International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Impact of Solar Activity and Human Factors on River Flows in India

Akash B Jadhav

[1]HOD Civil ,Shatabdi institute of Engineering

ABSTRACT

In the last two decades, in India, we have seen extraordinary climate changes and their consequences, such as flash floods, empty reservoirs, and forest burning. So, the objective of this article is to analyze the main drivers of climate change due to global warming, like Temperatures, Precipitation, River flows (TPQ), Human Activity (HA) on one side and the extraterritorial factor of sunspot number (NS) on the other side. The methodology of the approach is statistical, with trend detection, comparison, and calculation of significance for each factor. Data from state institutions, both daily and monthly, for TPQ from 1963–2022 and Sunspots from 1954–2006 were used. Three Highland (HL) rivers, two Lowland (LL) rivers, and two Temperature and Precipitation Meteorological stations were considered for analysis. For river LL1, the data needed to be completed, and correlation, calibration, and validation methods were applied to fill the gaps. Results indicate that sunspot numbers show a decrease of -18% from the average value, Temperature +24%, Precipitation +5%, HL1 flow -31%, HL2 -0.5%, HL3 -7.5%, LL1 -22%, and LL2 -13%. The significance of the impact of Sunspots on the air temperature approximates 75%, while the impact of human activity approximates 25%. This will be an excellent contribution to future water resource management plans in India.

Keywords: Sunspots; Temperatures; Precipitations; River-Flows; Trends.

1. INTRODUCTION

Our climate is changing. We need drinkable water, food, and energy-rich resources. Every year in India, we experiencesummer flash floods, forest fires, land use changes, dry reservoirs, and winter frontal floods, and yet we still lack comprehensive water resources management plans (for water protection and use). The water monitoring system is still in the process of consolidation (since the 1999 Kargil War). Without accurate data and information, no effective plans, models, or predictions exist. So, the question is: which hydroclimatic parameters are changing the climate in India? Which variables drive the climate? How do we predict the next drought and flood?

Many authors have written scientific articles about climate changes and the relationship between climate drivers, attempting to detect trends in hydroclimatic variables and their interrelations. It is well-known among meteorologists that solar activity and its sunspot number (NS) are the first "domino" that influences the Earth's humidity. After that, ocean circulation models, air temperature, precipitation, and river flows (TPQ) play critical roles. Can we predict droughts and floods in India? Can we find the relationship between them?concluded that if the sun-rainfall relationship persists in the future, sunspot cycles can be used for long-term prediction of precipitation anomalies. The objective of this article is to analyze the main drivers of climate change due to global warming in India, such as temperatures, precipitation, river flows (TPQ), and human activity (HA) on one side, and the extraterritorial factor of sunspot numbers (NS) on the other.

The methodology of this study is statistical, involving trend detection, comparison, and calculation of significance for each factor. By examining temperature, precipitation, river flows (TPQ), human activity (HA), and sunspot numbers (NS), this research aims to gain valuable insights into their individual and collective impacts on climate change in India. The statistical analysis will allow policymakers and researchers to better understand these drivers and their interactions, providing essential information for developing effective strategies to manage climate change and mitigate its adverse effects.

