Package 'VegSpecIndex'

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Type Package

Title Vegetation and Spectral Indices for Environmental Assessment

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Description Earth system dynamics, such as plant dynamics, water bodies, and fire regimes, are widely monitored using spectral indicators obtained from multispectral remote sensing products. There is a great need for spectral index catalogues and computing tools as a result of the quick rise of suggested spectral indices. Unfortunately, the majority of these resources lack a standard Application Programming Interface, are out-of-date, closed-source, or are not linked to a catalogue. We now introduce 'VegSpecIndex', a standardised list of spectral indices for studies of the earth system. A thorough inventory of spectral indices is offered by 'VegSpecIndex' and is connected to an R library. For every spectral index, 'VegSpecIndex' provides a comprehensive collection of information, such as names, formulae, and source references. The user community may add more items to the catalogue, which will keep 'VegSpecIndex' up to date and allow for further scientific uses. Additionally, the R library makes it possible to apply the catalogue to actual data, which makes it easier to employ remote sensing resources effectively across a variety of Earth system domains.

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Contents

`ARVI` *Atmospherically Resistant Vegetation Index*

Description

The advantage of ARVI is that it reduces the role of the atmospheric scattering that affects the images. Such effects are caused by the aerosols of both natural origin (e.g., rain and fog) and urban air pollution (e.g., dust or smog). Initially proposed and developed for the assessment of vegetation from the Earth Observing System (EOS), Moderate Resolution Imaging Spectro-radiometer (MODIS) sensor, ARVI can also be applied for the Landsat OLI/TIRS sensors since it contains necessary spectral bands: Blue, Red and Green (Kaufman & Tanre, 1992; Lemenkova & Debeir, 2023).

Usage

```
ARVI (BLUE, RED, GREEN)
```

Arguments

`BLUE`	Blue spectral band
`RED`	Red spectral band
`GREEN`	Green spectral band

Value

Atmospherically Resistant Vegetation Index

References

Rikimaru, A., Roy, P. S., & Miyatake, S. (2002). Tropical forest cover density mapping. Tropical Ecology, 43(1), 39–47.

Examples

```
ARVI(0.14628, 0.061663, 0.034204)
```

`AVI` *Advanced Vegetation Index*

Description

Advanced Vegetation Index (AVI) is a numerical indicator, similar to NDVI that uses the red and near-infrared spectral bands. Like NDVI, AVI is used in vegetation studies to monitor crop and forest variations over time. Through the multi-temporal combination of the AVI and the NDVI, users can discriminate different types of vegetation and extract phenology characteristics/ parameters (Rikimaru et al., 2002)

Usage

```
AVI(NIR, RED)
```

Arguments

`NIR`	Near-infrared spectral band
`RED`	Red spectral band

Value

Advanced Vegetation Index

References

Rikimaru, A., Roy, P. S., & Miyatake, S. (2002). Tropical forest cover density mapping. Tropical Ecology, 43(1), 39–47.

Examples

```
AVI(0.14628, 0.061663)
```

BSI *Bare Soil Index*

Description

Bare Soil Index (BSI) is generally used to identify the differences between the agricultural and non-agricultural vegetation. Bare soil is indicator normalized index in the soil reflectance depending soil characteristics. (Chen et al., 2004).

Usage

```
BSI (SWIR, RED, NIR, BLUE)
```

Arguments

SWIR	Short-wave infrared spectral band
RED	Red spectral band
NIR	Near-infrared spectral band
BLUE	Blue spectral band

Value

Bare Soil Index

References

Chen, W., Liu, L., Zhang, C., Wang, J., Wang, J., & Pan, Y. (2004). Monitoring the seasonal bare soil areas in Beijing using multi-temporal TM images. Int. Geosci. Remote Sens. Symp., 5, 3379–3382.

Examples

```
BSI (0.148425, 0.061663, 0.14628, 0.034204)
```

DVI *Difference Vegetation Index*

Description

The advantage of the Difference Vegetation Index (DVI) consists in the discrimination of soil from the vegetation biomass (Lemenkova & Debeir, 2023). However, the disadvantage is that it does not considers the difference between the spectral reflectance and radiance of soil surface caused by the atmospheric effects. The use of the DVI is based on the ratio between the NIR and Red spectral bands.

