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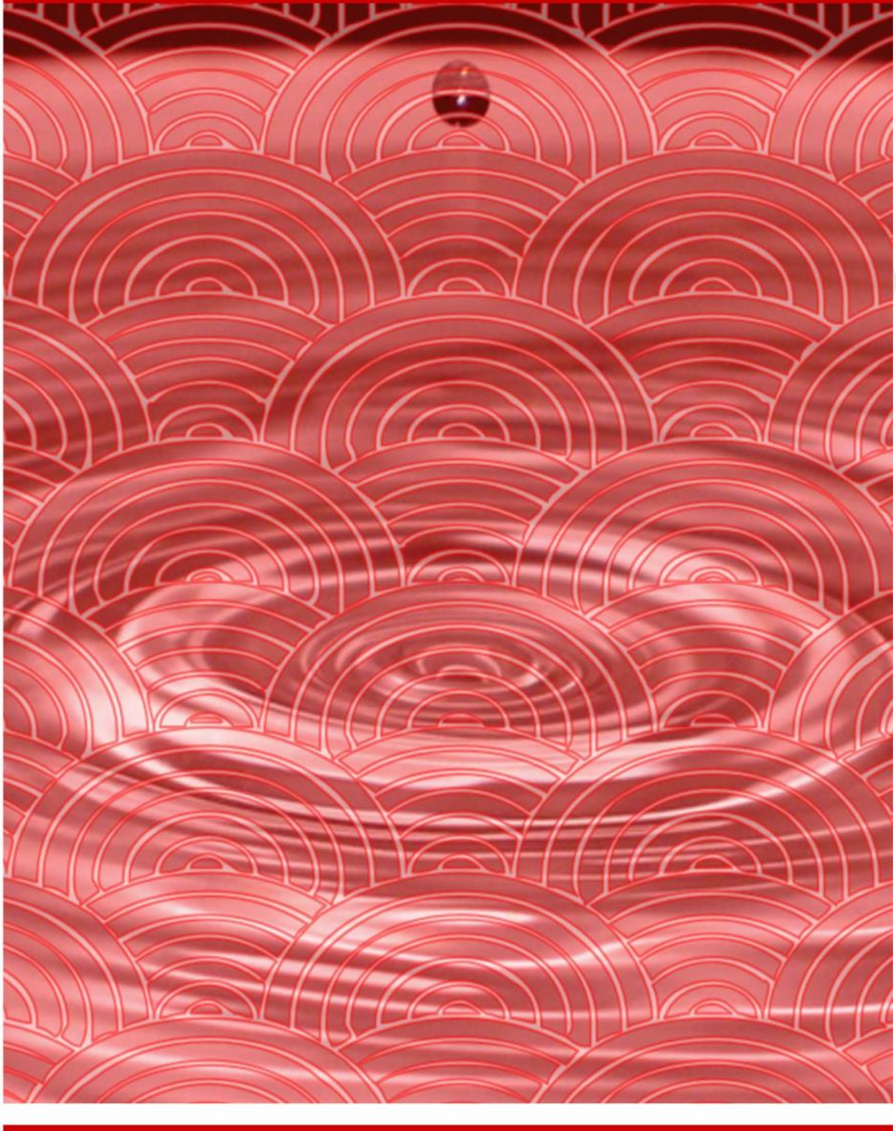
GeoPatterns



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Summary

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Using LiDAR in analyzing the relantionship between vegetation and built space – influences and interdependence. Case Study: Bucharest Municipality

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Abstract. Under increased urban settlement density, the central areas of cities are usually the main targets of the regeneration process. This action involves modern urban modelling methods to emphasize the buildings structures and vegetation assessment. One of the methods is represented by LiDAR (Light Detection And Ranging) technology. LiDAR offers high-resolution imagery for very detailed information on object attributes, such as spectral signature, texture and shape, very accurate position and height information. Recently, remote sensing techniques are being increasingly used for inventory, monitoring and management of vegetation. Precise and up to date spatial information on the current status of green areas is a requirement for the sustainable conservation of urban vegetation. Correct information of urban vegetation is important to preserve the ecological environment within urban spaces. The aim of this study is to expose the utility of the LiDAR technique for assessment of urban vegetation in relation with built-up space in Bucharest Municipality. The results show that spectral details of data reflect the relationships between green areas and their surrounding environment. Urban evolution of Bucharest municipality was very rapid, especially starting with the second half of the 19^{th} century, which led in time to a reduction of the green spaces. Although the capital city has a rich patchwork of green spaces (parks, public gardens, urban lawns, squares) and varied in terms of functionality (for recreation, for decorative purposes, with ecological function), we can observe they are diminishing in the recent years, due to the tendency for expansion of the residential areas.

Keywords: *urban vegetation mapping, built-up space, modified environments, spatial data, LiDAR, Bucharest municipality*

OVERVIEW

Urbanization is a complex process that determines important changes in land use of urban areas (Petrisor et al., 2010; Ianos et al., 2012; Le Roux et al., 2014; Bonthoux et al., 2014; Salvati, 2014; Ianos et al., 2014), modifying the environment and creating numerous human-altered landscapes (Digby, 2000; Popovici et al., 2013; Demiroz Kiray, Yildizci, 2014; Chase, Chase, 2016).

In this context, urbanism has the role to establish several rules for sustainable development in order to restrain urban sprawl, to promote sustainable land use policies, to conserve urban green areas (Antrop, 2004; Lundgren Alm, 2007; Grecea et al., 2010; Gridan et al., 2013; Feltynowski, 2015; Lafortezza et al., 2013; Chase, Chase, 2016; Nita, 2016).

Urban green areas constitute an element of urban environmental system within the city's area (Lundgren Alm, 2007; Suárez-Cáceres, Cariñanos, 2014; Giecewicz, 2005 quoted by Feltynowski, 2015; Chen, Yu, 2015; Nita, 2016).

Due to the fact that greenery is spread all over the urban landscape and in various scales, it is also potentially important as a key to understand and manage urban development (e.g. Antrop, 2004; Lundgren Alm, 2007; Colusca, Alpopi, 2011).

The urban green areas have not only a decorative or aesthetic role, but also are designed to accomplish specific services (e.g. ecological, social, economic and systemic) (Dobbs et al., 2011 quoted by Suárez-Cáceres, Cariñanos, 2014; Petrisor, 2015).

Greenery serves as an indicator of the environmental quality and ecological advantages, in that they contribute to the health and the quality of its surrounding land convers, they directly influence local climate conditions, moderating the effect of urban heat islands (Lundgren Alm, 2007; Lafortezza et al., 2009; Bowler et al., 2010; Adinolfi, Suárez-Cáceres, Cariñanos, 2014; Sirodoev et al., 2015; Nita, 2016; Davies et al., 2016).

Very often urban green areas constitute public space, where there is an interaction between the people (Adinolfi, Suárez-Cáceres, Cariñanos, 2014; Feltynowski, 2015).

In numerous studies,the role of urban vegetation in the population's health improvement is indicated (Jackson, 2003; Pretty, 2004; Velande et al., 2007; Ward Thompson, 2011 quoted by Adinolfi, Suárez-Cáceres, Cariñanos, 2014; Ambrey, 2016).

In this study the authors examine the relationships established between vegetation and the built environment in Bucharest municipality.

STUDY AREA

Bucharest is Romania's largest city, gathering, according to the last census in 2011, about 1.9 million inhabitants (ISSN, 2011). Also, Bucharest is one of the great metropoles of South Eastern Europe (Grosse-Espon project, 2014).

We selected a study area located in the center of Bucharest municipality (fig. 1).

The area is bordered by Victoria Avenue in the north, Polona street in the eastern axis, Unirii Quai – Independentei Quai in the south and, in the west, Berzei street (fig. 2).

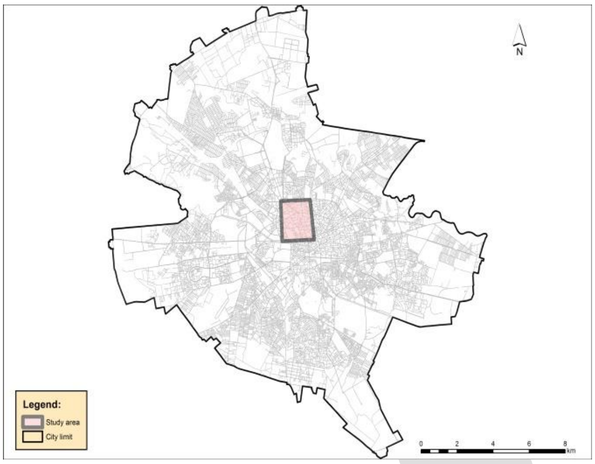

Figure 1. *Geographical location of the study area*

Figure 2*. Aerial imagery of study area*
Source: Data processed from orthophoto mosaic, March 2014

The selection of this area was determined by the fact that it is characterized by a long territorial evolution, marked by different stages that generated changes in the urban fabric. At present, the studied area shows a high density of built space, including old cores alternating with areas of modern housing style and with urban green areas (parks, public gardens, urban lawns, squares, aso).

METHODOLOGY

In the past years, teledetection techniques are used more and more frequently for different applications in the urban environment: map updating at large scale, communication analysis, virtual modelling, risk assessment and monitoring, and urban vegetation studies (respectively for inventory, monitoring and its management) (Höfle, Hollaus, 2010; Vengadeswari, Rajalakshmi, 2013; Apostol, 2015; Chase, Chase, 2016; Popescu, Iordan, 2016).

The LiDAR (Light Detection And Ranging) measurement technique, has the advantage of being able to penetrate beyond the vegetation courtain, using filtering techniques (Vengadeswari, Rajalakshmi, 2013; Sánchez-Lopera, Lerma, 2014; Iordan, Popescu, 2015), obtaining points on which it can be represented the 3D model of the terrain.

LiDAR is a detection technology through remote sensors. It utilizes its own source of energy (laser) to illuminate a target aiming at obtaining reliable measurements without having direct physical contact (Höfle, Hollaus, 2010; Popescu, Iordan, 2016; Chase, Chase, 2016).

Observations on vegetation zones, are based on multiple pulse returns that can be used for describing the structure of the canopy, emergent layer and forest debris (Popescu, Wynne, Nelson, 2003; Iordan, Popescu, 2015). Also, the LiDAR measurements offers the possibility to perform additional analysis of the forest inventory as they may investigate tree height and density of vegetation due to high resolution, 3D vegetation information, the average diameter of the tree trunk, the vertical profile of the sheath foliage, the canopy volume or interactions between vegetation and topography (Dubayah, Drake, 2000; Popescu, Wynne, Nelson, 2003; Sánchez-Lopera, Lerma, 2014; Apostol, 2015; Iordan, Popescu, 2015; Lim et al., 2003 in Tiede et al., 2005).

In addition, if sufficient return pulses are received from forest debris, a terrain model may be obtained as well.

Air data collection system LiDAR offers several advantages over conventional topographical studies, which are necessary but time-consuming. Elevation and location information are the most important components of LiDAR data (Iordan and Docan, 2013).

Data collection and transfer with this technology ensures better handling and efficient data management.

In this study the data obtained from the LiDAR measurements were used to map both green and built spaces and to analyze the relationships established between the built and green areas located within the study area.

After preprocessing the results obtained through measurements made using LiDAR technique, the next step was to classify the objects. The study is based on a classification of measured objects which involved dividing them into three categories: buildings, vegetation and other objects (roads, vehicles, shrubs).

The data obtained after LiDAR measurements were processed and mapped using GIS.

RESULTS AND DISCUSSIONS

Urban evolution of Bucharest municipality was very rapid, especially starting with the second half of the 19th century (Mihailescu, 2003).

The study area is a mix of old and new identifying the stages of the city development: from areas that retain the architectural imprint pattern of the XVIII-th and XIX-th centuries (both in terms of the built environment and the manner of arrangement of green spaces: the oldest public garden Cismigiu is arranged in English style) (Marcus, 1958).

During the Communist regime a massive demolition work of old stock houses was instituted in order to construct modern residential areas or headquarters of public institutions. Also, the most obvious urban changes were made during this period when the neighborhood Uranus was demolished to construct the megalomaniac building Palace of Parliament. In its vicinity, headquarters for public institutions were built (National Institute of Statistics, Ministry of Regional Development and Public administration, Ministry of Finance etc.). Also, during communism, urban parks were not a priority, resulting in large gaps in their share between different residential areas of the city - the central area (old) and new neighborhoods.

Bucharest Municipality has registered intense transformation, also in the last twenty-six years, caused mostly by the political changes (after 1989 the market-oriented economy system replaced the communist regime, which allowed a greater flexibility in applying territorial planning rules). Territorial dynamics recorded by the capital city in recent years has also been driven by the high value of land, which exerted pressure on green spaces surfaces, leading to their diminishing in favor of building new residential and commercial areas.

As the vegetation is an important component of urban space through the functions it performs (environmental, social, economic, systemic), it was mapped along with buildings, to highlight the relationships established between the two elements. Thus we created an urban model which aims to identify and measure the characteristics of buildings and trees using LiDAR.

The number of trees within the limits of the study area is 32 745 (Fig. 3).

