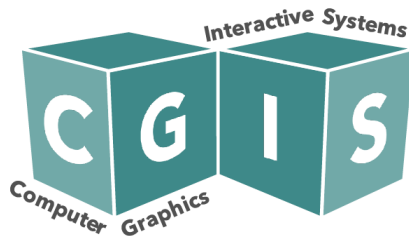




Experiments on Machine Learning Techniques for Soil Classification Using Sentinel-2 Products

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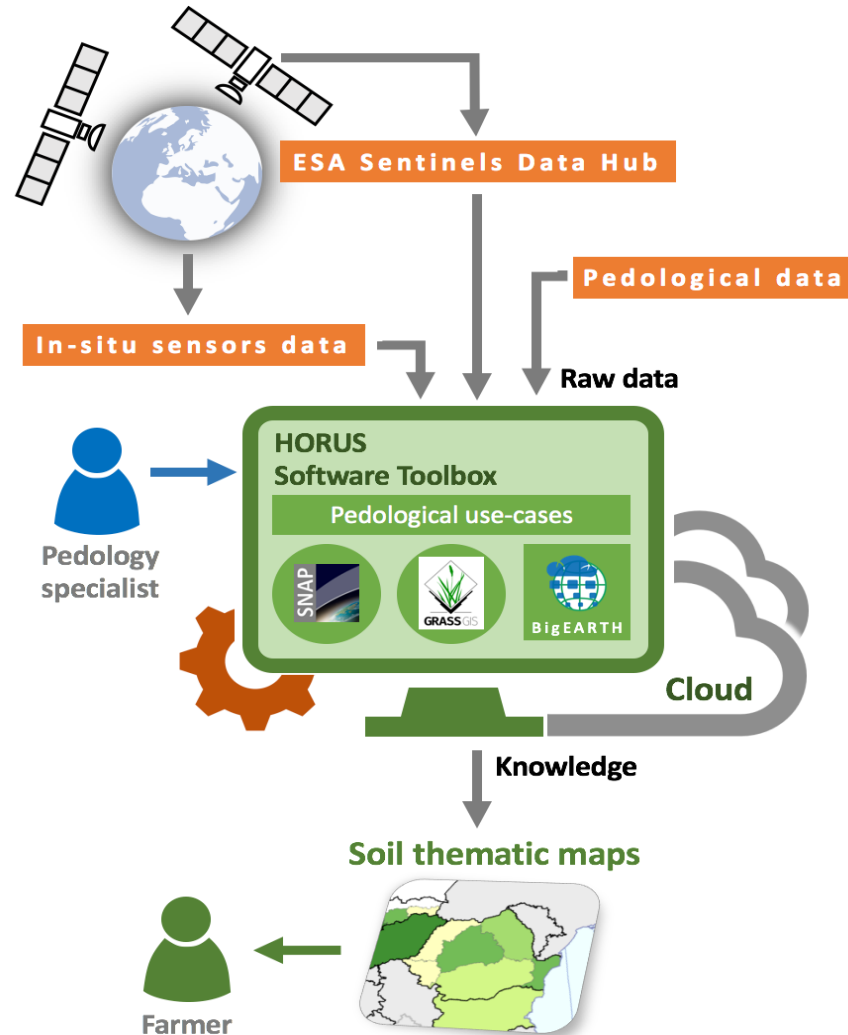


HORUS Project

- Software Toolbox for Pedological Monitoring of Transylvanian Area based on Sentinel-2 Data
- Funded by the Romanian Space Agency (ROSA), member of ESA
- Contract 184/2017, 2017-2019
- Partners:
 - Technical University of Cluj-Napoca (UTCN)
 - University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca (USAMV)

