European Journal of Geography

Volume 13, Issue 2, pp. 001 - 026

Special Issue
in memory of Professor Yorgos N. Photis

Guest Editor: Dr Maria Pigaki, pigaki@survey.ntua.gr

Article Info
Accepted: 12/04/2022
Corresponding Author: (*)lagarias@iacm.forth.gr
DOI: https://doi.org/10.48088/ejg.a.lag.13.2.001.026

Research Article

Assessing the coastal vs hinterland divide by use of multitemporal data: Case study in Corinthia, Greece

Apostolos **LAGARIAS**[1*], Ioannis **ZACHARAKIS**[1] & Anastasia **STRATIGEA**[1]

[1] *National Technical University of Athens, Greece*

Keywords

Urban development,
Coastal vs hinterland divide,
Coastal areas,
Multitemporal data,
Global Human Settlement Layer,
Corinthia

Abstract

Escalating urban development in coastal zones is currently noticed in many regions around the globe, leading to unsustainable future pathways. This, among others, accounts for: land and marine ecosystems' degradation; higher vulnerability to Climate Change impacts; and a largely uneven urban network pattern, raising issues of the 'coastal vs mainland' divide that hampers a balanced regional development. This holds true in the case study explored in this work, namely Regional Unit of Corinthia, Region of Peloponnese, Greece. This area, despite its natural and cultural assets and critical location as a transportation node in close proximity to Athens, displays certain spatial imbalances as to the coastal and hinterland urban expansion pattern that are linked also to developmental ones. Monitoring urban development by use of multi-temporal data for built-up areas can advocate the identification/assessment of important spatial dimensions of the aforementioned problems; and guide evidence-based policy decisions. Along these lines, this paper elaborates on the development of a methodology in response to the research question of quantifying urban development trends and assessing the "coastal vs hinterland" divide. This methodology is grounded in high-resolution multi-temporal data processing for built-up areas, provided by the Global Human Settlement Layer (GHSL); and the estimation of a Coastal vs Hinterland divide Index (CHI). Results highlight the criticality of coastal urban development and the need for an integrated policy, re-directing developmental impulses towards the less privileged hinterland urban constellations; while supporting endogenous development of territorial assets, in order for a more balanced and sustainable urban settlements' model to emerge.

Highlights:

- 'Coastal vs mainland' divide in coastal areas hampers balanced regional development

- Methodology is grounded in high-resolution multi-temporal data processing for built-up areas

- Urban development is monitored in Regional Unit of Corinthia, Greece, in the period 1975-2014

- A Coastal vs Hinterland divide Index (CHI) is used to assess the spatial divide

- Results highlight the criticality of coastal development and the need for an integrated policy

*The publication of the **European Journal of Geography** (EJG) (http://eurogeojournal.eu/) is based on the **European Association of Geographers**' goal to make European Geography a worldwide reference and standard. Thus, the scope of the EJG is to publish original and innovative papers that will substantially improve, in a theoretical, conceptual or empirical way the quality of research, learning, teaching and applying geography, as well as in promoting the significance of geography as a discipline. Submissions are encouraged to have a European dimension. The European Journal of Geography is a peer-reviewed open access journal and is published quarterly.*

1. INTRODUCTION

Coastal zones are characterized as highly vulnerable regions, but also places endowed by remarkable environmental, cultural and other resources (Tzoraki et al., 2018; Koutsi & Stratigea, 2019). In the Mediterranean Region, coastal zones play a major role for, among others, the economic wealth of related areas. In fact, Mediterranean Region as a whole is considered a major and dynamic global tourism destination that attracts over 25% of the world's tourism arrivals (Kizos et al., 2017; UN-WTO, 2019). Tourism-related economic growth and concomitant urbanization processes and infrastructure deployment in coastal zones (European Parliament Resolution, 2008), however, exert also severe environmental pressures. Such pressures are further increasing due to the vulnerability of Mediterranean coastal zones to Climate Change (CC) impacts (Fraile-Jurado et al., 2019), e.g., sea level rise, extreme weather conditions and decrease of humidity and precipitation (Nicholls et al., 2008; Seto et al., 2011; Kron, 2013; Satta et al., 2017; Marignani et al., 2017). According to research estimations, several highly populated coastal cities might actually sink in the future (Hallegatte et al., 2013; Nicholls et al., 2008); frequency of Mediterranean Cyclones ("Medicanes") is anticipated to increase (Flaounas et al., 2013; Cavicchia et al., 2014); while a rise of temperature by 3-5ºC by the end of 2100 is expected to reduce the average annual precipitation by 30% (IPCC, 2013). Furthermore, CC impacts on Mediterranean territories are predicted to: severely affect most socio-economic sectors (Stratigea et al., 2017); diminish water reserves (Ludwig et al., 2010); drop significantly the comfort levels in coastal urban environments (Ye et al., 2010); and lead to irreversible biodiversity loss and acceleration of coastal erosion (IPCC, 2014a & 2014b). Deployment of coastal urban settlements is radically affecting natural (land and marine) ecosystems; while CC repercussions, coupled with anthropogenic pressures, place vulnerable natural and man-made constellations in coastal areas at stake. Among the anthropogenic pressures, coastal urban development seems to be a rapidly escalating trend (Stratigea et al., 2017; Lagarias & Sayas, 2018), threatening *sustainability and resilience objectives* in coastal regions and related coastal zones worldwide (El Haité & El Yazami, 2016; Oppenheimer et al., 2019; Day et al., 2021; Lagarias & Stratigea, 2021; Leka et al., 2022).

A distinct particularity of the Mediterranean Region is a pattern of intense *linear urban development* along coastal zones, leading to a socio-economic and spatial polarization in these zones, compared to the hinterland ones. The term assigned to this pattern is *"coastalization"* (Serra et al., 2014; Mikhaylov et al., 2018; Lagarias & Sayas, 2018); and is mainly attributed to the attractiveness of the coastal zone for habitation and economic activities, among which *tourism* holds a prominent position (Soto & Clavé, 2017). Coastalization is usually related to an uncoordinated form of low-density urban growth, characterized as *"urban sprawl"* (Torrens & Alberti, 2000; Hasse & Lantrop, 2003). EEA (2006 & 2016) defines urban sprawl as the process of low-density spatial expansion of large urban areas, mainly fused to the surrounding agricultural areas. Such a process is mostly driven by market conditions and can lead to different types of urban sprawl (Couch et al., 2007) – e.g., scattered, leapfrog, strip and suburban development – mainly featured by distinct morphological characteristics. Urban sprawl is a specific type of urban development, standing at the opposite end of the compact city concept, not necessarily coinciding with suburbanization or urban growth in general (Ewing & Hamidi, 2015, Leontidou et al., 2005). Specific metrics/indicators are used to estimate its spatial characteristics (Hamidi at al., 2015; Pozoukidou & Ntriankos, 2017), while urban sprawl in the Mediterranean stands out as a particular case (Salvati et al., 2012; Egidi et al., 2020)

In the Mediterranean region, a number of factors are perceived as key drivers of coastalization (Cuadrado-Ciuraneta & Durà-Guimerà, 2018), namely the: population growth; suburbanization; mass-tourism development, coupled with the spreading of vacation houses; and deployment of transport infrastructure in coastal zones. However, the lack of a consistent and regulatory spatial planning framework; the massive investments of the past few decades in urbanization projects, supported by the local and regional authorities (Díaz-Pacheco &

García-Palomares, 2014); and a sort of a "laissez faire" attitude, have led to a rather clumsy urban sprawl pattern in the Mediterranean coastal zone (Valdunciel, 2014). The dynamic sprawling process, noticed in the Mediterranean coast, consumes vast amounts of natural and agricultural land, poses extreme pressure on the vulnerable Mediterranean ecosystems and results in unsustainable future pathways (Lagarias & Stratigea, 2021). Disordered standalone urbanization and infrastructure deployment as well as uncoordinated tourism-related, industrial, fishing and agricultural activities, constitute currently the causes for the rapid degradation of coastal habitats and the irrational use of resources, further increasing vulnerability to CC in coastal zones (Sterzel et al., 2020; Anfuso et al., 2021).

Ominous estimations about the future of this 'hot spot' part of the world – the Mediterranean – have motivated action for paving more sustainable pathways. Taking into consideration the position of Mediterranean coastal areas as highly-rated tourist destinations, specific emphasis is placed on the tourism sector. More specifically, based on the guidelines of the Barcelona Declaration (1995), alternative forms of tourism are gaining ground over the 3S mass model. Such a trend is further broadened by the foundation of the Union for the Mediterranean (2013) and the agenda towards a sustainable blue economy in this region (Plan Bleu, 2012; UfM, 2021). Additionally, the emergence of Marine Spatial Planning and the Integrated Coastal Zone Management (EU, 2009; EC, 2014; UN, 2018) are expected to address and manage conflicts among human activities in land and the sea; and promote more sustainable development agendas in coastal areas, monitoring critical resource consumption especially in the tourism industry (ECORYS, 2016).

Monitoring *urban development* by use of *multi-temporal data* for built-up areas can advocate the identification and assessment of its spatial dimension and related problems this creates (Lagarias & Stratigea, 2021). It can also be used as a tool for assessing the evolving urban growth imbalances among settlements of the urban network. Of notable importance, in this respect, is the development of pertinent methodologies, capable of handling such multi-temporal data; as well as the increase of technical capabilities and scientific knowledge for analyzing and monitoring urban growth imbalances that are mostly linked to developmental inequalities. These form the *key research concerns* of this work, serving actually a *twofold goal*, namely to: highlight the criticality of urban development in coastal areas to the detriment of inner urban constellations; and quantify the *'coastal versus hinterland divide'* for feeding more informed coastal sprawl-containment policy decisions that can re-direct spatial developmental impulses towards less privileged urban constellations in the hinterland. The latter is in alignment also with the emphasis placed on the territorial cohesion dimension by the regional development policy of the European Union, stating that *"promoting territorial cohesion should be part of the effort to ensure that all of Europe's territory has the opportunity to contribute to the growth and jobs agenda"* [COM(2008) 616 final: p. 4].

More specifically, this work attempts to highlight a specific dimension of *territorial peripherality or imbalance* that is grounded in the differentiation of spatial and developmental attributes along distance from the coastal zone. This dimension is captured by means of the spatial pattern of urban expansion which, coupled with a set of socioeconomic variables, can be used as a proxy of urban development or dynamism. Spatial analysis is accomplished, in this respect, by use of the newly developed spatial multi-temporal data for built-up areas, i.e., GHSL data for the time span 1975-2014; and their processing by use of GIS technology. Attention is paid to analyzing the way built-up densities are spatially diversified across different buffer distances from the coastline in order for more cohesive territorial development strategies to be formulated. Towards this end, a *Coastal/Hinterland Index* (CHI) is proposed, which is calculated as the ratio of built-up density of buffer zones close to the coast divided by the built-up density of zones further inland; and is used as a means for quantifying the 'coastal vs hinterland' divide.

Empirical application of the above is exemplified through a case study, conducted in the Regional Unit of Corinthia, Northern Peloponnese, Greece. Corinthia, a region lying in close proximity to Athens Metropolitan area, is considered as a typical example of Mediterranean coastal area. This region, despite owing a multitude of natural and cultural resources, is

perceived as a “lagging-behind region” (EU, 2017). It actually displays a declining productivity and employment pattern in the time span 2000-2013. Additionally, in the World Bank Report (Kilroy & Ganau, 2020), Corinthia is presented as a less developed (low income) region in the period 2003-2017. Built-up growth pattern demonstrates an extremely thin linear coastalization form along the Corinthian Gulf, being mainly the outcome of an outdated model of tourism development. This results in certain spatial imbalances as to the coastal and hinterland urban expansion pattern, which are furthermore linked to developmental ones. Regional imbalances call for more equitable and cohesive regional planning and policy development. This, in turn, implies the need for quantifying such imbalances in order for more informed policy decisions to be formulated.

The paper is structured as follows: in Section 2 the coastal vs hinterland divide, lying at the heart of this work, is shortly presented, with a specific focus on the Greek context and the policy challenges ahead for attaining a more balanced and sustainable pattern of development; in Section 3, the data and proposed methodology are presented; in Section 4 the case study area is shortly described and results as to the coastalization trend as well as the coastal vs hinterland divide in this area are sketched; while, finally, in Section 5 discussion on results and key conclusions are summarized.

2. THE COASTAL VS HINTERLAND DIVIDE IN GREECE

In the European context, spatial inequalities and polarized development constitute critical obstacles towards the realization of the vision of the united Europe (Panagiotopoulou & Stratigea, 2021). So far, the ample EU regional development policies have proven rather ineffective in coping with polarization trends. These trends appear to constantly escalate, taking the form of *economic, social and territorial disparities*; along with spatially diversifying environmental pressures and exposure to climate change (CC) risks (EC, 2020). According to Görmar et al. (2019), such polarized development in the EU roughly appears as: an increasing population concentration in and around large cities, coupled with trends of population decline in other regions; accumulation of investments and the bulk of economic activities in a few capital and metropolitan areas, leaving behind the rest of cities and regions; a spatially and socially uneven distribution of wealth and a sense of detachment from an inclusive European future vision.

