Coastal communities increasingly experience the effects of climate change. It is becoming urgent for researchers, local stakeholders and citizens to address and promote climate resilience and act collectively. Thessaloniki, a port city with a long and continuous history has always retained a strong relationship to its waterfront which extends today more than 40 kilometers along the south east coast of the Thermaicos Gulf in northern Greece. SOS Climate Waterfront is a research European funded project (H2020 – MSCA Rise), reflecting on issues of management, design and planning of waterfront zones. This book presents the outcomes of the event organized in Thessaloniki, focusing on two areas of the city's waterfront as case studies. Design proposals, scientific papers and reflection opinion articles present insights, strategies and design tools elaborated during this event through the interdisciplinary collaboration of academics, researchers and local government representatives aiming to enhance climate adaptation planning and face climate change risks in the area.

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Acknowledgments

This book is the result of the collective work and enthusiasm of the many participants that contributed and made possible the 2019 Thessaloniki Event organized by the European funded Research Project SOS Climate Waterfront (H2020 – MSCA Rise).

First, we would like to thank and acknowledge the support of the two municipalities where our two selected case study sites were located. Municipality of Kalamaria and Municipality of Ampelokipi – Menemeni provided us with all necessary cartographic material and data concerning their current agenda and planning projects and shared insights and visions for the waterfront areas discussed. The non-academic partner of the SOS Climate Waterfront Thessaloniki team, MDAT (Metropolitan Development Agency of Thessaloniki s.a.), being a regional agency helped with the organization of this event and provided us with an overview of the present challenges regarding the management of Thessaloniki's waterfront and enhanced our understanding of the social, administrative and local policy context in which any proposed action has to operate.

We would like to thank, for their invaluable contribution, the team of international and local researchers, professors and experts for their inspiring and hard work during this event:

Isabel Barbas, Francesco Calzolaio, Natalia Chrysikou, Jelle-Jochem Duits, Crisolita Fonseca, Pedro Ressano Garcia, Michal Habier, Lilia Isyk, Chrysostomos Kalogirou, Nikolaos Kalogirou, Paraskevi Kourti, Silvia Cruells Lado, Sara Macedo, Diogo Malanho, Miguel Martinho, MariaRita Pais, Natalia Pantelidou, Stella Psaropoulou, Joanna Radulska, Konstantinos Sakantamis, Paraskevi Tarani, Anastasia Tzaka. The contribution of Professor Prodromos Zanis and Associate Professor

Konstantina Tolika from the Faculty of Geology Department of Meteology AUTh and Professor Stefanos Sgardelis from the School of Biology Department of Ecological Landscape Management AUTh informed participants on issues and recent data related to their expertise. They all shared their keen insights, research outcomes and offered guidance to enlarge our perspective of climate change risks while helping to shape proposals, design tools and strategies for the waterfront sites discussed in this book. They have worked also with the group of external participants, post graduate students and PhD candidates, whose creativity and imaginative design work illustrate ideas discussed and exchanged during this event. The presence of the following external participants was valuable and enriching: Stavros Antoniou, Efstratios Axiotis, Olympiada Babouka, Maria Nefeli Gerotoliou, Steriani Konstantaki, Meropi Konstantinidou, Sofia Kyrkopoulou, Olga Mantzou, Emmanouela Myrtaki, Charikleia Papaioannou, Evangelia Raikidou, Konstantina Salata, Olga Strongylou.

The SOS Climate Waterfront Thessaloniki Event would not have been so productive and inspiring without the contribution of each one mentioned above.

Alkmini Paka
Coordinator of SOS Climate Waterfront AUTH Team

Table of Contents

Introduction

Throughout the Thessaloniki's waterfront workshop the innovative research emerges from the methodology used. Researchers enhance their ability to develop solutions of resilience to face climate change by benefiting from the international and interdisciplinary exposure. The search for excellence makes use of technology, data collection and imaginative design solutions.

Data collection feeds parameters that cover a broad range of topics listed by the European Green Deal strategy. Thessaloniki is exposed to heatwaves, flooding, rising sea levels and it is weakly equipped for adapting to climate change. Given these circumstances, our research project gathers local and international experts to re-think urban design solutions for two particular sites along the waterfront, Kalamaria and Ampelokipi – Menemeni. Both sites presenting still a natural waterfront that has not yet been rehabilitated, were used as laboratories for innovative climate adaptation strategies and mitigation solutions.

During the workshop, participating researchers were able to discuss design tools within the aim of addressing climate change being eventually applicable in their own countries and at a European level. S.O.S. – Sustainable Open Solutions- for infrastructure, planning strategies and urban design builds a new multidisciplinary collaboration network involving top European research institutions in architecture, regional planning and geography with non-academic partners, municipal representatives, and cultural institutions.

The theoretical work and the design tools discussed during the Thessaloniki event have the objective to address current and future societal, spatial and environmental challenges. Results are made available on open access source through the website of the program, shared data-base, videos, exhibitions as well as the publication of this book which will be also available online.

The research project is a fertile field for the elaboration of creative solutions. The governmental institutions, municipalities and regional agencies are permeable to political pressures. The project funded by the European Research Agency is financially and politically independent, therefore it is a unhampered field for the production of challenging ideas to flourish among those

imagining the future. The necessity for independent think-tanks comes from the exponential growth of severely affected areas in the region. According to experts in a short-term scenario, climate disasters will continue to take place and their frequency will increase thus raising considerable exponential costs.

Contributions to this work cover a quite broad spectrum of disciplines. They are linking research and innovation on waterfront areas, in an effort to combine technology and local knowledge for improving resilience to face climate change. Some authors present insights into how climate change will affect the city of Thessaloniki, while the outlines of their theoretical framework is informed by precedents from other places in Europe, as well. Strategies of resilience combine the need to adapt and mitigate which can be present in processes, strategies, and concepts. Some authors focus their contributions on the adaptation and illustrate solutions that imply the transformation of urban spaces and mobility infrastructures in Thessaloniki to face climate change.

The 100 Resilient Cities network initiative is discussed by Stella Psarropoulou, in her article "**Resilience and Sustainable Development in Thessaloniki: From strategy to the operation of an urban observatory"**. Urban Resilience is the capacity of the systems within a city to survive, adapt and grow while coping with multiple crisis or socks. Resilient thinking can be identified as a way of strengthening a city's fabric, tackling challenges and creating solutions and opportunities in an integrated, inclusive and forward-looking manner.

In her article **"Future Projections of Temperature and Precipitation over the Mediterranean Region: Climate Change and Natural Hazards"**, author Konstantina Tolika, claims that given the present measurement of listed parameters the climate system is affected by human activities and anthropogenic GHG emissions. The future projections demonstrate how it is increasing all over the world and will continue to increase in the future. The evidence sustains the need to transform and the urgency to find adaptive planning systems.

Maritime Urban and Suburban Transport is an environmentally friendly transport system that can relieve a city's heavy traffic load and promote the development of "green" transport and Sustainable Urban Mobility. In his article **"Waterfront cities, sustainable mobility & urban malfunctions: The case of Thessaloniki"**, Chrysostomos Kalogirou argues that in Thessaloniki the sea bay, both in the urban and in the peri-

urban part, is a strong ecosystem with economic dynamics and environmental challenges, offering citizens and visitors an aesthetic leisure and recreation area, a functional public space and consequently a tourist attraction. By proposing a new Maritime Transport system for Thessaloniki he is aiming at the improvement of transport policies in conjunction with a coherent tourism development strategy.

Paraskevi Kourti addresses changes that have occurred in planning models noticing mainly their gradual departure from physical (space) planning towards the argumentative perspective and thus to more strategic, goal – oriented, decision making. In her article **"Nature based Solutions (NbS): An updated strategy for the urban "wicked" problems"** she claims that these changes regarding urban design practices during the 1990s, are characterized by the tendency to re-naturalize urban scenery through incorporating the methods and forms of landscape architecture. Nature based Solutions (NbS) are presented as an idea and as a new "way of thinking" when included to urban design scale projects.

Heritage, memory and knowledge of the past lead authors Maria Rita Pais and Isabel Barbas to argue that climate change brings the opportunity for new paths: anticipation and recycle - ethics of ecology and the renegotiation of *The Principle of Mass Conservation*. In their article **"Future archeology: anticipating the rise of the sea water level"**, the authors discuss the interpretation of the Present - curating the shore and the archeology of the future, opening up new cultural approaches to address heritage issues, climate change mitigation and planning opportunities and constrains when designing on the waterfront.

In her article, Crisólita Fortes Fonseca, analyses the morphological structure of Kalamaria through the scientific perspective of the "Theory of Social Logic of Space." She argues that merging the coast with the inner urban fabric reinforces the marine characteristics of the neighborhoods, promotes social integration and symbiosis with nature, and could thus contribute to the regeneration and revitalization of the southeast coast. In her article **"The coastline / land relationship of waterfront cities: the case study of the municipality of Kalamaria"** the author claims that the results obtained from her Space Syntax model, associated with empirical site analysis, allow the identification of the most segregated areas on the shore and could support future coastal interventions.

The non-academic partner of Thessaloniki, MDAT (Metropolitan Development Agency of Thessaloniki s.a.), being a regional agency provides an overview of the present challenges regarding the management of ecosystem functions in Thessaloniki's waterfront. Paraskevi Tarani in her article **"Thessaloniki's urban waterfront: decision-making and governmental aspects for adding metropolitan ecosystem functions"** highlights the economic contributions of Thermaikos Gulf ecosystem goods and services to the city's welfare, and recommends actions and investments required to ensure that they are valued and integrated into metropolitan policy decision-making. Ecosystem functions are viewed as a robust framework for managing complex environmental challenges associated with modern metropolises.

EU-project GEOCRADLE, the "DEAR-Clima" (The Data Extraction Application for Regional Climate) is presented by professor Prodromos Zanis. Climate change in the Mediterranean, the Impacts and challenges from climate change in the Mediterranean, the added value from RCMs, and the DEAR-Climate application are carefully described in his article: **"Challenges and impacts of climate change in the Mediterranean - The added value from Regional Climate Models (RCMs)".**

The case of Mount Athos that is settled on a small surface, similar to the San Francisco Peninsula (California) stands out as a unique case. Pedro Ressano Garcia in his article **"Open Solutions in Mount Athos"** explores the territory both in time and space to argue the necessity to consider it as a case study. Mount Athos is viewed as a capsule of time where holistic solutions have been tested for centuries and as a place where the human presence and nature are harmoniously balanced. The observation of this territory may open new paths to engage the present discussion and the identification of new systems, their role and the interaction between parameters in order to shed light on how each model, and this one in particular can be useful to other communities facing the challenges of climate change.

Francesco Calzolaio reflects on the environmental issues related to the dense urban fabric of Thessaloniki emphasizing the need for addressing parameters affecting urban life such as: chaotic roads, densely built concrete blocks, lack of public spaces and foremost the loss of a direct and functional relationship of the city' s citizens to the sea. Inspired by old photos of the city' s waterfront he proposes in his article **"Thessaloniki waterfront between "stone" and the sea: thesis for a shared**

and sustainable water mobility" a new system of maritime transport, landscape acupuncture, participatory design processes and a series of thematic piers, in an attempt to reinsert a vibrant relation between the sea and the urban population of the city of Thessaloniki.

Authors contributing to this publication come from different disciplines and are developing their own researches. Together they offer an overview of the present debate on Thessaloniki's waterfront. Articles cover a wide spectrum of possibilities, addressing the city, its cultural identity, the role of local authorities, public and private investors and individuals. To enhance resilience, it is necessary to mitigate and adapt to face new weather patterns. It takes different approaches, social, economic, technologic, environmental, each in its own way and aim to protect a modern metropolis from climate disasters.

Solutions and future strategies, in somecases, demand a new culture to manage and heal the territory. The protection of biodiversity, the mobilization of civil society towards more sustainable behaviors come across several authors. Many design solutions illustrated in this book, are giving priority to urban porosity and addressing ways of incorporating new approaches to spatial planning at the scale of the wider metropolitan area of Thessaloniki. Contemporary design integrates parameters to reduce energy consumption and reach a more sustainable carbon footprint. The investment in permeable public spaces,vegetation and the use of micro production of energy, are complementary strategies that improve the resilience of each site. The combination of strategies of circular economy, management of ecosystem functions, a new maritime transportation network and contributions for successful sustainable built environment offer a smart collection of ideas that are put together by the authors presented in this book. Together they will guide the reader through innovative and clever new approaches to Thessaloniki and probably useful to other urban waterfronts in Europe or overseas.

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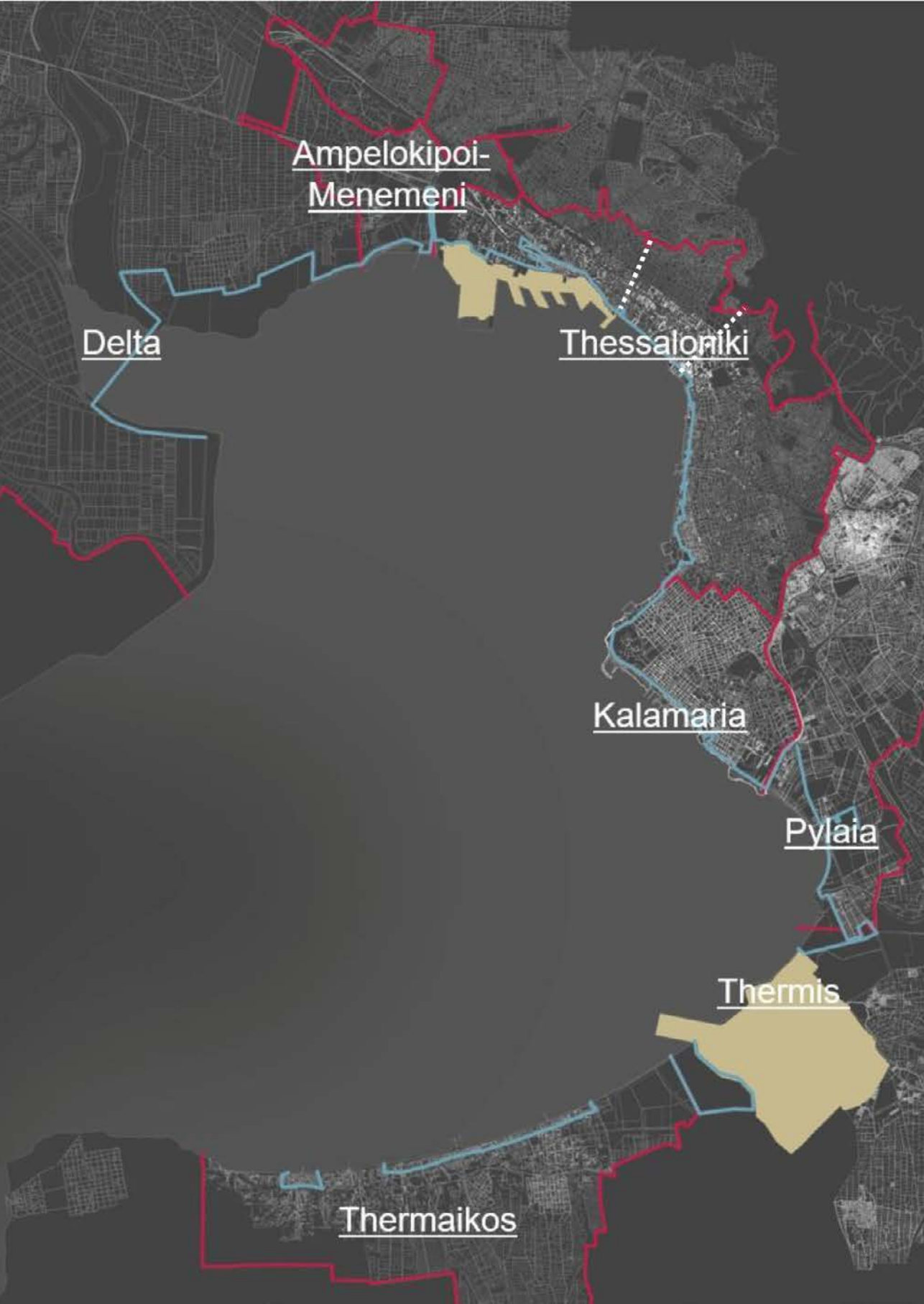
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Thermis
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Project Manager of Urban Resilience Observatory
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Stella Psarropoulou

Resilience and Sustainable Development in Thessaloniki: From strategy to the operation of an urban observatory

Abstract:

Urban Resilience is the capacity of the systems within a city to survive, adapt and grow while coping with multiple crisis or socks. Resilient thinking can be identified as a way of strengthening a city's fabric, tackling with challenges and creating solutions and opportunities in an integrated, inclusive and forward-looking manner.

The 100 Resilient Cities network initiative, pioneered by Rockefeller Foundation, gave to cities, from all over the world, the opportunity to build on resilient thinking, to eliminate chronic stresses and to future-proof city's fabric from eventual unprecedented crisis and socks.

Municipality of Thessaloniki was selected to become a member of 100 Resilient Cities network on 2014 and it was a unique opportunity to develop a long-term strategy to address current and future challenges with a robust and participatory approach. The city of Thessaloniki, used the city resilience framework tool and with the participation of more than 40 local stakeholders and 2000 citizens, identified five discovery areas and four goals under a common vision. As a port city, Thermaikos Bay forms an integral part of Thessaloniki's identity and an integrating economic and urban development could ensure that all potential investments could lead to the respect of its natural resources and social diversity.

To ensure the continuity of the resilient thinking, the city of Thessaloniki started operating on 2019 an urban observatory in order to collect data, monitor and evaluate indicators with imprint on GIS environment to measure and update the strategic framework. Having also as mission the implementation of the 17 Sustainable Development Goals, the urban observatory seeks to help decision-makers to better plan and future proof the city and prioritize the urban policies that allow Thessaloniki to thrive and become more sustainable and resilient.

Keywords: resilience; sustainable development; urban observatory; SDGs

1. Introduction

The 'Report of World Commission on Environment and Development: *Our Common Future'*, the so called, 'Brundtland Report' first mentioned the notion of sustainable development in 1987. Sustainable Development was defined as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [Blowers et Glasbergen, 1995], and social development within the restraints of the life support systems of the planet (Robert et al., 2005). The basic principles of the sustainable development are the interconnections between the environment, the economic growth and the social cohesion as pillars on the decision-making process and policies.

Accordingly, the notion of resilience is not another concept to replace sustainability but is another concept that needs to intersect with the sustainable development, the urban planning, needs and priorities. Nevertheless, resilience is more than ten years now in the scholar discourse and widespread in urban thinking and planning [TothIstvak2015;Simmie et Martin 2010; Lu et Stead, 2013;Chelleriet Baravikova, 2020; Salata et Yiannakou 2020; Athanasiou et al. 2015; Pitidis et Coaffee, 2020,]. Many different definitions have been given with a diversity of scientific approaches and many different studies related to resilience (Fernandes etChamusca, 2012; Holling 2001; Simmie et Martin, 2010). Some academics think that resilience is a buzzword as there is an ambiguous transformation from theory to practice (Harrison et al.2014) or there is no consensus on the common principles and methodologies in order to measure the progress on resilience (Walker et al.2004). Resilience is mostly related to climate change and environmental perspective (EU perspective), or in risk reduction (America's perspective) (Chelleri et Baravikova, 2020).

According to Capolongoet (Capolongoet al. 2018) urban resilience should be a long-term strategic planning and management and not just a "tactical approach" to each crisis or incident. Under this case, resilience is considered more as a process rather than a characteristic of a place (Simmie et Martin, 2010) that should activate and encourage citizens to use and advocate open green spaces and emphasize to policy-makers the move from strategic planning to the strategy implementation

(Capolongo et al.2018) and monitoring. Moreover, D'Amico et Currà, (2014) point out, that the implementation of urban resilience needs to loop through different components of a city.

Urban Resilience is the capacity of the systems within a city to survive, adapt and grow while coping with multiple crisis or socks. Resilient thinking can be identified as a way of strengthening a city's fabric, tackling with challenges and creating solutions and opportunities in an integrated, inclusive and forward-looking manner.

The 100 Resilient Cities network initiative, pioneered by Rockefeller Foundation, gave to various cities from all over the world the opportunity to build on resilient thinking to eliminate chronic stresses and to future-proof city fabrics from eventual unprecedented crisis and socks.

> ***"City Resilience describes the capacity of cities to function, so that people living and working in cities - particularly the poor and vulnerable – survive and thrive nomatter what stresses or shocks they encounter"***
>
> ***(City Resilience Index, Arup/ Rockefeller Foundation)***

Municipality of Thessaloniki was selected to become a member of 100 Resilient cities network on 2014 and it had the opportunity to develop a strategic plan to assess the main challenges, chronic stresses and to give prominence to the city's competences and values. Thermaikos Bay forms an integral part of Thessaloniki's identity having always been a major port city. An integrating economic and urban development of the city could ensure that all potential investments could lead to the respect of its natural resources and social diversity.

Figure 1. Vision and Goals Resilient Strategy (source: "Thessaloniki 2030")

Figure 2. Redevelopment of Waterfront (source: "Thessaloniki 2030")

2. Resilient Strategy "Thessaloniki 2030"

Municipality of Thessaloniki established a Resilient Office and took the opportunity to develop a long-term strategy to address current and future challenges with a robust and participatory approach. The city of Thessaloniki, used the city resilience framework tool by ARUP and Rockefeller Foundation and with the participation of more than 40 local stakeholders and 2000 citizens, identified five discovery areas and four goals under a common vision.

The fourth goal referred specifically to Thermaikos Bay and the waterfront, having economic, environmental and social impacts on citizens' daily life. The Bay comprises an extensive ecosystem of economic, environmental, social and cultural elements, making it a landmark with unique opportunities for sustainable urban development. The Waterfront was redeveloped on 2011-2012 and brought citizens and visitors closest to the sea, as it is considered the most prominent city's public space and attractive place for tourists. (Thessaloniki's Resilient Strategy, 2017)

During the implementation of the city's strategic objectives and goals, the Resilient Thessaloniki office cooperated with World Bank in three main projects that contributed to the institutionalization and establishment of the resilient thinking. One of these projects was the development of a masterplan for the redevelopment of the waterfront pointing out projections under the three pillars of sustainable development, environment, economy and society.

According to Redevelopment Strategy, the waterfront is divided into four zones (figure 4) with diverse characteristics and economic effects or targeting.

The main vision of this Framework plan, was defined by six overarching themes and broad objectives after a stakeholder consultation and participatory planning process facilitated by Deloitte GR, the World Bank and the team members of the Resilient Office (figure 5).

Through strategic planning, the waterfront and the Bay could give prominence to its full potential and utilities in economic, environmental and leisure terms.

Apart from the Waterfront and the Bay, Thessaloniki's Resilient Strategy also complements other strategic multi-level documents and it seeks a multi-sector collaboration and robust approach in order to bridge gaps between everyday management of the city, needs and long-term development goals and commitments. Additionally, being a member of significant

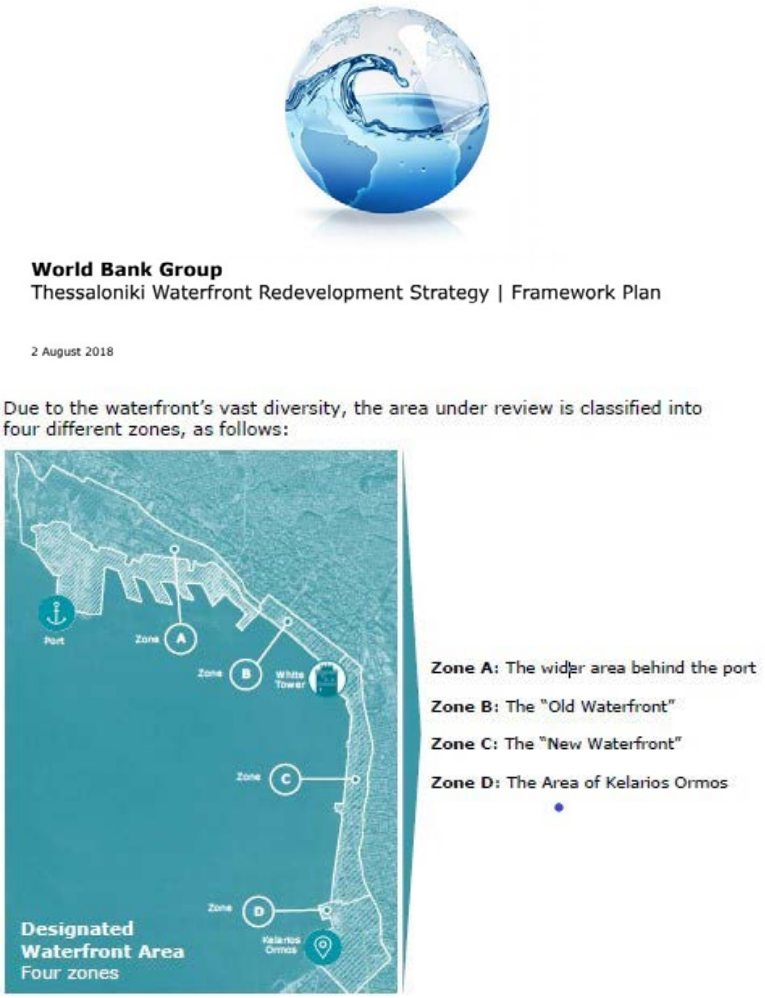

Figure 3. Thessaloniki Waterfront Redevelopment Strategy by Deloitte, funded by World Bank (source: Deloitte, World Bank / Thessaloniki 2030)

Figure 4. Zones of Waterfront area (source: Framework Plan by Deloitte, World Bank)

Figure 5. Vision of Framework Plan (source: Deloitte, World Bank / Thessaloniki 2030)

networks of cities, Thessaloniki has the opportunity to access peer-to-peer learning, technical knowledge on common themes and global or European synergies.

3. The Urban Resilience Observatory

To ensure the continuity of the resilient thinking, the city of Thessaloniki started operating on 2019 an urban observatory in order to collect data, monitor and evaluate indicators with imprint on GIS environment to measure and update the strategic framework.(figure 6 & 7) Having also as mission the implementation of the 17 Sustainable Development Goals, the urban observatory seeks to help decision-makers to better plan and future proof the city and prioritize the urban policies that allow Thessaloniki to thrive and become more sustainable and resilient.

The Urban Resilience Observatory, funded by NSRF (National Strategic Reference Framework) (ESPA 2014-2020, Operational Program "Central Macedonia"), from 2019 till 2022, establishes measuring and monitoring implementation progress on the three pillars of sustainable development, environment, economy and society and on specific GeoKpis, related to ISO's 37120 set of indicators.

4. Conclusions

The resilient thinking is an ongoing process for Thessaloniki. Through all these years, Resilient Thessaloniki managed to gain a position in national and international press and to attract the funding and the technical assistance of international or European institutions to help it incorporate urban development. As reported in World Bank's blog: "Thessaloniki's strategy provides a roadmap for cities to make revitalization projects happen, from concept to implementation and financing" (2018). According to the first Deputy Mayor for Urban Resilience of the Thessaloniki municipality: "in a city that is constantly changing, this strategy represents the start of a process of co-creation, a way to collectively work together, sharing responsibility, resources, opportunities and results" (Resilient Strategy, 2017). The resilient concept aided the image of the city of Thessaloniki as a paradigm

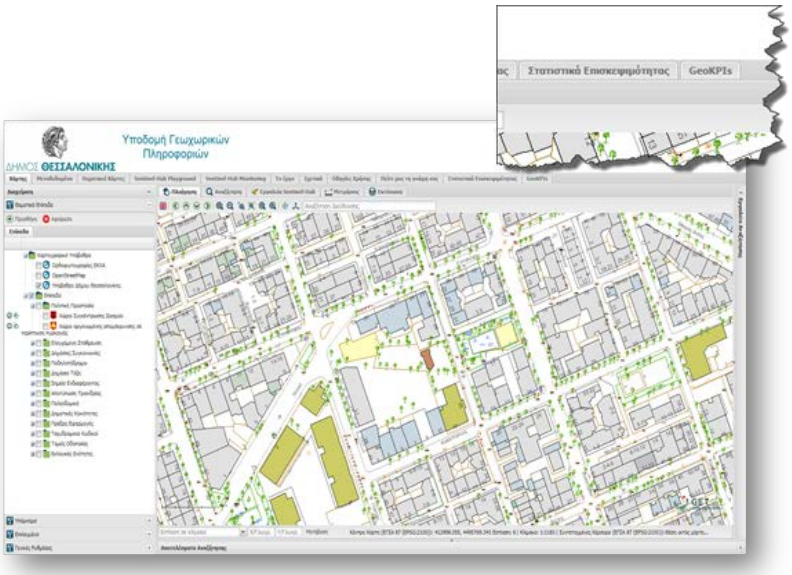

Figure 6. Operation of Urban Resilience Observatory&GeoKpis

Figure 7. Imprint on GIS- GeoKpis

of governmental transformation towards ~~to~~ more participatory procedures, embedded resilient thinking and adaptability to cross-departmental, cross-governmental practices as well as to the civil society of the city. As Pitidis and Coaffee (2020) mention:

"Thessaloniki's success in transforming entrenched governance traditions through the implementation of urban resilience should provide an example for other cities to proceed with further engagement of citizens in the decision making processes (...) to avoid returning to the prior state of institutional inertia".

Becoming a truly resilient city requires significant investment in terms of both time and resources. It requires hard work from all stakeholders across the city. "Thessaloniki 2030" reflects the values of the city and has the role of a roadmap to start working collaboratively, and include the principles of sustainable development and resilience into planning, policies and practice.

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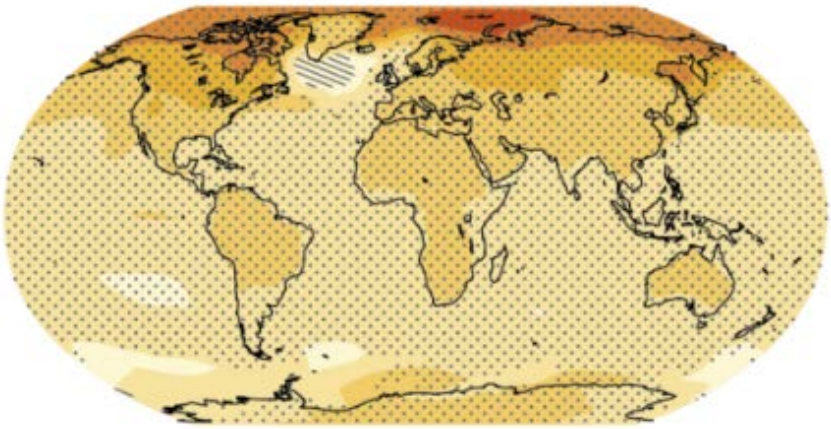

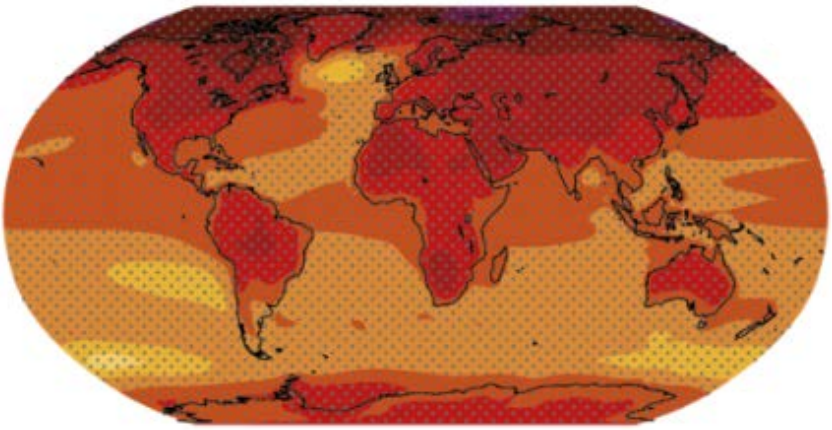

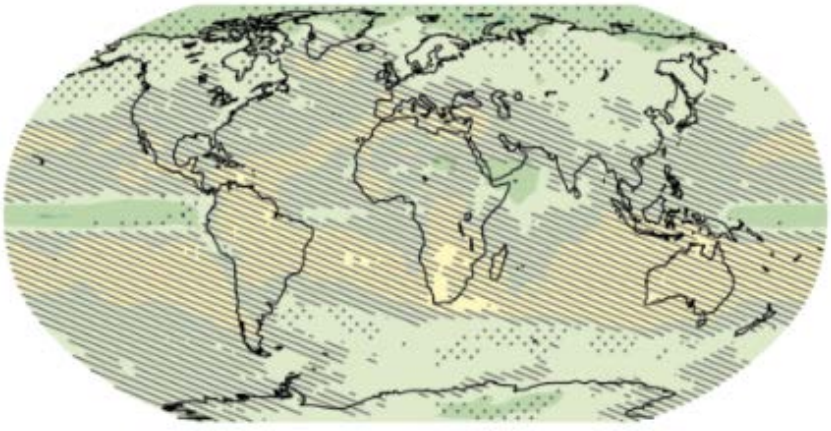

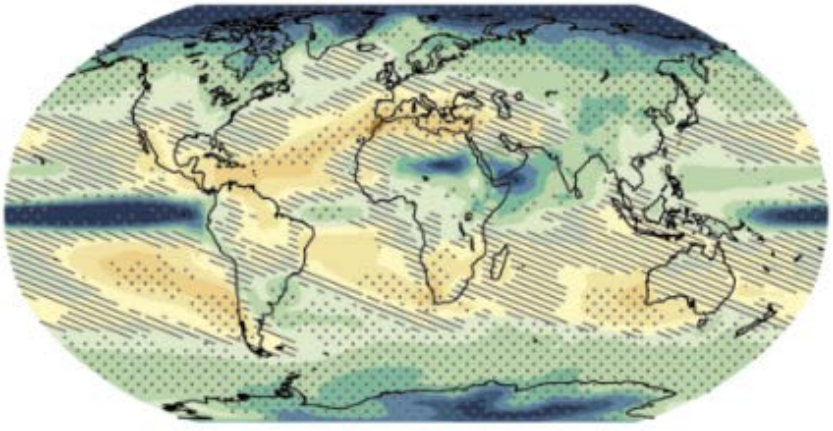

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Future Projections of Temperature and Precipitation over the Mediterranean Region:

Climate Change and Natural Hazards.

The current state of the climate:

One of the main challenges facing our society today is dealing with the uncertainty in the evolving climate. Apart from the numerous studies on the long term shifts in weather patterns and the potential changes of the mean climate, extreme weather events are also of major concern since they can lead to loss of life and property. In general, it is clear that climate change has far reaching implications in crucial sectors such as agriculture, tourism, infrastructure which are critical for the economies of countries all over the world. In order to analyze the possible climate change and its impacts, primarily it is important to define the term in a clear and distinct way. Thus, Climate Change is: "*The change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. This change may be caused either by* ***natural internal processes*** *or* ***external forcings****, or by* ***persistent anthropogenic changes*** *in the composition of the atmosphere or in land use* "(IPCC 2013).

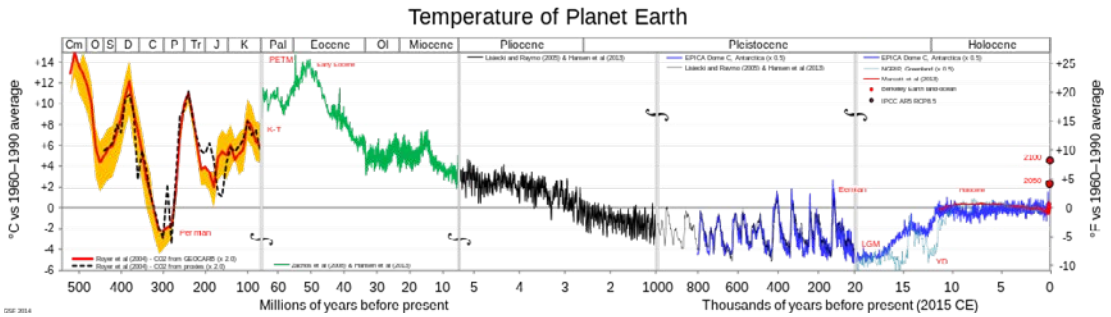
Nevertheless, a quite understandable question can be raised by many: Why such a fuss with Climate Change since the climate of the Earth was never stable? In the following figure the temperature anomalies over the planet are illustrated starting from almost 600 million years ago until nowadays (Figure 1)

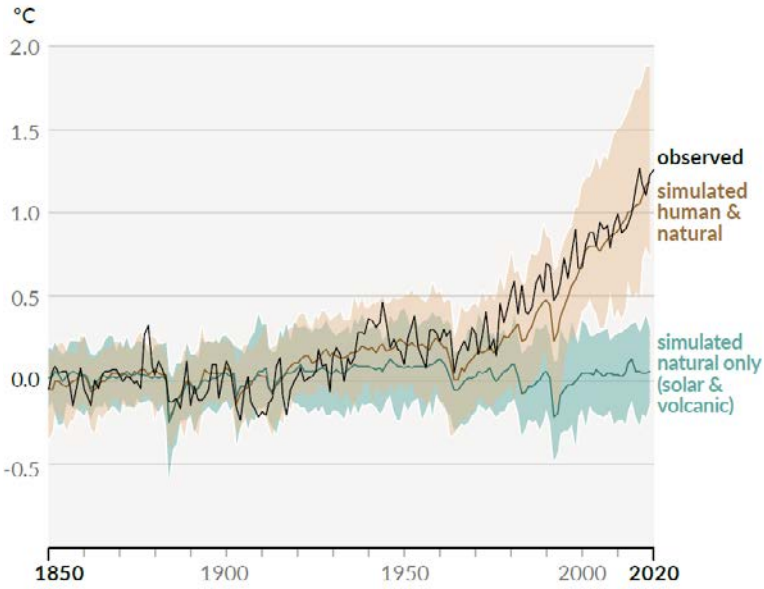
It is quite obvious that our planet has experienced during the past several periods of warmer or colder climate (as well as glacial and interglacial periods) both during the prehistoric and the historic years. However, the key difference of the past decades intense warming trend, which is observed all over the planet, is its anthropogenic origin. This means that now the climate system is affected by human activities and anthropogenic GHG emissions. One of the main and most important findings in the latest IPCC Reports of 2021 (IPCC AR6 WGI, Summary for Policy makers) is that it is undeniable that the warming of the atmosphere, the ocean and the land, is due to human influence (Figure 2). A comparison of observational data of the past 170 years with two different model simulations (the first with only natural forcings and the second one with natural and human drivers) shows clearly that only the latter one can capture the observed temperature increase.

Hence, it seems that the averaged global temperature is showing a warming trend of approximately 0.85 °C from 1880 since 2012 and according to the previous IPCC report (IPCC, 2014) the last 30 years have been likely the warmest ones over

Figure 1 Global average temperature anomalies (in comparison to 1980-1990) for the last 540Mya. (source: https://commons.wikimedia.org/wiki/File:All_palaeotemps.png)

Figure 2. Global surface temperature anomalies (annual average) from observational data and simulated date using human & natural and only natural factors (IPCC AR6 WGI, SPM)


Temperature of Planet Earth
Cm
O
S
D
C
P
Tr
J
K
Pal
Eocene
Oi
Miocene
Pliocene
Pleistocene
Holocene
PETM
K-T
Permian
LGM
°C vs 1960–1990 average
°F vs 1960–1990 average
Millions of years before present
Thousands of years before present (2015 CE)


°C
2.0
1.5
1.0
0.5
0.0
-0.5
1850
1900
1950
2000
2020
observed
simulated human & natural
simulated natural only (solar & volcanic)

the last 1400 years for the Northern Hemisphere. In addition to the above, the just released IPCC report (IPCC, 2021) comes to strengthen the previous statements. It is mentioned that air temperature is by 1.09°C higher in 2011– 2020 than 1850–1900 and the most intense increase is observed over land. This higher warming, in comparison to the previous report (AR5) could probably be attributed to the additional warming of the last few years as well as to the new datasets that have been used to update the IPCC's estimations. It is also underlined that the last four decades in our planet were continuously warmer than any decade that preceded it since 1850. Another important statement that should be taken under consideration is that the observed temperature increase has been the fastest since 1970 compared with any other period in the last 2000 years.

Regarding precipitation, the second main climatological parameter, even though the findings are not so coherent or so robust (due to lack of solid long – term data without gaps all over the world), it is found that over the mid-latitude continental regions of NH, rainfall has increased since the mid 20 century, while other areas in different latitudes present either positive or negative trend of their precipitation heights (IPCC, AR5). Especially for the Mediterranean region, often characterized as one of the main climatic "hot – spots" (Giorgi, 2006), it seems that is becoming drier, with an increase of droughts and aridity. From figure 4 it can be seen that Europe is almost "cut in half" with central and northern Europe presenting an increasing precipitation trend up to 10-25 mm /year per decade, while the Mediterranean countries are experiencing a decrease ranging from -25 to -50mm/year per decade (Figure 5).

The latest IPCC report of 2021 comes to agree with the previous conclusions adding a very important aspect: the human influence could likely (60-100% probability) have played an important role to the observed precipitation changes while it is high confidence that human activities have influenced also the near surface ocean salinity observed changes.

