One of the most complex discussions concerning climate emergency is the possible rise in sea level. Existing data show that rising water levels is already a reality, but the question is: how much will this rise be? And, how long do we have to act?

SOS Climate Waterfront is a research project financed by Research European Agency that make a reflection about some philosophical and project design questions that relate climate change and waterfront issues. This book present: Cascais - public space on the seafront; Mafra - World Reserve for Waves and Surf and Alcochete - Samouco Saltpans and the human made coastline.

Thematics were set in this book spelling out a set of discussions, ideas and potentials exposed by design project proposals, scientific papers and some opinion articles. The variety of approaches is a goal into the connection between the different parts in this discussion.

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Researchers critically reviewed the sites, produced research at a very high level relating the built environment and the impact of climate change. They had a crucial role in supporting the development of research and exchange of ideas. They also conducted a paralel event organized for a short period where graduate students coming from ten different countries worked under their supervision. The presence of the following external participants brought freshness and value to the research: Andrada Selter, André Nionje, António Buta, Bianka, Cláudio Evaristo, Dominik Wagner, Edmilson Soares, Evandro Lukeny, Flaminia D'Aria, Giacomo Mamo, Herlander Almeida, Inês Micaela, Joanne Abudalu, João Santos, Joel Ferreira, Keura

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During the event, we had the contribution of high-profile researchers, Pedro J. Pinto, Luís Lobo Xavier and Gustavo Magalhães who contributed to enlighten the whole group and who influenced the envisioning of Sustainable Open Solutions based on a strategy of excellence in research and innovation to design tools for the waterfront cities to face climate change.

Pedro Ressano Garcia
Primary Coordinator of H2020-MSCA-RISE

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SOS Climate Waterfront is a research project financed by Research European Agency (Horizon 2020 - RISE Marie Skłodowska-Curie Actions) that gathers five universities and five stakeholders from Portugal, Poland, Greece, Sweden, Italy, Nederland and Turkey. The participation in the events is open to researchers, PhD students and post-docs to improve and benefit the scientific excellence within the partnership. Municipality representatives collaborate by sharing technical and scientific information with the participants to enhance their knowledge of the local situation. The research team invites various experts from multiple fields of knowledge such as architects, urban planners, environmental engineers, meteorologists, hydraulic engineers, lawyers, economists, social and political scientists, landscape architects, journalists, writers and artists.

Researchers discuss the problematic with municipality representatives and local experts before developing innovative solutions. Researches succeed to strengthen the international and intersectorial collaborative networks and boosted the R&I capacity among participating organisations. While working together during the whole duration of the 30 days workshop they contribute with discussions on international examples of waterfront transformation and cross visions with the local situation. Researchers gained new skills that are transferable among the international partners.

The workshop started with site visits guided by local experts that shared the present challenges and future constrains within the forseen conditions affected by climate change. Followed by round-tables to compare best practices and operational tasks, researchers work among academic and non-academic sectors. The work was divided into groups according to workpackages and deliverables previously established.

Three groups were created for the three selected sites, while working intensively in their own proposals, researchers were continuously exchanging ideas, through group sessions, pin-up maps, swot analyses, drawings, internal and external presentations. Several international and national experts were invited to contribute with their scientific and technical comments which created a fertile environment to produce results at the highest level. By proposing architectural and urban design strategic solutions

researchers were able to overcome their initial knowledge on the subject, gained new skills, learned how to strengthen the value of the local system's sustainability.

This methodology was used throughout the training of researchers to enhance their ability to work in the international and intersectoral exposure with the aim of preparing them to fill the top positions of tomorrow in their own countries and at an European level. The tools provided during the training have the objective to solve current and future societal challenges and are made available on open source through the website of the program, shared database, videos, exhibitions and publication of results.

SOS Climate Waterfront project will focus in five main cities (Lisbon, Gdansk, Thessaloniki, Stockholm and Rome) that share the aim of understanding the most relevant problems, causes, potentials and possible solutions related with the connection between water and mainland, within the scoop of the climate crises. This publication is about the Great Metropolitan Area of Lisbon.

The workshop in Lisbon had the duration of one month and gathered an international team of researchers to reflect about the challenges of the sites selected by regional and municipality representatives in close collaboration with the academic researchers that integrate the team. The work methodology is based on three main steps:

— participants workshop led by several research and institutional experts;

— conferences introducing generalist and site-specific themes;

— meetings of researchers who gathered all the information and outlined potential ways and strategies for integrating climate change and transforming the waterfront.

The Lisbon workshop also beneficiated from a short term parallel event conducted by high profile scholars and graduate students enrolled in an intensive program named Waterfront Winter School.

The workshop participants aimed at widening, broadening, and sharing knowledge relevant on the inter relations between waterfronts and climate change and had the opportunity to discuss their ideas with an external guest which enhance some energies to the workshop.

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If humanity is structured around periods of major developments or thematic as we have seen in former periods like the iron period, the sedimentation period, the classical period, and others, climate emergency could now take the current times after Industrial Revo-

lution together with internet developments. Resource depletion and climate change due to land use and atmosphere overload are currently a real problem and the possible foreseen consequences a major research area. Factual data collection processed over the past 100 years together with the calculations for previous data present daunting scenarios for the future. Although some controversial research lines and sparing scenarios, discussions about the future is now on the table and participation is mandatory.

One of the most complex discussions is the possible rise in sea level. Existing data show that rising water levels is already a reality, but the question is: how much will this rise be?, how long do we have to act? And, what are the main consequences to humanity?

The present project introduces three specific strategic questions related to intrinsic and essential questions of the relationship between this territory and the sea.

As the poet says:

> ***"Here, almost the top of the head. From all over Europe, the Lusitanian Kingdom, where the land ends and the sea begins (...)" (Camões, 1572)***

From poetry to political strategy, the relationship with the sea is inseparable from the specific character of Portugal's culture heritage. As fish has been historically an important base of nourishment to this territory, also the immensity of the sea has been the great modeler of a certain portugality. Many historians link the Portuguese discoveries impetus to its territory geographical situation between Spain, our major enemy and the sea, the limit. At that historical moment, this situation could represent the salvation or, most likely, the easiest way out.

The tides and winds of the sea, have modeled Mediterranean to Atlantic Portuguese coast line, its natural species, ecosystems and the knowledge of living together with the sea. Portuguese waterfront presents formal geological variations inland and outland that have contributed to very specific land and water uses, as well as some very rich human settlements and habits. Despite climate affinities with the Mediterranean, Atlantic Ocean is the major atmosphere regulator in the whole territory (Ribeiro, 1945) bringing humidity and temperature stability.

Lisbon stands in the west coast bathed in the wild Atlantic. It is the end of the Europe continent, as the poet says. It is a hard relationship and the proof of this hardness is the cliff-shaped coast, the punctual settlements in the ports of shelter and the long promontories.

For this research, the local experts have chosen three thematic corresponding to three sites that represent maybe the most philosophical and speculative questions to develop research at a higher level with the international participants that that develop innovative solutions to mitigate the impact of climate change and investigate the future opportunities to adapt the built environment along the waterfront::

— Cascais - public space on the seafront - Located on a south facing seafront, it allows stabilized urban settlements directly related with the sea, establishing a strong social relationship, in a continuous public space - the seawall. With rising sea levels and following some extreme atmospheric phenomena, this space has been disturbed in recent years.

— Mafra - Ribeira d`Ilhas, World Reserve for Waves and Surf - Located on the Atlantic coast has a rough sea relation with high rocks and an economic and social dynamic related to water sports like surfing, kite surfing, windsurfing, etc.. Recently, the natural conditions were classified in a way to defend an environmental future as a factor of economic development for the County.

— Alcochete - Samouco Saltpans and the human made coastline - Located on the Tagus River estuary, Salinas do Samouco (Alcochete) represent a fertile territory dominated by men for thousands of years as an area for fish, saline and agricultural nurseries. This domain is now being invaded by the new super-infrastructures of bridges, airport and mass tourism, disturbing a stable balance between nature and man in the dominium of the water.

The topic has been addressed in this book through various approaches and discussions. Ideas and potentials were exposed throughout design project proposals, scientific papers and some opinion articles. The variety of approaches is a goal into the connection between the different parts in this discussion.

Camões, Luís. Os Lusíadas, 1572

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Pedro J. Pinto

Tagus Estuary: Past, present and future.

The Tagus Estuary was created after the end of the last glacial period, when the rising sea level drowned the lower Tagus River valley. After being drowned by the rapid post-glacial sea level rise, the inland delta of the Tagus grew through sediment deposition, and sediment further accreted along the margins of the estuary, allowing the establishment of tidal wetlands [1,2].

The evolution of wetlands and settlement around the Tagus estuary was one marked by repeated cycles of reclamation of the coastal prairie that formed behind the advancing ("prograding") pro-delta, situated at the upstream section of the estuary; as the frontline of mudflats and saltmarsh accreted and moved downstream, it created behind it a large floodplain of fertile soils, which were seized and used for agriculture by all the successive civilizations that controlled it, from the Romans to the Visigoths, on to the Moors and, eventually, the Portuguese. This special kind of low-land, reclaimed farmland, traditionally protected by low walls or stakes, along the lower Tagus valley, is called the Lezíria. The term derives from the Arabic al-jazīrah, meaning island, and originally referred to depositional islands, point bars, and tidal flats along the river channel. Later, it came to be synonymous with the alluvial plain as a whole.

Figure 1 is a composite based on over 30 map and document sources, and published originally in Pinto (2016) [3]. Each stage depicts an approximate reconstruction of how the estuary and surrounding lands evolved throughout the Holocene:

a. 12,000 YBP: Around Late Glacial Maximum, sea-level was about 60m lower than today. The rapid deglaciation that followed marked the beginning of the Holocene and about 8 millennia of rapid sea-level rise (SLR);

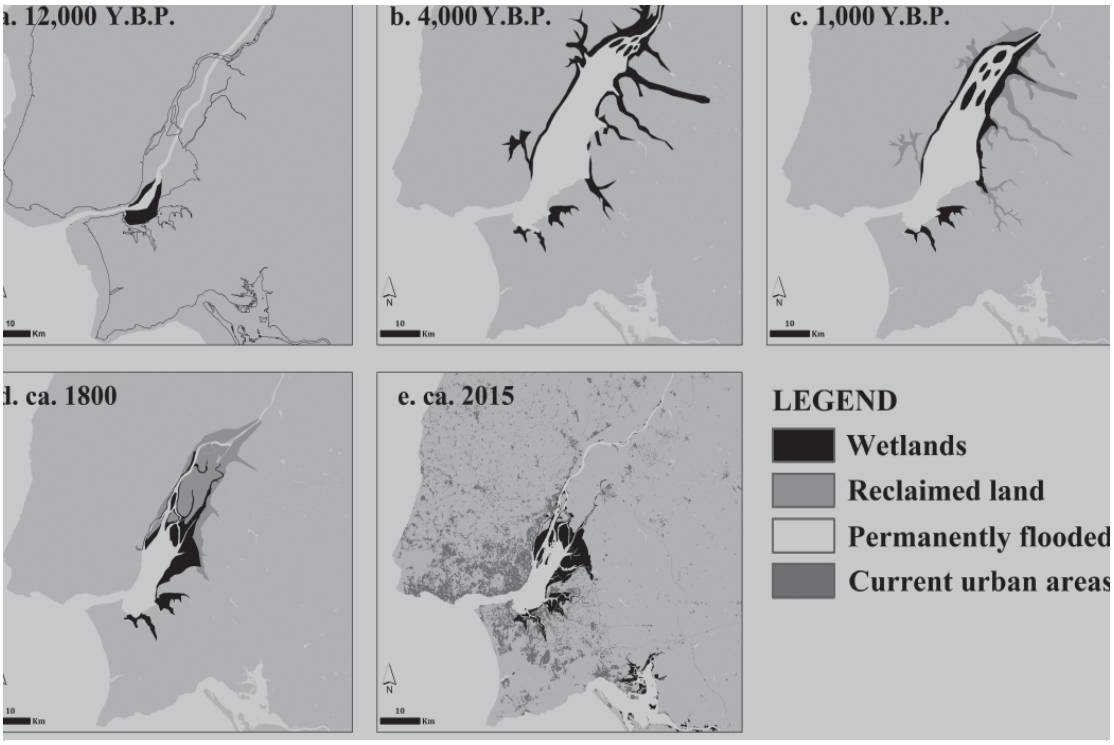
b. 4,000 YBP: Sea-level rise slowed down dramatically. This allowed saltmarshes to colonize the sheltered shores. The process of slow progradation (expansion and elevation) of the delta was initiated;

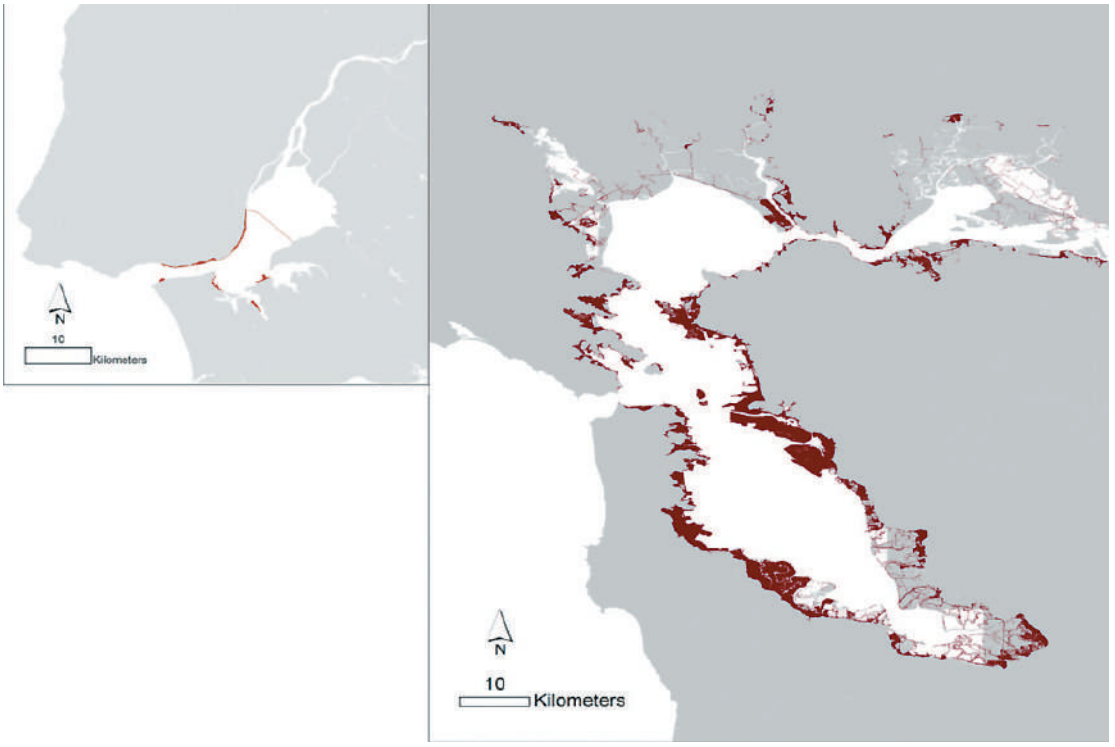
c. Year 1000ce: The natural process of progradation was much accelerated by human alteration of the land cover, which led to increased sediment yield. The cycles of transformation of high marsh and coastal scrubland to agricultural land on alluvial soils – which had been initiated by the Romans about a millennium earlier – had already produced significant alterations to the upper estuary ;

d. Year 1800ce: Much of the upper delta had been transformed by successive pushes to drain upper marshes and convert them into alluvial farmland (the Lezíria);

Figure 1: Environmental history of the Tagus Estuary, displaying wetlands (saltmarshes and mudflats), reclaimed land (wetlands drained for agriculture and other human uses), and permanently flooded areas (below the lowest tide). Y.B.P.=Years Before Present. Source: Pinto 2016 [3].

Figure 2: Urban and infrastructure development over landfill (represented in dark red) in the Tagus Estuary (left) is much less extensive than in other metropolitan regions, such as the San Francisco Bay Area (right). Both estuaries represented at the same scale. Source: Pinto (2015) [4].


a. 12,000 Y.B.P.
b. 4,000 Y.B.P.
c. 1,000 Y.B.P.
d. ca. 1800
e. ca. 2015
LEGEND
Wetlands
Reclaimed land
Permanently flooded
Current urban areas
10 Km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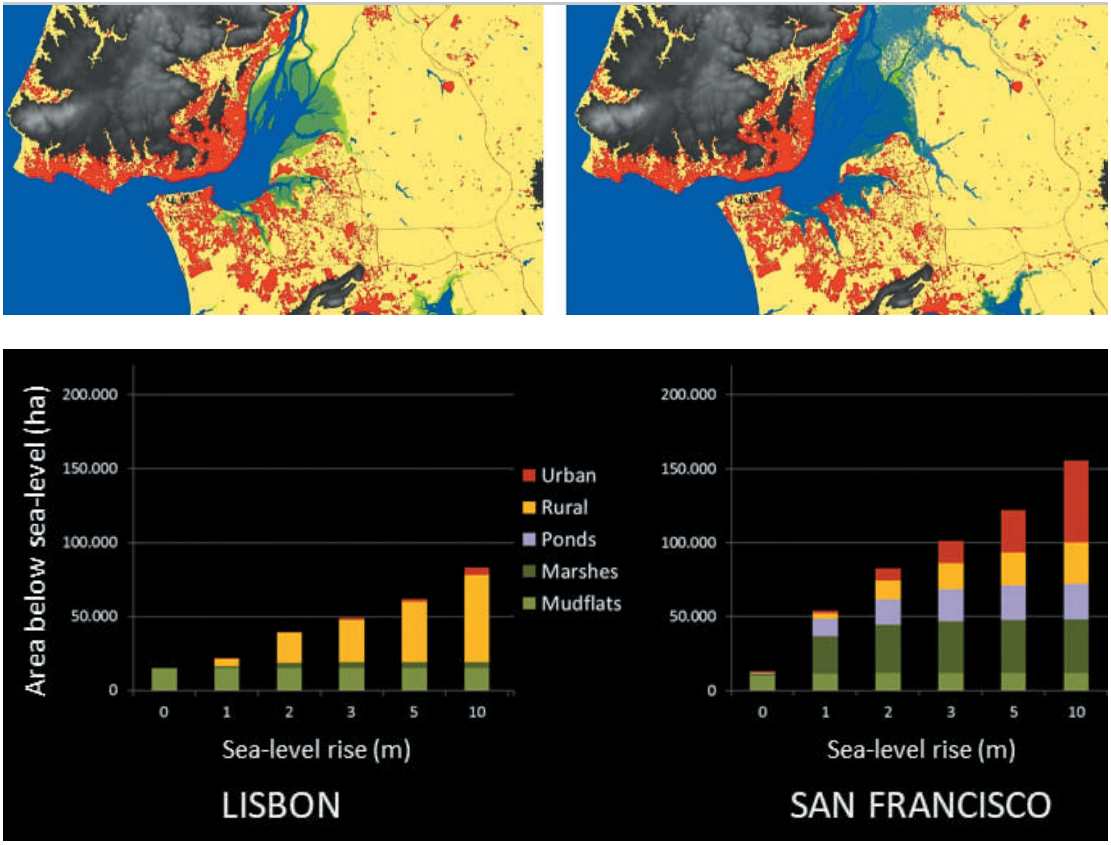
Area below sea-level (ha)
200.000
150.000
100.000
50.000
0
0
1
2
3
5
10
Sea-level rise (m)
Urban
Rural
Ponds
Marshes
Mudflats
LISBON
SAN FRANCISCO

e. ca. 2015: Currently, the Estuary still hosts an internationally-important wetland, protected by Law, and is at the center of a metropolitan area with a population of 3 million.

According to Roman Law, then Visigothic Codes, Muslim Law upheld by the Moors, and on to the Medieval Portuguese Laws, the beds and land subject to inundation were always the State's/King's land [3]. Around the Estuary, the standard for public domain was defined at the Spring High Water as early as the reign of King John I (1385-1433) [5]. Reclaimed land on the Estuary was consolidated onto the Crown Prince's Estate (Casa do Infantado). This Estate was sold to a private corporation in 1836 (the Companhia das Lezírias) which manages most of the low-lying farmland to this day. It was nationalized again in 1974. The riparian Public Domain was formalized in modern law code as early as 1864. Revision of laws within a Civil Law system is frequent, and there have been several expansions of mandates and jurisdictions. Portugal's admission to the European Union in 1986 saw a generalized improvement of planning and environmental protection standards

The most extensive efforts of landfilling for infrastructure, rather than farming, were related to the expansion of the Port along Lisbon municipality's waterfront, between the last couple of decades of the 19th century and the first three decades of the 20th century [6,7]. In total, some 397 ha of fill were created along the already urbanized waterfront, mostly within the Lisbon municipality. In the mid-20th century, some areas in the south bank of the estuary were landfilled for the expansion of large industrial units and port areas but together these areas amounted to only about 236 ha, to which a further 36.8 ha of localized expansions to pre-existent port areas were added in the first decade of the 21st century. In total, landfilling for purposes other than farming was less than 670ha, virtually all occupied by port and industrial areas. This moderate use of landfill contrasts with other metropolitan areas set around estuaries, such as the San Francisco Bay Area, where landfills are frequently occupied by residential and commercial areas (Figure 2).

The results are no doubt worrying, but are also still manageable, in that the vast majority of affected land-uses at the lower stages of SLR are "non-permanent" uses – simply put, these are areas with no permanent buildings – that can be more easily relocated or reconfigured. Even for hypothetical very high sea-level rises, the vast majority of land vulnerable to submersion would

Figure 3: Areas vulnerable to sea-level rise. On the left, current situation at high tide; on the right, with a 2m sea-level rise. The land uses below a 25-m elevation are represented as follows: In red, urban areas; in yellow, farmland and forest areas; in green, saltmarshes and mudflats (wetlands). Source: Pinto (2015) [4].

Figure 4: Comparison of vulnerability scenarios for Lisbon (Tagus Estuary) and the San Francisco Bay, USA. Adapted from Pinto (2015) [4].

still be wetlands and the low-lying Lezíria farmland. To the contrary, around the San Francisco Bay (USA) significant stretches of urban area, including residential and commercial areas, are at elevations lower than the sea-level with a 2-m SLR (Figure 4). And the situation is much worse in other metropolitan areas, such as Miami, Jakarta, or New Orleans.

I argue that the major threat to future adaptation to SLR in the Tagus Estuary comes in the form of projects that, while not currently implemented, are under consideration, and severely underestimate the risks posed by rising seas.

Portugal has an often-overlooked but longstanding cautionary approach to risk management. Other countries have fully embraced technological approaches to flood defense, which in turn have conveyed a false sense of safety that encouraged the installation of permanent uses, including houses, in floodplains. Having lacked the resources to fully adhere to expensive flood defense and control systems, the country has typically relied on risk avoidance as the main approach to risk management. This "soft" approach, based on regulation and common sense transmitted through generations, has prevented further damage from major events.

More recently, though, increased availability of funding has apparently rendered some decision-makers "blind" to this commendable age-old tradition of risk-avoidance: several projects, such as the proposed airport at the Montijo Air Base, the Lisnave/Almada Nascente Urban Redevelopment Project, or the Foz do Jamor project, appear to ignore, or minimize, the potential exposure to risk that SLR will pose to them in the latter half of the century; Others, such as the proposed Lower Tagus Valley Irrigation Project or the Alvito Dam, have been discussed with little regard to the potential impacts over sediment inflow to the Estuary, which is absolutely fundamental to the future viability of the wetland ecosystems that would ensure some level of coastal defense to the Estuary's margins.

So, and to conclude, the Tagus Estuary is the result of centuries (indeed Millenia) of transformation and interaction between Man and Nature. It has been a purveyor of bounty, both as a communication channel and as a source of rich farmland and seafood. It has given Lisbon its natural harbor, from where the Portuguese age of sailing set off. It is now under serious threat from sea-level rise and, especially, reckless decision-making.

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Water-Land Interface. Reflections on SOS Urban Waterfronts Project.

Lisbon 2019

Abstract: Coastal areas are changing fast due to lithodynamic process enhanced even further by the climate change. As they are vulnerable environments which have to adjust quickly to new conditions, they are very good living laboratories helping to understand also our human adaptive abilities. The three different sites were indicated to be a subject of careful waterfront study during the meeting of SOS Urban Waterfront Project in Lisbon 2019: the neighborhood of Alcochete, Centre of Cascais, and the coast of Ericeira commune. By projections of possible urban and architectural solutions and by discussion on possible consequences of these solutions on the whole waterfront area, the project participants were trying to understand how the water-land sub-systems work and evolve, and how to support the urban waterfronts' resilience.

Keywords: "Alcochete", "Cascais", "Ericeira", "Urban Waterfronts", "Climate Change"

Water combines seemingly very distant issues and phenomenon. Body of water as a continuous substance is touching at the same time urbanized and natural environments forcing people to treat them as a one system. Circulating in three states of aggregations water make us think 3 dimensionally, or even 4 dimensionally due to retardation of some processes. As water acts simultaneously across all the scales it pushes us to think outside the box. Water is therefore a medium that allows people for understanding beyond the standard categories we have been assigned to. But water is also very demanding partner in terms of human knowledge base, scientific preparation, or engineering experience. It is also a great, ruthless destructive force that does not forgive human mistakes or errors. Understanding the ways water is acting requires interdisciplinary approach basing on co-operation of people representing very different disciplines.

