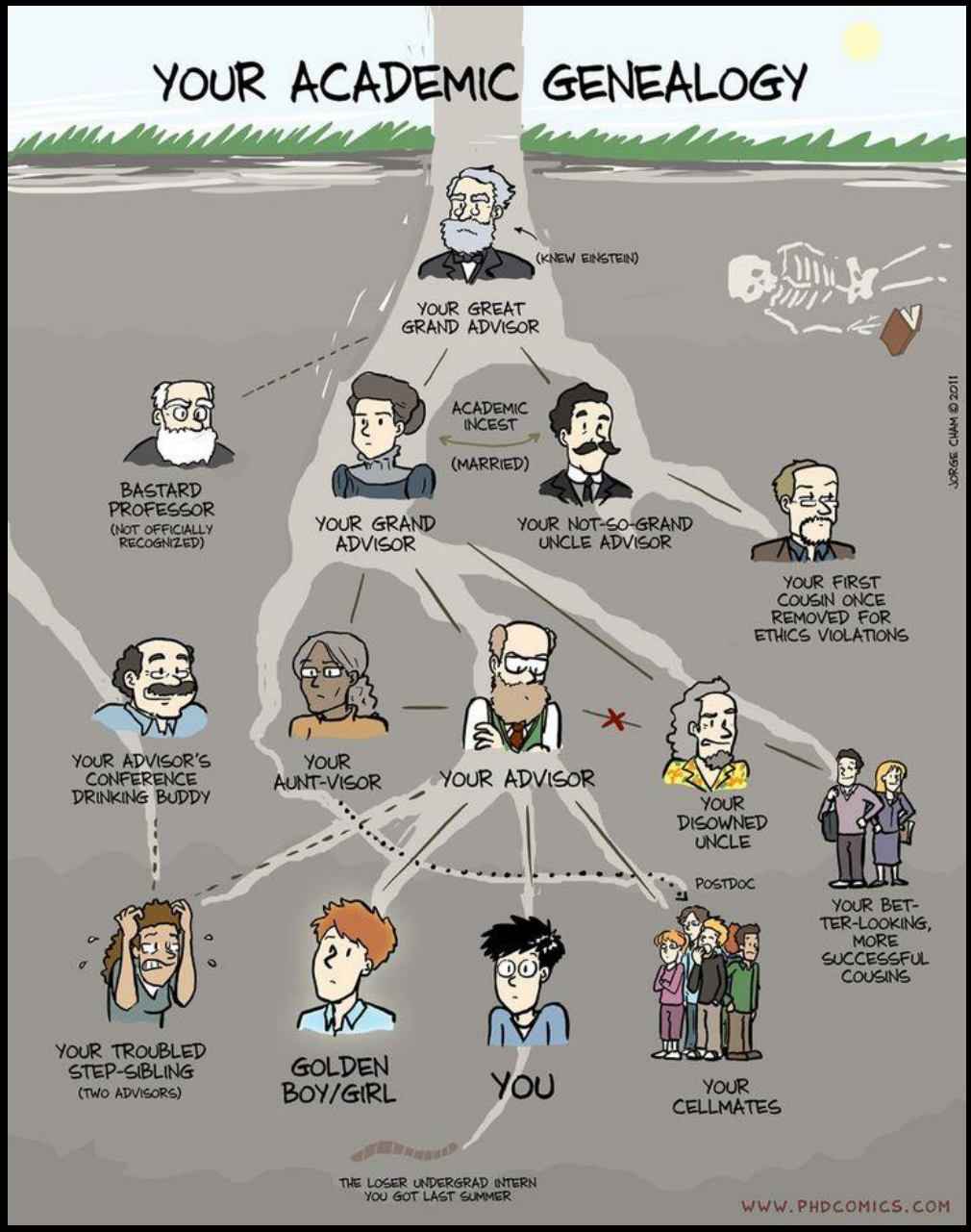
Universitatea
Transilvania
din Brașov

Landsat time series in forest research

Mihai Nita

Overview

- Brief introduction in Google Earth Engine
- Few words on image classification using QGIS plugins
- Few insights on pixel long-term analysis



Long term forest monitoring

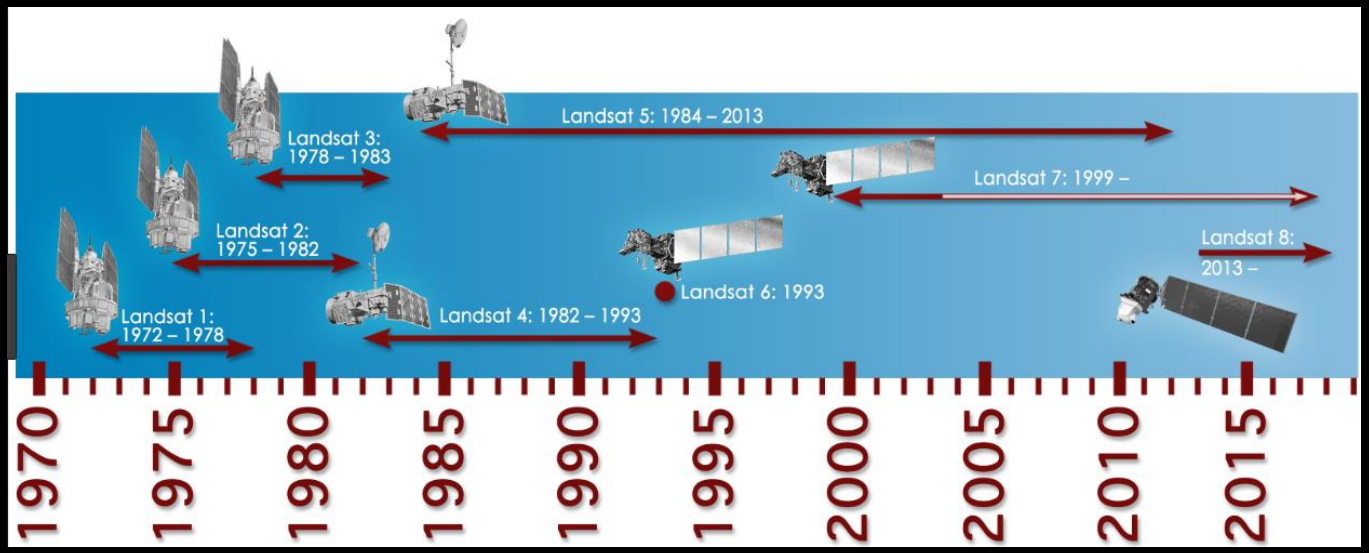
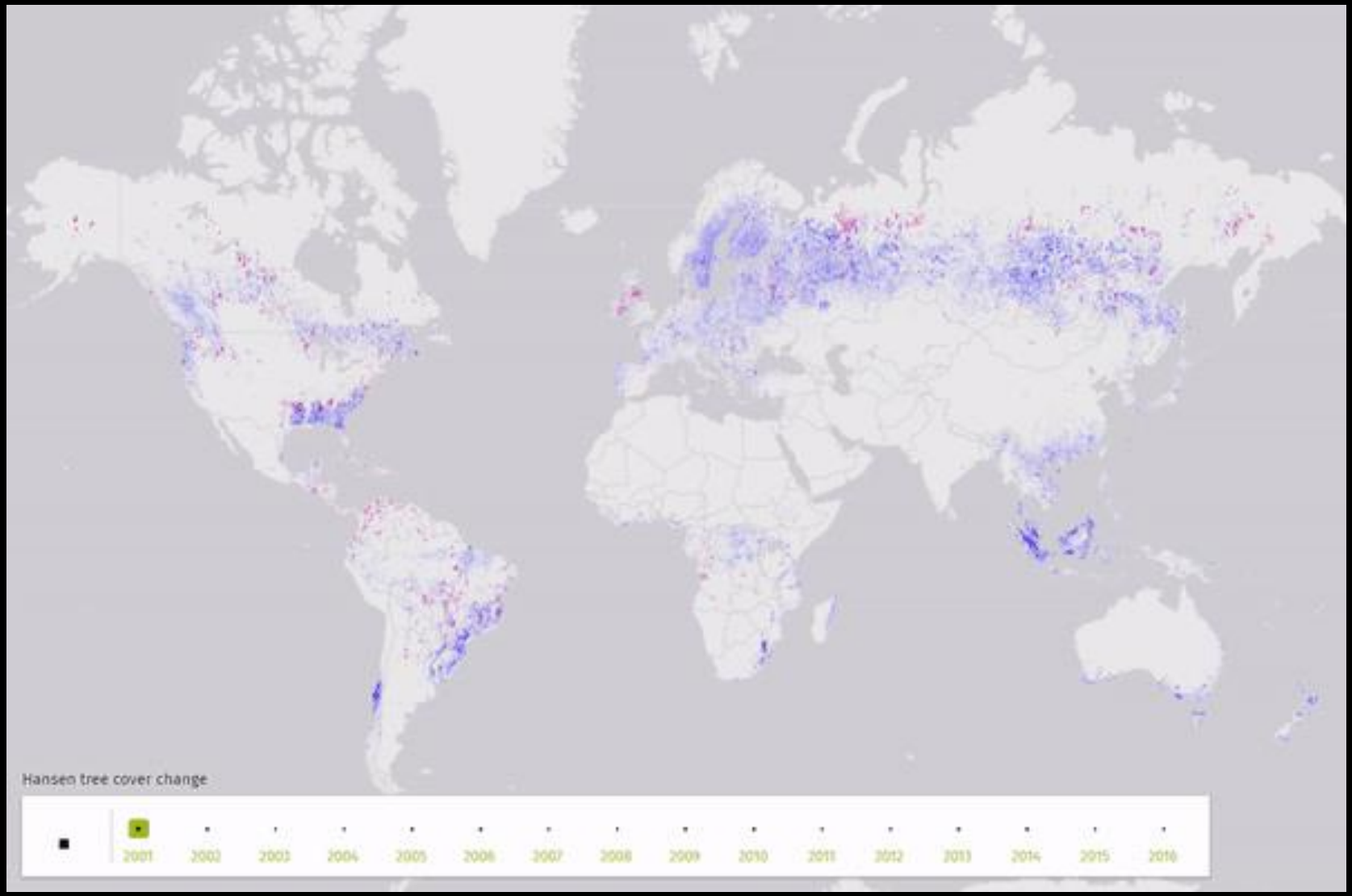
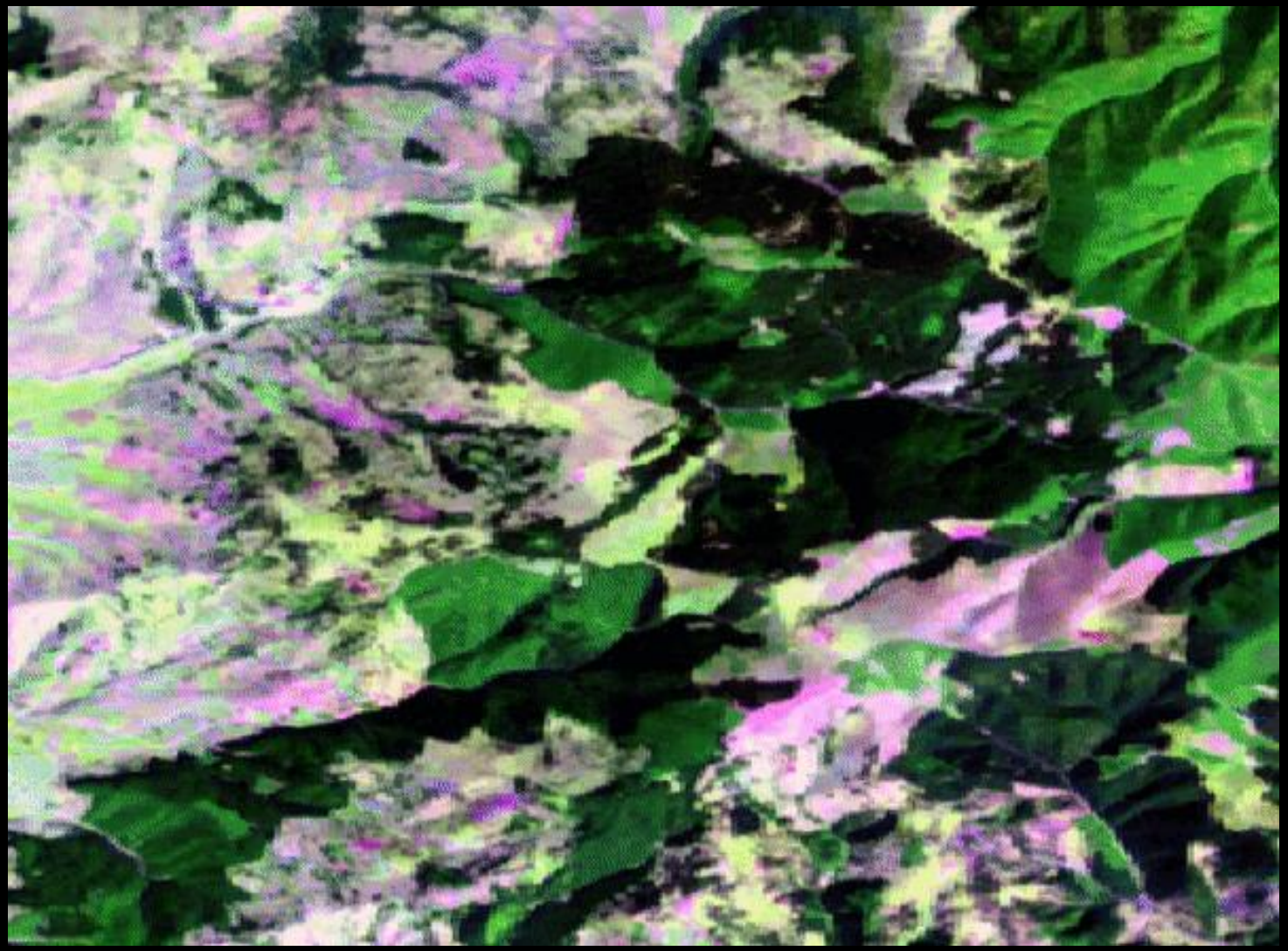


