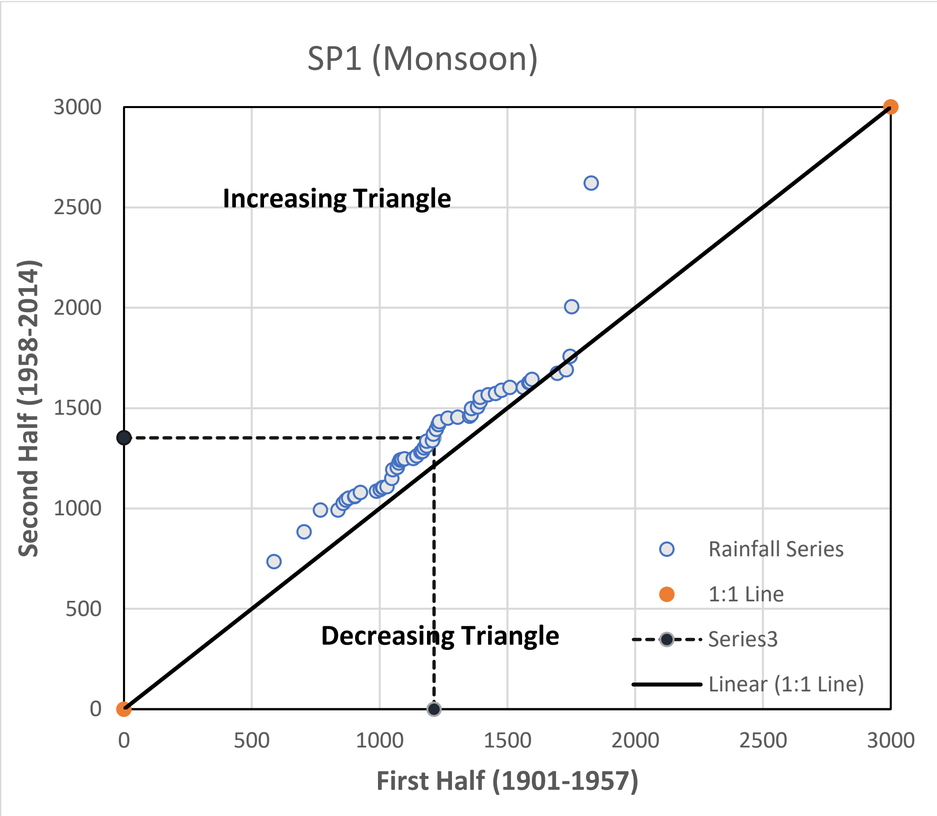


Fig. 4.2 ITA Slope of SP1 during Monsoon

To test the significance of the trend slope value, s, the null hypothesis, Ho, implies that there is not significant trend if the calculated slope value, s, is below a critical value, s_{cr} (Şen, 2017a). Otherwise, an alternative hypothesis, Ha, is valid when $s>s_{cr}$. As for the trend slope parameter, Eq. (1) shows that the stochastic property of s is a function of the first and second half time series arithmetic average values. Because $\bar{y}1$and $\bar{y}2$ are also stochastic variables, the first-order moment (expectation) of the slope can be computed by taking the expectation of both sides:

$$E(s) = \frac{2}{n}[E(\bar{y}_2) - E(\bar{y}_1)] \qquad (2)$$

For no trend centroid point lies on 1:1 line, implying that $E(y_1) = E(y_2)$, meaning E(s) = 0

Variance of slope;

$$\sigma^2{}_s = E(s^2) - [E(s)]^2$$

Since E(s) = 0, therefore $[E(s)]^2 = 0$,

Also, Since $E(\bar{y}_1) = E(\bar{y}_2)$, therefore $E(\bar{y}_1{}^2) = E(\bar{y}_2{}^2)$

And the correlation coefficient $\rho_{\bar{y}_2\bar{y}_1}$ between the two mean values in stochastic processes is given as,

$$\rho_{\bar{y}_2\bar{y}_1} = [E(\bar{y}_2\bar{y}_1) - E(\bar{y}_1)\mathrm{E}(\bar{y}_2)]/\sigma_{\bar{y}_1}\sigma_{\bar{y}_2} \quad (3)$$

Calculation of Variance of slope;

$$\sigma^2{}_s = E(s^2) - [E(s)]^2$$

$$\sigma_s^2 = E(s^2)$$

$$= E[\{2(\bar{y}_2 - \bar{y}_1)/n\}^2]$$

$$= E\{\frac{4}{n^2}(\bar{y}_2^2 + \bar{y}_1^2 - 2\bar{y}_1\bar{y}_2)\}$$

$$= \frac{4}{n^2}\{E(\bar{y}_2^2) + E(\bar{y}_1^2) - 2E(\bar{y}_2\bar{y}_1)\}$$

$$= \frac{4}{n^2}\{2E(\bar{y}_2^2) - 2E(\bar{y}_2\bar{y}_1)\}$$

$$= \frac{8}{n^2}\{E(\bar{y}_2^2) - E(\bar{y}_2\bar{y}_1)\}$$

Substituting Eq (3) and considering $\sigma_{\bar{y}_2} = \sigma_{\bar{y}_1} = \sigma/\sqrt{n}$,

$$= \frac{8}{n^2}\{E(\bar{y}_2^2) - E^2(\bar{y}_2) - \frac{\sigma^2}{n}\rho_{\bar{y}_2\bar{y}_1}\}$$

$$= \frac{8}{n^2}\{\sigma_{\bar{y}_2}^2 - \frac{\sigma^2}{n}\rho_{\bar{y}_2\bar{y}_1}\}$$

$$= \frac{8}{n^2}\{\frac{\sigma^2}{n} - \frac{\sigma^2}{n}\rho_{\bar{y}_2\bar{y}_1}\}$$

$$\sigma^2{}_s = \frac{8}{n^2}\frac{\sigma^2}{n}\{1 - \rho_{\bar{y}_2\bar{y}_1}\}$$

Standard Deviation of slope, $\sigma_s = \frac{2\sqrt{2}}{n\sqrt{n}}\sigma\sqrt{1-\rho_{\bar{y}_2\bar{y}_1}}$

Finally, the confidence limits (CL) of a standard normal PDF with zero mean and standard deviation are s_{cri}, then the confidence limits (CL) of the trend slope is given as

$$CL_{(1-\alpha)} = 0 \pm s_{cri} \times \sigma_s$$

where α is the significance level and σ_s is standard deviation of the slope.

For, SP1 during monsoon season, the correlation coefficient $\rho_{\bar{y}_2\bar{y}_1}$ is calculated as 0.9383

Standard Deviation of slope, σ_s is calculated as 0.1717.

Confidence Limit at 95% = ± 0.3365

Confidence Limit at 99% = ± 0.4423

Therefore, Slope of Monsoon Rainfall of SP1 is Positive and Significant at 99% confidence level.

Analysis and Result:

In this part, a detailed analysis and Calculation of Statistical and Trend parameters of Rainfall data for 4 meteorological seasons (Winter - Jan to Feb, Pre-Monsoon – March to May, Monsoon – June to September and Post Monsoon – October to December) with Slope of Trend graph for every season has been shown for every grid point in each district individually in the study area i.e., southern West Bengal.

For each season in every district, Statistical parameters and trend parameters are mentioned simultaneously in table format.

Statistical Parameters includes:

- Mean
- Standard Deviation
- Coefficient of Variation
- Skewness
- Kurtosis

Trend Parameters includes:

- Slope
- Standard Deviation of Slope
- Correlation Coefficient
- Significance level of ±5%
- Significance level of ±1%

4.1 South 24 PGS:

For Winter Season, following are the Statistical Parameters:
Table 1

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
South 24 Pgs	SP1	1	88.25	21.75	41.650	39.516	1503.223	1.476	3.120
South 24 Pgs	SP2	2	88.5	21.75	41.334	39.587	1518.206	1.650	4.080
South 24 Pgs	SP3	3	88.25	22	41.144	38.300	1400.706	1.544	3.604
South 24 Pgs	SP4	4	88.5	22	40.034	38.018	1376.090	1.727	4.458
South 24 Pgs	SP5	5	88.25	22.25	40.027	38.332	1392.601	1.678	4.090
South 24 Pgs	SP6	6	88.5	22.25	38.928	37.068	1241.571	1.700	4.439
South 24 Pgs	SP7	7	88.75	22.25	37.649	35.999	1141.309	1.698	4.493
South 24 Pgs	SP8	8	88.25	22.5	38.516	36.500	1140.745	1.727	4.673
South 24 Pgs	SP9	9	88.5	22.5	37.154	35.481	1071.484	1.773	5.034

For Winter Season, Following are the Trend Parameters:
Table 2

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
South 24 Pgs	SP1	1	88.25	21.75	-0.0968	0.0108	0.9861	-0.0212	0.0212	-0.0279	0.0279
South 24 Pgs	SP2	2	88.5	21.75	-0.0945	0.0088	0.9909	-0.0172	0.0172	-0.0226	0.0226
South 24 Pgs	SP3	3	88.25	22	-0.0992	0.0095	0.9886	-0.0187	0.0187	-0.0245	0.0245
South 24 Pgs	SP4	4	88.5	22	-0.1178	0.0080	0.9917	-0.0158	0.0158	-0.0207	0.0207
South 24 Pgs	SP5	5	88.25	22.25	-0.1283	0.0093	0.9891	-0.0182	0.0182	-0.0239	0.0239
South 24 Pgs	SP6	6	88.5	22.25	-0.1260	0.0136	0.9750	-0.0267	0.0267	-0.0351	0.0351
South 24 Pgs	SP7	7	88.75	22.25	-0.0954	0.0181	0.9531	-0.0355	0.0355	-0.0467	0.0467
South 24 Pgs	SP8	8	88.25	22.5	-0.1541	0.0164	0.9625	-0.0322	0.0322	-0.0423	0.0423
South 24 Pgs	SP9	9	88.5	22.5	-0.1202	0.0179	0.9530	-0.0350	0.0350	-0.0460	0.0460

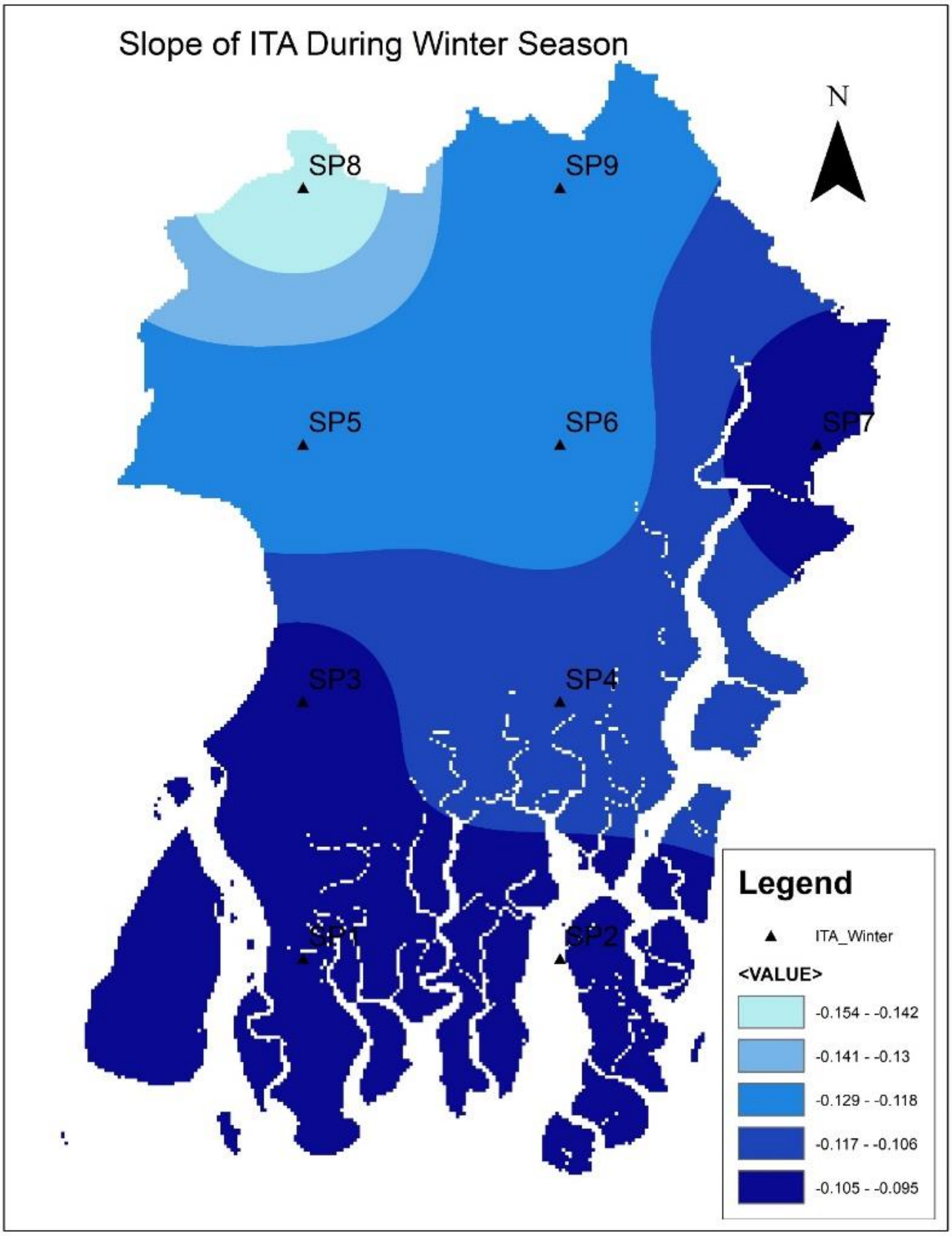


Fig. 4.1.1 ITA Slope Variation in South 24 PGS During Winter Season

Trend Analysis Curves for Winter Season:

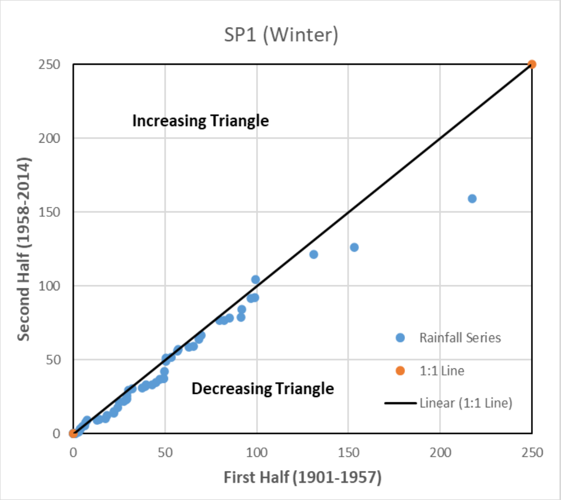


Fig 4.1.2 ITA plot for SP1 in Winter

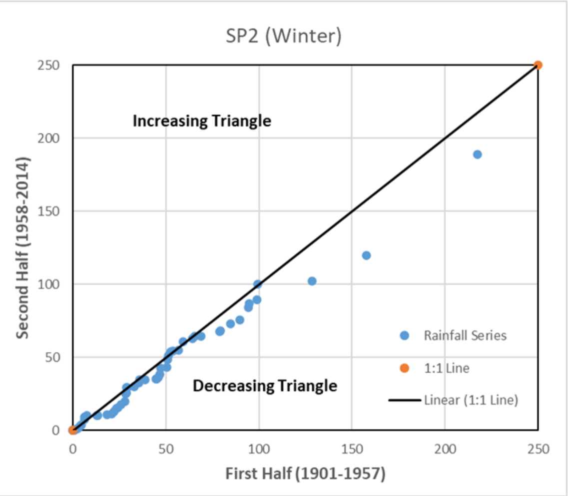


Fig 4.1.3 ITA plot for SP2 in Winter

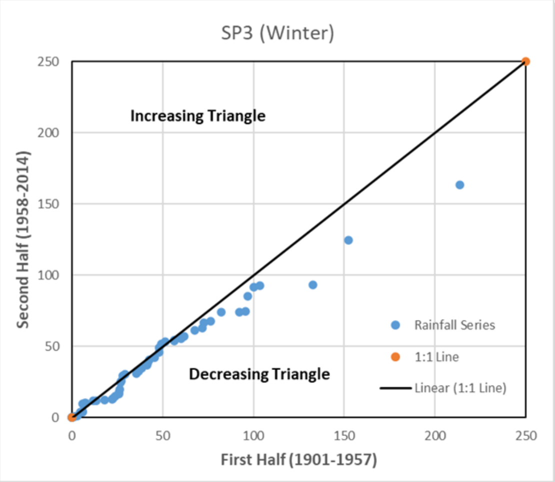


Fig 4.1.4 ITA plot for SP3 in Winter

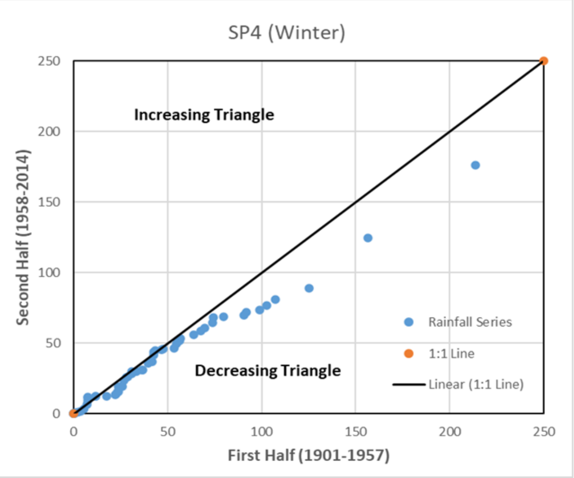


Fig 4.1.5 ITA plot for SP4 in Winter

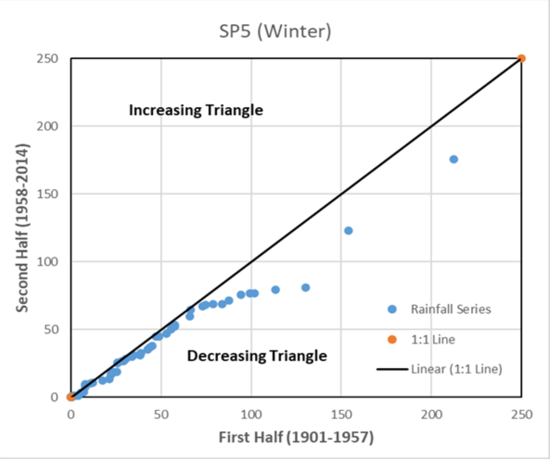


Fig 4.1.6 ITA plot for SP5 in Winter

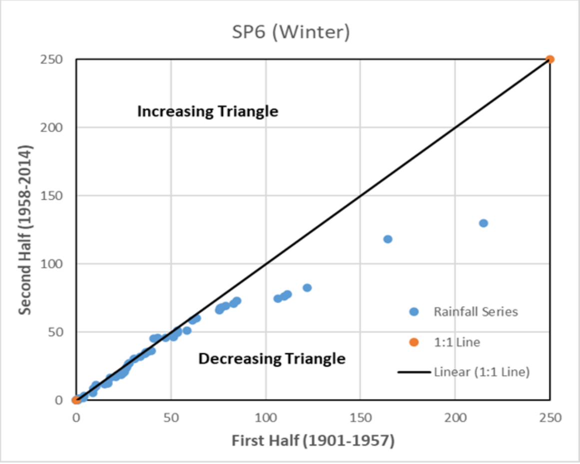


Fig 4.1.7 ITA plot for SP6 in Winter

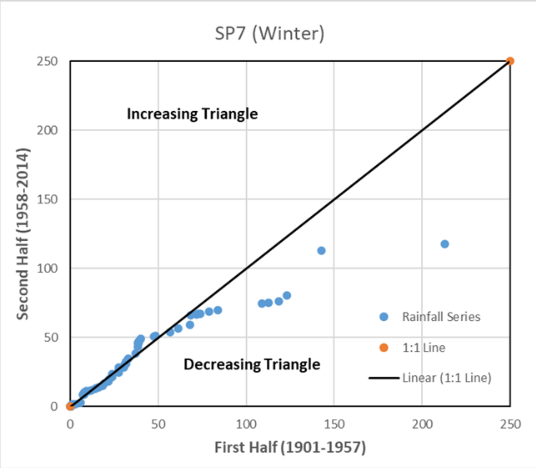


Fig 4.1.8 ITA plot for SP7 in Winter

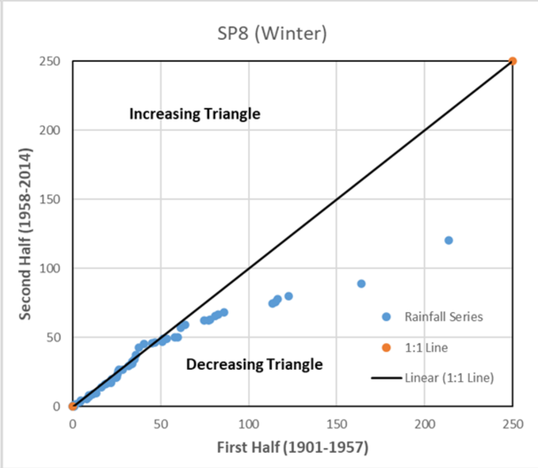


Fig 4.1.9 ITA plot for SP8 in Winter

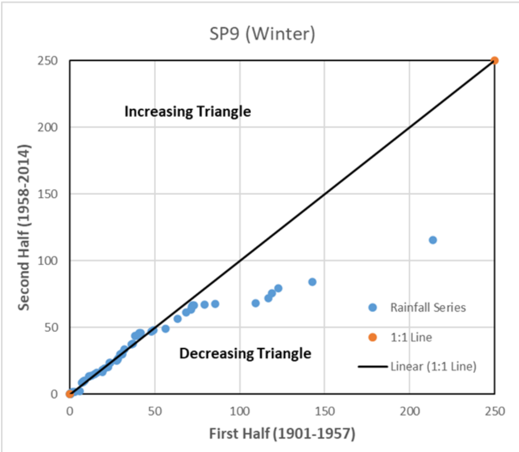


Fig 4.1.10 ITA plot for SP9 in Winter

For Pre-Monsoon Season, following are the Statistical Parameters;

Table 3

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
South 24 Pgs	SP1	1	88.25	21.75	210.581	106.683	11102.025	0.711	0.381
South 24 Pgs	SP2	2	88.5	21.75	212.026	103.867	10524.449	0.755	0.596
South 24 Pgs	SP3	3	88.25	22	214.387	100.854	9826.158	0.769	0.871
South 24 Pgs	SP4	4	88.5	22	217.043	100.263	9754.714	0.859	1.364
South 24 Pgs	SP5	5	88.25	22.25	219.842	101.810	10083.155	0.870	1.398
South 24 Pgs	SP6	6	88.5	22.25	218.413	100.378	9823.890	0.914	1.793
South 24 Pgs	SP7	7	88.75	22.25	215.156	97.422	9272.241	0.977	2.108
South 24 Pgs	SP8	8	88.25	22.5	218.298	100.463	9884.268	1.051	2.586
South 24 Pgs	SP9	9	88.5	22.5	216.017	95.871	8970.514	0.954	2.045

For Pre-Monsoon Season, Following are the Trend Parameters;

Table 4

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation $(\rho_{y_1 y_2})$	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
South 24 Pgs	SP1	1	88.25	21.75	-0.3598	0.0197	0.9937	-0.0385	0.0385	-0.0506	0.0506
South 24 Pgs	SP2	2	88.5	21.75	-0.2676	0.0231	0.9908	-0.0453	0.0453	-0.0596	0.0596
South 24 Pgs	SP3	3	88.25	22	-0.2606	0.0298	0.9839	-0.0583	0.0583	-0.0766	0.0766
South 24 Pgs	SP4	4	88.5	22	-0.1499	0.0294	0.9841	-0.0577	0.0577	-0.0758	0.0758
South 24 Pgs	SP5	5	88.25	22.25	-0.1074	0.0306	0.9833	-0.0600	0.0600	-0.0788	0.0788
South 24 Pgs	SP6	6	88.5	22.25	-0.0177	0.0289	0.9847	-0.0566	0.0566	-0.0744	0.0744
South 24 Pgs	SP7	7	88.75	22.25	0.0319	0.0270	0.9858	-0.0529	0.0529	-0.0695	0.0695
South 24 Pgs	SP8	8	88.25	22.5	-0.0462	0.0216	0.9915	-0.0423	0.0423	-0.0555	0.0555
South 24 Pgs	SP9	9	88.5	22.5	0.0153	0.0275	0.9848	-0.0539	0.0539	-0.0708	0.0708

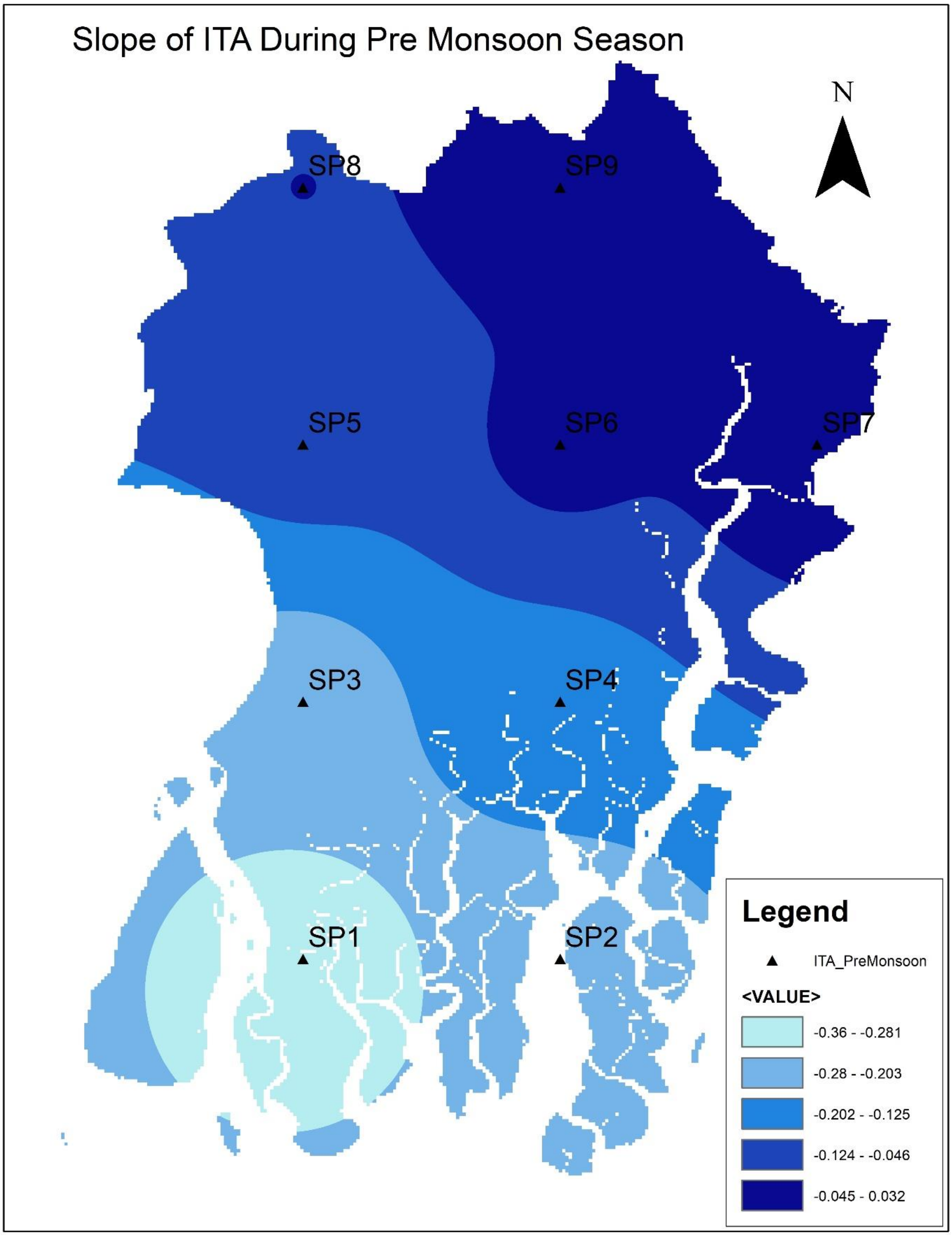


Fig. 4.1.11 ITA Slope Variation in South 24 PGS During Pre-Monsoon Season

Trend Analysis Curves for Pre-Monsoon Season:

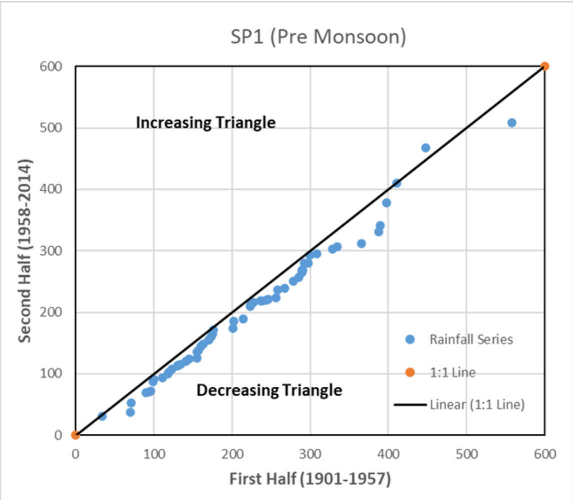


Fig 4.1.12 ITA plot for SP1 in Pre-Monsoon

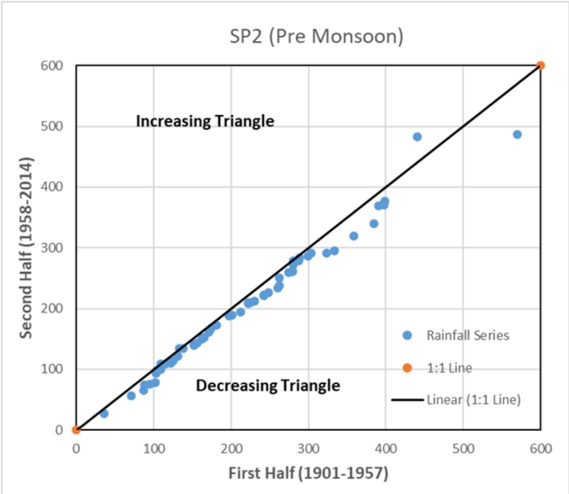


Fig 4.1.13 ITA plot for SP2 in Pre-Monsoon

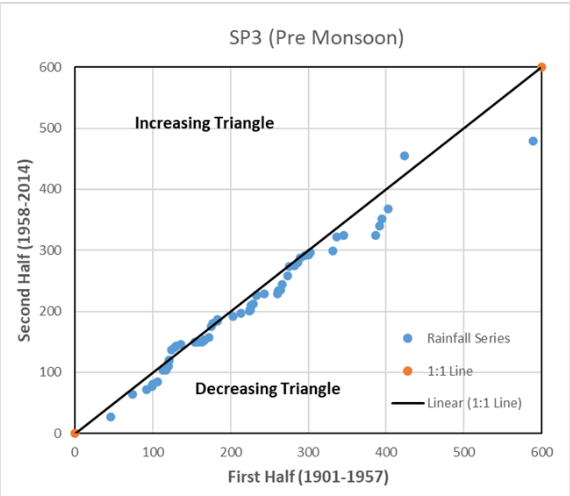


Fig 4.1.14 ITA plot for SP3 in Pre-Monsoon

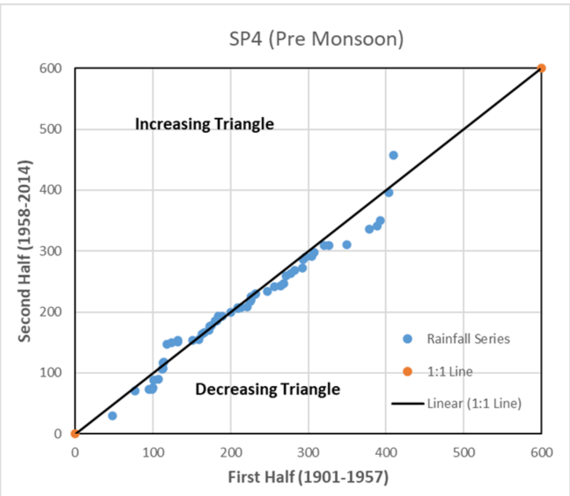


Fig 4.1.15 ITA plot for SP4 in Pre-Monsoon

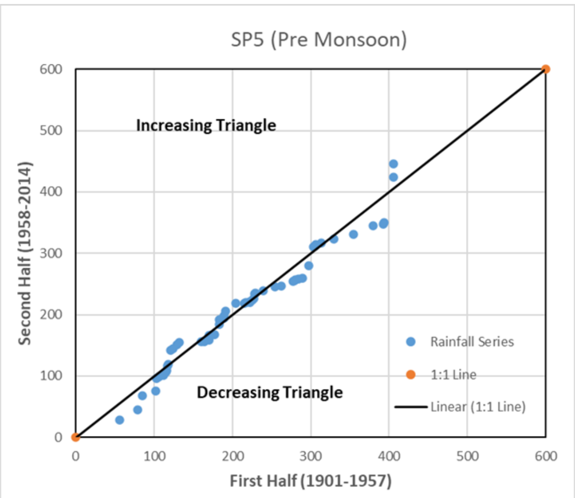


Fig 4.1.16 ITA plot for SP5 in Pre-Monsoon

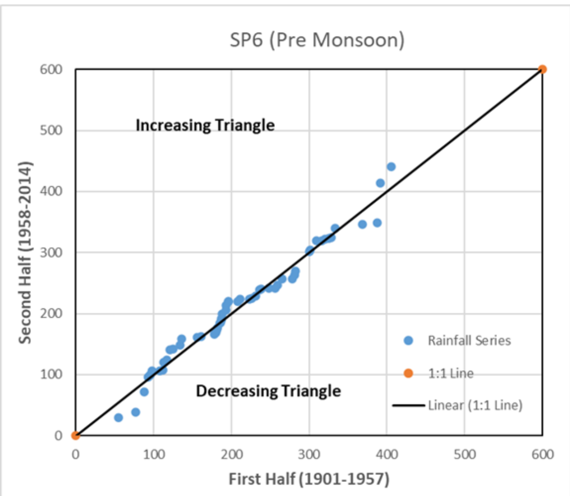


Fig 4.1.17 ITA plot for SP6 in Pre-Monsoon

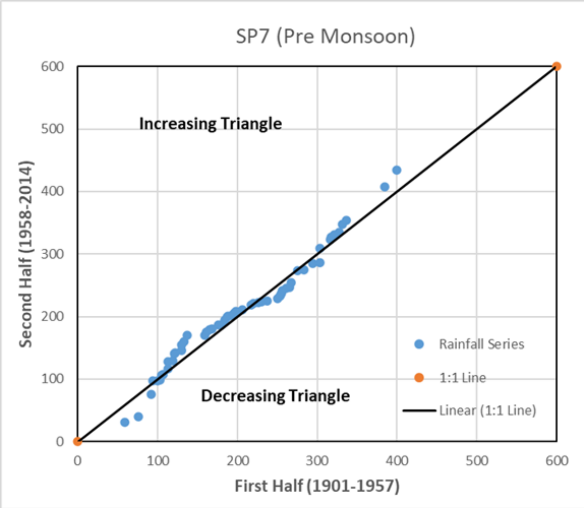


Fig 4.1.18 ITA plot for SP7 in Pre-Monsoon

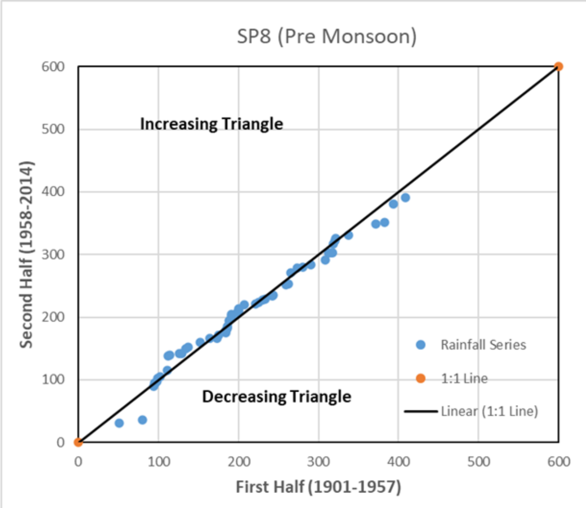


Fig 4.1.19 ITA plot for SP8 in Pre-Monsoon

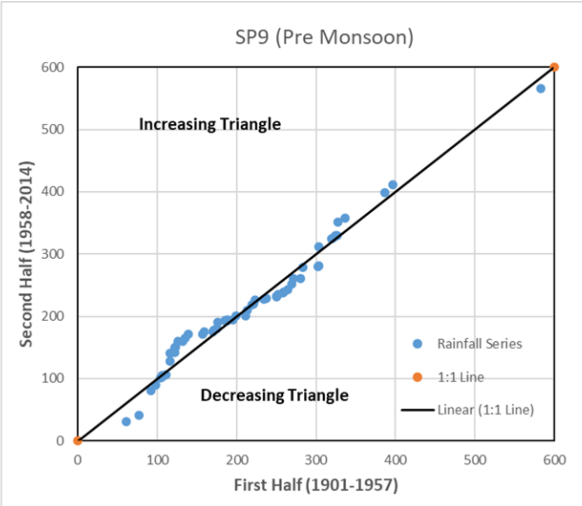


Fig 4.1.20 ITA plot for SP9 in Pre-Monsoon

For Monsoon Season, following are the Statistical Parameters;

Table 5

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
South 24 Pgs	SP1	1	88.25	21.75	1282.396	297.413	77600.384	0.803	2.619
South 24 Pgs	SP2	2	88.5	21.75	1268.284	319.879	84786.614	1.549	7.479
South 24 Pgs	SP3	3	88.25	22	1261.639	314.693	82312.473	1.517	6.870
South 24 Pgs	SP4	4	88.5	22	1242.297	324.573	87528.466	1.738	8.377
South 24 Pgs	SP5	5	88.25	22.25	1239.005	319.079	89171.945	1.257	4.497
South 24 Pgs	SP6	6	88.5	22.25	1205.227	322.805	85344.477	1.341	5.438
South 24 Pgs	SP7	7	88.75	22.25	1171.352	318.142	77471.393	1.227	4.723
South 24 Pgs	SP8	8	88.25	22.5	1183.789	333.112	91380.830	1.544	7.536
South 24 Pgs	SP9	9	88.5	22.5	1161.284	315.782	78203.601	1.032	4.341

For Monsoon Season, Following are the Trend Parameters;

Table 6

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
South 24 Pgs	SP1	1	88.25	21.75	2.4352	0.1717	0.9383	-0.3365	0.3365	-0.4423	0.4423
South 24 Pgs	SP2	2	88.5	21.75	2.7210	0.2217	0.9110	-0.4346	0.4346	-0.5712	0.5712
South 24 Pgs	SP3	3	88.25	22	2.6484	0.2148	0.9137	-0.4210	0.4210	-0.5533	0.5533
South 24 Pgs	SP4	4	88.5	22	2.6692	0.2062	0.9253	-0.4041	0.4041	-0.5310	0.5310
South 24 Pgs	SP5	5	88.25	22.25	2.5464	0.1406	0.9641	-0.2755	0.2755	-0.3621	0.3621
South 24 Pgs	SP6	6	88.5	22.25	3.2822	0.1957	0.9319	-0.3836	0.3836	-0.5042	0.5042
South 24 Pgs	SP7	7	88.75	22.25	4.0452	0.1979	0.9283	-0.3880	0.3880	-0.5099	0.5099
South 24 Pgs	SP8	8	88.25	22.5	2.6807	0.1986	0.9342	-0.3893	0.3893	-0.5116	0.5116
South 24 Pgs	SP9	9	88.5	22.5	3.6291	0.2018	0.9244	-0.3955	0.3955	-0.5198	0.5198

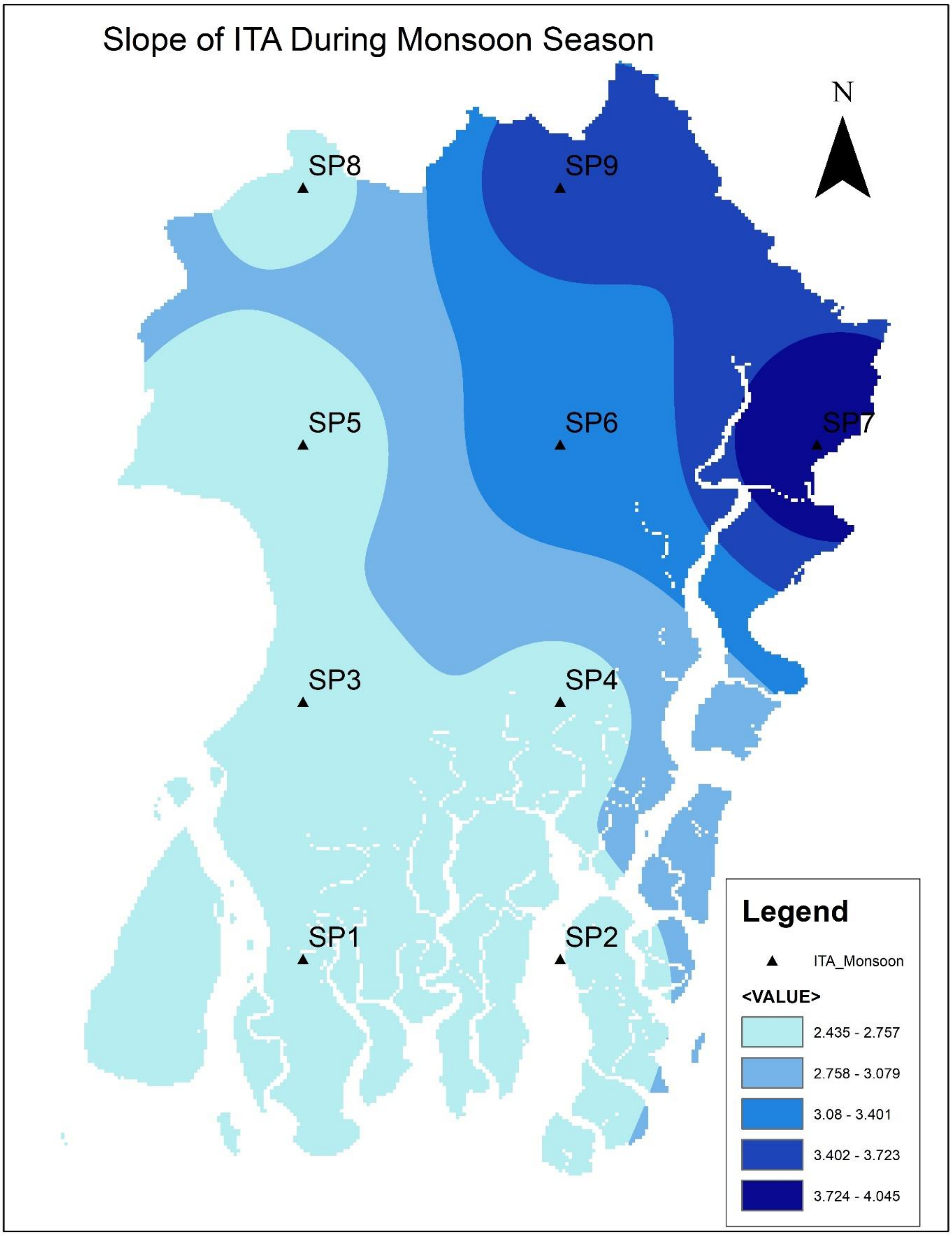


Fig. 4.1.21 ITA Slope Variation in South 24 PGS During Monsoon Season

Trend Analysis Curves for Monsoon Season:

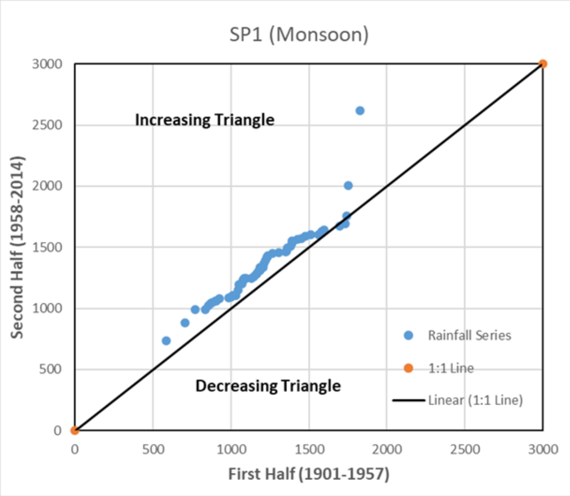


Fig 4.1.22 ITA plot for SP1 in Monsoon

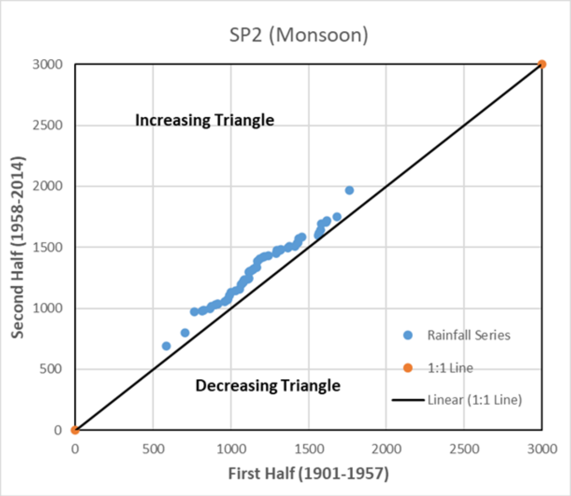


Fig 4.1.23 ITA plot for SP2 in Monsoon

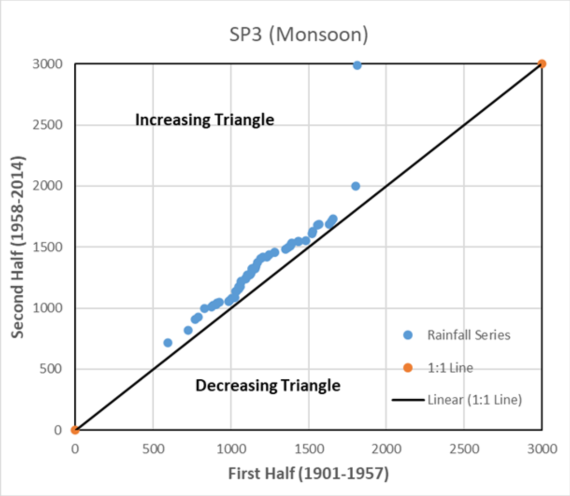


Fig 4.1.24 ITA plot for SP3 in Monsoon

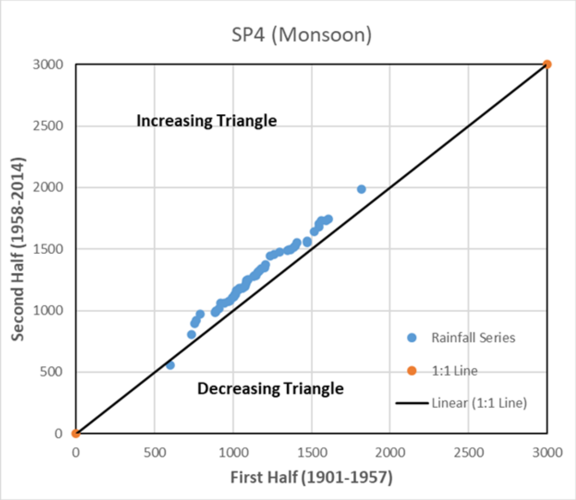


Fig 4.1.25 ITA plot for SP4 in Monsoon

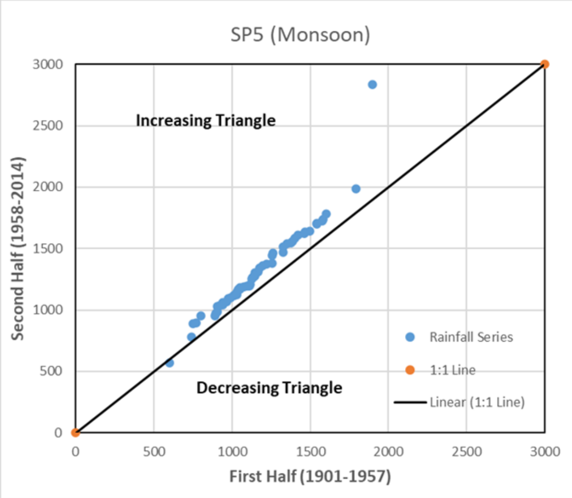


Fig 4.1.26 ITA plot for SP5 in Monsoon

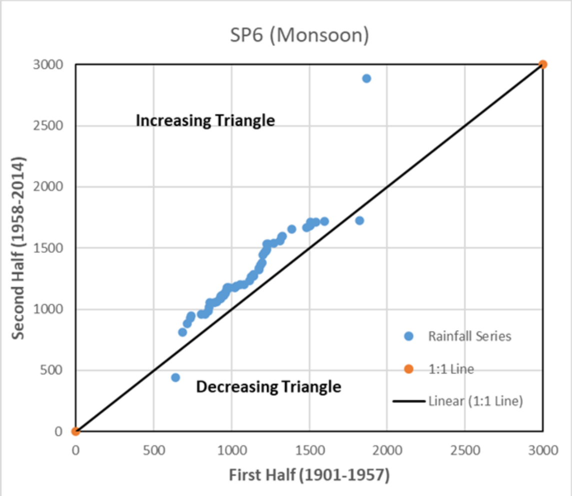


Fig 4.1.27 ITA plot for SP6 in Monsoon

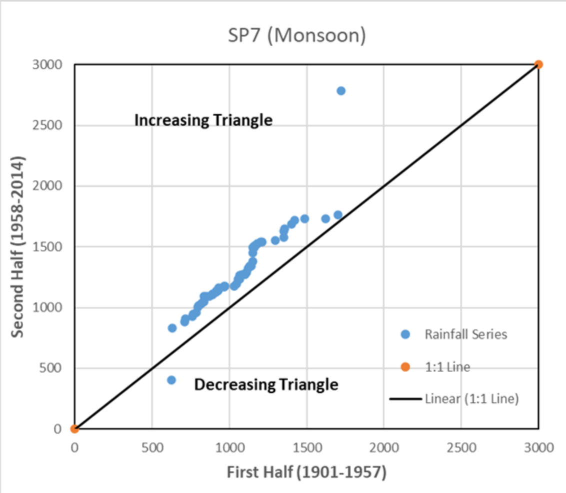


Fig 4.1.28 ITA plot for SP7 in Monsoon

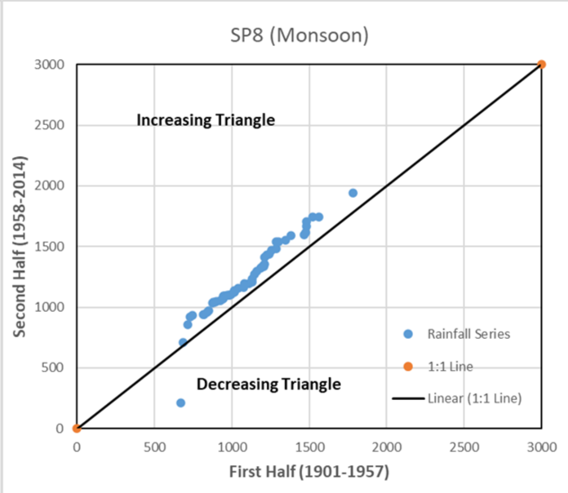


Fig 4.1.29 ITA plot for SP8 in Monsoon

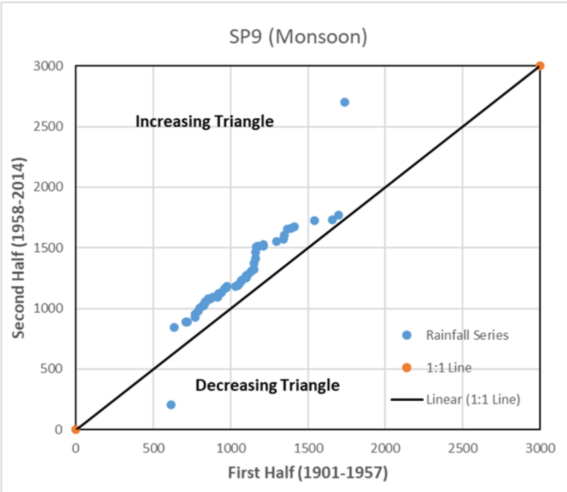


Fig 4.1.30 ITA plot for SP9 in Monsoon

For Post Monsoon Season, following are the Statistical Parameters;

Table 7

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
South 24 Pgs	SP1	1	88.25	21.75	191.681	123.134	14057.011	0.882	0.376
South 24 Pgs	SP2	2	88.5	21.75	183.701	115.504	12533.428	0.801	0.165
South 24 Pgs	SP3	3	88.25	22	177.086	110.582	11643.339	0.890	0.516
South 24 Pgs	SP4	4	88.5	22	170.899	109.146	11223.928	0.896	0.506
South 24 Pgs	SP5	5	88.25	22.25	168.286	109.947	11215.551	1.027	1.131
South 24 Pgs	SP6	6	88.5	22.25	163.726	107.488	10629.226	1.027	1.027
South 24 Pgs	SP7	7	88.75	22.25	158.710	104.373	9826.844	1.002	0.896
South 24 Pgs	SP8	8	88.25	22.5	162.211	106.858	10596.554	0.892	0.293
South 24 Pgs	SP9	9	88.5	22.5	156.927	102.779	9648.157	0.972	0.826

For Post Monsoon Season, Following are the Trend Parameters;

Table 8

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
South 24 Pgs	SP1	1	88.25	21.75	0.8495	0.0408	0.9797	-0.0800	0.0800	-0.1051	0.1051
South 24 Pgs	SP2	2	88.5	21.75	0.7557	0.0256	0.9909	-0.0501	0.0501	-0.0659	0.0659
South 24 Pgs	SP3	3	88.25	22	0.6385	0.0197	0.9941	-0.0387	0.0387	-0.0509	0.0509
South 24 Pgs	SP4	4	88.5	22	0.6250	0.0248	0.9905	-0.0486	0.0486	-0.0638	0.0638
South 24 Pgs	SP5	5	88.25	22.25	0.6109	0.0355	0.9807	-0.0695	0.0695	-0.0913	0.0913
South 24 Pgs	SP6	6	88.5	22.25	0.7155	0.0274	0.9880	-0.0537	0.0537	-0.0706	0.0706
South 24 Pgs	SP7	7	88.75	22.25	0.8129	0.0267	0.9879	-0.0523	0.0523	-0.0687	0.0687
South 24 Pgs	SP8	8	88.25	22.5	0.6624	0.0308	0.9846	-0.0604	0.0604	-0.0794	0.0794
South 24 Pgs	SP9	9	88.5	22.5	0.7693	0.0235	0.9904	-0.0460	0.0460	-0.0604	0.0604

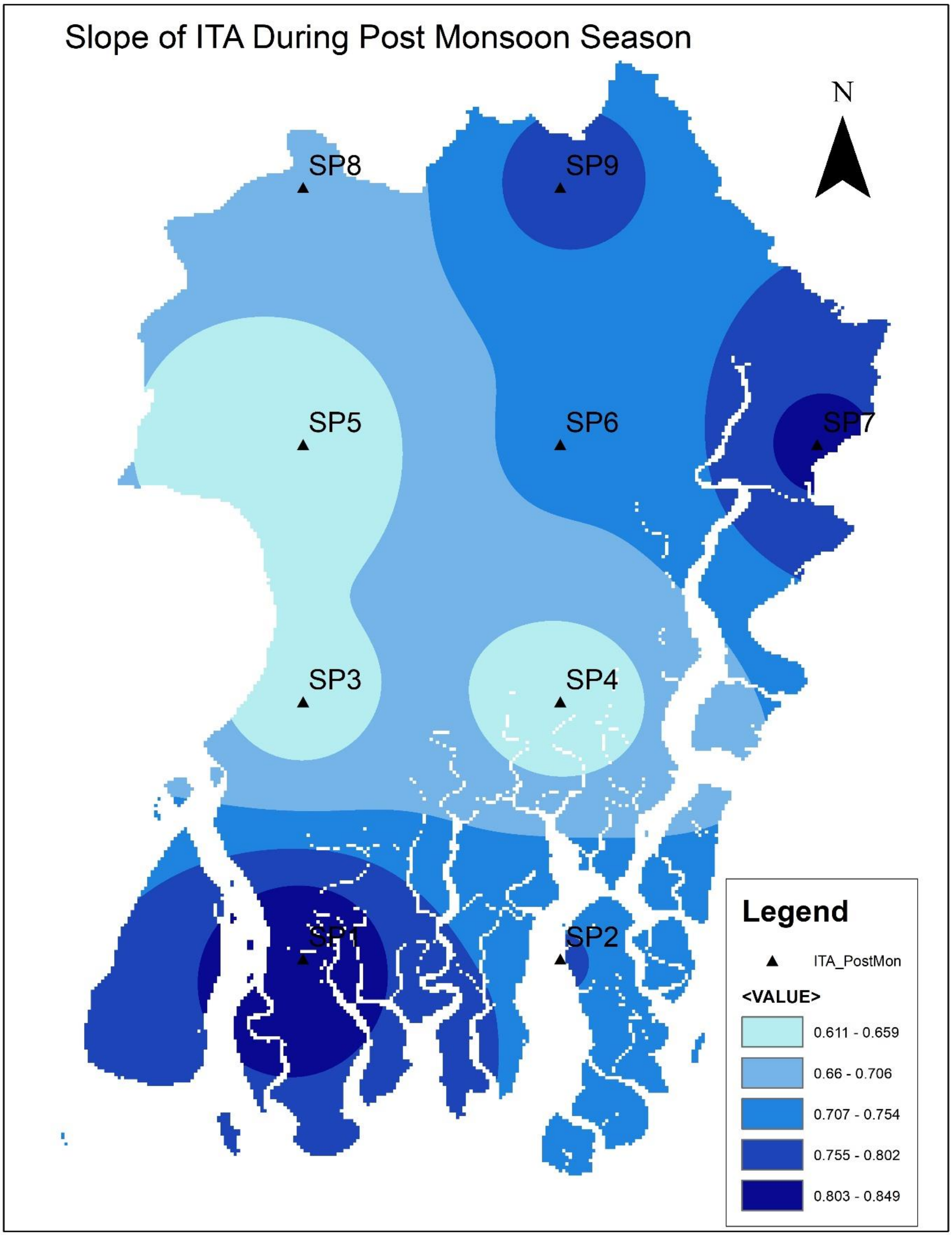


Fig. 4.1.31 ITA Slope Variation in South 24 PGS During Post Monsoon Season

Trend Analysis Curves for Post Monsoon Season:

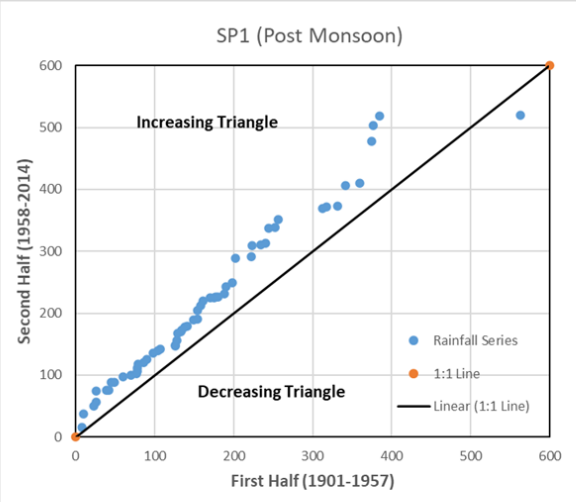


Fig 4.1.32 ITA plot for SP1 in Post Monsoon

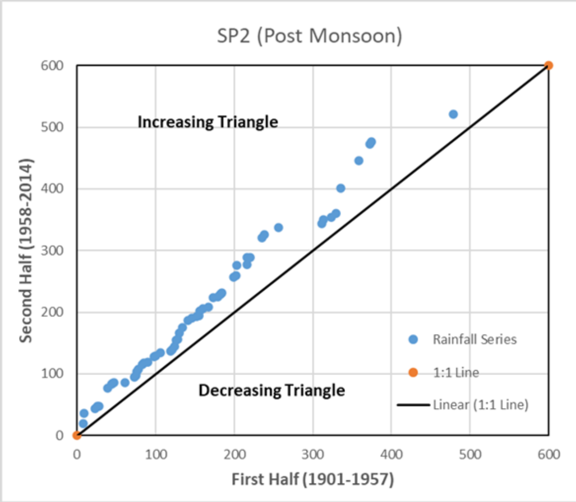


Fig 4.1.33 ITA plot for SP2 in Post Monsoon

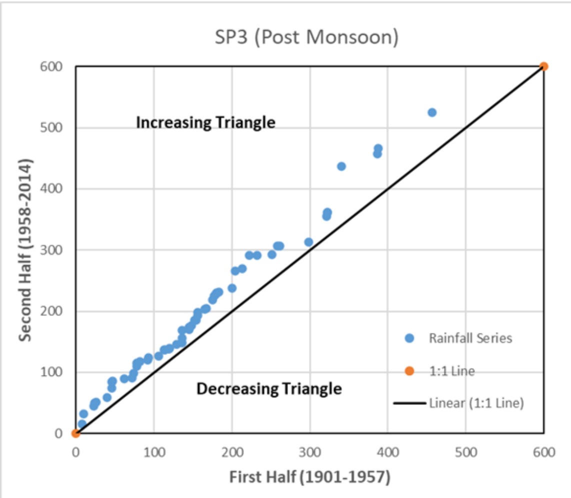


Fig 4.1.34 ITA plot for SP3 in Post Monsoon

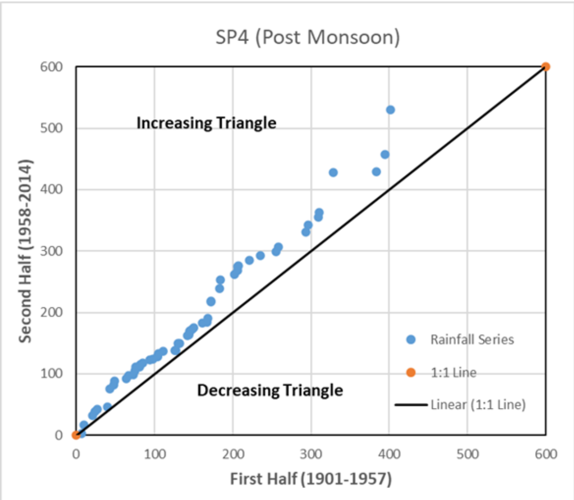


Fig 4.1.35 ITA plot for SP4 in Post Monsoon

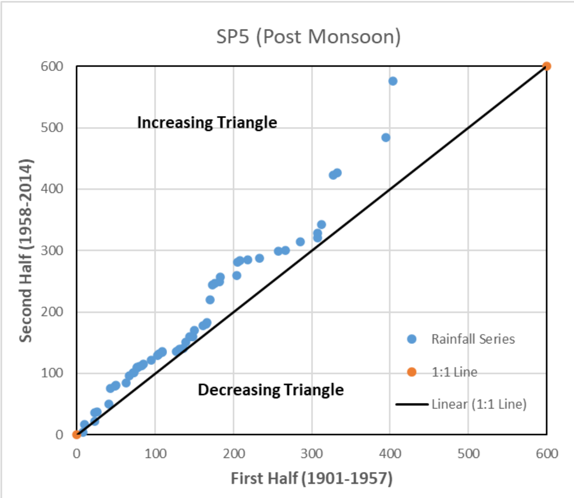


Fig 4.1.36 ITA plot for SP5 in Post Monsoon

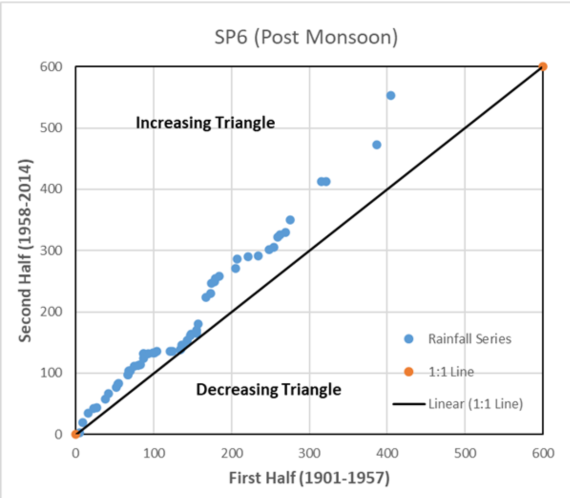


Fig 4.1.37 ITA plot for SP6 in Post Monsoon

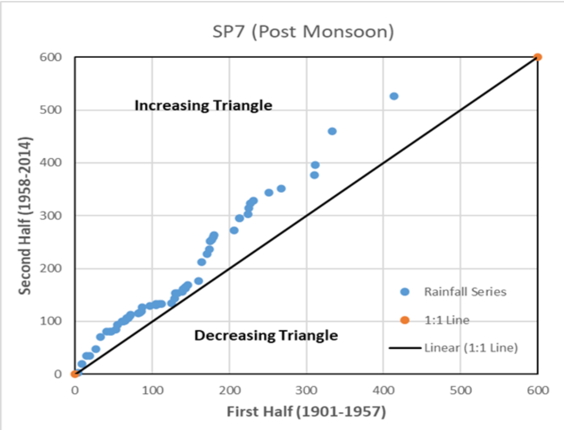


Fig 4.1.38 ITA plot for SP7 in Post Monsoon

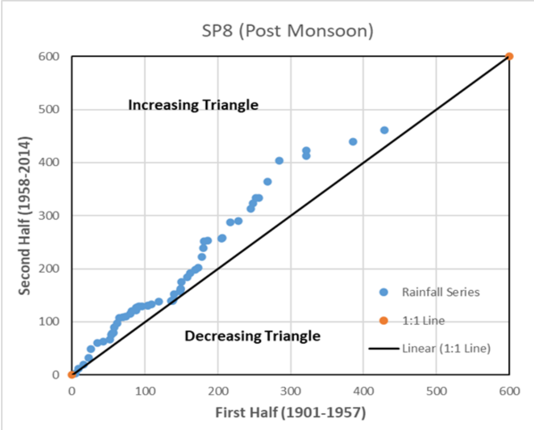


Fig 4.1.39 ITA plot for SP8 in Post Monsoon

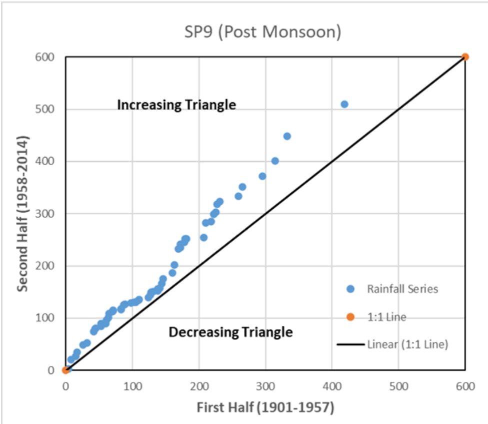


Fig 4.1.40 ITA plot for SP9 in Post Monsoon

4.2 North 24 PGS:

For Winter Season, following are the Statistical Parameters;

Table 9

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
North 24 Pgs	NP1	10	88.75	21.75	40.394	38.147	1387.299	1.710	4.496
North 24 Pgs	NP2	11	89	21.75	38.447	36.251	1237.355	1.698	4.126
North 24 Pgs	NP3	12	88.75	22	39.066	37.257	1321.214	1.784	4.814
North 24 Pgs	NP4	13	89	22	37.401	36.641	1261.925	1.755	4.275
North 24 Pgs	NP5	14	89	22.25	36.748	35.892	1176.966	1.681	4.082
North 24 Pgs	NP6	15	88.75	22.5	36.486	34.795	1032.680	1.667	4.305
North 24 Pgs	NP7	16	88.5	22.75	36.211	35.100	1125.083	1.567	3.486
North 24 Pgs	NP8	17	88.75	22.75	35.656	34.330	1068.062	1.548	3.485
North 24 Pgs	NP9	18	88.75	23	34.212	34.230	1053.733	1.645	3.754

For Winter Season, following are the Trend Parameters;

Table 10

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
North 24 Pgs	NP1	10	88.75	21.75	-0.099	0.009	0.990	-0.017	0.017	-0.023	0.023
North 24 Pgs	NP2	11	89	21.75	-0.075	0.010	0.986	-0.019	0.019	-0.025	0.025
North 24 Pgs	NP3	12	88.75	22	-0.083	0.009	0.988	-0.019	0.019	-0.024	0.024
North 24 Pgs	NP4	13	89	22	-0.055	0.013	0.976	-0.026	0.026	-0.034	0.034
North 24 Pgs	NP5	14	89	22.25	-0.071	0.016	0.965	-0.030	0.030	-0.040	0.040
North 24 Pgs	NP6	15	88.75	22.5	-0.115	0.017	0.954	-0.034	0.034	-0.045	0.045
North 24 Pgs	NP7	16	88.5	22.75	-0.073	0.014	0.971	-0.027	0.027	-0.036	0.036
North 24 Pgs	NP8	17	88.75	22.75	-0.082	0.013	0.973	-0.026	0.026	-0.034	0.034
North 24 Pgs	NP9	18	88.75	23	-0.144	0.010	0.985	-0.019	0.019	-0.025	0.025

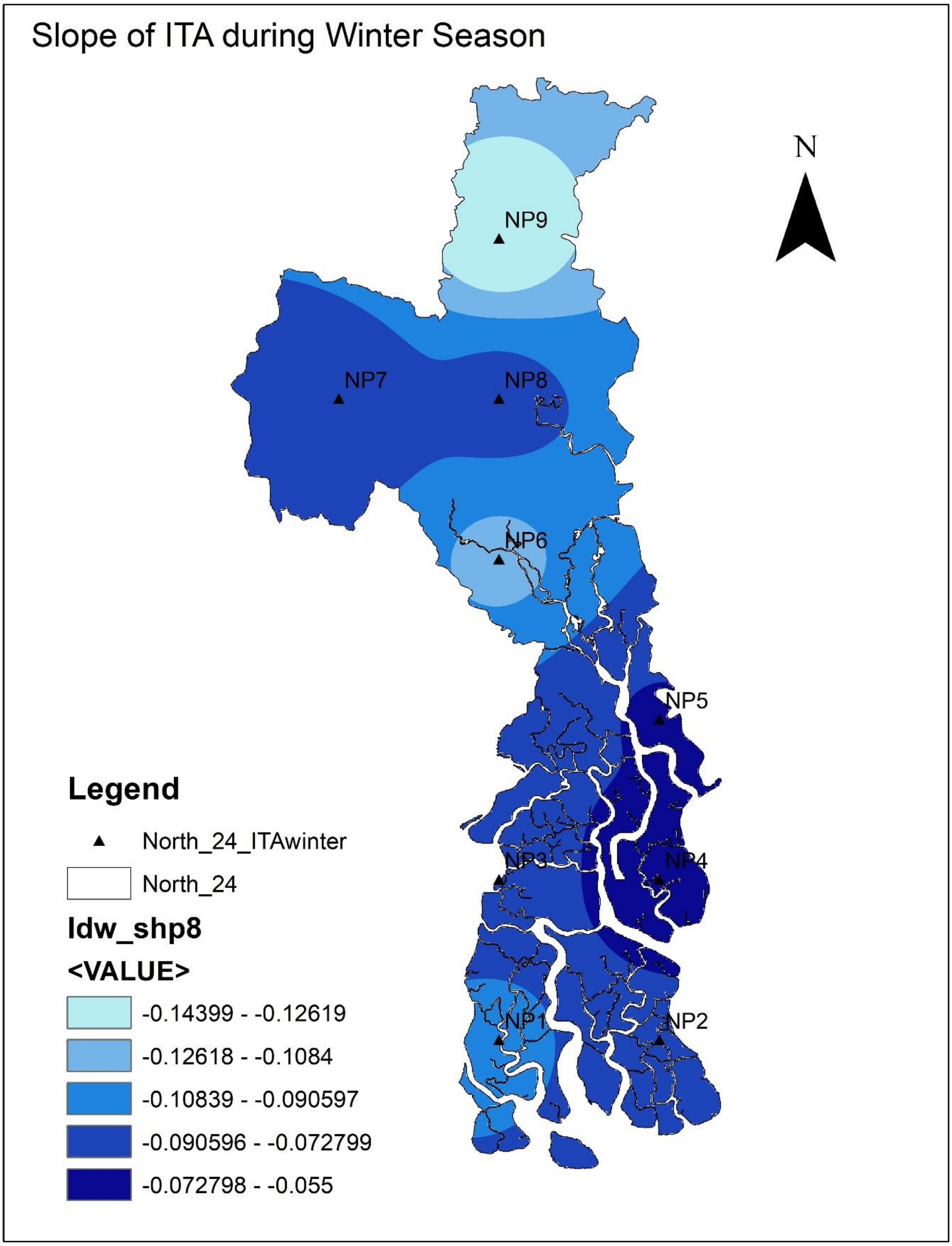


Fig. 4.2.1 ITA Slope Variation in North 24 PGS During Winter Season

Trend Analysis Curves for Winter Season:

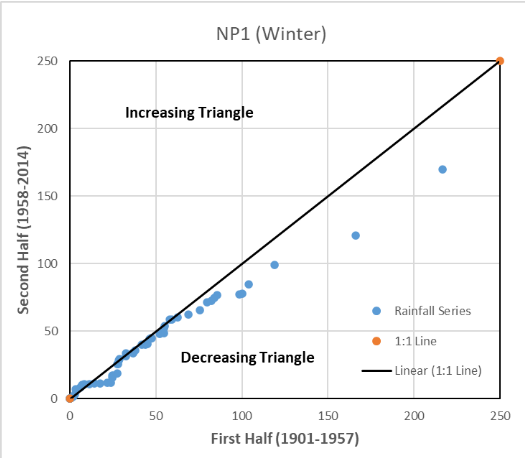


Fig 4.2.2 ITA plot for NP1 in Winter

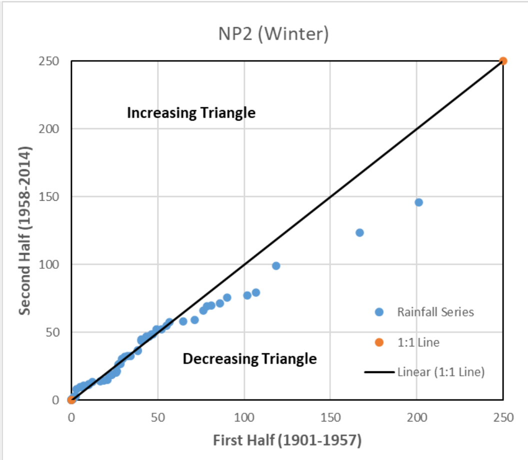


Fig 4.2.3 ITA plot for NP2 in Winter

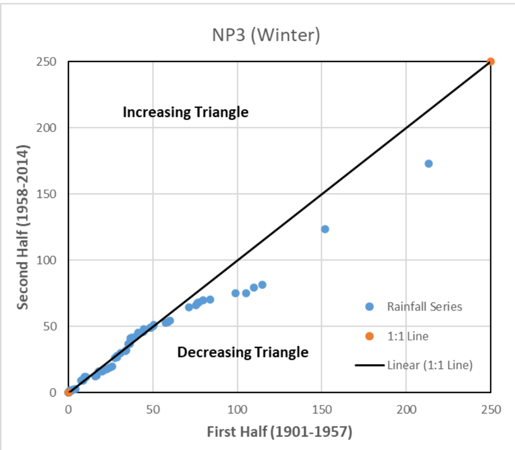


Fig 4.2.4 ITA plot for NP3 in Winter

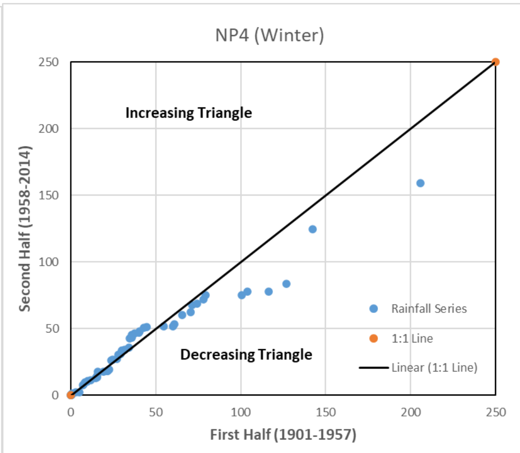


Fig 4.2.5 ITA plot for NP4 in Winter

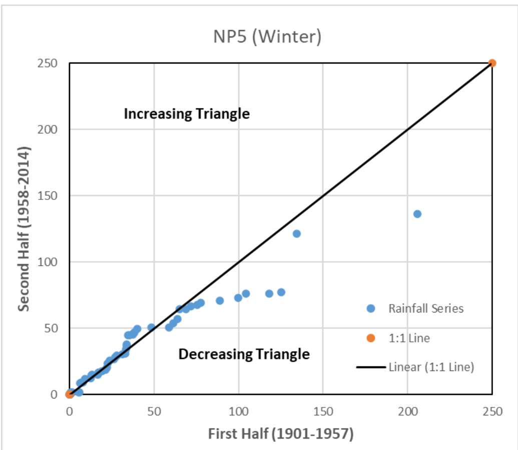


Fig 4.2.6 ITA plot for NP5 in Winter

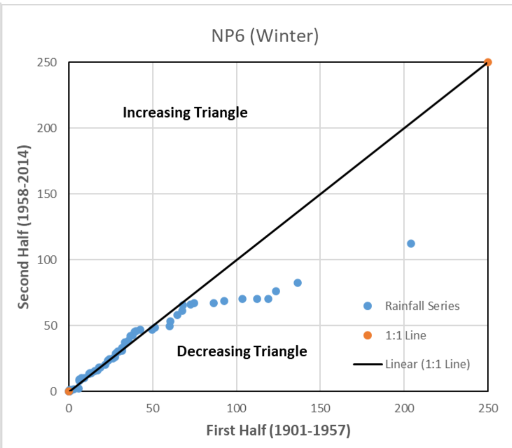


Fig 4.2.7 ITA plot for NP6 in Winter

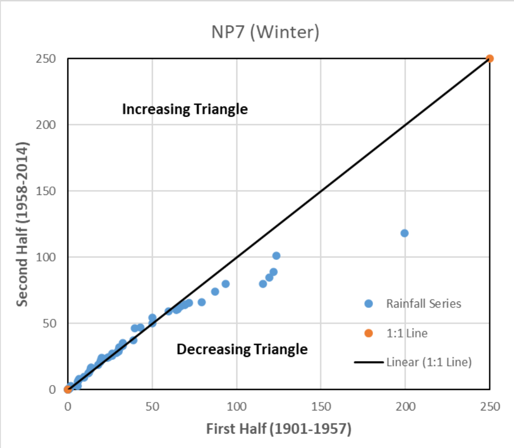


Fig 4.2.8 ITA plot for NP7 in Winter

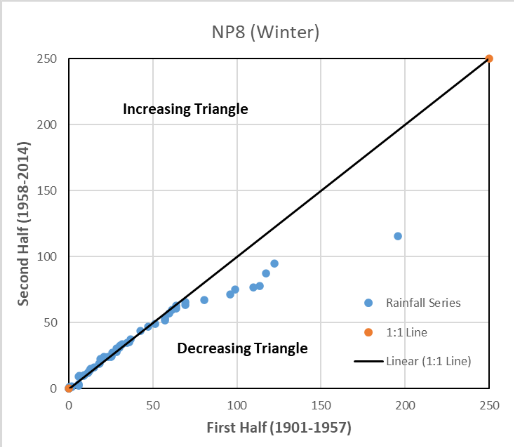


Fig 4.2.9 ITA plot for NP8 in Winter

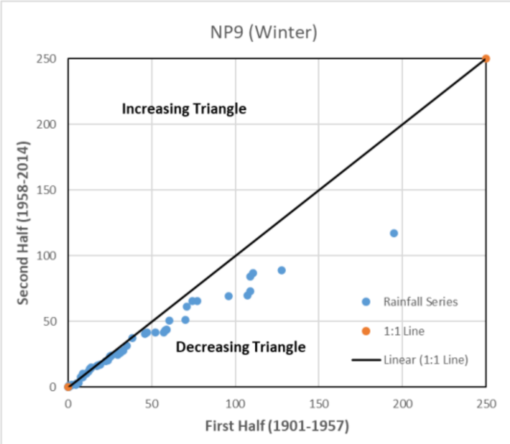


Fig 4.2.10 ITA plot for NP9 in Winter

For Pre-Monsoon Season, following are the Statistical Parameters ;

Table 11

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
North 24 Pgs	NP1	10	88.75	21.75	211.950	103.147	10399.846	0.782	0.788
North 24 Pgs	NP2	11	89	21.75	210.569	104.117	10536.245	1.001	2.002
North 24 Pgs	NP3	12	88.75	22	214.720	99.303	9589.327	0.950	1.997
North 24 Pgs	NP4	13	89	22	211.427	101.882	10065.702	1.163	3.017
North 24 Pgs	NP5	14	89	22.25	213.700	98.527	9445.117	1.048	2.410
North 24 Pgs	NP6	15	88.75	22.5	215.359	93.275	8448.564	0.921	1.921
North 24 Pgs	NP7	16	88.5	22.75	214.824	92.663	8359.278	0.964	2.262
North 24 Pgs	NP8	17	88.75	22.75	214.181	91.571	8179.881	0.777	1.304
North 24 Pgs	NP9	18	88.75	23	213.458	87.082	7223.539	0.515	0.014