METHODOLOGY

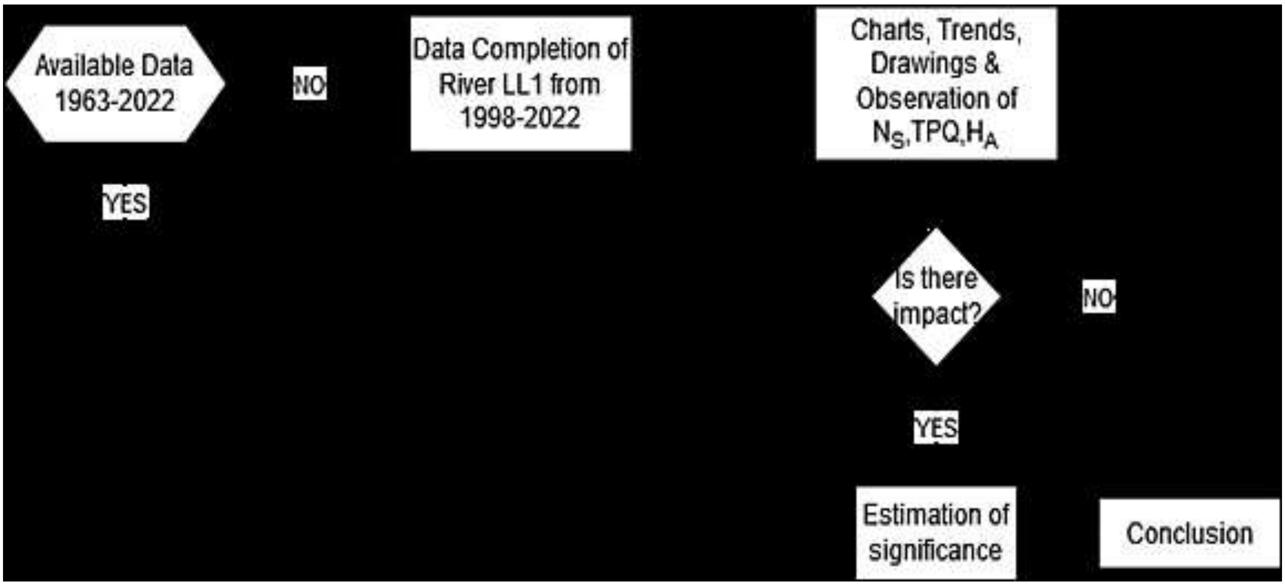
The methodology used in this article applies statistics in Hydrology. Initially, missing data were completed, which involved correlation, calibration, and validation of long-term daily and annual average data for temperatures, precipitation, and river flows in India. Then, charts for different time scales were created, focusing on three basic physical parameters of the climate (TPQ). By observing and comparing trends in solar activity and TPQ, their impact and connections can be detected. The application of the double mass method further helps to identify changes in hydro-meteorological parameters across India. The Black-Box model is effective in drawing conclusions if the observed data are accurate and reliable.,

2. MODELING AND ANALYSIS

The river LL1 in India is very difficult to explain. Officially processed flow data is available from 1963 to 1998. After that year, the data were correlated and validated up to 2021 because, for this period, the hydro-meteorological institution only provided depth data

$$H$$

H (cm), but not flow data. The main part of this river flows through an urbanized area with many sewage discharges. Over the last five years, it has shown very high water levels, often leading to floods during the summer (due to convective rainfalls) and winter (due to frontal precipitations). I expect that in the next five years, we will continue to face flash floods during the summer and heavy floods from frontal precipitation during the winter. Some deviation can also be observed in of the Double Mass Method (explained later).If we focus on the data presented in Figure 8-b, the long-term polynomial trend shows a decrease in flows, while the linear trend from 2001 to 2012 shows a significant deviation, likely due to sewage discharges, convective rainfall "flash" storms, and winter precipitation.presents the long-term annual flow hydrograph of Lowland River LL2 for the observed period of 1963–2021. This is another Lowland river in India, similar to LL1, but without the rapid urbanization and sewage discharges. The long-term polynomial trend shows a slight decrease in flows, while the linear trends of sunspot periodicity from 2000 to 2010 show a deviation from the "saw" pattern. This deviation must be attributed to global warming.



