MANUAL GOOGLE EARTH ENGINE APPLICATION

Met opmerkingen [NS1]: FAQ is a nice idea. Make sure to write our names and QGIS part.

ACT-60312 WUR
Persa Koutsouradi
Shoyo Nakamura
Marieke Buuts
Kristie Swinkels
Davey de Groot

June 16, 2022

Contents

Context of manual

Using Google Earth Engine (GEE) is a cloud-solution based application for processing large amounts of temporal satellite data. It provides cloud-computing, without the need for storing data on private servers. It scales easily, is flexible in choosing an 'area-of-interest', and when made into a web-application intuitively to use.

GEE is used because "*Earth Engine provides easy, web-based access to an extensive catalog of satellite imagery and other geospatial data in an analysis-ready format. The data catalog is paired with scalable compute power backed by Google data centers and flexible APIs that let you seamlessly implement your existing geospatial workflows. This enables cutting-edge, global scale analysis and visualization.*" (Source: Google)

The solution requested by the company of Wiertsema & Partners should be easy to learn, easy to use and easy to explore.

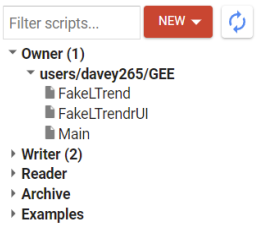
The reader of this manual will learn to select and analyze areas of interest by focusing on temporal trend analysis of NDVI-values. Meaning: have vegetated areas gained productivity or has productivity been declining?

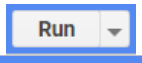
The skills the reader needs to use the application is common sense. The GUI in the GEE should be intuitively used by any person experienced in basic computer use and basic GIS knowledge.

The application provides a quick way to assess temporal trend analysis in vegetated areas. This result can further be used by Wiertsema & Partners in deciding potential measuring positions. As for the processing of data, GEE is especially useful in preventing the need for extensive importing of datasets on private servers.

First Part: Short and Quick manual

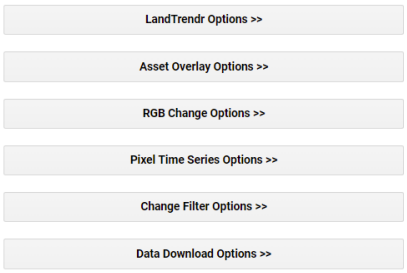
1: Open repository and click Main



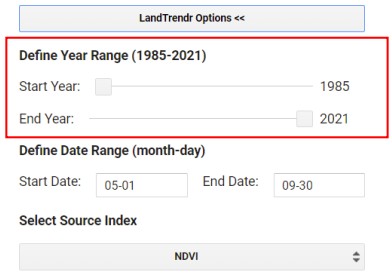
2: 

Click

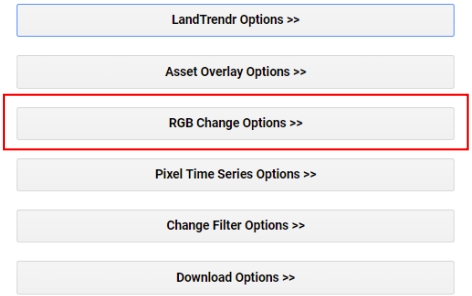
3: Click LandTrendr Options



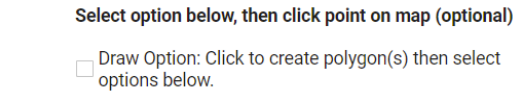
4: Define range of years (Default: 1985-2021)



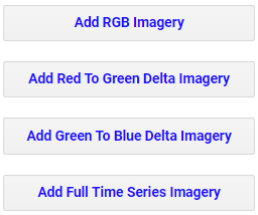
4: Click 'RGB Change Options'



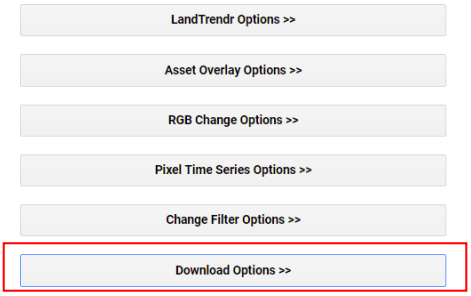
5: Draw polygon of research area



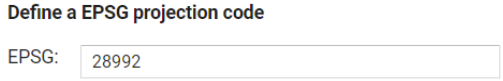
6: Click all four buttons to add imagery of change