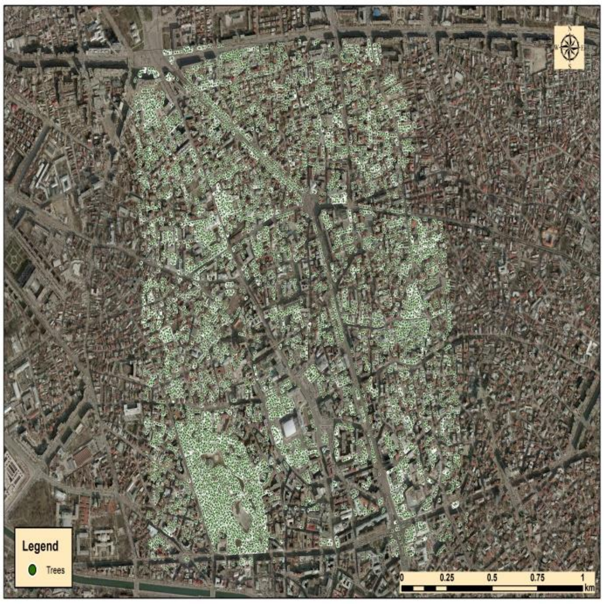

***Figure 3**. The trees' position established on the basis of the point cloud resulted from the LiDAR measurements*

The total surface of the study area is 347 ha, of which the built environment owns 174 ha (i.e. 50.1%), the traffic arteries (boulevards, streets, entrances) and sidewalks 92.8 ha (i.e. 26.7%), and the green spaces occupy an area of 23.2% (80.2 ha.) (Fig. 4).

In the case of the buildings, we could only measure the external elements, due to their opacity (roofs, exterior walls) (fig. 5).

After repeated scans from different angles, more of the features of the trees could be measured, based on the point cloud, that captured not only the upper surface of the canopies, but also the inner and under crown; it was highlighted together with their geometry.

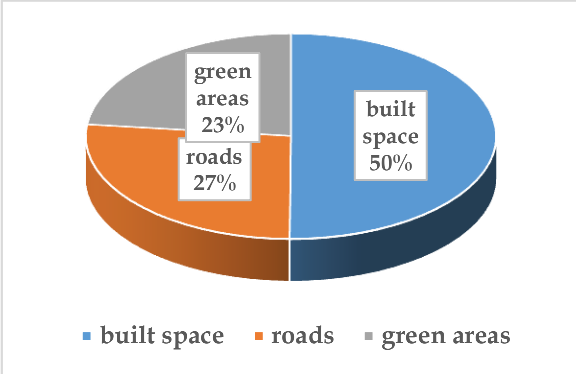

***Figure 4**. The share of land surfaces by category in study area*

***Figure 5**. LiDAR measurements for buildings*

The spatial distribution of green areas within the analyzed area, highlights their location near the old buildings, as well as the modern ones, individualizing them as discontinuous areas in a densely built area (Fig. 5).

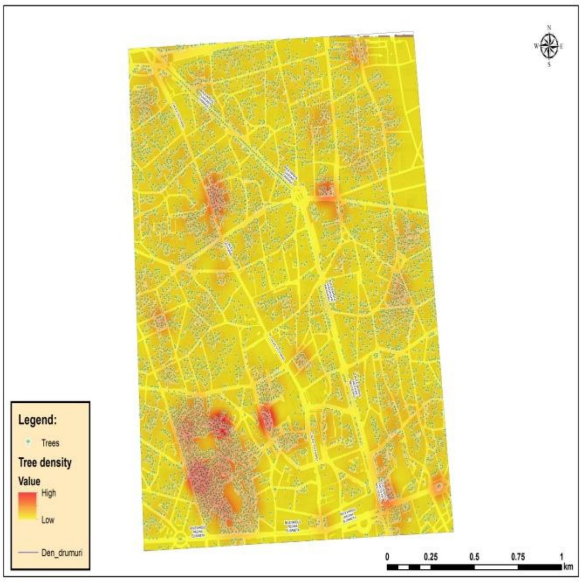

***Figure 6**. Density map of green spaces*

In terms of functional typology of urban green spaces (Czarnecki 1968, Davies et al. 2006 quoted by Feltynowski, 2015), the studied area has a large representation of public green areas, among them being the urban parks: (Izvor, Circului, Ion C. Brătianu, Nicolae Iorga s.a.), gardens (Icoanei, Cismigiu), and squares (Ateneu).

Another category is represented by green areas for a specific purpose (screening green trips, gardens, green areas accompanying communication along the main boulevards: Regina Elisabeta, Lascar Catargiu, Gheorghe Magheru); accompanying green areas, among others: in the scope of cultural-social services (the green space around the Romanian Opera), technical-economic services and housing estates (residential areas that have a higher density of green spaces Sala Palatului area); sightseeing-recreation areas (among others: public forests, historical parks and various forms of nature conservation).

Within the study area is the oldest public garden in the city, Cismigiu, designed in 1850, in order to ensure a recreational area for the population (Marcus, 1958). The Garden was founded by landscape artist Carl Friedrich Wilhelm Meyer and shows a high degree of compositional complexity (El Shamadi et al., 2009). It was built after the English model, representing the type of garden promenade with irregular geometry that is closer to the meaning of park (Baciu, 2014).

Cismigiu garden is an 'enclave' of green island in a densely built urban fabric.

Although the number of green spaces is not relatively large, their surface ranges from 17 ha (Izvor Park) to 0.25 ha (Atheneum square). However it is observed that the ratio between the built and green spaces, reflects a predominance of land occupied by buildings (fig. 7).

In the study area, the pressure of the built space was not so big on urban vegetation compared to other areas of Bucharest. This situation is explained also due to the fact that some green spaces in the study area were protected (e.g. Cismigiu Garden) because they are within the limits of protected urban ensembles or are located near the cultural objectives (Atheneum Square). For example, Cismigiu Garden is the only public green space arranged that keeps the original stylistic features imprinted by their creator in the nineteenth century (El-Shamali et al., 2009).

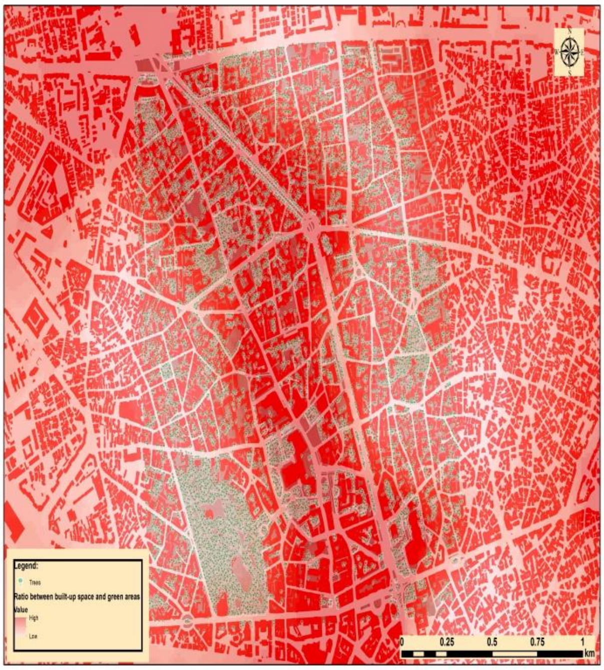

Figure 7*. The ratio between built space and green areas*

CONCLUSSIONS

Recent studies have demonstrated the benefits of combining imagery and LiDAR acquisition data to accomplish urban land cover classifications, especially for providing increased class separability between spectrally similar classes like buildings, roads, vegetation, etc. Accurate and up-to-date land cover data, particularly in cities characterized by accelerated dynamics, is a very important tool for urban planning.

Efforts have been made to build, develop, and conserve urban vegetation in order to adequately provide better living conditions for the urban population (e. g. mitigating urban heat island effects through increasing the amount of urban trees).

The multiple functions of urban vegetation indicate its role as resource of the urban environment, regardless of the scale of its registered transformation.

Bucharest, due to the role of capital city, which has conferred to it the status of most important urban center at national level, from the socio-economic and cultural point of view, registered an accelerated urban development. This led, in time, to an increased surface of the built space while reducing the green spaces.

In the current period, the evolution of the city is dominated by the prevailing building of residential complexes, usually on the periphery, and the green areas have a more individual character, being so constructed as buffer zones between the built perimeters and the playgrounds.

The area selected as a case study is characterized by a long urban evolution, showing within its limits buildings from periods of different urban planning, alternating with green spaces with various functions (entertainment, social function, ecological, aesthetic role, and decorative), some of which were landscaped after classical models (Cismigiu Garden, Garden Icoanei).

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Quantitative assessment of soil erosion using GIS empirical methods in the upper catchment of Bârsa River

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Abstract. The study regards the estimation of soil erosion rate through the application of the USLE/RUSLE equation within GIS in the upper basin of Bârsa River. Our work also compares between treed and deforested nearby areas. The end product is a susceptibility map that can be used as a support to determine the regions that are prone to erosion. This study only addresses rill and inter-rill erosion.

Keywords: *soil erosion, susceptibility, RUSLE equation*

1. INTRODUCTION

The determination of soil loss predisposition within a drainage basin is considered a significant theoretical and practical issue, the knowledge of it creating premises for a better management.

Various approaches can be adopted in soil loss determination. The main methods of risk erosion evaluation are classified as either *expert*-based or *model*-based approaches. (Knijff, et al., 2000).

The expert-based approaches imply the identification of areas with accentuated erosional processes by granting factorial scores. The main limitation in applying this method is linked to the uncertainty in defining the criteria according to which areas are delineated (Yassoglou et al., 1998).

The availability of digital databases eased the development and use of mathematical models for soil loss risk analysis. Another division can be made between empirical and physically-based models. (Grimm et al., 2002).

One of the most used empirical methods is the USLE model (Universal Soil Loss Equation) developed by Wischmeier & Smith in 1978. The USLE model is based on the regression rates of soil erosion analysis for annual determinations. In 1993, the Revised Universal Soil Loss Equation (Reynard et al., 1997) bettered up the previous one by updating the methods to calculate the terms in the mathematical equation. Although the model has limitations, it is used due to the flexibility and low data demand (Bosco et al., 2015)

In Romania, the Institute for Soil Science and Agrochemistry Research has made studies to calibrate these coefficients to the local and regional environmental conditions found in Romania.

2. METHODS

The quantitative assessment of the soil erosion for the Bârsa River upper catchment has been made using the RUSLE model and by adapting some of the coefficients according to IPCA methodology (Florea et al., 1987). The estimation of the soil erosion rates has been determined for the years 2006 and 2016, aiming to observe the influence of changes in land use and their implications in the quantities of eroded soil from the river basin.

The RUSLE model is designed to predict only rill and inter-rill erosion. Sediment deposition processes or concentrated overland flow erosion are not taken into consideration (Bosco et al., 2015).

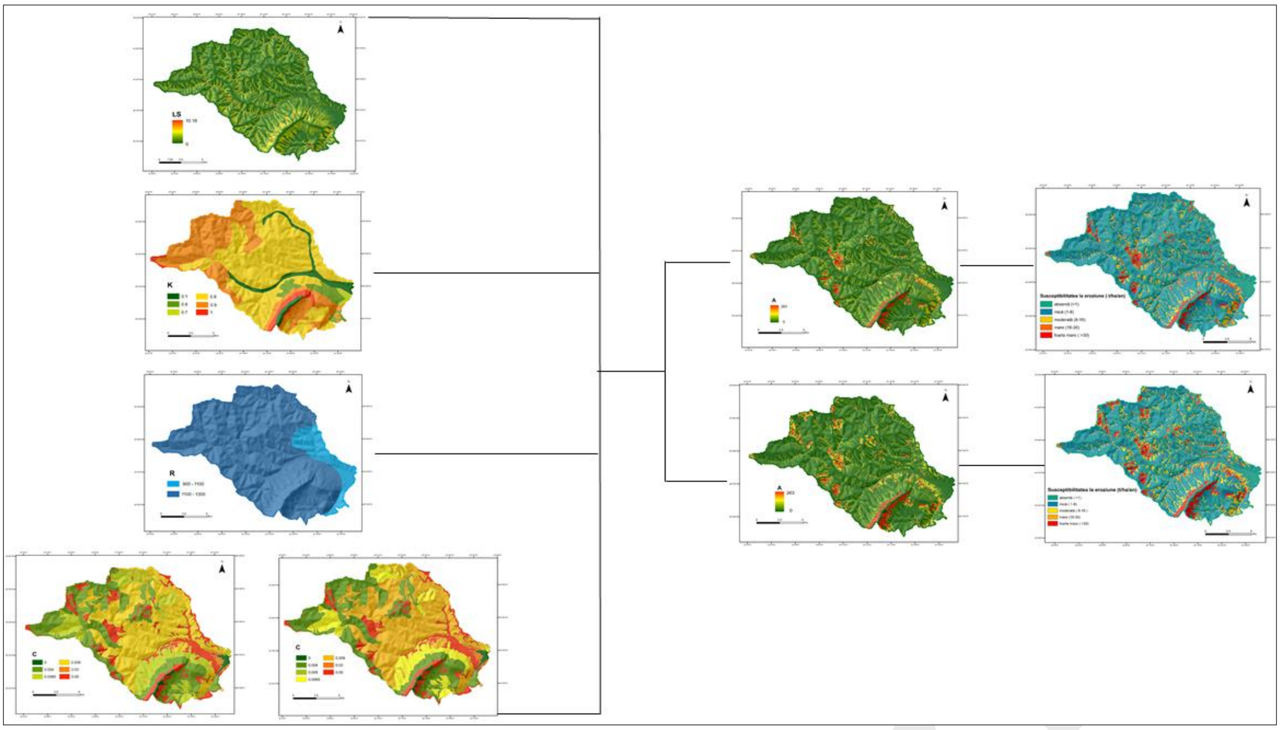

***Figure 1**. Implementation of RUSLE equation in ArcGis*

In the RUSLE model, five factors (LS, C, K, R, and P) are multiplied to compute the annual average soil loss per unit area. Because supporting practices are missing, the correction coefficient for the effect of erosion control measurements (P) is equal to 1.

RUSLE is defined as:

$$A = R \times K \times LS \times C \times P$$

- A: is the average annual erosion rate (t/ha an);
- R: is the rainfall erosivity;
- K: is the soil erodibility;
- LS: is the slope length influence;
- C: is the correction coefficient for the effect of vegetation;
- P: is the correction coefficient for the effect of erosion control measurements.

