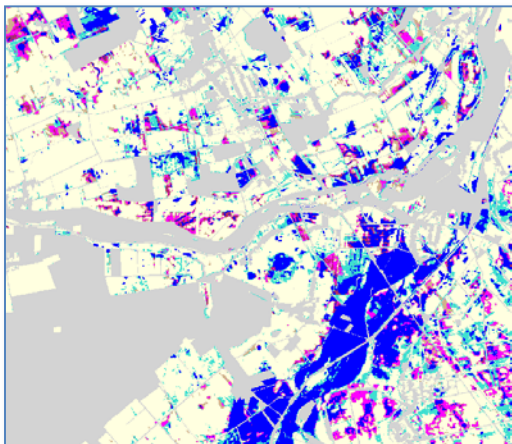




Flood and Waterlogging Detection

Land Showcase – Workflow 3



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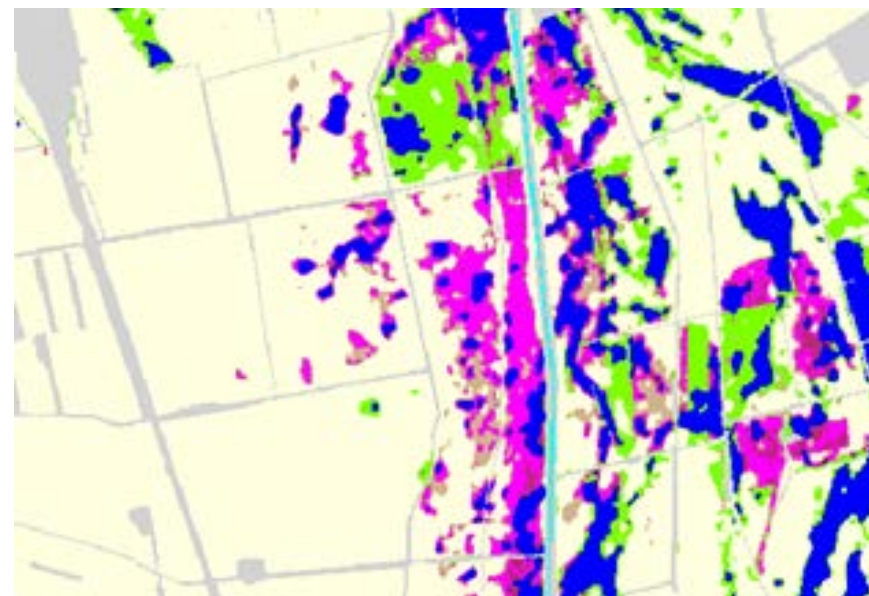
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The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 318787.

User Story:

„I want to quickly delineate and categorize flooded areas based on satellite/aerial imagery and combine it with existing spatial datasets to provide decision makers with information and maps for damage assessment.“

Source: Consolidated user requirements, Deliverable D1.2.2



„As-is” situation:

Current workflow implemented using proprietary software

- Preprocessing of satellite images
 - Geometric transformation, reprojection
 - Cloud and cloud shadow filtering ➡ cloud mask
 - Radiometric calibration ➡ ToA reflectance calculation
 - Calculation of spectral indices ➡ NDVI, NDSI, NDWI ➡ NDxi
- Processing – thematic classification via thresholding
 - Inputs: ToA reflectance calibrated image, spectral indices, cloud mask, mask of natural waters (rivers and lakes)
- Result: thematic image with 9 categories

