

**NATIONAL INSTITUTE OF TECHNOLOGY CALICUT  
G-18 PRESENTS**

# **A Curious Case of Bangalore**

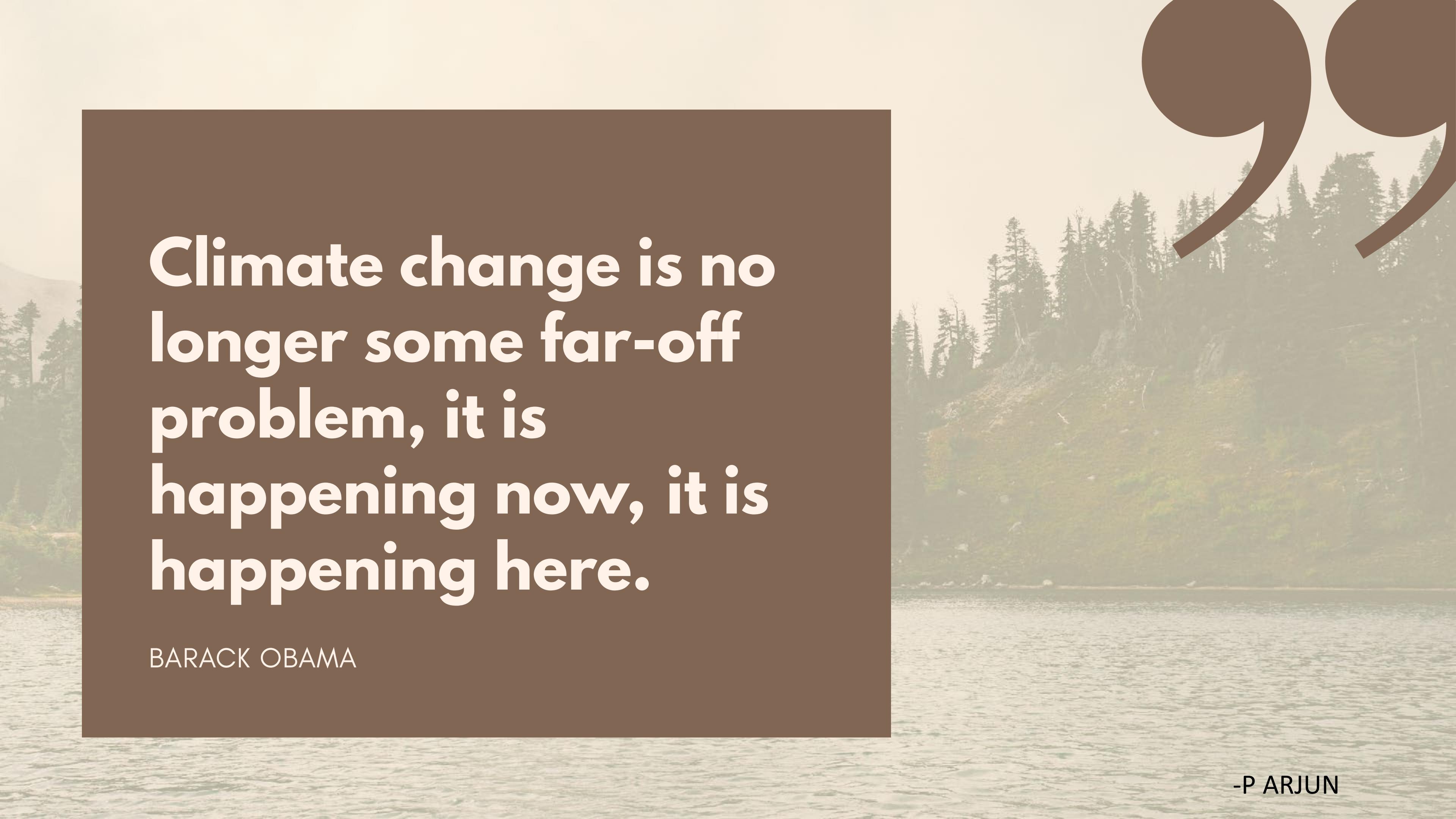
**Specific Case Study of Temperature of Bangalore Over Years**



# CONTENTS

## POINTS TO BE COVERED

- THE DATASETS
- METHODOLOGY
- GRAPHICAL ANALYSIS
- FACTS
- STORY 1 CORELATION BETWEEN TEMPERATURE AND EVAPOTRANSPIRATION
- STORY 2 THE THREAT OF INCREASING TEMPERATURE AND ITS IMPACTS
- CONCLUSION



**Climate change is no  
longer some far-off  
problem, it is  
happening now, it is  
happening here.**

BARACK OBAMA

-P ARJUN

# THE DATASETS

- MODIS\_AOD/AOD
- ERA5\_T/Temperature
- MODIS\_EVAPO/Evapotranspiration
- MODIS\_Green/NDVI & EVI
- NEX\_Precip/Precipitation

# METHODOLOGY

## MERGING THE DATASETS

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- AOD
- EVAPOTRANSPIRATION
- NDVI MEAN
- EVI MEAN
- PRECIPITATION
- TEMPERATURE

## PLOTTING AND ANALYSIS

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Correlation Analysis is done. Different curves are plotted to analyze the trends of the data and to find the relation between different variables. We chose Input (AOD, NDVI Mean and Evapotranspiration) to determine Output (Future Mean Temperature).

## REGRESSION ANALYSIS

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The future values of the selected values are determined with the help of Linear Regression. The curves are fitted quarterly. Future trends of the Input variables are determined.

## FINAL OUTPUT

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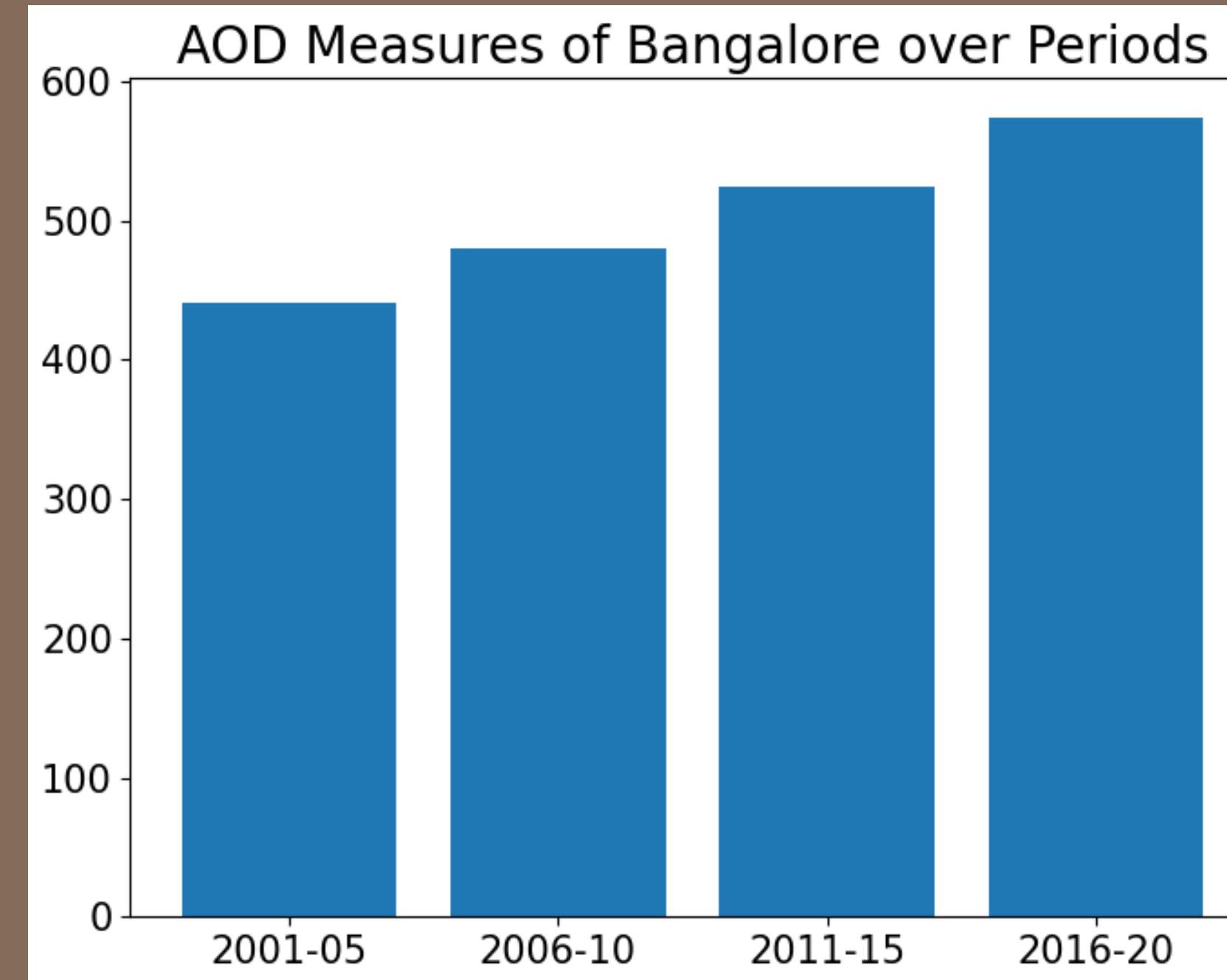
With the future and past values of the input variables, the future mean temperatures are predicted. using Linear Regression and Support Vector Regressor. The curves here too are fitted quarterly.

