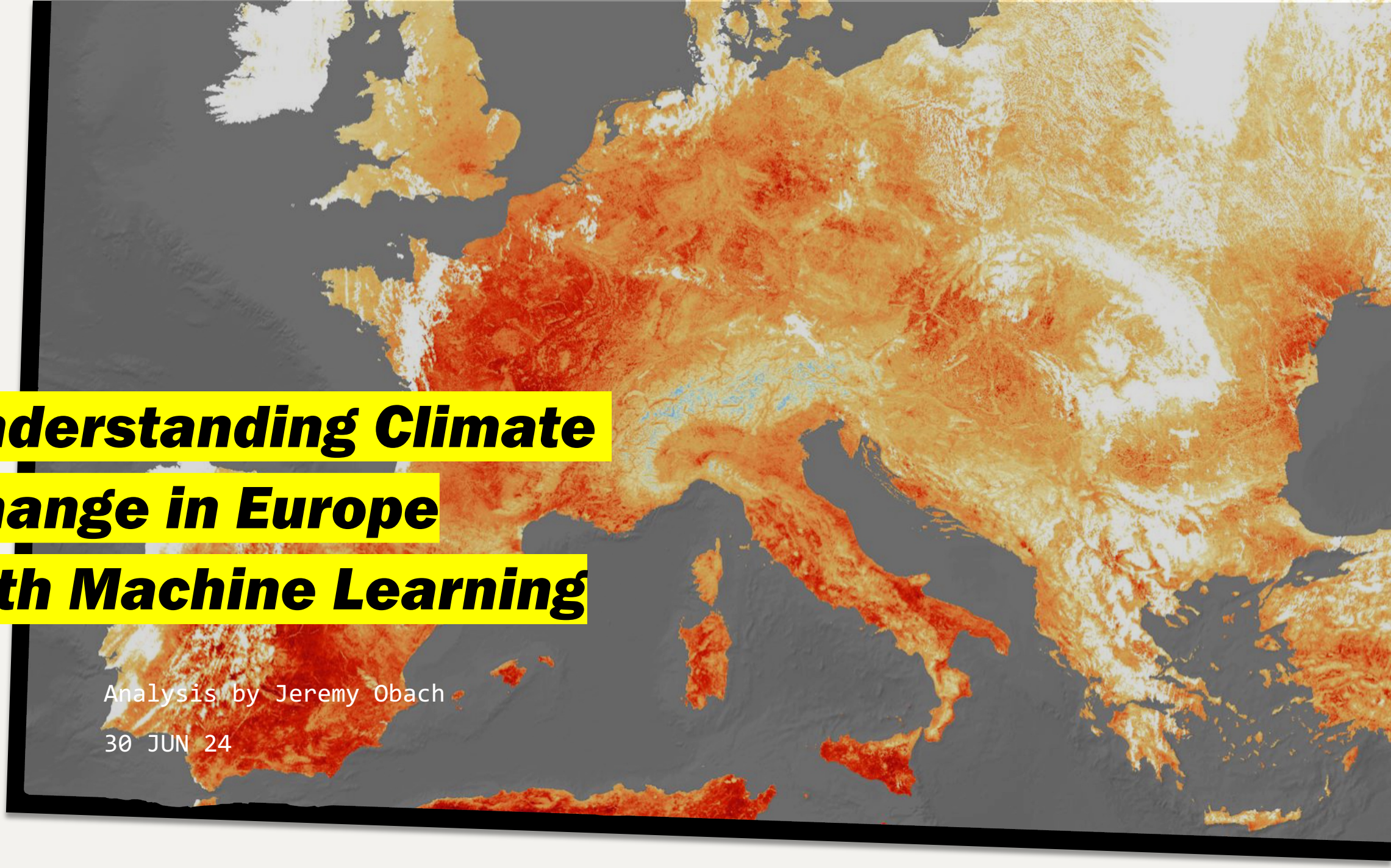


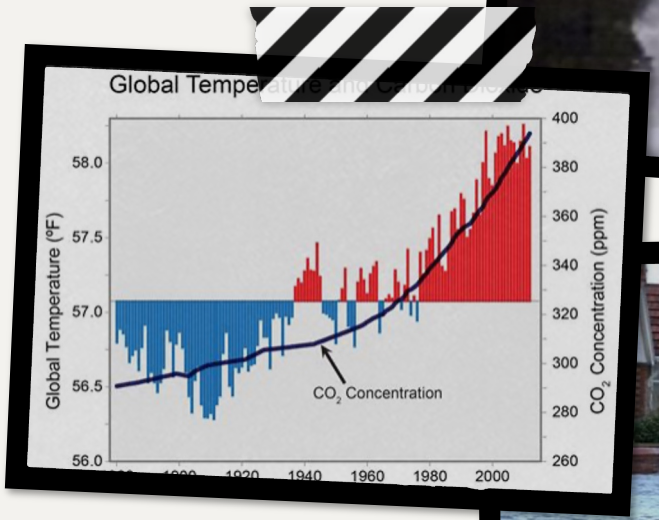
Understanding Climate Change in Europe with Machine Learning

