



# The results of Giwer development

Geolmage Workflow Editing Resources

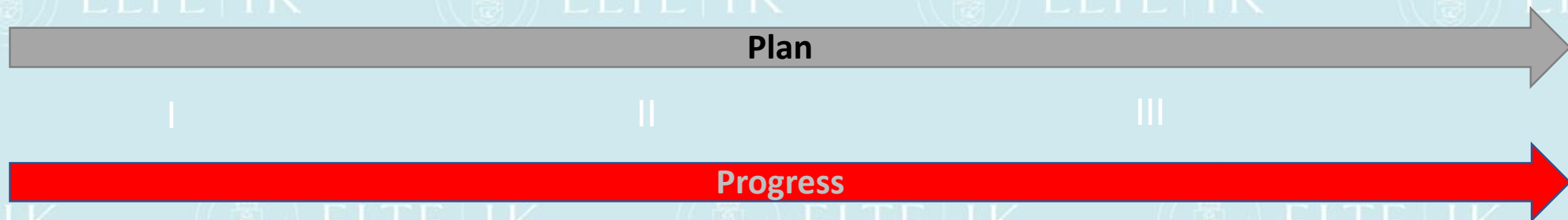
István Elek

TKP workshop, 26-27.05.2022, ELTE IK

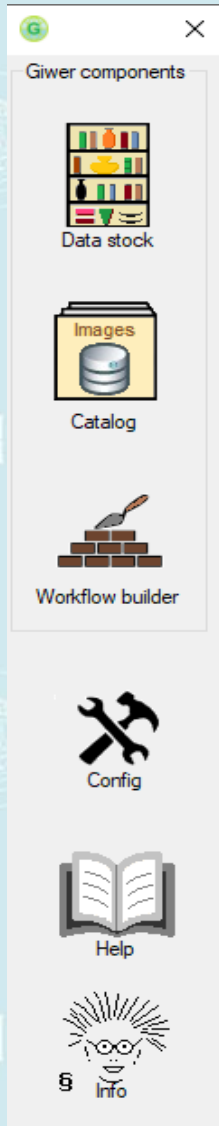
Project no. ED\_18-1-2019-0030 (Application-specific highly reliable IT solutions) has been implemented with the support provided from the National Research, Development and Innovation Fund of Hungary, financed under the Thematic Excellence Programme funding scheme..

# Objective

- I. Create a system for processing images taken from space and air, which can also process images from drones
- II. Users can compound their own workflows from the functions available in Giwer and run them on many images



# Sub-systems and modules



- 1. Catalog:** It organizes large number of images into a database. The Catalog organizes raw images into a database (Sqlite), which reads and stores many images and image parameters from their exif data, and also provides storage options in interactive fields.
- 2. DataStock:** It is an interactive image processing system. We have implemented large number of image processing functions that can be accessed via the menu system
- 3. WorkflowBuilder:** This is a workflow editor. From the available functions, arbitrary workflows can be compiled, so the user can create their own processing procedures based on their individual knowledge, experience and creativity.

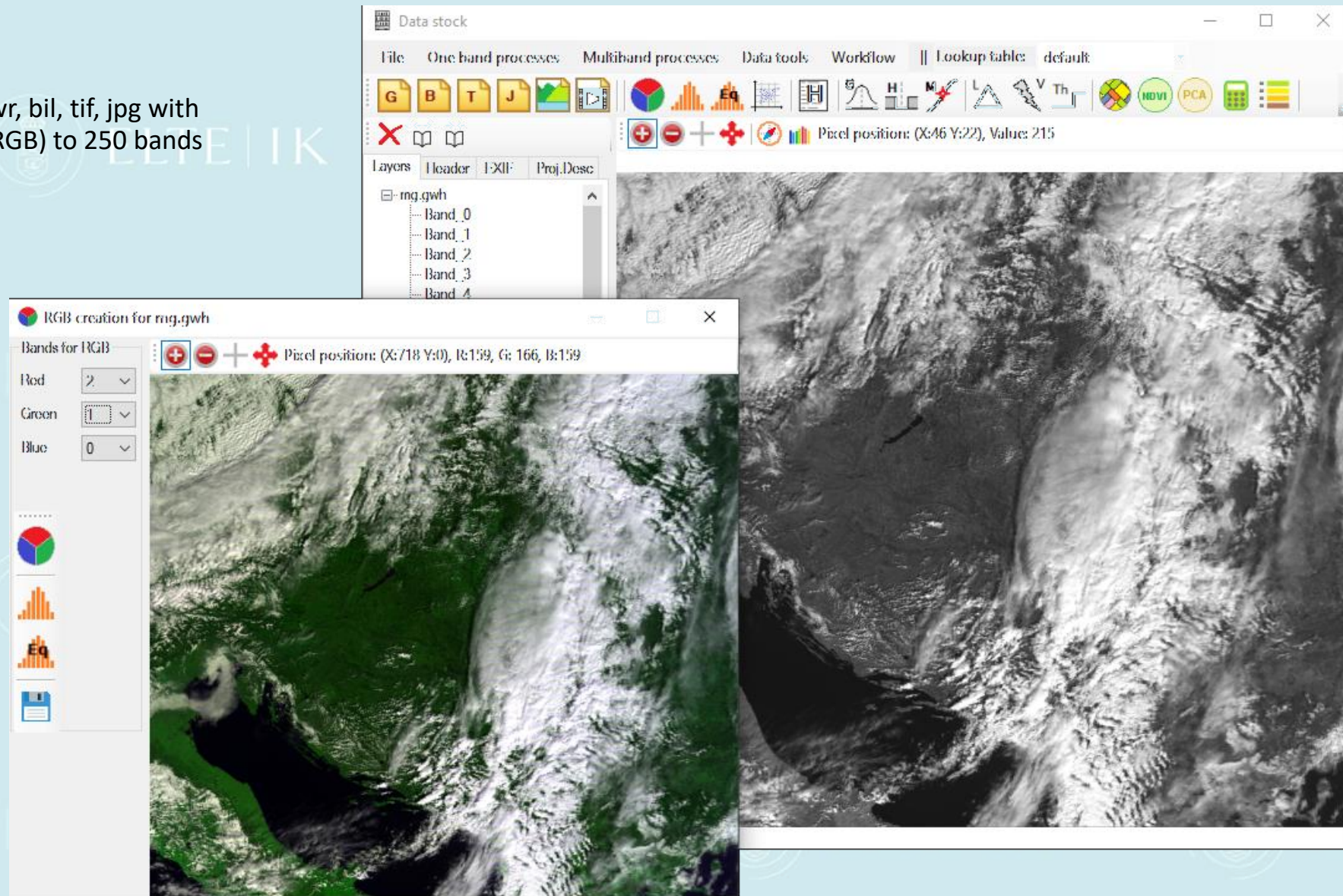
# Results briefly

1. DataStock (interactive) is completed (v1.0 completed)
2. Catalog is completed (v1.0 completed)
3. WorkflowBuilder is completed (v1.0 completed)
4. Giwer source has been uploaded to GitHub as an open source package
5. The necessary documentation is being prepared
  - a) users 'guide in Hungarian and English
  - b) Developer docs in English
  - c) Tutorials in Hungarian and English

