Unsurprised European Weather Predictions

by Robert Indelicato

Objective: Identify Europe's safest regions from extreme weather and predict weather patterns

- Detect in Europe's weather from historical norms for significant deviations patterns
- Analyze the weather patterns in Europe if it's increasing over time or not
- Identify Safe European Regions to live and forecast future weathers.

Where the Data comes from

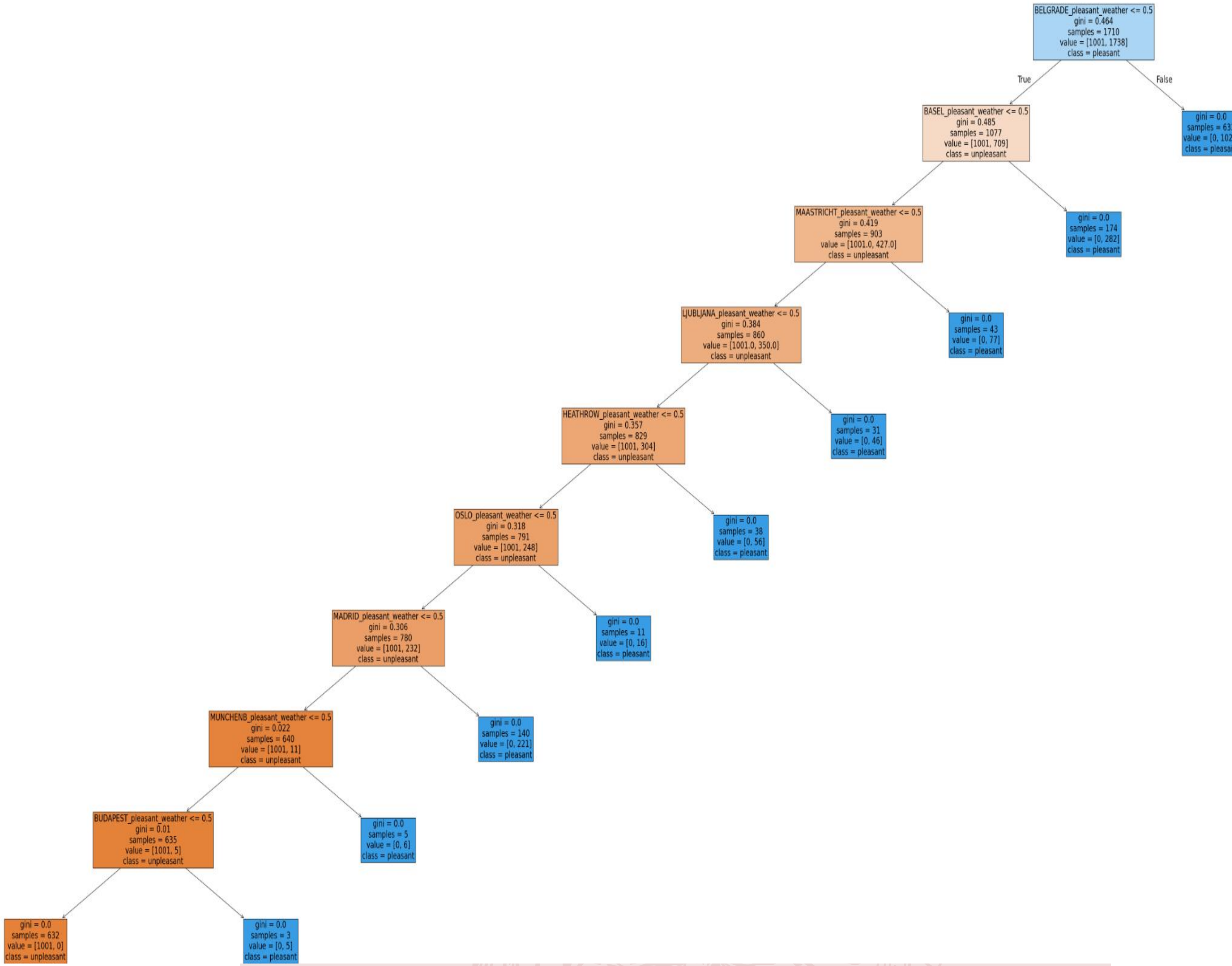
- The Dataset we use comes from European Climate Assessment & Data Set project: Weather-Prediction-dataset csv file Weather-Prediction-Pleasant-Weather-Answers csv file

