

Basic Vector Operations



ISTANBUL **TECHNICAL** UNIVERSITY

Sp. Anly. and Alg. in GIS

Week 1

Res. Assist. Ömer AKIN

Introduction & Aim of the Study

- *A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data.*
- *Geoprocessing is any GIS operation used to manipulate data.*

Aim of the Study:

- *Find roads and hotels that will be affected by a possible flood event for the European side of Istanbul.*

Input Data:

- *POI (Vector-Point/Geojson)*
- *Roads (Vector-Polyline/Geojson)*
- *Water Bodies (Vector-Polygon/Geojson)*
- *European Side of Istanbul (Vector-Polygon/Geojson)*

Introduction to Quantum GIS (QGIS)

- QGIS is a volunteer-led development project licensed under the GNU General Public License then was incubated with the Open Source Geospatial Foundation (OSGeo) in 2007.





- It has many open source desktop GIS tools within (GRASS & SAGA) and it also has a plug-in architecture. It is written in C++ but offers a rich Python scripting environment. It also includes drivers for connecting to PostGIS data as well as various other GIS data sources.

Installing/Updating Quantum GIS (QGIS)

Installation

Download for Windows

QGIS in OSGeo4W:

-  [OSGeo4W Network Installer \(64 bit\)](#)
-  [OSGeo4W Network Installer \(32 bit\)](#)

In the installer choose **Desktop Express Install** and select **QGIS** to install the *latest release*.
To get the *long term release* (that is not also the latest release) choose **Advanced Install** and select **qgis-ltr-full**
To get the *bleeding-edge development build* choose **Advanced Install** and select **qgis-full-dev**



Standalone installers from OSGeo4W packages

Latest release (richest on features):



IMPORTANT NOTE: we are holding back further download of 3.18.0 Windows installer because of some serious issues found after release.

Download links below are disabled until we release 3.18.1 with fixes for these issues.

The 3.18.0 download is still accessible through the "All Downloads" tab (for testing purposes)

Download Link	SHA256
 QGIS Standalone Installer Version 3.18 (64 bit)	sha256
 QGIS Standalone Installer Version 3.18 (32 bit)	sha256

Long term release repository (most stable):

Download Link	SHA256
 QGIS Standalone Installer Version 3.16 (64 bit)	sha256
 QGIS Standalone Installer Version 3.16 (32 bit)	sha256

OSGeo4W Net Release Setup Program

This setup program is used for the initial installation of the OSGeo4W environment as well as all subsequent updates. Make sure to remember where you saved it.

The pages that follow will guide you through the installation. Please note that OSGeo4W consists of a large number of packages spanning a wide variety of purposes. We only install a base set of packages by default. You can always run this program at any time in the future to add, remove, or upgrade packages as necessary.

☒ Express Desktop Install
☐ Express Web-GIS Install
☐ Advanced Install

< Back Next > Cancel

OSGeo4W Setup - Express Package Selection

Select Packages

☐ MapServer
☒ QGIS
☒ GDAL
☐ Apache Port number:
☐ uDig
☐ OpenEV
☒ GRASS GIS

< Back Next > Cancel

<https://qgis.org/en/site/forusers/download.html>

Updating

OSGeo4W

- GRASS GIS 7.8.4
- OSGeo4W Shell
- QGIS Desktop 3.18.0
- QGIS Desktop 3.18.0 with GRASS 7.8.5
- Qt Designer with QGIS 3.18.0 custo...
- SAGA GIS (2.3.2)
- Setup**
- Outlook 2016

OSGeo4W Net Release Setup Program

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☐ Express Desktop Install
☐ Express Web-GIS Install
☒ Advanced Install

< Back Next > Cancel

OSGeo4W Setup - Select Packages

Select Packages
Select packages to install

Search Clear

☐ Keep ☐ Prev ☒ Curr ☐ Exp View Category

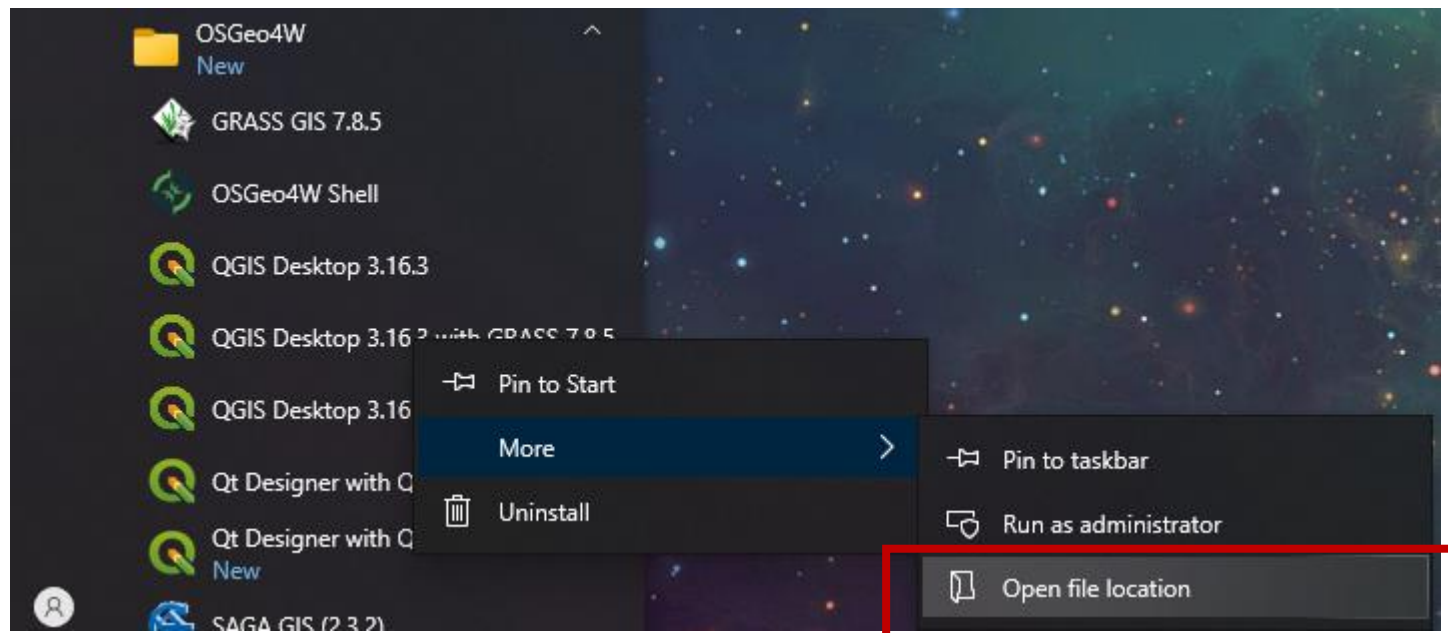
Category	Current	New	B...	S...	Size	Package
All	Default					
Commandline Utilities	Default					
Desktop	Default					
	7.8.4-1	7.8.5-1			446k	alkis-import: norGIS ALKIS Import
					543k	alkis-import-gid7: norGIS ALKIS Import (GeoInfoDok 7)
					586k	gpsbabel: GPSBabel GUI Frontend
					87,258k	grass: GRASS GIS
					87,397k	grass-daily: GRASS GIS - daily builds of development version
					25,320k	grass6: GRASS GIS - old stable release
					32k	libzip-bin: libzip (executables)
					160k	osg-bin: OpenSceneGraph (executables)
					951k	osgearth-bin: OSG Earth (executables)
	3.18.0-1	3.16.3-1			50,646k	qgis: QGIS Desktop
					?	qgis-dev
					519,705k	qgis-dev-pdb: Debugging symbols for QGIS nightly build of the development branch
	3.10-1	3.12-1			1k	qgis-full: QGIS Full Desktop (meta package for express install)
					1k	qgis-full-dev: QGIS nightly build of the development branch (metapackage with additional dependencies)
					1k	qgis-full-rel-dev: QGIS nightly build of the latest release branch (metapackage with additional dependencies)
		3.16.4-1			50,680k	qgis-ltr: QGIS Desktop (long term release)
					94,999k	qgis-ltr-dev: QGIS nightly build of the long term release branch
					510,215k	qgis-ltr-dev-pdb: Debugging symbols for QGIS nightly build of the long term release branch
		3.10-2			1k	qgis-ltr-full: QGIS Full Desktop (meta package: long term release)
					205,269k	qgis-ltr-pdb: Debugging symbols for the QGIS long term release
					204,876k	qgis-pdb: Debugging symbols for QGIS
					97,075k	qgis-rel-dev: QGIS nightly build of the release branch
					528,596k	qgis-rel-dev-pdb: Debugging symbols for QGIS nightly build of the release branch
					35,177k	saga: SAGA System for Automated Geographical Analyses
	2.3.2-4				9,647k	saga-ltr: SAGA (System for Automated Geographical Analyses; long-term release)

☒ Hide obsolete packages

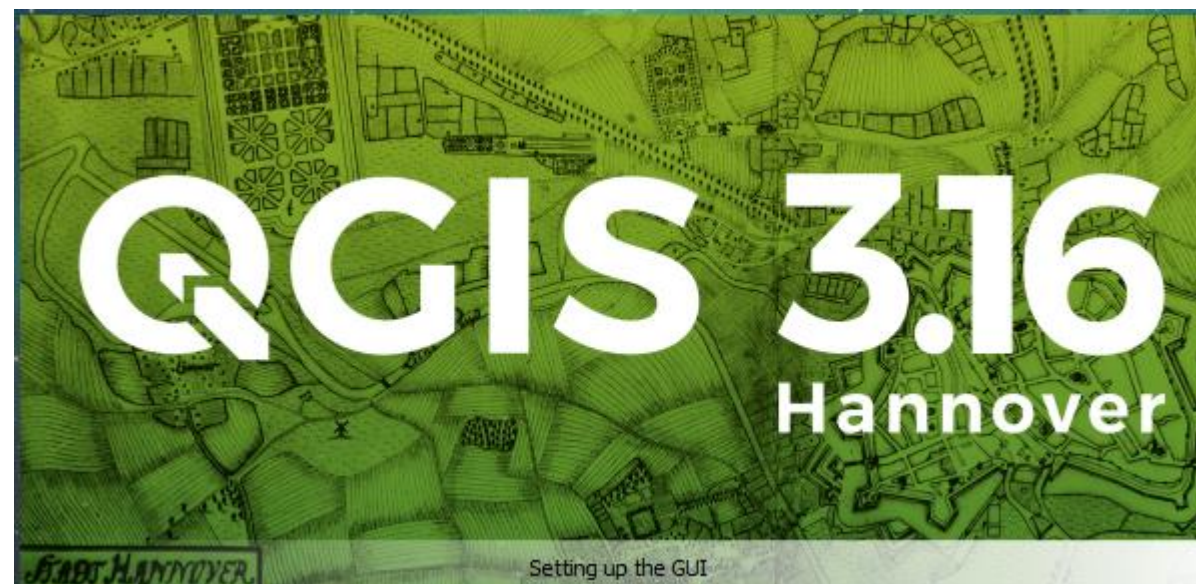
< Back Next > Cancel

Installing
Long
Term
Release

Opening Quantum GIS (QGIS)



Name	Date modified	Type	Size
GRASS GIS 7.8.5	3/16/2021 12:45 PM	Shortcut	2 KB
OSGeo4W Shell	3/16/2021 12:32 PM	Shortcut	2 KB
QGIS Desktop 3.16.3 with GRASS 7.8.5	3/16/2021 12:45 PM	Shortcut	1 KB
QGIS Desktop 3.16.3	3/16/2021 12:45 PM	Shortcut	1 KB
QGIS Desktop 3.16.4 with GRASS 7.8.5	3/16/2021 12:45 PM	Shortcut	1 KB
QGIS Desktop 3.16.4	3/16/2021 12:45 PM	Shortcut	1 KB
Qt Designer with QGIS 3.16.3 custom wid...	3/16/2021 12:45 PM	Shortcut	2 KB
Qt Designer with QGIS 3.16.4 custom wid...	3/16/2021 12:45 PM	Shortcut	2 KB
SAGA GIS (2.3.2)	3/16/2021 12:33 PM	Shortcut	2 KB
Setup	3/16/2021 12:32 PM	Shortcut	2 KB



Exploring Quantum GIS (QGIS)



Lab1 — QGIS

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

Layers

- poi
- roads
- water_bodies

Drag water_bodies.geojson, roads.geojson and poi.geojson to the QGIS Layers window.

