Abitare la Terra
Dwelling on Earth

SUPPLEMENTO AL NUMERO 51
ANNO XVIII 2019 TRIMESTRALE

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rivista di geoarchitettura a magazine of geoarchitecture

PER UNA ARCHITETTURA DELLA RESPONSABILITÀ | FOR AN ARCHITECTURE OF RESPONSIBILITY

DIRETTA DA / *CHIEF EDITOR*
PAOLO PORTOGHESI

Quaderni

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editoriale / editorial
Carmine GAMBARDELLA

Con il numero 37 la rivista "Abitare la Terra", a quattordici anni dalla sua nascita, cambia il suo formato, ma non il suo obiettivo: la tutela dell'ambiente e la promozione di una architettura, che abbandonata la tendenza all'esaltazione individualistica delle grandi personalità creative, che ha condizionato la produzione architettonica degli ultimi decenni, torni ad essere una disciplina rigorosa, che ha per obiettivo il miglioramento della vita di tutti gli esseri viventi e per questo non rinuncia a utilizzare i frutti di una esperienza secolare che coinvolge le diverse civiltà umane.
Il termine Geo-architettura, che si legge nella testata, è stato coniato da Le Corbusier, nel 1942 per la sua riflessione su *Les trois établissements humains* e allude a una architettura che abbracci tutto ciò che l'uomo ha costruito sulla superficie terrestre.
Per noi oggi Geo-architettura vuol dire una architettura umile, che, sia arte senza per questo ammantarsi della superbia del nuovo fine a sé stesso, che si faccia carico della necessità di proteggere l'ambiente, di ridurre i processi di inquinamento, di combattere la disuguaglianza tra i popoli, di ridurre i processi che attraverso i cambiamenti climatici rischiano di distruggere gli equilibri del pianeta e il suo paesaggio. Per fondare la Geo-architettura è necessario a nostro parere: imparare dalla natura e dalla storia, rispettare l'identità dei luoghi, recuperare la "coralità" degli spazi urbani, abbattere gli sprechi di risorse non rinnovabili e di tempo umano, contrapporre a uno sviluppo senza limiti, che presuppone una impossibile "crescita infinita", una crescita spirituale di cui si avvertono i primi sintomi anche nella architettura.

Fourteen years after *Abitare la Terra* was published for the first time we have decided to change its format, but not its goal: to protect the environment and promote architecture. No longer an architecture that has abandoned its tendency to praise and exalt larger-than-life creative individuals and the architectural works that have influenced recent decades, but an architecture that is once again a meticulous discipline focusing on improving the lives of all living creatures; an architecture that exploits the 'fruits' of its centuries-old history and many different civilisations.
The term Geo-architecture at the top of the front cover of this issue number was coined by Le Corbusier in 1942 when he wrote *Les trios établissements humains;* the term refers to an architecture that embraces everything man has built on the earth's surface. For us, Geo-architecture means humble architecture, an architecture that is art without necessarily the arrogance of being an end unto itself; an architecture that assumes the responsibility of protecting the environment, reducing pollution, fighting inequality between peoples, reducing the processes of climate change that may destroy the balance that exists here on earth and its landscapes. We believe that to create Geo-architecture we need to: learn from nature and history; respect the identity of places; reinstate the "choral nature" of urban spaces; drastically reduce the way we waste non-renewable resources and human time; and replace unlimited growth (involving impossible "endless growth") with spiritual growth, the seeds of which are now beginning to grow in architecture.

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Quaderni

sommariosummary

I Quaderni di Abitare la Terra sono a cura di Carmine Gambardella

IN COPERTINA / FRONT COVER
Lazaretto of Nisida, gauche, particular, mid 1800s, Museum of San Martino in Naples

Exposoma: Landscape for Health

Carmine Gambardella

The innocent eye sees nothing
(Ernst Gombrich)

In this particular time characterized by a pandemic due to the expansion of the Covid-19 virus throughout a globalized world, the destinies of everybody have suddenly changed behaviour, lifestyles, interpersonal relationships, production methods as well as the governing of the territory; the priority of investing in the healthcare sector has become increasingly urgent and indifferent with reference to a political management of the communities that prevents and does not suffer, as unprepared, the emergencies that increasingly afflict the community. Furthermore, in these months of "quarantine", the Planet has shown a Resilience that makes us hope for the future if the environmental data, which we are currently analysing as part of another Scientific Research Project, MAI, Monitoraggio Ambientale Irripetibile on the territory of the Campania Region, will articulate a behavioural demonstration scenario to concretely aim at a green policy, starting from the current "quarantine" data with future data relating to the progressive recovery of anthropic activities.

A response to the Culture of Emergency, which finds its generative ground not only in the healthcare sector but also in the governance of the territory, relates to the hydrogeological aspects, pollution of soils, air, water, illegal construction, the exploitation of energy resources faced with the use of the integral of scientific and managerial skills based on meritocracy.

Therefore, the research carried out for the Exposoma Project reflects the desired paradigm set out above: The concreteness of the results were produced through the interaction of the integrated thinking of different scientific disciplines involved such as Representation, Geochemistry, Cartography, Artificial Intelligence, Oncological medicine as well as the use of technologies applied as a prosthesis of thought itself. The actors of the research are the Benecon University Consortium which by statute can use all the scientific disciplines of the 5 universities, the Department of Medicine of the University of Naples Federico II and the Consortium ALI which represents the industrial part for the technology transfer to the business world.

The territorial data and environmental samples taken and measured, along with those analysed on consenting subjects (blood and seminal fluid) in one with an amnesic screening belong to a sample of citizens who, for many years, have been resident in the Municipalities of Afragola, Acerra and Giugliano in Campania. In addition, a determining factor for the study is the particularly complex environment with significant pollution problems.

Therefore, with the methodology proposed, aimed at undertaking, on the basis of the results, the modification of the environment, we have simplified the flow of information acquired from our historical knowledge experiences, classifying the analysed environment as made up of separate things to classify these segments into categories in an artificial order with respect to the universe of experience previously acquired. Thus, the population of real data in a multidimensional gis web has generated further information and hypotheses of reliable forecast scenarios governed by machine learning applications.

