Remotior Sensus Documentation

Release 0.7.4

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Jun 08, 2026

CONTENTS

Remotior Sensus (which is Latin for “a more remote sense”) is a Python package that allows for the processing of remote sensing images and GIS data.

Source code: https://github.com/semiautomaticgit/remotior_sensus

Bug reports: https://github.com/semiautomaticgit/remotior_sensus/issues

CHAPTER

ONE

DOCUMENTATION

1.1 Introduction


Remotior Sensus, developed by Luca Congedo, is a Python package that allows for the processing of remote sensing images and GIS data.

The main objective is to simplify the processing of remote sensing data through practical and integrated APIs that span from the download and preprocessing of satellite images to the postprocessing of classifications and GIS data. Basic dependencies are NumPy, SciPy for calculations, and GDAL for managing spatial data.

The main features are:

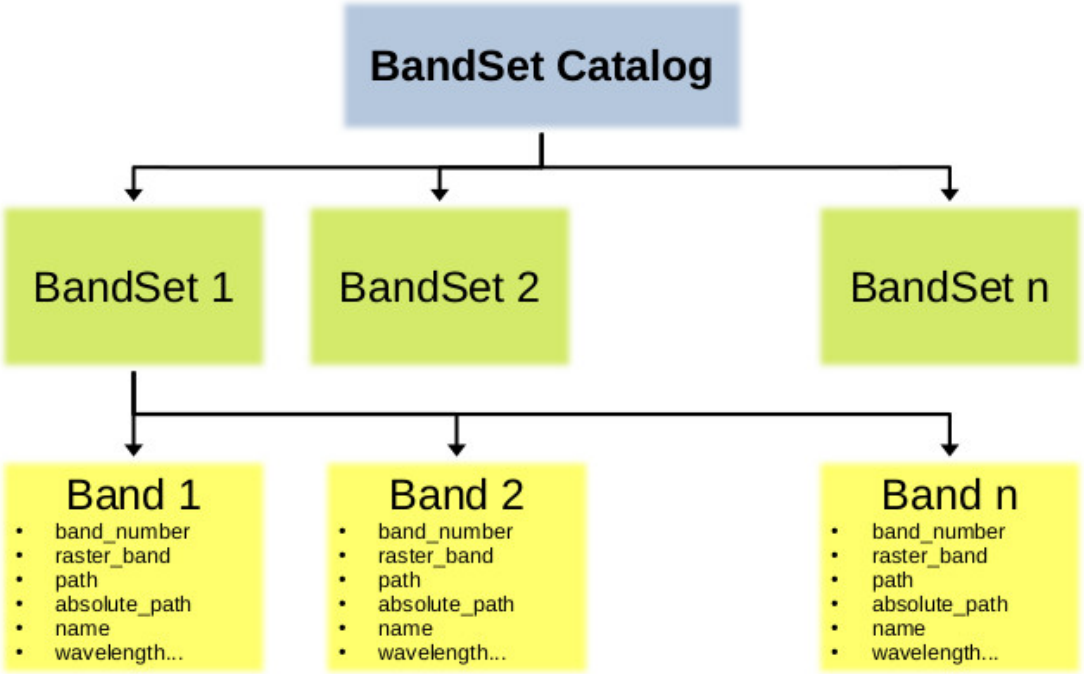
- **Search and Download** of remote sensing data such as Landsat and Sentinel-2.
- **Preprocessing** of several products such as Landsat and Sentinel-2 images.
- **Processing and postprocessing** tools to perform image classification through machine learning, manage GIS data and perform spatial analyses.
- **Parallel processing** available for most processing tools.

```
WARNING: Remotior Sensus is still in early development; new tools are going to be
added, tools and APIs may change, and one may encounter issues and bugs using Remotior
Sensus.
```

1.1.1 Management of Raster Bands

Most tools accept raster bands as input, defined through the file path.

In addition, raster bands can be managed through a catalog of BandSets (see *bandset_catalog()* (page 63)), where each BandSet is an object that includes information about single bands (from the file path to the spatial and spectral characteristics). Bands in a BandSet can be referenced by the properties thereof, such as order number or center wavelength.

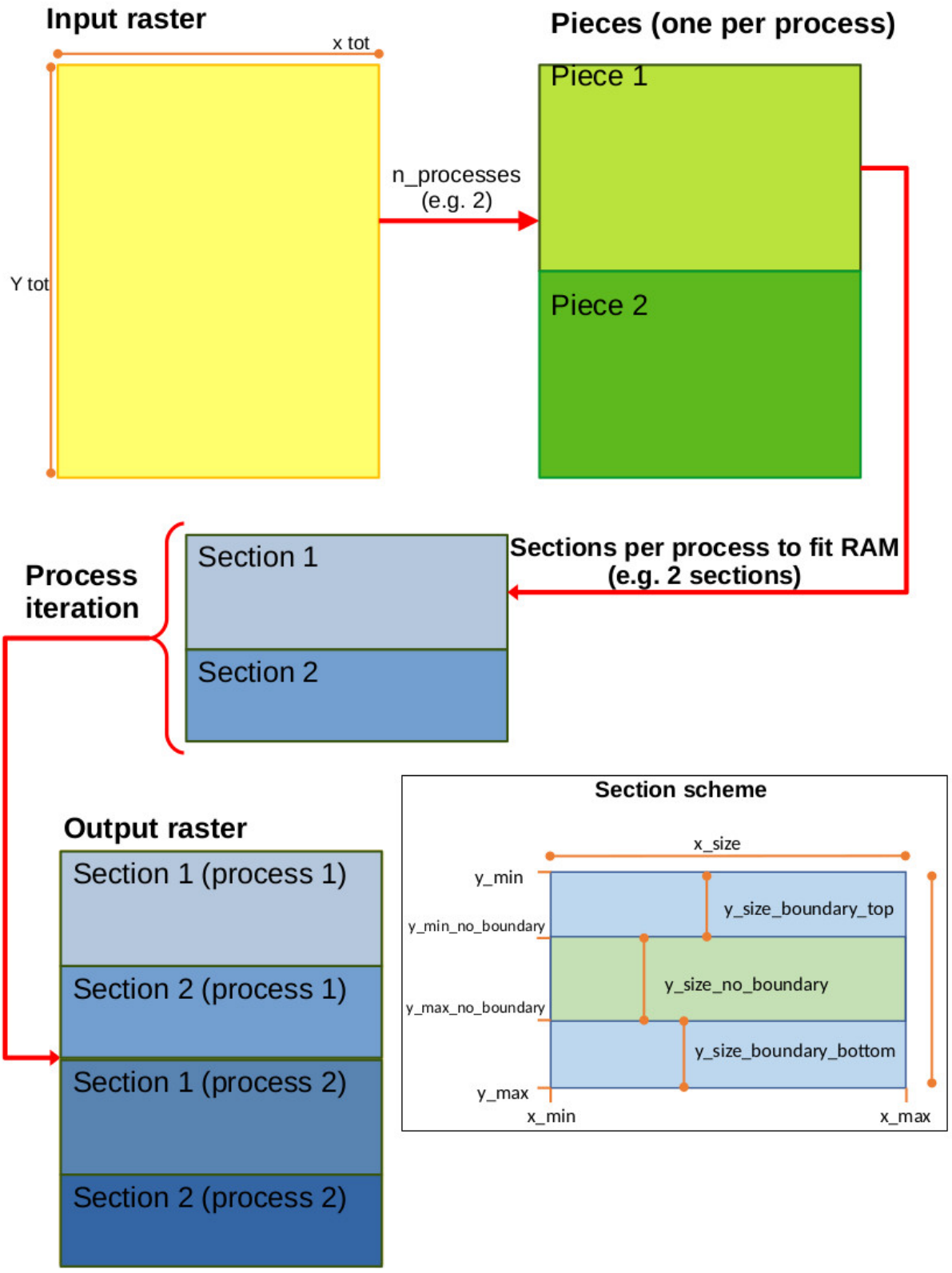


Multiple BandSets can be defined and identified by their reference number. Therefore, BandSets can be used as input for operations on multiple bands such as Principal Components Analysis, classification, mosaic, or band calculation.

In band calculations (see *band_calc()* (page 8)) name alias of bands based on center wavelength (e.g. blue, red) can be used to simplify the structure of calculation expression.

1.1.2 Performance

Most tools are designed to run in parallel processes, through a simple and effective parallelization approach based on dividing the raster input in sections that are distributed to available threads, maximizing the use of available RAM. This allows even complex algorithms to run in parallel. Optionally, the output file can be a virtual raster collecting the output rasters (corresponding to the sections) written independently by parallel processes; this avoids the time required to produce a unique raster output. Most tools allow for on the fly reprojection of input data.


Input raster
x tot
Y tot
n_processes
(e.g. 2)
Pieces (one per process)
Piece 1
Piece 2
Sections per process to fit RAM
(e.g. 2 sections)
Process
iteration
Section 1
Section 2
Output raster
Section 1 (process 1)
Section 2 (process 1)
Section 1 (process 2)
Section 2 (process 2)
Section scheme
x_size
y_min
y_min_no_boundary
y_max_no_boundary
y_max
x_min
x_max
y_size_boundary_top
y_size_no_boundary
y_size_boundary_bottom

1.1.3 Machine Learning

Remotior Sensus optional dependencies are PyTorch and scikit-learn, which are integrated in the tool *band_classification()* (page 11) to allow for land cover classification through machine learning. The aim is to simplify the training process and development of the model.

1.1.4 Source Code

The source code of Remotior Sensus is available at https://github.com/semiautomaticgit/remotior_sensus .

To report issues please visit https://github.com/semiautomaticgit/remotior_sensus/issues .

License of Remotior Sensus

1.1.5 How to cite

Congedo, Luca, (2023). Remotior Sensus. https://github.com/semiautomaticgit/remotior_sensus

1.1.6 Official site

For more information and tutorials visit the official site

From GIS to Remote Sensing

1.2 Installation

This section describes Remotior Sensus installation along with the required dependencies.

1.2.1 Dependencies

Remotior Sensus requires *GDAL*, *NumPy* and *SciPy* for most functionalities. Optionally, *scikit-learn* and *PyTorch* are required for machine learning. *Torchvision* is also required for specific machine learning algorithms. Python >= 3.10 is recommended.

1.2.2 Installation with Conda or Mamba

Before installing Remotior Sensus please install the dependencies using a *Conda* environment (if you don't know *Conda* please read https://conda-forge.org/docs). For instance, you can use Miniforge to create a *Conda* environment or *Mamba* environment.

Using *Conda*

```
$ conda create -c conda-forge --name environment python=3.10
Proceed ([y]/n)? y
$ conda activate environment
```

Install Remotior Sensus using *Conda* (the fundamental dependencies are also installed):

```
$ conda install -c conda-forge remotior-sensus
```

For machine learning functionalities run:

```
$ conda install -c conda-forge remotior-sensus scikit-learn pandas pytorch␣
↪torchvision libgdal-jp2openjpeg
```

Using *Mamba*

```
$ mamba create -c conda-forge --name environment python=3.10
Proceed ([y]/n)? y
$ mamba activate environment
```

Install Remotior Sensus using *Mamba* (the fundamental dependencies are also installed):

```
$ mamba install -c conda-forge remotior-sensus
```

For machine learning functionalities run:

```
$ mamba install -c conda-forge remotior-sensus scikit-learn pandas pytorch␣
↪torchvision libgdal-jp2openjpeg
```

1.2.3 Installation in Linux

The suggested way to install Remotior Sensus is using *Conda* (see *Installation with Conda* (page 6)).

Depending on the system, one could install the required dependencies as:

```
$ sudo apt-get install python3-numpy python3-scipy gdal-bin scikit-learn
```

For Remotior Sensus package installation use *pip*:

```
$ pip install -U remotior-sensus
```

Optionally install also *Pandas*, *PyTorch* and *Torchvision*.

1.2.4 Installation in OS X

The suggested way to install Remotior Sensus is using *Conda* (see *Installation with Conda* (page 6)).

1.2.5 Installation in Windows

The suggested way to install Remotior Sensus is using *Conda* (see *Installation with Conda* (page 6)).

1.2.6 Package installation

Given that dependencies are installed, for Remotior Sensus package installation use *pip*:

```
$ pip install -U remotior-sensus
```

1.3 Quickstart

Following the video of the tutorial.

https://www.youtube.com/watch?v=uv264j_oclU

Link to the guide: https://colab.research.google.com/gist/semiautomaticgit/0fdb7c2c5c0b3b990cf342d226b8ee43/quickstart.ipynb

1.4 Basic Tutorials

The following tutorials are available.

1.4.1 Download Sentinel-2 Data and Calculate NDVI

Link to the guide: https://colab.research.google.com/gist/semiautomaticgit/e20479e1cbfbf76f078bfb4f211f23fa/download_sentinel-2_data_and_calculate_ndvi.ipynb

1.4.2 Random Forest Classification

Following the video of the tutorial.

https://www.youtube.com/watch?v=Rc61lSWOgt4

Link to the guide: https://colab.research.google.com/gist/semiautomaticgit/5b3c6dca89b3764a69cf083cf3d0674f/random_forest_classification.ipynb

1.5 Tutorials

The following tutorials are available.

1.5.1 Create Sentinel-2 jpg file

Link to the guide: https://colab.research.google.com/gist/semiautomaticgit/0eb0a3e0e9794b66f162a46455b8a00d/create_sentinel2_jpg.ipynb

1.6 Tools

The following are the available tools.

1.6.1 remotior_sensus.tools package

Submodules

remotior_sensus.tools.band_calc module

Band calc.

This tool allows for mathematical calculations (pixel by pixel) between bands or single band rasters. A new raster file is created as result of calculation.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> output = rs.band_calc(
... input_raster_list=['file1.tif', 'file2.tif'], output_path='output.tif',
... expression_string='"file1 + file2"', input_name_list=['file1', 'file2']
... )
```

It is possible to iterate BandSets. BandSet iteration with structure

    forbandsets[x1:x2]name_filter

or

    forbandsets[x1,x2,x3]name_filter

or date iteration with structure

forbandsets[YYYY-MM-DD:YYYY-MM-DD]name_filter

or

forbandsets[YYYY-MM-DD, YYYY-MM-DD, YYYY-MM-DD, ...]name_filter

with `name_filter`: optional filter of name of first band in the BandSet.

It is possible to iterate bands in BandSet with structure

forbandsinbandset[x1:x2]name_filter

or

forbandsinbandset[x1,x2,x3,...]name_filter

or date iteration with structure

forbandsinbandset[YYYY-MM-DD, YYYY-MM-DD, YYYY-MM-DD, ...]name_filter

with `name_filter`: optional filter of name of first band in the BandSet.

`remotior_sensus.tools.band_calc.`**`band_calc`**(*expression_string: str*, *output_path: None | str = None*, *input_raster_list: list | None = None*, *input_name_list: list | None = None*, *n_processes: None | int = None*, *available_ram: None | int = None*, *align_raster: None | str = None*, *extent_raster: None | str = None*, *extent_list: list | None = None*, *extent_intersection: bool | None = True*, *xy_resolution_list: list | None = None*, *input_nodata_as_value: bool | None = None*, *use_value_as_nodata: None | int = None*, *output_nodata: None | int = None*, *output_datatype: None | str = None*, *use_scale: None | float = None*, *use_offset: None | float = None*, *calc_datatype: None | str = None*, *any_nodata_mask: bool | None = False*, *bandset_catalog:* BandSetCatalog *(page 74)* *| None = None*, *bandset_number: None | int = None*, *input_bands:* BandSet *(page 63)* *| None = None*, *point_coordinates: list | None = None*, *progress_message: bool | None = True*, *device=None*) → *OutputManager* (page 100)

Performs band calculation.

Calculation is defined by an expression string using variable names that corresponds to input bands or rasters. Expression can use band alias such as "bandset1b1", spectral band alias such as "#NIR#" for Near-Infrared and "#RED#" for Red, or expression alias such as "#NDVI#". Multiple expression lines can be entered for serial calculation. Several iteration functions are available for band sets. NumPy functions can also be used if the output is a single band array with the same size as input raster. Input rasters can have different projection definitions, as the tool will try to reproject input rasters on the fly based on a reference raster (first input raster or align_raster).

Parameters

- **`input_raster_list`** – list of input raster paths or list of lists [path, name] ignoring `input_name_list`.
- **`output_path`** – path of output file for single expression or path to a directory for multiple expression outputs.
- **`expression_string`** – expression string used for calculation; multiple expressions can be entered separated by new line.
- **`input_name_list`** – list of input raster names used in expressions (if name not defined in `input_raster_list`).
- **`input_bands`** – input BandSet for direct expression; in expressions, bands can be referred as "b1", "b2", etc.; also, spectral band alias such as "#RED#" or "#NIR#"; also "b*" for using all the bands.

- **n_processes** – number of threads for calculation.
- **available_ram** – number of megabytes of RAM available to processes.
- **align_raster** – string path of raster used for aligning output pixels and projections.
- **extent_raster** – string path of raster used for extent reference.
- **extent_list** – list of coordinates for defining calculation extent [left, top, right, bottom] in the same coordinates as the reference raster.
- **extent_intersection** – if True the output extent is geometric intersection of input raster extents, if False the output extent is the maximum extent from union of input raster extents.
- **xy_resolution_list** – list of [x, y] pixel resolution.
- **input_nodata_as_value** – if True then unmask the value of nodata pixels in calculations, if False then mask nodata pixels in calculations.
- **use_value_as_nodata** – use integer value as nodata in calculation.
- **output_nodata** – integer value used as nodata in output raster.
- **output_datatype** – string of data type for output raster such as Float64, Float32, Int32, UInt32, Int16, UInt16, or Byte.
- **use_scale** – float number used for scale for output.
- **use_offset** – float number used for offset for output.
- **calc_datatype** – data type used during calculation, which may differ from output_datatype, such as Float64, Float32, Int32, UInt32, Int16, UInt16, or Byte.
- **any_nodata_mask** – if True then output nodata where any input is nodata, if False then output nodata where all the inputs are nodata, if None then do not apply nodata to output.
- **bandset_catalog** – BandSetCatalog object for using band sets in calculations.
- **bandset_number** – number of BandSet defined as current one.
- **point_coordinates** – list of a point coordinates [x, y] for pixel calculations on Bandset
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).
- **device** – experimental parameter for processing device cpu (default) or cuda if available.

Returns

OutputManager() **(page 100) object with**

- paths = [output raster paths]

Examples

Sum of two raster files

```
>>> output_object = band_calc(
... input_raster_list=['file1.tif', 'file2.tif'], output_path='output.tif
↪',
... expression_string='"file1 + file2"', input_name_list=['file1', 'file2
↪']
... )
>>> # for instance display the output path
>>> print(output_object.paths)
['output.tif']
```

Calculation setting output datatype

```
>>> output_object = band_calc(
... input_raster_list=['file1.tif', 'file2.tif'], output_path='output.tif
↪',
... expression_string='"file1 + file2"', input_name_list=['file1', 'file2
↪'],
... output_datatype='Int32'
... )
```

Calculation setting the output extent as the maximum extent from union of input raster extents

```
>>> output_object = band_calc(
... input_raster_list=['file1.tif', 'file2.tif'], output_path='output.tif
↪',
... expression_string='"file1 + file2"', input_name_list=['file1', 'file2
↪'],
... extent_intersection=False
... )
```

remotior_sensus.tools.band_classification module

Band classification.

This tool allows for the classification of remote sensing images, providing several algorithms such as Minimum Distance, Maximum Likelihood, Spectral Angle Mapping. Also, machine learning algorithms are provided through PyTorch (pytorch_multi_layer_perceptron) and scikit-learn (random_forest, random_forest_ovr, support_vector_machine, multi_layer_perceptron).

Pretrained models are also available.

Currently, included pretrained models are:

- Swin-v2-Base model for Sentinel-2 single image. Requirements: Sentinel-2 bandset (TCI RGB (B04, B03, B02), TOA bands B05, B06, B07, B08, B11, B12). Normalization: TCI RGB bands divided by 255; B05, B06, B07, B08, B11, B12 divided by 8160 and clipped to 0-1. Framework: PyTorch. Source: Sentinel2_SwinB_SI_MS, pretrained by the Allen Institute for Artificial Intelligence (SatlasPretrain: https://satlas-pretrain.allen.ai). The model weights are released under the Open Data Commons Attribution License (ODC-BY). The repository code is licensed under the Apache License 2.0 (https://huggingface.co/allenai/satlas-pretrain). This tool downloads the official SatlasPretrain weights (Bastani et al., "SatlasPretrain: A Large-Scale Dataset for Remote Sensing Image Understanding", ICCV 2023, arXiv:2211.15660, https://doi.org/10.48550/arXiv.2211.15660). All model weights remain the property of their respective authors.
- Swin-v2-Tiny model for Sentinel-2 single image. Requirements: Sentinel-2 bandset (TCI RGB (B04, B03, B02), TOA bands B05, B06, B07, B08, B11, B12). Normalization: TCI RGB bands divided by 255; B05, B06, B07, B08, B11, B12 divided by 8160 and clipped to 0-1. Framework: PyTorch. Source: Sentinel2_SwinT_SI_MS, pretrained by the Allen Institute for Artificial Intelligence (SatlasPretrain: https://satlas-pretrain.allen.ai). The model weights are released under the Open Data Commons Attribution License (ODC-BY). The repository code is licensed under the Apache License 2.0 (https://huggingface.co/allenai/satlas-pretrain). This tool downloads the official SatlasPretrain weights (Bastani et al., "SatlasPretrain: A Large-Scale Dataset for Remote Sensing Image Understanding", ICCV 2023, arXiv:2211.15660, https://doi.org/10.48550/arXiv.2211.15660). All model weights remain the property of their respective authors.
- Swin-v2-Base model for Landsat 8 or Landsat 9 single image. Requirements: Landsat 8 or Landsat 9 bandset (Collection 2 Level-1 bands B01, B02, B03, B04, B05, B06, B07, B08, B09, B10, B11); Normalization: (band - 4000)/16320 and clipped to 0-1. Framework: PyTorch. Source: Landsat_SwinB_SI, pretrained by the Allen Institute for Artificial Intelligence (SatlasPretrain: https://satlas-pretrain.allen.ai). The model weights are released under the Open Data Commons Attribution License (ODC-BY). The repository code is

licensed under the Apache License 2.0 (https://huggingface.co/allenai/satlas-pretrain). This tool downloads the official SatlasPretrain weights (Bastani et al., "SatlasPretrain: A Large-Scale Dataset for Remote Sensing Image Understanding", ICCV 2023, arXiv:2211.15660, https://doi.org/10.48550/arXiv.2211.15660). All model weights remain the property of their respective authors.

Also, pretrained segmentation models are available:

- Swin-v2-Base segmentation for Sentinel-2 single image (4 bands). Requirements: Sentinel-2 bandset (TCI RGB (B04, B03, B02), TOA bands B08). Normalization: TCI RGB bands divided by 255; B08 divided by 8160 and clipped to 0-1. Framework: PyTorch. Output classes: background, water, developed, tree, shrub, grass, crop, bare, snow, wetland, mangroves, moss. Source: Satlas_MS_tci-b08_epoch150, pretrained by DPR Team as part of the DPR Zoo Segmentation Hub framework (https://github.com/DPR25/dpr-zoo-segmentation-hub) based on SatlasPretrain models. The repository code is licensed under the MIT License (https://huggingface.co/martinkorelic/dpr-zoo-models). This tool downloads the model weights (DPR Team, 2025. Made as part of Arnes Hackathon 2025). All model weights remain the property of their respective authors.
- Swin-v2-Base segmentation for Sentinel-2 single image (3 bands). Requirements: Sentinel-2 bandset (TCI RGB (B04, B03, B02)). Normalization: TCI RGB bands divided by 255. Framework: PyTorch. Output classes: background, water, developed, tree, shrub, grass, crop, bare, snow, wetland, mangroves, moss. Source: Satlas_RGB1_epoch70, pretrained by DPR Team as part of the DPR Zoo Segmentation Hub framework (https://github.com/DPR25/dpr-zoo-segmentation-hub) based on SatlasPretrain models. The repository code is licensed under the MIT License (https://huggingface.co/martinkorelic/dpr-zoo-models). This tool downloads the model weights (DPR Team, 2025. Made as part of Arnes Hackathon 2025). All model weights remain the property of their respective authors.

This module includes tools for training the algorithms using Regions of Interest (ROIs) or spectral signatures.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> file_list = ['file1.tif', 'file2.tif', 'file3.tif']
>>> # create BandSet
>>> catalog = rs.bandset_catalog()
>>> catalog.create_bandset(file_list, bandset_number=1)
>>> # create signature catalog
>>> signature_catalog = rs.spectral_signatures_catalog(
... bandset=catalog.get(1)
... )
>>> # import vector for training
>>> signature_catalog.import_vector(
... file_path='roi.gpkg',
... macroclass_field='macroclass', class_field='class',
... macroclass_name_field='macroclass', class_name_field='class',
... calculate_signature=True
... )
>>> # start the classification process
>>> classification = rs.band_classification(
... input_bands=file_list, output_path='output.tif',
... spectral_signatures=signature_catalog,
... algorithm_name=cfg.maximum_likelihood
... )
>>> # classification using a pretrained model
>>> file_list_2 = ['S2_B04.tif', 'S2_B03.tif', 'S2_B02.tif', 'S2_B05.tif',
... 'S2_B06.tif', 'S2_B07.tif', 'S2_B08.tif', 'S2_B11.tif', 'S2_B12.tif'
... ]
>>> # create BandSet
>>> catalog_2 = rs.bandset_catalog()
```