Photo credit: NASA and Airbus

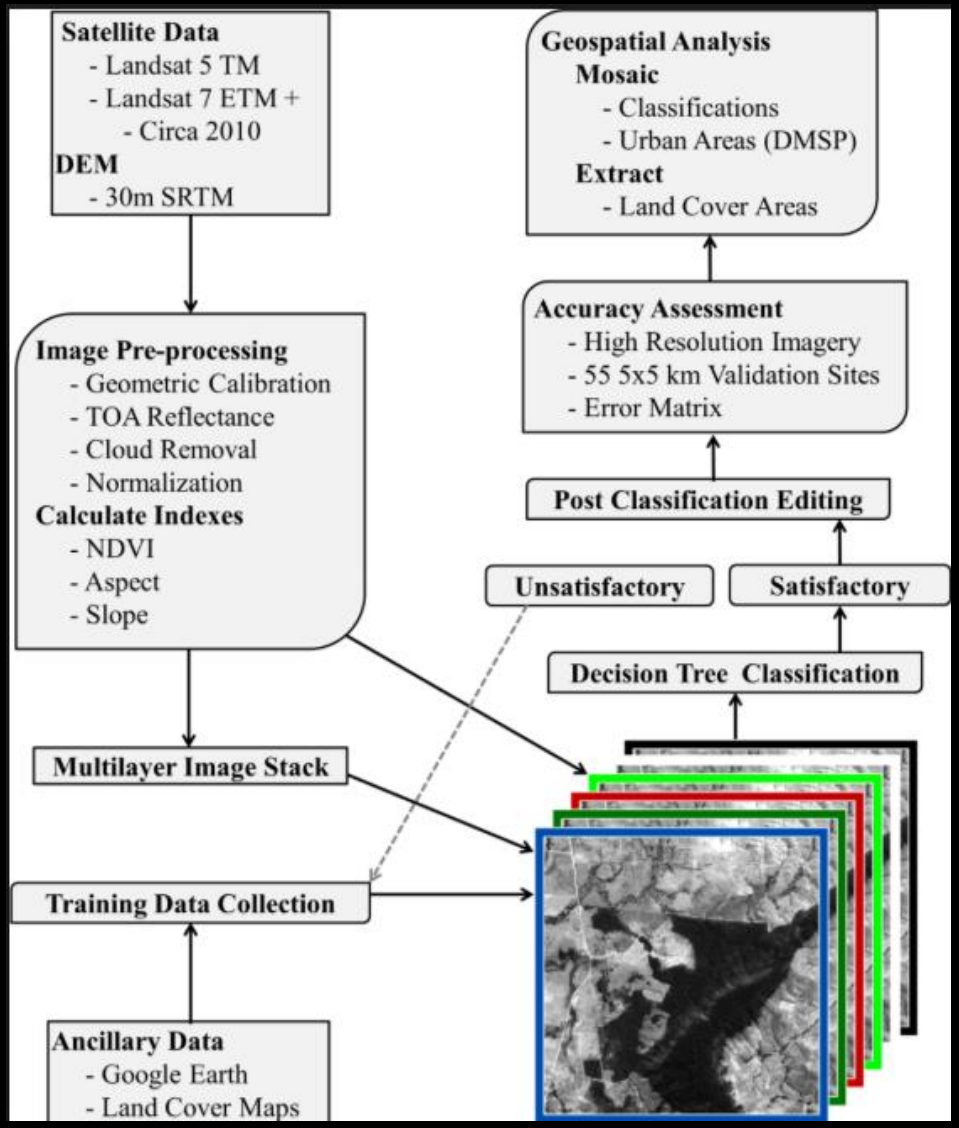
Landsat archive in forest research



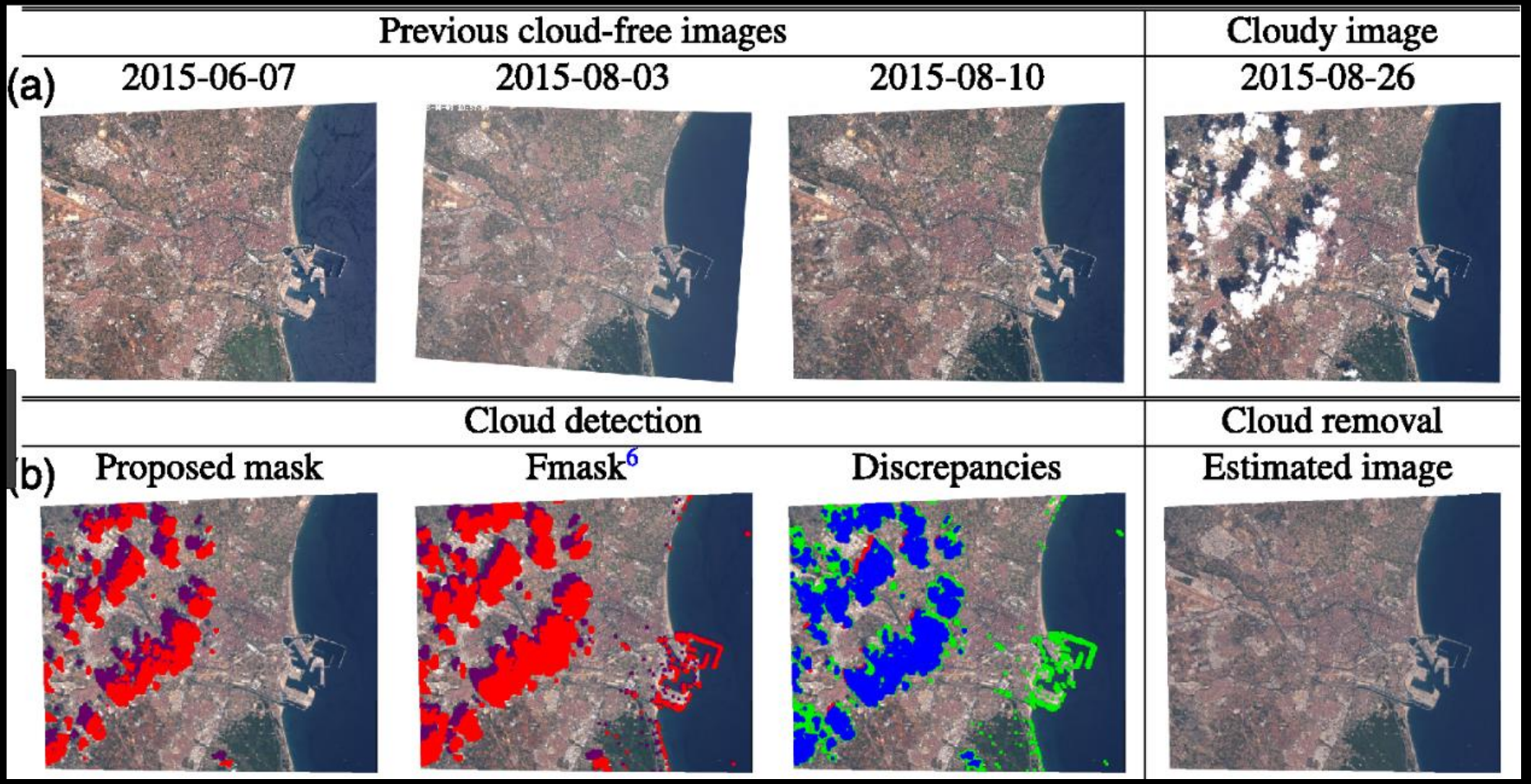
Landsat archive in forest research



Challenge – processing – classification



Challenge - Clouds

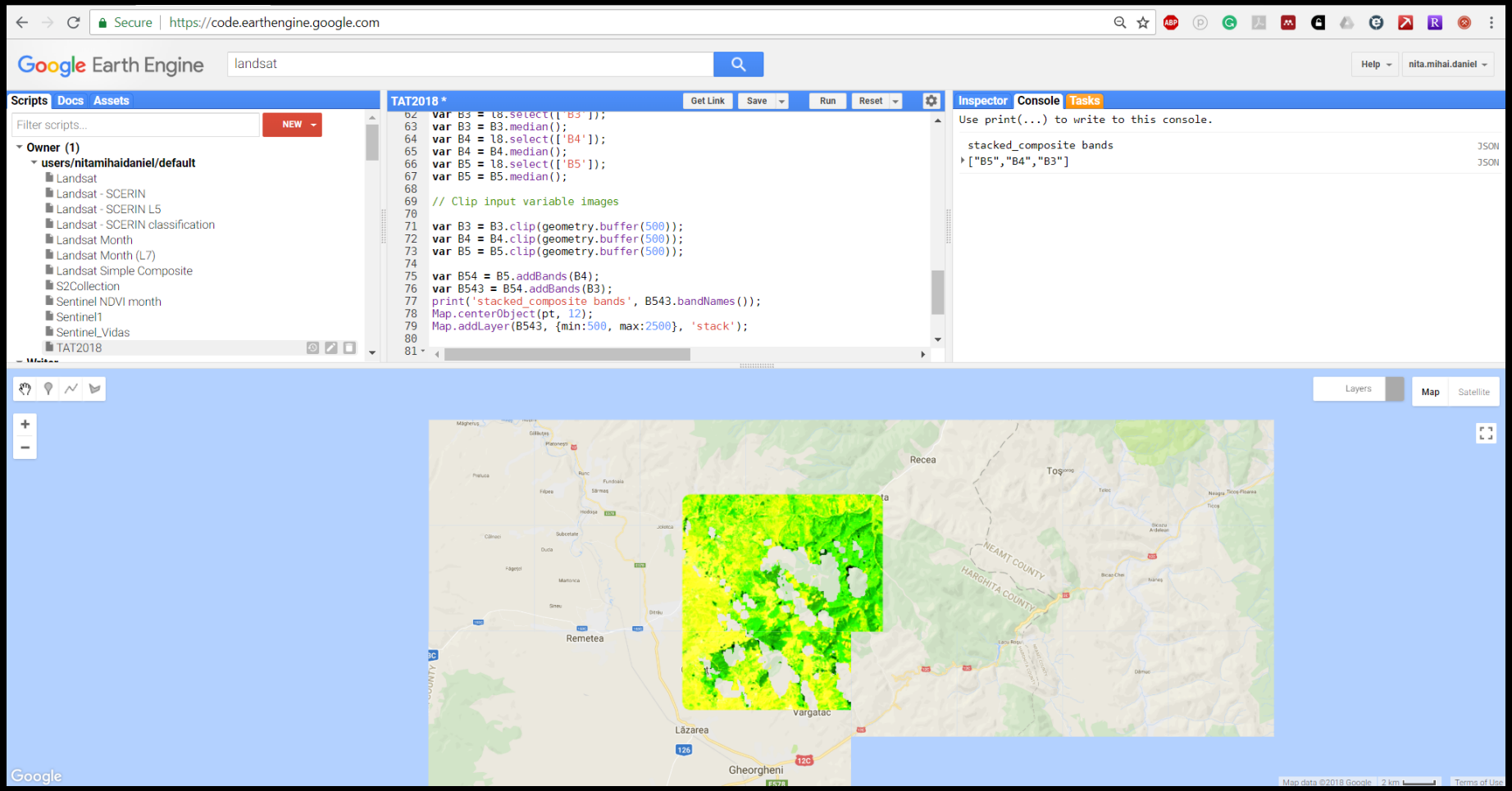


SPIE Digital Library

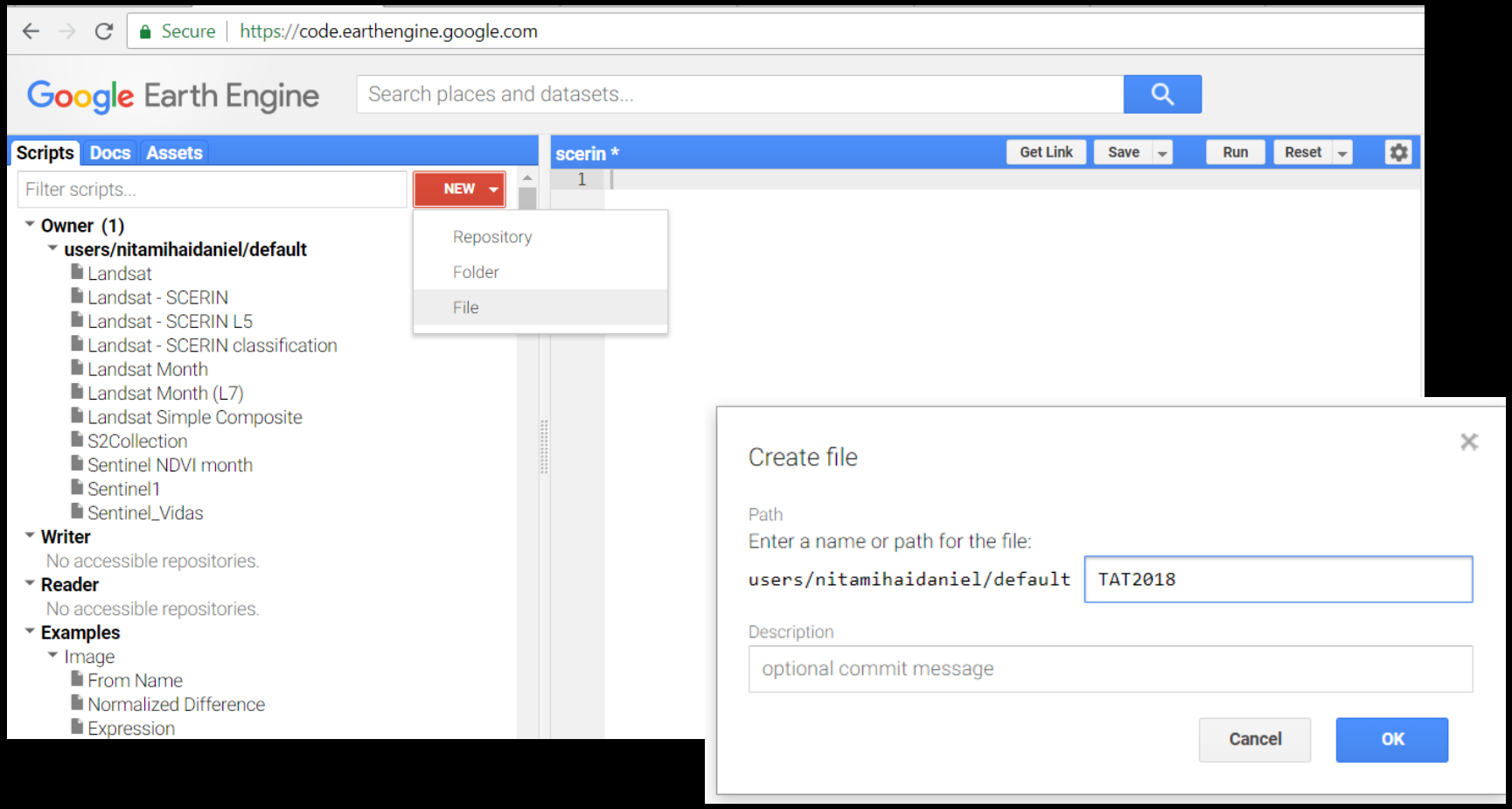
Solutions – open source solutions

- Google Earth Engine
- QGIS
- Python

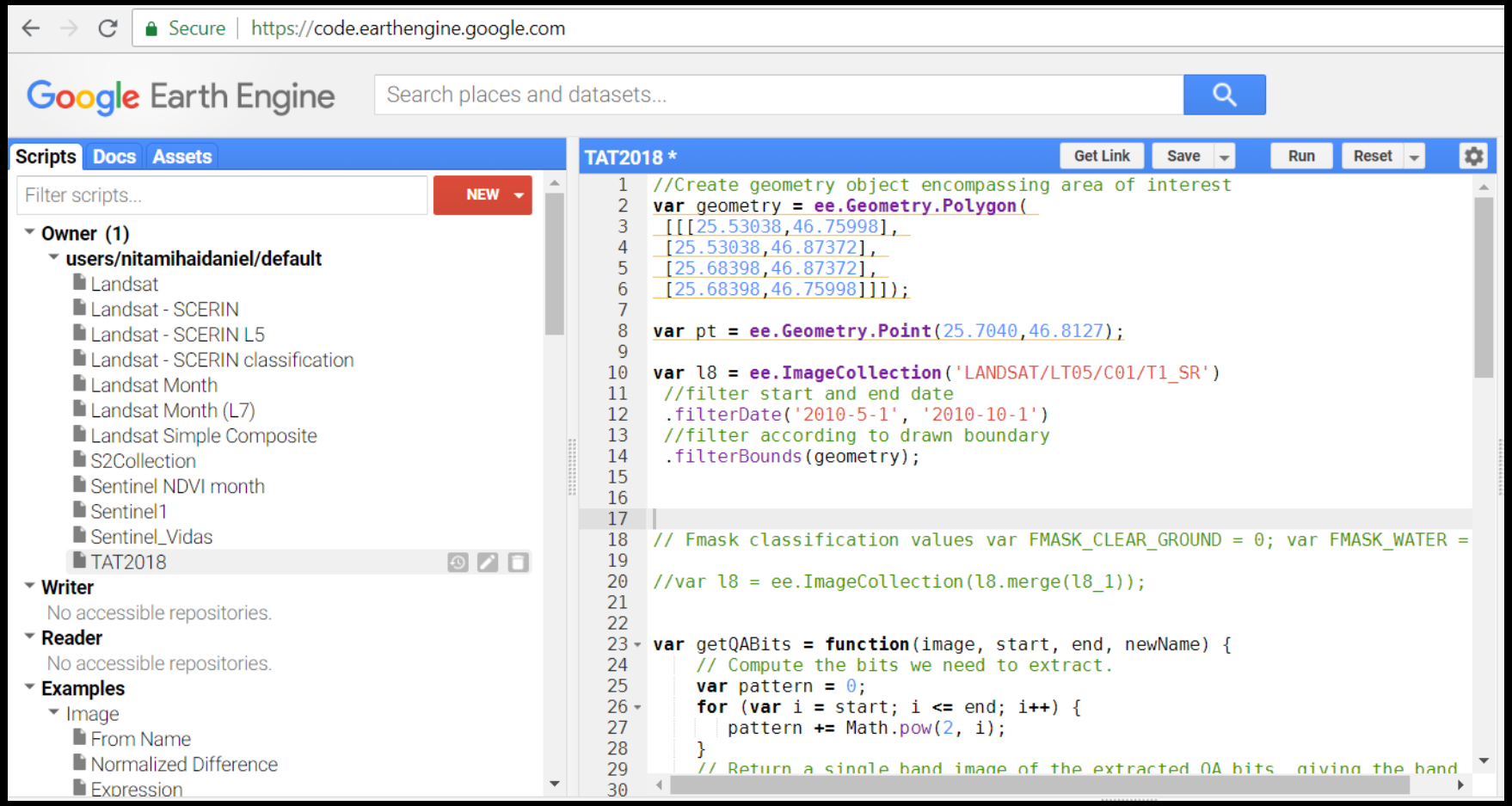
Google Earth Engine



Creating the code – New file



Creating the code – Adding code



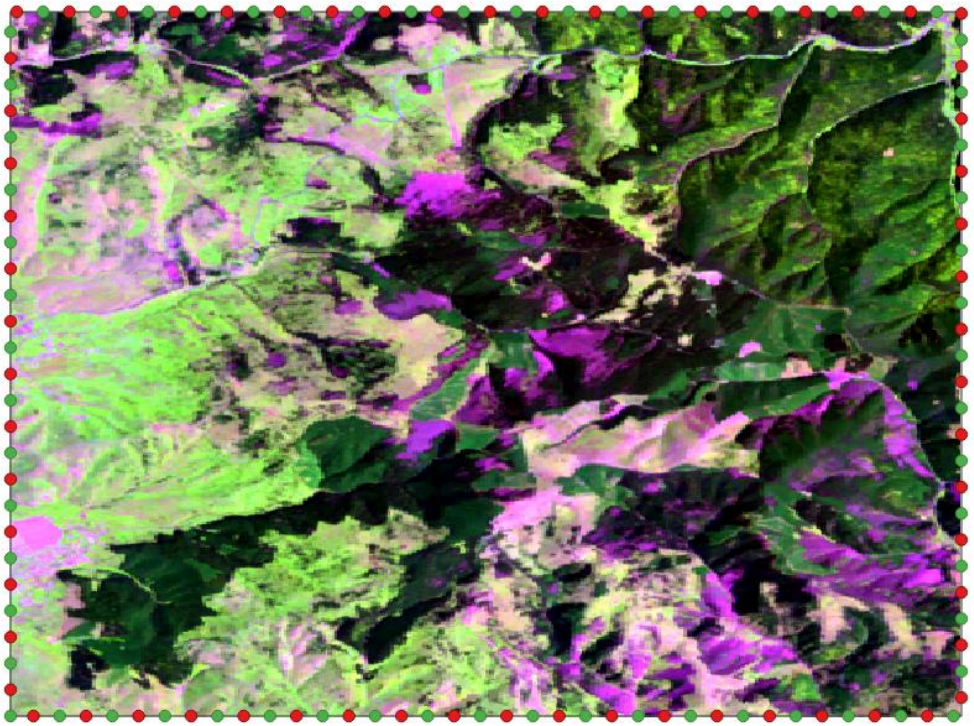
Simple copy paste the existing code from **landsat_TAT_code.txt**

Creating the code – Define variables

Extent

```
1  //Create geometry object encompassing area of interest
2  var geometry = ee.Geometry.Polygon(
3   [[[25.53038,46.75998],
4   [25.53038,46.87372],
5   [25.68398,46.87372],
6   [25.68398,46.75998]]]);
```

25.53038,46.8737
(2 - min,max)



25.68398,46.87372
(3 - max,max)

25.53038,46.75998
(1 - min,min)

25.68398,46.75998
(3 - max,min)

Creating the code – Define variables

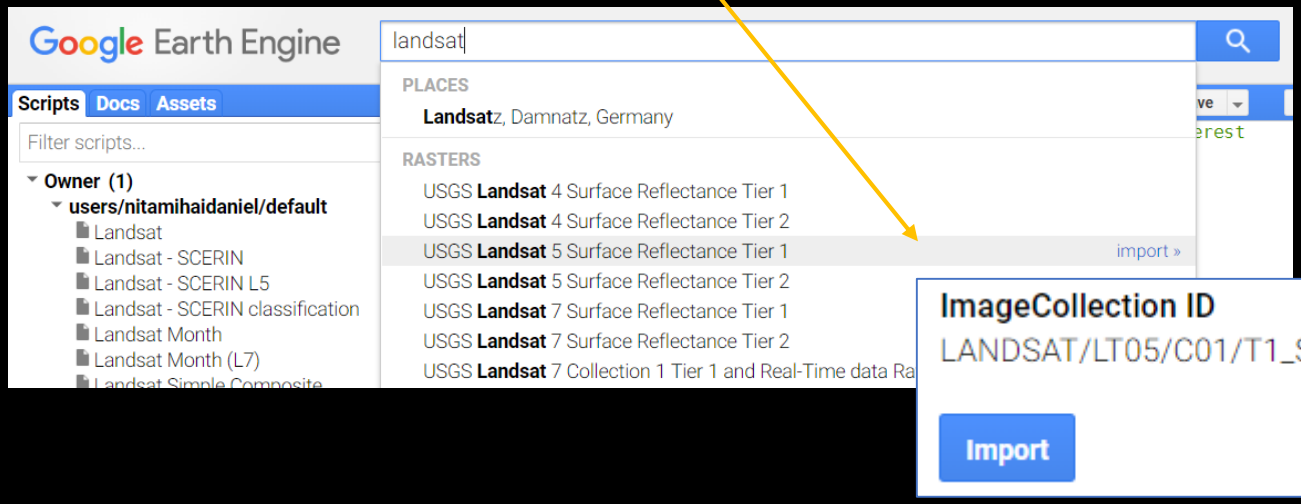
```
var geometry = ee.Geometry.Polygon(
 [[[25.53038,46.75998],
 [25.53038,46.87372],
 [25.68398,46.87372],
