ASSESSMENT OF CHANGE IN DTR OVER THE KRISHNA RIVER BASIN

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INTRODUCTION

- Monitoring climate change in a river basin is critical for sustainable management and water resource infrastructure development since it needs extra considerations in the context of climate change.
- The Diurnal Temperature Range (DTR) is a significant thermal metric for assessing the impact of climate change.
- This important meteorological measure can be calculated by finding the difference between the maximum and minimum temperatures of a given area within one day.
- DTR is one of the many climate variables that has an impact on people's health, agriculture, and society. It's vital to understand how DTR changes as an outcome of global warming.

SIGNIFICANCE OF STUDY

- Climate change is expected to have a substantial influence and will pose a serious risk to a basin's water supply in the future.
- In this study we have attempted to find how the DTR and Precipitation will vary at the end of this century over the Krishna River Basin.
- From the results obtained we have found conclusions about the climatic conditions and how they will affect the area over time.

STUDY AREA

- The Krishna river basin is Peninsular India's second largest eastward draining interstate river basin. It is located in the Deccan Plateau, covering major parts of Maharashtra, Karnataka, and Andhra Pradesh.
- The Krishna River begins in Mahabaleshwar, Maharashtra extending over an area of 258,948 km^2 which is almost 8% of the entire topographical area of India.
- Other than the western boundary that is made by an uninterrupted stretch of the Western Ghats, the majority of this basin is made up of rolling and undulating territory. Black soils, alluvium, red soils, laterite and lateritic soils, mixed soils, and alkaline and salty soils are all prominent soil types present in the basin.

CLIMATE MODELS

- Climate models have become the most important tools for studying the reaction of the climate system to various forcings, making climatic predictions on seasonal to decadal time periods, along with producing climate projections for the next century and beyond.

- The Coupled Model Intercomparison Project (CMIP) is a shared framework in climatology that aims to enhance climate change understanding.

- We have analysed CMIP historical simulations and two scenarios from the Scenario Model Intercomparison Project. The protocol for the historical simulations (experiment name: “historical”) has 63-year simulations (from 1951 to 2014). The scenario simulations are run for 85 years, from 2015 to 2100.

- In this study, I have used “ssp245” and “ssp585”.

