Fire-Climate Relationships in Continental Southeast Asia (SEA)

Vanessa Cheung, Alex Han, Danny Huang, Anthony Wu
Client: Andrea Ku, MSc Candidate at UBC Department of Geography
Supervised by Professors Keegan Korthauer, Melissa Lee, Rodolfo Lourenzutti, and Chloe You from UBC Department of Statistics

Abstract

Our project investigates relationships between climate factors (i.e. rainfall) and fire activity in continental SEA. We find that drought severity and percentage of vegetation have the greatest influence. Additionally, fire patterns do vary according to geographical patterns across SEA.

Introduction

Research Questions

1. How do fire patterns vary across continental SEA?
2. How do rainfall patterns influence the variations in fire activity?

Exploratory Data Analysis

./images/HQ_EDA.png

Figure 1: Visualizing data by raster graphics.

Regionalization

- Aim to cluster SEA into "similar" regions by fire patterns using Spatial 'K'luster Analysis by Tree Edge Removal (SKATER) algorithm.

Statistical Analysis

- Analyze model performance and variable importance by Generalized Additive Models (GAM) and Random Forest Regression (RF).

Results on Fire-Rainfall Relationships

Generalized Additive Model
Model: $log(y) = s(MAP) + s(drought\ severity) + s(seasonality\ index) + s(PNV)$, where s is the smooth function.

./images/HQ_GAMAll.png

Figure 3: **Left**: Drought severity and Seasonality index appear to be negatively correlated with all fire variables. **Right**: Based on F-stat, drought severity seems to be most important in fire size model and percentage of natural vegetation seems to be most important in burned area and number of fires model. F-stat indicates whether the smooth function term for the variable is significant in a particular model.

Random Forest Regression
Model: $log(y) = MAP + drought\ severity + seasonality\ index + PNV$

Statistical Model Performance

Generalized Additive Model performance

./images/GAMPerform.png

Figure 5: Cross-validation and fit R-squared scores are relatively comparable. The R-squared values range around 0.15 to 0.28.

Random Forest Regression performance

./images/RFPerform.png