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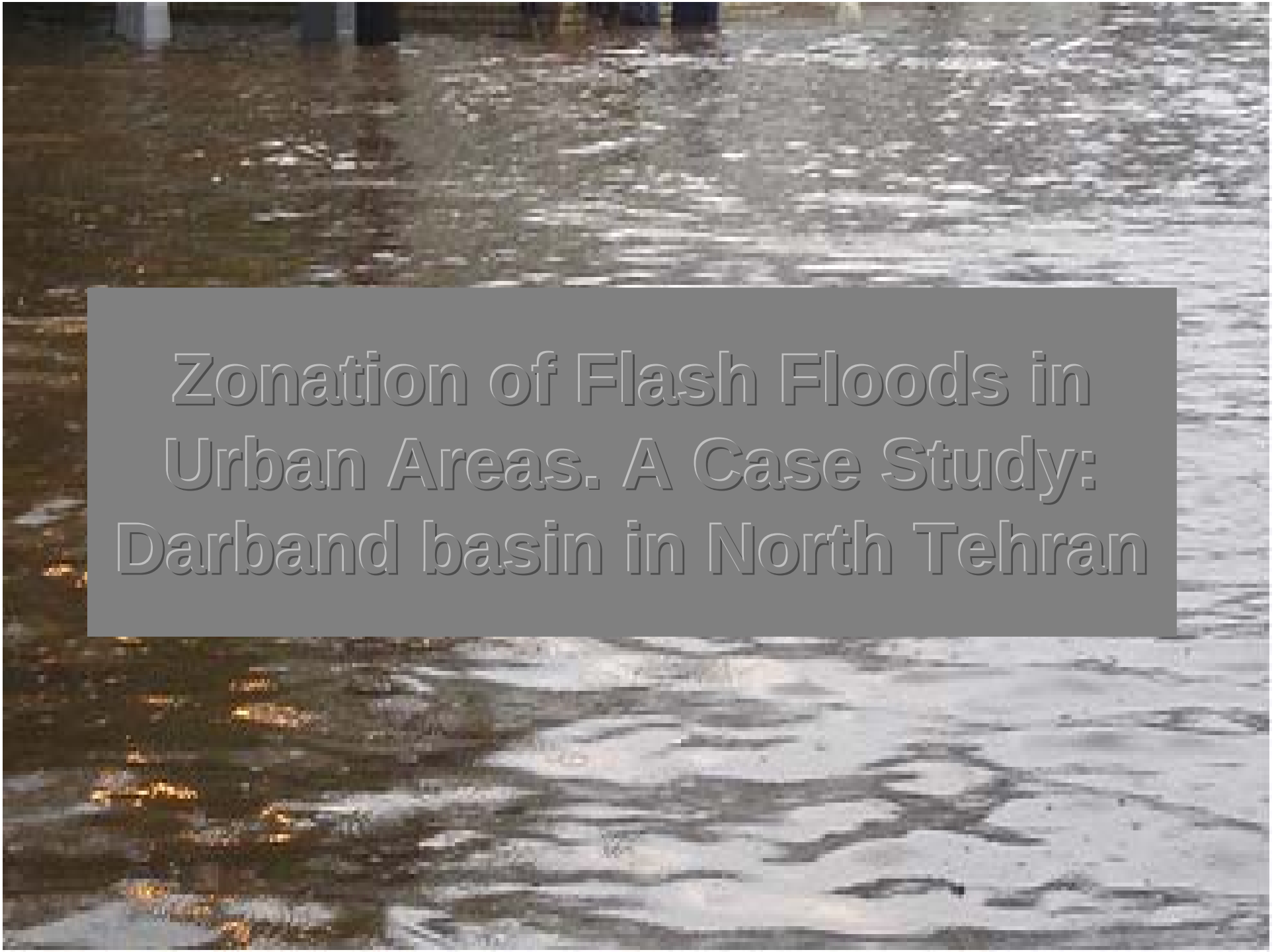

Zonation of Flash Floods in Urban Areas. A Case Study: Darband basin in North Tehran

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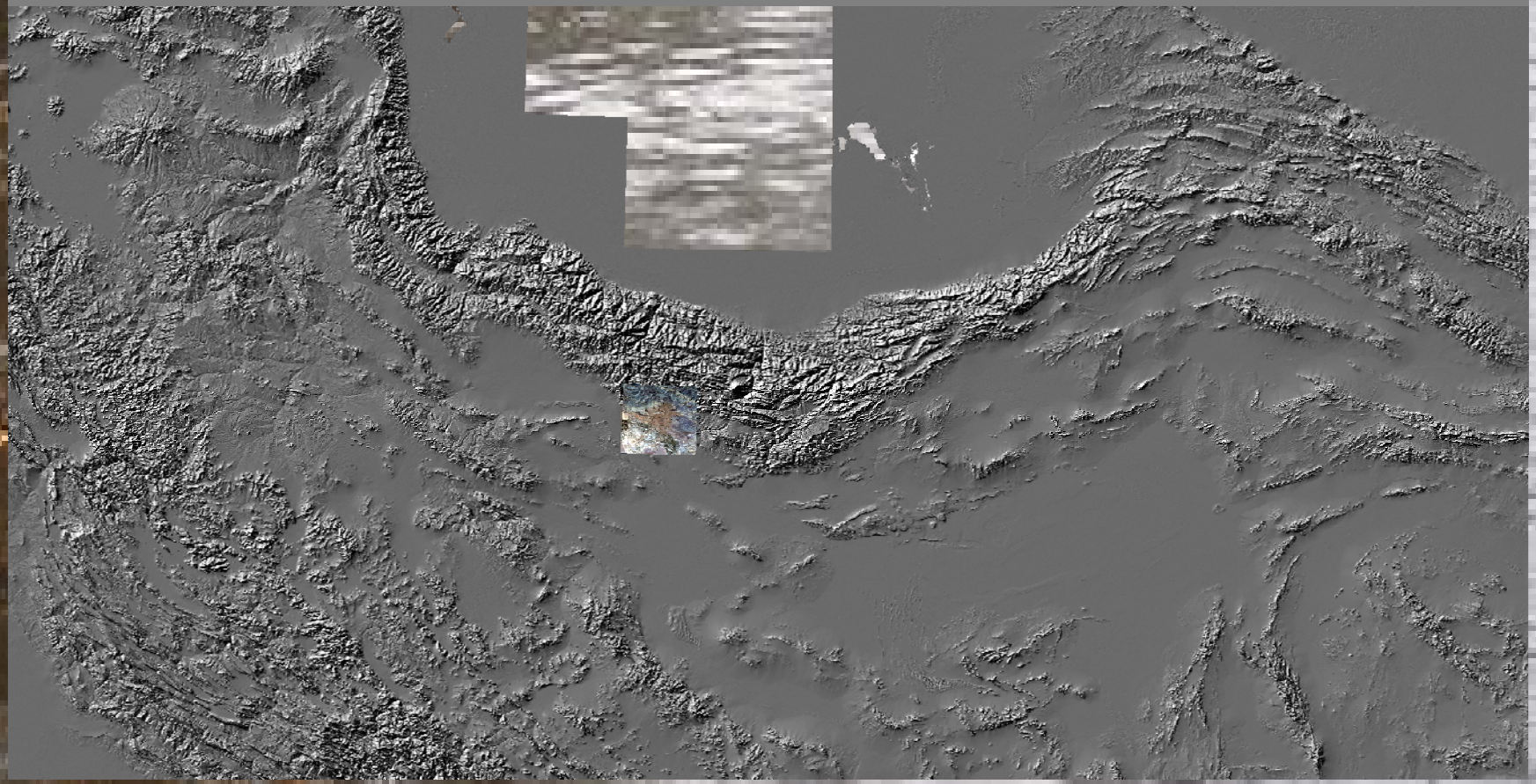
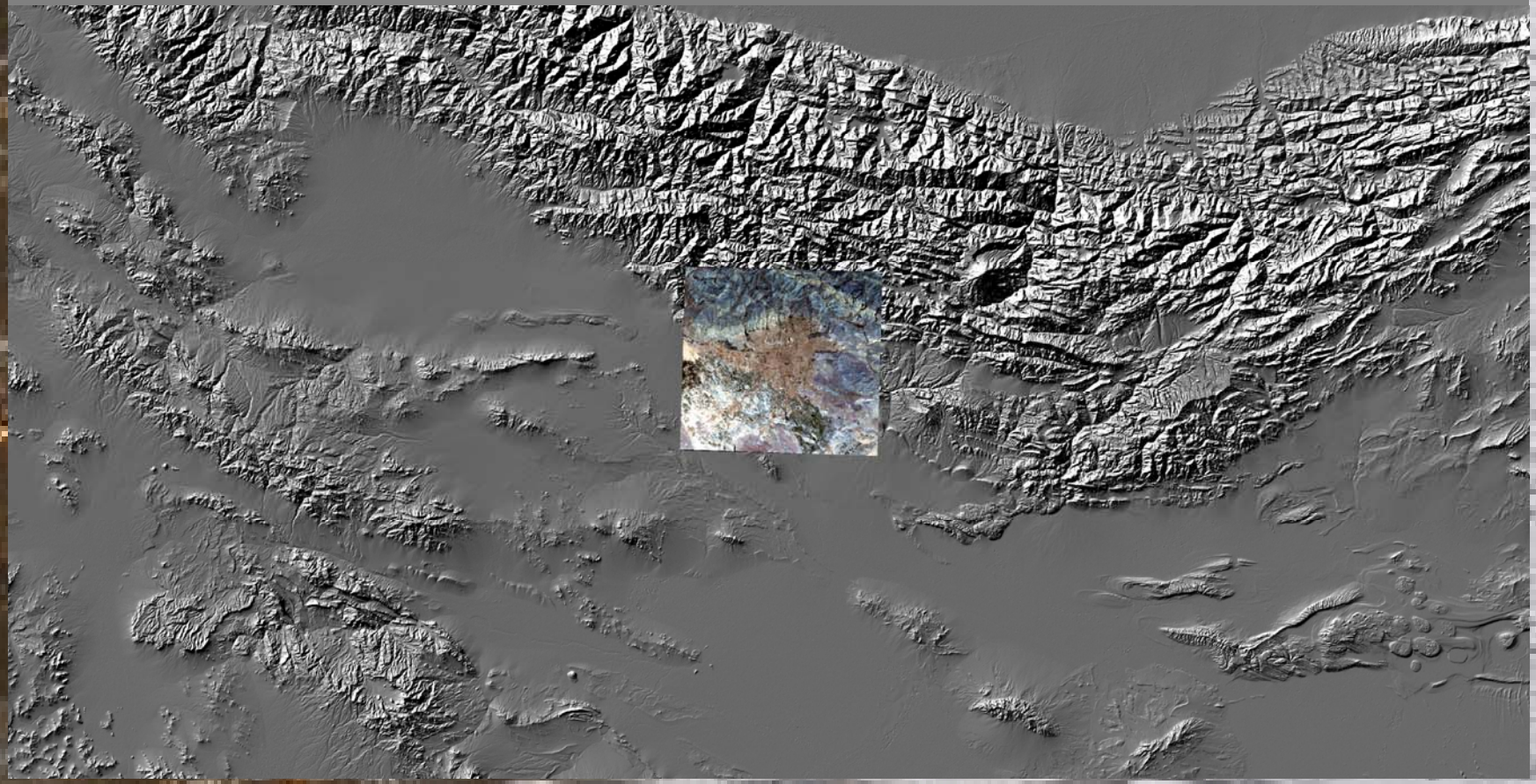
Introduction