3. RESULTS AND DISCUSSION

A flow trend is a curve that shows how a river's flow changes, either rising or falling. It can be represented by linear, polynomial, exponential, or logarithmic functions that best fit the random hydro-meteorological events. However, for hydro-meteorological events in India, this is a more complex task. First, the flow trend varies due to many parameters, most of which are determined, with at least one being random. The second issue is the time scale of the considered trend. As the number of sunspots and their periodicity change, we observe increasing (brightening) and decreasing (dimming) trend developments [20]. This represents one side of the "rope" (the "random action"). The other side consists of our planet's astronomical, geophysical, and geopolitical (human impact) conditions. This forms the "determined reaction." As a result, the estimation of these trends is quite relative. Typically, it takes 22 years for a sunspot cycle (2π). A minimum of two complete cycles of observed data are required to define a complex river flow trend.

presents the temperature data for two locations in India: Ferizaj, a mid-land city, and Sjenica, a high-land city. These temperatures were observed until 2020 and 2021 (officially), correlated for 2021 and 2022, and projected for 2023. We can see an up-and-down oscillation relative to the trend since 1961, but with a clear absolute increase since 1979. Temperatures have been rising for the past 40 years at all levels of altitude across India.

CONCLUSION

Sunspots, as a large-scale (global) generator of atmospheric humidity, lead to lower temperatures, large amounts of precipitation, and higher river flows. This has been observed in years such as 1958, 1969, 1980, 1989, 1999, 2010, and 2021 in India.Solar radiation, on the other hand, as a smaller (local) scale generator of atmospheric humidity, causes higher temperatures, less precipitation (especially during convective summer storm rainfalls), and, consequently, lower river basin flows in India.Human activity, including industrial emissions, urbanization, deforestation, forest burning, fossil fuel combustion, and even wars, is also a smaller (local) generator of atmospheric humidity. This factor, combined with the effects of solar radiation, has led to an increase in convective rainfalls. Urban "flash" storm floods, which were only 5% of annual precipitation two decades ago, now account for 15% or more of the total precipitation in India.

Sunspot activity follows a brightening and dimming cycle, but over the observed period, there has been a noticeable decrease in sunspot numbers, contributing to an increase in Earth's temperature (DTS). The temperature trend in India shows a clear rise, influenced both by solar radiation and human impact. The total increase in temperature (DTTOT) can be expressed as the sum of the rise in temperature due to sunspots (DTS) and human activity (DTHUM). This has led to decreased snow precipitation, increased rainfall (both frontal and convective), increased evaporation, and lower river flows.

Precipitation trends in India have also changed: Snow precipitation is decreasing both in cities and highland areas. Frontal precipitation is increasing in the highlands but decreasing in the lowlands. Meanwhile, convective precipitation is becoming more common in urbanized areas, contributing to an increase in flash floods during the summer months..

.

4. REFERENCES

[1] T. Mohana Priya, Dr. M. Punithavalli & Dr. R. Rajesh Kanna, Machine Learning Algorithm for Development of Enhanced Support Vector Machine Technique to Predict Stress, Global Jo[1] Stager, J. C., Ruzmaikin, A., Conway, D., Verburg, P., & Mason, P. J. (2007). Sunspots, El Niño, and the levels of major Indian lakes. *Journal of Geophysical Research Atmospheres*, 112(15), 1-13. doi:10.1029/2006JD008362.

[2] Laurenz, L., Lüdecke, H. J., & Lüning, S. (2019). Influence of solar activity changes on Indian rainfall patterns. Journal of Atmospheric and Solar-Terrestrial Physics, 185, 29–42. doi:10.1016/j.jastp.2019.01.012.Ganesh Kumar and P.Vasanth Sena, "Novel Artificial Neural Networks and Logistic Approach for Detecting Credit Card Deceit," International Journal of Computer Science and Network Security, Vol. 15, issue 9, Sep. 2015, pp. 222-234

[3] Schulte, J. A., Najjar, R. G., & Li, M. (2016). The influence of climate modes on streamflow in Indian river basins. Journal of Hydrology: Regional Studies, 5, 80–99. doi:10.1016/j.ejrh.2015.11.003..

[4] Maghrabi, A. H., Alamoudi, H. A., & Alruhaili, A. S. (2023). Long-Term Rainfall Trends in South Asia—India. American Journal of Climate Change, 12(01), 204–217. doi:10.4236/ajcc.2023.121010..