Browser

- Favorites
- C:\Lecture\Lab1\data
 - poi.geojson
 - roads.geojson
 - water_bodies.geojson
- Spatial Bookmarks
- Project Home
- Home
- C:\
- D:\
- GeoPackage
- Spatialite
- PostGIS
- MSSQL
- Oracle
- DB2
- WMS/WMTS
- Vector Tiles
- XYZ Tiles
 - OpenStreetMap
- WCS
- WFS / OGC API - Features
- OWS
- ArcGIS Map Service

Processing Toolbox

- clip
- Recently used
- Vector overlay
- GDAL
- SAGA

Layers Panel

Browser Panel

Processing Toolbox

Type to locate (Ctrl+K) Saved project to: C:\Users\PC\Desktop\Lab1.qgz Coordinate 494071,4595393 Scale 1:473970 Magnifier 100% Rotation 0.0 ° Render EPSG:5254

Available Vector Data Exchange Formats in QGIS



- Geopackage (.gpkg)
- ESRI Shapefile (.shp)
- GeoJSON (.geojson)
- Geography Markup Language (.gml)
- AutoCAD DXF (.dxf)
- Comma-separated values (.csv)
- GPS eXchange Format (.gpx)
- Keyhole Markup Language (.kml)
- SQLite/SpatiaLite (.sqlite/.db)

Exploring Data



• *Attribute Table*
• *Coordinate System*
• *Symbology*
• *Labeling*

Adding Basemap

EPSG:5254

Coordinate System of Dataframe

Data Properties

poi — Features Total: 33846, Filtered: 33846, Selected: 0

	osm_id	code	fclass	name
1	262396496	2401	hotel	Yiğitalp Oteli
2	262402714	2301	restaurant	Hamdi
3	266743039	2001	police	Yakacık Polis M...
4	269365937	2005	post_office	PTT
5	269366848	2005	post_office	NULL
6	269370709	2721	attraction	Rumeli Hisarı

Attribute Table

Field Properties

Layer Properties — poi — Fields

	Id	Name	Alias	Type	Type name	Length	Precision	Comment	Configuration
abc 0	osm_id		QString	String	0	0			
123 1	code		int	Integer	0	0			
abc 2	fclass		QString	String	0	0			
abc 3	name		QString	String	0	0			

Layer Properties — poi — Symbology

Single Symbol

Marker

Simple Marker

Unit: Millimeters

Opacity: 100.0 %

Color: [Red]

Size: 1.60000

Rotation: 0.00 °

Favorites

dot black, dot white, dot blue, dot green, dot red, effect drop shadow, shield disability, topo hospital, topo pop capital

Save Symbol... Advanced

Layer Rendering

Style

OK Cancel Apply Help

Symbology

Labeling

Layer Properties — poi — Labels

Single Labels

Value: abc name

Text Sample

Lorem Ipsum

1:473970

Coordinate System

Source

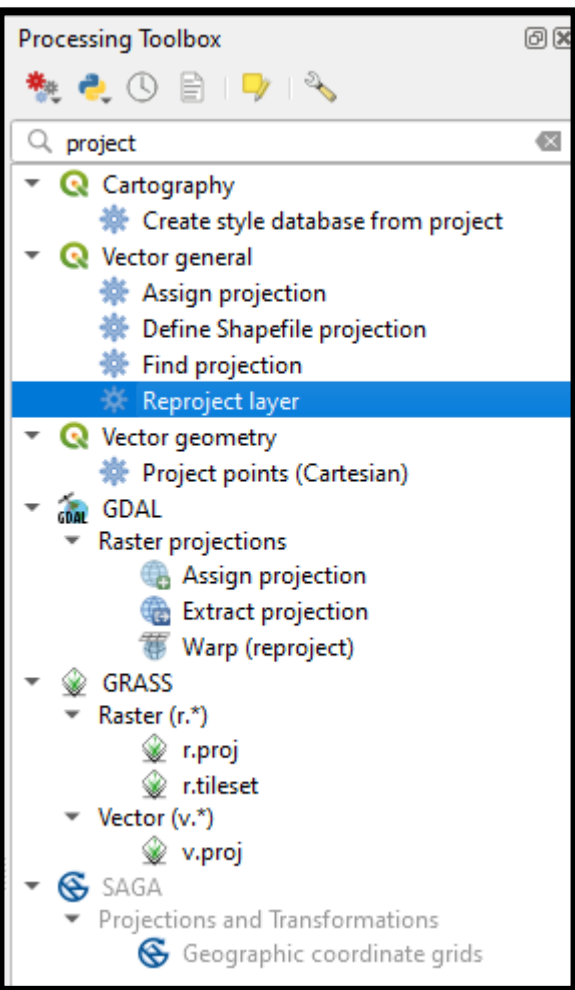
Data source encoding: UTF-8

Assigned Coordinate Reference System (CRS)

EPSG:4326 - WGS 84

Reprojection

- Reproject POI into TUREF TM30 for Istanbul



Processing Toolbox

- project
- Cartography
 - Create style database from project
- Vector general
 - Assign projection
 - Define Shapefile projection
 - Find projection
 - Reproject layer**
- Vector geometry
 - Project points (Cartesian)
- GDAL
 - Raster projections
 - Assign projection
 - Extract projection
 - Warp (reproject)
- GRASS
 - Raster (r.*)
 - r.proj
 - r.tilesset
 - Vector (v.*)
 - v.proj
- SAGA
 - Projections and Transformations
 - Geographic coordinate grids

Reproject Layer

Parameters Log

Input layer: poi [EPSG:4326]

Selected features only: ☐

Target CRS: EPSG:4326 - WGS 84

Advanced Parameters

Reprojected: [Create temporary layer]

Open output file after running algorithm: ☒

0%

Run as Batch Process... Run Close Help

Reproject layer

This algorithm reprojects a vector layer. It creates a new layer with the same features as the input one, but with geometries reprojected to a new CRS.

Attributes are not modified by this algorithm.

Coordinate Reference System Selector

Filter: TUREF

Recently Used Coordinate Reference Systems

Coordinate Reference System	Authority ID
TUREF / TM30	EPSG:5254

Predefined Coordinate Reference Systems

Hide deprecated CRSs: ☐

Transverse Mercator

Coordinate Reference System	Authority ID
TUREF / 3-degree Gauss-Kruger zone 10	EPSG:5270
TUREF / 3-degree Gauss-Kruger zone 11	EPSG:5271
TUREF / 3-degree Gauss-Kruger zone 12	EPSG:5272
TUREF / 3-degree Gauss-Kruger zone 13	EPSG:5273
TUREF / 3-degree Gauss-Kruger zone 14	EPSG:5274
TUREF / 3-degree Gauss-Kruger zone 15	EPSG:5275
TUREF / 3-degree Gauss-Kruger zone 9	EPSG:5269
TUREF / TM27	EPSG:5253
TUREF / TM30	EPSG:5254
TUREF / TM33	EPSG:5255
TUREF / TM36	EPSG:5256

WKT

```
PROJCRS["TUREF / TM30",  
  BASEGEOGCRS["TUREF",  
    DATUM["Turkish National Reference Frame",  
      ELLIPSOID["GRS 1980", 6378137, 298.257222101,  
        LENGTHUNIT["metre", 1]],  
    PRIMEM["Greenwich", 0,  
      ANGLEUNIT["degree", 0.0174532925199433]],  
    ID["EPSG", 5252]],  
    CONVERSION["3-degree Gauss-Kruger CM 30E",  
      METHOD["Transverse Mercator",  
        ID["EPSG", 9807]],  
      PARAMETER["Latitude of natural origin", 0,  
        ANGLEUNIT["degree", 0.0174532925199433],  
        ID["EPSG", 8801]],
```