# AOD

## AOD MEASURES OF BANGALORE OVER PERIOD 2001-20

Aerosol optical depth is a measure of the extinction of the solar beam by dust and haze. In other words, particles in the atmosphere (dust, smoke, pollution) can block sunlight by absorbing or by scattering light.

Unit of AOD is lumen.





## AEROSOL OPTICAL DENSITY

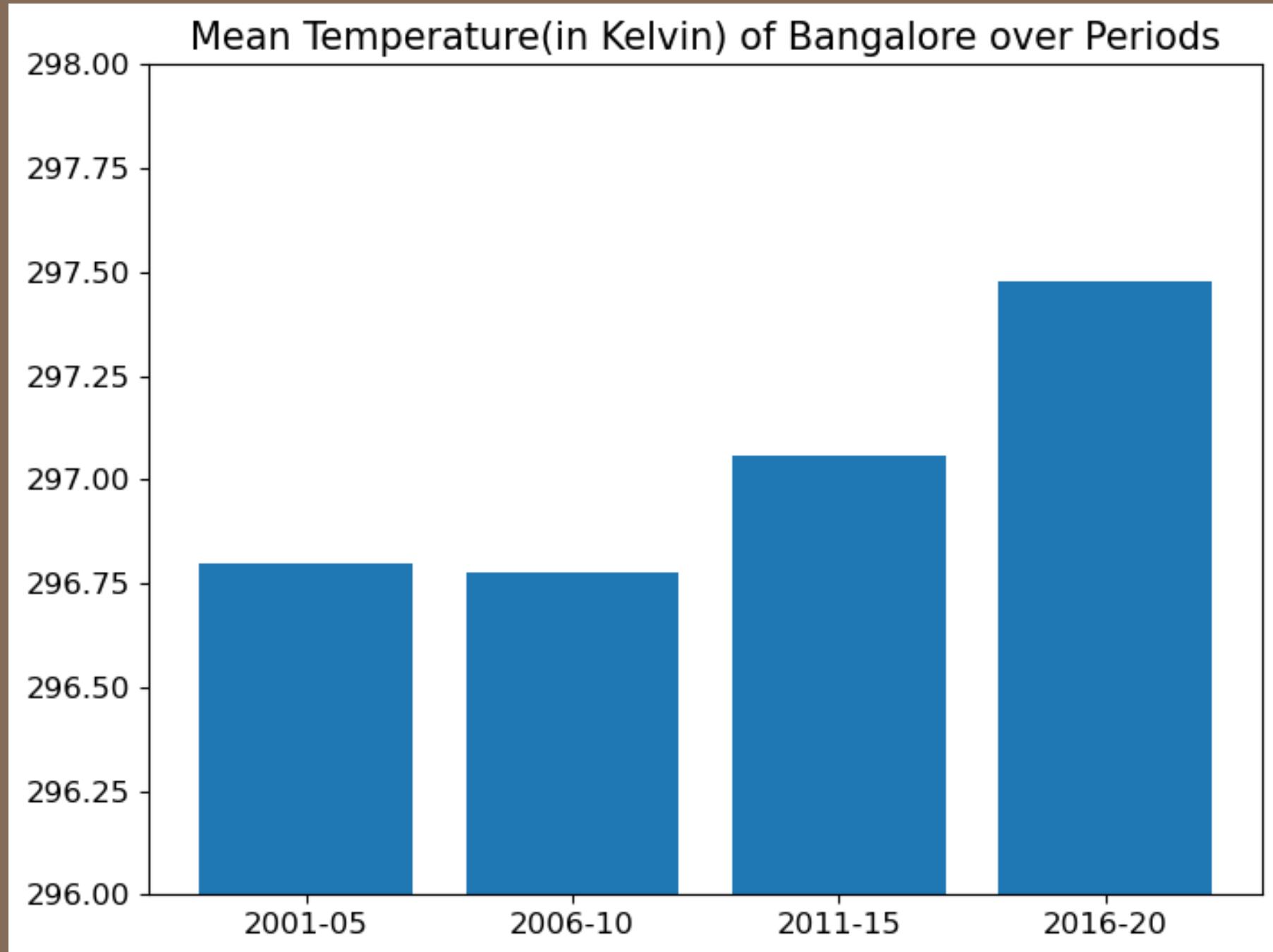
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- Measure of the extinction of the solar beam by dust and haze
- Increase in AOD over years
- More smoke and dust in the troposphere and stratosphere

# TEMPERATURE

## THE CHANGE OF TEMPERATURE OF BANGALORE OVER PERIOD 2001-20

Temperature is a quantity signifying the hotness or coldness at different levels of atmosphere. Unit of Measure of Temperature is Kelvin.





## TEMPERATURE

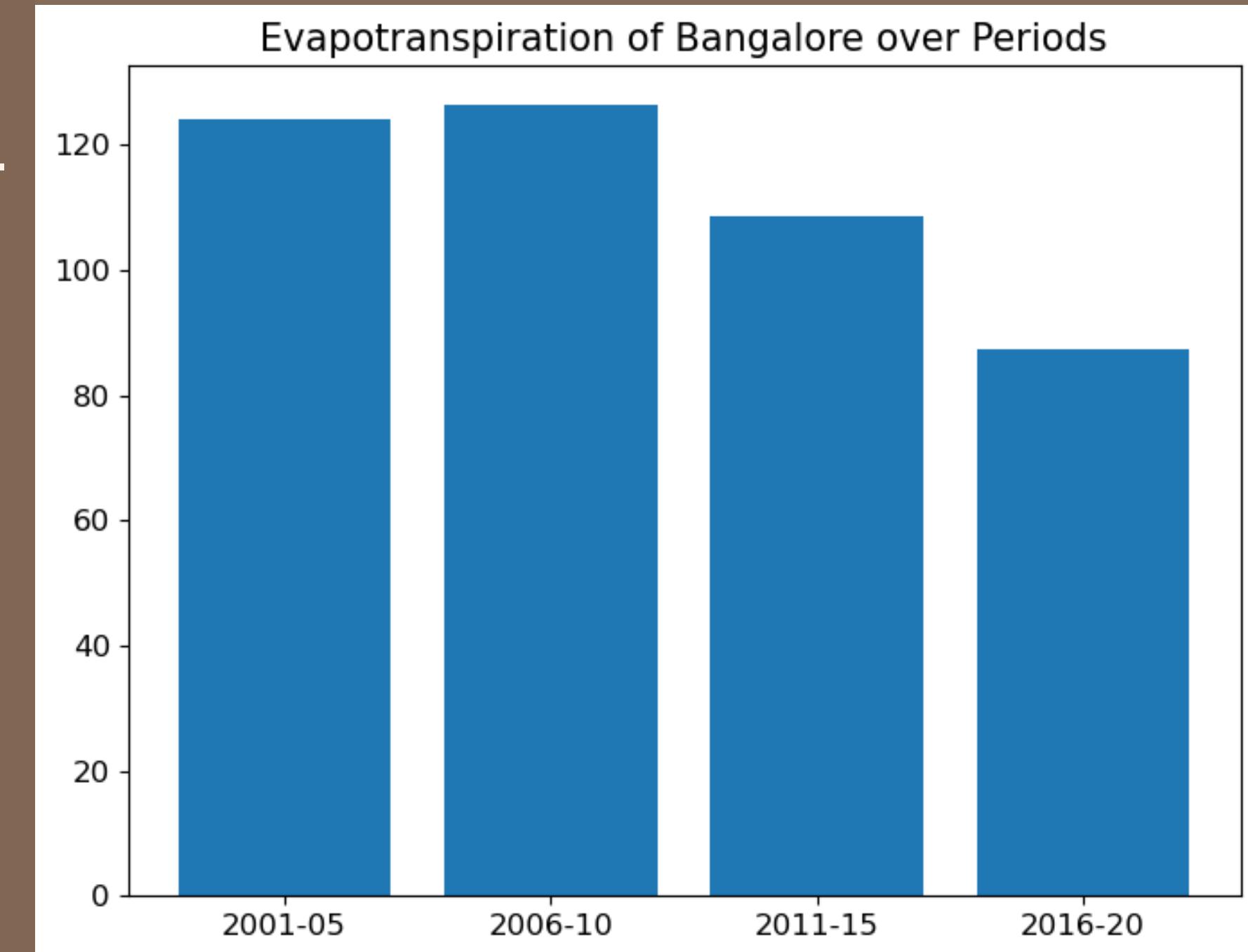
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- *Measure of hotness or coldness at different layers of atmosphere*
- *Increase in temperature over years*

# EVAPOTRANSPIRATION

## EVAPOTRANSPIRATION OF BANGALORE OVER PERIOD 2001-20

Evapotranspiration is the sum of transpiration i.e evaporating water from leaves through plant transpiration during photosynthesis and sum of evaporation from the Earth's land and ocean surface to the atmosphere. It varies because of a multitude of factors like wind, temperature, humidity, and water availability. The unit of measure of Evapotranspiration used is mm/time.





