INVESTIGATION LAND USE CHANGES IN MEGACITY ISTANBUL BETWEEN THE YEARS 1903-2010 BY USING DIFFERENT TYPES OF SPATIAL DATA

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Introduction

This study aims to present the temporal land use changes in the mega city of Istanbul, Turkey between 1903 and 2010.

Urbanization has been rapidly increased due to industrialization and immigration from the other regions of Turkey especially after the year of 1960s.

In this study, spatial distribution of urban sprawls and their temporal changes were analyzed and presented using different types of spatial data such as hard copy map produced in the year of 1903 and remotely sensed data obtained in 1987 and 2010. The conducted methodology to process these spatial data is presented in the study.

Introduction

In the study the temporal impact of rapid urban growth on forest cover in the mega city of Istanbul between the years of 1987-2007 were also examined.

Spatial distribution of forests and their temporal changes were analyzed and presented by utilizing the modern technologies of Remote Sensing and Geographical Information Systems (GIS).

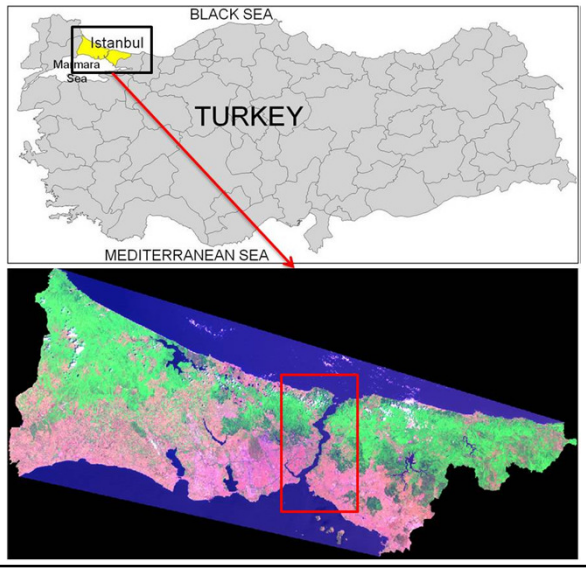
The VIS model is applied to differentiate urban land from rural land and to conduct urban morphology of the developed areas under three basic components of vegetation-impervious land and soil. Such practices enable to qualitatively and quantitatively calculate the spatial changes in selected areas.

Study Area

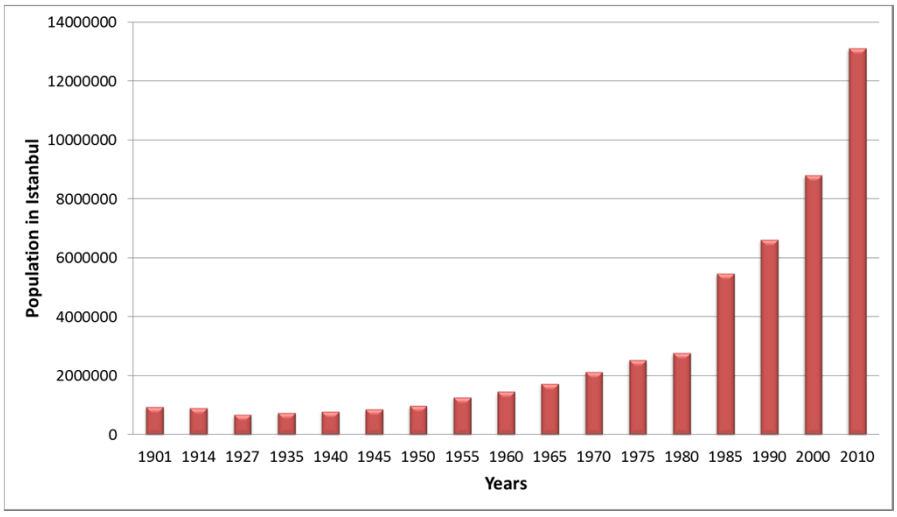
Istanbul is ranked among the first 20 crowded cities of the world. Beyond its current population around 13 million (12 915 158 in the year of 2009 according to the official figures), during the history of this old and ancient city that has hosted many different civilizations, it has always gained an attraction for human settlement due to its geographical location. The population of the city has been rapidly increased from the year of 1985 (5842985 capita) to present.

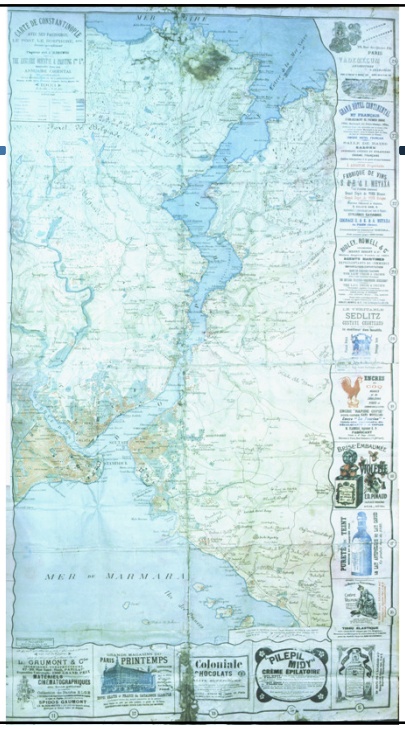
Study Area

Mega city Istanbul is selected as study area.