Check CRS visually

Create Temporary Layer

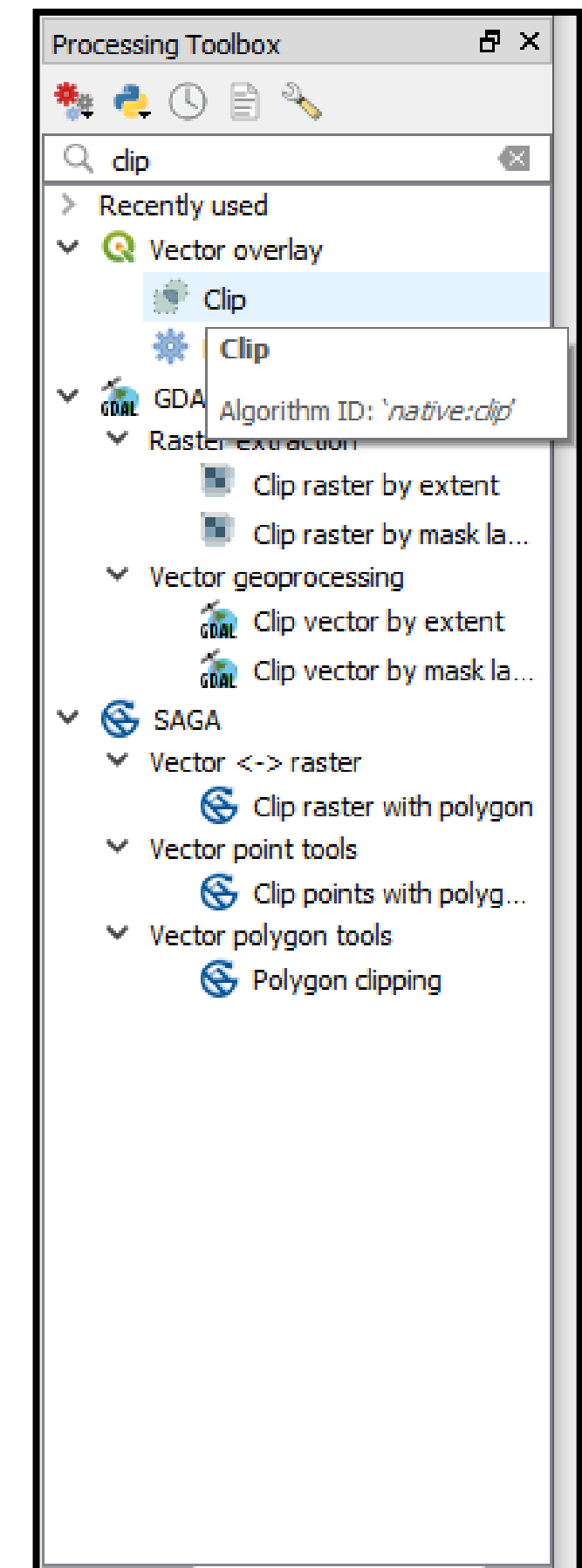
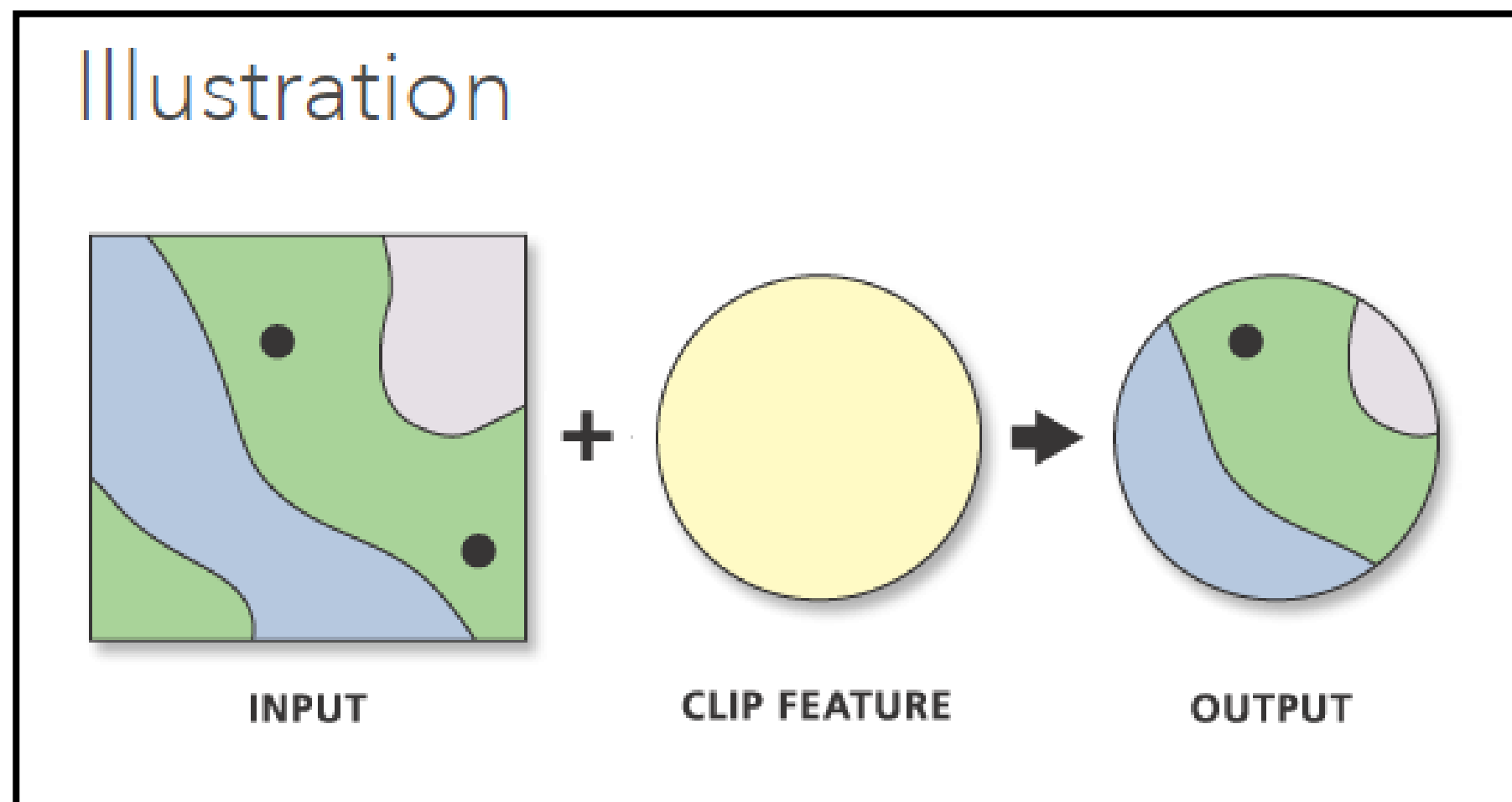
- Save to File...
- Save to GeoPackage...
- Save to Database Table...
- Append to Layer...
- Change File Encoding (System)...

Save projected poi as poi_reproj.gejson

- GPKG files (*.gpkg)
- SHP files (*.shp)
- 000 files (*.000)
- BNA files (*.bna)
- CSV files (*.csv)
- DGN files (*.dgn)
- DXF files (*.dxf)
- JSON files (*.json)
- GEOJSON files (*.geojson)**
- GEOJSON files (*.geojson)
- GML files (*.gml)
- GPX files (*.gpx)
- GXT files (*.gxt)
- ILI files (*.ili)
- ITF files (*.itf)
- JSON files (*.json)
- KML files (*.kml)
- ODS files (*.ods)
- SQL files (*.sql)
- SQLITE files (*.sqlite)
- TAB files (*.tab)
- TXT files (*.txt)
- XLSX files (*.xlsx)
- XML files (*.xml)
- XTF files (*.xtf)
- All files (*.*)
- GPKG files (*.gpkg)

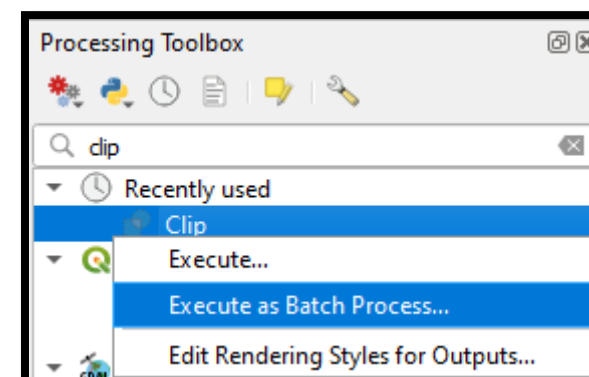
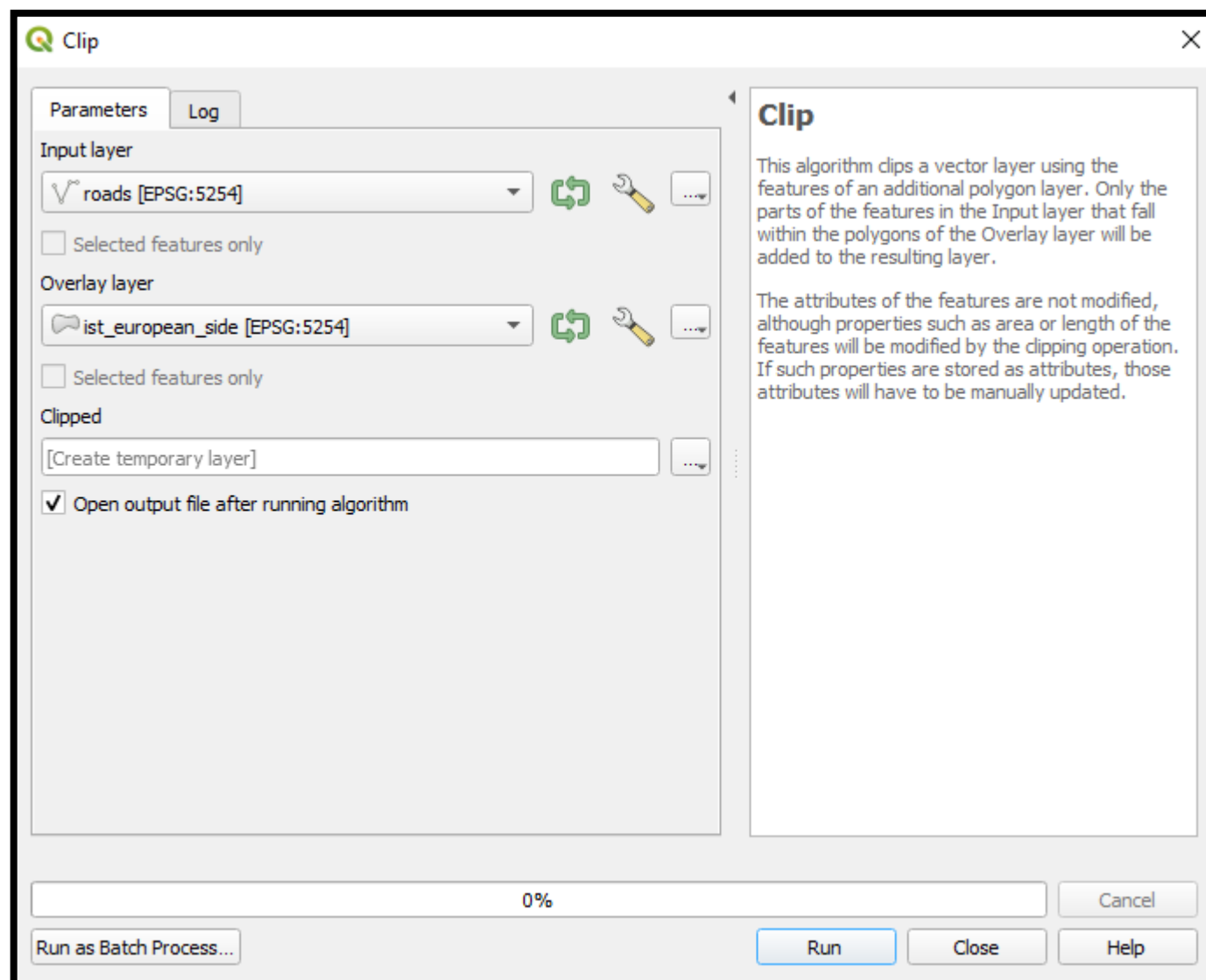
Clip Analysis

- Extracts input features that overlay the clip features.