## EVAPOTRANSPIRATION

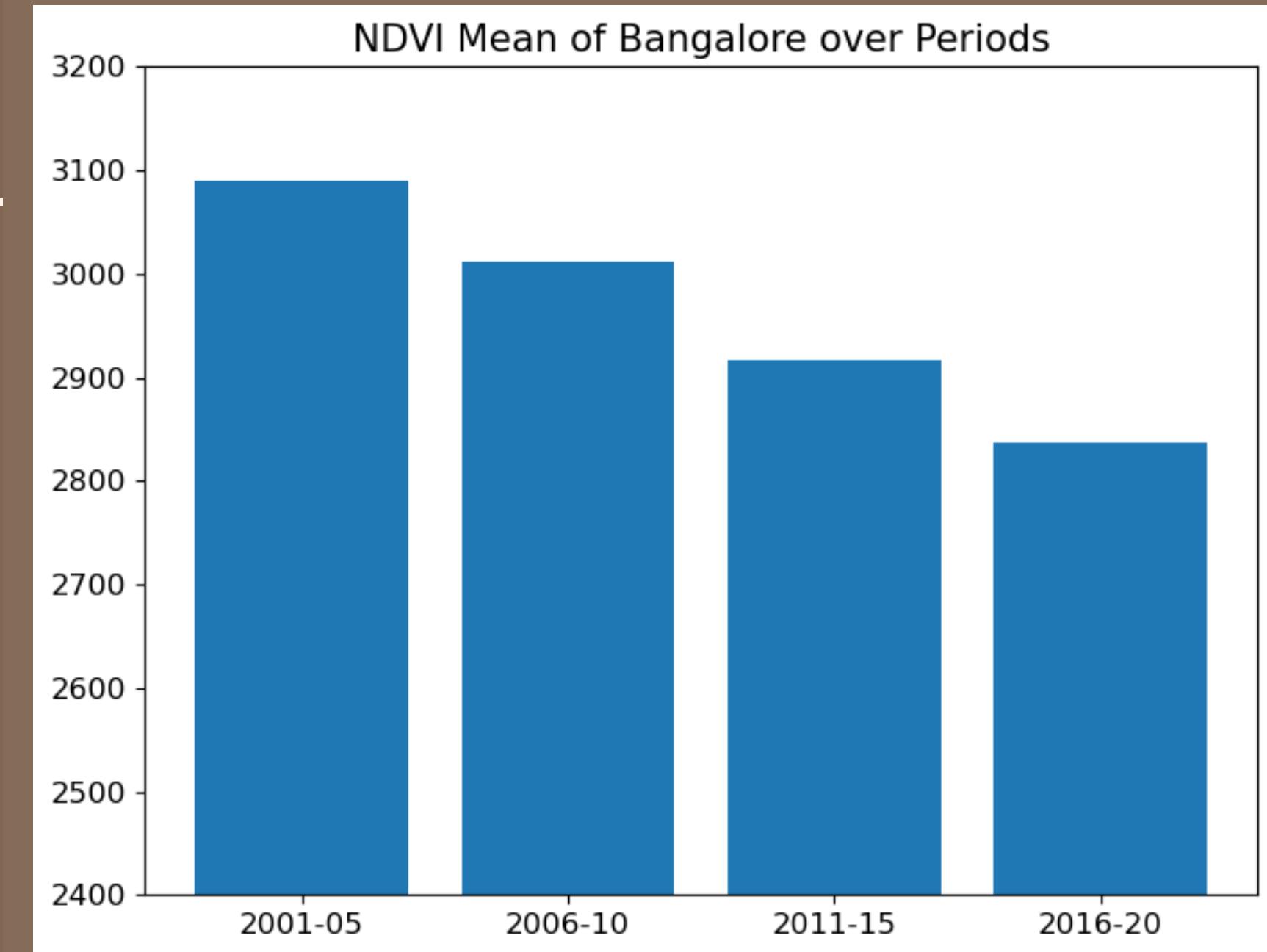
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- *Measure of total change of water to vapour*
- *Decrease in Evapotranspiration over years*

# NDVI MEAN

## NDVI MEAN OF BANGALORE OVER PERIOD 2001-20

The normalized difference vegetation index (NDVI) is a simple graphical indicator that can be used to analyze remote sensing measurements, often from a space platform, assessing whether or not the target being observed contains live green vegetation.





## NDVI MEAN

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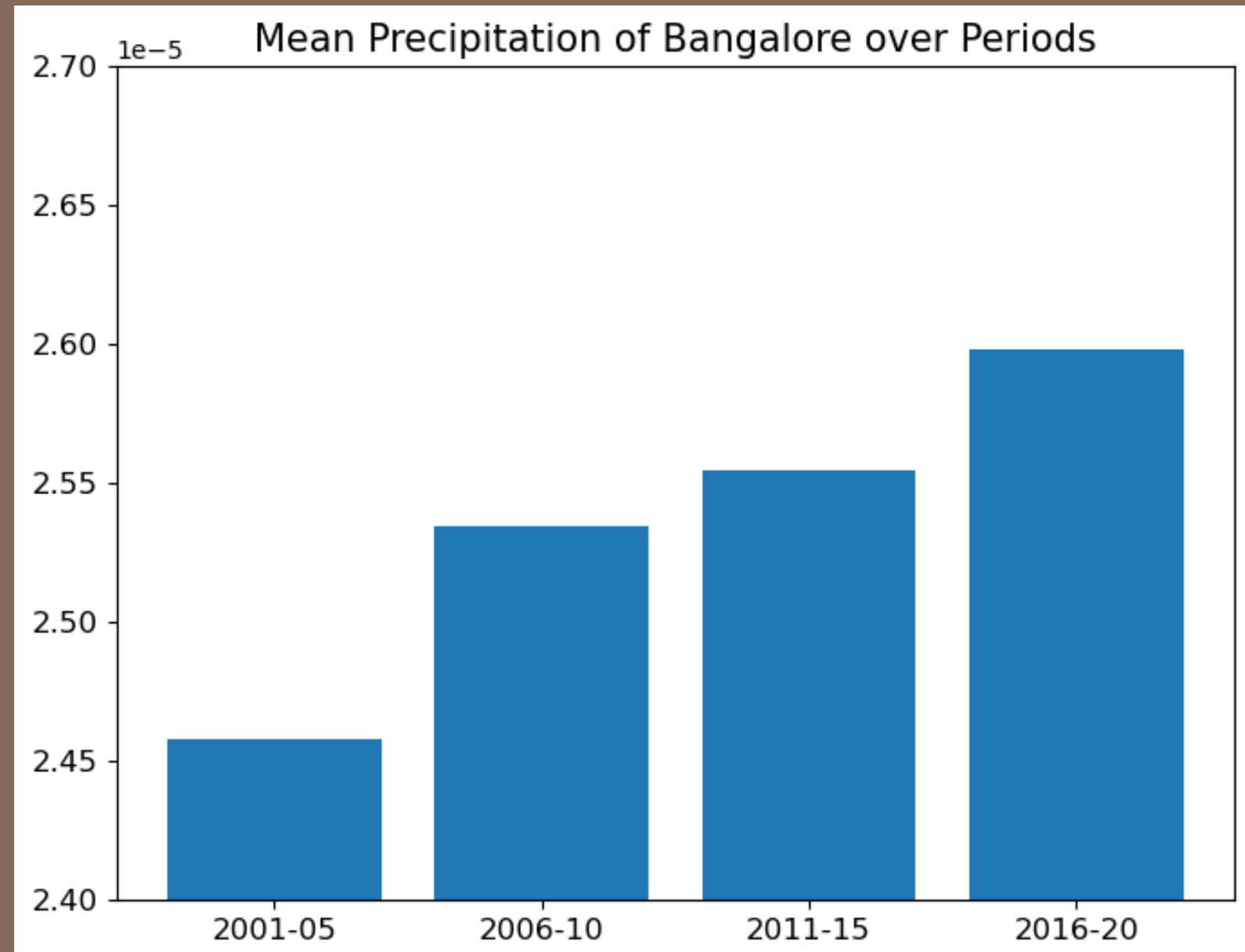
- *Measure of green land cover over a region*
- *Decrease in the values over time*

# PRECIPITATION

## MEAN PRECIPITATION OF BANGALORE OVER PERIOD

Precipitation is any product of the condensation of atmospheric water vapor that falls under gravity from clouds. The main forms of precipitation include drizzle, rain, sleet and snow.

Unit of measure of precipitation is centimetre.





