



HANDS-ON QGIS:

➤ Príprava dát



Ciele

1

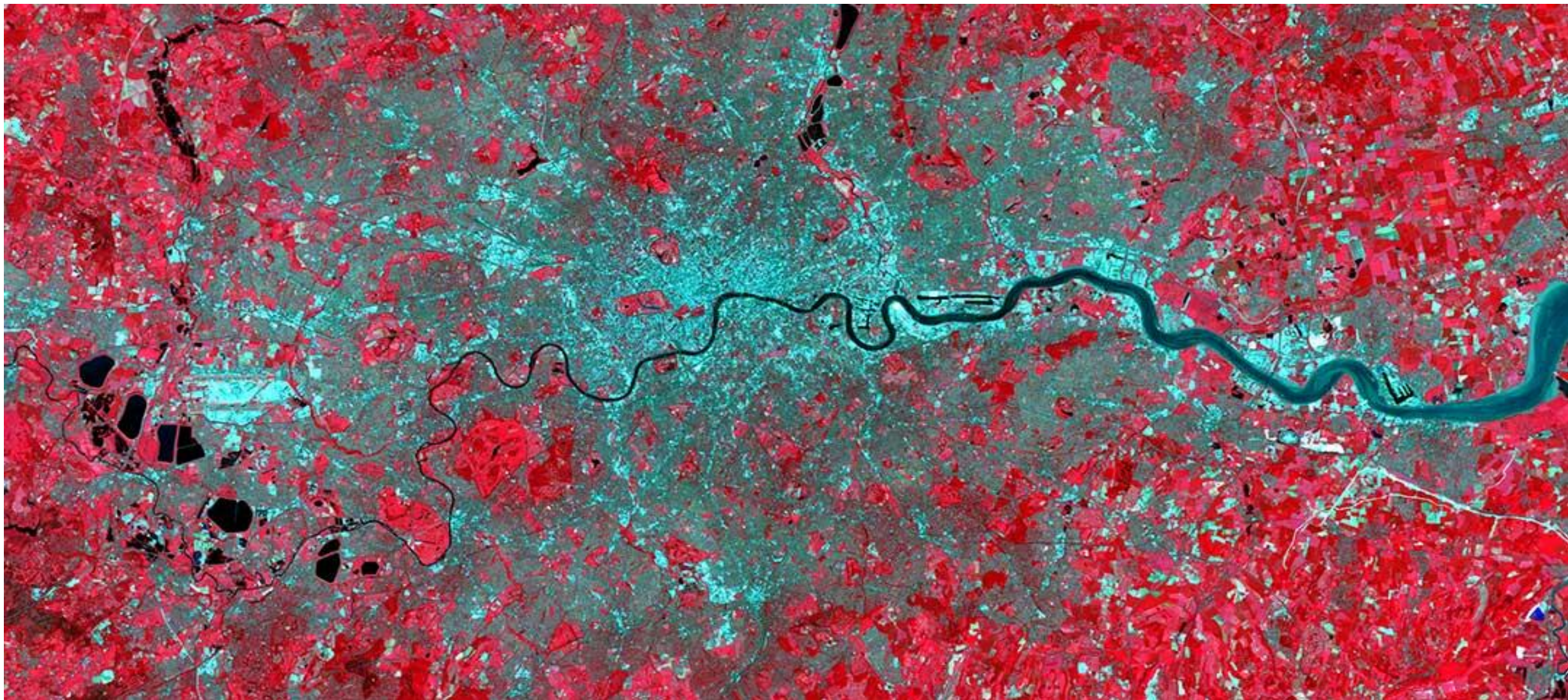
Zdroje open-source DPZ dát pre klasifikáciu obrazu
(práca s dátami Earth Explorer)

2

Interpretácia metadát a rozlíšenie záznamu

3

Farbené kompozície a indexy
- základné princípy tvorby a ich využitie

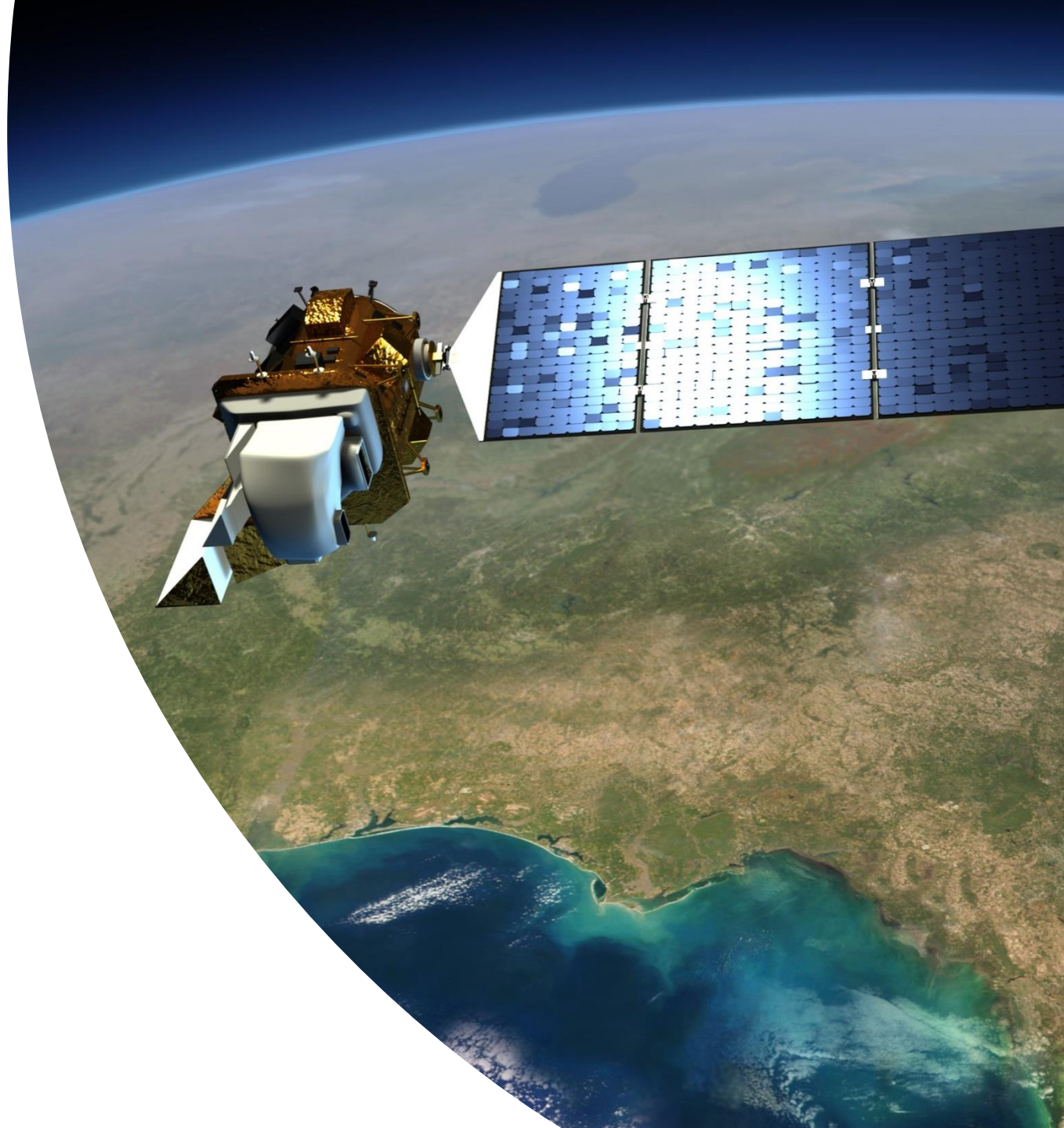


“Diaľkový prieskum Zeme je veda, technológia a umenie získavania informácií o objekte, území, jave na základe analýzy dát získaných zariadením, ktoré nie je v priamom fyzickom kontakte s týmto skúmaným objektom, územím alebo javom”

Lillesand et al. (2007)

ZDROJE OPEN-SOURCE DÁT

(aj) pre klasifikáciu obrazu



Zdroje DPZ dát

Earth Explorer (USGS)

<https://earthexplorer.usgs.gov/>

Sentinel (ESA)

<https://sentinels.copernicus.eu/web/sentinel/home>

WorldDem (Airbus Defence & Space)

<http://www.intelligence-airbusds.com/worlddem/>

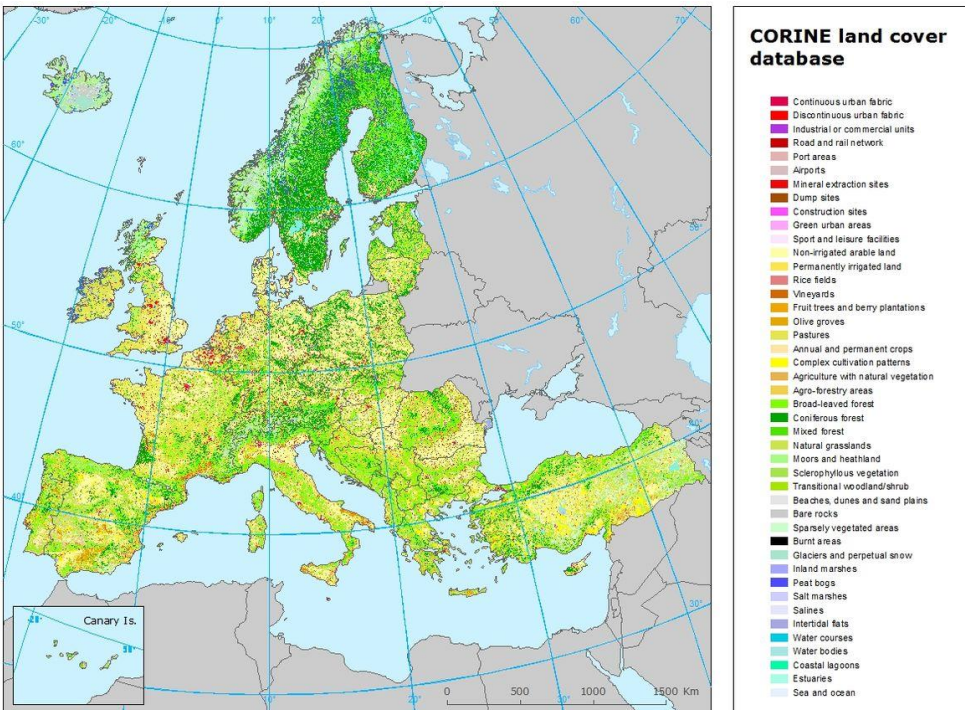
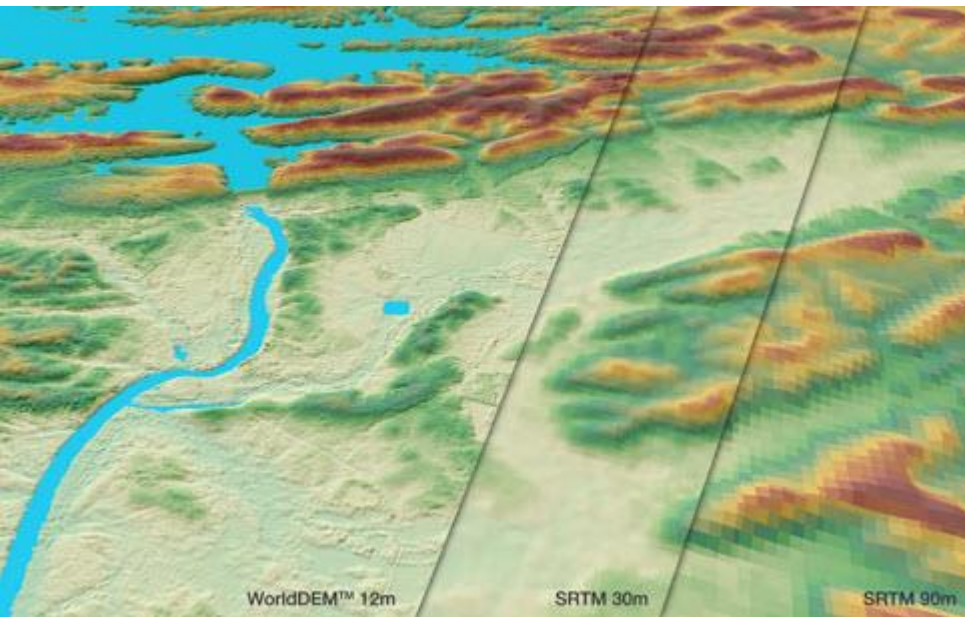
Corine Land Cover (Copernicus)

<https://www.eea.europa.eu/publications/COR0-landcover>

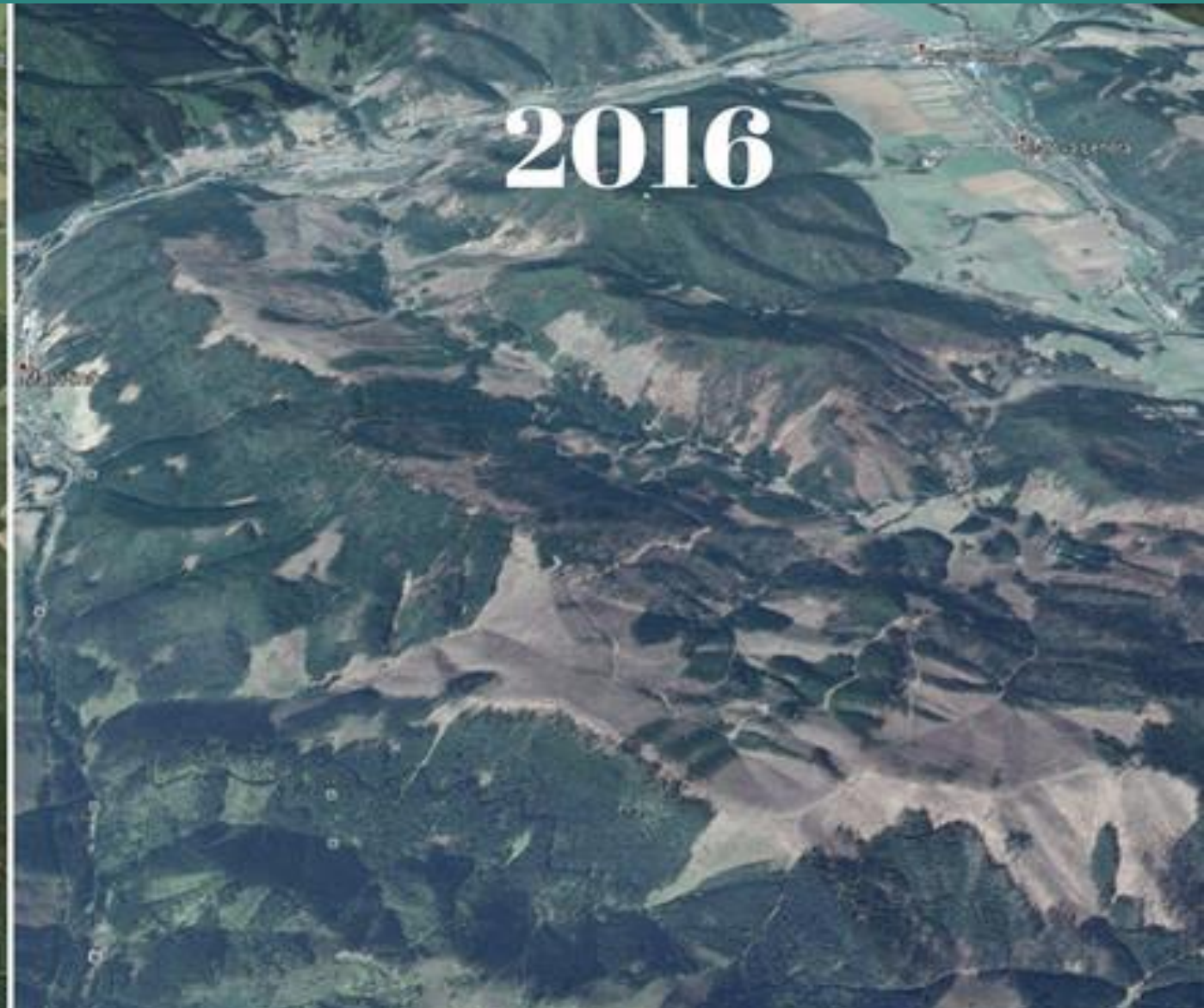
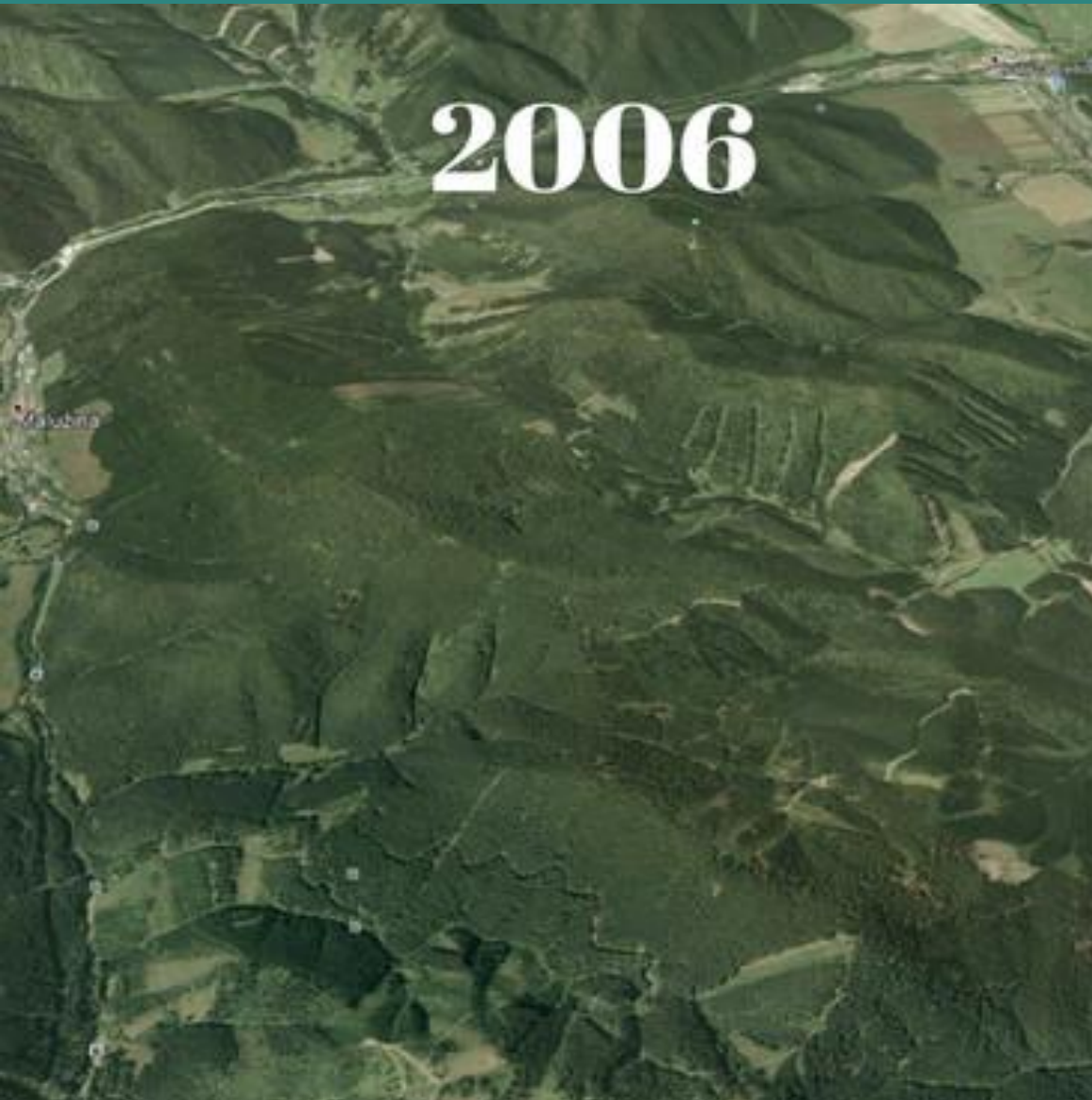
Urban Atlas

<http://land.copernicus.eu/local/urban-atlas>

Google Earth, Google Maps, súkromné spoločnosti...



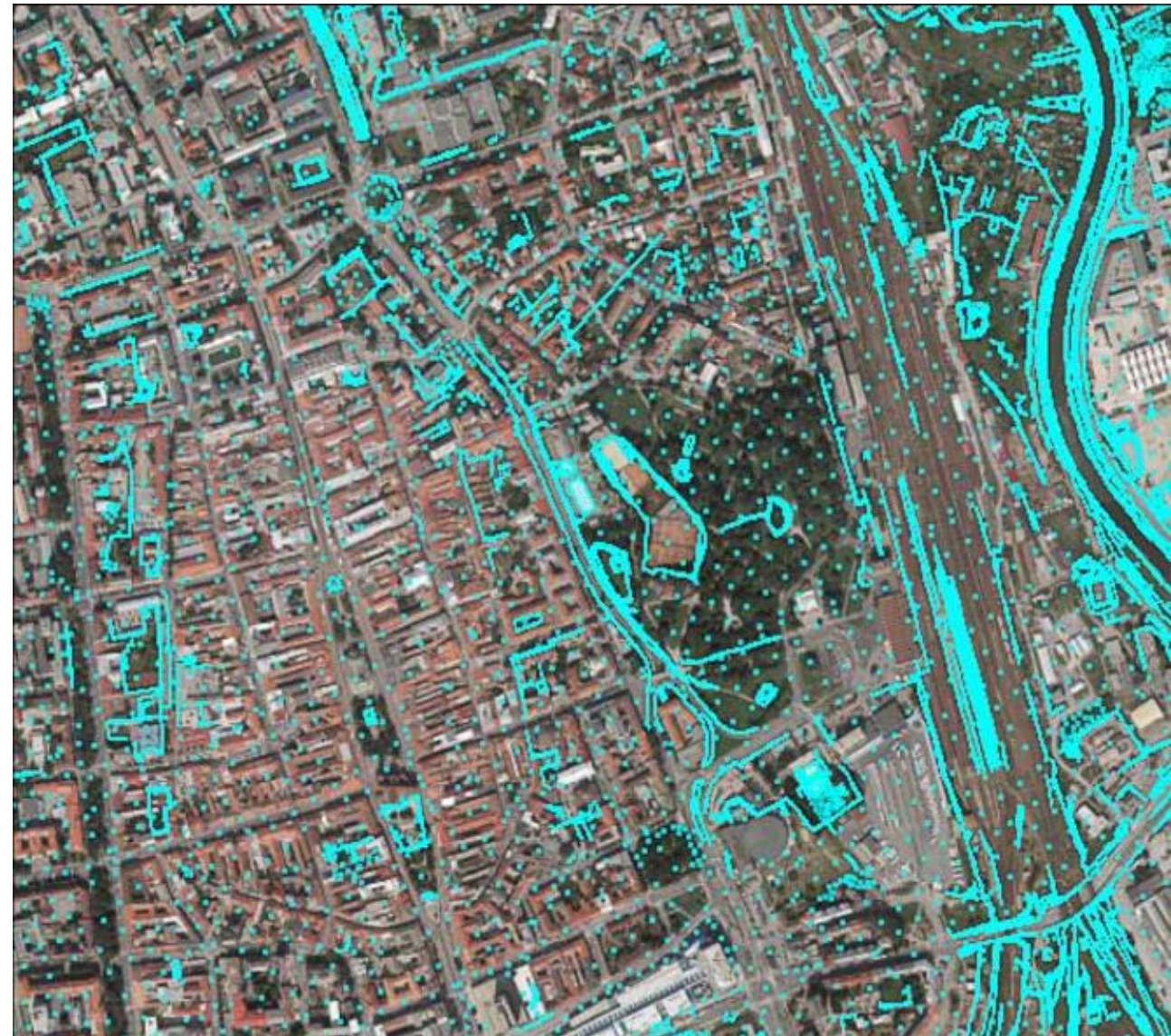
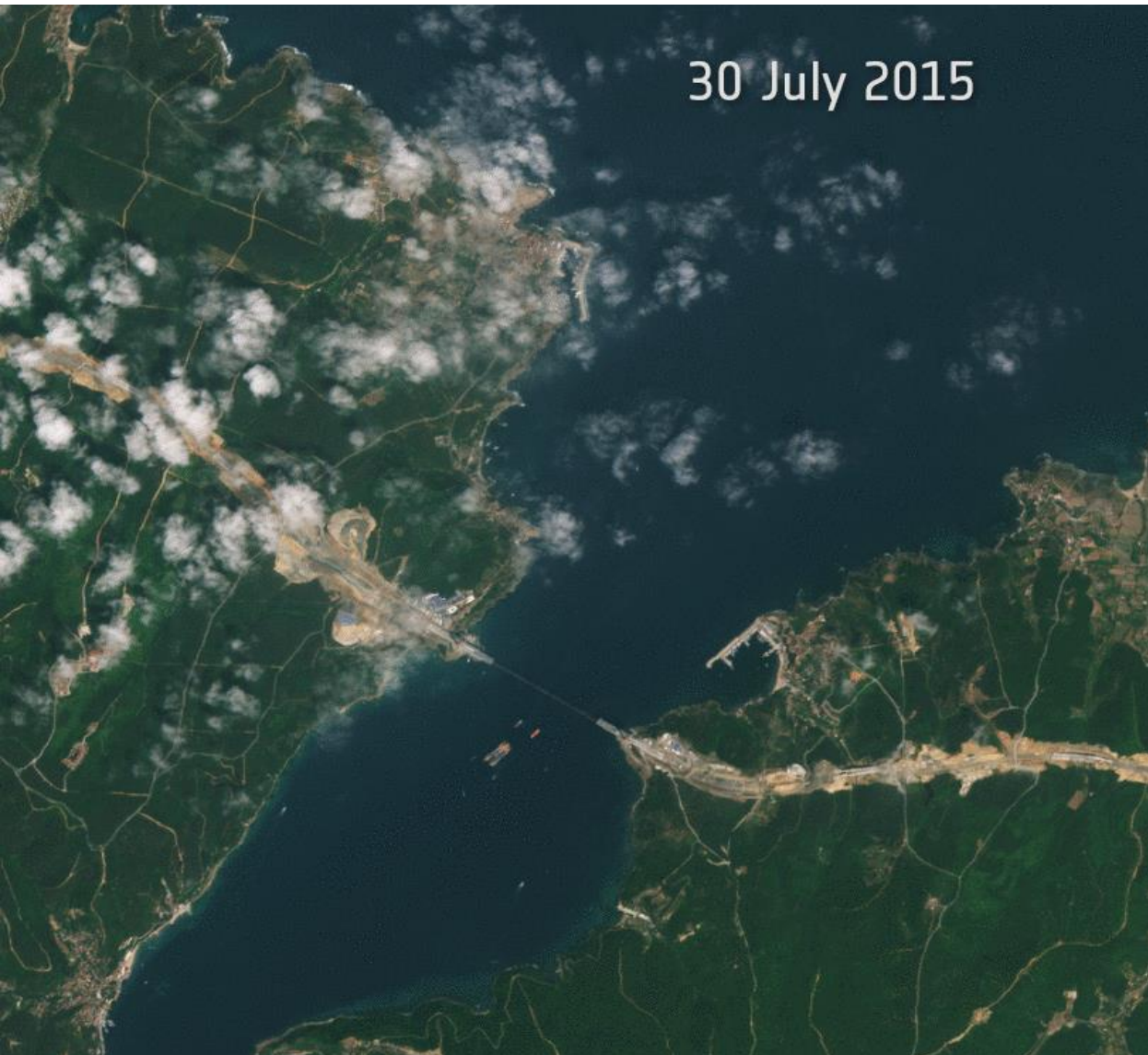
ZMENY V KRAJINE



Rozdiel v zalesnení oblasti Malužiná (Nízke Tatry) medzi rokmi 2006 a 2016.