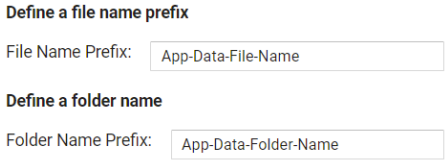
7: Click Download Options



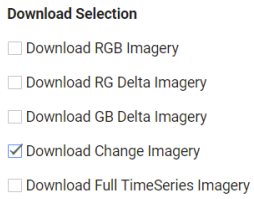
8: Set EPSG code (Default: 28992)



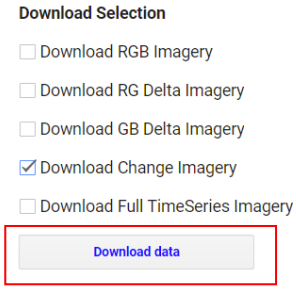
9: Define file name and file folder



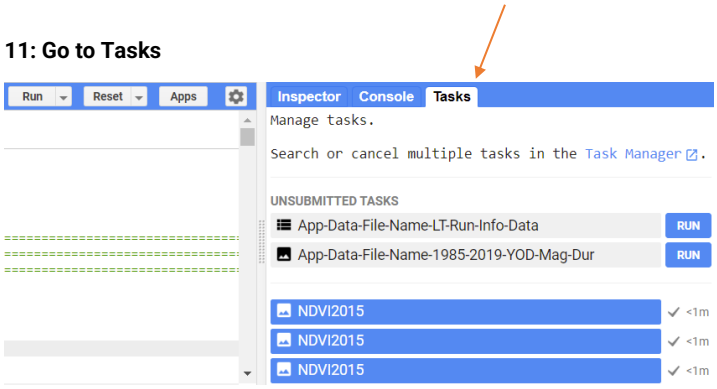
9: Check boxes for Download Change Imagery



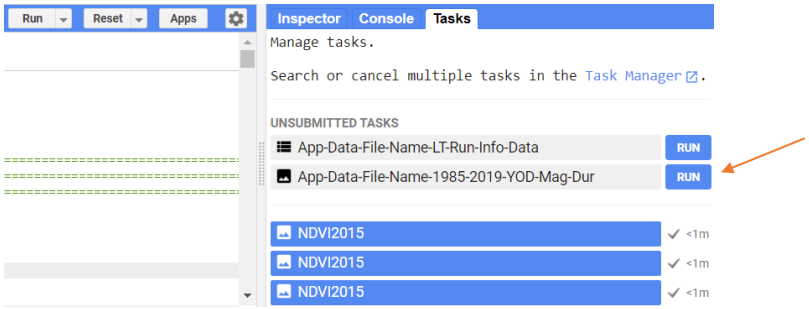
10: Click download (Image .tiff exports to Drive)



11: Go to Tasks



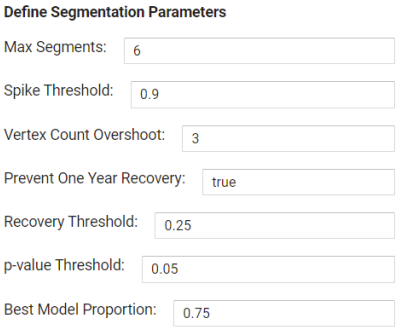
12: Click Run on the .tiff file (Upper file is .xlsx which provides info about XXX)



11: Change imagery (.tiff) is situated in Drive Folder, ready for download to own storage

Second Part: Detailed Manual

LandTrendr options



Explanation of segmentation parameters is found below (from https://pro.arcgis.com/en/pro-app/latest/help/analysis/raster-functions/landtrendr-analysis.htm)