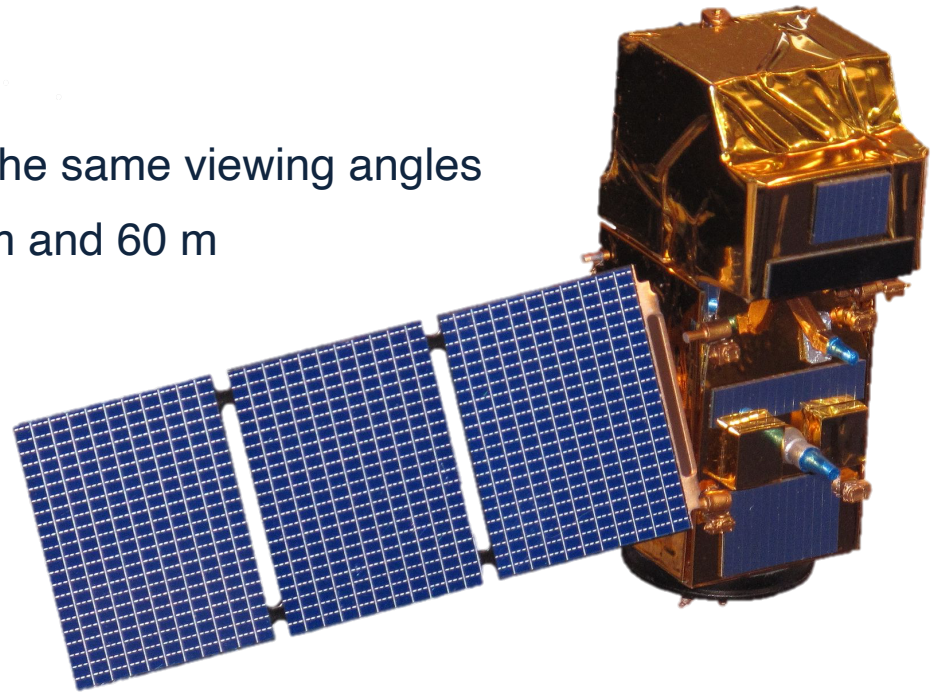


Satellite data to pedology



Sentinel-2 data

- Provided by Sentinel-2 satellites as part of the Copernicus Programme
- Characteristics:
 - Revisiting every 5 days under the same viewing angles
 - Spatial resolution of 10 m, 20 m and 60 m
 - Multi-spectral data (13 bands)
 - Free and open data policy
- Examples of applications:
 - Monitoring land cover changes
 - Agricultural crop monitoring
 - Observation of coastal zones
 - Glacier monitoring, ice extent mapping, snow cover monitoring
 - Flood mapping & management