Zdroj: Google Earth

ÚZEMNÉ PLÁNOVANIE



17 scén zo satelitu Sentinel-2A ukazuje ročný pokrok vo výstavbe 3. Bosporského mostu v Istanbule, Turecku.

Zdoj: ESA

POĽNOHOSPODÁRSTVO

*Využitie GIS, komplexných nástrojov
pre analýzu, senzorov*



Informácia v reálnom čase



Delenie polí na zóny



ŽIVELNÉ POHROMY- požiare



14 August
2017

Animácia ukazuje požiar a jeho následky – zdevastovanú oblasť 35 km SV od Atén v Grécku.

Zdroj: ESA

ŽIVELNÉ POHROMY- záplavy



17-02-2017

Záplavy v Indonézii.

Zdroj: ESA

1

Earth Explorer – registrácia a stiahnutie snímky

1.1 Registrácia na web stránke Earth Explorer <http://earthexplorer.usgs.gov/> od Geologickej služby Spojených štátov (USGS) a prihlásenie sa.

The screenshot displays the Earth Explorer website interface. At the top, the USGS logo is visible on the left, and navigation links for 'USGS Home', 'Contact USGS', and 'Search USGS' are on the right. Below the logo, the text 'EarthExplorer' is displayed, along with a 'Page Expires In 1:59:18' indicator. A navigation bar contains links for 'Home', '1 New System Message', 'Login', 'Register', 'RSS', 'Feedback', and 'Help'. The 'Register' link is highlighted with a red box and a red number '1' below it. The main content area is divided into two sections. On the left, the 'Search Criteria' section is active, showing options for 'Address/Place', 'Path/Row', 'Feature', and 'Circle'. Below these are input fields and buttons for 'Show' and 'Clear'. The 'Coordinates' section is also visible, with options for 'Predefined Area', 'Shapefile', and 'KML', and a message indicating 'No coordinates selected'. On the right, the 'Search Criteria Summary (Show)' section displays a satellite map of Europe and Asia, with a coordinate box showing '(59° 42' 43" N, 120° 56' 15" E)' and buttons for 'Options' and 'Overlays'. The map is currently set to 'Satelitné' (Satellite) view.

2

User Registration

User Credentials

Contact Demographic

Contact Information

Complete Registration

Registration and login credentials are required to access all system features and download data from USGS EROS web services. To ensure privacy and security, ERS uses Hypertext Transfer Protocol with Secure Sockets Layer (HTTPS) to encrypt user authentication.

To register, please create a username and password. The information gathered from the registration process is not distributed to other organizations and is only used to determine trends in data usage. Review [USGS Privacy Policies](#).

The Cancel button can be used to exit the registration process at any time and information entered will be lost.

Username

New Password

Confirm New Password



Type the text

[Privacy & Terms](#)

Continue

Username Requirements

- Must be between 4 and 30 characters
- May contain alphabetic and numeric characters
- May only contain the following special characters
 - period "."
 - at sign "@"
 - underscore "_"
 - dash "-"

Password Requirements

- Must be between 8 and 16 characters
- Must contain at least one alphabetic character
- Must contain at least one numeric character
- May only contain the following special characters
 - comma ","
 - hyphen "-"
 - period "."
 - pipe "|"
 - pound "#"
 - underscore "_"



EarthExplorer

Search Criteria Data Sets Additional Criteria Results

Search Criteria Summary (Show) **3** Clear Criteria

1. Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/Place Path/Row Feature Circle

Show Clear

Coordinates Predefined Area Shapefile KML

Degree/Minute/Second Decimal

i No coordinates selected.

Use Map Add Coordinate Clear Coordinates

Date Range Result Options

Search from: mm/dd/yyyy 📅 to: mm/dd/yyyy 📅

Search months: (all) ▼



1.2 Vyhraničenie záujmovej oblasti a zadanie požadovaného obdobia zhotovenia snímky.

Search Criteria Summary (Show) Clear Criteria

1. Enter Search Criteria
To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/Place Path/Row Feature Circle

Show Clear

Coordinates Predefined Area Shapefile KML

Degree/Minute/Second Decimal

1. Lat: 48° 54' 42" N, Lon: 020° 15' 21" E	🗑️ ❌
2. Lat: 48° 33' 43" N, Lon: 020° 29' 12" E	🗑️ ❌
3. Lat: 48° 36' 40" N, Lon: 021° 31' 59" E	🗑️ ❌
4. Lat: 48° 57' 30" N, Lon: 021° 35' 56" E	🗑️ ❌

Use Map Add Coordinate Clear Coordinates

Date Range Result Options

Search from: 08/01/2016 to: 08/30/2016

Search months: (all)

Data Sets » Additional Criteria » Results »

**1.) Vpísanie adresy/miesta...
...alebo súradníc...
...alebo priblíženie sa a klik na Use Map**

2.) Voľba dátumového intervalu alebo mesiacov

3.) Klik na Data Sets

1.3 Výber datasetu (datasetov) (napr. Landsat 8 OLI/TIRS, Landsat 7 ETM+, a pod.)

Search Criteria **Data Sets** Additional Criteria Results

2. Select Your Data Set(s)

Check the boxes for the data set(s) you want to search. When done selecting data set(s), click the *Additional Criteria* or *Results* buttons below. Click the plus sign next to the category name to show a list of data sets.

Use Data Set Prefilter [\(What's This?\)](#)

Data Set Search:

- Global Fiducials
- Global Land Survey
- HCMM
- ISERV
- Land Cover
- Landsat Archive**
 - Collection 1 Level-1
 - Pre-Collection Level-1
 - L8 OLI/TIRS
 - L8 OLI/TIRS Pre-WRS-2
 - L7 ETM+ SLC-off (2003-present)
 - L7 ETM+ SLC-on (1999-2003)
 - L4-5 TM
 - L1-5 MSS
 - Collection 1 Higher-Level (On-Demand)
 - Landsat Legacy
 - NASA LPDAAC Collections

Clear All Selected **Additional Criteria »** Results »

Search Criteria Summary (Show) **Clear Criteria**

Mapa **Sateltné** (47° 37' 42" N, 023° 32' 37" E) Options Overlays

Map showing a satellite view of Central Europe, with a red rectangular selection box highlighting the Košice region in Slovakia. The map includes labels for various cities and countries: Česko (Czechia), Slovensko (Slovakia), and Magyarország (Hungary). Major cities like Bratislava, Košice, and Budapest are visible. The map interface includes a search criteria summary bar at the top and a coordinate display in the top right corner.

1.4 Výber prídavných kritérií

Search Criteria Data Sets **Additional Criteria** Results

3. Additional Criteria (Optional)

If you have more than one data set selected, use the dropdown to select the additional criteria for each data sets.

Data Sets:
L8 OLI/TIRS ▾

Cloud Cover
All
Less than 10%
Less than 20%
Less than 30%
Less than 40% ▾

**Výber parametrov
(napr. oblačnosť
menšia ako 10%)**

Date L1 Generated (Ex. YYYY/MM/DD)
_____ to _____

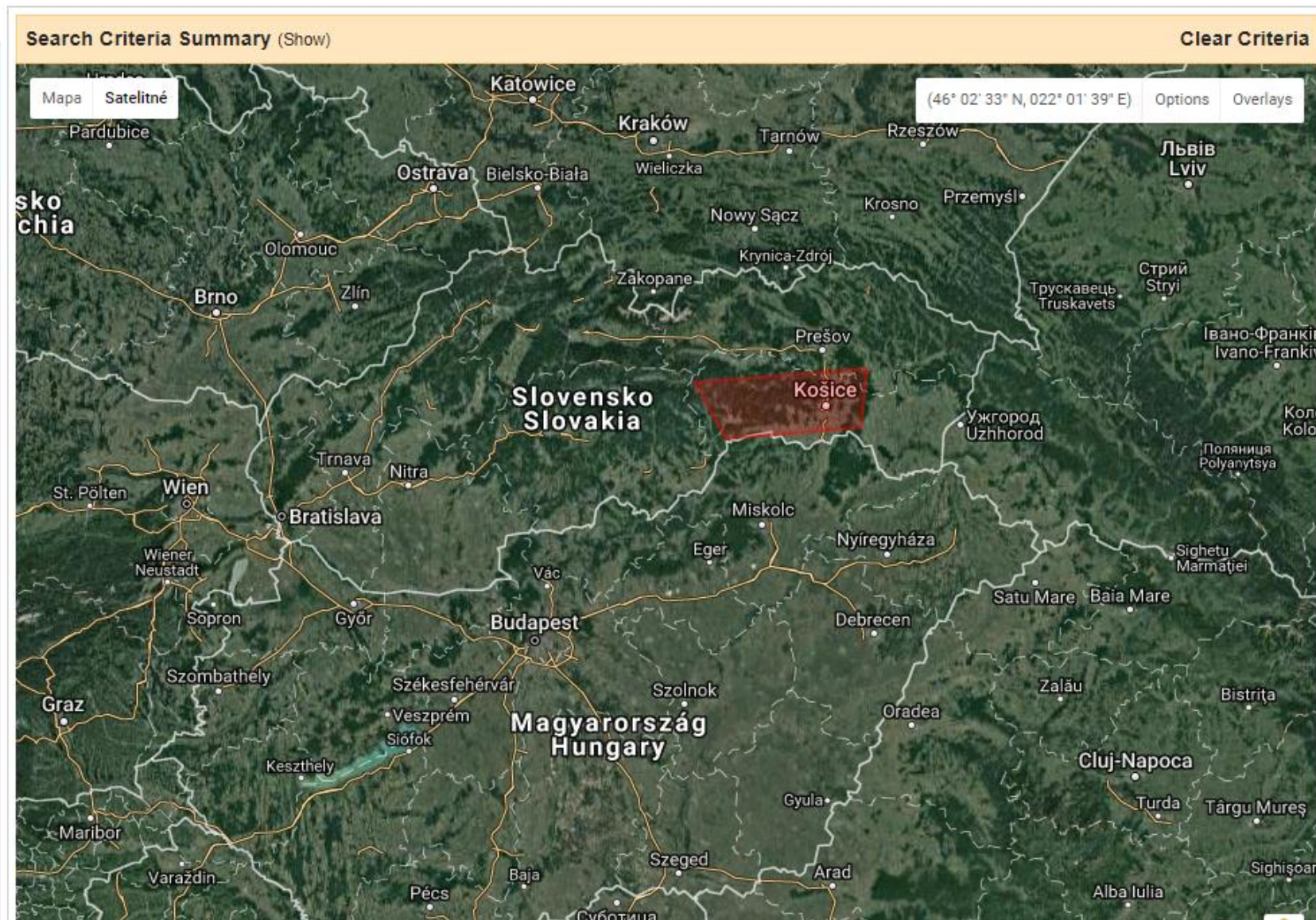
Day/Night Indicator
All
Day
Night ▾

Nadir/Off Nadir
All
Nadir
Off Nadir ▾

Processing Software Version
All
LPGS_2.5.1
LPGS_2.5.0
LPGS_2.4.0
LPGS_2.3.0 ▾

**Výber indikátora
(napr. snímka
za deň/noc)**

Clear All Criteria **Results »**



1.5 Výsledky a výber datasetu na stiahnutie

Search Criteria | Data Sets | Additional Criteria | **Results**

4. Search Results

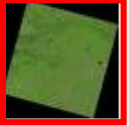
If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.

Show Result Controls

Data Set [Click here to export your results »](#)

L8 OLI/TIRS

« First < Previous 1 Next > Last »
Displaying 1 - 1 of 1 ⓘ

1 

Entity ID:LC81870262016221LGN00
Coordinates:48.86645,20.91212
Acquisition Date:08-AUG-16
Path:187
Row:26

« First < Previous 1 Next > Last »

2.) Ľavý klik – Náhľad a metadáta

Výber datasetu (napr. Landsat 8 OLI/TIRS)

Search Criteria Summary (Show) [Clear Criteria](#)

Mapa | Satelitné | (49° 00' 32" N, 025° 07' 32" E) | Options | Overlays

Click image to view in another window
LandsatLook.Natural Color Preview Image

Data Set Attribute	Attribute Value
Landsat Scene Identifier	LC81870262016221LGN00
WRS Path	187
WRS Row	026
Target WRS Path	187
Target WRS Row	026

1.6 Stiahnutie vybraného datasetu (napr. full dataset = Level 1 GeoTIFF Data Product)

4. Search Results

If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.

Show Result Controls


Data Set [Click here to export your results »](#)

L8 OLI/TIRS


« First < Previous 1 > Next > Last »

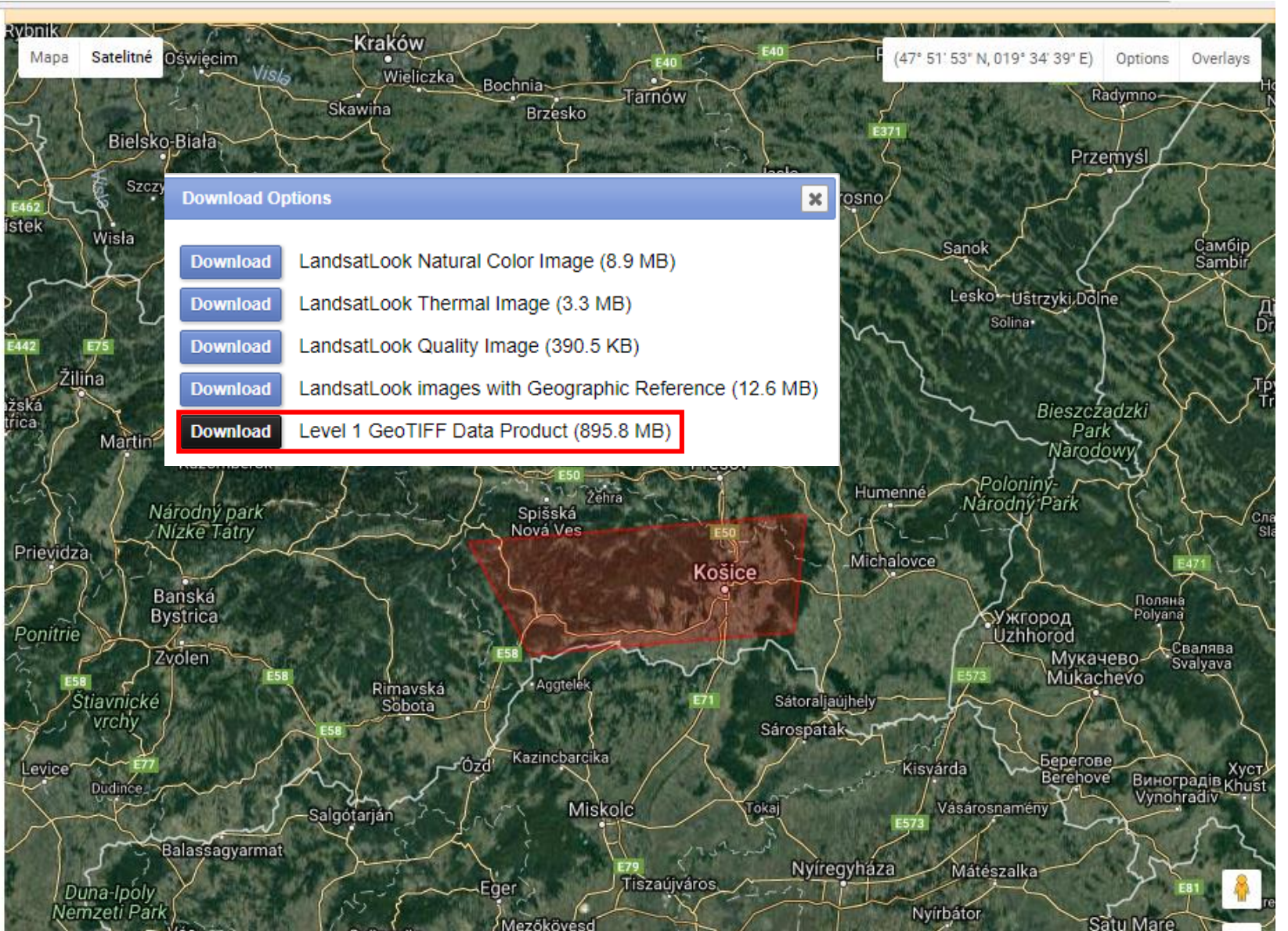
Displaying 1 - 1 of 1

Entity ID:LC81870262016221LGN00
Coordinates:48.86645,20.91212
Acquisition Date:08-AUG-16
Path:187
Row:26



1





Download Options

- Download LandsatLook Natural Color Image (8.9 MB)
- Download LandsatLook Thermal Image (3.3 MB)
- Download LandsatLook Quality Image (390.5 KB)
- Download LandsatLook images with Geographic Reference (12.6 MB)
- Download Level 1 GeoTIFF Data Product (895.8 MB)**

Ľavý klik – Možnosti sťahovania

Pr. Klimatické zmeny a ústup ľadovca

1. Vyhľadanie alebo zoom na “Jökulsárlón” (ľadovcová lagúna, Island)
2. Stiahnutie 2 scén (bez oblakov nad územím a bez snehu):
 - Súčasná snímka (2016-2017)
 - Snímka z obdobia 2000-2003
 - Snímka z obdobia 1987-1990

Pozn.:

- Využitie „Prídavných kritérií“ pre výber scén s malou oblačnosťou
- Ideálne - stiahnutie scén iba z obdobia (pravdepodobnosť čistej snímky)
- Predpoklad využívania rozličných datasetov (napr. Landsat 4-5, 7, 8)

3. Rozzipovanie stiahnutého súboru
4. Skopírovanie potrebných .tif súborov do nového priečinka
5. Skontrolovanie vlastností súboru (uistenie sa, že majú súrad. systém)
6. Usporiadanie súborov od najnovších po najstaršie
7. Vektorizácia alebo klasifikácia obrazu

Address/Place Path/Row Feature Circle

Jökulsárlón

Show Clear

Click on an Address/Place to show the location on the map and add coordinates to the Area of Interest Control.

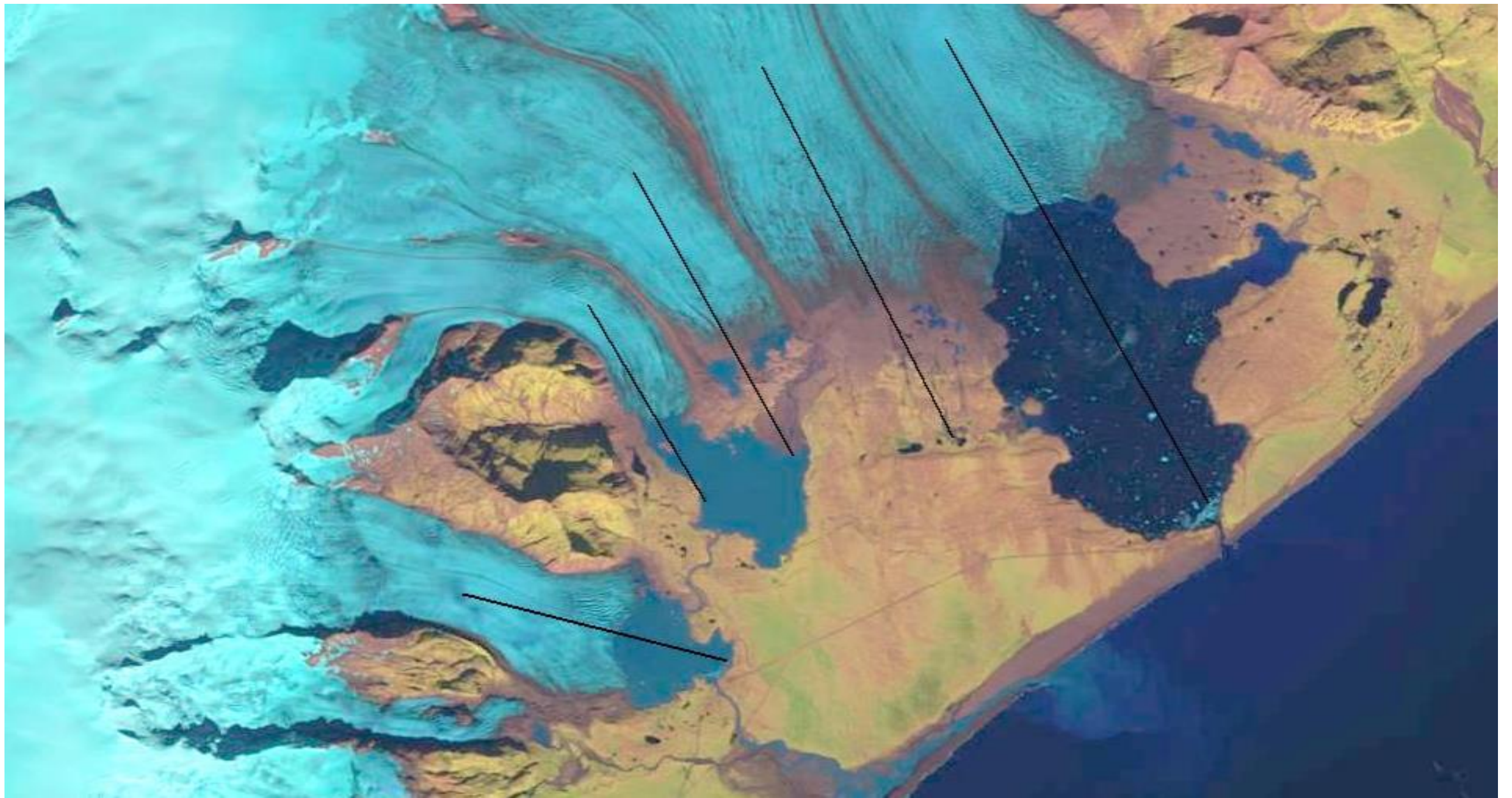
Num	Address/Place	Latitude	Longitude
1	Jökulsárlón, Island	64.0784	-16.2306