The implementation of the equation is presented in Figure 1.

The input parameters are represented by the STRM at a resolution of 90 m, the soil map (soil type and texture) at 1:200,000, the land use according to CLC 2006 and Google Earth Maps 2016. The spatial information was computed with the ArcMap 10.1 software.

Slope Length Factor (LS)

The LS factor represents the product of the slope length (L) and slope steepness (S) in order to represent the specific effects of topography on soil erosion.

The original USLE is only effective at predicting soil loss for slopes with a low gradient (Remortel et al., 2001), but RUSLE has been adopted to a wide range of slope gradients (McCool et al., 1989).

We chose to use the Unit Stream Power Erosion and Deposition Model for calculating the LS factor because it can be implemented by using ArcMap tools. The topographic calculations are shown separately:

$$L = (m+1)\left(\frac{\lambda_A}{22.1}\right)^m$$

L = the slope length factor at some point on the landscape

λ_A = the area of upland flow

m = adjustable value depending on the soil's susceptibility to erosion

22.1 = the unit plot length.

$$S = \left(\frac{\sin(0.01745 \times \theta_{deg})}{0.09}\right)^n$$

θ = the slope in degrees

0.09 = slope gradient constant

n = adjustable value depending on the soil's susceptibility to erosion

The values of the exponents m=*0.4* and *n =1.4* are typical for low susceptibility to rill erosion (Pelton et al., 2016). Because slope values have to be converted in radians for the sin calculation, they are multiplied by the constant 0.01745.

Soil erodibility Factor (K)

The soil erodibility factor is a quantitative description of the susceptibility of soil particles to split and be transported by rainfall and runoff. (McCloy, 1995). Our dataset only includes information only on soil type and soil texture (clay, silt, fine sand and sand). Because most calculating relations require structural and permeability information, we have used the erodibility values as specified by the *ICPA* standards (1987).

Cover management factor (C)

The C factor represents the effect of surface cover and roughness on soil erosion (Cogo et al., 1984). Vegetation directly influences the impact and intensity of rainfall, the resistance to water flow and the amount of water available for transporting the sediments (Rousseva, 2003). As the surface cover is less exposed to erosion, the C factor value approaches zero. The C-factor was defined for each CORINE Land Cover class according to literature values (Lee, 2006).

Rainfall erosivity factor (R)

Statistical studies conducted by the American Meteorological Society indicated that the annual rainfall-runoff erosivity factor (R) is closely related to the maximum amount of rainfall in 6 hours with 50 percent probability of occurrence (Păcurar, 2001). To estimate it, Wischmeier proposed the relation R = 27.38 (I6h, 50%) 2.17, where I6h, 50% is in inch. A similar relation has been established by Moțoc and Stănescu to evaluate rainfall-runoff erosivity for Romania: R = 0.0426 (I6h, 50%) 2.17, with I6h, 50% being measured in mm. It has to be mentioned that R coefficient values (calculated above) are expressed in US customary units, therefore it is necessary to transform them in SI units (MJ mm/ha-1 h-1 an-1) multiplying by 17.02.

Considering that the upper catchment of Bârsa River, part of the zone 19 that corresponds to the mountain area, the average intensity for the maximum of 6 hours rainfall and 50% probability of occurrence is given by STAS 9470-73- at 17 l/s ha (0.1 mm/min) resulting in a quantum of 36.72 mm. Applying the relations above, results a value for R factor of 1803.88 MJ mm ha-1 h-1 year-1, when using the relation proposed by Moțoc.

3. RESULTS

The estimation of the erosion risk resulted from multiplying the four grids corresponding to LS, K, C and R factors.

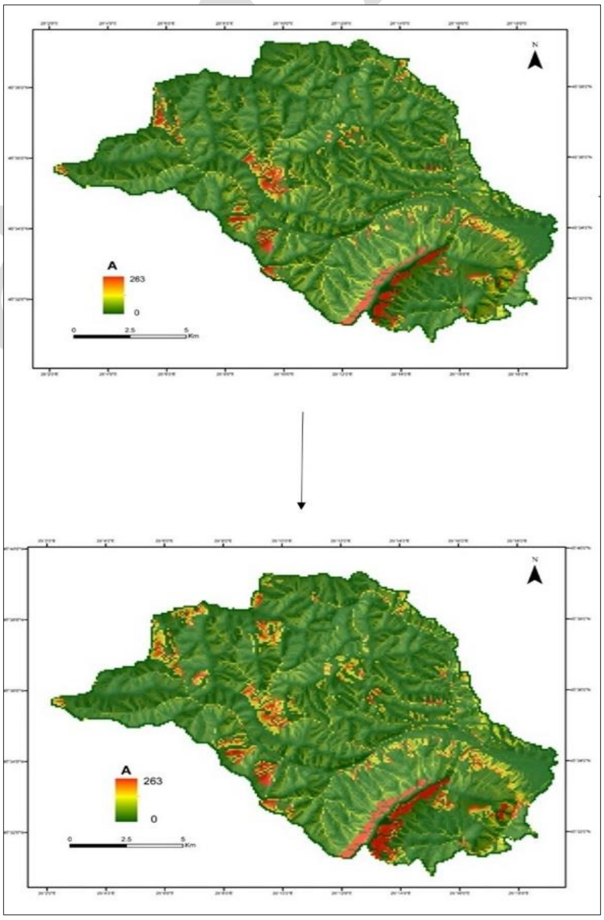

***Figure 2**. Approximated soil loss (t/ha/yr) in 2006 and 2016*

To be noted that LS, K and R factors don't variate for the given period.

The analysis of both maps (fig. 2) leads to the following observations:

- The estimated annual quantity of soil loss varies between 0 – 263 t/ha.

- Values higher than 100 t/ha have an insignificant weight.
- Most of the surfaces have a value in range of 0 – 25 t/ha which corresponds to wooded areas.
- The main areas susceptible to erosion are covered with herbaceous vegetation, or are rockery areas and steep valley thalwegs that appear as lines of concentration for the eroded soil, thus representing linear erosion channels.
- The areas located under the main ridge highlight the scale of linear erosion in subalpine torrential catchments, where the slope is the primary influencing factor.

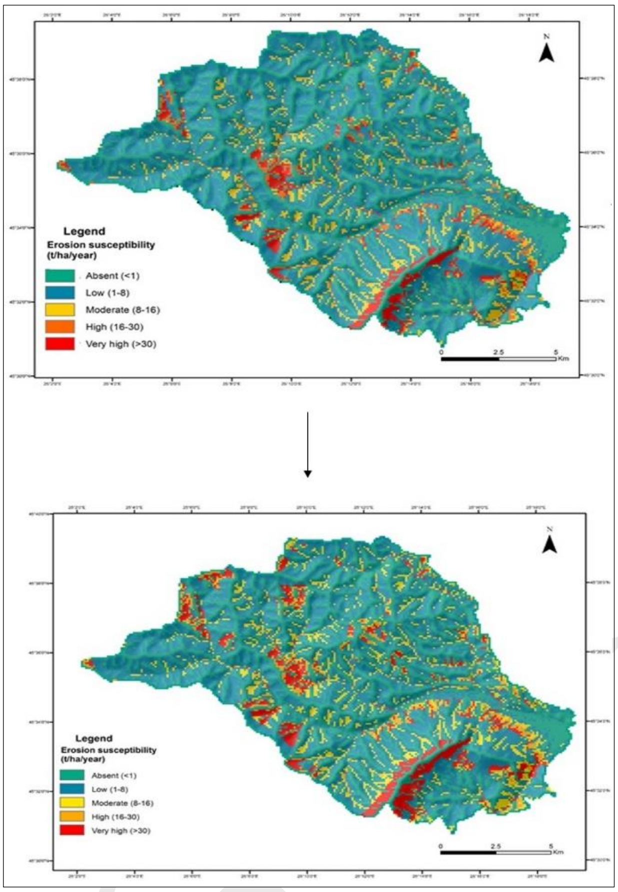

***Figure 3**. Soil erosion susceptibility in 2006 and 2016*

In both years, 2006 and 2016, the highest susceptibility shown in Fig. 3 corresponds to alpine and subalpine areas, where sheet washing is the main process. The valleys appear as areas with moderate soil loss owing to stream erosion.

Between 2006 and 2016, 583.8 hectares were deforested, which corresponds to 5% of the total catchment area. These land use modifications triggered changes in the spatial distribution of soil loss susceptibility classes, which can be observed in the two maps above.

4. CONCLUSION

The spatial distribution of the estimated erosion emphasizes the importance of cover management practices. Irrational deforestation favours the appearance of soil loss on land with high slope gradients, were values can be 10 times higher than those in adjacent wooded areas.

Even though we did not have measurements of erosion to validate the results, by comparing our outcomes with others studies the results are much alike.

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A methodological framework for the morphometric analysis of the fluvial islets along the Danube River in the Giurgiu – Oltenita sector

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Abstract. This paper presents a methodology exclusively based on using the Open Source GIS Technology for the morphometric analysis of the fluvial islets along the Danube course. The study area corresponds to the Giurgiu-Oltenita sector, one of the sectors displaying a relative stability regarding the number and distribution of such geomorphological landforms. In order to identify and achieve a morphometric analysis of the Danubian fluvial islets, we suggest a set of eight parameters: the total number of fluvial islets, maximum length, maximum width, elongation ratio, area, perimeter, perimeter/area ratio and shape index. The necessary geospatial data used to compute the morphometric parameters have been obtained from cartographic documents and ortorectificated aerial imagery, while in order to obtain the final results, a graphical geoprocessing model has been created and run.

Keywords: *methodology, morphometric analysis, fluvial islets, Danube, graphical model, GIS*

1. INTRODUCTION

Geographical descriptions frequently refer to the shape of geographical elements. Until the 1960s, the shape of a region or geographical object has been mainly used as a descriptive device (Boyce, Clark, 1964). Subsequently, the need to quantify the shape of geographical elements has lead to the identification of a considerable number of mathematical parameters.

Currently, the evaluation of shape represents a challenge, as there is no unanimous agreement regarding a standard set of parameters needed to quantify shape. According to Sovik (2014), the parameters tend to fall into two categories: i) single parameters (for example, perimeter or area) and ii) multiple parameters – usually involving more complex mathematical functions.

Geographical information systems represent a modern technique of achieving an objective and complex analysis of the shape of a geographical element. Its popularity among the Earth Sciences has lead to numerous functionalities implemented in specialized computer software.

This article intends to illustrate a methodological framework for the morphometric analysis of fluvial islets, using open source software. The final results were obtained by running a conceptual model of the operations flow of such an analysis.

Fluvial islets are positive geomorphological landforms, specific to fluvial relief. Their occurrence, development and disappearance, are largely influenced by changes of the hydrological parameters and anthropic activities. Fluvial islets may have a biological, socioeconomic, and even geopolitical impact (Picco et al., 2014, Sadek, 2012).

In the literature, a number of significant studies have been conducted to investigate the morphology and morphometry of these landforms (Wyrich, 2005; Ricaurte et al., 2012; Kiss, Andrási, 2014; Raslan, Salama, 2015). Wyrich (2015) investigates the correlation between the shape of fluvial islets and the hydrogeomorphological processes occuring in the river bed. The author describes the morphology and morphometry of several fluvial islets along various north-American rivers, in regard to an elongation ratio. Kiss and Andrasi (2014) suggest a classification of fluvial islets based on this elongation ratio. The authors have identified four classes: I) an elongation ratio less than or equal to 2 shows a fluvial islet with a circular shape; ii) an elongation ratio greater than 2, but less than or equal to 4 shows a slightly circular shape; iii) an elongation ratio greater than 4, but less than or equal to 6 shows an elongated shape, while iv) an elongation ratio greater than 6 shows a strongly elongated shape.

Ricaurte et al. (2012) have analyzed the spatial distribution and geometrical characteristics of fluvial islets along European rivers affected by engineering works, thus distinguishing ten morphometric parameters (from the number of islets to density index). Equally ample descriptions of fluvial islets geometry, through morphometric parameters (length, width, elongation ration, perimeter, aria, density index) have been addressed by Raslan and Salama (2015). The authors have chosen as case study the alluvial islets along the Nile, in the sector between the Aswan and Esna dams.

2. STUDY AREA

We have chosen to apply the suggested methodology of computing the morphometric parameters based on GIS technology on the Danube sector situated between the Romanian localities Giurgiu and Oltenita (Figure 1). Specifically, the focus is on the fluvial islets along this sector.

The difference between a fluvial bar and a fluvial islet has been based on the absence or presence of vegetation (Figure 2).

We have chosen this sector because of the fact that, along the Lower Danube, this is the only sector with a relative stability regarding the number and distribution of fluvial islets. In the past three decades, a general downward trend has been noticed, regarding both the number, and the area of fluvial islets along the Danube (Constantinescu et al., 2015). This tendency may be explained through: I) the construction of the dams Iron Gates I and Iron Gates II, ii) the construction of dams along the Danube's main affluents, iii) lower sediment transport rates, iv) embanking works of the floodplain and v) frequent and aggressive floods.

Currently, between Giurgiu and Oltenita, there are a little over 20 fluvial islets, their number remaining relatively unchanging over the years.

