

Monitoring Coastal Land Use Changes by Using Information Technologies

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SUMMARY

Coastal areas have become very important in view of human beings since the beginning of time. As a result of urbanization and population increase, controlling coastal areas has gotten hard recently. Building coastal zone management platform is important requirement to control natural resources and monitor coastal land use changes. As an example, developed information technologies such as Geographical Information System (GIS), Remote Sensing (RS), and Internet were used to monitor coastal land use changes. Current situation and the laws were examined in Turkey. The requirements for this study were determined. Coastal land use changes were determined with the using of GIS capabilities. To monitor and manage coastal regions efficiently, a web based platform was engineered. The users can reach up-to-date information thanks to internet opportunities.

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1. INTRODUCTION

Coastal Regions are the most important and intensely used areas settled by humans in the world. Coastal resources have been under intensive pressure throughout history and this situation will continue. Population has increased recently in Turkey. As a result of population increase and migration, unstable and unbalanced development is bringing about destroying all living organisms which want to stay alive. As time goes by, the demands to coastal areas which have fertile potential are increasing and tourism, industrial investments cause destructions which will never recycle.

A coastal management mechanism must be established to prevent these problems before appearing. Therefore, developing coastal management policies and strategies are important issues to prevent the harmful effects of environmental changes. For this, information technologies such as Geographical Information Systems (GIS), Remote Sensing (RS), and Internet are important requirements to be able to provide a sustainable life. These information technologies considerably support managerial decision-making process to manage spatial information. GIS integrates various information resources for coastal regions' management (Uckaç, 1998). Internet has also become a current topic recently. Internet can be used as the most efficient communication and management tool because of opportunities, which internet provides for accessing and sharing information.

In this study, legal and technical arrangements, which would enable public benefit from the coast, as suggested in the constitution, are investigated. Problems resulted from inconsistency in the coastal regulations of Turkey have been identified.

A pilot area located the east coast of Black Sea region of Turkey has been chosen in this study. After determining relations between land ownership coastline cover with the using of Geographic Information System (GIS) technologies, current land use changes along the coastlines of Trabzon City are investigated. Spatial data including cadastre maps and zoning plans and attribute data including property were combined to make analysis and queries on ArcInfo/View program environment. A web based monitoring and management platform was built with the using of ArcIMS Architecture. This system provides some advantages including updated and maintained data in a common platform and corporate decision-making process among authorities interested in coastal region.

2. CURRENT SITUATION ON THE COASTAL REGIONS IN TURKEY

In Turkey, according to the Turkish Coastal Law; coastal line is a natural line changing due to some meteorological events on the sea, lakes and rivers. These are formed by the fusion of the points on which the water touches the earth on the positions other than flood. Coast is an area between coastline and shore borderline. Shore line (Buffer Zone) is an area of at least 100 m

with horizontally from the coast line cover of sea, lakes and rivers to earth. Detecting the shore border line is compulsory to make plans and practice on the shore lines.

According to the Constitution Law of Turkish Republic, the coasts are at the disposal of the government. In utilizing from the sea, lake and river shore lines one must take care of first of all the Public Benefit. According to the Turkish Civil Law, the places with no property and the goods in the benefit of the public are in no ones ownership and can never be a subject of a private landownership. According to the Coastal Law, the detection of the shore borderline is obligatory to be able to make plans and plan's implementation on the coast and shoreline.

But unfortunately, the usage out of public benefit is being seen because of the agitated in planning and the detection of coastline cover not in the way or at the time it must be done.

Turkey has very long coastal band and three sides of its area are surrounded by sea. Environmental conditions such as the climate, topography, and the characteristics of habitation vary in the coastal regions of Turkey. Therefore, several problems appear in the applications related to coastal planning. In addition, Turkey has cultural and historical merits, especially natural attractiveness. Therefore, various investors prefer these areas. This situation causes many environmental problems on coastal areas. On coastal region in Turkey; sea and water pollution, prevented the public from accessing the coastline, contradictions and insufficiencies in legal arrangements, coastal erosions, filling the coasts for aiming to getting property, unbalanced construction causes unplanned urban areas, scattered buildings, environmental buildings, and destroying water sources, coastal region have insufficient social and technical infrastructure, uncontrolled urbanization and insufficient service appear, unbalanced developments on coastal areas result in land occupation, the filling to obtain land parts violates the public benefit (Kuleli, 1998).