Date Range Result Options

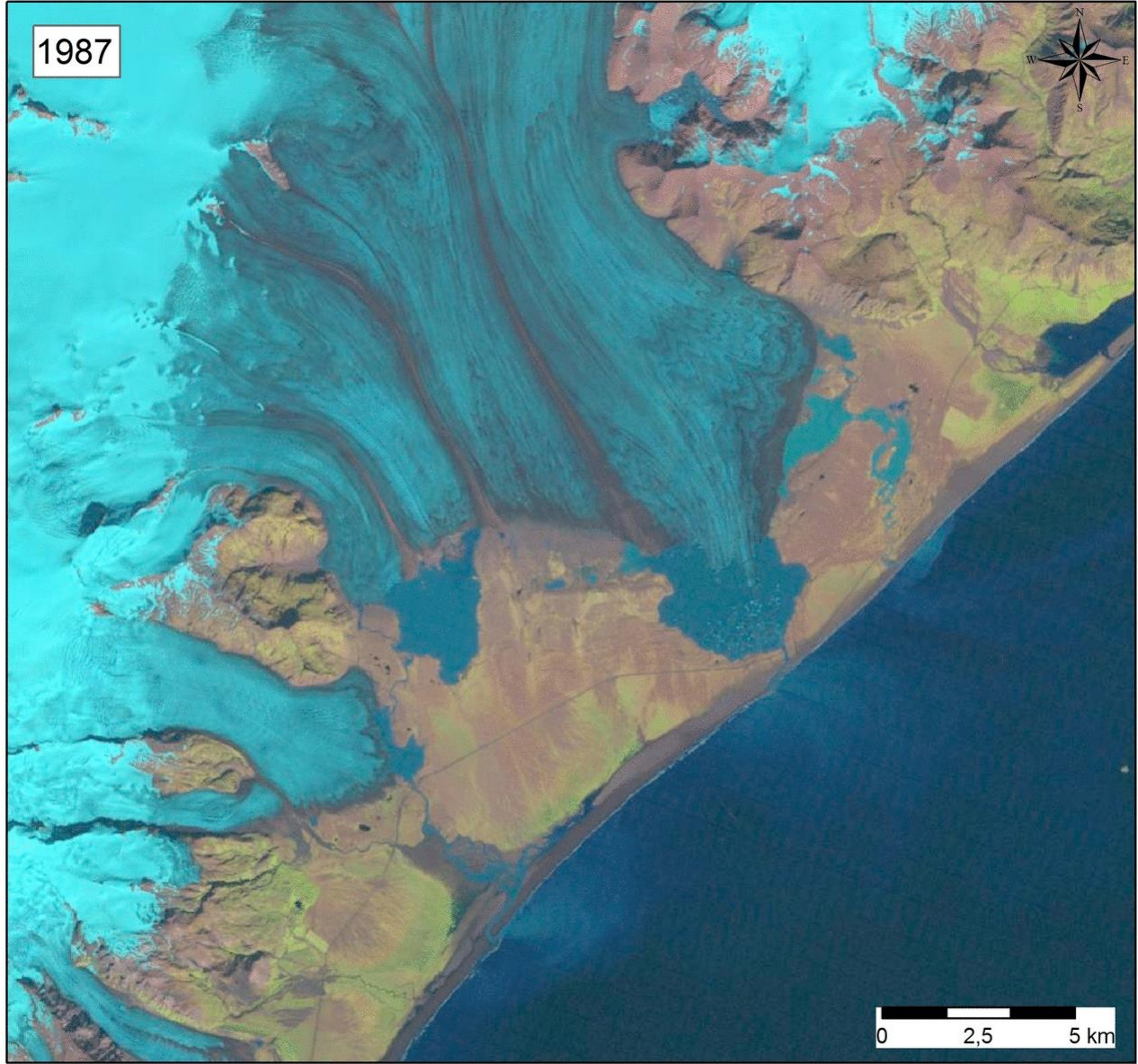
Search from: 08/01/1987 to: 08/31/1990

Search months: August

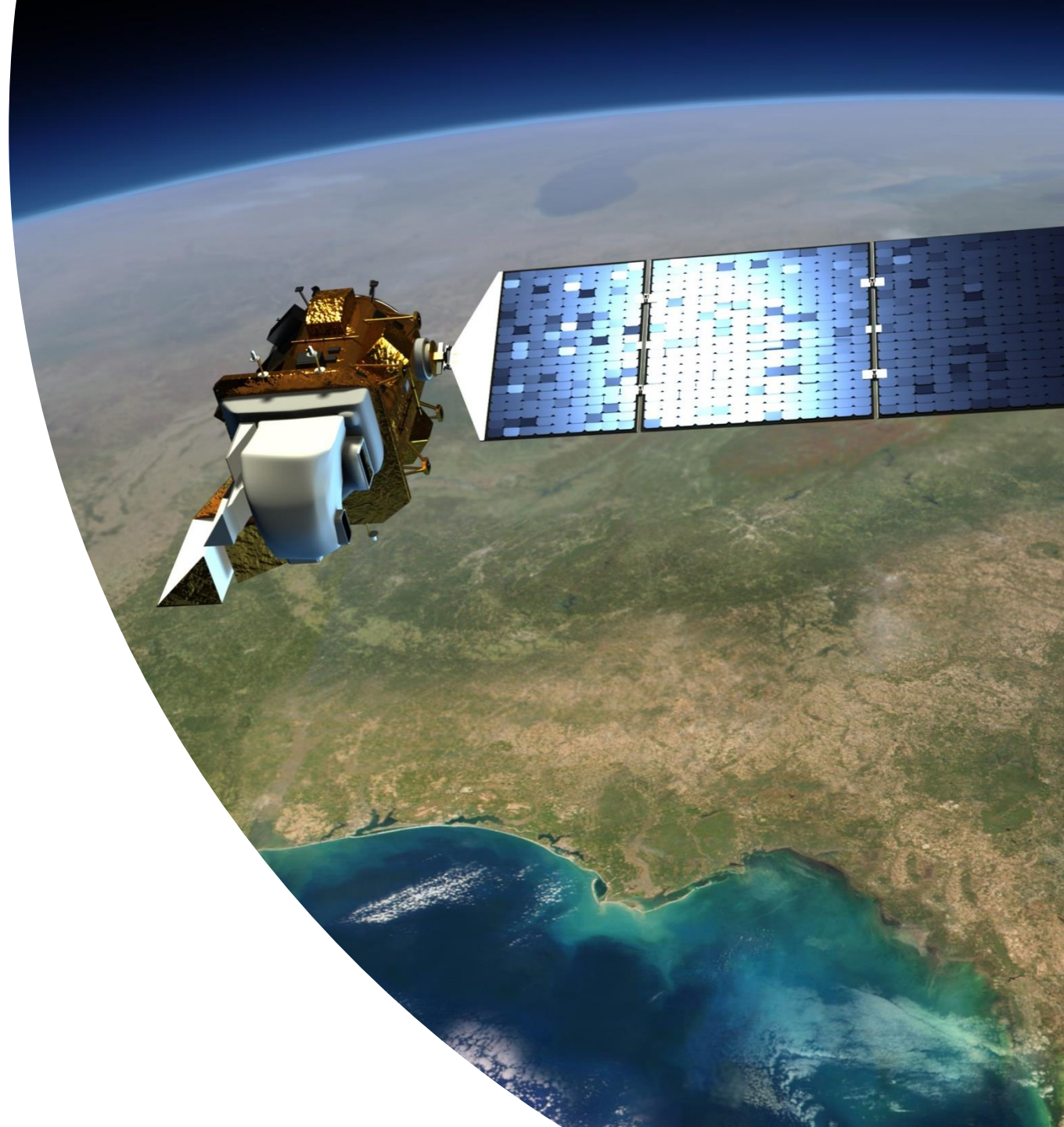




Zmeranie šírenia ľadovca pozdĺž 5 profilov (pre každú časť ľadovca a časové obdobie)



INTERPRETÁCIA METADÁT A ROZLIŠENIE ZÁZNAMU



2

Interpretácia metadát

4. Search Results

If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.

Show Result Controls

Data Set

Click here to export your results »

L8 OLI/TIRS

« First < Previous 1 > Next > Last »

Displaying 1 - 1 of 1



Entity ID:LC81870262016221LGN00
Coordinates:48.86645,20.91212
Acquisition Date:08-AUG-16
Path:187
Row:26



Ľavý klik – Ukážka metadát a prehľadávanie

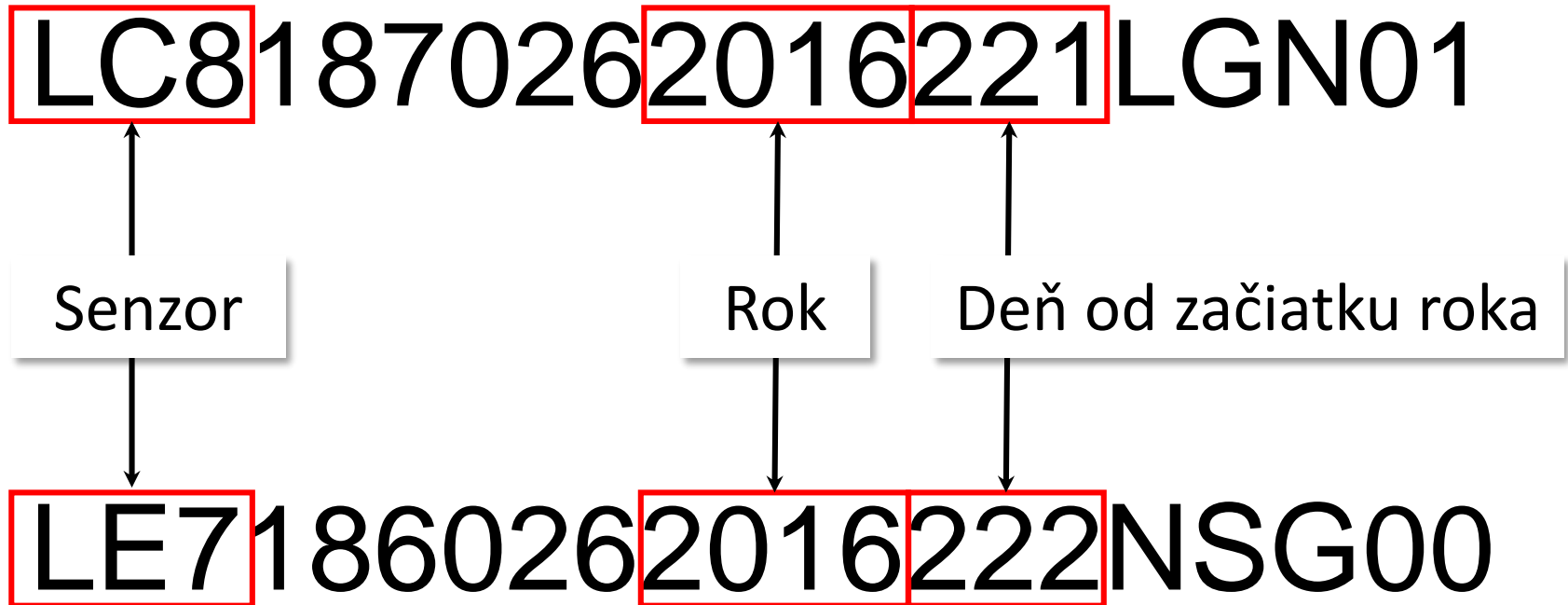
Mapa Satelitné Oświęcim Kraków Wieliczka Bochnia Brzesko Tarnów (47° 51' 53" N, 019° 34' 39" E) Options Overlays

Full Display of LC81870262016221LGN00

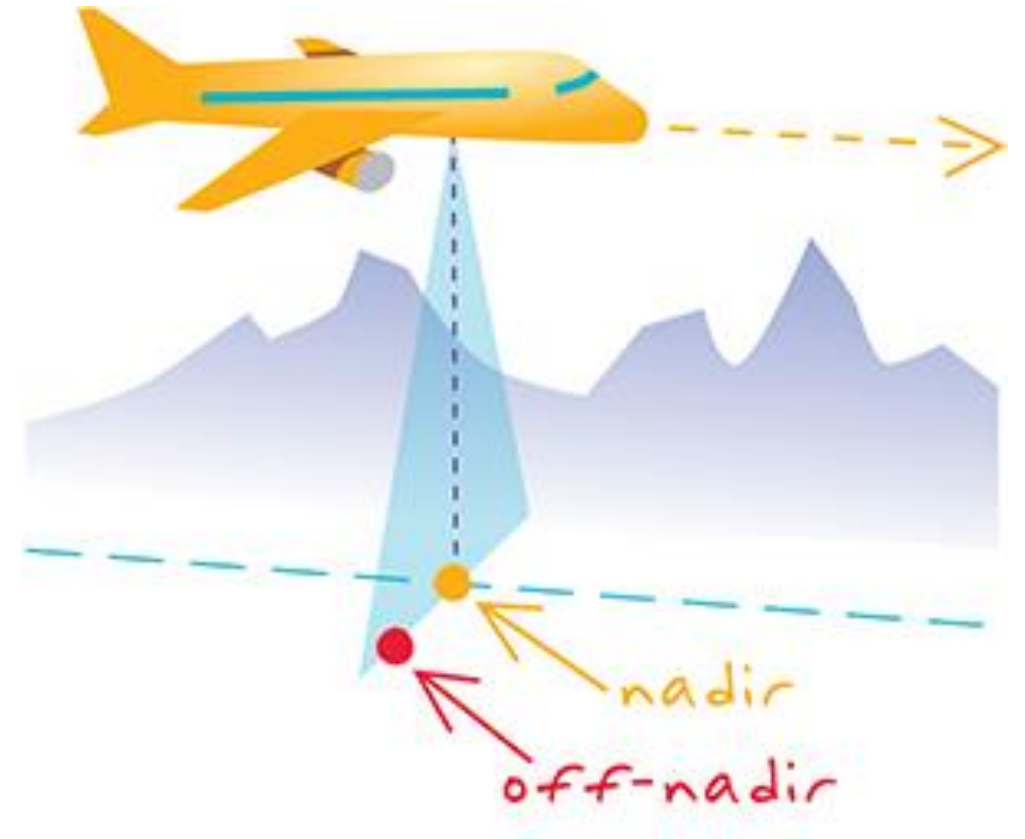
Data Set Attribute	Attribute Value
Landsat Scene Identifier	LC81870262016221LGN00
WRS Path	187
WRS Row	026
Target WRS Path	187
Target WRS Row	026
Full or Partial Scene	FULL
Nadir/Off Nadir	NADIR
Data Category	NOMINAL
TIRS SSM Model	FINAL
Bias Parameter File Name OLI	LO8BPF20160808091941_20160808094158.01
Bias Parameter File Name TIRS	LT8BPF20160803085042_20160818203550.01
Calibration Parameter File	L8CPF20160701_20160930.02
RLUT File Name	L8RLUT20150303_20431231v11.h5
Roll Angle	-.001
Station Identifier	LGN
Day/Night	DAY
Data Type Level1	L1T
Sensor Identifier	OLI_TIRS

Open New Window Close

Landsat – označenie súborov



Data Set Attribute	Attribute Value
Landsat Product Identifier	LC08_L1TP_187026_20160808_20170322_01_T1
Landsat Scene Identifier	LC81870262016221LGN01
Acquisition Date	2016/08/08
Collection Category	T1
Collection Number	1
WRS Path	187
WRS Row	026
Target WRS Path	187
Target WRS Row	026
Nadir/Off Nadir	NADIR
Roll Angle	-.001
Date L-1 Generated	2017/03/22
Start Time	2016:221:09:26:25.9597240
Stop Time	2016:221:09:26:57.7297210



3

Rozlíšenie záznamu

Layer Properties

General Source Key Metadata Extent Display Symbology

Property	Value
Raster Information	
Columns and Rows	7881, 7991
Number of Bands	1
Cell Size (X, Y)	30, 30
Uncompressed Size	120,12 MB
Format	TIFF
Source Type	Generic
Pixel Type	unsigned integer
Pixel Depth	16 Bit
Spatial Reference	
Linear Unit	Meter (1,000000)
Angular Unit	Degree (0,0174532925199433)
false_easting	500000
false_northing	0
central_meridian	21
scale_factor	0,9996
latitude_of_origin	0
Datum	D_WGS_1984

Data Source

Data Type: File System Raster
 Folder: I:\PhD\metody DPZ\cvicenia\L8_08_08_2016\
 Raster: LC81870262016221LGN00_B1.TIF

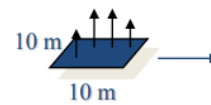
Set Data Source...

OK Zrušit Použiť

Spektrálne rozlíšenie

Priestorové rozlíšenie

Rádiometrické rozlíšenie



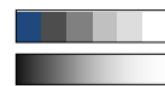
- 1. priestorová (mm, cm, dc, m, km)

- 2. spektrálna (spektrálny rozsah)



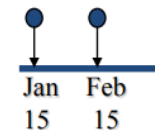
- VID, IČ, termálne, radar

- 3. rádiometrická (rozdelenie toku radiácie)



- elementárna jednotka <0, 255>

- 4. temporálna (časový interval 2 záznamov)



- operatívnosť nosičov – lietadlá, družice

Multispektrálne skenovanie

Landsat 8

- snímkovanie v 16-dňových intervaloch
- senzory OLI (z ang. Operational Land Imager) a TIRS (z ang. Thermal Infrared Sensor)

OLI

- 8 spektrálnych s priestorovým rozlíšením 30 m a panchromatické pásmo s rozlíšením 15 m

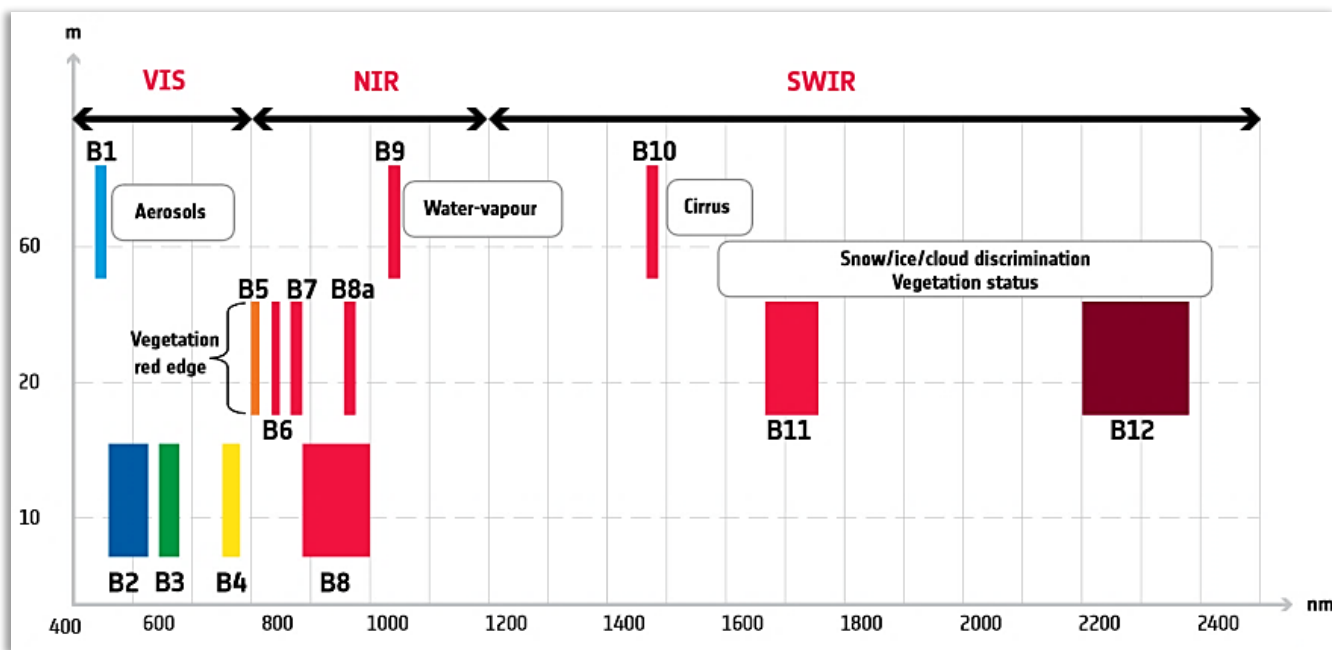
TIRS

- snímanie 2 termálnych pásem (pixel sa kvôli zhodnosti resampluje zo 100 m na 30 m rozlíšenie)

- zdroj dát: EarthExplorer (earthexplorer.usgs.gov)

Sentinel-2A

- snímkovanie v 10-dňových intervaloch
- senzor MSI (z ang. Multi-Spectral Instrument)
- 13 spektrálnych pásem
- zdroj dát: Copernicus Open Access Hub (scihub.copernicus.eu)



Obr. 7. Škála spektrálnych pásem družice Sentinel-2 a ich relatívne vysoké priestorové rozlíšenie otvára nové možnosti aplikácií vo výskume krajiny. Zdroj: ESA (2017)

Landsat 8 Operational Land Image (OLI) and Thermal Infrared Sensor (TIRS)

Band	Wavelength	Useful for mapping
Band 1 - coastal aerosol	0.43-0.45	Coastal and aerosol studies
Band 2 - blue	0.45-0.51	Bathymetric mapping, distinguishing soil from vegetation and deciduous from coniferous vegetation
Band 3 - green	0.53-0.59	Emphasizes peak vegetation, which is useful for assessing plant vigor
Band 4 - red	0.64-0.67	Discriminates vegetation slopes
Band 5 - Near Infrared (NIR)	0.85-0.88	Emphasizes biomass content and shorelines
Band 6 - Short-wave Infrared (SWIR) 1	1.57-1.65	Discriminates moisture content of soil and vegetation; penetrates thin clouds
Band 7 - Short-wave Infrared (SWIR) 2	2.11-2.29	Improved moisture content of soil and vegetation; penetrates thin clouds
Band 8 - Panchromatic	0.50-0.68	15 meter resolution, sharper image definition
Band 9 - Cirrus	1.36-1.38	Improved detection of cirrus cloud contamination
Band 10 - TIRS 1	10.60-11.19	100 meter resolution, thermal mapping and estimated soil moisture
Band 11 - TIRS 2	11.50-12.51	100 meter resolution, improved thermal mapping and estimated soil moisture

→ Fúziou takýchto dát sa dá predpokladať napr. zvýšenie rozlíšenia modelovanej teploty povrchu

Jednorazový
záznam



Letecká ortofotosnímka,
0.1 m



Letecké laserové skenovanie,
0.15 m

Periodický
záznam



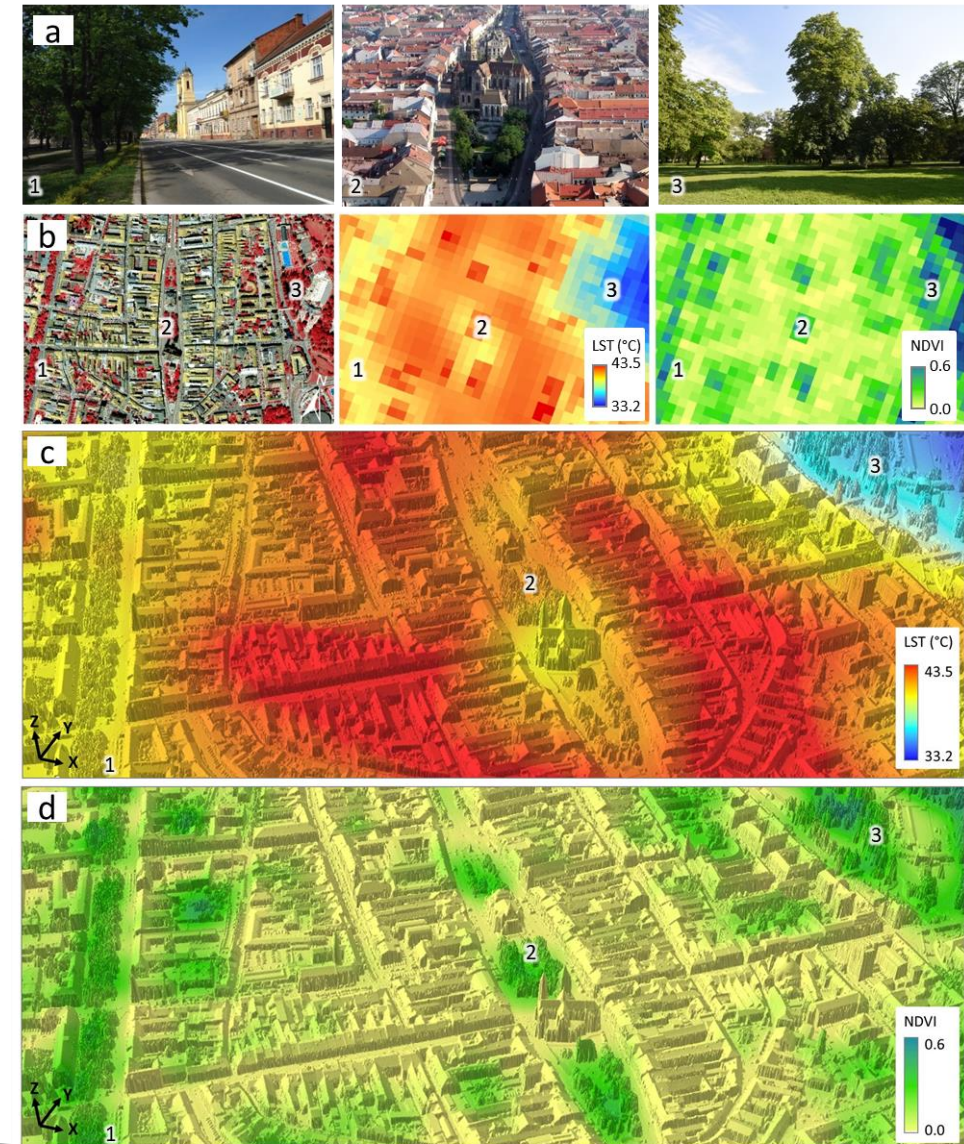
Sentinel 2A
10 m



Pozemné laserové
skenovanie, 0.005 m

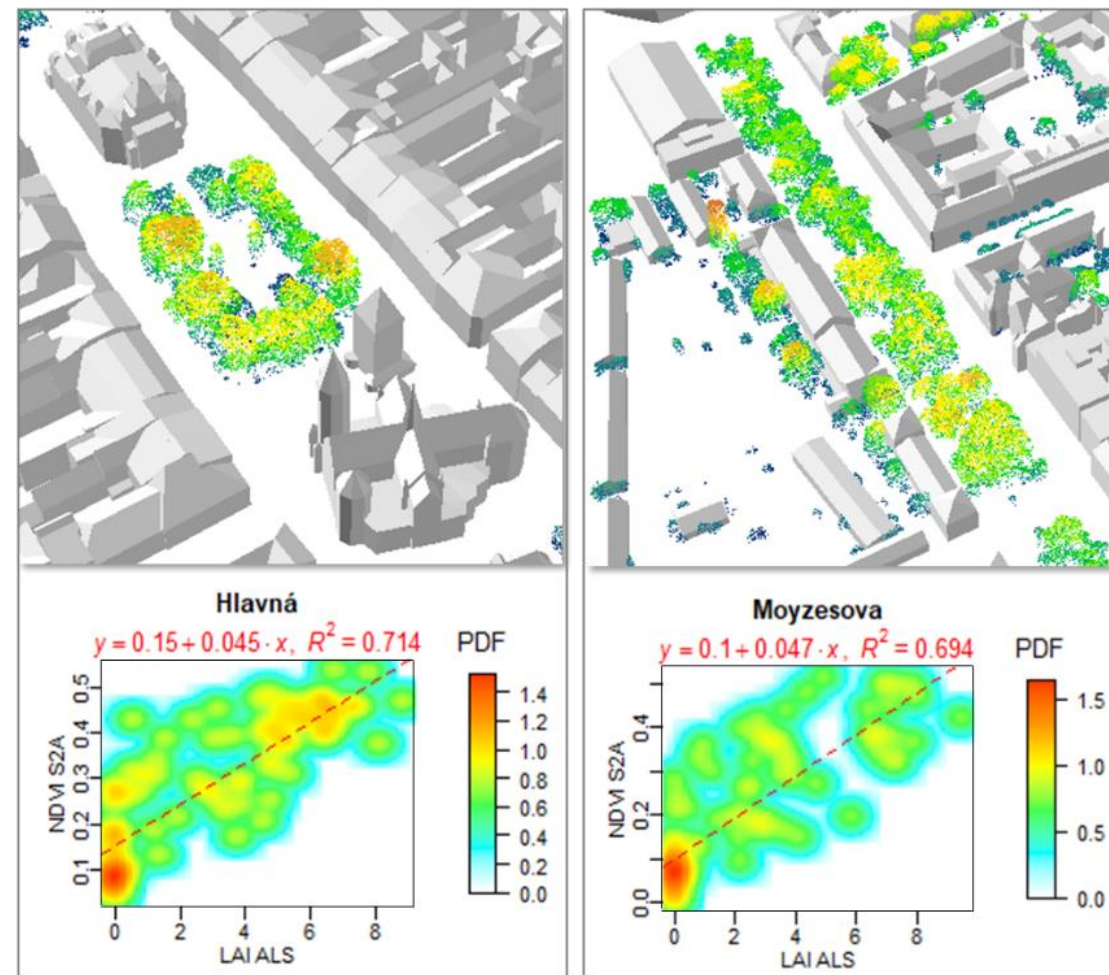
Dôkaz existencie tepelného ostrova v meste Košice (Onačillová a Gallay 2018)

- Fenomén MTO neobchádza ani stredné a malé mestá
- Priestorová distribúcia teplôt v rámci MTO v závislosti od typu krajinej pokrývky
- Aj malé plochy vegetácie, dokážu účinne znižovať teploty v rámci MTO



Obr. Hodnoty LST a NDVI pre 6. august 2015 vo vybraných častiach historického centra mesta Košice (A): 1 – stromová alej na Moyzesovej ulici, 2 – centrum mesta, 3 – Mestský park. (B) perspektívne 3D zobrazenie LST modelu resamplovaného na 0.5 m rozlíšenie na podklade digitálneho modelu povrchu odvodeného z lidarových dát ako uvádzajú práce Onačillová a Gallay (2018) práca Hofierka et al. (2017).

