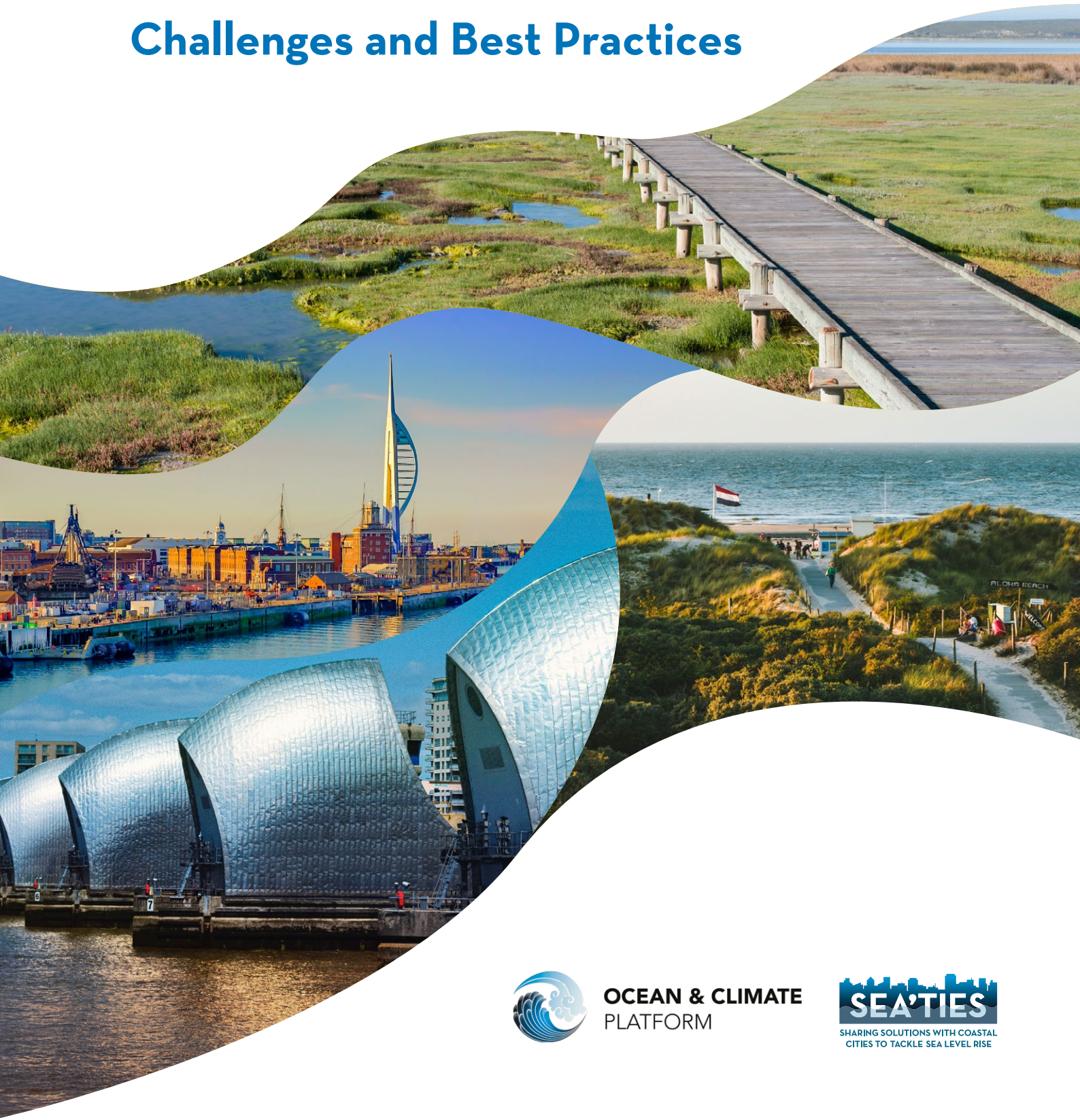
ADAPTING COASTAL CITIES AND TERRITORIES TO SEA LEVEL RISE IN NORTHERN EUROPE

Challenges and Best Practices



OCEAN & CLIMATE PLATFORM

SEA'TIES
SHARING SOLUTIONS WITH COASTAL CITIES TO TACKLE SEA LEVEL RISE

ACKNOWLEDGEMENTS

This report was co-authored by Sarah Palazot and Lisa Devignol and coordinated by Théophile Bongarts Lebbe and Raphaël Cuvelier.

This publication benefited from the collaborative efforts of Nicolas Becu (La Rochelle Université), Céline Damery (Conservatoire du Littoral), Patrycja Enet (MSP Europe), Aubrée Louarn (Université de Bretagne Occidentale), Robert Nicholls (Tyndall Centre for Climate Change), Catherine Pearce (Climate Ready Clyde, Sniffer), Murray Scown (Water, Climate & Future Deltas Hub, Utrecht University), Mark Stratton (Coastal Partners), Eduardo Zorita (Institute of Coastal Systems, Helmholtz-Zentrum Hereon) and Loreley Picourt, Marine Lecerf and Jay Marisca Gietzelt (Ocean & Climate Platform) who provided review and editorial support, recommended resources and shared their valuable insights.

Recommended citation: Ocean & Climate Platform. (2022). *Adapting Coastal Cities and Territories to Sea Level Rise in Northern Europe: Challenges and Best Practices*. Ocean & Climate Platforme. 39 pp.

Contact: Théophile Bongarts Lebbe, Project Manager of the Sea'ties Initiative, Ocean & Climate Platform: tbongarts@ocean-climate.org

Website: ocean-climate.org/en/seaties-2

Editing and layout: Natacha Bigan
Cover photos: johannlourens - Getty Image / Eric Laudonien - Getty Image / John Cameron - Unsplash / Tim Russmann - Unsplash
Back cover photos: Richard Brunsveld - Unsplash / Benjamin Elliott - Unsplash / Austin Loveing - Unsplash / Domenik Kowalewski - Unsplash

The Ocean & Climate Platform, Who are we?

The Ocean & Climate Platform is an international network of more than 90 organisations from civil society - including NGOs, research institutes, foundations, local authorities, international organisations and private sector entities - united around a key message: "a healthy ocean for a protected climate". The Platform aims to promote scientific expertise and advocate for a better recognition of ocean-climate-biodiversity issues by national and international decision-makers. At the science-policy interface, the Platform supports policymakers in need of scientific information and guidance in the implementation of public policies. In addition, the Platform provides a forum for exchange and reflection where stakeholders can build a common and holistic approach to the challenge of protecting marine ecosystems and tackling climate change. Drawing on its members' expertise, the Platform brings light to concrete solutions, based on the latest available science, to preserve the ocean, its biodiversity and the climate.

The OCP's agenda on adaptation at the United Nations Framework Convention on Climate Change (UNFCCC)

As an observer organisation to the UNFCCC, the OCP is committed to a better integration of ocean-related mitigation and adaptation measures into climate strategies, most notably the Parties' Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs), and as such, is mobilised to scale up States' ambitions to meet the targets of the Paris Agreement.

Expert Group on "Ocean and Coastal Zones" of the Nairobi Work Programme on adaptation (NWP-Ocean). The NWP-Ocean aims to develop knowledge tools for a better comprehension and integration of marine issues in States' adaptation strategies. Since 2019, the OCP has been one of the 23 constituting organisations and in quality of co-Chair, represented the NWP-Ocean during the first SBSTA Dialogue on Ocean and Climate Change, held online in 2020.

The Ocean and Climate Change Dialogue under the Subsidiary Body for Scientific and Technological Advice (SBSTA). Pursuant to the decision 1/CP26 paragraph 61, the Ocean and Climate Change Dialogue was mandated by the 26th Conference of the Parties to be organised annually to strengthen the understanding of and action on ocean and climate change adaptation and mitigation. The OCP will submit inputs collectively drafted with its members to feed in the discussions of the dialogue and will actively take part in each session.

The Global Climate Action Agenda under the Marrakech Partnership (MP-GCA). The MP-GCA establishes a dialogue between Parties and non-Party stakeholders (e.g. cities, regions, NGOs, businesses and investors) around seven priority climate actions, including the ocean. As co-focal point for the "Ocean and Coastal Zones" group, the OCP mobilises non-state actors around key messages, aligned with the Ocean Pathway, to scale-up ocean-based climate action towards a resilient, nature-positive and net-zero future.

TABLE OF CONTENTS

The Sea'ties Initiative

The Sea'ties Initiative aims to facilitate the development of public policies and the implementation of adaptation solutions to support coastal cities threatened by rising sea levels. Led by the Ocean & Climate Platform, the initiative is intended for elected representatives, administrators and stakeholders involved in this transition as a forum to exchange knowledge and experiences of sustainable solutions towards coastal resilience. Sea'ties is an international initiative which mobilises coastal experts and cities from five regions of the world featuring a diversity of climatic, geographic, social, economic and political contexts. A diversity of solutions has already been implemented across the world and can be inspirational for other coastal cities and territories. By making connections between real-world experiences and characterising them through illuminating scientific works, we can promote the most suitable practises and support the choices of political decision-makers and regional administrators.

Primary goals

1/ Compile scientific knowledge and data into accessible summaries and databases (Sea'ties' Map of Solutions), identifying and analysing solutions deployed by coastal cities across the world.

2/ Foster the emergence of good practices and facilitate the exchange of knowledge and experiences between coastal stakeholders during regional workshops. Leverage collective reflection for the identification of enabling factors for the deployment of sustainable adaptation solutions.

3/ Encourage the integration of adaptation challenges into public policies by promoting real-world experience complemented with scientific knowledge, and by submitting policy recommendations to decision makers so they can integrate the most suitable solutions into their international and national public policies.

Regional workshops

By bringing together experts and key stakeholders working on adapting coastal cities and territories to sea level rise - e.g. scientists, regional planners, NGOs, civil society representatives, elected officials - regional workshops aim to provide an understanding of the plurality of adaptation responses being deployed in diverse geographical and socio-economic settings. To highlight the plurality of approaches and solutions deployed across the world, five regional workshops are scheduled between 2021 and 2023.

To improve the integration of adaptation challenges into public policies, concrete returns on experience shared by participants will feed into the production of recommendation and the advocacy work of the Ocean & Climate Platform, including at the UNFCCC.

Reference tools and documents

The Sea'ties Initiative contributes to the enhancement and diffusion of knowledge on adaptation issues through the production of scientific papers, reference tools and documents to the address of the scientific community, policymakers and the general public.

• **The Sea'ties Declaration**

Initiated by the OCP, the French Government, the City of Brest with the support of ICLEI and Race to Resilience, the Sea'ties Declaration commits more than 40 mayors, governors and city networks across the world to the challenges of adapting coastal cities and territories to sea level rise. The Declaration is a call to accelerate adaptation action addressed to the international community which highlights four priority strategies: (1) the mobilisation of science and observation systems, (2) the integration of societal issues within adaptation plans, (3) the fostering of adaptive and hybrid solutions, and (4) the increase of public funding and private investments for adaptation to sea level rise.

• **Scientific Article - Designing Coastal Adaptation Strategies to Tackle Sea Level Rise**[1]

The article "Designing Coastal Adaptation Strategies to Tackle Sea Level Rise" is a synthesis of scientific literature and presents four archetypes of adaptation strategies to sea level rise. These are analysed according to their governance modalities and characterised based on their degree of implementation complexity. This synthesis was co-written by scientists from the RTPi-Sea'ties, co-led by the OCP and CNRS, and was published in the Journal Frontiers in Marine Science, Ocean Solutions in November 2021.

• **Policy Brief - Adapting Coastal Cities and Territories to Sea Level Rise**[2]

The policy brief "Adapting Coastal Cities and Territories to Sea Level Rise" addresses the challenges faced by stakeholders in the field of adaptation, and highlights the essential elements of a sustainable transition of coastal territories.

• **Map of Solutions**[3]

The Map of Solutions is an interactive cartography listing hybrid responses implemented around the world to tackle the risks associated with sea level rise. It provides project leaders with concrete feedback, highlighting the outcomes, takeaways, and cautionary remarks to inspire and support coastal stakeholders in the implementation of adaptation strategies in their coastal cities and territories.