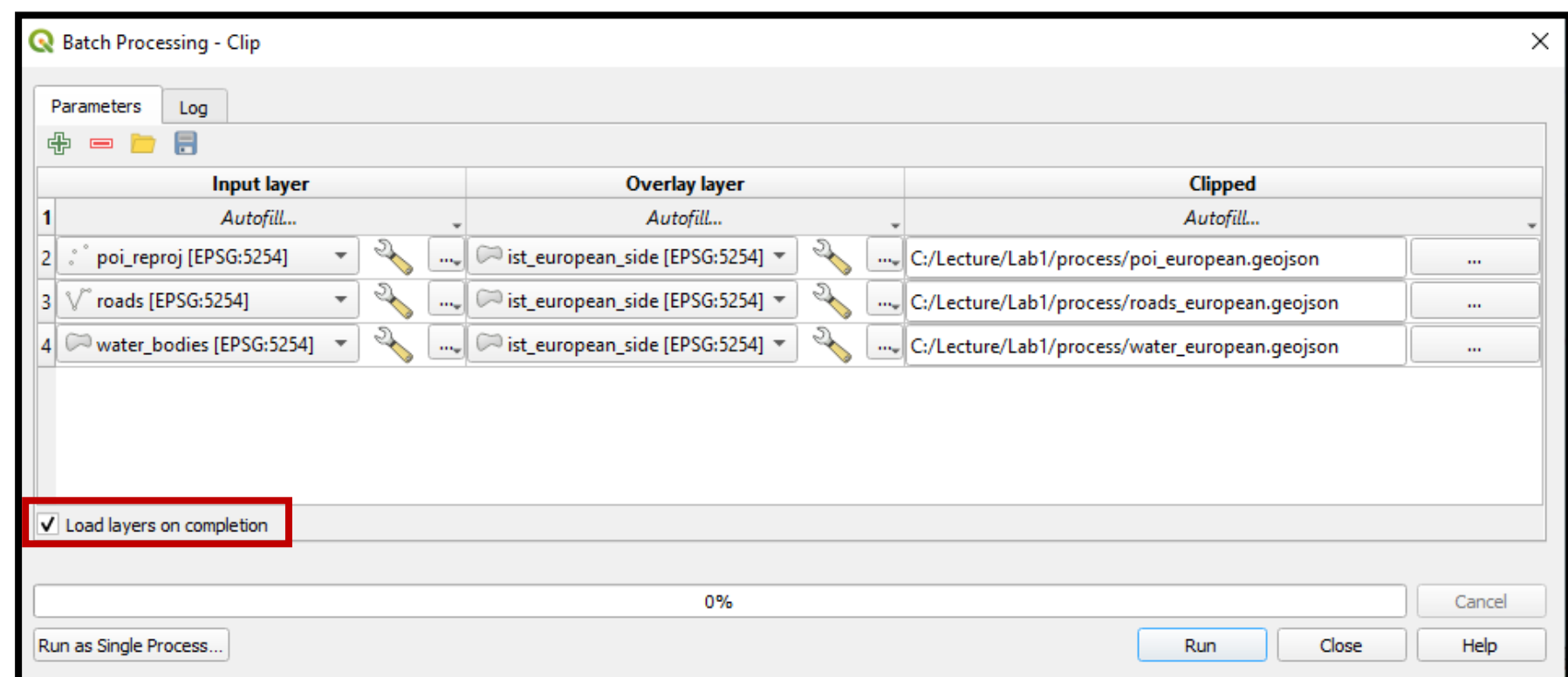


Clip Analysis

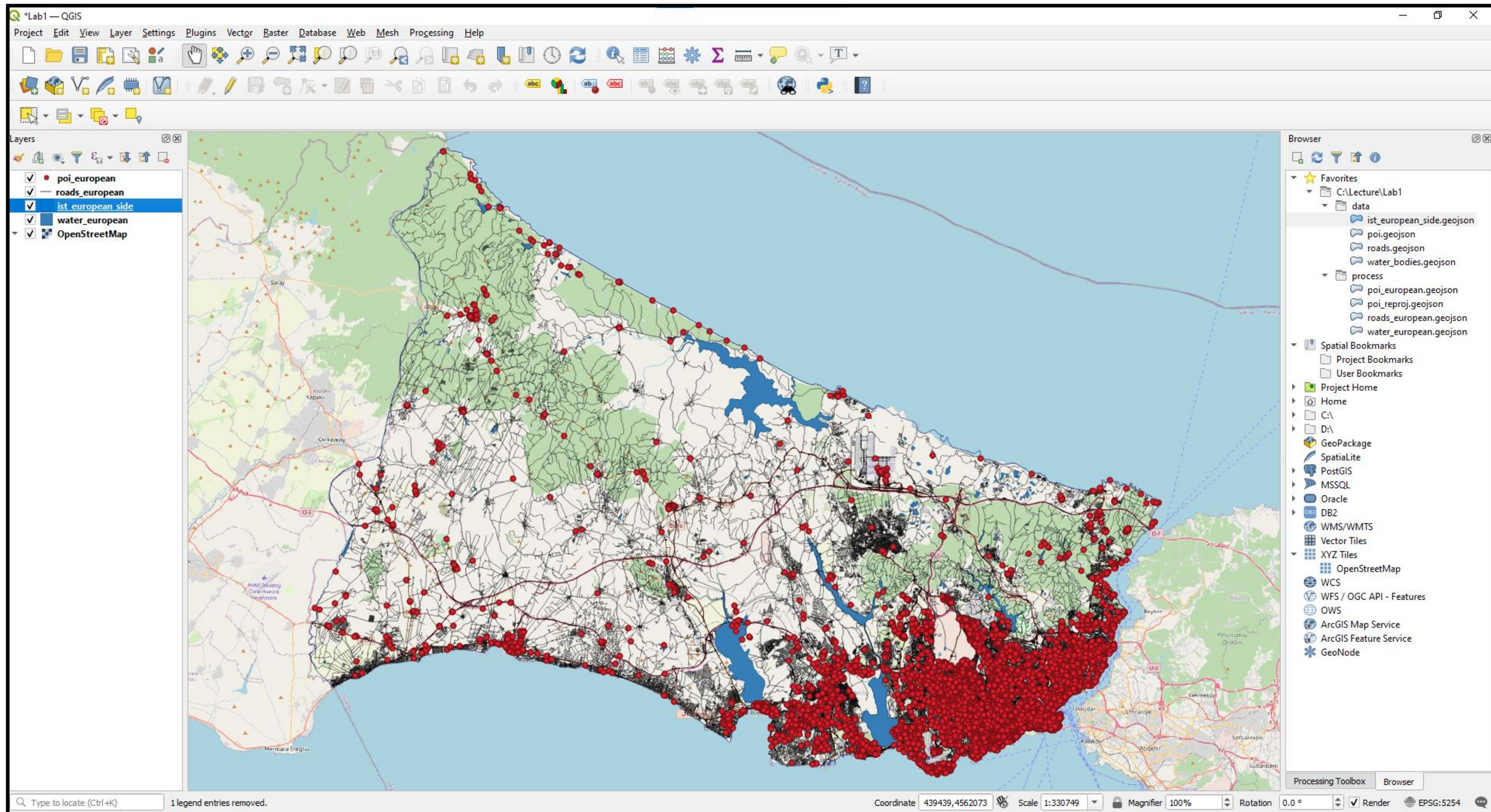
- Drag ist_european_side.geojson and clip all input data by using the extent of it



