# MACHINE LEARNING FOR WEATHER PREDICTION AND CLIMATE CHANGE

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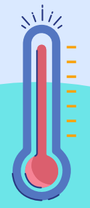
# OBJECTIVE AND THOUGHT EXPERIMENTS

Objective: To explore machine learning applications for predicting weather changes and assessing climate change impacts across Europe.

PREDICTING FUTURE WEATHER PATTERNS



IDENTIFYING CLIMATE CHANGE INDICATORS

ASSESSING SAFE HABITATS IN EUROPE

# MACHINE LEARNING OPTIONS

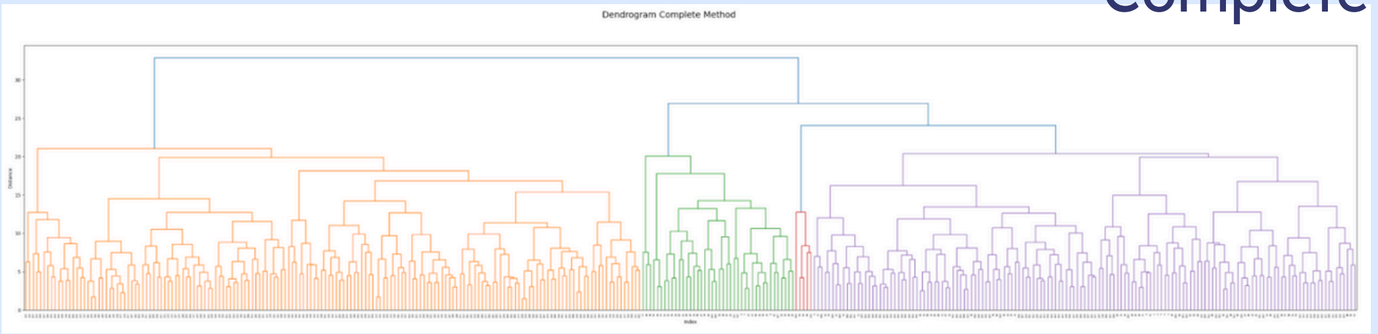
| Supervised Learning | Unsupervised Learning | Advanced Models | Composite Models |
| --- | --- | --- | --- |
| Linear Regression, Decision Trees | K-Means Clustering, PCA | CNN, RNN, GANs | Hybrid models combining supervised and unsupervised techniques |

# DETECTING NEW PATTERNS

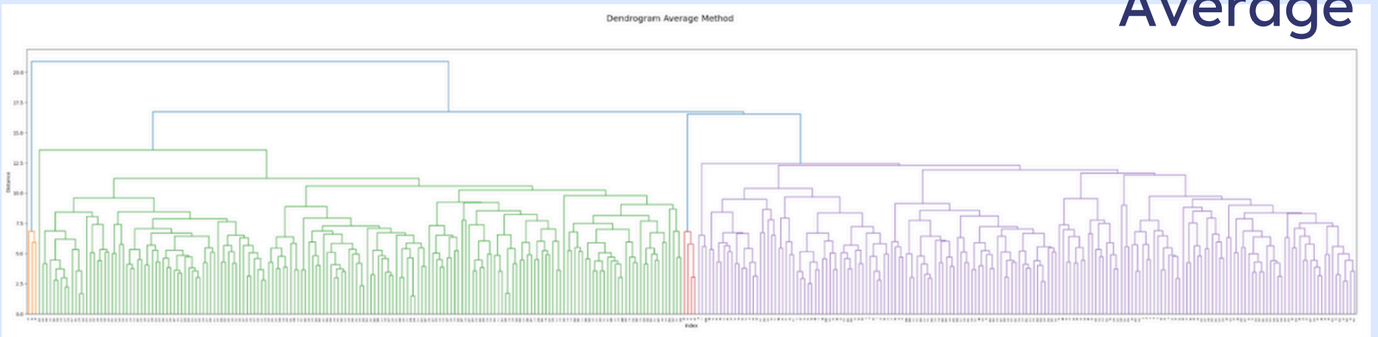
Goal: Find new patterns in weather changes over the last 60 years.

- Clustering Algorithms: K-means, hierarchical clustering (Dendrograms).
- Dimensionality Reduction: PCA.

