

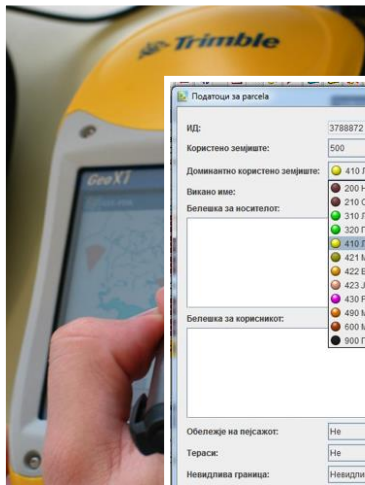
# Sentinel Hub - next generation platform for satellite imagery applications

Grega Milcinski, Sinergise

Matej Batic, Miha Kadunc, Primož Kolaric,  
Rok Mocnik and Marko Repše



# About Sinergise



Податоци за парцела

ИД: 3788972

Користено земјиште: 500

Доминантно користено земјиште: 410 Ложе

Владело име: 200 Нава

Белешка за носителот: 210 Стапеникот (П...  
310 Левада  
320 Пасиште  
410 Ложе  
421 Маслиник  
422 Видови овошје  
423 Јагмоста овошје  
430 Растенија со б...  
490 Мешани трави  
800 Малечни насади  
900 Превремено н...

Белешка за користењето:

Обележје на несајакот: Не

Тераси: Не

Невидлива граница: Неvidлива граница по...

Променета граница: Не

Систем за наводнување: Не

Задолжителна употреба: Не

Намалување: 100%

Право на користење: Да

FDC

Sales

Work packet: 1 -> Sales 309011000245-05101-093028

Sale area: 68.40

Cl sale property type id: apartments

Date contract: 2011.01.01 00:00:00

Sale price: 45000.00

Reg num: 309011000245-05101-093028

Sale items

Records: 1

Building part (68.4m2)

Cancel Save Delete

WebGIS Demo

PODATKI ISKANJE

HTRO ISKANJE

ESRC MID, Nestov

BLOJI

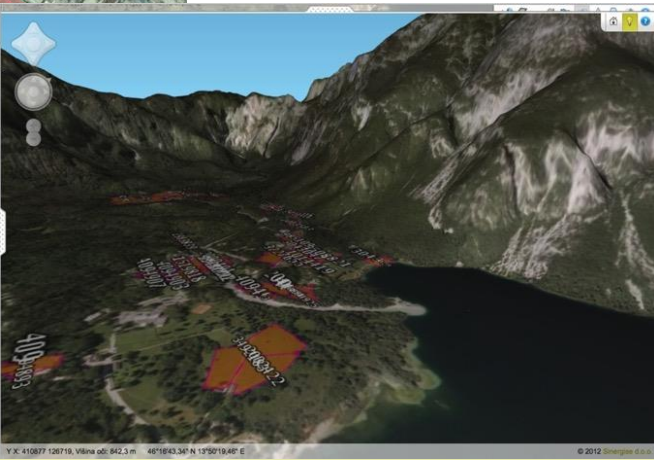
Rastorske podloge

- One foto
- Digitalni model reliefa
- Samostoi popravki
- Topografske in pregledne karte

Rata

- GERK
- Register prostornih enot, naslovi
- Poligoni za urejanje
- Točke za urejanje

iskad



# About Sinergise

The screenshot displays the Sinergise web application interface, which is used for managing and analyzing geospatial data. The interface is divided into several main sections:

- Top Bar:** Includes the logo for "JAVNI PREGLEDOVALNIK GRAFIČNIH PODATKOV MKGP" and navigation tabs for "PODATKI" and "ISKANJE".
- Search Panel:** A search bar with the text "Hitro iskanje" and a search box containing "KMG MID ali Naslov ali Parcela".
- Layers Panel:** A list of layers including "Satellite", "Aerial", "DEM", "Streets", "Buildings", "Cadastral Blocks", and "Scanned plans".
- Main Map View:** A large map area showing a parcel with various colored overlays (red, green, brown) and a "Main view" toolbar.
- Data Panel (Left):** A sidebar with a "filter" button and a list of layers such as "DOF, DMR, DTK50", "Zemljepisna imena", "Raba", "BLOK", "GERK", "RPE, Kataster", "Kontrolni sloji 2015", "Kontrolni sloji 2006 -> 2014", "Trajni nasadi", "KatMeSina", "Gozdarstvo", "Cebelarstvo", and "Obm, neprimerna za EKO čebele".
- Data Panel (Right):** A detailed view of a parcel with the following information:
  - Case:** 442, Parcel: 1602010079
  - General:**
    - ID: 329902
    - PIN: 1602010079
    - Block: 160201 (Bois Chen)
    - Type: [Dropdown]
    - Source: Morcellement Plan
    - Owner: [Text]
    - Deed Area: [Text] m²
    - GIS Area: 405.27 m²
    - Boundary length: 80.85 m
    - Notes: [Text area]
  - Date From:** [Text]
  - Date To:** [Text]
  - Lock:** true
  - Status:** LIVE
  - Active:** true
  - Case:** 442 (Owner: Mario Trebilan)

- Geopedia Panel (Bottom):** A panel for selecting Sentinel-2 use cases, including options like "Satellite", "Sentinel-2 - TRUE COLOUR", "Sentinel-2 - FALSE COLOUR", "Sentinel-2 - NDVI", "Sentinel-2 - RE-NDWI", "Sentinel-2 - EVI", "Sentinel-2 - EVI2", "Sentinel-2 - CRI 1", "Sentinel-2 - CRI 2", "Sentinel-2 - PSRI", "Sentinel-2 - PSRI-NIR", "Sentinel-2 - SR", "Sentinel-2 - ARI 1", "Sentinel-2 - ARI 2", "Sentinel-2 - SAVI (Soil Adjusted VI)", "Sentinel-2 - LAI\_SAVI", "Sentinel-2 - MSAVI2", "Other sources", and "Slovenia, GURS orthophoto imagery, 2014".
- Map Navigation:** A navigation panel on the right side of the map showing a zoomed-in view of the coastline and surrounding areas, with a scale bar indicating 25 km.
- Footer:** Includes the text "© 2015 Sinergise d.o.o. | Data: terrestris GmbH" and coordinates: "E N: 1350451.197 5707094.28 45°32'27.54" N 12°7'52.71" E".



