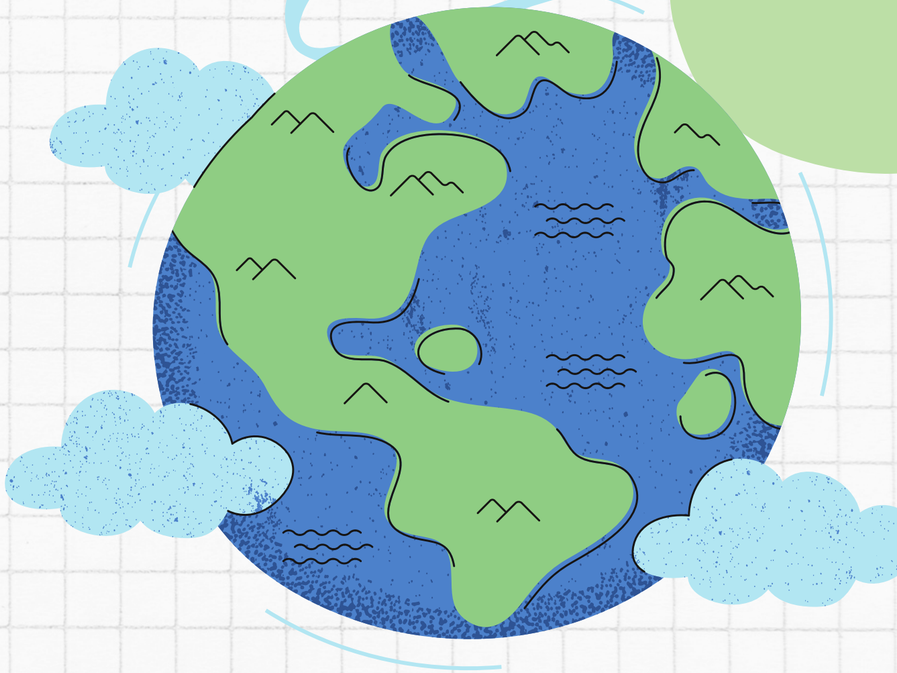
AGH University of Science and Technology, Kraków, Poland
Computational Techniques (2023/2024)

Analysis
Land Average Temperature

POLAT, LATIFE RABIA



The project focuses on analyzing average temperature trends by segmenting the dataset into 10-year and 50-year periods. My goal is to gain insights into climate change patterns over extended durations. The analysis involves grouping the data based on date information, calculating average temperatures for each 10-year and 50-year interval, and visually presenting the results in graphs.

80%

Success stories

my strategy involves a thorough exploration of the temperature dataset through the lens of polynomial regression.

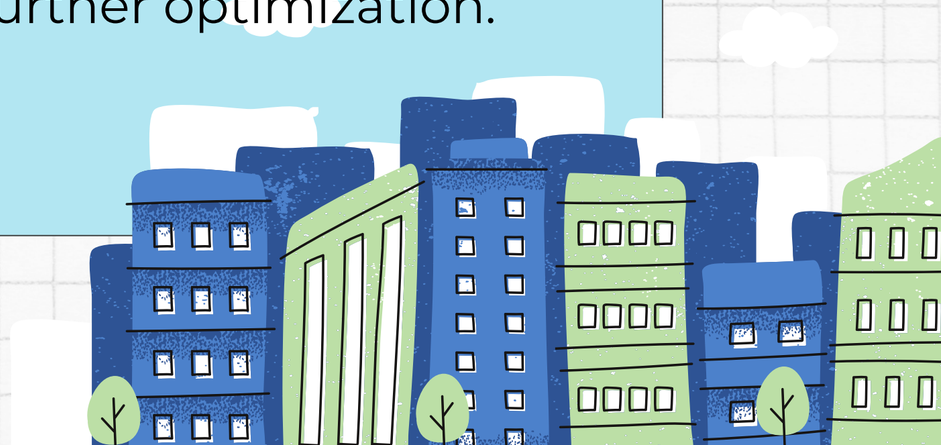
The objective is to leverage this understanding for making informed predictions about future temperature trends.