Exposoma: Elaboration of post-processing protocols

Alessandro Ciambrone

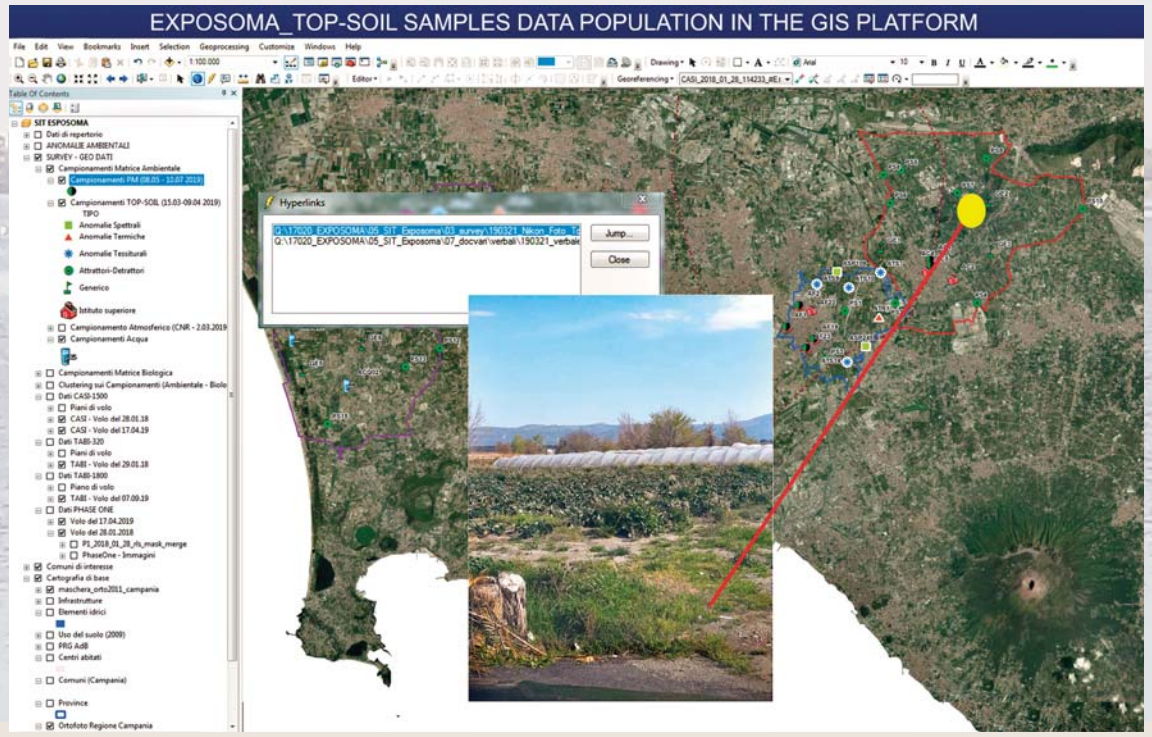
ROSARIA PARENTE, GIUSEPPE CIABURRO, ROSARIO PIVONELLO, CARMINE GAMBARDELLA, ALESSANDRO CIAMBRONE, LUCIANA ABATE, RO

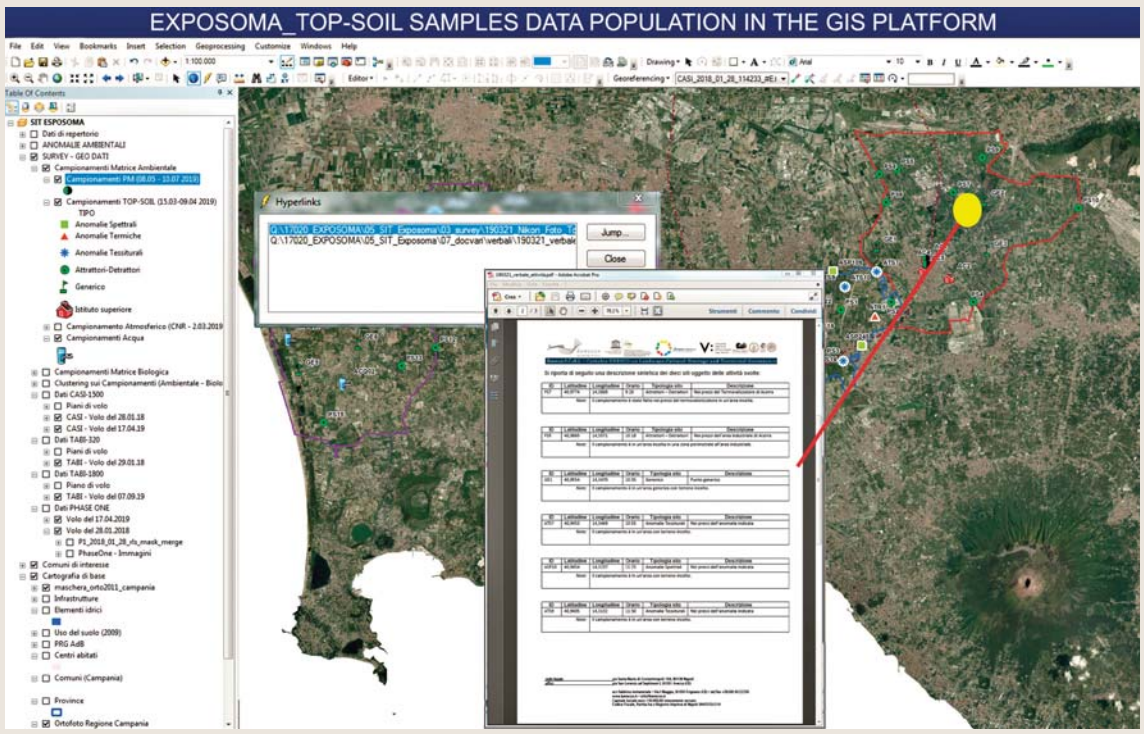
The scientific activities developed within the 'Exposoma and poly-focality in cancer prevention' project concerned, among other aspects, the production of territorial maps, the population of data, the development of integrated thematic maps, post-processing protocols and methodologies of data useful for the identification of polluting elements.

The elaboration of protocols and methodologies involved the processing of remote sensing data by means of hyperspectral and thermal sensors belonging to the Benecon University Consortium for the identified areas of the project.

Airborne sensing surveys, planned and carried out using scientific protocols codified by the Benecon Research Center, have identified anomalous areas for environmental parameters: therefore further in deep analysis for the identification of polluting elements were carried out. The principal aim of the project, in the management of environmental pollution framework, is to monitor the state of the territorial region of study and to develop a simulation model in order to identify the most exposed areas and to prepare appropriate remediation and regeneration plans. The studies, which support environmental monitoring tools, use various instruments and technologies that, starting from the raw data, allow to extract knowledge. These can be directly used in the decision-making processes by the institutional bodies responsible for the management and governance of the territory. Among the areas, which were found to be anomalous for the algorithms by the Benecon Research Center, the hot spots for top soil analysis and for the determination of total metals were selected. These are: characteristic soil parameters, total hydrocarbons, aromatic organic compounds. polycyclic aromatic hydrocarbons, pesticides (organochlorine pesticides).

