Open Access

Journal on Environmental Sciences

Analysis of Assam, North East India's Rainfall Trends

Kakoli Gogo

Discipline of Geography, School of Sciences, Indira Gandhi National Open University, New Delhi, India

Auother's information:
Kakoli Gogo
Discipline of Geography, School of Sciences, Indira Gandhi National Open University, New Delhi, India

Received Date: Dec 18, 2022
Accepted Date: Dec 20, 2022
Published Date: Jan 03, 2023

Abstract

Using data from 26 locations between 1981 and 2017, the spatio-temporal changes of long-term rainfall over Assam in the North Eastern region of India were examined. Mann-Kendall and Sen slope tests are used to analyse the patterns in the annual, monthly, and seasonal rainfall over several subregions.

The months of September, December, January, and February saw a decline. Using data from 26 locations between 1981 and 2017, the spatio-temporal changes of long-term rainfall over Assam in the North Eastern region of India were examined.Mann-Kendall and Sen slope tests are used to analyse the patterns in the annual, monthly, and seasonal rainfall over several subregions.The months of September, December, January, and February saw a decline. Using data from 26 locations between 1981 and 2017, the spatio-temporal changes of long-term rainfall over Assam in the North Eastern region of India were examined.Mann-Kendall and Sen slope tests are used to analyse the patterns in the annual, monthly, and seasonal rainfall over several subregions.

The months of September, December, January, and February saw a decline. flow, food availability, etc., which could result in differences in the socioeconomic circumstances of the region.The findings will help policymakers better understand the effects of climate change and determine how vulnerable natural and societal resources are to it.

Introduction

The livelihood and economy of India's rural people are supported in large part by agricultural operations, which depend on the availability of water resources and the fertility of the soil.Changes in temperature and rainfall have an impact on the socioeconomic growth of the natural environment by causing drought and flood-like conditions that lead to the loss of biodiversity and human life.Therefore, this connected research has become more significant globally in order to comprehend how regional climate change patterns affect agricultural patterns, productivity, and the economy. Climate studies need urgent and methodical attention.1-2.

Water resources, such as stream flow patterns, can be affected by climatic factors, especially rainfall and temperature. Lakes, ponds, and tanks in the area in question, as well as groundwater reserves.3 Extreme rainfall events can lead to devastating floods, which are frequent in many regions of India.

In recent years, numerous areas of the nation had heavy to extremely heavy rain during the summer monsoon (70 mm/day to roughly 120 mm/day), although overall monsoon rainfall remained essentially unchanged4-5.Regional-scale climate studies are considered essential since shifting climes affect how natural resources, such as flora and wildlife, are distributed.India's northeastern region is home to a diverse population, abundant forests, and successful agriculture.Many indigenous tribal people rely on different natural resources for their survival.

In these biologically varied regions, changing weather can affect the distribution and availability of resources, leading to malnutrition and food insecurity. According to IPCC6, climate change will affect how much food is produced, how often there are floods and droughts, how much groundwater is available, and other factors.The hydrological cycles and patterns of stream flows may be impacted by extreme weather conditions and global warming. The study used long-term series data from India and the Assam region7-8 to investigate rainfall patterns and their variability as well as extreme rainfall occurrences.

Additionally, numerous attempts have been made to use modelling techniques to analyse data from the India Meteorological Department (IMD) and the Precipitation Radar Tropical Rainfall Measuring Mission (PRTRMM) satellites of the National Aeronautics and Space Administration (NASA) in order to find anomalies at various time scales. 9.Climate change projections need the analysis of patterns and trends in climatic variables like precipitation and temperature.

The scientists employed The study examined rainfall patterns and their variability as well as instances of high rainfall using long-term series data from India and the Assam region7-8.Numerous attempts have also been made to use modelling techniques to analyse data from the Precipitation Radar Tropical Rainfall Measuring Mission (PRTRMM) satellites of the National Aeronautics and Space Administration (NASA) and the India Meteorological Department (IMD) in order to find anomalies at different time scales.9. Patterns and trends in climatic variables like precipitation and temperature must be analysed in order to make accurate climate change estimates.

The scientists working there historical and long-term series to investigate the spatiotemporal variation of rainfall and temperature in hilly and mountainous lands12, coastal and urban areas14, river basins16, and river basins18, all of which are prone to drought. In

the west and northeastern regions of India, variations in mean annual rainfall and extreme rainfall events are noted, primarily as a result of regional orography.
In Assam19, Deepak et al. (2012) noted a significant change in long-term rainfall as well as in the monsoon and post-monsoon seasons. Planning and improving water resources, agricultural productivity, and climate change mitigation strategies all benefit from spatial-temporal study of rainfall trends on a yearly, monthly, and seasonal basis.But for data collection, it needs a good distribution of hydro-meteorological stations.

Long-term satellite-based datasets can be used to estimate rainfall and obtain superior results when rainfall data is unavailable or missing20. Since the 1950s, Sikkim, Northeast India, has experienced a decline in monsoonal and annual rainfall, according to Namita and Soham (2022)21. In Assam, a temperature increase of +1.7 to 2.2°C and an increase of According to the Assam state climate action plan's monitoring of extreme rainfall occurrences, the percentage is about 40%.Begum et al. (2022)23 observed a non-significant declining trend during the monsoon season in various sites around the state after analysing the spatiotemporal trends of rainfall over Assam.

It is discovered that researching local rainfall patterns is crucial for determining how climate change will affect a certain area.
In order to develop effective strategies and adaptation plans to combat climate change, it is advised by IPCC6 that trends and fluctuations in rainfall be examined. The current research work aimed to analyse rainfall variations over different seasons, monthly, and annually across Assam of NE India by using the prior dataset, despite the fact that numerous studies on Indian summer monsoon rainfall had already been conducted (1981-2017).

Conclusions

The long-term rainfall over Assam state, NE India, from 1981 to 2017 was examined to look at yearly, monthly, and seasonal changes. The MK and Sen's slope test is used to evaluate rainfall trends.In September, December, January, and February, monthly rainfall trends showed a declining tendency.
May, June, and August all showed an upward trend that was determined to be statistically significant.Similar to this, yearly, PRMS, and MS increasing trends in rainfall were observed at a statistically significant level, while trends for POMS and WS were not.Demaji, Dibrugarh, Karimganj, and North Lakhimpur were the four stations in Assam that reported with above 2000 mm of average annual rainfall, while Diphu and Hulflong highlighted not more than 1500 mm.

More than 25% of the CV rainfall was recorded in the stations in Karimganj, Hailakand, Silchar, Gossiagaon, and Dhuburi.Premonsoon and monsoon rainfall over Assam showed growing patterns on a seasonal basis with statistically significant levels.Winter and post-monsoon rainfall showed declining trends, however these changes were not statistically significant.In order to analyse rainfall trends and draw valid findings for the current study, it may be necessary to add more data collection stations. People's livelihoods may be impacted by climate change, especially those who depend on natural resources.

Since it sustains numerous ethnic and folk groups with a rich cultural legacy and traditional understanding of the environment, Assam is regarded as a global biodiversity hotspot.Assam's rising carbon footprint can be ascribed to a variety of reasons, including change land use patterns, urbanisation, population expansion, the use of fossil fuels, altered agricultural practises combined with deforestation, and others. According to the evidence, the population increased significantly from roughly 8 million in 1951 to 32 million in 2011, which also increased pressure on the environmentthe region's natural resources.

The responsible authorities must take the necessary actions to establish eco-restoration, education and awareness programmes, and development of mechanisms at the regional and national levels coordination in protecting and conserving the natural resources of Assam in order to make appropriate adaptation and mitigation plans by taking future climates into consideration.Sudden rainfall events, precipitation declines in the POMS and WS, and their potential effects on ecosystems and human health are all very concerning.There have been reports of flash floods in various state locations are being brought on by unexpected, intense rains that are exceptional.
The Nor'westers, also known as Bordoisila in the area, are characterised by intense thunderstorms and high winds.

They raise concerns about climate change, which must be addressed with effective adaptation strategies to prevent future financial hardship. Future research must be undertaken using daily rainfall and rainy day data for long-term historical time series due to the increased growth of extreme weather events, such as floods and heatwaves in NE India in general and Assam in particular.Due to data discontinuities and non-availability, the To evaluate rainfall patterns, the current study solely examined monthly, seasonal, and yearly rainfall data for the years 1981–2017.The research area has a relatively small number of operational meteorological stations, and because to the rugged topography, it is impossible to build them everywhere.As a result, given the constraints of the local meteorological stations, further research can be done utilising long-term satellite-based rainfall estimates, which have grown to be crucial sources around the world for obtaining precipitation data for sparsely populated areas.

References

1. Guhathakurta P, Sreejith O. P, Menon P. A. Impact of Climate Changes on Extreme Rainfall Events and Flood Risk in India. Journal of Earth System Science. 2011, 120 (3), 359-373.

2. Ray K. C, Sinha, Srivastava A. K. Is there any Change in Extreme Events Like Heavy Rainfall? Current Science. 2000, 79(2), 155-158.

3. Dore M. H. I. Climate Change and Changes in Global Precipitation Patterns: What Do We Know? Environment International. 2005, 31, 1167-1181.

4. Goswami B. N, Venugopal V, Sangupta D, Madhusoodanan M. S, Xavier P. K. Increasing Trend of Extreme Rain Events Over India in a Warming Environment. Science. 2006, 314 (5804), 1442–1445.

5. Malik N, Bookhagen B, Marwan N, Kurths J. Analysis of Spatial and Temporal Extreme Mosoonal Rainfall over South Asia using Complex Networks. Climate Dynamics. 2012, 39, 971-987.

6. IPCC. Global warming of 1.5?. Special report, Intergovernmental Panel on Climate Change. 2020, 616.

7. Guhathakurta P, Rajeevan M. Trends in Rainfall Pattern Over India. International Journal of Climatology. 2008, 28, 1453–1469.

8. Gharphalia B. J, Deka R. L, Islam A. N, Dutta P, Medhi K. Variability and Tr nds of Rainfall Events in the Brahmaputra Valley of Assam, India. International Journal of Current Microbiology and Applied Science. 2018, 7(11), 1902-1912.

9. Shepherd J. M, Pierce H. F, Negri A. J. Rainfall Modification by Major Urban Areas: Observations from Spaceborne Rain Radar on the TRMM Satellite. Journal of Applied Meteorology and Climatology. 2002, 41(7), 689-701.

10. Francisco J. T. G, Thomas K. Precipitation-Temperature Variability and Drought Episodes in Northwest Baja California, México. Journal of Hydrology: Regional Studies. 2020, 27, https://doi.org/10.1016/j.ejrh.2019.100653.

11. Ramkar P, Yadav S. M. Spatiotemporal Drought Assessment of a Semi-Arid Part of Middle Tapi River Basin, India. International Journal of Disaster Risk Reduction. 2018, 28, 414-426, DOI:10.1016/j.ijdrr.2018.03.025.

12. Bhutiyani M. R, Kale V. S, Pawar N. J. Long-Term Trends in Maximum, Minimum and Mean Annual Air Temperatures across the Northwestern Himalaya during the Twentieth Century. Climatic Changes. 2007, 85, 159–177.

13. Yang J, Tan C, Zhan T. Spatial and Temporal Variations in Air Temperature and Precipitation in the Chinese Himalayas during the 1971-2007. International Journal of Climatology. 2012, 33, 2622-2632.

14. Dash S. K, Saraswat V, Panda S. K, Sharma N. A Study of Changes in Rainfall and Temperature Patterns at Four Cities and Corresponding Meteorological Subdivisions over Coastal Regions of India. Global and Planetary Change. 2013, 108, 175-194, https://doi.org/10.1016/j.gloplacha.2013.06.004.

15. Santosh M. P, Deepak K, Mahesh K. J, Jan A, Spatial and Temporal Trends of Mean and Extreme Rainfall and Temperature for the 33 Urban Centers of the Arid and Semi-Arid State of Rajasthan, India. Atmospheric Research. 2014, 138, 73-90, https://doi.org/10.1016/j.atmosres.2013.10.024.

16. Kothyari U. C, Singh V. P, Aravamuthan V. An Investigation of Changes in Rainfall and Temperature Regimes of the Ganga Basin in India. Water Resource Management. 1997, 11, 17-34, DOI: 10.1023/A:1017936123283.

17. Deka R. L, Mahanta C, Pathak H, Nath K. K, Das S. Trends and Fluctuations of Rainfall Regime in the Brahmaputra and Barak Basins of Assam, India. Theoretical and Applied Climatology. 2013, 114 (61-71), DOI: 10.1007/s00704-012-0820-x.

18. Rai R. K, Upadhyay A, Sarkar S, Upadhyay A. M, Singh V. P. GIUH based transfer function for Gomti River basin of India. Journal of Spatial Hydrology. 2009, 9, 24-50.

19. Deepak J, Brijesh K. Y, Sunil M, Surajit C, Anil K. K. Identification of Trends in Rainfall, Rainy Days and 24h Maximum Rainfall over Subtropical Assam in Northeast India. Comptes Rendus Geoscience. 2012, 344(1), 1-13, https://doi.org/10.1016/j.crte.2011.11.002.

20. Alemu Z. A, Dioha M. O. Climate Change and Trend Analysis of Temperature: The Case of Addis Ababa, Ethiopia. Environmental System Research. 2020, 9, 27, DOI: 10.1186/s40068-020-00190-5.

21. Namita, C. and Soham, B. Long period trend analysis of precipitation and temperature of West Sikkim, India. Mausam. 2022, 73, 2, 413-DOI:https://doi.org/10.54302/mausam.v73i2.5484.

22. ASAPCC. Assam State Action Plan on Climate Change (2015-2020), Department of Environment and Forests, Government of Assam. 2015.

23. Begum, Asfika and Mahanta, Ratul. Spatio-temporal trend determination of temperature and rainfall for climate change and variability in Assam state, India. 2022, 45 – 58.

24. Borah S. B, Sivasankar T, Ramy M. N. S, Raju P. L. N. Flood Inundation Mapping and Monitoring in Kaziranga National Park, Assam using Sentinel-1 SAR data. Environment Monitoring and Assessment. 2018, 190, 9, 1-11.

