

## Research Article

### Protection Strategy for the Coastal Areas of Climate Change “Syrian Coast, Tartous City”

<sup>1,3</sup>Tarek Rahmoun, <sup>1,3</sup>Maya Hassan and <sup>2,3</sup>Wael Alhasan

<sup>1</sup>Faculty of Architecture and Urban Planning, Chongqing University, Chongqing, P.R. China

<sup>2</sup>Faculty of Landscaping Architecture, Southeast University, Nanjing, P.R. China

<sup>3</sup>Faculty of Architectural Engineering, Tishreen University, Latakia, Syria

**Abstract:** This study will demonstrate the development of appropriate sustainable defensive strategies for the affected coastal areas due to climate change. Goals are to provide a basis for future planning strategies in accordance to the problem of Sea Level Rise (SLR) in the coastal cities. This study aimed at opening discussions concerning new ideas of protection strategies for the coastal cities. Analysis of the information collected for Possibilities of the Continental Shelf of Syrian coasts to create defensive islands able to grow in defense system according to the scenario (the attack for the defence); Recommendations based on the ECO-Land Requirements. The impact of climate change will result in catastrophic human consequences if action is not taken to address these concerns. Strategic urban planning can aide with the expected impacts from the climate changes moving forward. According to NASA reports formation of warm ocean currents will lead to accelerated melting of the Arctic ice resulting in sea level rise. This in turn affects human populations in the coastal cities for many of the world's regions for the past and current century.

**Keywords:** Climate change, continental shelf, ECO-land, Sea Level Rise (SLR), sustainable defence

## INTRODUCTION

The problem of global warming carries two main risks; the first risk is environmental risk for increasing drought-prone areas and the melting of Arctic ice. This will lead to SLR, the second risk is demographic risk because of population movement beside bodies of water, as rivers, seas and oceans. Because of the high proportion of drought in the interior areas, this will lead to Environmental Migration , while international reports indicate it will probably constitute a coastal population half the world's population in 2025 (Creel, 2003; Costanza *et al.*, 2011) .

Due to these risks, coastal areas and coastal cities will face two types of challenges:

- **A surge of coastal city growth:** Besides having innate qualities in the emergence of the coastal cities (good soil for agriculture, mild climate, trade, freshwater springs), there is additional external pressure on coastal cities (climate change, Rising rates of Drought in the inland areas, population growth) (Fig. 1). Ultimately, this large population pressure, will lead in accordance with Global Reporting to the rapid drain of natural energy sources, along the coastal areas (Rahman and Rahman, 2015).

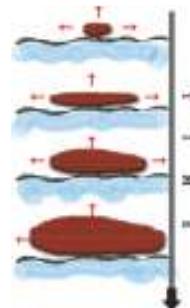


Fig. 1: The growth of coastal cities, the presence of the specified (water body), by the author

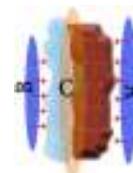


Fig. 2: Challenges in the coastal areas, by the author

- On the other hand Global warming can lead to the increase of natural disasters; starting from floods and hurricanes in addition to the big disaster of - RSL caused by the melting of continental ice, which is expected to lead to the disappearance of

some islands and parts of coastal cities along the world's coasts by the year 2060 (New *et al.*, 2011) unless the states work together to reduce Carbon emissions seriously, SLR could affect millions of people.

The challenges (A and B) as mentioned above could be solved with strategic plans for the coastal area (C). Different solution strategies directed to the specific coastal characteristics and problems. This may encourage new development for urban growth with accordance of environmental rules (Fig. 2).

Consequently the proposed defense strategy can be applied to face the SLR problem within area (C). Depending on the Continental shelf possibilities that will lead in the end to protect existing coastal areas and contain expected human activities in the future within the areas of progress to protect the threatened areas. The strategies will ultimately help with the emergence of new axes development for the coastal region as a whole.

### GLOBAL SCENARIOS REVIEW

Review of global scenarios for the proposed solutions in the face of danger SLR , during different periods of time (2030-2100) in different places around the world and in different environmental impressions depending upon the speed of the increase expected in sea-level rise and topography situation, led to many practical strategies and scenarios which gives different solutions from no action to construction the Levees or retreat, to protect the historical and current Human Inheritance and secure safe communities for life in the future (McNamee *et al.*, 2014; Tol *et al.*, 2006) (Fig. 3).

