



GUIDE TO IQMULUS WIZARD

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The Wizard guides you through the steps of using predefined, easy-to-use IQmulus workflows which can be temporarily modified according to your needs. You are allowed to change input data, parameters, or thresholds. Beside this, you can set up a new workflow also, using a Domain Specific Language (DSL) editor. This process requires some prior orientation regarding DSL usage. It is recommended to study the DSL content and structure of predefined workflows, and the provided DSL documentation.

Example workflow name: Predefined Land Showcase 3 (Landsat 8) VIS EOVI

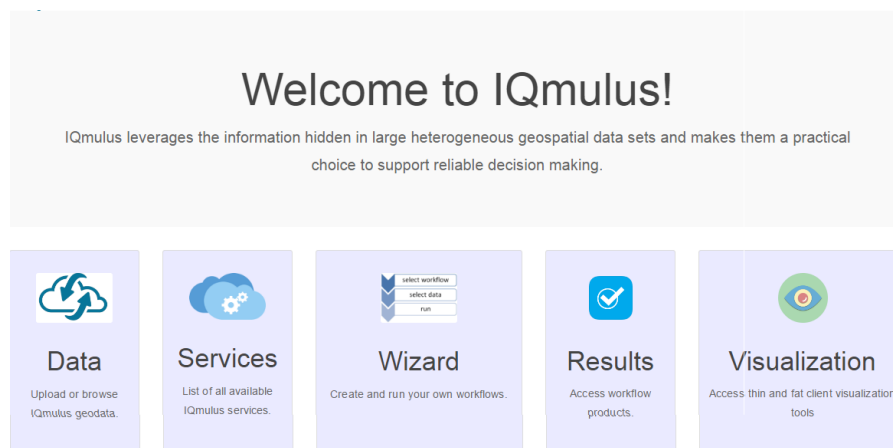


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USING WORKFLOWS IN IQMULUS

The Users may find some predefined, ready-to-go workflows on the IQmulus User Interface to solve some simple task concerning the IQmulus topics. It is possible to change parameters, services, or even add or delete database references using a Domain Specific Language (DSL) in these workflows. Changes will be temporary, valid for the actual session, so Ready-to-go workflows cannot be modified permanently.

It is also possible to set up completely new workflows in a workflow editor and save them. This procedure requires some experiences, so we recommend to study the DSL content and structure of predefined workflows, and the provided DSL documentation. It is also recommended to inquire about the build-in services for generating files for easy visualization.

Always look after data formats used by the workflow you have chosen.

About the example: This document guides you through the IQmulus Wizard with the help of “Land Showcase 3 (Landsat 8) VIS EOVI” predefined workflow. The workflow is a tool for detecting waterlogged areas on Landsat 8 images. Masks are used to filter out areas, we are not interested. The result is a thematic raster showing different categories of waterlogging. An .iqv visualization file is also generated to demonstrate the usage of the IQmulus Fat Client (IFC).

Categories of the thematic output raster:

1. Natural waters
2. Waterlog
3. Seriously affected soil
4. Moderately affected soil
5. Weakly affected soil
6. Vegetation in waterlog
7. Dry areas
9. Clouds
11. Not supported areas

THE WIZARD

WELCOME PAGE

→ Read

The IQmulus system starts with an easy to navigate interface (*Figure 1.*). In the upper right corner the IQmulus User guide offers assistance about the functions of the panels, buttons or menus, just click on it for appearing. Short description of further usage of tools hiding behind the panels is provided in present document.

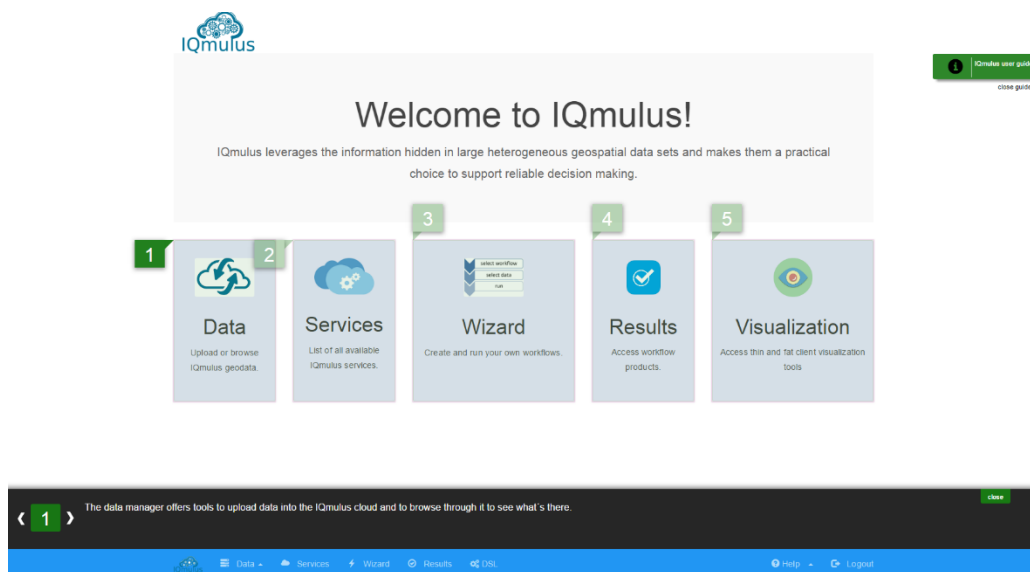



Figure 1.