Flooding, as one of the most important natural hazards, One option is to reduce the damage by delineating potential flooding areas (also called “zonation”). Zonation can play an important role in finding a suitable solution for long and mid terms policies of optimum land use. The following paper presents a case study of 155.74 km2, which is a small portion of Tehran. This area faces flooding quite often. Because of this dense texture of urban region, flooding will cause heavy loss of life and property. Tehran as the biggest city and the capital of Iran is facing floods in different areas. Darband-Glabdareh basin is one of northern basins in Tehran, and its floods threat some parts of this large city

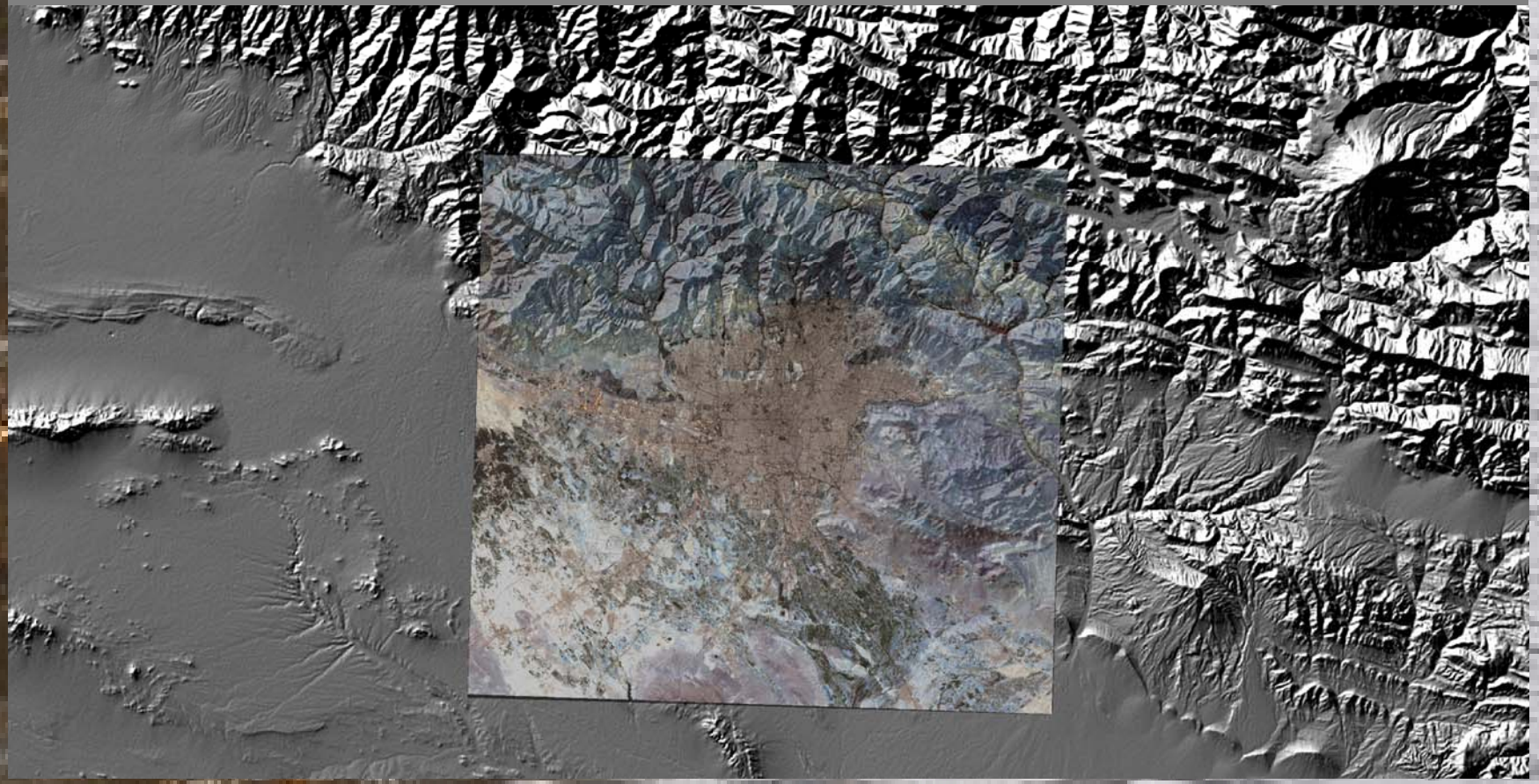
Alborz Chain



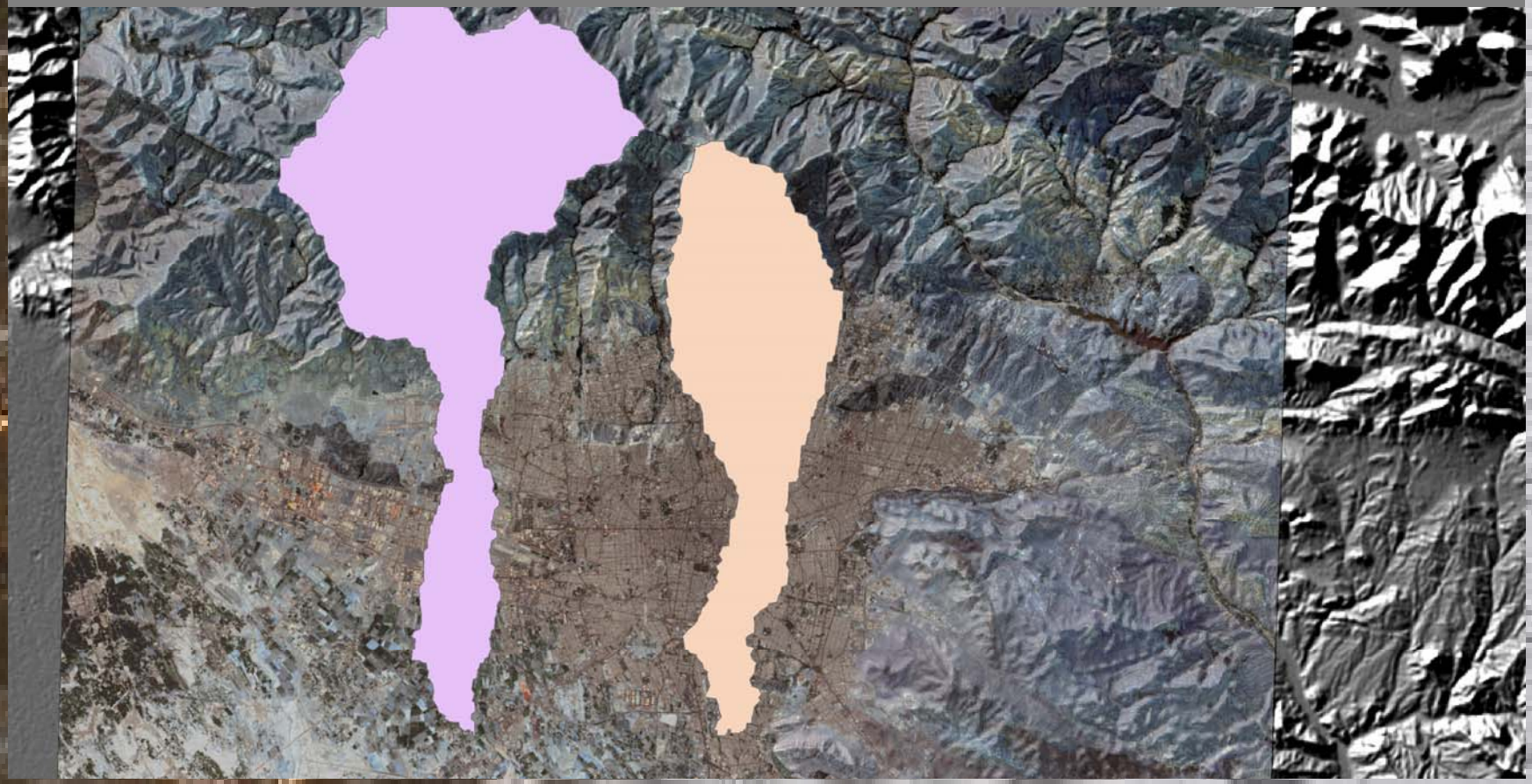
Central Alborz



Tehran



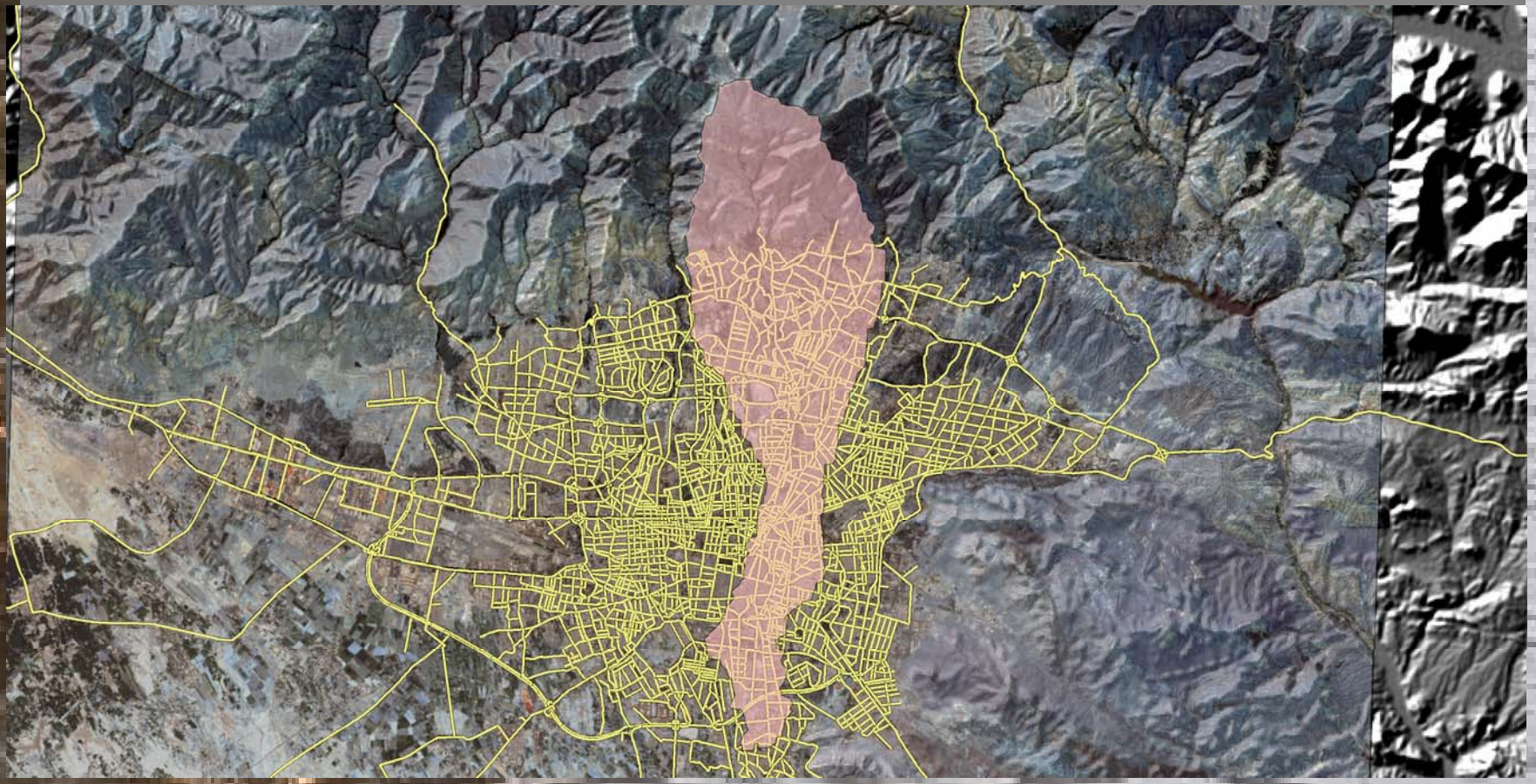
Darban and Hesarak Basins



Basin's characteristics