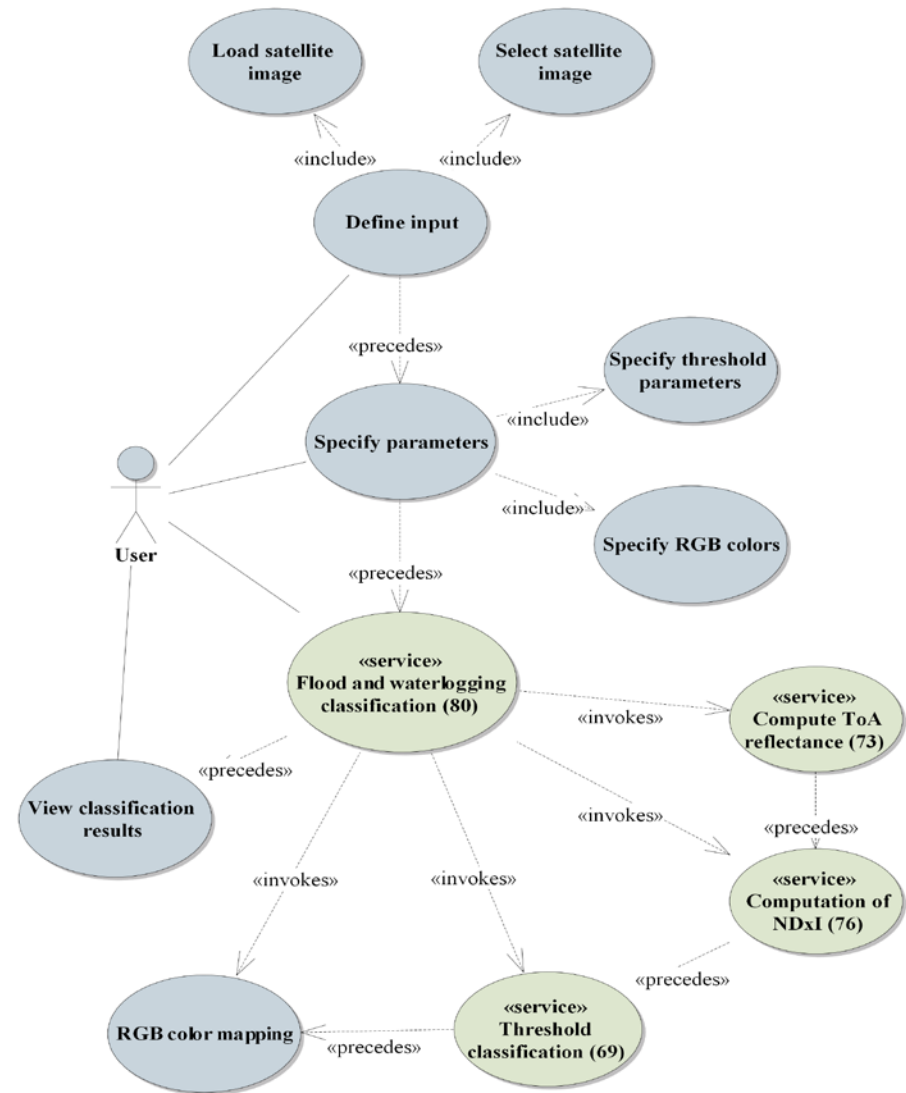
Row	Histogram	Class_Names	Color
0	19912179		
1	0	Natural waters	
2	806203	waterlog	
3	141084	seriously affected soil	
4	536413	moderately affected soil	
5	475654	weakly affected soil	
6	1205572	vegetation in waterlog	
7	22697039	dry areas	
9	0	clouds	
11	17325767	not supported areas	

Motivations:

- *Operational cooperation with civil protection and water authorities*
 - *National Agricultural Risk Management System (MKR)*
 - *EU-wide mapping of water bodies from HR satellite imagery*
 - *Country-wide delineation of lakes and ponds from orthophotos*
-
- Faster, more automated processing to enable more iterations to improve results
 - Processing on huge areas and/or high-resolution data
 - Better use of available processing power and human resources
 - More interactivity to determine appropriate parameters (thresholds)
 - Smarter algorithms to extract relevant information more efficiently

Services developed in cooperation with ELTE-IK, based on the **AEGIS open-source spatio-temporal framework** developed there