European Space Agency

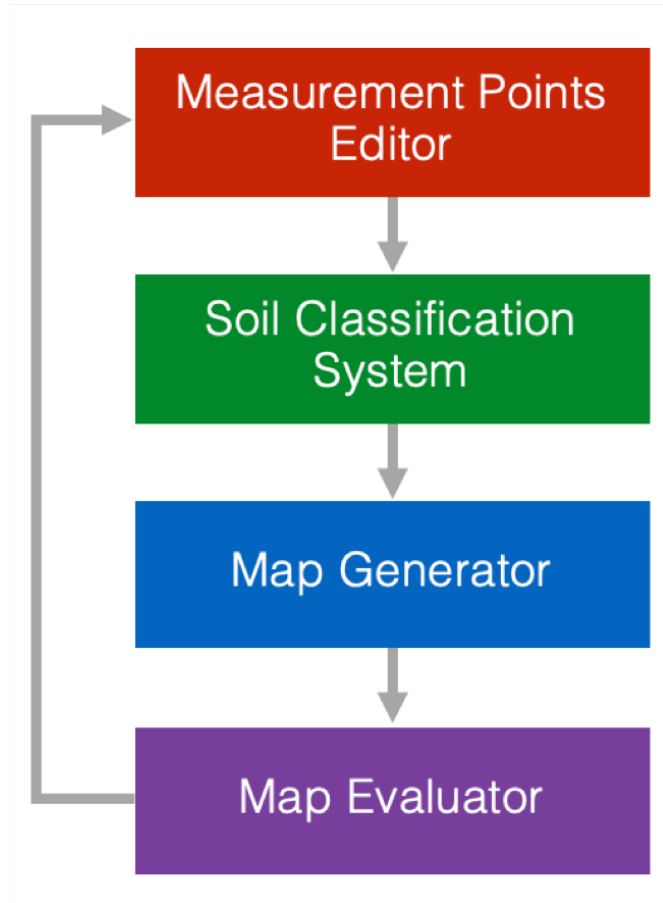
Sentinel-2 data processing

- Issues:
 - High volume of data
 - High computational resources
- Proposed solution:
 - Flexible description of processing
 - Parallel and distributed execution over the cloud
 - Interactive application

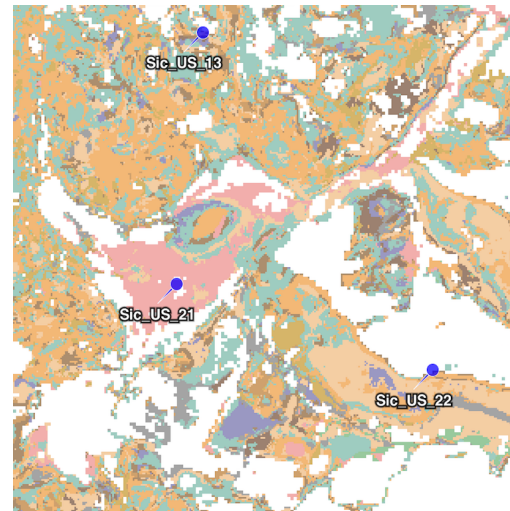
Soil classification

- Complex process based on the field observation and analysis
- Soil classification process is different for various countries and regions
- Not all soil parameters can be mapped onto the satellite data
- Satellite data computation needs local calibration based on particular context
- Classification criteria are indirectly inferred from the computed parameters
- Real time computation require high performance computation resource

HorusAPP



(a) Reference pedological map



(b) Generated map

Measurement Points Editor

- Allows the editing of the set of measurement points used for training the Soil Classification System

The screenshot displays the Measurement Points Editor interface. A map of a landscape with various colored regions (green, brown, red) is shown. A dialog box is open over the map, allowing the user to create a new measurement point. The dialog includes fields for Latitude (5931174.6341018975), Longitude (2663438.4821671443), Soil type (REGOSOL), Area size (100 x 100), and Label (Point 1). At the bottom of the dialog are buttons for Save, Cancel, and Delete. A small square on the map indicates the location of the new point.

Actions:

- Load soil index
- Load points list
- Create points
- Save points list
- Manage layers
- Show statistics

Points: 1 / 1 -- show all soil types --

Point 1	Soil type: REGOSOL
Lat: 46° 56' 00" N	Area size: 100 x 100
Lon: 23° 55' 34" E	

Measurement Points Editor

The interface displays a satellite map with numerous blue location pins. A central form allows editing a point's details:

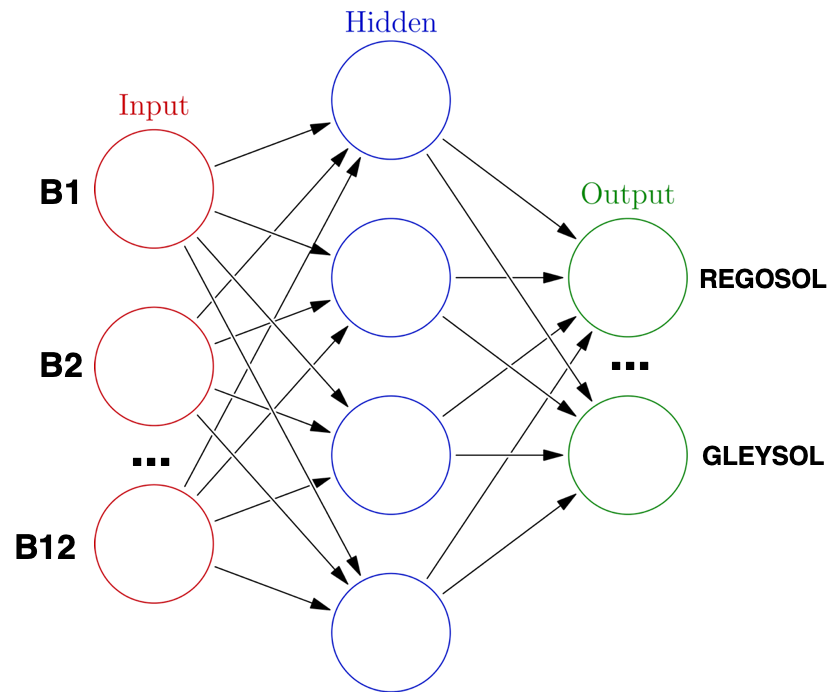
Latitude:	Longitude:
5930991.661691753	2658862.6687781303
Soil type:	
Regosol	
Area size:	
100 x 100	
Label	
SIC_2_208	
✓ Save	✗ Cancel
🗑 Delete	

On the right, the 'Actions' panel includes buttons for 'Load soil index', 'Load points list', 'Create points', 'Save points list', 'Manage layers', and 'Show statistics'. Below this, the 'Points' section shows 255 / 255 points, with a dropdown to 'show all soil types'. A list of points is displayed:

SIC	Lat	Lon	Soil type	Area size
SIC_2_208	46° 55' 56" N	23° 53' 06" E	Regosol	100 x 100
SIC_23_209	46° 56' 02" N	23° 52' 49" E	UNDEFINED	100 x 100
SIC_13_210	46° 56' 11" N	23° 52' 42" E	Solonet	100 x 100
SIC_9_211	46° 55' 33" N	23° 53' 39" E	Preluvosol	100 x 100
SIC_22_212	46° 55' 33" N	23° 53' 31" E	UNDEFINED	100 x 100

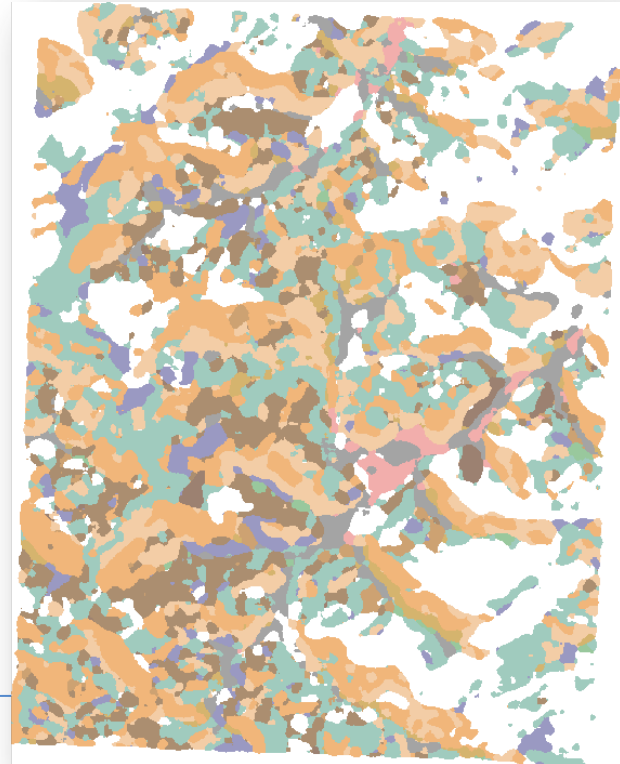
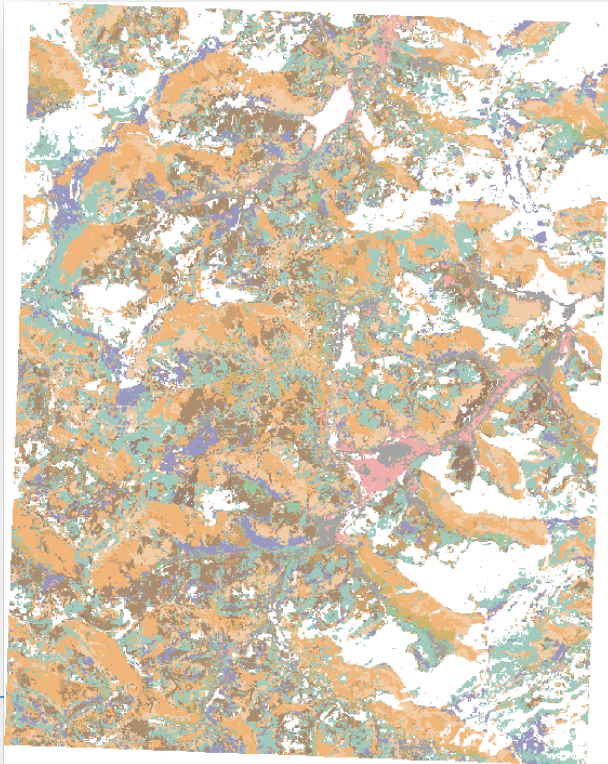
Soil Classification System