3. COASTAL ZONE MANAGEMENT

Coastal Zone Management is a resource management process for a sustainable development in coastal regions. The aim of coastal zone management is to built a management system which permit integrated politics and strategies of public and local authorities. Monitoring platform have to be established for determining coastal land use changes. The aim of monitoring works is to protect natural environment for using public benefit.

Coastal regions have to be undertaken as a whole because of covering both land and sea. Different working disciplines have to work together for this. For example, some people may want to evaluate water quality, depending on measurements. A coastal zone management platform analyses different data sets and determine current changes.

3.1 Using Data On Coastal Zone Management

The data which can be used on coastal zone management separates two different formats such as spatial and non-spatial data;

- Land use maps,
- Environmental protection plans,

- Transportation plans
- National parks
- City plans
- Administrative border maps
- Cadastral maps
- Topographical maps, etc.
- Non-spatial data
- Ecological data
- Meteorological data
- Water quality data
- Environmental data
- Population data, etc. (Alkış, 1997).

3.2 Activities Of Coastal Zone Management

- Activities related to coastal zone management can be summarized
- Collecting the data of coastal region
- Management the data of coastal region
- Providing the security of data
- Providing the update of data
- Supporting management and planning activities with information organizations have
- Comparing current choices with developed alternative scenario
- Making analysis and modeling works to clarify conceptual relations
- Supporting policies related to coastal regions (Kay and Alder, 1999).

4. GIS AND INTERNET ON COASTAL ZONE MANAGEMENT

With the helping of the systems which can manage spatial information, the support to decision making process can be provided. Management mechanism solves questions like what-where-when. GIS has become more than a program since GIS is a visual and analytical tool and helps the users to understand or visualize this information in a map form and enables the users to manage these information interactively and analytically.

It can be thought that using GIS technologies on coastal management is an advanced working area. Supporting a sustainable life and eliminating harmful materials can be possible with GIS query and analysis techniques. The system provides the integration of various information sources and enables common solutions for discordant decision-making mechanism.

GIS platforms have changed from workstations to desktop computers and internet users. GIS on Internet has been a current topic recently. Different opportunities have appeared, depending on web technologies. In the 21st century, internet, web technology is the center of activity in developing decision support environment. The users have been more global, complex, and connected. The advent of the Web has enabled inter-organizational decision support systems, and has given rise to numerous new applications of existing technology.

These approaches provide a computerized system that delivers decision support tools by a web browser.

General working principles have to be explained to understand application components. To illustrate this, in client and server architecture (Figure 1), client and server communicate across a computer network either on Internet or Intranet by means of a HTTP. It lies in creating software systems that are platform independent and run on open TCP/IP (Transmission Control Protocol/ Internet Protocol) based networks. A web browser is a usual client program. The browser program sends a request to the server and finally a file is transmitted from the server to the client by means of URL (Uniform Resource Locator). (Footh and Kirvan, 1998). Different strategies having advantages and disadvantages appeared for employing Internet GIS. These are server side, client side strategies or hybrid strategy including the common features of other strategies.