1. The Data Manager offers tools to upload data and metadata into the IQmulus cloud on one hand, on the other hand browsing uploaded and result files is also possible here.
2. The Service List (or Cue Card system) provides short description and parameter list for all available services you may use in your workflows. Keyword search will help to find the appropriate service(s). Check out the list to see what processing powers IQmulus has to offer.
3. ***The Wizard guides you through the steps of using predefined, easy-to-use IQmulus workflows which can be temporarily modified according to your needs. You are allowed to change input data, parameters, or thresholds. Modifications are valid for the session you are working on actually. Beside this, you can set up a new workflow also, using a Domain Specific Language (DSL) editor. This process requires some prior orientation regarding DSL usage. It is recommended to study the DSL content and structure of predefined workflows, and the provided DSL documentation. Your new workflow can be saved, and reused. Before you start using it, please check the notes and instructions on the Visualization possibilities also!***
4. All IQmulus jobs and related information are listed on this page. It provides workflow-status tracking and allows convenient access to the produced data through download or visualization.
5. IQmulus provides simple tools for Thin Client and Fat Client to visualize point cloud, triangle mesh, LR-spline surfaces, raster, etc. You may find all information about installation and

usage of the visualization tools here, but it is also recommended to inquire about the build-in services for generating files for easy visualization.

6. The main menus are available constantly (bottom of the page)
7. Go back to main menu by clicking on: 

→ Do

Choose the Wizard on the main page, and click on: **“Start Wizard”** (Figure 2.).

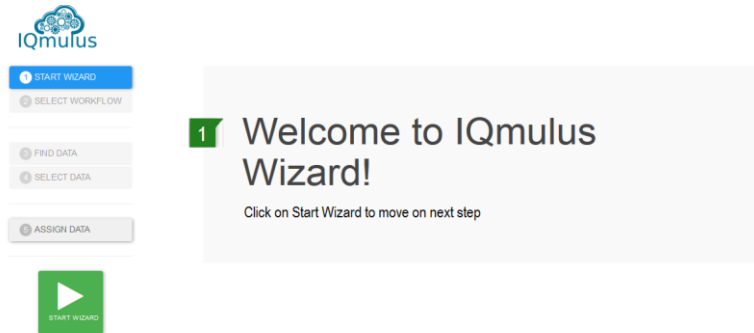


Figure 2.: Welcome page

The list of available workflows appears. Three groups of WFs can be distinguished (Figure 3).

1. all workflows (your newly created workflows will be listed here);
2. predefined workflows (well functioning ready-to go IQmulus workflows are available here)
3. and search results.

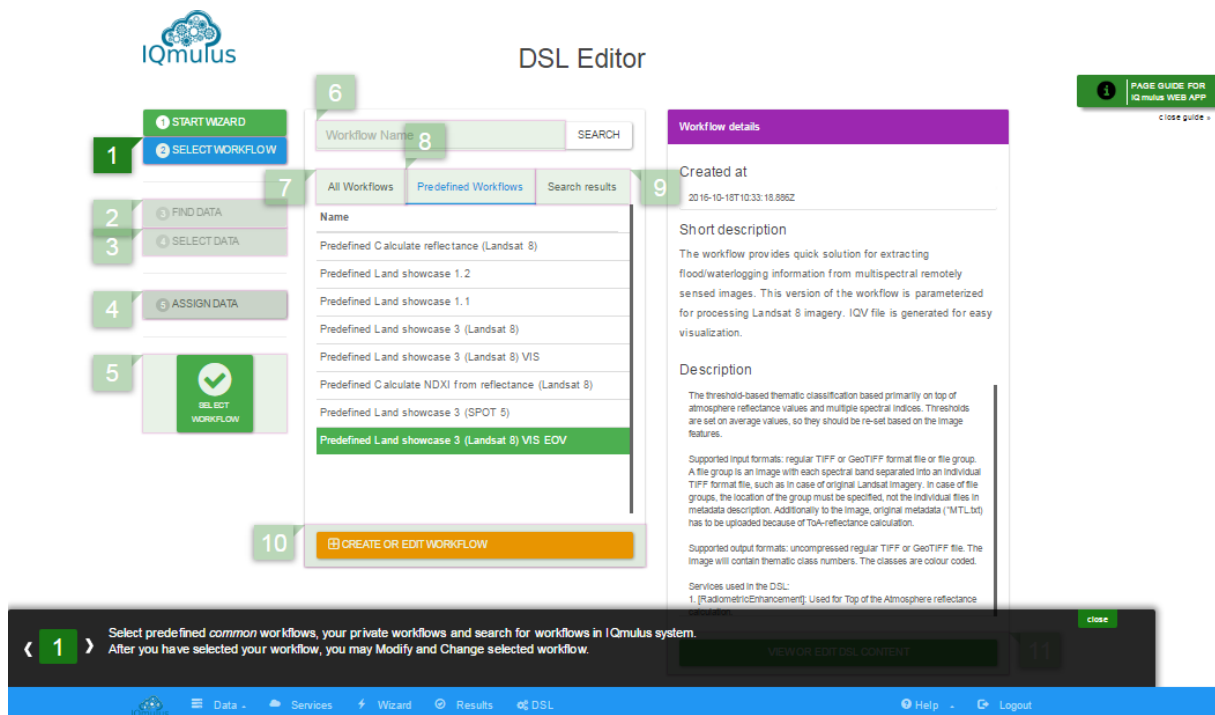


Figure 3.: Selecting a workflow in the Wizard

To get familiar with the functions, read the short explanations.

→ Read

- 1- 5. The panels guide you through the steps of using and/or building a workflow. First the User always has to select a workflow [1]. Search function is provided [6] but predefined WFs are also available [8]. Workflows can be edited if necessary. After editing, the “Select workflow button” [5] takes the User to the next step, which is find [2] and select data [3]. Finally data has to be assigned to the workflows [4].
- 7- All workflows are listed here.
- 8- All predefined, easy-to-use IQmulus workflows are listed here (Predefined workflows). Click on them and read the descriptions in the “Workflow details” panel [11] to figure out which one is appropriate for you. After finding the right one, the User has the possibility to read and make temporary edits in the DSL according to your needs (View or edit DSL content panel at the bottom of the “Workflow details” [11]). Changes are valid for the session you are actually working on.
- 9- Search results are listed here
- 10- It is possible to set up new workflows in a workflow editor and save them. This procedure requires some experiences, so we recommend to study the DSL content and structure of predefined workflows, and the provided DSL documentation. It is also recommended to inquire about the build-in services for generating files for easy visualization.

