Investigation of wildfire risk using multiple remote sensing parameters

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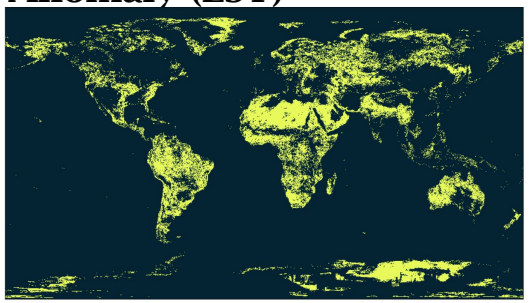
Objective

- Create a global wildfire risk map that incorporates data from multiple environmental factors
- Evaluate the global risk map based on actual burned area data

Five Factors

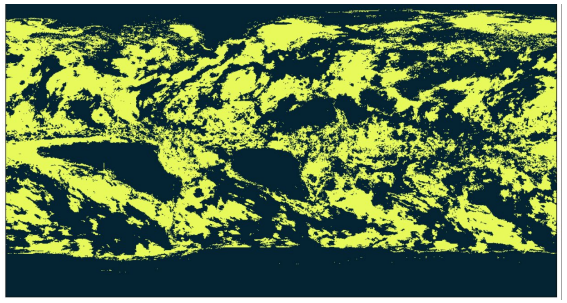
- To create a global risk map data from five environmental factors was incorporated, each with its own relation to wildfire dynamics
- Each factor's threshold was optimized for the best and most effective fit

Land Surface Temperature Anomaly (LST)



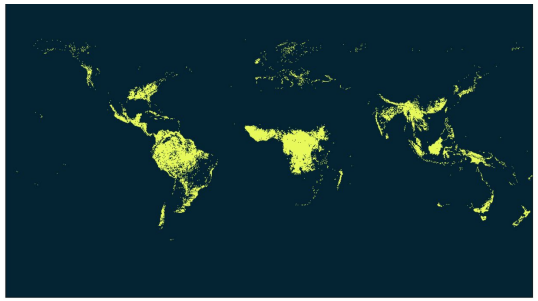
Threshold: 0 - 3

Precipitation Anomaly (PRCP)



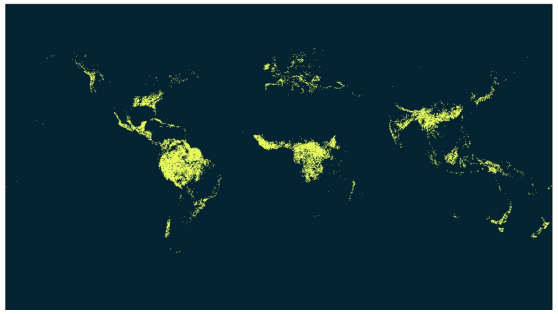
Threshold: (-10) - (-.5)

Leaf Area Index (LAI)



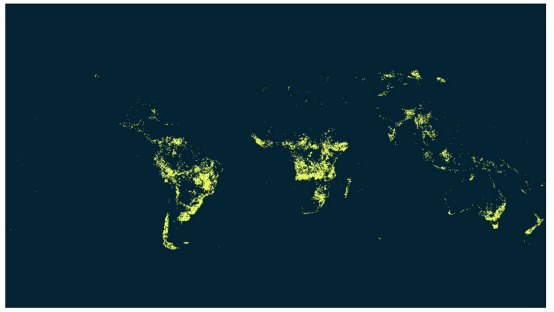
Threshold: 1.5 - 5.5

Normalized Difference Vegetation Index (NDVI)



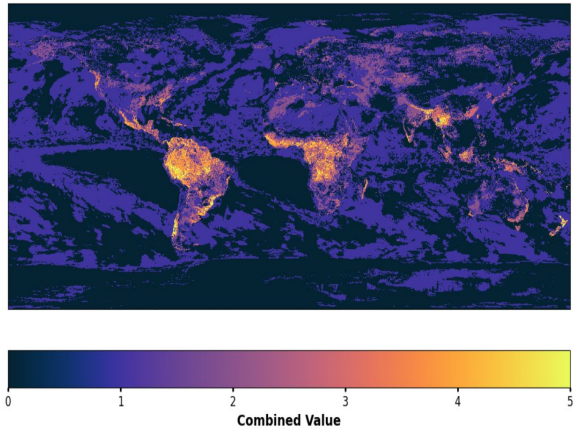
Threshold: .7 - .9

Evapotranspiration Anomaly (ET)



