

# Forestry Thematic Exploitation Platform



**forestry**  

---

**tep**

## User Manual

v2019.12

**VTT**

**CGI**

## Contents

1	Intro and overview .....	4
1.1	What is F-TEP? .....	4
1.2	Platform infrastructure.....	4
1.3	Data availability .....	4
1.4	Terminology and concepts .....	5
2	Getting started .....	7
2.1	User account.....	7
2.2	Entering the platform .....	8
2.3	Explorer interface .....	9
2.4	Searching for data.....	11
2.5	Databaskets .....	14
2.6	Manage / Share interface .....	17
2.7	Uploading reference data.....	18
2.8	Files interface .....	19
3	Running a service.....	21
3.1	Selecting the service .....	21
3.2	Defining inputs.....	22
3.3	Launching the service .....	22
3.4	Managing the job.....	22
3.5	Parallel processing.....	23
4	Processing services .....	25
4.1	VegetationIndices .....	25
4.2	ForestChangeS2 .....	27
4.3	LandCoverS2 .....	29
4.4	LandCoverS1 .....	32
4.5	LandCoverGeotiff.....	35
4.6	S1Biomass.....	37
4.7	S1Stack.....	40
4.8	CombS2granules and CombS2granulesZ .....	41
5	Application services .....	43
5.1	Monteverdi .....	43
5.2	QGIS v2.18 .....	45
5.3	QGIS v3.6 .....	47
5.4	SNAP .....	48
6	Collaborative aspects.....	50



---

6.1	Forum .....	50
6.2	Groups .....	51
6.3	Sharing data .....	53
7	Service development .....	54
7.1	Developer interface .....	54
7.2	Creating services.....	55
7.3	Service example.....	57
7.4	Sharing services .....	58

## 1 Intro and overview

### 1.1 What is F-TEP?

Forestry Thematic Exploitation Platform is an online platform that enables users to efficiently access and process satellite data for forest monitoring purposes. It offers a wide range of readily available processing services and tools, and it enables users to create and share their own processing services, tools and products.

The platform has been developed in projects funded by the European Space Agency (ESA). ESA continues to support the platform financially. The platform is operated by VTT in Finland and CGI IT UK, committed to maintain and develop the platform further and support the users. More background and general information on the platform can be found on other sections of the platform home page: <https://f-tep.com/>

### 1.2 Platform infrastructure

The Forestry TEP is integrated with CloudFerro's CREODIAS<sup>1</sup> infrastructure, one of the Data Information and Access Services (DIAS). The baseline processing environment available for all users consists of 4 virtual CPUs and 16 GB of RAM, along with temporary workspace storage of approximately 64 GB (SSD-type). Output product storage is not currently limited. The exact configuration of the processing environment, including sizing and enforcing of storage quotas, is still under review. Usage levels are monitored to ensure fair use.

Note that specific configurations are possible. If a processing service requires specific capacity for CPU, RAM or storage, we may arrange dedicated resources. Please contact the Forestry TEP team for further details.

From the user system set-up point of view, a screen width of 1920 pixels is recommended. This will improve particularly the visual experience of using the application services (e.g. QGIS, SNAP and Monteverdi).

### 1.3 Data availability

Through F-TEP, users can access all datasets stored in CREODIAS Earth Observation (EO) catalogue<sup>2</sup>. Currently, the list of available satellites includes:

Satellite	Platform
<b>Sentinel-1</b>	S1A, S1B
<b>Sentinel-2</b>	S2A, S2B
<b>Sentinel-3</b>	S3A, S3B
<b>Sentinel-5P</b>	S5P
<b>Landsat 5</b>	n.a.
<b>Landsat 7</b>	n.a.
<b>Landsat 8</b>	n.a.

<sup>1</sup> <https://creodias.eu/>

<sup>2</sup> <https://discovery.creodias.eu/dataset>



## 1.4 Terminology and concepts

This page describes the basic terminology and concepts that the user face while working on the platform.

**AOI:** Area of Interest. The F-TEP services expect the AOI in the Well-known text (WKT) format, a valid example being: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)).

**Databasket:** A databasket refers to a logical grouping of satellite products and/or F-TEP products and/or reference data held together for a particular purpose. A databasket is identified by a name and a description. User can view and manage their databaskets either within the data panel (at the bottom of the map panel in the 'Explorer' interface) or in 'Manage / Share' interface.

**Data Panel:** Data Panel opens along the bottom of the 'Explorer' page and includes details of recent data searches, databaskets, jobs and messages.

**Developer interface:** The developer interface allows a user to create his own workflows as services.

**Explorer interface:** The explorer interface is the main interface for a user to select, manage and use data and services.

**Group:** A group is a collection of users with a common interest. Groups allow users to communicate and share material within a selected number of peers. They are managed via the 'Manage / Share' interface.

**Helpdesk:** The helpdesk interface provides material and support to help users perform actions on the platform. It also provides service desk information.

**Job:** A job is a specific data processing activity that has been instigated by the user. Clicking on the jobs section of the data panel allows users to explore the job status.

**Manage / Share interface:** The Manage / Share interface lists the various groups that a user belongs to. Groups allow users to communicate and share material within a selected number of peers.

**Message Panel:** The message panel shows information from the F-TEP system to the user about jobs, projects, databaskets etc.

**My Account interface:** The My Account interface provides an overview of the user's account including profile and F-TEP account activity.

**Project:** A project is a collection of activities that a user has defined to be related. A user can create projects when commencing activities.

**Service:** A service is a data processing or visualisation application or workflows made available to the users.

**Coins:** Coins are currently used mainly to monitor usage levels. In the future, the coins will be part of the way to charge users for the use of the platform.

**Workspace:** The workspace panel is where the users manage all the activities and entities defined in the system. They can interact with defined databaskets associated to the current project here.

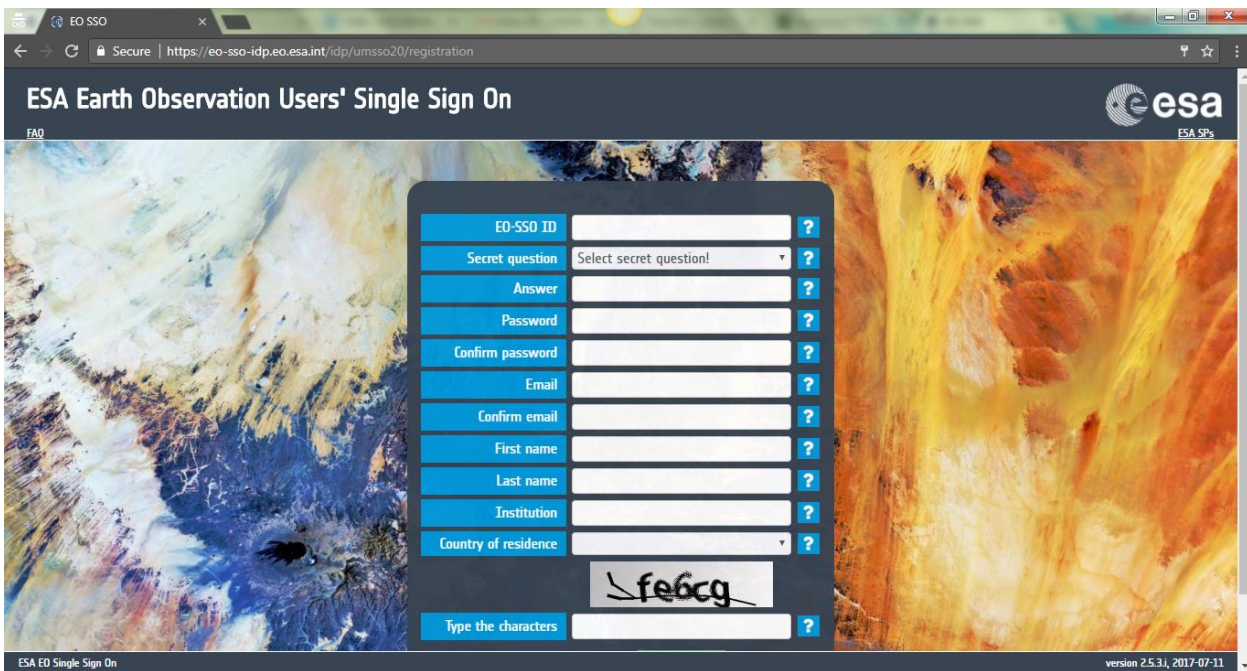
## 2 Getting started

### 2.1 User account

User authentication on the platform is managed by ESA's Earth Observation Single Sign On (EO-SSO). It is possible to access the platform only after a successful authentication. If you do not have an EO-SSO account yet, you can register using the following link (as provided also at the top of the ESA Earth Online<sup>3</sup> front page):

<https://eo-ssoidp.eo.esa.int/idp/umsso20/registration>

You will be presented with the following page:



Please note that your password must use at least 8 characters and include at least a lower case, an upper case, a digit and a special character.

Once you have completed and submitted the registration form successfully, the following message will be displayed:



You should then receive an email confirming that the first part of your registration has been successful. It will provide you with a link that you will need to follow to complete the registration process.

<sup>3</sup> <https://earth.esa.int/>

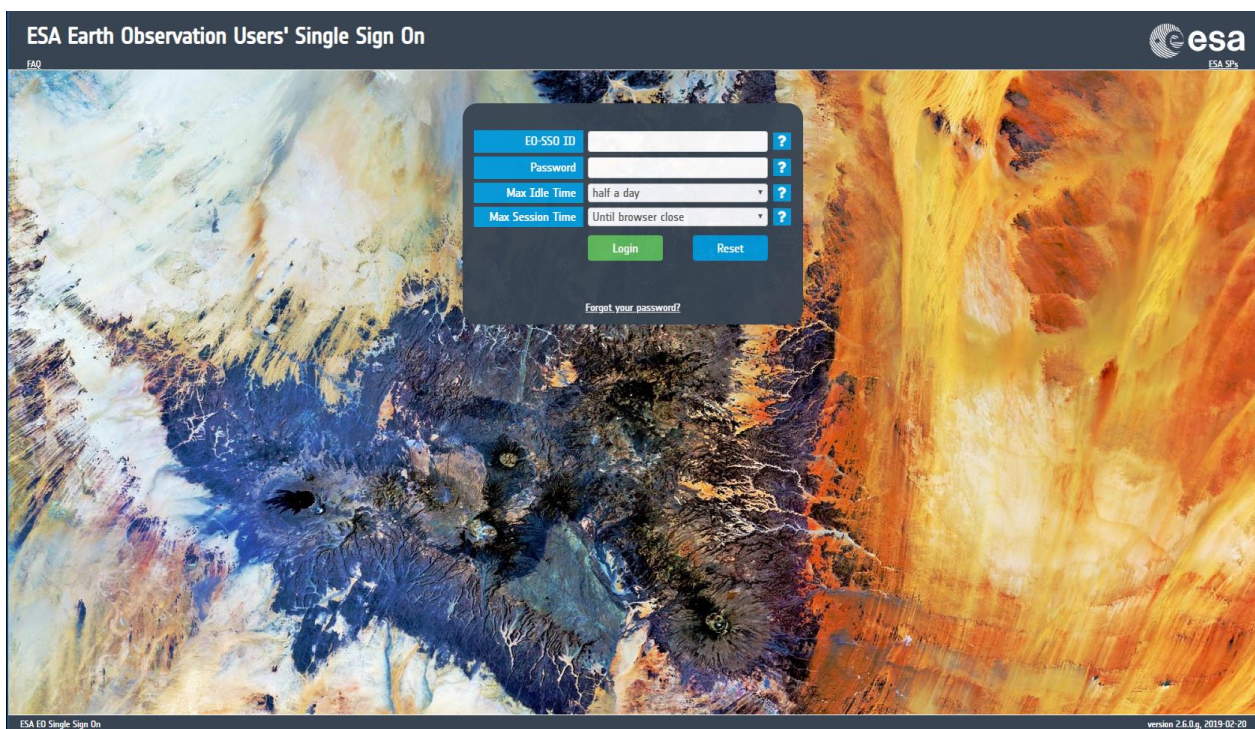
Once you click the link you should be presented with the following screen confirming that your account has been successfully activated:



## 2.2 Entering the platform

With a user account set up, the F-TEP platform can be accessed from the website front page at <https://f-tep.com/> via the "Enter the platform" link. The platform can also be reached through the direct link <https://f-tep.com/app/>.

On entering, you will first be redirected to ESA's EO-SSO platform and asked to login using the details of your user account. You can also set the maximum idle time and maximum session time that will determine how often you will be presented with the login screen.



Once you have logged in you will be redirected to the F-TEP platform interface.

The main screens of the platform user interface are the following - accessible through links at the top of the screen:

**Explorer:** This is the main, map-based interface for working with the input data, the services and the processing jobs, as described in the next section.



**Developer:** This interface allows expert users to create their own workflows and services. This page is only visible / accessible for expert users. If you cannot see the 'Developer' interface but would like to develop your own services, you are encouraged to request for an upgrade of your account status via the 'Helpdesk' (see below).

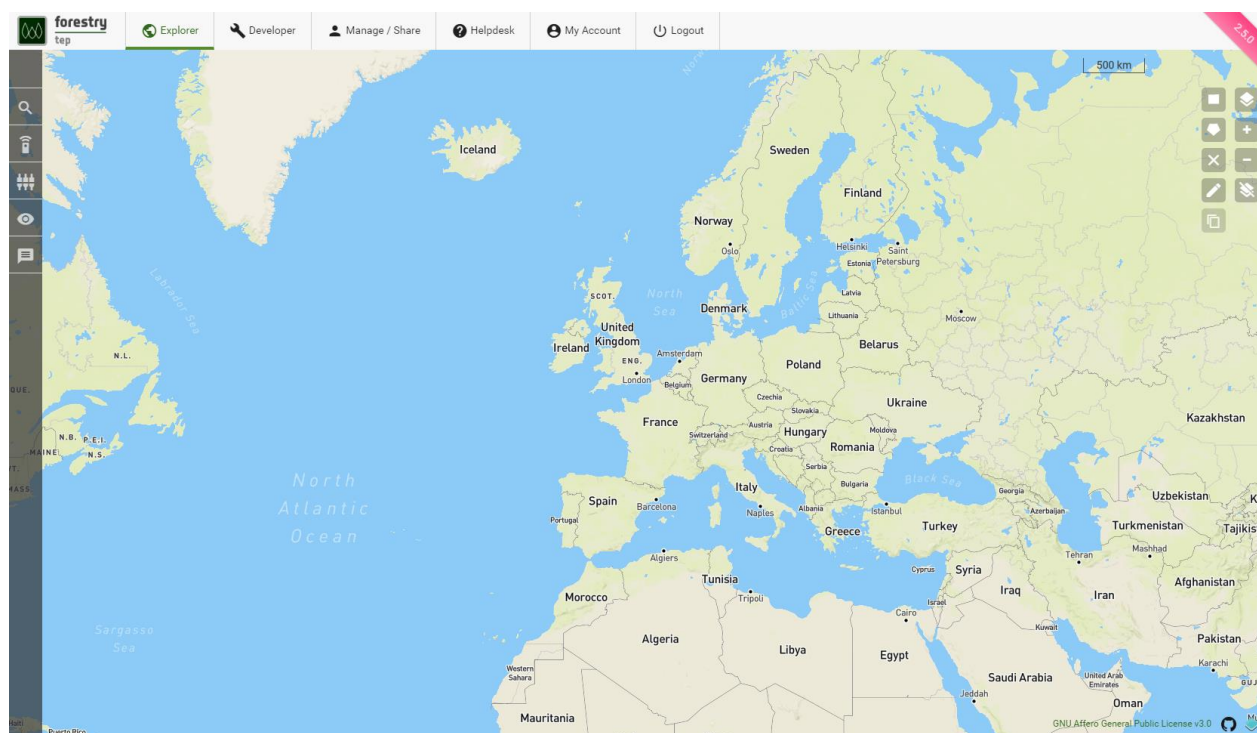
**Manage / Share:** This page allows a user to explore the various groups and projects they belong to as well as access their files, data baskets, logs of their run jobs and any services they have created. This page also allows users to share their services and products with selected users.

**Helpdesk:** This page provides the user with access to useful supporting materials (e.g. user manual and tutorial videos) and official documentation (e.g. Terms & Conditions and License). Contact and feedback address is also provided here.

**My Account:** This page provides the user with information on the activities on F-TEP including usage stats, profile information and use of 'Coins'.

## 2.3 Explorer interface

On entrance, the F-TEP platform opens with the Explorer user interface.



The Explorer interface is built around the map panel. The map acts both as an input element to specify an area of interest and to show the footprint of the results. Clickable icons can be found on the left and right to of the map panel to access various functionalities and to use necessary tools as described below.

The left column contains a series of icons that allow the user to execute various activities:



The 'Search' icon allows the user to search for various datasets, including EO data, reference data and existing F-TEP products.



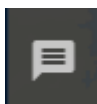
The 'Services' icon shows available services, which includes both satellite data pre-processing tools as well as forest and land cover monitoring applications.



The 'Workspace' icon allows the user to specify the parameters of a service and launch the process.



The 'Data Panel' icon opens the Data Panel along the bottom of the display. Search results, databaskets and information on jobs are provided in this panel.



The 'Messages' icon opens the Messages panel along the bottom of the display. Any messages from the system are provided in this panel.

Map tools can be found in the right column and include:



The 'Draw Square' icon allows the user to draw a square on the map, to be used to define search area.



The 'Draw Polygon' icon allows the user to draw a polygon on the map, to be used to define search area.



The 'Remove Search Polygon' icon deletes the square or polygon areas of interest currently on the map.



The 'Edit Polygon' icon allows the user to manually edit the vertex coordinates of a search polygon.



The 'Copy Polygon to Clipboard' icon allows user to copy the vertex coordinates of a search polygon to clip board, to be copied to any text editor.



The 'Map Layer' icon allows the user to choose the base map to be used.



The 'Zoom in' icon allows to user to zoom in on the map. Note that this can also be done with the scroll wheel of the mouse.



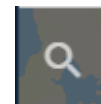
The 'Zoom out' icon allows to user to zoom out on the map. Note that this can also be done with the scroll wheel of the mouse.



The 'Clear Map' icon removes all polygons from the map and resets the map to default extent.

## 2.4 Searching for data

The search tool is activated by clicking the 'Search' icon.



This opens the search panel with three tabs to specify the target:

- **Satellite:** enables to search for satellite data. The search request is dispatched to the appropriate backend data provider. For most parameter configurations this will be the CREODIAS EO catalogue<sup>4</sup>. The list of available satellites can be seen in the drop down menu of the 'Mission' parameter.
- **Reference:** enables to search for data uploaded by or made available to the user.
- **F-TEP Products:** enables to search for products previously processed in F-TEP.

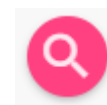
In each of the search panels, a set of parameters can be used to narrow down the search to limit the number of results.

To search for satellite data, the 'Satellite' tab is clicked, which opens the Satellite search panel. Available satellites can be seen in the drop down menu of the 'Mission' parameter. After choosing the satellite mission, the search panel shows a relevant selection of parameters.

To narrow the search to a specific time period, the start and end dates need to be specific in the 'Product date' parameter.