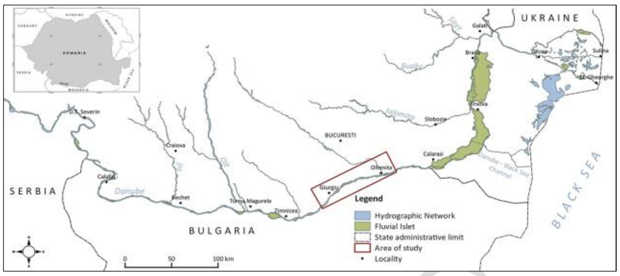

***Figure 1**. Localization of the study area*

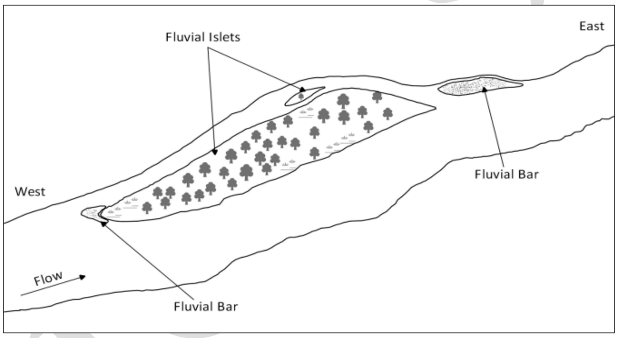

***Figure 2.** Identification and representation of fluvial islets and fluvial bars*

3. DATA PROCESSING

Using GIS technology to achieve a morphometric analysis requires a set of geospatial data in a format that is compatible with the software. Cartographic documents represent an important source to obtain historical data, allowing us to follow the evolution of geographical elements and phenomena.

We have selected four sets of historical maps and an ortophotoplan, spread over a total of 146 years (1864-2010). Five different years have been chosen as reference, corresponding to the following materials: *The Szathmary Map* (1864), *Islets Map* (1900), *Romanian maps under Lambert-Cholesky projection system* (1920), *Topographic Map of Romania 1:25k* (1980) și *Ortophoplan of Romania* (2010).

Out of the list of cartographic documents mentioned above, only *Islets Map* (1900) has been obtained non-georeferenced from Romanian Academy Library, The Maps Department. As such, the georeferencing process has been performed by us. As the map did not have a grid, we have opted for an image-to-image georeferencing, choosing as control points the geographical coordinates of milestones along the Danube. All cartographic materials were used in Romanian Stereo70 projection, Dealul Piscului Datum.

Subsequently, through digitization, positive geomorphological landforms, fluvial bars and fluvial islets have been extracted in polygonal format.

For each record, in the attribute table we have displayed both the attributes inferred by visual interpretation of the cartographic documents (for example, the type of landform, toponimy, the absence or presence of vegetation), as well as the morphometric attributes obtained by running specific algorithms implemented in Open Source GIS software.

4. AUTOMATION OF THE COMPUTATION OF MORPHOMETRIC PARAMETERS

To study the geometry of the fluvial islets, we have used a set of morphometric parameters, which have been computed for each of the five years used as reference (1864, 1900, 1920, 1980, 2010).

Morphometric parameter	Description
Total number of fluvial islets	The total number of fluvial islets along the study area
Maximum length	The maximum length of each islet, in meters
Maximum width	The maximum width of each islet, in meters
Elongation ratio	The ratio of the maximum length to the maximum width
Area	The area (m²) of each islet, divided by 1000000 to convert to km²
Perimeter	The perimeter (m²) of each islet, divided by 1000 to convert to km
Perimeter/area ratio	The ratio of the perimeter to the area of each islet
Shape index	100 * P/(2*√(π*S))

Table 1 *Parametrii morfometrici calculați*

From a geometrical point of view, the fluvial islets along the Danube river have an irregular shape, and as such, computing mathematical parameters using computer software proves difficult. Computing the length and width of each graphical entity was performed through the Minimum Bounding Box (MBB) or Minimum Bounding Rectangle (MBR) method.

The method aims to find the rectangular box with the smallest area, within which the irregular polygon lies, rotated according to the orientation of the irregular polygon. Unfortunately, few Open Source GIS software have such a functionality. As such, it has been a challenge, both finding a way to automatically find the length and width of each fluvial islet, and finding the right software to do so. Eventually, we have opted for the WhiteBox GAT software (Figure 3).

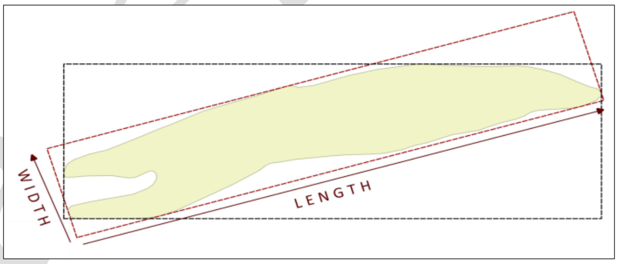

Figure 3. *MBB/MBR in QGIS (dotted black line), and in WhiteBox GAT (dotted red line)*

To automate the work flow, the functions have been joined in a graphical model, using the Processing Modeler module from Open Source Quantum GIS. To compute the area, perimeter and elongation ratio, we have used the specific function from Quantum GIS, while to compute the perimeter/area ratio and shape index, we have used functions from a different Open Source GIS software: SAGA GIS (Figure 4).

The main components of any GIS model are: the input data, the function, and the output data. In this case, the input data is represented by the vectorial geospatial data (in *shp format), illustrating the geometry and attribute data of the fluvial islets. The functions are the tools implemented in the aforementioned software, and the output data is the numerical data in the attribute table of the input shapefiles.

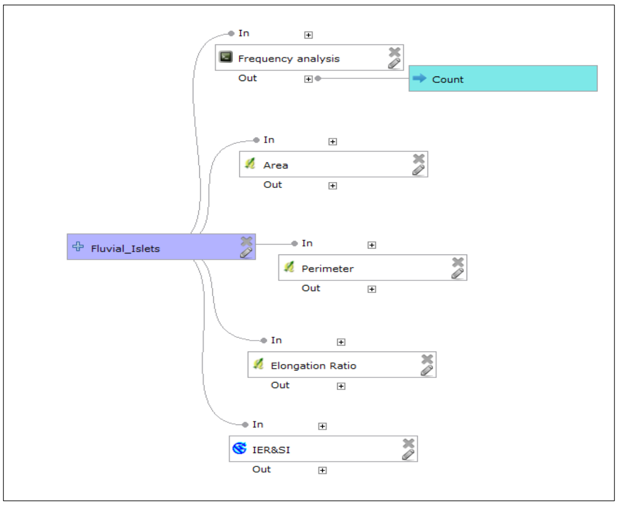

Figure 4. *Graphical Model*

4. RESULTS AND DISCUSSIONS

As a result of running the graphical model for each reference year, we have cataloged the fluvial islets (Figure 5) and computed the morphometric parameters mentioned in Table 1 (Figure 6).

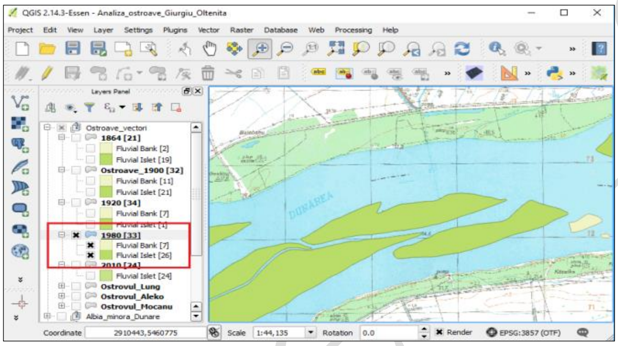

Figure 5*. The total number of fluvial islets and fluvial bars in the Giurgiu-Oltenita sector, shown in Quantum GIS (the red rectangle highlights an example for the reference year 1980)*

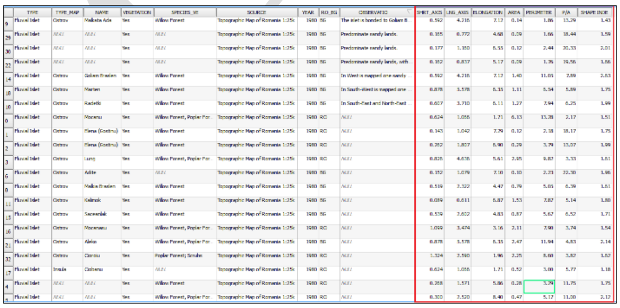

Figure 6*. The attribute table for the reference year 1980 (the red rectangle highlights the attributes added after running the graphical model)*

The output data may be visualized as a table, as seen in Figure 6, but also graphically (Figure 7), the latter proving more advantageous as a way to interpret the values of the morphometric parameters.

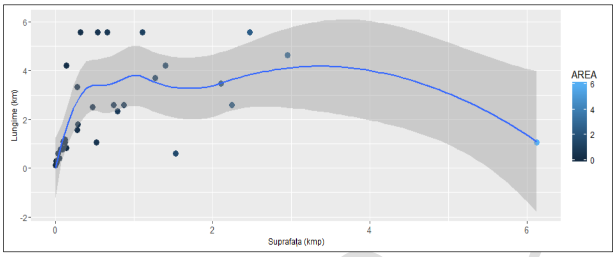

Figure 7*. An example of graphical representation of two morphometric parameters computed for the year 1980*

The results highlight a slight increase in the number of fluvial islets along the Giurgiu-Oltenita sector, with a total area ranging between 19.28 km² (1900) and 24.55 km² (1980). The elongation ratio values illustrate a tendency towards more elongated shapes, especially after 1980.

High values of the perimeter/area ratio (5-90) and shape index (1.2-3.0) showcase the irregular and complex shapes of the fluvial islets.

The irregular and elongated shape specific to the fluvial islets along the Danube may be associated to the erosion and accumulation process along the river bed, which in turn are influenced by a series of factors: water level, water discharges, sediment discharges, the frequency of floods and droughts, slope, currents, neotectonics movements, engineering works executed both upstream and in the study area.

5. CONCLUSION

This article presents a methodological framework based on using Open Source GIS Techniques, which allows the identification and morphometric analysis of the fluvial islets along the Danube course. As such, a set of eight parameters has been suggested: the number of fluvial islets, maximum length, maximum width, elongation ratio, area, perimeter, perimeter-area ratio, and shape index.

The automation of the computation of these morphometric parameters for the reference years has been performed by creating and running a geoprocessing model. Thus, a higher number of functions may be used, increasing efficiency. The graphical model may be used as an instrument through Quantum GIS software, aiming to perform the same kind of analysis for any other study area.

We believe that the suggested methodology offers a higher degree of objectivity in regard to the results, and is not as time-consuming compared to manually measuring and calculating the morphometric parameters.

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Participatory research methods applicable in geographic tudies

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Abstract. The aim of this article is to present methods of participatory research and PGIS participative mapping and their applicability to geographic studies. Participatory research has emerged as a reaction to the traditional pyramidal research approaches. 2014's Future Earth Agenda indicates that there are issues regarding a) the need for the co-creation of knowledge and integration of academic and non-academic knowledge and b) development of collaborative research with different stakeholders in order to address current global environmental challenges in a sustainable manner. After a theoretical introduction, the author presents the applicability of focus groups interviews and PGIS participative mapping in a trans-disciplinary project concerning the Lower Danube Floodplain evolution. The PGIS research field is a domain, which links GIS with the critical geography thinking being based on the implementation of participatory research methods. The current international policy of Future Earth is raising awareness about the importance of participative research methods and the article presents two practical applications of such methods.

Keywords: *participative research, focus group interviews, PGIS participative mapping, Lower Danube*

1. INTRODUCTION

The tradition in participatory research is based on the principles of Kurt Lewin (1946) about active/action research, which in turn was influenced by John Dewey (1910), the father of the educational philosophy of pragmatism who believed that education and learning are social and interactive processes. Richard Rorty (1979) was a continuator and a modern representative of this philosophical tradition who saw the idea of knowledge as a 'mirror of nature'.

Participatory research has emerged as a reaction to the traditional pyramidal approaches. Research strategies in Western Europe are largely based on participation and there are many positive example from United Kingdom (Cornwall and Jewkes 1995) where governmental and non-governmental organizations resort to participatory research methods motivated by pragmatism but also concerns about equity, including eco-equity.

As Cornwall. and Jewkes (1995) highlights traditional /conventional research methods generate knowledge / information that helps understand various phenomena, while participatory methods generate knowledge /information for action at the right time in a space inhabited by a group/community directly affected by a diversity of problems and issues debated by academia.

There are different types of participatory research methods according to the level of involvement of the participants to research, starting from a) business as usual **consultative research**, where the participants are passively involved in research led by academia or researchers to b) a new way of working such as **collaborative research** (Future Earth, 2014), where the participants to research (stakeholders /non-academia) play equal roles with academia in the research process to c) **Participatory Action Research (PAR),** a method used since the 1970s, in which the researcher acts only as a facilitator guiding participants to collect relevant information, reflect, plan and act on it. In this case the knowledge and decision making process belongs to the participants. Freire

(1970, 1973) developed the concept of 'Participatory action research' (PAR), which demonstrated that educating the masses is a tool that changes the structure of a society. The 'pupil' was considered a passive recipient of knowledge, which was in the possession of an 'educator', just as money is in the possession of a bank. He organized a multidisciplinary team that developed educational materials to stimulate groups to reflect on their own lives, organized people in circles to regain cultural identity and indigenous knowledge and encouraged them to discuss about controversial issues followed by reflection and action.

Braun AR and Hocde H (1998) define PAR as a process by which a group or a community identify a problem or an issue of interest, reviewing what it knows about it conduct research on the specific issue/problem, analyze information generated, conclude and implement solutions. The decision making position is implicit and belongs to the group / community involved.

Xunaxi Cruz Velasco (2013) suggestively defines the cyclical phases of PAR for sustainable community development, which are represented in Figure 1 below.

