

Integrarea sistemelor informatice



Suport curs practic nr. 3

Sisteme Informaționale Geografice – Platforme GIS

2024-2025

Obiective

- Înțelegerea procesului de generare a datelor geospațiale
- Înțelegerea arhitecturii platformelor GIS
- Familiarizare cu editoare GIS avansate – QGIS
- Identificarea alternativelor în realizarea aplicațiilor GIS integrate
 - Google Maps API
 - Leaflet.js
- Bonus: funcționalități GIS avansate – analiza datelor geospațiale

Platforme GIS

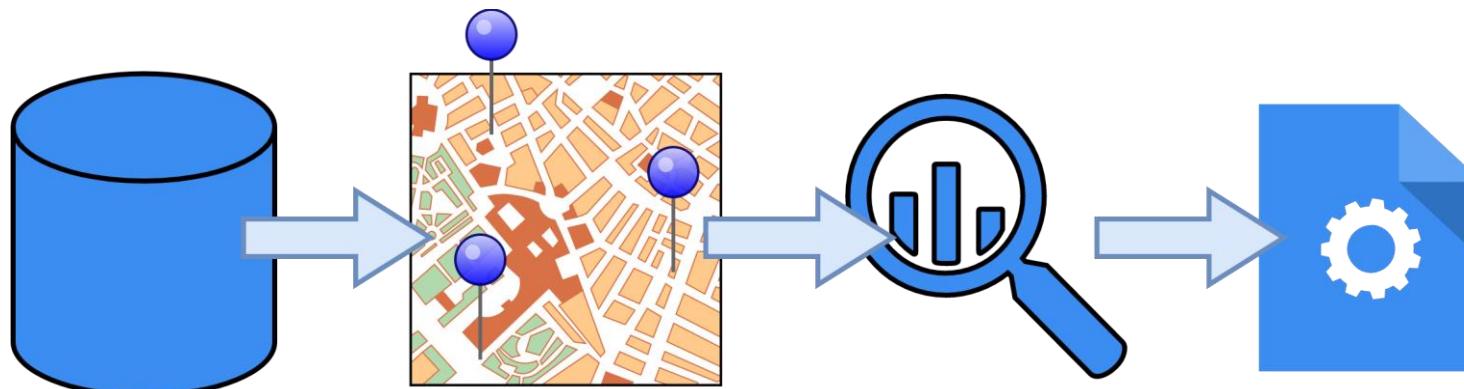
Platforma ArcGIS

- Platforma ArcGIS
- ArcGIS este un sistem GIS dezvoltat de Esri
- Arhitectură:
 - Web: ArcGIS Online
 - Desktop: ArcGIS Pro (Desktop)
 - Server: ArcGIS Server
 - API/SDK: ArcGIS Maps SDK for JavaScript, ArcGIS Maps SDK for .NET/Android/iOS/Java/Qt, ArcGIS REST API, ArcGIS API for Python



Platforma ArcGIS

- Funcționalități generale
 - Proiectarea bazei de date – [geodatabase](#)
 - Introducerea datelor: digitizare, scanare, conversie
 - Interogarea datelor: filtrare, vizualizare
 - Analiza datelor: generarea rezultatelor pe hartă
 - Afişarea rezultatelor: pe hartă, rapoarte, grafice



Platforma ArcGIS

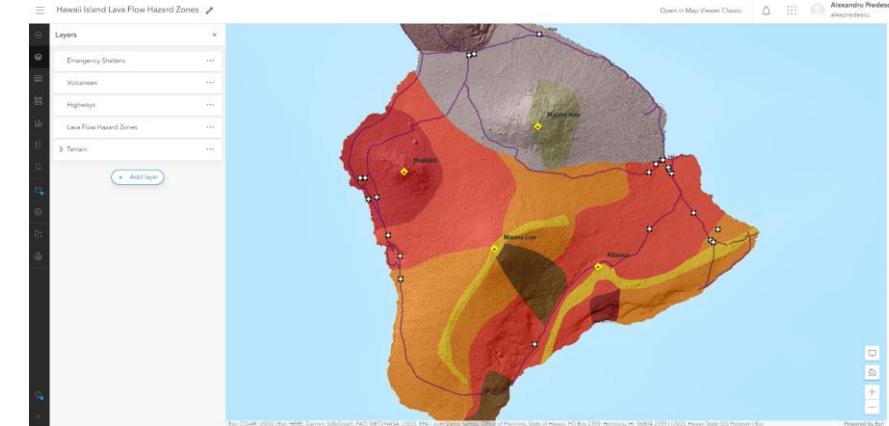


ArcGIS Online

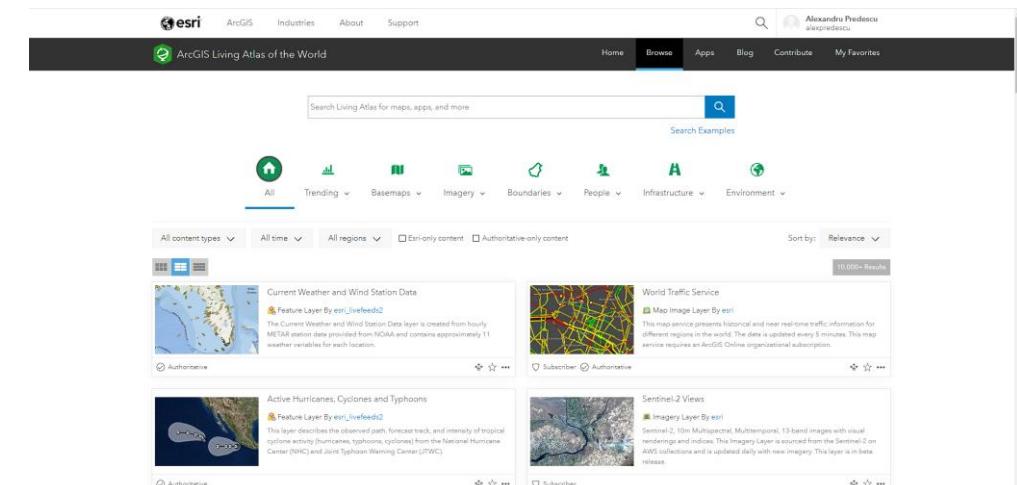
- Platformă web (SaaS)
- Funcționalități colaborative
- Resurse educaționale
- Open data
 - [ArcGIS Search](#) (căutare resurse GIS)
 - [ArcGIS Hub](#) (căutare date primare)
 - [Living Atlas](#) (căutare date prelucrate)



<https://www.arcgis.com/index.html>



Map Viewer



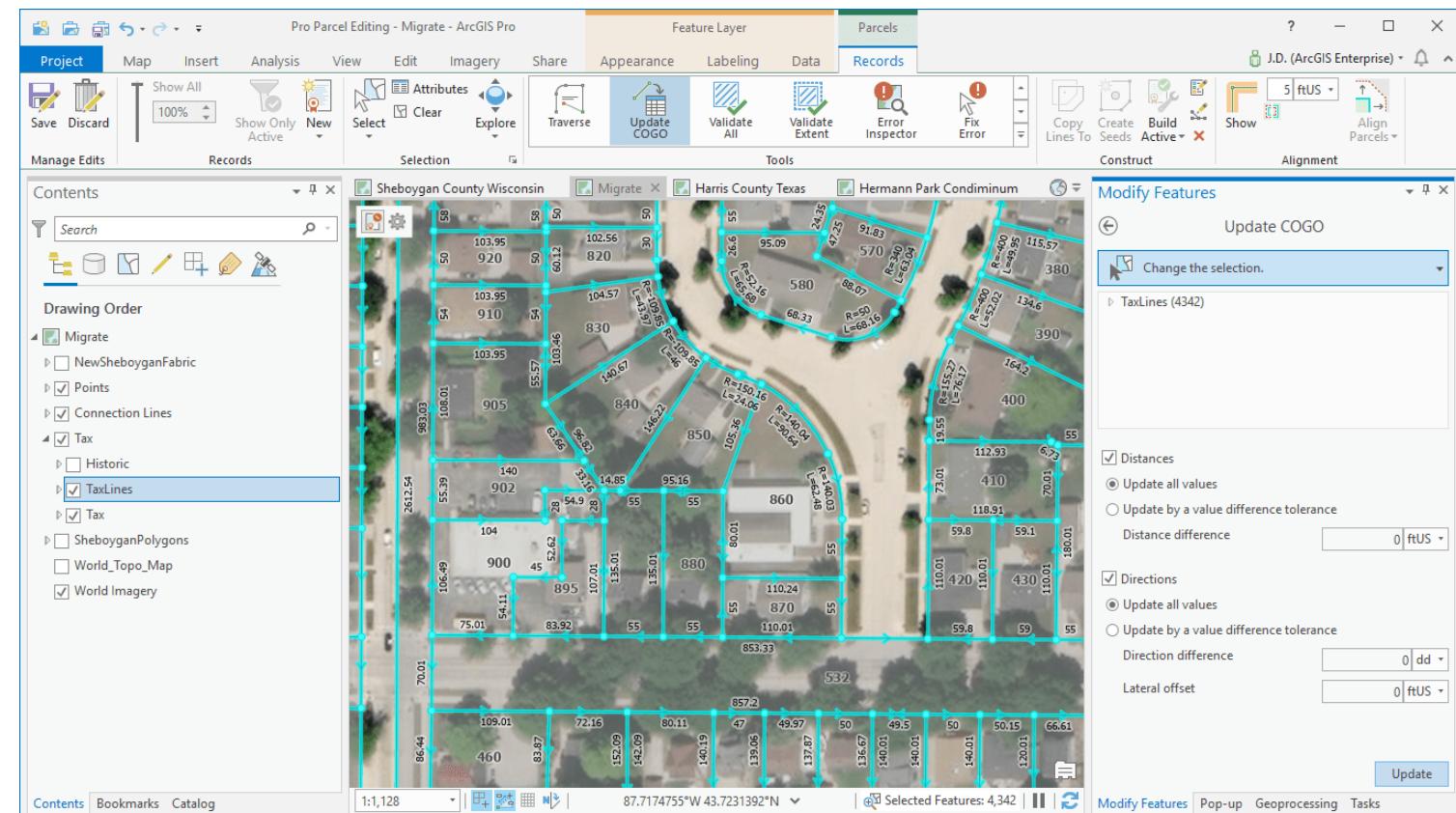
Living Atlas

Platforma ArcGIS



ArcGIS Pro

- Aplicație desktop
- Funcționalități avansate

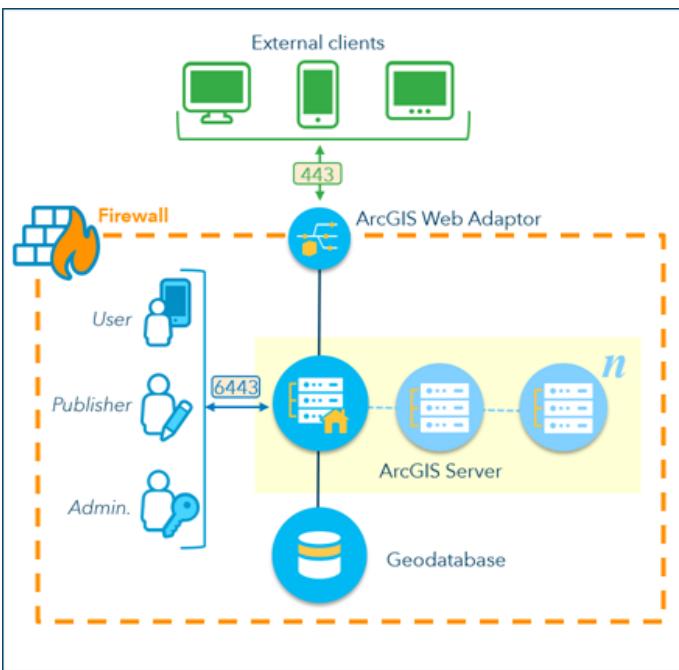


<https://pro.arcgis.com/en/pro-app/latest/get-started/download-arcgis-pro.htm>

Platforma ArcGIS

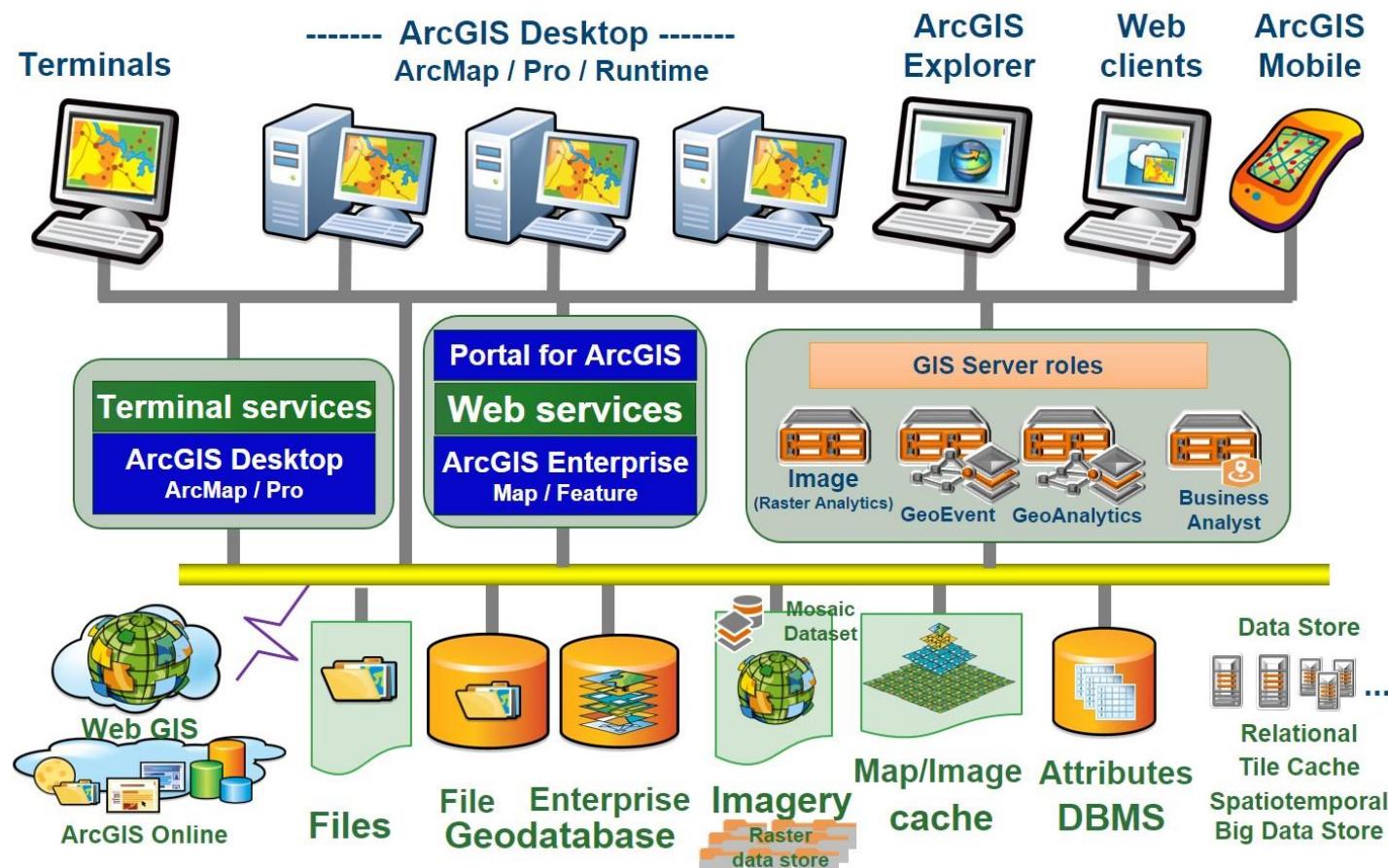
ArcGIS Server

- Aplicație server
- Publicare servicii GIS



Status	Start Time	End Time	Duration	Machine
Executing	Mar 28, 2019, 4:04:31 PM			SMMACDONALD....
Failed	Mar 28, 2019, 3:58:54 PM	Mar 28, 2019, 4:03:56 PM	00:05:02	SMMACDONALD....
Succeeded	Mar 28, 2019, 3:52:04 PM	Mar 28, 2019, 3:52:12 PM	00:00:07	SMMACDONALD....
Succeeded	Mar 28, 2019, 3:49:49 PM	Mar 28, 2019, 3:50:00 PM	00:00:10	SMMACDONALD....

