A Spatial Approach in the Context of Measuring Human Impact on Coastal Areas. The Anthropogenetic Intensity' Implementation along Hellenic Coasts.

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Abstract

Coastal areas face many challenges due to a number of unique characteristics that make them very vulnerable and in need of protection. On the other hand, the study of coastal areas through indicators is strongly recommended by the international bodies devoted to spatial planning and integrated coastal management.

In this context, "Anthropogenetic Intensity" is a spatial indicator that aims to measure the human impact on coastal areas, by calculating the total volume of man-made activities. It aims to reveal the degree of economic activities along a coast, the intensity of land uses and the total landscape annoyance caused by human involvement.

In order to study and finally measure the "Anthropogenetic Intensity", the "mean height" of buildings and all other constructions on a coastal area, at a specific point of time, can be used. The critical point is not only the selection of the appropriate land uses/covers classification but the weights with which each of the uses/covers will be endowed. Moreover, "Anthropogenetic Intensity" indicator may have extra weights related to other parameters, as the distance from the shoreline.

The "Anthropogenetic Intensity" indicator aspires to provide enough information about the coastal environment in order to improve the available spatial data and to assist all the involved stakeholders and policy makers in their strategies for integrated management and sustainable development. The most important and valuable results can derive from the differences of "Anthropogenetic Intensity" values at the same coast, at two different periods of time or at different coasts, at the same time. The magnitude of those differences can be used as an alert to activate already established mechanisms in order to control the land exploitation and organize the related reactions, in the context of coastal land use policy.

This proposed indicator is recently launched in the framework of AMICA ("Appraisal of man-made interventions along the Hellenic coastal areas"), a research project of the Spatial Analysis Lab., Technological Educational Institute (TEI) of Athens. Into the same framework, several case studies are under realization in order to test the effectiveness of the indicator and to define the critical and marginal values it may have.

Keywords: Anthropogenetic intensity, coastal area, spatial planning, AMICA.

1. Introduction

Coastal Management. As a result of their rich and unique resources, coastal areas have been among the most exploited and inhabited areas throughout the world. Being the interface between the land and the sea, coastal areas are considered as a common good that needs to be protected. The nowadays urgent and limitless demand of coastal land drives to environmental degradation and to many conflicts among the human activities, as the last ones are expressed by means of the numerous coastal land uses. The demands for coastal space will clearly be in excess of what is available. As a result, the entire coastal system faces a rather uncertain future. [Clark 1996, OECD 1997, UNEP 2001, EEA 2006, Valiela 2006, Goudie 2006, UNFPA 2007].

The related policies' response fluctuates widely. Usually, environmental, economic and social dimensions are recognized. Moreover, beyond the competing needs of numerous stakeholders, other parameters as temporality (seasonal land uses), the overlapping of terrestrial and marine features etc. make the management of coastal areas quite difficult. During the last 40 years and especially after the Earth Summit (Rio Janeiro, 1992), coastal nations have been encouraged to develop their own integrated coastal areas management (ICAM) infrastructures[1].

As a result, lots of efforts have occurred all over the world, but not all of them can be considered as successful. Usually, many different public, non public agencies and NGOs are responsible for different aspects of the same coastal area. Ministries often find themselves undertaking the same or similar tasks and sometimes, even working against each other due to their own inharmonious and competing objectives. Simultaneously, beyond to be a very long and tiring process of continuous confronting efforts against social, economic and political interests which usually protect the existing status quo, in many cases ICAM is only a part of the rhetoric for sustainable development.

Today, ICAM is rather an umbrella that includes coastal areas' planning and management, in general. In many times it deals only with just the ocean-side or the landward side of a coastal area. On the other hand, the specific problems and the majority of ICAM projects around the world are very similar. However, the interpretation of the national studies' results frequently is constrained by the fact that they were not conducted with the goal of providing a clear and understandable picture of the existing situation along a coastal area. Even if the scope of the related studies are different, the analysis process should be very precise and with adequate data.