SELECT A READY-TO-GO WORKFLOW

→ Do

From the “**Predefined workflow**” list choose “**Land showcase 3 (Landsat 8) VIS EOV**”. A short description is provided about the workflow in the “Workflow details” window.

VIEW OR MODIFY THE SELECTED WORKFLOW

As a next step, check the DSL of this workflow. Predefined masking possibilities are present in the DSL. In the example You will use all the masks provided, but we give instructions about how to modify the DSL in case not all the masks present.

→ Do

Click on: “**View or Edit DSL content**”.

→ Read

With the help of the Workflow editor you can view and modify the workflow according to your needs. In the next pages you can study the DSL of “**Land showcase 3 (Landsat 8) VIS EOV**” to get familiar with a DSL content and structure (*Figure 4.*). Explanation of services – as part of the DSL – is also presented (*Figure 5-8.*)

The workflow requires Landsat 8 image as input [**SatelliteImage**], and masks for filtering out areas not in interest. Up to five masks can be added to the workflow, but their use is not mandatory. In the workflow presented as example, three masks will be used: mask of natural waters [**NaturalWaterMask**], cloud mask [**CloudMask**], and mask of non-eligible areas [**NotSupportedAreaMask**].

Workflow DSL - Land Showcase (Landsat 8) VIS EOV workflow and its services

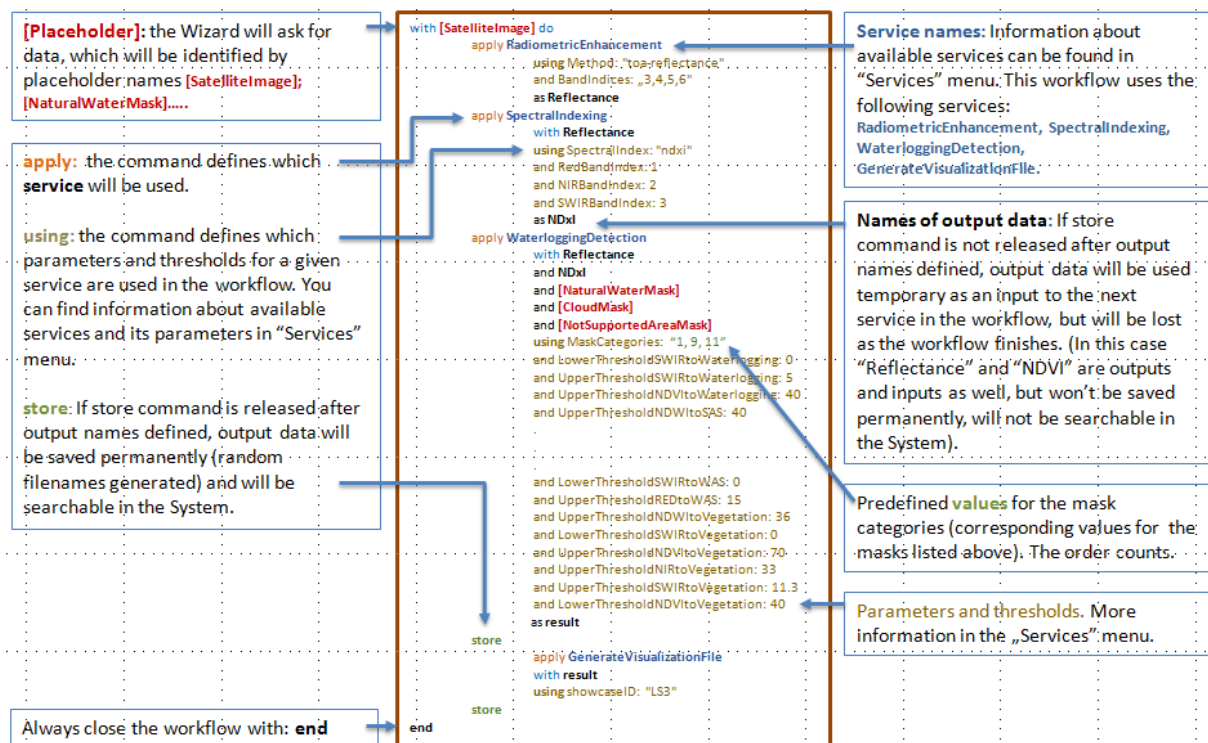


Figure 4.: The DSL content of Land Showcase (Landsat8) VIS EOV

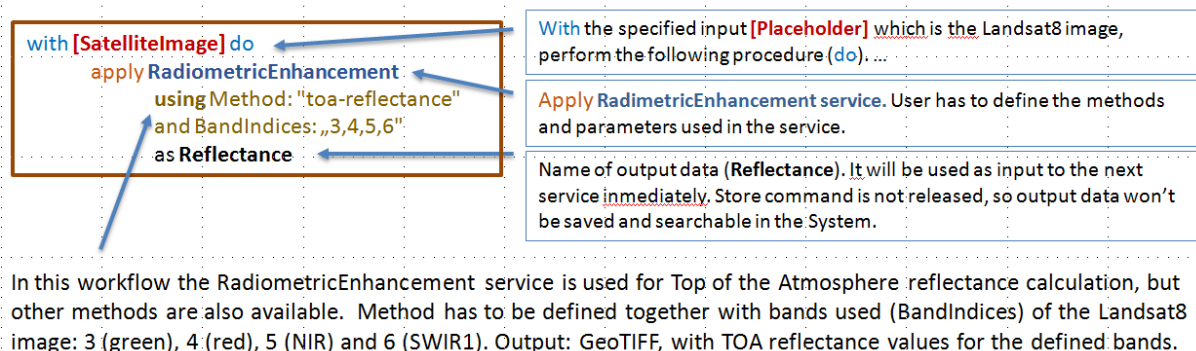


Figure 5.: The radiometric enhancement service

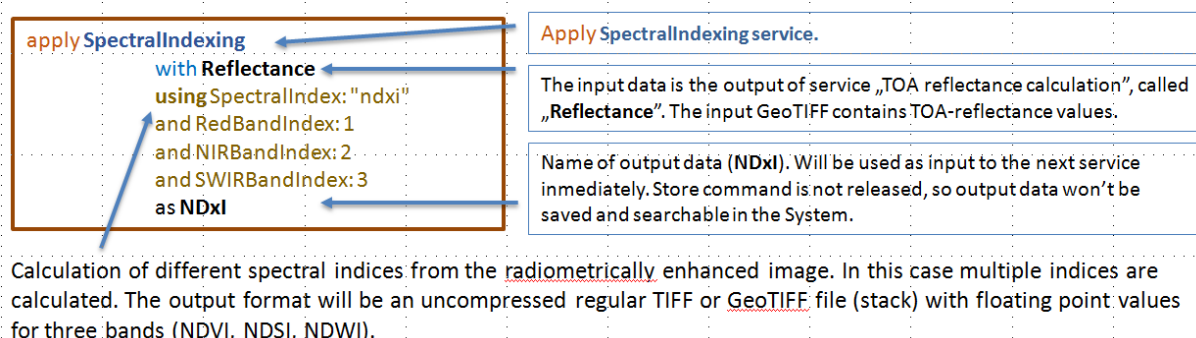


Figure 6.: The spectral indexing service

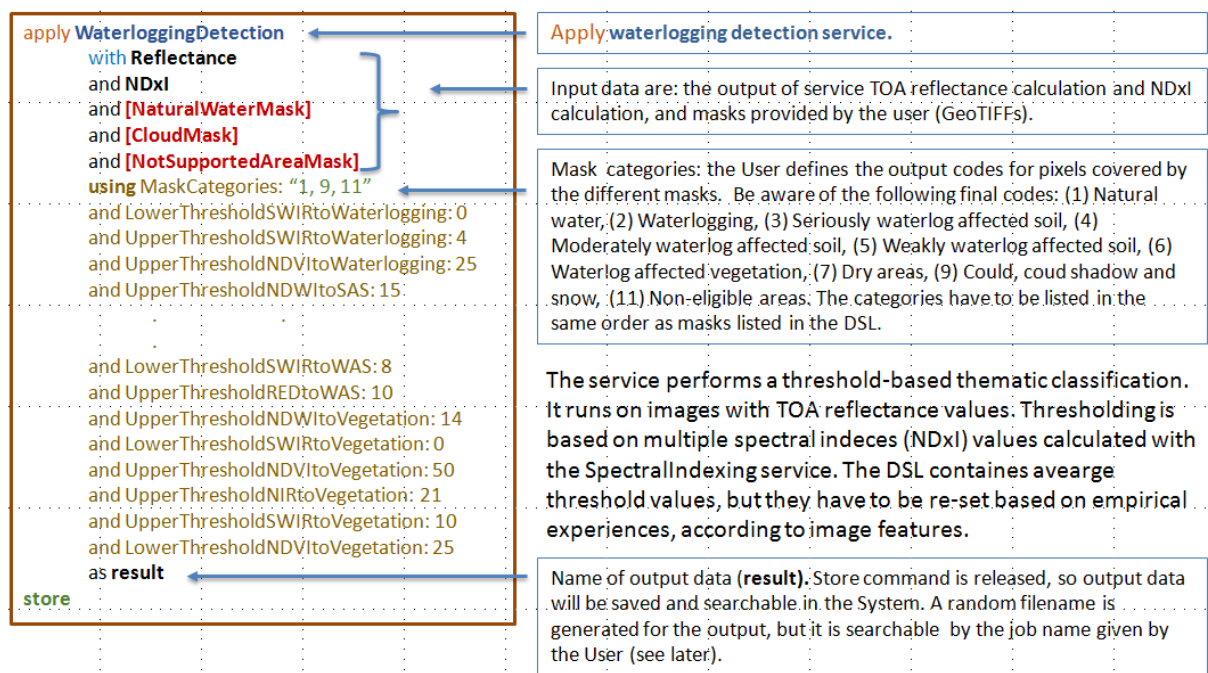


Figure 7.: The waterlogging detection service

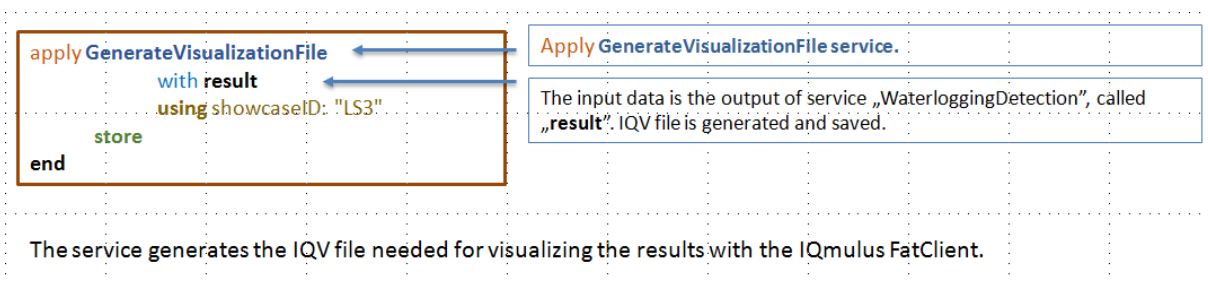
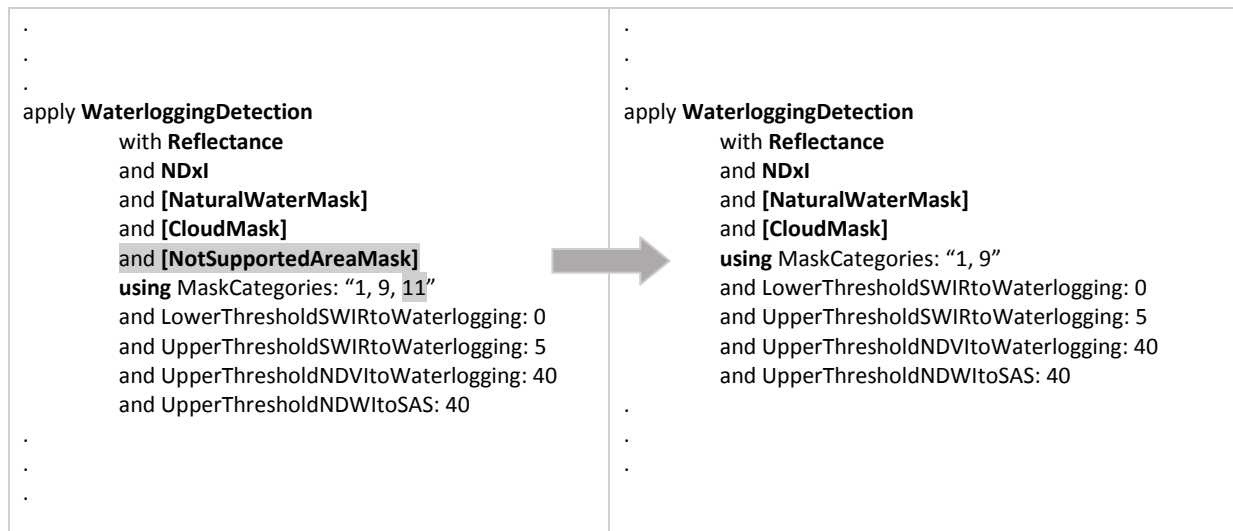