- The study area is located in Darband-Golabdareh basin within the north part of Tehran.This area includes 155.74 km2 (35º 38′ 25″ to 35º 53′ 35″ N and 51º 20′ 30 ″to 51º 35′ 00″ E), where this catchment's geological position is located at the western Alborz tectonic zone. The average precipitation of this catchment is ~300 mm with Mediterranean regime, and most rainfall is occurring during winter time. The maximum monthly precipitation is 83-100 mm. January and February are the coldest months with an average of -3.5°C. June is the warmest month with an average of 35°C. Darband catchement is a sub-basin of Tajrish catchment, which includes the Darband and Golabdareh rivers with 9.5 km and 4 km lengths, respectively. The land use of this study area are distributed into four classes; bare land, vegetation, dense, and sparse urban area.

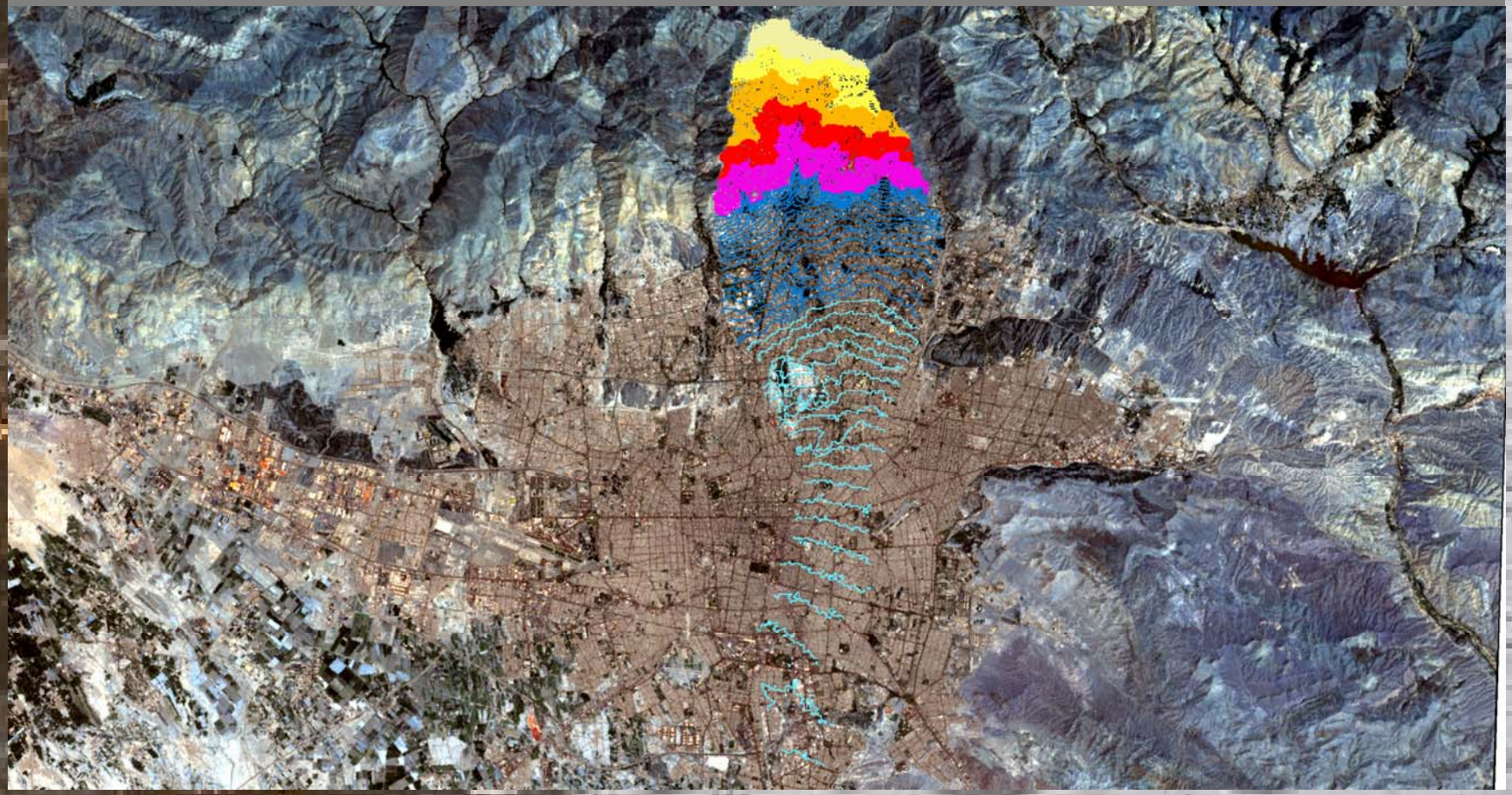
Darban Basin



Data and Method

- Darband's basin was extracted of a topographic map.