Consequently, it is widely accepted that the more important need for advancing the integrated management of coastal areas is improving the effectiveness of the information concerning coastal issues. The supply of efficient and effective information is one of the greatest needs -if not the greatest need- for successful management of coastal problems. Indeed, beyond the lack of information on the total assets of local resources at local level, there is no adequate information to cope with the real magnitude of human impact. Some coastal areas are characterised as overloaded, only because of their summer seasonal population, but there is no indicator to measure the magnitude of man-made environment (constructions of any kind and size) as an index of human impact along coastal areas. [UNEP 2001]

Furthermore, equivalent goals have the European Union's directives on the assessment of almost every sizable human (constructive) activity (EIA, Environmental Impact Assessment). The more recently launched Strategic Environmental Assessment (SEA) focuses on the environmental consequences of certain plans and programs, but in a greater spatial scale. Both of them (ICAM and EIA/SEA) require on-going information on the territory status, coastal areas included. In the same context, the under establishment TIA (Territorial Impact Assessment) will need continuous and up to date spatial information. [Kiousopoulos 2007].

Coastal Indicators. The research on indicators as an analysis tool is enormous and very productive, worldwide [indicatively: Bossel 1999, Belfiore et al. 2003]. In this framework, the study of coastal areas through indicators is strongly recommended by the international bodies devoted to integrated coastal management and environmental assessment. They are indispensable analysis tools to convert data into information [UN 1996, OECD 1998, OECD

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[1] Nowadays, ICAM is a very broad concept that incorporates multidisciplinary processes "that unite levels of government and the community, science and management, sectoral and public interests in preparing and implementing a program for the protection and the sustainable development of coastal resources and the environment". [Sorensen 2007].

2000, Belfiore et al. 2003, EEA 2005]. In addition, the use of tools designed to support the spatial data collection and analysis, such as remote sensing and geographic information systems, is almost compulsory for planners and policy makers concerned with coastal spatial planning and management [EC 1999, Longley & Batty 1996].

Indicators useful for the management procedure can be divided into several categories: environmental, socioeconomic, spatial or other special types. Beyond the purpose oriented criterion, the indicators can be categorized in frameworks, such as the Pressure-State-Response (PSR) framework (launched and supported by UN and OECD) and the Driving forces – Pressure – State – Impact – Response (DPSIR) framework (launched and supported mainly by EU and the affiliate agencies). [OECD 1994, UN 1996, Smeets 1999].

Numerous cores of indicators have been launched until now, mainly for environmental use [UN 1996; UNEP 2000; EEA 2005]. Those cores are classified into international, national and (rarely) local level of application. By any means, they are not so specialized to coastal areas. In addition, those related to coastal areas are rather suitable for a national or international approach, e.g. the "130 Indicators for sustainable development in the Mediterranean Region" [UNEP 2000]. Recently, many ambitious initiatives have been introduced, aiming to solve problems such as the fragmentation of datasets and sources, lack of harmonization between datasets at different geographical scales, gaps in availability etc. [Nebert 2004, INSPIRE 2007].

On the other hand, the land/surface dimension is absent across the previous mentioned efforts, even throughout those related to local level [UNEP 2000, Getimis et al. 1999, INDUROT 1999, EC 2002, NOAA 2007]. Some other efforts satisfy the previously mentioned spatial notion at local level, but they limit their interest in the islands. [Indicatively: Chalkias 2002]. This means that the geographic/geomorphologic information that characterizes and gives a special character in every examined coastal area is not regarded as valuable to be incorporated in the majority of the already proposed indicators.

2. Hellenic Coasts' Spatial Approach

Coastal Space. Hellas is a maritime nation that has strong and long-term historic and cultural links to the sea and marine resources. Simultaneously, is a rather mountainous country in the south end of the Balkan Peninsula. Its area extends to a little more than 130.000 sq. km. and its population exceeds 11 million of people.

