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Spatial typologies of Greek coastal zones and unregulated Urban growth

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Abstract Coastal zones attract a large number of people and productive activities. This puts pressure on ecosystems and affects the organization of local economies, having an impact on social cohesion and coherence. The complexity of coastal socio-spatial systems and the fact that coastal zones, and, more particularly, islands that are considered vulnerable areas (that is, parameters: such as sea level rising, desertification, built-up areas excessive expansion etc) and important for the overall operation of the state imply the significance of a further study of the subject. The paper deals with the principal socio-spatial pressures on coastal zones and islands that are caused by unregulated urban growth. The incompetent spatial planning framework, the "loose" political system, related to urban growth, and the socio-economical characteristics are considered as the principal reasons for built-up areas excessive dispersion. Here, delineation of the coastal zone is proposed, using physico-geographical and man-made variables. Soil Sealing dataset is used to illustrate where built-up areas dispersion and basic metrics can be applied. Furthermore, an overview of the planning spatial framework is attempted, so that the particularities of urban growth can be interpreted.

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Introduction

Spatial fragmentation and physico-geographical discontinuity are the typical characteristic of Greek geography, since almost 20 % of its territory consists of principally small islands and coastline with a length of more than 16,500 km, almost equal to that of the African continent (MEPPPW 2006b). The population living on a relatively narrow strip of land 1–2 km wide (in coastal Municipalities) represents 33 % of the total population. If one considers the population living in areas with access to the coast (45-min drive or up to 50 km from the seashore), then the coastal population is estimated to 85 % of the national population, while the GDP concentrated in the zone is over 65 % of the total GDP (MEPPPW 2006b). Prospects about coastal urbanization indicate a further development and activities concentration in the mid- and the long-term (year 2025). The percentage of urban coastal population is expected to rise from 59.37 % in 1985 up to 86.47 % in 2025, according to the Blue Plan/UNEP-MAP study scenario (MEPPPW 2006a; b).

Here, it is also worth mentioning that Greek insular and coastal areas - in spite of their heterogeneity of certain parameters, such as population, proximity, location, dominant economic activities, cultural differences, the exploitation of local resources etc. (Karampela et al. 2014) - also share certain notable features that make their identity be a whole. This particular geography creates fragile but unique ecosystems, vulnerable economies, generally with significant dependence on tourism (Tsartas et al. 2013; Karampela et al. 2014; Spilanis et al. 2012; Spilanis et al. 2008). Here, it is important to notice that these socio-spatial systems need to be studied further not

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only because of their vulnerability but also because of their importance for the overall operation of the state.

Obviously, the management of coastal zones and islands does not concern only the Greek case as it is of wider interest and numerous respectful studies focus on different aspects, different regions, different scales (CEC 2000, 2007a, b; Salvati 2009; Kiousopoulos 2008; Kiousopoulos and Lagkas 2005). Coastal zones are generally perceived as a land-sea interface, that is, the area where complex ecological and resource systems made up of biotic and abiotic components coexist and interact with local human communities and receive the impact of their relevant socio-economic activities (UNEP 2010). The resulting environment from the coexistence of two margins: (a) coast – land, that is defined as the terrestrial edge of continents, and (b) coastal waters, that is defined as the littoral section of shelf seas that together constitute a whole that needs a specific methodological approach and dedicated management methods. (EEA 2006). In other words, coastal areas are commonly defined as the interface or transition areas between the land and the sea, including large inland lakes. Coastal areas are diverse in function and form, dynamic and do not lend themselves well to definition by strict spatial boundaries. Unlike watersheds, there are no exact natural boundaries that unambiguously delineate coastal areas.

All the aforementioned definitions are flexible enough to accommodate the heterogeneity depending on the space and scale. Regarding the management of these distinct particular socio-spatial systems, there are two different spatial planning “divisions”: On the one hand, urban and Regional Planning (OGG 1997, 1999), and on the other hand, Maritime Spatial Planning (which has yet to be integrated and institutionalized in Greece), through the scope of different and complex natural and human activities. Although these zones are a whole and are characterized by ecological and socio-economical particularities (Spilanis et al. 2012; Spilanis et al. 2008), there is no spatial planning framework that focuses specifically on the issue. In Greece - despite the importance of coastal zones and islands and the fact that Law 2742/1999 (OGG 1999) recognizes the need of spatial planning of coastal zones and islands and the efforts made towards this direction in the early 2000s aiming to integrate and institutionalize the “Special framework on spatial planning and sustainable development of coastal zones and islands and strategy study of environmental impact of this” [“Eidiko plaisio chorotaxikou sxediasmou kai aeiforou anaptyxis gia ton paraktio xoro kai ta nisia”, in Greek], (MEPPPW 2003) - there is neither a spatial planning framework nor policy focusing on coastal zones and islands; instead, these areas are covered in a fragmentary manner within the context of other spatial planning studies.

As it is widely accepted and argued (Giannakourou 2005; Karidis 2006; Economou 2004), unregulated urban growth is a common practice for many Greek areas (peri-urban zones, ribbon residential clusters, roadside building construction areas, prime agricultural land etc) and is mainly directed towards coastal zones and islands, where, in some cases, it is done excessively. These practices are identified and interpreted largely with the help of the character of a general framework according to which cities were developed. In Greece urban area development has been implemented differently from the typical European case, driven mostly by spontaneous, self-promoted housing strategies (Karidis 2006; Economou 2004). Ad-hoc procedures were the dominant urban expansion mode. Cities development has very often happened without, or with a partial implementation, of the Urban Plan or other spatial plan projects. Unregulated urban growth had negative effects not only due to its volume, but mostly due to the character of receptor areas.