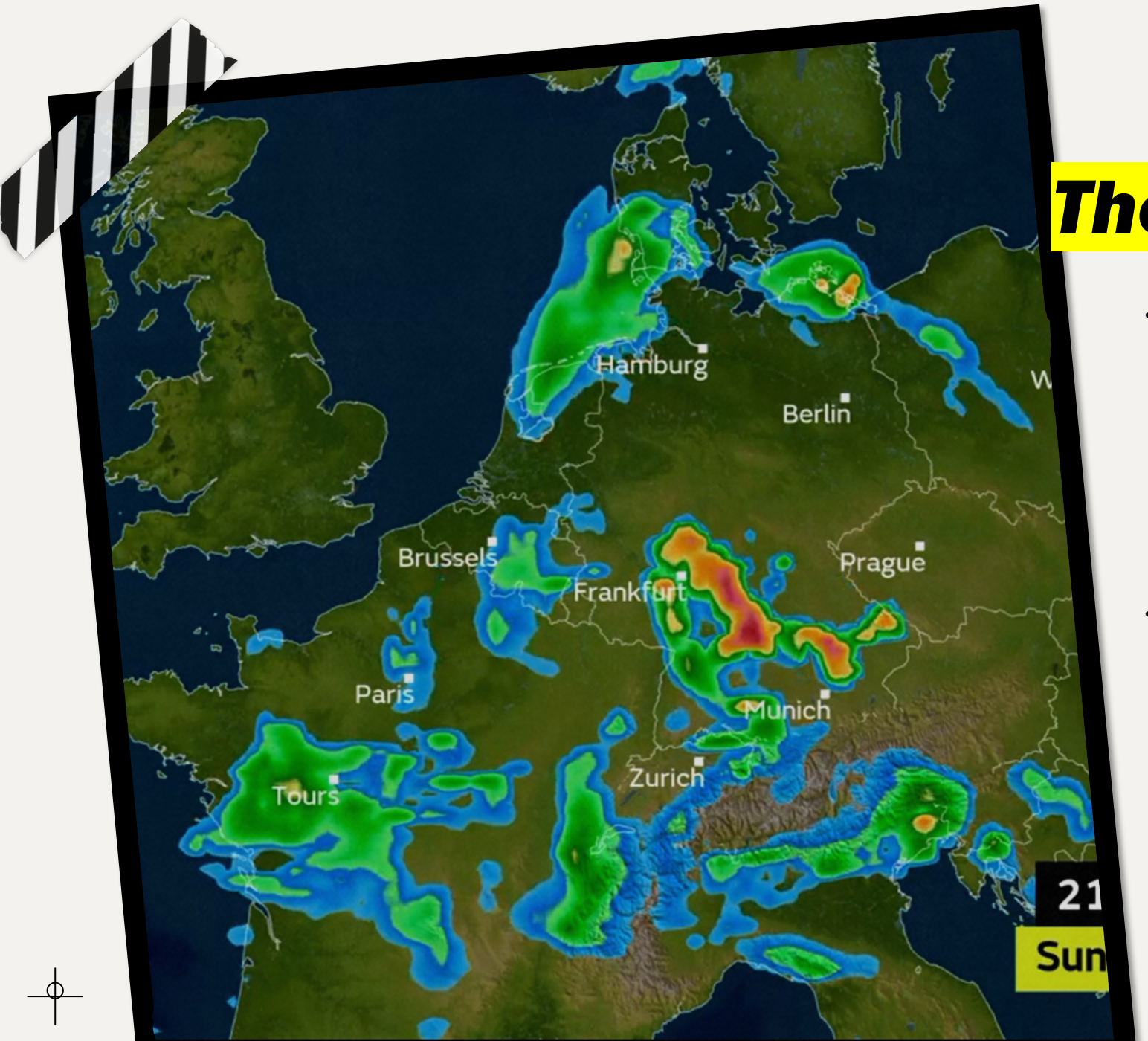
Analysis by Jeremy Obach

30 JUN 24

Objectives

- Identify weather patterns outside the regional norm in Europe.
- Determine if unusual weather patterns are increasing.
- Generate possibilities for future weather conditions over the next 25 to 50 years based on current trends.
- Determine the safest places for people to live in Europe over the next 25 to 50 years.





Thought Experiments

- Suppose a machine-learning model was powerful enough to predict the weather with 100 percent accuracy for the next 25-50 years – BUT the energy consumption required for the operation of this model has a **significant** detrimental effect on the climate.
  - 1) To what extent could the model's operation be justified based on insights garnered?
  - 2) How can we determine the maximum prediction benefit for the minimum climate detriment?
- Could a model use the migration data of human history to optimally place climate refugees in new nations?

+ 3) How should nations distribute the brunt of climate displacement/humanitarian aid?

Machine Learning Models

Convolution Neural Network

Recurrent Neural Network

Random Forest

Regression Analysis

Principal Component Analysis

Hyperparameter optimization

Data Needs

Weather data for Europe

18 weather stations from our study + representative weather samples to fill out underserved zones

- Metrics including temperature, precipitation, wind strength, etc.

Weather data for Earth

Advanced models could utilize satellite and radar for a more comprehensive understanding of weather patterns.

Destructive weather events and model data for land viability with heightened sea levels.

Migration data

Tracking population growth and decline of various groups, some measure of successful vs unsuccessful integration

Hypothetical “big data”

To 100% predict the weather for X years, would need input approximating all information in existence for an advanced model to train with.

Scenario 1

Thought Experiment: A ML weather model that damages the environment.	ClimateWins Objectives:	ML Models	Data Required