(continues on next page)

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```
>>> catalog_2.create_bandset(file_list_2, bandset_number=1)
>>> # create signature catalog
>>> signature_catalog_2 = rs.spectral_signatures_catalog(
... bandset=catalog.get(1)
... )
>>> # import vector for training
>>> signature_catalog_2.import_vector(
... file_path='roi.gpkg',
... macroclass_field='macroclass', class_field='class',
... macroclass_name_field='macroclass', class_name_field='class',
... calculate_signature=True
... )
>>> classification_2 = rs.band_classification(
... input_bands=file_list_2, output_path='output.tif',
... spectral_signatures=signature_catalog_2,
... algorithm_name=cfg.pytorch_pretrained_s2_swin_v2_tiny_a,
... additional_algorithm_name=cfg.random_forest,
... )
```

class remotior_sensus.tools.band_classification.**Classifier**(*algorithm_name*, *spectral_signatures*, *covariance_matrices*, *model_classifier*, *input_normalization*, *normalization_values*, *additional_algorithm_name*, *pretrained_model_path*, *pretrained_model_replace*, *n_processes*, *num_classes*, *feature_importance=None*)

Bases: `object`

Manages classifiers.

A classifier is an object which includes the required parameters to perform a classification, including the tools to perform the training.

algorithm_name

algorithm name selected form cfg.classification_algorithms.

spectral_signatures

a *SpectralSignaturesCatalog()* (page 114) containing spectral signatures.

covariance_matrices

dictionary of previously calculated covariance matrices (used in maximum likelihood only).

model_classifier

classifier object.

input_normalization

perform input normalization; options are `z_score` or `linear_scaling`.

normalization_values

list of normalization paramters defined for each variable [normalization expressions, mean values, standar deviation values, minimum values, maximum values].

framework_name

name of framework such as `classification_framework`, `scikit_framework`, or `pytorch_framework`.

classification_function

the actual classification function.

function_argument = a dictionary including arguments for the

classification function such as *model_classifier* (page 13), *covariance_matrices* (page 13), *normalization_values* (page 13), spectral_signatures_catalog.

Examples

Fit a classifier

```
>>> # Start a session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # create a BandSet
>>> catalog = rs.bandset_catalog()
>>> file_list = ['file1.tif', 'file2.tif', 'file3.tif']
>>> catalog.create_bandset(file_list, wavelengths=['Landsat 8'])
>>> # set a BandSet reference in signature catalog
>>> signature_catalog = rs.spectral_signatures_catalog(
>>>     bandset=catalog.get(1))
>>> # import vector in signature catalog
>>> signature_catalog.import_vector(
>>>     file_path='file.gpkg', macroclass_field='macroclass', class_
↪field='class',
>>>     macroclass_name_field='macroclass', class_name_field='class',
>>>     calculate_signature=True)
>>> # train a minimum distance classifier
>>> classifier = Classifier.train(
>>>     spectral_signatures=signature_catalog,
>>>     algorithm_name='minimum distance'
>>> )
```

__init__(*algorithm_name*, *spectral_signatures*, *covariance_matrices*, *model_classifier*, *input_normalization*, *normalization_values*, *additional_algorithm_name*, *pretrained_model_path*, *pretrained_model_replace*, *n_processes*, *num_classes*, *feature_importance=None*)

Initializes a classifier.

A classifier is an object which includes the

Parameters

- **algorithm_name** – algorithm name selected form cfg.classification_algorithms.
- **spectral_signatures** – a *SpectralSignaturesCatalog()* (page 114) containing spectral signatures.
- **covariance_matrices** – dictionary of previously calculated covariance matrices (used in maximum likelihood only).
- **model_classifier** – classifier object.
- **input_normalization** – perform input normalization; options are z_score or linear_scaling.
- **normalization_values** – list of normalization parameters defined for each variable [normalization expressions, mean values, standard deviation values, minimum values, maximum values].

- **additional_algorithm_name** – additional algorithm name useful for pretrained models, using parameters of the named algorithm; after executing the pretrained model, the additional algorithm is executed on the embeddings.
- **pretrained_model_path** – path to pretrained model
- **pretrained_model_replace** – pretrained model replace list
- **n_processes** – number of processes
- **num_classes** – number of classes for pretrained model
- **feature_importance** – optional feature importance for some algorithms

classmethod load_classifier(*algorithm_name=None*, *spectral_signatures=None*, *covariance_matrices=None*, *model_classifier=None*, *input_normalization=None*, *normalization_values=None*, *additional_algorithm_name=None*, *pretrained_model_path=None*, *pretrained_model_replace=None*, *n_processes=None*, *num_classes=None*, *feature_importance=None*)

Loads a classifier.

Creates a classifier from loading.

Parameters

- **algorithm_name** – algorithm name selected form cfg.classification_algorithms.
- **spectral_signatures** – a *SpectralSignaturesCatalog()* (page 114) containing spectral signatures.
- **covariance_matrices** – dictionary of previously calculated covariance matrices (used in maximum likelihood only).
- **model_classifier** – classifier object.
- **input_normalization** – perform input normalization; options are `z_score` or `linear_scaling`.
- **normalization_values** – list of normalization parameters defined for each variable [normalization expressions, mean values, standard deviation values, minimum values, maximum values].
- **additional_algorithm_name** – additional algorithm name useful for pretrained models, using parameters of the named algorithm; after executing the pretrained model, the additional algorithm is executed on the embeddings.
- **pretrained_model_path** – path to pretrained model
- **pretrained_model_replace** – pretrained model replace keys
- **num_classes** – number of classes for pretrained model
- **n_processes** – number of processes

Returns

Classifier() (page 13) object.

Examples

Load a classifier

```
>>> classifier = Classifier.load_classifier(
>>> algorithm_name=algorithm_name, spectral_signatures=spectral_
↪signatures,
>>> covariance_matrices=covariance_matrices, model_classifier=model_
↪classifier,
```

```
>>> input_normalization=input_normalization, normalization_
↪values=normalization_values)
```

run_prediction(*input_raster_list*, *output_raster_path*, *n_processes: None | int = None*, *available_ram: None | int = None*, *macroclass: bool | None = True*, *threshold: bool | None = False*, *signature_raster: bool | None = False*, *classification_confidence: bool | None = False*, *virtual_raster: bool | None = None*, *min_progress: int | None = 1*, *max_progress: int | None = 100*) → *OutputManager* (page 100)

Runs prediction.

Performs multiprocess classification using a trained classifier using input bands.

Parameters

- **input_raster_list** – list of paths of input rasters.
- **output_raster_path** – path of output file.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **macroclass** – if True, use macroclass ID from ROIs or spectral signatures; if False use class ID.
- **threshold** – if False, classification without threshold; if True, use single threshold for each signature; if float, use this value as threshold for all the signature.
- **classification_confidence** – if True, write also additional classification confidence rasters as output.
- **signature_raster** – if True, write additional rasters for each spectral signature as output.
- **virtual_raster** – if True, create virtual raster output.
- **min_progress** – minimum progress value for *Progress()* (page 106).
- **max_progress** – maximum progress value for *Progress()* (page 106).

Returns

OutputManager() (page 100) **object with**

- path = [output path]

Examples

Save a trainied classifier

```
>>> classifier = Classifier()
>>> # after the training
>>> prediction = classifier.run_prediction(
... input_raster_list=['file1.tif', 'file2.tif', 'file3.tif'],
... output_raster_path='file_path')
```

save_model(*output_path: str*) → *OutputManager* (page 100)

Saves classifier model.

Saves a classifier model to file to be loaded later.

Parameters

output_path – path of output file.

Returns

OutputManager() (page 100) object with

- path = [output path]

Examples

Save a trainied classifier

```
>>> classifier = Classifier()
>>> # after the training
>>> saved_model = classifier.save_model(output_path=output_path)
```

classmethod train(*spectral_signatures=None*, *algorithm_name=None*, *additional_algorithm_name=None*, *covariance_matrices=None*, *svc_classification_confidence=None*, *n_processes: int | None = None*, *available_ram: int | None = None*, *cross_validation=True*, *x_matrix=None*, *y=None*, *class_weight=None*, *input_normalization=None*, *normalization_values=None*, *find_best_estimator=False*, *rf_max_features=None*, *rf_number_trees=100*, *rf_min_samples_split=None*, *svm_c=None*, *svm_gamma=None*, *svm_kernel=None*, *pytorch_model=None*, *pytorch_optimizer=None*, *mlp_training_portion=None*, *pytorch_loss_function=None*, *mlp_hidden_layer_sizes=None*, *mlp_alpha=None*, *mlp_learning_rate_init=None*, *mlp_max_iter=None*, *mlp_batch_size=None*, *mlp_activation=None*, *pytorch_optimization_n_iter_no_change=None*, *pytorch_optimization_tol=None*, *pytorch_device=None*, *pretrained_model_path=None*, *pretrained_model_replace=None*, *num_classes=None*, *min_progress=1*, *max_progress=100*)

Trains a classifier.

Trains a classifier using ROIs or spectral signatures.

Parameters

- **spectral_signatures** – a *SpectralSignaturesCatalog()* (page 114) containing spectral signatures.
- **algorithm_name** – algorithm name selected from `cfg.classification_algorithms`; if None, minimum distance is used.
- **additional_algorithm_name** – additional algorithm name useful for pretrained models, using parameters of the named algorithm; after executing the pretrained model, the additional algorithm is executed on the embeddings.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **cross_validation** – if True, perform cross validation for algorithms provided through scikit-learn (`random_forest`, `random_forest_ovr`, `support_vector_machine`, `multi_layer_perceptron`).
- **x_matrix** – optional previously saved x matrix.
- **y** – optional previously saved y matrix.
- **covariance_matrices** – dictionary of previously calculated covariance matrices (used in maximum likelihood only).
- **svc_classification_confidence** – if True, write also additional classification confidence rasters as output; required information for support_vector_machine.

- **input_normalization** – perform input normalization; options are `z_score` or `linear_scaling`.
- **normalization_values** – list of normalization paramters defined for each variable [normalization expressions, mean values, standar deviation values, minimum values, maximum values].
- **class_weight** – specific for random forest and support vector machine, if None each class has equal weight 1, if `balanced` weight is computed inversely proportional to class frequency.
- **find_best_estimator** – specific for scikit classifiers, if True, find automatically the best parameters and fit the model, if integer the greater the value the more are the tested combinations.
- **rf_max_features** – specific for random forest, if None all features are considered in node splitting, available options are `sqrt` as square root of all the features, an integer number, or a float number for a fraction of all the features.
- **rf_number_trees** – specific for random forest, number of trees in the forest.
- **rf_min_samples_split** – specific for random forest through scikit, sets the minimum number of samples required to split an0 internal node; default = 2.
- **svm_c** – specific for support_vector_machine through scikit, sets the regularization parameter C; default = 1.
- **svm_gamma** – specific for support_vector_machine through scikit, sets the kernel coefficient; default = `scale`.
- **svm_kernel** – specific for support_vector_machine through scikit, sets the kernel; default = `rbf`.
- **mlp_training_portion** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, the proportion of data to be used as training (default = 0.9) and the remaining part as test (default = 0.1).
- **mlp_hidden_layer_sizes** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, list of values where each value defines the number of neurons in a hidden layer (e.g., `[200, 100]` for two hidden layers of 200 and 100 neurons respectively); default = `[100]`.
- **mlp_alpha** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, weight decay (also L2 regularization term) for Adam optimizer (default = 0.0001).
- **mlp_learning_rate_init** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, sets initial learning rate (default = 0.001).
- **mlp_max_iter** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, sets the maximum number of iterations (default = 200).
- **mlp_batch_size** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, sets the number of samples per batch for optimizer; if `auto`, the batch is the minimum value between 200 and the number of samples (default = `auto`).
- **mlp_activation** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, sets the activation function (default = `relu`).
- **pytorch_model** – specific for `pytorch_multi_layer_perceptron`, custom pytorch `nn.Module`.
- **pytorch_optimizer** – specific for `pytorch_multi_layer_perceptron`, custom pytorch optimizer.

- **pytorch_loss_function** – specific for pytorch_multi_layer_perceptron, sets a custom loss function (default = CrossEntropyLoss).
- **pytorch_optimization_n_iter_no_change** – specific for pytorch_multi_layer_perceptron, sets the maximum number of epochs where the loss is not improving by at least the value pytorch_optimization_tol (default = 5).
- **pytorch_optimization_tol** – specific for pytorch_multi_layer_perceptron, sets the tolerance of optimization (default = 0.0001).
- **pytorch_device** – specific for pytorch_multi_layer_perceptron, processing device cpu (default) or cuda if available.
- **pretrained_model_path** – path to pretrained model
- **pretrained_model_replace** – pretrained model replace keys
- **num_classes** – number of classes for pretrained model
- **min_progress** – minimum progress value for *Progress()* (page 106).
- **max_progress** – maximum progress value for *Progress()* (page 106).

Returns

Classifier() (page 13) object.

Examples

Load a classifier

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> signature_catalog = rs.spectral_signatures_catalog()
>>> classifier = Classifier.train(
>>> spectral_signatures=spectral_signatures,
>>> algorithm_name='minimum distance')
```

remotior_sensus.tools.band_classification.**band_classification**(*input_bands: list | int | BandSet (page 63), output_path: str | None = None, overwrite: bool | None = False, spectral_signatures: str | SpectralSignaturesCatalog (page 114) | None = None, algorithm_name: str | None = None, bandset_catalog: BandSetCatalog (page 74) | None = None, macroclass: bool | None = True, threshold: bool | float | None = False, classification_confidence: bool | None = False, signature_raster: bool | None = False, n_processes: int | None = None, available_ram: int | None = None, cross_validation: bool | None = True, x_input: array | None = None, y_input: array | None = None, covariance_matrices: dict | None = None, input_normalization: str | None = None, load_classifier: str | None = None, save_classifier: bool | None = False, only_fit: bool | None = False, class_weight: None | str | dict = None, find_best_estimator=False, rf_max_features=None, rf_number_trees: int | None = 100, rf_min_samples_split: None | int | float = None, svm_c: float | None = None, svm_gamma: str | float | None = None, svm_kernel: str | None = None, mlp_training_portion: None | float = None, mlp_hidden_layer_sizes: None | tuple | list = None, mlp_alpha: float | None = None, mlp_learning_rate_init: float | None = None, mlp_max_iter: float | None = None, mlp_batch_size: None | int | str = None, mlp_activation: None | str = None, pytorch_model: Optional = None, pytorch_optimizer: Optional = None, pytorch_loss_function: Optional = None, pytorch_optimization_n_iter_no_change: None | int = None, pytorch_optimization_tol: None | int = None, pytorch_device: None | str = None, pretrained_model_path: None | str = None, additional_algorithm_name: str | None = None, progress_message: bool | None*

Performs band classification.

This tool allows for classification of raster bands using the selected algorithm.

Parameters

- **input_bands** – list of input raster paths, or a BandSet number, or a previously defined BandSet.
- **output_path** – path of output file.
- **overwrite** – if True, output overwrites existing files.
- **spectral_signatures** – a *SpectralSignaturesCatalog()* (page 114) containing spectral signatures.
- **algorithm_name** – algorithm name selected from `cfg.classification_algorithms`; if None, minimum distance is used.
- **bandset_catalog** – BandSetCatalog object.
- **macroclass** – if True, use macroclass ID from ROIs or spectral signatures; if False use class ID.
- **threshold** – if False, classification without threshold; if True, use single threshold for each signature; if float, use this value as threshold for all the signature.
- **classification_confidence** – if True, write also additional classification confidence rasters as output.
- **signature_raster** – if True, write additional rasters for each spectral signature as output.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **cross_validation** – if True, perform cross validation for algorithms provided through scikit-learn (`random_forest`, `random_forest_ovr`, `support_vector_machine`, `multi_layer_perceptron`).
- **load_classifier** – path to a previously saved classifier.
- **x_input** – optional previously saved x matrix.
- **y_input** – optional previously saved y matrix.
- **covariance_matrices** – dictionary of previously calculated covariance matrices (used in `maximum_likelihood`).
- **input_normalization** – perform input normalization; options are `z_score` or `linear_scaling`.
- **only_fit** – perform only classifier fitting.
- **save_classifier** – save classifier to file.
- **class_weight** – specific for random forest and support vector machine, if None each class has equal weight 1, if 'balanced' weight is computed inversely proportional to class frequency.
- **find_best_estimator** – specific for scikit classifiers, if True, find automatically the best parameters and fit the model, if integer the greater the value the more are the tested combinations.
- **rf_max_features** – specific for random forest, if None all features are considered in node splitting, available options are `sqrt` as square root of all the features, an integer number, or a float number for a fraction of all the features.
- **rf_number_trees** – specific for random forest, number of trees in the forest.

- **rf_min_samples_split** – specific for random forest through scikit, sets the minimum number of samples required to split an internal node; default = 2.
- **svm_c** – specific for support_vector_machine through scikit, sets the regularization parameter C; default = 1.
- **svm_gamma** – specific for support_vector_machine through scikit, sets the kernel coefficient; default = `scale`.
- **svm_kernel** – specific for support_vector_machine through scikit, sets the kernel; default = `rbf`.
- **mlp_training_portion** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, the proportion of data to be used as training (default = 0.9) and the remaining part as test (default = 0.1).
- **mlp_hidden_layer_sizes** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, list of values where each value defines the number of neurons in a hidden layer (e.g., `[200, 100]` for two hidden layers of 200 and 100 neurons respectively); default = `[100]`.
- **mlp_alpha** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, weight decay (also L2 regularization term) for Adam optimizer (default = 0.0001).
- **mlp_learning_rate_init** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, sets initial learning rate (default = 0.001).
- **mlp_max_iter** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, sets the maximum number of iterations (default = 200).
- **mlp_batch_size** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, sets the number of samples per batch for optimizer; if `auto`, the batch is the minimum value between 200 and the number of samples (default = `auto`).
- **mlp_activation** – specific for `multi_layer_perceptron` and `pytorch_multi_layer_perceptron`, sets the activation function (default = `relu`).
- **pytorch_model** – specific for `pytorch_multi_layer_perceptron`, custom pytorch `nn.Module`.
- **pytorch_optimizer** – specific for `pytorch_multi_layer_perceptron`, custom pytorch optimizer.
- **pytorch_loss_function** – specific for `pytorch_multi_layer_perceptron`, sets a custom loss function (default `CrossEntropyLoss`).
- **pytorch_optimization_n_iter_no_change** – specific for `pytorch_multi_layer_perceptron`, sets the maximum number of epochs where the loss is not improving by at least the value `pytorch_optimization_tol` (default = 5).
- **pytorch_optimization_tol** – specific for `pytorch_multi_layer_perceptron`, sets the tolerance of optimization (default = 0.0001).
- **pytorch_device** – specific for `pytorch_multi_layer_perceptron`, processing device `cpu` (default) or `cuda` if available.
- **pretrained_model_path** – specific for pretrained models such as `pytorch_pretrained_s2_swin_v2_base`, the path to the pth file of the pretrained model.
- **additional_algorithm_name** – additional algorithm name useful for pretrained models, using parameters of the named algorithm; after executing the pretrained model, the additional algorithm is executed on the embeddings.

- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

If only_fit is True returns *OutputManager()* (page 100) object with

- extra = {'classifier': classifier, 'model_path': output model path}

If only_fit is False returns *OutputManager()* (page 100) object with

- path = classification path
- extra = {'model_path': output model path}

remotior_sensus.tools.band_classification.**check_pretrained_model_path**(*algorithm_name*, *pre-trained_model_path=None*)

remotior_sensus.tools.band_clip module

Band clip.

This tool allows for clipping the bands of a BandSet.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # box coordinate list
>>> extent_list = [230250, 4674510, 230320, 4674440]
>>> # start the process
>>> clip = rs.band_clip(input_bands=['path_1', 'path_2'],
... output_path='output_path', extent_list=extent_list)
```

remotior_sensus.tools.band_clip.**band_clip**(*input_bands: list | int | BandSet (page 63), output_path: str | list | None = None, vector_path: str | None = '', vector_field: None | str = None, overwrite: bool | None = False, prefix: str | None = '', extent_list: list | None = None, multiple_resolution: bool | None = True, n_processes: None | int = None, available_ram: None | int = None, bandset_catalog: BandSetCatalog (page 74) | None = None, virtual_output: bool | None = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Perform band clip.

This tool allows for clipping the bands of a BandSet based on a vector or list of boundary coordinates left top right bottom.

Parameters

- **input_bands** – input of type BandSet or list of paths or integer number of BandSet.
- **output_path** – string of output path directory or list of paths.
- **overwrite** – if True, output overwrites existing files.
- **vector_path** – path of vector used to clip.
- **vector_field** – vector field name used to clip for every unique ID.
- **virtual_output** – if True (and output_path is directory), save output as virtual raster of multiprocess parts
- **prefix** – optional string for output name prefix.

- **extent_list** – list of boundary coordinates left top right bottom.
- **multiple_resolution** – if True, keep the original resolution of individual raster; if False, use the resolution of the first raster for all the bands.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **bandset_catalog** – optional type BandSetCatalog for BandSet number
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- paths = output list

Examples

Clip using vector

```
>>> # start the process
>>> clip = band_clip(input_bands=['path_1', 'path_2'],
... output_path='output_path', vector_path='vector_path',
... prefix='clip_')
```

remotior_sensus.tools.band_clustering module

Band clustering.

This tool allows for the automatic clustering of a BandSet or a list of files.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> catalog = rs.bandset_catalog()
>>> # create a BandSets
>>> file_list_1 = ['file1_b1.tif', 'file1_b2.tif', 'file1_b3.tif']
>>> catalog.create_bandset(file_list_1, bandset_number=1)
>>> # start the process
>>> output = rs.band_clustering(
... input_bands=catalog.get_bandset(1), output_raster_path='output.tif',
... algorithm_name='minimum distance', class_number=10,
... seed_signatures='random pixel'
... )
```

remotior_sensus.tools.band_clustering.**band_clustering**(*input_bands: list | int | BandSet (page 63), output_raster_path: str, algorithm_name: str, class_number: int, seed_signatures: str | SpectralSignaturesCatalog (page 114) | None = None, threshold: None | float = None, max_iter: None | int = None, overwrite: bool | None = False, nodata_value: None | int = None, extent_list: list | None = None, n_processes: None | int = None, available_ram: int | None = None, bandset_catalog: BandSetCatalog (page 74) | None = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Calculation of Band Clustering.

This tool allows for the calculation of Band Clustering. A classification raster file is created. In addition, the spectral signatures of the final iteration are saved as .scpx file.

Parameters

- **input_bands** – input of type BandSet or list of paths or integer number of BandSet.
- **output_raster_path** – path of output file.
- **algorithm_name** – algorithm name selected from cfg.classification_algorithms between minimum distance and spectral angle maping.
- **class_number** – the output number of classes (default = 10).
- **seed_signatures** – the type of seed signatures (random pixel or band mean) or a *SpectralSignaturesCatalog()* (page 114) containing spectral signatures, or path of spectral signature file.
- **threshold** – if None, classification without threshold; if float, use this value as threshold for all the signatures.
- **max_iter** – sets the maximum number of iterations (default = 10).
- **overwrite** – if True, output overwrites existing files.
- **nodata_value** – value to be considered as nodata.
- **extent_list** – list of boundary coordinates left top right bottom.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **bandset_catalog** – optional type BandSetCatalog for BandSet number.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- path = [output path]
- extra = {'signature_path': output spectral signature .scpx file path}

Examples

Perform the clustering on a list of files

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # input file list
>>> file_list_2 = ['file1_b1.tif', 'file1_b2.tif', 'file1_b3.tif']
>>> # start the process
>>> output = rs.band_clustering(
... input_bands=file_list_2, output_raster_path='output.tif',
... algorithm_name='minimum distance', class_number=10,
... seed_signatures='band mean'
... )
```

remotior_sensus.tools.band_combination module

Band combination.

This tool is intended for combining classifications in order to get a raster where each value corresponds to a combination of class values. A unique value is assigned to each combination of values. The output is a raster made of unique values corresponding to combinations of values. An output text file describes the correspondence between unique values and combinations, as well as the statistics of each combination.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> combination = rs.band_combination(input_bands=['path_1', 'path_2'],
... output_path='output_path')
```

remotior_sensus.tools.band_combination.**band_combination**(*input_bands: list | int | BandSet (page 63), output_path: None | str = None, nodata_value: None | int = None, no_raster_output: bool | None = False, overwrite: bool | None = False, n_processes: None | int = None, available_ram: None | int = None, bandset_catalog: BandSetCatalog (page 74) | None = None, extent_list: list | None = None, column_name_list: list | None = None, output_table: bool | None = True, separator: None | str = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Calculation of band combination.

This tool allows for the combination of rasters or bands loaded in a BandSet. This tool is intended for combining classifications in order to get a raster where each value corresponds to a combination of class values. Input raster values must be integer type. The output is a combination raster and a text file reporting the statistics of each combination.