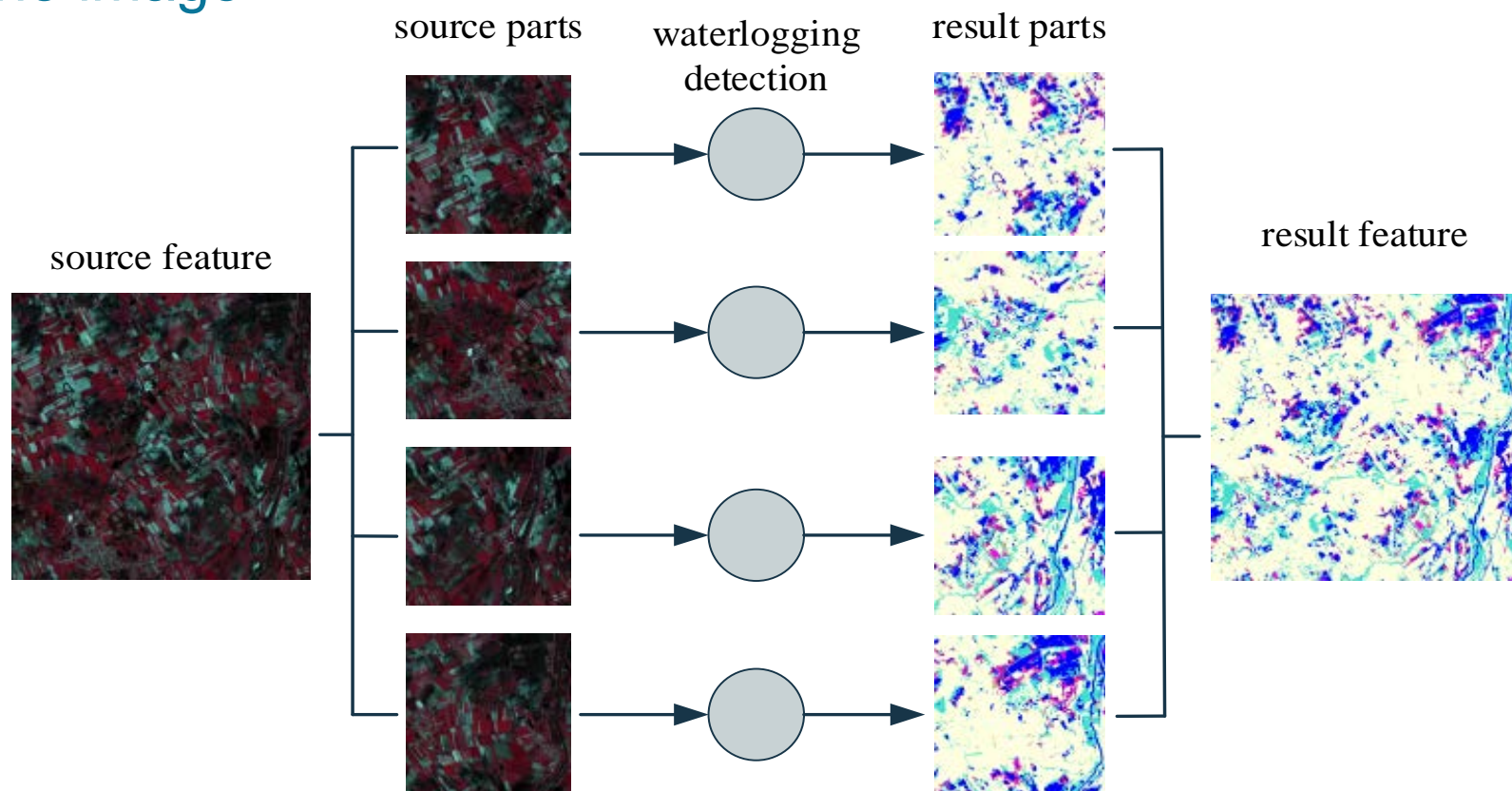
- **Preprocessing of raster data:** Calculates TOA reflectance. Automatic parameter setting for SPOT-5 based on metadata parser
- **Calculation of Spectral Indices:** to calculate NDxI indices for subsequent classification. Band combinations are set automatically based on image metadata
- **Thematic classification of raster data:** is used for the creation of thematic rasters with a pre-defined set of categories, based on thresholds
- **Flood and waterlogging classification:** complex wrapper service that enables workflow nesting