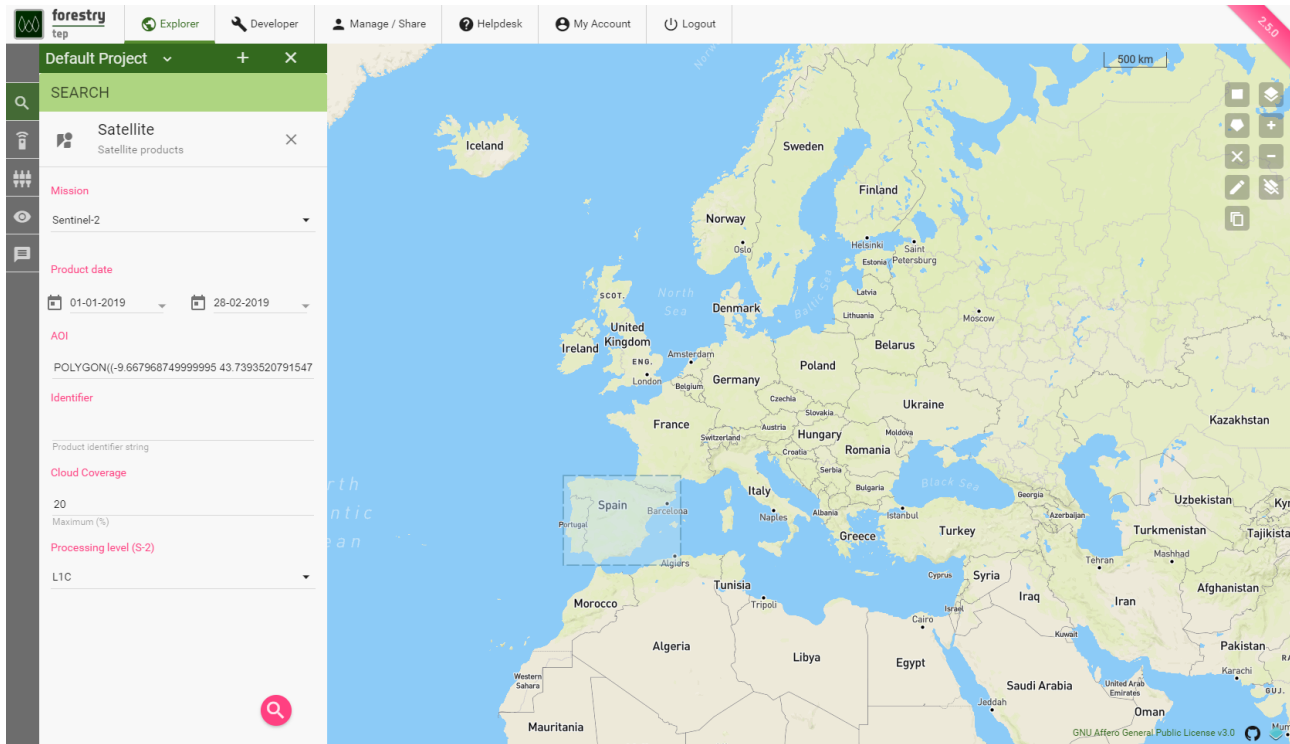
An area of interest (AOI) can be drawn on the map using the map tool provided on the right hand side. The coordinates of the polygon drawn on the map are automatically read into the 'AOI' parameter. It is also possible to define the Area of Interest (AOI) by drag-and-dropping a KML file from the user's file system on top of the map view.

To submit the search, click the search button at the bottom right corner of the of the search panel. The system will show a spinner while the search is being submitted and the results collected.



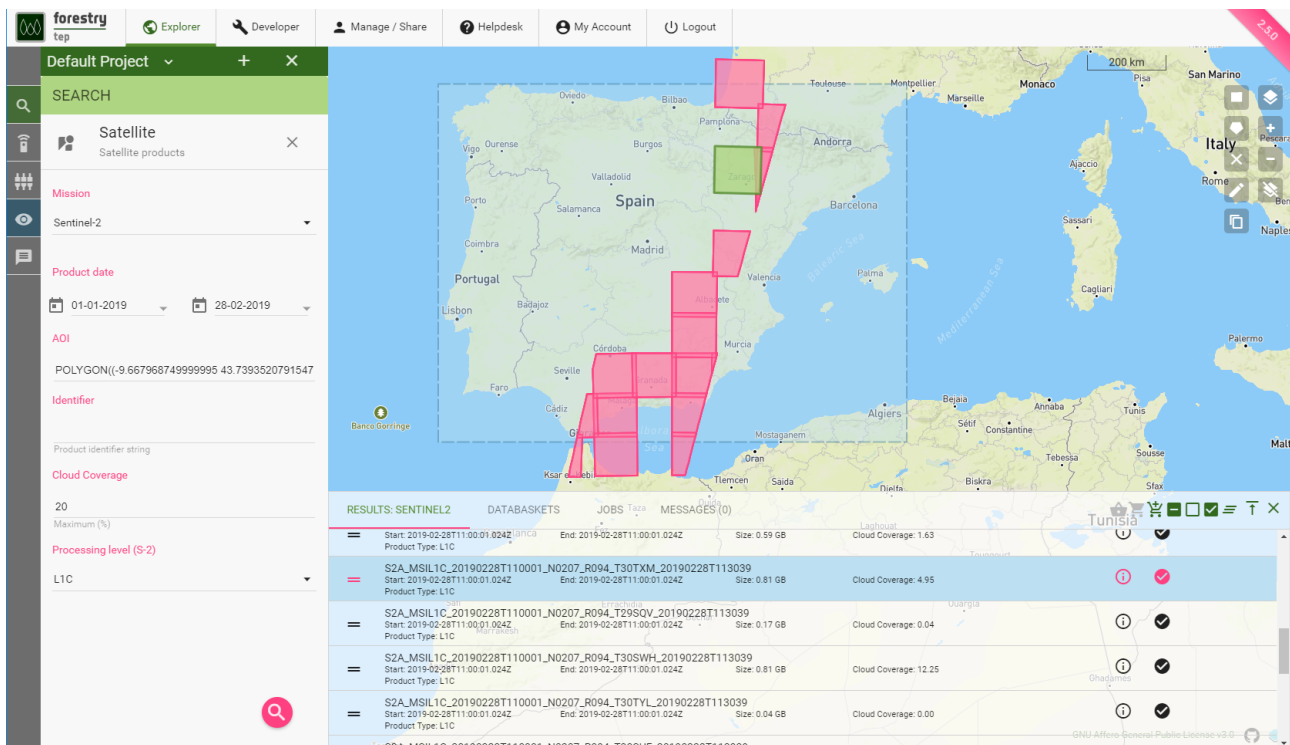
The picture below shows an example search for Sentinel-2 products, with an area of interest on the Iberian Peninsula and time range from Jan 1st 2019 to Feb 28th 2019. In addition, the maximum cloud coverage is set to 20% and level L1C products are searched.

<sup>4</sup> <https://discovery.creodias.eu/dataset>



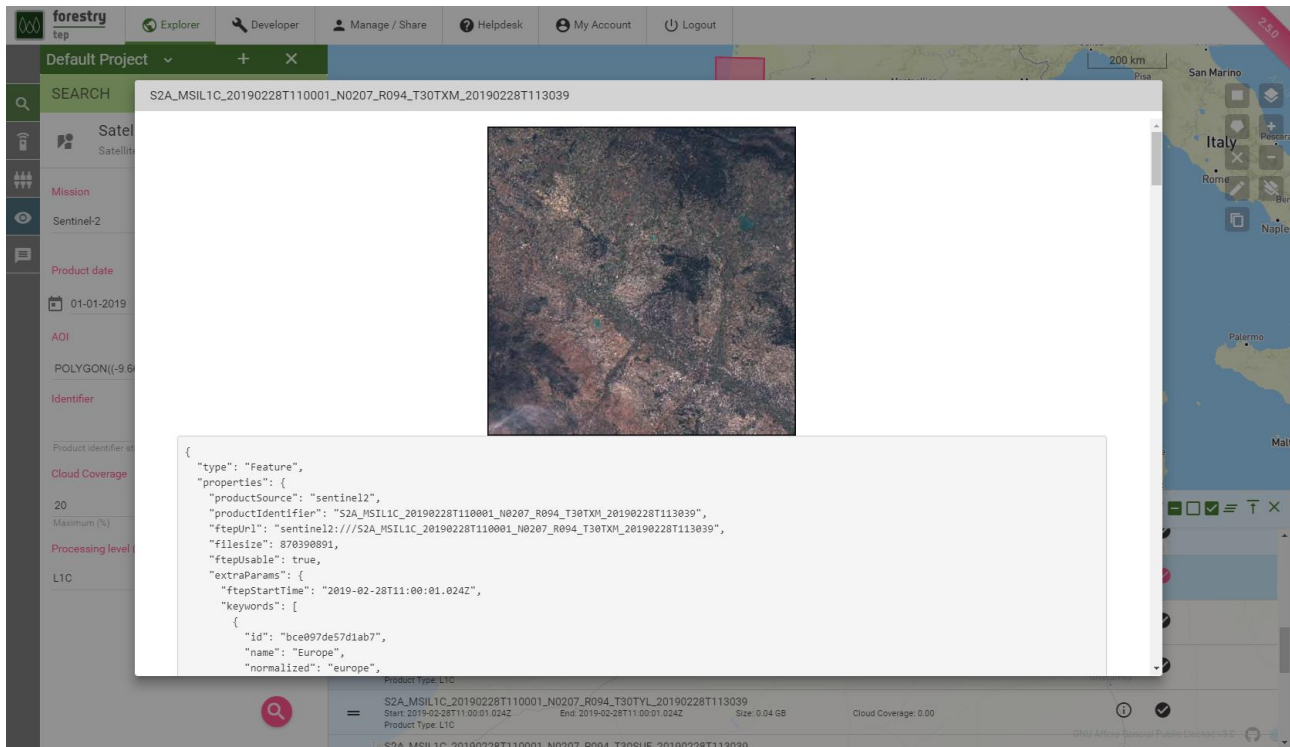
The list of results are shown in the 'Results' panel at the bottom of the page. Image footprints are also presented on the map. By clicking on a particular row or rows in the 'Results' panel, the corresponding map footprint(s) is shown and highlighted on the map.

Note that if the search returns many results, they are divided to multiple pages of results, and only the footprints of the current page of results are shown.





By clicking on the information link, metadata of the selected image will be shown. A quicklook image will also be shown, whenever available.



In case of Sentinel-2 data in particular, the user is generally recommended to identify as cloud-free images as possible.

Having located suitable data to use in processing, the user may be interested to proceed with selecting and launching a particular processing service or application, as described below in sections 3, 4 and 5. Alternatively, the user might want to collect the search results for later reference in a databasket, as described next in section 2.5.

## 2.5 Databaskets

A Databasket is a logical grouping of satellite data and/or F-TEP products and/or reference data held together for a particular purpose and identified by a name.

By selecting a number of products in the Result Panel and clicking on the 'Create New Databasket' button it is possible to create a databasket containing the selected products. A pop-up window listing all the selected images will open. In this window the user should give a name for the databasket. A short description of the databasket may also be given.



RESULTS: SENTINEL2	DATABASKETS	JOBS	MESSAGES (2)
Start: 2019-01-29T03:30:09.024Z Product Type: L1C			Size: 0.07 GB Cloud Coverage: 0.00
S2B_MSIL1C_20190129T033009_N0207_R018_T47PRS_20190129T074915 Start: 2019-01-29T03:30:09.024Z End: 2019-01-29T03:30:09.024Z Product Type: L1C			Size: 0.36 GB Cloud Coverage: 0.00
S2B_MSIL1C_20190129T033009_N0207_R018_T48QUE_20190129T074915 Start: 2019-01-29T03:30:09.024Z End: 2019-01-29T03:30:09.024Z Product Type: L1C			Size: 0.81 GB Cloud Coverage: 0.00
S2B_MSIL1C_20190129T033009_N0207_R018_T48PUC_20190129T074915 Start: 2019-01-29T03:30:09.024Z End: 2019-01-29T03:30:09.024Z Product Type: L1C			Size: 0.81 GB Cloud Coverage: 0.00
S2B_MSIL1C_20190129T033009_N0207_R018_T48QUD_20190129T074915 Start: 2019-01-29T03:30:09.024Z End: 2019-01-29T03:30:09.024Z Product Type: L1C			Size: 0.82 GB Cloud Coverage: 0.02

The 'Databaskets' panel allows managing and/or creating databaskets. The panel lists all the databaskets created by or shared to the user.

**Thailand 1**

Example databasket

- S2B\_MSIL1C\_20190129T033009\_N0207\_R018\_T48QUD\_20190129T074915
- S2B\_MSIL1C\_20190129T033009\_N0207\_R018\_T48PVC\_20190129T074915
- S2B\_MSIL1C\_20190129T033009\_N0207\_R018\_T48PUC\_20190129T074915

**Filters**

Thailand 1  
Items: 3

Page 1 of 1

For each databasket the available actions are detailed below.



The 'Information' icon provides basic information on the databasket.



The 'Share' icon allows the user to share the databasket with a selected group and choose the permissions to be given for the group.



The 'Edit' icon allows the user to modify the basic information and to delete the entire databasket. A confirmation will be needed to delete the databasket.



The 'Clone' icon creates a new databasket with the same content of the selected one. The user can specify the name and the description of the new databasket.

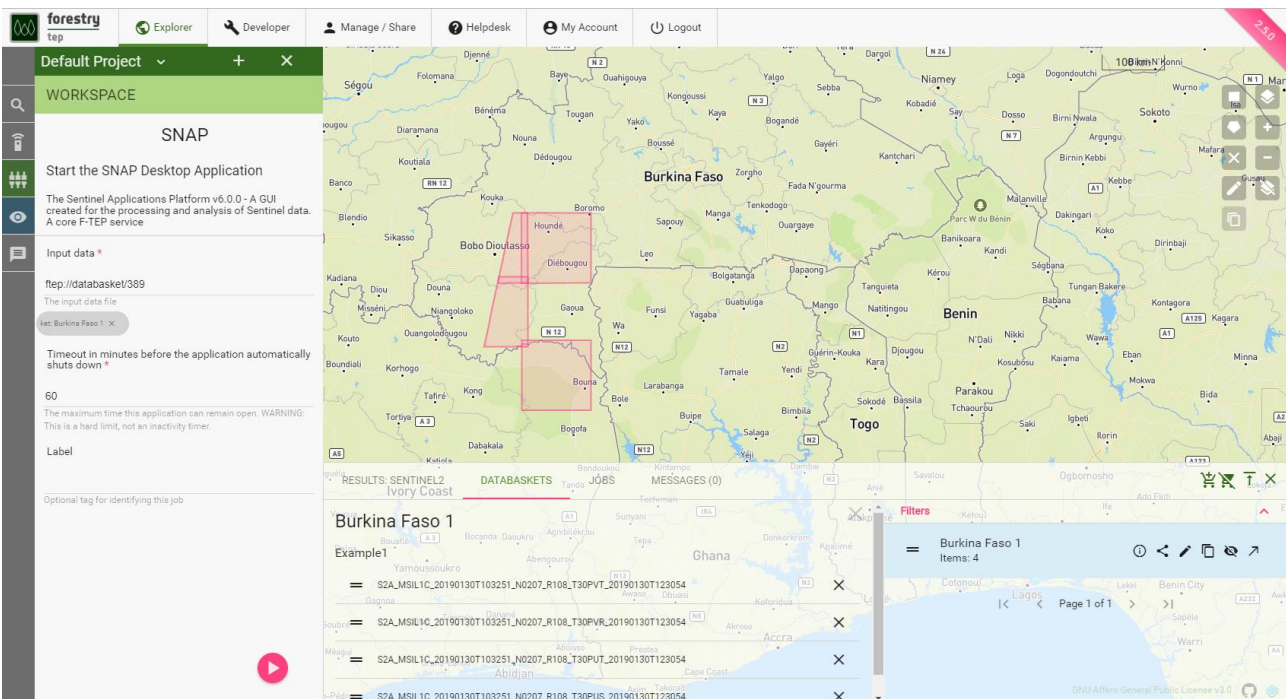


The 'Load/Unload' icon loads/unloads the images of the databasket on the map.



The 'Open in Manage/Share' icon will open the databasket in the Manage/Share interface. As well as managing within the Explorer interface, databaskets can also be created, deleted, and managed in the Manage/Share interface.

A Databasket can be used as input for a process, thus allowing launching a service or a graphical application on several files. The following picture shows the content of the databasket "Thailand 1" loaded on the map and used as input to the service 'SNAP' (i.e. the Sentinel Applications Platform). The databasket can be dragged into the 'Input data' parameter field of a service by grabbing and dragging the 'Drag databasket' icon in front to the databasket name.



It is possible to modify the content of a databasket at any time after its creation. Moreover it is possible to create a databasket containing mixed content. The sequence of pictures below shows the addition of a Sentinel-1 product to the databasket "Thailand 1" shown above containing Sentinel-2 products.



The following picture shows the result of a search for Sentinel-1 products. The selected item(s) can be added to any databasket the user has by clicking the 'Add to...' icon. If necessary, the desired databasket can be selected using the 'Select Databasket' icon.



**forestry tep** Explorer Developer Manage / Share Helpdesk My Account Logout

Default Project + x

**Mission**  
Sentinel-1

**Product date**  
01-01-2019 31-01-2019

**AOI**  
POLYGON((102.98034667968747 17.20901714139

**Identifier**  
Product identifier string

**Processing level (S-1)**  
1

**Product type**  
GRD

**Orbit direction**  
ASCENDING

**S-1 Platform**

**RESULTS: SENTINEL1** DATABASKETS JOBS MESSAGES (2)

Start	End	Size	Cloud Coverage	Actions
S1A_IW_GRDH_1SDV_20190121T110452_20190121T110517_025575_02D693_C46E	2019-01-21T11:04:52.072	2019-01-21T11:05:17.072	0.98 GB	-1.00
S1B_IW_GRDH_1SDV_20190120T111242_20190120T111307_014577_01B285_F6D5	2019-01-20T11:12:42.4022	2019-01-20T11:13:07.42	0.97 GB	-1.00
S1B_IW_GRDH_1SDV_20190120T111217_20190120T111242_014577_01B285_2970	2019-01-20T11:12:17.4012	2019-01-20T11:12:42.4012	0.94 GB	-1.00
S1B_IW_GRDH_1SDV_20190120T111152_20190120T111217_014577_01B285_D9F3	2019-01-20T11:11:52.4012	2019-01-20T11:12:17.42	0.94 GB	-1.00

The following picture shows the content of the "Burkina Faso 1" databasket after the addition of the Sentinel-1 product.

**forestry tep** Explorer Developer Manage / Share Helpdesk My Account Logout

50 km 101.7307, 16.4335

**RESULTS: SENTINEL1** DATABASKETS JOBS MESSAGES (3)

**Thailand 1**

Example databasket

S1B_IW_GRDH_1SDV_20190120T111217_20190120T111242_014577_01B285_2970	Bangkok
S2B_MSIL1C_20190129T033009_N0207_R018_T48PUC_20190129T074915	
S2B_MSIL1C_20190129T033009_N0207_R018_T48PUC_20190129T074915	
S2B_MSIL1C_20190129T033009_N0207_R018_T48PUC_20190129T074915	

**Filters**

Thailand 1 Items: 4

Page 1 of 1

## 2.6 Manage / Share interface

This interface allows users to manage and share their various assets and data. They can e.g. explore the various groups and projects they belong to, as well as access and manage their files, data baskets, logs of their jobs and any services they have created. This page also allows users to share their services and products with selected users.

The functionalities of the Manage / Share interface are accessed through the icons on the left hand side the page. After clicking the icons, the respective panel will open on the left hand side. In these panels users can filter between generic ('All'), their own ('Mine') or shared ('Shared') assets respectively. They can also search by name for a specific asset.



The 'Groups' icon allows the user to see and manage all the groups that the user belongs to or has created. Through this interface the user can e.g. change permission levels, add/remove users etc., or delete the entire group.



