February 2021

Thematic Dossier

Climate Change Adaptation

agenda 2030
by aivp

For 30 years, AIVP has been accompanying port cities to guide them towards a more resilient, more concerted and more sustainable future.

In 2018, AIVP launched the AIVP 2030 Agenda, the 1st global initiative that adapts the 17 UN Sustainable Development Goals (SDGs) to the specific context of City-Port relations. This document, drawn up jointly with AIVP members at the Quebec Conference, sets 10 objectives for 2030.

In February 2020, AIVP signed an MoU with UN-Habitat to disseminate good practices related to this agenda.

Since September 2020, responding to the interest of our members, we focus in-depth on one Agenda goal per month.

In this fifth dossier we focus on "Climate Change Adaptation". We wish you a fruitful reading!

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What is the AIVP 2030 Agenda?

The Agenda is designed to guide the actions and projects of port city stakeholders to ensure sustainable relations between the city and port. Port cities frequently find themselves in the front line when it comes to the most serious consequences of climate change (submersion, flooding, hurricanes, etc.), but they are also best placed to test innovative solutions in the following ten areas:

1. Adapting To Climate Change

2. Energy Transition And Circular Economy

3. Sustainable Mobility

4. Renewed Governance

5. Investing In The Human Capital Of Port Cities

6. Port Culture And Identity

7. Quality Food For All

8. City Port Interface

9. Health And Quality Of Life

10. Protecting Biodiversity

Discover the **AIVP Agenda 2030**

What is the "Climate Change Adaptation" goal in the AIVP 2030 Agenda?

Anticipating the consequences of climate change for river or maritime city ports:

1. Including joint City Port measures to prevent inundation and flooding of the port and connecting infrastructure in strategic planning documents, and through a suitable land management policy.
2. Promoting the renaturalisation of river banks and coastline to slow erosion and the impacts of extreme storm events.
3. Introducing an early warning system to reduce the human and economic consequences of exceptional climatic phenomena.
4. Considering other climatic changes, such as the consequences of drought and high temperatures, on port systems, supply chains, and labor.
5. Making resilience and carbon neutrality a priority in the design and operation of City Port installations with the use of the latest technologies in emissions reduction and CO2 capture/storage.

More details on **this goal**

Cities and ports working together to mitigate and adapt to climate change

AIVP Team

Tagus estuary, in Lisbon, Portugal. Photo by Bernardo Ferreira (BernardoUPloud), in Pixabay

Recent research published by international organizations linked to the UN, such as the IPCC, indicates that sea levels could rise by 61 to 110 cm by the year 2100, compared to 1990. This means that coastal areas, where there is also greater demographic pressure, will be even more vulnerable to extreme weather events, such as flooding. This phenomenon can have devastating consequences for port cities, where, in addition to large concentrations of population and wealth, essential functions for the functioning of the global economy are hosted. For this reason, adaptation to climate change is the number one objective of the AIVP Agenda 2030 for cities and ports.

Preparing Ports and Port Cities for Climate Change: Mitigation and Adaptation

To respond to this challenge, as Prof. Austin Becker points out in his article, a dual strategy needs to be developed. On the one hand, efforts must be intensified to reduce or eliminate polluting emissions that contribute to global warming, and on the other, clear measures must be taken to adapt coastal territories to these new conditions that will intensify in the coming decades. Innovative cases such as San Diego, eThekwini, Dunkirk, Le Havre, Trois Riviere or Rotterdam, are leading these efforts to adapt and mitigate climate change, as we will see in this dossier.

Building with nature: solutions for adapting to climate change in the City Port areas

To protect coastal territories is also possible to find alternative solutions, that can be Nature-based. In his article, Mr. Erik van Eekelen, explains that Building with Nature is a conceptual approach to creating, implementing, and upscaling Nature-based Solutions for water-related infrastructure. However, as he says, this will require a complete change in thinking, acting, and interacting.

Marconi waterfront development, Gemeente Delfzijl, The Netherlands. EcoShape

San Diego: able to face extreme climate disasters before 2035

The nature-based solutions are being also used in San Diego. In the U.S. port, pilot projects are being developed that combine shoreline protection with local biodiversity enhancement in new reefs. In the interview with Mr. Michael Zucchet, we can see how this port city will be more resilient against the sea level rise and extreme weather events in the long term.

eThekwini (South Africa): a unique approach to natural hazard prevention

The efforts to adapt coastal territories to the sea level rise must be complemented by early warning systems that enable the population and businesses to prepare for the impact of a storm, based on innovative data systems that improve forecasting and facilitate the management of these events, as is the case in eThekwini (Durban) in South Africa, explained in the interview with Dr Andrew Mather.

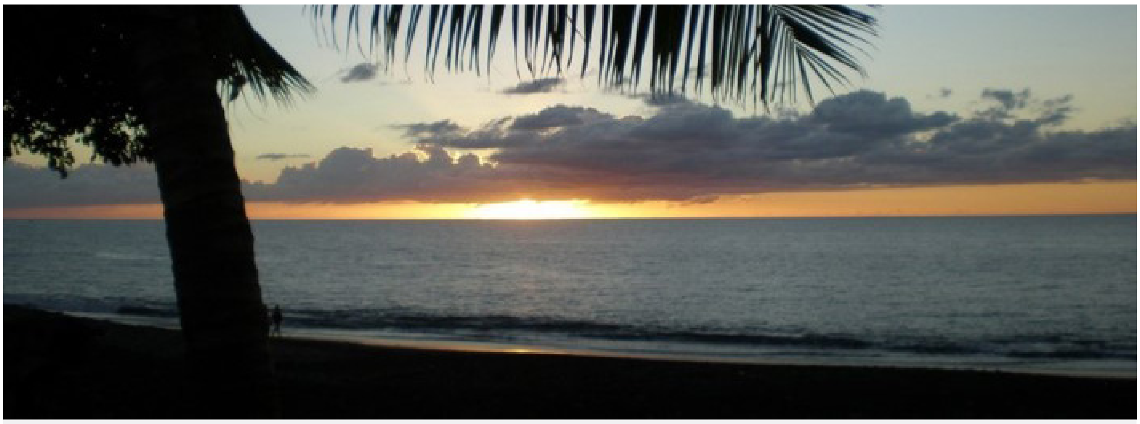
Durban waterfront. (© wikipedia commons)

Flood Risk Management in the port of Rotterdam

In Rotterdam, the port authority has been developing for years a strategy to ensure that its territory is resilient against flooding and sea level rise. This strategy combines large-scale engineering projects such as the Maeslant barrier, or the construction of raised port areas 3 to 6 meters above sea level, with awareness programs with port companies on the threats posed by climate change and flood risk management. As Mr. Marc Eisma, explains, this strategy is being developed in collaboration with the city council and other institutions on a regional scale, including specific agreements. These agreements allow for greater institutional cooperation to assess risks and define new measures, analyzing the different areas of the port of Rotterdam, which, let us not forget, is a territory extending over 40 km.