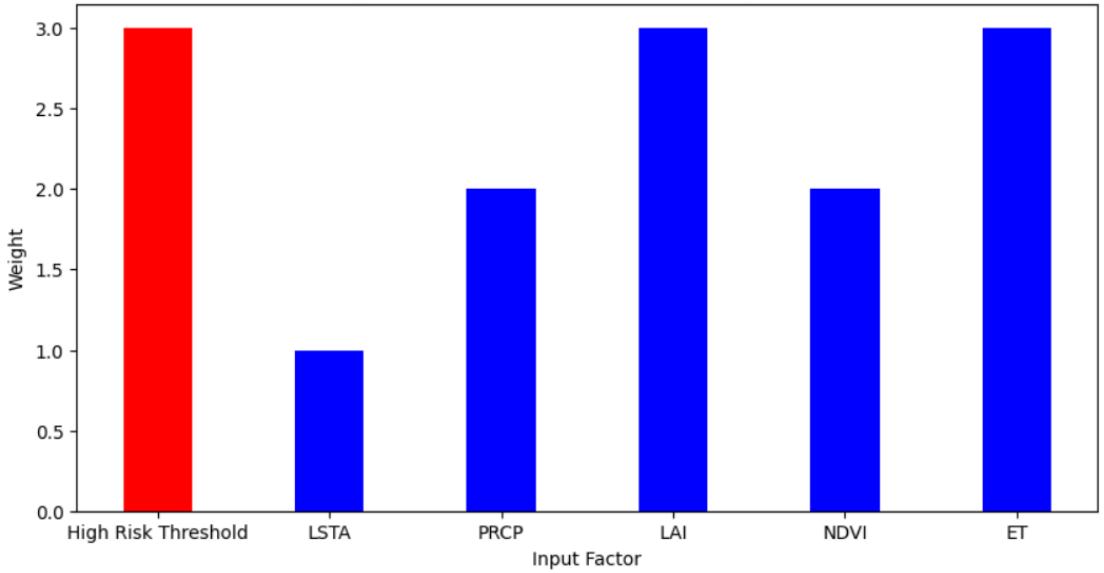
Threshold: 2 - 9.5

Overlay of Five Factors Combined



Developing a Global Wildfire Risk Prediction Map

Weight of Environmental Factors in Map Creation



How These Weights and Thresholds Were Found

Optimization Procedures

- Algorithm used to determine the best threshold
  - (0.7 * precision) + (0.2 * (1 / (1 + ratio_burned_shared))) + (0.1 * normalized_risk_count)