For Pre-Monsoon Season, following are the Trend Parameters ;

Table 12

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1 y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
North 24 Pgs	NP1	10	88.75	21.75	-0.177	0.024	0.990	-0.047	0.047	-0.062	0.062
North 24 Pgs	NP2	11	89	21.75	-0.047	0.030	0.985	-0.059	0.059	-0.077	0.077
North 24 Pgs	NP3	12	88.75	22	-0.033	0.030	0.983	-0.060	0.060	-0.078	0.078
North 24 Pgs	NP4	13	89	22	0.065	0.034	0.979	-0.067	0.067	-0.088	0.088
North 24 Pgs	NP5	14	89	22.25	0.021	0.031	0.982	-0.061	0.061	-0.080	0.080
North 24 Pgs	NP6	15	88.75	22.5	0.004	0.031	0.980	-0.060	0.060	-0.079	0.079
North 24 Pgs	NP7	16	88.5	22.75	-0.034	0.028	0.984	-0.054	0.054	-0.071	0.071
North 24 Pgs	NP8	17	88.75	22.75	-0.044	0.027	0.984	-0.052	0.052	-0.069	0.069
North 24 Pgs	NP9	18	88.75	23	-0.353	0.032	0.975	-0.063	0.063	-0.082	0.082

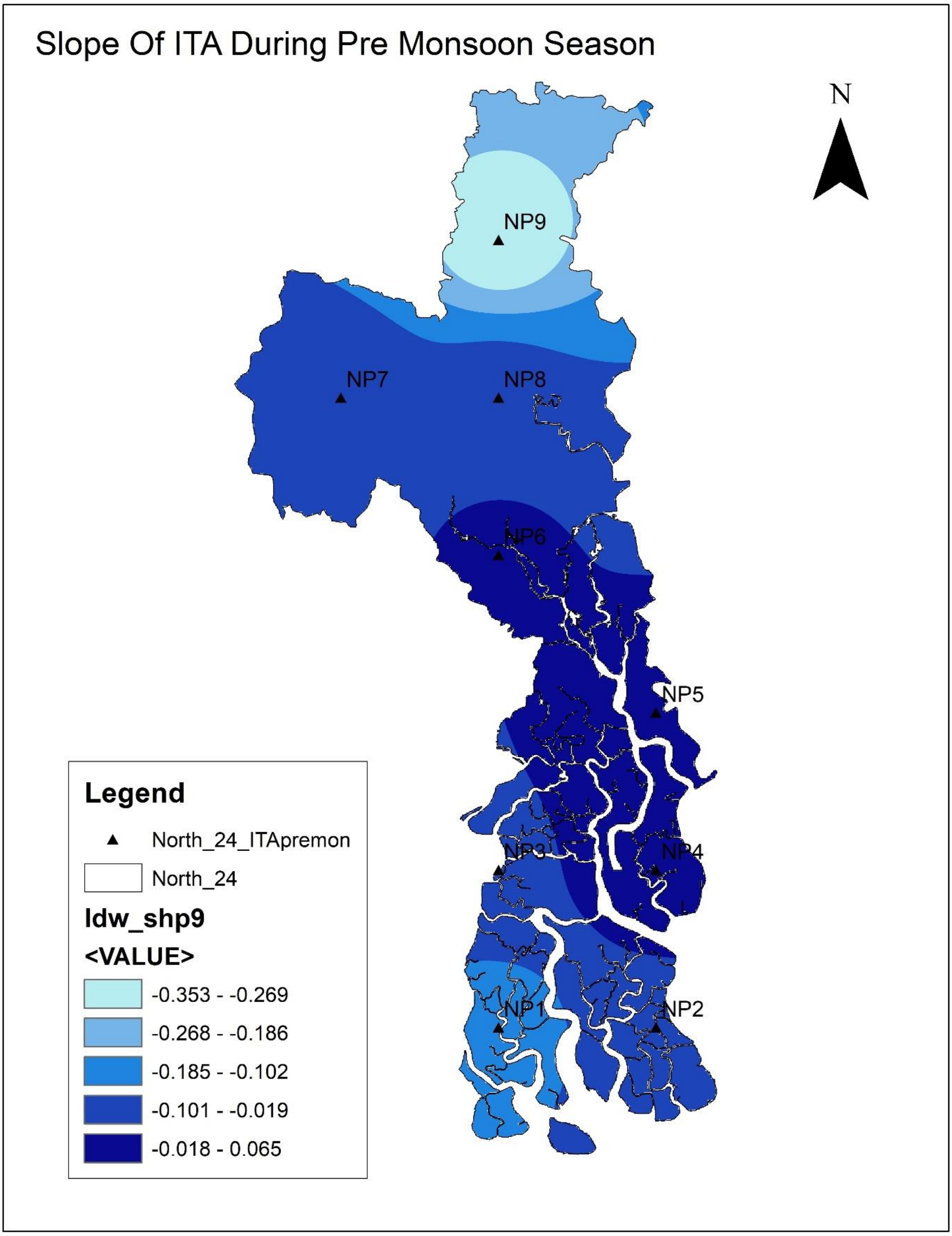


Fig. 4.2.11 ITA Slope Variation in North 24 PGS During Pre-Monsoon Season

Trend Analysis Curves for Pre-Monsoon Season:

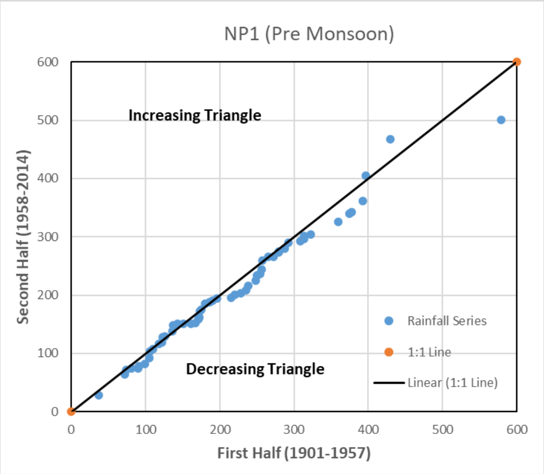


Fig 4.2.12 ITA plot for NP1 in Pre-Monsoon

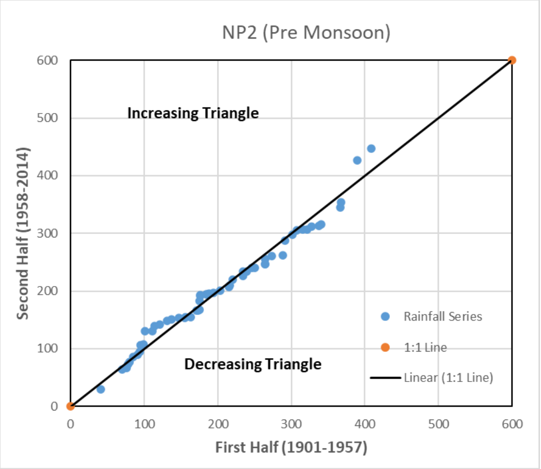


Fig 4.2.13 ITA plot for NP2 in Pre-Monsoon

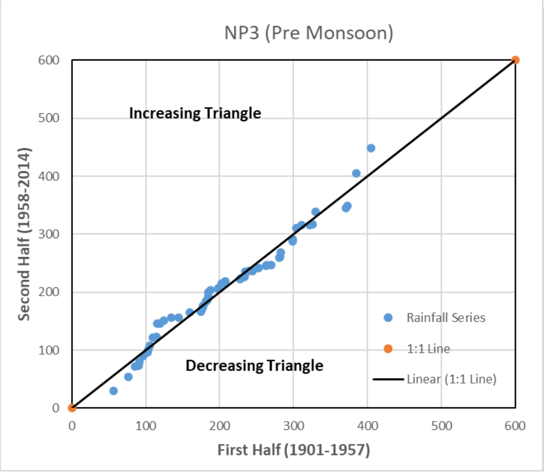


Fig 4.2.14 ITA plot for NP3 in Pre-Monsoon

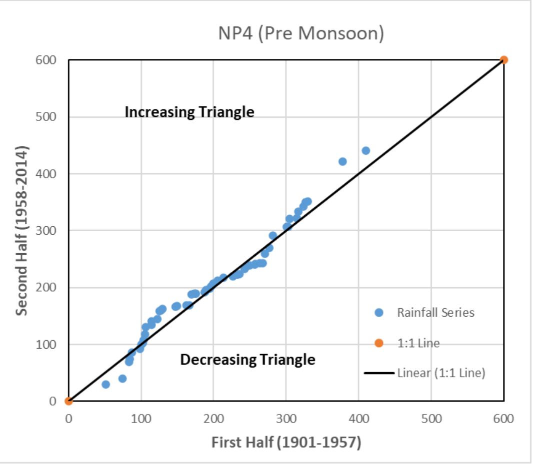


Fig 4.2.15 ITA plot for NP4 in Pre-Monsoon

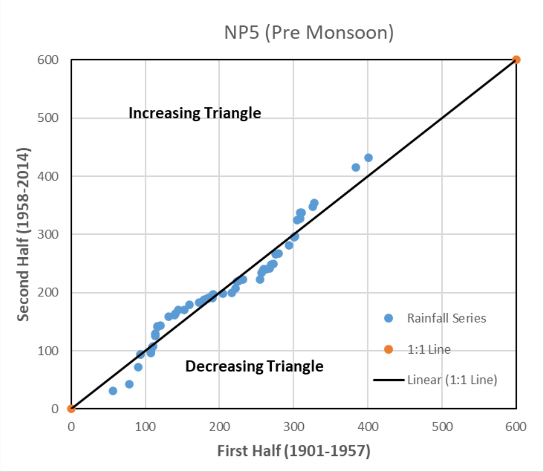


Fig 4.2.16 ITA plot for NP5 in Pre-Monsoon

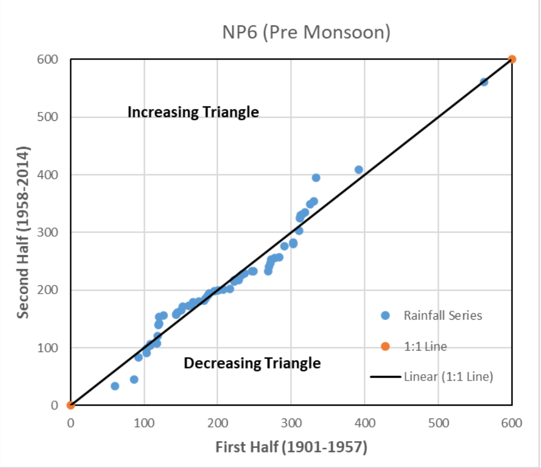


Fig 4.2.17 ITA plot for NP6 in Pre-Monsoon

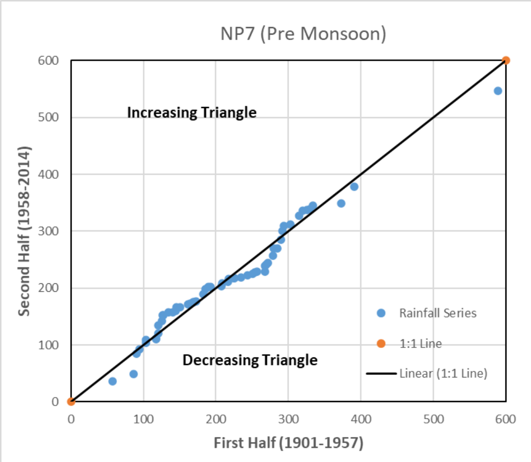


Fig 4.2.18 ITA plot for NP7 in Pre-Monsoon

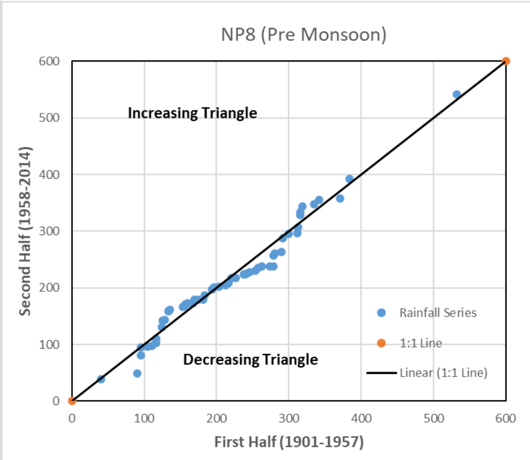


Fig 4.2.19 ITA plot for NP8 in Pre-Monsoon

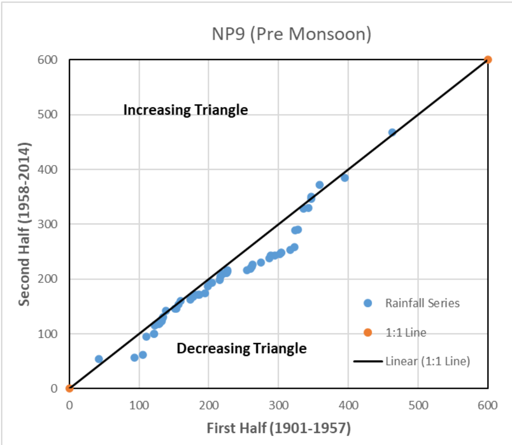


Fig 4.2.20 ITA plot for NP9 in Pre-Monsoon

For Monsoon Season, following are the Statistical Parameters;

Table 13

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
North 24 Pgs	NP1	10	88.75	21.75	1252.361	324.197	86293.717	1.682	8.367
North 24 Pgs	NP2	11	89	21.75	1228.478	331.678	88806.619	1.789	8.886
North 24 Pgs	NP3	12	88.75	22	1210.956	326.548	83747.968	1.694	7.509
North 24 Pgs	NP4	13	89	22	1173.789	336.635	82183.909	1.666	7.326
North 24 Pgs	NP5	14	89	22.25	1155.806	323.659	77463.548	1.193	3.954
North 24 Pgs	NP6	15	88.75	22.5	1147.934	309.737	76454.695	0.817	2.584
North 24 Pgs	NP7	16	88.5	22.75	1104.511	285.747	68673.135	0.750	1.248
North 24 Pgs	NP8	17	88.75	22.75	1093.276	280.048	60501.858	0.544	0.878
North 24 Pgs	NP9	18	88.75	23	1021.398	252.687	53239.656	0.665	1.951

For Monsoon Season, following are the Trend Parameters;

Table 14

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation $(\rho_{y_1 y_2})$	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
North 24 Pgs	NP1	10	88.75	21.75	3.081	0.217	0.917	-0.425	0.425	-0.559	0.559
North 24 Pgs	NP2	11	89	21.75	3.446	0.215	0.922	-0.422	0.422	-0.554	0.554
North 24 Pgs	NP3	12	88.75	22	3.758	0.199	0.931	-0.391	0.391	-0.514	0.514
North 24 Pgs	NP4	13	89	22	4.683	0.212	0.926	-0.416	0.416	-0.547	0.547
North 24 Pgs	NP5	14	89	22.25	4.656	0.185	0.940	-0.362	0.362	-0.476	0.476
North 24 Pgs	NP6	15	88.75	22.5	3.724	0.175	0.941	-0.343	0.343	-0.450	0.450
North 24 Pgs	NP7	16	88.5	22.75	3.241	0.129	0.962	-0.253	0.253	-0.332	0.332
North 24 Pgs	NP8	17	88.75	22.75	3.598	0.173	0.929	-0.340	0.340	-0.446	0.446
North 24 Pgs	NP9	18	88.75	23	1.635	0.192	0.893	-0.376	0.376	-0.494	0.494

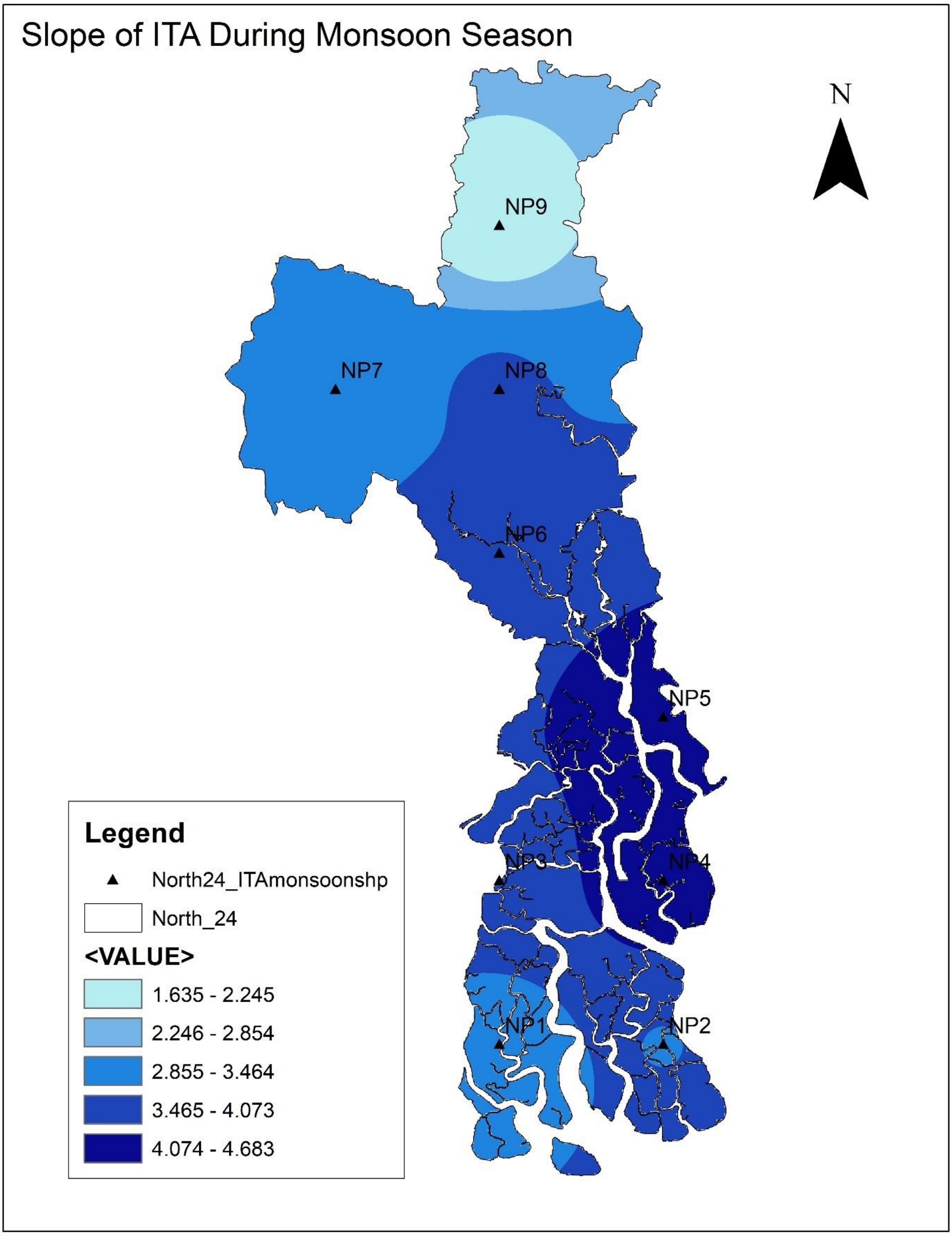


Fig. 4.2.21 ITA Slope Variation in North 24 PGS During Monsoon Season

Trend Analysis Curves for Monsoon Season:

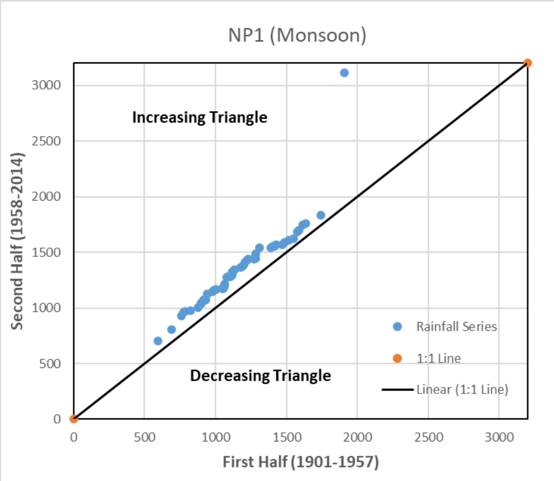


Fig 4.2.22 ITA plot for NP1 in Monsoon

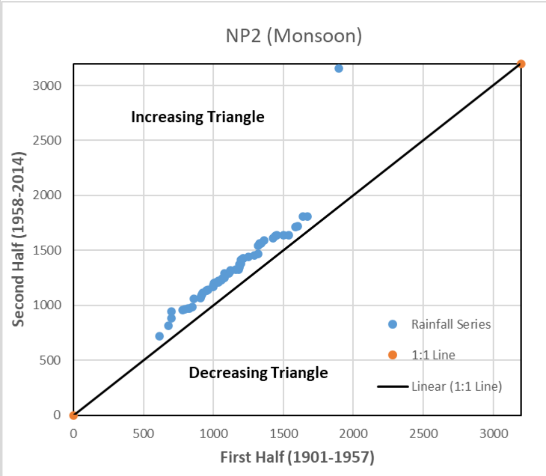


Fig 4.2.23 ITA plot for NP2 in Monsoon

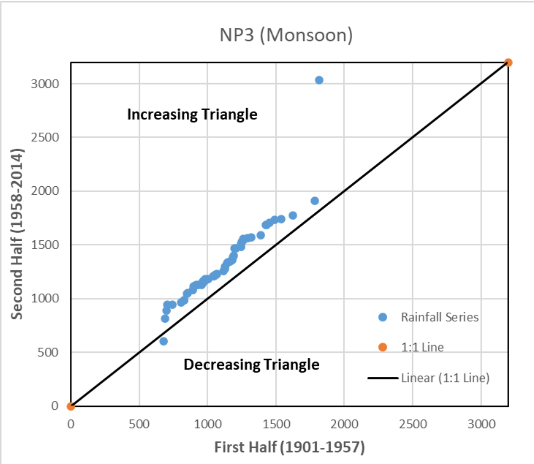


Fig 4.2.24 ITA plot for NP3 in Monsoon

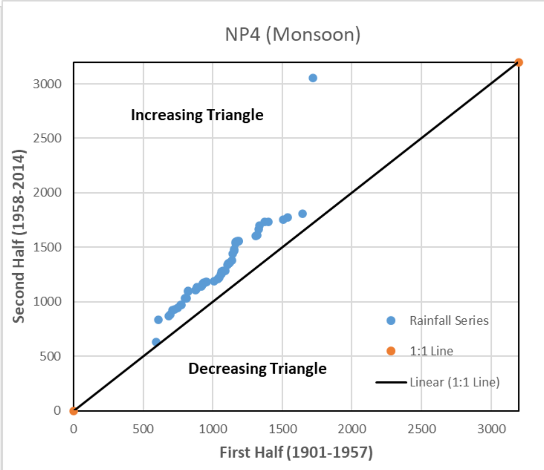


Fig 4.2.25 ITA plot for NP4 in Monsoon

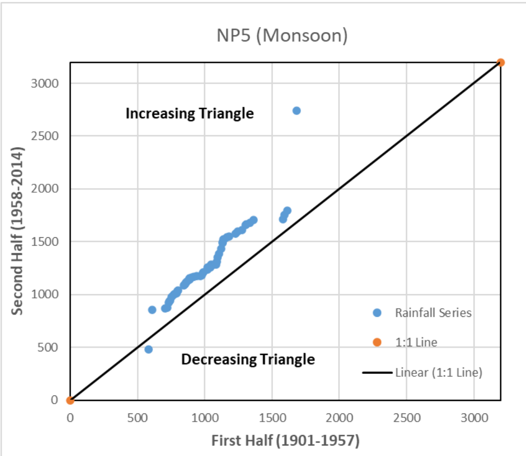


Fig 4.2.26 ITA plot for NP5 in Monsoon

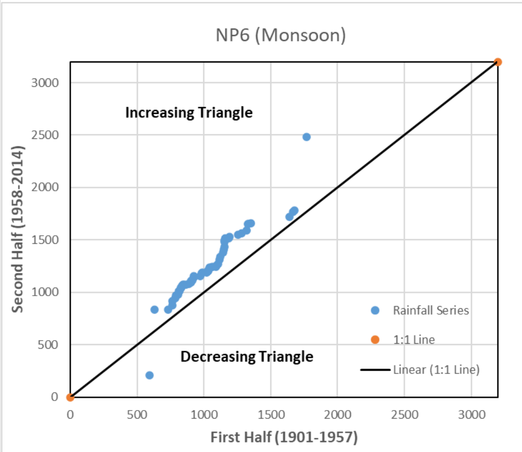
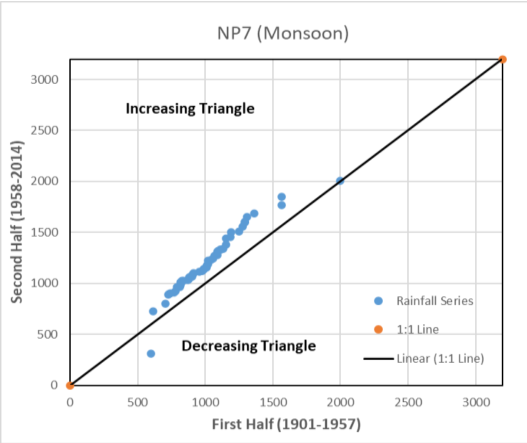


Fig 4.2.27 ITA plot for NP6 in Monsoon



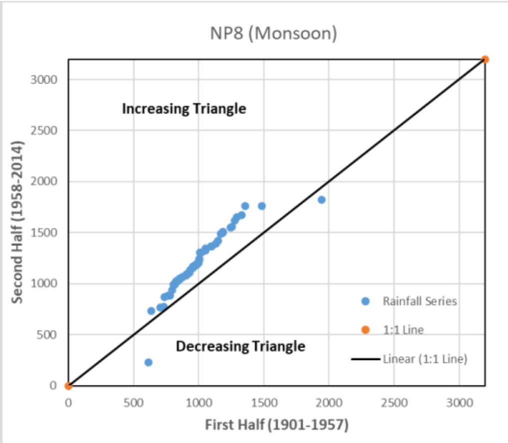


Fig 4.2.28 ITA plot for NP7 in Monsoon   Fig 4.2.29 ITA plot for NP8 in Monsoon

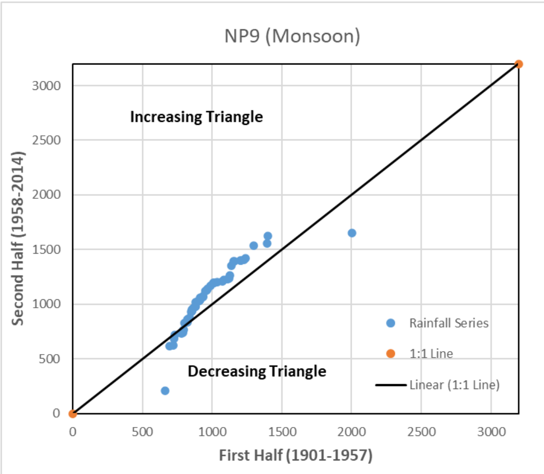


Fig 4.2.30 ITA plot for NP9 in Monsoon

For Post Monsoon Season, following are the Statistical parameters;

Table 15

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
North 24 Pgs	NP1	10	88.75	21.75	180.467	112.294	11685.867	0.898	0.535
North 24 Pgs	NP2	11	89	21.75	176.784	111.183	10930.595	1.047	1.247
North 24 Pgs	NP3	12	88.75	22	165.817	106.095	10240.428	0.950	0.705
North 24 Pgs	NP4	13	89	22	161.094	106.263	9837.961	1.087	1.279
North 24 Pgs	NP5	14	89	22.25	156.275	105.212	9675.100	1.073	1.200
North 24 Pgs	NP6	15	88.75	22.5	153.824	102.317	9462.632	0.956	0.799
North 24 Pgs	NP7	16	88.5	22.75	146.665	95.232	8201.183	0.895	0.507
North 24 Pgs	NP8	17	88.75	22.75	146.343	95.792	8207.311	0.983	0.855
North 24 Pgs	NP9	18	88.75	23	137.089	89.083	7298.920	0.899	0.418

For Post Monsoon Season, following are the Trend Parameters;

Table 16

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
North 24 Pgs	NP1	10	88.75	21.75	0.828	0.025	0.991	-0.050	0.050	-0.065	0.065
North 24 Pgs	NP2	11	89	21.75	0.981	0.037	0.979	-0.073	0.073	-0.096	0.096
North 24 Pgs	NP3	12	88.75	22	0.770	0.032	0.983	-0.063	0.063	-0.083	0.083
North 24 Pgs	NP4	13	89	22	0.924	0.037	0.978	-0.072	0.072	-0.094	0.094
North 24 Pgs	NP5	14	89	22.25	0.925	0.030	0.985	-0.059	0.059	-0.077	0.077
North 24 Pgs	NP6	15	88.75	22.5	0.841	0.023	0.991	-0.044	0.044	-0.058	0.058
North 24 Pgs	NP7	16	88.5	22.75	0.719	0.033	0.978	-0.064	0.064	-0.084	0.084
North 24 Pgs	NP8	17	88.75	22.75	0.799	0.026	0.987	-0.050	0.050	-0.066	0.066
North 24 Pgs	NP9	18	88.75	23	0.475	0.024	0.986	-0.048	0.048	-0.063	0.063

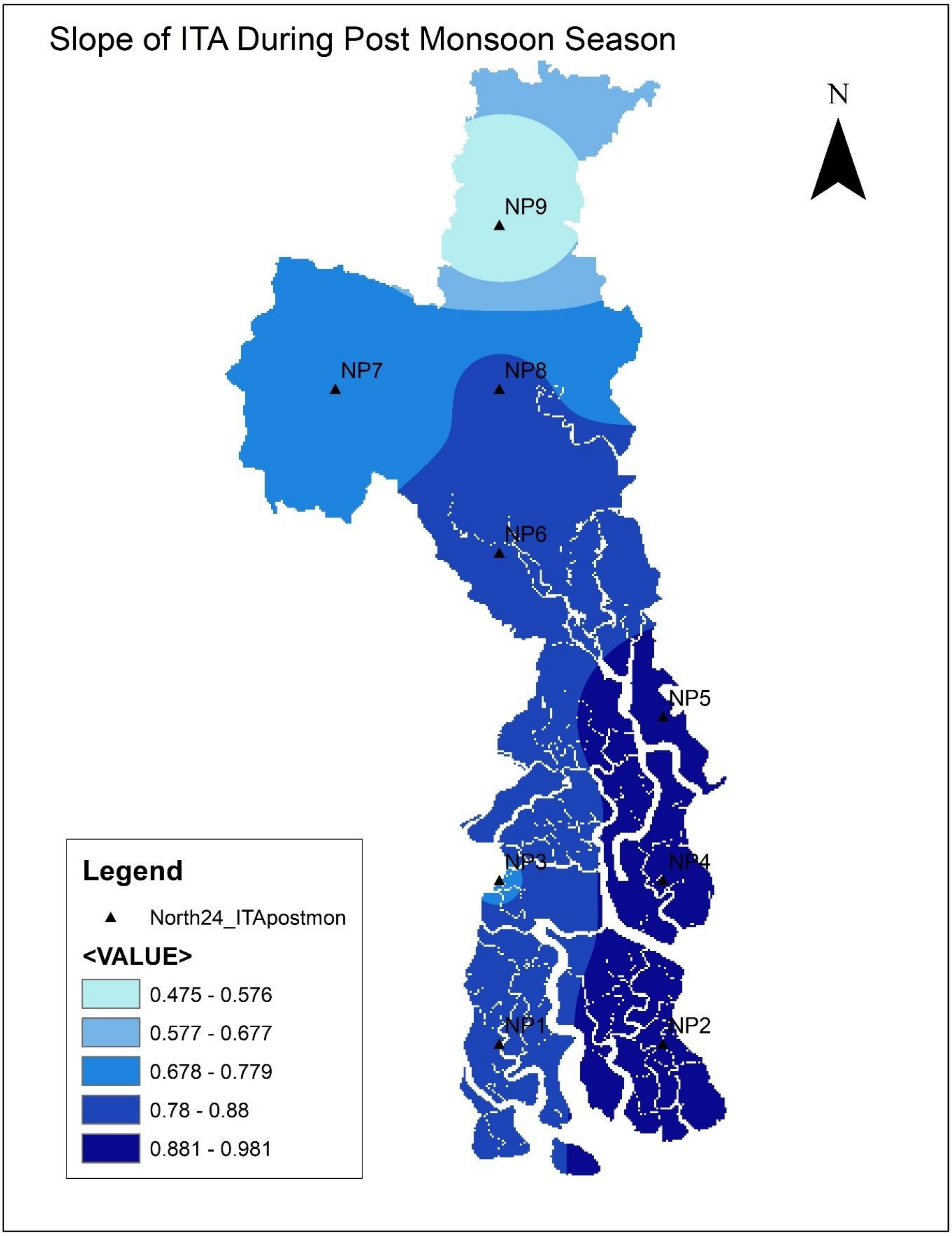


Fig. 4.2.31 ITA Slope Variation in North 24 PGS During Post Monsoon Season

Trend Analysis Curves for Post Monsoon Season:

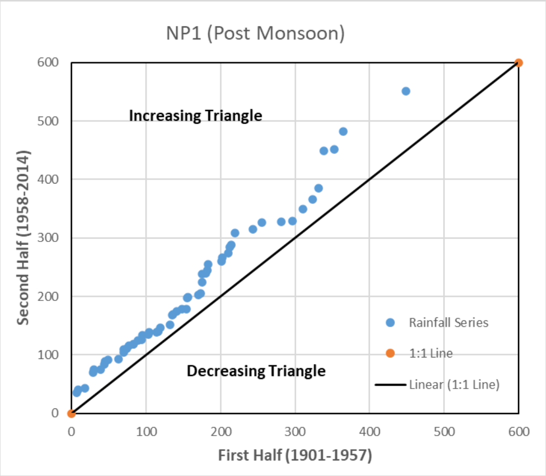


Fig 4.2.32 ITA plot for NP1 in Post Monsoon

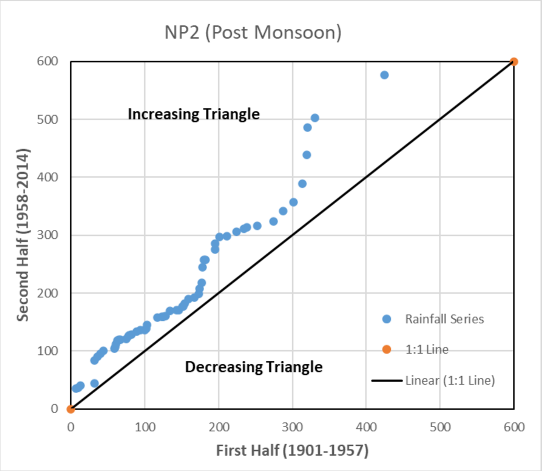


Fig 4.2.33 ITA plot for NP2 in Post Monsoon

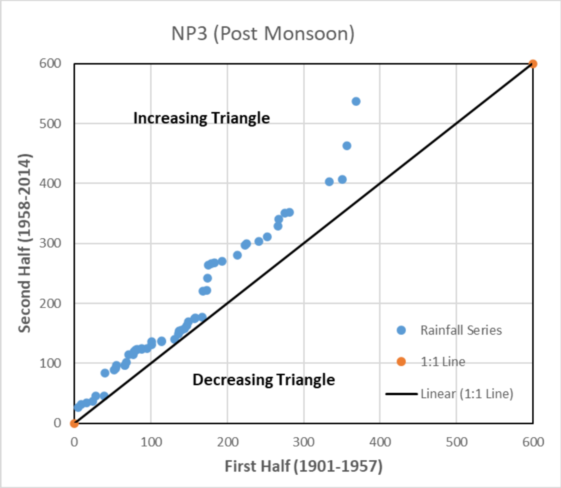


Fig 4.2.34 ITA plot for NP3 in Post Monsoon

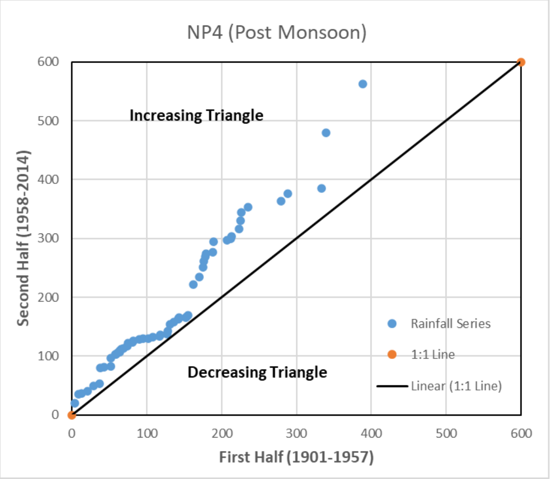


Fig 4.2.35 ITA plot for NP4 in Post Monsoon

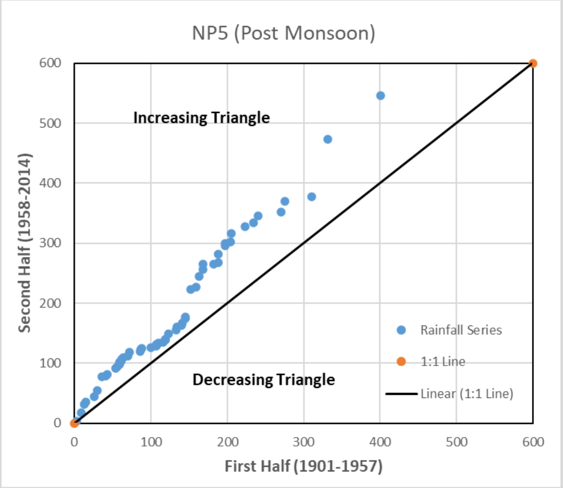


Fig 4.2.36 ITA plot for NP5 in Post Monsoon

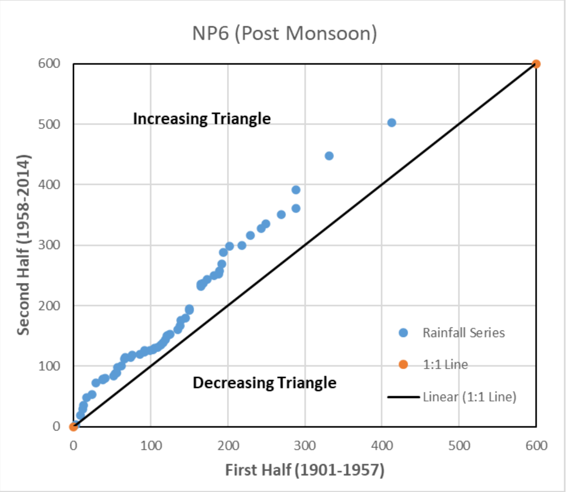


Fig 4.2.37 ITA plot for NP6 in Post Monsoon

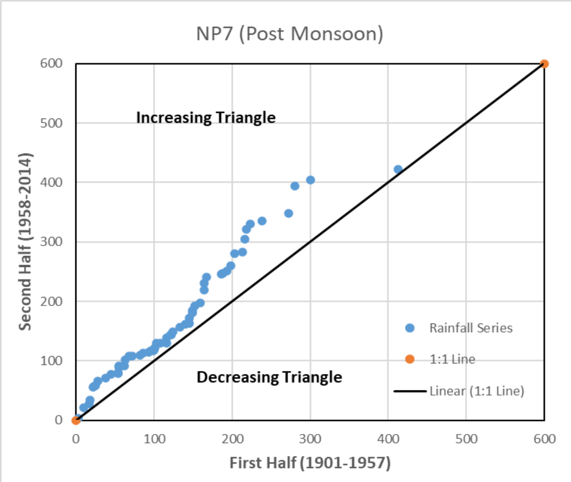


Fig 4.2.38 ITA plot for NP7 in Post Monsoon

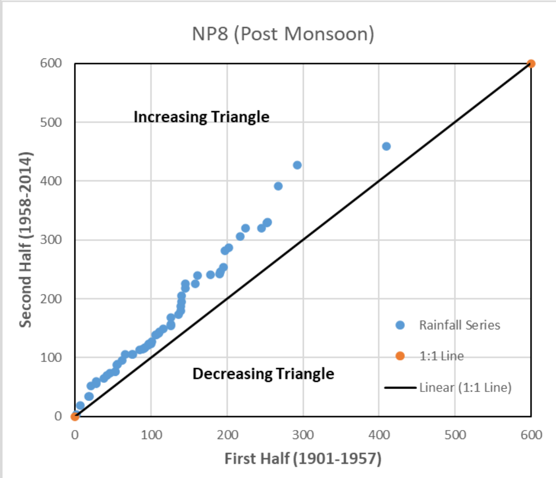


Fig 4.2.39 ITA plot for NP8 in Post Monsoon

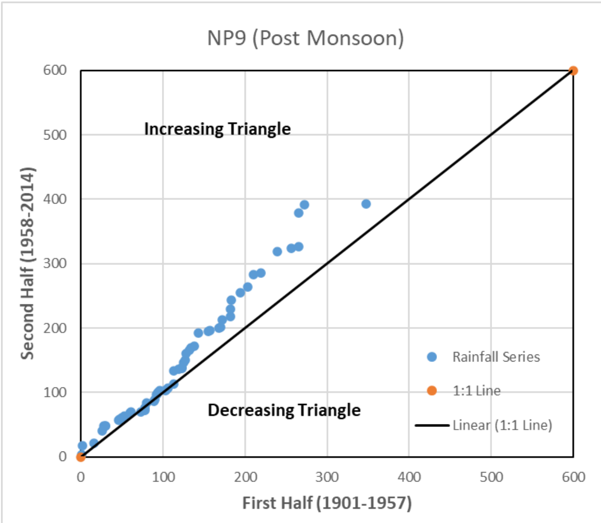


Fig 4.2.40 ITA plot for NP9 in Post Monsoon

4.3 Purba Medinipur:

For Winter Season, following are the Statistical Parameters;

Table 17

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purba Medinipur	Pb_M1	19	87.5	21.75	39.039	38.777	1437.686	1.441	2.088
Purba Medinipur	Pb_M2	20	87.75	21.75	40.709	38.931	1437.884	1.365	2.307
Purba Medinipur	Pb_M3	21	87.5	22	40.937	38.491	1405.542	1.411	2.436
Purba Medinipur	Pb_M4	22	87.75	22	41.932	39.792	1523.044	1.380	2.192
Purba Medinipur	Pb_M5	23	88	22	41.865	38.853	1439.021	1.408	2.854
Purba Medinipur	Pb_M6	24	87.75	22.25	42.322	38.944	1442.505	1.374	2.670

For Winter Season, following are the Trend Parameters;

Table 18

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purba Medinipur	Pb_M1	19	87.5	21.75	-0.147	0.010	0.988	-0.019	0.019	-0.026	0.026
Purba Medinipur	Pb_M2	20	87.75	21.75	-0.127	0.013	0.979	-0.026	0.026	-0.034	0.034
Purba Medinipur	Pb_M3	21	87.5	22	-0.150	0.010	0.987	-0.020	0.020	-0.026	0.026
Purba Medinipur	Pb_M4	22	87.75	22	-0.081	0.014	0.978	-0.027	0.027	-0.036	0.036
Purba Medinipur	Pb_M5	23	88	22	-0.091	0.013	0.980	-0.025	0.025	-0.033	0.033
Purba Medinipur	Pb_M6	24	87.75	22.25	-0.097	0.013	0.979	-0.026	0.026	-0.034	0.034

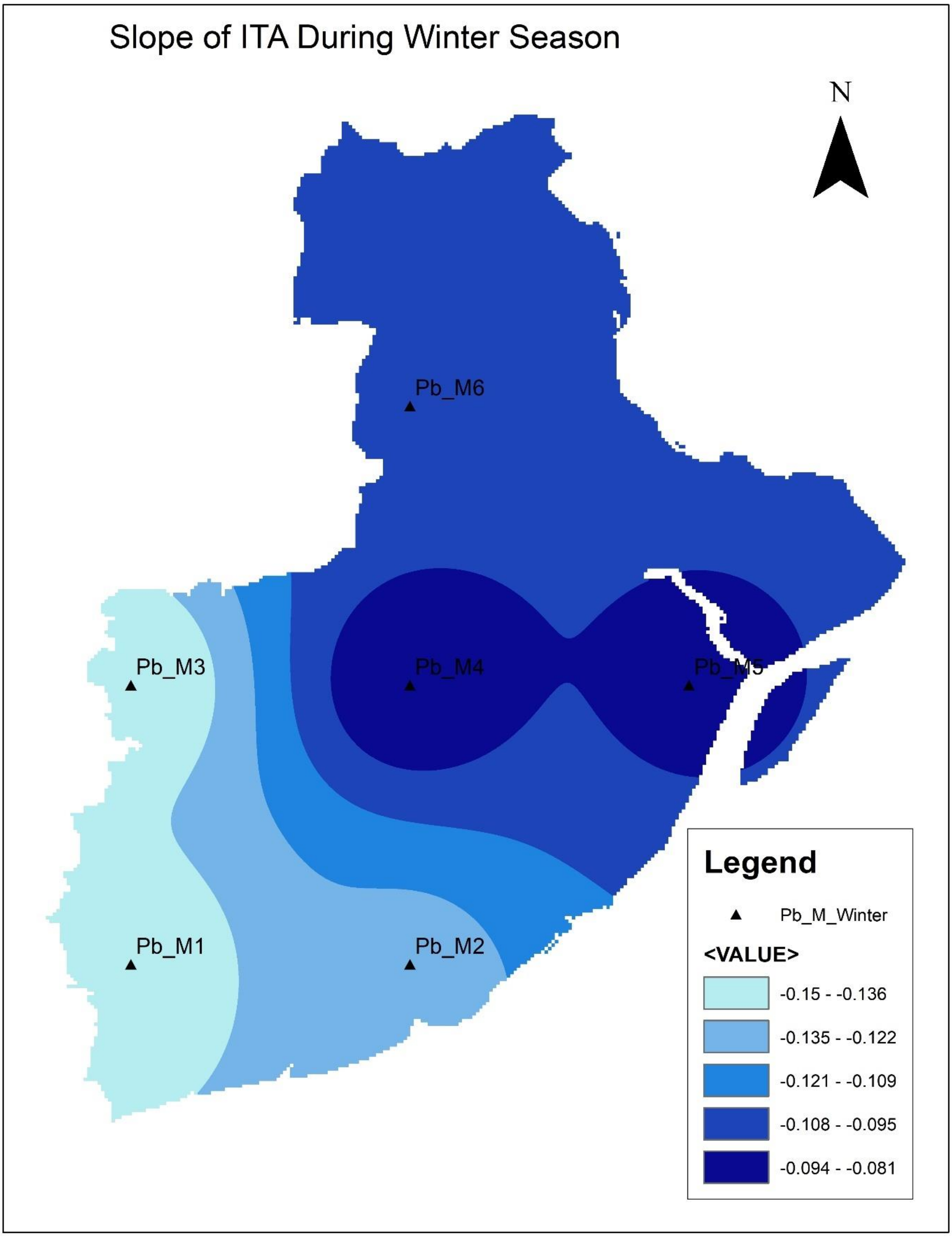


Fig. 4.3.1 ITA Slope Variation in Purba Medinipur During Winter Season

Trend Analysis Curves for Winter Season:

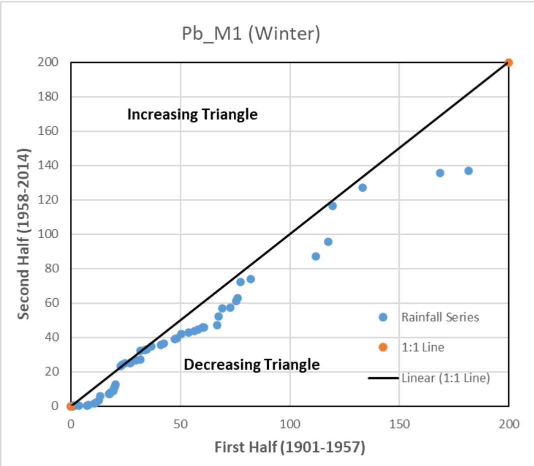


Fig 4.3.2 ITA plot for Pb_M1 in Winter

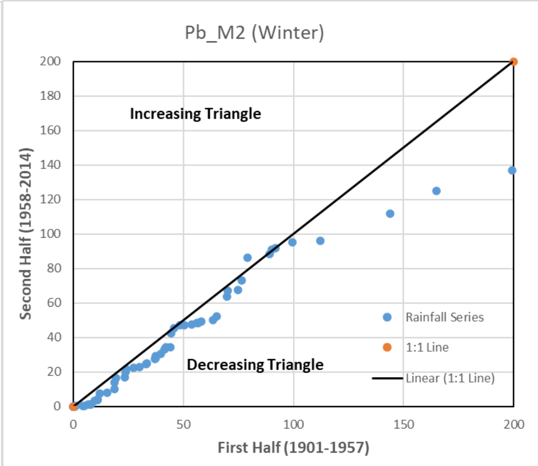


Fig 4.3.3 ITA plot for Pb_M2 in Winter

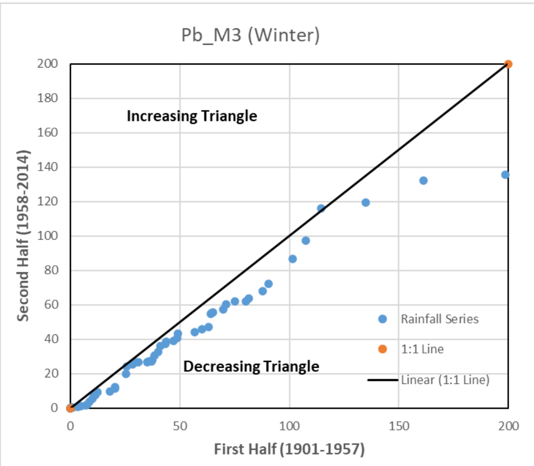


Fig 4.3.4 ITA plot for Pb_M3 in Winter

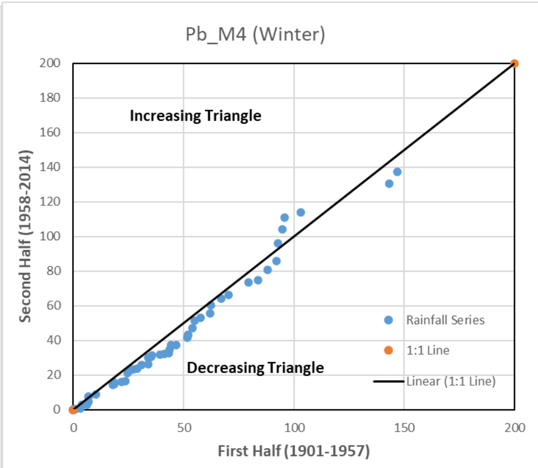


Fig 4.3.5 ITA plot for Pb_M4 in Winter

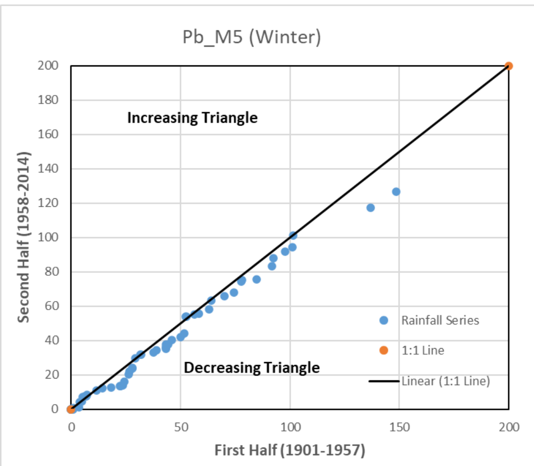


Fig 4.3.6 ITA plot for Pb_M5 in Winter

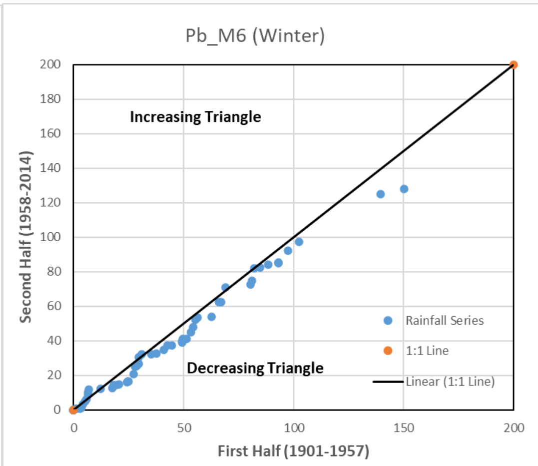


Fig 4.3.7 ITA plot for Pb_M6 in Winter

For Pre-Monsoon Season, following are the Statistical Parameters;

Table 19

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purba Medinipur	Pb_M1	19	87.5	21.75	186.864	108.428	10660.561	1.123	1.798
Purba Medinipur	Pb_M2	20	87.75	21.75	199.108	106.774	10330.122	0.806	0.947
Purba Medinipur	Pb_M3	21	87.5	22	204.622	105.249	10489.605	0.666	0.063
Purba Medinipur	Pb_M4	22	87.75	22	206.565	104.140	10439.719	0.523	-0.304
Purba Medinipur	Pb_M5	23	88	22	211.292	103.617	10450.378	0.723	0.494
Purba Medinipur	Pb_M6	24	87.75	22.25	214.080	101.964	10135.288	0.703	0.400

For Pre-Monsoon Season, following are the Trend Parameters;

Table 20

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purba Medinipur	Pb_M1	19	87.5	21.75	0.203	0.043	0.971	-0.084	0.084	-0.110	0.110
Purba Medinipur	Pb_M2	20	87.75	21.75	-0.212	0.059	0.943	-0.116	0.116	-0.152	0.152
Purba Medinipur	Pb_M3	21	87.5	22	-0.276	0.040	0.974	-0.078	0.078	-0.102	0.102
Purba Medinipur	Pb_M4	22	87.75	22	-0.504	0.023	0.991	-0.046	0.046	-0.060	0.060
Purba Medinipur	Pb_M5	23	88	22	-0.389	0.017	0.995	-0.033	0.033	-0.043	0.043
Purba Medinipur	Pb_M6	24	87.75	22.25	-0.344	0.019	0.994	-0.037	0.037	-0.048	0.048

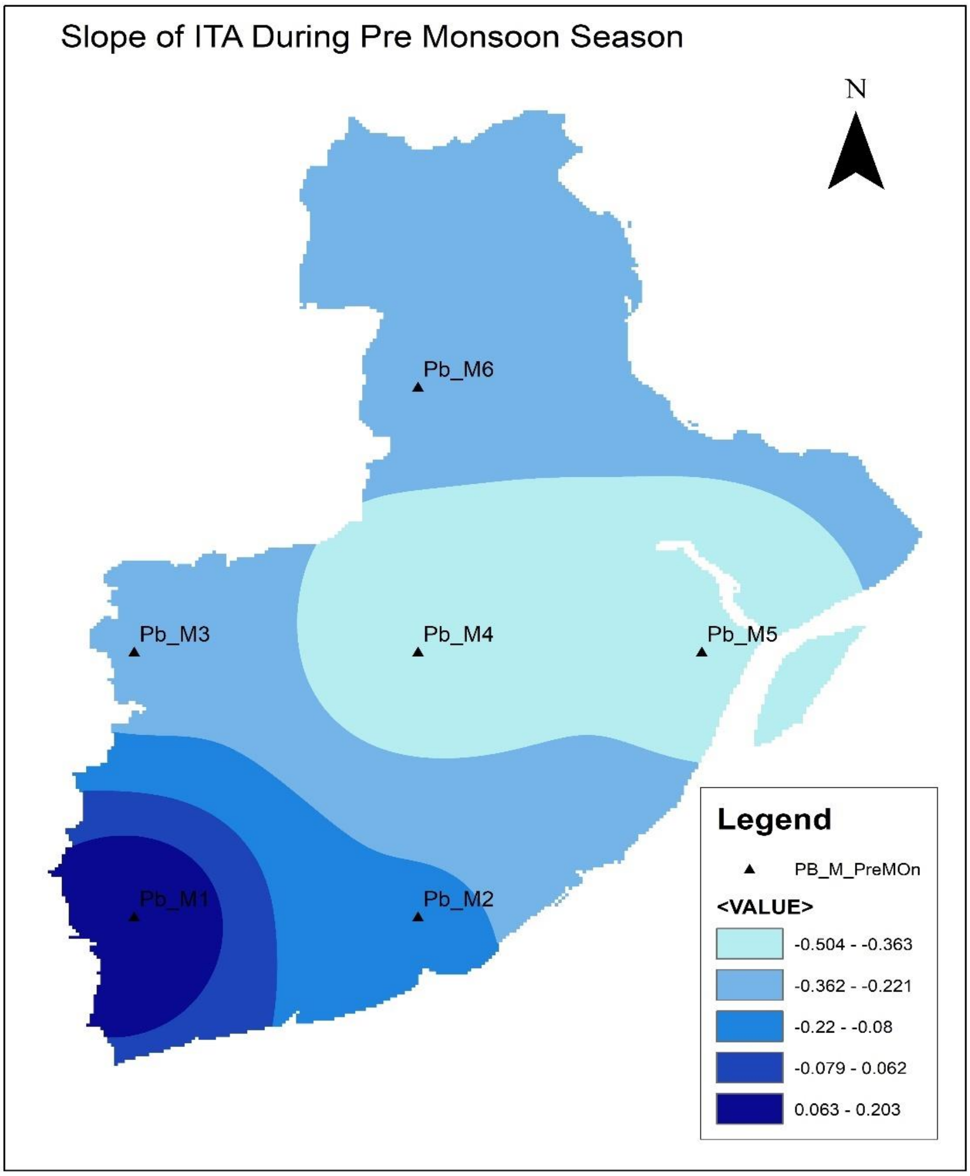


Fig. 4.3.8 ITA Slope Variation in Purba Medinipur During Pre-Monsoon Season

Trend Analysis Curves for Pre-Monsoon Season:

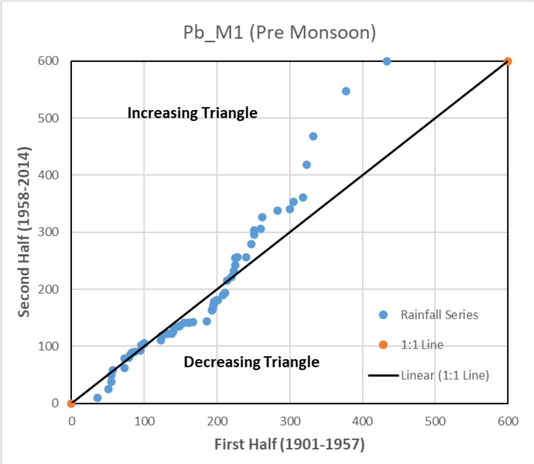


Fig 4.3.9 ITA plot for Pb_M1 in Pre-Monsoon

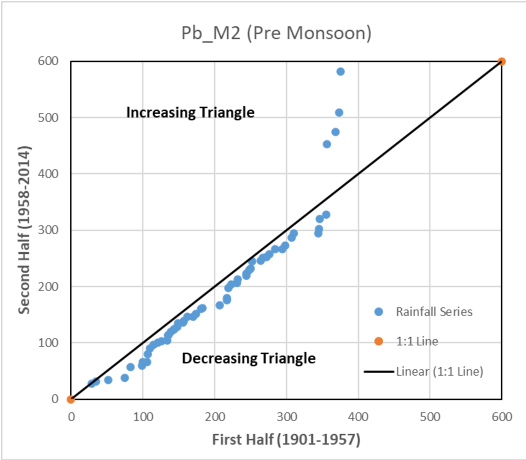


Fig 4.3.10 ITA plot for Pb_M2 in Pre-Monsoon

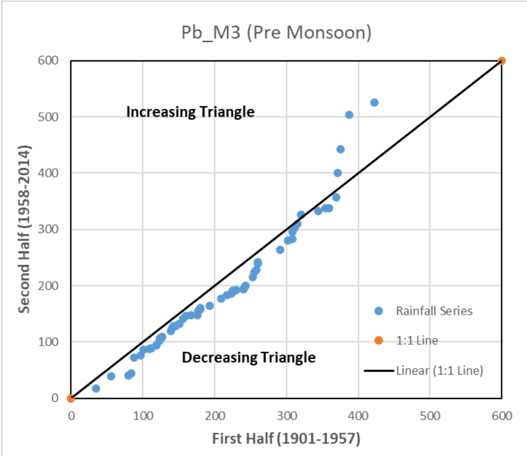


Fig 4.3.11 ITA plot for Pb_M3 in Pre-Monsoon

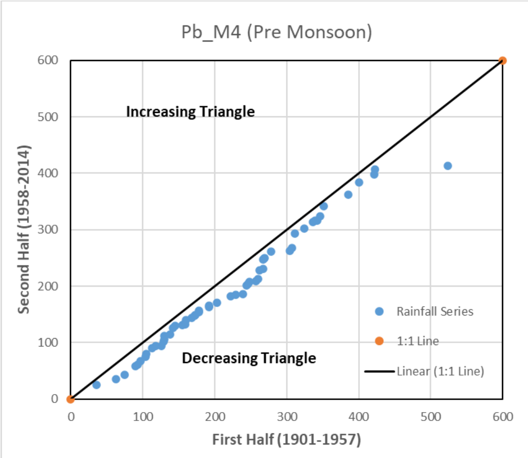


Fig 4.3.12 ITA plot for Pb_M4 in Pre-Monsoon

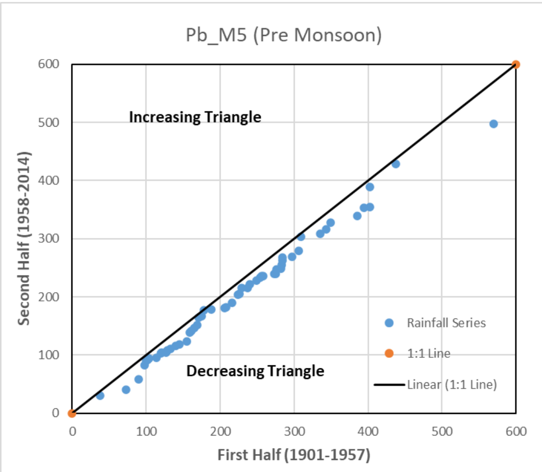


Fig 4.3.13 ITA plot for Pb_M5 in Pre-Monsoon

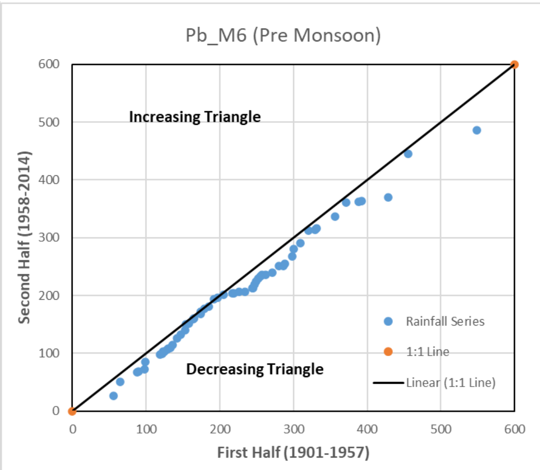


Fig 4.3.14 ITA plot for Pb_M6 in Pre-Monsoon

For Monsoon Season, following are the Statistical Parameters;

Table 21

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purba Medinipur	Pb_M1	19	87.5	21.75	1178.090	270.823	65012.885	0.866	1.426
Purba Medinipur	Pb_M2	20	87.75	21.75	1285.961	305.947	71994.795	1.480	4.955
Purba Medinipur	Pb_M3	21	87.5	22	1237.098	249.580	59467.013	0.562	0.901
Purba Medinipur	Pb_M4	22	87.75	22	1271.757	270.327	67758.161	0.320	-0.036
Purba Medinipur	Pb_M5	23	88	22	1263.151	281.894	71836.333	0.684	1.350
Purba Medinipur	Pb_M6	24	87.75	22.25	1235.728	291.313	79911.130	0.741	0.977

For Monsoon Season, following are the Trend Parameters;

Table 22

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purba Medinipur	Pb_M1	19	87.5	21.75	2.584	0.104	0.972	-0.205	0.205	-0.269	0.269
Purba Medinipur	Pb_M2	20	87.75	21.75	3.581	0.160	0.949	-0.314	0.314	-0.412	0.412
Purba Medinipur	Pb_M3	21	87.5	22	1.116	0.083	0.980	-0.163	0.163	-0.214	0.214
Purba Medinipur	Pb_M4	22	87.75	22	1.987	0.090	0.979	-0.177	0.177	-0.233	0.233
Purba Medinipur	Pb_M5	23	88	22	1.983	0.145	0.951	-0.285	0.285	-0.374	0.374
Purba Medinipur	Pb_M6	24	87.75	22.25	1.291	0.121	0.968	-0.238	0.238	-0.312	0.312

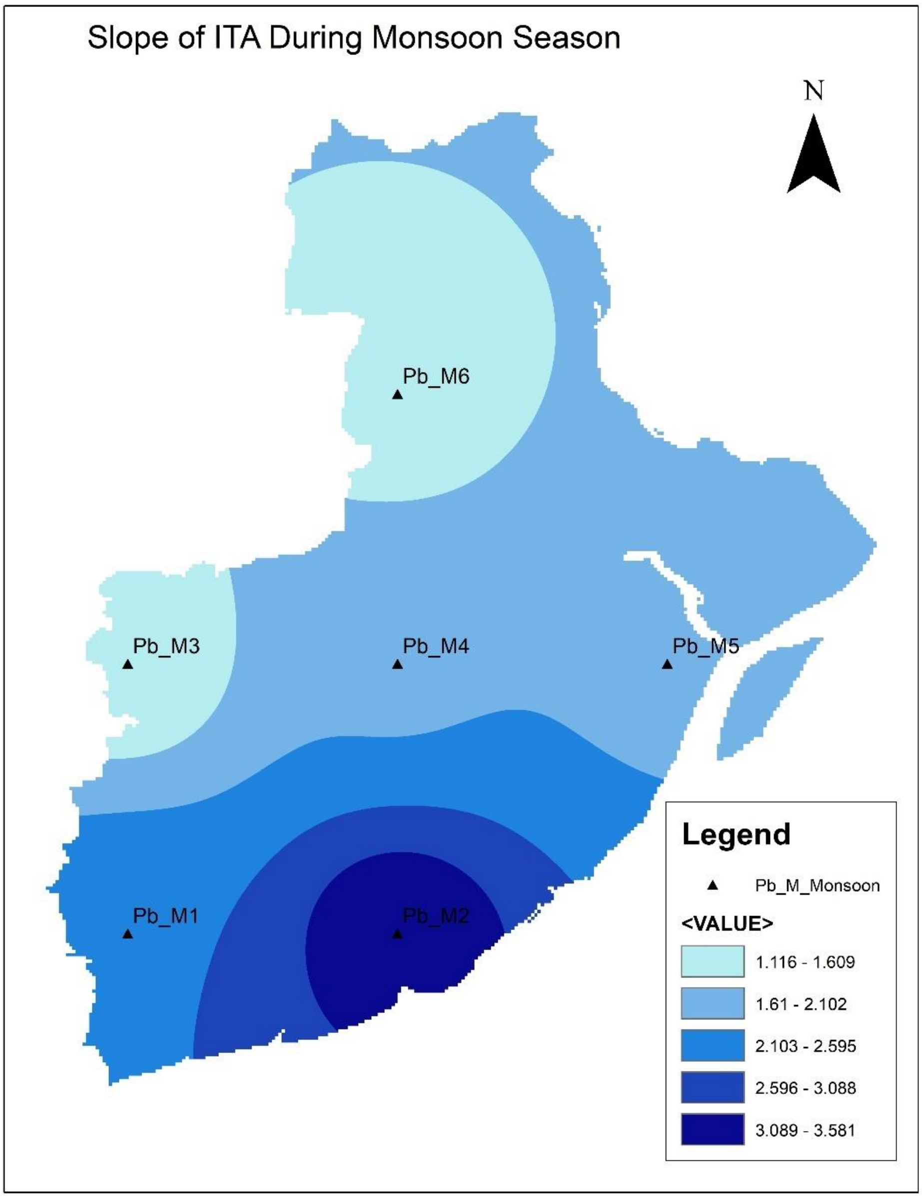


Fig. 4.3.15 ITA Slope Variation in Purba Medinipur During Monsoon Season

Trend Analysis Curves for Monsoon Season:

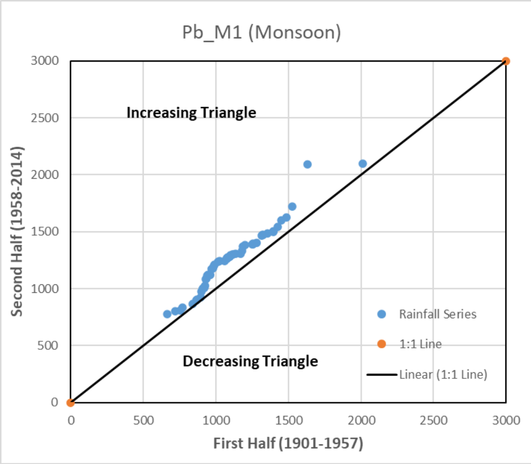


Fig 4.3.16 ITA plot for Pb_M1 in Monsoon

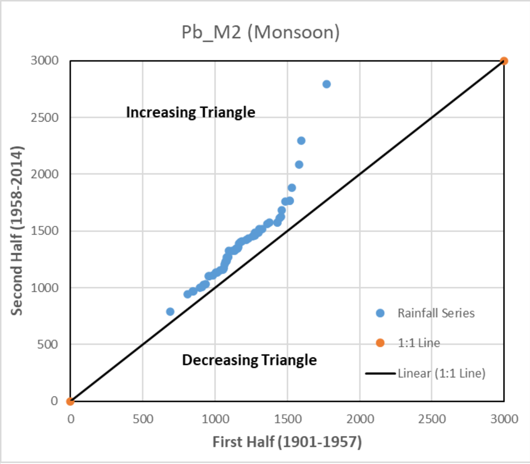


Fig 4.3.17 ITA plot for Pb_M2 in Monsoon

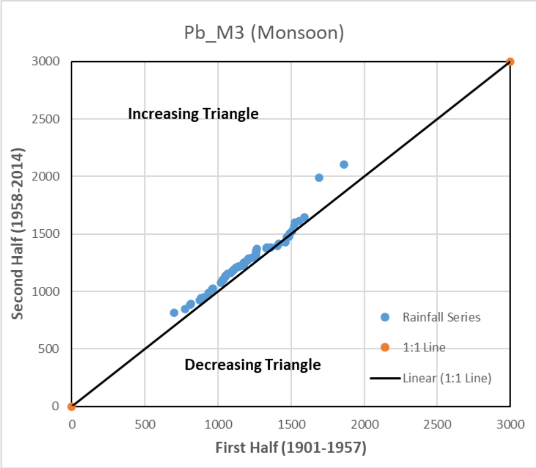


Fig 4.3.18 ITA plot for Pb_M3 in Monsoon

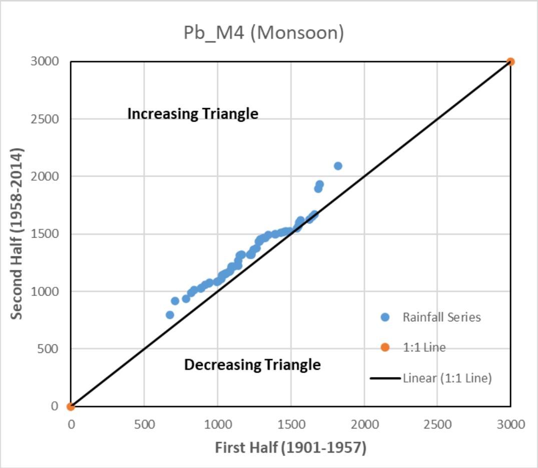


Fig 4.3.19 ITA plot for Pb_M4 in Monsoon

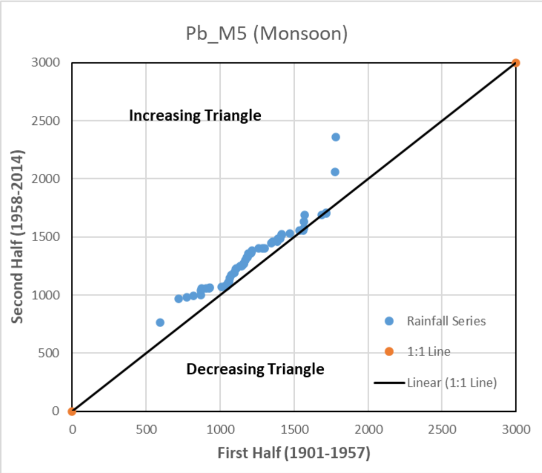


Fig 4.3.20 ITA plot for Pb_M5 in Monsoon

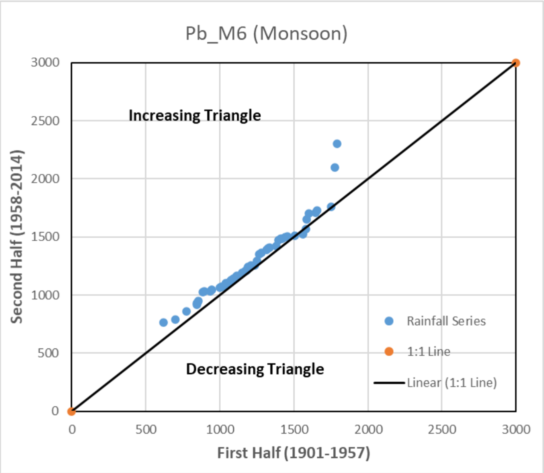


Fig 4.3.21 ITA plot for Pb_M6 in Monsoon

For Post Monsoon Season, following are the Statistical Parameters;

Table 23

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purba Medinipur	Pb_M1	19	87.5	21.75	213.775	155.806	23378.143	1.396	2.264
Purba Medinipur	Pb_M2	20	87.75	21.75	213.131	145.067	19499.972	1.059	0.878
Purba Medinipur	Pb_M3	21	87.5	22	196.855	135.347	17457.625	1.287	1.689
Purba Medinipur	Pb_M4	22	87.75	22	186.720	124.159	14460.024	1.058	1.045
Purba Medinipur	Pb_M5	23	88	22	181.908	116.141	12855.684	0.919	0.558
Purba Medinipur	Pb_M6	24	87.75	22.25	163.038	103.676	10412.038	0.891	0.354

For Post Monsoon Season, following are the Trend Parameters;

Table 24

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purba Medinipur	Pb_M1	19	87.5	21.75	0.168	0.052	0.979	-0.103	0.103	-0.135	0.135
Purba Medinipur	Pb_M2	20	87.75	21.75	0.903	0.031	0.992	-0.060	0.060	-0.079	0.079
Purba Medinipur	Pb_M3	21	87.5	22	0.422	0.044	0.980	-0.087	0.087	-0.114	0.114
Purba Medinipur	Pb_M4	22	87.75	22	0.639	0.046	0.975	-0.090	0.090	-0.118	0.118
Purba Medinipur	Pb_M5	23	88	22	0.624	0.029	0.988	-0.057	0.057	-0.075	0.075
Purba Medinipur	Pb_M6	24	87.75	22.25	0.309	0.020	0.993	-0.040	0.040	-0.052	0.052

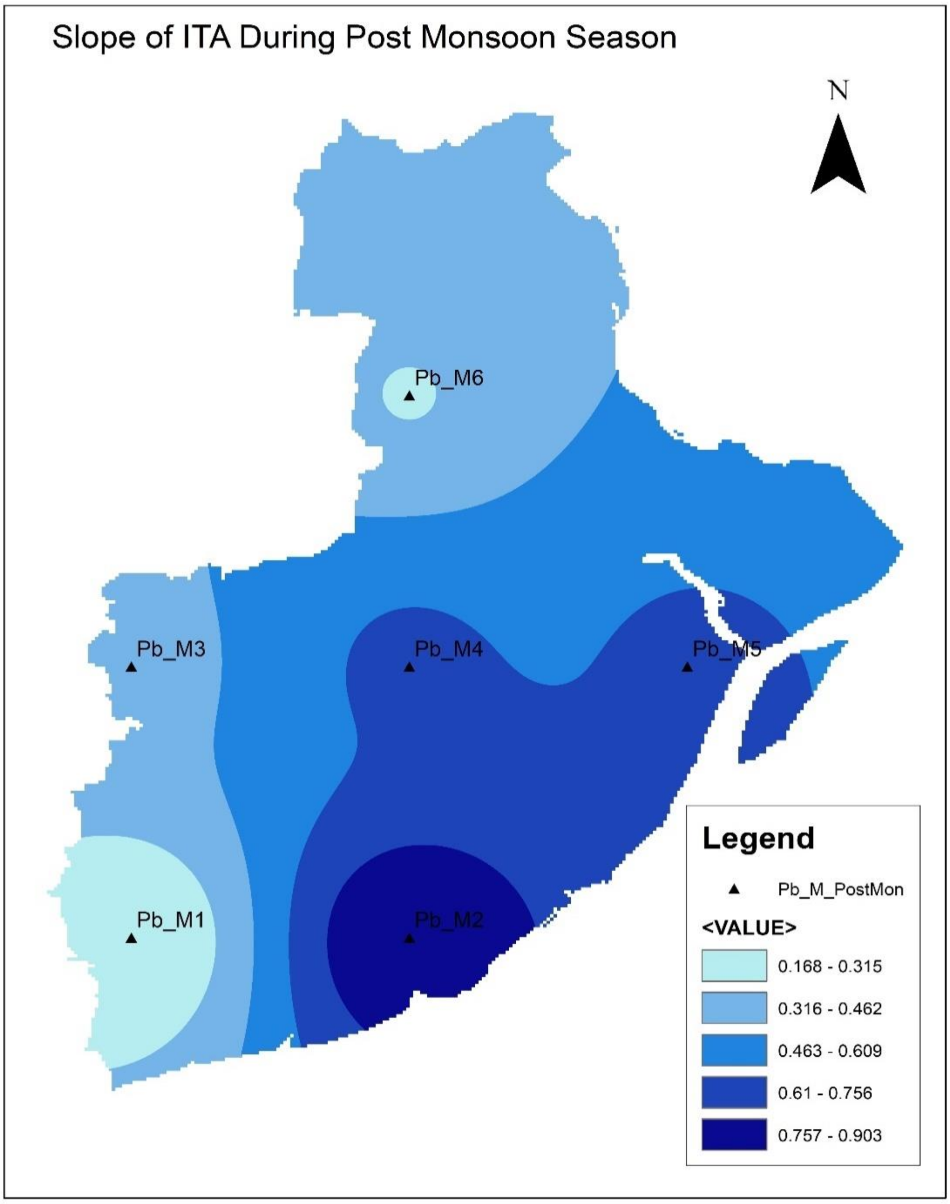


Fig. 4.3.22 ITA Slope Variation in Purba Medinipur During Post Monsoon Season

Trend Analysis Curves for Post Monsoon Season:

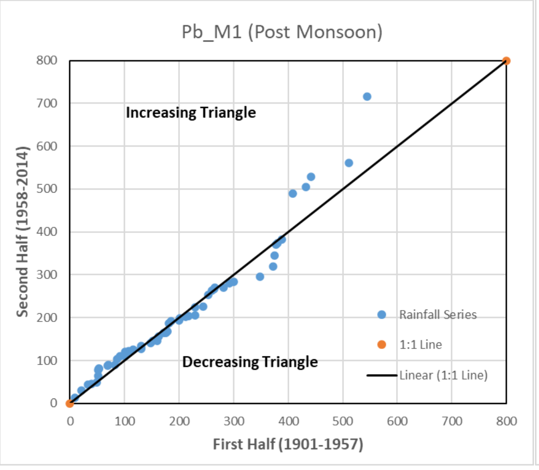


Fig 4.3.23 ITA plot for Pb_M1 in Post Monsoon

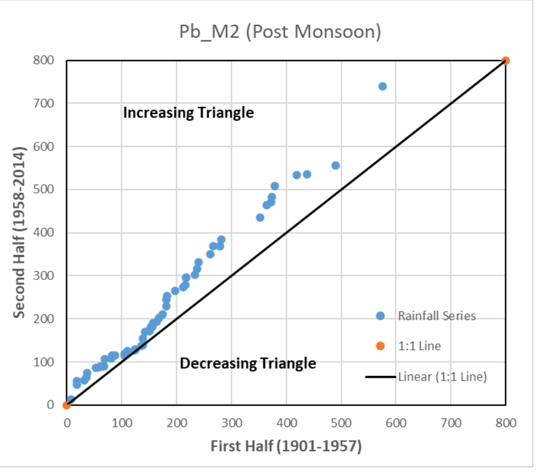


Fig 4.3.24 ITA plot for Pb_M2 in Post Monsoon

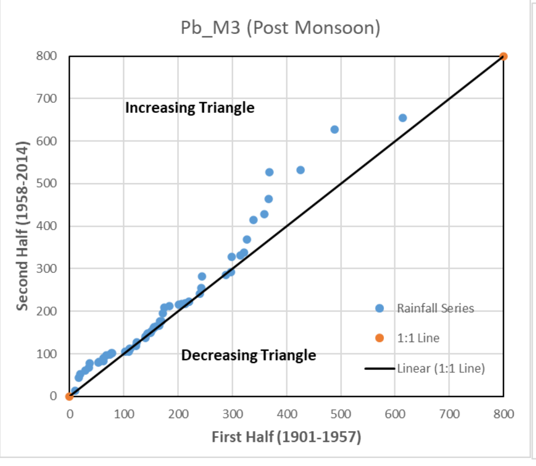


Fig 4.3.25 ITA plot for Pb_M3 in Post Monsoon

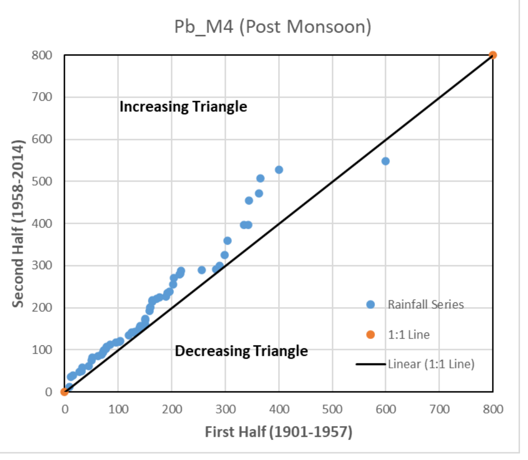


Fig 4.3.26 ITA plot for Pb_M4 in Post Monsoon

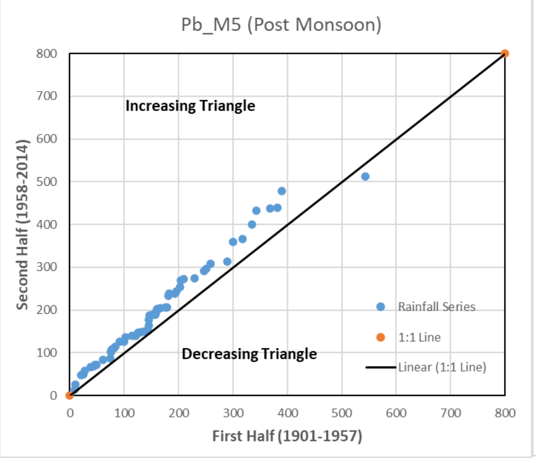


Fig 4.3.27 ITA plot for Pb_M5 in Post Monsoon

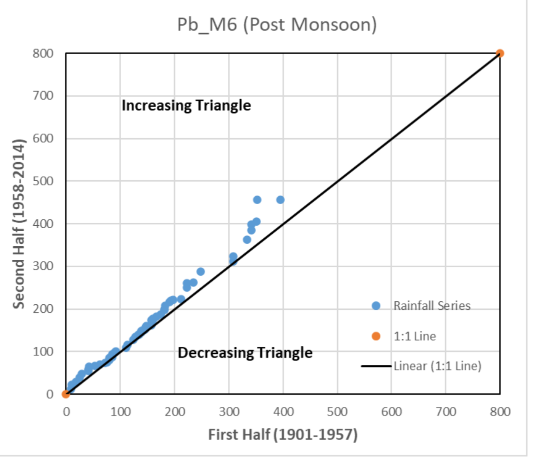


Fig 4.3.28 ITA plot for Pb_M6 in Post Monsoon

4.4 Paschim Medinipur:

For Winter Season, following are the Statistical Parameters;

Table 25

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Pashchim Medinipur	Ps_M1	25	87.25	22	39.901	38.384	1401.921	1.386	2.013
Pashchim Medinipur	Ps_M2	26	87.25	22.25	40.179	37.195	1292.240	1.399	2.356
Pashchim Medinipur	Ps_M3	27	87.5	22.25	40.596	37.305	1318.427	1.335	2.323
Pashchim Medinipur	Ps_M4	28	87.25	22.5	38.588	36.422	1262.256	1.290	1.674
Pashchim Medinipur	Ps_M5	29	87.5	22.5	39.492	37.382	1297.922	1.360	2.405
Pashchim Medinipur	Ps_M6	30	87.75	22.5	41.353	39.496	1421.241	1.521	3.791
Pashchim Medinipur	Ps_M7	31	87.25	22.75	34.715	33.324	925.223	1.375	1.888
Pashchim Medinipur	Ps_M8	32	87.5	22.75	35.229	34.713	1025.349	1.378	1.841

For Winter Season, following are the Trend Parameters;

Table 26

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Pashchim Medinipur	Ps_M1	25	87.25	22	-0.135	0.008	0.991	-0.017	0.017	-0.022	0.022
Pashchim Medinipur	Ps_M2	26	87.25	22.25	-0.151	0.012	0.982	-0.023	0.023	-0.030	0.030
Pashchim Medinipur	Ps_M3	27	87.5	22.25	-0.135	0.009	0.988	-0.019	0.019	-0.024	0.024
Pashchim Medinipur	Ps_M4	28	87.25	22.5	-0.118	0.009	0.990	-0.017	0.017	-0.022	0.022
Pashchim Medinipur	Ps_M5	29	87.5	22.5	-0.168	0.010	0.987	-0.020	0.020	-0.026	0.026
Pashchim Medinipur	Ps_M6	30	87.75	22.5	-0.201	0.012	0.984	-0.023	0.023	-0.030	0.030
Pashchim Medinipur	Ps_M7	31	87.25	22.75	-0.162	0.016	0.959	-0.031	0.031	-0.040	0.040
Pashchim Medinipur	Ps_M8	32	87.5	22.75	-0.210	0.012	0.979	-0.023	0.023	-0.030	0.030

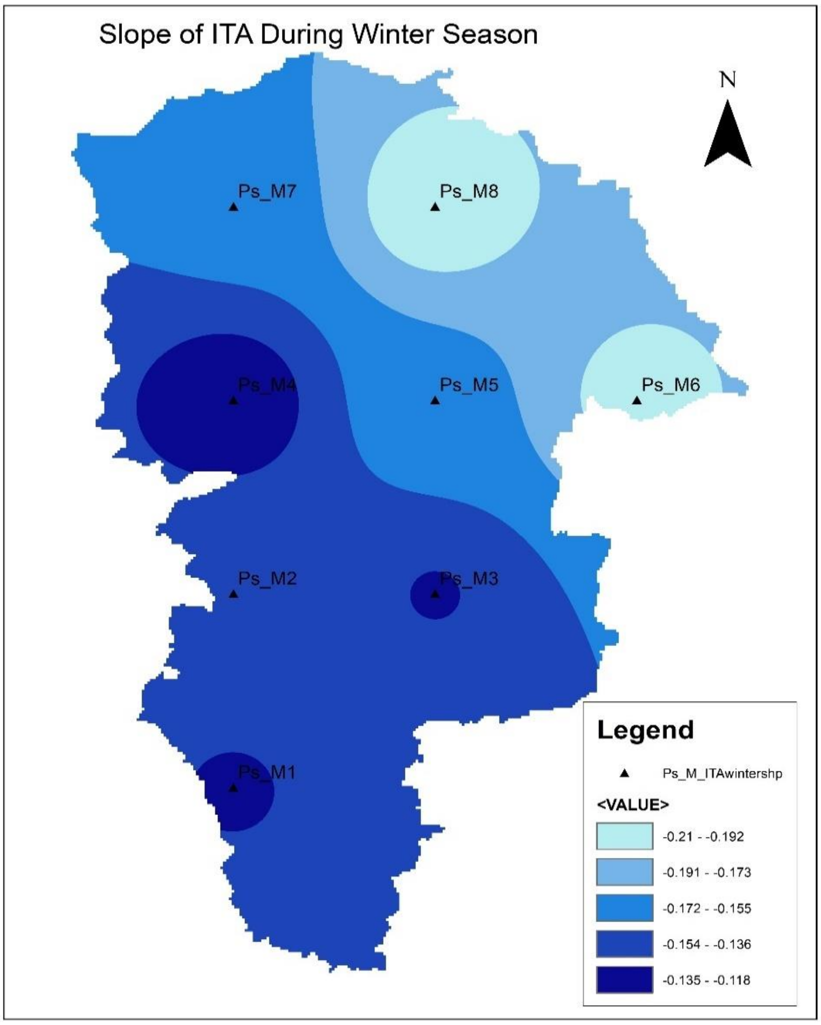


Fig. 4.4.1 ITA Slope Variation in Pashchim Medinipur During Winter Season

Trend Analysis Curves for Winter Season:

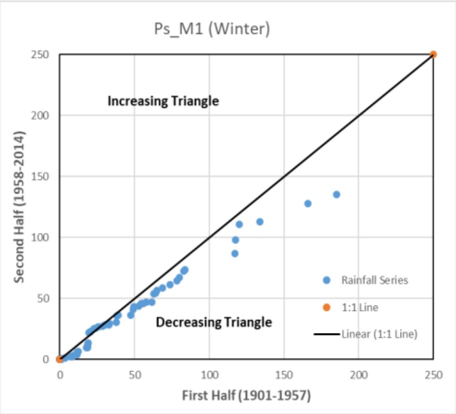


Fig 4.4.2 ITA plot for Ps_M1 in Winter

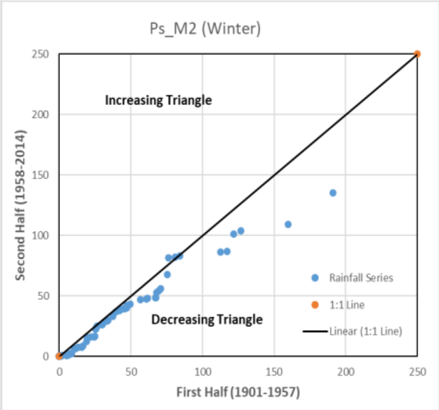


Fig 4.4.3 ITA plot for Ps_M2 in Winter

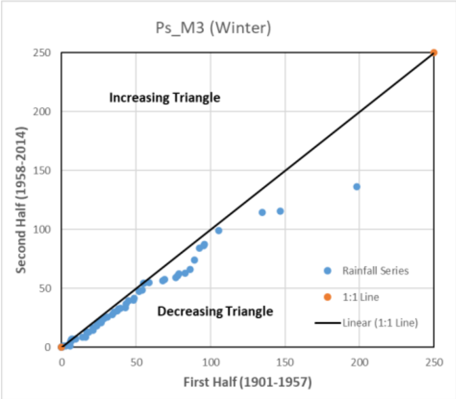


Fig 4.4.4 ITA plot for Ps_M3 in Winter

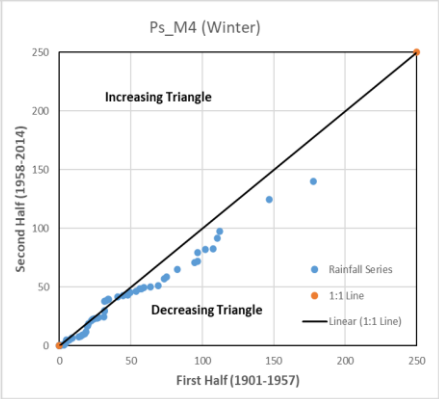


Fig 4.4.5 ITA plot for Ps_M4 in Winter

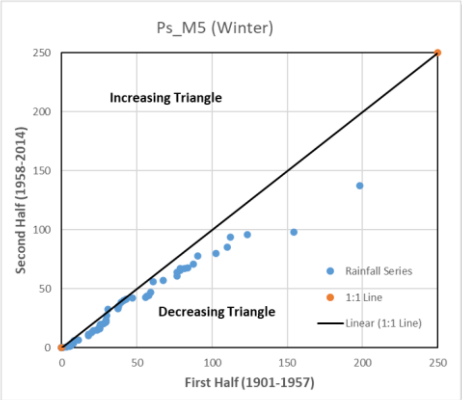


Fig 4.4.6 ITA plot for Ps_M5 in Winter

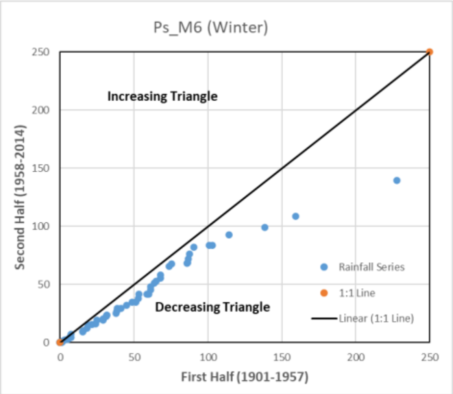


Fig 4.4.7 ITA plot for Ps_M6 in Winter

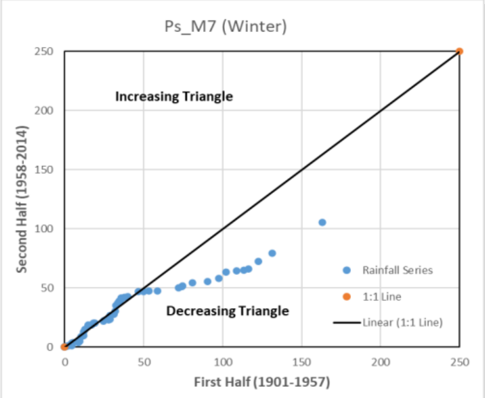


Fig 4.4.8 ITA plot for Ps_M7 in Winter

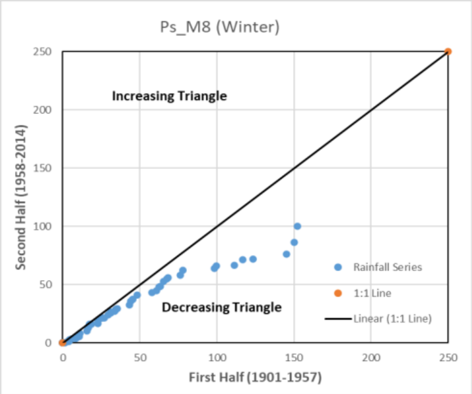


Fig 4.4.9 ITA plot for Ps_M8 in Winter

For Pre-Monsoon Season, following are the Statistical Parameters;

Table 27

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Pashchim Medinipur	Ps_M1	25	87.25	22	188.787	103.952	9830.804	1.171	1.998
Pashchim Medinipur	Ps_M2	26	87.25	22.25	207.664	92.057	8031.344	0.615	0.665
Pashchim Medinipur	Ps_M3	27	87.5	22.25	211.590	100.786	9778.079	0.696	0.257
Pashchim Medinipur	Ps_M4	28	87.25	22.5	214.529	96.175	8880.832	0.745	0.769
Pashchim Medinipur	Ps_M5	29	87.5	22.5	212.824	101.837	9937.828	0.790	0.569
Pashchim Medinipur	Ps_M6	30	87.75	22.5	211.253	105.679	10719.314	0.853	0.549
Pashchim Medinipur	Ps_M7	31	87.25	22.75	200.258	91.372	7842.505	0.902	1.365
Pashchim Medinipur	Ps_M8	32	87.5	22.75	212.662	100.736	9792.404	0.768	0.401

For Pre-Monsoon Season, following are the Trend Parameters:

Table 28

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Pashchim Medinipur	Ps_M1	25	87.25	22	0.311	0.046	0.964	-0.090	0.090	-0.119	0.119
Pashchim Medinipur	Ps_M2	26	87.25	22.25	-0.001	0.044	0.958	-0.086	0.086	-0.114	0.114
Pashchim Medinipur	Ps_M3	27	87.5	22.25	-0.510	0.020	0.993	-0.039	0.039	-0.052	0.052
Pashchim Medinipur	Ps_M4	28	87.25	22.5	-0.108	0.038	0.971	-0.075	0.075	-0.099	0.099
Pashchim Medinipur	Ps_M5	29	87.5	22.5	-0.550	0.023	0.990	-0.045	0.045	-0.059	0.059
Pashchim Medinipur	Ps_M6	30	87.75	22.5	-0.470	0.029	0.986	-0.057	0.057	-0.074	0.074
Pashchim Medinipur	Ps_M7	31	87.25	22.75	0.162	0.045	0.955	-0.088	0.088	-0.116	0.116
Pashchim Medinipur	Ps_M8	32	87.5	22.75	-0.382	0.025	0.988	-0.050	0.050	-0.066	0.066

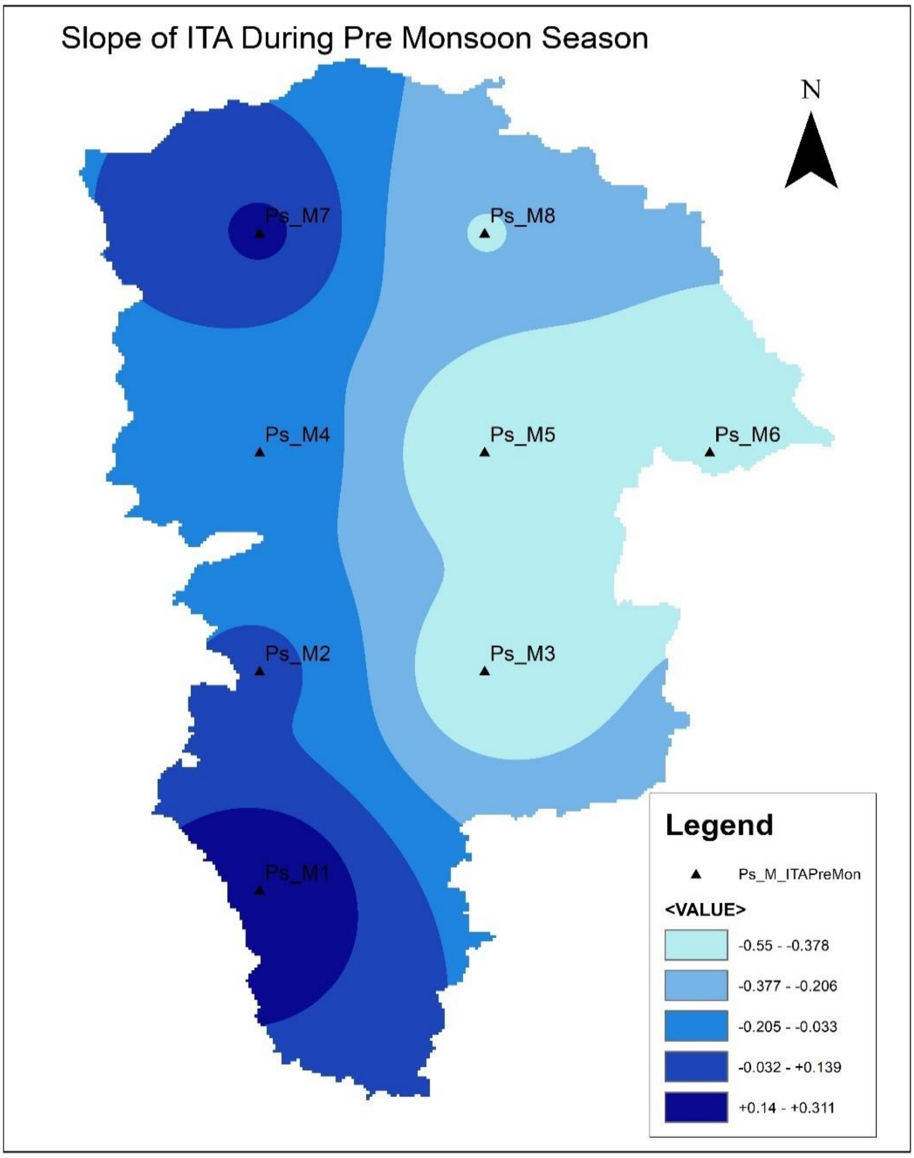


Fig. 4.4.10 ITA Slope Variation in Pashchim Medinipur During Pre-Monsoon Season

Trend Analysis Curves for Pre-Monsoon Season:

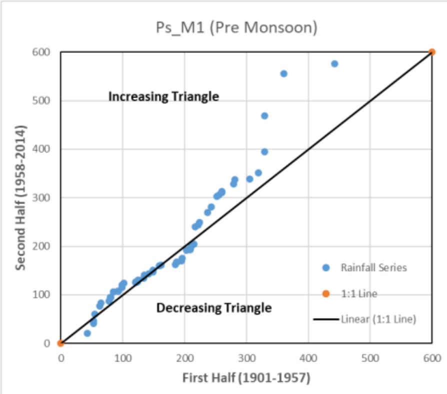


Fig 4.4.11 ITA plot for Ps_M1 in Pre-Monsoon

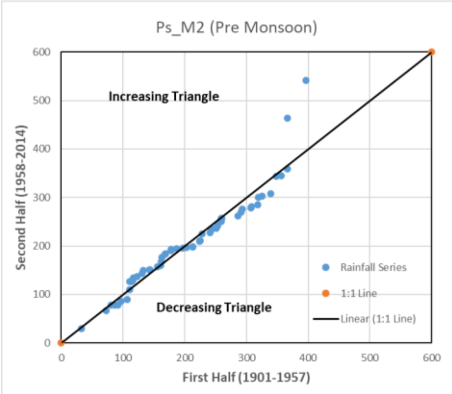


Fig 4.4.12 ITA plot for Ps_M2 in Pre-Monsoon

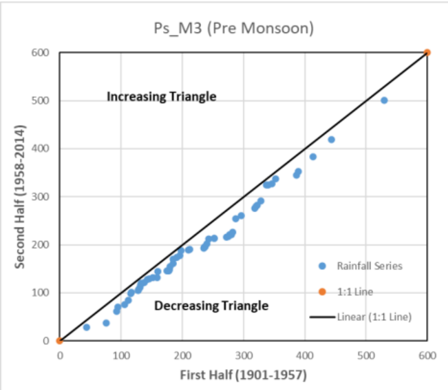


Fig 4.4.13 ITA plot for Ps_M3 in Pre-Monsoon

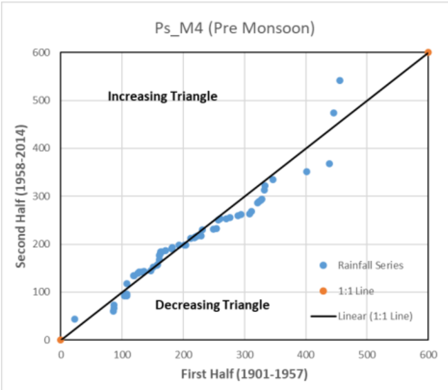


Fig 4.4.14 ITA plot for Ps_M4 in Pre-Monsoon

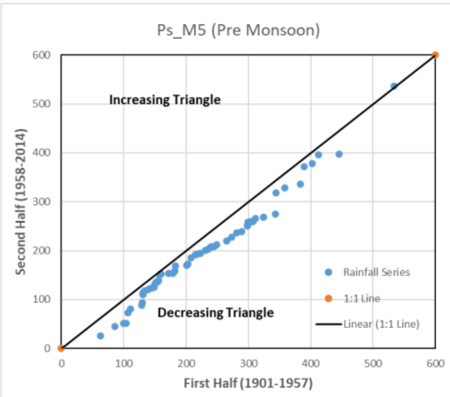


Fig 4.4.15 ITA plot for Ps_M5 in Pre-Monsoon

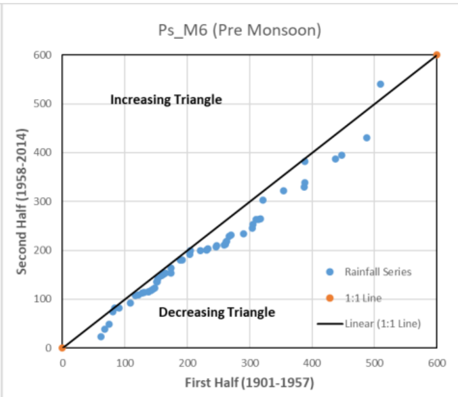


Fig 4.4.16 ITA plot for Ps_M6 in Pre-Monsoon

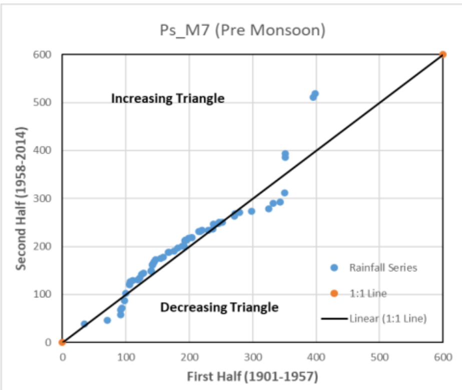


Fig 4.4.17 ITA plot for Ps_M7 in Pre-Monsoon

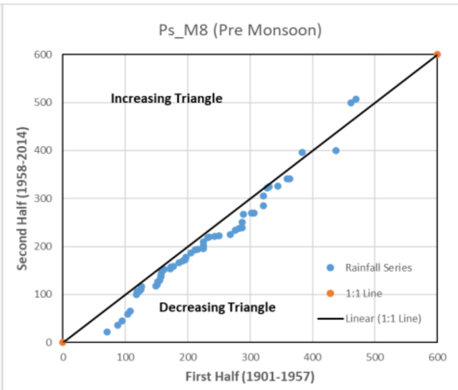


Fig 4.4.18 ITA plot for Ps_M8 in Pre-Monsoon

For Monsoon Season, following are the Statistical Parameters;

Table 29

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Pashchim Medinipur	Ps_M1	25	87.25	22	1162.346	262.541	59052.541	0.928	1.443
Pashchim Medinipur	Ps_M2	26	87.25	22.25	1168.619	246.111	55587.155	0.671	1.308
Pashchim Medinipur	Ps_M3	27	87.5	22.25	1213.823	256.681	63481.233	0.554	0.456
Pashchim Medinipur	Ps_M4	28	87.25	22.5	1158.806	257.102	63477.080	0.707	0.793
Pashchim Medinipur	Ps_M5	29	87.5	22.5	1182.265	280.208	76335.998	0.636	0.370
Pashchim Medinipur	Ps_M6	30	87.75	22.5	1214.325	302.364	89676.023	0.479	0.033
Pashchim Medinipur	Ps_M7	31	87.25	22.75	1081.007	231.189	50923.112	0.401	-0.540
Pashchim Medinipur	Ps_M8	32	87.5	22.75	1118.271	278.490	73136.025	0.900	1.460

For Monsoon Season, following are the Trend Parameters;

Table 30

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Pashchim Medinipur	Ps_M1	25	87.25	22	2.908	0.078	0.984	-0.153	0.153	-0.201	0.201
Pashchim Medinipur	Ps_M2	26	87.25	22.25	1.276	0.095	0.973	-0.185	0.185	-0.244	0.244
Pashchim Medinipur	Ps_M3	27	87.5	22.25	0.538	0.091	0.977	-0.178	0.178	-0.233	0.233
Pashchim Medinipur	Ps_M4	28	87.25	22.5	1.010	0.070	0.986	-0.138	0.138	-0.181	0.181
Pashchim Medinipur	Ps_M5	29	87.5	22.5	-0.015	0.077	0.986	-0.150	0.150	-0.197	0.197
Pashchim Medinipur	Ps_M6	30	87.75	22.5	-0.059	0.072	0.990	-0.140	0.140	-0.184	0.184
Pashchim Medinipur	Ps_M7	31	87.25	22.75	1.210	0.058	0.988	-0.113	0.113	-0.149	0.149
Pashchim Medinipur	Ps_M8	32	87.5	22.75	0.245	0.108	0.972	-0.212	0.212	-0.278	0.278

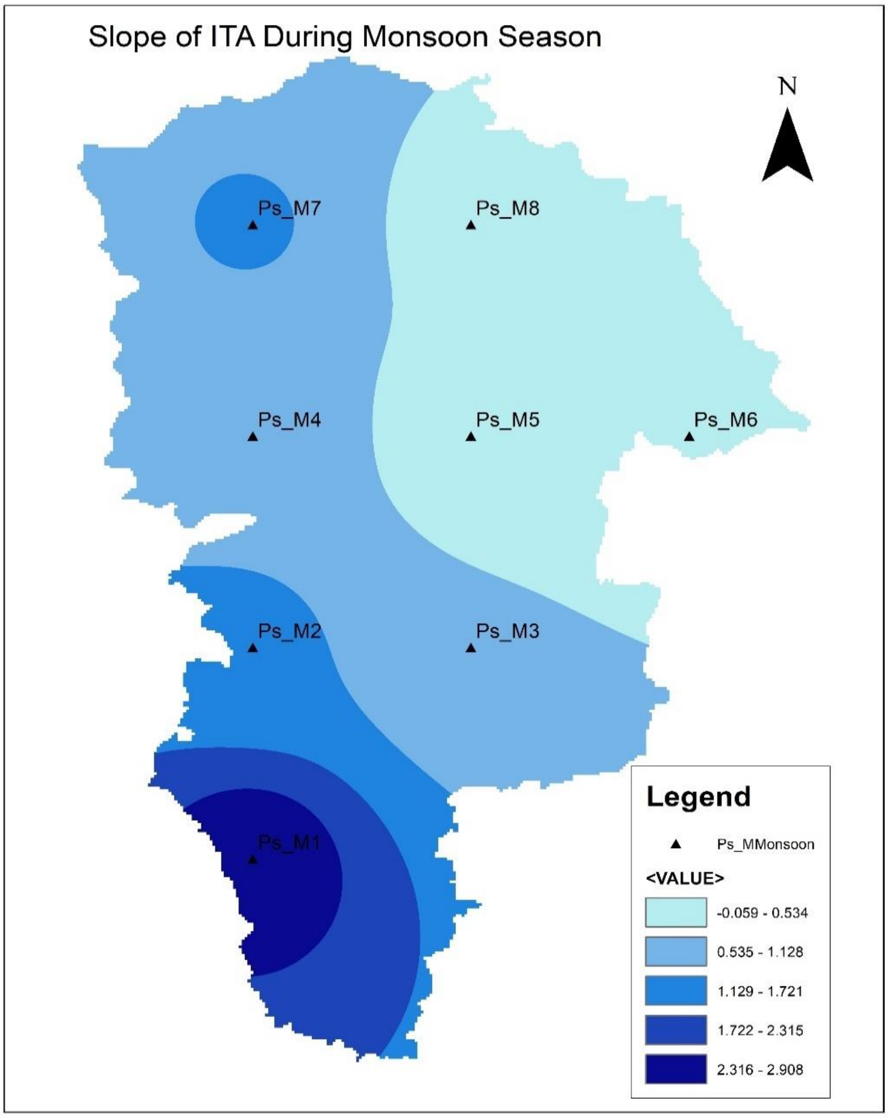


Fig. 4.4.19 ITA Slope Variation in Pashchim Medinipur During Monsoon Season

Trend Analysis Curves for Monsoon Season:

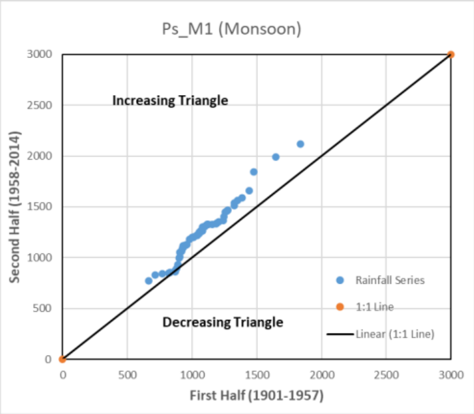


Fig 4.4.20 ITA plot for Ps_M1 in Monsoon

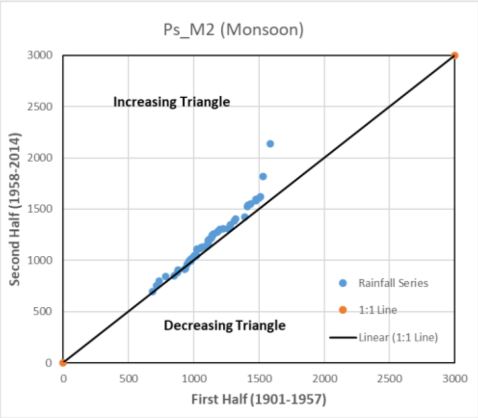


Fig 4.4.21 ITA plot for Ps_M2 in Monsoon

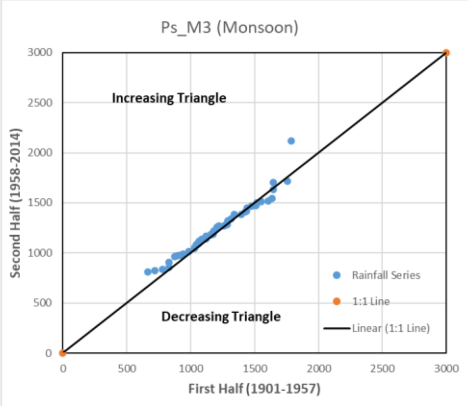


Fig 4.4.22 ITA plot for Ps_M3 in Monsoon

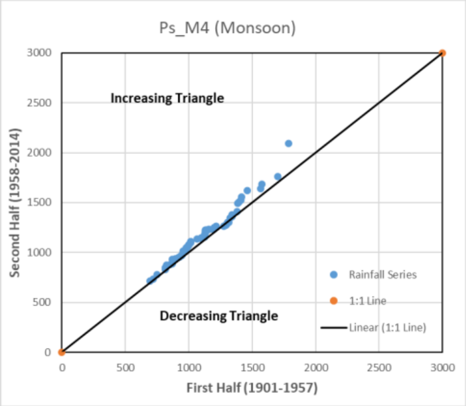


Fig 4.4.23 ITA plot for Ps_M4 in Monsoon

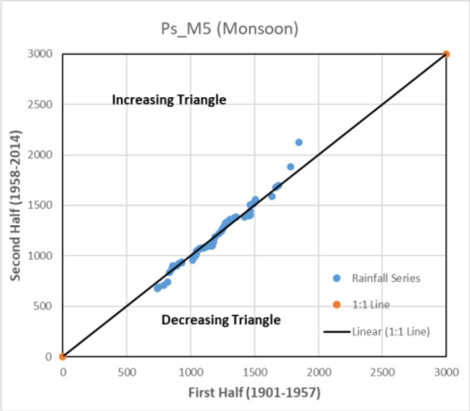


Fig 4.4.24 ITA plot for Ps_M5 in Monsoon

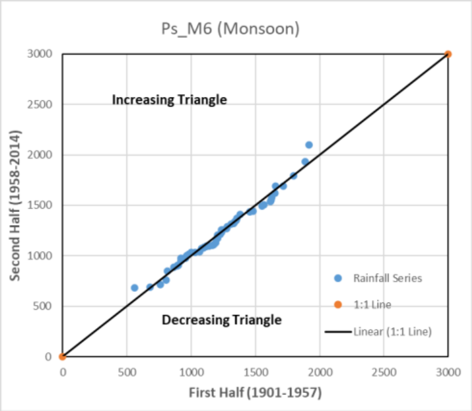


Fig 4.4.25 ITA plot for Ps_M6 in Monsoon

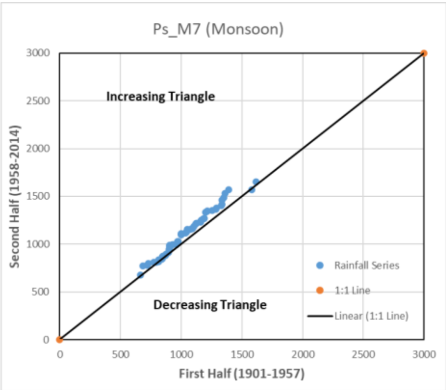


Fig 4.4.26 ITA plot for Ps_M7 in Monsoon

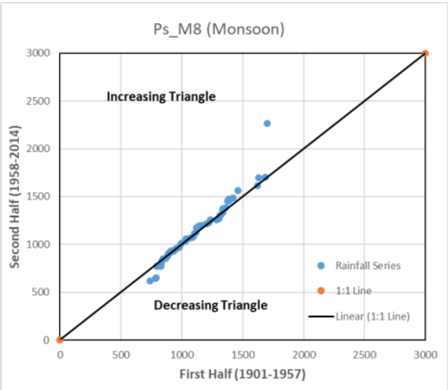


Fig 4.4.27 ITA plot for Ps_M8 in Monsoon

For Post Monsoon Season, following are the Statistical Parameters;

Table 31

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Pashchim Medinipur	Ps_M1	25	87.25	22	200.387	145.386	20143.480	1.287	1.712
Pashchim Medinipur	Ps_M2	26	87.25	22.25	158.212	106.347	10910.038	1.291	2.207
Pashchim Medinipur	Ps_M3	27	87.5	22.25	159.397	102.791	10258.510	0.953	0.597
Pashchim Medinipur	Ps_M4	28	87.25	22.5	137.412	95.801	8944.381	1.178	1.377
Pashchim Medinipur	Ps_M5	29	87.5	22.5	144.451	95.351	8889.021	0.994	0.803
Pashchim Medinipur	Ps_M6	30	87.75	22.5	156.241	104.613	10638.571	1.005	0.609
Pashchim Medinipur	Ps_M7	31	87.25	22.75	128.028	89.115	7671.873	1.217	1.345
Pashchim Medinipur	Ps_M8	32	87.5	22.75	136.406	94.025	8665.132	1.081	0.995

For Post Monsoon Season, following are the Trend Parameters;

Table 32

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Pashchim Medinipur	Ps_M1	25	87.25	22	-0.150	0.063	0.965	-0.123	0.123	-0.162	0.162
Pashchim Medinipur	Ps_M2	26	87.25	22.25	-0.254	0.037	0.978	-0.072	0.072	-0.094	0.094
Pashchim Medinipur	Ps_M3	27	87.5	22.25	0.156	0.027	0.987	-0.054	0.054	-0.071	0.071
Pashchim Medinipur	Ps_M4	28	87.25	22.5	0.063	0.026	0.987	-0.050	0.050	-0.066	0.066
Pashchim Medinipur	Ps_M5	29	87.5	22.5	-0.074	0.024	0.988	-0.048	0.048	-0.063	0.063
Pashchim Medinipur	Ps_M6	30	87.75	22.5	-0.044	0.032	0.982	-0.064	0.064	-0.083	0.083
Pashchim Medinipur	Ps_M7	31	87.25	22.75	0.104	0.029	0.980	-0.057	0.057	-0.075	0.075
Pashchim Medinipur	Ps_M8	32	87.5	22.75	0.085	0.020	0.992	-0.039	0.039	-0.051	0.051

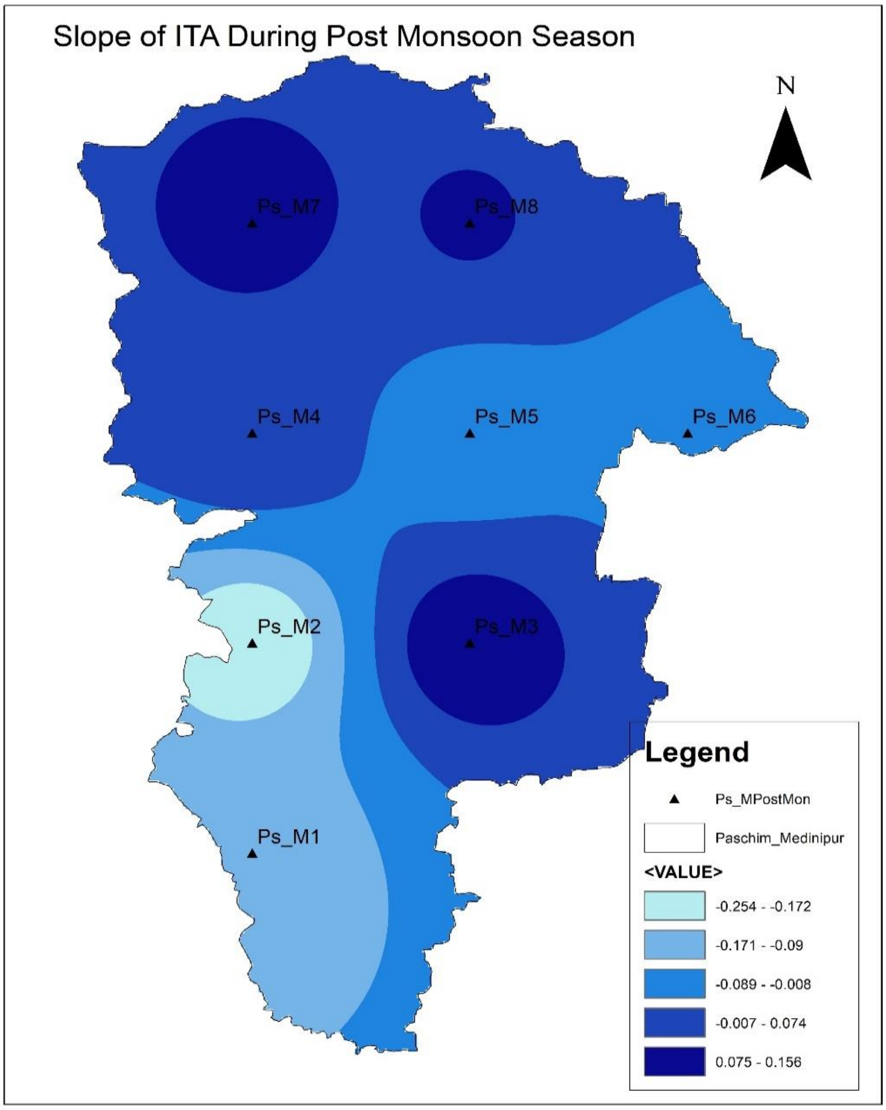


Fig. 4.4.28 ITA Slope Variation in Pashchim Medinipur During Post Monsoon Season

Trend Analysis Curves for Post Monsoon Season:

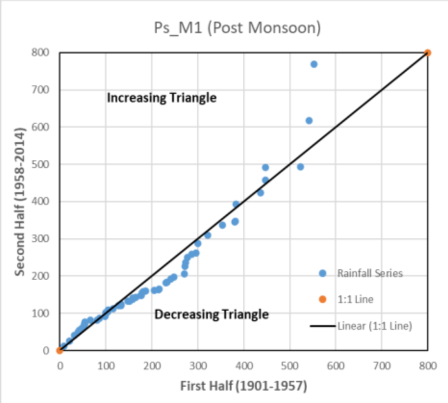


Fig 4.4.29 ITA plot for Ps_M1 in Post Monsoon

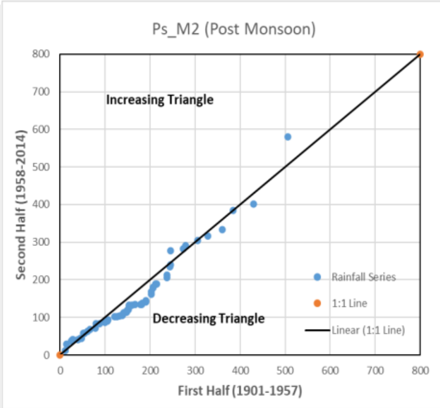


Fig 4.4.30 ITA plot for Ps_M2 in Post Monsoon

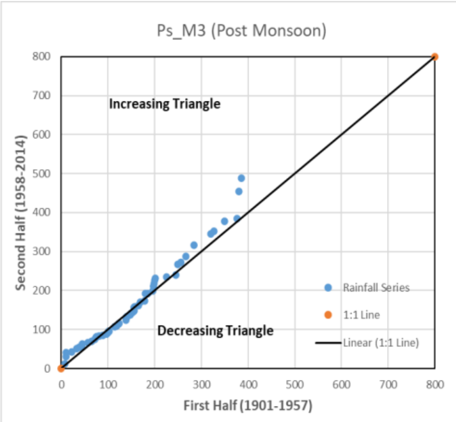


Fig 4.4.31 ITA plot for Ps_M3 in Post Monsoon

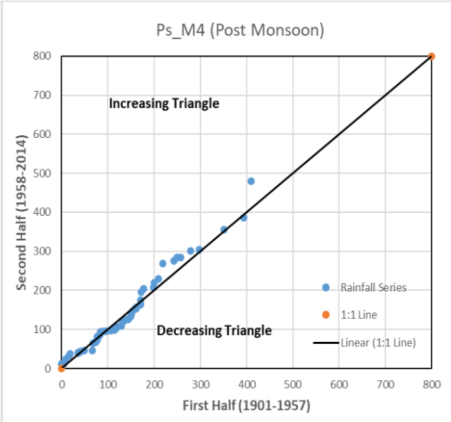


Fig 4.4.32 ITA plot for Ps_M4 in Post Monsoon

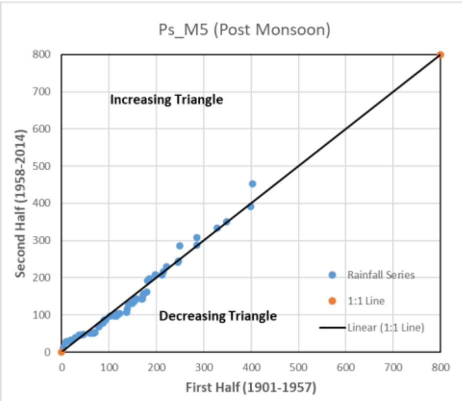


Fig 4.4.33 ITA plot for Ps_M5 in Post Monsoon

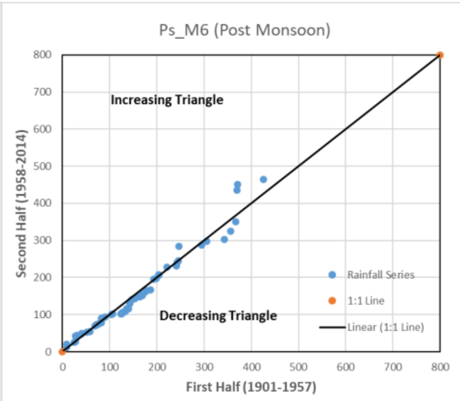


Fig 4.4.34 ITA plot for Ps_M6 in Post Monsoon

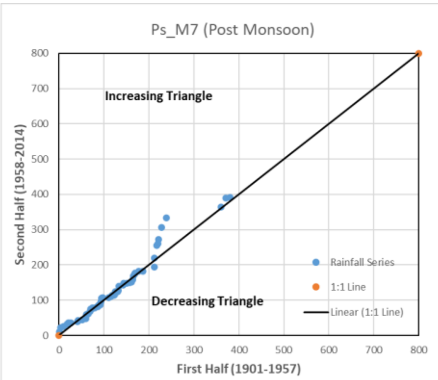


Fig 4.4.35 ITA plot for Ps_M7 in Post Monsoon

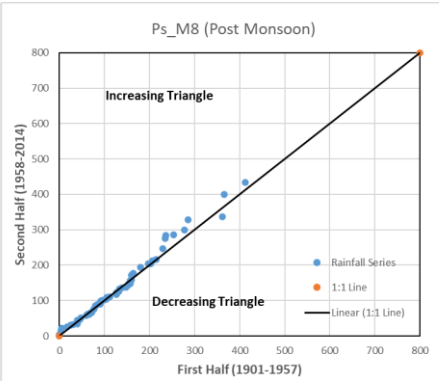


Fig 4.4.36 ITA plot for Ps_M8 in Post Monsoon

4.5 Jhargram:

For Winter Season, following are the Statistical Parameters;

Table 33

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Jhargram	Jh1	33	87	22.25	39.704	38.632	1395.791	1.504	2.557
Jhargram	Jh2	34	87	22.5	38.086	38.113	1347.746	1.748	4.309

For Winter Season, following are the Trend Parameters;

Table 34

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Jhargram	Jh1	33	87	22.25	-0.158	0.011	0.986	-0.021	0.021	-0.028	0.028
Jhargram	Jh2	34	87	22.5	-0.169	0.008	0.992	-0.015	0.015	-0.020	0.020

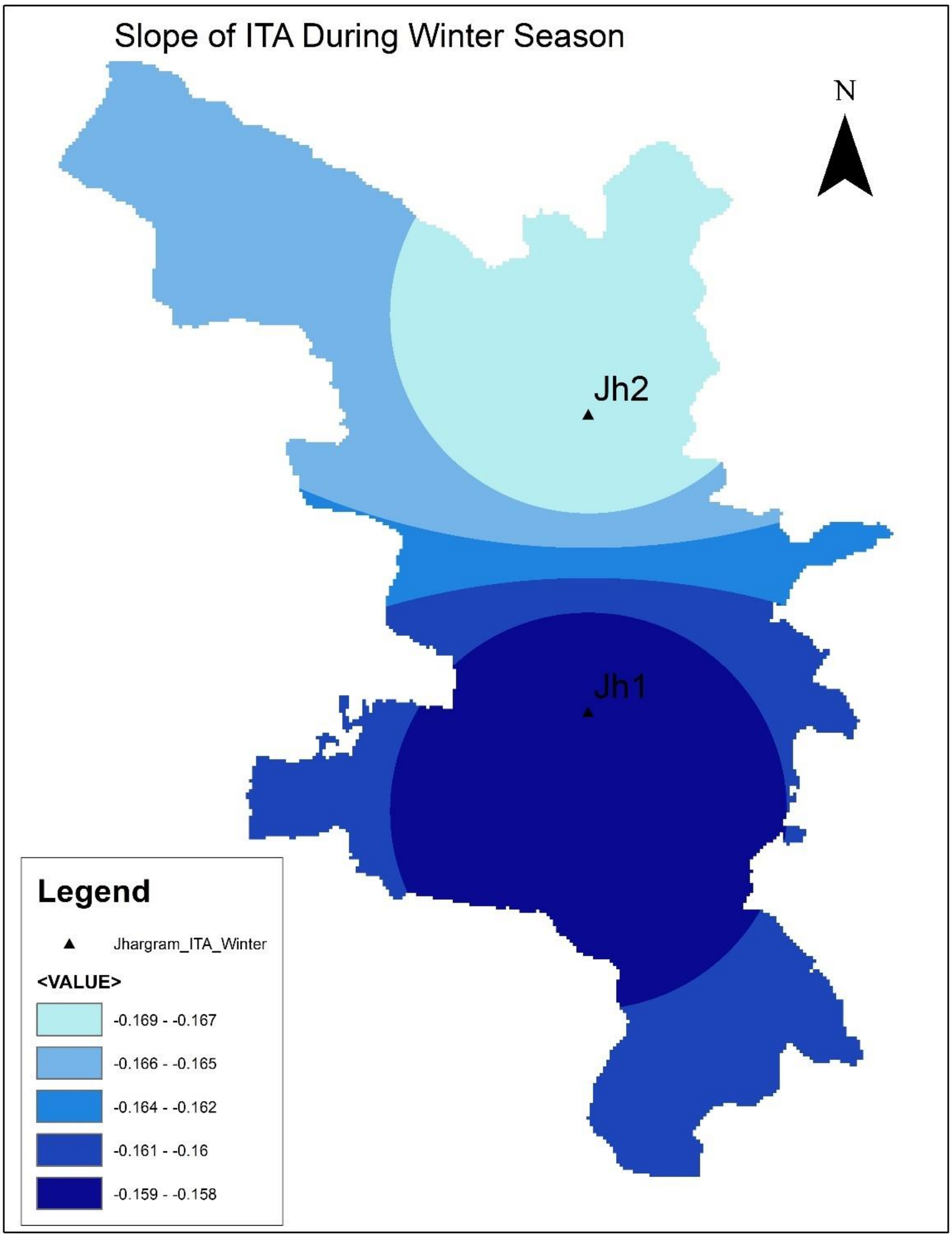


Fig. 4.5.1 ITA Slope Variation in Jhargram During Winter Season

Trend Analysis Curves for Winter Season:

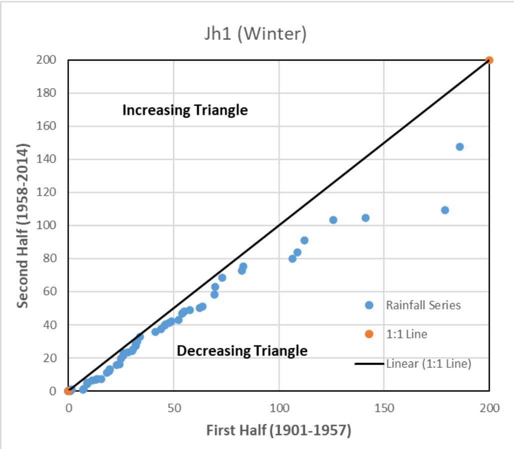


Fig 4.5.2 ITA plot for Jh1 in Winter

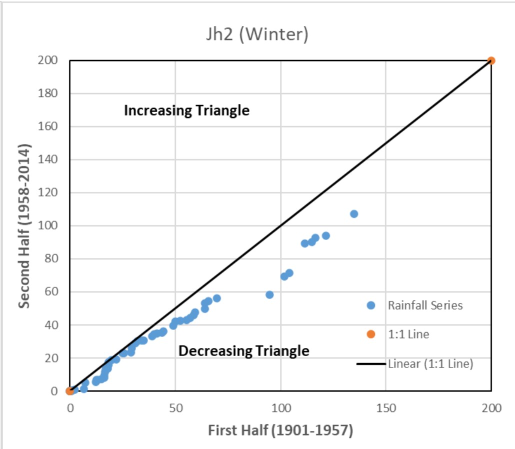


Fig 4.5.3 ITA plot for Jh2 in Winter

For Pre-Monsoon Season, following are the Statistical Parameters;

Table 35

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Jhargram	Jh1	33	87	22.25	191.118	91.358	7656.595	0.815	1.508
Jhargram	Jh2	34	87	22.5	195.266	91.968	7470.892	0.780	1.463

For Pre-Monsoon Season, following are the Trend Parameters;

Table 36

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation $(\rho_{y_1y_2})$	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Jhargram	Jh1	33	87	22.25	0.683	0.034	0.975	-0.066	0.066	-0.087	0.087
Jhargram	Jh2	34	87	22.5	0.768	0.038	0.968	-0.075	0.075	-0.099	0.099

Trend Analysis Curves for Pre-Monsoon Season:

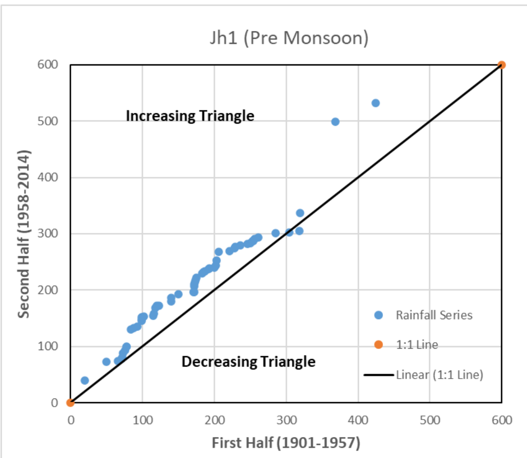


Fig 4.5.4 ITA plot for Jh1 in Pre-Monsoon

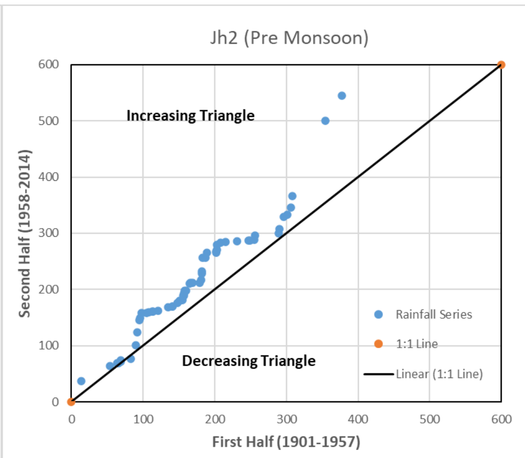


Fig 4.5.5 ITA plot for Jh2 in Pre-Monsoon

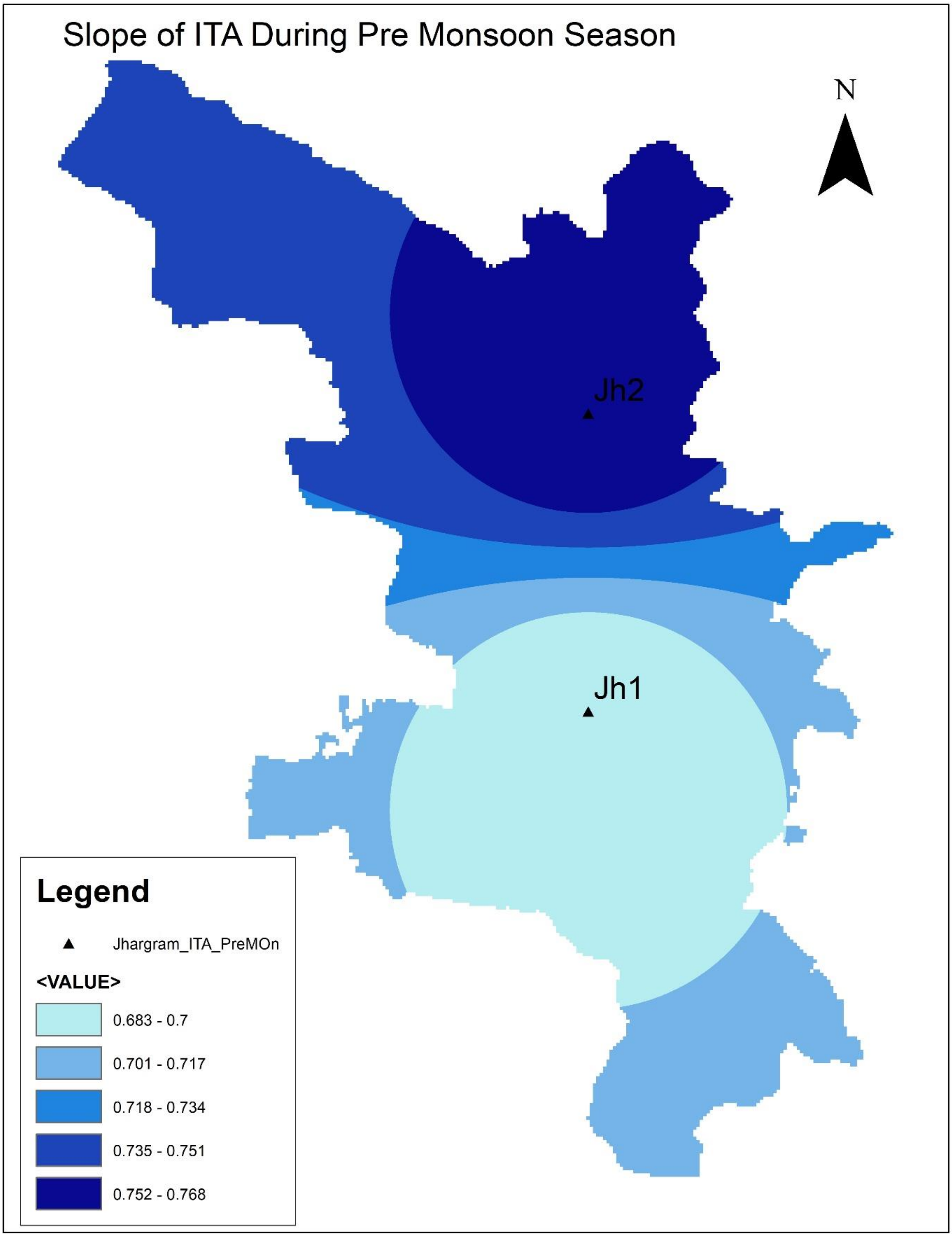


Fig. 4.5.6 ITA Slope Variation in Jhargram During Pre-Monsoon Season

For Monsoon Season, following are the Statistical Parameters;

Table 37

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Jhargram	Jh1	33	87	22.25	1124.654	254.272	51635.090	0.953	1.551
Jhargram	Jh2	34	87	22.5	1134.666	248.079	56015.961	0.568	0.294

For Monsoon Season, following are the Trend Parameters;

Table 38

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Jhargram	Jh1	33	87	22.25	2.798	0.072	0.985	-0.140	0.140	-0.184	0.184
Jhargram	Jh2	34	87	22.5	1.974	0.070	0.985	-0.138	0.138	-0.181	0.181

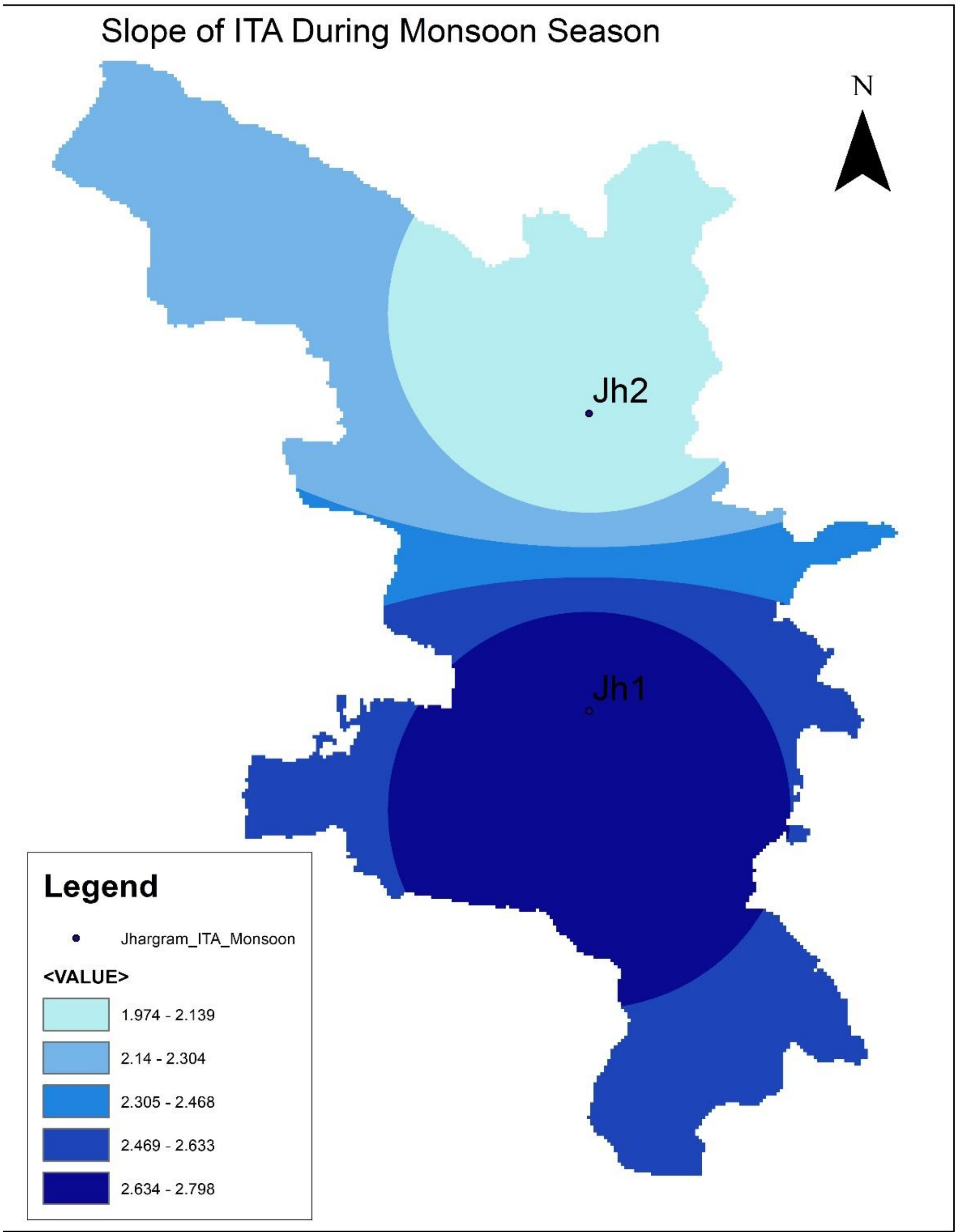


Fig. 4.5.7 ITA Slope Variation in Jhargram During Monsoon Season

Trend Analysis Curves for Monsoon Season:

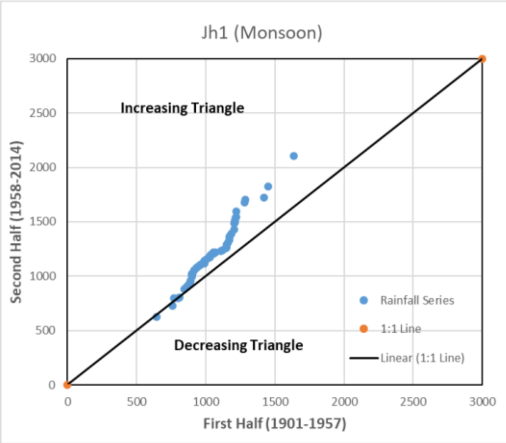


Fig 4.5.8 ITA plot for Jh1 in Monsoon

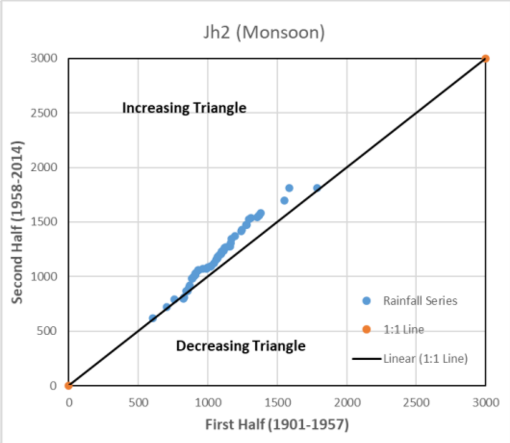


Fig 4.5.9 ITA plot for Jh2 in Monsoon

For Post Monsoon Season, following are the Statistical Parameters;

Table 39

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Jhargram	Jh1	33	87	22.25	154.861	113.719	12179.315	1.257	1.956
Jhargram	Jh2	34	87	22.5	126.435	92.027	8128.558	1.151	1.227

For Post Monsoon Season, following are the Trend Parameters;

Table 40

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1 y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Jhargram	Jh1	33	87	22.25	-0.457	0.051	0.963	-0.100	0.100	-0.131	0.131
Jhargram	Jh2	34	87	22.5	0.306	0.018	0.993	-0.035	0.035	-0.046	0.046

Trend Analysis Curves for Post Monsoon Season:

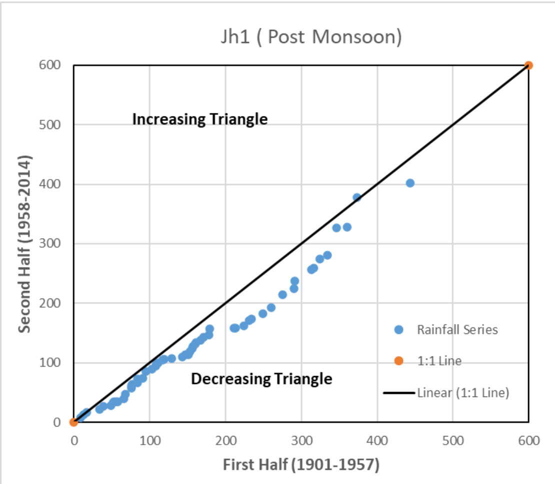


Fig 4.5.10 ITA plot for Jh1 in Post Monsoon

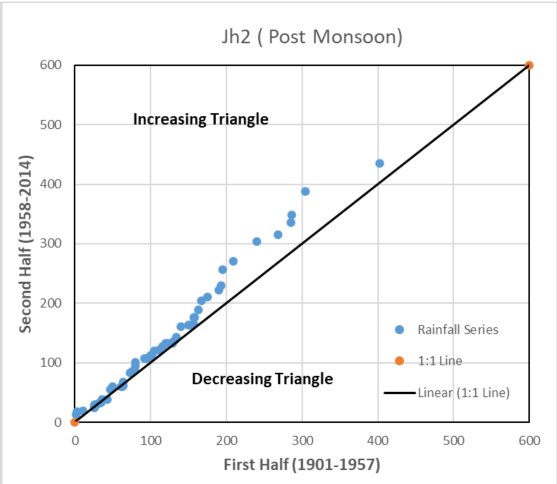


Fig 4.5.11 ITA plot for Jh2 in Post Monsoon

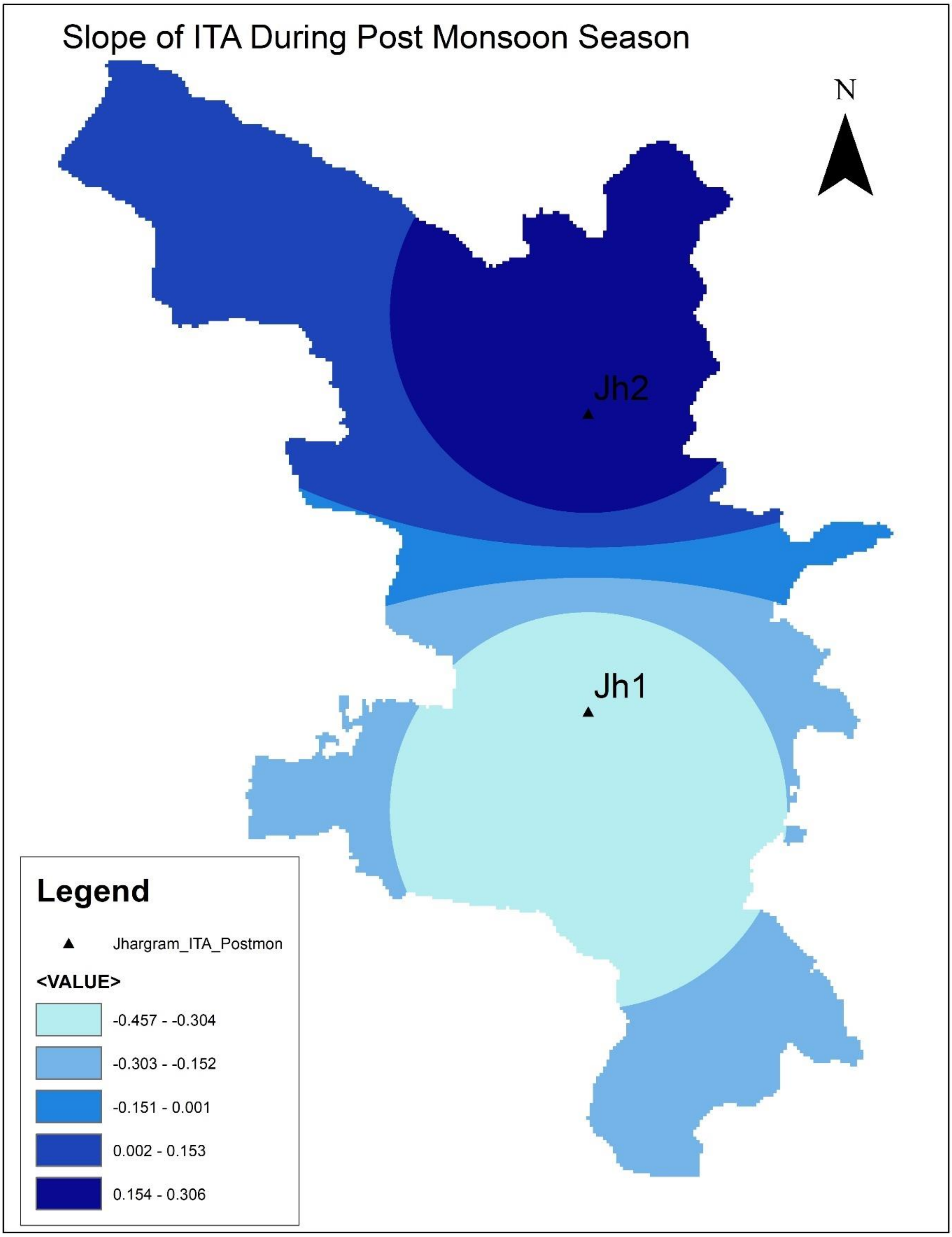


Fig. 4.5.12 ITA Slope Variation in Jhargram During Post Monsoon Season

4.6 Bankura:

For Winter Season, following are the Statistical Parameters;

Table 41

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Bankura	Bk1	35	86.75	22.75	37.086	37.193	1017.475	2.482	10.933
Bankura	Bk2	36	87	22.75	36.411	34.863	1034.460	1.806	5.383
Bankura	Bk3	37	86.75	23	35.519	36.084	1142.883	1.952	5.389
Bankura	Bk4	38	87	23	35.574	35.007	1073.671	1.564	2.785
Bankura	Bk5	39	87.25	23	33.604	36.110	1095.606	1.640	2.845
Bankura	Bk6	40	87.5	23	34.925	33.270	1037.773	1.263	1.402
Bankura	Bk7	41	87	23.25	35.164	36.441	1142.561	1.834	4.159
Bankura	Bk8	42	87.25	23.25	34.343	35.287	1075.635	1.639	3.076
Bankura	Bk9	43	87.5	23.25	37.904	38.947	1363.622	1.602	3.256
Bankura	Bk10	44	87	23.5	32.789	34.574	1046.812	2.058	5.780
Bankura	Bk11	45	87.25	23.5	29.282	31.829	928.930	2.125	6.439

For Winter Season, following are the Trend Parameters;

Table 42

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Bankura	Bk1	35	86.75	22.75	-0.231	0.024	0.921	-0.048	0.048	-0.063	0.063
Bankura	Bk2	36	87	22.75	-0.179	0.015	0.965	-0.030	0.030	-0.039	0.039
Bankura	Bk3	37	86.75	23	-0.178	0.011	0.981	-0.023	0.023	-0.030	0.030
Bankura	Bk4	38	87	23	-0.175	0.010	0.986	-0.019	0.019	-0.025	0.025
Bankura	Bk5	39	87.25	23	-0.173	0.014	0.972	-0.028	0.028	-0.036	0.036
Bankura	Bk6	40	87.5	23	-0.125	0.008	0.991	-0.015	0.015	-0.019	0.019
Bankura	Bk7	41	87	23.25	-0.187	0.010	0.985	-0.020	0.020	-0.027	0.027
Bankura	Bk8	42	87.25	23.25	-0.180	0.010	0.984	-0.020	0.020	-0.027	0.027
Bankura	Bk9	43	87.5	23.25	-0.226	0.009	0.991	-0.017	0.017	-0.022	0.022
Bankura	Bk10	44	87	23.5	-0.177	0.011	0.982	-0.021	0.021	-0.028	0.028
Bankura	Bk11	45	87.25	23.5	-0.043	0.012	0.974	-0.023	0.023	-0.031	0.031

Trend Analysis Curves for Winter Season:

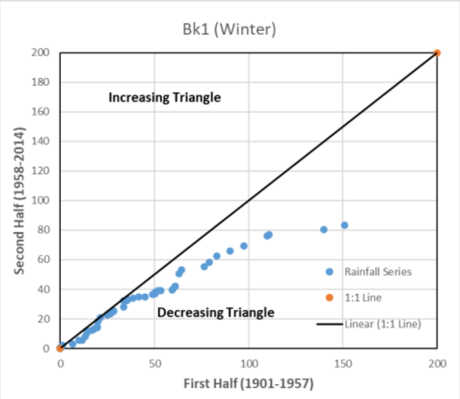


Fig 4.6.1 ITA plot for Bk1 in Winter

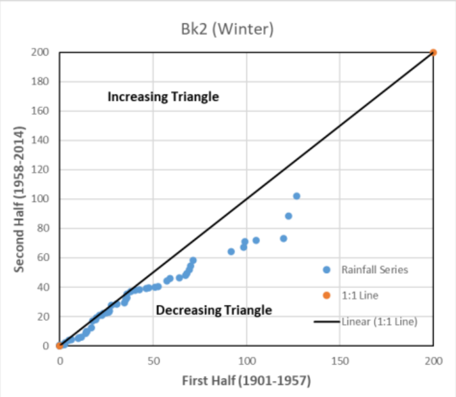


Fig 4.6.2 ITA plot for Bk2 in Winter

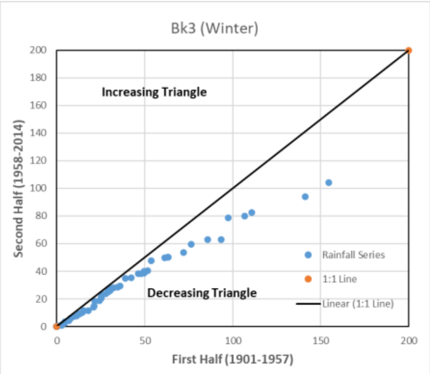


Fig 4.6.3 ITA plot for Bk3 in Winter

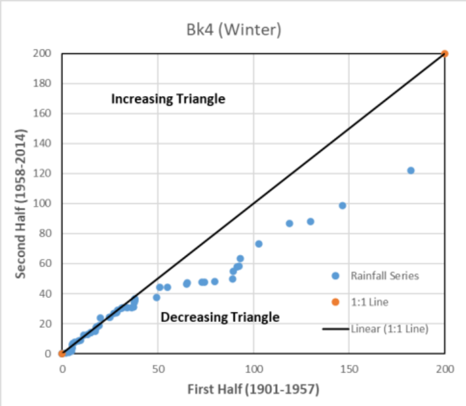


Fig 4.6.4 ITA plot for Bk4 in Winter

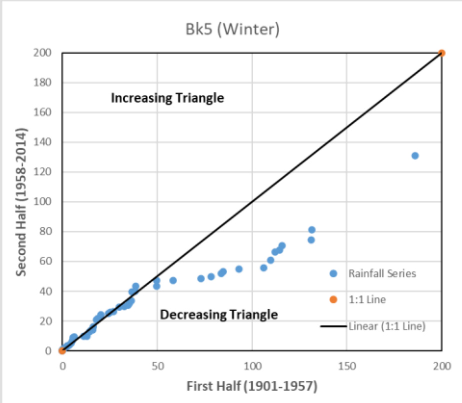


Fig 4.6.5 ITA plot for Bk5 in Winter

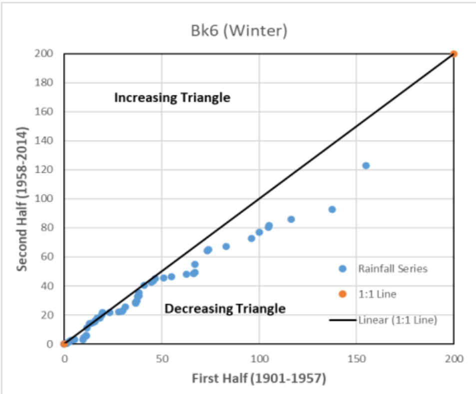


Fig 4.6.6 ITA plot for Bk6 in Winter

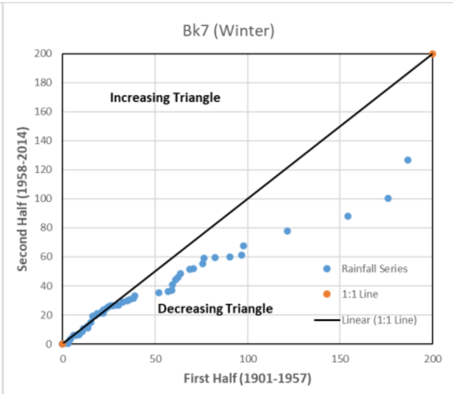


Fig 4.6.7 ITA plot for Bk7 in Winter

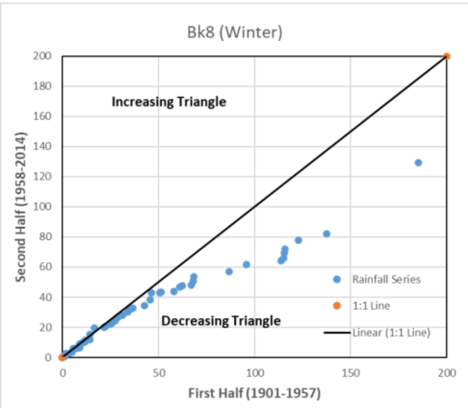


Fig 4.6.8 ITA plot for Bk8 in Winter

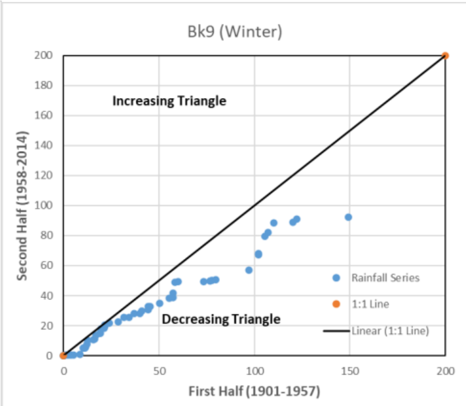


Fig 4.6.9 ITA plot for Bk9 in Winter

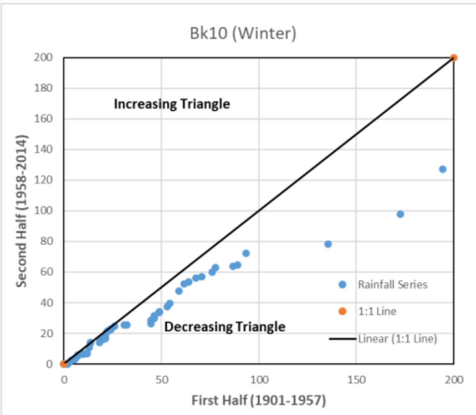


Fig 4.6.10 ITA plot for Bk10 in Winter

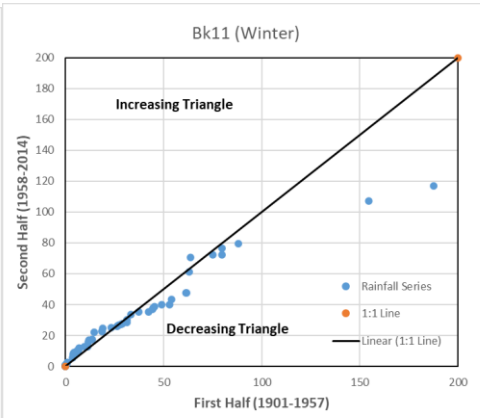


Fig 4.6.11 ITA plot for Bk11 in Winter

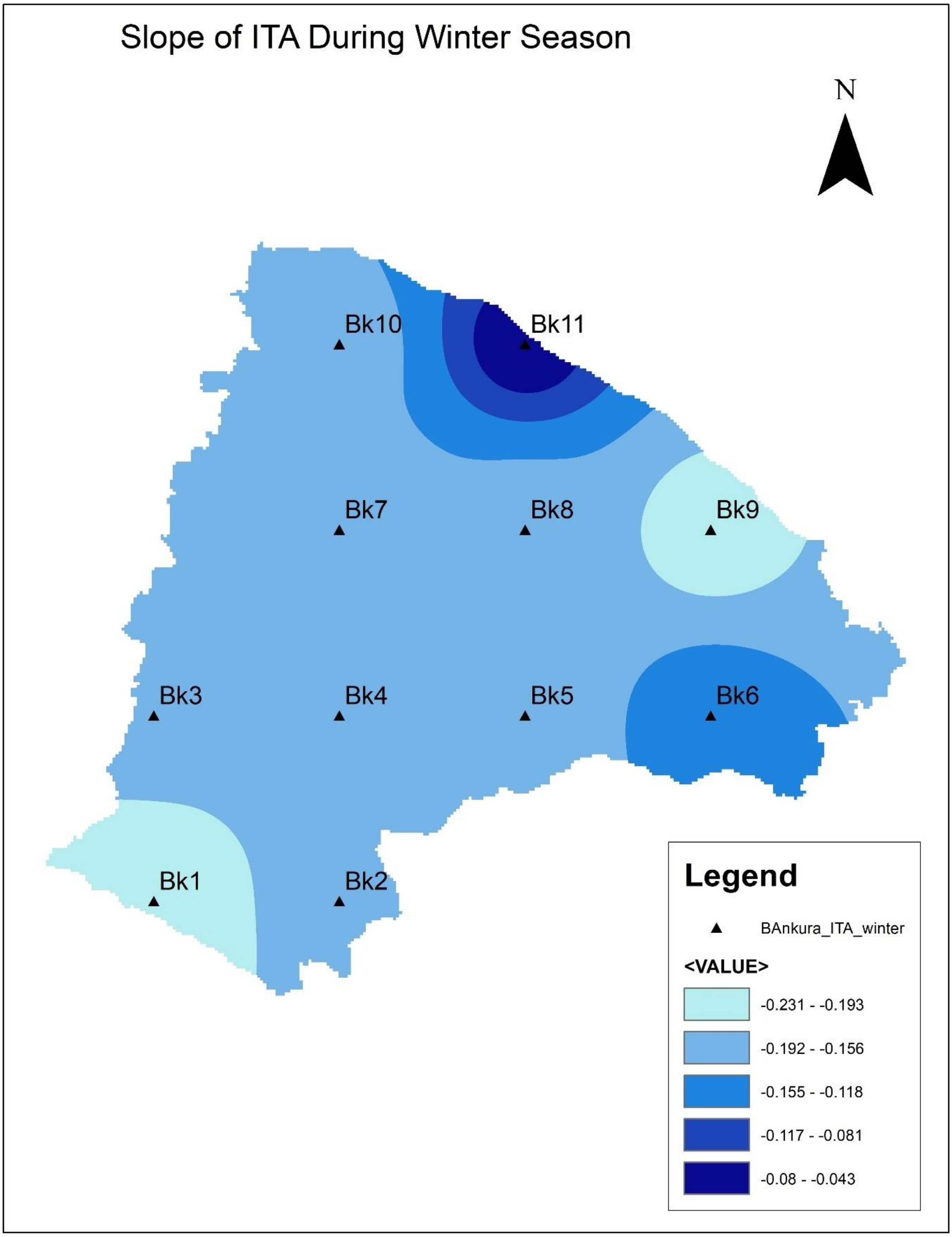


Fig. 4.6.12 ITA Slope Variation in Bankura During Winter Season

For Pre-Monsoon Season, following are the Statistical Parameters;