1/ Bongarts Lebbe, T., et al. (2021). Designing Coastal Adaptation Strategies to Tackle Sea Level Rise. Frontiers in Marine Science. doi: 10.3389/fmars.2021.740602
2/ Ocean & Climate Platform. (2021). Adapting Coastal Cities and Territories to Sea Level Rise. Ocean & Climate Platform 3/ Ocean & Climate Platform. (2022). Map of Solutions. Retrieved March 31, 2022, from https://seaties.ocean-climate.org

EXECUTIVE SUMMARY

This report draws on elements discussed during the Sea'ties Workshop "Adapting coastal cities to sea level rise in Northern Europe", hosted virtually by the Ocean & Climate Platform on November 29, 2021, as well as 10 individual interviews held between July and September 2021. The workshop gathered 20 experts (academics, researchers, representatives of maritime and environmental agencies, local planners and associations) from Belgium, France, Germany, the Netherlands and the United Kingdom, with the inputs of specialists from the University of California Santa Cruz and the University of California Santa Barbara, along with the City of Santa Cruz, United States.

This workshop provided a forum to share, connect and discuss current practices and common challenges, in order to identify avenues for further reflection. Divided into two thematic sessions "Building on scientific knowledge" and "Planning and implementing adaptation", it included plenary sessions where participants presented research and adaptation projects. Each of these sessions were followed by working groups where participants discussed their practices and the main obstacles that remain to be addressed. While the issues of financing adaptation and port transformation are critical concerns in Northern Europe, these complex, inherently distinctive issues require specific expertise and attention that could not be provided during the workshop and are therefore not developed in the present report.

This report provides an overview of the current obstacles and needs to be addressed to implement adaptation strategies in Northern Europe, with a special focus on the availability of scientific knowledge, the implementation of hybrid and dynamic strategies and social engagement. Intended for policymakers, city and territorial planners, and residents willing to pursue transformational change on their coasts, the report shares good practices and knowledge among peers by shedding light on concrete initiatives.

Although access to scientific information is substantive, critical knowledge gaps remain. These gaps highlight the importance of pursuing localised and systemic research to measure risks and vulnerabilities, providing additional analyses and innovative methods to assess the feasibility of interventions at scale, and establishing guidance to facilitate long-term monitoring, evaluation and reporting.

Improving governance frameworks will be pivotal to widen the adoption of hybrid and dynamic strategies put forth during the workshop. As there is no one-size-fits-all solution to tackle sea level rise, coastal planners and managers need to mix and sequence interventions through time and space. This approach implies considerable efforts to increase and adjust human, financial, institutional and socio-cultural capabilities.

Notably, improving stakeholder engagement throughout the entire adaptation process is a prerequisite for a just and equitable adaptation. Engagement will be all the more effective and fairer as work is put on identifying relevant actors, on informing their decisions and on supporting long term mobilisation.

ACRONYMS

AR5 - IPCC 5th Assessment Report

AR6 - IPCC 6th Assessment Report

CNRS - French National Centre of Scientific Research

CRC - Climate Ready Clyde

CSOs - Civil Society Organisations

ESS - European Statistical System

FPRNM - French Fund for the Prevention of Major Natural Hazards

GCR - Glasgow City Region

GERD - Gross Domestic Expenditures on Research and Development

GHG - Greenhouse gas

GIS - Geographic Information System

IPCC - Intergovernmental Panel on Climate Change

IUCN - International Union for the Conservation of Nature

LISCOAST - Large Scale Integrated Sea Level and Coastal Assessment Tool

LRTZC - La Rochelle Territoire Zéro Carbone

MDFK - Flemish Agency for Maritime and Coastal Services

MP-GCA - Global Climate Action Agenda under the Marrakech Partnership

MRE - Monitoring, Report and Evaluation

NbS - Nature-based Solutions

NDCs - Nationally Determined Contributions

NWP - Nairobi Work Programme

OCP - Ocean & Climate Platform

OECD - Organisation of Economic Cooperation and Development

RNOTC - Réseau National des Observatoires du Trait de Côte (translated into: French National Network of Coastline Observatories)

SBSTA - Subsidiary Body for Scientific and Technological Advice

SLR - Sea level rise

SMP - Shoreline Management Plans

SROCC - IPCC Special Report on Ocean and Cryosphere in a Changing Climate

TE2100 - Project Thames Estuary 2100

UNFCCC - United Nations Framework Convention on Climate Change

INTRODUCTION

Northern Europe confronted with sea level rise (SLR)

Throughout the 20th century global mean sea level has risen by about 20 cm[4]. Europe is subjected to a similar average rise and as such could observe an elevation of 1m by 2100 in a high GHG emissions scenario (RCP8.5)[5]. These projections could reach higher levels as future evolutions of the Greenland and Antarctic ice sheets remain uncertain. Yet, notable variations across the coastlines will be observed due to natural and anthropogenic coastal movements of land subsidence or uplift, storm surges, topography and land uses[6]. In this regard, the coasts of the northern Baltic Sea are relatively spared as land levels continue to rise faster than the sea. Conversely, low lying areas and deltas along the Wadden sea (Netherlands, Germany, Denmark), the British Isles and the Atlantic Ocean are particularly exposed and will experience a rise in absolute and relative sea level similar to global projections[7]. Potential impacts of sea level rise associated with increasing frequency and intensity of extreme events, include flooding, salinisation of soils, aquifers and surface water, and coastal erosion.

As such, SLR raises serious environmental, socio-cultural, economic and political threats. Indeed, close to half of the European population lives within 50 km of the coastline, mainly in urban and peri urban areas, characterised by sustained development of residential areas, significant historical and cultural heritage, and the continued attraction and concentration on a growing number of activities - e.g. tourism, shipping, fishing and aquaculture-making them highly vulnerable to SLR. Economic assets within 500 m of the sea are estimated at EUR 500-1000 billion[8]. Hence, by 2100, without upgrading existing adaptation measures, about 3 million people will be at risk[9] across the continent, while the estimated average annual losses from coastal flooding could reach EUR 31 billion. Meanwhile, marine and coastal ecosystems are almost completely depleted in city centres and are rapidly degrading in their environs as space for inward migration is shrinking and affected by sustained urban developments. SLR threatens 48.000 species[10] and about 4 to 5% of ecosystem services provided by coastal ecosystems could be lost by 2100[11].

Evolving adaptation practices

Northern Europe has a long tradition of tackling coastal floods, notably through intensive polderisation. In the mid-20th century, faced with storm surges and rising sea levels, Northern European countries turned towards systematic protection of their coastline by using dikes and levees. This is notably the case in the Netherlands, where at least one-third of the country is located below sea level. After drastically polderising coastal areas as early as the 17th century, two large-scale flood disasters in 1916 and 1953 were decisive in initiating the Delta Programme, which enshrined the systematic implementation of hard engineering protection along the coast,

4/ IPCC (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

5/ Ibid.

6/ McEvoy, S., Haasnoot, M., Biesbroek, R. (2021). How are European countries planning for sea level rise?. Ocean & Coastal Management, 203. https://doi.org/10.1016/j.ocecoaman.2020.105512

7/ Global and European sea level rise. (2021). European Environment Agency. Retrieved March 16, 2022, from https://www.eea.europa.eu/ims/global-and-european-sea-level-rise

8/ Europe's seas and coasts. (2020). European Environmental Agency. Retrieved March 16, 2022, from https://www.eea.europa.eu/themes/water/europes-seas-and-coasts

9/ Climate change impacts in Europe. (2020). European Environment Agency, Retrieved March 16, 2022, from https://www.eea.europa.eu/highlights/why-does-europe-need-to/climatechangeimpactineurope.pdf/view

10/ Europe's seas and coasts. (2020).

11/ European Commission. (2021). The EU Blue Economy Report. Publications Office of the European Union. Luxembourg. https://ec.europa.eu/oceans-and-fisheries/system/files/2021-05/the-eu-blue-economy-report-2021_en.pdf

including the Oosterscheldekering[12]. This approach was particularly developed in European cities that historically concentrated high-value assets and were densely populated. For instance, following the 1962 floods, most of Hamburg's centre and suburbs were surrounded with an extensive dike system comprising 25 km of seawall and 78 km of "green wall"[13]. Acknowledgement of the limits and costs of these structures and recognition of their impacts on sediment cycles combined with new environmental concerns led to a shift towards more "soft solutions", such as beach nourishment and, more recently, ecosystem-based adaptation. Acknowledgement on the necessity to integrate new approaches to strengthen coastal resilience is well reflected across Northern Europe, in the development of new or updated national strategies to address SLR - the OECD notably reports that the UK, Germany, Belgium and the Netherlands are leading the way in this domain[14]. These strategies provide significant policy guidance and are instrumental for planners and decision-makers at local scales. In this respect, coastal cities are particularly innovative in translating these national guidelines as they are eager to rethink the way populations inhabit and occupy the shoreline. However, implementing transformational change while necessary, entails dealing with increasing exposure to SLR, combined with high socio-economic stakes[15]. In other words, planning long-term, dynamic and integrative adaptation strategies is particularly challenging for coastal cities and remaining gaps often delay action. Although research and practical frameworks towards coastal adaptation have considerably evolved, reflection around coastal cities' distinctive challenges is still at an early stage in Northern Europe. The focus on "Cities and Settlements by the Sea"[16], in the second publication of IPCC's 6th Assessment Report (AR6) on "Impact, Adaptation and Vulnerability", is a definite step towards further visibility and reflection on this subject. While innovative in its focus on the strategies of Northern European cities to tackle SLR, this report also approaches coastal adaptation in a broader sense, and cities at a larger geographical scale to integrate territories in their multifacetedness.

The present report provides an overview of current practices and obstacles to defining and implementing adaptation strategies, put forth during the Sea'ties workshop "Adapting cities to sea level rise in Northern Europe". Accordingly, three key areas of concern emerged which are addressed in the following sections:

(1) Despite substantive access to scientific information, the lack of systemic and localised assessments, feasibility measures and MRE, constitute considerable knowledge gaps that impede on the implementation of tailored and informed strategies.

(2) As planners are eager to adopt hybrid and dynamic strategies, the institutional, financial, scientific and socio-cultural conditions need to be adjusted accordingly.

(3) Improving stakeholder engagement throughout the entire adaptation process is a prerequisite that necessitates additional efforts to ensure fair, effective and long-term participation.

12/ Mao, D., Lai, S., Su Li, H., Hsu, K. (2020). The Delta Programme: The Dutch integrated approach to climate resilience. Centre for Livable Cities. Singapore. https://www.clc.gov.sg/docs/default-source/commentaries/bc-2020-08-the-delta-programme.pdf

13/ Yeung, P. (2021). In Hamburg, Surviving Climate Change Means Living With Water. Bloomberg CityLab + Green. Retrieved March 15, 2022, from https://www.bloomberg.com/news/features/2021-12-18/how-hamburg-learned-to-live-with-rising-water

14/ OECD. (2019). Policy Highlights: Responding to Rising Seas: OECD Country Approaches to Tackling Coastal Risks. OECD Publishing. Paris. https://doi.org/10.1787/9789264312487-en.

15/ McEvoy S., Haasnoot M., Biesbroek R. (2021).

16/ Glavovic, B., Dawson, R., Chow, W., Garschagen, M., Haasnoot, M., Singh, C., Thomas, A. (2022). Cross-Chapter Paper 2: Cities and Settlements by the Sea. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

1 CLOSING KNOWLEDGE GAPS FOR INFORMED ADAPTATION

Risk and vulnerability assessments in Northern Europe are supported by substantial data production which is readily accessible and shared. Yet, the lack of systemic and localised evaluations hinders the comprehensive understanding of risks and vulnerabilities. Informed design, decisions and implementation of adaptation measures require innovative and systematic feasibility assessments to be conducted and shared among stakeholders. Meanwhile, frameworks and guidelines for monitoring could support a long term approach in the production of knowledge and the adjustment of strategies.

1.1. Conducting systemic and localised risk and vulnerability assessments

In Northern Europe, local risk and vulnerability assessments are based on substantial existing data that is accessible through regional and national platforms. At the European level, **Copernicus the European Union Earth observation programme,** provides information services that draw from satellite Earth observation and in-situ data[17]. Countries often complement data provision with national observation and modelling programmes, such as the third Independent Assessment of **UK Climate Risk (CCRA3)** due in 2022, which provides evidence base to inform national adaptation programmes in the UK[18]. Extensive socio-economic and policy indicators are also available with platforms such as the **European Statistical System (ESS)** which provides comparable statistics at the European Union level on a wide range of themes, e.g. "impacts and adaptation"; "biodiversity" and "equality" measures[19]. In addition, several European research programmes propose combined analysis of socio-economic and physical data. The **Large Scale Integrated Sea level and Coastal Assessment Tool (LISCOAST)** cross-references different types of observations and data to develop dynamic scenarios of coastal hazards, exposure and vulnerability, and carries out a bottom-up assessment of climate impacts on coastal areas[20].

Systemic analyses based on high-quality and timely data are still needed to produce accurate and site-specific evaluations, and thus, to better understand uncertainty.