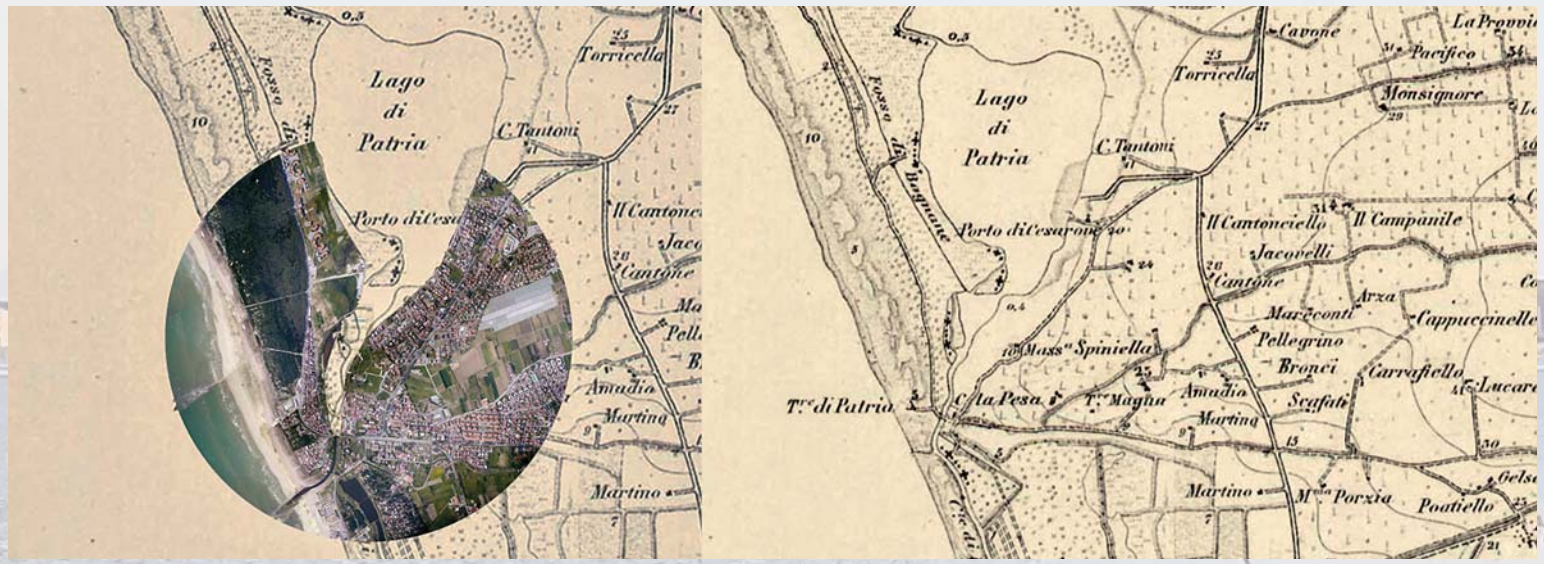
The analyzes were conducted in partnership with the Analytical Chemistry for the Environment Laboratory of the University of Naples Federico II, partner of the Benecon University Consortium. The data collected during the top soil analyzes on the area of interest were included, together with all the other multidisciplinary 'air-land-water' studies, in a Geodatabase. Each single point was georeferenced and the results of the produced analyzes were associated with each of them. The integration of geochemical data, 'air-water-soil' and seminal blood-liquid analyzes, which were conducted by the Department of Medicine at the University of Naples Federico II, partner of Benecon, produced an innovative methodology for the representation of multidisciplinary thematic maps. Additionally, the activities involved sampling of atmospheric particulates through the Benecon - Tecnam P2006T SMP aircraft, on which a control unit with miniaturized instrumentation was installed for the characterization of atmospheric particulate matter (PM) and some other gaseous components. In addition, the Researchers installed, in separate time spans, a Tecor Sky Post control unit for chemical investigations in ten high school institutions in the Municipalities of Acerra, Afragola, and Giugliano in Campania. In the period from 8 May to 10 July 2019, PM10 and PM2.5 samplings were carried out. The data deriving from the sampling of atmospheric particulates were processed using statistical analysis algorithms. The elaborated reports comprise a series of summary indicators





in order to characterize the analytes contained in the particulate surveys performed on the scheduled areas of interest. Top soil samplings were also carried out between 15 March and 9 April 2019 on the territory under examination. The types of sampling concerned higher education institutions, generic area without any particular characterization, sites of interest (attractors / detractors), environmental anomalies (thermal and hyperspectral). Subsequently, the data deriving from the survey of the particulates and from the top soil surveys were subjected to a clustering analysis in order to characterize their trends. Cluster Analysis has an exploratory role to look for existing but not yet identified structures in order to deduce the most likely group. Clustering methods are designed to find hidden patterns or groupings in a dataset. By applying this investigation technique to the acquired Big Data, it was possible to perform an interpretative process that led to the identification of similarity and / or dissimilarity in the data. The data collected in the Geographic Information System platform include the analysis of the results, the thematic maps, the tables and charts of classifications, and the forecast scenarios. The integral of multidisciplinary methodical competences can be considered both a scientific and an industrial product for Green companies and for the public institutions, which operate in the sector of environmental and health protection.

The area of study is of considerable historical importance. Amedeo Maiuri in 'Passeggiate Campane' reminds us that Liternum at the mouth of the Clanio river, the maritime colony of Rome, was built for the political and agrarian conquest of Southern Italy. In the marshy lands of the Volturum and Clanius, Greeks, Italics and Romans fought the most bitter battles for the dominion of the Campania Region. Liternum in 183 BC, after the Second Punic War, saw the exile of Publius Cornelius Scipio. Livio and Seneca tell us about the last years of Scipione's life and his residence. Those were the years when Roman grandeur was celebrated a few kilometers from Liternum in the sumptuous villas of the archaeological area of Baia in the Campi Flegrei.



Exposoma: Data Integration on Gis Platform

Luciana Abate

Producing quantitative data based on a multidisciplinary and multisensory analytical methodology of places through the collection of complex data represents the starting point for carrying out activities of Territorial Governance.

As already mentioned, the geographical data referring to dimensional areas, which vary from the minimum unit up to the large scale area, constitute the element thanks to which it is possible to analyze the multiple components of the territory in terms of mutual development relationships.

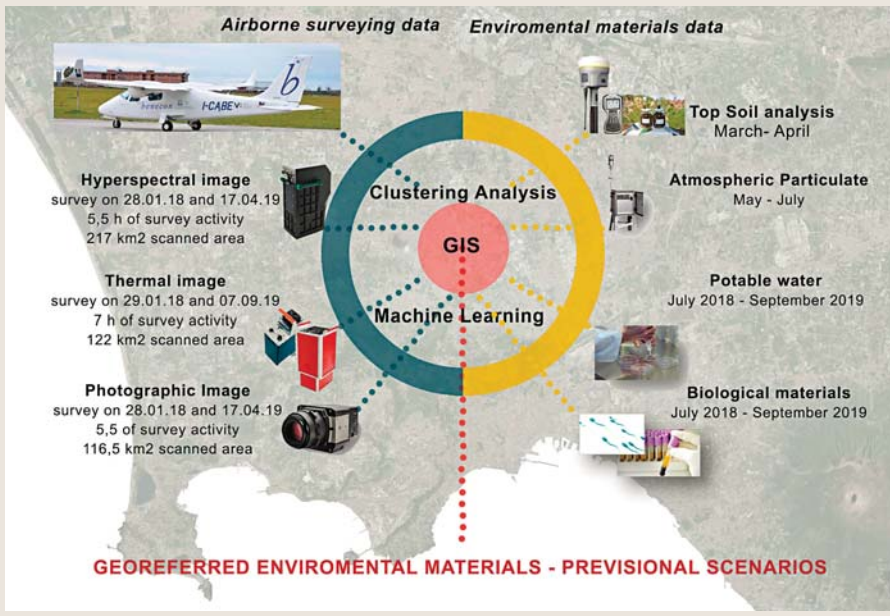
Therefore, the use of the Geographic Information System (GIS), which is able to accept, implement, manage and give back databases of different origin and nature, is fundamental.