The residential areas construction “outside the urban planning zone” [“ektos orion oikismou”, in Greek] is very often followed with partially or completely non legal procedures. To these activities, the state - for political reasons – has responded with great tolerance. These hybrid areas (rural areas with intensive urban functions) were “transformed” into urban areas by the *ex-post* implementation of the Urban Plan. The adopted mode preserves and amplifies the political clientelism between the state and its citizens, mostly at local level, and flourishes the land plots speculation since it allows a case-by-case approach. Housing areas developed by ad-hoc procedures are the triumph of the spatial “individualization” of the public space. These hybrid areas of dispersed housing are empty of collective consumption goods and very poor in infrastructures and public green spaces. (Karidis 1996).

In order to support spatial planning for coastal zones and islands, which is now more broadly recognized as a key priority, there is need for more accurate description of coastal zones that uses indicators and metrics pertinent to bring out coastal identity, thus enabling the comparison among all coastal areas, is a precondition (Kiousopoulos 2008; Kiousopoulos and Lagkas 2005). To that end, the paper attempts to examine how a flexible and composed definition of the coastal zone works in practice, in connection with an actual parameter that concerns built-up areas that are considered as a principal environmental pressure on coastal zones in the present paper (EC 2012). Here, it is adopted the thesis that applications of standard definitions – e.g. a buffer zone of 10 km coastal zone below 5 m elevation (EC 2006) - cannot integrate the complex and multidimensional character of coastal socio-spatial systems. So far, any attempt to define the coastal zone lacks flexibility and adaptability, since it has yet to incorporate in its methodology precise spatial properties and the specific scale of each study.

The data that support the coastal zone delineation and its typologies definition are the following: (a) Digital Elevation Model (DEM) of Greece, derived from the EEA 2000, GMES RDA project; (b) mountain basins; and (c) the coastline, derived from the MOEPPPW 2013; (d) the 50-m isobath contour, extracted from EMODNET Digital Bathymetry Model; (e) the 5-m elevation contour line, derived from EEA 2005; (f) Larger Urban Zones (LUZ), derived from the EEA 2006 Urban Atlas project; (g) the delineation of the Local Administrative Unit (LAU) and the population census, derived from the EL-STAT 2011; and (h) the raster data set of built-up and non built-up areas, provided by the EEA 2014. The goal of this study is to establish a solid methodology for a coastal zone delineation and spatial typologies definition of the coastal zone, so that various socio-spatial issues connected with the unregulated urban growth that is taking place can be studied in a more efficient way. Two basic requirements need to be fulfilled in the methodology adopted: flexibility and transparency. These requirements are critical for the proposed delineation of any strategic planning attempt. The lack of precise delineation of the coastal zone has as a result that spatial planning policy and projects (of strategic or physical nature) are altered, depending on the scope of the research and local parameters, instead of covering the whole of the coastal zone of Greek territory in a integrated and systematic way.

Data and Methods

Data

The data that support the production of the coastal zone delineation and the typologies are the following (Fig. 1): (a) The coastline derived from the MOEPPPW 2013 is used to supplement the proximity criterion, through the production of the buffer zones for the 2, 5, and 10 km respectively, resulting in the inland space required for this study. This criterion is also used to restrict other parameters; (b) The EU- Digital Elevation Model (EU-DEM) dataset of Greece is used to provide the elevation and slope parameters that allow to precisely determine the coastal zone relief; the data is derived from the EEA 2000, GMES RDA project; (c) The five-meter elevation contour line that enables the identification of lowlands is considered vulnerable to sea level rise and the risk of flooding. The data sets are derived from EEA 2005, EUROSION project; (d) 50 m-Isobath contour, extracted from EMODNET Digital Bathymetry Model, is initiated by the European Commission. 50 m-Isobath is used conventionally to determine the coastal zone on the side of the sea, after a series of production activities and ecological processes have occurred up to this depth (despite the fact that the photic zone where there is enough light available for photosynthesis is considered to extend up-to 200 m depth); (e) Mountain Basines,