 [25.68398,46.75998]]]);

var pt = ee.Geometry.Point(25.7040,46.8127);

var l8 = ee.ImageCollection('LANDSAT/LT05/C01/T1_SR')
 //filter start and end date
 .filterDate('2010-5-1', '2010-10-1')
 //filter according to drawn boundary
 .filterBounds(geometry);
```

Define the Landsat image collection filtering
by date
by geometry

Custom name of your Image collection



Creating the code – Masking clouds

```
var getQABits = function(image, start, end, newName) {
    // Compute the bits we need to extract.
    var pattern = 0;
    for (var i = start; i <= end; i++) {
       pattern += Math.pow(2, i);
    }
    // Return a single band image of the extracted QA bits, giving the band
    // a new name.
    return image.select([0], [newName])
                  .bitwiseAnd(pattern)
                  .rightShift(start);
};
```

Getting the Fmask classification
FMASK_CLEAR_GROUND = 0;
FMASK_WATER = 2;
FMASK_CLOUD_SHADOW = 3;
FMASK_SNOW = 4;
FMASK_CLOUD = 5;

```
// A function to mask out cloudy pixels.
var cloud_shadows = function(image) {
  // Select the QA band.
  var QA = image.select(['pixel_qa']);
  // Get the internal_cloud_algorithm_flag bit.
  return getQABits(QA, 3,3, 'Cloud_shadows').eq(0);
  // Return an image masking out cloudy areas.
};
```