Usage

```
DVI (NIR, RED)
```

Arguments

NIR	Near-infrared spectral band
RED	Red spectral band

Value

Difference Vegetation Index

References

Lemenkova, P., & Debeir, O. (2023). Computing vegetation indices from the satellite images using GRASS GIS scripts for monitoring mangrove forests in the coastal landscapes of Niger Delta, Nigeria. Journal of Marine Science and Engineering, 11(4), 871.

Examples

```
DVI (0.14628, 0.061663)
```

EVI *Enhanced Vegetation Index*

Description

The Enhanced Vegetation Index (EVI) was designed to quantify vegetation greenness by the combination of NIR, Red, and Blue spectral bands. The extended formula of EVI includes the corrections for the atmospheric conditions and considers the effects from the canopy background. Similar to the NDVI, the values of EVI range from -1 to +1, with the range indicating healthy vegetation located between 0.2 and 0.8 (Lemenkova & Debeir, 2023).

Usage

```
EVI (NIR, RED, BLUE)
```

Arguments

NIR	Near-infrared spectral band
RED	Red spectral band
BLUE	Blue spectral band

Value

Enhanced Vegetation Index

References

Lemenkova, P., & Debeir, O. (2023). Computing vegetation indices from the satellite images using GRASS GIS scripts for monitoring mangrove forests in the coastal landscapes of Niger Delta, Nigeria. Journal of Marine Science and Engineering, 11(4), 871.

Examples

```
EVI (0.14628, 0.061663, 0.034204)
```

GCI *Green Cover Index*

Description

The Green Cover Index is used to estimate the content of leaf chlorophyll in various species of plants and to monitor the impact of seasonality, environmental stresses, or applied pesticides on vegetation health. The chlorophyll content reflects the physiological state of vegetation, it decreases in stressed plants and can therefore be used as a measurement of plant health (EOS, 2022).

Usage

```
GCI (NIR, GREEN)
```

Arguments

NIR	Near-infrared spectral band
GREEN	Green spectral band

Value

Green Cover Index

References

EOS. (2022). Vegetation Indices to drive digital Agri solutions. EOS Data Analytics. <https://eos.com/blog/vegetation-indices/>.

Examples

```
GCI (0.14628, 0.058156)
```

GLI *Green Leaf Index*

Description

Green Leaf Index (GLI) was originally generated to determine the grazing impact of wheat. If the value is negative it represents soil or something non-living, and if the value is positive it is either green leaves or stems (Eng et al., 2019).

Usage

```
GLI (GREEN, RED, BLUE)
```

Arguments

GREEN	Green spectral band
RED	Red spectral band
BLUE	Blue spectral band

Value

Green Leaf Index

References

Eng, L. S., Ismail, R., Hashim, W., & Baharum, A. (2019). The Use of VARI, GLI, and VIgreen Formulas in Detecting Vegetation In aerial Images. International Journal of Technology, 10(7), 1385. <https://doi.org/10.14716/ijtech.v10i7.3275>

Examples

```
GLI (0.058156, 0.061663, 0.034204)
```

GNDVI *Green Normalized Difference Vegetation Index*

Description

Green Normalized Difference Vegetation Index (GNDVI) is modified version of NDVI to be more sensitive to the variation of chlorophyll content in the crop. The highest correlation values with leaf nitrogen content and DM were obtained with the GNDVI index in all data acquisition periods and both experimental phases. GNDVI was more sensible than NDVI to identify different concentration rates of chlorophyll, which is highly correlated at nitrogen, in two species of plants (EOS, 2022).

Usage

```
GNDVI (NIR, GREEN)
```

Arguments

NIR	Near-infra red spectral band
GREEN	Green spectral band

Value

Green Normalized Difference Vegetation Index

References

EOS. (2022). Vegetation Indices to drive digital Agri solutions. EOS Data Analytics. <https://eos.com/blog/vegetation-indices/>.