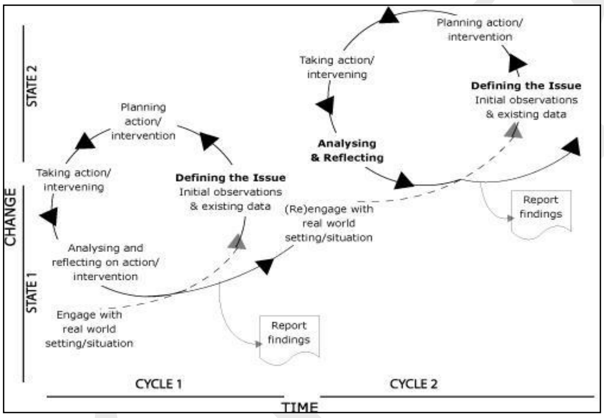

Figure 1. *PAR for a sustainable community*

An important principle of participatory research is that ethics should be at the core of the research process and the relationship between researcher and participant must be based on an informed and ongoing consent to participate in research.

Currently there are issues regarding the need for the co-creation of knowledge and integration of academic and non-academic knowledge and research (Mauser et al, 2013). In order to address this problem, the Agenda of the above mentioned Future Earth (former Global Environmental Facility – GEF) aims to create 'Knowledge-Action Networks,'. 'The networks bring multiple disciplines and societal actors together to understand and respond to the global challenges facing humanity'. Future Earth has a 'collaborative approach to knowledge generation' using academic and non-academic knowledge aiming to integrate natural and social sciences and humanities (www.futureearth.org).

Future Earth is based on a coalition of National Future Earth organizations. According to the Romanian Academician, Prof. Dr. Dan Balteanu (2016), the National Romanian Committee of Future Earth is an organisation named 'Terra in the future - Research for Global Sustainable Development' and the inaugural meeting of this committe was organized by the Institute of Geography of the Romanian Academy, in Bucharest on 30th of June, 2015.

2. STUDY AREA

This chapter presents two different methods ascribed to the participatory research field: a) the method of focus groups and b) PGIS (Participative Geographical Information Systems), a type of participative mapping developed in the last 10 years based on the sketch mapping, both methods were used in a project led by Francisc I Rainer Institute of Anthropology - 'Taming the post-socialist Nature: Floods, Local Strategies and National Policies along The Lower Danube' between 2013 - 2016 (www.politicalecology.ro).

What is distinctive for participatory research are not the methods used, which may be qualitative or quantitative, but the methodological and cultural context in which they are applied. Therefore essential to facilitate dialogue between people or 'groups' is the need for a system of common understanding, especially of concepts and ideas that might seem different from the terms defined by the scientific world as the common understanding but have a special meaning for the group concerned. Words / terms used become 'impregnated' with special meaning in certain social groups / communities.

2.1. The Focus Groups

The Focus Group interview idea was developed in the 1930s, but the acceptance of focus group interviews was delayed in the academic and scientific circles until de 1980s. In the 1970s the focus group interviews became a tool largely used by private sector marketing researchers, which discovered that the method was important in 'shaping marketing strategies for products' (Krueger and Casey, 2000).

For the last 20 years the 'Focus Group: A Practical Guide for Applied Research' by Krueger and Casey remains the most important book which explores the process of focus group research. The book was republished and up-dated 5 times drawing on the authors more than 30 years of hands-on experience in using focus groups.

A focus group is usually composed of 4 to10 participants who have certain characteristics in common that relates to the purpose of research, a facilitator/mediator who creates a comfortable and inviting environment, which allows people to express different points of view. Trends and patterns in perceptions on a number of themes (subjects) are identified after several focus groups (minimum number is 3). Despite the fact that the questions appear to be spontaneous, the first set of questions are ordered in a logical manner and carefully selected before the focus group interview.

The questions from the first focus group are usually more general, in time the questions evolve becoming more detailed and specific helping people to start talking and thinking, reflecting upon the themes/subjects. There is no pressure from the moderator that a consensus is reached, on the contrary special attention is paid to feelings, comments and any information on the local cultural/social context.

The main advantage of a focus group is that many people find a face to face interview an uncomfortable experience and focus groups include people who are usually excluded, such as minorities, women and people who do not participate because they think that only specialists and people with authority in their community should participate in research (Nenciu Posner, 2015).

2.2. The PGIS Method

PGIS site was formulated in close connection with the PAR concept within the context of emergence and widespread use of Geographical Information Systems (GIS) (Abbot et al, 1998).

PGIS aims to challenge the traditional roles of researcher and researched subject in geographic analyses. With PGIS, spatial analysis becomes a collaborative action involving constituents of a community (insiders) and researchers (outsiders) in a production system including spatial information which gives more power to local people. Increased availability of geospatial data and technology, combined with the iterative nature of the creation of digital maps and multimedia applications for viewing them in the community is the basis for PGIS (Elmore, 2013).

PGIS is an approach that allows the connection of sciences (geography, social sciences, cultural and environmental) and policies, plans and strategies through a bottom up process and representation of all interested parties (stakeholders).Free software such as Open Street Map, Quantum GIS, Global Mapper, Google Earth, satellite maps or orthophotoplans which can be accessed free of charge enables anyone with a computer and Internet access to create 2D/3D maps and a data base that can include important local knowledge (Nenciu Posner, 2015). PGIS increases the ability of disadvantaged people to generate, manage and use their Indigenous Spatial Knowledge (ISK) (Rambaldi, 2013) and spatial information generated from the outside in contexts such as:

- Managing and improving the conflicts in terms of access, use, control and allocation of natural resources;
- I is a collaborative research endeavour;
- Conservation of intangible cultural heritage and strengthening the identity of indigenous peoples and rural communities;
- Good governance in terms of transparency and decision making on spatial data in a consensual manner;
- Reducing the risk and hazard management by local communities (Gaillard and Maceda, 2009)
- Promoting equity on ethnicity, culture, sex and eco-justice.

3. RESULTS

During my research in Danube floodplain between 2013-2016 I used several focus groups in order to identify the human adaptation to changes of river and floodplain environment and facilitate discussions during two PGIS mapping exercises. I have also conducted several focus groups at different times with 4 groups of women to discuss day to day life specific to the Danube floodplain environment before and after embankment of Danube in 1960s.

The two methods of research were applied in two different communities from the Romanian Danube Valley: Gostinu Village, from Giurgiu County and Rast Village from Dolj County.

Gostinu is a village located on Danube floodplain with a population of 2032 inhabitants (2011 census) and a mixed economy: agriculture, fishing, tourism. The area has been enclosed by raised embankments and drained through different projects, started in the 1920's and continued up to the 1970's.

Rast Village, Dolj County is composed of Rastul (the old village) and Rastul Nou (located 9 km north of Rastul Vechi. Rast's economy is based on agriculture and has a population of 3343 inhabitants (2011 census) and is not situated in the floodplain, only the agricultural land being in the floodplain. Rast Village was dramatically affected by 2006 floods after which the local authority attempted to move the entire population to New Rast.

At first I started using the focus group method because the majority of women that I approached during my study were shy and reluctant to speak about their day to day life and thought that their opinion was not so valuable. Many women said that their role was not so important because they worked for the cooperative farm as unskilled labourers and suggested that I should speak to their husbands and other people, usually men who had powerful positions or worked for the agencies involved in embanking the Danube River.

The focus groups with women were the most valuable because they provided information on everyday life and human adaptation based primarily on the use of the Danube ecosystem services. Thus women identified a varieties of food sources - shellfish, wild edible plants (e.g. wild asparagus) that disappeared with the embankment and the destruction of natural floodplain environment. All women have discussed issues concerning difficulties regarding transport and communication, practical problems encountered during the last flood, then they indicated places where there were natural ponds in the middle of the village and the direction of pathways for water during floods.

The men from Gostinu put great importance on technology, the jobs they have made them to worship technology and over estimate its importance. Women instead were maintaining that the technology will not be enough if Danube River erodes its banks because there will not be enough boats for everyone in the village and all new houses built at altitudes lower than 18 m will be flooded.

The men from both Rast and Gostinu tended to use the formal terms, while women knew the local toponymy and its origin and used a rich vocabulary to describe their immediate environment and their observations of plants and animals specific for the floodplain.

Information obtained through the focus groups was not representative for the entire population but allowed me access to disadvantaged groups and valuable information/local knowledge on human adaptation. The PGIS method was used for a variety of reasons, but for the purpose of this article I will present two different PGIS maps, one from Rast and the other from Gostinu. Both maps were developed to identify the agricultural areas affected by infiltrations of water through the levees (longitudinal 4-5 m in height dykes built along the river). These phenomena determined huge agricultural losses in both villages under study.

The map in Figure 2 below identify areas of up to 30% of all arable land, where water accumulates due to infiltrations through the levees in areas which become unusable for agriculture.

In Rast the area affected by infiltrations is considerable as shown in Figure 3 below.

The areas affected by excess humidity were then superposed on older maps, indentifying that these areas occur mainly in areas of former ponds/lakes that were once part of the natural floodplain and an increased water logging in some areas due to the drainage works.

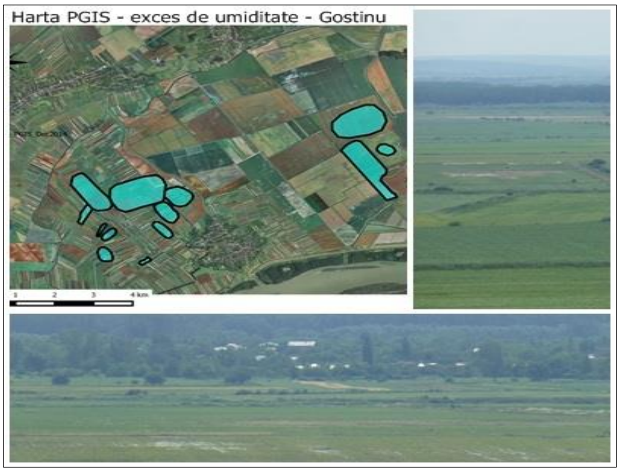

Figure 2*. Gostinu PGIS Map and pictures showing effects of water infiltration through the levee*

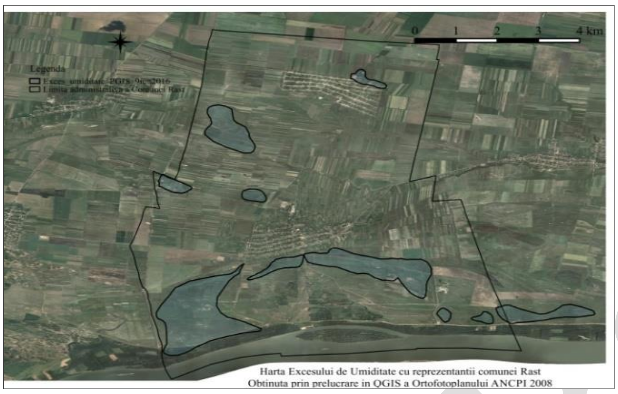

Figure 3*. Rast PGIS Map*

The use of the PGIS method was so suggestive and participants were very pleasde to work with a maps which were worth more than a thousand words.

4. CONCLUSION

The purpose of this article evidenced by the results regarding the use of the focus group and PGIS methods was to show that using participatory research methods brings very valuable information and local knowledge in one place, which is relevant to the communities studied, empowering them to make decisions about real problems identified by them.

By implementing participatory research methods such as PGIS the author gives an example on how to increase the capacity of villagers from Gostinu and Rast to visualize and understand spatial information and knowledge about their community. This information should help reflect and find appropriate ways of adapting to excess humidity affecting more than 30% of the arable land and to consider other options that are available to villagers current situation determined by specific geographical, ecological, cultural, social and economic contexts. In this process the participatory research brought together different generations, experts and non-experts to facilitate an exchange of information and learning about former adaptations, past mistakes and in this way to help create a collective spatial database.

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Corporate characteristics and anthropological disasters

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Abstract. Critical infrastructure is business. All critical infrastructure is managed by companies, whether state, public, or joint companies. These companies have owners (stockholders), again private and/or state entities, and employees (managers and workers). If we are to understand how an operationalisable behaviour such as whistleblowing works in relation to critical infrastructure vulnerability we must first analyse the wider level relationship companies/corporations have with society, particularly in terms of human health and safety and the environment. We therefore look at corporate accidents, characteristics, dangers, and accountability. The aim is to offer a background on which we can identify what makes a company behave ethically.

Keywords: *corporate accidents, whistleblowing, corporate dangers, corporate responsibilities, business ethics, critical infrastructure*

1. CORPORATE ACCIDENTS

Did you ever expect a corporation to have a conscience, when it has no soul to be damned, and no body to be kicked?' Baron Thurlow (1731-1806), Lord Chancellor of England, (Coffee, 1981).

There is an increasing awareness and expectation of the health and safety responsibilities and duties of large corporations. Advancements in technology have bettered our lives but have also changed the nature of disasters making them far costlier than in the past. Corporations are in a position which enables them to identify the risks flowing from their operations and take steps to avoid such disasters.

Before we even consider discussing organisational misbehaviour we must first deal with the wider, and only apparently more benign, issue of human error. Human errors in corporate operations can be traced back to defective systems – technological or procedural. The root causes can be found at what Whittingham (2008) calls the 'workface', or the interface between the worker and the work environment. Most errors are active, in that their effects are immediately observable. A train conductor not noticing a signal and derailing the train is an active error. However, what we usually notice is that this is not the root cause of the crash. The root cause is in defective systems, for example management allowing operations despite being aware the signal is obstructed. The point here is that the cause is not the driver but the system he relies on to operate in a safe manner. If fault is to be assigned, then it should go to the person responsible for the defective system.

Latent errors are errors whose effects are not immediately observed. Consequences can take effect at a later time and different place from that where the error took place. This makes them insidious and difficult to spot. Unless detected and corrected soon after they occur they generate the 'accident waiting to happen' type of scenario. We typically think of maintenance tasks not being carried out properly when considering latent errors yet the most far reaching latent errors are those at management level. Generally, management errors are latent errors.