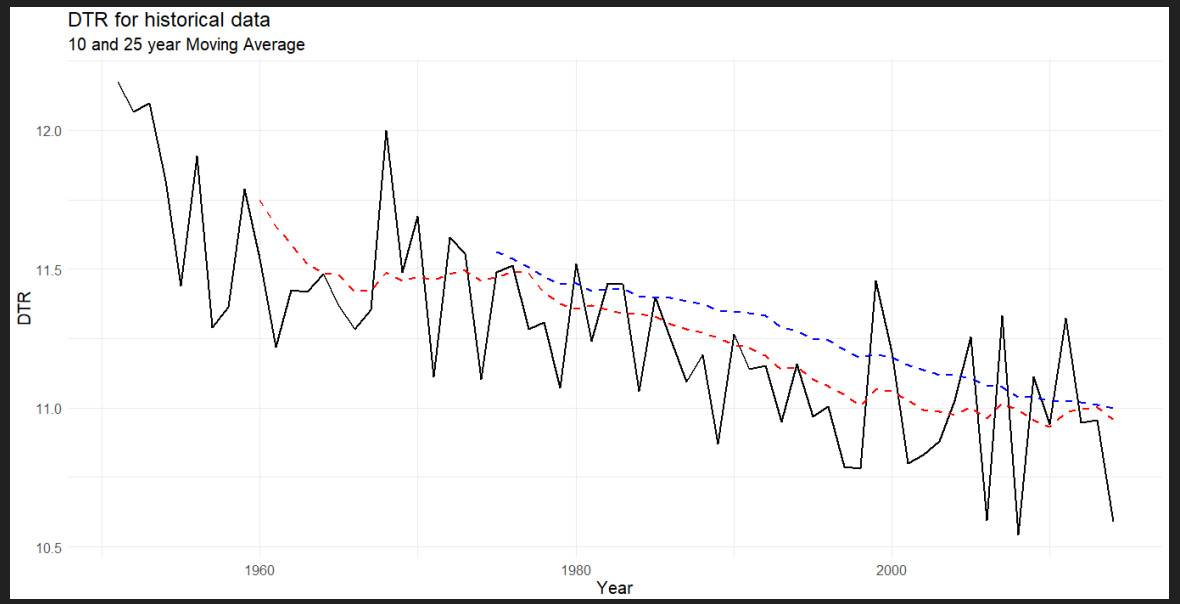
METHODOLOGY

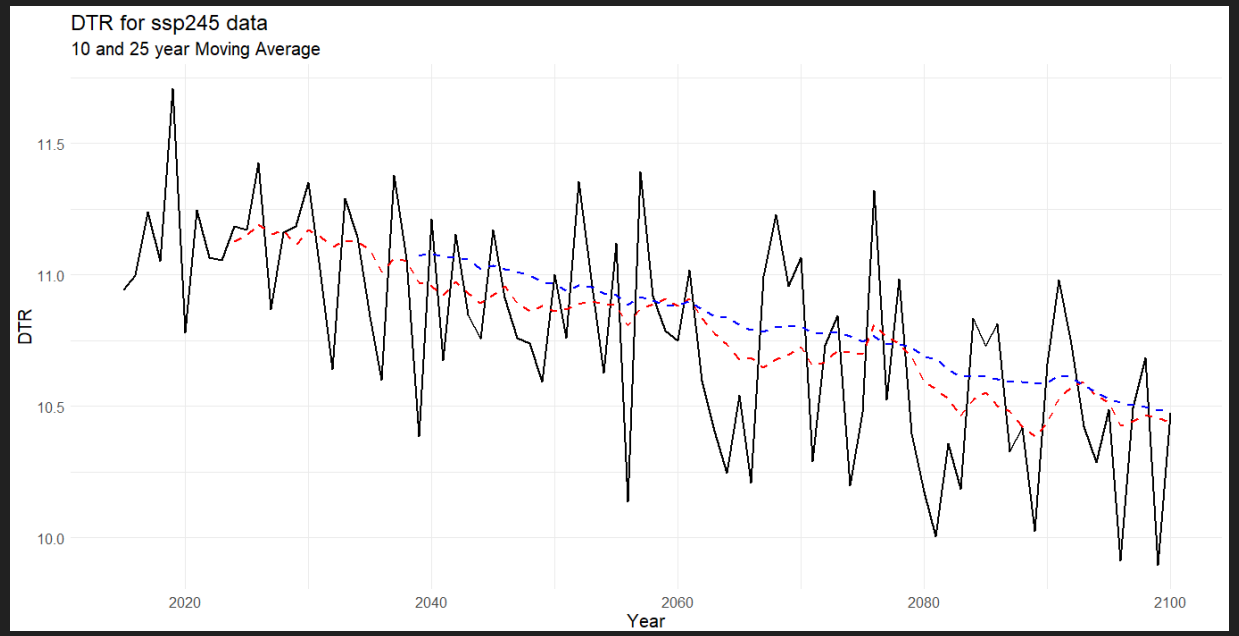
- Data Collection:
  - Data has been obtained from the National Data Centre (NDC) of India Meteorological Department (IMD).
  - Data has also been obtained from climate models for 85 years, from 2015 to 2100.
  - All data was in the form of daily Maximum Temperature, Minimum Temperature and Precipitation over the Krishna River Basin during the mentioned time periods.

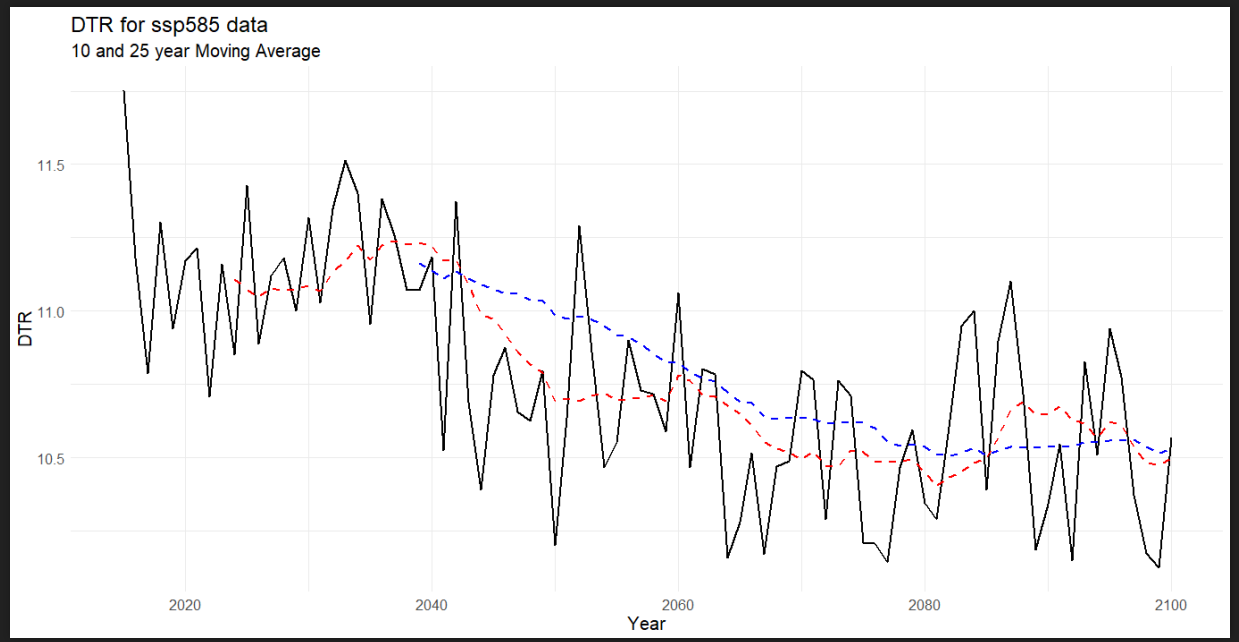
- Data Pre-processing and Analysis
  - DTR = Maximum Temperature – Minimum Temperature
  - Data was divided according to years into historical (1951-2014) and current (2015-2100)
  - Data was divided according to years into historical (1991-2020), the 20s (2021-2040), the 50s (2041-2070) and the 80s (2071-2100)
  - Data was divided according to seasons into Pre-Monsoon (March, April, and May), Monsoon (June, July, August, and September), Post-Monsoon (October, November) and Winter (December, January, February).

- Time Series Forecasting
  - The time series was decomposed using Simple Moving Average (SMA) and exponential smoothing was carried out by performing AutoRegressive Integrated Moving Average (ARIMA).

