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Under the aegis:

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European Association of Remote Sensing Laboratories (EARSeL)

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GEOSPATIAL DATA & ANALYSIS

LASER SCANNING

LAND PROPERTY

GEOPHYSICS

URBAN, RURAL & REGIONAL PLANNING

1st International GEOMAPPLICA Conference 2014
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The National Geographic Information System for Asbestos Mapping

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Abstract
Italy, in order to identify areas with asbestos contamination enacted the law 93 of 23.3.2001 which requires the complete mapping of the presence of asbestos in the National territory. The Italian Environment Ministry has prepared and issued the Ministerial implementing Decree n°101 of 03.18.2003, with the aim of creating an asbestos risks' mapping and to promptly start emergency safety measures and final remediation.
INAIL DIPIA, on the basis of the extensive experience acquired since 2003, developed the Guidelines for the uniform acquisition of information on national scale, structured in a specific format.
The work is the result of a number of technical meetings with the Local Bodies. The resulting information allowed us to develop a specific data-base in a INAIL-DIPIA Geographic Information System dedicated to processing the various research activities of the Department.
Data collected by Regions, elaborated on the basis of the INAIL DIPIA guidelines, have permitted to obtain an updated data base with homogeneous distribution of sites with Asbestos Containing Material (ACM) on the national territory. Have also been identified and classified the types of material, the ACM's quantities to be disposed of, thus reaching an initial estimate of the costs of disposal.
The present work will show how GIS techniques can be of support to the identification and management of risk situations by placing the issue in their local context and allowing for program planning for the implementation of disposal activities and remediation of ACM.
Keywords: GIS; Asbestos Containing Waste; Asbestos Risk Mapping

1. INTRODUCTION

Asbestos is a substance, which has been used by several countries all over the world. Asbestos and Asbestos Containing Materials (ACM) were produced in large amounts between 1970 and 1990. During this periods, over 3.000 categories of asbestos containing artefacts were produced and used in schools, hospitals, gyms, cinemas and industrial plants. Asbestos is now banned in 52 Countries. Italy was the first European country to ban the extraction, import, export, marketing and production of asbestos, asbestos products and products contaminated by asbestos (Act no. 257 of 03/27/1992)[1].

The wide diffusion on territory of Asbestos Containing Materials (ACM) determined the contamination of many sites. The resulting remediation operations have produced and produce huge amount of Asbestos Containing Waste (ACW) to be disposed, so as representing an extremely complex problem that involves economic, health, environmental, and social security.

Within the framework of the activities planned by the mapping of asbestos contaminated sites on national territory (in accordance with Art 20 of Law 93 of 23.3.2001 and Ministerial Decree 101 of 03.18.2003), INAIL-DIPIA has initiated research activity devoted to the design of a specific database and related Geographic Information System for the management of such sites

contaminated by Asbestos Containing Materials, in order to assess the modes of production and disposal of the ACW on entire national territory. At today Italian asbestos mapping has identified 31 961 sites contaminated by human activity and 160 Naturally Occurring Asbestos (NOA). Figures 1-2.