**Retreat:** Simply retreating from the problem. Thus, working to keep vital facilities and populations from risk zones in the future. The problem in the application of this scenario is that it requires coastal areas with low population density. This requirement is not available in many coastal areas today and will not be made available with the natural increase in population or environmental migration that we talked about. Supporters of this scenario find the idea of sustainability through new habitats resulting from retreat.

**Defend:** To ensure the protection of residential areas from entering water, building defenses must be taken into account in order to face the SLR problem. Scenario costs will be acceptable if defenses are invested in the development System of the Coastal Area. There may be additional advantages in providing alternative energy such as wind power and wave power. However, these defenses will remain limited to the future growth of cities towards the water bodies.

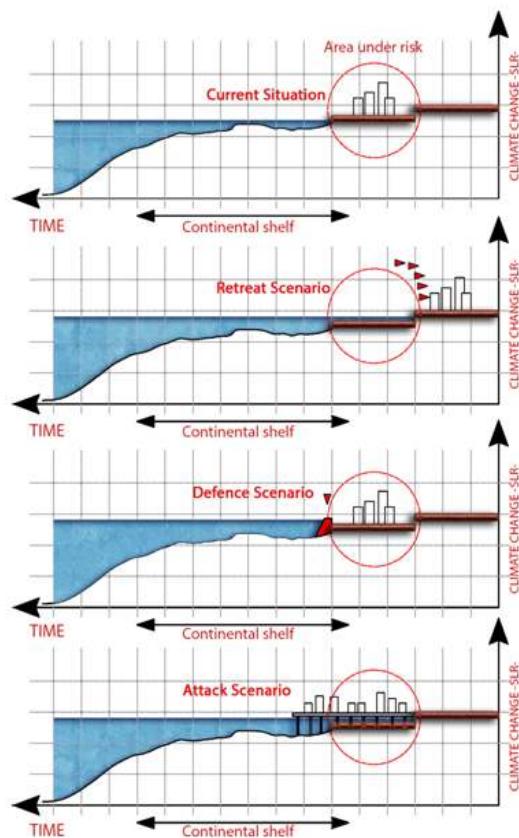


Fig. 3: Global scenarios, under of problem SLR, by the author

**Attack:** Real steadily progress towards the water by using new technologies that have been used in the 21<sup>st</sup> century (Floating structures and construction of homes with moving solutions appropriate to the problem of high water levels and even move towards the floating cities). Initialize new residential areas to receive water according to good plans. This requires enormous economic costs with no real guarantees for the protection of existing residential areas and vital facilities (Hardiman *et al.*, 2010).

### CASE STUDY

The coastal zone of the Mediterranean country as Syria Considered the most important of the shores of the Mediterranean "total seafront not exceeding 183 km length, against the total state area of 185,180 km<sup>2</sup>, a ratio of 1,012 km<sup>2</sup> for every 1 km seafront-more than five times the Mediterranean states' average of 192 km<sup>2</sup> per linear km of coastline" (Project, 2009).

Besides what constitutes the coastal region of significant support for the national economy as regards trade and tourism and agricultural activity, including the attributes of the newly discovered oil.

This strategic importance of the Syrian coast (Fig. 4). Made it a very important material to search for a mechanism to protect human populations from the risk of SLR.



Fig. 4: Syrian coastal zone and study case location by the author, Based on google map



Fig. 6: Pangaea to plate tectonics report, Halbert Katzen (2007)

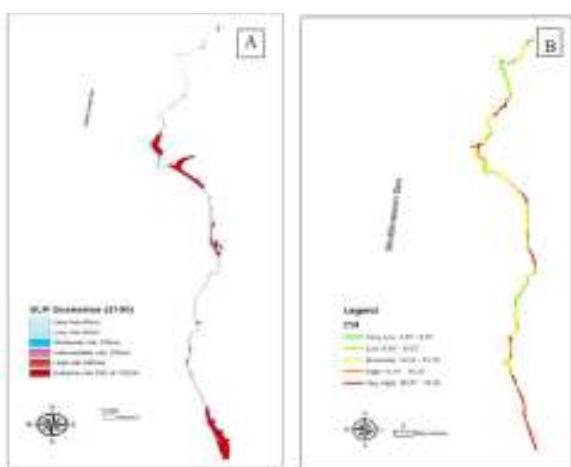


Fig. 5: SLR inundation map in 2100 (A) and Coastal Vulnerability Index (CVI) (B) GIS-based approach to the assessment of coastal vulnerability to sea level rise: Case Study on the Eastern Mediterranean, Dec. 2013, 1(3): 41-48

In addition, the vital slide and the future growth slide of Tartous city constitute an important case study for the proposed scenario we have chosen, with possibility of extending the model to different places of the Syrian coast (Fig. 5), in addition to the possibility of expanding the model to different areas of the Syrian coast (Faour *et al.*, 2013). Taking into account the most optimistic scenario of rising sea levels in the north-eastern part of the Mediterranean Sea basin, as well as the most pessimistic scenario, the water level rise of 0.5-0.75 m in 2100 (Church *et al.*, 2013). So we have to seek for a formula of the solution, starting from the current situation and the growth of the problem, considering that the level of risk is not specified.

## PROPOSAL SCENARIO BACKGROUND

"The Urantia Book also gives specific details about the sinking of a peninsula off the eastern coast of the

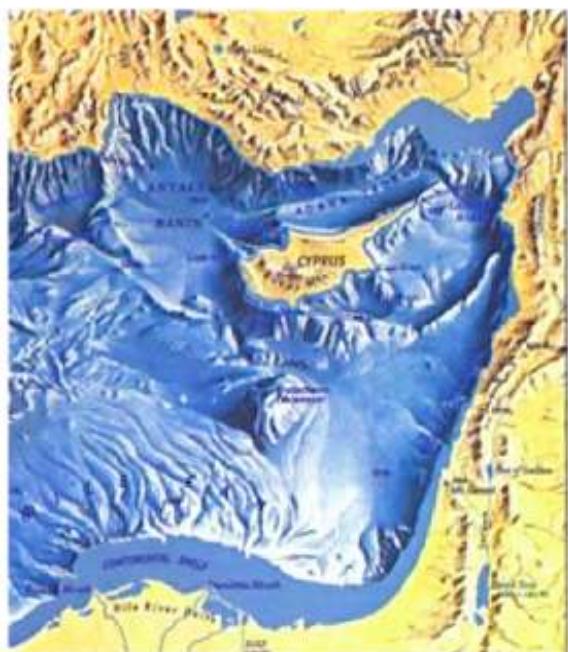


Fig. 7: Mediterranean seafloor map, national geographic 1982 by Pangaea to plate tectonics report, Halbert Katzen (2007)

Mediterranean some 33,000 years ago" (Halbert Katzen, 2007) (Fig. 6).

Thus the idea was launched mainly from the supposed possibility to restore parts of the continental shelf that submerged in water off the coastal cities on the Syrian shores back to life again, with a new structure suitable for the marine environment; constituting at the same time the real defense of the coastal population in the face of SLR problem.

Of course, when the writer spoke in "Urantia Book" about the theory of continental slipping (drift) and the sinking of a section of land in the water,

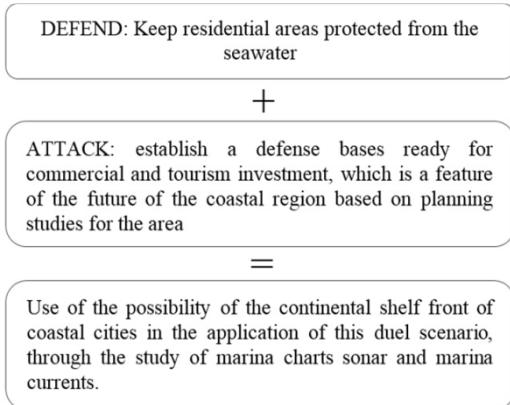


Fig. 8: The idea of the proposed scenario

scanning the marine depths was not yet known, as does the Navy sonar images, However, currently the modern technologies for marine survey reveals a topography with few depth under water off the Syrian coastal (Halbert Katzen, 2007) (Fig. 7).

