

# INVESTIGATION OF TIME-DEPENDENT CHANGES OF FILYOS RIVER AND ITS DELTA IN THE BLACK SEA COASTAL ZONE BY TEMPORAL GIS

I. Büyüksalih<sup>a\*</sup>, S. Öncü<sup>a</sup>, H. Akcin<sup>a</sup>

<sup>a</sup> ZKÜ Engineering Faculty, Geodesy & Photogrammetry Eng. Dept. , 67100 Zonguldak Turkey, ([muhendismail\\_s\\_öncü@my.net](mailto:muhendismail_s_öncü@my.net), [hakanakcin@karaelmas.edu.tr](mailto:hakanakcin@karaelmas.edu.tr) )

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## ABSTRACT

Filyos river is one of the important river of Turkey and it is the topic of this paper. This river and its delta was announced as free zone in which second largest investment project is being constructed. Its emphasis based on the fact that it is a stock of gravel and crashed zone. Due to the material substances its river bed and delta changes the location. These modifications occurred on the land affects the land use in the river basin such changes can be observed by remotely sensed images temporally and it has been analysed in this study over the 20 years period. In the experimental phase, Landsat TM and SPOT-5 HRG images were used. Then, by means of the object-oriental image segmentation and classification algorithms, vectorial layer has been derived and integrated to the GIS environment. Based on the findings, it has been realized that at the present time (2004), Filyos river falls into the sea with only one branch while it was droop of the Black sea from two points in 1983. Also, along with this 20 years period, changes of the mass accumulated in river bed and delta, changes of the length of river and dry area are investigated as graphical.

## 1. INTRODUCTION

Filyos river valley in one of main valley of Zonguldak city and lives along the Filyos River. Width of this valley reaches to 300-400 m in some places and includes Çaycuma downtown, saltukova/kokaksu-hisarönü. Filyos project over the Filyos river is the second largest investment in Turkey after southeast Anatolia project (GAP) ([www.Zonguldak.meb.gov.tr](http://www.Zonguldak.meb.gov.tr), [www.caycuma.com/tanitim](http://www.caycuma.com/tanitim)). In these contents, river side between the Gökçebeý in south and Black sea delta in North, Which extends about 1 km, has been announced as Frec zone. Moreover, delta side of the river has been planned as longest part of the country (Seker at all,2003). Project is Undertaken by Karabük Iron-steel factory Kardemir .Furthermore, this river carries the allvion material and this make it as one of the important industrial raw material center with sand-gravel and agrega.in this study, changes over the last 20 years river part between the Saltukova airport at south and its delta at Black sea coast have been analysed based on the 1:25000 scale topographic maps, Landsat TM and SPOT-5 HKG images under the GIS environment. As a result of such implementation, required statistics can be derived in temporal manner.

## 2. EXPERIMENTAL AREA: FILYOS RIVER AND ITS DELTA

Filyos River, 228 km with a basin of 13156sq.km, is located from the körođlu mountains, Çankırı, to the west side of the Black sea. The river consist of several brunches and than all of them combine in Gökçebeý-Zonguldak basin. From that point, the river streams 30 km in the north direction till reach to the Black Sea. In Figure 1, location of Filyos river valley is shown in the details. The figure represents 3-D DEM of Filyos delta and gives orthoimage and 1:25000 scale topographic maps superimposed onto the DEM. The Filyos

River has catchments of 1303.6sq.km in the Filyos valley. Total the discharge is 3213.91 hm<sup>3</sup> per year and average discharge 102.237 m<sup>3</sup> per sec. The discharge of Filyos river is fluctuated due to changes of seasons. Such as the discharge, in spring, 135.470 m<sup>3</sup> per sec. During the summer it goes down to 31.070 m<sup>3</sup> per sec. Also in fall season, it is 67,140 m<sup>3</sup> per sec last, in winter, it goes up again to 127.370 m<sup>3</sup>/sec. From the Filyos valley to the river delta, alluvial plain supplies high quality aggregates for concrete structures. Due to geological history of the delta, sand-gravels and crushed stone have unique engineer properties. According to Buzkan 1996, the reserves of aggregeten in the delta approximately 33 million cubic-meters.

## 3. METHODOLOGY

In this study, two different types of images have been used. First one is the Landsat TM images of 1992 and 2000 (including only spectral bands of 1,4 and 7 ) with a ground pixel size of 30 m. These images were geo-rectified by PCI Geomatica V9.1 software package based on the reference control set digitized from 1.25000 scale topographic maps. For the classification procedure, maximum likelihood method was used (lillesand and Kiefer, 2000). Second dataset is the SPOT-5 HRG level 1A October 2003 image taken by the new SPOT mission launched May, 2002. Ground resolution of the images from this satellite is changing and in this case, image with standard resolution (5m) was handled in the experimental process. For the geometric correction of this high-resolution data, GPS-surveyed GCPs with sub meter accuracy were utilized.