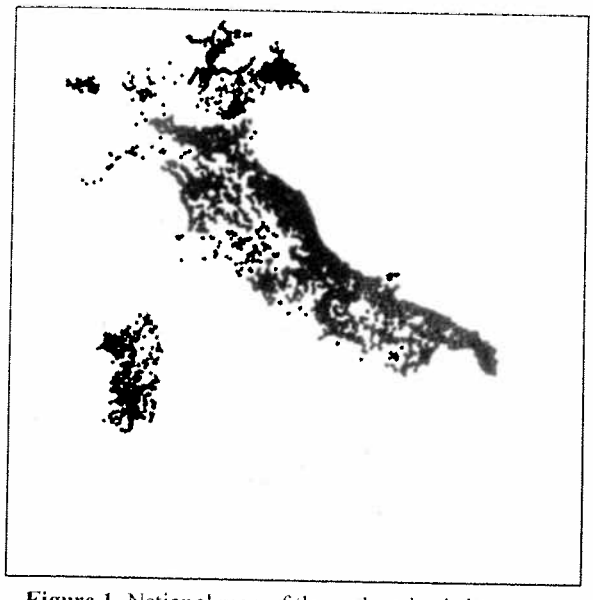

Figure 1. National map of the anthropized sites

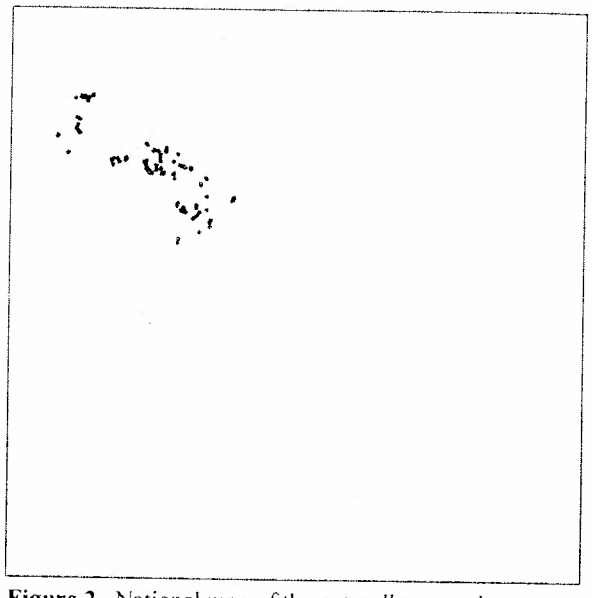

Figure 2. National map of the naturally occurring

The obtained data allowed us to map the diversified risk level determined by the different types of MCA, their compactness, their state of conservation, their location, the urgency to proceed with the remediation and then provide the relevant national Authority the most appropriate instruments to encourage the adoption/integration of asbestos' remediation and waste disposal plans.

2. AIMS OF THE RESEARCH

The INAIL DIPIA, has carried out studies and research dedicated to the mapping of the territory affected by the presence of asbestos. In fact INAIL DIPIA produced a dedicated Geographic Information System and Guideline for the correct acquisition of information in order to provide annually an updated overview on the asbestos presence at public and private sites, on Naturally Occurring Asbestos and on Asbestos Containing Materials.

The system is a support in order to know the volume of Asbestos Containing Material (ACM) and provide a tool to the Public Administration regarding remediation and disposal of Asbestos Containing Waste (ACW) and disposal costs on the national territory.

3. DATA ACQUISITION'S METHODOLOGY

The data of the mapping were acquired by Regional Governments through a specific census and sent to the Ministry of the Environment.[1]

The INAIL-DIPIA developed, on behalf of the Ministry of the Environment, a methodology, formalized in a Guideline for the correct acquisition of information and relative inclusion in the Data-base and Geographical Informational System. The guideline was drawn up on the basis of the extensive experience acquired since 2003, in the course of a number of technical meetings and of decisional processes (at national and local) with the National and local Authorities and Supervisory

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Bodies. The criteria specified in the Guideline are defined in a special format in which it is requested:

- to communicate all sites with the presence of Asbestos Containing Materials and Waste (ACM – ACW);
- that the data relating to the presence of asbestos must be evaluated considering the remediation activities, waste disposal and consequent environmental rehabilitation;
- to communicate all sites identified, including those considered at low risk;
- that the data must consider the application of the two algorithms, established with the "Procedure for the determination of urgent asbestos remediation" approved in the "State-Regions" Conference.
- to provide the geographic location of the sites according to the cartographic reference system WGS84 - UTM zone 32.

In this way, identifying the main information about the mapped sites and attributing to each one of them a value based on indicators and risk factors, it has been possible to apply the algorithm for calculating a final score for each site with asbestos occurrence. The application of the algorithms allowed us to identify the most critical issues on national territory. In the format attached to Guidelines are listed the fields that uniquely identify the site (ID), the personal data (Address, owner, etc.), the Category (1 - active or abandoned industrial plants; 2 - public and private buildings; 3 - natural occurrence asbestos, 4 - other asbestos from human activity), type of sites (hospitals, nursing homes, etc., all levels schools, public buildings, agricultural buildings and their appurtenances, buildings craft and service buildings industrial and their appurtenances, etc..), for a description of the site and of asbestos containing material. Also, are listed fields to define the actual amount of friable and compact asbestos, the exposed surfaces, the state of remediation with its remediation actions and lastly an indication of the remediation costs.

The "Procedure for the determination of urgent asbestos remediation", approved by the State-Regions Conference, has provided four indicators of risk (A - Friability, B - Public Use, C - Accessibility D - Presence of confinement) that through the flow chart (inside the Table 1), define five classes of priorities for intervention; attributing to them the values of the indicators provided by the algorithm, it was determined the final score within each priority class.[2-3]

The following Table 1 summarizes the indicators, the flow chart for the identification of the priority class of interventions and the algorithm relating to the categories 1,2,4.