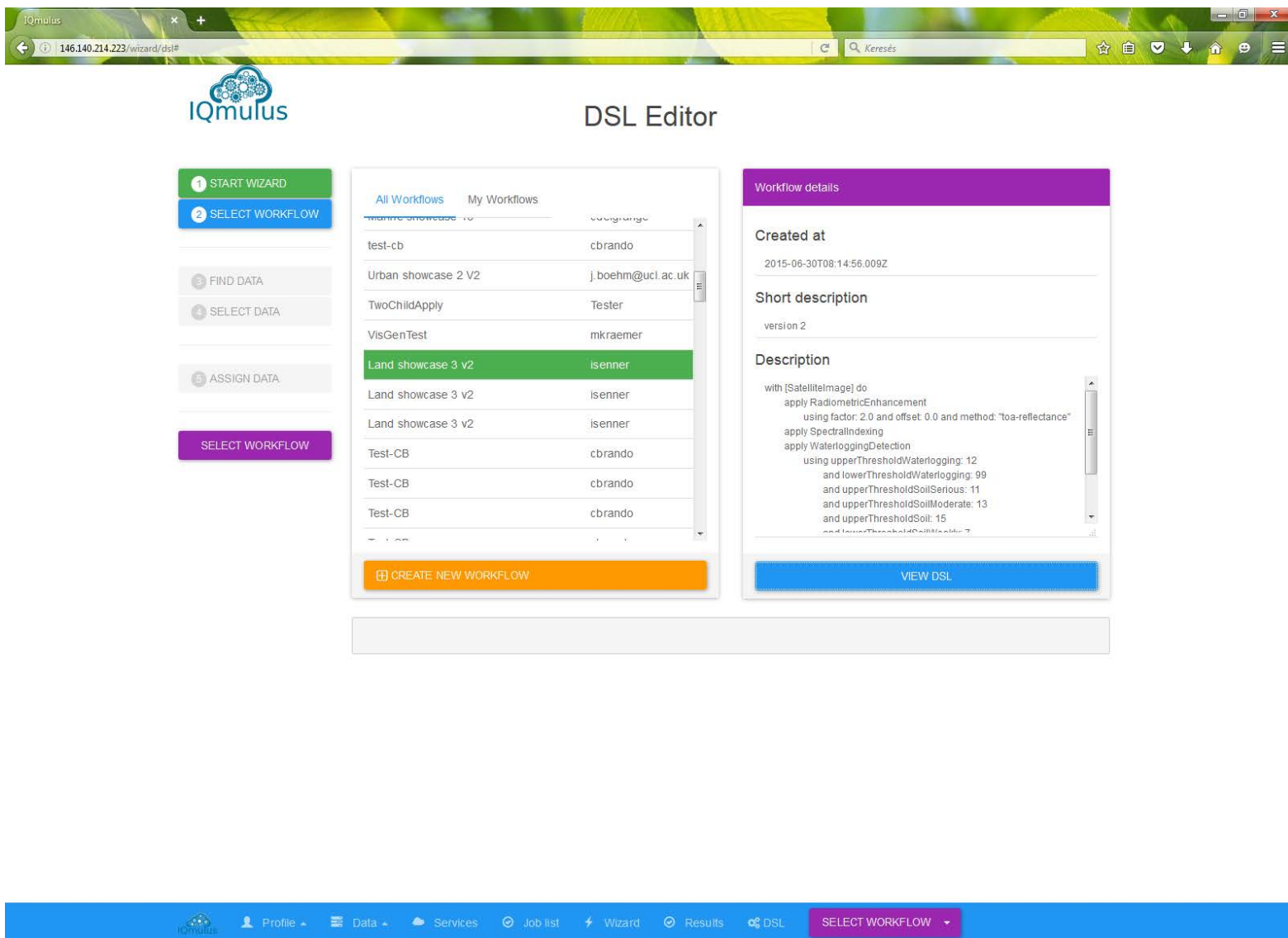


```
with [SatelliteImage] do
  apply RadiometricEnhancement
    using Method: "toa-reflectance"
    and BandIndices: "2,3,4,5"
    as Reflectance
  apply SpectralIndexing
    with Reflectance
    using SpectralIndex: "ndxi"
    and RedBandIndex: 1
    and NIRBandIndex: 2
    and SWIRBandIndex: 3
    as NDVI
  apply WaterloggingDetection
    with Reflectance
    and NDVI
    and [CloudMaskImage]
    and [NaturalWaterMaskImage]
    using LowerThresholdSWIRtoWaterlogging: 0
    and UpperThresholdSWIRtoWaterlogging: 5
    and UpperThresholdREDtoSAS: 15
    and UpperThresholdSWIRtoVegetation: 11.3
    and LowerThresholdNDVitoVegetation: 40
    as result
  store
  apply GenerateVisualizationFile
    with result
    using showcaseID: "LS3"
  store
end
```