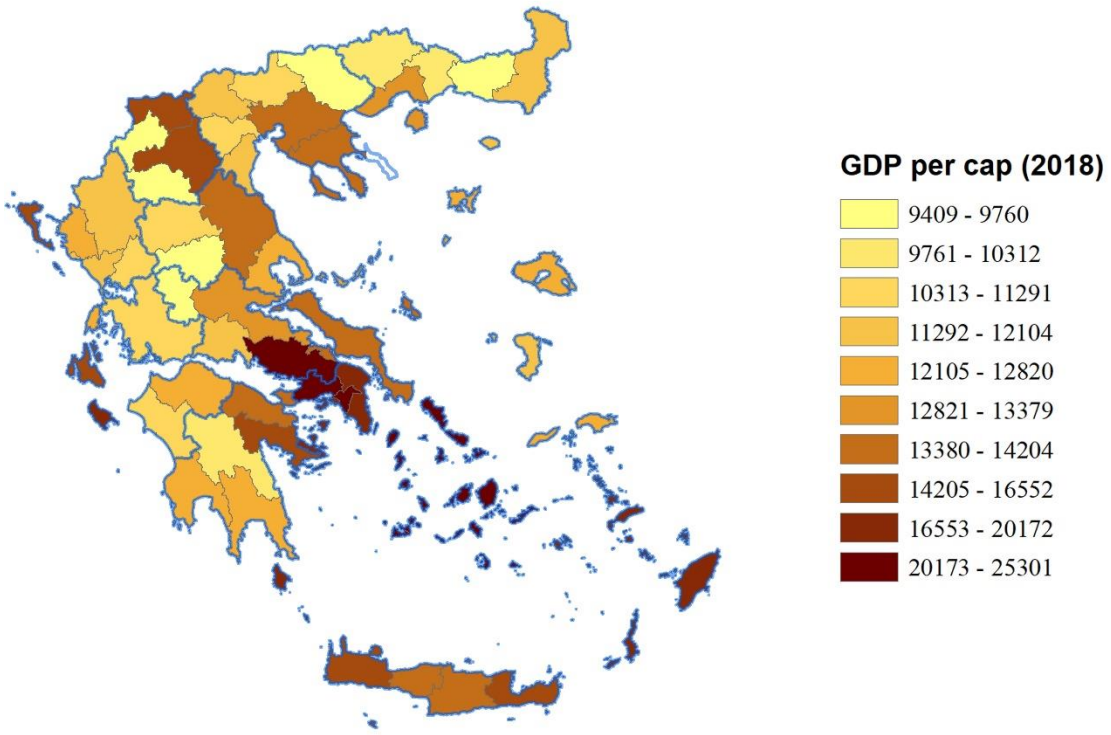
Speaking of *territorial peripherality* and the need to undertake action to cope with barriers to territorial cohesion through place-based strategies, Servillo et al. (2016) have set forward the concept of *inner regions*. Such regions tend to be at a distance from regional centres or capitals. In most of the cases, the term refers to rural or mountainous areas, including also autonomous small urban centres in the hinterland. Inner regions, as Servillo et al. (2014) claim, are generally marked by: low or negative job creation rates; a decline in service provision, forcing commuting of population to larger urban centres; a low level of quality of life; and often higher population outmigration rates.

One more dimension of *territorial peripherality or imbalance* is grounded in distance from the coastal zone; and is unveiled in the gap between settlements located along the coastal zone and those in the hinterland. The latter are considered as *lagging-behind or ‘inner’ regions* on the basis of their distance from the coastline, as opposed to the attractive coastal settlements that demonstrate rather escalating growth rates and dynamism. In reality, attractiveness of coastal regions, as opposed to the hinterland ones, seems to be a key driver of *polarized urban development*. Thus, coastal urban constellations act as ‘magnets’ for investments, entrepreneurship, job creation, wealth, etc.; to the detriment of the hinterland (inner) ones, which are confronted with marginalization, depopulation, and socio-economic decline. In terms of policy reaction, *assessment of that kind of gap* can serve a two-fold direction, namely: *urban sprawl-containment policy decisions* for counterbalancing territorial peripherality of the less privileged urban constellations in the hinterland, being the *main motive*

behind this work; and policy reactions that address *remediation or alleviation* of the carrying capacity surpass of coastal urban constellations.

The aforementioned gap, articulated in this work as the *'coastal vs hinterland divide'*, is valid in many Mediterranean countries (Romano & Zullo, 2014; Salvati et al., 2014; Tombolini et al., 2015); while it holds especially true in the case of Greece, a state that can be perceived as a distinct example of a *'coastalization hotspot'* in the Mediterranean Region (Lagarias & Stratigea, 2021). This is partly justified by the fact that Greece, according to the World Atlas estimation, owns the 11th longest coastline in the world; while it also owns over 200 habitable islands that are floating in the state's marine waters and most of them dispose highly overcrowded coastal settlements. These geographical peculiarities have so far significantly contributed to the growth of the national economy, by mostly affecting the blossoming of the tourism and real estate sectors in coastal areas. This fact is also reflected to the wealth of such regions, as this is demonstrated by the GDP per capita. In fact, according to OECD (2020a), the regions with relatively higher GDP per capita are the island regions of Southern Aegean, Ionian and Crete (with 109%, 93% and 84% of the national average respectively) (Fig. 1). These are followed by the region of Central Greece, hosting the satellite industrial areas of Attica (90% of national average); and the energy supplying region of Western Macedonia (87% of national average). The rest of the Greek regions are lagging-behind compared to the aforementioned ones as far as GDP per capita is concerned.

Figure 1. GDP per capita (€/inhabitant) in 2018 (Source: own elaboration based on Hellenic Statistical Authority data)



Apart from the achievements in terms of national/regional economic growth, attractiveness of coastal regions in Greece is also witnessed by a noticeable population concentration and prosperity that is observed in many Greek coastal areas (Fig. 2). Speaking of the population concentration, residential data show that almost half of the total population (47.5%) resides in a 5km zone from the coast, while coastal areas are characterized by a population density that is about 3 times higher than the density in hinterland zones (Table 1). In fact, if Attika Region,

containing Athens metropolitan area, is excluded, the coastal population percentage rises to 50.9% of total population. This is due to the fact that the central area of Athens is considered as “hinterland”, based on the 5km threshold.

Figure 2. Population distribution in Greece in selected coastal zones with intense coastal development (Source: own elaboration, based on GHS data, 2015)

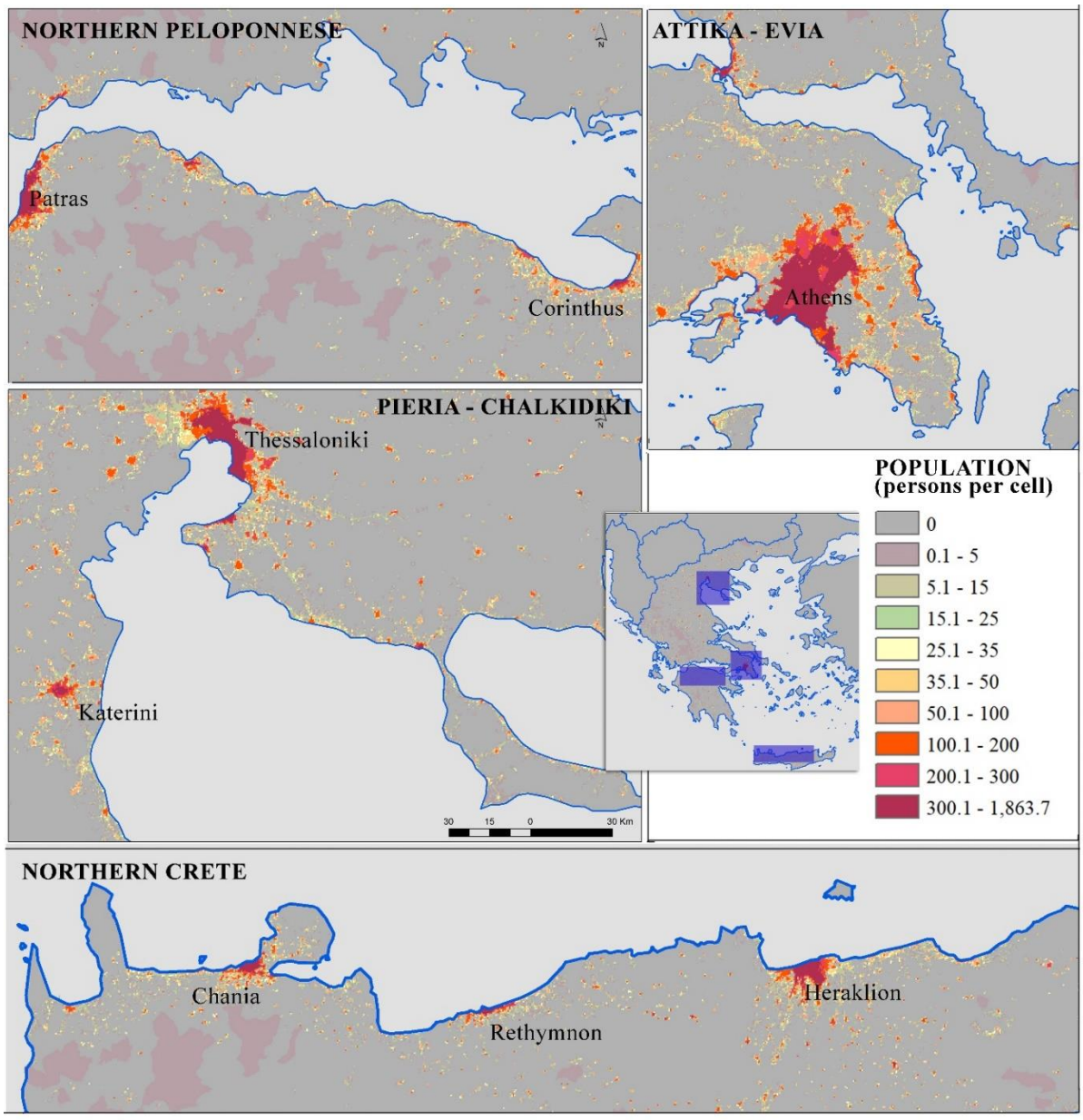


Table 1: Share of population and population density in coastal and hinterland zones of Greece. (Source: Own elaboration on GHSL data 2015)

Greece	Total population	Population %	Density (inhab. /km2)
Coastal areas (5km-zone from coast)	5,222,015	47.5	155.1
Hinterland areas (>5km from coast)	5,765,918	52.5	58.2

The high interest in the coastal counterparts of the Greek territory to the detriment of the hinterland ones unveils a sort of *deficiency* of both the national and the regional policy instruments to properly address and handle developmental perspectives of both types of land and reduce territorial inequalities (Lampropoulos et al., 2021). This deficiency is a double-sided coin, addressing the:

- lack of proper legislation and policy initiatives for sustainably handling the coastal zone on the one hand; and
- ineffectiveness of strategic policy directions at the national level (both spatial and sectoral ones) to motivate a more equitable, spatially-balanced and sustainable pattern of exploitation of the abundant natural and cultural resources, spread throughout the hinterland.

Speaking about the *coastal zone* per se, it can be inferred that the increased interest in coastal areas as *hubs* of residence and economic transactions, coupled with the noticeable deficit of a legislative framework towards an Integrated Coastal Zone Management (ICZM), have led to a systematic transgression of public land by population and economic stakeholders, evidenced in the seashore and the beach zones. It is worth noticing here that, at present, a plethora of current legislative initiatives, relevant to the management of specific dimensions/parts of coastal zones, is in place. Nonetheless, the legislative framework so far in force seems to have fallen short in restraining unsustainable developmental pathways of that part of the Greek territory. The main reason for that lies on their principal concern, over time, about the economic growth rather than the sustainable and integrated (spatial) planning and development of these land parts. An exception to that is the Biodiversity Law (Law No. 3937/2011) addressing, for the first time, critical parts of coastal zones. This law incorporates, among others, the seashore line; and foresees the banning of intensive uses and deployment of road transport infrastructure in coastal zones.

The interest in the coastal and maritime zones and related economic initiatives and entrepreneurship is expected to grow as a result of the current *blue growth strategy* of the European Union [COM(2012) 494 final]. Implementation of this strategy is generally expected to further increase the gap between the coastal and hinterland counterparts. Additionally, intensification of blue growth activities is expected to further worsen the carrying capacity surpass in coastal regions. The latter is due to the delay of the Greek state to enforce an ICZM policy, as well as carry out Marine Spatial Plans (MSP) in alignment with the Marine Spatial Planning Directive (EC, 2014) for delineating deliberate maritime uses, despite the fact that EU's deadline on March 2021 has gone past.

While the interest in coastal zones is continuously growing, however, same holds for their exposure to *high risks of CC*. In fact, CC in the Mediterranean in general and the Greek territory in particular is a critical challenge, threatening sustainability and resilience objectives of both natural ecosystems and human infrastructures across the coastal zone. Spatially-defined economic impacts of CC on the Greek economy as a whole, including coastal zones and related sectoral activities, are already articulated by the work of a dedicated Committee in 2011, working under the support of the Bank of Greece (Commission for Studying Climate Change Impact - EMEKA, 2011). The outcome of this Committee's work is a bundle of mitigation and adaptation strategies, mainly addressing the minimization of the economic impacts of CC on Greek regions and sectors. Additionally, by embodying the Paris Agreement (2015) to the national legislative framework, the necessity for working out action plans against CC at the national and regional level was enacted by the Greek government (Law No. 4416/2016). In 2016, the National Strategy against CC is articulated (Ministry of Environment and Energy, 2016). Since then, the majority of the respective Regional Strategies against CC has been approved, stimulating the revision of a number of Regional Spatial Plans, after almost two decades of their articulation.