Population of Istanbul from the year of 1901 to 2010

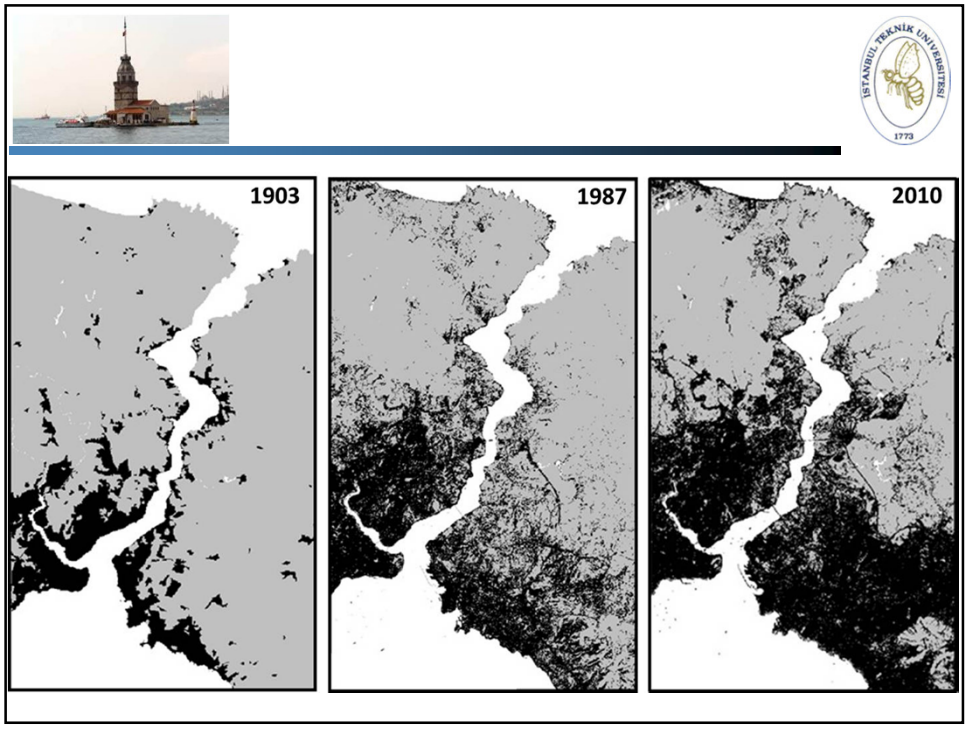




Hardcopy map of Istanbul dated 1903 done by J. Sloniewski who is a French civil Engineer.

	1987 (ha)	2010 (ha)
Urban	19258.92	27719.46
Agriculture	8427.78	3150.98
Water	17732.60	17789.90
Forest	34771.41	31530.37
Total	80190.71	80190.71

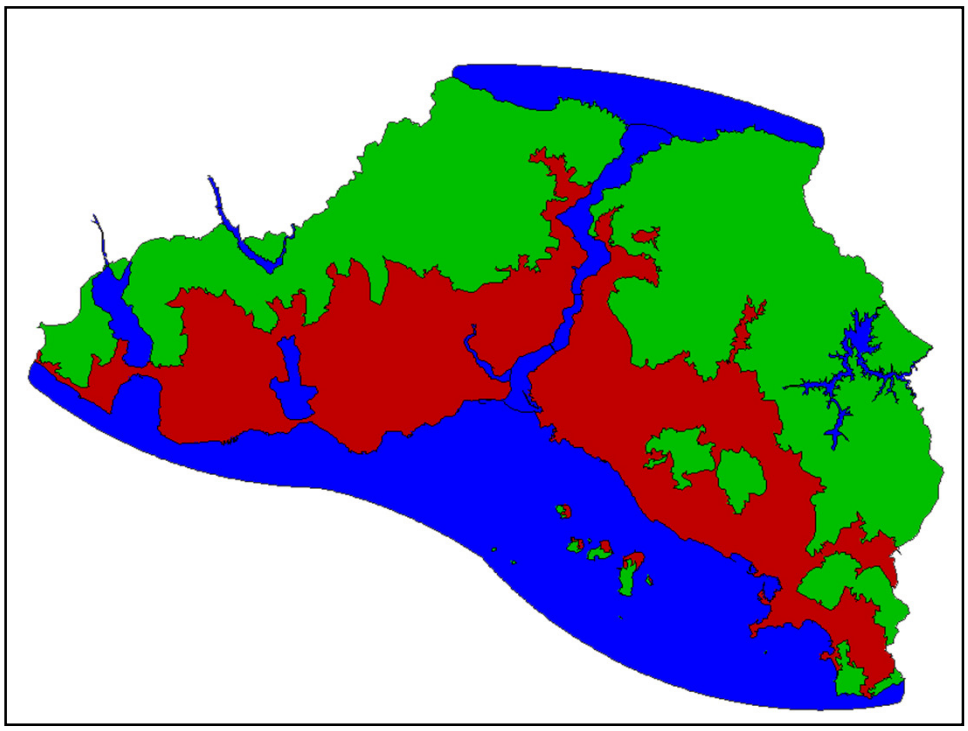
Land use changes between 1987 and 2010



Why Land use/cover Detection?

- Urban Planning,
- Environmental research and protection,
- Transportation planning and management,
- Facility planning and management.

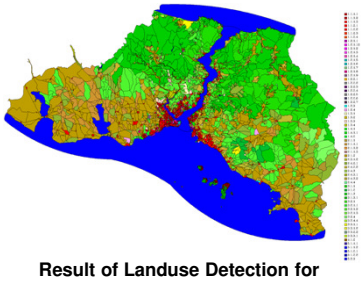
Land use classses are; Artificial Surfaces (Residential, commercial, industrial areas…), Agricultural Areas (Greenhouses, irrigated areas…), Forests and Semi-Natural Areas (forests, forests planted by human…), Wetlands, Water Bodies (Sea, ocean, lake…)



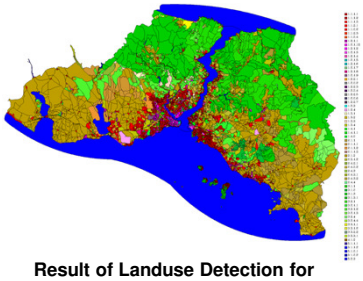
Used Data

- ✓IKONOS and IRS 1C/D satellite images for 2000
- ✓Topographical maps (Scales 1:25 000, 1:5 000 and 1:1 000)
- ✓KFA and KVR images for 1987/88
- ✓Aerial photographs for 1968 and 1940'ies (~1:35 000 and ~1:42 000)
- ✓DEM

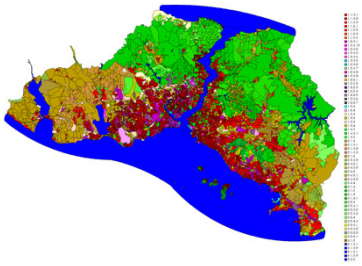
Results in General



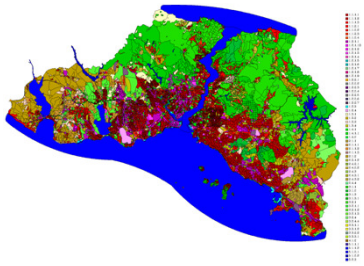
Result of Landuse Detection for 1940'ies



