Giwer: GeoImage Workflow Editing Resources

egy ELTE IK-s open sources csomag

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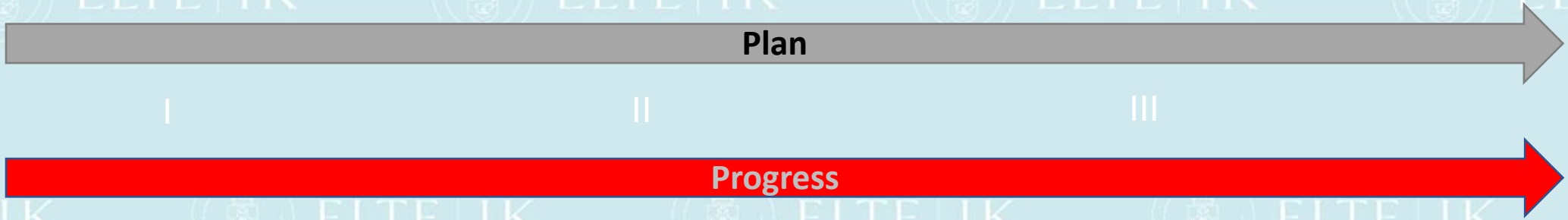
Objective

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.

Difficulties

- A wide variety of non-standard files need to be read
  - Geotif is still the most standard
  - Bil is so diverse that it is already annoying (ESRI bil, ENVI bil, ER Mapper bil)
  - Exif is not standard at all (we need to further develop different exif readers if we want to read the full exif of additional cameras)
- Data from different cameras is not uniform. For example, a DJI RGB camera contains altitude data, but Micasense does not, and the GPS built into the cameras is inaccurate. The RTK GPS built into the drone is accurate, but its data cannot be extracted from it.
- As long as there is no exact height data, we cannot calculate the coordinates of the corner points of the images, therefore it is not possible to display several images in a mosaic-like manner.

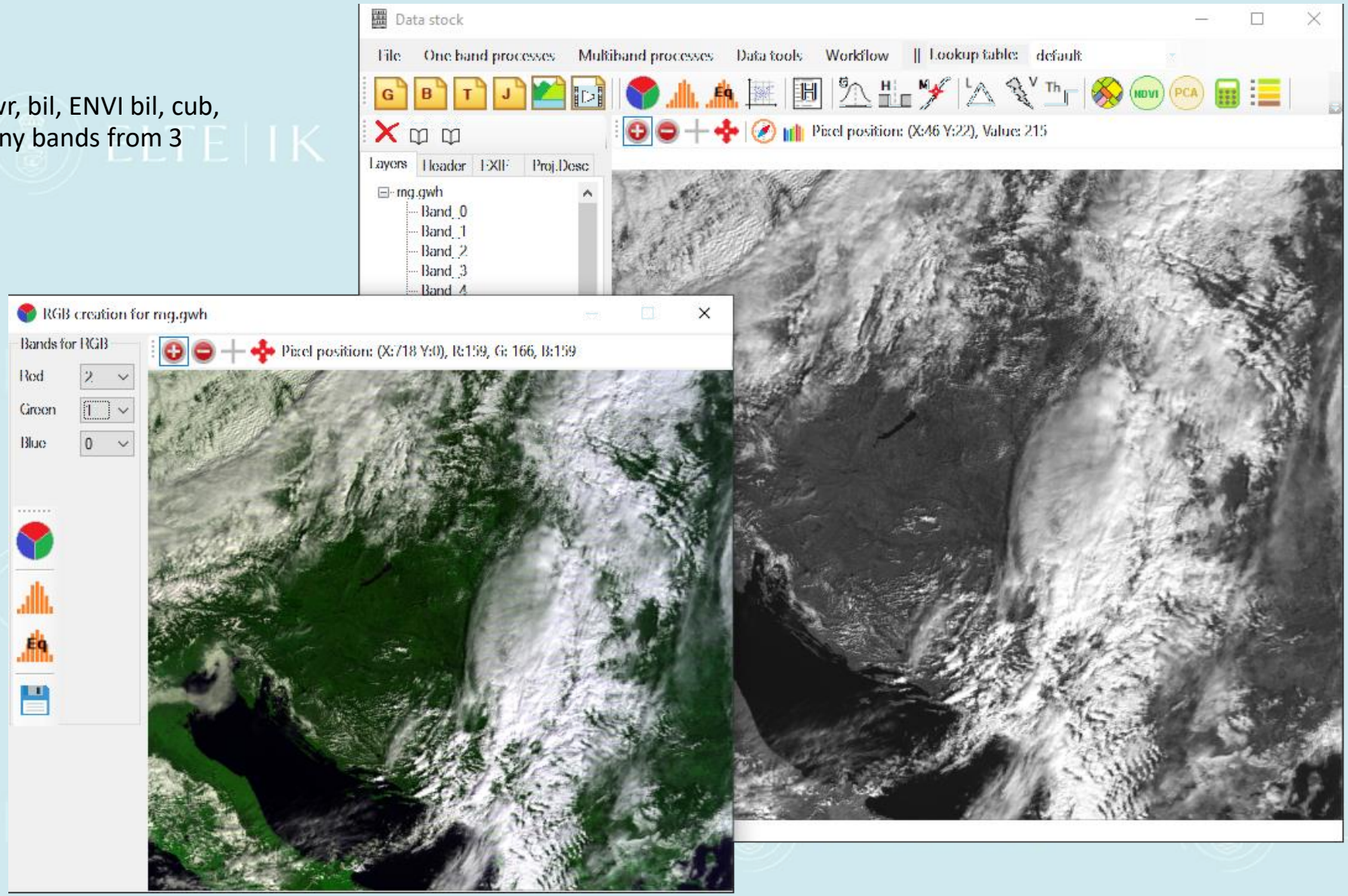
Results briefly

1. DataStock (interactive) is completed (v1.0 completed)
2. Catalog is completed (v1.0 completed)
3. WorkflowBuilder is completed (v1.0 completed)
4. The necessary documentation is being prepared
    a) users ’guide in Hungarian and English
    b) Developer docs in English
    c) Tutorials in Hungarian and English

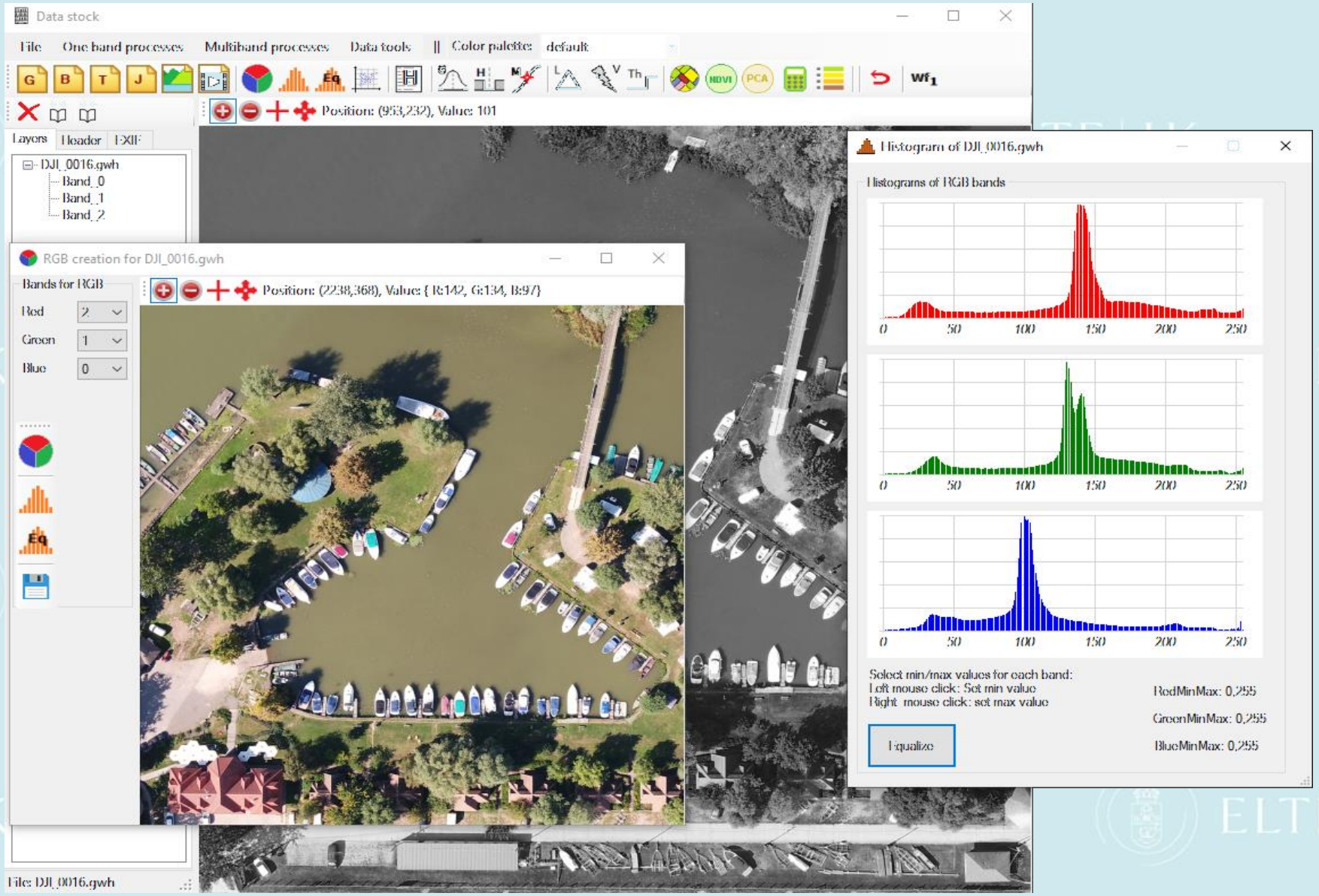
DataStock

Snapshots from DataStock's operations

- Loads images from different file format: gwr, bil, ENVI bil, cub, tif, grotif, 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