# About Sinergise

## Land management solutions

- Europe
  - Slovenia
  - France
  - Czech Republic
  - Azerbaijan
  - Croatia
  - Macedonia
  - Montenegro
  - Moldova
  - United Kingdom
- Africa
  - Ghana
  - Mauritius
  - Nigeria
  - Tanzania



# Plethora of EO data available – rapidly evolving



**proba-v**

# Some things do not change

Kontrola 2.1.3 (Zemlja 1.7.5.p) (pregledni način), Čuvši skupina: ZONE\_02\_PAZAR\_1 Tip: FOTODIFERENCIJACIJA

1/1 Lupa: LPSID parceli: /1/1

Parcela koju ste izabrali uređuje tako da Minuto Unos - par. Kad izvedete s LPS-om de tajnu status od poravnati na ZAKLUBI Kad zaradite sve parceli, možete zaključiti kontrolu.

ID	Ime parceli	Uzor	Površina	T	0	1	2
573259	IRBAM	300	88 81.88	✓	✓	✓	✓
573369	DRUM	300	88 42.14	✓	✓	✓	✓
573374	KALJED	300	88 81.88	✓	✓	✓	✓
573417	BLATKACA	400	88 19.88	✓	✓	✓	✓
573509	KOD GROBLJA	200	88 44.78	✓	✓	✓	✓
573581	KRBUJ	300	82 83.28	✓	✓	✓	✓
573602	REDAK	410	81 18.43	✓	✓	✓	✓
573652	KLAŠKA NIVA	410	88 87.77	✓	✓	✓	✓
573728	IRBAM	300	88 42.88	✓	✓	✓	✓

ID	Upravo	Kultura	Površina
70660	200	04	0.92

ID	Uzor	Kult	Površina	T	Upravo	Upravo	Toleran.
C	573374	200	0.82	✓	0.82	0.82	0.11
F	200	04	0.82	✓	0.82	0.82	0.11

Rezultati prevođenja sa RGB LPSID

ID	COLETT	VRBE
COLETT_ID		75284
TRF_ID		13782
TRF_ID		1
RABA_ID		200
KMRSI_SFRA		2008
POVRSCINA_M2		716 0388 88788 1 007 8 18788 1 007 8 18788
OPORBA		30
IND_NARAVNA_NEBRICKA		30
GEOMETRY		vrabe.vrd STRUCT(133888v7)

U: Hrvatska 500664.781, 5038440.845 0.0 m 12841 LPSID

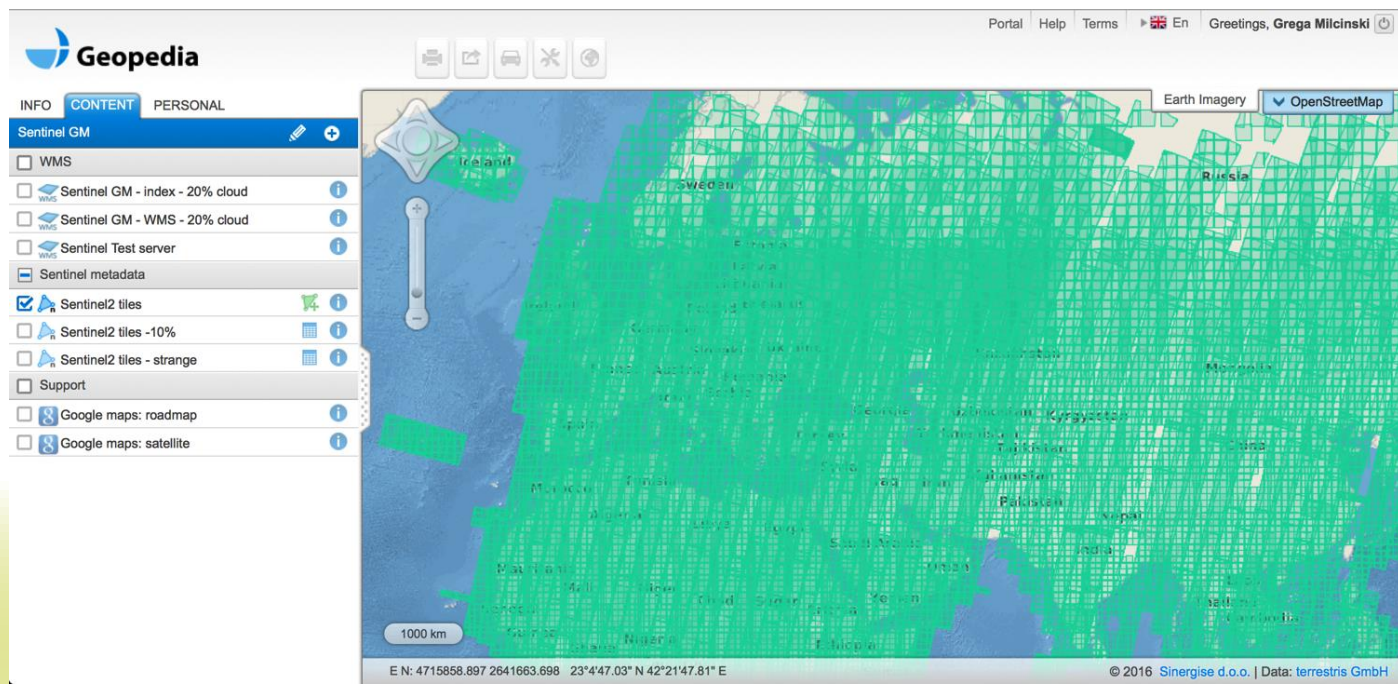
RGB Composite



# Weekly update of data

800 TB of Sentinel-2 data

2 TB per day and growing



The screenshot displays the Geopedia web application interface. The top navigation bar includes 'Portal', 'Help', 'Terms', a language selector set to 'En', and a user greeting 'Greetings, Grega Milcinski'. The main content area is divided into three tabs: 'INFO', 'CONTENT', and 'PERSONAL'. Under the 'CONTENT' tab, a list of layers is shown for 'Sentinel GM'. The layers include:

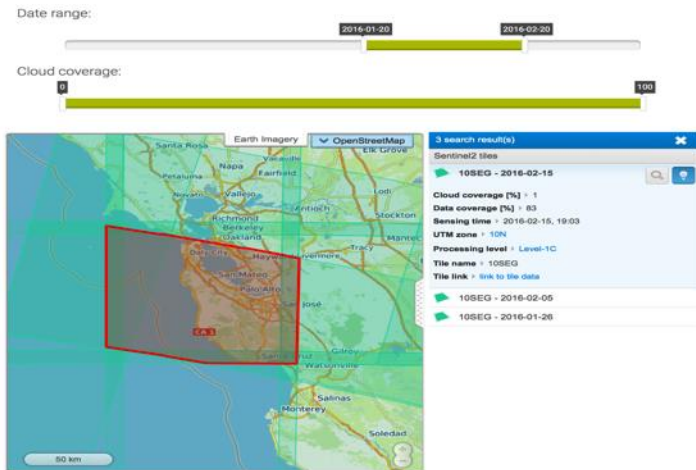
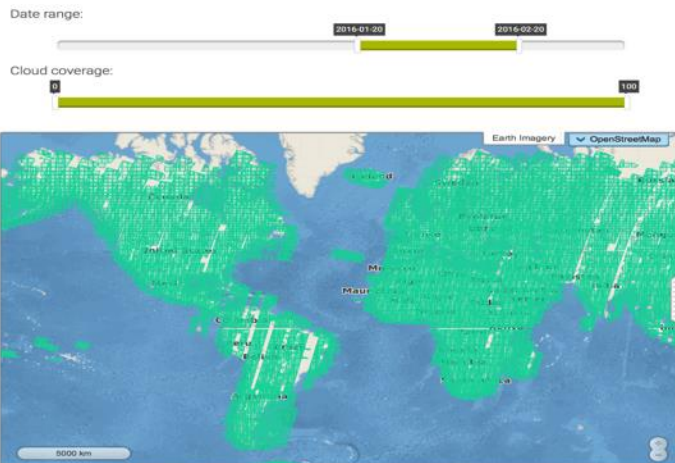
- WMS
- Sentinel GM - index - 20% cloud
- Sentinel GM - WMS - 20% cloud
- Sentinel Test server
- Sentinel metadata
- Sentinel2 tiles
- Sentinel2 tiles -10%
- Sentinel2 tiles - strange
- Support
- Google maps: roadmap
- Google maps: satellite

The map area shows a grid of green tiles overlaid on a satellite-style map of Europe. A scale bar indicates 1000 km. The bottom status bar shows coordinates: E N: 4715858.897 2641663.698 23°44'03" N 42°21'47.81" E. The bottom right corner contains the copyright notice: © 2016 Sinergise d.o.o. | Data: terrestris GmbH.

# Sentinel-2 on AWS

Sentinel-2 data is available for anyone to use via Amazon S3.

- `s3://sentinel-pds`
- `http://sentinel-pds.s3-website.eu-central-1.amazonaws.com`



## Sentinel public image browser

[sentinel-s2-11c](#) > [tiles](#) > [10](#) > [S](#) > [EG](#) > [2016](#) > [2](#) > [15](#) > [0](#)

[↑](#) ([folder up](#))

[auxiliary](#)

[qi](#)

[B01.jp2](#)

[B02.jp2](#)

[B03.jp2](#)

[B04.jp2](#)

[B05.jp2](#)

[B06.jp2](#)

[B07.jp2](#)

[B08.jp2](#)

[B09.jp2](#)

[B10.jp2](#)

[B11.jp2](#)

[B12.jp2](#)

[B8A.jp2](#)

[metadata.xml](#)

[preview.jp2](#)

[productInfo.json](#)

[tileInfo.json](#)

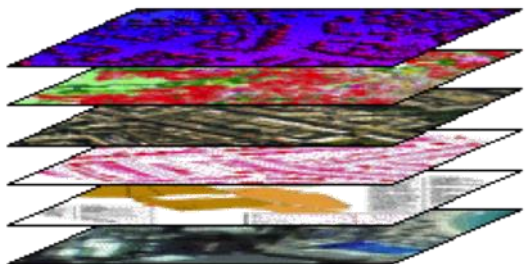


# EO Platforms

- AWS, Google Cloud, EODC, EO Cloud, DIAS
  - (some) data + VM
  - (lock-in)
- Google Earth Engine, GDBX, Planet, Urthecast
  - (some) data + VM + Services
  - lock-in
- Limitations
  - Limited datasets
  - Scalability



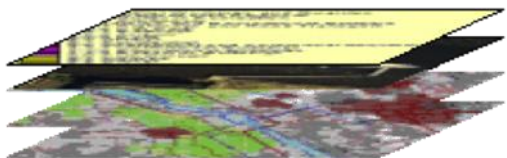
Open EO data - Sentinel-1, Sentinel-2, Landsat, etc.



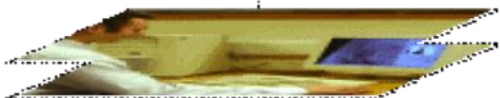
Commercial EO data – WorldWind, GeoEye,...