According to a recent official report of the Hellenic ministry responsible for the environment "Greece has a coastline of more than 16,500 kilometres (almost equal to that of the African continent), the longest of any other Mediterranean or European country"[2]. [MEPPPW 2006, UNEP/MAP 1996]. Hellas is also the Mediterranean country with the biggest number of islands, some of which are quite small and without inhabitants.[3]

According to the CORINE project results, 37,5% of the Hellenic territory belongs to a 10 km coastal zone. Administratively, Hellas is divided into 13 regions (NUTS II, according to the nomenclature of Eurostat), 51 prefectures (NUTS III), 1013 local authorities and the autonomous monastery region of Mount Athos. Only one region (NUTS II) does not have

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[2]   According to NSSG, the precise length of Hellenic coastline is 15.021 km. According to an official answer (1998) of Hellenic Navy to a relative question of the author, this length is 17.253,30 km. According to the same source, 5.310,89 km belong to the continental land and 11.942,41 km to the insular land. [Kiousopoulos 1999].

[3]   More than 3000 islands belong to the Hellenic State. Only four have surface greater than 1000 sq. km and only 23 more than 100 sq. km. The islands which overcome the limit of 100 habitants are almost 80. The total islands' surface corresponds to the 18,8% of the country, while the equivalent population corresponds to the 14,5% of the Hellenic population. [Kiousopoulos, 2008].

front to the sea. Among the 51 prefectures, only eleven do not have any vicinity to the sea. Mount Athos region and 450 of the 1013 local authorities are coastal. [Kiousopoulos 1999]. It is remarkable that more than the 60% of the population belong to a 10 km coastal zone. [EEA 2006].
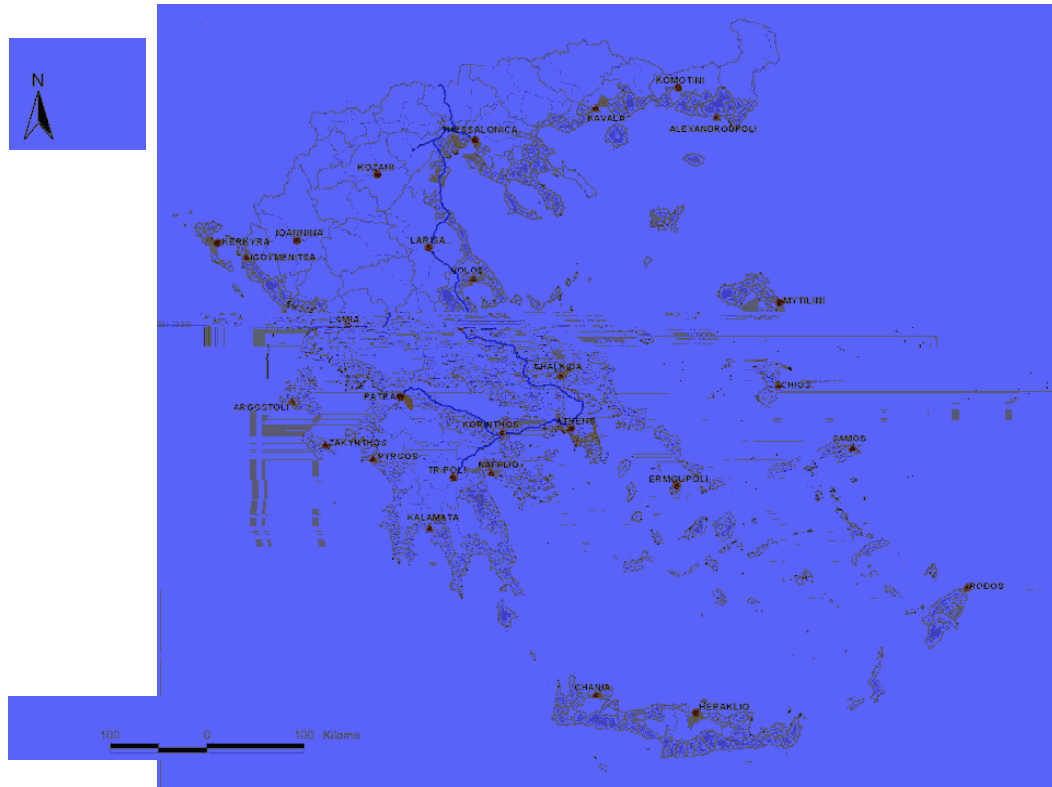