- The data set based on weather observations from 18 different weather stations across Europe, which contain data ranging from the late 1800s to 2022.

- Recordings exist foral most every day with values such as temperature, wind speed, snow, global radiation, and more

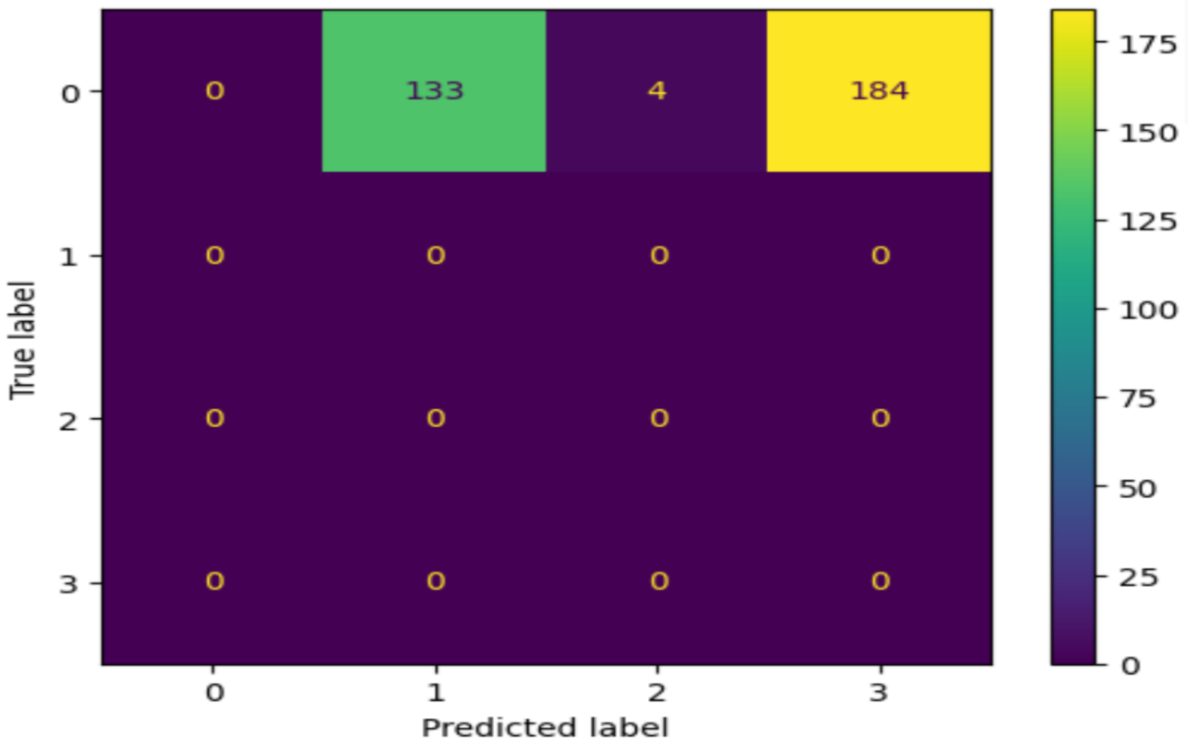
Random Forest

- Constructing multiple decision trees during training and outputs the class that is the mode of the classes (classification) or mean prediction (regression) of the individual trees.
- Apply to the Data: Identifies risk assessment and identify safest European regions.