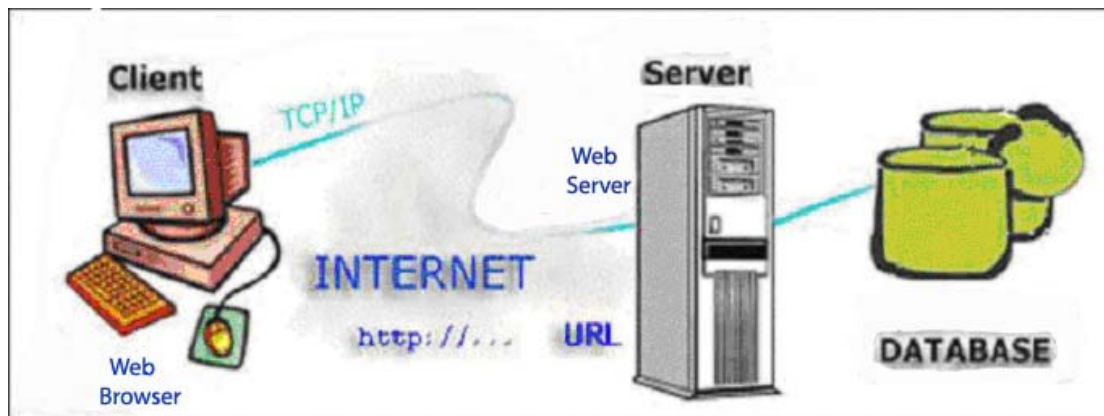


Fig.1: General Working Principles for Client-Server Architecture

Internet GIS has many technical advantages. Data can be maintained and be updated in a centralized location or be integrated with many sources on broad spectrum platforms. A web-based map can be used both privately and publicly. Access can be regulated and redundancy eliminated. The end-user software is an easy and cheap web browser, not an expensive and complex GIS program. The web browser provides a much more dynamic map tool than a static map display. The system may support various the end users. When people save and publish these data on the Internet, other people can access and browse these data simultaneously. Maps can be copied easily on the Internet and be downloaded for a more detailed use. As a result of this, GIS on the Web is an inexpensive method for reaching a vast audience (Aydinoglu and Yomralioglu, 2002).

Information sharing and discussion environment can be provided with web technologies for the future of coastal regions. Politicians, citizens, and managerial mechanisms related to coastal management can reach common aims. Coastal concepts can be collected on a web site to share information. The law, rules, and regulations can be browsed over the internet. Coastal ownership, coast line cover, and buildings can be browsed with the using of map services on internet. The related users can update information. A web based GIS platform can be reached

easily and be used updated. Public participation with form interfaces contributes managerial decision making process to provide idea exchange.

5. METHODOLOGY

In this study, the coast of Trabzon City is selected to build a coastal zone monitoring system. Trabzon is situated between $39^{\circ} 7' 30''$ - $40^{\circ} 30'$ east-longitudes and $40^{\circ} 30'$ - $41^{\circ} 7'$ north-latitudes in the middle of East-Blacksea Region of Turkey (Figure 2). In the city, increasing elevation beginning from the sea level exceeds 3000m in some areas. The city is the most important trade centre in the region with the features of having historical and cultural wealth, being the centre of other population units as well as its unique geographical position.