Despite the aforementioned efforts, however, no further steps have been undertaken to regulate the sustainable management of coastal and maritime space in Greece nor are these fragmentary efforts integrated into a comprehensive policy framework (Tsilimigkas & Rempis,

2017). Delays and selective/fragmented implementation of spatial planning, accompanied by the prevalence (up to today) of a mass tourism model have "pushed" coastal urban development along a thin strip of respective zones. This fact is particularly evident in insular regions, e.g. Crete (Lagarias & Stratigea, 2021), but also in other coastal zones of the mainland, such as Chalkidiki-Pieria (in close proximity to Thessaloniki Metropolitan Area), Eastern Attika – Evia (in close proximity to the Athens Metropolitan Area) and Northern Peloponnese (see Fig. 2). As a result, coastal zones in a large part of the Greek territory, apart from following an intensive and mostly unsustainable developmental path, constitute land compartments that are highly exposed to CC risks.

Speaking also from a balanced regional development perspective, being the 'lens' of the present work, such a developmental pattern of coastal areas has led to a clearly noticeable, and continuously escalating through time, *'divide'* between coastal and hinterland settlements, in both spatial and socioeconomic terms. Providences of strategic, spatial and sectoral, planning directions, as these are expressed by e.g. the General Spatial Planning Framework or the Special Spatial Planning Framework for Tourism, but also legislative action related to financial incentives (Law No 4399/2016) and their spatial implications, seem to have, so far, fallen short to shift the focus from coastal land parts to the hinterland, as is revealingly shown by the study of Lambropoulos et al. (2021), with a specific focus on the tourism sector.

In the rest of this work, an attempt to quantify the spatial counterpart of the *'coastal vs hinterland divide'* is undertaken, displayed in the spatial pattern of urban expansion, as a proxy of the dynamism of related settlements in both the coastal zone and the hinterland; further supported by socioeconomic data. The research question is downscaled at the local/regional level, using as a case study example the Regional Unit of Corinthia in Peloponnese Region.

3. MATERIAL AND METHODS

As high-resolution satellite imagery has triggered the proliferation of new, of global coverage, datasets on human settlements (Corbane et al., 2018), potential for the analysis and monitoring of urban development in coastal and hinterland zones is broadened; while same holds for capabilities of highlighting the coastal vs hinterland divide. Such an analysis actually aims at exploring built-up changes, thus establishing the ground for getting deeper insight into the evolving coastalization and urban dynamics.

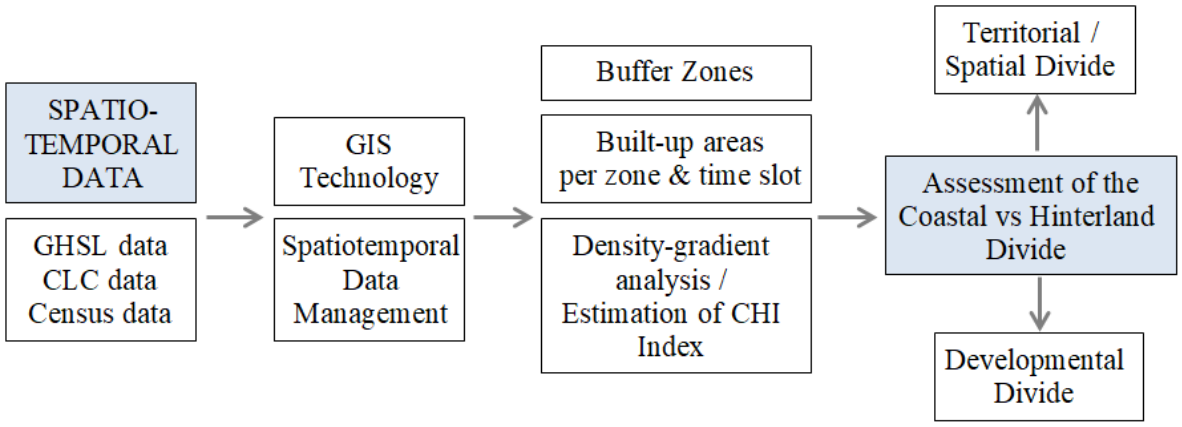
Such an exploration is grounded in data of the Global Human Settlement Layer (GHSL), emerging by the cooperation of prestigious European Institutions, such as the European Environment Agency (EEA), the Copernicus Land Monitoring Service (CLMS) and the Joint Research Center (JRC). These data provide insight regarding built-up areas, producing multitemporal grids of such areas, by using images organized in four Landsat data collections that are centered at 1975, 1990, 2000 and 2014 and are based on Symbolic Machine Learning (SML) classifier (Corbane et al., 2018). GHSL data offer a multitemporal raster dataset with global coverage. This dataset is delivered as 8bit VRT raster files, projected in Pseuso-Mercator projection (EPSG:3857) at a resolution of approximately 30m; and is capable of mapping built-up areas, using a binary approach (built-up / non built-up). Seven (7) categories are defined, namely: 0 = no data, 1 = water surface, 2 = land no built-up in any epoch, 3 = built-up from 2000 to 2014 epochs, 4 = built-up from 1990 to 2000 epochs, 5 = built-up from 1975 to 1990 epochs and 6 = built-up up to 1975 epoch.

GHS-BUILT data, compared to other land cover datasets, such as the Corine Land Cover (CLC), have specific advantages in capturing urban growth dynamics. This is mainly due to the fine resolution these data can provide in contrast to the CLC data. The latter provides only a crude view of land cover changes, through which inferences as to the dispersed low-density urban sprawl cannot be detected. However, as built-up areas encroach into agricultural zones and natural areas along the Mediterranean coasts – Greek coasts as well – the need for accurate spatial data for studying the dynamics of the built-up environment becomes urgent.

Therefore, CLC data are only used to identify the *land use pattern*, using the most recent release available (https://land.copernicus.eu/pan-european/corine-land-cover/clc2018).

Additionally, estimations of *population distribution* along the coastal zones and zones in the hinterland can be obtained by use of GHS-POP data (Pesaresi et al., 2019), i.e. a spatial raster dataset at a resolution of 250m. This depicts the population distribution as the number of inhabitants per respective cell (250x250m). Residential population estimates for target years 1975, 1990, 2000 and 2015, provided by the Gridded Population of the World (GPW) collection (CIESIN GPW v4.10), are disaggregated from census or administrative units to grid cells; informed by the distribution and density of built-up pattern, as mapped by the Global Human Settlement Layer (GHSL) per corresponding epoch (https://ghsl.jrc.ec.europa.eu). Finally, a set of socioeconomic data, emerging from the latest Census available in Greece (Hellenic Statistical Authority, Census data 2011) is used, including employment per sector, population changes, demographic structure, etc. Data for the period 1991 are also considered, so that temporal changes in socio-economic structure to be captured.

Figure 3. Steps of the proposed methodology (Source: own elaboration)



The proposed methodology (Fig. 3) is applied to the Corinthia Regional Unit. This area is a distinguished example of a highly impaired coastal zone in Greece, i.e. a region that is heavily burdened by an intense coastalization pattern; and displays a coastal-hinterland urban constellations' divide, threatening the social, economic and territorial cohesion of this area. The analysis includes multi-temporal classification of built-up presence in both the coastal zones and the hinterland, using recent GHSL data as derived from Landsat image collections (1975, 1990, 2000 and 2014) at 30m resolution. To analyze evolving urban spatial patterns as well as the divide between the coastal zones and the hinterland in the time span 1975-2014, a *density-gradient analysis* is applied, providing insight into buffer zones at different distances from coast.

More specifically, in order for the evolution of the *coastalization process* in the Regional Unit of Corinthia to be assessed, the study area is divided into zones, displaying different distances from coast. GHSL data are overlaid by these zones and statistics for the period 1975-2014 are estimated. GHS-BUILT data are processed using the Raster Analysis Tools (Unique values report). The percentage of built-up areas, tracked down in each single one of these zones, is used to construct density gradients, revealing coastalization evolution through time.

Quantification of the *'coastal vs hinterland divide'* is accomplished through the proposed CHI (Formula 1). This is calculated as the ratio of built-up density of buffer zones close to the coast (DC) by the respective built-up density of zones further inland (DH). CHI is estimated by the following formula:

$$CHI = DC / DH \quad [1]$$

When conducting the aforementioned calculation, a critical issue is the demarcation of the *boundary* between the coastal zones and the hinterland. This issue seems to be rather obscure, taking also into account that a clear-cut definition of the coastal zone does not exist. In fact, a variety of definitions can be encountered in the literature, each one reflecting different views and purposes. In the present study, the boundary between the coastal and the hinterland zone is identified by use of the density change along distance from coast. The point at which the density gradient is flattened is deemed to be the boundary line, separating the coastal zone from the hinterland one.

4. CASE STUDY AND RESULTS

4.1. The Corinthia Region at a Glance

The Regional Unit of Corinthia is located in the northeastern part of Peloponnese, at a distance of approximately 80 kilometers from the Athens metropolitan area, with the city of Corinth ("Korinthos" in Greek, at the exact location of the ancient city) being the administrative center and a major urban area (Fig. 4).

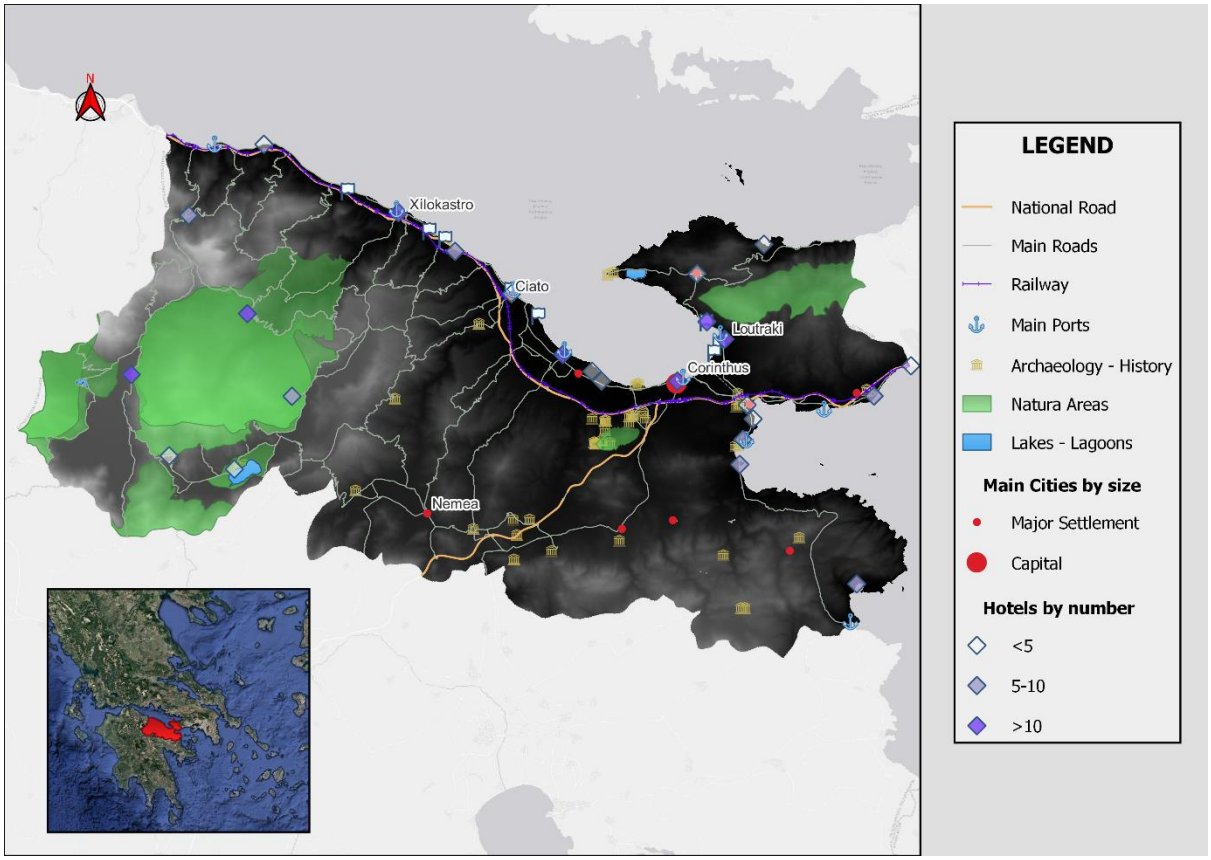
Corinthia counts for 145,082 inhabitants (Hellenic Statistical Authority, 2011) and covers a surface of 2,297 km^2. The study area disposes an extended coastline of about 400 km (own elaboration), lying along two major gulfs – the "Saronic" and the "Corinthian" gulf – which are connected through the Isthmus canal. The geomorphology of the region demonstrates a great variety, ranging from a rough terrain, endowed by distinct mountainous ecosystems in the western part; to a smoother one along the coast and the Isthmus canal area.