**Batch
Processing**

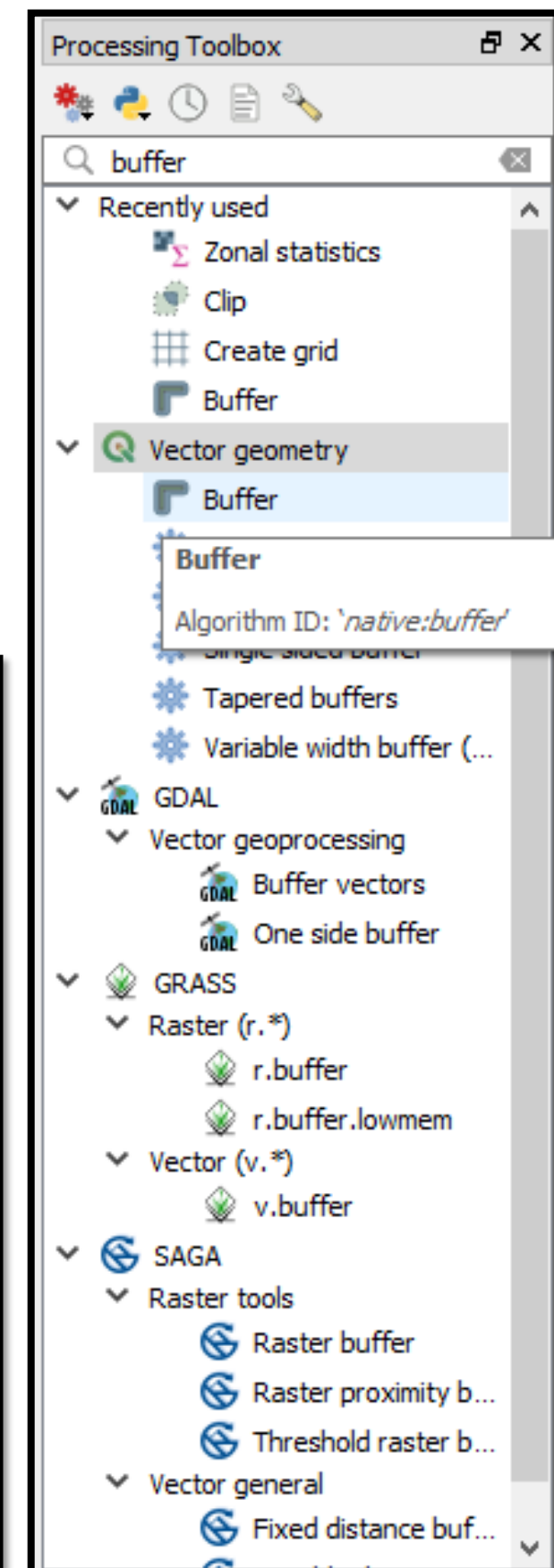
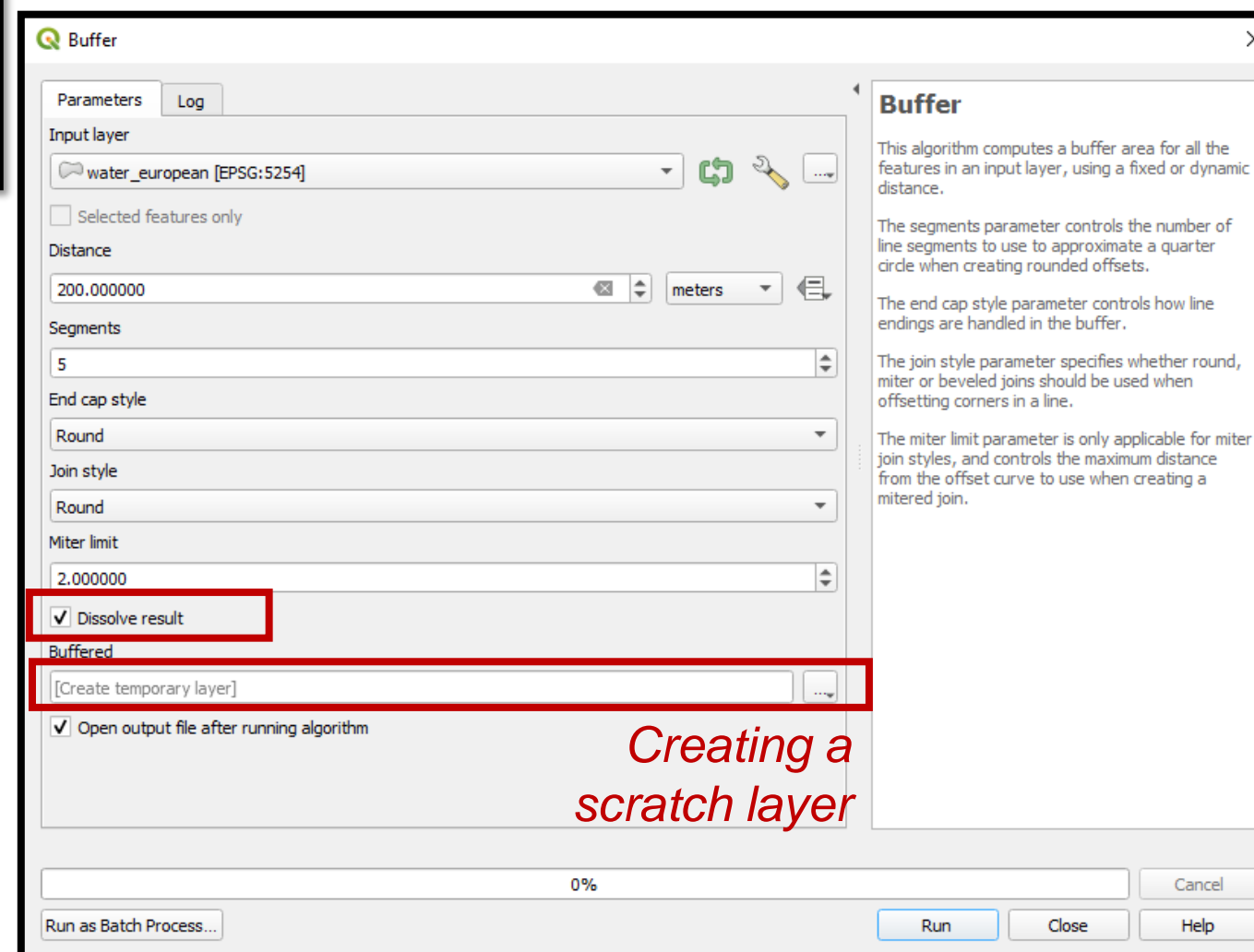
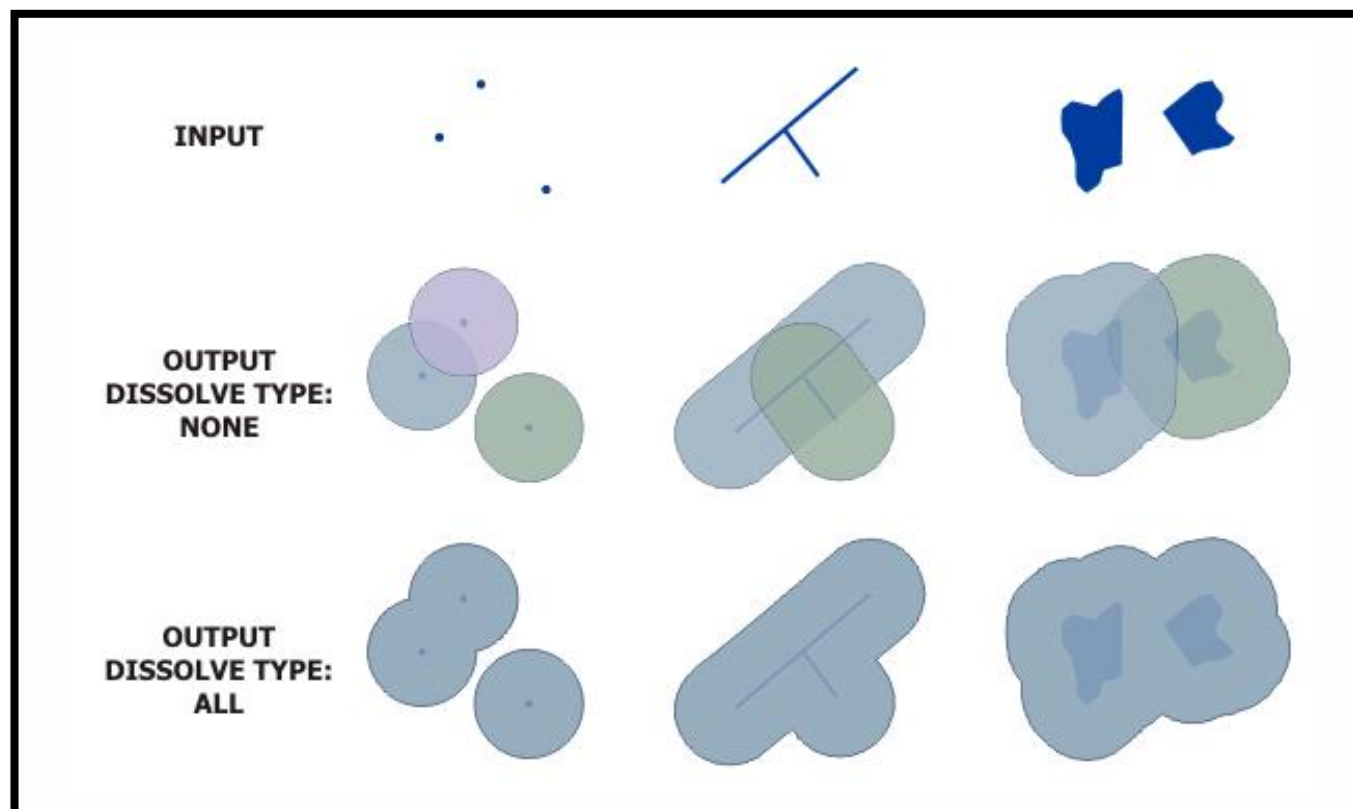


Result of Clip

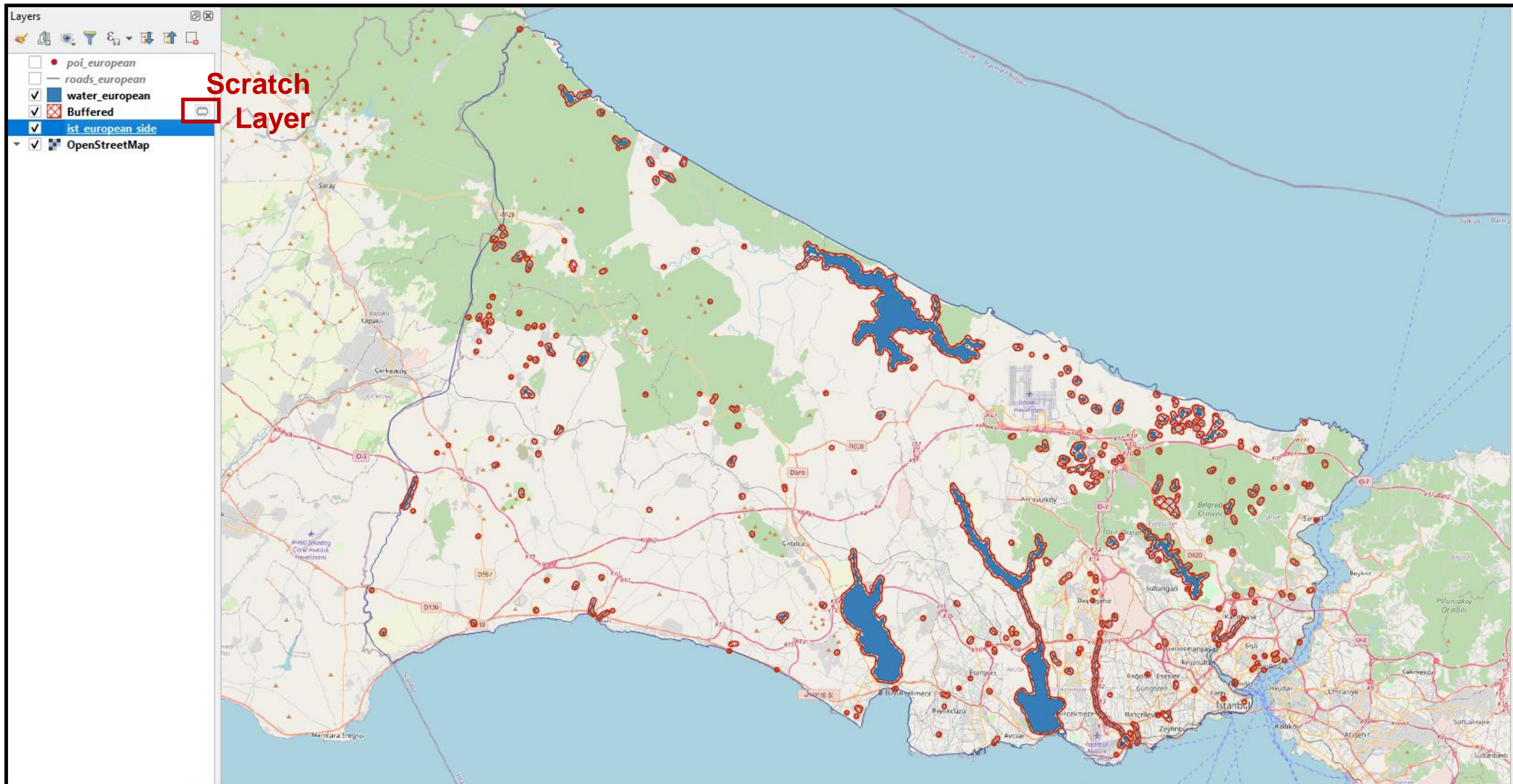


Buffer Analysis

- Creates buffer polygons around input features to a specified distance.
- Use 200m buffer to water bodies to find affected places