This includes having a sound understanding of the interactions between land, coastal and marine areas. While Northern European countries are leading actors in marine and ocean science and considerable budgets are allocated to ocean science comparatively with other regions[21], they remain modest compared to other research fields, i.e. land sciences. Putting this in perspective, in 2017, in France, Germany and the UK, the shares of gross domestic expenditures on research and development (GERD) allocated to ocean science were comprised between 0.2% to 1%[22]. Undertaking comprehensive and precise assessments will require a better balancing of efforts between land and coastal research as well as converging these research fields.

Bridging the gaps between research fields is all the more relevant as coastal settlements face compound and cascading risks. Assessing the joint influence

17/ Copernicus services. (2021). Copernicus. Retrieved March 16, 2022, from https://www.copernicus.eu/en/copernicus-services

18/ UK Climate Risk. (2022). What is the UK Climate Risk Independent Assessment (CCRA3)?. Retrieved April 7, 2022, from https://www.ukclimaterisk.org/about-the-ccra/uk-climate-risk-independent-assessment-ccra3/

19/ Eurostat. (2022). Data. Retrieved March 16, 2022, from https://ec.europa.eu/eurostat/web/main/data/database

20/ European Commission Joint Research Data Center Catalogue, "Large Scale Integrated Sea-level and Coastal Assessment Tool" https://data.jrc.ec.europa.eu/collection/liscoast#datasets

21/ IOC-UNESCO. (2020). Global Ocean Science Report 2020–Charting Capacity for Ocean Sustainability. K. Isensee (ed.), Paris, UNESCO Publishing. https://gosr.ioc-unesco.org/files/GOSR2020_IOC-UNESCO_full_report.pdf

22/ Ibid., p.77

of riverine and coastal flood drivers is essential to determine flood risks[23] faced by deltaic and estuarine cities in the region, e.g. Rotterdam, London.

Improving understanding of the sediment-cell scale is pivotal in defining the appropriate geographic area for adaptation planning. For instance, England and Wales Shoreline Management Plans (SMP) were delimited based upon sediment-cell boundaries and reviewed according to "shoreline evolution characteristics alone"[24]. To define tailored strategies at the sediment-cell scale, building on local research will be paramount to better understand sediment movement and possible large-scale disruptions caused by local activities.

Adopting an interdisciplinary approach is fundamental as the socio-economic implications of SLR and climate change are particularly high for coastal cities that concentrate a wide range of activities (e.g. tourism, shipping), cultural heritage and communities. Further research and cross-reference of humanities and social sciences with natural sciences will help better understand the interactions between physical risks and societies. This means that, not only accounting for natural hazards, but also integrating issues at stake (ecosystems, people, activities, properties, sectors exposed, physical and mental health), current risk management (preparedness) and representations (populations' relationship to risks)[25] is key when it comes to assessing systemic vulnerability.

Downscaling global data and model projections at a finer spatial and temporal scale is critical to uncover the dynamics at stake locally. To date, most projections are global and derived from global climate models. In Europe, primary sources of information for SLR planning are IPCC reports, with RCP4.5 - RCP8.5 scenarios being the most frequently used scenarios[26]. Yet, global models encompass a series of limitations that impede accurate local projections of SLR and the impacts of climate change. First, global climate models are currently unable to simulate the melting of Greenland and Antarctic ice-sheets, thereby contributing to regional uncertainty. Second, inadequate global references sometimes lead to the uptake of lower SLR scenarios. Moreover, considerable margins of error are observed locally, deriving from miscalculations on site erosion and elevation rates due to coarse resolution of satellite observation and missing representation of physical processes, such as tides, waves[27] and sediment reduction from dams. Addressing this gap, coastal observatories are working to provide timely and at scale data. Since 2019, in France, the **National Network of Coastline Observatories (RNOTC)** gathers local and independent observatories (e.g. **OSIRISC**, **Observatoire de la Côte Nouvelle Aquitaine**) in charge of collecting data in the field and ensures their interconnection to promote knowledge-sharing and achieve a global understanding of erosion and submersion processes, to eventually better inform decisions[28].

23/ Eilander, D., et al. (2020). The effects of surge on riverine flood hazard and impact in deltas globally. Environmental Research Letter. 15(10), 104007, https://doi.org/10.1088/1748-9326/ab8ca6

24/ Department for Environment Food and Rural Affairs. (2006). Shoreline management plan guidance - Volume 1: Aims and requirements. Department for Environment Food and Rural Affairs. London. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69206/pb11726-smpg-vol1-060308.pdf

25/ Meur-Ferec, C., et al. (2020). Une méthode de suivi de la vulnérabilité systémique à l'érosion et la submersion marines. Développement durable et territoires, 11(1).

26/ McEvoy, S., Haasnoot, M., Biesbroek, R. (2021).

27/ Ibid.

28/ Réseau national des observatoires du trait de côte. (2021). Accueil. Retrieved March 24, 2022, from http://observatoires-littoral.developpement-durable.gouv.fr/

Associating with local actors both strengthens capacities and helps produce more robust and actionable knowledge. On the one hand, there is a clear need for academia to get a better grasp of what decision-makers need in order to produce relevant knowledge. In parallel, it is critical to build policymakers and populations' capacities to collect, exploit and interpret data and projections at scale. With strengthened capabilities and exploitable knowledge, decision-making is likely to be better informed. On the other hand, associating academia with local actors in the production of knowledge can be conducive to its robustness and site-specific relevance. In this sense, local populations can act as knowledge generators, based on their grassroot experiences. Testimonies and historical evidence can thus provide practical information on the shoreline evolution.

1.2. Measuring feasibility to guide the design and implementation of adaptation measures

As there is no one-size-fits-all solution, feasibility analyses at scale are crucial to guide stakeholders during the design and implementation of tailored adaptation responses. Difficulties in designing and implementing adaptation responses partly derive from insufficient information on the benefits, limitations and thresholds of potential responses. Although global assessments give insight into the interests of adaptation options, e.g. **IUCN Global Standard for Nature-based Solutions**, they are not usually conceived to address the specific features of cities. To better inform decision-making, local, thorough feasibility assessments that not only account for the technical and economic challenges but integrate, geophysical, environmental, institutional and socio-cultural variables are needed[29, 30].

Feasibility analyses include measuring the technical feasibility of adaptation measures, that locally depend on resources availability, specific environmental constraints and the risk mitigation potential of the considered option. This applies particularly to Nature-based Solutions (NbS). Breaking with traditional grey infrastructures, their development is greatly constrained by a lack of knowledge on their feasibility, benefits and limitations[31]. They are particularly challenging for cities to implement as intense urbanisation limits available space while human demands for land sometimes conflict with

29/ Based on the definition given by the IPCC, feasibility can be understood as 'the degree to which climate goals and response options are considered possible and/or desirable' - IPCC (2018) Annex I: glossary. In: Matthews R (ed) global warming of 1.5°C

30/ Singh, C., Ford, J., Ley, D. et al. (2020). Assessing the feasibility of adaptation options: methodological advancements and directions for climate adaptation research and practice. Climatic Change, 162. pp. 255–277. https://doi.org/10.1007/s10584-020-02762-x

31/ Castellari, S., Davis, M. (2021). Global and European policy frameworks. Nature-based solutions in Europe: Policy, knowledge and practice for climate change adaptation and disaster risk reduction. European Environment Agency Report No 1/2021. doi: 10.2800/919315

ecosystem restoration activities[32]. To support the increasing number of cities that are taking on NbS for coastal adaptation, scientifically informed tools could be developed to identify the constraints and opportunities to optimise these options, especially in urban settings. In parallel, additional research and homogenised methods are needed to assess the scalability and replicability at larger scales of NbS. Indeed, the current heterogeneity of methods used to assess NbS technical feasibility and impacts impede the comparison between different options[33].

An example of feasibility research led on Nature-based Solutions in deltas and coastal areas - Water, Climate and Future Deltas Hub

The Water, Climate and Future Deltas Hub is conducting research on the feasibility of NbS in the contrasting Rhine and Mekong deltas. The study looks at nine options and assesses their feasibility based on their environmental (e.g. sediment availability, land use, sea level rise, subsidence) and policy requirements (e.g. legal sunsets, participatory decision-making, conflict resolution). Findings show that as most NbS options face environmental constraints, hybrid solutions are the most likely to reduce pressure. Those solutions should be complemented with mitigation actions as well as adaptive, transformative and interactive (participatory) governance.

Providing innovative, comprehensive and site-specific economic feasibility assessments will help local authorities to determine the viability of an option, in terms of financial costs and trade-offs, expected benefits and impacts - e.g. productivity, employment opportunities, ecosystem services, inequality reduction - compared to existing socio-economic capabilities - e.g. budget, tax system[34]. Among coastal cities, being able to compare adaptation options according to their costs and benefits is decisive[35] as capacities vary widely between large cities that may have the resources to develop larger and higher seawalls, and smaller towns and settlements for whom these responses may not be financially accessible. Indeed, hard protections are not likely to be economically justifiable given that defences do not necessarily meet the required standards for future sea elevation[36]. For instance, in England, it was estimated in 2017 that 71% of the coastline designated under a "hold the line" strategy presents an extremely low benefit-cost-ratio, thereby becoming undefendable at any reasonable cost in the near future[37]. To support site-specific economic assessments, several tools are available regionally such as the ECONADAPT Toolbox[38]. However, the methods and analyses are often inadequate for certain responses as many variables cannot be parametrised. In the case of managed retreat, an economic analysis fails to capture the costs of relocation relating to mental health[39]. Furthermore, a "static" cost-benefit analysis may be even more irrelevant for an adaptive approach which builds on flexibility[40]. In this regard, researchers are developing economic evaluations capable of reflecting dynamic decision-making by including "transfer costs" associated with a shift of adaptation responses[41].

Adaptation planning requires a clear understanding of stakeholders' preferences and the social acceptability of proposed measures[42]. This is particularly decisive yet challenging for coastal cities which concentrate varied communities with diverging interests. Better accounting for stakeholder preferences is key to ensuring inclusive, equitable and legitimate strategies. At the same time, research helps identify the constraints to and enabling factors of social acceptance - e.g. the level of information and trust in institutions[43]- that planners can accordingly address.

Research is needed to determine the institutional feasibility of adaptation interventions. Assessing institutional enablers and constraints is even more important in the domain of adaptation as it is embedded in long-term and integrative decision-making that is fundamentally distinctive from traditional policymaking. As current legislation, plans and strategies define the scope and process of actions, city planners consider adaptation strategies in the frame of current arrangements and operate accordingly. Furthermore, fragmented governance and a lack of coordination between services of a local authority, along with recurrent top-down decision-making are critical gaps that prevent integrative and sustainable planning[44]. Accordingly, assessments on legal, jurisdictional, institutional capacities help adjust and overhaul the setting to open the window of opportunities for planners.

Decision-making will be better informed as environmental feasibility assessments are conducted. Environmental feasibility integrates the potential impacts of adaptation measures on ecosystems and their ability to perform ecosystem functions such as providing essential ecosystem services. As national and local strategies now tend to promote biodiversity and environmental goals, technical and economic assessments do not suffice to prioritise options. This is reflected in the French Integrated Coastal Management National Strategy, which recommends the "integration of coastal ecosystems in the definition of adapted solutions[45]". Similarly, cities that have traditionally opted for hard engineering are now seeking to restore ecosystems and integrate them into existing infrastructure. To do so, policymakers need tools to compare the impacts that considered options could have on ecosystems and their services and to assess the potential of ecosystem rehabilitation in terms of risk reduction.

1.3. Defining frameworks and sharing experiences on monitoring and evaluation

Over time, continuous monitoring, reporting and evaluation (MRE) of adaptation can support the prioritisation, adjustment and sequencing of coastal adaptation strategies. Given that MRE are usually undertaken at the project level, planners need relevant and sufficient quantitative and qualitative data to monitor change and impacts. In parallel, building the capacity to interpret and exploit data is crucial to lead evaluation and reporting activities.