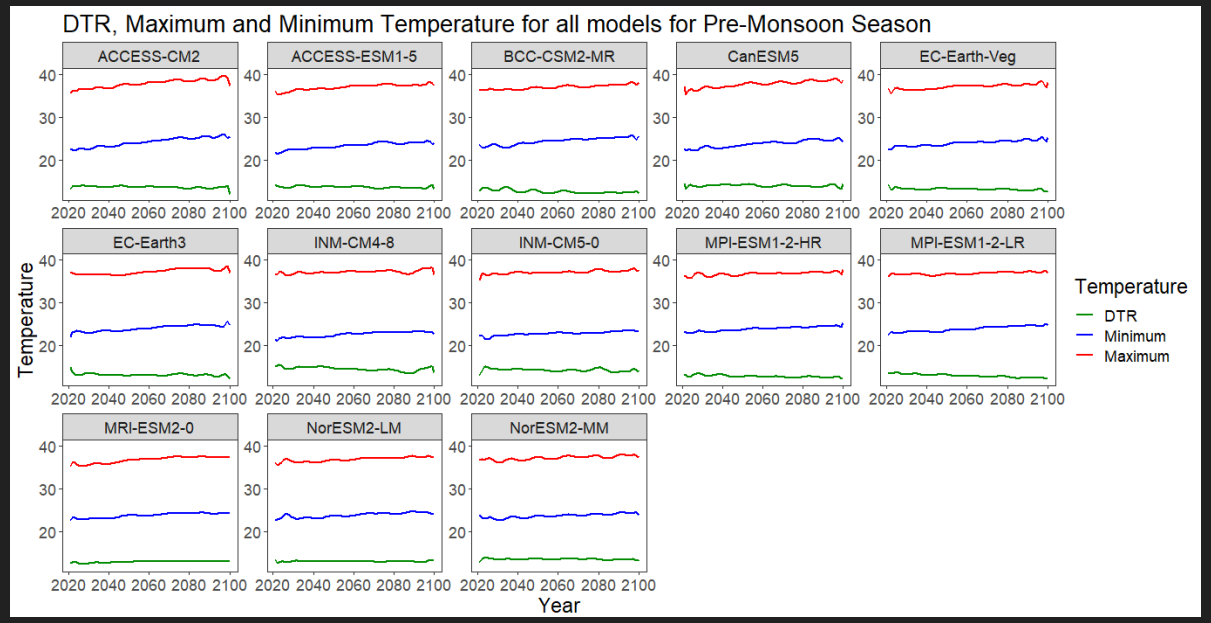
RESULTS AND DISCUSSION

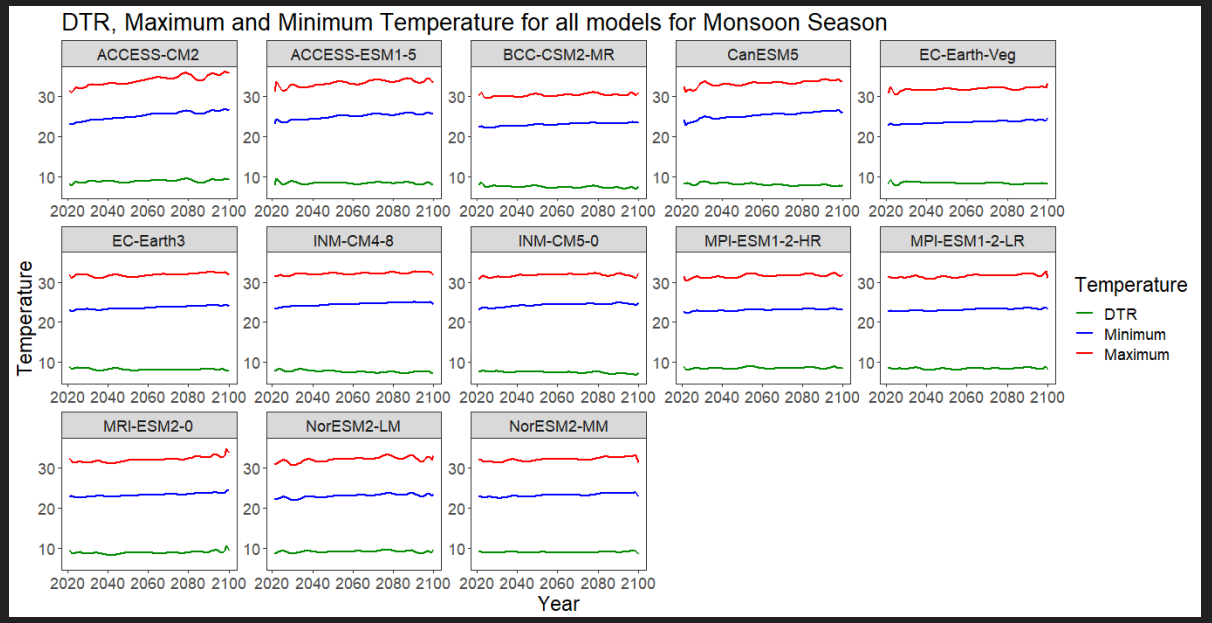


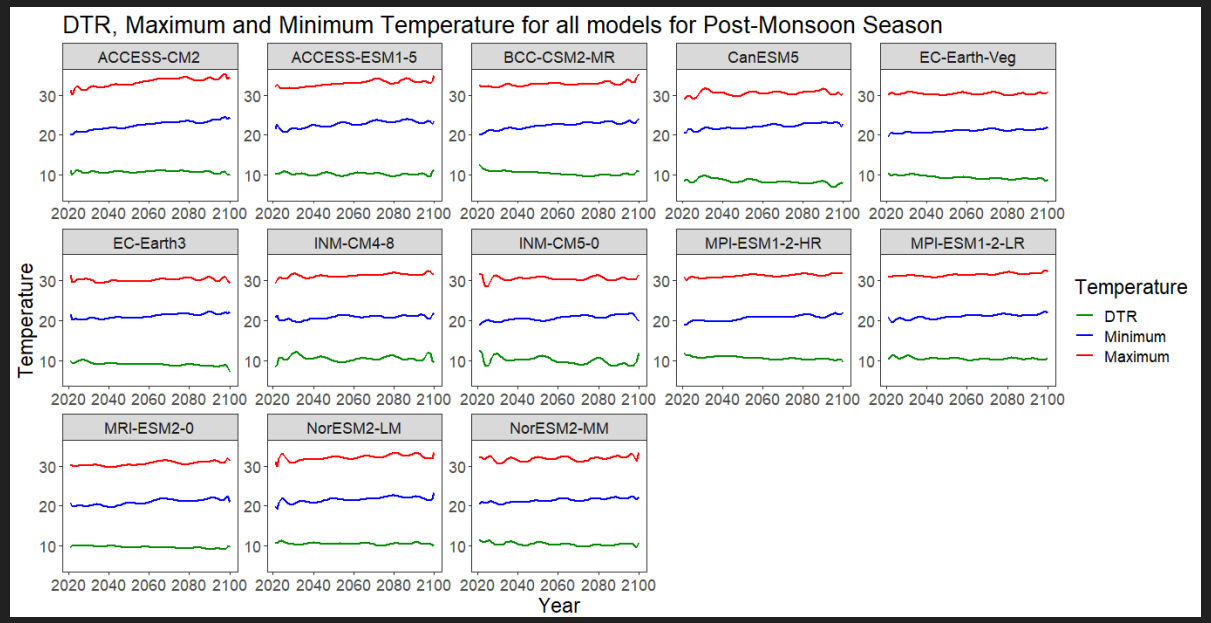


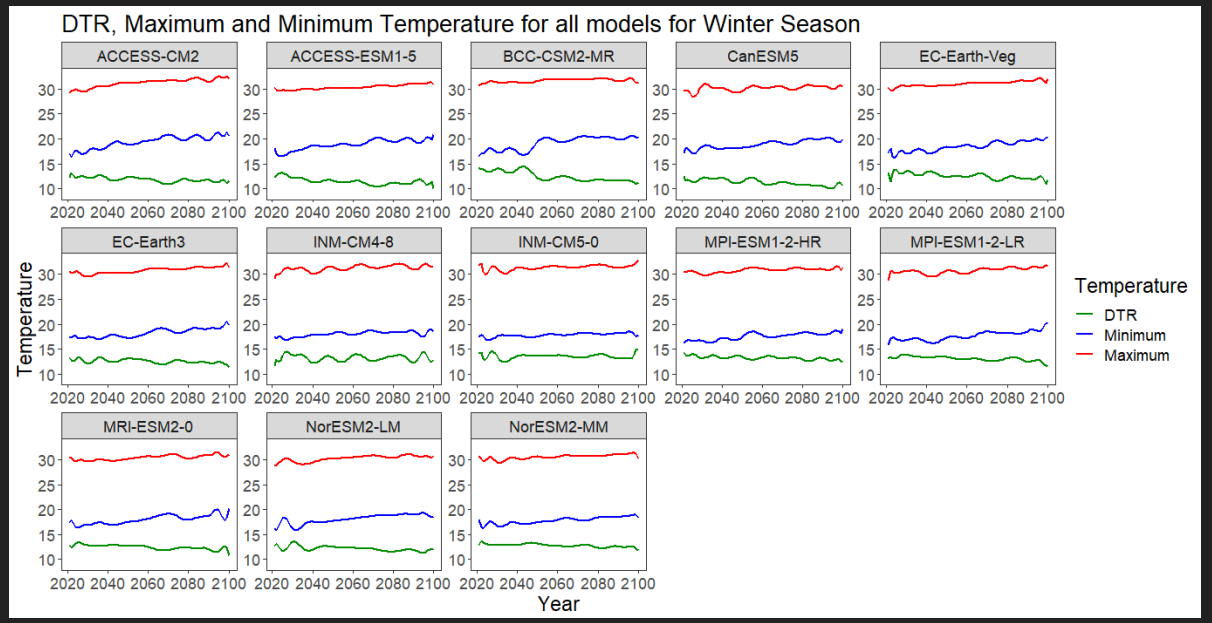


Graphs showing the original data points in black and the 10 (in red) and 25 (in blue) year moving average value for historical data, ssp245 and ssp585 models.