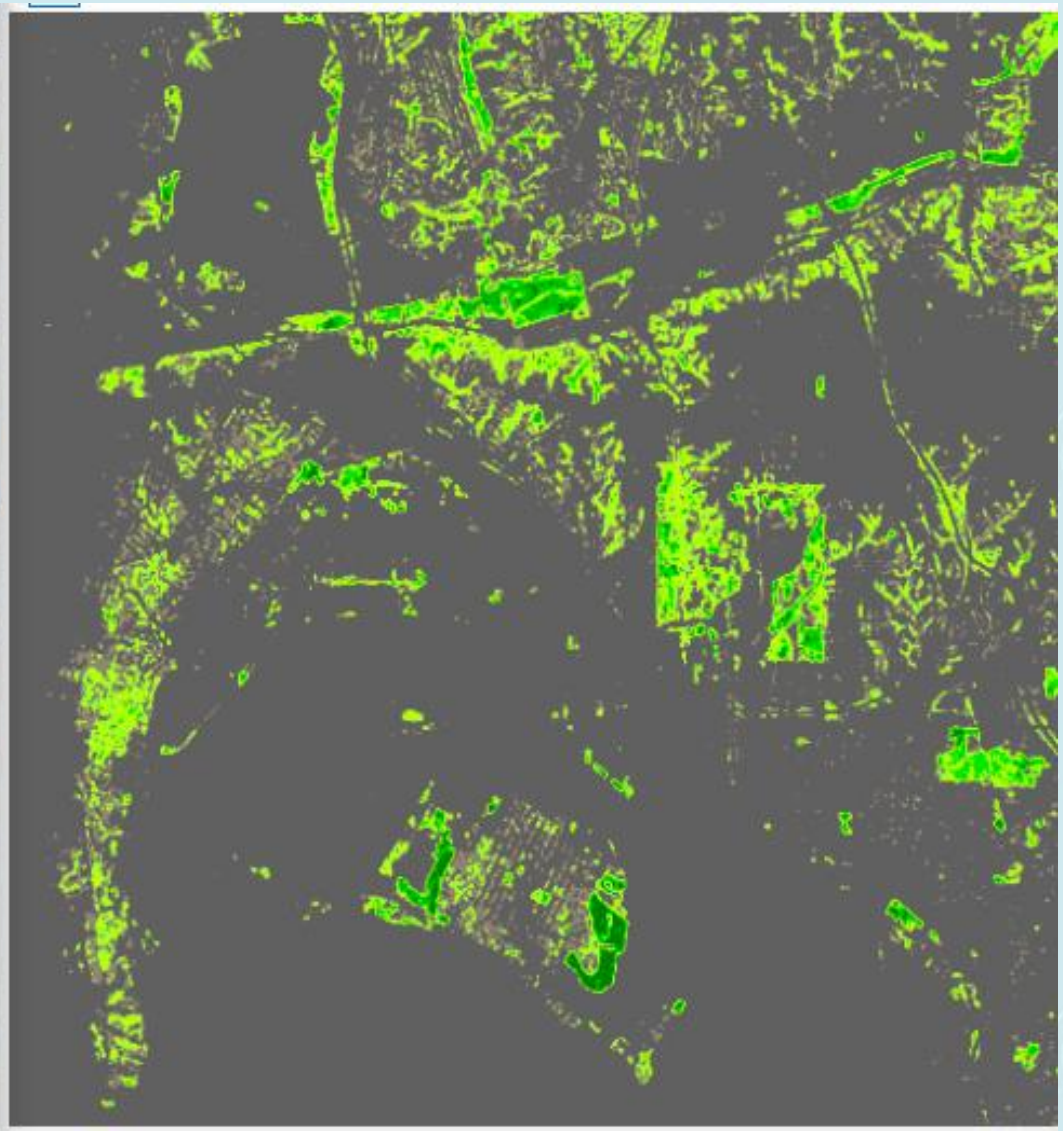


Snapshots from DataStock's operations



Snapshots from DataStock's operations

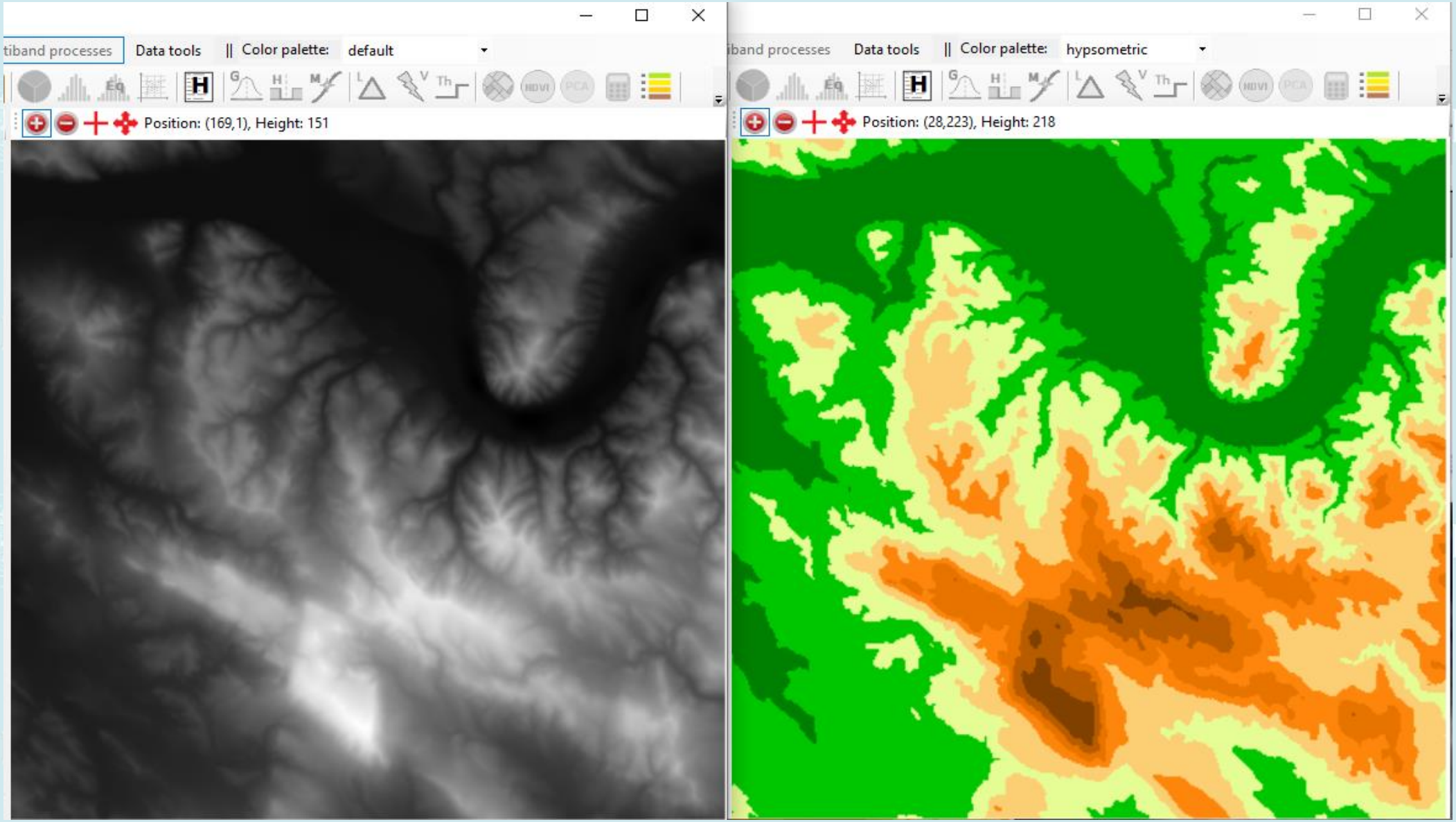
RGB



NDVI

Snapshots from DataStock's operations

3D

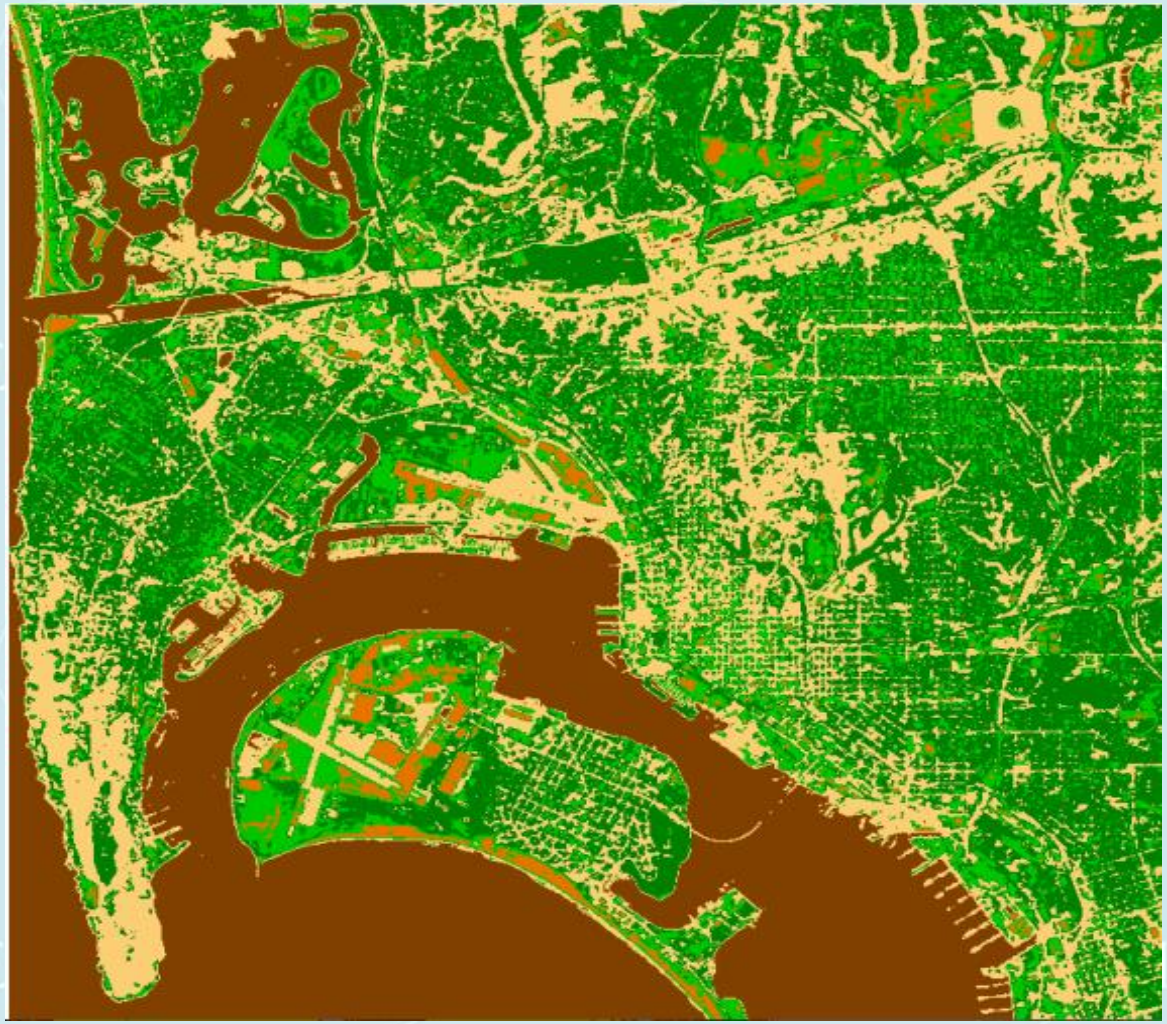


Snapshots from DataStock's operations

RGB