Further developing MRE methods and frameworks at different scales (local, national and global) and promoting real-world examples through experience sharing will be crucial in strengthening local stakeholders' capacities to conduct MRE. Setting guidelines and frameworks as well as sharing concrete examples of monitoring and evaluating adaptation will considerably facilitate this process and

32/ Glavovic, B., Dawson, R., Chow, W., Garschagen, M., Haasnoot, M., Singh, C., Thomas, A. (2022). Cross-Chapter Paper 2: Cities and Settlements by the Sea. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.
33/ Ibid
34/ Singh, C., Ford, J., Ley, D. et al. (2020).
35/ Adaptation costs are the "costs of planning, preparing for, facilitating, and implementing adaptation measures, including transition costs" and the benefits are "the avoided damage costs or the accrued benefits following the adoption and implementation of adaptation measures" in United Nations Framework Convention on Climate Change. (2011). The Nairobi Work Programme on impacts, vulnerability and adaptation to climate change, Assessing the Costs and Benefits of Adaptation Options. United Nations Framework Convention on Climate Change. Bonn. p.45. https://unfccc.int/resource/docs/publications/pub_nwp_costs_benefits_adaptation.pdf
36/ Committee on Climate Change. (2018). Managing the coast in a changing climate. Committee on Climate Change, London. https://www.theccc.org.uk/publication/managing-the-coast-in-a-changing-climate/
37/ Ibid., p. 56.
38/ Econadapt. (2019). Econadapt/Toolbox. Retrieved March 16, 2022, from https://econadapt-toolbox.eu/
39/ Thomas, A., Benjamin, L. (2020). Non-economic loss and damage: lessons from displacement in the Caribbean. Climate Policy, 20 (6). pp. 715-728. doi:10.1080/14693062.2019.1640105.
40/ Ruig, L.T., Barnard, P.L., Botzen, W.J.W., Grifman, P., Finzi Hart, J., Moel, H., Sadrpour, N., Aerts, J. (2019). An economic evaluation of adaptation pathways in coastal mega cities: An illustration for Los Angeles. Science of The Total Environment, 678. pp. 647-659, https://doi.org/10.1016/j.scitotenv.2019.04.308
41/ Haasnoot, M., et al. (2019). Investments under non-stationarity: economic evaluation of adaptation pathways. Climatic Change. https://doi.org/10.1007/s10584-019-02409-6
42/ Mallette, A., Smith, T.F., Elrick-Barr, C., Blythe, J., Plummer, R. (2021). Understanding Preferences for Coastal Climate Change Adaptation: A Systematic Literature Review. Sustainability, 13, 8594 https://doi.org/10.3390/su13158594
43/ Rey-Valette, H., Rocle, N., Vye, D., Mineo-Kleiner, L., Longépée, E., Bazart, C. & Lautrédou-Audouy, N. (2019). Acceptabilité sociale des mesures d'adaptation au changement climatique en zones côtières : une revue de dix enquêtes menées en France métropolitaine. VertigO, 19(2).
44/ Singh, C., Ford, J., Ley, D. et al. (2020).
45/ Ministère de la Transition Écologique. (2022). Adaptation des territoires aux évolutions du littoral. Retrieved April 1st, 2022, from https://www.ecologie.gouv.fr/adaptation-des-territoires-aux-evolutions-du-littoral

promote peer-learning. Nevertheless, few examples and references are available to this date as coastal adaptation MRE requires designing completely new and unique methods and references. **The Coastal Resilience Model** seeks to address this issue, proposing a practical method of measuring and monitoring resilience that incorporates stakeholders' objectives and policy-making contexts[46].

Defining and measuring the sustainability and effectiveness of responses will be facilitated by the establishment of objectives, priorities and indicators in national plans and strategies. Despite this, only a small number of countries have determined adaptation indicators in their MRE systems[47]. Their definition is complex due to limited time, data, human resources and capacities, as well as the inherent site-specificities, long horizon and uncertainties implied by SLR and climate change. Furthermore, actors are likely to have different perceptions and measures of success. In this respect, establishing and integrating relevant and operational sustainability and efficiency indicators need further coordination of stakeholders (academia, civil society, policymakers) at different scales (international, national, project levels). It is undoubtedly difficult to determine the effectiveness of adaptation planning. Nevertheless, municipalities' efforts to implement dynamic and hybrid strategies rely on their capacity to track change and potential impacts of chosen adaptation measures on the wider resilience of territories to avoid maladaptation.

46/ Townend, I.H., et al. (2021). Operationalising coastal resilience to flood and erosion hazard: A demonstration for England. Science of the Total Environment. https://doi.org/10.1016/j.scitotenv.2021.146880

47/ European Environment Agency. (2020). Monitoring and evaluation of national adaptation policies throughout the policy cycle. EEA Report No 6/2020, doi:10.2800/83221

Capitalising on the experience of flexible management

CONSERVATOIRE DU LITTORAL,

Adapto: Towards adaptive management

SUMMARY

The Adapto project, supported by the LIFE EU Program, explores solutions to the impacts of climate change on the French coasts by advocating adaptive coastal management. Experimental approaches are deployed on 10 pilot sites by using a frame of reference, analysing the context of each region (risk management, landscape, economy, social perception, etc.) and by implementing tools (3D modelling, landscape analysis, etc.), to build adaptation projects at territorial scale with local stakeholders (local authorities, managers, users).

CLASSIFICATION

Risks: Submersion, erosion, salinisation

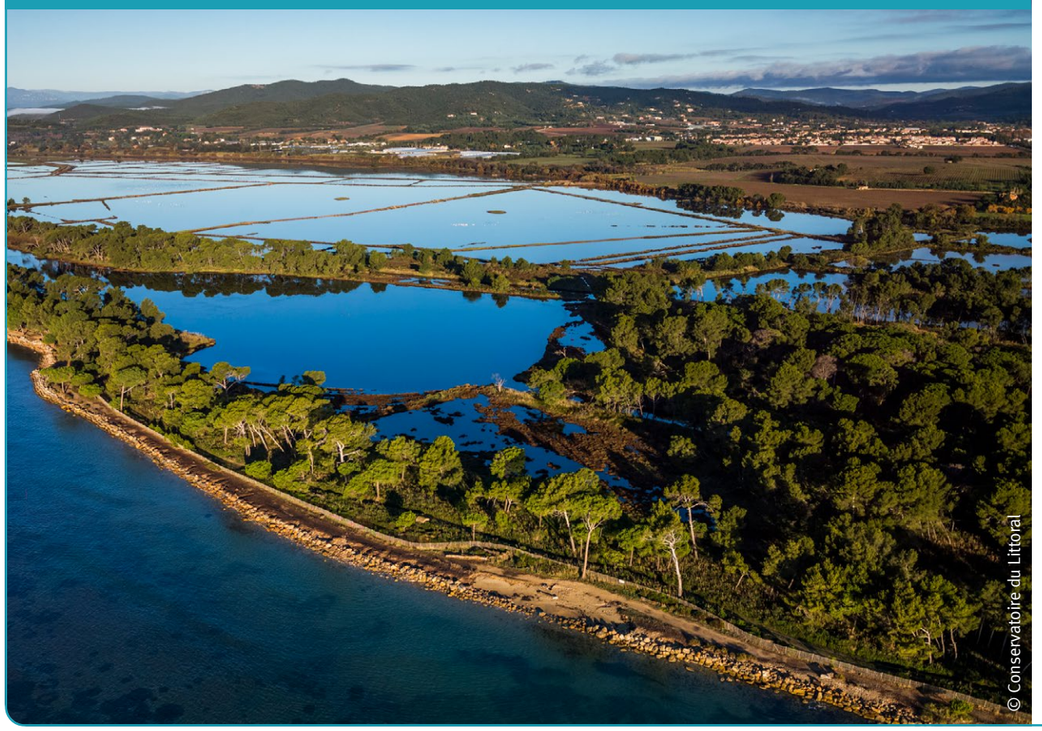
Typology of solutions: Research-action project, nature-based solutions, managed retreat, pPlanning document, capacity-building and knowledge-sharing activities

Geographical location: 10 pilot sites, France

Budget: More than EUR 1 million

Typology of actors: State services

Project duration: 2017-2022



© Conservatoire du Littoral

OBJECTIVES

Adapto aims to:

(1) Provide a better understanding of the coastline's dynamism and the need to adapt to it

(2) Create methodological tools allowing for the initiation, support and assessment of Nature-based adaptation solutions in coastal areas

(3) Develop knowledge about and acknowledgment for these solutions at all levels

(4) Define the role of natural environments in the organisation of an effective land-sea interface in relation to adaptation to climate change

(5) Allow the state of the art to improve through concrete actions in various environmental contexts representative of the diversity of ecosystems and coastal areas in Europe.

ACTIVITIES

Different kind of actions are planned:

(1) Experimentation of adaptative soft management process and methods on pilot sites: scientific and technical studies and monitoring, meetings with local stakeholders for project design based on adaptation scenarios, implementation works - e.g. renaturation, relocation, restoration.

(2) Pedagogy and communication: on-site animations, educational actions for schoolchildren.

(3) Capitalisation and experience-sharing: national and international workshops, field visits in France and Europe, website and social media reporting, newsletter, publications on pilot sites.

RESULTS

Results vary from one site to the other but main achievements include: development of decision-support tools, awareness-raising among schoolchildren, improved analysis of users' social perception, elaboration of an ecological quality indicator, mapping and projections of coastal natural habitats. Additionally, as the 10 pilot sites cover most of the European coastal environments (low and sandy Atlantic coasts, polderised low Atlantic coasts, Mediterranean barrier beaches, Mediterranean salt marshes, mangroves), the ADAPTO processes and methods are likely to be replica.

KEY TAKEAWAYS

(1) Involvement of a large diversity of stakeholders at different scales, allowing them to build their territorial project based on studies and analysis.

(2) Experience-sharing at national, European and international levels drawing on the experiences and specificities of the 10 pilot sites.

(3) Awareness-raising activities besides coastal adaptation strategies.

48/Conservatoire du Littoral. (2022). Changement climatique sur le littoral – Subir ou s'adapter ?. Retrieved March 15, 2022, from https://www.conservatoire-du-littoral.fr/38-changement-climatique.htm

49/Ocean & Climate Platform. (2021). Ocean of Solutions to tackle climate change and biodiversity loss. Ocean & Climate Platform, p. 45 https://ocean-climate.org/wp-content/uploads/2021/06/Ocean-solutions-report.pdf

2 STRENGTHENING GOVERNANCE FRAMEWORKS TO FACILITATE DYNAMIC AND HYBRID ADAPTATION MODELS

Hybrid and dynamic responses to SLR are gaining momentum in the scientific community and among policymakers. Combining and sequencing solutions foster a site-specific approach that integrates uncertainties. This approach entails more complex governance, whereby improved scientific, financial, socio-economic, political and technical conditions are prerequisites[50].

2.1. Hybridisation of solutions

Coastal settlements and cities in Northern Europe have a long history of composing with the sea, traditionally favouring protection to secure activities and gaining lands on the sea to develop agriculture. This approach is best exemplified in the Sigma (Belgium) and Delta (Netherlands) Plans that both enshrined "hard protection" strategies. Continuing engineering developments and rising concerns over biodiversity loss and climate change among Northern European countries have prompted the updating of strategies. To date, most solutions are not taken in isolation but rather in combination through time and space.

As there is no one-size-fits-all solution that can address the diversity of geographical, socio-economic, ecological and institutional conditions, stakeholders are being increasingly proactive; exploring and implementing new and hybrid strategies. Hybrid approaches consist in enhancing the resilience of existing protections and built environment while fostering the acceptance of coastal mobility and transformational change over the longer term.


© Conservatoire du Littoral

50/ Bongarts Lebbe, T., et al. (2021). Designing Coastal Adaptation Strategies to Tackle Sea Level Rise. Frontiers in Marine Science. doi: 10.3389/fmars.2021.740602

Combining engineering and ecosystems to provide co-benefits in La Rochelle, France - Tasdon wetland renaturation, La Rochelle Territoire Zéro Carbone (LRTZC)

The project "La Rochelle Territoire Zéro Carbone" (LRTZC) addresses the challenges of climate change mitigation and adaptation in La Rochelle, France. Comprised of 70 km of coastline including extensive marshes and intertidal mudflats, La Rochelle's natural environment has been severely damaged by continued urban and tourism development. One of the objectives of LRTZC is to improve coastal preparedness for sea level rise by preserving and restoring wetlands and the co-benefits they provide[51]. Therefore, the project plans to combine flood protection measures in residential areas with renaturation activities, such as in the Tasdon wetland. Located less than two kilometres from the city centre, Tasdon covers 84 Ha and provides natural protection against extreme surges by acting as a buffer zone. While the rapid urbanisation of the city in the 1970s and 1990s contributed to its disconnection from the sea, authorities and local stakeholders (e.g. universities, civil society) created more than 10 Ha of wetlands instead of limestone embankments, carried out reconnection work, designed basins, stabilised the banks and islets, built new hydraulic structures and paths to restore its natural functions and the biodiversity that it sustains (e.g. shorebird populations).