# DataStock

# Snapshots from DataStock's operations

- Loads images from different file format: gwr, bil, tif, jpg with 8,16,24,48 bits, with many bands from 3 (RGB) to 250 bands
- Creates RGB display
- Displays histogram and equalizes
- Draws crossplot with any of two bands
- Displays file header
- Applies functions of the filter bank
- Computes NDVI and PCA
- Loads and displays 3D data (digital terrain modell)
- Runs the raster calculator (select pixels under the given condition)
- Classification, clustering
- Combines images (add, average, exor, subtract, etc)
- Converts from one format to another
- Analyses and displays spectrums
- Extended raster calculator with graphics



# Snapshots from DataStock's operations

The image displays three overlapping windows from the DataStock software interface:

- Main Window (Data stock):** Shows a satellite image of a marina. The top menu includes "File", "One band processes", "Multiband processes", "Data tools", and "Color palette: default". A toolbar contains various icons for processing, including "G", "B", "T", "J", "Eq", "NDVI", "PCA", and "wf1". The status bar indicates "Position: (953,232), Value: 101". The Layers panel on the left shows a tree structure for "DJI\_0016.gwh" with sub-items "Band\_0", "Band\_1", and "Band\_2".
- RGB creation for DJI\_0016.gwh:** A dialog box for creating an RGB image. It has dropdown menus for "Red" (set to 2), "Green" (set to 1), and "Blue" (set to 0). It includes a color selection tool and an "Eq" icon. The status bar shows "Position: (2238,368), Values: { R:142, G:134, B:97 }".
- Histogram of DJI\_0016.gwh:** A window titled "Histograms of RGB bands" showing three histograms for the Red, Green, and Blue channels. The x-axis for all histograms ranges from 0 to 250. The Red histogram shows a sharp peak around 140. The Green histogram shows a peak around 130. The Blue histogram shows a peak around 100. Below the histograms, there is a legend: "Select min/max values for each band: Left mouse click: set min value, Right mouse click: set max value". The legend also shows "RedMinMax: 0,255", "GreenMinMax: 0,255", and "BlueMinMax: 0,255". An "Equalize" button is located at the bottom left of the histogram window.