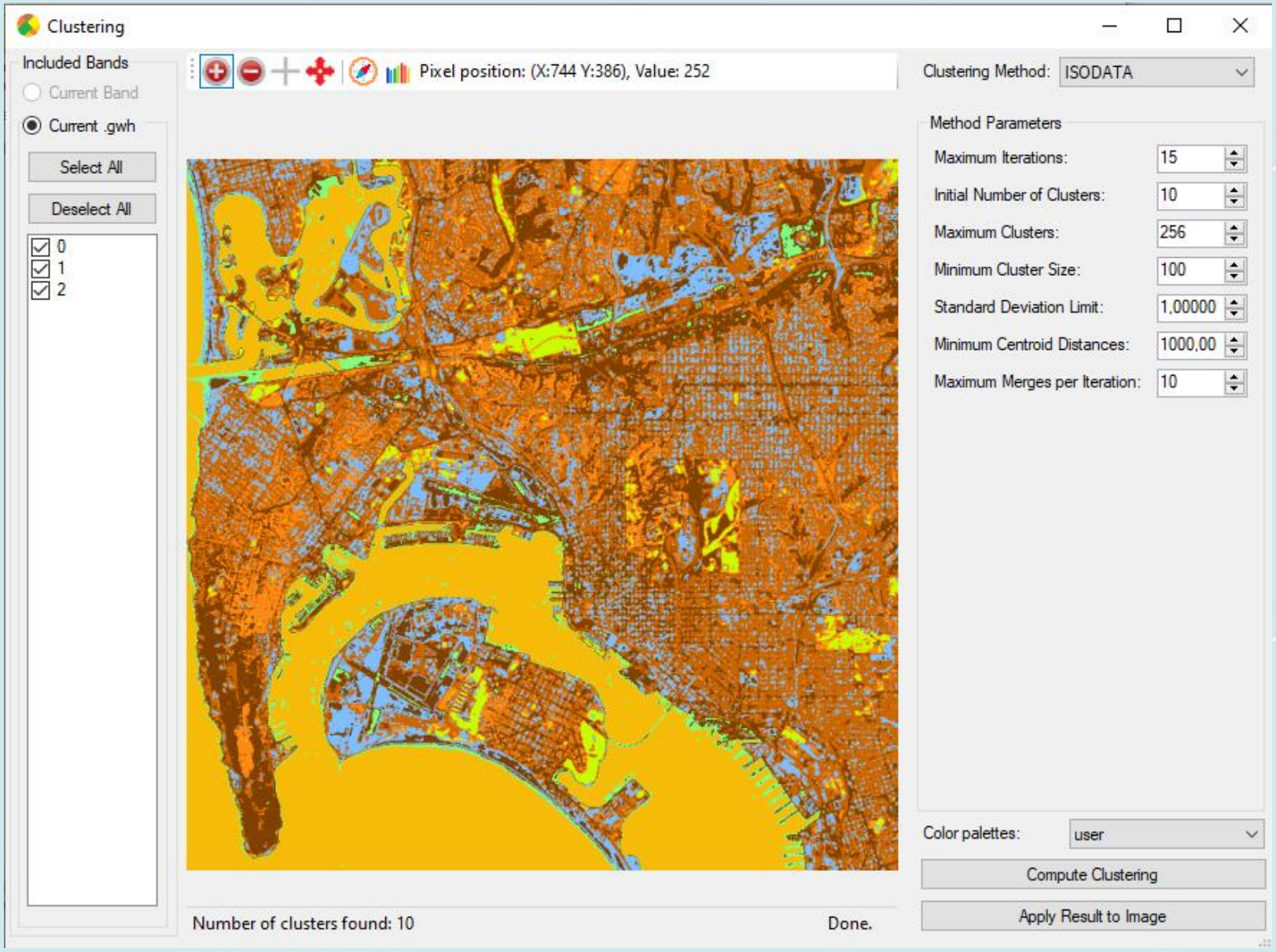
Clustering

SPOT satellite image



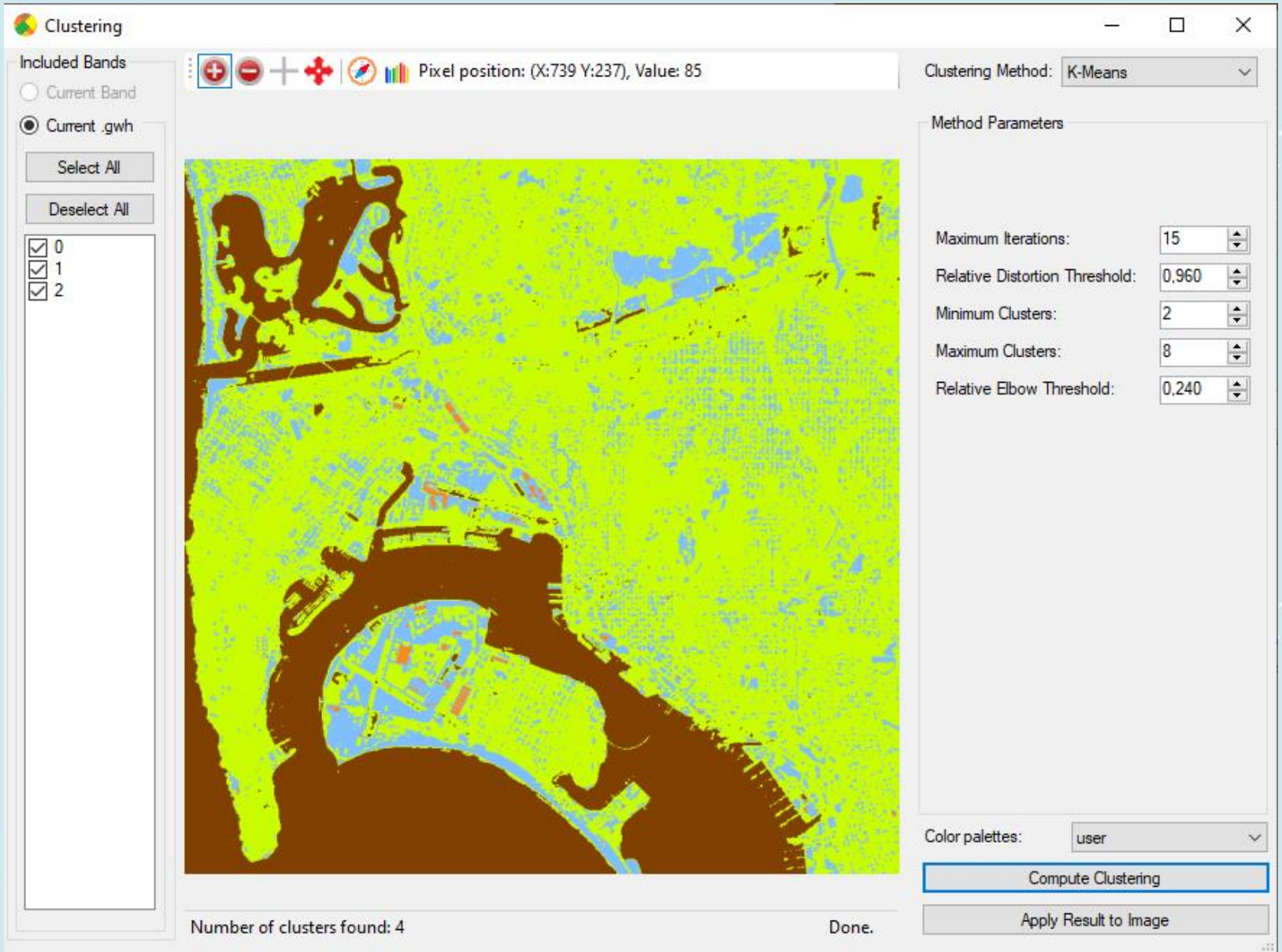
Snapshots from DataStock's operations

ISODATA clustering



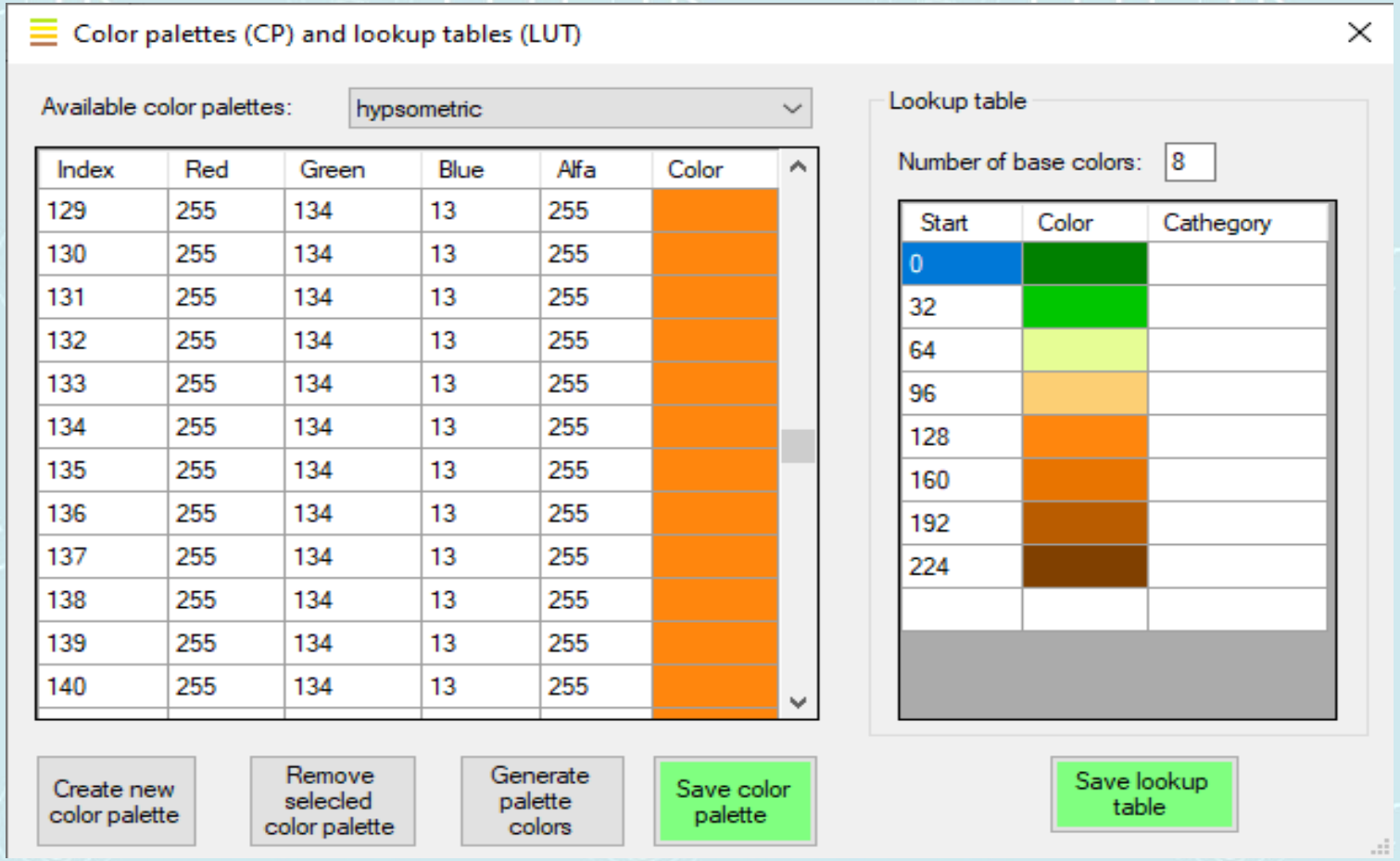
Snapshots from DataStock's operations

K-Means clustering



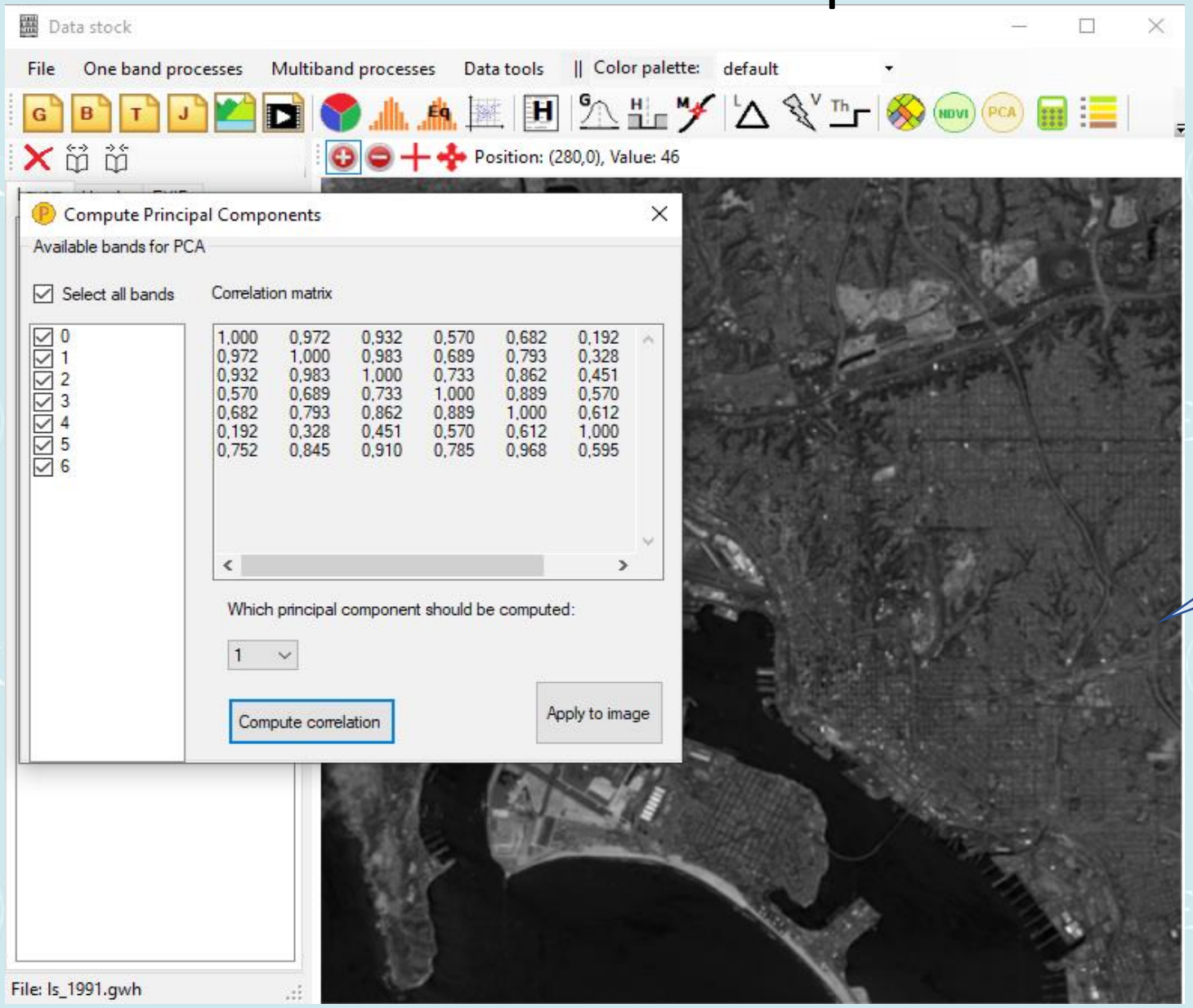