Table 43

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Bankura	Bk1	35	86.75	22.75	173.253	74.423	5063.742	0.493	1.100
Bankura	Bk2	36	87	22.75	182.134	77.131	5265.275	0.699	2.095
Bankura	Bk3	37	86.75	23	161.457	79.282	5484.467	1.253	4.084
Bankura	Bk4	38	87	23	161.378	71.643	4766.428	0.451	0.037
Bankura	Bk5	39	87.25	23	171.764	87.714	6978.982	0.820	1.117
Bankura	Bk6	40	87.5	23	194.574	92.192	7759.344	1.137	2.955
Bankura	Bk7	41	87	23.25	150.944	69.631	4719.211	0.215	-0.425
Bankura	Bk8	42	87.25	23.25	162.901	70.641	4781.587	0.313	-0.062
Bankura	Bk9	43	87.5	23.25	193.904	90.080	7309.662	0.616	0.611
Bankura	Bk10	44	87	23.5	142.810	70.274	4851.851	0.373	-0.186
Bankura	Bk11	45	87.25	23.5	152.204	70.230	4605.215	0.408	0.586

For Pre-Monsoon Season, following are the Trend Parameters;

Table 44

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Bankura	Bk1	35	86.75	22.75	0.476	0.037	0.955	-0.072	0.072	-0.095	0.095
Bankura	Bk2	36	87	22.75	0.570	0.043	0.941	-0.085	0.085	-0.112	0.112
Bankura	Bk3	37	86.75	23	0.123	0.045	0.939	-0.089	0.089	-0.117	0.117
Bankura	Bk4	38	87	23	0.006	0.034	0.959	-0.066	0.066	-0.086	0.086
Bankura	Bk5	39	87.25	23	-0.251	0.028	0.981	-0.055	0.055	-0.072	0.072
Bankura	Bk6	40	87.5	23	-0.213	0.058	0.927	-0.113	0.113	-0.149	0.149
Bankura	Bk7	41	87	23.25	0.005	0.017	0.990	-0.032	0.032	-0.043	0.043
Bankura	Bk8	42	87.25	23.25	-0.252	0.022	0.983	-0.042	0.042	-0.056	0.056
Bankura	Bk9	43	87.5	23.25	-0.801	0.026	0.985	-0.051	0.051	-0.067	0.067
Bankura	Bk10	44	87	23.5	0.064	0.014	0.992	-0.028	0.028	-0.037	0.037
Bankura	Bk11	45	87.25	23.5	0.316	0.031	0.964	-0.061	0.061	-0.080	0.080

Trend Analysis Curves for Pre-Monsoon Season:

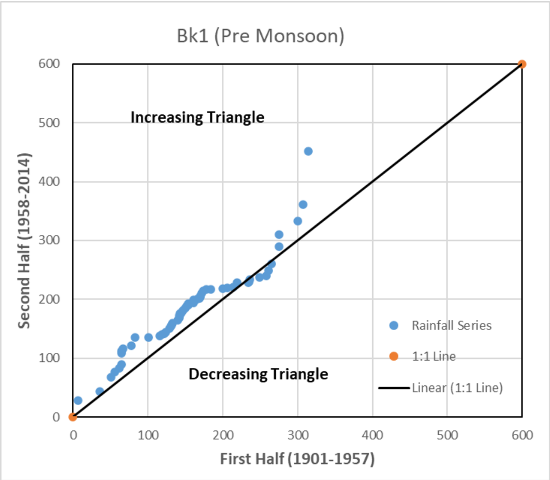


Fig 4.6.13 ITA plot for Bk1 in Pre-Monsoon

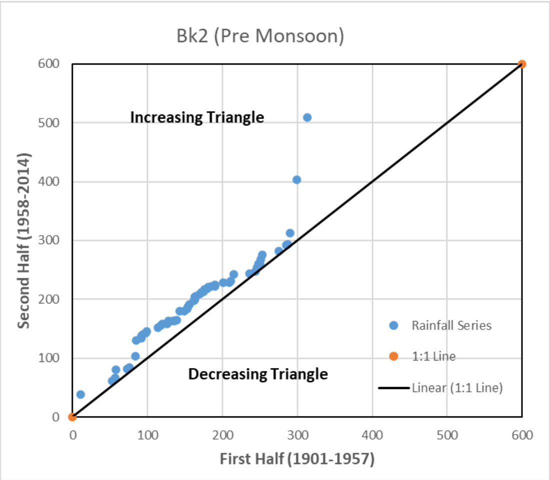


Fig 4.6.14 ITA plot for Bk2 in Pre-Monsoon

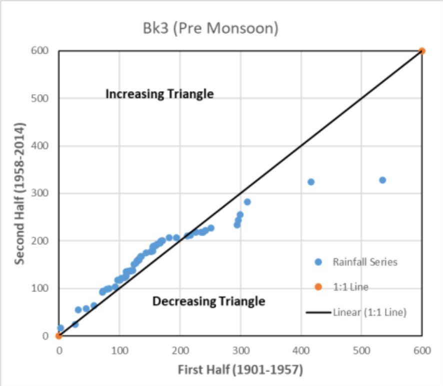


Fig 4.6.15 ITA plot for Bk3 in Pre-Monsoon

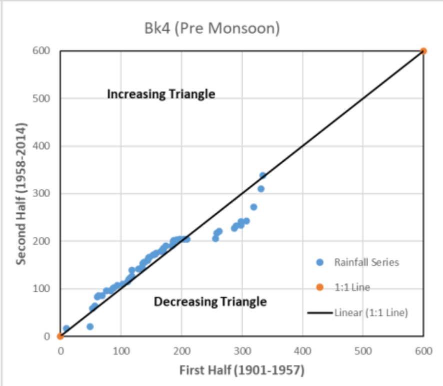


Fig 4.6.16 ITA plot for Bk4 in Pre-Monsoon

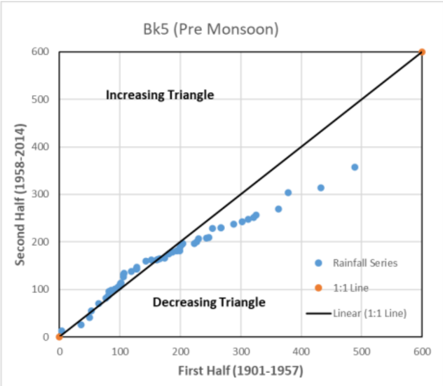


Fig 4.6.17 ITA plot for Bk5 in Pre-Monsoon

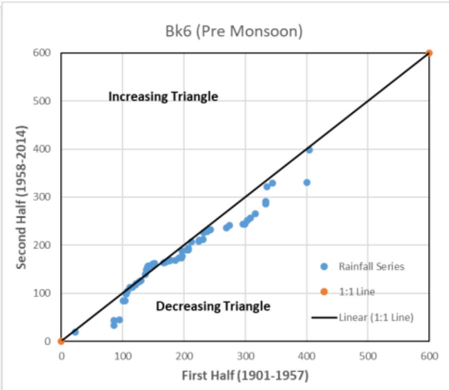


Fig 4.6.18 ITA plot for Bk6 in Pre-Monsoon

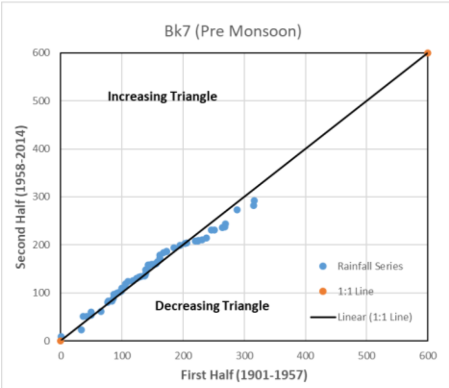


Fig 4.6.19 ITA plot for Bk7 in Pre-Monsoon

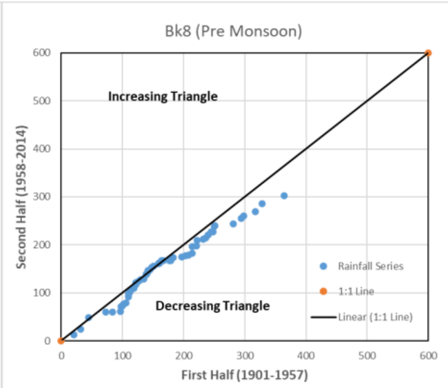


Fig 4.6.20 ITA plot for Bk8 in Pre-Monsoon

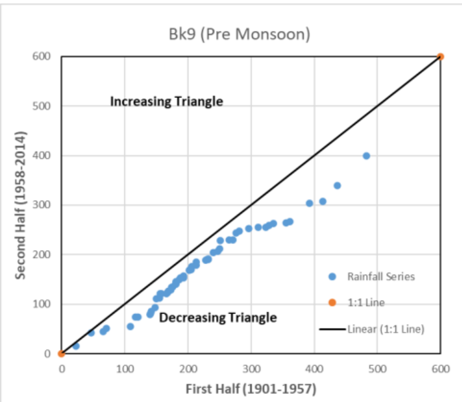


Fig 4.6.21 ITA plot for Bk9 in Pre-Monsoon

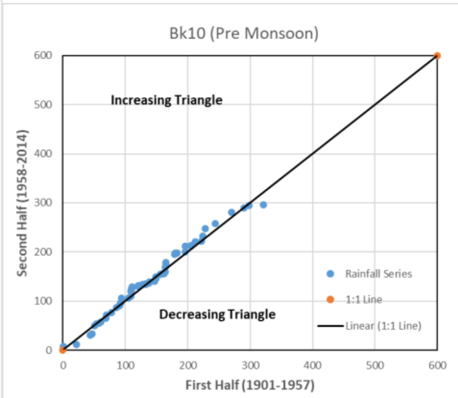


Fig 4.6.22 ITA plot for Bk10 in Pre-Monsoon

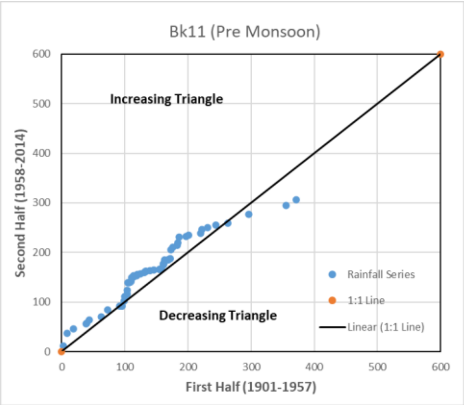


Fig 4.6.23 ITA plot for Bk11 in Pre-Monsoon

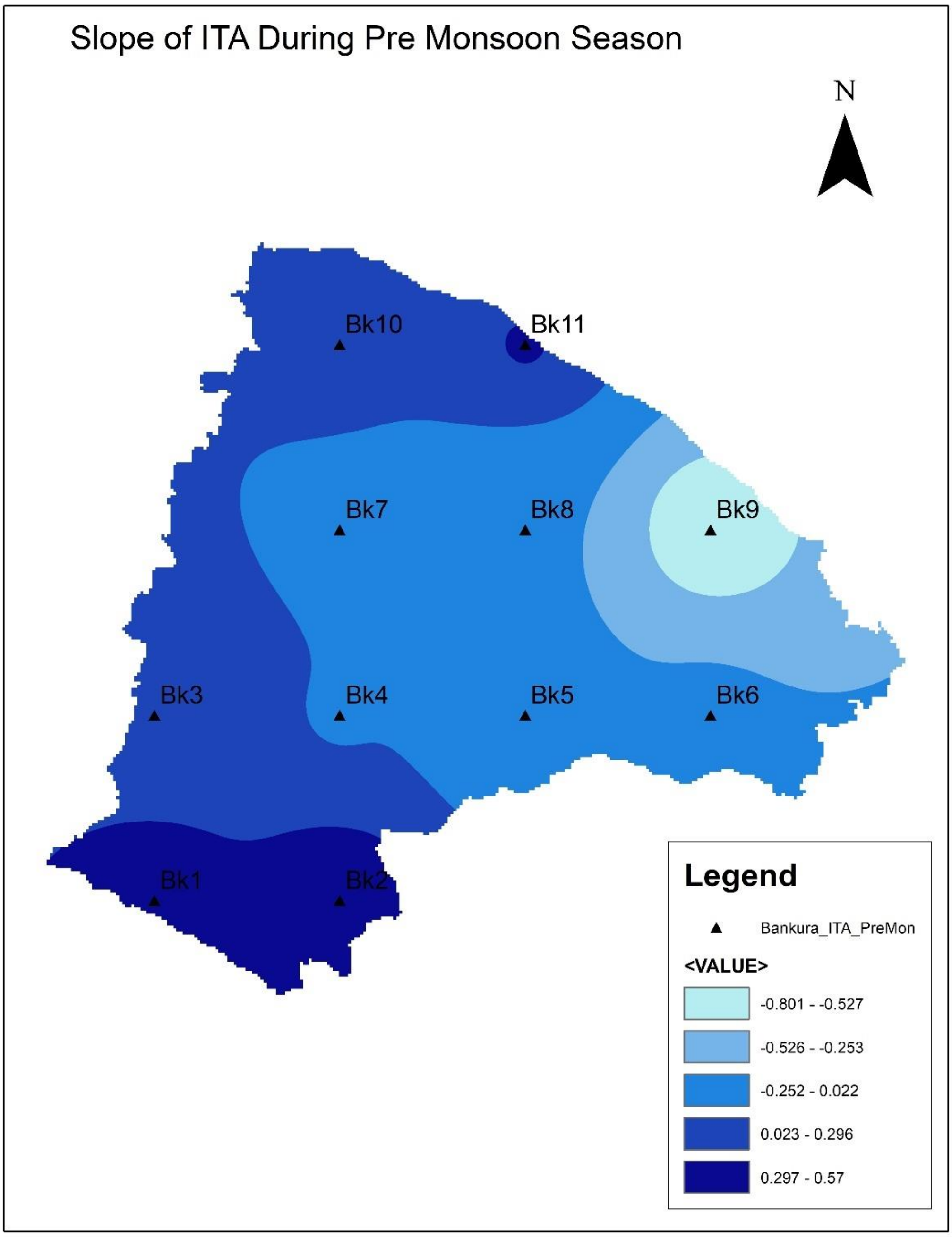


Fig. 4.6.24 ITA Slope Variation in Bankura During Pre-Monsoon Season

For Monsoon Season, following are the Statistical Parameters;

Table 45

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Bankura	Bk1	35	86.75	22.75	1094.476	239.121	52014.096	0.280	-0.455
Bankura	Bk2	36	87	22.75	1097.821	222.933	46386.201	0.646	-0.028
Bankura	Bk3	37	86.75	23	1120.696	344.056	97456.461	1.803	7.175
Bankura	Bk4	38	87	23	1053.947	224.662	48718.047	0.456	-0.007
Bankura	Bk5	39	87.25	23	1037.571	229.623	51397.314	0.393	-0.033
Bankura	Bk6	40	87.5	23	1055.431	230.473	51853.971	0.434	-0.433
Bankura	Bk7	41	87	23.25	1014.874	203.443	39549.042	0.544	0.465
Bankura	Bk8	42	87.25	23.25	1011.094	215.228	44153.645	0.679	0.605
Bankura	Bk9	43	87.5	23.25	1090.894	257.201	60916.907	0.839	1.219
Bankura	Bk10	44	87	23.5	981.158	233.461	51749.152	0.423	0.872
Bankura	Bk11	45	87.25	23.5	978.779	237.812	52169.549	0.470	0.366

For Monsoon Season, following are the Trend Parameters;

Table 46

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Bankura	Bk1	35	86.75	22.75	1.851	0.068	0.985	-0.133	0.133	-0.175	0.175
Bankura	Bk2	36	87	22.75	1.374	0.068	0.983	-0.134	0.134	-0.176	0.176
Bankura	Bk3	37	86.75	23	-0.790	0.255	0.898	-0.500	0.500	-0.657	0.657
Bankura	Bk4	38	87	23	0.505	0.071	0.982	-0.139	0.139	-0.182	0.182
Bankura	Bk5	39	87.25	23	0.237	0.066	0.985	-0.129	0.129	-0.170	0.170
Bankura	Bk6	40	87.5	23	0.242	0.063	0.986	-0.124	0.124	-0.163	0.163
Bankura	Bk7	41	87	23.25	0.864	0.061	0.983	-0.119	0.119	-0.157	0.157
Bankura	Bk8	42	87.25	23.25	0.416	0.087	0.970	-0.170	0.170	-0.224	0.224
Bankura	Bk9	43	87.5	23.25	-0.612	0.147	0.940	-0.287	0.287	-0.378	0.378
Bankura	Bk10	44	87	23.5	0.872	0.084	0.976	-0.165	0.165	-0.218	0.218
Bankura	Bk11	45	87.25	23.5	1.855	0.074	0.982	-0.145	0.145	-0.190	0.190

Trend Analysis Curves for Monsoon Season:

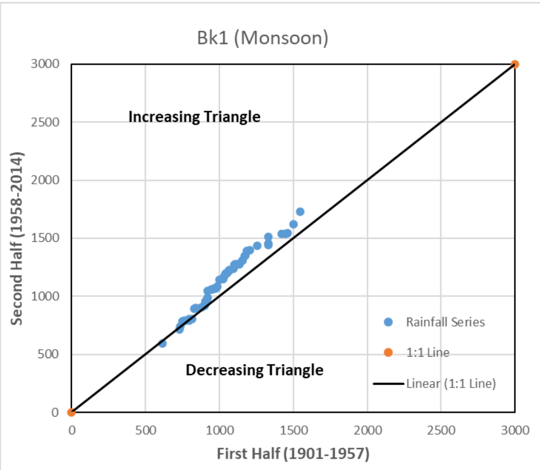


Fig 4.6.25 ITA plot for Bk1 in Monsoon

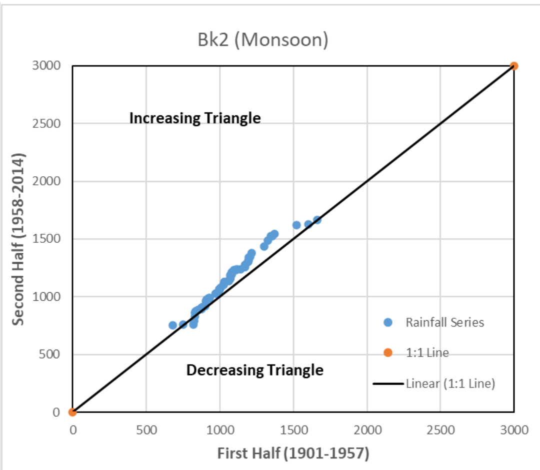


Fig 4.6.26 ITA plot for Bk2 in Monsoon

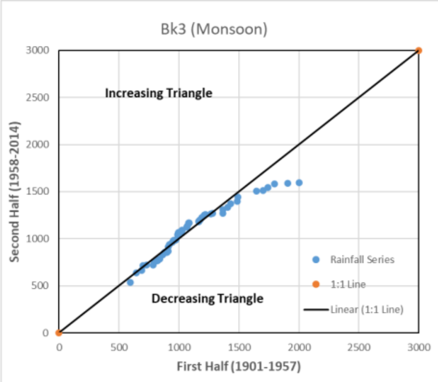


Fig 4.6.27 ITA plot for Bk3 in Monsoon

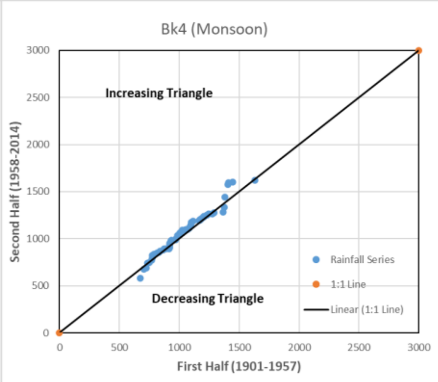


Fig 4.6.28 ITA plot for Bk4 in Monsoon

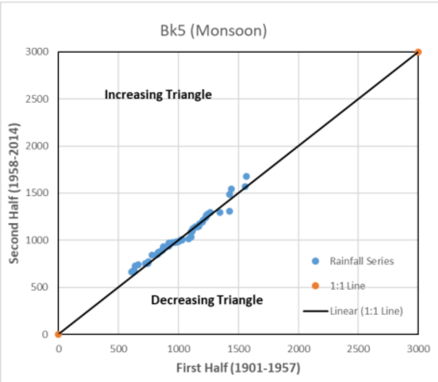


Fig 4.6.29 ITA plot for Bk5 in Monsoon

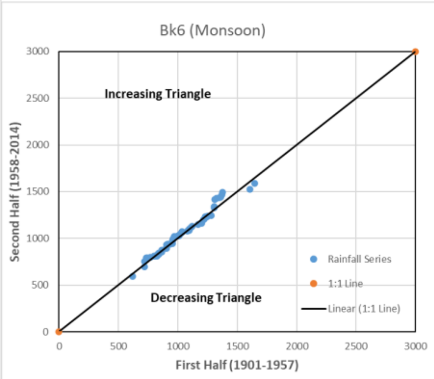


Fig 4.6.30 ITA plot for Bk6 in Monsoon

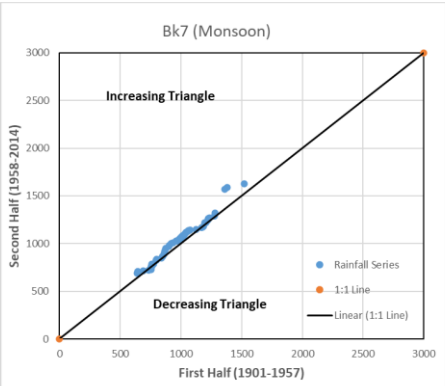


Fig 4.6.31 ITA plot for Bk7 in Monsoon

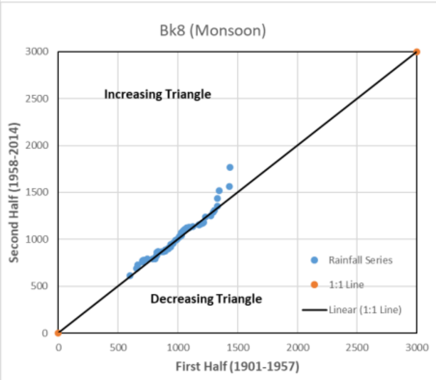


Fig 4.6.32 ITA plot for Bk8 in Monsoon

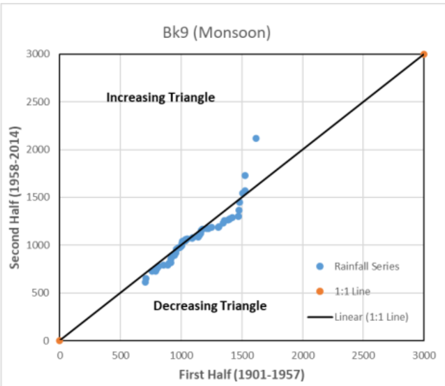


Fig 4.6.33 ITA plot for Bk9 in Monsoon

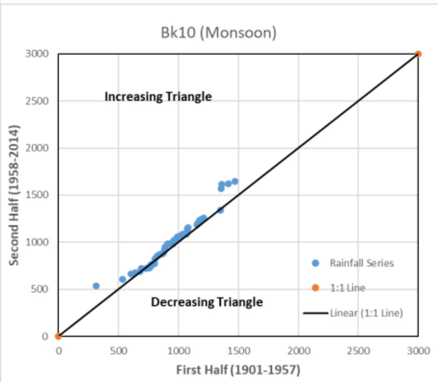


Fig 4.6.34 ITA plot for Bk10 in Monsoon

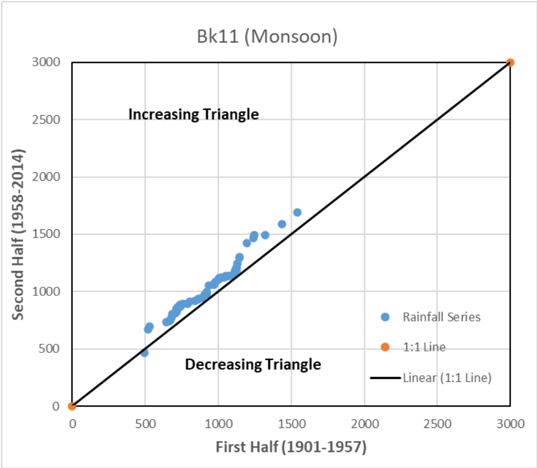


Fig 4.6.35 ITA plot for Bk11 in Monsoon

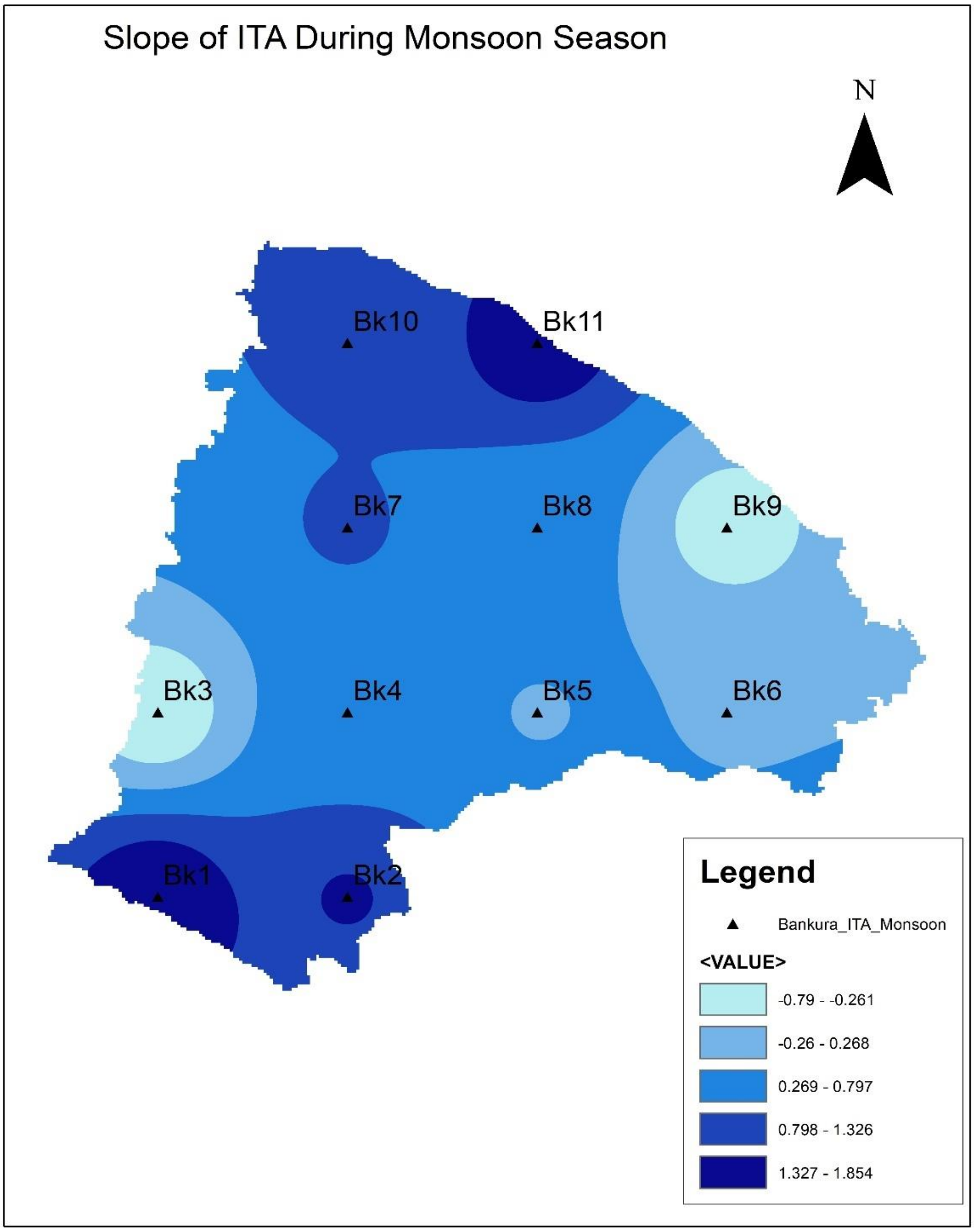


Fig. 4.6.36 ITA Slope Variation in Bankura During Monsoon Season

For Post Monsoon Season, following are the Statistical Parameters;

Table 47

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Bankura	Bk1	35	86.75	22.75	116.713	90.177	7811.585	1.307	1.884
Bankura	Bk2	36	87	22.75	119.230	83.697	6687.047	1.212	1.460
Bankura	Bk3	37	86.75	23	118.568	91.222	8174.194	1.339	1.781
Bankura	Bk4	38	87	23	117.387	78.814	6055.131	1.202	1.574
Bankura	Bk5	39	87.25	23	119.637	87.061	7175.236	1.266	1.746
Bankura	Bk6	40	87.5	23	130.108	89.335	7712.535	1.146	1.044
Bankura	Bk7	41	87	23.25	111.233	77.376	5777.573	1.367	1.992
Bankura	Bk8	42	87.25	23.25	115.495	86.722	7174.406	1.429	2.078
Bankura	Bk9	43	87.5	23.25	125.738	92.413	8096.551	1.667	3.862
Bankura	Bk10	44	87	23.5	107.933	85.943	7169.429	1.689	3.187
Bankura	Bk11	45	87.25	23.5	108.614	91.044	7786.416	1.594	3.208

For Post Monsoon Season, following are the Trend Parameters;

Table 48

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Bankura	Bk1	35	86.75	22.75	0.239	0.024	0.986	-0.048	0.048	-0.063	0.063
Bankura	Bk2	36	87	22.75	0.281	0.029	0.978	-0.056	0.056	-0.074	0.074
Bankura	Bk3	37	86.75	23	0.194	0.015	0.995	-0.030	0.030	-0.039	0.039
Bankura	Bk4	38	87	23	0.136	0.020	0.988	-0.039	0.039	-0.051	0.051
Bankura	Bk5	39	87.25	23	0.157	0.041	0.960	-0.080	0.080	-0.105	0.105
Bankura	Bk6	40	87.5	23	0.101	0.032	0.977	-0.062	0.062	-0.082	0.082
Bankura	Bk7	41	87	23.25	0.214	0.024	0.982	-0.047	0.047	-0.062	0.062
Bankura	Bk8	42	87.25	23.25	0.117	0.031	0.977	-0.060	0.060	-0.079	0.079
Bankura	Bk9	43	87.5	23.25	0.116	0.044	0.958	-0.086	0.086	-0.113	0.113
Bankura	Bk10	44	87	23.5	0.252	0.020	0.990	-0.040	0.040	-0.053	0.053
Bankura	Bk11	45	87.25	23.5	0.419	0.038	0.968	-0.075	0.075	-0.098	0.098

Trend Analysis Curves for Post Monsoon Season:

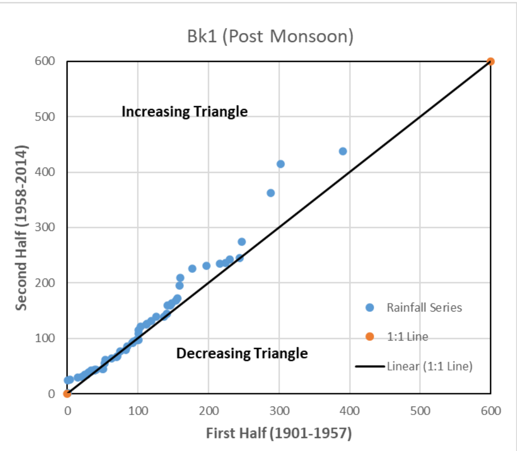


Fig 4.6.37 ITA plot for Bk1 in Post Monsoon

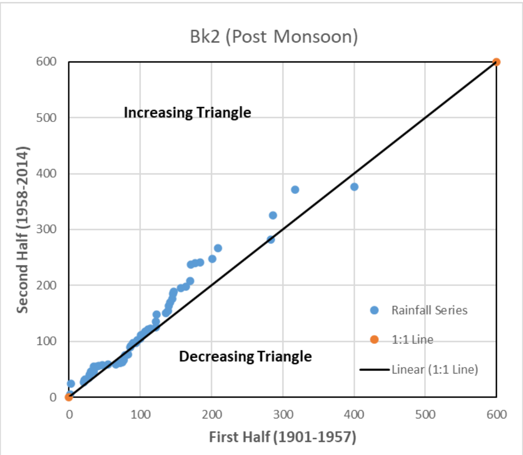


Fig 4.6.38 ITA plot for Bk2 in Post Monsoon

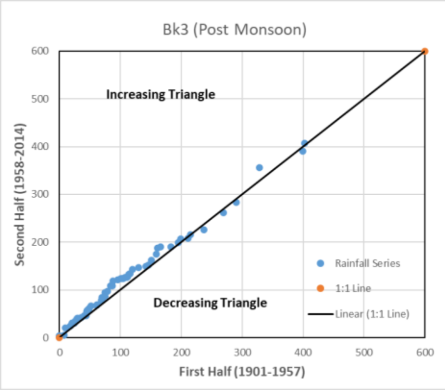


Fig 4.6.39 ITA plot for Bk3 in Post Monsoon

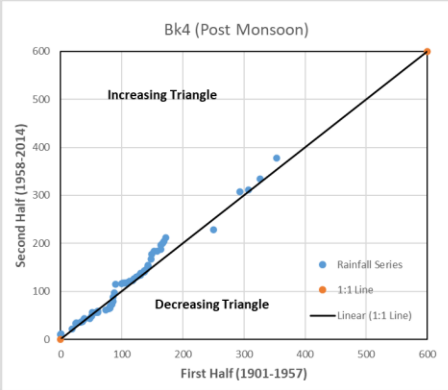


Fig 4.6.40 ITA plot for Bk4 in Post Monsoon

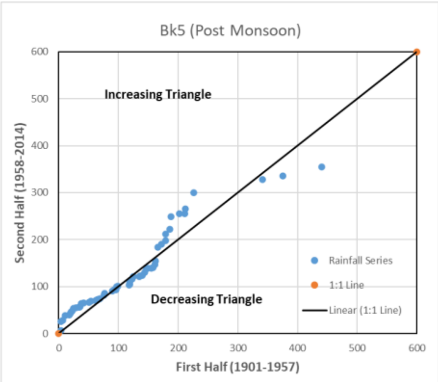


Fig 4.6.41 ITA plot for Bk5 in Post Monsoon

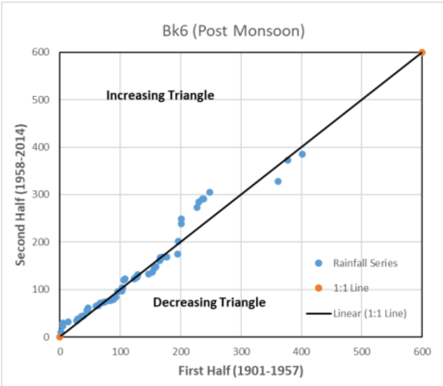


Fig 4.6.42 ITA plot for Bk6 in Post Monsoon

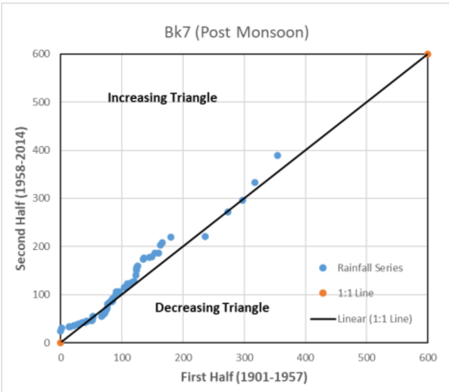


Fig 4.6.43 ITA plot for Bk7 in Post Monsoon

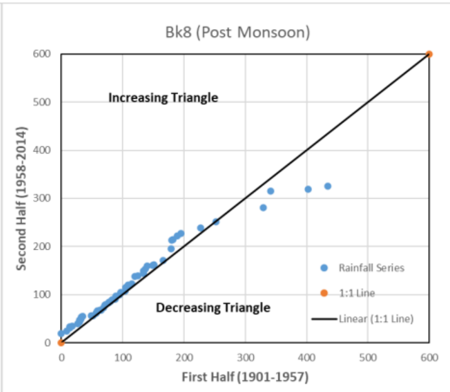


Fig 4.6.44 ITA plot for Bk8 in Post Monsoon

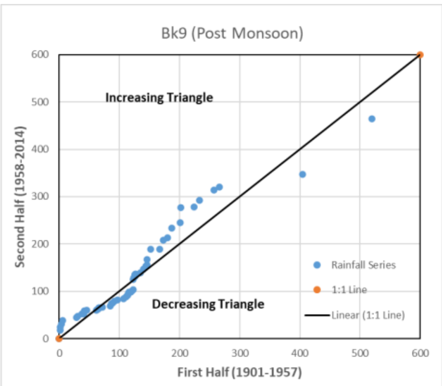


Fig 4.6.45 ITA plot for Bk9 in Post Monsoon

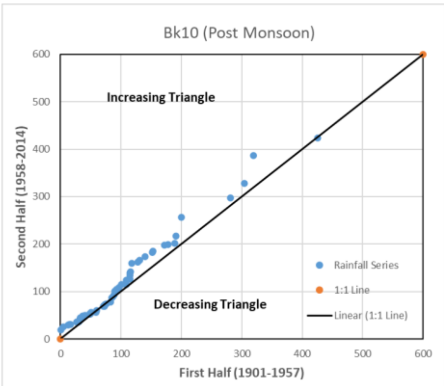


Fig 4.6.46 ITA plot for Bk10 in Post Monsoon

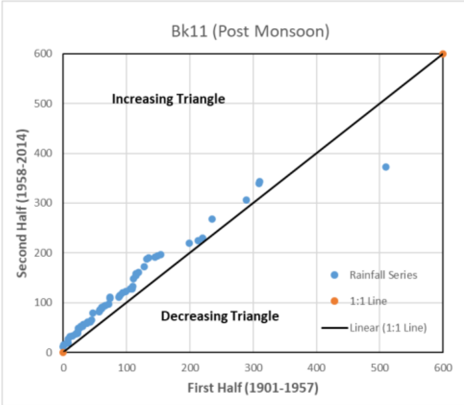


Fig 4.6.47 ITA plot for Bk11 in Post Monsoon

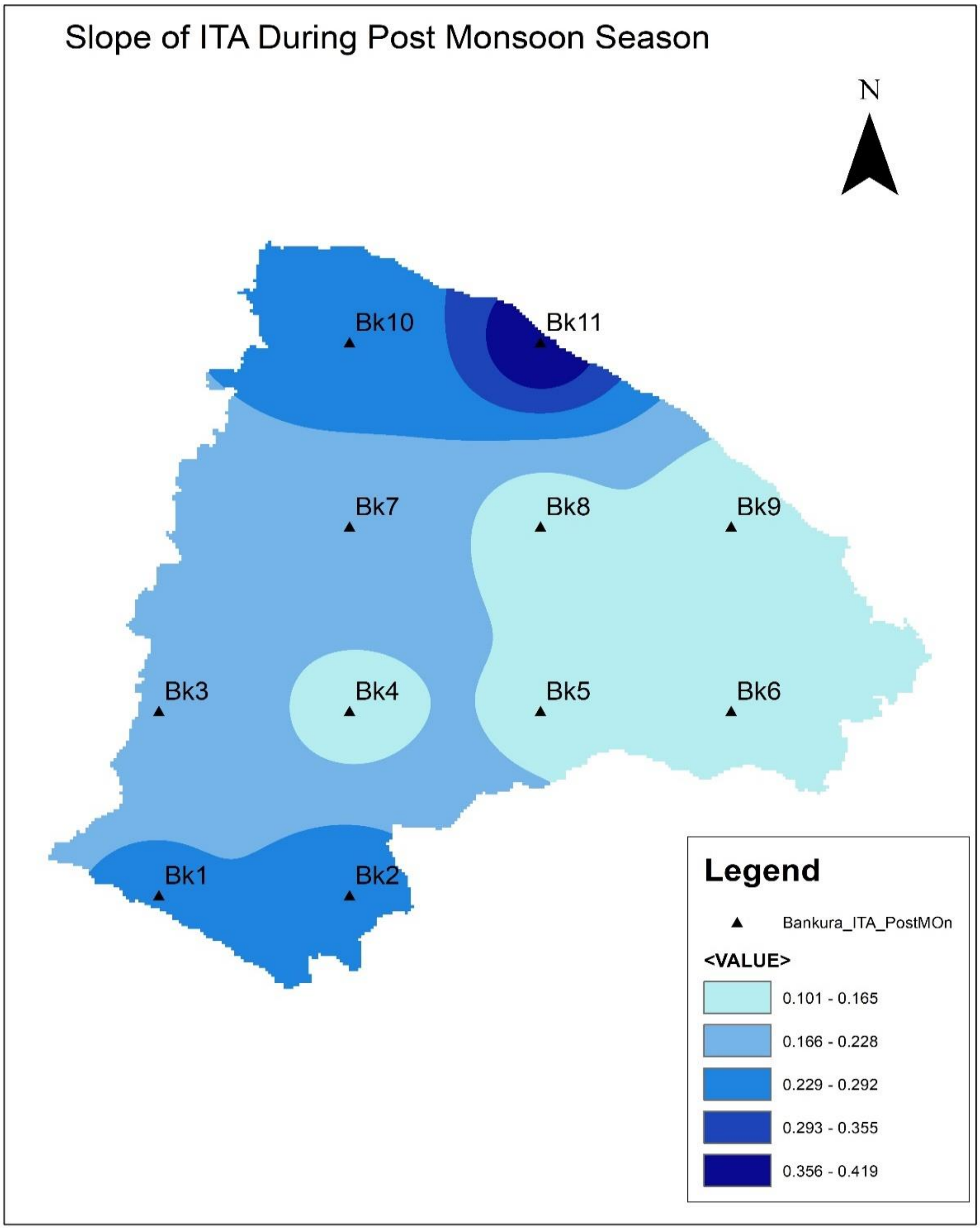


Fig. 4.6.48 ITA Slope Variation in Bankura During Post Monsoon Season

4.7 Howrah:

For Winter Season, following are the Statistical Parameters;

Table 49

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Howrah	Hw1	46	88	22.25	42.247	38.651	1417.775	1.394	3.029
Howrah	Hw2	47	88	22.5	40.768	37.233	1270.871	1.462	3.416

For Winter Season, following are the Trend Parameters;

Table 50

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Howrah	Hw1	46	88	22.25	-0.096	0.011	0.984	-0.022	0.022	-0.029	0.029
Howrah	Hw2	47	88	22.5	-0.122	0.014	0.972	-0.028	0.028	-0.037	0.037

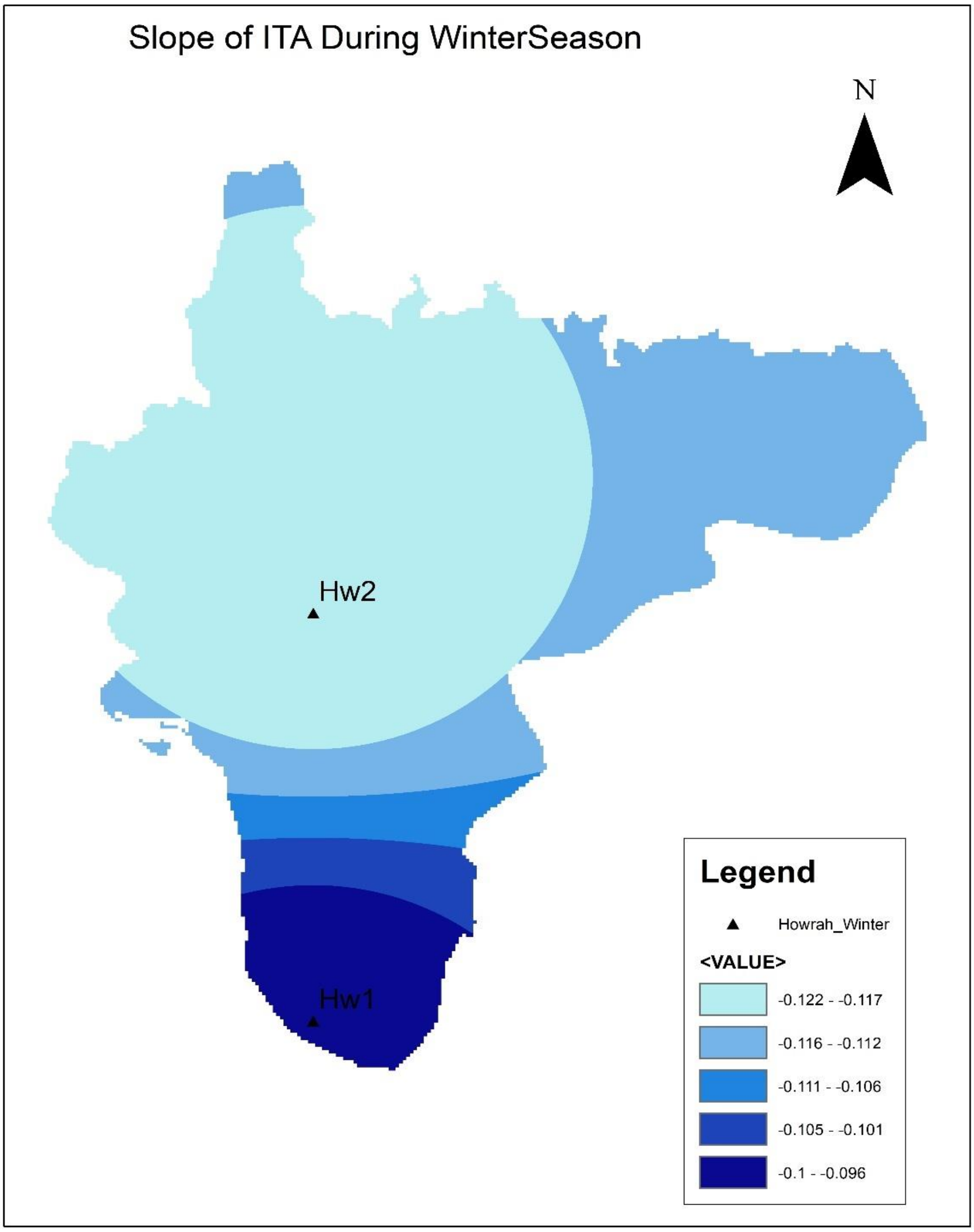
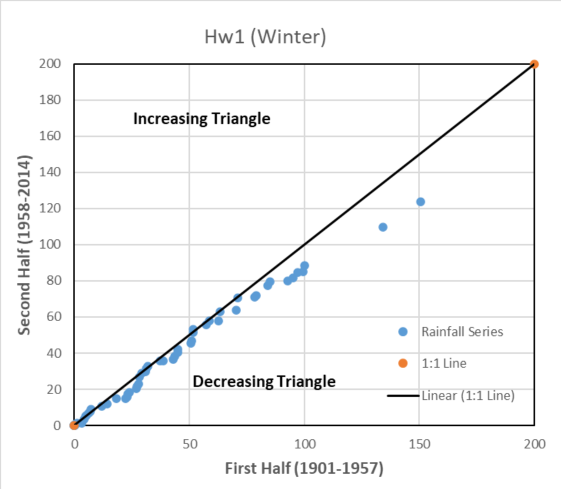


Fig. 4.7.1 ITA Slope Variation in Howrah During Winter Season

Trend Analysis Curves for Winter Season:



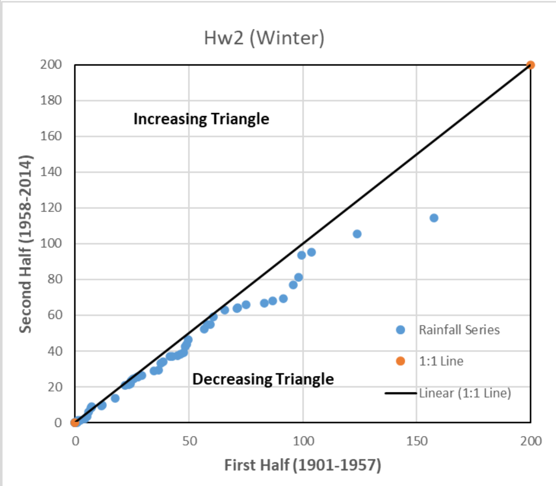


Fig 4.7.2 ITA plot for Hw1 in Winter

Fig 4.7.3 ITA plot for Hw2 in Winter

For Pre-Monsoon Season, following are the Statistical Parameters;

Table 51

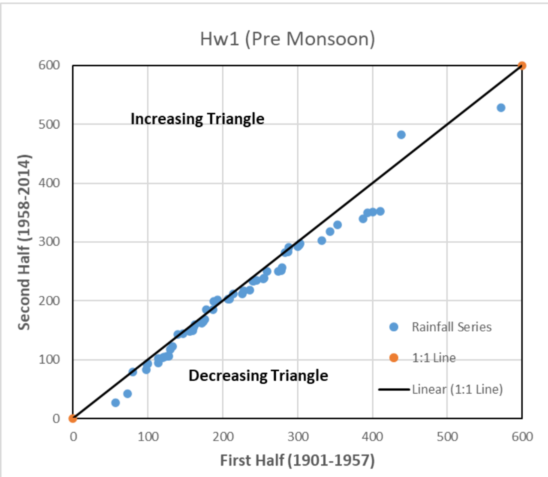
District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Howrah	Hw1	46	88	22.25	216.728	102.860	10312.727	0.796	0.870
Howrah	Hw2	47	88	22.5	216.474	104.547	10655.676	0.805	0.827

For Pre-Monsoon Season, following are the Trend Parameters;

Table 52

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Howrah	Hw1	46	88	22.25	-0.232	0.026	0.988	-0.051	0.051	-0.067	0.067
Howrah	Hw2	47	88	22.5	-0.143	0.029	0.986	-0.056	0.056	-0.074	0.074

Trend Analysis Curves for Pre-Monsoon Season:



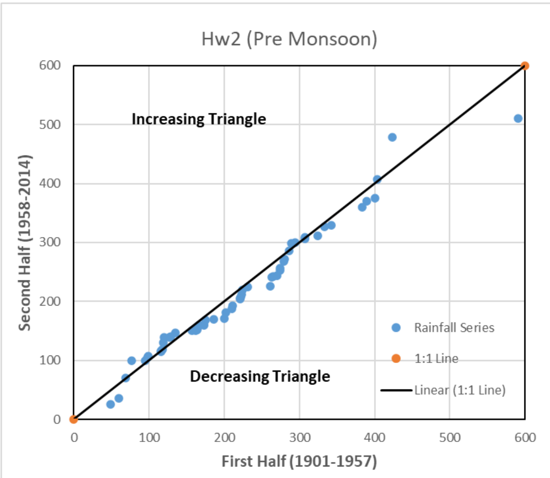


Fig 4.7.4 ITA plot for Hw1 in Pre-Monsoon

Fig 4.7.5 ITA plot for Hw2 in Pre-Monsoon

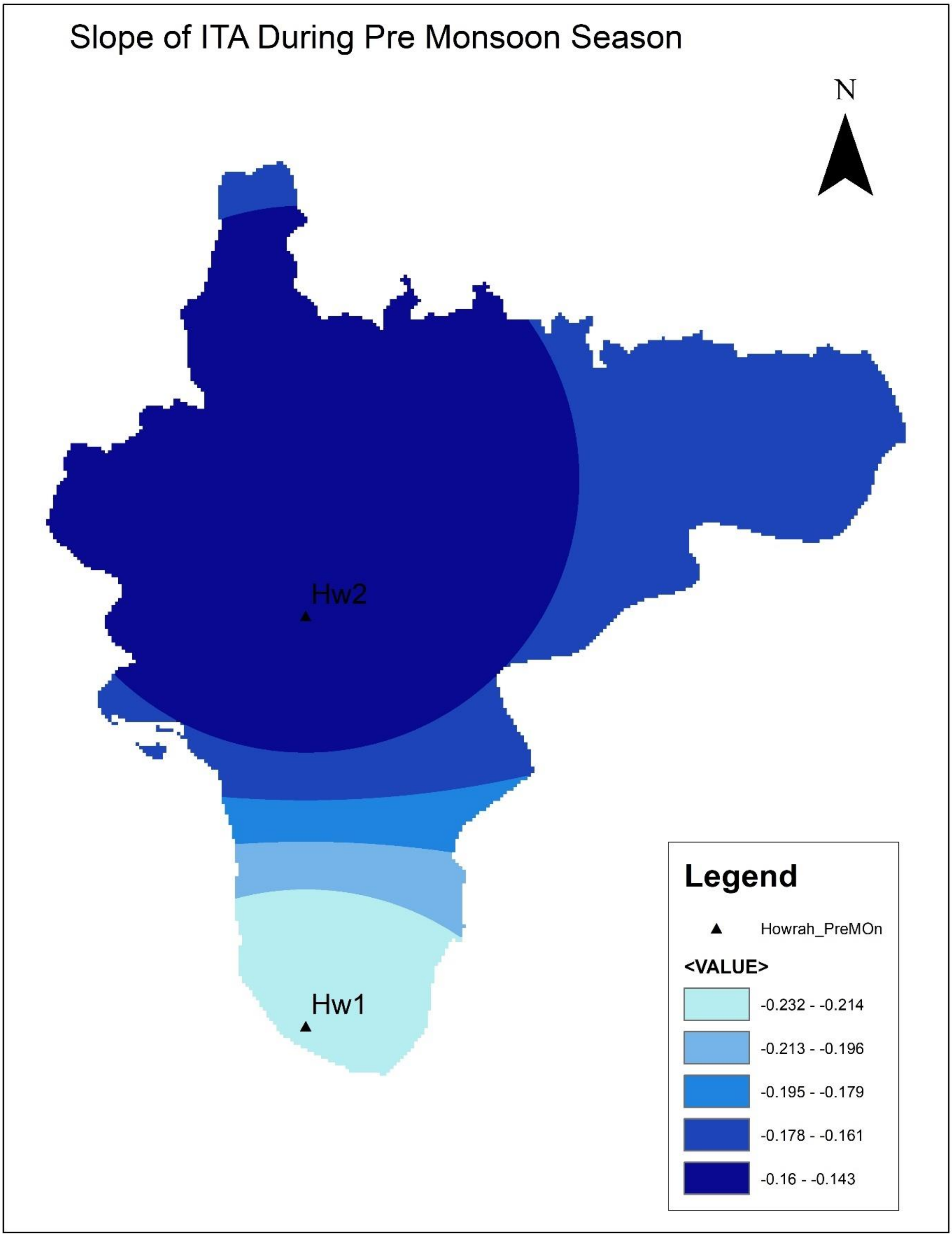


Fig. 4.7.6 ITA Slope Variation in Howrah During Pre-Monsoon Season

For Monsoon Season, following are the Statistical Parameters;

Table 53

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Howrah	Hw1	46	88	22.25	1238.597	304.833	83012.458	1.223	3.731
Howrah	Hw2	47	88	22.5	1236.362	327.502	93950.116	1.098	3.972

For Monsoon Season, following are the Trend Parameters;

Table 54

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Howrah	Hw1	46	88	22.25	1.673	0.176	0.938	-0.345	0.345	-0.453	0.453
Howrah	Hw2	47	88	22.5	2.266	0.161	0.955	-0.315	0.315	-0.414	0.414

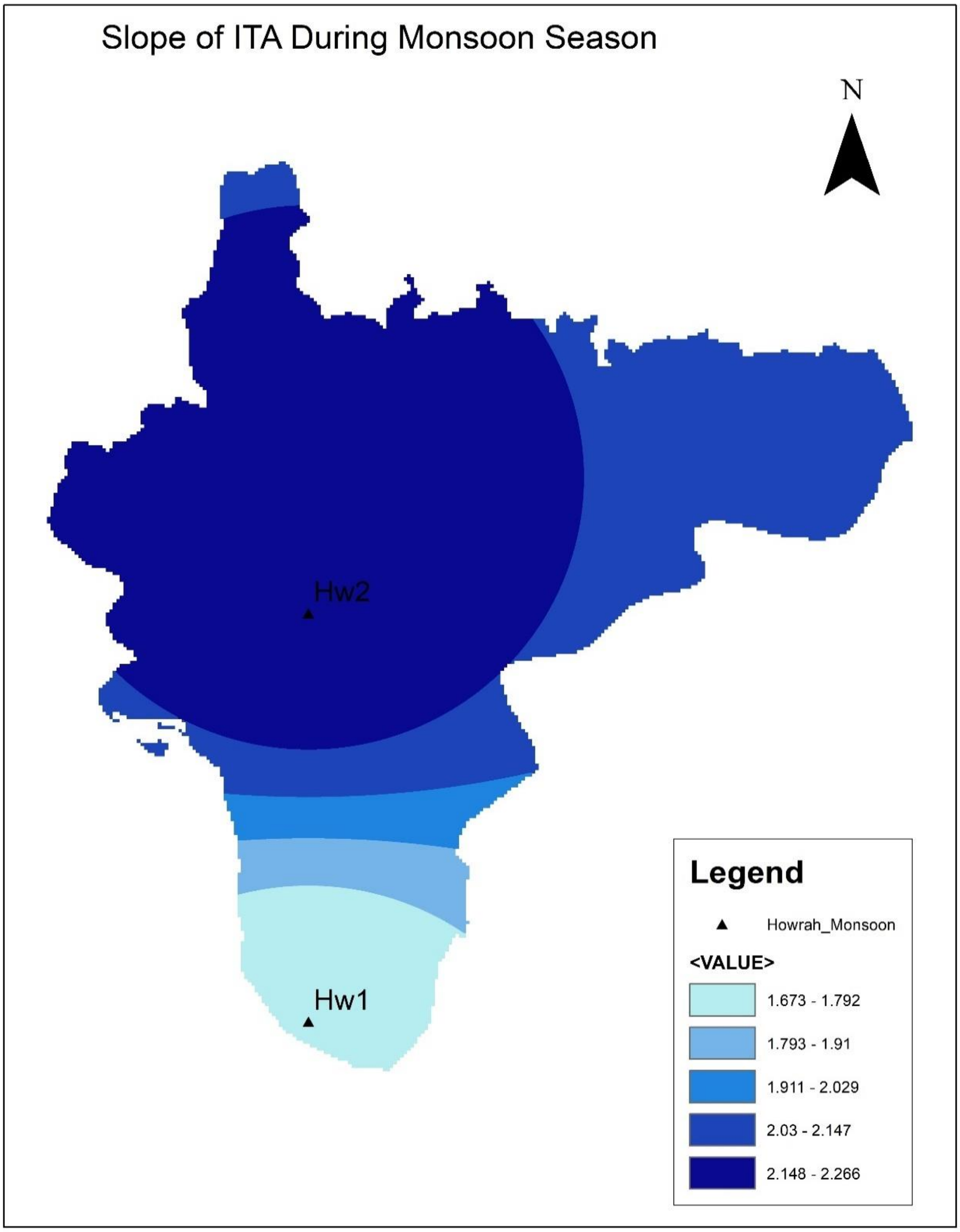


Fig. 4.7.7 ITA Slope Variation in Howrah During Monsoon Season

Trend Analysis Curves for Monsoon Season:

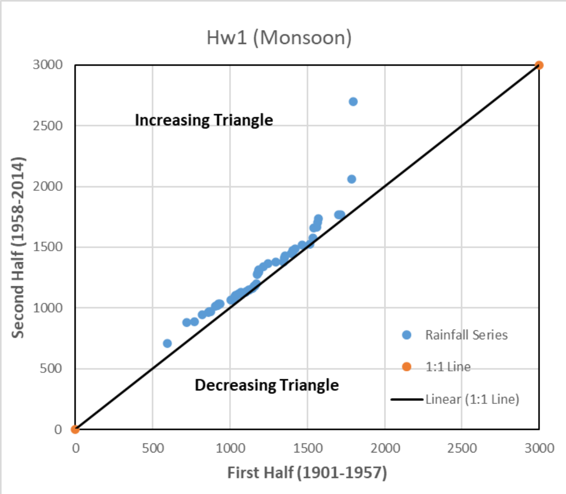


Fig 4.7.8 ITA plot for Hw1 in Monsoon

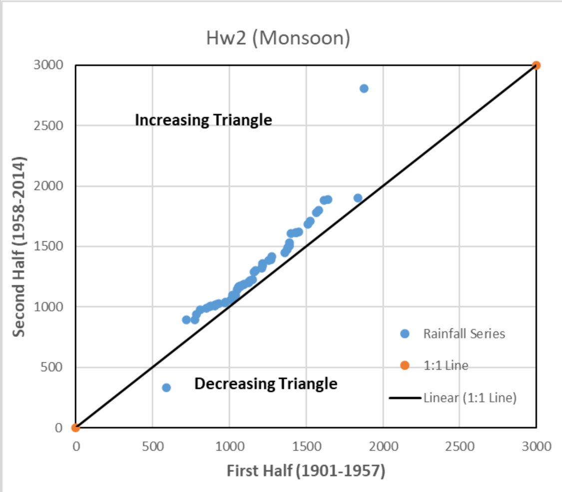


Fig 4.7.9 ITA plot for Hw2 in Monsoon

For Post Monsoon Season, following are the Statistical Parameters;

Table 55

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Howrah	Hw1	46	88	22.25	167.480	107.284	11115.406	0.855	0.134
Howrah	Hw2	47	88	22.5	174.409	113.903	12244.528	1.068	0.820

For Post Monsoon Season, following are the Trend Parameters;

Table 56

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation $(\rho_{y_1 y_2})$	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Howrah	Hw1	46	88	22.25	0.440	0.013	0.997	-0.026	0.026	-0.034	0.034
Howrah	Hw2	47	88	22.5	0.642	0.027	0.989	-0.053	0.053	-0.070	0.070

Trend Analysis Curves for Post Monsoon Season :

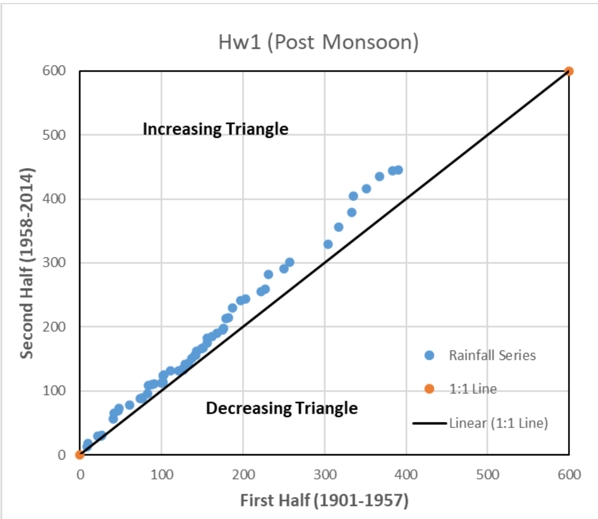


Fig 4.7.10 ITA plot for Hw1 in Post Monsoon

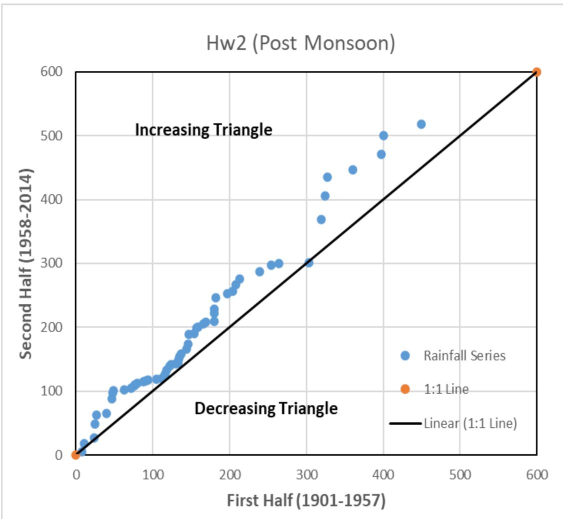


Fig 4.7.11 ITA plot for Hw2 in Post Monsoon

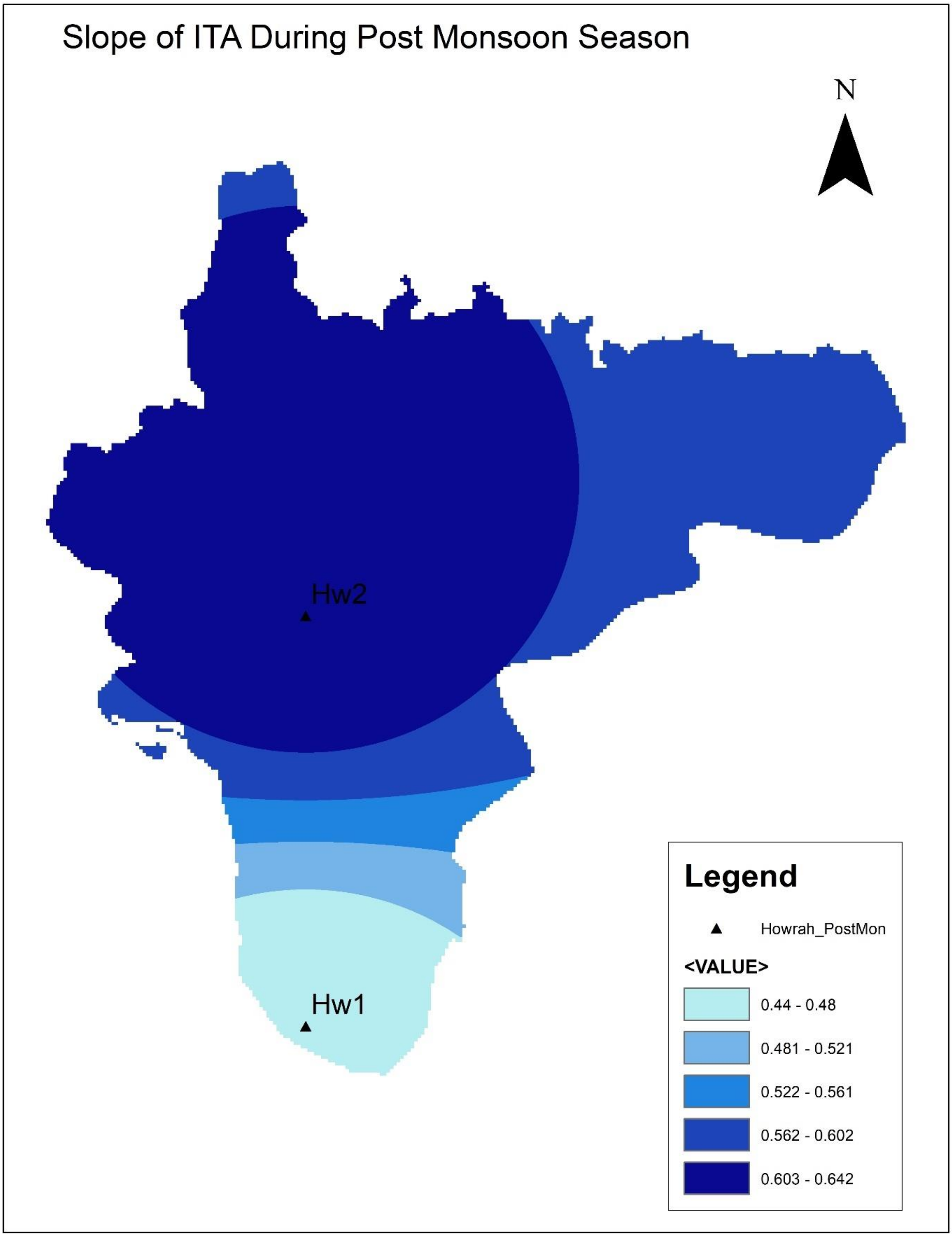


Fig. 4.7.12 ITA Slope Variation in Howrah During Post Monsoon Season

4.8 Hooghly:

For Winter Season, following are the Statistical Parameters;

Table 57

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Hooghly	Hg1	48	87.75	22.75	37.481	34.329	1019.816	1.363	2.921
Hooghly	Hg2	49	88	22.75	36.029	36.475	1221.969	1.554	2.696
Hooghly	Hg3	50	88.25	22.75	36.804	36.017	1167.303	1.624	3.745
Hooghly	Hg4	51	88.25	23	32.929	35.151	1159.630	1.625	3.343

For Winter Season, following are the Trend Parameters;

Table 58

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Hooghly	Hg1	48	87.75	22.75	-0.190	0.016	0.958	-0.032	0.032	-0.042	0.042
Hooghly	Hg2	49	88	22.75	-0.079	0.015	0.970	-0.029	0.029	-0.038	0.038
Hooghly	Hg3	50	88.25	22.75	-0.100	0.016	0.964	-0.031	0.031	-0.041	0.041
Hooghly	Hg4	51	88.25	23	-0.054	0.013	0.974	-0.026	0.026	-0.034	0.034

Trend Analysis Curves for Winter Season:

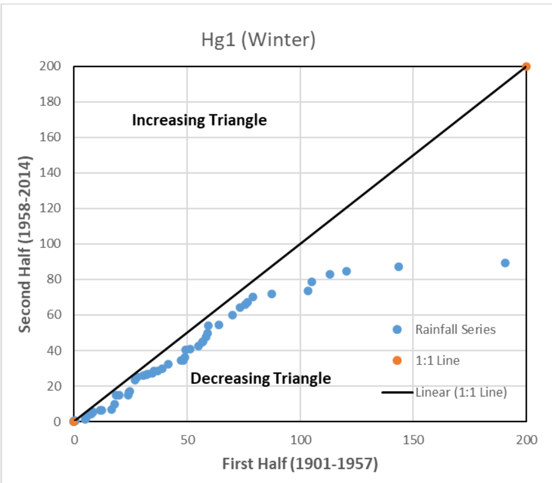


Fig 4.8.1 ITA plot for Hg1 in Winter

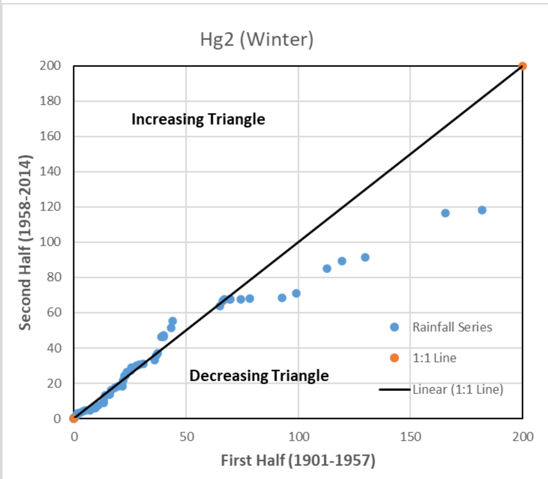


Fig 4.8.2 ITA plot for Hg2 in Winter

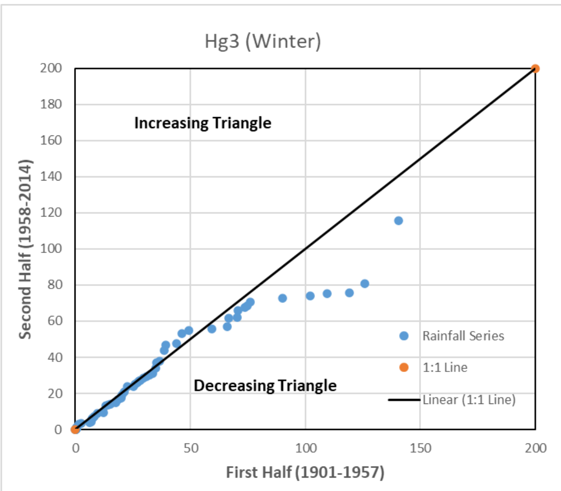


Fig 4.8.3 ITA plot for Hg3 in Winter

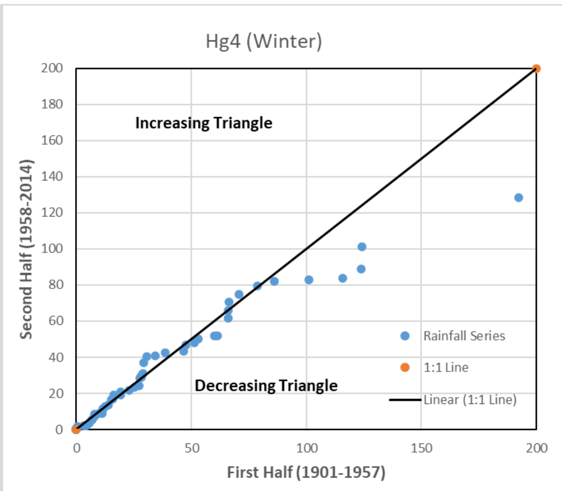


Fig 4.8.4 ITA plot for Hg4 in Winter

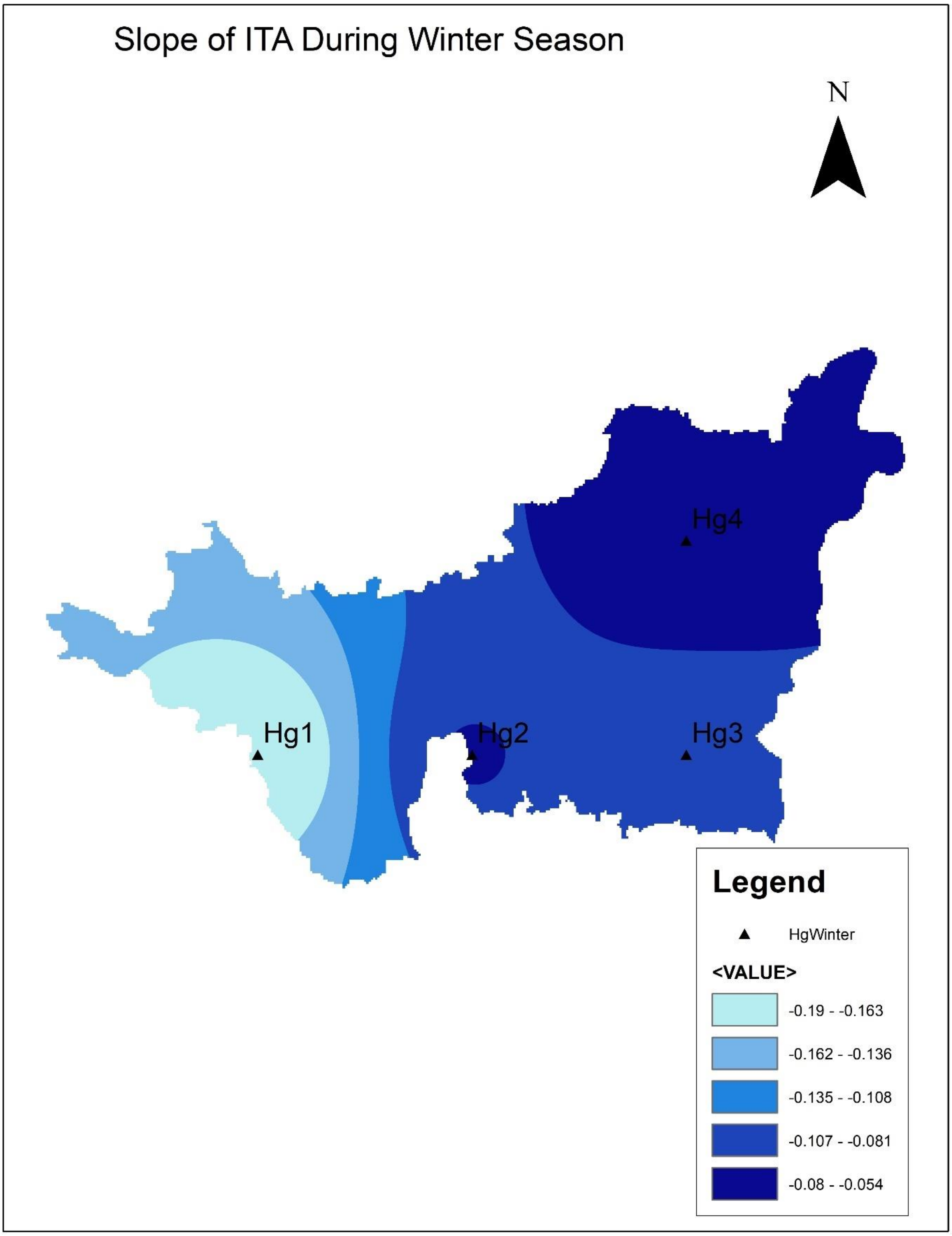


Fig. 4.8.5 ITA Slope Variation in Hooghly During Winter Season

For Pre-Monsoon Season, following are the Statistical Parameters;

Table 59

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Hooghly	Hg1	48	87.75	22.75	211.762	100.526	9613.089	1.096	2.000
Hooghly	Hg2	49	88	22.75	215.282	109.032	11349.094	1.247	3.644
Hooghly	Hg3	50	88.25	22.75	216.344	97.953	9381.590	1.164	3.246
Hooghly	Hg4	51	88.25	23	203.042	96.686	9074.025	0.739	0.907

For Pre-Monsoon Season, following are the Trend Parameters;

Table 60

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Hooghly	Hg1	48	87.75	22.75	-0.375	0.033	0.981	-0.064	0.064	-0.084	0.084
Hooghly	Hg2	49	88	22.75	0.099	0.035	0.981	-0.069	0.069	-0.091	0.091
Hooghly	Hg3	50	88.25	22.75	-0.039	0.025	0.988	-0.048	0.048	-0.064	0.064
Hooghly	Hg4	51	88.25	23	0.016	0.027	0.985	-0.053	0.053	-0.070	0.070

Trend Analysis Curves for Pre-Monsoon Season:

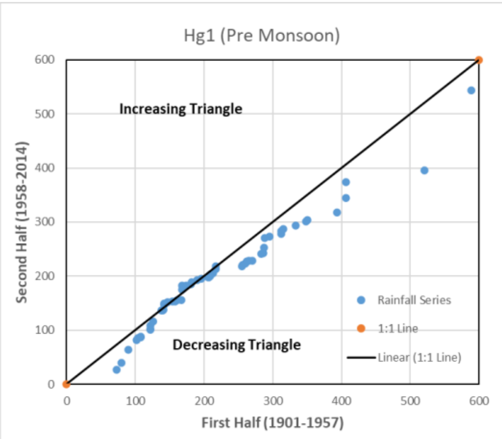


Fig 4.8.6 ITA plot for Hg1 in Pre-Monsoon

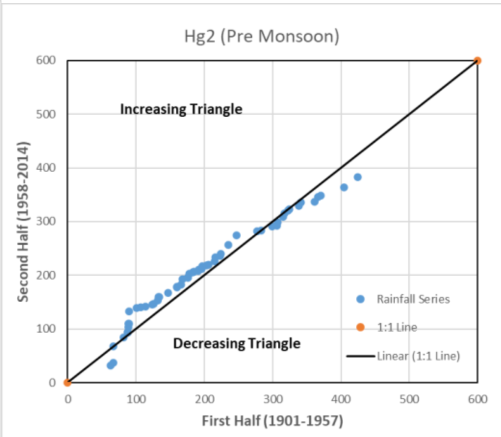


Fig 4.8.7 ITA plot for Hg2 in Pre-Monsoon

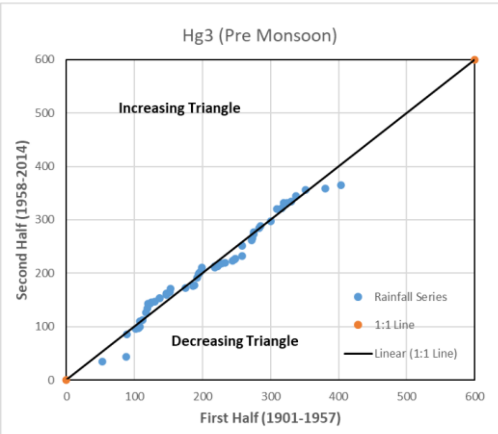


Fig 4.8.8 ITA plot for Hg3 in Pre-Monsoon

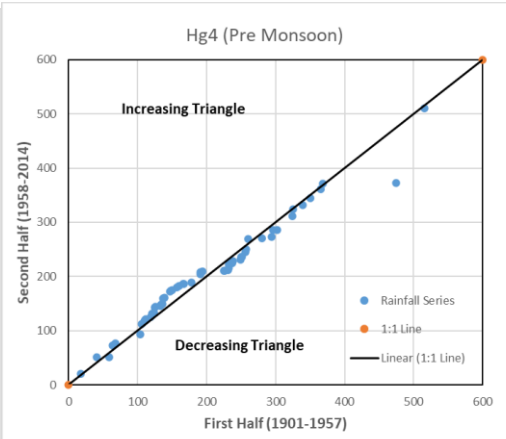


Fig 4.8.9 ITA plot for Hg4 in Pre-Monsoon

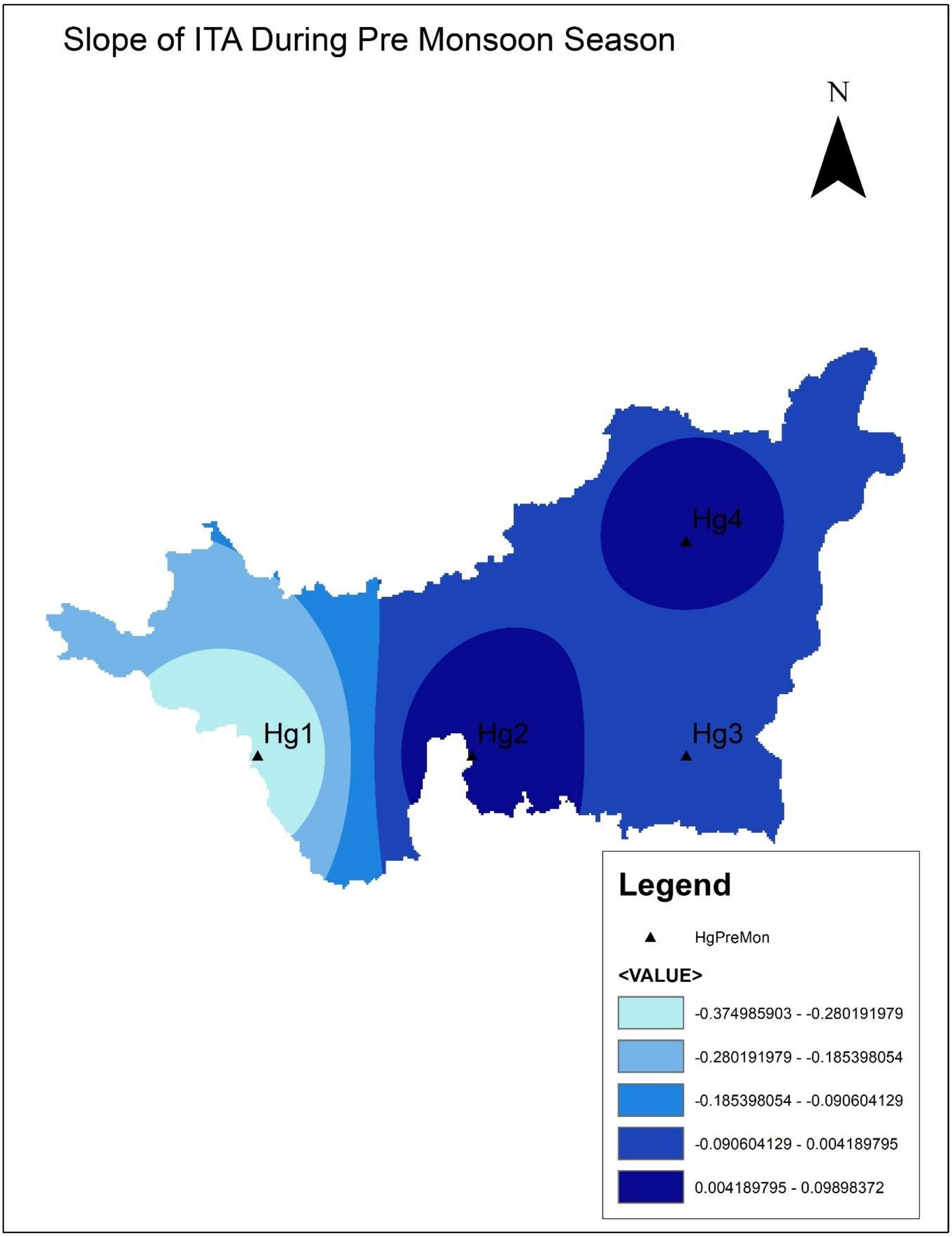


Fig. 4.8.10 ITA Slope Variation in Hooghly During Pre-Monsoon Season

For Monsoon Season, following are the Statistical Parameters;

Table 61

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Hooghly	Hg1	48	87.75	22.75	1135.279	276.468	74657.634	0.413	0.209
Hooghly	Hg2	49	88	22.75	1175.150	347.831	109615.644	0.985	2.859
Hooghly	Hg3	50	88.25	22.75	1134.730	313.420	79578.433	1.215	4.925
Hooghly	Hg4	51	88.25	23	995.376	348.690	87618.214	2.319	13.121

For Monsoon Season, following are the Trend Parameters;

Table 62

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation $(\rho_{y_1 y_2})$	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Hooghly	Hg1	48	87.75	22.75	-0.656	0.062	0.991	-0.122	0.122	-0.161	0.161
Hooghly	Hg2	49	88	22.75	2.458	0.170	0.956	-0.333	0.333	-0.438	0.438
Hooghly	Hg3	50	88.25	22.75	3.180	0.160	0.951	-0.314	0.314	-0.413	0.413
Hooghly	Hg4	51	88.25	23	2.459	0.357	0.806	-0.700	0.700	-0.920	0.920

Trend Analysis Curves for Monsoon Season:

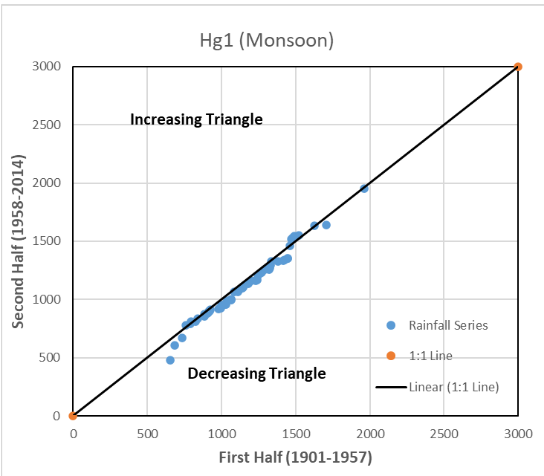


Fig 4.8.11 ITA plot for Hg1 in Monsoon

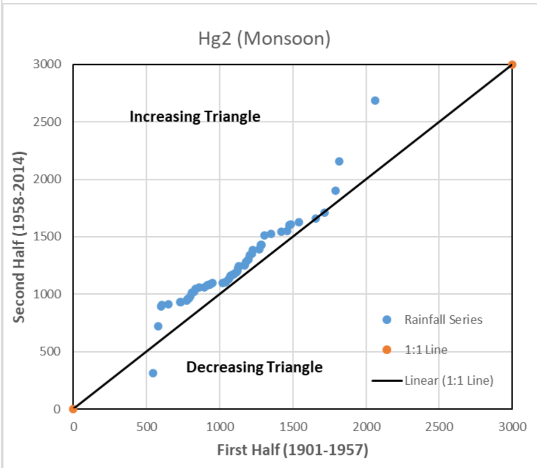


Fig 4.8.12 ITA plot for Hg2 in Monsoon

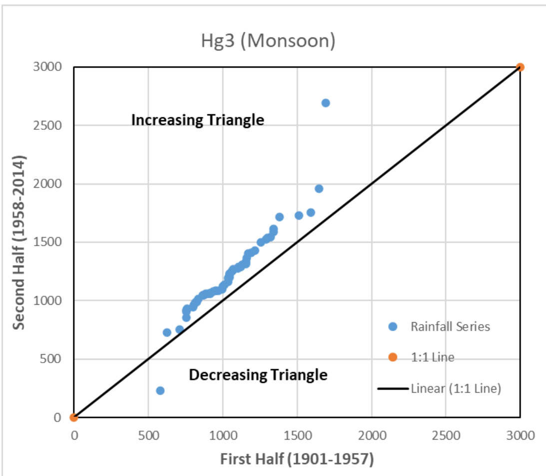


Fig 4.8.13 ITA plot for Hg3 in Monsoon

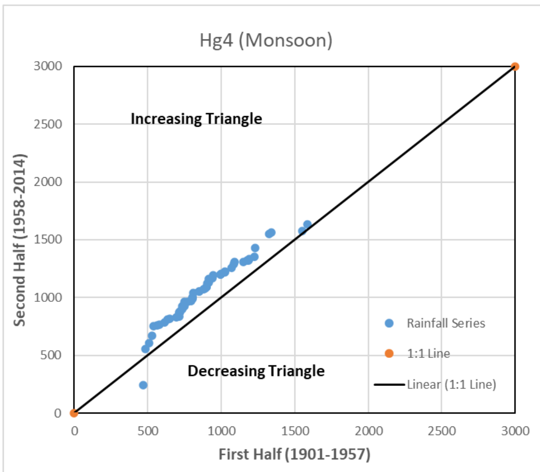


Fig 4.8.14 ITA plot for Hg4 in Monsoon

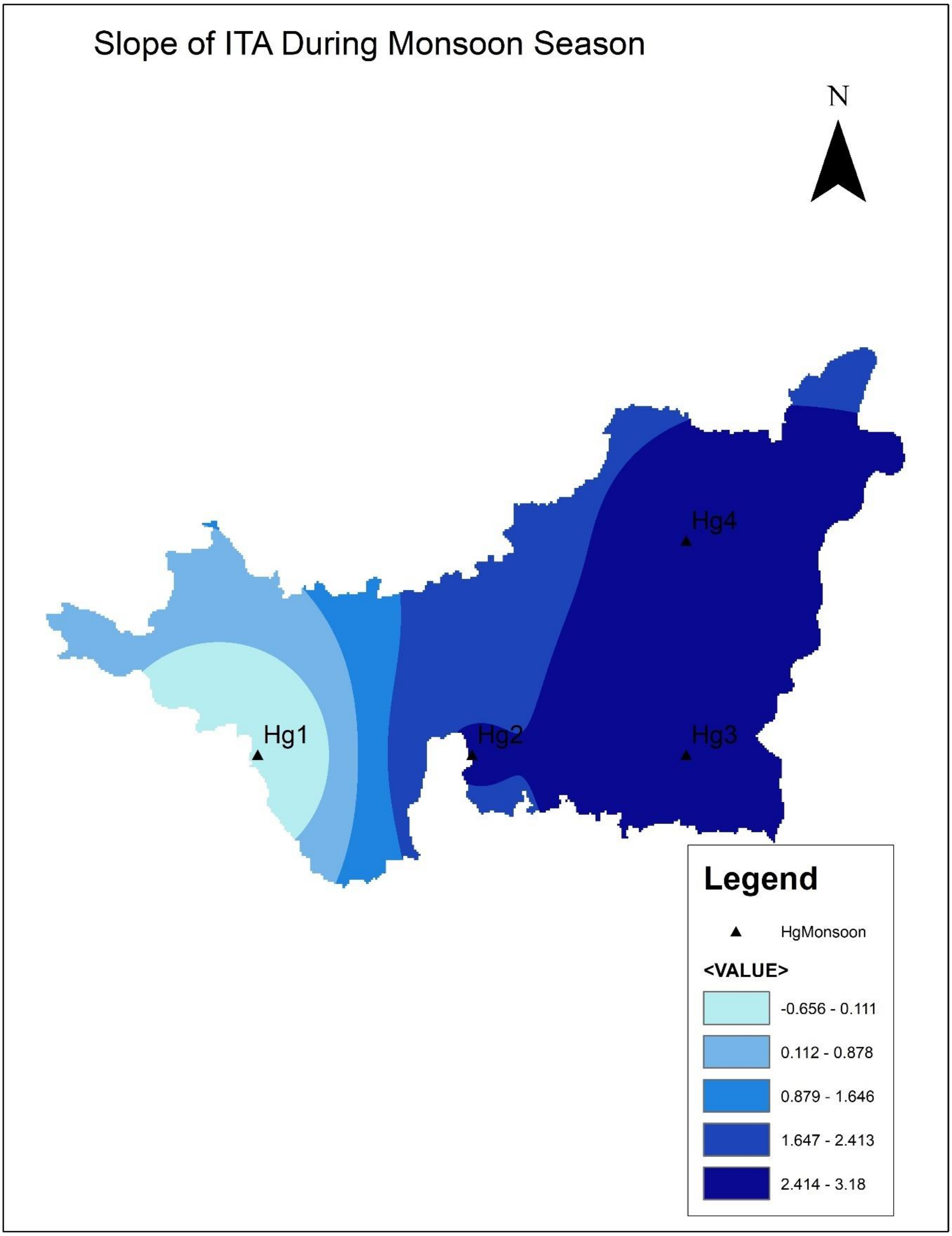


Fig. 4.8.15 ITA Slope Variation in Hooghly During Monsoon Season

For Post Monsoon Season, following are the Statistical Parameters;

Table 63

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Hooghly	Hg1	48	87.75	22.75	148.080	98.575	9509.787	1.103	0.927
Hooghly	Hg2	49	88	22.75	156.178	100.972	9439.956	0.751	0.076
Hooghly	Hg3	50	88.25	22.75	152.098	98.871	8838.034	0.841	0.270
Hooghly	Hg4	51	88.25	23	133.185	94.803	7965.106	1.033	0.478

For Post Monsoon Season, following are the Trend Parameters;

Table 64

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Hooghly	Hg1	48	87.75	22.75	0.108	0.022	0.991	-0.043	0.043	-0.057	0.057
Hooghly	Hg2	49	88	22.75	0.602	0.042	0.968	-0.083	0.083	-0.109	0.109
Hooghly	Hg3	50	88.25	22.75	0.695	0.038	0.973	-0.074	0.074	-0.097	0.097
Hooghly	Hg4	51	88.25	23	0.741	0.053	0.942	-0.104	0.104	-0.136	0.136

Trend Analysis Curves for Post Monsoon Season:

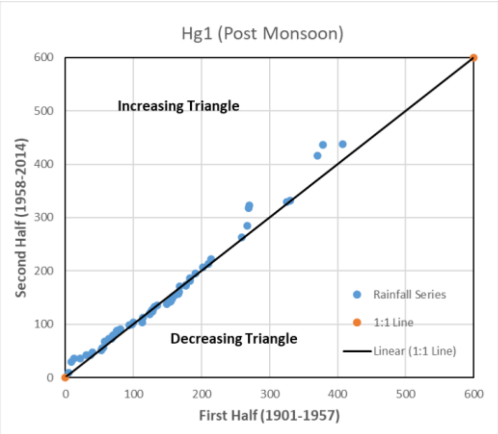


Fig 4.8.16 ITA plot for Hg1 in Post Monsoon

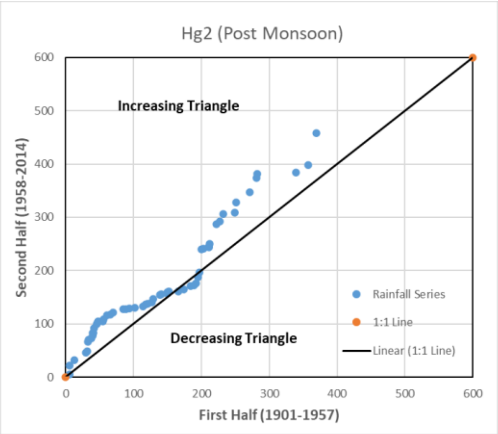


Fig 4.8.17 ITA plot for Hg2 in Post Monsoon

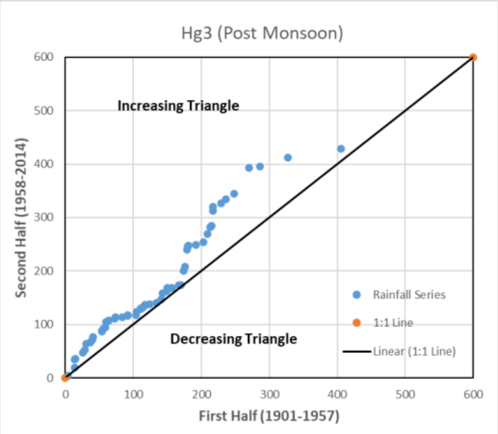


Fig 4.8.18 ITA plot for Hg3 in Post Monsoon

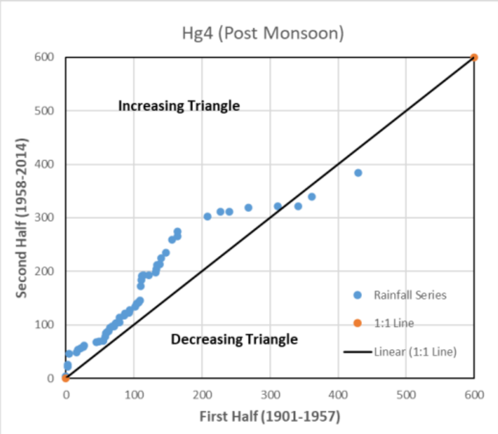


Fig 4.8.19 ITA plot for Hg4 in Post Monsoon

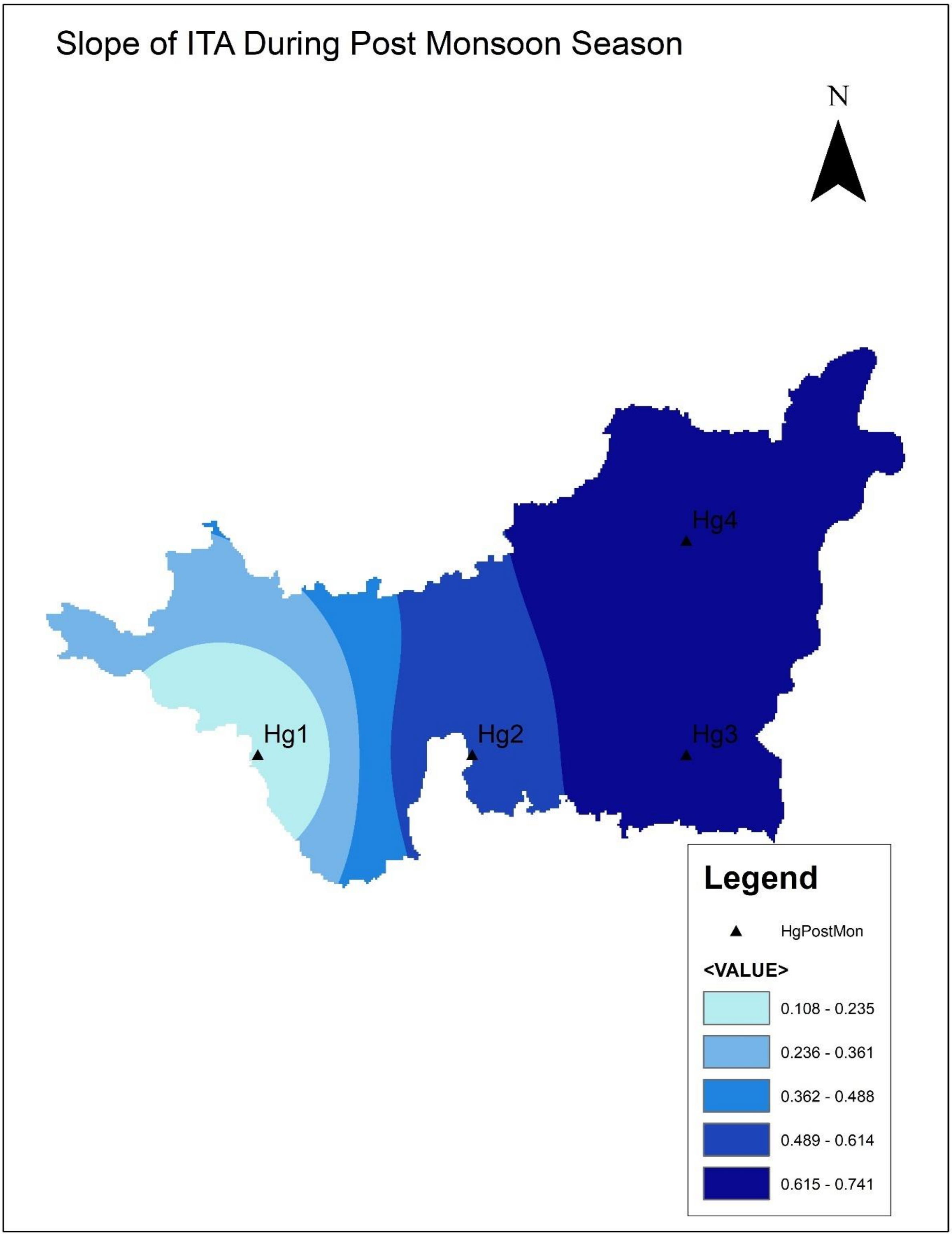


Fig. 4.8.20 ITA Slope Variation in Hooghly During Post Monsoon Season

4.9 Purba Bardhaman:

For Winter Season, following are the Statistical Parameters;

Table 65

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purba Bardhaman	Pb_B1	52	88	23	38.328	40.835	1557.620	1.611	3.138
Purba Bardhaman	Pb_B2	53	87.75	23	37.122	36.460	1234.714	1.350	2.004
Purba Bardhaman	Pb_B3	54	87.75	23.25	35.175	34.894	1118.256	1.464	2.780
Purba Bardhaman	Pb_B4	55	88	23.25	33.380	34.294	1082.070	1.463	2.562
Purba Bardhaman	Pb_B5	56	88.25	23.25	32.320	34.221	1023.588	1.514	2.554
Purba Bardhaman	Pb_B6	57	87.75	23.5	30.452	29.621	823.310	1.335	1.861
Purba Bardhaman	Pb_B7	58	88	23.5	31.125	29.976	814.469	1.391	2.541
Purba Bardhaman	Pb_B8	59	88.25	23.5	32.495	34.621	1096.336	1.592	3.053
Purba Bardhaman	Pb_B9	60	88	23.75	27.208	26.458	668.196	1.318	1.525

For Winter Season, following are the Trend Parameters;

Table 66

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purba Bardhaman	Pb_B1	52	88	23	-0.104	0.020	0.957	-0.039	0.039	-0.051	0.051
Purba Bardhaman	Pb_B2	53	87.75	23	-0.149	0.011	0.984	-0.021	0.021	-0.027	0.027
Purba Bardhaman	Pb_B3	54	87.75	23.25	-0.123	0.010	0.983	-0.020	0.020	-0.027	0.027
Purba Bardhaman	Pb_B4	55	88	23.25	-0.148	0.008	0.989	-0.016	0.016	-0.022	0.022
Purba Bardhaman	Pb_B5	56	88.25	23.25	-0.215	0.008	0.990	-0.016	0.016	-0.021	0.021
Purba Bardhaman	Pb_B6	57	87.75	23.5	-0.058	0.009	0.982	-0.018	0.018	-0.024	0.024
Purba Bardhaman	Pb_B7	58	88	23.5	-0.156	0.010	0.978	-0.020	0.020	-0.027	0.027
Purba Bardhaman	Pb_B8	59	88.25	23.5	-0.213	0.007	0.992	-0.014	0.014	-0.018	0.018
Purba Bardhaman	Pb_B9	60	88	23.75	-0.092	0.006	0.990	-0.012	0.012	-0.016	0.016

Trend Analysis Curves for Winter Season:

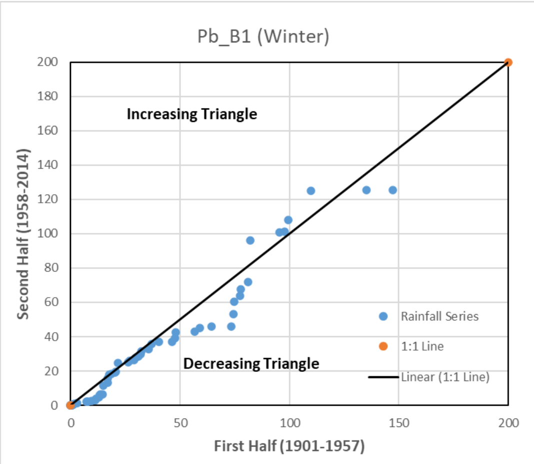


Fig 4.9.1 ITA plot for Pb_B1 in Winter

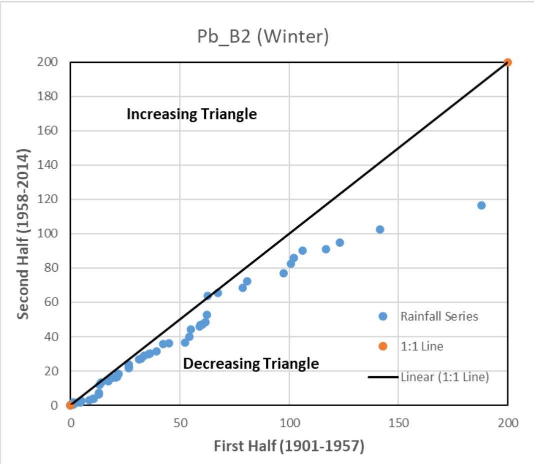


Fig 4.9.2 ITA plot for Pb_B2 in Winter

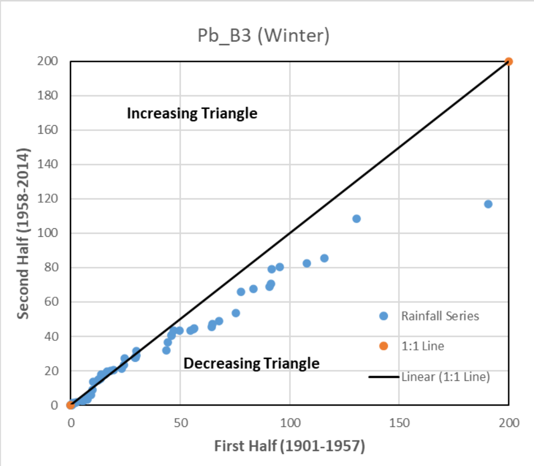


Fig 4.9.3 ITA plot for Pb_B3 in Winter

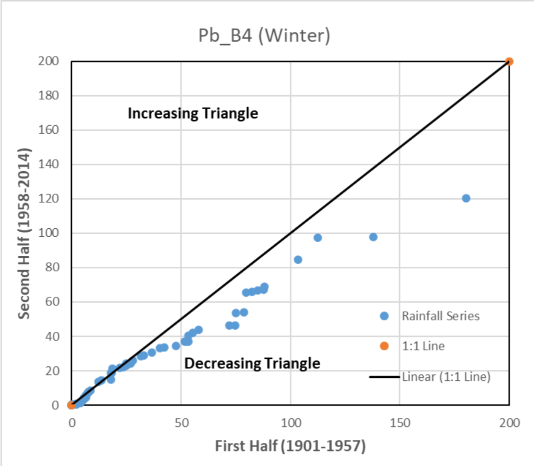


Fig 4.9.4 ITA plot for Pb_B4 in Winter

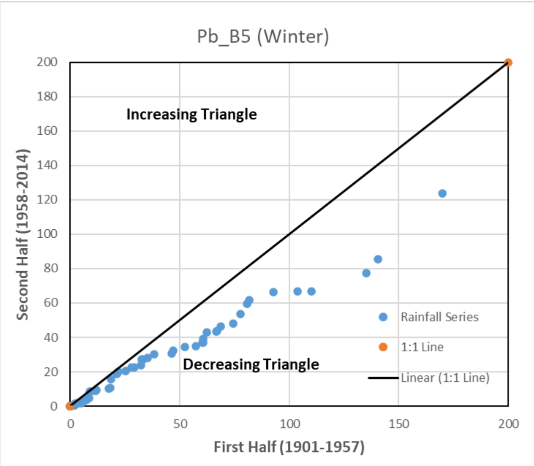


Fig 4.9.5 ITA plot for Pb_B5 in Winter

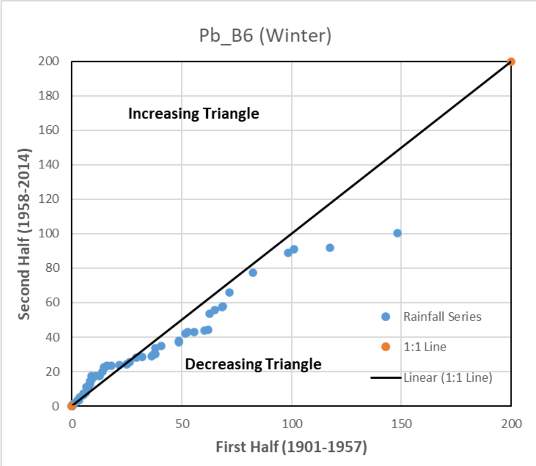


Fig 4.9.6 ITA plot for Pb_B6 in Winter

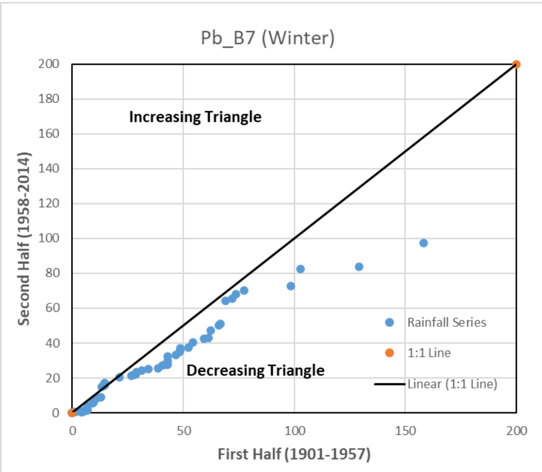


Fig 4.9.7 ITA plot for Pb_B7 in Winter

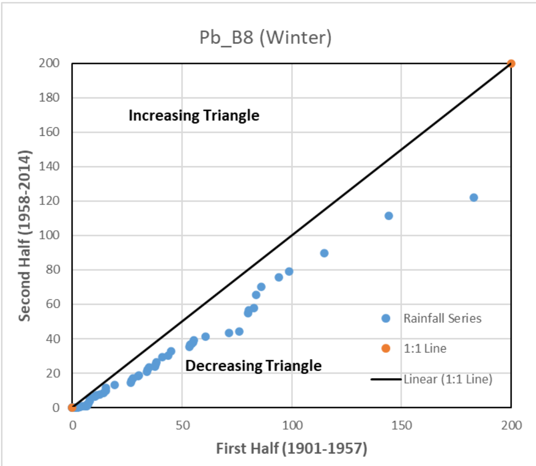


Fig 4.9.8 ITA plot for Pb_B8 in Winter

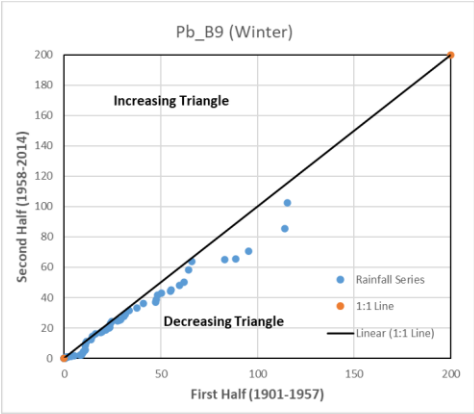


Fig 4.9.9 ITA plot for Pb_B9 in Winter

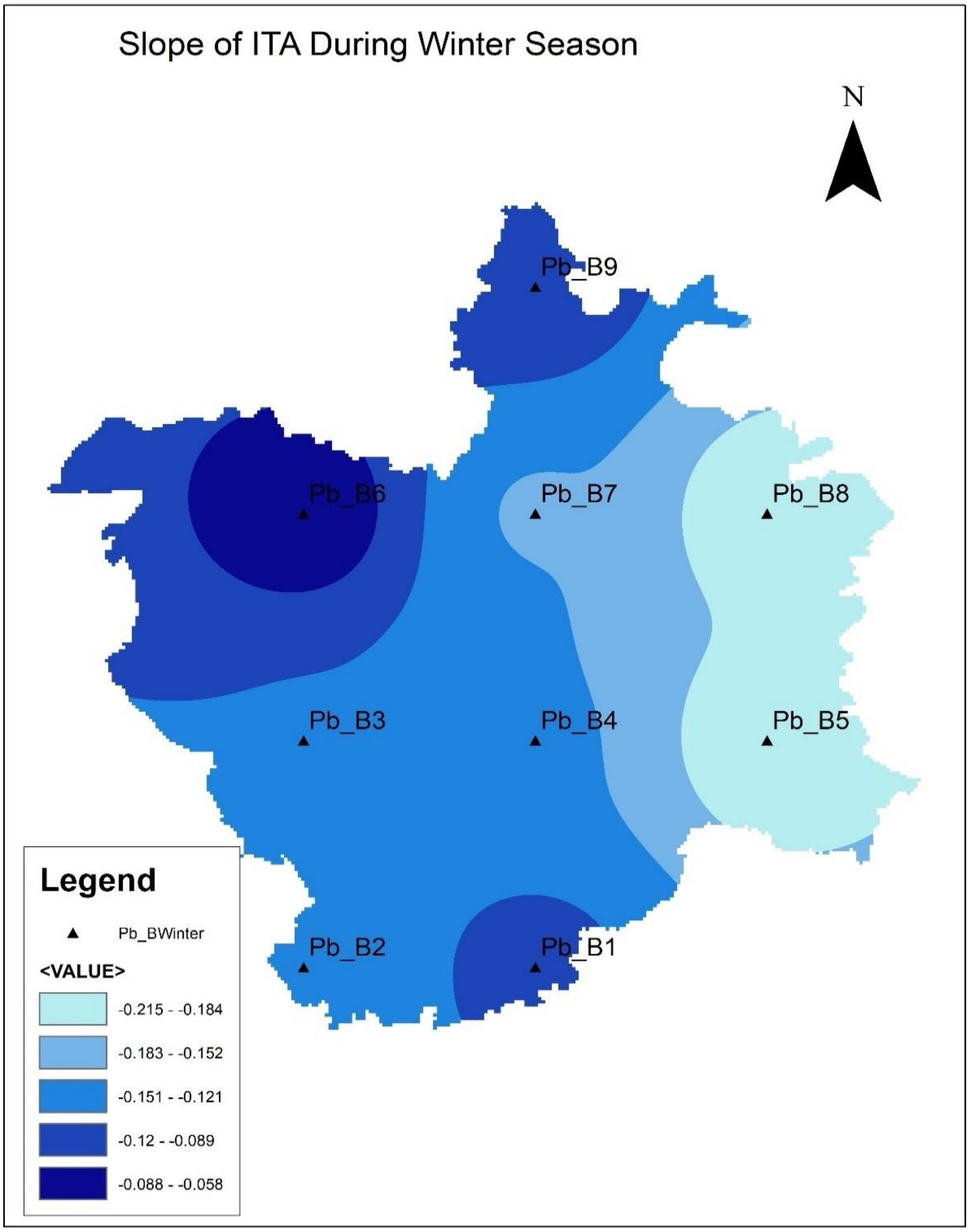


Fig. 4.9.10 ITA Slope Variation in Purba Bardhaman During Winter Season

For Pre-Monsoon Season, following are the Statistical Parameters;

Table 67

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purba Bardhaman	Pb_B1	52	88	23	222.769	106.328	10735.433	1.181	2.723
Purba Bardhaman	Pb_B2	53	87.75	23	209.933	91.674	7917.457	1.095	2.695
Purba Bardhaman	Pb_B3	54	87.75	23.25	197.114	89.184	7555.240	0.924	1.517
Purba Bardhaman	Pb_B4	55	88	23.25	207.244	108.735	10649.625	1.885	7.353
Purba Bardhaman	Pb_B5	56	88.25	23.25	207.547	98.668	8637.365	0.470	-0.539
Purba Bardhaman	Pb_B6	57	87.75	23.5	175.639	88.601	7563.452	1.059	1.955
Purba Bardhaman	Pb_B7	58	88	23.5	194.328	96.050	8687.561	0.635	-0.120
Purba Bardhaman	Pb_B8	59	88.25	23.5	212.475	104.269	9861.482	0.400	-0.352
Purba Bardhaman	Pb_B9	60	88	23.75	180.619	95.591	8696.241	0.706	0.262

For Pre-Monsoon Season, following are the Trend Parameters;

Table 68

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purba Bardhaman	Pb_B1	52	88	23	-0.225	0.044	0.969	-0.086	0.086	-0.113	0.113
Purba Bardhaman	Pb_B2	53	87.75	23	-0.393	0.033	0.976	-0.065	0.065	-0.085	0.085
Purba Bardhaman	Pb_B3	54	87.75	23.25	-0.481	0.027	0.983	-0.053	0.053	-0.070	0.070
Purba Bardhaman	Pb_B4	55	88	23.25	-0.485	0.064	0.936	-0.126	0.126	-0.165	0.165
Purba Bardhaman	Pb_B5	56	88.25	23.25	-0.873	0.044	0.964	-0.086	0.086	-0.113	0.113
Purba Bardhaman	Pb_B6	57	87.75	23.5	-0.054	0.034	0.973	-0.067	0.067	-0.088	0.088
Purba Bardhaman	Pb_B7	58	88	23.5	-0.589	0.030	0.982	-0.058	0.058	-0.076	0.076
Purba Bardhaman	Pb_B8	59	88.25	23.5	-0.988	0.027	0.988	-0.052	0.052	-0.069	0.069
Purba Bardhaman	Pb_B9	60	88	23.75	-0.306	0.032	0.980	-0.062	0.062	-0.081	0.081

Trend Analysis Curves for Pre-Monsoon Season:

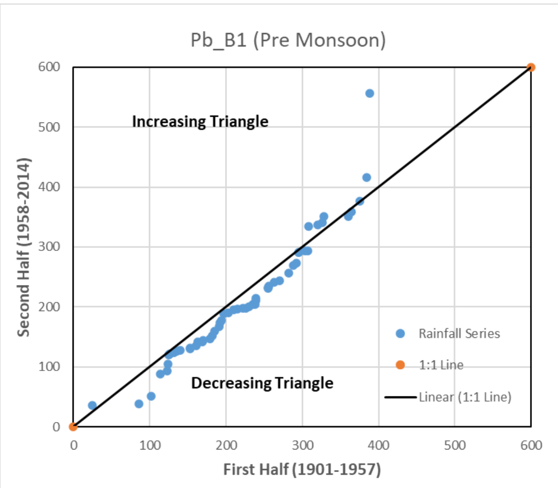


Fig 4.9.11 ITA plot for Pb_B1 in Pre-Monsoon

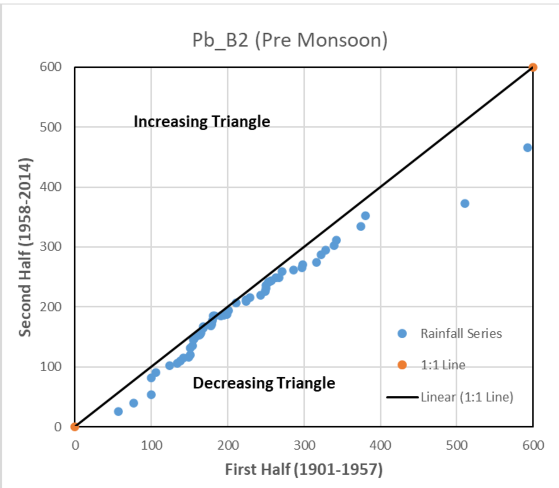


Fig 4.9.12 ITA plot for Pb_B2 in Pre-Monsoon

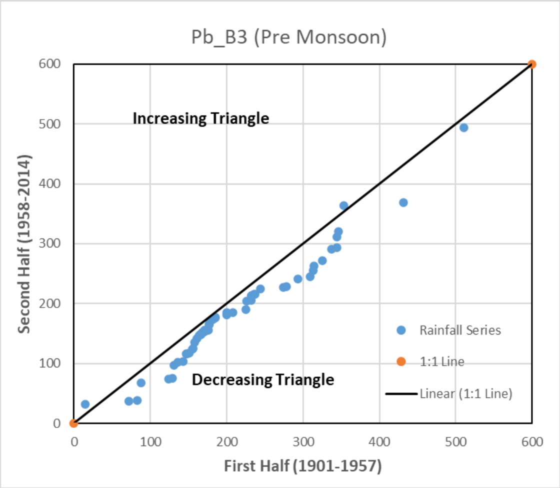


Fig 4.9.13 ITA plot for Pb_B3 in Pre-Monsoon

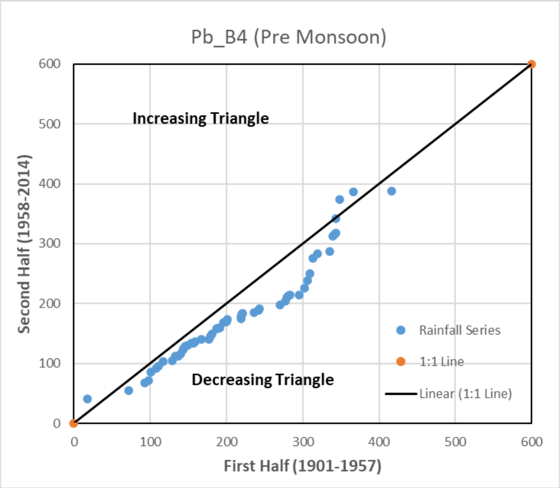


Fig 4.9.14 ITA plot for Pb_B4 in Pre-Monsoon

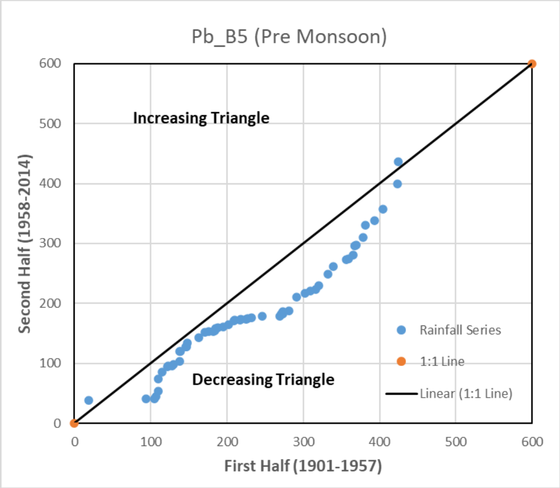


Fig 4.9.15 ITA plot for Pb_B5 in Pre-Monsoon

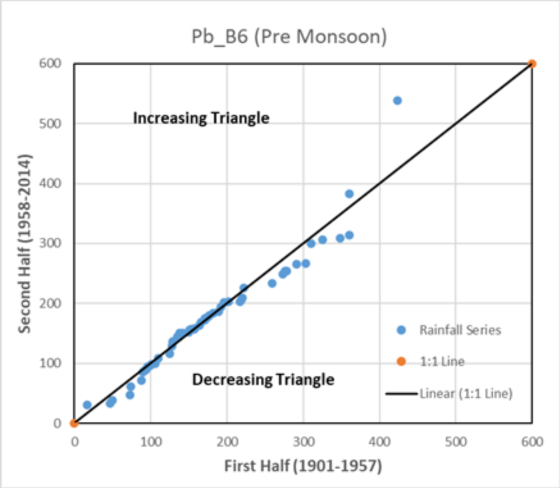


Fig 4.9.16 ITA plot for Pb_B6 in Pre-Monsoon

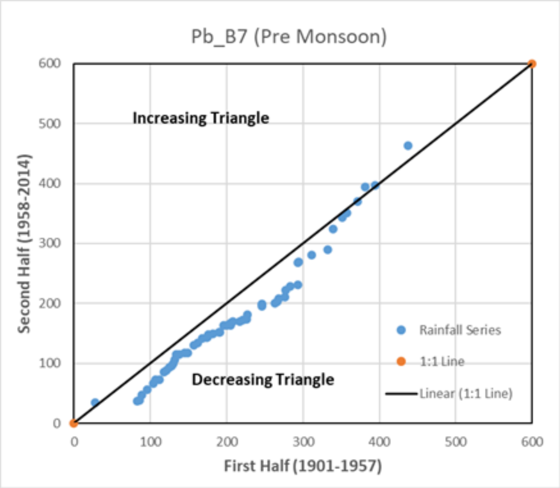


Fig 4.9.17 ITA plot for Pb_B7 in Pre-Monsoon

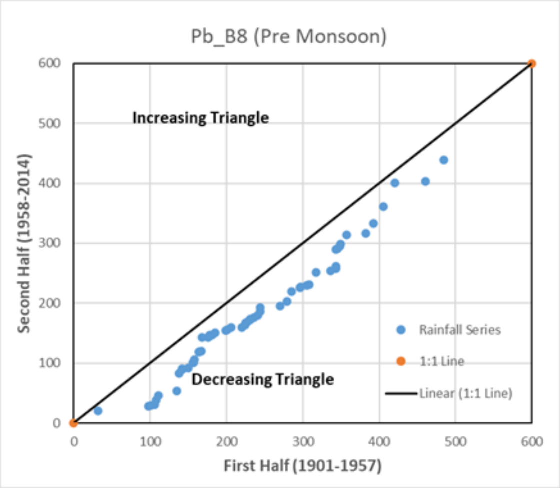


Fig 4.9.18 ITA plot for Pb_B8 in Pre-Monsoon

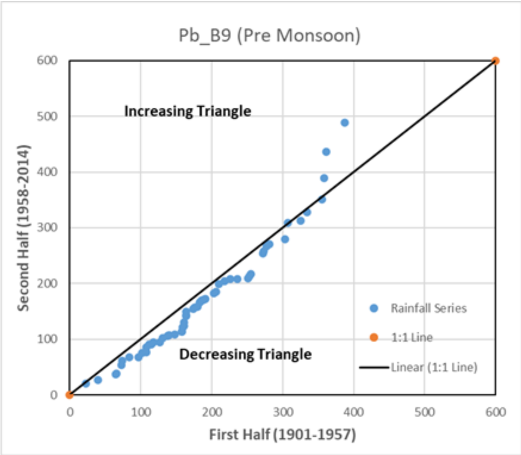


Fig 4.9.19 ITA plot for Pb_B9 in Pre-Monsoon

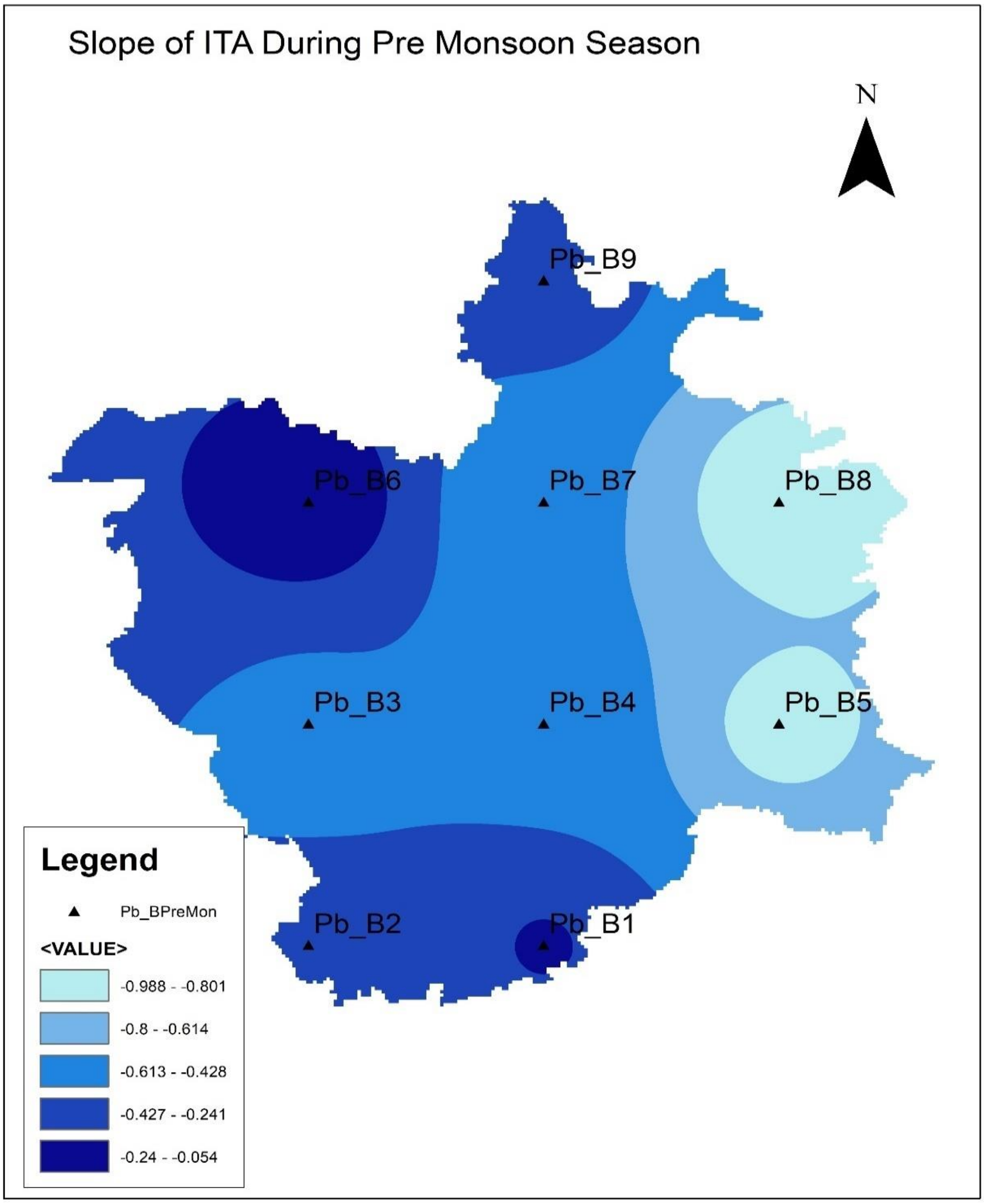


Fig. 4.9.20 ITA Slope Variation in Purba Bardhaman During Pre-Monsoon Season

For Monsoon Season, following are the Statistical Parameters;

Table 69

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purba Bardhaman	Pb_B1	52	88	23	1065.942	258.603	60582.707	0.368	1.005
Purba Bardhaman	Pb_B2	53	87.75	23	1080.060	253.285	62549.038	0.436	0.384
Purba Bardhaman	Pb_B3	54	87.75	23.25	1052.588	244.635	55040.709	1.033	3.883
Purba Bardhaman	Pb_B4	55	88	23.25	996.009	268.134	59048.597	1.485	7.321
Purba Bardhaman	Pb_B5	56	88.25	23.25	978.508	263.735	65145.051	0.076	-0.186
Purba Bardhaman	Pb_B6	57	87.75	23.5	1017.985	284.484	75876.772	1.391	5.275
Purba Bardhaman	Pb_B7	58	88	23.5	992.806	262.206	59630.800	0.633	2.140
Purba Bardhaman	Pb_B8	59	88.25	23.5	982.998	288.419	63597.659	0.251	1.616
Purba Bardhaman	Pb_B9	60	88	23.75	988.240	259.705	60287.488	0.490	1.381

For Monsoon Season, following are the Trend Parameters;

Table 70

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purba Bardhaman	Pb_B1	52	88	23	1.139	0.113	0.965	-0.221	0.221	-0.290	0.290
Purba Bardhaman	Pb_B2	53	87.75	23	0.149	0.064	0.988	-0.125	0.125	-0.164	0.164
Purba Bardhaman	Pb_B3	54	87.75	23.25	0.220	0.123	0.953	-0.241	0.241	-0.316	0.316
Purba Bardhaman	Pb_B4	55	88	23.25	0.837	0.157	0.937	-0.307	0.307	-0.404	0.404
Purba Bardhaman	Pb_B5	56	88.25	23.25	0.317	0.079	0.984	-0.154	0.154	-0.202	0.202
Purba Bardhaman	Pb_B6	57	87.75	23.5	1.112	0.119	0.968	-0.233	0.233	-0.306	0.306
Purba Bardhaman	Pb_B7	58	88	23.5	-0.316	0.081	0.982	-0.159	0.159	-0.209	0.209
Purba Bardhaman	Pb_B8	59	88.25	23.5	-0.747	0.152	0.949	-0.297	0.297	-0.390	0.390
Purba Bardhaman	Pb_B9	60	88	23.75	0.421	0.116	0.963	-0.227	0.227	-0.298	0.298

Trend Analysis Curves for Monsoon Season:

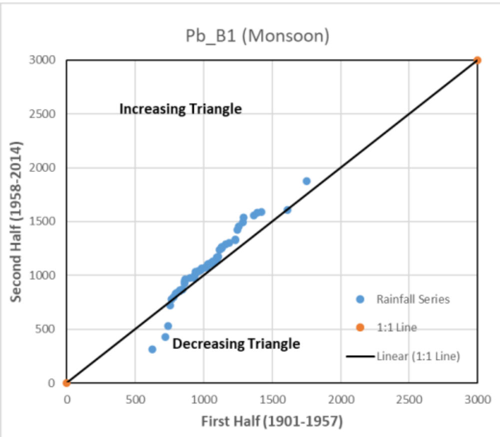


Fig 4.9.21 ITA plot for Pb_B1 in Monsoon

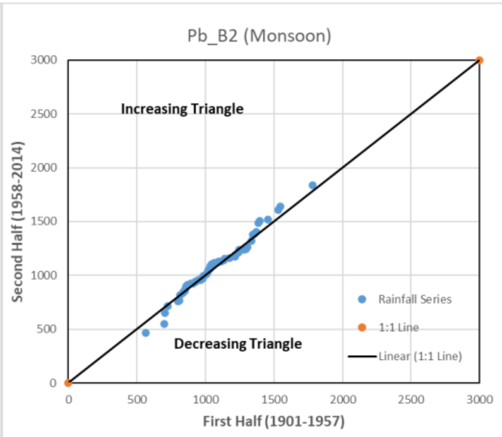


Fig 4.9.22 ITA plot for Pb_B2 in Monsoon

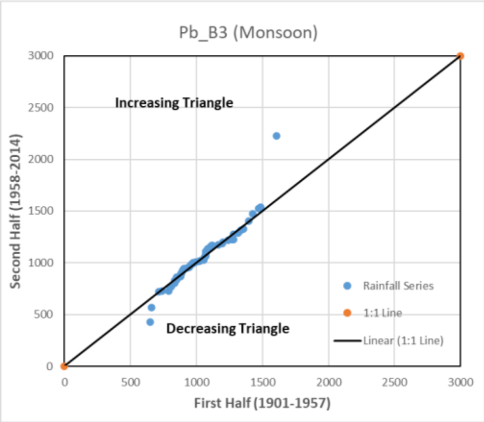


Fig 4.9.23 ITA plot for Pb_B3 in Monsoon

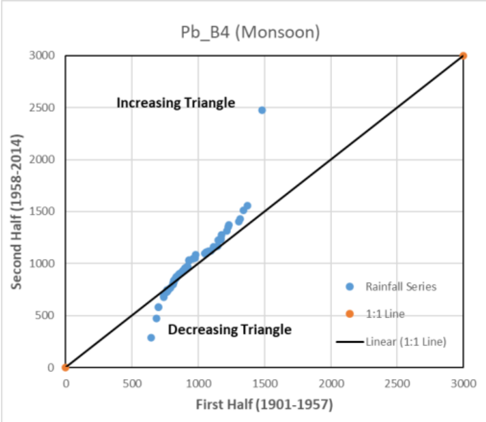


Fig 4.9.24 ITA plot for Pb_B4 in Monsoon

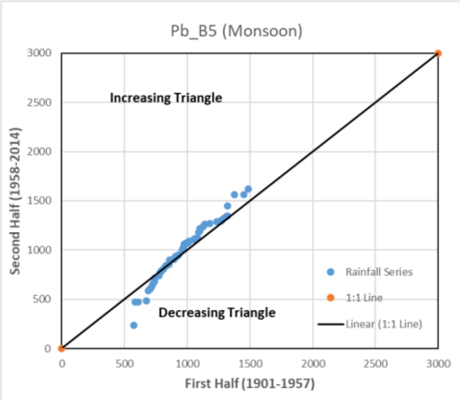


Fig 4.9.25 ITA plot for Pb_B5 in Monsoon

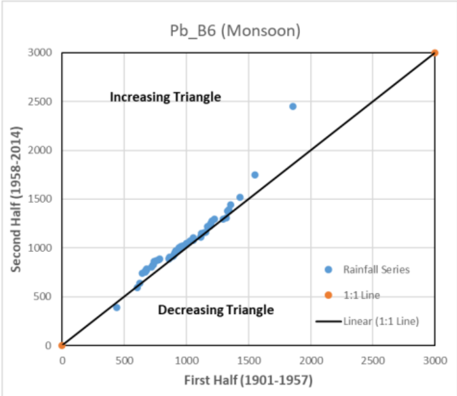


Fig 4.9.26 ITA plot for Pb_B6 in Monsoon

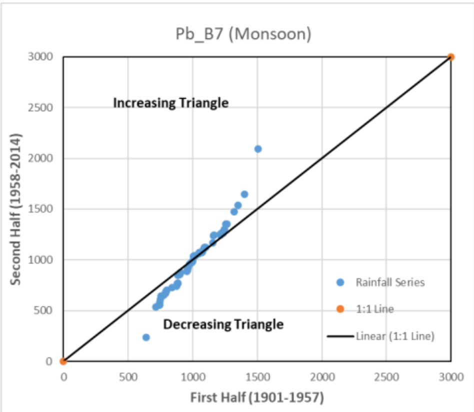


Fig 4.9.27 ITA plot for Pb_B7 in Monsoon

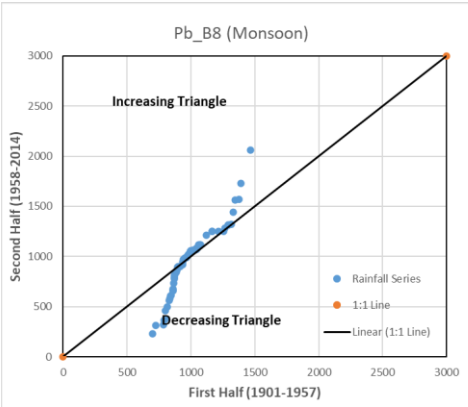


Fig 4.9.28 ITA plot for Pb_B8 in Monsoon

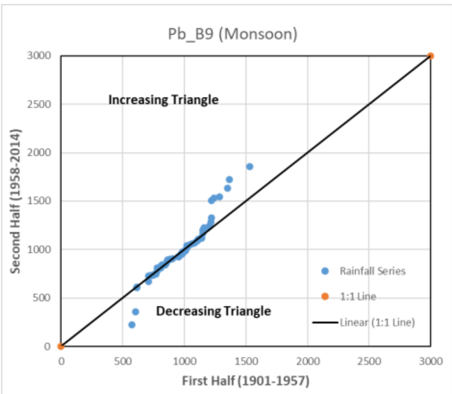


Fig 4.9.29 ITA plot for Pb_B9 in Monsoon

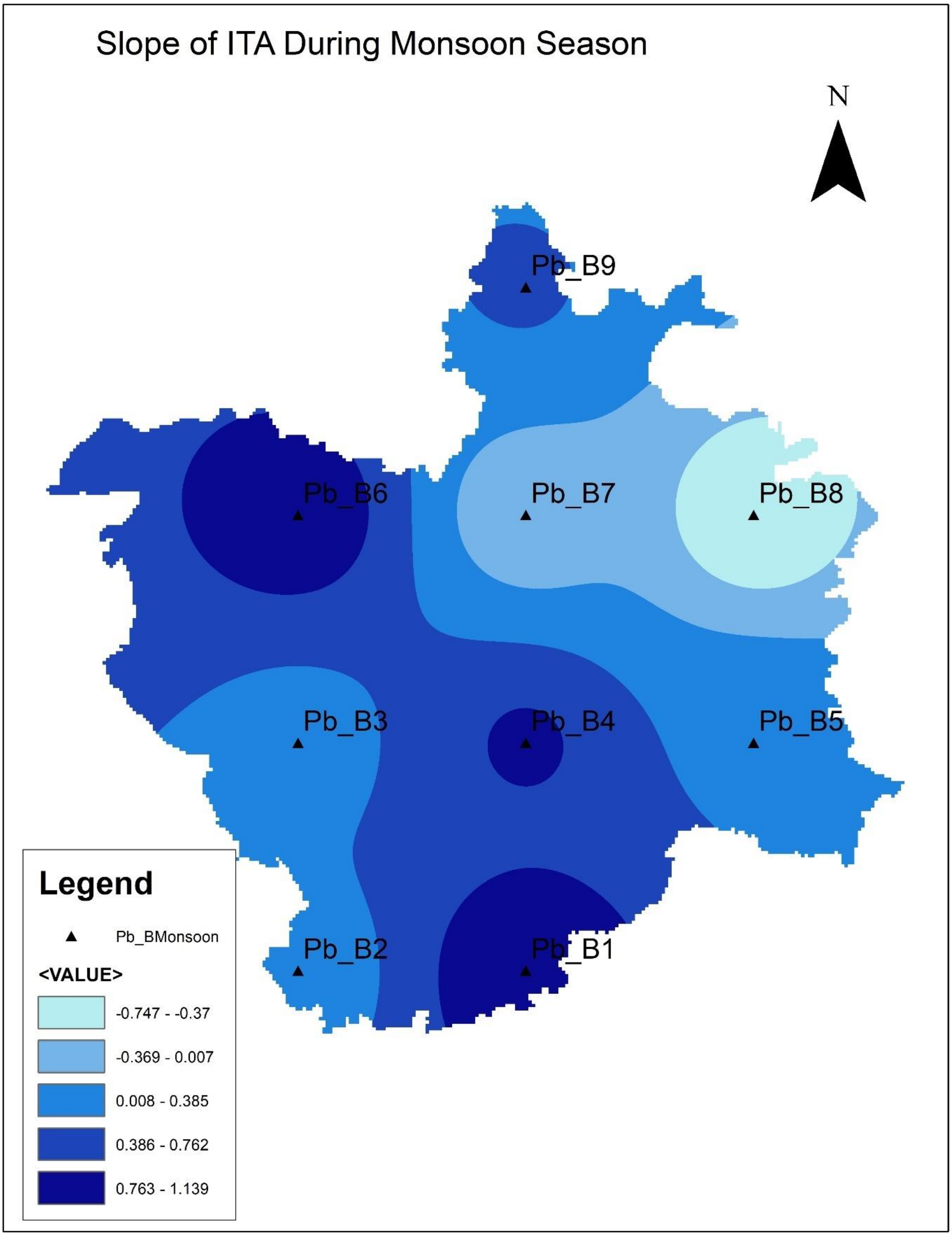


Fig. 4.9.30 ITA Slope Variation in Purba Bardhaman During Monsoon Season

For Post Monsoon Season, following are the Statistical Parameters;

Table 71

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purba Bardhaman	Pb_B1	52	88	23	137.494	90.395	7652.062	0.854	0.397
Purba Bardhaman	Pb_B2	53	87.75	23	136.187	91.003	8071.474	0.995	0.536
Purba Bardhaman	Pb_B3	54	87.75	23.25	126.645	85.029	6711.267	1.230	1.746
Purba Bardhaman	Pb_B4	55	88	23.25	129.305	89.067	7293.604	0.909	0.443
Purba Bardhaman	Pb_B5	56	88.25	23.25	128.774	93.339	8022.366	1.100	1.199
Purba Bardhaman	Pb_B6	57	87.75	23.5	121.912	83.774	6843.231	0.965	0.778
Purba Bardhaman	Pb_B7	58	88	23.5	130.530	90.564	7810.344	1.171	1.543
Purba Bardhaman	Pb_B8	59	88.25	23.5	135.736	95.390	8478.156	0.996	1.279
Purba Bardhaman	Pb_B9	60	88	23.75	125.296	98.754	9575.473	1.547	3.229

For Post Monsoon Season, following are the Trend Parameters;

Table 72

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1 y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purba Bardhaman	Pb_B1	52	88	23	0.368	0.037	0.968	-0.073	0.073	-0.096	0.096
Purba Bardhaman	Pb_B2	53	87.75	23	0.195	0.022	0.989	-0.043	0.043	-0.057	0.057
Purba Bardhaman	Pb_B3	54	87.75	23.25	0.252	0.042	0.954	-0.083	0.083	-0.109	0.109
Purba Bardhaman	Pb_B4	55	88	23.25	0.407	0.030	0.978	-0.060	0.060	-0.079	0.079
Purba Bardhaman	Pb_B5	56	88.25	23.25	0.251	0.029	0.982	-0.057	0.057	-0.074	0.074
Purba Bardhaman	Pb_B6	57	87.75	23.5	0.186	0.022	0.988	-0.042	0.042	-0.056	0.056
Purba Bardhaman	Pb_B7	58	88	23.5	-0.008	0.033	0.975	-0.065	0.065	-0.086	0.086
Purba Bardhaman	Pb_B8	59	88.25	23.5	-0.120	0.036	0.973	-0.071	0.071	-0.093	0.093
Purba Bardhaman	Pb_B9	60	88	23.75	0.253	0.015	0.996	-0.029	0.029	-0.038	0.038

Trend Analysis Curves for Post Monsoon Season:

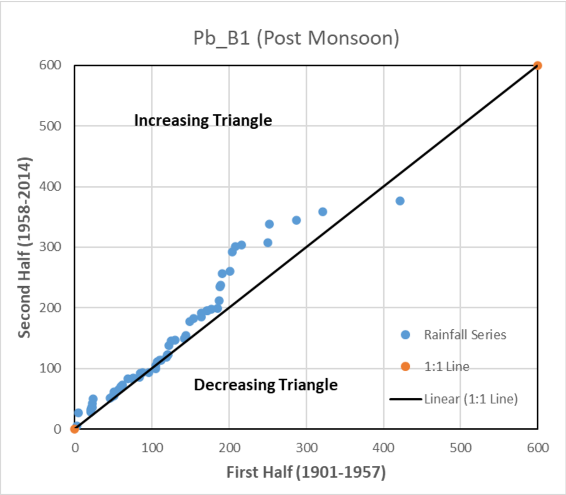


Fig 4.9.31 ITA plot for Pb_B1 in Post Monsoon

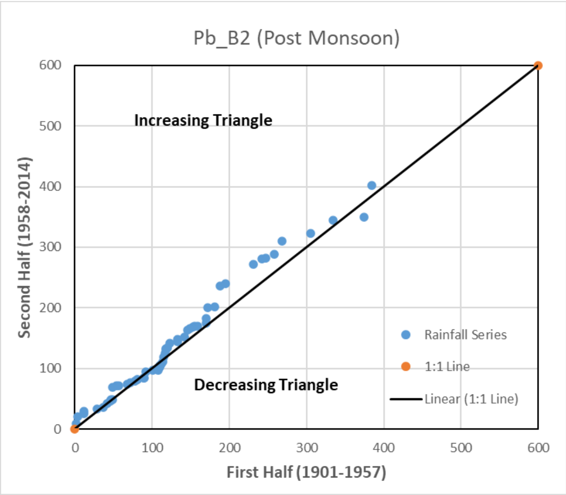


Fig 4.9.32 ITA plot for Pb_B2 in Post Monsoon

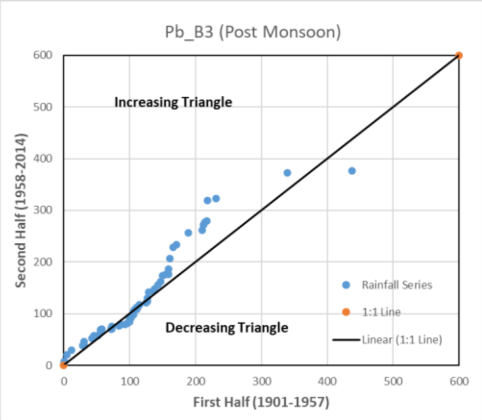


Fig 4.9.33 ITA plot for Pb_B3 in Post Monsoon

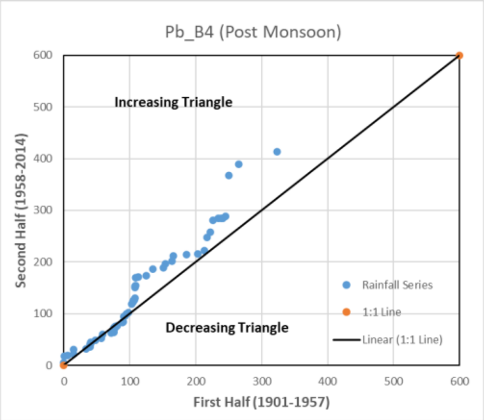


Fig 4.9.34 ITA plot for Pb_B4 in Post Monsoon

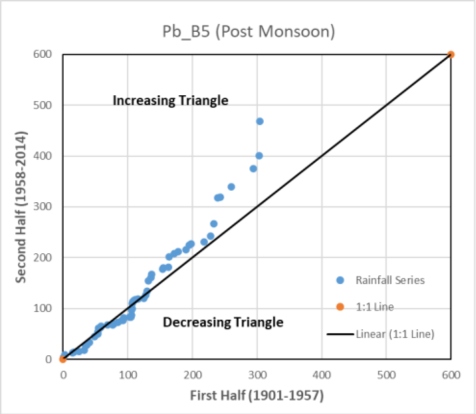


Fig 4.9.35 ITA plot for Pb_B5 in Post Monsoon

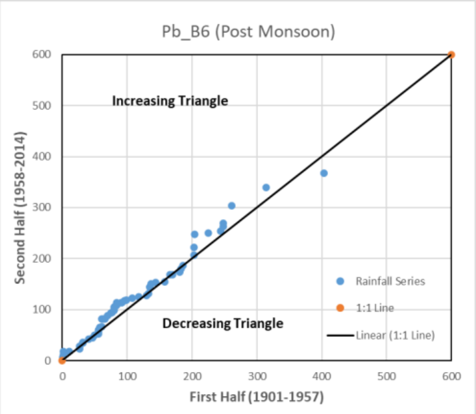


Fig 4.9.36 ITA plot for Pb_B6 in Post Monsoon

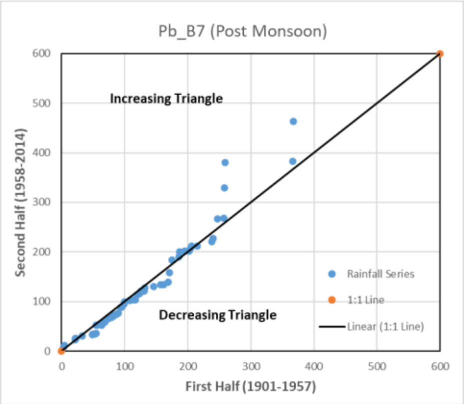


Fig 4.9.37 ITA plot for Pb_B7 in Post Monsoon

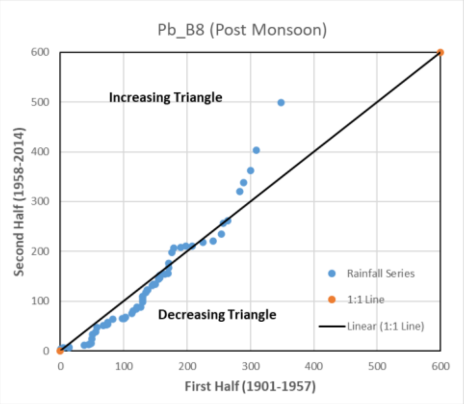


Fig 4.9.38 ITA plot for Pb_B8 in Post Monsoon

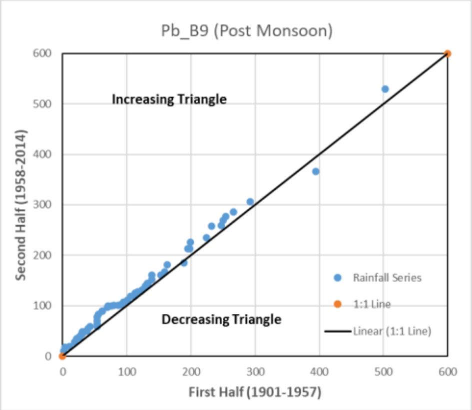


Fig 4.9.39 ITA plot for Pb_B9 in Post Monsoon

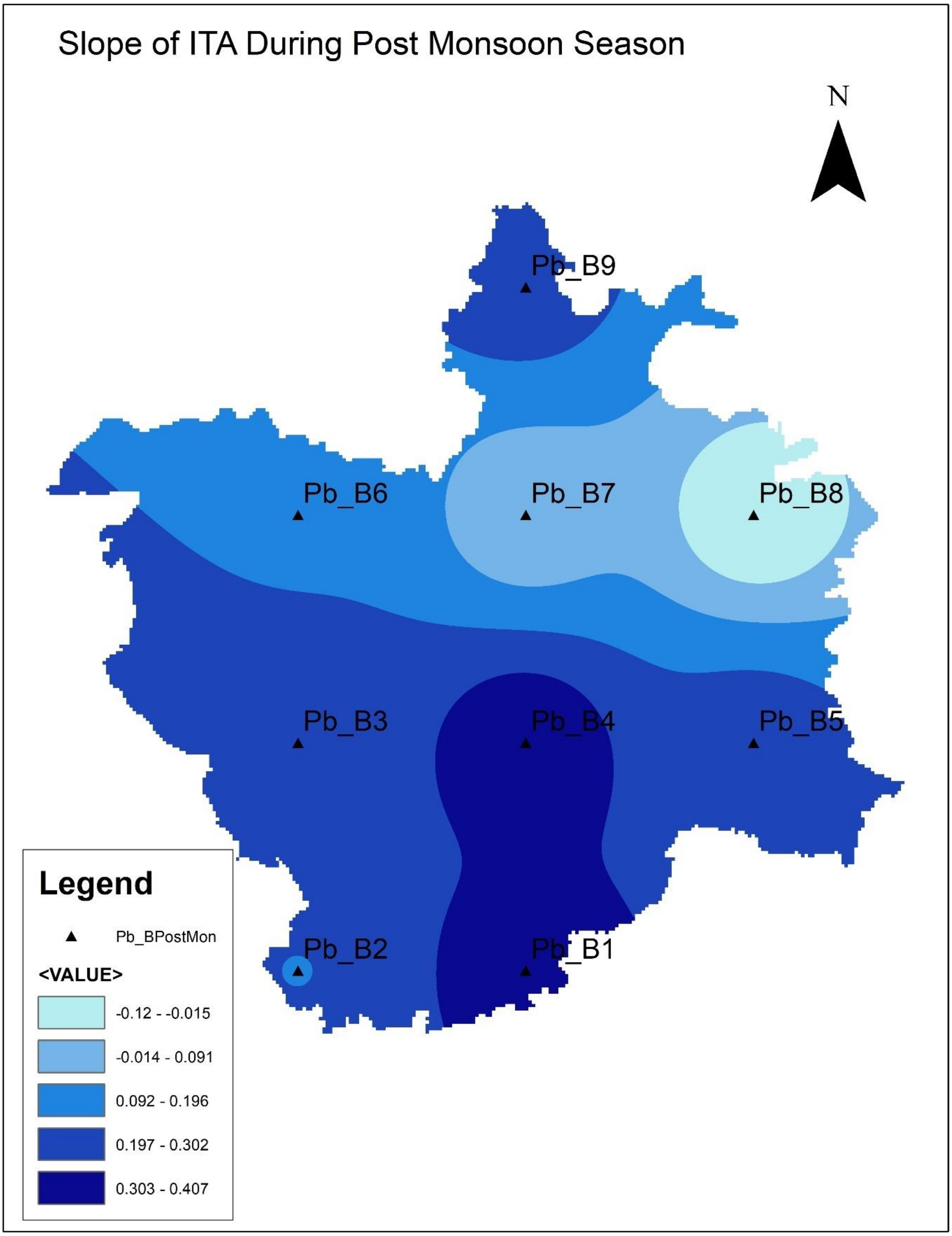


Fig. 4.9.40 ITA Slope Variation in Purba Bardhaman During Post Monsoon Season

4.10 Paschim Bardhaman:

For Winter Season, following are the Statistical Parameters:

Table 73

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Pashchim Bardhaman	Ps_B1	61	87.5	23.5	30.369	30.508	858.113	1.835	5.577
Pashchim Bardhaman	Ps_B2	62	87	23.75	31.814	31.535	908.965	1.657	2.772

For Winter Season, following are the Trend Parameters:

Table 74

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Pashchim Bardhaman	Ps_B1	61	87.5	23.5	-0.027	0.014	0.960	-0.028	0.028	-0.037	0.037
Pashchim Bardhaman	Ps_B2	62	87	23.75	-0.175	0.011	0.977	-0.022	0.022	-0.029	0.029

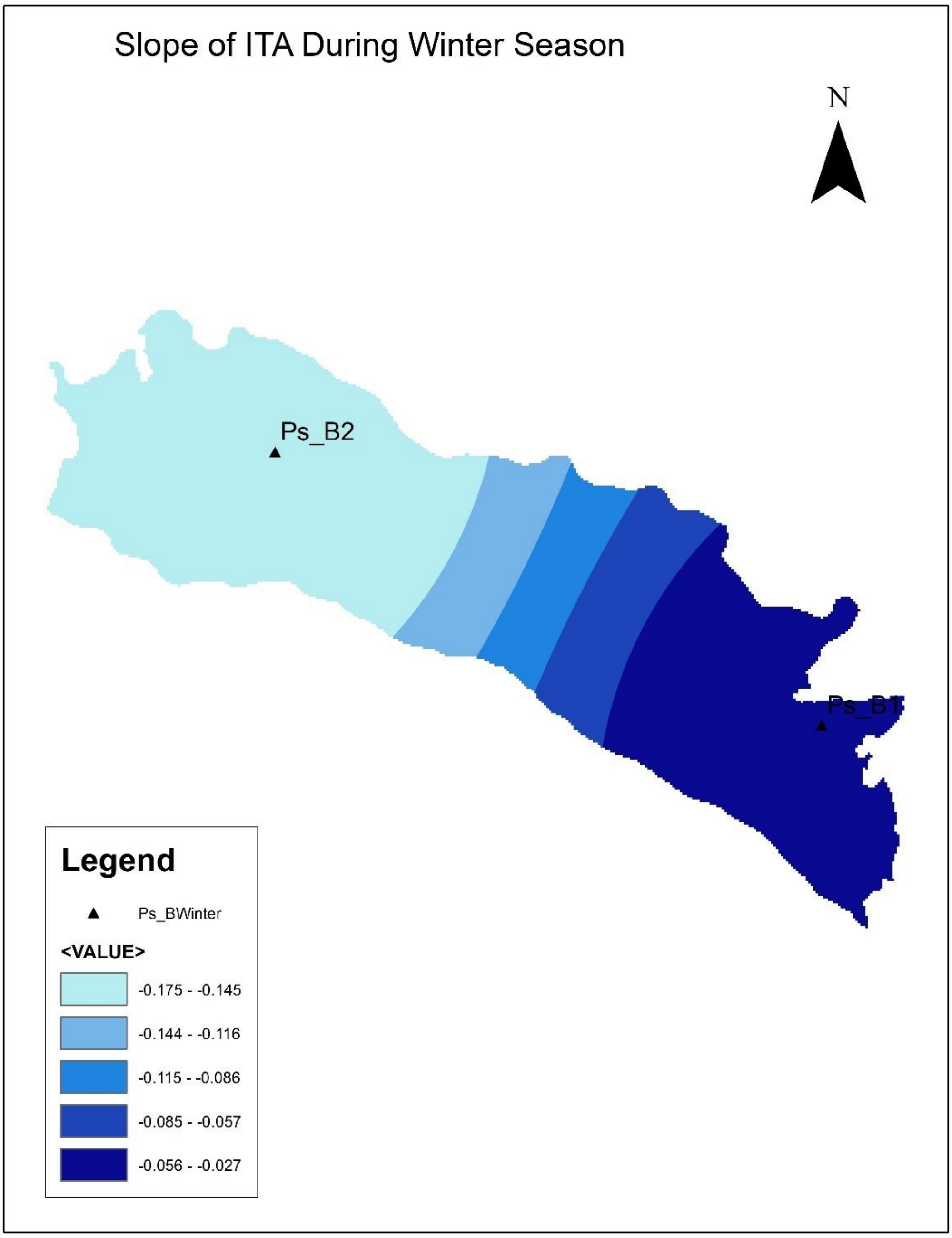


Fig. 4.10.1 ITA Slope Variation in Pashchim Bardhaman During Winter Season

Trend Analysis Curves for Winter Season:

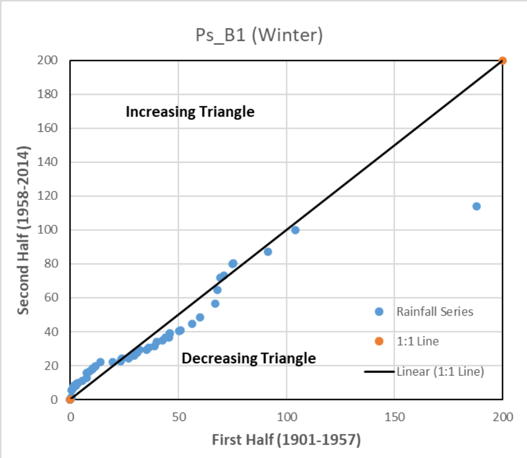


Fig 4.10.2 ITA plot for Ps_B1 in Winter

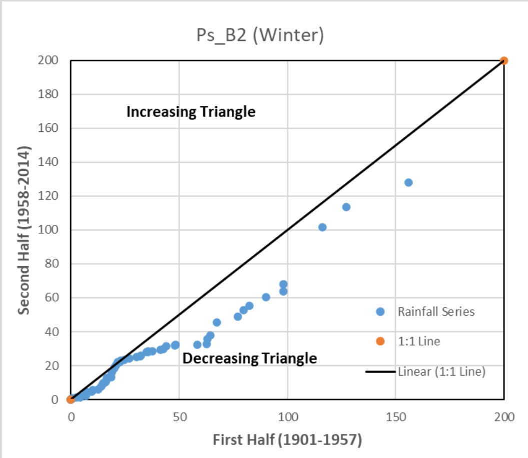


Fig 4.10.3 ITA plot for Ps_B2 in Winter

For Pre-Monsoon Season, following are the Statistical Parameters:

Table 75

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Pashchim Bardhaman	Ps_B1	61	87.5	23.5	168.925	88.057	7409.038	1.281	3.112
Pashchim Bardhaman	Ps_B2	62	87	23.75	138.186	61.873	3725.015	0.588	0.355

For Pre-Monsoon Season, following are the Trend Parameters:

Table 76

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation $(\rho_{y_1 y_2})$	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Pashchim Bardhaman	Ps_B1	61	87.5	23.5	0.071	0.039	0.965	-0.075	0.075	-0.099	0.099
Pashchim Bardhaman	Ps_B2	62	87	23.75	0.135	0.017	0.986	-0.034	0.034	-0.044	0.044

Trend Analysis Curves for Pre-Monsoon Season:

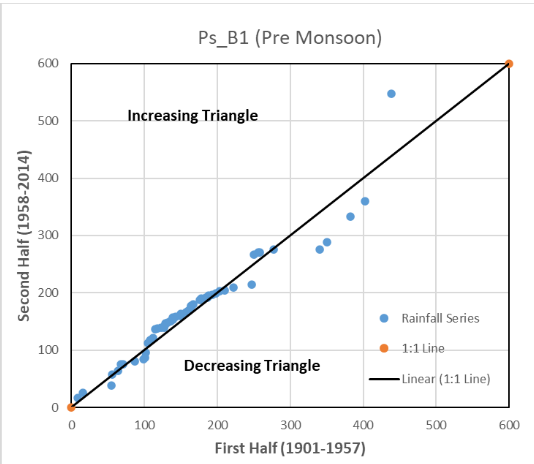


Fig 4.10.4 ITA plot for Ps_B1 in Pre-Monsoon

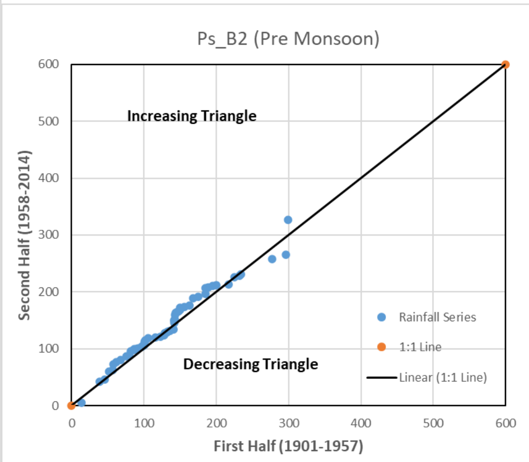


Fig 4.10.5 ITA plot for Ps_B2 in Pre-Monsoon

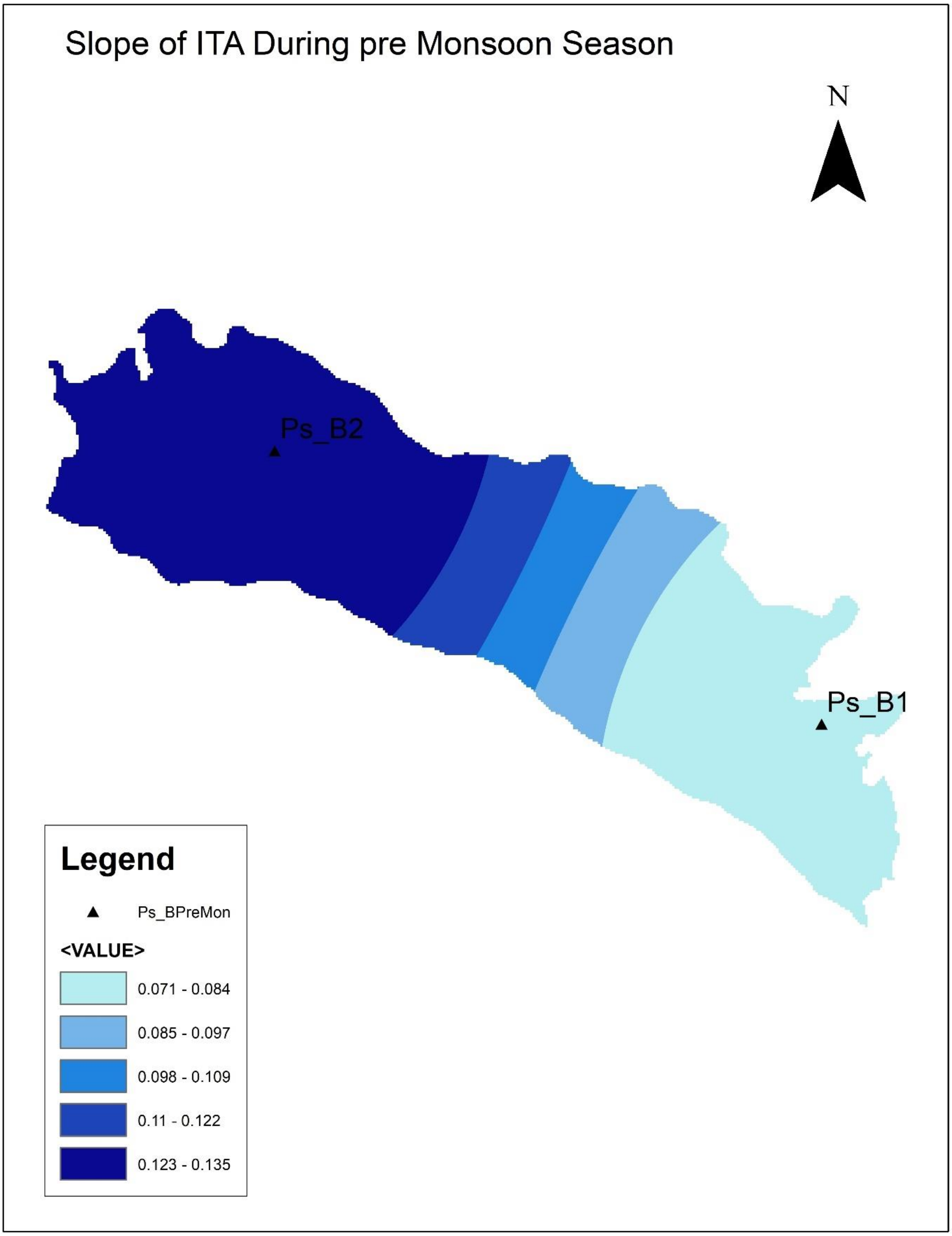


Fig. 4.10.6 ITA Slope Variation in Pashchim Bardhaman During Pre-Monsoon Season

For Monsoon Season, following are the Statistical Parameters:

Table 77

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Pashchim Bardhaman	Ps_B1	61	87.5	23.5	1013.761	277.314	66624.040	1.340	4.357
Pashchim Bardhaman	Ps_B2	62	87	23.75	1074.312	228.328	46553.844	0.575	0.133

For Monsoon Season, following are the Trend Parameters:

Table 78

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Pashchim Bardhaman	Ps_B1	61	87.5	23.5	2.357	0.142	0.951	-0.279	0.279	-0.366	0.366
Pashchim Bardhaman	Ps_B2	62	87	23.75	1.154	0.083	0.976	-0.162	0.162	-0.213	0.213

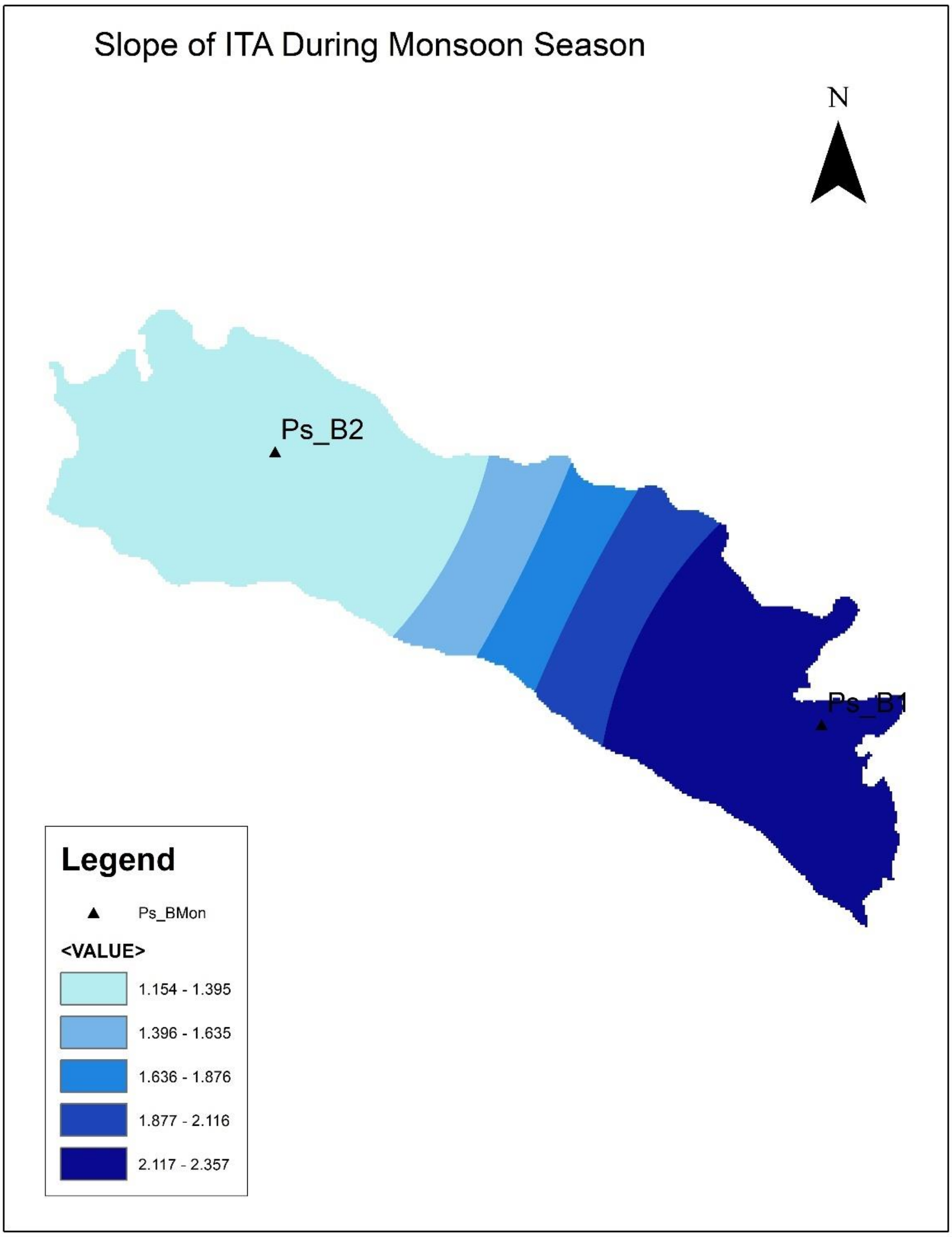


Fig. 4.10.7 ITA Slope Variation in Pashchim Bardhaman During Monsoon Season

Trend Analysis Curves for Monsoon Season:

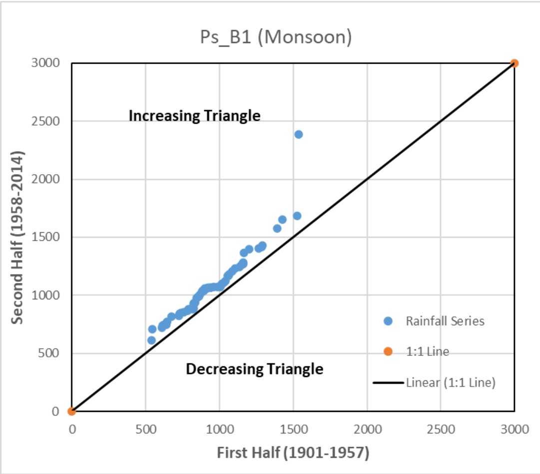


Fig 4.10.8 ITA plot for Ps_B1 in Monsoon

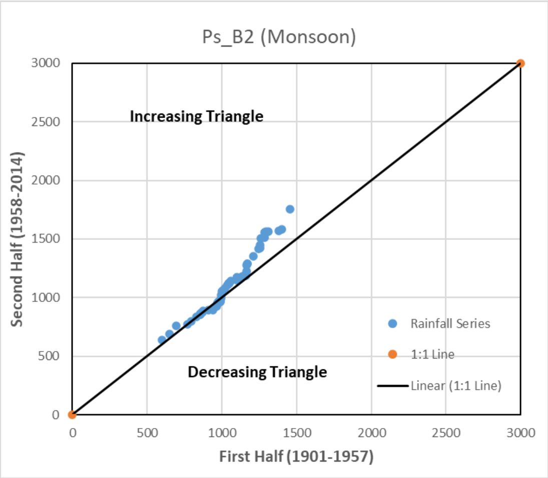


Fig 4.10.9 ITA plot for Ps_B2 in Monsoon

For Post Monsoon Season, following are the Statistical Parameters:

Table 79

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Pashchim Bardhaman	Ps_B1	61	87.5	23.5	114.074	84.242	6794.303	1.097	1.084
Pashchim Bardhaman	Ps_B2	62	87	23.75	120.041	84.879	6984.695	1.122	0.953

For Post Monsoon Season, following are the Trend Parameters:

Table 80

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Pashchim Bardhaman	Ps_B1	61	87.5	23.5	0.317	0.029	0.978	-0.057	0.057	-0.075	0.075
Pashchim Bardhaman	Ps_B2	62	87	23.75	0.280	0.016	0.993	-0.032	0.032	-0.042	0.042

Trend Analysis Curves for Post Monsoon Season:

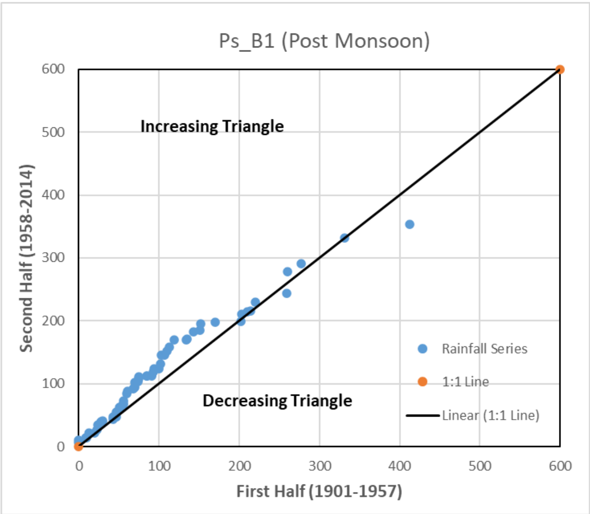


Fig 4.10.10 ITA plot for Ps_B1 in Post Monsoon

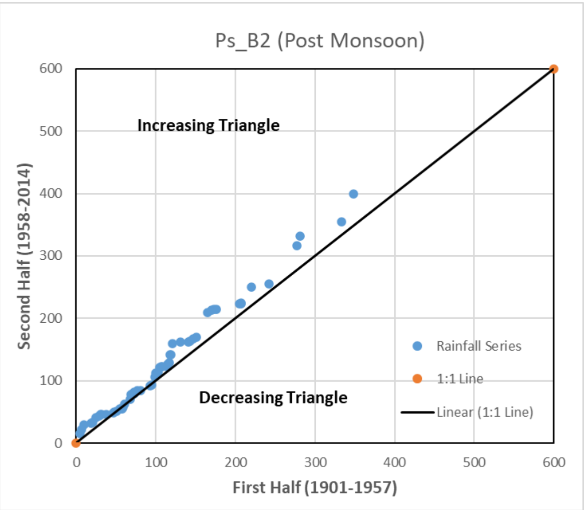


Fig 4.10.11 ITA plot for Ps_B2 in Post Monsoon

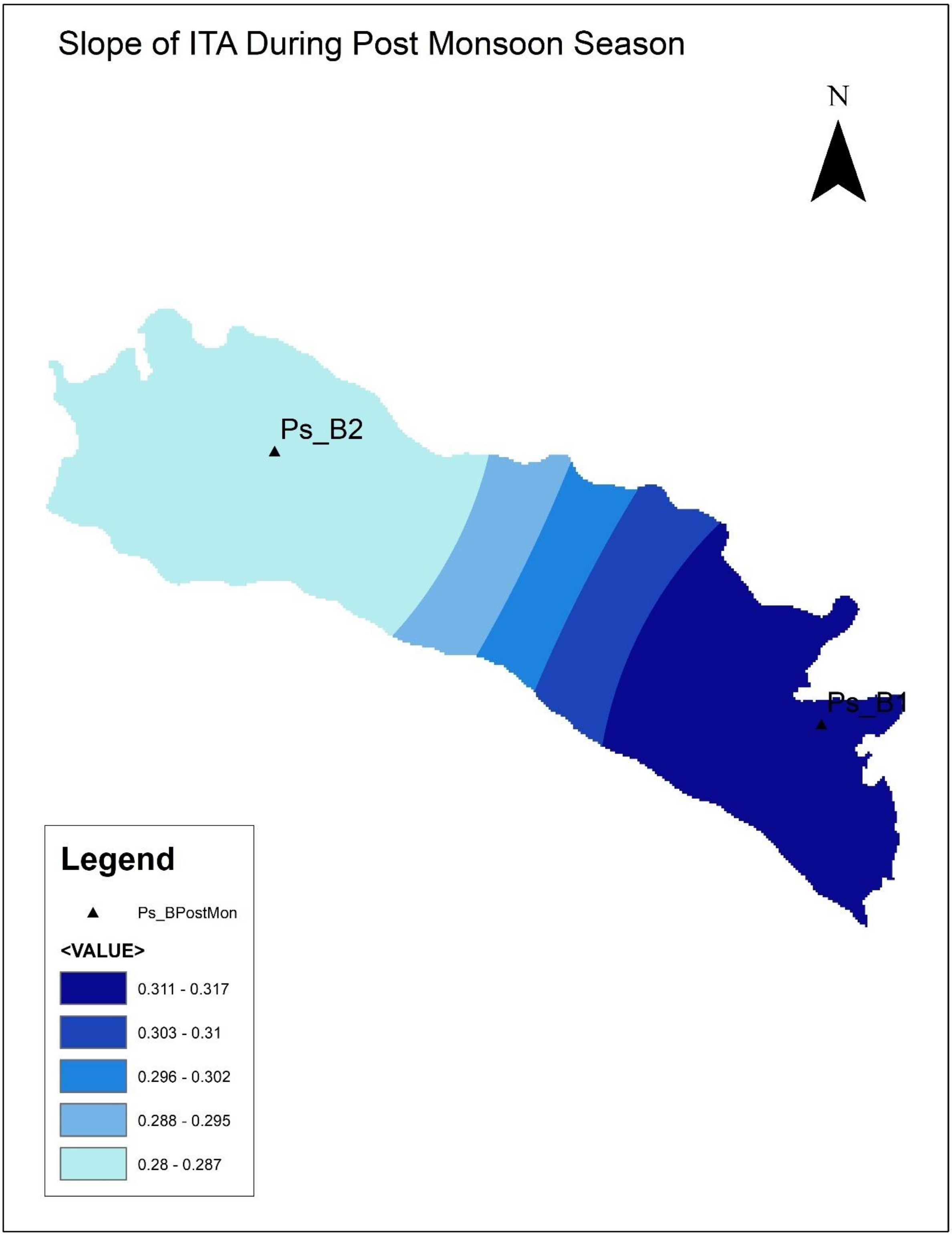


Fig. 4.10.12 ITA Slope Variation in Pashchim Bardhaman During Post Monsoon Season

4.11 Birbhum:

For Winter Season, following are the Statistical Parameters:

Table 81

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Birbhum	Br1	63	87.25	23.75	31.782	31.367	948.555	1.580	2.518
Birbhum	Br2	64	87.5	23.75	28.285	27.818	752.028	1.257	0.962
Birbhum	Br3	65	87.75	23.75	28.248	27.061	687.573	1.277	1.569
Birbhum	Br4	66	87.25	24	30.244	29.921	780.338	1.715	2.945
Birbhum	Br5	67	87.5	24	26.535	25.345	587.930	1.537	3.147
Birbhum	Br6	68	87.75	24	25.764	26.336	630.204	1.647	3.581
Birbhum	Br7	69	87.75	24.25	27.406	28.940	651.011	2.480	9.728
Birbhum	Br8	70	88	24.25	28.568	31.608	879.221	2.081	5.621

For Winter Season, following are the Trend Parameters:

Table 82

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Birbhum	Br1	63	87.25	23.75	-0.0388	0.0109	0.9775	-0.0214	0.0214	-0.0281	0.0281
Birbhum	Br2	64	87.5	23.75	0.0288	0.0081	0.9844	-0.0158	0.0158	-0.0208	0.0208
Birbhum	Br3	65	87.75	23.75	-0.1066	0.0066	0.9890	-0.0129	0.0129	-0.0170	0.0170
Birbhum	Br4	66	87.25	24	-0.1783	0.0164	0.9441	-0.0322	0.0322	-0.0423	0.0423
Birbhum	Br5	67	87.5	24	-0.1046	0.0081	0.9810	-0.0159	0.0159	-0.0209	0.0209
Birbhum	Br6	68	87.75	24	-0.0562	0.0106	0.9700	-0.0208	0.0208	-0.0273	0.0273
Birbhum	Br7	69	87.75	24.25	-0.1673	0.0171	0.9350	-0.0336	0.0336	-0.0442	0.0442
Birbhum	Br8	70	88	24.25	-0.1444	0.0102	0.9807	-0.0200	0.0200	-0.0263	0.0263

Trend Analysis Curves for Winter Season:

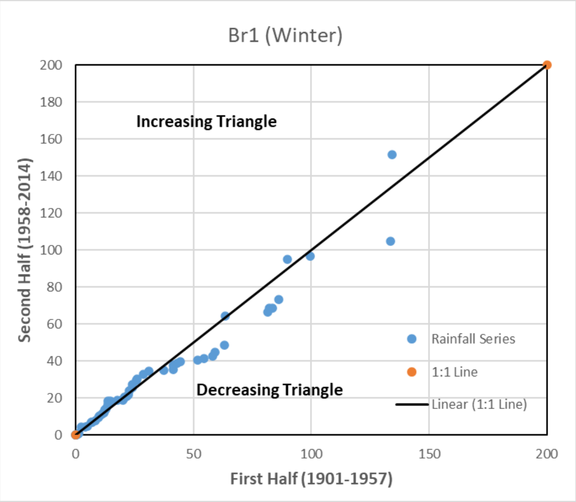


Fig 4.11.1 ITA plot for Br1 in Winter

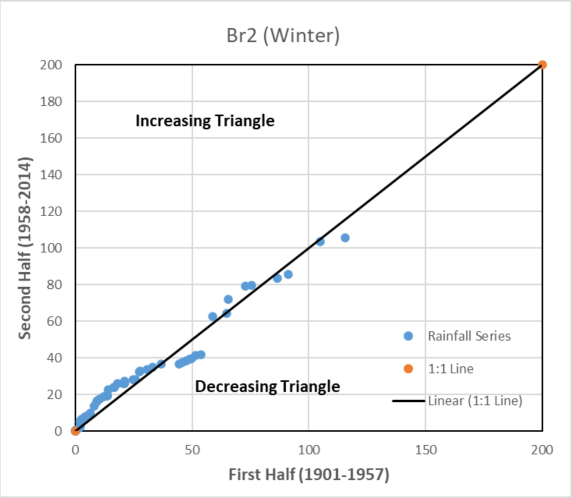


Fig 4.11.2 ITA plot for Br2 in Winter

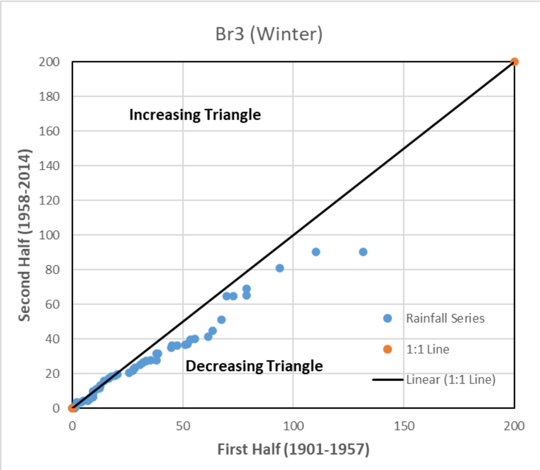


Fig 4.11.3 ITA plot for Br3 in Winter

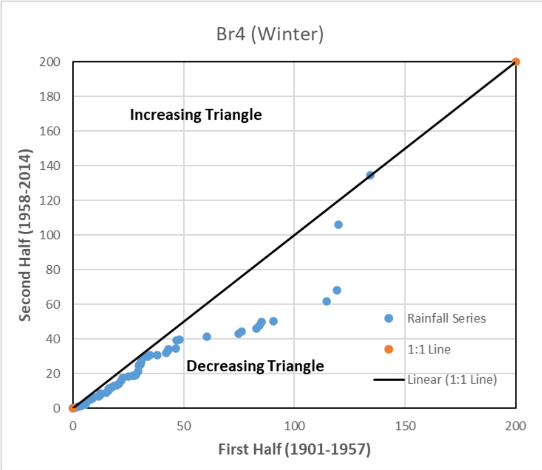


Fig 4.11.4 ITA plot for Br4 in Winter

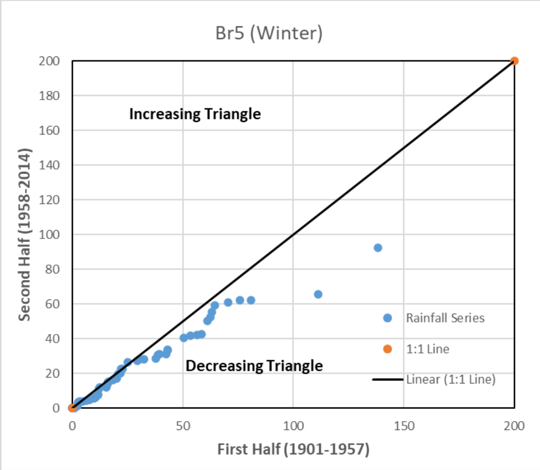


Fig 4.11.5 ITA plot for Br5 in Winter

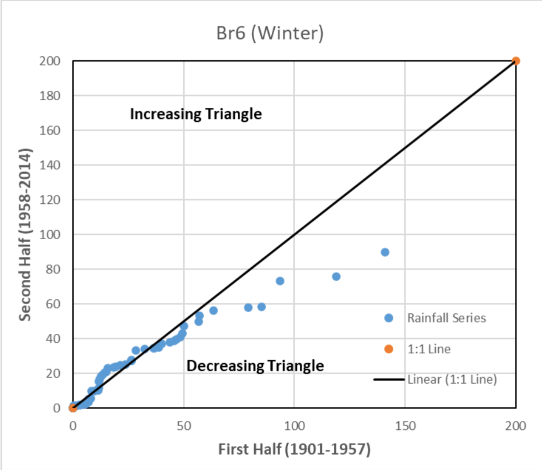


Fig 4.11.6 ITA plot for Br6 in Winter

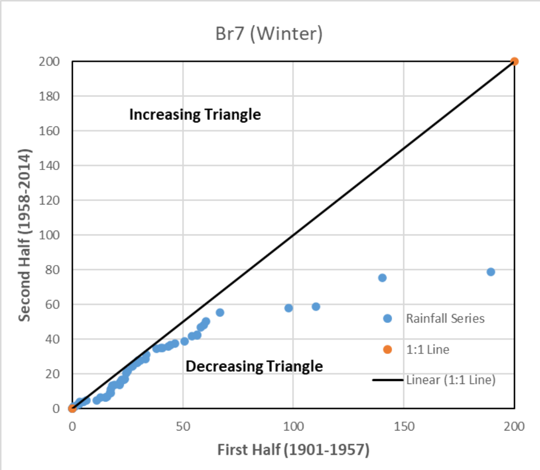


Fig 4.11.7 ITA plot for Br7 in Winter

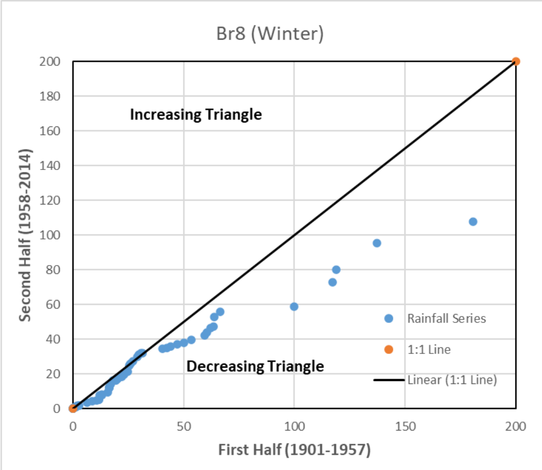


Fig 4.11.8 ITA plot for Br8 in Winter

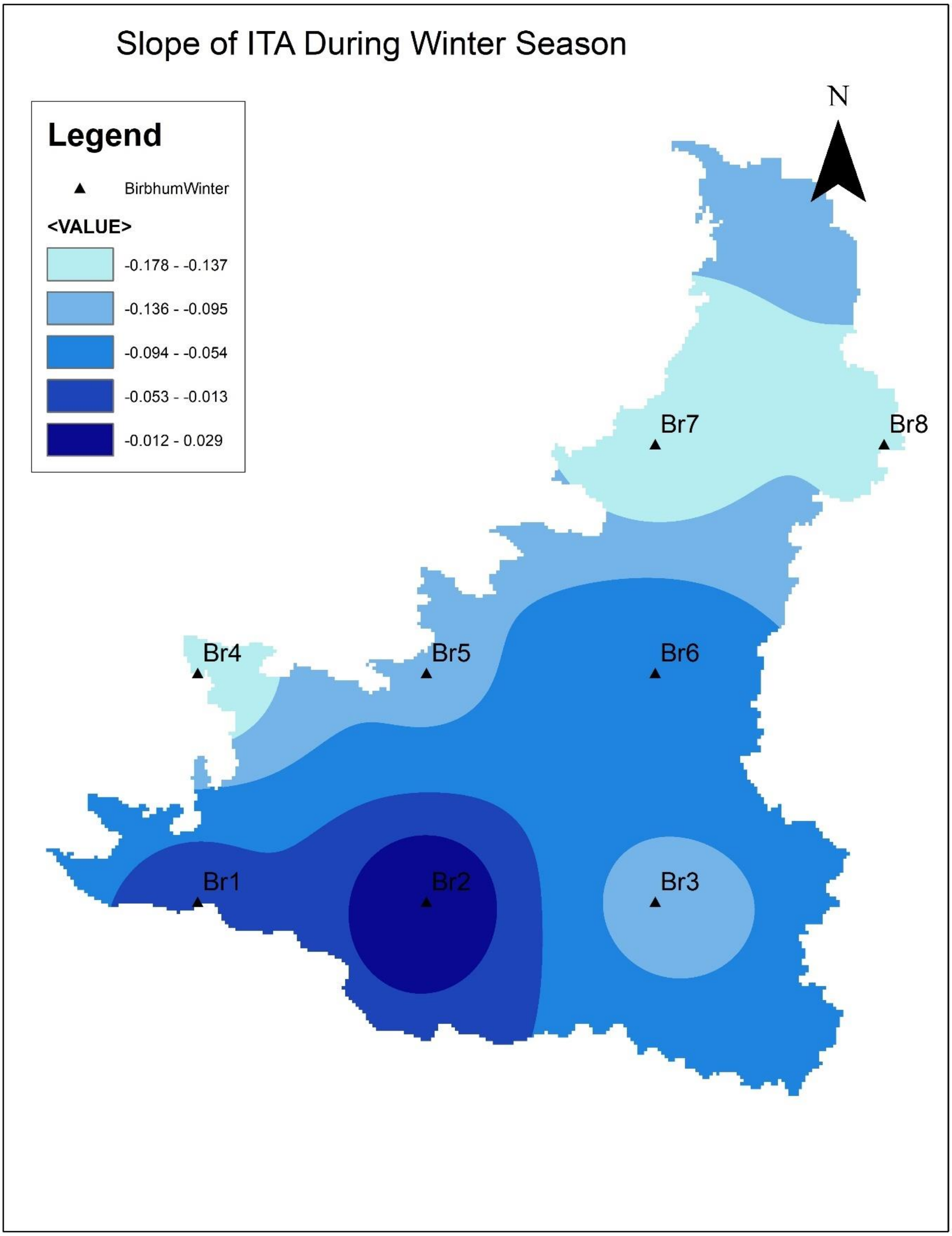


Fig. 4.11.9 ITA Slope Variation in Birbhum During Winter Season

For Pre-Monsoon Season, following are the Statistical Parameters:

Table 83

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Birbhum	Br1	63	87.25	23.75	155.244	68.497	4448.936	0.546	0.515
Birbhum	Br2	64	87.5	23.75	159.405	81.318	6344.515	0.611	0.291
Birbhum	Br3	65	87.75	23.75	174.193	84.347	6932.314	0.720	0.412
Birbhum	Br4	66	87.25	24	144.002	66.515	4156.957	0.581	0.317
Birbhum	Br5	67	87.5	24	153.300	76.684	5597.545	0.677	0.938
Birbhum	Br6	68	87.75	24	180.422	84.548	6866.374	0.669	0.818
Birbhum	Br7	69	87.75	24.25	174.849	85.432	7090.394	0.580	0.305
Birbhum	Br8	70	88	24.25	187.243	93.108	8455.049	0.560	0.081

For Pre-Monsoon Season, following are the Trend Parameters:

Table 84

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Birbhum	Br1	63	87.25	23.75	0.3648	0.0225	0.9800	-0.0441	0.0441	-0.0579	0.0579
Birbhum	Br2	64	87.5	23.75	0.2000	0.0299	0.9750	-0.0586	0.0586	-0.0770	0.0770
Birbhum	Br3	65	87.75	23.75	-0.2533	0.0190	0.9906	-0.0373	0.0373	-0.0490	0.0490
Birbhum	Br4	66	87.25	24	0.0185	0.0257	0.9724	-0.0504	0.0504	-0.0662	0.0662
Birbhum	Br5	67	87.5	24	-0.0843	0.0274	0.9763	-0.0537	0.0537	-0.0706	0.0706
Birbhum	Br6	68	87.75	24	-0.1566	0.0321	0.9733	-0.0629	0.0629	-0.0827	0.0827
Birbhum	Br7	69	87.75	24.25	-0.1480	0.0261	0.9827	-0.0512	0.0512	-0.0673	0.0673
Birbhum	Br8	70	88	24.25	-0.0911	0.0250	0.9867	-0.0489	0.0489	-0.0643	0.0643

Trend Analysis Curves for Pre-Monsoon Season:

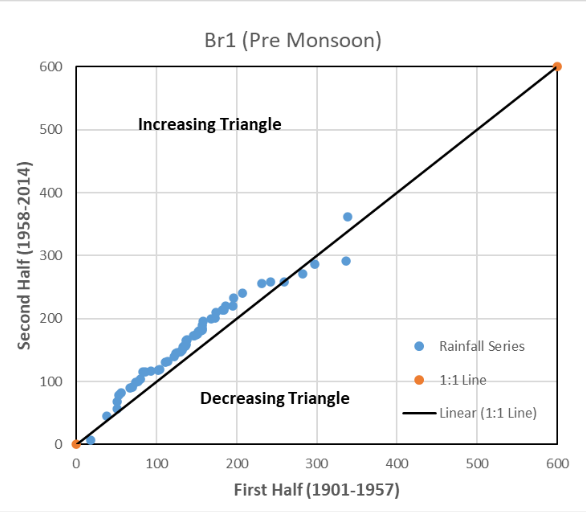


Fig 4.11.10 ITA plot for Br1 in Pre-Monsoon

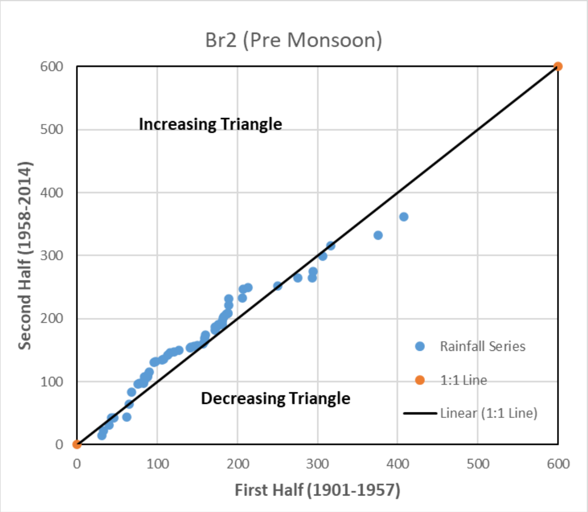


Fig 4.11.11 ITA plot for Br2 in Pre-Monsoon

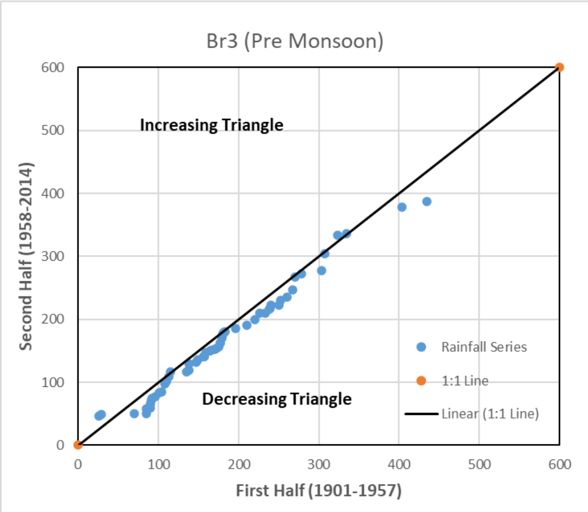


Fig 4.11.12 ITA plot for Br3 in Pre-Monsoon

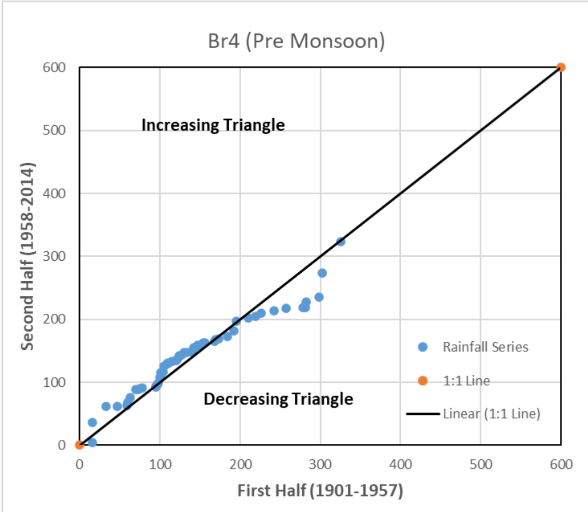


Fig 4.11.13 ITA plot for Br4 in Pre-Monsoon

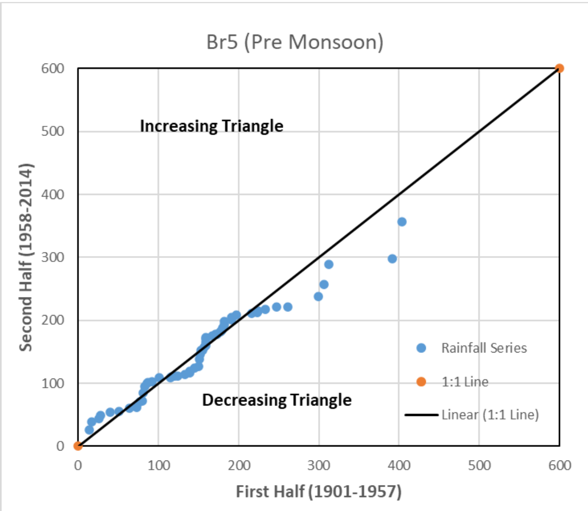


Fig 4.11.14 ITA plot for Br5 in Pre-Monsoon

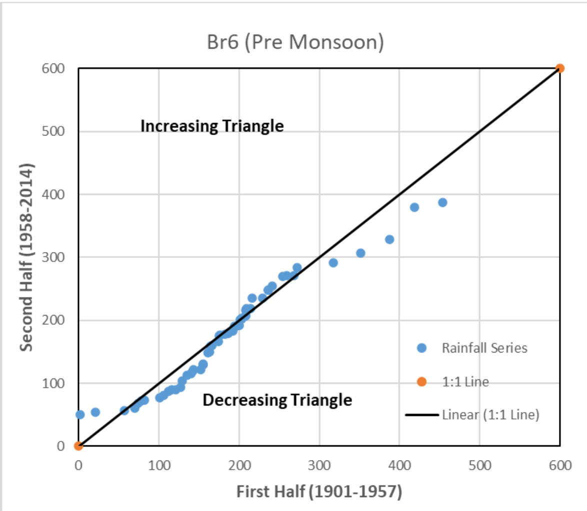


Fig 4.11.15 ITA plot for Br6 in Pre-Monsoon

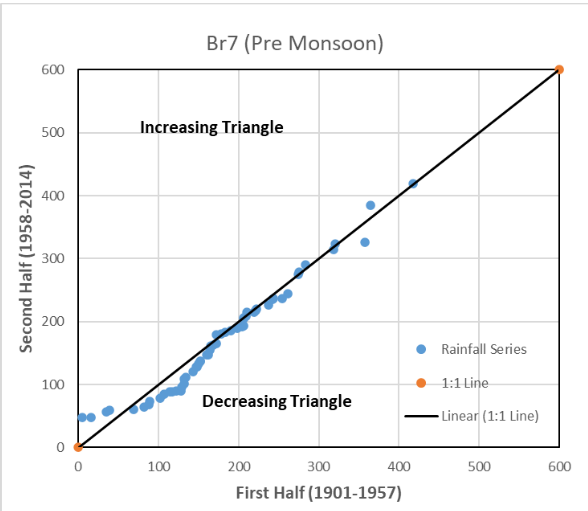


Fig 4.11.16 ITA plot for Br7 in Pre-Monsoon

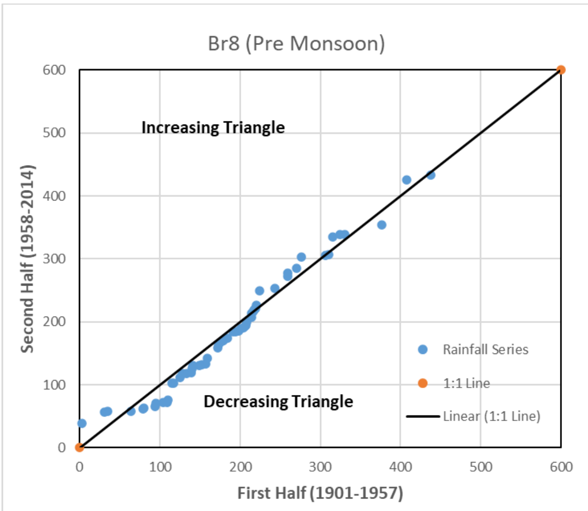


Fig 4.11.17 ITA plot for Br8 in Pre-Monsoon

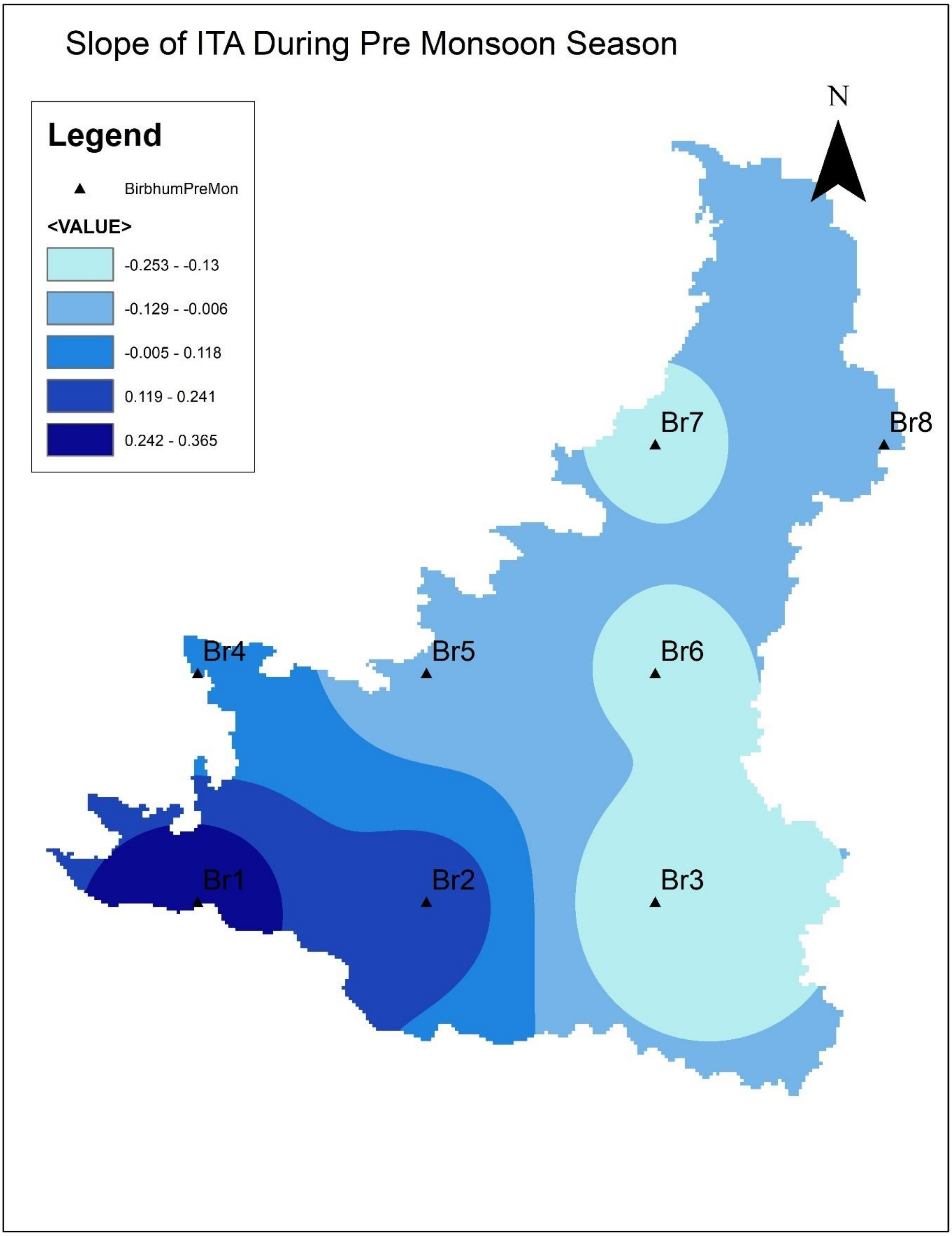


Fig. 4.11.18 ITA Slope Variation in Birbhum During Pre-Monsoon Season

For Monsoon Season, following are the Statistical Parameters:

Table 85

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Birbhum	Br1	63	87.25	23.75	1073.005	241.634	51233.108	0.608	0.373
Birbhum	Br2	64	87.5	23.75	1006.492	239.397	53645.165	0.400	-0.258
Birbhum	Br3	65	87.75	23.75	1014.391	254.876	59167.251	0.546	1.114
Birbhum	Br4	66	87.25	24	1153.160	271.869	65686.643	1.151	3.989
Birbhum	Br5	67	87.5	24	1064.659	287.410	75805.240	0.693	0.409
Birbhum	Br6	68	87.75	24	1047.249	283.162	74862.421	0.934	1.909
Birbhum	Br7	69	87.75	24.25	1055.907	243.105	57563.028	0.243	-0.109
Birbhum	Br8	70	88	24.25	1059.257	250.652	61104.618	0.157	-0.025

For Monsoon Season, following are the Trend Parameters:

Table 86

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Birbhum	Br1	63	87.25	23.75	1.6276	0.0834	0.9780	-0.1634	0.1634	-0.2147	0.2147
Birbhum	Br2	64	87.5	23.75	1.3257	0.0666	0.9857	-0.1306	0.1306	-0.1716	0.1716
Birbhum	Br3	65	87.75	23.75	0.7048	0.1138	0.9631	-0.2231	0.2231	-0.2932	0.2932
Birbhum	Br4	66	87.25	24	0.0366	0.1471	0.9458	-0.2884	0.2884	-0.3790	0.3790
Birbhum	Br5	67	87.5	24	1.7858	0.0952	0.9797	-0.1866	0.1866	-0.2453	0.2453
Birbhum	Br6	68	87.75	24	0.0372	0.1337	0.9587	-0.2621	0.2621	-0.3445	0.3445
Birbhum	Br7	69	87.75	24.25	0.5568	0.0634	0.9874	-0.1243	0.1243	-0.1634	0.1634
Birbhum	Br8	70	88	24.25	-0.4391	0.0718	0.9848	-0.1407	0.1407	-0.1850	0.1850

Trend Analysis Curves for Monsoon Season:

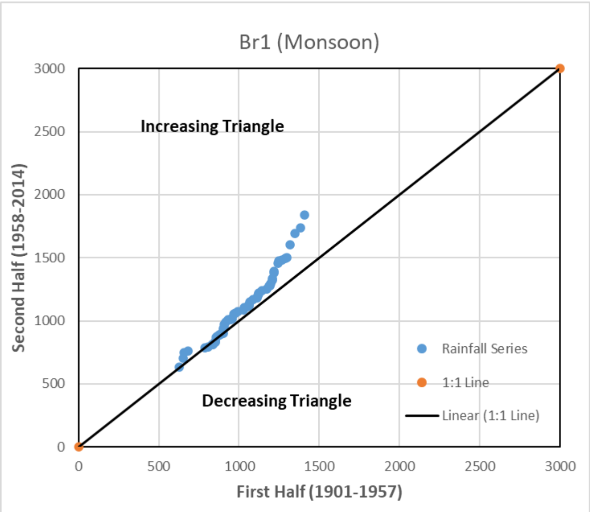


Fig 4.11.19 ITA plot for Br1 in Monsoon

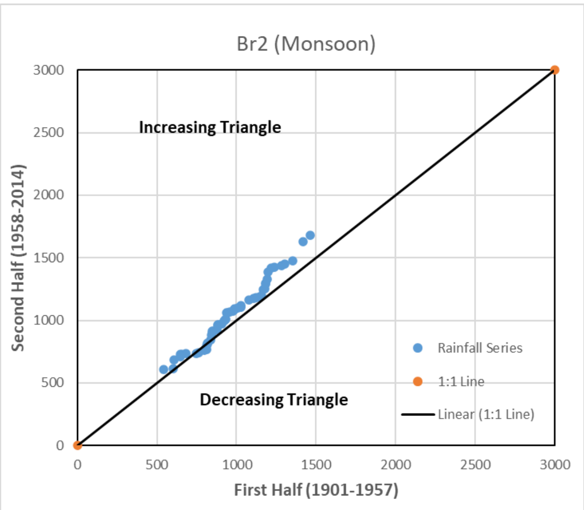


Fig 4.11.20 ITA plot for Br2 in Monsoon

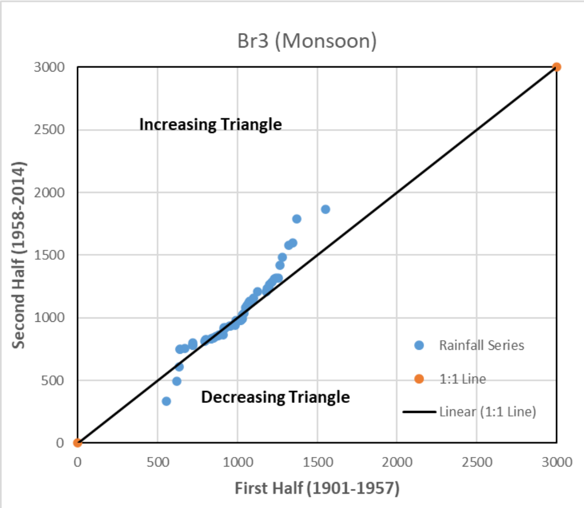


Fig 4.11.21 ITA plot for Br3 in Monsoon

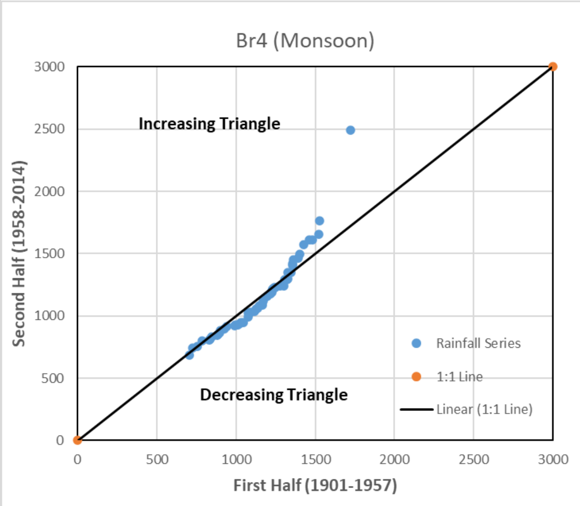


Fig 4.11.22 ITA plot for Br4 in Monsoon

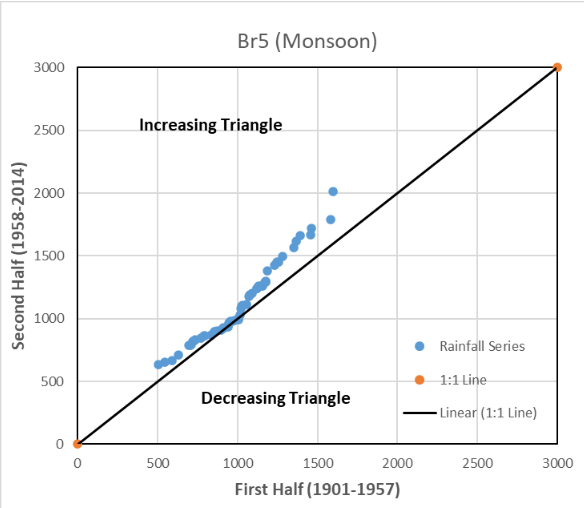


Fig 4.11.23 ITA plot for Br5 in Monsoon

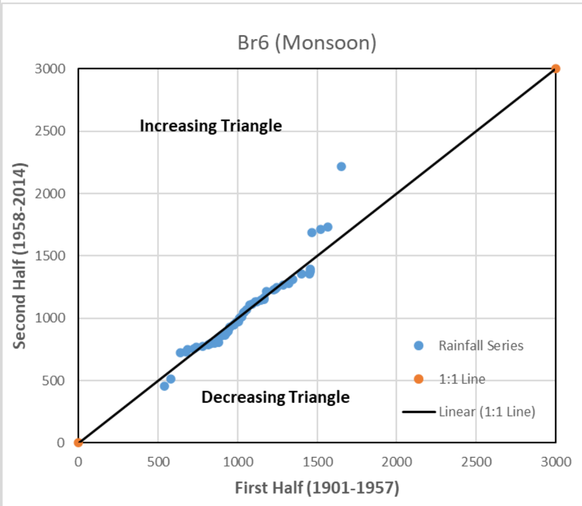


Fig 4.11.24 ITA plot for Br6 in Monsoon

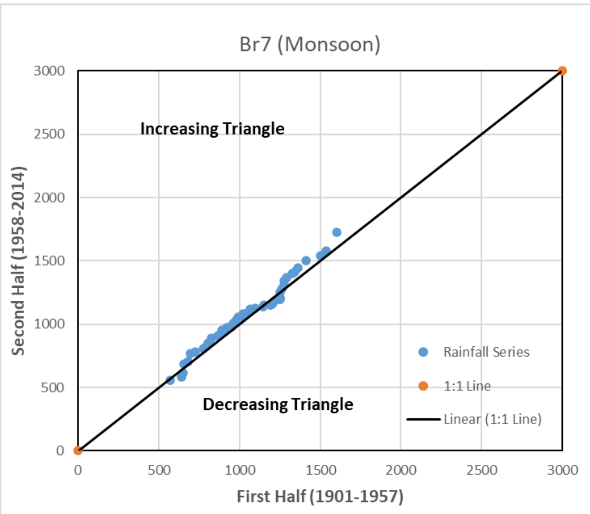


Fig 4.11.25 ITA plot for Br7 in Monsoon

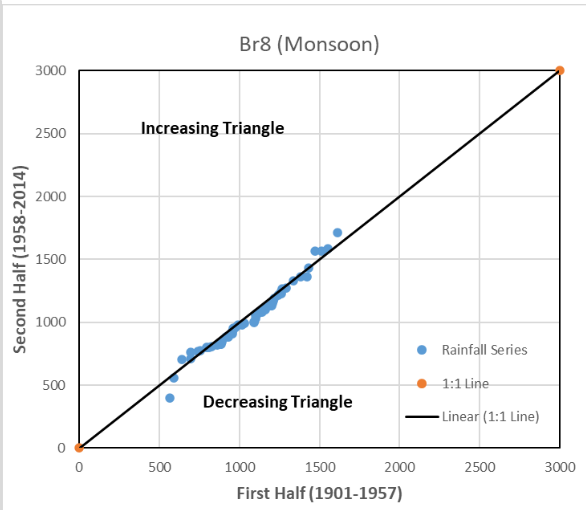


Fig 4.11.26 ITA plot for Br8 in Monsoon

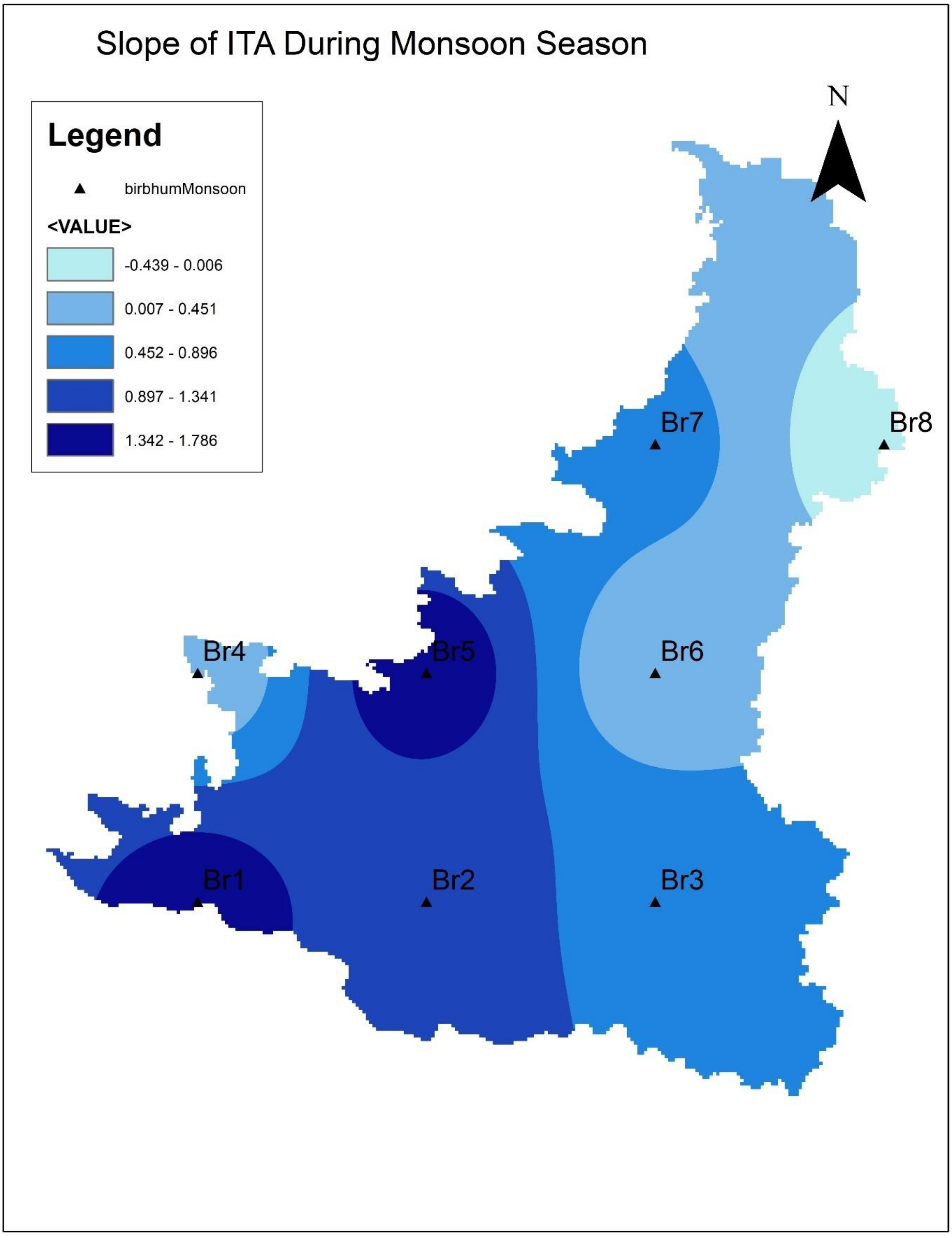


Fig. 4.11.27 ITA Slope Variation in Birbhum During Monsoon Season

For Post Monsoon Season, following are the Statistical Parameters:

Table 87

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Birbhum	Br1	63	87.25	23.75	122.331	84.060	6853.853	1.028	1.039
Birbhum	Br2	64	87.5	23.75	116.978	84.502	6950.097	0.830	0.314
Birbhum	Br3	65	87.75	23.75	126.333	90.621	7985.659	1.201	1.792
Birbhum	Br4	66	87.25	24	127.504	91.385	8104.793	1.209	2.072
Birbhum	Br5	67	87.5	24	121.703	86.517	7247.357	0.967	0.736
Birbhum	Br6	68	87.75	24	126.690	95.879	8356.662	1.730	5.947
Birbhum	Br7	69	87.75	24.25	133.816	103.520	10363.252	1.946	6.310
Birbhum	Br8	70	88	24.25	133.319	99.178	9282.155	1.797	4.891

For Post Monsoon Season, following are the Trend Parameters:

Table 88

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Birbhum	Br1	63	87.25	23.75	0.3401	0.0164	0.9930	-0.0321	0.0321	-0.0422	0.0422
Birbhum	Br2	64	87.5	23.75	0.3089	0.0166	0.9929	-0.0324	0.0324	-0.0426	0.0426
Birbhum	Br3	65	87.75	23.75	0.2082	0.0251	0.9858	-0.0491	0.0491	-0.0646	0.0646
Birbhum	Br4	66	87.25	24	0.2419	0.0211	0.9902	-0.0413	0.0413	-0.0543	0.0543
Birbhum	Br5	67	87.5	24	0.3144	0.0212	0.9889	-0.0415	0.0415	-0.0546	0.0546
Birbhum	Br6	68	87.75	24	0.2530	0.0572	0.9341	-0.1121	0.1121	-0.1473	0.1473
Birbhum	Br7	69	87.75	24.25	0.2936	0.0322	0.9821	-0.0631	0.0631	-0.0829	0.0829
Birbhum	Br8	70	88	24.25	0.1413	0.0288	0.9844	-0.0564	0.0564	-0.0742	0.0742

Trend Analysis Curves for Post Monsoon Season:

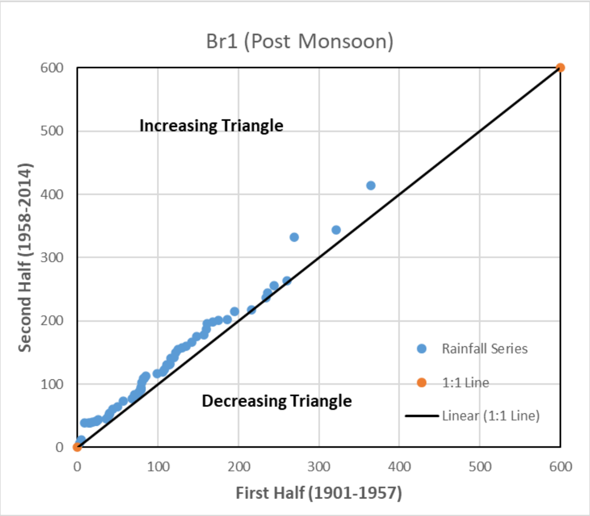


Fig 4.11.28 ITA plot for Br1 in Post Monsoon

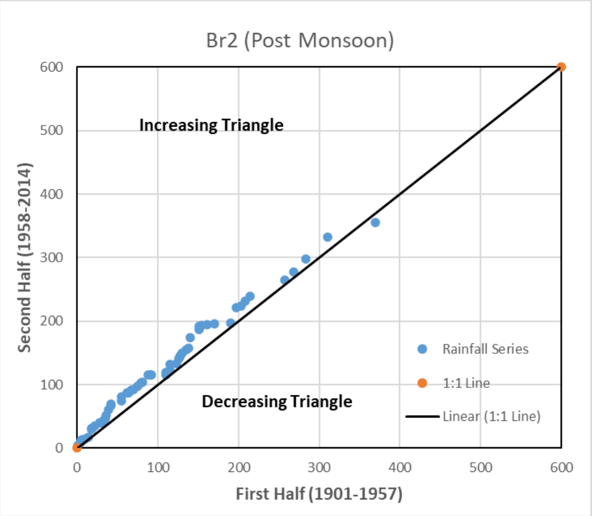


Fig 4.11.29 ITA plot for Br2 in Post Monsoon

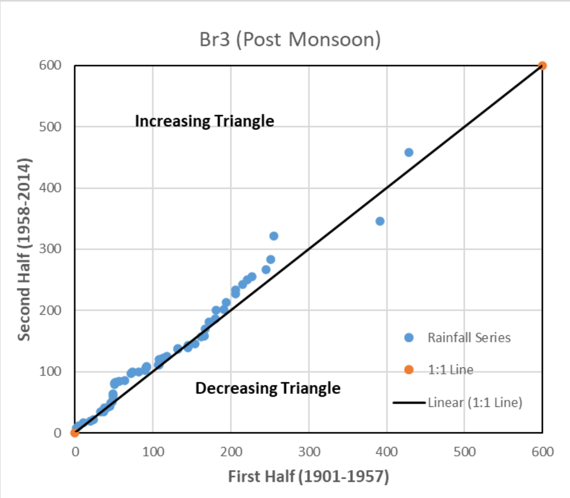


Fig 4.11.30 ITA plot for Br3 in Post Monsoon

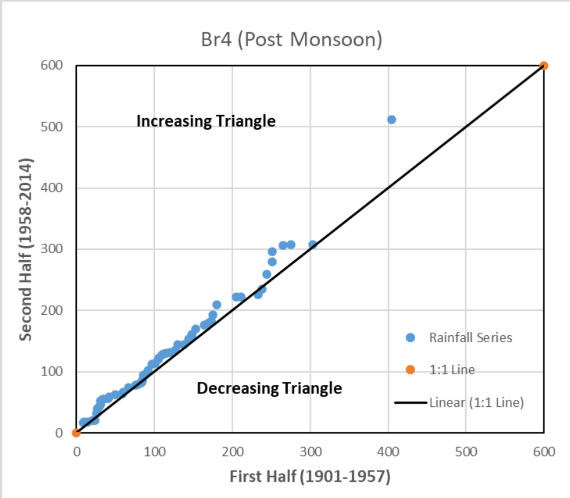


Fig 4.11.31 ITA plot for Br4 in Post Monsoon

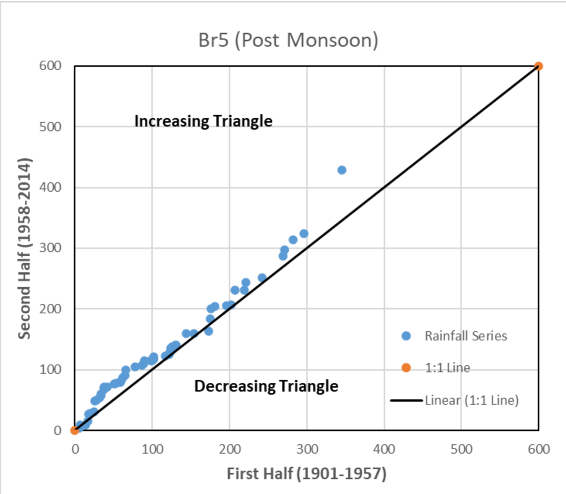


Fig 4.11.32 ITA plot for Br5 in Post Monsoon

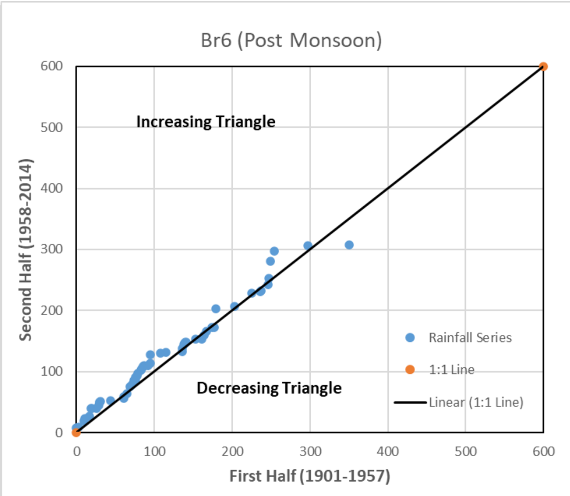


Fig 4.11.33 ITA plot for Br6 in Post Monsoon

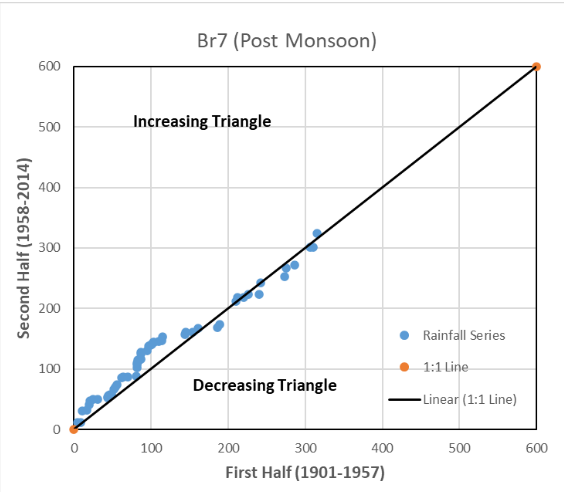


Fig 4.11.34 ITA plot for Br7 in Post Monsoon

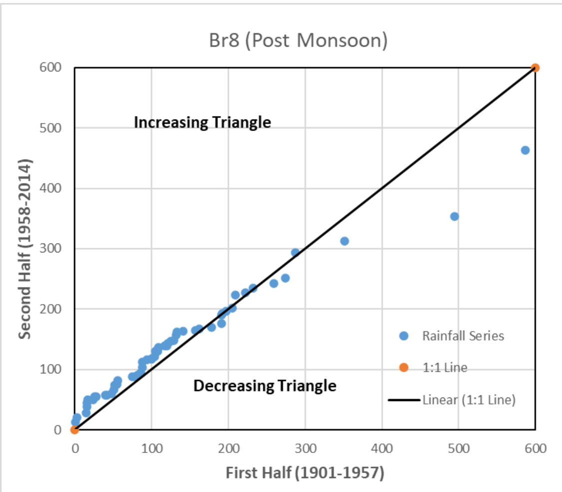


Fig 4.11.35 ITA plot for Br8 in Post Monsoon

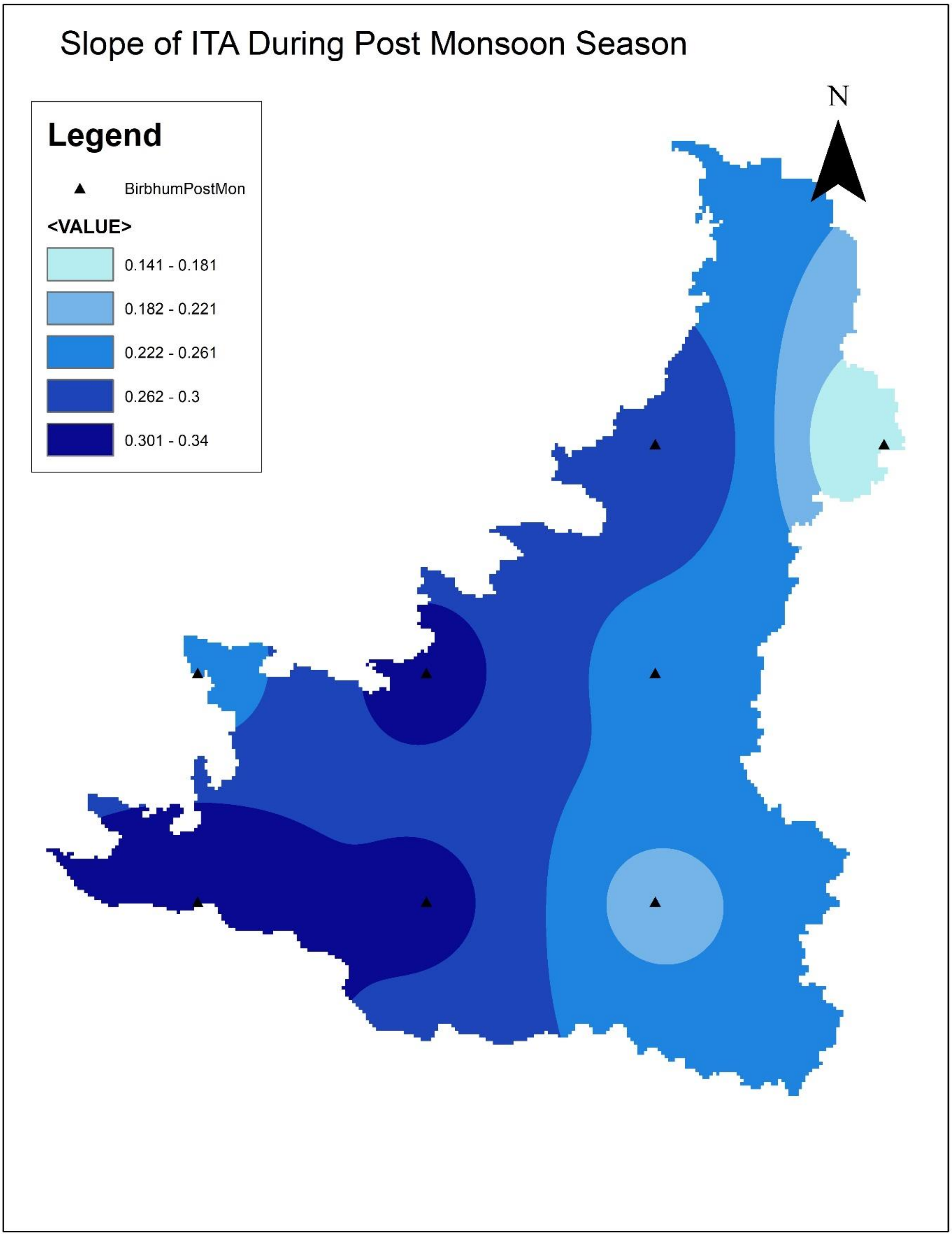


Fig. 4.11.36 ITA Slope Variation in Birbhum During Post Monsoon Season

4.12 Murshidabad:

For Winter Season, following are the Statistical Parameters:

Table 89

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Murshidabad	Msh1	71	88	24	27.562	28.539	766.850	1.726	3.451
Murshidabad	Msh2	72	88.25	24	26.948	27.995	705.024	1.901	5.191
Murshidabad	Msh3	73	88.5	24	27.310	28.026	710.681	1.737	3.906
Murshidabad	Msh4	74	88.25	24.25	27.358	28.831	689.698	2.126	6.438
Murshidabad	Msh5	75	88.5	24.25	27.194	28.479	676.271	2.112	6.549
Murshidabad	Msh6	76	88	24.5	27.545	27.545	585.808	2.274	8.030

For Winter Season, following are the Trend Parameters:

Table 90

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Murshidabad	Msh1	71	88	24	-0.094	0.007	0.989	-0.014	0.014	-0.018	0.018
Murshidabad	Msh2	72	88.25	24	-0.089	0.011	0.970	-0.022	0.022	-0.029	0.029
Murshidabad	Msh3	73	88.5	24	-0.099	0.011	0.970	-0.022	0.022	-0.029	0.029
Murshidabad	Msh4	74	88.25	24.25	-0.147	0.013	0.961	-0.026	0.026	-0.034	0.034
Murshidabad	Msh5	75	88.5	24.25	-0.132	0.015	0.951	-0.029	0.029	-0.038	0.038
Murshidabad	Msh6	76	88	24.5	-0.169	0.016	0.936	-0.032	0.032	-0.042	0.042

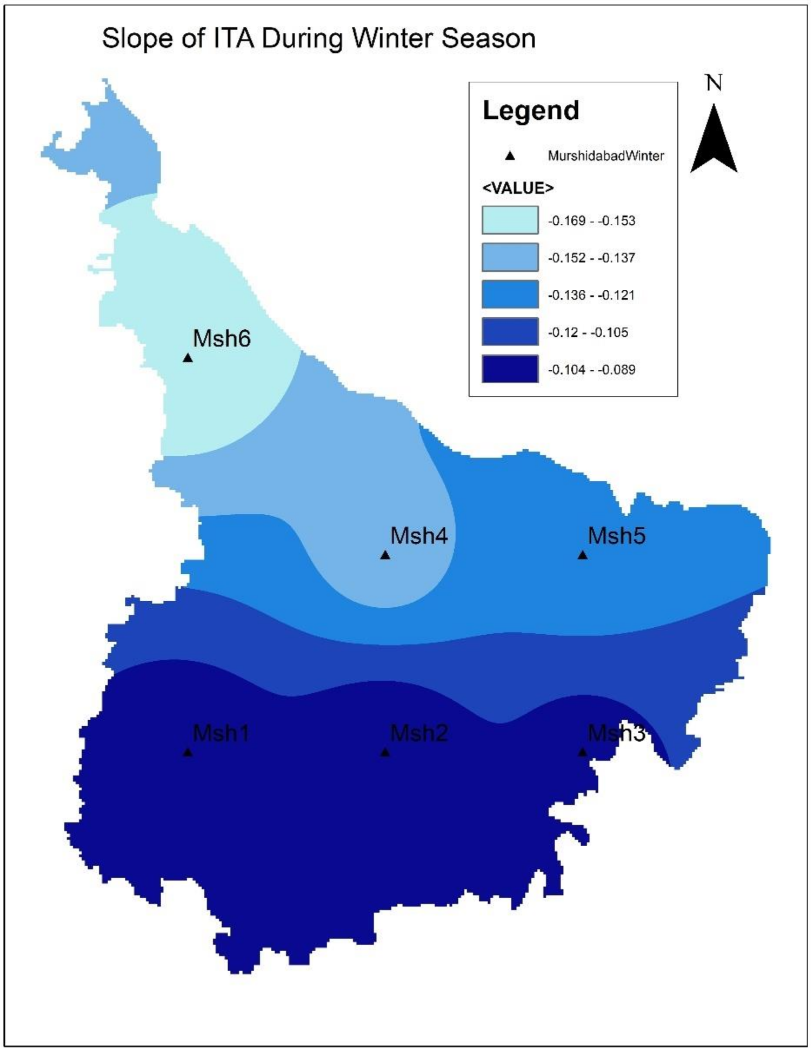


Fig. 4.12.1 ITA Slope Variation in Murshidabad During Winter Season

Trend Analysis Curves for Winter Season:

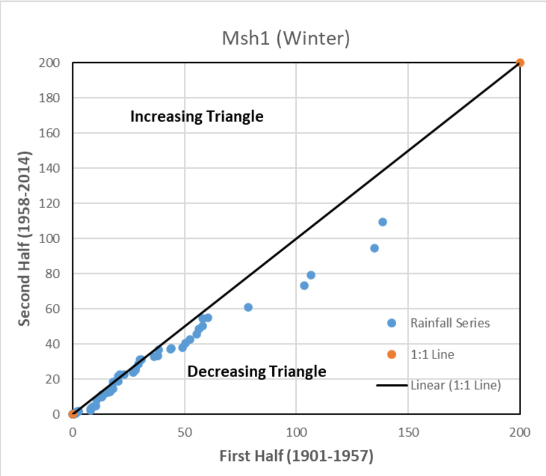


Fig 4.12.2 ITA plot for Msh1 in Winter

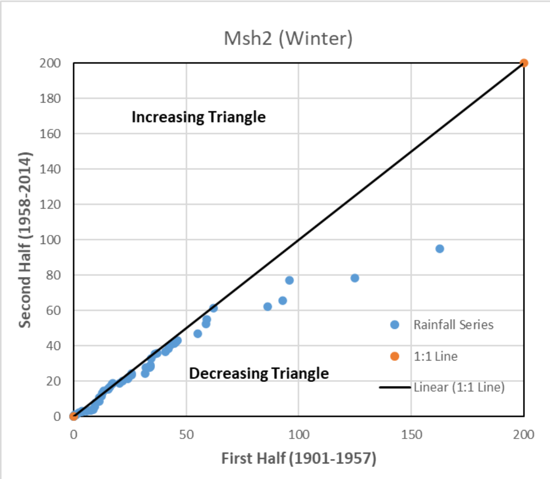


Fig 4.12.3 ITA plot for Msh2 in Winter

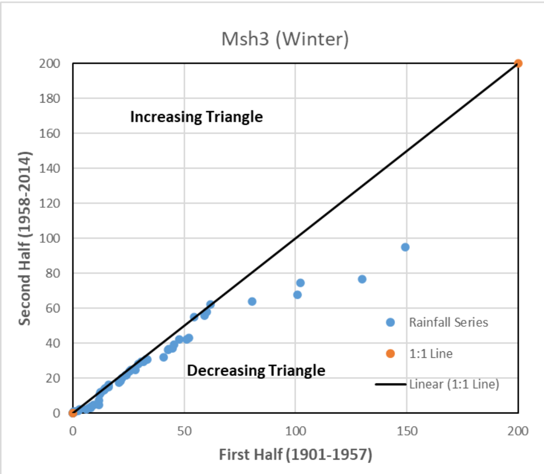


Fig 4.12.4 ITA plot for Msh3 in Winter

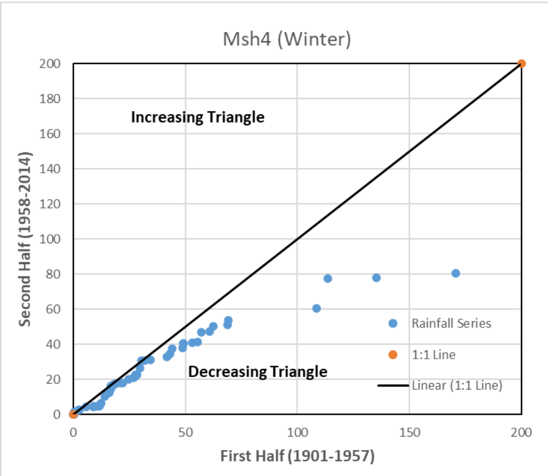


Fig 4.12.5 ITA plot for Msh4 in Winter

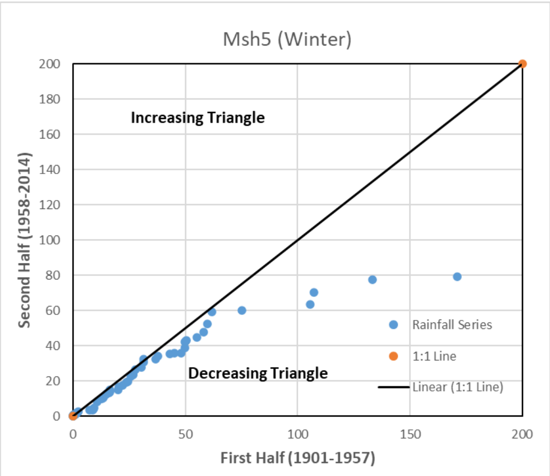


Fig 4.12.6 ITA plot for Msh5 in Winter

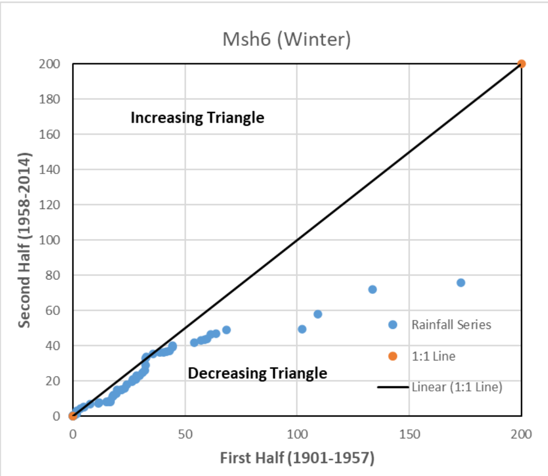


Fig 4.12.7 ITA plot for Msh6 in Winter

For Pre-Monsoon Season, following are the Statistical Parameters:

Table 91

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Murshidabad	Msh1	71	88	24	191.657	92.689	8351.228	0.519	0.036
Murshidabad	Msh2	72	88.25	24	194.112	92.566	8242.360	0.509	0.099
Murshidabad	Msh3	73	88.5	24	191.925	90.225	7889.476	0.486	0.097
Murshidabad	Msh4	74	88.25	24.25	187.346	90.453	7970.990	0.586	0.340
Murshidabad	Msh5	75	88.5	24.25	190.493	89.395	7801.007	0.503	0.243
Murshidabad	Msh6	76	88	24.5	176.656	81.300	6403.805	0.616	0.673

For Pre-Monsoon Season, following are the Trend Parameters:

Table 92

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Murshidabad	Msh1	71	88	24	-0.220	0.025	0.986	-0.050	0.050	-0.065	0.065
Murshidabad	Msh2	72	88.25	24	-0.398	0.025	0.986	-0.049	0.049	-0.065	0.065
Murshidabad	Msh3	73	88.5	24	-0.317	0.023	0.988	-0.045	0.045	-0.060	0.060
Murshidabad	Msh4	74	88.25	24.25	-0.220	0.023	0.988	-0.045	0.045	-0.059	0.059
Murshidabad	Msh5	75	88.5	24.25	-0.234	0.020	0.990	-0.040	0.040	-0.053	0.053
Murshidabad	Msh6	76	88	24.5	-0.144	0.026	0.981	-0.051	0.051	-0.068	0.068

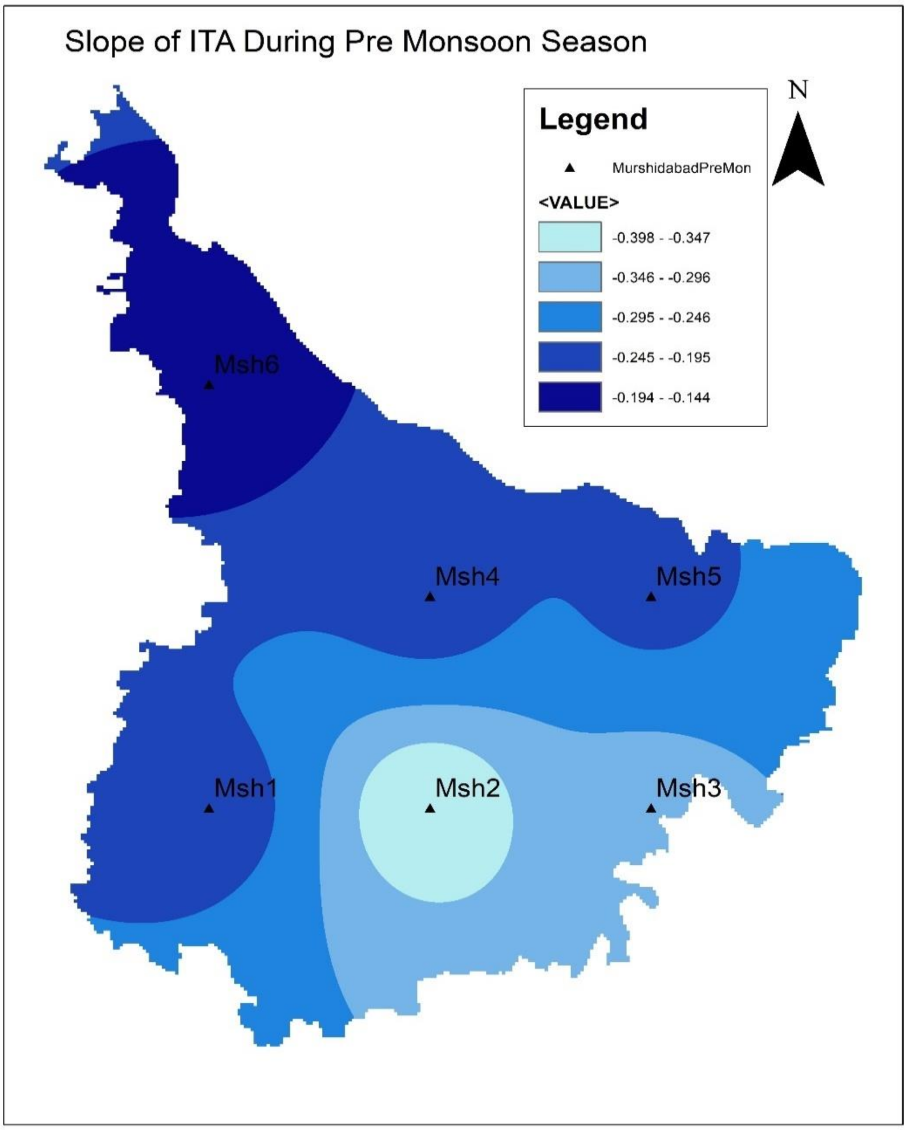


Fig. 4.12.8 ITA Slope Variation in Murshidabad During Pre-Monsoon Season

Trend Analysis Curves for Pre-Monsoon Season:

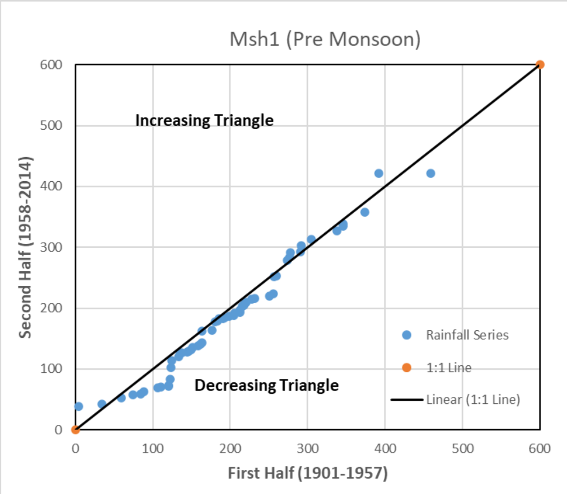


Fig 4.12.9 ITA plot for Msh1 in Pre-Monsoon

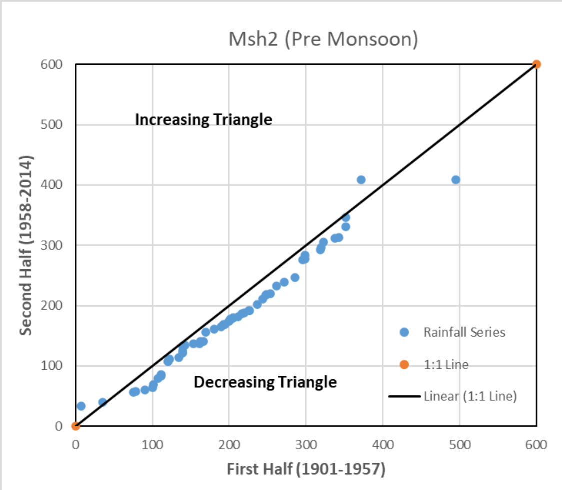


Fig 4.12.10 ITA plot for Msh2 in Pre-Monsoon

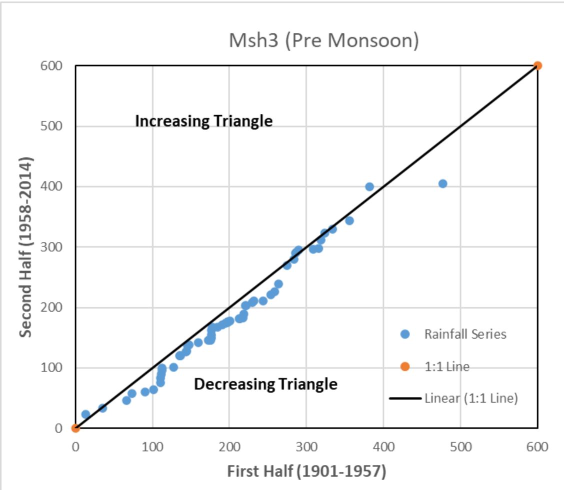


Fig 4.12.11 ITA plot for Msh3 in Pre-Monsoon

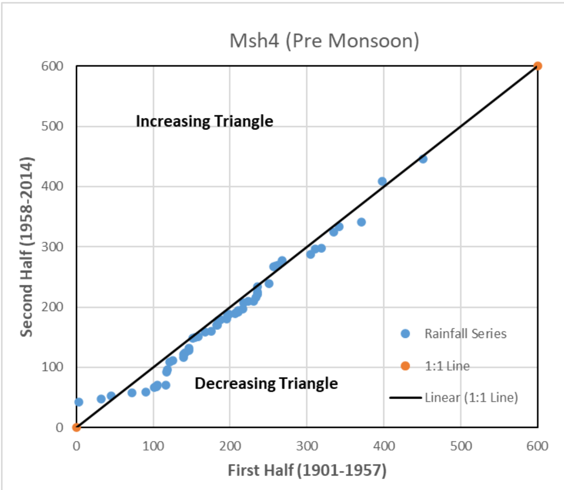


Fig 4.12.12 ITA plot for Msh4 in Pre-Monsoon

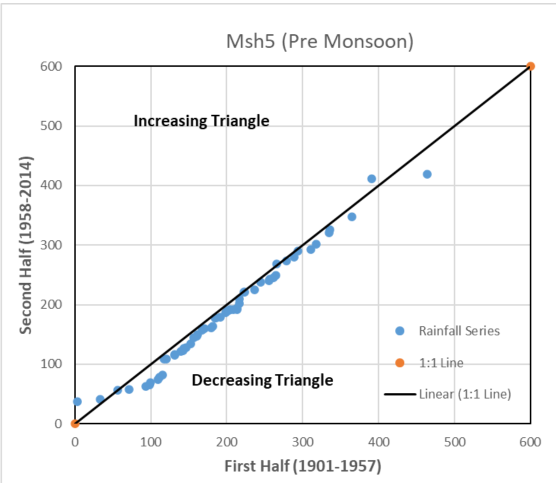


Fig 4.12.13 ITA plot for Msh5 in Pre-Monsoon

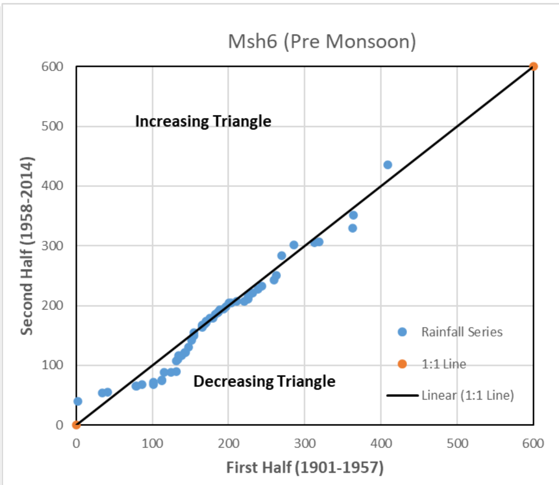


Fig 4.12.14 ITA plot for Msh6 in Pre-Monsoon

For Monsoon Season, following are the Statistical Parameters:

Table 93

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Murshidabad	Msh1	71	88	24	1033.748	230.002	50078.051	0.071	0.672
Murshidabad	Msh2	72	88.25	24	1010.328	220.752	45870.590	0.072	0.669
Murshidabad	Msh3	73	88.5	24	1006.169	232.649	50080.566	0.060	0.452
Murshidabad	Msh4	74	88.25	24.25	1036.003	228.875	50634.192	0.052	0.472
Murshidabad	Msh5	75	88.5	24.25	1020.434	221.142	46542.830	0.034	0.695
Murshidabad	Msh6	76	88	24.5	1065.290	221.779	48316.918	0.250	-0.097

For Monsoon Season, following are the Trend Parameters:

Table 94

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Murshidabad	Msh1	71	88	24	-0.266	0.073	0.981	-0.143	0.143	-0.188	0.188
Murshidabad	Msh2	72	88.25	24	0.054	0.070	0.981	-0.138	0.138	-0.181	0.181
Murshidabad	Msh3	73	88.5	24	-0.644	0.079	0.979	-0.154	0.154	-0.202	0.202
Murshidabad	Msh4	74	88.25	24.25	-0.408	0.070	0.982	-0.138	0.138	-0.181	0.181
Murshidabad	Msh5	75	88.5	24.25	-0.574	0.078	0.977	-0.152	0.152	-0.200	0.200
Murshidabad	Msh6	76	88	24.5	0.178	0.047	0.992	-0.092	0.092	-0.122	0.122

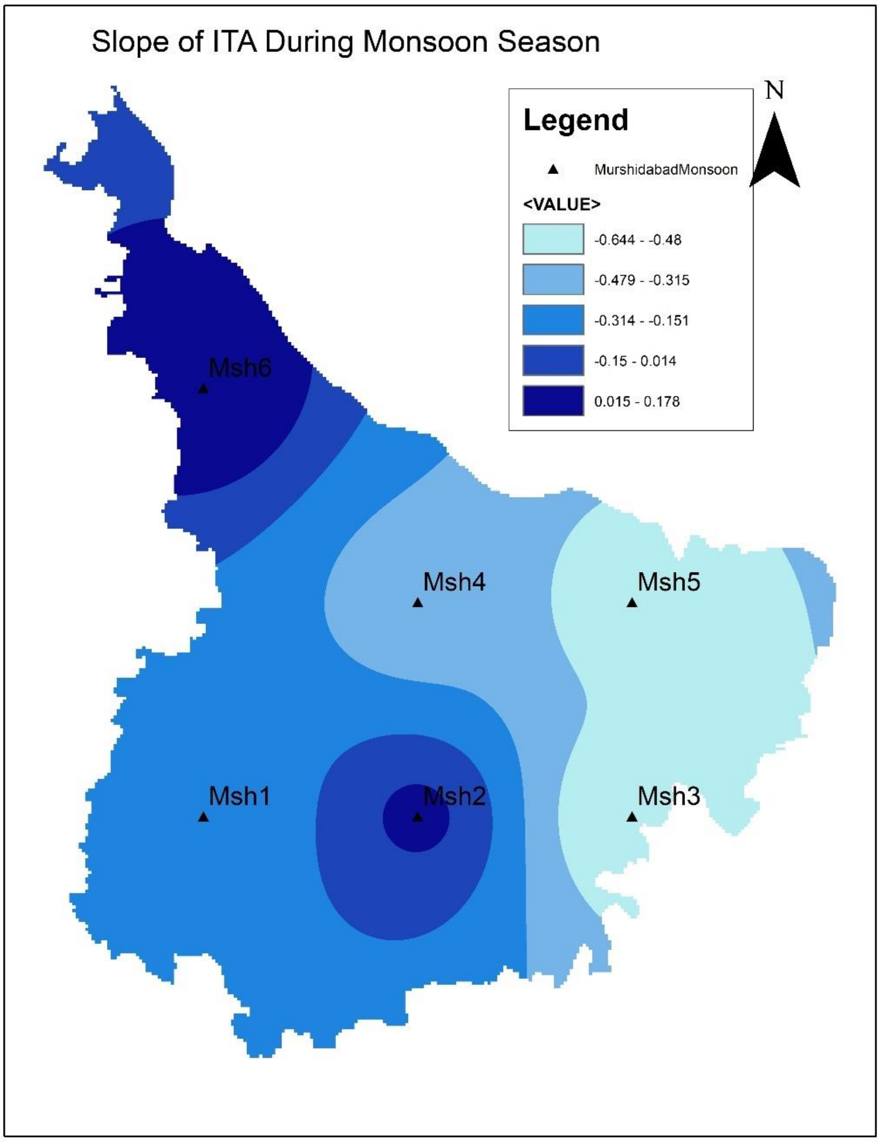


Fig. 4.12.15 ITA Slope Variation in Murshidabad During Monsoon Season

Trend Analysis Curves for Monsoon Season:

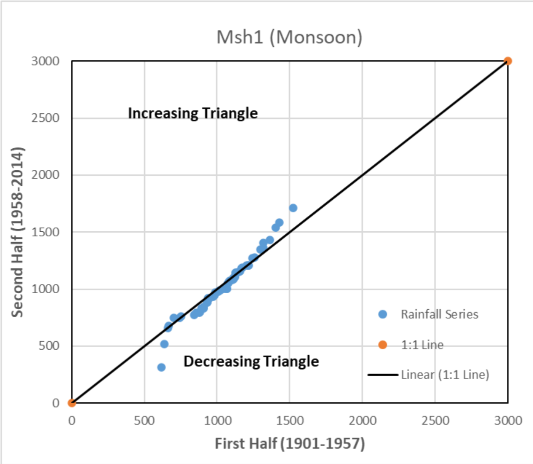


Fig 4.12.16 ITA plot for Msh1 in Monsoon

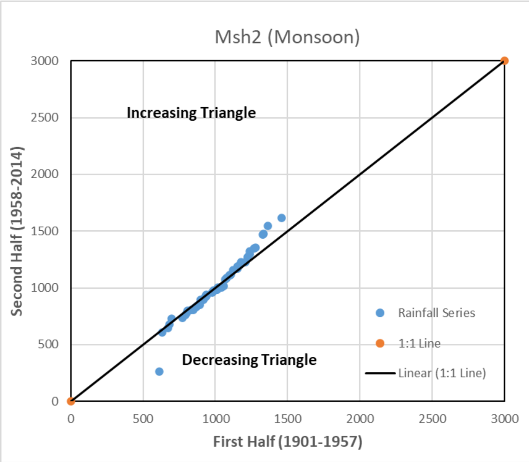


Fig 4.12.17 ITA plot for Msh2 in Monsoon

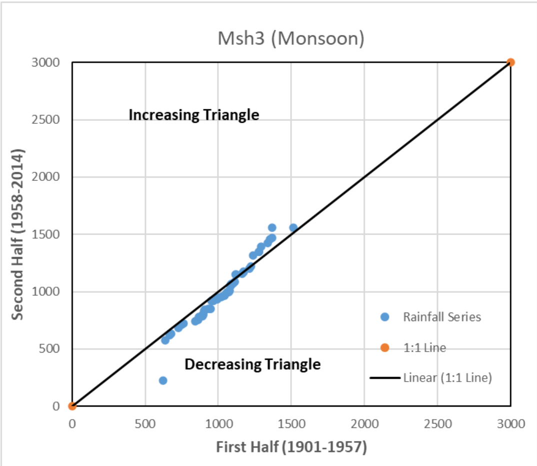


Fig 4.12.18 ITA plot for Msh3 in Monsoon

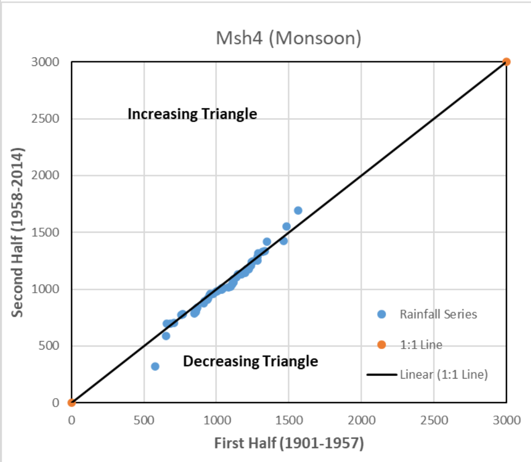


Fig 4.12.19 ITA plot for Msh4 in Monsoon

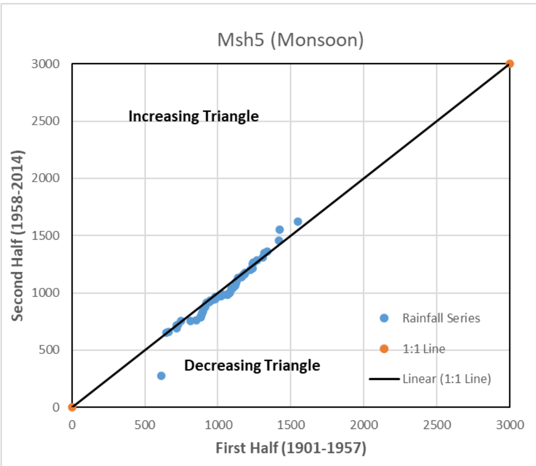


Fig 4.12.20 ITA plot for Msh5 in Monsoon

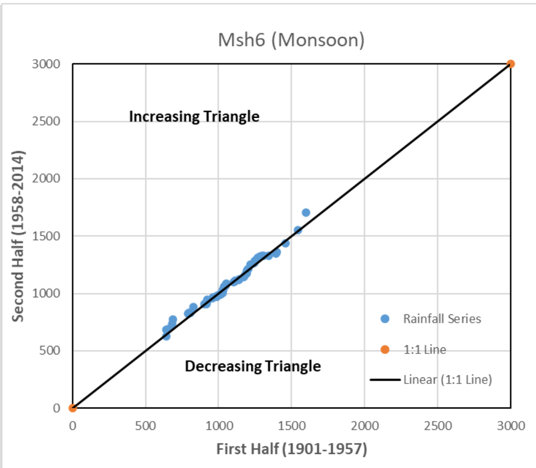


Fig 4.12.21 ITA plot for Msh6 in Monsoon

For Post Monsoon Season, following are the Statistical Parameters:

Table 95

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Murshidabad	Msh1	71	88	24	130.406	94.373	8579.636	1.655	4.382
Murshidabad	Msh2	72	88.25	24	126.728	92.395	8358.430	1.611	4.427
Murshidabad	Msh3	73	88.5	24	127.683	93.400	8513.784	1.597	4.101
Murshidabad	Msh4	74	88.25	24.25	131.719	96.068	8793.127	1.763	4.892
Murshidabad	Msh5	75	88.5	24.25	129.041	94.607	8650.950	1.760	5.034
Murshidabad	Msh6	76	88	24.5	133.471	95.806	8849.475	1.522	3.333

For Post Monsoon Season, following are the Trend Parameters:

Table 96

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Murshidabad	Msh1	71	88	24	0.162	0.024	0.988	-0.048	0.048	-0.062	0.062
Murshidabad	Msh2	72	88.25	24	0.283	0.013	0.996	-0.026	0.026	-0.034	0.034
Murshidabad	Msh3	73	88.5	24	0.189	0.017	0.994	-0.032	0.032	-0.043	0.043
Murshidabad	Msh4	74	88.25	24.25	0.164	0.033	0.979	-0.064	0.064	-0.084	0.084
Murshidabad	Msh5	75	88.5	24.25	0.175	0.024	0.988	-0.048	0.048	-0.062	0.062
Murshidabad	Msh6	76	88	24.5	0.224	0.022	0.990	-0.043	0.043	-0.057	0.057

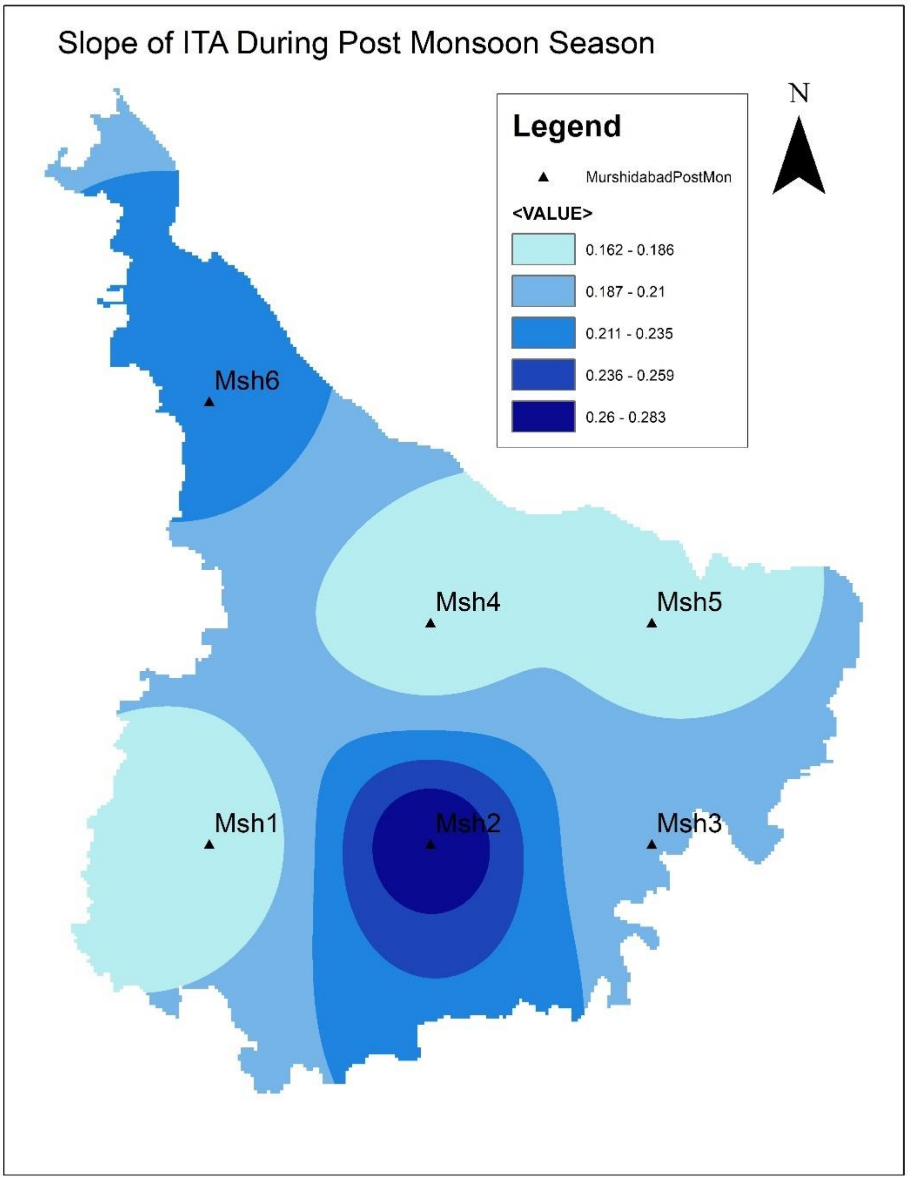


Fig. 4.12.22 ITA Slope Variation in Murshidabad During Post Monsoon Season

Trend Analysis Curves for Post Monsoon Season:

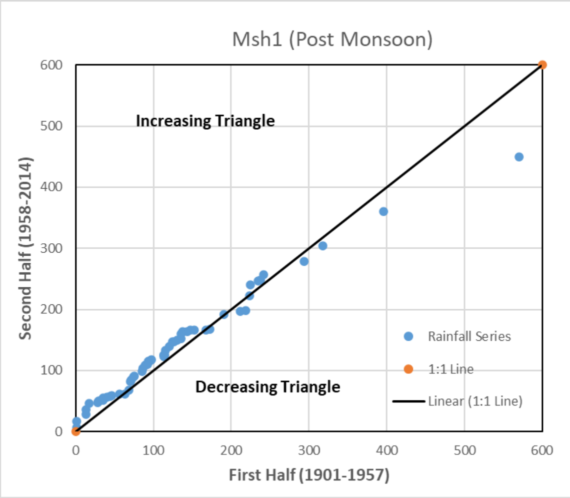


Fig 4.12.23 ITA plot for Msh1 in Post Monsoon

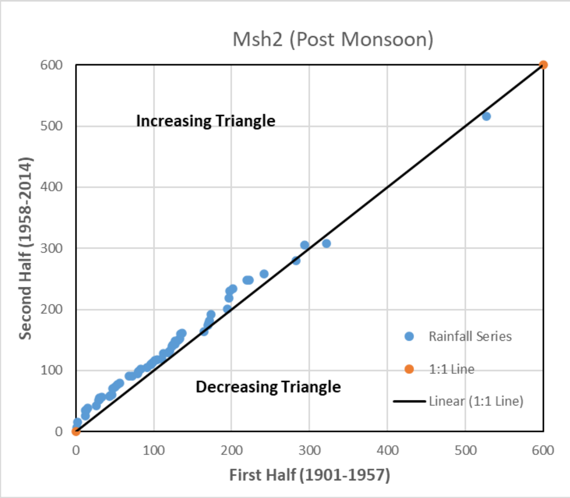


Fig 4.12.24 ITA plot for Msh2 in Post Monsoon

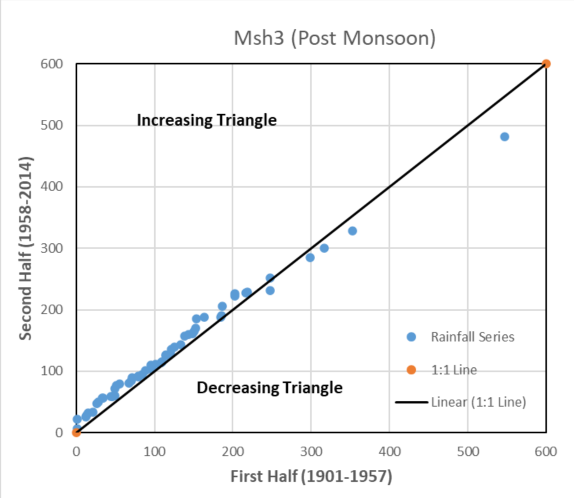


Fig 4.12.25 ITA plot for Msh3 in Post Monsoon

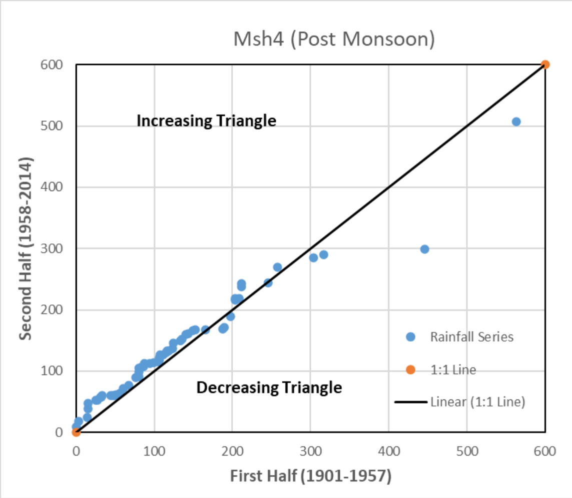


Fig 4.12.26 ITA plot for Msh4 in Post Monsoon

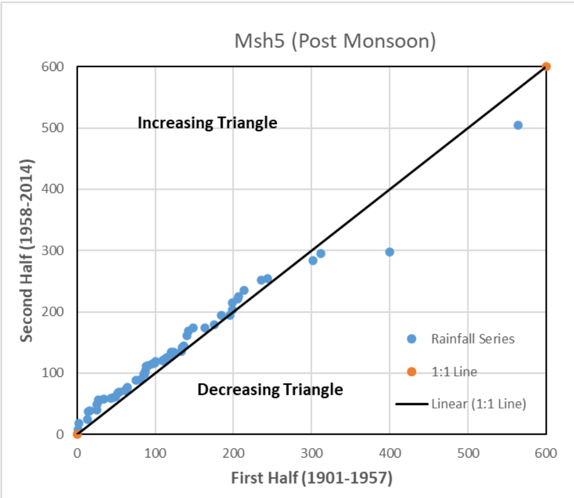


Fig 4.12.27 ITA plot for Msh5 in Post Monsoon

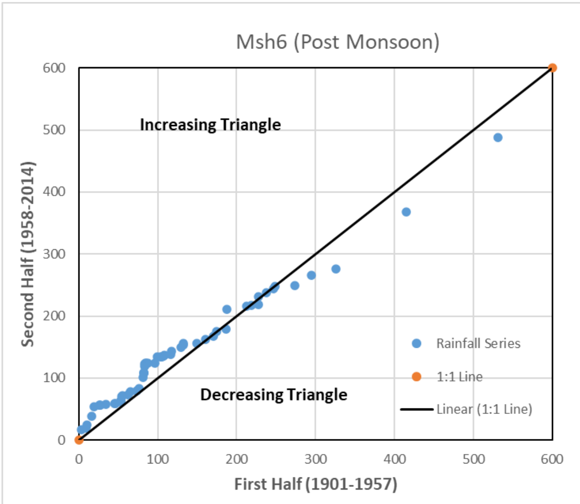


Fig 4.12.28 ITA plot for Msh6 in Post Monsoon

4.13 Nadia:

For Winter Season, following are the Statistical Parameters:

Table 97

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Nadia	Na1	77	88.5	23	34.125	34.724	1100.221	1.681	3.814
Nadia	Na2	78	88.5	23.25	32.659	33.360	1004.036	1.625	3.514
Nadia	Na3	79	88.5	23.5	31.726	31.674	929.755	1.384	2.045
Nadia	Na4	80	88.25	23.75	28.148	27.128	710.452	1.246	1.151
Nadia	Na5	81	88.5	23.75	29.385	27.653	710.554	1.186	1.073

For Winter Season, following are the Trend Parameters:

Table 98

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Nadia	Na1	77	88.5	23	-0.141	0.008	0.989	-0.016	0.016	-0.021	0.021
Nadia	Na2	78	88.5	23.25	-0.175	0.007	0.992	-0.014	0.014	-0.018	0.018
Nadia	Na3	79	88.5	23.5	-0.165	0.005	0.996	-0.010	0.010	-0.013	0.013
Nadia	Na4	80	88.25	23.75	-0.083	0.005	0.994	-0.009	0.009	-0.012	0.012
Nadia	Na5	81	88.5	23.75	-0.135	0.006	0.993	-0.011	0.011	-0.014	0.014

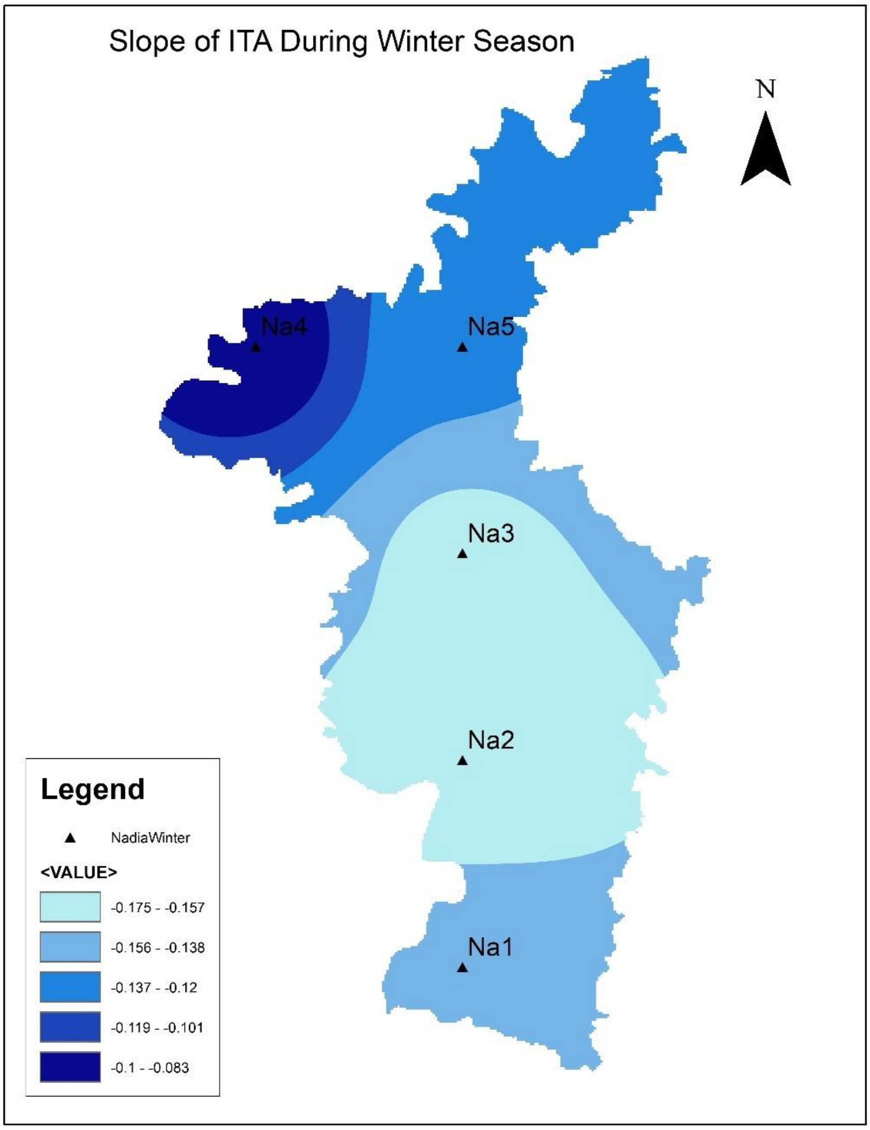


Fig. 4.13.1 ITA Slope Variation in Nadia During Winter Season

Trend Analysis Curves for Winter Season:

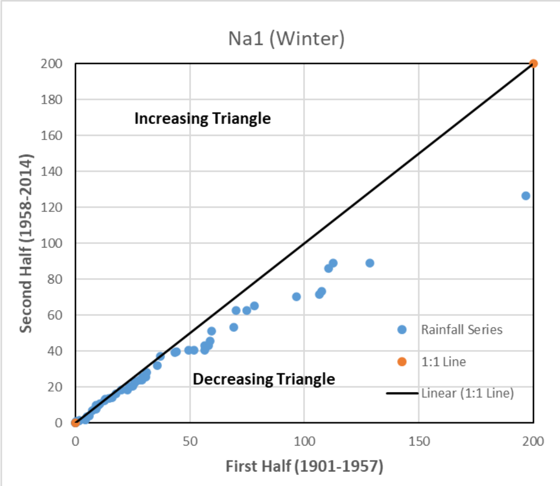


Fig 4.13.2 ITA plot for Na1 in Winter

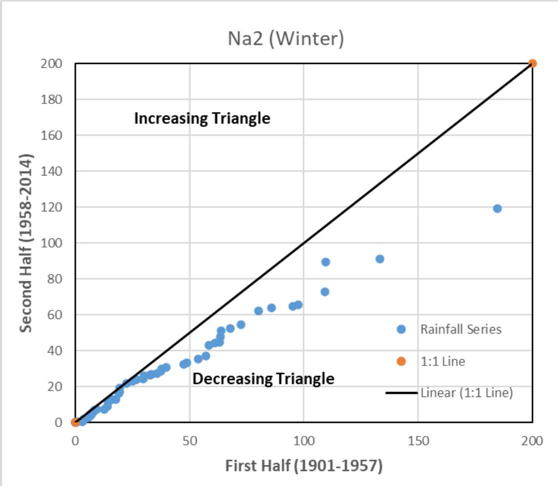


Fig 4.13.3 ITA plot for Na2 in Winter

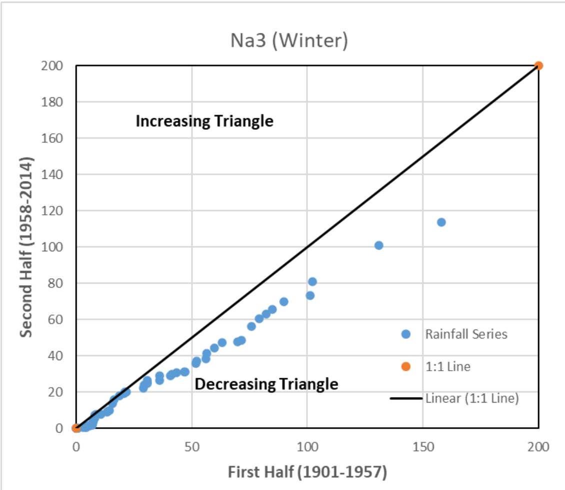


Fig 4.13.4 ITA plot for Na3 in Winter

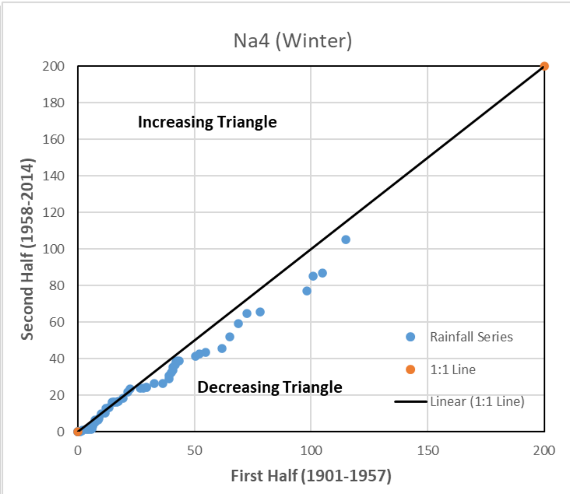


Fig 4.13.5 ITA plot for Na4 in Winter

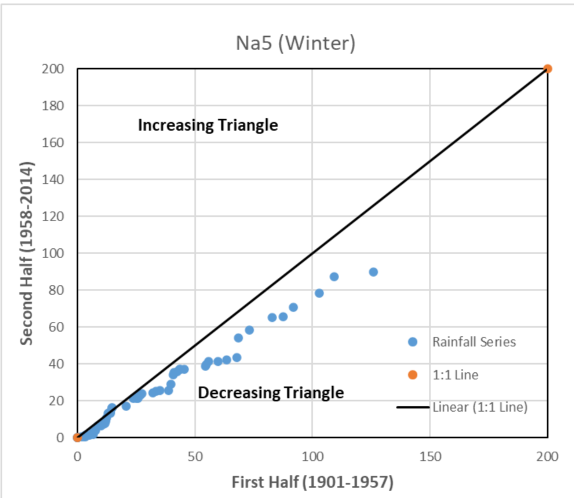


Fig 4.13.6 ITA plot for Na5 in Winter

For Pre-Monsoon Season, following are the Statistical Parameters:

Table 99

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Nadia	Na1	77	88.5	23	211.081	86.765	7203.105	0.531	0.014
Nadia	Na2	78	88.5	23.25	208.365	90.099	7419.510	0.463	-0.478
Nadia	Na3	79	88.5	23.5	209.496	92.981	7900.385	0.343	-0.605
Nadia	Na4	80	88.25	23.75	195.782	94.657	8476.177	0.506	-0.348
Nadia	Na5	81	88.5	23.75	200.168	92.389	7946.488	0.337	-0.630

For Pre-Monsoon Season, following are the Trend Parameters:

Table 100

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Nadia	Na1	77	88.5	23	-0.340	0.029	0.979	-0.058	0.058	-0.076	0.076
Nadia	Na2	78	88.5	23.25	-0.703	0.035	0.972	-0.068	0.068	-0.090	0.090
Nadia	Na3	79	88.5	23.5	-0.796	0.029	0.982	-0.057	0.057	-0.075	0.075
Nadia	Na4	80	88.25	23.75	-0.574	0.027	0.985	-0.053	0.053	-0.069	0.069
Nadia	Na5	81	88.5	23.75	-0.678	0.026	0.986	-0.050	0.050	-0.066	0.066

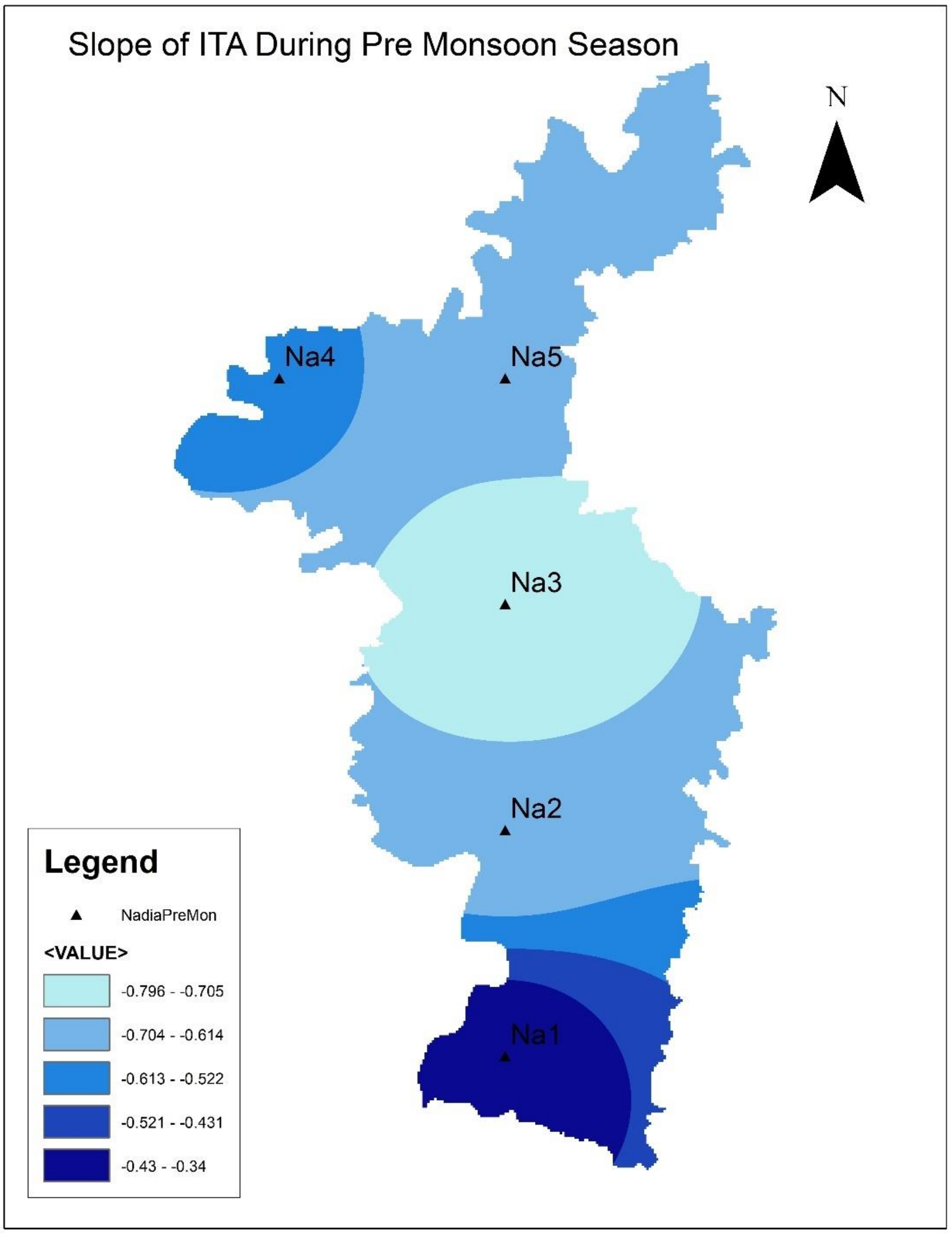


Fig. 4.13.7 ITA Slope Variation in Nadia During Pre-Monsoon Season

Trend Analysis Curves for Pre-Monsoon Season:

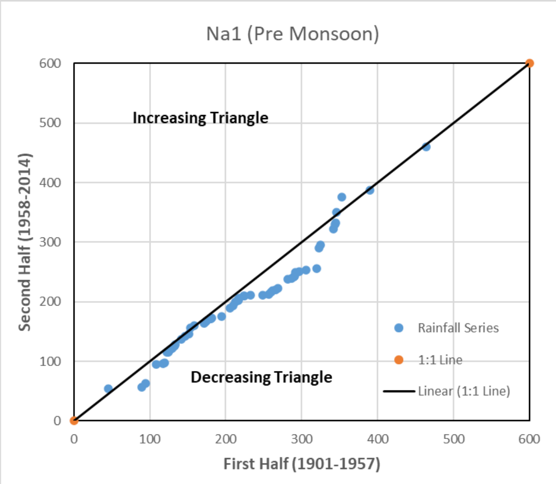


Fig 4.13.8 ITA plot for Na1 in Pre-Monsoon

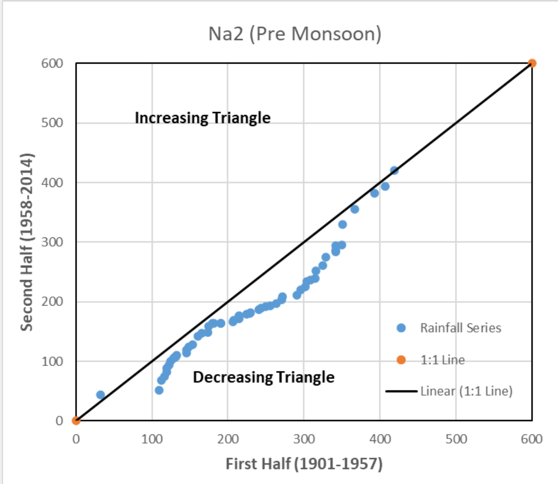


Fig 4.13.9 ITA plot for Na2 in Pre-Monsoon

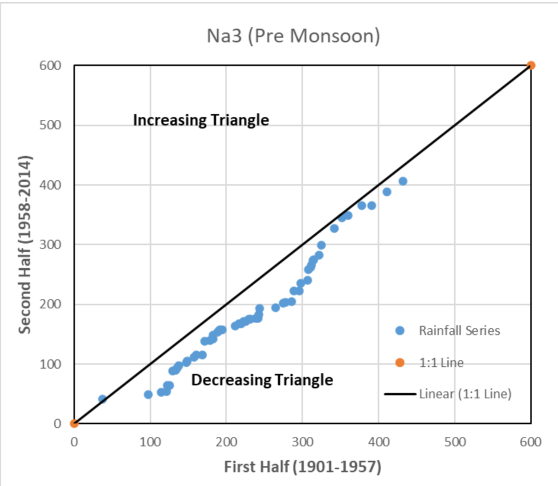


Fig 4.13.10 ITA plot for Na3 in Pre-Monsoon

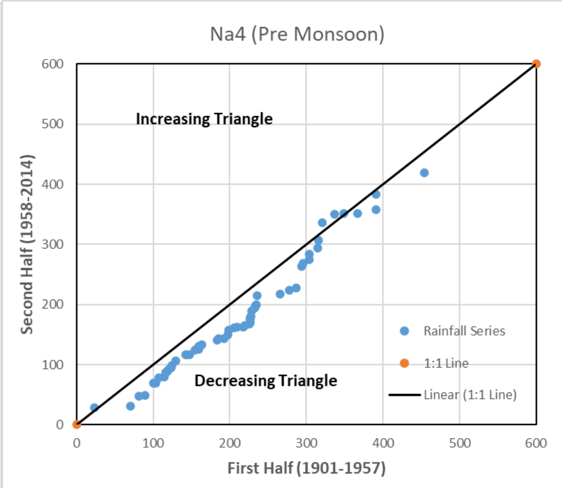


Fig 4.13.11 ITA plot for Na4 in Pre-Monsoon

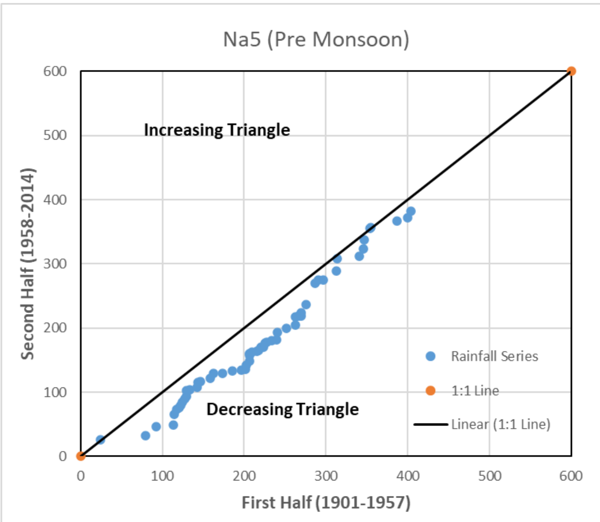


Fig 4.13.12 ITA plot for Na5 in Pre-Monsoon

For Monsoon Season, following are the Statistical Parameters:

Table 101

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Nadia	Na1	77	88.5	23	1013.048	259.790	56284.532	0.828	2.653
Nadia	Na2	78	88.5	23.25	987.296	249.549	53578.668	0.317	0.545
Nadia	Na3	79	88.5	23.5	981.475	247.258	49628.333	0.243	0.868
Nadia	Na4	80	88.25	23.75	978.551	249.118	53170.669	0.273	0.718
Nadia	Na5	81	88.5	23.75	979.336	239.724	46505.128	0.260	0.901

For Monsoon Season, following are the Trend Parameters:

Table 102

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Nadia	Na1	77	88.5	23	1.521	0.210	0.879	-0.411	0.411	-0.541	0.541
Nadia	Na2	78	88.5	23.25	0.610	0.145	0.937	-0.285	0.285	-0.375	0.375
Nadia	Na3	79	88.5	23.5	-0.077	0.088	0.976	-0.173	0.173	-0.227	0.227
Nadia	Na4	80	88.25	23.75	-0.208	0.079	0.981	-0.155	0.155	-0.204	0.204
Nadia	Na5	81	88.5	23.75	-0.186	0.058	0.989	-0.113	0.113	-0.149	0.149

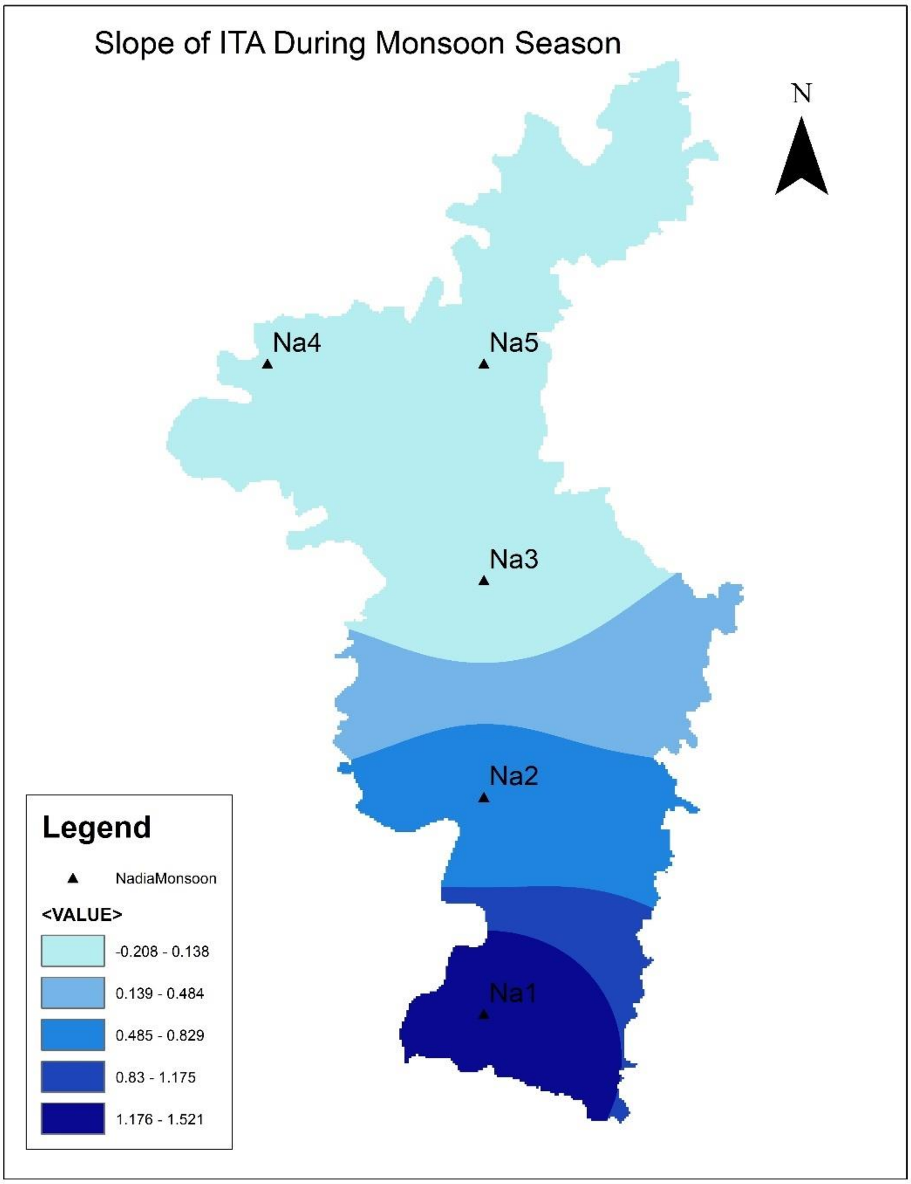


Fig. 4.13.13 ITA Slope Variation in Nadia During Monsoon Season

Trend Analysis Curves for Monsoon Season:

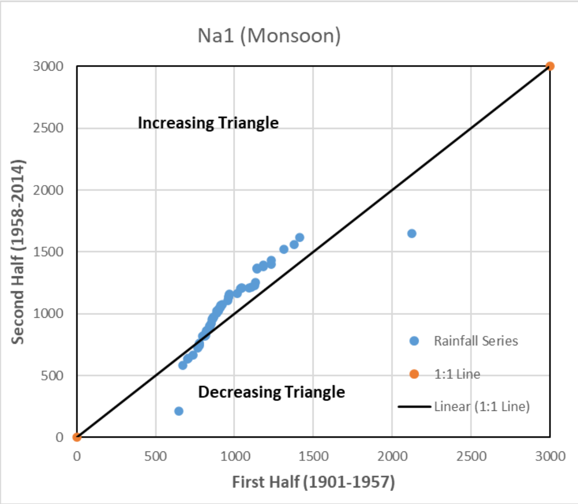


Fig 4.13.14 ITA plot for Na1 in Monsoon

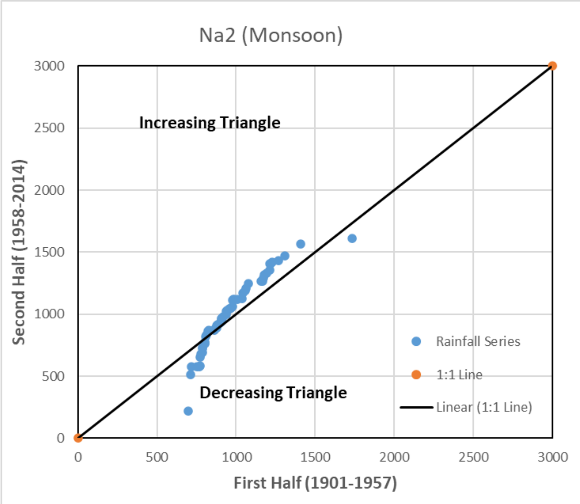


Fig 4.13.15 ITA plot for Na2 in Monsoon

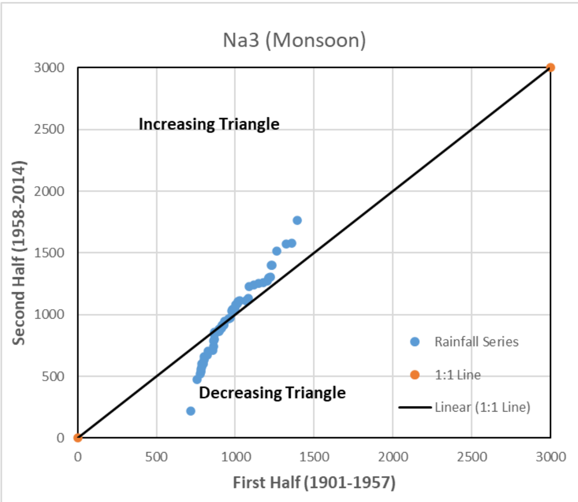


Fig 4.13.16 ITA plot for Na3 in Monsoon

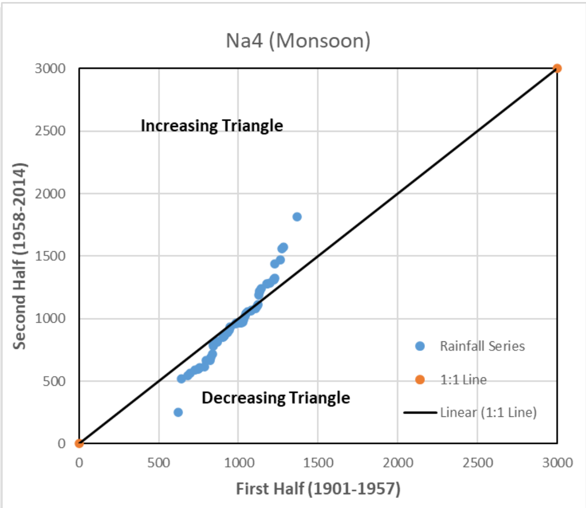


Fig 4.13.17 ITA plot for Na4 in Monsoon

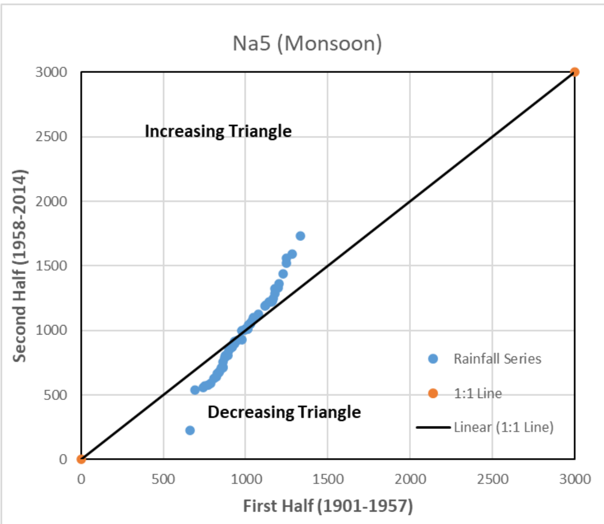


Fig 4.13.18 ITA plot for Na5 in Monsoon

For Post Monsoon Season, following are the Statistical Parameters:

Table 103

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Nadia	Na1	77	88.5	23	136.239	89.354	7335.203	0.889	0.261
Nadia	Na2	78	88.5	23.25	132.921	87.572	7169.550	0.871	0.494
Nadia	Na3	79	88.5	23.5	131.031	87.258	7162.941	0.965	1.114
Nadia	Na4	80	88.25	23.75	127.068	91.854	8278.679	1.497	3.558
Nadia	Na5	81	88.5	23.75	127.962	87.284	7470.063	1.228	2.273

For Post Monsoon Season, following are the Trend Parameters:

Table 104

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Nadia	Na1	77	88.5	23	0.505	0.025	0.985	-0.049	0.049	-0.064	0.064
Nadia	Na2	78	88.5	23.25	0.257	0.023	0.987	-0.045	0.045	-0.059	0.059
Nadia	Na3	79	88.5	23.5	0.140	0.030	0.978	-0.058	0.058	-0.077	0.077
Nadia	Na4	80	88.25	23.75	0.086	0.020	0.992	-0.038	0.038	-0.051	0.051
Nadia	Na5	81	88.5	23.75	0.076	0.018	0.992	-0.036	0.036	-0.047	0.047

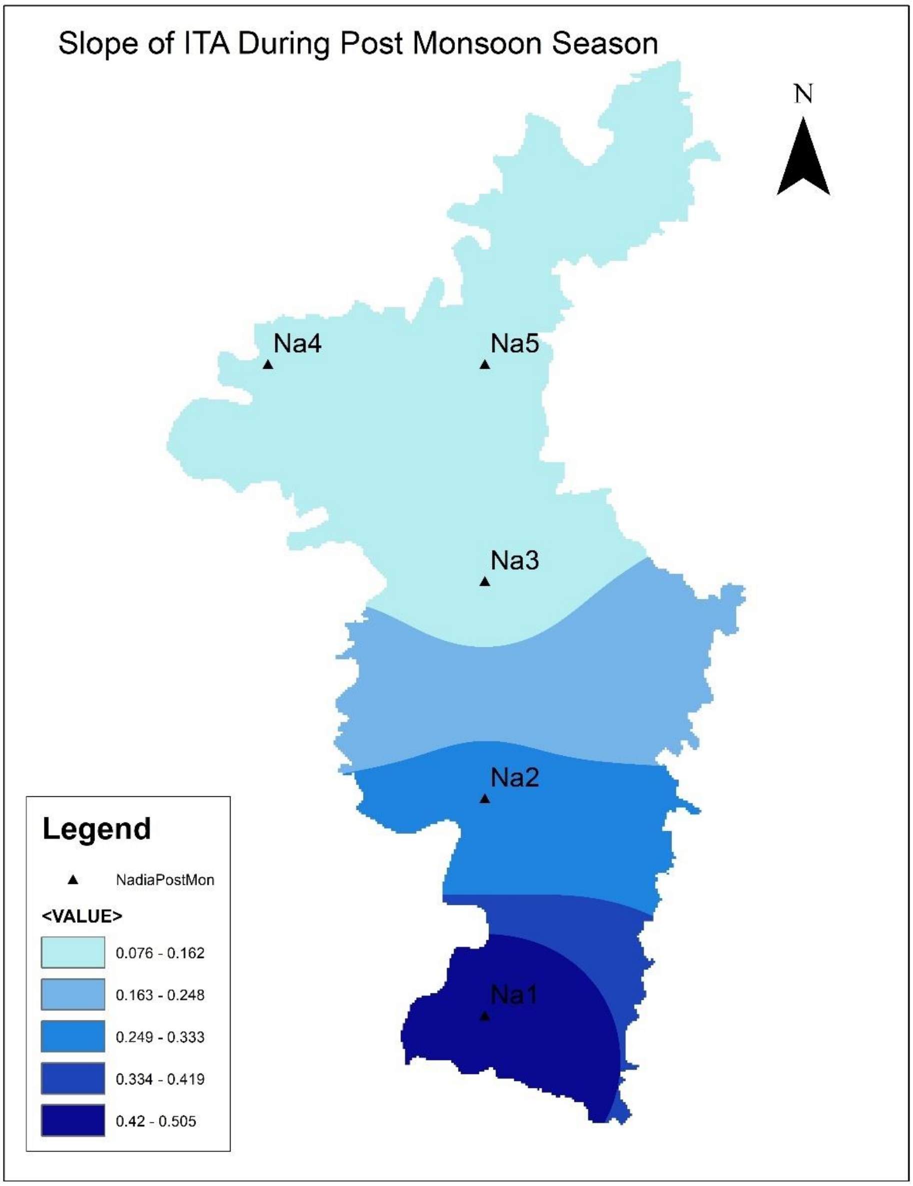


Fig. 4.13.19 ITA Slope Variation in Nadia During Post Monsoon Season

Trend Analysis Curves for Post Monsoon Season:

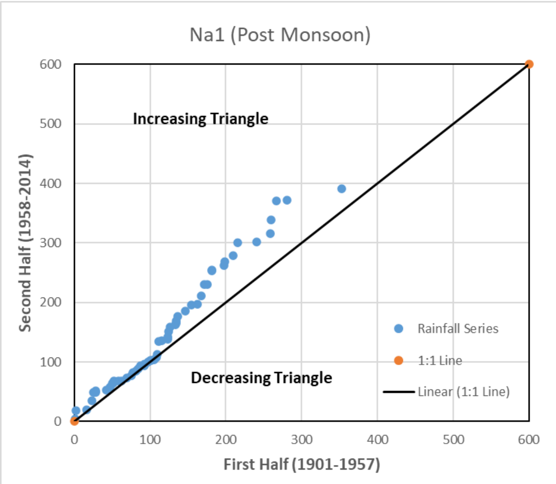


Fig 4.13.20 ITA plot for Na1 in Post Monsoon

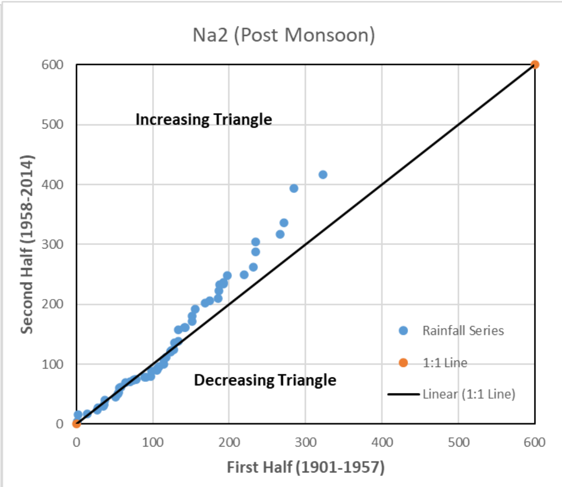


Fig 4.13.21 ITA plot for Na2 in Post Monsoon

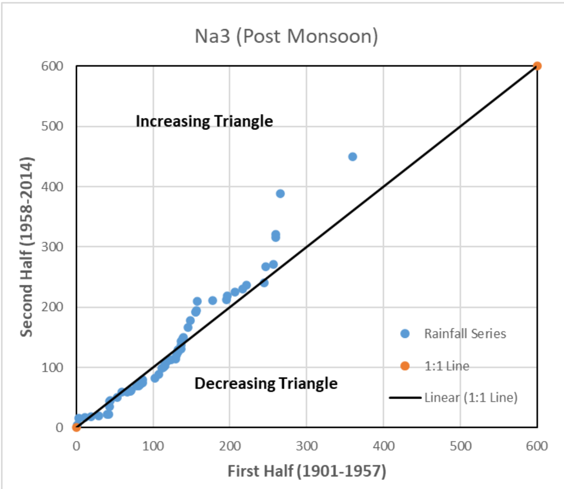


Fig 4.13.22 ITA plot for Na3 in Post Monsoon

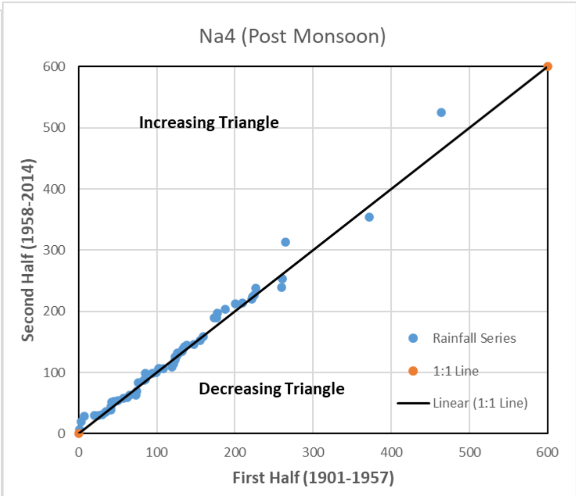


Fig 4.13.23 ITA plot for Na4 in Post Monsoon

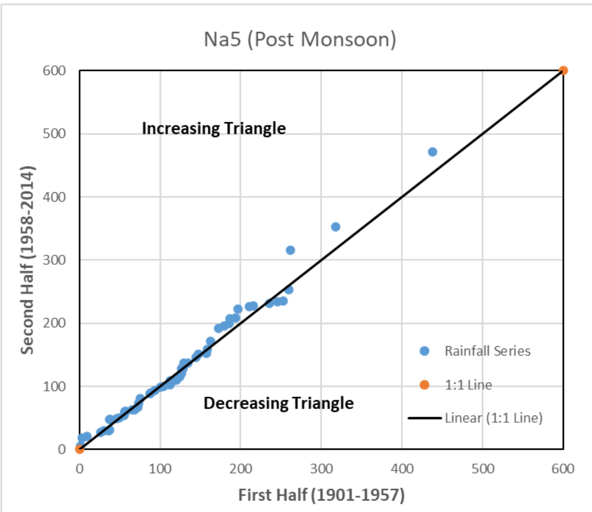


Fig 4.13.24 ITA plot for Na5 in Post Monsoon

4.14 Purulia:

For Winter Season, following are the Statistical Parameters:

Table 105

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purulia	Pr1	82	86.5	22.75	35.397	36.671	1067.775	2.488	10.134
Purulia	Pr2	83	86.25	23	37.911	38.286	1309.162	2.029	5.493
Purulia	Pr3	84	86.5	23	36.521	37.597	1293.518	2.122	6.182
Purulia	Pr4	85	86	23.25	39.937	40.855	1408.851	1.801	3.273
Purulia	Pr5	86	86.25	23.25	38.996	37.111	1205.094	1.734	3.334
Purulia	Pr6	87	86.5	23.25	35.360	35.081	1143.243	1.656	3.161
Purulia	Pr7	88	86.75	23.25	38.681	38.353	1382.602	1.497	2.065
Purulia	Pr8	89	86.5	23.5	33.016	32.632	945.973	1.849	4.173
Purulia	Pr9	90	86.75	23.5	33.231	33.842	1017.097	2.099	6.285

For Winter Season, following are the Trend Parameters:

Table 106

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purulia	Pr1	82	86.5	22.75	-0.271	0.016	0.965	-0.031	0.031	-0.041	0.041
Purulia	Pr2	83	86.25	23	-0.226	0.015	0.972	-0.029	0.029	-0.038	0.038
Purulia	Pr3	84	86.5	23	-0.084	0.012	0.980	-0.024	0.024	-0.032	0.032
Purulia	Pr4	85	86	23.25	-0.317	0.015	0.975	-0.030	0.030	-0.039	0.039
Purulia	Pr5	86	86.25	23.25	-0.245	0.012	0.981	-0.023	0.023	-0.030	0.030
Purulia	Pr6	87	86.5	23.25	-0.101	0.010	0.984	-0.020	0.020	-0.026	0.026
Purulia	Pr7	88	86.75	23.25	-0.138	0.009	0.989	-0.018	0.018	-0.024	0.024
Purulia	Pr8	89	86.5	23.5	-0.193	0.007	0.992	-0.013	0.013	-0.017	0.017
Purulia	Pr9	90	86.75	23.5	-0.141	0.012	0.978	-0.023	0.023	-0.030	0.030

Trend Analysis Curves for Winter Season:

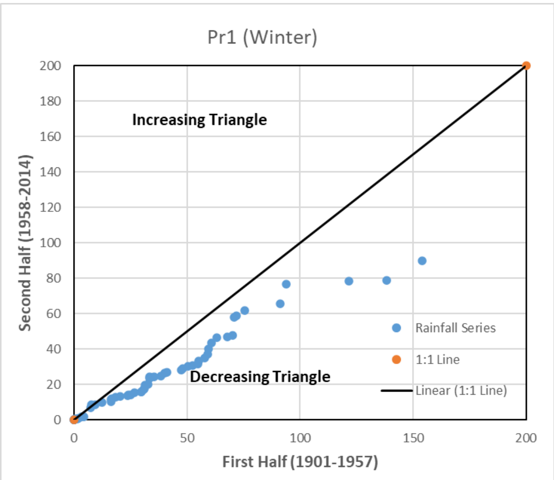


Fig 4.14.1 ITA plot for Pr1 in Winter

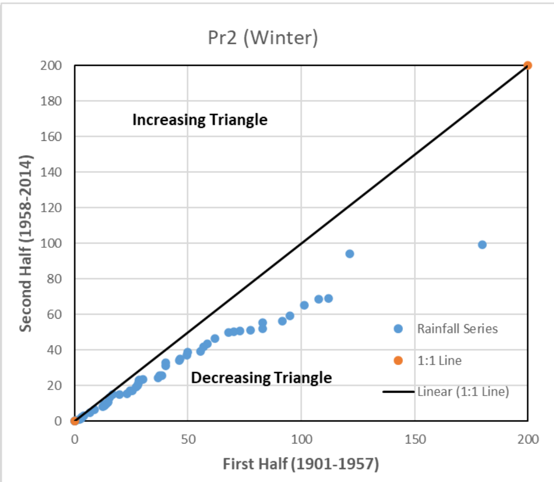


Fig 4.14.2 ITA plot for Pr2 in Winter

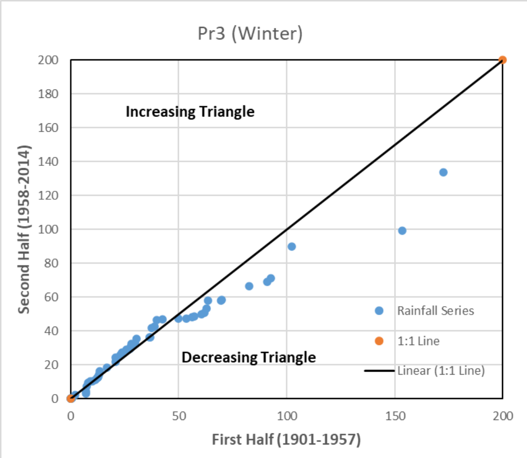


Fig 4.14.3 ITA plot for Pr3 in Winter

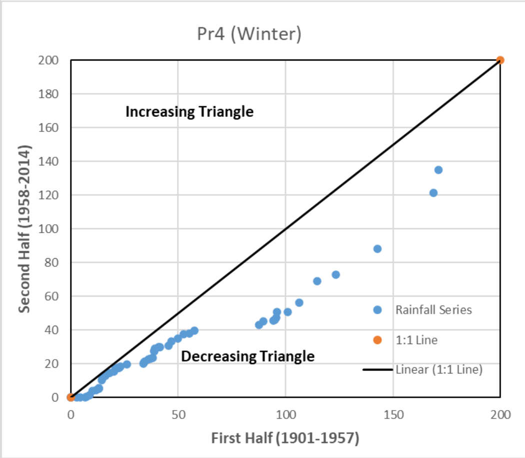


Fig 4.14.4 ITA plot for Pr4 in Winter

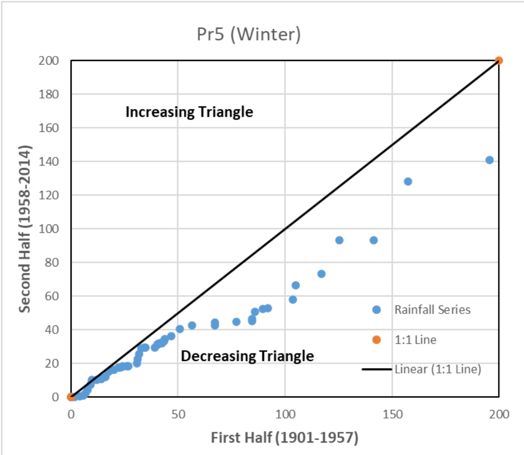


Fig 4.14.5 ITA plot for Pr5 in Winter

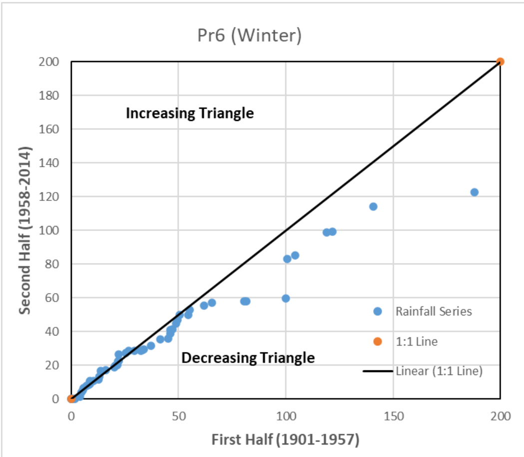


Fig 4.14.6 ITA plot for Pr6 in Winter

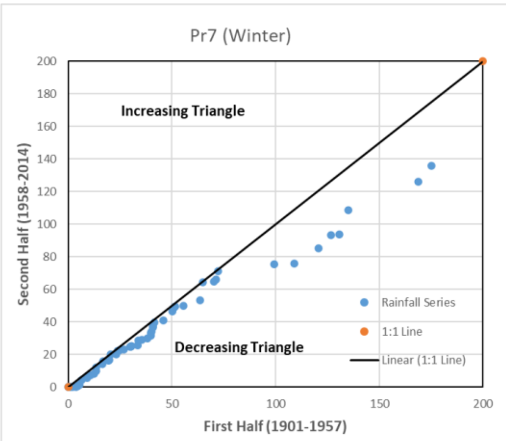


Fig 4.14.7 ITA plot for Pr7 in Winter

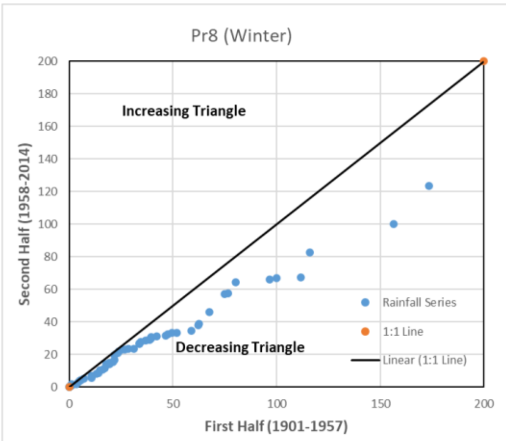


Fig 4.14.8 ITA plot for Pr8 in Winter

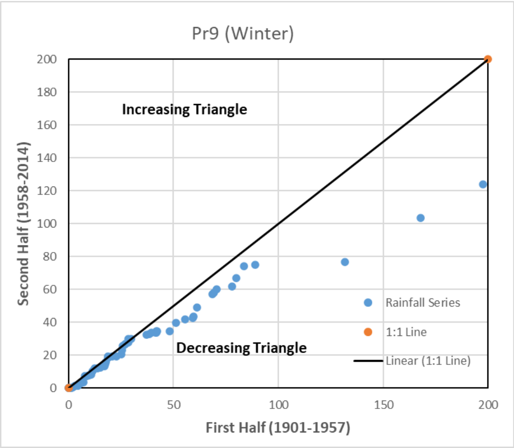


Fig 4.14.9 ITA plot for Pr9 in Winter

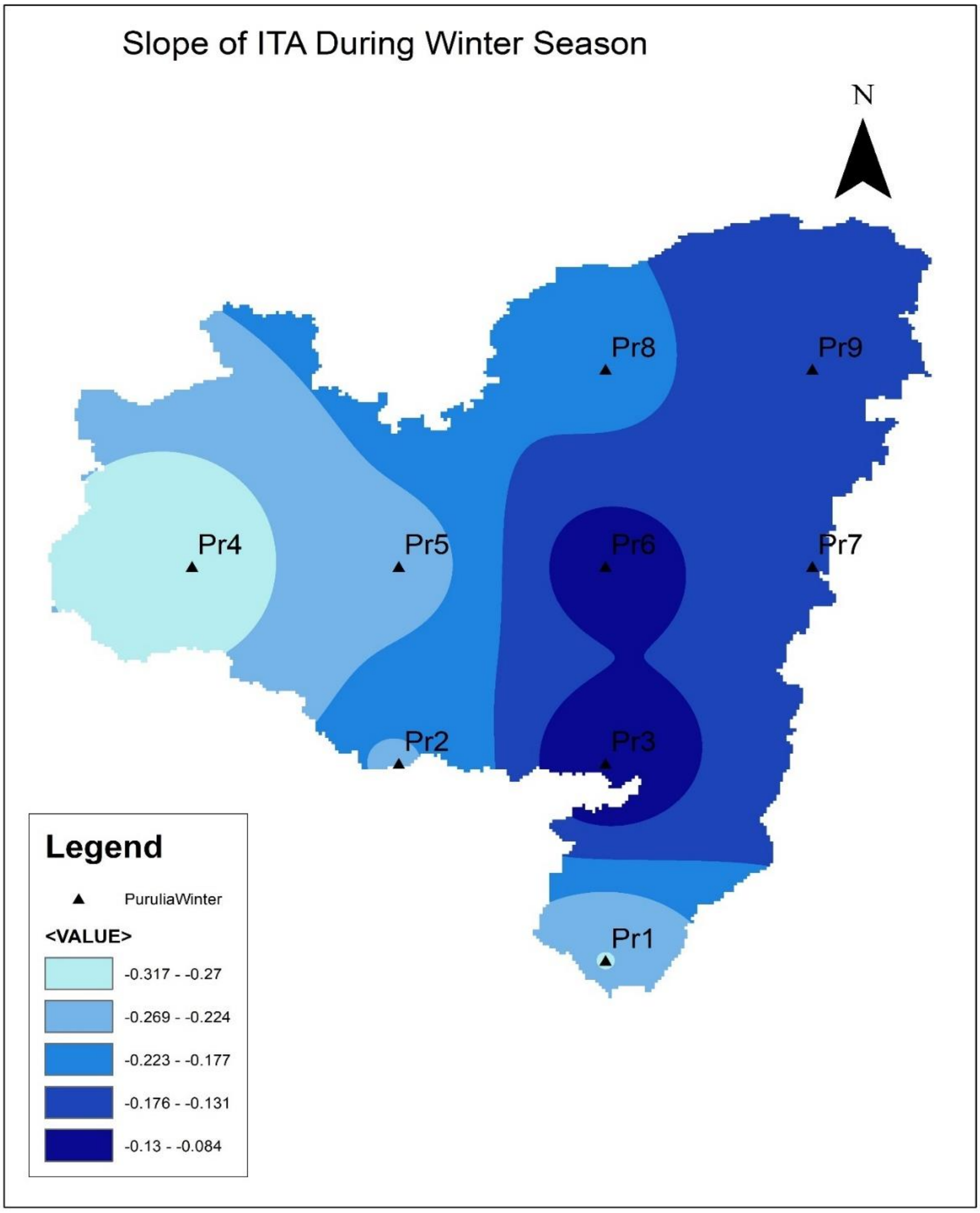


Fig. 4.14.10 ITA Slope Variation in Purulia During Winter Season

For Pre-Monsoon Season, following are the Statistical Parameters:

Table 107

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purulia	Pr1	82	86.5	22.75	151.525	68.017	4486.378	0.507	-0.154
Purulia	Pr2	83	86.25	23	119.793	56.159	3054.217	0.492	-0.064
Purulia	Pr3	84	86.5	23	142.567	62.928	3699.936	0.580	0.539
Purulia	Pr4	85	86	23.25	107.652	53.077	2725.228	0.374	-0.412
Purulia	Pr5	86	86.25	23.25	115.776	51.328	2546.911	0.343	-0.290
Purulia	Pr6	87	86.5	23.25	131.454	61.001	3297.069	0.334	-0.125
Purulia	Pr7	88	86.75	23.25	150.533	79.702	5824.654	0.751	0.658
Purulia	Pr8	89	86.5	23.5	108.529	54.435	2755.662	0.424	-0.351
Purulia	Pr9	90	86.75	23.5	127.341	61.019	3499.830	0.155	-0.690

For Pre-Monsoon Season, following are the Trend Parameters:

Table 108

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purulia	Pr1	82	86.5	22.75	0.099	0.017	0.988	-0.034	0.034	-0.045	0.045
Purulia	Pr2	83	86.25	23	-0.003	0.012	0.991	-0.024	0.024	-0.032	0.032
Purulia	Pr3	84	86.5	23	0.347	0.027	0.967	-0.052	0.052	-0.069	0.069
Purulia	Pr4	85	86	23.25	0.091	0.013	0.989	-0.025	0.025	-0.033	0.033
Purulia	Pr5	86	86.25	23.25	0.102	0.013	0.987	-0.026	0.026	-0.034	0.034
Purulia	Pr6	87	86.5	23.25	0.379	0.039	0.924	-0.077	0.077	-0.101	0.101
Purulia	Pr7	88	86.75	23.25	0.342	0.041	0.952	-0.079	0.079	-0.104	0.104
Purulia	Pr8	89	86.5	23.5	0.148	0.029	0.946	-0.058	0.058	-0.076	0.076
Purulia	Pr9	90	86.75	23.5	0.321	0.024	0.970	-0.048	0.048	-0.063	0.063

Trend Analysis Curves for Pre-Monsoon Season:

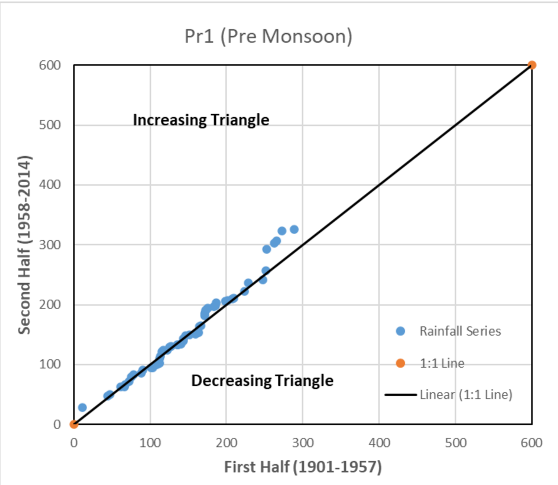


Fig 4.14.11 ITA plot for Pr1 in Pre-Monsoon

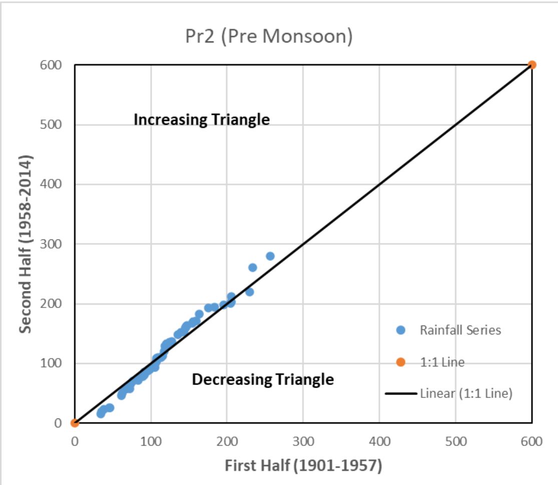


Fig 4.14.12 ITA plot for Pr2 in Pre-Monsoon

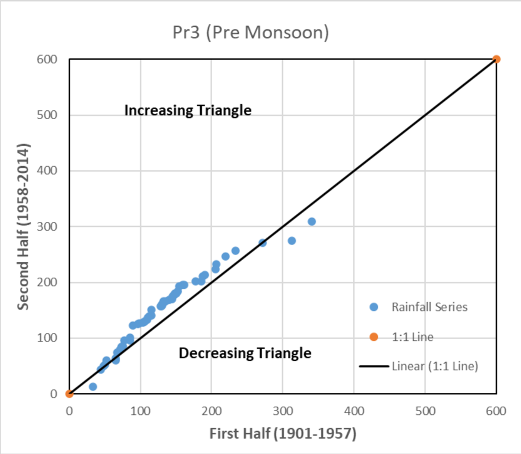


Fig 4.14.13 ITA plot for Pr3 in Pre-Monsoon

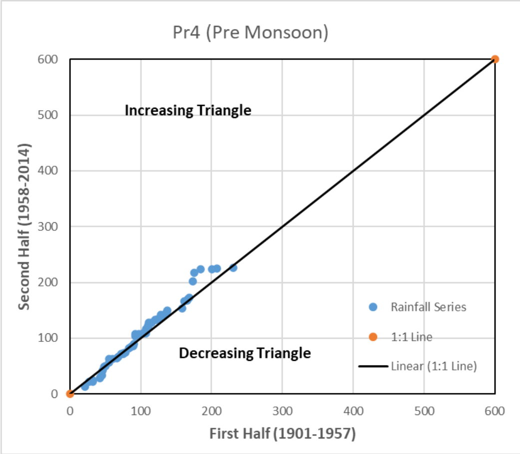


Fig 4.14.14 ITA plot for Pr4 in Pre-Monsoon

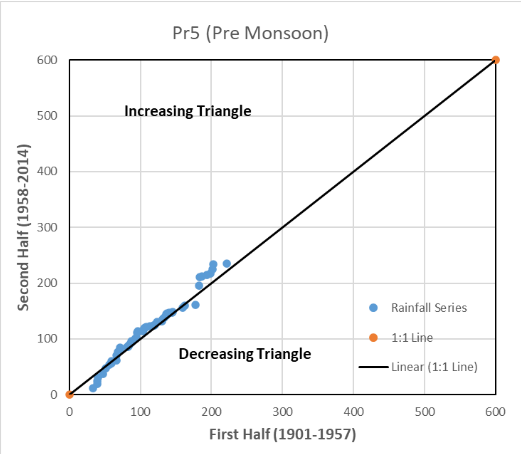


Fig 4.14.15 ITA plot for Pr5 in Pre-Monsoon

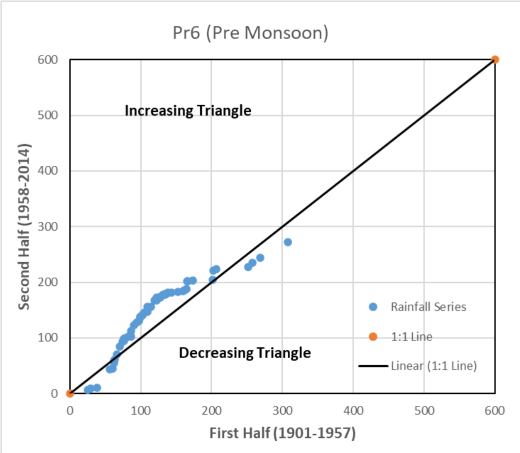


Fig 4.14.16 ITA plot for Pr6 in Pre-Monsoon

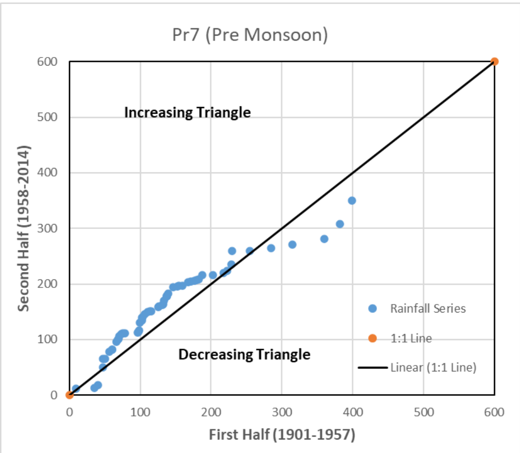


Fig 4.14.17 ITA plot for Pr7 in Pre-Monsoon

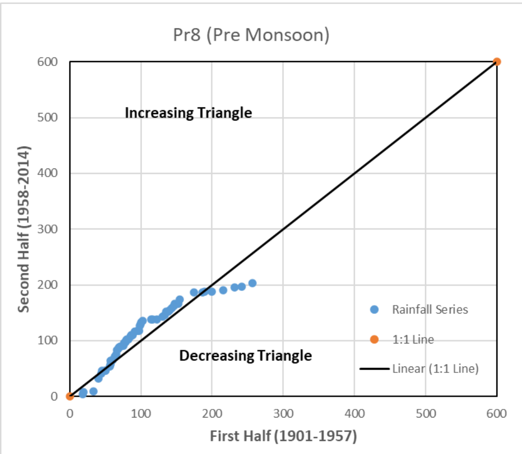


Fig 4.14.18 ITA plot for Pr8 in Pre-Monsoon

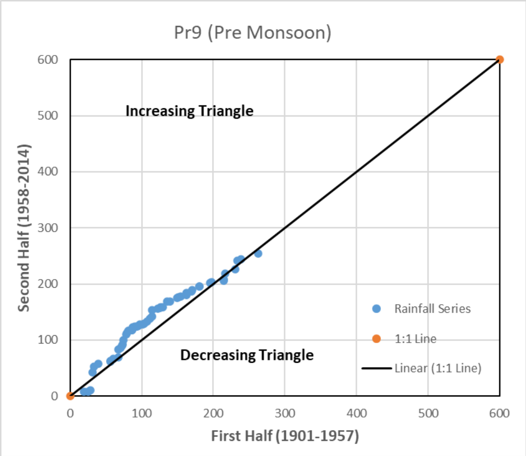


Fig 4.14.19 ITA plot for Pr9 in Pre-Monsoon

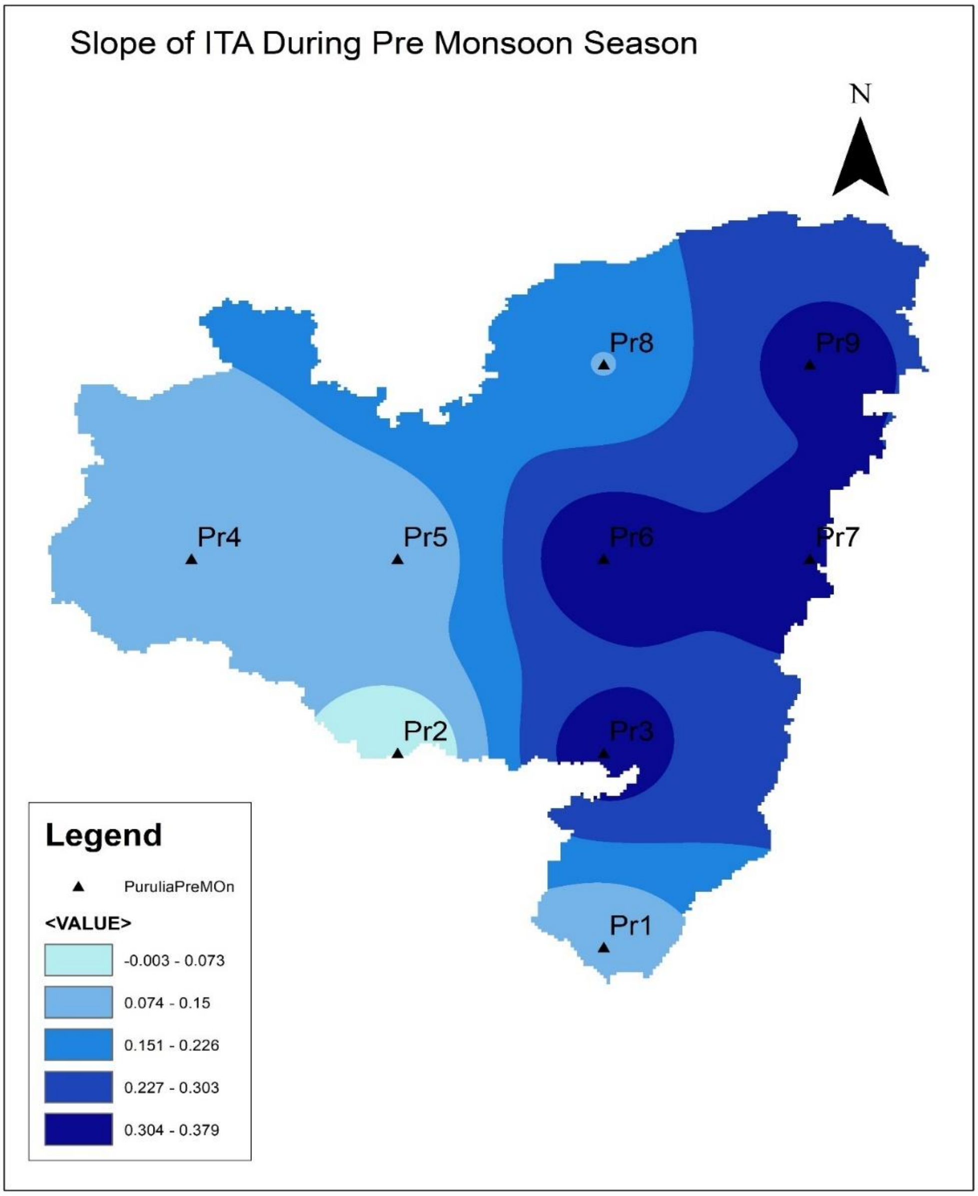


Fig. 4.14.20 ITA Slope Variation in Purulia During Pre-Monsoon Season

For Monsoon Season, following are the Statistical Parameters:

Table 109

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purulia	Pr1	82	86.5	22.75	1065.235	224.664	45124.299	0.138	-0.304
Purulia	Pr2	83	86.25	23	1080.075	240.255	56151.230	0.314	0.121
Purulia	Pr3	84	86.5	23	1058.064	240.137	52112.611	0.052	-0.132
Purulia	Pr4	85	86	23.25	1070.903	219.698	42554.515	0.146	0.430
Purulia	Pr5	86	86.25	23.25	1075.476	212.139	43108.917	0.353	-0.013
Purulia	Pr6	87	86.5	23.25	1064.578	243.192	53254.711	0.710	0.787
Purulia	Pr7	88	86.75	23.25	1108.568	278.792	72645.851	1.222	2.724
Purulia	Pr8	89	86.5	23.5	1032.273	243.419	53697.169	0.856	1.736
Purulia	Pr9	90	86.75	23.5	1042.637	218.459	44796.870	0.318	0.120

For Monsoon Season, following are the Trend Parameters:

Table 110

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho y_1 y_2$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purulia	Pr1	82	86.5	22.75	1.717	0.083	0.975	-0.163	0.163	-0.214	0.214
Purulia	Pr2	83	86.25	23	-0.114	0.076	0.982	-0.148	0.148	-0.195	0.195
Purulia	Pr3	84	86.5	23	2.080	0.078	0.980	-0.153	0.153	-0.201	0.201
Purulia	Pr4	85	86	23.25	-0.565	0.050	0.990	-0.099	0.099	-0.130	0.130
Purulia	Pr5	86	86.25	23.25	-0.279	0.064	0.983	-0.126	0.126	-0.166	0.166
Purulia	Pr6	87	86.5	23.25	1.466	0.132	0.946	-0.258	0.258	-0.339	0.339
Purulia	Pr7	88	86.75	23.25	1.167	0.064	0.990	-0.125	0.125	-0.164	0.164
Purulia	Pr8	89	86.5	23.5	1.251	0.104	0.966	-0.204	0.204	-0.269	0.269
Purulia	Pr9	90	86.75	23.5	1.386	0.055	0.988	-0.108	0.108	-0.142	0.142

Trend Analysis Curves for Monsoon Season:

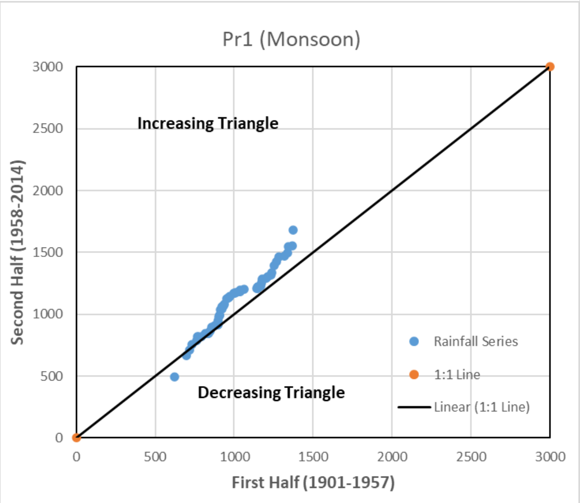


Fig 4.14.21 ITA plot for Pr1 in Monsoon

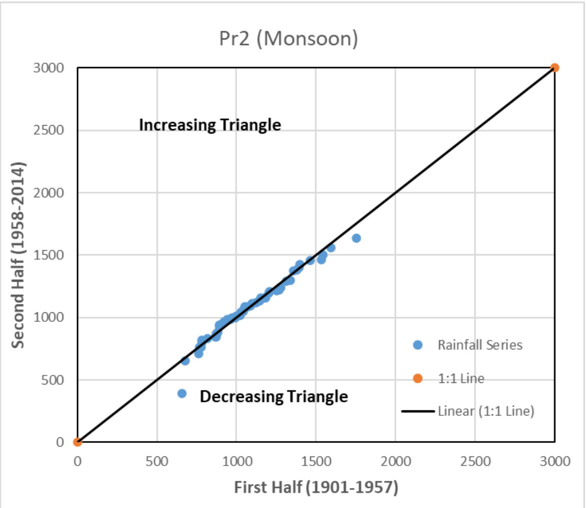


Fig 4.14.22 ITA plot for Pr2 in Monsoon

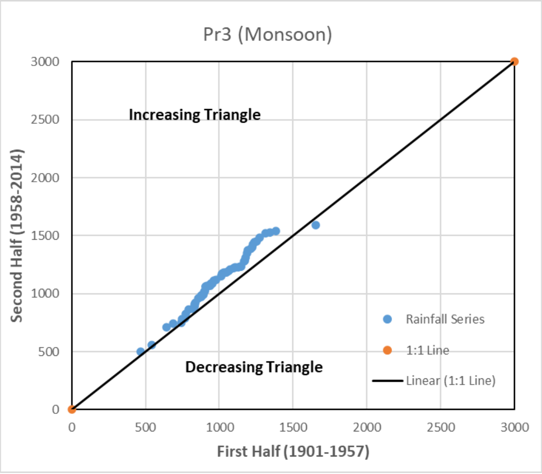


Fig 4.14.23 ITA plot for Pr3 in Monsoon

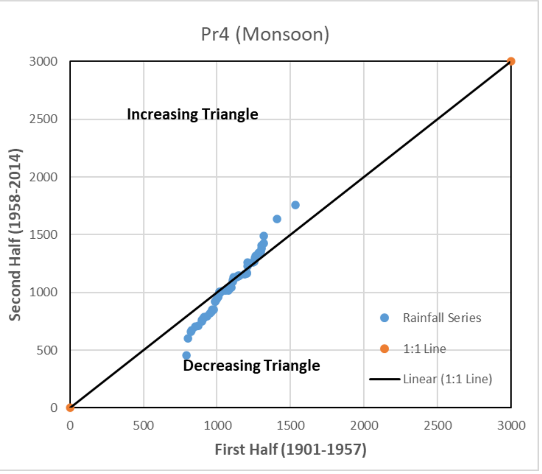


Fig 4.14.24 ITA plot for Pr4 in Monsoon

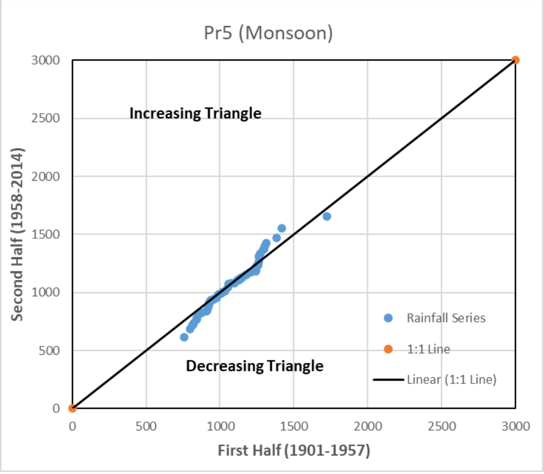


Fig 4.14.25 ITA plot for Pr5 in Monsoon

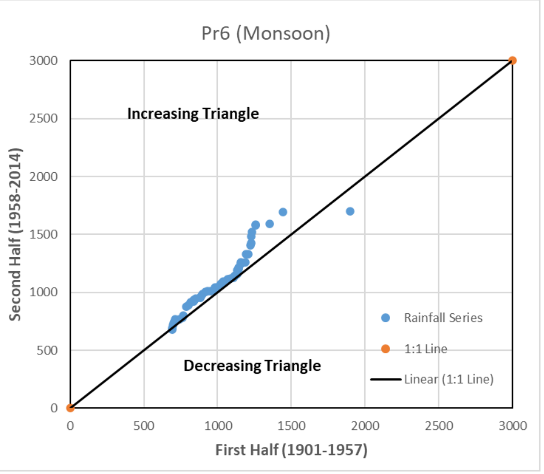


Fig 4.14.26 ITA plot for Pr6 in Monsoon

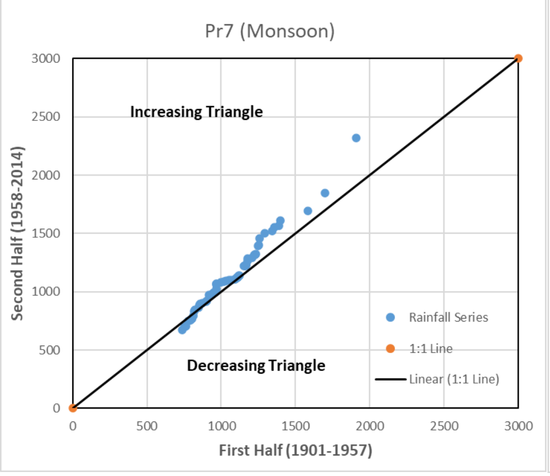


Fig 4.14.27 ITA plot for Pr7 in Monsoon

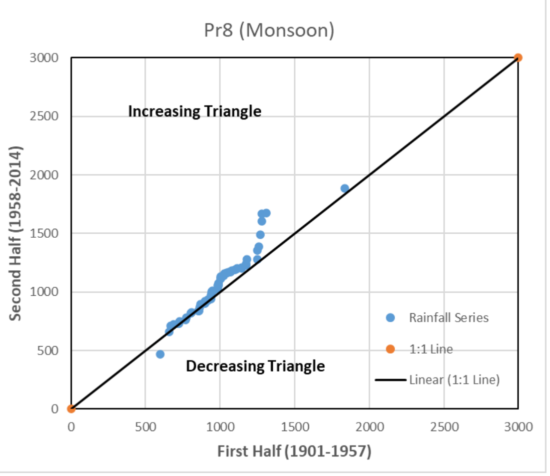


Fig 4.14.28 ITA plot for Pr8 in Monsoon

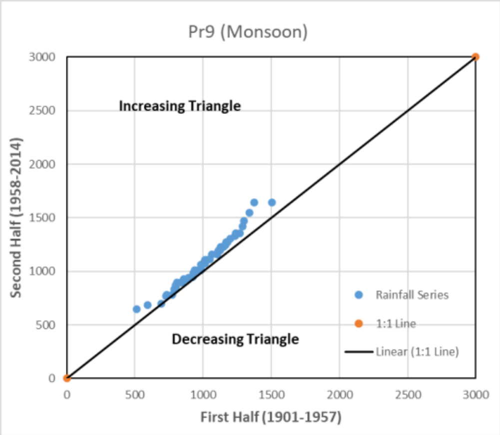


Fig 4.14.29 ITA plot for Pr9 in Monsoon

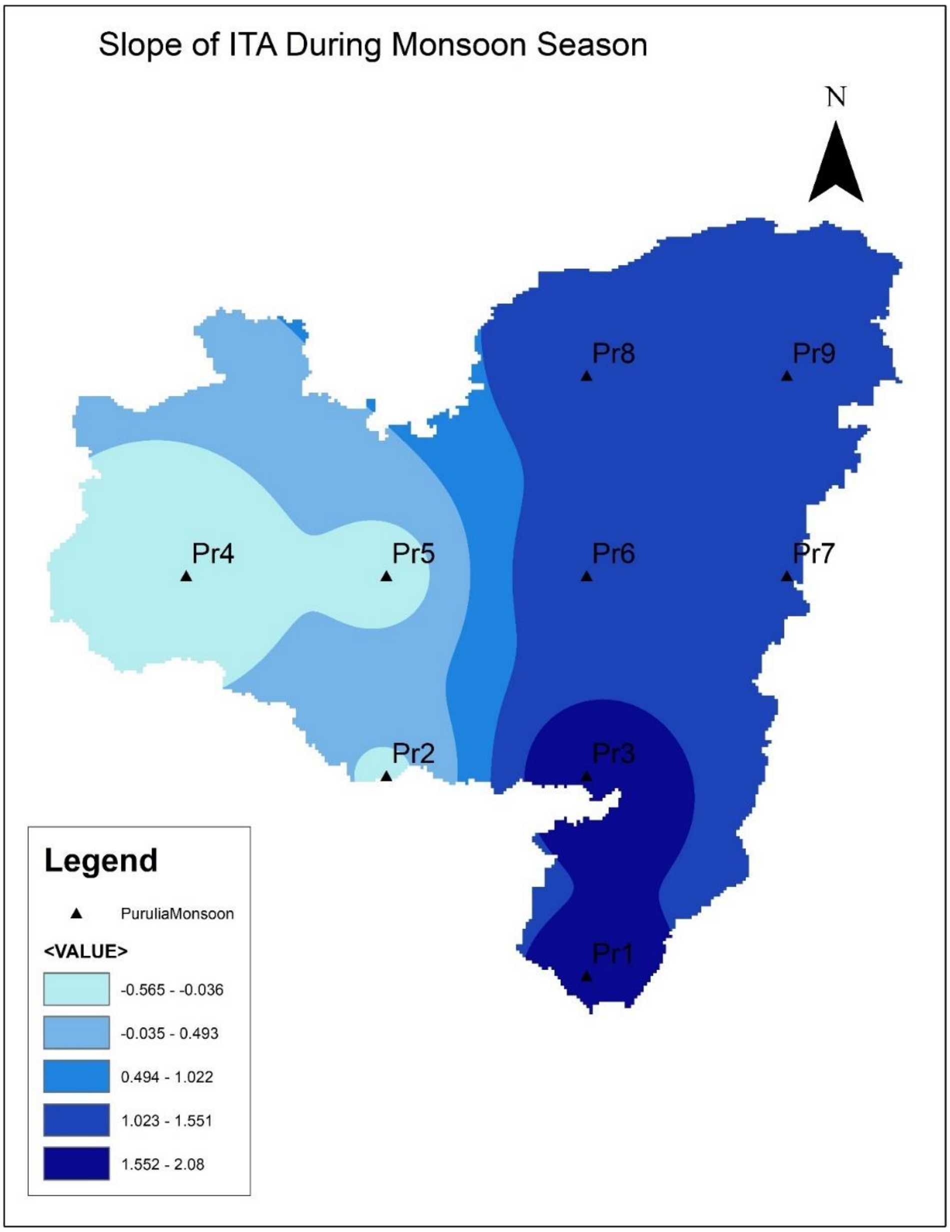


Fig. 4.14.30 ITA Slope Variation in Purulia During Monsoon Season

For Post Monsoon Season, following are the Statistical Parameters:

Table 111

District	Grid No.	Serial No.	Longitude	Latitude	Mean	Std. Deviation(SD)	Coeff. Of Variation (CV)	Skewness (CS)	Kurtosis (CK)
Purulia	Pr1	82	86.5	22.75	108.461	86.019	6812.024	1.845	4.891
Purulia	Pr2	83	86.25	23	104.233	78.719	5993.309	1.429	2.209
Purulia	Pr3	84	86.5	23	113.694	89.830	7767.985	1.617	3.340
Purulia	Pr4	85	86	23.25	109.248	81.009	6283.904	1.185	1.204
Purulia	Pr5	86	86.25	23.25	110.405	80.684	6174.984	1.268	1.791
Purulia	Pr6	87	86.5	23.25	109.215	81.157	6265.680	1.395	2.059
Purulia	Pr7	88	86.75	23.25	119.185	86.338	7111.066	1.424	3.132
Purulia	Pr8	89	86.5	23.5	101.890	79.820	6153.773	1.230	1.422
Purulia	Pr9	90	86.75	23.5	107.063	79.619	6062.495	1.363	2.153

For Post Monsoon Season, following are the Trend Parameters:

Table 112

District	Grid No.	Serial No.	Longitude	Latitude	Slope(S)	Slope Std. Deviation (σ)	Correlation ($\rho_{y_1y_2}$)	Sig. Level 5%(Lower)	Sig. Level 5%(Upper)	Sig. Level 1%(Lower)	Sig. Level 1%(Upper)
Purulia	Pr1	82	86.5	22.75	0.111	0.041	0.958	-0.080	0.080	-0.105	0.105
Purulia	Pr2	83	86.25	23	-0.038	0.021	0.986	-0.042	0.042	-0.055	0.055
Purulia	Pr3	84	86.5	23	0.257	0.028	0.982	-0.055	0.055	-0.072	0.072
Purulia	Pr4	85	86	23.25	0.103	0.031	0.972	-0.062	0.062	-0.081	0.081
Purulia	Pr5	86	86.25	23.25	0.081	0.032	0.972	-0.062	0.062	-0.081	0.081
Purulia	Pr6	87	86.5	23.25	0.432	0.025	0.983	-0.048	0.048	-0.064	0.064
Purulia	Pr7	88	86.75	23.25	0.442	0.020	0.991	-0.038	0.038	-0.050	0.050
Purulia	Pr8	89	86.5	23.5	0.292	0.022	0.986	-0.043	0.043	-0.056	0.056
Purulia	Pr9	90	86.75	23.5	0.258	0.028	0.976	-0.056	0.056	-0.073	0.073

Trend Analysis Curves for Post Monsoon Season:

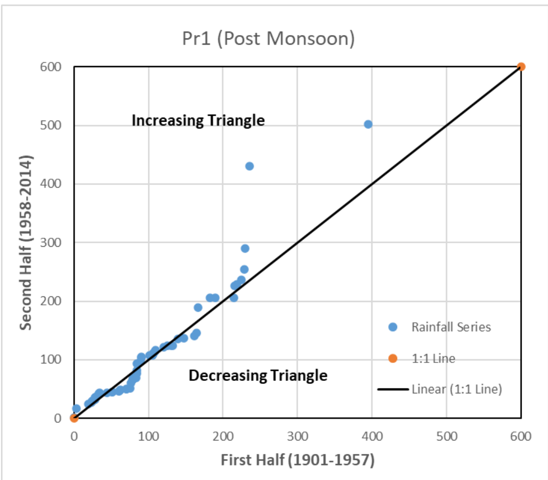


Fig 4.14.31 ITA plot for Pr1 in Post Monsoon

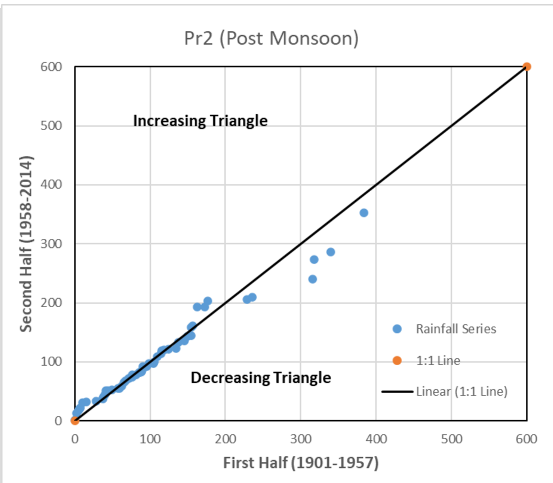


Fig 4.14.32 ITA plot for Pr2 in Post Monsoon

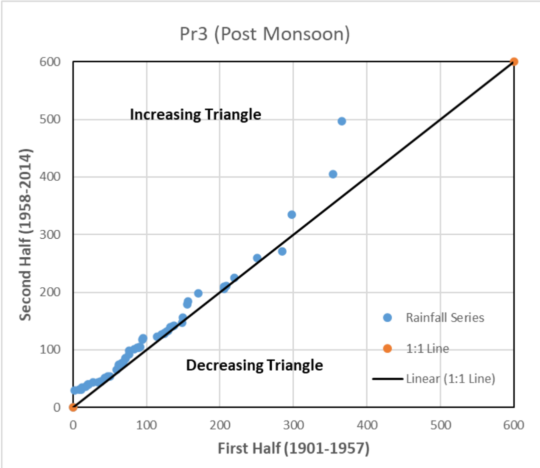


Fig 4.14.33 ITA plot for Pr3 in Post Monsoon

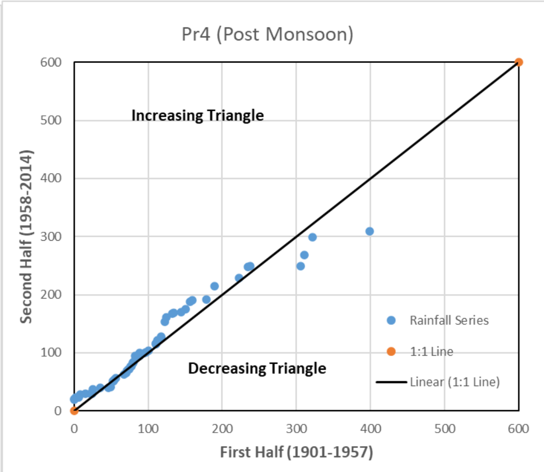


Fig 4.14.34 ITA plot for Pr4 in Post Monsoon

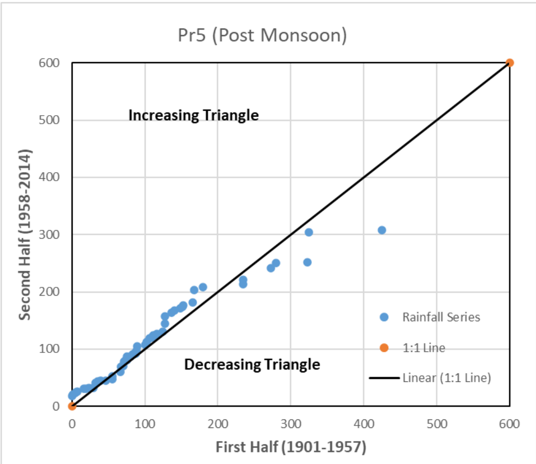


Fig 4.14.35 ITA plot for Pr5 in Post Monsoon

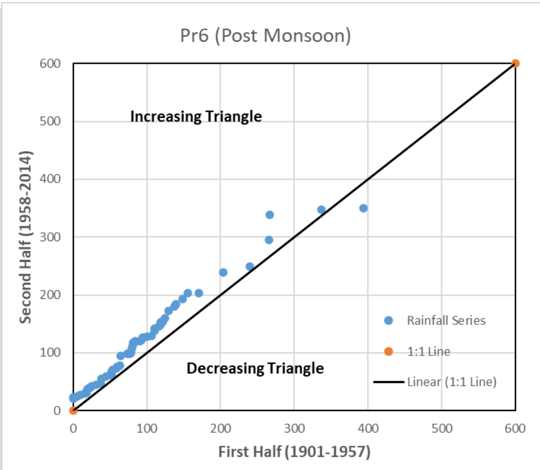


Fig 4.14.36 ITA plot for Pr6 in Post Monsoon

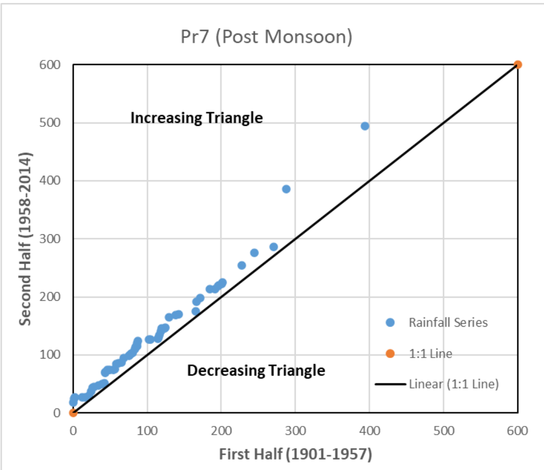


Fig 4.14.37 ITA plot for Pr7 in Post Monsoon

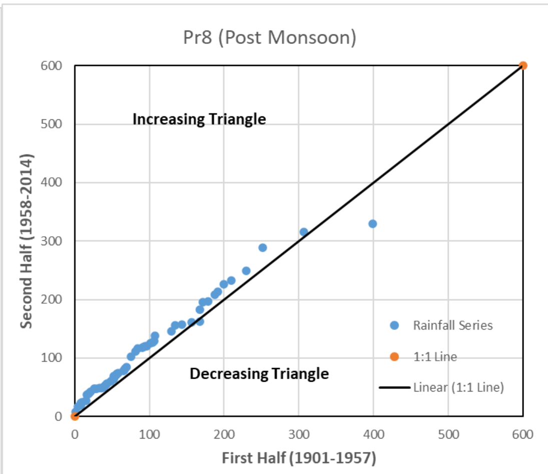


Fig 4.14.38 ITA plot for Pr8 in Post Monsoon

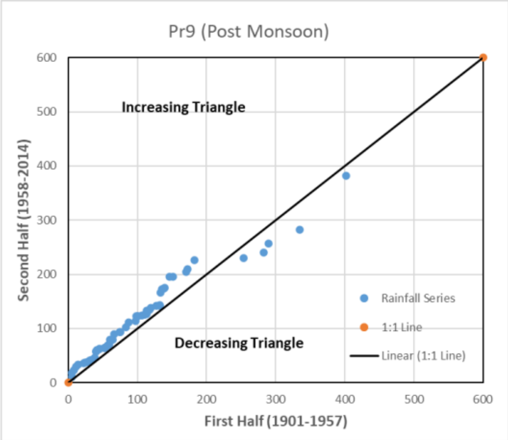


Fig 4.14.39 ITA plot for Pr9 in Post Monsoon

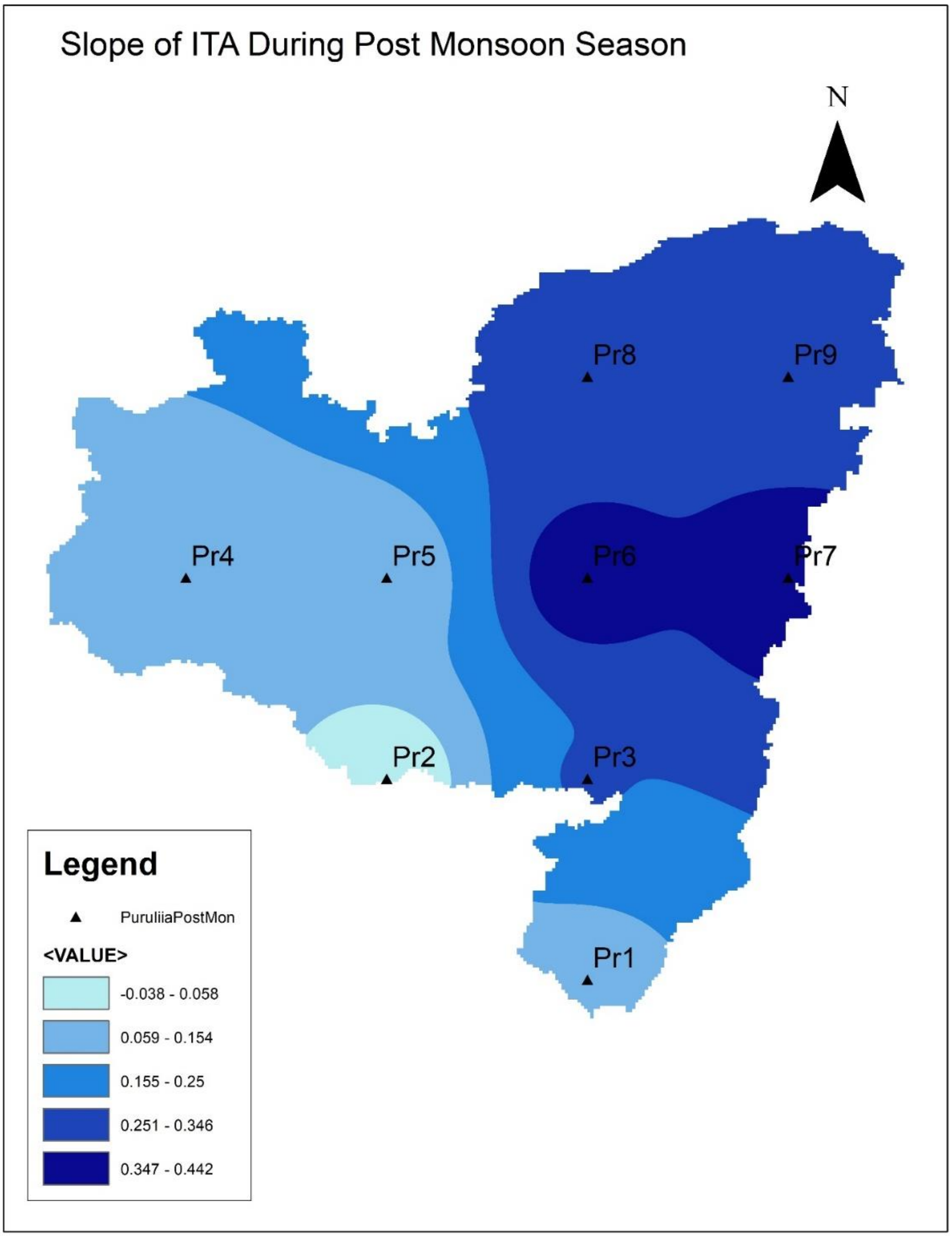


Fig. 4.14.40 ITA Slope Variation in Purulia During Post Monsoon Season

4.15 Southern West Bengal

Slope of ITA:

For Winter Season:

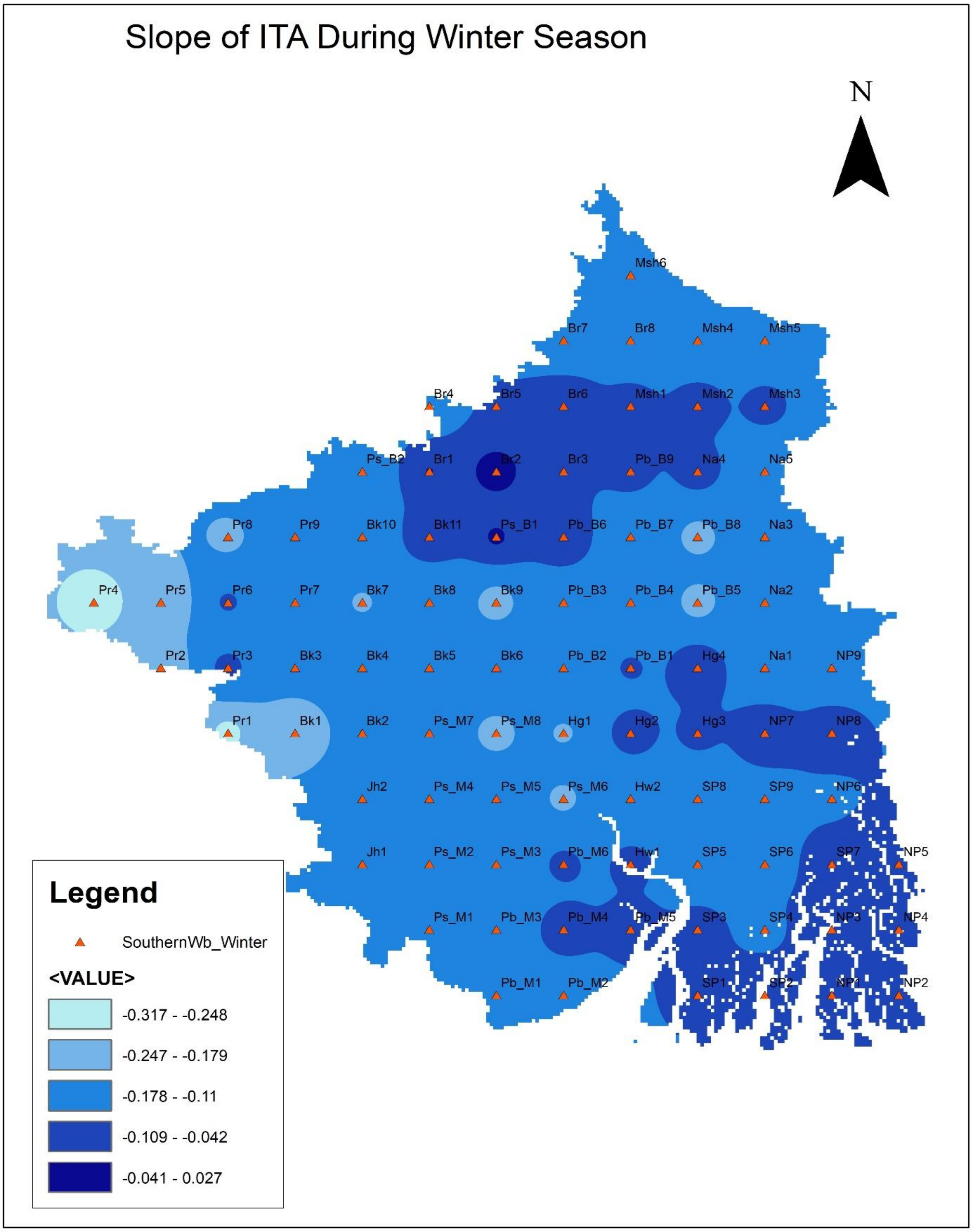


Fig. 4.15.1 ITA Slope Variation in Southern West Bengal During Winter Season

For Pre-Monsoon Season:

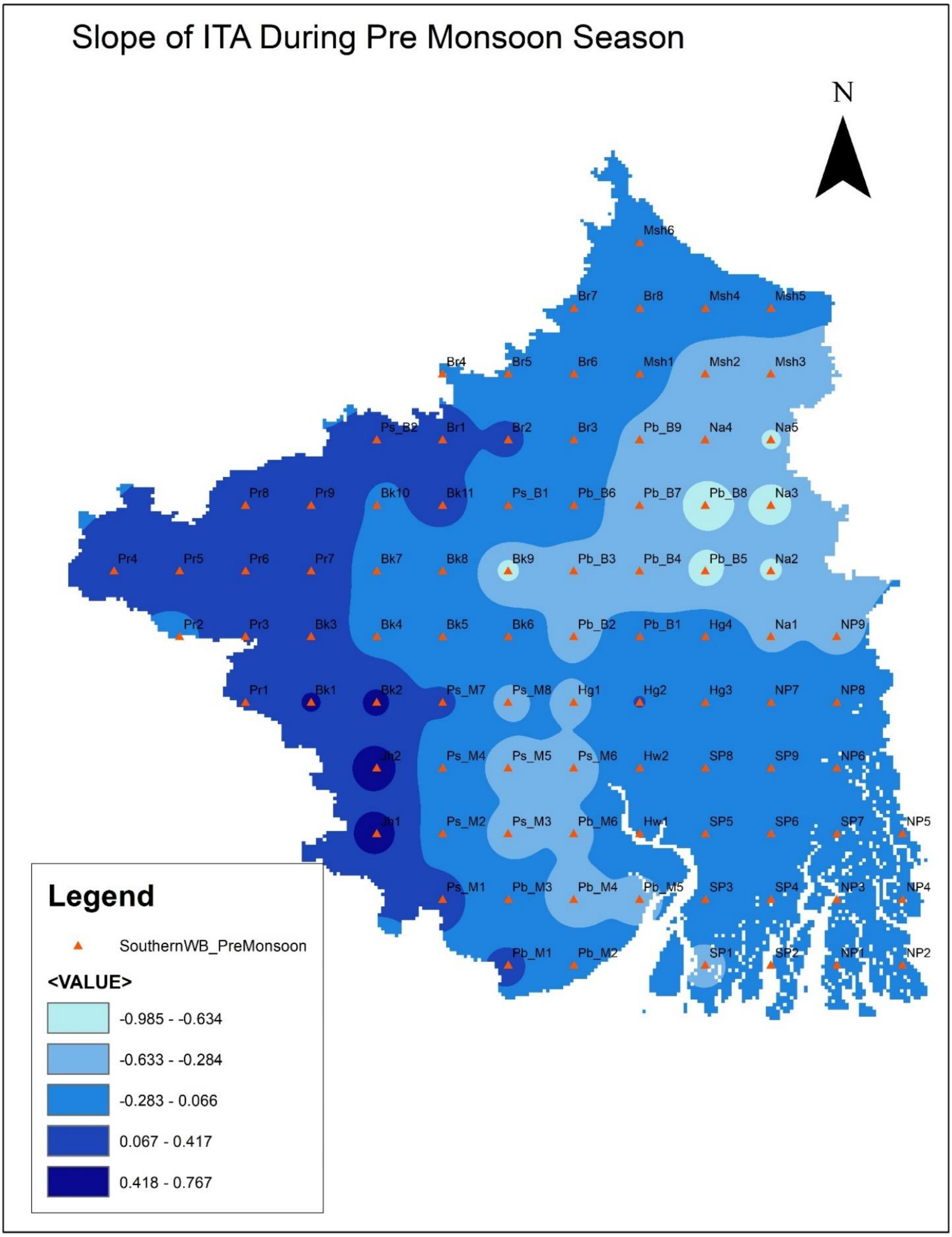


Fig. 4.15.2 ITA Slope Variation in Southern West Bengal During Pre-Monsoon Season

For Monsoon Season:

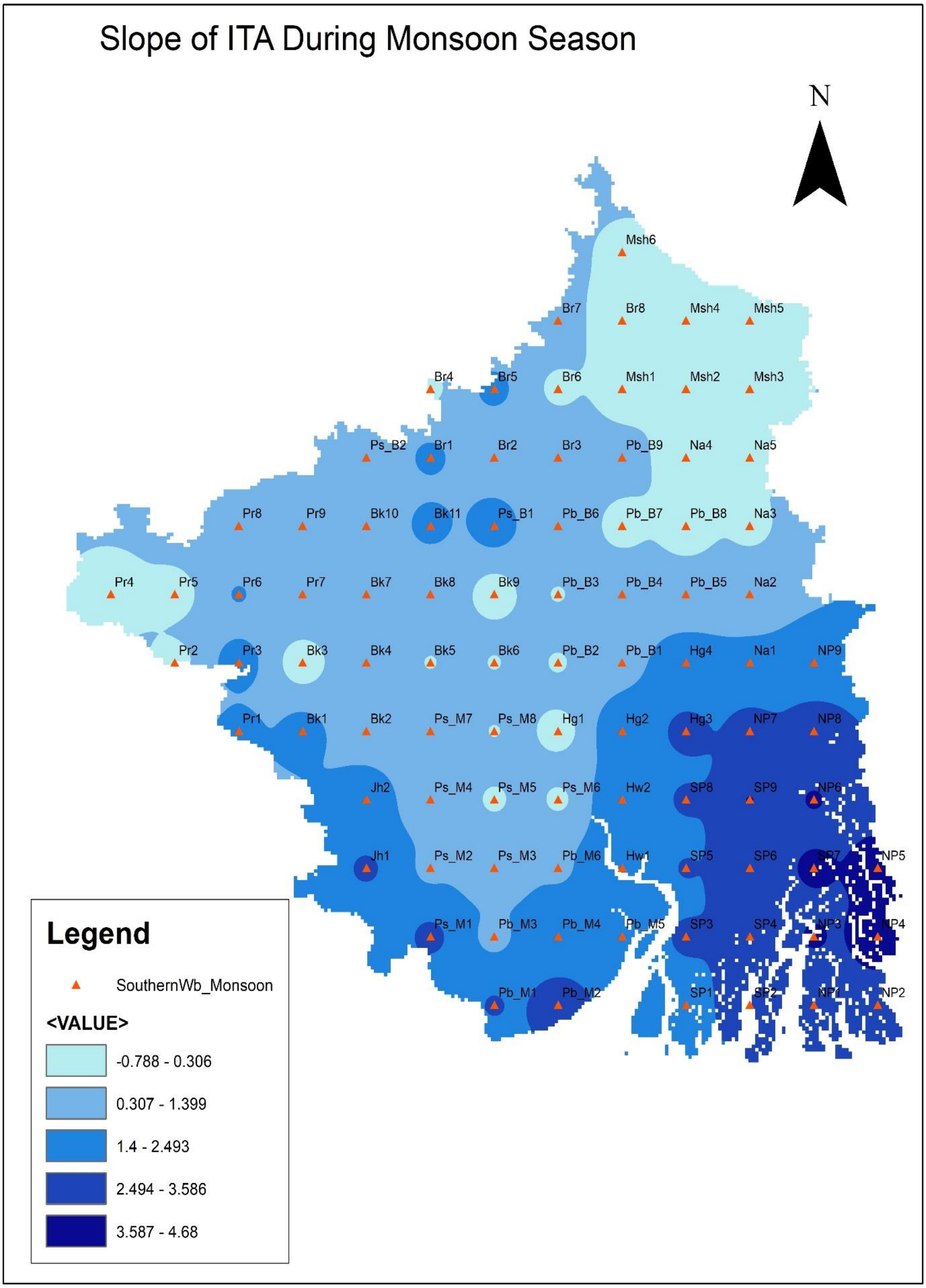


Fig. 4.15.3 ITA Slope Variation in Southern West Bengal During Monsoon Season

For Post Monsoon:

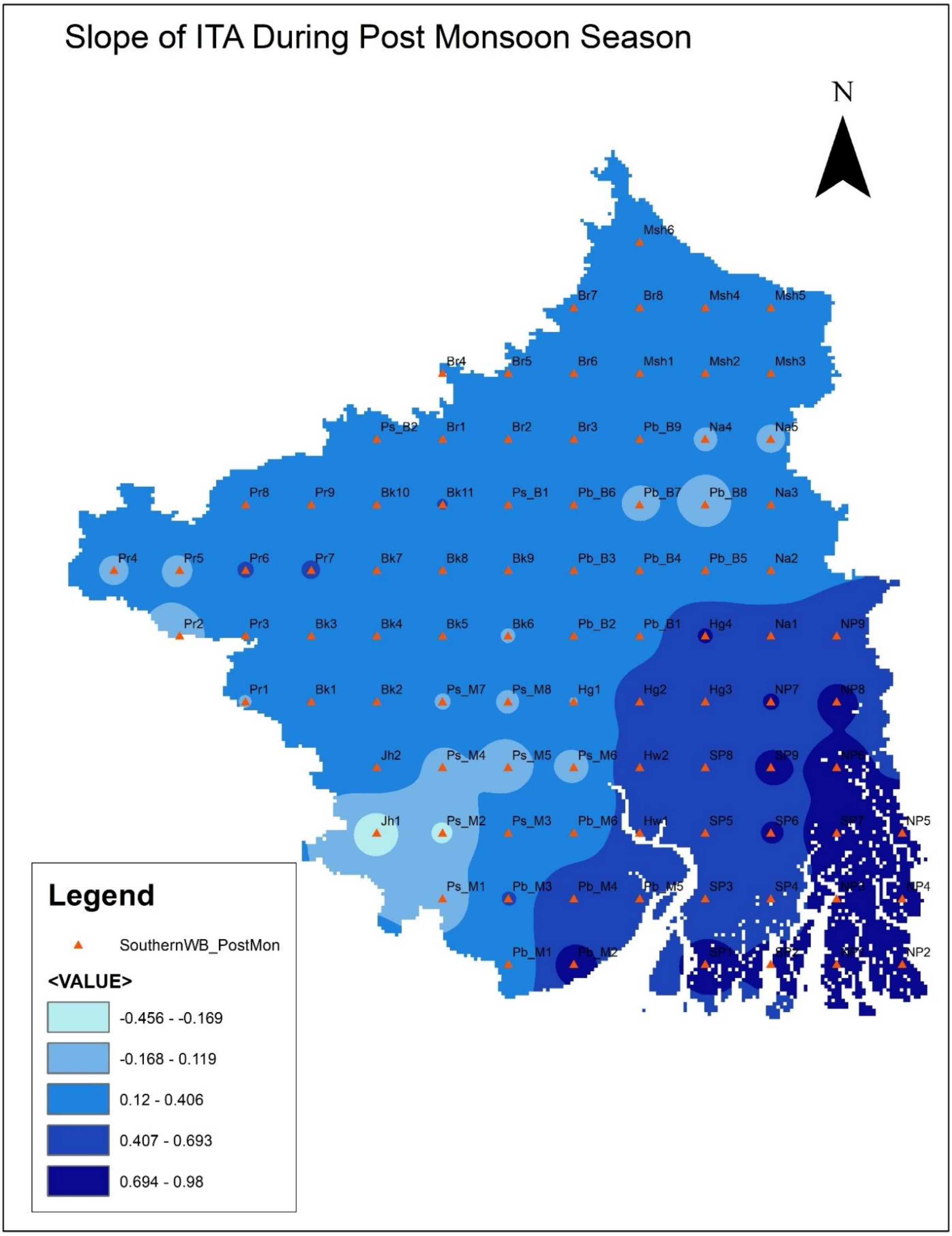


Fig. 4.15.4 ITA Slope Variation in Southern West Bengal During Post Monsoon Season

Chapter 5

Discussion:

The trends in South 24 PGS during winter rainfall using the ITA method are provided in Table 2. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 4, the result shows that slope of pre monsoon rainfall is negative for all the grids except for SP7 and SP9 and for grids SP1, SP2, SP3, SP4, SP5 trends are significant at 99% confidence level and SP8 at 95% confidence level whereas for SP6, SP7, SP9 there is no significant trend. For Monsoon season, trends using ITA method are provided in Table 6, which shows that slope of Monsoon season is throughout positive and trends in all is significant at 99% confidence. And lastly the post monsoon season, trend parameters are shown in Table 8, which shows positive slope for all points and significant trend at 99% confidence.

The trends in North 24 PGS during winter rainfall using the ITA method are provided in Table 10. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 12, the result shows that slope of pre monsoon rainfall is negative for all the grids except for NP4, NP5, NP6 and for grids NP1, NP9 trends are significant at 99% confidence level whereas for rest there is no significant trend. For Monsoon season, trends using ITA method are provided in Table 14, which shows that slope of Monsoon season is throughout positive and trends in all is significant at 99% confidence. And lastly the post monsoon season, trend parameters are shown in Table 16, which shows positive slope for all points and significant trend at 99% confidence.

The trends in Purba Medinipur during winter rainfall using the ITA method are provided in Table 18. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 20, the result shows that slope of pre monsoon rainfall is negative for all the grids except for Pb_M1 and for all grids trends are significant at 99% confidence level. For Monsoon season, trends using ITA method are provided in Table 22, which shows that slope of Monsoon season is throughout positive and trends in all is significant at 99% confidence. And lastly the post monsoon season, trend parameters are shown in Table 24, which shows positive slope for all points and significant trend at 99% confidence.

The trends in Pashchim Medinipur during winter rainfall using the ITA method are provided in Table 26. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 28, the result shows that slope of pre monsoon rainfall is negative for all the grids except for Ps_M1 and Ps_M7 and for all grids trends are significant at 99% confidence level except for Ps_M2 which shows no significant trend. For Monsoon season, trends using ITA method are provided in Table 30, which shows that slope of Monsoon season is positive for all except for Ps_M5 and Ps_M6 which have negative slope and trends in all is significant at 99% confidence except for Ps_M5, Ps_M6 and Ps_M8 with no trends. And lastly the post monsoon season, trend parameters are shown in Table 32, which shows positive slope for Ps_M3, Ps_M4, Ps_M7 and Ps_M8 while rest of the grids have negative slope and grids Ps_M2, Ps_M3, Ps_M5, Ps_M7, Ps_M8 shows significant trend at 99% confidence and rest have no significant trends.

The in trends Jhargram during winter rainfall using the ITA method are provided in Table 34. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 36, the result shows that slope of pre monsoon rainfall is positive for all the grids and trends are significant at 99% confidence level. For Monsoon season, trends using ITA method are provided in Table 38, which shows that slope of Monsoon season is throughout positive and trends in all is significant at 99% confidence. And lastly the post monsoon season, trend parameters are shown in Table 40, which shows positive slope for Jh2 and negative for Jh1 and both have significant trend at 99% confidence.

The in trends Bankura during winter rainfall using the ITA method are provided in Table 42. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 44, the result shows that slope of pre monsoon rainfall is negative for Bk5, Bk6, Bk8, Bk9 and rest have positive slope and for all grids trends are significant at 99% confidence level except for Bk4 and Bk7. For Monsoon season, trends using ITA method are provided in Table 46, which shows that slope of Monsoon season is throughout positive except for Bk3 and Bk9 and trends in all is significant at 99% confidence. And lastly the post monsoon season, trend parameters are shown in Table 48, which shows positive slope for all grids and all shows significant trend at 99% confidence.

The trends in Howrah during winter rainfall using the ITA method are provided in Table 50. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 52, the result shows that slope of pre monsoon rainfall is negative for all the grids and trends are significant at 99% confidence level. For Monsoon season, trends using ITA method are provided in Table 54, which shows that slope of Monsoon season is throughout positive and trends in all is significant at 99% confidence. And lastly the post monsoon season, trend parameters are shown in Table 56, which shows positive slope for both and both have significant trend at 99% confidence.

The trends in Hooghly during winter rainfall using the ITA method are provided in Table 58. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 60, the result shows that slope of pre monsoon rainfall is positive for Hg2, Hg4 and negative for Hg1, Hg3 and for Hg1, Hg2 grids trends are significant at 99% confidence level. For Monsoon season, trends using ITA method are provided in Table 62, which shows that slope of Monsoon season is positive for Hg2, Hg3, Hg4 while Hg1 has negative slope and trends in all is significant at 99% confidence. And lastly the post monsoon season, trend parameters are shown in Table 64, which shows positive slope for all grids and have significant trend at 99% confidence.

The trends in Purba Bardhaman during winter rainfall using the ITA method are provided in Table 66. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 68, the result shows that slope of pre monsoon rainfall is negative for all the grids and trends are significant at 99% confidence level except for Pb_B6. For Monsoon season, trends using ITA method are provided in Table 70, which shows that slope of Monsoon season is throughout positive except for Pb_B7, Pb_B8 and trends in all is significant at 99% confidence except for Pb_B2 and Pb_B3 which have no trend. And lastly the post monsoon season, trend parameters are shown in Table 72, which shows positive slope for all the grids except for Pb_B7, Pb_B8 and except for Pb_B7 all grids have significant trend at 99% confidence.

The trends in Pashchim Bardhaman during winter rainfall using the ITA method are provided in Table 74. The results show that slope s of Winter rainfall is negative throughout for all the grids and Ps_B1 has no trend and Ps_B2 has significant trend at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 76, the result shows that slope of pre monsoon rainfall is positive for all the grids and Ps_B1 has no trend and Ps_B2 has significant trend at 99% confidence level. For Monsoon season, trends using ITA method are provided in Table 78, which shows that slope of Monsoon season is throughout positive and trends in all is significant at 99% confidence. And lastly the post monsoon season, trend parameters are shown in Table 80, which shows positive slope for both and both have significant trend at 99% confidence.

The trends in Birbhum during winter rainfall using the ITA method are provided in Table 82. The results show that slope s of Winter rainfall is positive for Br2 and rest have negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 84, the result shows that slope of pre monsoon rainfall is positive for Br1, Br2, Br4 and negative for rest of the grids and trends are significant at 99% confidence level except for Br4. For Monsoon season, trends using ITA method are provided in Table 86, which shows that slope of Monsoon season is throughout positive except for Br8 and trends in all is significant at 99% confidence except for Br4 and Br6 which have no trend. And lastly the post monsoon season, trend parameters are shown in Table 88, which shows positive slope for all and all have significant trend at 99% confidence.

The trends in Murshidabad during winter rainfall using the ITA method are provided in Table 90. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 92, the result shows that slope of pre monsoon rainfall is negative for all the grids and trends are significant at 99% confidence level. For Monsoon season, trends using ITA method are provided in Table 94, which shows that slope of Monsoon season is throughout negative except for Msh2, Msh6 and trends in all is significant at 99% confidence except for Msh2. And lastly the post monsoon season, trend parameters are shown in Table 96, which shows positive slope for all and all have significant trend at 99% confidence.

The trends in Nadia during winter rainfall using the ITA method are provided in Table 98. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 100, the result shows that slope of pre monsoon rainfall is negative for all the grids and trends are significant at 99% confidence level. For Monsoon season, trends using ITA method are provided in Table 102, which shows that slope of Monsoon season is positive for Na1, Na2 and rest are negative and trends in all is significant at 99% confidence except for Na3. And lastly the post monsoon season, trend parameters are shown in Table 104, which shows positive slope for all and all grids have significant trend at 99% confidence.

The trends in Purulia during winter rainfall using the ITA method are provided in Table 106. The results show that slope s of Winter rainfall is negative throughout for all the grids and all of them are significant at 99% confidence level. Trends for Pre monsoon rainfall using ITA method are provided in Table 108, the result shows that slope of pre monsoon rainfall is negative for Pr2 and rest are positive and trends are significant at 99% confidence level except for Pr2 with no trend. For Monsoon season, trends using ITA method are provided in Table 110, which shows that slope of Monsoon season is throughout positive except for Pr2, Pr4, Pr5 and trends in all is significant at 99% confidence except for Pr2. And lastly the post monsoon season, trend parameters are shown in Table 112, which shows positive slope for all except for Pr2 and all have significant trend at 99% confidence except for Pr2.

WINTER			
Serial No.	District	Slope	Trend
1	South 24 PGS	Negative	Significant
2	North 24 PGS	Negative	Significant
3	Purba Medinipur	Negative	Significant
4	Pashchim Medinipur	Negative	Significant
5	Jhargram	Negative	Significant
6	Bankura	Negative	Significant
7	Howrah	Negative	Significant
8	Hooghly	Negative	Significant
9	Purba Bardhaman	Negative	Significant
10	Pashchim Bardhaman	Negative	Significant
11	Birbhum	Negative	Significant
12	Murshidabad	Negative	Significant
13	Nadia	Negative	Significant
14	Purulia	Negative	Significant

Fig 5.1 Overall Summary of Winter Season

PRE MONSOON			
Serial No.	District	Slope	Trend
1	South 24 PGS	Negative	Mostly Significant
2	North 24 PGS	Negative	No Trend
3	Purba Medinipur	Negative	Significant
4	Pashchim Medinipur	Negative	Significant
5	Jhargram	Positive	Significant
6	Bankura	Mix	Significant
7	Howrah	Negative	Significant
8	Hooghly	Mix	Mix
9	Purba Bardhaman	Negative	Significant
10	Pashchim Bardhaman	Positive	Mix
11	Birbhum	Negative	Significant
12	Murshidabad	Negative	Significant
13	Nadia	Negative	Significant
14	Purulia	Positive	Significant

Fig 5.2 Overall Summary of Pre-Monsoon Season

MONSOON			
Serial No.	District	Slope	Trend
1	South 24 PGS	Positive	Significant
2	North 24 PGS	Positive	Significant
3	Purba Medinipur	Positive	Significant
4	Pashchim Medinipur	Mostly Positive	Mix
5	Jhargram	Positive	Significant
6	Bankura	Mostly Positive	Significant
7	Howrah	Positive	Significant
8	Hooghly	Mostly Positive	Significant
9	Purba Bardhaman	Mostly Positive	Significant
10	Pashchim Bardhaman	Positive	Significant
11	Birbhum	Mostly Positive	Significant
12	Murshidabad	Mostly Negative	Significant
13	Nadia	Mix	Significant
14	Purulia	Mostly Positive	Significant

Fig 5.3 Overall Summary of Monsoon Season

POST MONSOON			
Serial No.	District	Slope	Trend
1	South 24 PGS	Positive	Significant
2	North 24 PGS	Positive	Significant
3	Purba Medinipur	Positive	Significant
4	Pashchim Medinipur	Mix	Mix Variation
5	Jhargram	Mix	Significant
6	Bankura	Positive	Significant
7	Howrah	Positive	Significant
8	Hooghly	Positive	Significant
9	Purba Bardhaman	Mostly Positive	Significant
10	Pashchim Bardhaman	Positive	Significant
11	Birbhum	Positive	Significant
12	Murshidabad	Positive	Significant
13	Nadia	Positive	Significant
14	Purulia	Mostly Positive	Significant

Fig 5.4 Overall Summary of Post Monsoon Season

Chapter 6

Conclusion:

Rainfall is the main source of moisture for agriculture in Indian Sub-Continent. Indian economy is majorly dependent on agriculture so it is necessary to understand the behaviour and pattern of rainfall over the past century to overcome its effects due to the climatic change and global warming. In this paper a study has been carried out in the Southern region of state of West Bengal, India to study the Seasonal Rainfall Trend over the last 114 years by Sen's Innovative Trend Analysis.

Detailed discussion for each district has been carried out in the chapter 5. From those discussions following can be concluded:

Winter Season:

- All the grids of each district are showing **negative** slope.
- **Only** Br2 region of Birbhum district has shown a **positive** slope.
- Almost in all grids and districts the trend is significant with 99% confidence level.

Pre-Monsoon Season:

- A mix of both **Positive** and **Negative** slope can be seen throughout the study area.
- However, **majority** of the slopes are **negative**.
- Most of the grid point have significant trend with 99% confidence throughout the region
- Some of the grids **don't** show any **significant trend** such as SP6, SP7, SP9, NP2, NP3, NP4, NP5, NP6, NP7, NP8, Ps_M2, Bk4, Bk7, Hg3, Hg4, Pb_B6, Ps_B1, Br4 and Pr2.

Monsoon Season:

- In **Majority** of the grid points**, positive** slope has been observed.
- Some of the points are having **negative** slope such as Ps_M5, Ps_M6, Bk3, Bk9, Hg1, Pb_B7, Pb_B8, Br8, Msh1, Msh3, Msh4, Msh5, Na3, Na4, Na5, Pr2, Pr4, Pr5
- **Nadia** and **Murshidabad** districts are the only two district which shows **overall negative** slope in monsoon season.
- **Almost** in all the points trends are **significant** with 99% confidence level.
- Ps_M5, Ps_M6, Ps_M8, Pb_B2, Pb_B3, Br4, Br6, Msh2, Na3 and Pr2 grids are showing **no trends**.

Post Monsoon Season:

- **Positive** slope has been observed in about 90% of the grid points over the region.
- Minority of area are showing **Negative** slope as Ps_M1, Ps_M2, Ps_M5, Ps_M6, Jh1, Pb_B7, Pb_B8, Pr2.
- We can say that all districts have overall **positive** slope for Post Monsoon Season.

- **Most** of the grids shows that the trend is **significant** and a **few** of them as Ps_M1, Ps_M4, Ps_M6, Pb_B7 and Pr2 shows **no** trend.

Winter Season and **Pre-Monsoon Season** are showing **negative** trend with major significance, so we can conclude that in the coming years there might be further **decrease** in overall amount of precipitation and subsequently decrease in the amount of runoff in the catchment which may result to **drought** conditions in these Seasons.

Also, as we can see during **Monsoon Season** and **Post Monsoon Season** a significant positive trend can be seen, which signifies **increase** in precipitation and further increase in runoff in the watershed which may lead to scenarios like **flood**.

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