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Mapping Agricultural-Driven Deforestation in Central Kalimantan with Remote Sensing

AI in Urban Sustainability

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Fires in Central Kalimantan (Fauzy Chaniago, 2019)

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01 Introduction

A night photograph of a forest fire. In the background, a large fire burns brightly, illuminating the surrounding trees and foliage with a warm, orange glow. In the foreground, two firefighters are visible, their silhouettes dark against the bright light of the fire. They are wearing reflective gear, including helmets and pants with reflective stripes. The scene is dark, with the fire providing the primary light source.

Region of Interest



- Borneo
 - An island in Southeast Asia
 - Brunei, Malaysia, and Indonesia
- Kalimantan makes up 73% of the island's area
 - Fall under Indonesia's jurisdiction

Region of Interest: Pulang Pisau





Bornean Orangutans (Anup Shah)

- Ecologically significant tropical habitat
 - Bornean Orangutan
 - Diverse flora and fauna
- Agricultural production has driven deforestation
 - Rubber
 - Palm Oil
 - Peatland drainage



Palm Oil Plantation in former orangutan habitat (Ulet Ifansasti, 2014)

- Ecologically significant tropical habitat
 - Bornean Orangutan
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2015 Haze Crisis in Central Kalimantan (Bjorn Vaughn, 2015)

- Severe peatland fires during dry seasons (June to October)
- Tremendous impacts on:
 - Environmental degradation
 - Health issues
 - Air pollution



02 Methodology

Fires in Central Kalimantan (Fauzy Chaniago, 2019)

Using Sentinel-2 Images to Identify burns

“Redefined burn-area mapping protocol using Sentinel-2 data”
(Gaveau et al., 2021)

Purpose

Compared total burn area estimates results between Landsat and Sentinel-2 data

Findings

Using Sentinel-2 data **increased** the total **estimates** of burned area because:

- **Higher resolution** than Landsat
- Picked up more nuances in the data, including **smaller fires**

More accurate estimates help us consider impacts of fires more accurately.

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Methodology

Step	Action
1	Subset Region of Interest to Pulang Pisau
2	Download Sentinel-2 SR (L2A) 2019
3	Cloud-masking and calculate NBR
4	Apply a moving window for dNBR detection
5	Create pre- and post-fire composites
6	Label training points (burned/unburned)
7	Train Random Forest
8	Map of burned areas
9	Validate with independent points

03 Progress

A night photograph of a forest fire. In the background, a large fire burns brightly, illuminating the surrounding trees and foliage with a warm, orange glow. In the foreground, two firefighters are visible, their silhouettes dark against the bright light of the fire. They are wearing reflective gear, including helmets and pants with reflective stripes. The scene is dark, with the fire providing the primary light source.

Data Collection

October 21, 2016

- The quality of images vary drastically due to high cloud coverage.
- Pre-processing is required to remove cloudy pixels
 - QA60 bitmasking