The islands of the South-West Indian Ocean faced with rising sea level

The effects of sea level rise will be even more extreme and devastating in areas such as the islands of the southwestern Indian Ocean, which will be partially submerged, including several port areas. The urgency to act is evident, there is more than enough scientific evidence, as explained in the article by Mr. Jean-Marc Beynet. We have seen several ways to act, but we must not forget that simultaneously, it is necessary to invest in other initiatives that contribute to mitigate climate change and its devastating consequences, betting on the energy transition to sustainable fuels.



Réunion island, west coast (© JM. Beynet)

How to adapt port cities to climate change. Challenges and solutions.

In the webinar dedicated to climate change adaptation, prepared with the support of Cerema, that was hosted in February, speakers from Dunkerque and Le Havre Seine Métropole from France, and Trois-Rivières, in Canada, we learnt about the latest research on this topic and what projects they are developing to increase their resilience.

Preparing Ports and Port Cities for Climate Change: Mitigation and Adaptation

Austin H. Becker

Dr. Austin Becker. Associate Professor and Director of Graduate Programs in the Department of Marine Affairs at the University of Rhode Island.

Ports city territories are at the front-line of climate change adaptation. In this article, Prof. Austin Becker briefly presents the challenges and how combining different approaches will be necessary to increase the resiliency of these coastal regions.

Climate change may be the greatest environmental challenge that global society has ever faced. The AIVP has joined the UN's Sustainable Development Goals to commit to being a part of the solution. The first of AIVP's 10 commitments is "adaptation to climate change." Ports and cities can and must work together to anticipate the consequences of climate change on maritime and river port cities. Coastal communities around the world are up against a confluence of threats from sea level rise, intensifying storm events, and extreme precipitation, not to mention myriad other climate related issues. Overcoming the challenge requires a two-pronged approach: On the one hand, we must do all we can to reduce (or even reverse) global emissions so as to slow or stop the warming trend; on the other hand we must take proactive and aggressive measures to adapt to the new conditions that science suggests will be upon us in the coming decades. As a critical member of global society, maritime transportation and ports must be on the front lines of both prongs of the approach. But, ports and shipping cannot do it alone: They must partner with their host communities and other stakeholders to advance solutions.

From the local to the global scale, society depends on maritime transport to enable life as we know it. More than 3,000 ports around the world serve as transfer points for energy products (coal, oil, and gas), manufactured goods, and raw materials. These include massive container ports (e.g., Rotterdam), to small niche ports that serve one type of freight (e.g., petroleum, coal, grain, or fishing). Ships move raw materials and finished products around the world's waterways, bringing jobs and improvements to quality of life. Without maritime commerce, the global economy would grind to a halt. Cities, in fact, have grown and thrived thanks to the ports they host, with other infrastructure developing outward from the seaport and advantaging the city in myriad ways. Ports, and their cities, enjoy economic advantages from their locations, but these estuarine areas also tend to be of critical from an ecological perspective. An "estuary," defined as the part of a river's mouth where the river current meets the tide, provides highly-productive for much of the world's marine life. It is thus in the interest of self-preservation, as well as the greater good, that ports and their host communities must direct resources toward understanding and strategizing for these new environmental realities.

Tagus estuary, in Lisbon, Portugal. Photo by Bernardo Ferreira (BernardoUPloud), in Pixabay

As major participants in the carbon economy, ports must prioritize new technologies and forward-thinking policies that lead to a reduction in emissions, as it is also indicated in the second goal of the AIVP Agenda regarding the energy transition. A global fleet of more than 50,000 commercial vessels already produces less GHG emissions per unit shipped than land or air modes. However, emissions from maritime industries contribute significantly to global warming, with shipping responsible for 1.5 – 3% of total global CO2 emissions. To address this, ports and shipper have initiated programs to curb their impact on global warming. The World Ports Climate Initiative assists ports through showcasing projects that reduce greenhouse gas emissions and improve air quality. For example, the WPCI created a new Environmental Ship Index scheme. The ESI creates an incentive for shipping companies to reduce the impacts of their vessels and earn the right to claim a high standard for environmental responsibility and to fly a "clean ship" flag. Terminal operations, too, emit pollutants and new regulations are requiring ports to upgrade their equipment. "Cold ironing," for example, allows ships to utilize shore power rather than relying on their own shipboard power plants, resulting in lower port emissions and opportunities to utilize cleaner energy from the local power utility.

In addition, ports must consider their business goals, their host communities, and the function they play in global trade and take steps to enhance their own resilience. Rising sea levels will chronically inundate some low-lying ports during regular tidal cycles and higher storm surge levels will cause more episodic extreme events. For some ports, sea level rise also will reduce air draft, or under-bridge clearances, and cause other problems for the interdependent infrastructure, like rail, pipelines, and bridges. Ports in developing nations will have different options and challenges than those in developed nations. Ports located in estuaries that provide nursery environments for marine life have an even greater responsibility to protect coastal waters. Elevating, diking, or moving entire ports are some of the more drastic measures that will need to be considered. Some ports and their host cities have already begun to take action to increase their resilience, but such actions require significant investment. For some ports, such as Rotterdam, becoming flood resistant means constructing flood defenses such as barriers and storm gates. But there are also opportunities to "build with nature" that allow for shifting marshes and coastlines. Eventually, we also see cases that are combining both approaches, as San Diego.

North bay looking south. (©Port of San Diego)

As global population increases, especially in cities and coastal areas, and as nations strive to improve their citizens' quality of life, international shipping likewise expand. Current forecasts project a doubling of cargo movement by 2040. The complexity of both adaptation and mitigation require the scientific community, policy makers, and the port authorities to work with other stakeholders to find financially sustainable solutions that also consider environmental and social concerns. To become more resilient to the impacts of climate change and to play a role in mitigating the acceleration of climate change, port decision makers will need to implement new strategies that range from policies (i.e., changing building codes), to design (i.e., creating new protective structures), to practices (i.e., emergency drills or alert systems).

Building with nature: solutions for adapting to climate change in the City Port areas

Erik van Eekelen

Erik van Eekelen. Program Manager at Ecoshape, Lead Environmental Engineer at Van Oord and Editor of the book "Building with Nature: Creating, implementing and upscaling Nature-based Solutions".