The unquestionable human induced climate change is tied strongly not only with mean climate parameters but also with the extremes. It is almost certain that heatwaves have become more frequent and intense in many continental regions while conversely cold waves and cold spells are rarer and less intense. Scientists also underline that some of most recent hot extremes would not have occurred without the human intervention to the climate system (IPCC, 2021). Moreover, it seems that it is very likely that there has been a global increase in the number of warm

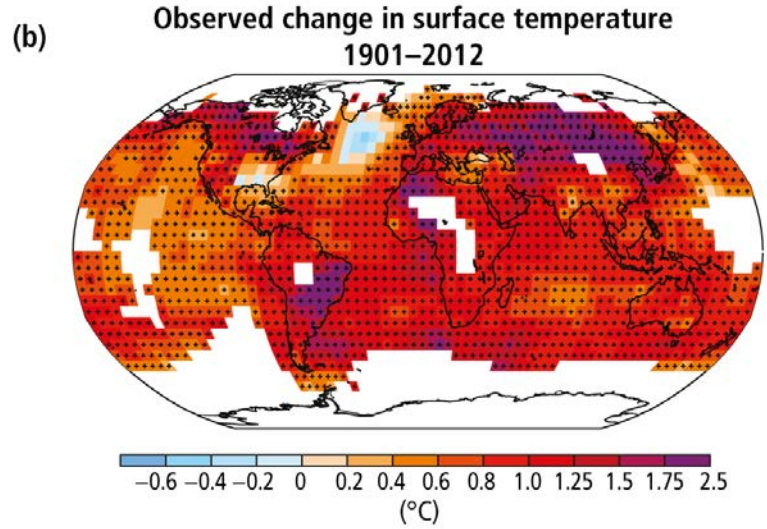


Figure 3. Geographical distribution of the changes of the mean temperature on a planetary scale (IPCC AR5, SPM)

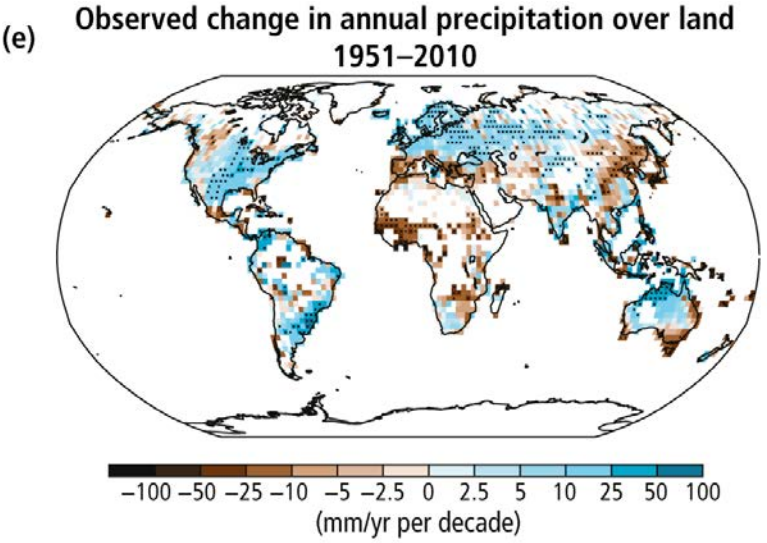


Figure 4. Geographical distribution of the observed changes of the mean annual precipitation heights on a planetary scale (IPCC AR5, SPM)

days and nights, as well as a decrease in the number of cold ones. These positive and negative trends have probably occurred and in a smaller, continental scale, characterizing N. America, Europe and Australia (Alexander, 2006; IPCC AR4 FAQ 3.3) (Figure 5). Specifically in the Mediterranean region, it is likely that the warm (cold) days have increased (decreased) with the most significant trends found in Spain and northern France. Also, western Mediterranean seems to be characterized by a possible increase (decrease) warm (cold) nights. Regarding the number of heat waves it is of high confidence that it has been increasing especially during the warm period of the year (JJA) (IPCC, AR5).

In the case of extreme precipitation, IPCC Report of the Management of the risks of Extreme Events (Seneviratne et al., 2012) stated that there has been an increasing trend of the heavy precipitation events worldwide, indicating that daily rainfall was become more extreme. Of course it should be highlighted that the observed changes of extreme precipitation are far less coherent on a spatial scale, and not systematically significant from a statistical point of view compared to the respected temperature extremes (Alexander et al., 2006). Contradicting results are also found in the case of the Mediterranean region. Alpert et al. (2002) showed that extreme daily precipitation increases despite the general decreasing trends of the rainfall totals. On the other hand, Lionello et al., 2010 mention that for a quite large number of stations, extreme precipitation events did not show any significant trend, during that same extended cold/wet period. The only exception was Greece with significant negative trend which according to the authors could be attributed to the decreasing tendency of the intense Mediterranean cyclones. However, leaving aside the incoherent findings of precipitation extremes, IPCC 2021 scientists are fairly certain that the changes in the frequency and intensity of heavy and extreme rainfall events are also climate change driven and human activities have contributed to the increase of droughts too.

From all the above it becomes clear that climate change is or should be of widespread concern and "*It represents and urgent and potentially irreversible threat to human societies and the planet. In recognition of this, the overwhelming majority of countries around the world adopted* ***the Paris Agreement in December 2015****, the central aim of which includes pursuing efforts to limit global temperature rise to 1.5*°C." (Special Report: Global Warming of 1.5 °C (2018)). Scientists all over the world mention that if the existing warming rate continues our planet will probably reach a global warming of 1.5°C around the year of 2040.

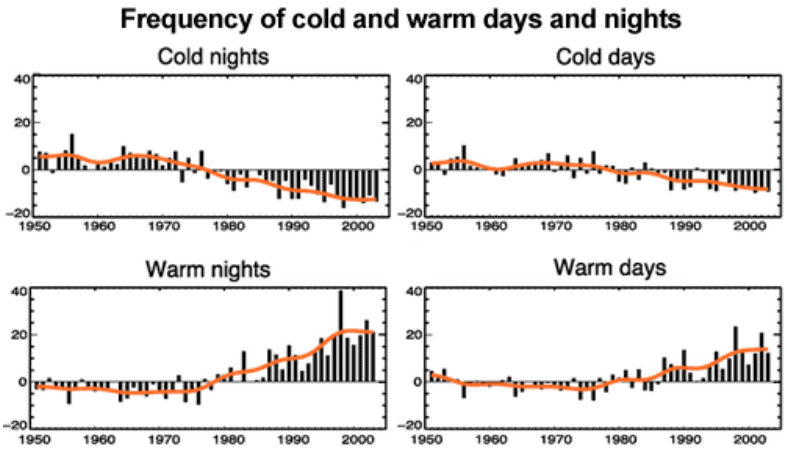


Figure 5. Interannual changes (trend) of the number of extreme cold (10% bottom) and warm (10% top) days and nights for the period 1951-2003 (Alexander, 2006).

Future projections:

Without doubt temperature is increasing all over the world and will continue to increase in the future. Unless we take action and reduce carbon dioxide and the rest of the greenhouse gasses, global warming will exceed 1.5°C and 2°C until the end of the century. All models and all emission scenarios (RCPs – Representative Emission Pathways) (IPCC, 2021) agree on that statement.

It is evident that the climatic signal is strong and robust and all model's runs project this future warming of the earth. The spatial distribution of the future temperatures reveal that the N. Hemisphere is expected to experience a more intense temperature increase with a gradient towards the higher latitudes. Also, the continents will become warmer than the oceans. The magnitude of the temperature changes varies according to the RCP used (Figure 7). On the other hand, in the case of precipitation future projections, the planetary spatial distribution of the potential future changes is less uniform with differences in the climate signal depending on each region. Overall, the conditions will become wetter in high latitude areas (up to 50% according to the RCP8.5) as well as in several parts of the Equatorial.

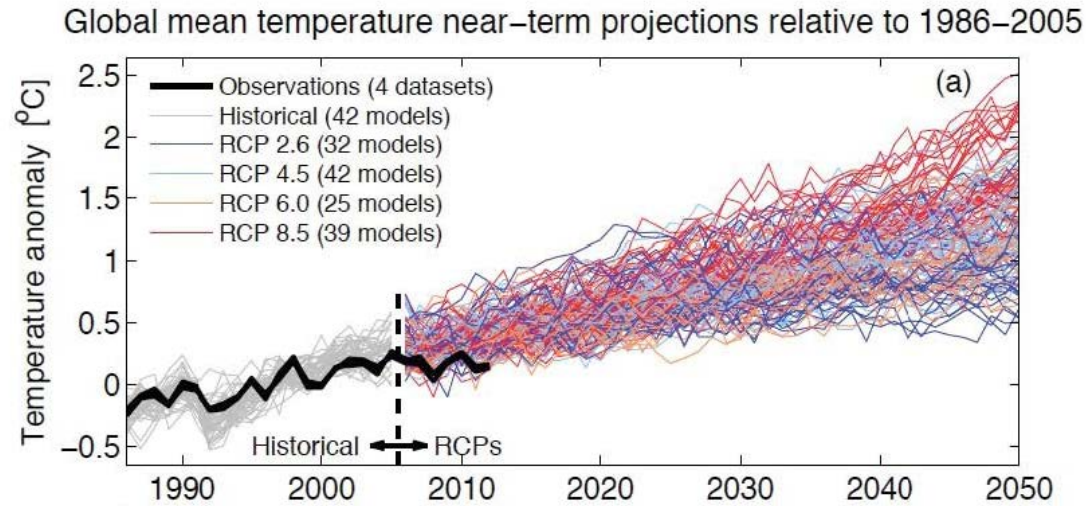
Conversely, several oceanic parts of the word as well as southern Europe and Mediterranean is expected to become drier (all models and all RCPs agree to that), reaching up to -30% (statistical significant differences) when the projections are forced by the high greenhouse gas emissions RCP8.5 scenario (IPCC, 2014).

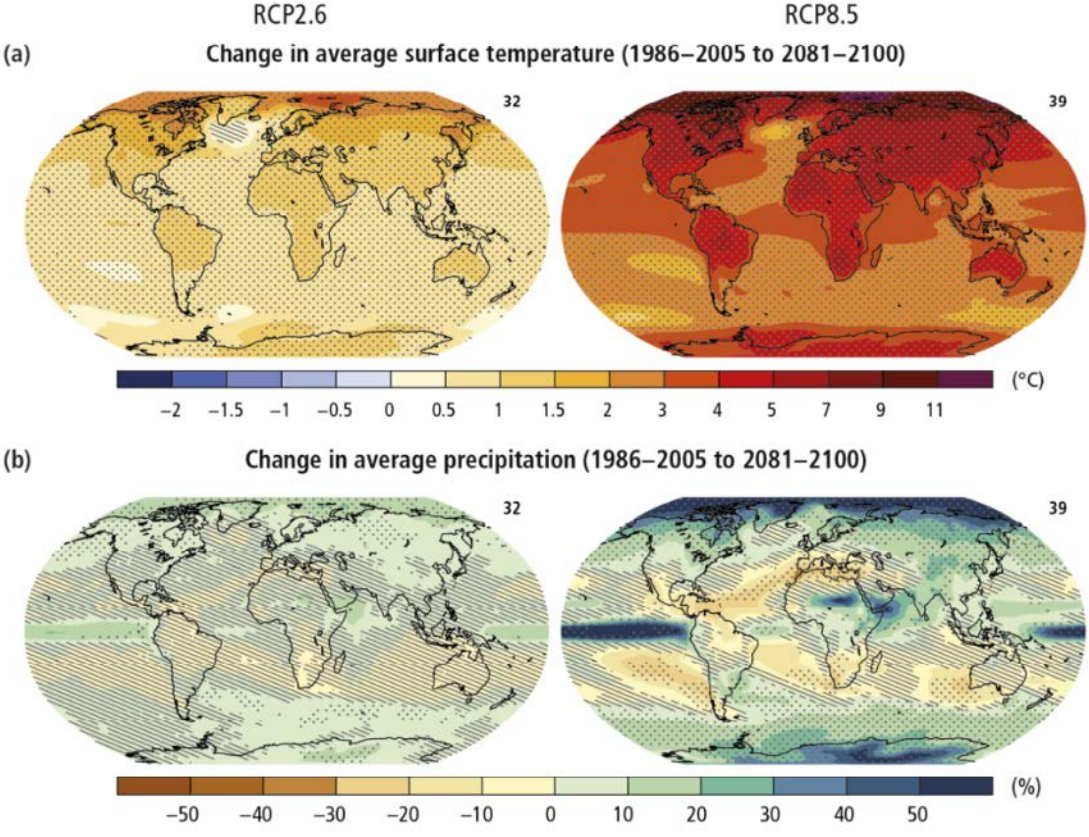
In detail, the ensemble of the EURO-CORDEX models shows a future warming varying from 0.9 to 1.5°C (RCP2.6) or 3.7 to 5.6°C (RCP8.5). It is also worth mentioning that the Mediterranean warming will exceed the global annual mean by 20%, a percentage that is even higher on a seasonal scale (especially summer) (MedECC MAR1). In the IPCC report of 2021 it is underlined that the potential future temperatures over this domain will be larger than global, results that both CMIP5 and CMIP6 datasets agree with. It also seems that the highest temperatures will appear in the future over the Alps, in central continental Iberian Peninsula and also the Balkan Peninsula (Figure 8).

As in global scale, the precipitation future projections present also an obvious spatial variability which is even more pronounced when we analyze the projections on a seasonal scale. However,

Figure 6. Future temperature projections (temperature anomalies in comparison to the period 1986-2005) for all the RCP scenarios and for the ensemble of different models (IPCC, AR5).

Figure 7. Future temperature and precipitation change on a global scale for the last 20 years of the 21st century. (AR5 Synthesis Report: Climate Change 2014).


Global mean temperature near–term projections relative to 1986–2005
Temperature anomaly [°C]
Observations (4 datasets)
Historical (42 models)
RCP 2.6 (32 models)
RCP 4.5 (42 models)
RCP 6.0 (25 models)
RCP 8.5 (39 models)
(a)
Historical
RCPs
2.5
2
1.5
1
0.5
0
−0.5
1990
2000
2010
2020
2030
2040
2050


RCP2.6
RCP8.5
(a)
Change in average surface temperature (1986–2005 to 2081–2100)
32
39
(°C)
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2
3
4
5
7
9
11
(b)
Change in average precipitation (1986–2005 to 2081–2100)
32
39
(%)
−50
−40
−30
−20
−10
0
10
20
30
40
50

almost all models agree that the Mediterranean will become drier over time, especially during the warmer period of the year (April – September) (MedECC, 2020). These drying conditions will mainly affect the southern coastal areas of Spain, Italy and Greece (Figure 8).

The future changes in the climate system due to the warming of the Mediterranean region, will also lead to the increase and intensification of temperature extremes. Thus, heat waves will become more frequent in the future with prolonged duration and more intense peak temperatures (Kostopoulou et al. 2014; Zittis et al. 2016; Lionello and Scarascia 2020}.

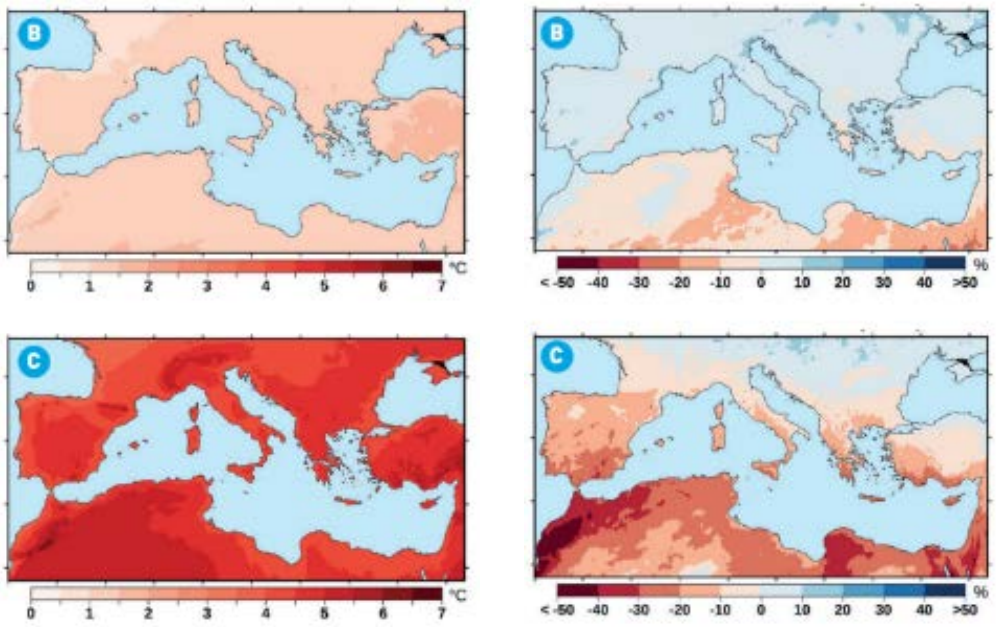
It is also worth mentioning that several areas of the Mediterranean will potential be characterized by an increase in the number of tropical nights almost by 60%, making the daily heat even more unbearable for the population due to the lack of heat relief. Especially during summer it is noted that all nights will be warm with an eclipse of cold days (Lionello and Scarascia 2020). This remarkable summer warming is associated with changes in the atmospheric circulation over the Mediterranean region and mainly due to the widening and extension of the Persian trough over the eastern parts of the Mediterranean with is expected in the future to intensify the thermal low in Sahara (Lelieveld et al. 2016).

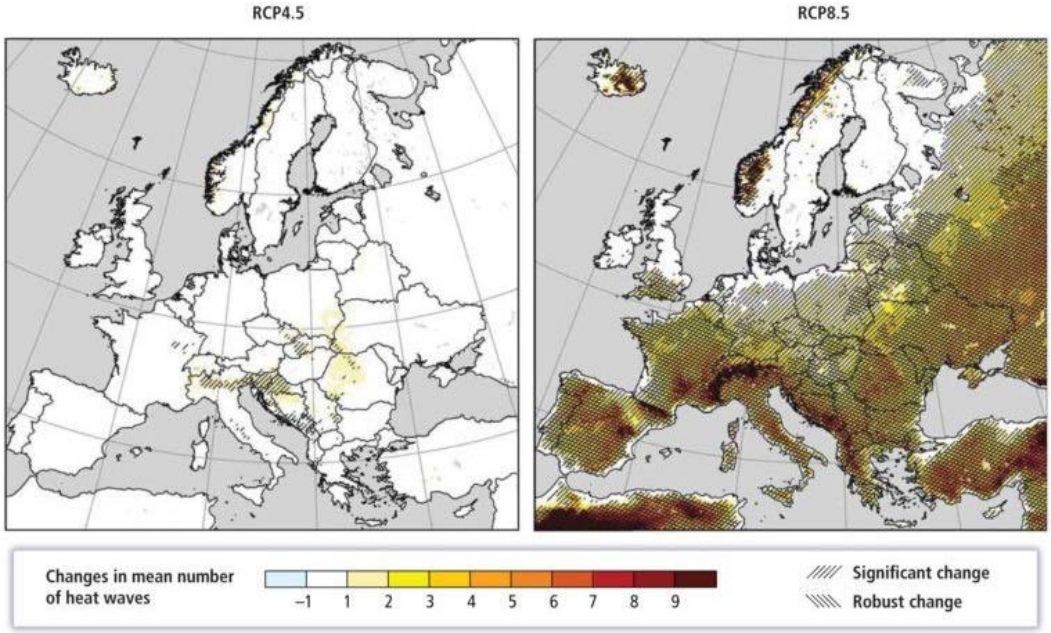
The overall conclusion according to both GCM and RCM projections, regarding precipitation, is that Mediterranean will experience in the future more intense precipitation extreme episodes (particularly during winter, spring and autumn) while longer dry spells will characterize the Mediterranean summers. These changes will intensify as we are reaching the last years of the century (*MedECC, 2020)*. Moreover, another key finding of numerus studies is the increase of the precipitation interannual variability mainly in areas that are expected to become much dryer in the future (e.g. Giorgi and Coppola 2009; Giorgi et al. 2019).

In detail, the more intense rainfall variability can be translated as an increase in daily precipitation intensity as well as of extreme daily precipitation amounts and on the other hand a decrease in the frequency of occurrence of rainfall events in addition to the decrease of the wet spells duration. All over the region of the Mediterranean Basin, the intensification of extreme events is accompanied with an increase of the number of dry days and also the dry spells duration (Giorgi et al., 2011, 2014). This potential future shift to dryer conditions will be more evident in the southern countries of the Mediterranean than the northern ones.

Figure 8. Temperature (first column) and precipitation (second column) anomalies at the end of the 21st century (2080-2099) (reference period 1980-1999). B refers to the future projections for the RCP2.6 and C for the RCP8.5. (MedECC, 2020)

Figure 9. Future changes of the number of heatwaves (periods 2071-2100 and ref. period 1971-2000) for the warm period of the year (May – September) for the European Region. (IPCC, 2014 AR5)


B
°C
0 1 2 3 4 5 6 7
B
%
< -50 -40 -30 -20 -10 0 10 20 30 40 >50
C
°C
0 1 2 3 4 5 6 7
C
%
< -50 -40 -30 -20 -10 0 10 20 30 40 >50


RCP4.5
RCP8.5
Changes in mean number of heat waves
–1 1 2 3 4 5 6 7 8 9
Significant change
Robust change

The following figure (Figure 10) illustrates the future changes of the 95th percentile of the length of dry spells according to RCP4.5 and RCP8.5 scenarios. It is obvious that central and northern Europe will not experience any change in the long dry spells while in the Mediterranean region their length will increase up to almost 24 days, specifically in Spain, southern Italy and Greece (significant differences).

The impact of Climate Change and Climate Extremes:

The rapid change of the mean and extreme climate characteristics could lead to severe impacts in several aspects of human life. Even though, not every extreme has to lead to a disaster since it largely depend on the prevailing conditions (IPCC, 2012a) it is obvious that the more vulnerable an area is, the higher is the risk during an occurrence of an extreme event or a natural hazard. According to the European Environmental Agency 1994-2019 the Mediterranean region will experience the highest negative impact due to climate change in comparison of the rest of the Europe (Figure 11). Also, the Mediterranean countries present a low capacity in adapting to climate change leading to be the most vulnerable to natural hazards and potential environmental disasters.

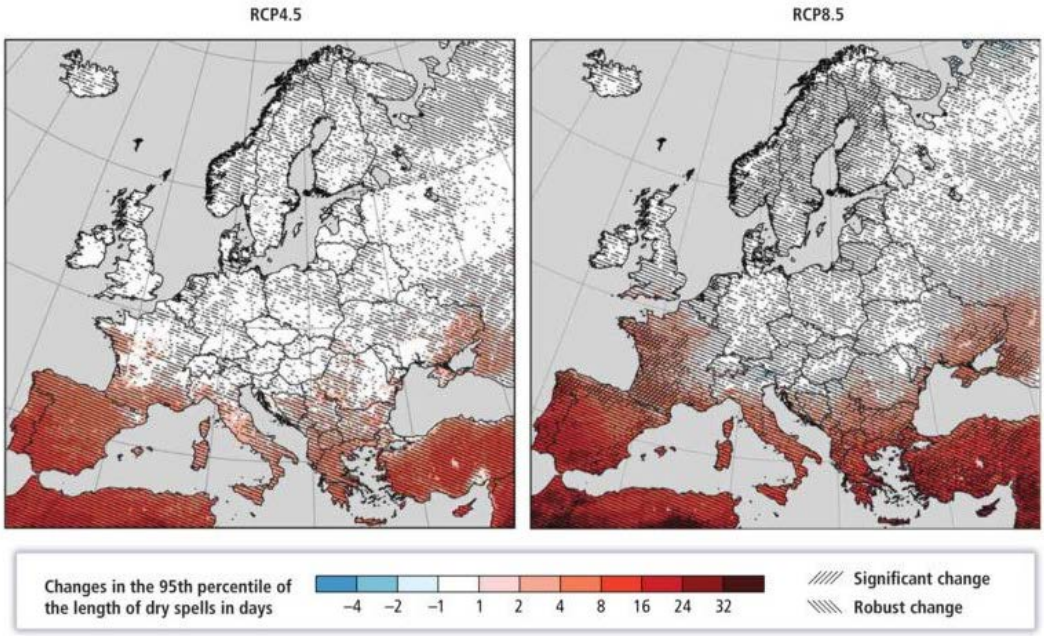
More specifically the main impacts of climate change in our domain of interest are: the increasing risk of biodiversity loss, the risk of desertification, the increasing water demand of agriculture purposes, the increasing risk of forest fire, the increase in mortality from heatwaves, the decrease of summer tourism and many others (European Environmental Agency).

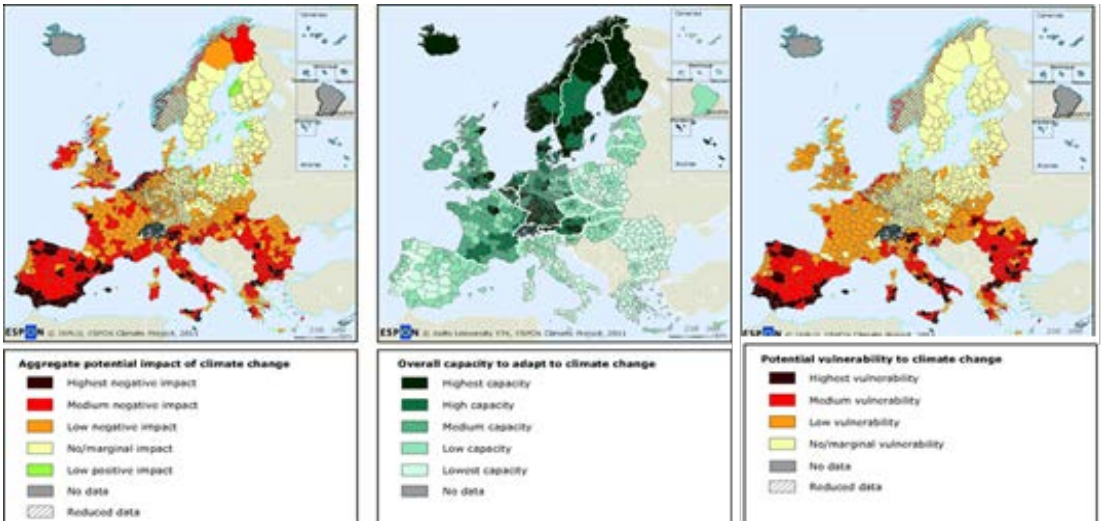
Since the potential changes in the main features of extreme temperatures and heatwaves were analyzed above, in this section the two main natural hazards directly associated with the decrease of precipitation and increase of the extreme rainfall events are featured. The first regarding **Drought** and the second regarding **Floods**.

Even though there are several types of drought (meteorological, agricultural and hydrological) here the main focus is the meteorological one which can be computed and analyzed with the use of precipitation indices. As a result of the stronger interannual variability of precipitation in the Mediterranean it is expected that this region will be impacted by an increase of the frequency of occurrence of the drought events and episodes and the region will become much drier especially during the summer months. (Hoerling et al. 2012; Caloiero et al. 2018)

Figure 10. Future changes in the 95th percentile of the length of dry spells (periods 2071-2100 and ref. period 1971-2000) in the European Region. (IPCC, 2014 AR5)

Figure 11. Potential impact, Overall Capacity and Potential Vulnerability to climate changes in the European region (European Environmental Agency 1994-2019)


RCP4.5
RCP8.5
Changes in the 95th percentile of the length of dry spells in days
−4 −2 −1 1 2 4 8 16 24 32
Significant change
Robust change


Aggregate potential impact of climate change
Highest negative impact
Medium negative impact
Low negative impact
No/marginal impact
Low positive impact
No data
Reduced data
Overall capacity to adapt to climate change
Highest capacity
High capacity
Medium capacity
Low capacity
Lowest capacity
No data
Potential vulnerability to climate change
Highest vulnerability
Medium vulnerability
Low vulnerability
No/marginal vulnerability
No data
Reduced data

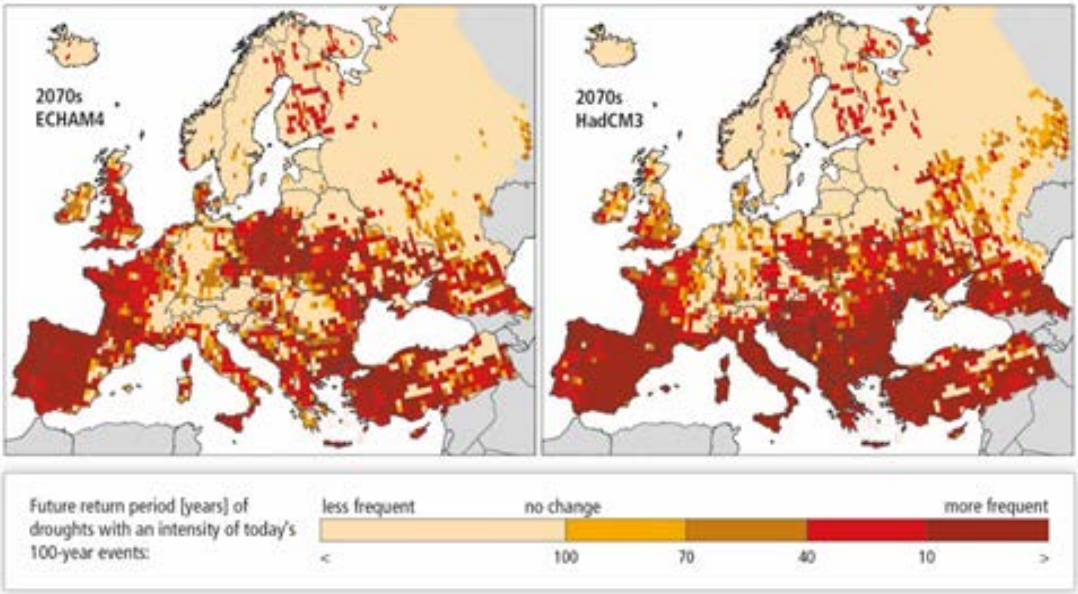
The drought risk in the Mediterranean countries is highly related to the frequency, severity and spatial and temporal distribution of the dry spells as well as to the level of vulnerability and exposure of the population and its economic conditions. It is highlighted that droughts could lead to economic losses that are larger than those from earthquakes and floods. (IPCC 2012). Drought can also affect the water supplies of a country, its tourism, the forestry and also the marine ecosystems. Finally, it is highly connected with the forest fire danger. As, the future projections from several climate models estimate an intense increase of these dry conditions there is an urgent need to take action for the diminish or reverse shift of these changes.

Flooding is the most frequent natural disaster in Europe (Hadmer et al., 2012). Apart from extreme precipitation events (their intensity, duration, amount of rainfall and timing) there are other drivers such as, the water level in rivers, the urbanization, the soil characteristics and the occurrence of storm surges that can lead to floods in a region. According to Peduzzi et al., 2011, the average physical exposure to floods assuming constant hazard in Europe were in 1970, 1650 thousands of people per year, a number that will increase up to 1870 thousands of people per year in the year of 2030. Hence, the estimated future increase of heavy precipitation may also result to a higher risk of fatality due to flash floods. High environmental and socioeconomic damages could also be a negative consequence of floods due to dam failure with the new urban developments, tourist facilities and recreation areas being the most vulnerable ones (Hadmer et al., 2012). The future increase, especially of coastal flooding can affect, according to WHO 2017 the water infrastructure, fresh water supplies could be contaminated and water borne diseases could increase. All the above could be threatening especially for populations that have limited access to water and sanitation. Finally, it should be taken under serious consideration that the potential future sea level rise over the Mediterranean region will also negatively attribute tothe increase of future flooding over the coastal areas (Figure 13)

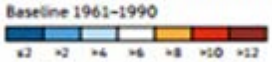
In conclusion, the aforementioned impacts of climate change on society and the planet, have made the need for our response and actions on mitigation and adaptation strategies urgent. Although, international and national adaptation policies can play an important role for the management of risks from extreme events, local scale measures have proven to be more effective since disasters occur primarily at a local level and affect local

Figure 12. Future changes of the drought frequency of occurrence with an intensity of today's 100-year period events according to the ECHAM4 and HadCM3 climate models (IPCC, 2012)

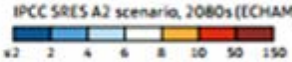
Figure 13. Number of people flooded (thousands/year) in coastal areas over the European region. (Left map for the reference period 1961-1990 and right map for the future 2080s according to the ECHAM4 projections) (Pic: CAN/IPCC).



People flooded (thousands/year) in coastal areas across Europe
Baseline 1961–1990



IPCC SRES A2 scenario, 2080s (ECHAM4), without adaptation



people (Cutter et al., 2012). Thus, the developing strategies in order to respond to future disaster risk should be customized to specific local conditions and needs. However, there are four major pillars which scientists recommend to focus to: 1) The raising of education and awareness as well as effective communication, 2) The effective changes of land use and ecosystem protection 3) The Structural Measures with engineering works that would provide protection with strengthening of the building as well as new design levels and 4) The storage and rationing of resources and prioritization of the improvement health and medical services (Cutter et al., 2012). Taking under consideration that our knowledge over climate changes, extremes and disaster is constantly and rapidly evolving and growing, hopefully our approaches for effective mitigation and adaptation approaches for the management of the disaster risks will lead to a sustainable and resilient future of our planet.

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Waterfront cities, sustainable mobility & urban misfunctions:
The case of Thessaloniki

Abstract

Thessaloniki is the second largest urban center in Greece, a strong pole of economic growth and extroversion, an extroverted city that gives space to all living forces, the youth, the field of innovation, young entrepreneurship, culture and society of citizens and is rapidly developing as an alternative tourist destination from different starting points, hosting twice its annual population. In addition to the historical and cultural stock (historical and modern) that has accumulated, the city has perhaps the strongest element of attraction...The sea bay, both in the urban and in the peri-urban part, is a strong ecosystem with economic dynamics and environmental challenges. The historic old seafront and the renovated new seafront give citizens and visitors an aesthetic rest area as a functional public space and consequently a tourist attraction, gradually transformed into a tourist city... Transportation to tourist destinations is a challenge that has not been given the proper attention. Understanding and managing the pressures faced by the economic, environmental and social systems poses a significant challenge. The aim is to improve transport policies in conjunction with tourism development policy. A common denominator should be the strengthening of local policies to move to a low carbon economy, as a priority for the sustainability of tourist destinations with an emphasis on sustainable mobility. Maritime Urban and Suburban Transport as an environmentally friendly transport system will relieve the city of a heavy cargo load and promote the development of "green" transport. Its operation will address part of the traffic problem as it is expected to reduce the entry of IX with beneficial effects on reducing pollution. Maritime Transport is an alternative mean which strengthens Sustainable Urban Mobility.

Thessaloniki a waterfront city...

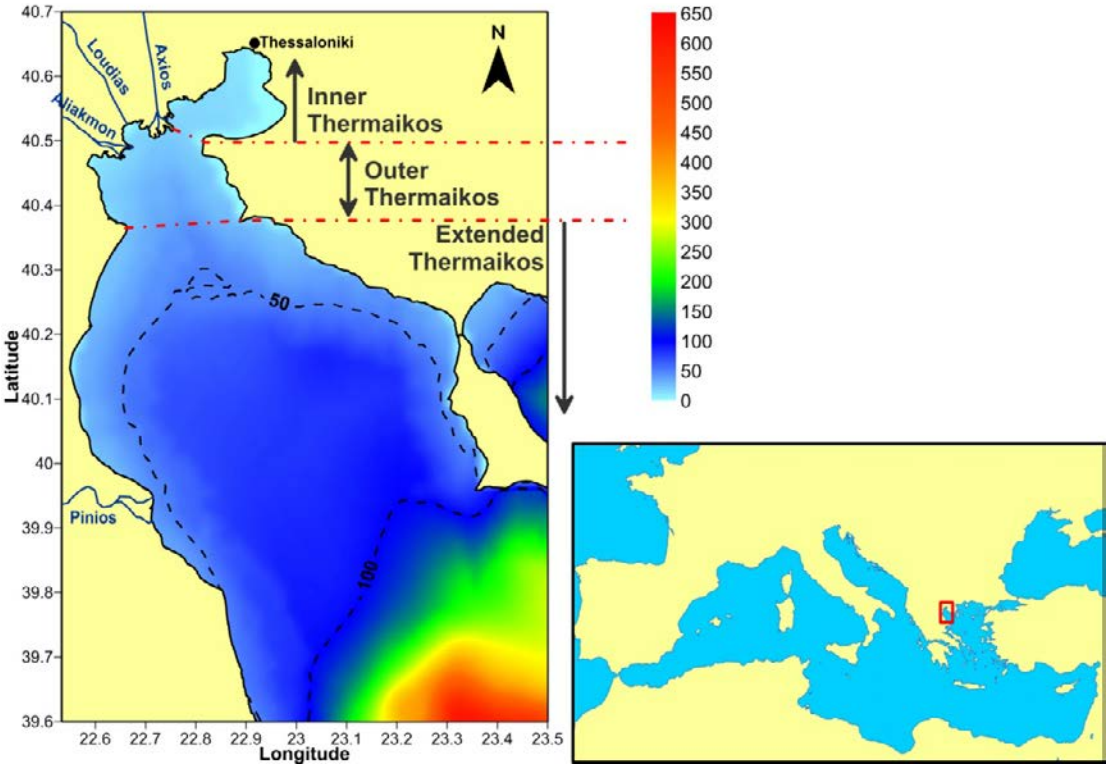
Thessaloniki is the second largest urban center in Greece. The city is a strong pole of economic growth and extroversion in the area of the Balkans, due to the second largest export port that connects European trade with the gates of Asia and China.

Thessaloniki's urban center has a continuous historical course of more than 2,300 years which secures strong economic and cultural ties with the countries of Southeast Europe and the Mediterranean. The city lived through all the historical phases of Hellenistic, Roman, Byzantine and Ottoman history and entered the 20th century as a multicultural city as various ethnic communities co-habituated its area. The influences of the multi-historical variety is still evident today with Roman, Byzantine and Ottoman monumental remains scattered across the urban tissue together with neoclassical elements of eclecticism that color's its architectural forms.

Today, Thessaloniki is an extroverted and active city that gives room to all living forces: youth (with the largest student population in Greece concentrated in its four Universities), innovation, entrepreneurship, culture and civil society organizations. The city is also developing rapidly as an alternative tourist destination hosting annually twice as many tourists as its population. In addition to the historical and cultural attractions, the city acquires the strongest element of tourism attraction…

Thessaloniki's bay, both in its urban and peri-urban part, is a strong ecosystem with economic dynamics and environmental challenges. For decades "fed" the city's population both actually and metaphorically. Today the bay ecosystem is under strict environmental protection that provides opportunities and possibilities for mild and socially useful investments, in the perspective of creating a new ecological, green and blue balance.

A large scale renovation project to Thessaloniki's urbanized waterfront area gave citizens and visitors a rest area that is closely linked to their daily life, a safe, picturesque and functional public space and therefore a tourist attraction that acts as a plus agent in the process of the city's gradual transformation into **a tourist destination…**


Thessaloniki
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Extended
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Latitude
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Tourism & local transportation: a necessary connection...

Transportation to tourist destinations is a challenge that has not been given the proper attention, especially in high tourism destinations and at peak times. Urban transport planning usually focuses on serving the daily movements of residents and employees, with the needs of tourists being omitted or underestimated. The need to explore and adapt local transport to the travel needs of visitors is strong, since tourism is an important economic activity.

Transport at European level is under transformative policies that aim in replacing polluting transport systems with alternative and durable ones that use environmental friendly technologies to reduce carbon footprint, especially in densely populated urban areas and high-rise areas.

Therefore, the main objective for tourist destinations is to redefine travel demand and switch to solutions for low-carbon systems which can bring significant benefits in quality of life, environment and climate action.

Thessaloniki's "touristification" as a new challenge.

With its diverse international presence,Thessaloniki gradually emerged as a city open to positive influences, attracting interest in a city that develops its identity as a recomposition of its historic and modern physiognomy. Tourism is now an important economic activity bringing not only investments and employment but also mobility in business sectors such as real estate management. Since Thessaloniki's tourism product is characterized by quality, it also is associated with its cultural - monumental and social potential, leading to the creation of a new identity, as a model city of the Mediterranean basin.

But tourism poses new challenges to the city. The tourism development model cannot be based on past standards. "Urban tourism" is a new form of economic activity which presupposes that tourists free time and activities would not be separate and differend from the ones that the local population deploy. Further more those should not contradict with one another.

Experiences in Europe already record an anti-tourism movement that raises serious concerns about the relationship between tourism, the city's functions and the living conditions of citizens. The reference to the "anti-tourism movement" is not made to reinforce such views but to reinforce the reflection on the desired model of the rapidly growing tourism activity in Thessaloniki.

Figure 1. It is a waterfront city...

Challenges, objectives and priorities...

Understanding and managing the pressures faced by the economic, environmental and social systems of an urban area poses a significant challenge. In the field of urban mobility of tourist destinations those challenges include capacity building of governance bodies, improvement existing systems by developing new, alternative and environmentally friendly systems, upgrading the transport infrastructure to serve the needs of citizens and visitors.

The aim is to improve transport policies in conjunction with tourism development policy, by integrating accessibility and "responsible mobility" strategies into the design of sustainable tourism development, through multimodal mobility, using environmental innovations in their implementation. The ultimate objective is to link the above with the Urban Sustainability Strategy, which is based on the critical relationship of the Tourism product as a business activity with local transportation services as an infrastructure in order to support and improve tourism activity in terms of environmental - economic - social resilience.

A common denominator for all action should be the strengthening of local policies to move to a low carbon economy, as a priority for the sustainability of tourist destinations with an emphasis on sustainable mobility and accessibility, such as:

- Investments in low carbon transport systems to convert mobile visitors from private cars to sustainable mobility systems,
- Intermodality infrastructure and services for visitors, Information and Communication Technologies and smart applications, Mobility as a Service (MaaS) solutions in Tourism,
- Accessibility to tourist attractions and tourist services, accessible tourism for all (disabled, elderly, families with young children, visitors with mobility problems).

Thessaloniki is facing serious weaknesses in public transportation. The multi-year constructions of the Metro have worsened the traffic operation and postponed the improvement of public transport systems to a distant future and while the present needs are served by a single means of transport that of city buses. The completion of the construction of the Metro is now visible in the nearby future, a fact that enhances expectations of significant rise in transport capacity that is, however, incapable of meeting all city needs.

The creation of complementary means of mobility is an urgent necessity for the viability of the Metro itself. For this reason, the city promotes requests for the development of alternative

Figure 2-3. Photograph by the author

transport systems with the most important one being the Maritime Urban Transport. The system will connect the city center with the coastal Municipalities of the metropolitan area and aims in stimulating movement in the “lower”, coastal zone of the city (which would not be served by the Metro).

Alternative transportation to Thessaloniki...The sea road...
Maritime Urban and Suburban Transport as an environmentally friendly transport system will relieve the city of a heavy cargo load and promote the development of “green” transport. Its operation will address part of the traffic problem as it is expected to reduce the entry of cars with beneficial effects on the reduction of the pollution.

Recently, 7 coastal municipalities of the metropolitan area of Thessaloniki proceeded to the elaboration of technical studies for the construction of an alternative transport system utilizing environmentally friendly sea vehicles. The provision for connecting the city by Maritime Transportation to the Airport is an important opportunity for the city. In this way, the renewed airport of the city will become the only Airport in Europe (except for the peculiar case of Venice) that will be connected to the city by sea, enhancing the tourist attractiveness of the city and the Airport itself.