To use all the opportunities and avoid the threats water is offering we started to work within the project Urban SOS waterfronts in Lisbon (March 2019). The project gathered international group of people having different backgrounds and responsibilities. We were artists, researches, representatives of municipalities and industry, students, activists, all trying to communicate through the medium of water to answer challenges at the water-land interface. Of course it is not possible to deal with the bulk of water-related problems at the same time. We decided to sample some waterfront study cases and try to understand a complexity

of problems existing in the limited space. The three areas within the Great Metropolitan Area of Lisbon were therefore chosen for a deep study analysis. For better comprehension both the method of brainstorming and learning by designing were used. So, by projections of possible urban and architectural solutions, and by discussion on possible consequences and impact of these solutions on the whole waterfront area, we were trying to identify how the water-land sub-systems work in particular space. One can call it "imaginary modelling of possible changes" The three different sites were indicated to be a subject of careful waterfront study were: the neighbourhood of Alcochete, Centre of Cascais, and the coast of Ericeira commune.

The area around Alcochete is in vicinity of old (but still active) military airport base located inside the Tagus estuary on the opposite side of the main city of Lisbon. The possibility of relocation of the Lisbon city airport to the site is considered by the municipalities and private investors since erecting the Vasco da Gama Bridge. Due to suburbanization there is also a strong investment pressure on the Alcochete unique fishing industrial heritage (Fig. 1.). The coast here is an alluvial tidal plane with characteristic anthropogenic landscape of salt pans; where from middle ages the salt was extracted. The salt pans are nowadays mostly abandoned and taken over by wild fauna and flora (especially by avifauna). The contemporary problems and challenges of the site are:

— almost forgotten heritage of producing salt and of knowing how to do this (there is only one, still active, salt pan left - Salina do Samouco);

— change of water relations and converting the historical man-made landscape into the wild one being home for many protected birds colonies (ex. flamingos);

— urban pressure exerted both by the growing neighboring towns (Alcochete and Montijo) as well as by the potential new Lisbon airport;

In Alcochete case study we were trying to answer the question: how to combine current needs (airport and new housing) with historical heritage (Salinas do Samouco and old fish factory), demands of environmental system (fauna and flora) in situation of potential sea level rise. We were considering very different approaches – starting from building the area with new, environmental-friendly structures, ending with leaving the land to be taken completely by the ocean waters.

Fig. 1. Fences for drying cod in the old fish factory in Alcochete. Photo: Karolina A. Krośnicka

The second case study was the centre of Cascais city with its' famous sea promenade, which is (among others)*a subject of the new, currently being developed, mobility plan for Cascais. Basic problem here is touristic pressure on the area (the city itself, its' beaches and promenade are overcrowded during the season), and to some extension, also an urban pressure caused by suburbanization of Lisbon.

The promenade is exposed to the open tidal waters of the ocean (Fig. 2). While using a model of water level rise (Flood map 2019) we noticed that flooding of Cascais will probably take place through the almost forgotten Vinha River, passing through the centre of the town. To gain more building space and to avoid violent flush floods from rains the river was covered and built-up. The local inhabitants still remember the flood from 1983 (the flooding sign showed water was at that time at the level of 1.5 m above ground) and the recent (2017) flood in the neighboring town Oeiras (Henriques 2014).

So the idea in case of Cascais was to face the problem of seawaters rising up the river and to uncover the Vinha River in the way the water might be properly managed so the land will be more "absorbent". We were asking questions such as: how can all the elements (ocean, river, rain water and water reservoirs, and urbanized space of the town) be combined into one efficient, save and resilient system? What parts of the Vinha river could be re-opened and re-naturalized? Is it possible to let the ocean water up the river valley in a safe way? How to design the water reservoirs along the river within the built-up area to assure its' safe distribution in case of flush rains and to use the water efficiently for different purposes (watering plants, cooling down the air, or producing energy)? It was also about the seashore protection enabling to develop the touristic movement along the promenade and at the same time leaving the possibility of use the beach.

The last study case was a protected area due to the unique wave's characteristics, caused by very peculiar configuration of cliffs and the seabed. In a bay located at the mouth of a little river there is a beautiful sandy beach (Ribeira d'Ilhas) intended for surfers and their activity (Fig. 3). The problem of this area is its uniqueness bringing here stationary tourists from all over the world. Some of the tourists settle down along the cliffs and this cause a strong urban pressure on the area. Here the waterfront is a style of life. The Ericeira community (the closest town located about 5 km to the south) collected quite a large data base allow-

Fig. 2. Main beach of Cascais. The fishing port in the foreground. The mouth of Vinha river visible in the background. Photo: Karolina A. Krośnicka

Fig. 3. Ribeira d'Ilhas and the high cliffs


HOTEL BAÍA

ing following processes appearing at the coast by mapping them. The commune has recently elaborated a strategy of adaptation to climate change. In case of cliffs of Ericeira the questions were mostly concerning coastal landscape. We were wondering how to protect the coast from anthropopression and at the same time make the area visually accessible for people.

While working on waterfronts around Lisbon we were searching for:

— understanding of environmental, economic and social processes taking place in the waterfronts

— methods of ensuring safety in case of flooding, especially in situations problems are overlapping each other;

— new and old knowledge helping to adapt to the rise of seawater level and living on waterfronts.

Coastal areas are changing fast due to lithodynamic process enhanced even further by the climate change. As they are vulnerable environments which have to adjust quickly to a new conditions, they are very good living laboratories helping to understand also our human adaptive abilities (Mohamed 2016). The question is however: how can we measure the vulnerability of waterfronts? And how can we define the most sensitive areas? There are specific factors of vulnerability of waterfronts on climate change (NOAA 2019), which makes us think that a problem should be discussed in layers such as: environmental impact (changing on the scale from full anthropopression to completely natural solutions), socio-cultural impact (taking into account all activities of all people in the area on one side of a scale, and single activities within some range of human activities), economic impact (starting from large scale investments and finishing with some small economic interventions). The layers should take under consideration also a time line. But they should also include the climate change or any change in general. As waterfronts are undergoing constant dynamic changes the static impact assessment is not sufficient.

During the discussions we found out, that in most of the situations 'nature knows better', and we should not fight against it, but try to collaborate. It is also a great knowledge to be aware where/when should we leave a place for nature, and where it is worth to overtake land. Although, as it was noticed, leaving an area for nature is in a way utopian, as it is against human nature of expansion.

We were searching the answers among new technologies by using artificial intelligence (AI) as a provocative tool to evoke

questions, which might change our perspective. What we found out was, that application of a new technologies without complex understanding of the place will probably not be successful, as*technologies are changing too fast, and a change of today is something completely different than a change of tomorrow. So, technology might be very helpful, but systemic understanding of the waterfront is a key issue while designing.

It is also worth to learn from our predecessors to avoid mistakes they were already familiar with (ex. never building basements in the areas exposed to flooding, avoiding the development of areas threatened by rare destructive phenomena), or to use creatively the knowledge they collected through years (ex. using water for economic purposes such as production of salt or energy). Our collective amnesia of traditional solutions, connected among others by too strong trust in our technological possibilities, might cost us a lot. Lisbon was a perfect place to understand that "there is no need to discover America once again" as we have hundreds or even thousands years of experience in struggling with the water level rise.

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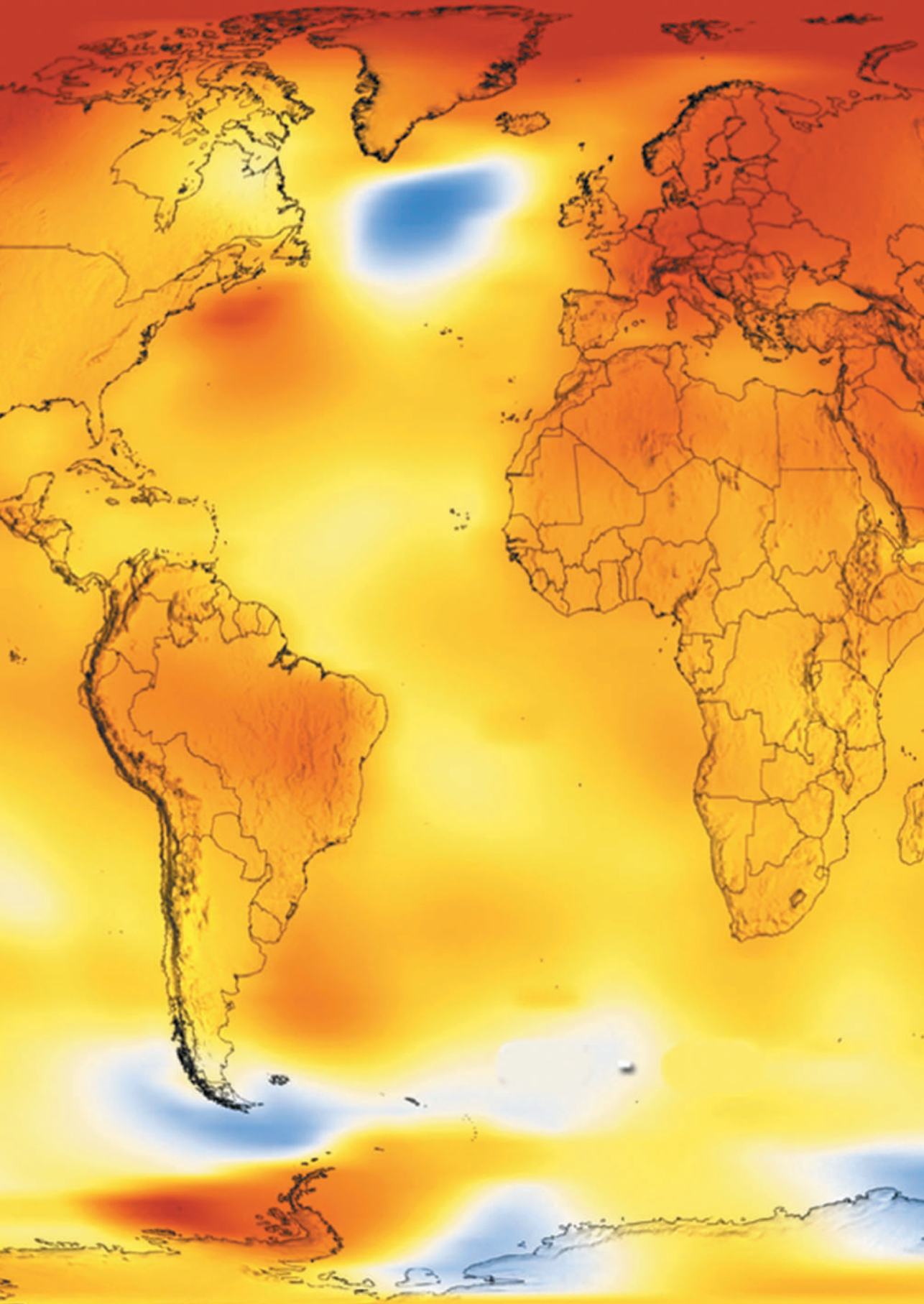


Municipality of Gdańsk, Poland
Paweł Łukasiak

Artificial Intelligence in Flood Protection Infrastructure Management

Abstract

Municipal authorities have a few tools to deal with climate change and flood protection. Artificial Intelligence (AI) and virtual reality (VR) are among - although less popular - options. They can help smart cities with weather forecasting, predicting levels of sea rise or local flood scenarios. However, these solutions are not perfect and still need further improvement. Especially decision-makers should pay more attention to environment dependencies and climate change issues. Only then adaptation and mitigation activities could be efficient and lead to sustainability, which means providing services for communities without stealing from future generations.

Keywords: municipal authorities, decision-makers, climate change, flood protection, artificial intelligence, virtual reality, AI, VR, smart cities, weather forecasting, sea level rise, flood scenarios, adaptation, mitigation, sustainability, future generations

Introduction

Management of modern cities is becoming more and more complex and challenging each day. This is because a lot of factors and variables have to be taken into account. One of the most important tasks of municipal authorities is to ensure flood protection, where modernization and construction of flood protection infrastructure is a key element of the adaptation and mitigation activities. Examples of investments in this area include: storm water drainage, erection of flood embankments, construction of retention reservoirs, strengthening of riverbeds and banks of rivers and streams.

Local bodies - within their budgets - fulfil many tasks with a certain amount of financial resources. This always requires setting priorities and making difficult decisions. It is strongly connected with the definition of affordability, which is “a measure of a financial ability to pay for infrastructure, service and content of technology” (IGI Global n.d.). It is extremely important to maintain a balance between cost and final outcome because, in the end, it allows to do more and to serve better to a local community. Each time, reconciliation of safety requirements, social factors and market laws requires reliable analysis. The pressure on the efficient use of resources while maintaining the high quality of services means that tools supporting analytical and decision-making processes are actively sought for. Urban initiatives should also be started with a consideration of their future impact in the context of the environment and society. Without this awareness, those settlements hardly make social and economic progress and are vulnerable to

external factors.

Fortunately, we can now observe a strong tendency towards so called Smart Cities, which are „cities using technological solutions to improve the management and efficiency of the urban environment. A smart city is a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business" (European Commission n.d.). Smart Cities Council says, that there are three pillars of this concept:

— Liveability: Cities that provide clean, healthy living conditions without pollution and congestion,

— Workability: Cities that provide the enabling infrastructure - energy, connectivity, computing, essential services - to compete globally for high-quality jobs,

— Sustainability: Cities that provide services without stealing from future generations (Smart Cities Council 2019).

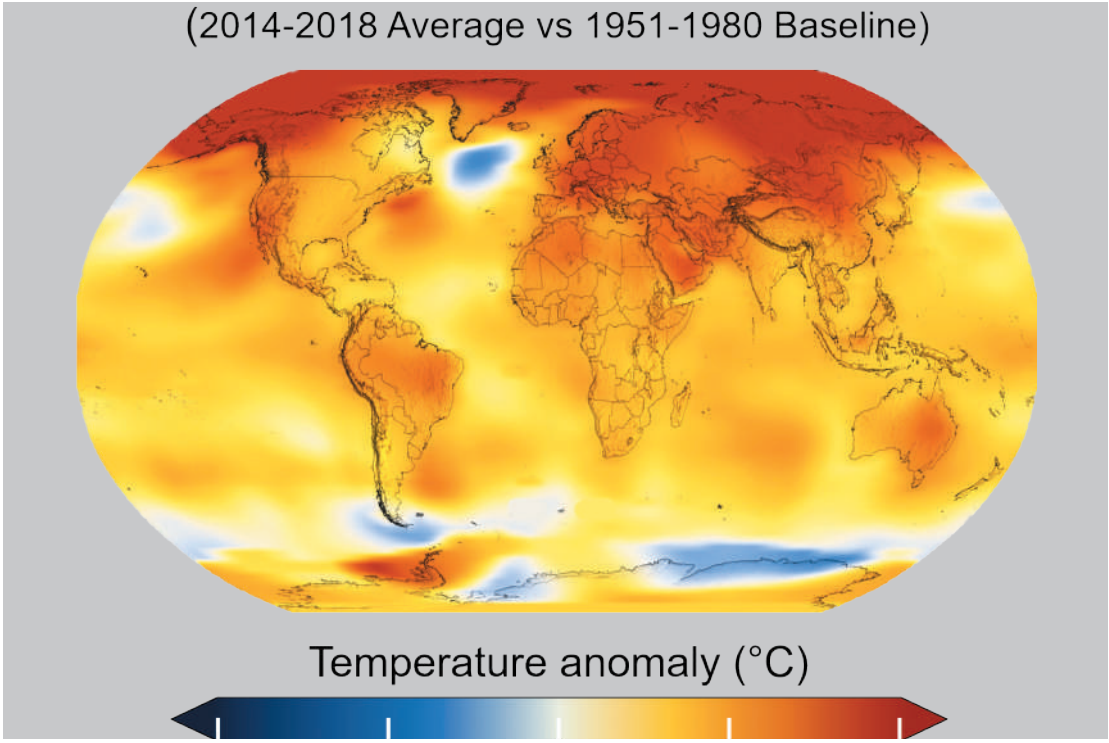
Why it is so important

As the planet continues to warm, climate change impacts are worsening. Twenty percent of species currently face extinction and that number could rise to 50 percent by 2100 (Cho 2018). Since 1970, the number of natural disasters has quadrupled, causing more than 3.3 million deaths and resulting in trillions of catastrophic damages (Wani 2017). Picture from NASA shows average global temperatures from 2014 to 2018 compared to a baseline average from 1951 to 1980.

Climate change is a serious issue that needs immediate attention across the globe, as it causes extreme weather events, warming oceans and sea level rise. Rising sea levels is a major factor in causing floods, shoreline erosion and sea-storms, all threatening human life. Every 8 of 10 world megacities (those with over 8 million inhabitants) are located by the coast (United Nations Atlas of the Oceans n.d.). That is a serious problem. United Nations Environment report states that even if 196 countries follow the arrangements made during the 2015 Paris Agreement, winter temperatures in the Arctic are still expected to rise by 3-5°C by 2050 (United Nations Environment Programme 2019).

According to the World Economic Forum, there are a few ways cities can use emerging technologies to fight climate change (Kabbara 2019):

— Big data - a large amount of information that can help cities to develop climate plans,


(2014-2018 Average vs 1951-1980 Baseline)
Temperature anomaly (°C)

— Artificial Intelligence, which is a branch of computer science dealing with the simulation of intelligent behaviour in computers or the capability of a machine to imitate intelligent human behaviour" (Merriam-Webster Inc. n.d.),

— Blockchain - to enhance data security and to facilitate international cooperation,

— 3D printing - efficient method of manufacturing that reduces the amount of waste (especially used in the Netherlands, where chosen bridges are printed),

— Virtual (mixed) reality (VR) - a powerful tool to present visualizations, scenarios and effects of climate change. US city of Santa Cruz, known as a leader in coastal planning, is working with the Center for the Blue Economy and using 3D VR technology product called „Sea Level Rise Explorer" (Christopherson 2019). First, the effects of climate change can be visualized, including sea level rise or a 100-year storm. Then the project uses 3D models of proposed adaptation actions.

Areas to implement A.I.

Artificial Intelligence may be a part of the toolkit for cities to be more smart, safe, convenient and sustainable. A.I. equips machines and computers with the ability to see, listen, move and think. Of course, databases and cheap computing contributed to the explosion of A.I, which is widely present in transportation (traffic control), healthcare (diagnosing), waste/water/power management and public safety (CCTV). Due to environmental pollution and the emitting of greenhouse gases to the atmosphere one of the biggest challenges facing many of today's cities is road traffic. A major objective of a smart city is to allow commuters to get from one point of the city to another safely and as fast as possible. By decreasing travel time, we reduce the emission of greenhouse gases responsible for global climate change. To achieve this, cities are turning to the A.I to regulate the flow of vehicles. This is achieved by adjusting traffic lights. When it comes to utilities (water, power), A.I. helps to minimize costs and contributes to increasing efficiency - smart grids, renewable energy management. According to the McKinsey Global Institute, A.I. solutions can help to minimize water consumption in cities by up to 15%, reduce the average time to commute by up to 20% and cut emissions by up to 15% (Woetzel et al. 2018).

Figure 1: Temperature Change According to NASA
Source: Perkins 2019.

For the proper operation of A.I., another component is also needed: the Internet of Things (IoT), which allows cities to gain intelligent insights from connected devices or sensors. Next, data

from the sensors go to databases (so-called Big Data). In recent years, massive amounts of data were gathered and stored thanks to computers and millions of sensors around us. Now, the major problem is with improving algorithms, that could utilize yesterday's data to predict trends and patterns for tomorrow.

Difficulties

Former chief of US Federal Emergency Management Agency - Craig Fugate - says:

"The ability to forecast a major flooding event has improved significantly. But understanding how such a storm will interact with the built environment and affect people living in a specific area is still quite limited. The factors involved in predicting flood scenarios are changing faster than tools that help people prepare and adapt" (Schwartz 2018).

He is now Chief Emergency Manager of a start-up called One Concern, which helps decision-makers in preparation solutions for extreme events like floods and storms. They support actions with A.I. tools and platforms that can predict weather impact scenarios a few days in advance in order to get ready for specific adaptation operations more precisely, f. ex. showing how big amount of flood-water will occur in each part of the city and how fast it will happen.

Conclusions

Many examples showed that flood protection actions should be taken in regional partnerships to use local assets effectively. Academic and non-academic institutions should work together to test and implement new solutions and to educate society. The field of A.I. is growing fast and it is obvious that it will play an increasingly important role in our life. But the human brain is still more powerful than a machine. According to the Network World ranking from June 2019, the world's fastest supercomputer is "Summit" based in US Department of Energy's Oak Ridge National Laboratory, which working speed is 148.6 petaFLOP, while a single human brain operates at the speed of 1 exaFLOP, so 6 times faster (Greene 2019). We must not forget that A.I. is only one of the tools. The most important thing is to raise awareness in communities about the dangerous effects of climate change and to convince decision-makers that real actions are needed immediately. Lisbon is not an exception. Natural location and demographic conditions are the city's major challenges when dealing with the effects of climate change. SOS Climate Waterfront initiative showed us that awareness of urgent actions is present, but the further intensification of efforts is needed.

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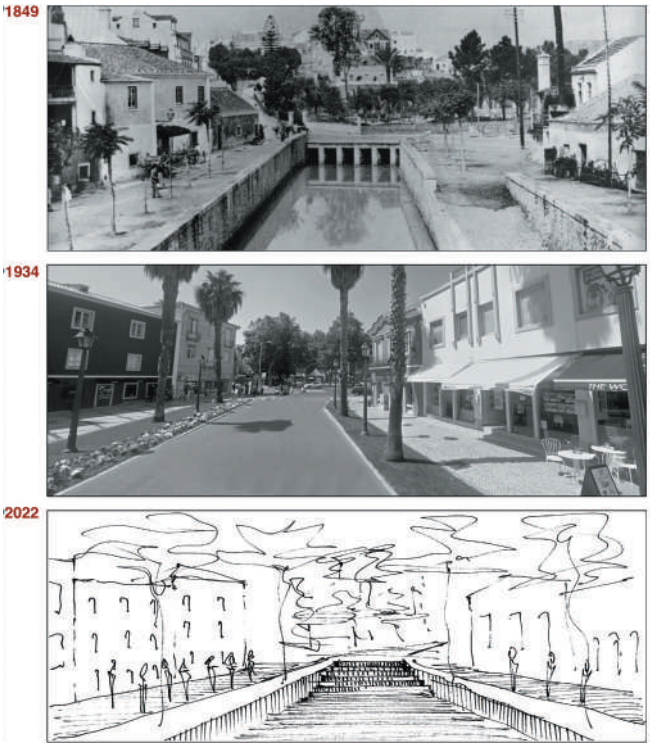
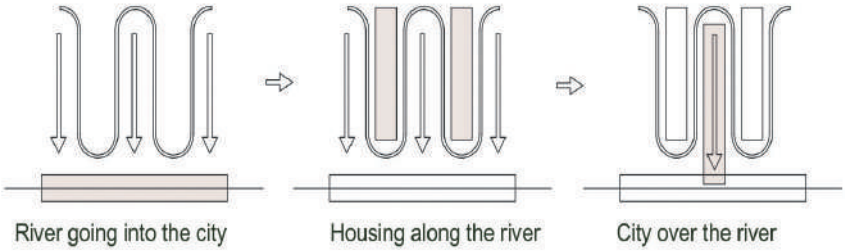


Historic Plans: 1849 | 1934

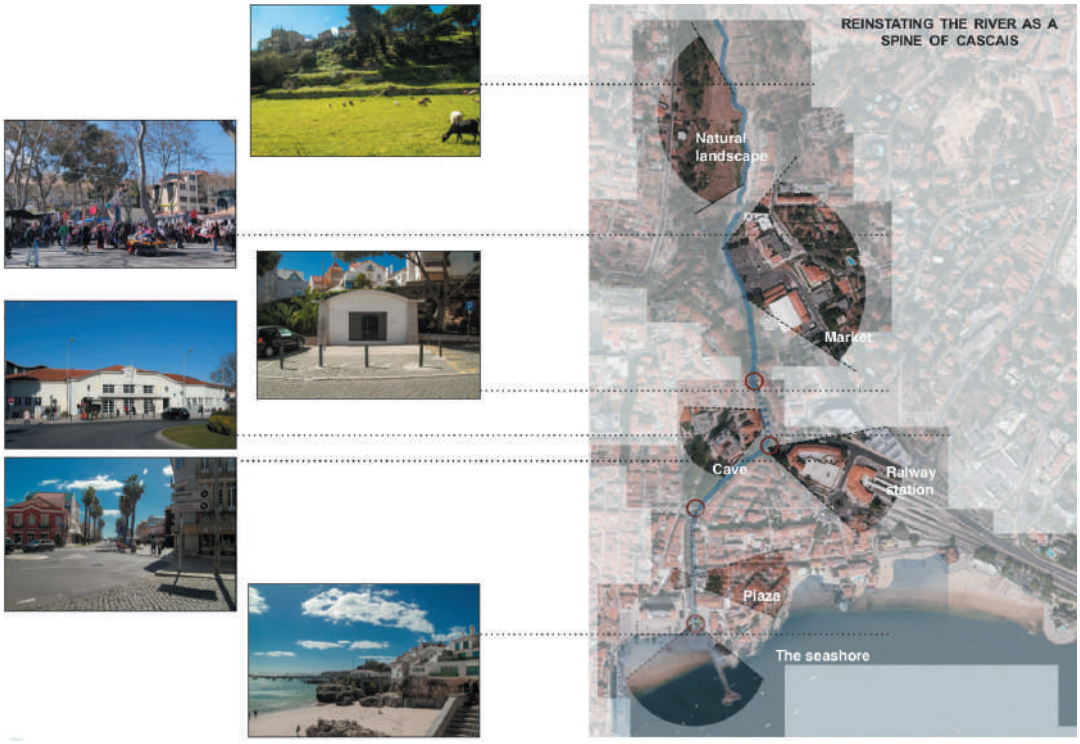
2022: Street removed to bring back the original water