CNN Convolutional Neural Networks

- Particularly effective for processing data with a grid-like structure, such as images, because they can capture spatial hierarchies and patterns.
- Apply to the Data: Forecast future weather conditions. Identify weather patterns and any deviations that arise.
- The 1st image CNN produced confusion matrix that is categorizing the weather conditions.
- the 2nd image shows Prediction display showing an example of an incorrect prediction.



CNN Convolutional Neural Networks

- The CNN model did not recognize all 15 stations. The accuracy is 19% around that.

Pred True	BASEL	BELGRADE	DUSSELDORF	MADRID	OSLO	STOCKHOLM
BASEL	2378	5	189	2	11	391
BELGRADE	896	0	1	0	0	0
BUDAPEST	167	0	0	0	0	0
DEBILT	60	0	0	0	0	0
DUSSELDORF	26	0	0	0	0	0
HEATHROW	75	0	0	0	0	0
KASSEL	11	0	0	0	0	0
LJUBLJANA	37	0	0	0	0	0
MAASTRICHT	9	1	0	0	0	0
MADRID	287	3	26	0	0	1
MUNCHENB	5	0	0	0	0	0
OSLO	5	0	0	0	0	0
STOCKHOLM	3	0	0	0	0	0
VALENTIA	1	0	0	0	0	0

GAN Generative Adversarial Networks

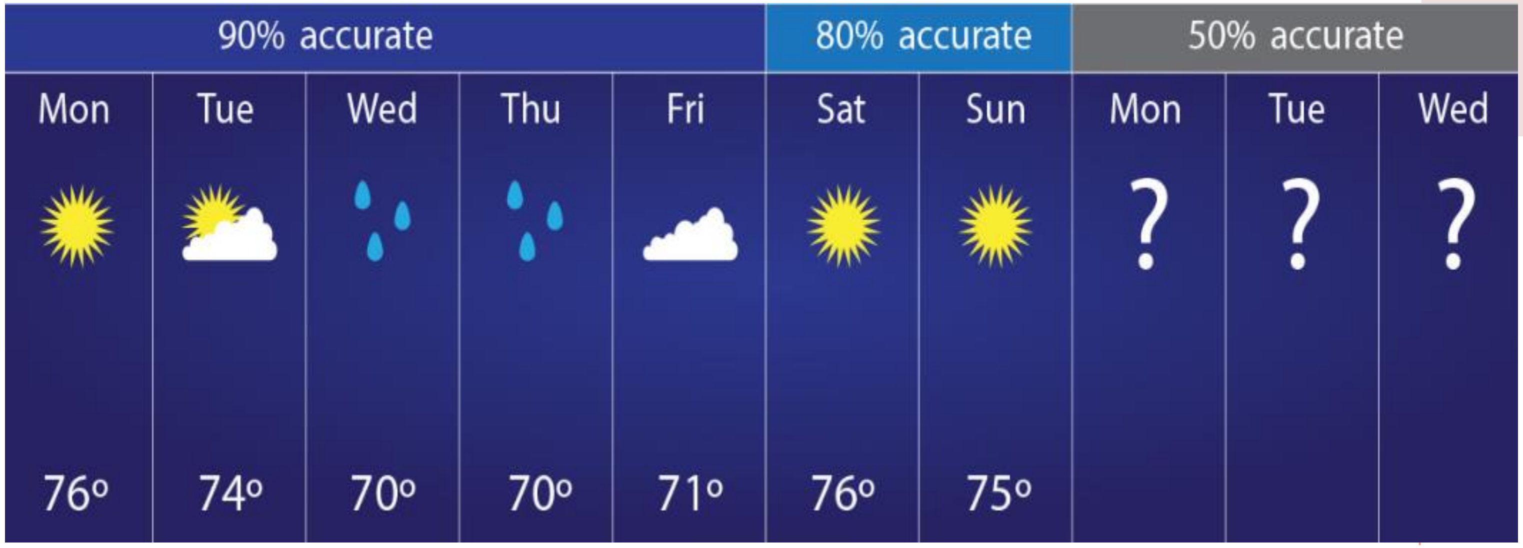
- Consist of two neural networks, a Generator (G) and a Discriminator (D), that are trained simultaneously through adversarial processes. The Generator tries to produce realistic data, while the Discriminator tries to distinguish between real data and data generated by the Generator.
- Apply to the Data: Allows for any future simulate weather scenarios to be predicted potential climate changes based on the weather.