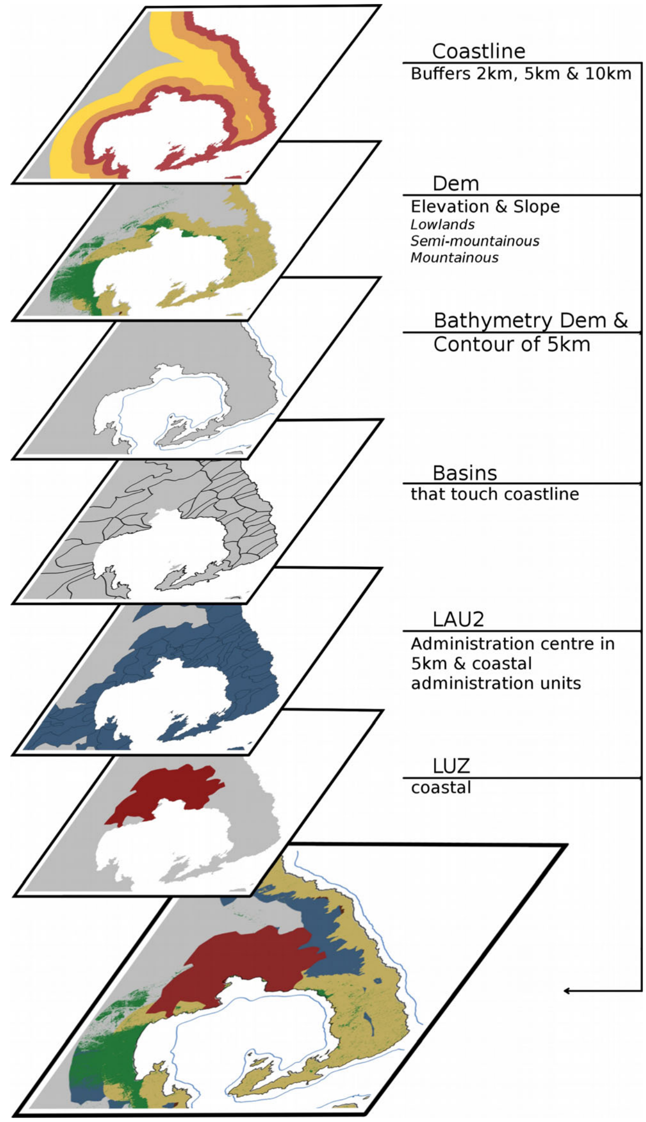

Fig. 1 Variables used for spatial typologies and the Coastal Zones definition. **a** Represents the proximity variable consisting of buffer zones and their respective spatial footprint shown both on inland and island areas, buffer zones for the 2, 5, and 10 km respectively; **b** Shows one of the topography variables, which consists of both the elevation and slope as extracted from the DEM and reclassified accordingly into three different classes: lowlands, semi-mountainous and mountainous; **c** The 5 m-elevation contour and the 50 m isobaths are used to incorporate areas whose dynamics and significance are subject to various scientific fields, methods and approaches that are beyond the purposes of the present paper and should not further investigated; **d** Completes the topography criterion with the inclusion of mountain basins, land areas where surface water from precipitation gathers according with the hydrology and hydrography of the area, with impact on downstream areas; **e** The LAU 2 administrative delineation means the Municipalities that have proximity with the shoreline; and **f** Larger Urban Zones, as provided from the Urban Atlas project, mean the city with its "functional urban region," as it follows the administrative delineation LAU 1

derived from the MOEPPPW 2013, are considered as a parameter with important environmental impact on coastal zones connected commonly with floods in downstream areas and pollution issues that are caused by fresh waters that cross cultivated zones and lead to the sea e.g. eutrophication etc.; (f) Larger Urban Zones (LUZ) represent the city and its surroundings. LUZ delineation follows the administrative boundaries that approximate the functional urban area means, the area around the core of the city that is actually defined by the percentage of everyday commuters and differs from country to country (Urban Audit 2012). The data is provided by the European Urban Atlas, part of the Global Monitoring for Environment and Security (GMES) / Copernicus land monitoring services. The data is provided on 1/10.000 scale in vector structure, here the data sets are rasterized in 20*20 resolution; (g) LAU 2 administrative delineation derived from the Hellenic Statistical Authority 2011. It represents the municipalities that have some proximity with the sea shore; (e) For some aspects of the urban growth to be quantified, Soil Sealing[1] data sets that are provided by the EEA 2014 are used. They provide the covering of the ground by an impermeable material. The data set of built-up and non built-up areas contains the degree of imperviousness ranging from 0 to 100 % (impervious surfaces of built-up areas account for 80 to 100 % of the total cover) (Kopecky and Kahabka 2009).

Working scale

The data spatial structure that is used here is raster (or vectors files converted into raster) and is provided by Lambert Azimuthal Equal Area (LAEA) coordinate reference system which is used conveniently in maps for European continent. A useful property of this projection is that it does not distort areas; thus, a comparative analysis on a greater scale is possible. It also provides the possibility for a comparative analysis to be made so that the method is implemented in other areas for further research. Another critical task is how to determine the scale. Here, two principal issues are taken into consideration: first, the study question, and, second, the data-sets availability. Therefore, in this study the working scale is fixed on 1:20.000, and, therefore, spatial resolution of the data-set, namely the dimension of the cell size representing the area covered on the ground, is set on 20*20 m. (Waldo 1988). The working scale is considered appropriate because of the nature of the paper question (typical scale for physical planning studies) and data availability.

[1] Soil sealing is considered as one of the main causes of soil degradation, the loss of soil resources, due to the covering of land for housing, infrastructures or other man-made constructions. It can be used to characterize the human impact on the environment. It is believed to be an important environmental, irreversible threat as it often affects fertile agricultural land, puts biodiversity at risk, increases the risk of flooding and water scarcity and contributes to global warming (EEA 2005). The data sets are chosen despite data accuracy questions (Maucha et al. 2010), first, because the provided datasets are in pertinent spatial resolution (20*20 m) according to the study questions, and, second, because there are more pertinent geospatial data-sets at the national level.

Methodological approach

The chosen methodology is pertinent in order to develop coastal zone delineation and define a plethora of spatial typologies, according to the chosen physical-geographical and man-made variables, instead of simply defining and using only buffer zones based on the proximity to the shoreline (Tsilimigkas and Kizos 2014). When six variables are crossed according to certain criteria, as shown in Table 1, an overlay raster of their respective values is resulted. Using this method, we can understand that for every pixel 20*20 m on the grid the exact typology is derived through the various variables used which translates into knowledge of three distinct spatial requirements considered here as “major categories”. The major categories are: (a) Relief (using Elevation and Slope) that provides the geomorphology attributes embedded in the zone; (b) Proximity with the shoreline that is used to restrict other criteria; and (c) administrative delineation and built-up areas. More details about these major categories are given below.

