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GEOTECHNICAL AND SPACE DATA FITTINGS IN ENVIRONMENTAL STUDIES

A.M. Hashimov [1] B.N. Aliyeva [2] S.R. Rustamova [3] R.B. Rustamov [4]

1. Physics and Technique of High Voltages Laboratory, Institute of Physics, Azerbaijan National Academy of Sciences, Baku, Azerbaijan, arif@physics.ab.az
2. Geotechnical Department, Encotec Company, Baku, Azerbaijan, bahar.aliyeva@yahoo.com
3. EBRD Business Advisory Services Program, Baku, Azerbaijan, sevinj@bas-az.org
4. Laboratory of Modern Method of Applied Electrodynamics, Institute of Physics, Azerbaijan National Academy of Science, Baku, Azerbaijan, r_rustamov@hotmail.com

Abstract- There is no doubt that investigation of soil is an excellent data source in use and application of space technology advance. Space data processing demands filed measurements and integrations of those into process as the main part of full stage. It has to be reliable evidence of high accuracy of conducted investigation of selected area. For this reason geotechnical data is one of the best way of use in space data processing. It relates in study of environmental aspects with use of achievements in space science and technology. Achievements in information systems, satellites imaging systems and improved software technologies have led to opportunities for a new level of information products from remote sensed data. The integration of these new products into existing response systems can provide a wide range of analysis tools and information products on the base of developed geographical information system (GIS). Using the higher resolution of space imagery and change detection analysis natural disaster awareness and damage assessment can be conducted rapidly and accurately. The paper is offering the assessment of environmental conditions been subjected to oil pollution of soil and water in some selected areas of Absheron peninsula of Baku, Azerbaijan. Soil pollution was graded into five conditions from low value of oil contamination to very high. At the beginning stage field data was collected and reflected in the map by grades indicated above. The polluted soil sections were coordinated and integrated with the space image used for further processing. The method has been applied for a wide area impacted by oil contamination that allowed assessment of environmental conditions in selected area. The methodology proposed for assessment can be successfully used for permanent monitoring of situation for further dynamic change of environment.

Keywords: Geotechnical investigations, Soil contamination, Environment, Contamination, GIS, Engineering Applications.

I. INTRODUCTION

Oil industry in Azerbaijan is one of the most profitable areas. It was known from manuscripts of most Parisian and Arabic that oil production in Apsheron peninsula started in Middle Ages. The oil industry itself started here in XIX century when one the most known oilfields called Bibi Heybat was place in operation. Multiple oil and gas fields are being explored nowadays. Today oil industry in Azerbaijan is a leading economical trade.

Unfortunately, human activity changes the nature. Preservation of the environment was not the main point for people in XIX and early XX centuries. Oil production was conducted without any measures taken to reduce the damage to the environment. As a result we have some territories on Apsheron peninsula looking like it is presented in Figure 1.

Figure 1. Typical polluted oilfield at Absheron peninsula [1]

II. ENVIRONMENTAL TESTING

Several types of contamination tests were conducted on soil and groundwater samples from potentially polluted sites in Apsheron peninsula. Below you can see short description of them:

A. BTEX (Benzene, Toluene, Ethylbenzene and Xylene)

This group of volatile organic compounds (VOCs) is found in petroleum hydrocarbons and other common environmental contaminants. BTEX constitute serious threats to groundwater reservoirs and indoor climate

deriving from contaminated sites due to the potential effects of benzene, which is considered a strong carcinogen, and which is highly mobile in the soil and groundwater environment.

B. PAH (Polycyclic Aromatic Hydrocarbons)

PAH present a group of over 100 different chemicals formed during the incomplete burning of coal, oil and gas, garbage, or other organic compounds. PAHs are known for their carcinogenic, mutagenic and teratogenic properties. PAHs can be found in petrochemicals, rubber, plastics, lubricants, antirust oil, paints, leather and other products.

C. TPH (Total Petroleum Hydrocarbons)

TPH is a term used to describe a broad family of several hundred chemical compounds that originally come from crude oil. The amount of TPH found in a sample is used as a general indicator of petroleum contamination at the site. TPH is released to the environment through accidents, as releases from industries, or as byproducts from commercial or private uses. The compounds in some TPH fractions can affect the blood, immune system, liver, spleen, kidneys, developing fetus, and lungs. Certain TPH compounds can be irritating to the skin and eyes.