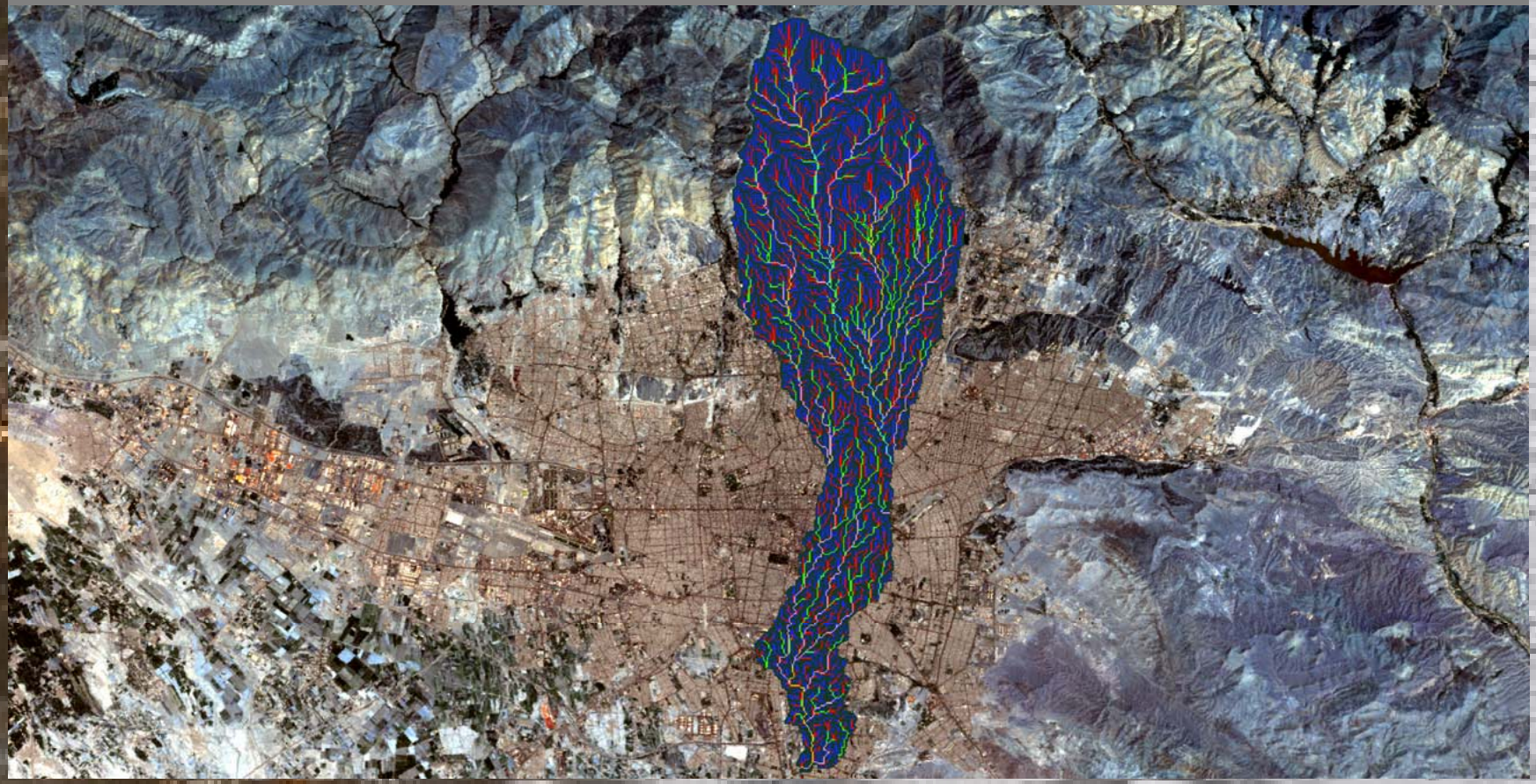
Contour of Darban Basin



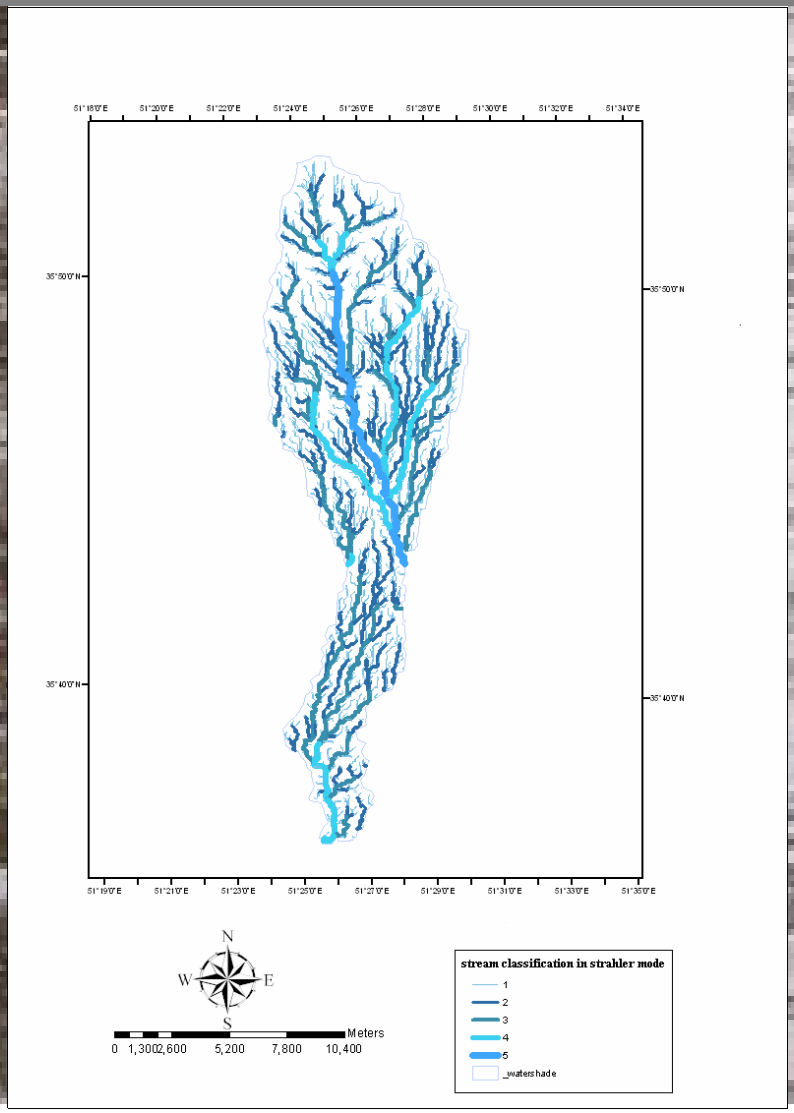
Data and Method

- Drainage network was delineated of its DEM by using a hydrological model of Arc-GIS software .The figure indicates that one drainage of Darband catchement enters into Shariati avenue, which is an essential north-south avenue. Another drainage is seen entering into the Vali-e-asr, while continuing into the south part of the city.

Drainage of Darban Basin



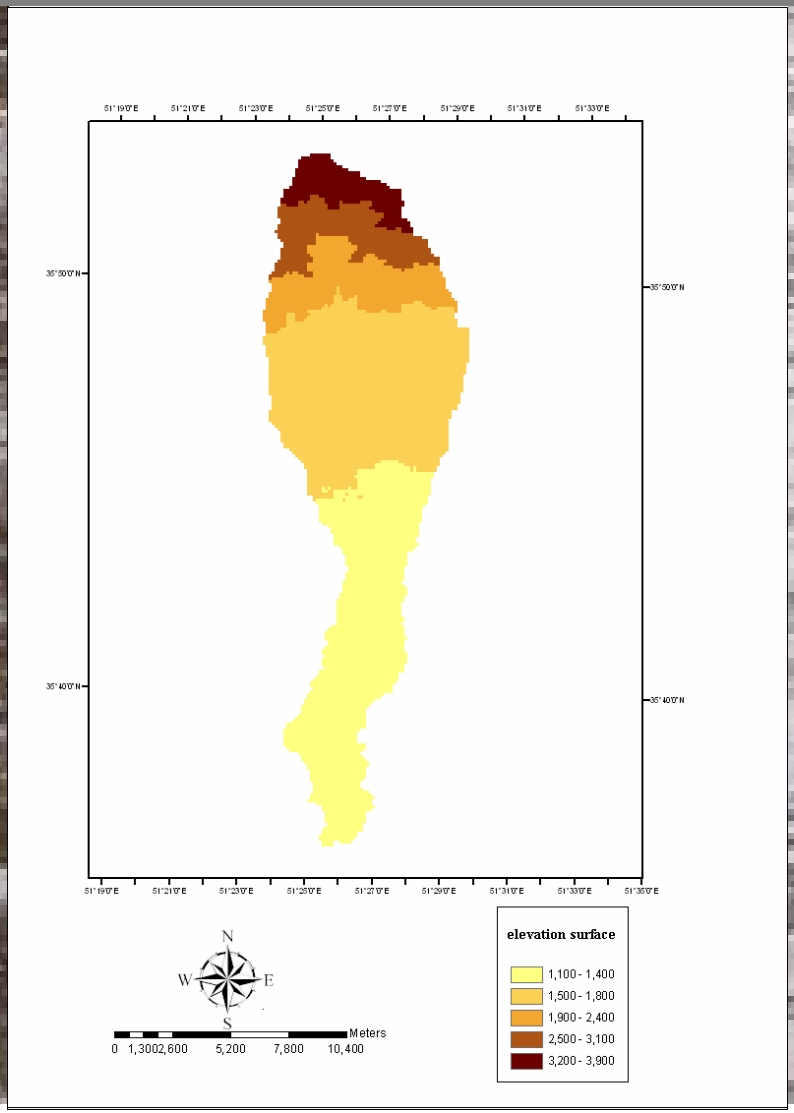
Drainage of Darban Basin



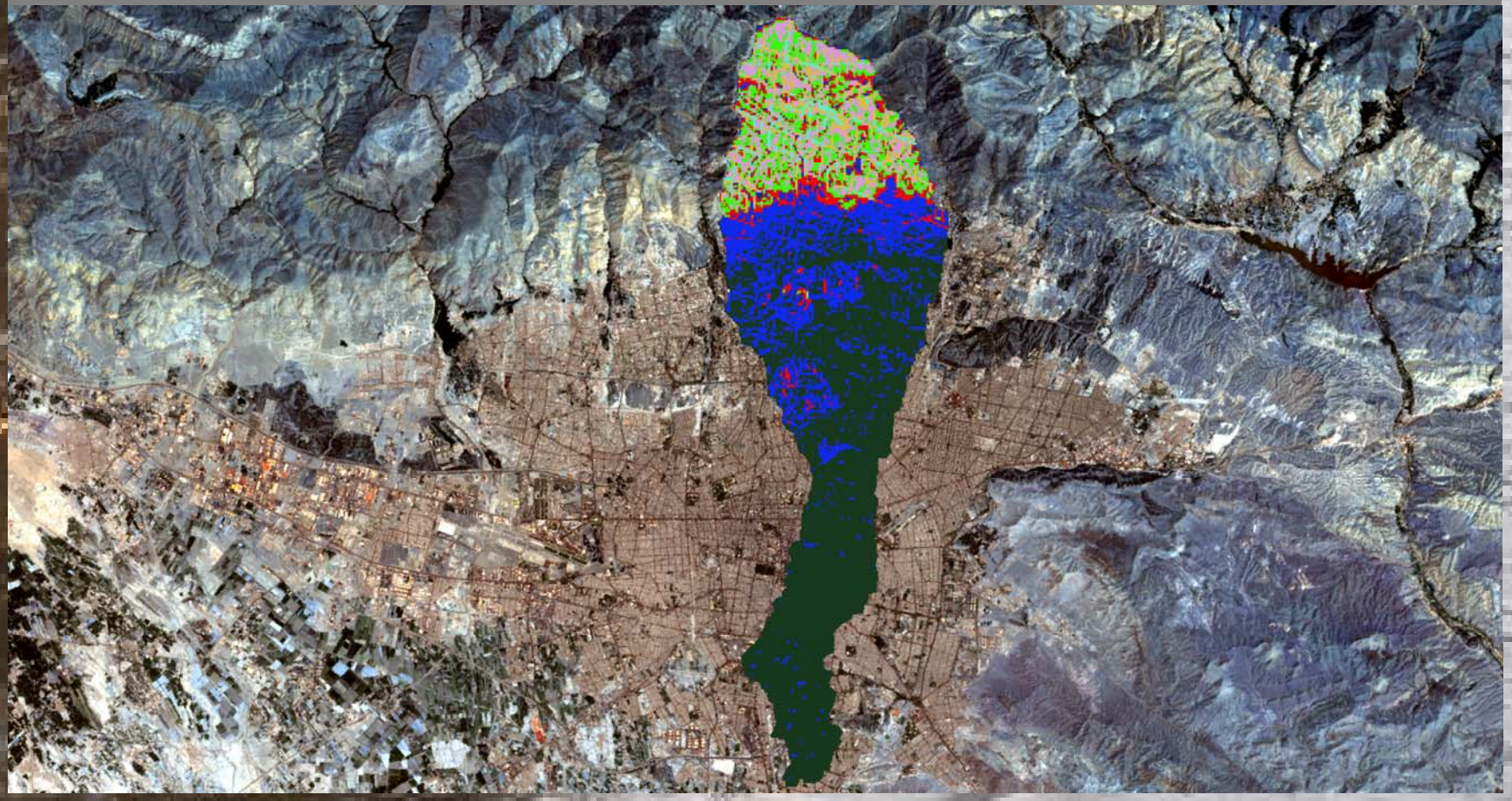
Data and Method

- The elevation, slope and slope directions map, were extracted from a DEM. This map indicates severe changes in the height of the north catchments, where the differences in height are gradually decreasing towards the south portion of the catchments.