Figure 1: Contemporary Hellenic Coastal Authorities (NUTS IV). [MEPPPW 2006]

Geographic patterns vary widely from place to place along the Hellenic coastline. In terms of land cover, the main types of coasts are three. The three-quarters of the total are covered with rocks (1st type). Beaches and sand dunes are roughly 1.000 km long and the majority of human activities are concentrated there. The third type of land cover is composed from a big variety of wetlands. Many rare species of birdlife can be found in those regions. [MEPPPW 2006].

According to the criterion of land use, built-up areas (with or without the occurrence of industrial activities), tourist areas, rural activities and natural/protected areas are recognized along the Hellenic coastal areas. In any case, Hellenic coastal areas are regarded as national capital because of the existence of plentiful natural resources (fauna, flora, landscape, sunny weather, clean waters etc.) and man-made resources (monuments, attractive built environment, tourist infrastructure etc).

On the other hand, the coastal ecosystems and landscape are under severe pressure due to: tourism development, intensive agriculture, uncontrolled urban expansion etc. When these activities are developed together on the narrow coastal strip, problems tend to arise, creating conflicts. At the same time, the expected growth, in tourism in particular, will increase human pressure on natural, rural and urban environments. In Hellas, as in the rest of the Mediterranean basin, the process of coastal overdevelopment has been ongoing for several decades. It leads almost inevitably to an artificial land cover of the natural environment, whether by new constructions or by restructuring the old ones.

Coastal Policy. Concerning Hellenic land policy, it is remarkable that until the end of 2007, no national spatial/physical plan has been legitimately approved. Moreover, spatial/physical planning, as an essential policy, seems not to be so widespread among neither the Hellenes nor the Hellenic administration. During the three last decades, a series of facts and initiatives were more or less absolutely dedicated on the control of man-made activities along the Hellenic coastal areas.

What we can name 'Hellenic coastal policy' faintly began during the '70. Its origin was the declaration that was included in the 1975' Hellenic Constitution concerning the state's obligation for protection of natural and cultural environment. Two laws for physical planning were approved by the Hellenic Parliament during 1979 and 1999, but none of them have been fully enforced yet. The last one (L. 2704/1999) is very similar to the simultaneously launched document "European Spatial Development Perspective" [EC 1999], aiming at the encouragement of a balanced and sustainable development of the European Union territory.

Beyond the previously mentioned facts, some of the more recent significant milestones related to the Hellenic coastal physical planning are the following:

2001.   The Hellenic Parliament voted Law 2971 for the management of the land zone near the shoreline (backshore plus a potential addition of a rather narrow zone of land). It intends to better assure: a) the ownership of the State (Ministry for the Finance) along the land near the sea and b) the public character of the coasts. This could be considered as another kind of refreshment of the administration interest for coastal areas, but not into the direction of ICAM.

2003.   The Special Framework (plan) for Physical Planning & Sustainable Development of Hellenic Coastal Areas was discussed but not officially approved.

2003.   The General Framework for Physical Planning & Sustainable Development (national spatial/physical plan) was discussed but not officially approved by the Parliament.

2007.   A new version of General Framework for Physical Planning & Sustainable Development (national spatial/physical plan) was discussed but not yet (December of 2007) officially approved by the Parliament.

Elements of coastal management can be found in sectoral policies, such as the related to urban development, tourism, industry, agricultural development and environmental protection. However, it is clear that those policies, even if they are successful, do not compose an integrated coastal management policy. Furthermore, the existent tools, which can be applied along the Hellenic coasts, come from the urban policy tools.