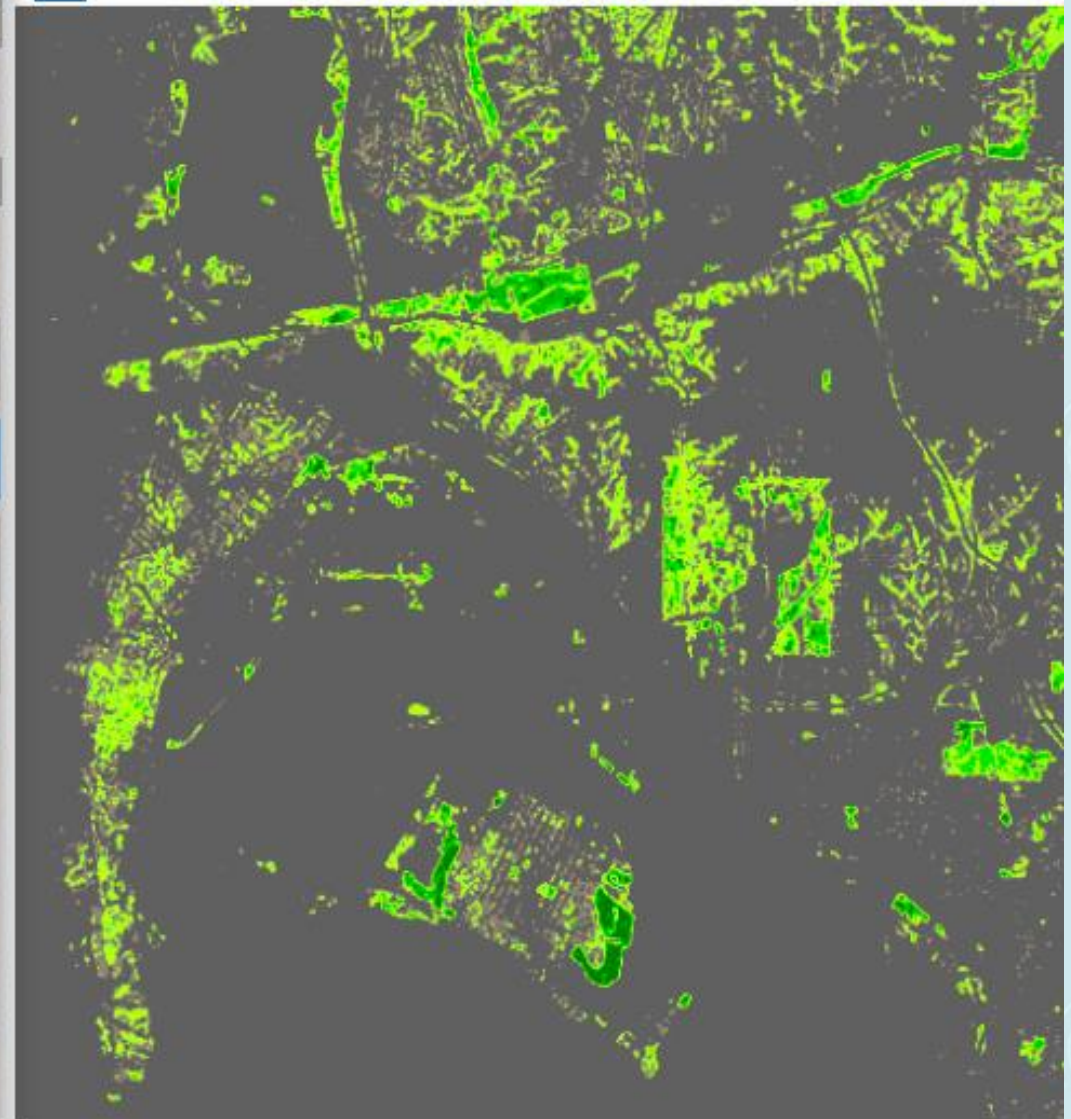
File: DJI\_0016.gwh

# Snapshots from DataStock's operations

RGB



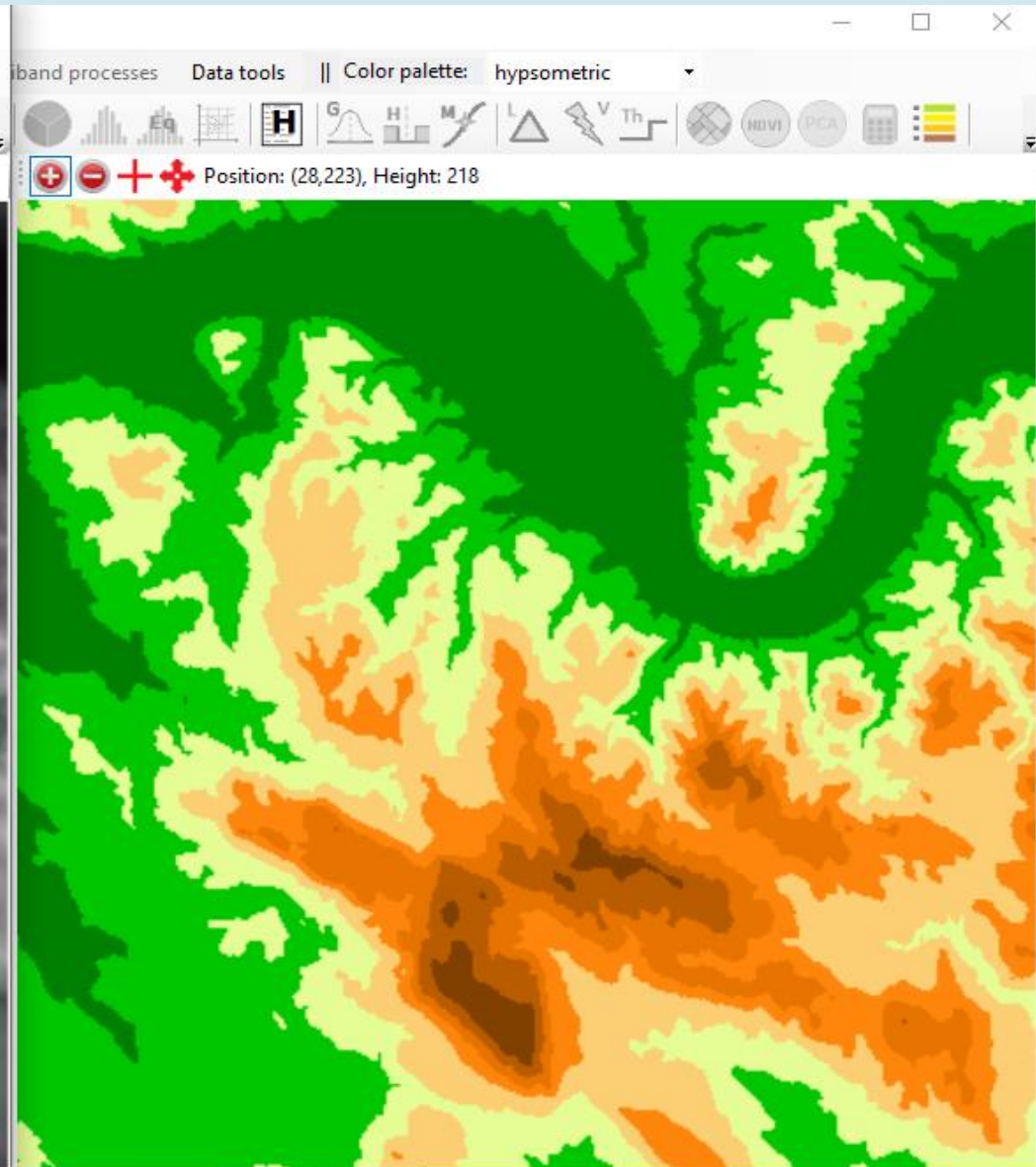
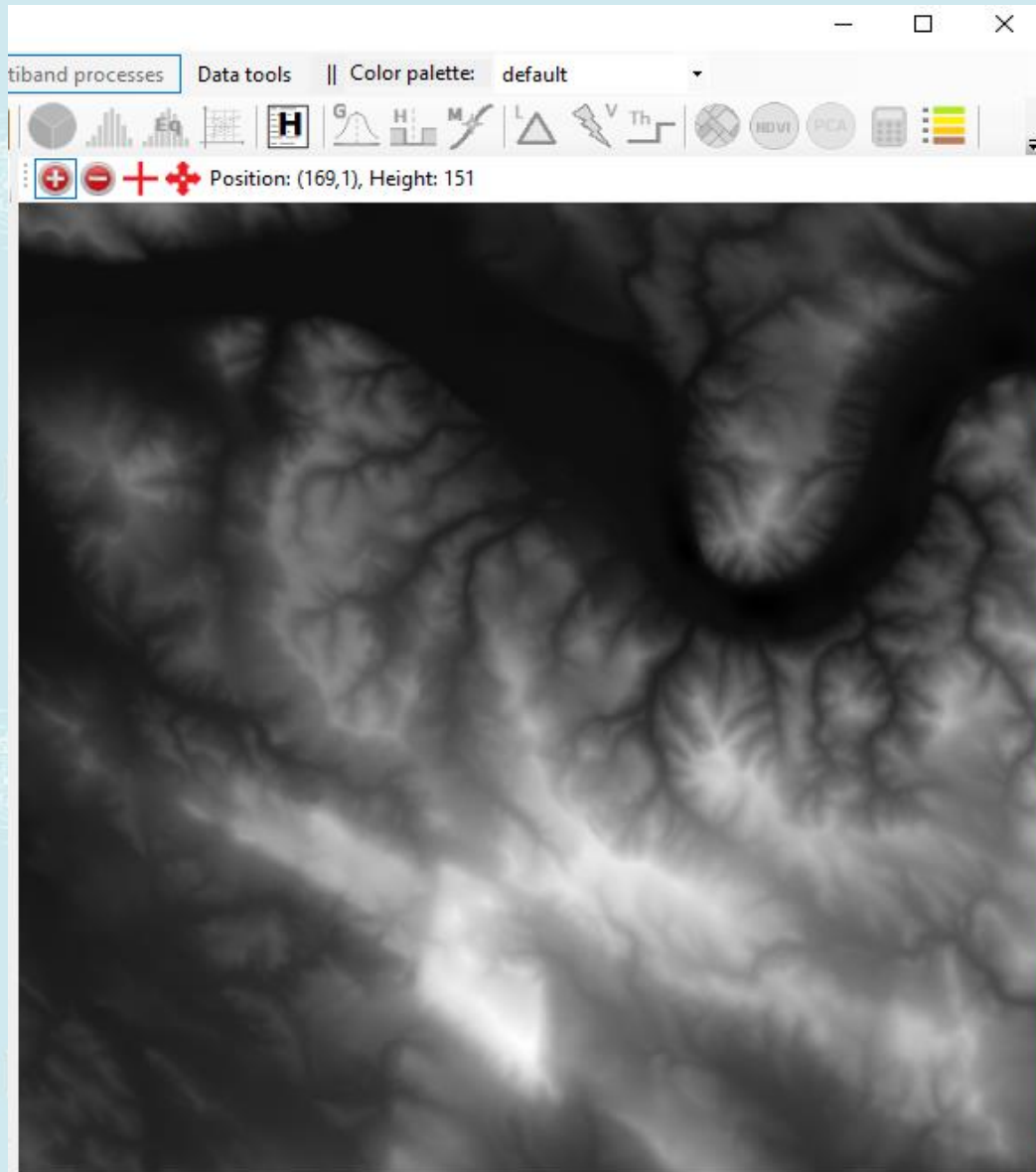
NDVI