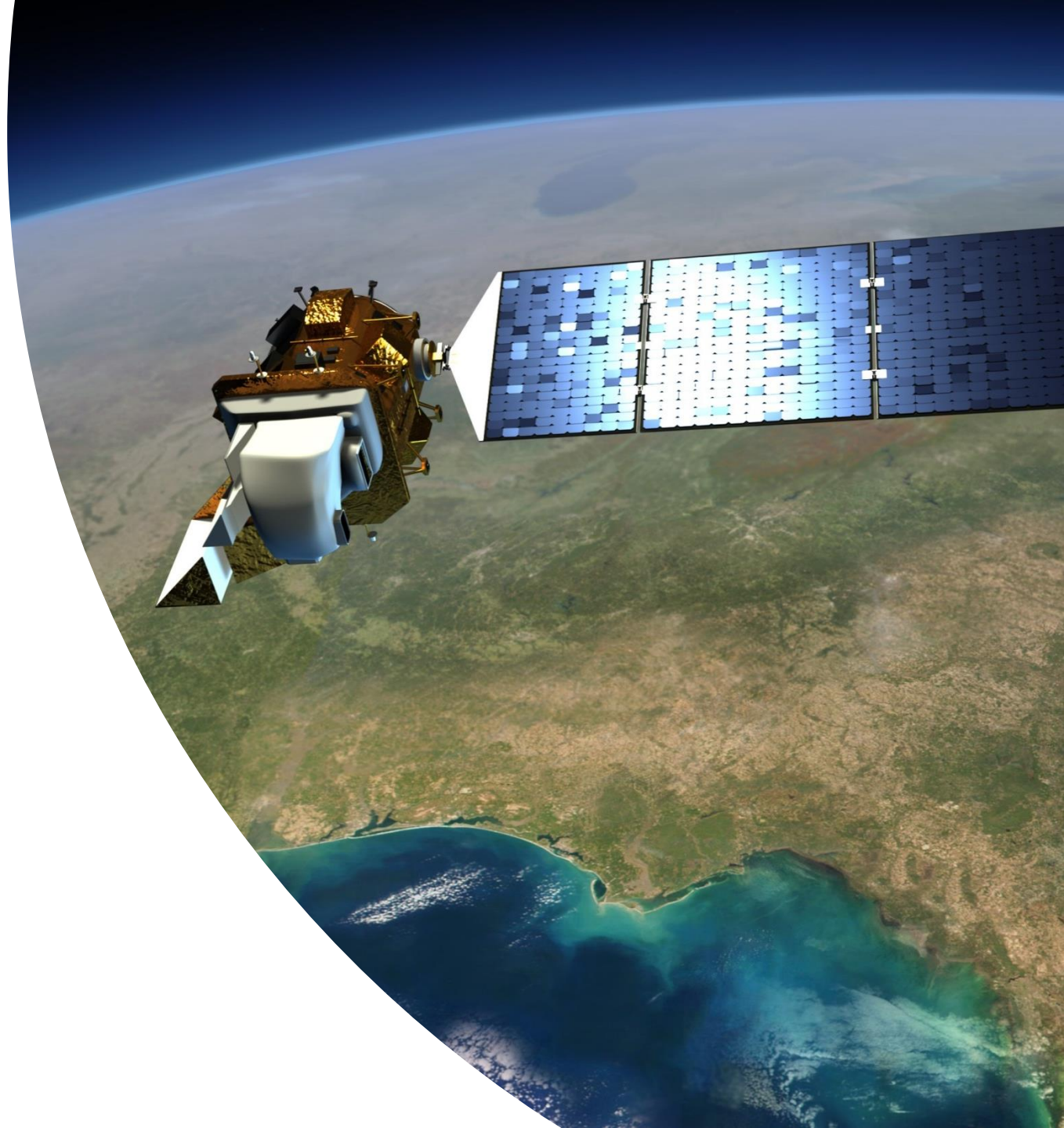
- Vzťah medzi dátami leteckého a pozemného laserového skenovania a dátami družice Sentinel 2 (Onačillová a Gallay 2018, správy pre ESA SURGE)
 - Možnosť využitia MS dát družice Sentinel-2A pre aproximáciu dynamiky fenologických fáz mestskej vegetácie v priebehu roka a pre parameterizáciu priepustnosti vegetácie pri modelovaní slnečného žiarenia a sledovanie prenosu tepla v urbánnom priestore
 - NDVI odvodené z dát družice Sentinel-2A sa ukázalo ako vhodná metrika pre parametrizáciu mestskej zelene, nakoľko úzko koreluje s hodnotami LAI (Leaf Area Index) odvodenými z dát leteckého a pozemného laserového skenovania (obr.)



Obr. NDVI odvodené z dát družice Sentinel-2A korelujúce s hodnotami LAI odvodenými z dát leteckého a pozemného laserového skenovania pre 14. september 2016.

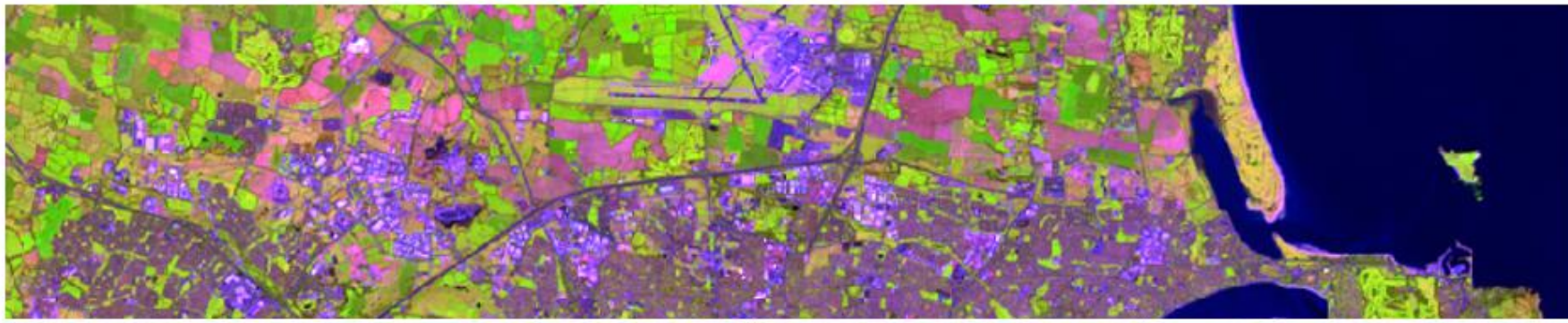
FARBENÉ KOMPOZÍCIE A INDEXY

- základné princípy tvorby a ich využitie

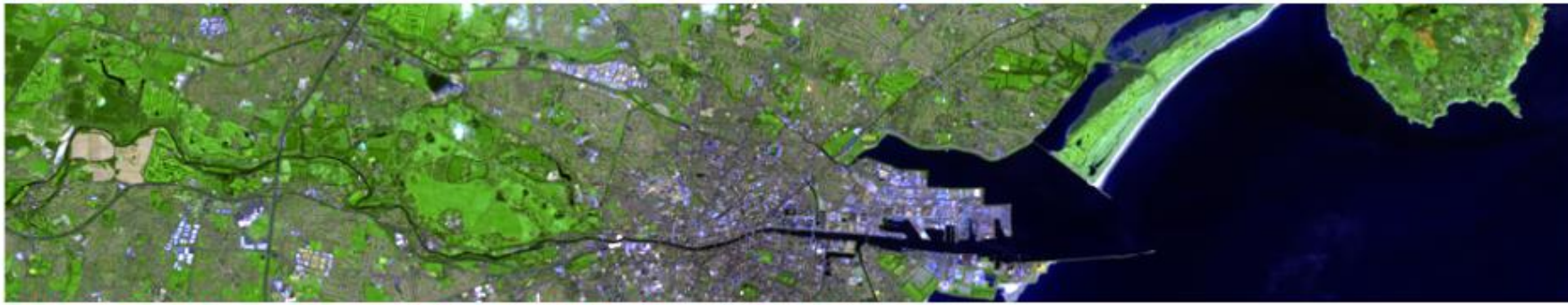


4

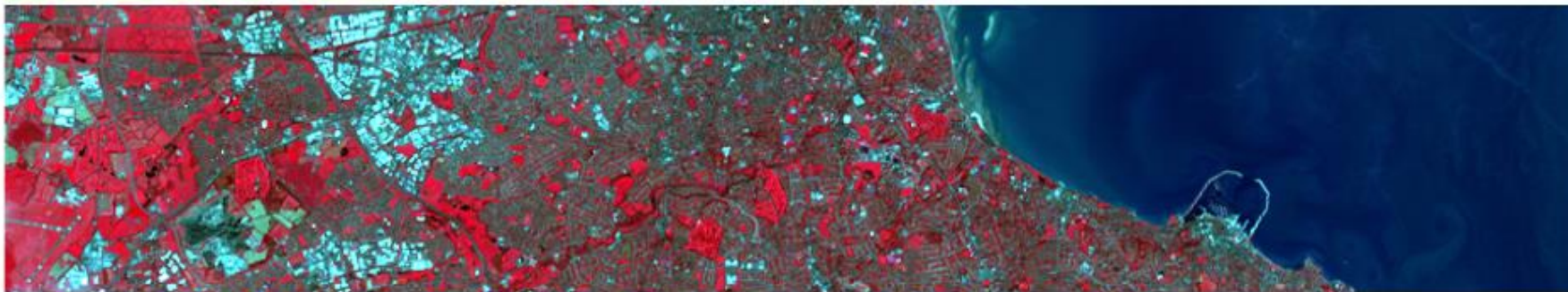
Farebné kompozície



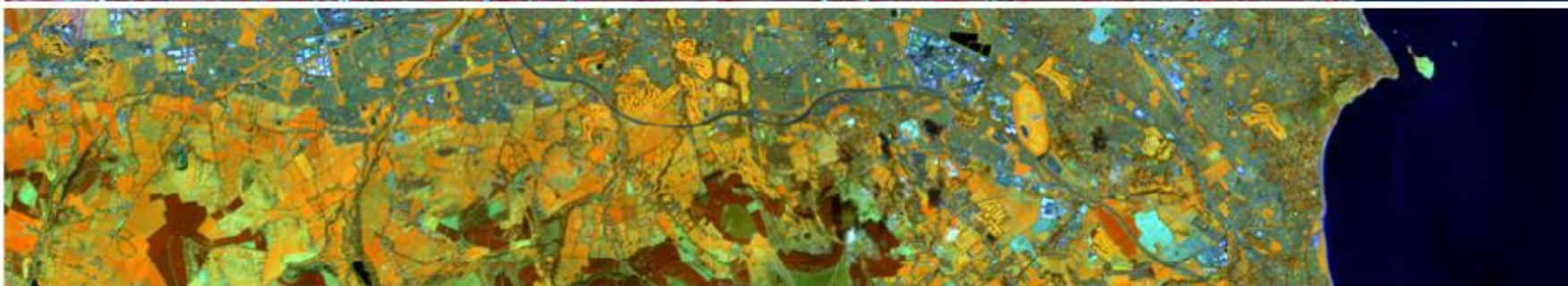
False Colour **6,5,2**
Vegetation



False Colour **7,6,4**
Urban



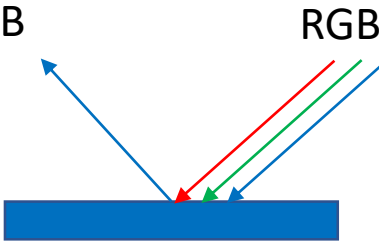
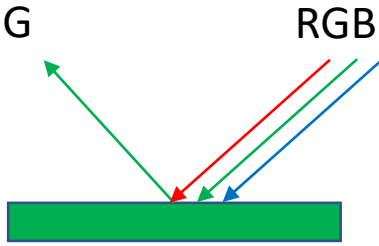
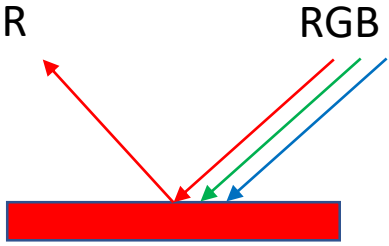
Colour IR **5,4,3**
Vegetation



False Colour **5,6,4**
Land/Water

Reflected portion
of the radiation

Incidence visible
radiation

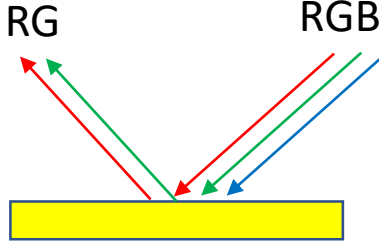
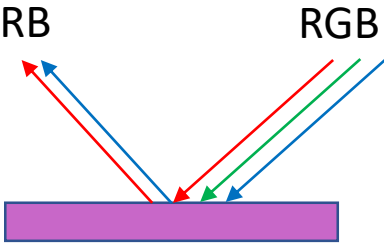
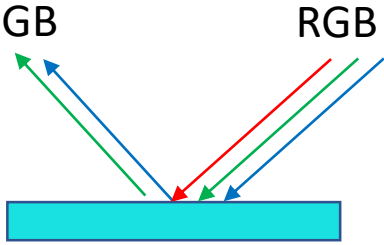


Surface colour appears:

red

green

blue



Surface colour appears:

cyan

magenta

yellow

Colour RGB 4,3,2 Natural colours

RGB



R



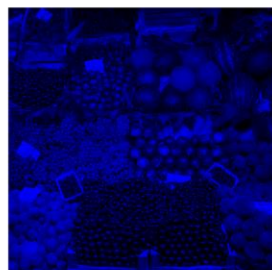
Red

G



Green

B

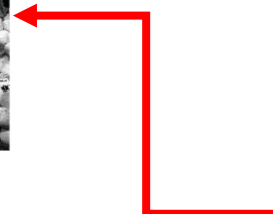


Blue



Landsat 8

Band
Band 1 - coastal aerosol
Band 2 - blue
Band 3 - green
Band 4 - red
Band 5 - Near Infrared (NIR)
Band 6 - Short-wave Infrared (SWIR) 1
Band 7 - Short-wave Infrared (SWIR) 2
Band 8 - Panchromatic
Band 9 - Cirrus
Band 10 - TIRS 1
Band 11 - TIRS 2



Colour RGB 4,3,2 Natural colours

RGB



R



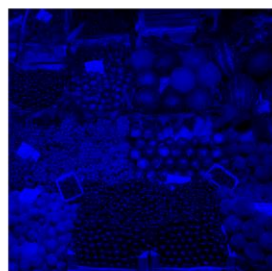
Red

G



Green

B

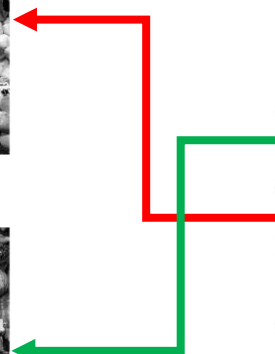


Blue



Landsat 8

Band
Band 1 - coastal aerosol
Band 2 - blue
Band 3 - green
Band 4 - red
Band 5 - Near Infrared (NIR)
Band 6 - Short-wave Infrared (SWIR) 1
Band 7 - Short-wave Infrared (SWIR) 2
Band 8 - Panchromatic
Band 9 - Cirrus
Band 10 - TIRS 1
Band 11 - TIRS 2



Colour RGB 4,3,2 Natural colours

RGB



R



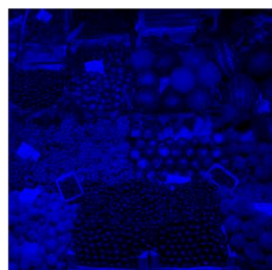
Red

G



Green

B

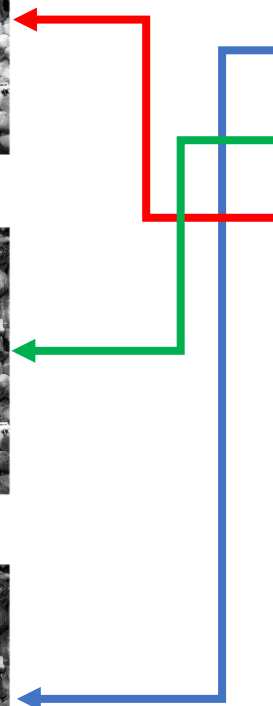


Blue



Landsat 8

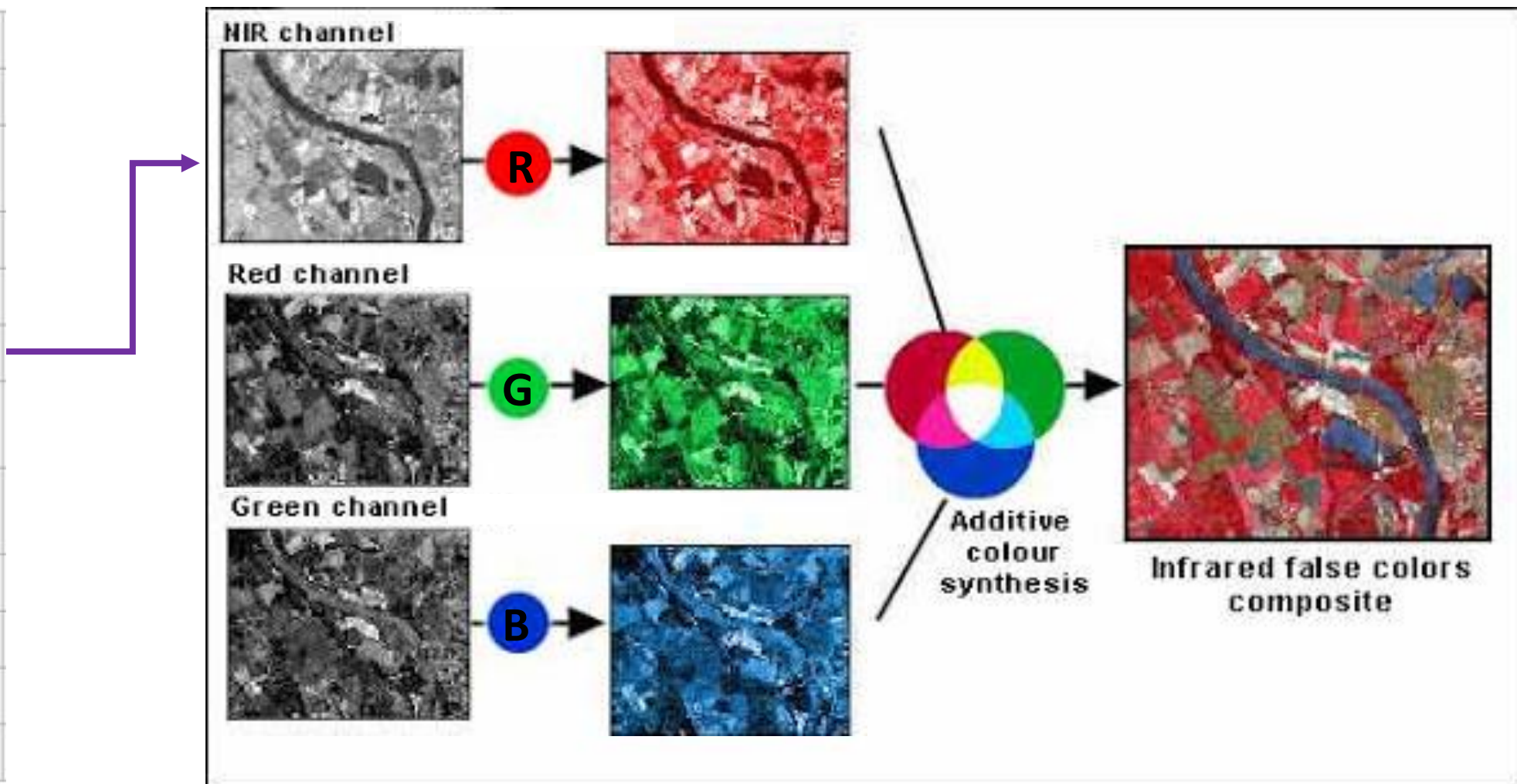
Band
Band 1 - coastal aerosol
Band 2 - blue
Band 3 - green
Band 4 - red
Band 5 - Near Infrared (NIR)
Band 6 - Short-wave Infrared (SWIR) 1
Band 7 - Short-wave Infrared (SWIR) 2
Band 8 - Panchromatic
Band 9 - Cirrus
Band 10 - TIRS 1
Band 11 - TIRS 2



Colour IR 5,4,3 Vegetation

Landsat 8

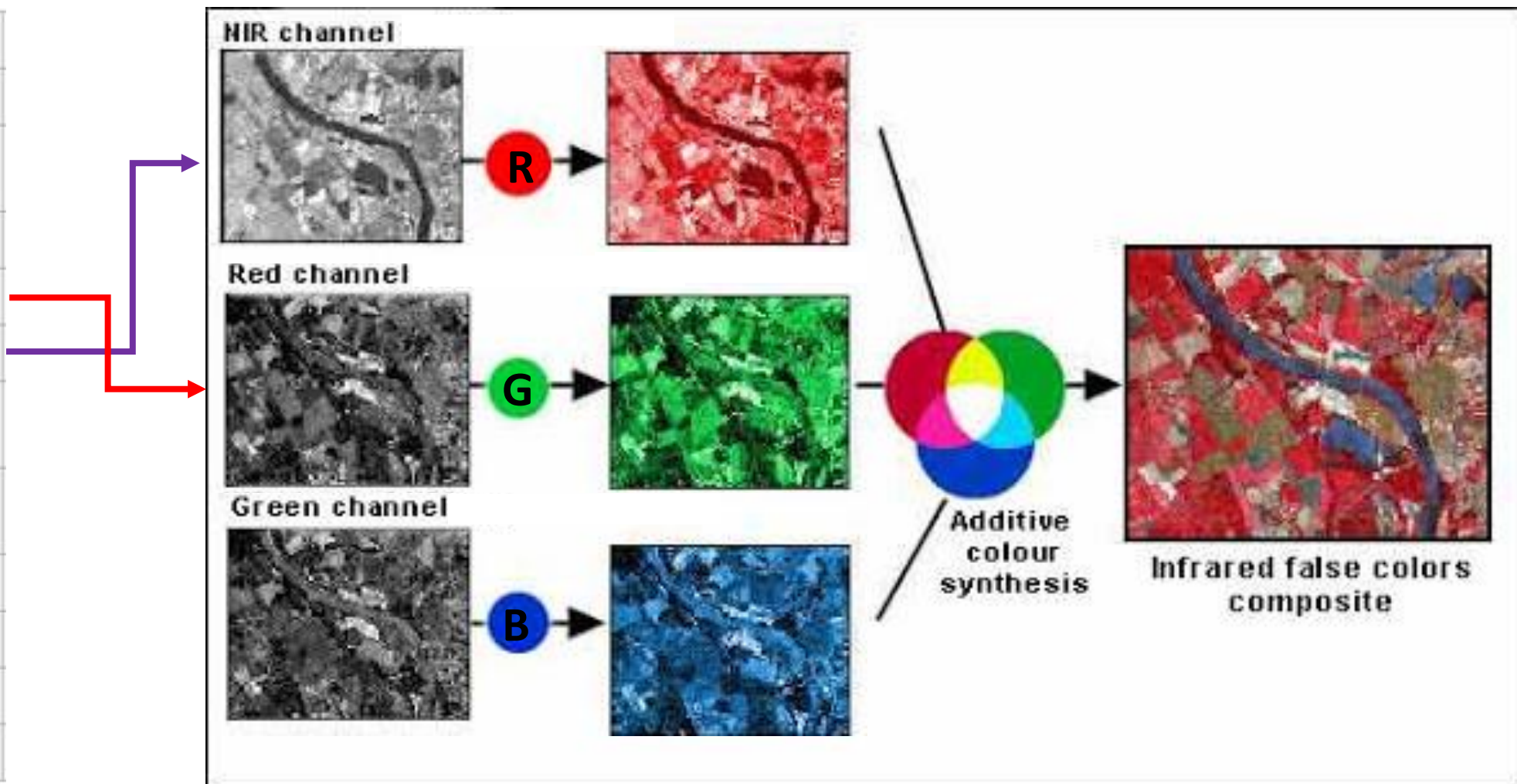
Band
Band 1 - coastal aerosol
Band 2 - blue
Band 3 - green
Band 4 - red
Band 5 - Near Infrared (NIR)
Band 6 - Short-wave Infrared (SWIR) 1
Band 7 - Short-wave Infrared (SWIR) 2
Band 8 - Panchromatic
Band 9 - Cirrus
Band 10 - TIRS 1
Band 11 - TIRS 2