Adaptation to climate change is the first objective of AIVP's Agenda 2030. It is one of the main concerns of coastal territories and port cities. As such, AIVP shares ideas that can inspire the various stakeholders to increase the resilience of the territories. In this article, Erik van Eekelen, sets out the six Enablers identified by EcoShape to "build with nature" in aquatic landscapes.

On the 25th of January, the Climate Adaptation Summit gathered several world leaders into a digital event, to put climate adaptation in the spotlight. Untill now, the Paris Agreement and many other world-wide initiatives on dealing with climate change have focused primarily on mitigation by limiting our greenhouse gas emissions towards zero by 2050. However, at the start of this decade, we can no longer close the eyes to the impacts that climate change is having already and will continue to have, even if we reach the most ambitious goals of the Paris Agreement. Rising sea levels, increased precipitation, droughts and heatwaves will disrupt the current status quo and impact our cities, landscapes, and ports. At the same time, we see a global decline in biodiversity. Ecosystems we depend upon are under an increased amount of stress. The majority of world leaders agree that we should act now: António Guterres (UN secretary-general), Ban

Ki-moon (co-chair of the Global Commission on Adaptation), Boris Johnson, Emmanuel Macron, Angela Merkel, and John Kerry (Special Presidential Envoy for Climate of the United States of America) included that in their statements.

But what kind of action do we need? At the Climate Adaptation Summit and COP25 summit there was a common understanding that Nature-based Solutions (NbS) are an invaluable part of the solution. But do we know how to realize those on a sufficient scale? And what is possible in the context of ports and cities? Following the Building with Nature (BwN) approach, EcoShape aims to inspire and respond to these questions.

Aerial photo of the salt marsh Delfzijl Photo from Ecoshape

Building with Nature is a conceptual approach to creating, implementing, and upscaling Nature-based Solutions for water-related infrastructure. Shifting the development paradigm toward Building with Nature requires redefining what to do, which design steps to follow, and how to do so; that is, a complete change in thinking, acting, and interacting. Building with Nature is a methodology to mainstream Nature-based Solutions, since it offers guidance on implementation and design. Being build on practical experiences of initiating, designing and realizing (pilot-)projects and executing knowledge development projects, it provides practical insights, tools and hands-on approaches, along with its broader philosophy, design and implementation guidance. Successful implementation of Nature-based Solutions is only possible when a project team considers the surrounding natural and social system, and proactively harnesses the forces of nature. Early stakeholder involvement is essential to maximize the positive outcomes of a project. All Nature-based Solutions have four primary characteristics in common, namely that they are inherently dynamic, multi-functional, context-specific and innovative. To enable Building with Nature these aspects must be carefully considered throughout the development process, and EcoShape has defined six Enablers to do so:

1. Technology and system knowledge | BwN requires knowledge of specific concepts and technology to design NbS. In addition, knowledge of the local ecosystem, social system, and physical system is essential for any BwN project to work

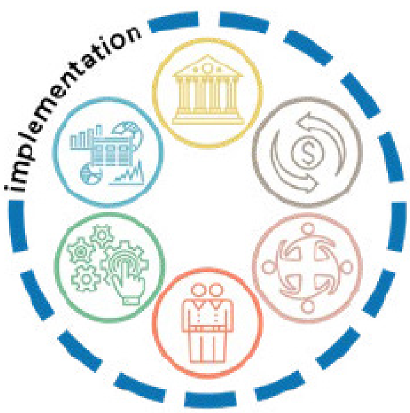
2. Multi-stakeholder approach | One single party can rarely implement BwN. Successful projects require stakeholder engagement from the start and through all the phases of design, implementation, operation, and ongoing maintenance.

3. Adaptive management, maintenance and monitoring | BwN designs are dynamic: they develop under changing climatic conditions. This requires an adaptive approach to manage, maintain, and monitor their performance long term.

4. Institutional embedding | BwN should fit into the local institutional context, following its norms and regulations. Further policies and processes can be developed to support the co-creation, partnerships, and funding schemes necessary for BwN implementation.

5. Business case | A sound and convincing business case can effectively generate support and financing for BwN applications. A key challenge is quantifying the wide range of savings and co-benefits of BwN, due to the 'soft' advantages and performance uncertainty of natural dynamics.

6. Capacity building | Capacity-building among policymakers, industry managers, and the local community is essential. It takes place through education, training, and knowledge sharing. People familiar with the BwN philosophy are more likely to support and participate in its applications, which is a benefit to scaling up and especially critical for the maintenance of NbS.



Six Enablers defined by EcoShape

Ports and cities are anthropogenic, designed landscapes. Humans have interfered with the natural systems, since they started to navigate and trade to maximize benefits for their societies. Mono-functional infrastructure such as breakwaters, quays, roads and stormwater infrastructure have altered the water-land transition creating a border between the built environment and its natural surroundings. Climate change urges the re-development of these interfaces to increase their resilience and adaptivity. Building with Nature offers the opportunity to maximize benefits for society and for the surrounding natural system. This restores the connectivity with and within the ecosystem, sustains economic functions of cities and ports and increases flood safety. Due to relatively dense living, high land value, and large economic activity, there is both a need and an appreciation for these various benefits of nature-based solutions. The approach in cities and ports should focus on the sediment and water balance within the built environment, navigation channels and port basins, the creation of more natural water-land transitions and the potential to connect to and strengthen ecosystems nearby.

A good example is the Marconi waterfront development, in The Netherlands. Several BwN-principles were applied in the same project: 16 ha. of pioneer salt marsh and 13 ha. of recreational salt marshes with walkways and bird observation points were created. The city beach was enlarged and coupled to a multifunctional boulevard. The project contributed to flood risk reduction, enhanced salt marsh habitats, added recreational value, and helped to reconnect the city of Delfzijl with the sea. Integrating the various natural features gained broad support among multiple stakeholders. In all, the development made perfect use of the local context and the ambition to restore Delfzijl's sea-focused identity, which had been diminished over the past century due to widespread industrialization and incremental dike strengthening works.

Marconi waterfront development, Gemeente Delfzijl, The Netherlands. EcoShape

The case of Marconi waterfront demonstrates the potential of NbS in coastal territories. More innovative projects for climate change adaptation applying these principles can be found in the new book "Building with Nature: Creating, implementing and upscaling Nature-based Solutions", published by EcoShape and nai010. From rivers and estuaries, to lowland lakes and port cities, each project provided lessons to be learnt and inspire local actors worldwide.

The book is available here.

Book edited by Erik van Eekelen and Matthijs Bouw: "Building with Nature: Creating, implementing and upscaling Natur-based Solutions".