Elevation of Darban Basin



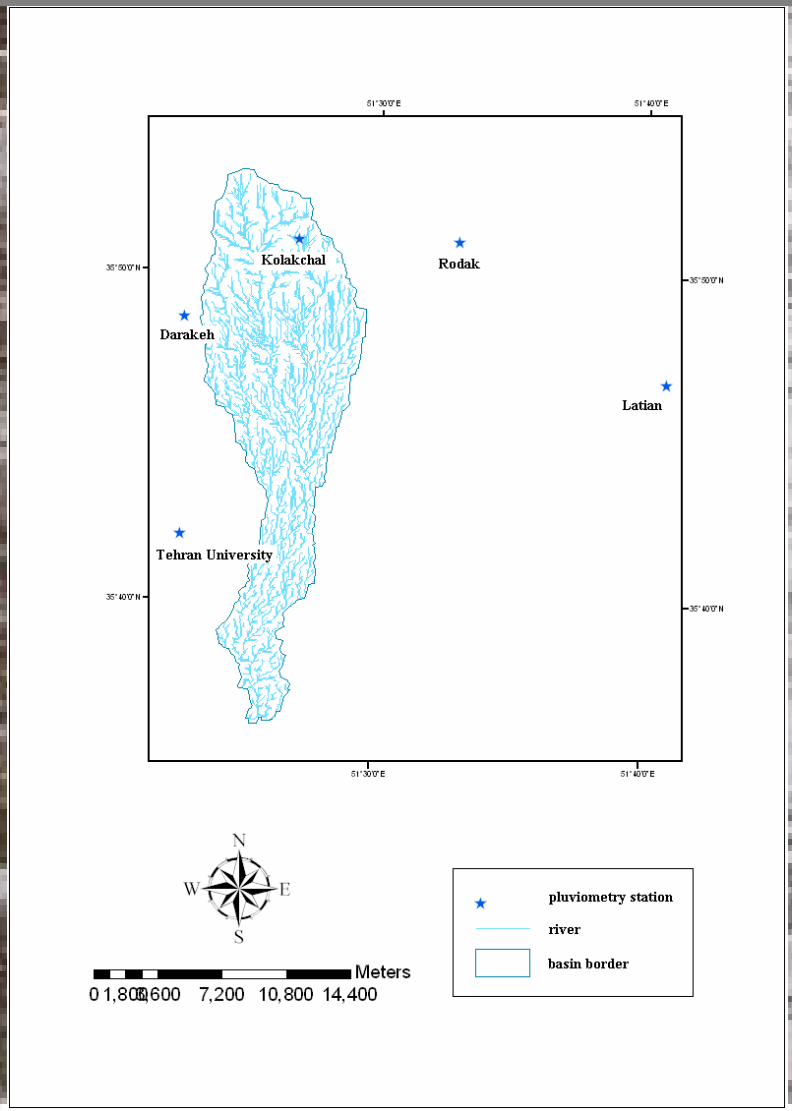
Darban Basin



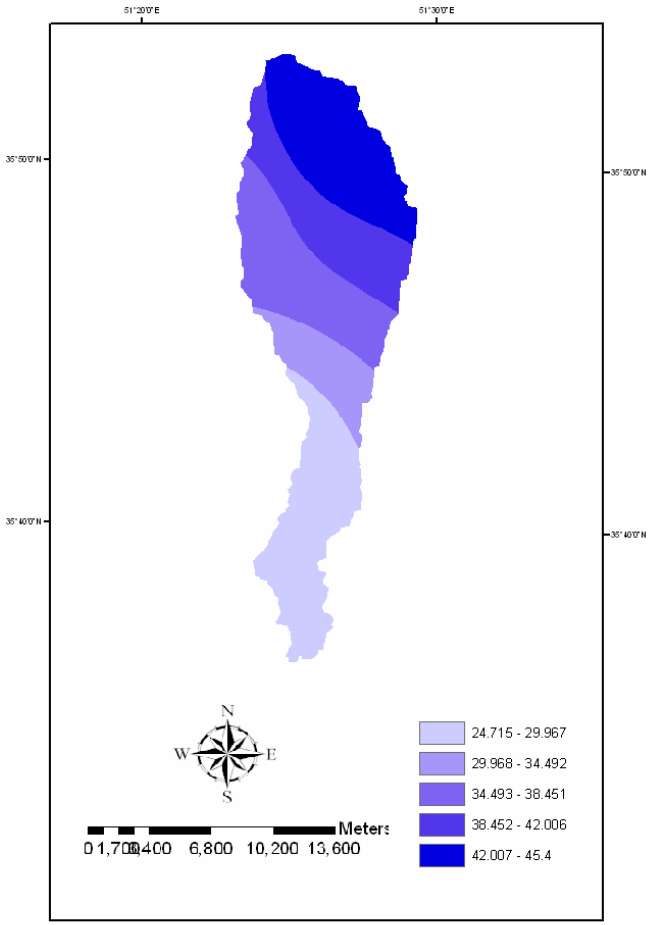
Data and Method

- for preparing isoheight map of this catchment, five fluvial-metrical stations of the ministry of power have been used. These stations are located inside and outside of the catchment's barrier. The layers of maximum, minimum and mean annual precipitation were prepared by the IDW method of Arc-GIS software.These layers indicate that the rate of precipitation is decreased from north to south since Teheran's precipitation has orographic regime, and it was abated from the northern mountain to the southern lower plain of the city. The precipitation isoline that is between 83 to 100 mm is most frequent during the maximum annual rainfall. The mean annual precipitation isolines that are 24-29 mm and 0.06-0.2 mm are less frequent during the minimum of annual precipitation period.

Synoptic station of Darban Basin



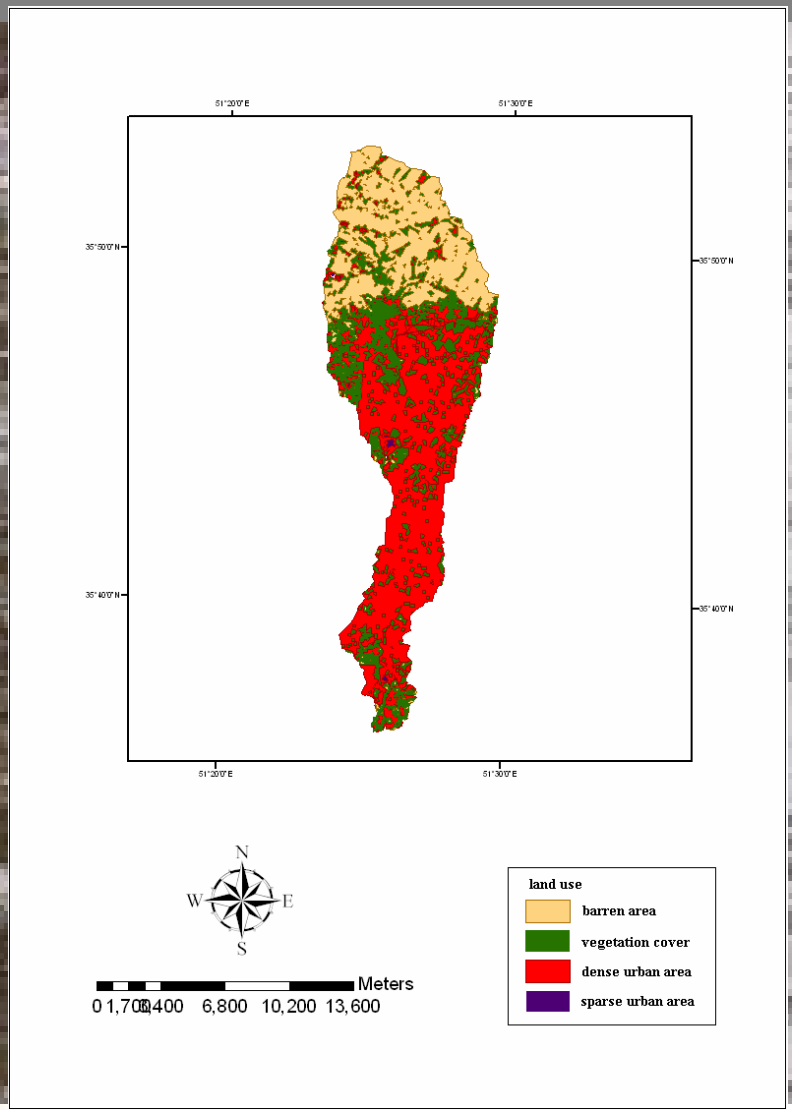
pricipitation of Darban Basin



Data and Method

- In order to increase the spatial resolution of IRS-LISSIII, image fusion of the panchromatic band has been made. Then, by using a supervised method and a field study, the land use has been defined and classified.