Parameters

- **input_bands** – list of paths of input rasters, or number of BandSet, or BandSet object.
- **output_path** – path of the output raster.
- **no_raster_output** – if True, no output raster is written to file.
- **overwrite** – if True, output overwrites existing files.

- **nodata_value** – input value to be considered as nodata.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **bandset_catalog** – BandSetCatalog object required if input_bands is a BandSet number.
- **extent_list** – list of boundary coordinates left top right bottom.
- **column_name_list** – list of strings corresponding to input bands used as column names in output table, if None then column names are extracted for input band names.
- **output_table** – if True then calculate output table; if False then calculate only array of combinations and sum.
- **separator** – separator of fields of output table (default tab)
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

If output_table is True returns the *OutputManager()* (page 100) object with

- paths = [output raster path, output table path]

If output_table is False returns the *OutputManager()* (page 100) object with

- paths = [virtual raster path]
- extra = {'combinations': array of combinations, 'sums': array of the sums of values}

Examples

Combination using two rasters having paths path_1 and path_2

```
>>> combination = band_combination(input_bands=['path_1', 'path_2'],
↪output_path='output_path')
```

The combination raster and the table are finally created; the paths can be retrieved from the output that is an *OutputManager()* (page 100) object

```
>>> raster_path, table_path = combination.paths
>>> print(raster_path)
output_path
```

Combination using a virtual raster as output file

```
>>> combination = band_combination(input_bands=['path_1', 'path_2'],
↪output_path='output_path.vrt')
>>> raster_path, table_path = combination.paths
>>> print(raster_path)
output_path.vrt
```

Using input BandSet number

```
>>> catalog = BandSetCatalog()
>>> combination = band_combination(input_bands=1,output_path='output_path
↪',bandset_catalog=catalog)
```

Using input BandSet

```
>>> catalog = BandSetCatalog()
>>> combination = band_combination(input_bands=catalog.get_bandset(1),
↪output_path='output_path')
```

remotior_sensus.tools.band_dilation module

Band dilation.

This tool allows for the spatial dilation, through a moving window, of band pixels selected by values.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> dilation = rs.band_dilation(input_bands=['file1.tif', 'file2.tif'],
... value_list=[1], size=3, output_path='directory_path',
... circular_structure=True, prefix='dilation_')
```

remotior_sensus.tools.band_dilation.**band_dilation**(*input_bands: list | int | BandSet (page 63), value_list: list, size: int, output_path: str | list | None = None, overwrite: bool | None = False, circular_structure: bool | None = None, prefix: str | None = '', extent_list: list | None = None, multiple_resolution: bool | None = True, n_processes: None | int = None, available_ram: None | int = None, bandset_catalog: BandSetCatalog (page 74) | None = None, virtual_output: bool | None = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Perform dilation of band pixels.

This tool performs the dilation of pixels identified by a list of values. A new raster is created for each input band.

Parameters

- **input_bands** – input of type BandSet or list of paths or integer number of BandSet.
- **output_path** – string of output path directory or list of paths.
- **overwrite** – if True, output overwrites existing files.
- **value_list** – list of values for dilation.
- **size** – size of dilation in pixels.
- **virtual_output** – if True (and output_path is directory), save output as virtual raster of multiprocess parts
- **circular_structure** – if True, use circular structure; if False, square structure.
- **prefix** – optional string for output name prefix.
- **extent_list** – list of boundary coordinates left top right bottom.
- **multiple_resolution** – if True, keep the original resolution of individual raster; if False, use the resolution of the first raster for all the bands.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **bandset_catalog** – optional type BandSetCatalog for BandSet number.

- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- paths = output list

Examples

Perform the dilation of size 5 for value 1 and 2

```
>>> dilation = band_dilation(input_bands=['path_1', 'path_2'],value_
↪list=[1, 2],size=5,output_path='directory_path',circular_
↪structure=True)
```

remotior_sensus.tools.band_erosion module

Band erosion.

This tool allows for the spatial erosion, through a moving window, of band pixels selected by values.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> erosion = rs.band_erosion(input_bands=['file1.tif', 'file2.tif'],
... value_list=[1], size=1, output_path='directory_path',
... circular_structure=True,prefix='erosion_')
```

remotior_sensus.tools.band_erosion.**band_erosion**(*input_bands: list | int | BandSet (page 63), value_list: list, size: int, output_path: str | list | None = None, overwrite: bool | None = False, circular_structure: bool | None = None, prefix: str | None = '', extent_list: list | None = None, multiple_resolution: bool | None = True, n_processes: None | int = None, available_ram: None | int = None, bandset_catalog: BandSetCatalog (page 74) | None = None, virtual_output: bool | None = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Perform erosion of band pixels.

This tool performs the erosion of pixels identified by a list of values. A new raster is created for each input band.

Parameters

- **input_bands** – input of type BandSet or list of paths or integer number of BandSet.
- **output_path** – string of output path directory or list of paths.
- **overwrite** – if True, output overwrites existing files.
- **value_list** – list of values for dilation.
- **size** – size of dilation in pixels.

- **virtual_output** – if True (and output_path is directory), save output as virtual raster of multiprocess parts.
- **circular_structure** – if True, use circular structure; if False, square structure.
- **prefix** – optional string for output name prefix.
- **extent_list** – list of boundary coordinates left top right bottom.
- **multiple_resolution** – if True, keep the original resolution of individual raster; if False, use the resolution of the first raster for all the bands.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **bandset_catalog** – optional type BandSetCatalog for BandSet number.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- paths = output list

Examples

Perform the erosion of size 1 for value 1 and 2

```
>>> erosion = band_erosion(
... input_bands=['path_1', 'path_2'], value_list=[1, 2], size=1,
... output_path='directory_path', circular_structure=True
... )
```

remotior_sensus.tools.band_mask module

Band mask.

This tool allows for masking bands using a vector or raster mask.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> rs.band_mask(input_bands=['path_1', 'path_2'],
... input_mask='mask_path', mask_values=[1, 2]
... output_path='output_path')
```

remotior_sensus.tools.band_mask.**band_mask**(*input_bands: list | int | BandSet (page 63), input_mask: str | None = None, mask_values: list | None = None, output_path: None | str = None, overwrite: bool | None = False, buffer: None | int = None, nodata_value: None | int = None, virtual_output: bool | None = None, compress=None, compress_format=None, prefix: str | None = '', extent_list: list | None = None, n_processes: None | int = None, available_ram: None | int = None, bandset_catalog: BandSetCatalog (page 74) | None = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Performs band mask.

This tool allows for masking bands using a vector or raster mask.

Parameters

- **input_bands** – reference_raster of type BandSet or list of paths or integer number of BandSet.
- **input_mask** – string path of raster or vector used for masking.
- **mask_values** – list of values in the mask to be used for masking.
- **output_path** – string of output path directory or list of paths.
- **overwrite** – if True, output overwrites existing files.
- **buffer** – optional buffer size, in number of pixels, to expand the mask.
- **nodata_value** – value to be used as nodata in the output.
- **virtual_output** – if True (and output_path is directory), save output as virtual raster of multiprocess parts.
- **prefix** – optional string for output name prefix.
- **extent_list** – list of boundary coordinates left top right bottom.
- **compress** – if True, compress output.
- **compress_format** – format of compressions such as LZW or DEFLATE.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **bandset_catalog** – optional type BandSetCatalog for BandSet number.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- paths = output list

Examples

Perform the band resample

```
>>> band_mask(input_bands=['path_1', 'path_2'],
... input_mask='mask_path', mask_values=[1, 2],
... output_path='output_path')
```

remotior_sensus.tools.band_neighbor_pixels module

Band neighbor pixels.

This tool allows for the calculation of a function over neighbor pixels defined by size (i.e. number of pixels) or a structure.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> neighbor = rs.band_neighbor_pixels(
... input_bands=['file1.tif', 'file2.tif'],
... size=1, output_path='directory_path', stat_name='Mean',
... circular_structure=True, prefix='neighbor_'
... )
```

remotior_sensus.tools.band_neighbor_pixels.**band_neighbor_pixels**(*input_bands: list | int | BandSet (page 63), size: int, output_path: None | str = None, overwrite: bool | None = False, stat_name: str | None = None, structure: any | None = None, circular_structure: bool | None = True, stat_percentile: None | int | str = None, output_data_type: None | str = None, virtual_output: bool | None = None, prefix: str | None = '', extent_list: list | None = None, multiple_resolution: bool | None = True, n_processes: None | int = None, available_ram: None | int = None, bandset_catalog: BandSetCatalog (page 74) | None = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Performs band neighbor pixels.

This tool calculates a function over neighbor pixels defined by size (i.e. number of pixels) or structure. A new raster is created for each input band, where each pixel is the result of the calculation of the function over the neighbor pixels (e.g. the mean of the pixel values of a 3x3 window around the pixel). Available functions are:

- Count
- Max
- Mean
- Median
- Min
- Percentile
- StandardDeviation
- Sum

Parameters

- **input_bands** – input of type BandSet or list of paths or integer number of BandSet.

- **output_path** – string of output path directory or list of paths.
- **overwrite** – if True, output overwrites existing files.
- **size** – size of dilation in pixels.
- **structure** – optional path to csv file of structures, if None then the structure is created from size.
- **circular_structure** – if True use circular structure.
- **stat_name** – statistic name as in configurations.statistics_list.
- **stat_percentile** – integer value for percentile parameter.
- **output_data_type** – optional raster output data type, if None the data type is the same as input raster.
- **virtual_output** – if True (and output_path is directory), save output as virtual raster of multiprocess parts.
- **prefix** – optional string for output name prefix.
- **extent_list** – list of boundary coordinates left top right bottom.
- **multiple_resolution** – if True, keep the original resolution of individual raster; if False, use the resolution of the first raster for all the bands.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **bandset_catalog** – optional type BandSetCatalog for BandSet number.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- paths = output list

Examples

Perform the band neighbor of size 10 pixels with the function Sum

```
>>> neighbor = band_neighbor_pixels(
... input_bands=['file1.tif', 'file2.tif'], size=10,
... output_path='directory_path', stat_name='Sum',
... circular_structure=True
... )
```

remotior_sensus.tools.band_pca module

Band PCA.

This tool allows for the calculation of Principal Components Analysis on input bands, producing rasters corresponding to the principal components.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
```

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```
>>> catalog = rs.bandset_catalog()
>>> # create a BandSets
>>> file_list_1 = ['file1_b1.tif', 'file1_b2.tif', 'file1_b3.tif']
>>> catalog.create_bandset(file_list_1, bandset_number=1)
>>> # start the process
>>> output = rs.band_pca(input_bands=catalog.get_bandset(1),
... output_path='directory_path')
```

remotior_sensus.tools.band_pca.**band_pca**(*input_bands: list | int | BandSet (page 63), normalize: bool | None = False, output_path: str | list | None = None, overwrite: bool | None = False, nodata_value: None | int = None, extent_list: list | None = None, n_processes: None | int = None, available_ram: int | None = None, bandset_catalog: BandSetCatalog (page 74) | None = None, number_components: None | int = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Calculation of Principal Components Analysis.

This tool allows for the calculation of Principal Components Analysis of raster bands obtaining the principal components. A new raster file is created for each component. In addition, a table containing the Principal Components statistics is created.

Parameters

- **input_bands** – input of type BandSet or list of paths or integer number of BandSet.
- **normalize** – if True, normalize input bands as .
- **output_path** – string of output path directory or list of paths.
- **overwrite** – if True, output overwrites existing files.
- **nodata_value** – value to be considered as nodata.
- **extent_list** – list of boundary coordinates left top right bottom.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **bandset_catalog** – optional type BandSetCatalog for BandSet number.
- **number_components** – defines the maximum number of components calculated.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- paths = output list
- extra = {'table': table path string}

Examples

Perform the PCA on the first BandSet

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> catalog = rs.bandset_catalog()
>>> # create a BandSets
```

```
>>> file_list_1 = ['file1_b1.tif', 'file1_b2.tif', 'file1_b3.tif']
>>> catalog.create_bandset(file_list_1, bandset_number=1)
>>> # start the process
>>> pca = rs.band_pca(input_bands=catalog.get_bandset(1),output_path=
↪'directory_path')
```

remotior_sensus.tools.band_resample module

Band resample.

This tool allows for resampling and reprojecting bands.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> rs.band_resample(input_bands=['path_1', 'path_2'],
... output_path='output_path')
```

remotior_sensus.tools.band_resample.**band_resample**(*input_bands: list | int | BandSet (page 63), output_path: None | str = None, epsg_code: None | str = None, align_raster: str | BandSet (page 63) | int | None = None, overwrite: bool | None = False, resampling: None | str = None, nodata_value: None | int = None, x_y_resolution: list | int | None = None, resample_pixel_factor: None | float = None, output_data_type: None | str = None, same_extent: bool | None = False, virtual_output: bool | None = None, compress=None, compress_format=None, prefix: str | None = '', extent_list: list | None = None, multiple_resolution: bool | None = True, n_processes: None | int = None, available_ram: None | int = None, bandset_catalog: BandSetCatalog (page 74) | None = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Performs band resample and reprojection.

This tool performs the resampling and reprojection of raster bands. Available resampling methods are:

- nearest_neighbour
- average
- sum
- maximum
- minimum
- mode
- median
- first_quartile
- third_quartile

Parameters

- **input_bands** – input of type BandSet or list of paths or integer number of BandSet.
- **output_path** – string of output path directory or list of paths.
- **epsg_code** – optional EPSG code for output.
- **align_raster** – string path of raster used for aligning output pixels and projections.
- **overwrite** – if True, output overwrites existing files.
- **resampling** – method of resample such as nearest_neighbour (default), average, sum, maximum, minimum, mode, median, first_quartile, third_quartile.
- **nodata_value** – value to be considered as nodata.
- **x_y_resolution** – integer pixel size of output raster or pixel size as list of x, y.
- **resample_pixel_factor** – define output resolution by multiplying original pixel size to this value.
- **output_data_type** – optional raster output data type, if None the data type is the same as input raster.
- **same_extent** – if True, output extent is the same as align_raster.
- **virtual_output** – if True (and output_path is directory), save output as virtual raster of multiprocess parts.
- **prefix** – optional string for output name prefix.
- **extent_list** – list of boundary coordinates left top right bottom.
- **multiple_resolution** – if True, keep the original resolution of individual raster; if False, use the resolution of the first raster for all the bands.
- **compress** – if True, compress output.
- **compress_format** – format of compressions such as LZW or DEFLATE.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **bandset_catalog** – optional type BandSetCatalog for BandSet number.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- paths = output list

Examples

Perform the band resample

```
>>> band_resample(
... input_bands=['path_1', 'path_2'], output_path='output_path',
... resampling='mode', resample_pixel_factor=2
... )
```

remotior_sensus.tools.band_sieve module

Band sieve.

This tool allows for performing the sieve of raster bands removing patches having size lower than a threshold (i.e. number of pixels).

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> sieve = rs.band_sieve(
... input_bands=['file1.tif', 'file2.tif'],size=2,
... output_path='directory_path', connected=False,prefix='sieve_'
... )
```

remotior_sensus.tools.band_sieve.**band_sieve**(*input_bands: list | int | BandSet (page 63), size: int, output_path: str | list | None = None, connected: bool | None = None, overwrite: bool | None = False, prefix: str | None = '', extent_list: list | None = None, multiple_resolution: bool | None = True, n_processes: None | int = None, available_ram: None | int = None, bandset_catalog: BandSetCatalog (page 74) | None = None, virtual_output: bool | None = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Perform band sieve.

This tool allows for performing the sieve of raster bands removing patches having size lower than a threshold (i.e. number of pixels).

Parameters

- **input_bands** – input of type BandSet or list of paths or integer number of BandSet.
- **output_path** – string of output path directory or list of paths.
- **overwrite** – if True, output overwrites existing files.
- **size** – size of dilation in pixels.
- **virtual_output** – if True (and output_path is directory), save output as virtual raster of multiprocess parts
- **connected** – if True, consider 8 pixel connection; if False, consider 4 pixel connection.
- **prefix** – optional string for output name prefix.
- **extent_list** – list of boundary coordinates left top right bottom.
- **multiple_resolution** – if True, keep the original resolution of individual raster; if False, use the resolution of the first raster for all the bands.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **bandset_catalog** – optional type BandSetCatalog for BandSet number.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- paths = output list

Examples

Perform the sieve of size 3 with connected pixel (8 connection)

```
>>> sieve = band_sieve(
... input_bands=['file1.tif', 'file2.tif'], size=3,
... output_path='directory_path', connected=True, prefix='sieve_'
... )
```

remotior_sensus.tools.band_spectral_distance module

Band spectral distance.

This tool allows for calculating the spectral distance pixel by pixel between two BandSets.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> catalog = rs.bandset_catalog()
>>> # create three BandSets
>>> file_list_1 = ['file1_b1.tif', 'file1_b2.tif', 'file1_b3.tif']
>>> file_list_2 = ['file2_b1.tif', 'file2_b2.tif', 'file2_b3.tif']
>>> catalog.create_bandset(file_list_1, bandset_number=1)
>>> catalog.create_bandset(file_list_2, bandset_number=2)
>>> distance = rs.band_spectral_distance(
... input_bandsets=[catalog.get(1), catalog.get(2)], output_path='output_path',
... )
```

remotior_sensus.tools.band_spectral_distance.**band_spectral_distance**(*input_bandsets: list*, *output_path: None | str = None*, *algorithm_name: None | str = None*, *nodata_value: None | int = None*, *threshold: None | float = None*, *n_processes: None | int = None*, *available_ram: None | int = None*, *virtual_output: bool | None = False*, *overwrite: bool | None = False*, *bandset_catalog: BandSetCatalog (page 74) | None = None*, *progress_message: bool | None = True*) → *OutputManager* (page 100)

Band spectral distance.

This tool allows for calculating the spectral distance pixel by pixel between two BandSets, which can be useful for change detection. A new raster is created where pixel values rapresent the spectral distance between pixels of input BandSets. Optionally, a threshold value can be defined to create a binary raster where pixel value is 1 if distance > threshold or 0 otherwise.

Parameters

- **input_bandsets** – list of number of BandSets, or BandSet objects.
- **output_path** – string of output path directory.
- **algorithm_name** – algorithm name selected form cfg.classification_algorithms.
- **nodata_value** – value to be considered as nodata.
- **threshold** – threshold value to create a binary raster if distance > threshold.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **virtual_output** – if True (and output_path is directory), save output as virtual raster of multiprocess parts.
- **overwrite** – if True, output overwrites existing files.
- **bandset_catalog** – optional type BandSetCatalog for BandSet number.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- path = output path

Examples

Perform the spectral distance of two BandSets using threshold

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> catalog = rs.bandset_catalog()
>>> # create three BandSets
>>> file_list_1 = ['file1_b1.tif', 'file1_b2.tif', 'file1_b3.tif']
>>> file_list_2 = ['file2_b1.tif', 'file2_b2.tif', 'file2_b3.tif']
>>> catalog.create_bandset(file_list_1, bandset_number=1)
>>> catalog.create_bandset(file_list_2, bandset_number=2)
>>> # start the process
>>> distance = rs.band_spectral_distance(
... input_bandsets=[1, 2], output_path='output_path',
... threshold=1000, bandset_catalog=catalog
... )
```

remotior_sensus.tools.band_stack module

Band stack.

This tool allows for stacking single bands in a multiband raster.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> stack = rs.band_stack(input_bands=['path_1', 'path_2'],
... output_path='output_path')
```

remotior_sensus.tools.band_stack.**band_stack**(*input_bands: list | int | BandSet (page 63), output_path: None | str = None, overwrite: bool | None = False, extent_list: list | None = None, bandset_catalog: BandSetCatalog (page 74) | None = None, n_processes: None | int = None, virtual_output: bool | None = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Stack single bands.

This tool allows for stacking single bands in a multiband raster.

Parameters

- **input_bands** – list of paths of input rasters, or number of BandSet, or BandSet object.
- **output_path** – string of output path.
- **overwrite** – if True, output overwrites existing files.
- **extent_list** – list of boundary coordinates left top right bottom.
- **bandset_catalog** – BandSetCatalog object required if input_bands is a BandSet number.
- **n_processes** – number of parallel processes.
- **virtual_output** – if True (and output_path is directory), save output as virtual raster.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

object *OutputManager()* (page 100) with

- path = output path

Examples

Perform band stack

```
>>> stack = band_stack(input_bands=['path_1', 'path_2'],
... output_path='output_path')
```

remotior_sensus.tools.cross_classification module

Cros classification.

This tool performs the cross classification which is similar to band combination, but it is executed between two files only. The reference file can also be of vector type. A unique value is assigned to each combination of values. The output is a raster made of unique values corresponding to combinations of values. An output text file describes the correspondance between unique values and combinations, as well as the statistics of each combination, with the option to calculate an error matrix or linear regression.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> cross = rs.cross_classification(
... classification_path='file1.tif', reference_path='file2.tif',
... output_path='output.tif'
... )
```

remotior_sensus.tools.cross_classification.**cross_classification**(*classification_path: str*, *reference_path: str*, *output_path: None | str = None*, *overwrite: bool | None = False*, *vector_field: None | str = None*, *nodata_value: None | int = None*, *cross_matrix: bool | None = False*, *regression_raster: bool | None = False*, *error_matrix: bool | None = False*, *extent_list: list | None = None*, *n_processes: None | int = None*, *available_ram: None | int = None*, *progress_message: bool | None = True*) → *OutputManager* (page 100)

Calculation of cross classification.

This tool allows for the cross classification of two files (a classification raster and a reference vector or raster) in order to get a raster where each value corresponds to a combination of class values. Input raster values must be integer type. The output is a cross raster and, depending on the parameters, a text file reporting the statistics of each combination, error matrix, or linear regression statistics.

Parameters

- **classification_path** – path of raster used as classification input.
- **reference_path** – path of the vector or raster file used as reference input.
- **vector_field** – in case of vector reference, the name of the field used as reference value.
- **output_path** – path of the output raster.
- **overwrite** – if True, output overwrites existing files.
- **nodata_value** – value to be considered as nodata.
- **cross_matrix** – if True then calculate the cross matrix.
- **regression_raster** – if True then calculate linear regression statistics.
- **error_matrix** – if True then calculate error matrix.
- **extent_list** – list of boundary coordinates left top right bottom.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- paths = [output raster path, output table path]

Examples

Perform the cross classification between two files

```
>>> cross = cross_classification(
... classification_path='file1.tif', reference_path='file2.tif',
... output_path='output.tif'
... )
```

Perform the cross classification between two files and calculate the error matrix