Aerial imagery (drone, plane)



Other raster data



**SENTINEL** Hub

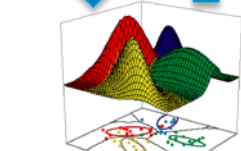


**WMTS**

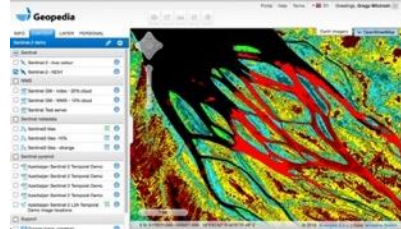
**WMS**

**WCS**

**API**



Machine learning



Cloud GIS



Web applications

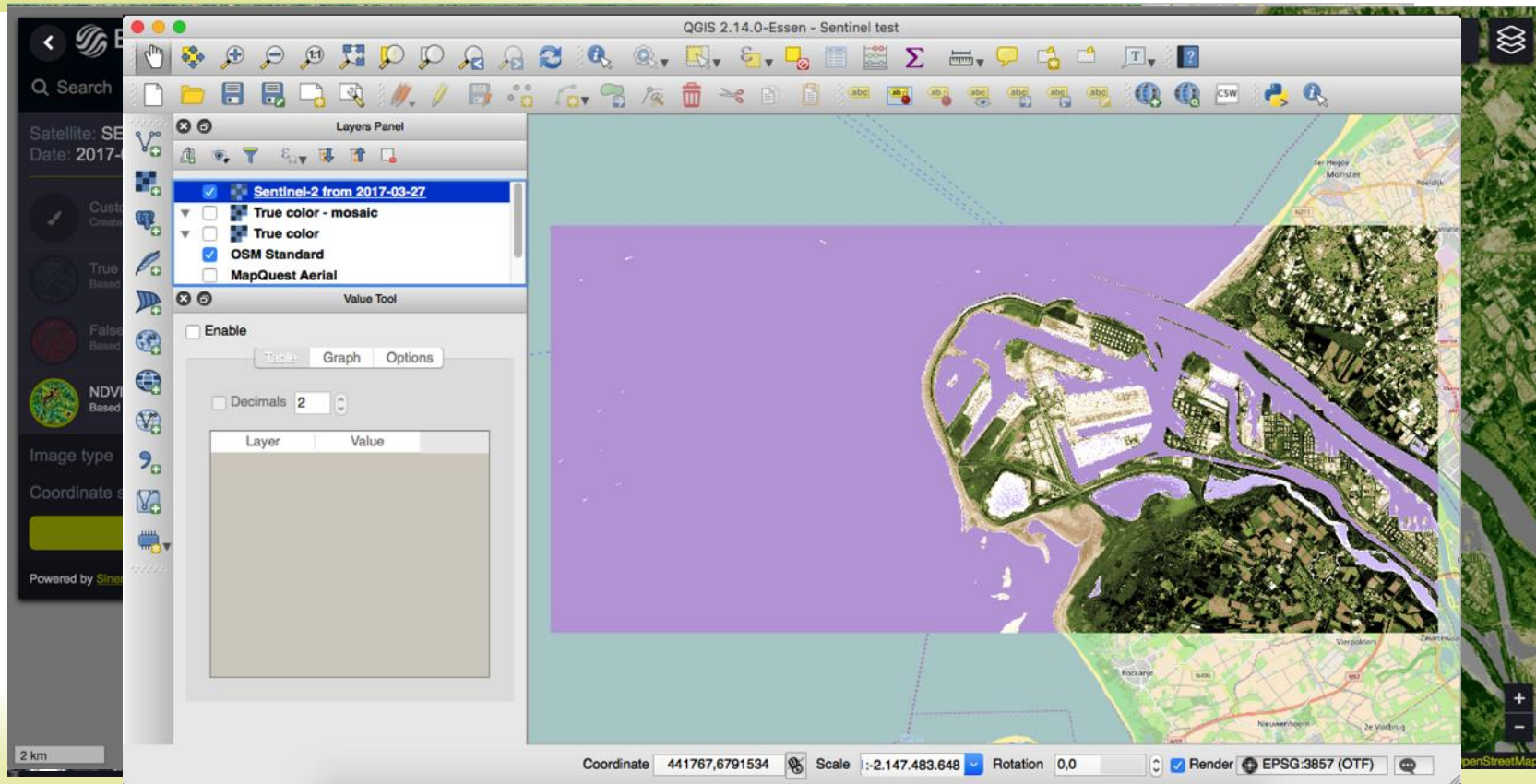


Open source GIS  
(QGIS, OpenJump,..)