Cultural resources in the study area are abundant. More specifically, a plethora of archeological sites can be detected, including the ancient cities of Corinthus and Nemea. In the wider area of Corinthia, the castle of Acrocorinthus is strategically located on a hill, and is connected to the ancient port of Lecheo through the Long Walls (http://odysseus.culture.gr/h/3/eh32.jsp). The latter hosts the remains of a prehistoric settlement. The area is crosscut by the national road network, part of which unfolds across its coastal zone (Olympia Highway). In particular, Corinthia is connected to the Athens metropolitan area and the city of Patras through a main (national) road arterial; and the city of Tripoli – the administrative center of the Region of Peloponnese – through a secondary road arterial. Tourism facilities include hotels and Airbnb rooms and apartments, mainly spreading along the coastal zone.

According to the World Bank Report for the period 2003-2017 (Kilroy & Ganau, 2020), Corinthia is classified into the group of less developed–low income regions. *Less developed regions* are those with an average yearly GDP per capita (period 2003-2017) between 50-75% of the sample average of regions incorporated in this report. *Low-income regions* are those with an average yearly GDP per capita (period 2003-2017) lower than the 50% of the sample average. Local economy mostly relies on activities of the tertiary/service sector, as employment in this sector raises to 64% (Hellenic Statistical Authority, 2011). Nevertheless, more than 56% of the total income is produced in the industrial sector, mainly through activities located in the greater Isthmus area. The agricultural sector also presents a great potential, with oil trees and vineyard products featuring the significant comparative advantage of the Corinthia area (Reid et al., 2012). Since the outbreak of the economic crisis in 2008-2009, the regional unit of Corinthia experiences a constant reduction of GDP per capita, with the GDP of the whole Region of Peloponnese being marginally higher than the one of Corinthia (Hellenic Statistical Authority, 2011). The GDP per capita in Corinthia (13,843 euro in 2018) is below the average of Greece as a whole (16,540 euro in 2018), and has increased by a moderate rate of 6.8% since 2014. Only 17.3% of the population of age groups 25-64 has a certain university degree, while respective rate in Greece as a whole raises to 25.4% (26.8% in EU-27) (EU, 2017). Unemployment in Corinthia in 2011 rates to 18% (equal to country's

average), while in the Peloponnese Region rates to 15% [Organization of Workforce Employment, 2011].

Figure 4. Location of Corinthia in the Greek territory **-** Major transport infrastructure, natural & cultural resources and tourism hosting facilities (Source: own elaboration)



Speaking of the *land use pattern*, Corine Land Cover (CLC) data for the year 2018 are presented in Table 2 and mapped in Figure 5. Based on these data, it is inferred that more than 53% of the Corinthia region is occupied by forest land and shrub and/or herbaceous vegetation; while a great part (approx. 40%) is covered with agricultural plants and trees. Forest land consists of coniferous and sclerophyllous vegetation, while tree plants – such as olive and apple trees – and vineyards cover the majority of the agricultural land. Artificial surfaces occupy a small part of total land (3.4%), with 1.9% being categorized as 'Urban Fabric' and 1% as 'Industrial/Commercial land'. Built-up areas are mainly distributed in a linear strip along the Corinthian Bay, spanning from Loutraki town resort to Xilokastro, in the western part of the region (see Fig. 4). Coastal urban development presents a dispersed low-density pattern, leading to urban sprawl. This is strongly related to the pattern of tourism development prevailing in Corinthia since the 70's, which is based on a major spread of vacation houses along the southern part of Corinthian Bay, mainly owned by citizens of the Athens Metropolitan area and the city of Corinthus.

A few large-scale tourism facilities are currently located in the Region (about 60 four- and five-star hotels in 2021). The tourism development model in Corinthia region is, therefore, less related to mass tourism. In fact, it follows a hybrid model, with vacation houses and a moderate number of hotel accommodations, recently enriched by Airbnb apartments and bedrooms. A comparison between 2010 and 2019 data (Hellenic Chamber of Hotels) reveals a steady decrease of available hotel bedrooms. This places Corinthia in a less-favorable position with

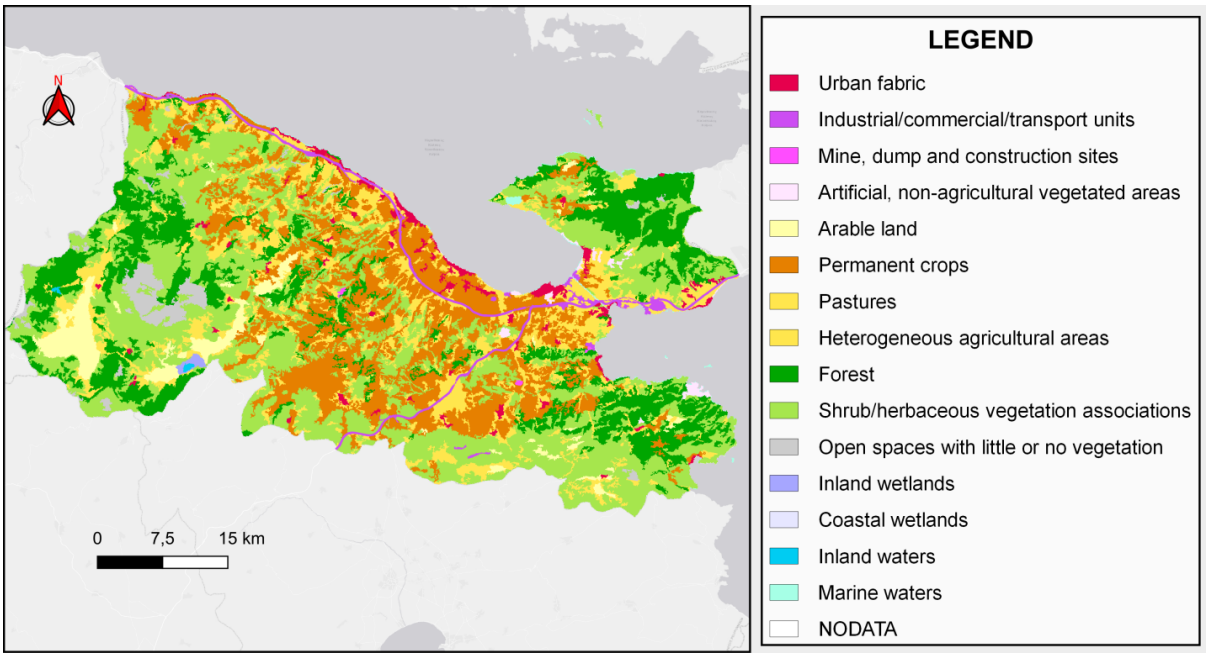
respect to other Regional Units of Peloponnese, especially those of Messinia and Lakonia, where tourism follows a more dynamic trajectory.

According to the RIS3 Regional Assessment for Peloponnese as a whole (Reid et al., 2012), a major problem for the local and regional economy is the lack of integration of the local economic sectors. Assessing the overall regional innovation potential and specialization, RIS3 for Peloponnese underlines as main *strengths* of Corinthia the accessibility to advanced infrastructure networks that is maximized in the Corinthia Regional Unit, mainly due to its close proximity to the city of Athens; and its geographic location at the crossroad of major transport infrastructures. Moreover, the study area is discerned for its natural and cultural wealth, mainly located in the inland areas of Nemea and Stymphalia Lake. Well known and highly extroverted are also the region's local agricultural products, such as the Nemea wines, standing out among the major export-oriented local products of Greece.

Table 2. Corine Land Cover (CLC) data in the Corinthia Regional Unit (2018)

Code	Description	Area (ha)	%
11	Urban Fabric	4,368	1.9
12	Industrial, commercial and transport units	2,394	1.0
13	Mine, dump and construction sites	131	0.1
14	Artificial, non-agricultural vegetated areas	976	0.4
21	Arable land	7,948	3.5
22	Permanent crops	49,407	21.6
23	Pastures	2,762	1.2
24	Heterogeneous agricultural areas	33,730	14.7
31	Forest	40,983	17.9
32	Shrub and/or herbaceous vegetation associations	80,878	35.3
33	Open spaces with little or no vegetation	4,679	2.0
41	Inland wetlands	335	0.1
42	Coastal wetlands	0	0.0
51	Inland waters	140	0.1
52	Marine waters	295	0.1

Figure 5. Land uses in the Corinthia Regional Unit (Source: own elaboration, based on CLC data 2018)

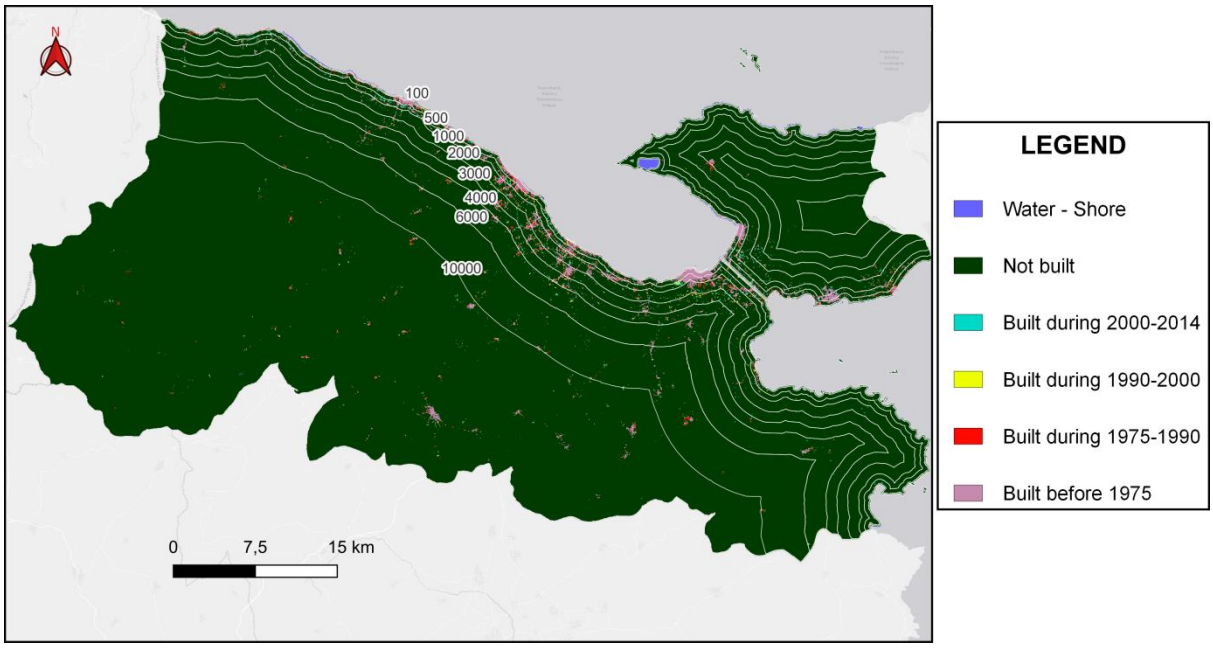


4.2 Results

According to the GHSL data for built-up areas, expansion of urban land in Corinthia displays a considerably escalating pattern, raising from a total of 3,180 ha in 1975 to 5353 ha in 2014 (an increase of approx. 68%). In the different time slots, built up area expansion has as follows: 59.5% was developed until 1975, 17.3% in the period 1975-1990, 7.8% in the period 1990-2000, and 15.3% in the period 2000-2014. From 2000 onwards, data show an accelerating urban expansion pattern, despite the severe economic crisis that hit Greece since 2008; and the collapse of the construction activity in the Regional Unit of Corinthia, dropping by 93% in the period 2008-2014 (from 1,49 million m^3 to 0,11 million m^3 per year) (Hellenic Statistical Authority, yearly statistical data 2008-2014).

Based on the methodology proposed by this work for assessing the evolution of the coastalization process as well as the coastal vs hinterland urban dynamics, the study area is divided into *buffer zones*, covering areas of 0-100m, 100-500m, 500-1000m, 1-2km, 2-3km, 3-4km, 4-6km, 6-10km and >10km distance from the coastline (Fig. 6). Beyond the distance of 10km, the remaining part of the region is perceived as a single zone. GHSL data were overlaid by these zones and statistics for the period 1975-2014 were estimated.

Figure 6. Global Human Settlement Layer data – Built-up grid and buffer zones (Source: own elaboration based on GHSL data).



4.2.1. *The Evolving Coastalization Process*

The percentage of built-up areas, tracked down in each single zone, is used to feature the urban fabric coverage per buffer zone in the different time slots (Table 3). Evolution of coastalization through time in each single buffer zone is presented in Fig. 6.

More specifically, results presented in Table 3 (also in Fig. 7) reveal that the deployment of the urban fabric slows down beyond a certain distance from coast. In fact, the urban fabric is mostly expanding in a zone of 1km distance from coast, while it practically diminishes beyond a distance from coast of about 4 km. In the 'immediate' to coast zone – i.e. distance up to 100m from coast – 28.9% of the total land is already developed. This percentage drops to 17.9% in the 100-500m zone and to 11.3% in the 500-1000m zone. This 1km zone appears therefore to be the most *critical coastal part*, the one that urban development mainly takes place and the host of all major settlements along the coastal zone of the Corinthia study area.