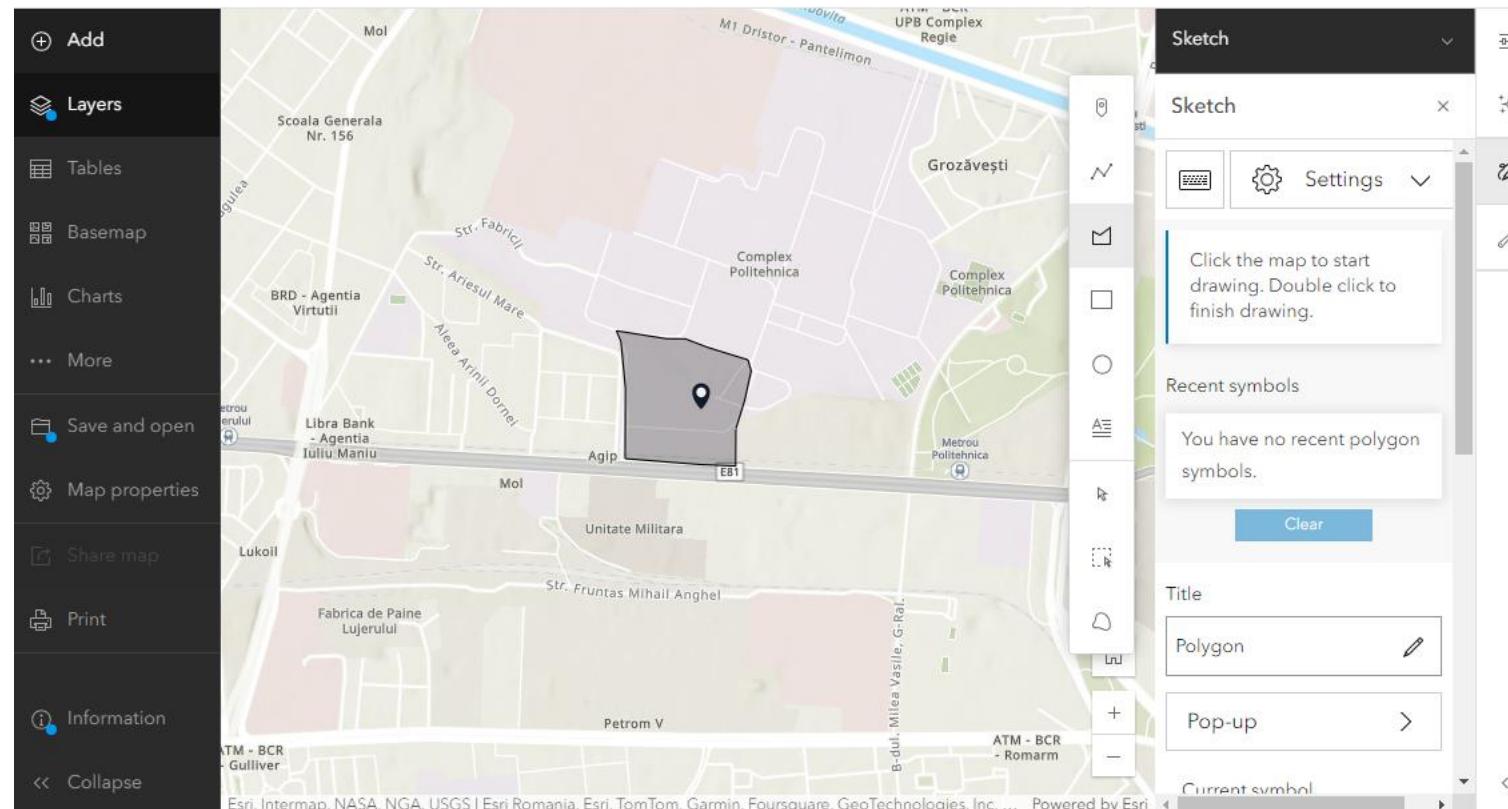
Platforma ArcGIS



[http://wiki.gis.com/wiki/index.php/GIS Product Architecture](http://wiki.gis.com/wiki/index.php/GIS_Product_Architecture)

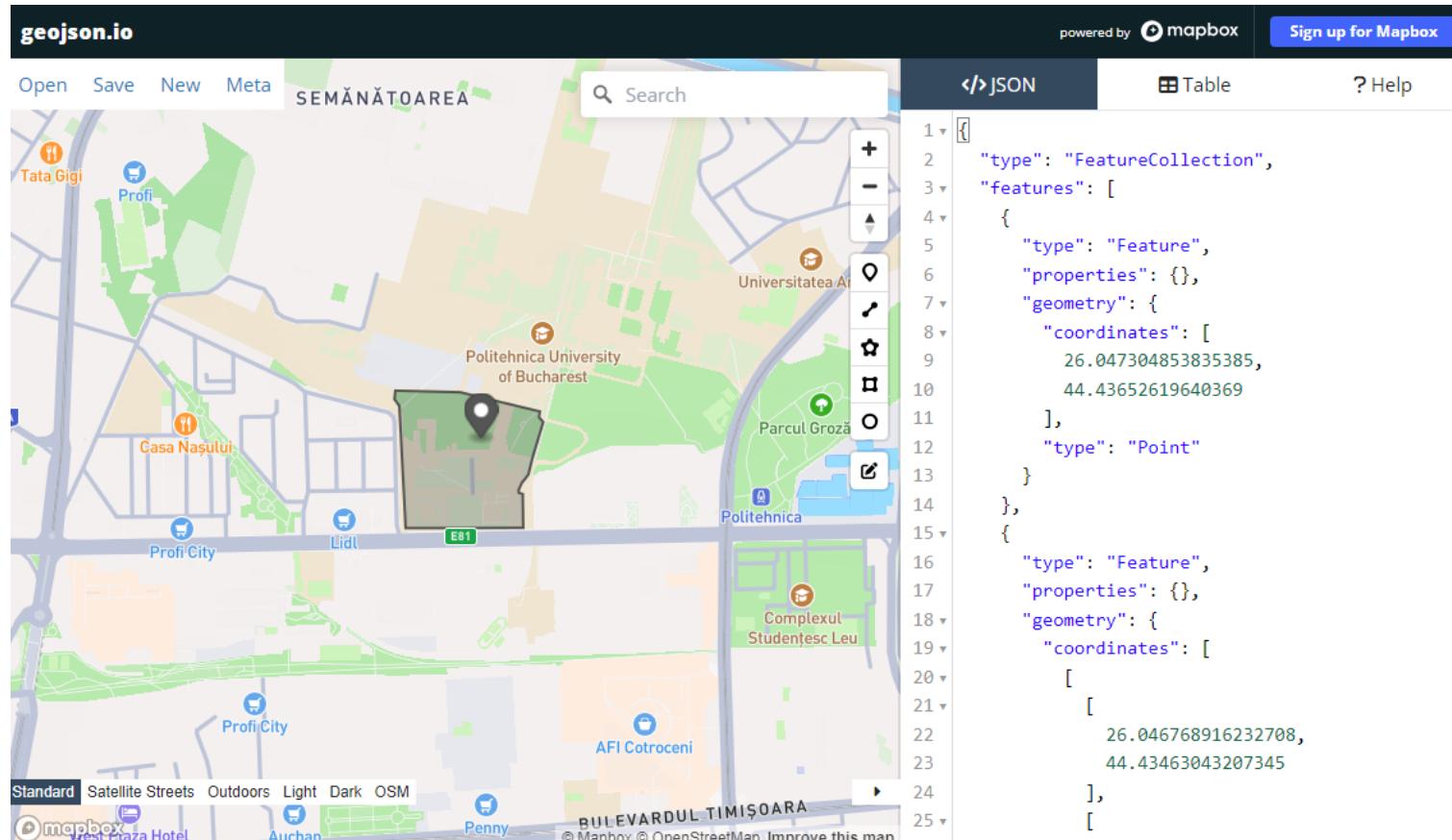


Generarea datelor geospațiale



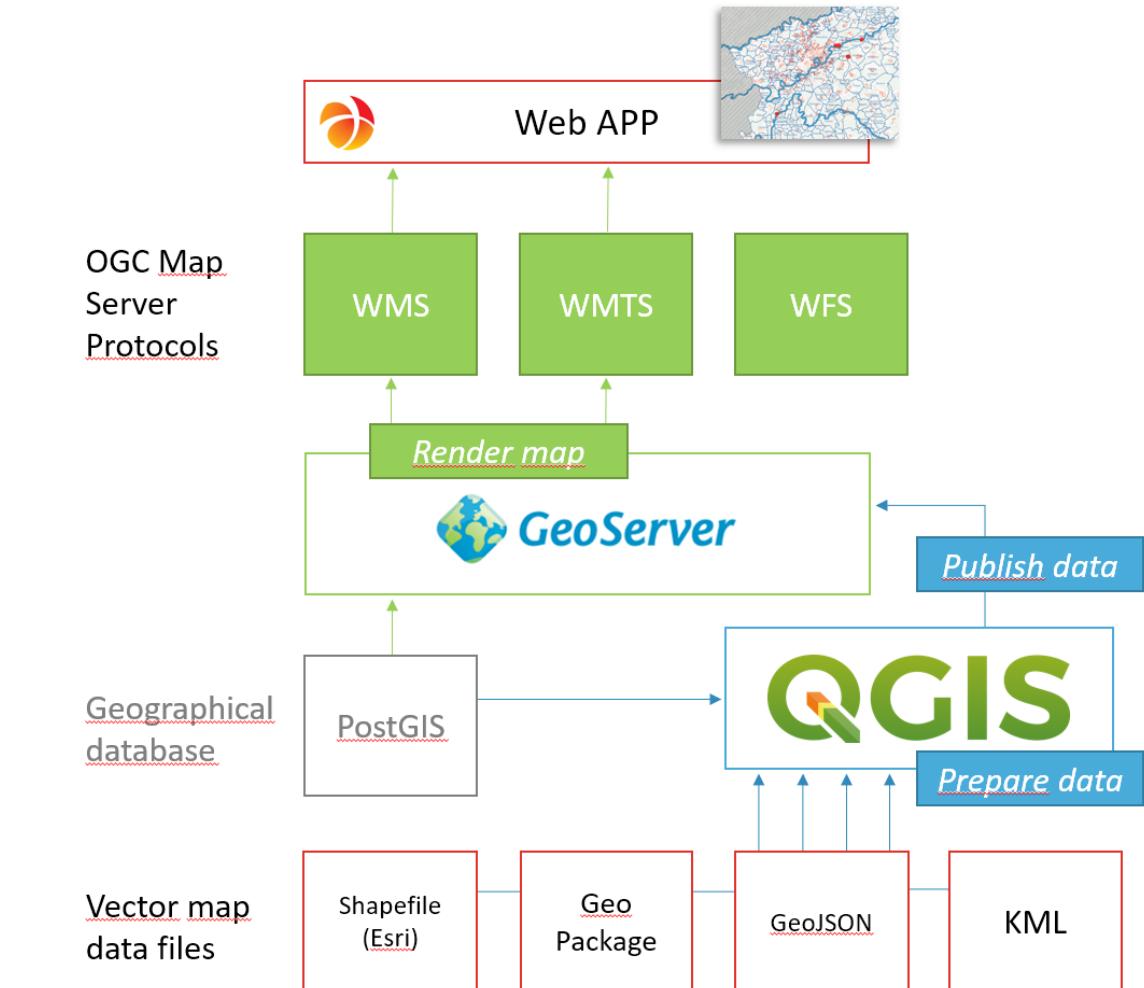
ArcGIS Online

Generarea datelor geospațiale



Open GIS

- Arhitectura software
 - QGIS: software GIS open-source
 - Preparare date geospațiale
 - OGC (Open Geospatial Consortium) – protocoale standardizate
 - WMS (Web Map Service)
 - WMTS (Web Map Tile Service)
 - WFS (Web Feature Service)
 - GeoServer: open-source map server
 - Publicare servicii de date

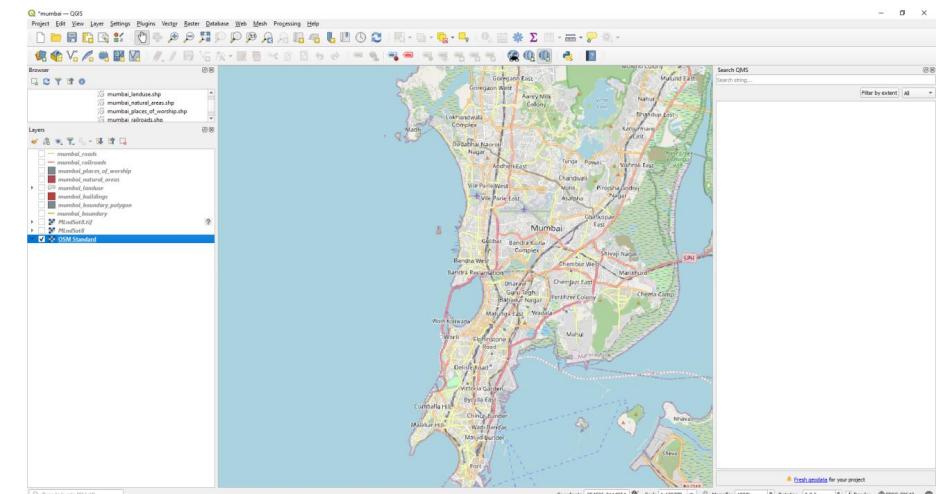


<https://techtalk.intersec.com/2021/10/open-source-map-server-with-geoserver-and-qgis/>



