Sen2Like

Introduction

Sen2Like is a processing algorithm that enables generation of Sentinel-2 like harmonised/fused surface reflectance products. Its primary benefit is in enabling higher amount of harmonized data in time series, through combining Landsat-8 and Sentinel-2 data products. This provides roughly 30 % increase in the number of acquisitions with respect to Sentinel-2 only.

The F-TEP Sen2Like services are used to generate an Analysis Ready Dataset from Sentinel-2 L1C (since July 2015) and Landsat-8 (since March 2013) imagery. The service uses the 90 m Copernicus DEM and data from the Copernicus Atmosphere Monitoring Service (CAMS). Atmospheric correction options SMAC and Sen2Cor3 are available. Two output product types for Landsat-8 images can be generated:

- Harmonized Surface Reflectance Products (Level 2H), at 30m resolution
- Fused Surface Reflectance Products (Level 2F), at 10-20m resolution

Sen2Like is offered as two services that perform identical processing but differ in how input data is selected:

- **Sen2LikeSingleTile:** Tile-based mode, where the user specifies the Sentinel-2 tile of interest and the temporal range, and the service handles the rest. The user-defined query specifies the data constraints (dates, cloudiness, coverage of the tile). The service retrieves all images from the CREODIAS data archive that match these criteria. The archive contains global Sentinel-2 L1C dataset and European coverage for Landsat-8.
- **Sen2LikeProduct:** Product-based mode, where the user assigns individual data products as input to the service. The user selects the Sentinel-2 and Landsat-8/9 products that should be processed. If a Landsat image is not available on CREODIAS, it can be uploaded as a zip file and processed.

A third offered service, **Sen2LikeSingleTileDataSearch**, can be used to check which image products would be used by the Sen2LikeSingleTile service with a specific set of input parameters. It produces a text file with the listing of products and their cloud coverage and tile coverage values. It is equivalent to using the Sen2LikeSingleTile service in 'Only check data availability' mode, but has less input parameters and starts usually faster as it is configured to use a worker pool that has always a worker virtual machine available.

For details on the format specification or the functionalities of the Sen2Like software, please refer to the Product Format Specification, the User Manual v1.9 and the project Github page.

Inputs

The input parameters for Sen2LikeSingleTile and Sen2LikeProduct are presented in Table 1. The parameters of Sen2LikeSingleTileDataSearch are a subset of the parameters.

Table 1. Input parameters

Input	Description
Tile ID	The target Sentinel-2 tile identifier, e.g. 31TFJ.
Start date	Input data start date in format yyyy-mm-dd. Single tile mode will use this in data search but both need it for auxiliary data selection.
End date	Input data end date in format yyyy-mm-dd. Single tile mode will use this in data search but both need it for auxiliary data selection.
Cloud coverage	Maximum cloud cover percentage in the processed images, 0-100. Default 10.
Image coverage	The minimum image coverage percentage for the tile, 0-100. Default 50.
Create fusion output	Create also 10 meter output dataset. Note: to create fusion output from Landsat-8 images, two earlier Sentinel-2 images from the area must be processed first. Default True.
Reference image	Reference image for geometry correction.
Reference image name pattern	String or regular expression that must match the reference image name. Use if there are multiple images in the given input. Use * to match any characters, e.g. *.tif to match all files with suffix .tif
Reference band	Reference band to use in geometry correction. Default B04.
Bands	Bands to process as a comma separated list (B01, ...). Default is all bands.
Atmospheric correction	The atmospheric correction to be applied to the images. Options: No | SMAC | Sen2Cor
Output type	The default output is in zipped .SAFE folder structures. With output type GeoTiff, a single GeoTiff image of each output is produced. The image contains bands B1, B2, B3, B4, B8A, B11, B12 (or a subset of those if output bands were limited).
Scale GeoTiff with quantification value	Applicable with GeoTiff output format only. Scale the data values with quantification value to produce a float32 output image in the range [0,1]. Otherwise an uint16 image with range [0,10000] will be produced.
Output GeoTiff resolution	Applicable with GeoTiff output format only. One of 10, 20, 30, or 60 meters.
Only check data availability *(Sen2LikeSingleTile only)*	If set to True: Provide a credit consumption estimate, instead of processing the images. Running in this mode does not consume coins. This only creates a text file with the list of images that would be processed with the given parameters. Using this mode is equivalent to running the separate Sen2LikeSingleTileDataSearch service.
Maximum product count *(Sen2LikeSingleTile only)*	Maximum number of products to process. This can be used to set the estimated cost of the job to the number of products an image search run has indicated, which matches the actual cost of the job. If the product count is not set, the estimated cost of the job is the number of days in the period * 0.67, and the user must have at least that many coins left.
Input images *(Sen2LikeProduct only)*	The Landsat-8 or Sentinel-2 images to process, one or more F-TEP URIs.
Input image processing order *(Sen2LikeProduct only)*	The order in which the input images should be processed as a comma-separated list of F-TEP URIs, e.g. sentinel2:///S2A_MSIL1C_...,landsat:///LC08_L1TP_... This is needed to ensure the correct processing order of the images, as the platform does not necessarily process the images in the order they were specified in the 'Input images' parameter.