The 'Projects' icon allows the user to see and manage all the projects that the user may have created. This feature is under development.



The 'Databaskets' icon allows the user to see and manage all the databaskets the user has created or has permissions on. The user can e.g. add result products or reference data into the baskets, remove files from the basket, or delete the entire basket.



The 'Jobs' icon allows the user to see and manage all the jobs the user has run or has permissions on. In addition to all the technical details of the job, the input files, output products and log files can be seen and the output products can be downloaded through this interface. The user can also share the job with other users.



The 'Services' icon allows the user to see and manage all the services the user has created or has permissions on. The user can edit the service descriptions and see the list of associated files. Note, however, that services are created and modified in the 'Developer' interface.



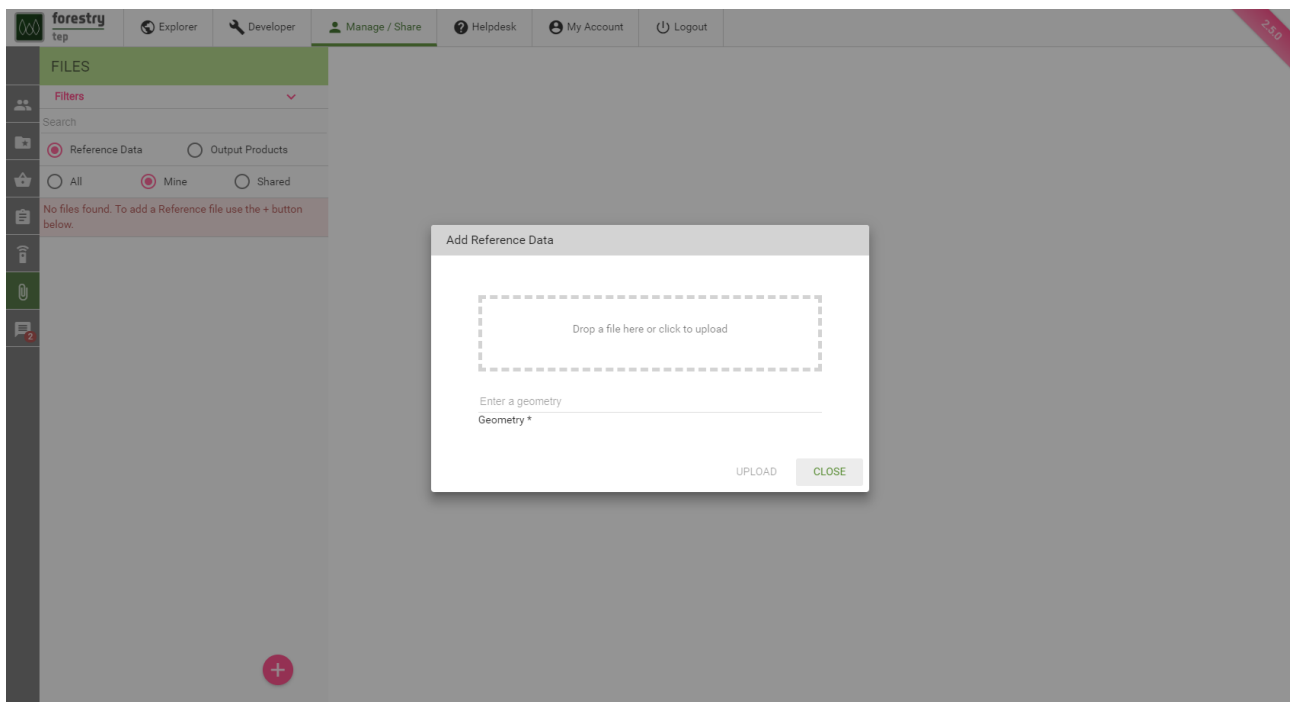
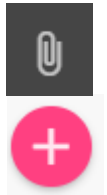
The 'Files' icon allows the user to see and manage all the file the user has produced, uploaded or has permissions on. The user can filter between reference data and output products. 'Reference data' is data generated outside of F-TEP and uploaded into the platform, whereas output products have been generated within F-TEP.



The 'Messages' icon opens the Messages panel along the bottom of the display. Any messages from the system are provided in this panel.

## 2.7 Uploading reference data

Reference data can be added in the 'Files' section of the Manage / Share interface. To add reference data, a user will click the 'Add' icon at the bottom of the panel and then drag and drop or click to select their local file to be uploaded (see the image below). The maximum file size is currently set to 50 MB. Users will also need to define the geometry to allow the data to be geographically mapped within the system. This is the geographic coverage of the data file and is given in the Well-known text (WKT)<sup>5</sup> POLYGON specification. An example of a valid AOI specification is: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)).



<sup>5</sup> [https://en.wikipedia.org/wiki/Well-known\\_text\\_representation\\_of\\_geometry](https://en.wikipedia.org/wiki/Well-known_text_representation_of_geometry)


## 2.8 Files interface

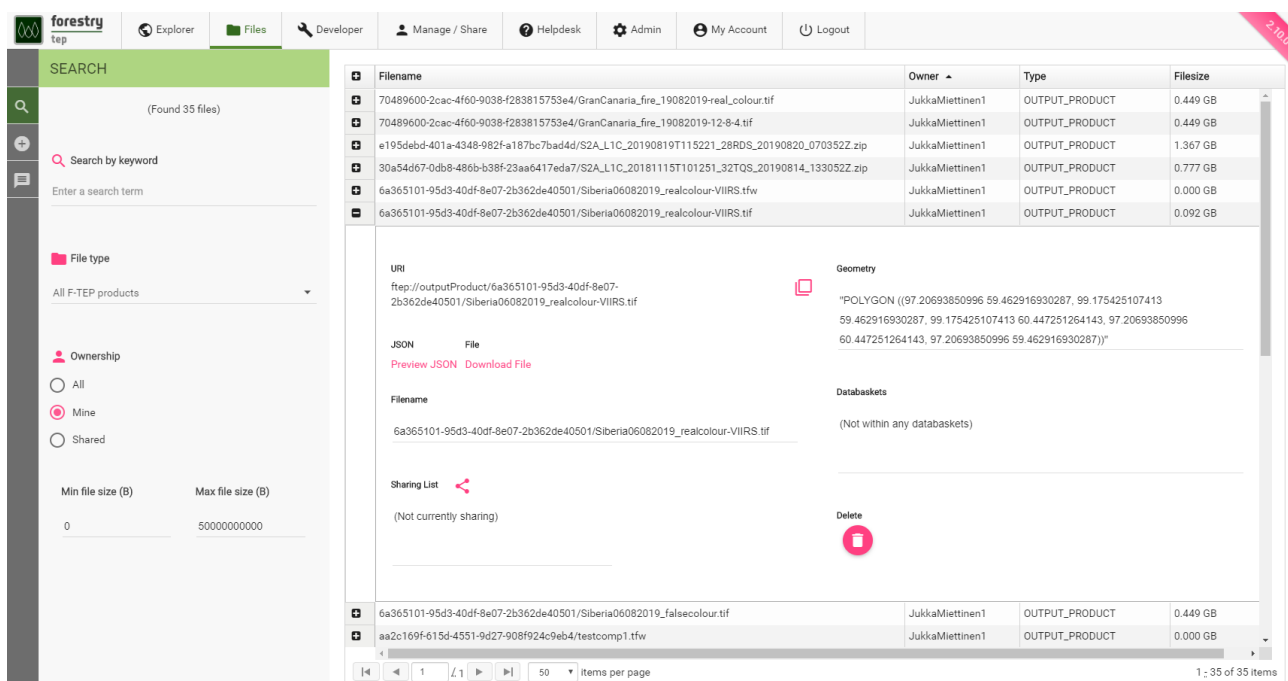
The 'Files' interface allows users to view and manage files that are stored in the F-TEP platform. They can search and browse all the files they have permissions for, view file details and conduct various management operations, including file deletion. It is also possible to upload new files into the system through this interface. The two main functionalities of the 'Files' interface are accessed through the icons on the left hand side of the page. After clicking the icons, the respective panel will open on the left hand side.



The 'Search' icon opens the search panel on the left hand side of the page.

Through this panel, the user can search and view all the files the user has produced, uploaded or has permissions on. The user can search the files by keywords. Note that the keyword search includes the labels the user may have used to identify jobs. This is often the easiest way to look for a specific file. The search can also be restricted by file type (limiting it to external product, output products or reference data), by ownership or by file size.

The search results update on the fly and are displayed on the right hand side of the page. Clicking the  sign in front of the file name opens a box with the file details. Through this interface, the user can view full URI address of the file and geometry information. Both of these pieces of information can be copied from this screen for easy input to a workflow. It is also possible to see if the files have been shared with someone or included in databaskets. A JSON file preview is also provided. Furthermore, the file can be downloaded or deleted through this view. Note that file deletions will break all job configurations where the file has been used as input data. After the deletion, these jobs cannot be re-run. For this reason, there is a warning before any deletion, listing all the connections the file has (e.g. "0 databaskets, 1 jobs and 0 job configurations") and requesting the user to verify the deletion.




The screenshot shows the Forestry TEP Files interface. The top navigation bar includes links for Explorer, Files, Developer, Manage / Share, Helpdesk, Admin, My Account, and Logout. The left sidebar contains a SEARCH panel with a search bar, file type filter (set to 'All F-TEP products'), ownership filter (set to 'All'), and file size filters (Min: 0, Max: 5000000000). The main content area displays a list of files with columns: Filename, Owner, Type, and Filesize. A detailed view of a selected file is shown on the right, including URI, Geometry, JSON preview, Databaskets, and Sharing List.

Filename	Owner	Type	Filesize
70489600-2cac-4f60-9038-f283815753e4/GranCanaria_fire_19082019-real_colour.tif	JukkaMiettinen1	OUTPUT_PRODUCT	0.449 GB
70489600-2cac-4f60-9038-f283815753e4/GranCanaria_fire_19082019-12-8-4.tif	JukkaMiettinen1	OUTPUT_PRODUCT	0.449 GB
e195debd-401a-4348-982f-a187bc7bad4d/S2A_L1C_20190819T115221_28RDS_20190820_070352Z.zip	JukkaMiettinen1	OUTPUT_PRODUCT	1.367 GB
30a54d67-0db8-486b-b38f-23aa6417eda7/S2A_L1C_20181115T101251_32TQS_20190814_133052Z.zip	JukkaMiettinen1	OUTPUT_PRODUCT	0.777 GB
6a365101-95d3-40df-8e07-2b362de40501/Siberia06082019_realcolour-VIIRS.tif	JukkaMiettinen1	OUTPUT_PRODUCT	0.000 GB
6a365101-95d3-40df-8e07-2b362de40501/Siberia06082019_realcolour-VIIRS.tif	JukkaMiettinen1	OUTPUT_PRODUCT	0.092 GB

**File Details:**

- URI:** ftep://outputProduct/6a365101-95d3-40df-8e07-2b362de40501/Siberia06082019\_realcolour-VIIRS.tif
- Geometry:** "POLYGON ((97.20693850996 59.462916930287, 99.175425107413 59.462916930287, 99.175425107413 60.447251264143, 97.20693850996 60.447251264143, 97.20693850996 59.462916930287))"
- JSON:** Preview JSON, Download File
- Filename:** 6a365101-95d3-40df-8e07-2b362de40501/Siberia06082019\_realcolour-VIIRS.tif
- Databaskets:** (Not within any databaskets)
- Sharing List:** (Not currently sharing)
- Delete:** [Delete icon]



The 'Upload' icon opens a panel that allows the user to upload new data into the system. The file can be dragged and dropped into the box. Alternatively, clicking the box makes a dialogue box to open where the user can search and choose the file to be uploaded. For certain file formats (currently Geotiff, Shapefile and FIS) and 'Auto-detect geometry' option is enabled. For all other file formats, users will need to define the geometry to allow the data to be geographically mapped within the system. This is the geographic coverage of the data file, which needs to be provided in the WKT POLYGON specification. An example of a valid AOI specification is: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)). When all the necessary information is in place, the file can be uploaded by clicking the  button. All files uploaded through this system will go into the 'Reference data' category in the system.

UPLOAD

Drop a file here or click to upload

AOI\_HYY.kml

File type \*

KML


▼

Auto-detect geometry

☐

POLYGON ((97.20693850996 59.462916930287, 99.1

Geometry \*



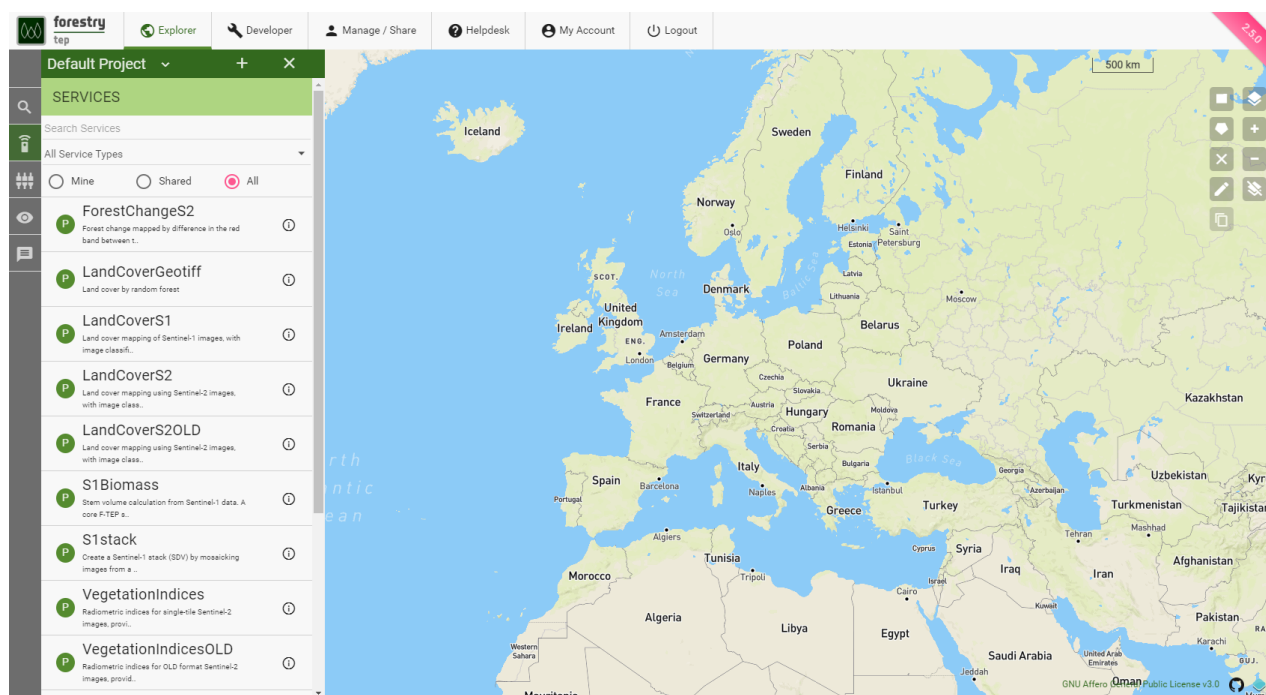


### 3 Running a service

The F-TEP portal allows users to run a selection of algorithms on search results and/or on products ingested in F-TEP itself. It is also possible for users to create their own services in the 'Developer' interface.

#### 3.1 Selecting the service

Available image processing algorithms (known as Services) can be browsed in the 'Services' panel which can be opened by clicking the 'Services' icon on the left hand side of the 'Explorer' interface. Clicking on the 'info' icon shows a brief description of the service.



Services are classified into different groups:

**'Processor Services'** - run on the F-TEP platform as single stage processes, such as Land cover mapping or Vegetation Indices.

**'Application Services'** - interactive open-source applications run inside the platform, such as SNAP or QGIS.

**'Bulk Processor Services'** - processor services designed for bulk / large volume processing. *Note:* this category is an artefact of a prior feature of the platform design and is being replaced with the Parallel Processing feature described below.

The user has an option to either browse all service types, or select the desired service type from the dropdown menu at the top of the 'Services' panel. Filtering options can be applied as well.

### 3.2 Defining inputs

When a service is selected, the 'Workspace' panel will open so the user can define the parameters needed for the service to run.



To define the input data, a user can drag into the input data field:

- Result(s) of a product search (Satellite, Reference or F-TEP Products)
- Output of a previous processing job
- Item(s) contained in a databasket
- A databasket itself, to add at once all the items contained

Note also the 'plus' sign on the right of the input data field. This allows opening a new input data field (for direct manual input) for those services that allow several input data files. The same effect can be reached by dragging any input image into the input data field, which will automatically open a new field for potential additional input data.



Apart from the inputs, each service will have a specific set of parameters, briefly described in the workspace. More information on particular services and the parameters needed to run them can be found in the service descriptions provided in the user manual.

### 3.3 Launching the service

Once the input data and other parameters have been defined, the service is executed by clicking the 'Launch' button at the bottom of the Workspace panel. The user is then asked for confirmation regarding spending of Coins. After accepting, the Data Panel opens at the bottom of screen with the 'Jobs' section open.



The launched job will appear at the top of jobs list, showing its unique numeric ID, the service name and the starting time (UTC). A coloured icon on the left depicts the status of the processing jobs. Below is an example of a successfully completed job.



Job ID: 4434 (ForestChangeS2)  
Start: 2019-03-27T15:27:48.147



### 3.4 Managing the job

The jobs listing provides for each job functional icons that allow to (from left to right):

- **View job metadata** such as the job owner, status, and start and end times;
- **'Share'**: share the job, including its outputs, to a specified group of users;
- **'Edit and re-run'**: use the input parameters defined for this job as a template for configuring a new run of the same service;
- **'Open in Manage/Share'**: open the job details in the Manage / Share interface.
- **'Terminate'** (for running jobs): allows to terminate the job execution manually, before its automatic termination that would happen on job completion, failure or timeout. In case of GUI applications, manual termination is useful in getting

access to any data that the user may have saved to the 'outDir' folder; these outputs will only be available after the job termination.

When clicking on a job, a panel opens with the INPUTS, OUTPUTS and LOGS sections.

- INPUTS shows a concise list of the parameters that were used for this job.
- OUTPUTS lists any outputs that were produced. The user can download each result, and in case of specific file types (GeoTiff in particular) also have the output visualized on the map interface. Note that the intensity scaling may not appear optimal, wherefore it is often favourable to instead open the file e.g. in QGIS. This would be done by dragging the output file to the input data field when preparing a QGIS job; in a similar fashion the output can be used as the input of other services too.
- LOGS shows both the system logs and developer-specified output from the execution of the processing job. Note that the logging data does not update in real-time nor is it fully chronological, as the data is collected by a separate platform component. Its primary purpose is to enable service developers to debug the service.