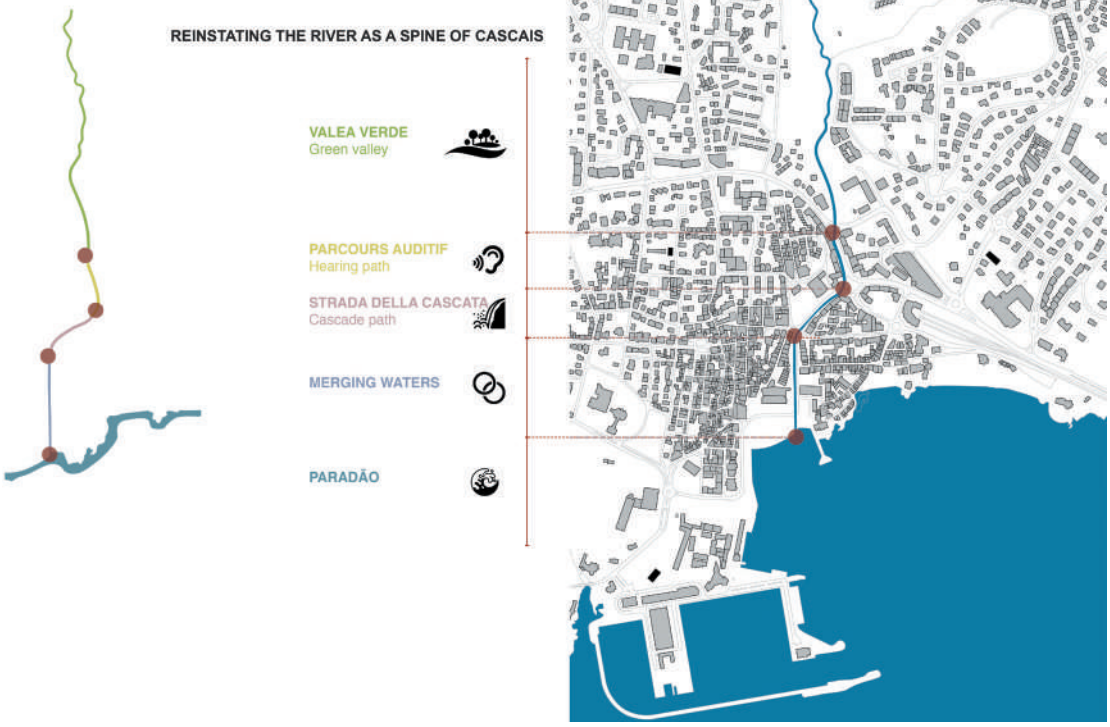
Hidden and missed potentials
1 - River
2 - Market and reservoir
3 - Paleolithic cave
4 - Fountain plaza
5 - Fishermen-Pirates pier
6 - Uncovering street

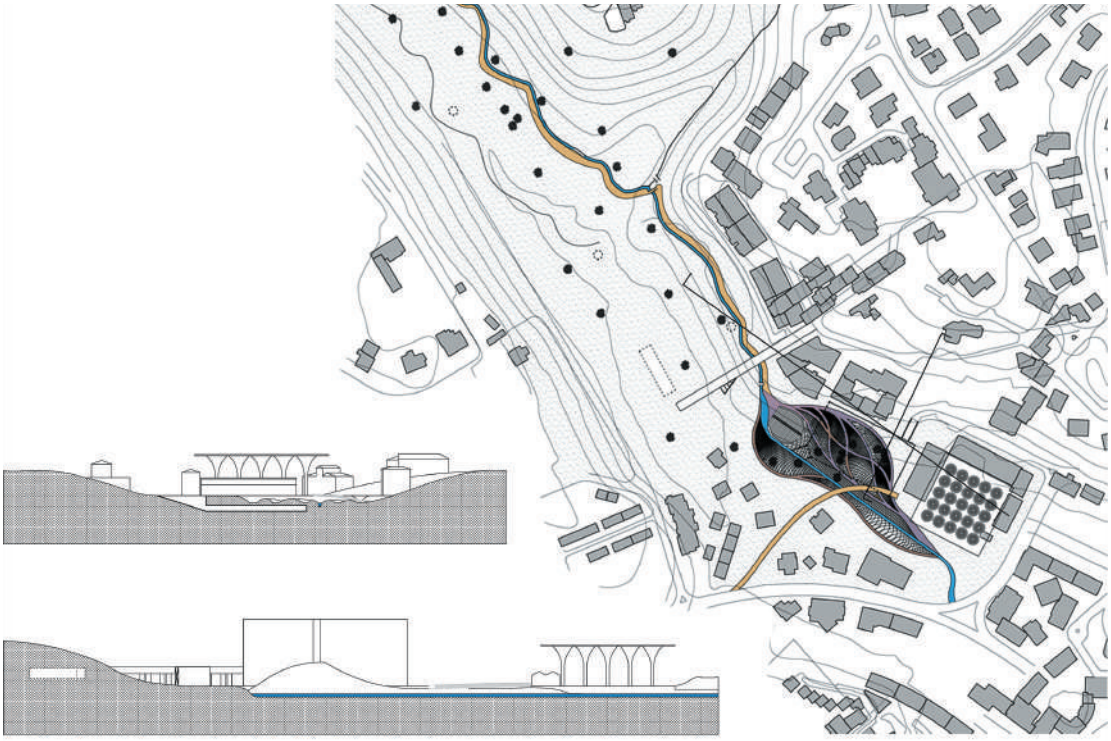


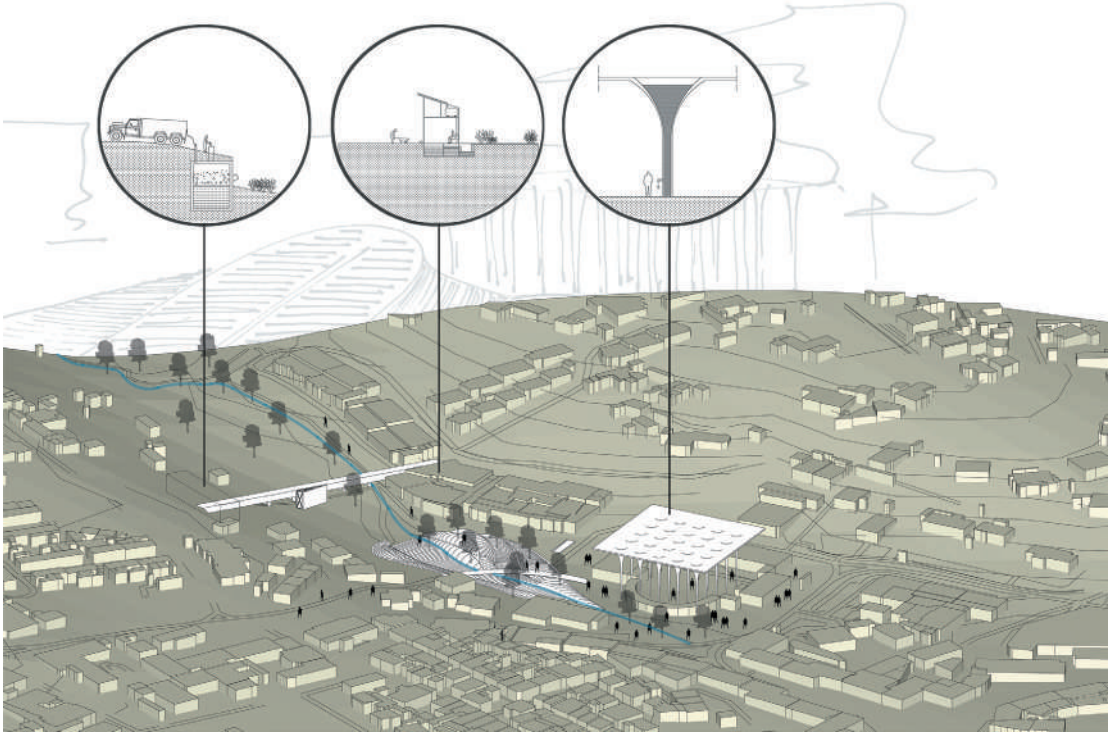
Problem

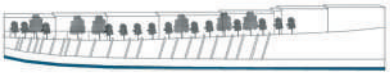
Vinha River as a Spine

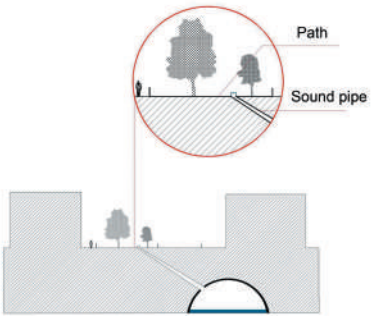

REINSTATING THE RIVER AS A SPINE OF CASCAIS
Natural landscape
Market
Cave
Railway station
Plaza
The seashore


REINSTATING THE RIVER AS A SPINE OF CASCAIS
VALEA VERDE
Green valley
PARCOURS AUDITIF
Hearing path
STRADA DELLA CASCATA
Cascade path
MERGING WATERS
PARADÃO



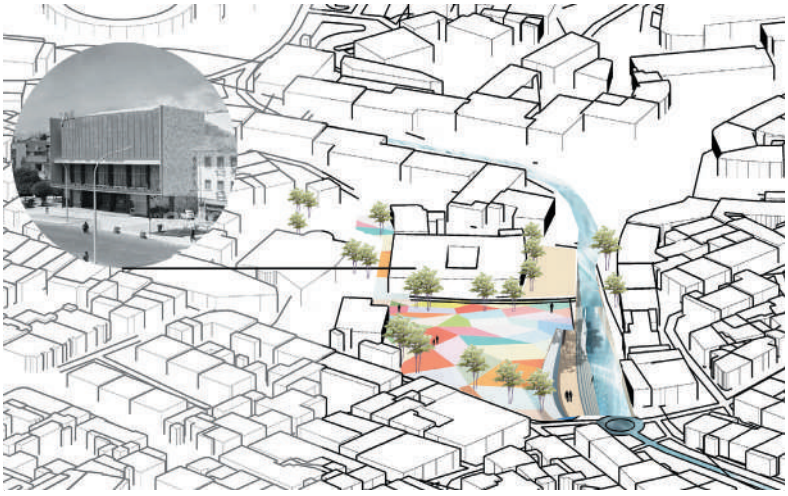




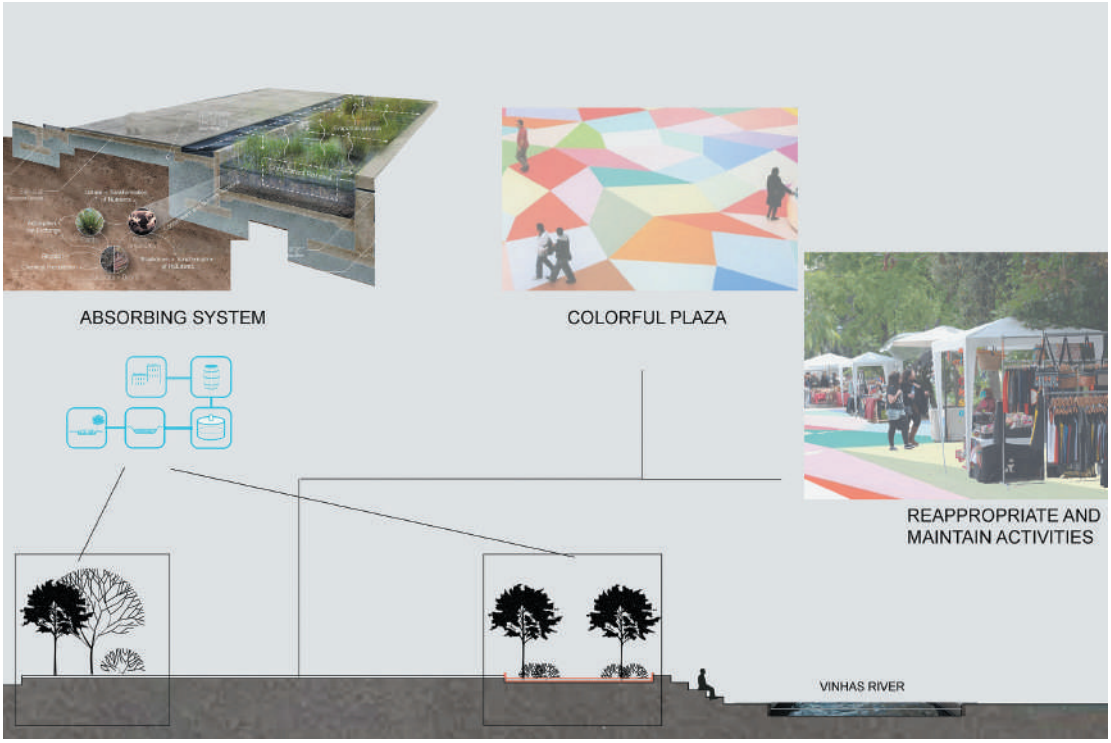


Project:
Valea Verde -
Green Valley

Project:
Parcours Auditif



Project:
Strada della Cascata -
Cascade Path


ABSORBING SYSTEM
COLORFUL PLAZA
REAPPROPRIATE AND
MAINTAIN ACTIVITIES
VINHAS RIVER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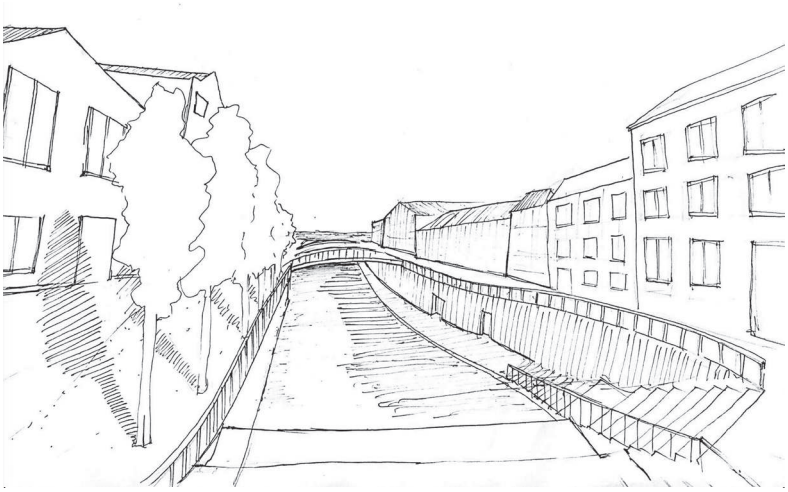

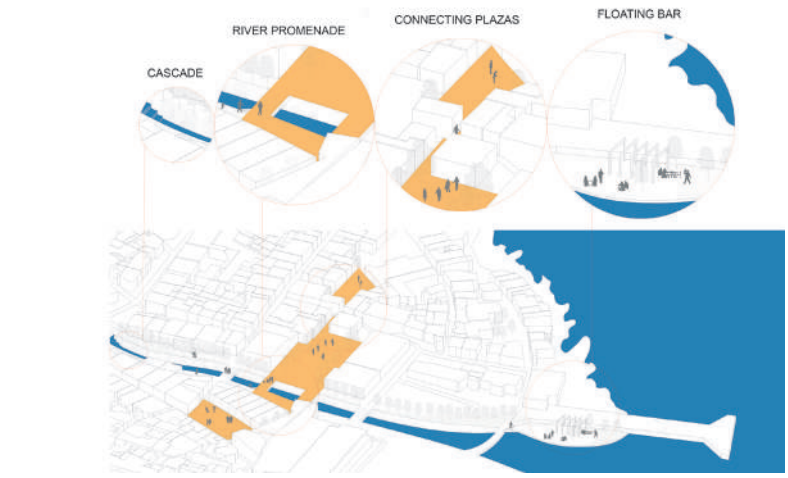

Project:
Merging Waters
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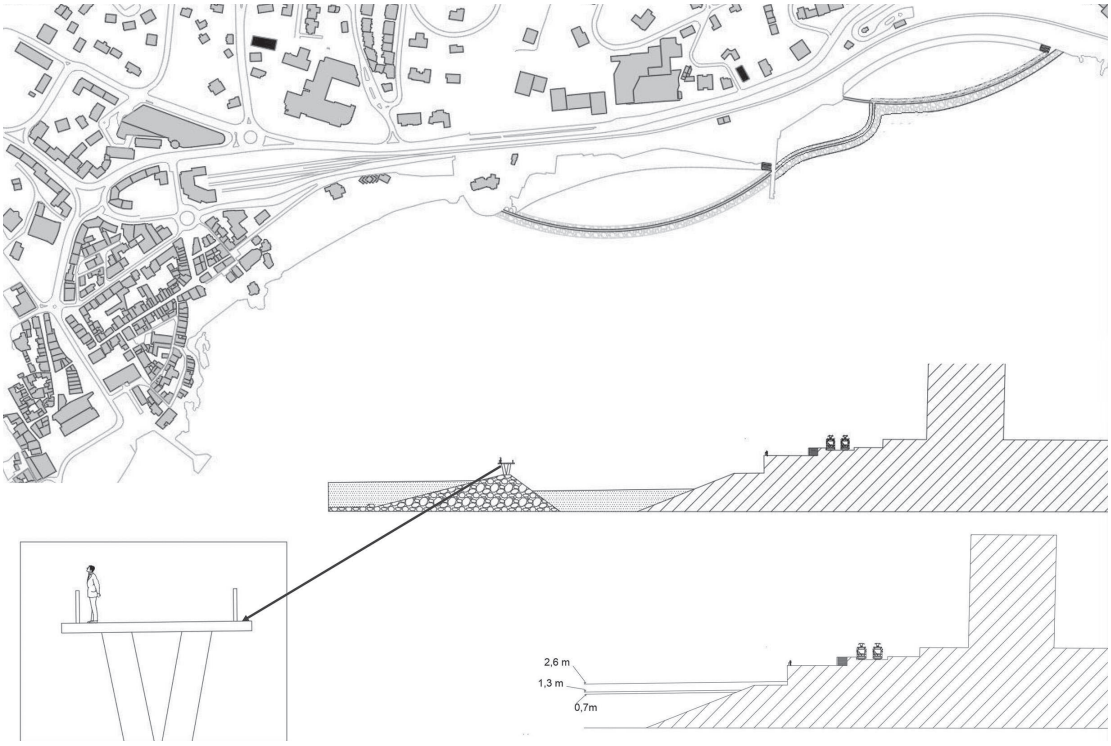
Project: Paradão


2,6 m
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Justyna Breś

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Zbigniew W. Paszkowski

Climate Change on the Cliff. Mafra Ericeira Atlantic Ocean Surf Reserve Protection

Abstract:

The vicinity of water has always been an important factor for location and development of human settlements. Apart from the positive influence of water source, it can also cause harm and difficulties for the city and especially its waterfront area. Rising level of the sea, risk of floods, storms, changes in the shape of the coast require cities to adapt flexibly to certain circumstances. Facing ever faster climate change cities are forced to overthink the strategy of spatial development, especially of their vulnerable coastal areas. As a result of increased awareness of the need to take action on the challenge of the changing climate, developing countries are increasingly promoting conducting research in this area regarding their own territory. In Portugal the first National Strategy for Adaptation to Climate Change (ENAAC) was adopted in 2010. Parallel to the development of the strategy, training was being conducted in several municipalities to develop local urban adaptation strategies. This resulted in implementation of the first communal adaptation strategies, among others, in the commune of Mafra, where the environmental features are unique when it comes to the coastal area, as it is the location of the first in Europe and the second in the world surfing reserve. This exceptional area has also been one of the subjects of workshop organized by the Lusófona University for an international team of students of architecture and urban planning, where participants put an effort to consider how the adaptation strategy can be implemented in the area of the Atlantic cliff surf reserve in Ericeira.

Keywords: Architecture, Waterfront, Climate Change, Surfing Reserve

Waterfront in the aspect of climate change

Water is a factor that strongly determines the functioning of urban areas located in its vicinity, which has a constructive or destructive effect. On one hand, due to the presence of water, waterfront space represents a significant development potential and has a unique character being a showcase of the city. On the other, this zone is exposed to various types of hydro-geological hazards, and the use of its potential requires consideration of many important factors and coordination of water and land management. This is especially in the context of observed climate change causing, among others, rising sea level or increased flood risk due to heavy rainfall or storm waves.

Climate change caused by fluctuations in solar radiation, changes in orbit parameters on which Earth moves, changes in the

composition of the Earth's atmosphere or air properties have been observed for millions of years. Factors affecting this state are both natural and mainly concern the first two mentioned, as well as anthropogenic in case of changes occurring in the atmosphere and air. Current global warming, however, is significantly different from earlier periods of global temperature rise due to the significant impact of human activity[1] . According to the latest report by the IPCC (Intergovernmental Panel on Climate Change), human impact on the climate is indisputable, and recent anthropogenic greenhouse gas emissions are the highest in history[2].

The increasing average surface temperature on Earth causes melting of glaciers and thermal expansion of the ocean all over affecting the change in the level of sea waters. As a result, in recent years, oceans have been rising at a rate of about 3 mm per year[3]. The effects of sea level rise in a coastal zone may be the displacement and disappearance of wetlands, flooding low-lying areas, increasing shoreline erosion, increasing the extent of flood zones, changing water circulation, and increasing the flow of seawater into groundwater. It is possible that due to climate change, there may be changes in storm patterns that alter the frequency and intensity of floods[4]. The threat created by the rising sea level (SLR) also increases the occurrence of land subsidence, which is called the relative rise in sea level (relative SLR)[5].

Strategy for development of Lisbon Metropolitan Area in the context of climate change

Despite the ever faster climate change, we still have the resources to limit the risks associated with them, implementing solutions that enable further economic and spatial development[6]. There are two models of action in the field of climate change policy. The first paradigm is associated with the mitigation of negative anthropogenic impact mainly by reducing greenhouse gas emissions that modern cities release into the atmosphere. The second, newer paradigm, which has dominated the pursuit of mitigation for about 20 years, proclaims the need to establish methods for adapting cities to the inevitable effects of change[7].

As a result of increased awareness of the need to take action on the challenge of the changing climate among national and local authorities, as well as the availability of data on this phenomenon developed, among others, by the IPCC, developing countries are increasingly promoting conducting research in this area regarding their own territory. In Portugal, this led to Portugal's first SIAM Project Report on climate policy[8]. The first National Strategy for

Adaptation to Climate Change (ENAAC) was adopted in Portugal in 2010, which set the main goals such as developing the right scientific basis for adaptation to climate change and implementation techniques, reducing vulnerability by identifying required actions, increas-ing overall awareness of climate change knowledge and strengthening cooperation internationally[9]. In relation to quays in Lisbon region, the risk of flooding has been identified as a critical factor in the light of climate change. This is due to the convergence of specific factors such as sea level rise, violent storms, effects of the Tag river floods, violent floods along the Portuguese coasts, tidal cycle effects, waves and the need for topographic correction of national cartography[10]. The strategy was updated in 2015 (ENAAC 2020). In the new national adaptation strategy on climate change, Portugal's vision was created as a country adapted to climate change by implementing solutions taking advantage of available technological possibilities and scientific knowledge based on recognized good practices.

In accordance with the ENAAC 2020 guidelines for growing territorial threats related to climate change for the Lisbon Metropolitan Area (AML), regional authorities have started work on a strategy for adaptation to climate change for the Lisbon Metropolitan Area (PMAAC-AML). Parallel to the development of the strategy, training was being conducted in 18 metropolitan municipalities to develop urban adaptation strategies. This results in municipalities being part of the metropolitan area developing local strategies for adapting to climate change. These activities resulted in implementation of the first communal adaptation strategies, among others, in the commune of Mafra.

Strategy for adaptation to climate change in the Mafra commune

The municipality of Mafra is located on the ocean shore in the northwestern part of the Lisbon Metropolitan Area. Its area covers 17 km of shoreline, along which there are 13 beaches known for their great surfing conditions. Most of these beaches are located in the coastal town of Ericeira. Ericeira is one of the 11 provinces of the municipality of Mafra. It is characterized by a space of unique landscape and environmental values due to the unique waves hitting the shore. In October 2011 these exceptional conditions were recognized in-ternationally, becoming the first in Europe and the second in the world surfing reserve - World Surfing Reserve. The Ericeira World Surfing Reserve stretches between the beaches of Empa and São Lourenço, on the coastal belt, which includes seven world-class wave types in just 4 km.