(a). Relief. The elevation and slope variables were extracted from the DEM, were reclassified and crossed, thus producing tree spatial categories according the following criteria: (i) Lowlands, plan zones characterized by elevation form 0 to 400 and slope from 0 to10% (17,818.24 km^2); (ii) semi-mountainous zones, characterized by elevation from 0 to 400 and slope greater than 10 %, and elevation from 400 to 600 and any slope as well as zones with elevation from 600 to 800 and slope lower than 3 % (15,965.72 km^2); and (iii) the mountainous zones characterized by elevation from 600 to 800 with slope greater than 3 % and zones with elevation higher to 800 and any slope (948.29 km^2). As far as Mountain basins are concerned, we chose all those that intersect with coastline, while restricting them inside the 10 km-buffer zone (58,793.46 km^2). The whole area is covered with 50 m-isobath zone (sea side) (3305.68 km^2) (and the 5 m-elevation contour in case that no other criterion covers the respective areas (3677.45 km^2).

(a) Proximity. We created 3 different proximity buffers from the coastline of 2, 5 and 10 km (10,248.86, 21,937.30, 36,898.60 km^2) respectively that follow definitions of coastline adopted with certain policies. This proximity of delineations is used to restrict other variables areas as they are respectively described. Concerning the details about the relief, the buffer of 2 km is used to delineate the mountainous area which extends to the coastal zone, whereas the buffer of 5 km identifies the areas of semi-mountainous and the buffer of 10 km identifies the areas of the lowlands. The criterion is used to cover the respective areas in case that no other criterion is fulfilled.
(b) Administrative delineation and built-up areas. Regarding the LAU 2, Municipal districts / Community districts, [“*Demotiko diamerisma / Koinotiko diamerisma*”, in

Table 1 Criteria used for spatial typologies and the coastal zones definition

Major categories	Variables	Criteria description
Relief	Elevation and slope	Lowlands (Low) Elevation 0–400 with slope 0–10 % → Inside buffer of 10 km Semi Mountainous (Semi) Elevation 0–400 with slope > 10 % and Elevation 400–600 with any slope and Elevation 600–800 with slope < 3 % → Inside buffer of 5 km Mountainous (Mount) Elevation 600–800 with slope > 3 % and Elevation 800+ with any slope → Inside buffer of 2 km
	Mountain Basins	Mountain Basins Inside Mountain Basins (Bas) → Inside buffer of 10 km
	Contour of 5 m	Contour of 5 m Inside contour of 5 m (Con5m)
	Isobaths of -50 m	Isobaths of -50 m Inside Isobaths of -50 m (Iso50)
Proximity to the shoreline	2 km buffer zone	2 km Buffer Area Inside the 2 km Buffer Area (In2)
	5 km buffer zone	5 km Buffer Area Inside the 5 km Buffer Area (In5)
	10 km buffer zone	10 km Buffer Area Inside the 10 km Buffer Area (In10)
	Large Urban Zone	Large Urban Zone Inside the Large Urban Zone (LUZ)
	Local Administrative Units	Local Administrative Units Inside Local Administrative Units LAU2 → LAU2 headquarters inside buffer of 5 km

Source: processing from, Tsilimigkas et al. 2016 (forthcoming)

Greek], we selected those that interact with the coastline and those whose municipality headquarters are included in the 5-km buffer zone with no further proximity limitation (40,167.71 km^2). As far as the LUZ is concerned, we chose to include all coastal LUZ and not to limit their expansion (6620.72 km^2).

Results

In respect with the described criteria, the overly of the above variables produces a coastal zone delineation that integrates spatial "realities", meaning that for every pixel on the grid, it is understood that the exact typology is derived through the various variables used, which translates into knowledge of three distinct spatial requirements: the Relief, the proximity with the shoreline and Administrative delineation and built-up areas. It is an effort to go beyond the common definitions of coastal zones that use only administrative (e.g. coastal municipalities) or proximity criterion (e.g. 10-km buffer zone) and have important spatial restrictions. This kind of "procrustean" delineations is not considered adequate to implement policies and projects on Integrated Coastal Zone Management (ICZM). The overly layers resulted from crossing variable layers have provided us with every possible spatial typology available in our data, as it has already been mentioned above. Of the 98 categories produced, according to the aforementioned method, a grouping into 5 separate coastal typologies is attempted (Table 2).

The dominant typology is "Semi-mountainous coastal zones" with approximately 53 % (21,937.31 km^2) of the total coastal land cover. In this typology, the distance that determines the extent of the zone of the semi-mountainous area is the buffer of 5 km. The second in extent typology is "Lowland coastal zones" with almost 19 % (7876.20 km^2) of the total coastal land cover. This broad category, like all the other typologies, contains all possible combinations that extend in lowland areas. The participation rate in the whole area is the extended, because coastal areas do not have high altitude and their range is defined by a greater distance from the coastline, (within the buffer of 10 km). The third in extent typology is LAU2 coastal zones with approximately 15.10 % (6224.10 km^2) of the total coastal land cover. This zone is defined by the administrative boundaries of the coastal area. The typology that follows is "LUZ coastal zones" with almost 12 % (4995.55 km^2) of the total coastal land cover. Urban areas occupy a large area of coastal areas as they represent highly attractive place for residential area. The last typology is Mountainous coastal zones with 0.48 % (196.60 km^2) of the total coastal land cover. The mountainous area is limited, almost not existent. This figure relates predominantly to cliffs and vertical surfaces of the relief of the coastline.