```
>>> cross = cross_classification(
... classification_path='file1.tif', reference_path='file2.tif',
... output_path='output.tif', error_matrix=True
)
```

remotior_sensus.tools.download_products module

Download products.

This tool allows for downloading products such as Landsat and Sentinel-2 datasets.

remotior_sensus.tools.download_products.**delete_copernicus_token**(*access_token*, *session_state*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*)

remotior_sensus.tools.download_products.**download**(*product_table*, *output_path*, *exporter=False*, *band_list=None*, *virtual_download=False*, *extent_coordinate_list=None*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*, *authentication_uri=None*, *nasa_user=None*, *nasa_password=None*, *copernicus_user=None*, *copernicus_password=None*, *progress_message=True*, *ignore_errors=False*) → *OutputManager* (page 100)

Download products.

This tool downloads product. Downloads Sentinel-2 images using the following Google service: https://storage.googleapis.com/gcp-public-data-sentinel-2 or https://catalogue.dataspace.copernicus.eu if copernicus_user and copernicus_password are provided.

Alternatively, downloads the collections from Microsoft Planetary Computer https://planetarycomputer.microsoft.com

Downloads HLS images from: https://cmr.earthdata.nasa.gov/search/site/search_api_docs.html.

Parameters

- **product_table** – product table object.
- **output_path** – string of output path.
- **exporter** – if True, export download urls.
- **band_list** – list of band numbers to be downloaded.

- **virtual_download** – if True create a virtual raster of the linked image.
- **extent_coordinate_list** – list of coordinates for defining a subset region [left, top, right, bottom] .
- **proxy_host** – proxy host.
- **proxy_port** – proxy port.
- **proxy_user** – proxy user.
- **proxy_password** – proxy password.
- **authentication_uri** – authentication uri.
- **nasa_user** – user for NASA authentication.
- **nasa_password** – password for NASA authentication.
- **copernicus_user** – user for Copernicus authentication.
- **copernicus_password** – password for Copernicus authentication.
- **progress_message** – progress message.
- **ignore_errors** – if True, ignore download errors and continue with the next product download.

Returns

object *OutputManager()* (page 100) with

- paths = output file list
- extra={'directory_paths': list of output directory paths}

remotior_sensus.tools.download_products.**export_product_table_as_xml**(*product_table*, *output_path=None*)

Exports product table as xml.

Exports a product table and attributes.

remotior_sensus.tools.download_products.**get_copernicus_token**(*user*, *password*, *authentication_uri=None*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*)

remotior_sensus.tools.download_products.**import_as_xml**(*xml_path*)

Imports a product table as xml.

Imports a product table and attributes.

remotior_sensus.tools.download_products.**mpi_bcast**(*value*)

remotior_sensus.tools.download_products.**product_names**() → list

Prints the products that can be searched and returns the list.

remotior_sensus.tools.download_products.**query_aster_l1t_mpc**(*date_from*, *date_to*, *max_cloud_cover=100*, *result_number=50*, *name_filter=None*, *coordinate_list=None*, *progress_message=True*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*) → *OutputManager* (page 100)

Perform the query of ASTER from Microsoft Planetary Computer.

This tool performs the query from Microsoft Planetary Computer https://planetarycomputer.microsoft.com.

Parameters

- **date_from** – date defining the starting period of the query
- **date_to**
- **max_cloud_cover**
- **result_number**
- **name_filter**
- **coordinate_list**
- **progress_message**
- **proxy_host**
- **proxy_port**
- **proxy_user**
- **proxy_password**

Returns

object OutputManger

remotior_sensus.tools.download_products.**query_cop_dem_glo_30_mpc**(*date_from*, *date_to*, *max_cloud_cover=100*, *result_number=50*, *name_filter=None*, *coordinate_list=None*, *progress_message=True*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*) → *OutputManager* (page 100)

Perform the query of MODIS temperature from Microsoft Planetary Computer.

This tool performs the query from Microsoft Planetary Computer https://planetarycomputer.microsoft.com.

Parameters

- **date_from** – date defining the starting period of the query
- **date_to**
- **max_cloud_cover**
- **result_number**
- **name_filter**
- **coordinate_list**
- **progress_message**
- **proxy_host**
- **proxy_port**
- **proxy_user**
- **proxy_password**

Returns
object OutputManger

remotior_sensus.tools.download_products.**query_landsat_mpc**(*date_from*, *date_to*, *max_cloud_cover=100*, *result_number=50*, *name_filter=None*, *coordinate_list=None*, *progress_message=True*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*) → *OutputManager* (page 100)

Perform the query of Landsat from Microsoft Planetary Computer.

This tool performs the query from Microsoft Planetary Computer https://planetarycomputer.microsoft.com.

Parameters

- **date_from** – date defining the starting period of the query
- **date_to**
- **max_cloud_cover**
- **result_number**
- **name_filter**
- **coordinate_list**
- **progress_message**
- **proxy_host**
- **proxy_port**
- **proxy_user**
- **proxy_password**

Returns
object OutputManger

remotior_sensus.tools.download_products.**query_modis_09q1_mpc**(*date_from*, *date_to*, *max_cloud_cover=100*, *result_number=50*, *name_filter=None*, *coordinate_list=None*, *progress_message=True*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*) → *OutputManager* (page 100)

Perform the query of MODIS from Microsoft Planetary Computer.

This tool performs the query from Microsoft Planetary Computer https://planetarycomputer.microsoft.com.

Parameters

- **date_from** – date defining the starting period of the query
- **date_to**
- **max_cloud_cover**

- **result_number**
- **name_filter**
- **coordinate_list**
- **progress_message**
- **proxy_host**
- **proxy_port**
- **proxy_user**
- **proxy_password**

Returns
object OutputManger

remotior_sensus.tools.download_products.**query_modis_11a2_mpc**(*date_from*, *date_to*, *max_cloud_cover=100*, *result_number=50*, *name_filter=None*, *coordinate_list=None*, *progress_message=True*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*) → *OutputManager* (page 100)

Perform the query of MODIS temperature from Microsoft Planetary Computer.

This tool performs the query from Microsoft Planetary Computer https://planetarycomputer.microsoft.com.

Parameters

- **date_from** – date defining the starting period of the query
- **date_to**
- **max_cloud_cover**
- **result_number**
- **name_filter**
- **coordinate_list**
- **progress_message**
- **proxy_host**
- **proxy_port**
- **proxy_user**
- **proxy_password**

Returns
object OutputManger

remotior_sensus.tools.download_products.**query_nasa_cmr**(*product*, *date_from*, *date_to*, *max_cloud_cover=100*, *result_number=50*, *name_filter=None*, *coordinate_list=None*, *progress_message=True*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*) → *OutputManager* (page 100)

Perform the query of NASA CMR.

This tool performs the query of NASA CMR Search https://cmr.earthdata.nasa.gov/search/site/search_api_docs.html.

Parameters

- **product**
- **date_from** – date defining the starting period of the query
- **date_to**
- **max_cloud_cover**
- **result_number**
- **name_filter**
- **coordinate_list**
- **progress_message**
- **proxy_host**
- **proxy_port**
- **proxy_user**
- **proxy_password**

Returns

object OutputManger

remotior_sensus.tools.download_products.**query_sentinel2_mpc**(*date_from*, *date_to*, *max_cloud_cover=100*, *result_number=50*, *name_filter=None*, *coordinate_list=None*, *progress_message=True*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*) → *OutputManager* (page 100)

Perform the query of Sentinel-2 from Microsoft Planetary Computer.

This tool performs the query from Microsoft Planetary Computer https://planetarycomputer.microsoft.com.

Parameters

- **date_from** – date defining the starting period of the query
- **date_to**
- **max_cloud_cover**
- **result_number**
- **name_filter**
- **coordinate_list**
- **progress_message**
- **proxy_host**
- **proxy_port**
- **proxy_user**

- **proxy_password**

Returns
object OutputManger

remotior_sensus.tools.download_products.**query_sentinel_2_database**(*date_from*, *date_to*, *max_cloud_cover=100*, *result_number=50*, *name_filter=None*, *coordinate_list=None*, *progress_message=True*, *copernicus_user=None*, *copernicus_password=None*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*) → *OutputManager* (page 100)

Perform the query of Sentinel-2 database.

This tool performs the query of Sentinel-2 database.

Query using Copernicus Data Space Ecosystem API https://documentation.dataspace.copernicus.eu/#/APIs/OData (from https://documentation.dataspace.copernicus.eu: 'Copernicus Data Space Ecosystem represents an overall and comprehensive data ecosystem accessible via web portal, applications and APIs. ... The Copernicus Data Space Ecosystem provides the essential data and service offering for everyone to use, for commercial and non-commercial purposes').

Sentinel-2 metadata are downloaded through the following Google service: https://storage.googleapis.com/gcp-public-data-sentinel-2 .

Parameters

- **date_from** – date defining the starting period of the query.
- **date_to**
- **max_cloud_cover**
- **result_number**
- **name_filter**
- **coordinate_list** – list [left, top, right, bottom] WGS84 coordinates.
- **progress_message** – progress message
- **copernicus_user**
- **copernicus_password**
- **proxy_host** – proxy host.
- **proxy_port** – proxy port.
- **proxy_user** – proxy user.
- **proxy_password** – proxy password.

Returns
object *OutputManager()* (page 100)

remotior_sensus.tools.download_products.**search**(*product*, *date_from*, *date_to*, *max_cloud_cover=100*, *result_number=50*, *name_filter=None*, *coordinate_list=None*, *progress_message=True*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*, *copernicus_user=None*, *copernicus_password=None*, *mpi_module=None*) → *OutputManager* (page 100)

Perform the query of image databases.

This tool performs the query of image products, currently Landsat, Sentinel-2, Harmonized Landsat Sentinel-2.

Sentinel-2 data can be searched from multiple sources.

Query using Copernicus Data Space Ecosystem API https://documentation.dataspace.copernicus.eu/#/APIs/OData (from https://documentation.dataspace.copernicus.eu: 'Copernicus Data Space Ecosystem represents an overall and comprehensive data ecosystem accessible via web portal, applications and APIs. ... The Copernicus Data Space Ecosystem provides the essential data and service offering for everyone to use, for commercial and non-commercial purposes').

Sentinel-2 metadata are downloaded through the following Google service: https://storage.googleapis.com/gcp-public-data-sentinel-2 .

Alternatively, query the collections from Microsoft Planetary Computer https://planetarycomputer.microsoft.com

Performs the query of Harmonized Landsat Sentinel-2 through NASA CMR Search https://cmr.earthdata.nasa.gov/search/site/search_api_docs.html.

Parameters

- **product** – product name from configurations.product_list
- **date_from** – date defining the starting period of the query.
- **date_to**
- **max_cloud_cover**
- **result_number**
- **name_filter**
- **coordinate_list** – list [left, top, right, bottom] WGS84 coordinates.
- **progress_message** – progress message
- **copernicus_user**
- **copernicus_password**
- **proxy_host** – proxy host.
- **proxy_port** – proxy port.
- **proxy_user** – proxy user.
- **proxy_password** – proxy password.
- **mpi_module** – optional mpi module, if True, only rank 0 is used.

Returns

object *OutputManager()* (page 100)

remotior_sensus.tools.mosaic module

Band mosaic.

This tool performs the mosaic of single bands, or multiple BandSets. Corresponding bands in two or more BandSet are merged into a single raster for each band, covering the extent of input bands. For instance, this is useful to mosaic several multiband images togheter, obtaining a multispectral mosaic of bands (e.g., the first band of the mosaic corresponds to all the first bands of input images).

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> file_list = ['file1_b1.tif', 'file2_b1.tif']
>>> mosaic_bands = rs.mosaic(input_bands=file_list,output_path='output_directory')
```

remotior_sensus.tools.mosaic.**mosaic**(*input_bands: list | int | BandSet (page 63), output_path: None | str = None, overwrite: bool | None = False, prefix: str | None = '', nodata_value: None | int = None, n_processes: None | int = None, available_ram: None | int = None, virtual_output: bool | None = False, output_name: None | str = None, reference_raster_crs: None | str = None, bandset_catalog: BandSetCatalog (page 74) | None = None, progress_message: bool | None = True*) → *OutputManager* (page 100)

Mosaic bands.

This tool performs the mosaic of corresponding bands from multiple BandSets. A new raster is created for each band, named as output_name or first band name, and followed by band number.

Parameters

- **input_bands** – list of paths of input rasters, or number of BandSet, or BandSet object.
- **output_path** – string of output path directory.
- **overwrite** – if True, output overwrites existing files.
- **prefix** – optional string for output name prefix.
- **nodata_value** – value to be considered as nodata.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **virtual_output** – if True (and output_path is directory), save output as virtual raster of multiprocess parts.
- **output_name** – string used as general name for all output bands.
- **reference_raster_crs** – path to a raster to be used as crs reference; if None, the first band is used as reference.
- **bandset_catalog** – optional type BandSetCatalog for BandSet number.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- paths = output list

Examples

Perform the mosaic of three BandSets

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> catalog = rs.bandset_catalog()
>>> # create three BandSets
>>> file_list_1 = ['file1_b1.tif', 'file1_b2.tif', 'file1_b3.tif']
>>> file_list_2 = ['file2_b1.tif', 'file2_b2.tif', 'file2_b3.tif']
>>> file_list_3 = ['file3_b1.tif', 'file3_b2.tif', 'file3_b3.tif']
>>> catalog.create_bandset(file_list_1, bandset_number=1)
>>> catalog.create_bandset(file_list_2, bandset_number=2)
>>> catalog.create_bandset(file_list_3, bandset_number=3)
>>> # start the process
>>> mosaic_bands = rs.mosaic(input_bands=[1, 2, 3],
... output_path='output_directory', bandset_catalog=catalog)
```

remotior_sensus.tools.preprocess_products module

Perform the preprocessing of products.

remotior_sensus.tools.preprocess_products.**create_product_table**(*input_path*, *metadata_file_path=None*, *product=None*, *nodata_value=None*, *sensor=None*, *acquisition_date=None*)

remotior_sensus.tools.preprocess_products.**perform_preprocess**(*product_table*, *output_path*, *dos1_correction=False*, *add_bandset=None*, *output_prefix=''*, *n_processes: int | None = None*, *available_ram: int | None = None*, *bandset_catalog:* BandSetCatalog *(page 74)* *| None = None*, *progress_message=True*) → *OutputManager* (page 100)

Preprocess products.

Perform preprocessing based on product table.

Parameters

- **product_table** – product table object.
- **output_path** – string of output path directory.
- **dos1_correction** – if True, perform DOS1 correction.
- **add_bandset** – if True, create a new bandset and add output bands to it; if False, add output bands to current bandset; if None, output bands are no added to any bandset.
- **output_prefix** – optional string for output name prefix.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.

- **bandset_catalog** – BandSetCatalog object.
- **progress_message** – progress message.

Returns

Object *OutputManager()* (page 100) with

- paths = output list

remotior_sensus.tools.preprocess_products.**preprocess**(*input_path*, *output_path*, *metadata_file_path=None*, *add_bandset=None*, *product=None*, *nodata_value=None*, *sensor=None*, *acquisition_date=None*, *dos1_correction=False*, *output_prefix=''*, *n_processes: int | None = None*, *bandset_catalog:* BandSetCatalog *(page 74) | None = None*, *available_ram: int | None = None*, *progress_message=True*) → *OutputManager* (page 100)

Create table and preprocess products.

Perform image conversion to reflectance of several products.

Can calculate DOS1 corrected reflectance (Sobrino, J. et al., 2004. Land surface temperature retrieval from LANDSAT TM 5. Remote Sensing of Environment, Elsevier, 90, 434-440) approximating path radiance to path reflectance for level 1 data:

TOA reflectance = DN * reflectance_scale + reflectance_offset

path reflectance p = DNm - Dark Object reflectance = DNm * reflectance_scale + reflectance_offset - 0.01

land surface reflectance = TOA reflectance - p = (DN * reflectance_scale) - (DNm * reflectance_scale - 0.01)

Landsat's data Collection 1 and 2 Level 1T Landsat 8-9 TOA reflectance proportional to exo-atmospheric solar irradiance in each band and the Earth-Sun distance (USGS, 2021. Landsat 8-9 Calibration and Validation (Cal/Val) Algorithm Description Document (ADD). Version 4.0. Department of the Interior U.S. Geological Survey, South Dakota)

TOA reflectance with correction for the sun angle = DN * Reflectance multiplicative scaling factor + Reflectance additive scaling factor / sin(Sun elevation)

Level 2S

Surface reflectance = DN * Reflectance multiplicative scaling factor + Reflectance additive scaling factor

Sentinel-2 data Level 1C

TOA reflectance = DN / QUANTIFICATION VALUE + OFFSET

Level 2S

Surface reflectance = DN / QUANTIFICATION VALUE + OFFSET

Parameters

- **input_path** – path containing the raster bands.
- **output_path** – string of output path directory.
- **metadata_file_path** – optional metadata file path.
- **dos1_correction** – if True, perform DOS1 correction.

- **add_bandset** – if True, create a new bandset and add output bands to it; if False, add output bands to current bandset; if None, output bands are no added to any bandset.
- **product** – product name.
- **nodata_value** – nodata value.
- **sensor** – sensor name.
- **acquisition_date** – acquisition date.
- **output_prefix** – optional string for output name prefix.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **bandset_catalog** – BandSetCatalog object.
- **progress_message** – progress message.

Returns

Object *OutputManager()* (page 100) with

- paths = output list

remotior_sensus.tools.raster_edit module

Raster edit.

This tool allows for the direct editing of a raster band. Warning, this tool edits the original input raster.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> edit = rs.raster_edit(raster_path='input_path',
... vector_path='vector_path')
```

remotior_sensus.tools.raster_edit.**check_expression**(*expression*, *constant_value*)

remotior_sensus.tools.raster_edit.**raster_edit**(*raster_path: str*, *vector_path: None | str = None*, *field_name: None | str = None*, *expression: None | str = None*, *constant_value: None | int | float = None*, *old_array: ndarray | None = None*, *column_start: None | int = None*, *row_start: None | int = None*, *available_ram: None | int = None*, *progress_message: bool | None = True*) → *OutputManager* (page 100)

Edit a raster band based on a vector file.

This tool allows for editing the values of a raster using a vector file. All pixel intersecting the vector will be edited with a new value. New pixel values can be a constant value or defined by a custom expression defining a condition. The input raster is directly edited, without producing a new file.

Parameters

- **raster_path** – path of raster used as input.
- **vector_path** – string of vector path (optional for undo operation).
- **field_name** – string of vector field name.

- **expression** – optional conditional expression; pixels are edited if intersecting the vector and the expression is True; the variable "raster" is used to refer to the raster pixel values; e.g. where("raster" > 500, 10, "raster").
- **constant_value** – optional new value for pixels.
- **old_array** – optional previous array for undo operation.
- **column_start** – optional starting column for undo operation.
- **row_start** – optional starting row for undo operation.
- **available_ram** – number of megabytes of RAM available to processes.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

object *OutputManager()* (page 100) with

- extra = {'old_array': previous array for undo operation, 'column_start': starting column for undo operation, 'row_start': starting row for undo operation}

Examples

Perform the edit of a raster

```
>>> edit_1 = raster_edit(raster_path='input_path',
... vector_path='output_path')
```

Perform the undo of edit of a raster

```
>>> edit_2 = raster_edit(raster_path='input_path',
... column_start=edit_1.extra['column_start'],
... row_start=edit_1.extra['row_start'],
... old_array=edit_1.extra['old_array']
... )
```

Perform the edit of a raster with condition

```
>>> edit_3 = raster_edit(raster_path='input_path',
... vector_path='output_path',
... expression='where("raster" > 500, 10, "raster")'
... )
```

remotior_sensus.tools.raster_label module

Raster label.

This tool allows for the label of raster pixels based on contiguous patches. Any value not equal to 0 is considered as input, while 0 is considered as background. Contiguous pixels having different values (not equal to 0) are considered as a patch. The 4 pixel connection is considered for retrieving patches. The output is a raster where each pixel value represents the pixel count of the patch thereof.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
```

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```
>>> label = rs.raster_label(raster_path='file1.tif',
... output_path='output.tif')
```

remotior_sensus.tools.raster_label.**raster_label**(*raster_path: str*, *output_path: None | str = None*, *overwrite: bool | None = False*, *extent_list: list | None = None*, *n_processes: None | int = None*, *available_ram: None | int = None*, *virtual_output: bool | None = None*, *progress_message: bool | None = True*) → *OutputManager* (page 100)

Performs raster label.

This tool allows for the label of raster pixels based on contiguous patches. Please note that the argument n_processes is currently ignored, and only 1 process is used for performance reasons.

Parameters

- **raster_path** – path of raster used as input.
- **output_path** – string of output path.
- **overwrite** – if True, output overwrites existing files.
- **extent_list** – list of boundary coordinates left top right bottom.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **virtual_output** – if True (and output_path is directory), save output as virtual raster of multiprocess parts.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- path = output path

Examples

Perform the raster label

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> label = rs.raster_label(raster_path='file1.tif',output_path='output.
↪tif')
```

remotior_sensus.tools.raster_reclassification module

Raster reclassification.

This tool allows for the reclassification of a raster based on a reclassification table.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
```

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```
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> reclassification = rs.raster_reclassification(raster_path='file1.tif',
... output_path='output.tif',
... reclassification_table=[[1, -10], ['nan', 6000]])
```

remotior_sensus.tools.raster_reclassification.**raster_reclassification**(*raster_path: str*, *output_path: None | str = None*, *overwrite: bool | None = False*, *reclassification_table: list | array | None = None*, *csv_path: None | str = None*, *separator: str | None = ','*, *output_data_type: None | str = None*, *extent_list: list | None = None*, *n_processes: None | int = None*, *available_ram: None | int = None*, *virtual_output: bool | None = None*, *progress_message: bool | None = True*) → *OutputManager* (page 100)

Performs raster reclassification.

This tool reclassifies a raster based on a reclassification table. The reclassification table is defined by two columns: old values and new values. Old values define the values of the raster to be reclassified to new values. Old values can be integer numbers or conditions selecting ranges of values.

Parameters

- **raster_path** – path of raster used as input.
- **output_path** – string of output path.
- **overwrite** – if True, output overwrites existing files.
- **reclassification_table** – table of values for reclassification or list of values [[old_value, new_value], . . .]; if None, csv_path is used.
- **csv_path** – path to a csv file containing the reclassification table; used if reclassification_table is None.
- **separator** – separator character for csv file; default is comma separated.
- **output_data_type** – set output data type such as 'Float32' or 'Int32'; if None, input data type is used.
- **extent_list** – list of boundary coordinates left top right bottom.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.

- **virtual_output** – if True (and output_path is directory), save output as virtual raster of multiprocess parts.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

Object *OutputManager()* (page 100) with

- path = output path

Examples

Perform the reclassification using a csv file containing the reclassification values

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> reclassification = rs.raster_reclassification(raster_path='file1.tif
↪',output_path='output.tif',csv_path='file.csv')
```

remotior_sensus.tools.raster_reclassification.**unique_values_table**(*raster_path: str*, *n_processes: None | int = None*, *available_ram: None | int = None*, *incremental: bool | None = False*, *progress_message: bool | None = True*)

Calculate unique values from raster.

remotior_sensus.tools.raster_report module

Raster report.

This tool allows for the calculation of a report providing information extracted from a raster.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> report = rs.raster_report(raster_path='file.tif',output_path='report.csv')
```

remotior_sensus.tools.raster_report.**raster_report**(*raster_path: str*, *output_path: None | str = None*, *nodata_value: None | int = None*, *extent_list: list | None = None*, *n_processes: None | int = None*, *available_ram: None | int = None*, *progress_message: bool | None = True*) → *OutputManager* (page 100)

Calculation of a report providing information extracted from a raster.

This tool allows for the calculation of a report providing information such as pixel count, area per class and percentage of the total area. The output is a csv file. This tool is intended for integer rasters.

Parameters

- **raster_path** – path of raster used as input.
- **output_path** – string of output path.
- **nodata_value** – value to be considered as nodata.
- **extent_list** – list of boundary coordinates left top right bottom.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

object *OutputManager()* (page 100) with

- path = output path

Examples

Perform the report of a raster

```
>>> raster_report(raster_path='file.tif',output_path='report.csv')
```

remotior_sensus.tools.raster_split module

Raster split.

This tool allows for splitting a raster to single bands.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> split = rs.raster_split(raster_path='input_path',
... output_path='output_path')
```

remotior_sensus.tools.raster_split.**raster_split**(*raster_path: str*, *output_path: str | None = None*, *prefix: None | str = None*, *extent_list: list | None = None*, *n_processes: None | int = None*, *virtual_output: bool | None = None*, *progress_message: bool | None = True*) → *OutputManager* (page 100)

Split a multiband raster to single bands.

This tool allows for splitting a multiband raster to single bands.

Parameters

- **raster_path** – path of raster used as input.
- **output_path** – string of output directory path.
- **prefix** – optional string for output name prefix.
- **extent_list** – list of boundary coordinates left top right bottom.
- **n_processes** – number of parallel processes.
- **virtual_output** – if True (and output_path is directory), save output as virtual raster.

- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

object *OutputManager()* (page 100) with

- path = output path

Examples

Perform the split of a raster

```
>>> split = raster_split(raster_path='input_path',
... output_path='output_path')
```

remotior_sensus.tools.raster_to_vector module

Raster to vector.

This tool allows for the conversion from raster to vector. A new geopackage is created from the raster conversion.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> vector = rs.raster_to_vector(raster_path='file.tif',output_path='vector.gpkg')
```

remotior_sensus.tools.raster_to_vector.**raster_to_vector**(*raster_path*, *output_path: None | str = None*, *dissolve: bool | None = None*, *field_name: None | str = None*, *extent_list: list | None = None*, *n_processes: None | int = None*, *available_ram: None | int = None*, *progress_message: bool | None = True*) → *OutputManager* (page 100)

Performs the conversion from raster to vector.

This tool performs the conversion from raster to vector. Parallel processes are used for the conversion, resulting in a vector output which is split as many in portions as the process numbers. The argument dissolve allows for merging these portions, but it requires additional processing time depending on vector size.

Parameters

- **raster_path** – path of raster used as input.
- **output_path** – string of output path.
- **dissolve** – if True, dissolve adjacent polygons having the same values; if False, polygons are not dissolved and the process is rapider.
- **field_name** – name of the output vector field to store raster values (default = DN).
- **extent_list** – list of boundary coordinates left top right bottom.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

object *OutputManager()* (page 100) with

- path = output path

Examples

Perform the conversion to vector of a raster

```
>>> raster_to_vector(raster_path='file.tif',output_path='vector.gpkg')
```

remotior_sensus.tools.raster_zonal_stats module

Raster zonal stats.

This tool allows for calculating statistics of a raster intersecting a vector.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> statistics = rs.raster_zonal_stats(
... raster_path='input_path', reference_path='input_vector_path',
... vector_field='field_name', output_path='output_path',
... stat_names=['Sum', 'Mean'])
```

remotior_sensus.tools.raster_zonal_stats.**raster_zonal_stats**(*raster_path: str*, *reference_path: str*, *vector_field: str | None = None*, *output_path: str | None = None*, *stat_names: str | list | None = None*, *stat_percentile: int | str | list | None = None*, *extent_list: list | None = None*, *n_processes: None | int = None*, *available_ram: None | int = None*, *progress_message: bool | None = True*) → *OutputManager* (page 100)

Raster zonal stats based on a polygon vector field.