Result of Landuse Detection for 1968

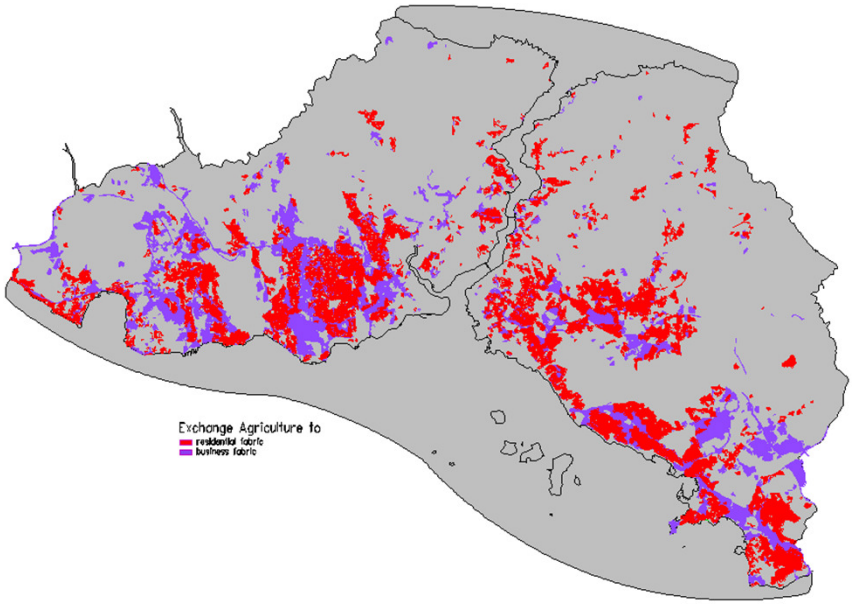


Result of Landuse Detection for 1987/88



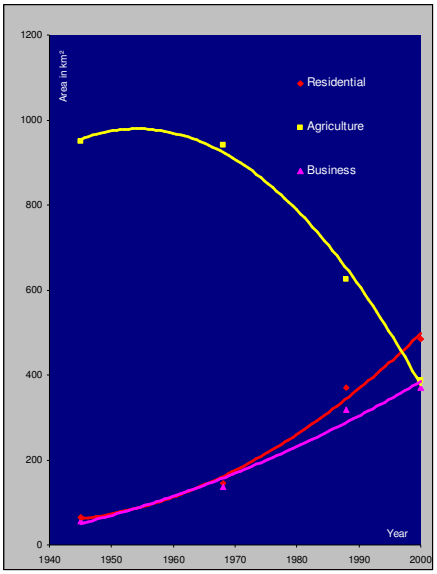
Result of Landuse Detection for 2000

Land-use Changes



Loss in agricultural areas with target

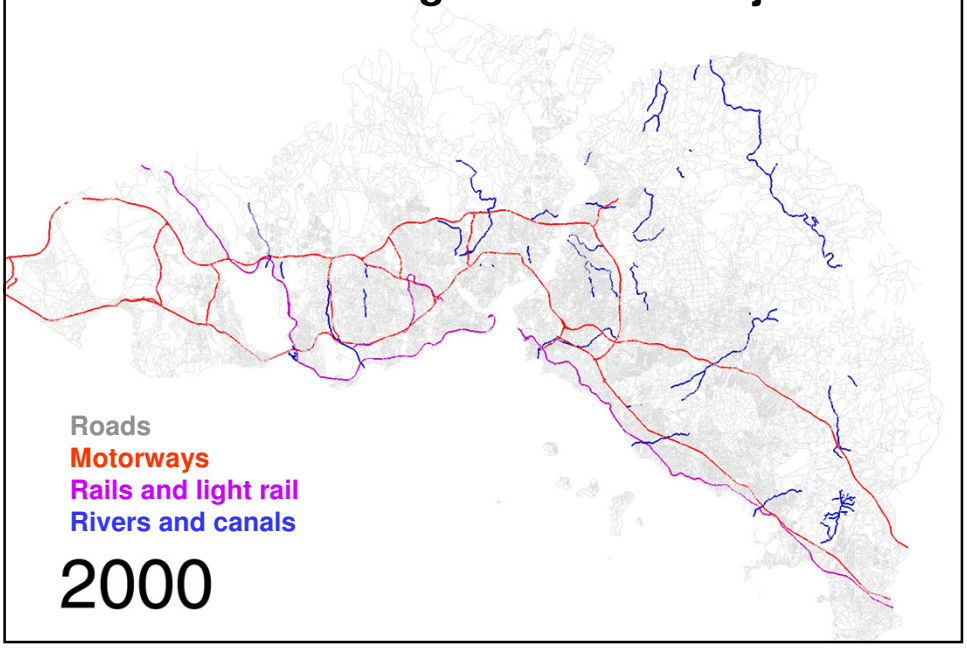
Land-use Change Analysis

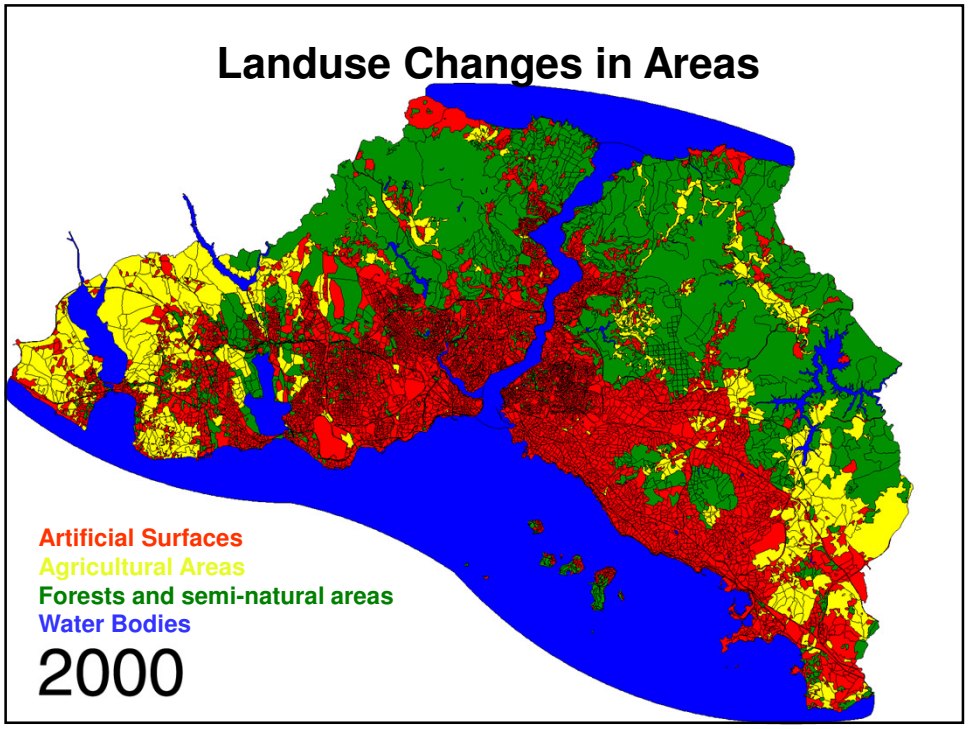


Year	Residential Surfaces (km²)	Agriculture Surfaces (km²)	Business Surfaces (km²)
1940'ies	65,37	949,91	55,34
1968	143,92	941,32	136,59
1988	368,86	625,80	317,49
2000	485,06	388,10	369,65