How can we determine the maximum prediction benefit for the minimum climate detriment?	Identify weather patterns outside the regional norm in Europe. Determine if unusual weather patterns are increasing.	Regression Analysis Principal Component Analysis	Weather data for Europe •18 weather stations from our study •Representative weather samples to fill out underserved zones Weather data for Earth •Advanced models could utilize satellite and radar for a more comprehensive understanding of weather patterns.

Scenario 2

A ML weather model that damages the environment

To what extent could the model's operation be justified based on insights garnered?

What insights could we draw from a complete knowledge of the next 50 years of weather, and would it be enough to offset the operation of the model?

ClimateWins Objectives

Generate possibilities for future weather conditions over the next 25 to 50 years based on current trends.

ML Models

Convolution Neural Network/ Recursive Neural Network

- Both use supervised and unsupervised learning to make connections, like the brain.

Hyperparameter optimization

- Bayesian, Random, Search

Data

Everything required for Thought Experiment 1, plus:

Hypothetical "big data"

- input approximating all information in existence for an advanced model to train with.

Scenario 3

Thought Experiment: A ML model to optimize Climate Refugee Placement	ClimateWins Objective:	ML Models:	Data
•How should nations distribute the brunt of climate displacement/humanitarian aid? •Based on relative economic strength? Availability of shelter/inhabitable land?	•Determine the safest places for people to live in Europe over the next 25 to 50 years.	•Random Forest – especially useful for categorical/sorting problems •PCA – reduce variables to include most important markers of success for refugee integration	•Migration data •Tracking population growth and decline of various groups, some measure of successful vs unsuccessful integration. •Region viability assessment for refugees: food and shelter, economic opportunity, proximity to familiar culture, hostility/receptiveness from host nation.

