Spectral Index Mapper, version 1.0

User guideline

Author: Dr. Stefan Peters, University of South Australia, +61 8 830 25245, stefan.peters@unisa.edu.au

About the App

The **Spectral Index Mapper** is an interactive web application developed on the Google Earth Engine platform to facilitate the analysis of Sentinel-2 satellite imagery. It allows users to visualise and compare spectral indices for a defined area and time range. The primary aim of the app is to support the **Green Triangle Forest Health Group**, particularly forestry companies, in assessing **forest health and detecting changes in forest cover** over time.

The app incorporates the following spectral indices:

1) **NDVI** (Normalized Difference Vegetation Index):
   Measures vegetation health and density. High values indicate healthy, dense vegetation.
2) **EVI** (Enhanced Vegetation Index):
   Improves on NDVI by reducing atmospheric and soil background effects, useful in dense vegetation.
3) **SAVI** (Soil-Adjusted Vegetation Index):
   Minimizes soil brightness influence, ideal for sparse vegetation.
4) **NDMI** (Normalized Difference Moisture Index):
   Detects vegetation water content (moisture stress).
5) **NBR** (Normalized Burn Ratio):
   Identifies burned areas and fire severity.
6) **NBR2** (Normalized Burn Ratio 2):
   Enhances detection of older burns or low-severity fires.
7) **GCI** (Green Chlorophyll Index):
   Estimates chlorophyll content in leaves (sensitive to greenness).
8) **GNDVI** (Green Normalized Difference Vegetation Index):
   Similar to NDVI but uses green band, better for crops with high chlorophyll.
9) **GEMI** (Global Environment Monitoring Index):
   Assesses vegetation while minimizing atmospheric effects (less common than NDVI).
10) **NDRE** (Normalized Difference Red Edge Index):
    Sensitive to chlorophyll content in vegetation.
11) **FDI** (Forest Degradation Index): Highlights forest degradation using Tasseled Cap components.

Instructions

1. Defining Your Area of Interest

To begin using the app, users must first specify an Area of Interest (AOI), which can be done by drawing a geometry directly on the map interface. This is typically done using the polygon or rectangle tools available in the map's top-left corner. You can draw multiple polygons (geometries) as part of an AOI (layer), however, the +layer option, although allowing to draw further geometries in a different colour, will not be considered into the AOI.
To remove drawn geometries, click on the CLEAR button.
The application will automatically disable critical controls, such as the "Run Geometry" and "Download" buttons, until a valid AOI has been provided. This helps prevent accidental processing and ensures the app only operates when required spatial inputs are available.
For browser-based mapping, the app can handle geometry areas of the size of the Green Triangle, but for Time Series Charting and Layer downloading it is recommended to avoid drawing areas larger than 10,000 km², as this can exceed Google Earth Engine's computational limits and may lead to errors or timeouts.
Instead of drawing an AOI, users can also utilize predefined geometries (shapefiles/assets) – see section '7. Run GEE-Asset Button (Load GEE-asset Text Box)'.

---

2. Defining Temporal Range

Once an AOI has been specified, users must define a time period for analysis. This is done using the start and end date (year and month) selectors provided in the user interface. The application filters Sentinel-2 satellite images within the given time frame, applies cloud masking, and computes image mosaic composites using the median of sorted images within the defined area and time period.
Users are advised to tailor the time range to suit their monitoring objective. Short date ranges are useful for detecting specific events such as fires, harvesting, or pest outbreaks, whereas longer ranges are better suited to seasonal or long-term trend analysis. If either the start or end date is left undefined, or if the combination is invalid, the app will automatically disable processing controls to avoid incomplete or invalid queries.

---

3. Selecting One or Two Spectral Indices

The app provides two drop-down menus allowing users to select one or two spectral indices for analysis. These indices include common vegetation and disturbance metrics such as the NDVI, NBR, NDMI, and EVI.
Users may compare two different indices or select the same index with different binary thresholds applied. If both selectors are set to the same index with identical threshold values, the app will automatically disable the second index to prevent duplication of layers. This ensures that each output map is unique and meaningful.
Threshold values are useful for generating binary layers, where areas exceeding or falling below a given index value are highlighted, for example to indicate zones of healthy vegetation or disturbed canopy.

---

4. Chart Checkbox

By selecting the "Chart" checkbox, users can request the generation of a time-series chart. This chart displays the temporal evolution of the selected spectral index over the AOI during the specified date range. The chart includes statistical summaries such as minimum, maximum, and mean index values, and can help users identify trends, such as recovery following disturbance or seasonal patterns.
Clicking the icon top right of the chart, users can open up the chart in full-size in a new browser tab which then also provides download option (in csv, svg, png file format).
The chart option is only available when a valid AOI and temporal range have been defined, and at least one index has been selected. If any of these prerequisites are missing, the checkbox will remain disabled. When a new chart is generated, any previous charts are automatically cleared from the interface to avoid clutter and confusion.

---

5. Map Checkbox and Map Controls

The "Map" checkbox enables the visualisation of selected spectral index layers directly on the interactive map. Once this option is checked and the index has been processed, users will see the output imagery rendered on the base map.
Users can interact with the map using standard controls, including zooming, panning, and switching between basemap styles (e.g., street map or satellite imagery). The geometry used for the AOI remains visible as a transparent overlay. The map also includes a layer panel for toggling individual layers on or off, a fullscreen button for detailed inspection.
The "Map" checkbox is automatically disabled until all required inputs—namely, the AOI, date range, and spectral index selection—are in place.

---

6. Run Geometry Button

Once the AOI has been drawn, a valid temporal range defined, and one or two indices selected, users can click the "Run Geometry" button to begin processing. This command initiates the retrieval and filtering of Sentinel-2 data from Google Earth Engine, applies cloud masking, computes the selected spectral indices, and displays the results on the map.
If any required input is missing—such as the absence of an AOI or an incomplete date range—the "Run Geometry" button will remain inactive until the issue is resolved. This feature helps ensure that users do not attempt to execute a process without supplying sufficient information.

---

7. Run GEE-Asset Button (Load GEE-asset Text Box)

For users who have saved geometries in their personal Google Earth Engine asset library, the app provides an input field to load a geometry by its asset ID. By entering a valid asset path (e.g., `users/yourname/forest_aoi`) and clicking the "Run GEE-Asset" button, the app will import the associated geometry and display it on the map.
Once a GEE asset is successfully loaded, it functions in the same way as a manually drawn AOI. If the asset path is invalid, not shared, or the geometry cannot be found, the app will display an error message and keep the processing buttons disabled.

To upload an AOI shapefile to your GEE asset library, refer to:
https://developers.google.com/earth-engine/guides/table_upload

---

8. Clear Button

The "Clear" button resets the application to its initial state. Pressing this button removes the AOI from the map, clears all selected layers and charts, and resets user inputs including date range and index selections.
This function is useful when beginning a new analysis or if the current session becomes too cluttered. After clearing, all relevant action buttons will be disabled until new input is provided.

---

9. Select a Layer for Download

Once index processing has been completed, the available layers are listed in the "Select a Layer for Download" dropdown menu. Each layer is uniquely named based on the selected index and time period. Users can review the available layers and select the one they wish to export.
If no layers have been generated during the current session, the dropdown menu remains disabled. Hovering over a layer name will reveal additional metadata such as the index type and date of creation.

---

10. Download Selected Image

After selecting a layer, users can click the "Download Selected Image" button to export the result. This function triggers Google Earth Engine's `getDownloadURL()` method, which generates a direct download link to a GeoTIFF file of the selected image.
Users can copy the download link text and open it in a new browser tab, which will start the download immediately.
If no valid layer is selected or if the app has not yet generated any results, the download button will remain inactive.

Final Notes

Processing Time varies with AOI size and date range.
Limitations: Single-task only; no batch processing.