- Performs soil classification using satellite data extracted from the measurement points based on a neural network



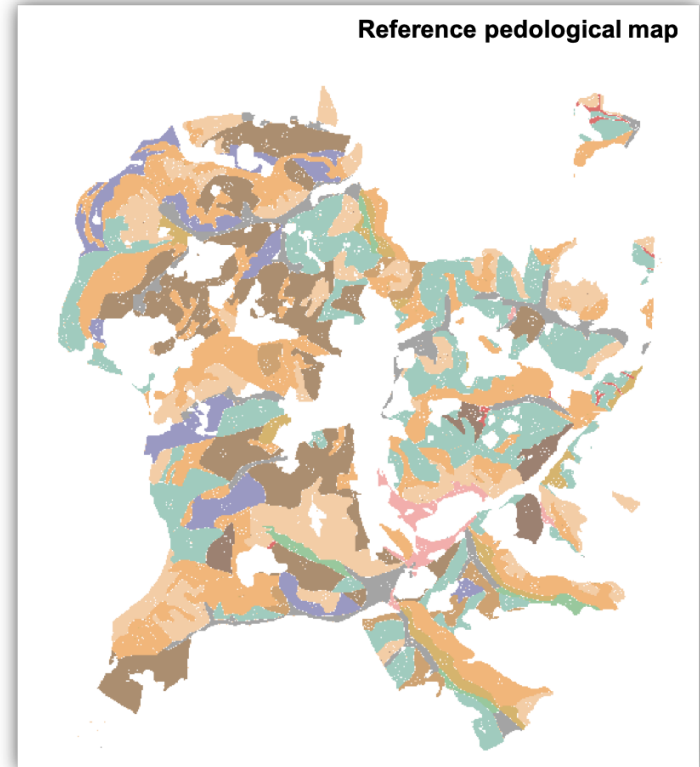
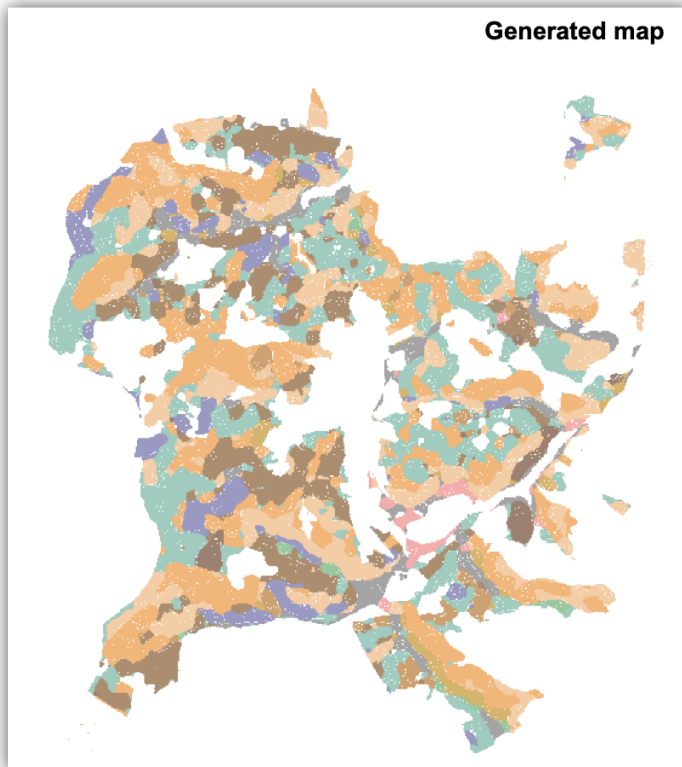
Map Generator