Combining upgraded engineered facilities with other methods such as soft protections (e.g. beach nourishment and sand management)[52] and NbS, potentially provides higher co-benefits, including higher socio-economic and ecological resilience, enhanced ecosystem services, while benefiting from a greater level of confidence than a single option (especially NbS)[53]. In line with this, the so-called "building with nature" approach is expanding. For instance, Ecoshape proposes to redesign the urban-water space through solutions that integrate nature alongside grey infrastructures such as reef-building shellfish enhancements[54]. Nonetheless, increasing protection levels could be insufficient and have adverse effects by creating long-term path-dependency, that is, a sense of being protected that not only spawns inertia but attracts new developments in exposed areas. Besides, as hard engineering can further disrupt ecological balances and fragilise the coast, a protection approach may not be best suited to long-term adaptation. Thinking of protection measures as a transitional stage will be paramount to implement transformational actions where populations are not opposed to nature but accept coastal mobility.

Next to protection, accommodation of existing settlements is the most widely used measure in European cities. Accommodation reduces exposure and/or vulnerability in the short to mid-term by flood-proofing facilities and properties, enhancing drainage systems, and developing early warning systems. Accommodation has the advantage of being easier to implement and with lower associated costs and environmental impacts, e.g. changing building standards[5556]. However, over the longer term and in the case of extreme sea levels, these measures may be insufficient. As such, they need to be integrated into larger strategies to prepare for more significant transformations of the uses of and settlements on the coast[57].

In this sense, all of the aforementioned options can

51/ La Rochelle Territoire Zéro Carbone. (2022). Nos Actions. Retrieved April 4, 2022, from https://www.larochelle-zerocarbone.fr/nos-actions

52/ Castellari, S., Davis, M. (2021). Global and European policy frameworks. Nature-based solutions in Europe: Policy, knowledge and practice for climate change adaptation and disaster risk reduction. European Environment Agency Report No 1/2021. doi: 10.2800/919315

53/ Ibid.

54/ Ecoshape. (2022). Cities. Retrieved March 16, 2022, from https://www.ecoshape.org/en/landscapes/cities/

55/ Dottori, F., Mentaschi, L., Bianchi, A., Alfieri, L., Feyen, L. (2020). Adapting to rising river flood risk in the EU under climate change. EUR 29955 EN. Publications Office of the European Union. Luxembourg. doi:10.2760/14505, JRC118425.

56/ Oppenheimer, M., Glavovic , B.C., Hinkel, J., van de Wal, R., Magnan, A.K., Abd-Elgawad, A., Cai, R., Cifuentes-Jara, M., DeConto, R.M., Ghosh, T., Hay, J., Isla, F., Marzeion, B., Meyssignac, B., Sebesvari, Z. (2019). Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press.

57/ Bongarts Lebbe, T., et al. (2021)

accompany the acceptance of coastal mobility and the implementation of managed retreat over the long term. Relocating populations and assets is the most effective measure to reduce vulnerabilities but can severely affect livelihoods, increase inequalities, and engage considerable expenses if not prepared. Several examples in Northern European towns of reactive retreat have resulted in resistance and resentment from local populations. For instance, in Soulac-sur-Mer, France, issues around the compensation of property owners led to deadlocks[58]. A preemptive and integrative approach supported by adequate governance frameworks and resources will be even more essential as managed retreat will be inevitable for many localities. This urgently applies to municipalities which lack the financial resources to invest in protections, but also to larger cities that need to control land availability and affordability to prevent path dependency. Limiting urban development along the coast in the short run, will make realignment policies easier and more affordable in the long run. For example, in **Criel-sur-Mer, France**, Cerema produced erosion projections at 20, 50 and 100 years, which strongly indicate that at least 11 properties are at risk of destruction in the nearest horizon and 70 at the end of the century. The agency accompanied local authorities in raising awareness of elected officials and administrative staff to foster the appropriation of the method and understanding of the report. Upon this assessment, a local adaptation plan was updated to prepare for managed retreat where necessary[59]. Beyond planning, the effective and fair implementation of this strategy will be contingent on the uptake of governance and financial enablers.

2.2. Dynamic adaptation through time and space

Adopting a flexible, responsive and long-term approach to adaptation is crucial to build sustainable strategies able to account for site-specificities and high uncertainties. In line with this, research has developed the Dynamic Adaptive Pathways theoretical framework[60]. Adaptation pathways seek to facilitate both long term vision and immediate action by sequencing and mixing accessible measures over different time horizons. Hence, they set out low-regret action, address potential maladaptation, prevent lock-ins and spread the costs.

Defining objectives is critical as adaptation pathways set out alternative routes to reach desired goals[61]. Whether being well-defined over time or broad and open to adjustments, these multidimensional objectives (ecological, socio-economic, cultural, technical or institutional) guide policymakers in the mapping of different combinations and paths[62]. Difficulties lie in collectively setting these goals. National guidance provides overarching goals but they sometimes compete with local realities and preferences. Thus, setting goals collectively entails engaging with populations at different levels of governance.

Developing adaptation pathways entails considering options over short, mid and long term horizons. Accordingly, adaptation planning uses distinctive time references compared to most public policies. Most adaptation plans incorporate long term horizons at 2100. While planning over the long term is necessary, setting short and mid terms objectives is equally relevant to avoid inaction as stakeholders may not feel the urgency to act strongly enough[63].

Anticipating the pace of SLR is key. Dynamic adaptation seeks to overcome uncertainty by anticipating thresholds and tipping points, based on assessments, projections and scenarios. Essentially, a tipping point is reached when an option fails to achieve its objectives, thereby triggering the need for a new action. Executing dynamic adaptation requires predefining the conditions leading to the tipping point and a rough estimate of when it will occur[64]. Given the remaining uncertainties on the melting of the Antarctic ice sheet, preparing for high-end climate change scenarios and high levels of SLR is particularly relevant. Although most countries are planning for high-end climate change scenarios (RCP4.5 and RCP8.5), they are not necessarily anticipating high SLR scenarios[65]. Whilst some states integrate important climatic changes in their national guidances[66] - such as Belgium through the **"Coastal Adaptation Masterplan" and the "Coastal vision project planning for protection against extreme SLR"** which define an adaptive strategy for 1, 2 and 3 m of SLR[67] - many national strategies still foresee high-end SLR below 1 m, e.g. France[68].

In practice, it can be challenging for cities and territories to develop adaptation pathways. Several tools can support the planning of dynamic models such as "territorial archetypes"[69], which show possible pathways according to a variety of territorial features, dynamics and capacities. Engaging stakeholders in the definition of objectives and tipping points can help reflect desired and unwanted change, thus supporting the collective definition of a territorial development project. Research also suggests that categorising options as "flexible", "reversible", and "low regret" or "robust" supports the decision-making over short and long horizons[70]. Likewise, visually representing pathways as sequences of decisions (e.g. diagrams) can help stakeholders understand adaptation as a series of feasible actions in coherence with longer objectives.

Adaptive planning: the case of the Project Thames Estuary 2100, England - UK Environment Agency

The Thames Estuary 2100 Plan (TE2100) is the first adaptive tidal flood risk management strategy developed in England. By taking an adaptation pathways approach, it is designed to be adaptable to different projections for climate change and SLR.

It sets out different sequences, or pathways, of actions for managing flood risk over three time periods: from 2010 to 2035, maintaining and improving current flood defences, and planning for future works; from 2035 to 2049, upgrading flood defences whilst improving the riverside environment; and from 2050 to 2100, replacing the Thames Barrier and further upgrading the network of tidal flood defences. A decision on the preferred end of century option will be taken around 2040.

Implementing the Thames Estuary 2100 Plan involves monitoring 10 change indicators to assess the most appropriate sequence of actions to manage the rate of SLR, and to adjust the timescales for those actions accordingly. This approach enables flood risk management authorities, businesses, and communities to work collaboratively to take the right actions, at the right time, to adapt to rising sea levels in the Thames Estuary.

58/ Barthélémy, S. (2020, November 06). Le Signal : épilogue d'un mauvais feuilleton à Soulac-sur-Mer. Rue89Bordeaux. Retrieved March 15, 2022, from https://rue89bordeaux.com/2020/11/le-signal-epilogue-dun-mauvais-feuilleton-a-soulac-sur-mer/#:~:text=Les%20propri%C3%A9taires%20des%2078%20appartements,plus%20de%20deux%20ans%20suite%E2%80%A6

59/ Cerema. (2018). Recul du trait de côte et identification des enjeux sur le littoral de la Seine-Maritime. Retrieved March 15, 2022, from https://www.cerema.fr/fr/projets/recul-du-trait-cote-identification-enjeux-littoral-seine

60/ McEvoy S., Haasnoot M., Biesbroek R. (2021).

61/ Haasnoot, M., Kwakkel, J. H., Walker, W. E., Maat, J. (2013). Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. Global Environmental Change. 23(2), pp. 485-498, https://doi.org/10.1016/j.gloenvcha.2012.12.006

62/ Werners, S. E., Wise, R., Butler, J., Totin, E., Vincent, K. (2021). Adaptation pathways: A review of approaches and a learning framework. Environmental Science & Policy, 116. pp. 266-275. https://doi.org/10.1016/j.envsci.2020.11.003

63/ Ibid.

64/ Haasnoot, M., Kwakkel, J. H., Walker, W. E., Maat, J. (2013)

65/ Ibid.

66/ Ibid.

67/ Presentation Peter Van Besien Northern Europe Workshop

68/ McEvoy S., Haasnoot M., Biesbroek R. (2021).

69/ Rocle, N., et al. (2020). Paving the way to coastal adaptation pathways: An interdisciplinary approach based on territorial archetypes, Environmental Science and Policy, 110, pp.34-45, https://doi.org/10.1016/j.envsci.2020.05.003

70/ Werners, S.E., et al. (2021). Adaptation pathways: A review of approaches and a learning framework. Environmental Science and Policy, 116, pp.266-275. https://doi.org/10.1016/j.envsci.2020.11.003

2.3. Developing new governance modalities to allow for hybrid and dynamic adaptation

It is paramount to strengthen local, national, European and international guidance and to reconsider appropriate levels of governance, as dynamic and hybrid adaptation plans rely on clear and ambitious roadmaps. While the local level is the most appropriate scale to define strategies that are flexible and tailored to site specificities, national plans and law that reflect on higher priorities can set guidelines, and open or constrain adaptation options for cities and territories. To date, governance frameworks are often missing and inadequately geared towards short to mid term objectives. They tend to promote grey infrastructures and pursue economic and political agendas in priority. Consequently, reforming governmental guidance is distinctly needed to reference appropriate climate change scenarios, SLR projections and time horizon, to define key concepts and processes, and to provide a clear vision of the goals and values underlying adaptation.

Improving access to finance and reforming insurance systems are essential enablers to implement hybrid and dynamic pathways that entail continuous and consequent investments[71]. Several

71/ European Commission, Directorate-General for Climate Action. (2018). Using insurance in adaptation to climate change. Publications Office. https://data.europa.eu/doi/10.2834/745494

funding programmes exist in Europe to support coastal adaptation projects, e.g. **EU Multiannual Financial Framework, the LIFE programme, Horizon Europe**. Besides, insurers and financing institutions are starting to mobilise new financing channels to support sustainable development and reduce coastal risks, e.g. impact investments, blue bonds, incentives and funding for pre-disaster mitigation, post-disaster recovery funds, premiums[72],[73] .
Nonetheless, the lack of economic resources is systematically reported locally. In addition to being insufficient, it is notoriously difficult for local stakeholders to gain information about and access to these programmes.

Moreover, current insurance systems are anticipated to become inadequate to support financial recovery while simultaneously incentivising risky developments in exposed areas. With increasing risks, the burden on public budgets and insurers to absorb impacts will rise drastically over the medium to long term. However, insurers can contribute to strengthening the information on risks by assessing, communicating and signalling. For instance, they can drive the reduction of impacts by setting incentives and requirements for risk management, e.g. price signalling. Furthermore, through adequate financial compensation, insurances can accelerate recovery[74]. The European Commission reports that insurance systems based on collective solidarity - such as insurance systems based on shared responsibility in France and the Netherlands, or the universal flood coverage provided in the UK - potentially provide maximum coverage and evenly distribute risks. Besides, research has shown that insurance systems covering risks separately have lower cost-effectiveness than single insurance products for multiple risks[75], especially since many cities face compound risks. In France, public compensations are provided for frontline assets through the Fund for the Prevention of Major Natural Hazards (FPRNM). Nonetheless, erosion risks are not counted as eligible risks, thereby separating submersion and erosion compensations[76]. Finally, insurance systems based on collaboration between public and private risk managers - as illustrated by the **Storm Council in Denmark** - usually perform better[77].