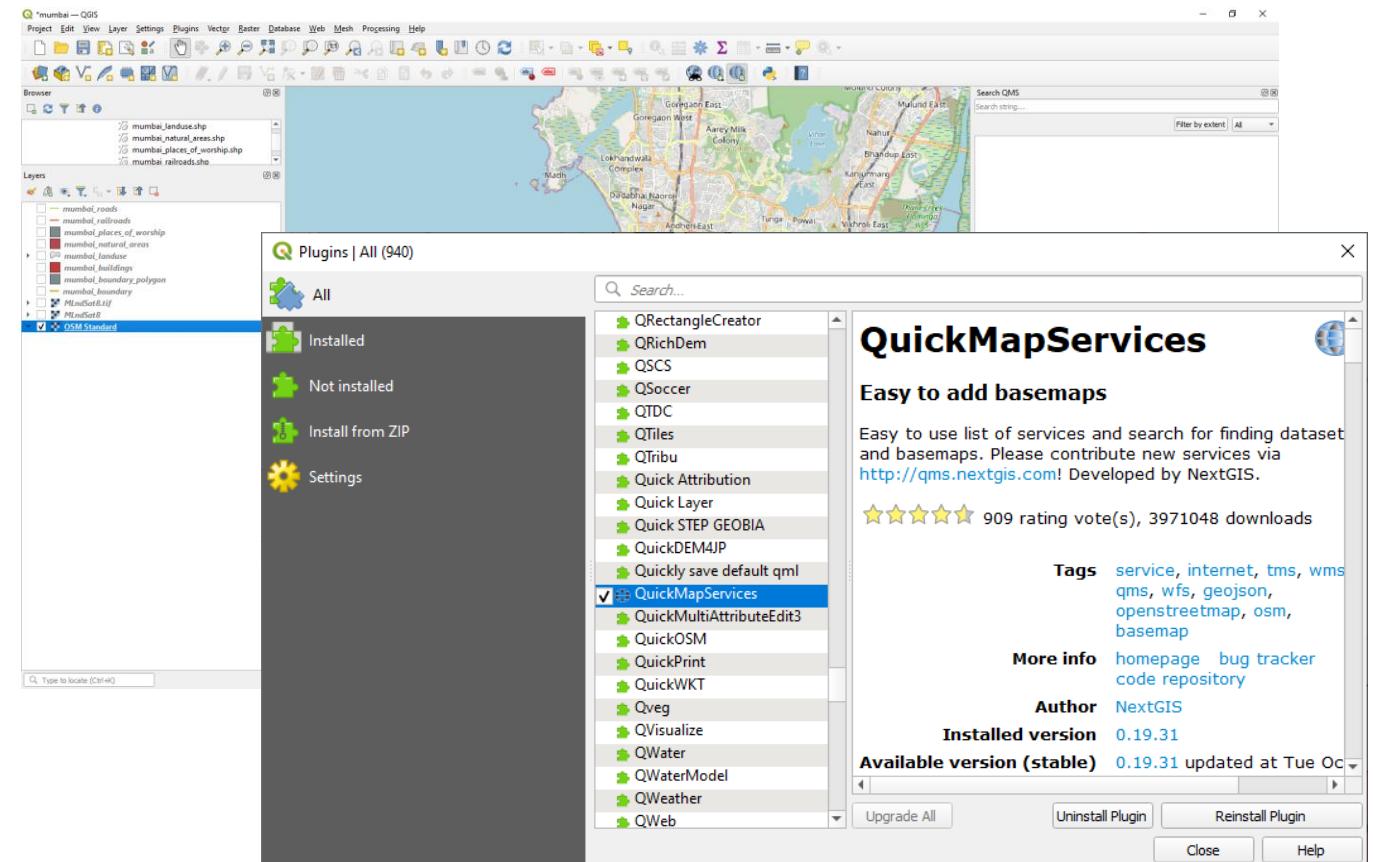
Open GIS: QGIS

- Utilizarea aplicației desktop QGIS
 - Adăugarea unei hărți de bază – OpenStreetMap
 - Crearea și editarea unui layer nou
 - Importarea unui layer
 - Dintr-un fișier
 - GeoJSON
 - CSV
 - ...
 - Dintr-o bază de date
 - Dintr-un FeatureServer din ArcGIS Online
 - [ArcGIS Search](#)
 - [Living Atlas](#)
 - [ArcGIS Hub](#)



Studiu de caz QGIS: Mumbai

- Arhivă resurse: [mumbai datasets.zip](#)
- Utilizarea aplicației desktop QGIS
- Pentru a adăuga ușor o hartă de bază (ex. OpenStreetMap), se instalează plugin-ul QuickMapServices



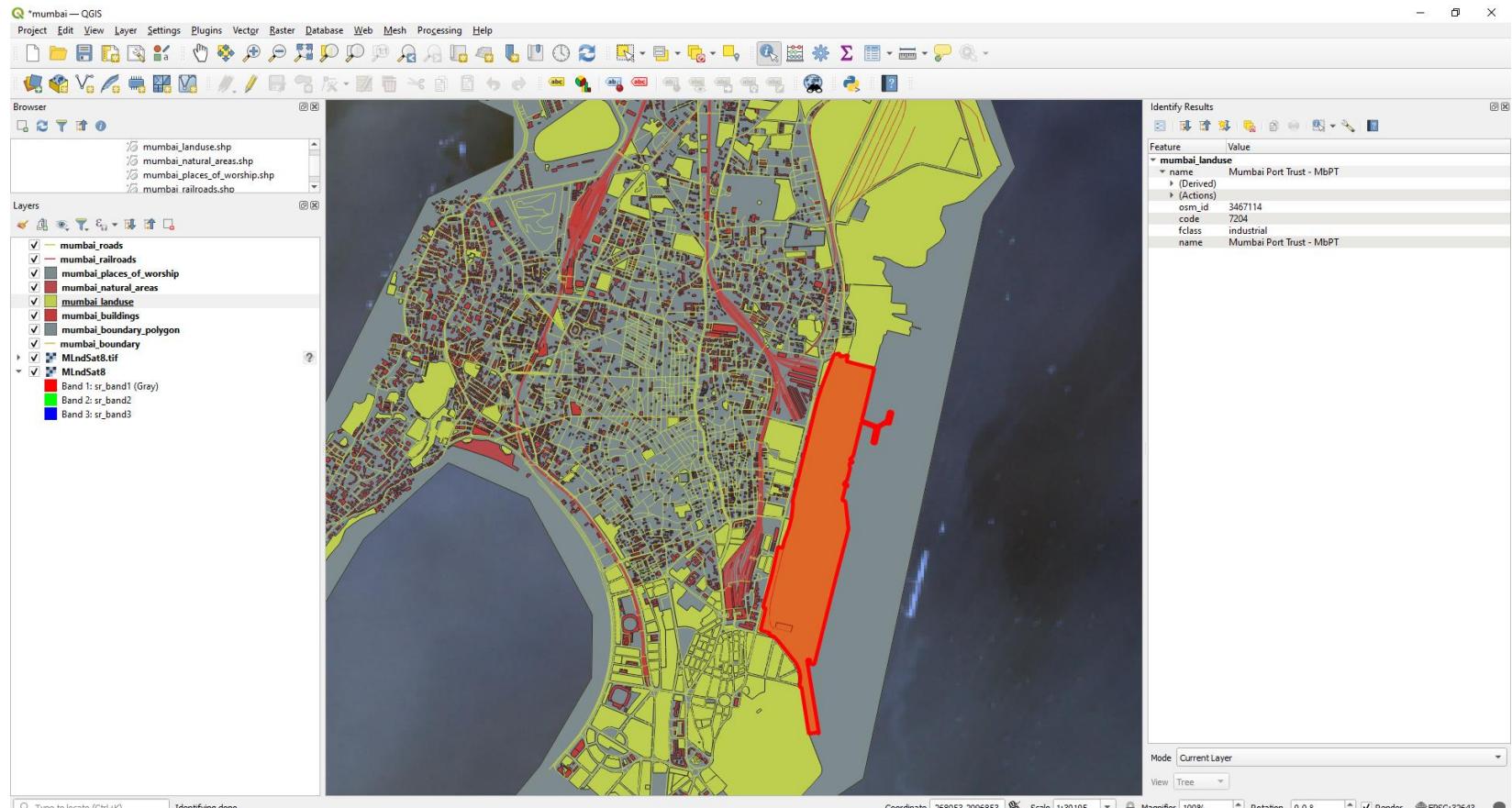
[Introduction to Geographic Information Systems \(GIS\) Software: An Open Source Lecture](#)

Studiu de caz QGIS: Mumbai

Layers (straturi)

Features (entități)

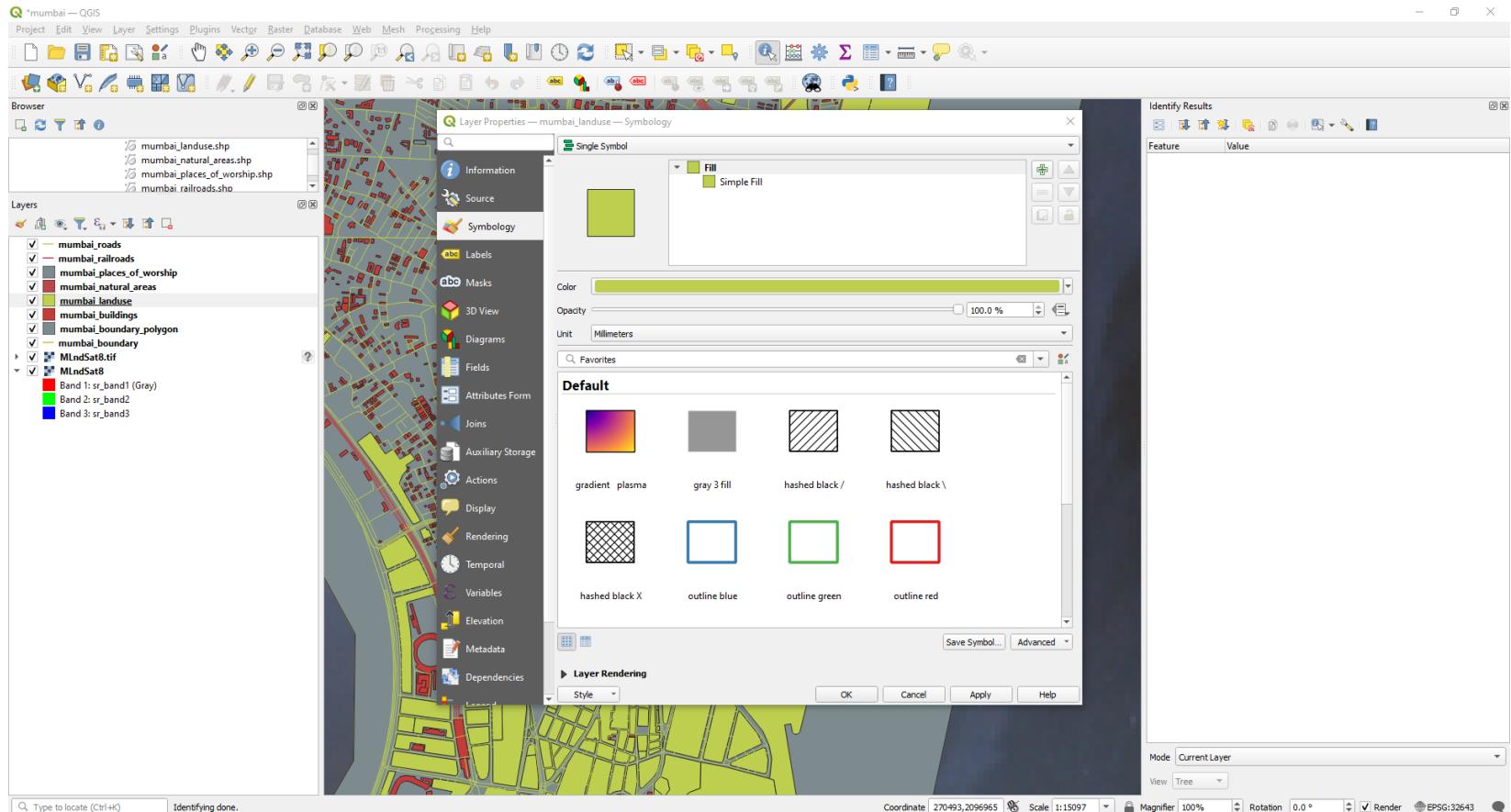
- Adăugarea layerelor în format shapefile (**Add layer to Project**)
- Utilizați modul **Identify Features** pentru a selecta o entitate dintr-un strat



Studiu de caz QGIS: Mumbai

Vizualizare

- Configurare simboluri vizuale (Properties – Symbology)