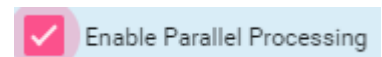
### 3.5 Parallel processing

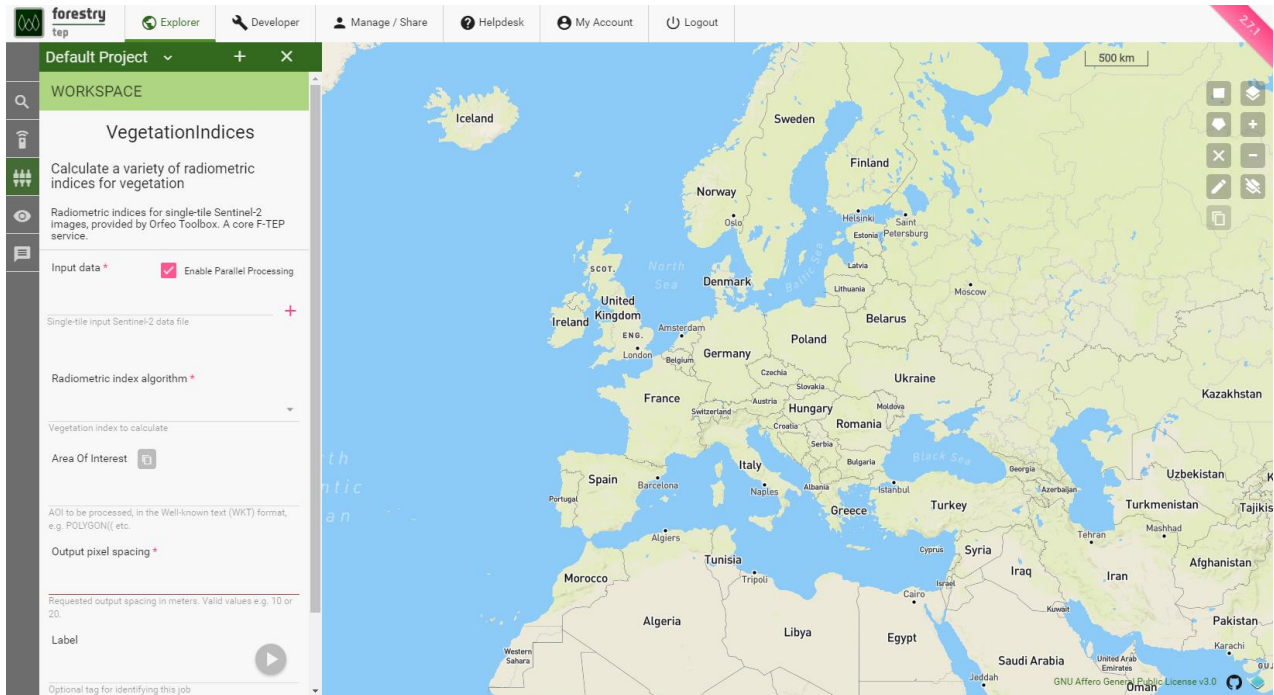
Some processor services are implemented in such a way as to permit configuration in 'parallel' mode. Whereas in a standard processor all input data products are passed to one processing job, the parallel processing mode will configure one 'sub-job' per input data product; all other input parameters remain constant.

When a parallel processing job is started, the user can see the "View subjobs" icon in the job field. By clicking this icon the user can see each individual 'sub-job' listed separately and can access their information and functions. After the job is finished, outputs of all parallel jobs can also be seen and accessed through the parent job.



The parallel processing can be enabled by activating the 'Enable Parallel Processing' icon next to the parameter. If checked, this job will execute in parallel mode. Each sub-job is discretely configured and can be inspected individually, including accessing the individual sub-job output products. The parent job provides a way to work with the aggregated output products of the sub-jobs.





## 4 Processing services

### 4.1 VegetationIndices

#### 4.1.1 Service description

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

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

The following vegetation indices can be calculated using the VegetationIndices service:

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

#### 4.1.2 Input data

The VegetationIndices service requires one or more Sentinel-2 L1C image. Note that cloud-free images should be selected, as the service does not perform radiometric corrections or cloud masking.

#### 4.1.3 Parameters

**Input data:** The input Sentinel-2 image which has been previously defined. Drag the input Sentinel-2 image (grabbing from the horizontal lines in front of its name) from the Results tab at the bottom of the screen to the input field.

**Vegetation Index:** Using the drop-down list, select a vegetation index. Options include: NDVI, TNDVI, RVI, SAVI, TSAVI, MSAVI, MSAVI2, GEMI, IPVI.

**Target CRS identifier:** This field defines the target coordinate reference system (CRS). It must be a string beginning with 'EPSG:', appended by a numeric code that is a valid system as defined by the European Petroleum Survey Group (EPSG). For UTM zones in the northern hemisphere and with the WGS84 datum, the numeric code is 32600 + the



UTM zone number. An example of a valid CRS specification is EPSG:32615, where "6" or "7" defines Northern/Southern hemisphere, and 15 represents the UTM zone.

**Area of interest (AOI):** An AOI to be processed is inserted here. This can be copied from an area drawn on the map by pressing the 'Copy From Map' icon. Alternatively, it can be specified in the Well-Known Text (WKT) POLYGON format. An example of a valid specification is: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)). The AOI should be large enough that it includes enough reference data for all target class.

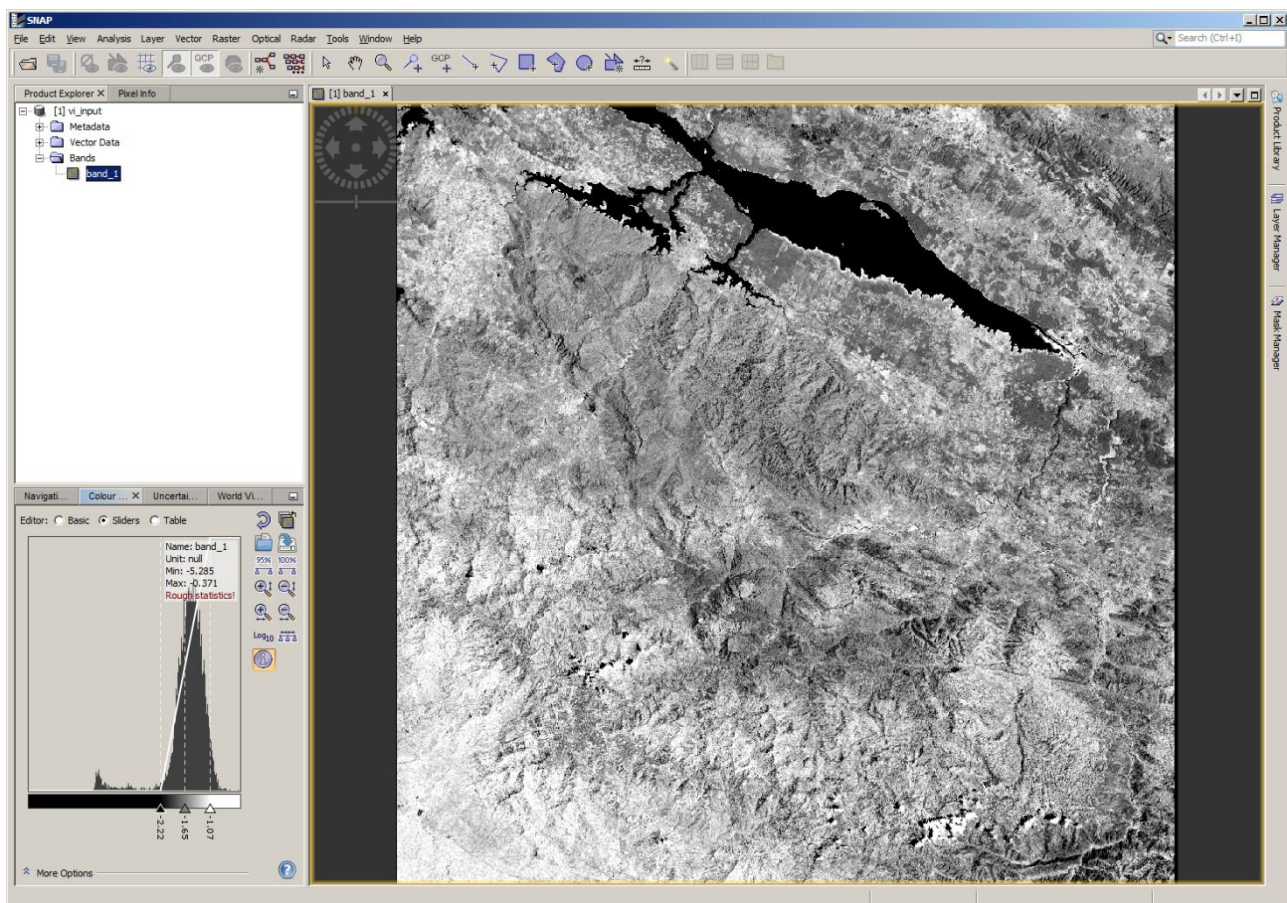
**Target Image Resolution:** The requested output image pixel spacing (in metres) is inserted here. For Sentinel-2 optical data, feasible values are between 10 and 100 m. Example: 20

**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

#### 4.1.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. The resulting output can be downloaded, re-used or displayed in one of the GUI applications, such as SNAP or QGIS. Soon after the desired application process (e.g. QGIS) is started, a 'Go to GUI' icon appears in the job description. You can access the desired GUI application by clicking this icon which opens the GUI in another browser tab.

The image below shows a generated TSAVI index map within SNAP.



## 4.2 ForestChangeS2

### 4.2.1 Service description

Forest clearance causes substantial changes in visible and near infrared reflectance. This is evident when investigating the various spectral bands of Sentinel-2 satellite images. Due to the reduction of photosynthetically active vegetation in logging operations, especially if bare ground is exposed, red reflectance rises significantly. This increase in red reflectance can be used as a simple indicator for potential forest clearance. The ForestChangeS2 service produces the ratio of red reflectance between two input images (*i.e.* “before” and “after” images). The service computes a red-reflectance ratio layer, which can then be further analysed *e.g.* in the QGIS application service together with other products (forest or land cover maps).

### 4.2.2 Input data

The service requires as its input data two Sentinel-2 L1C image tiles. The correct Sentinel-2 data format can be recognized by file names that begin with “S2A\_MSIL1C” or “S2B\_MSIL1C”. The images must cover the same area (*i.e.* the same Sentinel-2 tile). Cloud masking is performed with the cloud masks included in the Sentinel-2 L1C products. However, note that some clouds may have passed through the L1C cloud masking procedure, causing errors in the change detection. This has to be taken into account when interpreting the results. For the best results, both of the input images should be completely cloud-free.

### 4.2.3 Parameters

**Start product:** The first input Sentinel-2 image, which has been acquired before the assumed forest change. Drag the input Sentinel-2 image from a search results listing or from databasket contents at the bottom of the screen, by grabbing from the horizontal lines in front of its name.

**End product:** Select the second image in the same way and drag it here.

**Target CRS identifier:** This field is OPTIONAL. It defines the target coordinate reference system (CRS). If left empty, the CRS of the input data is used as default. This must be a string beginning with 'EPSG:', appended by a numeric code that is a valid system as defined by the European Petroleum Survey Group (EPSG). For UTM zones in the northern hemisphere and with the WGS84 datum, the numeric code is 32600 + the UTM zone number. An example of a valid CRS specification is EPSG:32635, where “6” or “7” defines Northern/Southern hemisphere, and 35 represents the UTM zone.

**Area of interest:** This field is OPTIONAL. It defines the area of interest (AOI) that the output image is cropped to. Note that full Sentinel-2 tiles are processed regardless of this setting. If left empty, an image covering the entire tile area is produced. The AOI can be copied from the area drawn on the map by clicking the ‘Copy From Map’ icon. Alternatively, it can be specified in the Well-Known Text (WKT) POLYGON format. An example of a valid specification is: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)).

**Target image resolution:** This field is OPTIONAL. It specifies the desired image resolution in metres, controlling resampling of the output image (pixel spacing). If left

empty, resolution of the input data (10) is used as default. For Sentinel-2 optical data, feasible values are between 10 and 100 (meters).

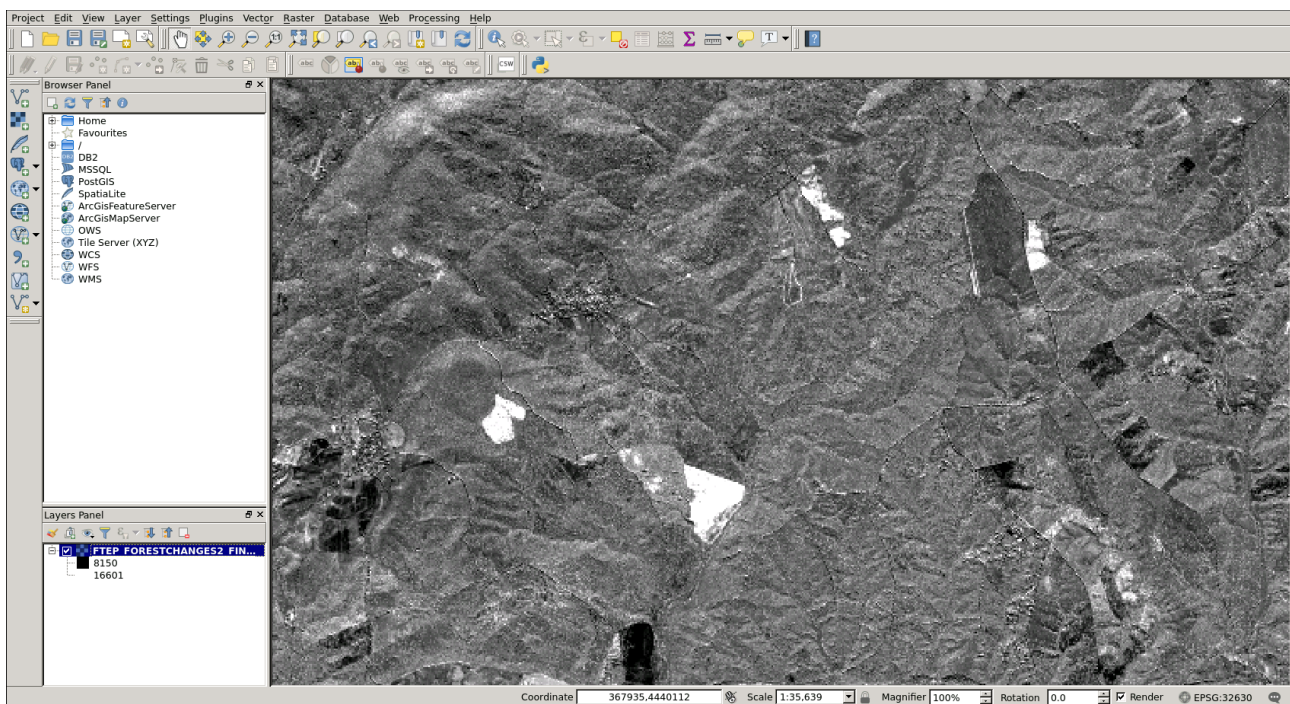
**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

#### 4.2.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. The processing can typically take 25 minutes. The resulting output is GeoTIFF file that can be downloaded, re-used or displayed in one of the GUI applications, such as SNAP or QGIS. Soon after desired application process (e.g. QGIS) is started, a 'Go to GUI' icon appears in the job description. The desired GUI application can then be accessed by clicking this icon, which opens the GUI in another browser tab.



The image below shows the red ratio result opened in QGIS, with some potential clearings visible (in white).





## 4.3 LandCoverS2

### 4.3.1 Service description

Land cover types (such as water, coniferous forest, or wheat field) reflect different amount of incoming sun radiation in different parts of the electromagnetic spectrum. This information can be used for land cover classification of satellite images. Many land cover mapping or classification algorithms have been developed over the past decades.

The LandCoverS2 service uses a random forest algorithm as implemented in the Orfeo toolbox (OTB). Based on samples of land cover classes, a set of decision trees are produced. For each tree, a random set of spectral bands at each decision node is chosen. The final land cover class is then chosen based on majority voting between the output of each decision tree. The benefits of the random-forest algorithm include good adaptation to many different types of classification problems as well as independence of assumptions on statistical distribution of band-wise reflectance values within a (land-cover) class.

### 4.3.2 Input data

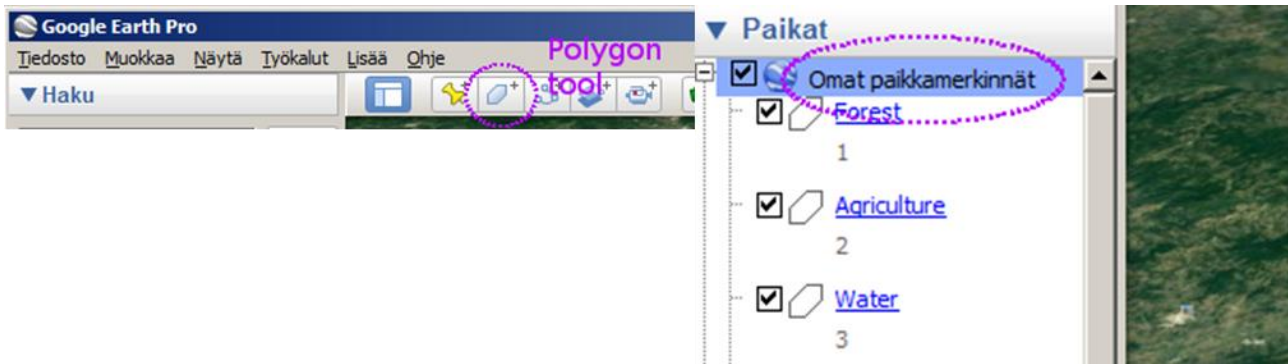
The LandCoverS2 service is designed to work with the Sentinel-2 L1C tile data, which can be recognized by file names that begin with “S2A\_MSIL1C” or “S2B\_MSIL1C”. It supports the use of full 10 m resolution. The service requires the following input data:

1. Shapefile containing reference data for training the classifier
2. Sentinel-2 image

The reference data shape file must include polygons, each polygon covering area belonging to just one land cover class. For each target class, the reference data must include several hundred pixels in the used input data at the selected pixel size. The reference data shape file – and all supporting files like the .dbf file, .prj file and the .shx file - must be packaged into a single .zip file. The zip file must be uploaded to F-TEP using the Files feature in the Manage/Share section, or alternatively placed in a web location that is accessible via a public URL (Universal Resource Locator) or web address.

The LandCoverS2 service does not pose strict requirements on the geographic distribution of the reference data as long as there are enough reference polygons for each class within the selected input image. The shape file can include e.g. 50 m by 50 m squares in a regular grid pattern and interpreted in some satellite imagery, air photos or maps. Or it can contain more freely selected polygons in places where the user knows the land cover. A good reference dataset includes all within class variation of the land cover classes. For instance, if land cover class “water” includes both clear water and turbid water with sediment, the water class in the reference data should include samples of both of these cases.

A simple reference data file can be made with GIS tools like QGIS or ArcGIS. Google Earth Pro can also be used. Delineate the class-wise polygons with the polygon tool of GoogleEarth Pro and write a numeric class code as a description of each polygon. Save the folder containing these polygons (by right clicking on the folder name) as a .kml file. Then convert the .kml file into a shape file using GIS tools like QGIS or the ogr2ogr utility, which is part of the GDAL software package.



#### 4.3.3 Parameters

**Input Data:** The name of the input file is inserted here. The file can be dragged from the search results panel at the bottom of the screen to the 'Input data' field.

**Reference data shapefile:** The reference data shapefile to be used (*i.e.* a .zip package file containing all the files belonging to the shapefile) is defined here.

If the reference data has been uploaded to the platform (using the 'Files' feature in the 'Manage / Share' interface), the file can be found by running a search on reference data. After selection of the correct file in the search results, it can be dragged into the input field in the workspace.

Alternatively, you can write in the reference data input field the URL of a reference data (zip packaged shapefile) that you have available in a publicly available web location. An example of a valid reference data address is:

<https://f-tep.com/sites/default/files/F-TEPchiapasLandCover.zip>

**Reference data field:** The field in the reference data shapefile that will be used to train the classifier needs to be defined here. The name of the column (*e.g.* 'tessellate') is inserted in this field. GIS tools (QGIS in this example) show the column names in an attribute table.