To better understand the root causes of management errors we need to look at common cause failures (CCFs). CCFs are 'external mechanisms which have a common effect on two or more activities or items of equipment' (Whittingham, 2004). The concept is widely used in reliability analysis to model combinations of events. The idea is that the probability of two or more independent failures happening at the same time is very small. However, this only holds if the events are completely independent of each other. In industrial or corporate systems this situation hardly exists (Perrow, 2011). A common cause will tend to produce multiple failures at a higher rate than what probabilistic theory would lead us to expect from independent failures. Strategies to prevent corporate accidents include: 1) Safety culture, 2) Understanding risk, 3) Safety regulation, 4) Safety management, 5) The learning organisation, and 6) Corporate social responsibility.

The word corporation is derived from the Latin *corpus* or body, here referring to a body of people. Interestingly, the Oxford English Dictionary defines it as a 'group of people authorised to act as an individual'; thus introducing the theme of corporate personality. Definitions will vary depending on the country's legal system. We also notice preferences for the inter-changeable 'company' in countries such as Romania and the UK. The meaning is the same and the key points are that this entity has the capacity to act as an individual and, unlike an individual, potentially live forever.

We can trace companies to at least Ancient Rome and many of the original characteristics can still be found today. Their existence is state sanctioned, they have stockholders who invest money in a joint enterprise for a specific purpose, and are more than the sum of their members. The modern company began its life in seventeenth century England during the Enlightenment. Single ownership or partnerships, before this time, had been limited in their ability to raise capital. When joint stock corporations were formed, capital started pouring in. Between 1825 and 1849 the capital raised to build railways in England went from 200,000 pounds to 230 million pounds (Whittingham, 2008).

Gradual acquisitions and mergers led to large transnational companies. Often their main operations are located in other countries than the host country. Some of these transnational companies have total turnovers larger than the gross national product of the countries they operate in. Combine the negotiating power this brings about with regulation not as strict as that of the host nation and the potential for serious impact on health, safety and environmental conditions is greatly increased.

2. CORPORATE CHARACTERISTICS

'As every individual, therefore, endeavours as much as he can both to employ his capital in the support of domestic industry, and so to direct that industry that its produce may be of the greatest value; every individual necessarily labours to render the annual revenue of the society as great as he can. He generally, indeed, neither intends to promote the publik interest, nor knows how much he is promoting it. By preferring the support of domestik to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for the society that it was no part of it. By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the publik good.' Adam Smith (1723-1790), The Wealth of Nations, IV.2.9.

Although Adam Smith's invisible hand would correct for shortages he also had something to say about letting the mechanism unchecked and the distortions this brings to society. In regard to government oversight he wrote:

Whenever the legislature attempts to regulate the differences between masters and their workmen, its counsellors are always the masters. When the regulation, therefore, is in favour of the workmen, it is always just and equitable; but it is sometimes otherwise when in favour of the masters. Adam Smith (1723-1790), The Wealth of Nations, I.10.121.

Under this *laissez-faire* model employment reaches equilibrium based on supply and demand. After the second world war, the ideas of J. Maynard Keynes were adopted by most western governments leading to government borrowing for job creation programmes. The idea is that governments can control unemployment through public spending and reduced taxation thereby adjusting demand (Keynes, 2010). In recent decades, partly due to the influence of economists such as Milton Friedman, there has been a return to previous thinking across the leading market economies (Friedman, 2007). Crises and disasters generate pressure for tighter regulations and the periods of calm in between bring company-driven pressures for deregulation.

3. CORPORATE DANGERS

a. Cost externalization

Most critiques of the capitalist system will tend to include some of the following: 1) workforce exploitation, 2) resource extraction – particularly from poorer countries, 3) environmental damage, 4) imposing risk on workforce and public through activities. All of these can be summarised as 'externalising costs'. Any cost that can be externalised is a cost the company doesn't have to pay and as such its profits increase. Milton Friedman (1912-2006) succinctly defines externality as 'the effect of a transaction between two individuals on a third party who has not consented to, or played any role in the carrying out of, that transaction' (Bakan, 2004).

Business sees regulation as a 'dead hand' (Wilson, 1971) weighing heavily on efficiency, entrepreneurialism and profitability. The response comes in the form of intensive lobbying to reduce business restrictions (Hojnacki and Kimball, 1998). Some companies simply factor in fines and penalties as part of their operational costs. The cost of the fine is less than the saving achieved through externalisation.

b. Limited liability

Limited liability was first introduced to the UK in 1851. In contrast to previous arrangements, where stockholders could face personal bankruptcy should the company go in to liquidation, this new type of ownership meant the stockholders were only liable for the value of shares held in the company, irrespective of its fortunes. Directors were also exempt liability for debts, except for cases of fraud or personal guarantees (Easterbrook and Fischel, 1985). Limited liability is relevant in the disaster management context for obvious reasons. When a corporate accident occurs we will generally look at the managers for responsibility. However, the financial penalties are not borne by the managers, as they are employees, or by the owners, as they have limited liability. It is the company itself which is liable which means we must look more carefully at the relationship between companies and their accountability.

4. CORPORATE ACCOUNTABILITY

Companies have evolved over the past two centuries from small family owned businesses to massive transnational behemoths which actively shape society and culture. Technology has improved wellbeing but has also increased the potential for harm (Perrow, 2011). We often refer to companies in anthropomorphic language. This is not necessarily surprising given that when a company is registered it becomes a legal entity, with rights and obligations of its own, and which are separate from that of its founders. We refer to a company as being good or bad depending on how we perceive its relationship with society. The precedent which created this artificial person under the law was in the UK in the case of Salomon v A. Salomon and Co. Ltd. (1897). When creditors to the company tried to enforce their debs on Mr. Salomon himself the court found he was not personally liable and so separated the company's identity from that of its owners. This is called the 'veil of incorporation' (Easterbrook and Fischel, 1985) and allows companies to own subsidiaries without being responsible for many of their liabilities.

Though companies can be brought to court there are a number of laws which simply cannot be applied to them. For example, it is extremely difficult to prosecute a company for murder as this implies intent and it is held that companies do not possess a state of mind. Corporate manslaughter charges have been attempted but there seems to be a shift towards statutory legislation directed specifically at the corporate body. This is again partly because of the impossibility to prove *mens rea* or guilty mind under common or civil law.

Prosecuting individuals within the company is seen as greater deterrence or retributive justice when a company causes harm to natural persons because of: 1) limitations with penalties, mostly fines, and which are seen as disproportionate to the damage done, 2) a perception of relative impunity for the crime-committing company together with perceived lack of accountability for managers, and 3) the inability of a company to manifest regret. Victims will want to know that the individuals in the company which are responsible for the accident are identified and made to answer personally for their failures.

The corporate desire to increase profits and share value might seem to come in to conflict with the intention to mitigate risks. The conflict is superficial as it has been shown that safe companies tend to be successful in the long run. Short-termism will however in practice obscure the need to operate safely. Profit or compliance with regulation will provide insufficient incentive for companies to become robust and safe. Avoiding disasters is a long-term strategy and past performance does not guarantee future results (Taleb *et al*, 2009). We then step in to the field of business ethics.

'If a builder builds a house for a man and does not make its construction firm, and the house which he has built collapses and causes the death of the owner of that house, that the builder shall be put to death. Hammurabi, the king of righteousness, on whom Shamash has conferred right (or law), am I. My words are well considered; my deeds are not equalled; to bring low those that are high; to humble the proud, to expel insolence.' Code of Hammurabi, c. 1800 BC.

Companies will have a natural tendency to externalise costs. There are two major forces opposing this process: regulations and the company's desire to project an image of ethical business practices. We now focus on the latter. Business reputation is a good motivator for companies to appear to act ethically (De Castro *et al*, 2006). We begin by looking at ethics in general, then corporate ethics, and finally at the roles the various human actors play in influencing corporate ethical behaviour.

The word ethics come from the Greek *ethos* meaning 'character'. Historically most societies have developed ethical codes and many of aspects covered have made it in to modern law where they punish various crimes. Ethics is different from morality in that morality defines the standards while ethics defines the behaviours which support these standards. A workable definition of ethics is 'a code of behaviour considered correct, especially that of a particular group, profession or individual' (Collins Dictionary). Three perspectives on ethics are briefly discussed next: virtue ethics, utilitarianism, and duty ethics.

Virtue ethics, as studied by Aristotle, holds that virtues are moral characteristics that encourage human development (e.g. perseverance, compassion). Behaviour should be virtuous and aim for common good (Hursthouse, 1999). To define a behaviour as virtuous we need to observe if the consequence of that behaviour was positive for that individual or group and for society. The limit of virtue ethics is that as it does not provide rules or codes it cannot provide adequate guidance nor resolve some moral dilemmas (e.g. honesty is a virtue yet compassion might require a lie).

Utilitarianism, as proposed by Jeremy Bentham, simply states that behaviour is to be judged based on its consequences, mainly their ability to produce the greatest happiness for the greatest number (Bentham, 1983). The issue here is that it is quantitative, and although attempts have been made, there is no accepted way of measuring the greatest happiness. Another limit is that by only looking at the consequences the motivations are ignored, thereby allowing for the question: can one behave morally wrong to bring happiness to many? This is addressed by duty ethics.

Duty ethics, as though of by Emmanuel Kant, is an ethical system based on reason and not utility. If behaviour is to be ethical the imperative behind it must be categorical and not conditional. As such, ethical behaviour is an end in itself and not a means to an end (Alexander and Moore, 2007). There is a distinction between perfect duty, which we should do all the time (e.g. not harming others) and imperfect duty, which one should do when possible (e.g. charity). Yet again there is the limit that conflicts of duty are not easily resolved.

Beside these three theories there are many branches of ethics such as meta-ethics (Goodwin and Darley, 2008)., normative ethics (Manners, 2008) and applied ethics (the study of specific, perhaps controversial, moral issues). Here we are mainly concerned with applied ethics in the field of business ethics in relation to corporate entities.

We have discussed earlier the idea of a company being an artificial person under the law. Given this it now makes sense to look at ethics in the context of individual, human, behaviour, before we move on to corporate ethical behaviour.

Modern democracies aim to allow individuals sufficient freedom so that they may pursue their interests without detriment on the freedom of others to do the same. Society limits liberty through the consensus of laws and regulations. Generally, people will accept these limitations of their freedom by governments. There are also inalienable freedoms such as freedom of speech or of assembly which push back on how much constrain we allow government to impose onto us. For less serious matters informal consensus is usually sufficient and there is little need to legislate. To be a citizen, these obligations, though not encoded in law, need to be observed, which brings to the fore the issue of morality and ethics.

What determines people to act ethically? We will in another section discuss this in more detail and in relation to misbehaviour at work but for the moment we briefly cover the first two of three groups of determinants: concern for others, concern for self, and personality. Concern for others is driven by empathy, the ability to put ourselves in someone else's place, imagine how that person is feeling and the urge to make them feel better (Davis, 1983). Governments will sometimes legislate this either in the form of making it an offence not to stop and provide assistance should one witness a road accident, for example, or by offering tax breaks on charity. The aim is the same, to encourage caring responses counter the individualistic tendency to look after one's own interests. The opposite motivation for ethical behaviours is concern for self, particularly the fear of stigma and punishment.

Apart from these negative motivations there is also the motivation to improve our image within society by acting, or seeming to act, ethically. Utilitarian ethics clearly allows for this motivation as what is important is the translation of concern in to ethical behaviour, irrespective of underlying motive.

5. CONCLUSION

Critical Infrastructure is, as any business or complex system, liable to accidents. There is growing awareness and expectation of the health and safety responsibilities which the operators, the large corporations, of this infrastructure have. Yet human errors, active or latent, will manifest and impact vulnerable systems, particularly those with high exposure to CCFs. Though companies are, to certain extent, treated as individuals we observe two corporate dangers: cost externalisation and limited liability. These dynamics are opposed by outside intervention in the form of regulation and societal pressure and interior dimensions such as empathy and concern for self. To understand the way managers perceive whistleblowing in their organisations, we must observe which of these drivers matter most in order to expend effort where it will have the largest impact on corporate safety.

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Monitoring historical urban infrastructure using multi-temporal InSAR techniques

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Abstract. Ranked tenth in the world regarding seismic risk, Bucharest is the most seismically exposed capital in Europe and has the highest risk among Romanian cities. Location on two faults, high population and preponderantly old buildings make Bucharest even more vulnerable to strong earthquakes that occur periodically in Romania. In order to prevent major live and material losses in the future, authorities are trying to generate a map of buildings classified according to the risk of collapsing at the next earthquakes. In an attempt to reduce the time necessary to identify buildings at high risk we propose using InSAR technology that detects fine movements of objects. In our study we are interested to find out if satellite measurements are able to distinguish between effects produced by damage and those brought about as a result of changes in for example non-structural components and the environmental conditions. Also it is important to consider whether the dynamic characteristics can be identified with the required accuracy using InSAR techniques. In this purpose we compare building behavior identified from satellite data with that resulted from terrestrial monitoring using high precision techniques. In the current paper, we present the methodology of rating buildings using health indices, and discuss possible outcomes.

Keywords: *infrastructure, InSAR, Permanent Scatterers, seismic risk*

1. INTRODUCTION

The forensic engineers that evaluate the health of buildings usually study the causes that lead to their failure in the first place. Most often, for finding the cause of collapsing, they analyze the failure mechanism of the building (Atkinson, 1998). The output of this type of studies can be used for improving the construction norms for future projects. The insight in the past offered by InSAR could represent a unique advantage in studying the causes that lead to infrastructure failure (Metternicht et al., 2005). Using this technology, we could observe the evolution of a deformation that is visible on the outer shell of constructions.

A forensic engineer can make a series of hypotheses regarding what caused the collapse, which can be eventually validated using InSAR. Studying building failure implies data collecting and analyzing for determining the cause of failure (Eisenhardt, 1989). The failure of a structure depends on the load and its ability to withstand the loads without the structural integrity to be affected (Ellingwood, 2006).