San Diego: able to face extreme climate disasters before 2035

Interview by Théo Fortin

Michael Zucchet, 2021 Chairman of the Port of San Diego Board of Port Commissioners.

As the pandemic is still raging in the United States, another crisis is underlying, more silent but even more dangerous: climate change. Its formidable consequences have already impacted parts of the United States during the past years, such as California which has faced terrible giga-fires in 2018 and 2020. Californian port cities have taken up this challenge, and among them San Diego is often highlighted for its impressive efforts on climate change adaptation. A carbon neutral and resilient port-city: this is the ambition Port of San Diego's executive board has been putting forward for many years on now. San Diego is the fourth largest port in California after LA-LB and the third for cruise traffic. Environmental preservation is a key-role Port of San Diego plays carefully. In line with Goal n°1 of our AIVP Agenda 2030, we wanted to discuss about the sustainability and the resiliency of the waterfront with **Michael Zucchet, 2021 Chairman of the Port of San Diego Board of Port Commissioners.**

Port of San Diego is a member of AIVP since 2015.

Solutions to reduce Co2 emissions

AIVP | *You have made clear that one of your top commitments is the reduction of San Diego's carbon impact and cleaner air. Your port authority wants to incentivize as much as possible the use of renewable energies and alternative fuels, to meet the goals of your Climate Action Plan and "Maritime Clean Air Strategy". Technical measures such as microgrid or battery storage are also key to optimize energy consumption.*

Could you tell us more about your solutions to reduce air pollution and carbon/greenhouse gas emissions?

Michael Zucchet, 2021 Chairman of the Port of San Diego Board of Port Commissioners | Our jurisdiction encompasses 34 miles of waterfront around San Diego Bay and borders five cities, so it is vital that we are a good neighbor and that we champion investment in and deployment of new clean air technologies to reduce maritime emissions and improve overall air quality. It's important not only in respect to climate change, but also to ensure that everyone who lives, works and plays on and around San Diego Bay has cleaner air to breathe.

North bay looking south. (©Port of San Diego)

To be a cleaner and greener port, we must set clear goals, aspirations and expectations for ourselves and for the people who do and want to do business with the Port of San Diego. And we need to plan strategically rather than on a project-by-project basis to set ourselves up for success.

To help us set goals and prioritize projects to further reduce maritime-related emissions and improve air quality, we are working with our stakeholders, partners and neighboring communities to develop a Maritime Clean Air Strategy, or MCAS. It will help us to determine which of our efforts are economically feasible – like developing a short-haul, multi-phased on-road electric drayage truck program for one or more routes to/from our terminal, or replacing higher-emitting cargo handling equipment with zero and near-zero cargo handling equipment. It will also help to clarify the role we can play in supporting our tenants and terminal operations with transitioning to zero and near-zero technologies. The MCAS will be an extension of our Climate Action Plan, which establishes greenhouse gas emissions reduction goals. We adopted the plan in 2013 and were among the first ports in the U.S. to put a Climate Action Plan in place. We've been successful so far, achieving our 2020 10-percent reduction target by 2016 with an 18 percent decrease in emissions from 2006 levels. We're now working to update our Climate Action Plan to ensure goal alignment with post-2020 targets set by the State of California.

The State of California has a goal of carbon neutrality by 2045. Because climate change is a significant threat to our region's prosperity, we are contributing to regional efforts to advance carbon neutrality in our region even earlier. San Diego County is developing a framework for a Regional Carbon Sustainability plan in partnership with the University of California San Diego. The framework will include strategies and initiatives to achieve carbon neutrality in the region by 2035. We are contributing by providing information on sources of emissions that are unique to ports such as goods movement vessels, vehicles and equipment. This kind of regional collaboration is essential to advance interconnected strategies and to achieve results.

You mentioned our microgrid, which will provide backup power to port-operated facilities on one of our cargo terminals, including security infrastructure, lights, offices, and the jet fuel storage system in support of the San Diego Airport's operations. We believe our microgrid will demonstrate a replicable model that can be used by other terminals and facilities in California.

We're also working on smart roadway improvements along Harbor Drive, the road that runs between our cargo terminals – intelligent transportation systems to reduce truck-related congestion, noise and pollution; improve electric vehicle charging infrastructure; and increase urban greening. This "haul road" will use technology like Freight Signal Priority, dedicated truck lanes and off-peak truck lanes to allow cargo hauling trucks to "jump the queue" and bypass other vehicles. This will help to reduce idling, separate trucks from other vehicle traffic, and keep trucks on the designated truck route outside the portside neighborhoods.

Harbor Drive 2.0 Rendering (©Port of San Diego)

These and other initiatives will help us be more sustainable while growing our businesses. In fact, we've shown that economic development and sustainability are not mutually exclusive – our 2017 Economic Impact Report showed our greenhouse gas emissions decreased 13 percent since 2006 while revenues increased 29 percent over the same time.

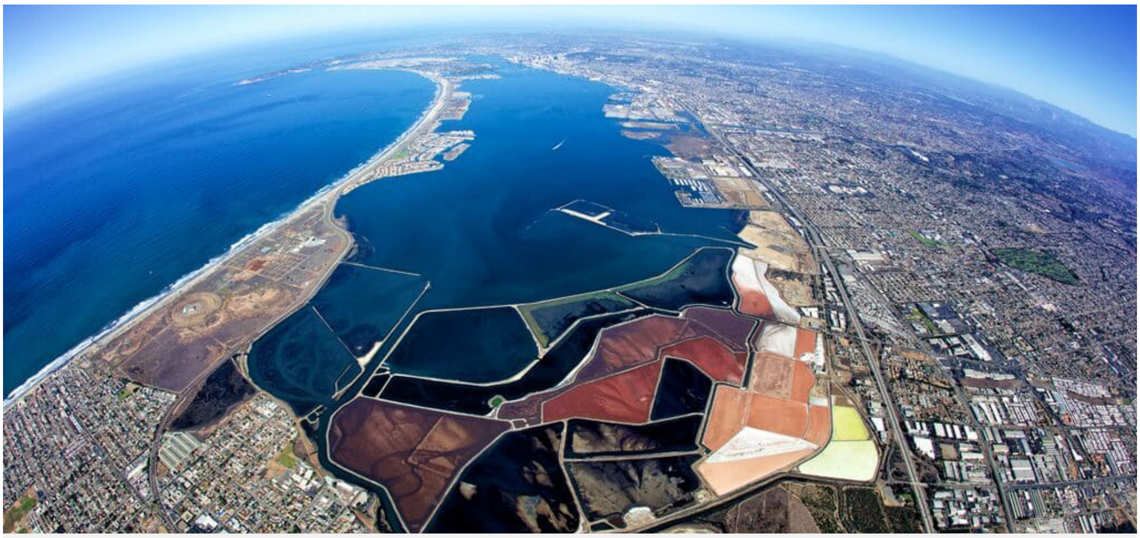
A master plan for coastal preservation

AIVP | *Coastal preservation and rehabilitation are essential to make the coastline resilient to the rise of the sea level. In our weekly newsletter we have highlight the innovative idea of creating an "Oyster Living Shoreline". Both land-based and water-based measures are included in your "port master plan".*

How would you describe this master plan for "future of the port" and how does it relate with coastal resiliency?

