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Protection strategy of the climate change for coastal heritage sites in Syria

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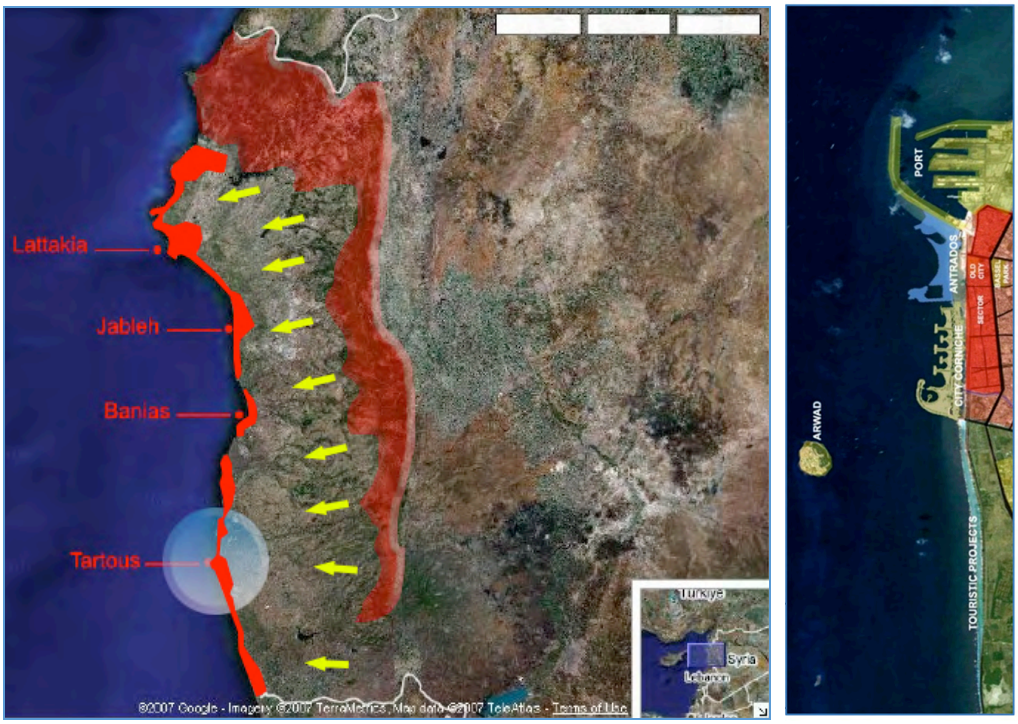
Abstract. *The climate changes will result in catastrophic human consequences, and will threaten archaeological sites and cultural inventory in many countries of the world, if rapid action is not taken to address them. This paper considers strategic urban planning can seriously help dealing with the expected impact of climate change in the coming years of the current century. Therefore, the development of appropriate defensive strategies for these areas must be considered as the basis for any future planning process, according to multiple stages of time that commensurate with the increasing problem of rising sea levels. The paper aims to develop a strategy for the protection of archaeological areas on the Syrian coast by creating a sustainable defensive lines are viable for growth and expansion, with a new idea in the protection of minatory coastal heritage areas of the main problem of climate change (SLR) which is based on the exploitation of natural and geographically elements of these areas, with new idea for economic investment and heritage promotion to have the sustainability of investment defenses step by step whenever widened. This coastal protection strategy of archaeological sites could be generalized in any coastal region in the world is threatened.*

Key Words: Climate Change, Sea level rise (SLR), Defense Strategy, Coastal heritage.