Colour IR 5,4,3 Vegetation

Landsat 8

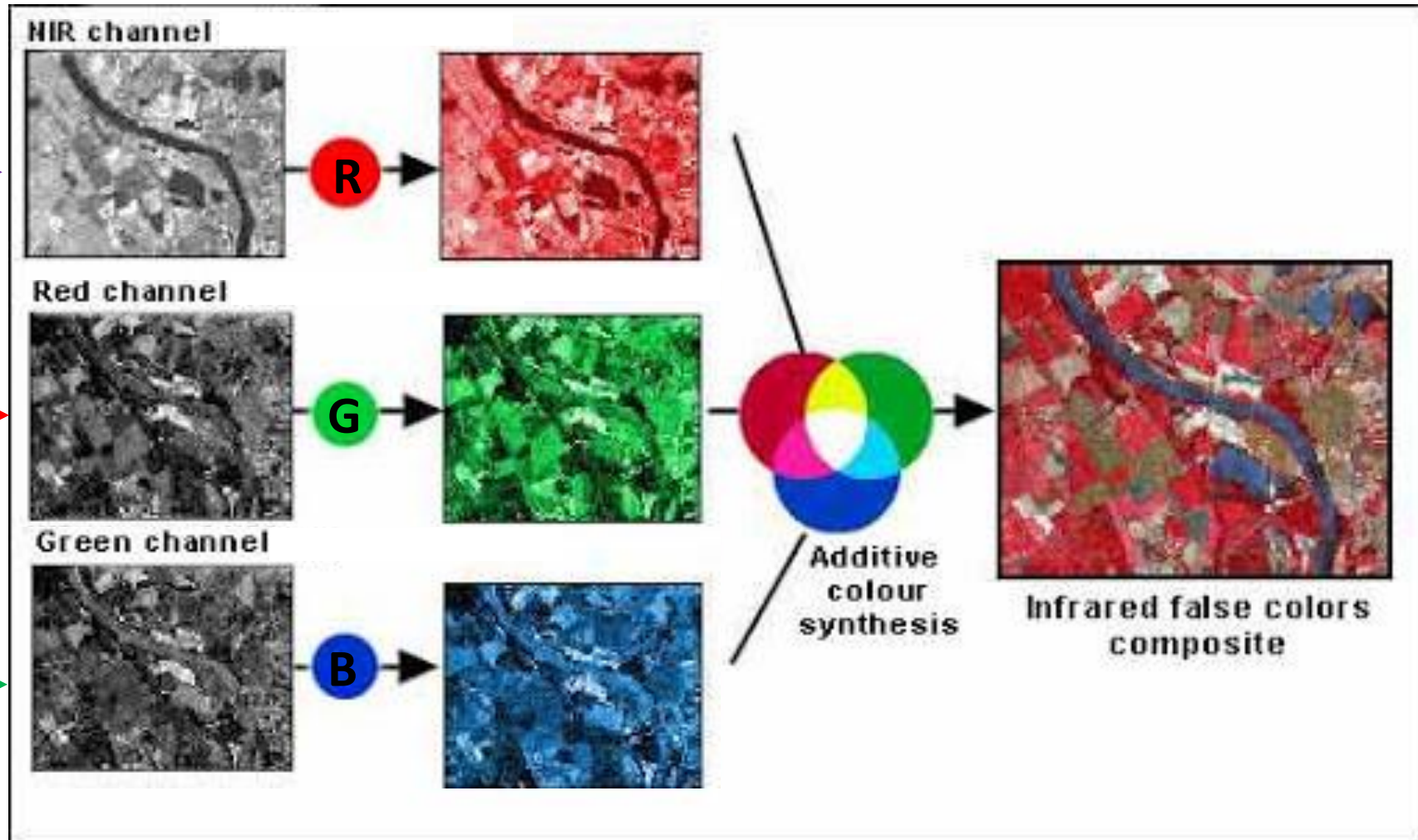
Band
Band 1 - coastal aerosol
Band 2 - blue
Band 3 - green
Band 4 - red
Band 5 - Near Infrared (NIR)
Band 6 - Short-wave Infrared (SWIR) 1
Band 7 - Short-wave Infrared (SWIR) 2
Band 8 - Panchromatic
Band 9 - Cirrus
Band 10 - TIRS 1
Band 11 - TIRS 2

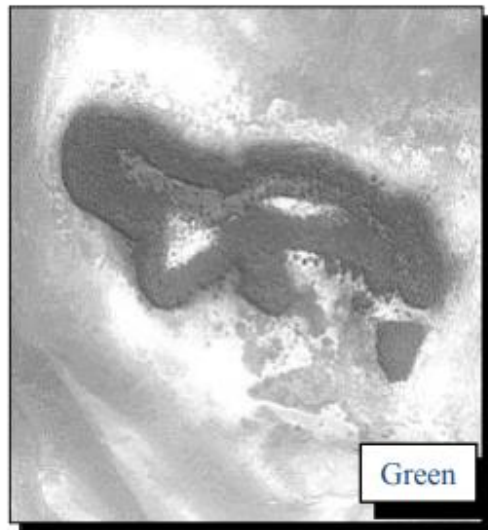


Colour IR 5,4,3 Vegetation

Landsat 8

Band
Band 1 - coastal aerosol
Band 2 - blue
Band 3 - green
Band 4 - red
Band 5 - Near Infrared (NIR)
Band 6 - Short-wave Infrared (SWIR) 1
Band 7 - Short-wave Infrared (SWIR) 2
Band 8 - Panchromatic
Band 9 - Cirrus
Band 10 - TIRS 1
Band 11 - TIRS 2

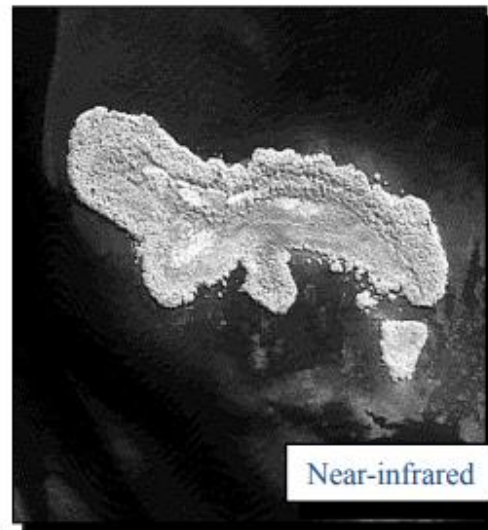




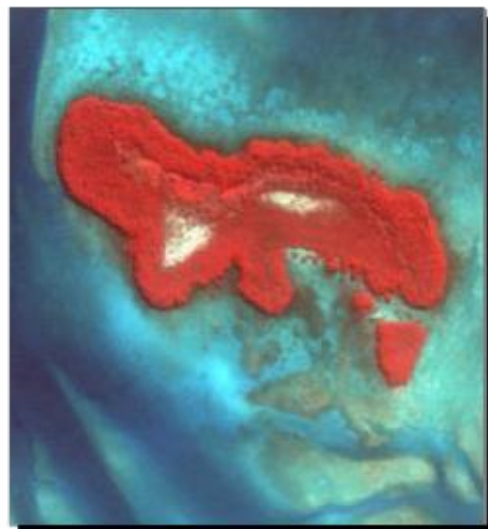
Green



Red



Near-infrared



Color composite
RGB = green, red, near-
infrared

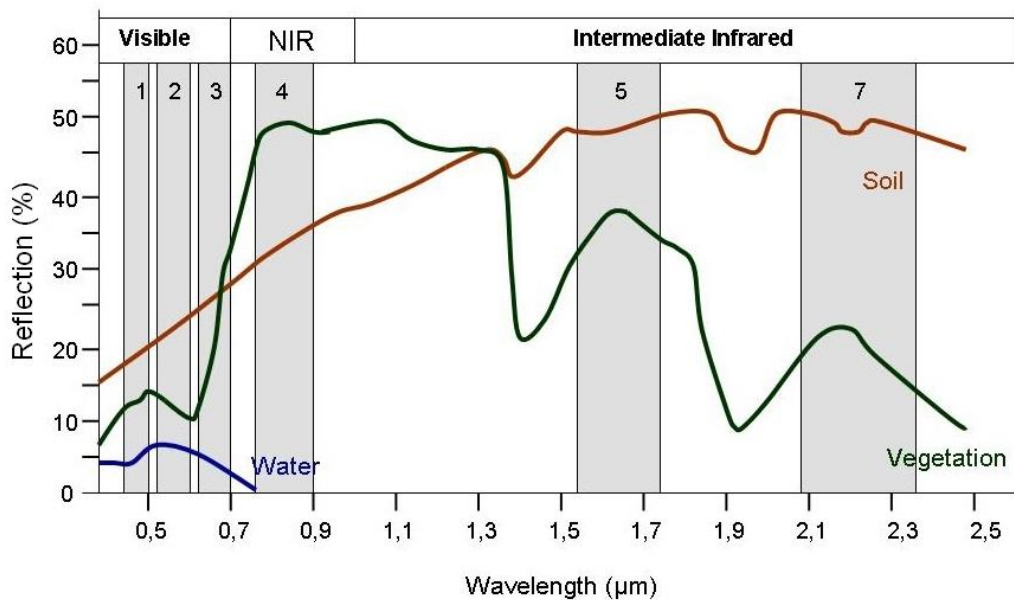
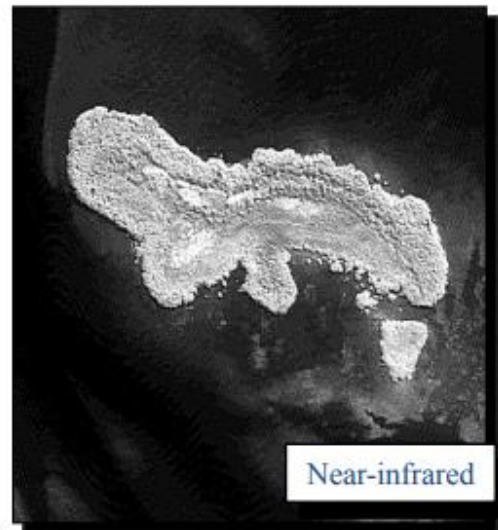
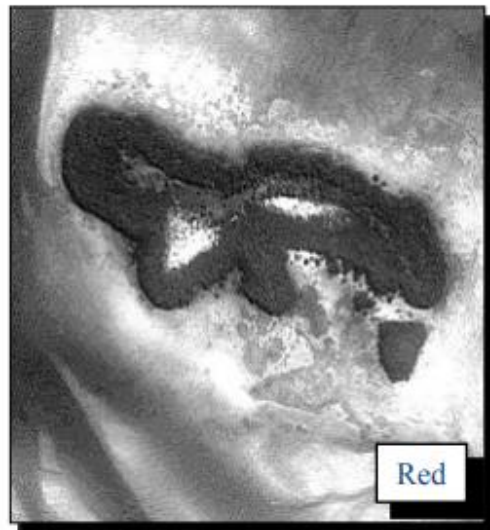
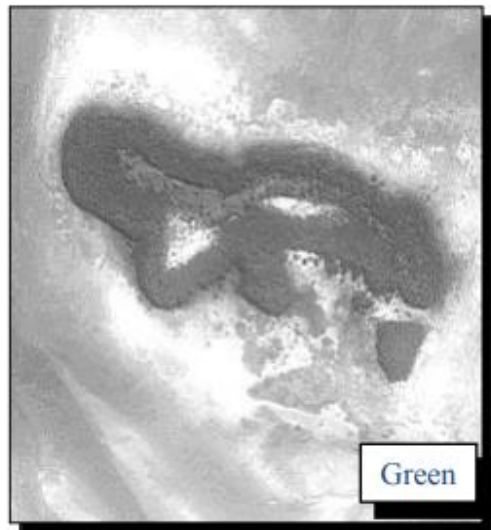
Jensen, 2007

Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) Bands

Band	Name	Band Width (λ , μm)	Spatial Resolution
1	Blue	0.45-0.515	30 m
2	Green	0.525-0.605	30 m
3	Red	0.63-0.69	30 m
4	Near Infrared	0.75-0.90	30 m
5	Shortwave IR-1	1.55-1.75	30 m
6	Thermal IR	10.4-12.5	60 m / 120 m*
7	Shortwave IR-2	2.09-2.35	30 m
8*	Panchromatic	0.52-0.9	15 m

Vlastnosti jednotlivých spektrálních pásem slúžia pre rôzne aplikácie.

<https://landsat.gsfc.nasa.gov/landsat-8/landsat-8-bands/>

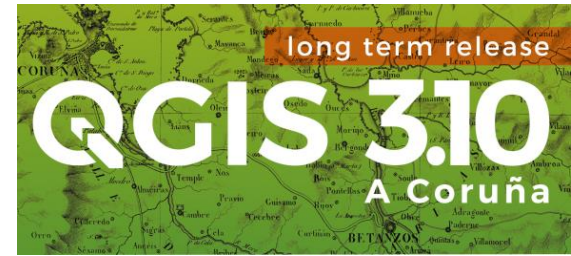
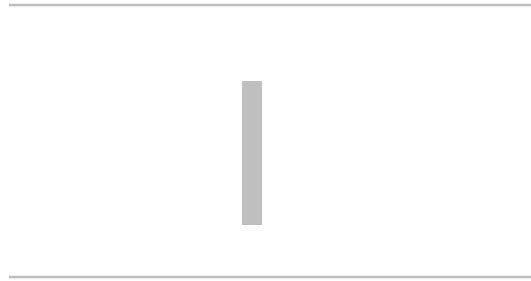


Color composite
 RGB = green, red, near-
 infrared

Jensen, 2007

Vlastnosti jednotlivých spektrálnych pásem slúžia pre rôzne aplikácie.

<https://landsat.gsfc.nasa.gov/landsat-8/landsat-8-bands/>



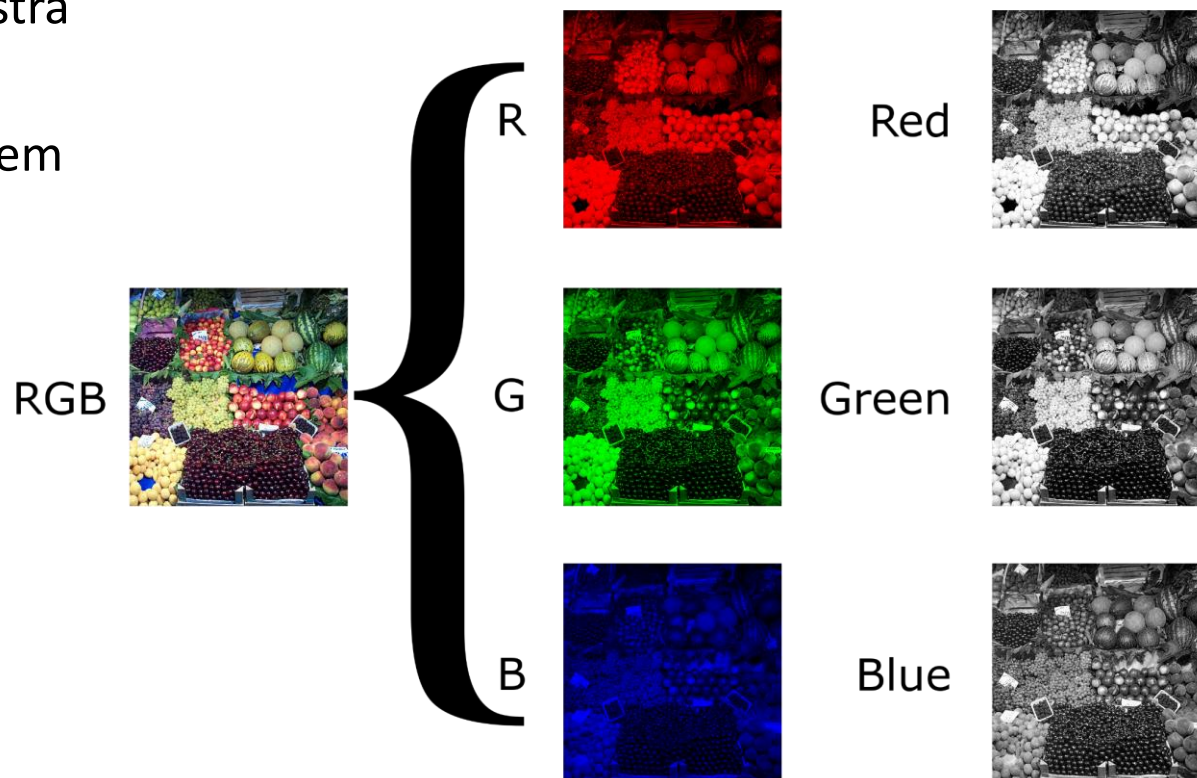
Farebné syntézy - tvorba a interpretácia

Pr. Vytvorenie kombinácie v prirodzených farbách (432) pre Landsat 8

1. Pridanie pásem
2 (blue), 3 (green), 4 (red) do QGIS

2. Vytvorenie virtuálneho rastra

2. Správne premietnutie pásem
cez kanály RGB

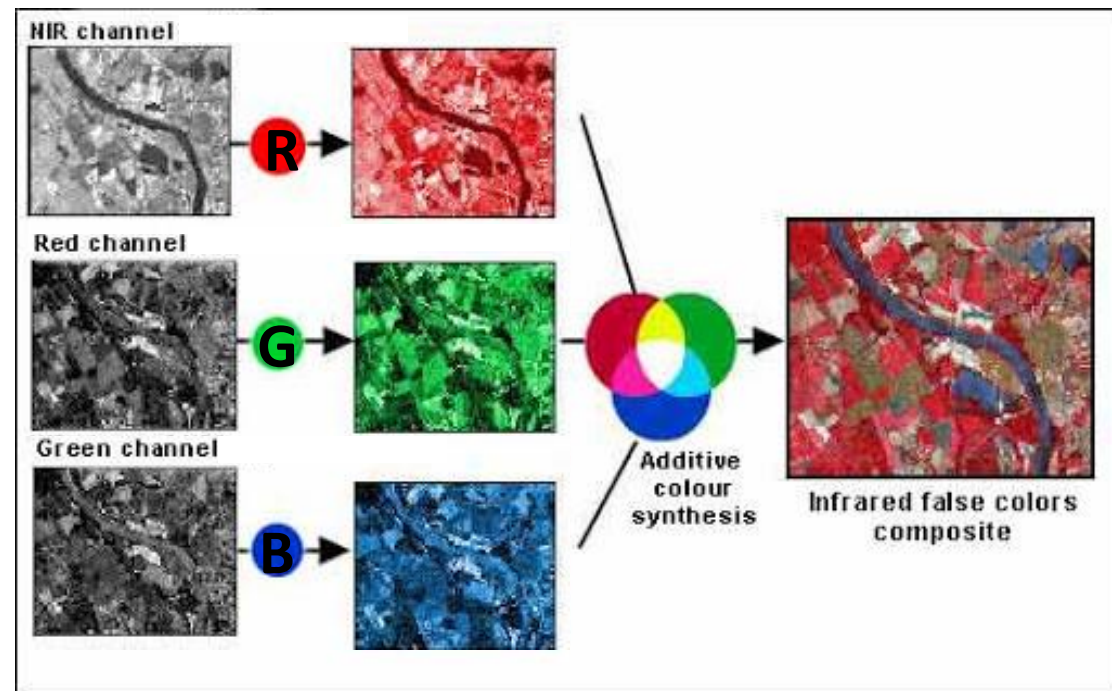


Band
Band 1 - coastal aerosol
Band 2 - blue
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Band 4 - red
Band 5 - Near Infrared (NIR)
Band 6 - Short-wave Infrared (SWIR) 1
Band 7 - Short-wave Infrared (SWIR) 2
Band 8 - Panchromatic
Band 9 - Cirrus
Band 10 - TIRS 1
Band 11 - TIRS 2

Pr. Vytvorenie kombinácie v neprirodzených farbách (napr. 543) pre Landsat 8

1. Pridanie pásem do QGIS:
3 (green),
4 (red),
5 (infrared)
2. Vytvorenie virtuálneho rastra
3. Správne premietnutie pásem cez kanály RGB

Band
Band 1 - coastal aerosol
Band 2 - blue
Band 3 - green
Band 4 - red
Band 5 - Near Infrared (NIR)
Band 6 - Short-wave Infrared (SWIR) 1
Band 7 - Short-wave Infrared (SWIR) 2
Band 8 - Panchromatic
Band 9 - Cirrus
Band 10 - TIRS 1
Band 11 - TIRS 2

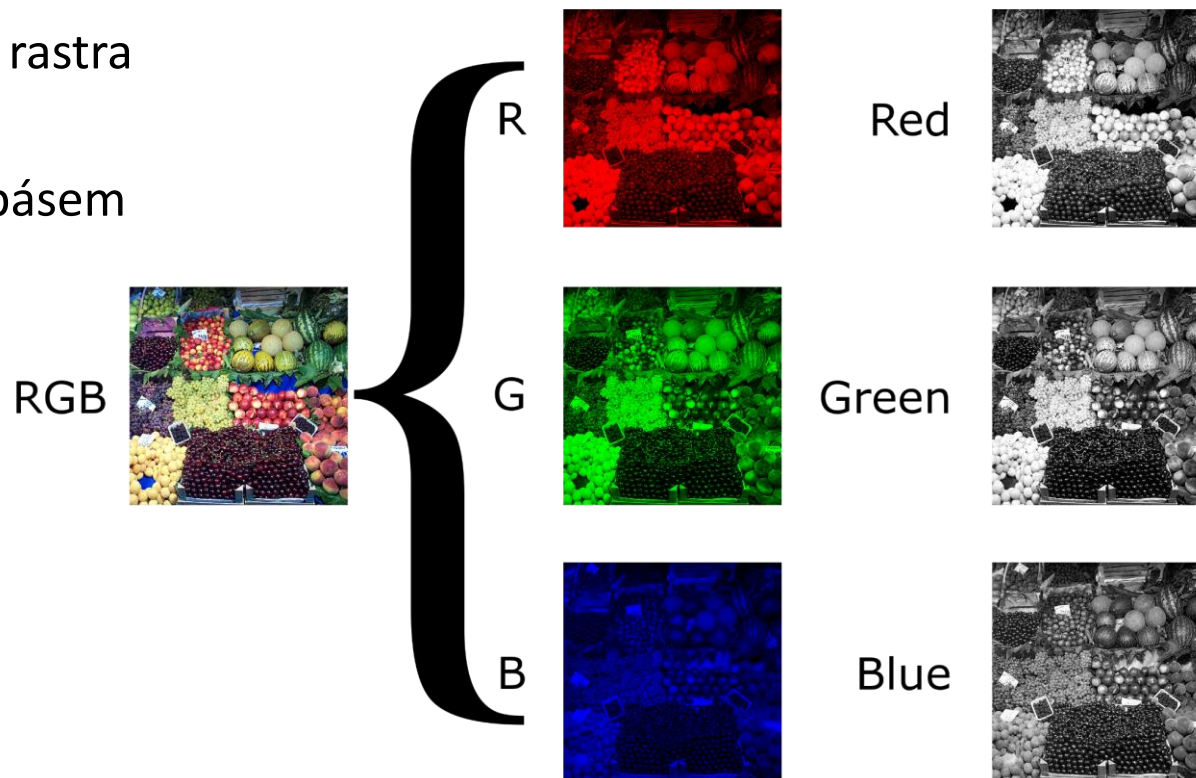


Pr. Vytvorenie kombinácie v prirodzených farbách (432) pre Sentinel 2

1. Pridanie pásem
2 (blue), 3 (green), 4 (red) do QGIS

2. Vytvorenie virtuálneho rastra

2. Správne premietnutie pásem
cez kanály RGB



Band	Description
B1	Ultra blue (Coastal and Aerosol)
B2	Blue
B3	Green
B4	Red
B5	Visible and Near Infrared (VNIR)
B6	Visible and Near Infrared (VNIR)
B7	Visible and Near Infrared (VNIR)
B8	Visible and Near Infrared (VNIR)
B8a	Visible and Near Infrared (VNIR)
B9	Short Wave Infrared (SWIR)
B10	Short Wave Infrared (SWIR)
B11	Short Wave Infrared (SWIR)
B12	Short Wave Infrared (SWIR)

Pr. Vytvorenie kombinácie v neprirodzených farbách (11-8-2) pre Sentinel 2

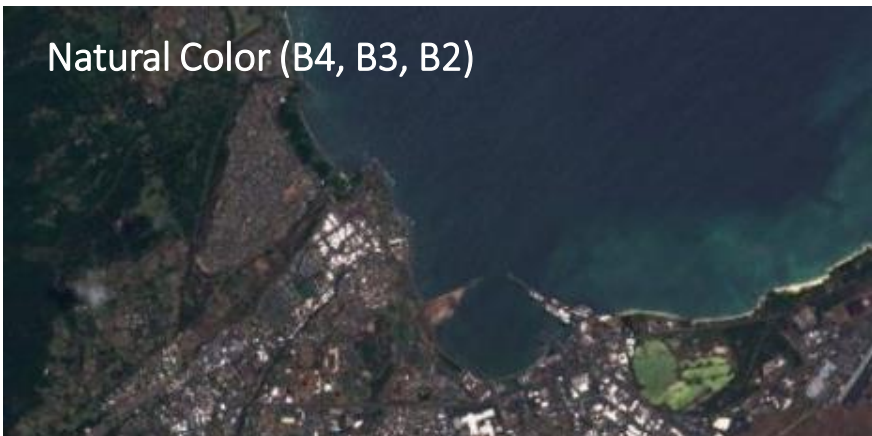
1. Pridanie pásem do QGIS:
2 (blue)
8 (VNIR)
11 (SWIR)
2. Vytvorenie virtuálneho rastra
3. Správne premietnutie pásem cez kanály RGB



Agriculture (B11, B8, B2)

Band	Description
B1	Ultra blue (Coastal and Aerosol)
B2	Blue
B3	Green
B4	Red
B5	Visible and Near Infrared (VNIR)
B6	Visible and Near Infrared (VNIR)
B7	Visible and Near Infrared (VNIR)
B8	Visible and Near Infrared (VNIR)
B8a	Visible and Near Infrared (VNIR)
B9	Short Wave Infrared (SWIR)
B10	Short Wave Infrared (SWIR)
B11	Short Wave Infrared (SWIR)
B12	Short Wave Infrared (SWIR)

Natural Color (B4, B3, B2)



Its purpose is to display imagery the same way our eyes see the world. Just like how we see, healthy vegetation is green. Next, urban features often appear white and grey. Finally, water is a shade of dark blue.