Michael Zucchet, 2021 Chairman of the Port of San Diego Board of Port Commissioners | Our Port Master Plan is essentially our water and land use law that designates specific areas of San Diego Bay and the surrounding waterfront for a balance of maritime, fishing, visitor-serving commercial, recreational, conservation and institutional uses. Our existing plan was certified in 1981 and has never had a comprehensive update. Obviously, a lot has changed in the last 40 years – our region has grown tremendously and protecting our coastal assets and resources is more important than ever. So, the Board of Port Commissioners launched an effort to update the plan in 2013 to plan for the future of the Port. The intent is that it will serve as the primary tool for balancing environmental, economic and community interests along the San Diego Bay waterfront for the next 30 years.

Important to our administration of the Tidelands of San Diego Bay is to ensure that we protect it for future generations. The impacts from climate change, particularly from sea level rise, represents a threat to the Port and our many uses—whether that is maritime and visitor-serving commerce, natural resources, recreational assets, and public safety. Resiliency in the face of sea level rise and flooding is very important to us. We believe there is not a one-size-fits-all solution to sea level rise. In some areas of the bay we will need to reinforce coastal armoring, but in other areas we feel that nature-based solutions will work.



Southern end of San Diego Bay. (©Port of San Diego)

The latest draft of the updated Port Master Plan includes various policies and strategies such as encouraging the use of nature-based solutions that increase shoreline biodiversity and coastal resiliency. Additionally, a recent amendment to the Port Master Plan supports deployment of a new living shoreline project in the southern end of our bay. This project, which was recently approved by the California Coastal Commission, will allow the Port, in partnership with the California State Coastal Conservancy, to pilot a native oyster living shoreline adjacent to the Chula Vista Wildlife Refuge in south San Diego Bay. The objectives of the living shoreline, the first of its kind in San Diego Bay, are to both increase biodiversity and protect the shoreline from impacts related to future sea level rise. Constructed with reef elements to attract and establish native oyster populations, the living shoreline will create a "reef" habitat for fish, birds, inverts, and aquatic plants, while also addressing climate change and sea level rise threats by naturally increasing wave attenuation in critical nearshore habitat, providing both shoreline stabilization and increasing sediment deposition and accretion on mudflat habitat vital to future upslope habitat transgression under sea level rise.

Early detection for storms and floods

AIVP | *Unfortunately, climate change adaptation cannot only rely on anticipation, because storms are already becoming worse and more frequent than before! We have heard about this partnership with FREDsense Technologies on stormwater monitoring. We will definitely need initiatives like that!*

What initiatives may Port of San Diego have launched on the resistance to extreme climate disasters, especially storms?

Michael Zucchet, 2021 Chairman of the Port of San Diego Board of Port Commissioners | The impacts of climate change, including sea level rise, will affect the world around us in tangible ways, and we need to plan for that and be a part of the solution. We've already experienced record-breaking tides caused by a combination of winter storms and King Tide events, which has caused shoreline erosion and some damage to infrastructure. In fact, the highest high tide ever recorded in San Diego Bay was just a few years ago in 2015.

To evaluate, assess and guard against future potential impacts, we've completed a formal sea level rise evaluation and assessment that includes sea level rise projections and looks at how our assets – roadways, parks, properties, etc. – and our natural resources may be impacted. We're also working with regional partners like the Navy and Scripps Institution of Oceanography. The Port and the Navy are the two biggest agencies with management responsibilities on and around San Diego Bay. We are collaborating to share information, evaluate the best available scientific information and modelling related to sea level rise, identify complementary adaptation policies and measures, and make better, more cost-effective decisions about the development, conservation, restoration and management of San Diego Bay. With Scripps, we are coordinating to develop a sea level rise and flood alert observation system to precisely measure environmental data to better understand flooding impacts in the bay.

On a project level, we've increased elevation on development sites, built a foundation when replacing the fender system at our cruise ship terminal that can be expanded over time, and rebuilt a boat launch ramp – believed to be the busiest in the state – to a more appropriate elevation to accommodate future anticipated sea level rise.

Shelter Island Boat Launch. (©Port of San Diego)

You mention FREDsense, an example of an innovative pilot project supported through our Port-led Blue Economy Incubator. The incubator was indeed established to seek innovative aquaculture and blue technologies proposals to build a portfolio of new businesses that can help meet our environmental needs, such as coastal resiliency and water quality. FRED-sense is working to develop and test a portable, five-in-one field testing sensor devise to provide real-time metals analysis during stormwater monitoring.

ECOncrete Install Ground. (©Port of San Diego)

Another Blue Economy Incubator project involves bio-enhancing shoreline armoring to provide stabilization that could potentially replace traditional riprap. ECOncrete is an early-stage company developing interlocking tidepools made of biologically enhanced concrete that will create a tidal pool system to provide shoreline stabilization while simultaneously creating a well-defined local ecosystem that mimics natural rock pools as well as increase local biodiversity and biological productivity. Results from the pilot will demonstrate an innovative win-win approach to coastal development, bridging the need for coping with climate change and urbanization while sustaining valuable marine life. ECOncrete has installed other designs of its tide pools into existing waterfronts in the U.S., Europe and Asia, including at Pier 6 in Brooklyn Bridge Park in New York and in the Port of Rotterdam in the Netherlands.

ECOncrete Tide Pool. (©Port of San Diego)

Port's contribution against mega-fires in California

AIVP | *Even if they seem to have so much water at their disposal, port cities can be threatened by fires. The world has witnessed California's efforts to fight against giga-fires, which could constitute direct consequences of global warming. San Diego seems to have been less impacted than San Francisco or Los Angeles in 2020, however there are odds that someday south California will be strongly hit too.*

What are your plans to prevent these hazards from disrupting your supply chain and overall from threatening human lives.

Michael Zucchet, 2021 Chairman of the Port of San Diego Board of Port Commissioners | While California is at high risk for wildland fires due to higher temperatures, seasonal dry winds, and ecological changes, because of our waterfront location and the urban character of our jurisdiction, San Diego Bay is not at a particularly high fire risk. However, during the 2000s, San Diego County experienced two massive wildfires in 2003 and 2007, which displaced many thousands of residents and disrupted our economy.