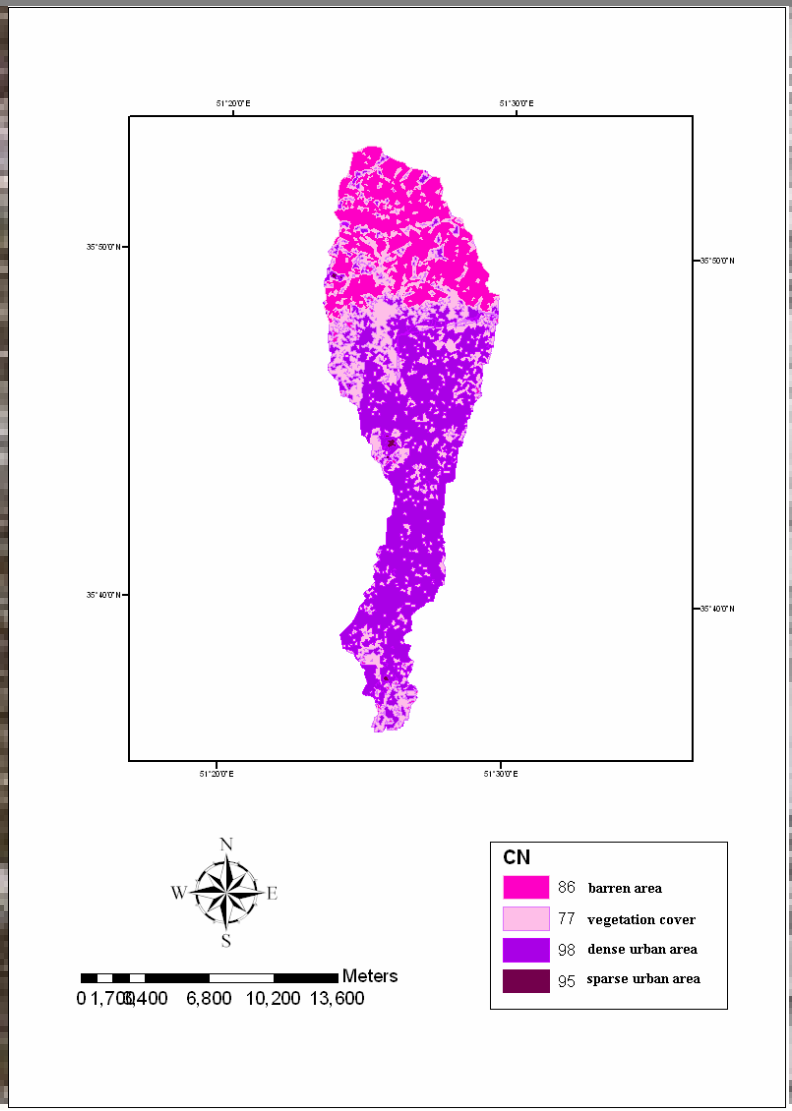
Landuse of Darban Basin



Data and Method

- Defining the curve number (CN) was based on hydrological soil groups, land use, hydrological conditions and antecedent moisture the land use has been defined and classified. This was done for determining the CN .In this layer, asphalt lands are mixed with bare land, and have the greatest number of CN. Dense residential land use was found to be the greatest area in these catchments.

CN of Darban Basin



Data and Method

- According to the relation between flooding in urban areas and parameters that were used in this study, spatial multi criteria evaluation model has been used.As a result of differences in the quantity and scale, these images have been modified into Raster format with 50 meter spatial resolution. Then these images were classified into various phenomenon related to floods. The parameters that were used in this study are: elevation surface, drainage network, land use, CN, and mean, minimum, and maximum annual precipitation. In order to calculate flooding, using the weight rosters and combine them according to this Table.

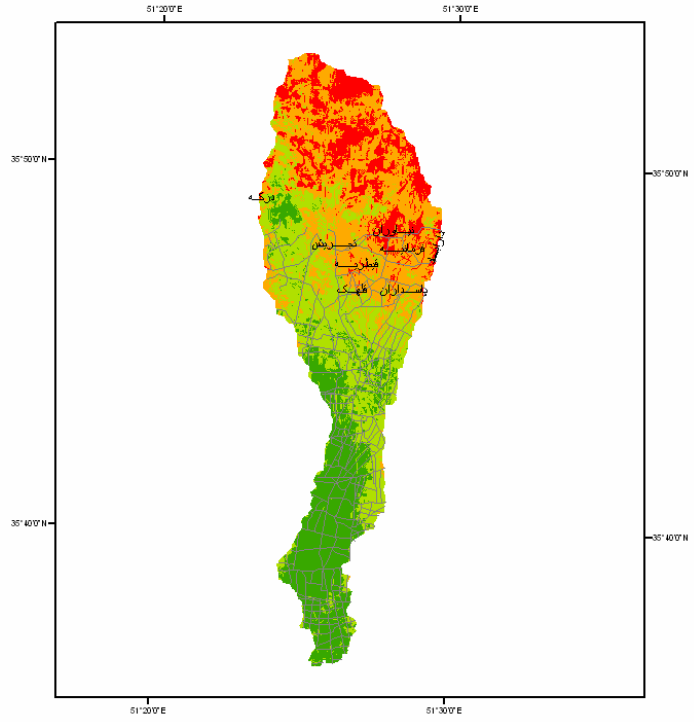
variables in weighted Model

Raster Layers	Value Cell						
	1	2	3	5	7	9	10
Elevation (m)	1100-1400	1410-1600	1610-2100	2110-2500	2510-2900	2910-3700	3710-4300
Slope (%)	0.5-3.8	3.85-10	10.05-18	18.05-25	25.05-32	32.05-40	40.05-64
Drainage Density (k/ha)	0.2	0.5		0.8	1		1.99
Stream Order	5	4		3		2	1
Land use	Vegetation cover		Sparse urban area		Dense urban area		Barren land
Curve Number	77		86		95		98
Max Rain(mm)	83-93	94-100	101-110	111-120	121-130	131-140	141-150
Min Rain(mm)	0.14-0.69	0.15-0.23	0.24-0.32	0.33-0.4	0.41-0.48	0.49-0.57	0.58-0.66
Mean Rain(mm)	25-28	28.1-31	31.1-34	34.1-37	380.1-40	40.1-43	43.1-64

Data and Method

- The map of flood zonation was also created according to the weighted model.It was found that the highest probability for flooding in Tehran is located in the Manzarieh and Jamaran areas, which is the highest topographic region in this city, yet most of the north-south avenue of Tehran in the eastern part were plunged by flooding.

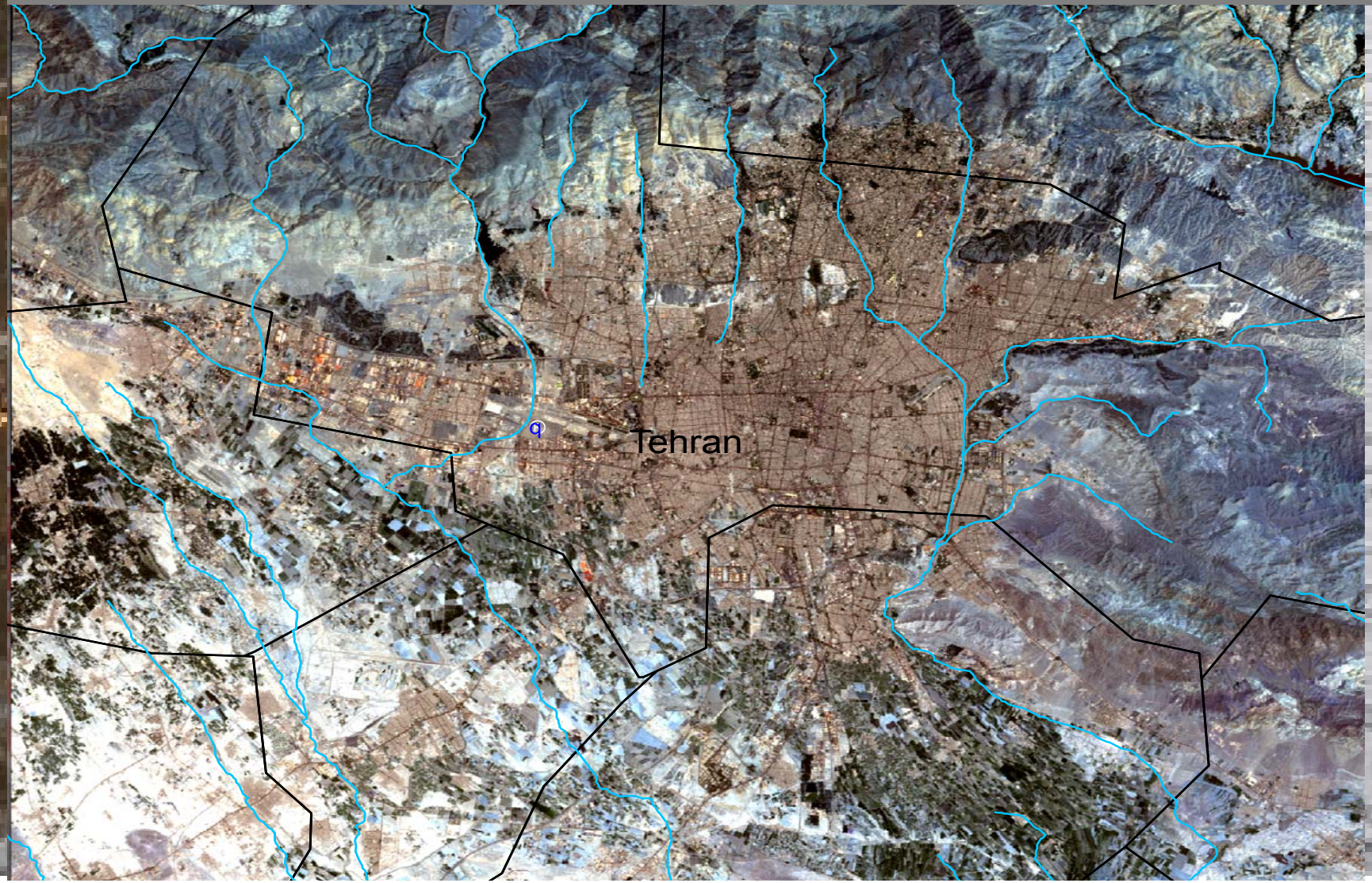
Flooding map of Darban Basin



Discussion and conclusion

- Tehran as the largest city in Iran has a great population. The distribution of this city is towards the southern slope of Alborz Mountain to the Masileh lowland and it is growing day by day. Tehran is faced by various problems such as dense population, air pollution, earthquake probability, land slide and floods.