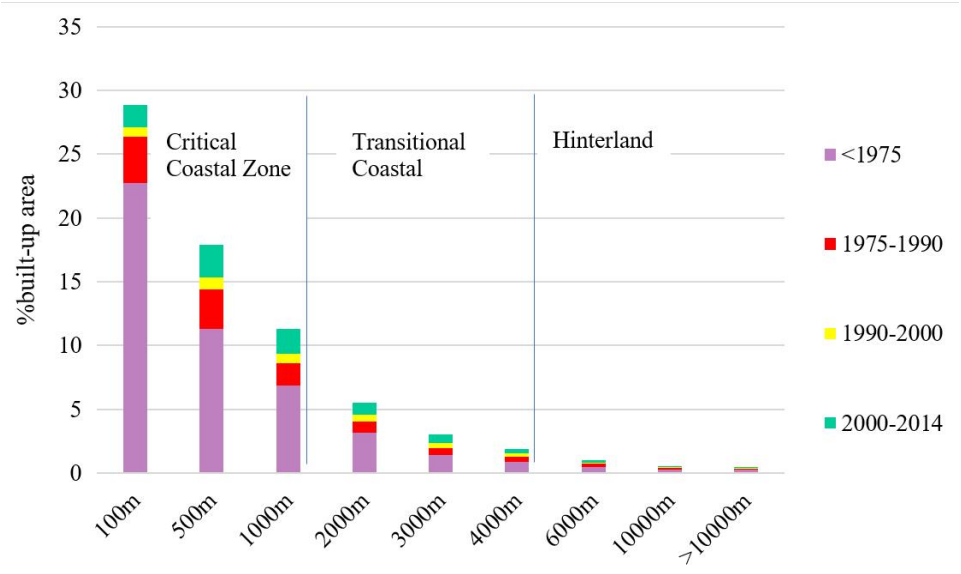
In the *'transitional' zone*, expanding from 1km to 4km distance from coast, urban developed land ranges from 1% to 10%. This zone incorporates relatively old and more compact urban constellations (e.g. the settlements of Velo, Assos and Zevgolatio); is in close proximity to the shore; and is well-connected to the strip-like coastal urban fabric (Fig. 8). Based on the data shown in Figures 7 and 8, this transitional zone (1-4km) is relatively dynamic, as urban land expands considerably in the period 1975-2014.

Beyond the distance of 4km, the *"hinterland" zone* is identified. The rate of change of the urban fabric in this zone drops to less than 1% and urban land expansion is marginal. Important is also the role of the national road network (Olympia Highway) spanning through the case study area. Results show that almost half (46.5%) of what is classified as "new development" (built-up expansion in the period of 2000-2014) in the whole Corinthia Regional Unit area is concentrated at a 1km buffer zone along this major network axis.

Table 3. Zones' classification according to GHSL built-up area per buffer zone.

Zones' Classi-fication	**Buffer Zones according to distance from coast**	**2000-2014**		**1990-2000**		**1975-1990**		**Up to1975**		**Total**	
		Built-up area									
		% of zone area	% of total built-up area	% of zone area	% of total built-up area	% of zone area	% of total built-up area	% of zone area	% of total built-up area	% of zone area	% of total built-up area
Critical Coastal Zone	<100m	1.8	4.6	0.8	3.9	3.6	8.3	22.8	15.4	28.9	11.6
	100-500m	2.6	23.2	1.0	16.8	3.1	24.2	11.3	26.4	17.9	24.8
	500m-1km	2.0	20.1	0.8	15.4	1.7	15.2	6.9	18.1	11.3	17.7
Transitio-nal Zone	1-2km	0.9	18.0	0.5	17.9	0.9	15.2	3.2	15.6	5.5	16.1
	2-3km	0.7	11.7	0.4	13.4	0.6	9.1	1.4	6.4	3.0	8.2
	3-4km	0.4	5.8	0.2	7.7	0.4	5.7	0.9	3.7	1.9	4.7
Hinterland Zone	4-6km	0.2	5.6	0.1	6.6	0.3	6.0	0.5	3.2	1.0	4.3
	6-10km	0.1	3.7	0.1	5.3	0.1	5.0	0.3	2.6	0.6	3.4
	> 10km	0.1	7.4	0.1	13.1	0.1	11.3	0.3	8.7	0.4	9.3

Figure 7. Percentage of built-up areas per buffer distance from coast (Source: own elaboration based GHSL data)



4.2.2. Coastal vs Hinterland Urban Growth Divide

The 'coastal vs hinterland urban growth divide' is used in this work as a proxy for identifying urban growth or dynamism of settlements located in the study region; and demonstrates, in a way, the *territorial peripherality* of the 'inner' urban settlements or settlements located in the hinterland as opposed to those located next to or in the vicinity of the coastal zone. To quantify such a divide, the CHI (see Formula 1) is calculated as the ratio of the built-up density in 0-4km zones (DC) divided by the built-up density in the hinterland zone (DH) (zone beyond 4km distance from coast) (Table 4).

Figure 8. Satellite image of the Vrahati settlement, demonstrating the critical coastal, the transitional and the hinterland zone and their linkages (Source: own elaboration).

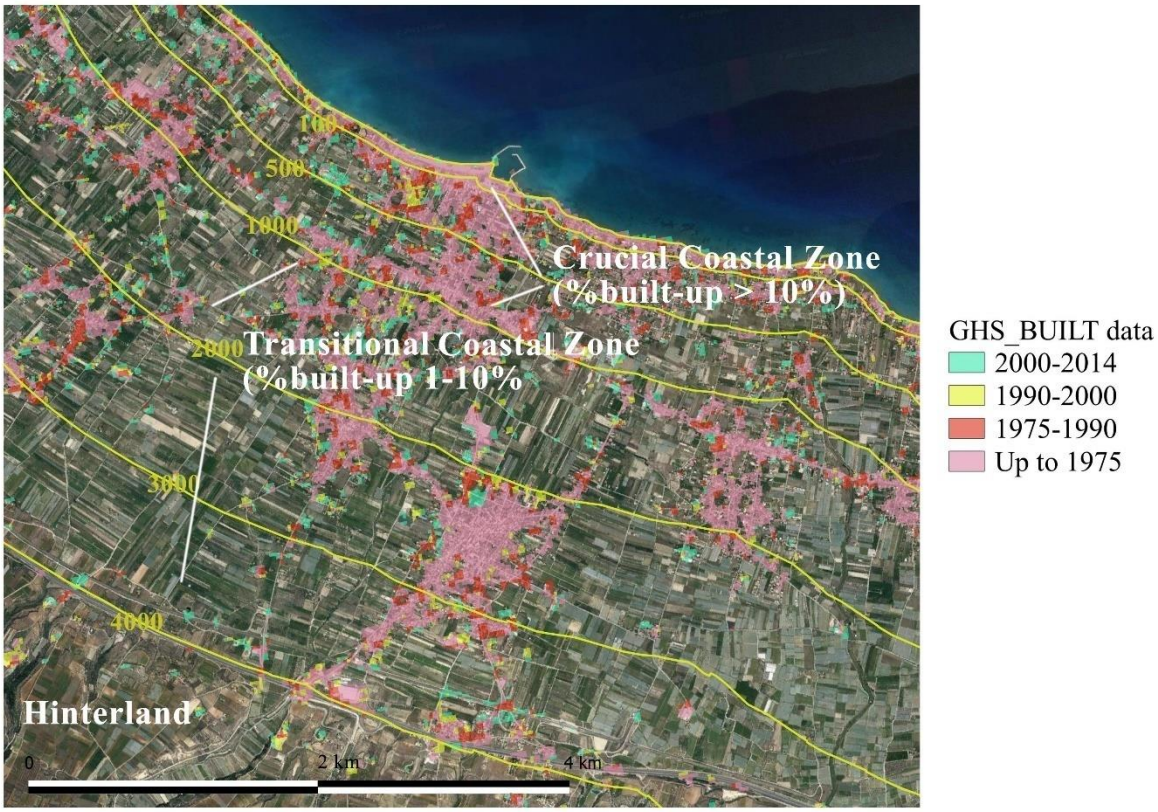


Table 4. CHI index for the Corinthia study region (1975-2014).

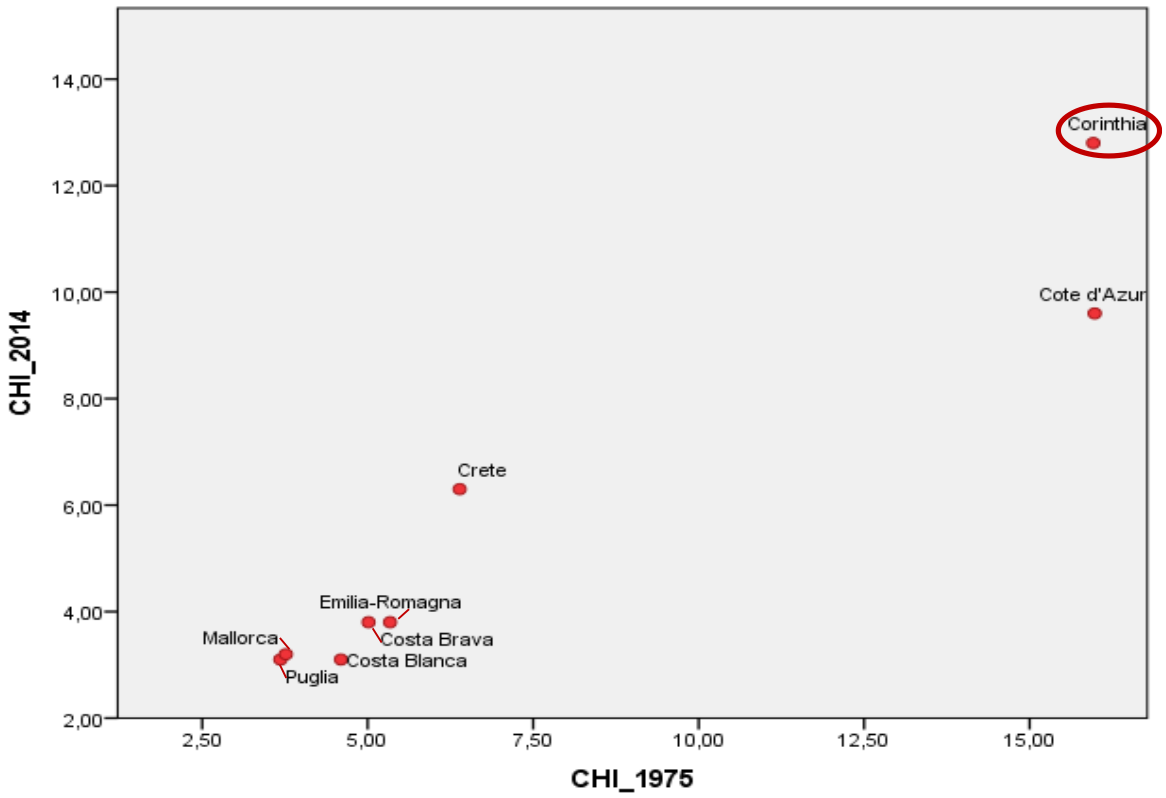
Corinthia	**1975**	**1990**	**2000**	**2014**
Built-area (ha) 4km-zone	48250	60245	65327	76728
Built-area (ha) >4km-zone	8204	11926	13807	16265
DC	4.38	5.46	5.92	6.96
DH	0.27	0.40	0.46	0.54
CHI	**16.0**	**13.7**	**12.8**	**12.8**

Results in case of Corinthia study region demonstrate a sharp divide between coastal and hinterland urban expansion patterns through time; and a rather slow downturn of CHI values

over the period 1975-2000 (Table 4). This image seems to change in the time span 2000-2014, where CHI values display certain stability, as a result of both the continuing acceleration of urban development in the coastal part and a relatively intensifying urban expansion in the hinterland. However, as shown in Table 4, developments in the built-area in the zone>4km, although doubled in the time span 1975-2014, following somehow the expansion rate of built-area in the 0-4km zone, do not practically alter the magnitude of CHI value, which still remains high. This confirms the steadily high interest in coastal urban zones. Additionally, it illuminates the diversifying pressure exerted in the agricultural and natural land as part of the urban expansion in the hinterland and coastal areas, with carrying capacity of the latter being substantially encumbered. Nonetheless, in order for the coastal vs hinterland divide to be assessed, further information needs to be co-estimated, e.g. population and economic dynamics, a task that is carried out in the following subsection.

Meanwhile, in order to better grasp and interpret the CHI values for the study region of Corinthia in the time span concerned, these are compared to respective values of a number of coastal regions in the Mediterranean (Fig. 9), falling into different countries, namely Spain, Italy, France, but also Greece (Region of Crete).These regions are also considered as hotspots in terms of coastalization by a recent research (Lagarias & Stratigea, 2022).

Figure 9. CHI values reported for seven Mediterranean coastal areas in Spain, Italy, France and Greece, 1975 and 2014 - Comparison to the Corinthia's CHI (Source: Own elaboration).