The Plan aims to integrate the important entry and exit points of visitors with the respective systems (Airport - Port - Railway Station - Metro Starting Points - City Bus Stations - public bicycles - TAXI Bus Stations - TAXI National Bus Stations) as well as highlighting to the tourist public the possibility of combined use of alternative transport systems that serve the tourist movement in 4 directions:

1. Centripetal (inward) flow: the movement from the four exhisting tourist entry points to the city and in particular from the Airport, the Port, the Railway Station and the Intercity Bus Station to the important tourist movement points (Hotels - Historic Center).

2. Inner-city mobility: the movement within the city as a policy of “urban tourism”, promotion, configuration and networking of walking and cycling routes of interest for visitors.

3. Transit-city mobility flows: the intermediate movement that includes a short stop in the city and destination the dynamic tourist areas around Thessaloniki.

4. Centrifugal (outward) mobility flows: of the movement, ie from the city to the tourist interest points of the wider tourist

living area (Archaeological Triangle: Vergina Pella Dion, Mount Athos, Meteora, Wetlands, Thermal Baths, etc.) within a one-day or short-distance radius.

Maritime Transport both as a mean of public transport and as a mean of tourist transport - since it is planned to be connected to the Airport but also enhances the possibilities of developing external synergies with tourist destinations such as Halkidiki and Pieria – becomes a powerful alternative that responds to the challenges both of environmentally friendly tourism and Sustainable Urban Mobility.

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1. SETNet: "Network of Southern European Cities against Touristification"…

SETNeT was created by various organizations from 14 southern European cities (including Thessaloniki, Barcelona, Venice, Malta, Malaga, Valencia, Palma, Lisbon). The network aimed in working with Local Authorities in order to make these waterfront cities socially, economically and environmentally sustainable tourist destinations. The list of problems dealt by the network included the "saturation" of Public Transport, difficulties in mobility for both local and tourist population, as well as pollution.

2. Desti smart project - HORIZON 2020

European strategies aim – among other things - in improving transport and tourism policies by integrating strategies of sustainable mobility, accessibility and "responsible tourism" and through actions of efficiency, intramodality, transport modernization, cycling and hiking for visitors…. This was a core aim for DESTI SMART project (Delivering Efficient Sustainable Tourism with Low Carbon Transport Innovations, Sustainable Mobility, Accessibility & Responsible Travel) in which Thessaloniki worked for.

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Nature-based Solutions (NbS): An updated strategy for the urban "wicked" problems

Abstract

The article includes a short but comprehensive reference to the changes that occurred to planning models noticing mainly their gradual departure from physical (space) planning towards the argumentative perspective and thus to more strategic, goal-oriented decision making. Changes to urban design from the 1990s, characterized by the tendency to re-naturalize urban scenery by incorporating landscape architecture methods and forms, would also be commented. Therefore, the article focuses on the strategy of Nature-based Solutions, in how and when this concept emerged and its existing definitions until now while arguing that it mainly consists of a "way of thinking" that, when included in urban design practice it can only enrich it.

Keywords: Nature-based Solutions, strategic planning, green and blue growth, urban design

Urban Problems and planning practices: a short but indicative story of the 1960s

In their paper «Dilemmas in a General Theory of Planning», published in 1973, H. Rittel and M. Webber characterized the problems that the planning process deals with as «wicked». Wicked in a meaning akin to malignant, vicious, or tricky. The authors were actually making room for the -since then- well-comprehended idea that planning can't be compromised to the science or engineering paradigm because it deals with societal systems and their problems, which are inherently complicated and hard to handle.

Rittel & Webber's work was actually a follow-up of what has happened in the «revolutionary» decade of the '60s. A decade characterized mainly by an upheaval of criticism in the theory and practice of urban planning and design that took the form of «war» against the architecture of the modern movement. Indicatively we can refer to J. Jacobs's - harsh and well-received by the public - critique of urban planning as a «pseudoscience» (Sparberg-Alexiou, 2006: 76), C. Alexander's categorical expressions of the complete failure of planned cities as sterile and uninteresting representations of tree-like graphs as well as the «mild manifesto» of R. Venturi (1966) against the «puritan ethics and language of the Modern School» and in favor of the contradiction and complexity of a «real city» and its architecture (Venturi, 1977: 17). Linked to this critique were the attempts for new ways of analyzing and recording the urban environment, which aimed to bring design and planning closer to the subjective experience of the city.

In that same era, empirical research by political scientists in the United States strengthened this tendency by adding another powerful controversy that this time challenged the rationality of the planning and decision-making process itself. What these studies unequivocally showed was that the processes of designing and implementing programmatic interventions in the city were complex, vulnerable to political influences and pressures, dependent on so many factors that their results seemed random and could not be attributed to rational choice aiming for the common good[1]. Neo-Marxist theories - which were already

1 Widely known is the work of C. Lindblom, who found that decision-making and planning had nothing to do with rational thinking but were complex processes shaped by an indistinguishable mix of different factors and principles, purposes, and means of its participants. This process was described by Lindblom as "muddling through" in his famous article "The Science of "Muddling Through". M. Simon also challenged the assumption that official bureaucracies make decisions and act rationally in the "public interest". He analyzed

widely reflected in European academic thought in the 60s - had also promoted new interpretations of the role of the state as a key factor in the reproduction of the capitalist system through the planning of public investment and the strengthening of mass consumption. Urban planning practice, through this prism, was also accountable as a means of legitimizing the activity of the state and capital, as well as depoliticizing social conflicts and transforming specific goals and interests into common and objective values (Hall, 1996).

The great impact of these positions was actually the outcome of broader changes that had occurred in the nature of urban problems, in the way these problems were manifested and handled politically as well as changes in the way the urban phenomenon was conceived theoretically. The biggest impact of these changes occurred right where urban problems were most acute, that is in North American cities. Those cities witnessed explosive population growth due to internal and external immigration, horrible living conditions in slums and ghettos, and uncontrolled urban sprawl. Moreover, and from the end of World War II until the mid-1960s, urban regeneration projects in the US maintained a strong interventionist character that resulted in a huge housing deficit, as well as the displacement of many low and middle-income families from their neighborhoods[2] (Mollenkopf, 1983). The racial segregation that was so prevalent in many American cities, along with poverty, unemployment, low education, and poor housing stock in black neighborhoods, also led to violent mass conflicts and unrest in various urban centers[3] (Alabama 1963, Harlem New York 1964, Detroit 1967).

All these parameters and many others that were not possible to be mentioned in this "short story", contributed to various changes and reorientations. In the broader sense of mistrust to top-down processes, urban planning practices moved away from physical planning and various forms of advocacy planning gained

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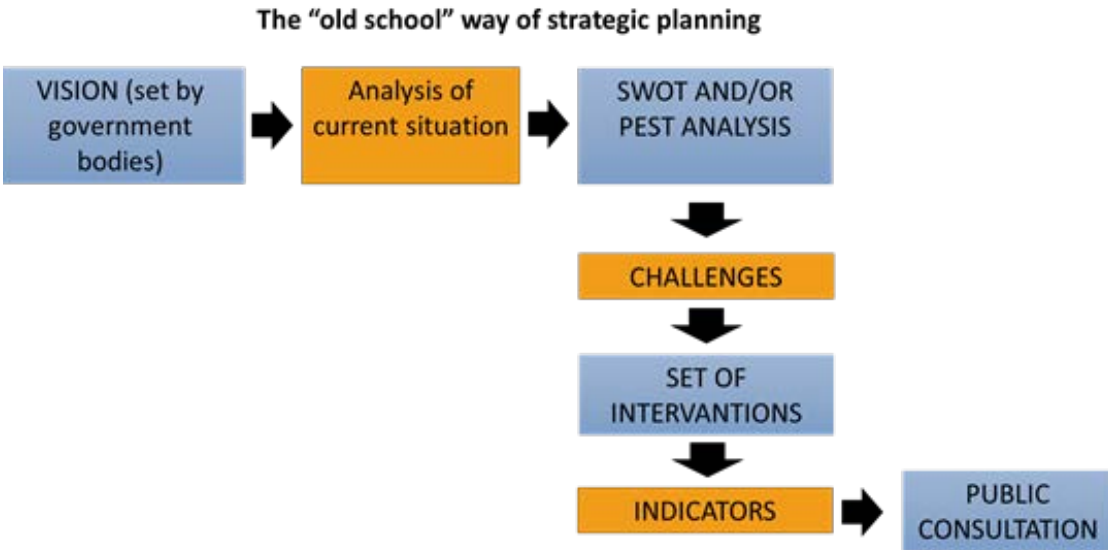
and substantiated empirically that the possibilities of rational thinking in organizations are limited by introducing the concept of "bounded rationality" (Simon, 1957).

2 J. Mollenkopf notes that between 1949 and 1966, more than 250,000 low-income homes in city centers were demolished in the USA, displacing nearly a million people. He also notes that only 114,829 new housing units were built on these sites and only 45,861 people were rehabilitated. Housing stock increased and displacement decreased only after a relevant legislation (1965 and 1968) promoting reuse against the demolition of homes.

3 D. Gale (1996: 59-61) notes that during the Vietnam War and especially with the organization of the anti-racist movement led by M.L. King, an "epidemic" of violent and mass outbreaks occurred in many American cities that peaked in 1966. The incidents occurred in 44 cities and involved the arrest of 2,200 people, 467 injuries, 9 dead and extensive property damage.

Diagram 1. By the author


The "old school" way of strategic planning
VISION (set by government bodies)
Analysis of current situation
SWOT AND/OR PEST ANALYSIS
CHALLENGES
SET OF INTERVANTIONS
INDICATORS
PUBLIC CONSULTATION

the lost ground (Gosling & Gosling, 2003: 71), establishing since then the well comprehended idea of participatory planning in different scales of decision making. Urban design was favored alongside the emergence of a variety of architectural tendencies, manneristic and eclectic, that restored historical and urban forms while the ideas of conserving, restoring, and reusing building environment were scaling up. At the level of public policies, large-scale "redistributive" urban projects were planned at the federal level and implemented locally. These projects included innovative mechanisms for participatory-consultative processes as well as multisectoral-multilevel interventions giving birth to the mainstream (since then) strategy of Integrated Urban Development[44]. Gradually but steadily, government policies in America and England began to recognize the social background of urban problems, to focus on improving and reusing building stock, upgrading infrastructure and public space in neighborhoods and including interventions in social areas such as work, education and health[5] (Tonkiss, 2000: 593).

What this "short story" aimed to highlight was that urban problems, planning & design methods and processes, and public policies and investments evolve to interconnect. This string of thought could be of great value to those striving to orientate through emerging new ideas, concepts, or methodologies. Furthermore, it draws attention to what – in my opinion – is a crucial and decisive factor in the evolution of urban matters: the socio-political process of what is conceived as an urban problem, represented and acted upon.

The most "wicked" problem of all

Since that era, new generations of planning models have evolved. They appeared hand in hand with new ways of urban living and their unprecedented challenges as well as new urban design theory and practice. None the less urban problems remained wicked, and since the begging of the 1970s, humans realized the most wicked of all: the environmental problem.

The significant influence of the environmental movement

4. A well comprehended brief of what Integrated methodology is can be found in https://ec.europa.eu/regional_policy/sources/docgener/informat/2014/urban_en.pdf

5. In the US, under the Great Society Federal Program (1964) that aimed to reduce poverty and racial inequality, legislation that significantly improved the housing problems of displaced families was introduced. In addition, a new active policy attempting to address the complex issues of spatial and social degradation entitled the "Model Cities Program" began in 1965 and included investments in both physical intervention and the social sector (Screenivasan, 2009: 403-404).

first became apparent in architecture as a strong interest in how buildings were incorporated into the ground (as a part of a local composition that may include both artificial and natural parts), formed in the late 1960s (Frampton, 1980: 305). Gradually and as J. Corner (2003) noted, each place began to be considered a landscape and, in this direction contributed not only ecology but also the failures of the utopian trends of modern design that through its transnational style ignored local characteristics and cultural values (Corner, 2003: 13). The rejection of the principles of the modern movement for universal design of the city space meant the gradual formation of a different direction in urban design too. This direction accepts the city in its post-modern version - that of the metapolis - and tries to meet its challenges with a willingness to compromise the contrasts, with the ingenuity and optimism of new fictional architectural forms that can often display a vague and fluid character. In this rough context, architectural interventions in public space gradually began to abandon the formalist lines and were replaced by proposals that favored liquidity, variability, transient and alternative uses. Landscape architecture has been adopted as the design language in the most important and largest outdoor projects in recent years. Green renovations of abandoned industrial facilities, military camps or inactive infrastructure networks imposed the new "ecological" urban scenery. A trend that definitely involves the reversal of the older conceptual city□nature dualism.

Changes related to the realization of the huge environmental problems caused by the industrialization and commercialization of every area of human activity influenced not only design but thankfully urban policies in general. In North America, the term "smart growth" was gradually used instead of other terms (such as placemaking, urban regeneration, etc.). Gradually the environmental movement meant to be accelerated into the strongest ideological framework influencing the birth of rapidly multiplying ideotypes of "smart", "sustainable", "healthy", "green", and more recently, "resilient" cities. And while the way these ideotypes are conceived and introduced through knowledge networks in governmental or supranational programs in quite analogous ways, they don't enjoy the same range of acceptance or penetration in political agendas as many other factors influence those agendas.

The updated strategy of Nature-based Solutions

Nature-based Solutions (NbS) is an idea for urban interventions developing mainly in the policy-making environment of the European Union. EU is a supranational formation that, through policy objectives, laws and funding, directs the implementation of cohesion policy to its member states. This supranational activity of policy-making triggers and is fed by much research, theory, and innovative ideas from universities, think tanks, NGOs, citizen's organizations, and initiatives to all relevant sectors. Through such an activity, new concepts may arise, and some of them make their way to policy agenda. One of these newly developed concepts is NbS. It was put forward in the late 2000s by the International Union for the Conservation of Nature and the World Bank in the context of finding new solutions to mitigate and adapt to climate change effects while simultaneously protecting biodiversity and improving sustainable livelihoods[6]. Thereafter it was used by policymakers in the European Commission to promote new initiatives and policy platforms[7] . In the current programming period 2014-2020 the EU supports a number of projects that promote research, co-design, testing, and deployment of improved and innovative NbS in an integrated way[8].

NbS is not a clear concept. Its general objective is clear, namely the sustainable management and use of nature for tackling societal challenges. However, different stakeholders view NbS from different perspectives. IUCN defines NbS as actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges effectively and adaptively while simultaneously providing human well-being and biodiversity benefits. EC defines NbS as solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social, and economic benefits and help build resilience. A substantial difference between the two definitions can be identified as IUCN deploys NbS for ecosystem interventions while EU considers NbS as a method imitating natural processes and can be deployed in all kinds of interventions. Therefore, and through EC policy-making think tanks,

The images incorporated below are abstract graphic representations of three types of strategic planning processes and highlight differences between NbS and other common planning methodologies. The NbS graph is attributed to CONNECTING NATURE EU project works in progress.

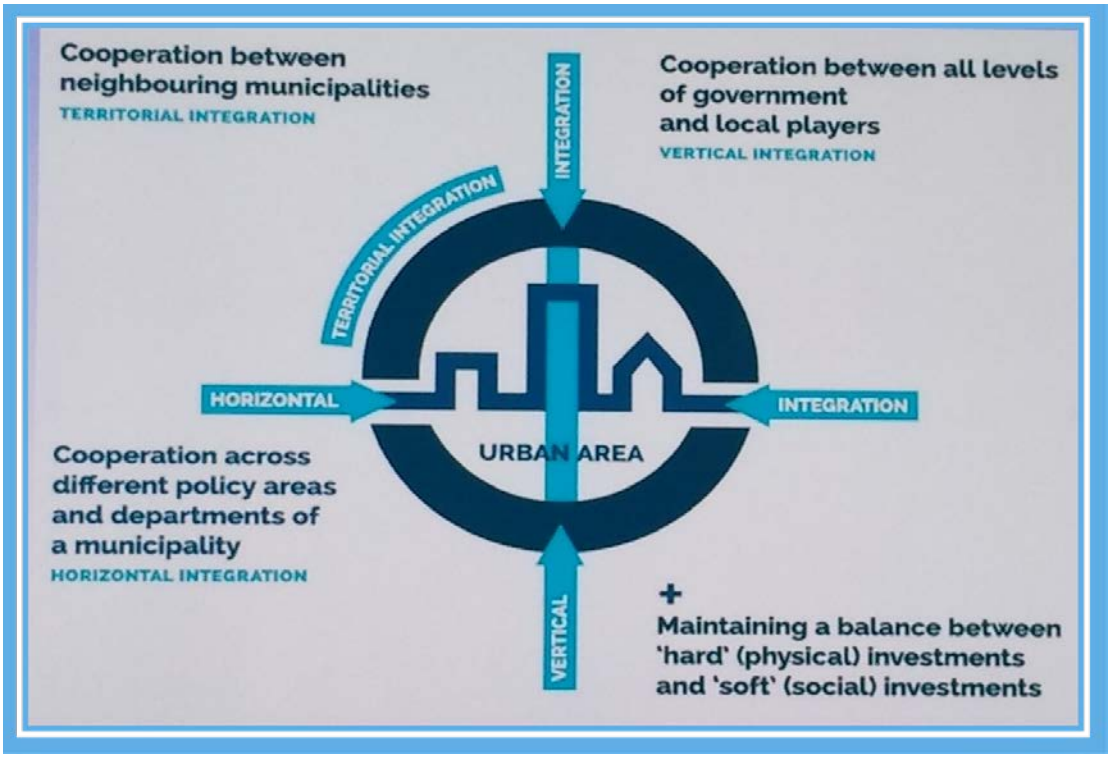
Diagram 2. Intergrated Urban Development Strategy (https://urbact.eu/integration)

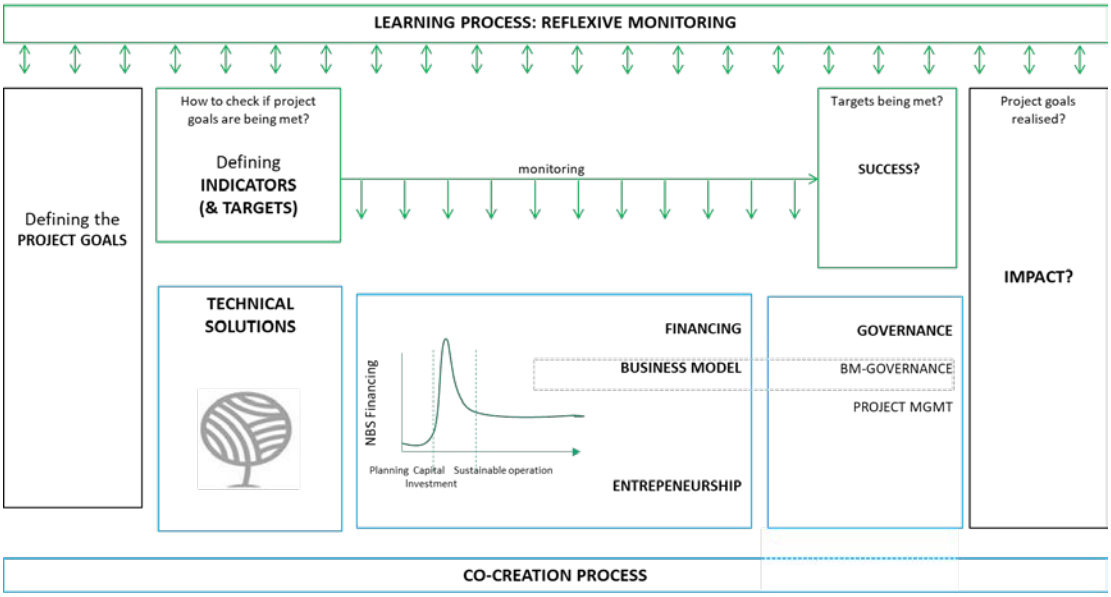
Diagram 3. NbS Framework (strategy) (Connecting nature, Horizon 2020 Innovation Action Programme, Deliverable 5: Nature-based framework for frontrunner cities, p. 18.)

6 IUCN, (2009) No time to lose – make full use of nature-based solutions in the post-2012 climate change regime. Position paper on the Fifteenth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 15), Gland: IUCN. MacKinnon, K., Sobrevila, C. Hickey, V. (2008) Biodiversity, climate change and adaptation: nature-based solutions from the Word Bank portfolio, Washington D.C.: World Bank.

7 European Commission, (2015) Towards an EU Research and Innovation policy agenda for nature-based solutions & re-naturing cities. Final Report of the Horizon2020 Expert Group on Nature-Based Solutions and Re-Naturing Cities, Brussels: EC.

8 See the platform of the project "ThinkNature" that is led by the technical university of Crete and "CONNECTING NATURE" that is led by the Trinity College of Dublin


Cooperation between neighbouring municipalities
TERRITORIAL INTEGRATION
Cooperation between all levels of government and local players
VERTICAL INTEGRATION
INTEGRATION
TERRITORIAL INTEGRATION
HORIZONTAL
INTEGRATION
URBAN AREA
Cooperation across different policy areas and departments of a municipality
HORIZONTAL INTEGRATION
VERTICAL
+
Maintaining a balance between 'hard' (physical) investments and 'soft' (social) investments


LEARNING PROCESS: REFLEXIVE MONITORING
Defining the PROJECT GOALS
How to check if project goals are being met?
Defining INDICATORS (& TARGETS)
monitoring
Targets being met?
SUCCESS?
Project goals realised?
IMPACT?
TECHNICAL SOLUTIONS
FINANCING
BUSINESS MODEL
ENTREPENEURSHIP
NBS Financing
Planning
Capital Investment
Sustainable operation
GOVERNANCE
BM-GOVERNANCE
PROJECT MGMT
CO-CREATION PROCESS

NbS are solutions that can bring more diverse, natural features and processes into cities, landscapes, and seascapes, targeting locally adapted, resource-efficient, and systemic interventions.

We can conclude then that NbS is not just another way of performing urban regeneration programs or a means of design to public spaces. It is more of a strategy, a whole new way of doing things in urban environments, from things we call "business as usual" to innovative interventions in all policy sectors, addressing all societal challenges.

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Project Team I

Ampelokipi Menemeni I

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Jelle - Jochem Duits

Located on the western edge of Thessaloniki, the Dendropotamos area faces many challenges today. The way the Western Districts of the city were built is characterized by a lack of strategic and physical urban planning but also from the fragmentation and partiality of subsequent interventions. New primary roads have overtaken everything below them, contributing in the present image of the city. The result of these actions is the current degraded urban quarters in Northwest Thessaloniki.

The study area is crossed by three parallel to the waterfront major axes that lead to the city center, but has poor connections to the northern housing areas of Menemeni and Evosmos. The area intersects with the rail network, which serves for loading the cargo of the industrial zone, while the port forms its waterfront. Furthermore, an interesting element of the area is the road that leads to Kalochori village which is elevated for a few hundred meters and functions as a bridge. However, all of these roads are extremely unfriendly to pedestrians and in combination with the degraded state of the site under the bridge, it is impossible for visitors to tour the surrounding area and reach the waterfront.

The present-day Dendropotamos is in fact a no-man's land rather than an urban waterfront zone and its surroundings, that were once a natural reserve, are now filled with debris and sewage, and face a series of overlapping hazards as a result. Today, the area faces the risks of storm water inundation and chemical sewage overflow, alongside coastal flooding due to long-term sea level rise as a part of the Mediterranean region. What's more critical, is that the area is overwhelmed with air pollution. The site is on the verge of the administrative boundaries of three municipalities and is subsequently lacking a unified development program. Different types of industries and artisans' workshops, as well as retail uses and office spaces are predominant in this area and an overall lack of public spaces is observed in the Municipality of Menemeni where the site actually belongs.

The proposed masterplan depicts a future vision for creating a harmonized transition between nature and the surrounding heavy industrial zone. Its aim is to achieve good connectivity and sustainable accessibility of the waterfront, by introducing a new network of paths addressing both locals and visitors. Changing land-use for the creation of natural public spaces as well as for economic development is also a critical element of the vision. The proposed functions combine educational activities, urban agriculture as well as leisure activities aiming to better

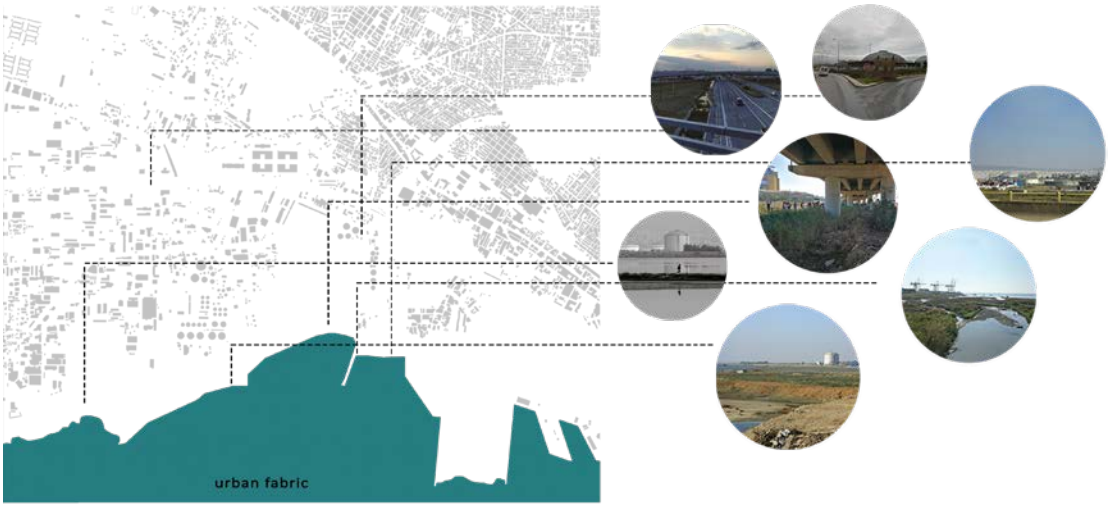
control the existing industrial activity so as to promote ecological sustainability.

The bridge's road axis is a distinct boundary between the artificial environment and the natural habitat. It is therefore a transition element that further guides and directs. The fact that it is an elevated bridge offers visitors views of the harbor, the city center and the sea. In order to exploit the possibilities offered by this axis, the purpose of the intervention is to exploit both the empty space below it enhancing accessibility for pedestrians and cyclists. The process followed was to create a series of central towers at the intersection points of the bridge with the new proposed axes. These towers are transitional elements and concentrate activities such as observation and leisure. At the same time, in the empty space below the bridge, starting from the towers, activities are spread along it. As this axis in the western part recedes back closer to the urban area, activities such as outdoor cinema, cafeteria, playground and public infrastructure are introduced. Then, as the axis continues east and closer to the natural environment, activities such as an environmental scientists' observation center, a pollution measuring center, and a waste collection site are located. The basic unit of the tower is a light metal structure with staircases and platforms for viewing. Panels are mounted on this structure to protect, reveal or hide views. In addition, they can be planted as green walls.

The interventions aim at smoothing the urban-industrial character of the landscape and preparing it to accept the constantly changing natural element. Essentially, it is an approach that embraces the human factor and respects nature by reducing their distance.


WEST WATERFRONT
EAST WATERFRONT
THERMAIC GULF


DENDROPOTAMOS
RIVER BANK



1871
creation of railway trail

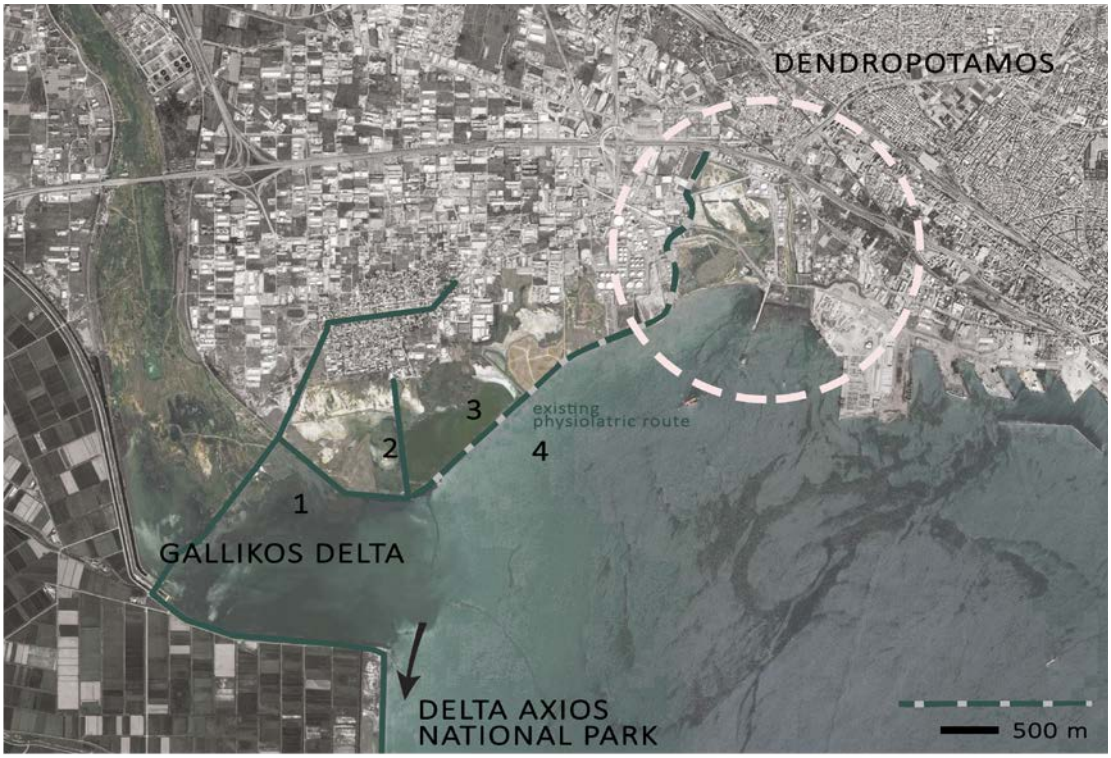
1922
refugee population from Asia Minor

1950-70
internal migration of Greek populations due to intense urbanization

1962
beginning of industrialization (1st petroleum fastory)

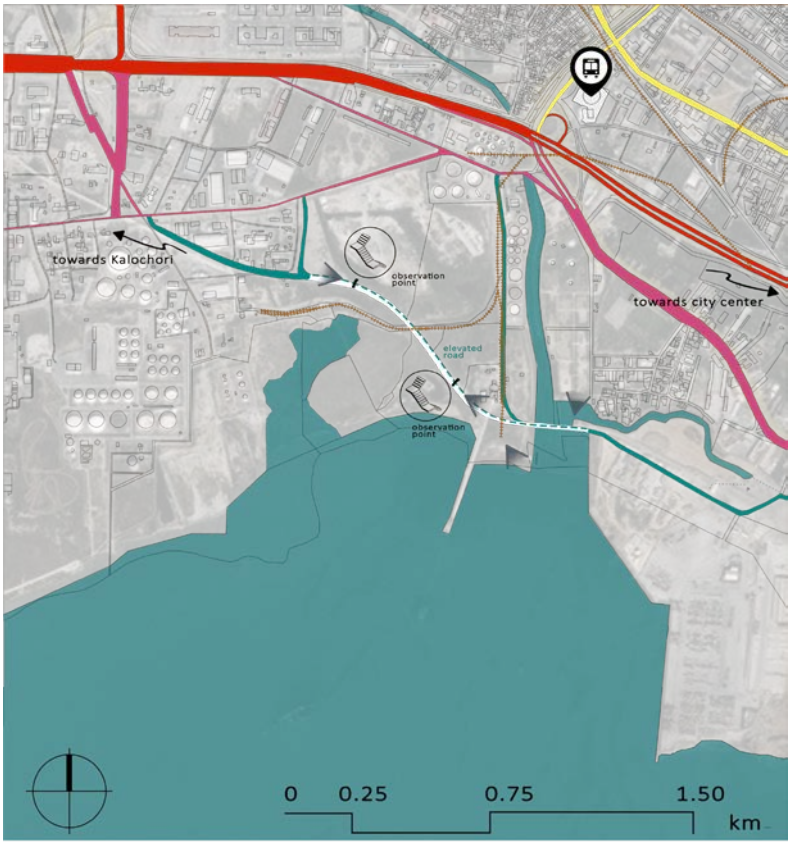
1976-85
migration of repatriated populations and immigrants from the Soviet Union

1990-TODAY
immigrant & refugee flows, expansion of housing complexes


DENDROPOTAMOS
existing
physiolatric route
1
2
3
4
GALLIKOS DELTA
DELTA AXIOS
NATIONAL PARK
500 m


1
2
3
4

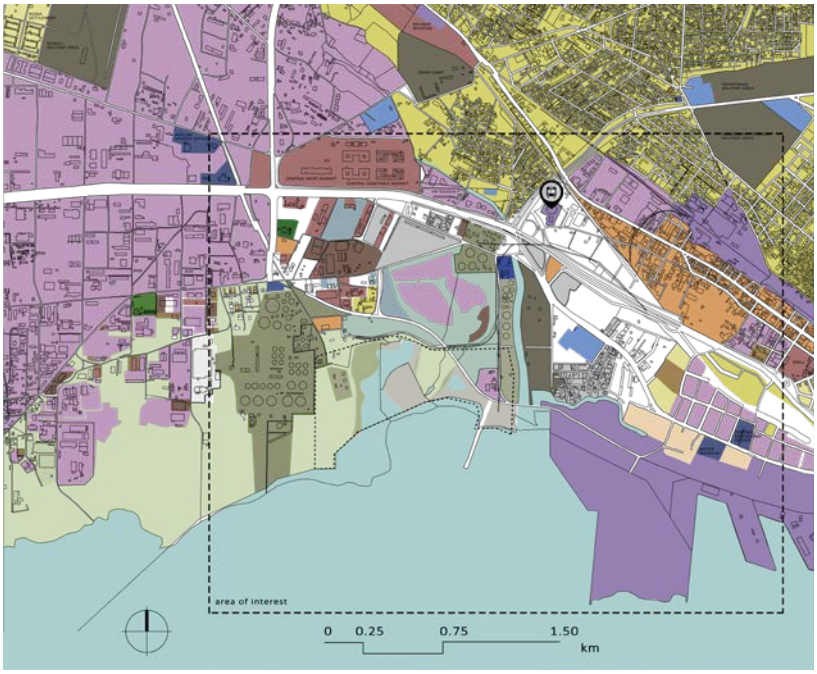

GREY PLOVER
GREENSHANK
NYCTICORAX
COMMON COOT

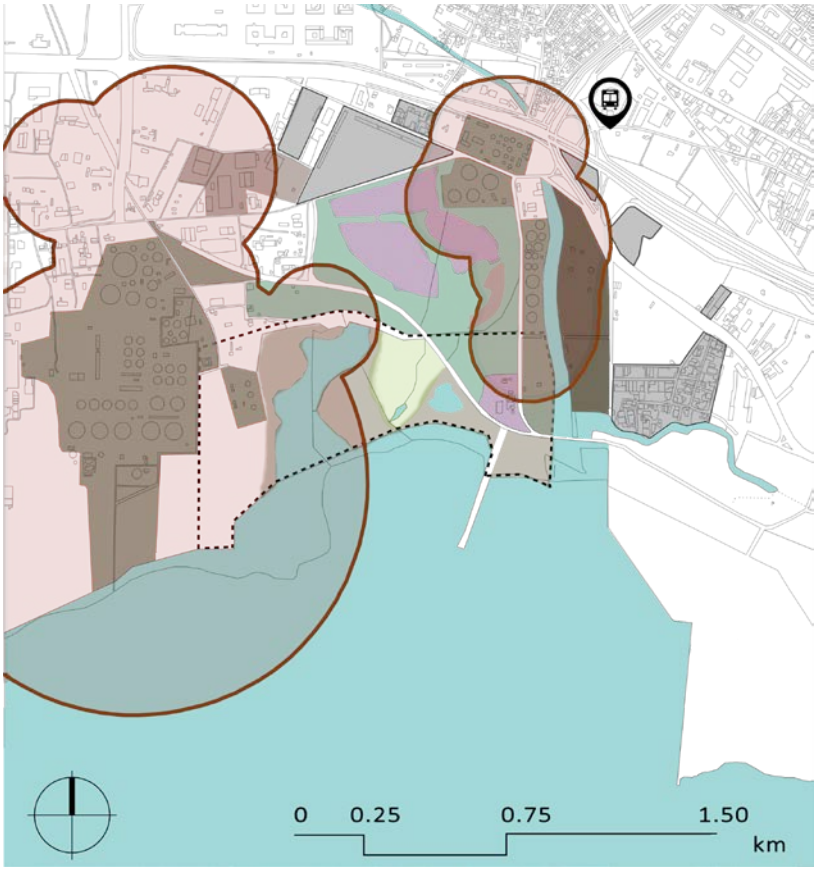


LEGEND

- old rail trail
- national network
- primary network
- provincial roads
- moderate traffic roads
- bus terminal

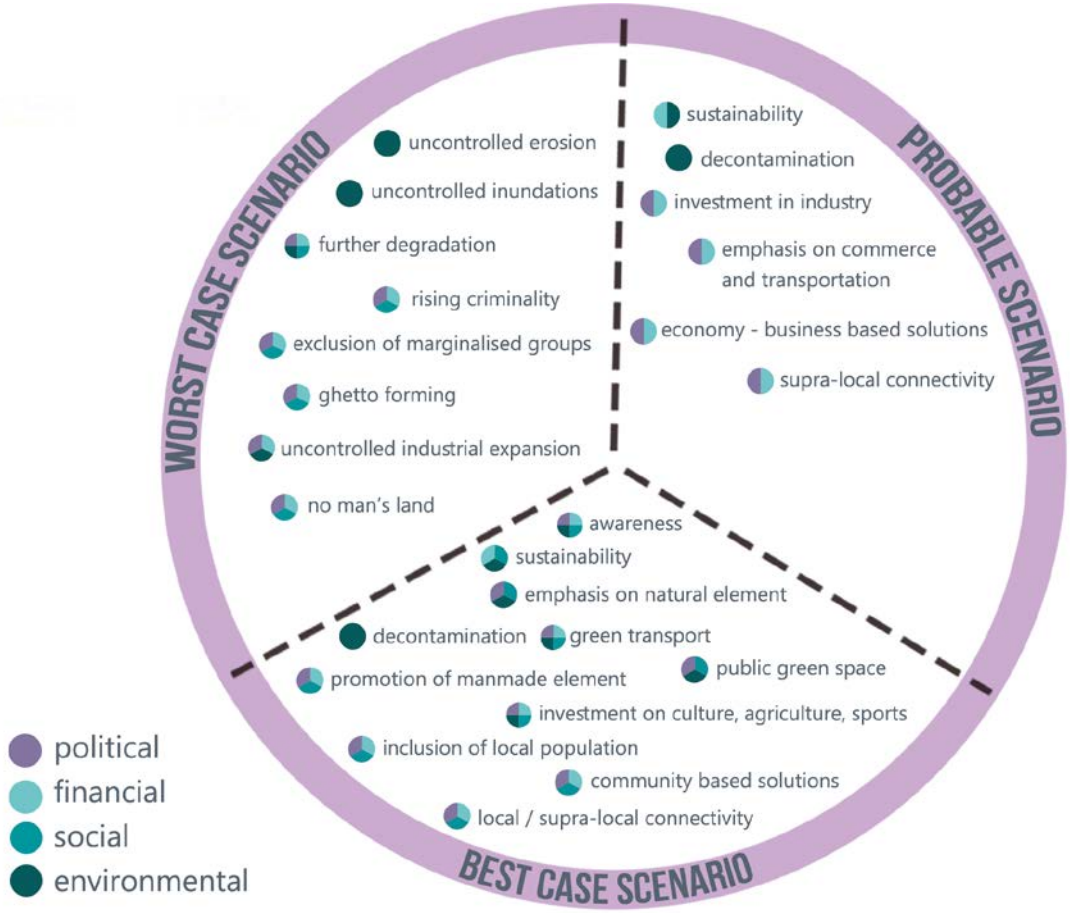
Environmental Documentation
Habitat
—
Existing Condition
Accessibility network

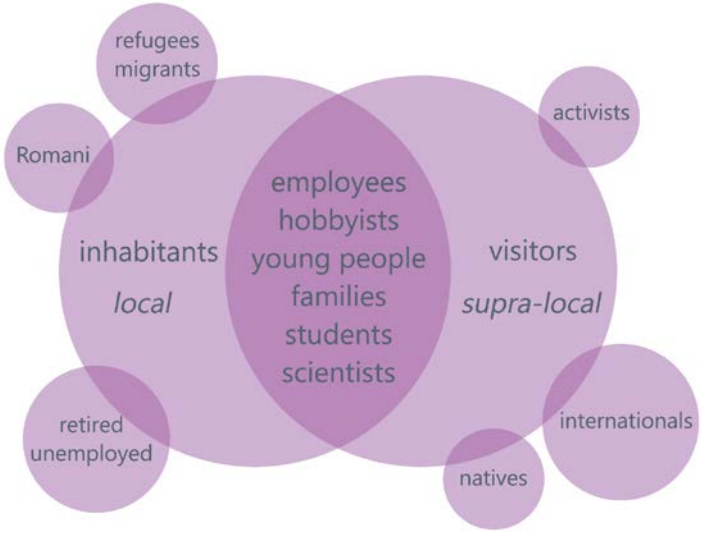


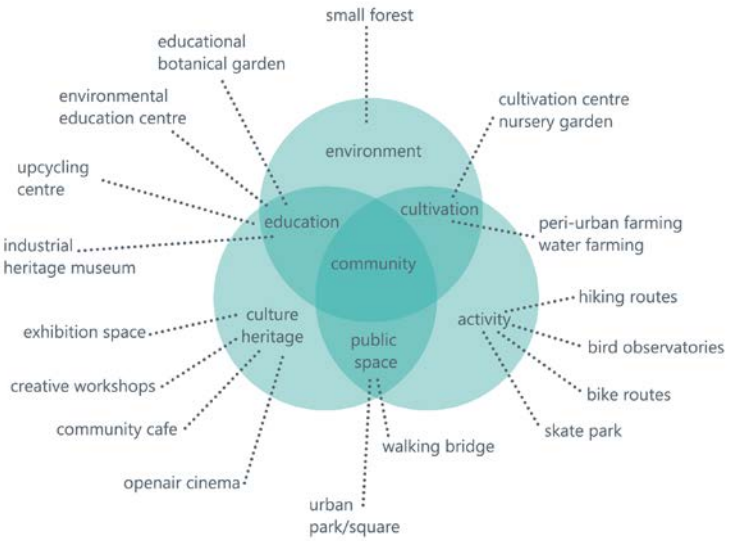


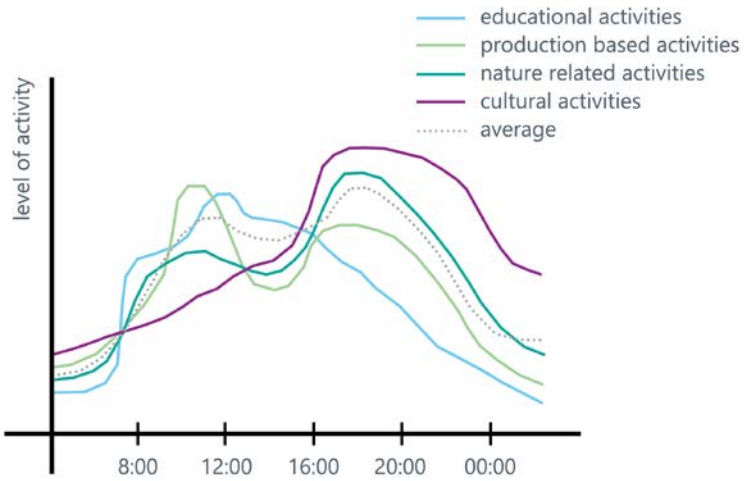
LEGEND

- entertainment
- offices
- education
- central city functions
- housing
- retail
- industry/ artisanship
- public transport facilities
- sports facilities
- military areas
- petroleum industry
- primary sector activities
- common interst facilities
- transportation companies
- water
- swamp
- low vegetation
- bushes & trees
- high risk area
- protected area
- bus termina


