A comparison of historical and modern ground-surface temperatures in Tucumán, Argentina

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Introduction

Over the last 30 years, Tucuman province in northwest Argentina (Figure 1), has experienced significant environmental changes as a result of climate change. Given the strengthening of climate-based studies in recent years, understanding the variations in ground-surface temperatures becomes crucial for assessing the environmental shifts in this region. Drastic variations in surface temperatures threaten environmental and social stability. As temperatures undergo unprecedented shifts, ecosystems face the risk of disruption, leading to the loss of biodiversity and the potential collapse of delicate ecological balances. Simultaneously, these fluctuations impact the lives and livelihoods of local communities, posing challenges to agriculture, water resources, and overall socio-economic well-being. Understanding the extent of these temperature variations in Tucuman, Argentina, becomes imperative for formulating adaptive strategies and fostering resilience. Through our analysis, we aim to shed light on the intricate interplay between temperature changes and their cascading effects, contributing to a more informed and proactive approach towards sustainable environmental and social practices in the face of a changing climate.

In the pursuit of this understanding, our project aims to explore and analyse temperature data to discern patterns, trends, and potential implications. The primary aim of this study is: how does the surface temperature record of 2023 in Tucuman, Argentina compare to the average of the last 30 years? From this a secondary aim can be formulated: what do rising global temperatures mean for the province of Tucuman, and what, if any, adverse socio and environmental effects are expected given the current projection of global temperate averages for the future? Within these aims the following objectives are set: to analyses and formulate a comprehensive comparison for the historical temperature data and modern data for the Tucuman province.

This study utilises Python to analyse historical temperature records and juxtapose them with contemporary data. Through this analysis, this study aims to provide a nuanced perspective on the intricate relationship between Tucuman's past and present temperature trends, ultimately contributing to the broader discourse on climate change impact assessment.

Figure 1: Tucuman Province located in northwest Argentina.

Methodology

1. Data Collection:

Historical (1991-2020) Temperature Data: Retrieved from https://www.smn.gob.ar/descarga-de-datos, accessed on 01/01/2024. Dataset "Estadisticas Climaticas Normales".
Modern (2023) Temperature Data: Retrieved from https://www.smn.gob.ar/descarga-de-datos, accessed on 01/01/2024. Dataset "Registro de Temperatura (365 dias)".

2. Data Pre-processing:

Prior to analysis, both historical and modern dataset were evaluated for missing values, outliers, and other inconsistencies such as formatting issues. The data was also standardised for the respective parameters focused on in this study.

3. Python Programming:

Python/Jupyter Notebook was used for data manipulation and data analyses. Libraries such as Pandas, xarray, NumPy, and Matplotlib were used and prove to be instrumental for data handling, statistical analysis, and visualization.

4. Code Documentation

All code used in this study can be located at https://github.com/Jared-Walsh/ERCA_W3_Group1

A 30 year perspective of temperature in Tucuman, Argentina

Temperatures in the last year increased in every month in comparison to the monthly average of the last 30 years. The biggest difference in temperature is in the month of March (4C). Late spring and summer shows the lowest differences in monthly average temperature while months succeeding summer consistently yield greater temperature differences (Figure 2).
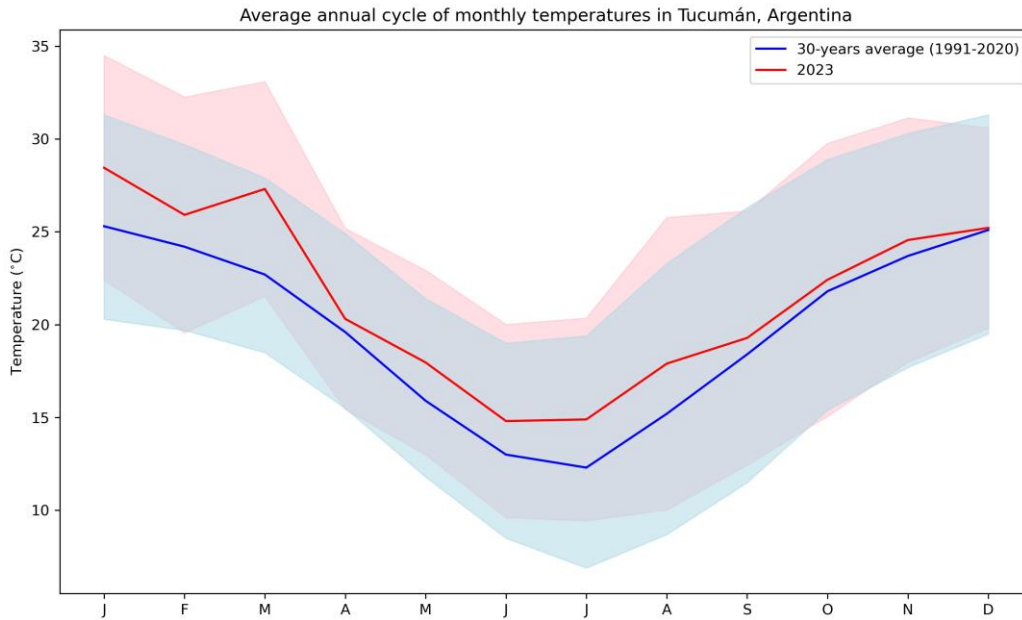

Figure 2: Average monthly temperatures in Tucuman, Argentina, for both the historical dataset (1991-2020) and the modern dataset (2023). Coloured regions are shown which represent the minimum and maximum temperatures for each respective month.

Conclusion

Climate change is real in Tucuman.

Acknowledgements

References

Villa Latina, and Mathieu. 2024. Nature. *Beijinhos 1-10*