Mafra municipality authorities, being aware of the significant impact of climate change on their development, in 2016 developed the Commune Strategy for Adaptation to Climate Change (EMAAC). The strategy was a pioneering document in the field of adaptation to climate change not only in Portugal but also in Europe. According to the national strategy (ENAAC 2020), it aims to promote a coherent development policy in the context of environmental challenges related to climate change. Following the new paradigm, this strategy focuses on issues related to adaptation to climate change, although the need to raise awareness of minimizing anthropogenic impact on progressive global warming has also been highlighted.

The City Council of Mafra developed Municipal Climate Change Adaptation Strategy as part of the ClimAdaPT. Local project[11]. As a project participant and with the support of its own technical team, City Council of Mafra followed a basic methodology called ADAM, which guided the elaboration of this strategy through a set of specific steps and tasks. The ADAM methodology sought to answer two key questions:

What are the main climate risks that affect or may affect the municipal territory and the decisions of the Mafra CM?

What are the main adaptation actions needed and available to respond to these climate risks?

These questions has been also raised in relation to the Ericeira cliff area of the Surf Reserve. The adopted methodology consists of six interrelated steps, forming a strategic development cycle, which are as following:

1. Prepare the work;
2. Identify current vulnerabilities;
3. Identify future vulnerabilities;
4. Identify adaptation options;
5. Evaluate adaptation options;
6. Integrate, monitor and review.

This methodology does not instantly produce an adaptation strategy, but rather provides a conceptual framework and a set of resources to support the production of the information needed to develop an EMAAC such as Mafra's. In each step of the ADAM methodology, several tasks and analyzes were developed and summarized.

The results of the analysis indicate that the main climatic influences observed in Mafra are usually associated with high temperatures and heat waves, excessive, rapid rainfall, rising sea level and strong wind. The analyzes show the forecasted increase in the average annual temperature in the municipality of Mafra by 1.2 - 3.8

Celsius degrees by the end of the 21st century. In addition, the sum of annual rainfall in the years is then to be 6-44% less (depending on the chosen analytical model) compared to the period from the end of the 20th century with a simultaneous increase in the frequency of torrential downpours. As for the average annual temperature, all scenarios predict an increase in extreme values, except for the number of frost days for which a decrease is expected. Depending on the scenario chosen, an increase in the average number of summer days (from 14 to 81 days) and an average number of very hot days (from 1 to 11 days) is expected by the end of the century. In case of the total number of heat waves for 30 years, both models and scenarios indicate an increase in their frequency. An important issue is of course the rising level of ocean water - according to global forecasts; an increase from 0.26 to 0.98 m in 2081-2100 is estimated, mainly due to the thermal expansion of water and the weight loss of glaciers and polar caps.

As an answer for the identified environmental challenges, the strategy presents potential adaptation measures with a priority to implement each of them. The process of identifying adaptation tasks for the municipality of Mafra has resulted in a set of options that correspond to the main needs, objectives and climate threats to which the municipality is currently exposed and which tend to increase in the future. An important aspect of adaptation strategy is implementation of sensible and pro-active spatial planning measures. Specific adaptation tasks within the field of spatial planning, include monitoring of the implementation of spatial plans with specific focus on adaptation to climate change measures or design-ing public spaces with a view to upcoming changes. The spatial planning system consists of instruments of territorial management of various scope defining the spatial functional arrangement, infrastructure distribution, as well as the forms and intensity of land use with the aim of using the potential of a given space and protecting its resources. In this context, vision for spatial development of public space that later becomes incorporated in spatial de-velopment plans can play a decisive role in adapting to climate change by municipalities. They allow avoiding certain forms of land use exposed to the most significant climatic im-pacts, using the identified conditions of a given location to provide solutions that are as sustainable as possible. Thanks to spatial planning, it is possible to combine mitigation strategies with adaptation to climate change and increase awareness of the situation.

Young generation's vision for Ericeira

The spatial development strategy adopted by the municipality of Mafra in relation to the Ericeira cliff area, with a view to climate change, consists primarily in raising public awareness of climate change and related effects, as well as limiting anthropopressure to areas being particularly at risk of climate erosion. As part of a workshop organized by the Lusofona University for an international team of students of architecture and urban planning, it was considered how this policy can be implemented in the area of the Atlantic cliff surf reserve in Ericeira. The concepts developed by the participating students were aimed at taking actions to preserve the natural configuration of the cliff, protect local vegetation, fauna and bird's habitats, strive to remove existing buildings from the cliff's vicinity and prohibit the introduction of new buildings, with exclusion of the historic fisher village of extraordinary waterfront location and beauty of its decent architectural forms.

The studies on the cliff area on possible reduction of anthropopressure indicated the need of revision and proper location of the municipal installation network, introduction of new hydrologic policy by limitation of storm water drainage systems in favor of local retention reservoirs. The sport and recreation facilities like land car parks, surfing sport service facilities, as well as streets and communication routes adjacent to the cliff should also be moved back from the constantly eroding rocky coast of Ericeira. Regarding the concept promoting protection of the Surf Reserve, it was proposed by the students to introduce an educational pathway along the ocean edge on the cliff, with various forms of impact on the visitors senses. The aim of introduction of such subtle landscape design that offers multi-sensory experience for users is to strengthen social sensitivity and consciousness to the unique, endangered landscape, flora and fauna of the Atlantic cliff.

In this way, with very simple intervention in the existing situation marked in the project, the student's aimed to provide the first cycle of the ADAM strategic methodology. As climate change adaptation is an ongoing process, this ADAM cycle should be repeated multiple times over time to incorporate new knowledge and respond to new needs. The further development of climate change phenomena will surely demand defining of new emerging threats and finding pro-active responses, according to the adopted ADAM methodology.

Conclusion

Climate change is a phenomenon with environmental, health

and economic consequences. As its frequency has increased in recent decades, the functioning of the community in many places around the world is changing. It requires coordinated and decisive action, ranging from hazard identification to appropriate mitigation and adaptation measures. Portugal is one of the countries where more and more attention is paid to the promotion of awareness and ability to act in the face of climate change. By promoting the strategy of adaptation to climate change, local self-government units implementing the global vision of development in the aspect of climate balance. The main challenges identified in the Mafra municipality of the Lisbon Metropolitan Area, such as decrease in average annual rainfall, increase in average annual temperature, increase in average sea water level and increase in extreme precipitation phenomena are a universal problem present in many other places in Europe and in the World. The strategy of adapting to the climate change of the Mafra Commune is therefore not only a local document but an example of good practice worth following in other municipalities and countries encouraging to make smaller or larger changes in the issue of planning local development, as well as in the everyday life of every citizen.

The International Students Workshop organized by the Lusófona University in Lisbon has brought the new knowledge about the problems embedded in the Mafra Commune area and promoted different vision for the future development of areas like the cliff of the Surf Reserve – decent, reductive, sensual and retrospective. This policy requires to adopt measurement for the possibility of the areal resilience, reinforcement of its natural values and beauty for the future.

Notes

1 Kundzewicz Z., Juda-Rezler K., Zagrożenia związane ze zmianami klimatu, NAUKA, 2010, 4/2010: 69-76.

2 IPCC, Climate Change 2014 Synthesis Report. 2014.

3 Ibidem, 2014.

4 Emanuel, Kerry A. 2005. "Increasing destructiveness of tropical cyclones over the past 30 years". Nature 436:686–688.

5 Kirshen, Paul, Kelly Knee, Matthias Ruth. 2008. "Climate change and coastal flooding in Metro Boston: impacts and adaptation strategies". Climatic Change 90:453–473.

6 IPCC, Climate Change 2014 Synthesis Report. 2014.

7 Costa, Joao P., Joao F. de Sousa, Maria M. Silva, Andre S. Nouri. 2014. "Climate change adaptation and urbanism: A developing agenda for Lisbon within the twenty-first century". URBAN DESIGN International 19 (1): 77–91.

8 Santos, Filipe D., K. Forbes, R. Moita. 2002. Climate Change in Portugal Scenarios, Impacts and Adaptation Measures – SIAM Project. Lisbon, Portugal: Gradiva.

9 National Strategy for Adaptation to Climate Change (ENAAC). 2010.

10 Costa, Joao P., Joao F. de Sousa, Maria M. Silva, Andre S. Nouri. 2014. "Climate change adaptation and urbanism: A developing agenda for Lisbon within the twenty-first century". URBAN DESIGN International 19 (1): 77–91.

11 Municipal Strategy For Adaptation To Climate Change of Mafra. 2016.

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Kundzewicz, Zbigniew W., Katarzyna Juda-Rezler. 2010. "Zagrożenia związane ze zmian-ami klimatu". NAUKA, 4/2010: 69-76.

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Municipal Strategy For Adaptation To Climate Change of Mafra. 2016.

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Mafra: Ericeira

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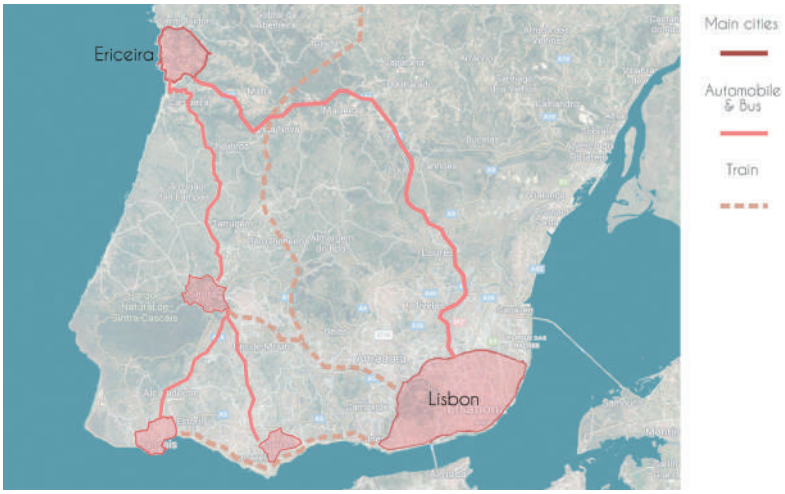
Joel Ferreira
Luis Ladeira
Keura Neto



Existing Connections

Methodology

Climate change

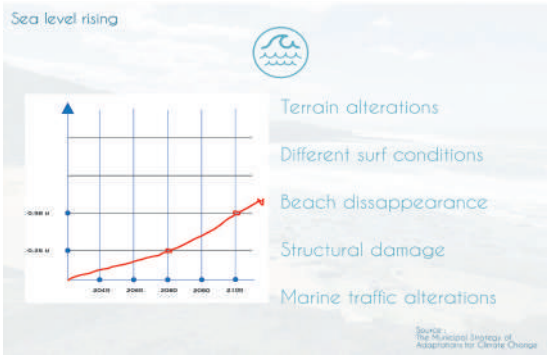
—

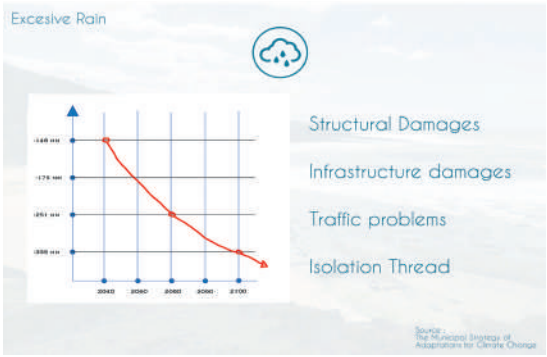
Sea level threats: Present

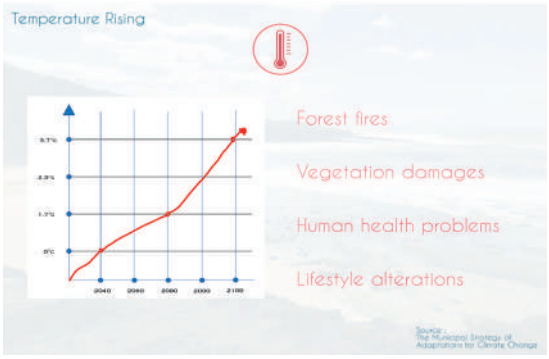
Sea level threats: Future

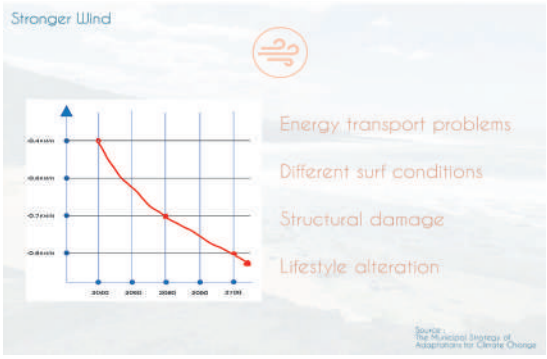

Ribeira d'ilhas beach
500 m
N

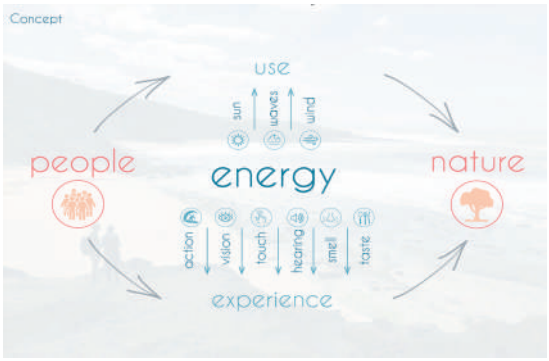

Ribeira d'ilhas beach
500 m
N

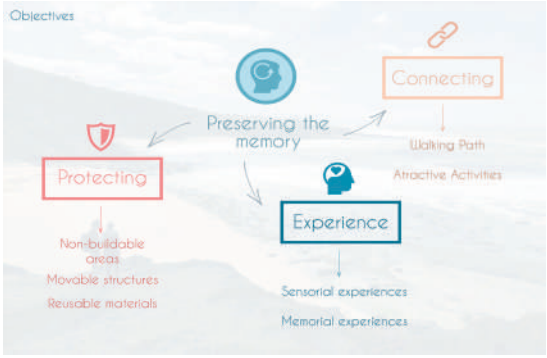

Sea level rising
Terrain alterations
Different surf conditions
Beach dissappearance
Structural damage
Marine traffic alterations

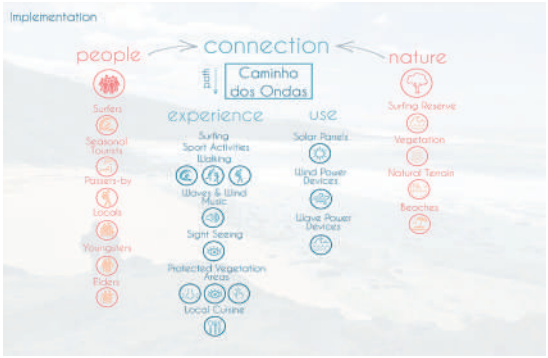

Excesive Rain
Structural Damages
Infrastructure damages
Traffic problems
Isolation Thread


Temperature Rising
Forest fires
Vegetation damages
Human health problems
Lifestyle alterations


Stronger Wind
Energy transport problems
Different surf conditions
Structural damage
Lifestyle alteration

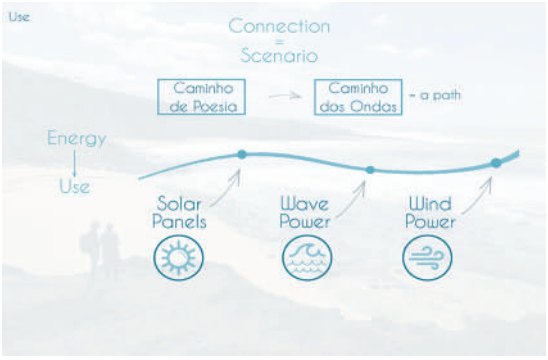

Concept
use
sun
waves
wind
people
energy
nature
action
vision
touch
hearing
smell
taste
experience


Objectives
Preserving the memory
Connecting
Walking Path
Atractive Activities
Protecting
Non-buildable areas
Movable structures
Reusable materials
Experience
Sensorial experiences
Memorial experiences


Implementation
people
connection
nature
path
Caminho dos Ondas
experience
use
Surfers
Seasonal Tourists
Passers-by
Locals
Youngsters
Elders
Surfing
Sport Activities
Walking
Waves & Wind Music
Sight Seeing
Protected Vegetation Areas
Local Cuisine
Solar Panels
Wind Power Devices
Wave Power Devices
Surfing Reserve
Vegetation
Natural Terrain
Beaches


People
Tourists
Locals
People
=
Actors
Surfers
Families
Seasonal Tourists
Elders
Passers-by
Youngsters


Nature
Natural Terrain
Nature
=
Scene
Surfing Reserve
Vegetation
Beaches


Use
Connection
=
Scenario
Caminho de Poesia
Caminho dos Ondas
- a path
Energy
Use
Solar Panels
Wave Power
Wind Power


Experience
Connection
=
Scenario
Surfing
Walking
Protected Vegetation Areas
Energy
Experience
Sport Activities
Sight Seeing
Waves & Wind Music
Local Cuisine

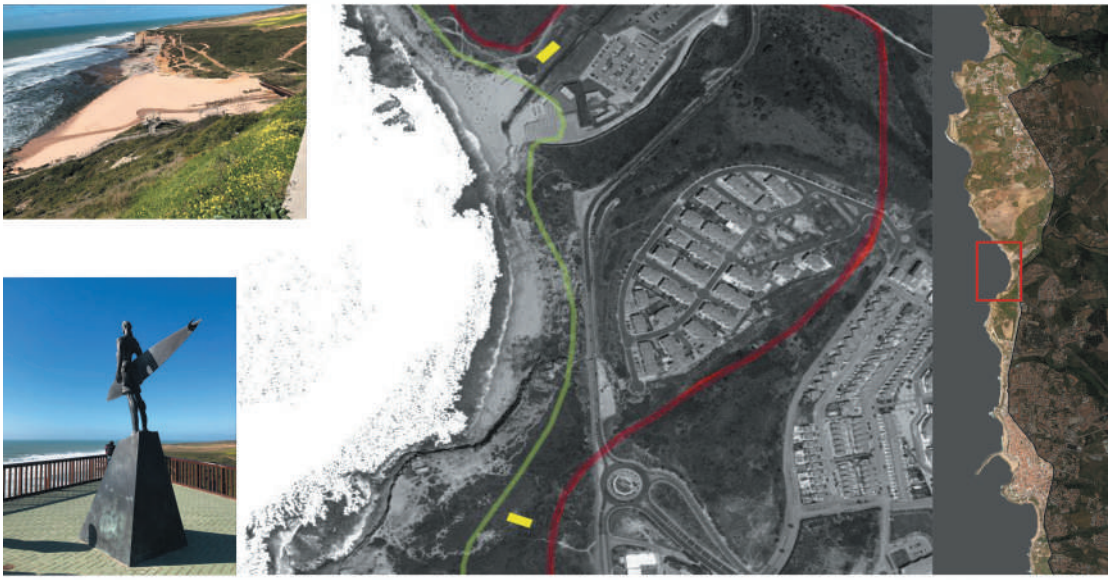

São Lourenço
Coxos
Crazy Left
São Lourenço
Ribeira d'Ilhas
Pedra Branca
Praia dos Pescadores
Praia do Sul
Total lenght: 6.16 Km
Local beaches
-
Main facilities
Pathways

São Lorenço North

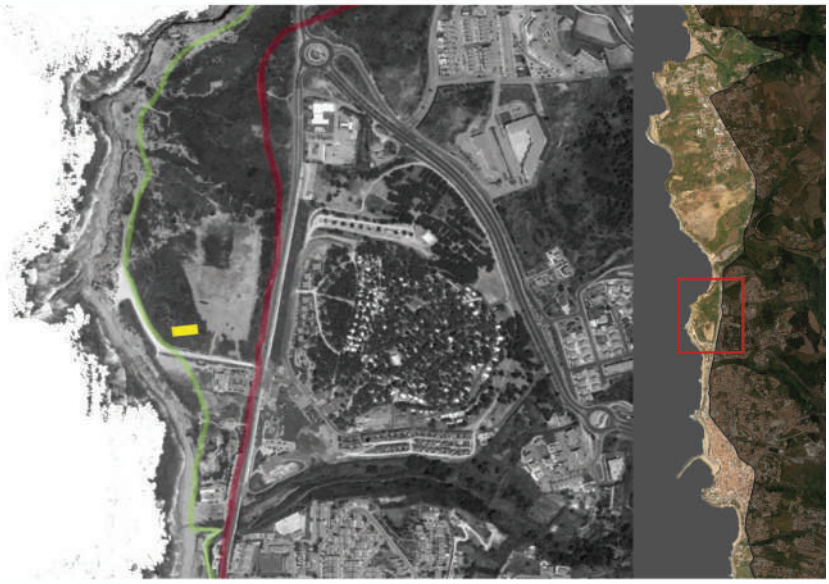
São Lorenço South

Coxos

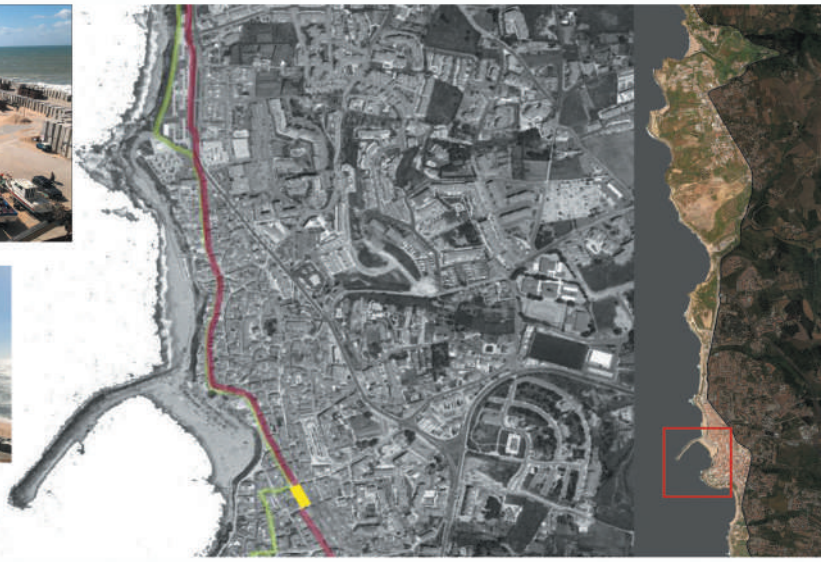
Ribeira d'Ilhas



Pedra Branca



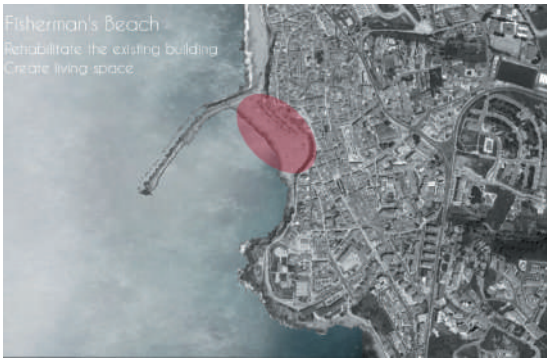
Praia dos Pescadores

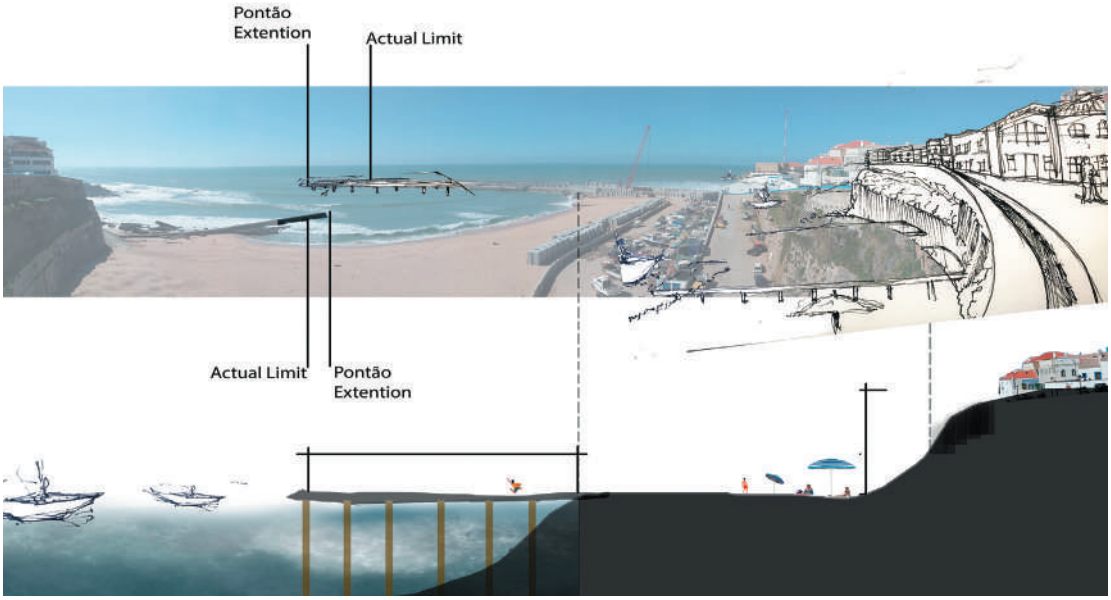



Fisherman's Beach
•Sea Level
•waves
•Sand


•Sea Level
•waves
•Sand


lose the bay
Extend the coast line
Barriers to sand
Sensors for measuring sea level


Fisherman's Beach
Rehabilitate the existing building
Create living space


Pontão
Extention
Actual Limit
Actual Limit
Pontão
Extention

Praia do Sul

Although the changes are unavoidable, with this we try to create a pleasing memory for the current and future generations, so they know what once stood here. For that there was the necessity to make people walk along the area and live along with the local scenary to show the importance of preservation

University of Ljubljana
Faculty of Architecture,
Slovenia

Spela Hudnik

BIRDPORT
Thank you for landing with us.