According to the Eurocode: Basis of structural design (2011), the loadings that can affect buildings are: permanent loadings, like the weight of structural elements, groundwater pressure or element tension that remain constant over time; and live loadings, such as people, cars, furniture, precipitations, wind loading, and temperature that vary most of the time; accidental loadings, like earthquakes, explosions or fires, that are characterized by large magnitudes and catastrophic consequences, but have a low chance of occurrence.

Being ranked as the tenth city in the world and first in Europe in terms of exposure to earthquakes, Bucharest is considered the city with the highest seismic risk in Romania (Armaș, 2006). Location on two faults, large population and large number of old buildings in the city increase the vulnerability to strong earthquakes that occur periodically in Vrancea.

There are many factors that influence the seismic risk in the capital (Carreño et al., 2007; Poljanšek et al., 2012), of which the most important are the geographical position – 100-170 km from the epicenter in Vrancea; the large number of buildings with more than P + 3 floors, constructed in concrete or masonry, built before 1940, with structures designed to withstand only the action of gravity, and degraded beforehand by earthquakes produced in 1940, 1977 1986 and 1990; lack of codes at national level during the construction of these buildings, providing knowledge and technical standards necessary for the realization of structures resistant to earthquakes; local conditions that lead to amplification of seismic movements with destructive effects on existing structures; own period of vibration of tall buildings built in the interwar period; vibration caused by strong earthquakes in the Vrancea, which produces the phenomenon of resonance is destructive for tall buildings (Vlad & Vlad, 2008).

In order to prevent loss of life and material in the future, authorities are trying to classify buildings according to the risk of collapse in the next earthquake.

Bucharest City Hall updated the list of earthquake risk buildings in the capital on October 30, 2015. According to the new data, 374 buildings present an extremely high seismic risk, of which 189 are classified as "public danger" and another 2,100 buildings fall into classes with lesser degrees of risk, requiring consolidation. 28 buildings have been consolidated so far.

Thus, the list published on the official website shows 374 buildings framed in class I of seismic risk (corresponding high risk of collapse in case of an earthquake) - of which 189 are listed in the category "Public Danger" (Figure 1).

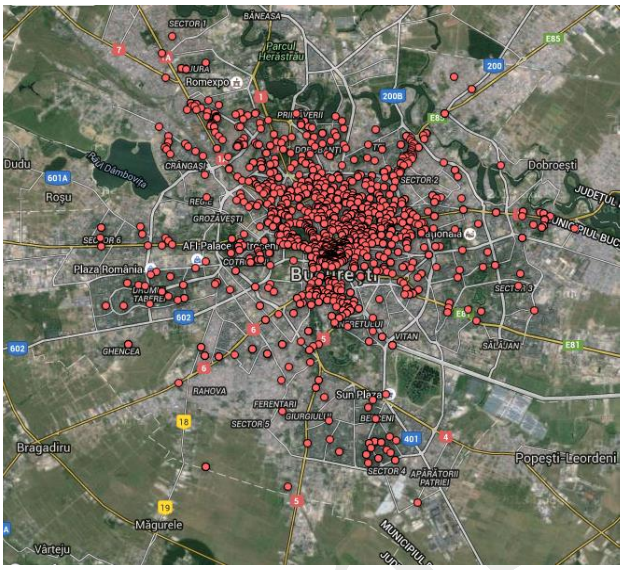

Figure 2*. Maps containing the location of buildings classified in the seismic risk class I within Bucharest (Source: www.riscseismic.ro)*

2. PROBLEM DESCRIPTION

Inventory process proves to be very difficult, mainly because the detection techniques used to identify structural defects in buildings is complex and lengthy (Glaser et al., 2007). The characterization of the likely behavior of a building in case of an earthquake must take into account a number of factors of different nature. Generally applicable rules cannot be given for the quantification of these factors, but by thorough interpretation of the results of all investigations made in the expertise, through comparisons with other similar situations, and by reasoning engineering, will be able to fit the building in question in one of the four classes of seismic risk.

From the point of view of seismic risk, meaning the likely effects of earthquakes, site characteristics, the existing buildings on that site, are the four classes of seismic risk established by authorities:

Class I matches for construction that presents a high risk of collapse in earthquakes with intensities corresponding to estimate seismic intervals (earthquake design);

II. Buildings corresponding to Class II have a reduced probability of collapsing, but major structural alterations that are expected incidence earthquake design;

III. Seismic risk III class contains corresponding constructions which are expected structural alterations that do not significantly affect the structural safety, but present damage of nonstructural elements that can be important;

IV. Seismic risk IV class corresponds to buildings with an expected seismic answer similar to new buildings designed based on regulations.

In deciding the seismic risk classes, the experts will take into account the seismic zone where the in construction is located and the composition criteria for construction, operation and behavior of seismic actions (Figure 2).

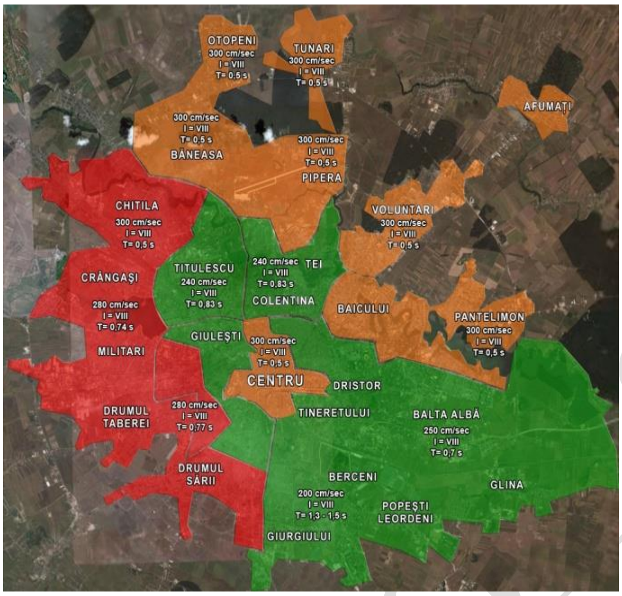

***Figure 2**. Seimsic areas in Bucharest classified according to soil acceleration in case of earthquakes; green corresponds to low acceleration, orange to medium and red to high (Source: www.riscseismic.ro)*

Our study suggests the use of InSAR technology as a quicker alternative identification of high-risk buildings, identifying fine movements of objects. The accumulation of structural defects may cause a change in the dynamic characteristics of structures. In our study we want to know whether satellite measurements are sufficient to distinguish between structural defects and the results of structural components or changes in environmental conditions. Also we have to consider the precision in detecting the dynamic characteristics of the infrastructure. In the current article describes the current state of application infrastructure analysis and investigation techniques using multi-temporal InsSAR.

The objective of this study is to verify the feasibility of the technique InSAR in monitoring degradation and identifying the degradation causes. We will mainly focus on the historical buildings found in the first seismic class. For our study we will consider firstly the database of buildings classified as class I of seismic risk. The first important information that must be known when analyzing a structure is the general information about it. It is mandatory to know its location, number of floors, building type and use of the building (Eastman et al., 2011). Where they exist, would also be important to have knowledge about possible types of phenomena affecting the building behavior: deformation description, construction materials, loadings of structural parts and other technical causes.

The studies of Terwel et al., (2012) and Terwel (2014) disclose that in buildings whose structure is affected by deformations, this becomes visible on the surface. Signs that may indicate strains include cracks, corrosion or displacement of elements and other indicators of physical degradation. For the current study, this category is very important as identifying indicators of degradation of the buildings is one of the most important aspects of the analysis of structures in danger.

3. METHODOLOGY

Monitoring buildings seeks to identify indicators of degradation, or indications that there is a danger of degradation in the future. The purpose of this section is to analyze how InSAR could be used as a means of monitoring, to serve the purpose of identifying those at high risk of collapsing buildings in Bucharest. First, it should be considered the difference between monitoring and investigating the causes of the collapse of buildings. Investigation is to identify the mechanism that led to the building and cause failure triggers, after the appearance of degradation (Chong et. al., 2006). Monitoring on the other hand tries to capture the initial stage of degradation, in order to prevent collapse. The methodology that is presented in the following section is inspired from the paper of Pratesi et al., (2015) and refers to identifying and classifying buildings according to movements that indicate future degradation.

The methodology described is based on the use of indexes for classifying information contained by every Permanent scatterer (PS point), which can assess the state of decay of urban infrastructure at local scales (Lan et al., 2012). Permanent scatterers are either natural or manmade objects that remain stable over time from a coherence point of view (Ferretti et al., 2000; Ferretti et al., 2001; Hooper et al., 2007). They appear as bright coherent points in interferogams, and can be used to identify point displacements. In our cases, PS points will be represented mainly by urban infrastructure. Points are grouped into "test areas" that correspond to buildings and their surrounding areas. The indices refer to the density of PS points in a test area (I_D), and to the critical degree of deformation of the individual structures of the adjacent areas (I_{CS}, I_{CZ}). Distributions of displacements on buildings facades can be classified as isolated (i) or diffuse (d), according to the speed distribution index (I_{DV}). The indices I_C and I_D will be divided into classes A to E to simplify results interpretation.

The steps that will be taken in order to classify the points and identify the level of hazard for each structure are:

- Calculation of Index I_D;
- Calculation of critical deformation indices for individual structures and adjacent areas (I_{CS} I_{CZ});
- Integration of additional information to calculate indices.

Defining test areas and PS points selection

PS valid points are marked by clearly two areas: perimeter studied object is drawn using orthophotomaps and adjacent area is considered as a buffer of this object. Adjacent area is included in the buffer whose stability is considered important for an object. Size of the buffer is chosen according to the spatial resolution of satellite images SAR (for TSX it is 1.7 m × 3.4 m). Size of the buffer is important because it must include georeferenced points that are a few meters outside the boundaries of the object, but resulted from a double reflection on the corners formed by the walls of the building and land area. Also the considered buffer zone can eliminate errors that occur when designing PS bracket points used to identify buildings (Figure 3, 4).

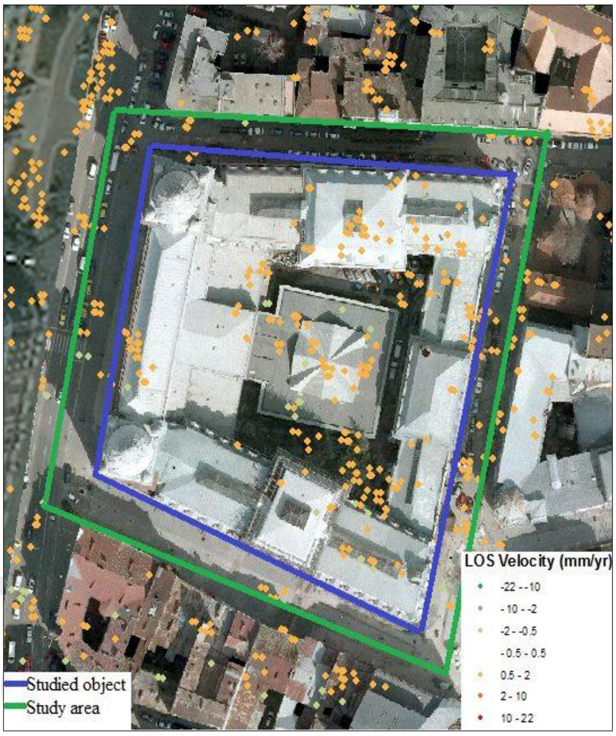

***Figure 3**. PS point selection for a church in Bucharest's centre. Delimitation of the studied object and the adjacent study area*

The calculation of the density index, I_D of points in a test area

This index shows the coverage of the object and its surroundings PS points, or degree of information for a study area. The numerical value of this index reflects the density of points PS (PS/m2) in the test area.

The first time the density of the points is calculated for the studied PS object (D_O). If it is 0, lower or higher than a fixed value for the average density of points PS (D_m), then the value attributed in part is 0, 0.25 or 0.5. The PS density in the surrounding area of the studied object (D_a) is calculated using the same partial scale as in the case of partial values of D_O. I_D is obtained then by adding the values of D_O and D_a, so I_D takes values between 0 and 1-Class E-Class, with a difference of 0.25 from one class to another. Thus, class E corresponds to areas that do not show any PS point, which means that the critical deformation index cannot be calculated. In this situation it is not recommended to extrapolate points in the vicinity of the study area, because the behavior of a building is individual, and can only be influenced by the surface that it is located on, but not entirely depending on it.

As mentioned by Bayarri et al., (2015), the same average density, D_m cannot be used for peri-urban areas, since the density and type of construction in these areas are different from those of urban areas. The average density D_m is obtained by calculating average values for D_a and D_O characterizing a study area. Dm also depends on the type of data used and can be adjusted for both medium (Envisat, ERS) and high resolution satellites (TerraSAR-X, CosmoSkymed).

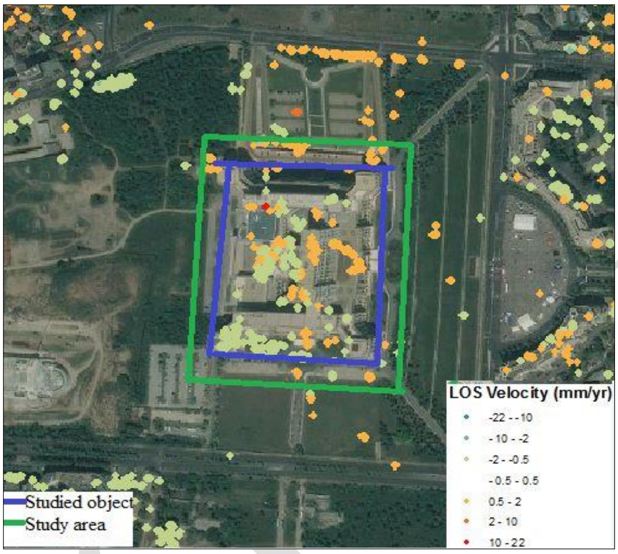

Figure 4. *PS point selection for The House of the People (Parlament Building). Delimitation of the studied object and the adjacent study area*

Critical deformation index calculation, I_C

This index expresses numerically the condition imposed for the studies object and the surrounding area, based on the maximum velocity value (Vmax) expressed along the Line-of-Sight (LOS) of the satellite for the whole period of monitoring, for all points in the study area. Similarly as in the density calculation, in the case of the I_C index, two indices are calculated first, I_{CO} and I_{CA}, that represent the critical deformation indexes for the studied object and the surrounding area. Starting from Vmax value found in the study areas of control, I_{CO} and I_{CA} are classified using 5 classes for critical deformation index, I_C, whose range is determined by the limits of the speed value interval within the range of values determined for the entire study area.