By doing so, ı aim to unravel subtle relationships and patterns among temperature variables.

The temperature dataset through polynomial regression analysis, ı aim to uncover subtle relationships and patterns among various temperature variables.

Assumptions

Several assumptions are made in the programming part of the project. It is assumed that the dataset is representative of the overall trends in land temperature and energy consumption. Additionally, the choice of the polynomial degree and the regularization parameter (λ) is made based on empirical observations and may be subject to further optimization.



Function: performPolynomialRegression

$P = (X'.X + \lambda.I)^{-1}.X'.y$

Function: makePredictions

predictions(i)= p(1)+p(2).x_values(i)+...+ p(degree+1).x_values(i)^degree

the Pearson correlation coefficient

$r = cov(x,y)/\sigma x.\sigma y$

cov(x,y) is the covariance between land temperature and energy consumption, and σx and σy are the standard deviations of land temperature and energy consumption, respectively.

I is the identity matrix

```
function avg_temp_years = calculateAverageTemperature(data,
years, interval)
    avg_temp_years = zeros(size(years));
    for i = 1:length(years)
        indices = find(year(data.dt) >= years(i) &
year(data.dt) < years(i) + interval);
        avg_temp_years(i) =
mean(data.LandAverageTemperature(indices));
    end

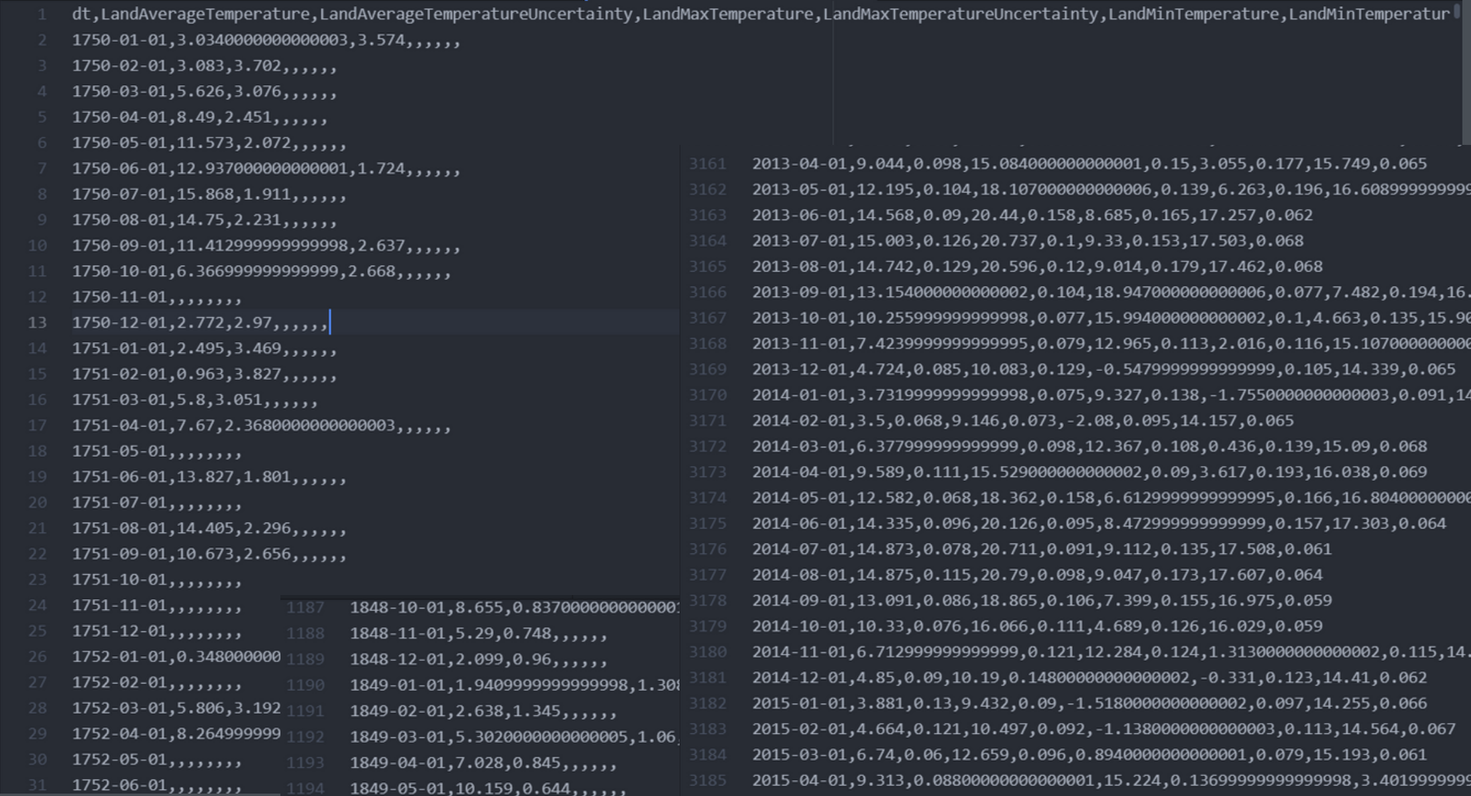
    disp(['Average Temperature Every ' num2str(interval) '
Years: ', num2str(avg_temp_years)]);
end
```

```
function p = performPolynomialRegression(x, y, degree, lambda)
    n = length(x);
    X = zeros(n, degree + 1);

    for i = 1:degree + 1
        X(:, i) = x.^(degree + 1 - i);
    end

    %
    p = (X' * X + lambda * eye(size(X, 2))) \ (X' * y(:));
end
```