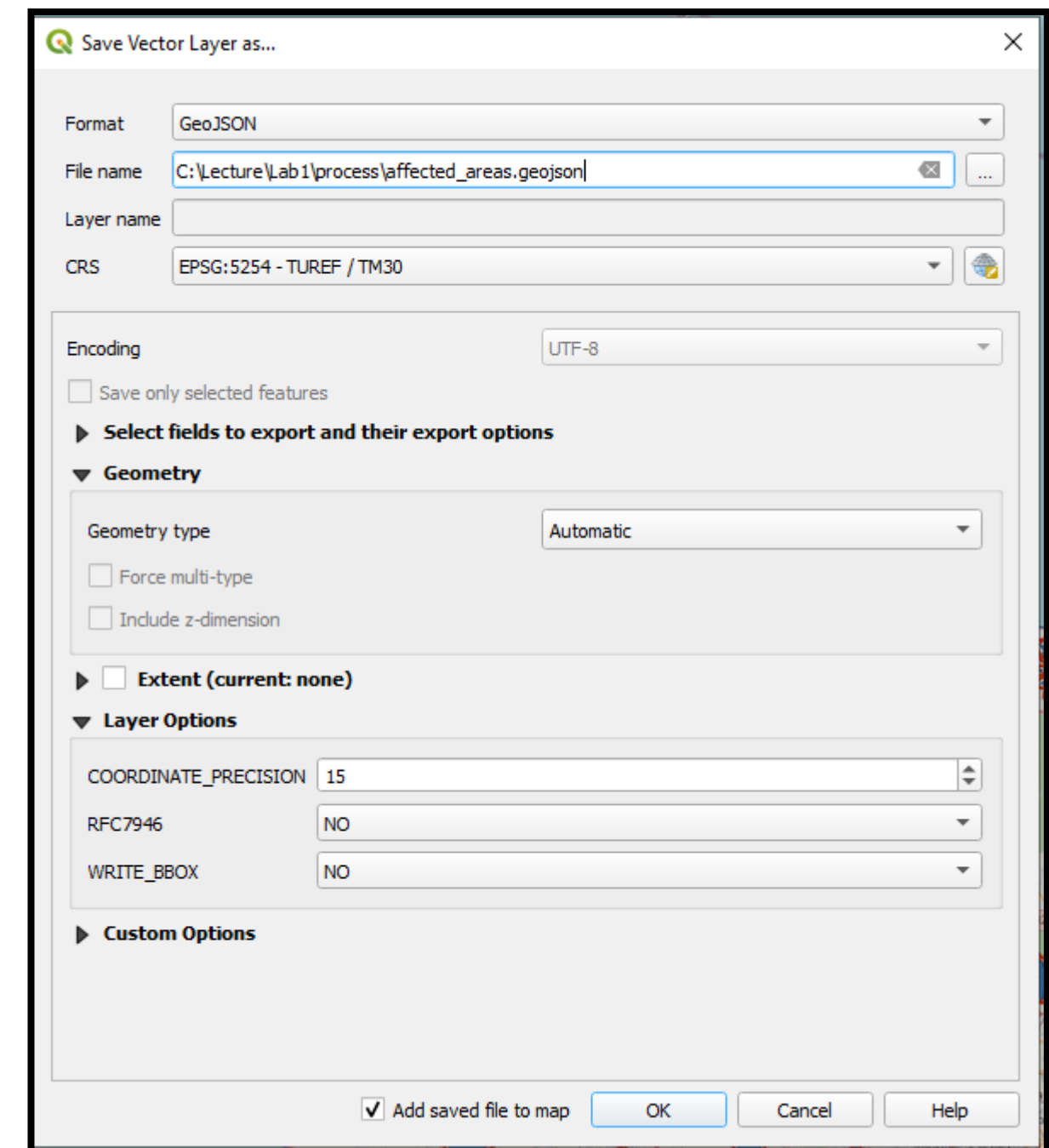
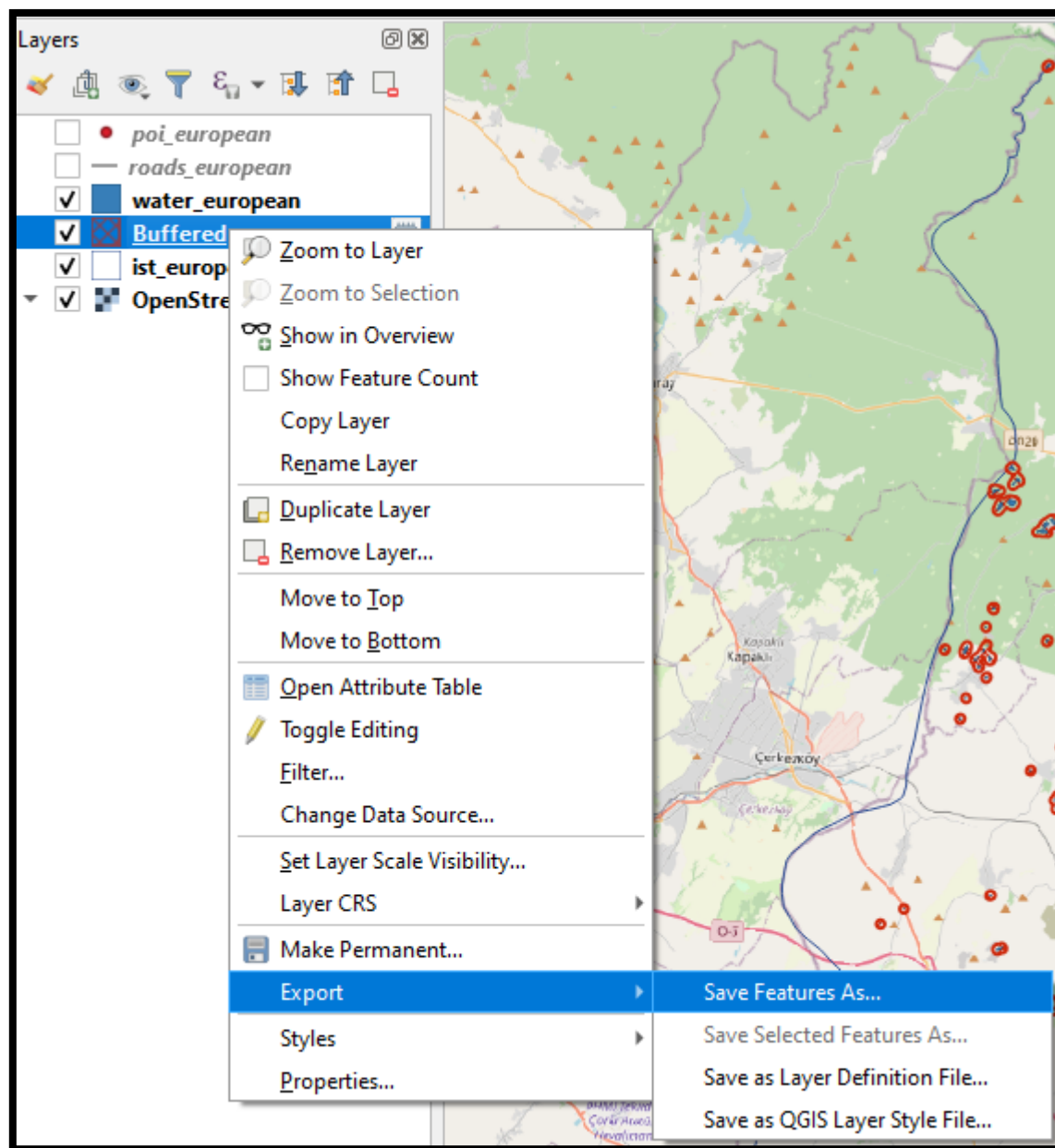


Result of Buffer

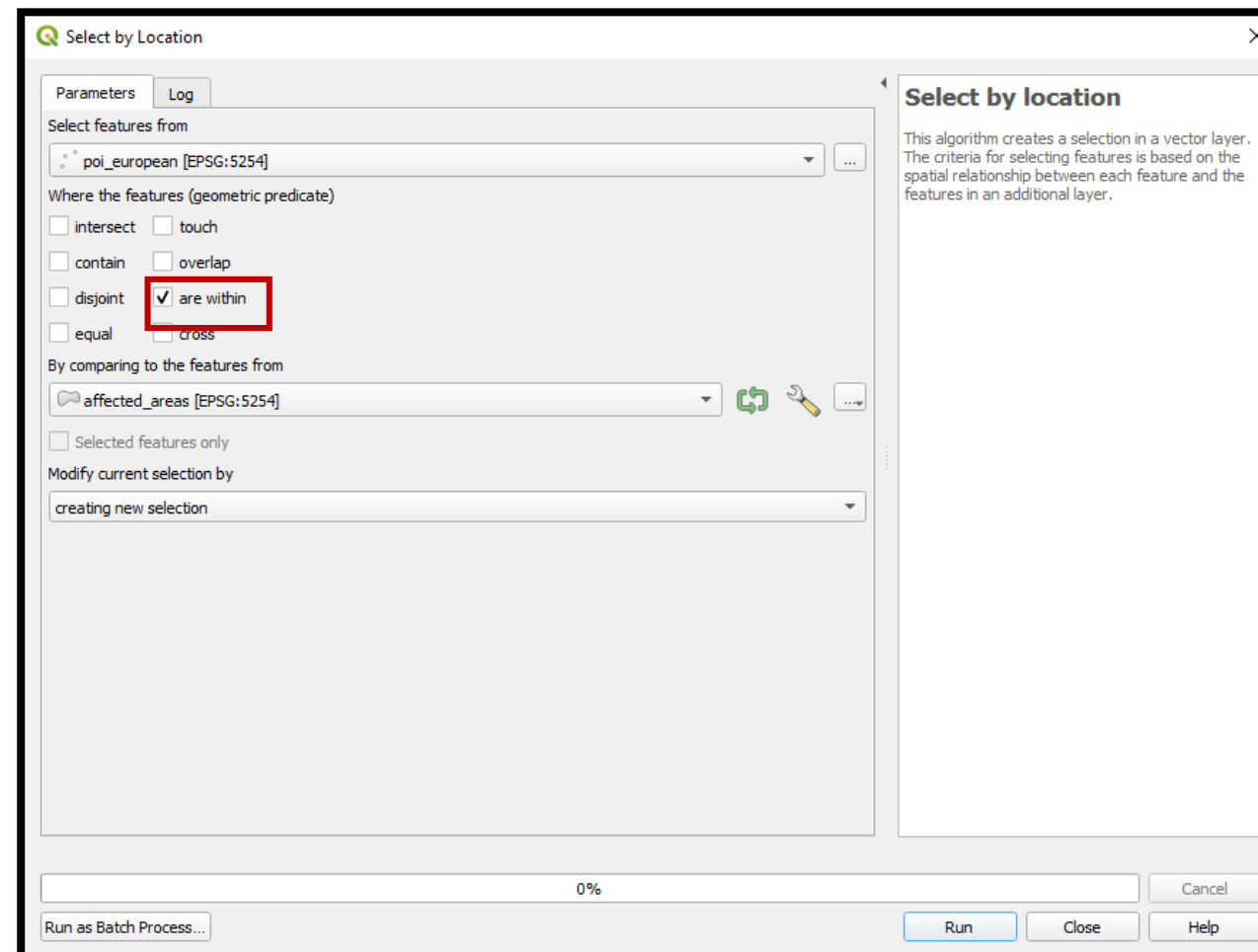
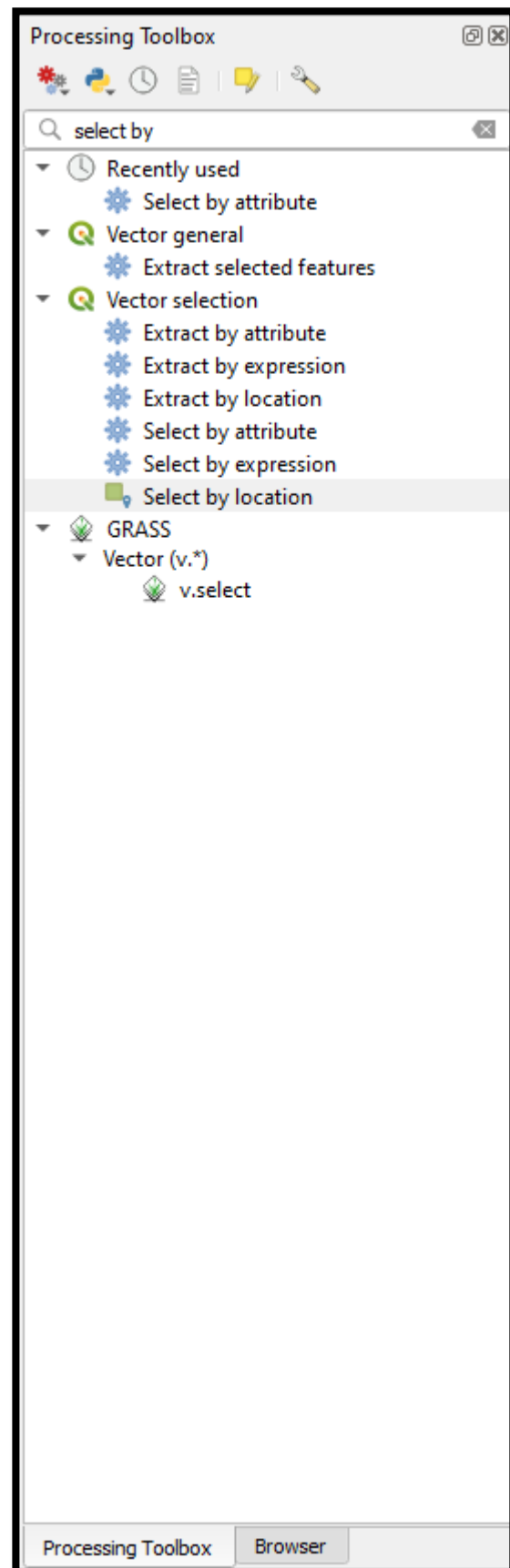