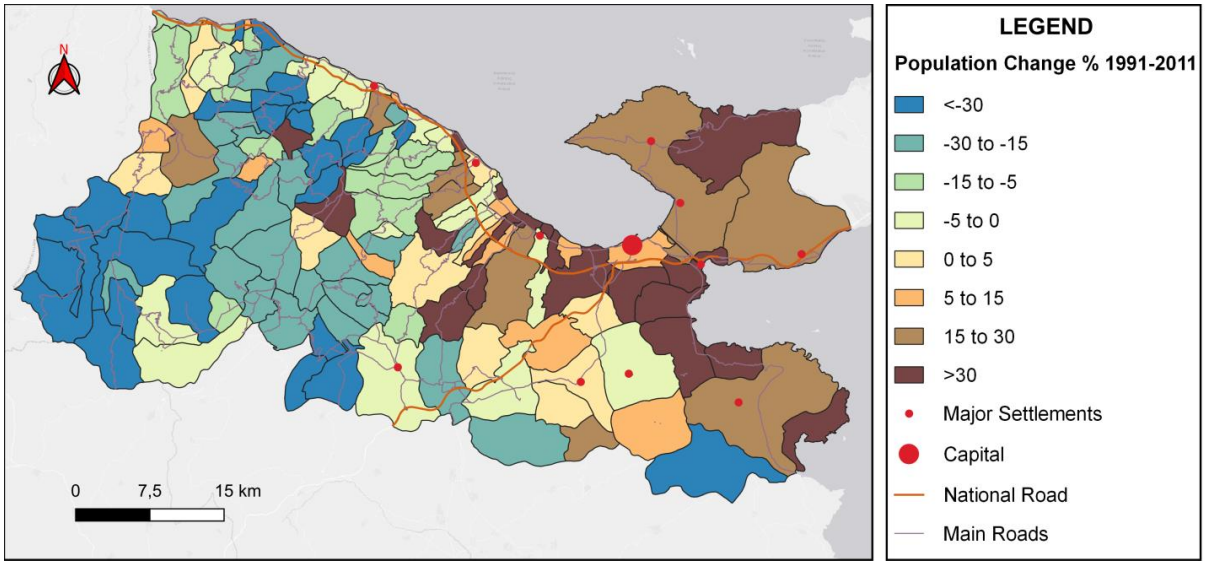
CHI values in Corinthia, in this respect, seem to keep a pretty high position in both 1975 and 2014 with respect to the positions that are held by the rest of case studies concerned. In fact, the CHI value of 12.8 (reported in 2014) can, out of this comparison, be classified as a "very high" one. This fact highlights a sharp divide between coastal and hinterland zones in Corinthia in terms of built-up land expansion. Furthermore, it displays that the evolving coastalization pattern in the Corinthia region constitutes a critical *policy challenge*; and calls for action in order for both sustainability and resilience of the coastal part as well as a balanced and equitable regional development pattern throughout the Corinthia region to be attained.

4.2.3. Territorial Peripherality and Developmental Repercussions

The previously identified sharp divide between the coastal and hinterland zones in Corinthia has critical implications on developmental perspectives of the settlements, located in both zones. Speaking of *urban settlements* in proximity to the coastal zone, issues raised relate to the surpass of carrying capacity limits in coastal zone and respective resource pressures that affect quality of life of respective population. Risks associated with CC impacts on natural ecosystems and manmade infrastructures are also noticeable. Pressures, but also risks related to urban sprawl in this part of the Corinthia region, coupled with CC risks, are critical, taking into consideration that this part of Corinthia area "absorbs" about 83% of the total built-up development.

As far as *settlements in the hinterland* are concerned, territorial peripherality has considerable implications with regard to developmental perspectives of these parts of the Corinthia area. Such implications are definitely fuelling also a certain developmental imbalance or gap between urban constellations in the coastal part and those in the hinterland. More specifically, the latter are marked by a certain developmental deficit that can be indicatively noticed by means of e.g. population distribution (Fig.10) and changes as to the prevailing economic sector in employment terms (Fig. 11).

Figure 10. Population change (%) in the time span 1991-2011 (Source: own elaboration, based on Population Census data).

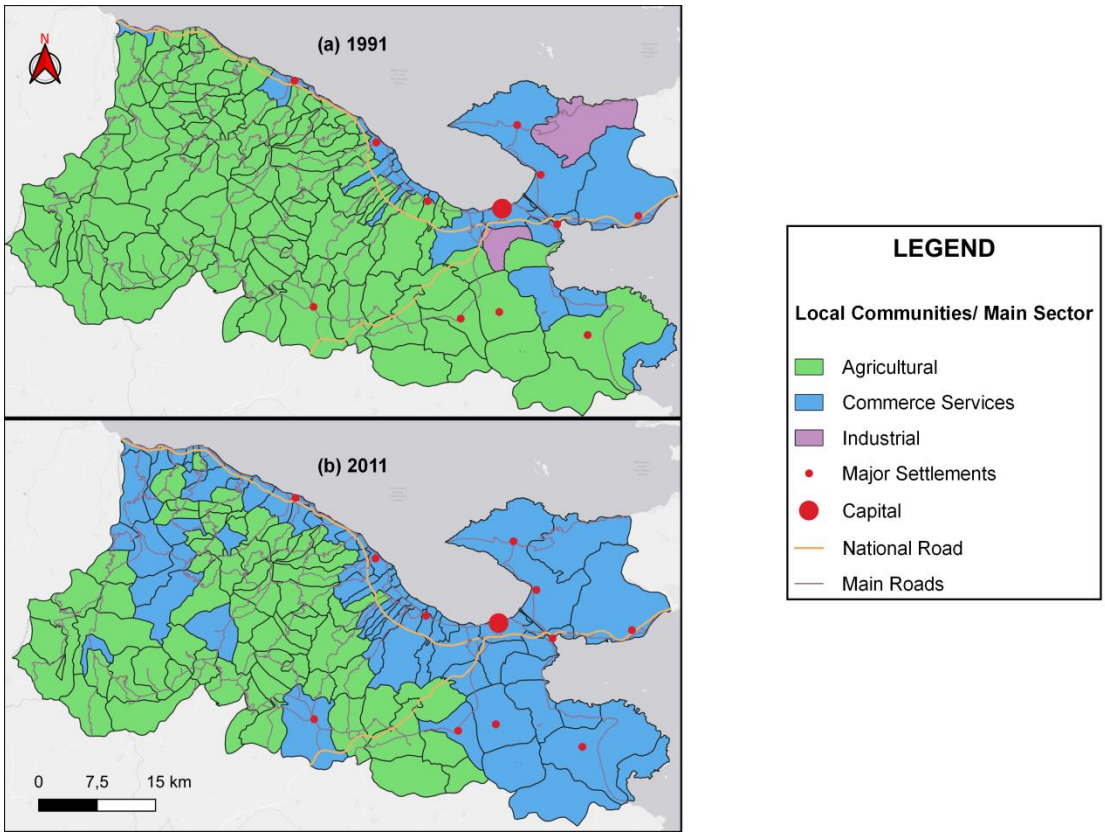


With respect to the *population distribution* in 2011, it is noticed that 73% of total population resides in the 43 coastal communities of the study region, having immediate access to the sea. The rest 27% resides in the 80 hinterland communities. Population change is positive in the coastal part (Fig. 10), concentrated mainly around the city of Corinthus and the Isthmus area, i.e. parts that are closer to the Athens metropolitan center. On the contrary, decline of population is observed in the majority of hinterland settlements, as well as in the western part of the coastal zone along the Corinthian Bay. The latter is interpreted by the fact that the western coastal part of the study region is mostly occupied by vacation houses and tourism infrastructure. Urban expansion, therefore, continues to impose pressure even on parts of land, where a population downturn is observed, resulting in an unbalanced sustainable development model.

As far as *sectoral employment* in concerned, it should be noticed that in 1991 the agricultural (primary) sector was the dominant one in the Corinthia Regional Unit, with the exception of the Corinthus-Isthmus area and the Kiato coastal settlement. In 2011, this pattern has considerably changed. More specifically, the coastal part is marked by a tertiarization of

the local economy (commerce/services, including tourism-related employment). On the contrary, employment pattern in the hinterland's local economy still appears overdependent on the primary sector, which remains the prevailing one in the economic structure of respective settlements.

Figure 11. Dominant economic sectors in employment terms in local administrative units in: (a) 1991, and (b) 2011 (Source: own elaboration, based on Census data).



5. DISCUSSION AND CONCLUSIONS

Treatment of both the *coastalization phenomenon* and related threats to coastal urban regions this entails; and the *territorial peripherality* as the result of, among others, distance from coast, seems to be a critical issue in the Mediterranean as a whole. This holds particularly true in case of Greece due to its quite long shoreline and the prevailing mass tourism model, leading to highly intensive coastalization patterns.

Results obtained in the Corinthia case study, witness a considerable "coastal vs hinterland" divide in both spatial and developmental terms. Monitoring of urban development, as quantified by built-up area expansion, unveils that considerable pressure is exerted on the coastal zone up to 4 km from the coastline. As far as the hinterland is concerned – settlements in the zone at a distance larger than 4km from coast – urban expansion pattern seems to follow a rather slower rate, although this part has also almost doubled its built-area in the 1975-2014 time-span. Despite this fact, however, values of Coastal vs Hinterland divide Index (CHI) seem to still remain pretty high, revealing the attractiveness of coastal areas vs the hinterland ones.

Furthermore, evolution of CHI values through time in Corinthia region reveal critical territorial imbalances, rating remarkably higher than those of a number of admittedly crowded coastal cities in the Mediterranean. These values, when coupled with a selected set of

socioeconomic variables, clearly unveil a certain developmental imbalance between urban constellations in the coastal part in the one hand and those in the hinterland on the other. Speaking of the former, coastal urban expansion pattern seems to threaten both agricultural land and marine ecosystems, thus questioning a sustainable and resilient future developmental pathway. When settlements in the hinterland are concerned, these are threatened by population shrinkage and a heavy dependence on the primary sector. Such results highlight the criticality of both coastalization and the coastal vs hinterland divide in sustainable development terms, calling for evidence-based policy response and remediation action. Future research paths of this work could get more insight into the morphological and spatial peculiarities of coastalization patterns. Use of spatial metrics could be relevant in this respect, in order for the level of urban sprawl and related sustainability concerns of urban zones in this specific case study example to be identified.

Coastalization and territorial peripherality are opposing to the outstanding objective of the European Union towards the reduction of territorial imbalances, already articulated in its founding Treaties; and need to be dealt following the recently renewed emphasis on territorial issues and territorial cohesion within the conception and execution of public policies, targeting a polycentric urban agglomeration pattern [Treaty of Lisbon, 2007; COM(2008) 616 final; Barca Report, 2009; EU, 2011]. The imbalance that seems to be in place when coastal and hinterland urban sprawl pattern, but also the developmental dynamics of related urban constellations, are concerned constitutes a significant barrier for attaining socio-economic and territorial cohesion objectives. In fact, both coastal urban expansion pattern and developmental dynamics seem to be prevalent vis-à-vis neighbouring hinterland areas. The latter are confronted with typical developmental obstacles of peripheral areas, with *territorial peripherality* (also seen from the distance from coast point of view, explored in this work) further enhancing marginalization at both the local/regional and/or the national level. Identifying and quantifying such kind of spatial and developmental imbalances can provide useful insight for featuring spatial planning and regional development policy interventions that are capable of managing, in alignment with other sectoral policies, emerging developmental and spatial 'gaps', thus increasing efficiency and effectiveness of public policies.

Options for handling such imbalances to the benefit of marginalized urban constellations in the hinterland can largely follow *two main streams*. The *first stream* rests upon the Barca (2009) *place-based approach*, presenting a *new paradigm* for achieving long-term sustainability objectives. This approach is mainly founded on the endogenous development of territorial assets. It draws upon the promotion of *attractiveness* of such lagging-behind regions as a key policy concept (Russo et al., 2012; Garau et al., 2020) that is grounded in the variety of their assets and territorial capital. In case of Corinthia region, this stream would imply a challenging narrative building endeavour and promotion of inner – at a distance from coast – regions on the basis of their natural and cultural wealth and especially the valuable – of international reach – cultural resources and local agricultural production (e.g. wine).

The *second stream* relies on the concept of *functional regions* (Ferrão et al., 2013), i.e. a territorial development instrument that can serve the design and implementation of related strategies. Based on that, planning-related spatial and other interventions are designed in support of new forms of territorial cooperation and deployment of intense functional relations. In such spatial contexts, there is considerable scope for designing and promoting *active complementarities* and *integration* between urban and rural areas, transitional and mixed spaces. Strengthening relationships and motivating synergies' creation between urban and peri-urban/rural areas, coastal and "inner" regions as well, through new forms of cooperation; but also promoting integration of different types of networks and infrastructures that connect such areas, are perceived as proper means for broadening effectiveness in managing polarization effects. A fertile ground for building up that kind of functionalities is evident in the case of Corinthia region; and can potentially contribute to the establishment of *win-win future conditions* for both coastal and hinterland settlements.

In order for the ground for properly implementing the above two streams to be prepared, this work has unfolded proper means and approaches for quantifying and spatially delineating

a distinct dimension of *territorial peripherality* in the Greek context, i.e. the distance from coast. The proposed methodology and related data sets, coupled with the empirical results in the specific case study of Corinthia, illuminate the potential offered to planners and policy makers for nurturing more informed policy decisions in order for territorial peripherality to be effectively alleviated and *spatial justice* concerns (Jones et al., 2019) to be attained.

ACKNOWLEDGEMENTS

The present research work is part of the postdoctoral research co-financed through the Greek State and EU (European Social Fund) accomplished under the framework of the Program "Workforce development, Education and continuing education", within the act "Financial assistance for Postdoc researchers – Cycle B", (MIS 5033021), led by IKY (State Scholarships Foundation of Greece).