Creates a single band with the cloud shadow value (3) calculated in QA band using Fmask classification

```
// A function to mask out cloudy pixels.
var clouds = function(image) {
  // Select the QA band.
  var QA = image.select(['pixel_qa']);
  // Get the internal_cloud_algorithm_flag bit.
  return getQABits(QA, 5,5, 'Cloud').eq(0);
  // Return an image masking out cloudy areas.
};
```

Creates a single band with the clouds value (5) calculated in QA band using Fmask classification

```
var maskClouds = function(image) {
  var cs = cloud_shadows(image);
  var c = clouds(image);
  image = image.updateMask(cs);
  return image.updateMask(c);
};
```

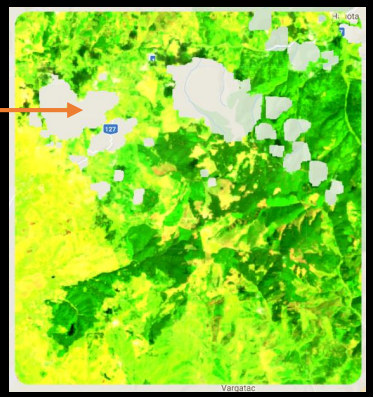
Constructs the function called maskClouds which applies the 2 masks defined earlier

Creating the code – Apply the mask

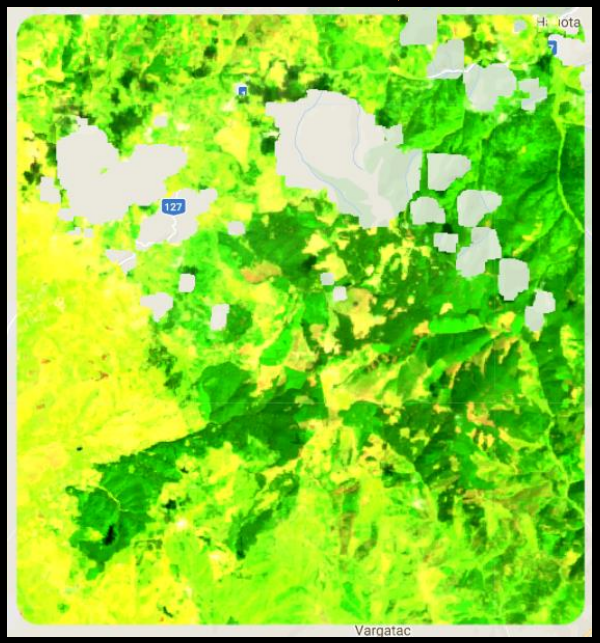
```
var l8 = l8.map(maskClouds);
var B3 = l8.select(['B3']);
var B3 = B3.median();
var B4 = l8.select(['B4']);
var B4 = B4.median();
var B5 = l8.select(['B5']);
var B5 = B5.median();
```

```
var l8 = ee.ImageCollection('LANDSAT/LT05/C01/T1_SR')
 //filter start and end date
 .filterDate('2009-5-1', '2009-7-1')
 //filter according to drawn boundary
 .filterBounds(geometry);
```

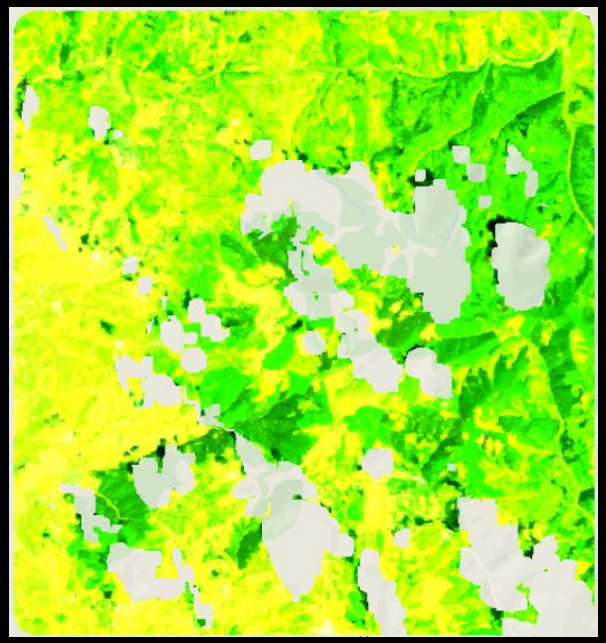
Masked band



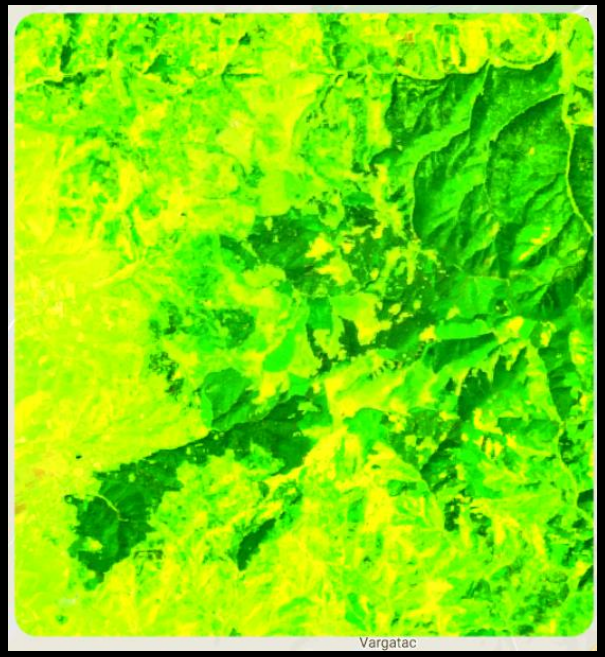
Mosaic band



+



=



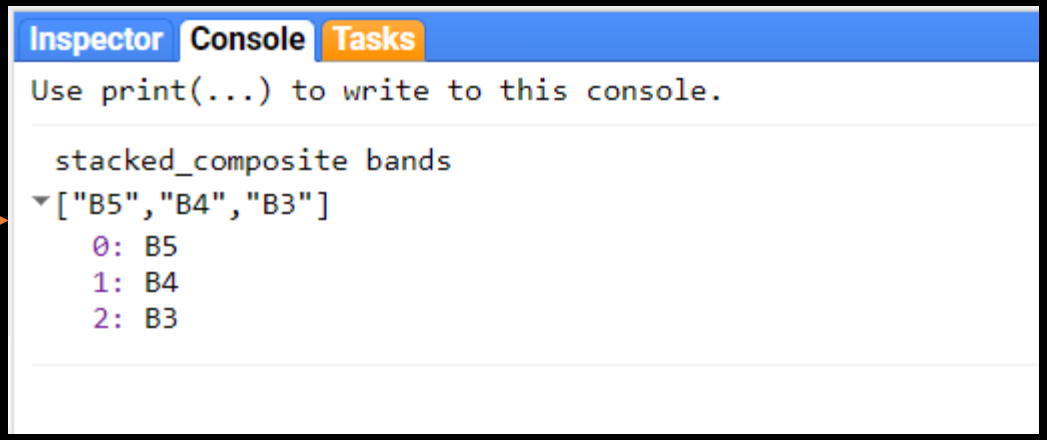
Creating the code – Band stacking and clipping

```
var geometry = ee.Geometry.Polygon(
 [[[25.53038,46.75998],
 [25.53038,46.87372],
 [25.68398,46.87372],
 [25.68398,46.75998]]]);
```

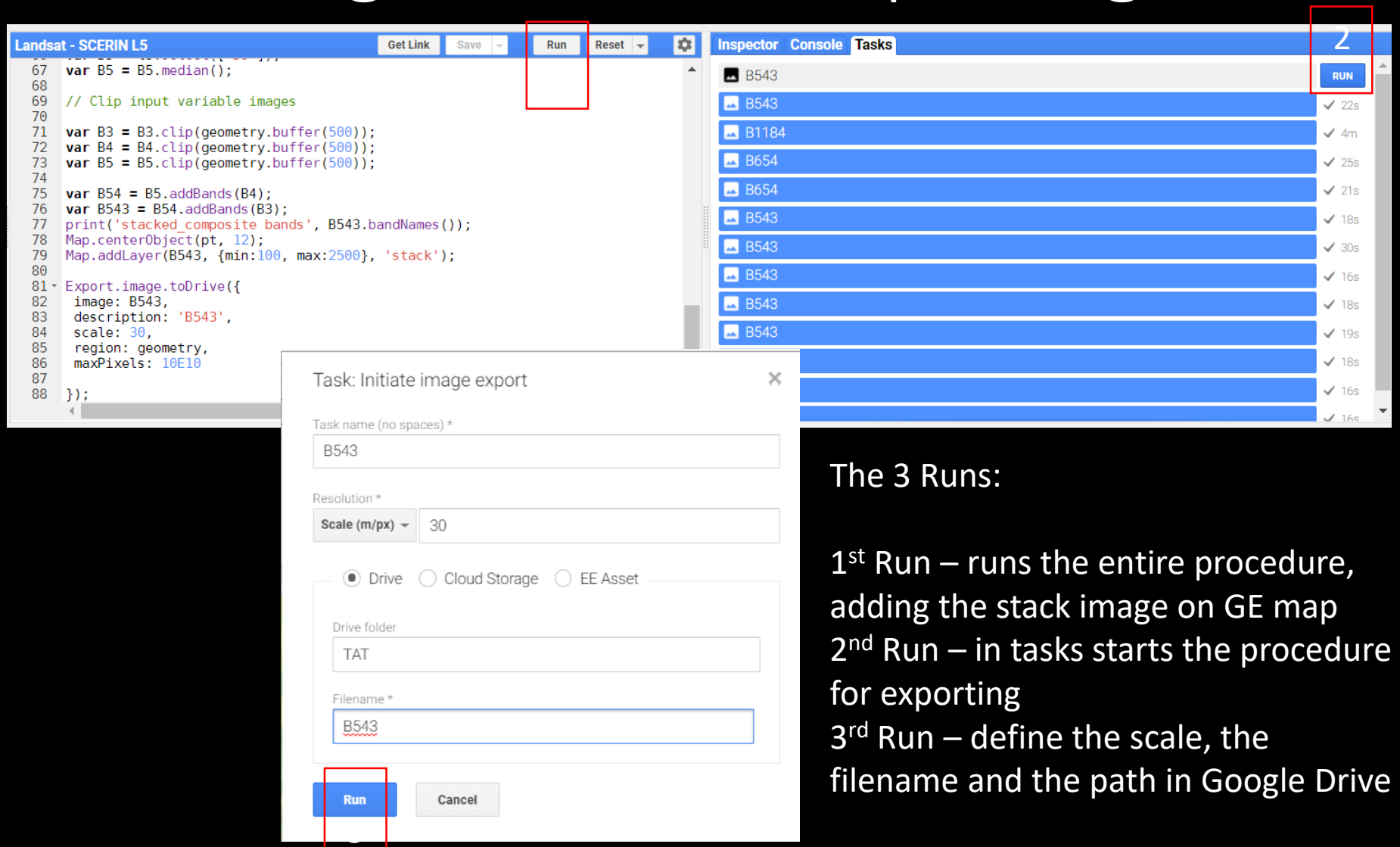
```
// Clip input variable images

var B3 = B3.clip(geometry.buffer(500));
var B4 = B4.clip(geometry.buffer(500));
var B5 = B5.clip(geometry.buffer(500));

var B54 = B5.addBands(B4);
var B543 = B54.addBands(B3);
print('stacked_composite bands', B543.bandNames());
Map.centerObject(pt, 12);
Map.addLayer(B543, {min:500, max:2500}, 'stack');
```



Creating the code – Exporting



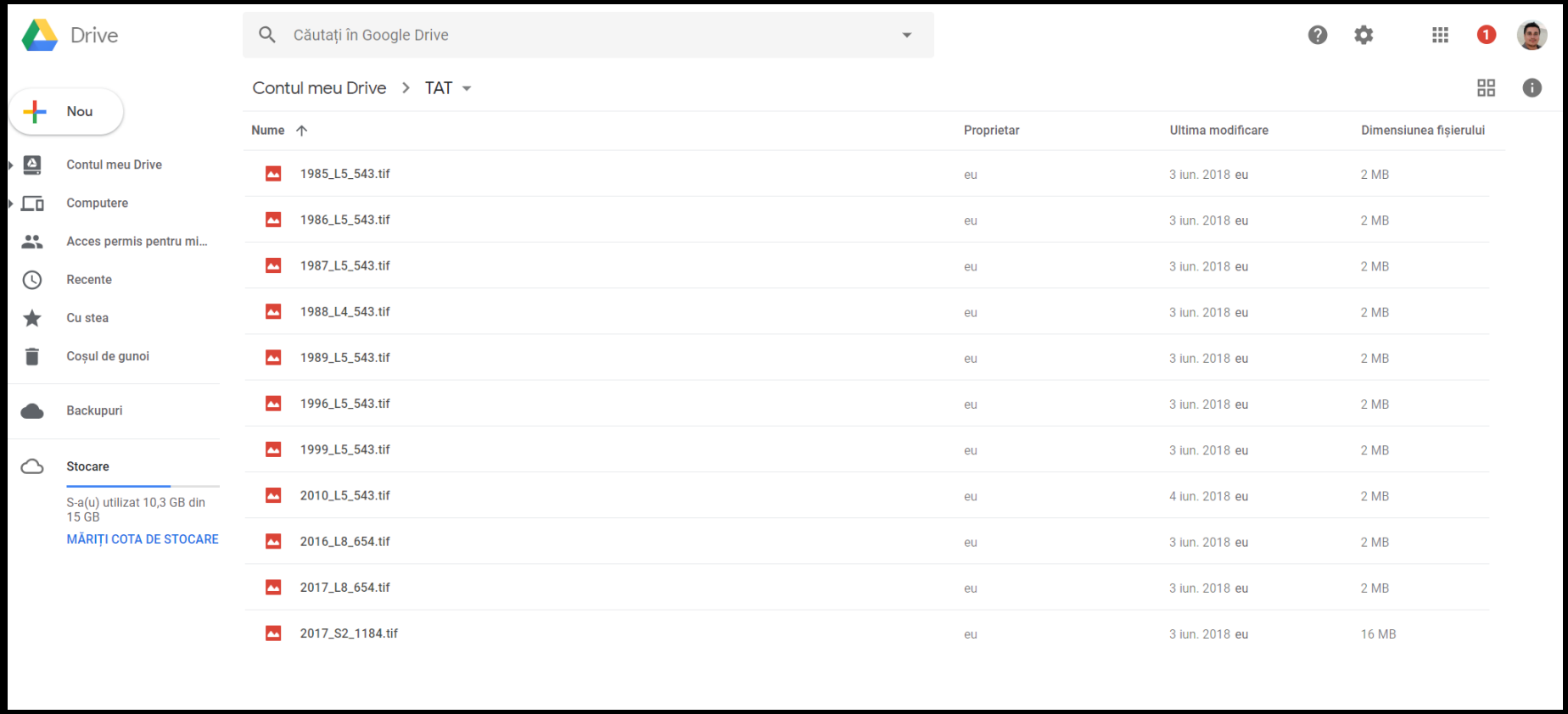
The 3 Runs:

1st Run – runs the entire procedure, adding the stack image on GE map

2nd Run – in tasks starts the procedure for exporting

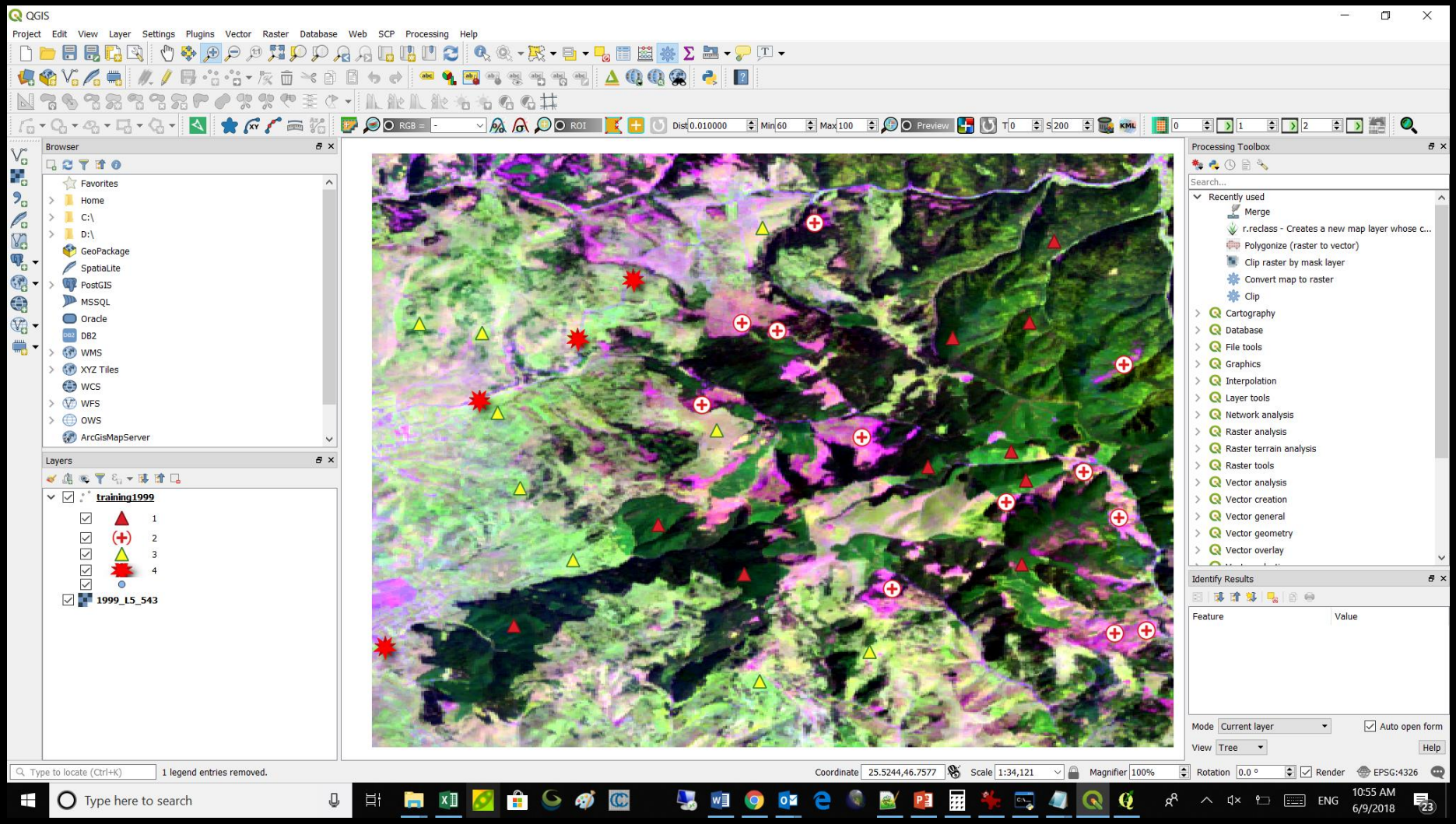
3rd Run – define the scale, the filename and the path in Google Drive

Creating the code – Exporting

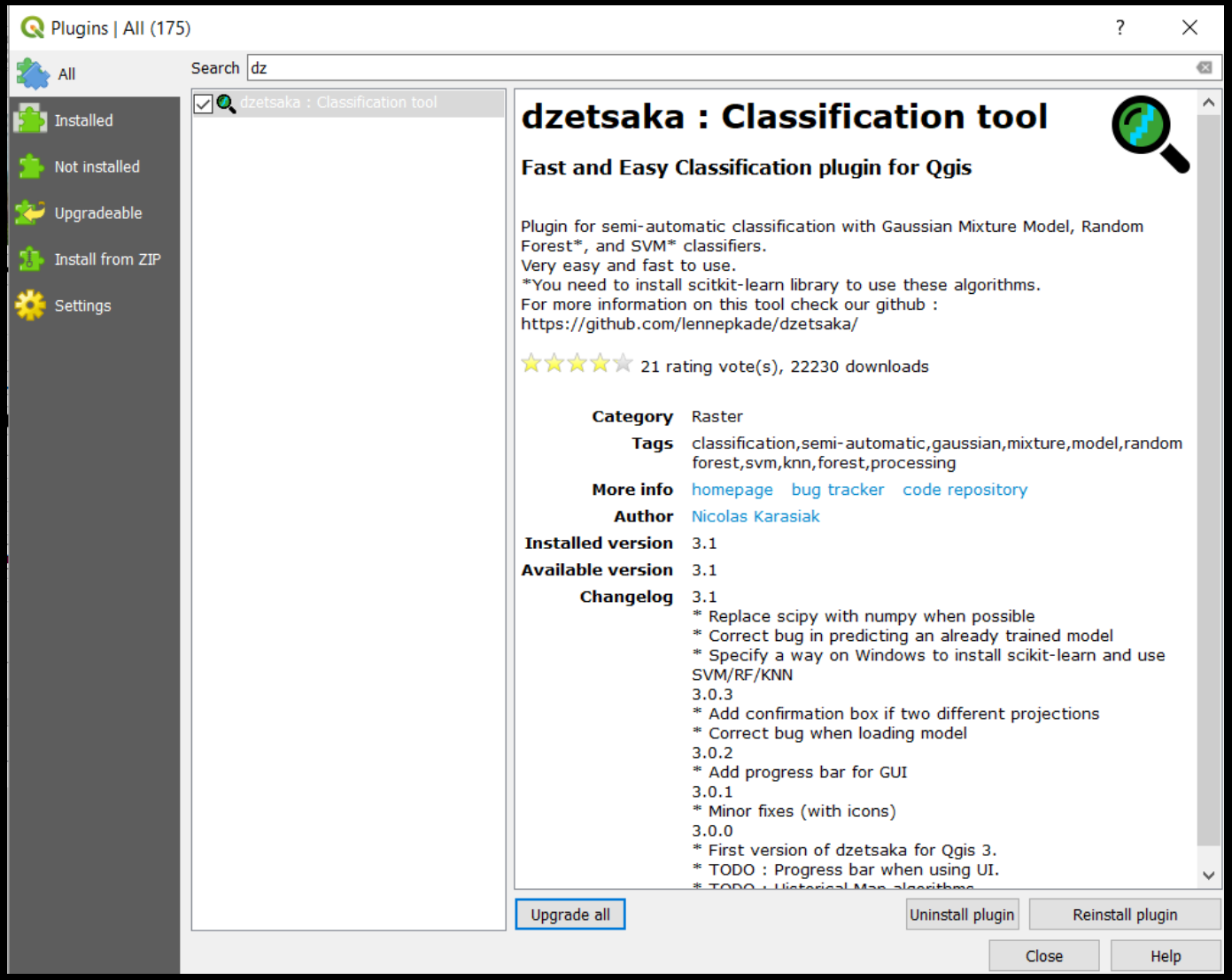


Results are geotiff, with all the stacked bands
Projection is EPSG:4326 – Geographic WGS84

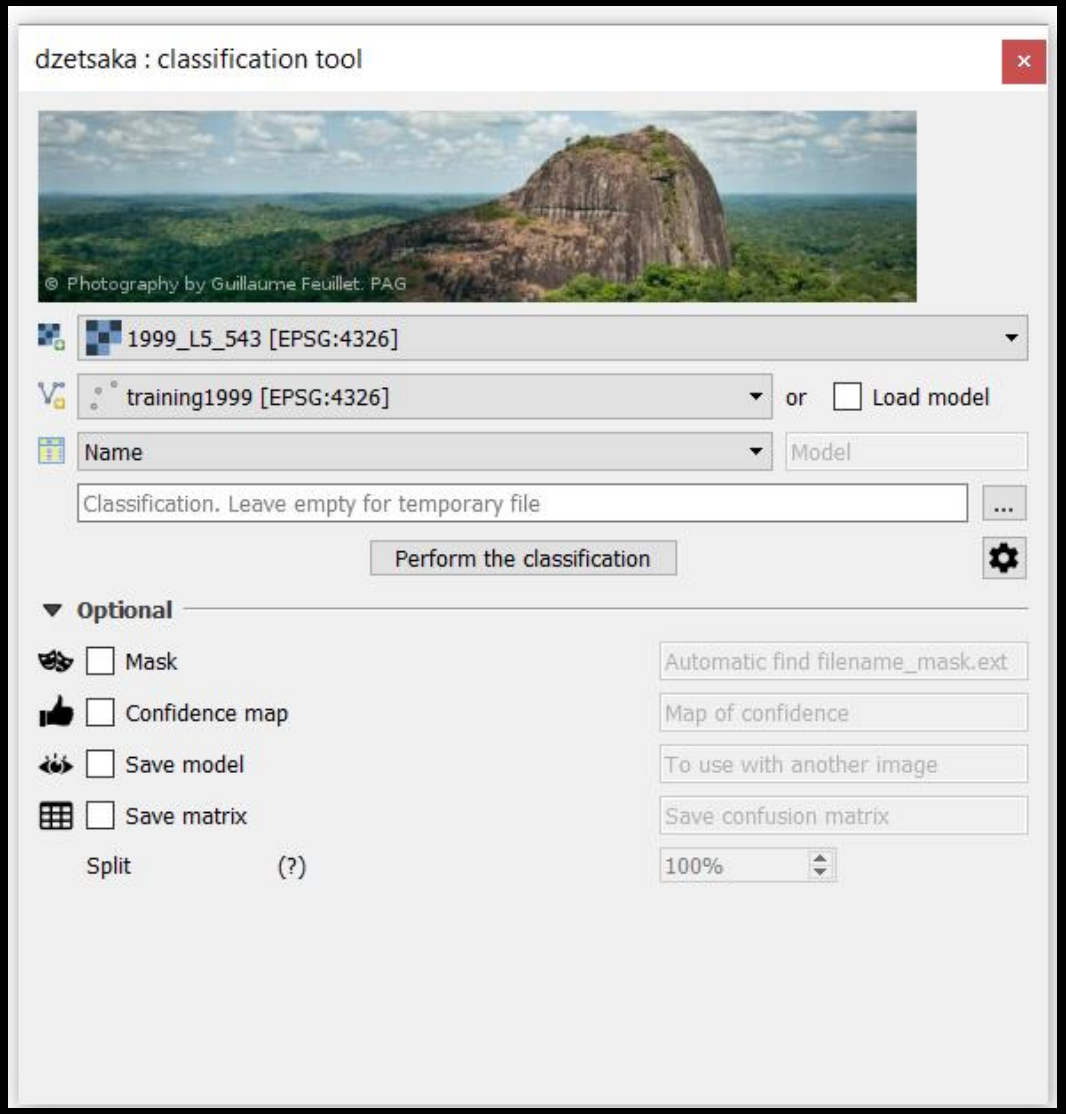
QGIS


QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web SCP Processing Help
Browser
Favorites
Home
C:\
D:\
GeoPackage
SpatiaLite
PostGIS
MSSQL
Oracle
DB2
WMS
XYZ Tiles
WCS
WFS
OWS
ArcGisMapServer
Layers
training1999
1
2
3
4
1999_L5_543
Processing Toolbox
Search...
Recently used
Merge
r.reclass - Creates a new map layer whose c...
Polygonize (raster to vector)
Clip raster by mask layer
Convert map to raster
Clip
Cartography
Database
File tools
Graphics
Interpolation
Layer tools
Network analysis
Raster analysis
Raster terrain analysis
Raster tools
Vector analysis
Vector creation
Vector general
Vector geometry
Vector overlay
Identify Results
Feature
Value
Mode Current layer
Auto open form
View Tree
Help
Type to locate (Ctrl+K)
1 legend entries removed.
Coordinate 25.5244,46.7577
Scale 1:34,121
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326
Type here to search
ENG
10:55 AM
6/9/2018