In this study, following steps have been realized over the Landsat and SPOT-5 images (Benz, 2004); agriculture, forested, mass, river-bed and sea neighboured areas have

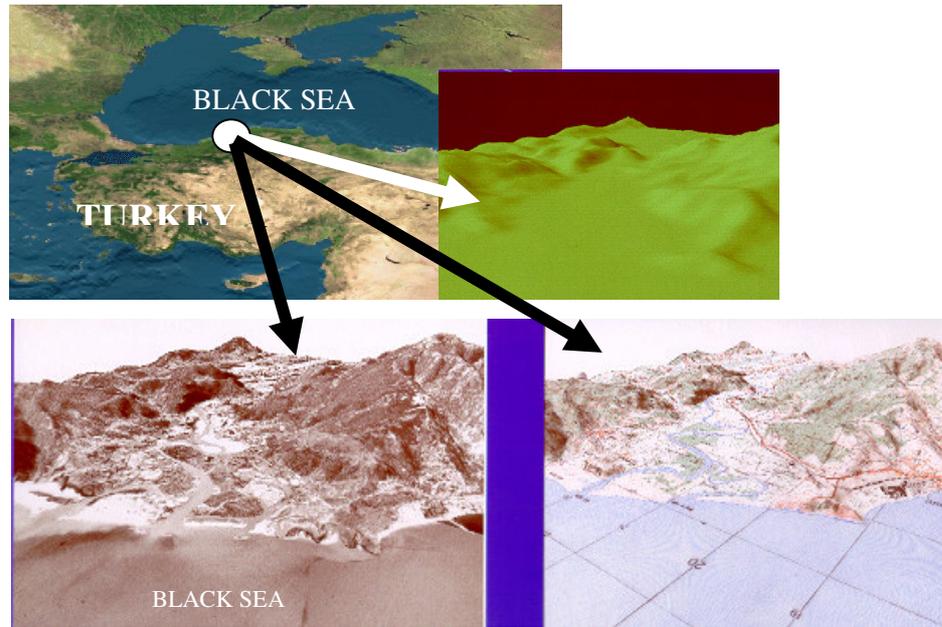


Figure 1. Location of Filyos river, 3-D DEM of Filyos delta and orthoimage and 1: 25000 scale topographic maps superimposed onto the DEM (Akdeniz, 2000).

been analyzed by means of object-oriented image analysis program system eCognition 3.0. used parameters in the implementation are given in TABLE 1.

	Landsat TM	SPOT 5
Scale Parameter	8	12
Color	0,8	0,8
Shape	0,2	0,2
Smoothness	0,0	0,0
Compactness	1	1

Table 1. Parameters for automatic Object oriented analyses

Derived segments for selected classes (see figs. 2) are integrated into the GIS software as vectorized class data. By means of the MAPINFO 7.0 software, sub-segments in relation to the each class are combined, thus template for each class is created (Fig.3a, 3b and 3c). By the superimposition of 2003 spot5 image onto the vectorized images relevant to the 1983, 1992, and 2000 for the changes in the river-bed and delta, visual structure has been generated (Figs.4a,4b and 4c).

Areal changes in rivebed and delta and the area with the dimension at 20 km<sup>2</sup> between 1983 and 2003 have been analysed based on the GIS

#### 4. CONCLUSION

Undertaken study has reached to following results related to the GIS-based temporal analysis of changes Filyos in the river and its delta over 20 years with the help of classification of remotely-sensed images.

- Temporal changes over the Filyos valley and its sea ad joint have been analysed by GIS

and acquired results are given in Fig.5 graphically.

- In the area between the delta to Southside with 20 km<sup>2</sup> corridor, length and dry areas of river has been evaluated temporally and amount of changes are represented over the graphic given in Fig.6
- Specifically, important decrease has been observed in the dimension of river delta. In 1984, river falls into the sea from two different locations, however, at present this is happening only from one location.
- Increase in the size of mass are as which contains alluvion material and located in the river-bed and delta mainly depends on the facts of floods happened in 1990 and the conversion of forested areas into the agriculture lands.