## PRECIPITATION

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- *Measure of total rainfall in a region*
- *Increase in precipitation over years*

# TRUE FACTS

DERIVED FROM  
THE STATISTICS  
OF LAST TWO  
DECADES



**29.52%**

DECREASE IN  
EVAPOTRANSPIRATION

**30.03%**

INCREASE IN DUST AND SMOKE

**2.87%**

INCREASE IN TEMPERATURE

**5.68%**

INCREASE IN RAINFALL

**8.13%**

DECREASE IN GREEN COVER

-VIMAL RAJESH

# OUR STORY

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A CURIOUS CASE  
OF BANGALORE

PART 1

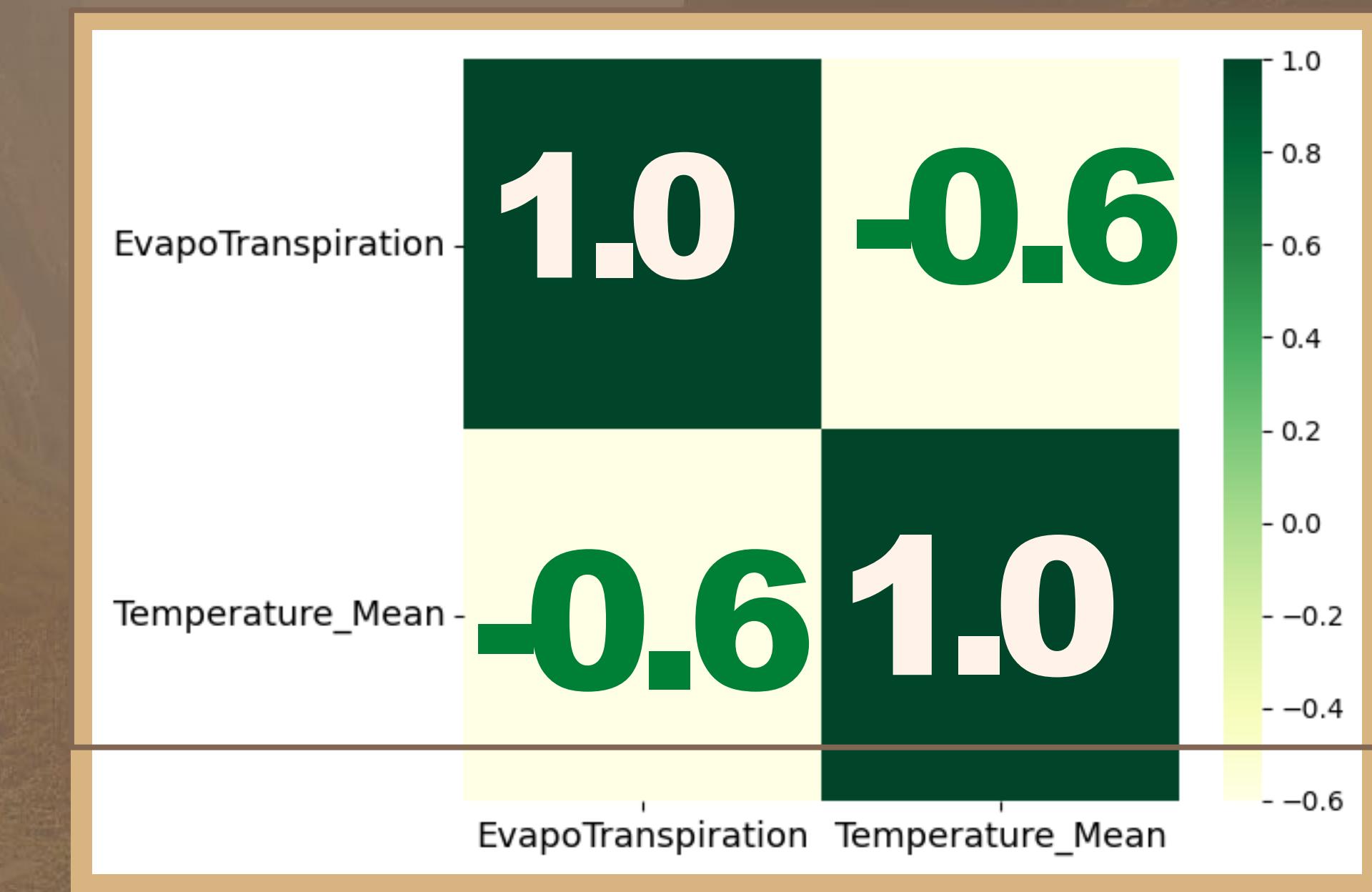
NEGATIVE CORRELATION OF  
EVAPOTRANSPIRATION AND  
TEMPERATURE IN BANGALORE

PART 2

THE THREAT OF INCREASING  
TEMPERATURE AND ITS FUTURE  
IMPLICATIONS



# CORRELATION BETWEEN EVAPOTRANSPIRATION AND TEMPERATURE IN LAST TWO DECades





*What does it*  
**SIGNIFY?**

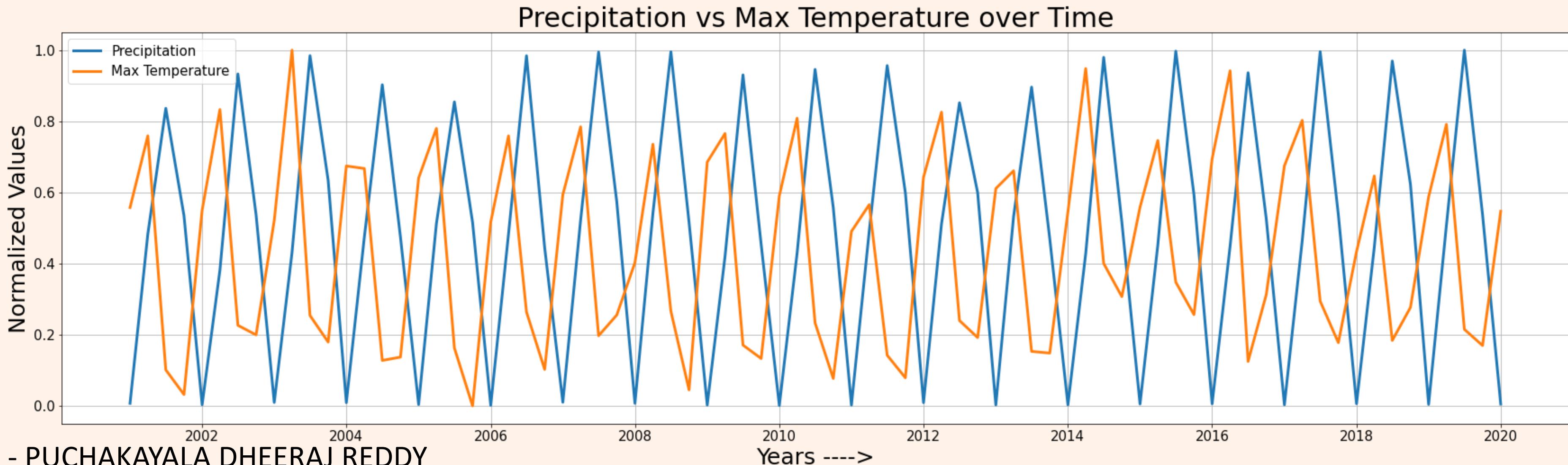
# WHAT IS INVERSE CORRELATION ?

USUAL RELATION BETWEEN TEMPERATURE AND EVAPOTRANSPIRATION

*Temperature and Evapotranspiration are usually positively correlated.  
As increase in temperature increase both evaporation and transpiration*

INVERSE CORRELATION

*It is a contrary relationship between two variables, such that when one variable decrease other increases.*



# REASONS FOR NEGATIVE CORRELATION



*Cold and Dry Climate*



*High Altitude of 920m  
(3000ft) above sea level  
(the highest among the  
major cities of India)*