Figure 8.: Generate visualization file service

More information about the Service parameters and thresholds are provided in the “Services” menu (at the bottom of the IQmulus pages).

Deleting a mask from the DSL

In case a User wants to delete a mask from the DSL, beside the placeholder the corresponding “MaskCategory” value also needs to be deleted. For example if data for *areas not supported* does not exist, the DSL has to be modified as follows:



However, adding new mask is also possible, but “MaskCategory” values mentioned before, should be taken into account:

- 1: Natural water (mask has to be provided)
- 2: Waterlogging (calculated automatically)
- 3: Seriously waterlog affected soil (calculated automatically)
- 4: Moderately waterlog affected soil (calculated automatically)
- 5: Weakly waterlog affected soil (calculated automatically)
- 6: Waterlog affected vegetation (calculated automatically)
- 7: Dry areas (calculated automatically)
- 9: Cloud, cloud shadow and snow (mask has to be provided)
- 11: Non-eligible areas (mask has to be provided).

Services as simple workflow

It is also possible to run single services as workflows, Check the following examples:

Calculating TOA reflectance from a satellite image (Landsat8 image) and store the result permanently as “Reflectance”.

The input is a Landsat8 image, the result is a GeoTIFF file, containing the TOA reflectance values for the defined bands. The result is downloadable and searchable in the IQmulus system. Method has to be defined (“toa-reflectance”) together with bands used (BandIndices) of the Landsat8 image: 3 (green), 4 (red), 5 (NIR) and 6 (SWIR1). Output: GeoTIFF, stored as “Reflectance”.

```
with [SatelliteImage] do  
  apply RadiometricEnhancement  
    using Method: "toa-reflectance"  
    and BandIndices: "3,4,5,6"  
    as Reflectance  
  store  
end
```

Calculating NDVI from an image with ToA-reflectance values. Store the result permanently as “NDVI”.

The input is a GeoTIFF file with TOA-reflectance values for the following bands: 3 (green), 4 (red), 5 (NIR) and 6 (SWIR1). Multiple indices will be calculated (we call it NDVI). The output format will be an uncompressed regular TIFF or GeoTIFF file (stack) with floating point values for three bands (NDVI, NDSI, NDWI).

```
with [Reflectance] do
  apply SpectralIndexing
    with Reflectance
      using SpectralIndex: "ndvi"
      and RedBandIndex: 1
      and NIRBandIndex: 2
      and SWIRBandIndex: 3
    as NDVI
  store
end
```

→ Do

After checking the DSL for the workflow “Land showcase 3 (Landsat 8) VIS EOVI”, click on Close, and press “Select Workflow” button.

FIND YOUR DATA

→ Read

The next step is to find data you want to use (Figure 9).

