Weather Catastrophe Prediction

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INTRODUCTION

Our research explores the rising frequency and severity of catastrophic weather events, analyzing their causes and impacts. Using data-driven methods, it aims to enhance predictive models for better disaster preparedness and mitigation strategies.

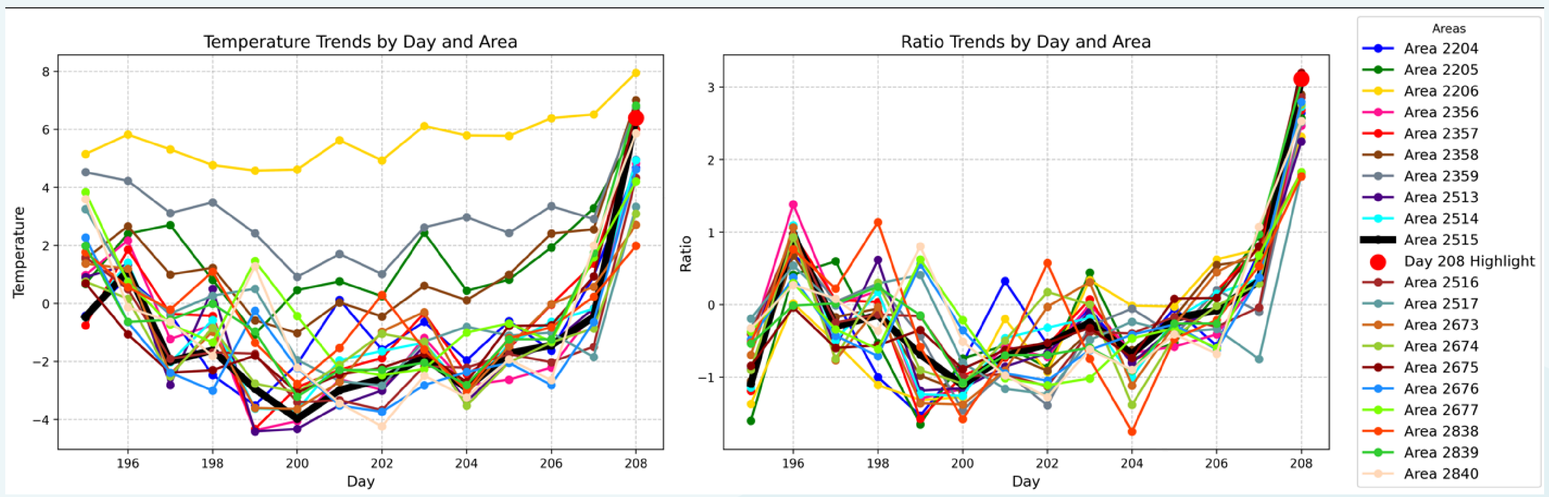
Problem

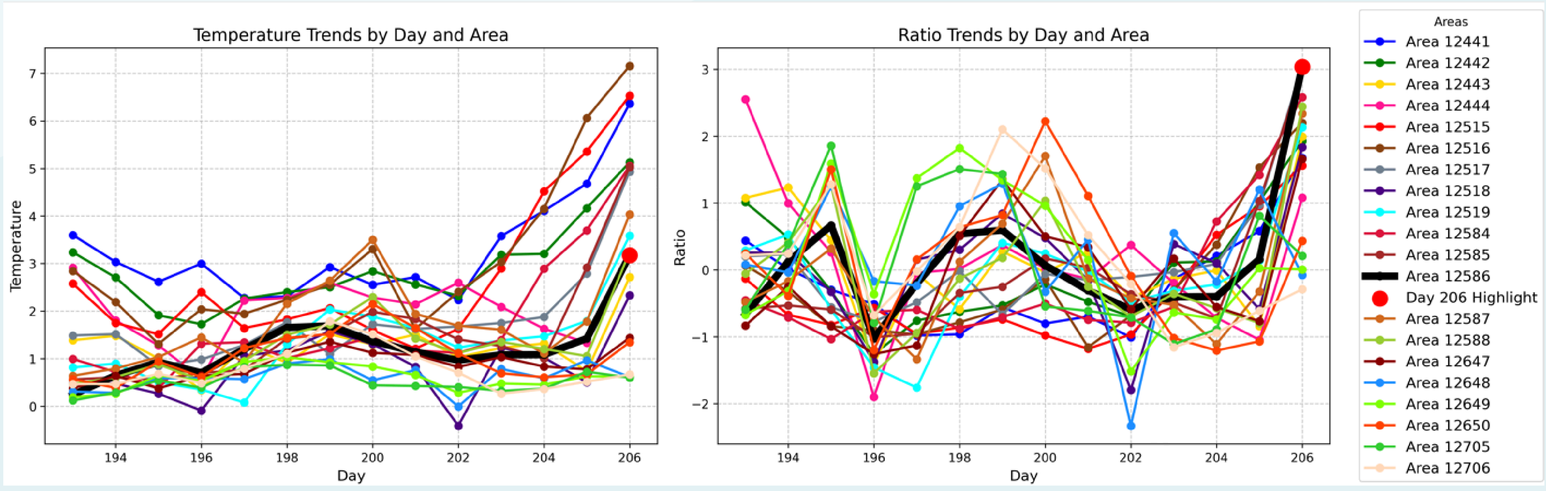