WORST CASE SCENARIO
uncontrolled erosion
uncontrolled inundations
further degradation
rising criminality
exclusion of marginalised groups
ghetto forming
uncontrolled industrial expansion
no man's land
PROBABLE SCENARIO
sustainability
decontamination
investment in industry
emphasis on commerce and transportation
economy - business based solutions
supra-local connectivity
BEST CASE SCENARIO
awareness
sustainability
emphasis on natural element
decontamination
green transport
promotion of manmade element
public green space
investment on culture, agriculture, sports
inclusion of local population
community based solutions
local / supra-local connectivity
political
financial
social
environmental







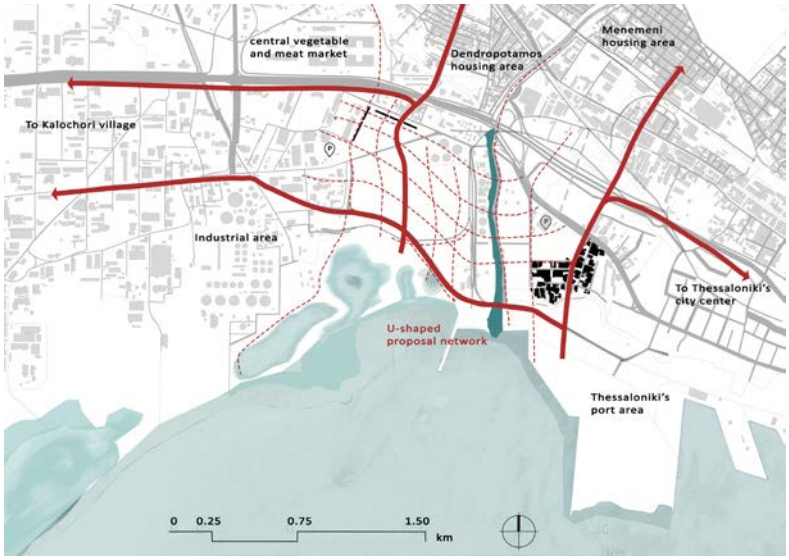
Future Scenarios

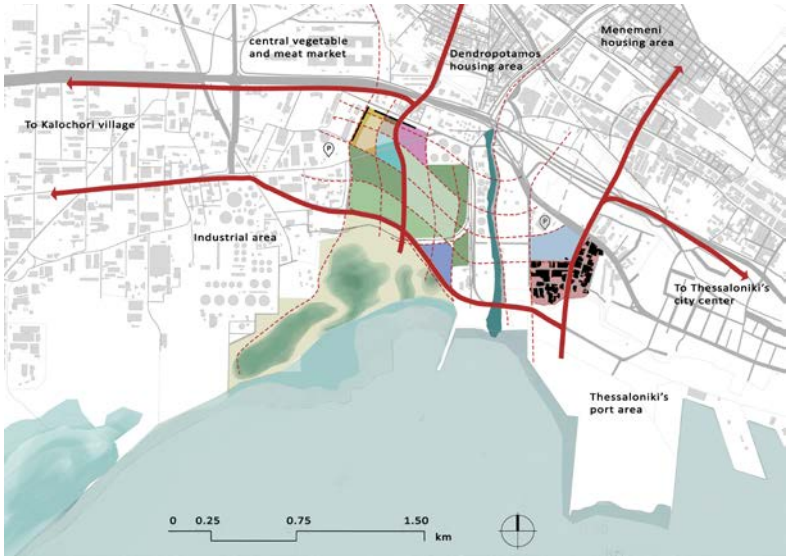
-

Target group of users

Program

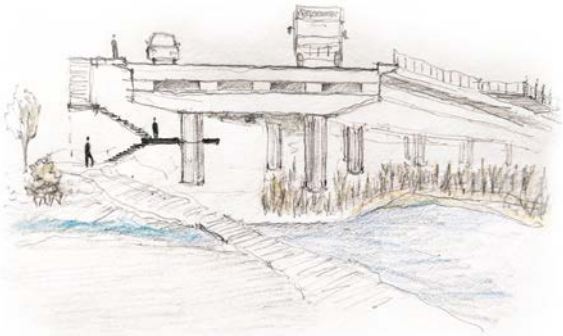
Activities Timeline



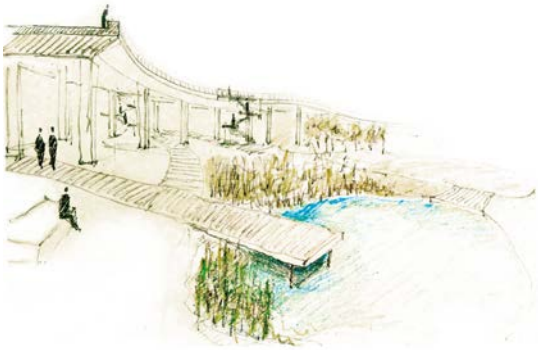


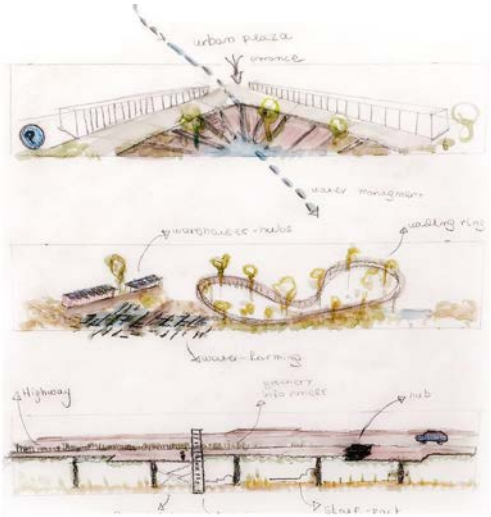
Enviromental education center
Up-cycling center
Cantine
Amphitheater (point of transition)
Nursery
Orchards
Botanical garden
Urban gardens
Hydroponic farming
Industrial heritage
open air museum
cultural activities
Sports activities
Protected natural environment

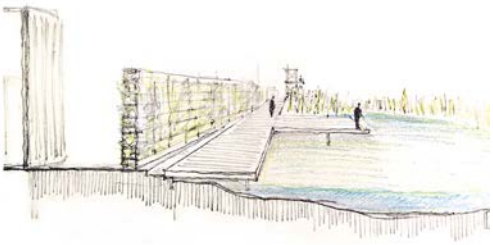

P
P
①
②
③
④
0
0.25
0.75
1.50
km



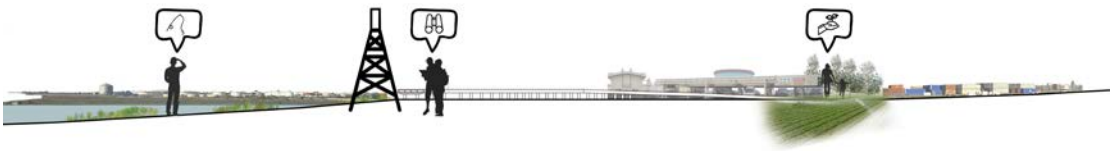
reclaim of the elevated road



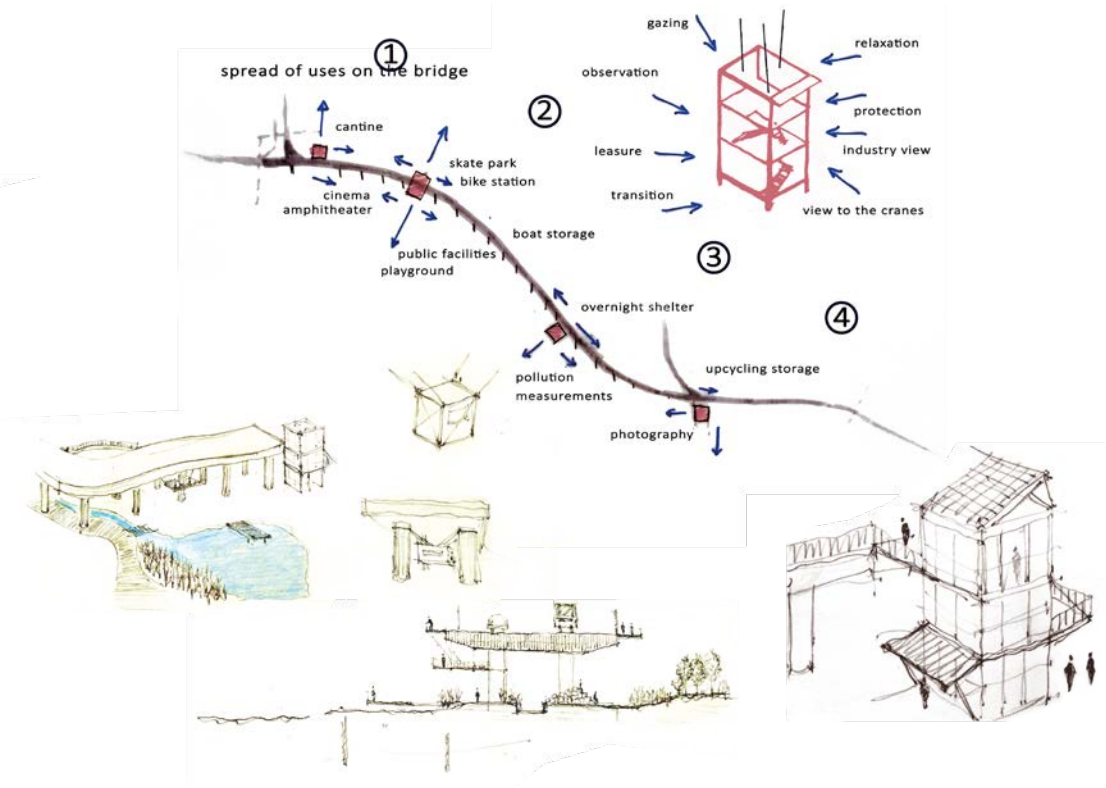


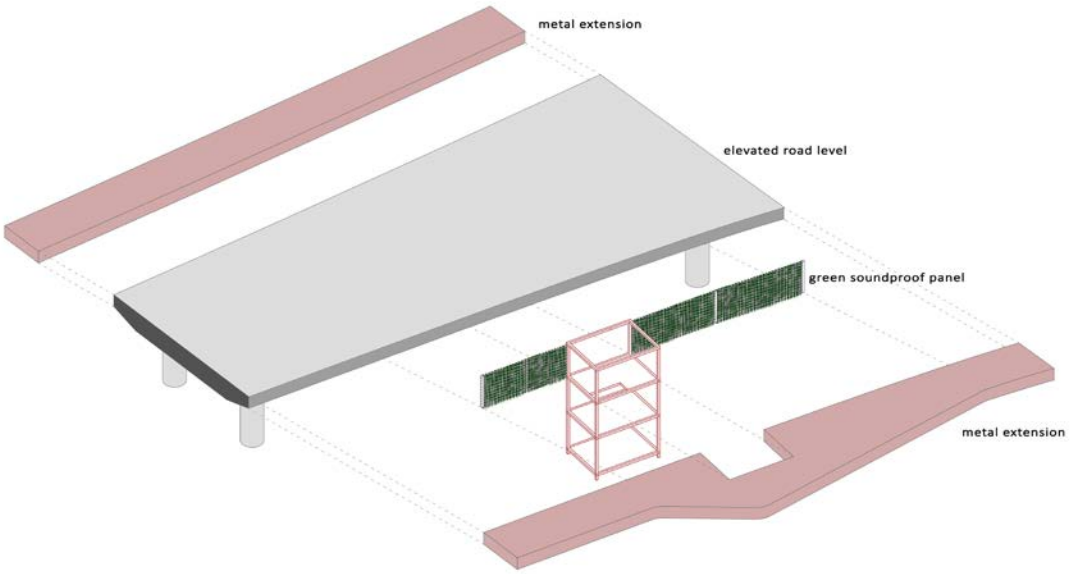


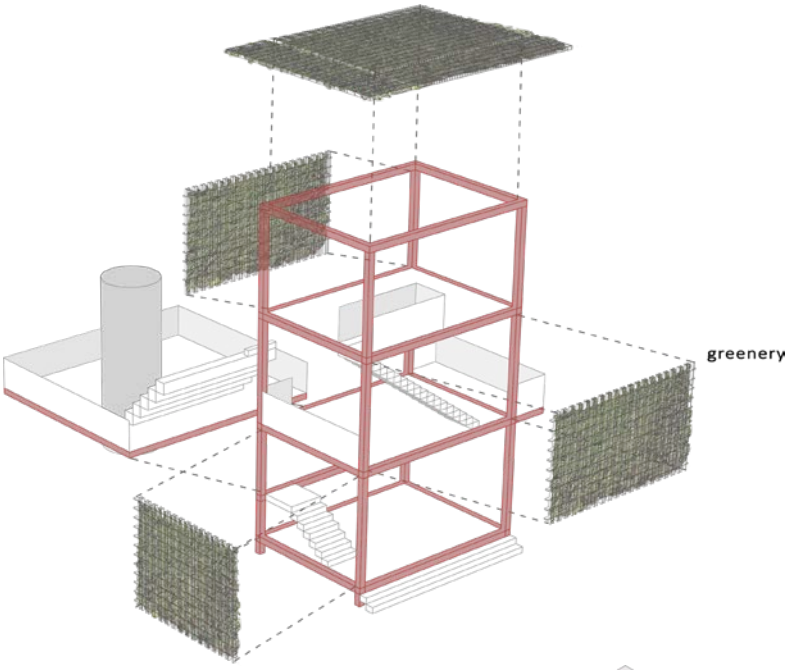
urban ecosystem_wetland park

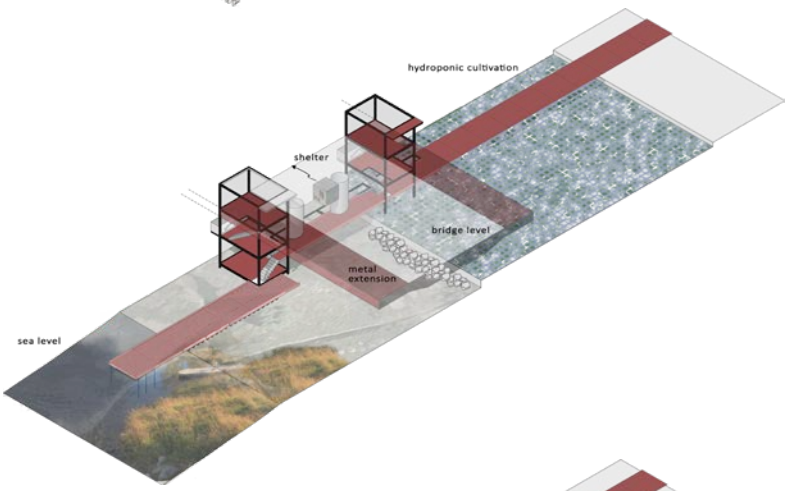


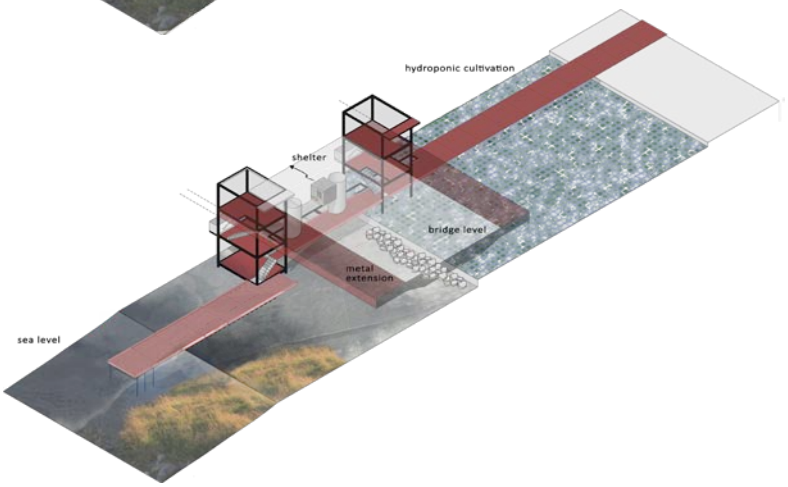

4
5
KRONIT MAIN


spread of uses on the bridge
1
cantine
skate park
bike station
cinema
amphitheater
public facilities
playground
boat storage
2
gazing
relaxation
observation
protection
leasure
industry view
transition
view to the cranes
3
overnight shelter
4
pollution
measurements
upcycling storage
photography


metal extension
elevated road level
green soundproof panel
metal extension


greenery


hydroponic cultivation
shelter
bridge level
metal extension
sea level


hydroponic cultivation
shelter
bridge level
metal extension
sea level

Project Team II

Ampelokipi Menemeni II

External Participants
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The project area is situated on the west side of the Urban Agglomeration of Thessaloniki and it is a part of the Municipality of Ampelokipoi - Menemeni, in close proximity to the Municipality of Thessaloniki. Dendropotamos stream is an important natural element of the area and the main collector of storm water for almost the entire western part of Thessaloniki. The project' s site constitutes a rather complex environment of mixed uses, with a dominance of informal industrial and other business activities, without a well planned street-lay-out and adequate infrastructure networks. Oil companies and refineries cover 26.4% of the total built-up area, while 8 more enterprises have been incorporated in the SEVESO II Directive. Moreover, there are important transportation infrastructure and facilities. The area is characterized by a constant duality between conflicting elements. The 'urban characteristics', due to the presence of various human activities, contradicts with the natural elements. The elevated road network contrasts with the depth swamps. The disturbing noisy area, because of the traffic, conflicts with the calm quite sound of the river. Moreover, the case study area demonstrates a dynamic relationship between the water element and the soil. This is due to the fact that large parts of the area is at the same or at lower level than the sea resulting, periodically, in large flooded areas. The area is experiencing heavy environmental pressures, caused by the lack of any official planning and the pollution of Dendropotamos stream. The main causes of pollution are the present industrial activity along with the existence of facilities which are currently out of service but used to be significant pollutants in the past (i.e. the area of the old tanneries) and the combined sewage overflow. Furthermore main reasons for the redevelopment of the area are the anticipated impacts of climate change (flash floods, rise of sea level), pollution, lack of public open spaces in the wider region and the desire of the citizens of the western districts of Thessaloniki to have access to the waterfront.

The vision for this area is based on the creation of green infrastructure, through the utilization of existing green and blue assets and the creation of new ones that will serve as links. Thus, the new proposed green corridor will provide access to public green spaces and to the waterfront. This includes ecological restoration of the stream, which could be achieved through the method of phytoremediation, and the creation of a new route along its course. Moreover, it will collect and absorb storm water, protecting the whole area of the risk of flash floods.

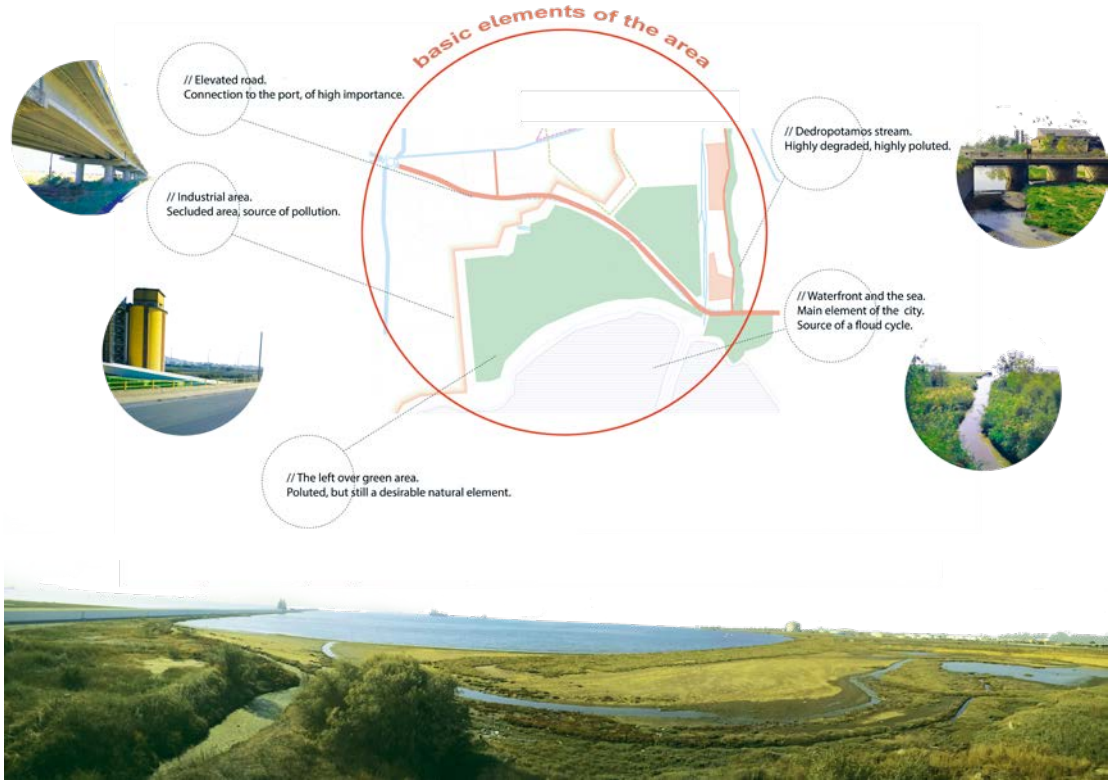
The existing elevated road and the view it provides, with the addition of a new structure for bikes and pedestrians will provide a safe access to the waterfront zone.

The creation of a Green Innovation Hub is proposed through the use of suspended containers attached to the bridge. The containers will be elevated and will communicate with each other through an external corridor. The term of Green Innovation Hub, implies the reuse of materials and the use of the existing infrastructure (bridge) indicating the reduction of land take and soil sealing. There will also be a transition point from the bridge to the ground level.

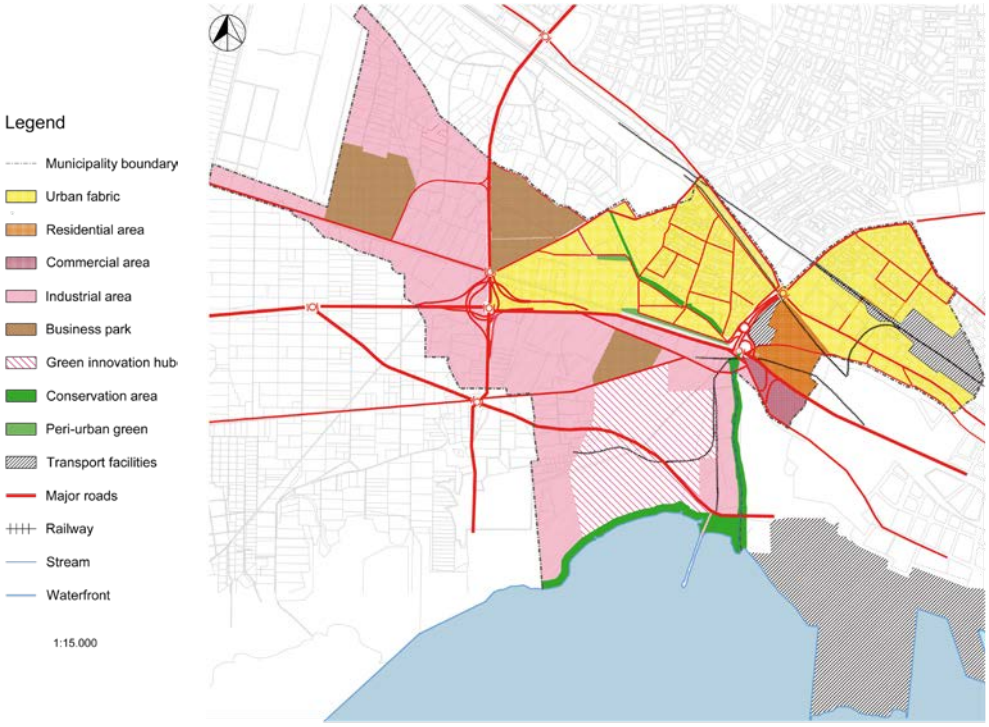
Following the ecological restoration of the site (phytoremediation process), basins and 'hills' will be created. The basins will collect sea water (when the sea level has risen) as well as, rain water and they will be connected by canals, minimizing in this way the risk of flooding. In the elevated parts, 'hills', parks and paths will be created, which will accommodate leisure and sports activities. Containers can also be placed in some parts for leisure amenities. Also, a protection zone will be created along the waterfront serving as a natural buffer against sea-level rise.

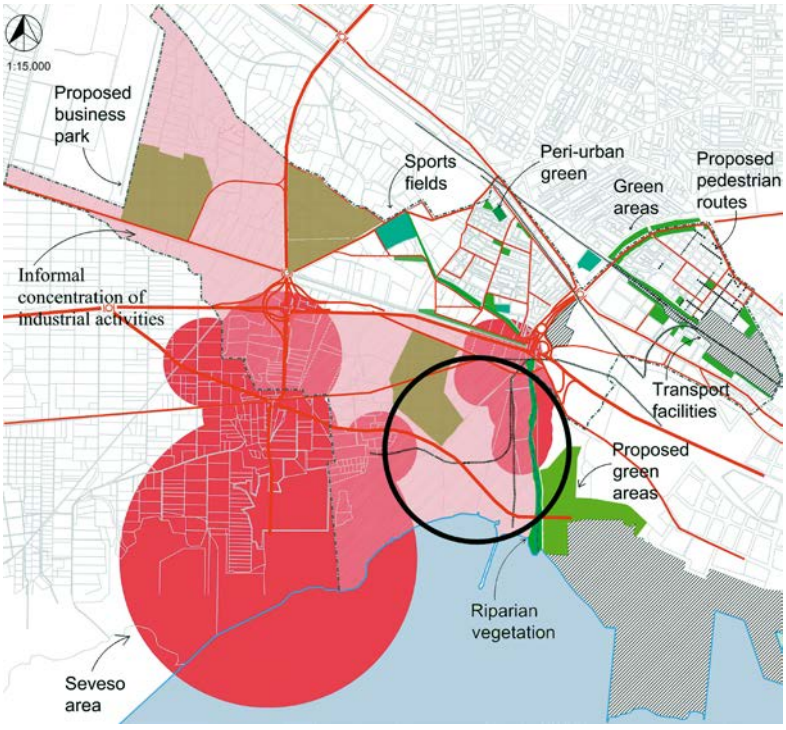
The creation of a floating pier is proposed in conjunction with the future urban water transportation of Thessaloniki. This can serve as an alternative route to the city center, along with other destinations, providing also a panoramic view of the city's waterfront.

The scale and the complexity of the site's transformation means that the process will inevitably take time and it should be completed in phases. The Master Plan envisions a steady and flexible growth, with public participation throughout the process, that will be able to accommodate change over time and respond to unforeseen events, yet sufficiently coherent in order to shape and define the site's future development, character and physical form. During this long implementation period the area should not be characterized as an endless construction site but as a public space in-progress.



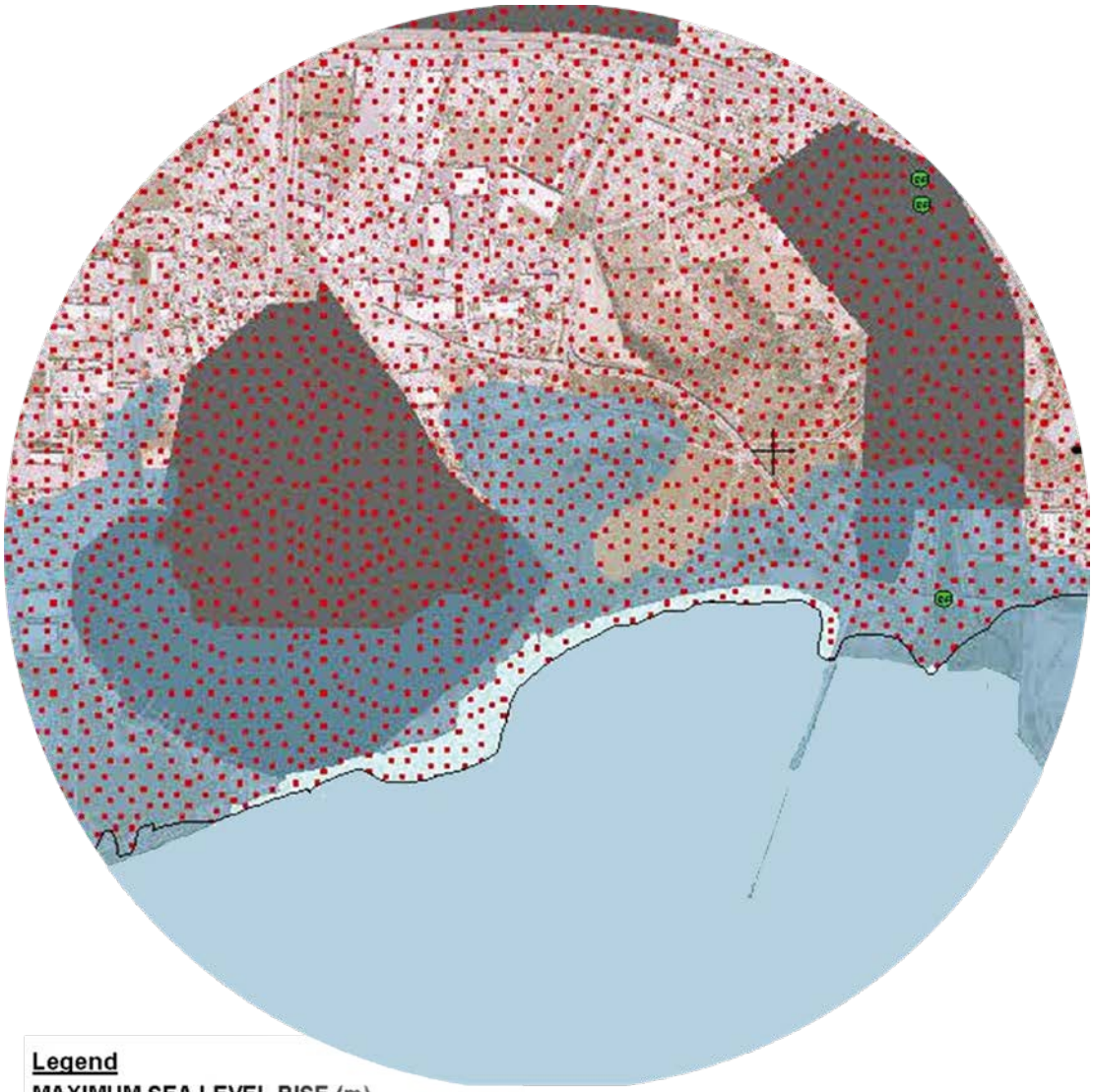
Perspective View of the West Waterfront





seveso area

proposed spatial urban plan



sea level rise
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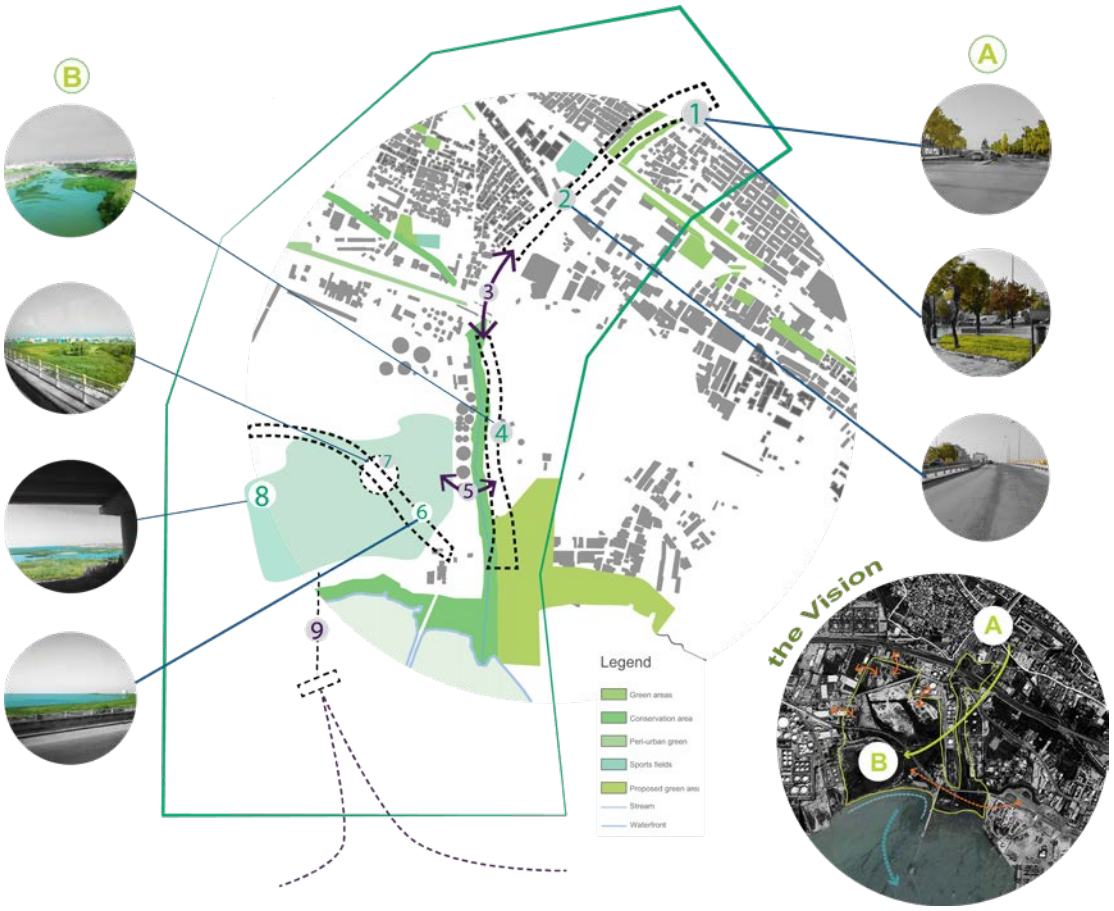

region master plan

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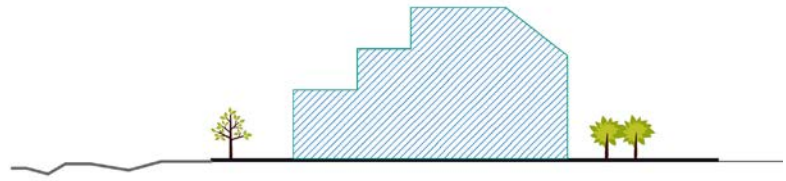
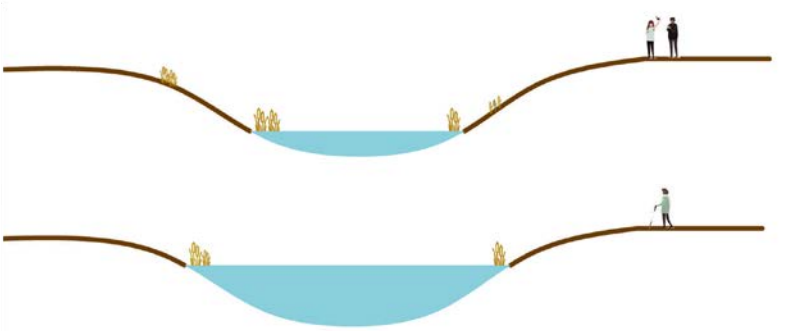
A Priority Resilience Area.
The Home Team. May2018

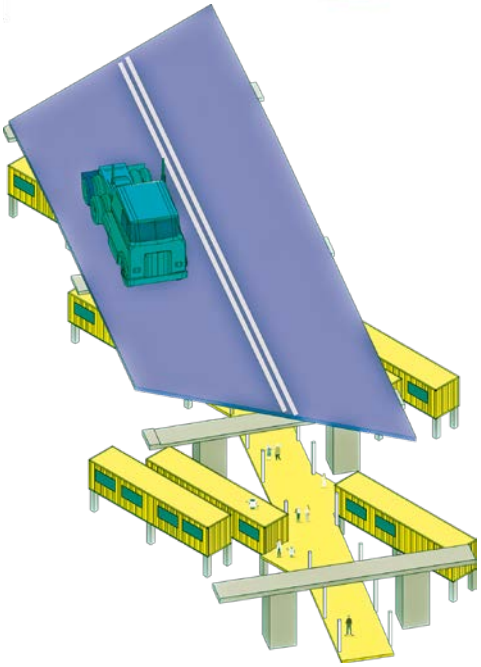
nature duality

manmade duality


lowland
landfill mounds
canals
wetland
water baisins
river Dendropotamos







section 1-1
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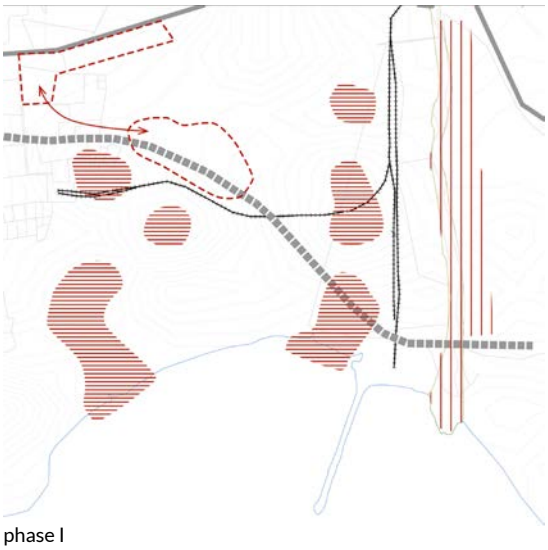
section 2-2

section 3-3

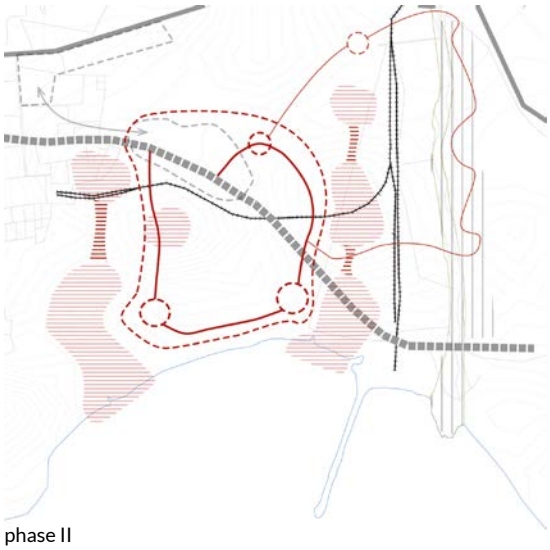
section 4-4

section 5-5

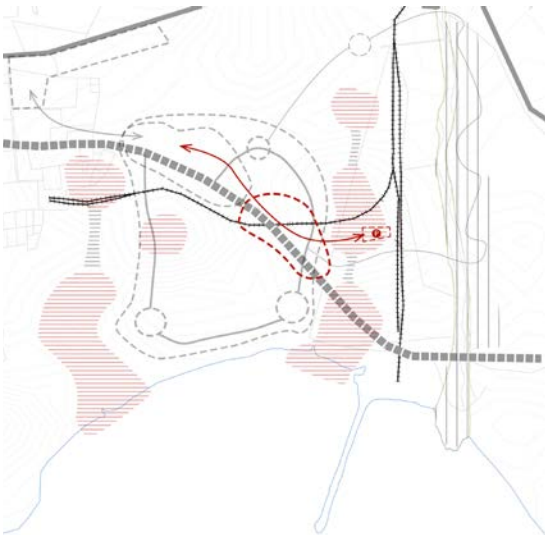
axonometric view of the containers
(section 2-2)



phase I



phase II



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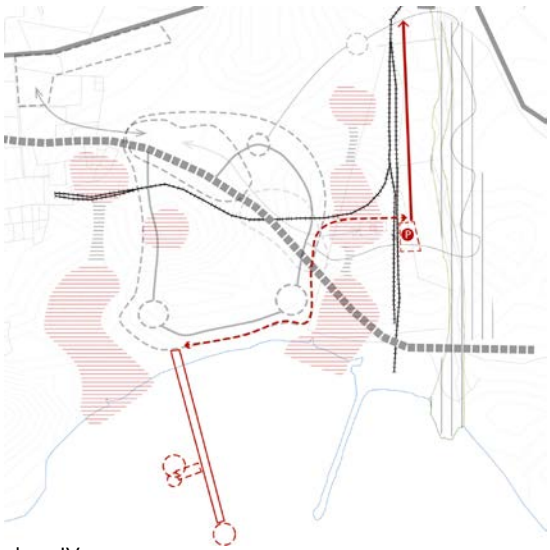

phase IV

basins

facilities

paths and streets

vegetation

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Future archeology: anticipating the rise of the sea water level

Abstract

According to French astrologer Michel de Nostredame, the 21st Century will bring Floods and other weather events. Currently, science can easily demonstrate that water has been changing levels through time. Between predictions and evidence, it seems obvious that sea level has been changing, so we may take this into consideration when designing waterfront. Architects, planners and specialists should predict scenarios discussing its constraints and opportunities.