Speed range interval which differentiates stable objects from the unstable ones is determined based on radar technology parameters used to determine the displacement and the distribution of speed values throughout the entire PS database. Class A indicates stable objects. Its limits depend on the precision achieved with a single measurement and the frequency of the radar signal. In the case of X-band radar sensor, the recommended standard deviation is 0.5 mm (Class A having Vmax≤0.5 mm/year). As mentioned in the literature (Hanssen, 2005; Crosetto et al., 2010; Cigna et al., 2013), rates higher than the signal wavelength lead to loss of coherence in SAR images. Class E is determined by the distribution of velocities of all PS points values. Intervals in Table 1 are set to encompass most PS points resulting from processing the SAR images the entire area of Bucharest.

I_C Class	Velocity range
A	$\lvert V_{max} \rvert \leq 0.5$ mm/yr
B	0.5 mm/yr < $\lvert V_{max} \rvert$ < 2.0 mm/yr
C	2.0 mm/yr < $\lvert V_{max} \rvert$ < 3.5 mm/yr
D	3.5 mm/yr < $\lvert V_{max} \rvert$ < 10.0 mm/yr
E	10.0 mm/yr < $\lvert V_{max} \rvert$

Table 1 *Critical deformation index classes and corresponding PS velocity ranges (Bayarri et al., 2015)*

Distribution of velocity index calculation, I_{DV}

The number of unstable points and their spatial relationship with stable PS points from the study area do not influence the value of the I_C index. In order to numerically express the spatial distribution of the estimated displacements, it was introduced a new index, I_{DV}, that represents the estimated speed distribution and will be calculated for each study area using the following formula:

$$I_{DV} = (g / G)\times 100$$

Where "g" is the maximum value of (Vmax-Vmin) and (Vmed-Vmin) and G of (Vmax-Vmin) with Vmax, Vmin and Vmed being the mean, maximum and minimum average speed of the PS points in the control area.

I_{DV} shows the degree of symmetry of all the points in a test area, relative to Vmed, and can indicate if there are at least three points included within its boundaries.

4. EXPECTED RESULTS

The outcome of our study will consist in historical buildings classified according to their health rating in 5 classes. The classes are established by calculating a critical deformation index, I_C, which depends on the point density on a studied object and within the adjacent area, as well as on the distribution of velocity values for the points on the object and the study area. The classes range from A to E, with A meaning the studied object is stable, and E corresponding to critical movement of the object. The classification would be represented as a map where buildings are represented according to their health score (Figure 5).

Identifying buildings at risk can represent a challenge because their behavior in case of structural damage can depend on height, construction materials, age, soil type, and soil acceleration in case of earthquakes. Therefore our study must include as many building types as possible, located in different sites all over Bucharest. In order to eliminate movement due to seasonality a dataset of at least 20 SAR images that cover a time period longer than 1 year and terrestrial monitoring over the same period of time are needed.

Also it is important to consider whether the dynamic characteristics can be identified with the required accuracy using InSAR techniques. In this purpose we compare building behavior identified from satellite data with that resulted from terrestrial monitoring using high precision monitoring techniques. By using terrestrial monitoring techniques we will analyze whether the processing results are reliable in the first place. The ground techniques will consist in high precision surveys and GNSS measurements.

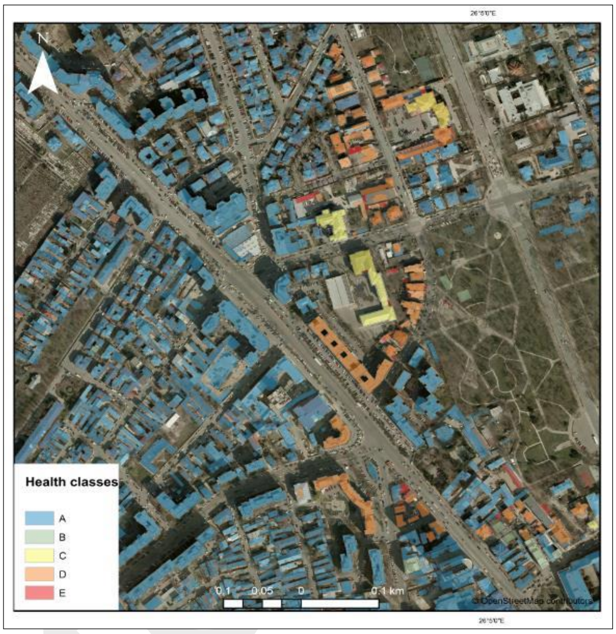

Figure 5. *Example of map presenting buildings classified in 5 classes, from A to E, according to their health status estimated using health indexes*

5. CONCLUSION

Our interest is mainly oriented to historical buildings corresponding to seismic risk class I. According to past theories, it is possible for the structural deformations to manifest on the outer shell of the building. Our hypothesis that the structure of old buildings with high failure risk displays a specific behavior over time that is visible on the outer shell can be tested by statistic analysis and ground validation. If the results are promising, the proposed approach may become a valuable tool in building monitoring and classification.

It is necessary to mention that we do not expect satellite technology to be able to entirely replace the classic methods of monitoring structures, but we hope that good results of the study will lead to an easier and faster identification of those buildings that are at high risk of collapsing and need further investigations using classic methods.

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Review: EGU TOPICAL EVENT - WATER AS HAZARD AND WATER AS HERITAGE, June 2016, Accademia di Romania, Rome

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Abstract. The paper is proposing a successive review of the EGU Topical Event: WATER AS HAZARD AND WATER AS HERITAGE that has been held in Rome within Accademia di Romania, on 13th June 2016, under the patronage of EGU – European Geosciences Union, Accademia di Romania, ICR – Institutul Cultural Român, Spazi Aperti, and Eng.Arch., PhD Architect, Maria Bostenaru Dan, Scholar Researcher of Vasile Pârvan Institute. The program has included more than twelve presentations from a wide inter_ and dedicated professional contemporary approaches of the proposed topic, several posters, dedicated discussions on the opportunities and emergencies at the beginning of the 21st century regarding water, from conceptual and practical studies, to connected inspirations, notable figures, urban behaviors and policies.

Keywords: *geosciences, landscape, architecture, art, cultural studies*

REVIEW

EGU Topical Event - WATER AS HAZARD AND WATER AS HERITAGE, took place on 13th June 2016, within Accademia di Romania, Rome, under the patronage of EGU – European Geosciences Union, Accademia di Romania, ICR – Institutul Cultural Român, Spazi Aperti, and Eng.Arch., PhD Architect, Maria Bostenaru Dan, Scholar Researcher of Vasile Pârvan Institute.

The concept of the event and topic were developed by Maria Bostenaru Dan, in the context of the multidisciplinary approach characterized by her work with notable connections and research actions from architecture and engineering to geosciences and art based cultural studies.

The hazard as motivational research input in an era based on combating and prevention of the risks, versus the positive inception of water as principle of life, development and beauty were two principles proposed to be developed in the workshop.

The event proposed twenty one questions to be discussed as tools: from focus on mapping, resources, sources, roles, strategies, vulnerabilities, modeling, multiple investigations, and searching on relevant case studies.

***Figure 3**. Accademia di Romania, Rome.*

The topic and approach of the event has developed a mutual connections between domains and professionals involved – geosciences, landscape, architecture, art, cultural studies – and the proposed science caffee encouraged a fructuous atmosphere for communicating research results, ideas, projects in progress, experiments and discussions for future projects.

The program has included more than twelve oral (paper) presentations from a wide inter- and dedicated professional contemporary approaches of the proposed topic, several poster presentations, dedicated discussions on the opportunities and emergencies at the beginning of the 21st century regarding water, from conceptual and practical studies, to connected inspirations, notable figures, urban behaviors and policies.

19 participants with different specialization but with the focus on (re)searching water importance – "as hazard" or "as heritage" – emphasized the beauty and relevance of great architectural creators (historical figures or/ and also relevant ancient, modernist and contemporary architects) of patrimony connected with waters, old and new urban policies, politics and master developments, the threats of hazards – water as hydrological view – but also to the super-technologies of smartness sustainability, cross-cultural links over seas, and the input of virtual research results on current museums. Auditorium and participants covered notable institutions and affiliations from Italy, Romania, UK, USA.

Results from previous a previous workshop developed by the same author, Maria Bostenaru Dan, were presented in the new editorial presentation of book "Space and Time Visualisation" edited at Springer (2016) by Maria Bostenaru Dan (Eng.Arch., PhD Architect) and Cerasella Craciun (Assoc.Prof.PhD.Architect, ViceDean Faculty of Urbanism, UAUIM Bucharest).

Website of the EGU event (https://sites.google.com/site/egutopicalevent/home) contents the theme development by Maria Bostenaru Dan and also the questions proposed for discussion, program development, topics of the presentations and authors, contributors and scientific and organizing committee, and also the connection with EGU - European Geosciences Union, and the hosts, Accademia di Romania, ICR – Institutul Cultural Român, Spazi Aperti. Also a photographical report consisting on images are available linked on the event' website. Reports on the event and abstracts are in progress to be added to the event' website.

Figure 2. *Image from the workshop presentations: EGU TOPICAL EVENT - WATER AS HAZARD AND WATER AS HERITAGE, June 2016, Accademia di Romania, Rome*

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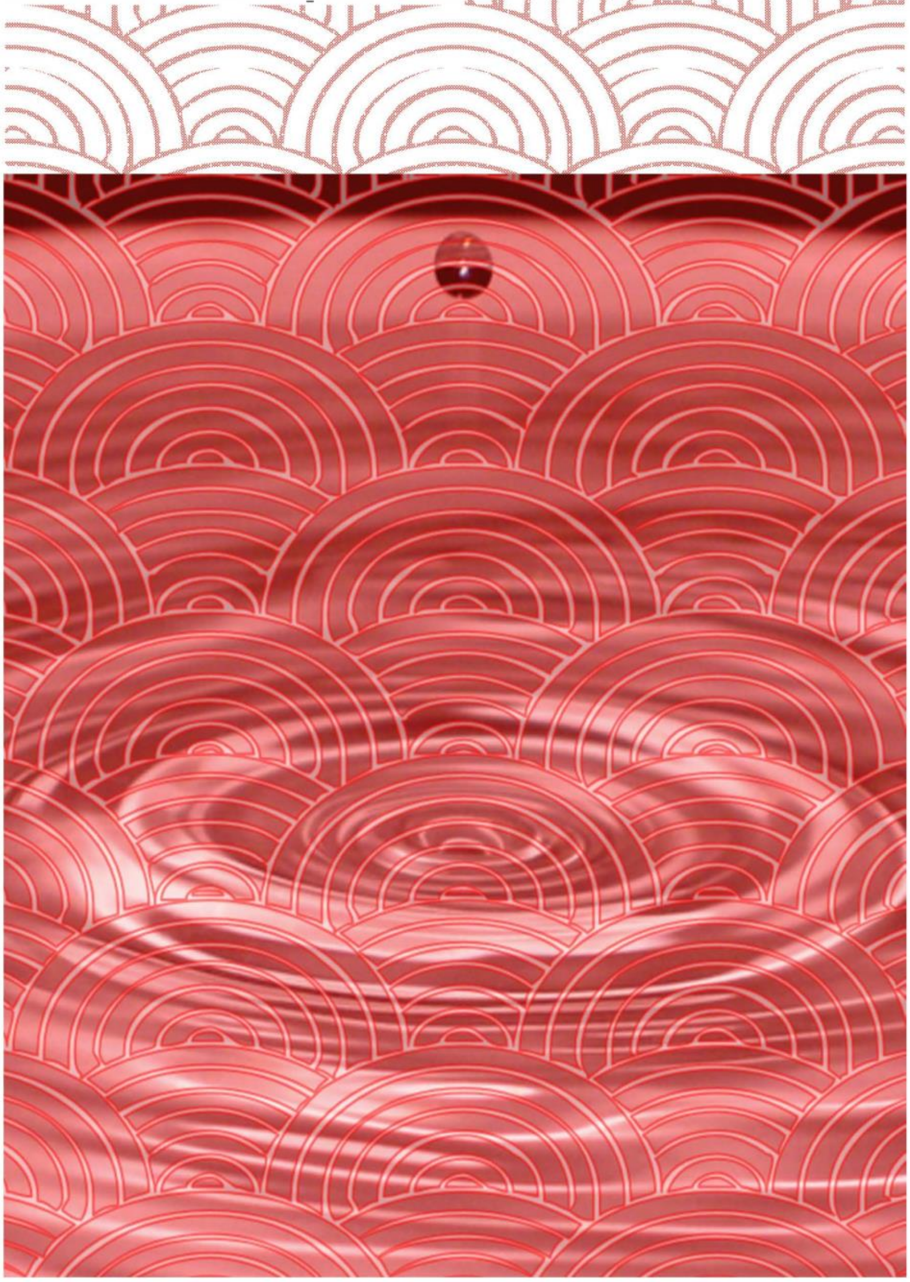

"Science is the millennial endeavor to identify the underlying patterns that form our world and explains the interconnectedness of the natural and social systems."

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