Exporting Spatial Data

- Scratch layers are not saved into disk, they need to be exported for further uses



Select by Location / Expression

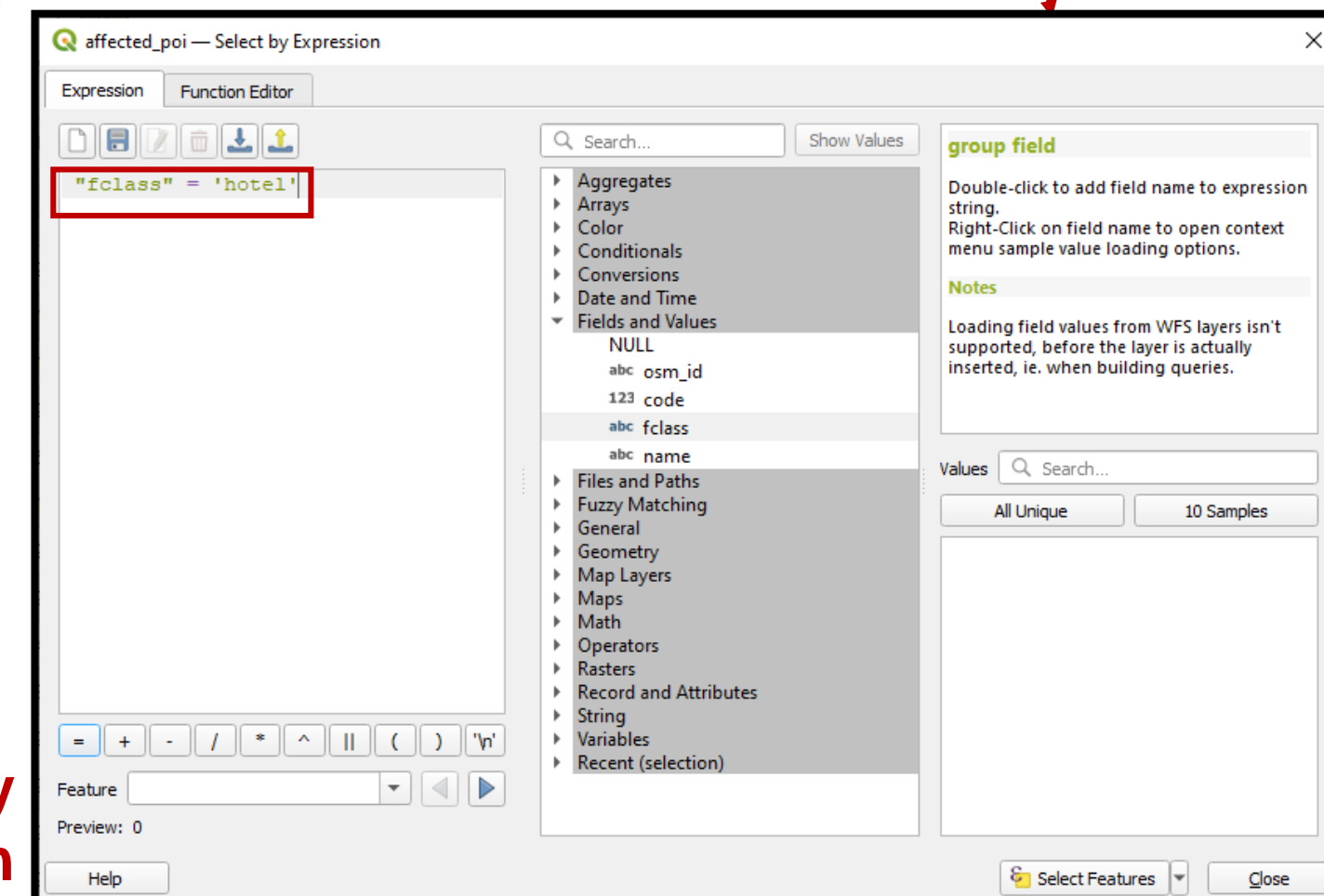


Select by Location

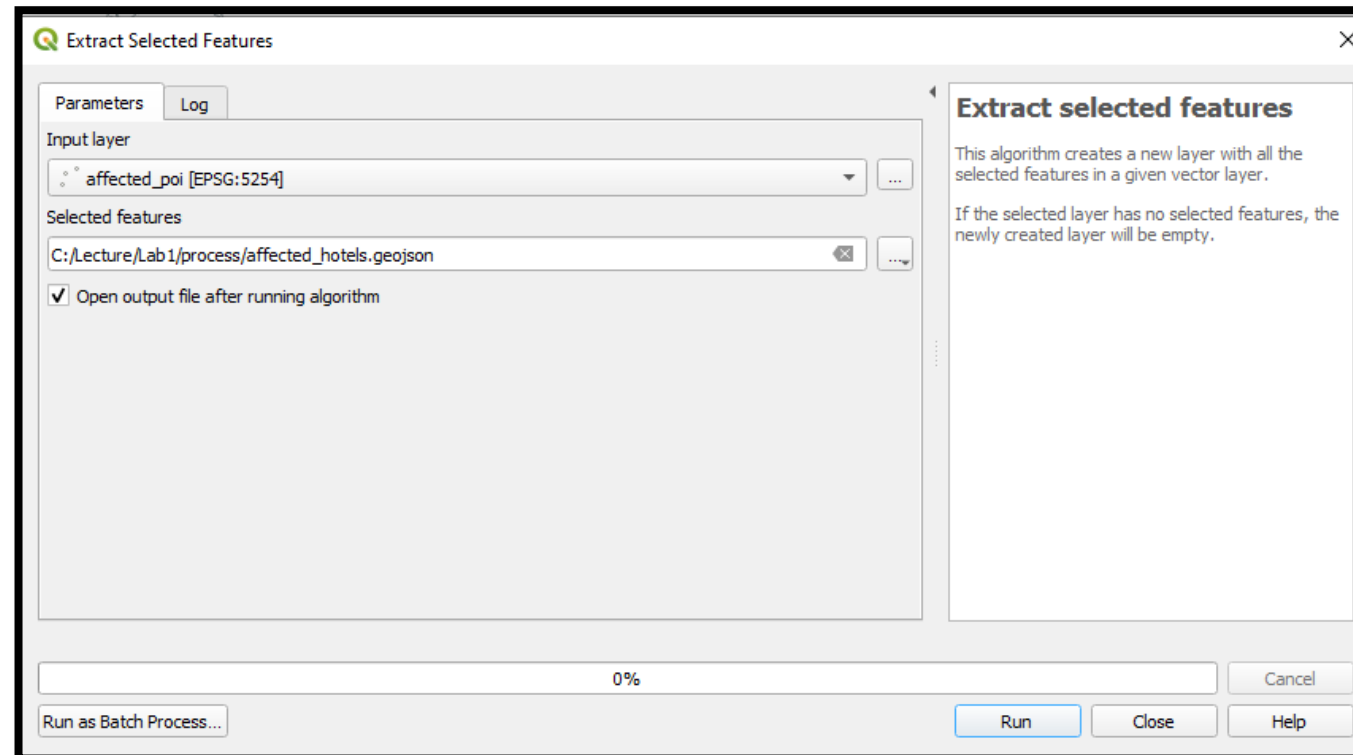
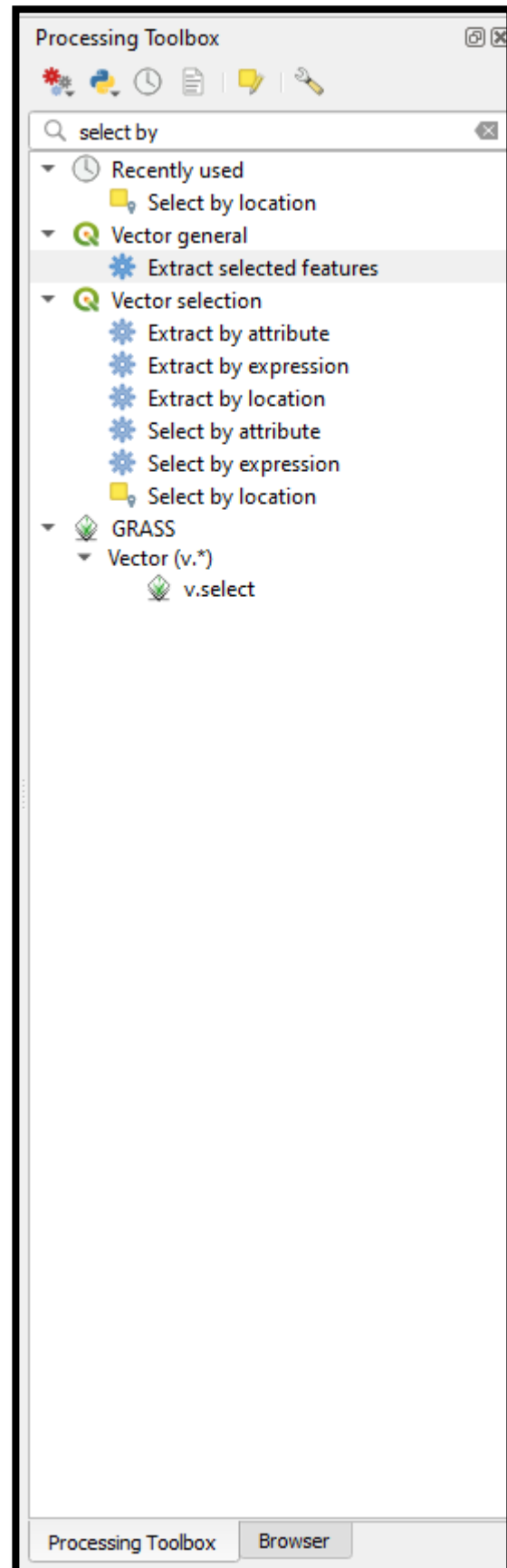
Inspect the results and export selected data as affected_poi.geojson. While exporting data, check "Save only selected features" box. Then perform a query over created feature to find hotels.

Finding hotels that will be affected by flood from POI file

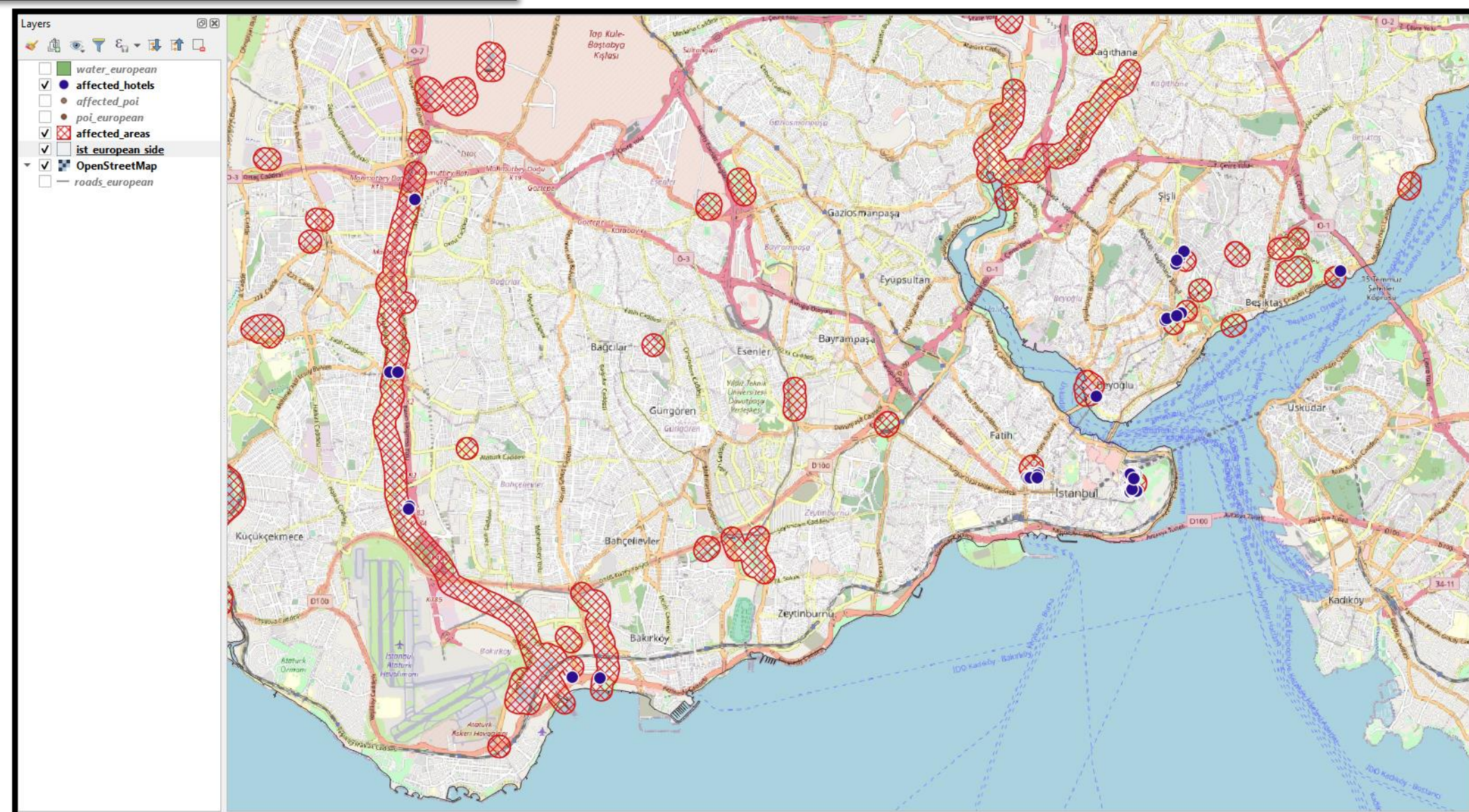
Select by Expression



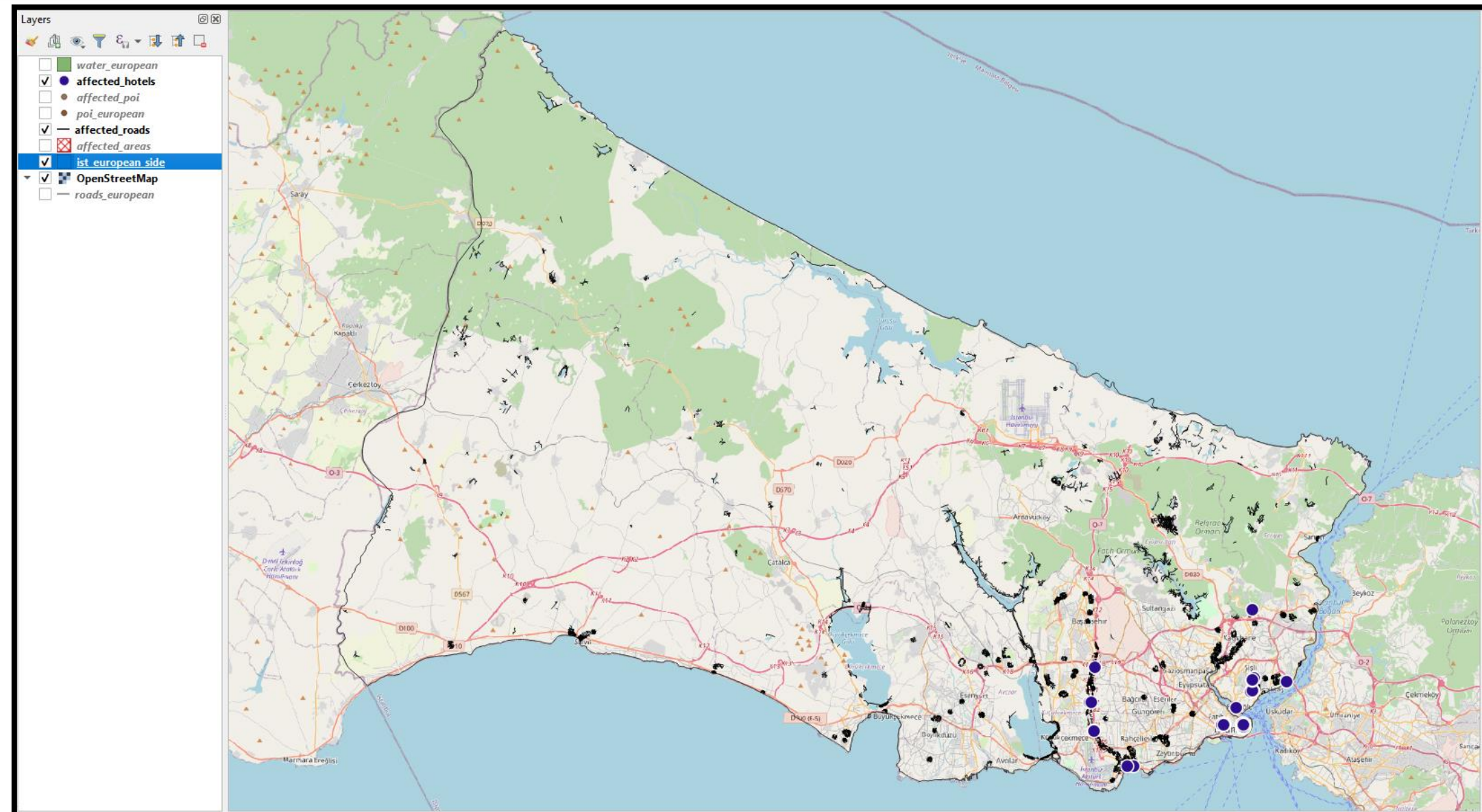
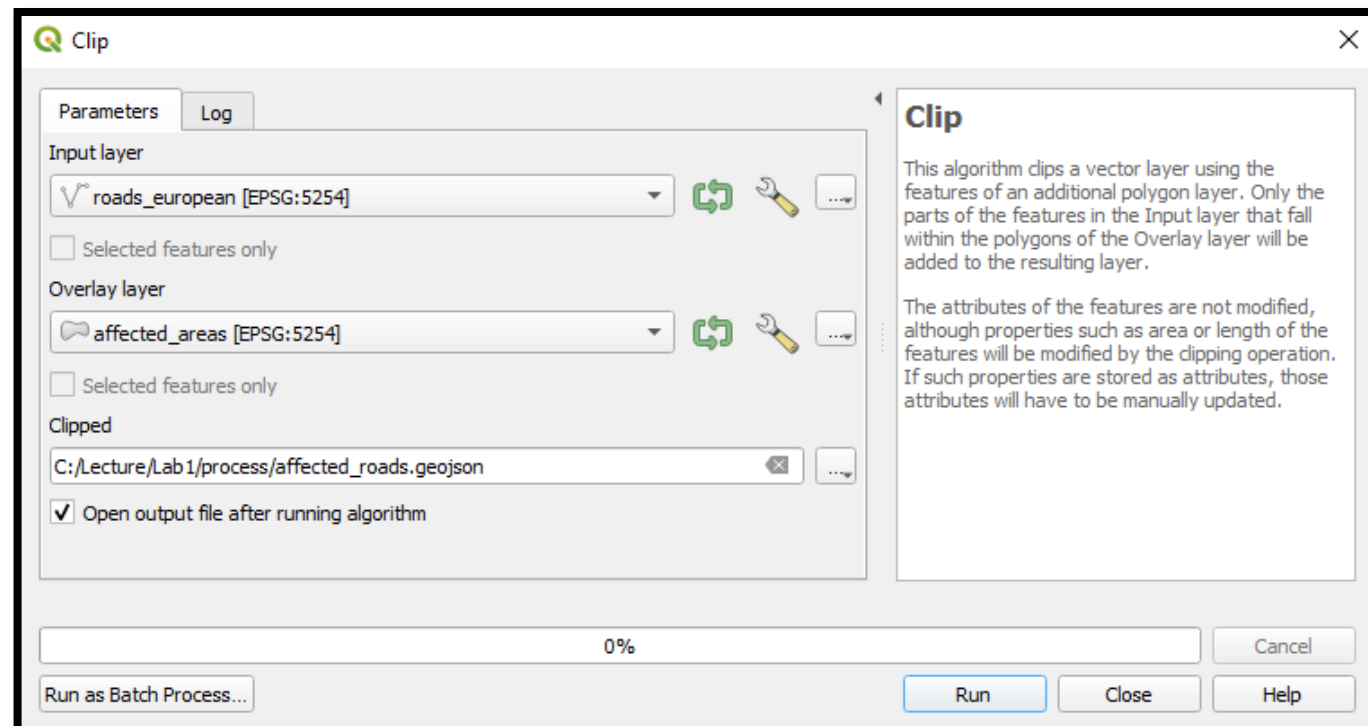
Affected Hotels



Zoom to
Layer



Affected Roads



Results & Take Home

Our aims were

- *Find roads and hotels that will be affected by a possible flood event for the European side of Istanbul.*

Output Data:

- *Affected Hotels (Vector-Point/Geojson)*
- *Affected Roads (Vector-Polyline/Geojson)*
- *Affected Areas (Vector-Polygon/Geojson)*

Take Home Part

- *Find schools and pharmacies that will be affected by using 350m buffer zone.*



Contact:

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