Loss in agricultural areas vs. increase in business and residential surfaces

Landuse Changes in Linear Objects



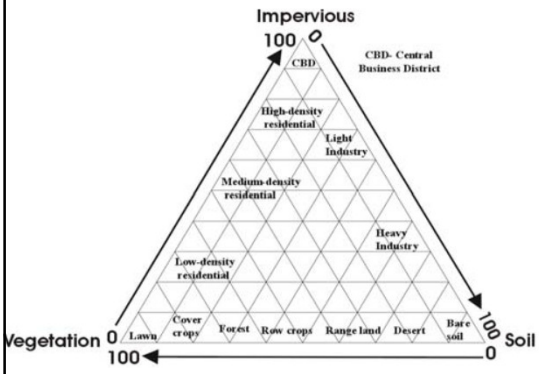


In the second part of the study, to identify the diminishing of forest areas within years due to rapid urbanization by using Landsat images and to alert the decision makers and those interested parties on the severe loss of forest areas.

For this purpose, the geometric and atmospheric corrections of the satellite images are done followed by classification of all the images by using the ISODATA uncontrolled classification algorithm. As the main target of the study is to indicate the impact of urbanization on the forests. Only 3 land use classes are selected which are; Vegetation, Impervious surface and Soil.

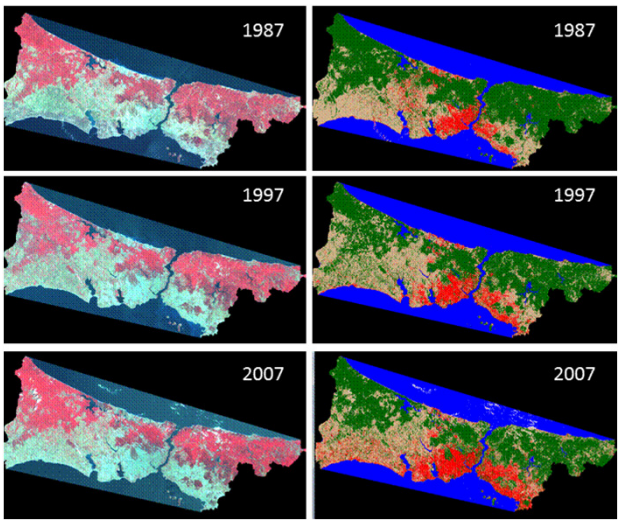
These components are then further utilized in the V-I-S model in classifying land- use in the context of densely populated city of Istanbul.

V-I-S Model



A biophysical arrangement can be obtained by the determined values for those 3 components (VIS-Vegetation- Impervious Surface- Soil) that indicate the urban surface properties. This method is usually used in examining the urban regions with satellite images. In order to identify and visualize the environmental changes in an urban area, VIS method is a convenient one to apply and achieve good results.

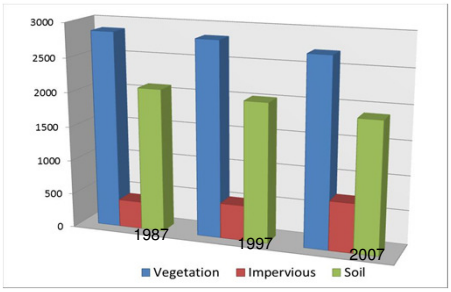
Some Results



Some Results

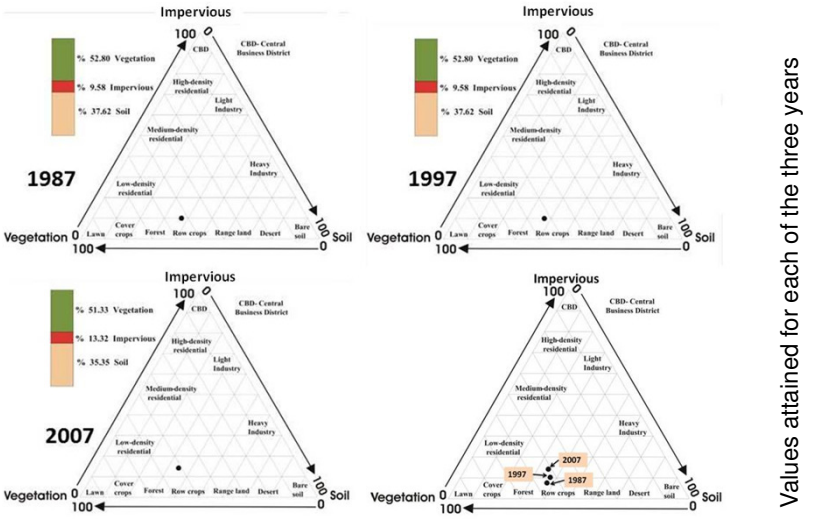
Classification results

Vegetation (forests, parks, green areas etc.)
Soil (Barren land, sands etc.)
Impervious surface (urban, road, industrial area etc.)