Introduction

The most important ancient civilizations originated on the banks of rivers and the seashores where the first human settlements formed near the water sources, seas, and rivers, and have been associated closely with life as an important source of food and essential transit for ways to maritime trade and communication civilization between the peoples of the East and the West. The twenty-first century has seen the emergence of new kinds of threats in climate change. The records of the Intergovernmental Panel on Climate Change (IPCC) for past changes in atmospheric composition over the last millennium demonstrate the increasing of the Earth's surface temperature and the rapid rise in greenhouse gases that are attributable, primarily, to industrial growth since 1750. The global average sea level rose (SLR) between 0.1 m and 0.2 m during the twentieth century, It is projected to rise by another 0.09 m to 0.88 m between 1990 and 2100 (Nakicenovic, Nebojsa; Intergovernmental Panel on Climate Change; Working Group III, 2000). According to the research, the archaeological sites and some buildings have survived at least two periods of global warming around 1500–1200 BC and 800–1200 AD and intervening cold periods. With international scientific evidence mounting and the reliability of future climate predictions increasing (Cassar & Pender, 2005). Due to the challenges that faced both of English Heritage and the National Trust to manage the coastal heritage in the face of sea level rise, the frequent flooding, and the increase in the expected flood risk in the future of the River Thames on London fabric and its built heritage, English Heritage had the point of the

research departure in 2002 to gather evidence on climate change as a possible cause of environmental instability of cultural heritage and to inform present and future planning (Cassar, May; Pender, Robyn, 2005). On the other hand, the adoption of the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage in 2003 reflected the growing awareness of the interdependence between the world's tangible and intangible heritage and the overall importance of safeguarding cultural diversity. All of these coincided with the escalation of international concerns about the climate change risks, so in 2005 the World Heritage Committee in collaboration with the Advisory Bodies (IUCN, ICOMOS, and ICCROM) started determining the impacts of climate change on World Heritage to define best practices for the strategy especially in developing countries. In 2007 UNESCO presented 26 case studies from selected natural and cultural World Heritage sites in order to illustrate the impacts of climate change that have already been observed, including Canadian Herschel Island, world Heritage sites of the City of London, and Venice and its Lagoon. Other reports have been published later on predicting and managing the impacts of climate change on World Heritage and Strategy to assist States Parties in implementing appropriate management responses and reducing disaster risks at world heritage properties.



(a) (b)

Figure 1: Case study location: (a) Syrian coastal zone. (b) Tartous coast.

Syria is characterized by geographical and historical elements that made it a cradle of the ancient civilizations and a cultural meeting point between the east and west. Syria had the greatest share of the sequence of civilizations for thousands of years, that appeared in the human discovery of the secrets of agriculture and the invention of the first alphabet and musical note in Ugarit, and the appearance of urban development systems represented by the buildings that the civilization had left, such as palaces, ports, castles, towers for watching and protection which still exist till now in Syrian coast. The coastal province geographically limited with narrow coastal plain and high population density concentrated in the coastal cities about six times more than the rest of the areas within the region, its coastline extends for a distance of 183 km with an area 185.180 km^2. The population of about 23 million in 2012, although it constitutes 2.5% of Syria space, it includes 11% of the number of Syrians. (Fig.1a). The strategic importance of the Syrian coast beside the significant specifications and support for the national economy as

regards trade and tourism and agricultural activity, including the attributes of the newly discovered oil; emphasise the importance of protecting the human history, populations, and activities from the risk of SLR. (Rahmoun, Tarek; Hassan, Maya; Alhasan, Wael, 2016). The paper focuses on the vital and the future growth area of Tartous city and its coastal heritage, and urban sites threatened of SLR problem, (Fig.1), which is an important area for starting take protection measures with the possibility of expanding the model later to different areas of the Syrian coast. Taking into account the most optimistic scenario of rising sea levels in the northeastern 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, 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.