# Snapshots from DataStock's operations

3D

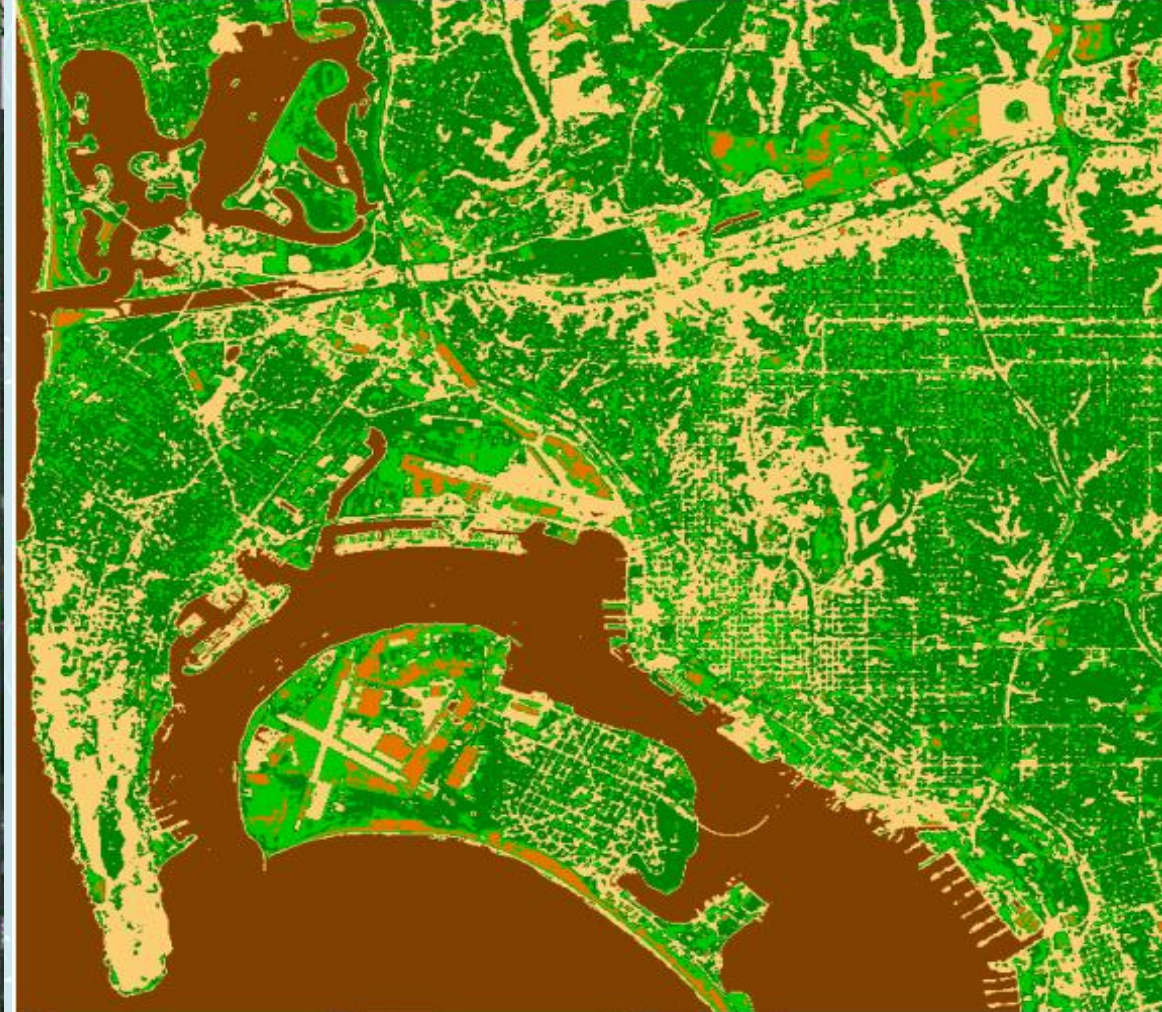


# Snapshots from DataStock's operations

RGB

Clustering

SPOT  
satellite  
image



# Snapshots from DataStock's operations

## ISODATA clustering

The screenshot displays the ISODATA clustering software interface. The main window is titled "Clustering" and features a central map of a city with clustered areas in yellow, orange, and blue. The interface includes several panels and controls:

- Included Bands:** A panel on the left with radio buttons for "Current Band" and "Current .gwh", and buttons for "Select All" and "Deselect All". Below this is a list of bands with checkboxes for 0, 1, and 2, all of which are checked.
- Pixel position:** A status bar at the top center displays "Pixel position: (X:744 Y:386), Value: 252".
- Clustering Method:** A dropdown menu on the right is set to "ISODATA".
- Method Parameters:** A panel on the right with several adjustable parameters:
  - Maximum Iterations: 15
  - Initial Number of Clusters: 10
  - Maximum Clusters: 256
  - Minimum Cluster Size: 100
  - Standard Deviation Limit: 1,00000
  - Minimum Centroid Distances: 1000,00
  - Maximum Merges per Iteration: 10
- Color palettes:** A dropdown menu at the bottom right is set to "user".
- Buttons:** Two buttons at the bottom right are labeled "Compute Clustering" and "Apply Result to Image".
- Status:** At the bottom center, it says "Number of clusters found: 10" and "Done.".

# Snapshots from DataStock's operations

## K-Means clustering

The screenshot shows the 'Clustering' dialog box in a GIS application. The 'Clustering Method' is set to 'K-Means'. The 'Method Parameters' section includes:

- Maximum Iterations: 15
- Relative Distortion Threshold: 0,960
- Minimum Clusters: 2
- Maximum Clusters: 8
- Relative Elbow Threshold: 0,240