Considering a larger governance scale facilitates more holistic and efficient responses given that coastal hazards affect the coastline beyond administrative limits. In this regard, some municipalities are already cooperating and partnering to accommodate the sediment cells instead of limiting action to the administrative boundaries. This approach is critical to preserve the ecological connectivity and ecosystemic integrity, thereby avoiding the potential transfer of impacts caused by disturbed sediment transport due to unilaterally chosen protection measures.Besides a concerted approach makes political and economic sense for localities which are able to share resources and capacities[78]. Extending the scope to inland territories is also relevant. In the case of managed realignment, coastal cities may have difficulty finding available land to relocate houses and activities. Meanwhile, decision-making will affect inland populations' uses of coastal assets while inland migrations of coastal communities and activities will further impact livelihoods and economies in the hinterland. As such, to allow local resettlement in the future, cities will have to foster cooperation with neighbouring localities.

Establishing participative and inclusive decision-making is necessary as coastal adaptation is fundamentally a question of social justice. Indeed, even more so than other territorial development projects, adaptation raises equity and solidarity concerns. Therefore, making sustainable, just and equitable decisions entails integrating and mobilising all stakeholders concerned, including the most vulnerable populations e.g. young and elderly populations. An added benefit of participative planning is that it tends to reinforce acceptance towards options that are usually disputed, e.g. managed retreat.

72/ Bongarts Lebbe, T., et al. (2021)
73/ Airoldi, L., Beck, M. W., Firth, L. B., Bugnot, A. B., Steinberg, P. D., & Dafforn, K. A. (2021). Emerging solutions to return nature to the urban ocean. Annual Reviews Marine Science, 13, 445-447. https://doi.org/10.1146/annurev-marine-032020-020015
74/ European Commission, Directorate-General for Climate Action. (2018). Using insurance in adaptation to climate change. Publications Office. https://data.europa.eu/doi/10.2834/745494
75/ Ibid.

76/ La Fabrique Ecologique. (2020). L'adaptation au changement climatique sur le littoral, Synthèse de la note. Online. https://www.lafabriqueecologique.fr/app/uploads/2020/05/Note-39-Adaptation-littoral-VP.pdf
77/ European Commission, Directorate-General for Climate Action (2018)
78/ Bongarts Lebbe, T., et al. (2021)

Planning transformational change in the City of Glasgow

SNIFFER

Climate Ready Clyde

SUMMARY

Climate Ready Clyde (CRC) is a cross-sector initiative funded by fifteen member organisations and supported by the Scottish Government to create a shared vision, strategy, and action plan for an adapting Glasgow City Region (GCR). CRC's vision is a Glasgow City Region which flourishes in the future climate.

Members include the eight Local Authorities located across GCR, NHS Greater Glasgow and Clyde, University of Glasgow, University of Strathclyde, Strathclyde Partnership for Transport, Scottish Environmental Protection Agency, SGN, NatureScot.

CLASSIFICATION

Risks: Submersion, erosion

Typology of solutions: Research-action project, nature-based solutions, capacity-building and knowledge-sharing activities

Geographical location: Glasgow, Scotland

Budget: Between EUR 100.000 – 1 million

Typology of actors: Association, NGOs, CSOs

Project duration: N/A

OBJECTIVES

Climate Ready Clyde builds on strengthening collective evidence and capacity to create the conditions for a regional transformation to achieve a more resilient, prosperous and fairer Glasgow City Region.

ACTIVITIES

CRC was established on the basis that adapting to climate change is cheaper, easier and more effective when done together. In line with this, CRC draws on the collaboration of its members and other actors, reaching across silos, sectors and agendas to create collective impact. By contributing to debates and discussions, CRC's members and its Secretariat are drivers for informing and shaping the direction of Glasgow City Region and wider Scotland. Besides, CRC's work on evidence, along with its adaptation guidance and resources supports easier, more substantive, and faster delivery of adaptation. Finally, it aspires leading in the global movement for climate action by showcasing Glasgow City Region's efforts to adapt on a global stage while connecting and learning from other cities to accelerate adaptation.

RESULTS

Since its launch, CRC has contributed to increasing the understanding of how changes in the climate are likely to affect the Glasgow City Region. Its productions include: a toolkit for assessing and addressing risk in the development of built environment and infrastructure projects; the Region's first Climate Risk and Opportunity Assessment; a Theory of Change which sets out a shared vision with over 100 stakeholders of what is needed to flourish in the future climate, a Literature Review Synthesis on transformational adaptation; as well as the Region's first Climate Adaptation Strategy and Action Plan.

KEY TAKEAWAYS

CRC has identified stretching targets to help ensure the Action Plan stays true to the intention of supporting the most vulnerable, and of overcoming the financial and inclusion barriers to achieving the Strategy's interventions. By 2025, Glasgow City Region should have:

(1) Increased the resilience of over 140,000 of the region's most vulnerable people to the impact of climate change.

(2) Closed the region's adaptation finance gap of £184 m a year.

(3) Involved 125 new organisations, community groups and businesses supporting Glasgow City Region to adapt.

3 SHAPING RESILIENT COASTAL CITIES THROUGH STAKEHOLDER ENGAGEMENT

Coastal cities are increasingly densely populated and, as such, federate diverse demographics and stakeholders with varied uses and visions of their environment. Adaptation, closely intertwined with social acceptance issues, offers the opportunity to collectively rethink coastal cities to create a common vision of territorial development. In this respect, decision-makers and planners need to better understand the needs and demands. A thorough identification and fair representation of the pertinent stakeholders is required in order to comprehensively grasp and address the large spectrum of issues raised by adaptation. Besides, as multiple, tailored, innovative means of communication are deployed to inform populations, the decision-making process is likely to be better informed, thus more efficient and sustainable. Coastal adaptation is a long term, ongoing process and engagement must be considered at every stage of the adaptation process - which often implies considerable capacity growth.

3.1. Reaching a multidimensional understanding of adaptation

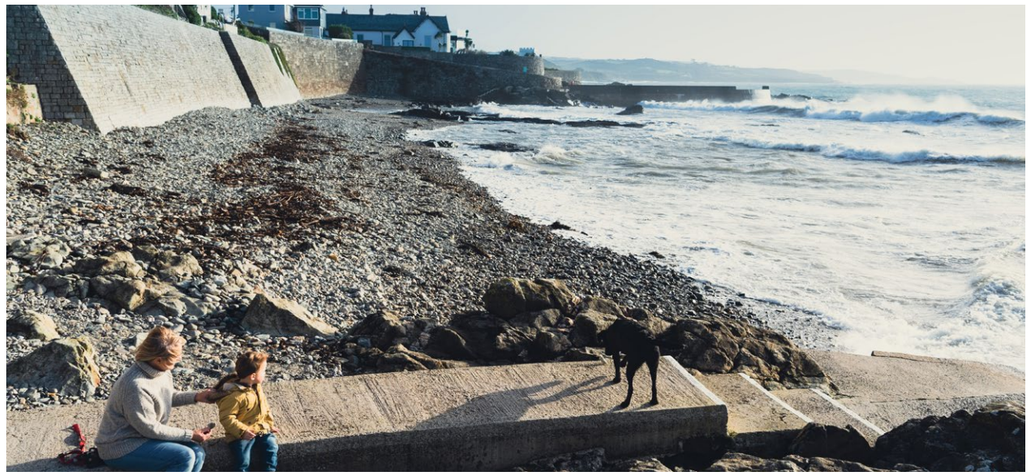
Consulting with local stakeholders and academics is essential to apprehend all dimensions of the challenges arising from SLR and adaptation. Eventually, it contributes to better integrate social equity concerns into the design and implementation of responses. Frontline communities can bring insight into the multidimensional risks brought by rising sea levels, thereby helping researchers identify the multitude of intersections between socio-economic conditions and exposure. Engaging with local actors enhances the comprehension of how communities prepare and cope with current hazards and how adaptation will positively benefit the population (e.g. reduce inequality). In this respect, integrating populations into knowledge generation through participatory science programmes can yield robust and site-specific knowledge. In line with this principle, **the Dôme in Caen, France, implements Living Labs** which bring together scientists, economic stakeholders, representatives of local authorities and civil society around scientific and social issues related to the evolution of their territories to improve local vulnerability diagnosis[79].

Apprehending the consequences of SLR and adaptation responses requires preliminary identification work of relevant actors. This work aims to determine the type and scope of actors with whom competent authorities should engage. It is paramount that this identification and classification of stakeholders works through assumptions and perceptions to reach a fair representation of the widest variety of concerns. Indeed, preconceptions about the interest and qualification of stakeholders to participate in the decision-making can undermine their representation and integration, e.g. young demographics[80]. Another barrier lies in the self-identification of populations which may differ from that assigned to them. For example, so-called "vulnerable" communities may not relate to said category. This renders mobilisation even more challenging.

Policymakers must consider stakeholders across time and generations given that adaptation is a long-term process. Adopting a trans-generational approach helps build a collective, holistic vision for the future of the coastlines that can guide adaptation

79/ Millet, F., Ducoulombier, P. (2021). Living Lab de recherche et médiation scientifique : une tentative d'innovation populaire. VertigO - la revue électronique en sciences de l'environnement [En ligne], Hors-série 34, DOI : https://doi.org/10.4000/vertigo.30249

80/ Rhys, K., Ute, K. (2019). Community engagement on climate adaptation - an evidence review, From the project: Working together to adapt to a changing climate: flood and coast. Environment Agency, Horizon House, Deanery Road. Bristol. BS1 5AH, ISBN: 978-1-84911-429-5



strategies. This means considering communities who have used, are currently using and/or will use the coast in the future. This is essential to better grasp the connection that communities have to the coastline, which has driven them to value, enjoy and inhabit it, and will encourage them to protect it in the future.

Delimiting the right geographical scale is thus primordial. A scale that is too limited may overlook populations that are impacted by adaptation planning - albeit differently from those already clearly identified, especially inland populations. Coastal towns are often popular tourist destinations for inland populations whose access to and enjoyment of coastal assets may be affected by adaptation measures. Enlarging the geographical scale contributes to fostering territorial solidarity and capacity building, bringing in additional competencies, capital and insights from similar experiences. In this regard, regional and international solidarity networks that share experiences and resources are contributing to more efficient processes and work.

3.2. Enabling informed participation

Collective capacity building helps pinpoint and work through cognitive and behavioural biases impeding adaptation and informed decision-making. Indeed, cognitive biases (optimism and misperception of risks), combined with emotional and cultural attachment to assets and landscapes, often result in resistance towards change. Meanwhile, elected officials seeking to ensure the electoral vote and fearing contestation, sometimes opt for short term solutions and/or for the *status quo*[81].

Raising awareness implies disseminating accessible, understandable and actionable scientific knowledge among populations. It is about creating a new risk culture in which a set of perceptions and behaviours are adopted by society in the face of risk, thereby allowing it to consider adaptation as a solution to their constraints. Furthermore, presenting adaptation alternatives to hard protection and explaining the benefits and limits of each of the options improve decision-makers and populations' acceptance of other responses than say defences[82]. This is particularly relevant for managed retreat which communities often view as disproportionate compared to their risk perception. Different tools such as virtual reality or serious games can help citizens and policymakers to collectively commit and consider different pathways. In addition, infusing a long term perspective and anticipating future risks allow immediate decision-making to be more careful and supportive of long-term adaptation. All combined, this contributes to strengthening a risk culture while guiding preferences towards sustainable alternatives.

81/ Rey-Valette, H., Rulleau, B. (2016). Gouvernance des politiques de relocalisation face au risque de montée du niveau de la mer. Développement durable et territoires. 7(1). DOI : 10.4000/developpementdurable.11282

82/ Rhys, K., Ute, K. (2019).

Experimenting adaptation strategies through "Serious Game" with LittoSIM, France - CNRS UMR LIENSs

LittoSIM is a participative simulation platform financed by the CNRS, the Fondation de France and the Region of Nouvelle-Aquitaine.

The platform enables local elected officials and technicians to experiment and co-elaborate on different adaptation paths. The simulation takes the form of a "serious game" which integrates the risk of marine submersion, models the actors involved in the territory and simulates the game actions played in situ by elected officials and technicians. Different configurations are available to adapt the game to local specificities such as low sandy coasts, cliffs and valleys, as well as estuarine areas.

The game explores different flood risk management scenarios, where development is driven by the players' planning choices and the simulation itself. At the end of the game, the strategies tested by the different teams are discussed and debated.

Following a workshop conducted in 2017 in Oleron Island, France, surveys showed that a third of participants changed their opinion on different prevention strategies, with a notable positive evolution towards so-called soft protection strategies[83].

Building on relevant communication and mobilisation channels and networks will improve the exchange of information between policymakers and communities. It is critical to understand that these channels usually differ among actors, according to their age, role, location, etc. Among communities, partnering with key intermediaries facilitates the channelling of information and fosters mobilisation. Intermediaries include religious communities, community champions, but also schools and museums.