On the other hand, there is a general lack of coordination (associated to coastal areas) between physical planning and socio-economic development. In parallel, the absence of a national cadastral information system and the involvement of numerous ministries in the coastal issues are very essential constraints towards the implementation of an ICAM along the Hellenic coasts. Simultaneously, due to the absence of: a) a national spatial plan and b) of detailed land uses plans for the whole country, it is very easy for anybody to ask from the Council of State (the higher administrative court in Hellas) to annul administration acts, such as the related to a industrial unit location or the construction of a new highway etc.[4]

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[4]   This is a very common practice in Hellas during the last decades. A lot of petitions of individuals, of NGOs or other groups of interest have coped to cancel (or to delay the implementation) plenty of administrative acts related to urban, spatial planning and environment protection. Finally, it is questionable if this uneven way of spatial arrangement acts really to the right direction of an integrated coastal management.

3. Need for New Coastal Indicators.

In spite of hundreds of indicators already proposed and a number of tools designed to support the spatial data analysis, a lack of explicit criteria to classify the coastal areas at local level is more than obvious. This fact generates a deficiency of detailed and appropriate catalogues concerning the terrestrial part of Hellenic coastal areas' types.

Therefore, the land/field dimension is absent, even throughout those indicators that are related to local level. This means that the geographic information which characterizes and gives a special character in every examined (small) coastal area is not yet considered as valuable to be incorporated in an indicator.

In this framework, specific emphasis has been given to the creation of new indicators, particularly for the coastal abiotic environment near the seafront, in a zone up to 10 km width. In general, the main factors that have to be incorporated are: a) position and geometry, as they can expressed by the distance from the shoreline and b) the human impact along a coastal area, as it can be expressed by the area of land uses and the height of the related constructions.

Such indicators have to be able to facilitate:

o   The classification of coastal areas at local level and the creation of a related typology.

o   The foreseen of the potential development dynamics of a (not only Hellenic) coastal area.

Since the above mentioned ideal indicators will be applied along the Hellenic coasts (in the context of spatial planning procedure), they are not accompanied -for the time being- by additional parameters, applicable to other coasts all over the world, such as tidal range etc.

4. Anthropogenetic Intensity (AI)

The concept. Coastal areas attract a big variety of human activities and each (coastal) land use annoys the physical landscape and environment in a different (and more or less aggravating) degree. Anthropogenetic Intensity aims to answer the question "How intense are the man-made activities along a coastal area?" and to be a feasible tool to assess all the activities along a coast. In this context, it measures the mad-made "volume" and provides information about the amount of human intervention on the terrestrial part of a ten-kilometre coastal zone.

Preconditions. Only the terrestrial part of the Hellenic coastal areas is subject of interest of this indicator.

The geographical scales (size) of the coastal area should be corresponding to local level of approach. So, an important topic will be the selection of the more convenient (the less run the risk of falling into ecological fallacy) size of land handled as unit area. Because of the fact that the related coastal study depends usually on administrative boundaries, the total study area could be 20 sq. km, more or less. This area is rather equal to the mean area of Hellenic local authorities according to the old division of the administration system. An alternative level of approach could be equal to the mean area of authorities according to the new division (100 sq. km).[5] On the other hand, for reasons of specific studies, very small areas could be chosen as well (e.g. coastal area of 5 sq. km).

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[5]   Hellas is divided into 13 Regions (mean area = 10.153 sq. km), 51 Prefectures (mean area = 2.588 sq. km), 1.033 Local Authorities (mean area = 127 sq. km) and roughly 6.500 old Local Authorities according to the old division of the administration system (mean area = 20 sq. km).

Beyond the previous preconditions, the new indicators should: a) be of state or pressure type, b) focus on spatial concept, c) be designed exclusively for coastal areas, d) be convenient for planners and local authorities, e) be clearly defined and able to shape indices and f) be easy and inexpensive in measuring.