Table 1. Indicators and algorithm of the Categories 1,2 e 4

Indicator	**Score**
A – Friability	NO = 1 YES = 2
B - Type of Activity:	Public Use No = 1 Public Use Yes YES = 2,5
C – Accessibility	NO = 1 YES = 2,5
D - Presence of confinement:	NO = 2,5 YES = 1
I1 - Estimated amount of the material	<500 kg = 5 500kg - 10.000kg=10 >10.000kg= 15
I2 - Presence of a "Control and Maintenance" programme	NO = 10 YES = 1
I3 – Activity	Active =1 Abandoned =3

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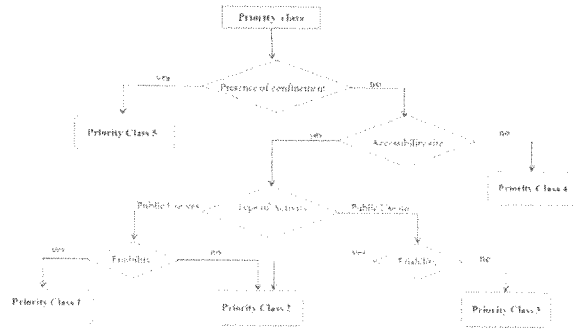
I4 - Presence of causes which create or favour the dispersion of fibres	NO = 1 YES = 5
I5 - Concentration of airborne fibres (f/l)	<1 = 2 >1=5
I6 - Site's extension area (m^2)	<500 = 3 500 - 5.000g=5 >5.000= 9
I7 - Surface exposed to air (m^2)	<500 = 5 500 - 5.000=8 >5.000= 10
I8 - Involvement of the site in urbanization works	NO = 1 YES = 3
I9 - Conservation state of the buildings	Damage <10%=5 Damage >10%=30
I10 - Time since abandonement (year)	<3=1 3 -10=3 >10=7
I11 - Type of asbestos present	Chrysotile =1 Chrysotile + Amphiboles =3
I12 - Epidemiological data	NO = 1 YES = 10
I13 - Frequency of use	Occasional =5 Periodical =10 Constant =20
I14 - Distance from the urban area (m)	0=5 1-1.000=3 >1.000=1
I15 - Density of the population involved	Conurbation = 4 Scattered houses =2
I16 - Average age of users (years)	<29=10 >29=2
Priority class: according to the flow chart shown on the right.	
Priority class coefficients:	Class coefficient 1 = 1.2 Class coefficient 2 = 0.8 Class coefficient 3 = 0.7 Class coefficient 4 = 0.4 Class coefficient 5 = 0.3
Final Score	**((D * (i1 + i6 + i7 + i11 + (i14 * i15))) + (C * (i1 + i2 + i4 + i9 + i12 + i13 + i16)) + (B * (i9 + i4 + i7 + i10 + i13 + (i15 * i14) + i16)) + (A * (i2 + i6 + i8 + i10))) * (i5 + i3) * Priority class coefficients**

The data sheet (Table 2) for the mapping of sites with naturally occurring asbestos (category 3) shows the fields to uniquely identify the site (ID), personal data (Address, owner, etc.), a description of the site, its extension, restrictions (environmental, etc.), the status of remediation with the relevant types of actions and finally an indication of the remediation costs.

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Table 2. Indicators and algorithm of the Category 3

Indicator	Score
in1 : Material forming the asbestos containing rocky outcrops	highly friable= 10 poorly friable= 3 non friable= 1
in2 : Presence of outcrops less than 50 meters from residential or frequently occupied areas;	YES = 5 NO <1000mt=2 NO>1000 mt=1
in3 : Airborne fibres near the receptor (f/l)	< 1 = 2 >1 = 5
in4 : Extent of the outcrops containing asbestos	Outcrop = 5 Single Outcrop < 50 = 2 Single Outcrop < 50 = 1
in5 : Involvement of the site in development work	YES = 5 NO = 2
in6 : Epidemiological data referring to mesothelioma cases	YES = 10 NO = 1
Final Score	**= (in1 * in4 + in3 + in5+ in6) * in2**

Moreover the integration of data produced in that format allowed us to carry out a check on the proper allocation of the class, the values of the indicators and the calculation algorithm.