Outputs

The services can produce both harmonized (L2H) and fusion (L2F) output versions. The output files of the Sen2Like processing services are images in either .SAFE or GeoTiff format:

- In .SAFE format, each output image is in its own Zip file, named with the .SAFE folder name with ".zip" suffix.
- In GeoTiff format, each output image is a multiband GeoTiff image containing the bands shown in Table 2, or a subset of those if processing was not requested for all of them. The table also shows their corresponding bands in the input Sentinel-2 or Landsat-8 images.

Table 2. Bands in the output

Output GeoTiff band	Sentinel-2 band	Landsat-8 band
B1	B1	B1
B2	B2	B2
B3	B3	B3
B4	B4	B4
B8A	B8A	B5
B11	B11	B6
B12	B12	B7

The outputs will be available for 14 days. The platform subscription packages can be used for extended storage or further processing.

Coin consumption

For pay-per-use access to the service, the user first acquires a suitable number of credits, which are then consumed in processing based purely on the number of images. The processing cost is one coin per processed image, regardless of whether only L2H or both L2H and L2F outputs are produced.

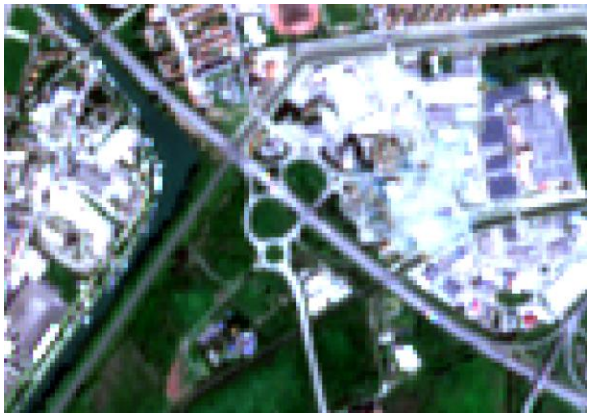
When a job is launched, its coin consumption is estimated based on the input parameters. The estimates are calculated as follows:

- **Sen2LikeSingleTile:** Length of the time interval in days * 0.67, rounded to the next larger integer, or the value of the 'Maximum product count' parameter if it has been specified and is smaller than the day count based estimate. There is no cost in the 'Only check data availability' mode.
- **Sen2LikeProduct:** The number of input images.
- **Sen2LikeSingleTileDataSearch**: No cost.

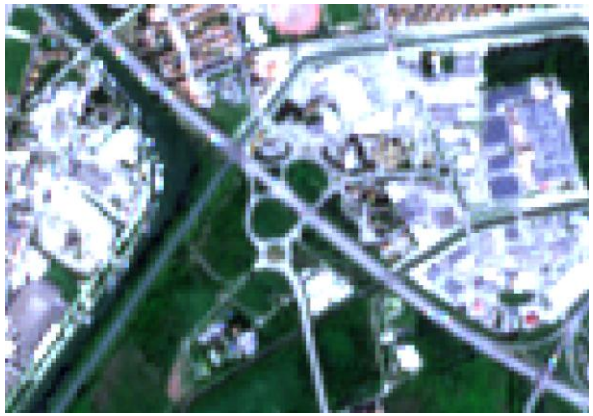
A processing job is launched if the estimated number of required coins is available. After the processing is finished, coins are charged from the user wallet based on the number of images that were processed.

Sample outputs (Arles, France)

Fused 10 m output



Sentinel-2 **1.4.2024**



Sentinel-2 **11.4.2024**

Landsat-8 **14.4.2024**

Harmonised 30 m output

Landsat-8 **14.4.2024**