Color Infrared (B8, B4, B3)



This combination is meant to emphasize healthy and unhealthy vegetation. By using the near-infrared (B8) band, it's especially good at reflecting chlorophyll.

Short-Wave Infrared (B12, B8A, B4)



The short-wave infrared band combination uses SWIR (B12), NIR (B8A) and red (B4). Darker shades of green indicate denser vegetation. Brown - bare soil and built-up areas.

Agriculture (B11, B8, B2)



The agriculture band combination uses SWIR-1 (B11), near-infrared (B8) and blue (B2). It's mostly used to monitor the health of crops because how it uses short-wave and near infrared.

Farebné kompozície (pre Sentinel 2)

Možnosti vytvárania skriptov

[Sentinel Hub](#) – EO Browser

[Sentinel Playground](#)

QGIS - API

TAKE PART IN THE SENTINEL HUB CUSTOM SCRIPT CONTEST!
ATTRACTIVE PRIZES, FAME AND GLORY AWAIT YOU!

```
function a(a, b) {return a + b};  
function stretch(val, min, max) {return  
function stretch(rgbArr) {  
  var avg = rgbArr.reduce((a, b) => a + b  
  return rgbArr.map(a => avg * (1 - sat  
function highlightBurnscar(val, oLow  
function satArg(rgbArr) {  
  var avg = rgbArr.reduce((a, b) =>  
  return rgbArr.map(a => avg *  
  highlightBurnscar(val, oLow,  
  if ((B11 + B10 > 0.03) && (val >
```

Sentinel Hub Custom Script Contest
Copernicus Europe's eyes on Earth
esa
SINERGISE

SENTINEL Hub PLAYGROUND

2016-08-08 22 %

Vale de Cambra, Portugal Sentinel 2

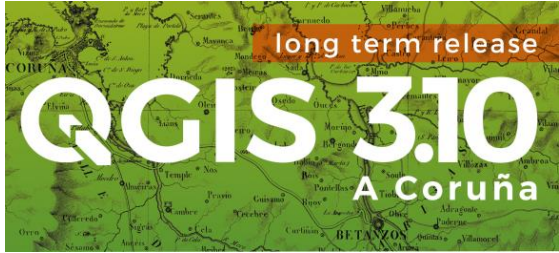
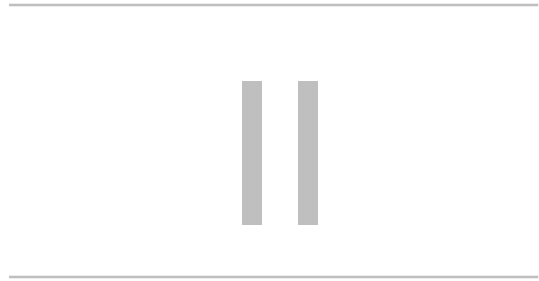
Rendering Effects

- Color Infrared (vegetation)
Based on bands 8,4,3
- False color (urban)
Based on bands 12,11,4
- Agriculture
Based on bands 11, 8A and 2
- Atmospheric penetration
Based on bands 12,11,6A
- Bathymetric
Based on bands 4,3,1
- Geology
Based on bands 12,4,2
- Moisture Index
Based on combination of bands (B8A - B11)/(B8A + B11)
- SWIR
Based on bands 12,8A,4
- Vegetation Index
Based on combination of bands (B6 - B4)/(B6 + B4)

REFRESH GENERATE

apps.sentinel-hub.com/sentinel-playground/#tabs-1

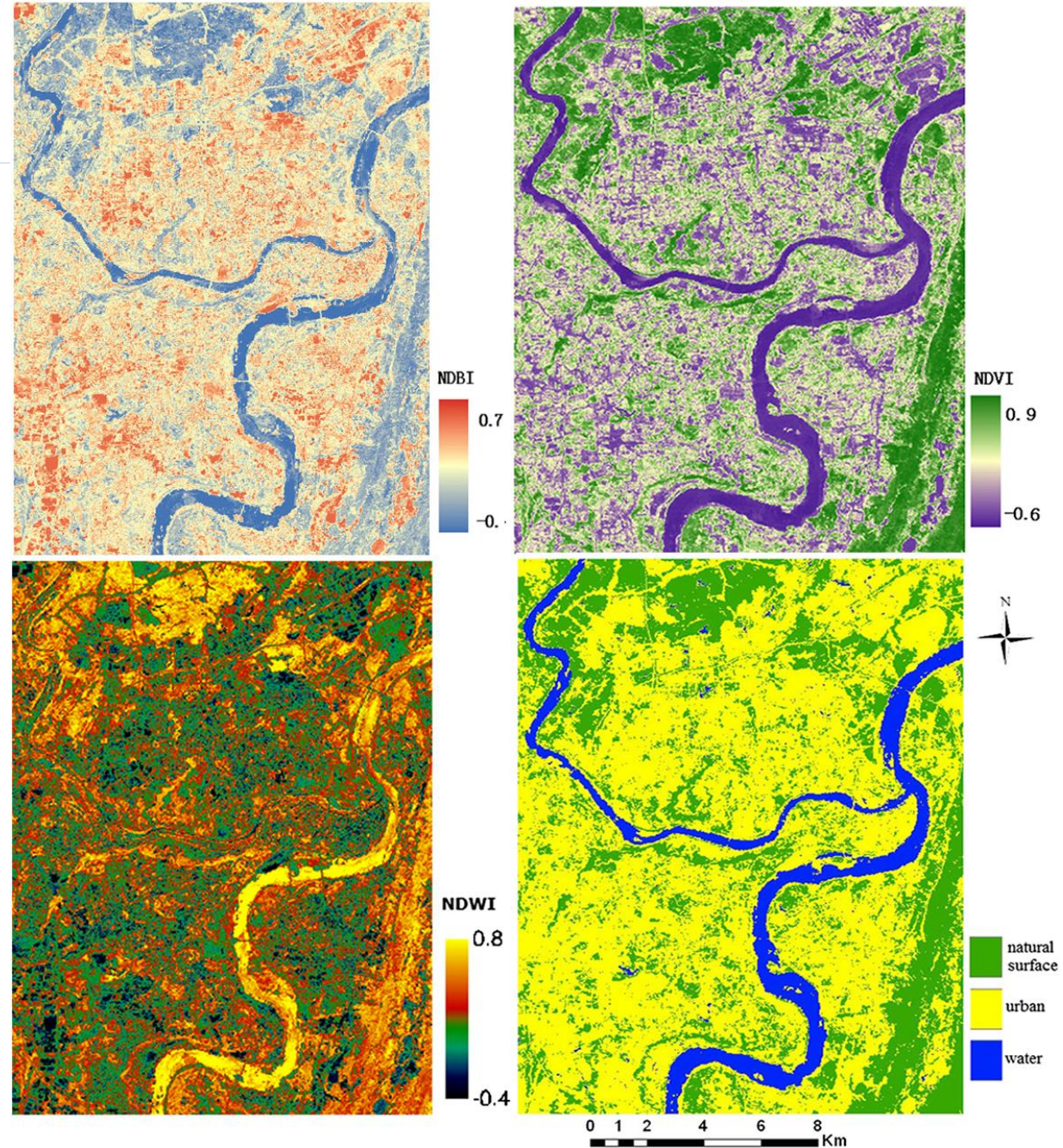
Leaflet | © OpenStreetMap contributors, © Sentinel layer contributors



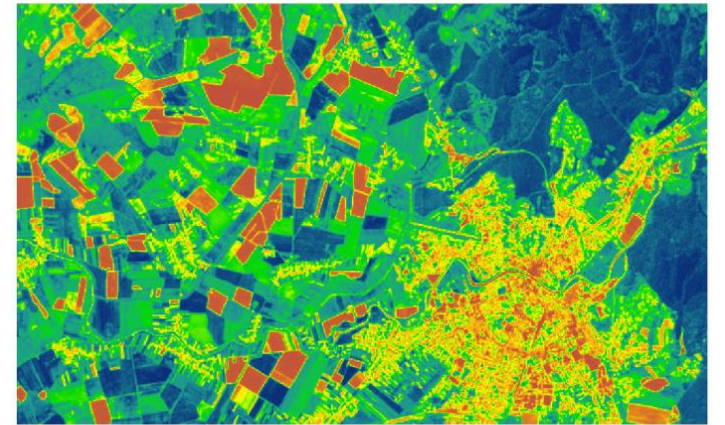
Spektrálne indexy

Spektrálne indexy

- Pomer medzi DN dvoch alebo viacerých spektrálnych pásiem
- Pre viaceré typy analýzy krajiny umožňuje vyhnúť sa prepočtu DN na hodnoty odrazivosti
- Pomer totiž ostáva rovnaký na plochách privrátených a odvrátených ku Slnku v rámci danej scény pre určitý časový okamih
- Bežne sa používajú vegetačné indexy (VI, NDVI, NNWI, NDBI...)



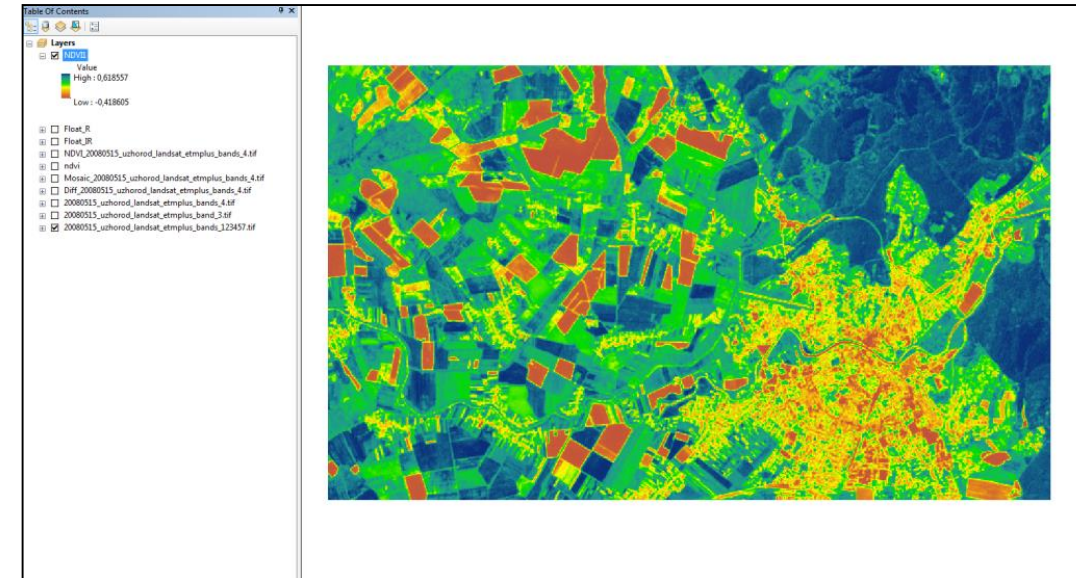
Výpočet NDVI



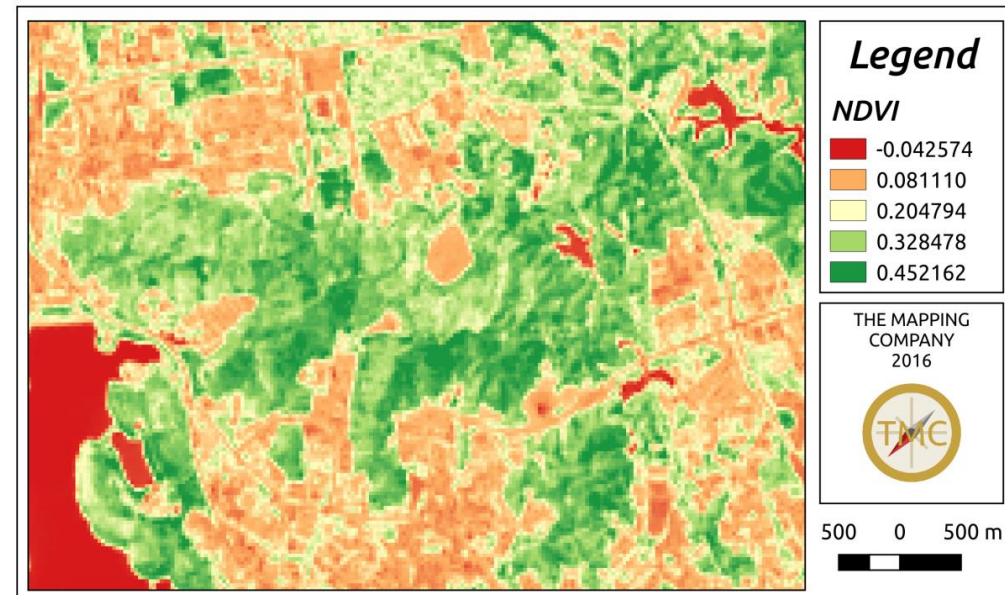
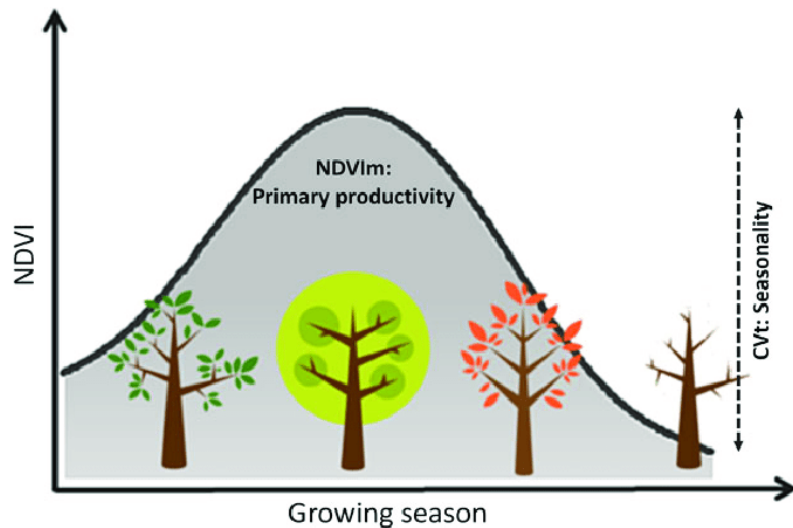
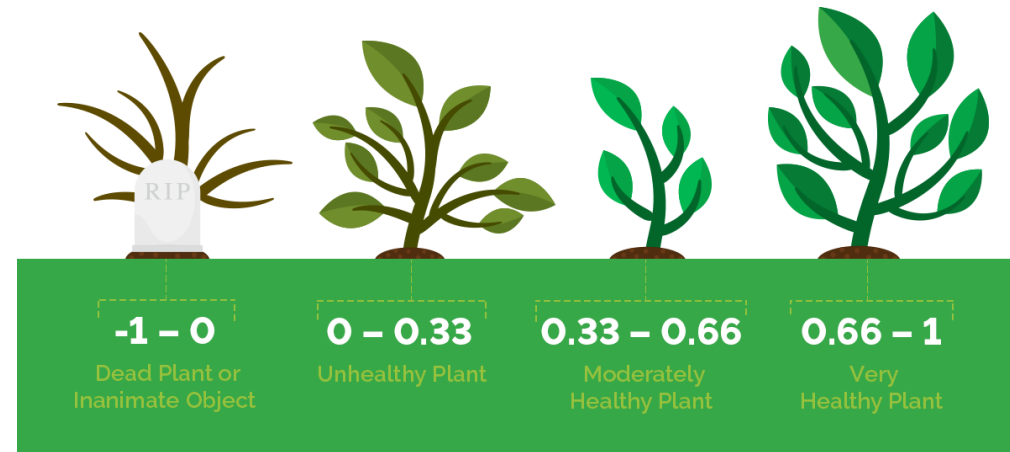
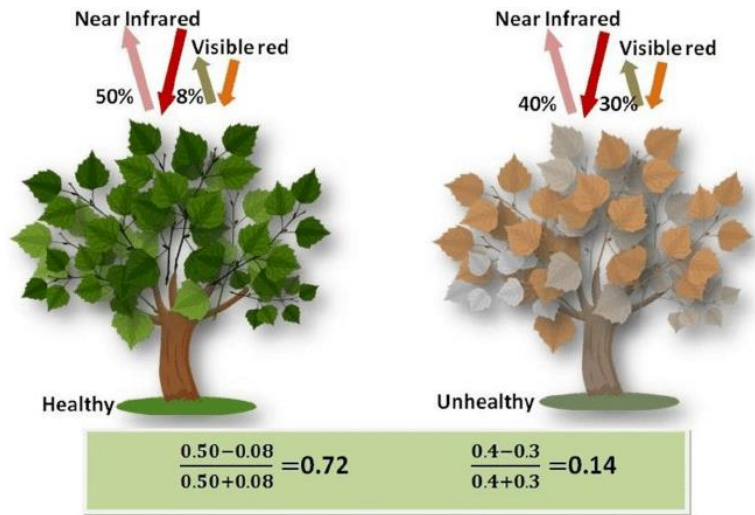
$$\text{NDVI} = (\text{IR} - \text{R}) / (\text{IR} + \text{R})$$

Výpočet NDVI

- Výstupný rozsah indexu sa pohybuje v rozmedzí hodnôt -1 až 1:
 - **veľmi nízke hodnoty (0.1 a nižšie, resp. blízke -1)** zodpovedajú neúrodným oblastiam odkrytej/holej pôdy, skál, piesku a snehu
 - **stredné hodnoty (0.2 – 0.3)** reprezentujú kríky a trávnaté plochy
 - **vysoké hodnoty (0.6 – 0.8, resp. blízke 1)** reprezentujú zeleň (kvalitnú, hustú vegetáciu, resp. lesy mierneho pásma, pralesy)



Výstupné dáta: ďalšie interpretácie indexu





HANDS-ON GRASS (QGIS):

- Klasifikácia obrazu



Ciele

1

Objasnenie princípov klasifikácie obrazu

2

Riadená klasifikácia obrazu
- snímok Landsat 8 a Sentinel 2A

3

Presnosť klasifikácie obrazu – interpretácia chybovej matice

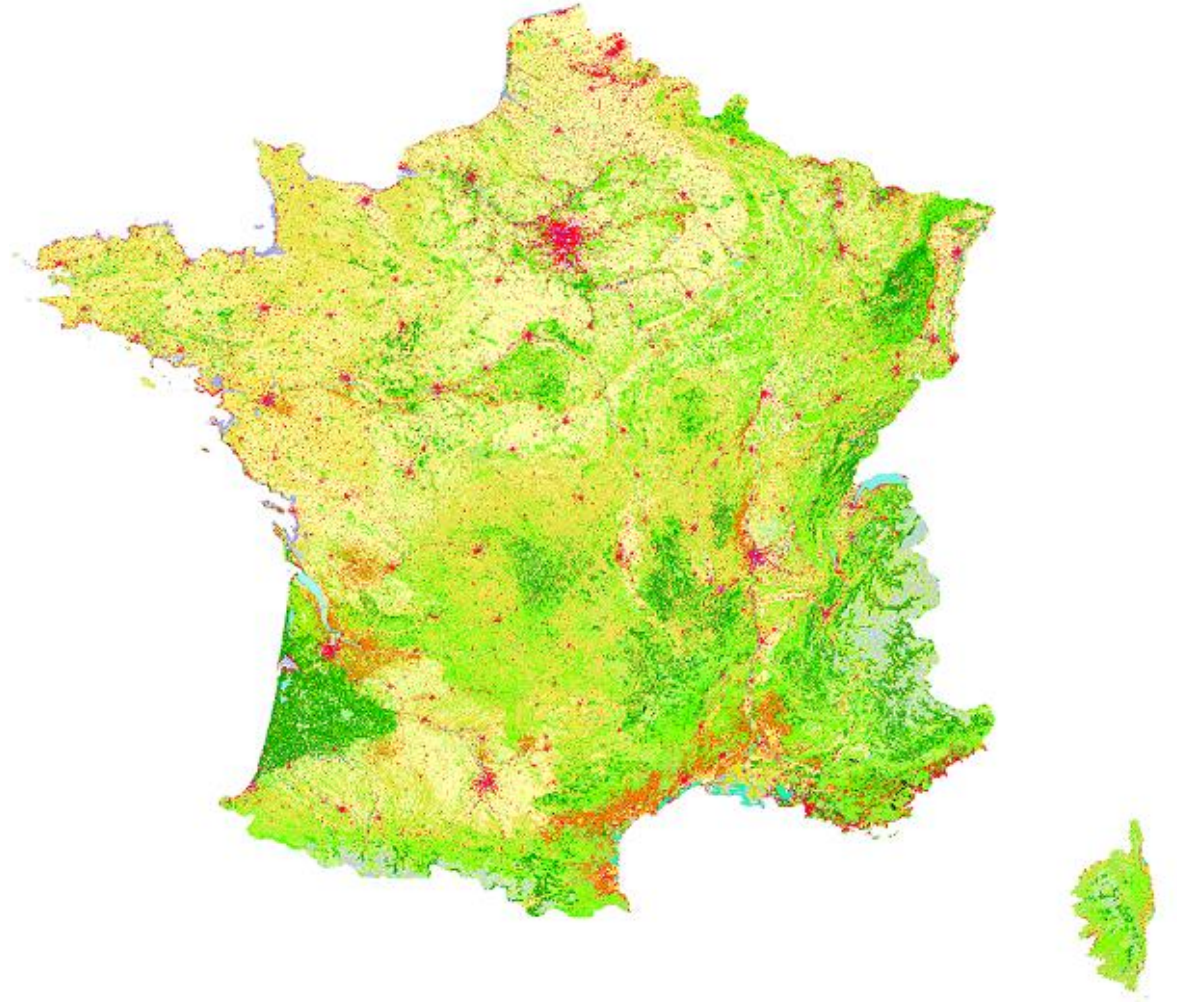
1

Objasnenie princípov klasifikácie obrazu

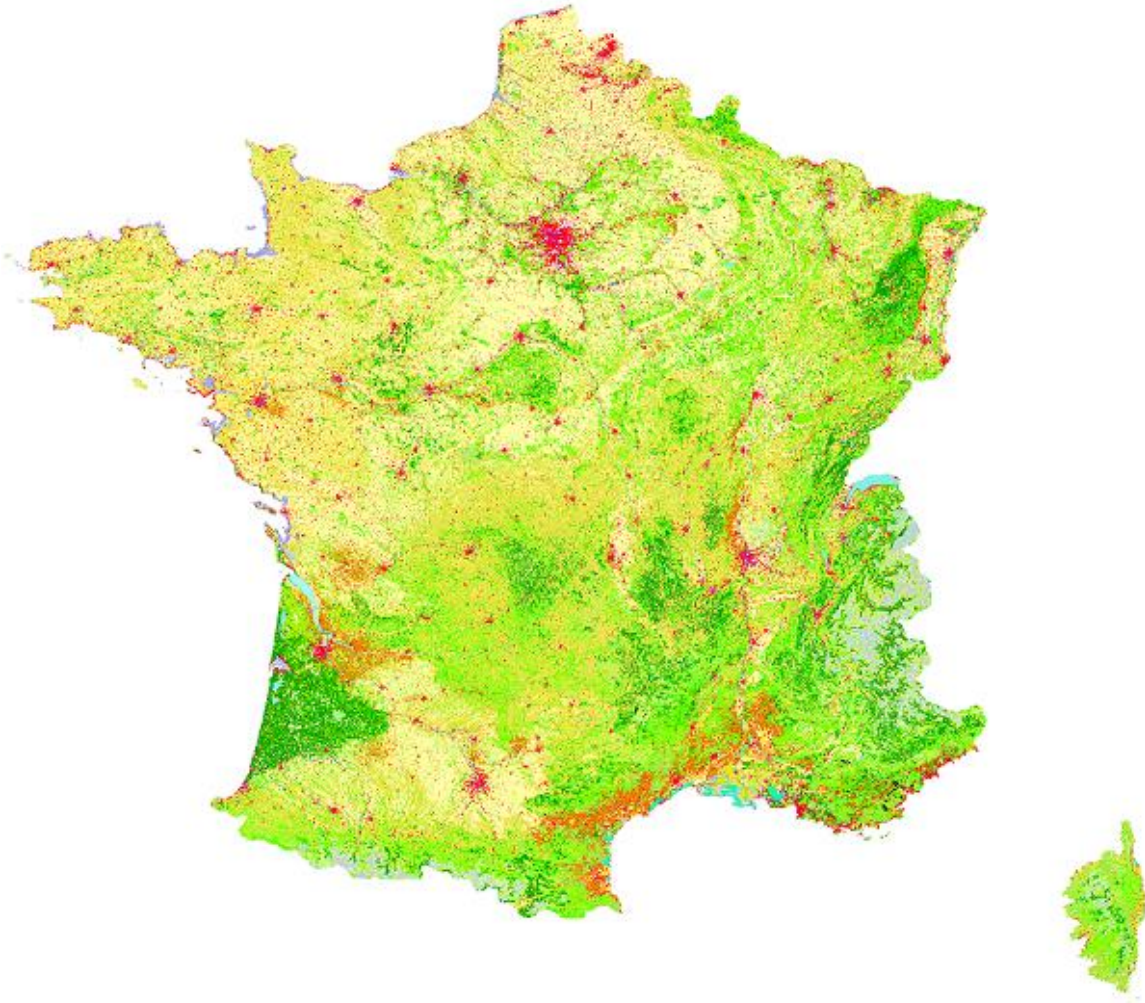
Klasifikácia obrazu

- proces triedenia pixlov do určitého počtu tried na základe ich údajových hodnôt
- ide o hľadanie zmysluplných vzorov v údajoch (spektrálnych a priestorových)
- cieľom je zjednodušiť/spresniť interpretáciu záznamu DPZ

- Príklad: Priradenie všetkých pixelov snímky do tried (napr. voda, listnatý les, ihličnatý les, pole, pôda, sneh..)