**Target CRS identifier:** This field defines the target coordinate reference system (CRS). It must be a string beginning with 'EPSG:', appended by a numeric code that is a valid system as defined by the European Petroleum Survey Group (EPSG). For UTM zones in the northern hemisphere and with the WGS84 datum, the numeric code is 32600 + the UTM zone number. An example of a valid CRS specification is EPSG:32615, where "6" or "7" defines Northern/Southern hemisphere, and 15 represents the UTM zone.

**Area of interest (AOI):** An AOI to be processed is inserted here. The AOI should be large enough that it includes enough reference data for all target class. This can be copied from an area drawn on the map by pressing the 'Copy From Map' icon. Alternatively, it can be specified in the Well-Known Text (WKT) POLYGON format. An example of a valid specification is: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)).

**Target Image Resolution:** The requested output image pixel spacing (in metres) is inserted here. For Sentinel-2 optical data, feasible values are between 10 and 100 m. Example: 20

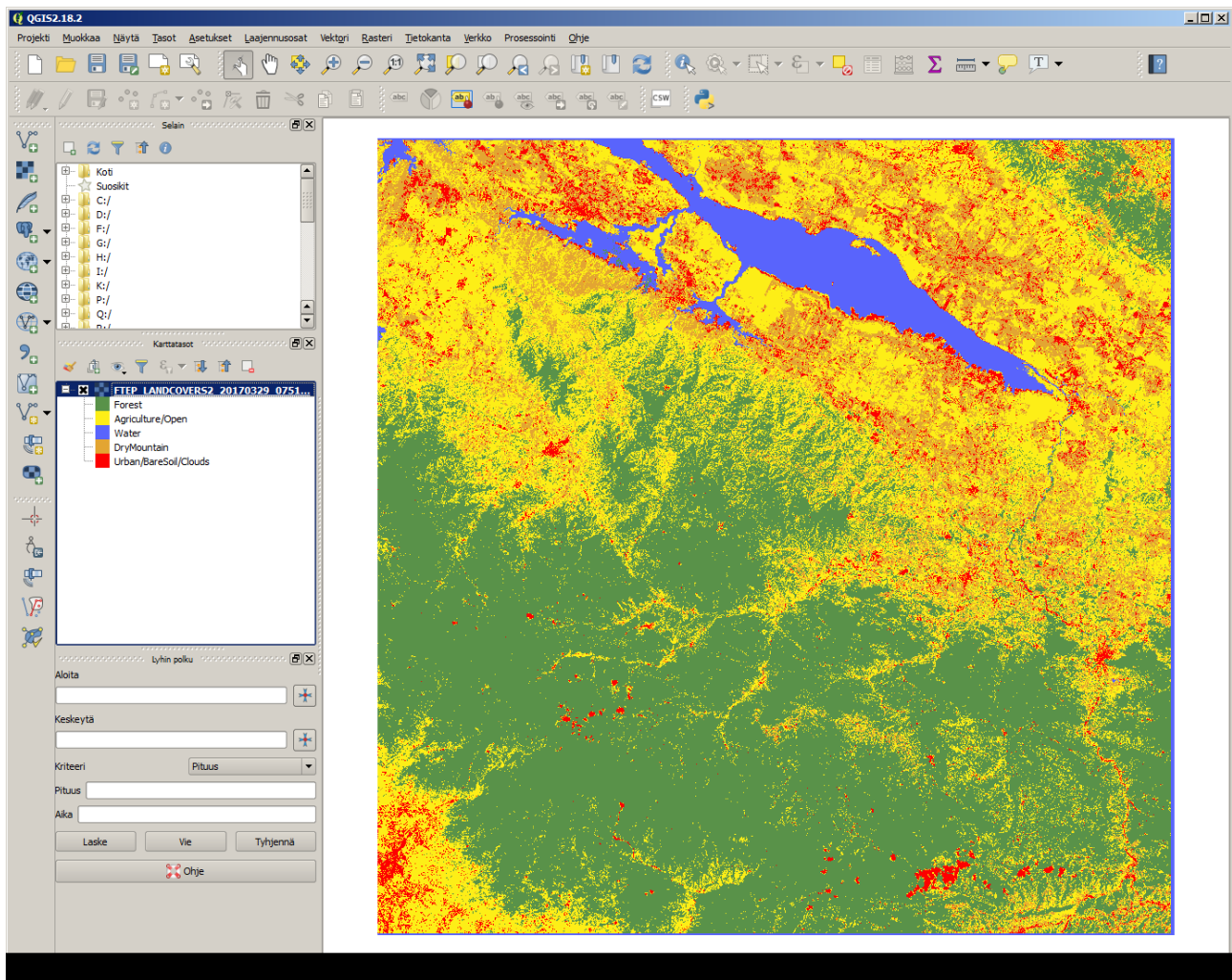
**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

#### 4.3.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. The resulting output can be downloaded, re-used or displayed in one of the GUI applications such as SNAP or QGIS. Soon after the desired application process (e.g. QGIS) is started, a 'Go to GUI' icon appears in the job description. You can access the desired GUI application by clicking this icon which opens the GUI in another browser tab.



The image below shows a generated land cover map within QGIS.



## 4.4 LandCoverS1

### 4.4.1 Service description

Persistently cloudy weather conditions complicate land cover mapping in many areas (e.g. in the humid tropics). Sentinel-1 C-band radar data penetrates cloud cover and allows regular observation even in areas with persistent cloud cover. The LandCoverS1 service allows land cover mapping into a few general land cover classes with Sentinel-1 time series.

Image time series (instead of a single image) allows utilization of the differences in variation of backscatter over time in various land cover types. For instance, mature forest has a very stable backscatter level while many agricultural areas show distinct variations depending on the crop type and crop calendar. When combining acquisitions from different parts of the year, these variations can be used to map land cover types. VV-polarized Sentinel-1 data are used in this algorithm because this is the most widely acquired data type globally (present in both dual and single-polarized scenes).

The service uses a random forest algorithm as implemented in the Orfeo toolbox (OTB). Based on samples of land cover classes, a set of decision trees is produced. For each tree, a random set of spectral bands at each decision node is chosen. The final land cover class is then chosen based on majority voting between the output of each decision tree. The benefits of the random-forest algorithm include good adaptation to many different types of classification problems as well as independence of assumptions on statistical distribution of band-wise backscatter values within a (land-cover) class. The latter property is important for radar data since the distribution of radar backscatter data tends to differ from normal distribution.

### 4.4.2 Input data

The service requires the following input data:

1. Shapefile containing reference data for training the classifier
2. Time series of Sentinel-1 VV-polarised (SVV) images or a collection of Sentinel-1 VV-polarised images collected in a databasket

The reference data shape file must include polygons, each polygon covering an area that belongs to just one land cover class. For each target class, the reference data should include several hundred pixels in the used input data at the selected pixel size. The reference data shape file – and all supporting files like the .dbf file, .prj file and the .shx file - must be packaged into a single .zip file. The zip file must be uploaded to F-TEP using the 'Files' feature in the Manage/Share section, or alternatively placed in a web location that is accessible via a public URL (Universal Resource Locator) or web address. The LandCoverS2 service description shows a way to produce an acceptable shape file using freely available Google Earth Pro software.



### 4.4.3 Parameters

**Input Data:** The most convenient way is to collect the input Sentinel-1 images (GRD products) into a databasket, which is then dragged to 'Input data' field. In case of just one Sentinel-1 input image, it can be dragged from the search results into the 'Input data' field.



**Reference data file:** Here, the reference data (i.e. a .zip package file containing all the files belonging to the shapefile) need to be identified.

If the reference data has been uploaded to the platform, the file can be found by running a search on reference data. After selection of the correct file in the search results, it can be dragged into the input field in the workspace.

Alternatively, you can write in the reference data input field the URL of a reference data (zip packaged shapefile) that you have available in a publicly available web location. An example of a valid reference data address is:

<https://f-tep.com/sites/default/files/F-TEPchiapasLandCover.zip>

**Reference data field:** The field in the reference data shapefile that will be used to train the classifier needs to be defined here. The name of the column (e.g. "tessellate") is inserted in this field.

**Target CRS identifier:** This field defines the target coordinate reference system (CRS). It must be a string beginning with 'EPSG:', appended by a numeric code that is a valid system as defined by the European Petroleum Survey Group (EPSG). For UTM zones in the northern hemisphere and with the WGS84 datum, the numeric code is 32600 + the UTM zone number. An example of a valid CRS specification is EPSG:32615, where "6" or "7" defines Northern/Southern hemisphere, and 15 represents the UTM zone.

**Area of interest (AOI):** An AOI to be processed is inserted here. The AOI should be large enough that it includes enough reference data for all target class. This can be copied from an area drawn on the map by pressing the 'Copy From Map' icon. Alternatively, it can be specified in the Well-Known Text (WKT) POLYGON format. An example of a valid specification is: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)).



**Digital elevation model:** A DEM is needed for ortho-rectification and terrain correction of Sentinel-1 radar images. The identification string for the SNAP software (where the corrections are run) is inserted here. The default is "SRTM 1Sec HGT", which is valid between -60 and 60 latitudes. The SRTM DEM is downloaded automatically by SNAP. If an external DEM is used, it must be in GeoTiff format, its projection must be plate carre (latitude-longitude), and its elevation unit must be 1 metre.

**Target Image Resolution:** The requested output image pixel spacing (in metres) is inserted here. For Sentinel-1 radar data, feasible values are between 20 and 100 m. Example: 20

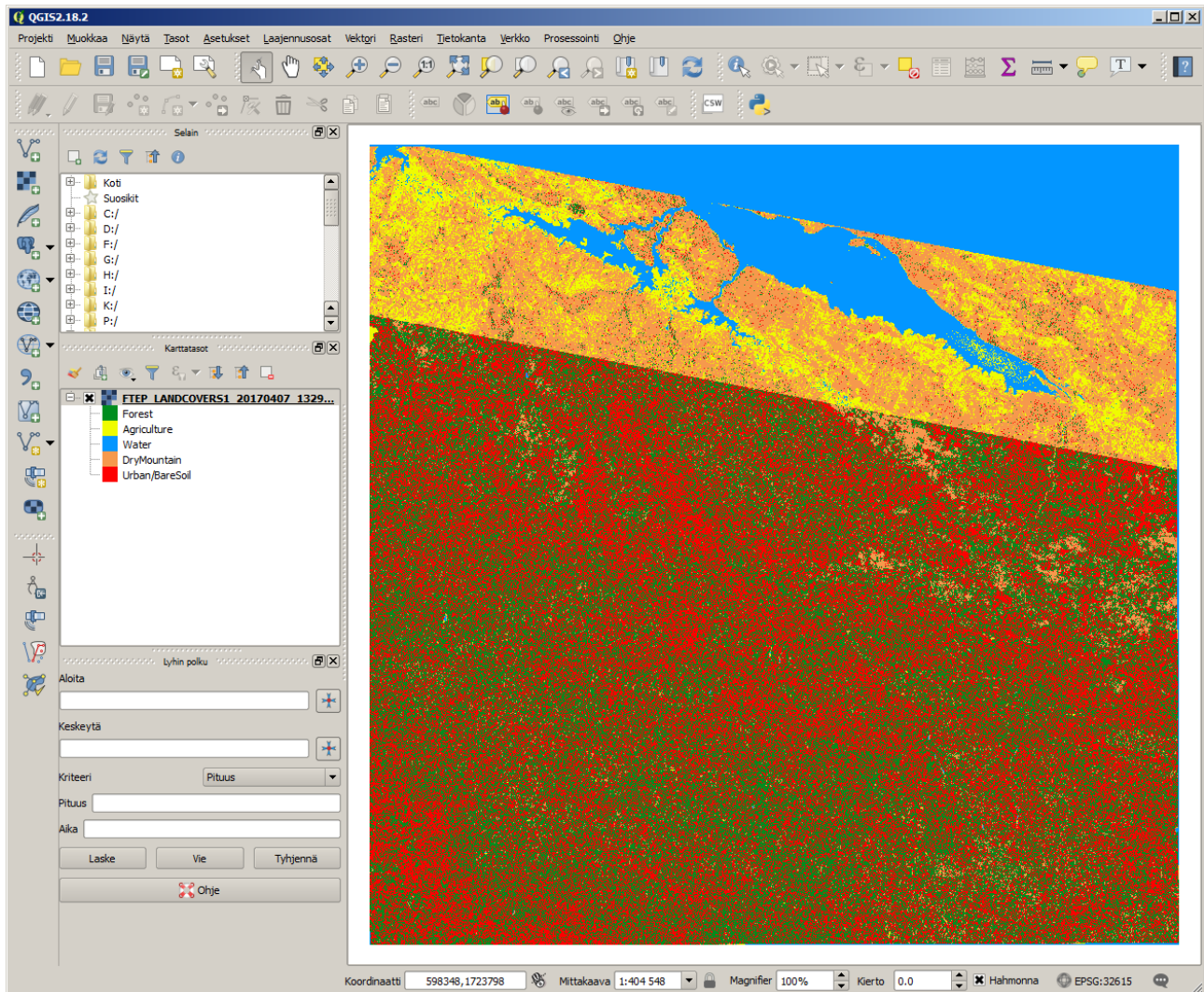
**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

#### 4.4.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. The resulting output can be downloaded, re-used or displayed in one of the GUI applications, such as SNAP or QGIS. Soon after the desired application process (e.g. QGIS) is started, a 'Go to GUI' icon appears in the job description. You can access the desired GUI application by clicking this icon which opens the GUI in another browser tab.



The image below shows a generated (with four images covering the AOI variably) land cover map within QGIS. A longer time-series covering the whole area of interest is needed for a good land cover map.



## 4.5 LandCoverGeotiff

### 4.5.1 Service description

The LandCoverGeotiff service makes land cover classification using a random forest classifier as implemented in the Orfeo toolbox. The service requires training data in the form of a shape file. The used earth observation data is not limited to any specific sensor. The input geotiff file can be from any satellite sensor or even a combination of several sensors.

### 4.5.2 Input data

The service requires an input geotiff image file which can be from any satellite sensor.

### 4.5.3 Parameters

**Input Data:** The name of the input geotiff file is inserted here. The file can be dragged from the search results panel at the bottom of the screen to the 'Input data' field. Typically the input data is taken from reference data if the user has uploaded an external geotiff file or from the F-TEP results if e.g. the user wants to use a multi-temporal stack of Sentinel-1 data or some mosaic of Sentinel-2 data.

**Reference data shapefile:** The reference data shapefile to be used (*i.e.* a .zip package file containing all the files belonging to the shapefile) is defined here.

If the reference data has been uploaded to the platform (using the 'Files' feature in the 'Manage / Share' interface), the file can be found by running a search on reference data. After selection of the correct file in the search results, it can be dragged into the input field in the workspace.

Alternatively, you can write in the reference data input field the URL of a reference data (zip packaged shapefile) that you have available in a publicly available web location. An example of a valid reference data address is:

<https://f-tep.com/sites/default/files/F-TEPchiapasLandCover.zip>

**Reference data field:** The field in the reference data shapefile that will be used to train the classifier needs to be defined here. The name of the column (e.g. 'tessellate') is inserted in this field. GIS tools show the column names in an attribute table.

**Target CRS identifier:** This field defines the target coordinate reference system (CRS). It must be a string beginning with 'EPSG:', appended by a numeric code that is a valid system as defined by the European Petroleum Survey Group (EPSG). For UTM zones in the northern hemisphere and with the WGS84 datum, the numeric code is 32600 + the UTM zone number. An example of a valid CRS specification is EPSG:32615, where "6" or "7" defines Northern/Southern hemisphere, and 15 represents the UTM zone.

**Area of interest (AOI):** An AOI to be processed is inserted here. The AOI should be large enough that it includes enough reference data for all target class. This can be copied from an area drawn on the map by pressing the 'Copy From Map' icon. Alternatively, it can be specified in the Well-Known Text (WKT) POLYGON format. An example of a valid specification is: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)).



**Target Image Resolution:** The requested output image pixel spacing (in metres) is inserted here. For Sentinel-2 optical data, feasible values are between 10 and 100 m. Example: 20

**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

#### 4.5.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. The resulting output can be downloaded, re-used or displayed in one of the GUI applications, such as SNAP or QGIS. Soon after the desired application process (e.g. QGIS) is started, a 'Go to GUI' icon appears in the job description. You can access the desired GUI application by clicking this icon which opens the GUI in another browser tab.





## 4.6 S1Biomass

### 4.6.1 Service description

Radar signals can penetrate into forest canopy and scatter back from plant elements of various sizes. The greater biomass a forest has the higher the backscatter. L-band and longer wavelength radar data have been used successfully to map forest biomass for large areas. Even the C-band Sentinel-1 radar data can be used to estimate forest biomass, but note that it may saturate already at moderate forest biomass levels. The S1Biomass service uses multi-temporal VH-polarized data from dual-polarized IW (Interferometric Wide swath) products. The biomass mapping is based on multi-temporal averaging combined with a fixed model relating radar backscatter to forest biomass. The model is based on the water cloud model introduced by Attema and Ulaby 1978 (Attema, E. and Ulaby, F. 1978. Vegetation modeled as a water cloud, Radio Science, vol. 13, no. 2, p. 357-364).

### 4.6.2 Input data

The S1Biomass service requires the following input data:

1. Digital Elevation Model (DEM), in geotiff format
2. Forest mask, in geotiff format
3. Collection of Sentinel-1 images in a databasket

The DEM as a geotiff file is required so that the service is available globally, not just in the zone between latitudes -60 degrees to 60 degrees, where SRTM DEM is available in SNAP. The DEM must be in plate carrée projection (regular grid in latitude and longitude). Its unit must be 1 meter (*i.e.* the pixel value is the elevation of the pixel in metres). The name of the DEM file must end in ".tif". The DEM file must be loaded to F-TEP as reference data. An example of a valid DEM file (140 Mb):

[https://f-tep.com/sites/default/files/DEM\\_ChiapasSRTM.tif](https://f-tep.com/sites/default/files/DEM_ChiapasSRTM.tif)

The forest mask must be a geotiff file, whose name ends in ".tif". The pixel value must be 1 for forest and 0 for areas outside forest. The forest mask must also be loaded to F-TEP as reference data. The forest mask can be made using the LandCoverS2 service, but usually this requires that all forest classes are combined to a single forest class with a class code of 1 and all non-forest classes to a single non-forest class with a class code of 0. An example of a valid forest mask file (20 Mb):

[https://f-tep.com/sites/default/files/ForestMask\\_chiap.tif](https://f-tep.com/sites/default/files/ForestMask_chiap.tif)

The input Sentinel-1 images must be in a databasket. All images must cover exactly the same area, so either ascending orbit images (from south-east to north-west) or descending-orbit images (from north-east to south-west) should be used, but not both. Only images in GRD format can be used.

### 4.6.3 Parameters

**Input data:** The input Sentinel-1 data files which have been collected in the input data basket. To select them, drag the input databasket in this field (using the horizontal lines to the left of the name).

**Reference DEM:** Expected is a single .tif with filename matching '\*.tif'. Drag the DEM file from a search results list of reference data to Input Field 2.

**Reference forest mask:** Expected is a single .tif with filename matching '\*.tif'. Drag the Forest Mask file from a search results list of reference data to Input Field 3.

**Target CRS identifier:** This field defines the target coordinate reference system (CRS). It must be a string beginning with 'EPSG:', appended by a numeric code that is a valid system as defined by the European Petroleum Survey Group (EPSG). For UTM zones in the northern hemisphere and with the WGS84 datum, the numeric code is 32600 + the UTM zone number. An example of a valid CRS specification is EPSG:32615, where "6" or "7" defines Northern/Southern hemisphere, and 15 represents the UTM zone.