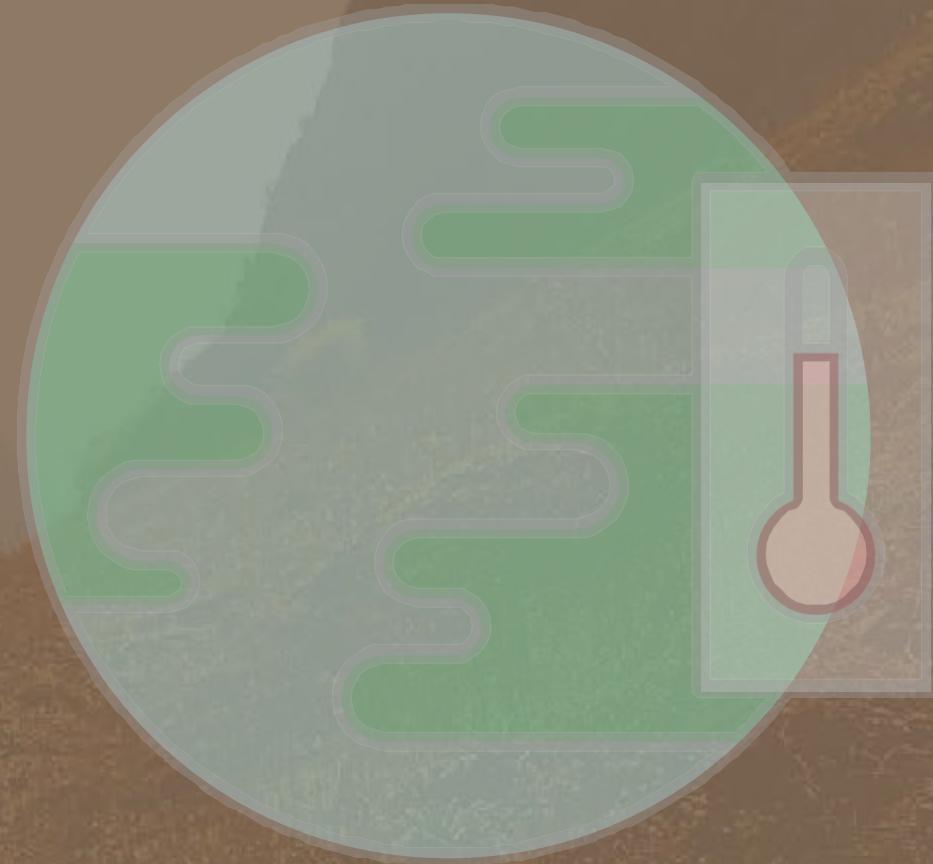


*Higher Wind Speeds*



*Far from Large Water  
Bodies*

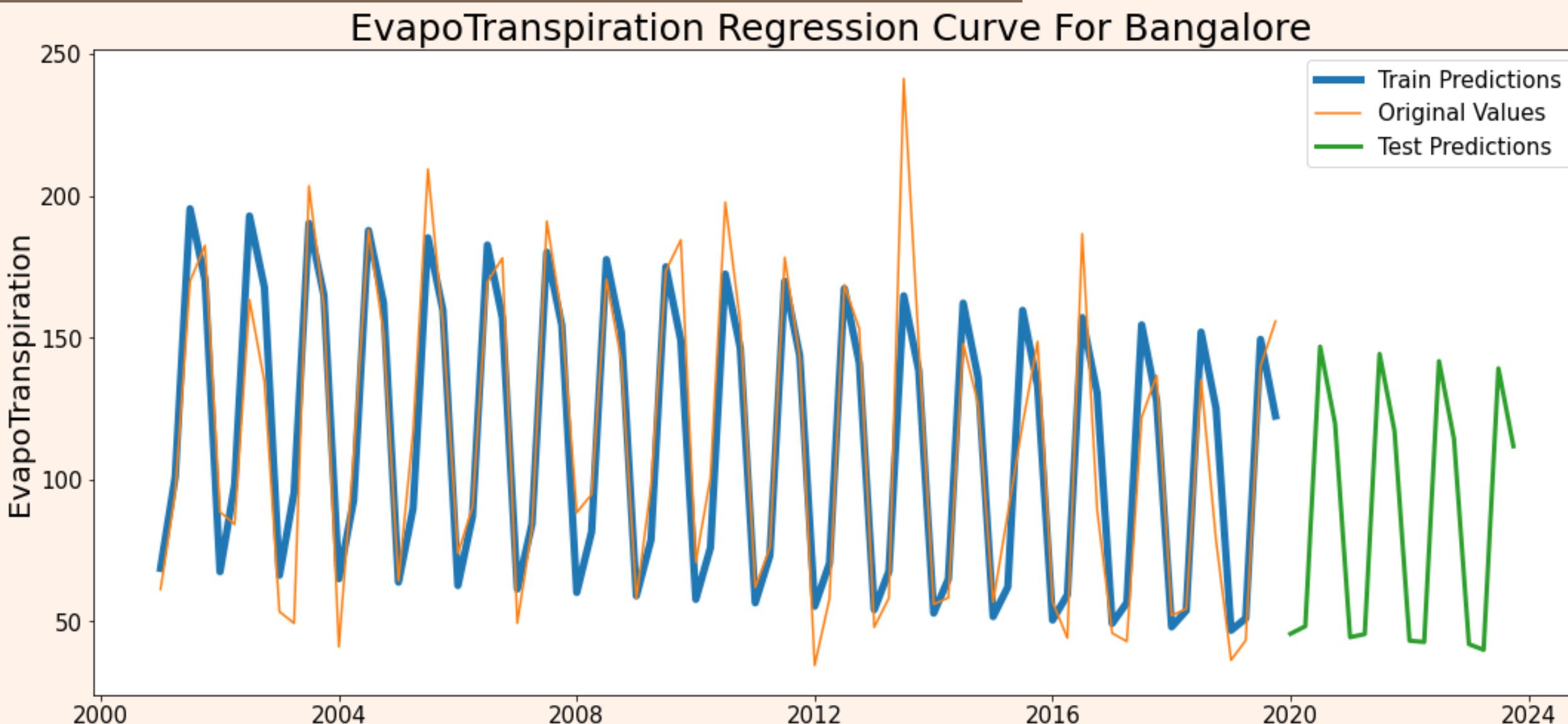
# THE THREAT OF INCREASING TEMPERATURE AND ITS FUTURE IMPLICATIONS



# REGRESSION CURVE FOR EVAPOTRANSPIRATION

THE R2 SCORE FOR OUR MODEL IS 0.8551674278721275

- Gradually decreasing Evapotranspiration over time
- Curves Fitted:
  - a) Q1 - Linear Regression
  - b) Q2 - Linear Regression
  - c) Q3 - Linear Regression
  - d) Q4 - Linear Regression



WE CAN SEE THAT OUR MODEL  
REASONABLY FITS THE ORIGINAL  
VALUES CURVE AND WE CAN  
OBSERVE THE DECREASING TREND  
OF EVAPOTRANSPIRATION WHICH  
COULD BE INDICATING HIGHER  
TEMPERATURES AND LESSER  
VEGETATION COVER AS SOME OF  
THE REASONS.

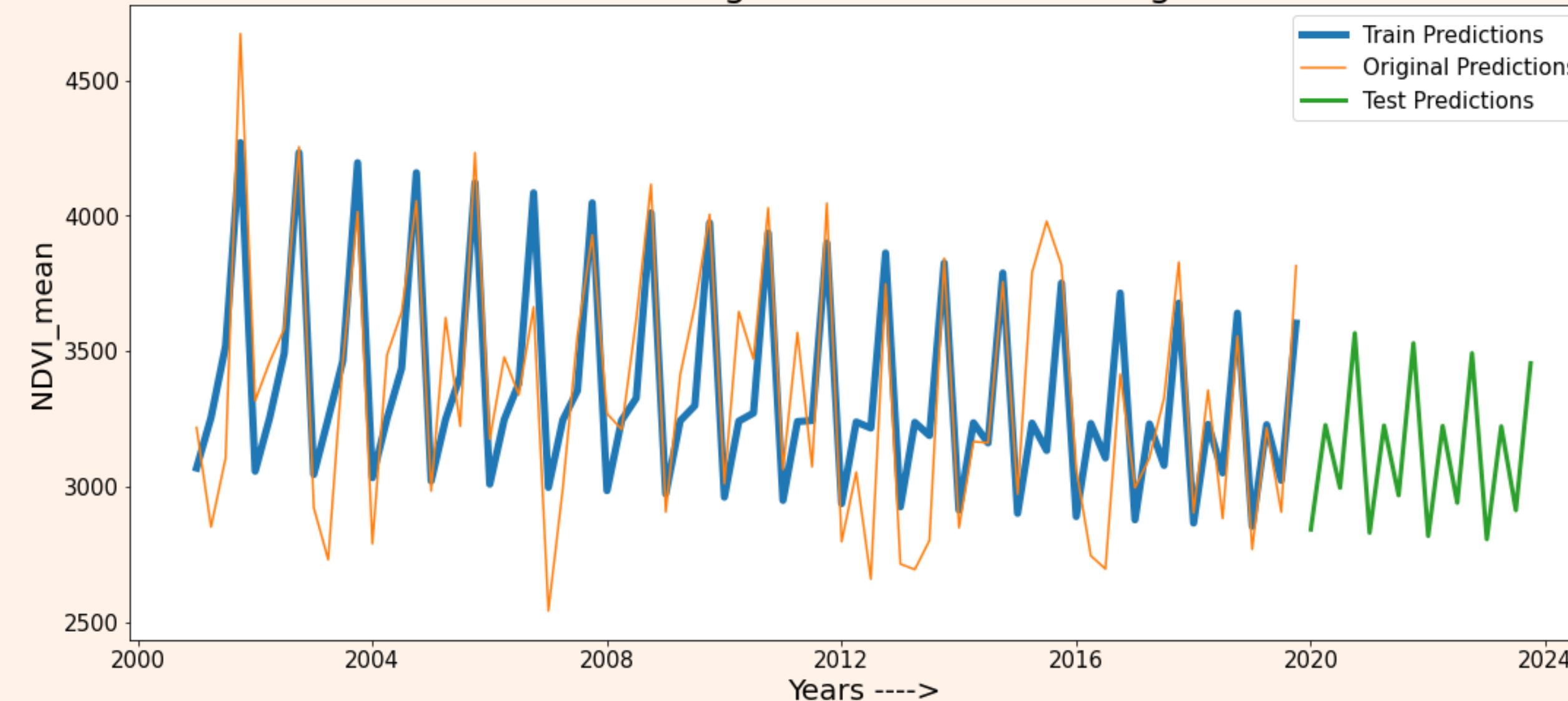
- PUCHAKAYALA DHEERAJ REDDY

# REGRESSION CURVE FOR NDVI MEAN

THE R2 SCORE FOR NDVI MEAN MODEL = 0.6754288842109899

- Gradually decreasing green tree coverage
- Curves Fitted:
  - a) Q1 - Linear Regression
  - b) Q2 - Linear Regression
  - c) Q3 - Linear Regression
  - d) Q4 - Linear Regression

NDVI Mean Regression Curve For Bangalore



THE REGRESSION CURVE FITS  
REASONABLY WELL ONCE  
AGAIN. WE CAN OBSERVE THE  
VEGETATION COVER IS  
DECREASING SLOWLY AND  
STEADILY WITH A FEW SPIKES.