Abstract:

The article represents four scenarios of near and far future of the Natural reserve Salinas do Samouco - Alcochete / Montijo, Portugal as a result of international student's project BirdPort. Multidisciplinary and multicultural approches, various mind strategies represent different approaches to foresee different scenarios that address topics like global warming, rising water level and political responsibility of exploiting the living environment due to the interests of global economic lobbies. It opens discourse about climate change, new technological challenges, living conditions for future generations and inhabitation of different spheres and layers of the Earth.

Keywords: Climate Change, Natural Reserve Salinas do Samouco, Flood, Biodiversity, Future Scenarios, Ecological Crises, Montijo Airport, Bird Port

"The «here» - where we are – is an enigma. We are lost, we just know that we have to land somewhere, but we don't know where."[1] (Latour 2017)

Introduction

We live in a world of facts and effects of climate change. It is calling us to create a new agenda for quality of life. We live in an imaginative world of a risky future.

In the interview Can we land on Earth? the french philosopher Bruno Latour discussed the meaning of the words green, global and nature, and found out that in the context of global ecological crisis, sciences and society to identify the new territory, "all of these thinks are absolutely wrong in terms of finding out where we are. We don't know where we reside." … "We should understand that we land on a different type of territory, in the layers of the Earth and that we are one of the layers."[2]

We are forced to establish new relations between nature, science and society. Global climate protests led by young activist Greta Thunberg to protect the vulnerability of planet Earth have united all generations around the world under the message "There

is no Planet B". They urge the politicians to reduce emissions and stabilize the atmosphere to improve sustainable living conditions for future generations. They forced them to change their political discourse and stop exploiting the living environment due to the interests of the global economic lobbies.

Project BirdPort is an international student project that brings together different cultural approaches to foresee different scenarios. In many ways they are seeking the answers "How to land on new layers of Salinas do Samouco?" within the unpredictable global climate changes. The topics of the project are global warming, raising the water level and political responsibility. It opens the discourse about new technological challenges, new living conditions and inhabitation of different spheres and layers of the Earth.

Natural reservat Salinas do Samouco - Alcochete / Montijo, Portugal

The salt pans complex Salinas do Samouco is located on the south bank of the Tagus River, between Montijo and Alcochete. It is a natural protected area within the Natural Reserve Natural of Tejo Estuary, established in 1976. It is one of the largest wetlands and most important breeding, wintering and migratory water bird's area in Portugal and Europe, with large mud and swamp areas.

It is covering over 360 hectares. The complex is a system of channels and water reservoirs built for the traditional production of salt and salt marshes, river dunes, vegetation and agricultural land important for ecology and the conservation of biodiversity. It is 11 meters above the sea level and at a depth of 10 meters.

Past, Present, Future

The Samouco complex, which originally constitutes 56 salt pans for salt production, dates back to the 13th century and employed 1.500 workers. Today, only one salt pan and 5 workers are in operation, the rest is an ecologically protected area, the habitat for thousands of birds and other species (fish, shelves, crustaceans) to feed, shelter and nest. According to a report by the Foundation for Environmental Protection and Management of Samouco's Salterns[3], this area hosts around 195 different water bird species (Phoenicopterus roseus, Anser anser, Calidris alpina, Limosa limosa, Circus cyaneus, Pandion haliaetus, Luscina svecica, Regulus ignicapillus, Remiz pendulinus,..) of which 42% are migratory birds, 44% wintering and 14% nesting. In order to preserve

biodiversity, the protection of this area is very important not only locally, regionally, nationally but also transnationally. Therefore, the Foundation's priority is to preserve and maintain this natural complex system, to promote the sustainable use of natural resources (biological gardens, the halophytic plant collection), and to conserve the biodiversity. The natural reserve of salt pans is not intended only for research and education purposes. It is important to raise awareness among the general and local population of its influence on their environment, for equilibrium in everyday life and for the future of next generations.

Definition of the problem

Climate changes and strong human pressure on Lisbon estuarial and coastal habitats dramatically destroy birds inhabiting area. Therefore, it is imperative that future urbanization and infrastructure projects should implement these natural factors in development strategies as a crucial integrative approach for climate change adaptation.

The problems of the Salinas do Samouco Nature Reserve have been identified through literature, future scenario analysis (IPCC), open source databases, interviews with local government, local community, foundation representatives, general public and in collaboration with experts from various disciplines (urban planner, architects, IT technologist, conservationists, biologist, ...).

Main problems:

— Global warming

— Rising of the sea level, floods, extreme weather conditions

— Intensive urbanization of Alcochete - pressure from tourist lobbies

— Infrastructure projects - New Montijo airport, bridge Vasco da Gama

— Illegal exploitation of flora and fauna

— The devastating cultural heritage of all industrial facilities

— No serious political interest

Scenarios

"We are landing on a different type of territory, so don't believe that you know what is it when we talked

about nature."[4] (Latour 2017)

Future scenarios for Salinas do Samouco that should be taken into consideration as dystopic, are based on political and economic interest. All of them predict short-term and long-term effects on ecosystem and biodiversity: The New Montijo Airport, Tourist Attack – SPA Resort and The Submerge. While BirdPort project scenario is utopic, an imagination of "Where do we land?".

1. Scenario: The New Montijo Airport

"The world which lives after nature and after the end of tradition is one marked by a transition from external to what I call manufactured risk[3]."[5] (Giddens 1999)

The scenario is based on media articles that reveal the background details of the construction of the new Montijo airport. Different political opinions of position and opposition show irrelevance to the certain fact that the new infrastructure of the airport will destroy the ecosystem of the Samouco natural reserve in the interest of capital.

In 2008 Lisbon airport on-line portal announces the news about a location of new international airport in Alcochete: "The Portuguese Government decided to build a new airport to serve the Lisbon region, which will be located some 42 km east of the city center on the South bank of the river Tagus. The site is currently used by the Portuguese Armed Forces. The decision was driven by the lack of additional capacity at the current Lisbon Airport and the impossibility of significantly expanding the existing facilities."[6]

In Portugal news[7], 24.4.2019 is an article, that Portugal's prime minister Antonio Costa has said he has no "plan B" for Lisbon's new international airport, following an outcry by environmental activists. The news announced the parliamentary debate between Prime minister Antonio Costa and member of the parliament Andre Silva:

"The environmental impact assessment that was presented is


FINNAIR
AEROFLOT

being analyzed by APA (Portugal's Environment Agency) and now is not a time for a political decision but a time for technical evaluation." (Costa, 2019)

"Are you really going to insist on works that will damage people's health and which will devastate the avifauna of the Tagus estuary, an ecosystem that is already quite fragile?" ...

"Reconsider the location of the airport. The city of Beja, in southern Portugal, could be an alternative." (Andre Silva, member of parliament of People-Animal-Nature Party)

2. Scenario: Tourist attack – SPA RESORT

The scenario predicts and manipulates with the original Salmouco Foundation report Optimizing habitats for birds at the Samouco salt pans -Tagus Estuary SPA like:

We could read the report that beside ecological objectives of the area, one of the future goal forced by foundation is socio-economic objectives to build a SPA RESORT.

"It also meets the management objectives derived from the inclusion of the area as a SP for the Tagus estuary."

Original report:

"It also meets the management objectives derived from the inclusion of the area as an SPA for the Tagus estuary, being one of the most important breeding, wintering, and migratory passage for water birds in Portugal."[8]

Fig. 1: The new Montijo Airport
The construction of an airport would completely destroy the nature reserve ecosystems. The density of people and traffic, noise and pollution would threaten the existing habitats - fauna and flora, bird's migration paths and tradition in the context based on short term political and economic interest. Source: Project BirdPort

Fig. 2: Tourist attack – SPA RESORT
With the tourist boom that has completely transformed Lisbon, Alcochete would be a new potential location for urban expansion and development of SPA touristic resorts. Samouco Salt pans would no longer be the primary habitat of water birds, but would become healing pools for global tourists, taking advantage of its natural resources - salt and mud – for short-term pleasures. Source: Project BirdPort

3. Scenario: The Submerge

> ***"The earth is partly a ruin because it's completely anthropogenic and destroyed, but at the same time it's also full of different entities."[9] (Latour 2017)***

The Submerge scenario considers the fact that all climate changes will affect all global ecosystems. Politicians should stop supporting irresponsible investments at the global and local levels, given the fact that we will all submerge under the water.

According to the IPCC (International Panel on Climate Change), the average sea level in the Lisbon coastal and estuarial area is projected to increase by 2.00 m over the next century and continue at time intervals 2120/2130/2140/2145 by 3 m/5 m/8 m/10

m. Even if we couldn't exactly predict the future with data or like Giddens said in his text The Modern Law Review that "we often don't really know what the risks are and how to calculate them accurately in terms of probability tables." But to understand today the facts that it will affect the loss of coastal and belt wetlands, biodiversity, vegetation, migratory routes means that, the previous two scenarios couldn't have arguments in the future.

The global society demands the implementation of agreements to mitigate climate change and develop flexible and innovative strategies. While we all should adapt to local and regional scenarios of climate change and their consequences on new living conditions.

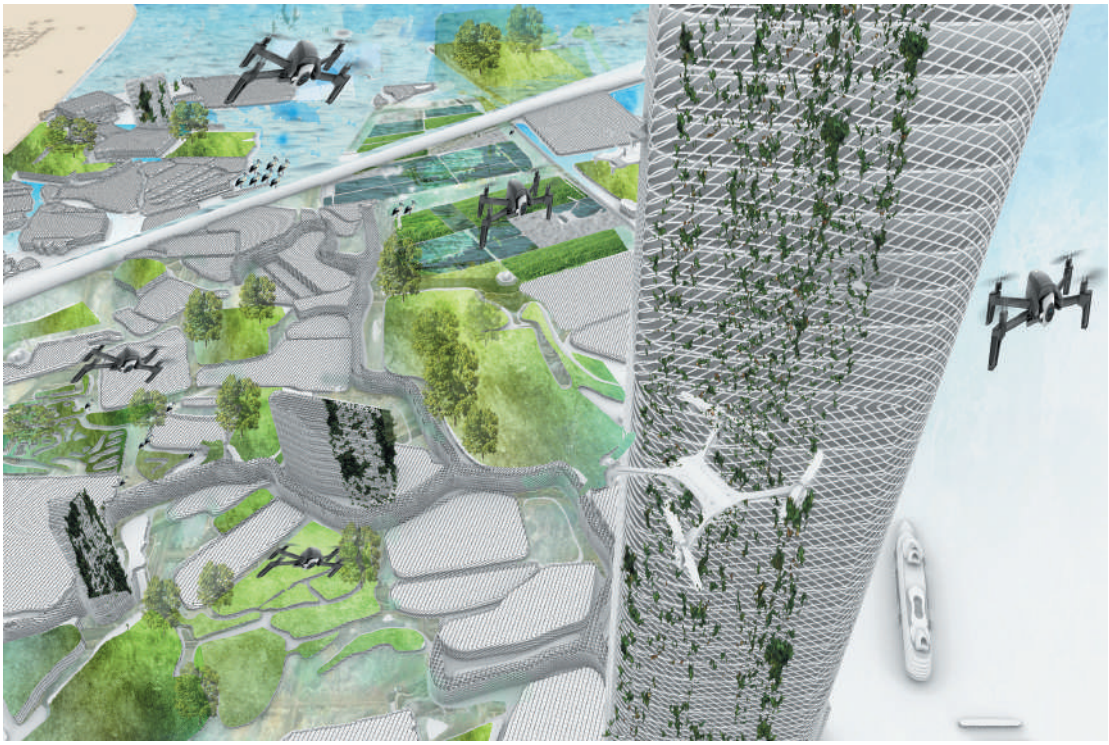
4. Scenario: BirdPort – Thank you for landing with us

> ***"In the Anthropocene – this new time of ecological crises- we are all immersed in a gigantic process of collective reorientation: what kind of earthly beings are we now becoming, and which kind of earth are we submerged in?"[10] (Latour 2017)***

The prediction 100 years in advance the consequences of rising water level are essential for preventing or adapting humans and other species to survive in global risk territory which is also Salinas do Samouco. The BirdPort project is a timeline project (2020-2150).

Constant refreshment of databases adapts changes in a very flexible way. With floating and raising platforms, that create co-existence of new habitats and natural environment, they enhance and conserve the biodiversity and bird migration routes. The human, bird species, protected habitats, salt pans, airplanes, renewable energy technology and all other things important for new living become part of different vertical layers-towers- of the area/ Earth. Human and water bird species are inhabiting and operating at different altitudes. Their living forms and flying routs are constantly made and maintained through the computer operation system depending on the climate situation and heterogeneity of

Fig. 3: The Submerge Where do we land? Source: Project BirdPort



the program. Flip from the horizontal view of the landscape to the vertical layers (sideway view) of living forms offers an ultimately new vision of future living, or to Latour's stratigraphically approach of layers of earth, where the things are above and below and we are inside them.

Conclusion

"The urgency makes us think and imagine: where do we land?"[11] (Latour 2017)

Thank you for flying with us

Fig. 4: BirdPort
The coexistence of new habitat, new population, new renewable technology, natural reserve area, vegetation islands and salt towers - for salt and energy production, for birds to enhance their quality of feeding, sheltering and nesting, for purification of drinking water and observation. Source: Project BirdPort

Fig. 5: BirdPort
The new BirdPort complex is adapted to all climate change to conserve the biodiversity of the area and offers a variety of activities from salt production to fishing, watersport activities, educational and scientific exploration. It is a test field for new living conditions. Source: Project BirdPort

Notes

1 Line Marie, Thorsen et al., "Can we land on earth? – An Interview with Bruno Latour." in Moving Plants, ed. Line Marie Thorsen (Rønnebæksholm, Næstved: Narayana Press, 2017), 155–156. Regarding the ecological crises Latour learnt from soil scientists to approach new way of understanding the critical zones, new living territories for planetary living conditions. We live in a new earth, a new soil and ground by exploring the critical zones. His notion of critical zones is extended from a group of scientists that studied specific layers of land, specificities of particular places but in different ways, to one specific fragile critical zone recovering the heterogeneity of the earth - Gaia.

2 The Foundation for Environmental Protection and Management of Samouco's Salterns (Fundação para a Proteção e Gestão Ambiental das Salinas do Samouco) is a non-profit (charitable) institution. In the mid-1990s, under the environmental compensation measures resulting from the construction of the Vasco da Gama bridge, the Portuguese State expropriated 360 hectares of land to the Samouco salt flats. This area belonged to a larger territory exclusively allocated towards nature conservation and environmental education, managed by Salinas do Samouco Foundation.

Bycima. 2019. Salinas de Samouco Foundation and LIFE-Salinas. Accessed August 6, 2019.

https://lifesalinas.es/en/salinas-de-samouco-foundation-and-life-salinas/

3 Manufactured risk is a risk created by the very progression of human development, especially by the progression of science and technology. Manufactured risk refers to new risk environments for which history provides us with little previous experience. Anthony Giddens. "Risk and Responsibility." The Modern Law Review 62, no.1 (January 1999): 3.

4 Lisbon Airport Info Center. 2008. Lisbon International airport. The new Lisbon Airport. Last modified September 29, 2019.

http://www.lisbon-airport.com/new-lisbon-airport.html

In the context of Environment and Land Use the Government decision pertaining to the selection of the new airport location was taken following a Strategic Environmental Evaluation, with a Public Hearing procedure, through which the environmental viability of the selected location was confirmed.

Timeline of the new airport project:

2008: government confirmed the location, 2010: start and stop the project construction, 2018-2019: restart the project construction, 2022: deadline, capacity: 43 million passenger/2050

5 Emília Paula, Silvia et al. 2006. Optimizing habitats for birds at the Samouco salt pans -Tagus Estuary SPA. Accessed December, 2019.

http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LIFE03_NAT_P_000014_LAYMAN.pdf

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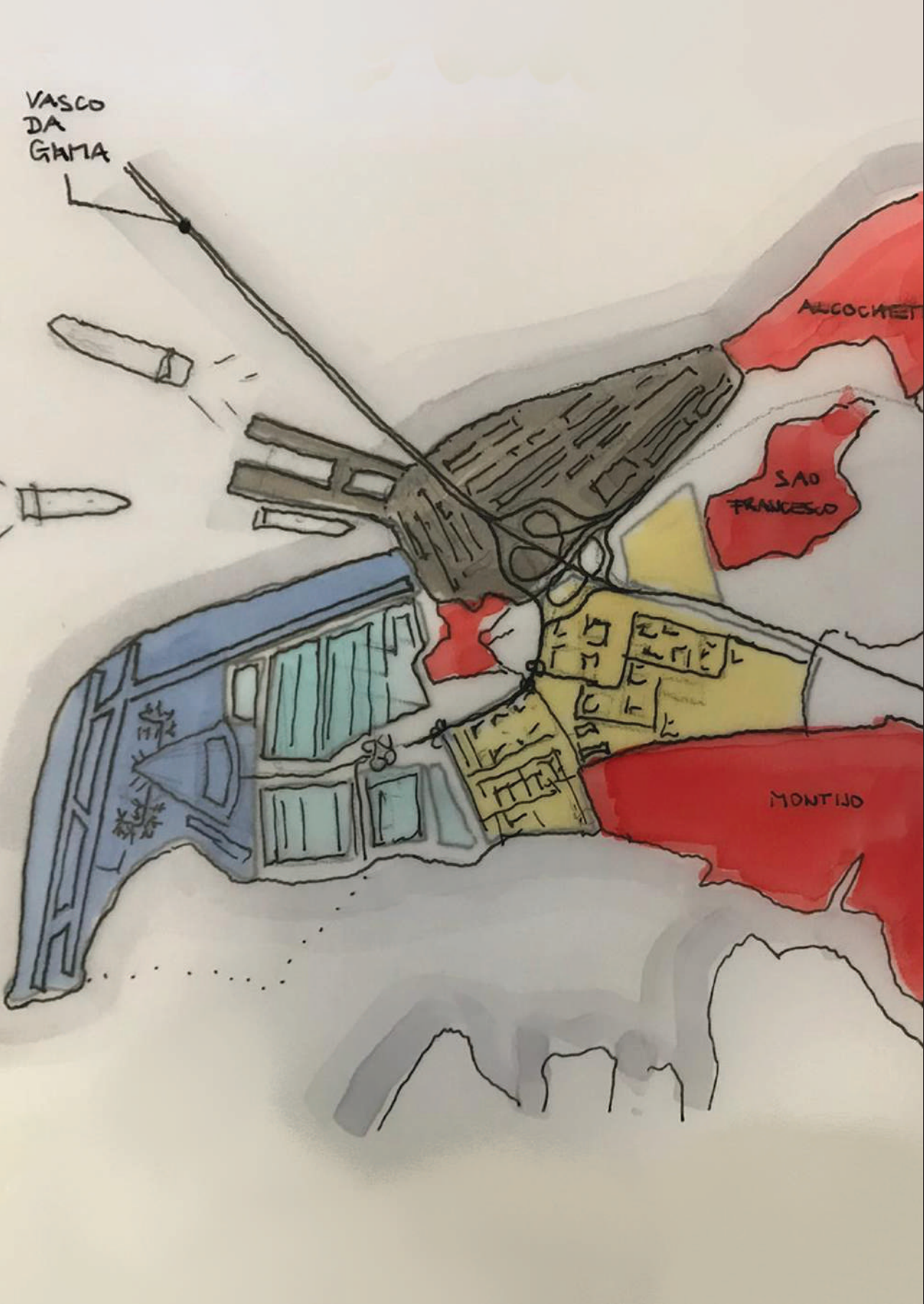
VASCO
DA
GAMA
ALCOCHET
SAO
FRANCESCO
MONTIJO

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New Lisboa Airport, the discussion in 2019

The discussion about the new Lisbon airport focuses on two hypotheses: Alcochete or Montijo. Being both linked to Lisbon by the Vasco da Gama bridge across the Tagus Estuary (Alcochete to the west, Montijo to the east), they may superficially look like similar solutions. However they have very different impacts on the Metropolitan Area of Lisbon.

The first solution, Alcochete (Canha), is the result of a process of systematic comparison with alternative locations. It was compared with other valid hypotheses and presented itself as the best option, having been the object of in-depth environmental impact studies and operational solution development [1].

The second hypothesis, locating the airport at Air Base No. 6 (Montijo), was compared for the last time in 1994 [2], having been put aside precisely for its enormous environmental impact on the estuary ecosystems.

While the first solution is grounded in and anchored in the principles of operational efficiency and impact mitigation, the second is basically the idea of a minister, apparently adopted uncritically by two governments of different colors and the by the holder of the concession of the airport.

The former Minister of Planning and Infrastructure, Pedro Marques, commenting on the privatization of the Airports Authority of Portugal (ANA), stated in 2018 that with the "ANA privatization model applied by the previous government, the construction of a new airport financed by airport taxes was compromised" [3]. In other words, the Portuguese Government has made a decision that may compromise its freedom to decide for decades, and force it to settle for a poor solution because it has signed a damaging sub-concession contract with a private operator.

Alcochete would require an international competition and a carefully-planned and phasedinvestment, likely including partial public funding. Montijo would theoretically be fully financed by the concessionaire, VINCI, that invests in the new terminal. The Alcochete hypothesis was abandoned during the Euro crisis, although all supporting studies had been concluded, including a true comparative assessment of the merit of the solution, something that was never done for Montijo.

Since during the crisis it was unreasonable to discuss an ambitious solution for the future, the preference for the less ambitious and temporary solution grew. But now, once the crisis is over, why does the Montijo hypothesis still warrant unchallenged acceptance?

At environmental level there are big differences; Alcochete is far from urban areas and far from protected landscape zones.

On the contrary, Montijo is in the center of the Tagus estuary, an internationally-important wetland, a Ramsar site and a Natural Reserve.

A relevant aspect regarding potential environmental compensation's measures is the reproducibility of the affected environment; a compensation policy typically compensates the affected habitats with the creation / upgrading of habitats of similar characteristics when on-site conservation is impossible. While this is feasible in the case of the montado (cork oak forest) patches affected in Alcochete, through careful planting and management of new areas, it is extremely difficult to replace the marshland habitats and mudflats directly and indirectly affected by a civil airport at Montijo Air Base (AB).

The "solution" proposed in the Environmental Impact Study is unrealistic: to compensate the loss of salt flats, already used by birds today, would be acquired by VINCI so that they could continue to... be used by birds. This is not a true compensation measure because the net loss of habitat is evident. Preserving existing habitat (already protected by law [4]) cannot be considered a true compensation. As it will be unrealistic to expect reproduction of marshland outside the estuary, as it is a tidal habitat, the strategy of creating new ex-situ habitat is doubtful.

In addition, military air base number 6 resembles other air bases in Europe, which since World War II have evolved into a form of unintended protected landscape areas: the site's military use has severely limited access, and this has allowed the return of wildlife.

At the social level, the decision mainly affects future generations who will be the most harmed by the negative impacts and their associated costs.

If the intention is to build a "temporary" airport, then expected air traffic growth will inevitably demand a re appreciation of the construction of a true, and more permanent, new Lisbon airport, which would signify paying for the same product twice; if, on the other hand, the intention is indeed to set the Montijo solution as a permanent infrastructure, then one third of the runway does not meet minimum elevations and is thus vulnerable to flooding with expected sea-level rise [5], which will severely compromise its operational capacity in the second half of this century. This issue appears not to concern the current executive.

Both outcomes are forms of shifting costs and problems onto future generations.

At the economic level, handing over of the investment to the concessionaire apparently relieves the Government of the first effort of the investment, yet puts control over decisions in a foreign group of investors. The Portuguese State thus appears to be postponing a strategic investment and replacing it with a patch, in a solution that appears to disproportionately benefit the airport sub-concessionaire, and that could reach its capacity within a decade or two [6].

The absence of a true strategic environmental assessment, where the Montijo hypothesis could be compared against well-studied alternatives, was merely a maneuver to circumvent the legislation in a dubious way. It is most likely that the airport project at the Air Base would never survive a serious comparison with the Alcochete / Canha alternative.

Lisbon's Humberto Delgado Airport, is at present not only saturated, but also a source of huge disruption in Lisbon's city center. Noise and air pollution reach far above the legally desirable levels, and the risk of an accident in the city center is so disturbing that the state and populations prefer not even to consider it a possibility - but it is. An airport in Montijo suffers from the same problems, only shifting them over to towns in the municipalities of Barreiro, Montijo and Alcochete [7].