Formula. At first level of approach, every land use (and probably land cover) will be represented by its surfaces. Secondly, its physical (mean) height will be a critical size. At a third level, weights will be used to express the real environmental annoyance. With those parameters AI can be calculated according to the following formula '1'. In addition, the distance from the shoreline (as it is expressed by the integer part of the distance value in km) leads to the calculation of the Anthropogenetic Intensity (AI) with the following alternative formula '2':

$$AI = \frac{\sum_{1}^{v} s_i \cdot h_i \cdot w_i}{S} \qquad \text{'1'}$$

$$AI = \frac{\sum_{1}^{v} s_i \cdot h_i \cdot w_i \cdot (1 - 0.1 \cdot \text{int} D_i)}{S} \qquad \text{'2'}$$

where: s_i : area of each polygon with the same land use/cover,

h_i : the physical (mean) height of man-made constructions, in meters, for each land use polygon

w_i : weights for each land use/cover,

int D : the integer part of the distance (D, in km) from the shoreline, for each land use polygon.

S : the total area of all the polygons under examination,

Comments. The version '1' is built without the Distance component. It means that there is not importance where (how far away from the shoreline) each land use/cover is located. According to this version, all the AI values are positive. The version '2' is built with the Distance component. It means that there is great significance where (how far away from the shoreline) each land use/cover is located. According to this second (full) version of the Anthropogenetic Intensity formula, all the AI values are positive inside a coastal zone of 10 km from the shoreline.

Anthropogenetic Intensity (AI) reveals the degree of economic activities along a coast, the intensity of land uses and the total landscape annoyance caused by human interference. It is expressed in meters and this value depicts the "mean height" of buildings and all other constructions on a coastal area, at a specific point of time. The value AI = 0 m (zero meters) indicates a pure natural coastal environment, without any man-made intervention.

The advantage of this indicator is that it can be used to measure the total stress from man-made activities. But the most important and valuable conclusions can derive from the differences of values at the same coast at two different points of time and at different coasts at the same time. The magnitude of those differences can be used as an alert to activate already established mechanisms (or only the stakeholders/officers in charge) in order to

control the land exploitation and organize the related reactions, in the context of coastal land use policy.

In addition, Anthropogenetic Intensity fulfils the earlier mentioned criteria (see: Preconditions). Indeed, it is of pressure type (according to the P-S-R framework) and moreover, it incorporates the spatial concept and it seems to be very functional for planners and local authorities. In addition, this complex indicator is quite easy and inexpensive to be measured. Last but not least, as it is designed exclusively for coastal areas, it takes into account a very important parameter for coastal affairs, the distance from the shoreline.

Finally, because of the previously mentioned advantages, Anthropogenetic Intensity can help the building of a coastal typology for small coastal areas (local approach).

5. Anthropogenetic Intensity' Implementation (Case studies)

Introduction. The first coastal area that has been studied to test the appropriateness of Anthropogenetic Intensity is the coastal area in Navpaktos (greater region between Navpactos and Antirrion), Hellas. (Figure 2). It belongs to the prefecture of Aetolia-Akarnania and it is a rather rural region. In this greater region, the following two case studies have been realised:

Figure 2: Location of Navpaktos, Hellas (Greece).

1. NAVPAKTOS I. This is an area of 4,2 sq. km and its Ideal Shoreline[6] is 5,2 km. Anthropogenetic Intensity indicator is tested during two points of time, the first one was in 1985 and the second one in 2007. For the first case, 5 aerial photos (30cm * 30cm, scale 1:6.000) from the Hellenic Mapping & Cadastral Organization (____) were used (scale 1:5000). For the year 2007, 5 satellite images from Google Earth 2007 were used. It is remarkable that in both the studies Anthropogenetic Intensity indicator is calculated with and without using the part of the formula that refer to the distance from the shoreline.

2. NAVPAKTOS II. This is an area of 185,4 sq. km and its Ideal Shoreline is 21 km (it incorporates the study area of NAVPAKTOS I). Anthropogenetic Intensity indicator is tested only for the year 2007, and 1 satellite image from Google Earth 2007 were used (scale 1:25.000).