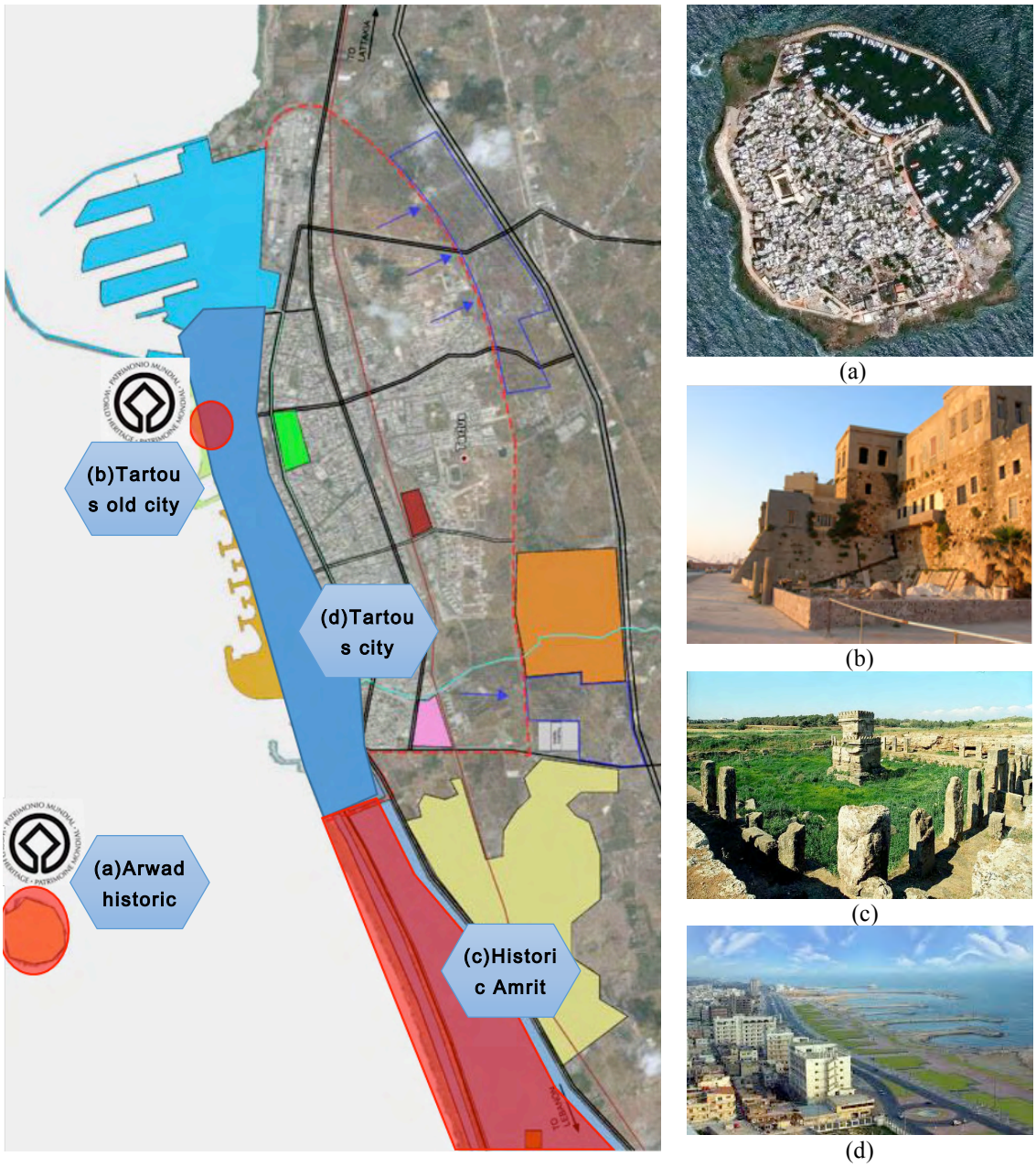


Figure 2: Tartous stone heritage and urban sites are threatened by SLR: (a) Historical Arwad Island. (b)Tartous old city. (c) Historic Amrit and its sectors. (d)Tartous city seafront

Case study sites:

The coastal heritage and urban sites threatened of SLR problem in Tartous city presented by the historic Arwad Island, Tartous old city, historical Amrit and its sectors, and Tartous city seafront. (Fig.2). Amrit site registered as a national heritage, while the national cultural heritage sites of Tartous old city, historical Arwad Island have been submitted to the world heritage tentative list since 1999, that stopped registration after 2011 due to Syrian war and Syrian heritage sites and buildings have classified in danger since 2013.

a. Arwad Island, the only island opposite the Syrian coast, was founded by the Phoenicians as a maritime trade base for them, and they built a defensive wall of huge stone square form for protection from high waves and attack enemy ships. As well as the remains of Phoenician defense wall and submerged underwater antiquities, Arwad island contains the old rock ruins and caves carved into the rocks in the western facade of the island, which back to the mother rock that Arwad Island and was built on in the ancient time. As well the archaeological buildings represented by the Citadel, tower and the remains of the Ottoman bath, and the traditional residential buildings belong to various periods.