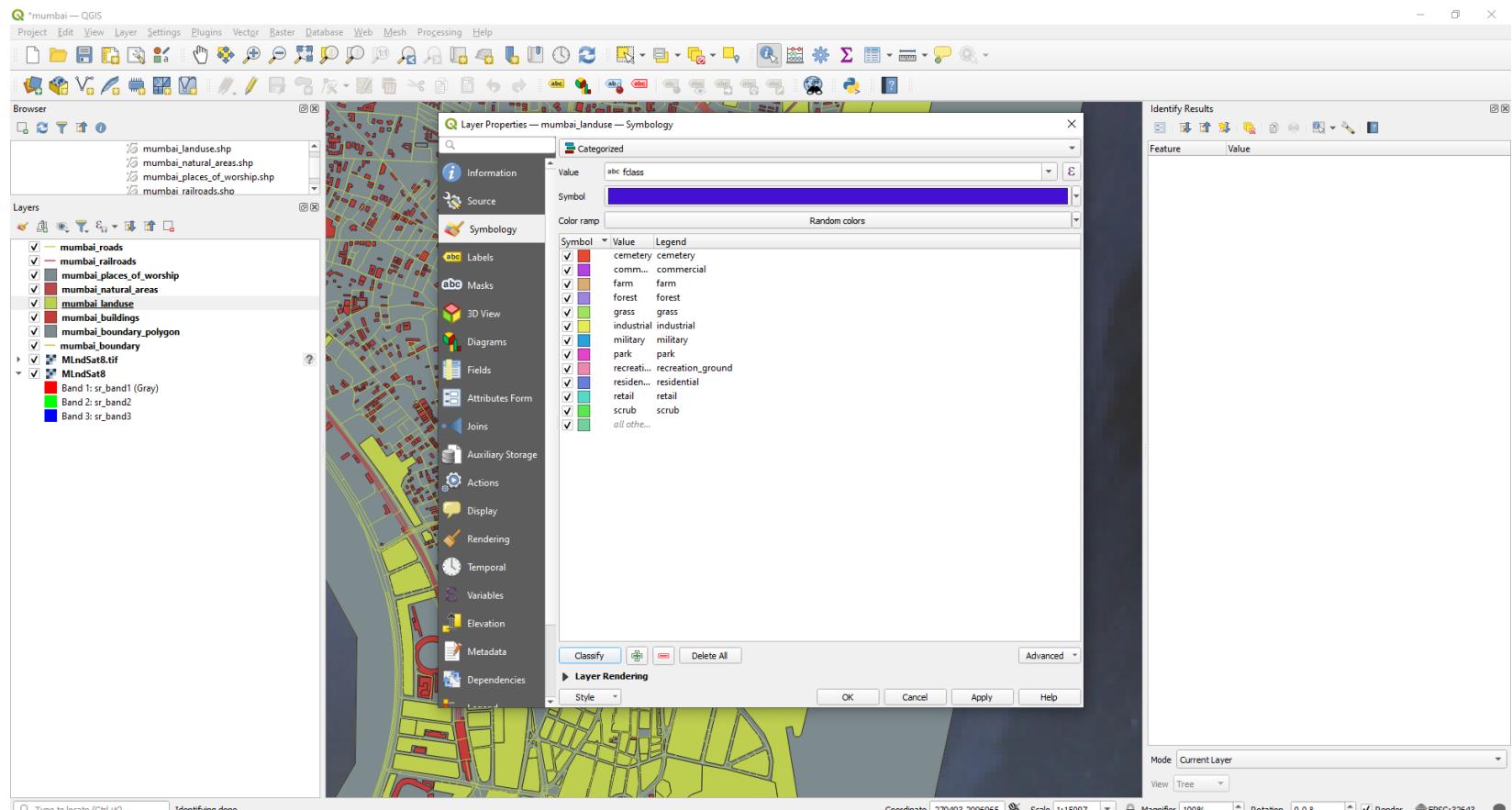


Modificați simbolurile pentru layer-ul *mumbai_boundary_polygon*

Studiu de caz QGIS: Mumbai

Clasificare

- Selectare atribut
- Configurare simboluri

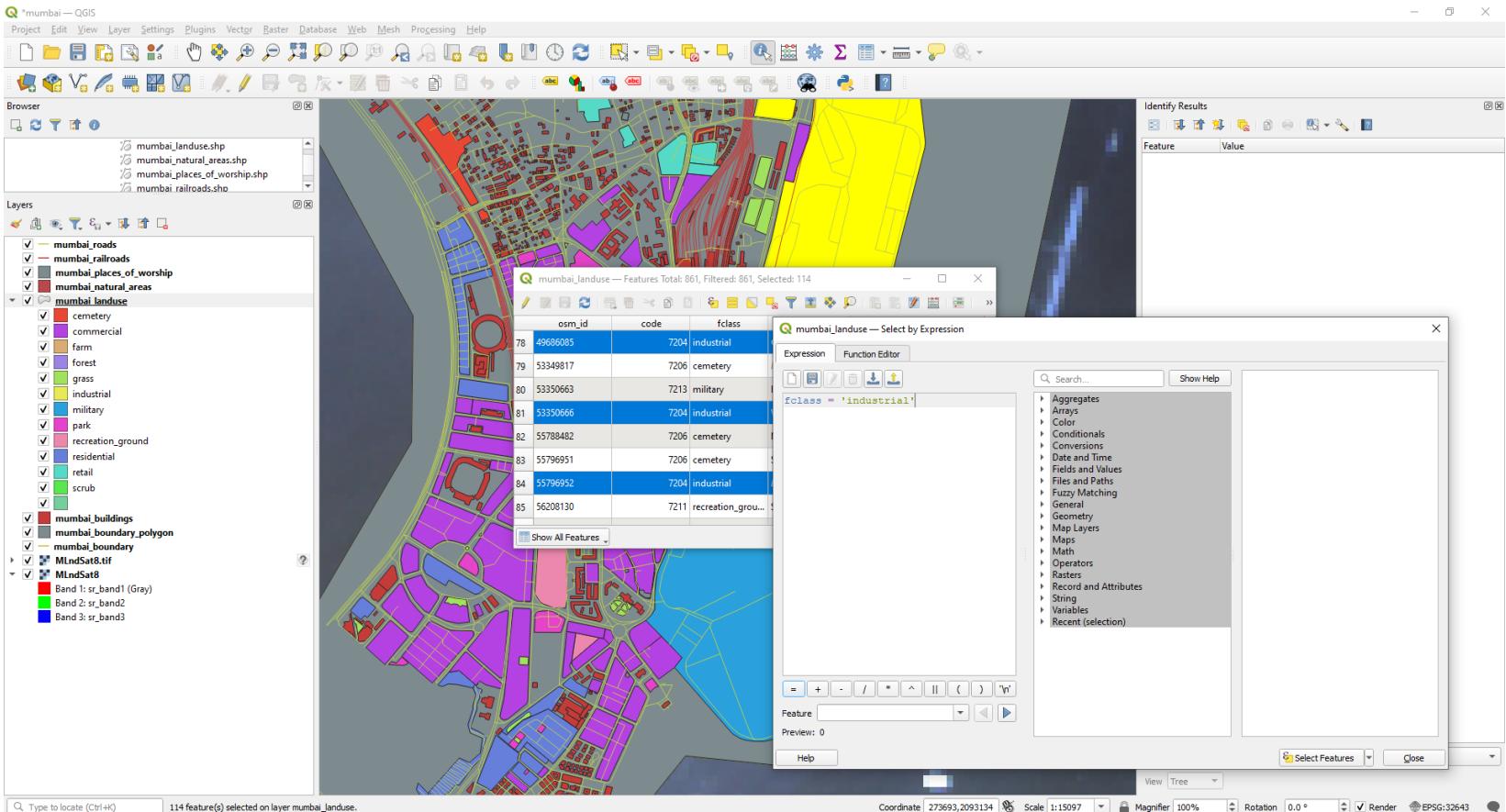


Properties → Symbology → Categorized → Classify

Studiu de caz QGIS: Mumbai

Filtrare

- Open Attribute Table – Switch to table view
- Select features using an expression
- Entitățile selectate vor fi colorate cu galben

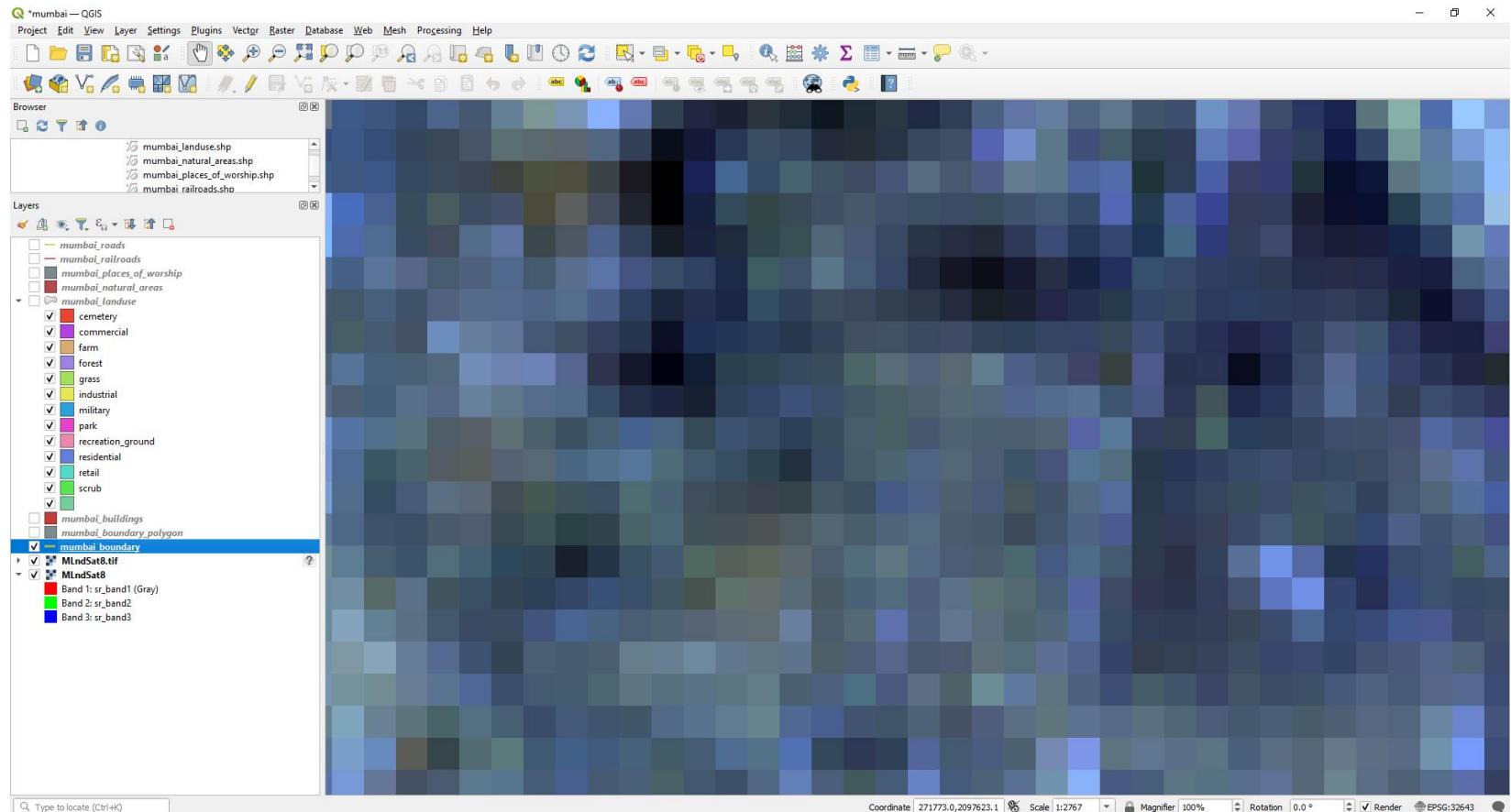


Adăugați expresia de căutare: fclass = 'industrial'