In the scientific literature, information systems are defined as computerized calculation systems, used to manage, analyze, extract and display georeferred information.

In this regard, it is important to define the concept of GIS, as a set of Hardware, Software and Database Management System instruments, which allow to integrate graphic and alphanumeric information referring to a precise geographical reality.

In this phase of the EXPOSOMA project all the data obtained from the previous analyzes were integrated into the GIS platform. Through Geostatistical Analysis and Interpolation it was possible to identify relationships among trends in the data acquired and local locations, in order to determine the exposure of one specific pollutant on portions of the population. The integration of the results has an effective use in the various phases of the Territorial Governance model.

In identifying the spectral anomalies of the flight on 28 January 2018 and 17 April



2019, it affected the hyperspectral images to which the Reed-Xiaoli algorithm was applied, using a comparative window of 50 x 50 m². This algorithm automatically highlights the areas where surface materials have a significantly different radiance spectrum than the immediate boundary area. In order to homogenize the pixels with said divergence characteristics and therefore regulate their spatial aggregation on the map according to clear contours, the following have been applied:

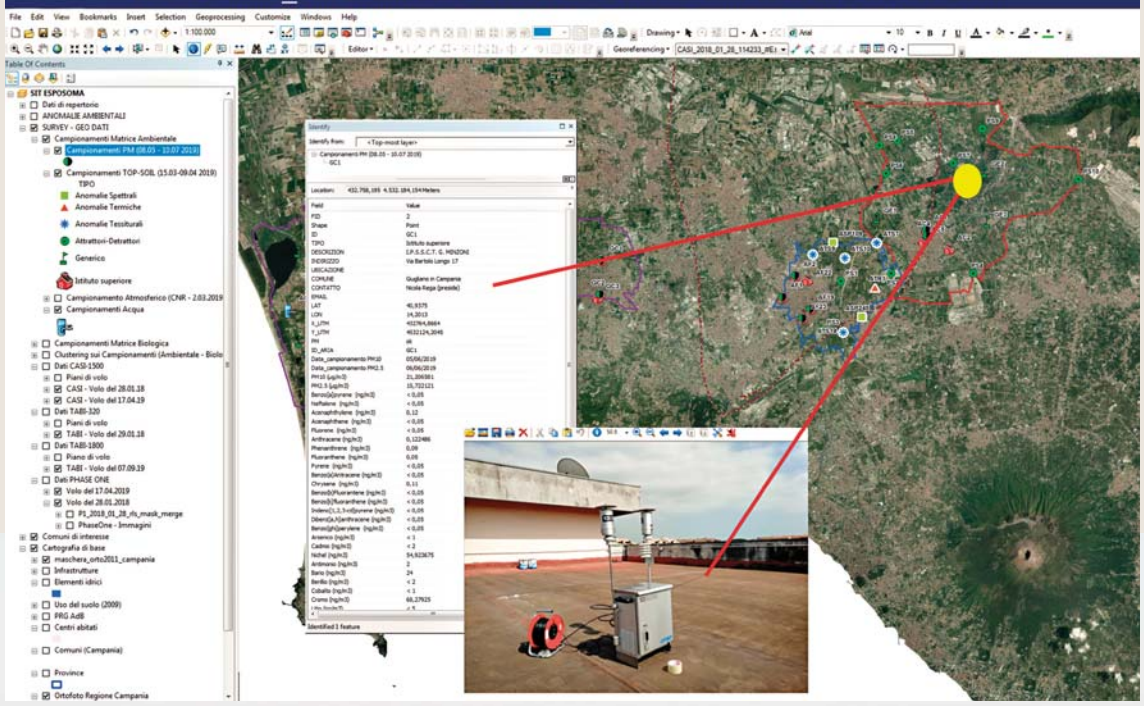
– A filtering threshold equal to 0.05% higher value than the Reed-Xiaoli filter
– A 3x3 pixel opening-closing morphological filter
– A 500-meter space filter around the reported hot spots.

From these came: a map for the flight of 28 January 2018 with highlighted the parameters of 360 spectrally anomalous areas (RXD polygons), from which we passed to a subset of 15 units; the same procedure followed the analysis for the flight of 17 April 2019, which led to the evidence of 27 spectrally anomalous areas.

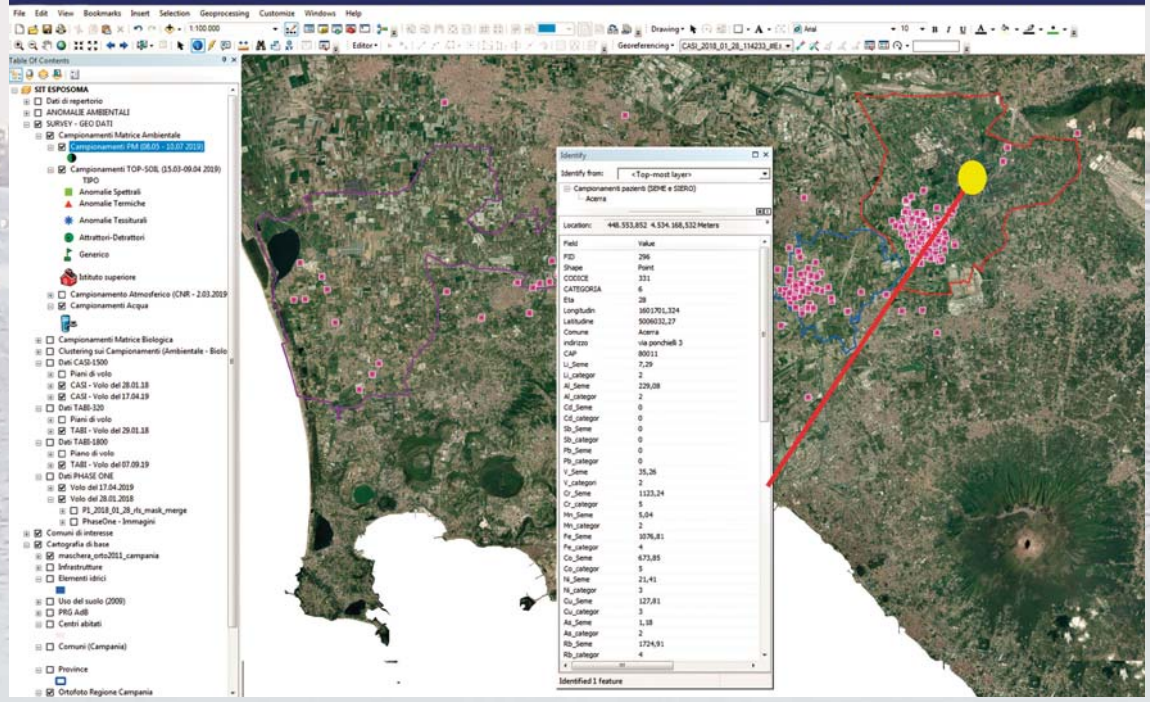
The topological Overlay in the GIS model of the CASE thematic levels and of the PhaseOne photographic shots relating to the flight of 29 January 2018 for the detection of textural anomalies, led to the visual identification of various anomalies. These correspond to the morphological and textural characteristics of burnt areas, debris, extractive materials, waste materials or earth movements. Therefore, 25 areas with textural anomalies were identified in the 500 m buffer from the hot spots.