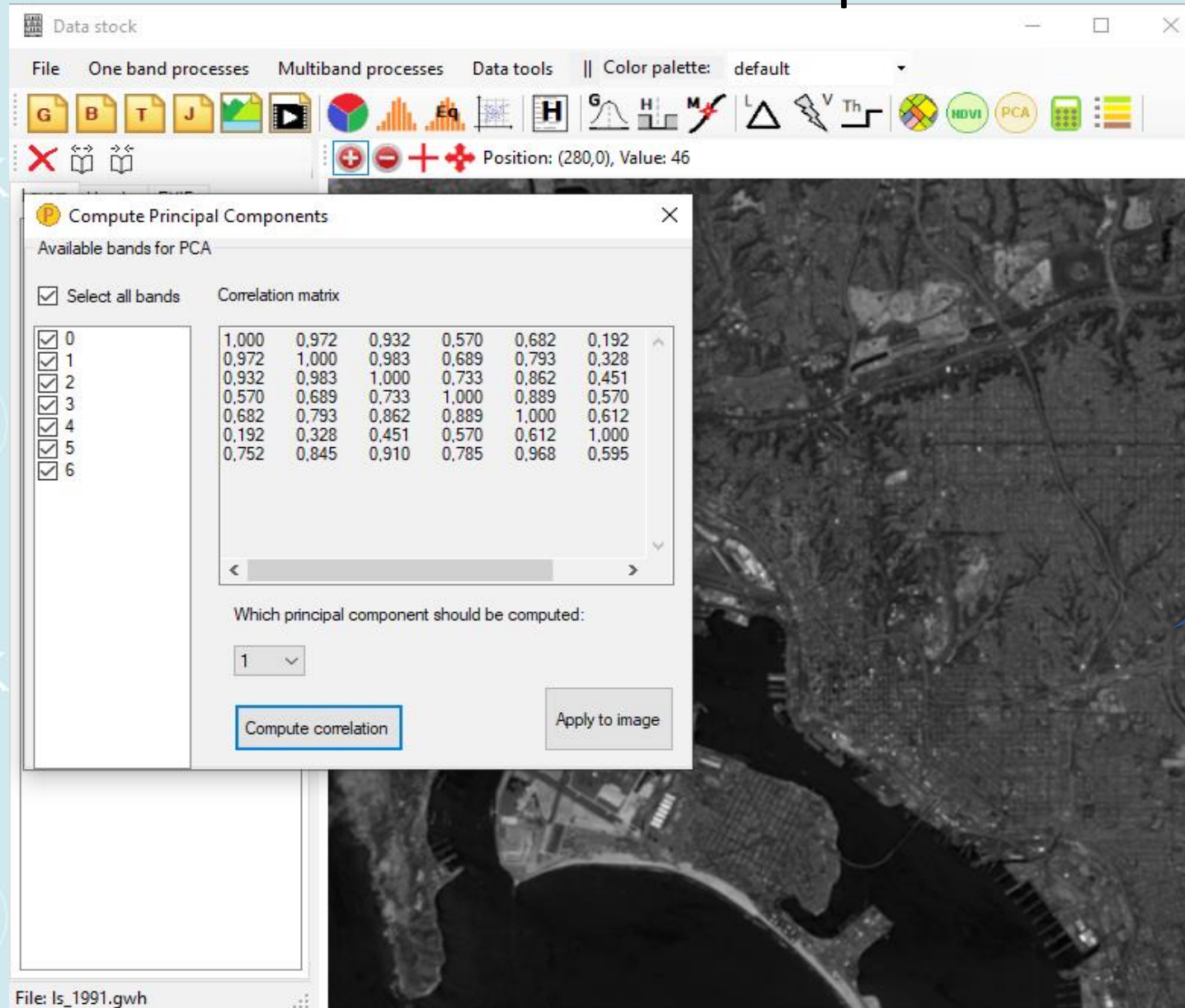
The 'Color palettes' dropdown is set to 'user'. The 'Compute Clustering' button is highlighted with a blue border. The 'Apply Result to Image' button is also visible.

The central preview window shows a satellite image of a city with a river, where the image has been clustered into four distinct colors: red, green, blue, and yellow. The status bar at the bottom indicates 'Number of clusters found: 4' and 'Done.'.

On the left side of the dialog, the 'Included Bands' section shows 'Current .gwh' selected. Below it, a list of bands 0, 1, and 2 is checked. The 'Pixel position: (X:739 Y:237), Value: 85' is displayed at the top right of the preview window.