Examples

```
GNDVI (0.14628, 0.058156)
```

MSAVI *Modified SAVI*

Description

The Modified SAVI vegetation index is designated to mitigate soil effects on crop monitoring results. Therefore, it is applied when NDVI cannot provide accurate values, particularly, with a high percentage of bare soil, scarce vegetation, or low chlorophyll content in plants. MSAVI is useful at the very beginning of crop production season, when seedlings start to establish (EOS, 2022).

Usage

```
MSAVI (NIR, RED)
```

Arguments

NIR	Near-infra red spectral band
RED	Red spectral band

Value

Modified SAVI

References

EOS. (2022). Vegetation Indices to drive digital Agri solutions. EOS Data Analytics. <https://eos.com/blog/vegetation-indices/>.

Examples

```
MSAVI (0.14628, 0.061663)
```

NDMI *Normalized Difference Moisture Index*

Description

The NDMI is a vegetation index that uses remote sensing data to determine the water content of vegetation. It is used to monitor droughts and fuel levels in areas that are prone to fire. Negative values are the indicator of water stress or non-vegetated areas, the values approaching -1, indicate water stress and values approaching +1, indicate waterlogged area (Vermote et al., 2016).

Usage

```
NDMI (NIR, SWIR)
```

Arguments

NIR	Near-infra red spectral band
SWIR	Short wave infra-red spectral band

Value

Normalized Difference Moisture Index

References

Vermote, E., Justice, C., Claverie, M., & Franch, B. (2016). Preliminary analysis of the performance of the Landsat 8/OLI land surface reflectance product. Remote Sensing of Environment, 185, 46–56.

Examples

```
NDMI (0.14628, 0.148425)
```

NDVI *Normalized Difference Vegetation Index*

Description

Among the typical spectral vegetation indices, NDVI is one of the most suitable to track crop development dynamics since it measures photosynthetically active biomass in plants. Standard method for comparing the vegetation greenness explains density of vegetation. The NDVI values tentatively ranges between -1 to +1, the values close to +1 denotes the good health of vegetation (Vermote et al., 2016).

Usage

```
NDVI (NIR, RED)
```

Arguments

NIR	Near-infra red spectral band
RED	Red spectral band

Value

Normalized Difference Vegetation Index

References

Vermote, E., Justice, C., Claverie, M., & Franch, B. (2016). Preliminary analysis of the performance of the Landsat 8/OLI land surface reflectance product. Remote Sensing of Environment, 185, 46–56.

Examples

```
NDVI (0.14628, 0.061663)
```

NDWI *Normalized Difference Water Index*

Description

The values of the Normalized Difference Water Index (NDWI) are strongly dependent on the water content in the landscapes. Hence, the NDWI serves as an accurate indicator of the water areas and water bodies (rivers, lakes, estuaries, deltas). The NDWI is derived from the NIR and Green bands using the original formula as a ratio of Green and NIR spectral bands (Lemenkova & Debeir, 2023).

Usage

```
NDWI (GREEN, NIR)
```

Arguments

GREEN	Green spectral band
NIR	Near-infra red spectral band

Value

Normalized Difference Water Index

References

Lemenkova, P., & Debeir, O. (2023). Computing vegetation indices from the satellite images using GRASS GIS scripts for monitoring mangrove forests in the coastal landscapes of Niger Delta, Nigeria. Journal of Marine Science and Engineering, 11(4), 871.

Examples

```
NDWI (0.058156, 0.14628)
```

PVI *Perpendicular Vegetation Index*

Description

The use of the PVI is based on the formula originally developed by Richardson and Wiegand in 1977. Sensitive to the atmospheric variations, the PVI is intended to monitor the productivity of range, forest, and croplands. Similar to DVI, it measures the perpendicular distance of the pixels from the soil line, since it is based on the assumption that soil reflectance supplies the background signal of the vegetated surfaces (Richardson & Wiegand, 1977).