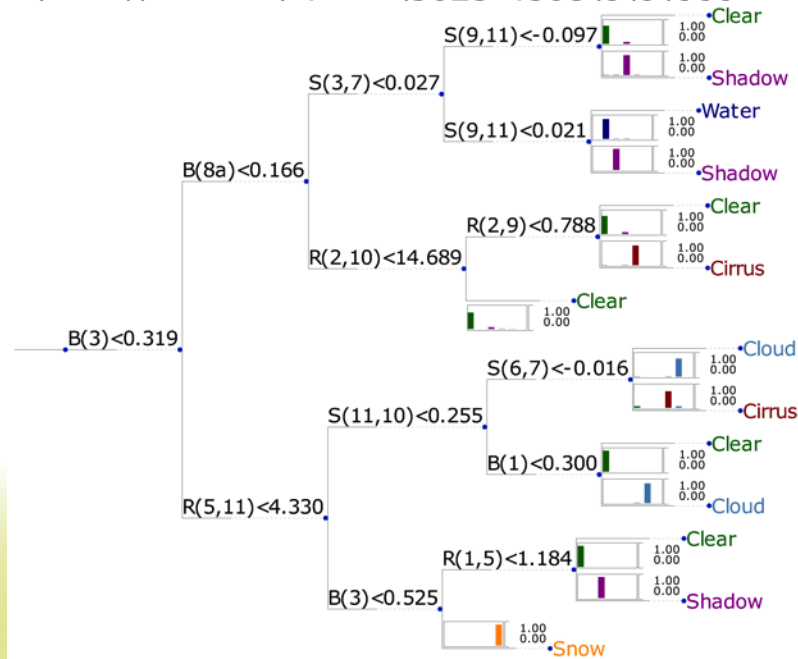
# EO Browser



<http://apps.sentinel-hub.com/eo-browser/>

# EO classification example

Hollstein et. al: *Ready-to-Use Methods for the Detection of Clouds, Cirrus, Snow, Shadow, Water and Clear Sky Pixels in Sentinel-2 MSI Images*



```
JavaScript
var S = function(a, b) { return a - b };
var R = function(a, b) { return a / b };
var natCol = [3*B04, 3*B03, 3*B02];
var CLEAR = natCol; // [0.1, 0.9, 0.1];
var SHADOW = natCol; // [0.8, 0.0, 0.7];
var WATER = [0.1, 0.1, 0.7];
var CIRRUS = [0.8, 0.1, 0.1];
var CLOUD = [0.3, 0.3, 1.0];
var SNOW = [1.0, 0.8, 0.4];

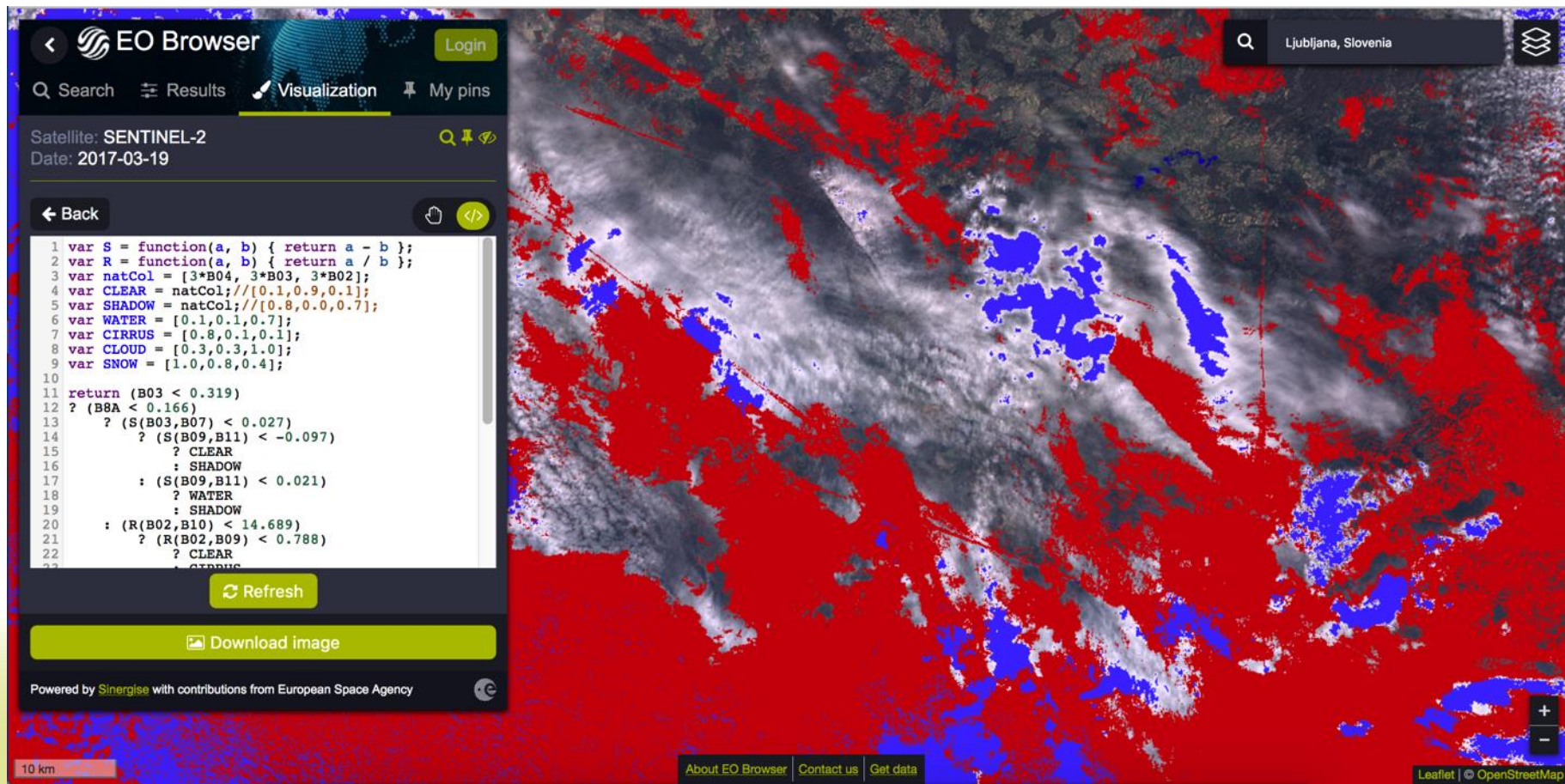
return (B03 < 0.319)
? (B8A < 0.166)
  ? (S(B03, B07) < 0.027)
    ? (S(B09, B11) < -0.097)
      ? CLEAR
      : SHADOW
    : (S(B09, B11) < 0.021)
      ? WATER
      : SHADOW
    : (R(B02, B10) < 14.689)
      ? (R(B02, B09) < 0.788)
        ? CLEAR
        : CIRRUS
      : CLEAR
  : (R(B05, B11) < 4.33)
    ? (S(B11, B10) < 0.255)
      ? (S(B06, B07) < -0.016)
        ? CLOUD
        : CIRRUS
      : (B01 < 0.3)
        ? CLEAR
        : CLOUD
    : (B03 < 0.525)
      ? (R(B01, B05) < 1.184)
        ? CLEAR
        : SHADOW
      : SNOW;
```