Klasifikácia obrazu



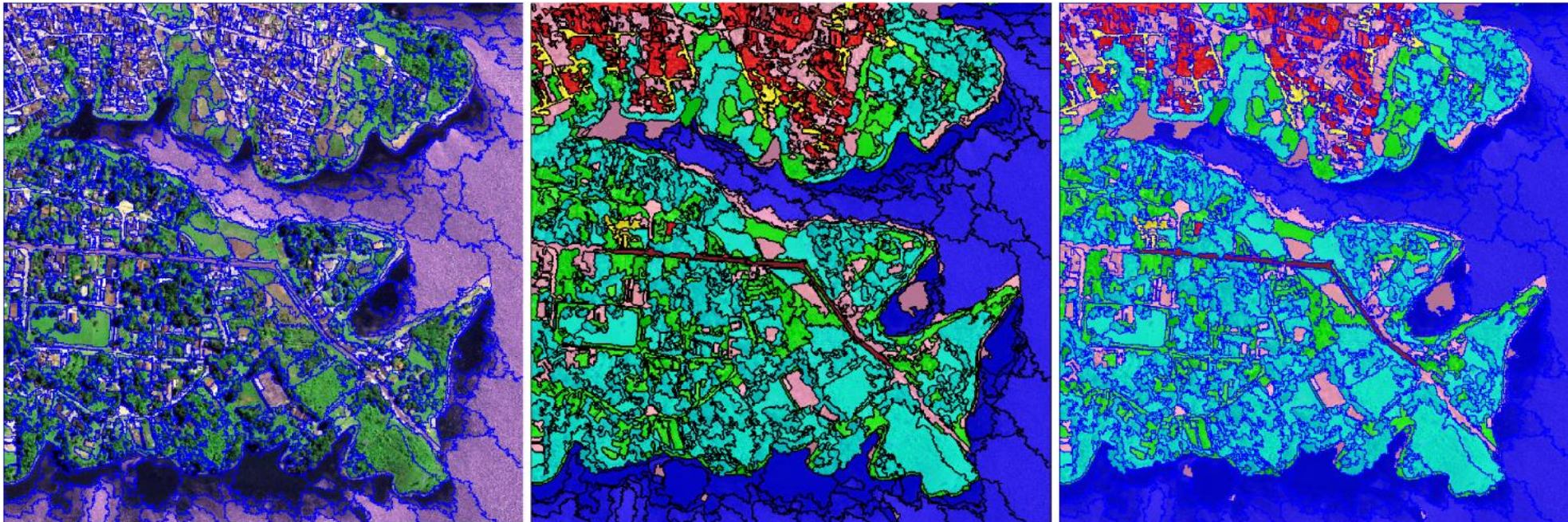
Legend:

Agro-forestry areas	Fruit trees and berry plantations	Pastures
Airports	Glaciers and perpetual snow	Peat bogs
Annual crops associated with permanent crops	Green urban areas	Permanently irrigated land
Bare rocks	Industrial or commercial units	Port areas
Beaches, dunes, sands	Inland marshes	Rice fields
Broad-leaved forest	Intertidal flats	Road and rail networks and associated land
Burnt areas	Land principally occupied by agriculture, with significant areas of natural vegetation	Salines
Coastal lagoons	Mineral extraction sites	Salt marshes
Complex cultivation patterns	Mixed forest	Sclerophyllous vegetation
Coniferous forest	Moors and heathland	Sea and ocean
Construction sites	Natural grasslands	Sparsely vegetated areas
Continuous urban fabric	Non-irrigated arable land	Sport and leisure facilities
Discontinuous urban fabric	Olive groves	Transitional woodland-shrub
Dump sites		Vineyards
Estuaries		Water bodies
		Water courses

2 prístupy

a) Objektovo-orientovaná (OBIA)

- Využíva súčasne spektrálnu informáciu aj jej priestorové rozmiestnenie



(a) Segmented

(b) Classified

(c) Region merged



2 prístupy

b) Založená na pixloch (per-pixel)

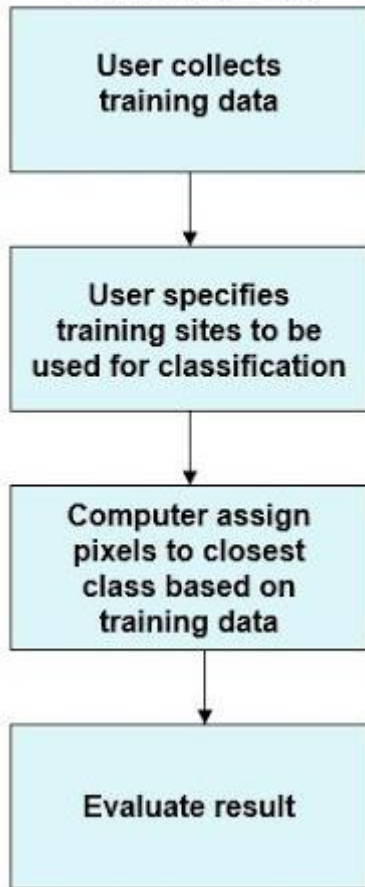
- Využíva iba spektrálnu informáciu
- Nevyužíva priestorové rozmiestnenie a susedské vzťahy

Typy:

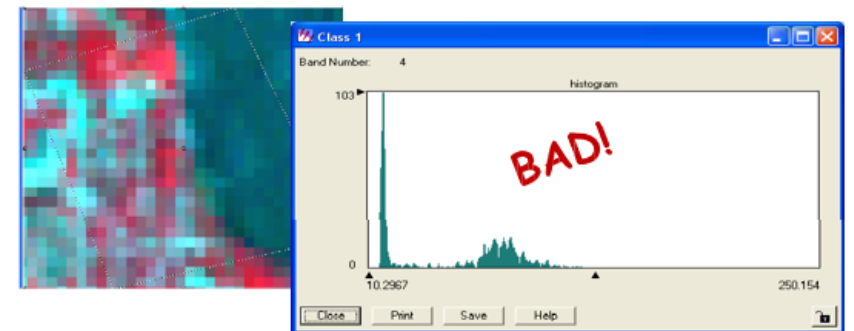
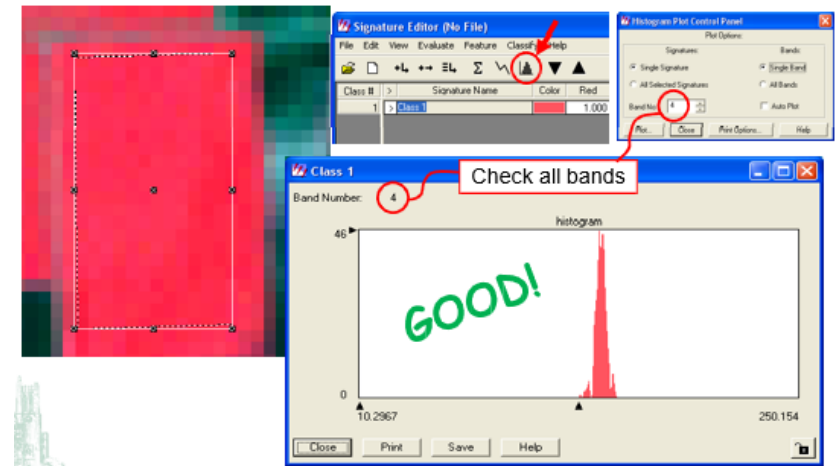
- **Riadená klasifikácia** (Supervised classification)
- **Neriadená klasifikácia** (Unsupervised classification)
- Založená na inom pravidle

Riadená klasifikácia

Supervised Classification



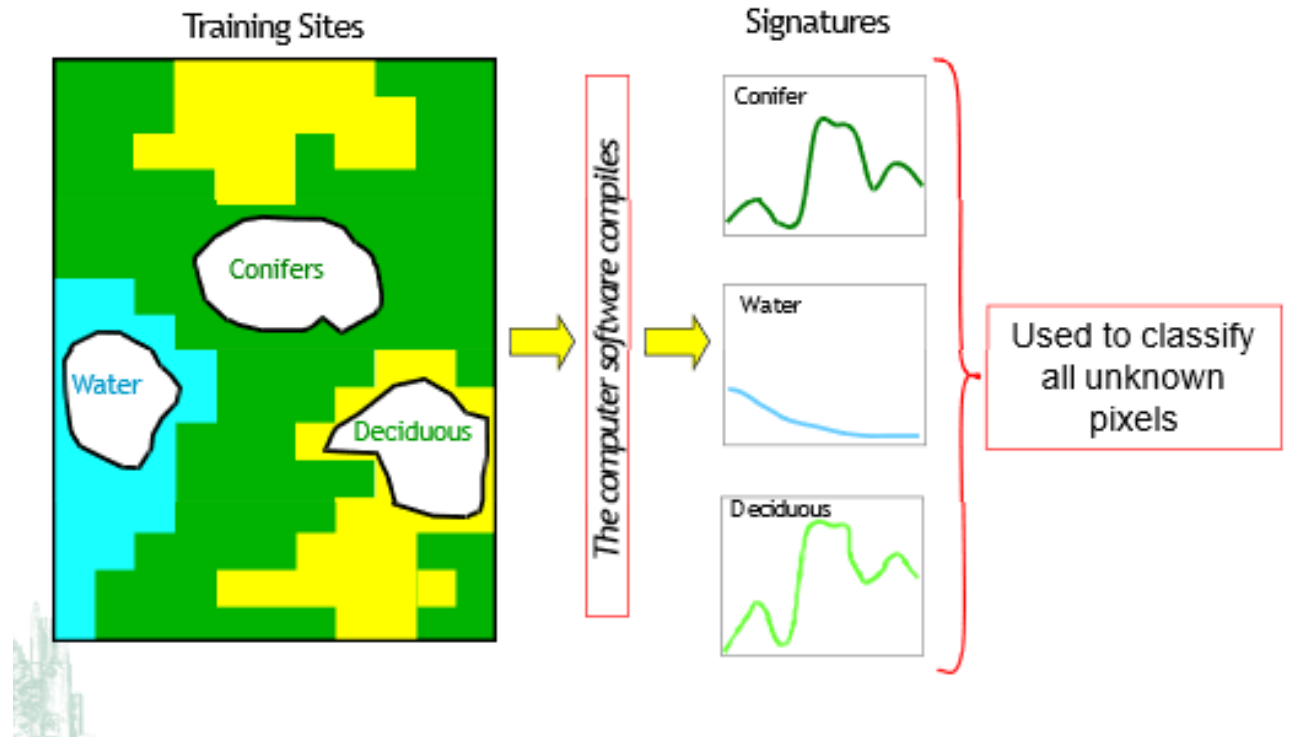
- Užívateľ zdefinuje homogénne, reprezentatívne vzorky, tzv. **trénovacie plochy** rôznych typov krajinej pokrývky
- Počítač na základe zvoleného **algoritmu** priradí pixely do vizuálne najbližšej triedy na základe trénovacích plôch
- Ideálna je dobrá znalosť klasifikovaného územia a dobrá vizuálna interpretácia



Riadená klasifikácia

Typy:

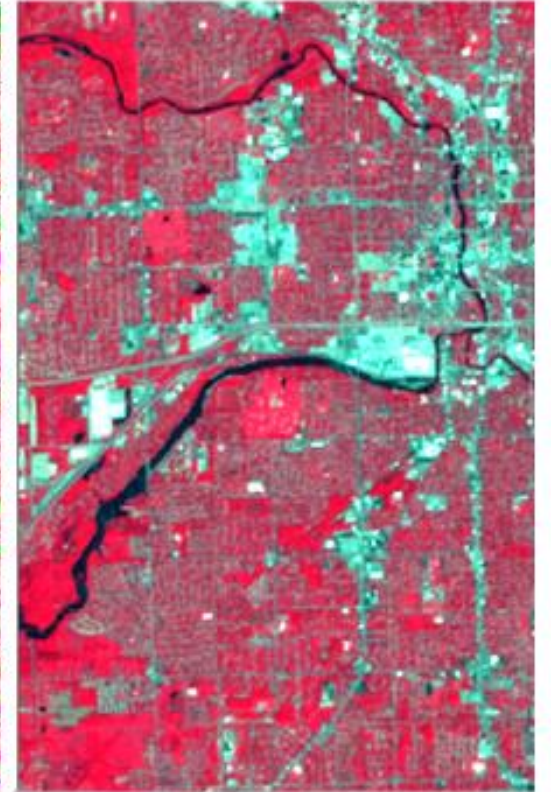
- **Minimum Distance-to-Means**
– priemer hodnôt DN
- **Maximum Likelihood**
– pravdepodobnosť príslušnosti ku triede
- **Spectral Angle Mapper**
– minimálny rozdiel od n-dimenziálneho spektrálneho vektora triedy



Neriadená klasifikácia

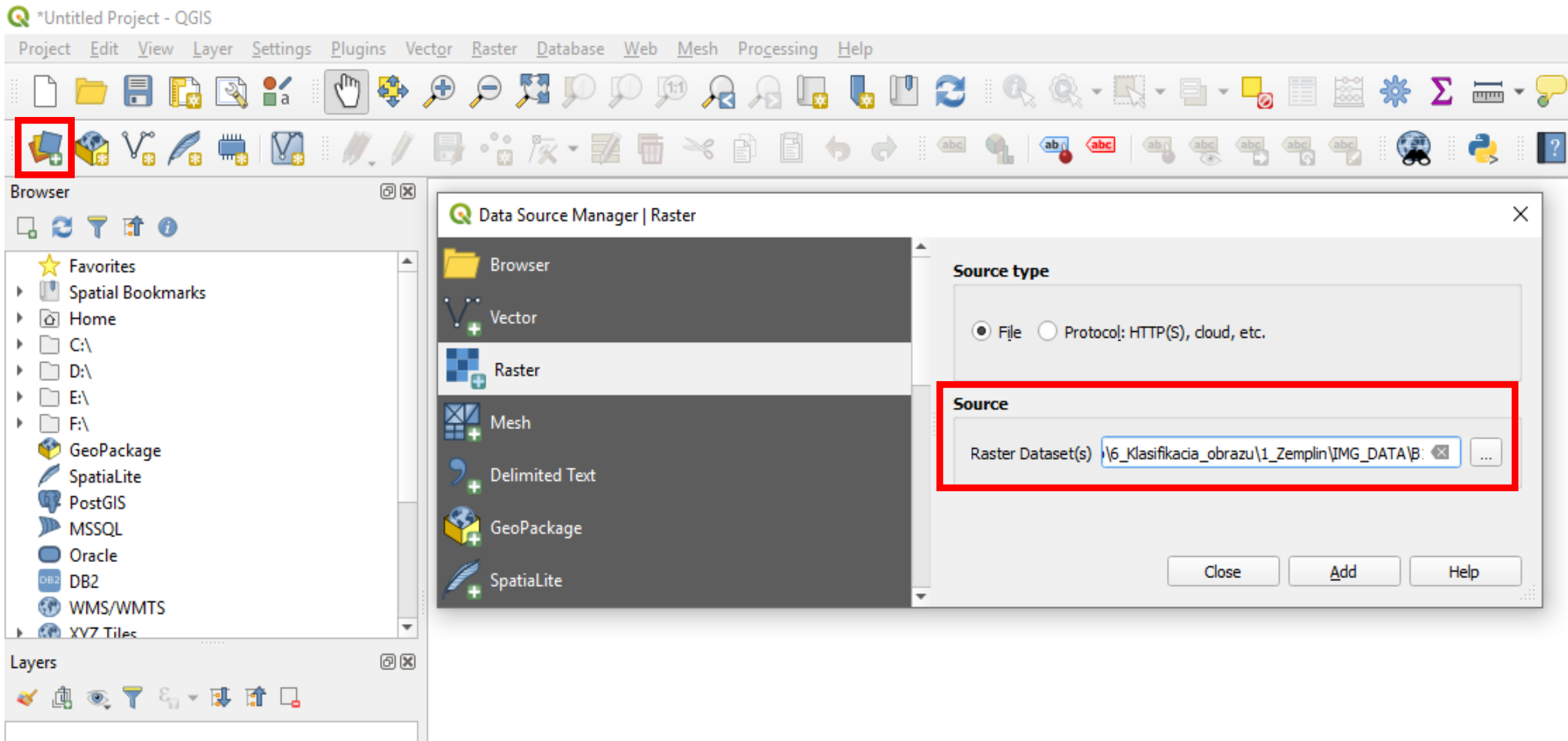
- Surové spektrálne dáta sú zoskupené len na základe štatistickej štruktúry dát
- Potom počítač priradí každý štatistický cluster do vhodnej triedy (ak je to možné)

20 Clusters
6 Iterations

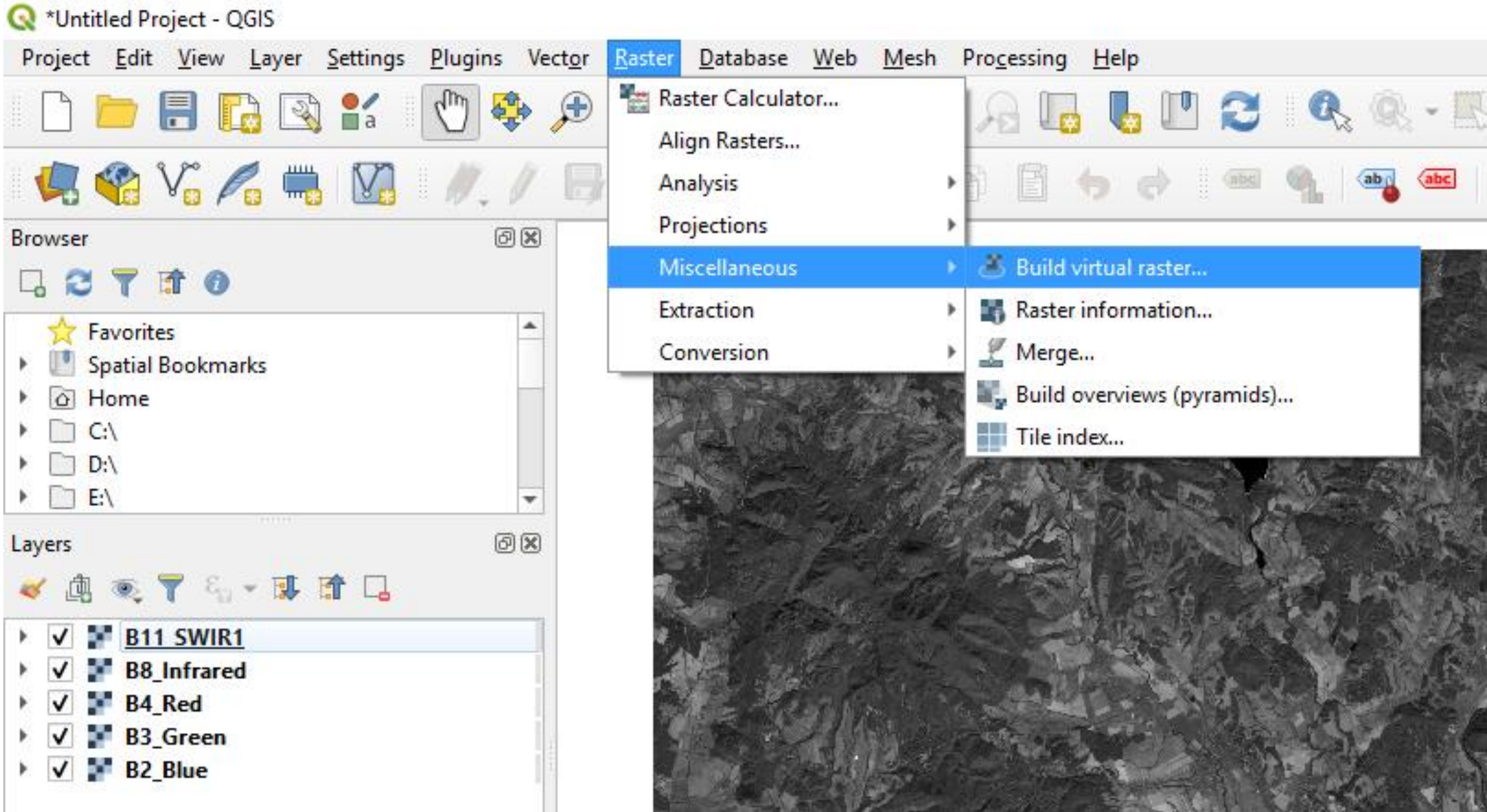


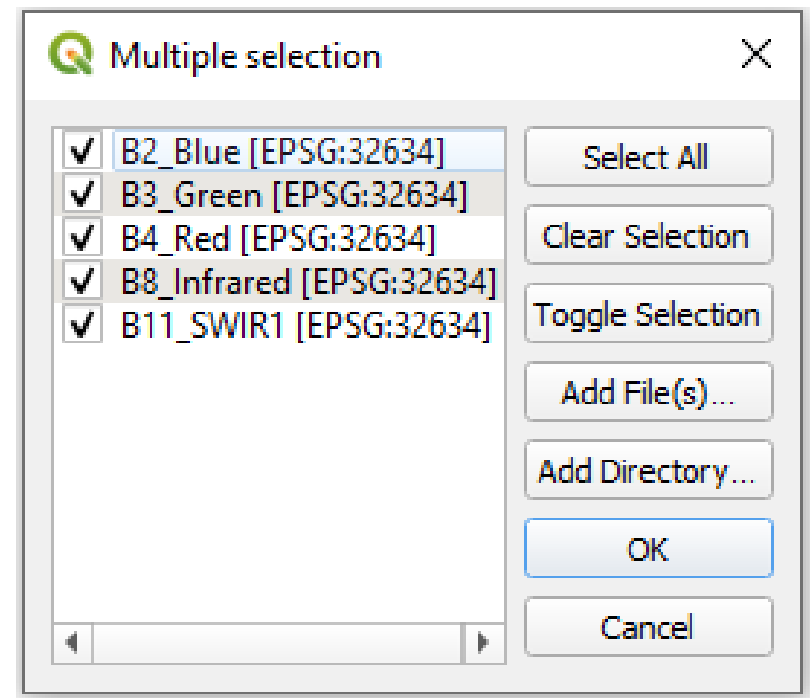
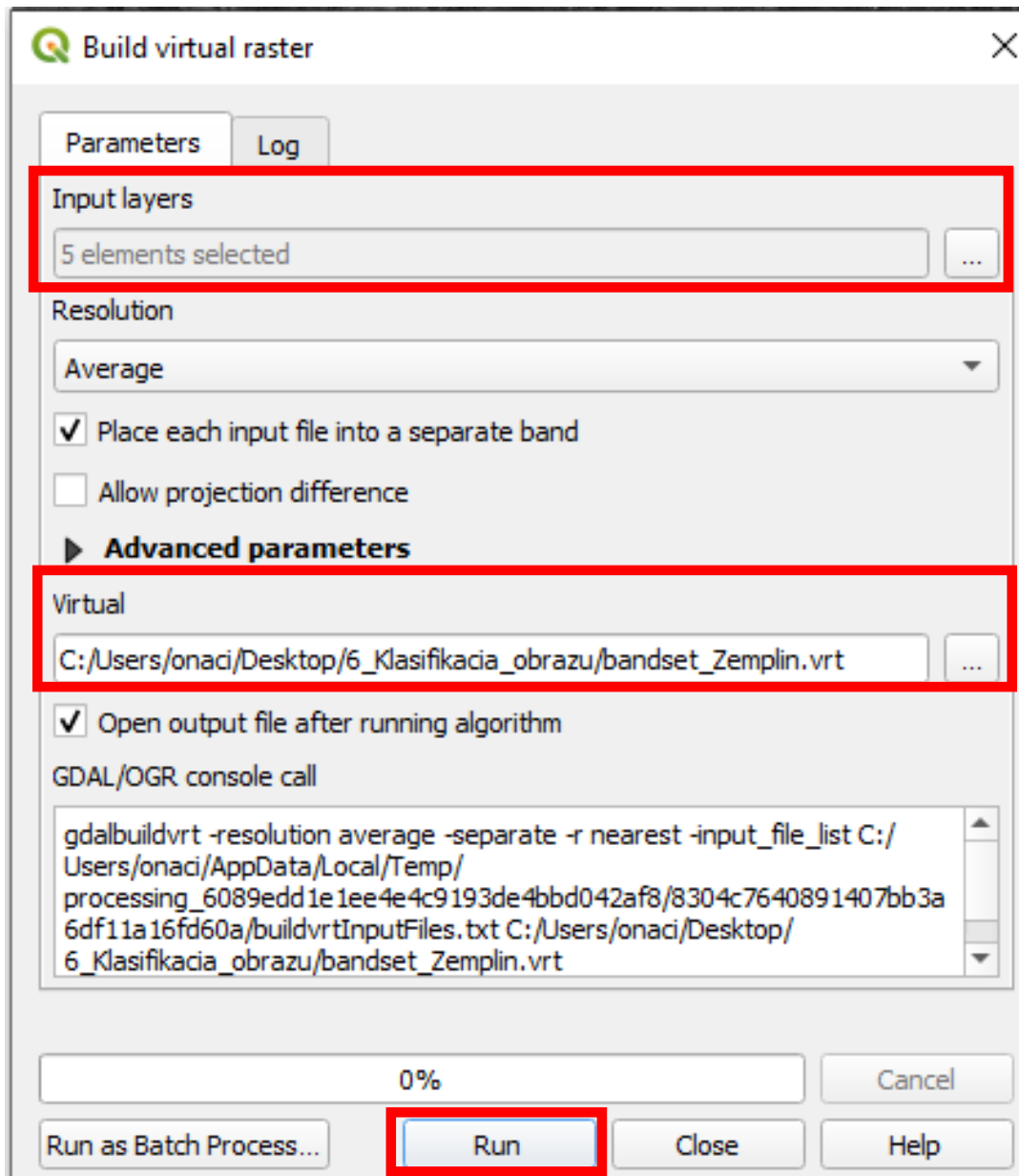
October 2015