This essay presents a theory for Future Archeology. The concept arises from the look into a specific site intervention concerning the sea level rise in Thessaloniki, more precisely the Galikos river delta, a post-industrial bank around Thessaloniki industrial zone. Menemeni is a Municipality neighboring Thessaloniki that connects the Aegean sea through n enormous industrial forgotten area. This "Junk Space" (Koolhaas, 2006) is what remains after modernization has run its course. The site appears as a natural remaining area from the industrial surroundings, with a small delta and huge variety of fauna and flora.

Future archeology is a theory that looks into a place-in-change as today's waterfronts and proposes an archeological study with a goal, not from past remains, but from future legacy. This legacy can be decided and studied in advance, as well as cataloged and archived. Also, from this action, today we can choose what to do with the physical body and selected archives. Knowledge brings anticipation. So, the first step is to set up this theory of the future archeology and, the second step, is to organize this methodology and demonstrate its pertinence to the near future.

Keywords: architecture; waterfront; Thessaloniki; future; climate change

Anticipate and recycle - ethics of ecology

The *Principle of Mass Conservation*, from Antoine-Laurent de Lavoisier, states that "In nature, nothing is created, nothing is lost, everything is transformed". But despite the beauty of the circular idea of the material world and the benefits of being able to reuse, we are prisoners of a "disposable society". The only way to escape is to recycle, we already know (Desilvey, 2017). Today we live in a time that makes evident the weight of the things left behind from past generations. The industry of recycling is a powerful solution, of course, but despite that we, as individuals and as a society, need some memory of the past, to better understand the present. Contemporary historians, researchers and institutions are making great advances in preserving the best examples, by scrupulously physically preserving some buildings, landscapes and even immaterial heritage, trying to extend the life of these examples to future generations. Nevertheless, it is evident that we can not save all buildings or turn everything into heritage, first because we really need to evolve, and second, because it is physically impossible, by weathering, intrinsic materials degradation, new space needs or, as we here discuss, by the change of the waterfronts, by the expected rise in water levels.

The phenomenon of sea water levels changing is not new, sea level has been highly variable, increasing usually during warm periods and decreasing during cold periods. In fact, about 18,000 years ago, sea levels were as much as 120 meters below present. Recent measurements[1] show that this "recent" rise in global sea level began with the Industrial Revolution and has started accelerating starting in the beginning of the 20th century. Since 1900 up to 2017, the global average sea level increased between 16 and 21 cm and some more accurate data collected from recent satellite radar measurements reveal an accelerated increase of 7.5 cm in the period between 1993 to 2017[2], which means a trend of around 30 cm per century. Scientific studies relate this acceleration to climate change, which is causing thermal

1 For this study, we have consulted:
European Environmental Agency: https://www.eea.europa.eu/data-and-maps/indicators/sea-level-rise-6/assessment
Climate Nasa: https://climate.nasa.gov/vital-signs/sea-level/
Flood Map: https://www.floodmap.net/
National Ocean Service: https://oceanservice.noaa.gov/facts/sealevel.html
Nature: https://www.nature.com/articles/s41467-019-12808-z
United States Environmental Protection Agency: https://www.epa.gov/climate-indicators/climate-change-indicators-sea-level

2 WCRP Global Sea Level Budget Group (2018). "Global sea-level budget 1993–present". Earth System Science Data. 10 (3): 1551–1590.

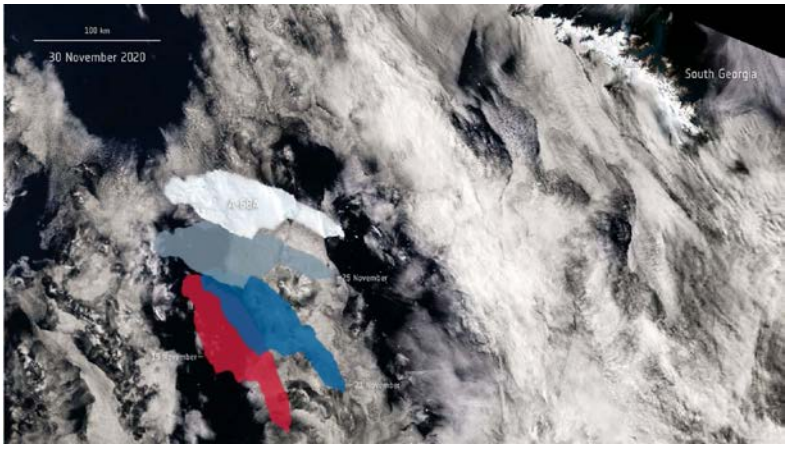

Figure 1. Composition with visual comparison between iceberg A-76 surface and Maiorca Island surface. The image is composed by a satellite image captured by a satellite of the Copernicus mission. In Lusa and Público, May 19, 2021. HYPERLINK "https://www.publico.pt/2021/05/19/ciencia/noticia/maior-

Figure 2. Image with movement study of iceberg A-76. In Público, May 19, 2021. HYPERLINK "https://www.publico.pt/2020/12/16/ciencia/noticia/missao-cientifica-vai-estudar-icebergue-gigante-soltou-antarctica-1943077"https://www.publico.pt/2020/12/16/ciencia/noticia/missao-cientifica-vai-estudar-icebergue-gigante-soltou-antarctica-1943077)

expansion of sea water and the melting of terrestrial ice layers and glaciers. Despite the differences in the interpretation of this phenomena, the reality already shows some of its effects with the ocean acidity and coastal flooding in several different points in the planet.

The European Space Agency (ESA) reported, on May 19, 2021, the detachment of the largest iceberg from the Roone ice shelf in northeastern Antarctica. It is a mass of ice measuring 4320 square kilometers, (larger than the island of Majorca (3640 km2) in Spain), called A-76. According to ESA, it is the largest iceberg in the world at the moment, dethroning iceberg A-23A (3880 km2).

Despite being a large iceberg, it is not among the ten largest on record. "In a big context, this is not gigantic,"said Mark Drinkwater of ESA. Even so, depending on your trajectory, it can have a significant impact. "It's big enough to influence the ocean and its salinity. Depending on the trajectory, it can be as significant as the A-68a", warns Alex Brisbourne. Last year, the A-68a iceberg even threatened to hit the island of South Georgia, which ended up not happening because it broke."

Meanwhile, as architects and participating together with the scientific community, stakeholders, and as individuals with extended responsibility with the built and natural environment, we should look up to coastal territory with double care: by thinking what and how to build or unbuild in a way to improve the performance of the place in the face of the recognized rise in water levels; and also in a way to reinstall the funcional life and the memory of the sites that we are going to lose. Despite the big level of positivity that we, as architects usually see in the future scenarios, the "Inconvenient Truth" is that a large portion of land, architecture, communities and cultural life (material and immaterial) is going to be lost, literally taken with the waves.

Architecture today is clearly informed by critical theory and assumes the task of reading and interpreting the signs of space, with the intention of activating it socially, through a critical artistic/architectural praxis that can be considered micro-politically operative; on this subject-matter see the analysis developed by Jane Rendell in her book Art and Architecture, a place between. Mário Caeiro in Arte na Cidade (Art in the City) also tells us that the practice of an "environmental-architecture" leads "to the production of experience, memory, context, in an era in which, for the first time in human history, memory is about, not with the past, but with the future" (Caeiro, p.367).

Thus, architects and urban planners have to look to the present and look for this hybrid and indefinite time dominated by a growing "alienating" technology in "crisis", (debtor of a past that has not ended yet, projecting itself into a future which has not just started), action strategies that can fit into a broader perspective of intervention in/on space. From postmodern geography to spatial psychosociology "it was a small leap for the most varied disciplines to exercise their property rights over a dimension that proposes to replace time and history. Formless, lacking a concrete definition, space became the favorable condition for the osmosis of diverse knowledge, the place of contagion." (Gadanho, 2009)

The Copernicus iceberg observation mission, which has two polar-orbiting satellites observing the most remote regions of Antarctica, serves as a metaphor for the method proposed here: with an anticipatory perspective, it proposes to observe and record through a sharp and critical look at the most sensitive aspects, sometimes invisible, but often the most important in understanding the place or socio-spatial territory. An "archeology of the future" is suggested as a method of intervention in changing territory.

Act with anticipation means that we can choose what to perceive and what to forget. Adrian Forty reminds us in his book *The Art of Forgetting*, another book of Alexander Lúria that described a man with the capacity to remember everything, a mnemonist. According to Forty, Lúria explained that his major problem was to forget due to the congestion of remembering everything. This is also a process that we should take in consideration in our "disposable" society, we have to choose what has the utility to preserve and what is better to forget. And here we find the first problematic: one thing is the individual memory, and another completely different is the collective memory. The second problematic is one stressed by Paul Connerton in his book *How societies remember* (1989) and it is that "past factors tend to influence, or distort, our experience of the present" (Connerton, p.2) so we may also stress that choices made today will influence or distort our experience in the future.

Past - memory and knowledge

There are some traumatic events that changed historiography studies definitively. Dana Arnold, in her book *Reading Architectural History*, argues about the impact on the writing of architectural history and the way in which it is read. She goes back to the Second World War and the visible threat of losing countless

buildings during the London bombings in Britain. “In 1943 the Ministry of Town and Country Planning was instructed to draw up an inventory of buildings of national historic importance” (p.8). Naturally, writing this list would have been a problematic process. What criteria can we use when choosing buildings to register for future memory? Have they artistic, social, political or cultural values?

This attitude toward the future is also understood in several called timeless constructions in the history of architecture and man. In his *The Timeless Way of Building* (1979), Christopher Alexander, discusses that it is not just the material permanence that starts a timeless building, but also a certain quality that “cannot be named” (p.28). So we can argue that the permanence of a certain object in the future can rest in its strong materiality as well as other qualities, either immateriality or subjectives. Alexander also speaks about the possibility of “being alive” as a constant that can be in “anything - in buildings, animals, plants, cities, streets, the wilderness - and in ourselves” (p.47). And, in this sense, we can bring different possibilities for things to be relevant, from the physical materiality, the invisible geometry and cultural significance of the pyramids of Gizé, to the character, standard patterns or even the uniqueness of day-to-day life and community values.

The architecture of our time has revealed, through the awareness of the fragile permanence of our “environments”, a purposeful approach to artistic sublimation. Able to translate a critical and sharp look at the space we inhabit, some of our contemporary artists take space “as an instrument of analysis for the human soul” – words borrowed from Gaston Bachelard who also writes in his *The Poetics of Space*: “the inhabited space transcends geometric space”. (p.385)

It is in this I/world relationship - ideas, actions, words, thoughts-emotion in relation to the reality of matter, the physicist, the object - that we observe the need to resort to memory as the only “tool” capable of establishing itself with the objective of reifying a life event, a critical analysis, an idea of the “past-future”. The ephemeral and increasingly rapid transformation of contemporaneity leads us to consider an “archeology for the future” as a way of establishing the “memories” that can reach a public place, that is, a place in the city, which according to Gonçalo M. Tavares is a collective way that man has found to become immortal. (Tavares, 2015) According to Tavares, “art” is also the thing that “(...) being a kind of useless architecture, with no

practical use, its greatest usefulness lies precisely in its durability, (...) which will occupy the number one position among things made by humans. (...) The artist promises that the object he made - under normal circumstances, excluding catastrophes - will last for centuries (...)." (p.35-36) We are facing the idea of the "immortality of the work of art". What lasts and registers our humanity as our ability to bequeath memory to future generations. On the other hand, we are confronted by the idea of "catastrophe", the only force capable of erasing the work.

We are at a time when the awareness of "human action" embraces our territory (see Joseph Beuys' ideas) threatened by the 'natural catastrophe' that creeps in at every moment. In the 1960s and 1970s, this ecological awareness and geopolitical relations became a matter of artistic interest. Movements such as Fluxus, Situationism, Events, Performance, Land art, Body art and Documental art, the latter crossing all the others for its own interest in the "document" but also for the aforementioned artistic desire to transcend the ephemerality of artistic actions and achievements, documenting them, making them "memory objects".

This is the sense of documenting human activity on the socio-geographic/political territory that we can find in the photographs by Bernd and Hilla Becher who originally intended to document the industrial architecture of the beginning of the 20th century that was disappearing, such as the towers of extraction on coal mines in the Ruhr, or water towers, houses built in the "Fachwerk" system, etc., but which later became an artistic process that allowed the creation of archives of "typologies" of architectural constructions designed by engineers or foremen leading artists to develop a sculptural concept for their photographs – "anonymous sculptures". From the document, there was a radical formulation of the concept of sculpture. The sculpture would no longer be the product of an authorial artistic practice, but of an anonymous work or work displaced from the artistic field revealed by the document: "the sculptural practice of material production is replaced by a practice of reading and recording (photographic)". (Loock, p.65)

Robert Smithson, too, seeks to avoid the limitations or cultural determinations of art by integrating terms such as "landscape" and "architecture" into his sculptures, (see Partially Buried Woodshed, a log cabin that was partially buried by 20 earth trucks in 1970), terms that, according to Rosalind Krauss, go against the traditional concept of sculpture (sculpture is neither

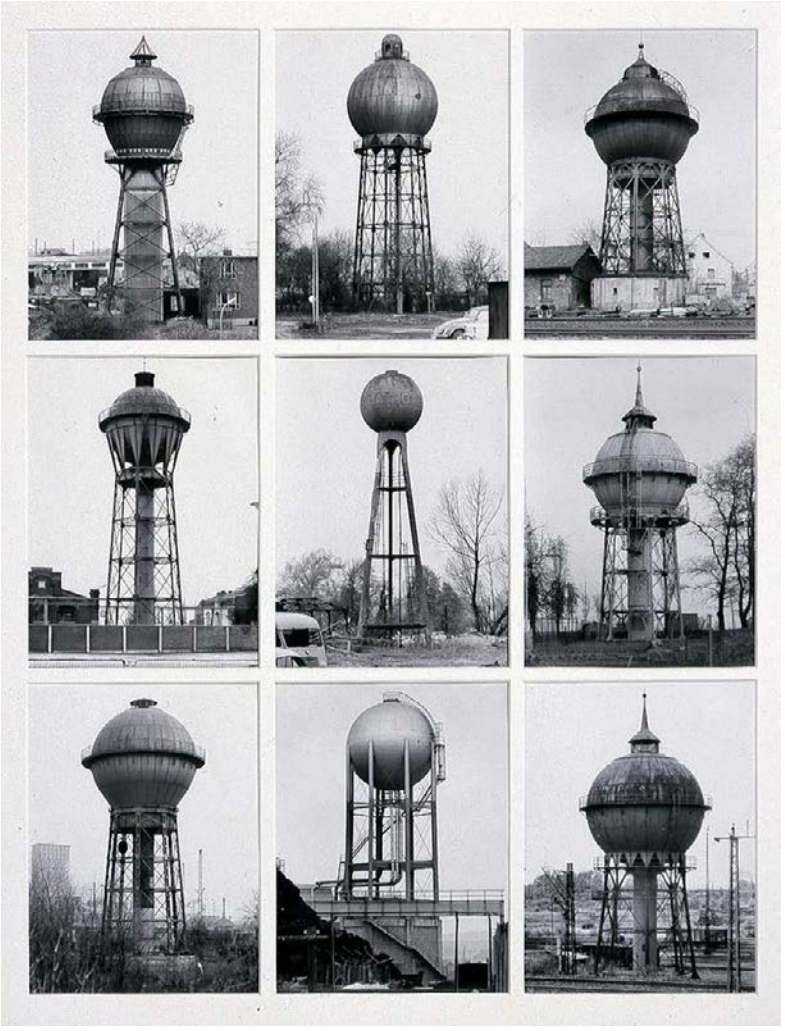

Figure 3. Bernd Becher and Hilla Becher 1931-2007, 1934-2015. fromWater Towers. on paper, print. 9 photographs, gelatin silver print on paper. 1972. Source: The Broad. © Estate of Bernd Becher & Hilla

landscape nor architecture). The concept of "entropy" developed by Smithson feeds on the "destructive" relationship between architecture and landscape and can be understood as the opposite of all architectural construction. Smithson tells us: "Architects tend to be idealistic rather than dialectical. I propose a dialectic of entropic variation." (Loock, p.84)

The artistic project on the ruins of the Hotel Palenque, close to the Mayan archeological site of Yucatan, illustrates well this dialectical conception with the (de)constructed landscape, or rather, using its own words, a landscape of "de-architecture". Smithson photographs a hotel that was abandoned in the middle of the work and comments on it slide by slide. He describes its formal and aesthetic characteristics with words – (undifferentiated, centerless, pavement-free, polychromatic, etc.) – that seem to emerge from the theories of architectural post-modernity, confirming the revolutionary transition from plastic arts to architecture. In his words: "(...) in fact, I spent many happy moments at the Hotel Palenque meditating on this section. I really like it a lot. I like that broken look. It seems that we are seeing the hammers hitting and tearing out the pieces of cement". (Loock, p.86)

Gordon Matta-Clark, in an attitude similar to Smithson's "de-architecture" and taking into account the advances in minimalism, in particular Carl Andre's "cut in space", advances with the term "anarchitecture" which gave its name to a homonymous group founded in 1973 that proposed alternatives in/for unstable urban spaces; "metaphorical voids, intervals, spaces that were left over" defined Matta Clark. (Loock, p.95)

Clark, literally, began cutting down houses on the chaotic outskirts of urban centers. Simple gestures towards complexity: a strong criticism of urban degradation and real estate exploitation but also, and now in a non-real but metaphorical sense, an act of salvation; an operation that is not only aesthetic but also ethical. Like Bechers or Smithsons, the documentation of these cuts on architecture gives visibility to constructions that are doomed to ruin and destruction, proposing a meditation before their collapse. In a literal sense, the cut opens tears bringing light and new spatial possibilities, destroying the public and private dichotomy, attacking the intimate and feminine space inside the house, freeing corsets from the traditional functions (even gender) of the architectural space.

Figure 4. Robert Smithson, Hotel Palenque,1969-72; facsimile of the page 84, In: Loock, Ulrich (Ed.) (2005). anArquitectura, de Andre a Zittel. Colecção de Arte Contemporânea 04. Porto: Público, Serralves.

Robert Smithson comments on the lower right image:
"This slide shows an interesting situation. It's obvious that at some point they decided to build some floors and then they thought it wasn't a very good idea and demolished them, but they left that effect of jagged, irregular irons projecting from the wall. I think of Piranesi. I don't Know if you're familiar with Piranesi's prisons, but they're full of floors that don't actually lead anywhere and staircases that simply disappear into the clouds and this looks like it's going to bury itself in mexican soil, leaving us only with the beautiful structure of that wall, I especially like this technique. It is a "de-architecture", we could say. It's a release from unnecessary floors. After all, floors aren't just meant to be walked on, I mean, we can have a partial floor motif. In Fact, I spent many happy moments at Hotel Palenque meditating on this section. I really appreciate it. I like that split look. It seems that we are seeing the hammers hitting and pulling out the pieces of cement.``

As he himself wrote, in several of his texts or cards, “the cut creates space without building”. The actions of “cutting buildings”, together with their “art cards”, “subtracted drawings” and “photographic cuts”, reveal a concern with decomposing and analyzing architecture and social space, taking “cutting” as an analytical act . (Ribas & Sardo, 2017)

Present - curating the shore

It is a fact, currently, we deal with a tense situation of the accumulation of material artifacts, but also of immaterial knowledge. Our difficulty lies in being able to find a useful order among this unbounded accumulation of knowledge layers so that this knowledge makes sense and is, in fact, useful to us.

Globalization process of the free market and the democratic system are the most significant evidences in the transition from the 20th to the 21st century. The result is a hyper communicative world, where the massification of available information is such that it becomes contradictory, or worse, banal and inconvenient. The slow sequence of maturation of facts and ideas was broken, restraining a more natural acceptance of facts and transforming the simplest analysis processes in a complex system of knowledge building. The complexation of knowledge construction makes it difficult to create a more objective knowledge, thus contributing to a subjectivation of individual, society and institutions positioning.

In a perspective that History is the memory we need to locate our present, we can say that in the past, this History was willing to memorize monuments of the past, while in the present History is the means that turns documents into monuments (Foucault, 1969, p.8). We witness, on the one hand, the inconstancy of truths and, on the other, their impossibility of generalization, characteristics that trigger the notion of relativity of historical knowledge. So, we can now look at our History as something alive and continuous, something that depends on the human.

Artistic production generates visions of the world that we want to share and that communicate to us, as we have seen in the aforementioned works, innovative perspectives on history and reality, leaving us with objects (documents) for the future. Any artistic object is a mediator of meanings and conveys plural narratives, provoking the spectator, who thus becomes a participant in the work. In this sense, artistic objects are investigations that one wants to share; questions that need to be asked; absences that you want to fill.

Figure 5. Gordon Matta-Clark, Splitting (interior view), 1974 (Collection Centre Canadien d'Architecture, © Succession of Gordon Matta-Clark and Estate of Gordon Matta-Clark. Reprint made by the Estate of Gordon Matta-Clark from Matta-Clark negatives. Original photograph in the collection of SFMOMA)

Natália López tells us that for Arthur Danto art has come to an end. The grand narratives that defined the history of traditional art were completed. The "end of art" is the end of a historical narrative. We are now in a post-historical epoch where "anything goes", including the questioning of aesthetic judgment. For Danto, the paradigm of contemporary art is symbolized in "*collage*" or appropriation. (López, p.41) With Picasso's *collages* and Duchamp's *ready-mades* or surrealist *photomontages* and *objects trouvé*, tactics of choice and decontextualization are inaugurated, which nowadays reach subversion and play.

Take the example of Rachel Whiteread's action when filling a Victorian house with concrete (the last in a row of identical houses that were destroyed), then removing the casing, that is, also destroying the artist herself, the house. With this operation, she conserves the interior (memory, intimate life) of the 'house', inverting the logic of full/empty space. All the details of the interior of the house – switches, windows, baseboards, textures, etc. – thus became visible from the outside. These printed marks (negative collages) made public what was previously private, breaking, like Matta Clark, the traditional separation between pre-conceived spaces and denouncing an "urbanistic" situation that was leading families and their memories to eviction . This double violation, the first political and the second sculptural and architectural (the intervened space became a closed body, with the interior facing outwards), was left for public interpretation for one year so that the community could reflect on the idea of a "monument in the public space" on a human scale, about the "use value", the ephemeral nature of life, art and architecture; about memory and "the desires and fears of a population". (Loock, p.238-139)

Future - archeology

The past leaves its traces in the form of archives, be them documents, oral tradition or the things themselves, and archeology works exactly with this materiality of things left behind. Regarding architecture, as Arnold refers "to consider a building in isolation as a total history in itself, and concentrate solely on form or appearance, is to denote it of much of its meaning. This demonstrates that the sum of the parts of "architecture" is greater than the physical whole" (2002, p.7), that is to say that the representations of architecture open a variety of readings that can begin a process of specification, subjectivization and criticism, all contributing to the valorization of knowledge.

Figure 6. Rachel Whiteread, House, 1993-94, project commissioned and produced by Artangel, London. Source: https://awarewomenartists.com © Photo: Rachel Whiteread

Now bringing the case of the unstable waterfront that we predict today that it is going to disappear somewhere in the future, we can today also say that the waterfront itself is the primary archive and that it will totally or partially disappear by demolition, ruin or the passage of natural deterioration due to erosion of wind, water and other atmospheric conditions. So, it will be the, what we call here, the secondary archive, or its representations, the source of our waterfront memory in the near future: drawings, photographs, films, literature, journalistic material, official documents, surveys and databases among many others.

This exact line of thought happened during the 2nd World War, when in 1943, there was a place to instructions to draw up an inventory of buildings of historical national importance with at least a photographic or drawn record of the British Monuments.

The architect and artist Maia Lin has developed a work that we can also interpret as a kind of inventory of the way we experience and relate to the (threatened) landscape, establishing a systematic ordering of the land linked to history, memory, time and language. His interest in landscape is revealed in works influenced by topography and geographic phenomena and his most recent project *What is missing*[3] is a memory of the ecosystem "in action", it is not establishes itself as a "fixed monument", but rather as a palimpsest work, which uses various means (photography, video, maps, sounds, testimonies) to document several places, simultaneously appealing to the participation and involvement of all. On the project's website, Lin calls for the sharing of memories about conservation or ecological restoration or about situations of disappearance or alteration and reduction of threatened ecosystems or geographic spaces[4]. It is a project that uses virtual means of communication, spread by globalization, but that places them at the service of the ecological cause whose logic goes from the micro to the macro scale, underlining the importance of participation and freedom from the "active will" described by Beuys as the "good will of the creative act", in his words: "for the personal responsibility regarding the participation in the work of shaping the world or of a future image of man and the world." (Harlan, 2021: 162)

In this reflection, we propose the task of registering the intervention sites and, as a possibility, reporting to Maia Lin the fragility of this territory, or simply recording/creating, as in the

3 https://www.whatismissing.org/
4 https://www.whatismissing.org/share-a-memory

examples mentioned above, a critical document on the landscape of Menemeni that it needs, like most post-industrial seafront or riverside territories, a critical review and alternative readings to enable a creative intervention, that is, and according to the above, a creative intervention socially and ecologically committed and multidisciplinary.

In Thessaloniki, we clearly see that no matter what main problematics we are dealing with, legislation, forgotten leisure buildings or post-industrial patrimony, we do have a common concern: to chose what we can keep and what we must let go during this process of rising of the sea water levels. Nature is relentless here and science has been unanimous enough. Our role here, is not to continue the discourse of misfortune about that awaits us in the future or to make even more different predictions, but to assume that nature a new order here and the usefulness of our role here as architects is to look to the future and imagine space, as defined as possible with the help of meteorological, physical and geological sciences and, with the help of these predictions, decide on two major vectors of action: defining this future limit line in order to improve the future situation and defining the *future archeology*, determining so what will be the memory of these water fronts, their shape, their people and their architecture.

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Team Project III

Kalamaria I

External Participants
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Meropi Konstantinidou
Olga Strongylou

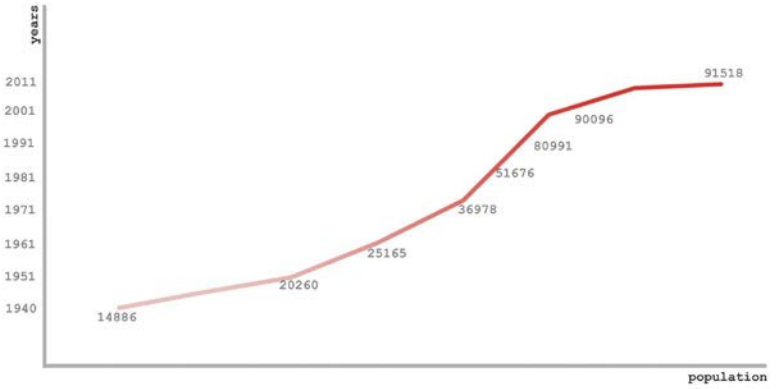
Studio Tutors
Konstantinos Sakantamis
Isabel Barbas, Lilia Isyk
Michal Habier

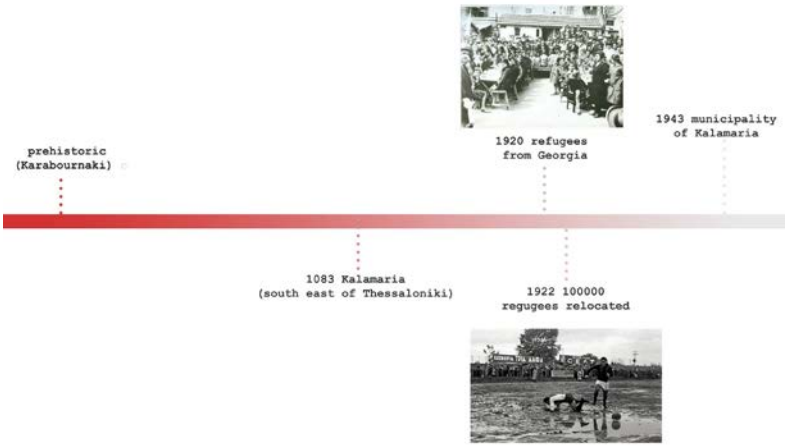
The climate of the Municipality of Kalamaria is typically Mediterranean, with cold and humid winters and hot and dry summers. Its main characteristic is the increased humidity, which is mainly due to the presence of a mountainous bulk to the north and the east of the city combined with the proximity of the closed, shallow and warm sea of the bay.

According to a future scenario for the years 2070-2100 (National PRECIS regional climate model Athens Observatory) the average monthly maximum temperature in Thessaloniki will show significant increases, especially in spring and summer. In the last years the city has become more arid as the annual rainfall has been severely reduced. (In particular, the average rainfall in the period 1959-2007 was 579 mm, with 1955 showing the highest annual rainfall, 612.1 mm, and in 2000 the lowest, 231.7 mm) Another important element is that the pace of the sea level rise in the city of Thessaloniki is greater from the world average (1-2 mm / year) and in particular shows a rate of 4.0 mm / year. It is estimated that Thessaloniki, along with the Nile Delta and Venice, are the areas that are expected to face the biggest problem because of sea level rise.

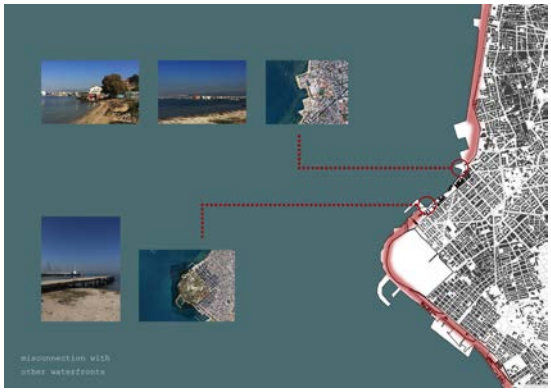
During the 20th century the area of Kalamaria started developing -around the prehistoric site of Karabournaki- when refugees from Asia Minor settled there after 1912. The Municipality of Kalamaria was founded in 1943. The urban fabric of Kalamaria is cut away from its still natural waterfront zone which has remained unplanned due to land ownership issues. The waterfront area is characterized by a diversity of building types with 6 floor apartment blocks and small illegal buildings side by side, forming an awkward landscape. Moreover, the local population's belief that the sea is polluted, discourage them from using the natural beach which is easy to access.

The strategy proposed acknowledges the importance for this natural waterfront site and reflects the idea of the community about the need for more public spaces in the area. A high priority of the proposed plan was linking the residential blocks to the waterfront through a network of green corridors and the redesign of the natural beach.

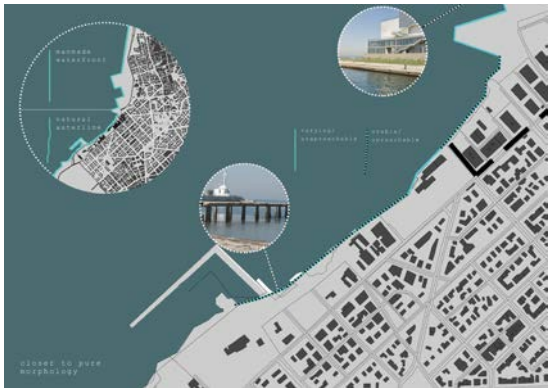

years
2011
2001
1991
1981
1971
1961
1951
1940
14886
20260
25165
36978
51676
80991
90096
91518
population

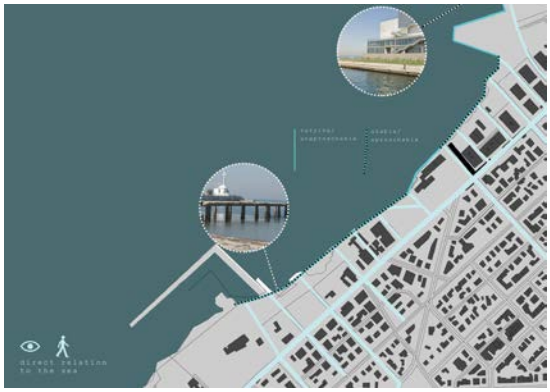

prehistoric
(Karabournaki)
1083 Kalamaria
(south east of Thessaloniki)
1920 refugees
from Georgia
1922 100000
regugees relocated
1943 municipality
of Kalamaria

abandoned


misconnection with
other waterfronts


_link to the local


closer to pure
morphology

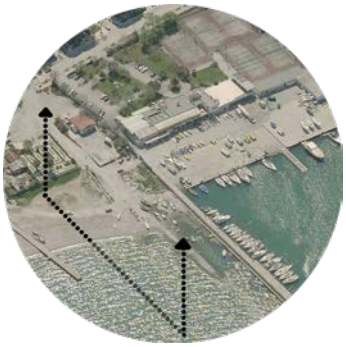

direct relation
to the sea

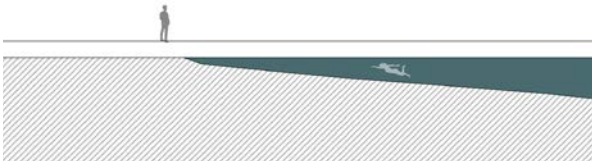

illegal buildings
legal difficulties

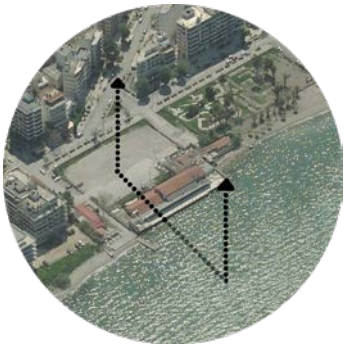

fear of
polluted water

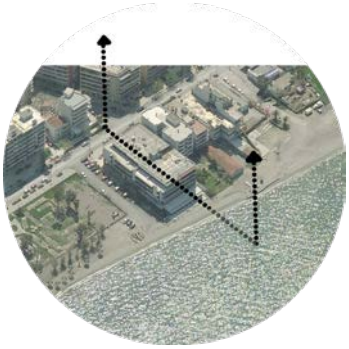

EDGE
BORDER OF
MUNICIPALITIES
DISCONTINUITY
CHARACTERLESS AREA
DISTRICT
POINT OF CONFUSION
DISCONNECTED, HIDDEN
WATERFRONT
FEAR OF THE
POLLUTED WATER

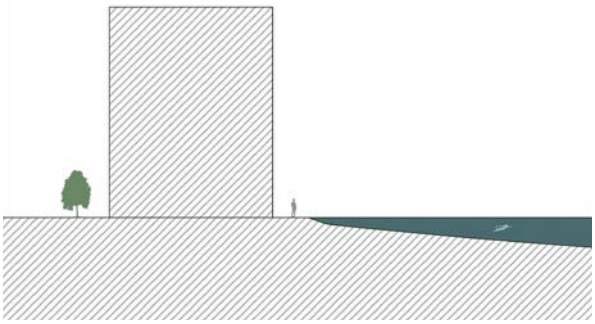

future possibilities
potentials

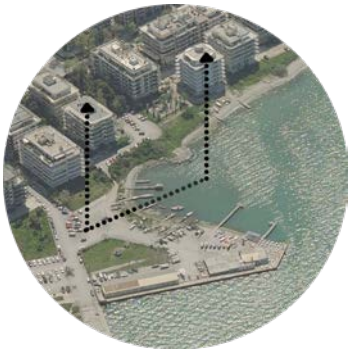


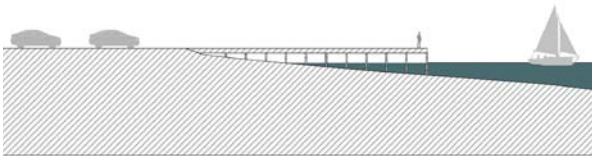


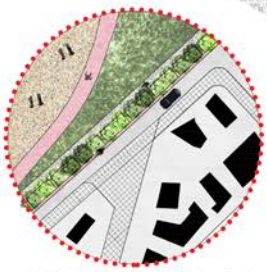










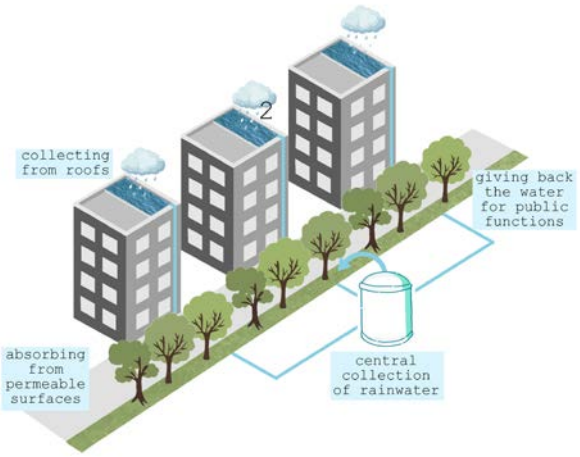


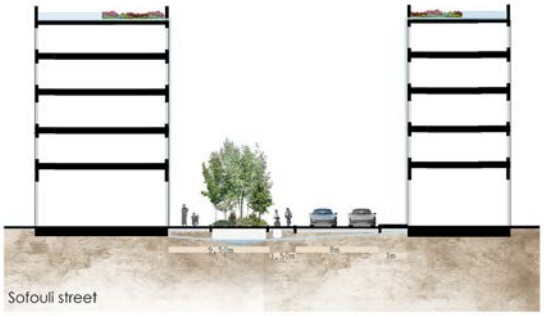
Sofouli street - diagonal pedestrian street

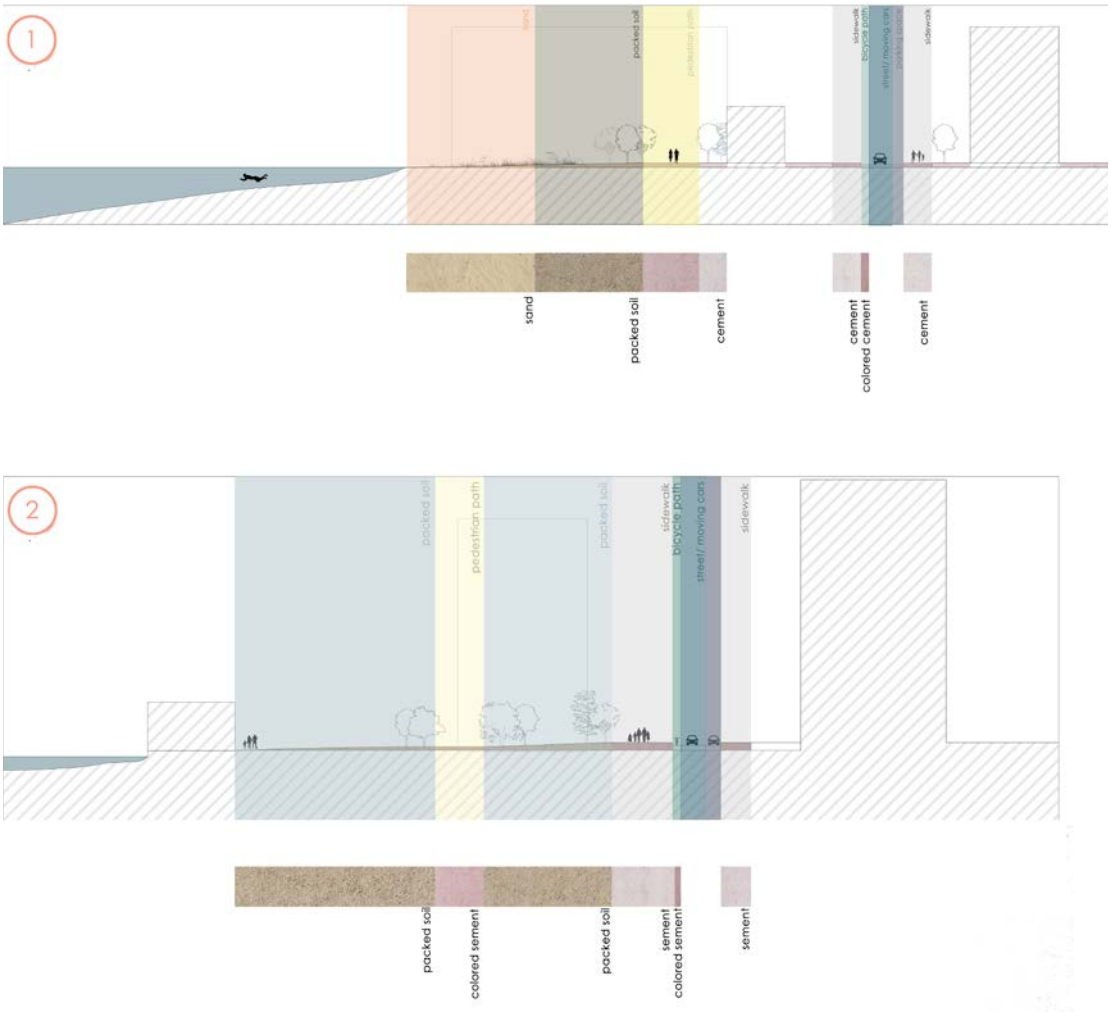
diagonal pedestrian street - slow traffic street

slow traffic street - main two way street

rain water management






1
sand
packed soil
pedestrian path
sidewalk
bicycle path
street / moving cars
parking space
sidewalk
sand
packed soil
cement
cement
colored cement
cement
2
packed soil
pedestrian path
packed soil
sidewalk
bicycle path
street / moving cars
sidewalk
packed soil
colored cement
packed soil
cement
colored cement
cement


0
100
200
300
1
2

Team Project IV

Kalamaria II

External Participants
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Olympiada Babuka
Steriani Konstantaki
Charikleia Papaioannou

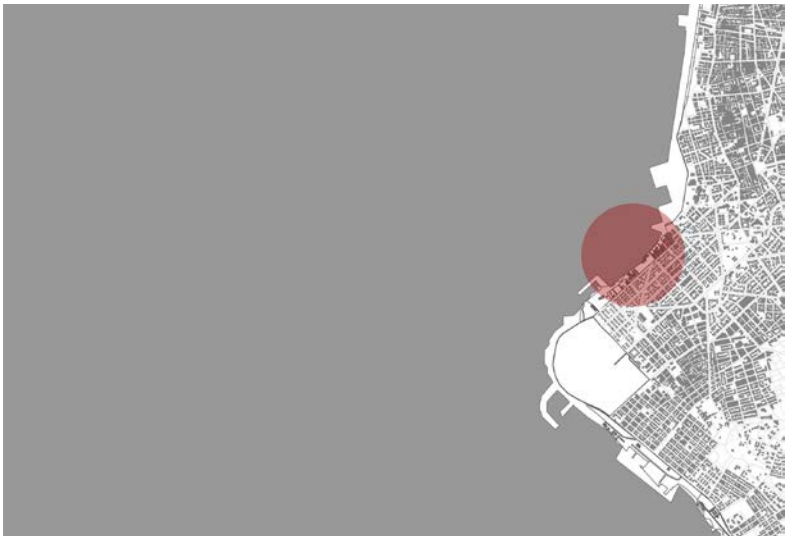
Studio Tutors
Alkmini Paka
Pedro Ressano Garcia
Natalia Chrysikou

The case study area is located on the east waterfront zone of Thessaloniki -on the boundary between the municipalities of Thessaloniki and Kalamaria- and more specifically between the Concert Halls site and the Nautical Club of Thessaloniki.

