Modeling Wildfire Risk in Alaska

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Background:

- Changing Weather Patterns and Increasing Risk

- Risk of *Occurrence* vs. Spreading Behavior

- Study Area: Alaska (Originally US)

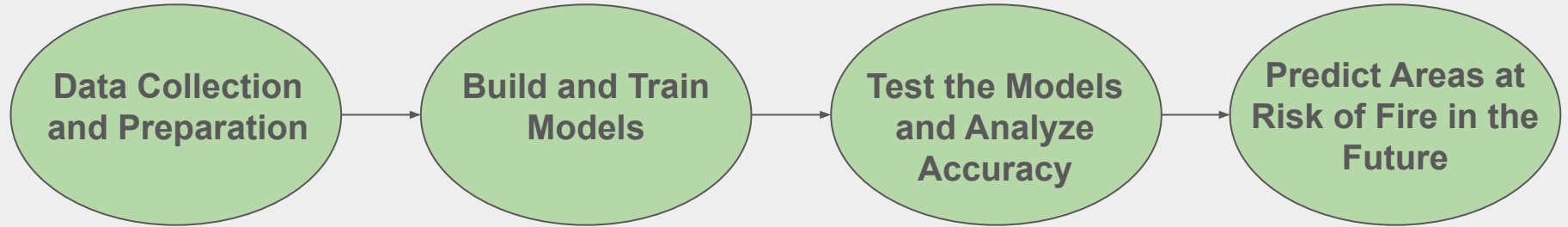"Massive wildfires burn through 'fireproof' regions in Alaska"

"As Alaska Warms, Wildfires Pose a Growing Threat"

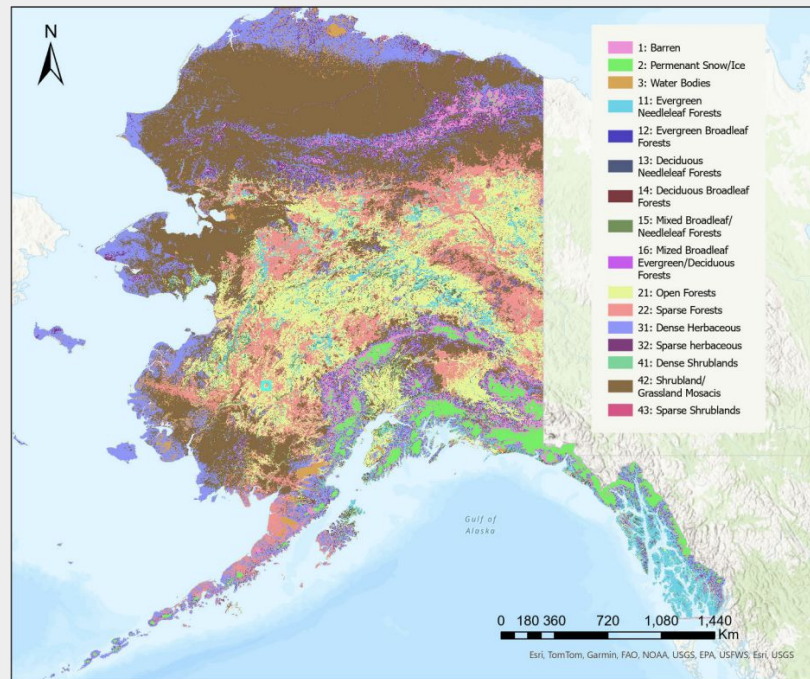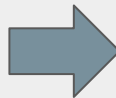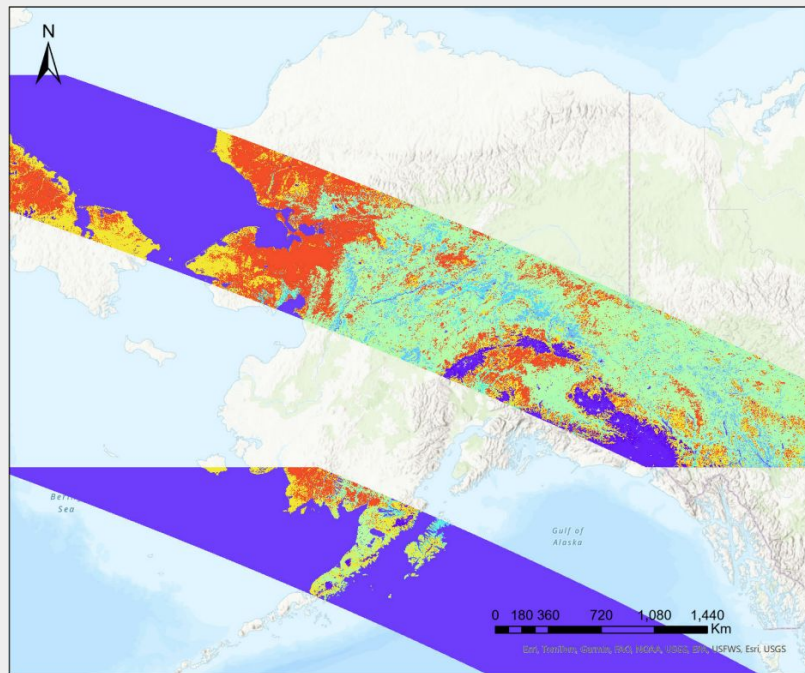"Wildfire Is Transforming Alaska and Amplifying Climate Change"