To the contrary, the Alcochete (Canha) alternative would efectivly reduce the direct negative impacts of urban areas, promoting a significant improvement of the quality of life of the comunities of the Metropolitan Area of Lisbon.

The Tagus Estuary was heavily affected by pollution, but regeneration started at the end of the 20th century and it has gradually recovered its environmental quality. The preservation, to this day, of one of the most important wetlands of the Iberian Peninsula, within the largest urban area of the country, results from the efforts of previous generations, who have been able to value this unique ecosystem [8]. An international airport in the middle of the estuary would be a setback of decades in the effort to regenerate the estuary and may compromise the delicate environmental balance of the estuary.

The Portuguese State's de decision to delegate the choice of where to build the airport on Vinci, a private sub-concessionaire, is an unambitious solution that neglects the local community, disregards future generations, compromises the environmental

balance and reveals a rushed and understudied preference. It remains to be seen whether civil society will let this decision stand.

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[3] https://jornaleconomico. sapo. pt/noticias/privatizacao-da-ana-comprometeu-novo-aeroporto-de-lisboa-128130

[4] https://www. dinheirovivo. pt/economia/spea-admite-agir-judicialmente-para-travar-novo-aeroporto/

[5] https://expresso. pt/sociedade/2019-09-15-Novo-aeroporto-estudo-oficial-subestima-e-omite-riscos-de-subida-do-mar

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[9] http://portaldoclima. pt/en/

[10] https://smart. campus. ciencias. ulisboa. pt/portal/apps/MapSeries/index. html? appid=ebee609293804c49abd52ccfb07f4762

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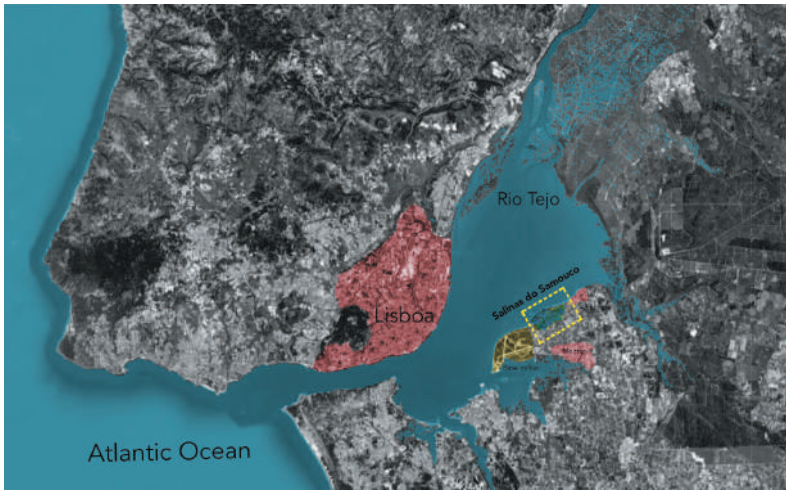
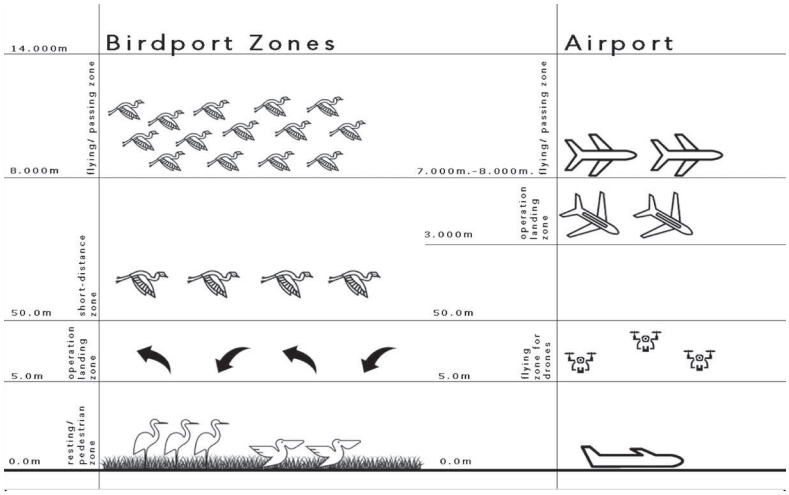
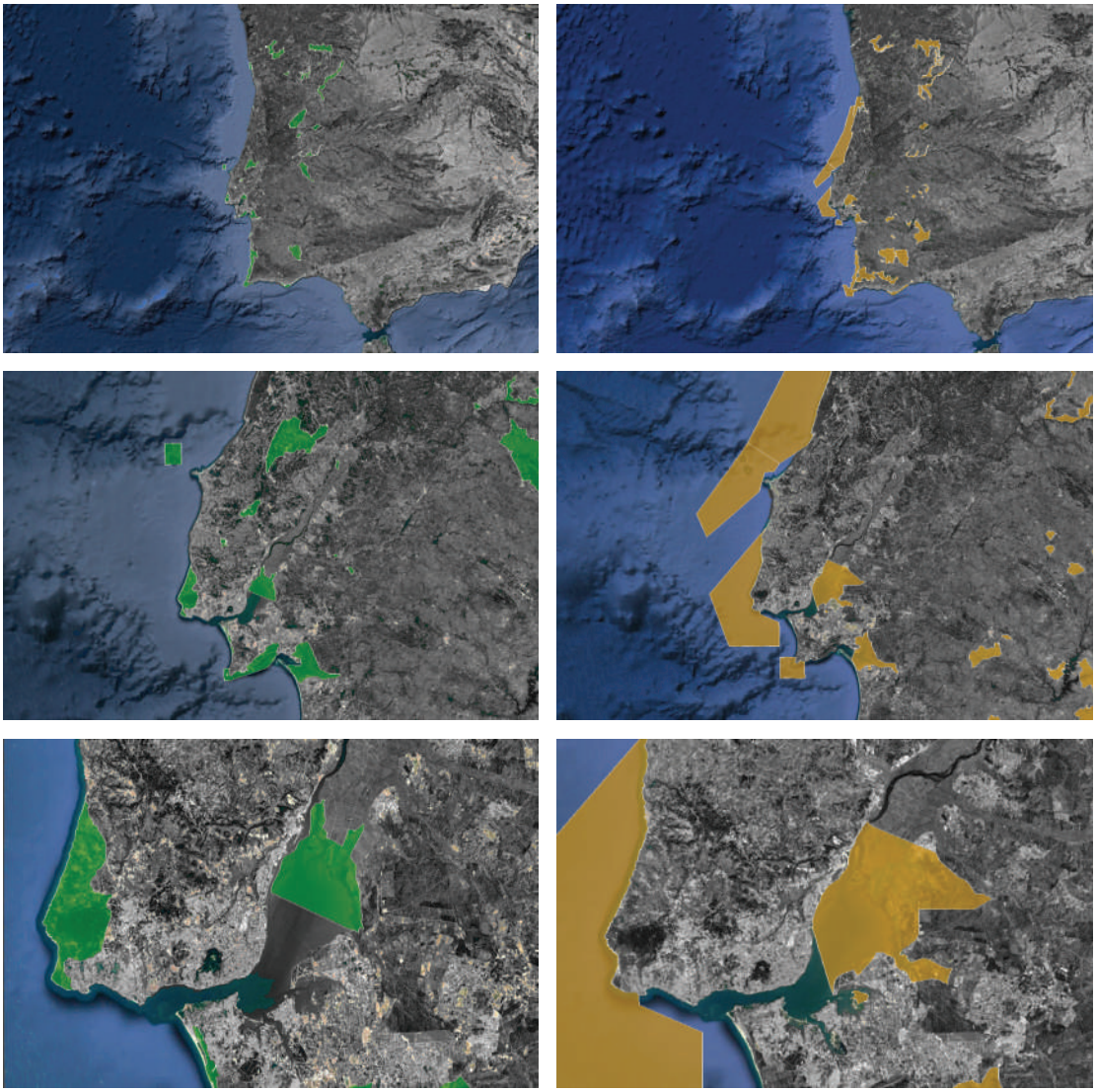


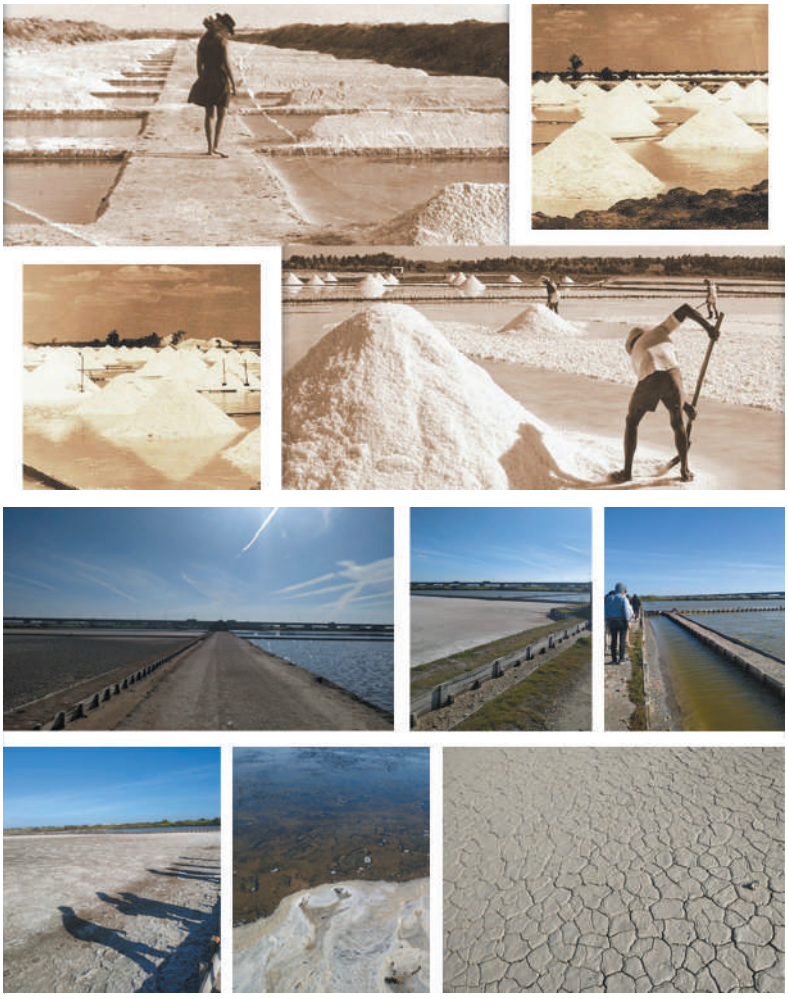


Site Plan

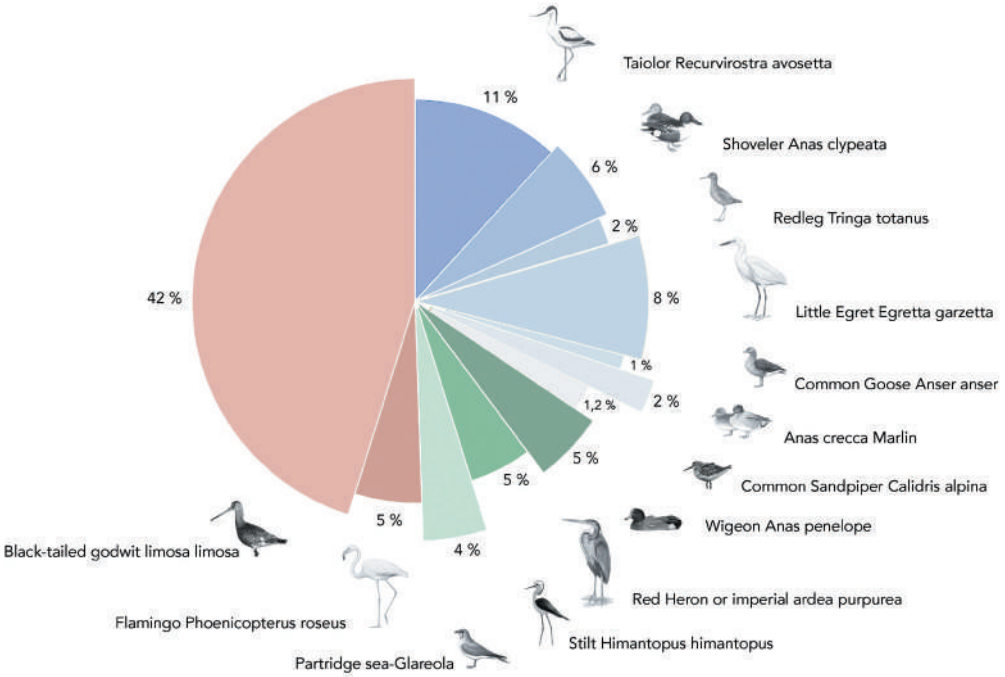
Birdport zones and airport
—
Protected zones and natural reserves:
Iberian Peninsula
Great Metropolitan Area of Lisbon
Lisbon District

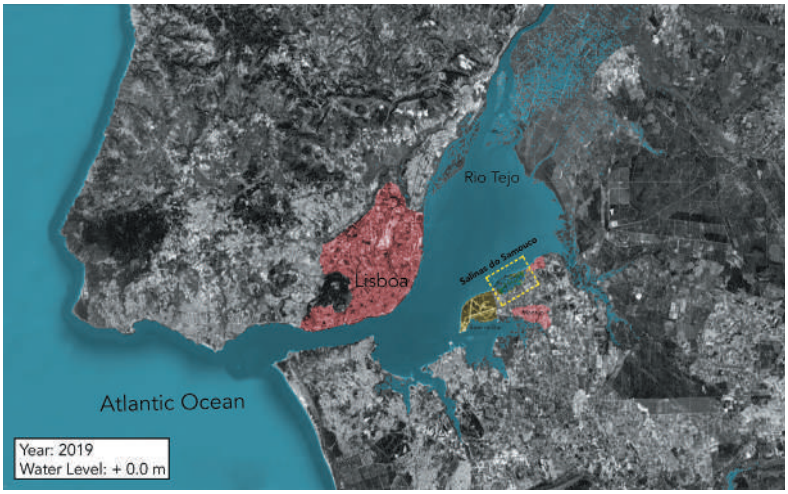
Special protected zones for birds:
Iberian Peninsula
Great Metropolitan Area of Lisbon
Lisbon District





Salinas:
Historic Past and Present
—
Species of Birds Around Lisbon
Distopia


Taiolor Recurvirostra avosetta
11 %
Shoveler Anas clypeata
6 %
Redleg Tringa totanus
2 %
Little Egret Egretta garzetta
8 %
42 %
Common Goose Anser anser
1 %
Anas crecca Marlin
2 %
1,2 %
Common Sandpiper Calidris alpina
5 %
5 %
Wigeon Anas penelope
5 %
Black-tailed godwit limosa limosa
4 %
Red Heron or imperial ardea purpurea
Flamingo Phoenicopterus roseus
Stilt Himantopus himantopus
Partridge sea-Glareola


Rio Tejo
Lisboa
Salinas do Samouco
Atlantic Ocean
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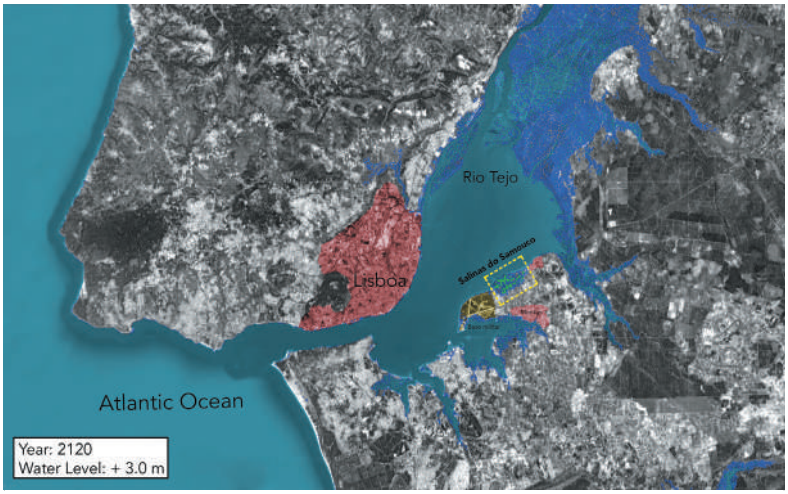
Water Level: + 0.0 m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Salinas do Samouco
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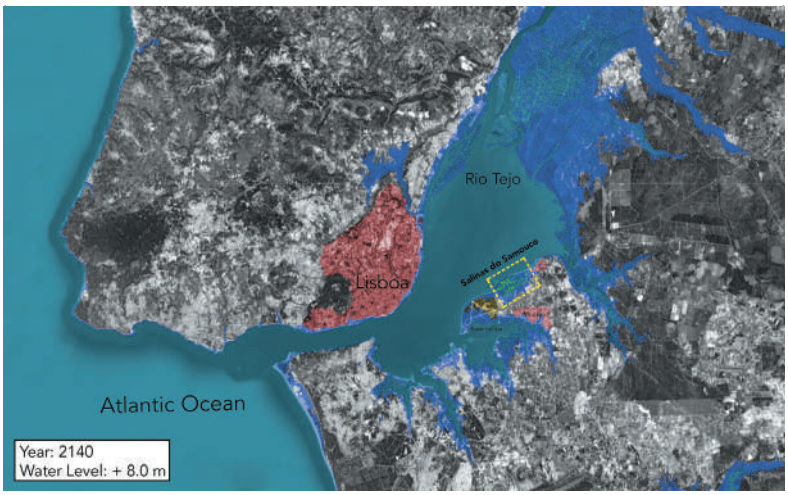
Water Level: + 3.0 m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Salinas do Samouco
Atlantic Ocean
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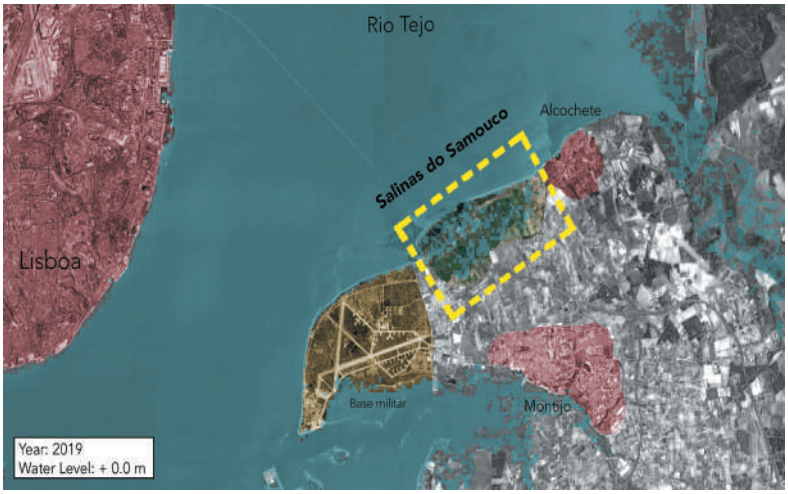
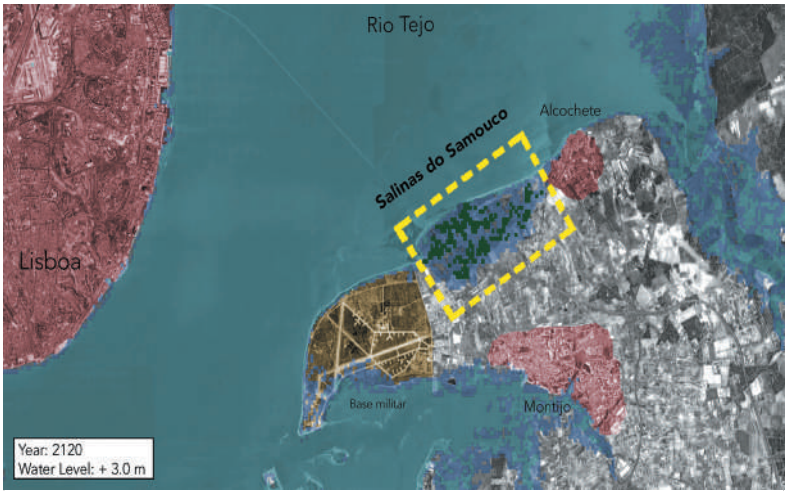
Water Level: + 8.0 m


Rio Tejo
Alcochete
Salinas do Samouco
Lisboa
Base militar
Montijo
Year: 2019
Water Level: + 0.0 m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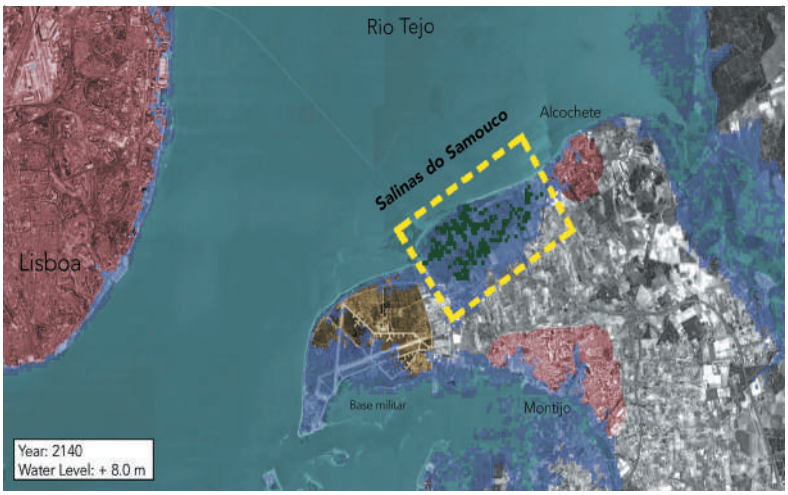
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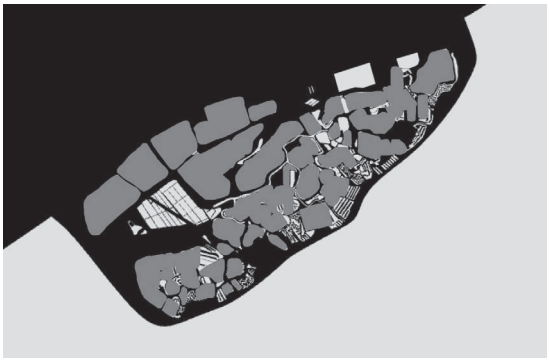
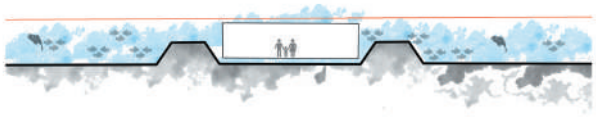
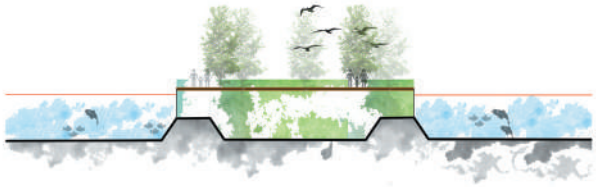


Project Concept Birdport:
Platforms | Reserved Areas
Path | Towers
-
Typologies

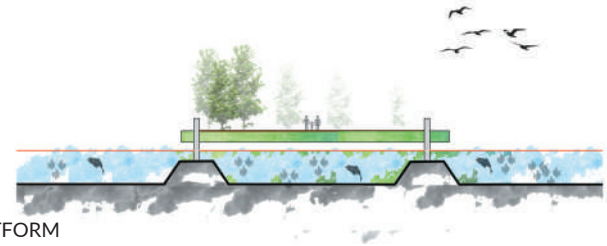


SUBMARINE

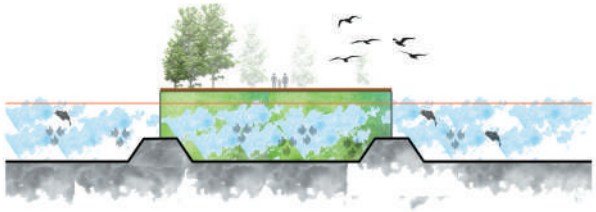


MASSIVE
PLATFORM

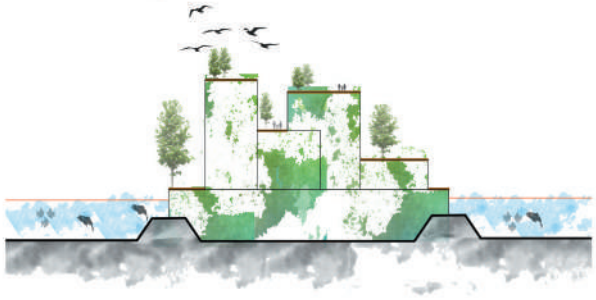
RESERVE AREA



RAISED PLATFORM



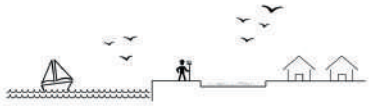
FLOATED
PLATFORM



TOWER

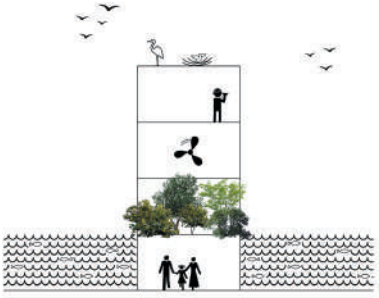
Renewable Energy Typologies
-
Utopia future