On the other hand, the historical archaeological study of the Phoenician island of Arwad; the front of the city of Tartous on the Syrian coast, by a joint Syrian-Japanese mission in 1985. Arwad is not entirely a natural island but it is considered an artificial island built purposely in the sea in order to increase the habitable land areas on the expense of the sea, using

marine construction methods as is the case in the construction of the artificial islands and subsequent ports, according to the latest scientific theories at the moment (Hijazi, 1991).

Previous documents, with a group of tourism projects put forward by the Ministry of Tourism in 2006, based on marine backfill and artificial islands to support tourism investment and after comparing data for the Syrian coast with global scenarios in the face of SLR danger.

**The proposed scenario (Attack for Defence):** The new particular scenario to protect threatened coastal cities from the danger on the Syrian coast, based on consolidation scenarios attack and defense in a new idea is the attack and stability for defense in the future, which is based on sustainable planning of the coastal region. Because the risk of SLR problem start from the erosion of beaches gradually stage, until reaching the immersion stage (Fig. 8).

This proposed scenario will lead to the emergence of a group of designed islands; taking into account the problem RLS and the possibility of expansion and integration according to directions imposed by the study of the continental shelf, through a specific planning stages which constitute the islands in the future shield that will protect coastal cities in the previously a specific points, so as to give a solution;

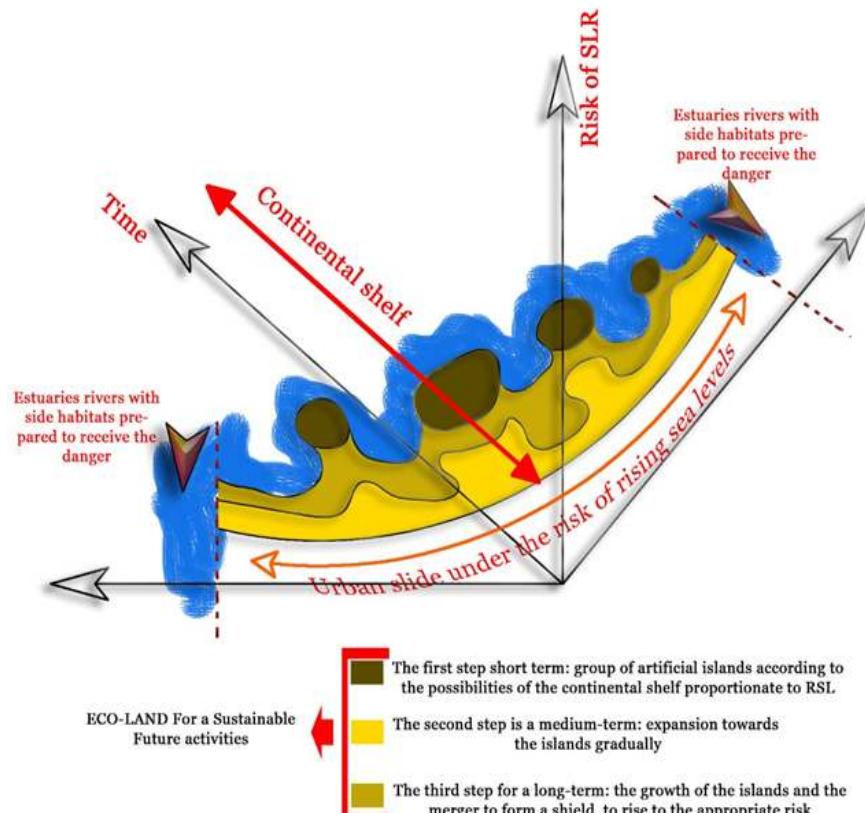


Fig. 9: The proposed scenario, by the author

taking into account the expansion of these cities. It inevitably ECO-LANDS that will accommodate human activity in the future (Fig. 9), selected for each coastal city according foundations of regional planning, but within the rules of blue communities compatible as much as possible with necessary marine environmental requirements, such as the use of alternative energy and new applications in waste disposal, with modern environmental science ways (Salahuddin, 2009; Mangor, 2012).