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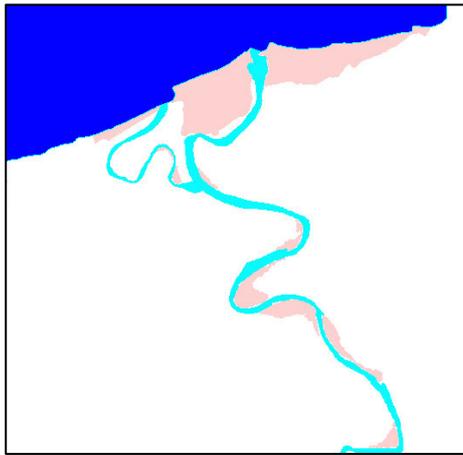
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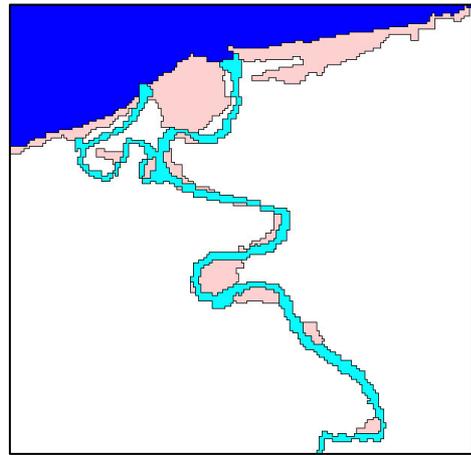
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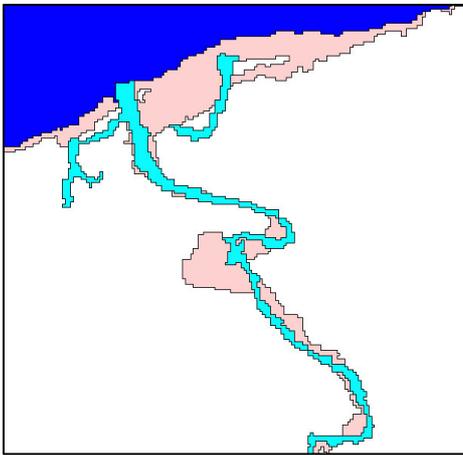
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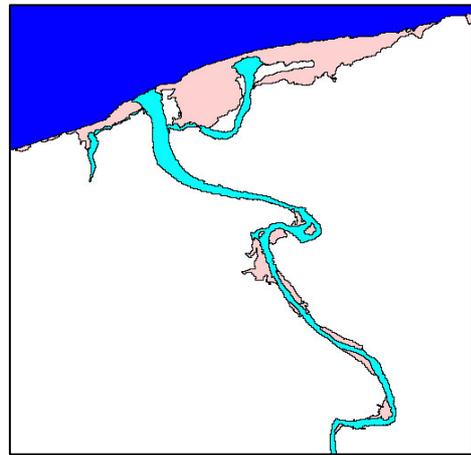
1983 Segments (1:25000 map)