b. After Phoenicians had founded Arwad Island, they moved to Tartous coast, where they found good soil for agriculture and established the Kingdom of Amrit in the south of the current city near a small river is known as Amrit River as a site for their activities, sports, and cemeteries for their people. Historic Amrit site has the remains of the temple in the middle of a large square court defined by a colonnade, and Hellenistic sport stadium with the residential area, funerary monuments, tombs and stone sarcophagi dating back to the third century B.C. Amrit site is divided into sectors are offered for tourism investment, taking into account the relics

c. Despite the first Phoenician presence in the city of Tartous, the basic core for the emergence of the old city of Tartous current form dates back to the Knights Templar, when the Crusaders arrived in the Levant. Then, they quickly tightened their control on it, because of its important strategic nautical location, off the coast of Cyprus. Tartous became one of the main settlements of the Knights Templar who built the Citadel in the seafront with double concentric walls and a double moat, and the famous Knights Templar buildings presented by Banqueting Hall and the Chapel. Also, they constructed a lady Tartous Cathedral, Tartous Museum now, in the same location, which is believed to contain the ancient temple of the Virgin Mary. The dwellings were later built within the Citadel and the remains of its walls, and the later Ottoman additions such as the galleries along the walls, are still clearly visible.

Research problem:

International reports indicate that it will probably constitute a coastal population half the world's population in 2025 because of environmental migration (climate change, rising rates of drought in the inland area). The innate qualities in the coastal cities as the moderate climate, good soil for agriculture, freshwater springs and trade, as well the pressure of population growth, in the presence of the water body as a specified will cause a surge of coastal city growth and large population pressure, that will lead in accordance with Global Reporting to the rapid drain of natural energy sources along the coastal areas (Creel, 2003) (Costanza, Robert; Kubiszewski, Ida; Roman, Joe; Sutton, Paul, 2011). On the other hand, climate change and 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 , Mark; Liverman, Diana ; Schroeder, Heike ; Anderson, Kevin, 2011), unless the states work together to reduce Carbon emissions seriously, SLR could affect millions of people. The climatic and demographic challenges for the coastal area could be solved by strategic plans and different

solution strategies directed to the specific coastal characteristics and problems; this may encourage a new development for urban growth contains expected human activities in the future and protect existing coastal areas from SLR problem in accordance with environmental rules.

Methodology

After defining the research problem, determining the threatened stone heritage sites of Tartous coast , and identification the important data. The paper applied a series of data collection and analysis steps with the goal of discovering and finding out the solution keys, the resources available for the Syrian coast, three stages of analysis are used in this paper started with the possibilities of the continental shelf, then the possibilities of the Syrian territorial waters and geopolitical situation within the territorial waters, followed by analysis of Tartous shoreline development. The triangulation is concurrently used to compare information from different independent sources, and gather the facts and data to evaluate the area and find out outlines for drawing together the level of intervention, the proposed scenario, and strategy for protecting Syrian coastal heritage built on the evidence base and systematic review of relevant literature.

Results and Discussion:

1. The possibilities of the continental shelf:

Utilizing the survey by Commander A.L. Mansell and French Government Maps 1952 for the topography of Mediterranean Sea for Syria and Lebanon from Latakia to Sour (Mansell, 27.Aug.1954), Arwad island port map of 1960 (Hydrographic Office of Admiralty, 26.Aug1960), and the ports in Syria- D-Tartus map of 1999 (Admiralty, 25.February.1999), and based on the data collection from Maritime Office of the port and local navigators of Tartous, a clear image of the continental shelf opposite of Syrian coast and marine depths were obtained, starting from the port of Tartous in the north to the Syrian-Lebanese border in the south. Syrian coast is characterized by good space within the Continental Shelf, and has an underwater mountain range in the eastern basin of the Mediterranean, that forms a rocky floor paralleled the Tartous shoreline, starts from Arwad Island and continues to other small islands and spots sequential towards the south, as well as another set of submerged rock masses of water between this range and the shoreline. (Fig.3). Arwad island and the nature of the geological rock for many parts of the continental shelf gives us a clear vision of the focal points of the supposed defensive line, and the possibility of creating a collection of artificial defensive islands built on the rocky apparent bases in the marine survey schemes with proportionate heights for the problem of SLR.