The analysis of the region captured in a series of maps the current state and the various conditions that co-existed in the wider area. The existing natural shoreline of the site is badly maintained and underused while there is no connection to the rehabilitated New Waterfront promenade of the city, a main attraction point for visitors and locals. This lack of connection is not only confined to the coastal promenade but also concerns the urban fabric of Kalamaria as well as the wider area of Thessaloniki. The present image of the site is that of derelict and abandoned public space.

The main objective of the project was the direct connection of the coastal front with the long promenade of the New Waterfront, so that the flow of pedestrians will not be diffused. Furthermore, the green spaces along the existing or preexisting streams within the urban fabric were used as green corridors to link the natural beach with residential quarters promoting pedestrians flows. In addition, it was considered important to preserve and enhance the existing green public spaces which would serve as a transitional zone between the dense urban landscape and the waterfront. The natural beach of this particular area in the dense urban fabric of Thessaloniki can serve as an attraction for all age groups taking on a variety of uses and activities.

Among the new proposed functions were urban swimming pools, floating platforms and new urban green infrastructure promoting sustainable mobility and improvement of environmental conditions while responding to the expected sea level rise in the coming decades.



Climate data

Municipality of Kalamaria

- **mediterranean,** with cold and humid winters and hot and dry summers

- **increased humidity,** which is mainly due to the presence of mountainous bulk combined with the proximity of the closed shallow and the warm sea of the bay of the city

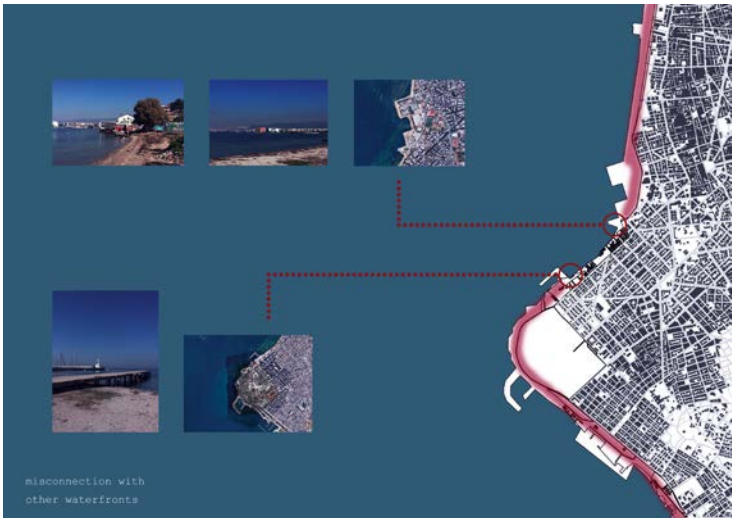
- **highest** average annual **temperature** recorded in 1958 **(21.60 ° C)** and **lowest** in 1965 **(8.30 ° C)**

- according to a **future scenario for the years 2070-2100,** the **average monthly maximum temperature** in Thessaloniki **will show significant increases,** especially in spring and summer

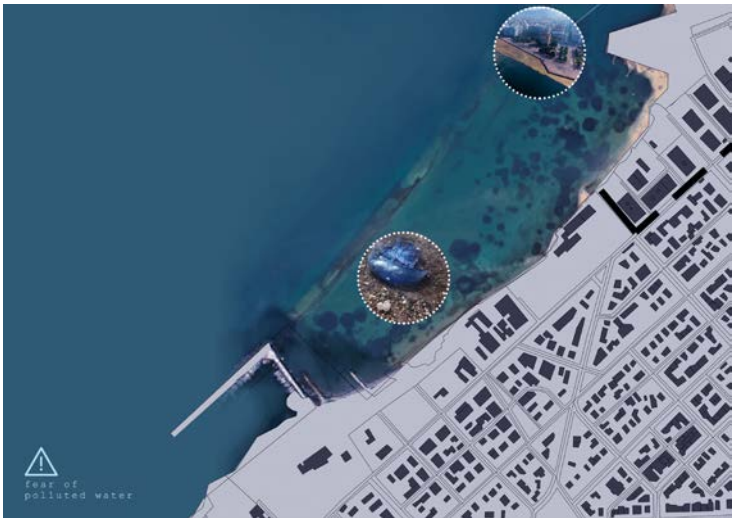
- in the last years the city has become significantly **more arid** as the annuals rainfall was severely reduced and became more rapid

- **the sea level rise** in the city of Thessaloniki is greater from the world average.It is estimated that Thessaloniki, along with the Nile Delta and Venice, are the areas that are expected to face the biggest problem because of it sea level rise, as expected at its average level sea level in the Mediterranean will increase at a rate of 5 cm / decade. Basically it will increase by 50 cm by 2100

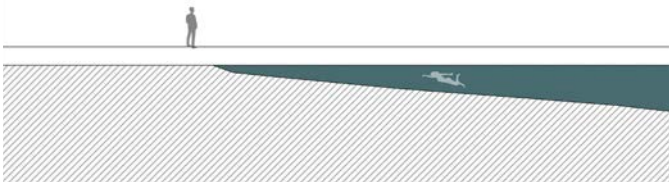
General Information

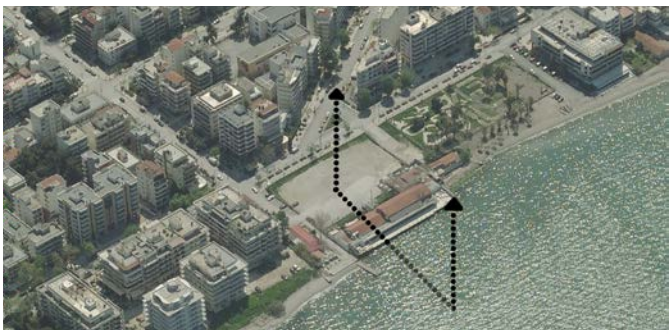


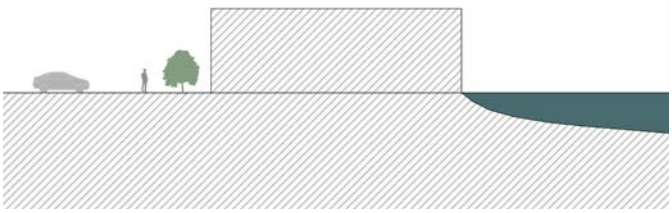
Importan Issues - Diagrams



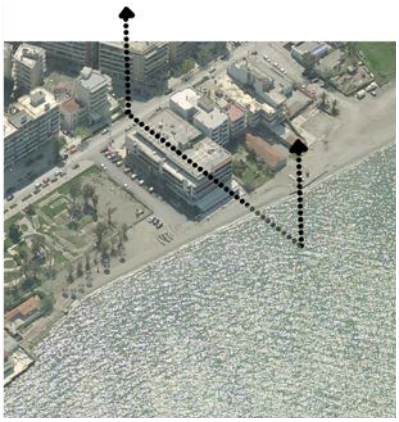
Importan Issues - Diagrams

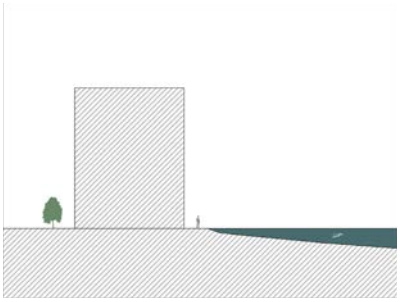


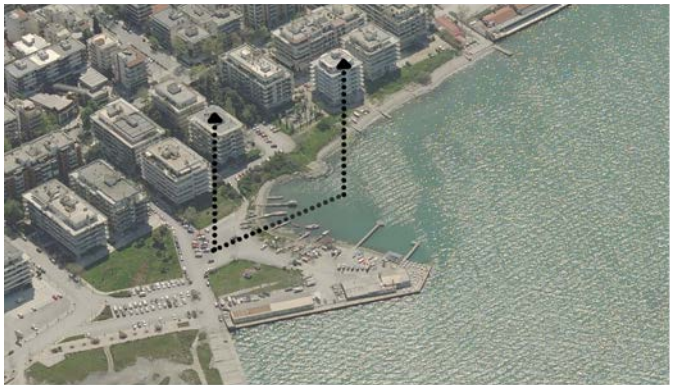


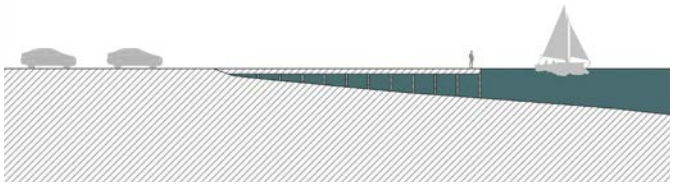


Sections - Current Situation

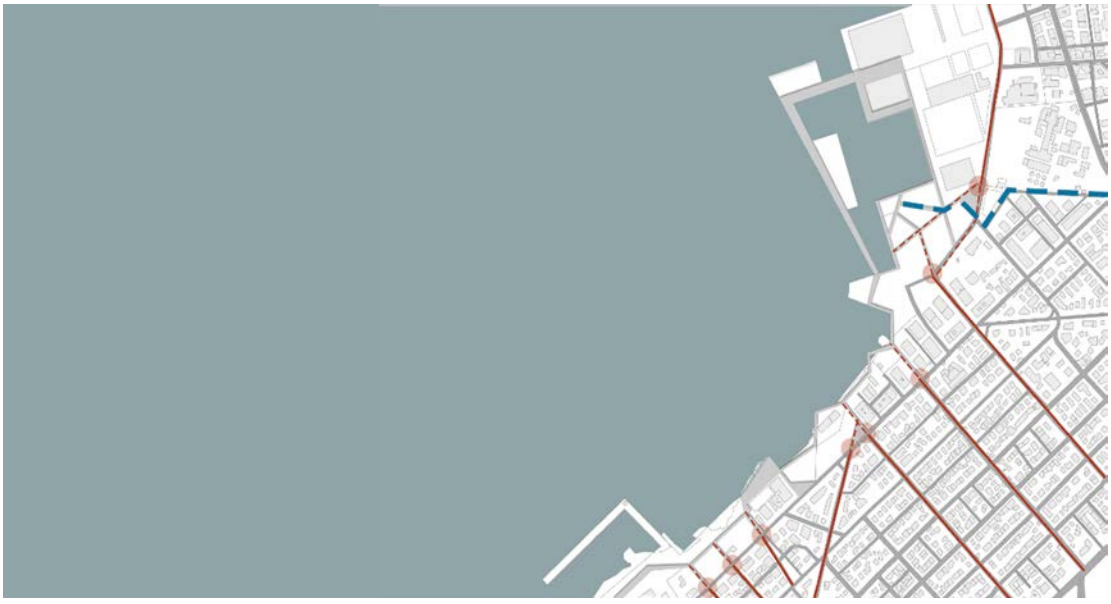








Sections - Current Situation



Strategic Plan Diagram 1
Connect the new Waterfront of Thessaloniki with the project area

Strategic Plan Diagram 2
Connect the Waterfront of the project area with the urban fabric

Strategic Plan Diagram 3
Maintaining the existing greenery|highliting the natural environment

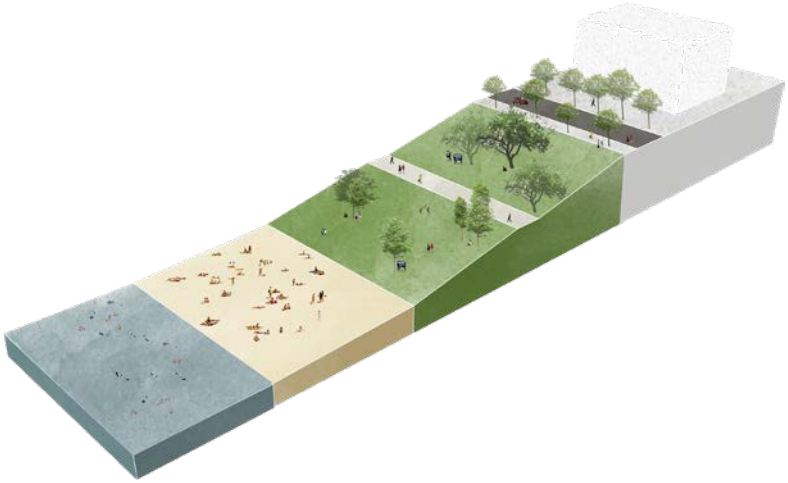
Strategic Plan Diagram 4
Proposed functions

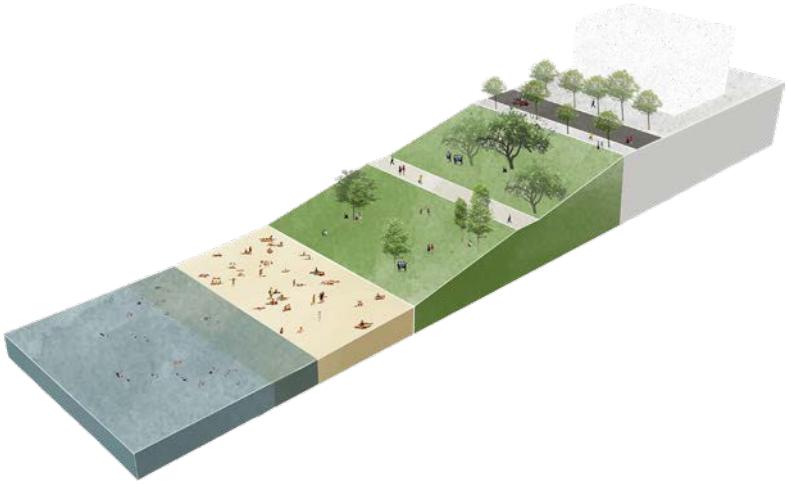
Proposal - Area 1

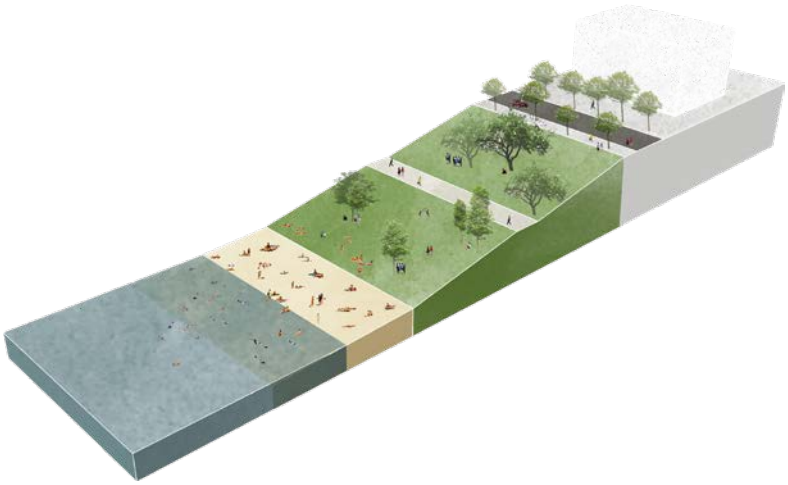
Proposal - Area 2

Proposal Plan

Proposal - Area 3





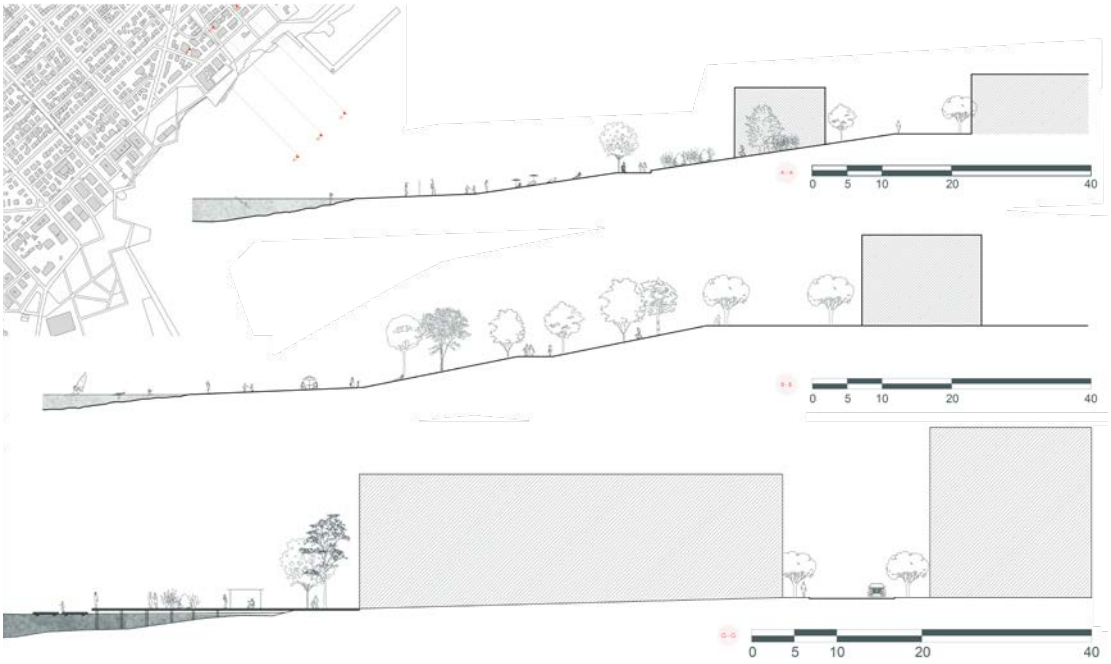


Sea Level Rise Diagram
- Today
- 20 Years Later
- 50 Years Later


Vegetation
cercis siliquastrum
liquidambar
acer negundo
tilia platyphylus
ornamental morus
dictamnus
levanda
rosemary
taxus baccata


Materials
asphalt
high strength cast pavement
cast pebble pavement
cold white color plaster
decking wood
cobblestone
lawn
compacted soil
water

Sections


0 5 10 20 40
0 5 10 20 40
0 5 10 20 40

Crisólita Fortes Fonseca

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Universidade Lusófona
de Lisboa, Department
of architecture and
urbanism

The coastline / land relationship in waterfront cities: the case study of the municipality of Kalamaria

Abstract

This article intends, through the "Theory of Social Logic of Space", to study the urban accessibility of coastal cities and their relationship with the waterfront based on their morphological structure. Taking the municipality of Kalamaria as a case study, the objective develops from the understanding of the potential of the connection of the sea and the coastline with the inner urban fabric, reinforcing the marine characteristics in the neighbourhoods, social integration, living with nature and specifically contributing to the regeneration and the revitalization of the northwest coast which currently presents some degradation. The Angular Segment Analysis method was used to assess accessibility to the shore, resulting in a set of integration and choice maps on a global, regional and local scale, thus enabling a more detailed spatial analysis. The achieved results, associated with the empirical analysis, allow the identification of the most segregated areas on the shore and could support future coastal interventions.

Keywords: Land / sea interaction; urban structure; Kalamaria; Space Syntax; Angular Segments Analysis.

Introduction

The spatial configuration of coastal cities can be assessed in different ways, namely in terms of the use and function of their coastline. Some of these areas, initially related to port activities and defence infrastructure, became obsolete with the beginning of deindustrialization and technological change. However, the conditions of abandonment don´t indicate the end of direct interaction in the land/water dynamics, nor do they devalue the relevance of ports in the current economy of cities. With the emergence of post-carbon societies, the development of clean energies and concerns about climate change (Costa, 2013), issues regarding the resilience of the urban coastline and the harmonic coexistence with the urban territory are highlighted.

In fact, the climatic changes of the last decades have been the main causes of transformations of the coastline, which could contribute to the disarticulation between the city and its shore1. However, according to Castro (2011), the land/water interaction goes beyond the physical and direct connection, also passing through the way the coastline is experienced and perceived within the city. The assessment and enhancement of the seafront interconnected to urban accessibility, can promote coastal identity beyond the land physically connected to the coast, support effective revitalization and aim at environmental protection. This way, it could become an asset in monitoring and adapting the coast to climate change. In this study, coastal identity is understood "not in the sense of equality with anything else, but meaning individuality or particularity" (Lynch, 1960, p. 18), as the construction of a pattern (Hillier, Leaman, Stansall, & Bedford, 1976), that is, the liveliness of the water in the interior urban fabric and the enjoyment of coastal quality throughout the urban territorial expansion.

The "Theory of Social Logic of Space" or Space Syntax [SS] also used in the investigation of the physical accessibility of the object, contributed to the understanding of the main objective of this article: the urban accessibility of the municipality of Kalamaria. As such, the understanding of the relationship between the urban structure of the city and the coastline, the physical accessibility of the city to the sea and the integration of the water in the interior urban spaces, in order to contribute to the regeneration and revitalization of the coast. This coast, located on the south extension of the new waterfront of Thessaloniki, currently

1 Some actions to improve these conditions are explained in items 13 and 15 of the Sustainable Development Goals [SDG] of Agenda 2030.

presents some urban degradation which according to Yiannakou & Salata (2017), makes the area vulnerable to climate change. In this context, physical accessibility is used as the easiness by which the waterfront environment reaches the inner urban fabric. The Angular Segment Analysis [ASA] method of SS was used in this urban study, elaborated from integration and choice measures, at the global, regional and local morphological scale. However, it should be noted that the study does not frame the temporal dimension of urban transformations, environmental, social and economic processes of the city, capturing only the current physical and relational nature of the waterfront with the urban structure.

The theory of space syntax and the angular segments analysis

Space Syntax [SS] was developed in the 1980s by Bill Hillier and Julienne Hanson at the Bartlett University College of London. It was published in the book 'The Social Logic of Space', arguing how the spatial configuration could interfere with human behavioural patterns.

SS is based on a diversity of principles described mathematically, allowing to generate graphs[2] and numerical results, and to map and analyse spatial configurations and human preferences in buildings and urban areas at different morphological scales. For this, data processing software is used, applying three techniques, which allow graphical analysis of the studied area: linearity[3] - axial or segment, used mainly in axial maps to analyse the urban system; convexity[4], best for analysing closed spaces; and isovists[5], used essentially to show different perspectives of urban squares and public spaces.

A new way to study the theory was proposed by Turner (2000): Angular Segment Analysis. ASA allows a more complete analysis than the classical, axial analysis, in which: i) the relationship between parts of the city is not only topological, but also angular; ii) the 'break' of the axes at their intersections with other axes, allowing the calculation of each individually created segment.

2 In space syntax, the points of a graph denote spaces (for example, streets, rooms, or corridors), and the lines represent intersections between pairs of spaces.
3 Considering that people move in line, it represents linear spaces and the potential for movement in them. They can be represented in the form of axial lines, segments or road center line.
4 The space in which everyone can see everyone else. It enables co-presence, that is, people interact in convex space.
5 The representation of everything that can be seen directly from a given point in space. When we move through complex patterns of space, in built environments, it makes it possible to change the visual field

(Castro A., 2016). It measures the accessibility and traffic potential of each street segment in relation to the whole.

The models generated are used to predict socio-economic consequences, diagnose problems in buildings and cities, test development options, design the built environment, and support decision-making. They include space - motion models, and space - attractiveness models. The former are used to describe and predict pedestrian/vehicle movement in relation to spatial form, and the latter explore the different activities that manifest themselves in the structuring of space.

Most of the calculations applied in ASA are similar to those of the axial analysis, although they have undergone changes to adapt to the new way of analysis. The values are presented on a chromatic scale, where conventionally warmer colours (red and orange) indicate a higher potential for accessibility in that calculation, and cooler colours (green and blue) indicate a lower potential. (Castro A., 2016). The main parameters used in spatial relationships are: integration and choice, intrinsically linked to human movement. Integration reflects the selection of a destination. It can be angular, topological and metric, and according to Hillier et. al (1993) measures the distance an axial line is from all the others in the system. i.e., the ease of an access. In turn, the choice parameter, "calculates the probability of crossing a given segment from all other origin and destination points." (Castro A., 2016), i.e., it measures the flow of traffic.

The municipality of Kalamaria and its coastline

Kalamaria is located in the region of Central Macedonia, in the metropolitan area of Thessaloniki. The municipality occupies a territorial area of 7.2 km^2 and has a population density of 14,258.71 hab./km^2, (Kalamaria City Council, 2021).

Even without focusing on details, one can observe the break of the natural line of the coastline, framing various constructions and urban infrastructure. The above map (figure 01) proposes a first reading of the shore. The two main lines of the road system by the waterfront, Themistokli Sofouli and Nikolaou Plastira, are the separators between the urban area and the coastline. This municipality, with a coastline of 4.5 km, is connected to its waterfront by straight routes starting from the shore going towards the inner urban fabric, visually connecting it to the water.

Methodology

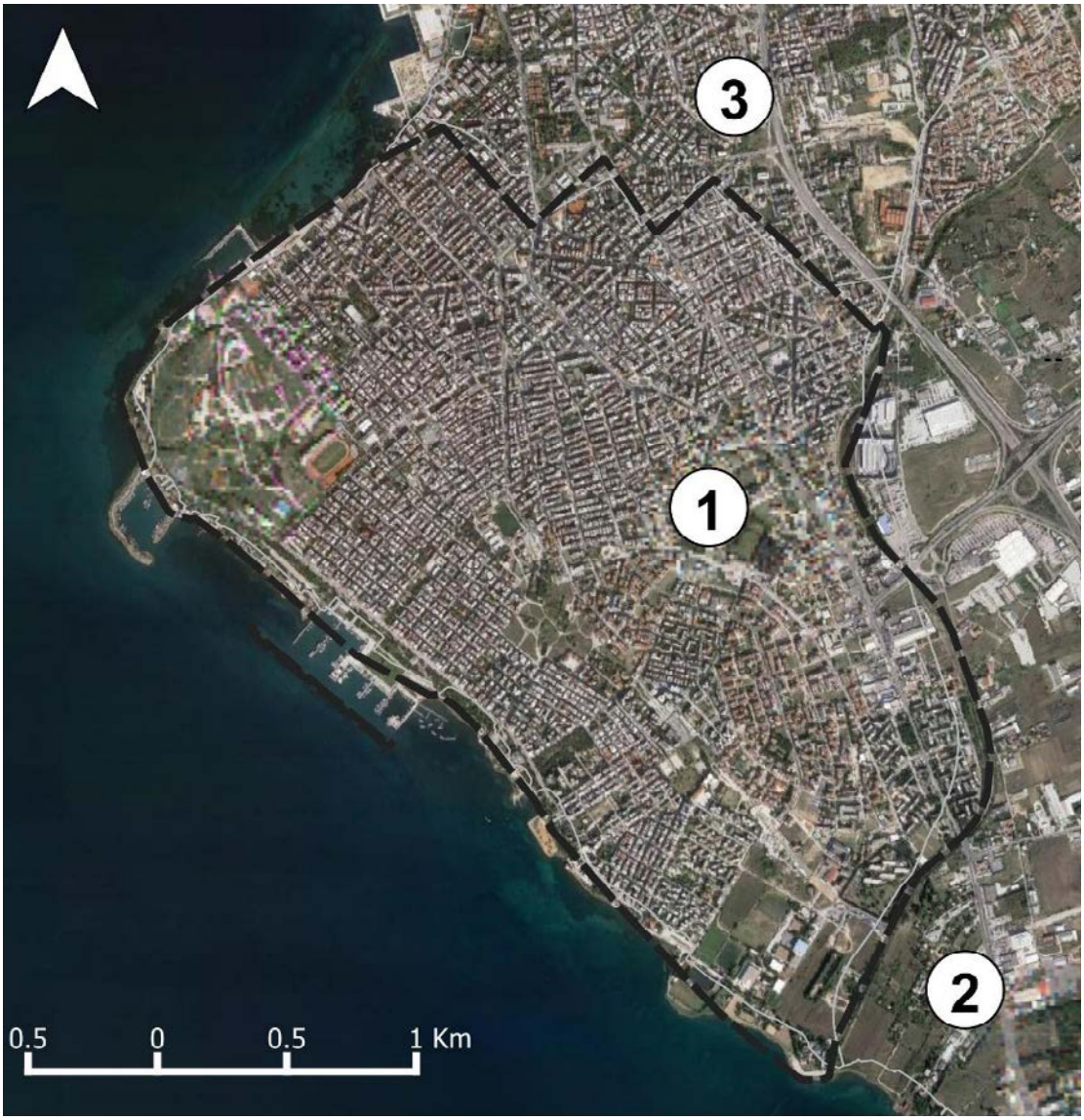
The methodology is based on the following steps:

Collection and organization of 'geospatial' data from Kalamaria, obtained from the official website of GEODATA, Greece, at http://geodata.gov.gr/en/dataset?q=Kalamaria.

1. Modelling of the axial map based on the city's urban grid, using the software of Geographic Information System (GIS - free QGIS 3.10.)
2. Creation of the segment map and syntactic calculations of integration and choice, by transporting the axial map to the Depthmap software. For the intended analysis, the scales used were: global - radius n[6] regional (radius 1200m)[7]; and local (radius 400m)[8], in the A-B section of the coastline. These calculations are standardized.
3. Transferring of the maps to the free software QGIS 2.18, for the syntactic analysis of the data, from the Space Syntax toolkit plugin, and the production of the final maps.
4. Conclusion: the results obtained are crossed-checked with the 'empirical analysis'[9].

6 It highlights the central areas of the road system.
7 Corresponding to a 15-minute walk.
8 Evidence calculations that approximate pedestrian movement patterns.
9 Related to patterns, and socio-spatial logic of the city in relation to its coastline, specifically, the northwest coastline.

Figure 1. Municipal limits of Kalamaria. Source: Google Earth /Author.



Legend

----- City limits of Kalamaria

1 - Municipality of Kalamaria

2 - Municipality of Pylaia

3 - Municipality of Thessaloniki

Analysis of Kalamaria accessibility: global and regional scale

Figure 02 illustrates the results of global integration, representing the most permeable axes in the city. As the main parameter of analysis of urban accessibility, it shows that the central area of the city corresponds to the area of greater integration, developing around the Pontou street.

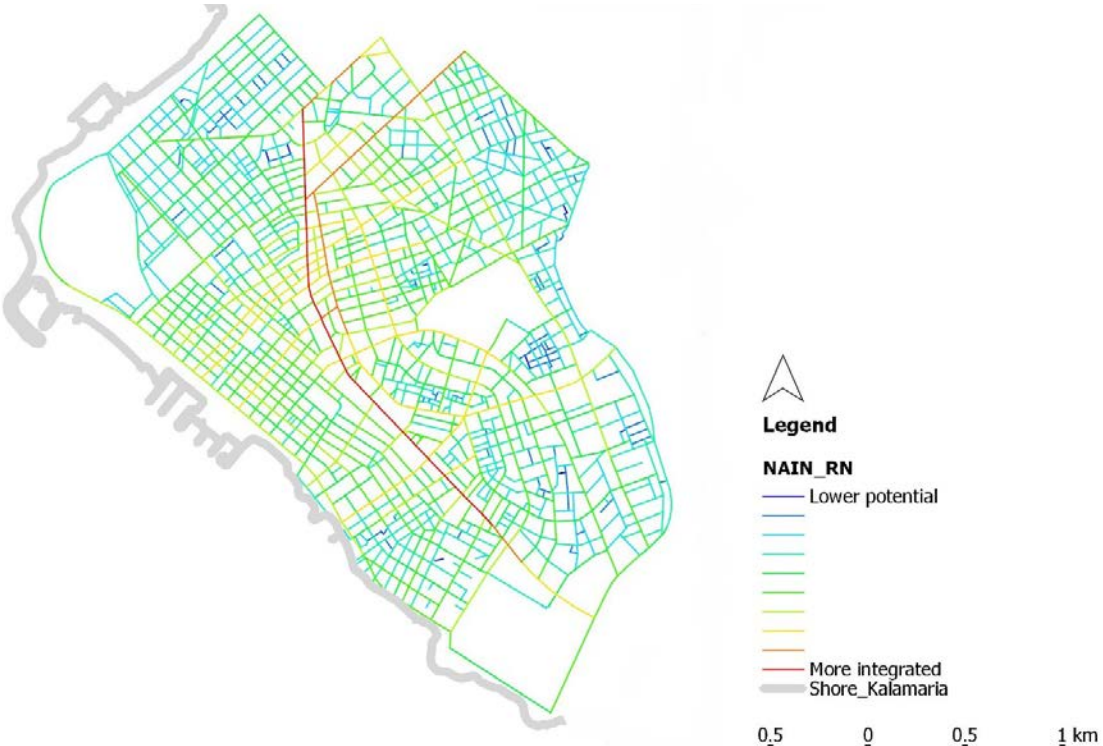
The high potential for angular integration of Nik. Plastira street, contiguous to the south and southwest coast, and the axes starting from this coast, intersecting the Pontou and continuing into the inner urban fabric, influence the appropriation and valorisation of the coastline.

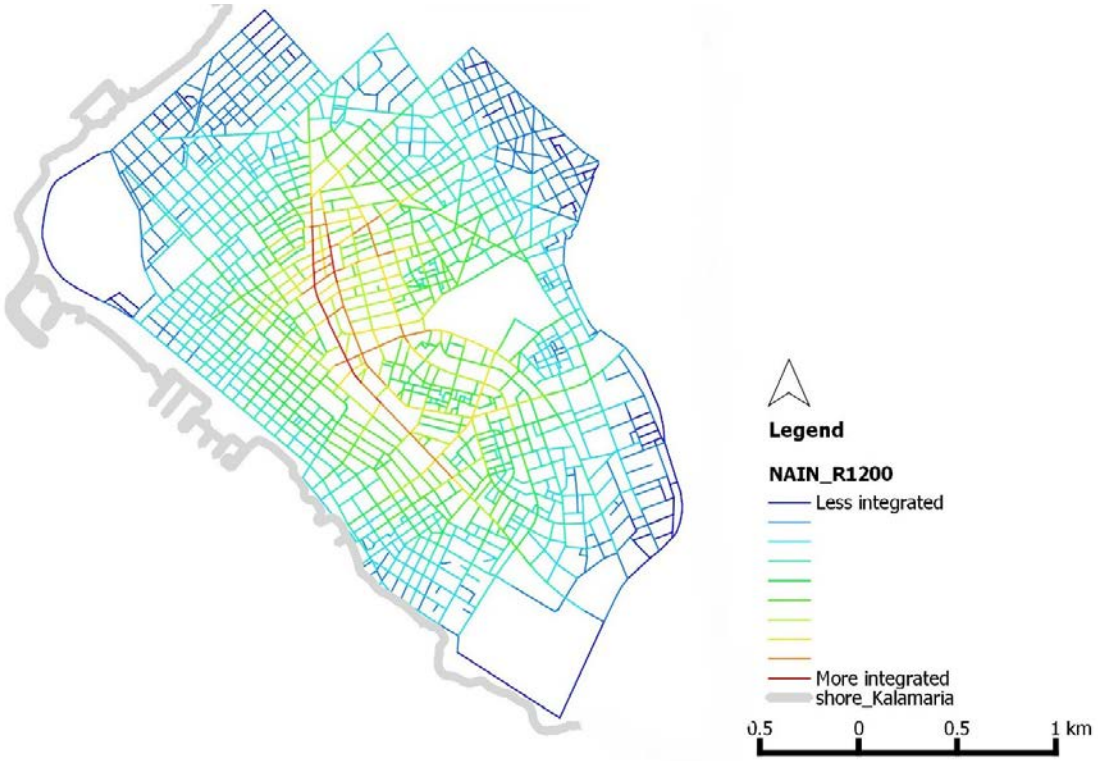
In the calculation of angular integration on a regional scale, figure 03, confirms a greater accessibility in the central areas and some segregation of coastal areas. It is also possible to verify the supremacy of angular integration of the south/southwest coast in relation to the northwest coast, in the context of the city.

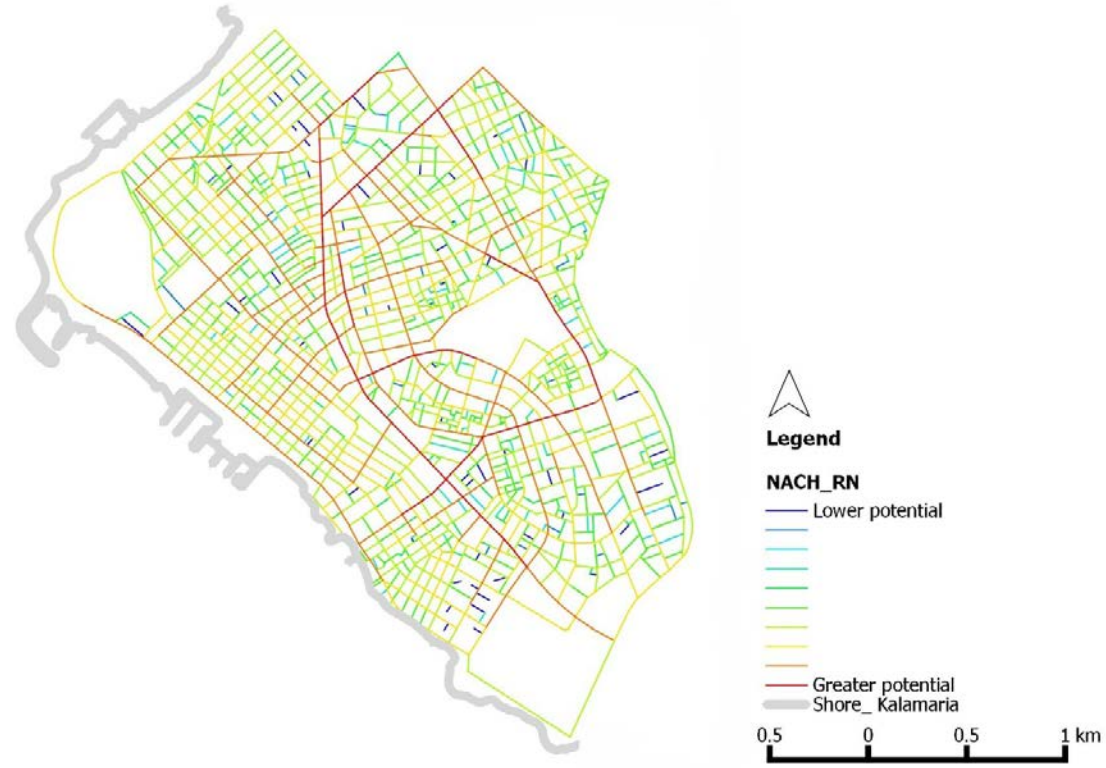
The angular choice calculation identifies Kalamaria as a municipality with a good crossing potential, highlighting several segments represented with high values of the choice parameter, especially at the global scale (figure 04). At the regional scale (figure 05), it turns out that the roads along the coast, Themistokli Sofouli and Nik. Plastira, have a good potential for choice.

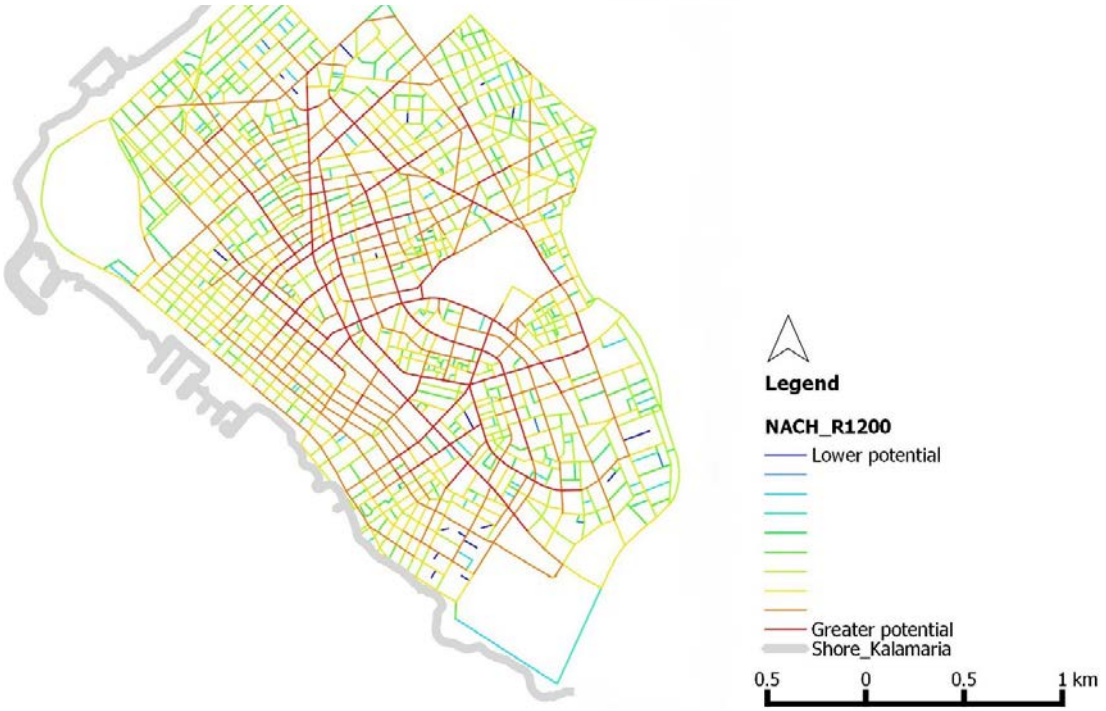
Figure 2. Normalised Angular Integration [NAIN]_RN. Source: Author.

Figure 3. NAIN_R1200. Source: Author.


Legend
NAIN_RN
Lower potential
More integrated
Shore_Kalamaria
0.5
0
0.5
1 km


Legend
NAIN_R1200
Less integrated
More integrated
shore_Kalamaria
0.5
0
0.5
1 km


Legend
NACH_RN
Lower potential
Greater potential
Shore_ Kalamaria
0.5
0
0.5
1 km


Legend
NACH_R1200
Lower potential
Greater potential
Shore_Kalamaria
0.5
0
0.5
1 km

Analysis of Kalamaria accessibility: local scale (northwest coast)

The calculations at the local scale were performed in an urban area bounded by the ABCD polygon, on the northwest coast and delimiting a depth of 1 km from the limit of the coast. The choice of this coast is due to: i) its segregation in relation to the city, resulting from the angular analysis of integration and choice on a global and regional scale; ii) its location on the extension line, to the south, of the municipality of Thessaloniki; iii) its proximity to a housing area.