**Area of interest (AOI):** An AOI to be processed is inserted here. This can be copied from an area drawn on the map by pressing the 'Copy From Map' icon. Alternatively, it can be specified in the Well-Known Text (WKT) POLYGON format. An example of a valid specification is: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)). The AOI should be large enough that it includes enough reference data for all target class. The AOI should be tight enough so that it only includes pixels in the common overlap area of all input images. Areas with less radar observations get artificially small biomass volumes.

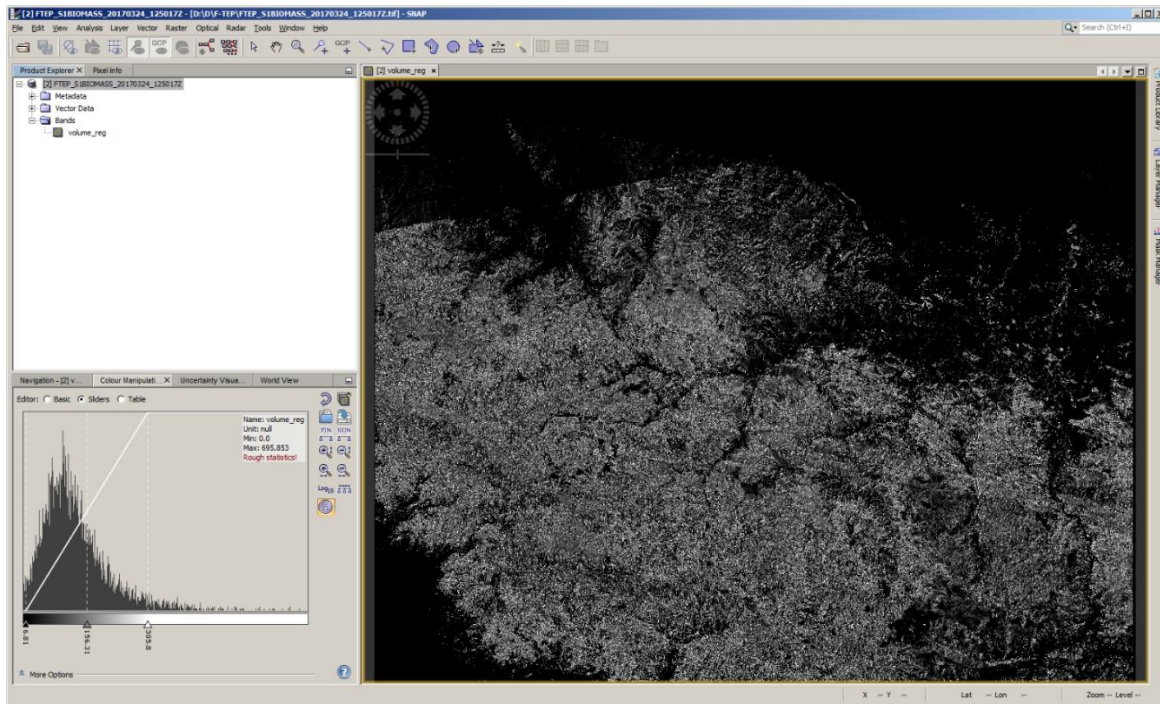
**Target Image Resolution:** The requested output image pixel spacing (in metres) is inserted here. For Sentinel-1 radar data, feasible values are between 20 and 100 m. Example: 20

**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

#### 4.6.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. The resulting output can be downloaded, re-used or displayed in one of the GUI applications, such as SNAP or QGIS. Soon after the desired application process (e.g. QGIS) is started, a 'Go to GUI' icon appears in the job description. You can access the desired GUI application by clicking this icon which opens the GUI in another browser tab.

A typical output biomass map is displayed below using the SNAP application.



## 4.7 S1Stack

### 4.7.1 Service description

The S1stack service mosaics dual-polarized Sentinel-1 GRD images along orbit and assigns acquisition dates as bands in a multi-temporal output image. This way, areas crossing scene boundaries can be used as input to e.g. the LandCoverGeotiff service.

### 4.7.2 Input data

The S1Stack service requires a set of same-geometry dual-polarized Sentinel-1 images in GRD format as input data.

### 4.7.3 Parameters

**S1/GRDH/SDV images:** A set of same-geometry dual-polarized Sentinel-1 images in GRD format, preferably collected into a databasket.

**Coordinate system:** This field defines the target coordinate reference system (CRS). It must be a string beginning with 'EPSG:', appended by a numeric code that is a valid system as defined by the European Petroleum Survey Group (EPSG). For UTM zones in the northern hemisphere and with the WGS84 datum, the numeric code is 32600 + the UTM zone number. An example of a valid CRS specification is EPSG:32615, where "6" or "7" defines Northern/Southern hemisphere, and 15 represents the UTM zone.

**Area of interest (AOI):** An AOI to be processed is inserted here. This can be copied from an area drawn on the map by pressing the 'Copy From Map' icon. Alternatively, it can be specified in the Well-Known Text (WKT) POLYGON format. An example of a valid specification is: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)).



**DEM file:** If the input field is empty the service uses SRTM DEM, which is downloaded automatically by SNAP. In areas outside the coverage of SRTM DEM (valid between -60 and 60 latitudes), an external DEM must be uploaded as reference data and then dragged to this input field. The DEM must be in plate carre projection (equal pixel spacing in latitude and longitude, its unit must be 1 m, and its format must be GeoTiff.

**Output label:** A string that is used as part of the output filename

**Output pixel spacing:** The requested output image pixel spacing (in metres) is inserted here. For Sentinel-1 radar data, feasible values are between 20 and 100 m. Example: 20

**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

### 4.7.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. The resulting output can be downloaded, re-used or displayed in one of the GUI applications, such as SNAP or QGIS. Soon after the desired application process (e.g. QGIS) is started, a 'Go to GUI' icon appears in the job description. You can access the desired GUI application by clicking this icon which opens the GUI in another browser tab.







**Area of interest (AOI):** An AOI to be processed is inserted here. The AOI should be large enough that it includes enough reference data for all target class. This can be copied from an area drawn on the map by pressing the 'Copy From Map' icon. Alternatively, it can be specified in the Well-Known Text (WKT) POLYGON format. An example of a valid specification is: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)).

**Beginning of name of output GeoTiff file:** The beginning of the output file name. Date and time are added to obtain unique file names (to prevent accidental overwrite).

**Target Image Resolution:** The requested output image pixel spacing (in metres) is inserted here. For Sentinel-2 optical data, the most feasible value is 10 (the pixel spacing of the input data).

**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

#### 4.8.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. The resulting output can be downloaded, re-used or displayed in one of the GUI applications, such as SNAP or QGIS. Soon after the desired application process (e.g. QGIS) is started, a 'Go to GUI' icon appears in the job description. You can access the desired GUI application by clicking this icon which opens the GUI in another browser tab.



## 5 Application services

### 5.1 Monteverdi

#### 5.1.1 Service description

Monteverdi, provided within the Orfeo Toolbox v 5.8.0, is a GUI application that allows users to view, edit and analyse satellite imagery and data products. This service runs the Monteverdi application in a browser tab on any image either produced inside the F-TEP system or resulting from a search query. Comprehensive advice about how to use Monteverdi within the Orfeo Toolbox is provided here: <https://www.orfeo-toolbox.org/CookBook/Monteverdi.html>

#### 5.1.2 Input data

As input data, the Monteverdi service requires an input image or product which the user wants to open in Monteverdi.

#### 5.1.3 Parameters

**Input data:** Input image or product file name is inserted here. It can be dragged from the result list of a search or job run previously.

**Timeout:** A timeout in minutes before the application automatically shuts down is inserted here. Note, this is not an inactivity timer but a hard limit after which the service shuts down (unless terminated earlier by clicking the 'Terminate this job' icon in the job description).

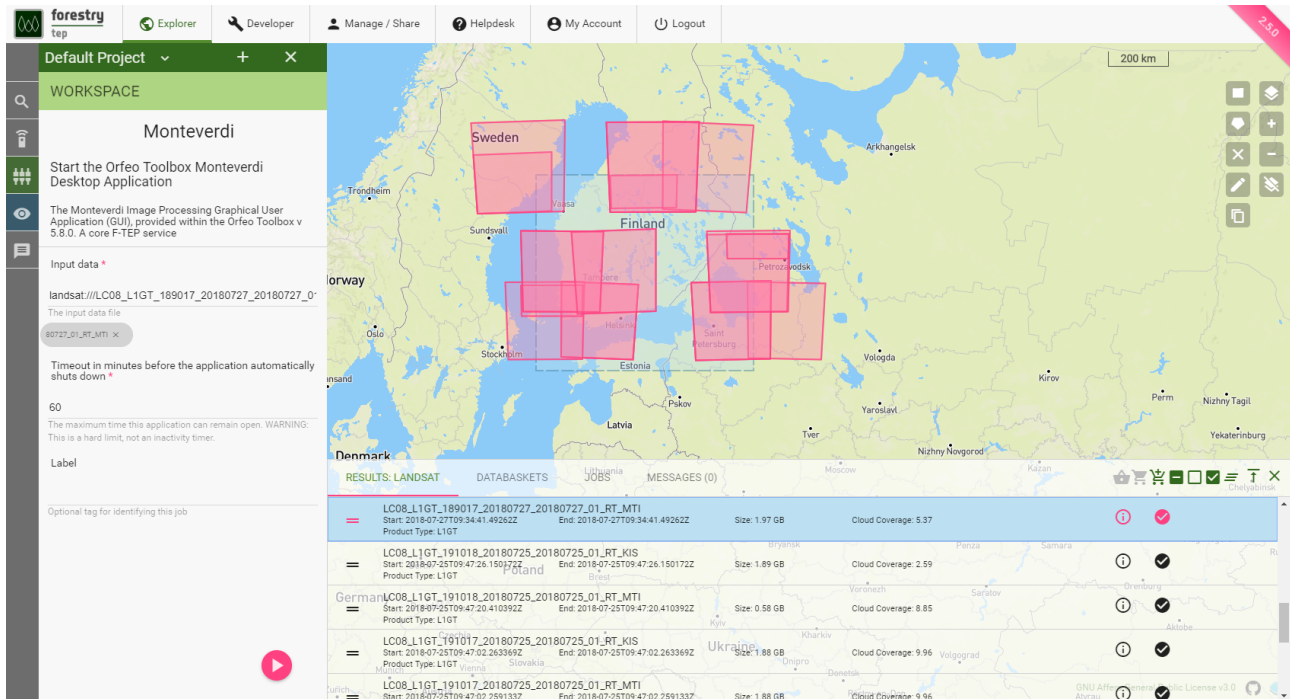
**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

#### 5.1.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. This starts a 'Job' which can be seen in the 'Job' tab on the results panel at the bottom of the map panel. The job runs through three different states: 1. Fetching data, 2. Processing and 3. Completed. While in the status 'Processing', the user can open a browser interface of the application and use the selected inputs.

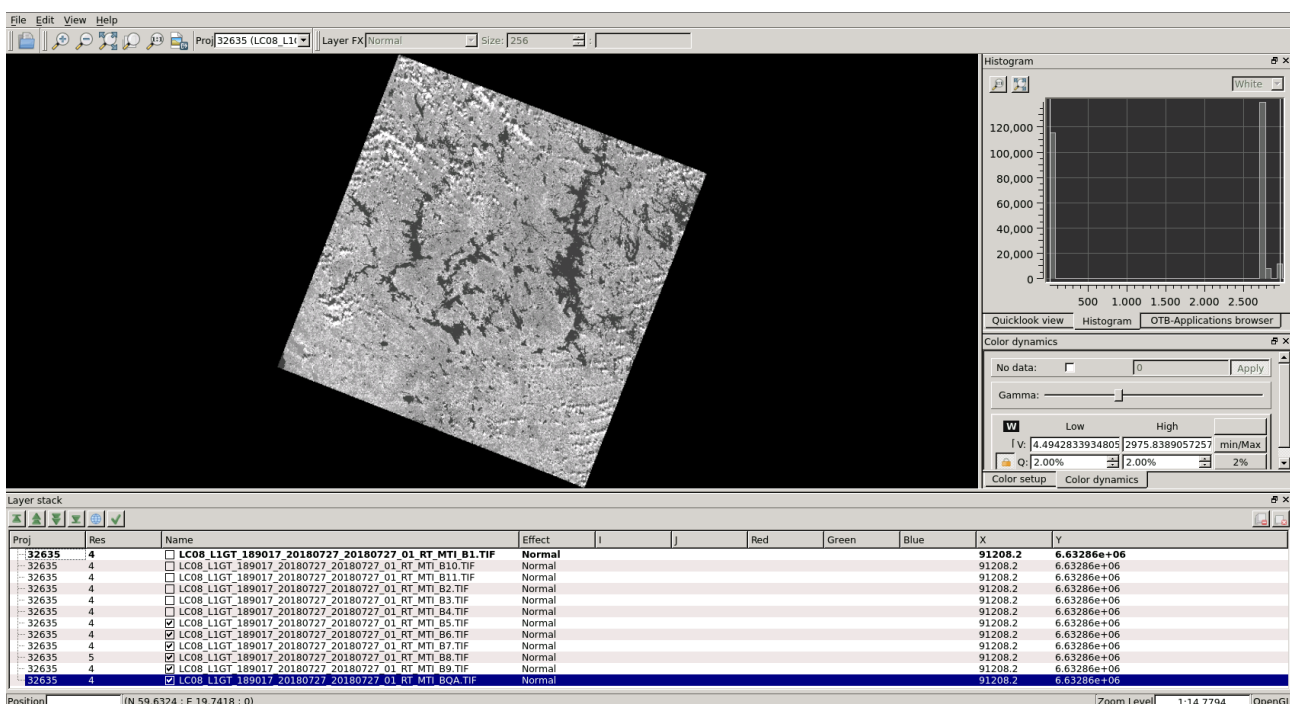
When the Monteverdi service job reaches 'Processing' status, a 'Go to GUI' icon appears in the job description. By clicking on the "Go to GUI" icon a user is presented - in a new browser tab - a login panel to access the graphical interface of the Monteverdi application. By clicking the OK button the user is directly to the Monteverdi interface.

If the user e.g. wants to open a Landsat 8 image in the Monteverdi application, the desired image can be dragged directly from the search results to the Monteverdi service 'Input data' field, as seen in the image here:



A while after launching the service, the 'Go to GUI' icon appears in the job description. By clicking the icon, and accepting the login screen, the user can reach the Monteverdi application.

After accepting the 'Multi-resolution pyramid' screen, the image will open (bands separated in different files). If no image/product opens automatically, the user can look for the data at 'File' → 'Open image' → 'InDir' → 'Inputfile' → and select the desired file. Below image shows Landsat 8 band 5 visible in the Monteverdi application. All the functionalities (including Orfeo Toolbox if selected under 'View' → 'OTB applications browser') are now the user's disposal.



## 5.2 QGIS v2.18

### 5.2.1 Service description

QGIS (previously known as Quantum GIS) is a cross-platform free and open source desktop geographic information system (GIS) application that provides data viewing, editing, and analysis capabilities. This service runs the QGIS version 2.18 application in a browser tab on any image either produced inside the F-TEP system or resulting from a search query. Further guidance on QGIS functionalities can be found here:

<https://www.qgis.org/en/site/about/index.html>

### 5.2.2 Input data

As input data, the QGIS service requires an input image or product which the user wants to open in QGIS.

### 5.2.3 Parameters

**Input data:** Input image or product file name is inserted here. It can be dragged from the result list of a search or job run previously.

**Timeout:** A timeout in minutes before the application automatically shuts down is inserted here. Note, this is not an inactivity timer but a hard limit after which the service shuts down (unless terminated earlier by clicking the 'Terminate this job' icon in the job description).

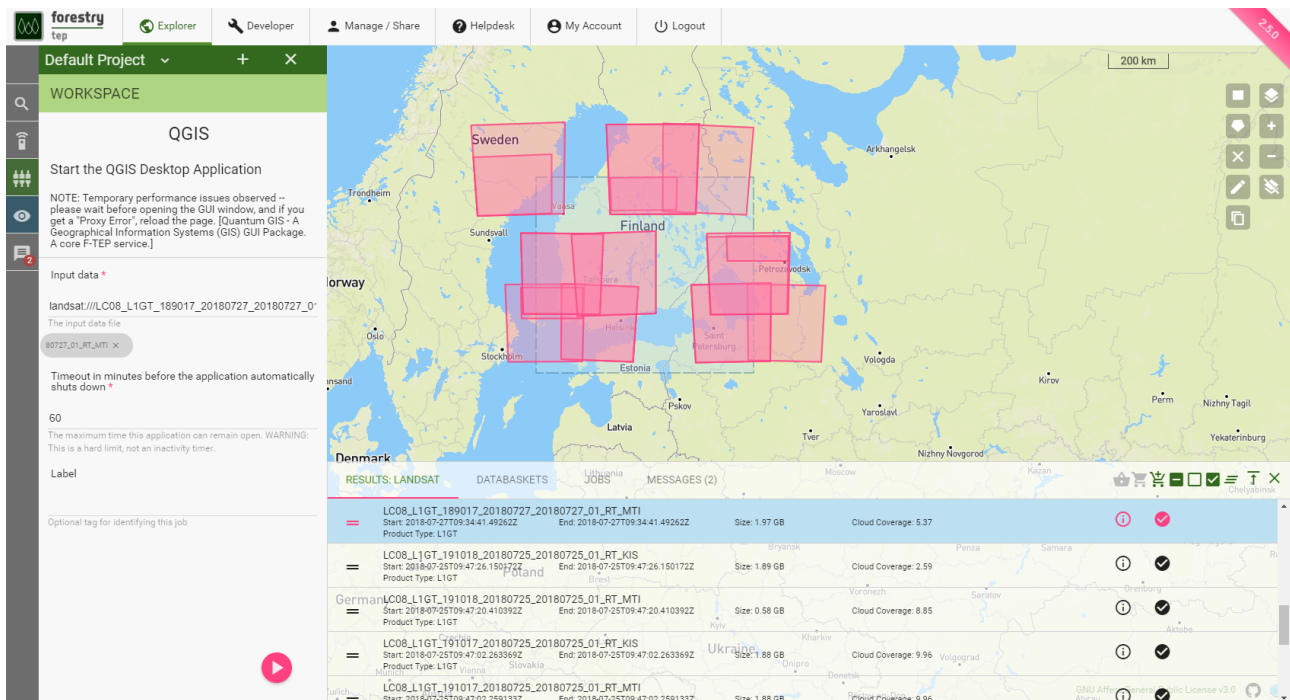
**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

### 5.2.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. This starts a 'Job' which can be seen in the 'Job' tab on the results panel at the bottom of the map panel. The job runs through three different states: 1. Fetching data, 2. Processing and 3. Completed. While in the status 'Processing', the user can open a browser interface of the application and use the selected inputs.

When the QGIS service job reaches 'Processing' status, a 'Go to GUI' icon appears in the job description. By clicking on the "Go to GUI" icon a user is presented - in a new browser tab - a login panel to access the graphical interface of the QGIS application. By clicking the OK button the user is directly to the QGIS interface.