Usage

```
PVI (NIR, RED, s, a, b)
```

Arguments

NIR	Near-infra red spectral band
RED	Red spectral band
s	Soil adjacent factor
a	intercept of NIR Vs RED data
b	slope of NIR Vs RED data

Value

Perpendicular Vegetation Index

References

Richardson, A. J., & Wiegand, C. L. (1977). Distinguishing Vegetation from Soil Background Information. Photogramm. Eng. Remote Sens., 43, 1541–1552.

Examples

```
PVI (0.14628, 0.061663, 0.08, 0.310932791, 0.294346983)
```

RVI *Ratio Vegetation Index*

Description

Ratio Vegetation Index (RVI) indicates the amount of vegetation and reduces the effects of atmosphere and topography. RVI has the prospective to designate the stress level of crops due to its high correlation with the leaf area, dry biomass and chlorophyll content (Pandey et al., 2024).

Usage

```
RVI (NIR, RED)
```

Arguments

NIR	Near-infra red spectral band
RED	Red spectral band

Value

Ratio Vegetation Index

References

Pandey, A., Mondal, A., Guha, S., Upadhyay, P. K., Rashmi, & Kundu, S. (2024). Comparing the seasonal relationship of land surface temperature with vegetation indices and other land surface indices. Geology, Ecology, and Landscapes, 1–17. <https://doi.org/10.1080/24749508.2024.2392391>

Examples

```
RVI (0.14628, 0.061663)
```

SAVI *Soil-Adjusted Vegetation Index*

Description

The SAVI is presented to mitigate the impact of soil brightness and to minimize the effects of the soil background on vegetation. Its creator "Huete" added a soil adjustment factor L to the equation of NDVI in order to correct for soil noise effects (soil colour, soil moisture, soil variability across regions, etc.), which tend to impact the results. L varies from –1 to +1, depending on the amount of green vegetation present in the area. In areas with high green vegetation L= 0, and in this case, SAVI is the same as NDVI. Conversely, L = 1 for low green vegetation zones. Most usually, L is set to 0.5 to adjust to most land cover (EOS, 2022).

Usage

```
SAVI (NIR, RED, L)
```

Arguments

NIR	Near infra-red spectral band
RED	Red spectral band
L	Soil adjustment factor

Value

Soil-Adjusted Vegetation Index

References

EOS. (2022). Vegetation Indices to drive digital Agri solutions. EOS Data Analytics. <https://eos.com/blog/vegetation-indices/>

Examples

```
SAVI (0.14628, 0.061663, 0.5)
```

SI *Shadow Index*

Description

The characteristics of canopy shadow are associated by the total spectral radiance that is reflected from the canopy. Canopy shadow provides essential information about trees and plants arrangement. As a remote sensing index, Shadow Index (SI) is calculated using the visible bands of the spectrum, in a way that simulates the amount energy not reflected back to the sensor. It is usually combined with other indices like AVI and BSI to understand the status of vegetation (Sykas, 2025).

Usage

```
SI (BLUE, GREEN, RED)
```

Arguments

BLUE	Blue spectral band
GREEN	Green spectral band
RED	Red spectral band

Value

Shadow Index

References

Sykas, D. (2025). Spectral Indices with multispectral satellite data. Why Use Spectral Indices from Satellites <https://www.geo.university/pages/spectral-indices-with-multispectral-satellite-data/>.

Examples

```
SI (0.034204,0.058156,0.061663)
```

VARI *Visible Atmospherically Resistant Index*

Description

The Visible Atmospherically Resistant Index (VARI) is designed to emphasize vegetation in the visible portion of the spectrum, while mitigating illumination differences and atmospheric effects. In other words it is used to estimate the fraction of vegetation with a minimal sensitivity to atmospheric effects (Mokarram et al., 2016).

Usage

```
VARI (GREEN, RED, BLUE)
```

Arguments

GREEN	Green spectral band
RED	Red spectral band
BLUE	Blue spectral band

Value

Visible Atmospherically Resistant Index

References

Mokarram, M., Boloorani, A. D., & Hojati, M. (2016). Relationship between Land Cover and Vegetation Indices. Case Study: Eghlid Plain, Fars Province, Iran. European Journal of Geography, 7(2), 48–60.

Examples

```
VARI (0.058156,0.061663, 0.034204)
```

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