

Creating Vegetation Indices

v.1.2

Note this service was originally developed with the Forestry-Thematic Exploitation Platform (F-TEP) project. For more details visit <https://f-tep.com/>.

For training purposes suitable processing jobs that could be cloned and repeated include #1404 (NDVI), #471 (SAVI) and #462 (GEMI).

Service description

The measured reflectance in various parts of visible and infrared spectrum (i.e. in various spectral bands of the MSI instrument aboard Sentinel-2 satellites) correlates to properties of vegetation canopies. When applying ratios between spectral bands, indices with correlation to canopy properties and photosynthetic capacity can be derived. Using band ratios, the effects of potential inter-image variation caused (e.g. by atmospheric effects) are reduced.

The most commonly used vegetation index is the *Normalized Difference Vegetation Index* (NDVI), which correlates very strongly with the proportion covered by leaves when the background is bare soil and when the proportion covered by leaves is not excessively high. In addition to NDVI, several other vegetation indices have been developed. These newer indices make modifications to counter-act effects of soil properties or atmospheric effects.

The following vegetation indices can be calculated using the Vegetation Indices service:

- **NDVI:** Normalized Difference Vegetation Index $(NIR-Red)/(NIR+Red)$,
- **TNDVI:** Transformed Normalized Difference Vegetation Index $(\sqrt{NDVI + 0.5})$,
- **RVI:** Ratio Vegetation Index (Red/NIR) ,
- **SAVI:** Soil Adjusted Vegetation Index $(NDVI*(1+S))$, S = soil adjustment factor),
- **TSAVI:** Transformed Soil Adjusted Vegetation Index,
- **MSAVI:** Modified Soil Adjusted Vegetation Index,
- **MSAVI2:** Modified Soil Adjusted Vegetation Index 2,
- **GEMI:** Global Environment Monitoring Index, &
- **IPVI:** Infrared Percentage Vegetation Index.

Input data


The **Vegetation Indices** service processes Sentinel-2 L1C images. Note that cloud-free images should be selected, as the service does not perform radiometric corrections or cloud masking.

Service Outputs

The **Vegetation Indices** service output will be a single band (grayscale) GeoTIFF image of the selected vegetation index. Its characteristics include:

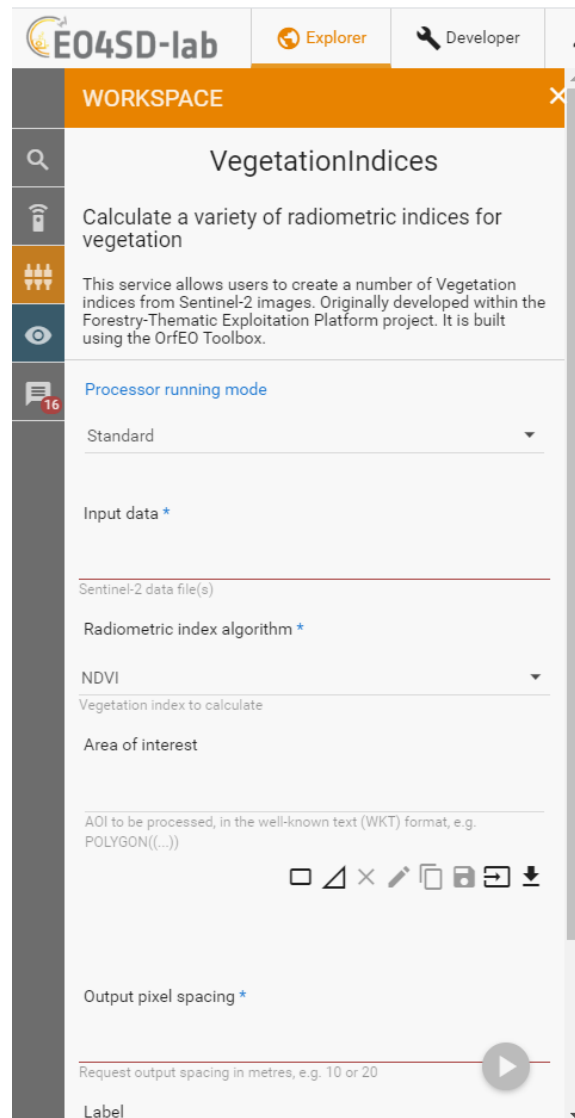
Correspondent file	User selected Vegetation Index
Information type	Single band grayscale image
Raster format	GeoTIFF
Resolution	User defined
Projection Type	WGS84
Bit depth	Float 32
Processing level	Vegetation Index
Naming convention	EO4SD-Lab_ [Vegetation-Index] _ [Input Sentinel-2 filename] .tif

Selecting the service

The **Vegetation Indices** service is selected by clicking on the services  icon on the left of the screen on the *Explorer pane*. This opens up the Service list, which can be filtered by service type (such as application or processor). Scroll down or type into the search interface the name of the service and after selection the *Workspace* panel will open.

Parameters

- **Processor Running Mode:** The Processors can be run in two modes **standard** or **systematic**. Most users will just require standard processing i.e. processing in a single processing run. For advanced users, systematic processing allows the service to be run periodically if the platform identifies input data that matches the user-defined criteria.
- **Input Data:** The input Sentinel-2 image which has been previously defined. Drag the input Sentinel-2 image (grabbing from the horizontal lines in front of its name) from the Results tab at the bottom of the screen to the input field.
- **Vegetation Index Algorithm:** Using the drop-down list, select a vegetation index. Options include: NDVI, TNDVI, RVI, SAVI, TSAVI, MSAVI, MSAVI2, GEMI, IPVI.
- **Area of interest:** An OPTIONAL field to define an Area of Interest (AOI) to be used to create a geographic subset of the output image. The AOI can be drawn on the GeoBrowser, extracted from a shapefile uploaded by the user or selected from a previously defined AOI. Alternatively, it can be specified in the Well-Known Text (WKT) POLYGON format. An example of a valid specification is: POLYGON ((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411))
- **Output Pixel Spacing:** This specifies the desired image resolution in metres, controlling resampling of the output image (pixel spacing). If left empty, resolution of the input data (10) is used as default. For Sentinel-2 optical data, feasible values are between 10 and 100 (meters).
- **Label:** An OPTIONAL field for free form tagging for later identification of this processing job.




Service Execution

Once all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. The resulting output is a GeoTIFF file that can be downloaded, re-used or visualised in the GeoBrowser.

To aid visual interpretation a colour scale has been applied to these various vegetation products when displayed in the GeoBrowser. The colour code applied is the NDVI RGBA code as defined within the

Grass GIS package (<https://grass.osgeo.org/grass78/manuals/r.colors.html>). Within this code vibrant vegetation appear Green and low / no vegetation appear blue.

 **ndvi**: Normalized Difference Vegetation Index colors [range: -1 to 1]

The image below shows a generated MSAVI2 index in Central Italy from April 2020 within the GeoBrowser. It shows a network of fields with varying level of vegetation, with darker green indicating higher values and hence higher level of vegetation.



Further analysis can be undertaken in one of the GUI applications, such as SNAP, QGIS or Monteverdi. Soon after desired application process (e.g. QGIS) is started, a 'Go to GUI' icon appears in the job description. The desired GUI application can then be accessed by clicking this icon, which opens the GUI in another browser tab.