Population distribution in space is undoubtedly an important element in spatial analysis, especially for coastal zones and insular areas, wherein excessive expansion of cities and intensive urban sprawl take place. Although it is not the main issue of the present paper, it is worth underlining that - according to the coastal zone delineation that covers 44,554.03 km^2, which means 34.23 % of the total Greek area – 8,204,710 people live, corresponding to 75 % of the total population

Table 2 Coastal zone typologies and their representation in coastal zone

Categories	Land cover km2	Land cover %	Categories	Land cover km2	Land cover %
COASTAL LAU2	6224.10	15.10 %	COASTAL LUZ	4995.55	12.12 %
“Basins”; “In 10”; “In 5”	149.07	0.36	“LUZ”	1344.02	3.26
“LAU2”; “In 10”	889.32	2.16	“LUZ”; “In 10”	308.18	0.75
“LAU2”; “In 10”; “In 5”	25.41	0.06	“LUZ”; “In 10”; “In 5”	0.02	0.00
“LAU2”; “Bas”; “In 10”	3611.08	8.76	“LUZ”; “Bas”	861.04	2.09
“LAU2”; “Bas”; “In 10”; “In 5”	1549.22	3.76	“LUZ”; “Bas”; “In 10”	485.70	1.18
COASTAL LOWLANDS	7876.20	19.10	“LUZ”; “Bas”; “In 10”; “In 5”	1.11	0.00
“Low”; “In 10”	1118.54	2.71	“LUZ”; “LAU2”	6.04	0.01
“Low”; “In 10”; “In 5”	193.21	0.47	“LUZ”; “LAU2”; “In 10”	132.40	0.32
“Low”; “In 10”; “In 5”; “In 2”	17.60	0.04	“LUZ”; “LAU2”; “In 10”; “In 5”	10.66	0.03
“Low”; “Bas”; “In 10”	529.81	1.29	“LUZ”; “LAU2”; “Bas”	184.82	0.45
“Low”; “Bas”; “In 10”; “In 5”	102.60	0.25	“LUZ”; “LAU2”; “Bas”; “In 10”	578.88	1.40
“Low”; “Bas”; “In 10”; “In 5”; “In 2”	8.93	0.02	“LUZ”; “LAU2”; “Bas”; “In 10”; “In 5”	47.73	0.12
“Low”; “LAU2”; “In 10”	544.58	1.32	“LUZ”; “Low”; “In 10”	95.76	0.23
“Low”; “LAU2”; “In 10”; “In 5”	1241.83	3.01	“LUZ”; “Low”; “In 10”; “In 5”	14.60	0.04
“Low”; “LAU2”; “In 10”; “In 5”; “In2”	1510.84	3.66	“LUZ”; “Low”; “In 10”; “In 5”; “In 2”	3.59	0.01
“Low”; “LAU2”; “Bas”; “In 10”	213.91	0.52	“LUZ”; “Low”; “Bas”; “In 10”	102.55	0.25
“Low”; “LAU2”; “Bas”; “In 10”; “In 5”	949.70	2.30	“LUZ”; “Low”; “Bas”; “In 10”; “In 5”	21.79	0.05
“Low”; “LAU2”; “Bas”; “In 10”; “In 5”; “In 2”	1444.65	3.50	“LUZ”; “Low”; “Bas”; “In 10”; “In 5”; “In 2”	0.81	0.00
COASTAL SEMI-MOUNTAINOUS	21,937.31	53.21	“LUZ”; “Low”; “LAU2”; “In 10”	7.36	0.02
“Semi”; “In 10”; “In 5”	154.04	0.37	“LUZ”; “Low”; “LAU2”; “In 10”; “In 5”	70.53	0.17
“Semi”; “In 10”; “In 5”; “In 2”	11.77	0.03	“LUZ”; “Low”; “LAU2”; “In 10”; “In 5”; “In 2”	118.83	0.29
“Semi”; “Bas”; “In 10”; “In 5”	766.59	1.86	“LUZ”; “Low”; “LAU2”; “Bas”; “In 10”	98.74	0.24
“Semi”; “Bas”; “In 10”; “In 5”; “In 2”	59.29	0.14	“LUZ”; “Low”; “LAU2”; “Bas”; “In 10”; “In 5”	157.46	0.38
“Semi”; “LAU2”; “In 10”; “In 5”	906.19	2.20	“LUZ”; “Low”; “LAU2”; “Bas”; “In 10”; “In 5”; “In 2”	206.69	0.50
“Semi”; “LAU2”; “”; “In 10″; “In 5″; “In 2”	1896.36	4.60	“LUZ”; “Semi”; “In 10”; “In 5”	24.95	0.06
“Semi”; “LAU2”; “Bas”; “In 10”; “In 5”	8181.23	19.84	“LUZ”; “Semi”; “In 10”; “In 5”; “In 2”	0.29	0.00
“Semi”; “LAU2”; “Bas”; “In 10”; “In 5”; “In 2”	9961.84	24.16	“LUZ”; “Semi”; “Bas”; “In 10”; “In 5”	108.29	0.26
COASTAL MOUNTAINOUS	196.60	0.48	“LUZ”; “Semi”; “Bas”; “In 10”; “In 5”; “In 2”	2.71	0.01
“Mount”; “Bas”; “In 10”; “In 5”; “In 2”	1.31	0.00			
“Mount”; “LAU2”; “In 10”; “In 5”; “In 2”	3.82	0.01			
“Mount”; “LAU2”; “Bas”; “In 10”; “In 5”; “In 2”	191.47	0.46			

Source: processing from, Tsilimigkas et al. 2016 (forthcoming)

(EL-STAT 2011). The SL in coastal area covers a total area of 28,251.71 km^2, which means 63.41 % (Fig. 2).