In order to characterize the 25 textural anomalies, an Overlay was carried out with the images repertoires of the Campania Region and with hyperspectral images MSAVI, RedVeg and PCA123 of the flight on 29 January 2018, which led to the discretization of 5 anomalies and 18 deserving units of investigations. The same procedure was carried out for the flight on 17 April 2019, this led to the identification of 3 units of spectral anomalies worthy of investigation.

EXPOSOMA_PM SAMPLES DATA POPULATION IN THE GIS PLATFORM



EXPOSOMA _THE SAMPLES of the SEMINAL LIQUID and the SERUM _ POPULATION IN THE GIS PLATFORM



The activity carried out for the Characterization of the capitalized data for use in the production processes of the enterprises operating in the field of "air / ground" remediation, carried out by the BENECON University Consortium focused on the accurate methodologies for the creation of a technology platform able of managing the various information collected during the aerial and terrestrial survey phases, data summarized in different knowledge layers.

The comparative analysis of the documentary media of the territory was performed on the GIS platform that represents the technology in which the thematic maps produced following critical analyzes and specific operations of topological Overlay, Query, Buffering are contained.

The analytical data thus collected and systematized in specific layers, were assessed by comparison, in order to highlight any areas with differences that deserve on-site analysis.Therefore TOP-SOIL samples were taken, the results of which were included in the GIS organized for Intersect operations. The study was carried out with a view to producing services related to the management of integrated processes for the processing of BIG DATA and the solution of polluting phenomena harmful to the environment and humans.

The points previously exposed have been elaborated in order to create a single system of detection and scientific definition of cause and effect.

The complex of acquired characteristics make the remote sensing image and scientific data totally compatible for their introduction into GIS platforms.

The analyzes conducted by the Benecon University Consortium, flow into Databases for the management of BIG DATA with the aim of implementing knowledge and solutions useful to the business world in the field of "air / land" remediation, from surveying to monitoring the territories polluted, up to oncological prevention and the protection of human health.

Exposoma: Design Beyond Visible

Rosaria Parente

The Research activity, carried out within the EXPOSOMA project and focus on cancer prevention, is a syncretic action of gathering information concerning the natural and built environment and the Man. The collected data, properly processed, are the basis for the planning of prevention and safeguarding human health activities. The analyzes conducted, from material to immaterial, from air, to soil, to biological liquids, infact represent the input for the configuration of a supervisory investigation. The project provided for the involvement of different scientific knowledge that, through coordinated actions, achieved the set objectives by collecting the information, each for their own skills. Also in this occasion, quoting Carmine Gambardella, "the integral of skills" has shown itself as the best choice for the management of integrated processes for the elaboration of Big Data in the perspective to finding a solution to the phenomena polluting the environment and the man. Never as in this historical moment, where we are witnessing the continuous globalization that makes geographic borders ephemeral and increases the ease of dissemination of news, of people, viruses, the prevention becomes very important by the application of multidisciplinary scientific research involving numerous skills able to operate on the environment and consequently on human health with a future-oriented attitude. Here EXPOSOMA and focus in cancer prevention is shown as a best practice in which the role of the discipline of Representation and Drawing is of fundamental importance for the achievement of the set objectives.

The representation of the territory by means of the hyperspectral and thermal aerial survey was the basis on which to plan subsequent cognitive investigation activities. The aerial survey has actualized in the creation of maps from airborne sensors relating to data processing and management of big data banks (Big Data). It was an integrated environmental monitoring as it is able to combine remote sensing activities with airborne sensors and sensors positioned on the ground by sampling different environmental materials, subject to specific laboratory investigations.

The processing of remote sensing data, through the sensors of the BENECON University Consortium, pertains to the study areas of the Project: Acerra, Afragola and Giugliano in Campania. In particular, specific algorithms were used for the post-processing of non-static thematic maps obtained from the integration of the data surveyed by airborne sensors with analyzes concerning the physical-chemical definition of environmental parameters through geochemical analysis on different environmental materials.

The activity carried out has also produced the certification of the algorithms adopted in data processing in order to make the data obtained from airborne sensors and geochemical measurements on the ground compatible. Therefore, the result obtained by integrating upgradeable and sensitive maps to define the alert of polluted areas was of significant scientific interest.

The cartographic information was enriched with a terrestrial characterization action of maps from airborne sensors post-processed by spectral and thermal algorithms.

The activities led to the quanti-qualitative analysis of CASI-1500 data, PhaseOne with TECNAM P2006SMP. The investigations were aimed at identifying spectral and textural anomalies on georeferenced maps through:

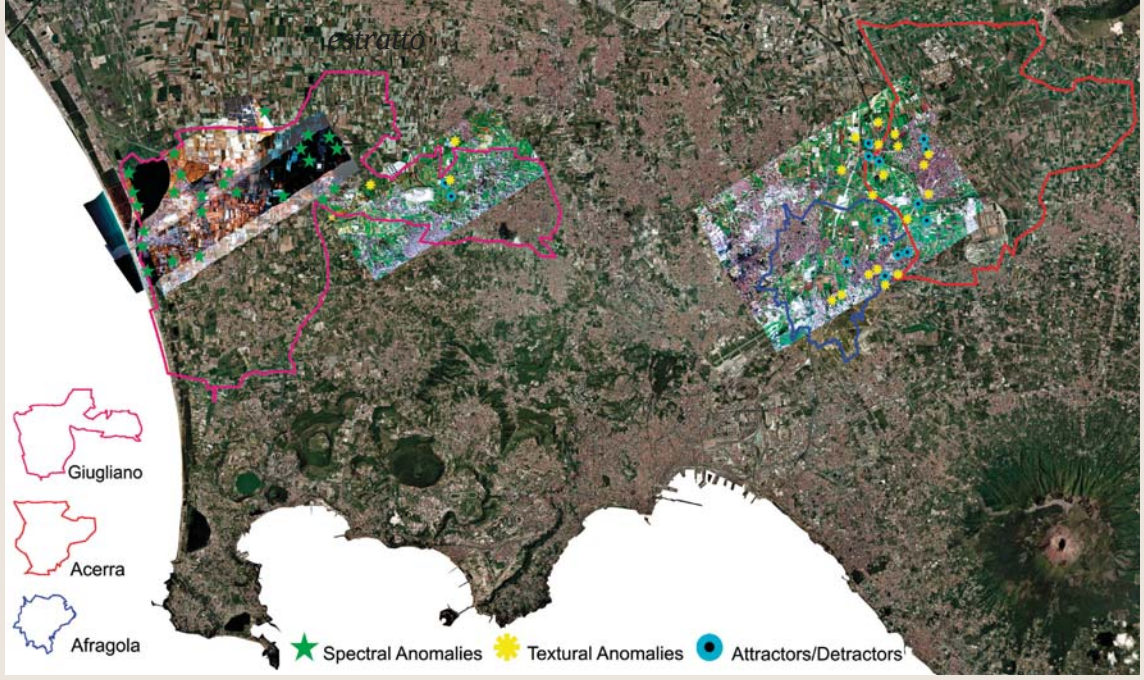
– Red Vegetation representation of the CASI-1500 hyperspectral image;
  Representation of vegetated areas, sampling in shades of red in relation to the presence of vegetation (deep red thick vegetation; soft red sparse vegetation);
– False color representation MSAVI (Modified Soil Adjusted Vegetation Index) of the hyperspectral image CASI-1500, sampled with increasing gradations from white to black in relation to the greater or lesser chlorophyll activity of vegetation, for the representation of plant areas with greater concentration of the chlorophyll activity;
– False color representation PCA (Principal Components Analysis), sampled according to a statistical processing of the acquired electromagnetic bands that maximizes the variance spectral data and filters electromagnetic 'noise'.