Project Design:

Data Collection + Prep (1)

**Land Cover Classifications:**

- **Source:** MCD12Q1 v061, MODIS/Terra+Aqua Land Cover Type Yearly L3 Global SIN Grid
    - Procured 13 tiles to cover area of Alaska using the MODIS Sinusoidal Tile Grid
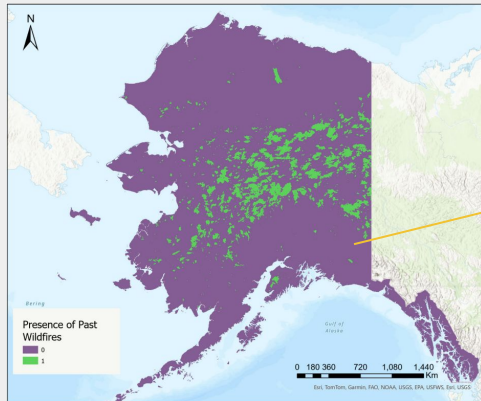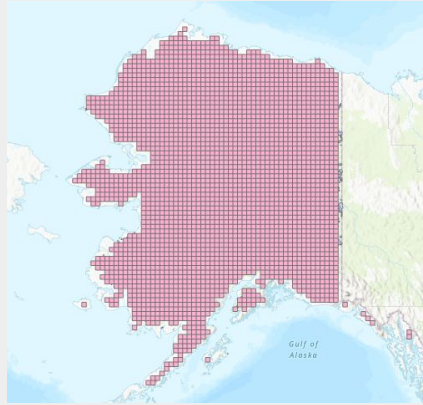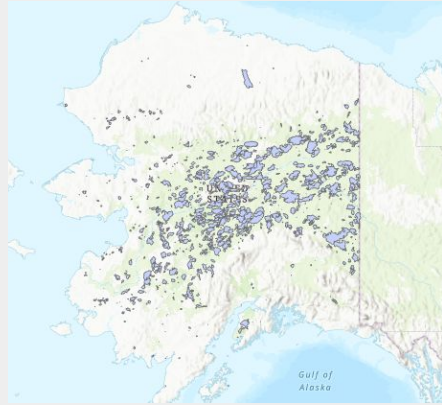- **Projection and Resolution:** 1000 x 1000 m

Data Collection + Prep (2 + 3)