degree = 4	**% Polynomial degree**
lambda = 0.1	**% Regulation degree**



```
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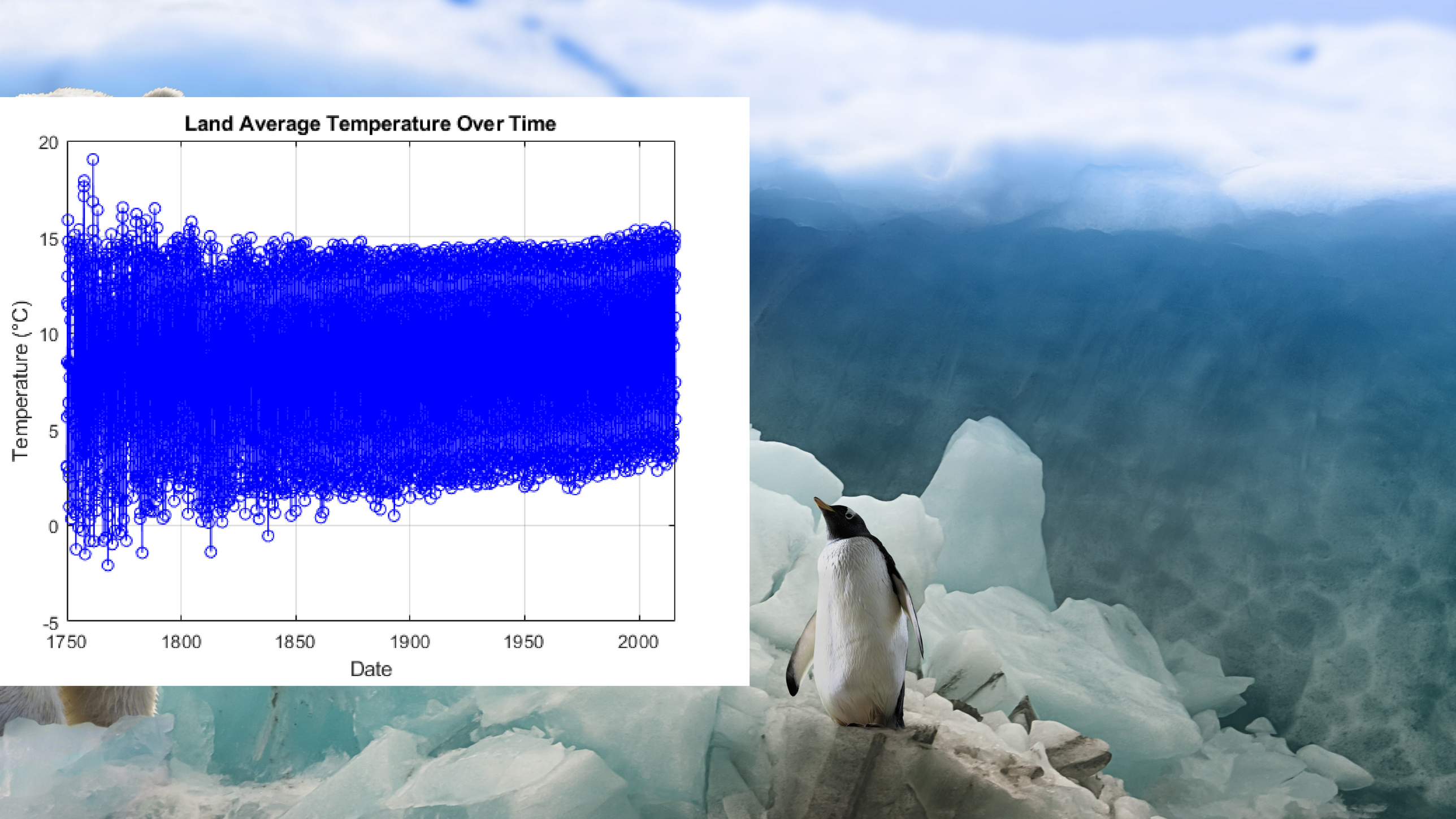
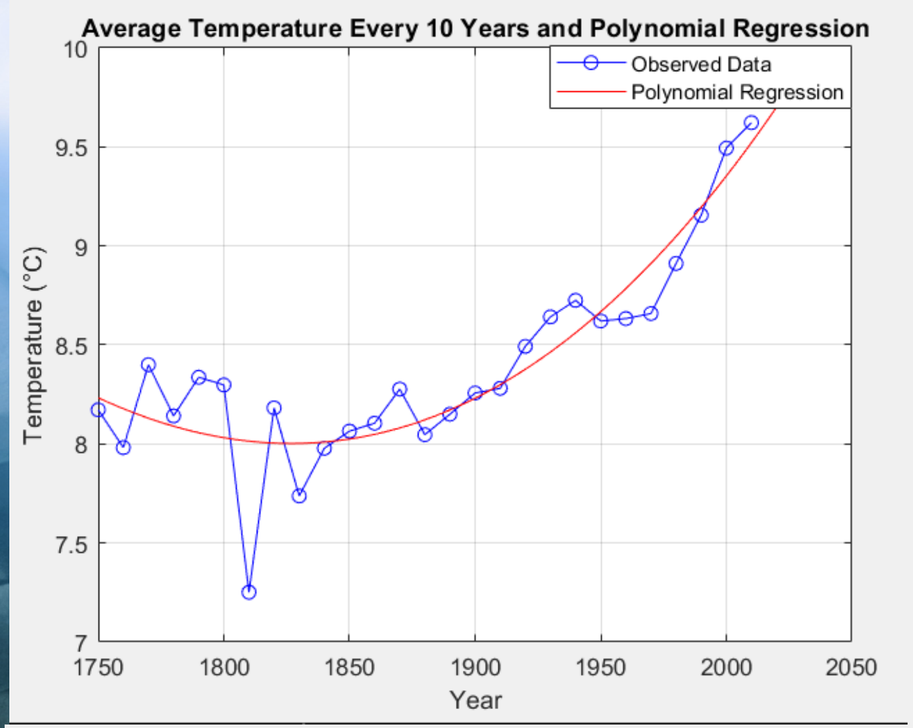
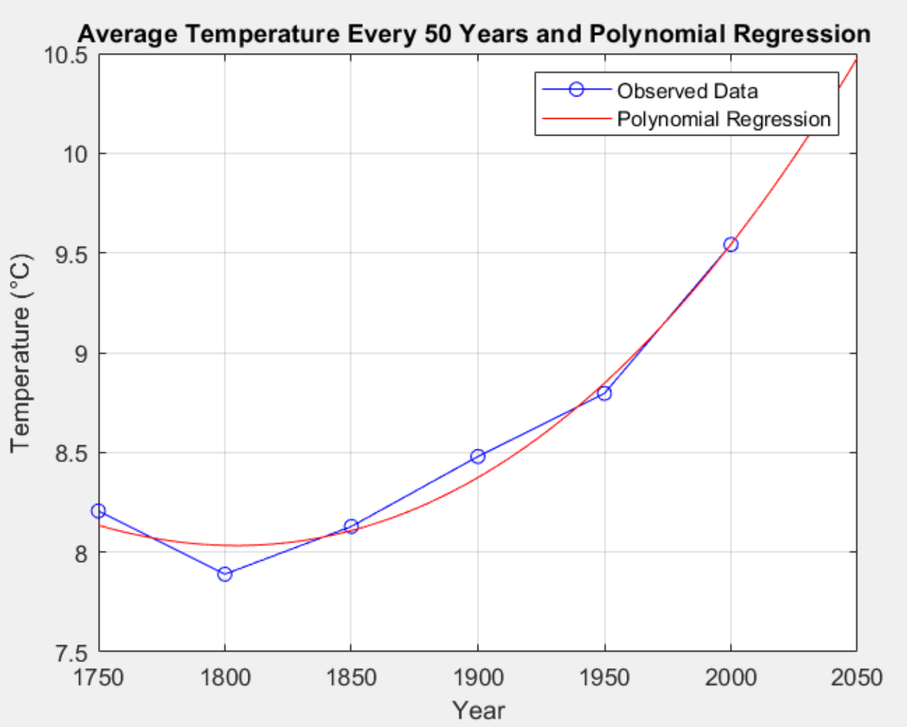
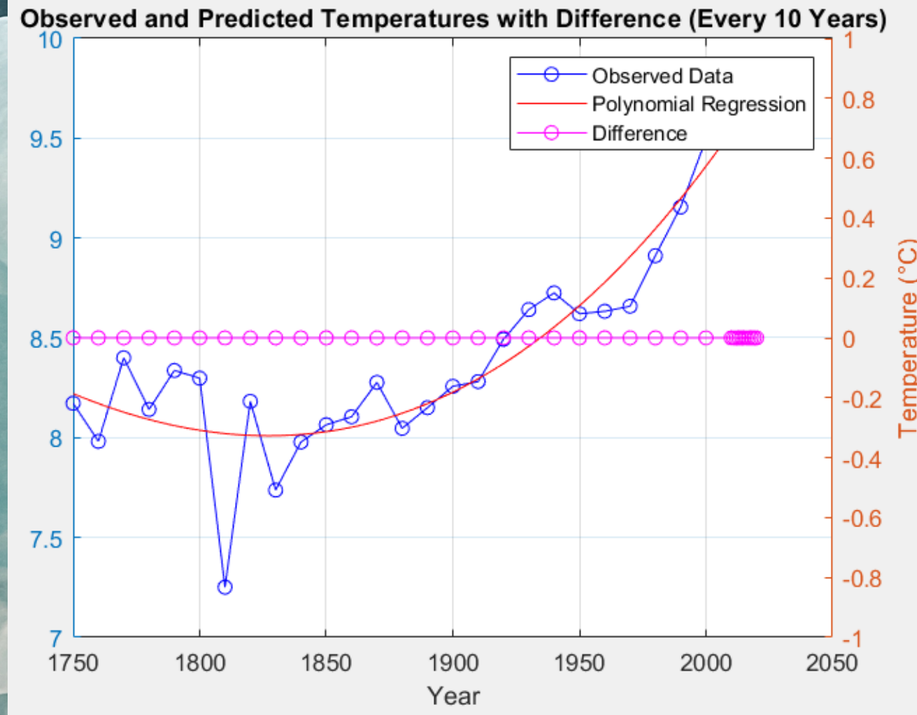
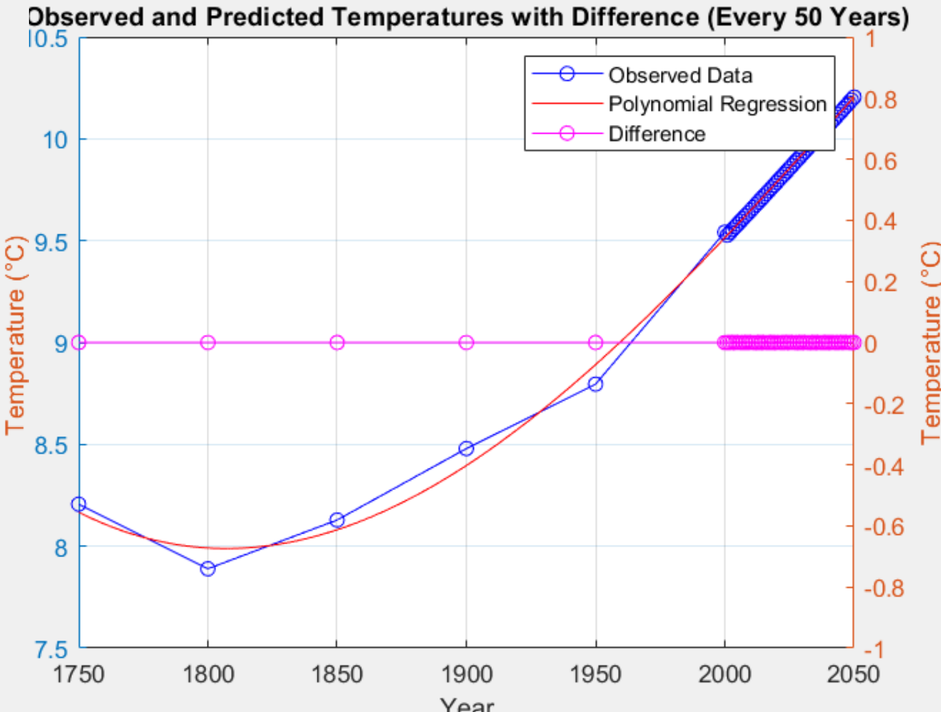