### THE METHODS

After determining the problem and exclusion of the retreat scenario because of the negative results on the economic fundamentals and public facilities and according to the review of many theories and strategies, also collected relevant information from published literatures of different scientific research work, to apply the new scenario of protecting Syrian coastal cities includes analysis marine topographic survey schemes in parallel with the analysis of the nature and the needs of current communities through three stages.

**The first stage: Analysis of the possibilities of the continental shelf:** This analysis and study gives us a clear image of shape of the proposed defenses (a series of islands with continued growth) and places most convenient for its establishment, based on the study of marine depths of the continental shelf, as well as the appropriate directions for future growth.

**The Second stage: Analysis of the current status of the endangered slice of the city and development projects in it.**

**The third stage: Analysis of sources and possibilities, within the territorial waters and the state plan for investment:** This analysis specify the nature of the advantage of defences (artificial islands viable to connect in the future), in order to develop sustainable development plans. And suggest the nature of the proposed human activity in the future plans, between the shoreline and the defensive line.

### RESULTS ANALYSIS

**Continental shelf possibilities:** From analysis of the possibilities of the continental shelf opposite the Syrian coast and detailed analysis of the marine depths corresponding to the slice studied:

#### Simple results:

- Syrian coast characterized by good space within the Continental Shelf (Fig. 10).
- There is a mountain range running parallel the coastline of the eastern basin of the Mediterranean.
- Because of the good extension of the continental shelf in front of the Syrian coast gives an idea about the gradient acceptable marine depths.

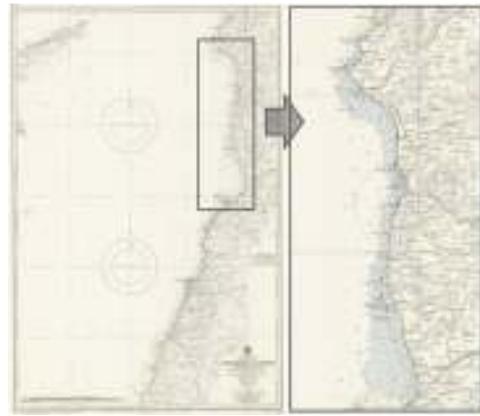


Fig. 10: Mediterranean Sea Syria and Lebanon topography is taken chiefly from French Government Maps with corrections to 1952

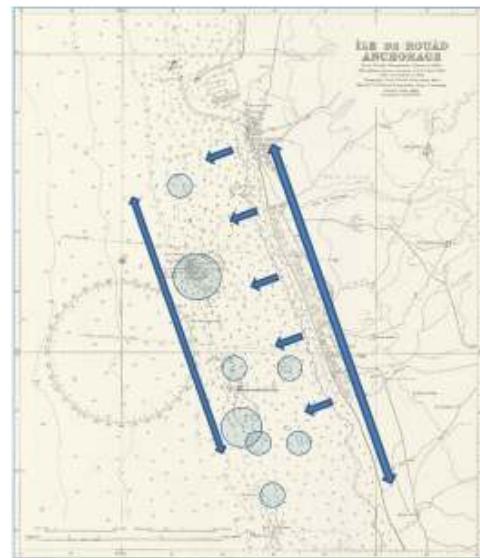


Fig. 11: Analysis of the possibilities of the continental shelf based on French Government Maps with corrections to 1952

**Partial results for our case study:** Using schemes French marine survey of the Syrian shores in 1952, compared with admiralty charts and publications 1579: ports in Syria Version No. 101 dated 19/10/2011. We can get accurate information for marine depths within the continental shelf corresponding to the case study, starting from the port of Tartus in the north to the Syrian-Lebanese border in the south. this shows clearly the existence of a rocky line, parallel to shoreline starts from Arwad Island, which is the only inhabited island among a series of small islands, small spots that show sequential towards the south (Fig. 11). As well as another set of submerged rock masses of water between this line and the shoreline, which gives us a clear vision of the focal points of the supposed proposal defensive line, which will be initially a collection of artificial defensive islands built on the rocky apparent bases in

the marine survey schemes, proportionate heights with the problem of SLR.

Then grows continuously according to time strategy plans to merge in the second stage in one defensive line and follow the growth direction of shoreline in the third stage based on specific axes in advance, taking into account the sea currents movement in the study area. In every stage of growth, leave the set for the continuation of the ports, during periods of growth before preparing full-lock that comply with the growth of the problem of SLR, to the extent that it constitute the maximum risk to human communities on the shoreline, as the problem of rising water is problem non-momentary will gradually increase over time.