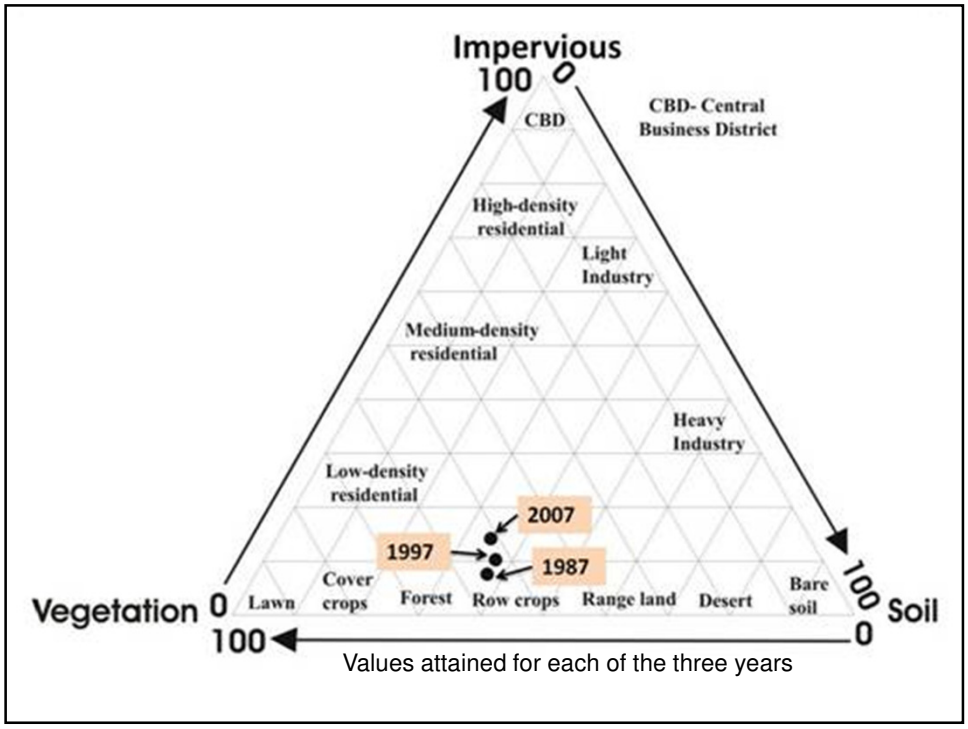


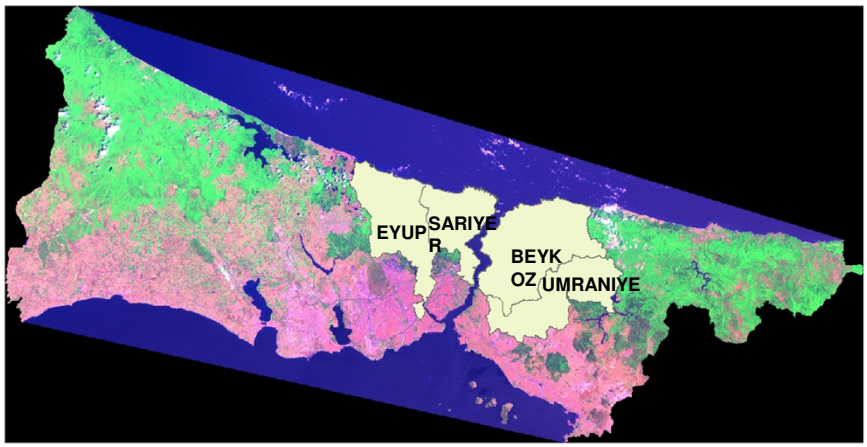
Class	Area (km^2) Year 1987	Area (km^2) Year 1997	Area (km^2) Year 2007	Changes 1987-1997	Changes 1997-2007	Changes 1987-2007
Vegetation	2867	2832	2714	-34.81	-117.79	-152.60
Impervious	402	513	714.17	+110.94	+200.49	+311.43
Soil	2090	2017	1895	-72.57	-122.02	-194.59

Some Results



Values attained for each of the three years


Impervious
100
0
CBD
CBD- Central
Business District
High-density
residential
Light
Industry
Medium-density
residential
Heavy
Industry
Low-density
residential
2007
1997
1987
Vegetation
0
100
Lawn
Cover
crops
Forest
Row crops
Range land
Desert
Bare
soil
100
0
Soil
Values attained for each of the three years