REFERENCES

Anfuso, G., Postacchini, M., Di Luccio, D. & Benassai, G. (2021). Coastal sensitivity/vulnerability characterization and adaptation strategies: A review. *Journal of Marine Science and Engineering, 9*, 72. https://doi.org/10.3390/jmse9010072

Barca, F. (2009). An agenda for a reformed cohesion policy. A place-based approach to meeting European Union challenges and expectations. Brussels: European Commission.

Barcelona Declaration (1995). Euro-Mediterranean Conference, Barcelona, https://eeas.europa.eu/archives/docs/euromed/docs/bd_en.pdf(Accessed 23.10.2021)

Cavicchia, L., von Storch, H. & Gualdi, S. (2014). Mediterranean tropical-like cyclones in present and future climate. *Journal of Climate*, 27(19), 7493–7501. https://doi.org/10.1175/JCLI-D-14-00339.1

Hellenic Statistical Authority (2011). Census data, https://www.statistics.gr (Accessed 18.10.2021)

COM(2008) 616 final. Green paper on territorial cohesion - Turning territorial diversity into strength. Communication from the Commission to the Council, the European Parliament, the Committee of the Regions and the European Economic and Social Committee, Commission of the European Communities, Brussels, 6.10.2008.

COM(2012) 494 final. Blue growth opportunities for marine and maritime sustainable growth. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, European Commission, Brussels, 13.9.2012.

Commission for Studying Climate Change Impact (EMEKA) (2011). *Environmental, Economic and Social consequences of Climate Change in Greece*. National Bank of Greece. ISBN 978-960-7032-49-2.

Corbane, C., Florczyk, A., Pesaresi, M., Politis, P. & Syrris, V. (2018). GHS built-up grid, derived from Landsat, multitemporal (1975-1990-2000-2014). R2018A. European Commission, Joint Research Centre (JRC). https://doi.org/10.2905/jrc-ghsl-10007, PID: http://data.europa.eu/89h/jrc-ghsl-10007

Corbane, C., Pesaresi, M., Kemper, Th., Politis, P., Florczyk, A., Syrris, V., Melchiorri, M., Sabo, F. & Soille, P. (2019). Automated global delineation of human settlements from 40 years of Landsat Satellite Data Archives. *Big Earth Data*, 3(2), 140–169. https://doi.org/10.1080/20964471.2019.1625528

Couch, C., Leontidou, L. & Petschel-Held, G. (Eds.) (2007). *Urban sprawl in Europe: Landscapes, land-use change & policy*. Oxford: Wiley-Blackwell Publishing, ISBN: 978-0-470-69134-2.

Cuadrado-Ciuraneta, S. & Durà-Guimerà, A. (2018). From tourism to Metropolization: Analysis of the driving forces of urban transformation along the northern Costa Brava (Catalonia, Spain), *European Journal of Geography*, 9(1), 91-104

Day, W.J., Gunn, D.J. & Burger, J.R. (2021). Diminishing opportunities for sustainability of coastal cities in the anthropocene: A review. *Frontiers in Environmental Science*, 9. https://www.frontiersin.org/article/10.3389/fenvs.2021.663275https://doi.org/10.3389/fenvs.2021.663275

Díaz-Pacheco, J. & García-Palomares, J.C. (2014). Urban sprawl in the Mediterranean urban regions in Europe and the crisis effect on the urban land development: Madrid as study case. *Urban Studies Research*, Article ID 807381. doi:10.1155/2014/807381

Di Peri, R. & Giordana, R. (Eds.) (2011). Mare Nostrum - Sustainable tourism in the Mediterranean, A case of participatory approach in Rhodes and Tyre. Euromed Heritage IV Project. EH4 M" 150-825, L' Harmattan Italia Srl, Torino.

ECORYS (2016).*Study on specific challenges for a sustainable development of coastal and maritime tourism in Europe – Final Report*. Publications Office of the European Union. https://doi.org/10.2905/jrc-ghsl-10007 10.2826/94993

European Commission (EC) (2014). Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 on establishing a framework for maritime spatial planning. *Official Journal of the European Union*, L 257/135, 28.8.2014.

European Commission (EC) (2020). Territorial agenda 2030 - #TerritorialAgenda a future for all places. Informal meeting of Ministers responsible for spatial planning and territorial development and/or territorial cohesion, Germany, 1.12.2020, https://territorialagenda.eu/wp-content/uploads/TA2030_jun2021_en.pdf(Accessed 10.10.2021)

EEA (European Environment Agency) (2006). Urban sprawl in Europe — The ignored challenge. EEA Report No 10/2006, Publications Office of the European Union.

EEA (European Environment Agency) (2016). Urban sprawl in Europe. EEA Report No 11/2016, Publications Office of the European Union.

Egidi, G., Cividino, S., Vinci, S., Sateriano, A. & Salvia, R. (2020). Towards local forms of sprawl: a brief reflection on Mediterranean urbanization, *Sustainability*, 12, 58. https://doi.org/10.3390/su12020582

El Haité, H. & El Yazami, D. (2016). *The Mediterranean region under climate change - A scientific update*. IRD Éditions, Institut De Recherche Pour Le Développement, Marseille, ISBN 978-2-7099-2219-7.

European MSP Platform (2018). Maritime spatial planning (MSP) for blue growth - Final technical study. Publications Office of the European Union (Luxemburg).

European Parliament Resolution (2008). Regional development aspects of the impact of tourism on coastal regions [2008/2132(INI)], 16 December. https://www.europarl.europa.eu/doceo/document/TA-6-2008-0597_EN.html (Accessed 12.10.2021)

European Union (EU) (2009). Protocol on integrated coastal zone management in the Mediterranean. *Official Journal of the European Union*, L 34/19, 4.2.2009.

European Union (EU) (2011). Territorial agenda of the European Union - Towards an inclusive, smart and sustainable Europe of diverse regions. Agreed at the Informal Ministerial Meeting of Ministers responsible for Spatial Planning and Territorial Development on 19th May 2011 Gödöllő, Hungary. https://ec.europa.eu/regional_policy/sources/policy/what/territorial-cohesion/territorial_agenda_2020.pdf (Accessed 16.11.2021)

European Union (2012). Sustainable tourism in the Mediterranean. Aston University, Birmingham, ISBN: 978-92-895-0667-0. doi: 10.2863/69472.

https://cor.europa.eu/en/engage/studies/Documents/sustainable-tourism-mediterranean/sustainable-tourism-mediterranean.pdf(Accessed 16.10.2021)

European Union (EU) (2017). The lagging regions EU report - Competitiveness in low-income and low-growth regions. https://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/lagging_regions%20report_en.pdf (Accessed 12.09.2021)

Ewing, R.& Hamidi, Sh. (2015). Compactness versus sprawl: a review of recent evidence from the United States. *Journal of Planning Literature*, 30(4), https://doi.org/10.1177/0885412215595439

Ferrão, J., Mourato, J., Balula, L. & Bina, O. (2013). Functional regions, urban-rural relations and post-2013 cohesion policy. Project 'Functional Regions, Urban-Rural Relations and Post-2013 Cohesion Policy', Final Report, University of Lisbon. https://doi.org/10.13140/RG.2.2.22281.03684.https://www.researchgate.net/publication/312248901_Functional_Regions_Urban-Rural_Relations_and_Post-2013_Cohesion_Policy (Accessed 15.10.2021)

Flaounas, E., Drobinski, P. & Bastin, S. (2013). Dynamical downscaling of IPSL-CM5 CMIP5 historical simulations over the Mediterranean: Benefits on the representation of regional surface winds and cyclogenesis. *Climate Dynamics*, 40, 2497–2513. https://doi.org/10.1007/s00382-012-1606-7

Fraile-Jurado, P., Iglesias-Campos, A., Simon-Colina, A. & Hodgson, N. (2019). Methods for assessing current and future coastal vulnerability to sea level rise. A review for a case-study in Europe. *European Journal of Geography,* 10 (3), 97-119.

Garau, C., Desogus, G. & Stratigea, A. (2020). Territorial cohesion in insular contexts: assessing external attractiveness and internal strength of major Mediterranean islands. *European Planning Studies*, 28(12), 1–21. https://doi.org/10.1080/09654313.2020.1840524

Görmar, F., Lang, T., Nagy, E. & Raagmaa, G. (2019). Re-thinking regional and local policies in times of polarisation: An introduction. In T. Lang & F. Görmar (Eds.), *Regional and Local* Development in Times of Polarisation: Re-thinking Spatial Policies in Europe, 1–24, Singapore: Palgrave Macmillan, ISBN 978-981-13-1189-5. https://doi.org/10.1007/978-981-13-1190-1_1

Hamidi, S., Ewing, R., Preuss, I. & Dodds, A. (2015). Measuring sprawl and its impacts: an update. Journal of Planning Education and Research, 35 (1), 35–50. https://doi.org/10.1177/0739456X14565247

Hasse, J.E. & Lathrop, R.G., (2003). Land resource impact indicators of urban sprawl. *Applied Geography*, 23(2), 159–175. https://doi.org/10.1016/j.apgeog.2003.08.002

Hallegatte, S., Green, C., Nicholls, R.J. & Corfree-Morlot, J. (2013). Future flood losses in major coastal cities. *Nature Climate Change*, 3. https://doi.org/10.1038/nclimate1979

Hellenic Statistical Authority, www.statistics.gr (Accessed 15.10.2021)

Hellenic Chamber of Hotels, https://www.grhotels.gr/en/

Hepcan, C.C. (2013). Quantifying landscape pattern and connectivity in a Mediterranean coastal settlement: The case of the Urla district, Turkey. *Environmental Monitoring and Assessment*, 185, 143–155. https://doi.org/10.1007/s10661-012-2539-7

IPCC (Intergovernmental Panel on Climate Change) (2013). Climate Change 2013 - The Physical Science Basis. Working Group I – AR5 Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,Cambridge University Press, ISBN 978-1-107-05799-1. https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_all_final.pdf(Accessed 22.09.2021)

IPCC (Intergovernmental Panel on Climate Change) (2014a). *Climate Change 2014 - Impacts, Adaptation and Vulnerability*. Part A - Global and Sectoral Aspects, Cambridge University Press.

IPCC (Intergovernmental Panel on Climate Change) (2014b). *Climate Change 2014 - Impacts, Adaptation and Vulnerability*. Part B - Regional Aspects, Cambridge University Press.

Jones, R., Moisio, S.M., Weckroth, M.T.K., Luukkonen, J.M., Mayer, F. & Miggelbrink, J. (2019). Re-conceptualising territorial cohesion through the prism of spatial justice: Critical perspectives on academic and policy discourses. In T. Lang & F. Görmar (Eds.), *Regional and Local Development in Times of Polarisation: Re-thinking Spatial Policies in Europe*, 1–24, Singapore: Palgrave Macmillan, ISBN 978-981-13-1189-5. https://doi.org/10.1007/978-981-13-1190-1

Kilroy, A. & Ganau, R. (2020). Economic growth in European Union NUTS-3 regions. World Band Group, Finance, Competitiveness and Innovation Global Practice, December 2020, Policy Research Working Paper 9494. http://hdl.handle.net/10986/34938 (Accessed 14.11.2021)

Kizos, T., Tsilimigkas, G. & Karampela, S. (2017). What drives built-up area expansion on islands? Using soil sealing indicators to estimate built-up area patterns on Aegean Islands, Greece. *Tijdschriftvoor Economische en Sociale Geografie*, 108(6), 836–853. https://doi.org/10.1111/tesg.12244

Koutsi, D. & Stratigea, A. (2019). Unburying hidden land and maritime cultural potential of small islands in the Mediterranean for tracking heritage-led local development paths – Case study Leros-Greece. *Heritage,2*(1), 938–966. https://doi.org/10.3390/heritage2010062

Kron, W. (2013). Coasts: the high-risk areas of the world. *Natural Hazards*, 66, 1363–1382. https://doi.org/10.1007/s11069-012-0215-4

Lagarias, A. & Sayas, J. (2018). Urban sprawl in the Mediterranean: Evidence from coastal medium-sized cities. *Regional Science Inquiry*, 0(3), 15–32. http://www.rsijournal.eu/ARTICLES/December_2018/1.pdf(Accessed 13.10.2021)

Lagarias, A. & Stratigea, A. (2021). High-resolution spatial data analysis for monitoring urban sprawl in coastal zones: A case study in Crete Island. In Gervasi, O., Murgante, B., Misra, S., Garau, C., Blečić, I., Taniar, D., Apduhan, B.O., Rocha, A.M.A.C., Tarantino, E. & Torre, C.M. (Eds.), *Computational Science and Its Applications - ICCSA 2021*, LNCS 12958, Proceedings, Part X, 75–90, 21st International Conference, Cagliari, Italy, September 13–16, Springer Nature Switzerland, ISBN 978-3-030-87016-4. https://doi.org/ 10.1007/978-3-030-87016-4

Lagarias, A. & Stratigea, A. (2022). Coastalization patterns in the Mediterranean: a spatiotemporal analysis of coastal urban sprawl in tourism destination areas. *GeoJournal* (accepted for publication, 08.04.22).

Lampropoulos, V., Panagiotopoulou, M. & Stratigea, A. (2021). Assessing the performance of current strategic policy directions towards unfolding the potential of the culture–tourism nexus in the Greek territory. *Heritage*, 4, 3157–3185. https://doi.org/10.3390/heritage4040177

Law 4399/2016. Legislative framework in support of private investments for the regional and economic development of Greece. *Official Government Gazette*, Part A', No. 117/22.06.2016, 6865–6928.