The increasing frequency and intensity of catastrophic weather events pose significant risks to infrastructure, economies, and human lives, requiring more accurate prediction and early warning systems.

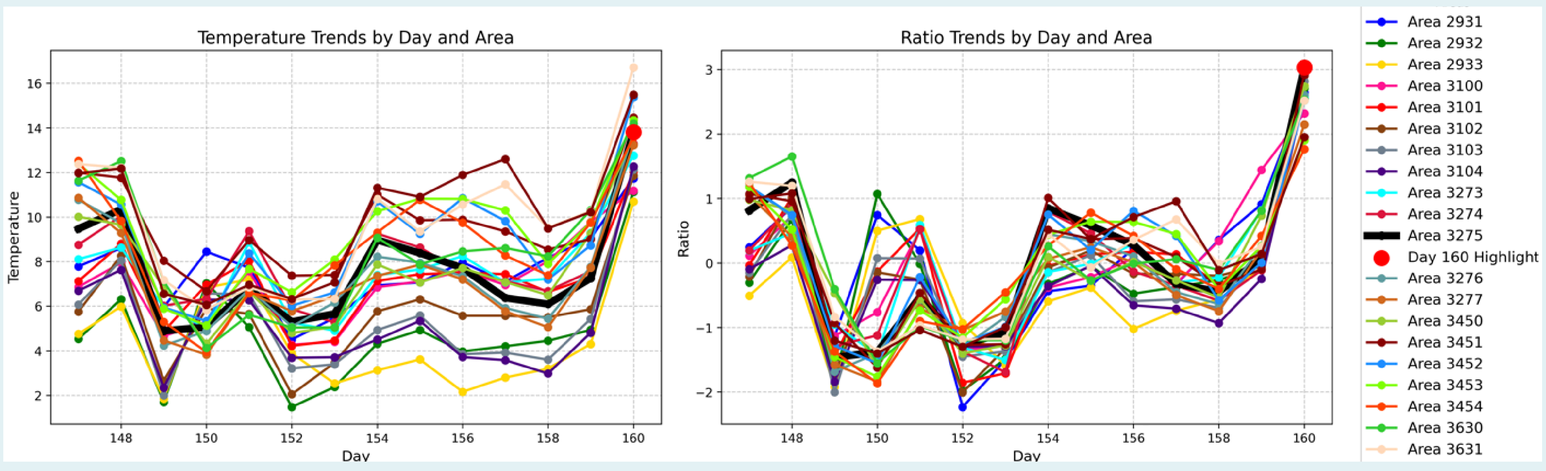
Solution

This project develops a data-driven algorithm that analyzes climate parameters using a 200x200 km grid, detects anomalies, tracks event trajectories, and identifies precursor signs to improve forecasting and disaster preparedness.