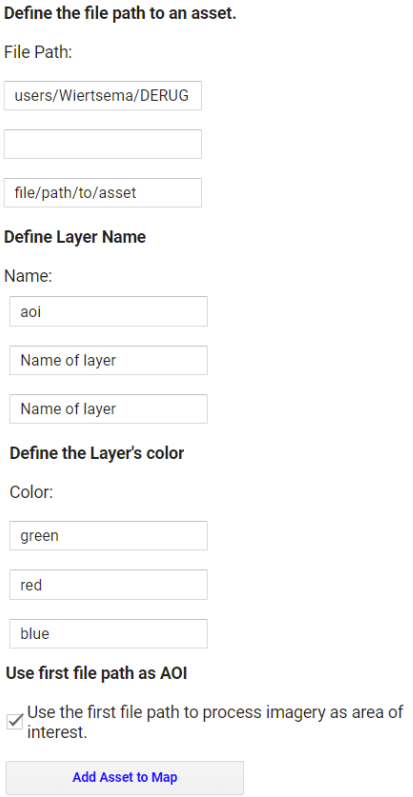
PARAMETER	DESCRIPTION
SOURCE INDEX	The vegetation index name to use for segmenting the pixel value trajectories over time. Choose the index name that will best capture the changes in the feature you want to observe.
YEAR RANGE	The range of years used to define the change between two temporal dimensions.
DATE RANGE	The date range used to find the 95% percentile (used as maximum) NDVI value in a year.
MAXIMUM NUMBERS OF SEGMENTS	The maximum number of segments to be fitted to the time series for each pixel. The default is 6.
SPIKE THRESHOLD	The threshold to use for dampening spikes or anomalies in the pixel value trajectory. The value must range between 0 and 1 in which 1 means no dampening. The default is 0.9.

VERTEX COUNT OVERSHOOT	The number of additional vertices beyond max_num_segments + 1 that can be used to fit the model during the initial stage of identifying vertices. Later in the modeling process, the number of additional vertices will be reduced to max_num_segments + 1. The default is 2.
PREVENT ONE YEAR RECOVERY	Specifies whether segments that exhibit a one year recovery will be excluded. • Checked—Segments that exhibit a one year recovery will be excluded. This is the default. • Unchecked—Segments that exhibit a one year recovery will be not be excluded.
RECOVERY THRESHOLD	The recovery threshold value in years. If a segment has a recovery rate that is faster than 1/recovery threshold, the segment is discarded and not included in the time series model. The value must range between 0 and 1. The default is 0.25.
P-VALUE THRESHOLD	The p-value threshold for a model to be selected. After the vertices are detected in the initial stage of the model fitting, the tool will fit each segment and calculate the p-value to determine the significance of the model. On the next iteration, the model will decrease the number of segments by one and recalculate the p-value. This will continue and, if the p-value is smaller than the value specified in this parameter, the model will be selected and the tool will stop searching for a better model. If no such model is selected, the tool will select a model with a p-value smaller than the lowest p-value × best model proportion value. The default is 0.01.
BEST MODEL PROPORTION	The best model proportion value. During the model selection process, the tool will calculate the p-value for each model and identify a model that has the most vertices while maintaining the smallest (most significant) p-value based on this proportion value. A value of 1 means the model has the

	lowest p-value but may not have a high number of vertices. The default is 1.25.
MIN OBSERVATIONS NEEDED	The minimum number of valid observations required to perform fitting. The number of years in the input multidimensional dataset must be equal to or greater than this value. The default is 6.

Asset overlay options

This is used for importing an area of interest, instead of drawing your own polygon, and using this for analysis. Three areas of interest can be used at the same time.



File formats used: Shapefile (.shx, .shp, .dbf, .prj, or .zip), csv, tif, TFRecord (TFRecord +.json)

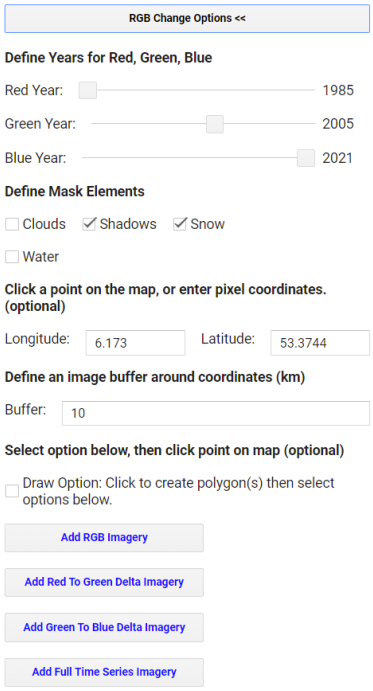
1) Define the path to an asset. This asset will be loaded into the map view as a layer. The asset path can be found by clicking on an asset (go to the assets tab) and recording the path under "Table ID".