25. Mann H. B. Nonparametric Tests against Trend. Econometrica. 1945, 13(3), 245-259.

26. Kendall M. G. Rank Correlation Methods. Griffin, London. 1975, 160.

27. Ahmed M, Hoque A, Islam MDK. A Trend Analysis of Climatic Variables in the Karimganj District of Assam, India. Indian Journal of Science and Technology. 2022, 15(10): 442-450. https://doi.org/10.17485/IJST/v15i10.109.

28. Priyanka, S. and Naresh, K. Analysis of trend and temporal variability in rainfall over Northeast India. Mausam. April 2022, 73(2), 307-314. DOI:https://doi.org/10.54302/mausam.v73i2.5479

29. Praveen, B., Talukdar, S., Mahato, S., Mondal, J., Sharma, P., Islam, A. R. M., and Rahman, A. Analyzing trend and forecasting of rainfall changes in India using non-parametrical and machine learning approaches. Scientific reports. 2020, 10(1), 1-21.

30. Mallick, J., Talukdar, S., Alsubih, M. et al. Analysing the trend of rainfall in Asir region of Saudi Arabia using the family of Mann-Kendall tests, innovative trend analysis, and detrended fluctuation analysis. Theor Appl Climatol. 2021, 143, 823–841. https://doi.org/10.1007/s00704-020-03448-1

31. Muthoni, F.K., Odongo, V.O., Ochieng, J. et al. Long-term spatial-temporal trends and variability of rainfall over Eastern and Southern Africa. Theor Appl Climatol. 2019, 137, 1869–1882. https://doi.org/10.1007/s00704-018-2712-1

32. Arab Amiri, M. and Goci?, M.,. Innovative trend analysis of annual precipitation in Serbia during 1946–2019. Environmental Earth Sciences. 2021, 80(23), pp.1-15.

33. Bartels, R.J., Black, A.W. and Keim, B.D.,. Trends in precipitation days in the United States. International Journal of Climatology. 2020, 40(2), pp.1038-1048.

34. Yildirim, G., Rahman, A. Homogeneity and trend analysis of rainfall and droughts over Southeast Australia. Nat Hazards. 2022, 112, 1657–1683. https://doi.org/10.1007/s11069-022-05243-9 Barnard G. A. Significance Tests for 2 x 2 tables. Biometrika. 1947, 34, 123-138.

35. Barnard G. A. Significance Tests for 2 x 2 tables. Biometrika. 1947, 34, 123-138.

36. en P. K. Estimates of the Regression Coefficient Based on Kendall's Tau. Journal American Statistical Association. 1968, 63(324), 379-89.

37. Shekhar, K. and Nageswara Rao, K. Analysis of temperature and precipitation for assessment of climate change during 20th century in Beas river basin. Mausam. April 2021, 72, (2), 489-506.

38. Burrough, P.A., and McDonnell, R.A. Principles of geographical information systems for land resources assessment, Oxford University Press, New York, 1998.

39. Alashan S. Combination of Modified Man-Kendall Method and Sen Innovative Trend Analysis. Engineering Reports. 2020, DOI: 10.1002/eng2.12131.

40. Abegaz WB. and Mekoya A. Rainfall variability and trends over Central Ethiopia. Int J Env Sci Nat Res. doi.org/10.19080/IJESNR.2020.24.556144.

41. Goyal, M.K. Statistical Analysis of Long Term Trends of Rainfall During 1901–2002 at Assam, India. Water Resour Manage. 2014, 28, 1501–1515. ttps://doi.org/10.1007/s11269-014-0529-y

42. Deka RL, Mahanta C, Pathak H, Nath KK, Das S. Trends and fluctuations of rainfall regime in the Brahmaputra and Barak basins of Assam, India. Theor Appl Climatol. 2013, 114:61–71.

43. airenjam, C., Hodam, S., Bandyopadhyay, A. and Bhadra, A. Historical and temporal trends of climatic parameters in North East India. Global NEST Journal. 2017, 19(4), 547-561.

44. Kumar V, Jain S. K, Sing Y. Analysis of Long-Term Rainfall Trends in India. Hydrological Sciences Journal. 2010, 55(4), 484-496, DOI: 10.1080/02626667.2010.481373.

45. Kumar R. K, Pant G. B, Parthasarathy B, Sontakke N. A. Spatial and Sub-Seasonal Pattern of Long-Term Trends of Indian Summer Monsoon Rainfall. International Journal of Climatology. 1992, 12(3), 257-268.

46. Dash S. K, Jenamani R. K, Kalsi S. R, Panda S. K. Some Evidence of Climate Change in Twentieth-Century India. Climatic Change. 2007, 85, 299-321.