D. Heavy Metals

Heavy metals that have been identified in the polluted environment include As, Cu, Cd, Pb, Cr, Ni, Hg and Zn. The presence of any metal may vary from site to site, depending upon the source of individual pollutant. Soil contamination with heavy metals may cause changes in the composition of soil microbial community, adversely affecting soil characteristics.

E. Organochlorine Pesticides

Organochlorine pesticides are man-made organic chemicals that have been used to control everything from fungus to grasshoppers. *P*olychlorinated biphenyls (PCBs) are by-products and constituents of a variety of industrial products, such as electrical transformers. Many organochlorine pesticides are extremely persistent in the environment. As a result of chemical tests we obtained results showing differentiation of contamination level in these points.

III. ADVANCES OF USE OF SPACE TECHNOLOGIES

GIS are in wide use as tools to digitize remotely sensed or cartographic data complemented with various ground - truth data which are geocoded using global positioning systems (GPS). GIS can help analyze the spatial characteristics of the data over various digital layers. If sequential data are available, quantification of spatial changes becomes possible through overlay analysis. GIS is an expanding information technology for creating database with spatial information which can be applied to both human settlements (e.g. demographic databases) and to the natural environment (e.g. distribution of populations and environmental factors).

Most importantly, the combination of both types of database can ensure sustainable management. GIS will continue to improve as an essential acquisition tool and analysis tool respectively not only in the analytical description of spatial subjects, but also in environmental planning, impact assessment, disaster management and simply monitoring remote sensing.

GIS technology can be used for scientific investigations, resource management, asset management, archaeology, environmental impact assessment, urban planning, cartography, criminology, geographic history, marketing, logistics, prospectively mapping, and other purposes. The current challenge to remote sensing and GIS - based investigations is to combine data from the past and the present in order to predict the future.

Remote sensing plays an integral role in environmental assessment. Remote sensing will never replace the field work and observations but it offers a great support in huge areas as follows:

- Remote and difficult access areas like dense forests, glaciated areas, swamps, high elevation, etc.;
- Areas undergoing rapid changes;
- Countries with poor infrastructure and limited transportation;
- Areas of active natural hazards and disasters: flooded areas, active volcanic regions, forest fires, earthquake and landslide hazardous areas, etc.; and
- Construction of a broad overview or a detailed map of a large area.

Remote sensing techniques can increase the speed in which one can analyze a landscape and therefore help make quick and focused decisions. Among the available remote sensing technologies producing high spatial resolution data, aerial photography was superior to space - borne data, despite the higher spectral resolution of the latter. However, digital air - borne multi - spectral imagery such as the Compact Air - Borne Spectrographic Imager (CASI) is at least as accurate as aerial photography for the same purpose and it is less expensive to obtain and therefore more cost effective. It is also important to proceed in the evaluation of a new scientific application of more common imaging techniques such as video and photography from low - flying aircrafts. In space - borne remote sensing, the IKONOS satellite was the first one to challenge the very high spatial resolution (1 m resolution) data obtained from air - borne remote sensing technology. The EROS satellite has a spatial resolution of 1.8 m but no multi - spectral capability.

However, its future sensors are reported to generate multi - spectral combined with a spatial resolution of 0.82 m. In the meantime imagery, the QUICKBIRD satellite leads the quality list of optical remote sensing with panchromatic imagery of 0.70 m spatial resolution and multi - spectral imagery of 3 m spatial resolution [2, 3].

Achievements in information systems, satellites imaging systems and improved software technologies have led to opportunities for a new level of information products from remote sensed data. The integration of these new products into existing response systems can provide a wide range of analysis tools and information products on the

base of developed geographical information system (GIS). Using the higher resolution of space imagery and change detection analysis natural disaster awareness and damage assessment can be conducted rapidly and accurately [4-6].

IV. OUTCOMES

Soil samples from six sites at Absheron Peninsula were collected and tested in environmental laboratory. Figure 1 which indicates those sites.

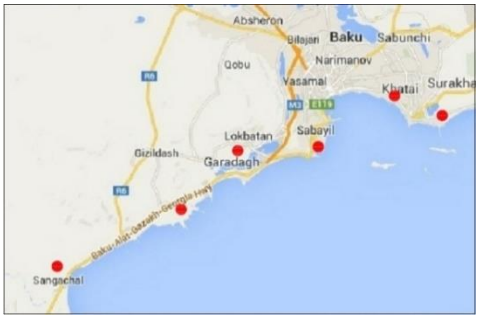

Figure 2. Sites where soils samples were collected [7]

Chemical analysis of soil contamination has been provided by different methods according to international standards. Table 1 demonstrates the results of conducted chemical tests which have been integrated into the space data for further data processing and analysis.