The critical difference between the two cases is the different set of land uses and the related weights that have been used. (see Table 1). On the other hand, the rest of the procedure is

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[6] 'Ideal Shoreline' is an indicator already introduced by John Kiousopoulos and his collaborators, in the context of AMICA research project. [Kiousopoulos 1997; Kiousopoulos 1999, Kiousopoulos & Lagkas 2005; Kiousopoulos 2007]. It refers to an already delimited coastal area and it is defined as the straight distance between the two end points of the related shoreline. In cases of an island, ideal shoreline is equal to the length of a circle's perimeter that has an area equal to the area of the island. 'Ideal shoreline' is a numeric quantity expressed in meters. [Kiousopoulos 2008].

similar. The created geodatabase have been georeferenced in the Greek Geographic Coordinate System GCS_GGRS_1987 (____87). The necessary elaboration has been done in the environment of ArcGIS 9.2 software.

Table 1: The land use sets and the related parameters.

LAND USES	NAVPAKTOS I		NAVPAKTOS II	
	height (m)	weight	height (m)	weight
Continuous Urban Fabric Area	15,0	2,0		
Discontinuous Urban Fabric Area	10,0	2,0		
Tourism	10,0	2,0		
Industry	8,0	4,0		
Highway	4,0	4,0		
Local Road	3,0	3,0		
Dirt Road	3,0	2,0		
Permanent Crops	3,0	0,5		
Annual Crops	1,0	0,5		
Olive Groves	3,0	0,5		
Open Spaces with little or non vegetation	1,0	0,5		
Shrubs and/or herbaceous vegetation	1,0	0,5		
Trees	3,0	0,0		
River	0	0,0		
Seashore	0	0,0		
Sports	15,0	2,0		
Horticultural-Cerials-Pasture Land			1,0	0,5
Trees			3,0	0,5
Forests			10,0	0,0
Industry- Deposits			8,0	4,0
Highway			4,0	4,0
Secondary- Rural Roads			3,0	3,0
Forestal – Dirt Road			3,0	2,0
Ports			10,0	4,0
Intermediate cities			15,0	2,0
Villages			5,0	1,0
Separated Buildings			10,0	2,0
Discontinuous Urban Fabric Area			5,0	1,0
River			0,0	0,0

Preliminary Results. In the case of NAVPAKTOS I, the results are available only according to the version '1' of the formula, it means without the use of the Distance component. In this case the Anthropogenetic Intensity value for 1985 is 4,55 m, while in 2007 Anthropogenetic Intensity is equal to 5,72 m. There is a modification of 1,17 m, between 1985 and 2007. This shows an 25,7% augmentation of the intensity of man-made activities, in the region of Navpaktos, during a period of 18 years. (see Figure 3)