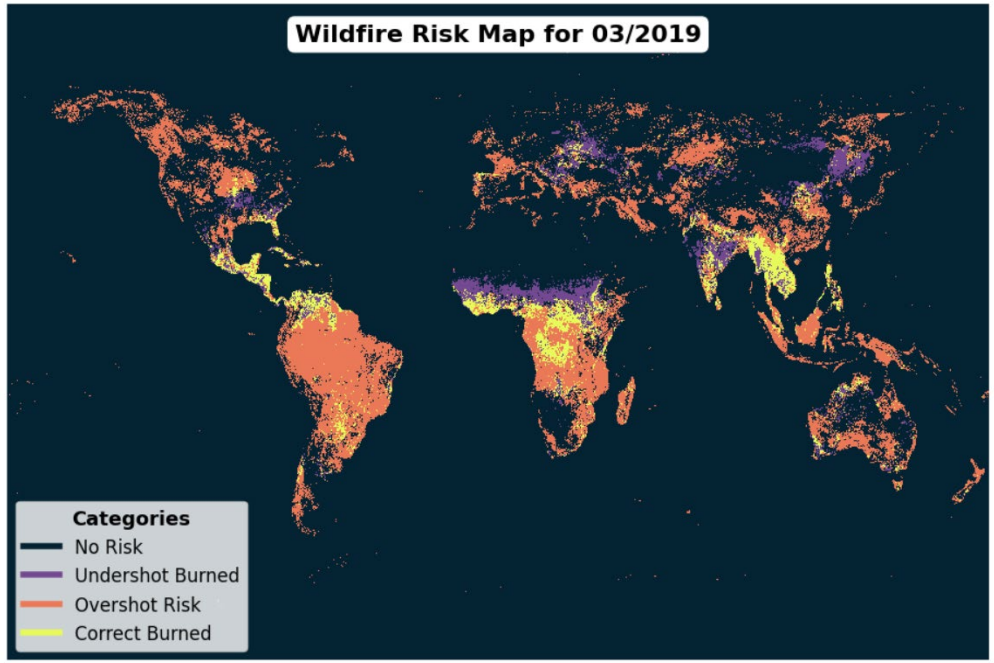
- Method used to determine the best weight for each factor
  - If shared_count/burned_count > 1.25
  - If risk_count < (shared_count + burned_count)*3
  - Then find the highest precision

How the model works

Retrieves Input Data → Thresholds Are Assigned → Factor Weights Added → Tested Against Burned Data → Output Map Created

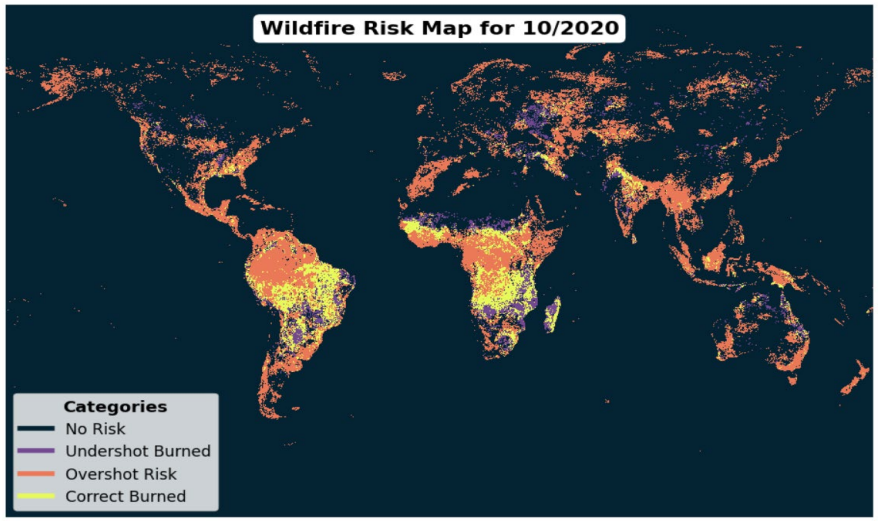
What This Map Shows

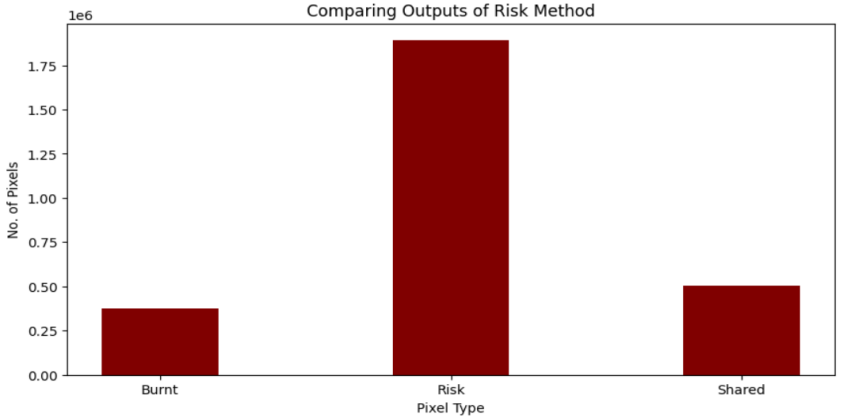
- **No Risk** – Model Identified No Risk for Pixel
- **Undershot Burned** – Burned Pixel Not Identified As Risk
- **Overshot Risk** – Identified as Risk But Not Burned
- **Correct Burned** – Identified as Risk and Was Burned