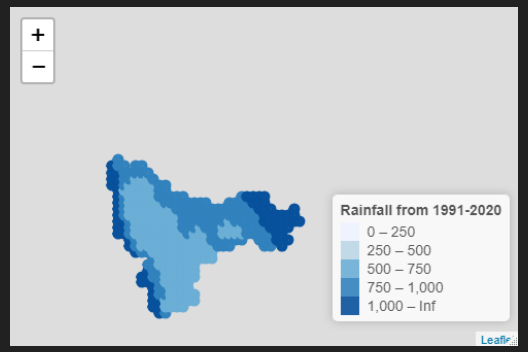


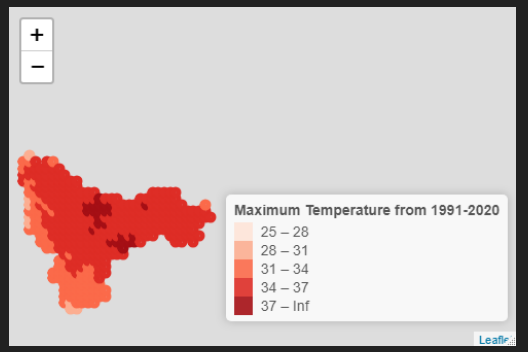


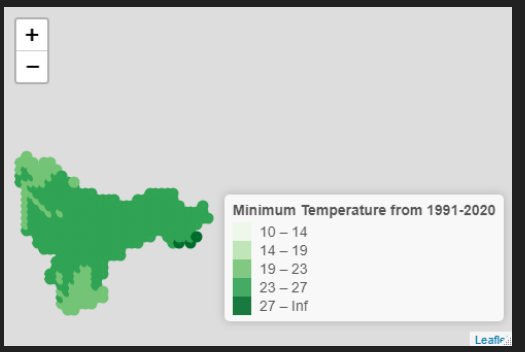


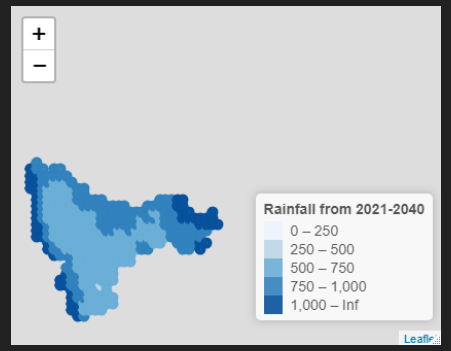
Graphs showing Maximum, Minimum Temperature with DTR for Pre-Monsoon, Monsoon, Post-Monsoon and Winter Season

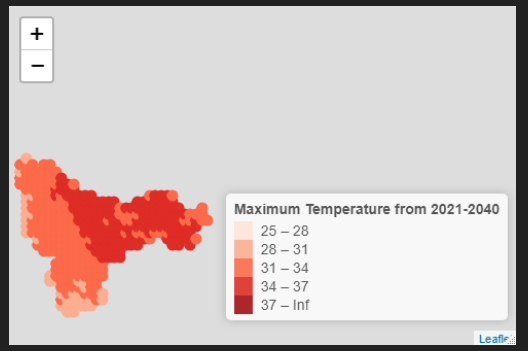
Maps showing Rainfall, Maximum and Minimum temperature over the years.