Average Summer Temperatures and Precipitation (June - August):
- **Source:** USDA Rocky Mountain Research Station: Water and Watersheds Research Program
- **Projection and Resolution:** 1000 x 1000 m
  - Alaska Albers Equal Area Conic → NAD (2011) Alaska Albers (Meters)
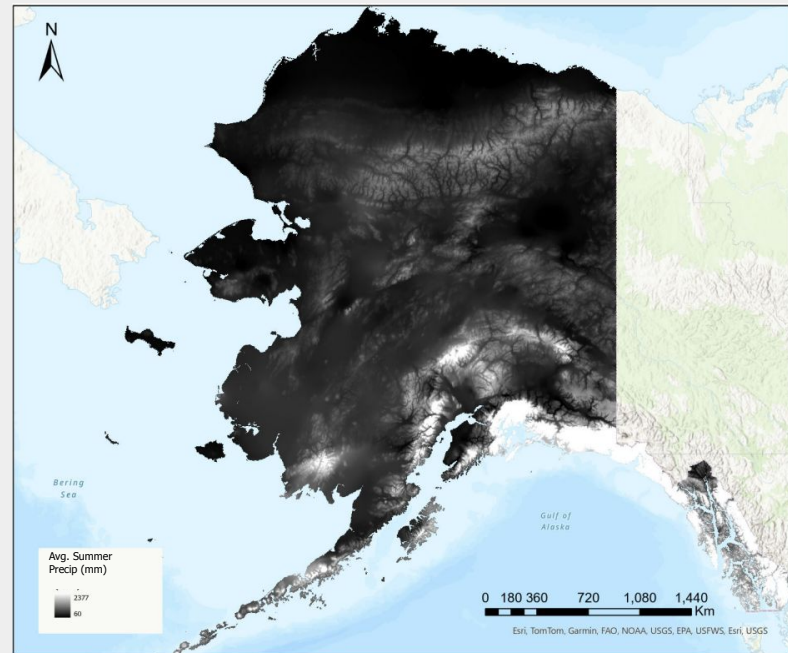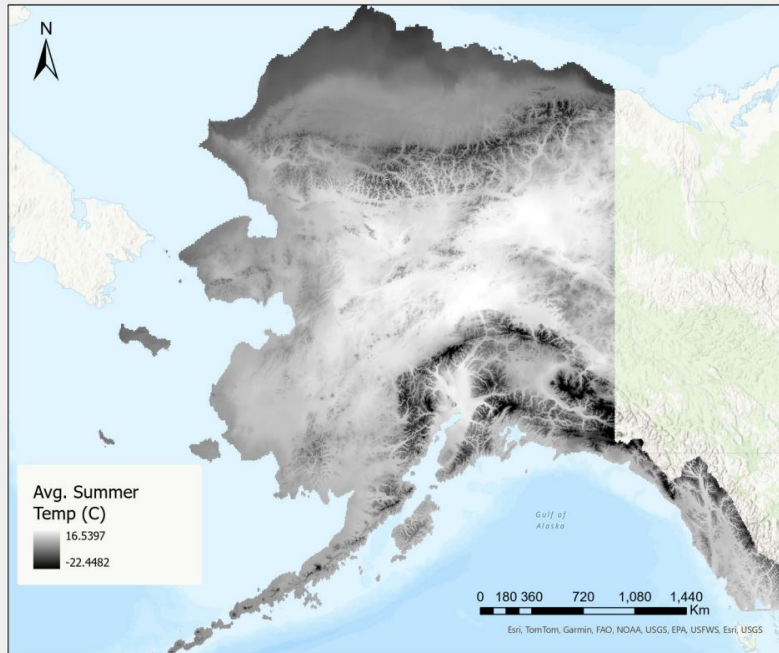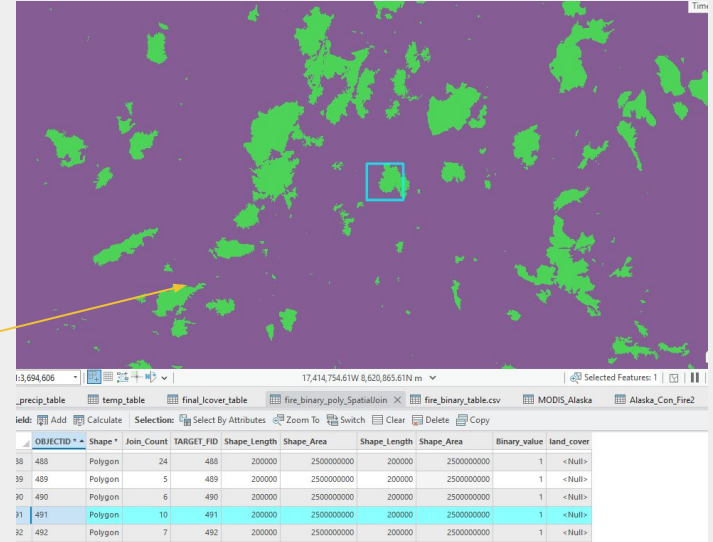
Data Collection (4):

Historical Wildfire Extent (2000-2018):
- **Source:** Geospatial Multi-Agency Coordination (USGS)
- **Projection:** WGS 1984 Web Mercator (auxiliary sphere) → NAD (2011) Alaska Albers (Meters)

Implementation:

- Variables
  - <u>Feature Variables (X):</u> Average Summer Temp, Average Summer Precip, Land Cover Type
  - <u>Target Variable (y):</u> Historical Wildfires as binary variable
- Train/Test Split (80/20)
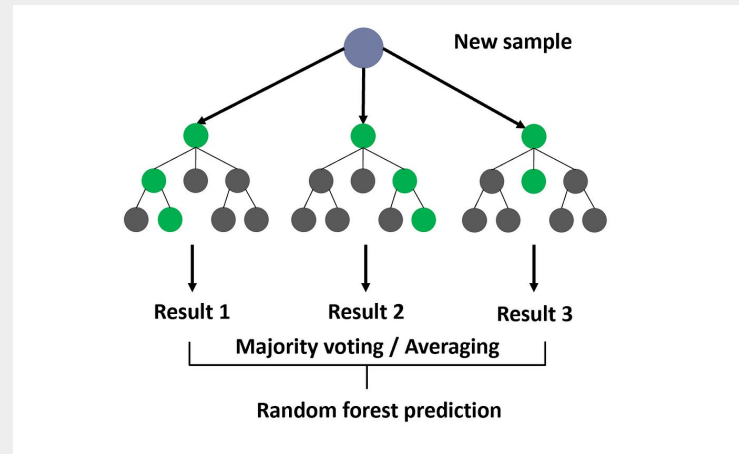- Hyperparameter Tuning (GridSearchCV)
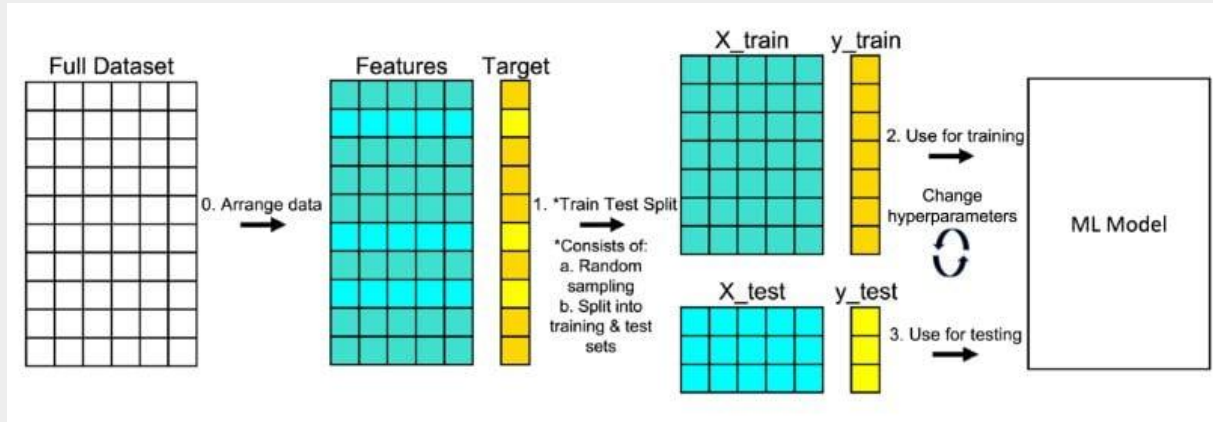
Implementation:

- In Sci-Kit Learn, experimented with:

  - Decision Tree (CART: Classification and Regression Tree, Supervised)

  - Logistic Regression (for categorical variables)

  - Random Forest
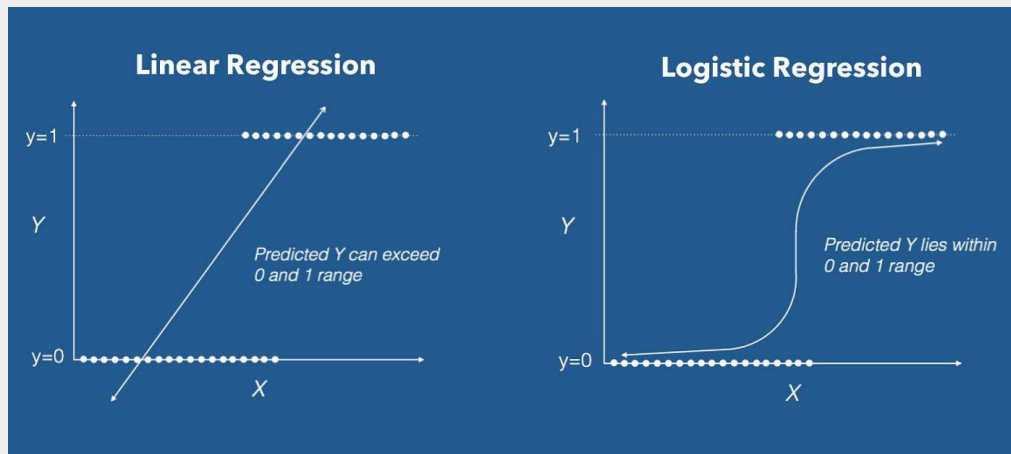
Difference between a Linear and
Logistic Regression