2) Optional, define a name to call the loaded asset.

3) Optional, define the color of the asset.

4. Check box to use first file as area of interest in analysis. Add asset to map.

RGB Change Options



1) Define years to represent red, green, and blue color in the final RGB composite. The Red Year value is the year value for the Full Time Series Display image.

2) Define Masking options. Each item selected will be masked out as NoData to the best of its ability

3) Optionally define a pixel coordinate set to view the time series of, alternatively you'll simply click on the map. Note that the coordinates are in units of latitude and longitude formatted as decimal degrees (WGS 84 EPSG:4326). Also note that when you click a point on the map, the coordinates of the point will populate these entry boxes.

4) Define a buffer around the center point defined by a map click or provided in the longitude and latitude coordinate. The units are in kilometers. It will draw and clip the map to the bounds of the square region created by the buffer around the point of interest.

5) Optionally Draw a polygon by clicking the check box. Then click on the map to draw a polygon that will be the extent of the imagery displayed. To remove the polygon and us the point buffer extent simply uncheck the draw box.

6) Click the Add RGB Imagery button to add red year, green year, and blue year composite to the map view. The extent of the imagery displayed is define by a point buffer or drawn polygon.

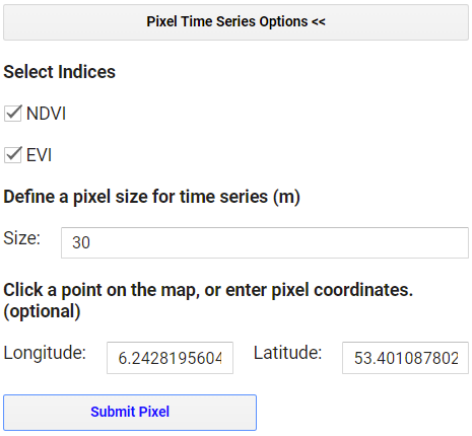
7) Click the Add RED to Green Delta button to add an image of magnitude and direction from the red year to the green year to the map view. The extent of the imagery displayed is define by a point buffer or drawn polygon.

8) Click the Add Green to Blue Delta button to add an image of magnitude and direction from the green year to the blue year to the map view. The extent of the imagery displayed is define by a point buffer or drawn polygon.

9) Click the Add Full Time Series Imagery to add an image of the whole time series

Pixel Time Series Options

Used for the analysis of a single point



1) Select spectral indices and bands to view. You can select one or two.

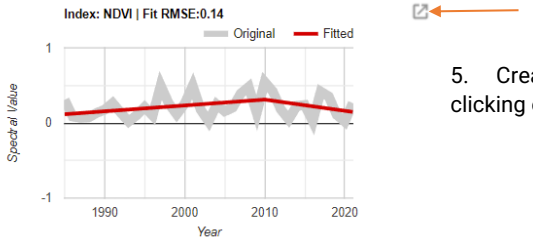
2) Define pixel size for time series (m)

3) Identify location with one of two options:

a) Click on the map. The coordinates of the point will populate the latitude and longitude (coordinates are in units of latitude and longitude formatted as decimal degrees (WGS 84 EPSG:4326).

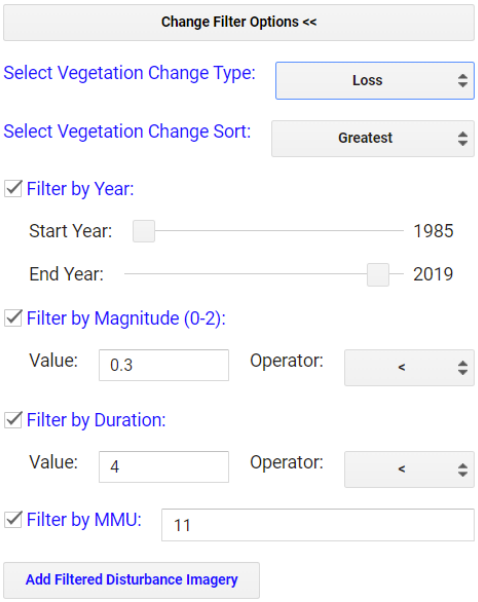
b) Enter pixel coordinates in decimal degrees.