- Interrogates the Soil Classification System for each location in the map and obtains the soil type
- The generated map is labeled with the determined soil type

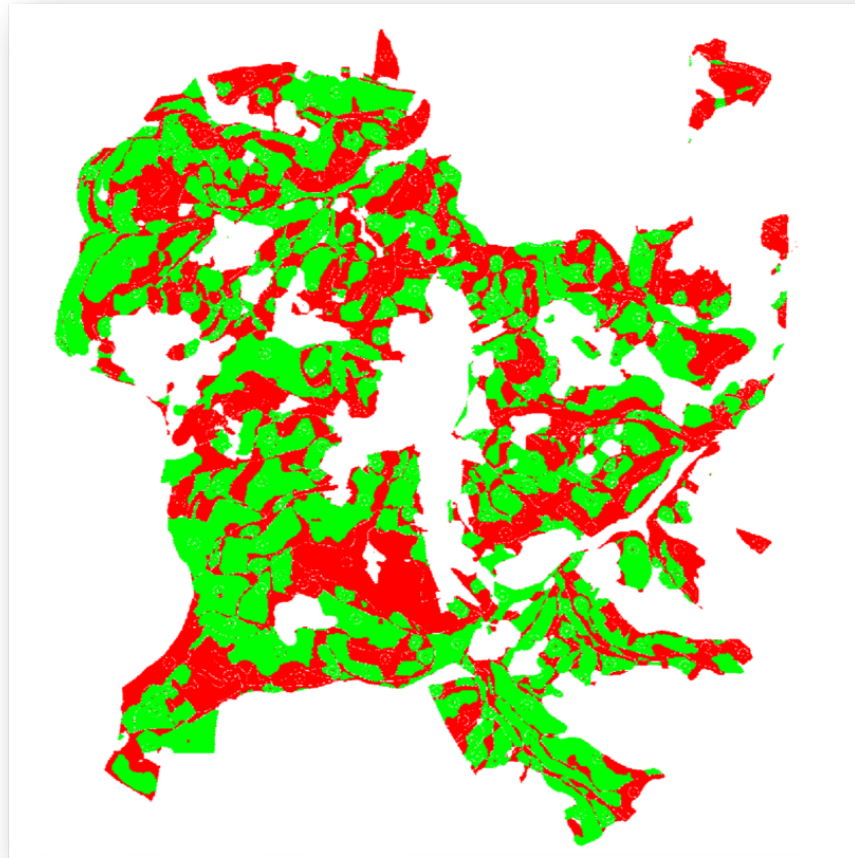


Map Evaluator

- Evaluates the quality of the generated pedological map. The evaluation is done according to a metric that compares two pedological maps



Map Evaluator

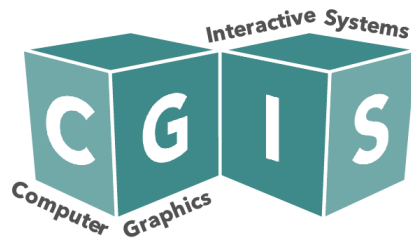


■ Correct
classification

■ Incorrect
classification



Many thanks for your attention!



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