1. Načítanie vstupných dát – pásom Sentinel 2



2. Vytvorenie virtuálneho rastra





Browser



★ Favorites

▶ Spatial Bookmarks

▶ Home

▶ C:\

▶ D:\

▶ E:\

Layers



bandset Zemplin

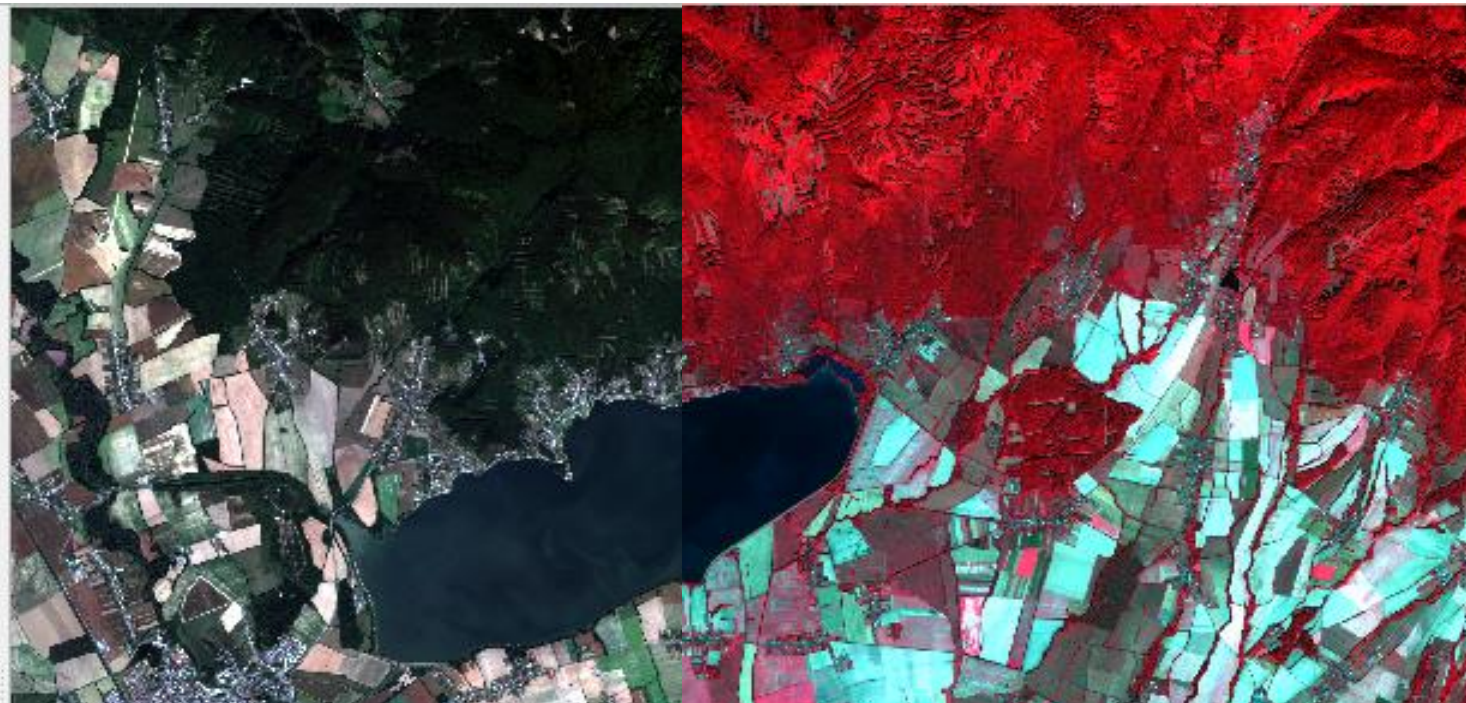
▶ **B11_SWIR1**

▶ **B2_Blue**

▶ **B3_Green**

▶ **B4_Red**

▶ **B8_Infrared**



Layer Properties - bandset_Zemplin | Symbology



Information

Source

Symbology

Transparency

Histogram

Rendering

▼ **Band Rendering**

Render type **Multiband color**

Red band **Band 4**

Min **317** Max **1926**

Green band **Band 3**

Min **548** Max **1608**

Blue band **Band 2**

Min **726** Max **1533**

Project Edit View Layer Settings **Plugins** Vector Raster Database Web Mesh Processing Help

Manage and Install Plugins...
Python Console Ctrl+Alt+P



Browser

- ★ Favorites
- ▶ Spatial Bookmarks
- ▶ Home
- ▶ C:\
- ▶ D:\
- ▶ E:\

Layers

- bandset Zemplin
- ▶ B11_SWIR1
- ▶ B2_Blue
- ▶ B3_Green
- ▶ B4_Red
- ▶ B8_Infrared



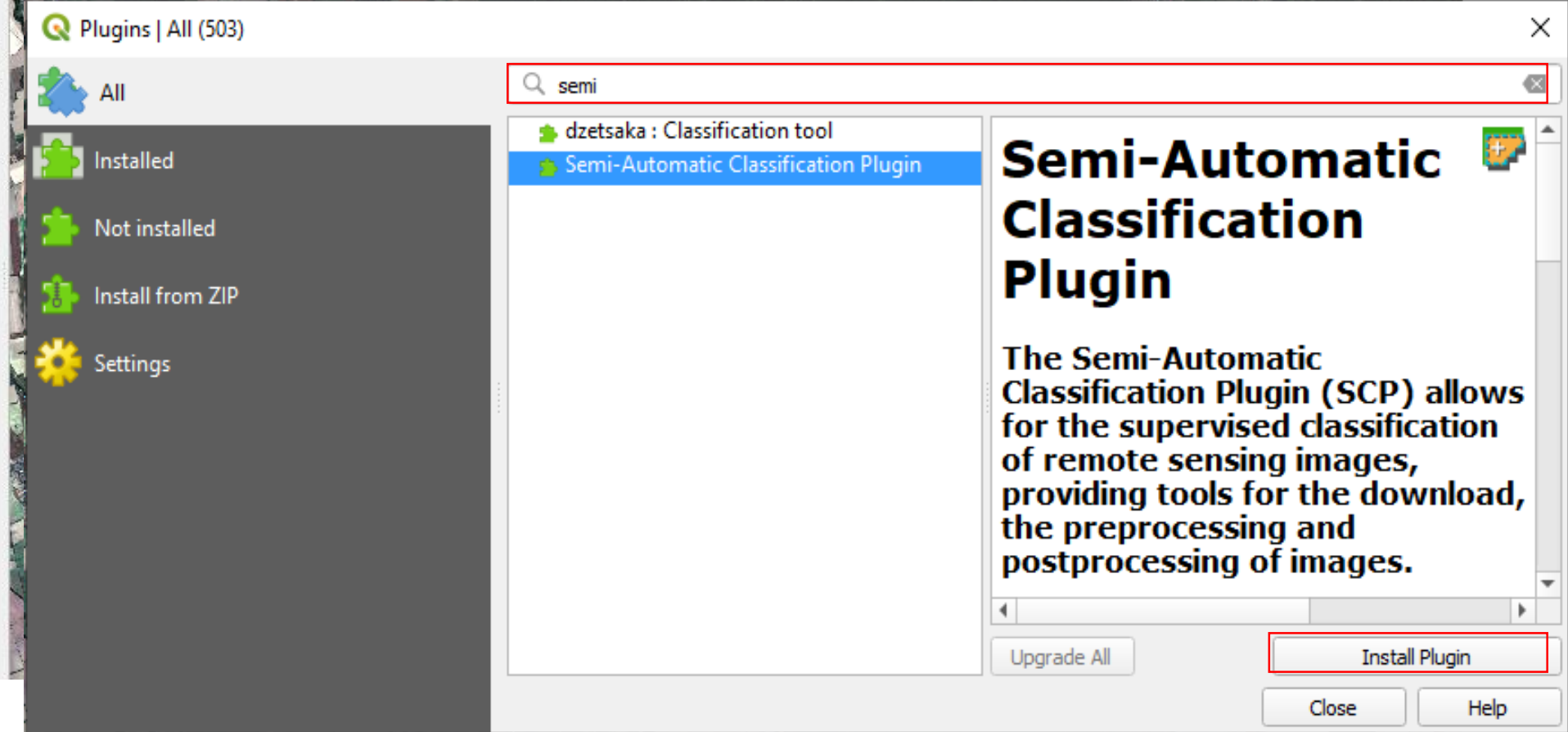
Plugins | All (503)

dzetsaka : Classification tool
Semi-Automatic Classification Plugin

Semi-Automatic Classification Plugin

The Semi-Automatic Classification Plugin (SCP) allows for the supervised classification of remote sensing images, providing tools for the download, the preprocessing and postprocessing of images.

Upgrade All Install Plugin Close Help



*Untitled Project - QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing SCP Help

0 1 2 RGB = ROI Dist 0,010000 Min 60 Max 100 Preview



SCP Dock

Home 6_Klasifikacia_obrazu/1_Zemplin/trenovacie_plochy.scp

Training input ROI Signature list

Classification Macroclass list

ROI options

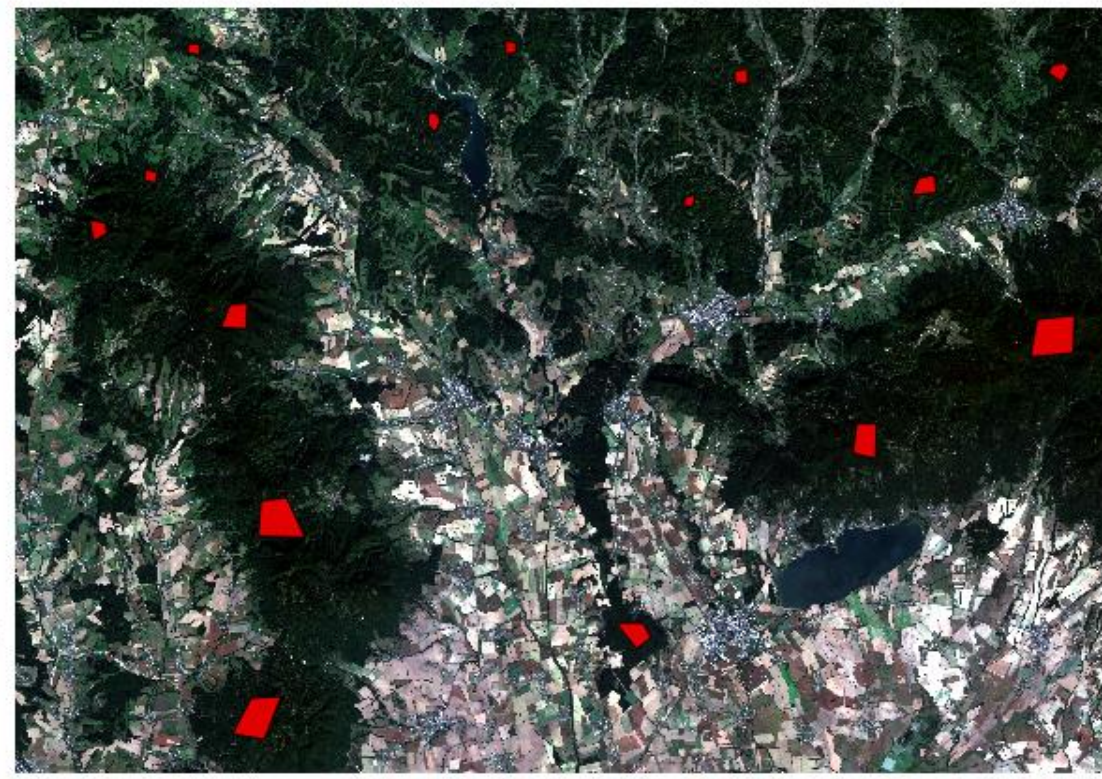
S	Type	MC ID	C ID	C Info	Color

MC ID 1 MC Info MC 1

C ID 1 C Info C 1

Autosave Signature

- Layers
- trenovacie plochy**
 - bandset_Zemplin**
 - B11_SWIR1
 - B2_Blue
 - B3_Green
 - B4_Red
 - B8_Infrared



SCP & Dock

Home

Training input

Classification

ROI Signature list

Macroclass list

ROI options

pp/6_Klasifikacia_obrazu/1_Zemplin/trenovacie_plochy.scp

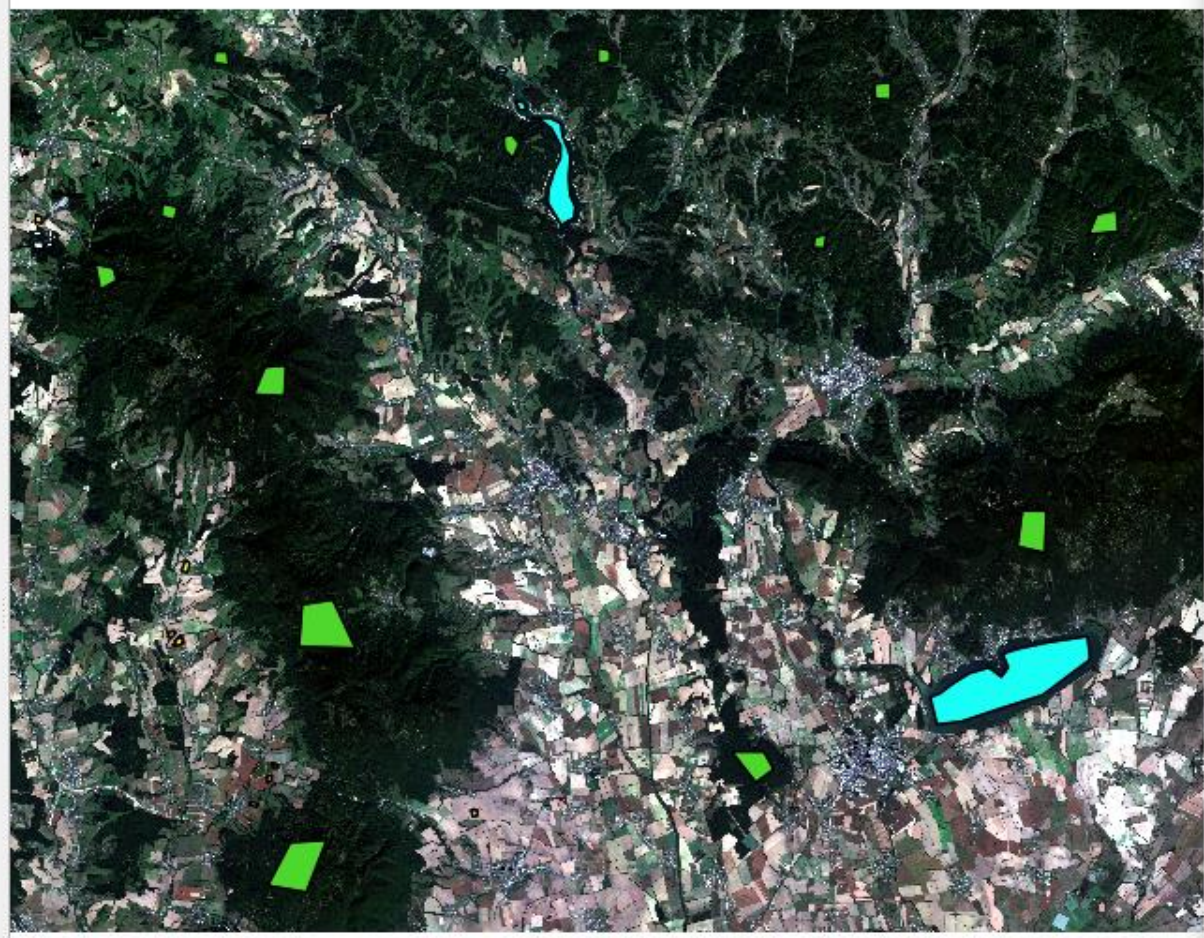
	S	Type	MC ID	C ID	C Info	Color
1	<input checked="" type="checkbox"/>	B	1	1	forest	
2	<input checked="" type="checkbox"/>	B	1	1	forest	
3	<input checked="" type="checkbox"/>	B	1	1	forest	
4	<input checked="" type="checkbox"/>	B	1	1	forest	
5	<input checked="" type="checkbox"/>	B	1	1	forest	
6	<input checked="" type="checkbox"/>	B	1	1	forest	
7	<input checked="" type="checkbox"/>	B	1	1	forest	
8	<input checked="" type="checkbox"/>	B	1	1	forest	
9	<input checked="" type="checkbox"/>	B	1	1	forest	
10	<input checked="" type="checkbox"/>	B	1	1	forest	
11	<input checked="" type="checkbox"/>	B	1	1	forest	
12	<input checked="" type="checkbox"/>	B	1	1	forest	
13	<input checked="" type="checkbox"/>	B	1	1	forest	
14	<input checked="" type="checkbox"/>	B	1	1	forest	
15	<input checked="" type="checkbox"/>	B	1	1	forest	

MC ID: 1 MC Info: MC 1

C ID: 1 C Info: forest

Autosave Signature

- Layers
- trenovacie plochy
 - les
 - pole_luka
 - vodna_plocha
 - zastavana_plocha
 - bandset_Zemplin
 - B11_SWIR1
 - B2_Blue
 - B3_Green
 - B4_Red
 - B8_Infrared



SCP & Dock

Home Training input Classification Macroclass list ROI options

ROI Signature list

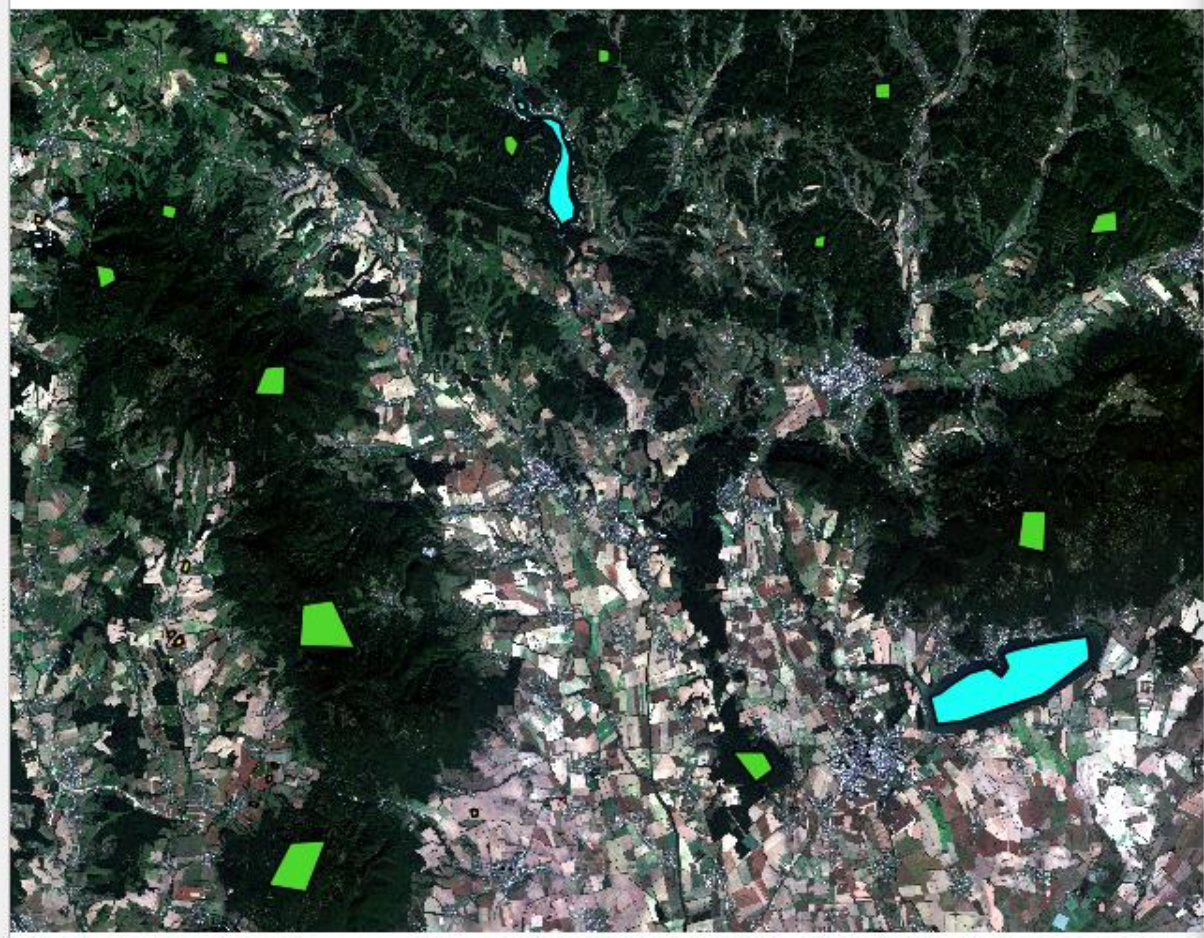
S	Type	MC ID	C ID	C Info	Color	
1	<input checked="" type="checkbox"/>	B	1	1	les	■
2	<input checked="" type="checkbox"/>	B	1	2	vodna_...	■
3	<input checked="" type="checkbox"/>	B	1	3	pole_luka	■
4	<input checked="" type="checkbox"/>	B	1	4	zastava...	■

MC ID: 1 MC Info: MC 1

C ID: 6 C Info: zastavana_plocha

Autosave Signature

- Layers
- ✓ **trenovacie plochy**
 - ✓ les
 - ✓ pole_luka
 - ✓ vodna_plocha
 - ✓ zastavana_plocha
 - ✓ **bandset_Zemplin**
 - B11_SWIR1
 - B2_Blue
 - B3_Green
 - B4_Red
 - B8_Infrared



SCP & Dock

Home Use MC ID C ID

Algorithm
Maximum Likelihood

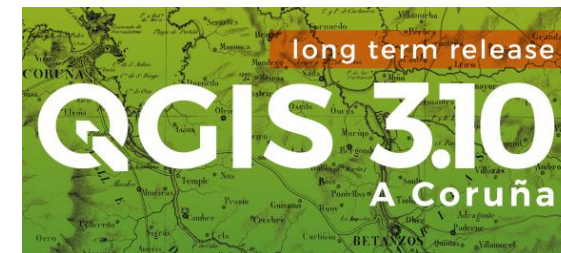
Training input
Threshold 0,0000

Land Cover Signature Classification
Use LCS
 Algorithm only overlap

Classification output
Load qml style [] []
 Apply mask [] []
 Create vector Classification report
 Save algorithm files

RUN

3



Presnosť klasifikácie obrazu

– interpretácia chybovej matice

Chybová matica

		Referenčné údaje						
	Kategória	zastavaná plocha	PHP plocha	lesná plocha	vodná plocha	Celkový súčet	EC (%)	UA (%)
		zastavaná plocha	2	38	2	1	43	95,35%
Klasifikované údaje	PHP plocha	18	53	22	3	96	44,79%	55,21%
	lesná plocha	2	47	88	0	137	35,77%	64,23%
	vodná plocha	1	4	11	8	24	66,67%	33,33%
	Celkový súčet	23	142	123	12	300		
	EO	91,30%	62,68%	28,46%	33,33%		49,67%	
	PA	8,70%	37,32%	71,54%	66,67%			50,33%

EC – chyby nadhodnotenia – reprezentujú pixely, ktoré patria do inej kategórie, akou je záujmová kategória

EO – chyby z podhodnotenia reprezentujú pixely, ktoré patria do správnej kategórie

PA - producentská presnosť - ako dobre môže byť istá plocha klasifikovaná (chyba z podhodnotenia)

UA – užívateľská presnosť – pravdepodobnosť, s akou pixel triedy na mape reprezentuje pixel triedy vzhľadom na ostatné kategórie

+ **Kappa koeficient** – celková štatistická presnosť



ĎAKUJEM ZA POZORNOSŤ