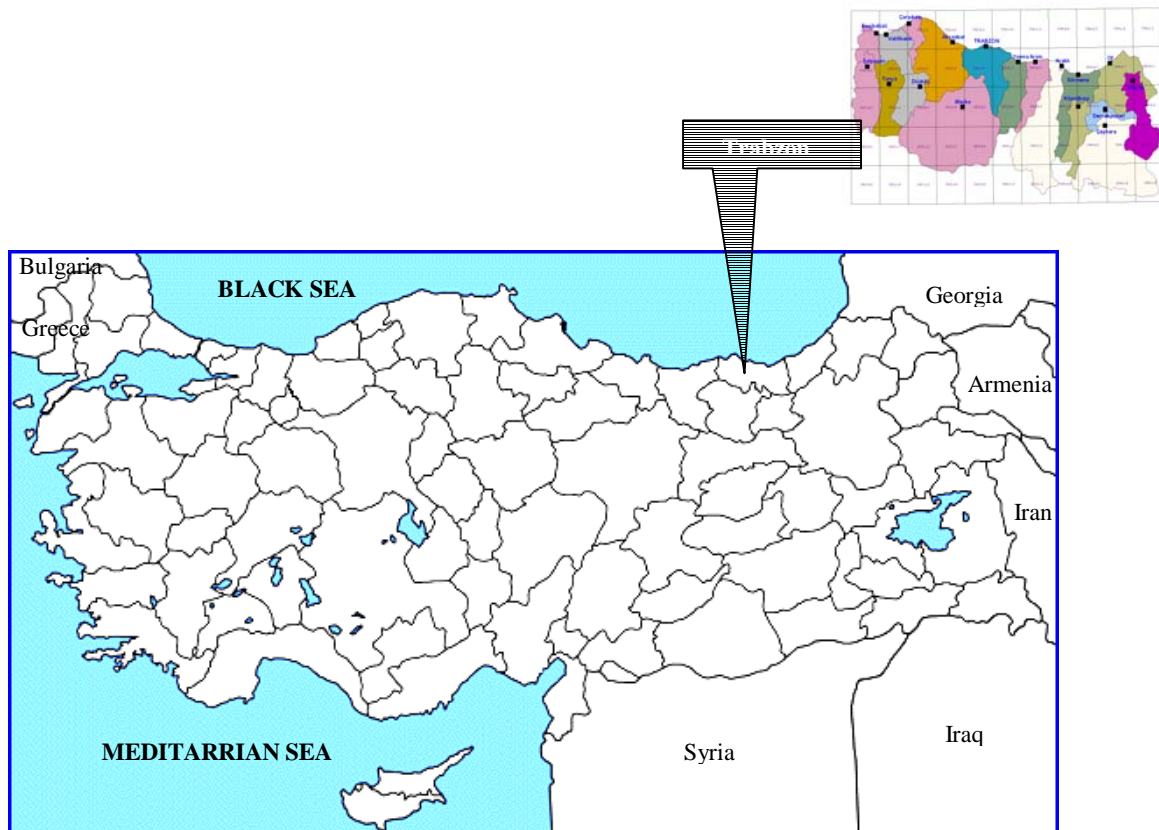


Fig. 2: The Location of Trabzon in Turkey

5.1 Designing Database And Collecting Data

Designing database and collecting data is the first step of this work. Database design was executed, depending on system requirements. This database can be used similar works. Current data category was summarized on Table.1

Table 1. Data Type and Categories used in this study

DATA TYPE	DATA CATEGORY
SPATIAL	Geological structure
	Topographical structure
	Cadastral structure
	City Plan (zoning plan)
	Shore border line
NON SPATIAL	Land ownership
	Area
	Land use type
	Detail on parcel
	Construction type

5.2 Determining Coastal Land Use Changes By GIS Technology

The data related to coastal regions was collected from different organizations. Spatial Data, which is generally analog format was transformed into digital format. Graphical corrections area quality control, and the topology of graphic data have been made with the using of ArcInfo and ArcView program environment. Spatial and non-spatial data were combined, depending on database design. Various query and analysis functions can be done by means of GIS tools.

Because highway construction has begun to increase since 1960 on coastal regions, land ownership has rapidly changed with the zoning plan implementations in this region. Samsun-Sarp Double Highway has been constructed since 1998. There is a big difference between these three situations (Figure 2, 3). These constructions have been changed in view of the natural coast (Sesli and Aydinoglu, 2003).



Fig. 2: Coastal zone changes after and before highway construction



Fig. 3: Coastal zone changes after and before highway construction

Coastal areas are being used out of the public benefit though this is main aim. The function determining violated lands is executed with intersect command. Spatial area and land ownership related to violations are displayed on Figure 4.

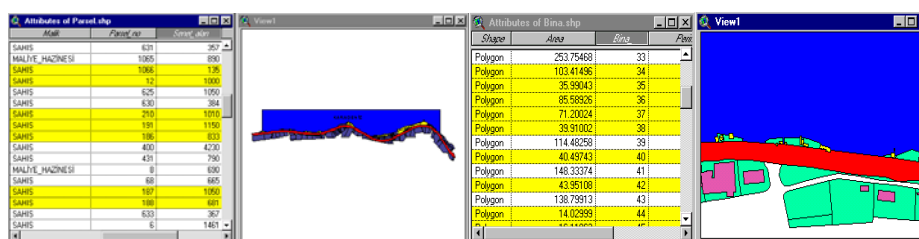


Fig. 4: Violation of shore border line

5.3 Building A Web Based Monitoring And Management Platform

A web based GIS system using ESRI ArcIMS Architecture is engineered with the using of ArcIMS Architecture to serve geographic data and services on the Internet for coastal region of Trabzon. Microsoft IIS is used as a web server. ArcIMS has a multitier architecture consisting of presentation, business logic, and data storing tiers. The business logic tier including server components are used to process requests, create and run Map Services, and manage the site. The data storage tier includes the sources of data. Communication between the tiers is handled through ArcXML a specified XML language. Client viewer processes the data on the client machine performing many tasks without further interaction with the server.