2. The current situation of the case study:

Arwad island currently suffers from the storms and high waves problem, that cause temporary emigration of the local people every winter from the western waterfront house to the center of the island or the city of Tartous, without any measure or protection project since the Phoenician great defense wall that still exists even today as remnants. The submerged ruins underwater that mentioned by the archaeologist Honor Frost confirms the historical SLR problem. Tartous City stayed a long time as an important agricultural city, the waterfront contains the old city and the city center which also remained without development projects. Due to the importance commercial and tourist role, Tartous municipality started developing the real estates and tourism of the shoreline since the beginning of this century by two reinforcement operations and urban

expansion area projects. The first project is the promenade seashore of Tartous municipality for public entertainment, that has completed since 2006 with a group of public facilities, squares and areas of the tourism investment with arms extended into the sea as a starting point toward the defense plan. In 2008 the second project is the 7-star tourism investment project behind the Tartous port began working. All engineering and construction works of seashore projects in the parts implemented or being implement are designed to protect the residential area of the city of Tartous from high marine waves, which is located at the same time under the risk of SLR. Strong winds that have occurred recently in 2014 and 2015 proved that the seafront promenade development project is not designed to be the defense line of the waterfront sector, and the property development of the shoreline, which proposed by the municipality to be the new waterfront of Tartous city, did not notice the SLR problem. The same situation for Amrit site and its futuristic tourism development projects in the southern sectors of the city of Tartous. (Fig.1b).

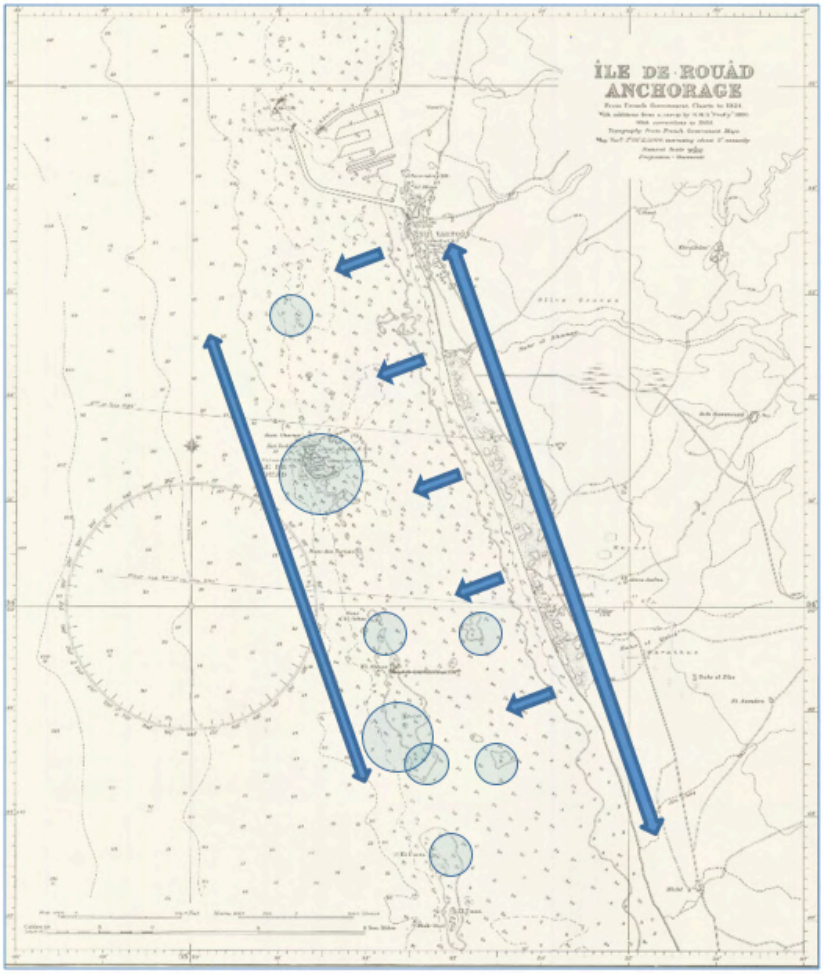


Figure 3: Underwater mountain range and a set of submerged rock masses under water between this range and the Tartous shoreline.