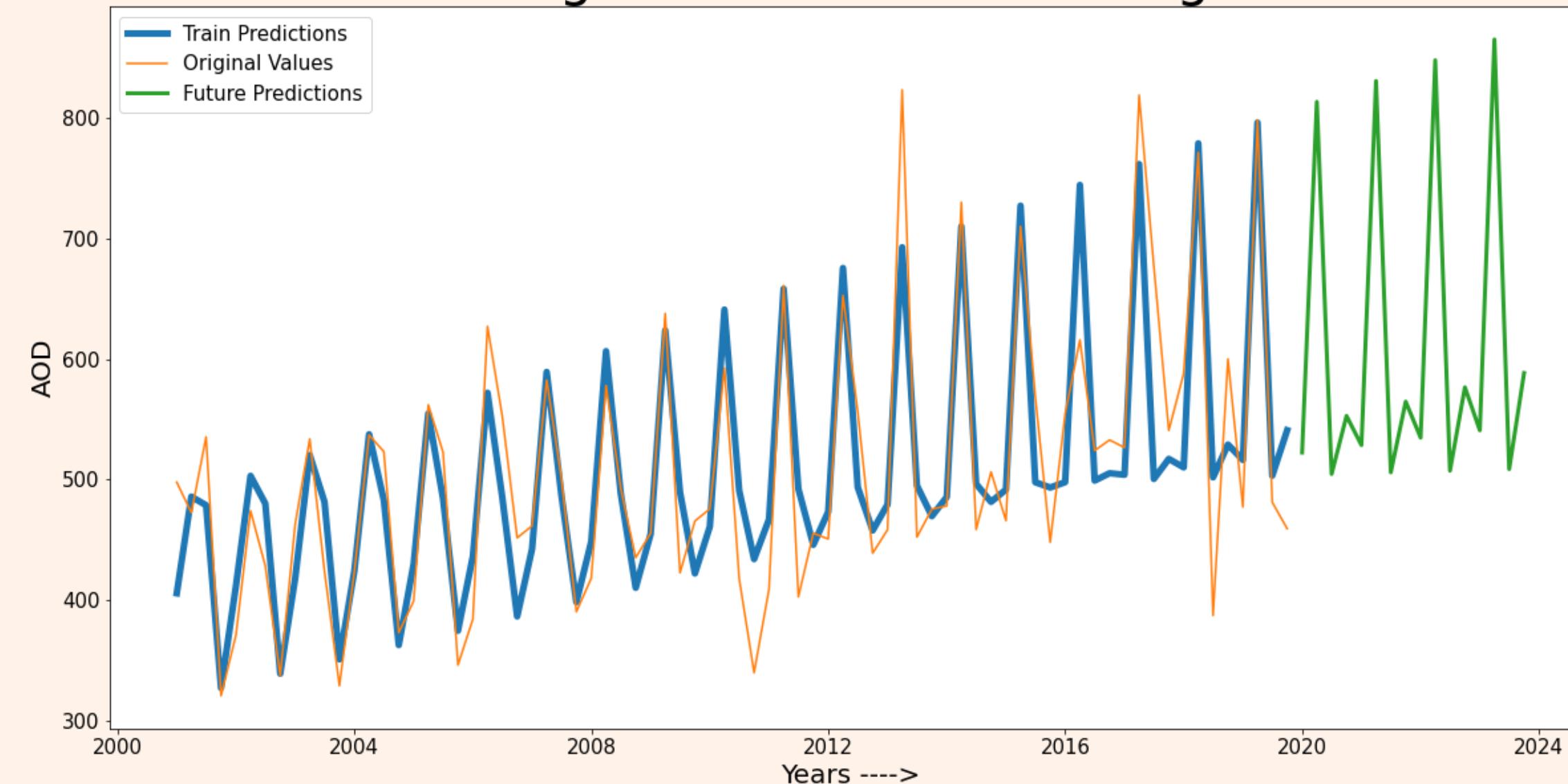
-P ARJUN

# REGRESSION CURVE FOR AOD

THE R2 SCORE FOR THIS AOD MODEL = 0.7872749465378956

- Gradually increasing AOD values
- Curves Fitted:
  - a) Q1 - Linear Regression
  - b) Q2 - Linear Regression
  - c) Q3 - Linear Regression
  - d) Q4 - Linear Regression

AOD Regression Curve For Bangalore



THE REGRESSION CURVE FITS  
REASONABLY WELL AND WE CAN SEE  
THAT AOD HAS BEEN INCREASING  
OVER THE PAST FEW YEARS AND WILL  
CONTINUE TO INCREASE.

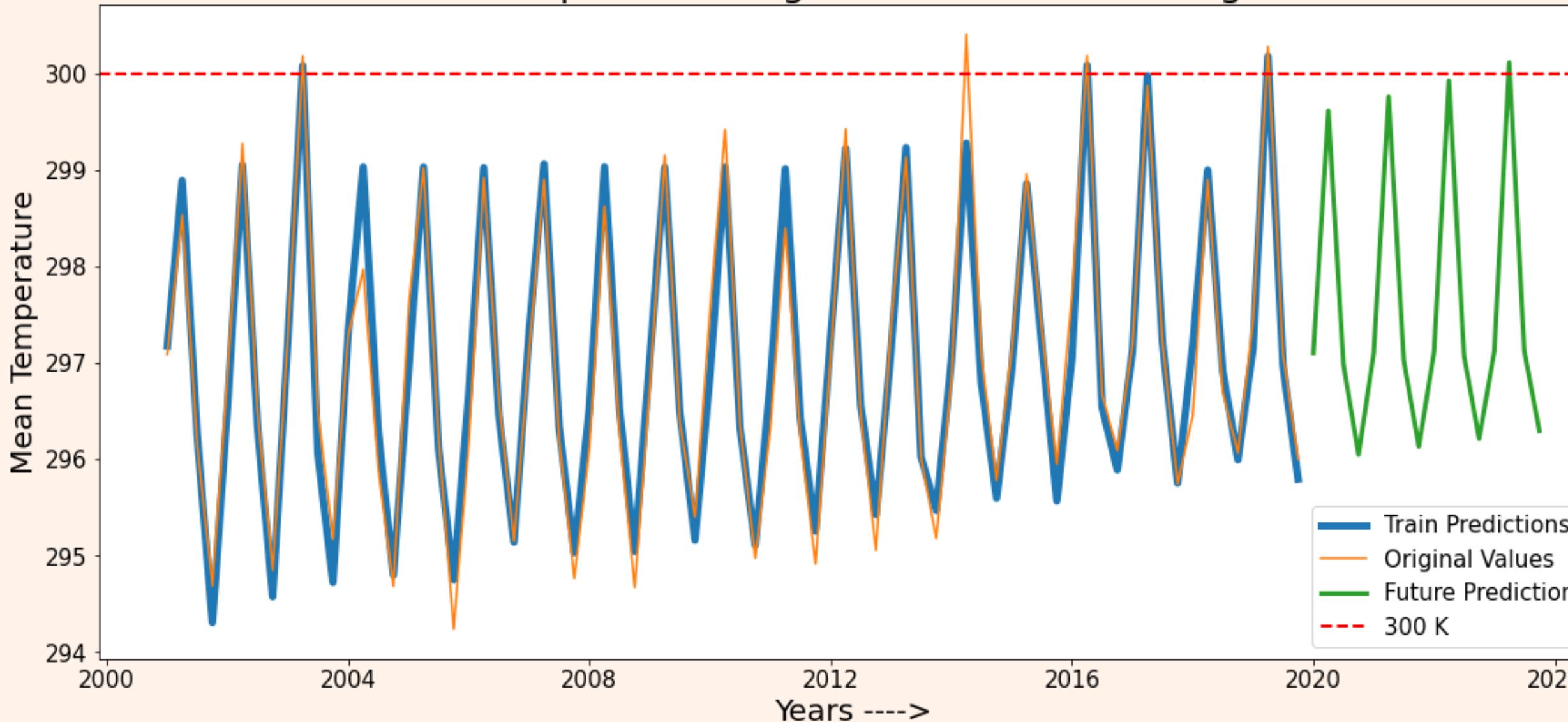
- KUNAL RAVIKUMAR JAGTAP

# REGRESSION CURVE FOR TEMPERATURE

THE R2 SCORE FOR THIS TEMPERATURE MODEL = 0.9511385775390162

- Gradually increasing temperature values over time.
- Curves Fitted:
  - a) Q1 - Linear Regression
  - b) Q2 - Support Vector Regression (SVR)
  - b) Q2 - Linear Regression
  - d) Q4 - Linear Regression