# EO classification example

The screenshot displays the EO Browser interface. The top navigation bar includes a back arrow, the EO Browser logo, a 'Login' button, and a search bar labeled 'Search places'. Below this, a secondary navigation bar contains 'Search', 'Results', 'Visualization', and 'My pins'. The main sidebar on the left features a 'Finish comparison' button, a 'Clear pins' button, and a 'Split mode' selector with 'Opacity' and 'Split' options. Two data layers are listed: 'Sentinel-2: 4\_CLOUDS | 2017-03-14' and 'Sentinel-2: 1\_TRUE\_COLOR | 2017-03-14', each with a 'Split position' slider. The bottom of the sidebar includes the text 'Powered by SinerGise with contributions from European Space Agency' and a logo. The main map area shows a satellite image with a classification overlay in red and yellow. A '10 km' scale bar is located in the bottom left corner. The bottom right corner contains zoom controls (+ and -) and a footer with links for 'About EO Browser', 'Contact us', and 'Get data'.



# EO classification example



The screenshot displays the EO Browser interface. The top navigation bar includes a search icon, the text "EO Browser", a "Login" button, and a search bar containing "Ljubljana, Slovenia". Below the navigation bar, there are tabs for "Search", "Results", "Visualization" (which is active), and "My pins".

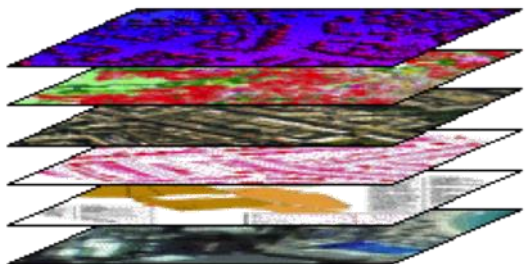
The main content area is divided into two sections. The left section contains a code editor with a "Back" button and a "Refresh" button. The code is as follows:

```
1 var S = function(a, b) { return a - b };
2 var R = function(a, b) { return a / b };
3 var natCol = [3*B04, 3*B03, 3*B02];
4 var CLEAR = natCol; //[0.1,0.9,0.1];
5 var SHADOW = natCol; //[0.8,0.0,0.7];
6 var WATER = [0.1,0.1,0.7];
7 var CIRRUS = [0.8,0.1,0.1];
8 var CLOUD = [0.3,0.3,1.0];
9 var SNOW = [1.0,0.8,0.4];
10
11 return (B03 < 0.319)
12 ? (B8A < 0.166)
13   ? (S(B03,B07) < 0.027)
14     ? (S(B09,B11) < -0.097)
15       ? CLEAR
16         : SHADOW
17       : (S(B09,B11) < 0.021)
18         ? WATER
19         : SHADOW
20     : (R(B02,B10) < 14.689)
21       ? (R(B02,B09) < 0.788)
22         ? CLEAR
23         : SHADOW
```

The right section shows a satellite image of Ljubljana, Slovenia, with a color-coded classification overlay. The map is predominantly red, with blue areas representing water bodies and white areas representing snow or ice. A scale bar at the bottom left indicates 10 km. The bottom right corner features a "10 km" scale bar, a "Powered by Sinergise with contributions from European Space Agency" logo, and a "Creative Commons" license icon.

At the bottom of the interface, there are several utility buttons: "Download image", "About EO Browser", "Contact us", "Get data", and "Leaflet | © OpenStreetMap".

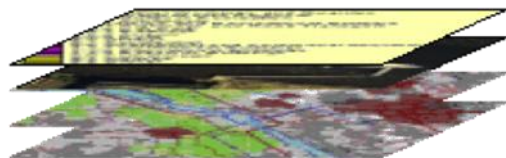
Open EO data - Sentinel-1, Sentinel-2, Landsat, etc.



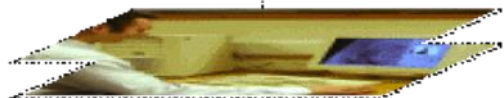
Commercial EO data – WorldWind, GeoEye,...



Aerial imagery (drone, plane)



Other raster data



**SENTINEL** Hub

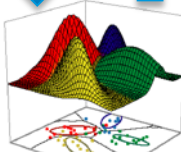


**WMTS**

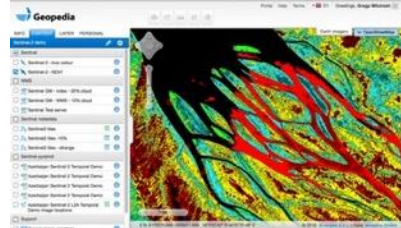
**WMS**

**WCS**

**API**



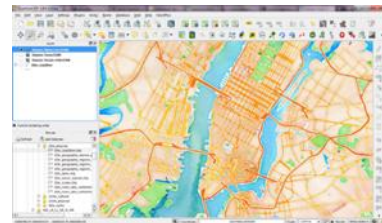
Machine learning



Cloud GIS



Web applications



Open source GIS  
(QGIS, OpenJump,..)



# Using Sentinel Hub OGC services

The screenshot displays the ArcGIS Online web interface. The browser address bar shows the URL `www.arcgis.com/home/webmap/viewer.html`. The page title is "ArcGIS - My Map". The search bar contains the text "Istanbul, Istanbul, Turkey".

The interface includes a top navigation bar with "New Map" and "Grega" options. Below this is a toolbar with icons for "Details", "Add", "Basemap", "Save", "Share", "Print", "Measure", and "Bookmarks".

The left sidebar contains a "Contents" panel with the following items:

- Sinergise WMS service for Sentinel imagery
  - Tile ID texts
  - Tile date texts
  - Tile fills
  - Tile outlines
  - NDVI
  - True color
- Topographic

The main map area shows a satellite image of Istanbul, Turkey, with a prominent bridge crossing the water. The map includes standard navigation controls (home, pan, zoom in, zoom out, refresh) and a scale bar.