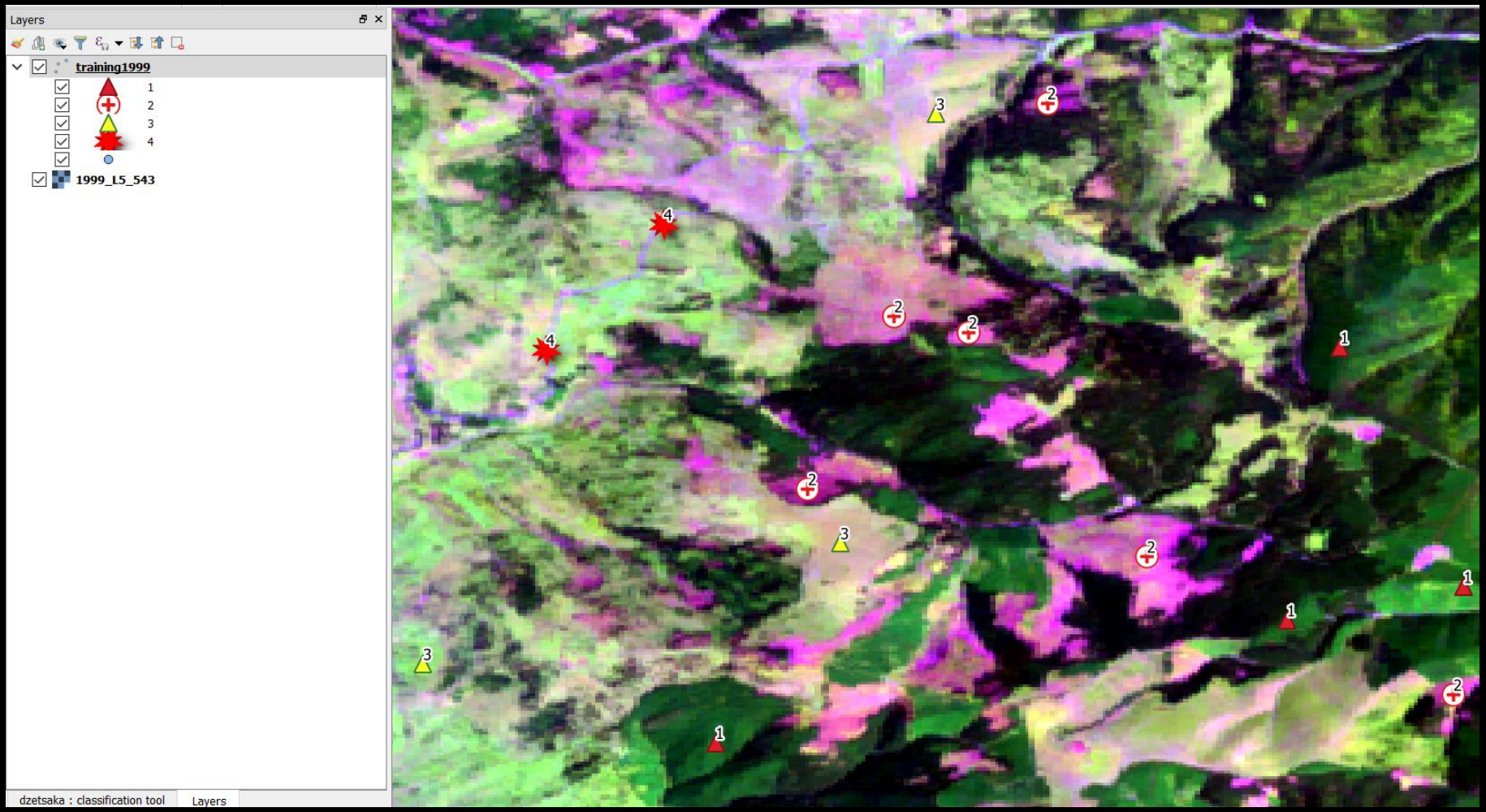
Classification tool



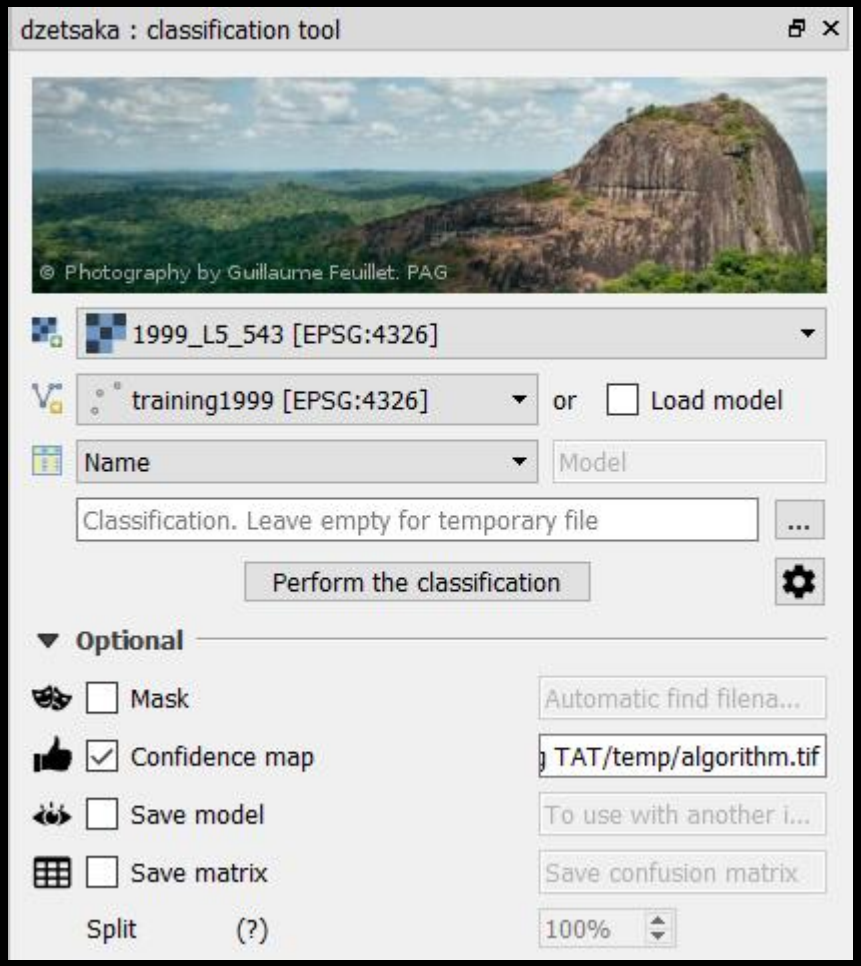
Classification tool



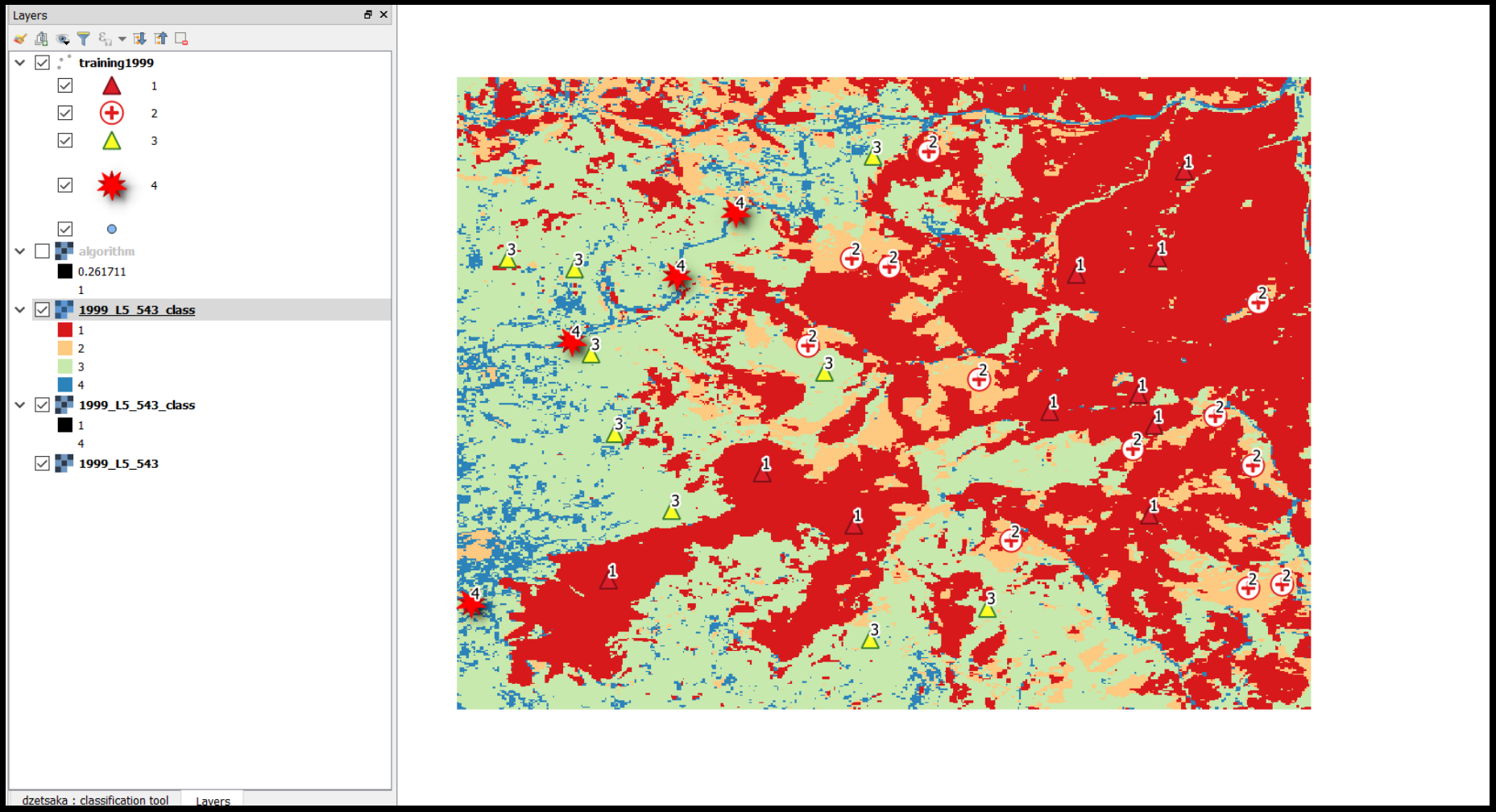
Classification tool



Classification tool



Results


Layers
training1999
1
2
3
4
algorithm
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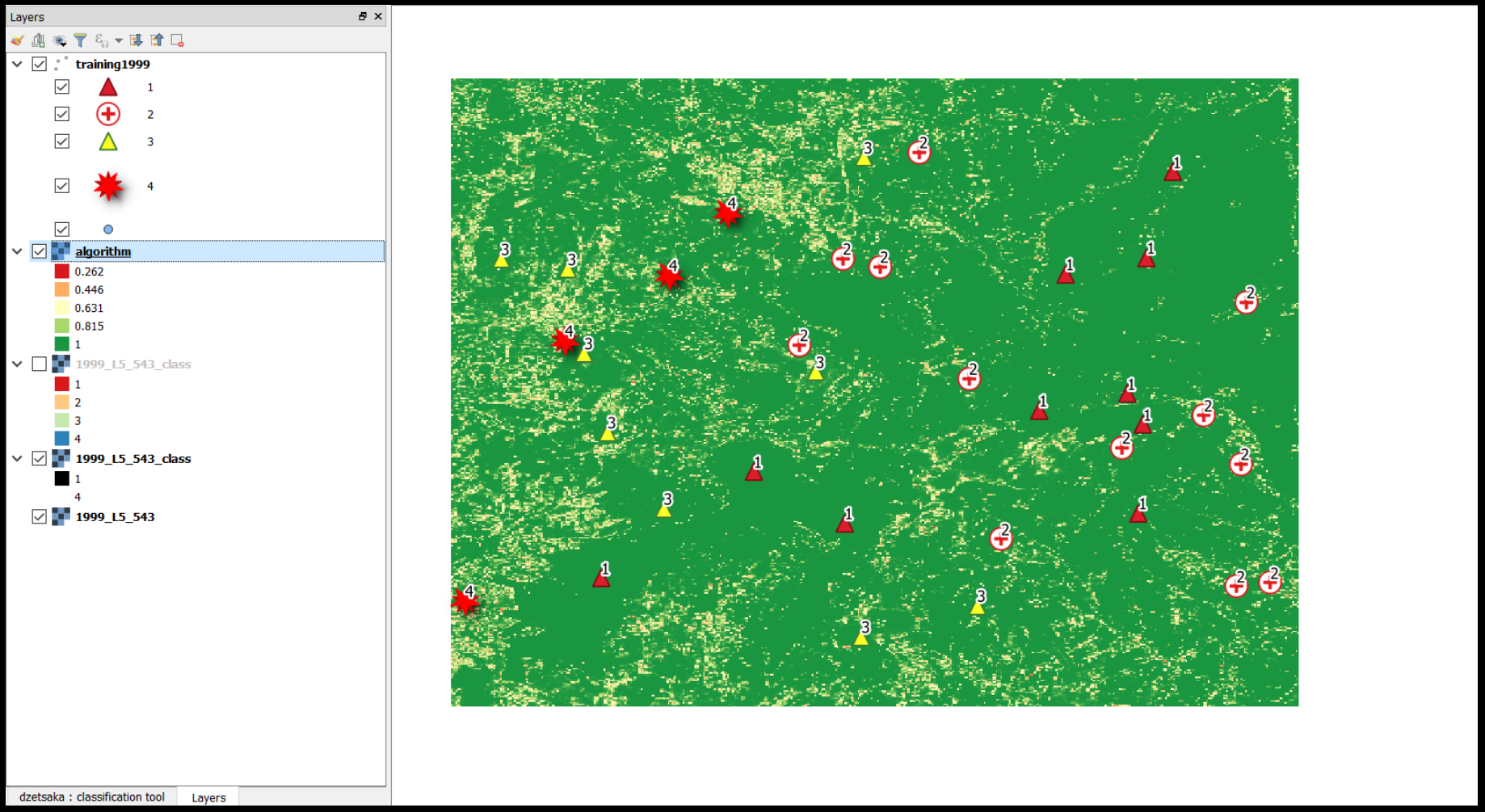
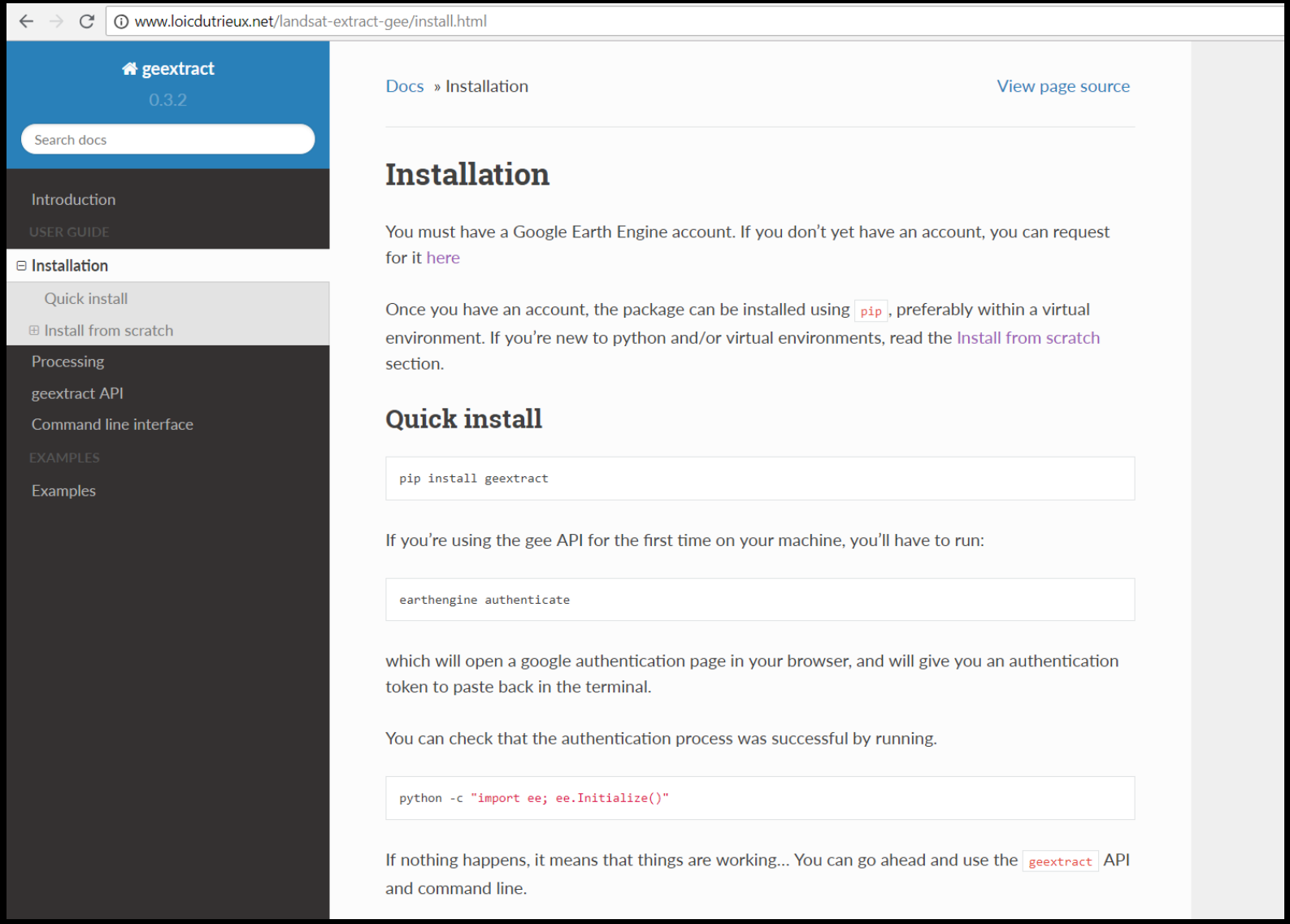
1
1999_L5_543_class
1
2
3
4
1999_L5_543_class
1
4
1999_L5_543