4 DATA ANALYSIS

Regarding natural occurring asbestos (category 3) have been mapped 160 sites related to data collected from five Italian Regions. From the analysis of the sites' typology have emerged 16 active quarries, 83 closed or disused quarries, 8 under reclamation actions, 3 mines and 16 outcrops. By the application of the algorithm were identified sites with priority values risk between 290 and 6. The maximum priority value (290) is related to a quarry with the presence of chrysotile with tremolite and actinolite.

Regarding sites with asbestos contamination by human activity (category 1,2,4), mapping has involved:

a. sites to be remediated;
b. partially remediated sites, in which they were made partial ACM's remediation actions through the removal and/or encapsulation and/or confinement;
c. sites in which have been completed the remediations, indicating the specific procedures.

The analysis of the data provided by the Regions as a result of the database updates, revealed the presence of 27.865 records of which about 25.903 related to sites requiring remediation, about 441 to sites partially reclaimed and 1.521 to reclaimed sites.

The application of the "Procedure for the determination of urgent asbestos remediation", cited above, attributing to them the values of the indicators provided by the algorithm, determines the final score. This score within each priority class identifies higher risk situations.

Table 3 shows the number of sites in each category and the corresponding minimum and maximum score. Figure 3 shows the 344 sites in class 1. In the priority class of intervention 1, the site at higher risk has a score of 4.512.

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Table 3. Classification of sites according to priority class

Priority class	Number of Sites	Maximum score	Minimum score
Priority class 1	344	4.512	556
Priority class 2	5.223	1.826	295
Priority class 3	8.248	1.552	246
Priority class 4	10.758	790	104
Priority class 5	1.330	518	57

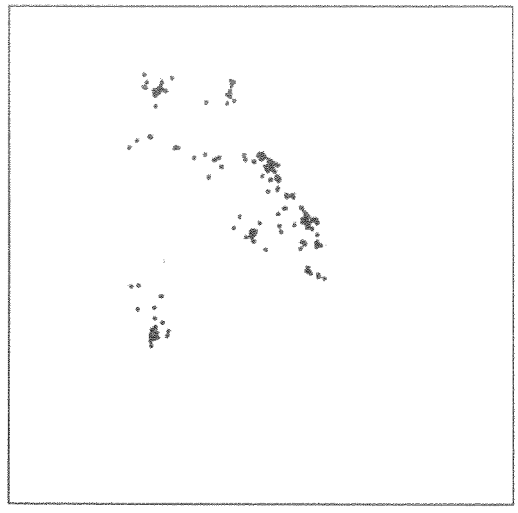

Figure 3. Map of the sites requiring remediation - Class 1

At present, in Italy, in the mapped sites are present friable ACM, for a total of more than 4.000 tons and compact ACM for a total of more than 255.000 tons.

Figure 4 shows the distribution at the national level of the sites with friable ACM.

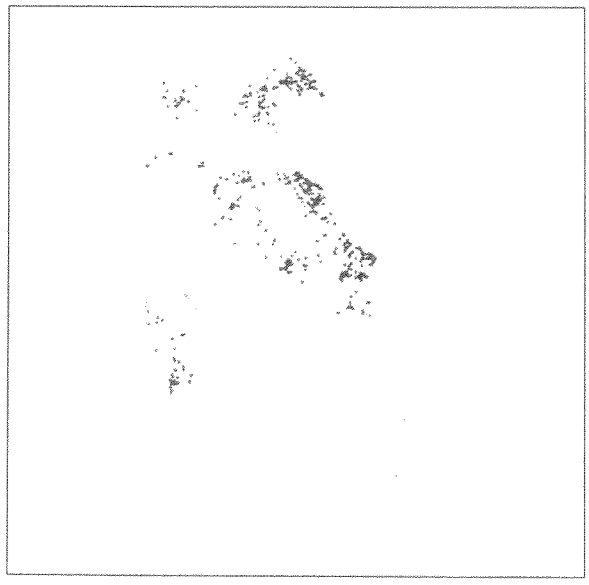

Figure 4. Map of the sites with friable ACM

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The sites where the presence of friable ACM is the most frequent are the public buildings in the urban area with quantities equal to 2,439,163 kg (58.91%); while the higher concentration of MCA compact is located in the Sites civil or productive working, also disused, for a total amount of 52,917,511.25 kg (26.19%).

5. CONCLUSIONS

This paper gives an overview of the distribution of sites with ACM all over the Country and provides a concrete work basis for the planning of intervention by the Authorities.