Discussion

Subsequently in 2014, European Union establishes a framework for Maritime Spatial Planning, (EP&C, 2014). According to the Directive for the Integrated Maritime Policy (CEC, 2007a), the Maritime Spatial Planning implementation and enactment is a key priority in order to achieve the objectives concerning sea management. The Maritime Spatial Planning Directive 2014/89/EU aimed to promote sustainable development of maritime economies, sustainable development of maritime areas and sustainable use of marine resources. Member States had to adopt and implement maritime spatial plans at the latest by March 31, 2021 taking into consideration the specificities of maritime areas, the relevant existing and future activities and uses and their environmental impact and also the interaction between land and sea (EP&C, 2014).

Coastal zones, as it has been aforementioned, are not “autonomous” spaces; instead, they are directly interconnected with the mainland and the seas (EC, 2013). The increased tendency for maritime uses as well as, the population and activities hyper-concentration in coastal zones drive to an

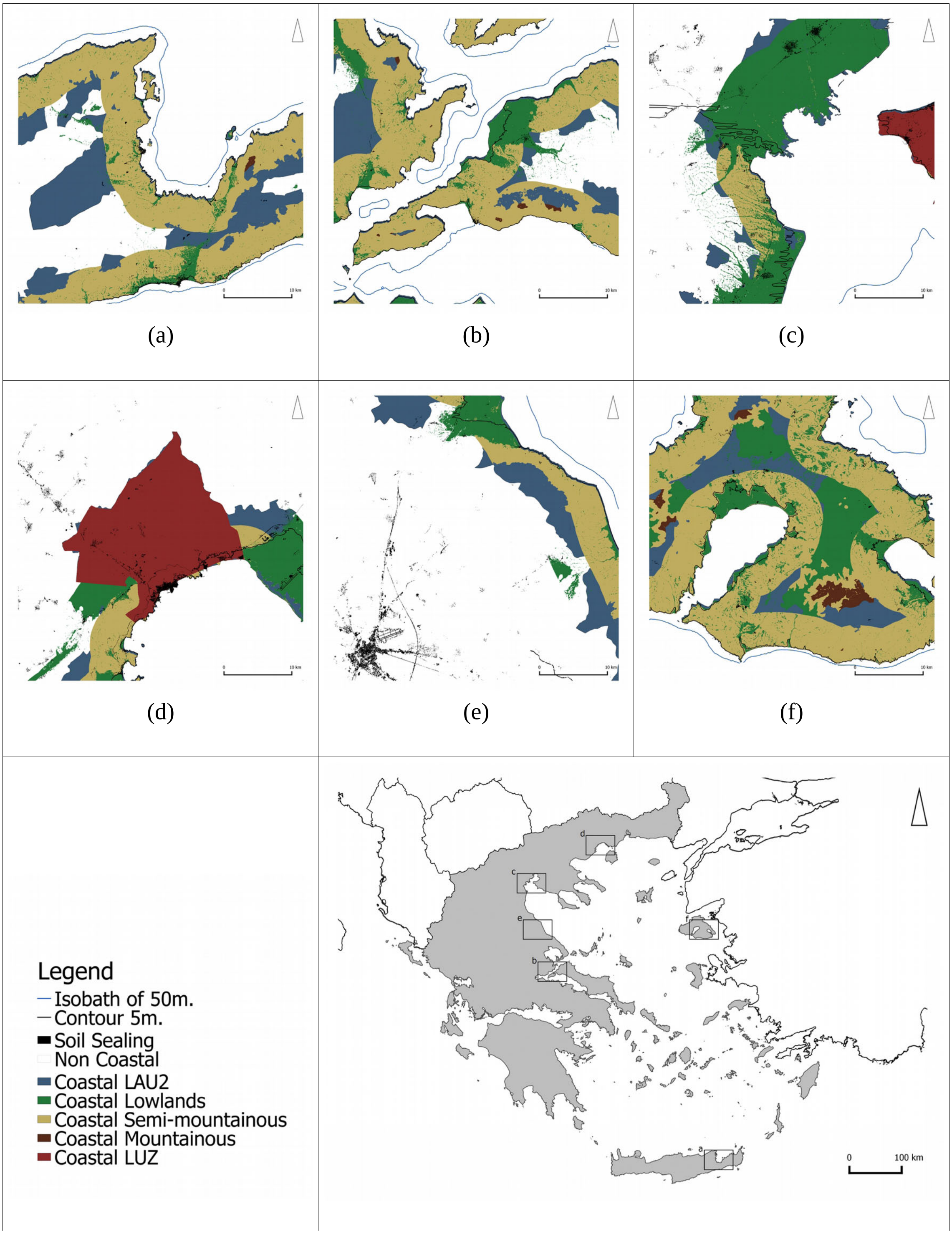

Fig. 2 Cases of major spatial typologies of Coastal Zones

amplification of coastal socio-spatial systems pressure that often exceeds their carrying capacity. Coastal zones are in fragile balance, with highly competitive and unstable socio-economic relations, while rich littoral ecosystems are frequently degraded due to significant pressures (Tsilimigkas and Gourliotis 2015). In addition, the ever increasing menace from the climate change, desertification of certain regions and the risk of natural disasters such as wild fires, fluids and the erosion, render these into particularly vulnerable areas.