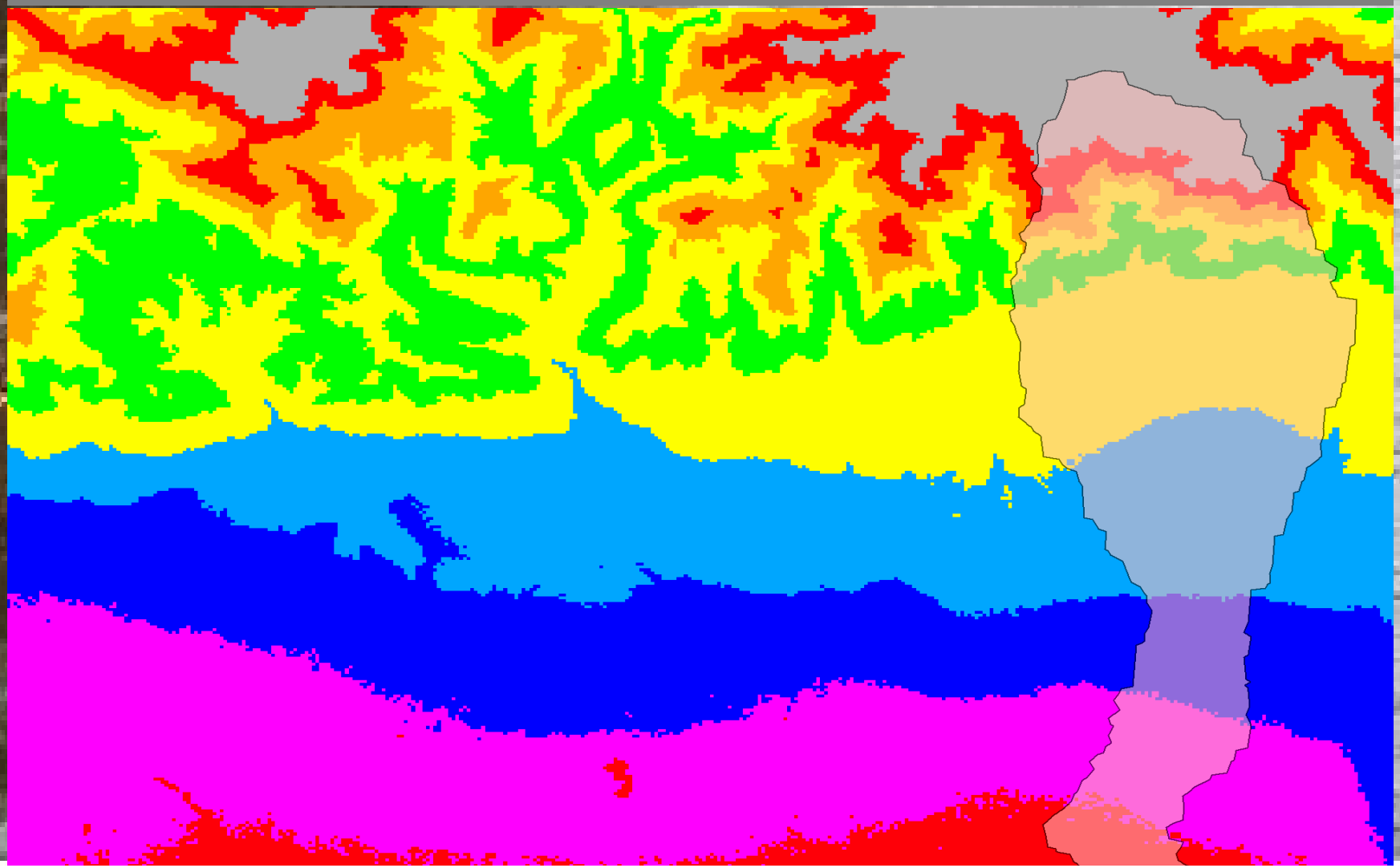
Tehran



Discussion and conclusion

- Flooding issue is an important in this city since it occupies a few valleys in the north – south direction of Alborz Mountain while their heights are over looking to the valleys. These elevations are responsible for most of their winter precipitation such as snow and rain in the end of the winter and between mid April and early May. In these days the temperatures are starting to rise and snow melts. Spring's precipitation causes violent damage to vegetation on the slope of the mountains. This is causing a mix of asphalt ground with urban drainage, and a great flood in the urban area.

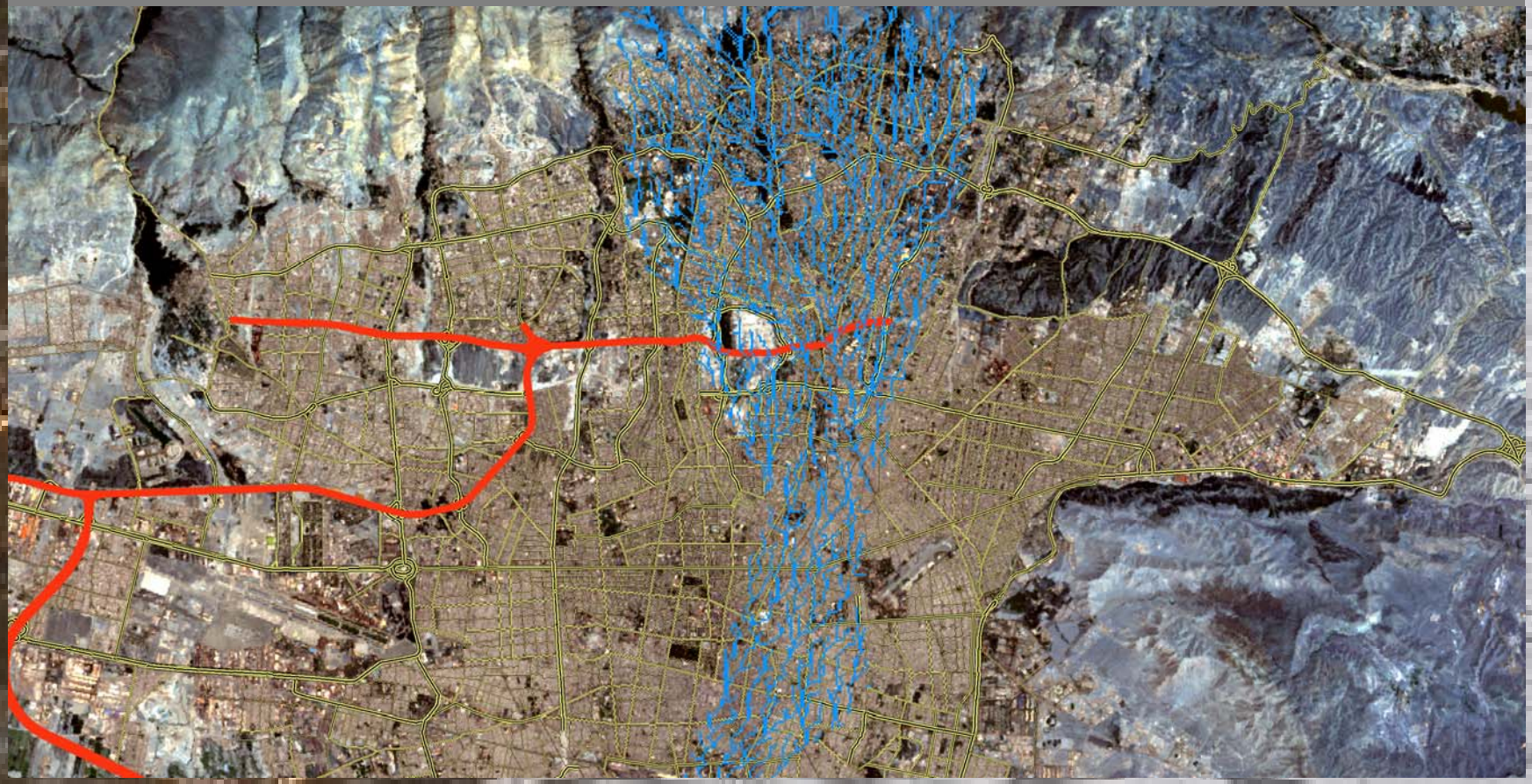
DEM of Tehran



Discussion and conclusion

- Darband catchment has bad memory of floods. Division line for this north-south catchment has started from the north of Tehran to the south, along with a north-South Avenue, such as the Shariati, Modarres highway and Vali-e-asr.
- Extracting network drainage has shown that as a result of grading and construction, this catchment barrier was damaged with its neighboring catchments and it has emanated so that once flood starts, there is no guaranty that it will flow in the direction of its catchment. Yet there is no doubt that north-south Avenue will result in significant more damage than the east- west street in the city.