WORKFLOW DESCRIPTION IN DSL

- The detection process can be performed pixel-wise, thus the operation can be performed in parallel on any part of the image





The screenshot shows the IQmulus DSL Editor web application. The browser address bar displays '146.140.214.223/wizard/dsl#'. The page features a sidebar on the left with a vertical list of steps: 1. START WIZARD, 2. SELECT WORKFLOW, 3. FIND DATA, 4. SELECT DATA, and 5. ASSIGN DATA. Below these steps is a 'SELECT WORKFLOW' button. The main content area is titled 'DSL Editor' and contains a table of workflows. The table has two columns: 'Workflow' and 'User'. The 'Land showcase 3 v2' workflow is highlighted in green and is associated with the user 'isenner'. Below the table is a 'CREATE NEW WORKFLOW' button. To the right of the table is a 'Workflow details' panel. This panel includes a 'Created at' timestamp (2015-06-30T08:14:56.009Z), a 'Short description' (version 2), and a 'Description' section containing a JSON-like DSL script. At the bottom of the details panel is a 'VIEW DSL' button. The bottom navigation bar includes links for Profile, Data, Services, Job list, Wizard, Results, and DSL, along with a 'SELECT WORKFLOW' dropdown menu.

Workflow details

Created at

2015-06-30T08:14:56.009Z

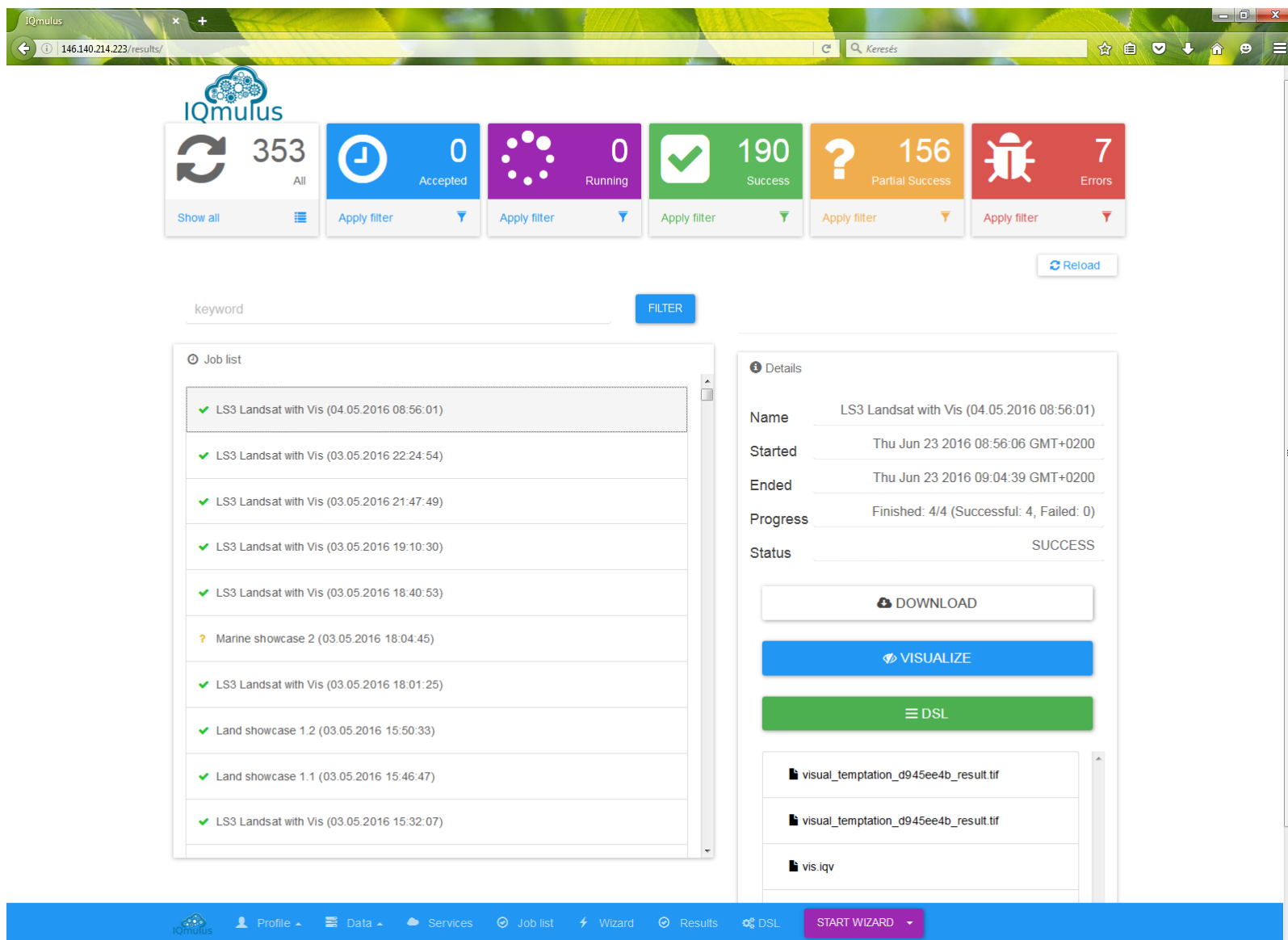
Short description

version 2

Description

```
with [SatelliteImage] do
  apply RadiometricEnhancement
    using factor: 2.0 and offset: 0.0 and method: "toa-reflectance"
  apply SpectralIndexing
  apply WaterloggingDetection
    using upperThresholdWaterlogging: 12
      and lowerThresholdWaterlogging: 99
      and upperThresholdSoilSerious: 11
      and upperThresholdSoilModerate: 13
      and upperThresholdSoil: 15
      and lowerThresholdSoilModerate: 7
```