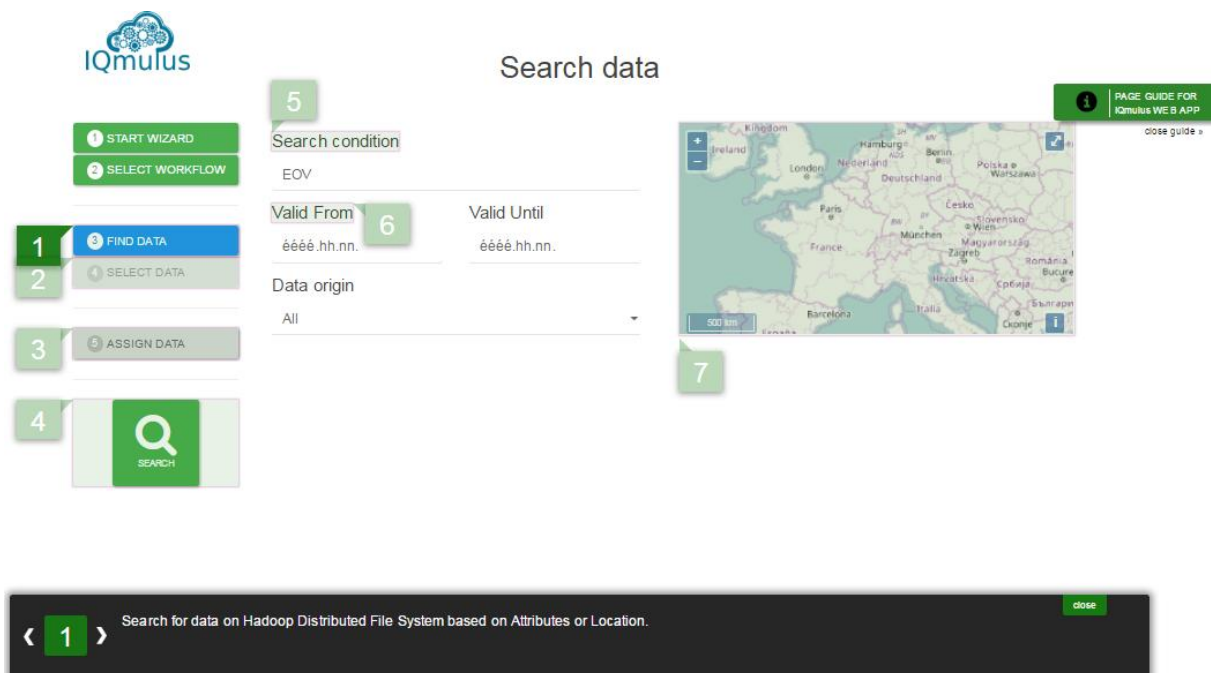


Figure 9: Search data

- 1- 3. Steps of workflow setting
- 4- After setting the search criteria, click “Search” to get the results.
5. Keyword search for input data is present here. Please remember, that keyword search is based on the content of the uploaded metadata file belonging to the data.
6. Input data search based on “begin date” and “end date” registered in the metadata file belonging to the data. You can filter your search results by file format (Data origin).
7. Using geographical search the User can look for data by simply drawing a rectangle on the map.

→ Do

Data sets are provided for testing **Land showcase 3 (Landsat 8) VIS EOVI**. It is easy to find the data with the keyword: **EOVI**. Press the “Search” button.

→ Read

Sample data provided for **Land showcase 3 (Landsat 8) VIS EOVI** are grouped in the search result list in the Relations [4] window as “Test EOVI Landsat 8”. Files (Landsat 8 image and masks) included in the group are listed in the “Data files window”.

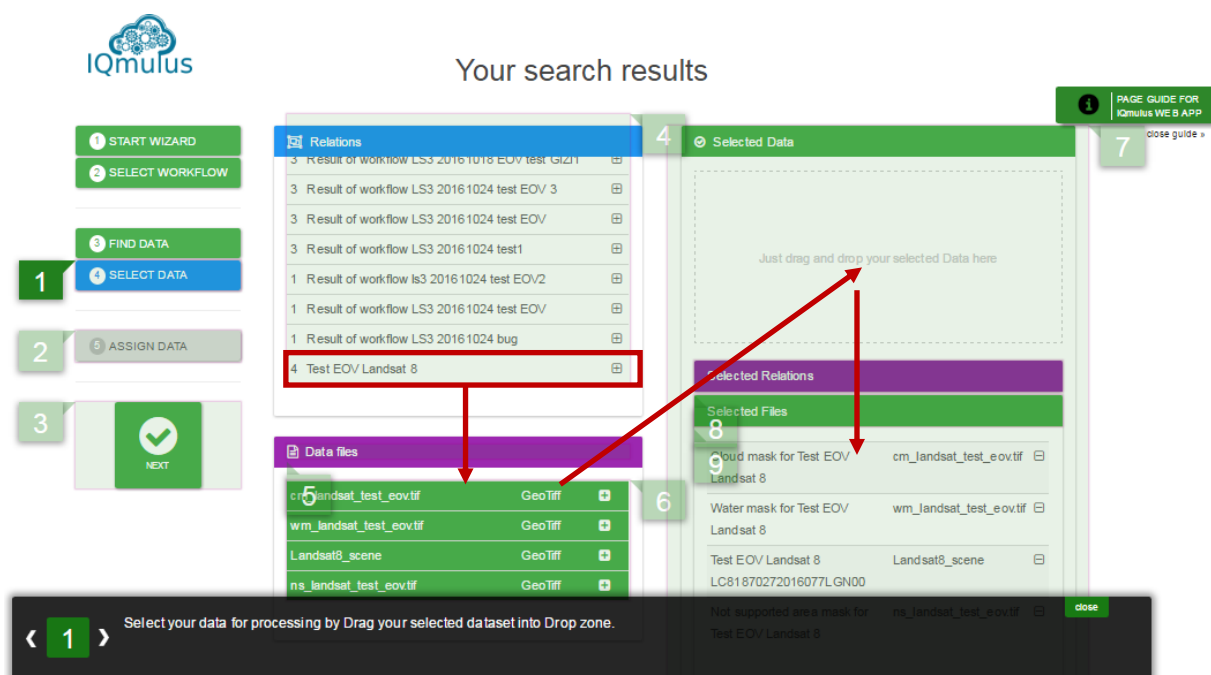



Figure 10: Search results

- 1.- 2. Steps of workflow setting
3. After selecting the data, click the button for the **Next** step.
4. Relations: search results of the previous (Find Data) step are listed here, based on Relations (groups they are belonging to). Relations are defined by the parent Identification numbers which are included in the metadata files. All Relations meet your criteria are listed here.
5. Data file: all data belonging to the same Relation are listed here. You may get more information by clicking on a selected file.

- 6.- 8. Just drag the file(s) or collection(s) you want to use from the “Relations” [4] or “Data files” section [5], and drop it to “Selected data” window [7]. They will be listed immediately as “Selected files” [8] or “Selected Relations [9].
9. Clicking on the  sign the selected Relation or Data can be removed from the list, so it won't be used in the workflow.


→ Do

Find and click the “Test EOVS Landsat 8” in the “**Relation**” window, corresponding files will appear in the “**Data files**” window. Choose the files one by one, drag and drop them to the “**Selected data**” window. All data chosen will be listed in the “**Selected files**” box (check figure 10).