In the case of NAVPAKTOS II, the Anthropogenetic Intensity value is calculated according to the version '2' of the formula, it means with the use of the Distance component. The AI value (for 2007) is 1,41 m. (see Figure 4).
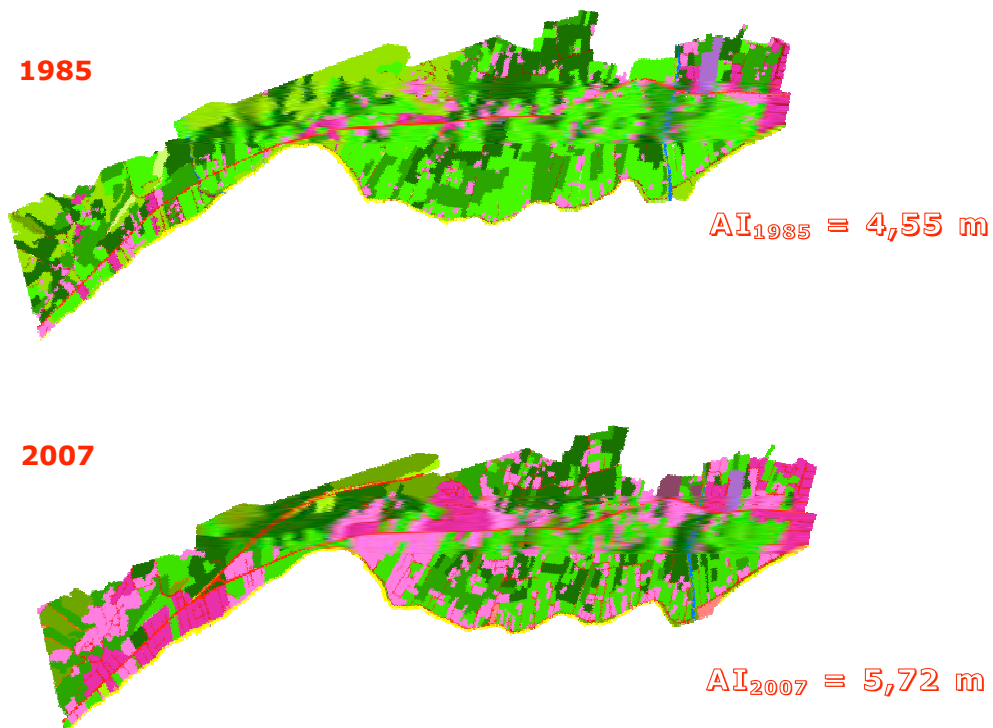
1985

$AI_{1985} = 4{,}55\ m$

2007

$AI_{2007} = 5{,}72\ m$

Figure 3: The area of case study Navpaktos I and the results. [Veizi et.al 2007]

Conclusion

Anthropogenetic Intensity aims to enrich the spatial planning procedure and to promote the spatial notion into the indicators sets. This new (geo)indicator considered to be very keen to illustrate small coastal areas, more precisely than the existing indicators are. But it is remarkable that it does not annul the existed ones. Anthropogenetic Intensity acts complementary, in a collaborative manner to accomplish a more precise description of coastal areas and a more accurate monitoring of man-made activities there.

The till now measured values of the new indicator 'Anthropogenetic Intensity' (AI) are encouraging and rather acceptable. Indeed, the two values of NAVPAKTOS I as well as their difference are logical. In the case of Navpaktos II, the Anthropogenetic Intensity value is smaller, because of the big percentage of the extra natural space in the related coastal area.

A big number of case studies is already in progress, in order to test AI indicator in different places (Hellenic coastal areas). During those attempts, all the involved parameters will be changed, with the purpose of improving the reliability of the AI formula. For example, the scale of approach (in order to examine if the AI indicator could be adjusted to different geographical scales), the set of land uses and the related weights, the depth[7] of the examined coastal area, the source of the digital data etc.

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[7] 'Depth' (or 'Terrestrial Depth') is another indicator has been already introduced by Kiousopoulos 1999]. 'Depth' is used to depict how deep landward the terrestrial section of the examined coastal

There is no doubt that the idea of Anthropogenetic Intensity needs further development. Finally, the ongoing research will be considered as successful, if the proposed indicator can promote the coastal identity and enable the comparison among all coastal areas. In parallel, the following two critical questions should be answered:

o   Could Anthropogenetic Intensity be "the one" indicator to assess sufficiently the total pressure on a coastal area and base (some) decisions on it?

o   Could coastal typology be based on Anthropogenetic Intensity?

Figure 4: The area of case study Navpaktos _I and the result.

area exceeds. In other words, it gives an idea of the mean width of the terrestrial part. If the area and the ideal shoreline of the coastal area are used as input data it can be defined as follows:
Terrestrial Depth, D = Land area / Ideal Shoreline.
'Depth' is a numeric quantity measured in meters. Small 'Depth' value means that the examined coastal area has an extensive waterfront and from that it can be concluded that there is high interaction between the marine and terrestrial part. On the other hand, high terrestrial depth value shows that the examined coastal area exceeds very far away landward, it has limited waterfront and relatively limited interaction between its marine and terrestrial section.

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