The Port of San Diego has prepared plans, in coordination with regional partners, to assure adequate emergency response and recovery in the event of a natural or human-caused disaster. Our Emergency Operations Plan addresses our responsibility during a sizable emergency to include key decision makers, an emergency organizational structure, and activation of our Emergency Operations Center. Additionally, our Maritime Emergency Restoration Plan lays out the process to coordinate with government and commercial entities to efficiently re-open the Port following official closure or partial closure by the U.S. Coast Guard Port Captain due to an imminent or credible threat, sustained threat, or disaster.

Tenth Avenue Windmill Towers. (©Port of San Diego)

While the Port itself may not be threatened by wildfire, the thousands of employees who work along the bayfront as well as visitors who come to the bay may be impacted. Cargo, of course, that passes through our marine terminals is transported along our regional highway and railway infrastructure. These corridors can be impacted delaying the transport of much needed goods and services. Lastly, having a deep-water harbor and port is a resilience measure for the San Diego region. The ability for emergency services to access our region may be very important in the event of a major catastrophe. As stated previously, we work across the region to help with these issues to ensure a more resilient San Diego.

eThekwini: a unique approach to natural hazard prevention

Interview by Théo Fortin

Dr Andrew Mather, Project Executive in Coastal Policy, eThekwini municipality (Durban), South Africa.

The municipality of eThekwini (South Africa) consists of several municipalities, including Durban, which is world famous for the 2011 climate summit. This major port city also hosted AIVP World Conference in 2014. Adaptation to climate change is now Goal n°1 of our association's Agenda 2030. In this case, eThekwini municipality is facing major climate challenges and its policies in this area are unique in Africa. That is why we interviewed Dr Andrew Mather, Project Executive in Coastal Policy, at eThekwini Municipality.

eThekwini municipality has been an active member of AIVP since 2002.

Protecting coastlines against submersion

AIVP | *Durban is at the forefront of climate change adaptation. It was one of the first African cities to develop a climate change strategy. This is all the more necessary as marine flooding could become a serious threat to the Durban waterfront.*

How do you manage climate risks, especially in coastal areas?

Dr Andrew Mather, Project Executive in Coastal Policy, eThekwini municipality | Inclusivity, the integration of mitigation and adaptation response, effective governance and monitoring and evaluation, and ecological infrastructure as the basis of climate protection are the key principles.

The city has been proactive in identify the regional sea level rise rates and from this the likely future impacts under a range of scenarios. These scenarios are been used to:

1. Determine the risk to new developments
2. The risk to current development
3. The options of defend, retreat or accommodate

While we live on an exposed, high energy coastline we have a relative steep bathymetric profile and so predicted shoreline retreat is relative narrow. That said, we are monitoring the situation and using adaptive management to decide when, where and how we adapt to rising sea levels.

Acting together with Transnet port authority

AIVP | *Transnet, the South African port authority, has announced its intention to prepare the ports to face extreme climatic phenomena.*

What joint actions to resist hurricanes and cyclones?

Dr Andrew Mather, Project Executive in Coastal Policy, eThekwini municipality | Durban is not threatened by cyclones (the term used for hurricanes in the region) in our modelling. In our Durban Climate Change Strategy is a project to collaborate with Transnet in the development and response of their climate change strategy. There are various projects within themes of the DCCS that relate to reducing flooding and other impacts on the harbour from inland.

In the background, the Port of Durban (©AIVP 2014)

Early warning systems against climate risks

AIVP | *We have been much interested in this brand-new "weather alert system" your municipality has put in place: the FEWS. When it comes to natural risks, early-warning systems constitute decisive assets.*

How does your "weather alert system" works?

Dr Andrew Mather, Project Executive in Coastal Policy, eThekwini municipality | The eThekwini municipality experiences flooding on an annual basis, these events can vary in severity ranging from minor damage to loss of lives and infrastructure. Although these events are natural disasters, an action plan needs to be put in place to minimize the effects of such events. Changes in rainfall patterns, rising sea-levels, population growth and economic activity are driving an increase in demand for flood risk forecasting and mitigation engineering.

World-wide flood disasters account for about one third of all-natural disasters. South Africa's increasing demand on cities for employment, results in large scale urbanization into flood plains and river courses. Furthermore, the capacity of aging urban drainage systems to cope with infrastructure development and changes in climatic rainfall patterns will increase the probability of extreme events.

The Coastal, Stormwater and Catchment Management Department (CSCM), within eThekwini Municipality has implemented a Forecast Early Warning System (FEWS), to better manage and mitigate the effects of flood related disasters.

Durban waterfront, much vulnerable to submersions (© wikipedia commons)

eThekwini's FEWS program is a first of its kind on the African continent. FEWS is a disaster management and data monitoring tool that simulates flood scenarios, environmental water quality, coastal erosion and wave behavior. Access to reliable weather forecast data allows the system to predict the effects of natural disasters ahead of time, allowing enough time for the information to provide for emergency resources so that the city is better prepared.

CSCM has developed the operational flood forecasting models that use rainfall forecasts from the South African Weather Services to simulate what effect the rainfall has on rivers and streams. This allows for eThekwini Disaster Management to prepare for impending flooding events and identifies any areas that are at risk of flooding. FEWS can very roughly be broken into 4 phases – the data feeds phase, which our instrumentation team will expand on looks at sources of information, ranging from internal equipment to satellite measurements. This data is then imported into FEWS, which is a multi-layered process to ensure the validity of the data received. The data are then transformed to a format suitable for our models to interpret, which again feeds the results back into the system. The results from our models is what drives our team into action, FEWS presents the results of all of our models in a single interface, streamlining our processes.

The FEWS team also notifies the relevant departments within the Engineering Unit, i.e., Roads and Stormwater Maintenance Departments are advised of upcoming events to obtain a preventative approach rather than dealing with blockages and overtopping of stormwater infrastructure after the event.

Flood Risk Management in the port of Rotterdam

Marc Eisma

Mr. Marc Eisma, advisor for environmental management in the port of Rotterdam Photo by Marc Nolte

In this article, Mr. Marc Eisma, advisor for environmental management in the port of Rotterdam, explains in detail the port's strategy to protect the territory against flooding and the sea level rise.

Background

The risk of flooding will rise in the port of Rotterdam and the surrounding areas over the decades ahead as a result of climate change, and in particular the rise in sea level. Current climate scenarios foresee a sea level rise by 2100 of between 35 and 110 cm compared to 1990. The great economic significance and the presence of essential and vulnerable functions in the port area triggered research into the consequences of this.

