

A General Overview of Understanding Trend Analysis of Climatic Parameters

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Climate is one of the most important factors influencing our daily lives, agriculture, water resources, and overall environment. Over the years, scientists have observed that rainfall, temperature, and humidity are changing slowly. Some areas are becoming hotter, some are receiving more or less rainfall, while others are turning drier. To study these changes, researchers use statistical tools that can detect whether the climate is really changing or if the observed variations are just random. Two such widely used tools are the Mann-Kendall test and Sen's slope estimator. The Mann-Kendall test helps to check whether there is a consistent upward (increasing) or downward (decreasing) trend in the data over time. For example, is rainfall gradually increasing every decade, or is temperature slowly rising? On the other hand, Sen's slope tells us how much the change is happening per year or per decade. Together, these two methods give us a clear picture of climatic trends and their speed. Understand this through some simplified results on rainfall, temperature, and humidity over four decades.

Table 1. Rainfall Trends (1980–2020)

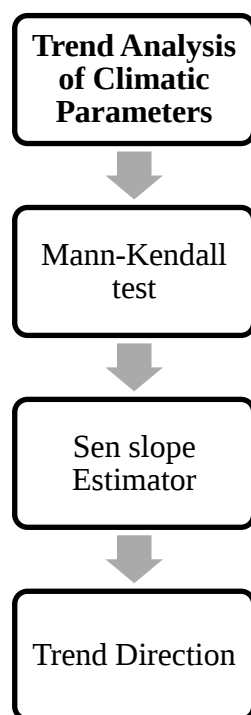
Decade	Average Rainfall (mm)	Mann-Kendall Test Result	Trend Direction	Sen's Slope (mm/year)
1980–1990	980	Weak positive	Slight increase	+2.3
1991–2000	1024	Significant positive	Increasing	+4.1
2001–2010	1102	Strong positive	Increasing	+5.7
2011–2020	1158	Moderate positive	Increasing	+2.8

Rainfall shows a clear increasing trend, meaning more rainfall is received in recent decades compared to the past.

Table 2. Maximum Temperature Trends

Decade	Avg. Max Temp (°C)	Mann-Kendall Result	Trend	Sen's Slope (°C/decade)
1980–1990	31.8	Weak positive	Slight increase	+0.1
1991–2000	32.2	Significant positive	Increasing	+0.3
2001–2010	32.8	Strong positive	Increasing	+0.4
2011–2020	33.5	Strong positive	Increasing	+0.5

The maximum temperature has been rising steadily, confirming global warming effects at the local level.

**Table 3. Minimum Temperature Trends**

Decade	Avg. Min Temp (°C)	Mann-Kendall Result	Trend	Sen's Slope (°C/decade)
1980–1990	22.5	Slight negative	Decreasing	-0.1
1991–2000	22.8	Slight positive	Increasing	+0.2
2001–2010	23.1	Significant positive	Increasing	+0.3
2011–2020	23.8	Strong positive	Increasing	+0.4

Initially, minimum temperature slightly decreased, but in the last three decades it has shown strong upward trends. This means nights are becoming warmer.

Table 4. Relative Humidity Trends

Decade	Avg. Humidity (%)	Mann-Kendall Result	Trend	Sen's Slope (%/decade)
1980–1990	69.4	Weak negative	Slight decrease	-0.2
1991–2000	67.8	Significant negative	Decreasing	-0.3
2001–2010	65.9	Strong negative	Decreasing	-0.5
2011–2020	64.5	Strong negative	Decreasing	-0.6

Humidity is steadily decreasing, showing that the atmosphere is becoming drier over the years.

Conclusion

From this simple analysis, we can see that rainfall, maximum temperature, and minimum temperature are showing upward trends, while humidity is decreasing. This pattern suggests that the region is becoming hotter and wetter in terms of rainfall, but drier in terms of atmospheric moisture. Such changes have strong implications for agriculture, water resources, and daily living conditions. Farmers may face challenges such as increased water demand, higher risk of crop stress, and shifting crop seasons. Policymakers and researchers

can use these trend analysis methods to plan better irrigation systems, introduce climate-resilient crops, and manage water resources wisely. In short, trend analysis using Mann-Kendall and Sen's slope helps us clearly understand how our climate is changing step by step. It turns complex climate data into meaningful insights that can guide society towards sustainable adaptation strategies.

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