At the bottom of the map, there is a "Geopedia" logo on the left and "POWERED BY esri" on the right. The footer text reads: "Esri.com ArcGIS Marketplace Help Terms of Use Privacy Contact Esri Report Abuse" and "Terra Mapping the Globe Ltd, Esri, HERE, DeLorme, INCREMENT P, USGS, METI/NASA".

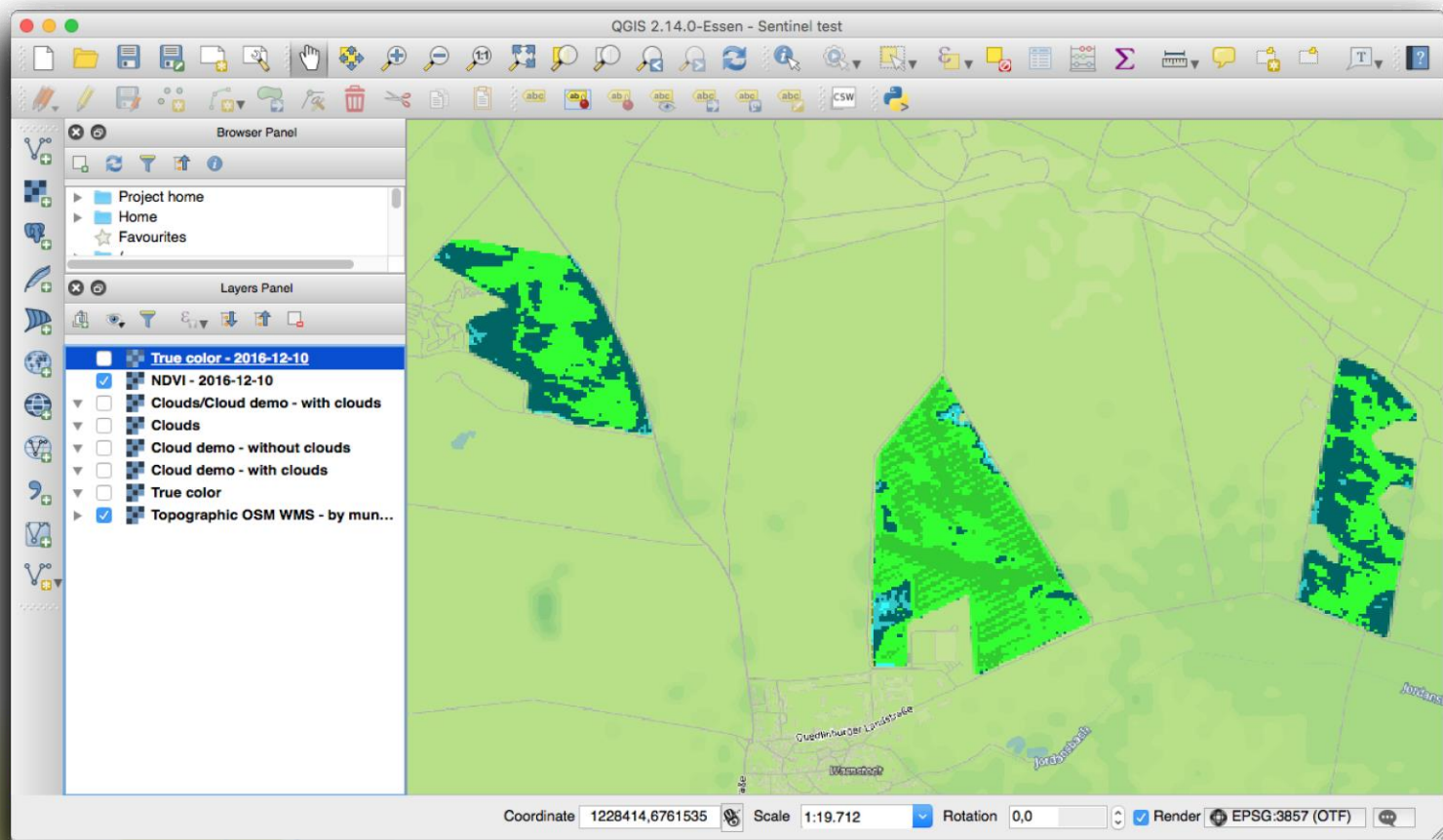


# Web Coverage Service

- post-processing of data
- GeoTiff, JP2
- full resolution
- reflectance/composites