Studiu de caz QGIS: Mumbai

Date de tip raster

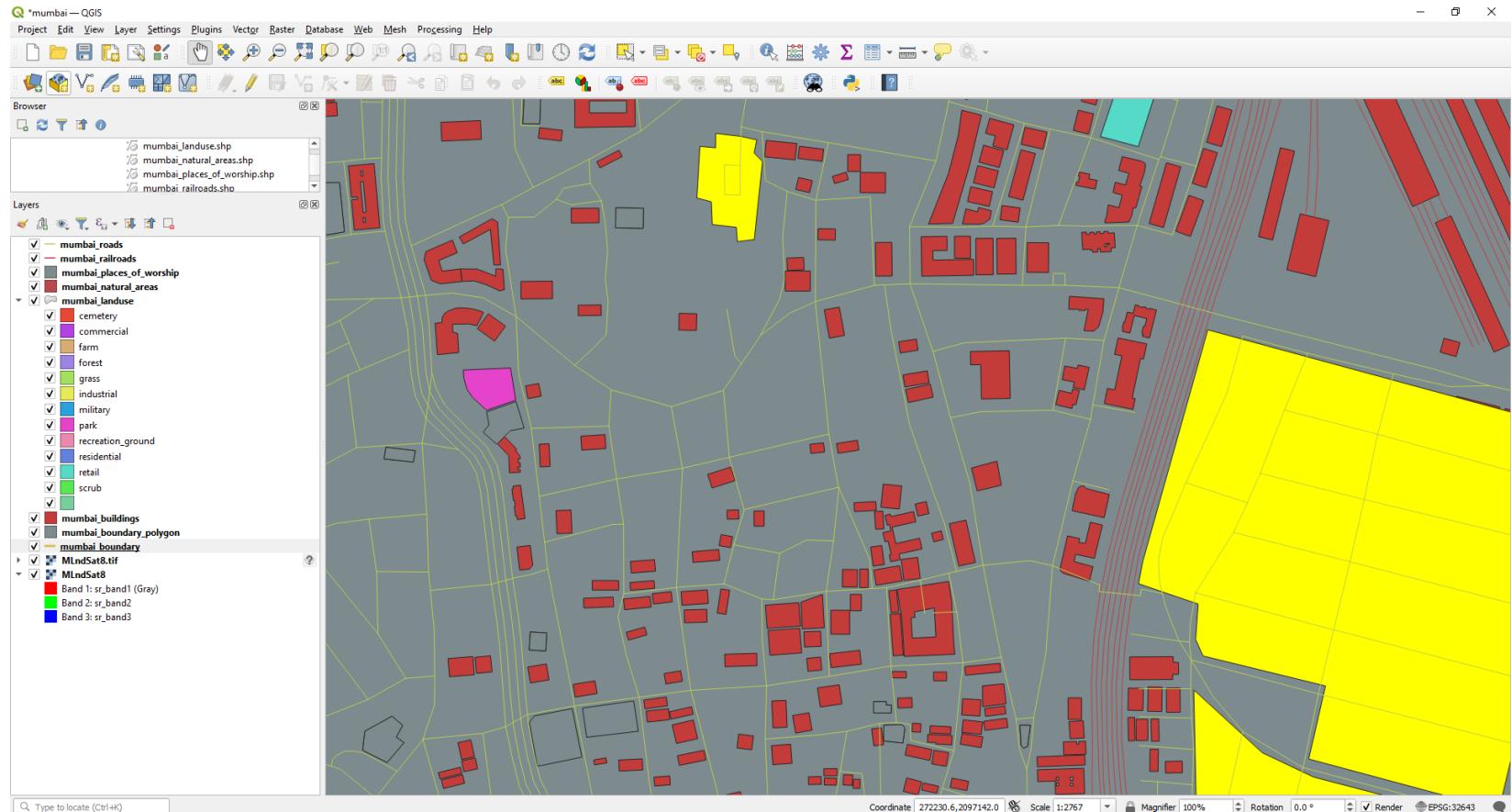
- Imagini satelitare prelucrate



Studiu de caz QGIS: Mumbai

Date de tip vector

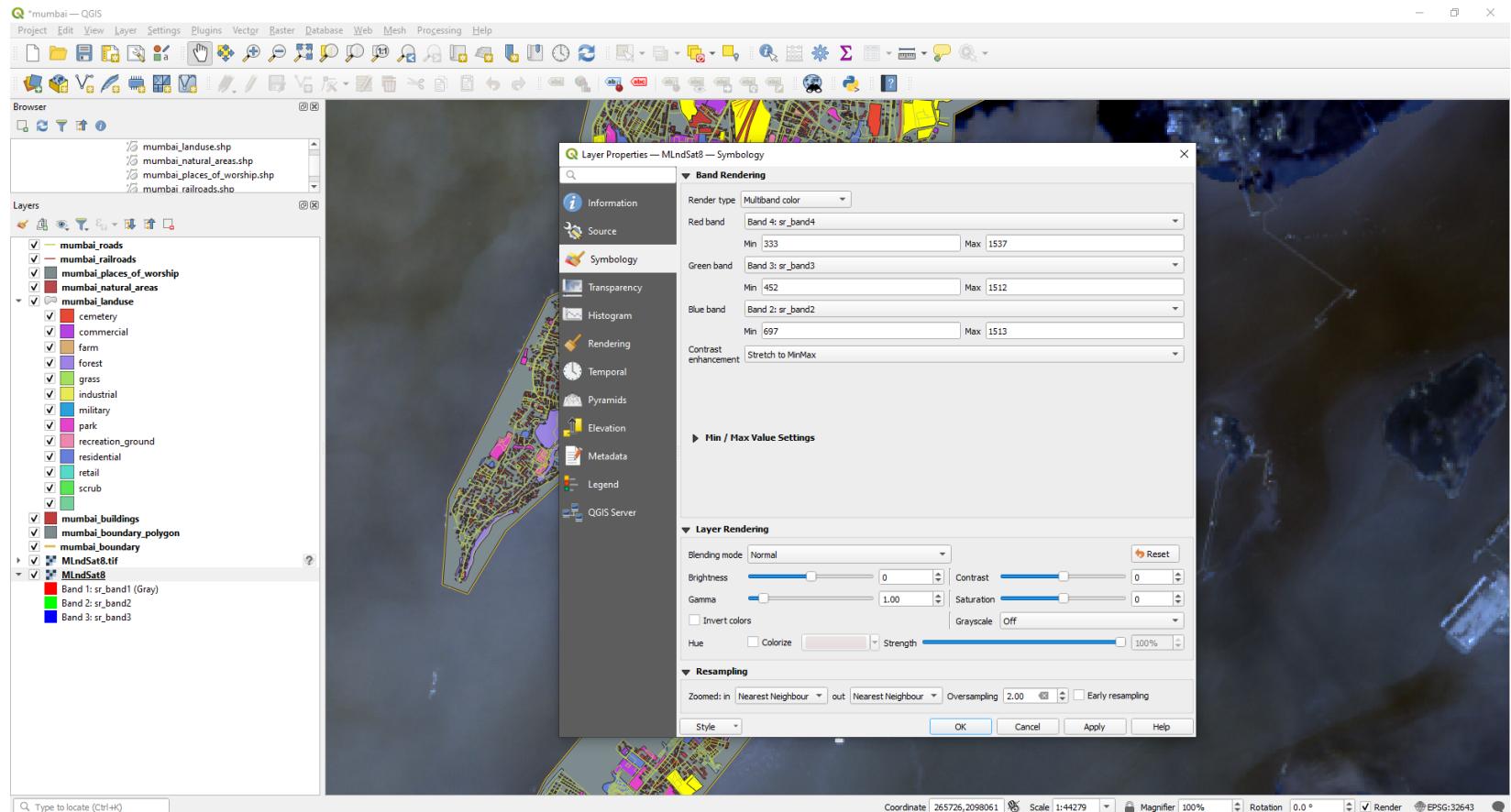
- Reprezentări grafice ale fenomenelor



Studiu de caz QGIS: Mumbai

Vizualizare date raster

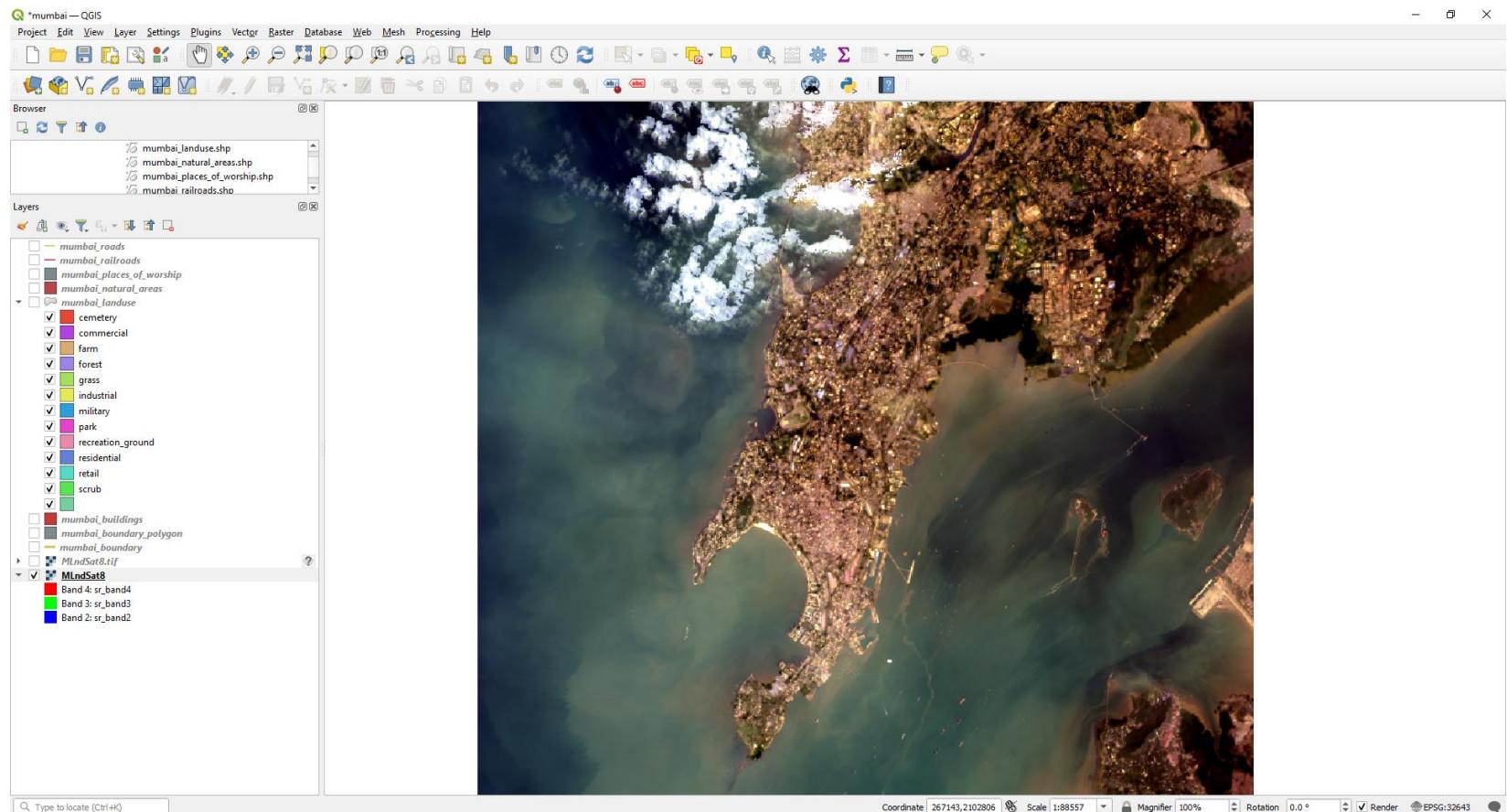
- Configurare bandă spectrală
- Properties – Symbology



Studiu de caz QGIS: Mumbai

Vizualizare date raster

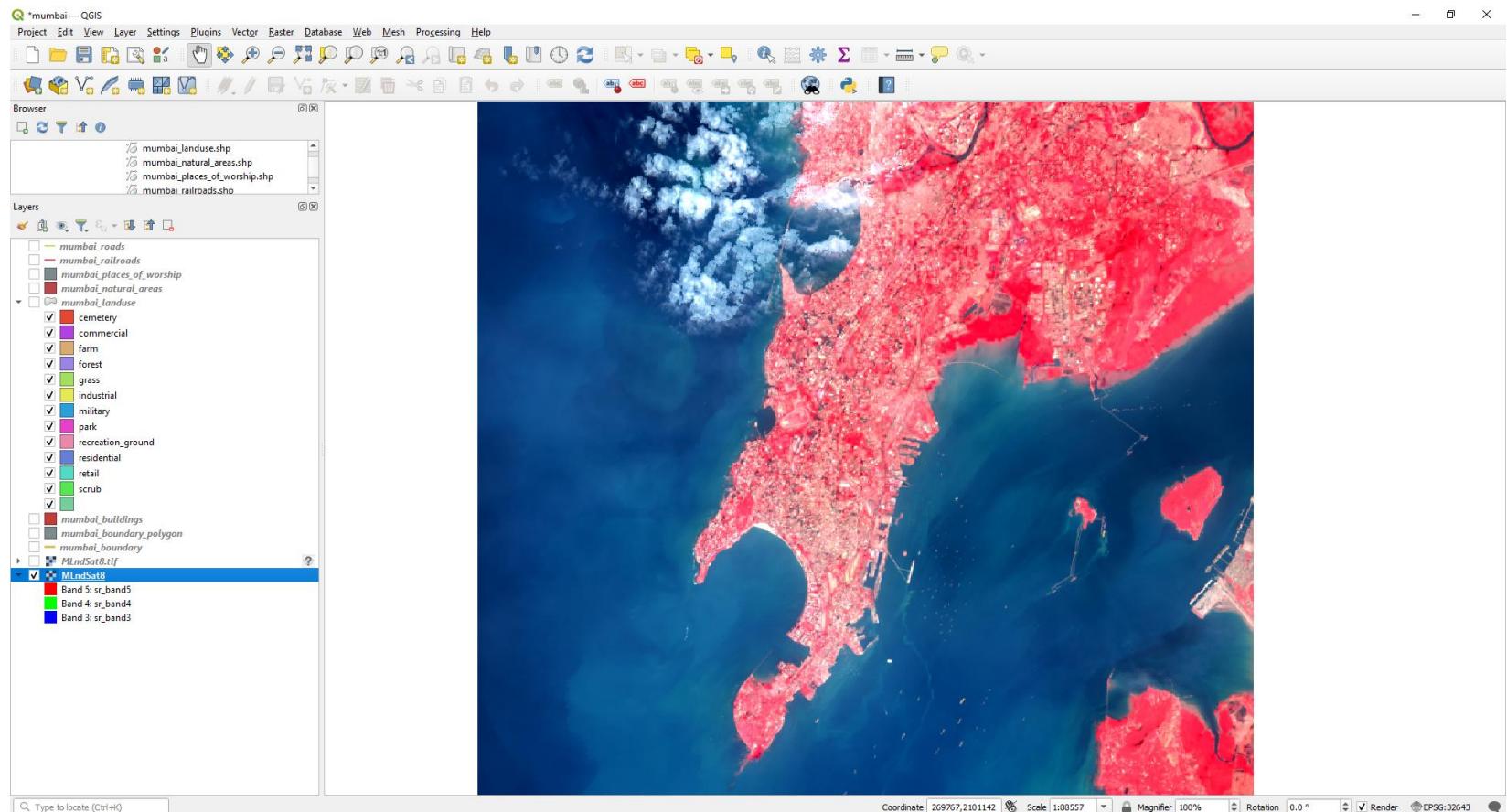
- Configurare bandă spectrală
- Natural – RGB (Band 4,3,2)
- Utilizare: Reprezentare naturală



Studiu de caz QGIS: Mumbai

Vizualizare date raster

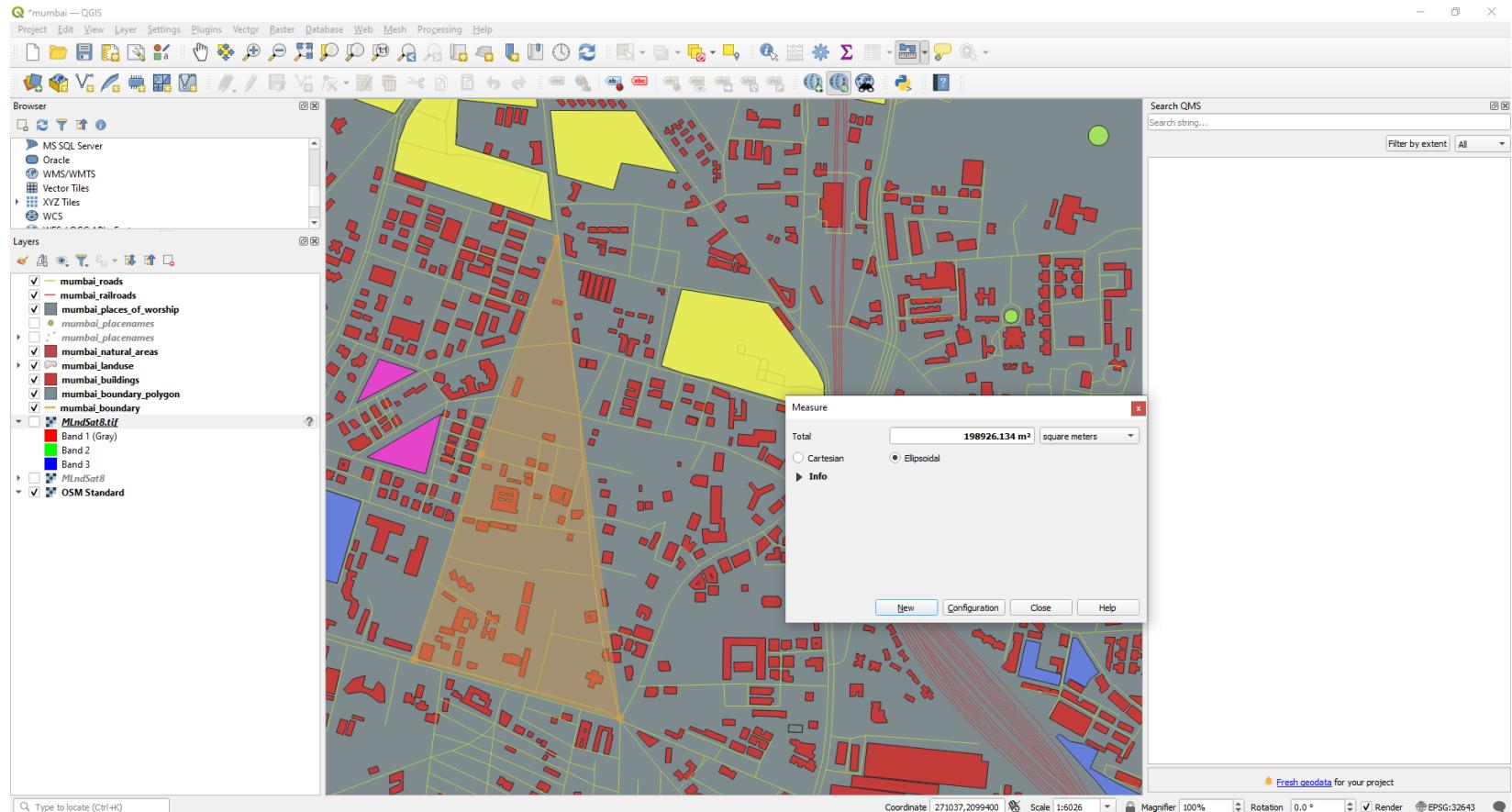
- Configurare bandă spectrală
- Infraroșu – RGB (Band 5,4,3)
- Utilizare: Evidențierea vegetației



Studiu de caz QGIS: Mumbai

Instrumente de măsurare

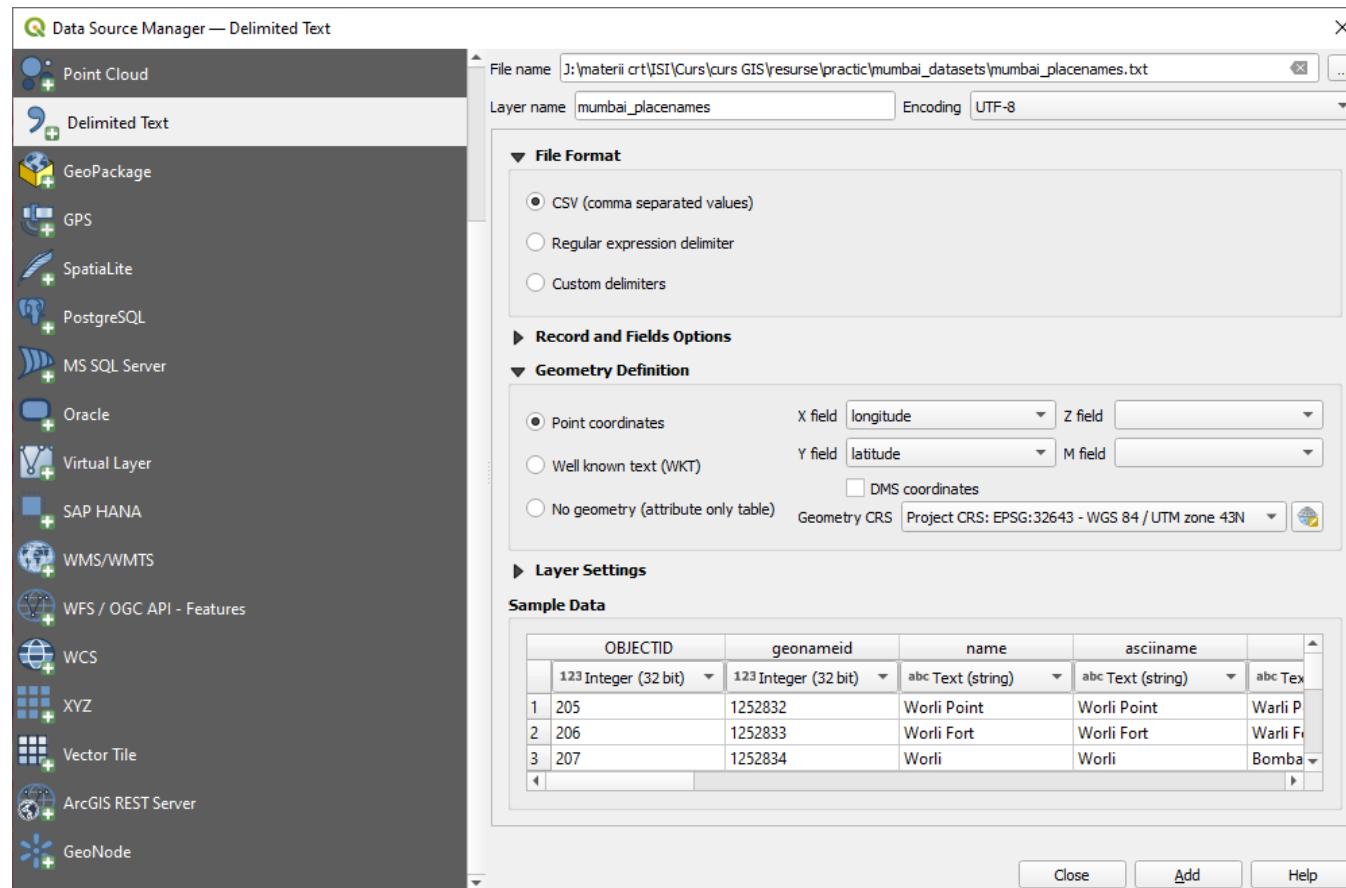
- Distanțe, suprafețe, direcție, unghiuri