Future audiences

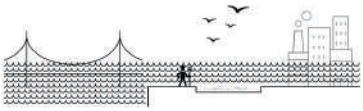


PAST

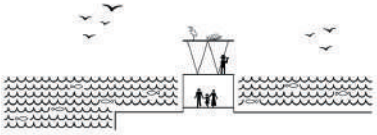
PRESENT



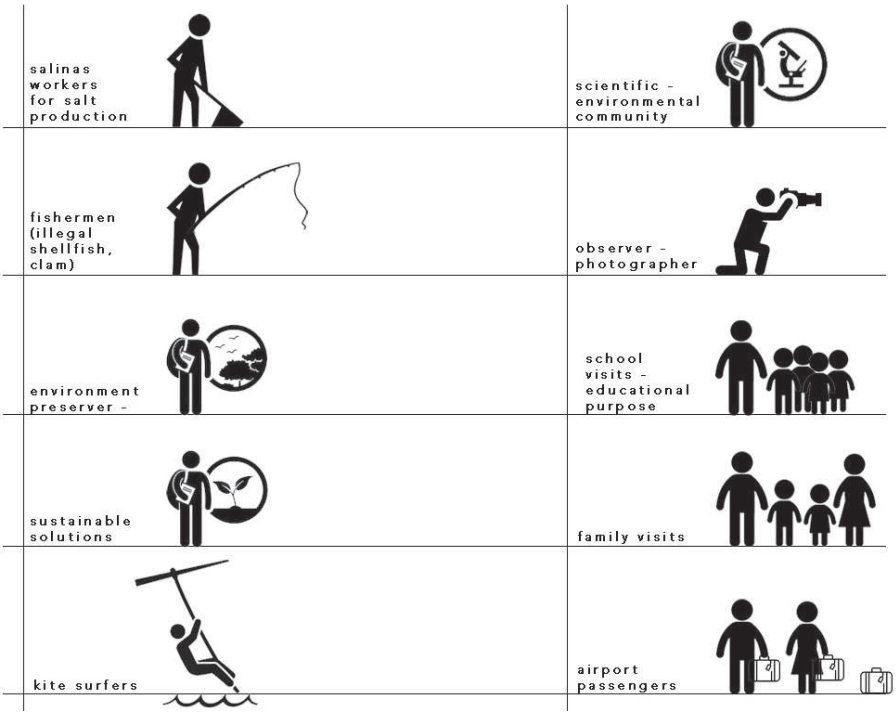
UTOPIA FUTURE

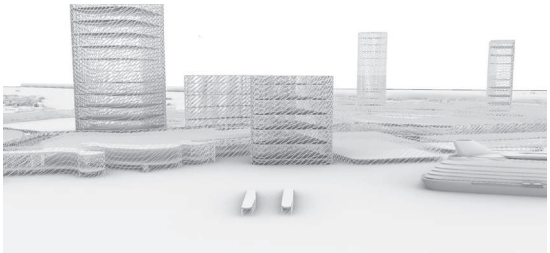


DISTOPIA FUTURE



UTOPIA FUTURE





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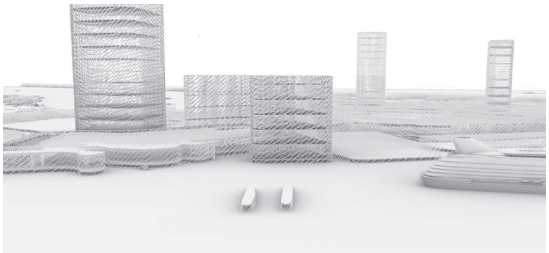

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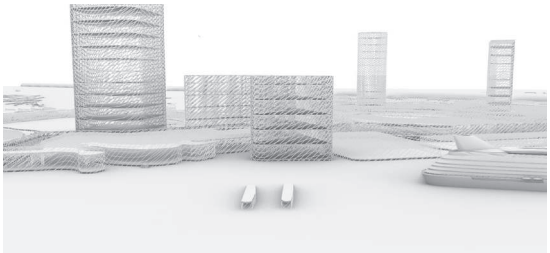

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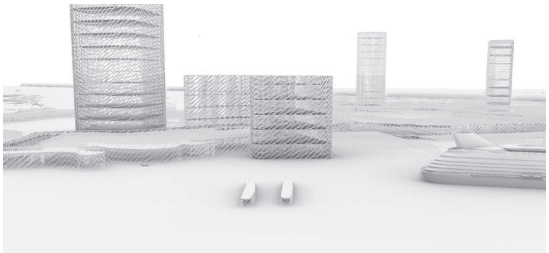

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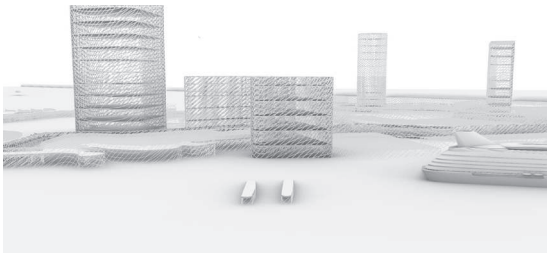

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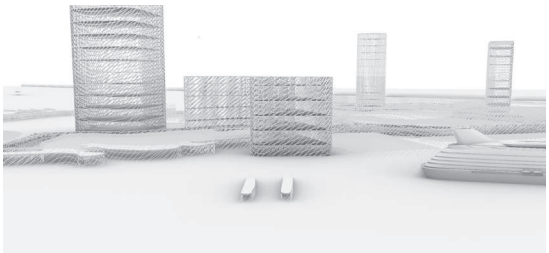

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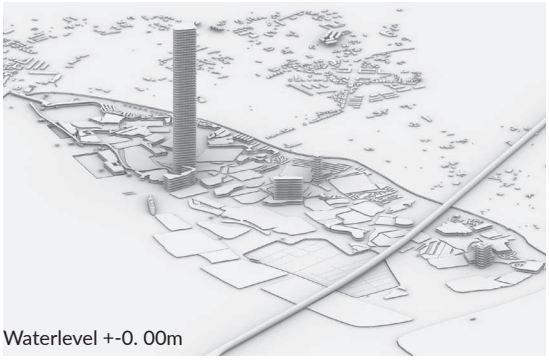

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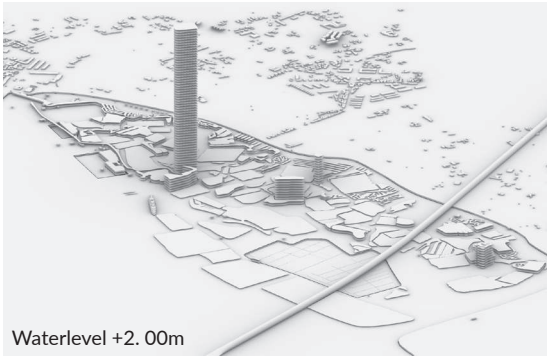

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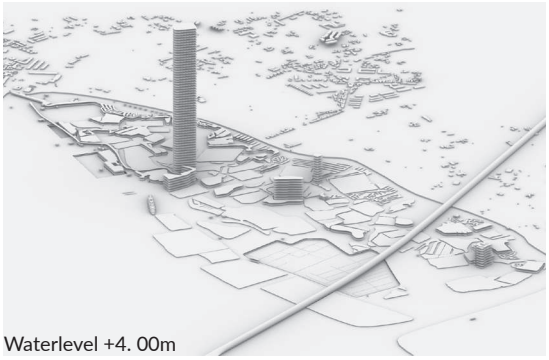

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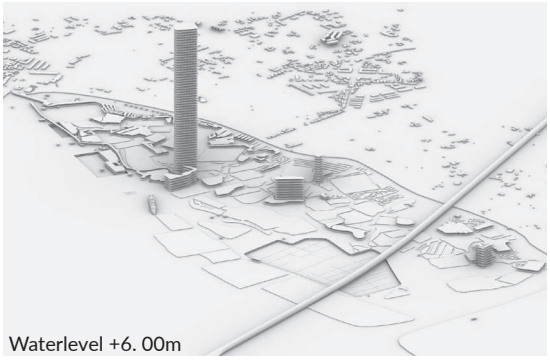

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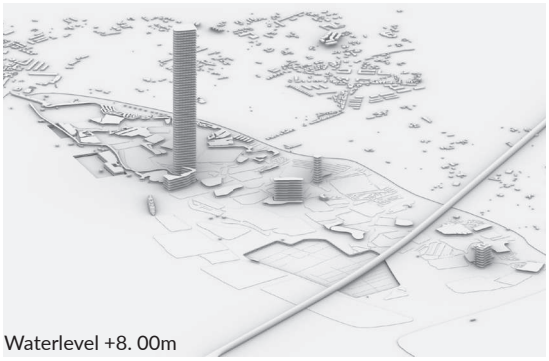

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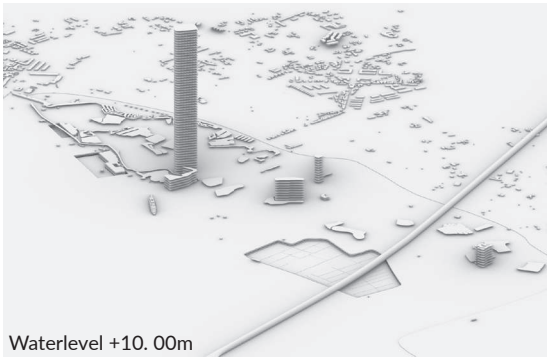

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Flood Animations

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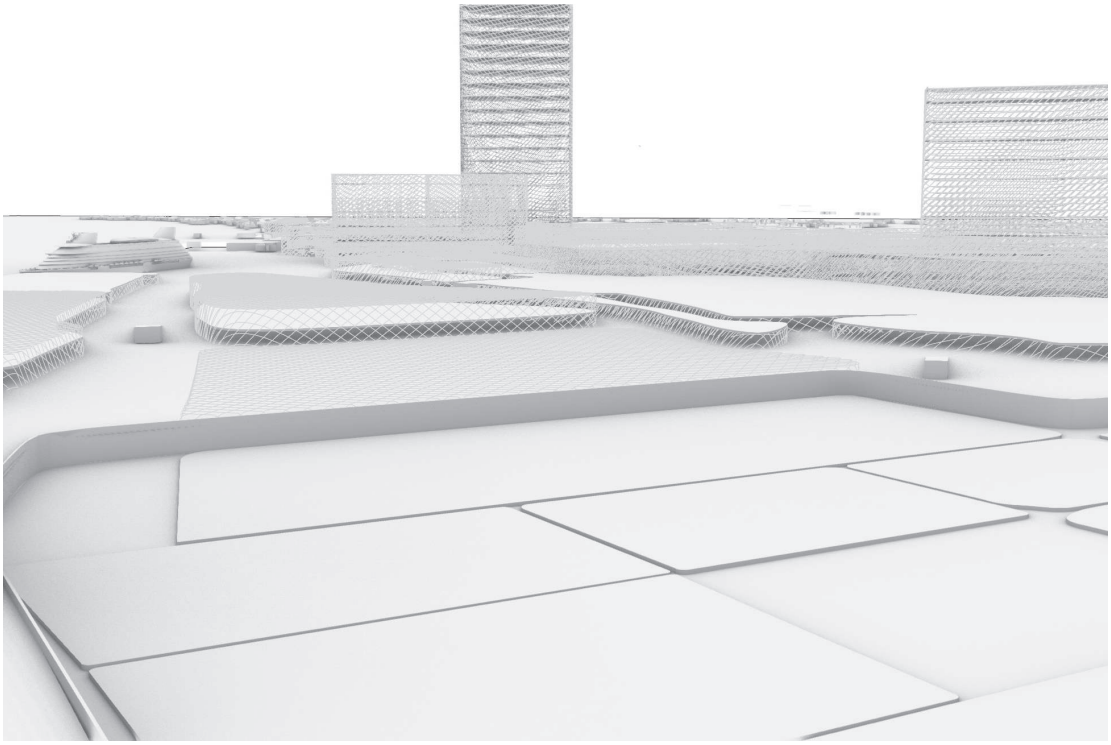
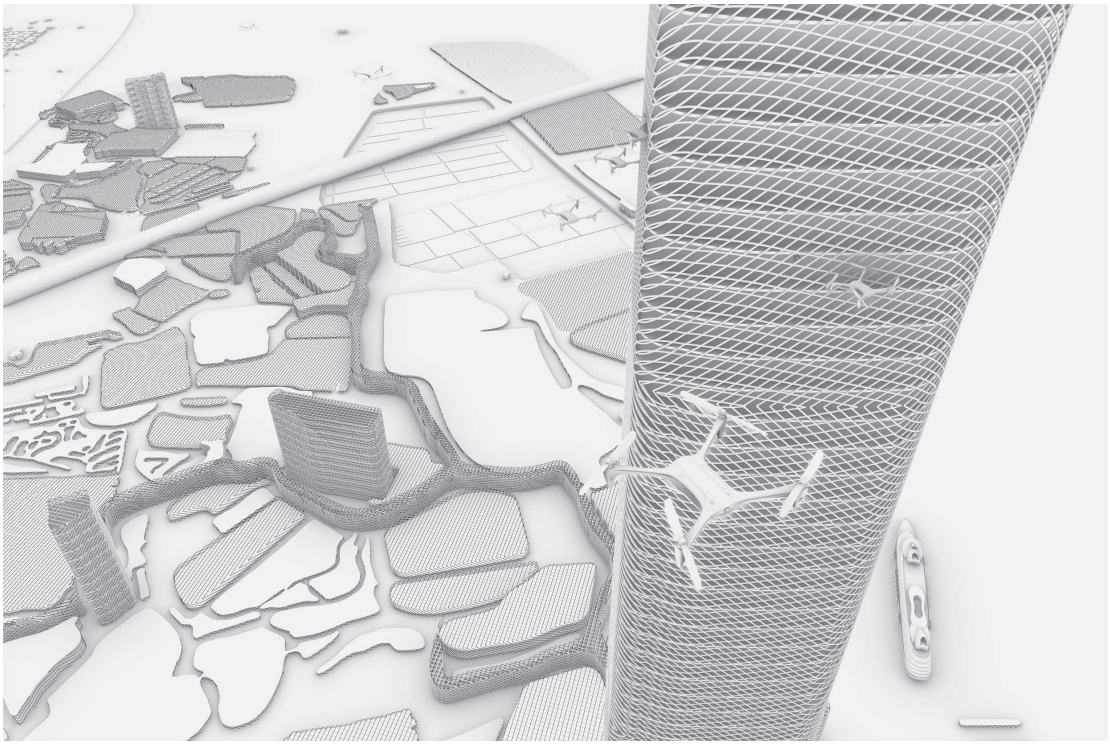
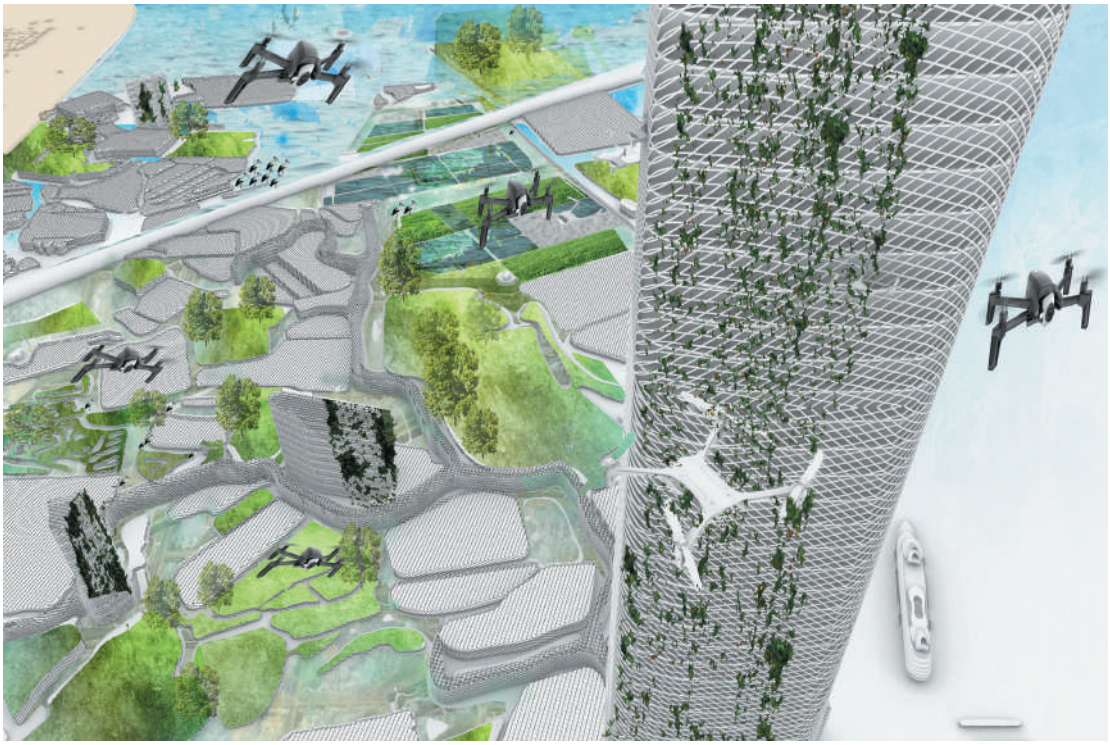
Salinas (Project)

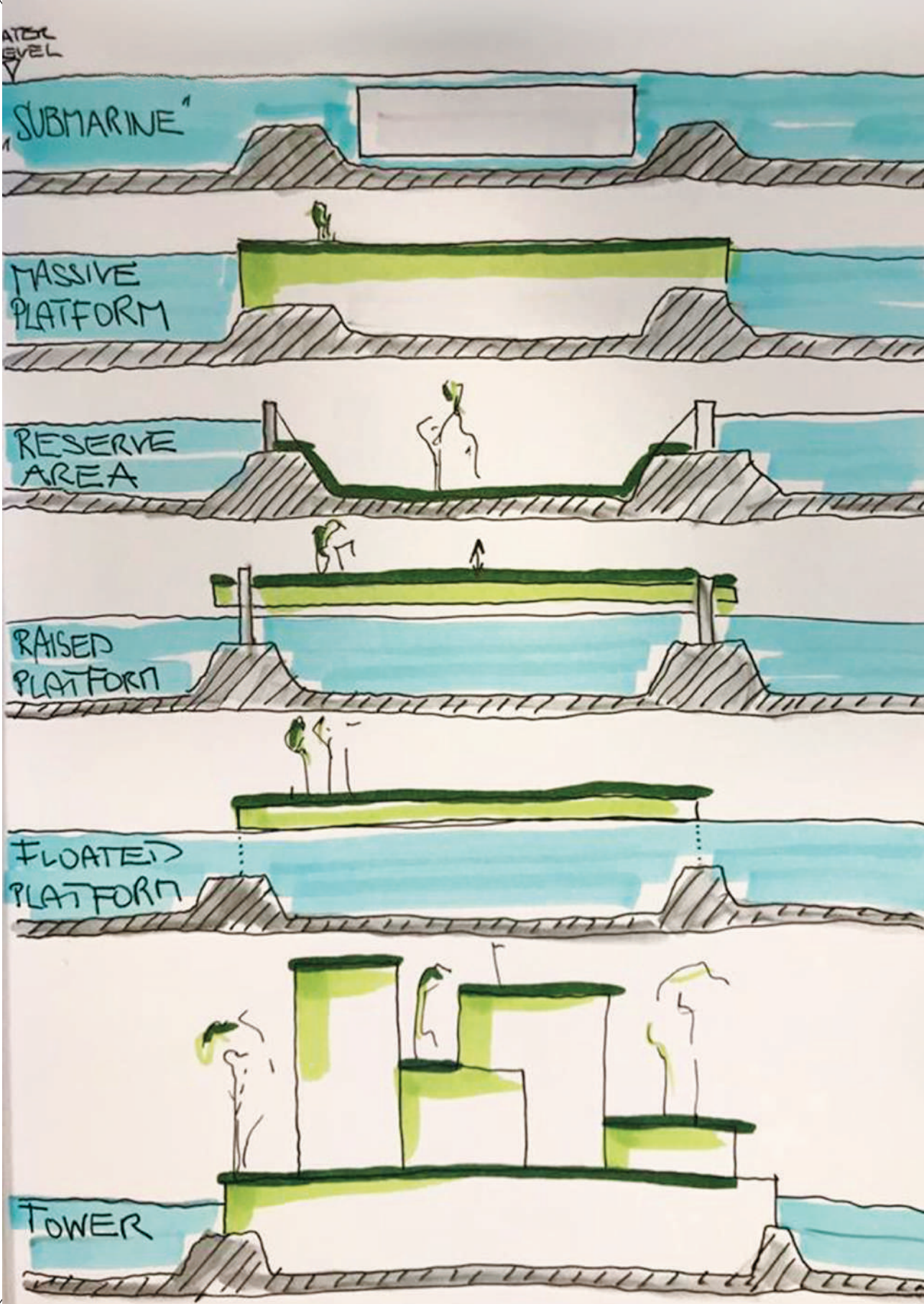
-

Aircraft Landing Zone (Project)








ATER
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University of Florence,
Department of
Architecture,
Italy

Dimitra Babalis

Responding to Waterfront Urban Space Climate Change Risks

Abstract:

The aim of this contribution is to define the 'Waterfront Urban Space' (WUS) and its protection from the most dramatic climate-related urban risks. It shows how evolving vulnerability along sensitive urban waterfronts should be faced properly through integrative planning and resilient design solutions. Accordingly, it deals with identifying new urban strategies for flood protection that should be developed to respond to the consequences of climate change. In terms of sustainable waterfront regeneration, the adopted protection systems can create attractive urban environments and in accordance to the character of place. The methodology adopted is this to analyse comparatively defence strategies and design solutions through case studies in Europe and USA in order to explore urban scenarios at the various scales of intervention (large scale-city level/medium scale-district level/small scale-site level). Specifically, a deeper understanding of the various types of flood protection can be used as a basis to re-create dynamic waterfront environments while adopting integrative protection solutions. Discussion on climate change should consider integrative planning policies and strategies to set better urban scenarios. Finally, waterfront management with the use of appropriate engineering techniques can produce an easy accessibility, protection and urban safety.

Keywords: climate change, urban space transformation Waterfront Open Space (WUS), waterfront design, case study methodology.

Climate change and urban risks

Nowadays it is becoming increasingly clear that climate change should be significantly faced with integrative planning to deal with urban risks. In recent evidence, changing climate priorities should be given to urban change. However, the focus of climate adaptation it must be ensured on building stock and associated infrastructures, on flooding and environment of water sites. For sure, urban waterfronts need to be particularly considered for protection, urban safety and mitigation of hydraulic risks.

'Waterfront Urban Space' and its definition

The re-designing of derelict and abandon urban waterfronts is clearly meant to encourage ecological and sustainable urban change. In this respect, waterfronts should highlight potentialities improving waterside environment and reviewing emerging nodes

that can add value and aware for a successful waterside design process. To do so, urban watersides can be considered as attractive places for well-being and sociability. Improving waterfronts can enhance integration of land and city's accessibility and connectivity. Further, can create new opportunities for development, re-configuring the image and identity of the city offering a range of new public spaces. It is, therefore, important to adapt to climate change and to smart technologies; to adopt proper strategies and sustainable waterfronts systems; to re- design for successful working and living places. Macro and micro urban design attempts to propose projects that can give a new characterization of urban space while their urbanity can offer solutions that should be based on more specific criteria on ecological and sustainable transformation.

In response to climate change, many proposals for waterfront change seek to respond and promote sustainable development in a variety of ways by:

— Improving water quality and aquatic habitat restoration, where applicable.

— Greening the waterfronts by upgrading, creating and linking new and existing parks, elevated greenways for protection and to support biodiversity.

— Promoting sustainable design and building development including energy use and waste minimization.

— Developing and implementing strategy for risk and urban resilience.

A main goal of urban waterfront regeneration is where a place can express cultural heritage and history. Therefore, the protection of cultural heritage can preserve local character including urban form and highlighting legacies. (Babalis 2017, pp. 8-9)

In defining the 'Waterfront Urban Space', (WUS)[1] it should be taken into consideration the concept of inclusiveness of an urban space and its transformation towards a place in order to receive sociability and enjoyment, to integrate local cultural and economic values, to promote health and well-being in accordance to urban resilience. (Babalis, 2017)

Specifically, waterfront urban spaces with a great potentiality for regeneration should follow specific urban strategies. On the other hand, proposed project methods to design must be based on sustainable and smart design solutions. It is recorded that consequences of good decision-making and appropriate local actions can lead to the quality of bluespaces and can contribute to well-changed urban scenarios.

Designing for the 'Waterfront Open Space protection'

To reach a good urban 'Waterfront Open Space', (WUS) it is essential to consider aspects of local culture and human history, considering that waterfronts were places of prosperity and centers of attractiveness. To give back the dignity to urban waterfronts is essential to consider protection of waterfront heritage, upgrading bluespaces for urban living and working.