Within this framework, it is worth underlining that coastal zones are vital areas for human activities. A large number of activities are taking place there, which are related to: tourism, transportation, agricultural etc., as well as qualities natural and cultural environment and landscapes. The intense land use concentration commonly drives to land use conflicts that may concern conflicts between human activities (e.g. intensive touristic development and aquaculture) or incompatibilities between human activities and the characteristics of the natural and the man-made environment (e.g. intensive touristic development in NATURA200 areas). Within this context, in 2013 the European Commission adopted a Directive proposal for a framework for Maritime Spatial Planning and Integrated Coastal Zone Management in order to implement a comprehensive planning framework for the coherent management of these sensitive areas (EC 2013).

At the international level, the Barcelona Convention on the protection of the Mediterranean against pollution (UNEP/MAP 1976) - as it is subsequently amended and renamed as "Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean" – stressed the importance to promote further the integrated planning of coastal zones, taking into account the protection of areas of natural and cultural value, and ensured the equitable use of natural resources (UNEP 1995). Within this framework it was decided inter alia: (a) the principal aim to monitor marine pollution; (b) the importance of the sustainable management of marine and coastal natural resources; (c) the importance of the protection of natural and cultural Mediterranean heritage; (e) it also highlights concrete environmental practices in social and economic development; and (f) the priority for cooperating in development practices among the Mediterranean countries concerning the environment and the enhancement of living standards (UNEP/MAP 1976). In 2008, the Protocol on Integrated Coastal Zone Management in the Mediterranean was signed in Madrid in order to enhance the need and international planning framework for these particular areas. The priorities emerged from the Protocol focus on: (a) sustainable management and use of coastal zones; (b) a conservation of coastal resources and ecosystems; (c) proactive policies development against natural hazards; and (d) on the amplification of coordination between authorities involved in coastal and maritime zones (UNEP/MAP 2008).

At the European level, the European Union enacted an Integrated Maritime Policy in October 2007, the most important step towards the protection and the equitable use of maritime space, with important direct effects on coastal zones. Principally, this enactment aimed to: (a) increase the sustainable use of oceans and seas; (b) build maritime policy that is based on knowledge and innovation; and (c) to provide the highest quality of life in coastal areas. To that end, Maritime Spatial Planning, maritime monitoring and a comprehensive and accessible source of data and information are considered as principal requirements (CEC 2007a; b). Following-up this enactment, the European Union enacted the Directive 2008/56/EC in 2008 and established a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) in order to set out a common framework and objectives to prevent, protect and preserve the marine environment (EP&C 2008).

Subsequently, the European Union established a framework for Maritime Spatial Planning in 2014 (EP&C 2014). According to the Directive for the Integrated Maritime Policy (CEC 2007a, b), the Maritime Spatial Planning implementation and enactment were key priorities so that the objectives concerning the sea management could be fulfilled. The Maritime Spatial Planning Directive 2014/89/EU aimed to promote sustainable development of maritime economies, sustainable development of maritime areas and sustainable use of marine resources. Member States had to adopt and implement maritime spatial plans at the latest by March 31, 2021, taking into consideration the specificities of maritime areas, the relevant existing and future activities and uses and their environmental impact on them as well as the interaction between land and sea (EP&C 2014).

Within this international and European context of the Integrated Coastal Zone Management and Maine Spatial Planning, the Greek planning system needs to adjust in a flexible and efficient way. Coastal zones and island management are covered by numerous national, regional and local spatial planning frameworks and plans in a patchy way. There is not a single planning policy that focuses specifically on them, despite the fact that Spatial Planning Law 2742/1997, Article 7 (OGG 1999) makes a provision for that. It should be noted that efforts towards that direction were made as early as in the 2000s, aiming to integrate and institutionalize the "Special framework on spatial planning and sustainable development of coastal zones and islands" ["Eidiko plaisio chorotaxikou sxediasmou kai aeiforou anaptyxis gia ton paraktio xoro kai ta nisia", in Greek], (MEPPPW 2003). More specifically, spatial planning frameworks that manage issues that concern coastal zones and islands provide statutory requirements or strategic guidance are the following:

(a) At national level: (i) the General Spatial Planning and Sustainable Development Framework ["Geniko plaisio xorotaxikou sxediasmoy kai aiforou anaptiksi", in Greek], (OGG 2008a) sets the principal spatial and developmental priorities, covering among others, issues related to both coastal and insular areas, without following or/and delivering any specific policy for these areas. Apart from that, at national level: the Special Frameworks on Spatial Planning and Sustainable Development ["Eidika plaisia Chorotaxikoύ Schediasmou kai Aeifóroy Anaptyxis", in Greek]; (ii) on Tourism, (OGG 2009; 2013); (iii) on Renewable Energy, (OGG 2008a; b); (iv) on Aquaculture, (OGG 2011); (v) on Industry, (OGG 2009) contain important sectoral arrangements, of statutory character, with territorial impact, without being part of an integrated policy for coastal zones and islands. In other words, at a national level, the existing planning frameworks, while being of strategic and statutory character, regulate issues related to coastal zones and islands without proposing or being part of an integrated policy for these areas; this means that the adoption of non-complementary and even competitive policies and priorities is possible, since the choices made have been based on ad hoc response of spatial and sectoral needs and priorities.