Land Average Temperature Over Time
Temperature (°C)
20
15
10
5
0
-5
1750
1800
1850
1900
1950
2000
Date


Average Temperature Every 10 Years and Polynomial Regression
Observed Data
Polynomial Regression
Temperature (°C)
Year
10
9.5
9
8.5
8
7.5
7
1750
1800
1850
1900
1950
2000
2050

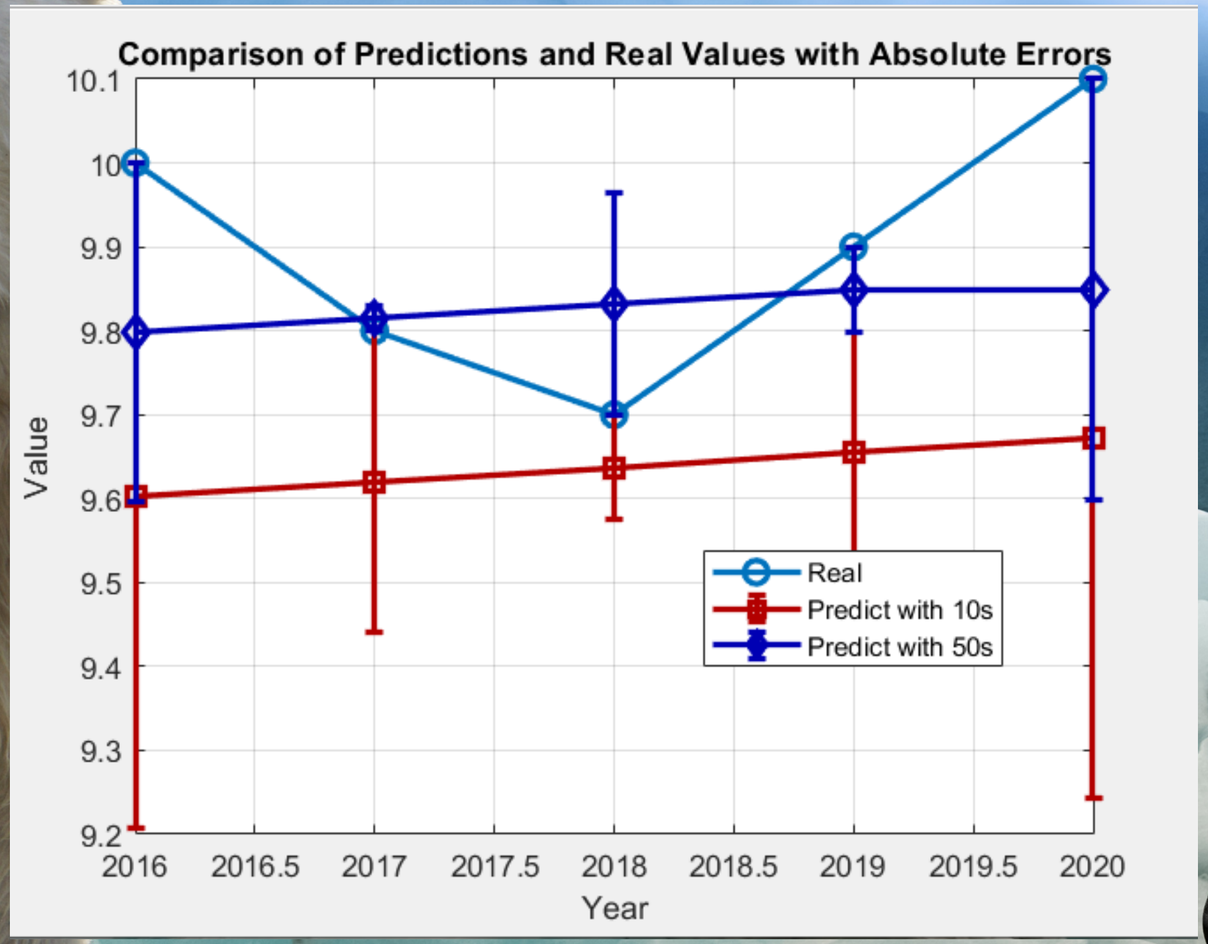

Average Temperature Every 50 Years and Polynomial Regression
Observed Data
Polynomial Regression
Temperature (°C)
Year
10.5
10
9.5
9
8.5
8
7.5
1750
1800
1850
1900
1950
2000
2050


Observed and Predicted Temperatures with Difference (Every 10 Years)
Observed Data
Polynomial Regression
Difference
Year
10
9.5
9
8.5
8
7.5
7
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
1750
1800
1850
1900
1950
2000
2050


Observed and Predicted Temperatures with Difference (Every 50 Years)
Observed Data
Polynomial Regression
Difference
Temperature (°C)
Year
10.5
10
9.5
9
8.5
8
7.5
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
1750
1800
1850
1900
1950
2000
2050

years	2016	2017	2018	2019	2020
predictions_10s	9.60319	9.6202	9.63731	9.6545	9.67178
predictions_50s	9.79818	9.81512	9.83214	9.84924	9.84924
real_values	10	9.8	9.7	9.9	10.1

```
abs_errors_10s = abs(predictions_10s - real_values);
abs_errors_50s = abs(predictions_50s - real_values);
```



Thank you very much!