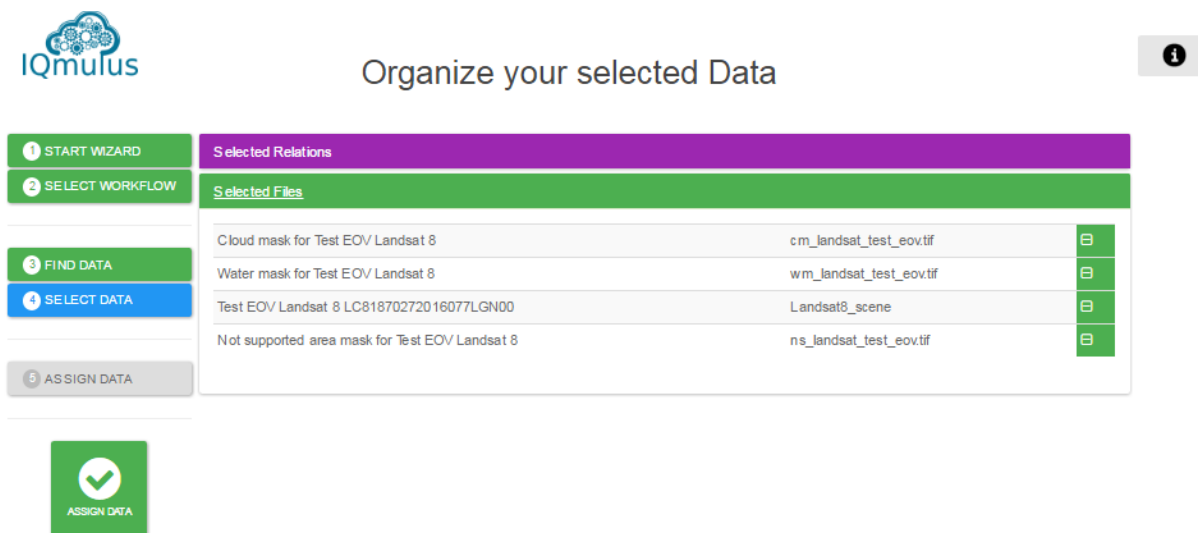
Click the “**Next**” button.





ASSIGNING SELECTED DATA TO THE WORKFLOW AND RUN.

→ Read

As the next step the User can organize the data again (Figure 11.). By clicking on the  sign the selected Relation or File can be removed from the list, so it won't be used in the workflow. It is also possible to go back to “Find data” to look for new data. If everything is Ok, press “**Assign data**”.

The next step is to choose the input data for each placeholder (Figure 12.), and define a name for the workflow. You also have chance to modify some parameters or thresholds if you missed it before, but new data placeholders cannot be introduced.



Selected Relations		
Selected Files		
Cloud mask for Test EOVS Landsat 8	cm_landsat_test_eov.tif	
Water mask for Test EOVS Landsat 8	wm_landsat_test_eov.tif	
Test EOVS Landsat 8 LC81870272016077LGN00	Landsat8_scene	
Not supported area mask for Test EOVS Landsat 8	ns_landsat_test_eov.tif	


 ASSIGN DATA

Figure 11: Organize your data

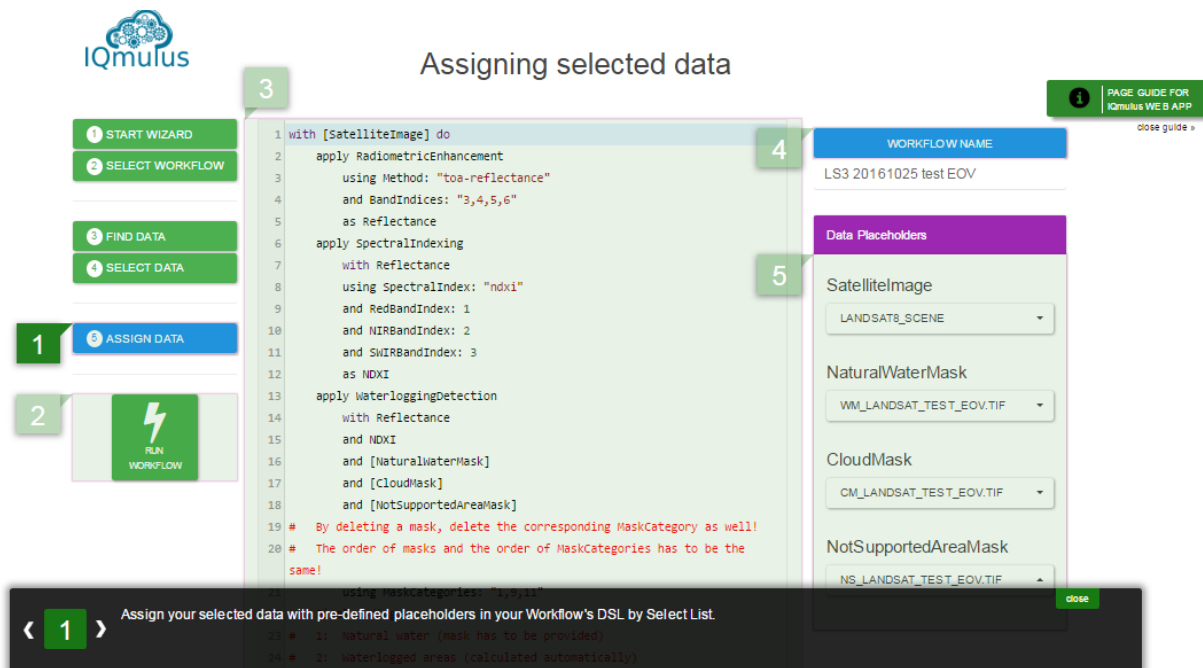


Figure 12.

1. Step of assign data.
2. Click the button for the next step.
3. It is possible to check the workflow again in this section. Missed changes or edits can be fixed.
 - Your possibilities are: changing thresholds.
 - Not feasible changes: add new placeholders, delete existing placeholders, add new services.
4. Define a workflow name here. Your workflow will be traceable on the Results page by the name you have defined. Keyword search works well for results if the words are separated with "space" (For example use: waterlogging detection Landsat8 - instead of: waterlogging_detection_Landsat8).
5. Data placeholders represents all data are used in the workflow. You have to link your previously selected data to each placeholder.