A multimedia approach multiplies opportunities to reach out to a large number of stakeholders. Although traditional media such as print, television and email are still prominent, communication through social media and platforms to address younger demographics is relevant too.

Similarly, relying on different formats to convey knowledge can enlarge the uptake of adaptation issues. Preparing participatory and educational activities such as participatory GIS and DIY[84] sensors, using new technologies like virtual reality, mobilising artists and organising festivals are innovative ways already used in Northern Europe to raise awareness amongst a large and diverse range of actors.

It is worth considering the role of memory in raising awareness. For instance, in several coastal towns of the **Charente region in France, authorities installed landmarks indicating sea levels** reached during severe storms in order to remind populations of the submersion risk[85]. Indeed, acting on the collective memory of past floods can create social learning opportunities and improve engagement in the future by reactivating the remembrance of past events that may have had fade over time[86, 87].

A particular emphasis should be put on using appropriate language and frames when informing and communicating with populations. The use of complex technical terms constitutes a major barrier to collective understanding and learning. While being scientifically accurate, adaptation terminology may be understood differently and even negatively. Focusing on providing precise facts but conveying them intelligibly reinforces public comprehension and appropriation of information. Meanwhile, engaging with diverse communities implies giving equal participation capacities. For instance, translations, when needed, should be provided. Furthermore, reframing may be necessary to change perceptions and assumptions about particular options and contribute to building a stronger sense of responsibility. For example, instead of referring to "flood defence", "flood management" conveys the idea that options are not limited to protection, and that there is a collective and active responsibility to plan and implement adaptation[88]. **Offering the tools and platforms for actors to express their concerns, needs, interests and opinions as well as to resolve potential conflicts is essential.** In this regard, organising regular meetings and workshops is crucial to allow populations to communicate and inform decision-making. These meetings help track the impacts of adaptation strategies and co-define what the "success" of an adaptation measure looks like. Indeed, determining the effectiveness and sustainability of an intervention is likely to considerably vary among stakeholders and some impacts may be hard to measure - e.g. loss of cultural heritage[89].

3.3. Building long-term and substantive engagement

Co-conceived measures have a better chance to become inclusive, legitimate and equitable strategies, reflective of people's preferences, values and cultures. Indeed, adaptation planning offers the opportunity to create a sense of ownership of the decided trajectory and to reinforce trust towards implementing institutions. Hence, this implies considerable capacities and time to build long-term and substantive engagement that coastal planners are often currently lacking.

Whenever possible, engagement should be undertaken at all stages of adaptation. Stakeholder participation needs to occur early, often and over the long term, given that resilience draws on preparedness, that information may change as conditions evolve and that the challenges continue well beyond the implementation of strategies. So far, the occurrence of stakeholder engagement throughout the entire adaptation process appears to be limited in Northern Europe. With fewer guidelines and examples on public involvement during the implementation, evaluation and monitoring phases, these steps can be mis-planned, resulting in lower ownership and understanding of the chosen strategies. In turn, there is a clear need to launch an active reflection on effectively engaging populations beyond the planning phase and translating it into actual guidance to facilitate stakeholder engagement from risk assessment to MRE.

Offering compensation and creating opportunities such as improved public access and utilities, community buy-in, mobilisation and growth of the local workforce may be good ways to engage communities over the long run. Indeed, adaptation planning is an occasion to associate with and develop new economic sectors. It is particularly relevant as contestation may arise throughout the process, while the level of interest may decrease over time, especially as changes are slow and the perception of solutions' impacts may be delayed with time.

The level of engagement must be flexible depending on the type of measures and actors. Projects may require differentiated levels of engagement, such as information and communication activities, reviewing strategies, and cooperation and partnering around the co-design and implementation of responses. Some interventions require lower mobilisation and consultation, such as the upgrade of infrastructures, while others such as managed retreat necessitate a high degree of transparency in the information provided and greater engagement of stakeholders. In parallel, authorities need to ensure that the actors who are disproportionately affected and/or traditionally excluded from decision-making have the resources and agency to contribute to the development of adaptation strategies. In doing so, it is paramount to prevent tokenism, namely a symbolic representation of particular communities which does not translate into their ability to actively participate.

Long term engagement requires aligning resources with political ambitions. Allocating more human and economic resources to stakeholder engagement is a sine qua non condition for coastal adaptation. Besides, providing national strategic plans for population engagement throughout the entire adaptation process can reduce the burden on local authorities. Ultimately, involving and empowering Civil Society Organisations (CSOs) with experience in planning and facilitating engagement may accelerate and improve participation planning.

83/ Ocean & Climate Platform. (2021). *Map of Solutions' Project Sheet, Participative simulation to raise awareness among coastal planning stakeholders on maritime flood risks* (LittoSIM). Retrieved March 16, 2022, from: https://ocean-climate.org/en/participative-simulation-to-raise-awareness-among-coastal-planning-stakeholders-on-maritime-flood-risks-littosim/

84/ GIS and DIY respectively stand for Geographic Information System and Do It yourself

85/ EPTB Charente. (2017). Repères de Crues et de Submersions, Bassin Versant de la Charente. http://www.fleuve-charente.net/wp-content/uploads/2015/09/4-PAGES-LIVRET-REPERES-CRUE-A3-web.pdf

86/ Garde-Hansen, J., McEwen, L., Holmes, A., & Jones, O. (2017). Sustainable flood memory: Remembering as resilience. Memory Studies, 10(4), pp. 384–405. https://doi.org/10.1177/1750698016667453

87/ Ibid.

88/ Rhys, K., Ute, K. (2019).

89/ Rhys, K., Ute, K. (2019).

Delivering more through effective partnerships

COASTAL PARTNERS

SUMMARY

Coastal Partners was launched to deliver a combined, efficient, and comprehensive coastal management service across the coastlines of four Local Authorities including: Havant Borough Council, Portsmouth City Council, Gosport Borough Council and Fareham Borough Council. Coastal Partners is an innovative initiative made up of a 55 strong team of specialist coastal officers and engineers who manage 162 km of the southern UK coastline. This comprehensive coastal management service is driven forward by the central notion that coastal processes and coastal risk do not respect administrative boundaries, alongside the aspiration that by working together as a group of Risk Management Authorities, more could be achieved for the coastal communities being served.

CLASSIFICATION

Risks: Submersion, erosion

Typology of solutions: Research-action project, Nature-based solutions / Ecosystem-based adaptation, Managed realignment, Planning documents, Hard and soft protections, Accommodation, Capacity-building and knowledge-sharing activities, Community participation and engagement, Habitat creation and environment improvements

Geographical location: cities of Havant, Portsmouth, Gosport, Fareham, England

Budget: + EUR 1 million

Typology of actors: Local, regional authorities

Project duration: Since 2008

© Coastal Partners

OBJECTIVES

Coastal Partners' vision is to manage coastlines, improve community resilience and enhance the natural environment. Its mission include:

(1) Providing leading edge and innovative solutions which demonstrate best practice in coastal, environmental and community support.

(2) Providing coastal defence and management services.

(3) Developing and delivering environmental and habitat services, which are complementary to coastal defence and maintenance.

(4) Shaping, developing, maintaining places which reduce risk, and enhancing resilience for communities.

(5) Delivering high quality outcomes.

(6) Leading and developing the service through high professional standards, expertise, innovation, collaboration and partnership.

ACTIVITIES

Coastal Partners functions involve managing flood and erosion risk, planning and designing new coastal defence schemes, inspecting and maintaining existing defences and working towards a flood resilient future through adaptation. In addition, the organisation has evolved its expertise into habitat and environmental matters, geomatics, funding, research and data analysis.
By working closely with local and regional stakeholders across the four Local Authorities, Coastal Partners have been pioneering a more open and joined-up approach to coastal management to facilitate place shaping and place making. Alongside this, the organisation promotes collaboration between national and local government agencies, highlighting the need for them to recognise the benefits of aligning multiple objectives and funding partners to deliver holistic outcomes for coastal communities.

RESULTS

Over the next 10 years the capital programme alone identifies nearly EUR 358 million of project delivery (across 30 projects) to better protect over 10,000 homes from coastal flooding and erosion for the next 100 years. These projects include critical environmental initiatives such as intertidal habitat creation and saltmarsh restoration[90].

KEY TAKEAWAYS

Coastal Partners' success stems from partnerships and driving values:

- Strong leadership, staff development and support; high professional standards.
- Leading and innovating sustainable services.
- Delivering high quality community satisfaction.
- Communicating with and understanding the community's needs.
- Partnering and effectively sharing resources.
- Environmentally conscious, protective and enhancing resilience.

90/ Coastal Partners. (2020). Report 2020. Retrieved March 15, 2022, from https://issuu.com/coastalpartners/docs/cp_pr_2020_singles_lr

RESOURCES

Presentation made at the Sea'ties Workshop Adapting Coastal Cities to Sea Level Rise in Northern Europe

Douglas., C. (2021). Video - *UK Environment Agency*. Sea'ties Workshop Adapting Coastal Cities to Sea Level Rise in Northern Europe, Online.

Nicholls, R. (2021). *Planning and implementing coastal adaptation responses*. Sea'ties Workshop Adapting Coastal Cities to Sea Level Rise in Northern Europe, Online.

Pearce, C. (2021). *Climate Ready Clyde: Local Adaptation Planning*. Sea'ties Workshop Adapting Coastal CIties to Sea Level Rise in Northern Europe, Online.

Scown, M. (2021). *Nature-based solutions in coastal deltas*. Sea'ties Workshop Adapting Coastal Cities to Sea Level Rise in Northern Europe, Online.

Stratton, M. (2021). *Delivering more through effective partnership*. Sea'ties Workshop Adapting Coastal Cities to Sea Level Rise in Northern Europe, Online.

Van Besien, P. (2021). *Agency for Maritime Services and Coast (MDK)*. Sea'ties Workshop Adapting Coastal Cities to Sea Level Rise in Northern Europe, Online.

Wisewest, T. (2021). *Equity in coastal adaptation planning*. Sea'ties Workshop Adapting Coastal Cities to Sea Level Rise in Northern Europe, Online.

Literature

Airoldi, L., Beck, M. W., Firth, L. B., Bugnot, A. B., Steinberg, P. D., & Dafforn, K. A. (2021). *Emerging solutions to return nature to the urban ocean. Annual Reviews Marine Science*, 13, 445-447. https://doi.org/10.1146/annurev-marine-032020-020015

Bongarts Lebbe, T., Rey-Valette, H., Chaumillon, É., Camus, G., Almar, R., Cazenave, A., Claudet, J., Rocle, N., Meur-Férec, C., Viard, F., Mercier, D., Dupuy, C., Ménard, F., Rossel, B.A., Mullineaux, L., Sicre, M-A., Zivian, A., Gaill, F., & Euzen, A. (2021). Designing Coastal Adaptation Strategies to Tackle Sea Level Rise. Frontiers in Marine Science. doi: 10.3389/fmars.2021.740602

Eilander, D., et al. (2020). The effects of surge on riverine flood hazard and impact in deltas globally. *Environmental Research Letter*. 15(10), 104007, https://doi.org/10.1088/1748-9326/ab8ca6

Garde-Hansen, J., McEwen, L., Holmes, A., & Jones, O. (2017). *Sustainable flood memory: Remembering as resilience. Memory Studies*, 10(4), pp. 384-405. https://doi.org/10.1177/1750698016667453

Haasnoot, M., et al. (2019). Investments under non-stationarity: economic evaluation of adaptation pathways. Climatic Change. https://doi.org/10.1007/s10584-019-02409-6

Haasnoot, M., Kwakkel, J. H., Walker, W. E., Maat, J. (2013). Dynamic adaptive policy pathways: *A method for crafting robust decisions for a deeply uncertain world. Global Environmental Change*. 23(2), pp. 485-498, https://doi.org/10.1016/j.gloenvcha.2012.12.006

Mallette, A., Smith, T.F., Elrick-Barr, C., Blythe, J., Plummer, R. (2021). *Understanding Preferences for Coastal Climate Change Adaptation: A Systematic Literature Review. Sustainability*. 13, 8594 https://doi.org/10.3390/su13158594

Mao, D., Lai, S., Su Li, H., Hsu, K. (2020). The Delta Programme: The Dutch integrated approach to climate resilience. *Centre for Livable Cities*. Singapore. https://www.clc.gov.sg/docs/default-source/commentaries/bc-2020-08-the-delta-programme.pdf

McEvoy, S., Haasnoot, M., Biesbroek, R. (2021). *How are European countries planning for sea level rise?. Ocean & Coastal Management*. 203. https://doi.org/10.1016/j.ocecoaman.2020.105512.