Impact of the Results

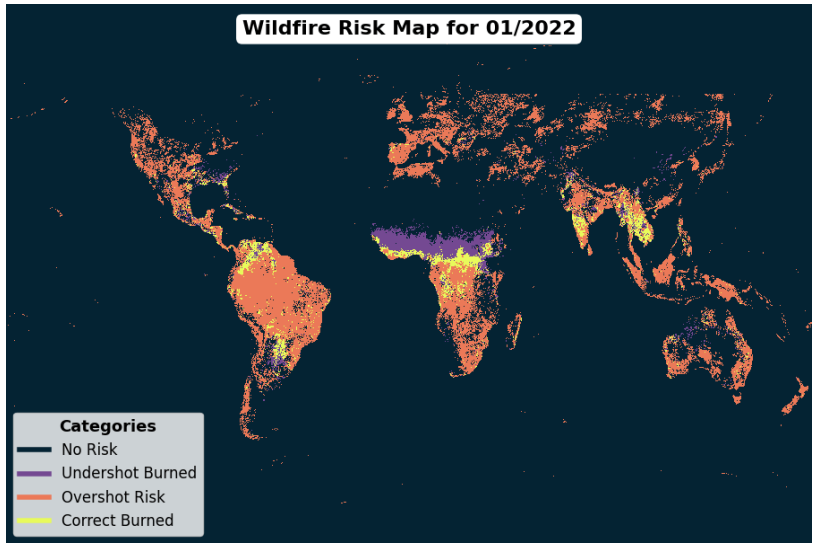
Example for One Month





Accuracy: 0.9294810142688674
Error Rate: 0.07051898573113255
Precision: 0.21108631048557752

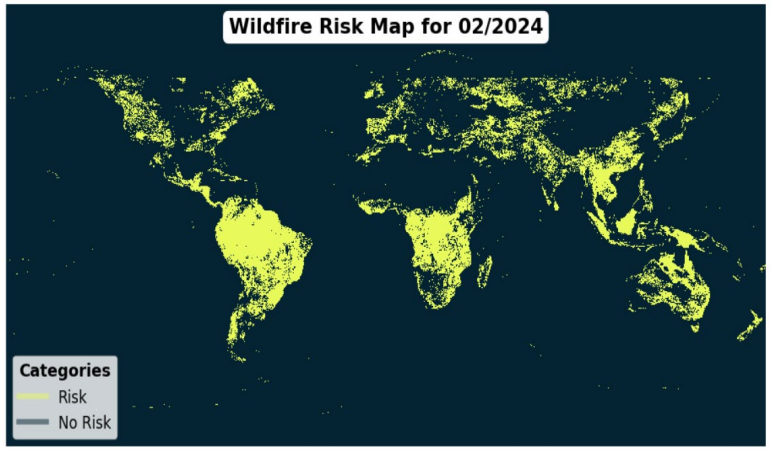
Timescale for one year of prediction (2022)



Limitations

- With more factors included in the model process results could become even more accurate
- A location (lat, long) specific threshold could also be utilized to improve the model

Risk Prediction Map for More Recent Data



Results

- Built script that takes input factors and creates a global risk map that illustrates where risk areas are and where burned areas are correctly identified
- Could be used to help identify high-risk areas for wildfire outbreaks, enabling targeted risk mitigation strategies and efficient resource allocation

References
Sayad, Y. O., Mousannif, H., & Al Moatassime, H. (2019). Predictive modeling of wildfires: A new dataset and machine learning approach. *Fire Safety Journal, 104*, 130-146. https://doi.org/10.1016/j.firesaf.2019.01.006
Miller, C., & Ager, A. A. (2013). A wildfire risk assessment framework for land and resource management. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. https://www.fs.usda.gov/rm/pubs/rmrs_gtr315.pdf