Snapshots from DataStock's operations

Colour palette and lookup table



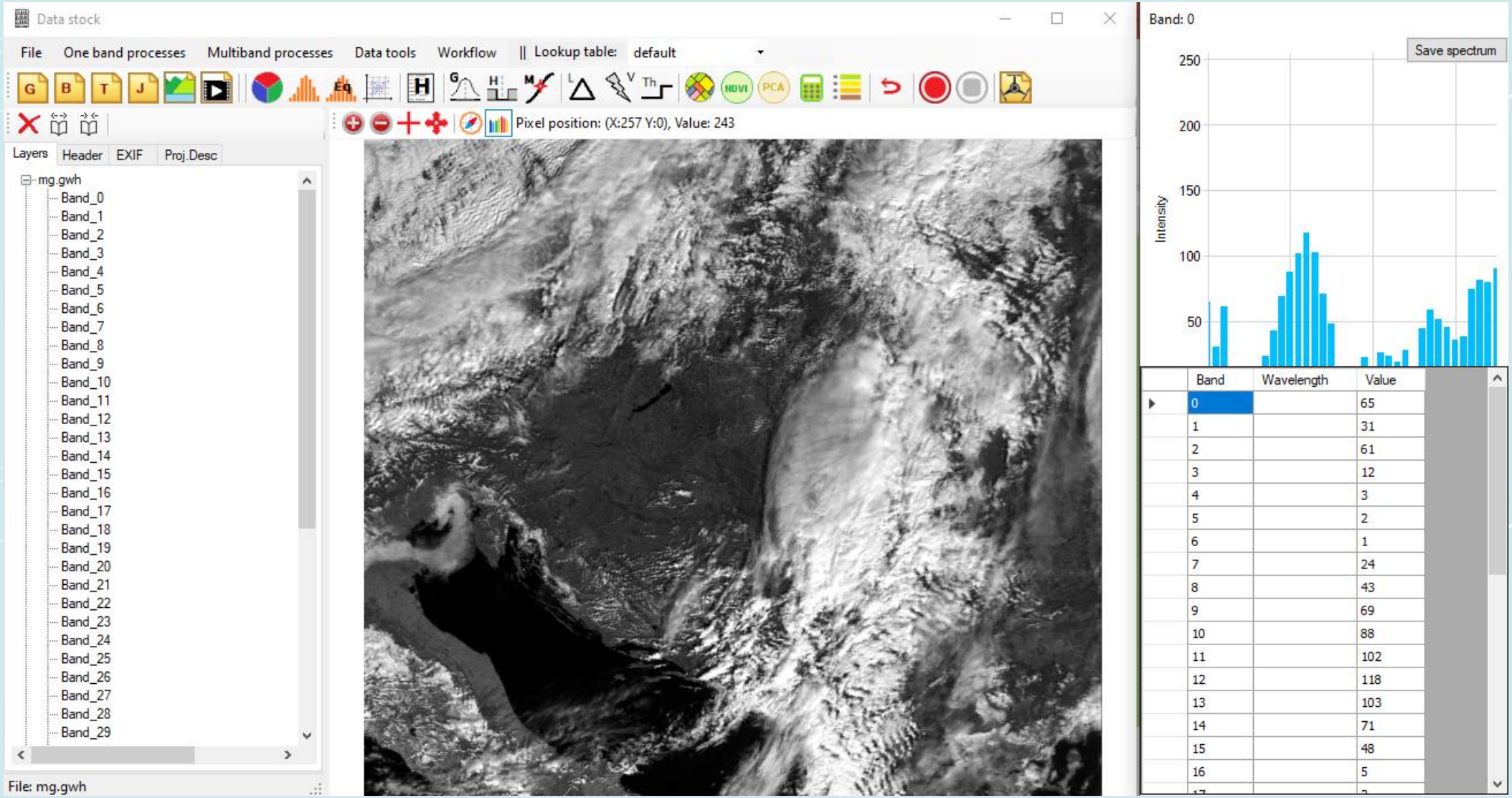
Snapshots from DataStock's operations

Principal component analysis



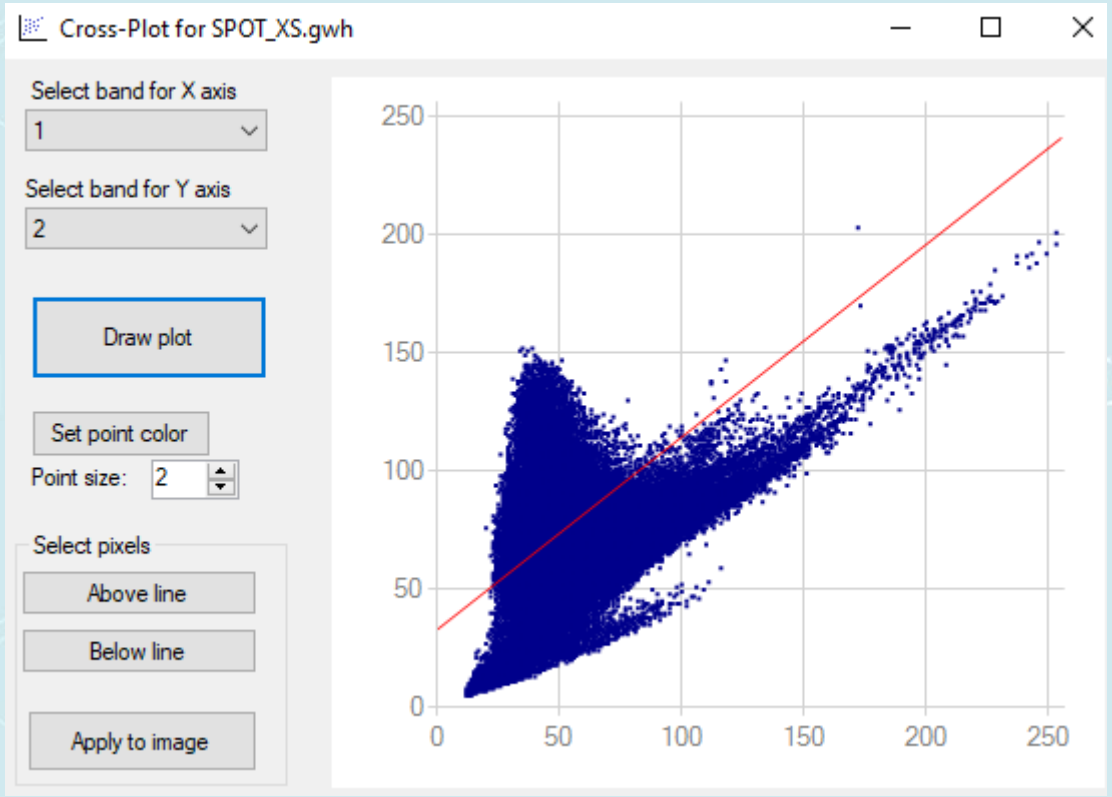
Snapshots from Giwer's operations

Methods for analysing hyperspectral images