This tool allows for calculating statistics of a raster intersecting a vector. For each unique value in the vector field, one ore more statistics can be calculated based on raster pixel values intersecting the vector polygons. The output is a csv file and a numpy records table including the statistics for each unique value in the vector field. Available functions are:

- Count
- Max
- Mean
- Median
- Min
- Percentile
- StandardDeviation

- Sum

Parameters

- **raster_path** – path of raster used as input.
- **reference_path** – path of the vector or raster file used as reference input.
- **vector_field** – the name of the vector field used as reference value.
- **stat_names** – statistic name as in configurations.statistics_list.
- **stat_percentile** – integer value for percentile parameter.
- **output_path** – string of output directory path.
- **extent_list** – list of boundary coordinates left top right bottom.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

object *OutputManager()* (page 100) with

- path = output csv path
- extra = {'table': table as numpy records}

Examples

Perform the calculation

```
>>> stats = raster_zonal_stats(
... raster_path='input_path', reference_path='input_vector_path',
... vector_field='field_name',output_path='output_path',
... stat_names=['Percentile', 'Max', 'Min'],stat_percentile=[1, 99]
... )
```

remotior_sensus.tools.vector_to_raster module

Vector to raster.

This tool allows for the conversion from vector polygons to raster.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # start the process
>>> vector = rs.vector_to_raster(vector_path='file.gpkg',
...     align_raster='reference.tif', output_path='raster.tif')
```

remotior_sensus.tools.vector_to_raster.**vector_to_raster**(*vector_path: str*, *align_raster: str | BandSet (page 63) | int*, *vector_field: None | str = None*, *constant: None | int = None*, *pixel_size: None | int | float = None*, *output_path: None | str = None*, *method: None | str = None*, *area_precision: int | None = 3*, *resampling='mode'*, *nodata_value: None | int = None*, *output_data_type: str | None = 'Int32'*, *minimum_extent: bool | None = True*, *extent_list: list | None = None*, *output_format='GTiff'*, *compress=None*, *compress_format=None*, *n_processes: None | int = None*, *available_ram: None | int = None*, *bandset_catalog: BandSetCatalog (page 74) | None = None*, *progress_message: bool | None = True*) → *OutputManager* (page 100)

Performs the conversion from vector to raster.

This tool performs the conversion from vector polygons to raster.

Parameters

- **vector_path** – path of vector used as input.
- **align_raster** – optional string path of raster used for aligning output pixels and projections; it can also be a BandSet or an integer number of a BandSet in a Catalog.
- **output_path** – string of output path.
- **vector_field** – the name of the field used as reference value.
- **constant** – integer value used as reference for all the polygons.
- **pixel_size** – size of pixel of output raster.
- **minimum_extent** – if True, raster has the minimum vector extent; if False, the extent is the same as the align raster.
- **extent_list** – list of boundary coordinates left top right bottom.
- **output_format** – output format, default GTiff
- **method** – method of conversion, default pixel_center, other methods are all_touched for burning all pixels touched or area_based for burning values based on area proportion inside the pixel (warning: using area_based method, a pixel covered by multiple polygons each covering less than 50% of the area may be incorrectly assigned).
- **area_precision** – for area_based method, the higher the value, the more is the precision in area proportion calculation.
- **resampling** – type for resampling when method is area_based.
- **compress** – if True, compress the output raster.
- **compress_format** – compress format.
- **nodata_value** – value to be considered as nodata.
- **output_data_type** – optional raster output data type, such as Int32, UInt32, Int16, UInt16, or Byte.
- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes.

- **bandset_catalog** – BandSetCatalog object.
- **progress_message** – if True then start progress message, if False does not start the progress message (useful if launched from other tools).

Returns

object *OutputManager()* (page 100) with

- path = output path

Examples

Perform the conversion to raster of a vector using area_based method

```
>>> vector_to_raster(vector_path='file.gpkg', align_raster='reference.tif
↪', method='area_based', output_path='raster.tif')
```

Module contents

1.7 Core Modules

The following are the core modules.

1.7.1 remotior_sensus.core package

Submodules

remotior_sensus.core.bandset_catalog module

class remotior_sensus.core.bandset_catalog.**BandSet**(*bandset_uid*, *bands_list=None*, *name=None*, *date=None*, *root_directory=None*, *crs=None*, *box_coordinate_list=None*, *catalog=None*)

Bases: `object`

Manages band sets.

This module allows for managing bands in a BandSet.

bands

BandSet of band tables.

get

alias for get_band function.

Examples

Create a BandSet

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> file_list = ['file_1.tif', 'file_2.tif', 'file_3.tif']
>>> bandset = rs.bandset.create(file_list)
```

Get the first band

```
>>> band_1 = bandset.get_band(1)
```

__init__(*bandset_uid*, *bands_list=None*, *name=None*, *date=None*, *root_directory=None*, *crs=None*, *box_coordinate_list=None*, *catalog=None*)

Initializes a BandSet.

Initializes a BandSet defining a unique ID. One should use the create method for creating new BandSets.

Parameters

- **bandset_uid** – unique BandSet ID.
- **bands_list** – list of band tables.
- **name** – optional BandSet name.
- **date** – optional BandSet date.
- **root_directory** – optional BandSet root directory for relative path.
- **crs** – BandSet coordinate reference system.
- **box_coordinate_list** – list of coordinates [left, top, right, bottom] to create a virtual subset.
- **catalog** – BandSet Catalog

Examples

Initialize a BandSet

```
>>> BandSet.create(name=name,box_coordinate_list=box_coordinate_list)
```

add_new_band(*path: str*, *band_number: int | None = None*, *raster_band=None*, *band_name=None*, *date=None*, *root_directory=None*, *multiplicative_factor=None*, *additive_factor=None*, *wavelength=None*, *unit=None*)

Adds new band to a BandSet.

Adds a new band to a BandSet with the option to set the band number for the position in the BandSet order.

Parameters

- **path** – file path.
- **band_number** – sets the position of the band in BandSet order.
- **raster_band** – number of band for multiband rasters.
- **band_name** – name of raster used for band.
- **date** – single date (as YYYY-MM-DD).
- **multiplicative_factor** – multiplicative factor.
- **additive_factor** – additive factor.
- **wavelength** – center wavelength.
- **unit** – wavelength unit.
- **root_directory** – root directory for relative path.

Examples

Add a new band

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = BandSet()
>>> bandset.add_new_band(
... path=path, band_number=band_number, raster_band=raster_band,
... band_name=band_name, date=date, root_directory=root_directory,
... multiplicative_factor=multiplicative_factor,
... additive_factor=additive_factor, wavelength=wavelength, unit=unit
... )
```

property box_coordinate_list

Optional BandSet box coordinate list for virtual subset.

Type
list

calc(**args*, ***kwargs*)

Executes a calculation.

Executes a calculation directly from the BandSet, passing the argument input_bands. The arguments are related to the function. Bands in the BandSet can be reffered in the expressions such as "b1" or "b2"; also band alias such as "#RED#" and expression alias such as #NDVI# can be used.

Parameters
kwargs – See *band_calc()* (page 8).

Returns
The output of the function.

Examples

Given that a session was previously started

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = rs.bandset.create(
...     ['file1.tif', 'file2.tif'], wavelengths=['Sentinel-2'],
... )
```

Calculation of sum of the first two bands and saving the output in temporary directory

```
>>> output_object = bandset.calc('"b1" + "b2"')
```

Calculation of NDVI

```
>>> output_object = bandset.calc(output_path='output.tif',
...     expression_string='("#NIR#" - "#RED#") / ("#NIR#" + "#RED#")'
... )
```

classification(**args*, ***kwargs*)

Executes a classification.

Executes a classification directly from the BandSet, passing the argument input_bands. The arguments are related to the function.

Parameters
kwargs – See *band_classification()* (page 11).

Returns
The output of the function.

combination(**args*, ***kwargs*)

Band combination.

Combines classifications directly from the BandSet, in order to get a raster where each value corresponds to a combination of class values. The arguments are related to the function.

Parameters
kwargs – See *band_combination()* (page 26).

Returns
The output of the function.

Examples

Given that a session was previously started

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = rs.bandset.create(['file1.tif', 'file2.tif'])
```

Combination using two rasters having paths path_1 and path_2

```
>>> combination = bandset.combination(output_path='output_path')
```

classmethod create(*paths: str | list | None = None*, *band_names: list | None = None*, *wavelengths: list | None = None*, *unit: None | str = None*, *multiplicative_factors: list | None = None*, *additive_factors: list | None = None*, *dates: list | None = None*, *root_directory: None | str = None*, *box_coordinate_list: list | None = None*, *name: None | str = None*, *catalog=None*)

Creates a BandSet.

This method creates a BandSet defined by input files. Raster properties are derived from files to populate the table of bands.

Parameters

- **catalog** – BandSet Catalog object.
- **name** – BandSet name.
- **paths** – list of file paths or a string of directory path; also, a list of directory path and name filter is accepted.
- **band_names** – list of raster names used for identifying the bands, if None then the names are automatically extracted from file names.
- **wavelengths** – list of center wavelengths of bands or string of sensor names (also partial).
- **unit** – wavelength unit.
- **multiplicative_factors** – multiplicative factors for bands during calculations.
- **additive_factors** – additive factors for bands during calculations.
- **dates** – list of date strings, or single date string (format YYYY-MM-DD) or string defined in configurations date_auto to detect date from directory name.
- **root_directory** – root directory for relative path.
- **box_coordinate_list** – list of coordinates [left, top, right, bottom] to create a virtual subset.

Returns
returns BandSet.

Examples

Given that a session was previously started

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # set lists of files, names and center wavelength
>>> file = ['file_1.tif', 'file_2.tif', 'file_3.tif']
>>> names = ['name_1', 'name_2', 'name_3']
>>> wavelength = [0.6, 0.7, 0.8]
>>> # create a BandSet
>>> bandset = rs.bandset.create(file,band_names=names,
↪wavelengths=wavelength)
```

Passing a directory with file name filter and the wavelenght from satellite name.

```
>>> bandset = rs.bandset.create(['directory_path', 'tif'],␣
↪wavelengths='Sentinel-2')
```

property crs

crs.

Type
str

property date

Optional date.

dilation(**args*, ***kwargs*)

Band dilation.

Band dilation directly from the BandSet, passing the argument input_bands. The arguments are related to the function.

Parameters
kwargs – See *band_dilation()* (page 28).

Returns
The output of the function.

Examples

Given that a session was previously started

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = rs.bandset.create(['file1.tif', 'file2.tif'])
```

Dilation

```
>>> dilation = bandset.dilation(output_path='directory_path',
...     value_list=[1, 2], size=5)
```

erosion(**args*, ***kwargs*)

Band erosion.

Band erosion directly from the BandSet, passing the argument input_bands. The arguments are related to the function.

Parameters

kwargs – See *band_erosion()* (page 29).

Returns

The output of the function.

Examples

Given that a session was previously started

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = rs.bandset.create(['file1.tif', 'file2.tif'])
```

Erosion

```
>>> erosion = bandset.erosion(output_path='directory_path',
...     value_list=[1, 2], size=1)
```

execute(*function*, **args*, ***kwargs*)

Executes a function.

Executes a functions directly from the BandSet, passing the argument input_bands. The arguments are related to the function.

Parameters

function – the function to be executed.

Returns

The output of the function.

Examples

Given that a session was previously started

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = rs.bandset.create(
...     ['file1.tif', 'file2.tif'], wavelengths=['Sentinel-2'],
... )
```

Calculation of sum of the first two bands

```
>>> output_object = bandset.execute(
...     rs.band_calc, output_path='output.tif', expression_string='
↪"b1" + "b2"'
... )
```

Calculation of NDVI

```
>>> output_object = bandset.execute(
...     rs.band_calc, output_path='output.tif',
...     expression_string='("#NIR#" - "#RED#") / ("#NIR#" + "#RED#")'
... )
```

Calculation of band combination

```
>>> output_object = bandset.execute(rs.band_combination, output_path=
↪'output.tif')
```

export_as_xml(*output_path=None*)

Exports a BandSet as xml.

Exports a BandSet bands and attributes.

Examples

Export a BandSet.

```
>>> bandset = BandSet()
>>> # reset
>>> bandset.export_as_xml()
```

find_values_in_list(*attribute*, *value_list*, *output_attribute=None*) → list

Adds new band to a BandSet.

Finds BandSet values in a list and return a band attribute or band numbers.

Parameters

- **attribute** – attribute name for identification.
- **value_list** – attribute value list for indentification.
- **output_attribute** – attribute name of desired output; if None returns the band number.

Returns

returns list of band attributes.

Examples

Find values from wavelength attribute

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = BandSet()
>>> bandset_values = bandset.find_values_in_list(
... attribute='wavelength', value_list=[0.6, 0.7],
... output_attribute='path'
... )
```

static generate_uid() → str

Generates unique ID for BandSet

Returns

returns table of bands.

get_absolute_path(*band_number*) → str

Gets the absolute path of band.

get_absolute_paths() → list

Gets the list of absolute paths.

get_band(*number=None*) → array

Gets a band.

Gets a band by number.

Parameters
number – band number.

Returns
the band table; if number is None returns all the bands; returns None if band number is not found.

Examples

Get bands by number

```
>>> bandset = BandSet()
>>> # get first band
>>> band = bandset.get_band(1)
>>> # band x size
>>> band_x_size = band.x_size
>>> # get band nodata directly
>>> band_nodata = bandset.get_band(1).nodata
```

get_band_alias() → list

Gets bands alias (with band number) used in band_calc

Returns
the list of band aliases.

get_band_attributes(*attribute: str | None = None*) → list

Gets band attributes.

Gets an attribute of bands.

Parameters
attribute – attribute name.

Returns
returns list of attributes; if attribute is None returns the bands; if attribute is not found returns None.

Examples

Get band names

```
>>> bandset = BandSet()
>>> names = bandset.get_band_attributes('name')
```

get_band_by_wavelength(*wavelength: float*, *threshold: float | None = None*, *output_as_number=False*) → array

Gets band by wavelength.

Gets band by nearest wavelength.

Parameters

- **wavelength** – value of wavelength.
- **threshold** – threshold for wavelength identification, identifying bands within wavelength +- threshold; if None, the nearest value is returned.
- **output_as_number** – if True returns the number of the band, if False returns the band table.

Returns
returns band table.

Examples

Get band by wavelength

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = BandSet()
>>> # get band by nearest wavelength
>>> band_x = bandset.get_band_by_wavelength(
>>> wavelength=0.7, threshold=0.1
    )
```

get_band_count() → int

Gets the count of bands.

get_bands_by_attributes(*attribute: str*, *attribute_value*, *output_as_number=False*) → array

Gets bands by attribute.

Gets bands identified by an attribute value (identified bands have the attribute value equal to the attribute_value).

Parameters

- **attribute** – attribute name.
- **attribute_value** – attribute value.
- **output_as_number** – if True returns the number of the band, if False returns the band table.

Returns
if output_number is True, returns list of band number; if output_number is False, returns bands identified by attribute; returns None if no band has the attribute value.

Examples

Get bands by attributes

```
>>> bandset = BandSet()
>>> band_x = bandset.get_bands_by_attributes('wavelength',0.8)
```

get_path(*band_number*) → str | None

Gets the absolute path of band.

get_paths() → list

Gets the list of bands.

get_raster_band_list() → list

Gets the list of raster bands.

get_wavelength_units() → list

Gets the list of wavelength units.

get_wavelengths() → list

Gets the list of center wavelength.

import_as_xml(*xml_path*)

Imports a BandSet as xml.

Imports a BandSet bands and attributes.

Examples

Import a BandSet

```
>>> bandset = BandSet()
>>> # reset
>>> bandset.import_as_xml('xml_path')
```

property name

Optional BandSet name.

Type
str

neighbor_pixels(**args*, ***kwargs*)

Band neighbor pixels.

Band neighbor pixels directly from the BandSet, passing the argument input_bands. The arguments are related to the function.

Parameters
kwargs – See *band_neighbor_pixels()* (page 31).

Returns
The output of the function.

Examples

Given that a session was previously started

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = rs.bandset.create(['file1.tif', 'file2.tif'])
```

Neighbor pixels

```
>>> neighbor = bandset.neighbor_pixels(output_path='directory_path',
... size=10, circular_structure=True, stat_name='Sum')
```

pca(**args*, ***kwargs*)

Band PCA.

Band PCA directly from the BandSet, passing the argument input_bands. The arguments are related to the function.

Parameters
kwargs – See *band_pca()* (page 33).

Returns
The output of the function.

Examples

Given that a session was previously started

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = rs.bandset.create(['file1.tif', 'file2.tif'])
```

PCA

```
>>> pca = bandset.pca(output_path='directory_path')
```

print()

Prints a BandSet.

Prints a BandSet bands and attributes.

Examples

Print a BandSet.

```
>>> bandset = BandSet()
>>> # reset
>>> bandset.print()
```

reset()

Resets a BandSet.

Resets a BandSet destroyng bands and attributes.

Examples

Reset a BandSet

```
>>> bandset = BandSet()
>>> # reset
>>> bandset.reset()
```

property root_directory

Optional BandSet root directory for relative path.

Type
str

sieve(**args*, ***kwargs*)

Band sieve.

Band sieve directly from the BandSet, passing the argument input_bands. The arguments are related to the function.

Parameters
kwargs – See *band_sieve()* (page 37).

Returns
The output of the function.

Examples

Given that a session was previously started

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = rs.bandset.create(['file1.tif', 'file2.tif'])
```

Sieve

```
>>> sieve = bandset.sieve(output_path='directory_path', size=3)
```

sort_bands_by_name(*keep_wavelength_order=True*)

Sorts band order by name

sort_bands_by_wavelength()

Sorts band order by wavelength

spectral_range_bands(*output_as_number=True*) → list

Gets bands from spectral range.

Gets bands from spectral range blue, green, red, nir, swir_1, swir_2.

Parameters
output_as_number – if True returns the number of the band, if False returns the band table.

Returns
returns list of bands.

Examples

Gets bands from spectral range

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> bandset = BandSet()
>>> # spectral range bands
>>> (blue_band, green_band, red_band, nir_band, swir_1_band,
... swir_2_band) = bandset.spectral_range_bands(
... output_as_number=False)
```

property uid

Unique BandSet ID.

Type
str

class remotior_sensus.core.bandset_catalog.**BandSetCatalog**

Bases: object

Manages BandSets.

This class manages BandSets through a catalog, defining attributes and properties of BandSets.

bandsets
dictionary of the actual BandSets

bandsets_table
table of BandSets containing the properties thereof

get
alias for get_bandset

Examples

Create a BandSet Catalog

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> catalog = rs.bandset_catalog()
```

__init__()
Initializes the catalog with an empty BandSet

add_band_to_bandset(*path: str*, *bandset_number: None | int = None*, *band_number: None | int = None*, *raster_band: None | int = None*, *band_name: None | str = None*, *date: None | str = None*, *unit: None | str = None*, *root_directory: None | str = None*, *multiplicative_factor: None | int = None*, *additive_factor: None | int = None*, *wavelength: None | float = None*)
Adds a new band to BandSet.

This function creates a new band and adds it to a BandSet.

Parameters

- **path** – file path.
- **band_name** – raster name used for identifying the bands.
- **wavelength** – center wavelengths of band.
- **unit** – wavelength unit as string
- **multiplicative_factor** – multiplicative factor for bands during calculations.
- **additive_factor** – additive factors for band during calculations.
- **date** – date string (format YYYY-MM-DD).
- **bandset_number** – number of the BandSet; if None, the band is added to the current BandSet.
- **root_directory** – root directory for relative path.
- **raster_band** – raster band number.
- **band_number** – number of band in BandSet.

Examples

Add a band to BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> catalog.add_band_to_bandset(
    path='file1.tif', bandset_number=1, band_number=1, raster_band=1
... )
```

add_bandset(*bandset: BandSet (page 63), bandset_number: None | int = None, insert=False, keep_uid=False*)

Adds a BandSet to Catalog.

This function adds a previously created BandSet to BandSet Catalog.

Parameters

- **bandset** – the BandSet to be added.
- **bandset_number** – number of BandSet; if None, current BandSet is used.
- **insert** – if True insert the BandSet at bandset_number (other BandSets are moved), if False replace the BandSet number.
- **keep_uid** – if True, keeps uid from the original bandset to the added one.

Examples

Insert a BandSet as BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> catalog.add_bandset(bandset_number=1, insert=True
... )
```

build_bandset_band_overview(*bandset_number: int | None = None*) → bool

Build bandset band overviews.

Build bandset band overviews as external files to faster the visualization.

Parameters
bandset_number – number of BandSet; if None, current BandSet is used.

Returns
True if successfull.

Examples

Build BandSet 1 overview.

```
>>> catalog = BandSetCatalog()
>>> catalog.build_bandset_band_overview(1)
```

calculate_scatter_plot_histogram(*bandset_number: int, band_x: int, band_y: int, vector_path: str*) → bool

Calculate scatter plot histogram.

Calculate scatter plot histogram from two bands and a vector, useful for scatter plot display.

Parameters

- **bandset_number** – number of BandSet; if None, current BandSet is used.
- **band_x** – number of band x.
- **band_y** – number of band y.
- **vector_path** – path to the vector used for histogram calculation.

Returns
NumPy histogram.

Examples

Caculate BandSet 1 scatter plot.

```
>>> catalog = BandSetCatalog()
>>> catalog.calculate_scatter_plot_histogram(
... bandset_number= 1, band_x=1, band_y=1,  vector_path='path')
```

`clear_bandset`(*bandset_number=None*)

Function to clear a BandSet.

`create_band_string_list`(*bandset_number: int | None = None*) → list

Creates band string list.

Creates band string list such as "bandset1b1" for all the bands in a BandSet. Used in tool *band_calc()* (page 8).

Parameters
bandset_number – number of BandSet; if None, current BandSet is used.

Returns
List of band string such as ["bandset1b1", "bandset1b2"].

Examples

Get BandSet 1 band string list.

```
>>> catalog = BandSetCatalog()
>>> catalog.create_band_string_list(1)
```

`create_bandset`(*paths: str | list | None = None, band_names: list | None = None, wavelengths: list | None = None, unit: None | str = None, multiplicative_factors: list | None = None, additive_factors: list | None = None, date: list | None = None, bandset_number: None | int = None, insert: bool | None = False, root_directory: None | str = None, bandset_name: None | str = None, box_coordinate_list: list | None = None*) → *BandSet* (page 63)

Creates a BandSet adding it to the catalog.

This function creates a BandSet adding it to the catalog, by inserting or replacing the BandSet at specific BandSet number. Wavelength is defined by providing a list of values for each band, or a string of sensors names as defined in configurations sat_band_list such as:

- Sentinel-2;
- Landsat 8;
- Landsat 5;
- ASTER.

Wavelength unit is defined by a string such as:

- band number unitless band order as defined in the BandSet;
- µm (1 E-6m) micrometers;
- nm (1 E-9m) nanometers.

Parameters

- **paths** – list of file paths or a string of directory path; also, a list of directory path and name filter is accepted.
- **band_names** – list of raster names used for identifying the bands, if None then the names are automatically extracted from file names.
- **wavelengths** – list of center wavelengths of bands or string of sensor names (also partial).
- **unit** – wavelength unit as string
- **multiplicative_factors** – multiplicative factors for bands during calculations.
- **additive_factors** – additive factors for bands during calculations.
- **date** – list of date strings, or single date string (format YYYY-MM-DD) or string defined in configurations date_auto to detect date from directory name.
- **bandset_number** – number of the BandSet, replacing an existing BandSet with the same number.
- **insert** – if True insert the BandSet at bandset_number, if False replace the BandSet number.
- **root_directory** – root directory for relative path.
- **bandset_name** – name of the BandSet.
- **box_coordinate_list** – list of coordinates [left, top, right, bottom] to create a virtual subset.

Returns

The created BandSet.

Examples

Create a first BandSet from a file list with files inside a data directory, setting root_directory, defining the BandSet date, and the wavelenght from satellite name.

```
>>> catalog = BandSetCatalog()
>>> file_list = ['file1.tif', 'file2.tif', 'file3.tif']
>>> bandset_date = '2021-01-01'
>>> data_directory = 'data'
>>> bandset = catalog.create_bandset(
... paths=file_list, wavelengths=['Sentinel-2'], date=bandset_date,
... root_directory=data_directory
... )
```

Create a new BandSet from a file list with files inside a data directory (setting root_directory), defining the BandSet date, and explicitly defining the BandSet number.

```
>>> catalog = BandSetCatalog()
>>> file_list = ['file1.tif', 'file2.tif', 'file3.tif']
>>> bandset_date = '2021-01-01'
>>> data_directory = 'data'
>>> bandset = catalog.create_bandset(
... paths=file_list, wavelengths=['Sentinel-2'], date=bandset_date,
... bandset_number=2, root_directory=data_directory
... )
```

Passing a directory with file name filter and the wavelenght from satellite name.

```
>>> bandset = catalog.create_bandset(['directory_path', 'tif'],␣
↪wavelengths='Sentinel-2')
```

create_bandset_stack(*bandset_number: int | None = None*, *output_path: str | None = None*, *nodata_value: int | None = None*, *intersection: bool = False*) → str

Creates a raster stack of a bandset.

Stacks the raster bands of a bandset in a multiband raster.

Parameters

- **output_path** – output path of the raster; if None, use temporary path.
- **bandset_number** – number of BandSet; if None, current BandSet is used.
- **nodata_value** – nodata value.
- **intersection** – if True get minimum extent from input intersection, if False get maximum extent from union.

Returns

Path of the output raster.

Examples

Create BandSet 1 raster.

```
>>> catalog = BandSetCatalog()
>>> catalog.create_bandset_stack(1)
```

create_jpg(*bandset_number: int | None = None*, *bands: list | None = None*, *output_path: str | None = None*, *quality: int = 90*, *nodata_value: int | None = None*, *intersection: bool = False*) → str

Creates a jpg raster of a bandset.