3. Syrian territorial waters possibilities, sources, and the investment plan:

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. 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). 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 24.03.2011, the announcement includes a presentation of three marine areas with an approximate area of about 3000 km^2 for one block. The four largest oil fields are concentrated off the Syrian coast and down to 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 image for the future new human activity on the Syrian coast and provides an idea of sustainable planning in the future to the Syrian coast in general and the importance of finding a suitable 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 and reducing their impact on the heritage sites.

4. The discussion of the global scenarios in the coastal area against climate change:

The review of global scenarios for the proposed solutions in the face of danger SLR, during the different periods of time (2030-2100) in various 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 give 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, Kerry; Wisheropp, Evan; Weinstein, Christopher; Nugent, Andrew; Richmond, Laurie, 2014), (Tol, R.S.; Bohn, M.; Downing, T.E.; Guillerminet, M.L.; Hizsnyik, E.; Kasperson, R.; Lonsdale, K.; Mays, C.; Nicholls, R.J.; Olsthoorn, A.A., and Pfeifle, G, 2006). (Fig.4). The global scenarios with three different visions could be summarized as:

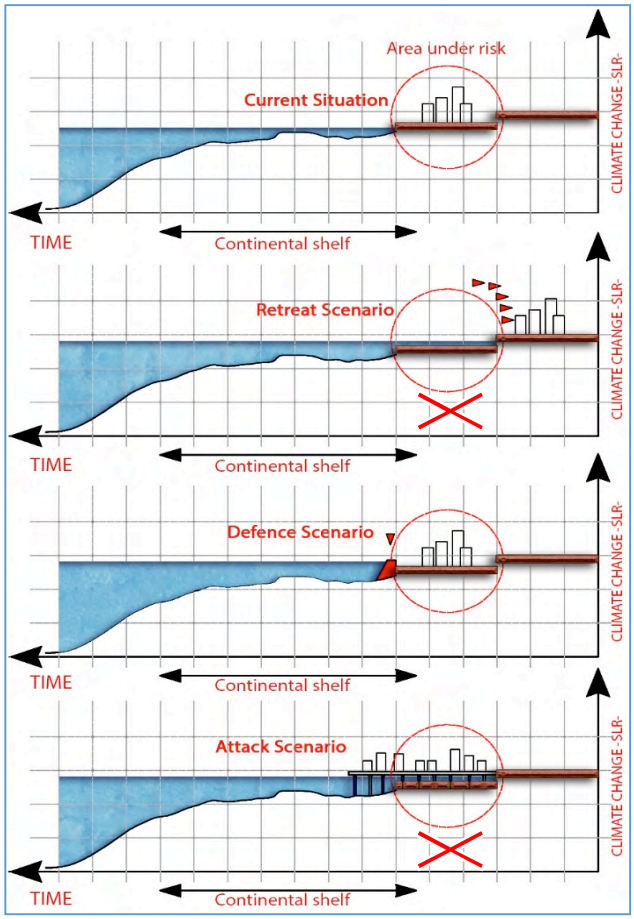
I. **Retreat**: Retreat from threatened locations and pull out towards the areas of the desired altitude to face the risk of flooding, the supporters of this scenario find the idea of sustainability through new habitats resulting from the retreat. This scenario requires coastal areas with low population density, that will not be available with the natural increase in population or environmental migration that we talked about, as well as the loss of authenticity of the heritage buildings by moving them from their locations.

II. **Defend**: To protect the residential areas from entering the water by the future growth of cities towards the water bodies in order to face the SLR problem, building defenses costs are not acceptable without additional advantages in providing alternative energy such as wind power and wave power could be invested in developing the system of the Coastal Area.