RESULTS







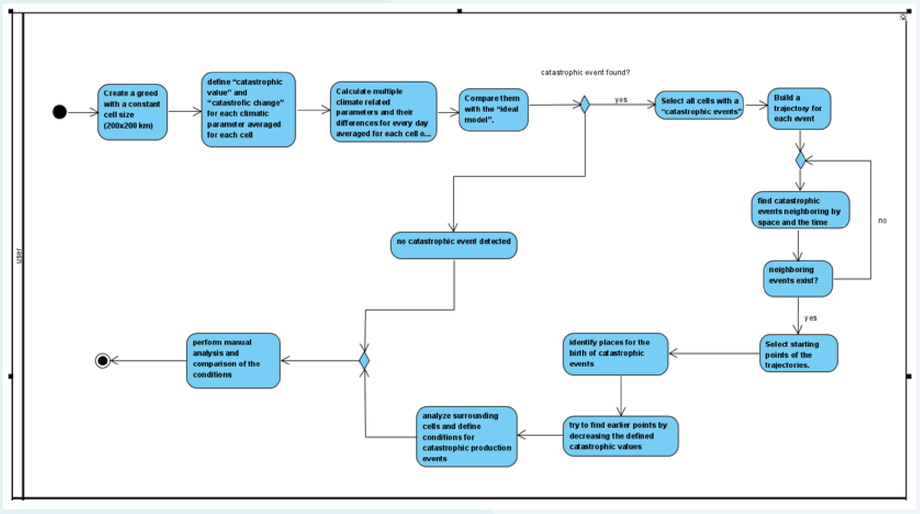
Work Flow

1. **Data Collection** – Read and process raw climate data from CSV files
2. **Data Processing** – Divide data into time-based periods and calculate statistical parameters.
3. **Anomaly Detection** – Identify and extract significant deviations in climate patterns.
4. **Geographical Integration** – Combine anomaly data with spatial coordinates for location-based analysis.
5. **Filtering & Proximity Analysis** – Analyze events based on time and spatial proximity.
6. **Distance Calculation** – Compute distances between affected areas for trajectory tracking.
7. **Result Storage & Reporting** – Save processed data in structured files for further analysis.

Algorithm

- **Grid Creation:** Construct a 200x200 km geographic grid for organizing climate data.
- **Catastrophic Metrics Definition:** Set thresholds for catastrophic values and changes for temperature.
- **Daily Parameter Calculation:** Compute daily climate parameters and compare them with an ideal model to detect deviations.
- **Identification of Catastrophic Cells:** Flag grid cells with values or changes exceeding catastrophic thresholds.
- **Trajectory Building:** Connect flagged cells in space and time to trace the evolution of catastrophic events.
- **Identification of Starting Points:** Determine where each catastrophic event originated.
- **Backtracking to Earlier Points:** Lower thresholds to identify precursor signs and extend event origins.
- **Condition Analysis:** Analyze surrounding cells to define conditions that led to the event's formation.
- **Manual Analysis & Comparison:** Compare multiple events to identify patterns and contributing factors.

Activity Diagram



Conclusion

Our research successfully developed a tool for detecting and analyzing catastrophic climatic events using geographic and temporal data. By organizing the Earth's surface into a structured 200x200 km grid and defining anomaly thresholds for key climate parameters, we were able to track event trajectories and identify their origins. The backtracking approach provided insights into precursor signs, enhancing early warning capabilities. Unfortunately, the data collection and preparation required to much time, and only manual review was done. It helps to establish key environmental conditions contributing to catastrophic event formation, supporting disaster preparedness and mitigation efforts.