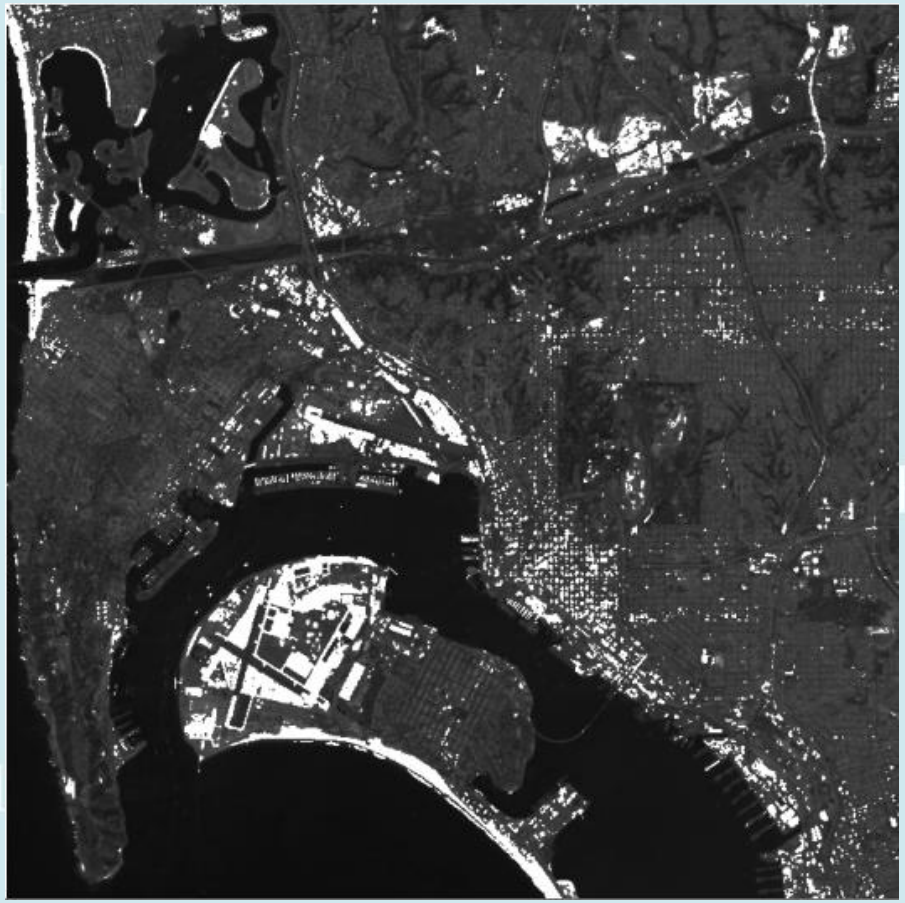


Snapshots from Giwer's operations

Raster calculator

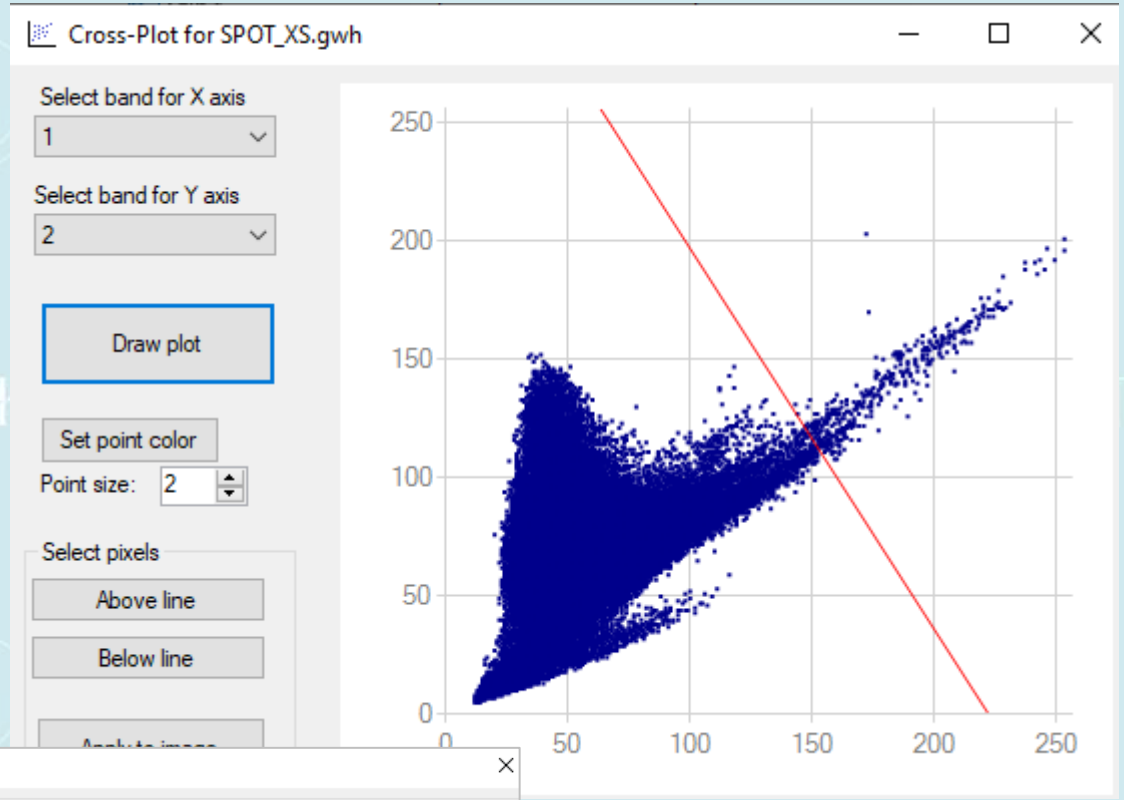


By plotting the intensities of the different frequency bands in a cross-plot, certain areas can be queried by graphical selection. For now, only one arbitrary line is the tool of separation.



Snapshots from Giwer's operations

Rastercalculator



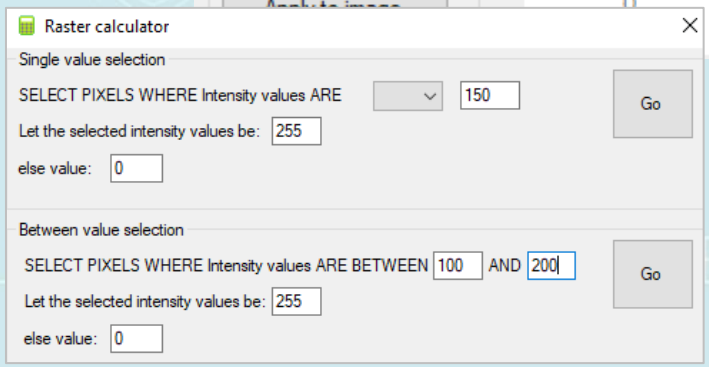


Image catalogue

Catalog's operations briefly

- Catalog is an SQLite-based program for registering images in the file system and storing their attributes in a 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.