dzetsaka : classification tool
Layers

Results

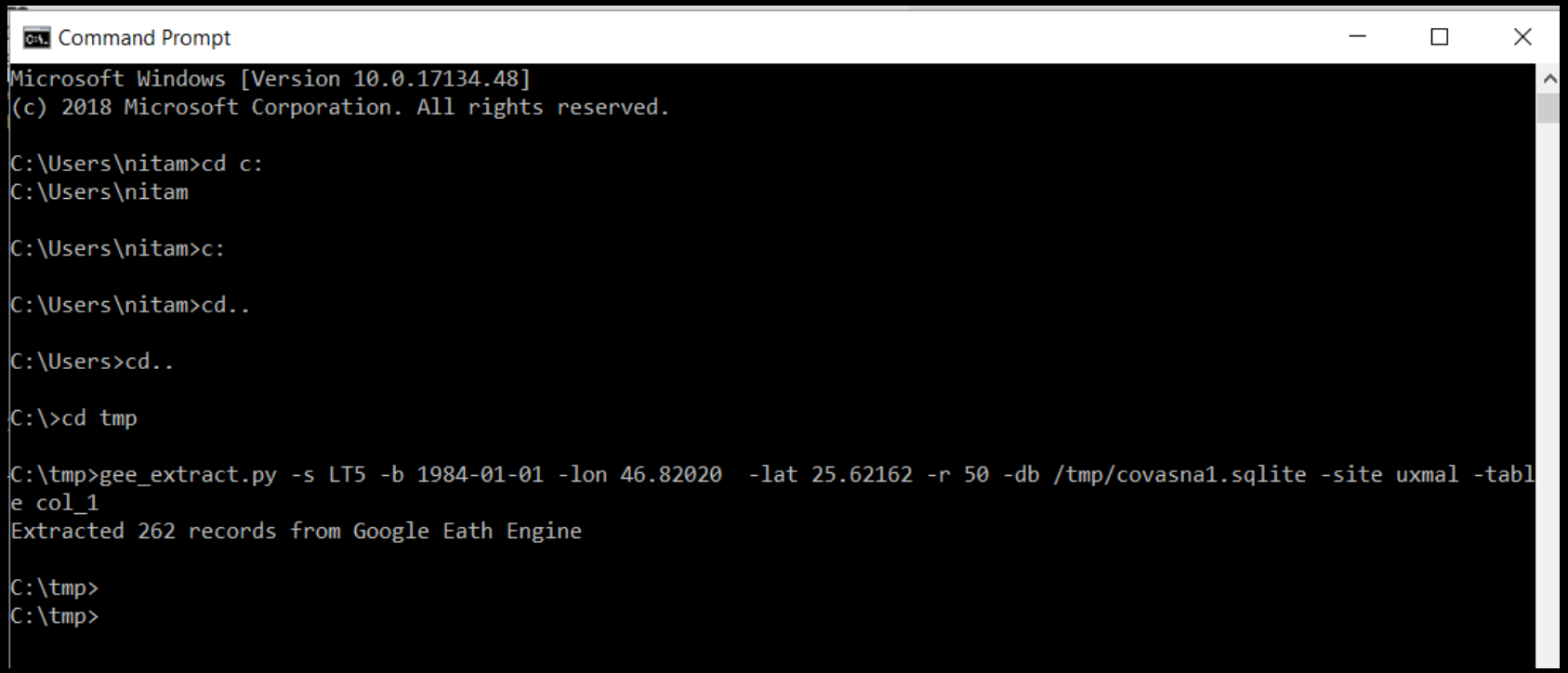

Layers
training1999
1
2
3
4
algorithm
0.262
0.446
0.631
0.815
1
1999_L5_543_class
1
2
3
4
1999_L5_543_class
1
4
1999_L5_543
dzetsaka : classification tool
Layers

Python - geextract

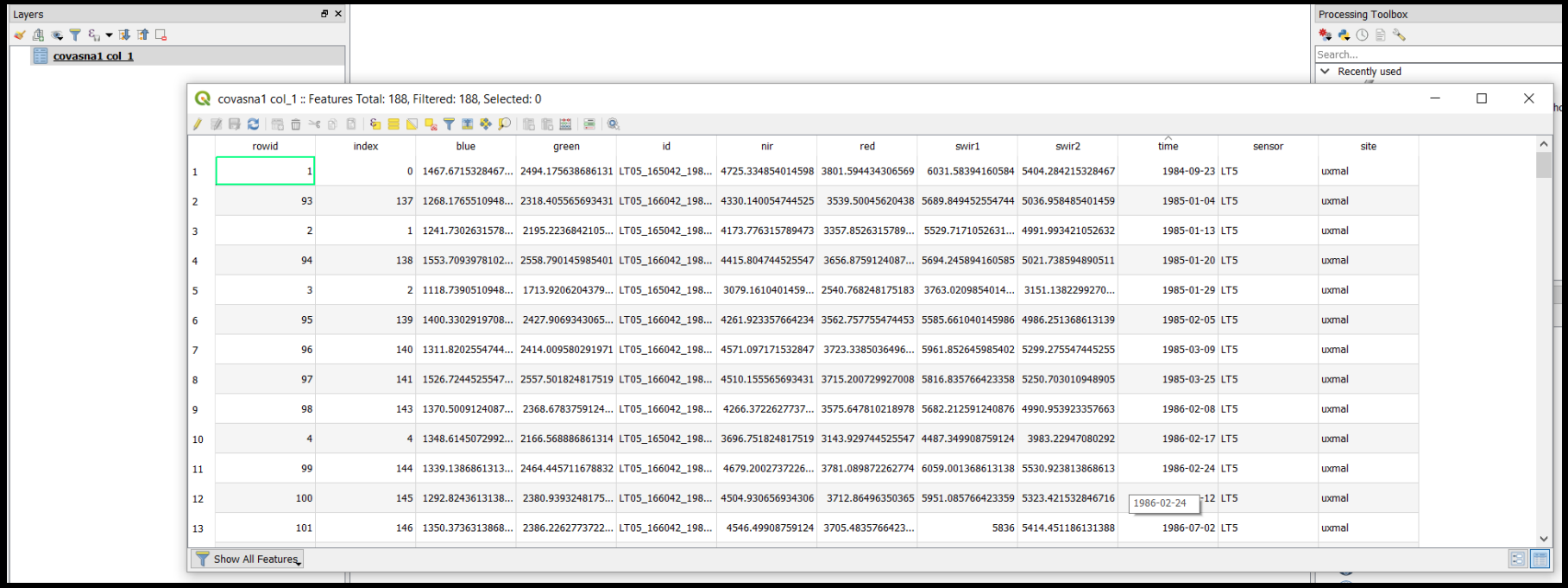


Pixel based Analysis

gee_extract.py -s LT5 -b 1984-01-01 -lon 25.62162 -lat 46.82020 -r 50 -db /tmp/cv_tst.sqlite -site uxmal -table col_1