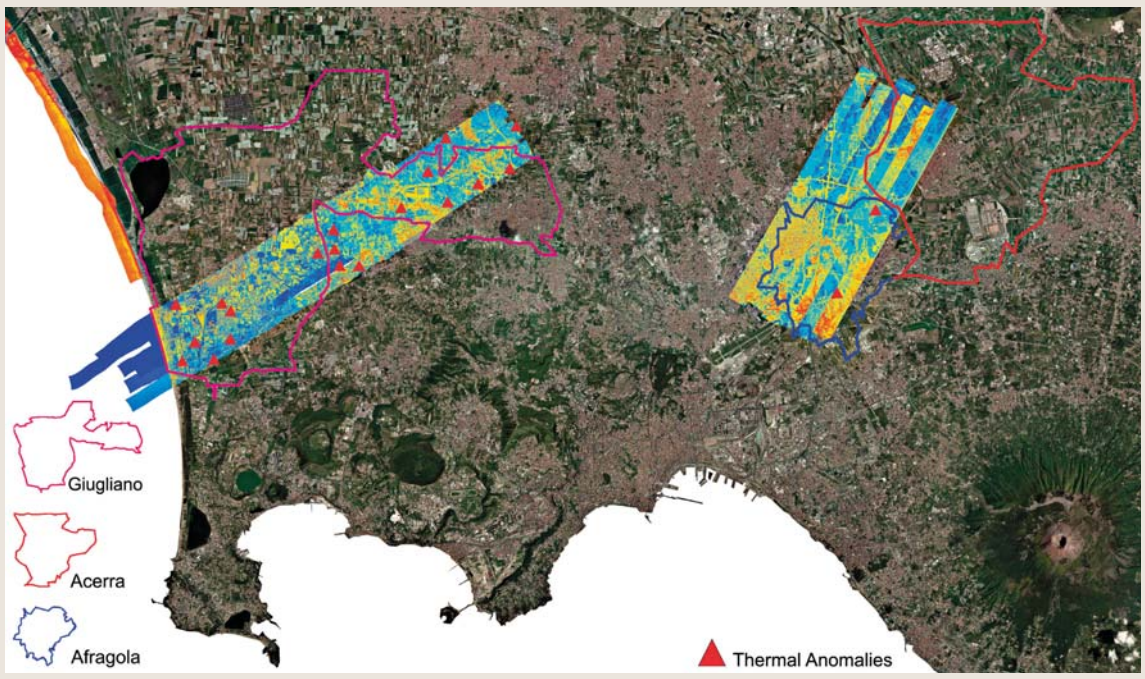
The remote sensing campaigns with the ITRES TABI-320 sensor were aimed at identifying thermal anomalies. In particular, maps were developed through:

– Representation of the thermal images acquired with the TABI-320 sensor. Representation of the brightness measurement of the observed surface, the color scale from blue (cold) to red (hot) allows to highlight the surface temperature variations;
– Identification of environmental anomalies of a thermographic nature generated through use automatic algorithms that measure and identify the thermal variation of each pixel of the image with respect to its surroundings.

Specifically, the analysis carried out by the multidisciplinary Research team concerned the air-Earth-water and biological liquids materials. As regards Top Soil analyzes, the data collected during the analysis were processed using statistical analysis algorithms. The same methodology was necessary for the analysis of data deriving from water sampling and those deriving from seminal fluid sample. The data sheets drawn up as the final product contain a series of

summary indicators in order to characterize the analytes contained in the Top-Soil surveys and in the water surveys carried out on the sites of interest. In conclusion, a report has been written containing the profile referring to each analyte identified by an ID. For each analyte the following descriptors are reported: Minimum, 1st quartile (25-th percentile), Median, Average, 3rd quartile (75-th percentile), Maximum. In addition, the Team elaborated also the diagram containing the Histogram of the analyte class distribution and the Boxplot for each analyte. Subsequently, the data deriving from the Top Soil survey, from the water and semen measurements were subjected to a clustering analysis in order to characterize the similarities / dissimilarities between the sites in question. The data sheets contain a series of summary indicators in order to characterize the analytes contained in the particulate surveys performed on appropriately reported sites.
The Research Project had the aim to produce services related to the management of integrated processes for the elaboration of Big Data and was carried out to find a solution to the phenomena polluting the environment and humans. To this end, the analyzes will constitute and flow into Databases to implement knowledge and solutions regarding the survey and monitoring of polluted areas to be reclaimed, precision agriculture, cancer prevention and human health in order to create a paradigmatic system of detection and scientific definition of potential cause-effect links between environmental polluting factors and man.