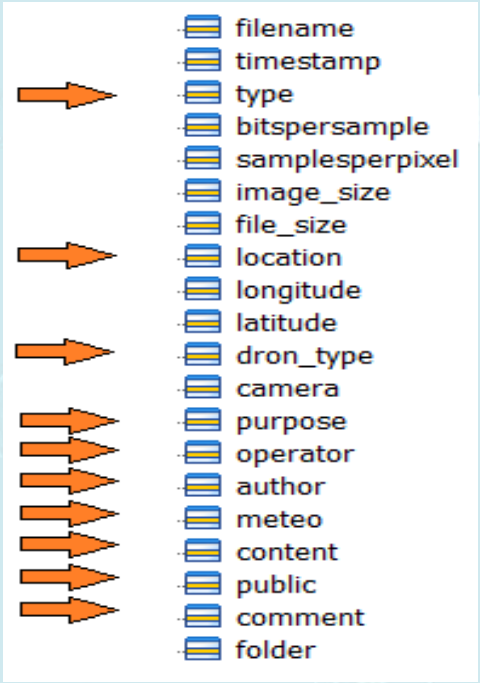
Snapshots from Catalog's operations

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

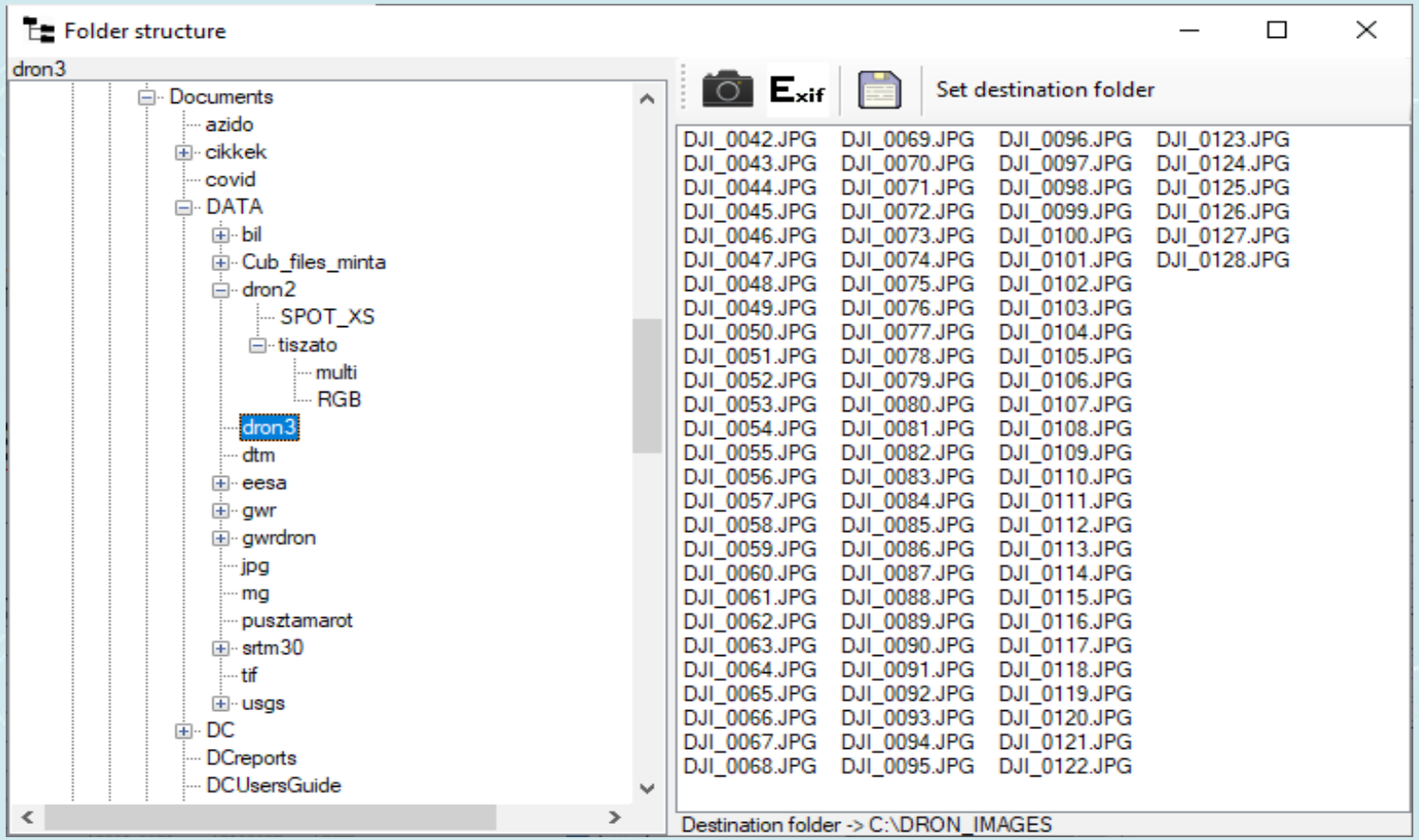
cursor position: 1 / 18 932 | Exif | SQL | Select all

id	filename	timestamp	type	bitspersample	samplesperpixel	image_size	file_size	l
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