To this end, 'Waterfront Urban Space' and its relations with spatial, environmental and social dynamics is becoming the main topic for planning and design in order to:

— Revitalize and re-appropriate urban living.
— Restore and better define urban form.
— Re-locate new uses and functions.
— Guarantee accessibility, protection and interaction with urban context.
— Integrate nature and culture for sociability and economic upgrade of place.

It is crucial to establish concepts and methods of urban change for a new dynamism on waterfronts and creation of new urban environments. The methodology to be undertaken is the proposal of a 'Waterfront Master Vision' that should consider the importance of change of waterfront sites in accordance of their location, historic, cultural and environmental values.

Waterfronts are areas of flood risks and designing for adaptation to reduce climate risks is essential. Deciding where to retreat, defend or change a sensitive waterfront site reducing the severity of a climate change impact is central to improve adaptive capacity.

By examining the potential impact of long-lasting climate hazards scenarios, design must be performed where new infrastructures likely to be positioned. Good urban strategies can better identify where and how to intervene softer or to engineer more robust defenses. (Babalis, 2018)

Waterfront design solutions for protection, accessibility and urban quality

Figure 1: Proposed design concepts along the Florence's Riverfront: flood barriers for protection and urban safety. The proposed 'Waterfront Urban Space' with temporary floating walkpaths can also guarantee accessibility, rest, socialisation and urban quality.

There are many design solutions for waterfront urban space management. These solutions were developed as responses to specific needs in accordance with the specific planning strategies and site characteristics. Appropriate selection of solutions is important for the success of waterfront design.

In the context of the 'Water Sensitive Urban Design'[2] it is important to follow an integrative planning conception such as

an interdisciplinary co-operation of urban planning, urban design, landscape architecture and water management.[3]

Specifically, the following design principles should be taken into consideration such as: *Water Sensitivity* (to bring urban water management closer to the natural water cycle); *Aesthetic benefit* (adaptable to the design of the surrounding area); *Functionality* (appropriate design and adaptability); *Usability* (usable for recreation and nature conservation); *Public perception and acceptance* (involvement of stakeholders in planning process)[4].

To mitigate flood risks or water rise while creating preserving urban heritage and quality innovative ways for protection, accessibility and urban regeneration should be identified. To reduce climate change risks, in fact, some design solutions have to be taken into consideration.

The following is a description of some essential solutions for sustainable Waterfront Urban Space management[5]:

— Waterfront walls to protect from storm and flood and provide a high-quality waterfront space. Proposed projects including promenades and shelters can have a better impact on bluespace sites. Consequently, improved waterfront spaces can increase sociability and urbanity. Further, the use of relevant waterfront walls and stairs can be considered as a protective buffer zone of a soft system protection.

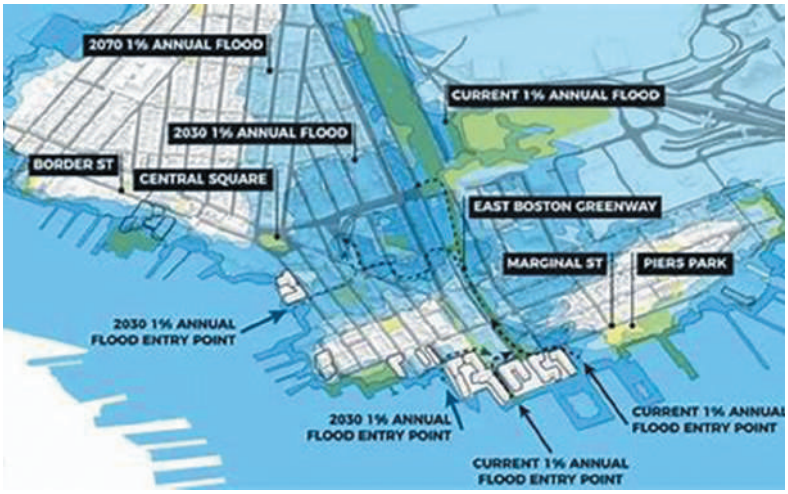
— Temporary floating structures to be used as walkways, gathered places and so on. A basic element of these platforms consists of floating polyethylene cubes of a range of dimensions. Thanks to their easy and speed of assembly and disassembly, allows the realization of structures of all shapes and sizes, suitable for a variety of uses.

— Removable seating steps for rest and protection made of wood and steel constructed as a soft protection that can be easily dismantled in a few hours in case of flood and guarantee a high performance in terms of both environmental impact and safety.

— Flood barriers, parapets and retaining walls to provide permanent protection. Parapets and retaining walls can erect along waterfronts to guarantee the necessary protection of a historic environment in case of flood or rises of water. To this end, the design choice is crucial for the protection and therefore necessary for a complex and permanent intervention. However, the use of parapets can be considered as a robust protection, especially in case of a critical hydraulic risk, needed for the safety of a valuable historical environment.

— Environmental and ecological engineering to provide

Figure 2: The “2016 Climate Ready Boston Plan” - East Boston showing existing pathways at high risk of coastal flooding. Proposed elevated pathways and park system for both flood protection and sociability. source: ©www. boston. gov.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PIERS PARK
2030 1% ANNUAL FLOOD ENTRY POINT
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CURRENT 1% ANNUAL FLOOD ENTRY POINT
CURRENT 1% ANNUAL FLOOD ENTRY POINT

CONFLUENCE DISTRICT
IDE DISTRICT
: DISTRICT
KET DISTRICT

Figure 3: Chicago Riverwalk Framework Plan - The Arcade District. This section proposes the establishment of four distinct districts along the “Main Branch Riverwalk” creating purposes for flood protection and urban quality.
source: ©https://www. chicago. gov

appropriate solutions for protection. In detail, for erosion problems, plants could be used to absorb excess water and drain it without leaving any damage to the soil. The techniques developed in recent years, are inspired by the formation of vegetation (herbaceous and/or woody), naturally present on the banks and able to withstand large external power-driven actions.

— The defense realized through naturalistic engineering, therefore, allows responding to the various needs for protection and control of riverbanks and safeguarding local ecosystems.

— Urban design smart solutions such as: (a) smart seats with information panels, solar panels that produces electricity and plugs for charging notebooks and smartphones; (b) smart street-lights with solar panels and high energy saving LED lamps; (c) smart gym-fitness facilities for health and well-being. (Babalis, 2019).

Case Studies

Waterfront visions and design guidelines have been developed and applied in many cities in Europe and all around the world to promote sensitive waterfront transformation while loading spaces to support waterfront lifestyle and landscaping sites to attract people. Specific masterplans to respond to climate change also include conceptual designs for good living and working waterfront places. The following is a selection of case studies to demonstrate a successful conception and application of waterfront design for protection and urbanity. Additionally, the case studies were selected to reflect the diverse sites, scales, and scenarios to which waterfront design could be applied.

The selected case studies include large, medium and small scale of transformation such as at city, district and site level:

Coastal Resilience Solutions for East Boston and Charlestown (large scale - city level)

The '2016 Climate Ready Boston Plan' is considered as the major step in integrating climate change into all aspects of city planning while reviewing and regulating the updated 'Boston's Climate Action Plan' that set 'The 2016 Climate Ready Boston Report'[6] included:

— Updated projections of climate change in Boston.

— More detailed vulnerability assessment of specific areas.

— Principles, strategies for major climate change awareness.

The 'Plan for East Boston and Charlestown' led by the City of Boston Environment Department and the 'Boston Planning &

Development Agency' presents near-and long-term strategies to adapt to climate change and protect the context from sea level and coastal flooding while supporting goals related to open space, mobility, affordable housing, economic growth, and natural resources.

The study areas were selected at first as they have extended areas at high risks from coastal flooding and are affective by narrow and well-defined flood pathways. There are four pathways, in fact, that connect inland areas to the waterfront.

The City's strategy is mainly focused on improving infrastructures; to expand planning to include the waterfront; to integrate coastal resilience design.

The goals of the project are to:

— Improve pedestrian, bicycle connectivity.

— Create new open space and public realm.

— Provide new opportunities for appropriate development.

Further, to improve flood protection and waterfront accessibility can be implemented:

— Elevated waterfront walkway system on narrow strips of land to connect parks and transportation network.

— In-water features as recreational, educational, and seating stairs as aesthetic and protection system along the waterfront.

— Natural features such as created living shorelines, wetland terraces, sandy beaches, rocky shores, and floating wetlands can be implemented as natural buffers from storm damage and increased rainfall.

— Mobility and connectivity improvements make easier, safer and more enjoyable waterfront lifestyle.

Finally, the proposed coastal resilience open space systems for East Boston and Charlestown such parks and pathways of further elevation or deployable flood walls are also adaptable to even greater sea level rise for extra flood protection and more effectiveness.

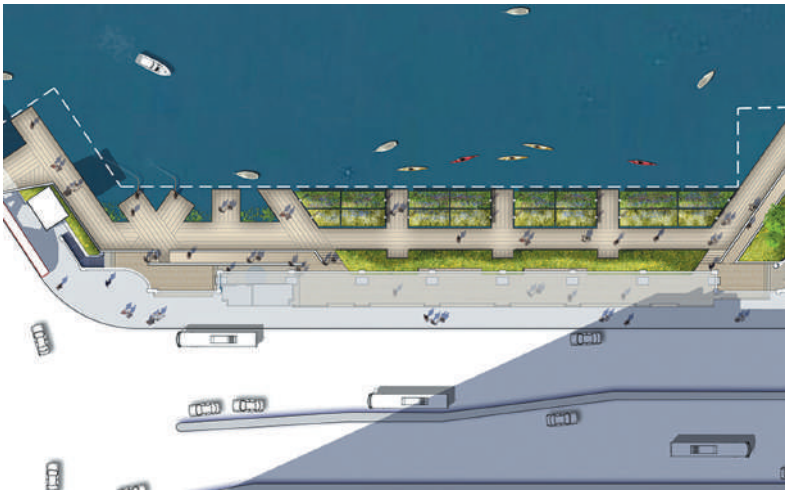
Chicago Riverwalk Development (medium scale - district level)

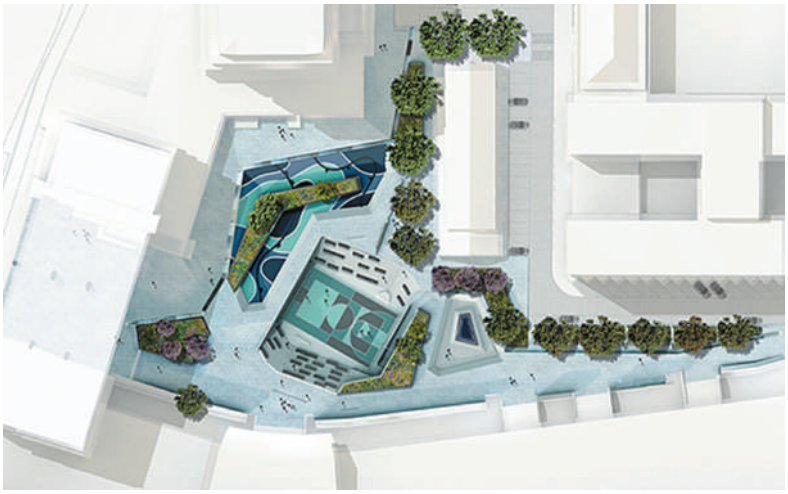
The 'Framework Plan' was prepared by the Chicago Department of Zoning and Planning in cooperation with the Chicago Department of Transportation for the Chicago Riverwalk Development[7].

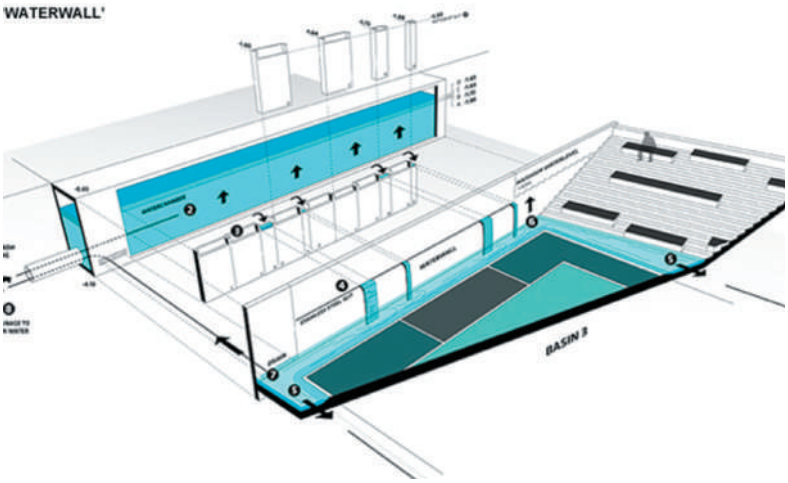
The contents of this report are organized as follows:

— Vision and Design Principles: This section articulates the Vision for the Main Branch Riverwalk and defines the set of design principles that were used to guide the development of plan recommendations.

Figure 4: Chicago Riverwalk - The Arcade District: floating pathways, retaining walls and stairs for rest and urban safety. source:© https://www. chicago. gov






WATERWALL'
BASIN 3

— Riverwalk Systems: This section establishes guidelines for the location and character of improvements that address vertical access, loading and service, boat access, pedestrian amenities and historic elements.

— District Improvements: This section proposes the establishment of four distinct districts along the "Main Branch Riverwalk". Improvement guidelines are provided for each of these districts, and conceptual designs are provided for the "Main Branch Corridor".

The 'Main Branch of the Chicago River' runs from North to South into the City of Chicago and throughout time has undergone several transformations The Chicago Riverwalk concept is created by planners and designers as an opportunity to both re-think the linear park and as an independent waterway system for protection and urbanity.

The main goals are to:

— Restore the aquatic habitat and improve water quality to reduce existing pollution levels.

— Increase cultural and recreational activities close the river with sustainable construction techniques.

— Increase livability through the redevelopment of the pre-existing docks used in the past for cargo loading and unloading and for years in a state of disuse.

Finally, the redevelopment project of the 'Main Branch Riverwalk' has been divided into three phases. The first phase affected areas from the Bridgehouse Museum Plaza to the Vietnam Veteran Memorial Plaza with the creation of different levels of transit generated by 'artificial hills' that give large and enjoyable green areas. The second phase affected the area between State Street and LaSalle Street offering pedestrian connection along the water's edge with riverfront green areas for rest and enjoyment. The third phase affected the area from LaSalle Street to Lake Street offering floating pathways and terraces to connect and protect from high water while creating diversity of the riverfront open spaces.

Water Square Benthemplein (small scale - site level)

The 'Water Square'[8] in Rotterdam was developed from the co-operation between the local authority and local people. The main aim was to create a dynamic place for young people, a space to play but also to enjoy with nature. The created urban environment combines storm water management and urban design and follows

Figure 5: Rotterdam: Water Square: stormwater management within a core urban space to reduce risks in case of heavy rain while creating a recreational place. Plan and section.
source: © De Urbanisten

a strategy based on rainwater collection and storage in order to create both urban and environmental quality. Most of the time the created 'Water Square'[9] can be dry and usable as a recreational space. The project is based on three basins to collect rainwater: two basins receive the water every time it rains, while the deepest one - corresponding to the central part of the square - receives water only in case of heavy rain.

To ensure the double use of the public space, the gutters are oversized so that they can be used by skaters. A wall of water that collects the rainwater from the surrounding areas towards the central square creates a cascading effect and gives also character and quality of an open space. The water of the two submerged basins flows into an underground infiltration device and gradually penetrates the underground natural aquifers. Therefore, the underground water balance and allows it to cope with periods of drought. This helps trees and plants to reduce the urban heat island effect.

The space of the three basins is designed also as a multifunctional space for sports, dance while the large one for rest and enjoyment. The floors of the three basins are painted in blue colors combined with the colors of the surrounding environment.

Finally, experiences show that although international standards are the basis for a sustainable waterfront design and management, successful places should be better created by setting urban strategies locally.

Discussion

Climate change should consider integrative planning policies and strategies. From the multiplier impacts of climate change and in terms of people protection, the need for integrative planning can better set the scenarios. Further, protection, accessibility, urban resilience of a 'Waterfront Urban Space ', (WUS) should be considered as a model for urban change. The use of engineering techniques can produce an easy accessibility, protection, and urban safety. In this context, it is important for local authorities to prioritize plans to manage sustainably waterfronts sites. Notably, waterfront management can be used to create places for both urban drainage and urban planning.

From urban planning point of view, sustainable waterfront systems should be attractive and efficient. During the last years various techniques for waterfront management have been developed. However, waterfront facilities have often been engineered without considering sustainability. In fact, ecological, social and aesthetic

qualities are important to create successful waterfront places. Integrative planning should be focused on waterfront urban areas of high risk for major people's protection and urban quality.

The analysis of the case studies taken into consideration demonstrates that most activity for waterfront management and design should be developed mainly at the local level addressing critical knowledge gaps around urban climate tools. Particularly, the experts and designers should explore methodologies for identifying, monitoring and prioritizing design solutions to achieve best possible urban quality.

However, the process of developing and refining local strategies clearly plays a key role in the implementation of sustainable waterfront design and water management. It appears that providing information, guidance and technological awareness is important for future projects to be initiated. For many cities, the resilient approach offers a holistic understanding of urban challenges to face climate change and increase local safety and urban quality.

Notes

1 The definition of 'Waterfront Urban Space', (WUS) is developed by the author in the framework of the research: Waterfronts and Eco-sustainable Urban Management funded by the University of Florence, Academic Year 2017-2018.

2 'Water Sensitive Urban Design', (WSUD) is the interdisciplinary cooperation of water management, urban design, and landscape planning […]. WSUD develops integrative strategies for ecological, economic, social, and cultural sustainability". See: Hoyer J., Dickhaut W., Kronawitter L., Weber B., (2011) Water Sensitive Urban Design. Principles and Inspiration for Sustainable Stormwater Management in the City of the Future.

3 See: Hoyer J., Dickhaut W., Kronawitter L., Weber B., (2011) Water Sensitive Urban Design. Principles and Inspiration for Sustainable Stormwater Management in the City of the Future - Manual, p.14.

4 Ibidem note 3, pp. 28-29.

5 "Waterfront design for protection, accessibility and urban security" with design solutions has been studied by the author in the framework of the research Transformation of Cultural Heritage and Climate Change, funded by the University of Florence. Academic Year 2018-2019.

6 City of Boston, (2017) Coastal Resilience Solutions for East Boston and Charlestown. Final Report, Boston, pdf available at: www.boston.gov (accessed: 13/09/2019).

7 Chicago Riverwalk Main Branch Framework Plan, ©Skidmore, Owings & Merrill LLP. July 2009, pdf available at: https://www.chicago.gov/city/en/depts/dcd/supp_info/chicago_river_mainbranchframeworkplan.html, (accessed: 15/09/2019).

8 See: © De Urbanisten Report, pdf available at: http://www.urbanisten.nl/wp/?portfolio=waterplein-benthemplein

9 "The typology of the water square was created in 2005 for the International Architecture Biennale Rotterdam (IABR) "The Flood". The water square became official policy on an urban scale in the 'Rotterdam Waterplan 2' in 2007. In 2010 "De Urbanisten and the Wondrous Water square" was published by 010, Rotterdam. In 2011 the preliminary design for the Benthemsquare has been made. In December 2013 the water square has been officially opened". © De Urbanisten Report. Ibidem note 8.

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2. Dimitra Babalis, "Innovative ways for more protection of historic waterfronts" in Proceedings of the International Conference on Changing Cities IV. Spatial, Design, Landscape & Socio-Economic ed. Aspa Gospodini, (Volos: Lab of Urban Morphology and Design, 2019) p. 483-485.

3. Dimitra Babalis, Tim G. Townshend, "Changing attitudes for sensitive urban waterfronts" in Dimitra Babalis, Tim G.Townshend eds. Urban waterfronts and Cultural Change. New perspectives and opportunities (Florence: Altralinea Edizioni), 9-11.

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The three sites located along the waterfront of the Metropolitan Area of Lisbon face different challenges and raise complementary questions regarding the communities, local infrastructures and the local ecology. The point of departure among the involved stakeholders and authors in this book shared that the impacts of humans on the planet are becoming increasingly evident both in the form of extreme weather events which causes natural disasters, and in terms of climate change manifestations such as sea level rise. Human settlements located in low lying coastal areas or near streams, rivers, or the seacoast likely have a higher risk of damage from sea level rise or flooding. [1]

The illustration of the hypothesis presented for each location in developing solutions and strategies to face climate change is innovative. Researchers from several European countries have analysed geographic and historic records, data collected in the last 100 years and processed large quantities of information on climate, pollution, energy consumption, transformation of the built environment and consumption behaviours. Further they have discussed with local representatives before imagining future scenarios for adapting and mitigating risks for each site.

To face the climatic crisis there is no single solution, the solution arises from a multiplicity of factors and their correct relation. In summary, there are several main complementary ingredients to be considered: nature regeneration in the urban environment, resilience to extreme climate variations, renewable energy production, rainwater collection for reuse, reduction of CO2 emissions from people's transport, building energy consumption and construction materials. In each site, there are a number of measures to be incorporated. The work carried out includes an interdisciplinary research [2] between experts, researchers, professional doctoral students, and the involvement of local institutions that will inevitably have an impact on future decisions.

The data collected for Cascais, Mafra and Alcochete show changes in the patterns of humidity and temperature, sea-level rise and other climatic indicators [3], thus putting at risk the stability of the ecologic balance in each region. The design proposals present hypothesis that integrate constrains and launch solutions for these problems.

Cascais - public space on the seafront – includes a channelized river that is turned into an urban hydrological artefact that prevents floods and accommodates sea level rise currently in progress in the Atlantic Ocean. The exposure of an open air-river should turn into an opportunity to expand and enhance public space for the local community and create a continuous public space, from the seawall towards inland.

Mafra - World Reserve for Waves and Surf – the classification of waves as a common good [4] brought an environmental, economic and social dynamics related to water sports, surfing, kite surfing, windsurfing, ecology and education, etc. The classification of waves that change daily and last only a few seconds is an innovative strategy in the context of waterfront areas. As the group of experts seek to promote the excellency in research and innovation to develop instruments to face climate, the strategy used here holds great value in lessons to be learned regarding future strategies.

Alcochete - Samouco Saltpans and the human made coastline – presents a design that grows with the expected transformations brought by the new super-infrastructures of airport and mass tourism. The design solution presents an efficient strategy to deal with the expected turbulences and enhance the stable balance between the natural and the built environment along the waterfront.

All this was made possible by the continuous commitment of participants and technical personnel dealing with the territory (architects, city planners, graduate students, researchers, landscape designers, etc.) who investigate the transformation of the built environment to find new strategies to enhance its resilience. Although it contains good intentions, the action of transformation holds in its essence a control over nature. An ecological vision, on the contrary promotes the integration of systems: not the control, but the relation, the participation in the ecosystem, to establish bridges between the various components and to contribute to the balance of the whole.

To deal with the complexity of the ecological crisis and its multiple causes, there is a growing recognition that the stakeholders cannot come from a single way of interpreting and transforming reality. It is necessary to address the diversity of cultural conditions, learn the art and poetry, the inner life and spirituality of each community. To build an ecology that will allow the reparation of all that has been destroyed, no branch of science and no form of wisdom can be neglected.

Hope in technical solutions, merely technical, risk to take into consideration symptoms that do not correspond to the most profound problems. It is necessary to interpret the behaviours of people and each culture; understanding the development of a social group supposes a historical process, within a cultural context, that constantly requires the role of local social authors, from their own perspective. All research that was carried out has been to "cultivate curiosity without being obsessed by utility or profit. In fact, the fundamental discoveries that have revolutionized the history of humankind are the result, mostly, of research far removed from any utilitarian objective." [5]

In general, apart from some visible signs of pollution and degradation, it seems that things are not that serious, and that the planet could survive for a long time under current conditions. The expansion of the consumerism society to larger numbers of the world population leads ecosystems to unprecedented levels of stress and destruction. Such evidence is so hard to face that a large number of humans develop a sense of denial and promote a behaviour that maintains the current lifestyles, production and consumption. It is the way human beings organize themselves to feed all self-destructive addictions: trying not to see them, struggling not to recognize them, postponing important decisions, acting as if nothing had happened.[6]

A central aspect of consumerism society is the continuous growth of consumption. The inner discovery of what is enough initiates a critical attitude towards the expansion of consumption. To learn what is enough lead the individual to enhance a sustainable life. The consciousness of the extractive impact of the consumed goods is complementary to the aim for health and positive behaviours. It necessarily leads to continuously consider life of the next generations [7].

Human ecology is also something deeper than indispensable in order to further create the necessary relationship between human life and the law inscribed in nature itself.

Several experts agree on the need to prioritize transport. But it is difficult for some measures deemed necessary to be peacefully taken by society without a substantial improvement in transport, which in the listed sites entails unworthy treatment of people due to the discomfort of the low frequency of services and insecurity. In the projects presented here, the importance

of these points of view always contributes to the analysis of the built environment.

The projects and solutions presented in this book were not driven by the pursuit of beauty. This has been considered to not be enough, because it has to serve another kind of beauty: the quality of life of people, their harmony with the environment, the engagement of natural systems, the promotion of local ecologies and mutual help between nature and human presence.

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