Areas inside the dykes are protected by a network of dykes and barriers. This does not hold for the areas outside the flood defence system, like the port of Rotterdam. Here businesses and owners of assets themselves bear responsibility for taking measures to limit the consequences from flooding and for any damage that results from this.

Our aim is to ensure that the port of Rotterdam remains a safe place for business. We raise awareness among local companies of the potential threats created by climate change and how to manage the risk of flooding to an acceptable level.

Port site Kop van de Beer, Europoort. Danny Cornelissen. Provided by the Port of Rotterdam.

We are a flood-resistant port

While the Rotterdam port area lies largely outside the flood defence system and in open connection to the North Sea, it is currently well protected against flooding. The port area has been constructed well above sea level relatively speaking and is partially protected by storm surge barriers. Only under very extreme weather conditions a small number of companies would possibly suffer flooding. This has never happened in the port to date.

Adaptation Strategy

In order to ensure that the port area remains flood-resistant in the future, we are looking into possible flood risks and how we can prevent or manage this to an acceptable level. We aim to increase the awareness and sense of personal responsibility of users in the area. In considering various climate change scenarios, we are developing an adaptation strategy for coping with flood risk in collaboration with the Municipality of Rotterdam, other governmental organisations, the companies and utility owners. We are mapping out the probabilities and consequences of flooding, weighing up the risks and listing and selecting appropriate measures.

- The following port areas are being studied:
- Botlek and Vondelingenplaat (completed 2017)
- Waalhaven and Eemhaven area (completed 2018)
- Merwe-Vierhaven area (completed 2019)

- Europoort (completed 2020)
- Maasvlakte (will be completed 2021)
- The adaptation strategies comprise of three types of measures, or a combination of them:

  Preventive Measures | Reducing the risk of flooding by taking physical measures, including raising barriers, sites and bank structures (this concerns slopes and quay walls in this area).

  Spatial Adaptation | Managing flood risk by preparing sites and assets for a flood by for example raising vulnerable systems or sites and by 'water proofing' buildings and assets.

  Crisis Management | Agreeing and implementing crisis management and disaster measures in good time, so that a flooding event can run its course in a managed and controlled way, and functions and processes can be restarted again quickly. This concerns drawing up emergency, recovery and crisis management plans and the preparation of emergency facilities.

Aerial photo Theemwegtracé, Botlek. Danny Cornelissen. Provided by the Port of Rotterdam.

Assessment framework

The risk assessment methodology adopted a matrix-based approach to assessing the consequences associated with the low and high sea level rise scenarios (see figure). The consequence categories included economic damage, environmental damage, risk to life and social disruption. This assessment framework has been specifically developed for the port.

A series of workshops were held to assess the risk from sea level rise induced ocean inundation for a range of port assets and functions. The results show that the main outcome of a possible future flood will be economic damage. This damage comprises both direct damage to buildings, systems and other facilities and indirect damage resulting from business interruption and/or the sub-optimal utilisation of the available infrastructure. There is limited risk of environmental damage and flooding is expected to lead to no human casualties.

In some cases, the indirect damage will actually transcend the afflicted area. Chain effects play an important role in this context, since most companies are linked via pipelines and utilities networks. The various activities are not only closely connected and mutually dependent within the area itself, but also interwoven with activities in the surrounding port areas and beyond. The economic damage is heavily dependent on where the flooding takes place, and the type of company.

Monitoring

We have made use of the best models and data available. Nevertheless, the various adopted methodologies still contain quite a few hypotheses and provisional elements. The types of data used in the study included existing water level, economic, logistics and other data to inform the risk assessment and cost-benefit assessment of options. The project also involved hydrodynamic modelling of storm surges to better characterise the potential impacts of flooding on the port.

Aerial photo Maasvlakte, Danny Cornelissen. Provided by the Port of Rotterdam.

Adaptation report outcomes

An effective region-wide adaptation strategy combines preventive measures with spatial adaptation and emergency response and tailors each measure to specific characteristics of an area (e.g. with regard to flood probability, the different activities in the area and area dynamics).

It is clear that the port of Rotterdam is taking decisive actions for climate change adaptation, that will allow to anticipate the rise in sea level and incorporate it into further development. Consequently, the port will be able to make responsible investments to maintain its flood-resistant status. At the same time, other initiatives from the port of Rotterdam in the field of energy transition and circular economy contribute to the climate change mitigation, by reducing the port's environmental footprint.

The islands of the South-West Indian Ocean faced with rising sea levels

Jean-Marc Beynet

Jean-Marc Beynet, engineer in ports and waterfront infrastructure

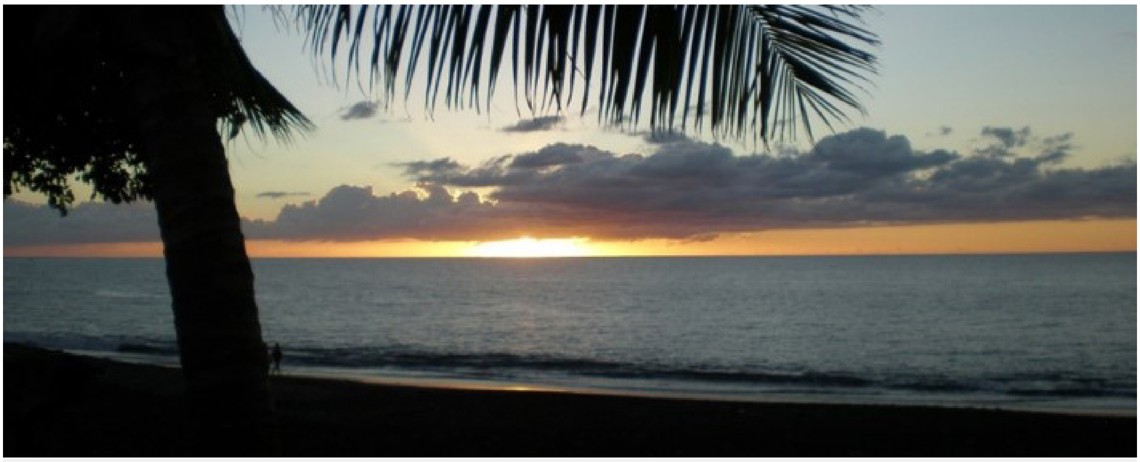
Article based on « La vie des îles autour du monde – Naissance, histoire, présent, futur probable » ("The Life of Islands Around the World – Birth, History, Present, and likely Future") by Jean-Marc Beynet, to be published soon by Editions Nombre 7 (Nîmes, France).