Basicly, ArcIMS work can be phased over six steps. (Figure 5) Firstly, the client over the Internet sends a request to the web site. Secondly, the Web server receives the request and passes the connector. The connectors provide a communication pathway between a Web Server and The Application Server. Thirdly, the request handed from the connector providing communication for request and response to the Application Server. The Application Server handles the load distribution of incoming requests. Fourthly, The Application Server distributes the requests to appropriate The Spatial Server. The Spatial Server processes requests for maps and related information. When a request is received, Spatial Server performs functions such as creating map image files, streaming map features, feature extraction, geocoding, querying. Fifthly, The Spatial Server creates response. Finally, the response returns through the reverse order of the initial request (ESRI, 2000).

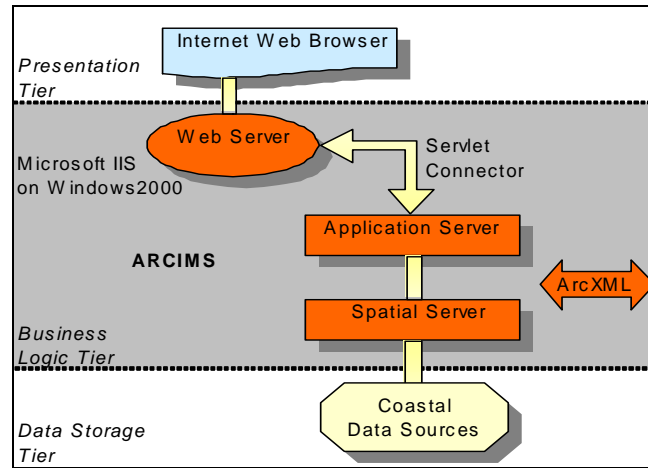


Fig. 5: ArcIMS working principle

Active X Connector is used to develop specific applications, depending on user needs. Microsoft ASP (Active Server Pages) as a COM application is used for ActiveX Connector. (Figure 6) This implementation allows for processing on the server side. The advantage to this scenario is that the client viewer does not need to generate a request or parse the response, making the client much thinner.

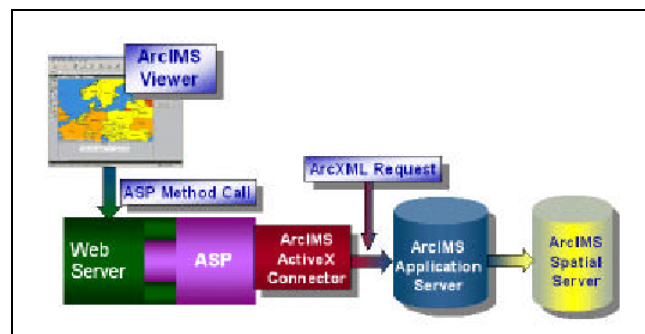


Fig. 6: Using the ArcIMS ActiveX Connector

5.4 The Use of this System

This web site can be reached from anywhere all over the world. The system users include planners and administrative personal, organizations, politicians, public, companies, etc. A user may have only a web browser to benefit GIS opportunities. This system presents basic GIS functions including pan and zoom the map, identify and find features, etc (Figure 7). Attribute searches and queries can be done with ASP user interface. On this architecture, the data can be maintained and updated in a centralized location. The system has restrictive access capacity. That is, related person can reach this system to update information. This approach provides corporate decision making opportunity and continuously updated information.

The laws and implementations were browsed on this web site (Figure 8). Forums and discussion platform were executed for corporate decision making and future planning. Any person can browse this site and monitor current coastal land use, and send a comment to take into consideration of administrative people concerned with coastal regions.