Scenario Assessments

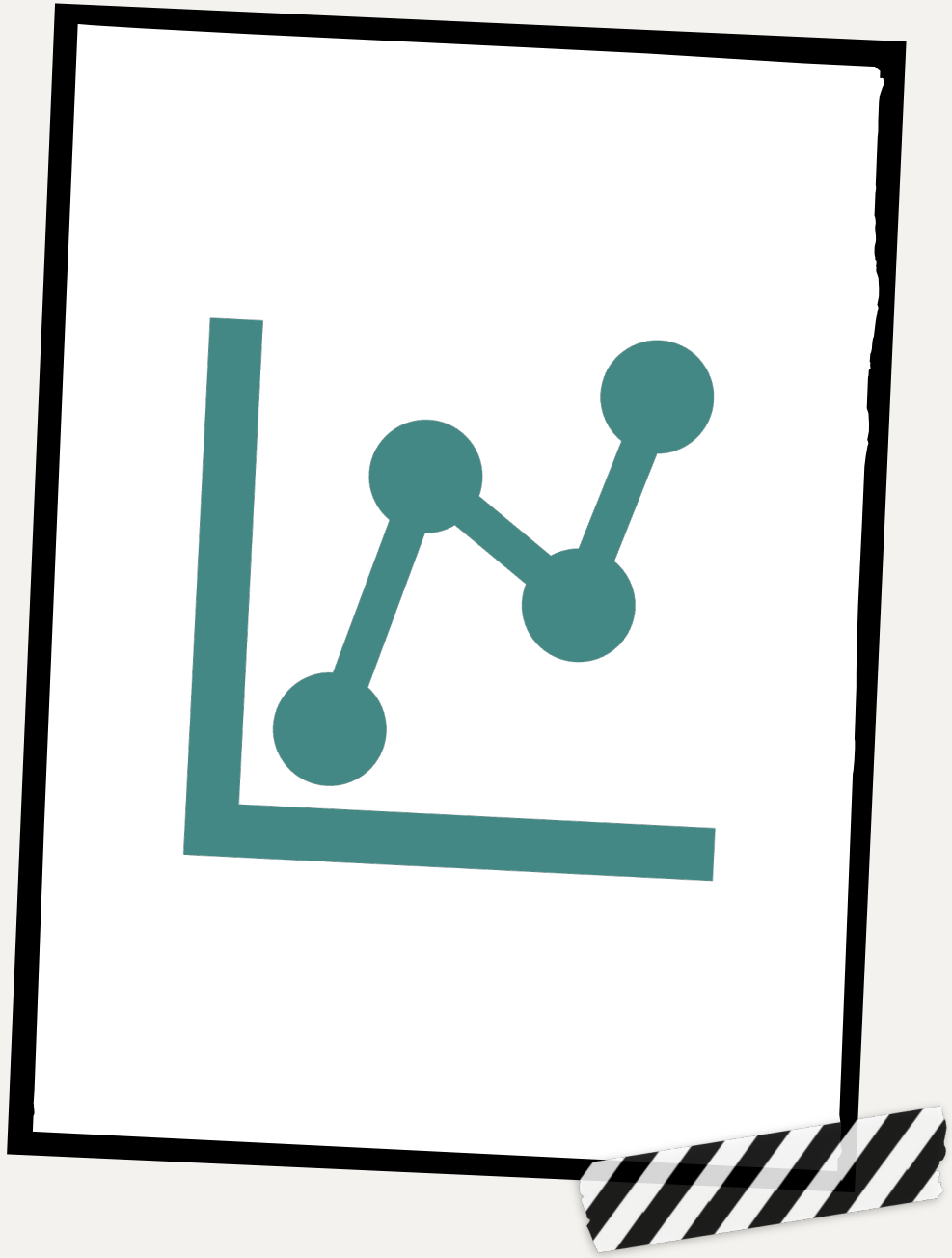
Thought Experiment #1 is the most achievable.

Thought Experiment #2 is the most ambitious.

Thought Experiment #3 has the most political implications.

Recommended Approach

- Scenario 1 can be meaningfully explored to achieve ClimateWins stated goals with current technology and without catastrophic environmental damage
  - + Optimization thru Regression Analysis and PCA, and Hyperparameter analysis.
  - + Can analyze past weather data to assess historical conditions, detect if extreme weather is increasing across Europe.



Questions?

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