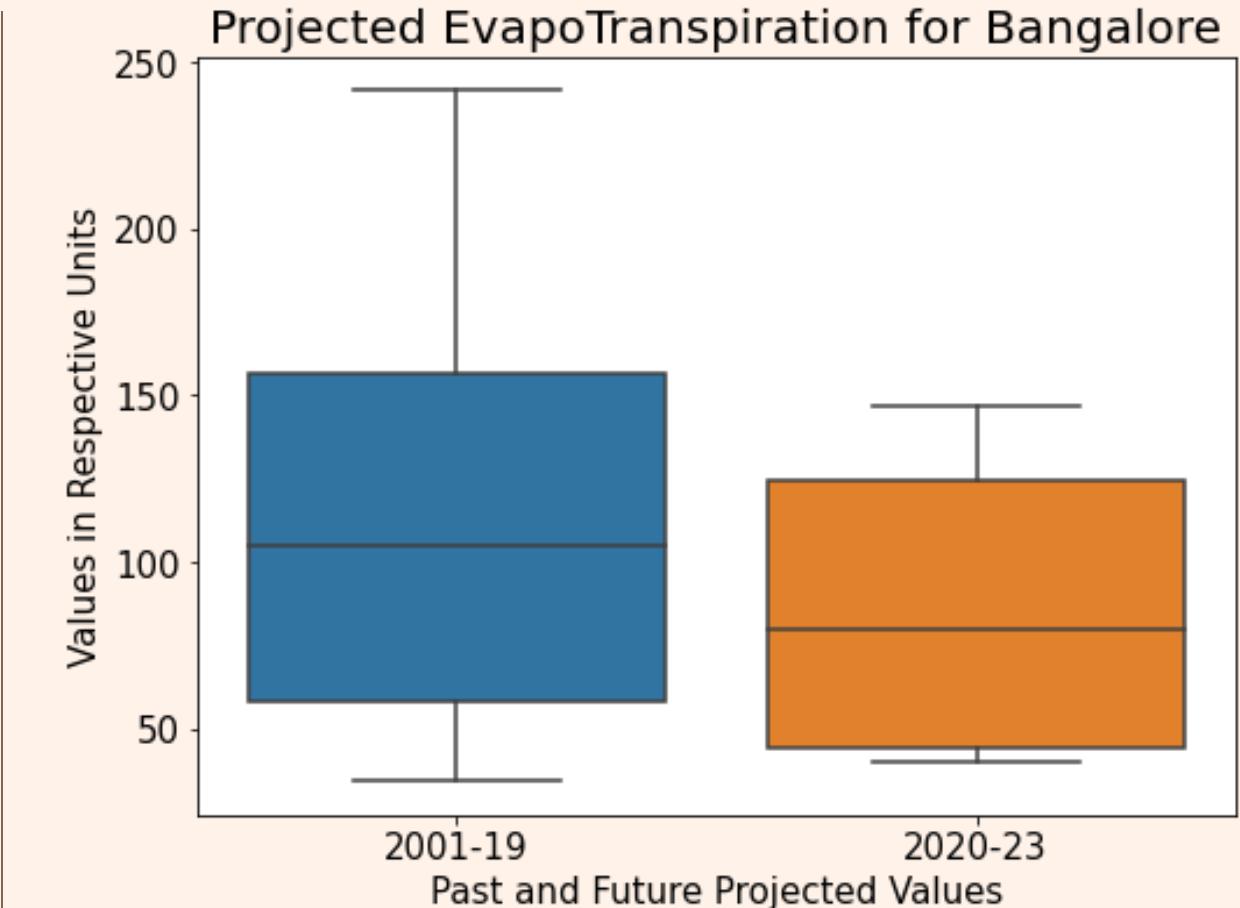
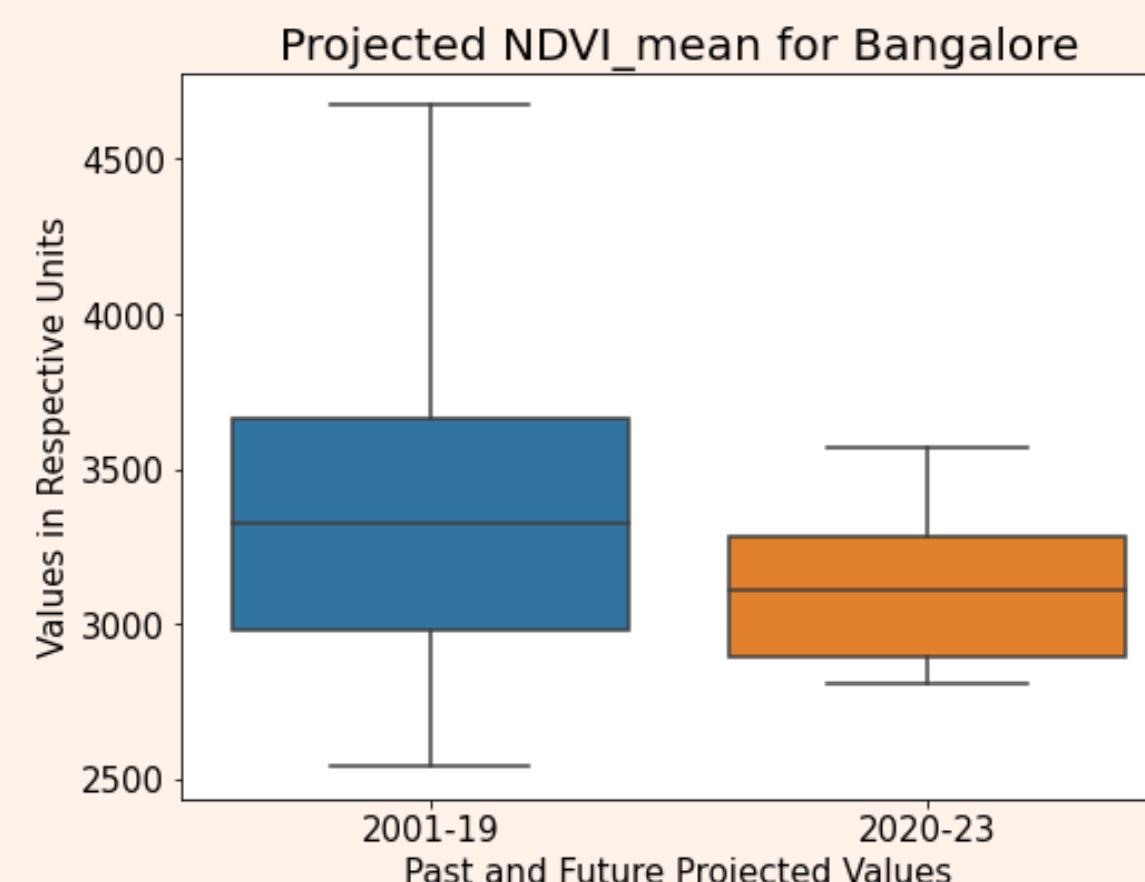
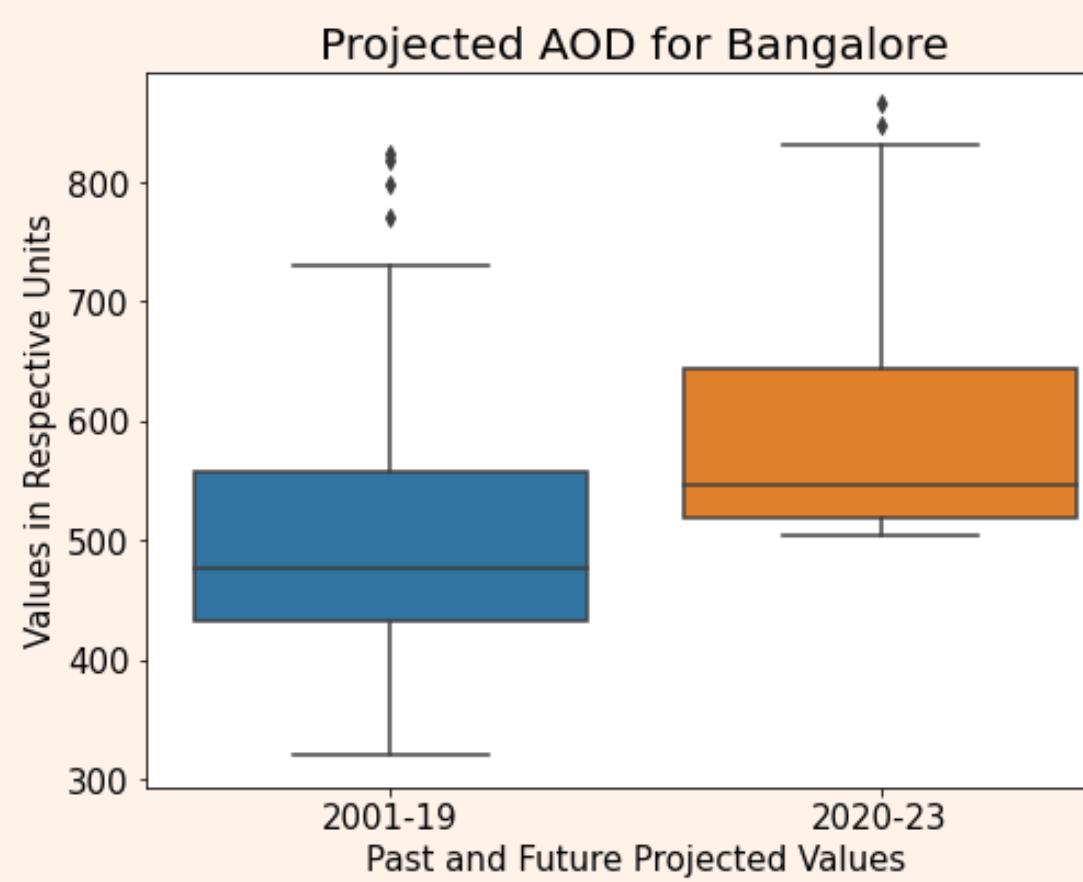
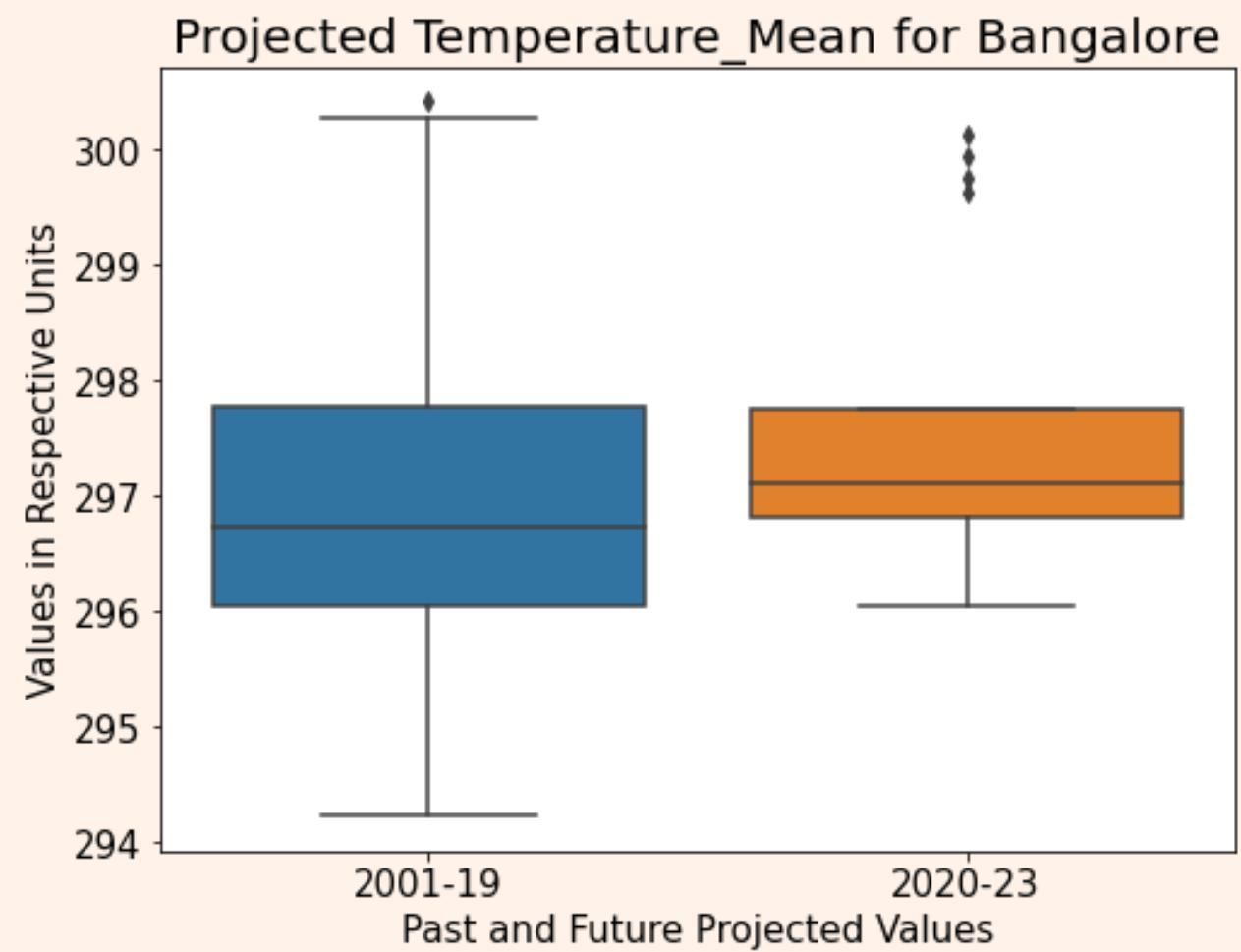
Mean Temperature Regression Curve For Bangalore