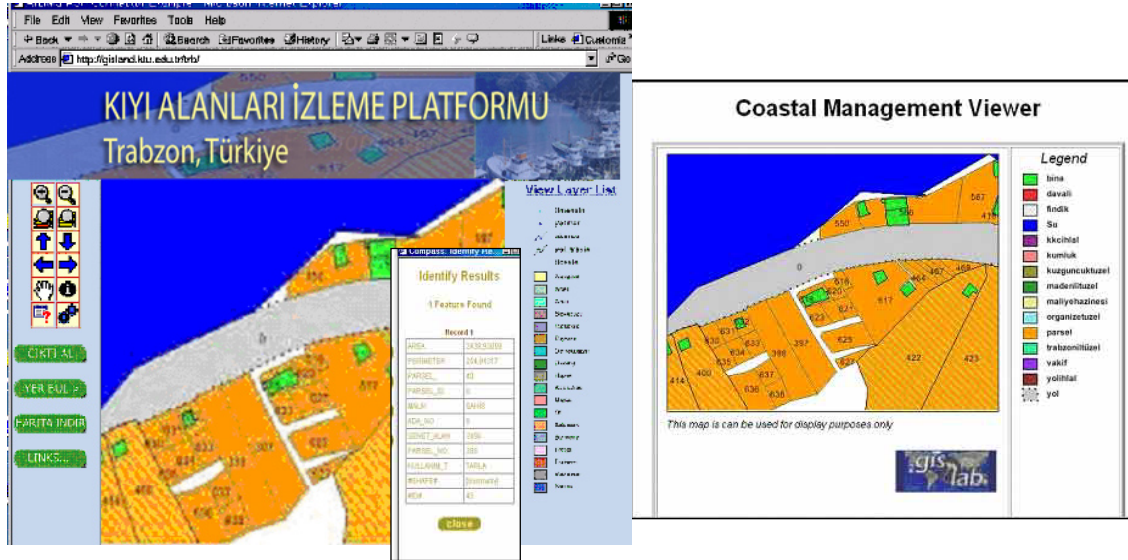


Figure 7: GIS user interface and print preview window over the web browser



Fig. 8: A user interface of monitoring coastal zone platform

6. CONCLUSION

- Coast is the place with no property and the goods in the benefit of the public are in no ones ownership and can never be a subject of a private ownership. Shore border line must be detected on all coastal region of Turkey. Land ownership boundary and their legal states must immediately be defined clearly. If there is an ownership on Coast, this give up Public Benefit.
- The information required for the management of coastal areas must be provided, to be available to use the coastal areas for the public benefit. On the intensive coastal settlements the studies to obtain data for the management of coasts is being performed with GIS.
- Using the techniques of GIS Technologies for analyzing and querying functions related to coastal areas must be used seems promising for detecting changes in the coastal zone.
- The protection of natural balance on the coastal area and shore lines, the analyses of the land ownerships and the decisions of planning associated with these studies can be realized with GIS Technologies.
- With the helping of WEB Technology, decision making and future planning can be possible if the data accurately and up to date. WEB based system can also incorporate up-to-date and real-time information and make overlapping inter-disciplinary information possible to manage Coastal Region.
- In monitoring the coastal region that have a rapid changing characteristic, that analyzing land use changes with Information Technologies is far more easy and fast than the classical monitoring methods, especially for administrators.

REFERENCES

- Alkış, Z., “Kıyı Yönetiminde Coğrafi Bilgi Sistemlerinin Önemi”, Türkiye’ nin Kıyı ve Deniz Alanları 1. Ulusal Konferansı, 24-27 Haziran 1997, Ankara, Türkiye Kıyıları 97 Konferansı Bildiriler Kitabı, 107-114.
- Aydınöğlü, A.C., Yomralıoğlu, T., Web Based Campus Information, System, International Symposium on GIS, Istanbul, Turkey, 2002.
- Environmental Systems Research Institute, Inc., ArcIMS 3 Architecture, White Paper, California, USA, 2000.
- Foote, K. E. and, Kirvan, A.P., “WebGIS”, NCGIA Core Curriculum in GIScience, Available: <http://www.ncgia.ucsb.edu/giscc/units/u133/u133.html>, USA, 1998.
- Kay, R. And Alder, J., “Coastal Planning and Management”, E&FN SPON, 1999.
- Kuleli, T., “Adana –Hatay İl Sınırından Yumurtalık’a Kadar Olan Kıyı Şeridi İçin CBS İle Kıyı Yönetim Planı Oluşturulması”, Doktora Tezi, Çukurova Üniversitesi Fen Bilimleri Enstitüsü Su Ürünleri Anabilim Dalı, 1998.
- Sesli, F. A., Aydınöğlü, A. C., “Monitoring Relations Between Coast Line Cover And Land Ownership Via The Web : An Example From Black Sea”, Coastal Zone 03, July 13-17, 2003, Baltimore, USA.
- Uçkaç, Ş., “Kıyı Alanlarında Coğrafi Bilgi Sistemlerinin Kullanımı”, Türkiye’ nin Kıyı ve Deniz Alanları 2. Ulusal Konferansı, 22-25 Eylül 1998, Ankara, Türkiye Kıyıları 98 Konferansı Bildiriler Kitabı, 557-564.

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