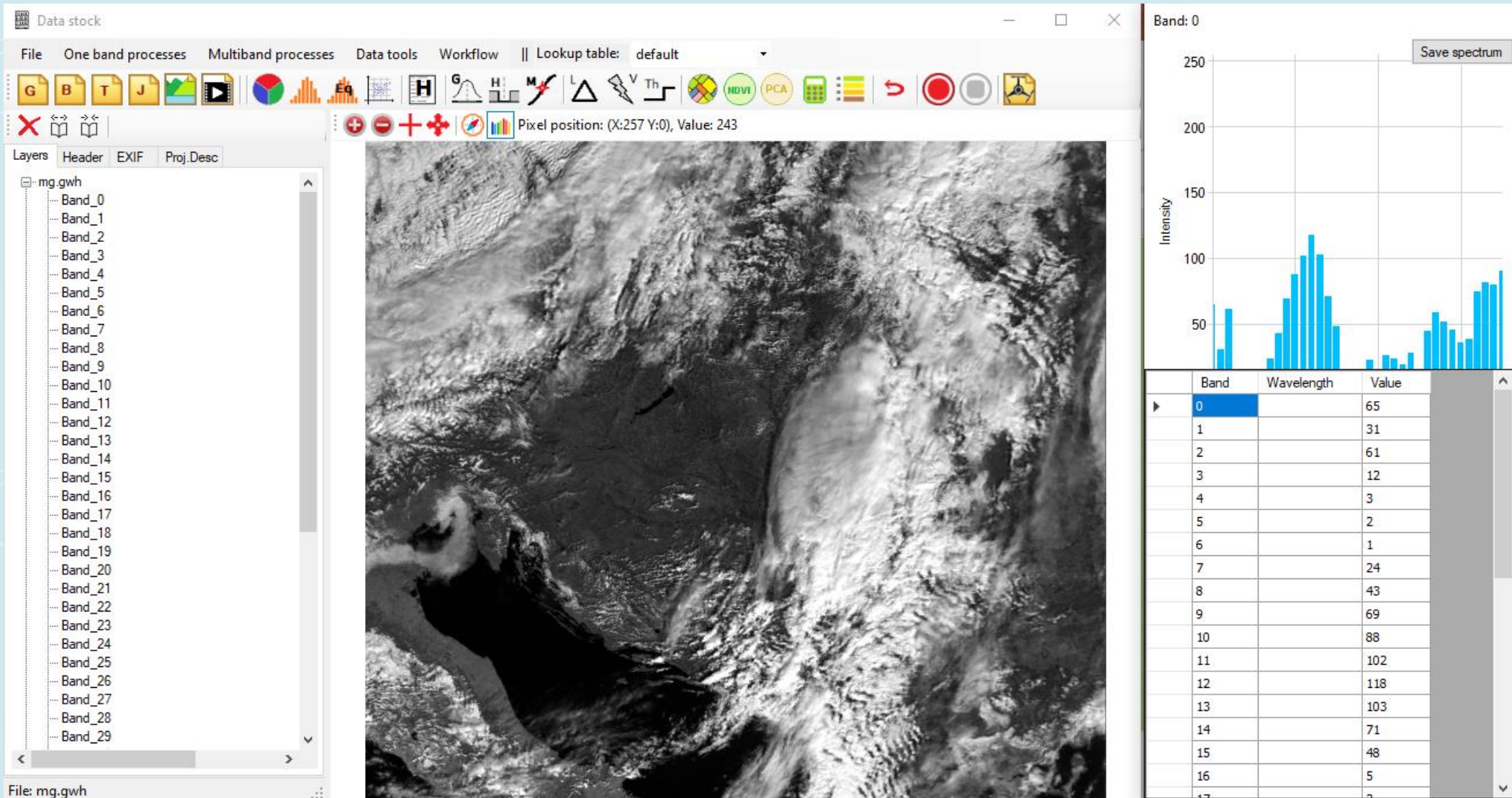
# Snapshots from DataStock's operations

Principal component analysis



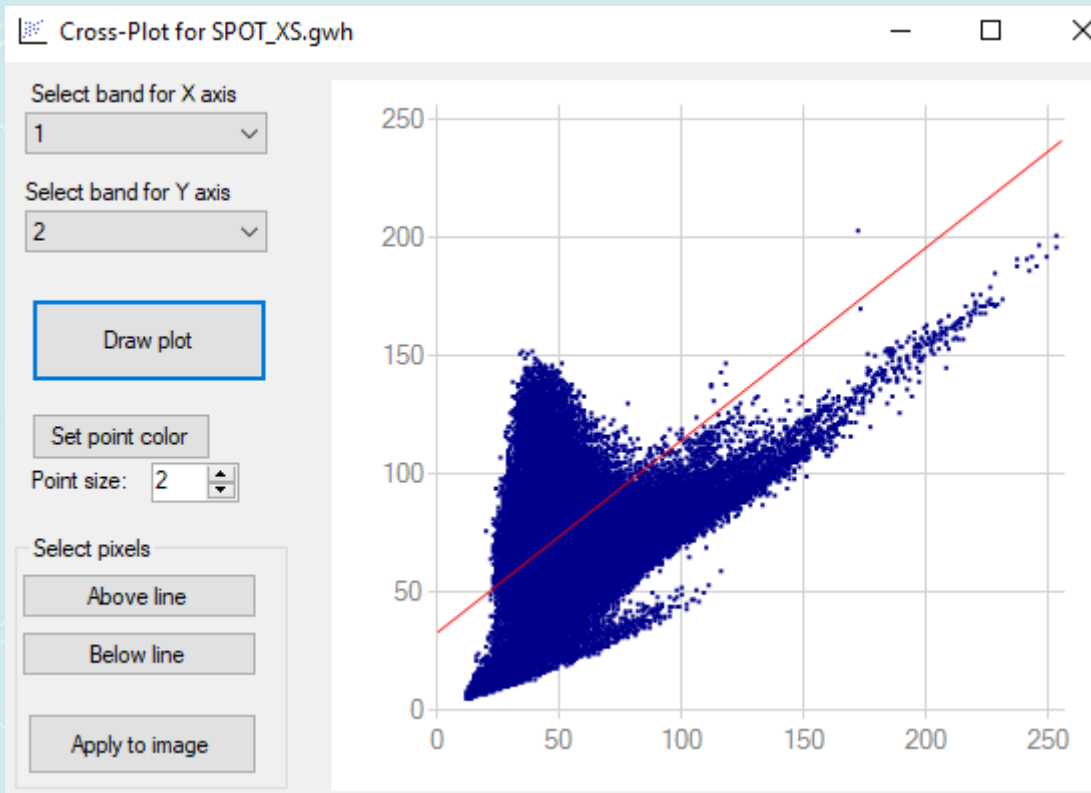
# Snapshots from Giwer's operations

## Methods for analysing hyperspectral images

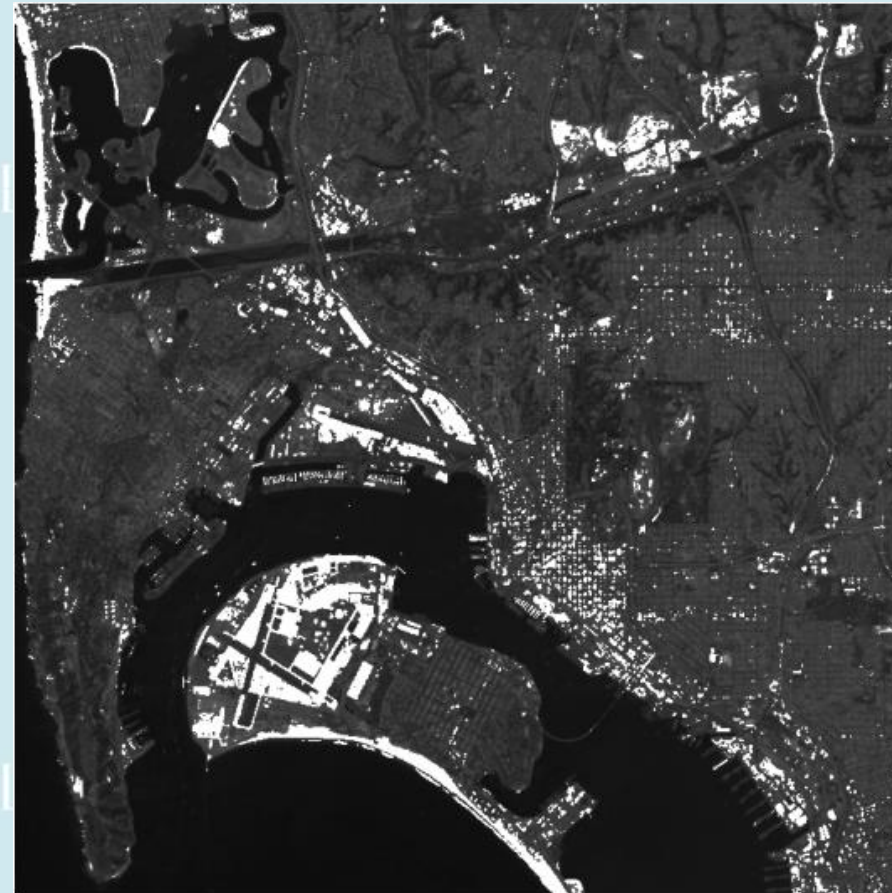


# Snapshots from Giwer's operations

## Raster calculator

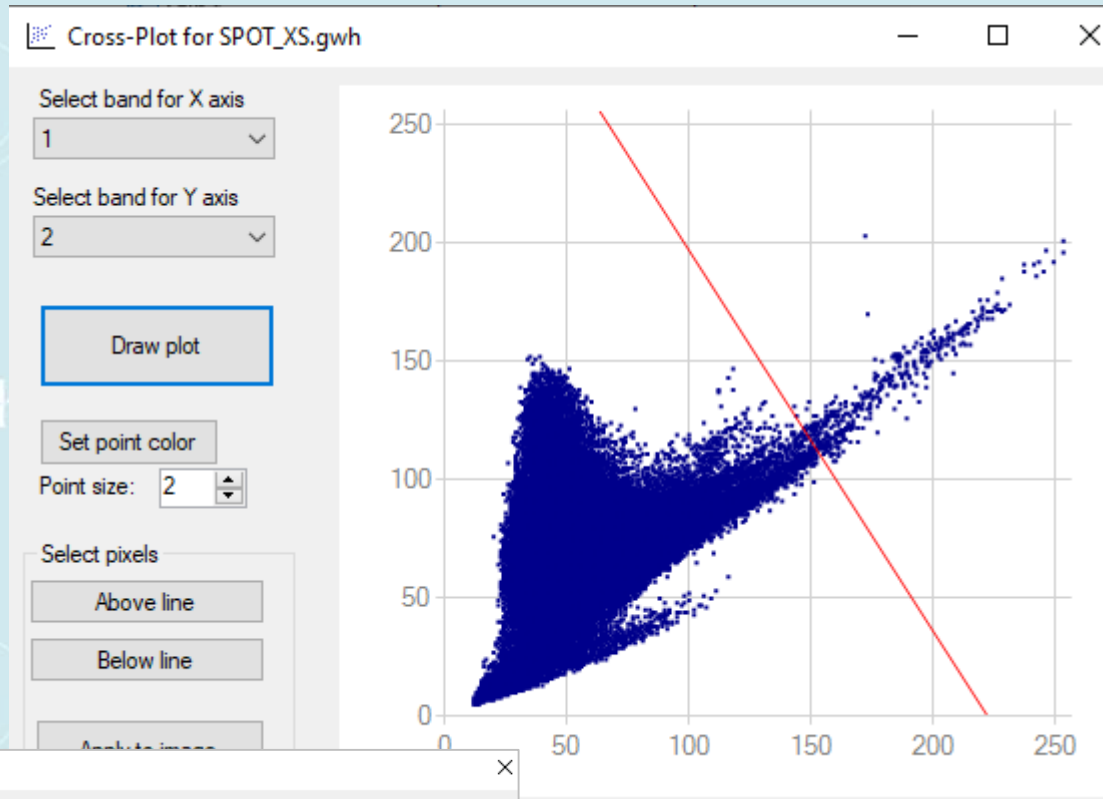


By plotting the intensities of the different frequency bands in a cross-plot, certain areas can be queried by graphical selection. For now, only one arbitrary line is the tool of separation.



# Snapshots from Giwer's operations

## Rastercalculator



Raster calculator

Single value selection

SELECT PIXELS WHERE Intensity values ARE

Let the selected intensity values be:

else value:

Between value selection

SELECT PIXELS WHERE Intensity values ARE BETWEEN  AND

Let the selected intensity values be:

else value:

The figure shows a "Raster calculator" dialog box. It has two sections: "Single value selection" and "Between value selection". In the "Single value selection" section, the "SELECT PIXELS WHERE Intensity values ARE" dropdown is set to "150", and the "Let the selected intensity values be:" field is set to "255". In the "Between value selection" section, the "SELECT PIXELS WHERE Intensity values ARE BETWEEN" dropdown is set to "100" and "200", and the "Let the selected intensity values be:" field is set to "255". Both sections have an "else value:" field set to "0".





# Catalog's operations briefly

- Catalog is an SQLite-based program for registering images in the file system and store their attributes to an SQLite data table.
- It allows you to import taken images directly from the drone's media, read their attribute data, and store them in an SQLite data file. We can store data either from the EXIF automatically, some fields can be filled interactively or even a deployment report can be written too.
- The Sql command editor helps you find the images you need.

# Snapshots from Catalog's operations

C:\Users\eleki\Desktop\cat\dronimagecatalog.s3db

cursor position: 1 / 18 932

id	filename	timestamp	type	bitspersample	samplesperpixel	image_size	file_size	I