→ Do

Set Data placeholders as provided in the example (Figure 12.), and give a name for the workflow.

[SatelliteImage] = Landsat8_Scene

[NaturalWaterMaskImage] = wm_Landsat_Test_EOV.tif

[CloudMaskImage] = cm_Landsat_Test_EOV.tif

[NotSupportedAreaMask] = ns_Landsat_Test_EOV.tif

Finally click **"Run workflow"** for execution.

→ Read

You are navigated to the Result page now, where you can follow the status of your workflow, and download and/or visualize your results (*Figure 13*).

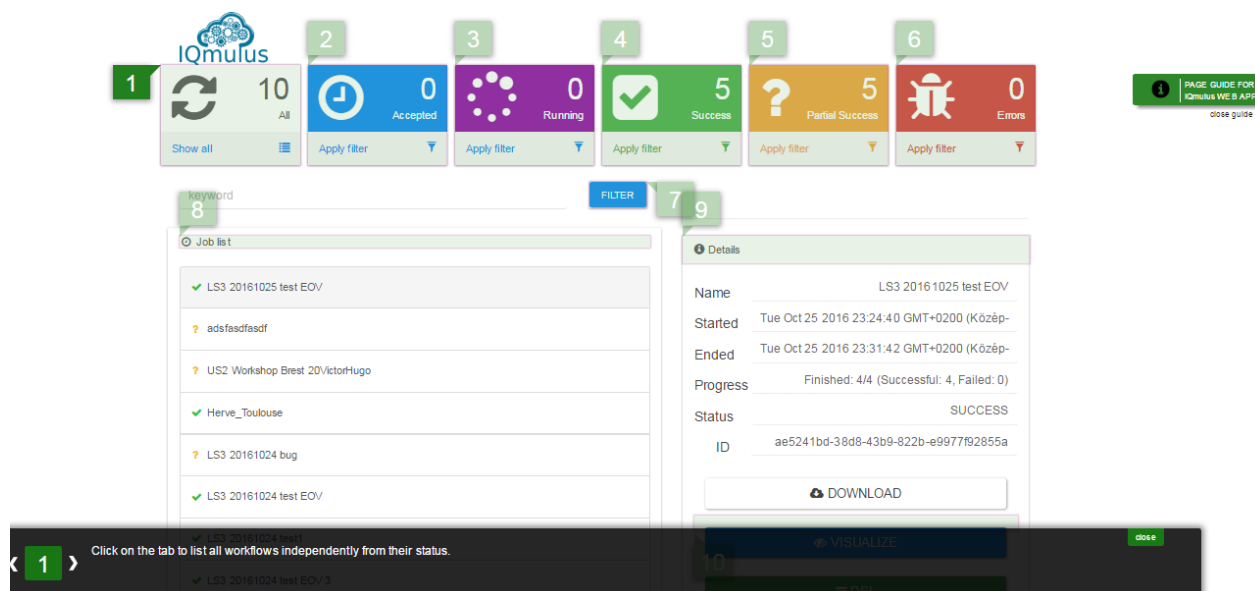


Figure 13.

1. Click on the tab to list *all workflows* independently from their status.
2. Workflows accepted for processing.
3. Running workflows.
4. All workflows run successfully.
5. Workflows partially succeeded. In this case partial results are present, but the process was not complete. If errors present in the workflow, a red tab appears as “Errors” (*Figure 14*).
6. Workflows listed here were not succeeded at all. User can check the errors by clicking the tab “Errors”, or the “Debug Log” (*Figure 14*).
7. Keyword search present for workflow names defined.
8. The list of workflows selected by the status - which is defined at the top of the Result page - is presented.
9. Choose one workflow from the result list to check the details. The start and end dates of the process, the progress and the status can be read here.

<div> <div>DOWNLOAD</div> <div>VISUALIZE</div> <div>DSL</div> <div>DEBUG LOG</div> <div> <div>bland_year_5522b28c_result.tif</div> <div>vis.iqv</div> <div>vis-parameters-4s3.json</div> </div> </div>	<p>Download data: User will be directed to the HDFS. Left-click on the data to download, and visualize it with a software you prefer. You can also load the downloaded TIFF as an „external file” into the IQmulus Fat Client.</p> <p>If a visualization service was built in your workflow, the results can be visualized by IQmulus Fat Client and Thin Client.</p> <p>Check the DSL for the selected workflow if necessary.</p> <p>The collection of resulted data from the given workflow is listed here.</p>
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If there is an error, the workflow will be placed to the “Partial error” or “Error” group. In this case the User can check the error by pressing the “Errors” tab, or checking the “Debug log”. The debug log stores the information of all workflows running a day, so it is suggested to search for the workflow by its ID (Figure 14). In the example data (a mask) was not assigned to one of the placeholders.

Figure 14 shows a screenshot of a workflow management interface. On the left, a 'Details' panel for a workflow named 'LS3 20161024 Bug' is visible. The workflow status is 'PARTIAL SUCCESS'. Below the details, there are buttons for 'DSL', 'ERRORS', and 'DEBUG LOG'. The 'ERRORS' button is highlighted with a red box. To the right, a 'Processing error' dialog box is open, displaying the message: 'Missing required value for option "mask"-[{}]'.

Figure 14.

→ Do

Click on the status tab of your result, and check its attributes. Download your result. Visualize it with a software you prefer.

VISUALIZATION WITH IQMULUS FAT CLIENT

Three options are available for IFC visualization:

1. Click on „Visualize” button, than on „Config file” – which is the .IQV file generated for visualization. Now it is downloaded. Click on the downloaded .IQV file, and IFC starts. Login is required. Data will be displayed in the Render Window.
2. Start IFC, and run your workflow within the framework of IFC. In the „Result Window” click on „Visulaize” button, than „Config file”, visualization starts automatically (login is required).
3. If the result is already downloaded to the computer, the file can be loaded to IFC by choosing File/Load local file menu.