Predicting Weather Conditions Using Machine Learning For ClimateWin

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Objectives

ClimateWin are looking to use machine learning to help better predict the consequence of climate change around Europe.

Aims and Objectives

- Identifying weather patterns that deviate from regional norms across Europe.
- Projecting potential future climate conditions over the next 25 to 50 years based on current trends.
- Evaluating whether the frequency of unusual weather patterns is increasing.

Beyond Historical Data

Additional Data requirements

- **Radar Imaginary** – provides visual context to current weather conditions.
- **Extreme Weather** – Information on extreme weather events across Europe. Including storms, heatwaves and cold snaps.
- **Real Time Weather Conditions** – Immediate weather information from the different stations around Europe.

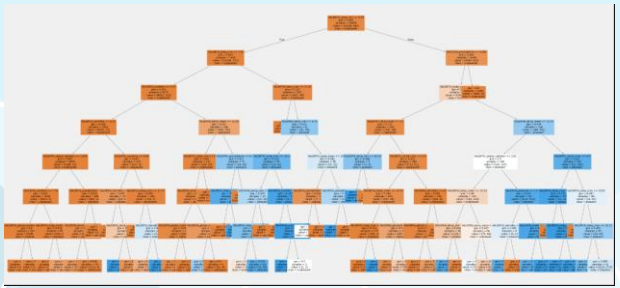
Machine Learning Models

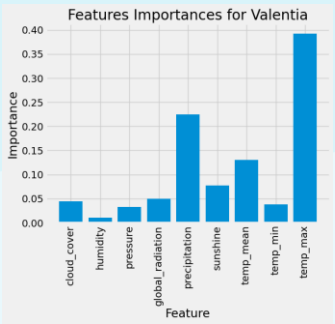
Random Forest	CNN	GAN
• The Model is based on multiple decision Trees. • Random subset of data and features are combined to make predictions. • Can help predicting temperature and precipitation.	• CNN uses satellite and radar data to classify weather conditions. • CNN learns features of the data set and creates classification. • Analyse satellite to recognise weather patterns.	• Two Networks compete to create a realistic fake image. • Increases the amount of data available for the model. • Able to create data which mimics real weather conditions.

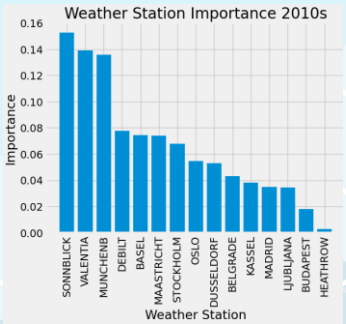
Thought Experiment #1

#1 Classify Unusual Weather Events

Goal	Detect unusual weather events using historical data.
Approach	The Random Forest Model will be able to provide insight into key feature importance of weather station to indentify anomolies in different weather conditions such as extreme temperature or precipitation. The Model will need to be optimised to increase accuracy via adjusting n_estimators, Max_depth as well as Min_samples_split.
Results	The Model accuracy increased from 58% to **66%** after the hyperparameter optimisation. Weather stations with the most significant Weather variations were SONNBLIK, VALENTIA and MUNCHENB.
Next Steps	The Model was successfully able to identify areas of deviation including extreme weather and precipitation. The next steps is to increase the accuracy of the model and use the model in conjunction with other models to get more precise results.



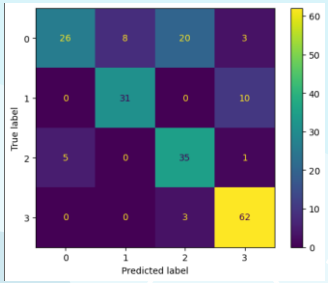


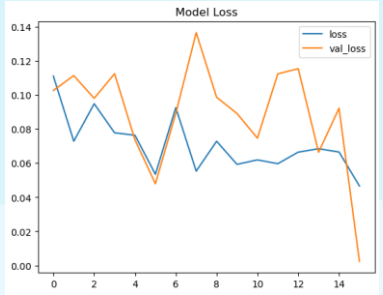


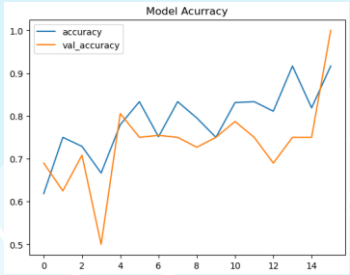
Thought Experiment #2

#2 Weather Trend Classification With CNN

Goal	Improve predictions of weather trends using CNN.
Approach	The CNN model can be used to classify different weather conditions. The model will be trained with images of different weather patterns to identify. Once classified, we can use the model to predict future weather conditions. To increase the accuracy of the model, bayesian optimisation can be used to fine tune the hyperparameters.
Results	The optimised model had an accuracy of **92%** and a loss of 0.046 after initial unoptimised models indicated a max accuracy of 46%. The model was also able to successfully classify different weather conditions.
Next Steps	The model can successfully identify different weather patterns. The next step is to use the model in conjunction with other models to make predictions on weather trends as well as continue to train the model to increase accuracy.







Thought Experiment #3

#3	Predicting The Effects Of Climate Change
Goal	Using GAN to create synthetic weather conditions to mimic climate change.
Approach	The GAN model can be used to generate synthetic weather scenarios using a mixture of historical data, radar and satellite images. Once trained, we can use the model to simulate different climate change scenarios.
Next Steps	Analyse the outcomes of the simulated climate change scenarios. These findings can inform future climate predictions and support the development of strategies to mitigate the impacts of climate change.

Recommendations

- Implement the Random Forrest Model to identify any deviation from usual weather conditions around Europe.
- Use the optimised CNN model to classify weather conditions with a **92%** accuracy to help predict weather trends.
- Simulate different Climate change scenarios using GAN to create strategies to mitigate the impacts of climate change.

Thanks!

Do you have any questions?

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