EYUP
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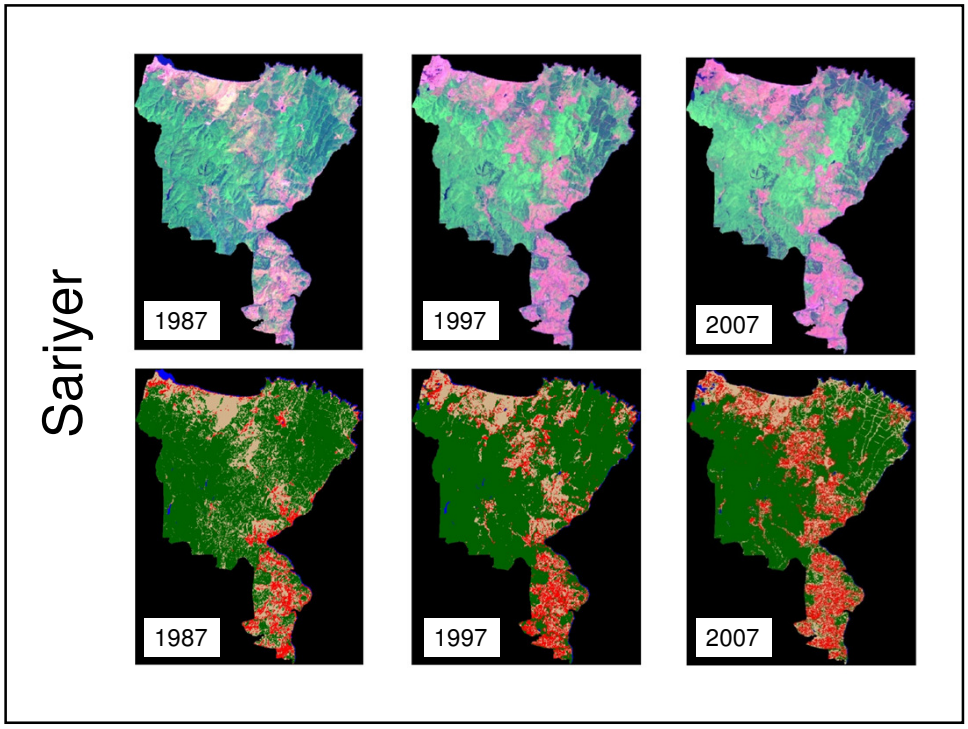
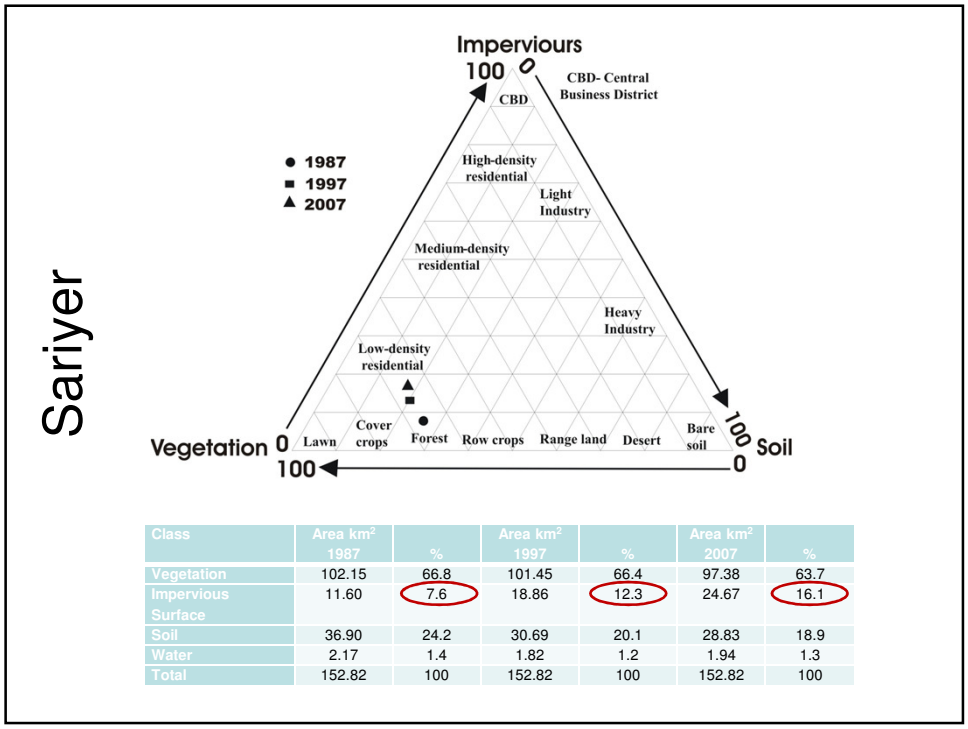
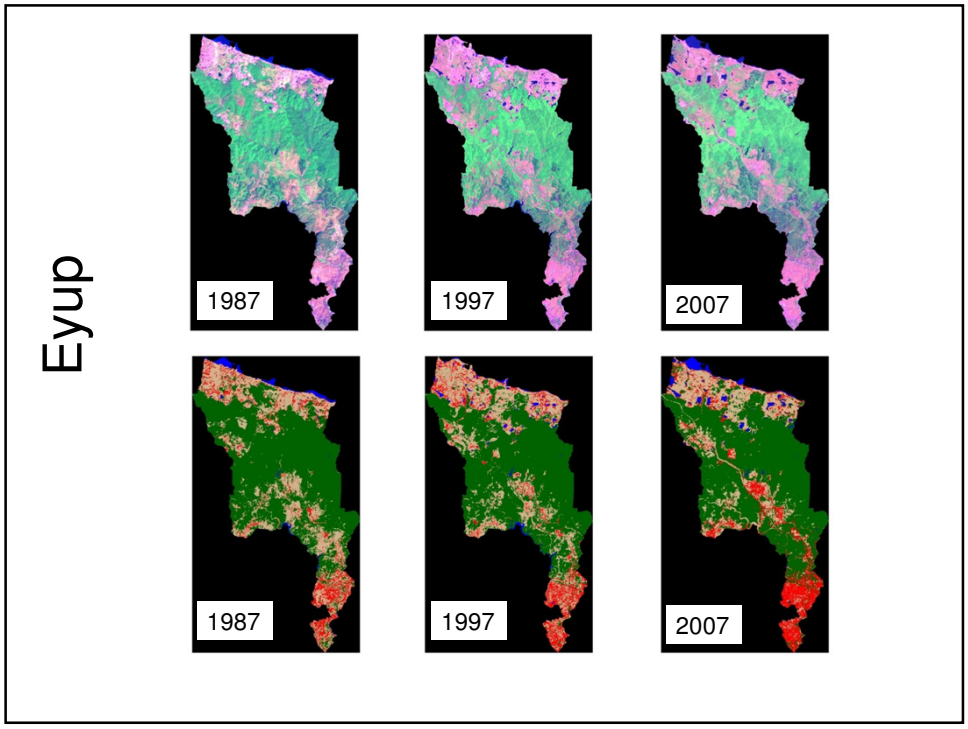
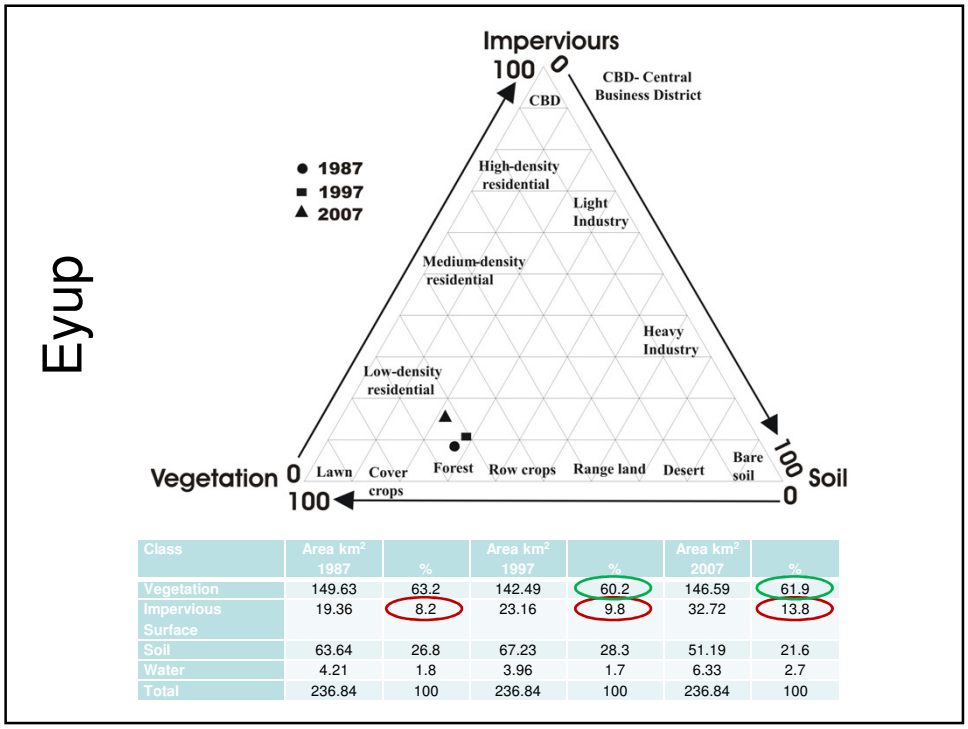