Exposoma: Clustering and Machine Learning

GIUSEPPE CIABURRO

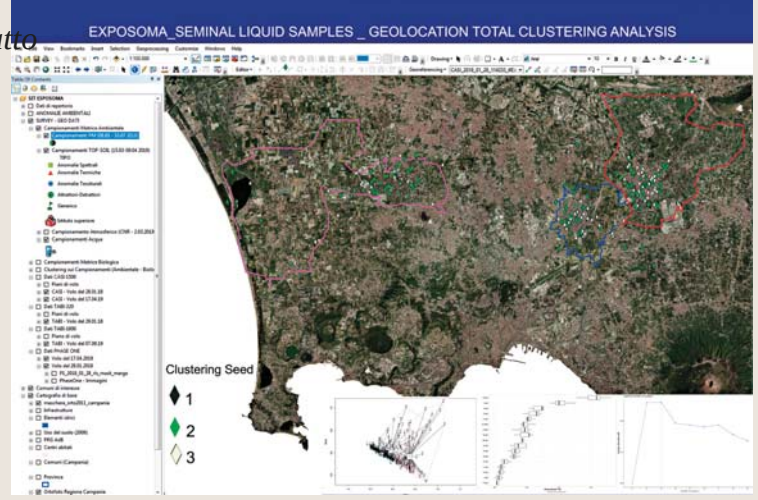
The aim of this study is to monitor the environment state and develop a simulation model of the phenomenon such as to identify the most exposed areas and prepare appropriate remediation/regeneration plans. To do this, the data deriving from environmental monitoring were analyzed using a Cluster Analysis and subsequently integrated into a GIS platform containing the maps of the areas under investigation. In this way it was possible to identify relationships between data trends and territorial locations in order to determine the exposure of a specific pollutant on portions of the population. The integration of the results lends itself to effective use in the various phases envisaged by the management and governance model of the environment: In the prevention phase it allows, through a multi-temporal study of the area, to identify potential areas subject to risk and to estimate the population density exposed. In the emergency management phase, it is a useful tool for the planning of remediation interventions, for the design of storage centers for recovered material, and proves useful in the creation of warning systems. During the site recovery phase, it allows to quickly evaluate the possible uses of the reclaimed areas based on the potential offered by the neighboring areas.
Cluster Analysis searches for groups of objects such that the objects belonging to a group are like each other and different from the objects in the other groups. Conceptually significant classes or groups of objects that share common characteristics play an important role in the way people analyze and describe the environment. In fact, humans are adept at dividing objects into groups (grouping) and assigning objects to these groups (classification). Clustering methods are designed to find hidden patterns or groupings in a dataset. It is an unsupervised learning technique that groups statistical units to minimize distance within groups (intra-group) and maximize distance between different groups (inter-group). The distance between the groups is quantified by means of similarity/dissimilarity measures defined between the statistical units. Two groups are close together when their dissimilarity or distance is small or, equivalently, when their similarity is large. Proximity measures can be determined both directly and indirectly, the latter being more common in most applications. To perform cluster analysis, a previously elaborated interpre-

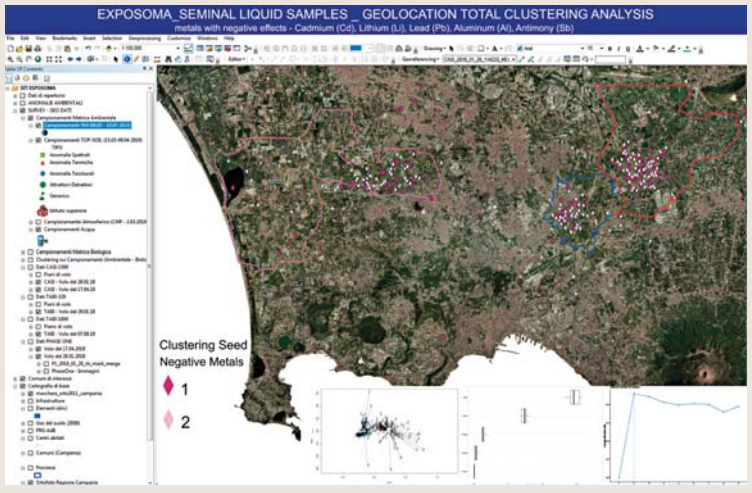
tative model is not required. In fact, unlike other multivariate statistical techniques, this does not make an a priori hypothesis on the existing fundamental typologies that can characterize the observed sample. Cluster Analysis has an exploratory role to look for existing but not yet identified structures in order to deduce the most likely group.

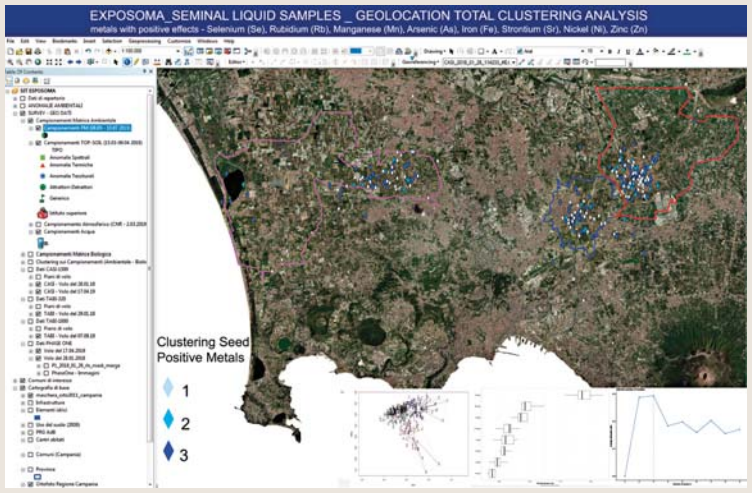
In order to perform a cluster analysis, it is necessary to select in advance an adequate proximity measure; the most used measure is the Euclidean distance. The distance between two statistical units on which k characters are detected, is a distance in a k-dimensional space and expresses the difference considering all the k characteristics between the two units. The choice of the grouping procedure and the choice of the distance measurement are related to each other. The relative size of clusters should be significant, meaning that clusters should be interpreted in terms of centroids. In this study, a clustering analysis based on the k-means algorithm was performed. In a first exploratory phase, the raw data deriving from environmental monitoring were used for the pre-processing of the data in search of possible outliers, to perform a reduction in the noise of the dataset, and to highlight possible anomalies (warnings).

The first step when using the k-means method is to indicate the number of clusters (k) that will be generated in the final solution. The algorithm starts by randomly selecting k objects from the dataset to act as starting centers for clusters. The selected objects are also known as cluster averages or centroids. Successively, each of the remaining objects is assigned to the nearest centroid, where the closest is defined using the Euclidean distance between the object and the cluster mean. This step is called the cluster assignment step. Note that, to use the correlation distance, the data is entered as scores. After the assignment phase, the algorithm calculates the new average value of each cluster by carrying out a sort of update of the centroid. Now that the centers have been recalculated, each observation is double checked to see if it could be closer to a different cluster. All objects are reassigned using updated cluster means. The cluster assignment and centroid update steps are repeated until the cluster assignments stop changing, that is, until convergence is achieved.

Finally, the information deriving from the Cluster Analysis was added to the Geographic Information System platform, with the aim of identifying trends through spatial analysis. Spatial analysis allows us to study and understand real-world processes by developing and applying manipulations, criteria and analysis models and creating integrated models. These criteria show us the underlying trends in spatial data, making new information available. Studying the phenomena that occur in space through the analysis of the spatial distribution of data represents a great challenge to understanding fundamental problems in many fields of knowledge.