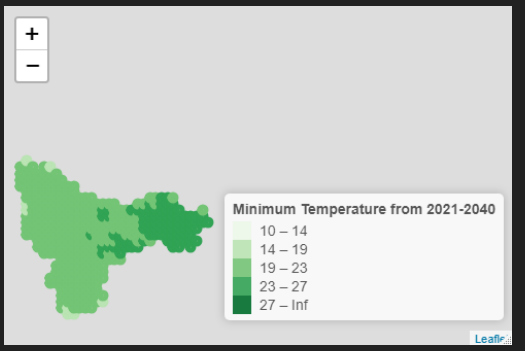


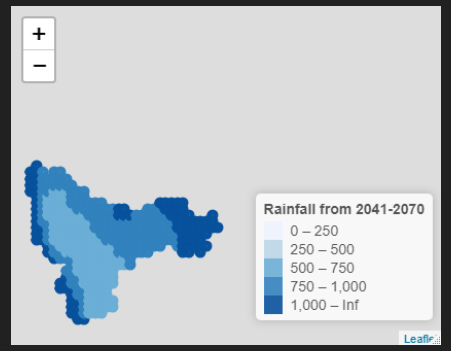


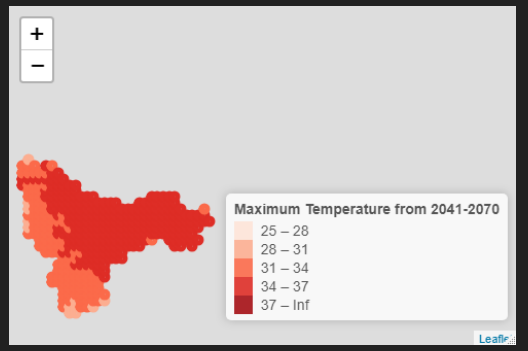


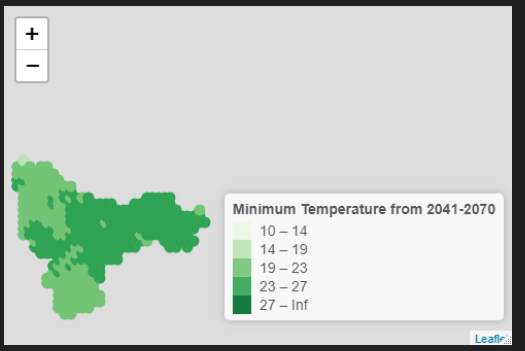


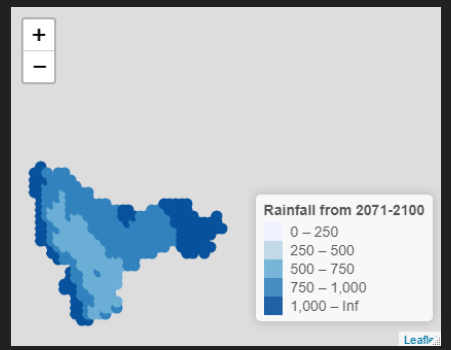


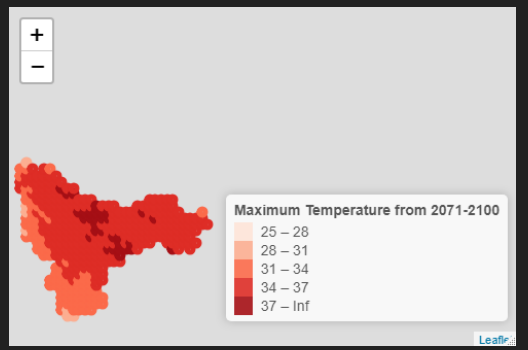


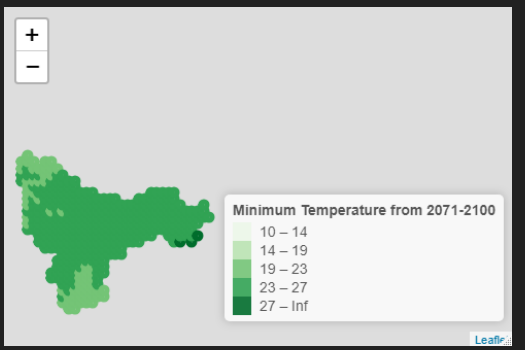


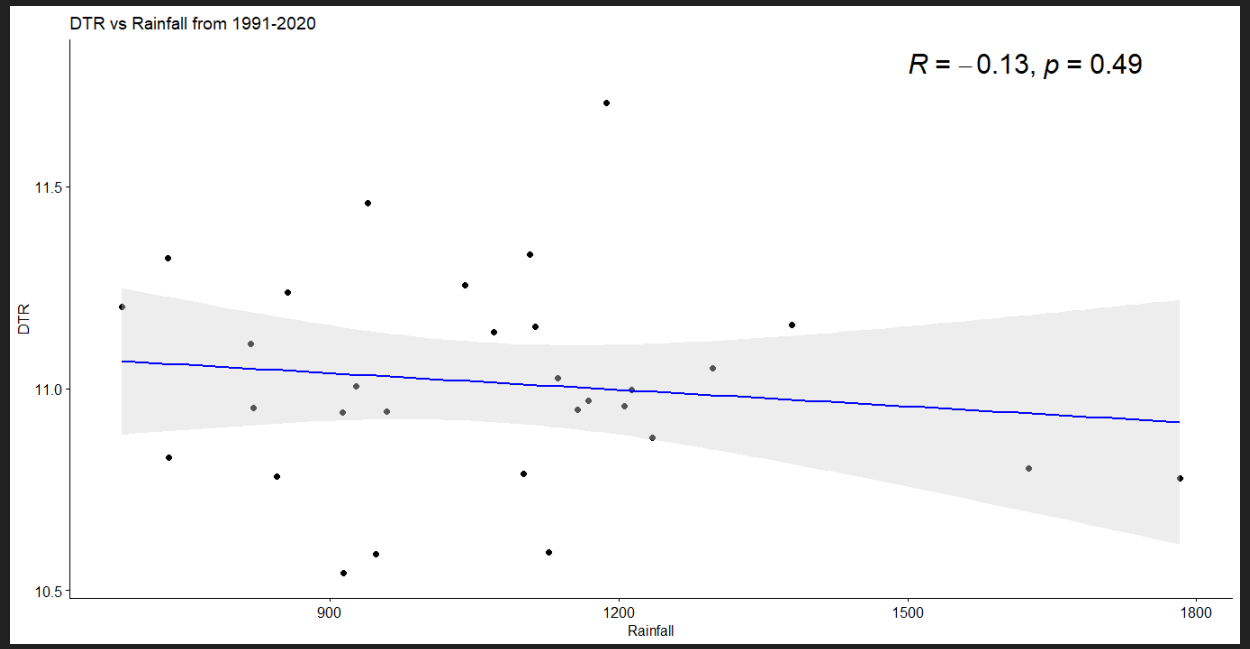


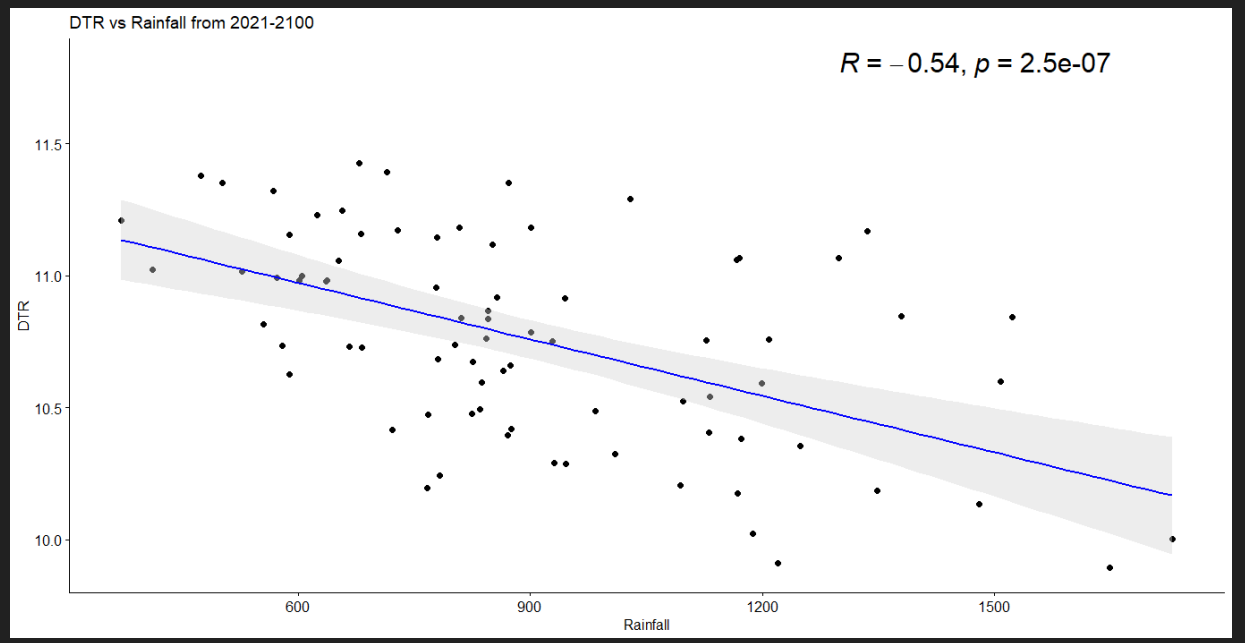


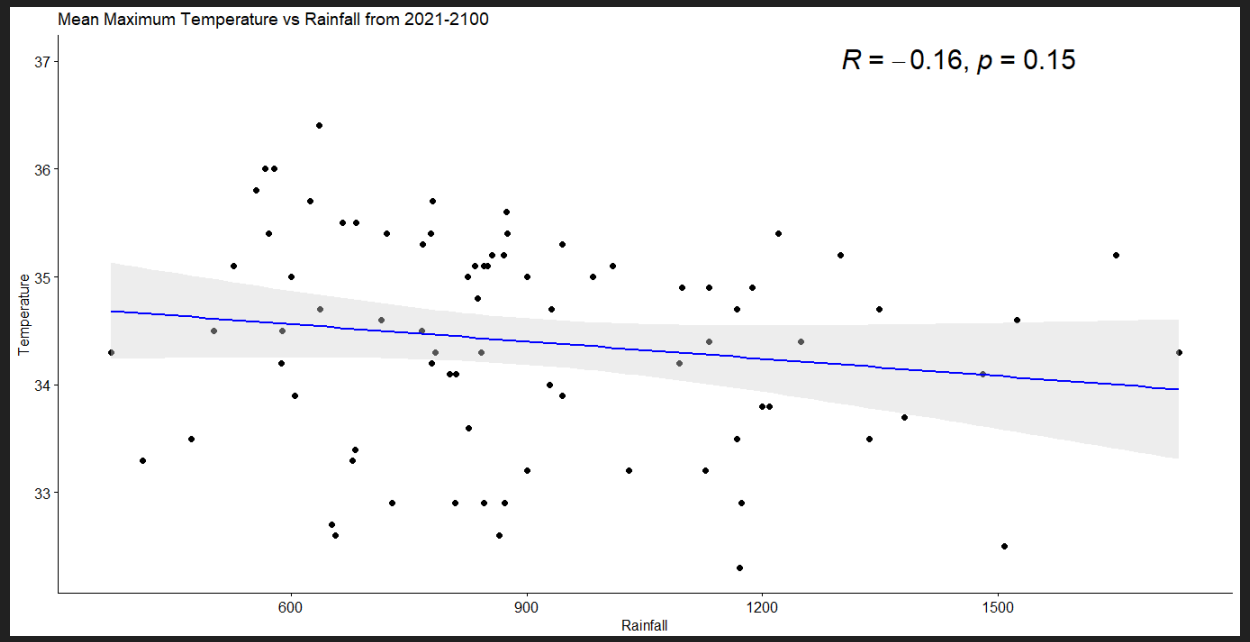


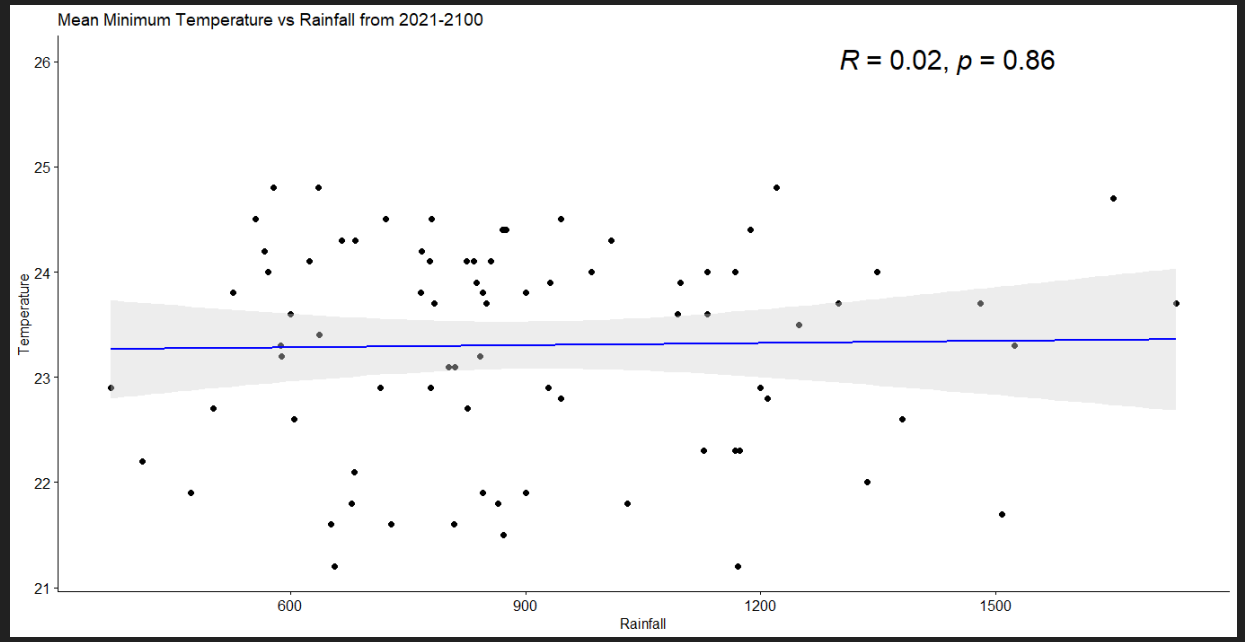




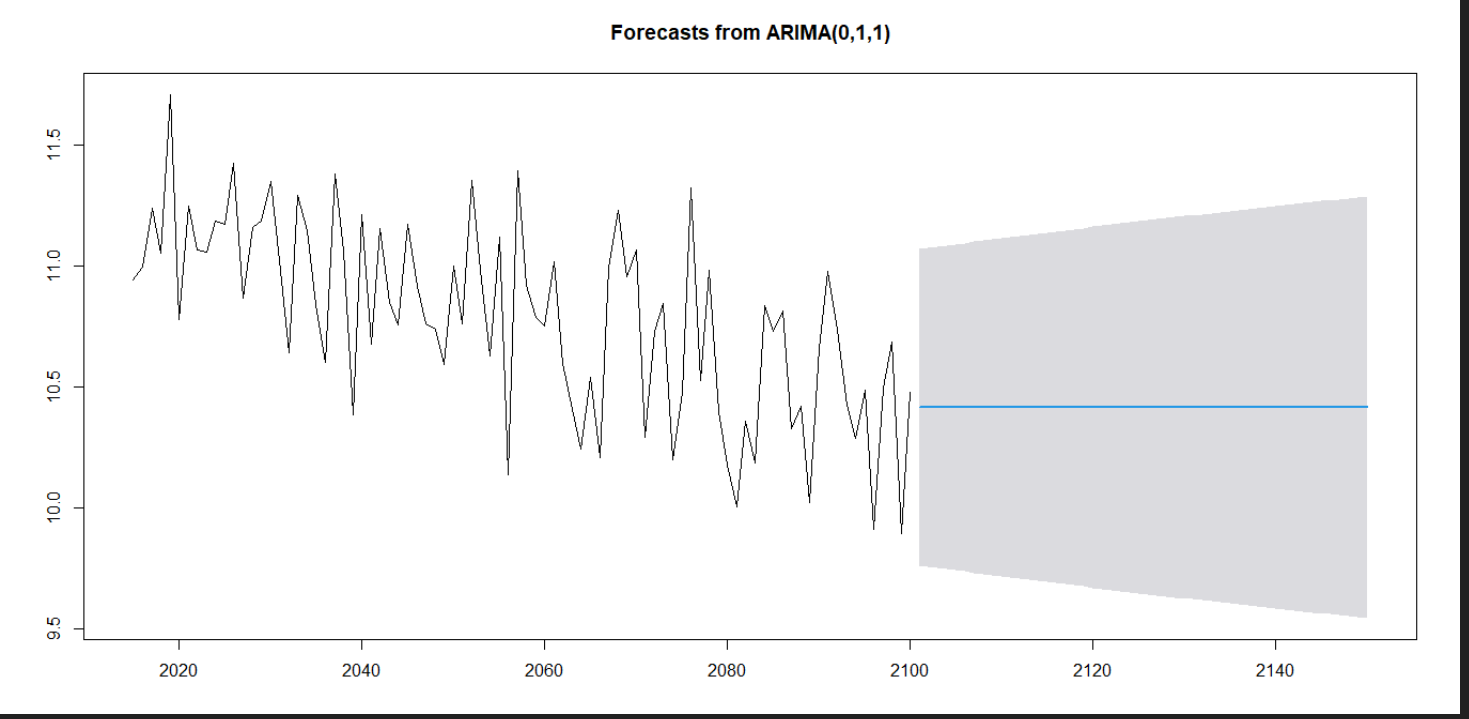