1992 Segments (Landsat TM)

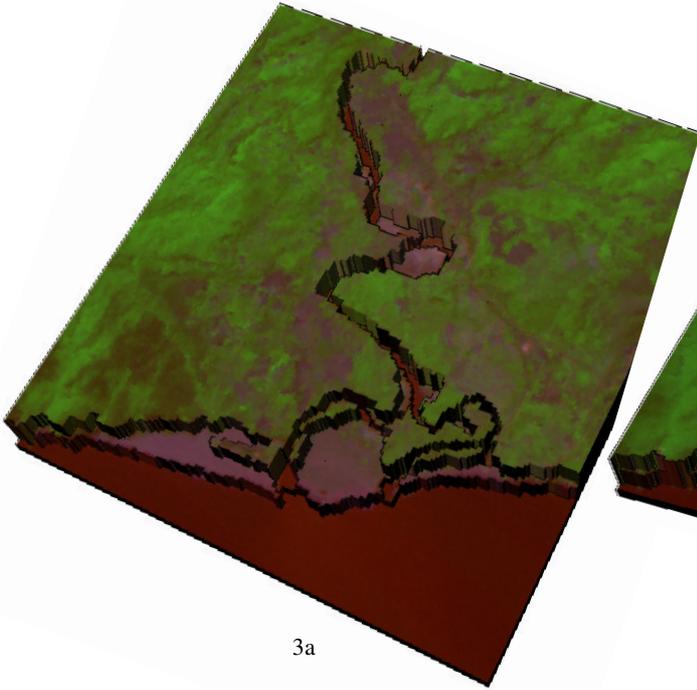


2000 Segments (Landsat TM)

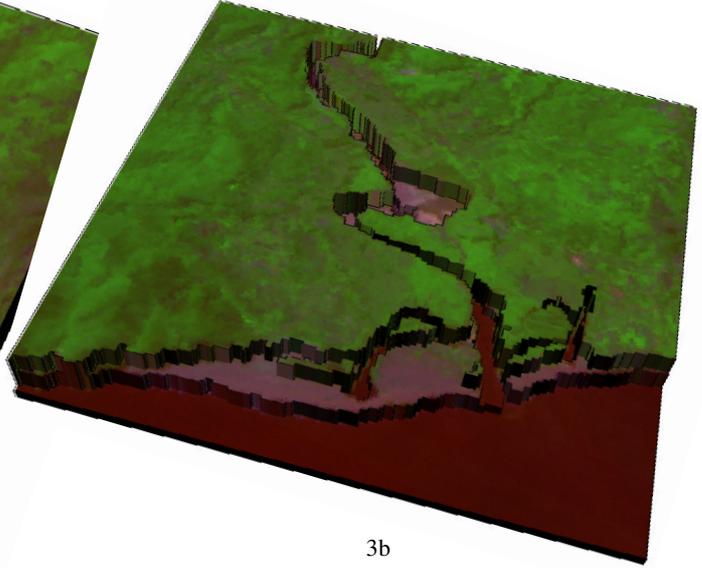


2003 Segments (Spot5)

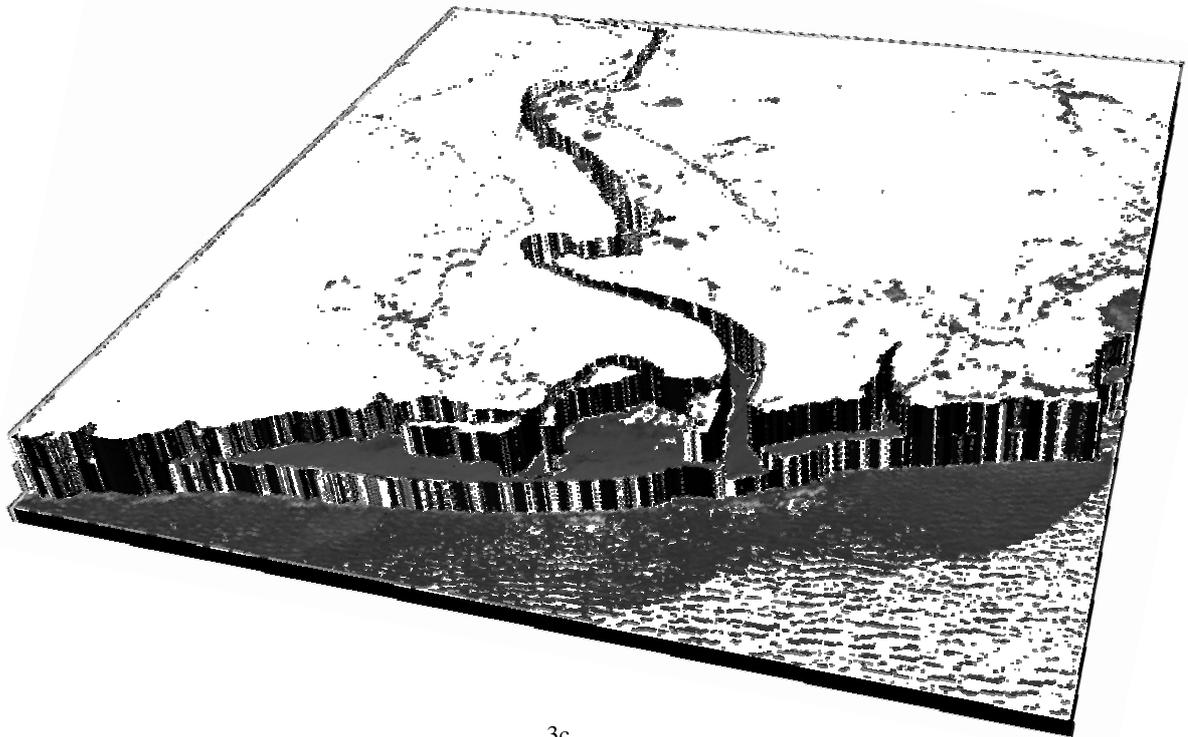
Figure 2. Derived segments for selected classes in eCognition software.



3a



3b



3c

Figure 3. 3-D template for 1992 and 2000 Landsat TM and 2003 Spot5 images.



Figure 4. Superimposition of 2003 spot5 image onto the vectorized images relevant to the 1983, 1992, and 2000 for the changes in the river-bed and delta ( blue is 1983 segment, green is 1992 segment and yellow is 2000 segment).