1	IMG_0600_1.tif	2020. 09. 10. 11:46	multi	16	1	2064x1544	6382034	T
2	IMG_0600_2.tif	2020. 09. 10. 11:46	multi	16	1	2064x1544	6382008	T
3	IMG_0600_3.tif	2020. 09. 10. 11:46	multi	16	1	2064x1544	6382012	T
4	IMG_0600_4.tif	2020. 09. 10. 11:46	multi	16	1	2064x1544	6382004	T
5	IMG_0600_5.tif	2020. 09. 10. 11:46	multi	16	1	2064x1544	6382018	T
6	IMG_0600_6.tif	2020. 09. 10. 11:46	multi	16	1	160x120	44722	T
7	DJI_0007.JPG	2020. 09. 10. 13:40	RGB	8	3	5280x2970	6799825	T
8	DJI_0009.JPG	2020. 09. 10. 13:43	RGB	8	3	5280x2970	7026657	T
9	DJI_0010.JPG	2020. 09. 10. 13:44	RGB	8	3	5280x2970	6602686	T
10	DJI_0011.JPG	2020. 09. 10. 13:44	RGB	8	3	5280x2970	6592771	T
11	DJI_0014.JPG	2020. 09. 10. 13:45	RGB	8	3	5280x2970	6968375	T
12	DJI_0015.JPG	2020. 09. 10. 13:45	RGB	8	3	5280x2970	6973159	T
13	DJI_0016.JPG	2020. 09. 10. 13:46	RGB	8	3	5280x2970	6972641	T
14	DJI_0019.JPG	2020. 09. 10. 13:50	RGB	8	3	5280x2970	7224836	T
15	DJI_0020.JPG	2020. 09. 10. 13:50	RGB	8	3	5280x2970	7192925	T
16	DJI_0021.JPG	2020. 09. 10. 13:50	RGB	8	3	5280x2970	7014559	T
17	DJI_0022.JPG	2020. 09. 10. 13:50	RGB	8	3	5280x2970	6984827	T

Editable mezők

→	filename
→	timestamp
→	type
→	bitspersample
→	samplesperpixel
→	image_size
→	file_size
→	location
→	longitude
→	latitude
→	dron_type
→	camera
→	purpose
→	operator
→	author
→	meteo
→	content
→	public
→	comment
→	folder

# Snapshots from Catalog's operations


DJI\_0021.JPG

cursor position: 15/19

id	filename	timestamp	type	bitspersample	samplesperpixel	image_size	file_size
1	IMG_0600_1.tif	2020.09.10.11:46	multi	16	1	2064x1544	6382034
2	IMG_0600_2.tif	2020.09.10.11:46	multi	16	1	2064x1544	6382008
3	IMG_0600_3.tif	2020.09.10.11:46	multi				
4	IMG_0600_4.tif	2020.09.10.11:46	multi				
5	IMG_0600_5.tif	2020.09.10.11:46	multi				
6	IMG_0600_6.tif	2020.09.10.11:46	multi				
7	DJI_0007.JPG	2020.09.10.13:40	RGB				
8	DJI_0009.JPG	2020.09.10.13:43	RGB				
9	DJI_0010.JPG	2020.09.10.13:44	RGB				
10	DJI_0011.JPG	2020.09.10.13:44	RGB				
11	DJI_0014.JPG	2020.09.10.13:45	RGB				
12	DJI_0015.JPG	2020.09.10.13:45	RGB				
13	DJI_0016.JPG	2020.09.10.13:46	RGB				
14	DJI_0019.JPG	2020.09.10.13:50	RGB				
15	DJI_0020.JPG	2020.09.10.13:50	RGB				
16	DJI_0021.JPG	2020.09.10.13:50	RGB				
17	DJI_0022.JPG	2020.09.10.13:50	RGB				