Tehran on ETM

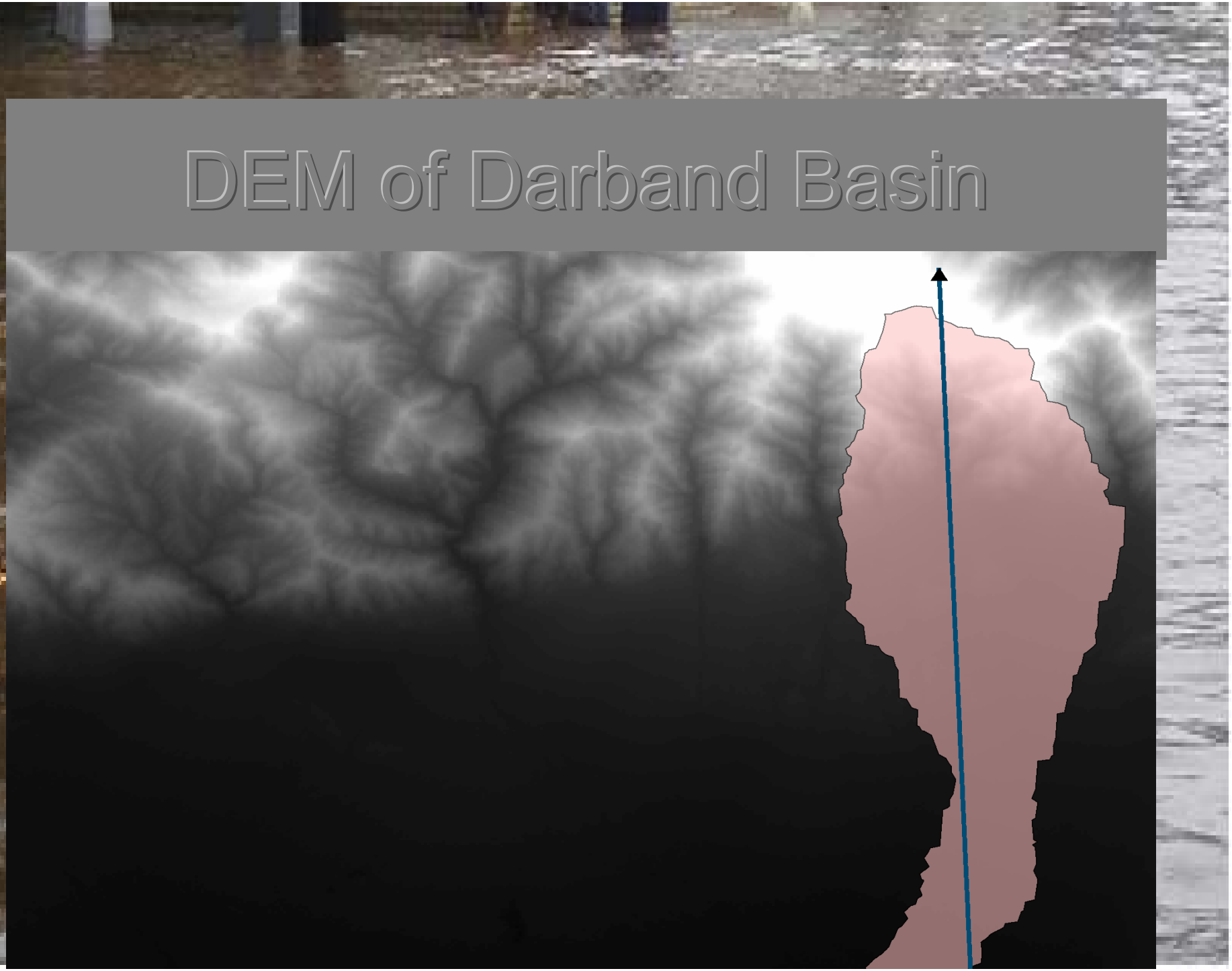


Tehran on ETM

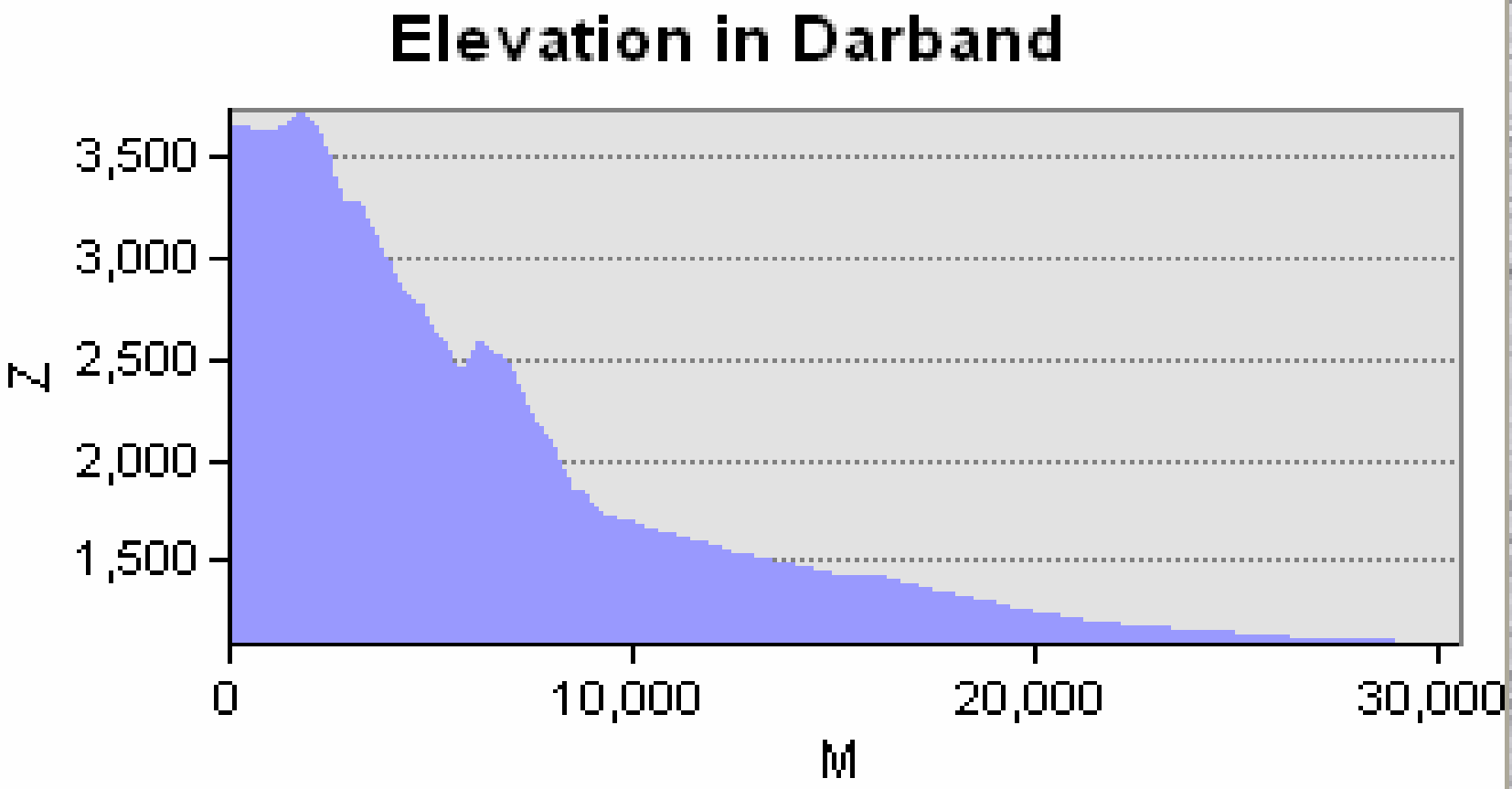
Discussion and conclusion

- Studying elevation and slop variations has shown that it is possible to create new flooding channels for emergency situations, which can shift a great amount of flood out of the city. Therefore, it can prevent damage to southern part of city which is more crowded.
- Flood zonation map expresses that prevention actions like increasing vegetation cover, quit construction in flood channels of the northern part of the catchment may reduce many of the floods effects in lowland areas.

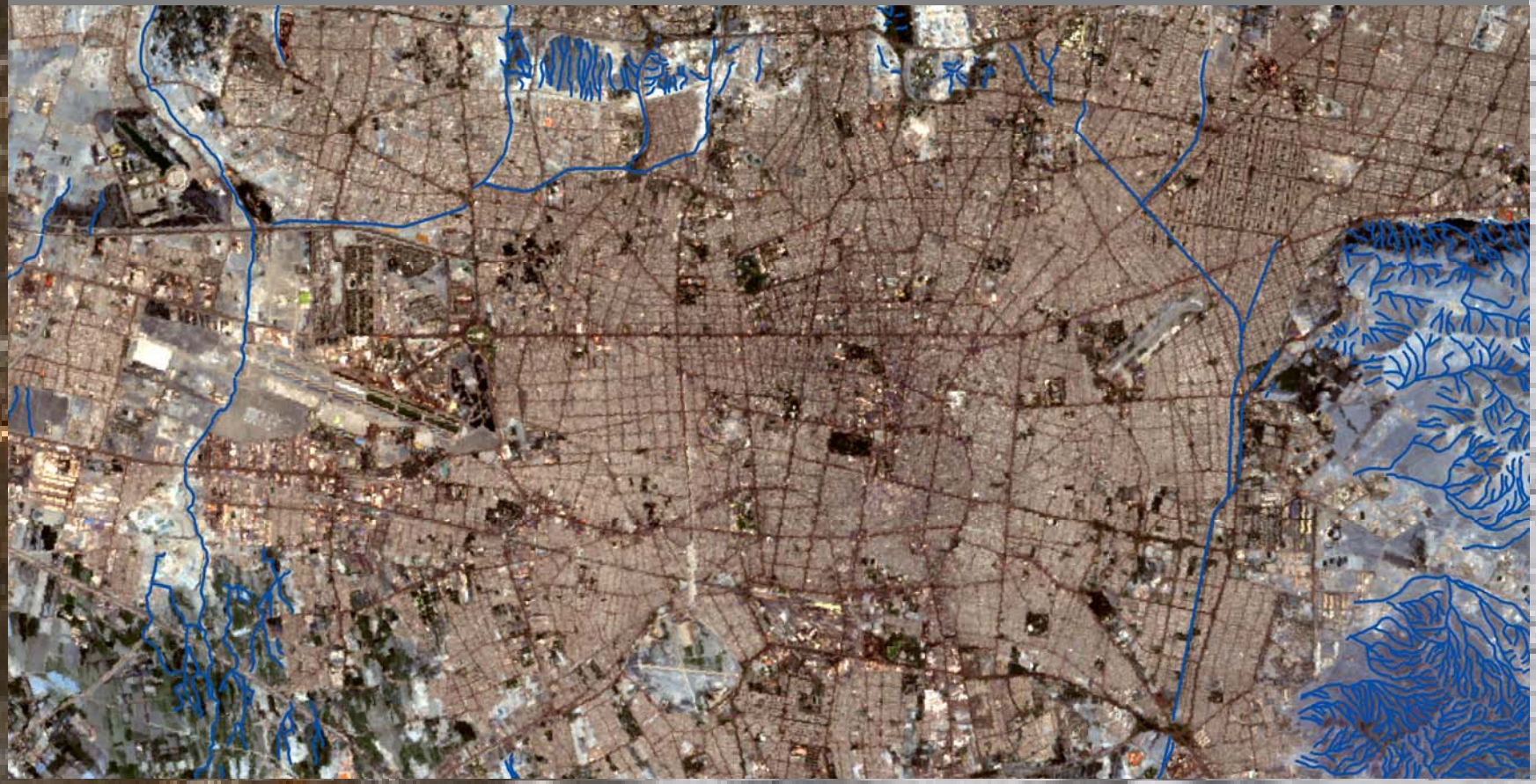
DEM of Darband Basin



DEM's profile of Darband Basin



Tehran



Tehran


Thanks for your attention