VIEW DSL



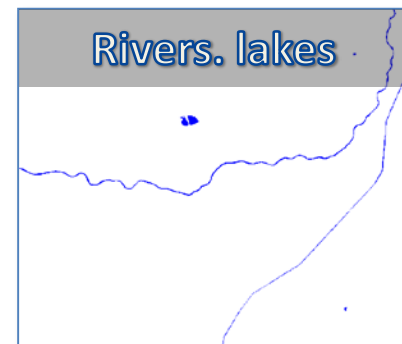
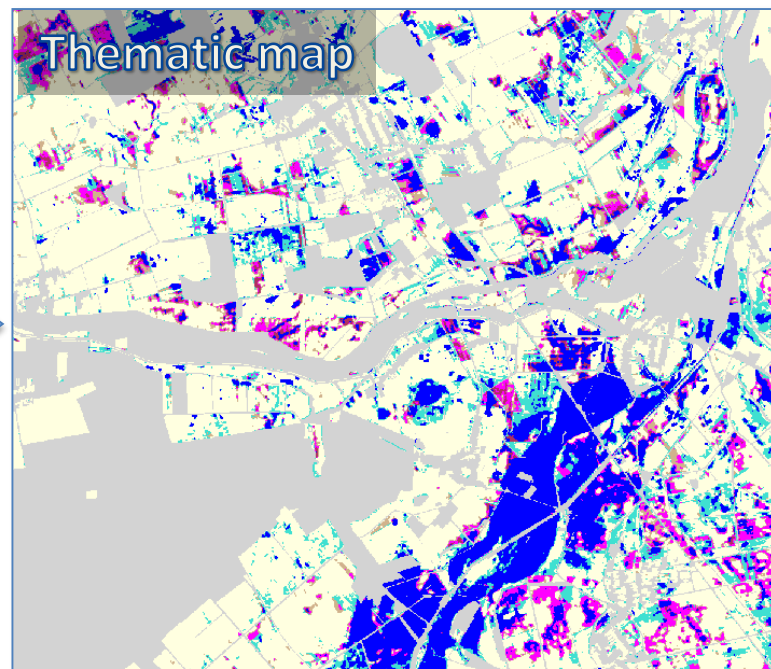
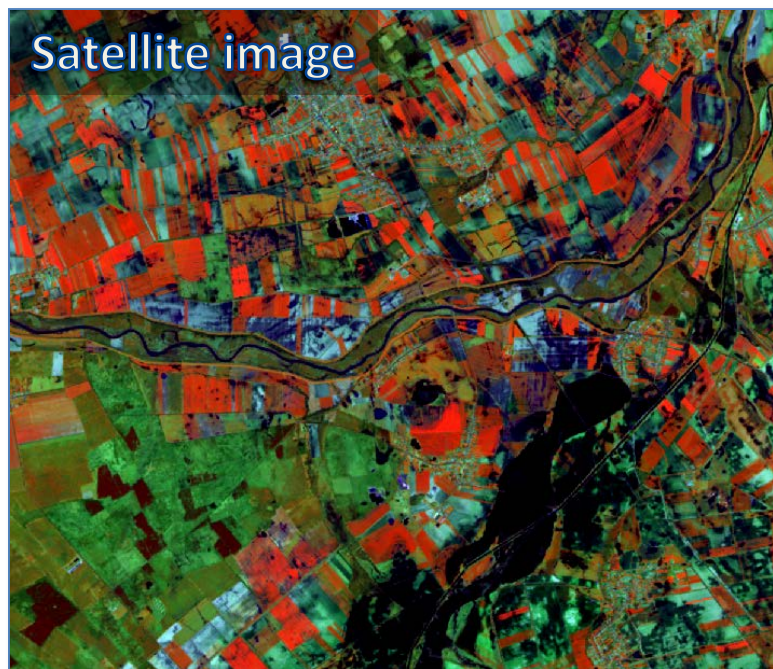
The screenshot displays the IQmulus web interface. At the top, a navigation bar shows the IQmulus logo and a search bar. Below this, a summary dashboard provides an overview of the workflow execution:

Icon	Count	Status	Action
Refresh	353	All	Show all
Clock	0	Accepted	Apply filter
Network	0	Running	Apply filter
Checkmark	190	Success	Apply filter
Question mark	156	Partial Success	Apply filter
Warning	7	Errors	Apply filter

A 'Reload' button is located to the right of the summary cards. Below the summary, a 'keyword' search bar and a 'FILTER' button are present. The main content area is divided into two panels:

- Job list:** A scrollable list of jobs, each with a status icon (green checkmark for success, yellow question mark for partial success) and a timestamp. The first job, 'LS3 Landsat with Vis (04.05.2016 08:56:01)', is highlighted.
- Details:** A panel showing the details of the selected job. It includes fields for Name, Started, Ended, Progress, and Status. Below these fields are three buttons: 'DOWNLOAD', 'VISUALIZE', and 'DSL'. At the bottom, a list of output files is shown, including 'visual_temptation_d945ee4b_result.tif' and 'vis.iqv'.

The bottom navigation bar contains links to Profile, Data, Services, Job list, Wizard, Results, and DSL, along with a 'START WIZARD' button.



- Distributed and automated processing of satellite imagery for mapping flood and waterlogging is implemented
- Automatic preprocessing implemented based on image metadata parsing
- Algorithms for image analysis are implemented on a uniform platform - quicker, more efficient than the previous solution
- Important exploitation path for the post-project period: replacement of the old solution with IQmulus LS3 workflow
- Works for *Sentinel-2*, *Landsat* and *SPOT* satellite imagery – can be extended to other sensors



Thank you! Questions?

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