Assessing Unusual weather patterns and trends.

- Analyze the historical patterns to see where there are shifts in climate behavior and intensity and frequency causing unusual weather patterns to increase.
- Time Series data
- Algorithms that were used:
  RNNs & Random Forest: Analyze sequential data to detect trends and patterns over time. Modeling any features of importance and detect trends in weather data.
- ANN & KNN: Supplementary models for capturing non-linear relationships and trend comparison

Protruding future weather scenarios and safety regions

- Generating future weather condition scenarios for the next 25-50 years.
- Historical time-series data for weather abnormality.
- Algorithms that were used:
  Random Forests & GANs: Conducting risk assessments, factor in predicted on weather conditions and assess safety regions. Induce and implement future weather scenarios to simulate different climate conditions.
- KNN and Decision tree will handle the risk factors.

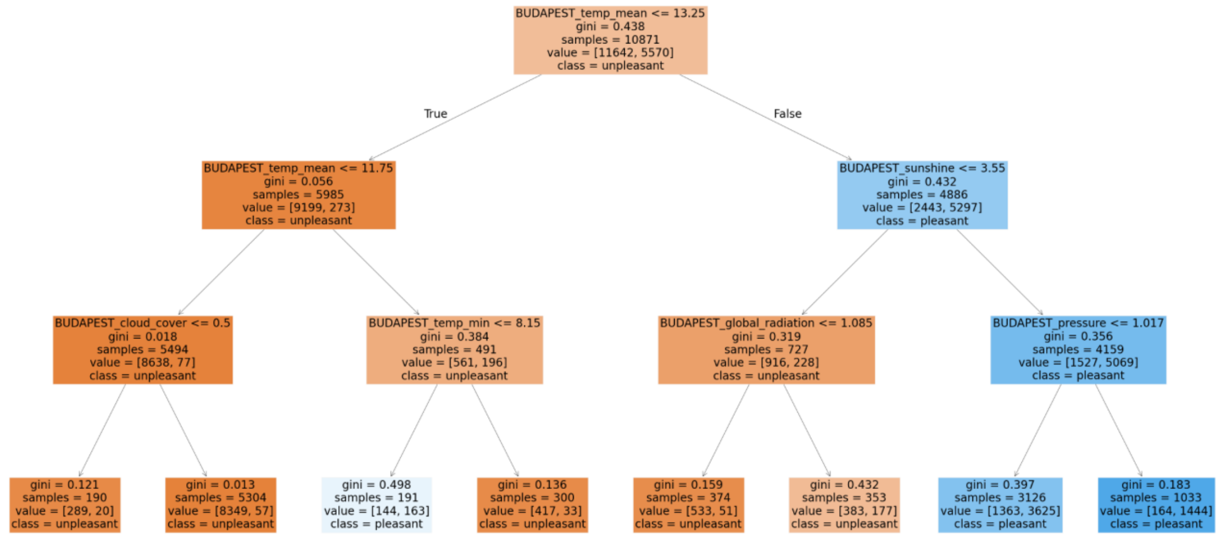


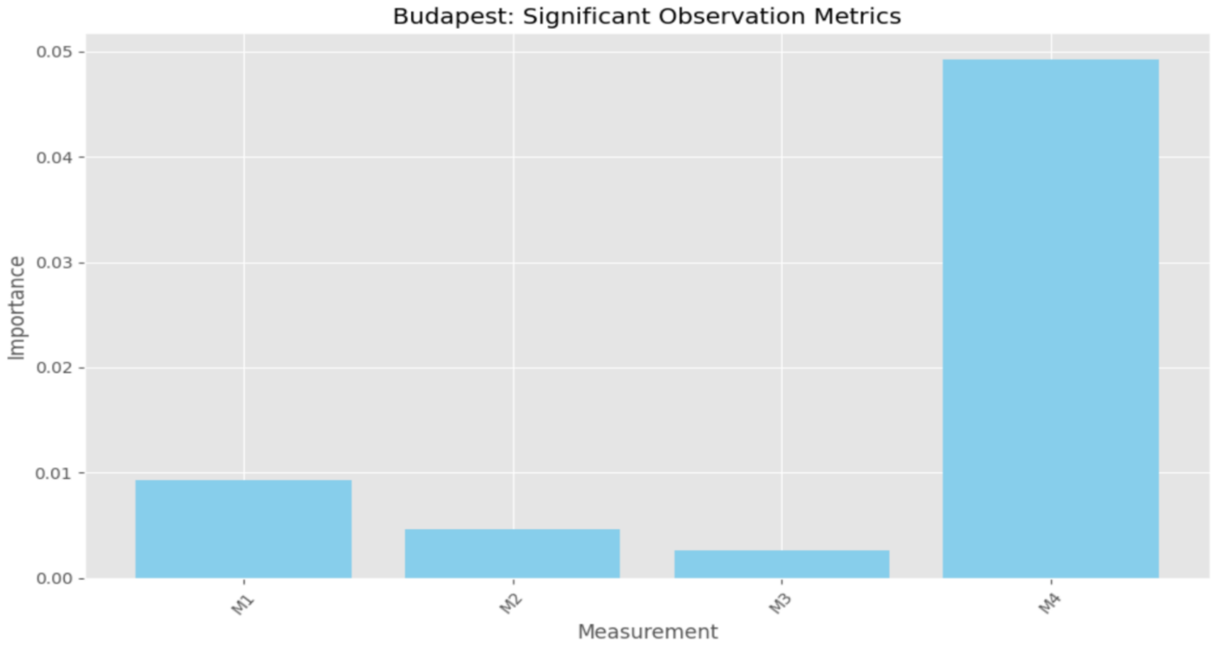
Budapest scenario

- Random forest for Budapest's weather station categorizing pleasant and unpleasant weather data points.

- Plot of Budapest random forest's feature importance.

- M4 shows large significant increase then M1-M3.





Ethics consideration

- Communities can prepare for and mitigate the impacts of climate change by understanding which regions are experiencing unusual weather patterns.
- By identifying trends and unusual weather patterns we create safety measures to address and adapt to potential changes in climate behavior.
- Communities should identify where there are safe regions and plan for future infrastructure, disaster preparedness to ensure population safety.

Results & Summary

High Accuracy in Weather Categorization: The CNNs along with GANs categorized weather conditions that accurately categorize and depict abnormal weather from abnormal historical weather patterns.

Lower Accuracy for Temporal Data: Despite using optimizations, RNNs have a smaller accuracy compared to CNNs, indicating it's harder to utilize the temporal component of the data effectively.

Effective Risk Categorization: Random Forests have a high categorization accuracy for determining unpleasant and pleasant weather data around 99%, which could be very helpful for categorizing risk based on possible extreme weather conditions created by GANs.

Thought experiment 1's use of CNNs for spatial pattern recognition and high accuracy in detecting weather condition anomalies provides a robust foundation for predicting future climate impacts.

Combining the insights from Experiment 1's framework with Random Forests' categorization power will provide ClimateWins with comprehensive insights to detect climate abnormities and predict future weather impacts Effectively in the regions.

Thank You and Questions

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