Law No. 3937/2011, Maintenance of biodiversity and other legal provisions, *Government Gazette*, Part A', No. 60/31.03.2011, 1619–1656.

Law No. 4416/2016. Enacting of Directive 2014/91/EE/ L 257 and other legal provisions. *Government Gazette*, Part A', No. 160/06.09.2016, 8459–8474.

Leka, A., Lagarias, A., Panagiotopoulou, M. &Stratigea, A. (2022). Development of a tourism carrying capacity index (TCCI) for sustainable management of coastal areas in Mediterranean Islands – Case study Naxos, Greece. *Ocean & Coastal Management*, 216. https://doi.org/10.1016/j.ocecoaman.2021.105978

Ludwig, W., Bouwman, A.F., Dumont, E. &Lespinas, F. (2010). Water and nutrient fluxes from major Mediterranean and Black Sea rivers: Past and future trends and their implications for the basin-scale budgets. *Global Biogeochemical Cycles*, 24(4), 1–14. https://doi.org/ 10.1029/2009GB003594

Marignani, M., Bruschia, D., Garcia, D. A., Frondoni, R., Carli, E., Pinna, M. S., Cumo, F., Gugliermettia, F., Saatkamp, A., Doxa, A., Queller, E. M., Chaieb, M., Dagher-Kharrat,

M. B., El Zeine, R., El Jeitanie, S., Khater, C., Mansour, S., Al-Shamig, A., Harik, G., Alameddine, I., El-Fadel, M. & Blasia, C. (2017). Identification and prioritization of areas with high environmental risk in Mediterranean coastal areas: A flexible approach. *Science of the Total Environment*, Vol. 590–591, 566–578. https://doi.org/10.1016/j.scitotenv.2017.02.221

Mikhaylov, A., Mikhaylova, A. & Kuznetsova, T. (2018). Coastalization effect and spatial divergence: segregation of European regions. *Ocean & Coastal Management,* 161, 57–65. https://doi.org/10.1016/j.ocecoaman.2018.04.024

Ministry of Environment and Energy (2016). National strategy for adaptation to climate change.https://www.depa.gr/wp-content/uploads/2020/02/06.04.2016-espka-teliko_.pdf (Accessed 15.11.2021)

Nicholls, R., Wong, P., Burkett, V., Woodroffe, C. & Hay, J. (2008). Climate change and coastal vulnerability assessment: scenarios for integrated assessment. *Sustainability Science*, 3(1), 89–102. https://doi.org/10.1007/s11625-008-0050-4

OECD (2020a). Regional policy for Greece Post-2020 - Regional profiles. OECD Territorial Reviews. https://patt.espa2127.gr/sites/default/files/2021-03/1_201110%20TR%20Greece%20-Attica_Regional%20Profile.pdf (Accessed 22.10.2021)

OECD (2020b). Regional policy for Greece Post-2020. OECD Territorial Reviews, OECD Publishing, Paris, https://doi.org/10.1787/cedf09a5-en

Oppenheimer, M., Glavovic, B. C., Hinkel, J., van de Wal, R., Magnan, A. K., Abd-Elgawad, A. et al. (2019). Sea level rise and implications for low-lying islands, coasts and communities. In H. O. Pörtner, D. C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, et al. (Eds.), *Ocean and Cryosphere in a Changing Climate*, IPCC Special Report, Geneva, Switzerland, 321–445.

Organization of Workforce Employment (2011). https://www.oaed.gr/(Accessed 15.10.2021)

Panagiotopoulou, M. & Stratigea, A. (2021). Strategic planning and web-based community engagement in small inner towns: Case study municipality of Nemea – Greece. In Gervasi, O., Murgante, B., Misra, S., Garau, C., Blečić, I., Taniar, D., Apduhan, B.O., Rocha, A.M.A.C., Tarantino, E. & Torre, C.M. (Eds.), Computational Science and Its Applications – Proceedings of ICCSA 2021, Part V, 519–532, 21st International Conference, Cagliari, Italy, September 13–16, ISBN 978-3-030-86975-5. https://doi.org/10.1007/978-3-030-86976-2

Pesaresi, M., Florczyk, A., Schiavina, M., Melchiorri, M. & Maffenini, L. (2019). GHS settlement grid, updated and refined REGIO model 2014 in application to GHS-BUILT R2018A and GHS-POP R2019A, multitemporal (1975-1990-2000-2015), R2019A. European Commission, Joint Research Centre (JRC), https://doi.org/10.2905/42E8BE89-54FF-464E-BE7B-BF9E64DA5218, PID: http://data.europa.eu/89h/42e8be89-54ff-464e-be7b-bf9e64da5218 (Accessed 22.10.2021)

Plan Bleu (2012). Towards a Euro-Mediterranean sustainable urban strategy (EMSUS) within the framework of the Union for the Mediterranean. *Urban working group of the Secretariat of the Union for the Mediterranean*, https://planbleu.org/en/publications/vers-une-strategie-urbaine-durable-euro-mediterraneenne-sudem-dans-le-cadre-de-lunion, (Accessed 10.1.2022)

Pozoukidou, G. & Ntriankos, I. (2017). Measuring and assessing urban sprawl. A proposed indicator system for the city of Thessaloniki, Greece. Remote Sensing Applications: Society and Environment, 8, 30–40. https://doi.org/10.1016/j.rsase.2017.07.005

Prastacos, P., Lagarias, A. & Chrysoulakis, N. (2017). Using the urban atlas dataset for estimating spatial metrics - Methodology and application in urban areas of Greece. Cybergeo: *European Journal of Geography*, Document 815. https://journals.openedition.org/cybergeo/28051 (Accessed 15.4.2021)

Reis, J.P. & Silva, E.A. (2016). Spatial metrics to study urban patterns in growing and shrinking cities. *Urban Geography*, 37 (2), 246–271. https://doi.org/10.1080/02723638.2015.1096118

Reid, A., Komninos, N., Sanchez-P, J.-A. & Tsanakas, P. (2012). RIS3 regional assessment: Peloponnese - A report to the European Commission. Directorate General for Regional Policy, Unit I3 - Greece & Cyprus Smart Specialisation Strategies. https://www.eydpelop.gr/2014-2020/wp-content/uploads/2017/10/RIS3-review-report-Peloponnese-final-edited-2012.pdf(Accessed 17.6.2021)

Romano, B. & Zullo, F. (2014). The urban transformation of Italy's Adriatic coastal strip: Fifty years of unsustainability. *Land Use Policy*, 38, 26–36. https://doi.org/10.1016/j.landusepol.2013.10.001

Russo, A., Smith, I., Atkinson, R., Servillo, L., Madsen, B. & Van der Borg, J. (2012). ATTREG - The attractiveness of European regions and cities for residents and visitors. Applied Research 2013/1/7, Scientific Report, ISBN: 978-2-919777-26-6, ESPON 2013 Programme.

Salvati, L., Sateriano, A. & Bajocco, S. (2012). To grow or to sprawl? Land cover relationships in a Mediterranean city region and implications for land use management. *Cities*, 30, 113–121.

Salvati, L. & Morelli, V.G. (2014). Unveiling urban sprawl in the Mediterranean region: Towards a latent urban transformation? *International Journal of Urban & Regional Research*, 38(6), 1935–1953. https://doi.org/10.1111/1468-2427.12135

Salvati, L., Smiraglia, D., Bajocco, S. & Munafò, M. (2014). Land use changes in two Mediterranean coastal regions: Do urban areas matter? World Academy of Science, Engineering and Technology, *International Journal of Environmental and Ecological Engineering*, 8(9), 562–566. https://doi.org/10.5281/zenodo.1337441

Tombolini, I., Zambon, I., Ippolito, A., Grigoriadis, S., Serra, P. & Salvati, L. (2015). Revisiting "Southern" sprawl: Urban growth, socio-spatial structure and the influence of local economic contexts. *Economies*, 3(4), 237–259. https://doi.org/10.3390/economies3040237

Satta, A., Puddu, M., Venturini, S. & Giupponi, C. (2017). Assessment of coastal risks to climate change related impacts at the regional scale: The case of the Mediterranean region. *International Journal of Disaster Risk Reduction*, 24, 284–296. http://dx.doi.org/10.1016/j.ijdrr.2017.06.018

Serra, P., Vera, A. & Tulla, A.F., (2014). Spatial and socio-environmental dynamics of Catalan regional planning from a multivariate statistical analysis using 1980s and 2000s data. *European Planning Studies*, 22(6), 1280–1300. https://doi.org/10.1080/09654313.2013.782388

Servillo, L., Atkinson, R., Smith, I., Russo, A., Sýkora, L., Demazière, C. & Hamdouch, A. (2014). TOWN - Small and medium-sized towns in their functional territorial context. Final Report, ESPON, Luxembourg, ISBN 978-2-919777-65-5.

Servillo, L., Russo, A.P., Barbera, F. & Carrosio, G. (2016). Inner peripheries: Towards an EU place-based agenda on territorial peripherality. *Italian Journal of Planning Practice*, VI(1), 42–75.https://123dok.org/document/y4wj28p5-inner-peripheries-eu-placebased-agenda-territorial-peripherality.html (Accessed 30.10.2021)

Seto, K.C., Fragkias, M., Güneralp, B. & Reilly, M.K. (2011). A meta-analysis of global urban land expansion. *Plos ONE*, 6 (8), p. e23777.

Soto, M.T.R.& Clavé, S.A. (2017). Second homes and urban landscape patterns in Mediterranean coastal tourism destinations. *Land Use Policy*, 68, 117–132. https://doi.org/10.1016/j.landusepol.2017.07.018

Sterzel, T, Lüdeke, M.K.B., Walther, C., Kok, M.T., Sietz, D, & Lucas, P.L. (2020). Typology of coastal urban vulnerability under rapid urbanization. *PLoS ONE* 15(1), e0220936. https://doi.org/10.1371/journal.pone.0220936, https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0220936 (Accessed 13.10.2021).

Stratigea, A., Leka, A. & Nicolaides, Ch. (2017). Small and medium-sized cities and island communities in the Mediterranean: Coping with sustainability challenges in the smart city context. In Stratigea, A., Kyriakides, E. & Nicolaides, Ch. (Eds.), *Smart Cities in the*

Mediterranean - Coping with Sustainability Objectives in Small and Medium-sized Cities and Island Communities, 3–29, Springer, ISBN 987-3-319-54557-8.

Torrens, P. & Alberti, M. (2000). Measuring sprawl. *CASA working paper series n.27*. UCL, https://www.bartlett.ucl.ac.uk/casa/pdf/paper27.pdf (Accessed 13.10.2021).

Treaty of Lisbon (2007). Amending the Treaty on European Union and the Treaty establishing the European Community. *Official Journal of the European Union*, *OJ C 306, 17.12.2007,* 1–271.

Triantakonstantis, D. & Stathakis, D. (2015). Examining urban sprawl in Europe using spatial metrics. *Geocarto International*, 30(10), 1092–1112. https://doi.org/10.1080/10106049.2015.1027289

Tsilimigkas, G. & Rempis, N. (2017). Maritime spatial planning and spatial planning: Synergy issues and incompatibilities – Evidence from Crete Island, Greece. *Ocean & Coastal Management*, 139, 33–41. https://doi.org/10.1016/j.ocecoaman.2017.02.001

Tzoraki, O., Monioudi, I., Velegrakis, A., Moutafis, N., Pavlogeorgatos G. & Kitsiou, D. (2018). Resilience of touristic island beaches under sea level rise: A methodological framework. *Coastal Management*, 46(2), 78–102. https://doi.org/10.1080/08920753.2018.1426376

Union for the Mediterranean (UfM) (2021). Towards a sustainable blue economy in the Mediterranean region. 2021 Edition, Union for the Mediterranean, https://ufmsecretariat.org/wp-content/uploads/2021/07/21.7.19-2021UfM.studydefEN-web.pdf(Accessed 13.12.2021)

United Nations (UN) Environment (2018). Conceptual guidelines for the application of marine spatial planning and integrated coastal zone management approaches to support the achievement of sustainable development goal targets 14.1 and 14.2. UN Regional Seas Reports and Studies, No. 207, United Nations. https://wedocs.unep.org/bitstream/handle/20.500.11822/26440/MSP_ICZM_Guidelines.pdf?sequence=1&isAllowed=y (Accessed 7.12.2021).

UN-WTO (2019). International Tourism Highlights. https://www.e-unwto.org/doi/pdf/10.18111/9789284421152(Accessed 18.10.2021)

Valdunciel, J. (2014). The anatomy of urban sprawl in the Mediterranean region: the case of the Girona districts, 1979–2006. Urban and Environmental Analysis Group, University of Girona. In D. O' Donoghue (Ed.), *Urban Transformations: Centres, Peripheries and Systems*, Chapter 1, Routledge. ISBN 9781315548685.

Ye, H., Wang, K., Huang, S., Chen, F., Xiong, Y. & Zhao, X. (2010). Urbanisation effects on summer habitat comfort: a case study of three coastal cities in southeast China. International Journal of Sustainable Development & World Ecology, 17(4), 317–323. https://doi.org/10.1080/13504509.2010.493324