GEO 312E Spatial Analyses and Algorithms in GIS
Homework - 1

Floods have devastating effects on both land, infrastructure and people's lives. To predict and determine the possible effects of a flood event, it is important to consider different types of spatial data and analysis techniques. As a GIS analyst who works on disaster management, the task of determining the areas under risk in a pre-determined study area is given to you. After identifying these regions, you should answer several important questions about the impacts of the flood.

Scope of the Homework:

- To perform such complex tasks that need comprehensive decision-making steps, a Multi-criteria decision-making analysis that allows finding the relative importance of different factors needs to be conducted.
- To detect risky areas, you should use different types (i.e., vector or raster) of spatial data, reclassification parameters and criterion weights given for this study.
- After finding risky areas, spatial queries have to be performed to answer specific questions given in the following sections.

Input Data:

- Digital Elevation Model (DEM) (Raster)
    - SRTM 1-Arc Second Global Elevation data
    - Can be acquired from https://earthexplorer.usgs.gov/
- Point of Interests (Vector/Point)
- Waterways (Vector/Polyline)
- Land Use (Vector/Polygon)
- Water Bodies (Vector/Polygon)
    - OpenStreetMap vector data can be acquired for Turkey from https://download.geofabrik.de/
- The extent of the study area
    - Given in the homework documents

Steps:

- Download the necessary spatial data by using given sources.
- Subset the data according to the given study area's extent. (Check the coordinate systems of each data in every process and remember that TUREF TM30 needs to be used (EPSG:5254) for analyzes). 30m pixel size will be used for spatial analysis.
- Generate proximity data for waterways and water bodies. In other words, locations close to waterways and water bodies are riskier than distant locations. So, close locations should have the highest value (i.e., 5) after reclassification.
- Use DEM (i.e., elevation), proximity to waterways and proximity to water bodies criteria to detect areas under risk. To collectively use all of these data, they need to be reclassified into 5 classes that represent corresponding risky areas shown in Table 1.

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Table 1. Risk levels and their representations in data

Risk Levels	Raster Value
Very High Risk	5
High Risk	4
Medium Risk	3
Low Risk	2
No Risk	1

- Reclassification parameters for each criterion are given in Tables 2 and 3. The table values should be interpreted as "min <= value < max"

Table 2. Reclassification parameters for DEM

Minimum Value (m)	Maximum Value (m)	Reclassified Value
Local Minimum	10	5
10	25	4
25	50	3
50	150	2
150	Local Maximum	1

Table 3. Reclassification parameters for Proximity to Water Bodies and Waterways

Minimum Value (m)	Maximum Value (m)	Reclassified Value
0	250	5
250	500	4
500	1000	3
1000	2500	2
2500	Local Maximum	1

- Use the weights in Table 4 for each criterion to generate the risk map

Table 4. Weights for each criterion

Criterion	Weights
Proximity to Water Bodies	0.197
Proximity to Waterways	0.341
DEM	0.462

- Reclassify the output raster using threshold values shown in Table 5

Table 5. Reclassification parameters for risky areas

Minimum Value	Maximum Value	Reclassified Value	Risk Levels
Local Minimum	2	1	No Risk
2	3	2	Low Risk
3	4	3	Medium Risk
4	5	4	High Risk
5	Local Maximum	5	Very High Risk

- Import required data and the result of the analysis into PostGIS environment and perform spatial queries (by using SQL) to answer the following questions:
    - Which schools are located in Medium Risk areas?
    - What is the total area of residential areas intersected with High-Risk or Very High-Risk areas?

Excepted outputs:

- A report **(maximum 15 pages)** that includes:
    - All of your inputs, data preprocesses, analysis and queries. The resulting maps from each step need to be shown in the report. These maps should be prepared based on cartographic principles and have proper map elements (title, basemap, legend, scale, etc.).
    - A risk map that shows risky areas in five classes that are shown in Table 1.
    - Answers of given questions.
- Resulted Risk Map in GeoTIFF format.
- Result of queries in a geopackage.

Tips:

- If you get "Feature has invalid geometry. Please fix the geometry or change the Processing setting to the "Ignore invalid input features" option. Execution failed after X seconds" error, use QGIS's "Fix Geometries" tool on the data to fix geometry errors.
- QGIS offers several additional GIS environments to work with. Please consider using tools from Grass & SAGA if you encounter a problem with built-in QGIS tools.
- After generating the risk map in raster format, convert it to vector and dissolve by using DN values to later import it into the PostGIS environment.

Deadline: 16.05.2022