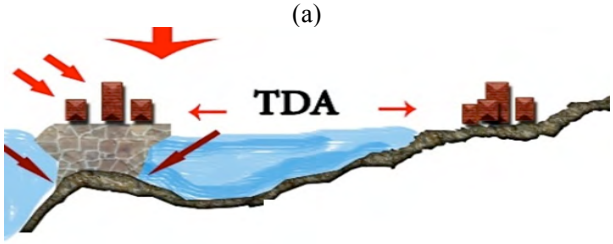
III. **Attack**: Real steady progress towards the water by using new technologies that have been utilized in the 21st century as the floating structures, construction of homes with moving solutions appropriate to the problem of high water levels, and even move towards the floating cities, and initialize 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, Nick; Robinson, Dickon; Hamer, Ben; Davies, Brett; Wilkes, David, 2010)

The stone material, which is considered the most important features of the ancient Syrian civilizations in most heritage sites, and helped to the steadfastness of these civilizations, despite all the natural and human conditions to the present day, and achieved the spiritual relation between time and space where they built on. Therefore, the stone structure and construction of the built heritage are sensitive for applying the previous protection theories and solutions, where it's impossible to transfer this stone historical coastal sites which threatened by the SLR problem

to some other areas, without losing their authenticity and cultural value, which is linked to the sea and the transition between the world beaches.



(a)



(b)

Figure 4: The idea background: (a) Global scenarios in the coastal area against the climate change. (b) The consolidation scenarios in a new one.

5. The three stages of analysis and proposed scenario background:

Urantia Book gives specific details about the sinking of a peninsula off the eastern coast of the Mediterranean some 33,000 years ago (Urantia Foundation, 1955). At that time the theory of continental slipping and the sinking of a section of land in the water, scanning the marine depths was not yet known, as does the Navy sonar images. However, the modern technologies for marine survey currently reveal a topography with small depth under water off the Syrian coastal. On the other hand, the archaeological study of Phoenician Arwad island 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 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 (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 Syrian coast with global scenarios in the face of SLR danger. The idea was launched mainly from the supposed possibility to restore parts of the continental shelf that submerged under 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. The three steps of analysis and continental shelf, topographic survey schemes and marine depths, in parallel with the analysis of the nature and the needs of current communities, specify the nature of the advantage of defences (artificial islands viable to connect in the future as a series of islands with continued growth), and places most convenient for its establishment. 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, as well as the appropriate directions for future growth.

6. The proposed scenario (Attack for Defence):

Develop the plans and defensive strategies compatible with the nature of the coasts, that are threatened in each region of the world, is the key solution to address SLR and the increasing of the demographic problems in the coast, taking into account the environmental, demographic and ecological impacts in the area of the application scenario. The proposed scenario of protection the threatened coastal heritage and cities from SLR danger in Syria is based on the attack scenario for future defense. The targeted area in this scenario is characterized by a natural potential of the continental shelf, and allows the application of an advanced defensive scenario for the threatened historic area by building a series of scattered artificial islands in front of the coast, which are available to grow gradually in line with time and the exacerbating of the problem of rising sea levels to the extent that it constitutes the maximum risk to human communities on the shoreline. Then merging the islands in the second stage in one defensive line and following the growth direction of the shoreline in the third stage based on specific axes in advance, taking into account the sea current movement in the study area, to reach at the end the implementation of the scenario to what looks like an arched shield in front of the protected area. At the same time, these islands as they grow naturally could receive the increased human activities in the coastal region, thus as well as the defensive role they could have formed a new urban spaces, so the required environmental requirements should be put before, during, put up for investment within the concept of Eco-Land and blue communities. On the other hand, the gradual growth process of the defensive arc process toward the opposite coasts must be synchronized with the documentation survey of the submerged human heritage in the study area and to launch the preservation, maintenance, and rehabilitation processes during the implementation of the defensive scenario.

Conclusion:

This paper presented the coastal heritage sites in Tartous city, which is threatened by the main problem of climate change (SLR), and focused on finding a protection strategy for minatory coastal areas as a strategic shift from a reactive to a proactive preventive approach. Based on three stages of analysis for the natural and geographic possibilities and human activities of the coastal areas, using strategic planning and sustainable development based on the definition of regional planning to exploit all natural and human resources on land and sea and beneath it and above it, without 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. This paper could be considered as 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 the planning studies process in the coastal areas when placing future plans for the medium and long-term development in any coastal region in the world is threatened.

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