This coastline is marked by two pier-type constructions, and frames a small beach with 'some urban degradation'[10], fig. 6.

With the calculation of angular integration (figure 07) to a greater or lower degree of accessibility, it is possible to denote a good connection between the shore and the city. This fact is resulting from its regular layout, with axes perpendicular to the coast and interconnected to the centralised axis in this study area, Grigoriou Kidonion. Among the axes with good angular integration, the Kapetan Goni route stands out, for its direct relationship with the flow-generating axis, Pontou.

Analysing the map of the parameter choice (figure 08), it presents a high potential for choice and visual reach in the land/water relationship of the Kerasountos street. This effect is expanded by the interaction of this street with the Kalamaria promenade.

Figure 4. Normalized Angular Choice [NACH]_RN. Source: Author.

Figure 5. NACH_R1200m. Source: Author.

10 Regarding the apparent state of abandonment.

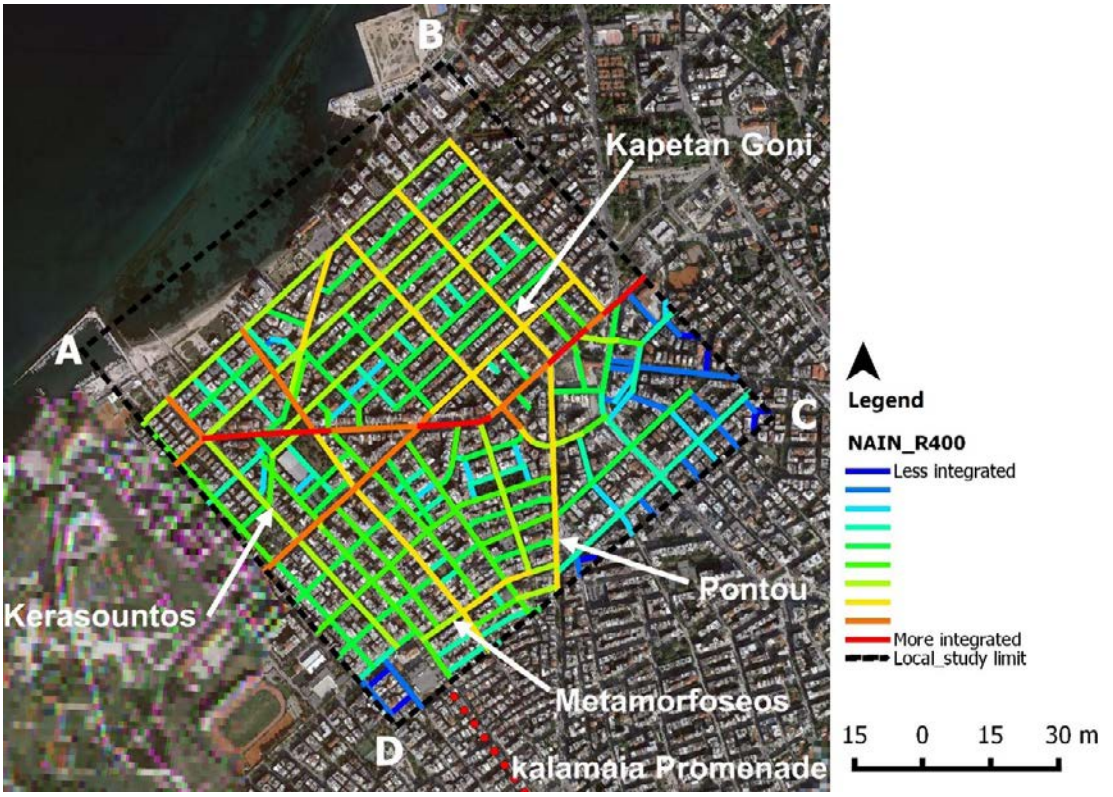
(a): View towards of Thessaloniki city

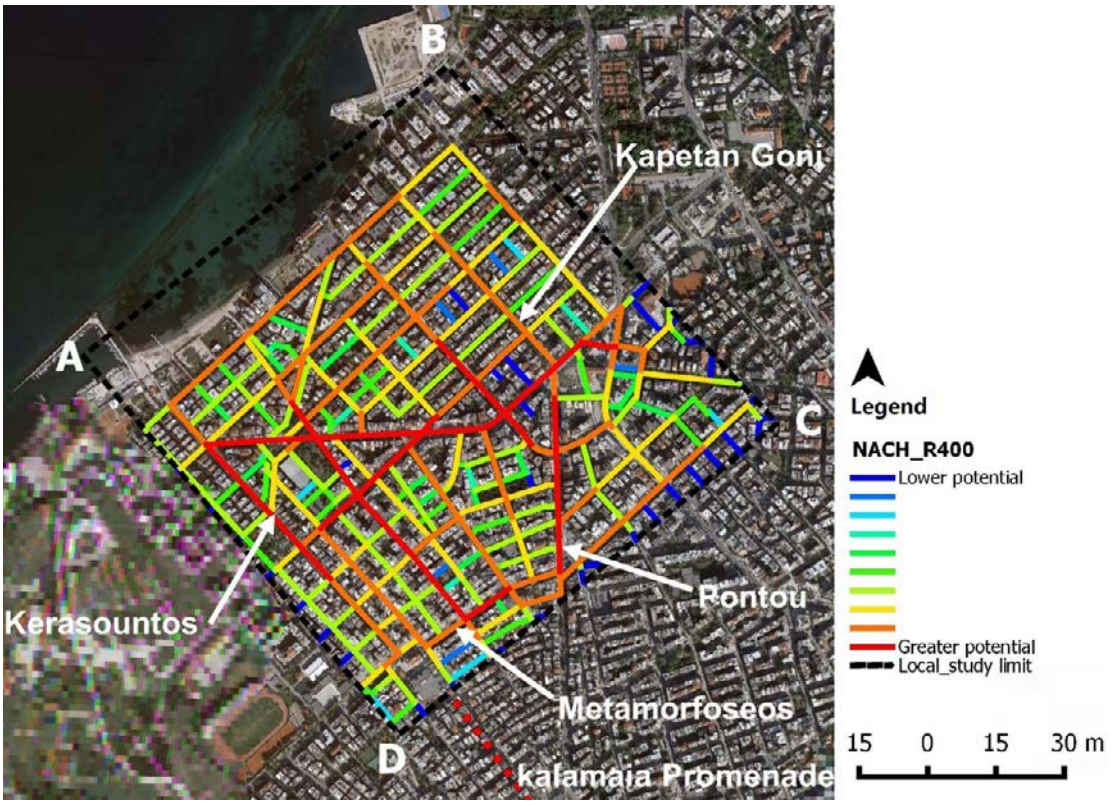
(b): view towards Nautical club of Thessaloniki

Figure 6. Northwest coastline of Kalamaria. Source: Google map.

Figure 7. NAIN_R400m. Source: Author

Figure 8. NACH_R400m. Source: Author.


B
Kapetan Goni
A
C
Legend
NAIN_R400
Less integrated
More integrated
Local_study limit
Pontou
Kerasountos
Metamorfoseos
D
kalamaia Promenade
15 0 15 30 m


B
Kapetan Goni
A
C
Legend
NACH_R400
Lower potential
Greater potential
Local_study limit
Pontou
Kerasountos
Metamorfoseos
D
kalamaia Promenade
15 0 15 30 m

Final considerations

Arguing that the coastline is a natural territory for the population to interact with the marine environment, in the case of Kalamaria it was found that the regular urban network enhances accessibility[11]. This is highlighted by Pontou, an important flows generator axis, and the high potential of choice parameter of axes close to the sea[12]. However, the northwest coast shows some segregation[13], possibly resulting from the level of accessibility to it, which is relevant exclusively for short axes. For a better integration of this coast to the inner urban fabric it is proposed[14]:i) the creation of a 'serial view'[15] on the transversal axes with a higher level of integration and choice; and, ii) the expansion of the Kalamaria promenade to the coastal area through the Kerasountos street. This way it would be possible to combine the urban configuration with the attractiveness of coastal spaces, contributing to the regeneration and revitalization of the coast. (figure 09)

Through the demonstration of relevant factors in the study of urban accessibility, we note the importance of Space Syntax tools in the deepening of understanding of urban space. It also shows the need for the integration of the coastal environment as a guiding element in urban projects, while avoiding the segregation of coastal areas, enhancing social coexistence and increasing the maritime characteristic throughout the urban area.

11 These conditions are visualized in the integration and choice maps on a global and sectoral scale

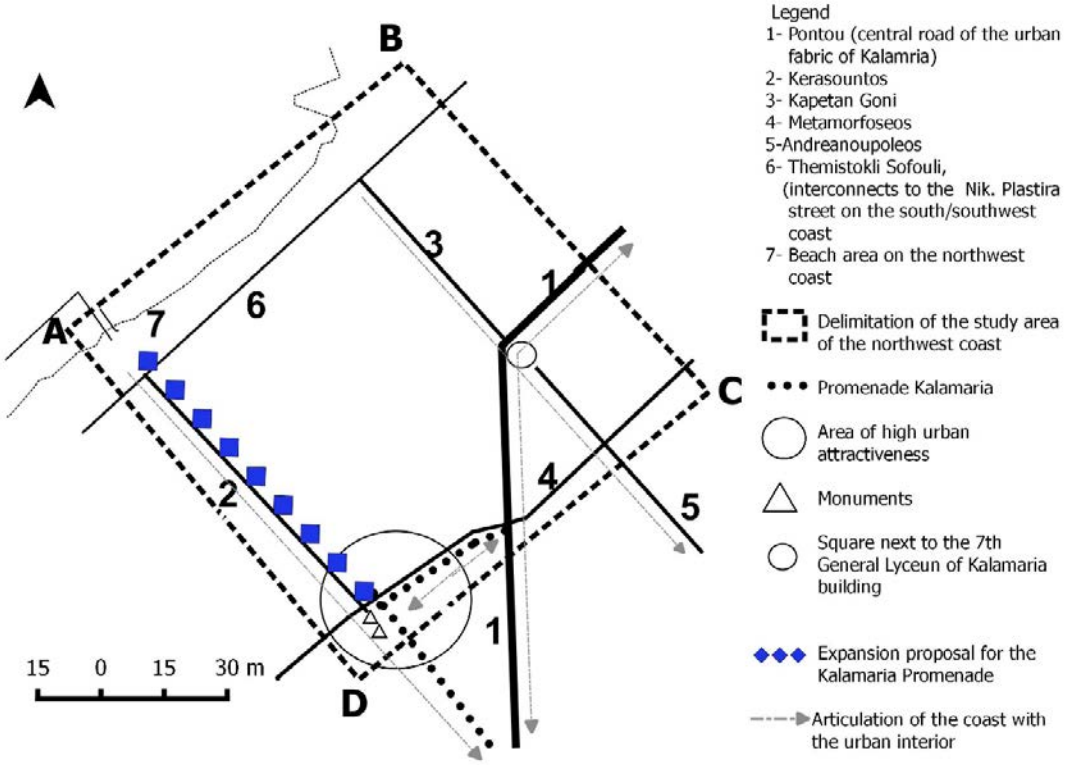
12 Themistokli Sofouli e via Nik. Plastira.

13 In the global urban context

14 These essential components in the promotion and enhancement of the sea front, propel the improvement of the spatial and urban quality from the relationship between land and the water body.

15 Where the deviation from the route occurs at the point of encounter with a monument or public space.

Figure 9. Proposal for the articulation of the northwest coast into the inner urban fabric. Source: Author


B
A
C
D
7
6
3
1
2
4
5
1
15 0 15 30 m
Legend
1- Pontou (central road of the urban fabric of Kalamria)
2- Kerasountos
3- Kapetan Goni
4- Metamorfoseos
5-Andreanoupoleos
6- Themistokli Sofouli, (interconnects to the Nik. Plastira street on the south/southwest coast
7- Beach area on the northwest coast
Delimitation of the study area of the northwest coast
Promenade Kalamaria
Area of high urban attractiveness
Monuments
Square next to the 7th General Lyceun of Kalamaria building
Expansion proposal for the Kalamaria Promenade
Articulation of the coast with the urban interior

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Thessaloniki's urban waterfront: decision-making and governmental aspects for adding metropolitan ecosystem functions

Abstract

Ecosystem functions offer a robust framework for managing complex environmental challenges associated with modern metropolises. Comprehensive urban ecosystem approach, face certain urban areas, such as urban waterfronts, as valuable natural resources interrelated to the entire urban environment, aiming to provide strategic solutions for enhancement of integrated ecosystem services. This paper argues that we should consider ecosystem functions within the city as dynamic, hybrid and living ecosystems lying between the city and the nature. This approach provides new key aspects for policy makers and planners, particularly as urban sustainability, resilience, and environmental crisis, increasingly reshape cities and elevate consideration of these topics.

The paper highlights the economic contributions of Thermaikos Gulf ecosystem goods and services to the city's welfare, and recommends actions and investments required to ensure that they are valued and integrated into metropolitan policy decision-making.

Keywords: urban ecosystem, ecosystem function, ecosystem services, metropolitan planning, metropolitan governance

Metropolitan areas, urban ecosystems, ecosystem functions and services

Planet earth is increasingly becoming an urbanized landscape occupying about 3% of the earth's land surface with over half of the human population inhabiting the cities. Earth's population living in cities, has more than doubled over the last 40 years, going from 1.5 billion inhabitants in 1975 to 3.5 billion in 2015. It is projected to reach 5 billion and almost 55% of the world population by 2050(OECD, 2020, p.10).

According to the degree of global urbanisation, OECD classifies the entire earth territory into three categories: (a) cities, concentrating almost half of the world's population (48%), (b) rural areas where lives the quarter (24%) of the world's population, and (c) the towns and semi-dense areas, consecrating the remaining 28% of the global population. By defining three types of areas, the Degree of Urbanisation captures the continuity between cities and rural areas and provides a nuance contemporary perspective than the traditional urban-rural dichotomy (OECD, 2020, p.10). In the same report, OECD, additionally uses a definition of metropolitan areas, which consider cities together with their surrounding commuting zones. Metropolitan areas account for 54% of total world population, with commuting zones representing 17% of the overall metropolitan population, a share that rises to 31% in high-income countries (OECD, 2020, p.23).

The term "metropolitan area" used by OECD, referred at the level of the Functional Urban Area (FUA), definition developed by the European Union and the OECD (EU OECD, 2019 pp 1-18 and Moreno-Monroy et all, 2021). This definition specifies that a FUA consists of a cluster of local administrative units that are either part of a city or its commuting zones. Local units in the commuting zones must have at least 15% of their working population commuting to the city for work.

The explosion of urbanization and especially the condition of continuity of urbanized land, has caused enormous and varied environmental problems. Purely natural areas of the planet are constantly shrinking, and the natural ecosystems remain under pressures caused by urbanized land. Major threats have been brought about by the climate crisis, the unsustainable resource use, and the inadequate city planning. Cities became increasingly unsustainable, insecure, and vulnerable, therefore, achieving urban sustainability and resilience must be high on any government's agenda.

Life forms on planet earth are now forced to live and adapt to these new conditions of dense and continues urbanisation. Evolutionary biologist Menno Schilthuizen through his vibrant book on urban evolution, "Darwin Comes to Town", introduces a new and appealing argument that "we must embrace and harness the evolutionary forces that are shaping novel ecosystems right here, right now, and work towards allowing nature to grow in the hearts of our cities" (Schilthuizen, 2019, p.26). Far from viewing large cities as the enemies of nature, Schilthuizen advances the idea that many species are adapting to the urban conditions, creating a new wealth of biodiversity.

The author's point is that cities host an accelerated and unique evolutionary environment. In the book, there are a lot of examples that reward imagination about the existence of a parallel, secret and nature-adapted ecosystem that grows within the cities. For example, Europe's urban blackbirds sing at a higher pitch than their rural cousins, to be heard over the low-frequency roar of urban traffic. In the same logic, there are various recent initiatives and strategies for "urban rewilding" that promote the natural "wildness" in public spaces but also in any remaining urban void, allowing nature to create micro-ecosystems and cycles of life.

Of course, "urban wilderness" can hardly be understood as a pure wild area as natural processes as do not unfold uninfluenced by human beings and since the areas will almost never be undissected areas of sufficient size[1].Nevertheless, most of our knowledge for evolutionary biology to date comes from the natural areas, recently, there is a growing interdisciplinary literature trying to analyse and understand how the urbanization is affecting the evolution of life forms that inhabit the cities. And furthermore, how can nature and anthropogenic ecosystem can co-exist in a sustainable and resilient way. In this process, cities are not something separate from their natural elements but come together generating hybrid places, both natural and human made.

Based on the above, we can say that cities are dependent on the natural ecosystems beyond the city limits, but also benefit from internal ecosystems and natural resources of any kind such as the waterfront areas, river, lakes, and streams, wetlands, urban forests and lawns or parks, even though street trees and cultivated land.

Figure 1. Darwin Comes to Town, the inspiring book of Menno Schilthuizen and biodiversity blooms in cities when green spaces go wild. An urban void occupied by nature and flora from Kodra ex-military camp, Thessaloniki.

1 Even though, Schilthuizen is not arguing that the spreading urbanization evolution and the natural selection in the cities will take care of all crucial issues of the lost natural biodiversity, this approach has received various criticisms. Some of the scientists are critical to the position that humans are the "nature's ultimate ecosystem engineers" and find the view that man is able to "plan" and "control" the planetary evolution too optimistic and immoderate.


DARWIN COMES TO TOWN
HOW THE URBAN JUNGLE DRIVES EVOLUTION
PICADOR
MENNO SCHILTHUIZEN

In general, the literature on ecosystem valuation uses the terms "structure" and "function" in order to describe the natural systems. These are features of natural complex systems that result in a capacity to provide goods and services, which can in turn be valued by humans. The identification of an ecosystem structure and function is the reasonable starting point for the subsequent mapping of ecosystem goods and service.

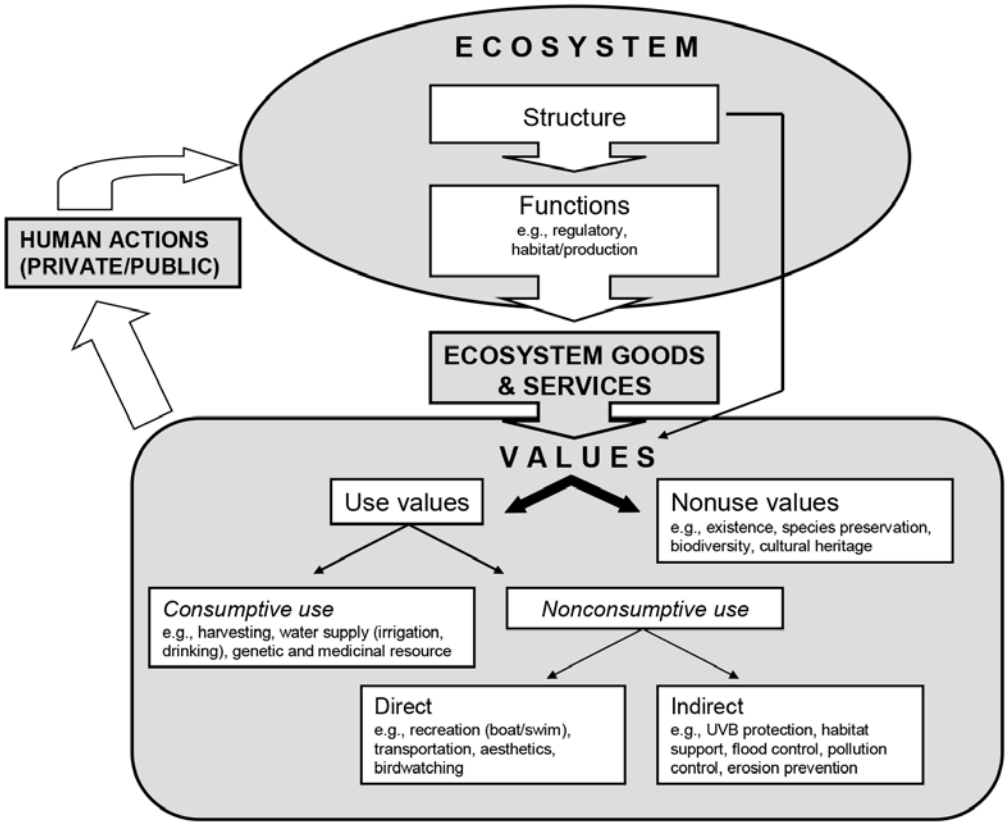
Ecosystem structures: it is difficult to define clear boundaries for urban ecosystems because many of the relevant fluxes and interactions necessary to understand their character extend far beyond the urban boundaries defined by administrative, spatial, or biophysical factors. Thus, the relevant scope of urban ecosystem analysis reaches beyond the city area itself; it comprises not only the ecological infrastructure within cities, but also the hinterland that are directly affected by them (Pickett et al. 2001, p. 129), and that's why the metropolitan dimension is very crucial for environmental planning and governance.

Ecosystem functions captures the role that water and vegetation within or nearby the built environment play in delivering **ecosystem services** at different spatial scales (building, street, neighborhood, and region). It includes all "green and blue spaces" that may be found in urban and peri-urban areas.

Ecosystem services, defined by Daily et al. (1997) are considered as "a wide range of conditions and processes through which natural ecosystems, and the species that are part of them, help sustain and fulfill human life." These services support the production of ecosystem goods, "such as seafood, wild game, forage, timber, biomass fuels, natural fibers, and many pharmaceuticals, industrial products, and their precursors."Taylor (1986) argued that the sustainability of ecosystem services can be viewed in two ways: (1) an anthropocentric approach assuming that natural capital has value only on the basis of its benefits to human welfare; or (2) a biocentric approach assuming that the natural capital also has non-consumptive value, a value that may not be easily priced on specific market products but should be considered in policy decisions and strategic plans.

Based on the above, the USA National Research Council in a consensus study report valuing ecosystem services towards better environmental decision making (NRC, 2005 p.241), illustrates the connections between ecosystem structure and function, services, policies, and values, providing the current state of knowledge for urban ecosystems (figure 2).

Figure 2. Explaining the connections between ecosystem structure and function, services, values, and policies. Source: (NRC, 2005 p.241)


ECOSYSTEM
Structure
Functions
e.g., regulatory, habitat/production
HUMAN ACTIONS (PRIVATE/PUBLIC)
ECOSYSTEM GOODS & SERVICES
VALUES
Use values
Nonuse values
e.g., existence, species preservation, biodiversity, cultural heritage
Consumptive use
e.g., harvesting, water supply (irrigation, drinking), genetic and medicinal resource
Nonconsumptive use
Direct
e.g., recreation (boat/swim), transportation, aesthetics, birdwatching
Indirect
e.g., UVB protection, habitat support, flood control, pollution control, erosion prevention

Defining the Ecosystem Services of Thessaloniki's Urban Waterfront area

Thessaloniki is a midsize city situated in northern Greece, on Thermaikos Gulf, part of the Aegean Sea. With a total length of more than 40 km, Thessaloniki's shoreline is the city's major geographic feature. It marks the end of Thermaikos Gulf, following its curve from the Axios River delta in the west to the coastal resort of Karabournou in the south. Its course has many, varied natural features, is full of history and is open to a multitude of readings.

The city sprawls around an arc of coastline of the Thermaikos Gulf. Thessaloniki's urban shape differs from other European cities that extend circularly around their historic center. Extending, of necessity, between its natural boundaries of Mt Chortiatis and the Thermaikos Gulf, the city conceived as a linear city, having its activities arranged more or less in a line along the sea front. A more careful observation of the urban hinterland will inevitably lead us to a butterfly pattern, whose mechanical skeleton consists of the public transport networks. The city does indeed seem to balance symmetrically along the sides of a central axis (Vougias, 2010).

The extent and multifunctional coastal line is one of the major spatial characteristic of the city's greater urban area, as it connects the various urban activities, most of them of regional and national importance (such as the City Port and the Airport).

For Thessaloniki whose long history is inseparably bound up with the sea, the city inevitably grew in a linear pattern along the coast. The seafront represents the surviving line of the visual contact between the city and the nature, a contact which in the past occurred along the entire length of the urban perimeter. The development of the city, especially under the phenomenon of urban sprawl, has erased the difference between the inside and the outside, between the city and its peri-urban and rural periphery.

Thermaikos Gulf consists of a marine ecosystem of high complexity due to the various activities taking place in the greater area. Thermaikos Gulf is the final receiver of the discharges of Axios, Aliakmon, Loudias and Gallikos Rivers. Despite the strong anthropogenic pressures originated from agricultural, industrial, commercial, marine and aquaculture activities, the ecosystem goods offered to the city are of major importance. As a real natural ecosystem, Thermaikos Gulf is not static and the exchanges with the open Aegean Sea waters across the

Table 1. Aquatic Ecosystem Services of Thessaloniki's Waterfront urban area
Source: Adapted from National Research Council (NRC, 2005 p.46)and Barbier (1994) methodology

Use Values			Nonuse Values
Consumptive	**Non – Consumptive**		Habitat / biodiversity
Fishing	**Direct**	**Indirect**	Provision of natural resources
Mussels and other seafood products	Marine economy and shipping	Urban heat control	Living space for wild plant and animal species
Raw materials	Sea Transportation	Climate regulation	Resources for future generations
Medicinal resources	Aquaculture	Nutrient retention and cycling	Providing opportunities for cognitive development
	Public spaces and recreation	**Delta wetland**	Scientific and educational opportunities
	Tourism activities	Protection of the inhabited and rural areas from flooding	Natural heritage
		Cleaning of surface water	Cultural heritage
		Protection of the fields from salinisation	Inspiration for creative activities
		Realimentation of the aquifer with fresh water	Sea and the city, health, and quality of living

southern boundary are an additional factor that affects the stratification, circulation, and renewal of the Gulf (Krestenitis et al., 2012pp.132-151).

The wetland ecosystem of the Axios – Loudias – Aliakmon Delta offers a series of valuable ecosystem services that are of vital importance for the city and the broader region. Like all wetlands, it contributes to the cleaning of surface water and to the realimentation of the aquifer with fresh water. It supplies water for irrigation, protects the inhabited and rural areas from flooding, regulates the climate, provides food and products. The wetland regulates the climate, rendering it milder, thus contributing to mitigating weather events. It produces large quantities of oxygen, while capturing large quantities of carbon dioxide from the atmosphere, thus it is an important factor for mitigation and adaptation of urban activities to the climate change (Vareltzidou et al., 2009 p.7).

Based on the NRC diagram (figure 2), we are trying to define Thessaloniki's waterfront ecosystem services by grouping its values (table 1). Consumptive uses involve extracting a component of the ecosystem to support a certain anthropocentric purpose. This kind of uses involves extraction and hence diminution in the quantity of the resources available. In contrast, non-consumptive uses involve services provided directly by aquatic ecosystems without extraction and diminution of the resources' availability. However, non-consumptive uses can diminish the quality of aquatic ecosystems through pollution or other external effects.

This methodology can enhance our understanding of how the natural environment matters to human communities and think of urban ecosystems as natural capital and one of city's most important assets. Furthermore, this comprehensive approach can support decision and policy making and planning based on the specific character of each ecosystem function.

Governmental and Decision-Making issues for Thessaloniki's metropolitan urban area

The size, the demographic issues and the expanded role of urban areas that are now considered as metropolitan areas requires another level of local government beyond the responsibilities of the municipalities. The metropolitan government concerns collaborations between administrative units, which jointly develop and implement strategies for major urban issues in an integrated approach for the entire city -

metropolis. Climate change, energy crisis, urban resilience, and the management of natural resources that cannot be seen siloed within the urban environment, demand the cooperation of local governmental units at metropolitan level.

The difficulty of traditional spatial planning tools in handling the complexity of metropolitan cities has led many European countries to delegate expanded responsibilities to Metropolitan Organizations and place them administratively between regional and local government.

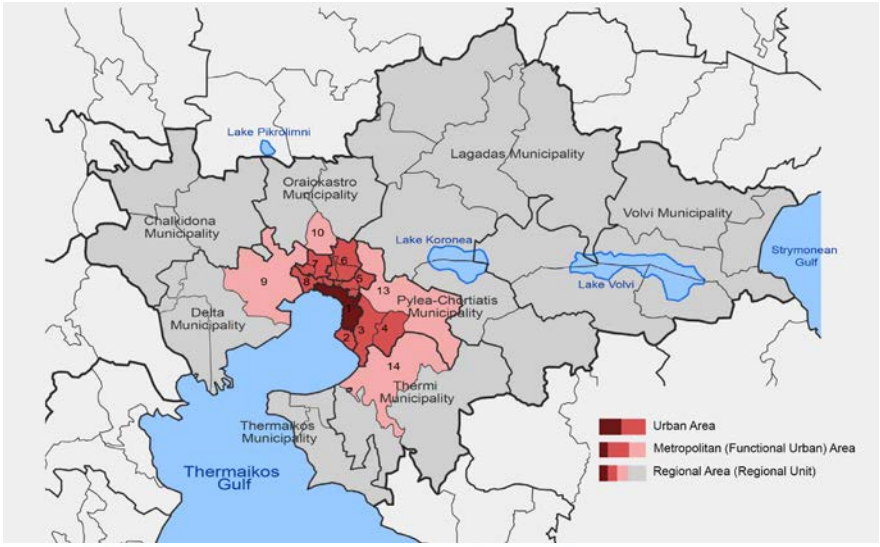
Although, spatial planning in Greece, not only hasn't been adapted to these needs, on the contrary, it has weakened this level of government by abolishing the Regulatory Planning Organizations of the two major cities, Athens, and Thessaloniki. Remaining clearly as a meteor, the level of metropolitan governance in Greece, stumbles between national, regional, and local government with no successful results and efficient decision-making process.

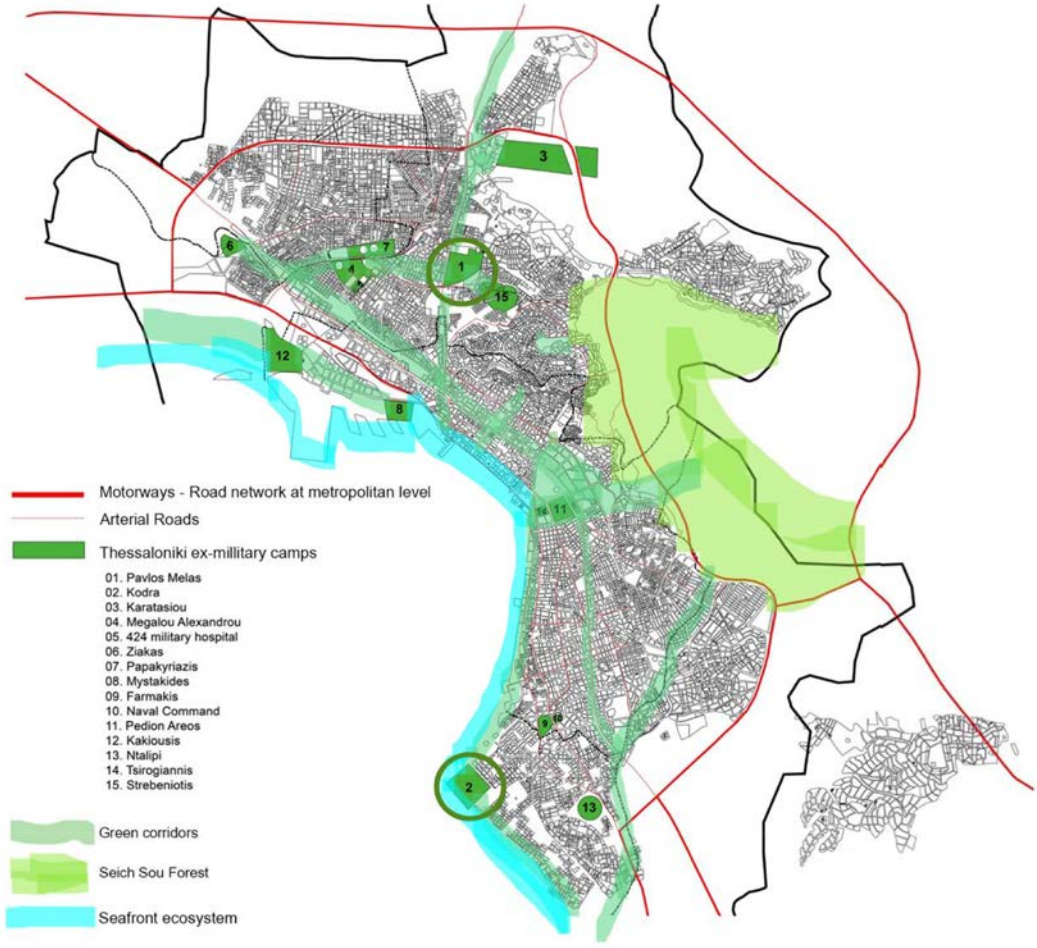
The Official Master Plan of Thessaloniki ("Regulatory Plan" in Greek: Rythmistiko Sxedio), (Law 1561/1985 FEK 148/□'/6.9.1985) has defined as area of its intervention, the Greater Thessaloniki Area, consisting of three main planning zones: (1) the metropolitan center, (b) the urban agglomeration of Thessaloniki and (c) the peri-urban zone.

Given the geographical and spatial characteristics of the city and the fact that there is no other official document that defines Thessaloniki's Metropolitan Area, based also on the definition of EU-OECD for delineating metropolitan areas as Functional Urban Areas, we can define as Thessaloniki's metropolitan area the urban center, the urban agglomeration area and the peri-urban zone (figure 3).

Major Development Agency Thessaloniki (MDAT S.A.) is a joint inter-municipal Development Organisation supporting local authorities (municipalities) for various urban issues. The Agency's shareholders include 11 Municipalities of the metropolitan area (Thessaloniki, Kalamaria, Pavlos Melas, Neapolis-Sykies, Kordelio-Evosmos, Pilea-Chortiatis, Ampelokipi-Menemeni, Delta, Oreokastro, Thermi, Chalkidona) and 2 City Institutions (NOESIS Thessaloniki Science Park & Technology Museum and CERTH – Center for Research and Technology Hellas).

MDAT S.A acts as a decision-making initiator for metropolitan Thessaloniki by activating inter-municipal initiatives, acting as intermediary body between authorities, city institutions and civil society initiatives, trying always to rise collective and


Lake Pikrolimni
Lagadas Municipality
Oraiokastro Municipality
Chalkidona Municipality
Volvi Municipality
Lake Koronea
Strymonean Gulf
Lake Volvi
Pylea-Chortiatis Municipality
Delta Municipality
Thermi Municipality
Thermaikos Municipality
Thermaikos Gulf
Urban Area
Metropolitan (Functional Urban) Area
Regional Area (Regional Unit)


Motorways - Road network at metropolitan level
Arterial Roads
Thessaloniki ex-millitary camps
01. Pavlos Melas
02. Kodra
03. Karatasiou
04. Megalou Alexandrou
05. 424 military hospital
06. Ziakas
07. Papakyriazis
08. Mystakides
09. Farmakis
10. Naval Command
11. Pedion Areos
12. Kakiousis
13. Ntalipi
14. Tsirogiannis
15. Strebeniotis
Green corridors
Seich Sou Forest
Seafront ecosystem

participatory approaches engaging all relevant stakeholders in each project.

The idea of continuity and proper functioning of the ecological metabolism and rethinking city's natural resources as ecosystem functions and networks where nature flows came from the RiConnect – URBACT Project, where Thessaloniki has been involved through MDAT as metropolitan partner. RiConnect is a network of eight metropolises whose aim is to rethink, transform and integrate mobility infrastructures to reconnect people, neighbourhoods, and natural spaces. RiConnect provides a new way of understanding mobility infrastructure removing the barrier effect and foster a new relationship with the city and the place. In this framework, Thessaloniki aims to develop an Integrated Action Plan for the city's former military reserved land, aiming at:

Raising awareness for people and authorities for the overall planning of the former military land not seen separately but as an ecosystem network.

Considering the former military camps as the available land where a network of new collective green spaces can be developed in connection with the city's existing natural resources such as the seafront ecosystem.

Rising intermunicipal collaborations and projects for green and blue ecosystem functions and services in metropolitan level.

Figure 3. Thessaloniki's metropolitan area (FUA): (1) Municipality of Thessaloniki, (2) Municipality of Kalamaria, (3 -4) Municipality of Pylea – Chortiatis (administrative units of Pylea and Panorama), (5) Municipality of Neapolis –Sykees,(6) Municipality of Pavlos Melas,(7) Municipality of Evosmos – Kordelio,(8) Municipality of Amelokipi – Menemeni,(9) Municipality of Delta (administrative unit of Exedorou), (10) Municipality of Oreokastro (administrative unit of Oreokastro), (13) Municipality of Pylea Chortiatis, (14) Municipality of Thermi (administrative unit of Thermi).

Figure 4. Mapping an indicative network of ecosystem functions for Metropolitan Thessaloniki. Source: MDAT, RiConnect Thessaloniki Integrated Action Plan.

Conclusions

Ecosystem functions offer a robust framework for managing complex environmental challenges associated with modern metropolises. Comprehensive urban ecosystem approach, face certain urban areas, such as urban waterfronts, as valuable natural resources interrelated to the entire urban environment, aiming to provide strategic solutions for enhancement integrated ecosystem services. This paper argues that we should consider ecosystem functions within the city as dynamic, hybrid and living ecosystemslying between the city and the nature. This approach provides new key aspects for policy makers and planners, particularly as urban sustainability, resilience, and environmental crisis, increasingly reshape cities and elevate consideration of these topics.

Ecosystems functions and new governance: urban ecosystem dynamics has to be reached by a new systemic approach either in the field of analysis or for policy desiscions. There are no common solutions for adding ecosystems functions as they are living

organisms, beeing in a continuing wave of change where their essential elements act in daily positive or negative interaction and feed-back. Based on that, the policy approach for ecosystems functions and services must bridge the gap between the bottom-up investments in infrastructure and the understanding of the emergent structures arising from all the actors' activity in the area.

Ecology for the City: this concept can be seen as a new planning paradigm that emphasizes how the interaction of environmental place-based science and decision makers' actions are the main drivers that are shaping urban ecosystems. Like natural ecosystems, urban ecosystems have inputs, through inputs and outputs operating in open exchange relationship with its environments. Multiple layers and levels of the system has to be integrated to form a complete complex system. Such systemic approach has, by nature, the capacity to ensure resilient solutions for urban problems.

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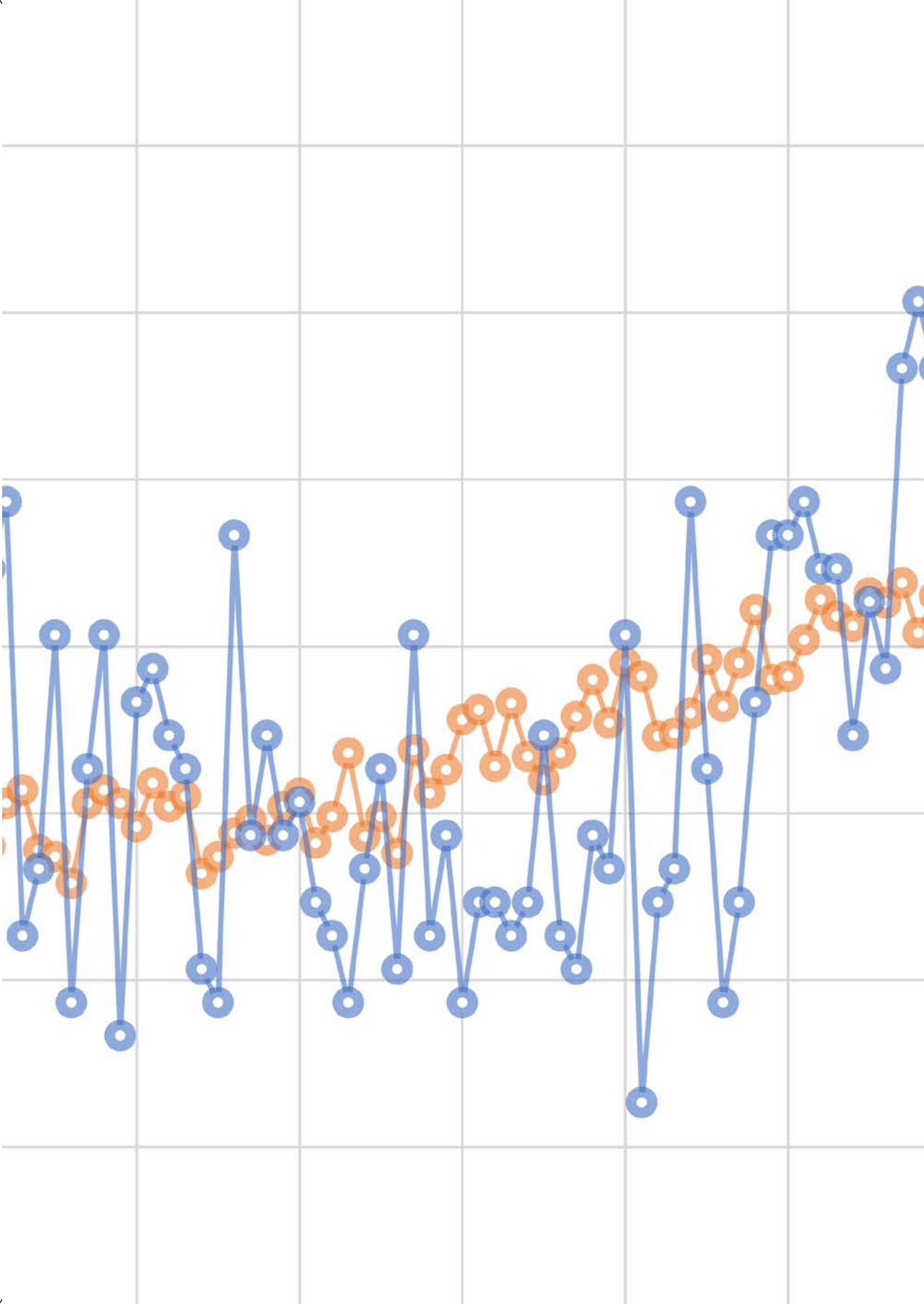

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Challenges and impacts of climate change in the Mediterranean

The added value from Regional Climate Models (RCMs)

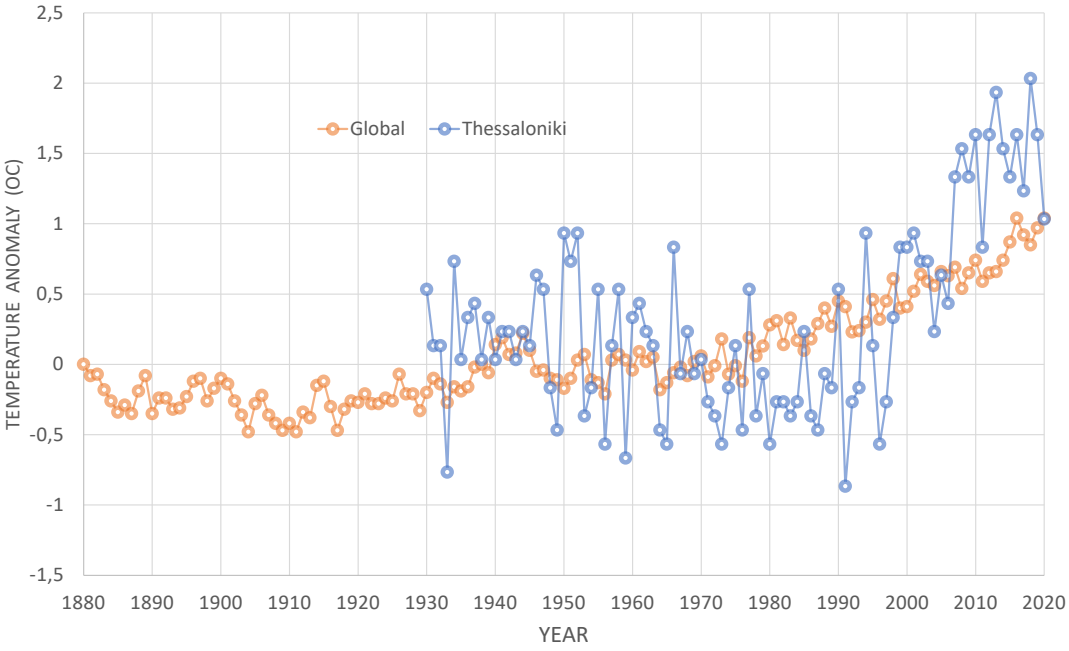
Climate change in the Mediterranean

The Mediterranean is an ecological region with 46.000 km coastline hosting 10% of the global vegetation species and 7% of the marine species. It is surrounded by 22 countries that are inhabited by roughly 480 million people with a high population density (~60 persons/km^2). Meteorologically, it is influenced by subtropical processes and mid-latitude dynamics. The Mediterranean (and the surrounding regions) is one of the most sensitive and vulnerable to anthropogenic climate change regions on Earth because the continental regions surrounding the Mediterranean basin are situated at the edge of semi-arid zones. As a result, a northward shift of baroclinic instability due to climate change could bring about drastic changes, particularly in the balance of precipitation in the Mediterranean (Giorgi, 2006; IPCC, 2007). Average annual temperatures in the Mediterranean region are now approximately 1.5°C higher than during the period 1880-1899, well above current global warming trends (1.1°C) (Cramer et al., 2018). This is also evident for individual Mediterranean sites, like the city of Thessaloniki where it is noted the higher interannual variability in temperature anomalies at local scale than in global scale but also a stronger warming trend over the last 50 years (1970-2020) with an increase in temperature of 2.24 °C in Thessaloniki and 0.97 °C globally (see Figure 1).