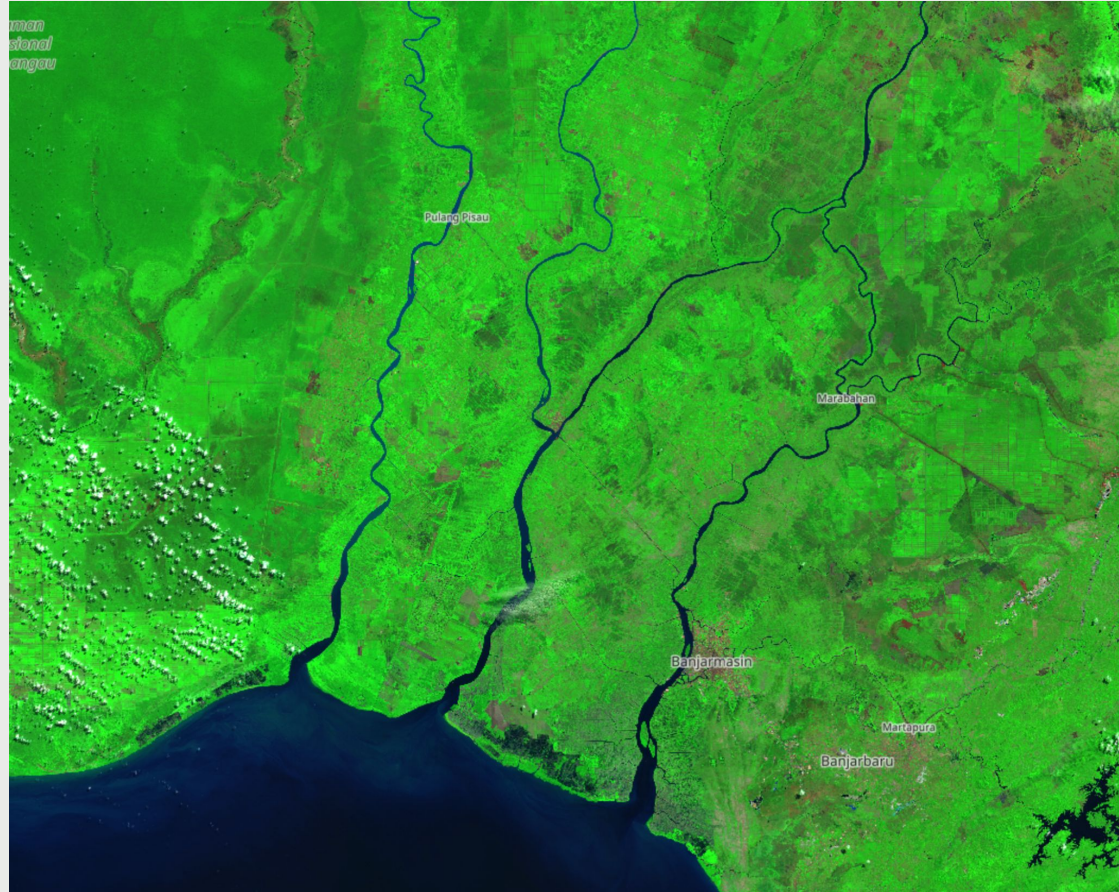


Exploratory Analysis

July 25, 2019

Pulang Pisau - Before the fires

Using composite bands (SWIR2 (R), NIR (G), Red (B)) to show extent of burns

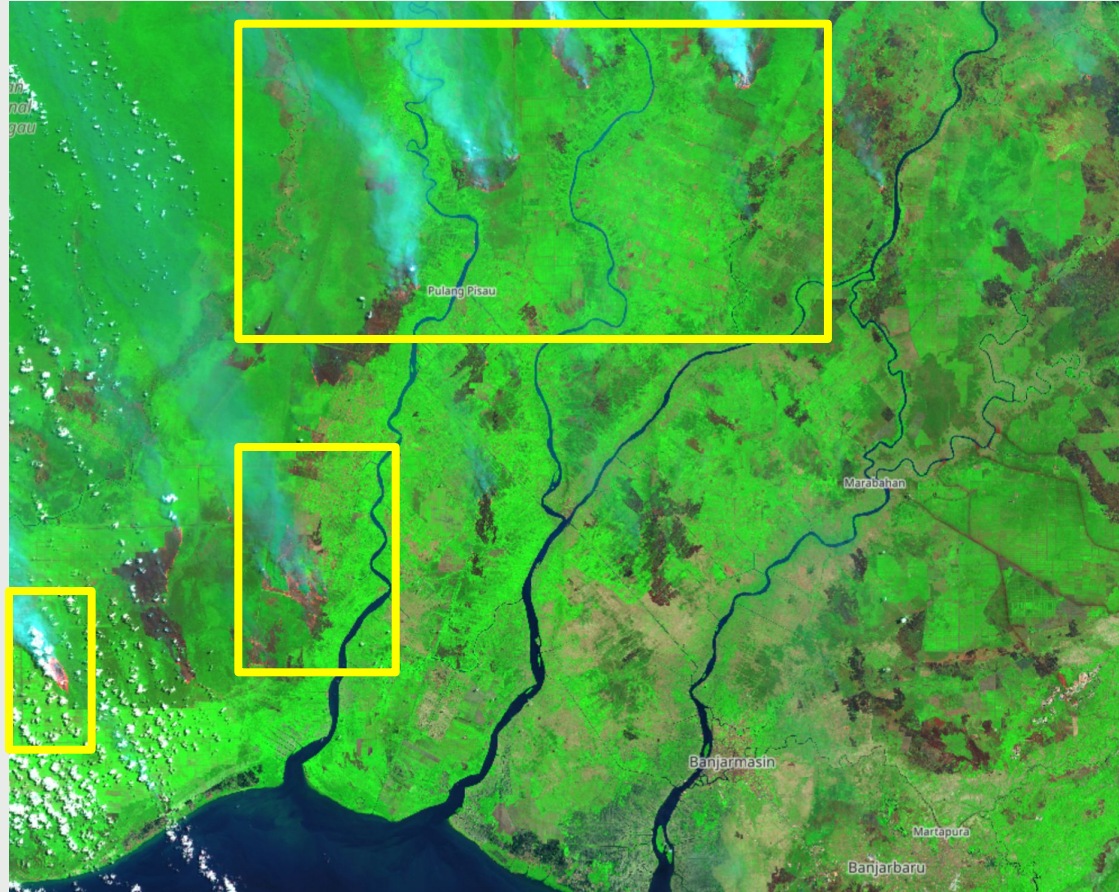


Exploratory Analysis

September 13, 2019

Pulang Pisau - During the fires

Using composite bands (SWIR2 (R), NIR (G), Red (B)) to show extent of burns

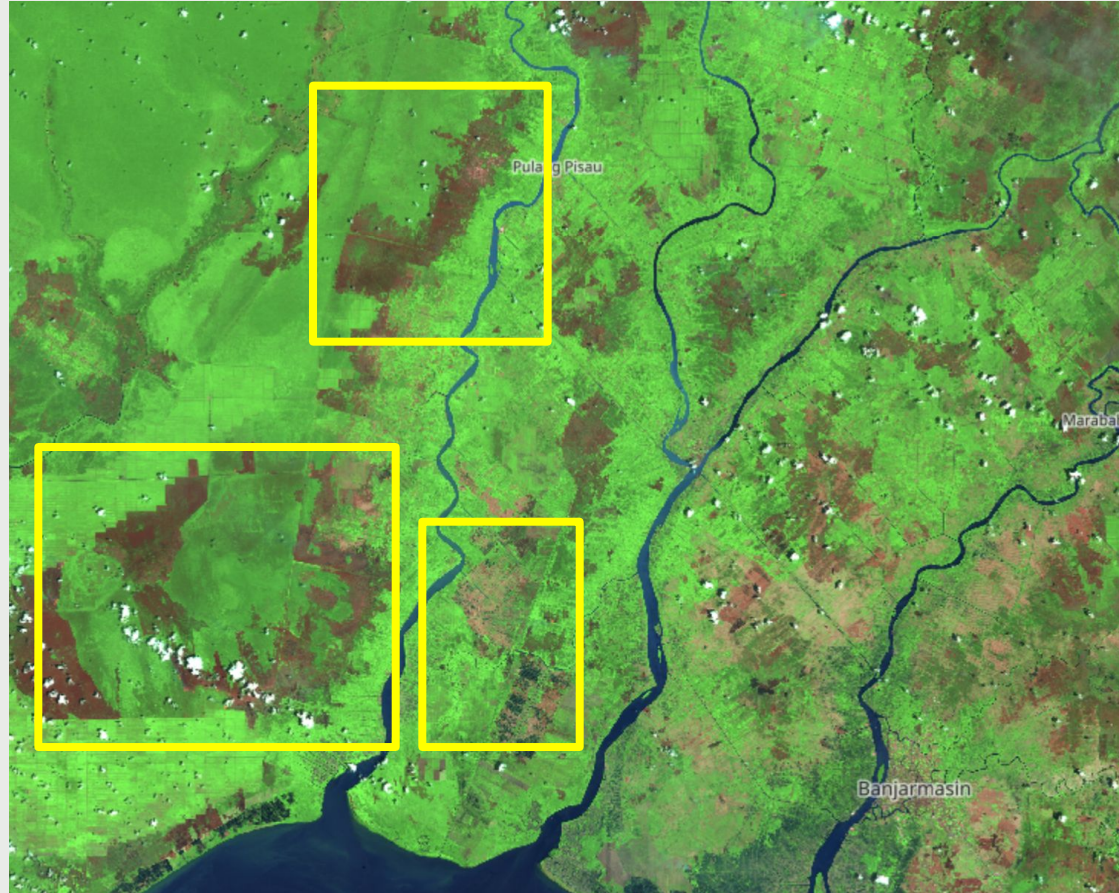


Exploratory Analysis

October 23, 2019

Pulang Pisau - After the
fires

Using composite bands (SWIR2 (R), NIR (G),
Red (B)) to show extent of burns



Burn Analysis

- Change detection between pre- and post-fire results.
- Dark Red and Black regions show moderate to major burns



An aerial photograph showing a dense forest in Central Kalimantan. Thick, white smoke is rising from various points across the landscape, partially obscuring the dark green and brown trees. The smoke is most concentrated in the upper right and center of the image. The overall scene depicts a large-scale fire event.

04 Next Steps

Fires in Central Kalimantan (Fauzy Chaniago, 2019)

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I could not do a moving window due to the data quality.

Decided to do split the data into two seasons (Jan-Jun and Sep-Dec).

Create 500 labels
30-40% burned
60-70% unburned

Thank You!