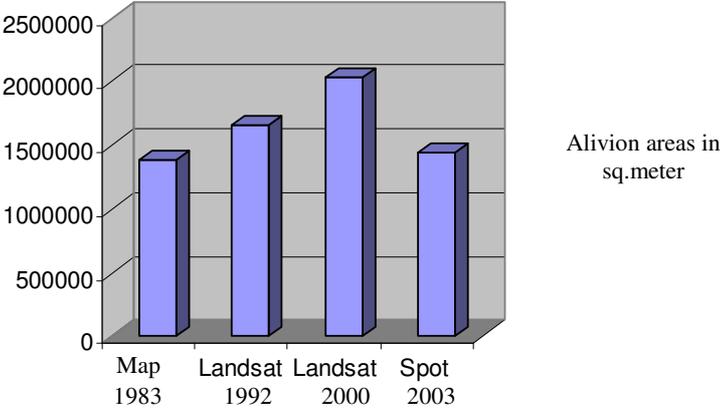


Figure 5. Graphic of temporal changes in alivion areas over the Filyos valley and its sea ad joint.

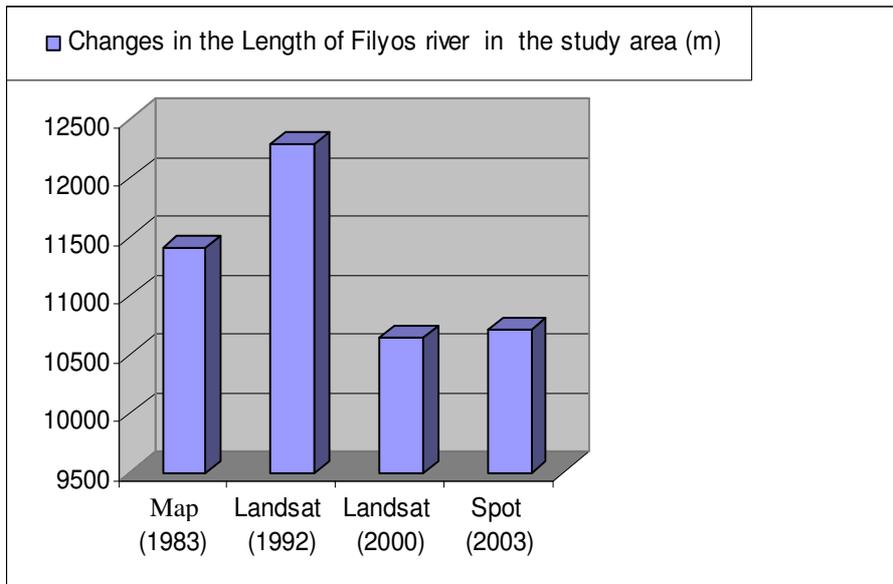
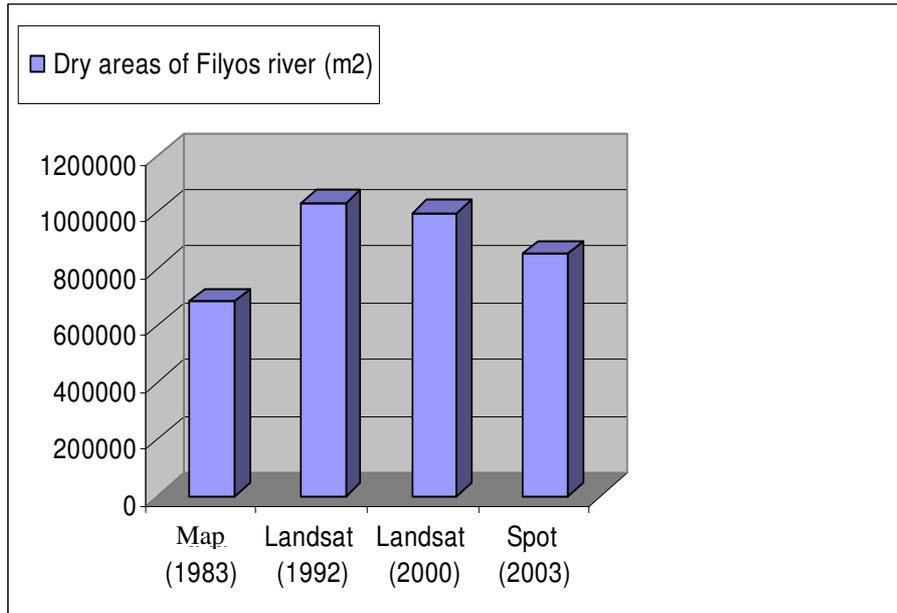


Figure 6. Graphics of temporal changes in length and dry areas of river.