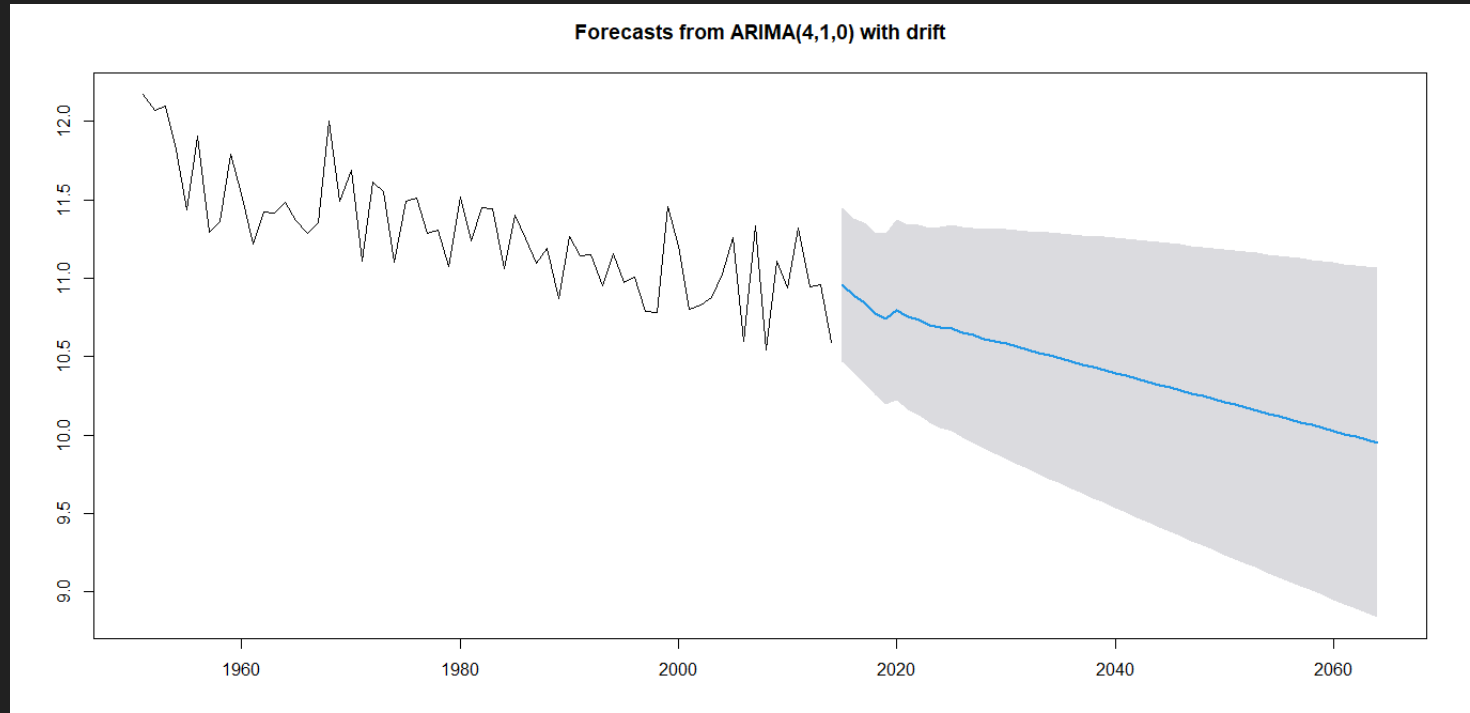


Scatterplot between DTR, Maximum and Minimum Temperature vs Rainfall with linear trend line at 95% confidence interval.



Graph showing forecasts for ssp245 data for ARIMA (0,1,1) for the nest 50 years

Graph showing forecasts for ssp585 data for ARIMA (0,1,1) for the next 50 years



CONCLUSION

- It was found that the maximum temperature has seen a rise of approximately 1.8°C and the minimum temperature has seen a rise of approximately 1.7°C from 1991-2020.
- Further, it was calculated that the maximum temperature will see a further rise of approximately 4.1°C and the minimum temperature will see a rise of approximately 3.6°C by 2100.

- A gradual and steady decrease in DTR is observed over the entire time period, 1951-2100. Seasonal and annual time scales both show decreasing trend in DTR and increasing trend Maximum and Minimum temperatures, except in the Monsoon season, where all factors remain mostly constant.
- Rainfall is seen to be increasing at a steady rate during the time period, 1991-2100. Warmer temperatures lead to higher precipitation.
- Correlation analysis showed that rainfall or precipitation has negative effect on DTR, i.e., with increase in rainfall, DTR decreases, which proves the above conclusion that DTR is decreasing and rainfall is increasing at the same time period. Correlation analysis between maximum and minimum temperatures and rainfall showed a minimal negative and positive relationship, respectively.