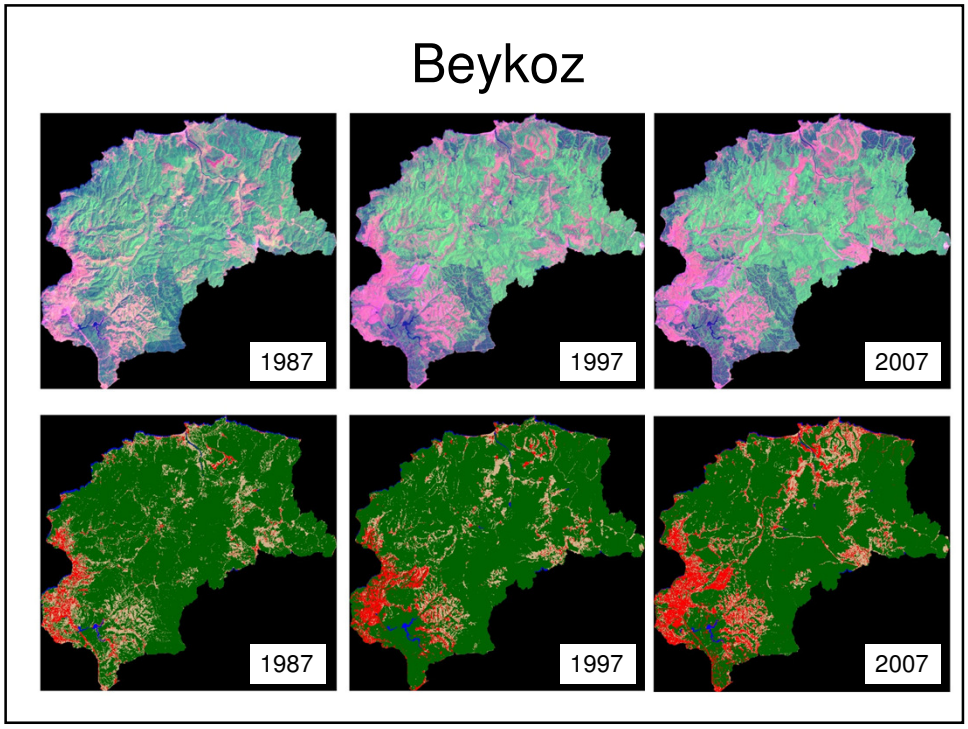


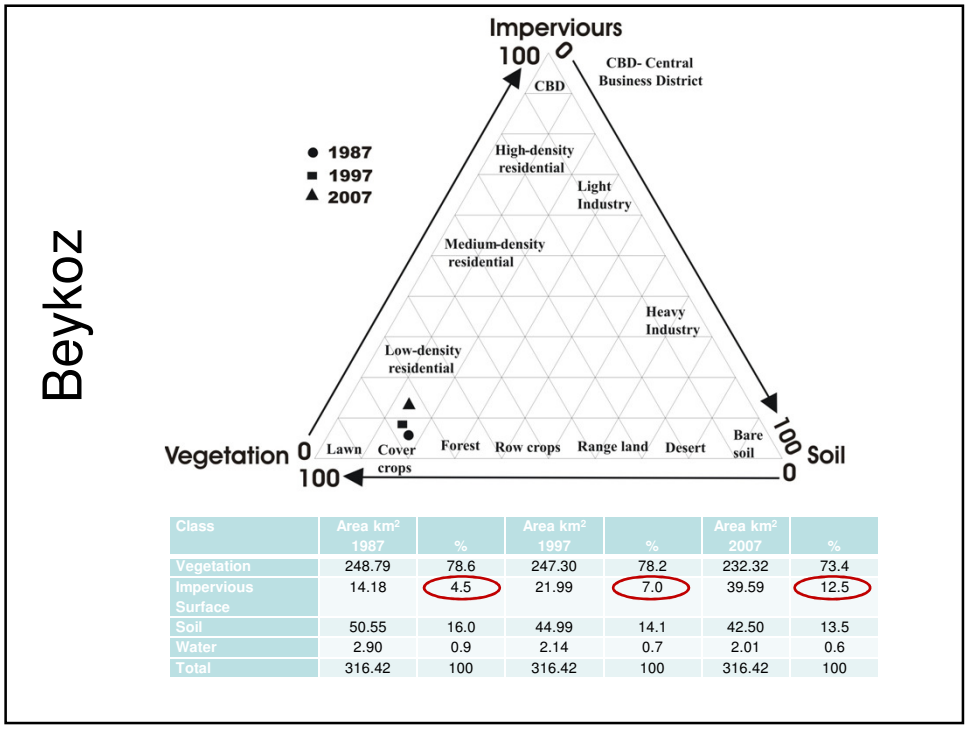
Class	Area km² 1987	%	Area km² 1997	%	Area km² 2007	%
Vegetation	102.15	66.8	101.45	66.4	97.38	63.7
Impervious Surface	11.60	7.6	18.86	12.3	24.67	16.1
Soil	36.90	24.2	30.69	20.1	28.83	18.9
Water	2.17	1.4	1.82	1.2	1.94	1.3
Total	152.82	100	152.82	100	152.82	100