Studiu de caz QGIS: Mumbai

Integrarea datelor tabelare

- Fișiere text/csv
- Layer / Data Source Manager / Delimited Text
- Selectați sistemul de coordonate de referință (CRS) corespunzător
- Geometry Definition: Geometry CRS – Default CRS: EPSG:4326 – WGS84



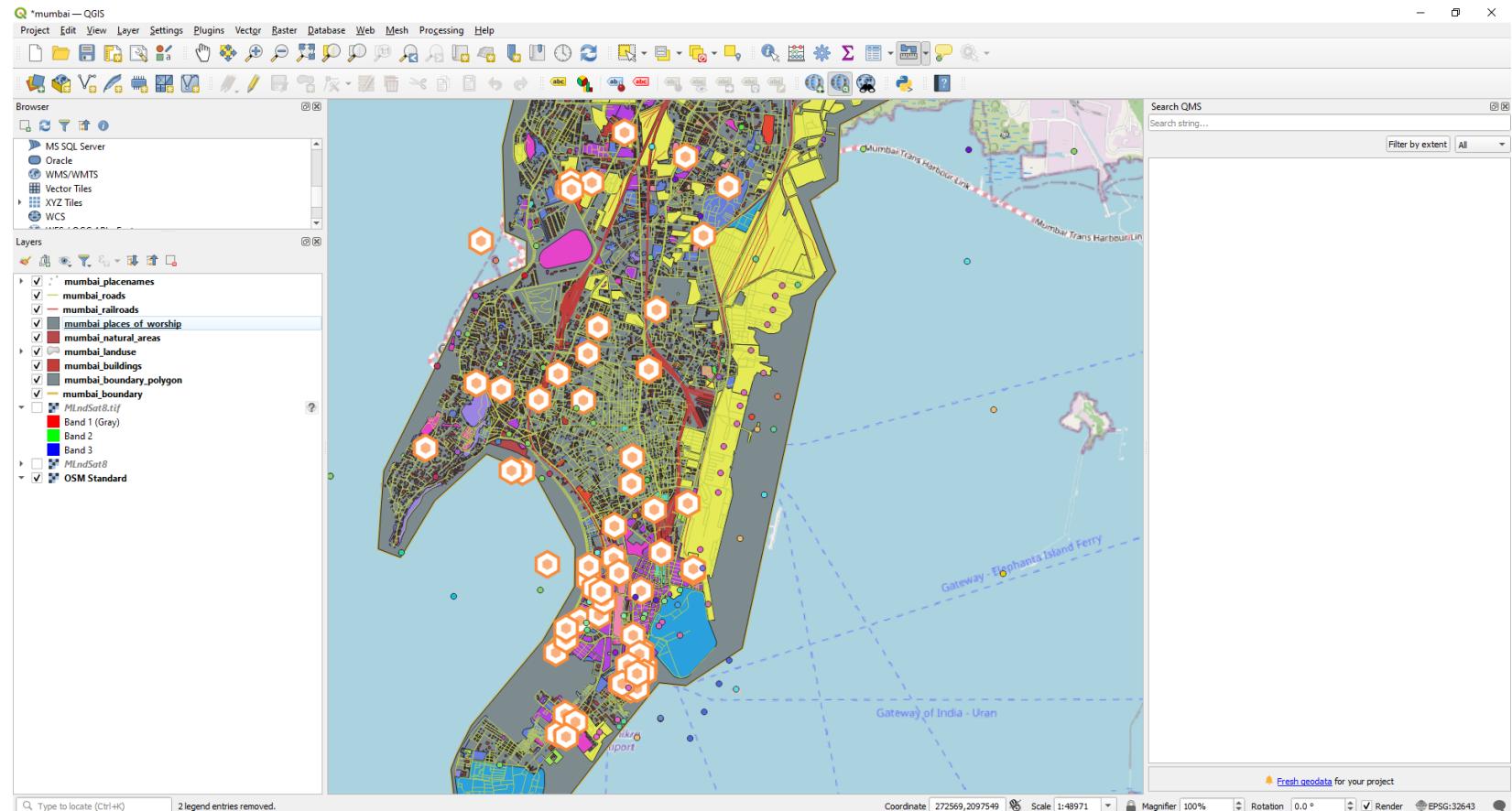
Adăugați fișierul: mumbai_placenames.txt

Studiu de caz QGIS: Mumbai

Exercițiu

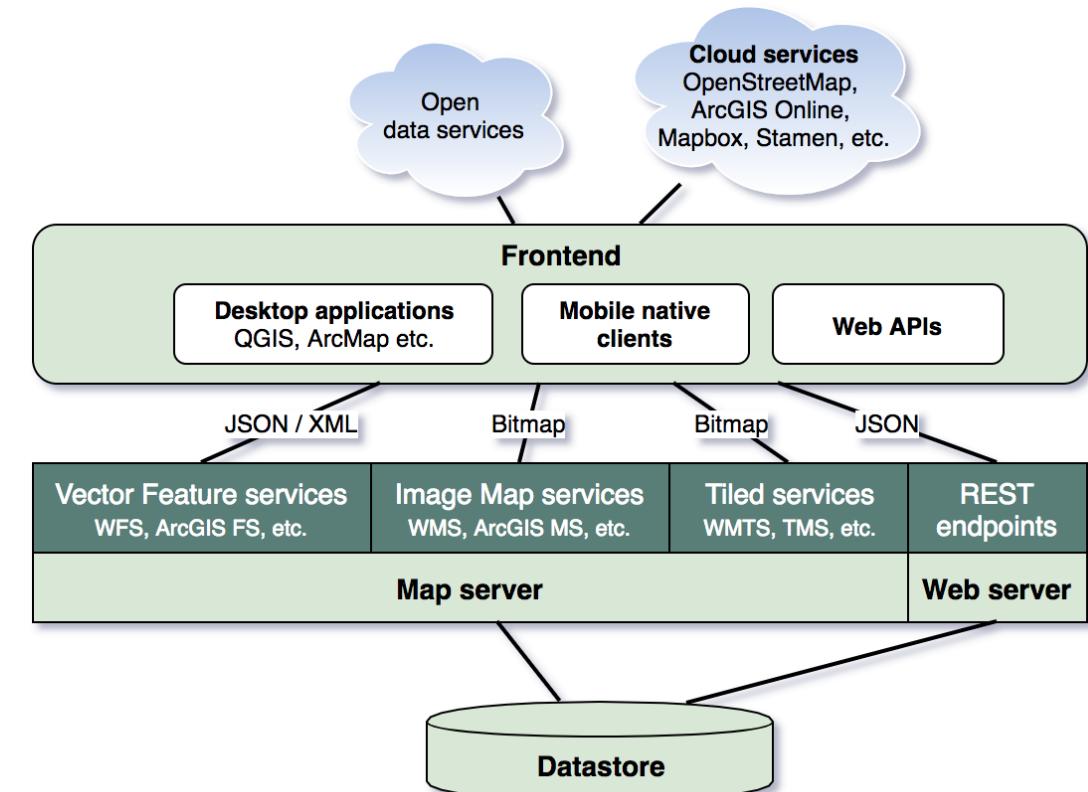
Reprezentați datele din fișierul CSV în funcție de tipul locațiilor

- Clasificare + configurare simboluri



Arhitecturi GIS combinate

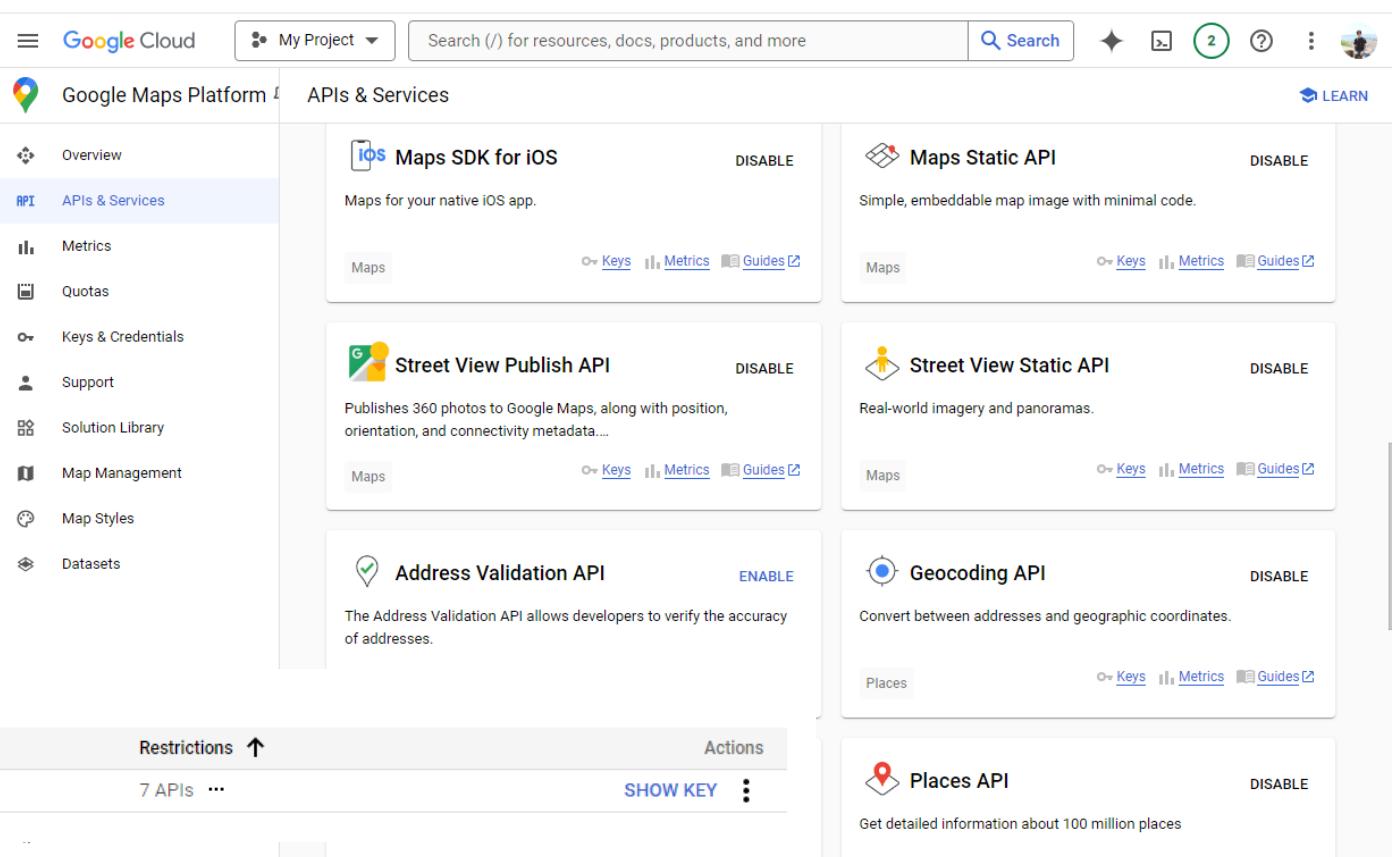
- Arhitectura sistemului Web GIS
 - Vector Feature services
 - Interfață REST: JSON, XML
 - WFS (Web Feature Service), ArcGIS FeatureService
 - Image Map services
 - Server-side rendering
 - WMS (Web Map Service), ArcGIS MapService
 - Tiled services
 - Hărți de bază salvate sub formă de parcele, de ex. 256 x 256 pixeli



Platforme GIS – Alternative

Google Maps API

- Platforma Google Maps
 - Google Cloud Console
 - APIs & Services
 - API-uri
 - SDK-uri
- Setup
 - API Key



The screenshot shows the Google Cloud Console interface for the Google Maps Platform. The left sidebar includes links for Overview, APIs & Services (which is selected), Metrics, Quotas, Keys & Credentials (which is highlighted in blue), Support, Solution Library, Map Management, Map Styles, and Datasets. The main content area displays a grid of API cards:

- iOS Maps SDK for iOS**: DISABLED. Description: Maps for your native iOS app.
- Maps Static API**: DISABLED. Description: Simple, embeddable map image with minimal code.
- Street View Publish API**: DISABLED. Description: Publishes 360 photos to Google Maps, along with position, orientation, and connectivity metadata...
- Street View Static API**: DISABLED. Description: Real-world imagery and panoramas.
- Address Validation API**: ENABLED. Description: The Address Validation API allows developers to verify the accuracy of addresses.
- Geocoding API**: DISABLED. Description: Convert between addresses and geographic coordinates.
- Places API**: DISABLED. Description: Get detailed information about 100 million places.

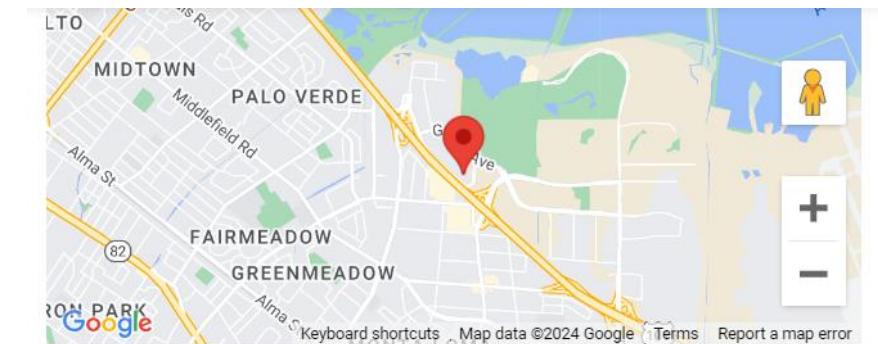
At the bottom of the sidebar, there are links for Metrics, Quotas, and Keys & Credentials. The Keys & Credentials link is highlighted in blue. The main content area also has a header bar with tabs for Overview, APIs & Services, Metrics, Quotas, Keys & Credentials, and Guides.