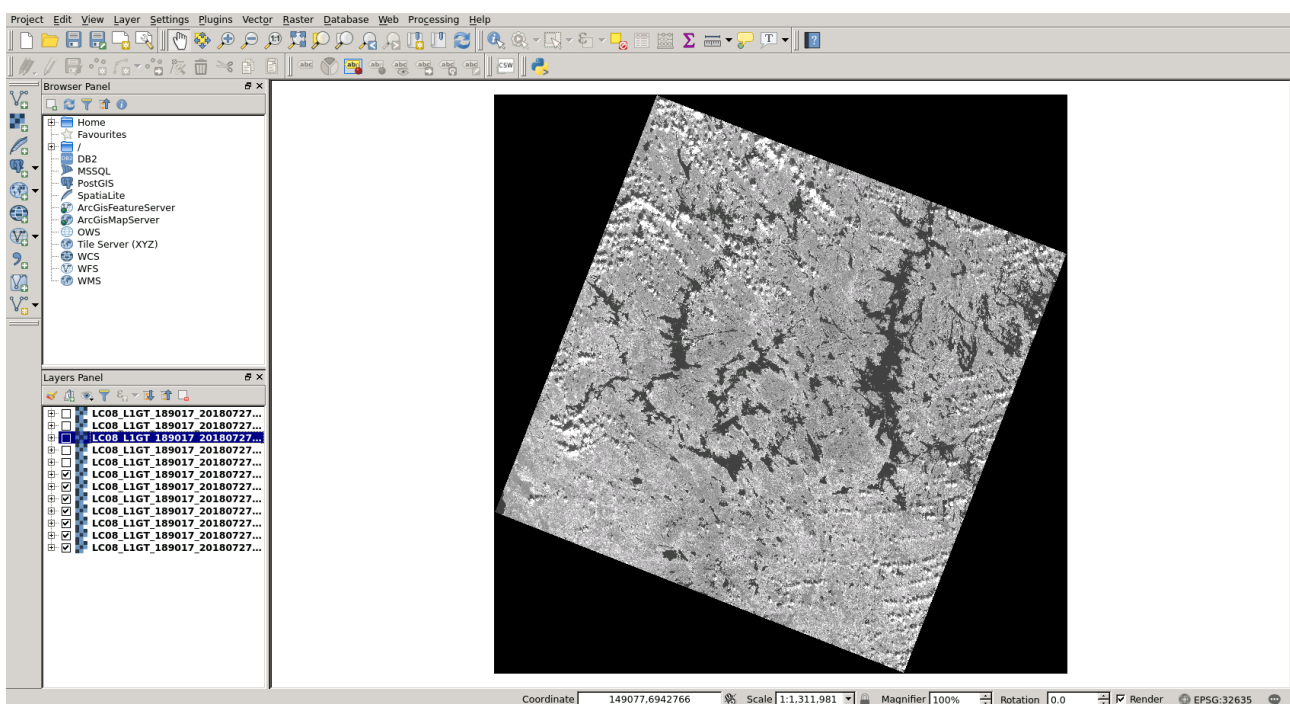
If the user e.g. wants to open a Landsat 8 image in the QGIS application, the desired image can be dragged directly from the search results to the QGIS service 'Input data' field, as seen in the image here:



A while after launching the service, the ‘Go to GUI’ icon appears in the job description. By clicking the icon, and accepting the login screen, the user can reach the QGIS application.



QGIS will automatically open the Landsat 8 image (bands separated in different files). If no image/product opens automatically, the user can look for the data at ‘Layer’ → ‘Add Layer’ → ‘Add Raster Layer’ → ‘InDir’ → ‘Inputfile’ and select the desired file. Below image shows Landsat 8 band 5 visible in the QGIS application. All the functionalities of QGIS are now the user’s disposal.





## 5.3 QGIS v3.6

### 5.3.1 Service description

QGIS (previously known as Quantum GIS) is a cross-platform free and open source desktop geographic information system (GIS) application that provides data viewing, editing, and analysis capabilities. This service runs the QGIS version 3.6 application in a browser tab on any image either produced inside the F-TEP system or resulting from a search query. Further guidance on QGIS functionalities can be found here:

<https://www.qgis.org/en/site/about/index.html>

### 5.3.2 Input data

As input data, the QGIS service requires an input image or product which the user wants to open in QGIS.

### 5.3.3 Parameters

**Input data:** Input image or product file name is inserted here. It can be dragged from the result list of a search or job run previously.

**Timeout:** A timeout in minutes before the application automatically shuts down is inserted here. Note, this is not an inactivity timer but a hard limit after which the service shuts down (unless terminated earlier by clicking the 'Terminate this job' icon in the job description).

**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

### 5.3.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. This starts a 'Job' which can be seen in the 'Job' tab on the results panel at the bottom of the map panel. The job runs through three different states: 1. Fetching data, 2. Processing and 3. Completed. While in the status 'Processing', the user can open a browser interface of the application and use the selected inputs.

When the QGIS service job reaches 'Processing' status, a 'Go to GUI' icon appears in the job description. By clicking on the "Go to GUI" icon a user is presented - in a new browser tab - a login panel to access the graphical interface of the QGIS application. By clicking the OK button the user is directly to the QGIS interface.

## 5.4 SNAP

### 5.4.1 Service description

The Sentinel Application Platform (SNAP) consists of a rich set of visualisation, analysis and processing tools for the exploitation of Sentinel data. It also supports other ESA Earth Observation missions, such as Envisat (MERIS & AATSR), ERS (ATSR), as well as third party data from RapidEye, SPOT, MODIS (Aqua and Terra), Landsat (TM), ALOS (AVNIR & PRISM) and others. The various tools can be run from an intuitive desktop application or via a command-line interface. A rich application programming interface allows for development of plugins using Java or Python. This service runs the SNAP application in a browser tab on any image either produced inside the F-TEP system or resulting from a search query. Further guidance on SNAP functionalities can be found here: <http://step.esa.int/main/toolboxes/snap/>

### 5.4.2 Input data

As input data, the SNAP service requires an input image or product which the user wants to open in SNAP.

### 5.4.3 Parameters

**Input data:** Input image or product file name is inserted here. It can be dragged from the result list of a search or job run previously.

**Timeout:** A timeout in minutes before the application automatically shuts down is inserted here. Note, this is not an inactivity timer but a hard limit after which the service shuts down (unless terminated earlier by clicking the 'Terminate this job' icon in the job description).

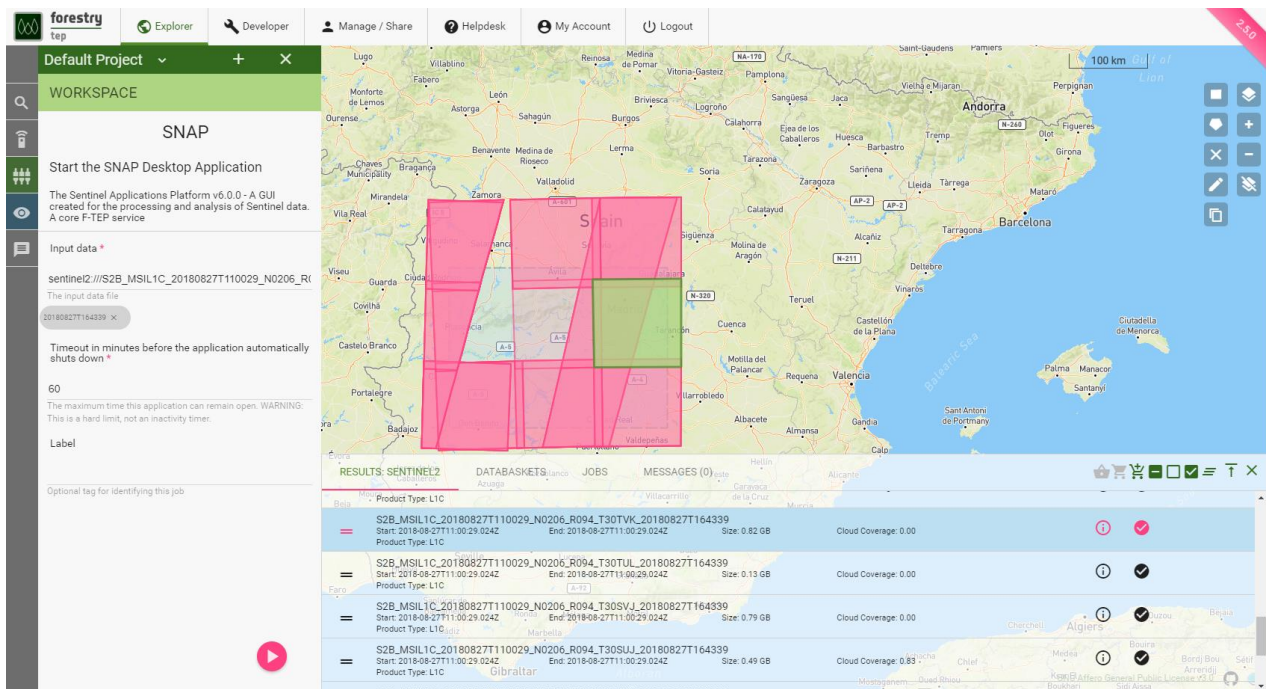
**Label:** OPTIONAL. Allows free form tagging for later identification of this processing job.

### 5.4.4 Usage

After all input fields have been filled in, the service is launched by clicking the round play button at the bottom right corner of the input dialogue area. This starts a 'Job' which can be seen in the 'Job' tab on the results panel at the bottom of the map panel. The job runs through three different states: 1. Fetching data, 2. Processing and 3. Completed. While in the status 'Processing', the user can open a browser interface of the application and use the selected inputs.

When the SNAP service job reaches 'Processing' status, a 'Go to GUI' icon appears in the job description. By clicking on the "Go to GUI" icon a user is presented - in a new browser tab - a login panel to access the graphical interface of the SNAP application. By clicking the OK button the user is directly to the SNAP interface.

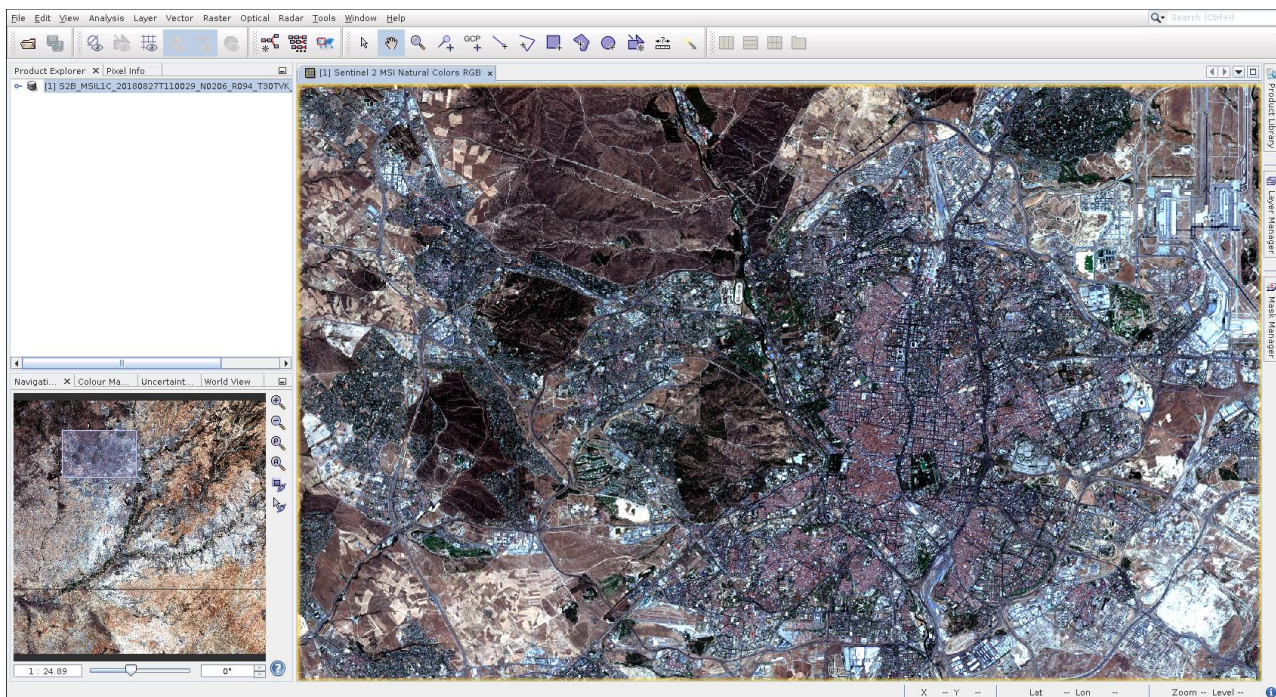
If the user e.g. wants to open a Sentinel-2 image in the SNAP application, the desired image can be dragged directly from the search results to the SNAP service 'Input data' field, as seen in the image here:



A while after launching the service, the 'Go to GUI' icon appears in the job description. By clicking the icon, and accepting the login screen, the user can reach the SNAP application.



The Sentinel-2 image can be seen listed in the 'Product explorer'. The user may e.g. want to view the image (right click the product name → 'Open RGB image window') or perform any other work on the image using the SNAP functionalities which are all at the user's disposal. If no image/product opens automatically, the user can look for the data at 'File' → 'Open Product' → 'InDir' → 'Inputfile' and select the desired file. Below image shows a natural colour Sentinel-2 image opened in the SNAP application.



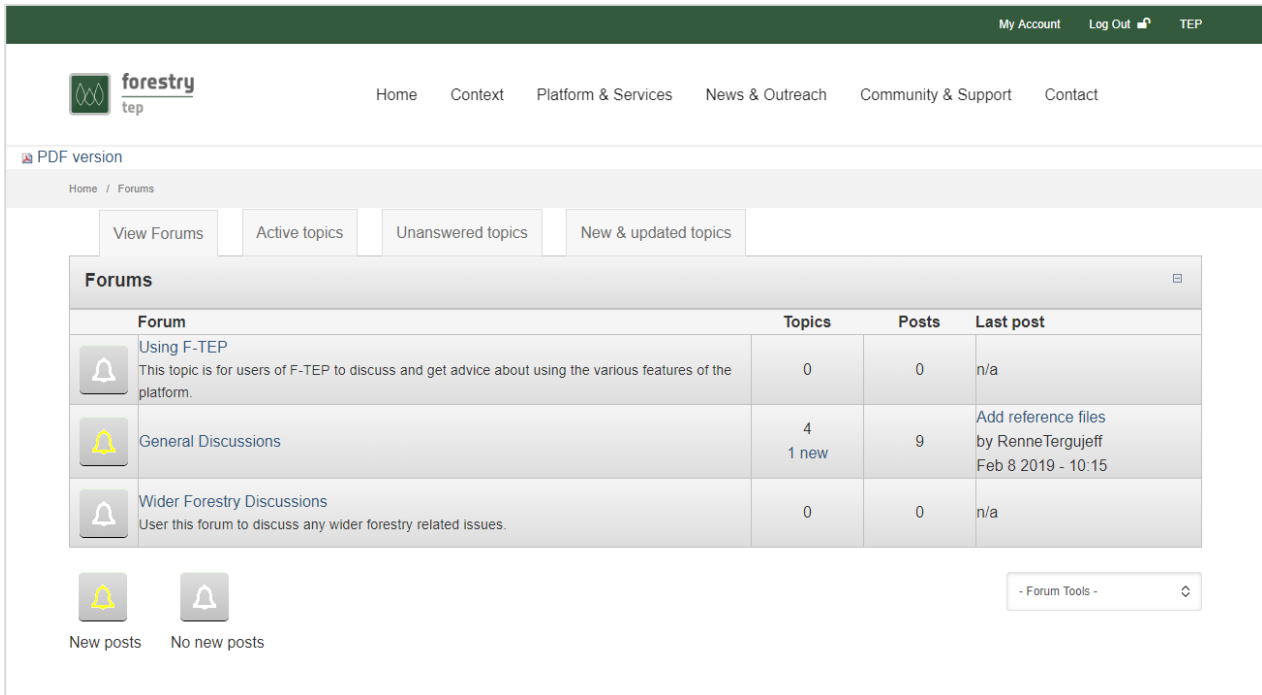
[Can you recognize the capital city in the image?]



## 6 Collaborative aspects

### 6.1 Forum

The F-TEP Forum enables the user community to engage into communication with each other and share information. The F-TEP Forum here: <https://f-tep.com/?q=forum>



Forum	Topics	Posts	Last post
Using F-TEP This topic is for users of F-TEP to discuss and get advice about using the various features of the platform.	0	0	n/a
General Discussions	4 1 new	9	Add reference files by RenneTergujeff Feb 8 2019 - 10:15
Wider Forestry Discussions User this forum to discuss any wider forestry related issues.	0	0	n/a

The forum is divided into different broad discussion forums (such as using F-TEP) and within each forum into a collection of topics (such as discussions about a particular aspect of the F-TEP portal).

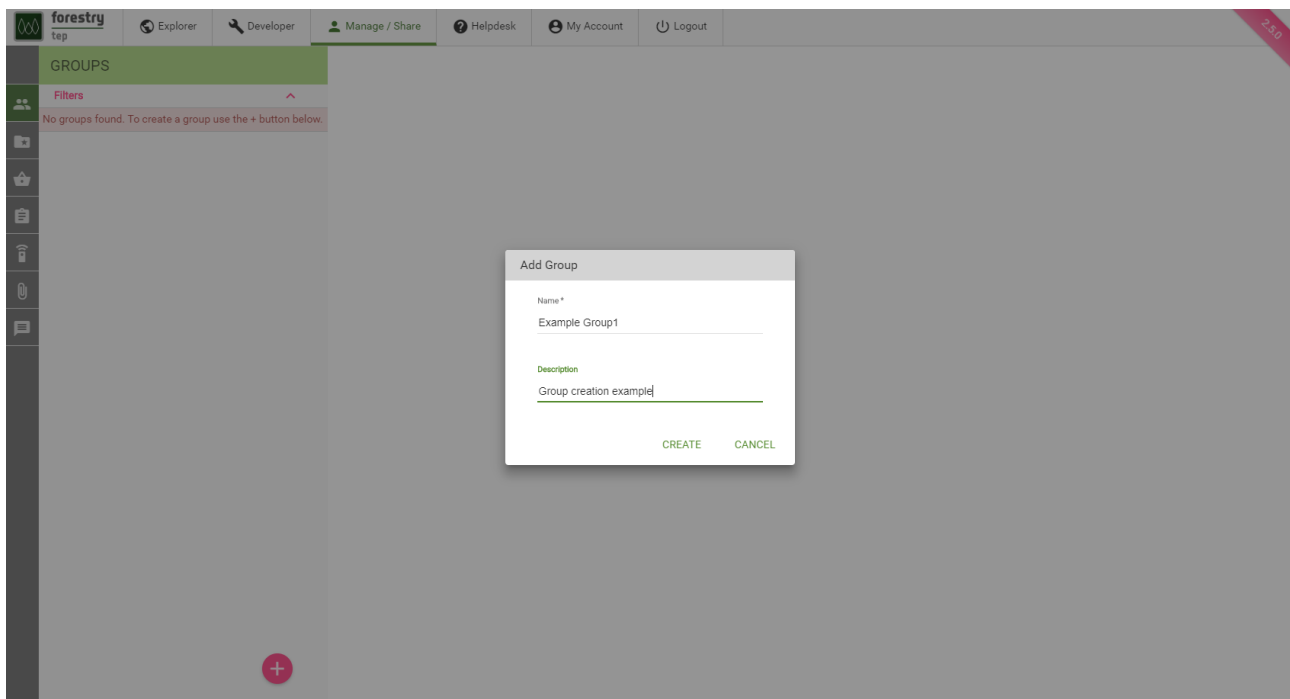
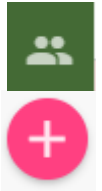
In order to create a forum message the user needs to be logged in (with the EO-SSO account). When logged in the forum, a user can create a new Topic (clicking the new topic button) or add a message within an existing topic.

## 6.2 Groups

In order to share material or work together with other F-TEP users, it is possible to create groups of users using the 'Groups' function. F-TEP users can be grouped together e.g. if they are sharing the same datasets or are contributing to the same project. All group members can see and use all the datasets created or uploaded by any of the group member. It is possible to assign either 'read', 'write' or 'admin' permissions to the group.