Model projections based on Global Climate Models (GCMs) and Regional Climate Models (RCMs) indicate consistent warming and drying of the Mediterranean region mainly over for the last decades of the 21st century for various emission scenarios (e.g. Gibelin and Déqué, 2003; Gao et al., 2006; Diffenbaugh et al. 2007; Goubanova and Li, 2007; Giorgi and Lionello, 2008; Zanis et al., 2009; Tolika et al., 2012; Lelieveld et al., 2013; IPCC, 2013; Zanis et al., 2015; Zittis et al., 2019).

Observed precipitation trends in the Mediterranean are characterized by high variability in space and in time, but climate models clearly indicate a trend towards reduced rainfall in coming decades. Several studies focusing on changes in temperature and rainfall extremes report that heat stress (Diffenbough et al., 2007) and the duration of drought periods (Goubanova and Li, 2007) will drastically increase in the Mediterranean region in the future. An ensemble of Coordinated Regional Downscaling Experiment (CORDEX) RCM simulations for the Mediterranean showed a general warming by the end of the century (between 1 and 5 °C with respect to the 1986–2005 reference period),

Figure 1. Annual mean temperature anomalies with respect to the period 1951-1980, for the globe (based on the GISS surface temperature analysis, https://data.giss.nasa.gov/gistemp/tabledata_v4/GLB.Ts+dSST.txt) and the city of Thessaloniki (based on data since 1930 from the meteorological station of the Department of Meteorology and Climatology at the Aristotle University of Thessaloniki).


2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
TEMPERATURE ANOMALY (OC)
Global
Thessaloniki
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
YEAR

which is expected to be strongest during summer (up to 7 °C), and a general drying between 10 and 40% (Zittis et al., 2019). It was pointed that the CORDEX ensemble corroborates the fact that the Mediterranean is already entering the 1.5 °C climate warming era and it is expected to reach 2 °C warming well within two decades, unless strong greenhouse gas concentration reductions are implemented (Zittis et al., 2019).

Warming of the Mediterranean Sea surface is currently estimated at 0.4°C per decade for the period between 1985 and 2006, while sea level in the Mediterranean has risen between 1970 and 2006 at the level of 1.1 mm per year (Meyssignac et al. 2010; Cramer et al., 2018). Future projections in global mean sea level rise range go from 52 to 190 cm by 2100 but there are important uncertainties that will largely influence the Mediterranean Sea level rise, because of the connection to the global ocean through the Strait of Gibraltar (Cramer et al., 2018). The response of thermosteric sea level rise in the Mediterranean ranges from +34 to +49 cm (2070–2099 versus 1961–1990), mainly depending on the Atlantic forcing (Adloff et al., 2015).

Impacts and challenges from climate change in the Mediterranean

In this complex situation of climate change in the Mediterranean region, (characterized by warming, drying, changing extreme events, sea-level rise and ocean acidification), there are anticipated several direct and indirect impacts in the coming decades (water resources, food resources, ecosystems, deforestation, desertification, natural disasters, fires, land degradation, agriculture, tourism, health, air quality, energy demand, political conflicts, civil security, migration and cultural heritage) and new challenges arise (Zerefos et al., 2011; Cramer et al., 2018). Because of the precipitation decrease, the temperature increase, and the population growth, freshwater availability in the Mediterranean Basin will be reduced, especially in the countries with stressed water supply. Water availabilities may drop to below 500 m^3 per capita per year (water scarcity) in the near future (Cramer et al., 2018). Under the 2°C global warming scenario, freshwater availability in the Mediterranean region is likely to decrease substantially (by 2 to 15%), which is among the largest decreases in the World (Gudmundsson et al., 2017). Furthermore, the coupled effect of warming and drought is expected to lead to a general increase in aridity and subsequent desertification of many Mediterranean land ecosystems.

Coastal ecosystems, being at the interface between land and sea, are also vulnerable under the impact of climate and environmental change. In addition, there are important coastal risks for humans as one third of the Mediterranean population lives close to the sea and the infrastructures are often very close to mean sea level (Becker et al., 2012). Harbors, port cities and other coastal infrastructures, as well as wetlands and beaches around the Mediterranean, will be at high risk due to the impact of climate change on rising sea levels, storm-surges, flooding, erosion and local land subsidence (Satta et al., 2017). About 15 megacities (port cities with a population greater than 1 million in 2005) will be at risk from flooding due to sea level rise, unless further adaptation is undertaken (Hallegatte et al., 2013). By 2050, for the lower sea-level rise scenarios and current adaptation measures, cities in the Mediterranean will account for half of the 20 global cities with the highest increase of the average annual damages (Hallegatte et al., 2013).

The added value from RCMs

Policy and decision-makers in governmental and non-governmental organizations, as well as end-users in the private sector and the public, require detailed regional information on future climate to assess the risks of the anticipated climate change due to the anthropogenic enforcement of the greenhouse effect. GCMs used in the IPCC fifth assessment report (AR5) still have a coarse horizontal resolution to resolve the effects on regional climate of local and regional scale forcings such as topographic characteristics with complex mountain ranges, coastlines, peninsulas, small islands and lakes, as well as land-use characteristics.

To support local/regional climate change impact studies as well as regional adaptation and mitigation strategies, it is hence necessary to use high-resolution future climate data from model projections based on RCMs. Although there is plenty of climate change information from RCMs in open access databases, there is limited usability from non-experts, due to complexities in exploring big databases. User-friendly open access data extraction application tools for future climate change are essential to support decision-makers, stakeholders, intermediary users and end-users for climate change impacts, mitigation, and adaptation. Usually, intermediate users and end-users need the information of essential climate variables or other climate indices in the simple form of a single time series at a certain point or region.

The DEAR-Clima application

In this scope and in the framework of the EU-project GEOCRADLE, the "DEAR-Clima" (The Data Extraction Application for Regional Climate) application has been developed by members of the Department of Meteorology and Climatology, AUTH. DEAR-Clima is a user-friendly interactive web application tool that visualizes and provides time series of essential climate variables and climate indices for end-users and intermediary users based on high horizontal resolution Regional Climate Model (RCM) simulations (http://datahub.geocradle.eu/dataset/dear-clima). This service processes data from simulations which were carried out in the framework of the Coordinated Regional Downscaling Experiment (CORDEX) research program (https://cordex.org/), they cover the EURO-cordex domain, have a high spatial resolution (0.11°), and span a time period from 1950 to 2100 (Jacob et al., 2014). The historical period of each experiment refers to 1950-2005, while the future projection period is 2006-2100 under the influence of three specific greenhouse gas emission scenarios; the Representative Concentration Pathways (RCPs), RCP8.5, RCP4.5 and RCP2.6 (Meinshausen et al., 2011). Each scenario describes a future greenhouse gas concentration trajectory up to the year 2100 and the potential radiative forcing that they will cause relative to the pre-industrial period. The simulations are a product of various Regional Climate Models (RCMs) driven by Global Climate Models (GCMs) as shown in Table 1.

Based on these high-resolution RCM simulations (see Table 1), the multi-model mean of annual temperature change is shown in Figure 2 for the city of Thessaloniki over the future period 2006-2100 with reference to the mean value of the historical period 1975-2004, for RCP8.5, RCP4.5 and RCP2.6 with the highest warming trend for the business-as-usual scenario RCP8.5 and the lowest warming for the scenario RCP2.6 with the strongest mitigation in greenhouse gases.

Scenario	Period	RCM	GCM
historical	195001-200512	CLMcom-CCLM4-8-17	CNRM-CERFACS-CNRM-CM5
historical	195001-200512	CNRM-ALADIN53	CNRM-CERFACS-CNRM-CM5
historical	197001-200512	SMHI-RCA4	CNRM-CERFACS-CNRM-CM5
historical	195001-200512	KNMI-RACMO22E	ICHEC-EC-EARTH
historical	195101-200512	IPSL-INERIS-WRF331F	IPSL-IPSL-CM5A-MR
historical	197001-200512	SMHI-RCA4	IPSL-IPSL-CM5A-MR
historical	194912-200512	CLMcom-CCLM4-8-17	MOHC-HadGEM2-ES
historical	197001-200512	SMHI-RCA4	MOHC-HadGEM2-ES
historical	194912-200512	CLMcom-CCLM4-8-17	MPI-M-MPI-ESM-LR
historical	195002-200512	MPI-CSC-REMO2009	MPI-M-MPI-ESM-LR
rcp26	200601-210012	CNRM-ALADIN53	CNRM-CERFACS-CNRM-CM5
rcp26	200601-210012	MPI-CSC-REMO2009	MPI-M-MPI-ESM-LR
rcp45	200601-210012	CLMcom-CCLM4-8-17	CNRM-CERFACS-CNRM-CM5
rcp45	200601-210012	CNRM-ALADIN53	CNRM-CERFACS-CNRM-CM5
rcp45	200601-210012	KNMI-RACMO22E	ICHEC-EC-EARTH
rcp45	200601-210012	IPSL-INERIS-WRF331F	IPSL-IPSL-CM5A-MR
rcp45	200601-210012	SMHI-RCA4	IPSL-IPSL-CM5A-MR
rcp45	200601-209911	CLMcom-CCLM4-8-17	MOHC-HadGEM2-ES
rcp45	200601-209911	SMHI-RCA4	MOHC-HadGEM2-ES
rcp45	200601-210012	CLMcom-CCLM4-8-17	MPI-M-MPI-ESM-LR
rcp45	200601-210012	MPI-CSC-REMO2009	MPI-M-MPI-ESM-LR
rcp85	200601-210012	CLMcom-CCLM4-8-17	CNRM-CERFACS-CNRM-CM5
rcp85	200601-210012	CNRM-ALADIN53	CNRM-CERFACS-CNRM-CM5
rcp85	200601-210012	KNMI-RACMO22E	ICHEC-EC-EARTH
rcp85	200601-210012	IPSL-INERIS-WRF331F	IPSL-IPSL-CM5A-MR
rcp85	200601-210012	SMHI-RCA4	IPSL-IPSL-CM5A-MR
rcp85	200601-209912	CLMcom-CCLM4-8-17	MOHC-HadGEM2-ES
rcp85	200601-209912	SMHI-RCA4	MOHC-HadGEM2-ES
rcp85	200601-210012	CLMcom-CCLM4-8-17	MPI-M-MPI-ESM-LR
rcp85	200601-210012	MPI-CSC-REMO2009	MPI-M-MPI-ESM-LR

Table 1. Description of the RCM simulations used for calculating the change in annual temperature in Figure 2, including the name of the scenario, the RCM and the forcing GCM. Source of RCM simulations: https://esgf-node.llnl.gov/search/esgf-llnl/.

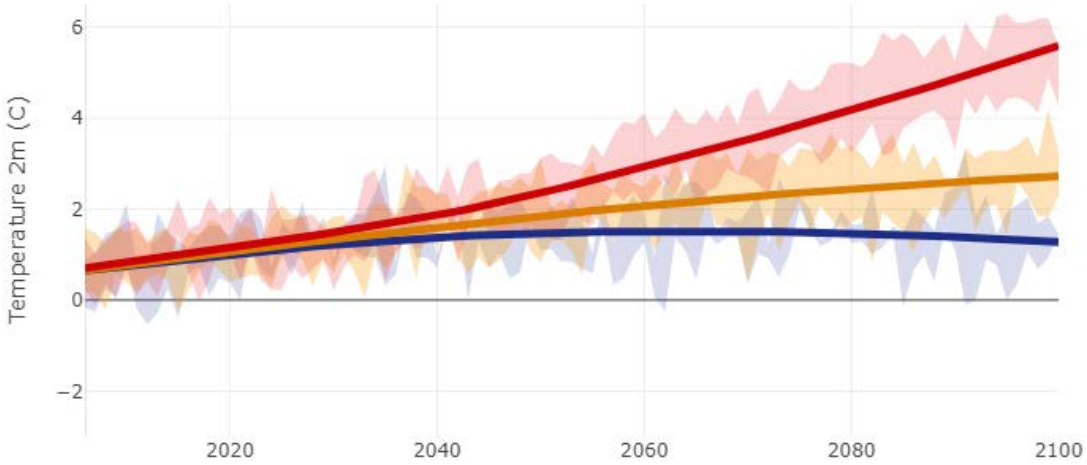


Figure 2. Smooth running multi-model mean of annual temperature change for Thessaloniki over the future period 2006-2100 with reference to the mean value of the historical period 1975-2004, for the IPCC scenarios RCP8.5 (bold red line), RCP4.5 (bold orange line) and RCP2.6 (bold blue line). The analytical description of the simulations is presented in Table 1. The shaded area corresponds to the standard deviation among the different RCM simulations and the bold solid red line denotes. The plot has been produced with the DEAR-Clima application (http://meteo3.geo.auth.gr:3838/) developed in the Department of Meteorology and Climatology of Aristotle University of Thessaloniki in the framework of the EU-project GEO-CRADLE (http://geocradle.eu/).

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Open Solutions in Mount Athos

Abstract

In times of climate change created by human's actions on the planet, decision makers and the communities question what can be done. The discussion regards the impact of climate change, how to mitigate and improve the situation. Actions are mainly related to the production of energy from fossil fuels, growth of CO2 emission and exponential consumption with the growing tendency towards hyper consumption.

Located near Thessaloniki, Mount Athos is a region that pursuit differently. Human activities are not contributing to the exponential rhythm of growth of energy hyper consumption. The religious community, constituted by monks and pilgrims, follow specific and unique regulations seeking a symbiosis of humans and the natural environment. It has also been described as a closed community, a capsule of time that refuses the contemporary way of living. However from the climatic perspective it is a unique case in Europe, a leading carbon positive territory sustained by energy free from fossil fuels and hyper consumption.

In Mont Athos, a combination of multiple strategies have been implemented successfully, thus it is worth learning from these solutions and interpret their implementation.

Introduction

The challenge brought by climate change created by human's actions on the planet, raises multiple questions, opens new perspectives and consequently demands different responses. The discussion regards the reduction of the impact of human actions and includes the interest for new models. Carbon neutrality emerges as a common goal for the younger generation who claims the same rights and privileges as those of the previous generations. The growing importance of the topic is raising an exponential diversity of answers in order to mitigate and adapt waterfronts to climate change.

Responses cover a wide range of opinions from scientific to holistic and from emerging generation to the older ones. Some believe science will solve the problem, other blame consumerism and a growing number share hope in Green Deals.

Conservative political leaders and CEO of large corporations such as Microsoft, along with other opinion makers, believe scientific innovative solutions[1] and high technology will provide the necessary answers for the climatic crisis. A different opinion is shared by religious leaders such as the Patriarch (Orthodox Christian), the Pope (Catholic, Christian), the Caliph (Sunni Islam) and Dalai Lama (Buddhist Tibetan), who claim the need to take care of the common house[2] and share a humanistic perspective and consequent urgency to promote symbiotic relations between humans and the natural environment[3]. Some authors argue that the anthropogenic period is at the end and develop philosophical approaches based on this premises. Editor of the book Enlightenment and Ecology, Yavor Tarinski claim that:

"Climate change will deepen ongoing current crises. It has the potential to radically alter the face of the planet, making our future on it quite uncertain. In a sense it is a holistic crisis. Thus, the climate crisis has an existential character that places us on a crossroad – to continue down the road we are currently on, or choose a different path. That's why conventional approaches like responsible parliamentarism and green capitalism seems out of place and offer no real solution to climate change."[4]

An increasing number of authors agree that our industrialized world endangers, by its hyper consumption, the very future of humanity, thus our research includes the identification of communities that succeed to diminish our ecological footprint[5] and place it as their first duty. The goal of "sosclimatewaterfront"

research project is to find sustainable open solutions and disseminate them to larger audiences. This short essay intends to open up the discussion towards new paths found in Mount Athos' strategies.

New paths

In this moment of crisis and conflicting perspectives it is particularly relevant to observe the actions and the positions of the younger generations concerned with the discussion. They tend to integrate scientific high-tech solutions with holistic sustainable strategies and share a critical perspective on economic activities spread worldwide that follow models of continuous growth. It is appropriate to observe their growing awareness and understand how human presence might be less damaging for the planet. What can be improved to mitigate ecological disasters, the exponential loss of biodiversity or how it might be possible to reach a healthy balance of CO2 emissions?

At present, actions are mainly related to the production of energy from fossil fuels and exponential consumption with the growing tendency towards hyper consumption. This model is being exported from developed countries to developing countries thus enhancing CO2 emission and harming the environment.

In 2020 organized by the International Society of City and Regional Planners, the World Congress Team produced a Declaration that stated:

"These simultaneous crises – climate, environment, health, social, economic – are demonstrating the fragility of our world. For planners, this is highlighting the need for integrated solutions, as we realize that we cannot put the climate agenda and planning for a post-oil future aside while we take on unprecedented challenges like the current pandemic. They all pose the question: how resilient is the physical, social and political infrastructure of our urbanized, globalized, ecologically imbalanced world? Is more change necessary than previously thought?"[6]

The final question shared by many young researchers, expresses the general perception of the next generation. Previous models seem outdated and the urgency to find adequate answers are brought to the center of the discussion. Promoting solutions of circular economy, the European Green Deal takes over in search for new potential models, which introduces the transition to the core of the debate. In his book Political Ecology: Beyond Environmentalism, Dimitrios Roussopoulos stated that there are fundamental questions to be addressed:

"Despite many international meetings, dealing with every subject from biodiversity to climate change, the national political elites have found it impossible to come to meaningful agreements to deal with the environmental crisis. […] There is no avoiding of imagining new and different scenarios than the status quo. Surely another world is possible."[7]

It is this different world that acquires an urgent necessity to be analyzed and discussed from another perspective in order to explore new systems that could be implemented to counterbalance the dominating models. Different worlds already exist and one of them is located in Europe. Mount Athos, an autonomous region located in the Aegean Sea Greece, is a territory that is 6 miles wide and 35 miles long with nearly 130 square miles. The surface is similar to the San Francisco Peninsula (California) or to Grenada (Spain). It is a small territory useful to observe as a laboratory for potential new worlds where there is a better balance between human presence and the natural environment.

The case of Mount Athos

Located near Thessaloniki, Mount Athos is a self-governed part of the Greek State, administered by the "Sacred Community" which consists of the representatives of the 20 Holy Monasteries.

All persons leaving in Mount Athos are dedicated to a monastic life. Visits to the peninsula are possible for the public, but they need a special permit similar to a visa. Everyday an average of 1000 visitors are inside the territory, hosted by 2000 monks a density similar to the country of Canada.

Human activities are not contributing to the exponential rhythm of growth of energy hyper consumption. The balance between humans and the natural environment shows a different approach where there is a low rate of CO2 emissions. The strategies adopted contribute to the 'decarbonisation' therefore it is mandatory to learn what solutions have been implemented in the territory. Most buildings make use of renewable sources of energy instead of fossil fuels and their internal habits of consumption are minimal.

The religious community, constituted by monks and pilgrims, follow specific organization and unique regulations seeking a symbiosis of humans and the natural environment. It has also been described a closed community, a capsule of time that refuses the contemporary way of living. However, from the climatic perspective it is a unique case in Europe, a leading carbon positive

territory sustained by energy free from fossil fuels and hyper consumption.

According to scholar Marius Dorobantu who studied the community, this is a growing healthy community who is increasing their influence and spreading a new perspective:

"The relatively young brotherhoods in the Athonite monasteries today are mostly formed by educated men, with a strong monastic vocation and with a clear vision of what they want to achieve. Their courageous and pragmatic approach towards spiritual life could also stem from the new way in which modern people perceive themselves, their own life and their place in the world: with a strong sense of self-determination and with an increased inclination to plan ahead, optimize and measure (spiritual) progress."[8]

The strategies reinforced in the last twenty years give us the evidence of how it can play a role model on waterfront community's capacity to adapt to climate change[9]. To contribute to the present debate each parameter should be addressed independently but there is an urgent need to find new paradigms as Canadian philosopher Harvey Mead[10] states:

> ***"we have no choice: either we change our system by a massive community effort, or this system will collapse under the weight of its excesses, whether of an economic, social or ecological nature."***

The center of the discussion is the identification of new systems, their role and the interaction between parameters in order to shed light on how this model can be useful to other communities facing the challenges of climate change. The north-American environmental activist, Wendell Beny, born in 1934, is an author who is ahead of his time and expressed ideas that were only celebrated late in his life. On his 2019 book Essays 1969-1990, Beny states:

"What is represented is a world in which humans belong, but which does not belong to humans in any tidy economic sense; the Creation provides a place for humans, but it is greater than

Figure 1. Map of Greece indicating the location of Mount Athos

Figure 2. Mount Athos, Dochiariou Monastery

humanity and within it even great men are small. Such humility is the consequence of an accurate insight, ecological in its bearing not a pious deference to "spiritual" value."[11]

In the present debate a growing number of authors point out the inevitability of a new world, the implementation of new models, the importance of common goods, the relevance of the spiritual experience and the importance of responsible consumption. In this context Mount Athos provide a coherent illustration of a possible new model.

Conclusion

S.O.S. Climate Waterfront, Sustainable open Solutions rely on the exchange of best practices and cross references between different geographies. The strategy applied in case studies examined make use of historic and geographic records of specific waterfronts. The collection of data is used to construct patterns of development, feed algorithms and integrate the support of artificial intelligence to design future possible scenarios. The lesson brought by Mount Athos is that solutions can only be successful if they also engage the community, educating them about other possible ways of living, relating to the environment and fostering possible changes in lifestyles.

The balance between human presence and natural environment particularly on the waterfront are well illustrated in Mount Athos, which offers an alternative lesson for possible solutions. Mount Athos's community succeeds to overcome difficulties, integrates cutting edge technologies combined with low tech solutions to build up a model of adaptation. The uniqueness of the community of monks cannot be replicated to other communities but the model of resilience certainly offers an unavoidable reference for future communities in search of transition.

Figure 3. Mount Athos, the natural waterfront

Figure 4. Mount Athos, Xenofontos Monastery

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Thessaloniki waterfront between "stone" and the sea: thesis for a shared and sustainable water mobility

Design workshop

At the moment, the Old and New waterfront of Thessaloniki is an urban cyclist-pedestrian and highwayabout eight kilometers from the industrial port to the Concert Halls site.

The old waterfront of the historic city was cleverly extended to the east by five kilometers, adding a green zone with leisure facilities between the four lane road and the waterfront pedestrian route. It is an urban linear park, which is widely used by citizens. To the east, shipyards, industrial infrastructure and recreation are practically alternated until the airport,with a unique sequence of marinas, equipped beaches and boatyards. To the west, the industrial site is located to the east of the Axios Delta, rich in natural lagoons, formed by the estuary of the three rivers converging to the western waterfront of the Thermaic Golf.

Amid the industrial port and the delta on one end, and amid the Concert Halls site and the tourist marinas on the other, are the two sites selected as case study areas of the workshop. More specifically, to the west, the natural waterfront and the marshes near the Dendropotamos stream in the Municipality of Menemeni – Ampelokipi was the selected site and to the east, the natural waterfront in the interface area of the Municipalities of Thessaloniki and Kalamaria.

Green corridors

The workshop will focus on the natural waterfront of these two areas. The goal is to search for landscape architecture solutions capable of initiating water management processes, and encourage re- recruitment processes by the local community. It should be noted that, as evidenced bythe chapters devoted to workshop's participants work, the best projects were able to combine careful reading of urban systems facing the waterfront and redesign of new green and pedestriansareas. Also similarly, they revisited the waterfront renegotiating the interface of land and water, proposing new sustainable mobility functions, both at local and wider urban scale.

Chaotic roads

In addition to the its undoubted urban quality, the waterfront delimits and separates today two compact and functionally unrelated systems, the sea and the dense urban fabric. The sea and the human activities related to it have undergone a drastic transformation over the centuries. From the many activities, such as fishing and sailing, with yachts, small local

freights and large anchored ships seen on the wider Thessaloniki Bay in old photos, today only large freight anchored ships are seen in the wider port area.

On the other hand, the urban building system is compact to the point of frenzy. It consistsof a series of urban blocks and streets without intersecting pedestrians' and green axes comparable to the urban park along the waterfront. Therefore, the main roads are mostly longitudinal. The result is a complete dependence on car transportation. In addition, the number of city buses is insufficient and their speed is very slow. Furthermore, the bus lane is accessible to cars and taxis only from 8:00 p.m in the evening to 6:00 a.m. in the morning. All these factors make road transport chaotic. Another very important pollution factor for the city is the old fleet of vehicles.

Concrete block

New dialogues between the sea and the urban fabric ~~system~~ can contribute to greater sustainability and Thessaloniki moves in this direction; MDAT SA, which a few yearsago proposed an international competition for the design of maritime transport stops, presented its results during the workshop. The subway line under construction will have little influence in the near future, because the difficulty of managing theinnumerable archaeological resources in the subsoil makes its realization very slow. The name given by some citizens to the urban fabric of Thessaloniki is significant: the "concrete block city" or "the stone", to emphasize that it is a solid and monolithic built system.

Maritime transport

During the workshop the complexity of the urban impacts of climate change has been addressed in a series of preliminary lectures by experts and and academics presenting a sequence of information fromthe most general, ie about climate change in the Mediterranean, to the most detailed, ie ~~of~~ about the Rapid Water Mobility Network.

The latter, from the institutional partner of the project, MDAT, proposes exploring thepossibilities of initiating synergic and complex processes, in addition to the multi functionality of access points to the express maritime transport line. The workshop promotedand encouraged the discussion by narrowing the study areas to the two most problematic sites ~~areas~~ mentioned above and revolved around the urban waterfront and the vast metropolitan area. However, the complexity of the interactions

between city and sea through the waterfront zone, obviously cannot be resolved by the scale of just these two areas. At bay scale, the transformation of the waterfront to modular antenna dependency is appropriate to addressthe risk of climate change, because its constant excess reduces the impact of any sea-level rise.

Tentative design

The plan / project of MDAT and the metropolitan body is to achieve a rapid water transport network, as mentioned above. In the light of reflections on a holistic, multifunctional and shared approach embedded in the most recent strategies to tackle climate change risks, we were striving here to make an innovative contribution to this plan / project. This could be an opportunity to rethink the total Thessaloniki's relationship with the sea, which is aprerequisite or, better, a light infrastructure, for a new view of the water; a new interaction of functions on a metropolitan, urban and neighborhood scale. It is an "experimental design" to try and accommodate the boundaries of the proposed new functions and the institutions involved in achieving common solutions. There is no reference here to architectural forms, as "a wise play of volumes under the sun", but as a "stage of human interaction". It is a concept of architecture that looks at the reflection on the forms that are implied as a final part of a complex and plural process, starting with defining the role of those who will cross the predetermined positions. A similar "urban acupuncture" strategy led to the definition of the Venice Lagoon waterway anchorage points in the "master plan for enhancing the lagoon's landscape and culture" prepared by the Unesco Site Management Office and lagoon ".

Landscape acupuncture

Even in Thessaloniki it would be useful to "overthrow the telescope", as they say in Italian to allude to a radical change of approach, and to rethink the waterfront from the point of view of the water, and not only of walking along the linear park. It is a question of imagining the sequence of landings as the anchor points of the complex network of relations between the sea and the city, in other words between its citizens and the water. Today, no boat plies the calm waters of the gulf, except for some rowing in the evening, or some pirate-like boat or Roman-like galley, for tourism purposes. Just go back in time to see images of the water in front of the dense central waterfront of any type.

Figure 1. Thessaloniki 1 - Thessaloniki' s waterfront with the White Tower in the background in the 1930s, Source: Yannis Megas, Nikos Horbos, Thessaloniki through the lens of George Lykidis (in greek), Thessaloniki, 2002, IANOS ed., p. 51

Figure 2. Thessaloniki 3 - Thessaloniki' s waterfront view from the White Tower- nautical festivities in the 1930s, Source: Yannis Megas, Nikos Horbos, Thessaloniki through the lens of George Lykidis (in greek), Thessaloniki, 2002, IANOS ed., p. 59


-ΠΡΟΚΥΜΑΙΑ — ΘΕΣΣΑΛΟΝΙΚΗ
LE QUAI — SALONIQUE


ΘΕΣΣΑΛΟΝΙΚΗ. Ναυτική γιορτή 1935

1 1913, Auguste Léon

A 2014

(figure 1,2,3: the Thessaloniki's waterfront in 1930s, courtesy of Olga Deligianni /legend for Thessaloniki 1/Thessaloniki1, 2/Thessaloniki3, 3/Thessaloniki4). A wealth of daily functional interchange that has disappeared today, but which is easy to imagine ~~is~~ being foreverlatent. And so, to restore functional flows, enough skilful and active acupuncture / landscape acupuncture is sufficient, such as very fine needles are gently made for the lymphatic flows of the human body.

We like to imagine the piers leading to the terminals as ~~a~~ modular linear system, a complexintermediate body of water-related activities. It is intended primarily, but not exclusively,for specific and diverse groups of citizens coming from both near and far, from the vast area, the city and the neighborhood, and ~~to~~ help identify the multiple activities of their potential relationship with the sea.

Participatory process

The urban system of Thessaloniki is too complex and intertwined to refer generically to citizens and their representatives. In this sense it is necessary to break them down into different classes of users, according to different skills and abilities, in order to be able to indicate and involve in the process homogeneous groups of citizens, and therefore represented in coherent associations of citizenship. By way of example, we can refer to groups of elderly and disabled, students and researchers, lovers of water sports and the sea, sensitive to issues of environmental sustainability and alternative energy sources, dedicatedto military defense or cultural functions, etc. It is not a question of defining "ghettos" for these categories, but of privileged users, useful not only to give shape to actual and inclusive functions, but also to become involved in the very initiation of the design process. They have to be involved immediately in the choices of functions, through a jointed process inspired by the Council of Europe Faro Convention. The "Framework Convention on the Social Value of Cultural Heritage" entrusts in fact the role and responsibility, in the development of the cultural landscape, to the patrimonial communities expressed by the citizens, under the aegis of the public administration.

Figure 3. Thessaloniki 4 - City view from the sea (1913)- Source: THESSALONIQUE 1913 & 1918, LES AUTOCHROMES DU MUSÉE ALBERT KAHN, ATHÈNES 1999, OLKOS éd., p.28

Anchor points

These theses for sustainable mobility start from an assumption of shared responsibility with respect to each proposed pier by a series of coherent associations, representing a part of the

population, of specific users but, as mentioned, not exclusive. Let's imagine a series of piers along the waterfront of the old historic city center and the linear park, about eight hundred meters apart, taking their name from the activities associated with each category of users, meeting the needs of interconnection with the sea they are already consciously expressing and urging new uses. The communities involved, through the associations and public administration structures, should first define their needs and then ~~to~~ the values of proposed new functions through the immediate management of certain new sites. Each of the piers could combine~~s~~ these thematic activities, with general functions such as the clear connection of the waterfront and the catering services to the longitudinal pedestrian axis, as well as a limited number of moorages for citizens' vessels, a new and private exchange between the city and the sea. Finally, a friend wisely suggested that the docks could accommodate electric boats to rent and move from one pier to another to mimic the incredible success of free renting scooters on the waterfront in Thessaloniki.

Thematic piers

All the proposed activities ~~are~~ should be accessible to the entire population of the city and not only to the categories already involved, but also to all visitors, thus prefiguring a symbiosis between the needs of tourists and citizens, that can avoid the exasperated conflicts so harmful in other cities of art. Obviously it's not wise to start with large equipment, but to ignite forall the piers a path with minute and temporary activities first, then bigger and morestable, after evaluating their economic sustainability. The jetties will have a modular configuration, able to adapt and transform according to the foreseen, and unforeseen, needs. They will be anchored to the urban system from bicycle-pedestrian paths, from parking lots and from exchangers between the different mobility transit system (metro, bike, car, bus), but the complexity of this theme suggests delegating it to further investigations.

A first tentative list of thematic piers, open to mergers and additions, is as follows:

1. mobility pier, dedicated to the elderly and disabled, prefiguring an environment that is fully accessible to all categories of users, even to those who are in some way limited in mobility. Obviously this is not a ghetto, but a place of interchange between generations and skills. For example, it is enough to recall the success of the public in Italy that hashad an exhibition dedicated

to the sensory experiences of the blind, where they have become healthy carriers of a tactile vision, highly instructive for all.

2. research pier, open to the impressive number of students and researchers that populate the largest university city of Greece, where it will be up to their creativity to place compatible functions, and fill them with life.

3. sport pier, where to place activities related to rowing and water sports, and to whateverelse the sports associations will be able to identify and manage.

4. sea pier, where there is a space to learn about the marine environment of the gulf, the Aegean and the Mediterranean, including even an aquarium in the future. It is recalled, for example, that the Genoa aquarium played a fundamental role in the revival of the ancient port, and is still widely used by citizens and visitors.

5. energy pier, dedicated to those who are sensitive to issues of environmental sustainability and alternative energy sources. Here are moored and represented boats with new propulsion systems. It should be noted, for example, that IWI (Inland Waterways International) is organizing the first e-Regatta in Venice next June, a promotional event that can be played in the calm waters of the Gulf. A strategy that is not only ethically responsible, but can open new roads to the rich shipbuilding production in the metropolitan area of Thessaloniki.

6. defense pier, dedicated to the history and functions of the Greek navy.

7. cultural pier, which includes an interpretative center of cultural resources around, inside and under the waters of the Gulf of Thessaloniki.

This network of moorings refers to the urban section of the waterfront, between the commercial port and the philharmonic center, which is denser because it is more inhabited. The territorial waterfront, and therefore the whole connective network, extendsfrom east to west, from the airport to the Axios delta, from the main international connection point to the main nature reserve. Between these extremes and the central waterfront there are further piers that refer to local communities to interpret and propose their use values.

Dialectic process

The philosopher Aristotle was born near Thessaloniki. Our thesis is not only an homage to his articulation of the "dialectic discourse" but also a strategic reference. Actually the shared process nowadays needs in the first phase a tentative "thesis". The second phase uses it, as inquiry to the stakeholders and communities, to raise the consciousness and collective proposals and "antithesis". The third resume a "synthesis" in a proper urban design. This of course, will be done in a process of continuous back and forth, from the general to the particular. We are not saying that it is easy but that it is worth it. This can be a process not indefinite in time, but it could be short and effective.

We do not know if and how local administrations will take part in the process described so far, but certainly it would allow the unexpressed potential of a unique metropolis overlooking its gulf to emerge. A participatory and sustainable urban planning process will be launched, capable of being implemented in a short period of time, being economically viable and, moreover, using a revival process to improve the quality of life of citizens. A process that tackles climate change, exemplary for innovation in urban development, while preserving the ancient values of a bay-town maritime community, butalso of the Mediterranean and the world.

Conclusion

The Thessaloniki Event took place during fall 2019 and the preparation of this book should have followed immediately afterwards for presenting its outcomes. The outbreak of the COVID-19 pandemic interrupted this process and our research project received an 18 months period of extension. This period offered a great opportunity for reflection concerning multiple issues. The pandemic has revealed humanity's intimate relationship with the natural world, while several human impacts on the global environment that have contributed to climate change are also factors in the emergence of the novel coronavirus. The pandemic catalyzed public awareness of social and environmental injustices, including those associated with climate change enhanced by extreme weather events during the last two years[1]. What is politically possible to face a global urgent problem revealed a decisive change in practices and priorities for governments around the planet. For researchers who track how information spreads, COVID-19 was an experimental subject like no other. "This is an opportunity to see how the whole world pays attention to a topic," says Renée diResta at the Stanford Internet Observatory in California[2]. Climate change will demand actions to adapt and mitigate depending on the dissemination of scientific facts related to human activity and its impact on the natural world. Informing public opinion and raising awareness of the necessity to act urgently to face climate change is a major challenge. Dissemination of data, global cooperation and interdisciplinary research will have to focus on these issues while providing sustainable open solutions to face the future.

"The scale of recent changes across the climate system as a whole and the present state of many aspects of the climate system are unprecedented over many centuries to many thousands of years…. Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since the Fifth Assessment Report (AR5)."

(IPCC Sixth Assessment Report / 9 August 2021)[3]

Half of the world's population now lives in cities, and this is projected to increase to two thirds by 2050 [4].Addressing environmental planning for climate change should try and develop tools, urban policies, strategies and practices that would help tackle climate change from both an adaptation and mitigation perspective. Any planning action towards these goals should address the complex urban environment at multiple scales having an integrated approach regarding social, economic, technological, environmental and cultural parameters. Planning should involve participatory practices involving multiple local stakeholders, local governance bodies, private and public investors and dissemination

of knowledge and public awareness is a key factor for the demanded paradigm shift that has to be acheived.

The two selected sites along the 40 km Waterfront of Thessaloniki Metropolitan area face today a series of challenges regarding their ecology, their potential to function as urban public spaces and their latent qualities to contribute to the city' s resilience. Both have retained their natural shoreline and have not been rehabilitated. The waterfront site of the Municipality of Ampelokipi-Menemeni lies to the north west of Thessaloniki' city center, trapped between the heavy port infrastructure and the industrial zone further to the west.

The site faces important environmental pressure caused by lack of official planning, pollution of soil and water while large parts of the land is at the same or at lower level than the sea resulting, periodically, in large flooded areas. The municipality's lack of public open spaces in the wider region and the desire of the citizens of the western districts of Thessaloniki to have access to the waterfront have set the agenda of our workshop research. In contrast to the underprivileged western districts of the city, the waterfront site of the Municipality of Kalamaria to the south east of the city' s center, is located in a residential quarter of middle to upper class housing. Despite the high cost housing and services in the area, the waterfront site in Kalamaria is also unplanned and abandoned with the natural shoreline being conserved. Site visits by the group of researchers and participants provided a better understanding of the spatial and geographical configuration, topography, landscape qualities, existing heritage and present functions of the study areas. Local government engineers, experts and representatives informed researchers of existing planning strategies and provided necessary data related to the two sites. High priority of the four groups dealing with the two sites was the discussion, elaboration and application of environmental planning strategies contributing to the city' s adaptation to face climate change by re-animating the urban waterfront as public space and upgrading it environmentally .

The presentation of the outcomes of the workshop was conceived as a traveling exhibition – exhibited at Remezzo Exhibition Centre" in the Municipality of Kalamaria, Greece, between 7th – 13th of November, 2019 and consequently at Thessaloniki's Town Hall, at the City Council Assembly Hall, between 21st – 29th of November, 2019. Results were presented

in posters displayed and intended for the wider public. The exhibition comprised twelve (12) A0 posters with the analysis and proposals for the two sites and the projection of a power point presentation of the two wider areas. As pilot projects the workout concepts presented here could play a pivotal role for the sustainable development of the whole urban waterfront of Thessaloniki.

In this book the results of the Thessaloniki Event comprise illustrative material of the intensive design and planning workshop as well as the scientific and opinion papers by researchers and participants. It is an overview of a fruitful collaboration within the common goal of contributing to better understanding climate change processes in waterfront urban environments for building resilience and reducing vulnerability to climate-related disasters. The outcome was the result of a transdisciplinary, multilevel and participatory approach focusing on the elaboration of sustainable, energy and resource efficient, technically and socially innovative design tools that could shape resilient, inclusive and attractive public space on the urban waterfronts.

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