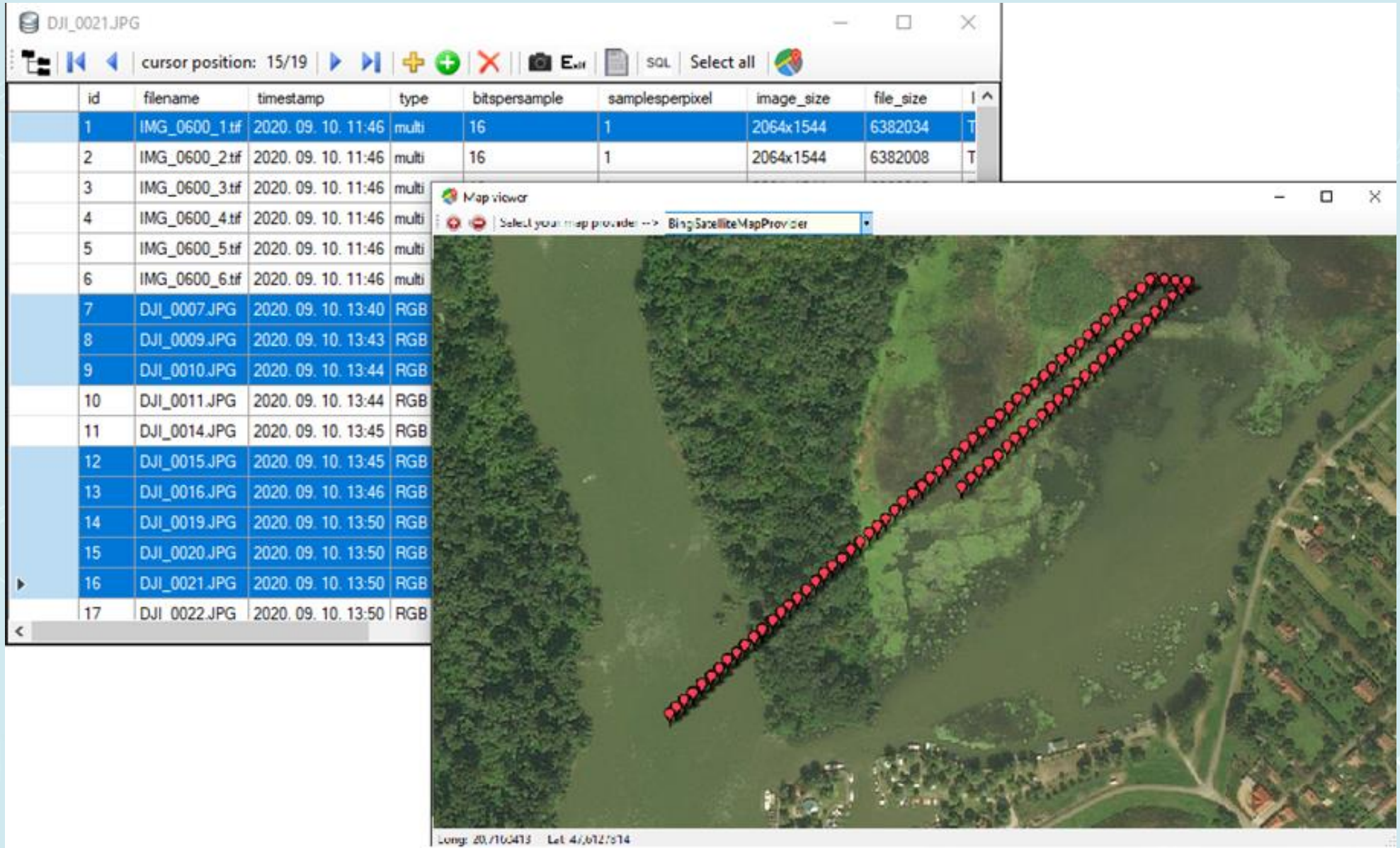
Editable fields



Snapshots from Catalog's operations

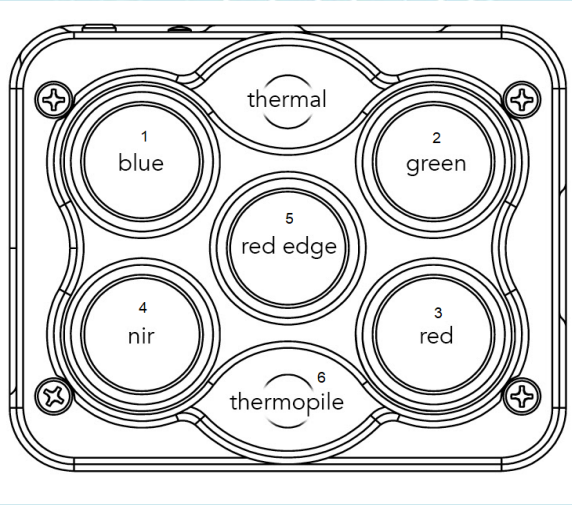


Snapshots from Catalog's operations



Problems with drones

Mapping errors in the images of the multispectral camera

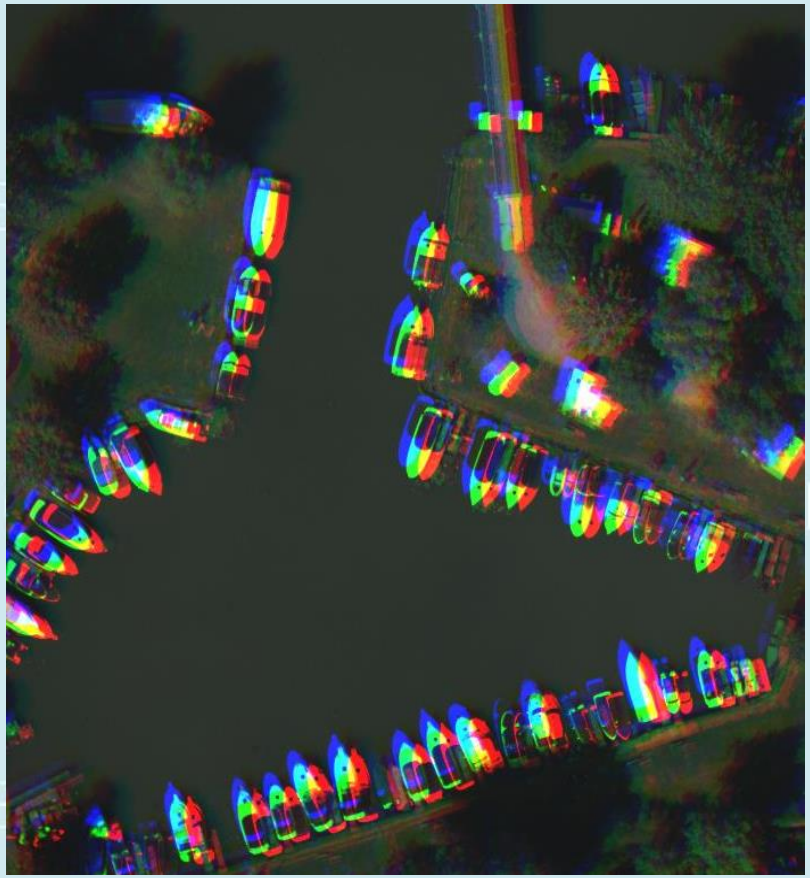


- One image file is generated per frequency band (this would not be a problem yet)
- However, these images do not exactly overlap: 5-25 pixels shift between frequency bands
- The coordinates of the image position given by the GPS built into the cameras are not accurate enough, so flight data and image positions make it difficult to match overlapping images (mosaic)
- Camera distortions make it difficult to fit images. All of the problems above need to be corrected.

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.



Improve of Catalog's operations

We solved the storage of raw images and header data (Exif, header, etc.). These are raw data only, although it may be necessary to store calculated data in the database, even if these can be calculated from the raw data.

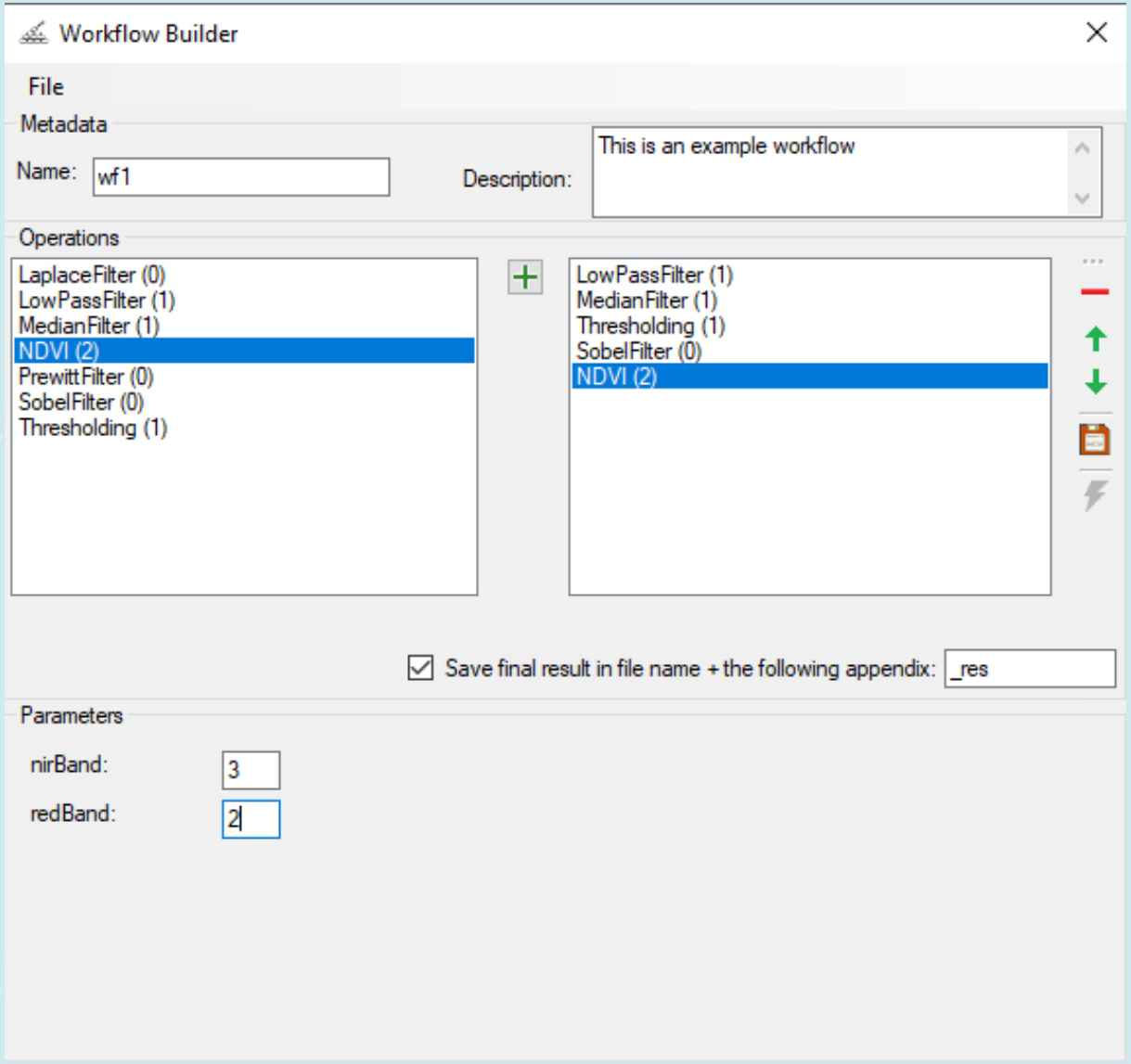
This can be an obvious extension of version 1. The benefit of previous version, despite the wide variety of file formats, is easy to handle these images since they are in known image formats (tif, geotif, jpg, geojpg, bil, ENVI bil, ER Mapper bil, cub, etc.). If you are going to store special remote sensing files too this can be the next task to improve Catalog's functionality. It can be useful for any image processing program, regardless of the Giwer.

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.



Snapshots from Workflow's operations

Workflow

```
#Description:
This is an example workflow
#Methods:
LowPassFilter (1)
3
MedianFilter (1)
5
Thresholding (1)
50
SobelFilter (0)
NDVI (2)
3
2
```

Project

```
#Description:
This project is for reading and handling two
satellite images (LANDSAT and SPOT)
#Files:
C:\Users\eleki\Documents\DATA\gwr\landsat_TM_1985.gwh
C:\Users\eleki\Documents\DATA\gwr\SPOT_XS.gwh
#Config_data:
BilDataFolder, C:\Users\eleki\Documents\DATA\bil
JpgDataFolder, C:\Users\eleki\Documents\DATA\jpg
TifDataFolder, C:\Users\eleki\Documents\DATA\tif
GiwerDataFolder, C:\Users\eleki\Documents\DATA\gwr
3DDataFolder, C:\Users\eleki\Documents\DATA\dtm
ProjectFolder, C:\Users\eleki\Documents\DATA\projects
WorkflowFolder,
C:\Users\eleki\Documents\DATA\projects
```

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.
5. Istvan Elek: GeoImage Workflow Editing Resources: GIWER, book chapter, New Trends and Challenges in Open Data, IntechOpen, England, 2023, DOI: 10.5772/intechopen.1001297

Be the Giwer open source ?

Yes, let it be. The complete Giwer package has been uploaded to gitHub with minimal documentation (users' guide in Hungarian). Version 1.0 has been completed for all modules.

From May to the end of July, when the TKP is closed, we will write documentation, users' guide (in Hungarian and English), developers' documentation (in English only), and tutorial (in Hungarian and English).

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Thanks for your attention