THE REGRESSION CURVE  
FITS REASONABLY WELL AND  
WE CAN SEE THAT MEAN  
TEMPERATURE HAS BEEN  
PROJECTED TO INCREASE IN  
THE UPCOMING YEARS.

-VIMAL RAJESH

# COMPARISION OF PRESENT AND PREDICTED DATA FOR BANGALORE



# HISTORY OF TEMPERATURES OF BANGALORE

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2003:

*Revols rise in Bangalore to oppose cutting of trees for the development of buildings and roads. Bangalore slowly moving from "Garden City" to "Silicon City".*

2016:

*The peak rise in the temperature for a consecutive 4 years period due to pollution becomes an issue for the elections.*

2017:

In winters of 2017 when the average temperature was 2.95 degrees Celsius higher than the 1901-1930 baseline, the worst drought in a century happened in southern India: Tamil Nadu, Andhra Pradesh, Karnataka and Kerala were worst-hit, with 330 million people coming under the grip of drought.

2020:

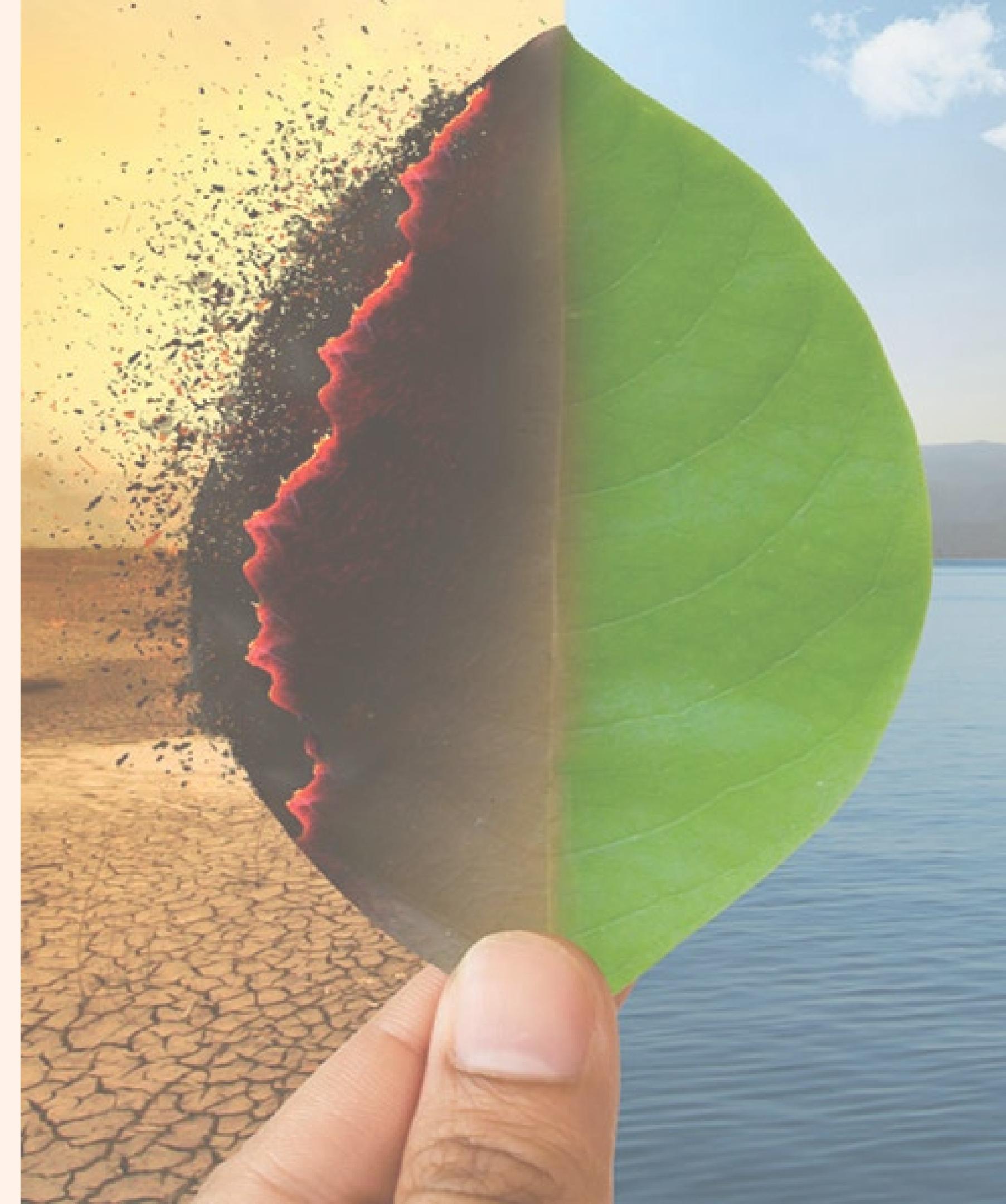
Bangalore records a record high temperature of 33.4 in 150 years

2023:

Our model predicts that mean temperature in the summers for Bangalore will soar over 300 K from this year , consistently until relevant measures and steps are taken to stop this.

# EFFECTS OFF INCREASING TEMPERATURE

- There has been a rise of minimum temperature by 2 degrees in the past 20 years. By our model, we can observe that the mean temperature has risen by over  $1.25^{\circ}\text{C}$
- The temperature was above 300K only 3 times before 2020
- But the trend shows consistent peak above 300K every year after that.



**PROJECTED MEASURE  
OF TEMPERATURE**

**2.28%**

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PROJECTED INCREASE IN  
MEAN TEMPERATURE IN °C  
OF 2020-23 COMPARED  
TO 2001-19

The projections are of just the Mean Temperature of Bangalore. Newer peaks of Maximum Temperature are attained almost every year as of now. In 2020, Bangalore touched the maximum temperature of 33.4° C, which was the highest in the last 150 years.

-VIMAL RAJESH





# **CLIMATE CHANGE IS DEFINITELY NOT A MYTH !!!**

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THE TIME TO REACT TO THE CHANGING CLIMATE AND INCREASING TEMPERATURES IS PASSING AWAY QUICKLY. IF WE DO NOT ACT SOON, THE SITUATION WILL BE OUT OF OUR REACH AND WE HAVE TO FACE THE WRATH OF NATURE.



*thank  
you*