In particular, the mapping has supplied contributions regarding the following problems:

- the presence, at present, of 380 sites identified at higher risk in which remediation actions are required;
- the presence of different types of waste highlights the need for programming and nationwide distribution of suitable facilities for the storage and final disposal of the ACW.[4]

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4. S. Bellagamba, F. Paglietti, F. Damiani, B. Conestabile Della Staffa 2013 "Geographical Information System for mapping asbestos landfill in Italy 14° International Wast Management and Landfill Symposium – Sardinia 2013 30 September – 04 October 2013.

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Book of Abstracts

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The National Geographic Information System for Asbestos Mapping

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Abstract

Italy, in order to identify areas with asbestos contamination enacted the law 93 of 23.3.2001 which requires the complete mapping of the presence of asbestos in the National territory. The Italian Environment Ministry has prepared and issued the Ministerial implementing Decree n°101 of 03.18.2003, with the aim of creating an asbestos risks' mapping and to promptly start emergency safety measures and final remediation.

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Regarding the NOA sites have emerged 16 active quarries, 16 outcrops, 83 quarries closed or disused and 8 in phase of accommodation, 3 mines. The analysis of the data received relative sites contaminated by human activity as result of the updates provided by the regions in the database, revealed the presence of 29.239 records of which about 27.277 sites requiring remediation, about 441 sites partially reclaimed and 1.521 reclaimed sites. At present, in Italy, in the mapping sites ACM friable is present for a total of 4.157.152 kg and ACM compact is present for a total of 255.1800053 kg.

This paper gives an overview of the distribution of sites with MCA in the country and provides a concrete basis of work for the planning of intervention by the Authorities.

In particular, the mapping has supplied contributions regarding the following issues:

- the presence, at present, of 380 sites identified at higher risk in which intervention is required remediation;
- the presence of different types of waste highlights the need for programming and nationwide distribution of suitable facilities for the storage and final disposal of the MCA.

Keywords: GIS; Waste Containing Asbestos; Asbestos Risk Mapping

PROGRAMME OF THE 1st INTERNATIONAL GEOMATICS APPLICATIONS "GEOMAPPLICA" CONFERENCE

8-10 September 2014, Skiathos Island, Greece

Organized by the Department of Planning & Regional Development,

University of Thessaly

TUESDAY SEPTEMBER 9	ROOM A	ROOM B
13:00 – 13:15	*Application of Geospatial Technology for Landslide Vulnerability Assessment-A Case study of Sikkim Himalayas in India* ***L. Sharma***	*Design of a Model for Managing Public Property in Greece* ***E. Kalogianni and E. Dimopoulou***
14:00 – 15:30	**LUNCH (Lunch offered for Conference participants at main hotel restaurant of Skiathos Palace Hotel)**	
	GEOPHYSICS ***CHAIRS: M. Zoran and A. Alothman***	**URBAN, RURAL & REGIONAL PLANNING I** ***CHAIRS: A. Stergiadou and K. Lalenis***
16:30 – 16:45	*Earthquake anomaly recognition through time series satellite data* ***M. Zoran, R. Savastru and D. Savastru***	*Employment infrastructures in mountainous areas* ***A. Stergiadou, V. Drosos, A. K. Doucas and V. Giannoulas***
16:45 – 17:00	*Determination of Contemporary Velocity Field of Southwest Anatolia and Change of Strain Area* ***T. İbrahim, S. H. İbrahim, G. Engin, E. Saffet, U. Murat, Y. Mustafa, and D. A. Ahmet***	*Spatial configuration of soil sealing: Aegean islands case study* ***G. Tsilimigkas, L.s Liakos , A. Chatzikonstantinou***
17:00 – 17:15	*Wavelet approach for analysing a regional gravimetric geoid: Saudi Arabia case study* ***A. Alothman, R. Grebenitcharsky and B. Elsaka***	*The National Geographic Information System for Asbestos Mapping* ***S. Bellagamba, F. Paglietti, S. Malinconico, B. Conestabile della Staffa, P. De Simone***
17:15 – 17:30	*The Effect of 2011 Van/Turkey Earthquake (M = 7.2 Mw) on CORS-TR Network* ***T. İbrahim, U. M. Ali, Y. Mustafa and K. Hasan***	*Interaction between River and City Morphology. A case study of integration of GIS and space syntax in Angers city, France* ***E. Abshirini***
17:30 – 18:00	**COFFEE BREAK**	

Under the aegis of: