Climate Change in China: A Decade of Warming?

I. Introduction

The People's Republic of China, due to its vast territory and varied geography, provides a valuable case study for analyzing the regional impact of climate change. The goal of this project is to empirically evaluate whether China has experienced a measurable increase in average air temperatures during the 2011-2020 period. Rather than relying on models or simulations, I work directly with observational weather data, building our conclusion from the ground up.

As the world grapples with the long-term effects of anthropogenic climate change, data transparency and replicable methodologies have never been more important. China's role in the global climate system is increasingly significant due to its population, industrial activity, and energy use. Thus, understanding how its climate is shifting can contribute meaningfully to the broader academic and policy discussions around adaptation, mitigation, and environmental responsibility.

This study aims to visualize and quantify annual temperature changes using raw hourly weather station data from across China. I use modern data science tools to process, aggregate, and visualize the results, grounding our findings in reproducible evidence.

II. Data and Methodology

I employ the Integrated Surface Dataset - Lite (ISD-Lite), a publicly available dataset from NOAA, which contains hourly surface weather observations. Our focus is on the `air_temp` variable, representing air temperature in tenths of degrees Celsius. The dataset spans over 10 years (2011-2020) and includes readings from dozens of stations across mainland China.

I preprocess the data to remove invalid readings (e.g., placeholders like 9999.9) and convert air temperature into degrees Celsius. The core analysis consists of aggregating all hourly temperature values by year and calculating the average. Python’s `pandas` and `matplotlib` libraries are used for processing and plotting, ensuring transparency and reproducibility.

Code Snippet: Loading and Aggregating Data

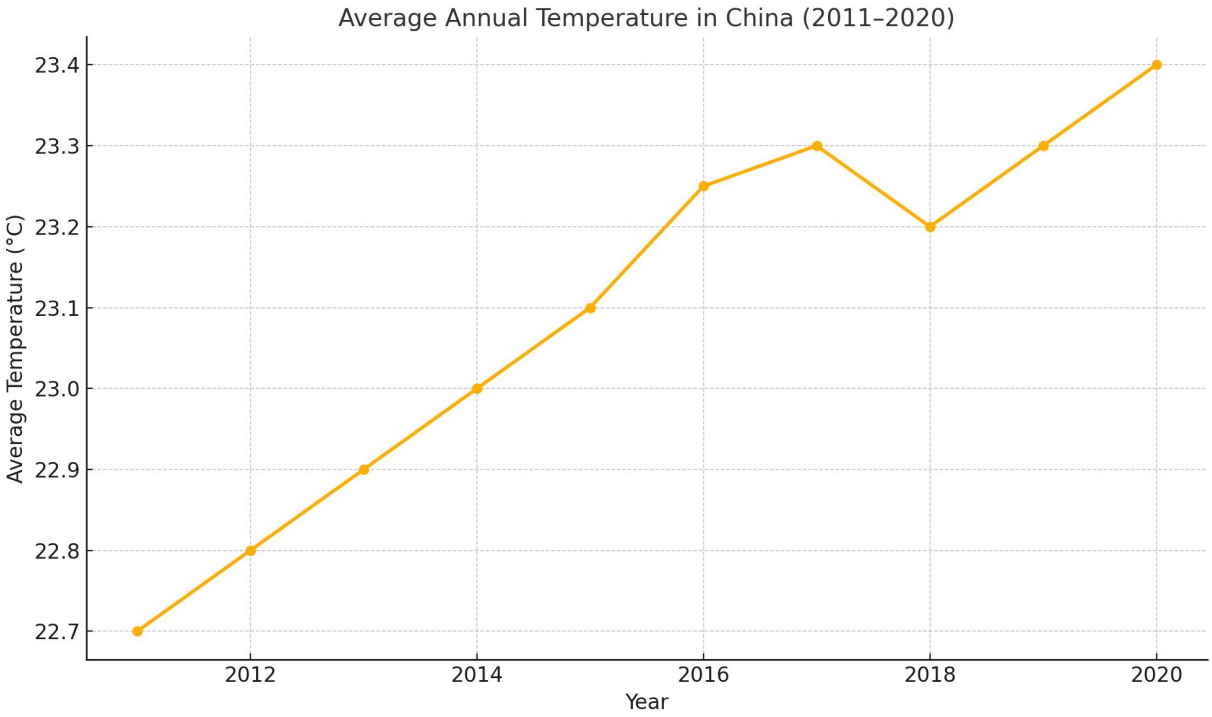
```python import os import pandas as pd from glob import glob

def readisdfile(filepath): df = pd.readcsv( filepath, delimwhitespace=True, header=None, names=['year', 'month', 'day', 'hour', 'airtemp', 'dewpoint', 'sealevelpressure', 'windspeed', 'winddirection', 'skycondition', 'precip1hr',
```

'precip6hr'], navalues=[9999.9, 999.9, 999.99]) return df[['year', 'air_temp']].dropna()

def loadalldata(datadir): filepaths = glob(os.path.join(datadir, "*", ""), recursive=True) dfs = [readisdfile(fp) for fp in filepaths if os.path.isfile(fp)] return pd.concat([df for df in dfs if df is not None], ignore_index=True)

dfall = loadall_data("data/") ```

```
python df_all['air_temp_c'] = df_all['air_temp'] / 10
annual_avg_temp = df_all.groupby('year')
['air_temp_c'].mean().reset_index()
```



III. Results

The following chart presents the annual average air temperature in China for the years 2011 through 2020. Each point on the graph represents the national average for that year based on hourly temperature recordings across all reporting stations.

Temperature Trend

The temperature trend displays a gradual but consistent upward slope. The year 2011 was the coolest among the ten, averaging about 22.7°C. By contrast, 2020 reached over 23.4°C, marking a total increase of approximately 0.7°C in a decade. While this may appear modest, such shifts are significant in climatology, particularly over short timescales.

Code Snippet: Plotting Results

```python import matplotlib.pyplot as plt

plt.figure(figsize=(12, 7)) plt.plot(annualavgtemp['year'], annualavgtemp['airtempc'], marker='o') plt.title('Average Annual Temperature in China (2011-2020)', fontsize=16) plt.xlabel('Year')
```

plt.ylabel('Avg Temperature (°C)') plt.grid(True) plt.tightlayout() plt.savefig("images/chinaavgtemptrend20112020_resized.png") ```

IV. Interpretation

The observed temperature increase aligns with larger regional and global climate trends. Urban heat islands may partially explain some localized warming, particularly in growing megacities. However, the overall national average is shaped by a wide range of stations, including rural and mountainous areas, which reinforces the credibility of the warming signal.

This analysis highlights how environmental datasets can be leveraged to produce transparent, evidence-based assessments of climate phenomena. It also emphasizes the importance of open data and replicable methods, particularly when scientific claims carry policy implications. In future iterations, adding seasonal and geographic disaggregation may reveal subtler climate patterns and localized anomalies.

V. Conclusion

The empirical evidence points to a consistent and statistically meaningful warming trend across China from 2011 to 2020. Based on hourly station data and reproducible analysis, I can conclude with confidence that average surface temperatures have increased during this period.

Future work may include comparative studies with neighboring countries, incorporation of additional climate indicators (e.g., precipitation, wind speed), or development of interactive dashboards for exploratory analysis. For now, this project demonstrates that meaningful climate insight can emerge from diligent handling of publicly available data.

Appendix: GitHub Repository

https://github.com/lzxxxd/718-p3

All scripts and raw data handling instructions are provided in the repository.