#### **Current situation of Tartous coast:**

**Study the emergence and development of the city of Tartous guides the proposal optimized to exploit the defensive islands sustainably:** Tartous city of important agricultural, commercial and tourist cities on the Syrian coast, with the development of the tourism role of the city since the beginning of this century, it has been the division of marine slide, corresponding to a slice of real estate development that will form the waterfront of the city for several sections.

Since 2006, with the completion of seafront promenade slice and began working in 2008 in the tourism investment slice, adjacent to the port. While not start working in the southern part, which is the future of urban expansion area (Fig. 12).

All engineering and construction works in the parts implemented or being implement are designed to protect the residential segment of the city of Tartous from high marine waves, which is located at the same time under the risk of SLR.

So it can be considered as the arm that will carry the proposed final defenses in the first step, in addition to that it gives a clear idea about the important part of the nature of human activity (tourism activity) for supplementing tourism role of the city, When the studying sustainable planning process blue communities (defensive islands able to grow).

**Syrian territorial waters possibilities:** Ministry of Petroleum and Mineral Resources launched an international tender for the work of prospecting, exploration and exploitation of OIL and gas. N 81 Date 3/24/2011 (Fig. 13):

- Modern American studies recently confirmed the discovery of gas and oil treasure in a huge basin of the Mediterranean estimated reserves to 122 trillion cubic feet of natural gas and 107 billion barrels of oil (Schenk, 2010).
- In 2007-ANSYS, Inc Co. - conducted a survey of Geodesy Syrian coast, stretching from the Lebanese border north to the Turkish border, including various marine depths, according to the findings of the competent Norwegian company also analyzed the information and data, confirmed that there are 14 oil fields in Syria.

The four largest oil fields are concentrated off the Syrian coast and down until the city of Banias is expected to be equivalent to discovered quantities daily production up to 1.6 million barrels per day (Shuaibi, 2013), this gives a clear picture for the future new human activity on the Syrian coast and thus Gives an idea of sustainable planning in the future to the Syrian coast in general and the importance of finding a suitable



Fig. 12: Tourism development projects, on the coastline within the study case area, by Tartous municipality-urban planning