Createsa a jpg raster of a bandset.

Parameters

- **bandset_number** – number of BandSet; if None, current BandSet is used.
- **bands** – list of 3 band numbers (e.g., [3, 2, 1])
- **output_path** – output path of the jpg raster; if None, use temporary path.
- **quality** – jpg quality, default 85.
- **nodata_value** – nodata value.
- **intersection** – if True get minimum extent from input intersection, if False get maximum extent from union.

Returns

Path of the output jpg file.

Examples

Create BandSet 1 jpg.

```
>>> catalog = BandSetCatalog()
>>> catalog.create_jpg(1)
```

create_virtual_raster(*bandset_number: int | None = None*, *output_path: str | None = None*, *nodata_value: int | None = None*, *intersection: bool = False*) → str

Creates the virtual raster of a bandset.

Creates the virtual raster of a bandset.

Parameters

- **output_path** – output path of the virtual raster; if None, use temporary path.
- **bandset_number** – number of BandSet; if None, current BandSet is used.
- **nodata_value** – nodata value.
- **intersection** – if True get minimum extent from input intersection, if False get maximum extent from union.

Returns

Path of the output virtual raster.

Examples

Create BandSet 1 virtual raster.

```
>>> catalog = BandSetCatalog()
>>> catalog.create_virtual_raster(1)
```

property current_bandset: int

Property that defines the current BandSet in the catalog.

This property identifies a BandSet number which is considered current (i.e. active) in several other tools when no BandSet is specified.

Returns

The integer number of current BandSet.

Examples

Get current BandSet.

```
>>> catalog = BandSetCatalog()
>>> bandset_number = catalog.current_bandset
>>> print(bandset_number)
1
```

Set current BandSet.

```
>>> catalog = BandSetCatalog()
>>> print(catalog.current_bandset)
1
>>> catalog.current_bandset = 2
>>> print(catalog.current_bandset)
2
```

export_bandset_as_xml(*bandset_number*, *output_path=None*)

Function to export a BandSet as xml.

find_bandset_names_in_list(*names: list*, *lower=True*, *output_number=True*, *exact_match=False*) → list

Finds BandSet names.

This function finds BandSet names in a list and return BandSets
or BandSet numbers.

Parameters

- **names** – list of string names.
- **lower** – if True, finds by lowering all the names.
- **output_number** – if True returns the number of the band, if False returns the BandSet.
- **exact_match** – if True, names are compared by equality.

Returns
if output_number is True, returns list of band number; if output_number is False, returns list of BandSets.

Examples

Find BandSet from name list.

```
>>> catalog = BandSetCatalog()
>>> name_list = ['name1', 'name2']
>>> bandsets = catalog.find_bandset_names_in_list(names=name_list)
```

`get_band_count`(*bandset_number: None | int = None*) → None | int

Gets band count.

Gets band count of a BandSet.

Parameters
bandset_number – number of BandSet; if None, current BandSet is used.

Returns
Count of bands.

Examples

Get BandSet 1 band count.

```
>>> catalog = BandSetCatalog()
>>> catalog.get_band_count(1)
```

`static get_band_list`(*bandset: int | list | BandSet (page 63) = None*, *bandset_catalog: Optional = None*) → list

Gets band list.

This function gets band list from several types of input.

Parameters

- **bandset** – input of type BandSet or list of paths or integer number of BandSet.
- **bandset_catalog** – optional type BandSetCatalog if bandset argument is a number.

Returns

If argument bandset is a BandSet or a BandSet number,
returns list of bands in the BandSet; if argument bandset is already a list, returns the same list.

Examples

Get band list of BandSet 1.

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> catalog = BandSetCatalog()
>>> list_1 = rs.bandset_catalog.get_band_list(1, catalog)
>>> # which is equivalent to
>>> bandset_1 = bandset_catalog.get_bandset(1)
>>> list_2 = bandset_1.get_absolute_paths()
```

get_bandset(*bandset_number: int | None = None*, *attribute: None | str = None*) → None | str | list | *BandSet* (page 63)

Get BandSet or BandSet attributes by number of the BandSet.

This function gets the BandSet or BandSet attributes by the number
of the BandSet.

Parameters

- **bandset_number** – number of the BandSet
- **attribute** – string of the attribute name, if None then the BandSet is returned

Returns
The BandSet band attributes or the BandSet.

Examples

Get the 'name' attribute of bands of the BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> names = catalog.get_bandset(bandset_number=1,
attribute='name')
>>> print(names)
['file1', 'file2', 'file3']
```

Get the BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> bandset_1 = catalog.get_bandset(bandset_number=1)
>>> print(bandset_1)
BandSet
```

get_bandset_bands_by_attribute(*bandset_number: int*, *attribute: str*, *attribute_value: float | int | str*, *output_number: bool | None = False*) → None | list | recarray

Get BandSet bands from the attributes thereof.

This function gets BandSet bands or the band number of bands whose
attributes match an attribute value.

Parameters

- **bandset_number** – number of the BandSet
- **attribute** – string of the attribute name
- **attribute_value** – value of the band attribute to find
- **output_number** – if True then the output is the band number list, if False then the output is the band array

Returns

The band number list or the array of bands.

Examples

Get the 'name' attribute of bands of the BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> band_number = catalog.get_bandset_bands_by_attribute(bandset_
↪number=1,attribute='wavelength',attribute_value=0.443,output_
↪number=True)
>>> print(band_number)
[2]
```

Get the BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> band_x = catalog.get_bandset_bands_by_attribute(bandset_number=1,
↪attribute='wavelength',attribute_value=0.443,output_number=True)
>>> print(band_x)
[(1, 1, '/data/file1.tif', '/data/file1.tif', 'file1', 0.443, 'µm (1␣
↪E-6m)', ...]
```

get_bandset_by_name(*bandset_name: str*, *output_number: bool | None = False*) → None | int | *BandSet* (page 63)

Get BandSet by name thereof.

This function gets the BandSet by the name thereof.

Parameters

- **bandset_name** – name of the BandSet
- **output_number** – if True then the output is the BandSet number, if False then the output is the BandSet

Returns

The BandSet identified by the name.

Examples

Get the number of the BandSet having the name 'example'.

```
>>> catalog = BandSetCatalog()
>>> bandset_number = catalog.get_bandset_by_name(
bandset_name='example', output_number=True)
>>> print(bandset_number)
3
```

Get the BandSet having the name 'example'.

```
>>> catalog = BandSetCatalog()
>>> bandset = catalog.get_bandset_by_name(
bandset_name='example', output_number=False)
>>> print(bandset)
BandSet object
```

get_bandset_by_number(*number: int*) → None | *BandSet* (page 63)

Get BandSet by number thereof.

This function gets the BandSet by the number thereof.

Parameters

number – number of the BandSet

Returns

The BandSet identified by the number.

Examples

Get the first BandSet.

```
>>> catalog = BandSetCatalog()
>>> bandset_1 = catalog.get_bandset_by_number(1)
>>> print(bandset_1)
BandSet object
```

get_bandset_catalog_attributes(*bandset_number: int*, *attribute: None | str = None*) → None | str | list

Get BandSet Catalog attributes by number of the BandSet.

This function gets the BandSet Catalog attributes by number of the BandSet.

Parameters

- **bandset_number** – number of the BandSet
- **attribute** – string of the attribute name, if None then the list of attributes is returned

Returns

The BandSet attribute or the list of attributes ('bandset_number', 'bandset_name', 'date', 'root_directory', 'uid').

Examples

Get the 'date' attribute of the BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> date = catalog.get_bandset_catalog_attributes(bandset_number=1,␣
↪attribute='date')
>>> print(date)
2000-12-31
```

Get the list of attributes of the BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> attributes = catalog.get_bandset_catalog_attributes(bandset_
↪number=1)
>>> print(attributes)
[(1, 'example', '2000-12-31', 'None', '20000101_1605495327_293')]
```

get_bandset_count() → int

Gets count of BandSets in the catalog.

This function gets the count of BandSets present in the catalog.

Returns

The integer number of BandSets.

Examples

Count of BandSets present.

```
>>> catalog = BandSetCatalog()
>>> count = catalog.get_bandset_count()
>>> print(count)
1
```

get_bandsets_by_date(*date_list: list*, *output_number: bool | None = False*) → list

Get BandSets by date.

This function gets the BandSets by date.

Parameters

- **date_list** – list of date strings, or single date string (format YYYY-MM-DD); it can also include ranges using > or <, multiple conditions including &
- **output_number** – if True then the output is the BandSet number, if False then the output is the BandSet

Returns

The BandSet identified by the name.

Examples

Get the number of the BandSet by date.

```
>>> catalog = BandSetCatalog()
>>> bandset_number = catalog.get_bandsets_by_date(date_list=['2020-
↪01-01'], output_number=True)
>>> print(bandset_number)
[1]
```

Get the number of the BandSet by range of dates.

```
>>> catalog = BandSetCatalog()
>>> bandset_number = catalog.get_bandsets_by_date(date_list=['2020-
↪01-01', '>=2021-01-01 & <=2022-01-02'], output_number=True)
>>> print(bandset_number)
[1, 3]
```

get_bandsets_by_list(*bandset_list: list | None = None*, *output_number: bool | None = False*) → list

Gets BandSets by list.

This function gets all the BandSets in the Catalog or filtered using a list of BandSet numbers.

Parameters

- **bandset_list** – list of integers BandSet numbers.
- **output_number** – if True, returns the list of BandSet number; if False, returns the list of BandSet object.

Returns

List of BandSets, or list of BandSets numbers if output_number is True.

Examples

Get BandSets.

```
>>> catalog = BandSetCatalog()
>>> bandset_t = catalog.get_bandsets_by_list()
>>> for bandset in bandset_t:
>>>     print(bandset)
```

get_bbox(*bandset_number: int | None = None*) → None | list

Get BandSet bounding box.

This function gets the bounding box coordinates of a BandSet.

Parameters

bandset_number – number of the BandSet

Returns

The bounding box coordinates [left, top, right, bottom].

Examples

Get the bounding box of the BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> names = catalog.get_bandset(bandset_number=1)
>>> print(names)
['file1', 'file2', 'file3']
```

Get the BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> bandset_1 = catalog.get_bandset(bandset_number=1)
>>> print(bandset_1)
BandSet
```

get_box_coordinate_list(*bandset_number: int | None = None*) → None | list

Gets BandSet box coordinate list.

Gets BandSet box coordinate list.

Parameters

bandset_number – number of BandSet; if None, current BandSet is used.

Returns
List of box coordinates [left, top, right, bottom].

Examples

Get BandSet 1 band count.

```
>>> catalog = BandSetCatalog()
>>> catalog.get_box_coordinate_list(1)
```

`get_crs`(*bandset_number: None | int = None*)

Gets BandSet crs.

Gets BandSet crs from Bandset information.

Parameters
bandset_number – number of BandSet; if None, current BandSet is used.

Examples

Get BandSet 1 crs.

```
>>> catalog = BandSetCatalog()
>>> catalog.get_crs(bandset_number=1)
```

`get_date`(*bandset_number: None | int = None*) → str

Gets BandSet date.

Gets BandSet date.

Parameters
bandset_number – number of BandSet; if None, current BandSet is used.

Returns
Date string.

Examples

Get BandSet 1 date.

```
>>> catalog = BandSetCatalog()
>>> catalog.get_date(1)
```

`get_name`(*bandset_number: None | int = None*) → str

Gets BandSet name.

Gets BandSet name.

Parameters
bandset_number – number of BandSet; if None, current BandSet is used.

Returns
BandSet name.

Examples

Get BandSet 1 date.

```
>>> catalog = BandSetCatalog()
>>> catalog.get_name(1)
```

get_root_directory(*bandset_number: None | int = None*) → str

Gets BandSet root directory.

Gets BandSet root directory.

Parameters
bandset_number – number of BandSet; if None, current BandSet is used.

Returns
Root directory string.

Examples

Get BandSet 1 root directory.

```
>>> catalog = BandSetCatalog()
>>> catalog.get_root_directory(1)
```

import_bandset_from_xml(*bandset_number*, *xml_path*)

Function to import a BandSet from xml.

iterate_bandset_bands(*attribute: str*) → list

Iterates BandSet attributes.

This function gets BandSet attributes iterating all the BandSets
in the Catalog.

Parameters
attribute – attribute name.

Returns
List of attributes

Examples

Get BandSet names.

```
>>> catalog = BandSetCatalog()
>>> names = catalog.iterate_bandset_bands('name')
```

move_band_in_bandset(*band_number_input: int*, *band_number_output: int*, *bandset_number: None | int = None*, *wavelength=True*)

Moves band in Bandset.

This function reorders a band in a Bandset.

Parameters

- **band_number_input** – number of band to be moved.

- **band_number_output** – position of the moved band.
- **bandset_number** – number of BandSet; if None, current BandSet is used.
- **wavelength** – if True, keep the wavelength attributes of the band order.

Examples

Move the second band of the BandSet 1 to position 5.

```
>>> catalog = BandSetCatalog()
>>> catalog.move_band_in_bandset(
... bandset_number=1, band_number_input=2, band_number_output=5
... )
```

move_bandset(*bandset_number_input: int*, *bandset_number_output: int*)

Moves a BandSet.

This function reorders a BandSet in the BandSet Catalog.

Parameters

- **bandset_number_input** – the BandSet number to be moved.
- **bandset_number_output** – the new poistion of BandSet.

Examples

Move BandSet 1 to position 3.

```
>>> catalog = BandSetCatalog()
>>> catalog.move_bandset(bandset_number_input=1, bandset_number_
↪output=3)
```

print_bandset(*bandset_number=None*)

Function to print a BandSet bands and attributes.

remove_band_in_bandset(*band_number: int*, *bandset_number: None | int = None*)

Removes band in Bandset.

This function removes a band in Bandset identified by a number. Automatically reorders other band numbers.

Parameters

- **band_number** – number of band to be removed.
- **bandset_number** – number of BandSet; if None, current BandSet is used.

Examples

Remove the second band of the BandSet.

```
>>> catalog = BandSetCatalog()
>>> catalog.remove_band_in_bandset(
... bandset_number=1, band_number=2
... )
```

remove_bandset(*bandset_number: int*)

Removes a BandSet.

This function removes a BandSet by the number thereof.

Parameters
bandset_number – the BandSet number to be removed.

Examples

Remove BandSet 2.

```
>>> catalog = BandSetCatalog()
>>> catalog.remove_bandset(2)
```

reset()

Resets the BandSets Catalog.

This function resets the BandSets Catalog removing all BandSets and
creating an empty one.

Examples

Reset the BandSets catalog.

```
>>> catalog = BandSetCatalog()
>>> catalog.reset()
```

set_box_coordinate_list(*box_coordinate_list: list*, *bandset_number: None | int = None*)

Sets BandSet box coordinate list.

Sets BandSet box coordinate list for virtual subset.

Parameters

- **box_coordinate_list** – list of coordinates [left, top, right, bottom] to create a virtual subset.
- **bandset_number** – number of BandSet; if None, current BandSet is used.

Examples

Set BandSet 1 coordinate list.

```
>>> catalog = BandSetCatalog()
>>> catalog.set_box_coordinate_list(
... bandset_number=1, box_coordinate_list=[230000, 4680000, 232000,␣
↪4670000]
... )
```

set_crs(*crs: str*, *bandset_number: None | int = None*)

Sets BandSet crs.

Sets BandSet crs from Bandset information.

Parameters

- **crs** – crs string.
- **bandset_number** – number of BandSet; if None, current BandSet is used.

Examples

Set BandSet 1 crs.

```
>>> catalog = BandSetCatalog()
>>> catalog.set_crs(bandset_number=1, crs='PROJCS["WGS 84 / UTM zone␣
↪33N"...')
```

set_date(*date: str*, *bandset_number: None | int = None*)

Sets BandSet date.

Sets BandSet date.

Parameters

- **date** – date string (format YYYY-MM-DD).
- **bandset_number** – number of BandSet; if None, current BandSet is used.

Examples

Set BandSet 1 date.

```
>>> catalog = BandSetCatalog()
>>> catalog.set_date(bandset_number=1, date='2021-01-01')
```

set_name(*name: str*, *bandset_number: int | None = None*)

Sets BandSet name.

Sets BandSet name.

Parameters

- **name** – name.
- **bandset_number** – number of BandSet; if None, current BandSet is used.

Examples

Set BandSet 1 name.

```
>>> catalog = BandSetCatalog()
>>> catalog.set_name(bandset_number=1, name='example')
```

set_paths(*path_list*, *bandset_number=None*)

Sets BandSet band path.

Sets BandSet band path based on list of paths.

Parameters

- **path_list** – list of string paths.
- **bandset_number** – number of BandSet; if None, current BandSet is used.

Examples

Set BandSet 1 satellite wavelengths.

```
>>> catalog = BandSetCatalog()
>>> catalog.set_satellite_wavelength(
... bandset_number=1, path_list=['path_1', 'path_2']
... )
```

set_root_directory(*root_directory: str*, *bandset_number: None | int = None*)

Sets BandSet root directory.

Sets BandSet root directory for relative path.

Parameters

- **root_directory** – root directory path.
- **bandset_number** – number of BandSet; if None, current BandSet is used.

Examples

Set BandSet 1 root directory.

```
>>> catalog = BandSetCatalog()
>>> catalog.set_root_directory(bandset_number=1, root_directory=
↪'data_directory')
```

set_satellite_wavelength(*satellite_name*, *bandset_number=None*)

Sets BandSet center wavelength based on satellite.

Sets BandSet center wavelength based on satellite name.

Parameters

- **satellite_name** – name of satellite (e.g., Landsat 8)
- **bandset_number** – number of BandSet; if None, current BandSet is used.

Examples

Set BandSet 1 satellite wavelengths.

```
>>> catalog = BandSetCatalog()
>>> catalog.set_satellite_wavelength(
... bandset_number=1, satellite_name='Sentinel-2'
... )
```

set_wavelength(*wavelength_list*, *unit*, *bandset_number=None*)

Sets BandSet center wavelength based on list.

Sets BandSet center wavelength based on list.

Parameters

- **wavelength_list** – list of wavelength values.
- **bandset_number** – number of BandSet; if None, current BandSet is used.

- **unit** – wavelength unit.

Examples

Set BandSet 1 satellite wavelengths.

```
>>> catalog = BandSetCatalog()
>>> catalog.set_satellite_wavelength(
... bandset_number=1, wavelength_list=[1, 2, 3], unit='µm (1 E-6m)'
... )
```

sort_bands_by_name(*bandset_number: None | int = None*, *keep_wavelength_order: bool | None = True*)

Sorts bands by name.

This function numerically sorts bands in a BandSet by name.

Parameters

- **bandset_number** – number of BandSet; if None, current BandSet is used.
- **keep_wavelength_order** – if True, keep wavelength_order.

Examples

Sort bands in BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> catalog.sort_bands_by_name(bandset_number=1)
```

sort_bands_by_wavelength(*bandset_number: None | int = None*)

Sorts bands by wavelength.

This function numerically sorts bands in a BandSet by wavelength center.

Parameters

bandset_number – number of BandSet; if None, current BandSet is used.

Examples

Sort bands in BandSet 1.

```
>>> catalog = BandSetCatalog()
>>> catalog.sort_bands_by_wavelength(bandset_number=1)
```

sort_bandsets_by_date()

Sort BandSets by BandSet date.

This function sorts BandSets in the BandSet Catalog based on the date.

Examples

Sort BandSets.

```
>>> catalog = BandSetCatalog()
>>> catalog.sort_bandsets_by_date()
```

update_crs(*bandset_number: None | int = None*)

Updates BandSet crs.

Updates BandSet crs from Bandset first band.

Parameters

bandset_number – number of BandSet; if None, current BandSet is used.

Examples

Update BandSet 1 crs.

```
>>> catalog = BandSetCatalog()
>>> catalog.update_crs(bandset_number=1)
```

remotior_sensus.core.configurations module

Configuration module. Module containing shared variables and parameters across tools.

remotior_sensus.core.configurations.**multiprocess:** *Multiprocess* **(page 96)**

remotior_sensus.core.log module

Logging manger.

Core class that manages logs during processes.

Typical usage example:

```
>>> # create a log file in a directory
>>> Log(directory='directory_path', level=10)
```

class remotior_sensus.core.log.**Log**(*file_path: None | str = None, directory: None | str = None, level: int | str | None = None, multiprocess=False, time=True, stream_handler=True*)

Bases: object

__init__(*file_path: None | str = None, directory: None | str = None, level: int | str | None = None, multiprocess=False, time=True, stream_handler=True*)

Manages logs.

This module allows for managing logs of processes.

file_path

path of a log file.

directory

directory path where a log file is created if file_path is None.

level

level of logging (10 for DEBUG, 20 for INFO).

multiprocess

if True, sets logging for parallel processes.

time
if True, time is saved in log file.

stream_handler
if True, create stream handler.

Examples

Create a log file and starts logging.

```
>>> Log(file_path='file.txt', level=20)
```

log = None

set_level(*level*)

remotior_sensus.core.messages module

Manager of messages.

Console messages during processes.

Typical usage example:

```
>>> # display a warning message
>>> warning('warning message')
```

remotior_sensus.core.messages.**error**(*message: str*)

Error message.

Prints an error message.

Parameters
message – message.

Examples

Display a message

```
>>> error('error message')
```

remotior_sensus.core.messages.**info**(*message: str*)

Info message.

Prints an info message.

Parameters
message – message.

Examples

Display a message

```
>>> info('error message')
```

remotior_sensus.core.messages.**warning**(*message: str*)

Warning message.

Prints a warning message.

Parameters

message – message.