Table 1. Contamination levels at different sites on Absheron peninsula [8]

Contamination Level	Site No					
	1	2	3	4	5	6
None	*	*				
Low			*			
Medium						*
High				*	*	
Very High						

The laboratory test results have been based of the samples taken from different selected areas which were coordinated using GPS system. Indeed samples have been graded by status indicated above. The laboratory results were of merged with processed space data and applied and distributed for all selected territory in accordance with the oily soil polluted degree.

V. CONCLUSIONS

The paper is dedicated to the monitoring of environmental aspects of the soil condition. It has been demonstrated two types of research of sources both laboratory chemical testing and use of remotes sensing methods and GIS technologies for oil contamination degrees in the soil. It is reflected of successful use of space science and technology advances in oil pollution monitoring opening excellent advantages for rapidly soil monitoring investigation. It has been shown easily integration laboratory testing data into the space with field investigation data as the instrument of problem solving in oil pollution exploration areas.

An outcomes reflect of successfully use of geotechnical data into space information in the stage of data processing making excellent evidence of high accuracy of conducted measurements and results.

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BIOGRAPHIES

Arif M. Hashimov was born in Shahbuz, Nakhchivan, Azerbaijan on September 28, 1949. He is a Professor of Power Engineering (1993); Chief Editor of Scientific Journal of "Power Engineering Problems" from 2000; Director of Institute of Physics of Azerbaijan National Academy of Sciences (Baku, Azerbaijan) from 2002 up to 2009; and Academician and the First Vice-President of Azerbaijan National Academy of Sciences from 2007 up to 2013. He is laureate of Azerbaijan State Prize (1978); Honored Scientist of Azerbaijan (2005); Cochairman of International Conferences on "Technical and Physical Problems of Power

Engineering" (ICTPE) and Editor in Chief of International Journal on "Technical and Physical Problems of Engineering" (IJTPE). Now he is a High Consultant in "Azerenerji" JSC, Baku, Azerbaijan. His research areas are theory of non-linear electrical Networks with distributed parameters, neutral earthing and ferroresonant processes, alternative energy sources, high voltage physics and techniques, electrical physics. His publications are 280 articles and patents and 5 monographs.

Bahar N. Aliyeva was born in Terter, Azerbaijan, 1983. She took her B.Sc. and M.Sc. degrees from Geological and Exploitation Department of Azerbaijan State Oil Academy (Baku, Azerbaijan) in 2004 and 2006, respectively. At the present time she is Ph.D. student of Institute of Physics, Azerbaijan National Academy of Sciences (Baku, Azerbaijan). Currently works as Geotechnical Engine in Encotec Company, Baku, Azerbaijan.

Sevinj R. Rustamova was born in St. Petersburg, Russia on October 12, 1984. She has completed her Master degree in Master of Business Administration at Azerbaijan State Oil Academy in cooperation with the Georgia State University (USA). She has experienced mainly in consulting for business advisory services in project developments and implementations. Recently, she has started to introduce the application of business administration processes in a wide area of management with application of space technology methods. She has published scientific a paper in the foregoing indicated area.

Rustam B. Rustamov was born in Ali Bayramli, Azerbaijan, on May 25, 1955. He is an independent expert on Space Science and Technology. In the past, he was in charging of the Azerbaijan National Aerospace Agency activities as an Acting Director General. He has mainly specialized in space instrumentation and remote sensing and GIS technology. He has graduated Ph.D. at the Russian Physical-Technical Institute, S. Petersburg, Russia. He was invited for the work at the European Space Agency within the Framework of the United Nations Program on Space Applications at the European Space Research and Technology Center, The Netherlands. He has appointed for the United Nations Office for Outer Space Affairs Action Teams (member, Vienna, Austria), United Nations Economical and Social Commission for Asia and the Pacific (national focal point, Thailand), International Astronautically Federation (Federation's contact, France), Resent Advances in Space Technologies International Conference Program Committee (member, Turkey). He is an author of 11 books published by the European and United States famous publishers and more than 80 scientific papers.