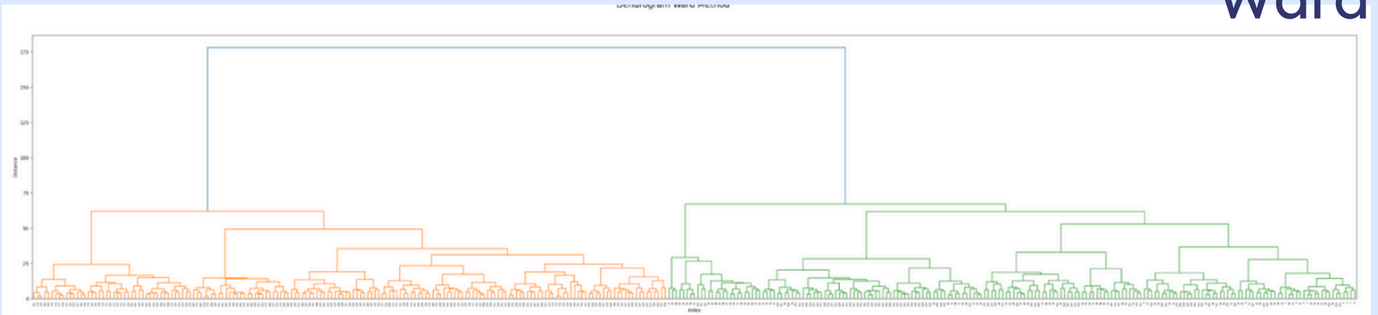
Complete




Average



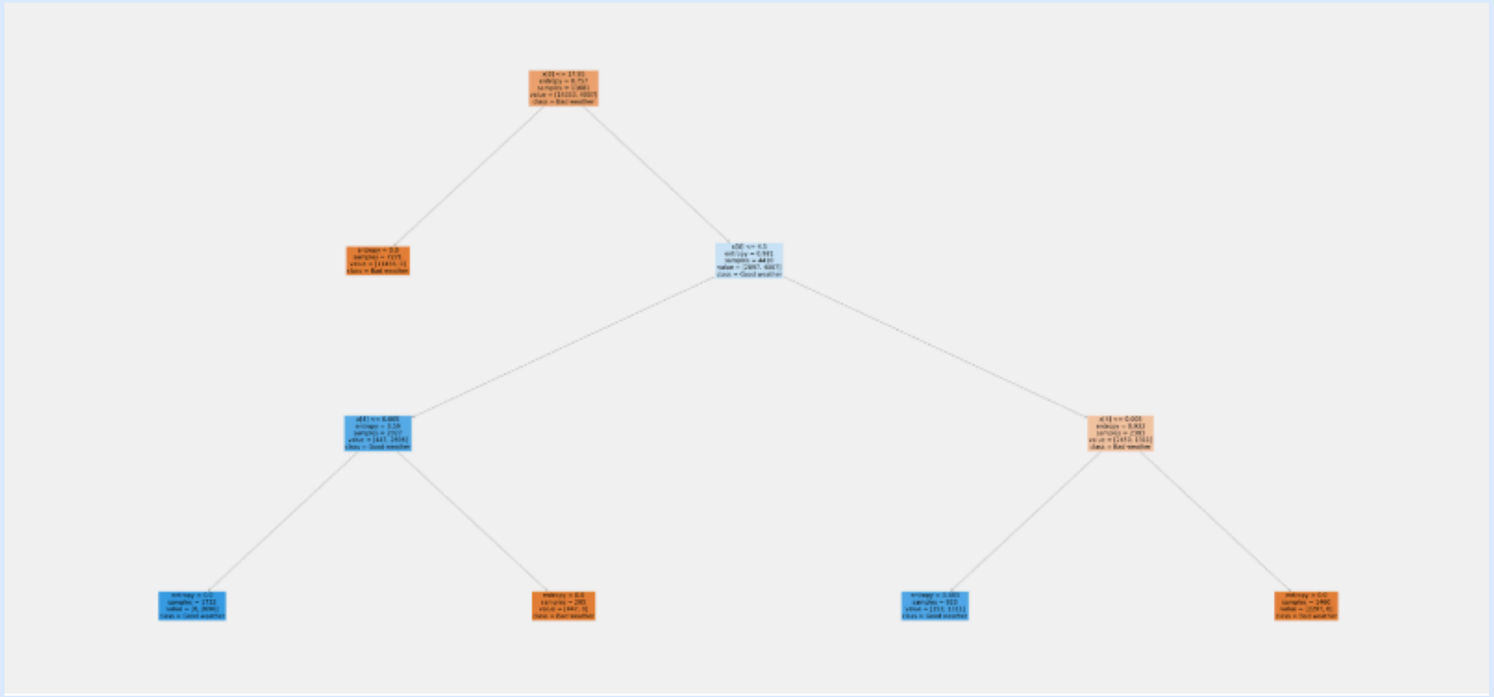

Ward



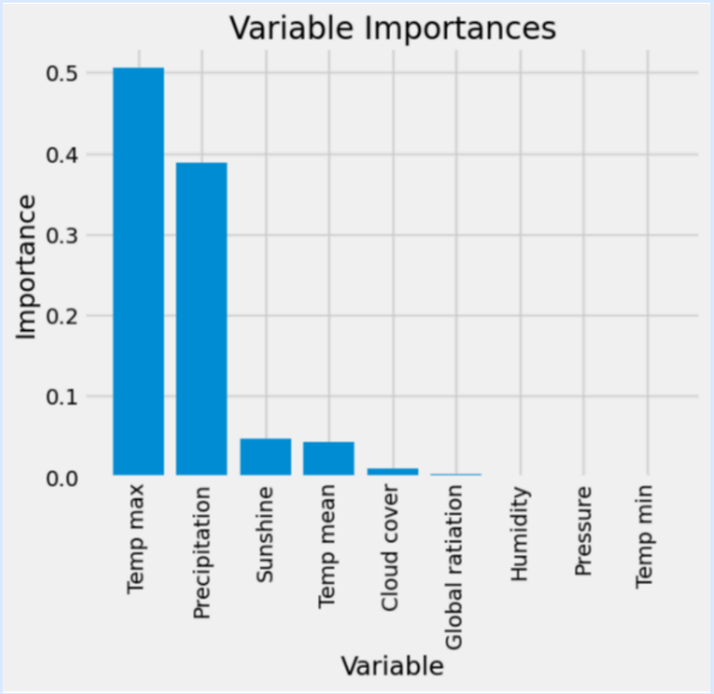

The Ward, Average, and Complete methods provide more conclusive clustering compared to the single method. The Ward and complete methods, in particular, reveal distinct clusters that are easier to interpret.

# IDENTIFYING AND PREDICTING UNUSUAL WEATHER PATTERNS

- Random Forests: Identify significant features and classify patterns.
- RNNs: Efficiently handle time-series data.



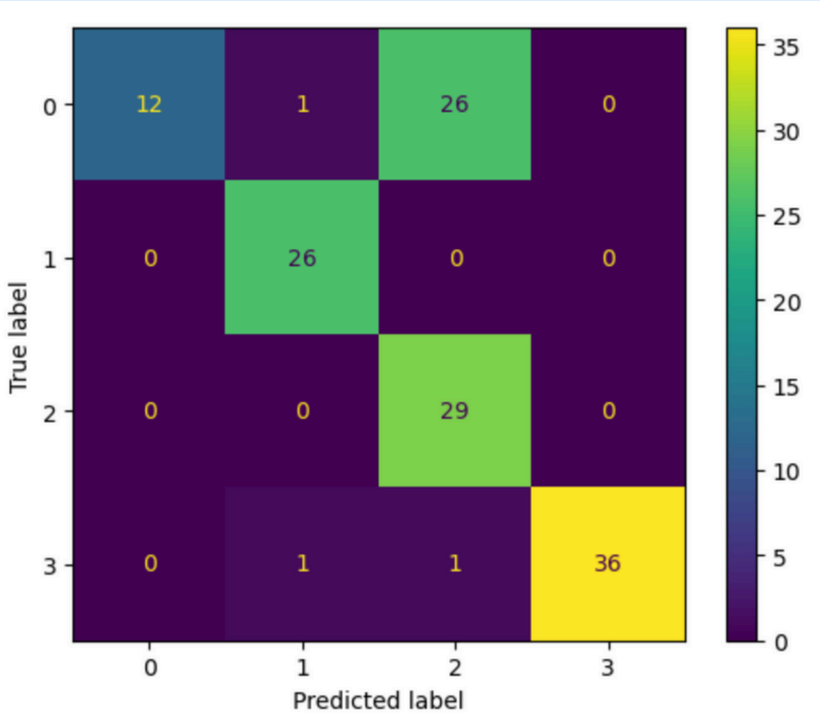
DUSSELDORF emerged as the most important station, followed by MUNCHENB and BASEL. DUSSELDORF is the most important station after optimization.




Precipitation and maximum temperature have the most influence on how the random forest divides up data.

# GENERATING FUTURE WEATHER CONDITIONS

CNN&GANs: Generate realistic future weather scenarios




Confusion matrix derived from CNN model categorizing weather condition.


Example of prediction.

# SUMMARY

- High Accuracy in Weather Categorization: CNNs demonstrated a high accuracy rate in categorizing weather conditions. When combined with GANs, this approach can effectively categorize and visualize unusual weather patterns compared to typical historical weather.

- Lower Accuracy for Temporal Data: Despite optimization efforts, RNNs have shown lower accuracy compared to CNNs, suggesting challenges in effectively utilizing the temporal aspects of the data.

- Effective Risk Categorization: Random Forests exhibit high accuracy in categorizing favorable and unfavorable weather conditions. This can be particularly useful for assessing risk based on extreme weather scenarios generated by GANs.

# THANK YOU!