Examples

Display a message

```
>>> warning('warning message')
```

remotior_sensus.core.multiprocess_manager module

class remotior_sensus.core.multiprocess_manager.**Multiprocess**(*n_processes: int | None = None*, *multiprocess_module=None*, *mpi_module=None*)

Bases: object

__init__(*n_processes: int | None = None*, *multiprocess_module=None*, *mpi_module=None*)

create_warped_vrt(*raster_path*, *output_path*, *output_wkt=None*, *align_raster_path=None*, *same_extent=False*, *n_processes: int | None = None*, *src_nodata=None*, *dst_nodata=None*, *resample_method=None*, *extra_params=None*, *min_progress=None*, *max_progress=None*, *mpi_module=False*)

find_minimum_dn()

find_minimum_maximum()

gdal_copy_raster(*input_raster*, *output*, *output_format='GTiff'*, *compress=None*, *compress_format='DEFLATE'*, *additional_params=''*, *n_processes=None*, *available_ram: int | None = None*, *min_progress=None*, *max_progress=None*, *disable_warnings=True*, *skip_bcast=False*)

gdal_vector_translate(*input_file*, *output_file*, *attribute_field*, *output_drive=None*, *explode_collections=None*, *available_ram: int | None = None*, *min_progress=None*, *max_progress=None*)

gdal_warping(*input_raster*, *output*, *output_format='GTiff'*, *s_srs=None*, *t_srs=None*, *resample_method=None*, *raster_data_type=None*, *compression=None*, *compress_format='DEFLATE'*, *additional_params=''*, *n_processes: int | None = None*, *available_ram: int | None = None*, *src_nodata=None*, *dst_nodata=None*, *min_progress=None*, *max_progress=None*)

get_dictionary_sum()

join_tables_multiprocess(*table1*, *table2*, *field1_name*, *field2_name*, *nodata_value=None*, *join_type=None*, *postfix=None*, *n_processes: int | None = None*, *progress_message=None*, *min_progress=None*, *max_progress=None*)

Parameters

- **table1** – input numpy table 1
- **table2** – input numpy table 2
- **field1_name** – input field table 1

- **field2_name** – input field table 2
- **nodata_value** – input nodata value
- **join_type** – join type
- **postfix** – postfix string
- **n_processes** – number of parallel processes.
- **progress_message** – progress message
- **min_progress** – minimum progress value
- **max_progress** – maximum progress value

multi_download_file(*url_list*, *output_path_list*, *authentication_uri=None*, *user=None*, *password=None*, *proxy_host=None*, *proxy_port=None*, *proxy_user=None*, *proxy_password=None*, *progress=None*, *message=None*, *min_progress=0*, *max_progress=100*, *retried=False*, *timeout=20*, *copernicus=False*, *access_token=None*, *ignore_errors=True*)

multiprocess_pixel_value()

multiprocess_raster_sieve(*raster_path*, *n_processes: int | None = None*, *sieve_size=None*, *connected=None*, *output_nodata_value=None*, *output=None*, *output_data_type=None*, *compress=None*, *compress_format=None*, *available_ram: int | None = None*, *min_progress=0*, *max_progress=100*)

multiprocess_raster_to_vector(*raster_path*, *output_vector_path*, *field_name=None*, *n_processes: int | None = None*, *dissolve_output=False*, *min_progress=0*, *max_progress=100*, *available_ram: int | None = None*)

multiprocess_region_growing()

multiprocess_roi_arrays()

multiprocess_scatter_values()

multiprocess_spectral_signature()

multiprocess_sum_array(*nodata=None*)

multiprocess_unique_values()

multiprocess_vector_to_raster(*vector_path*, *field_name=None*, *output_path=None*, *reference_raster_path=None*, *output_format=None*, *nodata_value=None*, *background_value=None*, *burn_values=None*, *minimum_extent=None*, *x_y_size=None*, *all_touched=None*, *compress=None*, *compress_format=None*, *available_ram: int | None = None*, *min_progress=0*, *max_progress=100*)

run(*raster_path*, *function=None*, *function_argument=None*, *function_variable=None*, *calculation_datatype=None*, *use_value_as_nodata=None*, *any_nodata_mask=True*, *output_raster_path=None*, *output_data_type=None*, *output_nodata_value=None*, *compress=None*, *compress_format='LZW'*, *n_processes: int | None = None*, *available_ram: int | None = None*, *dummy_bands=1*, *output_band_number=1*, *boundary_size=None*, *unique_section=False*, *keep_output_array=False*, *keep_output_argument=False*, *delete_array=True*, *scale=None*, *offset=None*, *input_nodata_as_value=None*, *classification=False*, *classification_confidence=False*, *signature_raster=False*, *virtual_raster=False*, *super_resolution=False*, *super_resolution_factor=None*, *multi_add_factors=None*, *separate_bands=False*, *progress_message=None*, *device=None*, *multiple_block=None*, *specific_output=None*, *skip_output=False*, *min_progress=None*, *max_progress=None*)

Parameters

- **device** – processing device 'cpu' or 'cuda' if available.
- **classification_confidence** – if True, write also additional classification confidence rasters as output.
- **signature_raster** – if True, write additional rasters for each spectral signature as output.
- **raster_path** – input path.
- **multi_add_factors** – list of multiplicative and additive factors.
- **virtual_raster** – if True, create virtual raster output.
- **offset** – integer number of output offset.
- **scale** – integer number of output scale.
- **delete_array** – if True delete output array.
- **keep_output_argument** – if True keep output argument for post processing.
- **keep_output_array** – if True keep output array for post processing.
- **unique_section** – if True consider the whole raster as unique section.
- **dummy_bands** – integer number of dummy bands to be counted for calculating block size
- **available_ram** – integer value of RAM in MB.
- **any_nodata_mask** – True to apply the nodata where any input is nodata, False to apply nodata where all inputs are nodata, None not apply nodata
- **input_nodata_as_value** – consider nodata as value in calculation
- **output_data_type** – string of data type for output raster such as Float32 or Int16
- **output_band_number** – number of bands of the output
- **output_nodata_value** – output nodata value
- **compress_format** – string of format of raster compression
- **compress** – True to compress the output raster or False not to compress
- **boundary_size** – integer number of pixels used to extend the boundary of calculations
- **output_raster_path** – list of output path strings
- **calculation_datatype** – datatype use during calculation
- **function_variable** – list of variables for function
- **function_argument** – arguments of function
- **n_processes** – number of parallel processes.
- **function** – function name
- **specific_output** – dictionary of values for specific output raster
- **skip_output** – if True, skip output process
- **classification** – if True, settings are defined for a classification output
- **use_value_as_nodata** – integer value as nodata in calculation
- **separate_bands** – if True, calculate a section for each raster range
- **super_resolution** – if True, create super resolution output

- **super_resolution_factor** – factor size for super resolution output
- **progress_message** – progress message
- **multiple_block** – allows for setting block size as a multiple of the pixel count here defined
- **min_progress** – minimum progress value
- **max_progress** – maximum progress value

run_iterative_process(*function_list*, *argument_list*, *min_progress=None*, *max_progress=None*, *n_processes=None*, *message='processing'*)

run_scikit(*function*, *classifier_list=None*, *list_train_argument_dictionaries=None*, *n_processes=None*, *available_ram: int | None = None*, *min_progress=None*, *max_progress=None*)

run_separated(*raster_path_list*, *function=None*, *function_argument=None*, *function_variable=None*, *calculation_datatype=None*, *use_value_as_nodata=None*, *any_nodata_mask=True*, *output_raster_list=None*, *output_data_type=None*, *output_nodata_value=None*, *compress=None*, *compress_format='LZW'*, *n_processes: int | None = None*, *available_ram: int | None = None*, *output_band_number_list=None*, *boundary_size=None*, *dummy_bands=0*, *skip_output=False*, *keep_output_array=False*, *keep_output_argument=False*, *scale=None*, *offset=None*, *input_nodata_as_value=None*, *multi_add_factors=None*, *progress_message=None*, *min_progress=None*, *max_progress=None*, *rank=None*)

Parameters

- **multi_add_factors** – list of multiplicative and additive factors
- **offset** – list integer number of output offset
- **scale** – list of integer number of output scale
- **keep_output_argument** – if True keep output argument for post-processing
- **dummy_bands** – integer number of dummy bands to be counted for calculating block size
- **keep_output_array** – if True keep output array for post-processing
- **available_ram** – integer value of RAM in MB
- **any_nodata_mask** – True to apply the nodata where any input is nodata, False to apply nodata where all inputs are nodata, None not apply nodata
- **input_nodata_as_value** – consider nodata as value in calculation
- **output_data_type** – list of data type string for output raster such as Float32 or Int16
- **output_band_number_list** – list of number of bands of the output
- **output_nodata_value** – nodata value of the output
- **compress_format** – string of format of raster compression
- **compress** – True to compress the output raster or False not to compress
- **boundary_size** – integer number of pixels used to extend the boundary of calculations
- **output_raster_list** – list of output path strings
- **calculation_datatype** – datatype use during calculation
- **function_variable** – list of variables for function
- **function_argument** – arguments of function
- **n_processes** – number of parallel processes.

- **function** – function name
- **raster_path_list** – input path
- **use_value_as_nodata** – list of integer values as nodata in calculation
- **skip_output** – if True, skip output process
- **progress_message** – progress message
- **min_progress** – minimum progress value
- **max_progress** – maximum progress value
- **rank** – optional, if True each rank is used for independent processes

start(*n_processes*, *multiprocess_module=None*, *mpi_module=None*)

stop()

remotior_sensus.core.multiprocess_manager.**create_task**(*task*)

remotior_sensus.core.multiprocess_manager.**mpi_bcast**(*value*)

remotior_sensus.core.output_manager module

Output manager.

Core class that manages several types of output, mainly intended for tools that have several outputs.

Typical usage example:

```
>>> # process output is checked
>>> OutputManager()
```

class remotior_sensus.core.output_manager.**OutputManager**(*check: bool = True*, *path: str | None = None*, *paths: list | None = None*, *extra=None*)

Bases: `object`

Manages output.

This class manages several types of output, mainly intended for tools that have several outputs. Check argument is False if output failed. Single output raster or multiple file paths can be defined as arguments. Additional output files or tables are managed with an extra argument. The type of the extra argument can be flexible depending on the process output.

check

True if output is as expected, False if process failed.

path

path of the first output.

paths

list of output paths in case of multiple outputs.

extra

additional output elements depending on the process.

Examples

Output failed

```
>>> OutputManager(check=False)
```

Output is checked and file path is provided

```
>>> OutputManager(path='file.tif')
```

__init__(*check: bool = True*, *path: str | None = None*, *paths: list | None = None*, *extra=None*)

Initializes an Output.

Initializes an Output.

Parameters

- **check** – True if output is as expected, False if process failed.
- **path** – path of the first output.
- **paths** – list of output paths in case of multiple outputs.
- **extra** – additional output elements depending on the process.

Examples

Create an object with a single file path

```
>>> OutputManager(path='file.tif')
```

Create an object with several output file paths in a list and an extra argument for a dictionary

```
>>> OutputManager(
... paths=['file1.tif', 'file2.tif'],
... extra={'additional_output': 'file.csv'}
... )
```

)

add_to_bandset(*bandset_catalog: BandSetCatalog (page 74)*, *bandset_number=None*, *band_number=None*, *raster_band=None*, *band_name=None*, *date=None*, *unit=None*, *root_directory=None*, *multiplicative_factor=None*, *additive_factor=None*, *wavelength=None*)

Adds output to BandSet.

Adds the OutputManager.path as a band to a BandSet in a BandSetCatalog.

Parameters

- **bandset_catalog** – BandSetCatalog object.
- **band_name** – raster name used for identifying the bands.
- **wavelength** – center wavelengths of band.
- **unit** – wavelength unit as string
- **multiplicative_factor** – multiplicative factor for bands during calculations.
- **additive_factor** – additive factors for band during calculations.
- **date** – date string (format YYYY-MM-DD).
- **bandset_number** – number of the BandSet; if None, the band is added to the current BandSet.
- **root_directory** – root directory for relative path.

- **raster_band** – raster band number.
- **band_number** – number of band in BandSet.

Examples

Add the output to BandSet 1 as band 1.

```
>>> catalog = BandSetCatalog()
>>> OutputManager.add_to_bandset(
... bandset_catalog=catalog, bandset_number=1, band_number=1
... )
```

remotior_sensus.core.processor module

class remotior_sensus.core.processor.**RasterPiece**(*section_list*, *x_min*, *y_min*, *x_max*, *y_max*, *x_size*, *y_size*, *y_min_no_boundary=None*, *y_max_no_boundary=None*, *y_size_boundary_top=None*, *y_size_boundary_bottom=None*, *y_size_no_boundary=None*)

Bases: object

__init__(*section_list*, *x_min*, *y_min*, *x_max*, *y_max*, *x_size*, *y_size*, *y_min_no_boundary=None*, *y_max_no_boundary=None*, *y_size_boundary_top=None*, *y_size_boundary_bottom=None*, *y_size_no_boundary=None*)

Parameters

- **section_list** – list of sections
- **x_min** – left position
- **y_min** – top position
- **x_max** – right position
- **y_max** – bottom position
- **x_size** – piece x size
- **y_size** – piece y size
- **y_min_no_boundary** – top position without boundary
- **y_max_no_boundary** – bottom position without boundary
- **y_size_boundary_top** – top pixel buffer
- **y_size_boundary_bottom** – bottom pixel buffer
- **y_size_no_boundary** – piece size without buffer

y_details()

class remotior_sensus.core.processor.**RasterSection**(*x_min*, *y_min*, *x_max*, *y_max*, *x_size*, *y_size*, *y_min_no_boundary=None*, *y_max_no_boundary=None*, *y_size_boundary_top=None*, *y_size_boundary_bottom=None*, *y_size_no_boundary=None*)

Bases: object

__init__(*x_min*, *y_min*, *x_max*, *y_max*, *x_size*, *y_size*, *y_min_no_boundary=None*, *y_max_no_boundary=None*, *y_size_boundary_top=None*, *y_size_boundary_bottom=None*, *y_size_no_boundary=None*)

Parameters

- **x_min** – left position
- **y_min** – top position
- **x_max** – right position
- **y_max** – bottom position
- **x_size** – section x size
- **y_size** – section y size
- **y_min_no_boundary** – top position without boundary
- **y_max_no_boundary** – bottom position without boundary
- **y_size_boundary_top** – top pixel buffer
- **y_size_boundary_bottom** – bottom pixel buffer
- **y_size_no_boundary** – section size without buffer

y_details()

remotior_sensus.core.processor.**array_multiplicative_additive_factors**(*array*, *multiplicative_factor*, *additive_factor*)

remotior_sensus.core.processor.**download_file_processor**(*input_parameters*, *process_parameters=None*)

remotior_sensus.core.processor.**download_file_processor_rank**(*input_parameters*, *process_parameters=None*, *configuration_module=None*)

remotior_sensus.core.processor.**function_initiator**(*process_parameters=None*, *input_parameters=None*, *output_parameters=None*, *function=None*, *function_argument=None*, *function_variable=None*, *run_separate_process=False*, *classification=False*, *classification_confidence=False*, *signature_raster=False*, *super_resolution=False*)

remotior_sensus.core.processor.**gdal_translate**(*input_file=None*, *output=None*, *option_string=None*, *process_parameters=None*)

remotior_sensus.core.processor.**gdal_vector_translate**(*input_file=None*, *output=None*, *attribute_field=None*, *output_drive=None*, *process_parameters=None*, *explode_collections=None*)

remotior_sensus.core.processor.**gdal_vector_translate_rank**(*input_file=None*, *output=None*, *attribute_field=None*, *output_drive=None*, *process_parameters=None*, *explode_collections=None*, *configuration_module=None*)

remotior_sensus.core.processor.**gdal_warp**(*input_file=None*, *output=None*, *option_string=None*, *process_parameters=None*)

remotior_sensus.core.processor.**get_raster_band_array**(*gdal*, *band*, *calculation_datatype*, *_a*, *_a_mask*, *sec*, *input_nodata_as_value*, *value_as_nodata*)

remotior_sensus.core.processor.**raster_sieve_process**(*process_parameters=None*, *input_parameters=None*, *output_parameters=None*)

remotior_sensus.core.processor.**raster_sieve_process_rank**(*process_parameters=None*, *input_parameters=None*, *output_parameters=None*, *configuration_module=None*)

remotior_sensus.core.processor.**raster_to_vector_process**(*raster_path*, *output_vector_path*, *field_name=False*, *process_parameters=None*, *connected=4*, *configuration_module=None*)

remotior_sensus.core.processor.**raster_to_vector_process_sub**(*raster_path*, *output_vector_path*, *field_name=False*, *process_parameters=None*, *connected=4*, *configuration_module=None*, *log_module=None*)

remotior_sensus.core.processor.**table_join**(*table_1_parameters*, *table_2_parameters*, *nodata_value*, *join_type*, *features*, *output_names*, *process_parameters*)

remotior_sensus.core.processor.**vector_to_raster**(*process_parameters=None*, *input_parameters=None*, *output_parameters=None*)

remotior_sensus.core.processor.**vector_to_raster_rank**(*process_parameters=None*, *input_parameters=None*, *output_parameters=None*, *configuration_module=None*)

remotior_sensus.core.processor_functions module

remotior_sensus.core.processor_functions.**band_calculation**(**argv*)

remotior_sensus.core.processor_functions.**band_calculation_pytorch**(**argv*)

remotior_sensus.core.processor_functions.**bands_covariance**(**argv*)

remotior_sensus.core.processor_functions.**calculate_pca**(**argv*)

remotior_sensus.core.processor_functions.**classification_maximum_likelihood**(**argv*)

remotior_sensus.core.processor_functions.**classification_minimum_distance**(**argv*)

remotior_sensus.core.processor_functions.**classification_pytorch**(**argv*)

remotior_sensus.core.processor_functions.**classification_pytorch_pretrained**(**argv*)

remotior_sensus.core.processor_functions.**classification_scikit**(**argv*)

remotior_sensus.core.processor_functions.**classification_spectral_angle_mapping**(**argv*)

remotior_sensus.core.processor_functions.**clip_raster**(*process*, *progress_queue*, *argument_list*, *logger*, *temp*)

remotior_sensus.core.processor_functions.**create_vrt_iter**(*process*, *progress_queue*, *argument_list*, *logger*, *temp*)

remotior_sensus.core.processor_functions.**create_warped_vrt_iter**(*process*, *progress_queue*, *argument_list*, *logger*, *temp*)

remotior_sensus.core.processor_functions.**cross_rasters**(**argv*)

remotior_sensus.core.processor_functions.**edit_raster**(*process*, *progress_queue*, *argument_list*, *logger*, *temp*)

remotior_sensus.core.processor_functions.**fit_classifier**(**argv*)

remotior_sensus.core.processor_functions.**get_band_arrays**(*process*, *progress_queue*, *argument_list*, *logger*, *temp*)

remotior_sensus.core.processor_functions.**get_values_for_scatter_plot**(**argv*)

remotior_sensus.core.processor_functions.**percentile_calc**(*array*, *percentile=90*, *axis=0*)

remotior_sensus.core.processor_functions.**percentile_calc_pytorch**(*array*, *percentile=90*, *dim=0*)

remotior_sensus.core.processor_functions.**raster_class_unique_values_with_sum**(**argv*)

remotior_sensus.core.processor_functions.**raster_dilation**(**argv*)

remotior_sensus.core.processor_functions.**raster_erosion**(**argv*)

remotior_sensus.core.processor_functions.**raster_label_part**(**argv*)

remotior_sensus.core.processor_functions.**raster_neighbor**(**argv*)

remotior_sensus.core.processor_functions.**raster_pixel_count**(**argv*)

remotior_sensus.core.processor_functions.**raster_point_values**(*process*, *progress_queue*, *argument_list*, *logger*, *temp*)

remotior_sensus.core.processor_functions.**raster_reclass**(*process*, *progress_queue*, *argument_list*, *logger*, *temp*)

remotior_sensus.core.processor_functions.**raster_resample**(**argv*)

remotior_sensus.core.processor_functions.**raster_unique_values**(**argv*)

remotior_sensus.core.processor_functions.**raster_unique_values_with_sum**(**argv*)

remotior_sensus.core.processor_functions.**reclassify_raster**(**argv*)

remotior_sensus.core.processor_functions.**region_growing**(**argv*)

remotior_sensus.core.processor_functions.**score_classifier**(**argv*)

remotior_sensus.core.processor_functions.**score_classifier_stratified**(*process*, *progress_queue*, *argument_list*, *logger*, *temp*)

remotior_sensus.core.processor_functions.**segmentation_pytorch_pretrained**(**argv*)

remotior_sensus.core.processor_functions.**spectral_distance**(**argv*)

remotior_sensus.core.processor_functions.**spectral_signature**(**argv*)

remotior_sensus.core.processor_functions.**super_resolution_pytorch_pretrained**(**argv*)

remotior_sensus.core.processor_functions.**vector_to_raster_iter**(*process*, *progress_queue*, *argument_list*, *logger*, *temp*)

remotior_sensus.core.processor_functions.**zonal_rasters**(**argv*)

remotior_sensus.core.progress module

class remotior_sensus.core.progress.**Progress**(*process=None*, *step=None*, *message=None*, *percentage=None*, *callback=None*)

Bases: object

__init__(*process=None*, *step=None*, *message=None*, *percentage=None*, *callback=None*)

callback = None

elapsed_time = None

failed()
Ends progress and resets.

finish()
Ends progress and resets.

get()

message = 'starting'

percentage = False

ping = 0

previous_step = 0

previous_step_time = None

static print_progress(*process=None*, *step=None*, *message=None*, *percentage=None*, *elapsed_time=None*, *previous_step=None*, *start=None*, *end=None*, *failed=None*, *ping=0*)

static print_progress_replace(*process=None*, *step=None*, *message=None*, *percentage=None*, *elapsed_time=None*, *previous_step=None*, *start=None*, *end=None*, *failed=None*, *ping=0*)

process = 'remotior_sensus'

remaining = ''

start_time = None

step = 0

update(*process=None*, *step=None*, *message=None*, *percentage=None*, *start=None*, *end=None*, *failed=None*, *ping=None*, *steps=None*, *minimum=None*, *maximum=None*)

remotior_sensus.core.progress.**beeps**(*frequency: int*, *duration: float*)

remotior_sensus.core.progress.**failed_sound**()

remotior_sensus.core.progress.**finish_sound**()

remotior_sensus.core.progress.**send_smtp_message**(*subject: str | None = None*, *message: str | None = None*)

remotior_sensus.core.session module

Session manager.

Core class that manages the Remotior Sensus' session. It defines fundamental parameters such as available RAM and number of parallel processes. Creates a temporary directory to store temporary files. Exposes core functions and tools. It includes a method to close the session removing temporary files and stopping parallel processes.

Typical usage example:

```
>>> # start the session
>>> rs = Session()
>>> # optionally set session parameters
>>> rs.set(n_processes=2)
>>> # close the session when processing is done
>>> rs.close()
```

class remotior_sensus.core.session.**Session**(*n_processes: int | None = 2*, *available_ram: int = 2*, *temporary_directory: str | None = None*, *directory_prefix: str | None = None*, *log_level: int = 20*, *log_time: bool = True*, *progress_callback=None*, *multiprocess_module=None*, *messages_callback=None*, *smtp_server=None*, *smtp_user=None*, *smtp_password=None*, *smtp_recipients=None*, *smtp_notification=None*, *sound_notification=None*, *log_stream_handler=True*, *mpi_module=None*, *keep_log=None*)

Bases: `object`

Manages system parameters.

This module allows for managing Remotior Sensus' session, setting fundamental processing parameters and exposing core functions and tools.

configurations

module containing shared variables and functions

bandset

access *BandSet()* (page 63) class

bandset_catalog

access *BandSetCatalog()* (page 74) class

spectral_signatures_catalog

access *SpectralSignaturesCatalog()* (page 114) class

spectral_signatures_plot_catalog

access *SpectralSignaturePlotCatalog()* (page 112) class

spectral_signatures_plot

access *SpectralSignaturePlot()* (page 112) class

output_manager

access *OutputManager()* (page 100) class

table_manager
access functions of *table_manager()* (page 116) module

dates_times
access dates and times utilities

download_tools
access download utilities

shared_tools
access shared tools

files_directories
access files directories utilities

band_calc
tool *band_calc()* (page 8)

band_classification
tool *band_classification()* (page 11)

classifier
tool *Classifier()* (page 13)

band_clustering
tool *band_clustering()* (page 24)

band_combination
tool *band_combination()* (page 26)

band_dilation
tool *band_dilation()* (page 28)

band_erosion
tool *band_erosion()* (page 29)

band_mask
tool *band_mask()* (page 30)

band_neighbor_pixels
tool *band_neighbor_pixels()* (page 31)

band_pca
tool *band_pca()* (page 33)

band_resample
tool *band_resample()* (page 35)

band_sieve
tool *band_sieve()* (page 37)

band_spectral_distance
tool *band_spectral_distance()* (page 38)

band_stack
tool *band_stack()* (page 39)

cross_classification
tool *cross_classification()* (page 40)

download_products
tool *download_products()* (page 42)

mosaic
: tool *mosaic()* (page 50)

preprocess_products
: tool *preprocess_products()* (page 51)

raster_edit
: tool *raster_edit()* (page 53)

raster_label
: tool *raster_label()* (page 54)

raster_reclassification
: tool *preprocess_products()* (page 51)

raster_report
: tool *raster_report()* (page 57)

raster_split
: tool *raster_split()* (page 58)

raster_to_vector
: tool *raster_to_vector()* (page 59)

raster_zonal_stats
: tool *raster_zonal_stats()* (page 60)

vector_to_raster
: tool *vector_to_raster()* (page 61)

jupyter
: starts a Jupyter interface

Examples

Start a session

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
```

Start a session defining number of parallel processes. and available RAM

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session(n_processes=4,available_ram=8)
```

Create a *BandSetCatalog()* (page 74)

```
>>> catalog = rs.bandset_catalog()
```

Run the tool for raster report

```
>>> output = rs.raster_report(raster_path='file.tif', output_path=
↪'output.txt')
```

Start an interactive Jupyter interface

```
>>> rs.jupyter().download_interface()
```

Stop a session at the end to clear temporary directory

```
>>> rs.close()
```

__init__(*n_processes: int | None = 2*, *available_ram: int = 2*, *temporary_directory: str | None = None*, *directory_prefix: str | None = None*, *log_level: int = 20*, *log_time: bool = True*, *progress_callback=None*, *multiprocess_module=None*, *messages_callback=None*, *smtp_server=None*, *smtp_user=None*, *smtp_password=None*, *smtp_recipients=None*, *smtp_notification=None*, *sound_notification=None*, *log_stream_handler=True*, *mpi_module=None*, *keep_log=None*)

Starts a session.

Starts a new session setting fundamental parameters for processing. It sets the number of parallel processes (default 2) and available RAM (default 2048MB) to be used in calculations. It starts the class Temporary to manage temporary files by creating a temporary directory with an optional name prefix. It starts the class Log for logging (with a default level INFO) and creates a logging formatter with the option to hide time. It starts the class Progress for displaying progress with a default callback function. A custom progress callback function can be passed optionally.

The sessions also allows for accessing to the core functions and tools.

In the end, the close() function should be called to clear the temporary directory and stop the parallel processes.

Parameters

- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes; if value < 1000 then available RAM is evaulated as gigabytes.
- **temporary_directory** – path to a temporary directory.
- **directory_prefix** – prefix of the name of the temporary directory.
- **log_level** – level of logging (10 for DEBUG, 20 for INFO).
- **log_time** – if True, logging includes the time.
- **progress_callback** – function for progress callback.
- **multiprocess_module** – multiprocess module, useful if Remotior Sensus' session is started from another Python module.
- **messages_callback** – message module, useful if Remotior Sensus' session is started from another Python module.
- **smtp_server** – optional server for SMTP notification.
- **smtp_user** – user for SMTP authentication.
- **smtp_password** – password for SMTP authentication.
- **smtp_recipients** – string of one or more email addresses separated by comma for SMTP notification.
- **smtp_notification** – optional, if True send SMTP notification.
- **sound_notification** – optional, if True play sound notification.
- **log_stream_handler** – optional, if True create stream handler.
- **mpi_module** – optional mpi module, if None or False then multiprocess is used. In case mpi_module is True, n_processes should be the number of tasks per node and available_ram should be the available be node RAM.
- **keep_log** – optional, if True keep log file in temporary directory

Examples

Start a session

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
```

close(*log_path: str | None = None*)

Closes a Session.

This function closes current session by deleting the temporary files and stopping parallel processes.

Parameters

log_path – path where the log file is saved

Examples

Given that a session was previously started

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
```

Set the number of parallel processes and available RAM

```
>>> rs.set(n_processes=8, available_ram=20480)
```

Set the logging level to DEBUG

```
>>> rs.set(log_level=10)
```

set(*n_processes: int | None = None*, *available_ram: int | None = None*, *temporary_directory: str | None = None*, *directory_prefix: str | None = None*, *log_level: int | None = None*, *log_time: bool | None = None*, *progress_callback: LambdaType | None = None*, *smtp_server=None*, *smtp_user=None*, *smtp_password=None*, *smtp_recipients=None*, *sound_notification=None*, *smtp_notification=None*, *log_stream_handler=True*)

Sets or changes the parameters of an existing Session.