We tend to think of most islands as dream destinations, an invitation to travel, sail, and explore. Does time pass more slowly there than on the mainland? When and how did islands come into existence? When and how did they come to be inhabited? What legends and beliefs do islanders have? What is their philosophy on life? And what does the future hold for these islands and their inhabitants, with sea levels set to rise in the decades ahead?

There are many lessons to be drawn from the islands of the South West Indian Ocean, which include the Mascarenes (Mauritius and Réunion), along with Madagascar, Comoros, Mayotte, and the Seychelles. These islands owe their existence to geology and volcanoes.

This makes them excellent candidates on which to based a forward-looking analysis of the likely impacts of rising sea levels on islands and their populations, taking into account the latest report by the IPCC (September 2019), and more recent studies that will form the basis for the IPCC's next report, due for publication in September 2021.

This analysis can be based on Milankovic's astronomical theory, which offers an explanation for major climatic variations in glacial cycles. With the world gradually heating up since the last glacial period, sea levels have risen 120 metres since the peak or "late glacial maximum", which occurred around 20,000 years ago. However, since the advent of the Anthropocene period, industrial activity has altered the climate, pushed up temperatures, and accelerated the rise in the level of the seas and oceans. The average rise was 0.3 mm/year in the 18th century before the industrial era, 0.4 mm/year in the 19th century, then 1.7 mm/year in the 20th century, and finally 3.5 mm/year between 2004 and 2015. By the end of the 21st century, the sea could be rising at a rate of between 8 and 16 mm/year in the worst case scenario, if greenhouse gas emissions continue to rise (Blanfuné et al., 2018).



Réunion island, west coast (© JM. Beynet)

Humanity will be unable to stop the climate change that results from Milankovic's astronomical cycles. However, humans have a responsibility to limit the amount of CO2 they emit into the atmosphere in order to slow the process of climate change, as was voted in the 2015 Paris Agreement. In the IPCC report published in September 2019, scientists emphasised that sea levels have been rising more quickly in recent decades. They note that the rate of rise is now 2.5 times greater than it was over the period between 1900 and 1990. As a result, climatologists have been forced to revise their forecasts for the end of the century. Whereas in 2013, they predicted that sea levels would rise by between 30 and 90 cm by the year 2100, in their latest report in 2019, the IPCC's experts announced that the rise would in fact be between 60 cm and 1.10 m. They explain the increase partly by thermal expansion (the more the oceans heat up, the greater their volume), and partly due to the two polar ice caps melting more rapidly. Yet despite the alarm bells being run by the IPCC, some countries are ignoring the threat. They are in "denial", as described by the scientists of the AllEnvi Alliance (Lacroix et al., 2019; 2020).

Based on the IPCC's scenarios, Météo-France and the Institut Pierre Simon Laplace (IPSL) published the results of their digital simulations in early 2020. For the end of the century, if no action is taken, they predict that the global temperature will rise by 6 to 7 °C compared with the 19th century. In May 2020, an article published in the international journal Nature Research claimed that, under the IPCC's two most extreme scenarios, the minimum rise in the global mean sea level would likely be between 0.63 m and 1.32 m by 2100, while the maximum rise would be between 1.67 m and 5.61 m by 2300 (Horton et al., 2020) .

These are worrying figures, as not only coastal areas of islands all over the world find themselves underwater, but most coastal ports and cities on the mainland will also. Major metropolises like New York, London, Hamburg, Amsterdam, Venice, Singapore, Jakarta, etc., are just the best known of those likely to be severely affected. But in fact virtually all of the world's port cities are already concerned. In 2019, in its 2030 Agenda, AIVP identified adapting to climate change as the number one priority: "Preparing city ports for the consequences of climate change".


Réunion island, BCR blocks on a protection dyke at Port-Est (© JM. Beynet)

In the future, it will be vital to consider each island individually, its topography, the coastal areas and port and airport infrastructures that will be most affected by the rising level of the Indian Ocean.

On the island of Mauritius, the port and lowland districts of Port-Louis will be partially submerged. In the south, however, the international airport runway will be spared.

• On the island of Réunion, the northern coastal area of the city of Le Port will be affected, in the zone where hydrocarbons are stored. The port infrastructures will be partially affected, also to the west and east of Le Port, along with the marinas of Sainte-Marie, Saint-Gilles, and Saint-Pierre. However, the runway of Roland-Garros international airport is higher up and will remain above the water.

• In Madagascar, the mangroves will find themselves under water, whether on the west coast, the Mozambique Canal side, or on the east coast. The port infrastructures will also be partly submerged.

• Some of France's Scattered Islands in the Indian Ocean will be partly reclaimed by the ocean.

• In Mayotte, as in Madagascar, the mangroves will be the worst affected. In addition, part of Mayotte is affected by subsidence.

• In the Seychelles, Mahé airport and the coast road leading to the capital Victoria will be under water. The town itself will be partly submerged, along with the port infrastructures.

Réunion island, "Le Barachois" coast in Saint-Denis (© JM. Beynet)

We must raise the alert and highlight the need to adapt to the rise in sea levels, which is set to accelerate in the decades ahead. This is vital for the islands of the Indian Ocean, as they are also at risk from cyclones, which are also set to increase in intensity. And these islands rely on their crucial port and airport infrastructures for supplies and travel. These infrastructures are essential to their economies (imports, exports, tourism). For ports, it is becoming more and more urgent not just to reinforce and raise sea defences, but to raise their docks and embankments to ensure they remain operational in the coming decades. All of these adaptations need to be planned in advance, so that they can be deployed quickly.

Learn more on this fascinating topic by reading the book « La vie des îles autour du monde – Naissance, histoire, présent, futur probable », available on March 15th (in French only). Pre-orders are open.

How to adapt port cities to climate change. Challenges and solutions

Webinar

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Despite the most recent efforts by estates and international organizations. Climate change is a palpable reality that we cannot escape. The sea level rise and more common extreme weather events will demand adaptation measures from port cities all over the world. Considering the urgency of this situation, AIVP decided to make climate change adaptation goal n° 1 of its 2030 Agenda, explicitly indicating the urgency to take action. In this webinar we discover the most recent research on this topic and learn from three ports and cities what projects are they developing to increase their resiliency. More concretely, we discuss:

- City-port strategic planning for climate change adaptation and resilience,

- Examples of projects and measures related to the renaturation of banks and coastlines to slow down erosion and the effects of storms.

- Warning and prevention systems against the effects of extreme weather events

- Examples of measures and challenges to prepare the city-port territory against sea submergence and flooding

- Coordination between entities for adaptation to climate change

- The role of citizens in climate change adaptation operations

Watch this **Webinar**

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