Pixel based Analysis



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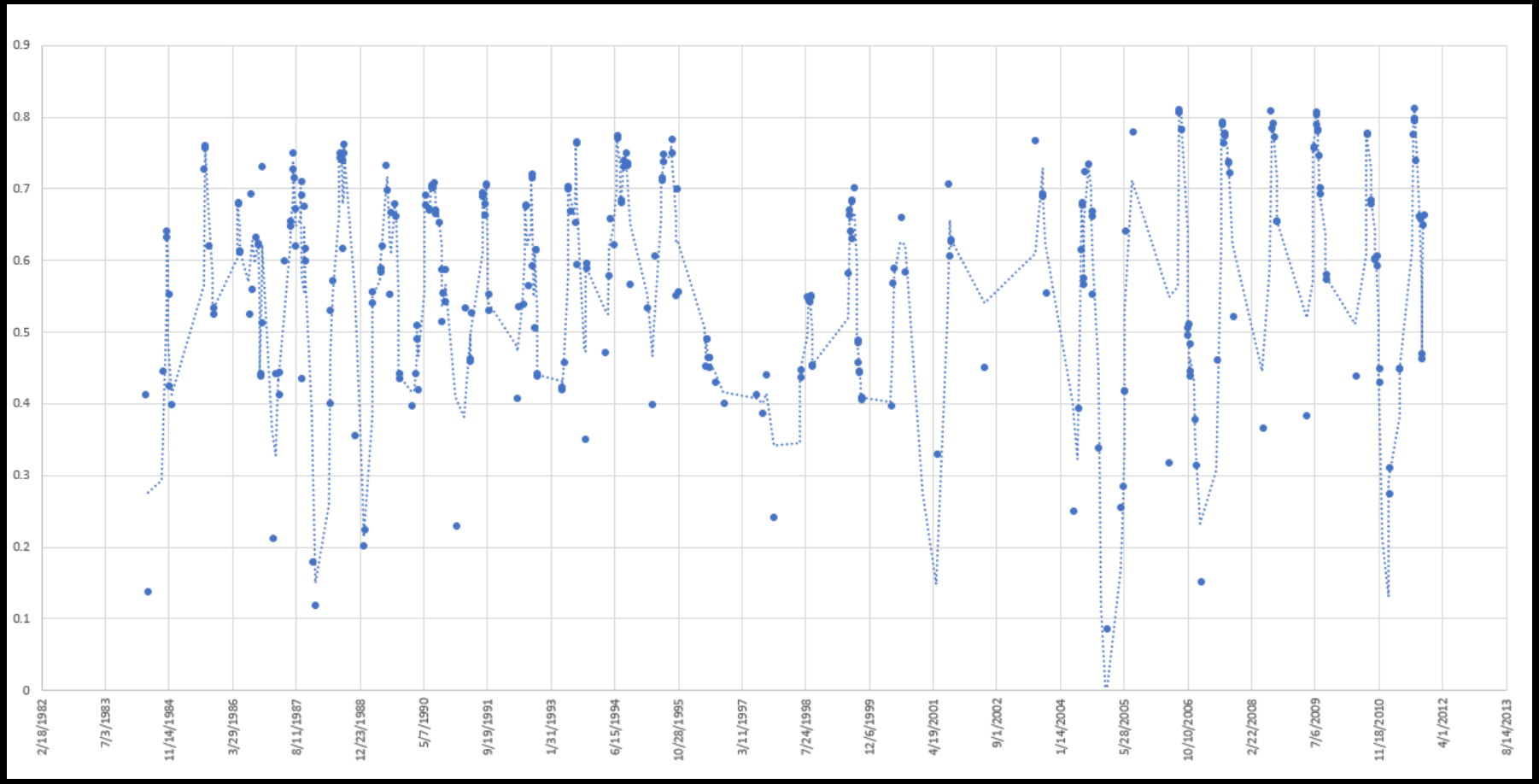
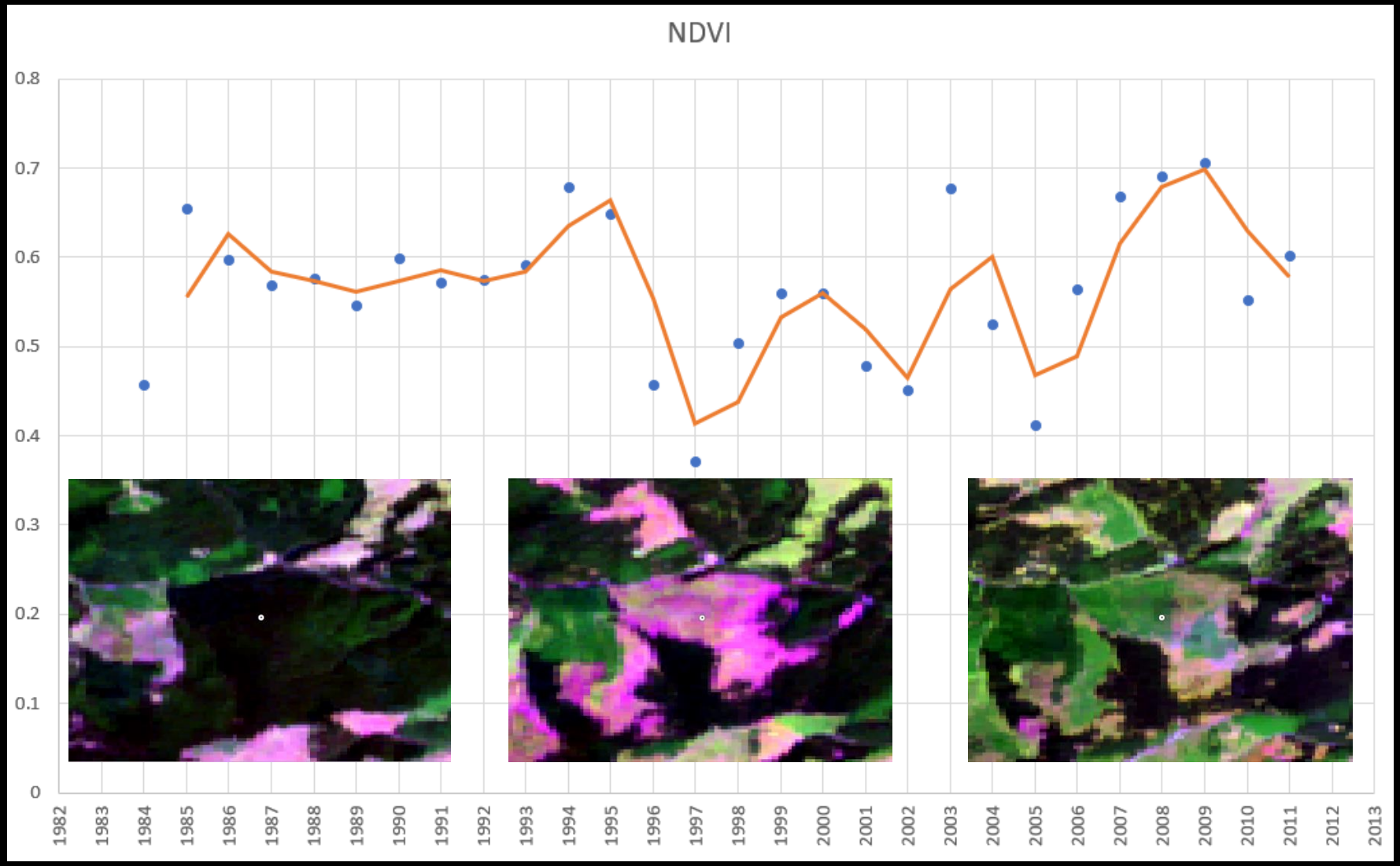
2	93	137	1268.1765510948...	2318.405565693431	LT05_166042_198...	4330.140054744525	3539.50045620438	5689.849452554744	5036.958485401459	1985-01-04	LT5	uxmal
3	2	1	1241.7302631578...	2195.2236842105...	LT05_165042_198...	4173.776315789473	3357.8526315789...	5529.7171052631...	4991.993421052632	1985-01-13	LT5	uxmal
4	94	138	1553.7093978102...	2558.790145985401	LT05_166042_198...	4415.804744525547	3656.8759124087...	5694.245894160585	5021.738594890511	1985-01-20	LT5	uxmal
5	3	2	1118.7390510948...	1713.9206204379...	LT05_165042_198...	3079.1610401459...	2540.768248175183	3763.0209854014...	3151.1382299270...	1985-01-29	LT5	uxmal
6	95	139	1400.3302919708...	2427.9069343065...	LT05_166042_198...	4261.923357664234	3562.757755474453	5585.661040145986	4986.251368613139	1985-02-05	LT5	uxmal
7	96	140	1311.8202554744...	2414.009580291971	LT05_166042_198...	4571.097171532847	3723.3385036496...	5961.852645985402	5299.275547445255	1985-03-09	LT5	uxmal
8	97	141	1526.7244525547...	2557.501824817519	LT05_166042_198...	4510.155565693431	3715.200729927008	5816.835766423358	5250.703010948905	1985-03-25	LT5	uxmal
9	98	143	1370.5009124087...	2368.6783759124...	LT05_166042_198...	4266.3722627737...	3575.647810218978	5682.212591240876	4990.953923357663	1986-02-08	LT5	uxmal
10	4	4	1348.6145072992...	2166.568886861314	LT05_165042_198...	3696.751824817519	3143.929744525547	4487.349908759124	3983.22947080292	1986-02-17	LT5	uxmal
11	99	144	1339.1386861313...	2464.445711678832	LT05_166042_198...	4679.2002737226...	3781.089872262774	6059.001368613138	5530.923813868613	1986-02-24	LT5	uxmal
12	100	145	1292.8243613138...	2380.9393248175...	LT05_166042_198...	4504.930656934306	3712.86496350365	5951.085766423359	5323.421532846716	1986-03-12	LT5	uxmal
13	101	146	1350.3736313868...	2386.2262773722...	LT05_166042_198...	4546.49908759124	3705.4835766423...	5836	5414.451186131388	1986-07-02	LT5	uxmal

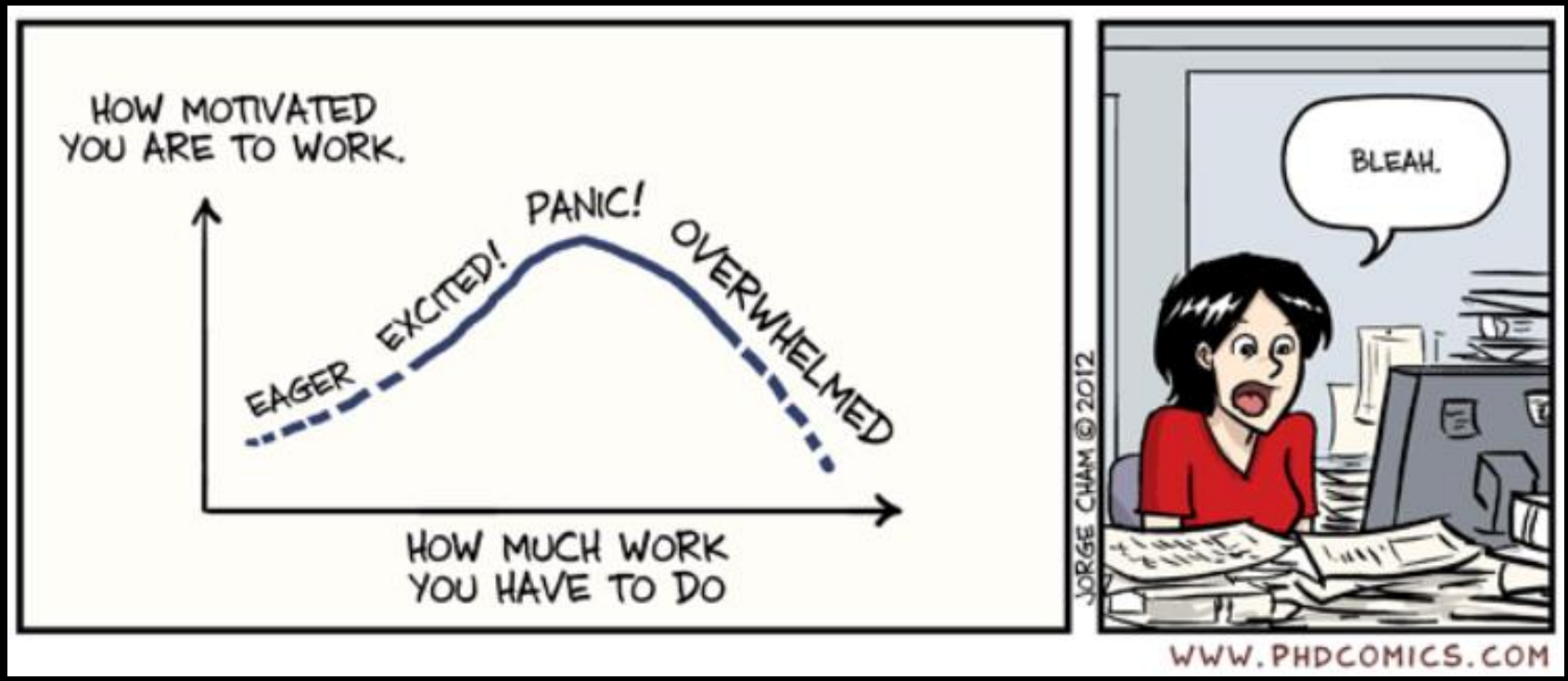
Pixel based Analysis



Pixel based Analysis



Practice


HOW MOTIVATED YOU ARE TO WORK.
EAGER
EXCITED!
PANIC!
OVERWHELMED
HOW MUCH WORK YOU HAVE TO DO
BLEAH.
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