

# Documentation for Calculating NDBI and Visualizing GeoJSON Data Using Landsat 8 and Streamlit

## Introduction

This document provides a step-by-step guide to calculate the Normalized Difference Built-up Index (NDBI) using Landsat 8 data from the Microsoft Planetary Computer for a specified region for the year 2016 with less than 10% cloud cover. Additionally, it demonstrates how to visualize population and household income GeoJSON data in a Streamlit application.

## Dependencies

Ensure the following Python packages are installed:

- rasterio
- numpy
- requests
- planetary\_computer
- matplotlib
- shapely
- streamlit
- leafmap

## Steps

### 1. Define the Bounding Box for the Region

Specify the approximate coordinates for the region of interest.

### 2. Search for Landsat 8 Scenes

Define the search criteria to find scenes from 2016 with less than 10% cloud cover using the STAC API.

### 3. Download the Necessary Bands

Download the Near-Infrared (NIR) and Shortwave Infrared (SWIR) bands using their respective URLs from the search results.

### 4. Calculate NDBI

Read the downloaded bands and calculate the NDBI using the formula  $(SWIR - NIR) / (SWIR + NIR)$ .

## 5. Save NDBI to a GeoTIFF File

Update the profile of the NIR band to match the new NDBI data and save it as a GeoTIFF file named NDBI.TIF.

## 6. Plot NDBI

Visualize the NDBI using matplotlib to confirm the results.

## 7. Visualize GeoJSON Data in Streamlit

- Create a Streamlit application to visualize population and household income GeoJSON data using the leafmap library.
- Setup Streamlit Application: Initialize the Streamlit application and set the title.
- Define GeoJSON URLs: Specify the URLs for the population and household income GeoJSON data.
- Layer Selection: Add a sidebar for selecting which GeoJSON layers to display.
- Basemap Selection: Add a sidebar for selecting the basemap type (ROADMAP, SATELLITE, TERRAIN, HYBRID).
- Layer Styling: Allow users to pick colors and opacity for each layer through the sidebar.
- Apply Styling: Apply the selected styles to the GeoJSON data.
- Display the Map: Use the leafmap library to display the map with the selected and styled GeoJSON layers.

## Summary

This guide demonstrates how to calculate the NDBI for a specified region using Landsat 8 data from the Microsoft Planetary Computer for the year 2016 with less than 10% cloud cover. Additionally, it shows how to create a Streamlit application to visualize population and household income GeoJSON data. The process involves searching for relevant scenes, downloading necessary bands, calculating the NDBI, saving it as a GeoTIFF file, and visualizing the results in a Streamlit app.