4) If you want to change anything about the run, but keep the pixel coordinate, make the changes and then hit the ReSubmit Pixel button.



5. Created graph. Graph can be exported by clicking on the small arrow.

Change Filter options



Change Filter Usage

1) Define the vegetation change type you are interested in - either vegetation gain or loss.

2) Define the vegetation change sort - should the change be the greatest, least, longest, etc. This applies only if there are multiple vegetation changes of a given type in a pixel time series. It is a relative qualifier for a pixel time series.

3) Optionally filter changes by the year of detection. Adjust the sliders to constrain the results to a given range of years. The filter is only applied if the Filter by Year box is checked.

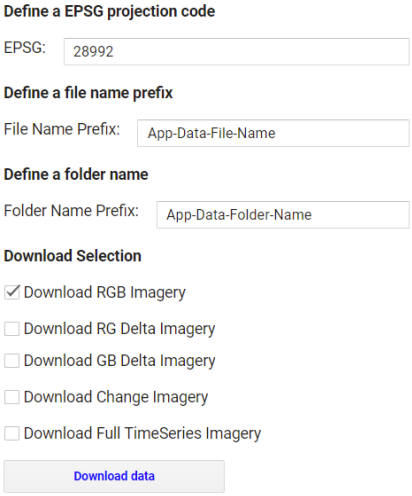
4) Optionally filter changes by magnitude. Enter a threshold value and select a conditional operator. For example, if you selected the change type as vegetation loss defined by NDVI and wanted only high magnitude losses shown, you would maybe want to keep only those pixels that had greater than 0.4 NDVI units loss - you would set value as 0.4 and select the > operator.The filter is only applied if the Filter by Magnitude box is checked.

5) Optionally filter by change event duration. Enter a threshold value and select a conditional operator. For example, if you only want to display change events that occurred rapidly, you would maybe set the value as 2 (years) and the operator as < to retain only those changes that completed within a single year. The filter is only applied if the Filter by Duration box is checked.

6) Optionally filter by a minimum disturbance patch size, as defined by 8-neighbor connectivity of pixels having the same year of change detection. The value is the minimum number of pixel in a patch. The filter is only applied if the Filter by MMU box is checked.

7) Click the add imagery to add image to the map viewer.

Download options



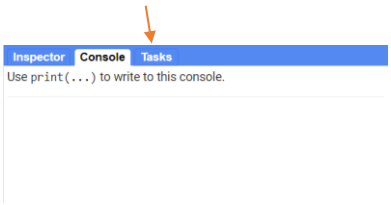
1) Define the output imagery projection in the form of a EPSG code.

2) Define a file name prefix. Image information such as selected years and other info will be appended the file name prefix.

3) Define a folder name prefix to store the imagery in your Google Drive. Image information such as selected years and other info will be appended the folder name prefix. Also, each image represented by a checked box will be downloaded into its own folder. This will help manage mergers of image chucks if necessary.

4) Select the checkboxs for the data you wish to download.

5) Click the Download Data button to start tasks.



6) Look under the Tasks tab for the export processes.

7) Click the RUN button to start the downloading process to your Google Drive. Each process will create its own folder in your google drive and save data to those locations.

QGIS PART

- **Selecting AOI**
- **Importing data from GEE**
- **Exporting to Google Drive**
- **Interpreting results**

Important parts for changing code in Code Editor

- **Crucial part one**
- **Crucial part two**
- **Crucial part three**
- **Importing shapefiles**
- **Setting global variables**
- **Exporting to drive**

Images should illustrate or show the result of an action.

Frequently Asked Questions (FAQ)

How do I sign up to Google Earth Engine?

Visit signup.earthengine.google.com to sign up for the platform.

Where can I find more information about GEE?

You can find more, such as scripts, API's and datasets on https://developers.google.com/earth-engine/