# Mosaic Generator



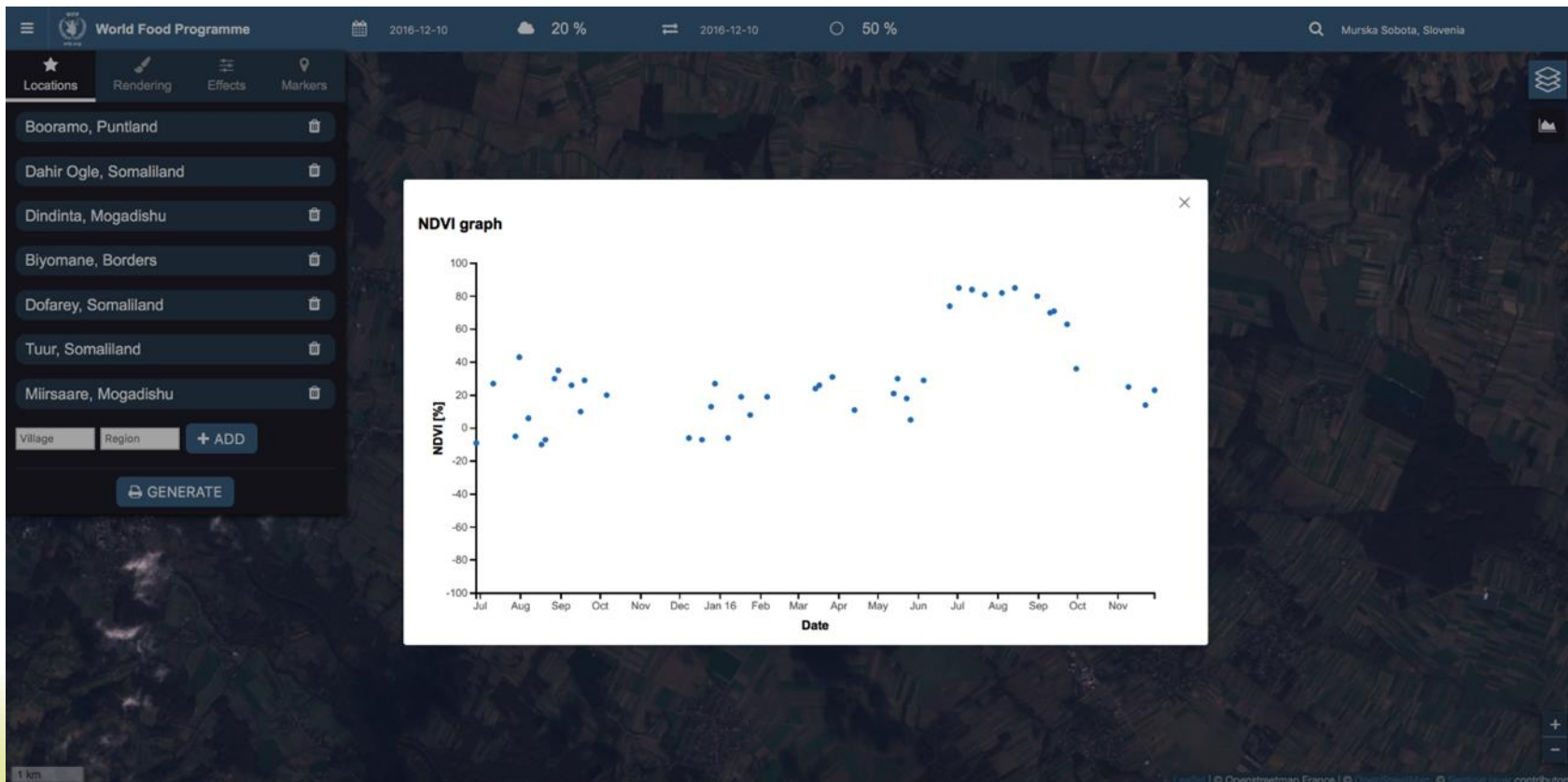
# Statistical API – time series

```
{
  "NDVI": [
    {
      "date": "2015-08-30",
      "basicStats": {
        "min": -0.5478424429893494,
        "max": 0.7815912365913391,
        "mean": 0.147320137875888,
        "stDev": 0.35443419609590726
      }
    },
    {
      "date": "2015-07-11",
      "basicStats": {
        "min": -0.5127978920936584,
        "max": 0.8115044236183167,
        "mean": 0.20168528533031557,
        "stDev": 0.31436594348376923
      }
    }
  ]
}
```

```
{
  "NDVI": [
    {
      "date": "2015-08-30",
      "basicStats": {
        "min": -0.5478424429893494,
        "max": 0.7815912365913391,
        "mean": 0.147320137875888,
        "stDev": 0.35443419609590726
      },
      "histogram": {
        "bins": [
          {
            "value": -0.23164855383139124,
            "count": 14377.0
          },
          {
            "value": 0.08134964140017291,
            "count": 1844.0
          },
          {
            "value": 0.23792375711536012,
            "count": 4692.0
          },
          {
            "value": 0.37365802377462387,
            "count": 4.0
          }
        ]
      }
    }
  ]
}
```



# Statistical API



# Integration in web applications

The screenshot displays the GEO-Wiki LAND-COVER web application interface. At the top left, the GEO-Wiki logo and the text "LAND-COVER" are visible. To the right, the IIASA logo and the text "International Institute for Applied Systems Analysis" are present. Below the header, there is a search bar containing "Land-Cover" and navigation buttons for "Homepage", "gmlcinski", and "Logout".

The main content area features a satellite map of a river delta. On the left side, there is a sidebar with a zoom slider, navigation icons (pan, pan with info, zoom in), and a list of overlays: "Don't show any overlays" (selected), "Global Land Cover", "Disagreement", "Geo-Wiki Pictures", "Feedback", and "Download".

On the right side of the map, there is a legend for the map layers: "Sentinel-2 cloud-free (SENTINEL Hub)" (selected), "Google Maps", "Bing Aerial With Labels", and "Bing Aerial".

At the bottom left of the map, the Google logo and a "10 km" scale bar are visible. At the bottom right, the text "Imagery ©2016 TerraMetrics" and "Terms of Use" are displayed.

# Sentinel Hub

- Existing datasets
  - Sentinel-2 (full global archive)
  - Sentinel-3 OLCI (full global archive)
  - Landsat-5, 7, 8 (ESA Archive)
  - Landsat-8 USGS (almost full global archive)
  - Envisat MERIS (full global archive)
- Coming
  - Sentinel-1 GRD
  - MODIS Terra and Aqua
- Synced with SciHub and USGS



# Possibility for cooperation

ESA Pathfinder – Sentinel Hub @ EO Cloud (IPT Poland)

- Free accounts for research purposes
- <https://earth.esa.int/aos/OSEO>



# Summary

- Stop “build in-house” paradigm! Use existing tools, platforms, services.
- Avoid mass processing. Process only when needed (and what needed)
- Stop shuffling pixels. Focus to end-user results.
- Be flexible. Change, fine tune, re-run.
- Use Sentinel Hub services

## More info

- <http://sentinel-hub.com/>
- <http://apps.sentinel-hub.com/eo-browser/>
- <http://apps.sentinel-hub.com/sentinel-playground/>
- <https://earth.esa.int/aos/OSEO>



SINERGISE