(b) As it is expected, respective issues also emerge at the lower planning level, the regional one. The eleven Regional Frameworks of Spatial Planning and Sustainable Development ["Perifereiako plaisio xorotaksikou sxediasmoy kai aiforou anaptiksis", in Greek], (OGG 2003a; b; c; d; e; f; g; h; i; j; k; l) that cover all regions that intersect with coastal zones (having been in procedure of assessment, amendment and specialization since 2010) propose strategic guidelines and statutory regulations for them, without being part of an integrated policy for coastal zones and islands. More specifically, they are the Regional Frameworks of Spatial Planning of: Central Greece, Central Macedonia, Crete, Eastern Macedonia and Thrace, Epirus, Ionian Islands, North Aegean, Peloponnese, South Aegean, and Thessaly. Only Western Greece region is excluded, because it has no proximity to the waterfront, and Attica, because there are no Regional Frameworks of Spatial Planning and Sustainable Development for it. The dominant rationale underpinning this case is the adoption of ad-hoc choices that fit with the region character and respond to territorial and sectoral needs and priorities, ignoring, however, the overall operation of coastal zones and islands.

(c) At a local level, physical planning is applied by General Urban Plans ["*Genika Poleodomika Sxedia*", in Greek] or by the Open City Spatial and Housing Organization Plan ["*Sxedia Xorikis kai Oikistikis Organosis Aniktis Polis*", in Greek], (OGG. 1997): massively implemented at NUTS 1 level by the municipalities. They regulate critical issues concerning coastal zones and islands, without specifying coherent guidelines from the upper planning level (regional or national). It is worth underlining here that commonly the upper coming directions are not complementary, whereas, in cases, competing priorities are adopted, thus creating, among others, significant problems in administration and fundamental difficulties in physical planning implementation.

Many issues emerge from the "loose" planning system, the obstructionism of the institutional framework that is combined with the great tolerance of the political system concerning the residential production (Giannakourou 2005). Unregulated urban growth on coastal zones and islands here is considered as the principal issue that puts a significant pressure on these particular socio-spatial systems. A quite number of studies develop arguments on this, providing specific aspects of the issue from different viewpoints (Economou 2004; Chorianopoulos et al. 2014; Sayas 2006. Salvati 2013; Leontidou et al. 2007; Tsilimigkas and Kizos 2014; Tsilimigkas et al. 2015). Nevertheless, a further analysis of the co-existence of unregulated urban growth and urban sprawl goes beyond the purpose of this paper.

Two main issues, commonly identified that involve this practice are considered as the principal typologies of unregulated urban growth that takes place in the study area. Unregulated buildings are developed (a) along the coastline and (b) along roads. Ribbon urbanization along both sides of roads concerns, first, retail development and, second, housing clusters, both attracted by the existing infrastructure and the favorable regulatory arrangements for the plots that have road proximity. The main effects of ribbon urban development are, first, the substantial burden of the bearing capacity of roads; and, second, the creation of significant difficulties in the perspective of future widening projects.

The principal consequences of built-up areas concentration along the coastline -where building are attracted by the quality of the environment that the proximity with the sea generally ensures -are: first, landscape degradation through the diffusion of buildings and infrastructures that follow (roads, power grids and telecommunication networks, etc.). Degradation of landscape is an even more important issue, if it is considered that unregulated urban growth along the coast is usually attracted from areas of special quality to natural and man-made environment. Second, build-up areas concentration along the coastline puts significant environmental pressures on littoral forests, agricultural land, coastal ecosystems etc.

Besides the specific issues that the two typologies of unregulated urban growth involve, a series of common problems also emerge. They concern: (a) the important construction cost and the low quality of infrastructures and social services provided in unregulated urban growth clusters; and (b) the "compromise" created by this practice that significantly limits the applicability of future "integrated" urban plans. Postdated urban plans will restrict their proposals in a de-facto formed context and commonly they will focus on responding to urging needs, emerging from the already shaped residential areas instead of implementing an integrated urban plan.

Conclusion

Within this context, the adoption of an integrated planning framework for coastal zones and islands is a requirement, despite the significant organizational and operational issues that are likely to occur. Integrated coastal zone management is considered as a need not only for their particular importance for Greek territory (coastline of more than 16,500 km and about 3000 islands, a few hundreds of which are inhabited) but also for environmental and developmental issues emerging in these areas. In order for an Integrated Coastal Zone Management to take place, coastal zone delineation is a prerequisite for sustainable management of these particular areas that are characterized by ecological and socio-economical complexity and fragility. To that end, the present paper proposes a solid methodology for coastal zone delineation.

To sum up, we have considered that coastal zone management could be embodied in the National Spatial Planning framework in order to identify the guidelines that will be more specialized in the Special Framework on Spatial Planning of coastal zones and islands. At the national level, the aforementioned frameworks could establish fundamental guidelines and priorities for a spatial policy, focusing on these particular areas. Respectively, at the regional level, Regional Frameworks of Spatial Planning could provide and specify the fundamental guidelines as they are considered the pertinent studies to manage and better emerge the uniqueness of each geographical unit based on a holistic spatial approach.

Key issues expected to emerge are: (a) the formulation of objectives at the national and regional level; (b) determination of guidelines for the lowest spatial planning levels, (local plans); (c) confrontation of legal restrictions that are produced by a complex institutional system; (d) achievement of compatibility with other spatial and sectoral plans; (e) assessment of direct and indirect spatial impact on socio-economical and environmental issues; (f) formulation of coherent policy actions and measures; and (g) establishment of a single base of geo-spatial data. The focus should be, in accordance with the subsidiarity principle, on functional articulation of decision making and planning bodies. Through this organizational approach, synergy knowledge and actions could be achieved by the different policy actors and stakeholders.

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