<https://console.cloud.google.com/google/maps-apis/home>

Google Maps API

- Web → Maps JavaScript API
 - Basics → Simple Map
 - Advanced Markers → Create an advanced marker
 - Draw on the Map → Circles, etc.
 - Customizing the Map → Styled Maps
 - Layers → Data Layer: GeoJSON



TypeScript JavaScript CSS HTML

```
async function initMap() {
  // Request needed libraries.
  const { Map } = await google.maps.importLibrary("maps")
  const { AdvancedMarkerElement } = await google.maps.importLibrary("marker")

  const map = new Map(document.getElementById('map') as HTMLElement, {
    center: { lat: 37.4239163, lng: -122.0947209 },
    zoom: 14,
    mapId: '4504f8b37365c3d0',
  });

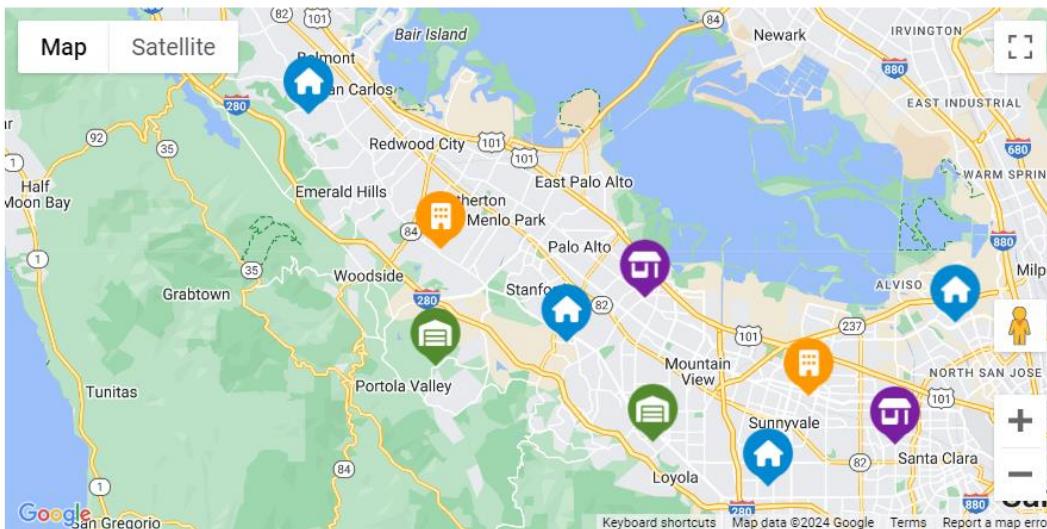
  const marker = new AdvancedMarkerElement({
    map,
    position: { lat: 37.4239163, lng: -122.0947209 },
  });
}
```

<https://developers.google.com/maps/documentation/javascript/examples?authuser=0>



Google Maps API

- Web → Maps JavaScript API
 - Places → Nearby Search
 - Services → Directions Service



```
function initMap(): void {
  const directionsService = new google.maps.DirectionsService();
  const directionsRenderer = new google.maps.DirectionsRenderer();
  const map = new google.maps.Map(
    document.getElementById("map") as HTMLElement,
    {
      zoom: 7,
      center: { lat: 41.85, lng: -87.65 },
    }
  );
  directionsService.route({
    origin: "Chicago, IL",
    destination: "Los Angeles, CA",
    travelMode: "DRIVING"
  }, (response, status) => {
    if (status === "OK") {
      directionsRenderer.setDirections(response);
    } else {
      window.alert(`Directions request failed due to ${status}`);
    }
  });
}
```

<https://developers.google.com/maps/documentation/javascript/examples?authuser=0>



Google Maps API @angular

- Se poate integra direct Google Maps JS API
- Există și componente Angular deja pregătite:
<https://github.com/angular/components>
- Demo cu Angular: <https://github.com/selsapingardi/angular-google-maps>
 - Adăugați API Key-ul din Google Maps Platform în index.html
 - Creați un map ID (Map Management → Create map ID → Vector)
 - Copiați map ID-ul în obiectul de configurare (din app.component.ts)

```
options: google.maps.MapOptions = {
  center: { lat: -31, lng: 147 },
  zoom: 4,
  mapId: "DEMO_MAP_ID",
};
```

[Create new map ID](#)

Name *

Description

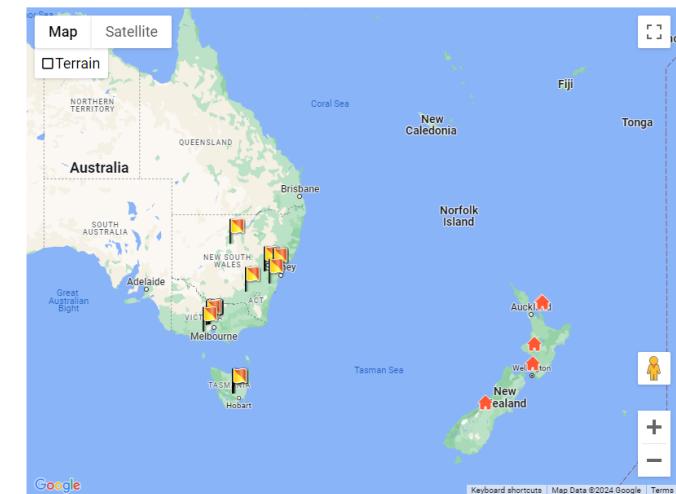
Map type *

Raster
 Vector

Tilt
 Rotation

Please note that these settings can also be overridden in code.

Google Maps in Angular 17



<https://github.com/angular/components>



Leaflet.js

- Bibliotecă open-source pentru JavaScript
 - Simplă, eficientă, modulară
 - Mobile-friendly
 - Extensibilă prin plugin-uri

```
// HTML
<div id="mapId"></div>

// JS
var map = new L.Map('mapId', {
  center: [51.505, -0.09],
  zoom: 13
});
```

- [Overlay Animations](#)
- [Clustering/decluttering](#)
- [Heatmaps](#)
- [DataViz](#)

Markers & renderers

These plugins provide new markers users versed in GIS also know these

Besides tile layers, you can easily add other things to your map, including markers, polylines, polygons, circles, and popups. Let's add a marker:

```
var marker = L.marker([51.5, -0.09]).addTo(map);
```

Adding a circle is the same (except for specifying the radius in meters as a second argument), but lets you control how it looks by passing options as the last argument when creating the object:

```
var circle = L.circle([51.508, -0.11], {
  color: 'red',
  fillColor: '#f03',
  fillOpacity: 0.5,
  radius: 500
});
```

A Marker extension to display circles with directional arrows.

[Demo](#) [R.A. Porter](#)

[Leaflet.Arc](#)

[Leaflet.ArrowCircle](#)

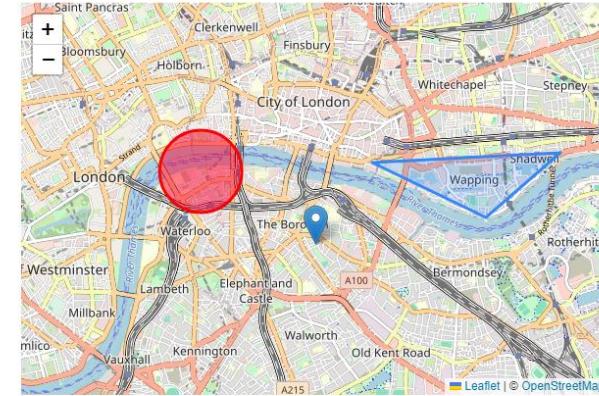
[Leaflet.Awesome-Markers](#)

Colorful, iconic & retina-proof markers based on the Font Awesome icons/Twitter Bootstrap icons

[Demo](#) [Lennard Voogdt](#)

Lightweight plugin that adds colorful iconic markers without

Markers, circles, and polygons



[See this example stand-alone.](#)

<https://leafletjs.com/examples/quick-start/>



“Pick your weapon”

	ArcGIS Online	QGIS	Google Maps Platform	Leaflet.js
Pros	<ul style="list-style-type: none"> Platformă completă de dezvoltare sisteme GIS și materiale educaționale Nivel de date bine reprezentat (layers) 	<ul style="list-style-type: none"> Aplicație free, open-source de lucru cu date geospațiale Alternativă la ArcGIS Pro 	<ul style="list-style-type: none"> Platformă centrată pe nivelul aplicație (API, SDK) Suport bun pentru aplicații mobile Acces la baza de date Google Places 	<ul style="list-style-type: none"> Bibliotecă open-source simplă, eficientă, modulară, extensibilă prin plugin-uri
Cons	<ul style="list-style-type: none"> Ecosistem fragmentat și schimbător Limitări impuse prin tipuri diferite de conturi și modele de monetizare 	<ul style="list-style-type: none"> Este doar o componentă dintr-un sistem GIS open-source 	<ul style="list-style-type: none"> Nivel de date fragmentat (Google Places, Markers, Overlays, Data Layers) 	<ul style="list-style-type: none"> Ecosistem fragmentat, probleme de compatibilitate între plugin-uri
Aplicații	<ul style="list-style-type: none"> Platforme guvernamentale, aplicații centrate pe GIS 	<ul style="list-style-type: none"> Gestionare/editare date geospațiale 	<ul style="list-style-type: none"> Aplicații de nivel consumer 	<ul style="list-style-type: none"> Aplicații GIS open-source

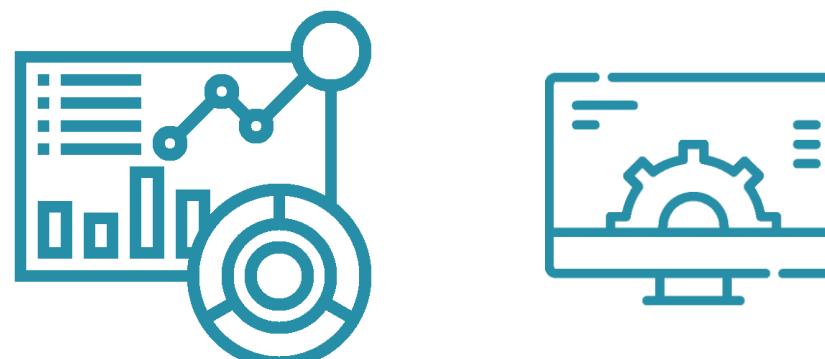
Întrebări?



Funcționalități GIS avansate

Analiza datelor geospațiale

- Clasificarea – reprezentare vizuală în funcție de atributele asociate
- Analiza overlay – realizarea unor combinații între primitivele (de același tip) aflate pe straturi diferite, în funcție de anumite condiții logice (AND – INTERSECT, OR – UNION, XOR, NOT)
- Analiza corelațiilor spațiale – identificarea relațiilor între diferite tipuri de date geospațiale distribuite pe mai multe straturi, e.g. analiza fenomenelor de tip cauză-efect