Melet, A., et al. (2021). European Copernicus Services to Inform on Sea-Level Rise Adaptation: Current Status and Perspectives. *Frontiers in Marine Science*. 8. doi=10.3389/fmars.2021.703425

Meur-Ferec, C., et al. (2020). *Une méthode de suivi de la vulnérabilité systémique à l'érosion et la submersion marines. Développement durable et territoires. 11(1).*

Millet, F., Ducoulombier, P. (2021). *Living Lab de recherche et médiation scientifique : une tentative d'innovation populaire. VertigO - la revue électronique en sciences de l'environnement* [En ligne], Hors-série 34, DOI : https://doi.org/10.4000/vertigo.30249

Rey-Valette, H., Rocle, N., Vye, D., Mineo-Kleiner, L., Longépée, E., Bazart, C. & Lautrédou-Audouy, N. (2019). Acceptabilité sociale des mesures d'adaptation au changement climatique en zones côtières : une revue de dix enquêtes menées en France métropolitaine. *VertigO*. 19(2).

Rey-Valette, H., Rulleau, B. (2016). Gouvernance des politiques de relocalisation face au risque de montée du niveau de la mer. *Développement durable et territoires*. 7(1). DOI : 10.4000/developpementdurable.11282

Rhys, K., Ute, K. (2019). Community engagement on climate adaptation - an evidence review, From the project: Working together to adapt to a changing climate: flood and coast. *Environment Agency, Horizon House, Deanery Road. Bristol*. BS1 5AH, ISBN: 978-1-84911-429-5

Rocle, N., et al. (2020). *Paving the way to coastal adaptation pathways: An interdisciplinary approach based on territorial archetypes, Environmental Science and Policy*, 110, pp.34-45, https://doi.org/10.1016/j.envsci.2020.05.003

Ruig, L.T., Barnard, P.L., Botzen, W.J.W., Grifman, P., Finzi Hart, J., Moel, H., Sadrpour, N., Aerts, J. (2019). *An economic evaluation of adaptation pathways in coastal mega cities: An illustration for Los Angeles. Science of The Total Environment*. 678. pp. 647-659, https://doi.org/10.1016/j.scitotenv.2019.04.308.

Singh, C., Ford, J., Ley, D. et al. (2020). *Assessing the feasibility of adaptation options: methodological advancements and directions for climate adaptation research and practice. Climatic Change*. 162. pp. 255–277. https://doi.org/10.1007/s10584-020-02762-x

Thomas, A., Benjamin, L. (2020). Non-economic loss and damage: lessons from displacement in the Caribbean. *Climate Policy*. 20 (6). pp. 715-728. doi:10.1080/14693062.2019.1640105.

Townend, I.H., et al. (2021). *Operationalising coastal resilience to flood and erosion hazard: A demonstration for England. Science of the Total Environment, Vol 783*. https://doi.org/10.1016/j.scitotenv.2021.146880

Werners, S. E., Wise, R., Butler, J., Totin, E., Vincent, K. (2021). Adaptation pathways: A review of approaches and a learning framework. Environmental Science & Policy. 116. pp. 266-275. https://doi.org/10.1016/j.envsci.2020.11.003.

Reports

Castellari, S., Davis, M. (2021). *Global and European policy frameworks. Nature-based solutions in Europe: Policy, knowledge and practice for climate change adaptation and disaster risk reduction*. European Environment Agency Report No 1/2021. doi: 10.2800/919315

Committee on Climate Change. (2018). *Managing the coast in a changing climate*. Committee on Climate Change, London. https://www.theccc.org.uk/publication/managing-the-coast-in-a-changing-climate/

Department for Environment Food and Rural Affairs. (2006). *Shoreline management plan guidance - Volume 1: Aims and requirements*. Department for Environment Food and Rural Affairs. London. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69206/pb11726-smpg-vol1-060308.pdf

Dottori, F., Mentaschi, L., Bianchi, A., Alfieri, L., Feyen, L. (2020). *Adapting to rising river flood risk in the EU under climate change. EUR 29955 EN. Publications Office of the European Union*. Luxembourg. doi:10.2760/14505, JRC118425.

European Commission. (2021). *The EU Blue Economy Report*. Publications Office of the European Union. Luxembourg. https://ec.europa.eu/oceans-and-fisheries/system/files/2021-05/the-eu-blue-economy-report-2021_en.pdf

European Commission, Directorate-General for Climate Action. (2018). *Using insurance in adaptation to climate change. Publications Office*. https://data.europa.eu/doi/10.2834/745494

European Environment Agency. (2020). *Monitoring and evaluation of national adaptation policies throughout the policy cycle*. EEA Report No 6/2020, doi:10.2800/83221

La Fabrique Ecologique. (2020). *L'adaptation au changement climatique sur le littoral, Synthèse de la note*. Online. https://www.lafabriqueecologique.fr/app/uploads/2020/05/Note-39-Adaptation-littoral-VP.pdf

Glavovic, B., Dawson, R., Chow, W., Garschagen, M., Haasnoot, M., Singh, C., Thomas, A. (2022). Cross-Chapter Paper 2: Cities and Settlements by the Sea. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

IOC-UNESCO. (2020). *Global Ocean Science Report 2020–Charting Capacity for Ocean Sustainability*. K. Isensee (ed.), Paris, UNESCO Publishing. https://gosr.ioc-unesco.org/files/GOSR2020_IOC-UNESCO_full_report.pdf

IPCC (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

IPCC (2018). Annex I: Glossary [Matthews, J.B.R. (ed.)]. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press

Ocean & Climate Platform. (2021). *Adapting Coastal Cities and Territories to Sea Level Rise. Ocean & Climate Platform*. https://ocean-climate.org/wp-content/uploads/2021/11/Policy_Brief_AdaptationEN_V4-1.pdf

Ocean & Climate Platform. (2021). Ocean of Solutions to tackle climate change and biodiversity loss. *Ocean & Climate Platform*, p. 45 https://ocean-climate.org/wp-content/uploads/2021/06/Ocean-solutions-report.pdf

OECD. (2019). *Policy Highlights: Responding to Rising Seas: OECD Country Approaches to Tackling Coastal Risks*. OECD Publishing. Paris. https://doi.org/10.1787/9789264312487-en.

Oppenheimer, M., Glavovic , B.C., Hinkel, J., van de Wal, R., Magnan, A.K., Abd-Elgawad, A., Cai, R., Cifuentes-Jara, M., DeConto, R.M., Ghosh, T., Hay, J., Isla, F., Marzeion, B., Meyssignac, B., Sebesvari, Z. (2019). Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press.

United Nations Framework Convention on Climate Change. (2020). Policy Brief: Technologies for Averting, Minimizing and Addressing Loss and Damage in Coastal Zones. UNFCCC. https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/2020_coastalzones/

United Nations Framework Convention on Climate Change. (2011). *The Nairobi Work Programme on impacts, vulnerability and adaptation to climate change, Assessing the Costs and Benefits of Adaptation Options*. United Nations Framework Convention on Climate Change. Bonn. p.45. https://unfccc.int/resource/docs/publications/pub_nwp_costs_benefits_adaptation.pdf

Websites

Cerema. (2018). *Recul du trait de côte et identification des enjeux sur le littoral de la Seine-Maritime*. Retrieved March 15, 2022, from https://www.cerema.fr/fr/projets/recul-du-trait-cote-identification-enjeux-littoral-seine

Climate Ready Clyde. (2020). *The Difference We Make*. Retrieved March 15, 2022, from http://climatereadyclyde.org.uk/the-difference-we-make/

Coastal Partners. (2020). *Report 2020. Retrieved* March 15, 2022, from https://issuu.com/coastalpartners/docs/cp_pr_2020_singles_lr

Conservatoire du Littoral. (2022). *Changement climatique sur le littoral – Subir ou s'adapter ?*. Retrieved March 15, 2022, from https://www.conservatoire-du-littoral.fr/38-changement-climatique.htm

Copernicus. (2021). *Copernicus services*. Retrieved March 16, 2022, from https://www.copernicus.eu/en/copernicus-services

Econadapt. (2019). *Econadapt/Toolbox*. Retrieved March 16, 2022, from https://econadapt-toolbox.eu/

Ecoshape. (2022). *Cities. Retrieved* March 16, 2022, from https://www.ecoshape.org/en/landscapes/cities/

European Commission. (2021). *Joint Research Data Center Catalogue, Large Scale Integrated Sea-level and Coastal Assessment Tool.* Retrieved March 16, 2022, from https://data.jrc.ec.europa.eu/collection/liscoast#datasets

European Environment Agency. (2020). *Climate change impacts in Europe. Retrieved March 16, 2022, from* https://www.eea.europa.eu/highlights/why-does-europe-need-to/climatechangeimpactineurope.pdf/view

European Environment Agency. (2020). Europe's seas and coasts. Retrieved March 16, 2022, from https://www.eea.europa.eu/themes/water/europes-seas-and-coasts

European Environment Agency. (2021). Global and European sea level rise. Retrieved March 16, 2022, from https://www.eea.europa.eu/ims/global-and-european-sea-level-rise

Eurostat. (2022). Data. Retrieved March 16, 2022, from https://ec.europa.eu/eurostat/web/main/data/database

EPTB Charente. (2017). Repères de Crues et de Submersions, Bassin Versant de la Charente. Retrieved March 16, 2022, from http://www.fleuve-charente.net/wp-content/uploads/2015/09/4-PAGES-LIVRET-REPERES-CRUE-A3-web.pdf

La Rochelle Territoire Zéro Carbone. (2022). Nos Actions. Retrieved April 4, 2022, from https://www.larochelle-zerocarbone.fr/nos-actions

Ministère de la Transition Écologique. (2022). Adaptation des territoires aux évolutions du littoral. Retrieved April 1st, 2022, from https://www.ecologie.gouv.fr/adaptation-des-territoires-aux-evolutions-du-littoral

Ocean & Climate Platform. (2022). Home page. Retrieved March 31, 2022, from https://ocean-climate.org/en/home-2/

Ocean & Climate Platform. (2022). *Map of Solutions*. Retrieved March 31, 2022, from https://seaties.ocean-climate.org

Ocean & Climate Platform. (2022). Sea'ties. Retrieved March 31, 2022, from https://ocean-climate.org/en/seaties-2/

Ocean & Climate Platform. (2021). *Map of Solutions' Project Sheet, Participative simulation to raise awareness among coastal planning stakeholders on maritime flood risks (LittoSIM)*. Retrieved March 16, 2022, from: https://ocean-climate.org/en/participative-simulation-to-raise-awareness-among-coastal-planning-stakeholders-on-maritime-flood-risks-littosim/

UK Climate Risk. (2022). *What is the UK Climate Risk Independent Assessment (CCRA3)?*. Retrieved April 7, 2022, from https://www.ukclimaterisk.org/about-the-ccra/uk-climate-risk-independent-assessment-ccra3/

UKESM. (2017). *About us*. Retrieved March 16, 2022, from https://ukesm.ac.uk/about-us-2/

Réseau national des observatoires du trait de côte. (2021). *Accueil*. Retrieved March 24, 2022 from http://observatoires-littoral.developpement-durable.gouv.fr/

Articles

Yeung, P. (2021). In Hamburg, *Surviving Climate Change Means Living With Water. Bloomberg CityLab + Green*. Retrieved March 15, 2022, from https://www.bloomberg.com/news/features/2021-12-18/how-hamburg-learned-to-live-with-rising-water

Barthélémy, S. (2020,). *Le Signal : épilogue d'un mauvais feuilleton à Soulac-sur-Mer*. Rue89Bordeaux. Retrieved March 15, 2022, from https://rue89bordeaux.com/2020/11/le-signal-epilogue-dun-mauvais-feuilleton-a-soulac-sur-mer/#:~:text=Les%20propri%C3%A9taires%20des%2078%20appartements,plus%20de%20deux%20ans%20s-uite%E2%80%A6

OCEAN & CLIMATE PLATFORM

SEA'TIES
SHARING SOLUTIONS WITH COASTAL CITIES TO TACKLE SEA LEVEL RISE

CONTACT

Théophile Bongarts Lebbe
tbongarts@ocean-climate.org

ocean-climate.org/en/seaties-2

ENDORSED BY 2021 2030 United Nations Decade of Ocean Science for Sustainable Development

FINANCIAL SUPPORT

PRINCE ALBERT II OF MONACO FOUNDATION
INSTITUT PAUL RICARD OCÉANOGRAPHIQUE
Fondation de France
Fondation VEOLIA
cnrs
Gouvernement Princier PRINCIPAUTÉ DE MONACO