Sets the parameters of an existing Session such as number of processes or temporary directory.

Parameters

- **n_processes** – number of parallel processes.
- **available_ram** – number of megabytes of RAM available to processes; if value < 1000 then available RAM is evaulated as gigabytes.
- **temporary_directory** – path to a temporary directory.
- **directory_prefix** – prefix of the name of the temporary directory.
- **log_level** – level of logging (10 for DEBUG, 20 for INFO).
- **log_time** – if True, logging includes the time.
- **progress_callback** – function for progress callback.
- **smtp_server** – optional server for SMTP notification.
- **smtp_user** – user for SMTP authentication.
- **smtp_password** – password for SMTP authentication.
- **smtp_recipients** – string of one or more email addresses separated by comma for SMTP notification.
- **smtp_notification** – optional, if True send SMTP notification.

- **sound_notification** – optional, if True play sound notification.
- **log_stream_handler** – optional, if True create stream handler.

Examples

Given that a session was previously started

```
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
```

Stop a session

```
>>> rs.close()
```

Stop a session saving also the log to a file

```
>>> rs.close(log_path='file.txt')
```

remotior_sensus.core.spectral_signatures module

class remotior_sensus.core.spectral_signatures.**SpectralSignaturePlot**(*value*, *wavelength*, *standard_deviation=None*, *pixel_count=None*, *signature_id=None*, *macroclass_id=None*, *class_id=None*, *macroclass_name=None*, *class_name=None*, *color_string=None*, *selected=None*)

Bases: `object`

A class to manage Spectral Signatures for plots.

__init__(*value*, *wavelength*, *standard_deviation=None*, *pixel_count=None*, *signature_id=None*, *macroclass_id=None*, *class_id=None*, *macroclass_name=None*, *class_name=None*, *color_string=None*, *selected=None*)

class remotior_sensus.core.spectral_signatures.**SpectralSignaturePlotCatalog**(*signature:* SpectralSignaturePlot *(page 112)* | *None = None*)

Bases: `object`

A class to manage Spectral Signatures Catalog for plots.

__init__(*signature:* SpectralSignaturePlot *(page 112)* | *None = None*)

add_signature(*signature:* SpectralSignaturePlot *(page 112)*)

get_generic_attributes(*selected=True*) → list

Gets generic attributes in the catalog.

This function gets generic attributes from the catalog.

Returns
The list of values.

get_signature(*signature_id*) → *SpectralSignaturePlot* (page 112)

Gets signature in the catalog.

This function gets signature by id from the catalog.

Returns
The SpectralSignaturePlot.

Examples

Get signature.

```
>>> catalog = SpectralSignaturePlotCatalog()
>>> signature = catalog.get_signature(signature_id='signature_id')
>>> print(signature.signature_id)
'signature_id'
```

get_signature_color(*selected=True*) → list

Gets signature color in the catalog.

This function gets signature color from the catalog.

Returns
The list of values.

get_signature_count() → int

Gets count of signatures in the catalog.

This function gets the count of signatures present in the catalog.

Returns
The integer number of signatures.

Examples

Count of signatures present.

```
>>> catalog = SpectralSignaturePlotCatalog()
>>> count = catalog.get_signature_count()
>>> print(count)
1
```

get_signature_ids() → list

Gets signature ids in the catalog.

This function gets signature ids from the catalog.

Returns
The list of ids.

Examples

Get signature.

```
>>> catalog = SpectralSignaturePlotCatalog()
>>> signature_ids = catalog.get_signature_ids()
>>> print(signature_ids)
['signature_id']
```

get_signature_names(*selected=True*) → list

Gets signature names in the catalog.

This function gets signature names from the catalog, derived from SpectralSignaturePlot.

Returns
The list of values.

Examples

Get signature.

```
>>> catalog = SpectralSignaturePlotCatalog()
>>> signature_names = catalog.get_signature_names()
>>> print(signature_names)
['name']
```

get_signature_standard_deviation(*selected=True*) → list

Gets signature standard deviation in the catalog.

This function gets signature standard deviation from the catalog.

Returns
The list of values.

get_signature_values(*selected=True*) → list

Gets signature values in the catalog.

This function gets signature values from the catalog.

Returns
The list of values.

get_signature_wavelength(*selected=True*) → list

Gets signature wavelength in the catalog.

This function gets signature wavelength from the catalog.

Returns
The list of values.

remove_signature(*signature_id: str*)

class remotior_sensus.core.spectral_signatures.**SpectralSignaturesCatalog**(*bandset: BandSet (page 63) | None = None, catalog_table=None, geometry_file_path=None, macroclass_field=None, class_field=None*)

Bases: object

A class to manage Spectral Signatures and ROIs.

__init__(*bandset:* BandSet *(page 63)* | *None = None*, *catalog_table=None*, *geometry_file_path=None*, *macroclass_field=None*, *class_field=None*)

add_signatures_to_plot_by_id(*signature_id_list*, *return_plot=False*)

add_spectral_signature(*value_list*, *macroclass_id=None*, *class_id=None*, *macroclass_name=None*, *class_name=None*, *wavelength_list=None*, *standard_deviation_list=None*, *signature_id=None*, *selected=1*, *min_dist_thr=0*, *max_like_thr=0*, *spec_angle_thr=0*, *geometry=0*, *signature=0*, *color_string=None*, *pixel_count=0*, *unit=None*)

Adds a spectral signature.

This method adds spectral signature to Spectral Signatures Catalog.

Parameters

- **value_list**
- **macroclass_id**
- **class_id**
- **macroclass_name**
- **class_name**
- **wavelength_list**
- **standard_deviation_list**
- **signature_id**
- **selected**
- **min_dist_thr**
- **max_like_thr**
- **spec_angle_thr**
- **geometry**
- **signature**
- **color_string**
- **pixel_count** – pixel count
- **unit** – unit

Returns

object *OutputManager()* (page 100)

calculate_bray_curtis_similarity(*signature_id_x*, *signature_id_y*)

calculate_euclidean_distance(*signature_id_x*, *signature_id_y*)

calculate_scatter_plot(*roi_path*, *band_x*, *band_y*, *n_processes: int* | *None = None*)

calculate_scatter_plot_by_id(*signature_id: str*, *band_x*, *band_y*, *decimal_round: int* | *None = None*, *plot=False*, *n_processes: int* | *None = None*)

calculate_signature(*roi_path*, *n_processes: int* | *None = None*, *rank=None*)

calculate_spectral_angle(*signature_id_x*, *signature_id_y*)

export_signature_values_for_plot(*signature_id*, *plot_catalog=None*)

export_signatures_as_csv(*signature_id_list*, *output_directory*, *separator=','*)

export_vector(*signature_id_list*, *output_path*, *vector_format=None*)

import_file(*file_path*)

import_spectral_signature_csv(*csv_path*, *macroclass_id=None*, *class_id=None*, *macroclass_name=None*, *class_name=None*, *separator=','*, *color_string=None*)

import_vector(*file_path*, *macroclass_value=None*, *class_value=None*, *macroclass_name=None*, *class_name=None*, *macroclass_field=None*, *class_field=None*, *macroclass_name_field=None*, *class_name_field=None*, *calculate_signature=True*, *color_string=None*, *rank=None*)

load(*file_path*)

merge_signatures_by_id(*signature_id_list*, *calculate_signature=True*, *macroclass_id=None*, *class_id=None*, *macroclass_name=None*, *class_name=None*, *color_string=None*)

remove_signature_by_id(*signature_id: str*)

save(*output_path*, *signature_id_list=None*)

set_crs_from_bandset(*bandset*)

set_macroclass_color(*macroclass_id*, *color_string*)

signature_to_catalog(*signature_id*, *macroclass_id*, *class_id*, *macroclass_name=None*, *class_name=None*, *selected=1*, *min_dist_thr=0*, *max_like_thr=0*, *spec_angle_thr=0*, *geometry=0*, *signature=0*, *color_string=None*, *pixel_count=0*, *unit=None*)

remotior_sensus.core.spectral_signatures.**generate_signature_id**()

remotior_sensus.core.table_manager module

Table manager.

This tool allows for managing table data as NumPy structured arrays. It includes functions for field calculation, join and pivot tables. Also, functions to manage tables used in other tools are included. Tables can be exported to csv files.

In case of MPI, rank 0 is mainly used.

Typical usage example:

```
>>> # import Remotior Sensus and start the session
>>> import remotior_sensus
>>> rs = remotior_sensus.Session()
>>> # open a file
>>> file1 = 'file1.csv'
>>> table1 = rs.table_manager.open_file('file1.csv', field_names=['field1', 'field2'])
>>> # perform a calculation
>>> calculation = rs.table_manager.calculate(
... matrix=table1, expression_string='"field1" * 1.5',
... output_field_name='calc'
... )
>>> # export the table to csv
>>> rs.table_manager.export_table(
```

(continues on next page)

(continued from previous page)

```
... matrix=calculation, output_path='output.csv',
... fields=['field1', 'calc'], separator=';', decimal_separator='.'
... )
```

remotior_sensus.core.table_manager.**add_product_to_preprocess**(*product_list*, *spacecraft_list*, *processing_level*, *band_name_list*, *product_path_list*, *scale_list*, *offset_list*, *nodata_list*, *date_list*, *k1_list*, *k2_list*, *band_number_list*, *e_sun_list*, *sun_elevation_list*, *earth_sun_distance_list*)

remotior_sensus.core.table_manager.**add_spectral_signature_to_catalog_table**(*signature_id=None*, *macro-class_id=0*, *class_id=0*, *class_name=None*, *previ-ous_catalog=None*, *selected=1*, *min_dist_thr=0*, *max_like_thr=0*, *spec_angle_thr=0*, *geometry=0*, *signature=0*, *color_string=None*, *pixel_count=0*, *unit=None*)

remotior_sensus.core.table_manager.**append_field**(*matrix*, *field_name*, *data*, *data_type*)

remotior_sensus.core.table_manager.**append_tables**(*matrix1*, *matrix2*)

remotior_sensus.core.table_manager.**append_values_to_table**(*matrix*, *value_list*)

remotior_sensus.core.table_manager.**calculate**(*matrix*, *expression_string*, *output_field_name*, *progress_message=True*, *calculation_type=None*)

Parameters

- **matrix** – input matrix
- **expression_string** – string used for calculation where fields must be named using double quotes e.g.”field_name” or using ‘field.’ such as field.field_name or ‘matrix.’ such as matrix.field_name
- **output_field_name** – string of output field name
- **progress_message** – optional, if True display process message
- **calculation_type** – optional, numpy calculation dtype

remotior_sensus.core.table_manager.**calculate_multi**(*matrix*, *expression_string_list*, *output_field_name_list*, *nodata_value_output=None*, *output_field_dtype=None*, *progress_message=True*)

Parameters

- **matrix** – input matrix
- **expression_string_list** – list of strings used for calculation where fields must be named using double quotes e.g."field_name" or using 'field.' such as field.field_name or 'matrix.' such as matrix.field_name
- **output_field_name_list** – list of strings of output field names
- **nodata_value_output** – optional, nodata value for output
- **output_field_dtype** – optional, list of output dtypes
- **progress_message** – optional, if True display process message

remotior_sensus.core.table_manager.**columns**(*matrix*)

remotior_sensus.core.table_manager.**create_band_table**(*band_number=0*, *raster_band=None*, *path=None*, *name=None*, *wavelength=0*, *wavelength_unit=None*, *additive_factor=0*, *multiplicative_factor=1*, *date='1900-01-01'*, *x_size=0*, *y_size=0*, *top=0*, *left=0*, *bottom=0*, *right=0*, *x_count=0*, *y_count=0*, *nodata=None*, *data_type=None*, *crs=None*, *root_directory=None*, *number_of_bands=0*, *x_block_size=0*, *y_block_size=0*, *scale=None*, *offset=None*)

remotior_sensus.core.table_manager.**create_bandset_catalog_table**(*bandset_number=0*, *root_directory=None*, *date='NaT'*, *bandset_uid=0*, *bandset_name=None*, *previous_catalog=None*, *crs=None*, *box_coordinate_left=None*, *box_coordinate_top=None*, *box_coordinate_right=None*, *box_coordinate_bottom=None*)

remotior_sensus.core.table_manager.**create_bandset_table**(*band_list*)

remotior_sensus.core.table_manager.**create_generic_table**(*value_list*, *dtype_list*)

remotior_sensus.core.table_manager.**create_product_table**(*product=None*, *product_id=None*, *acquisition_date=None*, *cloud_cover=None*, *zone_path=None*, *row=None*, *min_lat=None*, *min_lon=None*, *max_lat=None*, *max_lon=None*, *collection=None*, *size=None*, *preview=None*, *uid=None*, *image=None*, *ref_url=None*)

remotior_sensus.core.table_manager.**create_spectral_signature_table**(*value_list*, *wavelength_list*, *standard_deviation_list=None*)

remotior_sensus.core.table_manager.**define_fields**(*matrix*, *field_list*)

remotior_sensus.core.table_manager.**export_table**(*matrix*, *output_path*, *fields=None*, *field_decimals: int | list = 2*, *separator=None*, *decimal_separator=None*, *nodata_value=None*, *nodata_value_output='nan'*, *progress_message=True*)

Parameters

- **matrix** – input matrix
- **output_path** – output path
- **fields** – optional list of fields to export
- **field_decimals** – integer number of decimals for decimal fields or list of integer values for decimal fields
- **separator** – separator of fields (default tab)
- **decimal_separator** – optional decimal separator for float values replacing . character
- **nodata_value** – optional nodata value to be replaced
- **nodata_value_output** – optional string to replace nodata value in output
- **progress_message**

remotior_sensus.core.table_manager.**find_nearest_value**(*array*, *field_name*, *value*, *threshold=None*)

remotior_sensus.core.table_manager.**get_values**(*matrix*, *value_field*, *conditional_string=None*, *progress_message=True*)

Parameters

- **matrix** – input matrix
- **value_field** – string of value field name
- **conditional_string** – optional string used for condition where field must be referred to using 'field.' such as field.field_name or 'matrix.' such as matrix.field_name
- **progress_message** – optional, if True display process message

remotior_sensus.core.table_manager.**join_matrices**(*matrix1*, *matrix2*, *field1_name*, *field2_name*, *join_type='leftouter'*, *matrix1_postfix='_m1'*, *matrix2_postfix='_m2'*, *use_mask=False*, *progress_message=True*)

remotior_sensus.core.table_manager.**join_tables**(*table1*, *table2*, *field1_name*, *field2_name*, *postfix='2'*, *nodata_value=None*, *join_type='left'*, *n_processes: int | None = None*, *progress_message=True*, *min_progress=None*, *max_progress=None*, *use_pandas=True*)

remotior_sensus.core.table_manager.**matrix_to_csv**(*matrix*, *output_path*, *fields=None*, *field_decimals: int | list = 2*, *separator=None*, *decimal_separator=None*, *nodata_value=None*, *nodata_value_output='nan'*, *progress_message=True*)

Parameters

- **matrix** – input matrix
- **output_path** – output path
- **fields** – optional list of fields to export
- **field_decimals** – integer number of decimals for decimal fields or list of integer values for decimal fields
- **separator** – separator of fields (default tab)
- **decimal_separator** – optional decimal separator for float values replacing . character

- **nodata_value** – optional nodata value to be replaced
- **nodata_value_output** – optional string to replace nodata value in output
- **progress_message**

remotior_sensus.core.table_manager.**mpi_bcast**(*value*)

remotior_sensus.core.table_manager.**open_file**(*file_path: str*, *separators: str | list | None = None*, *field_names: list | None = None*, *skip_first_line: bool | None = True*, *progress_message: bool | None = True*) → recarray | None

Opens a file.

Opens a file by reading the content and creating a table (which is a NumPy structured array). File formats csv and dbf are supported.

Parameters

- **file_path** – path of output file.
- **separators** – list of characters used as separator in csv files; default is tab and comma.
- **field_names** – list of strings to be used as field names.
- **skip_first_line** – skip the first line in csv files, in case the first line contains field names.
- **progress_message** – if True then start progress message; if False does not start the progress message (useful if launched from other tools).

Returns

Table as NumPy structured array.

Examples

Open a file

```
>>> table_1 = open_file('file.csv')
```

remotior_sensus.core.table_manager.**pivot_matrix**(*matrix*, *row_field*, *column_function_list*, *secondary_row_field_list=None*, *filter_string=None*, *nodata_value=-999*, *cross_matrix=None*, *field_names=False*, *progress_message=True*, *use_pandas=True*, *input_nodata_value=None*)

Parameters

- **matrix** – matrix array
- **row_field** – field out_column_name of values used as rows
- **column_function_list** – list of lists of column out_column_name and function on values and optional out dtype
- **secondary_row_field_list** – optional list of fields to be used as secondary rows
- **filter_string** – optional string for filtering input matrix values
- **nodata_value** – optional, value for nodata
- **cross_matrix** – optional, if True the output table field names are only combination values

- **field_names** – optional, if True returns field names without performing the pivot matrix
- **progress_message** – optional, if True display process message
- **use_pandas** – optional, if True use Pandas if available
- **input_nodata_value** – optional, value for input nodata

remotior_sensus.core.table_manager.**redefine_matrix_columns**(*matrix*, *input_field_names*, *output_field_names=None*, *progress_message=True*)

Parameters

- **matrix** – matrix array
- **input_field_names** – list of field names to be included in output
- **output_field_names** – optional list of output field names with the same length as input_field_names
- **progress_message** – optional, if True display process message

remotior_sensus.core.table_manager.**rename_field**(*matrix*, *old_field*, *new_field*)

remotior_sensus.core.table_manager.**replace_numpy_operators**(*expression*)

remotior_sensus.core.table_manager.**replace_variables**(*matrix*, *expression_string*)

remotior_sensus.core.table_manager.**sort_table_by_field**(*matrix*, *field_name*)

remotior_sensus.core.table_manager.**stack_product_table**(*product_list*)

remotior_sensus.core.temporary module

class remotior_sensus.core.temporary.**Temporary**(*temp_dir=None*)

Bases: object

__init__(*temp_dir=None*)

clear(*keep_log=None*)

classmethod create_root_temporary_directory(*prefix=None*, *directory=None*)

create_temporary_directory(*rank=None*)

temporary_file_path(*name_suffix=None*, *name_prefix=None*, *name=None*, *directory=None*, *rank=None*, *synch_ranks=None*)

temporary_raster_path(*name=None*, *name_suffix=None*, *name_prefix=None*, *extension='.tif'*, *rank=None*)

remotior_sensus.core.temporary.**mpi_bcast**(*value*)

remotior_sensus.core.temporary.**remove_root_temporary_directory**(*directory*)

Module contents

1.8 API Reference

1.8.1 remotior_sensus package

Subpackages

Module contents

1.9 Changelog

1.9.1 v0.7.4

- Minor update to vector to raster with parameter for output data type such as Int32, UInt32, Int16, UInt16, or Byte.

1.9.2 v0.7.3

- Minor bug fixing.

1.9.3 v0.7.2

- Minor bug fixing.

1.9.4 v0.7.1

- In "Band classification" tool added feature importance output when using Random Forest with scikit framework.
- Minor bug fixing.

1.9.5 v0.7.0

- New optional dependency mpi4py for MPI bindings.
- Implementation of MPI in several tools for parallel processing.

1.9.6 v0.6.3

- Fix band name for several products in download_products by Cemu0.

1.9.7 v0.6.2

- Minor bug fixing.

1.9.8 v0.6.0

- Added optional dependency Pandas for performance improvement in tabular data.
- In tool "Band classification" added option for using PyTorch pretrained model. In case a pretrained model is selected, and additional algorithm is selected for classification, using the same parameters of the named algorithm (e.g. random forest); after executing the pretrained model, the additional algorithm is executed on the embeddings for classification. Currently, it works with models pretrained by the Allen Institute for Artificial Intelligence (SatlasPretrain: https://satlas-pretrain.allen.ai) in particular, Sentinel-2 swin-v2-base single-image multispectral and swin-v2-tiny single-image multispectral models, and Landsat 8 Landsat 9 swin-v2-base single-image multispectral model. SatlasPretrain model weights are released under the Open Data Commons 'Attribution License (ODC-BY). The repository code is licensed under the Apache License 2.0 (https://huggingface.co/allenai/satlas-pretrain). This tool downloads the official SatlasPretrain weights (Bastani et al., "SatlasPretrain: A Large-Scale Dataset for Remote Sensing Image Understanding", ICCV 2023, arXiv:2211.15660, https://doi.org/10.48550/arXiv.2211.15660). All model weights remain the property of their respective authors.
- In tool "Band classification" added PyTorch pretreained segmentation models for Sentinel-2 (swin-v2-base single-image multispectral model using 3 bands or 4 bands) pretrained by DPR Team as part of the DPR Zoo Segmentation Hub framework (https://github.com/DPR25/dpr-zoo-segmentation-hub) based on SatlasPretrain models. The model output classes: background, water, developed, tree, shrub, grass, crop, bare, snow, wetland, mangroves, moss. The repository code of DPR Zoo models are licensed under the MIT License (https://huggingface.co/martinkorelic/dpr-zoo-models). This tool downloads the model weights (DPR

Team, 2025. Made as part of Arnes Hackathon 2025). All model weights remain the property of their respective authors.

- In tool "Download products" included the download of Sentinel-2 L2A SCL band.
- In tool "Preprocess products" included the Sentinel-2 L2A SCL band.
- Improved progress monitoring for multiprocess.
- Code optimization and bug fixing.

1.9.9 v0.5.2

- Performance improvement for the tool "Vector to raster" with the method area_based.
- Improvement of the multiprocess iterator.
- Minor fixes

1.9.10 v0.5.1

- Fixed issue with the tool "Vector to raster" where a few polygons were randomly skipped using the method area_based.
- Minor fixes

1.9.11 v0.5.0

- New tool "Raster label" for calculating the area of contiguous patches in a raster. The output is a raster where each pixel value represents the pixel count of the patch thereof.
- Performance improvement for the tool "Vector to raster" with the method area_based.
- Minor fixes

1.9.12 v0.4.4

- Changed raster_zonal_stats to accept raster input as reference_path
- Fixed handling nan value as nodata

1.9.13 v0.4.3

- First experimental implementation of Pytorch for band_calc
- Minor fixes

1.9.14 v0.4.2

- Minor fixes

1.9.15 v0.4.1

- Fixed preprocessing calculation
- Minor fixes

1.9.16 v0.4.0

- Added tool "Band clustering" for unsupervised K-means classification of bandset
- Added tool "Raster edit" for direct editing of pixel values based on vector
- Added tool "Raster zonal stats" for calculating statistics of a raster intersecting a vector.
- Improved the NoData handling for multiprocess calculation

- In “Band clip”, “Band dilation”, “Band erosion”, “Band sieve”, “Band neighbor”, “Band resample” added the option multiple_resolution to keep original resolution of individual rasters, or use the resolution of the first raster for all the bands
- In “Cross classification” fixed area based accuracy and added kappa hat metric
- In “Band combination” added option no_raster_output to avoid the creation of output raster, producing only the table of combinations
- In “Band calc” replaced nanpercentile with optimized calculation function
- Improved extraction of ROIs in “Band classification”
- Minor bug fixing and removed Requests dependency

1.9.17 v0.3.5

- Fixed Copernicus access token error
- Fixed automatic band wavelength definition in BandSet

1.9.18 v0.3.04

- Fixed Jupyter interface

1.9.19 v0.3.03

- Fixed Jupyter interface

1.9.20 v0.3.02

- Fixed Jupyter interface

1.9.21 v0.3.01

- Added functions for interactive interface in Jupyter environment
- Fixed Sentinel-2 band 8A identification in preprocess products

1.9.22 v0.2.01

- In Download Products added the functions to search and download Collections from Microsoft Planetary Computer: Sentinel-2, Landsat, ASTER, MODIS Surface Reflectance 8-Day, and Copernicus DEM

1.9.23 v0.1.24

- Fixed band calc calculation with multiband raster as bandset
- Fixed preview path for Copernicus products

1.9.24 v0.1.23

- Minor fixes

1.9.25 v0.1.22

- Fixed prepare input function
- Fixed logger for multiprocess

1.9.26 v0.1.21

- Fixed requirements

1.9.27 v0.1.20

- Fixed Copernicus search and download service

1.9.28 v0.1.19

- Fixed Copernicus search and download service

1.9.29 v0.1.18

- Added Copernicus download service from https://catalogue.dataspace.copernicus.eu if copernicus_user and copernicus_password are provided.

1.9.30 v0.1.17

- Fixed spectral signature calculation for multiband raster
- Fixed closing multiprocess at exit

1.9.31 v0.1.16

- Fixed issue in block size calculation for multiprocess in case of large input raster and low RAM;
- Fixed management of bandsets using multiband rasters;
- Minor fixes to multiprocess download;

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