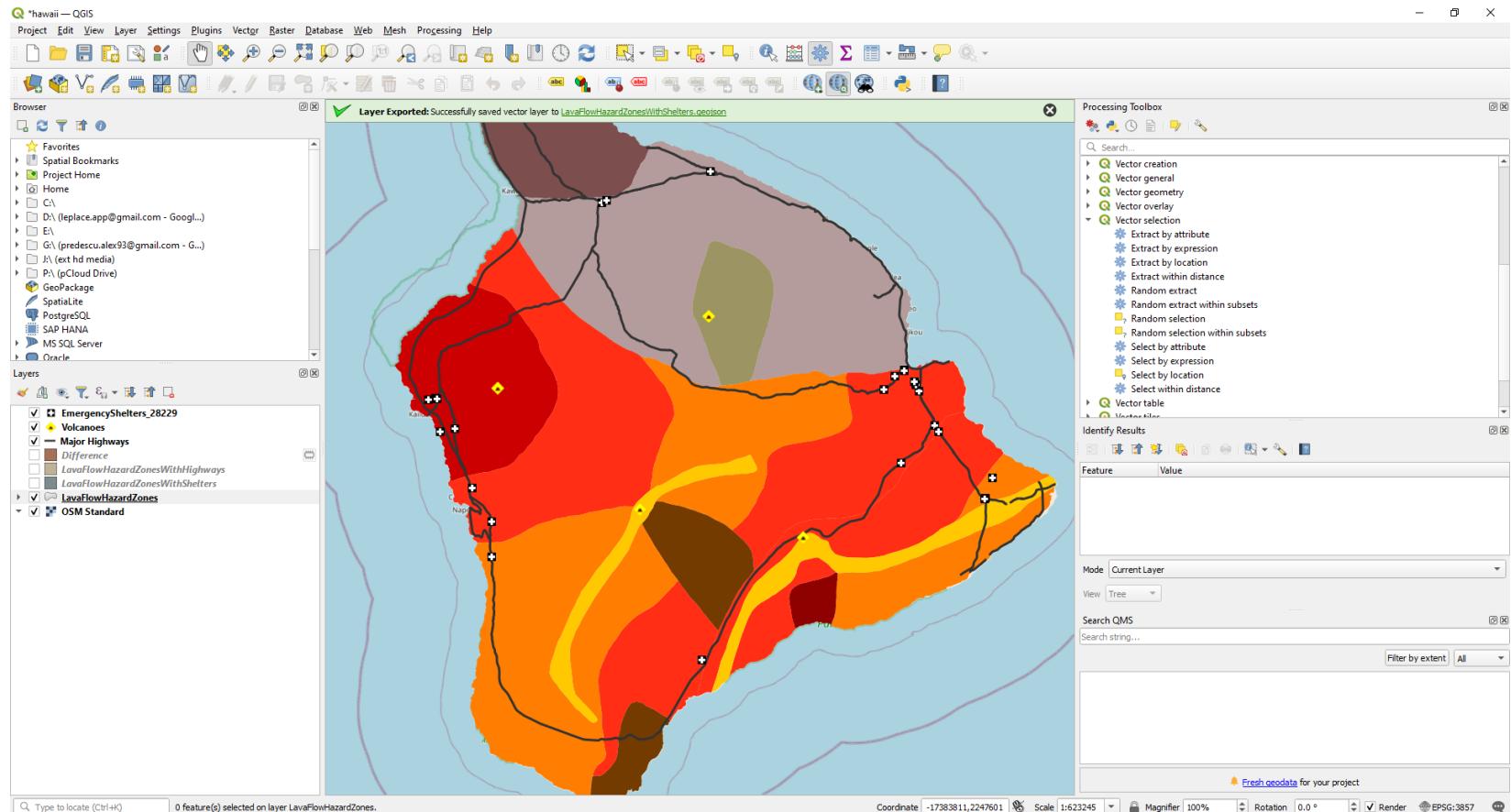


Studiu de caz: Hawaii

Integrarea datelor dintr-un FeatureLayer ArcGIS

- Layer > Data Source Manager
- ArcGIS REST Server > New Connection

Processing Toolbox

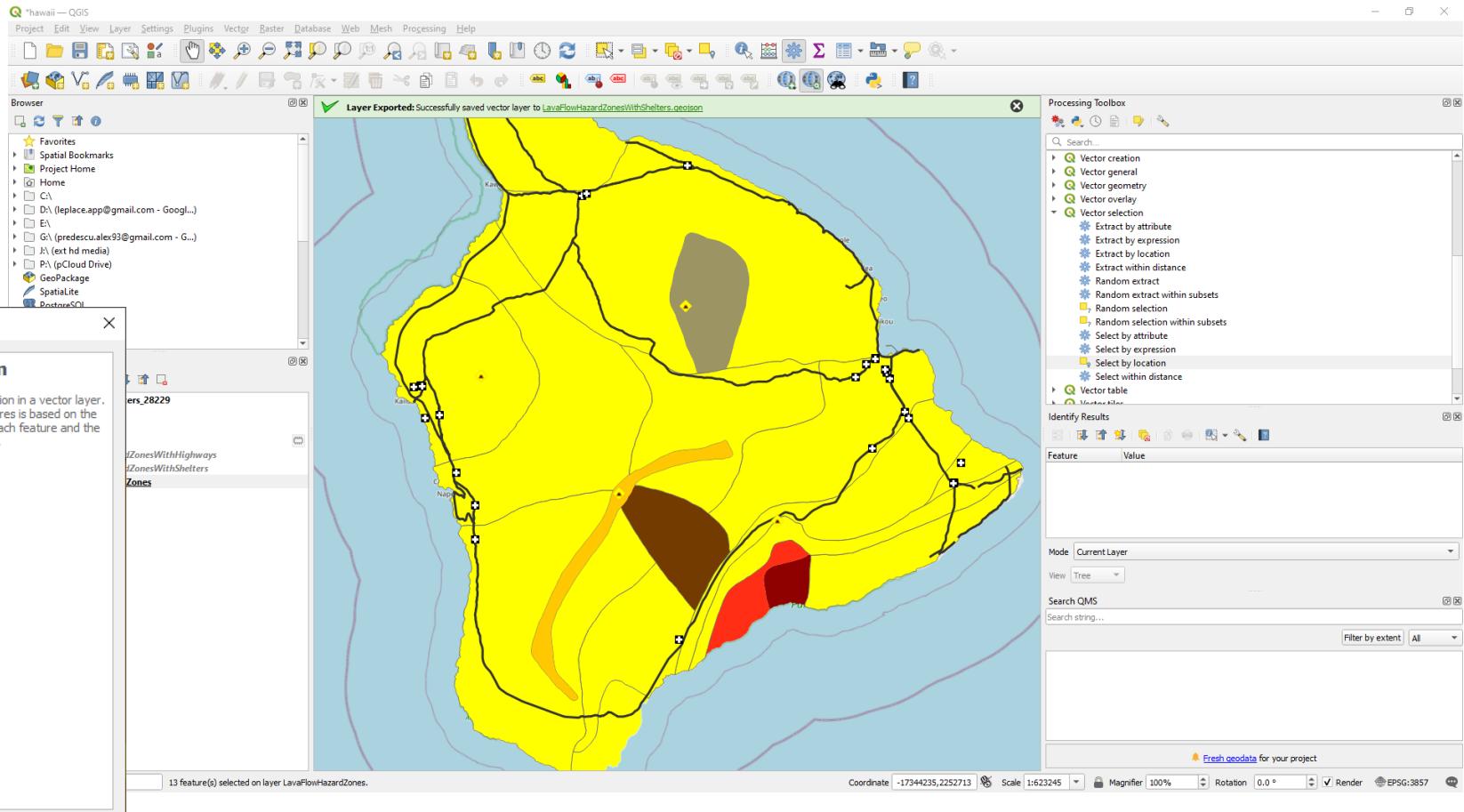
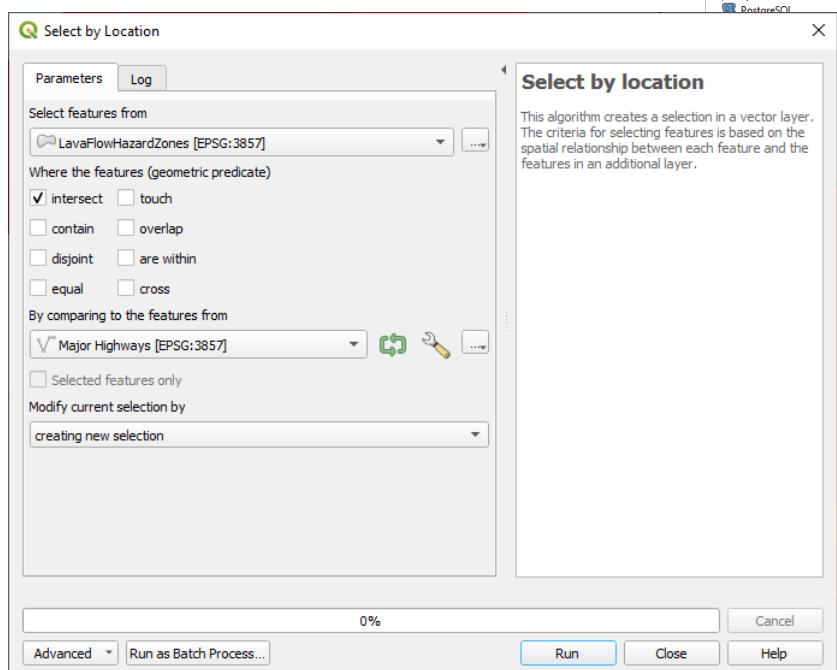


[Performing a spatial query in QGIS](#)

Studiu de caz: Hawaii

Processing Toolbox

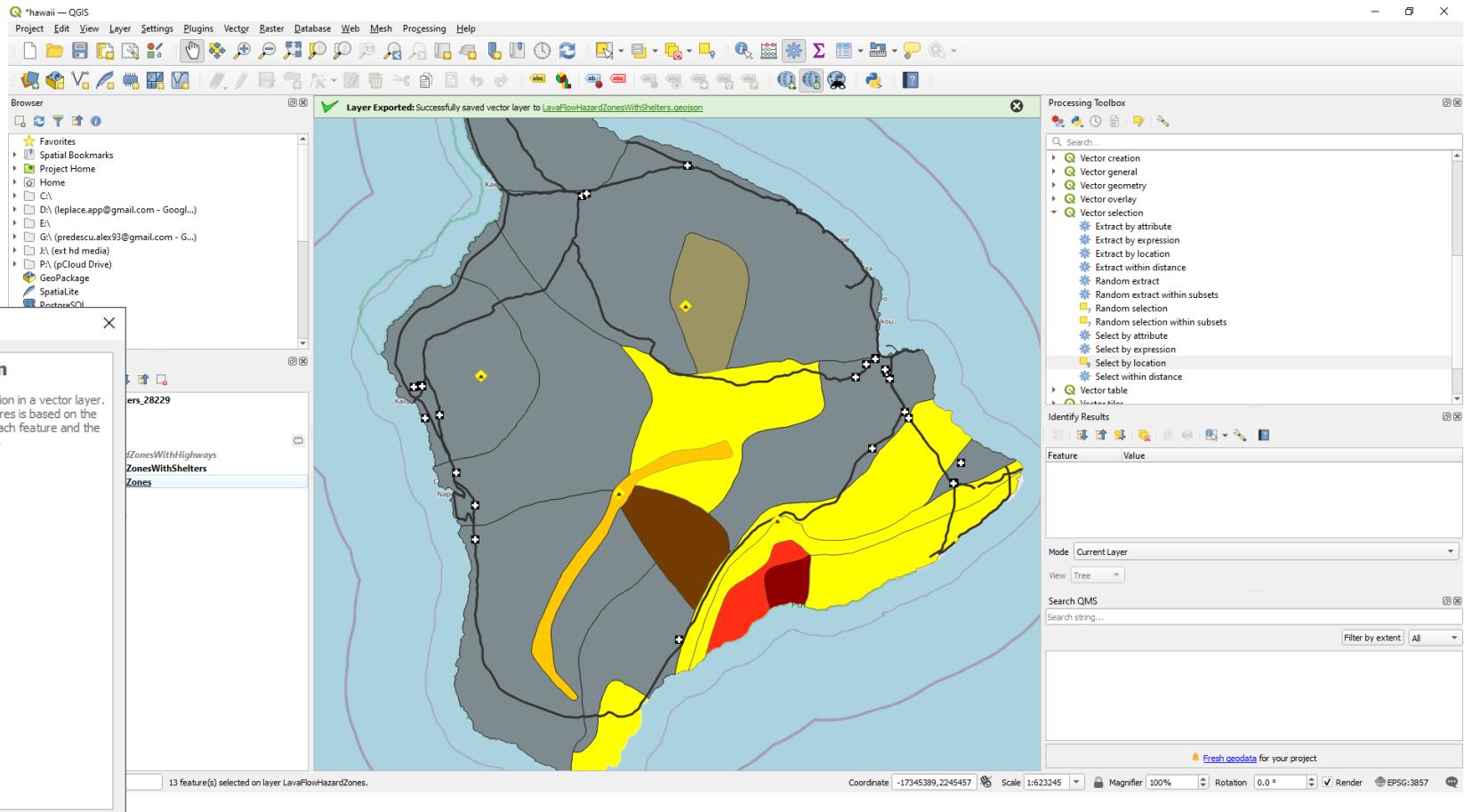
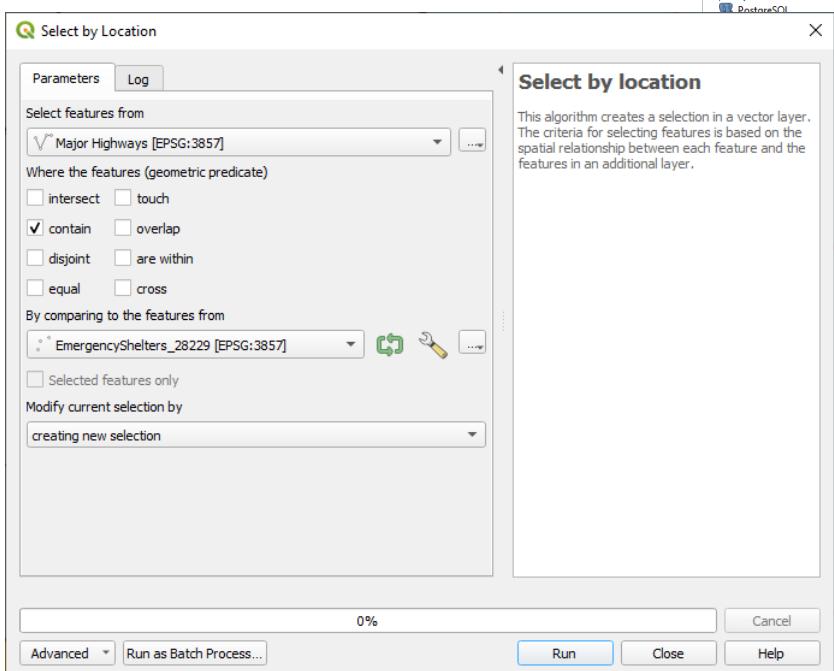
- Select by location



Studiu de caz: Hawaii

Processing Toolbox

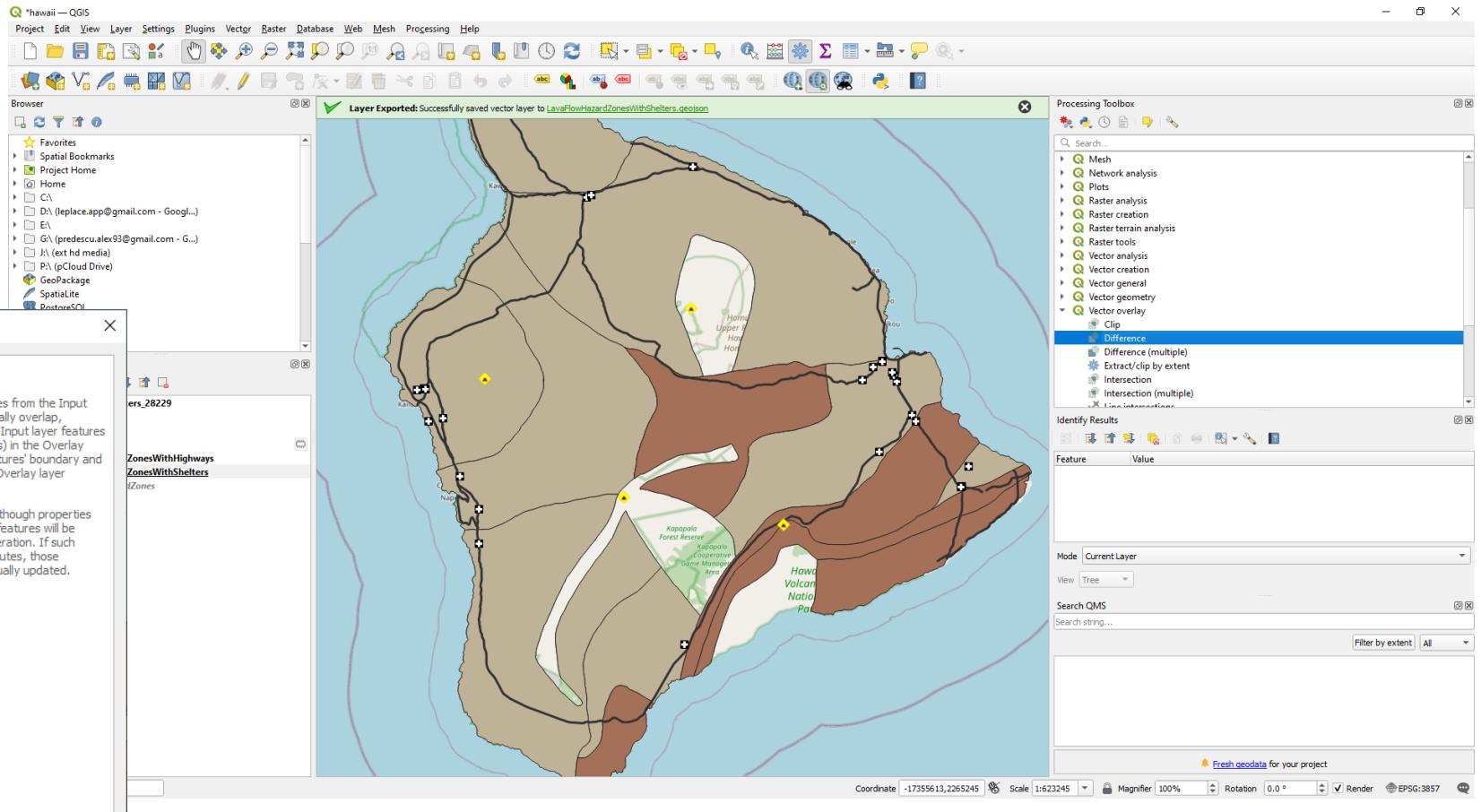
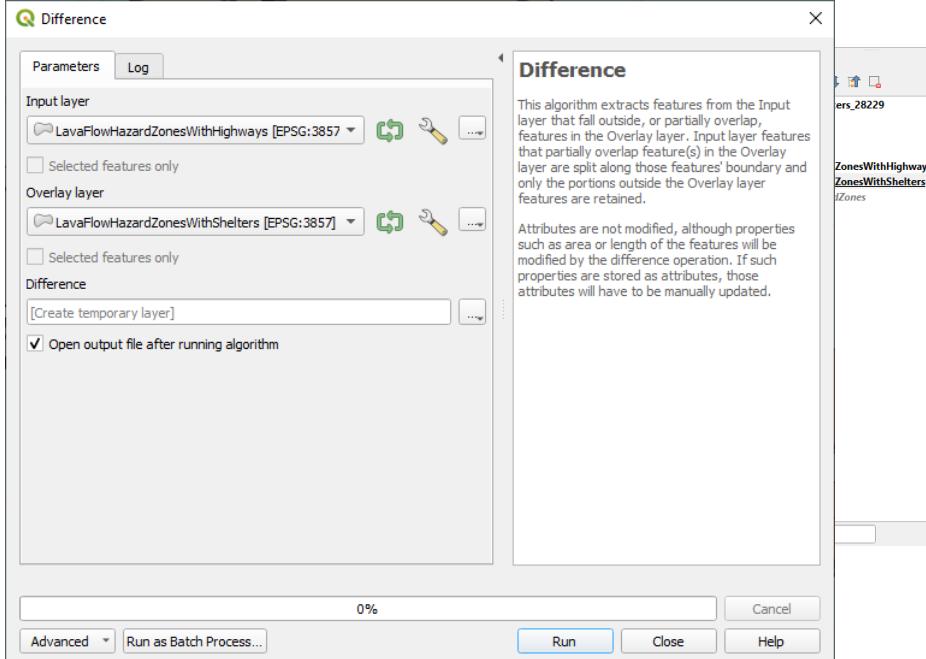
- Select by location



Studiu de caz: Hawaii

Processing Toolbox

- Vector overlay
- Difference



Bibliografie

- [QGIS Documentation](#)
- [MapServer: OGC Support and Configuration](#)
- [Maps JavaScript API | Google for Developers](#)
- [Leaflet Quick Start Guide](#)