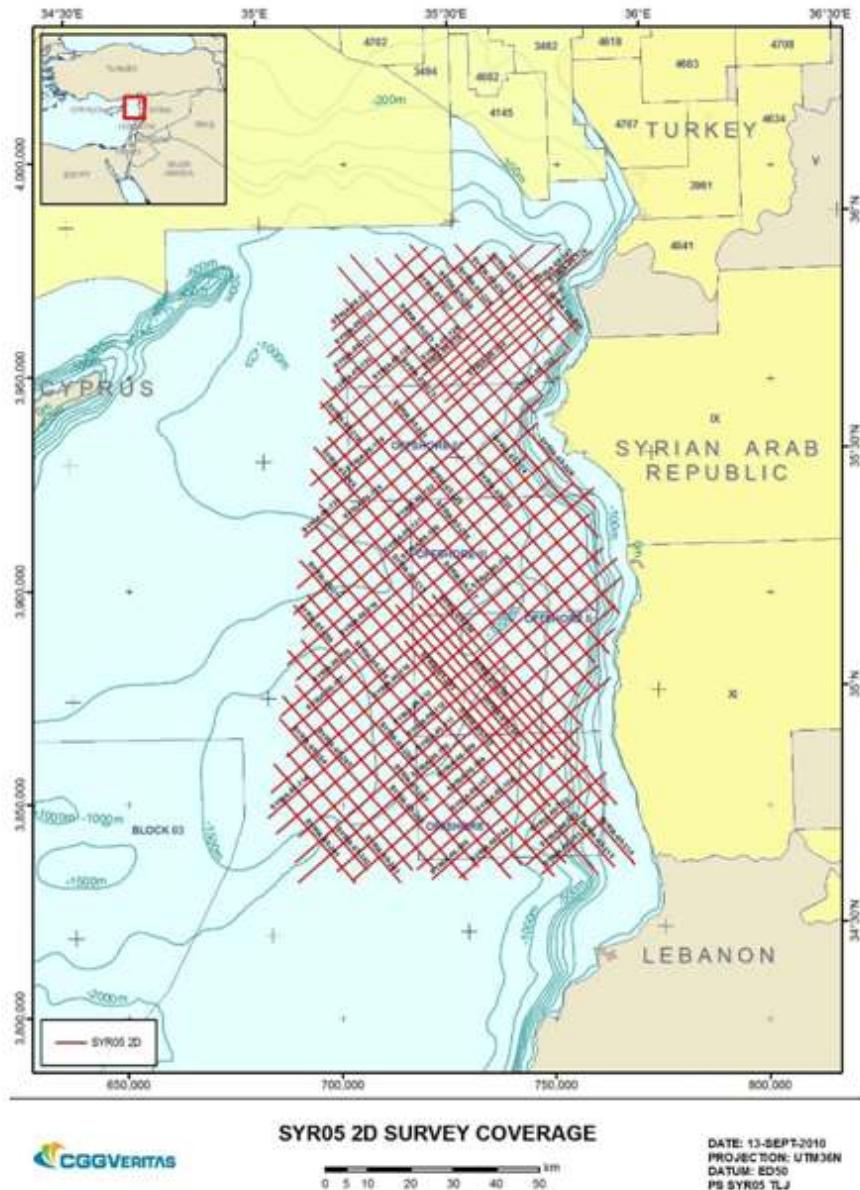


Fig. 13: CGG VERITAS 2D survey coverage offshore Syria VERITAS offers geophysical and geological datasets to support the syrian international offshore 2011 bid round

areas for the presence of investing companies, proposed defence islands to protect the coastline of the headquarters appropriate for this new future activity allowing trade and economic investment opportunities for this defensive islands, as well as Tourism Investment.

## DISCUSSION

From the previous three stages of analysis we can reach to the results form the basis for the development of future plans for the protection of coastal cities, according to the adoption of sustainable development, the proposed defences in the face of SLR problem.

The area between the shoreline and defences resulting from the exploitation of the possibilities of the continental shelf features, to urban development area based on clean energy and always work under the blue communities address and ECO-Land conditions (Fig. 14).

So this idea is applicable in any area after analysis disappearing natural possibilities, according to the previous three stages, we propose sustainable defences that commensurate with the geographic, economic and political nature of each country, because It means progress and customize with the problem and propose sustainable solutions on the basis of creating defensive communities of the population, vital projects on the

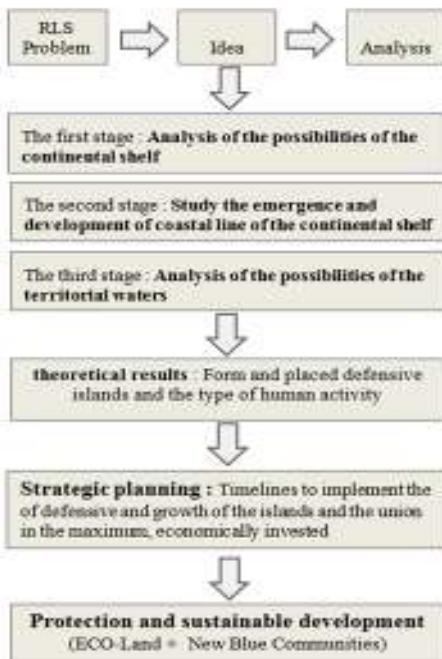


Fig. 14: Protection strategy for the coastal areas

coast and contain the disaster in points which we identify, not nature.

## CONCLUSION

In this study, we have introduced a new idea in the protection of minatory coastal areas of the main problem of climate change (SLR) which is based on the exploitation of natural and geographically elements of these areas. But not to escape from the solutions required under the pretext of the economic costs, because this idea means the sustainability of investment defenses step by step whenever widened.

The main idea behind this study was definition of regional planning to exploit all natural and human resources on land and sea and beneath it and above it.

As the title suggests, this is a preliminary step and the idea of a strategic included within the ideas proposed to save the important regions of the world in the future during this century. For future studies, this idea provides planning studies process in coastal areas when placing future plans for the medium and long-term development.

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