Map viewer

Select your map provider --> Bing Satellite Map Provider

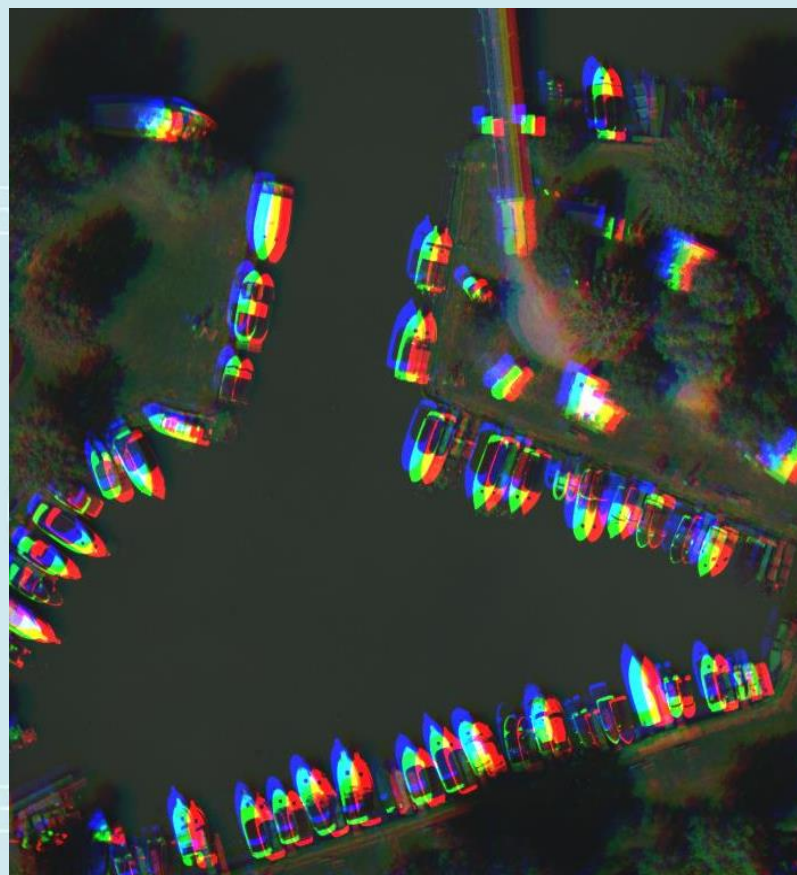


Long: 20,7160473 Lat: 47,6727974

# Snapshots from Catalog's operations

## Micasense camera correction

The correction procedure for shifted individual frequency bands were prepared by Máté Cserép. The process is based on an affine transformation which computes the cross correlation between images, and computes the shifts in this way.

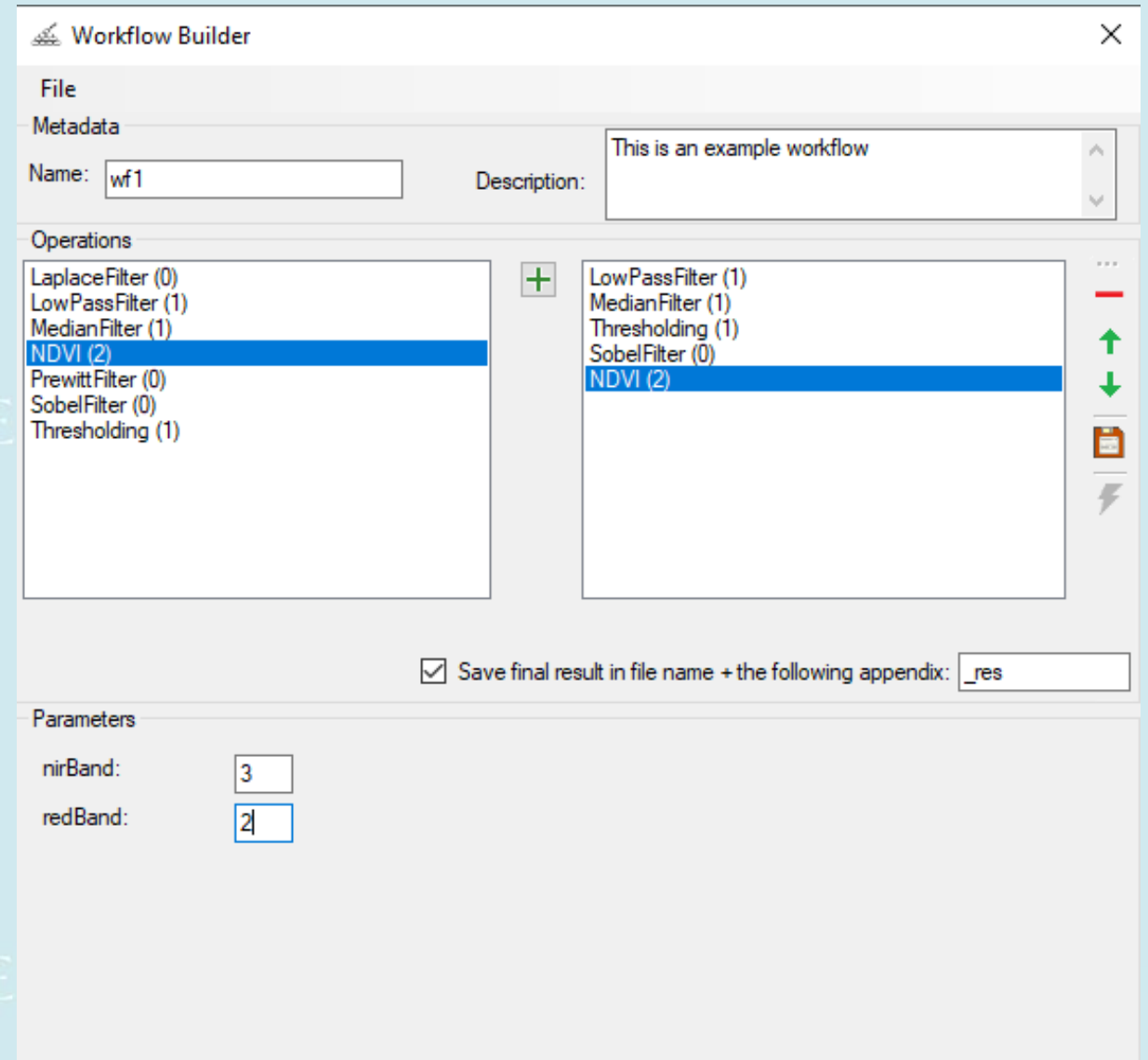


# Workflow builder

# Snapshots from Workflow's operations

From Giwer's functions you can create any workflow that can be saved, edited and run. If an experienced user wants to create their own processing procedures, they can do so with workflow builder. If the task is to do some processing on hundreds of images, the workflow builder is a great tool for that. However, we need to create a project file in advance, which we will use workflow.

Development is complete, but it should be emphasized that this is only the version 1.0.



# Publications

1. Istvan Elek: Boundary Detection of Point Clouds on the Images of Low-Resolution Cameras for the Autonomous Car Problem, Intelligent Computing : Proceedings of the 2020 Computing Conference, Volume 2, Cham: Springer, pp 572-581 (2020) (Advances in Intelligent Systems and Computing ; 1229)
2. Elek István – Cserép Máté: Drón képek feldolgozása a nyílt forráskódú Giwer programcsomaggal, GITA, 16. Műszaki Térinformatika online konferencia, 2021. június
3. Istvan Elek – Máté Cserép: Processing drone images with the open source Giwer software package, FTC 2021 - Future Technologies Conference 2021, 28-29 October 2021, Vancouver
4. Nour Naaouf – István Elek: Geospatial Analysis for assessing the Potentials of Large-Scale generation of Solar Energy in SYRIA, Geodézia és Kartográfia, 2022.