Random Forest Classifier
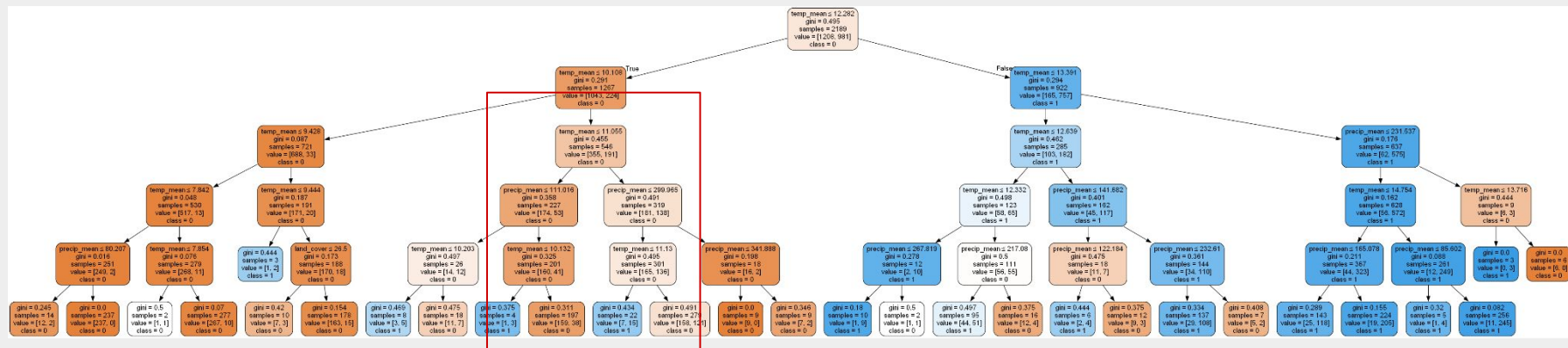
ML Performance and Outputs

- Model Accuracies:

Model	Accuracy	True Positive/False Positive
Decision Tree	0.8011	0.735/0.148
Logistic Regression	0.8047	0.761/0.161
Random Forest	0.8102	0.761/0.161

- Model Output:
  - Array of ones and zeros, predicting whether each grid cell in the test set has had a fire (1) or hasn't (0)
  - Join this array back on x-variables and ObjectID of test set to visually analyze in ArcGIS Pro

Preliminary Results

Decision Tree

Log Regression

Random Forest

Legend:
- True Positive
- True Negative
- False Negative
- False Positive
- Training Data

Next Steps → Future Research:

Predict areas where future wildfires are likely to occur with predicted future average summer temperatures and precipitation levels

Future Research Might Include:

- Cross-validation to get predictions for every grid cell in Alaska
- Finer-scale predictions (fishnet)
- Adding additional variables:
    - Soil Moisture, Humidity, Topography, Fuel Structure/Distribution
- Expand to other study areas

Sources:

Dobilas, Saul. 2021. "CART: Classification and Regression Trees for Clean but Powerful Models." *Medium.* https://towardsdatascience.com/cart-classification-and-regression-trees-for-clean-but-powerful-models-cc89e60b7a85

Oxford, Mariah. 2022. "Wildfire Hazard map Gives Residents Important Risk Information." *University of Alaska Anchorage.* https://www.uaa.alaska.edu/news/a rchive/2022/05/wildfire-hazard-map-residents-risk-information.cshtml.

"Wildfires and Climate Change." *Center For Climate and Energy Solutions.* https://www.c2es.org/content/wildfires-and-climate-change/#:~:text=Wildfire%20risk%20depends%20on%20a,climate%20variability%20and%20climate%20change.

 Zhai, Jun, Zhuo Ning, Ram Dahal, and Shaoyang Yang. 2023. "Wildfire Susceptibility of Land Use and Topographic Features in the Western United States: Implications for the Landscape Management" *Forests* 14, no. 4: 807. https://doi.org/10.3390/f14040807

Data:

https://www.google.com/url?q=https://www.usgs.gov/centers/eros/science/national-land-cover-database&sa=D&source=docs&ust=1709585457011980&usg=AOvVaw1_qHfnJjwXo0uS6WF39oY_

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