Exposoma: potential association between exposure to non-essential trace elements and other pollutants and testis pathophysiology

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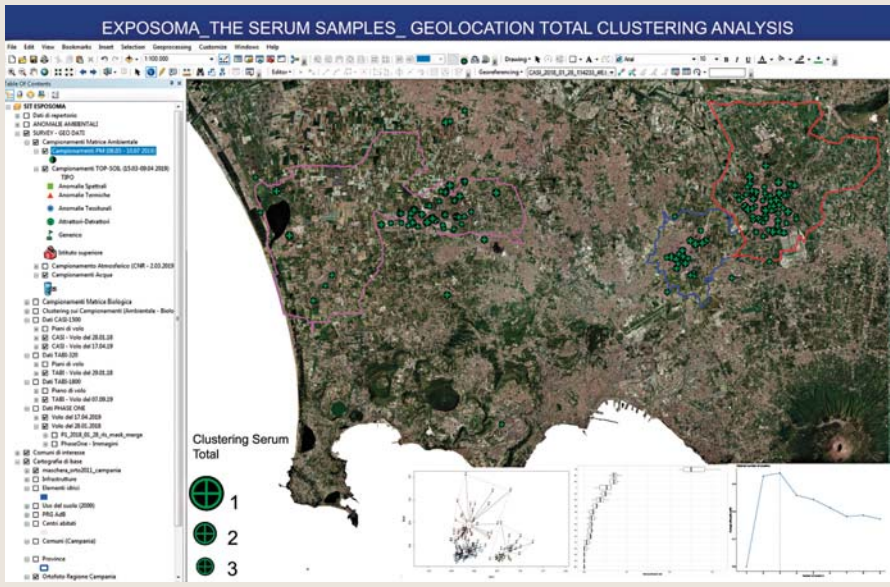
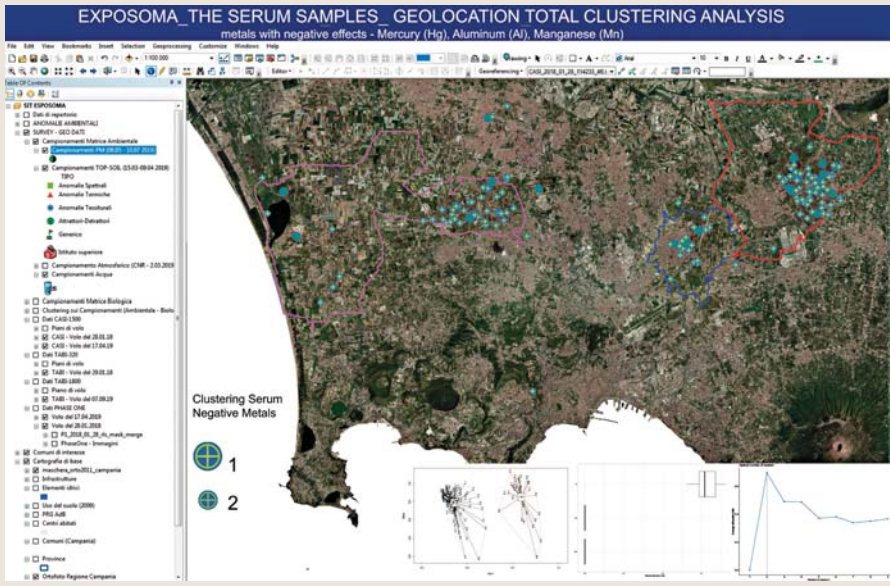
A clinical research study was performed on a large cohort of men of reproductive age, non-occupationally exposed to toxic chemicals, aiming at bridging the existing gap of information concerning testis cancer, risk factors for testis cancer, testicular disorders and male infertility, in men who had lived for at least 10 years in the high environmental pressure area "Land of Fires" (LF) within Campania Region, particularly, form Acerra, Afragola and Giugliano in Campania municipalities, and to investigate the potential association between exposure to non-essential trace elements and other pollutants and testis pathophysiology. The anamnestic, andrological, and semen quality assessment demonstrated no different prevalence of andrological dis-

orders, including cryptorchidism, testis cancer, familiarity for testis cancer, testicular lesions, testicular microlithiasis, testicular inhomogeneous echogenicity, and no different prevalence of below-reference values for seminal parameters, between the total LF cohort, or each single LF municipality, and a control group of men living in other Campania Region areas, not belonging to the LF. Nevertheless, a significantly higher prevalence of azoospermia was detected in men from the LF. Objective human exposure to non-essential trace elements was detected by quantification in serum and semen samples. Main results demonstrated that cadmium (Cd), a known reproductive toxicant, might be detected in semen at significantly higher concentrations than serum, confirming the widely accepted notion that Cd specifically accumulates within the testis, and more precisely mirrors local testicular exposure, suggesting that seminal Cd determination might serve as a sensitive earlier marker of exposure, particularly in non-occupationally exposed men, which might have cumulative low exposure; in our LF cohort semen Cd concentrations were frequently below the level of detection, and median concentration was overall lower than that experimentally reported for high environmental pressure areas. Noteworthy, semen Cd negatively correlated to sperm concentration, total count, and normal morphology, and this finding was consistent across different statistical strategies; indeed, men with detectable semen Cd concentrations had significantly reduced sperm total count and normal morphology, along with a higher prevalence of poor semen quality. Consistently, semen Cd concentration was significantly higher in men with pathological seminal parameters, compared to normozoospermics. The robust association of semen Cd with poorer semen quality found in the LF area of Campania Region underpins the majority of clinical studies demonstrating an inverse relationship with seminal parameters in environmentally exposed men, and supports the assumption that even micro-doses of metal may have effects on semen quality. Considering that male infertility is increasingly acquiring more importance as a potential testis cancer risk factor, and taking into account that infertility is a highly relevant disease, with much socio-economic bearing burden, it might be advised to perform active biomonitoring with follow up visits and semen analysis, including non-essential trace elements quantitation in semen, in particularly susceptible populations, or individuals from high environmental pressure areas. ■





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1. P. 5. Bagnoli, Naples, photo by Benecon Tecnam P2006T SMP.
2. P. 5. Patria Lake, Giugliano in Campania Municipality, on background the Islands of Ischia (right) and Procida (left).
3. P. 6. Exposoma. Top-Soil Samples Data Population in the Gis Platform.
4. P. 6. Exposoma. Top-Soil Samples Data Population in the Gis Platform.
5. P. 7. 1885 Historical Map, Geographical Military Institute, Municipality of Giugliano, Patria Lake, archeological area of Liternum, Mediterranean Protected area, Ancient Domitiana street I AD. Historical comparison with the recent constructions around the Patria Lake.
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10. P. 10. Benecon Tecnam P2006T SMP: Flight on 28 January 2018 with CASI-1500 Hyperspectral sensor on the municipalities of Giugliano in Campania, Afragola and Acerra; Flight on 17 April 2019 with CASI-1500 Hyperspectral sensor on the municipal territory of Giugliano in Campania.
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17. P. 12. Exposoma. The Serum Samples. Geolocation Total Clustering Analysis.
18. P. 12. Exposoma. The Serum Samples. Geolocation Total Clustering Analysis: metals with negative effects - Mercury (Hg), Aluminum (Al), Manganese (Mn).

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