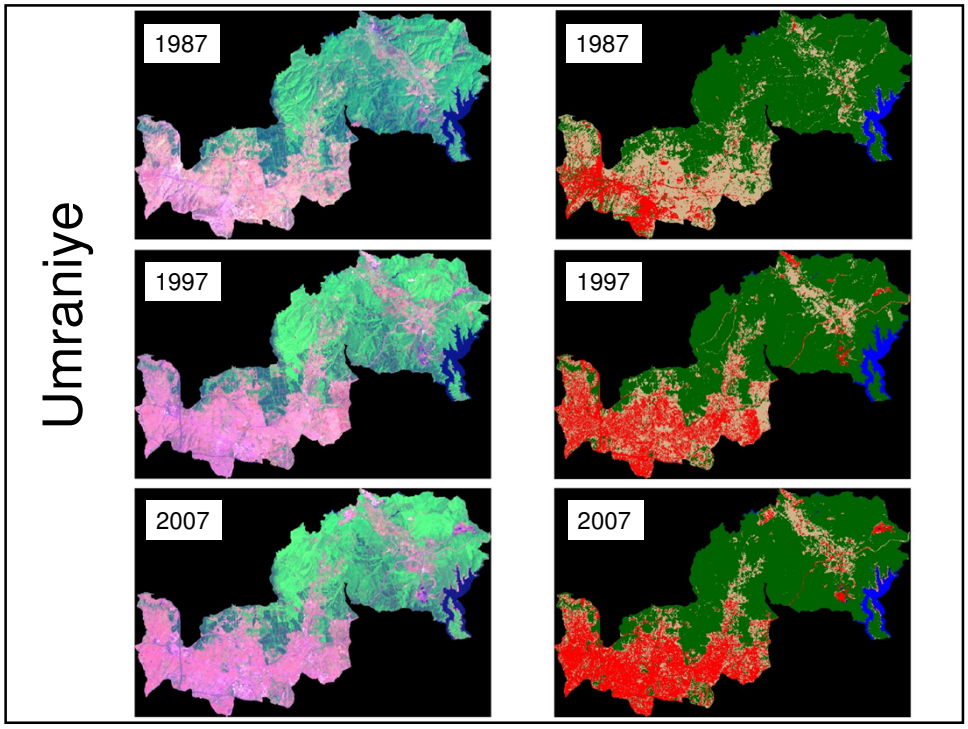


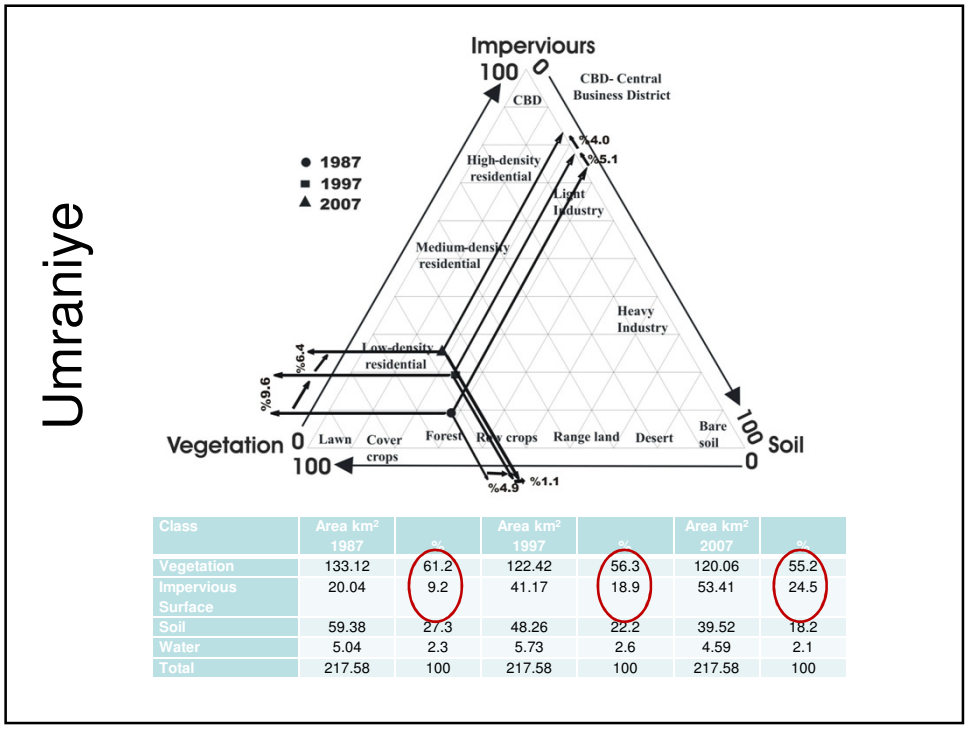
Class	Area km² 1987	%	Area km² 1997	%	Area km² 2007	%
Vegetation	149.63	63.2	142.49	60.2	146.59	61.9
Impervious Surface	19.36	8.2	23.16	9.8	32.72	13.8
Soil	63.64	26.8	67.23	28.3	51.19	21.6
Water	4.21	1.8	3.96	1.7	6.33	2.7
Total	236.84	100	236.84	100	236.84	100





Class	Area km² 1987	%	Area km² 1997	%	Area km² 2007	%
Vegetation	248.79	78.6	247.30	78.2	232.32	73.4
Impervious Surface	14.18	4.5	21.99	7.0	39.59	12.5
Soil	50.55	16.0	44.99	14.1	42.50	13.5
Water	2.90	0.9	2.14	0.7	2.01	0.6
Total	316.42	100	316.42	100	316.42	100





Class	Area km² 1987	%	Area km² 1997	%	Area km² 2007	%
Vegetation	133.12	61.2	122.42	56.3	120.06	55.2
Impervious Surface	20.04	9.2	41.17	18.9	53.41	24.5
Soil	59.38	27.3	48.26	22.2	39.52	18.2
Water	5.04	2.3	5.73	2.6	4.59	2.1
Total	217.58	100	217.58	100	217.58	100

Conclusions

- Digital multi-spectral satellite technology nowadays provides valuable opportunities for qualifying and comparing urbanized areas in the world.
- Vegetation-Impervious land-Soil (VIS) model proposes the fundamentals of standardization, comparison and variation in urbanized ecosystems. The model presents the purpose of science, environmental management and urban planning. This model can be used to obtain information on the magnitude and direction of urbanization.
- More evaluation possibility arises on the urban land by the development vector. The direction of the vector enables to have an idea on the future possible urbanization trend.

Conclusions

- When the findings of the study are analyzed, it is observed that rapid urbanization within a period of 20 years on forests has a negative impact on forests and within this period loss of forests have become significant on the contrary to urbanization. If this trend continues in future and if no precautions are to be taken, severe threat will be expected to occur on the forests of Istanbul.
- However, the world became industrialized after 1950s and this resulted in immigration from suburban to urban areas. Especially big cities of developing countries such as Istanbul have faced with many problems because of this situation. This study examined the spatial distribution of urban areas in 1903, 1987 and 2010. This study proved that integration of old hard copy maps with new spatial data such as remotely sensed data could provide valuable information to monitor urbanization in different cities temporaly.

Thank you very much for
your attention...

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