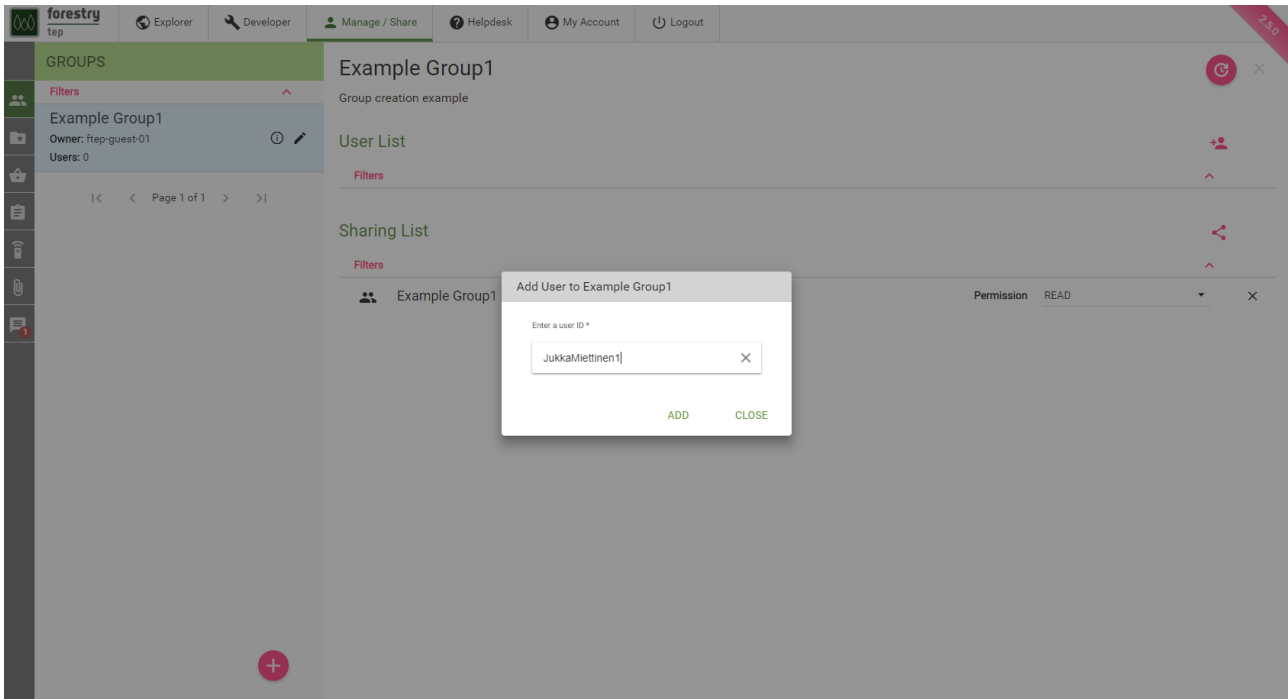
Groups are created in the 'Manage / Share' interface, in the 'Groups' panel that is accessible by clicking the 'Groups' icon. A new group can be created by clicking the plus button at the bottom.

The below image shows how to create a new group and assign it a name and a description.

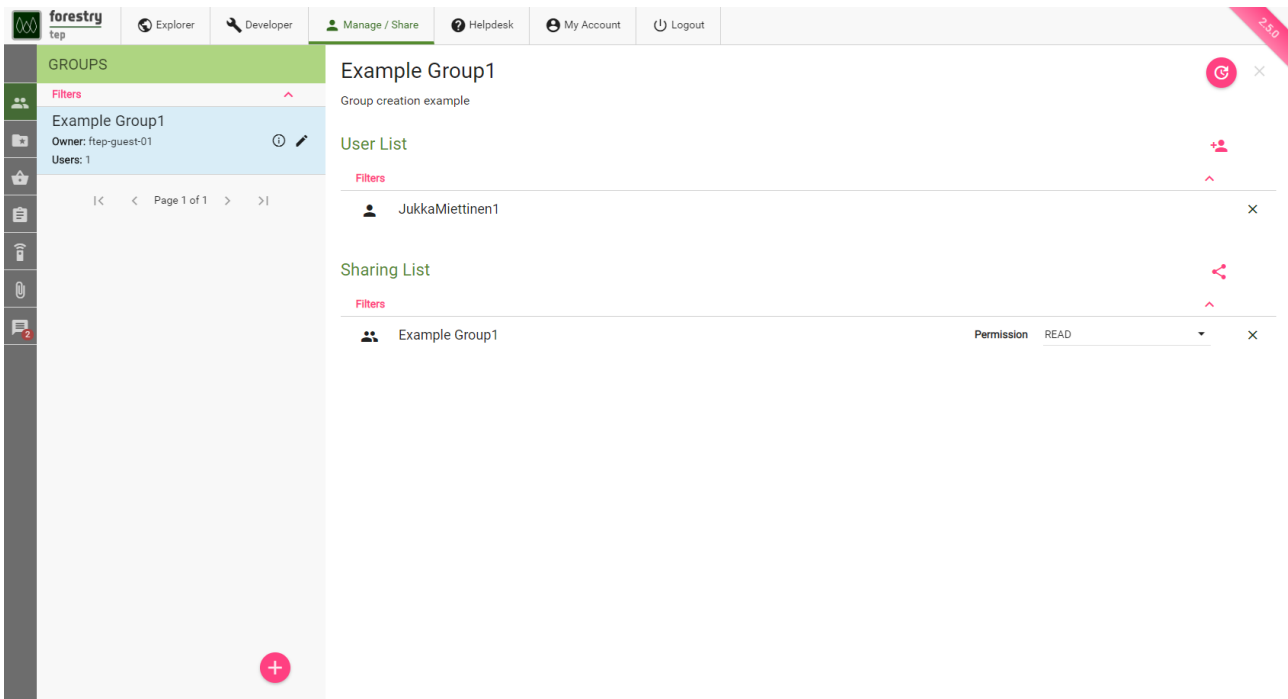




The groups are managed as well through the 'Groups' panel. The panel lists the all the groups created by the user. To add users to groups, use the 'Add users' icon. You can search all F-TEP users and add members to the group one by one.



The new user is now added to the group.



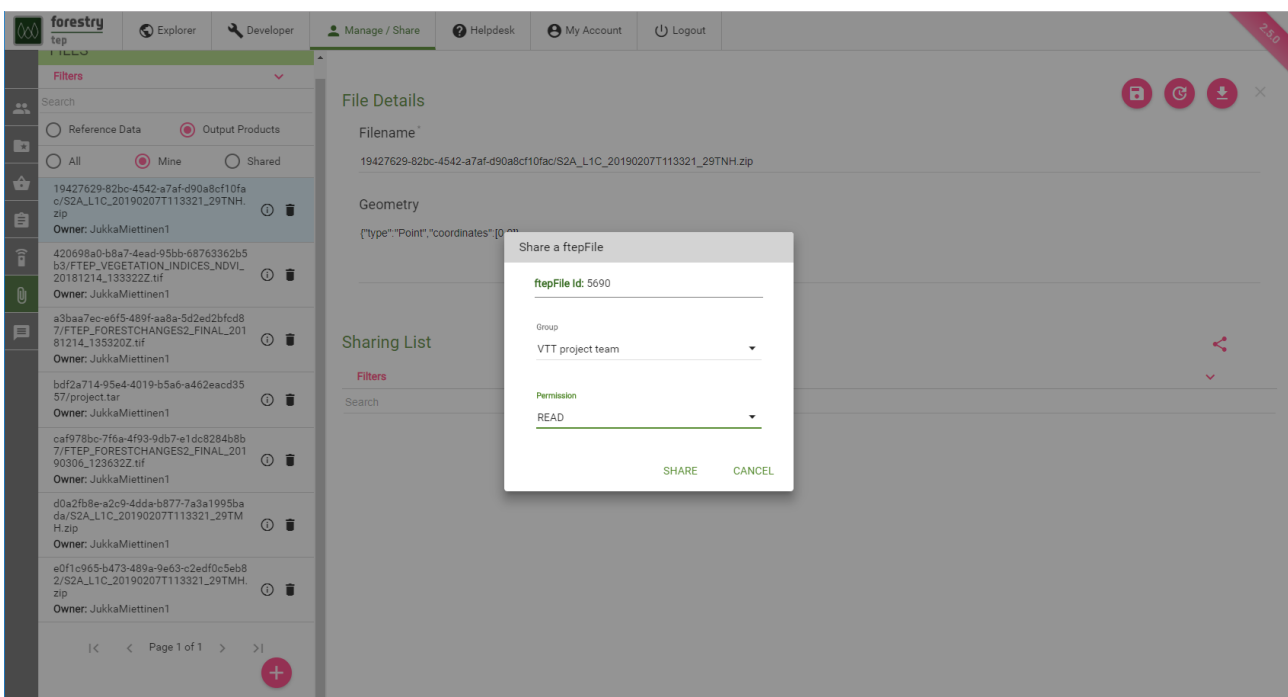
### 6.3 Sharing data

A key aspect of F-TEP is the ability to share items with other F-TEP users. Sharable items include groups, projects, databaskets, logs of jobs, services and data (both output products and reference data). Most of this is controlled via the 'Manage / Share' interface.

In this page, sharing of reference data and output products is described. Reference data is considered to be data that is generated outside of F-TEP and uploaded into the platform, whereas output products have been generated within F-TEP. These are both controlled in the 'Files' tab in the 'Manage / Share' interface. As well as filtering between reference data and output products, users can also filter between generic data ('All'), their own data ('Mine') or data specifically shared by others with that user ('Shared'). They can also search by name for a specific file.

To add reference data, a user will click the 'Add' icon at the bottom of the panel and then drag and drop or click to select their local file to be uploaded (see the image below). Note the maximum file size is currently set to 50 MB. Users will also need to define the geometry to allow the data to be geographically mapped within the system. This is the geographic coverage of the data file, which needs to be provided in the WKT POLYGON specification. An example of a valid AOI specification is: POLYGON((-92.906633 16.190411,-92.066559 16.188383,-92.070266 15.376645,-92.907004 15.378567,-92.906633 16.190411)).

By selecting any file (reference or output), and then clicking the 'Share' icon, the user can share the data to allow groups to access the file. The level of permission rights (read or edit) is also assigned at this stage. All members of the target group can now see the file in question, and they have the assigned level of right to work with it.



## 7 Service development

One of the key collaborative aspects of F-TEP is the ability for users to create and share services with others. This gives the users the ability to shape the services that F-TEP offers and give other users the chance to use novel algorithms and processors on a satellite data tailored for their needs.

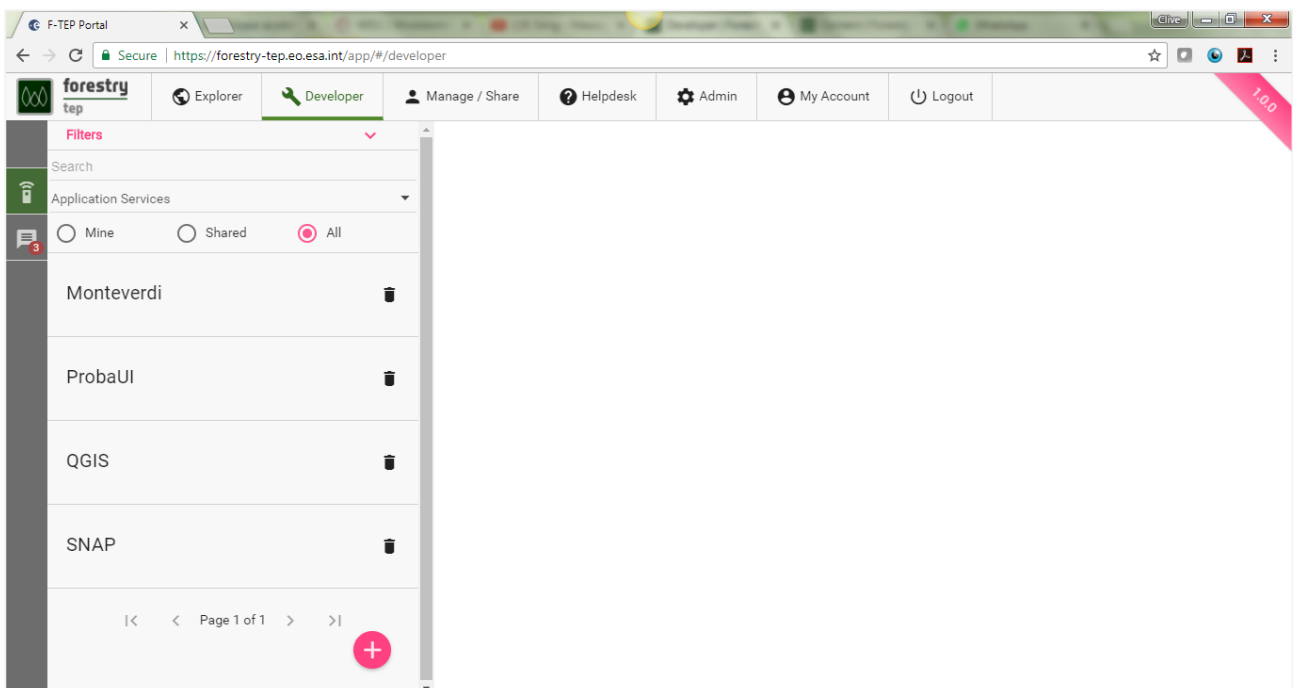
### 7.1 Developer interface

The Developer interface is where 'Expert Users' will be able to see the source codes of the services, both their own services as well as the range of F-TEP core services. If you cannot see the 'Developer' interface you are not an 'Expert User' and hence you need to request for an upgrade of your account status via the Helpdesk interface.

The 'Services' panel (which can be reached by clicking the 'Services' tab) on the left of the screen lists all the services that a user has access to. These will be made up of:

1. Core services, provided by F-TEP and made available to all
2. Own services, created by the user, which may not be visible to others
3. Shared services, provided by other F-TEP users

Users can filter within the services panel by 'Mine', 'Shared' or 'All' criteria, or they can search services by typing in a keyword.



## 7.2 Creating services

In the 'Developer' interface, users can create new services. An F-TEP service includes four key components:

1. Defined *input files* - the type of input files are defined by the service developer, with the actual files chosen by the service user
2. Defined *input parameters* - the parameters defined by the service developer, with the actual values chosen by the service user
3. Defined *output files* - the type of output files are defined by the service developer, with the actual file(s) chosen by the service user
4. The actual *service engine*, which is normally created within a 'Docker' container

It is expected that the service creator has some basic knowledge of Docker and shell scripting, although template files and guidance are provided, and users can contact the F-TEP Helpdesk for further guidance.

To start service development, an Expert user logs into the F-TEP portal and navigates to the 'Developer' interface. The user then clicks on the large plus button towards the bottom of the Services Panel to 'Create New Service'. The user then fills in the pop-up box with the name and the description of the service and after they have accepted the Terms and Conditions, click 'create' to create the Service. The service framework is then automatically created, consisting of files needed for the service:

- *DockerFile*: this default file provides SNAP and Orfeo toolbox on top of the Ubuntu 16.04 Operating System. This is expected to be sufficient in many cases for creating tailored EO data processing services that utilise SNAP algorithms.
- *A workflow.sh File*: this required executable bash script file allows the user to arbitrarily define the service procedure. The default file demonstrates the expected directories for input and output data, and how to read input parameter values. If the service developer requires an alternative scripting language, workflow.sh can be updated to call another script, or the ENTRYPOINT parameter in the Dockerfile may be changed.

To define the service, the user can enter various different pieces of information including:

- **Docker Tag**: automatically generated by F-TEP
- **Version**: the developer can assign a version number for their service
- **Service Type**: this can either be a Processor, Application or Bulk Processor
- **Summary**: Free text for the user to describe their service
- **Input Definitions**: allows users to define the service's Input parameters. Required fields include Field ID, Field Title, Field Description, parameter type. A minimum of one input parameter is needed. Furthermore, optional parameters allow specific behaviour for the inputs:
  - "Data Reference" inputs enable the drag-and-drop behaviour for input data;

- “Enable Parallel Processing” inputs (likely only useful when “Max Occurs” is >1) allow the service to be launched as a batch with one sub-job per value.
- **Output Definitions:** allows users to define the service’s Output parameters. Required fields include Field ID, Field Title, Field Description, parameter type. A minimum of one output parameter is needed.

The user can test the service via the ‘Explorer’ interface, where the service should be visible.

The screenshot shows the 'Developer' tab in the Forestry TEP portal. The left sidebar contains a 'Filters' section and a list of 'Application Services' including ForestChangeS2, LandCoverS1, LandCoverS2, S1Biomass, and VegetationIndices. The main panel displays the configuration for 'ExampleService'. The 'FILES' tab is selected, showing a Dockerfile and a workflow.sh file. The Dockerfile content is as follows:

```

1 FROM ubuntu:16.04
2
3 MAINTAINER Forestry TEP
4
5 # Dependencies
6 RUN apt-get update && apt-get install -y\
7 bc\
8 curl\
9 libfreetype6\
10 python\
11 python-dev\
12 && apt-get clean && rm -rf /var/lib/apt/lists/*
13
14 #####
15 # Download and install SNAP
  
```

The screenshot shows the 'Developer' tab in the Forestry TEP portal, with the 'OUTPUT DEFINITIONS' tab selected. The table below defines the output parameters for the service:

ID	Title	Description	Type	Default Value	Min Occurs	Max Occurs	
Output_File	Output File	ne your output file	stri...		0	0	

A green plus icon is visible below the table, indicating the option to add new output definitions.



### 7.3 Service example

Below is a simple example service that can be created to demonstrate the key steps:

1. User creates a new service and keeps the default Dockerfile template.
2. Input parameter definitions are created, for example string parameters "foo" and "bar".
3. Output parameter definitions are created, for example "baz".
4. The default workflow.sh file is updated with these parameters in mind, for example see below.
5. The service is saved and tested via the Explorer interface. It may be shared with other groups for testing. When the service is run, the user will see in the job log the standard output/error as well as step-by-step command output from the workflow.sh execution. The result of the below example script will produce a single output file containing the input parameters concatenated.
6. When ready, the service is requested to be published.
7. An F-TEP Content Authority will review the service and if approved, take the necessary publishing actions. As a result, the new service will be visible to all users in the Explorer interface, and exposed via WPS for external usage.

#### Example workflow.sh

```
#!/usr/bin/env bash

set -x -e

# F-TEP service environment
WORKFLOW=$(dirname $(readlink -f "$0"))
WORKER_DIR="/home/worker"
IN_DIR="${WORKER_DIR}/workDir/inDir"
OUT_DIR="${WORKER_DIR}/workDir/outDir"
WPS_PROPS="${WORKER_DIR}/workDir/FTEP-WPS-INPUT.properties"
PROC_DIR="${WORKER_DIR}/procDir"
TIMESTAMP=$(date --utc +%Y%m%d_%H%M%S)

mkdir -p ${PROC_DIR}
mkdir -p ${OUT_DIR}/baz

# Input params
source ${WPS_PROPS}

# Processing
echo "${foo} ${bar}"
>${OUT_DIR}/baz/MY_SERVICE_OUTPUT_${TIMESTAMP}.txt
```

## 7.4 Sharing services

*Sharing the service:* The user can make their service accessible to group(s) of selected users via the 'Manage / Share' interface.

*Publishing the service:* Publishing refers to making the service available to all. Publishing is not instantaneous, as any new services will be reviewed by F-TEP to ensure they are safe to be used by others.